OPERATION AND INSTALLATION INSTRUCTIONS

MOBILE MAP PLUS™ (MMP) RADIO-GRAPHIC DISPLAY SYSTEM

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Communications & Documentation Technologies

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1.0 General Description

1.1 Purpose

Mobile Map Plus provides reliable, accurate alarm reporting to personnel responding from vehicles roving a facility. Its major use is alarm annunciation of perimeter fence alarm systems. *Mobile Map Plus* provides responding personnel rapid indication and exact location of a perimeter alarm occurrence. (See Figure 1-1.)

Effective perimeter alarm response by vehicles equipped with *Mobile Map Plus* units has contributed to reducing or eliminating the need for manned towers. Personnel previously required to occupy towers can be effectively assigned to other important tasks with considerable yearly savings.

1.2 Features

The *Mobile Map Plus™ (MMP)* is a state-of-the-art mobile radio-graphic display system. Alarms received by the *MMP* encoder are checked and formatted into an error-checking frequency-shift-keying (FSK) signal, which is sent to the radio transmitter for wireless signalling to the *MMP* Radio-Graphic Displays. (See Figure 1-1.)

The radio signal is received no matter the location of the *MMP* display. The alarm information is checked for accuracy, displayed on the graphic front panel map of the *MMP* display, and announced by an audible warning signal. The audible warning can be silenced using the top-mounted silence switch. However, any new alarm appearing at the mobile map unit will cause the audible alarm to resound. The *MMP* is continuously supervised “in use” for both communications to the central control unit and interference by outside signals.

The *MMP* encoder periodically sends a test signal to each *MMP* display whether or not alarms are present. Each *MMP* display continuously listens for transmissions from the *MMP* transmitter and for unidentified radio signals on the *MMP* radio frequency. Separate front panel lamps indicate loss of communications with the central transmitter and/or the presence of an interference signal.

The *MMP* encoder can format and transmit up to 64 independent alarm signals to each *MMP* mobile radio-graphic display. The FSK signalling scheme allows complete transmission in less than one second. A programmable feature of each *MMP* display allows combinations of alarm, tamper, access, and secure signals up to a maximum of 64 signals.

An optional security code can be added. The 8-bit security code ensures that only accurate messages are presented on the mobile displays.

The *MMP* mobile radio-graphic display features self-contained construction in a sealed, drawn metal enclosure with integral sunshield. The

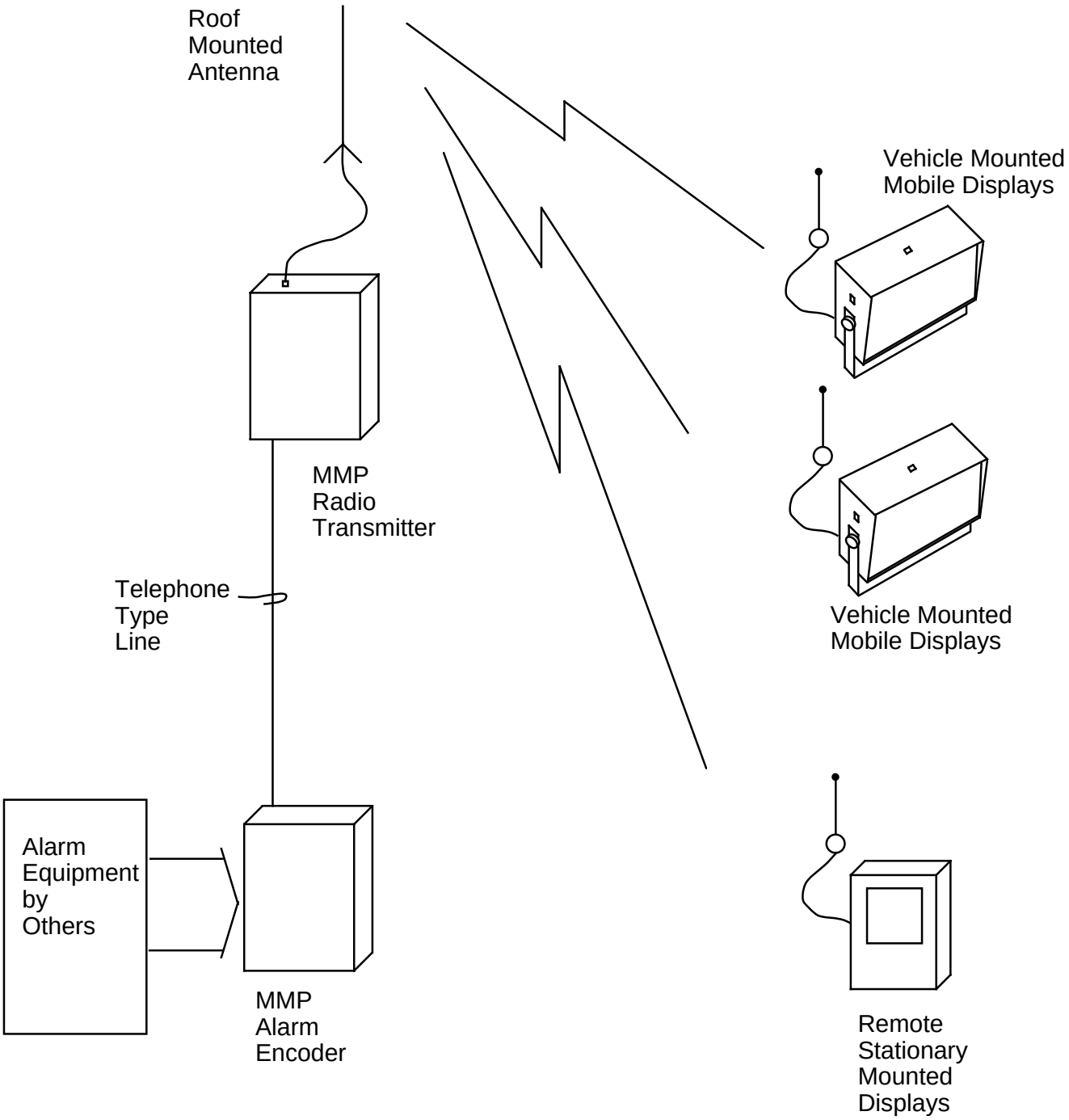
graphic panel is a custom computer-aided-design-produced polycarbonate sheet. The graphic is photographically reproduced on the reverse side of the faceplate. Long-life ultrabright LED indicators are imbedded in the reverse side of the graphic. Back lighting is provided for nighttime use. A rear panel audio output jack enables testing without special test equipment. The *MMP* mobile display is furnished with an adaptable mounting bracket. Both the display enclosure and bracket are finished with a heat-sealed powder-coat surface.

The *MMP* radio transmitter is built in a rugged metal enclosure enabling remote mounting near the antenna location. The radio transmitter is matched to an antenna and transmission line to provide the desired radio coverage. Interface to the alarm encoder is a two-wire “telephone line” enabling encoder-to-transmitter mounting distances up to 3000 feet. A built-in transmission test button enables radio testing without special test equipment. Optional internal battery back-up is available. An environmentally sealed enclosure suitable for outdoor mounting is also available.

The *MMP* alarm encoder is provided in a convenient wall-mounted enclosure. Wiring connections are via screw-type terminal strips or ribbon cable. A built-in test switch allows testing the complete *MMP* system without the need for special test equipment. Optional internal battery backup is available.

Each *MMP* radio-graphic display system is “burned in” and tested at the factory before shipment. An optional “installation and test kit” can be furnished on a loan basis to ensure the installation is properly tested. Frequency selection and licensing assistance is also available from the factory.

Figure 1-1 Typical Mobile Map Plus (MMP) Installation



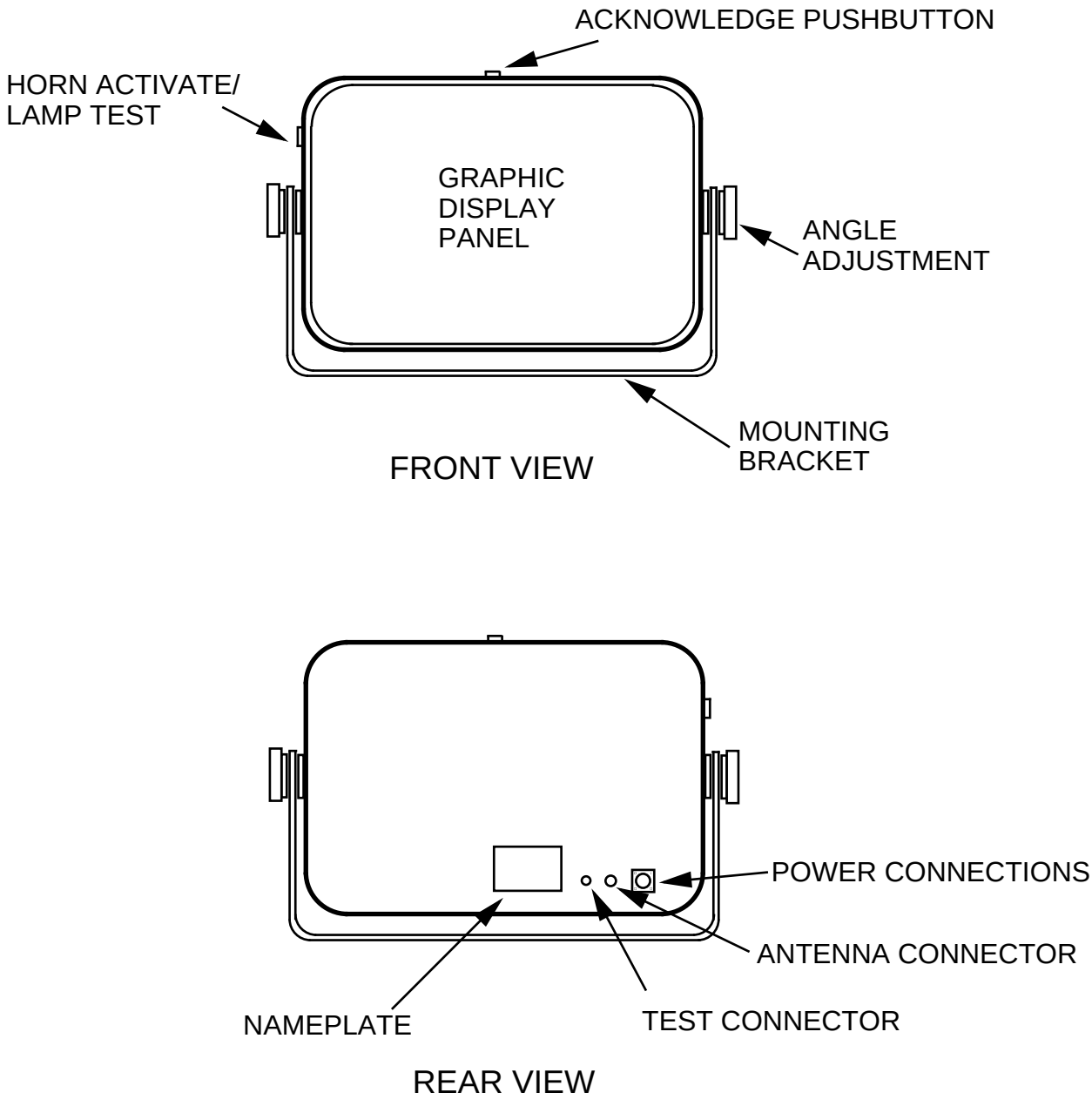
1.3 Specifications

Mobile Radio-Graphic Display

(See Figure 1-2)

Frequency: 450-470 MHz
Other frequencies available: 148-174 MHz, 406-420 MHz
Sensitivity: 0.5 uV.
Signal-to-Noise Ratio: 12 dB SINAD
Electronics:
FSK Signal Decoder
CMOS Integrated Circuit Logic
Power Supply: 12 VDC, 1 amp from vehicle battery
Controls:
Alarm Acknowledge Switch
Lamp Test Switch, momentary rocker, P/O horn activate
Vehicle Horn Activate Switch, maintained rocker
Audio output (rear panel) for receiver testing
Custom Graphic Display:
1/4-inch polycarbonate display screen
Photo-produced on reverse side of display
Alarm Lamps: Ultrabrite LEDS
Type and color depends on nature of display
LEDs installed to provide wide viewing angle
"REC" LED (red) indicates proper operation of "in use" supervision.
"INT" LED (yellow) indicates presence of an interference signal or presence of alarm transmission.
Dimensions:
8" X 11" X 3-1/2", plus sunshield
(20.5mm X 28mm X 9mm)
Weight: 3.5 lbs.
Temperature Range: –25˚ C to +55˚ C (–13˚ F to 131˚ F)
Connections:
4-pin captive connector (power, ground, horn, and lights)
(Power, lights, and horn separately fused)
BNC connector, antenna input

Figure 1-2 Mobile Radio-Graphic Display

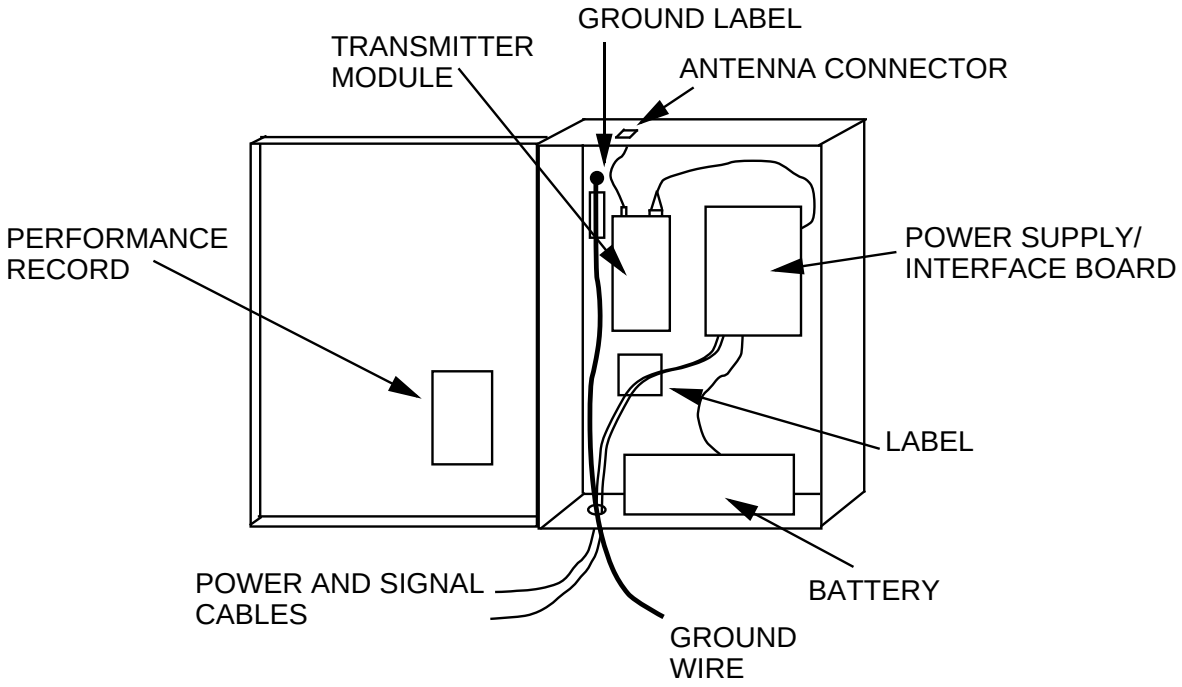


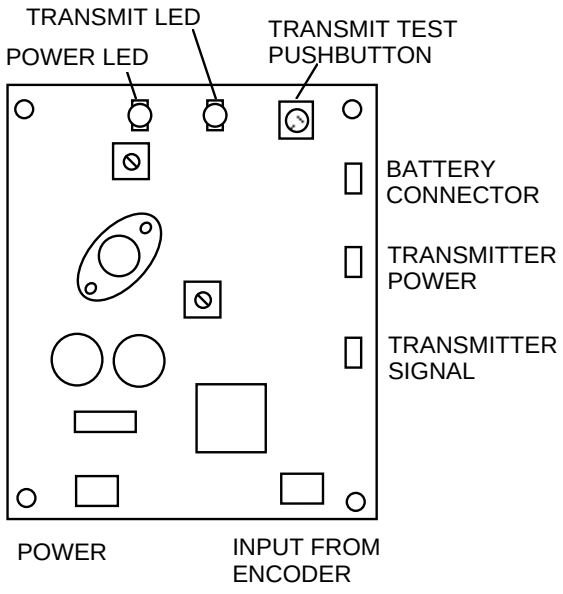
Radio Transmitter

(See Figure 1-3)

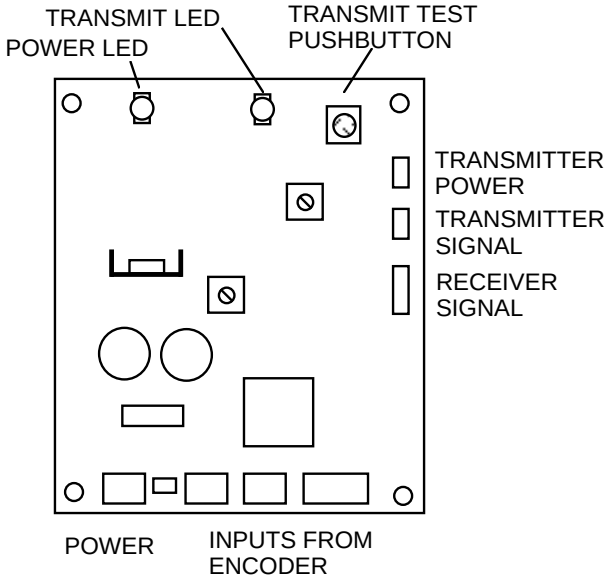
Frequency Range: 450-470 MHz
Other frequencies available: 148-174 MHz, 406-420 MHz
Power Output: 2 watts into 50 ohms (5 watts optional)
Signal Input: Current loop from encoder unit
1000-ohm maximum loop resistance
Indicator Lamps:
Green LED, power
Red LED, transmit
Controls: Test transmit switch, push button
Power Supply: 12 VDC, 1.5 amp plug-in power supply (included)
Battery Backup: 12 VDC, 4.5 AH installed in enclosure (optional)
Temperature Range: –25˚ C to +55˚ C (–13˚ F to 131˚ F)
Enclosure:
12” X 12 ” X 4 ”
(30.5mm X 30.5mm X 10mm)
NEMA 1 steel enclosure
NEMA 4 environmental enclosure (optional)
Weight: 14 lbs.
Connections: Captive screw-type, color coded

Figure 1-3 Radio Transmitter Unit





-01 Board
Mid 1997 and older



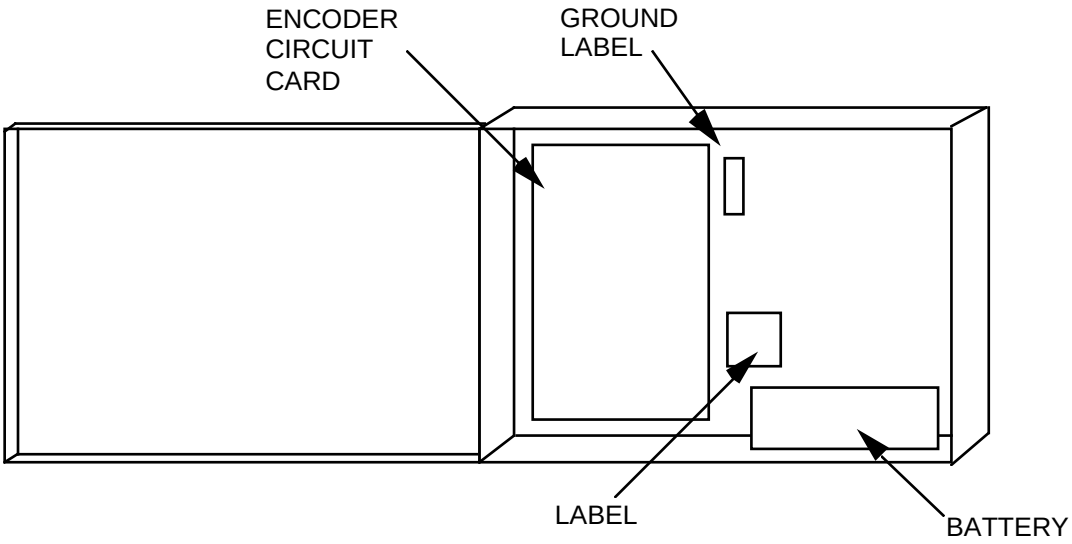
-05 Board
Mid 1997 and newer

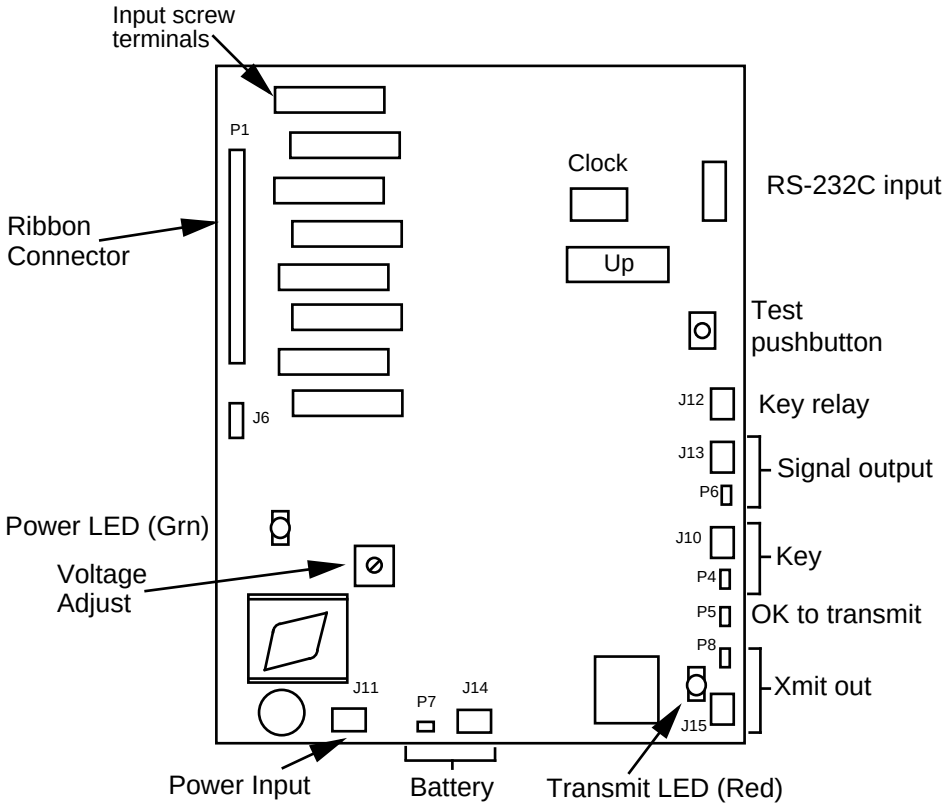
POWER SUPPLY/INTERFACE CIRCUIT BOARD

Alarm Encoder

Alarm Inputs:
8 inputs per basic encoder
Expandable in groups of 8 inputs to a maximum of 64 inputs
All inputs optically isolated
Signal Output: 2-wire "telephone line" current loop compatible with radio transmitter input. 1000-ohm maximum loop resistance. Typical encoder to transmitter distances up to 3000 feet.
Indicator Lamps:
Green LED, power
Red LED, transmit
Controls: Manual keying test switch, push button
Power Supply: 12 VDC, 1 amp provided from wall-mounted plug-in transformer (included).
Battery Backup: 12 VDC, 2.2 AH installed in enclosure (optional).
Temperature Range: 0˚ C to +55˚ C (32˚ F to 131˚ F)
Enclosure:
18-1/2" X 14-1/4 " X 4-1/8"
(47mm X 36mm X 10.5mm)
NEMA 1-style steel-hinged enclosure
Additional room and mounting studs provided for interface equipment.
Weight: 5 lbs.
Connections: Captive screw-type, numbered and color coded

Figure 1-4 Encoder Unit





ENCODER CIRCUIT CARD

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2.0 Theory of Operation

2.1 Concept

The *Mobile Map Plus* utilizes modern state-of-the-art technology to provide reliable wireless alarm communications between points that cannot be effectively connected by conventional wiring.

Information is transmitted on standard UHF and VHF frequencies using a well-proven frequency shift keying (FSK) system. The FSK audio frequencies easily pass through conventional radio systems that are equipped to transmit audio frequencies and provide a very reliable link for alarm data.

The FSK transmission method allows the *Mobile Map Plus* to communicate up to 64 different alarm signals, transmitted two times, all within one second. Transmissions are checked for parity and compared for validity before alarm is displayed.

Supervision of the communications path is accomplished in two ways. First, the complete system is supervised "in use" by an alarm transmission that is sent every 5 minutes regardless of whether an alarm is present on the system. Any valid alarm transmission received by the mobile displays will cause the "REC" lamp to light. If a valid alarm signal is not received in the period, the lamp will extinguish. Second, each mobile display contains a circuit that looks for signals that are on the same frequency but are not valid alarm transmissions. If a signal like this is received, the "INT" lamp on the display front panel is lit.

2.2 Operation

(See Figures 2-1 and 2-2)

2.2.1

The *MMP* connects to the equipment sending alarms via screw-type terminals, or a multiconductor ribbon cable. Each input is completely isolated by optical couplers. The input voltage applied by the external alarm equipment activates the optical coupler input which in turn provides input to the *MMP* input latch circuit.

2.2.2

The *MMP* input is latched when the alarm input is received. Each input is latched into two registers. The registers are strobed approximately every one second. During the strobe the registers are compared to determine if a change of input condition has occurred since the last strobe. Because the *MMP* will transmit on changes in the alarm status, any change will cause new alarm data to be transmitted to all remote units.

2.2.3

Alarm transmission is initiated by one of three conditions; a change in alarm input status, activation by the automatic supervision circuit, or operation of the manual activation (test) button located on the encoder unit.

2.0 THEORY OF OPERATION

Figure 2-1 Encoder Block Diagram

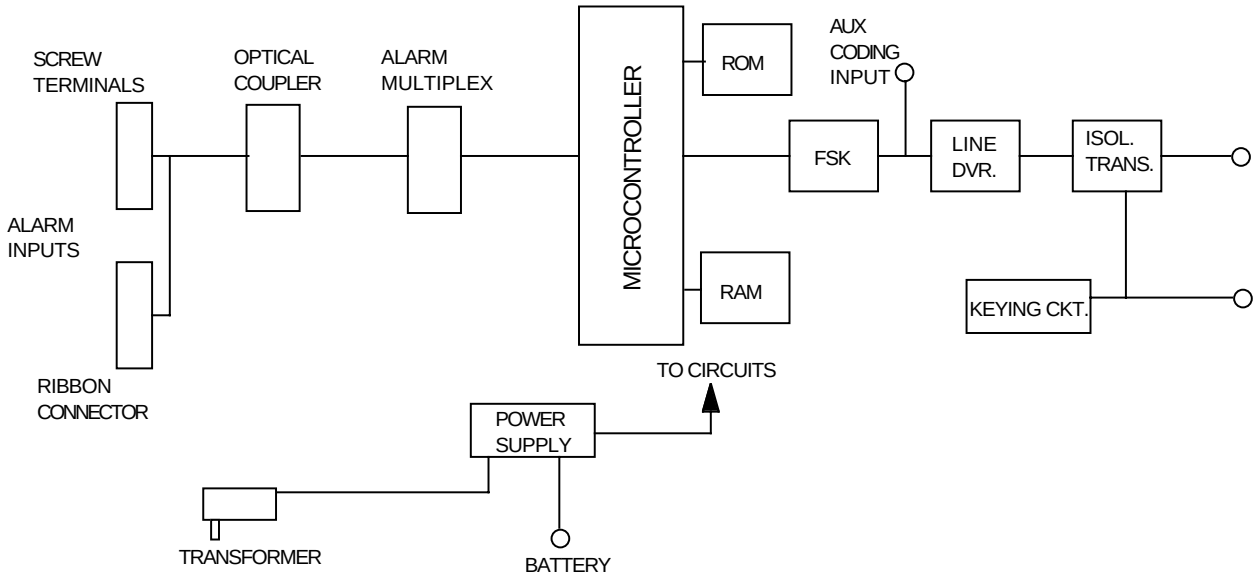
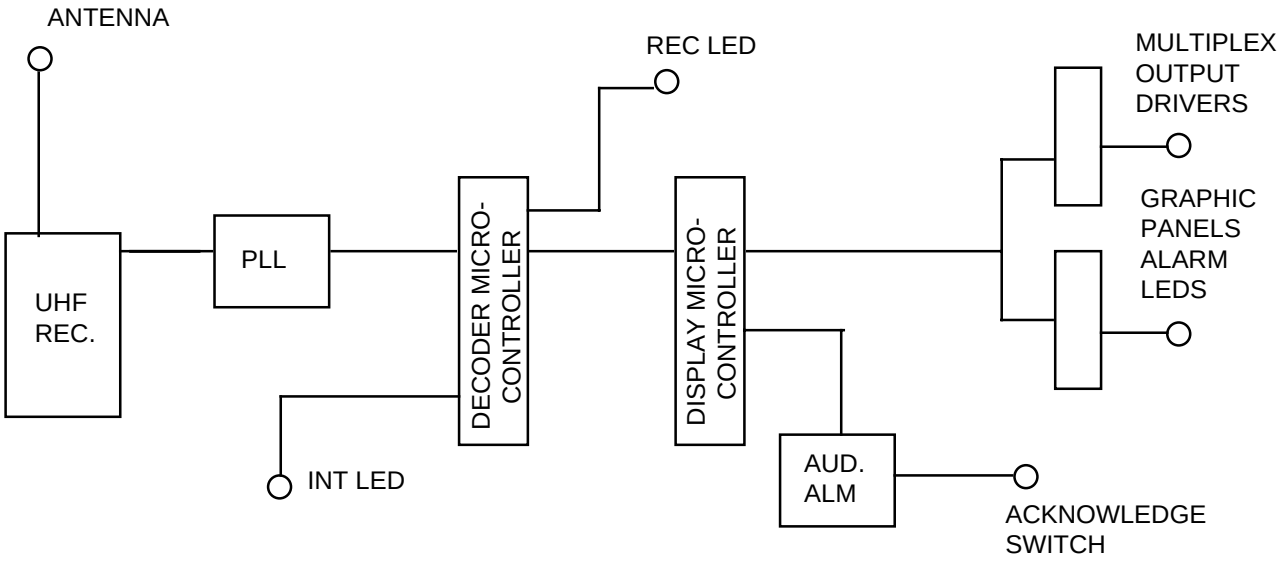
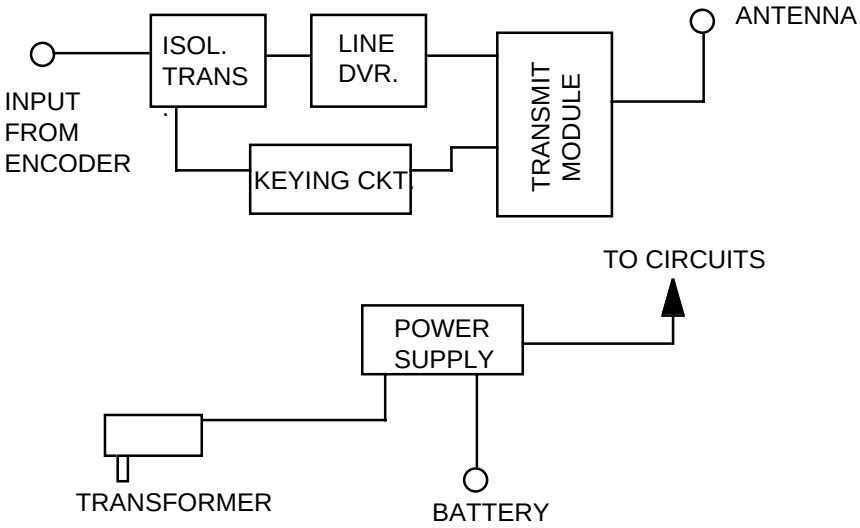


Figure 2-2 Decoder and Transmitter Block Diagrams



MOBILE DISPLAY DECODER BLOCK DIAGRAM



TRANSMITTER BLOCK DIAGRAM

2.2.4 When an alarm is present, the microcontroller prepares a serial digital message with the proper security code.

2.2.5 The string of serial data is sent to an FSK transmitter circuit. The serial data is FSK modulated to two FSK audio frequencies. The output is amplified and sent to the radio frequency transmitter which is usually remotely located.

2.2.6 The output of the FSK transmitter is converted to a balanced 600 ohm "telephone type" output at an approximate 0 dBm level. This signal is suitable for transmission to the remote transmitter unit over a dedicated twisted pair wire or a telephone line. This signal can also be used to connect to radio systems by other manufacturers.

2.2.7 The FSK data signal is received by the remote transmitter unit through a 600-ohm balanced circuit similar to the same circuitry in the encoder unit. The data is sent to the input of the radio frequency module which produces a frequency modulated 2-watt or 5-watt (optional) RF output.

2.2.8 The RF output is sent to the transmit antenna via the Type N connector located on top of the transmitter cabinet. The radio frequency transmission line available from the factory is a preconnectorized low loss cable assembly manufactured to match both the radio and the antenna. The radio transmission cable is normally limited to 25 feet with a maximum length of 40 feet. This is to limit the amount of power loss in the cable.

2.2.9 Several different types of antennas are recommended, depending on the transmission distances, antenna location, and construction of the buildings. The factory can recommend a particular antenna.

2.2.10 The transmitted signal is received by the mobile unit antenna. This antenna is typically mounted on the roof or trunk of a vehicle. The mobile display unit is self-contained, meaning that the radio receiving system and the decoding logic are contained in one unit.

2.2.11 The received signal is demodulated and sent to a phase lock loop with decoding circuitry to match that of the FSK transmitter encoder unit. The phase lock loop converts the received signal to the series of digital pulses matching the alarm information transmitted from the encoder unit.

2.2.12 The data is sent to the decoder microcontroller which determines if the transmission is valid and sends the decoder data to the display microcontroller. The output of the register display microcontroller operates the audible alarm and the front panel indicating lamps through multiplex driver circuitry.

2.3 Supervision

2.3.1

An alarm signal is not considered valid unless several tests are passed. When the radio signal is received, it must be on frequency and the receiver must send a carrier-detected signal. The data is sent to the phase lock FSK decoder which must receive data with the correct frequency. After the data is considered valid, it is sent to the microcontroller.

2.3.2

A signal that is on frequency but does not contain valid data is considered an interference that could jam the operation of the display system. If a signal such as this is received, the decoder circuitry will light the "INT" light on the display front panel.

2.3.3

The encoder alarm data is sent twice and parity signals are added. When received, the data is checked for parity and compared for accuracy before an alarm is displayed.

2.3.4

The supervision circuit of the display unit requires that a valid transmission be received by the mobile display at least every 5 minutes. The circuit continuously monitors each transmission and times the period between transmission. If a 5-minute period appears with no valid alarm signal, the circuit will turn out the front panel "REC" lamp.

2.3.5

An 8-bit security code can be added to the encoder and each mobile display. The addition of the security code assures that only valid alarm transmissions from the encoder are received and displayed by each *Mobile Map Plus*.

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3.0 Installation

3.1 General

3.1.1

CDT's EMPACT series *Mobile Map Plus (MMP)* Radio-Graphic Display system installation generally consists of the following components:

- Encoder Unit which receives alarm information from another alarm system and formats the correct annunciation messages for transmission to the mobile display units.
- Transmitter Unit which receives a formatted alarm signal from the Encoder Unit and provides a radio frequency output.
- The roof-mounted antenna and mast which receives the radio frequency transmitter output.
- Mobile Display Units with antennas in one or more vehicles or remote stationary locations.

3.1.2

The key to a successful installation is proper initial planning and attention to the details of installation. The following installation procedure provides a guideline for successful field installation of a complete *MMP* display system.

> *PLEASE NOTE: Before attempting field installation, the complete* MMP *display system should be interconnected and tested in your shop. Use the procedures shown in the Initial Setup and Adjustment Section for shop testing and alignment before installation.*

3.2 Initial Planning

Initial installation planning includes the general layout of the complete system and a determination of where each piece of equipment will be installed. The placement of equipment is very important for the correct operation of the *MMP* system. This is particularly true when choosing the antenna location. Proceed with your installation planning as follows:

3.2.1

Locating the Encoder Unit. (See Figure 1-4.)

The *MMP* encoder unit must interface with the alarm equipment that will generate the alarms that are to be sent to the mobile displays. The output of the encoder unit will connect to the *MMP* transmitter unit that will normally be remotely mounted near the antenna.

The MMP encoder should be located within 15 feet of the alarm system. If distances are farther than 15 feet, shielded wiring should be used. The encoder should also be located within 15 feet of a standard power outlet.

The encoder is provided in an enclosure suitable for wall or telephone backboard-type mounting. Mount the encoder securely using four screws in the rear panel mounting holes. Refer to paragraph 3.4.1 for wiring and connection information.

3.2.2

Locating the Antenna and Transmitter. (Refer to Figures 1-2, 3-1, and Appendices B and C.)

Location and mounting of the antenna is very important for proper operation of the system. Typically, the two items that can improve transmission coverage are the antenna height and transmitter power.

The antenna must be located on a tall building to provide the height required for good signal coverage. If possible, the antenna should be mounted on the tallest building in the facility. Because the radio frequencies are typically in the UHF region, the best operation will occur if the primary operational area of the mobile displays is in a line-of-sight with the transmitter antenna.

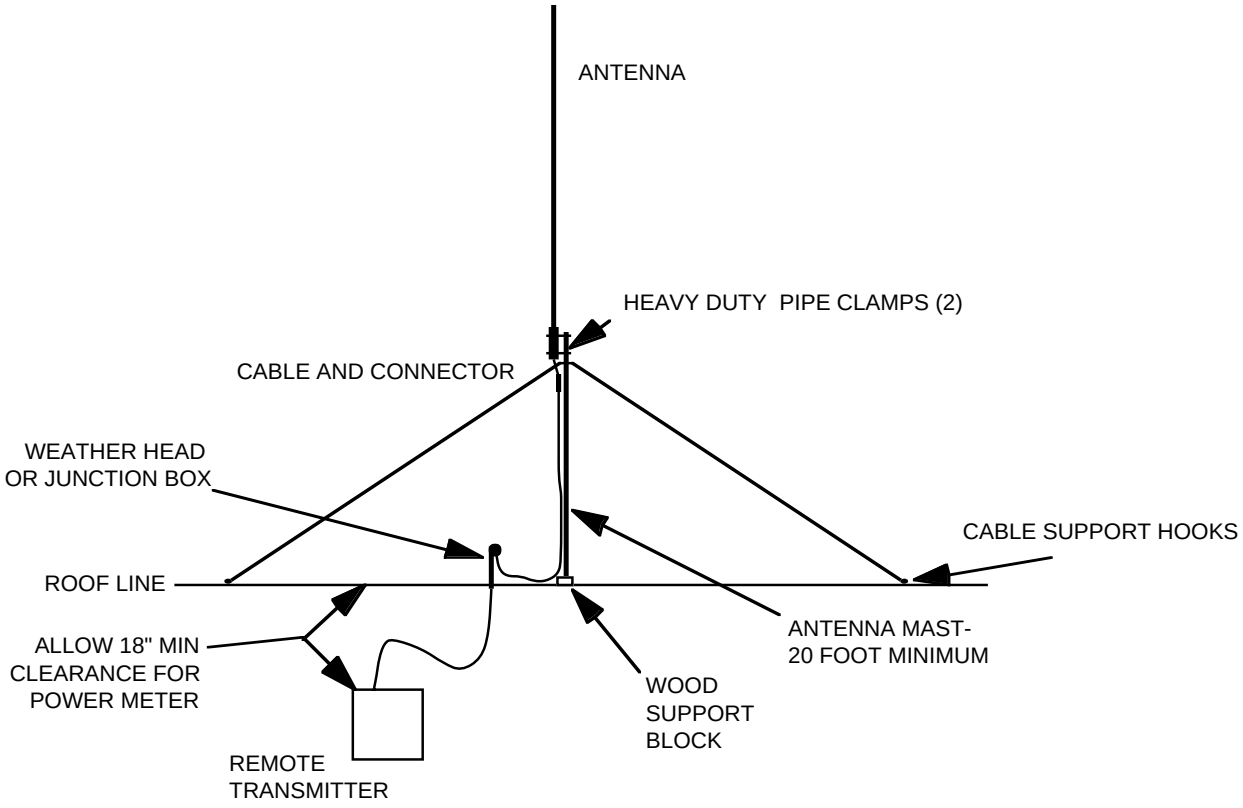
The antenna should be mounted on a minimum 20-foot mast. The mast should be constructed of rigid galvanized pipe or other weather-resistant metal piping sold for use as antenna mast. The mast can be either one piece or a multisection mast. Multisection masts are often easier to erect, especially on a pitched roof.

Provide a suitable guy wire for each mast section in accordance with acceptable antenna mast-mounting practices. Four sets of guy wires should be located 90 degrees apart. In no case should there be less than three sets of guy wires located 120 degrees apart. Each mast section should have its own set of guy wires. Figure 3-1 shows a typical antenna and mast installation. Appendix B and C provide specific antenna installation information.

The transmitter must be located inside the building below where the antenna is located and as close to the antenna as possible. At UHF frequencies, a considerable amount of signal loss can occur in the antenna connecting cable. For this reason, the recommended cable length from transmitter to antenna is 25 feet. The maximum recommended cable length is 40 feet.

The antenna cable must enter the building using a suitable weatherhead or other acceptable roof penetration. The cable must enter the building without crimping or damaging the cable by excessively tight bends. Additionally, the roof must not leak at the penetration.

Figure 3-1 Transmitter and Antenna Installation Guidelines



Installation Notes

1. Antenna mast must be a rigid galvanized pipe or other galvanized pipe sold for antenna installation. Minimum diameter must be 1-1/4 inches.

2. Install antenna in strict accordance with the antenna manufacturer's instructions and recommendations.

3. Guy antenna in four directions with guy wires at 90 degrees to one another. Make the angle of the guy wires to the roof as low as possible. The angle of the guy wires to the roof must not exceed 45 degrees.

4. Provide weather-sealed connector boot or moisture-proof seal over cable connectors. Fasten cable to mast using U/V-resistant plastic cable ties or equal. Seal all roof penetrations and fastening locations in an approved manner to preclude roof leaks.

5. Submit each proposed antenna mounting for approval before installation.

Locate the transmitter on a vertical surface, such as a telephone backboard. If a telephone backboard is not available, locate the transmitter on a sturdy vertical surface. It may be necessary to install a mounting surface in an area near the base of the antenna.

Locate the transmitter unit with sufficient space above the unit to allow connection of the cable and a RF power meter if necessary. Allow 18 inches minimum for cable and test power meter.

The transmitter unit MUST have a minimum 10-gauge ground wire running from the transmitter enclosure ground lug to a cold water pipe or independent ground rod. Grounding is very important for lightning protection. It is best to provide a good ground for the antenna mast also.

The transmitter should be located near a standard AC outlet. If a standard outlet is not available within 15 feet of the transmitter location, power can be run from AC outlets at further distances by increasing the size of the power wiring from the wall-mounted transformer to the transmitter unit as noted below. Refer to paragraph 3.4.2 for further wiring and connection information.

DISTANCE	WIRE SIZE
0-15 FEET	18 AWG
16-40 FEET	16 AWG
41-80 FEET	14 AWG

3.2.3 Locating the Mobile Display Unit

The Mobile Display Unit is self-contained, so the entire installation consists of positioning, mounting, and connecting the display unit.

The Mobile Display Unit has been used in roving automobiles and trucks and also in remote fixed structures where connections with standard wiring was not possible. In any installation, several general recommendations apply:

- Position the display where it can be easily read by the operator. In a vehicle, the operator may be the driver or the passenger. Request advice from the operational personnel.

- The map display will probably be used in both daytime and nighttime. Position the display so it can be seen at night but is not in the direct sunlight during the day. The display is hard to read when the sun shines directly on the faceplate.

- The most common vehicle mounting locations are from the dashboard or nearer the floor between the driver and passenger seats.

Refer to paragraph 3.4.3 for wiring and connection information.

3.2.4 Locating the Mobile Unit Antenna

The location of the mobile unit antenna is very important to proper reception of alarm signals. The most common mobile antennas use the mounting surface as a ground plane, which also improves the reception.

The best location is on the highest point of the vehicle—normally the roof. The next best location is on the trunk, which is normally flat but not as high off the ground.

The antenna should be mounted in the center of the roof or trunk at a minimum of 4 feet from any other antennas that may be mounted on the same vehicle.

3.3 Mounting

3.3.1 Mounting the encoder unit

The encoder unit is mounted using the four mounting holes located in the corners of the enclosure.

Make a paper template of these mounting holes, or measure and transfer the dimensions to the mounting surface.

Drill and tap the mounting holes before positioning the encoder unit. Mount the encoder with #10 or other suitable hardware.

If special conduit connection or access holes must be added to the enclosure, carefully remove the encoder unit circuit board before working on the cabinet.

> *CAUTION: Metal filings, wood chips, and excessive dirt and dust can affect the encoder operation. Also avoid excessive pounding and vibration.*

3.3.2 Mounting the Transmitter Unit

Follow the instructions provided above for the encoder unit.

3.3.3 Mounting the Transmitter Antenna

The mounting and installation of the transmitter may be the most important part of the *MMP* installation. This is because the antenna is a very important part of the transmission coverage, and it is also outside where it can be affected by weather and by lightning.

Special care must be taken with the antenna installation. Guy wires and other attachments must be secured to solid building members. Mounting cables and attachments must be strong enough to withstand the loading caused by the winds in the area. All electrical connections must be correctly made, then wrapped with waterproof material to protect from moisture and cold weather. Any plastic parts used (e.g., ty-raps, fasteners, etc.) shall be U/V protected.

Appendix B contains general antenna installation and safety information. Review this information before mounting and connecting your antenna.

Appendix C contains copies of the installation information for the most common types of antennas used with the *Mobile Map Plus* system. This information should also be packed with the antenna. If the information in Appendix C does not show your antenna, or if the antenna you purchased does not have installation information packed with it, please contact the factory.

3.3.4 Mounting the Mobile Radio-Graphic Display Unit

Mount the Mobile Display Unit with the U-shaped bracket provided with the unit. Remove the bracket from the display by unscrewing the two large knobs located on each side. Slightly spread the bracket to remove the display. Retain the knobs and the black friction washers for reinstallation.

Fasten the mount in place through the mounting slots using suitably sized hardware. Sheet metal-type screws with washers will normally provide sufficient mounting. If the display is to be mounted on thin metal, wood, or plastic, use of 1/4-20 machine bolts with washers and lock nuts are recommended.

Reinstall the display by slightly spreading the bracket and slipping the display mounting posts through the holes in the bracket. Make sure that the black friction washers are installed before slipping the display into the bracket. Reinstall and tighten the knobs.

Check to verify that the display is free to rotate in the bracket. Also verify that the bottom of the display where the wiring will be connected is not obstructed.

3.3.5 Mounting the Mobile Unit Antenna

The mounting and installation of the receiving antenna is a very important part of the *MMP* installation. This is because the antenna is a very important part of the transmission pattern, and it is also outside where it can be affected by weather.

Special care must be taken with the antenna installation. Appendix D contains copies of the installation information for the mobile antennas used with the *Mobile Map Plus* system. This information should also be packed with the antenna. If the information in Appendix D does not show your antenna or the antenna you purchased does not have installation information packed with it, please contact the factory.

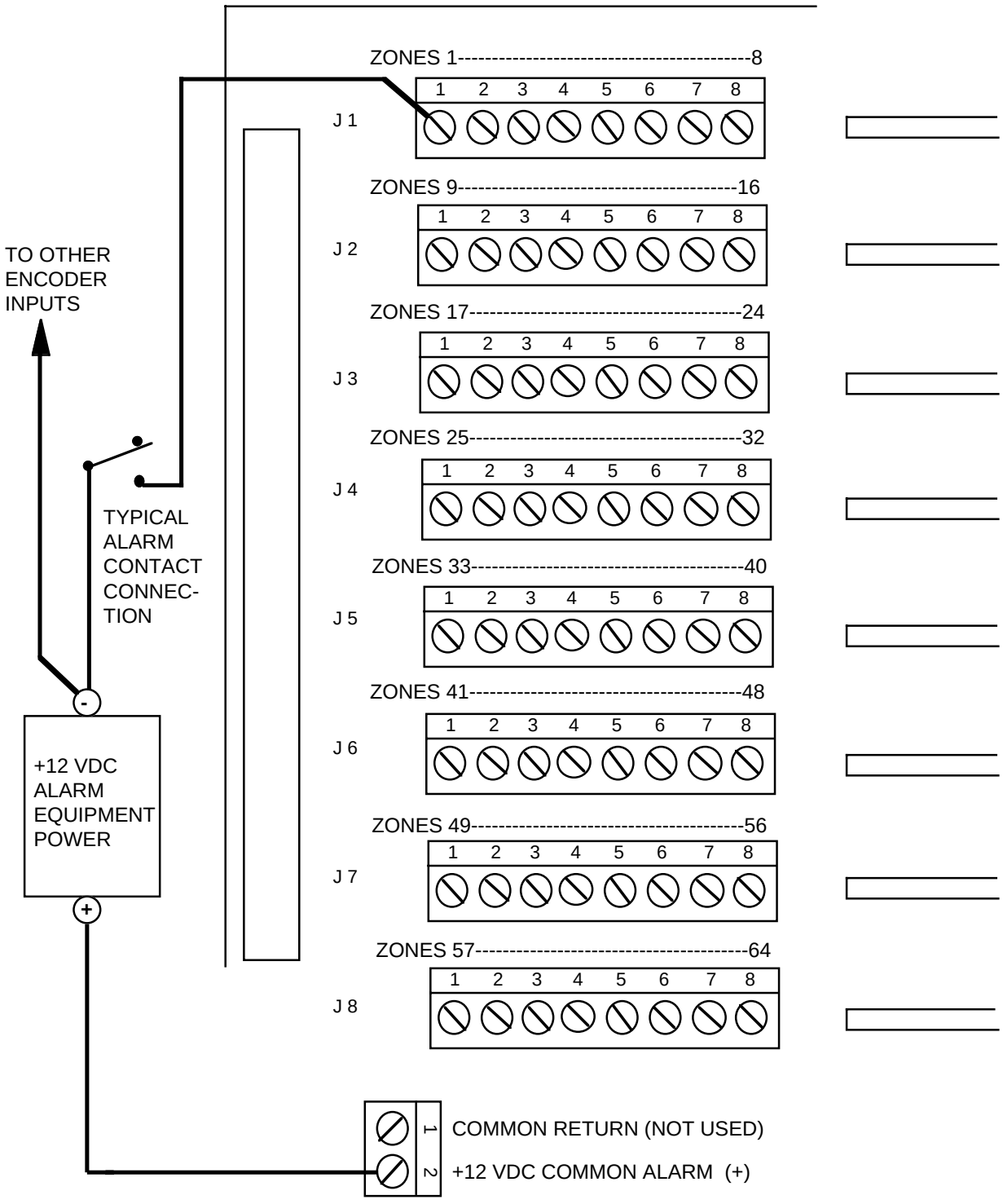
A cable-mounted male BNC connector connects to the Mobile Display Unit. This connector is not factory installed because it might interfere with routing the cable through the vehicle. Be very careful installing this connector. Refer to Appendix E for installation information. Check the connector for shorts with an ohmmeter before and after installing connector.

3.4 Wiring and Connections

3.4.1 Connecting the Encoder Unit

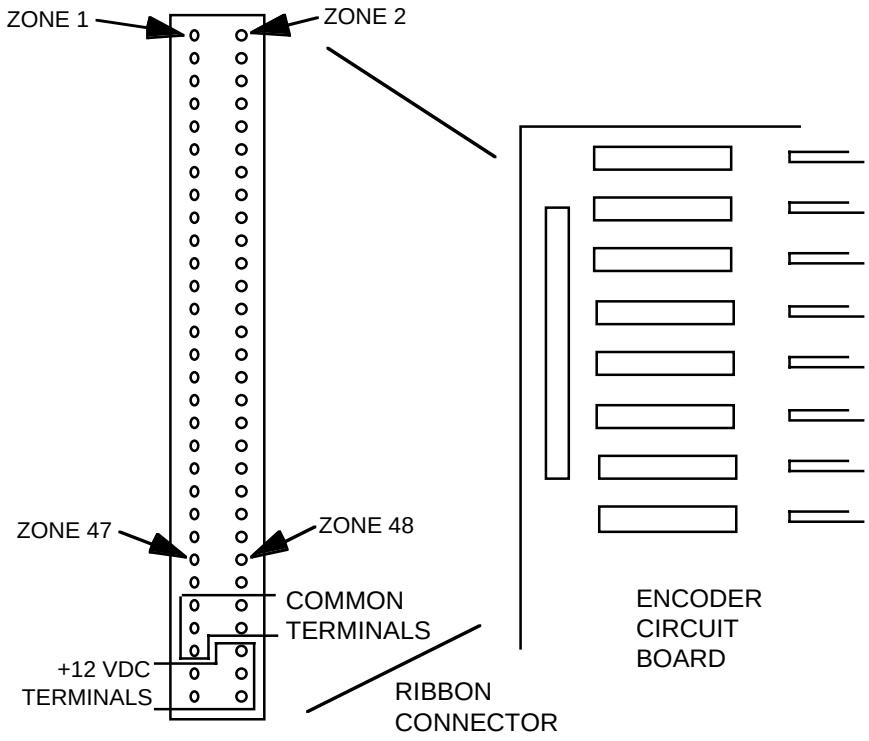
Connect the alarm inputs using the circuit board-mounted screw terminals or the board-mounted multi-pin IDC connector. Figure 3-2 shows the numbering of each screw terminal. The encoder inputs are fully isolated by optical couplers. In order to maintain the isolation, both the alarm signal voltages and the signal return must come from the equipment generating the alarms. Figure 3-2 shows the typical connection of the input wiring. Wiring should be 20 or 22 gauge. Multiple-conductor color-coded cable is preferable to individual conductors.

Figure 3-2 Encoder Unit—Alarm Input Terminal Connections



The multi-pin IDC connector is provided for connecting equipment that can provide alarm outputs on a ribbon cable. Figure 3-3 identifies the function of each pin on the connector.

Figure 3-3 Ribbon Cable Connections

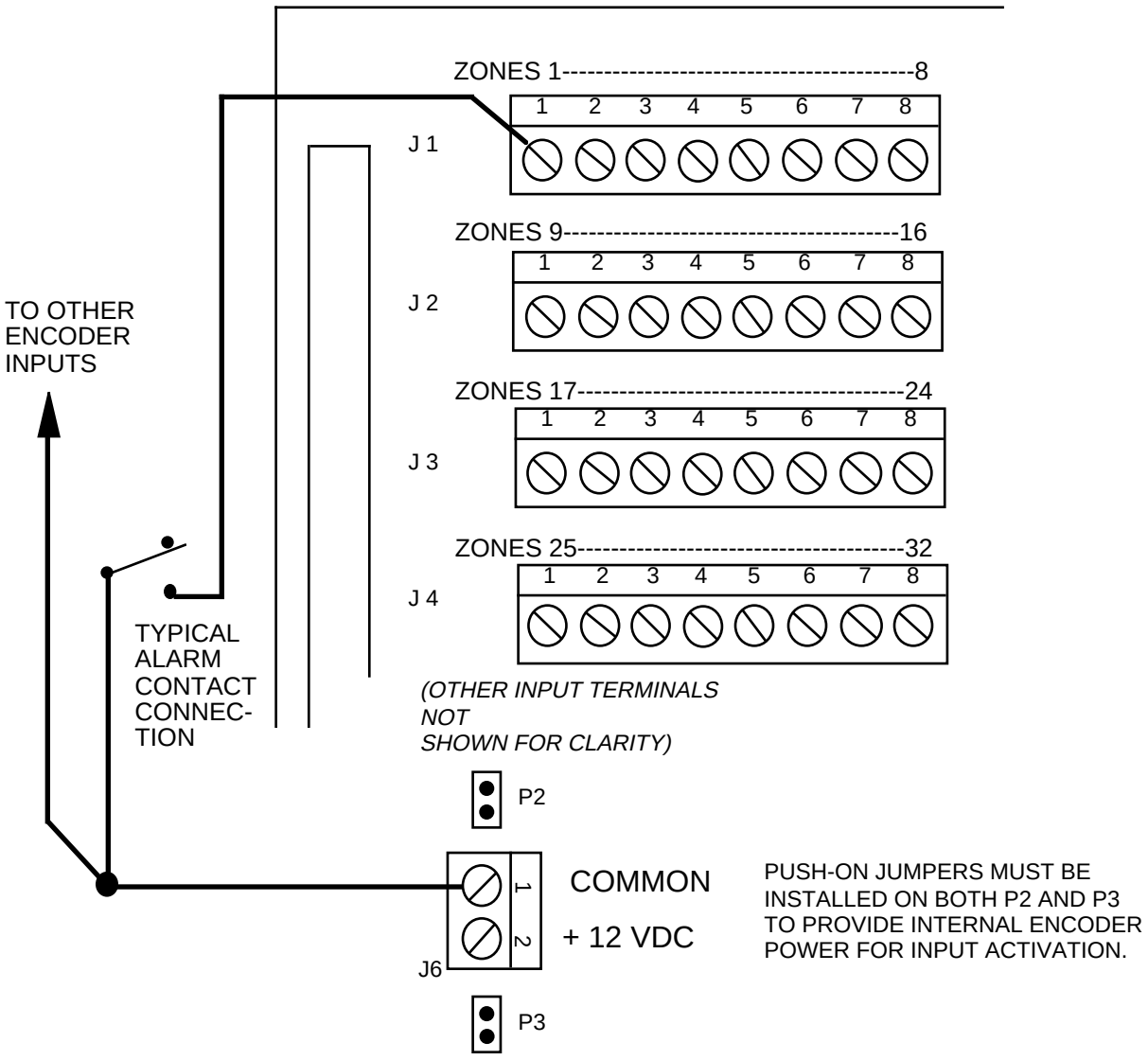


Note: If the multi-pin connector is used to connect to the Perimeter Products MX-1000 system, refer to Appendix F for additional connection information.

When alarm inputs are from dry, isolated relay contacts it is still recommended that all the alarm input voltage and return wiring come from the external alarm equipment. However, in special cases where the alarm inputs are from dry, isolated relay contacts and the distance to the alarm input contacts is less than 5 feet, the internal power from the encoder may be used to activate the encoder inputs. Figure 3-4 shows the jumper installation required ONLY IF the encoder power is used.

CAUTION: If the encoder power is used to activate the encoder inputs from closed contacts, the encoder power must be completely isolated from all other circuitry.

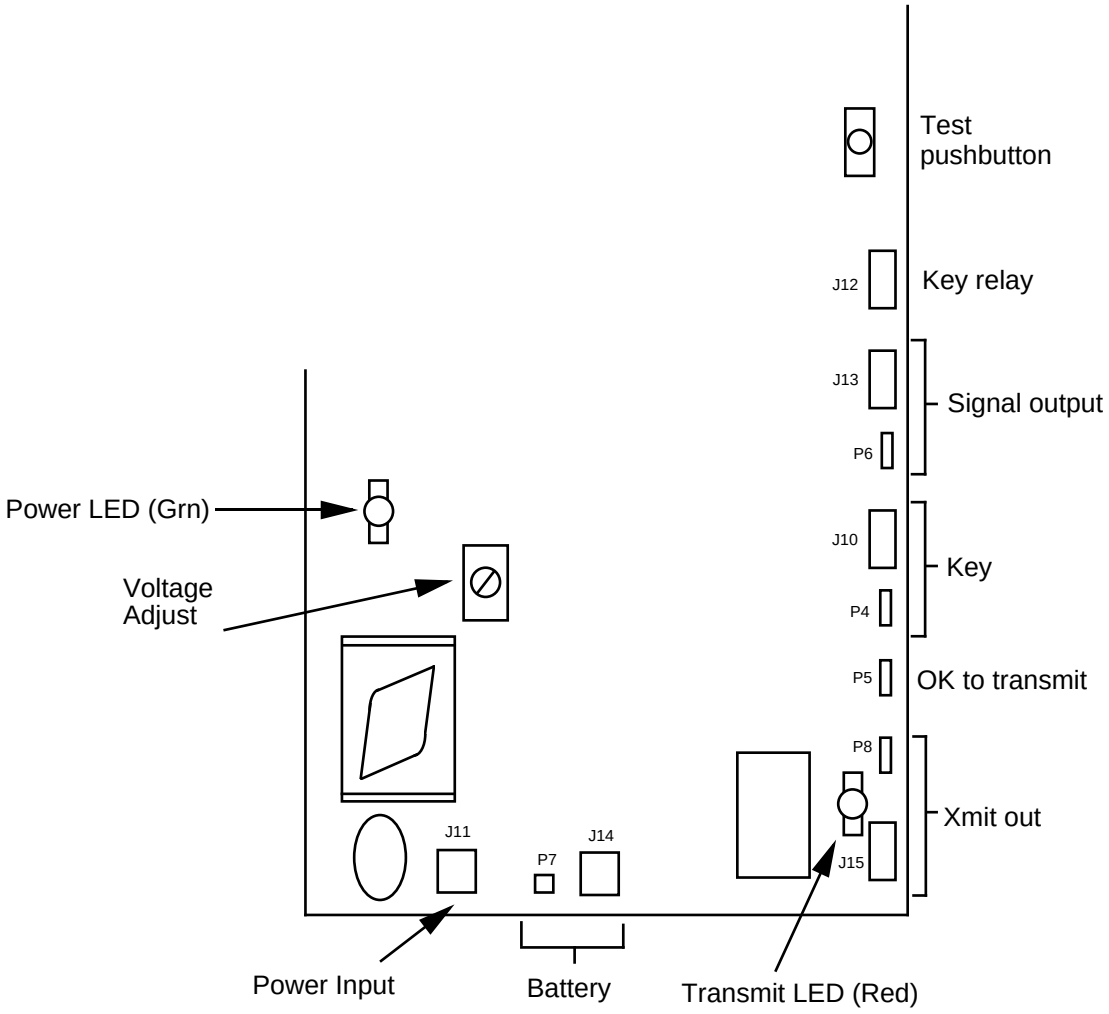
Figure 3-4 Encoder Internal Power Connections



CAUTION: SYSTEM ISOLATION IS REMOVED IF INTERNAL ENCODER POWER IS USED TO ACTIVATE INPUTS.

The encoder output is a two-wire connection to the remote transmitter unit. The wire should be a minimum 20- or 22-gauge twisted-pair cable. Shielded cable is required for cable distances over 50 feet or where the output cable will run adjacent to or in a conduit with other wiring. The polarity of the two wires is important and must be observed. Figure 3-5 indicates the encoder output wiring.

Figure 3-5 Encoder Unit—Power and Output Wiring



The encoder power is provided by the wall-mounted transformer furnished with the unit. The wiring from the wall-mounted transformer to the encoder should be a minimum 18-gauge, two-conductor twisted cable. The wiring distance should not exceed 15 feet, or a larger conductor size should be used.

Figure 3-5 shows the connection of the power wiring. Connect the power wiring but do not plug in the encoder unit until you have double checked all connections and verified that there are no shorts or grounds present.

For best results, the encoder must be firmly grounded to an acceptable earth ground in accordance with the National Electrical Code. Run a minimum 14-gauge ground wire from the encoder ground lug to an earth ground. An acceptable earth ground can be furnished by either a metal cold water pipe or an independent ground rod.

3.4.2 Connecting the Transmitter Unit

Connecting the transmitter unit consists of connecting the antenna, signal input, power, and earth ground.

The transmitter is connected to the antenna transmission cable by the Type N female bulkhead connector located on the top of the transmitter unit. The transmission cable is normally shipped from the factory with the mating connectors already installed. Simply screw the connector in place and hand tighten. Be careful that the transmission cable does not contain any tight bends that could affect performance. Avoid cable bends that are less than one foot in radius. Carefully bend cable and position cable connector in line with the transmitter connector BEFORE screwing connector in place. Leave a sufficient service loop to allow the temporary installation of a RF power meter if required in the future. Refer to Figure 3-6.

The two-conductor incoming signal line is connected to the transmitter input circuit board via board-mounted captive screw-type connectors. Polarity of the two wires is important for proper operation. Refer to Figure 3-7.

The two-conductor power supply cable is connected to the transmitter input circuit board via board-mounted captive screw-type connectors. Polarity of the two wires is not important for proper operation. Refer to Figure 3-7.

Figure 3-6 RF Transmission Cable Connection

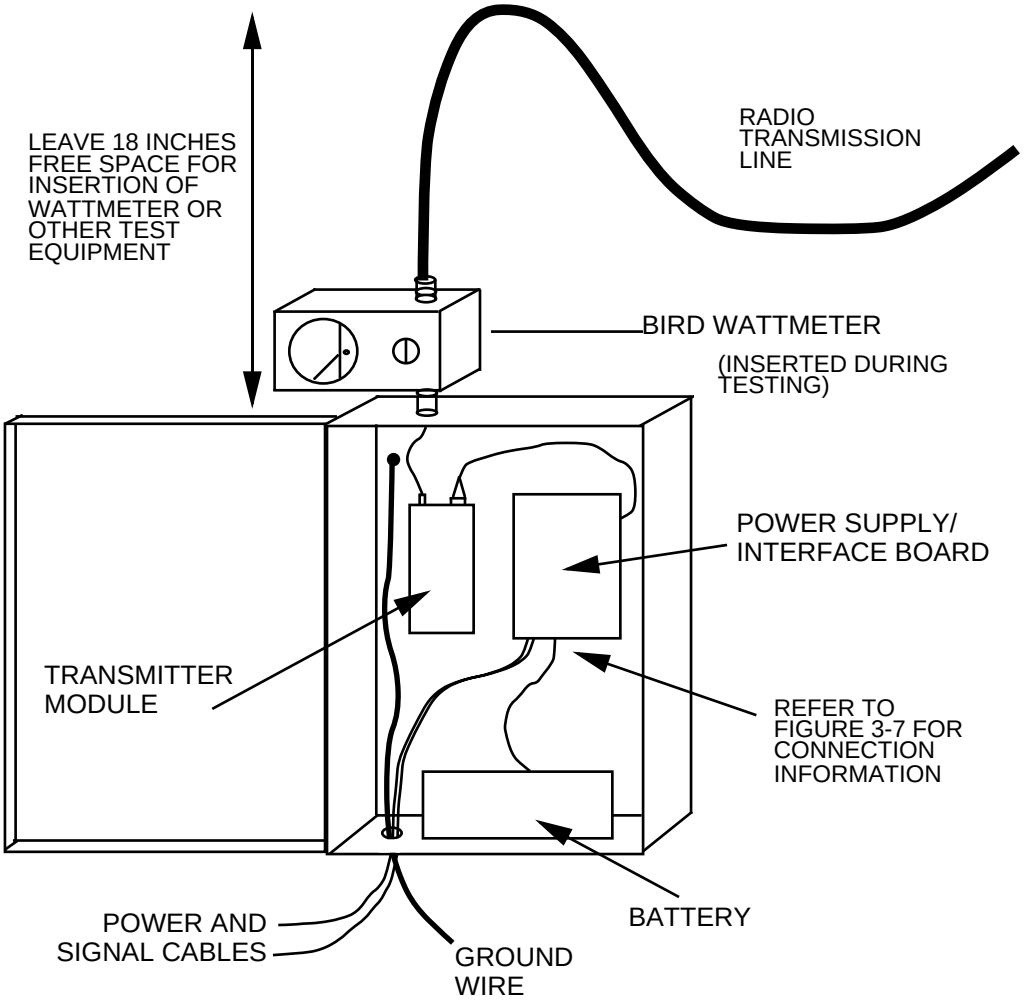
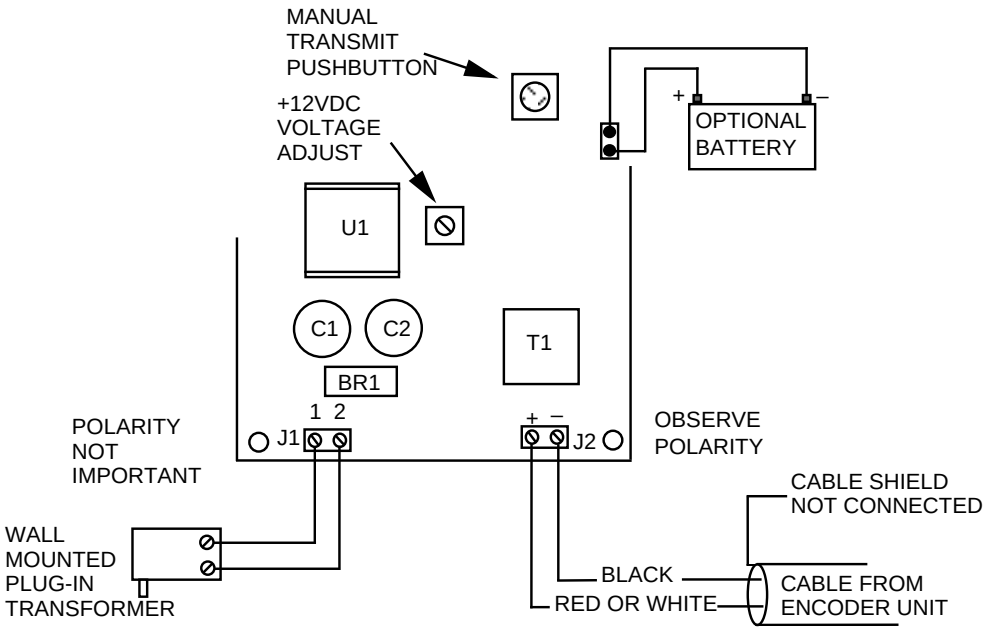
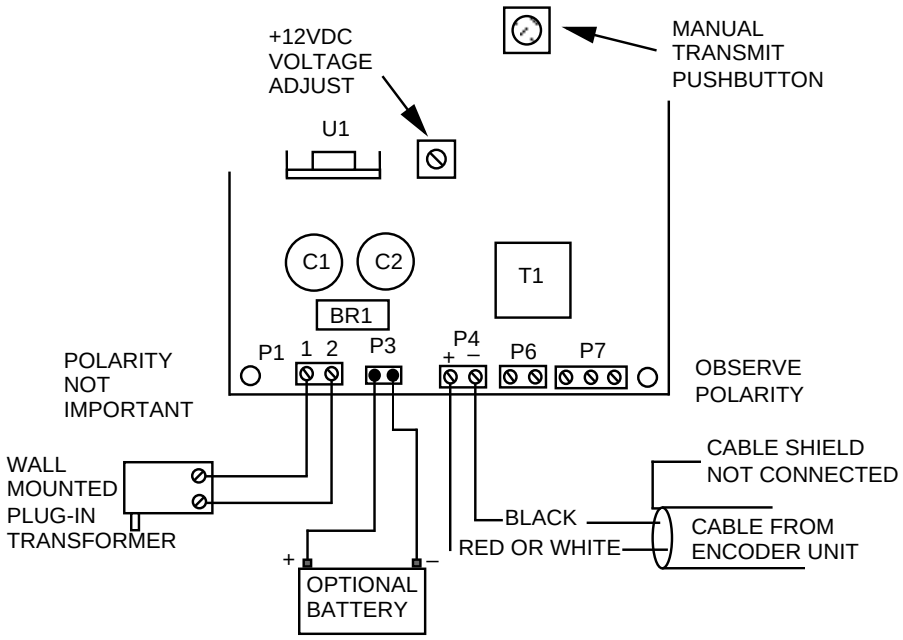


Figure 3-7 Transmitter Unit—Power and Output Wiring



-01 Board, Mid-1997 and Older



-05 Board, Mid-1997 and Newer

The earth ground connection is very important for lightning protection. Connect the earth ground to the terminal located inside the transmitter cabinet. (See Figure 3-6.)

3.4.3 Connecting the Mobile Radio-Graphic Display Unit

Connection of the Mobile Display consists of connecting the BNC antenna connector and making the appropriate connections to the vehicle electrical system.

The vehicle electrical connections consists of +12VDC power, ground, instrument lights, and optional horn. Refer to Figure 3-8 for wiring and connection information.

Note: The service manuals on the vehicle may be helpful when determining where the electrical connections should be made.

CAUTION: Each Mobile display power connection is protected by an in-line fuse. DO NOT remove or compromise these fuses. If a fuse blows, replace it with the same size and type.

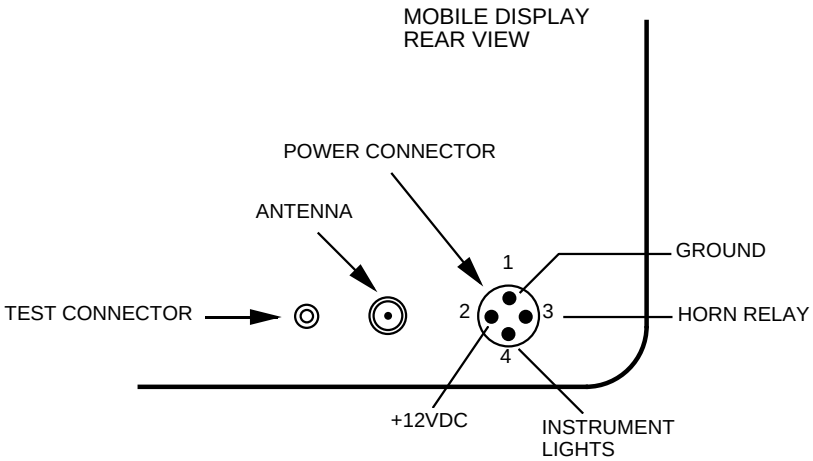
The +12VDC connection should be made to the vehicle power that is activated whenever the vehicle key is turned to either “on” or “accessory.”

The ground connection should be made to a ground terminal or spliced to a vehicle ground wire. If a ground terminal is not available, install a dedicated ground screw. DO NOT rely on grounding by pushing the ground wire under the mounting bracket or other mounting hardware.

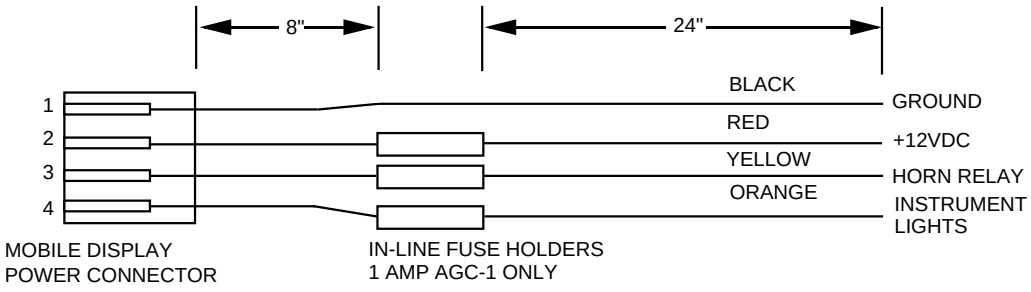
The instrument light connection provides back illumination for the display for night-time viewing. This connection should be made to the vehicle wiring that is activated whenever the instrument lights are turned on. Sometimes the customer requests that the mobile display be illuminated at all times during use. If this is the case, connect the instrument light connection to the +12VDC connection.

The horn connection provides for the vehicle horn to sound whenever the mobile display audible alarm is activated. Upon alarm the horn connection is connected to ground through an internal relay contact. Refer to the vehicle manual for proper connection of this feature. The internal relay has a 500 ma. maximum current capability. If more horn current is required, or the vehicle horn wiring is not compatible with the relay contact to ground, the optional horn relay should be ordered.

Figure 3-8 Mobile Display Power Connections



MOBILE DISPLAY ELECTRICAL CONNECTIONS



MOBILE DISPLAY POWER CABLE, STANDARD

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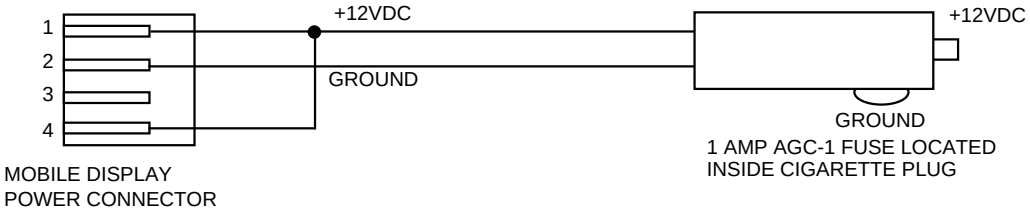


CIGARETTE LIGHTER POWER CABLE

Connect the antenna by connecting the antenna cable mounted BNC connector to the BNC connector on the Mobile Display rear panel. Allow sufficient service loop on the antenna cable and the power wiring that will allow angle adjustment by the operator without damage to the wiring.

4.0 Initial Setup and Adjustment

4.1 General

4.1.1

The *Mobile Map Plus (MMP)* system is a simple installation requiring no field adjustments. Although an uncomplicated installation, it is very important that the system be set up and tested in your shop before the equipment is installed at the project site.

4.1.2

The typical *MMP* installation consists of an encoder in the control area, a transmitter and antenna near or on the roof, and one or more mobile displays installed in roving vehicles. Troubleshooting the distributed system can be difficult and time consuming. Testing in your shop is much more convenient and cost effective.

4.1.3

This procedure is set up to be used in your shop or in the field. It is recommended that this procedure be first used in the shop. When the equipment is installed in the field, paragraphs 4.4 through 4.7 of this procedure can be used to check out the installed system.

4.1.4

It is further recommended that you obtain the following special test equipment to test the frequency and output power of your completed installation. This equipment is available as a "loaner" kit from **CDT**. Refer to brochures and price list.

- Frequency scanner or receiver adjusted to receive the operating frequency of your installation.
- RF power meter, such as a Bird Model 43 Thruline wattmeter with a 5-watt 400-1000 MHz, or other suitable plug-in element.
- Rubber duck antennas for testing each unit.
- Appropriate adapters to connect power meter to transmission line.

4.2 Overview of Setup Procedure

4.2.1

The bench set up consists of assembling all equipment in your shop, interconnecting the equipment, and running tests.

4.2.2

For best results, the encoder unit should be placed in one area and the transmitter and antenna located in another area at least 35-50 feet away. The *MMP* radio-graphic displays can be placed on the bench near the encoder.

4.3 Beginning Procedures

4.3.1 Locate and inventory all components needed for the system installation including test equipment.

4.3.2 Check each unit for physical damage. Check for loose parts and connectors.

4.3.3 Open the encoder unit and place on the bench. Connect the wall-mounted power supply and the 50-foot, or longer if required, piece of two-conductor, 18- to 22-gauge cable for connection to the transmitter unit. (See Figure 3-5.)

Note: DO NOT power any unit until the complete system is connected and checked.

4.3.4 Open the transmitter unit and place on a bench in the remote location. Connect the wall-mounted power supply and the other end of the 50-foot, two-conductor cable coming from the encoder unit. (See Figures 3-5 and 3-7.)

4.3.5 Assemble the antenna using the instructions contained with the antenna or the appropriate Appendix.

4.3.6 Carefully unpack and uncoil the antenna cable. This cable is normally terminated at the factory and ready for installation. If, for some reason, the cable is not terminated or not supplied for your installation, an antenna transmission line must be fabricated for your installation. Use *only* low-loss RG-8, Belden 9913, or RG-213/U, Belden 8267, or an acceptable equivalent. Install connectors in accordance with the appropriate information in Appendix E.

4.3.7 Connect the antenna transmission cable between the antenna and the connector on the RF power meter. Connect the other side of the RF power meter to the transmitter unit. (Refer to Figure 3-6.) Set the power meter to read the forward power. For this test, the antenna can be hung on a string or stood in the corner away from excessive metalwork.

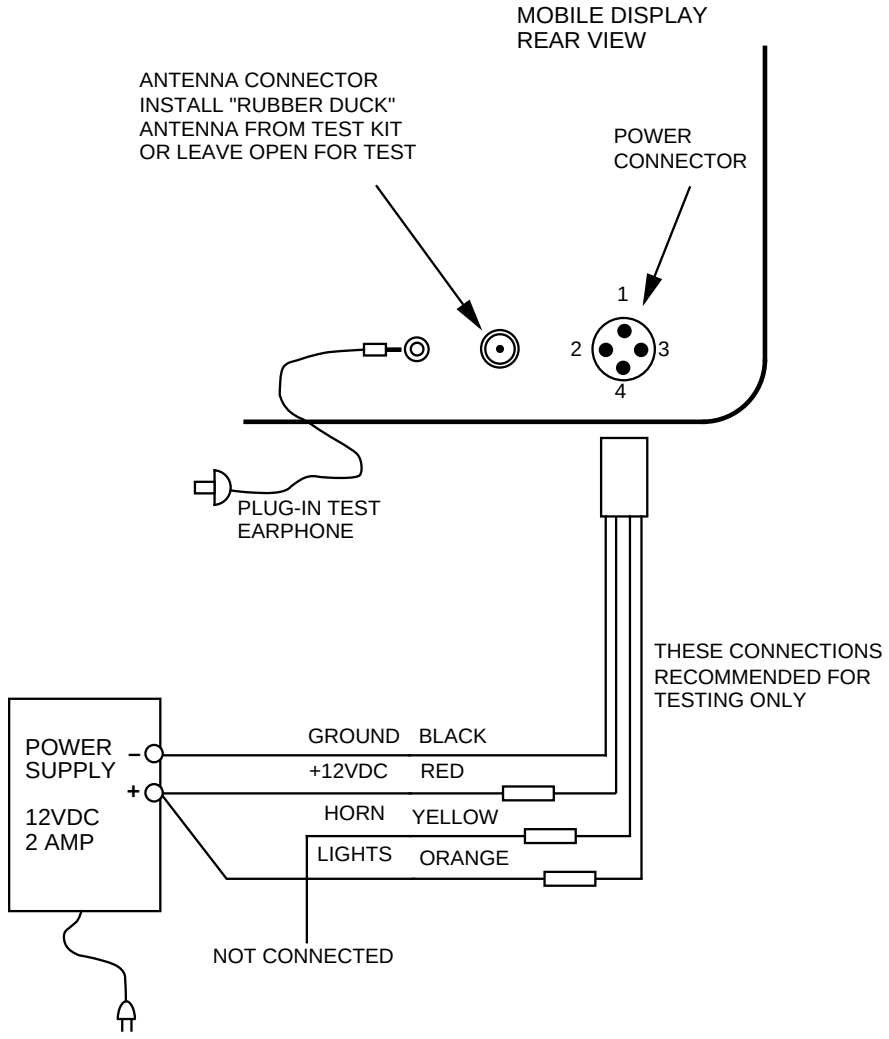
4.3.8 Unpack each mobile display and place on the bench. For this test, an antenna is not necessary, although a suitable “rubber duck” or one of the mobile antennas can be used.

4.3.9 Obtain a 12VDC, 2-amp power supply, or a 2-amp-hour 12VDC battery. A car battery can also be used. Connect the battery to the leads coming from the mobile map power connector in accordance with Figure 4-1. The battery in this case will power both the mobile map electronics and the faceplate illumination.

4.3.10 You will probably have several mobile maps to test. The one mobile map power connector can be used with each mobile map by unplugging from one and plugging into the next unit.

4.3.11 You are now ready to begin bench testing.

Figure 4-1 Mobile Display Test Connections



4.4 Initial Power Up

4.4.1 Power up and test the transmitter and then the encoder unit. Then power up and test each of the mobile displays.

4.4.2 It is recommended that the tests be completed in the order shown. If problems occur and you call the factory, it is best to know what tests have been completed.

4.5 Initial Transmitter Testing

4.5.1 Apply power to the transmitter unit by plugging in the wall-mounted power transformer.

4.5.2 The green LED on the top side of the circuit board will light, showing that the power supply is operating correctly. (See Figure 1-2.)

4.5.3 Press the manual test pushbutton located on the circuit board. (See Figure 1-2.) The transmitter should be transmitting carrier only and the red “transmit” LED will light. The indication on the power meter should be between 1.5 and 2.0 watts for a 2-watt transmitter and 4.5 and 5.0 watts for a 5-watt transmitter. Release the manual test pushbutton.

4.5.4 Reverse the “slug” in the power meter to read reflected power. Momentarily key the transmitter. The reflected power should read almost zero. If the reflected power is more than one-half watt, there is a problem with the antenna or transmission line. The problem, however, could also be caused by the temporary location of your antenna. Relocate your antenna to an open area outside and repeat tests from 4.5.3 above. If the problem recurs, check each of the connections. If in doubt, contact the factory.

4.5.5 Tune your receiver/scanner to the transmitter frequency. When the transmitter is keyed, the presence of the carrier should be evident by the carrier “quieting” heard on the scanner.

4.5.6 This completes the tests of the transmitter unit, and you can proceed to the encoder.

4.6 Initial Encoder Testing

4.6.1 Apply power to the encoder unit by plugging in the wall-mounted power transformer.

4.6.2 The green power LED in the lower left of the circuit board should light, indicating that the power supply is operating correctly. (See Figure 1-3.)

4.6.3 Measure the power supply voltage by placing voltmeter probes on the +12 and GND terminals. The voltage should be 12VDC ± 0.5 volts, or 13.5 ± 0.1 volts if a backup battery is connected.

4.6.4 Momentarily press the test/reset pushbutton located on encoder board. (See Figure 1-3.)

- The red transmit LED on the encoder board should light for about 8.0 msec.
- The red transmit LED in the transmitter unit should light for about 800 msec.
- The RF power meter should indicate power output just as in paragraph 4.5.3 above.
- The receiver/scanner should receive the FSK tones. The tones represent a data sent two times within about 800 milliseconds. The tones will sound like a warbling 2500 Hz tone with less than one second duration.

4.6.5 The action in paragraph 4.6.4 should reoccur each time the encoder transmit pushbutton is pressed. If the system does not check out as indicated above, proceed as follows:

Check the power supply voltages at both the encoder and the transmitter units. The voltage should be 12VDC ± 0.5 VDC.

If the encoder transmit LED lights but the transmitter LED does not, check the polarity of the wiring connections between the encoder and transmitter.

Go back to paragraph 4.5 and retest the transmitter unit. If the transmitter tests good again, the encoder may be defective. Contact the factory for assistance.

4.6.6 This completes the initial tests of the encoder unit, the connection to the transmitter and the antenna. You can proceed to test the mobile displays.

4.7 Mobile Radio-Graphic Display Initial Testing

Note: This procedure should be conducted on each MMP *Mobile Display in the system.*

4.7.1 Apply power to the first graphic display by connecting the power connector to the rear of the Mobile Display and plugging in the power supply. (See paragraph 4.3.9 above.)

4.7.2 There are three types of lamps and an audible alarm on a typical Mobile Display faceplate.

Note: The front panel lamps are programmable. Please refer to the special information shipped with the Mobile Display if the light configuration is not as indicated below.

- The combination red/green LEDs show each zone alarm. There will be one LED for each zone.
- The red LED marked “REC” indicates the system has received the supervisory transmission or a valid alarm transmission. Refer to paragraph 2.3 for further explanation.
- The yellow LED marked “INT” indicates that the display is receiving an invalid transmission that does not contain alarm or supervisory data. This lamp will flash when a valid transmission is received. The lamp will illuminate when an invalid or “jam” signal is received. Refer to paragraph 2.3 for further explanation.
- The audible alarm will activate any time a valid alarm (red alarm LED) is received. The audible alarm is silenced by the top-mounted Acknowledge pushbutton. A re-alarm feature assures that the next alarm will reactivate the audible alarm.

4.7.3 Plug the furnished “test” earphone into the jack on the Mobile Display rear panel. The earphone will be used to listen for reception of the radio signals.

4.7.4 Momentarily press the test pushbutton located in the encoder unit.

- The test earphone will emit the FSK tones (paragraph 4.6.4) indicating the transmission is being received.
- The encoder red transmit LED should light for about 200 msec.
- The red REC LED on the Mobile Display should light.
- The yellow INT LED will flash during alarm transmission.

4.7.5 Press the test pushbutton for approximately 2 seconds and release. The system will automatically enter the system test mode. Each zone lamp will flash, and the audible alarm will sound for each alarm zone, one after another, starting with zone 1. This test will continue until stopped by again pressing the test pushbutton for approximately 2 seconds.

4.7.6 Temporarily activate the zone 1 input on the encoder by placing a shorting jumper and jumper lead as shown in Figure 4-2.

- The operation of paragraph 4.4.9 will occur.
- The red alarm LED will flash indicating alarm reception.
- The audible alarm will activate. Silence the alarm by momentarily pressing the Acknowledge button.
- You may also check for horn relay operation by connecting an ohmmeter to the connector and verifying that the contact is closing at the same rate as the audible alarm (before the ACK button is pressed). *Note: The horn activate switch must be activated.*

4.7.7 Remove the zone 1 alarm input from 4.4.11 above.

- The operation of paragraph 4.4.9 will occur. (The REC LED will remain illuminated.)
- The flashing red LED will revert to green.

4.7.8 Sequentially activate and then deactivate each zone on the graphic display.

- The operation of paragraph 4.4.9 and 4.4.11, and then 4.4.12 should occur.

4.7.9 Experiment by placing several alarms at one time and then removing one or several at a time.

- The operation of paragraph 4.4.9 and 4.4.11, and then 4.4.12 should occur for each alarm condition.
- A transmission should occur each time the alarm conditions are changed.

4.7.10 If any zone does not pass the tests, check all connections and retest. If the problem reoccurs, contact the factory.

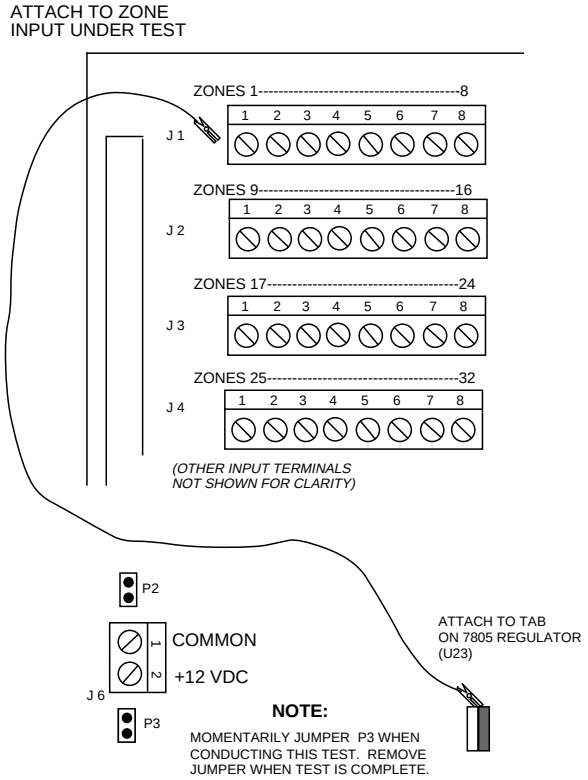
4.7.11 This completes the test of this *MMP* Mobile Display Unit. Repeat these tests for each Mobile Display in your system.

4.7.12 Test the radio system in accordance with the appropriate Motorola manuals. Because each radio is delivered with a microphone and internal loudspeaker, these can be used for normal tests. However, the internal loudspeaker and hand-held microphone will be disconnected when used with the Mobile Map System.

Note: Be sure to fasten the 16-pin accessory connector delivered with each radio to the rear of the radio when the mobile map harness is not connected. The accessory connector has two jumpers that must be installed if you are to use the radio with loudspeaker and microphone. Retain the accessory connector for system testing if needed at a later date.

4.7.13 In conjunction with the radio system testing, the trunked radio software system will require reprogramming to ensure the correct assignment of repeaters (important during failsoft conditions) and to ensure that the mobile map channel is normally clear under normal trunking system operation. See Appendix B and the appropriate manuals for the radio system.

Figure 4-2 Alarm Input Test Jumpers



5.0 System Start-Up and Testing

5.1 General

5.1.1 This section covers start-up and testing of the field-installed system.

5.1.2 This section assumes that the system has been tested in the shop in accordance with Section 4.0 and each piece of equipment has been installed in accordance with Section 3.0.

5.2 Applying Power and Initial Testing

5.2.1 Power-up and test the transmitter and antenna in accordance with paragraph 4.5. The RF power meter should be used for this test and the forward and reflected power recorded on the form inside the transmitter enclosure for future reference when servicing. The use of a portable receiver/scanner can aid your testing.

5.2.2 Power-up and test the encoder (in conjunction with the transmitter) in accordance with paragraph 4.6.

5.2.3 Power-up and test each *MMP* Mobile Display in accordance with paragraph 4.7. The test earphone plugged into the Mobile Display will indicate whether the FSK alarm transmission is being received and the relative strength of the alarm signal and the noise level.

5.2.4 Drive the perimeter or the area that will be normally patrolled by the Mobile Display-equipped vehicles. Send periodic alarm transmissions to verify that alarms are reliably received in all areas. The automatic zone test described in paragraph 4.7.5 can be used to send automatic periodic transmissions. Temporarily removing the red jumper on P5 will lengthen the time between periodic transmissions.

The test earphone will indicate the relative signal strength.

A cellular telephone or a high power set of radios will speed testing. If a telephone or radios are not available, set up a time schedule for sending alarms. Record the receipt of alarms for test verification.

5.3 Final Testing

5.3.1 At the completion of initial testing, if the system demonstrates proper operation, you should be ready for final testing and acceptance with the owner's representative.

5.3.2 Proceed with testing in a logical manner. The *MMP* system can be tested in conjunction with the other alarm systems being installed at the same time.

5.3.3 Record the acceptance of all tests and obtain an acceptance signature from the owner's representative.

5.4 Operator Training

5.4.1 Following final testing and acceptance, at least one operator training session should be conducted. As you are aware, many of the first service calls on any system are from operators who do not understand the system operation. An informed operator and maintenance technician are your best spokespersons.

5.4.2 Appendix A contains an operator's guide. A copy of Appendix A should be furnished to each operator during training.

5.5 Maintenance Training

Following final testing and acceptance, at least one maintenance training session should be conducted. Maintenance training should be conducted in association with the operator training and should be conducted "hands-on" with the equipment. Copies of this manual should be provided to the maintenance personnel during maintenance training.

6.0 Maintenance

6.1 General

The *Mobile Map Plus* system, once installed, is part of the total security system and should be tested as part of the complete system. Refer to the manuals for the alarm system connected to the *MMP* to determine how testing should be conducted.

6.2 Periodic Tests

6.2.1

Periodic tests should be conducted by performing the testing detailed in paragraph 5.2. If defects are discovered, refer to the troubleshooting section.

6.2.2

Perform a system retest following any system repairs or changes.

6.3 Cleaning/ Adjustment

Special cleaning and adjustments are normally not required. However, the antenna installation should be visually inspected each month and whenever severe changes in weather or lightning occurs.

6.4 Special Requirements

6.4.1

The facility management may have requirements and procedures that require additional maintenance and testing beyond those listed herein.

6.4.2

If questions arise about maintenance and testing, please contact your factory representative.

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7.0 Troubleshooting

7.1 Systematic Testing

7.1.1 Problems sometimes occur due to equipment failures. However, in most cases, problems are caused by human- or installation-related items such as:

- Shipping damage
- Disturbed wiring or connections
- Incorrect connections
- Physical damage
- Lightning damage.

7.1.2 Always look for the simplest problem first. For example, always check for power supply voltages before starting any further testing.

7.1.3 When approaching a system malfunction, look first for a related activity that could have caused the problem. This will help you go directly to the possible problem areas and/or obtain more accurate factory assistance. Examples are:

- Recent maintenance actions or installations of other equipment in the same area or equipment rooms.
- Water or lightning damage.

7.1.4 Factory customer assistance is available to help you find and correct system errors. It is important that you keep your as-built documentation and test records so the factory will have the data needed to help resolve your problem.

7.2 Problem Identification and Resolution

7.2.1 Figure 7-1 is provided to help you find and resolve system defects.

7.2.2 If a problem occurs, test by following the procedures provided in paragraph 5.2.

7.2.3 If an RF power meter is not available, perform a good physical inspection of the antenna and transmission cable before proceeding with any other tests.

7.2.4 If an RF power meter or receiver/scanner is not available, remove one Mobile Display Unit from its bracket, connect a power supply in accordance with paragraph 4.3.9, plug in the test earphone and rubber duck, and use as a test instrument. If assistance is required, contact the factory.

7.3 Repair

7.3.1 Perform system repairs using good commercial practice. It is recommended that repairs be performed by personnel who have received factory training. Improper repairs or system damage caused by untrained personnel can affect the warranty.

7.3.2 Isolate defective components by swapping field connections with known good components or by using spare components reserved for maintenance actions. Repairs to circuits contained inside the equipment are not recommended in the field unless authorized by a factory technician.

7.3.3 Return components thought to be defective to **CDT** for repair in accordance with the repair procedure. Include information describing the nature of the problem with the component to be repaired. This will shorten the factory repair time.

7.4 Warranty

7.4.1

CDT MAKES NO WARRANTY, EXPRESSLY OR BY IMPLICATION EXCEPT AS SET FORTH BELOW. **CDT** warrants that the products delivered hereunder will be in substantial conformity with applicable specifications and will be free from defects in material and workmanship. **CDT**'s obligation under this warranty shall be limited to (at its option) repairing, replacing, or granting a credit at the prices invoiced at the time of shipment for any of said products which shall, within one year after shipment, be returned to the factory of origin, transportation charges prepaid, and which are, after examination, disclosed to **CDT**'s satisfaction to be thus defective. This warranty shall not apply to any of such products which shall have been repaired or altered, except by **CDT**, or which shall have been subjected to physical or electrical abuse or misuse.

7.4.2

THE WARRANTIES STATED HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND **CDT** NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY. **CDT** SHALL NOT BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE WITH RESPECT TO ANY PRODUCTS OR SERVICES RENDERED HEREUNDER. NO PRODUCT IS WARRANTED TO BE FIT FOR ANY PARTICULAR USE OR APPLICATION.

7.0 TROUBLESHOOTING

FIGURE 7-1
TROUBLESHOOTING GUIDELINES

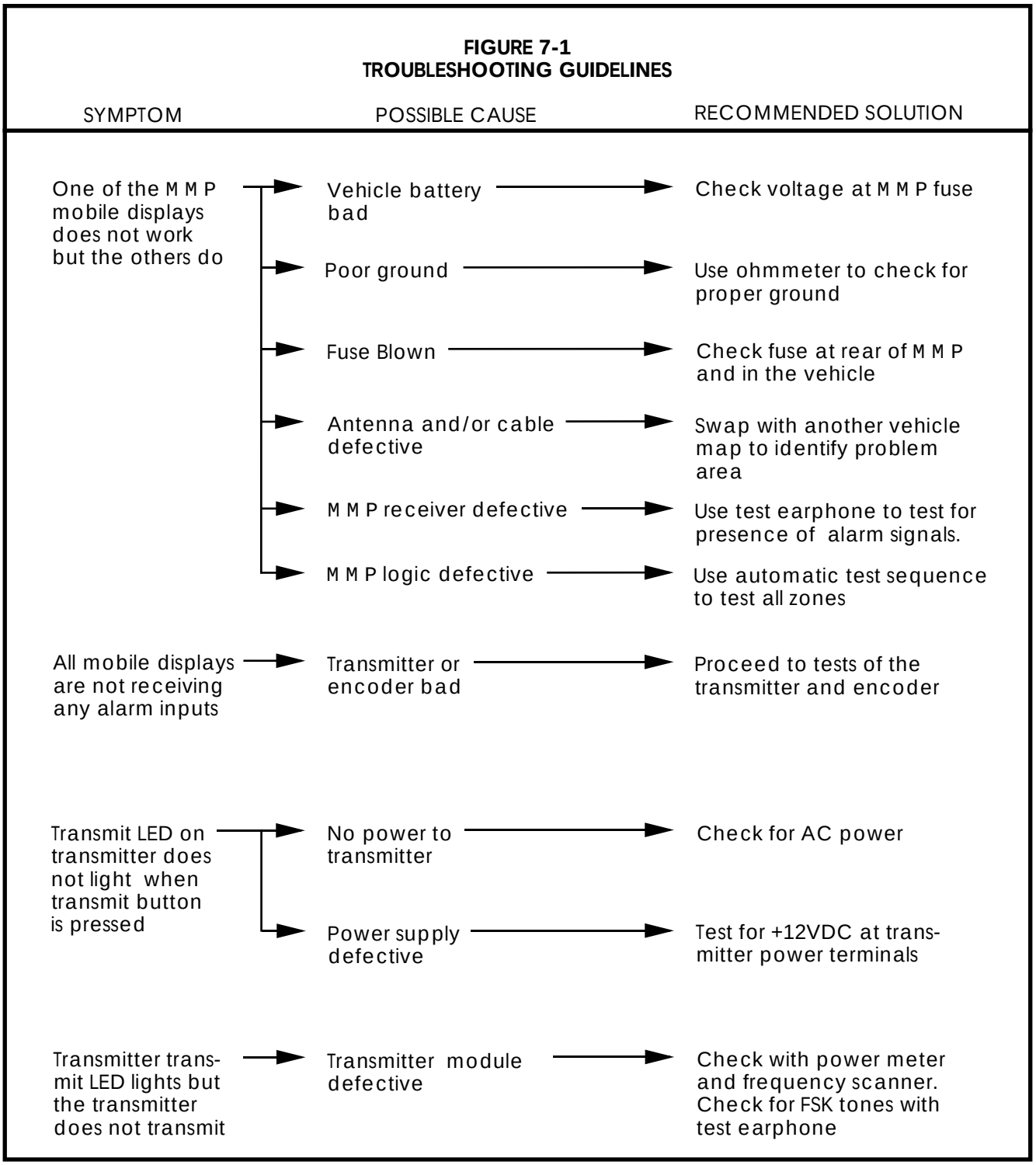
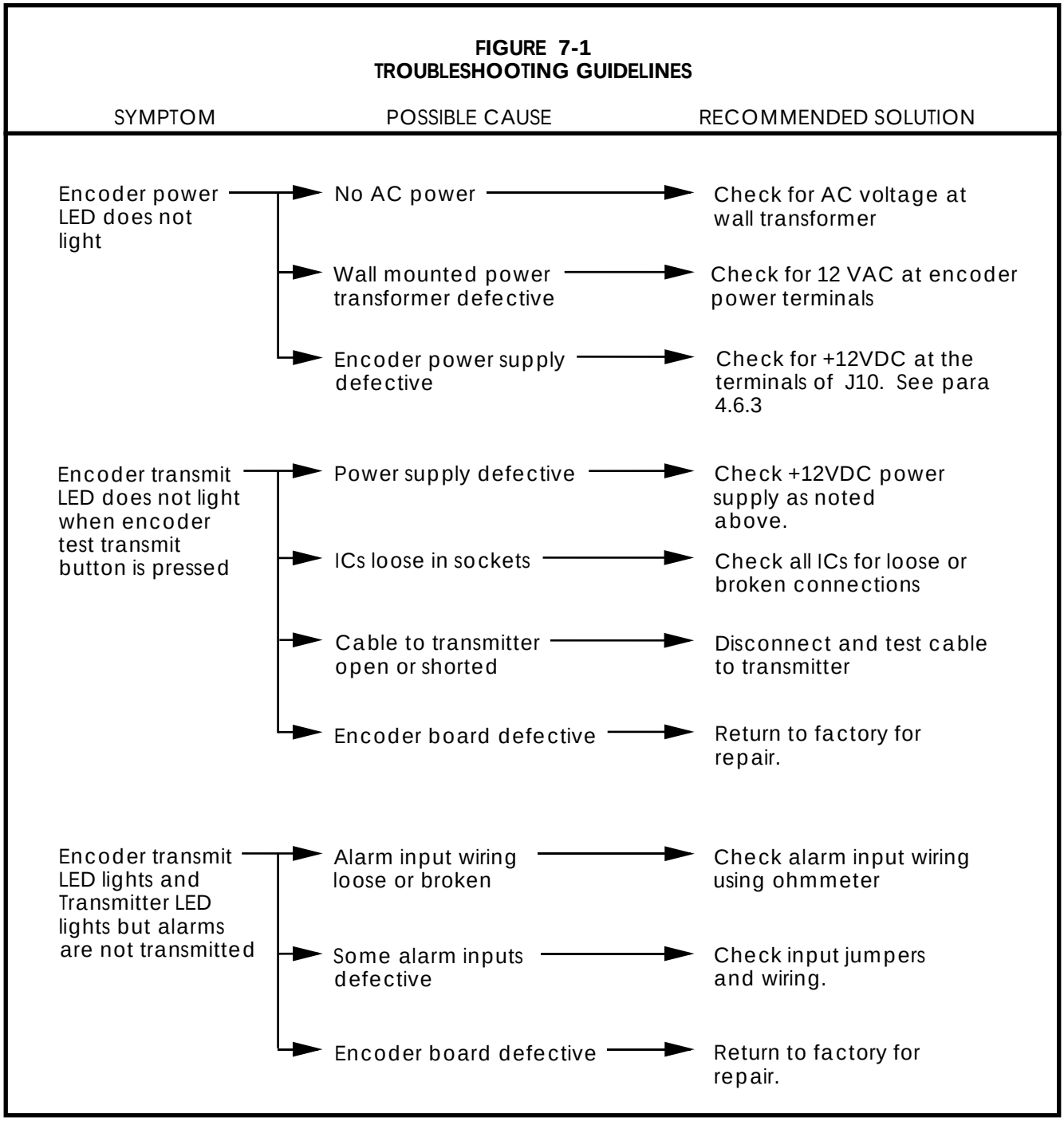


FIGURE 7-1
TROUBLESHOOTING GUIDELINES



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Appendix Contents

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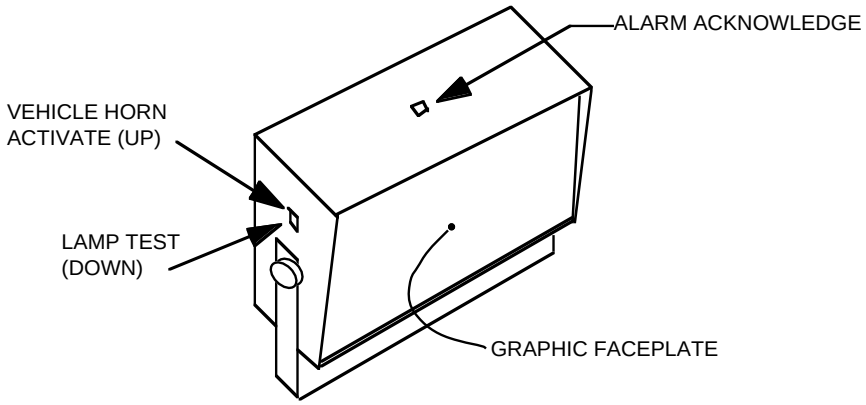
A—Operator's Guide



A zone alarm will be shown by a flashing red lamp on the graphic display where the alarm has occurred.

A secure zone is indicated by a solid green lamp for that zone on the graphic display.

The red “REC” lamp indicates that this Mobile Display is correctly receiving alarm and supervisory signals from the central alarm system. *Note: This light may not come on immediately when the vehicle is turned on because no transmissions have occurred. If the light is not lit within 5 minutes of vehicle operation, notify the Maintenance Department.*

The yellow “INT” light indicates a signal is present that may interfere with Mobile Display operation. If this lamp lights, notify Control immediately. *Note: This lamp will flash approximately 1/2 second when a normal transmission is received.*

Test front panel alarm lamps by momentarily pressing the lamp test button. Upon pressing all alarm lamps and the audible signal will flash approximately four times.

Activate the vehicle horn connection (if connected) by pressing the vehicle horn switch.

If you doubt the operation of the Mobile Display, request that Control transmit a test alarm signal.

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B—Standard Antenna Installation Information

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YOU, YOUR ANTENNA, AND SAFETY

WARNING

INSTALLATION OF THIS PRODUCT NEAR POWER LINES IS DANGEROUS!

FOR YOUR SAFETY, FOLLOW THE INSTALLATION INSTRUCTIONS

Each year hundreds of people are killed, mutilated, or receive severe permanent injuries when attempting to install or remove an antenna. In many of these cases, the victim was aware of the danger of electrocution but did not take adequate steps to avoid the hazard.

For your safety, and a proper installation, please READ and FOLLOW the safety precautions that follow — THEY MAY SAVE YOUR LIFE.

Save these instructions for future reference. The same precautions will apply when dismantling an antenna.

GENERAL SAFETY DIRECTIONS

1. If you are installing an antenna for the first time, please, for your own safety as well as others, seek PROFESSIONAL ASSISTANCE. Consult your dealer. He can explain which mounting method to use for the size and type antenna you are about to install.

2. Select your installation site with safety, as well as performance, in mind (see page 2 for 'Site Selection'). REMEMBER: ELECTRIC POWER LINES, PHONE LINES AND GUY WIRES LOOK ALIKE. FOR YOUR SAFETY, ASSUME THAT ANY OVERHEAD LINES CAN KILL YOU.

3. Call your electric power company. Tell them your plans and ask them to come look at your proposed installation. This is little inconvenience, considering YOUR LIFE IS AT STAKE.

4. Plan your installation procedure carefully and completely before you begin. Successful raising of a mast or tower is largely a matter of coordination. Each person should be assigned to a specific task, and should know what to do and when to do it. One person should be designated as the "boss" of the operation to call out instructions and watch for signs of trouble.

5. When installing your antenna, REMEMBER:
   DO NOT use a metal ladder.
   DO NOT work on a wet or windy day, especially during electrical storms or when there is thunder and lightening in the area.
   DO dress properly — shoes with rubber soles and heels, rubber gloves, long sleeve shirt or jacket.

6. If the assembly starts to drop, get away from it and let it fall. REMEMBER: The antenna, mast, cable and metal guy lines are excellent conductors of electrical current. Even the slightest touch of any of these parts to a power line completes an electrical path through the antenna and the installer — THATS YOU!

7. If any part of the antenna system should come in contact with a power line, DON'T TOUCH IT OR TRY TO REMOVE IT YOURSELF. CALL YOUR LOCAL POWER COMPANY. They will remove it safely.

8. If an accident should occur with the power lines: DON'T grab hold of the person in contact with the antenna and power line or you too will be electrocuted. Use a DRY board, stick or rope to push or pull the victim away from the antenna. If the victim has stopped breathing, administer artificial respiration — and stay with it. Have someone call for medical help.

SITE SELECTION

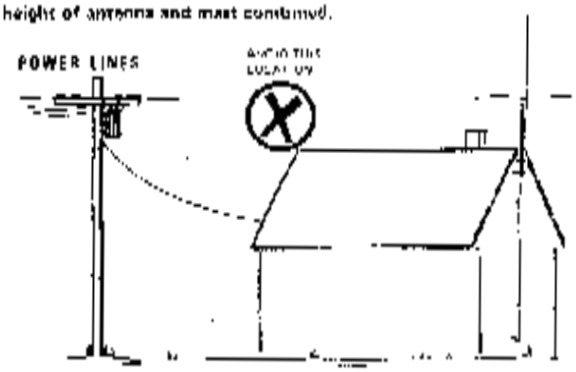
Before attempting to install your antenna, think where you can best place your antenna for safety and performance. To determine a safe distance from wires, power lines and trees:

1. Measure the height of your antenna.
2. Add this length to the length of your tower or mast.
3. Then, double this total for the minimum recommended safe distance.

If you are unable to maintain the safe distance, STOP! GET PROFESSIONAL HELP. Select an alternate location.

Most antennas are supported by pipe masts attached to the chimney, roof or side of the house. Antennas can also be attached to self supporting towers or masts or towers and masts supported by guy lines. Generally, the higher the antenna is above ground, the better it performs. Good practice is to install your vertical antenna about 5 to 10 feet above the roof line and away from power lines and obstructions. Remember that the FCC limits your antenna height to 60 feet. If possible, find a mounting place directly above your set, where the antenna wire can take a short, vertical drop on the outside of the house for entry through a wall or window near the set. Your dealer carries a complete line of installation hardware.

The safe distance from power lines should be at least twice the height of antenna and mast combined.

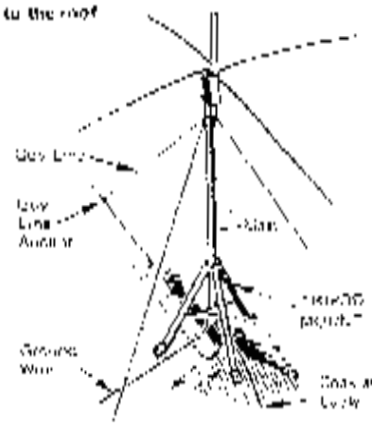


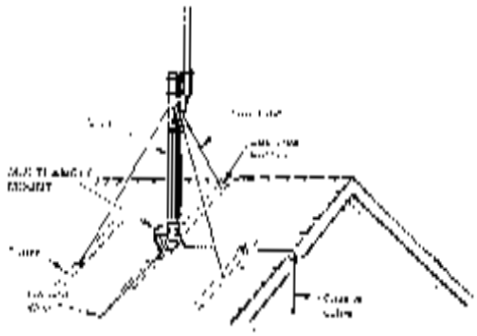
CHOOSE A PROPER SUPPORT AND MOUNTING METHOD

There are three types of supporting structures commonly used in antenna installations; roof, free standing and side-of-house mounts. Illustrations of these devices and various mounting methods follow.

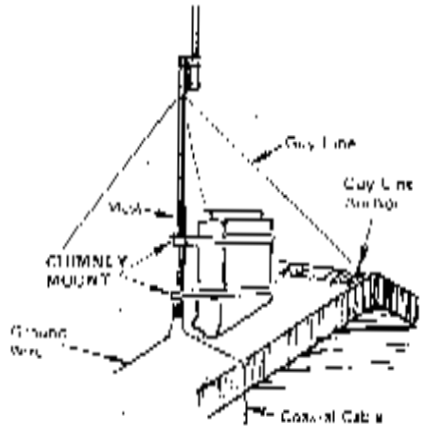
ROOF MOUNT for flat or peaked roofs

A tripod mount will support a five to ten foot 1½" diameter steel mast for CB omni-directional antennas. One clamp type bracket is used with three or four guy lines equally spaced around the mast and anchored to the roof.





The swivel feature of the multi-angle mount makes a convenient CB omni-directional antenna mount. One clamp-type bracket is used with three or four guy lines equally spaced around the mast and anchored to the roof.



The chimney is often an easy and convenient mounting place. But, the chimney must be strong enough to support the antenna in high winds. Do not use a chimney that has loose bricks or mortar.

A good chimney mount makes use of a five or ten foot 1½" diameter steel mast and a heavy duty two-strap clamp-type bracket. Install the upper bracket just below the top course of bricks and the lower bracket two to three feet below the upper bracket. For maximum strength, space the brackets as far apart as possible and use guy lines.

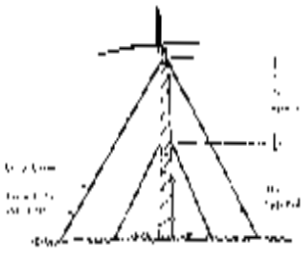
Follow suitable mounting methods and limitations described in the instructions supplied with the mount.

On all roof mounts, apply roofing compound around the base of brackets, screws and anchors for moisture sealing.

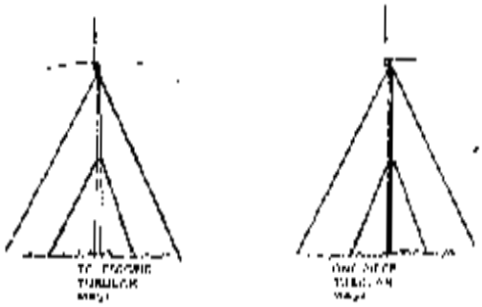
Make guy wire attachments through roof and into rafters for strength.

The safe distance from power lines is at least twice the height of the antenna and mast combined.

FREE STANDING MOUNTS
with guy lines or alongside a structure



The one-piece mast, telescopic tubular mast and tower allows the antenna to be mounted away from structures. However, for added strength, a mast or tower may be erected next to a structure and attached to it.



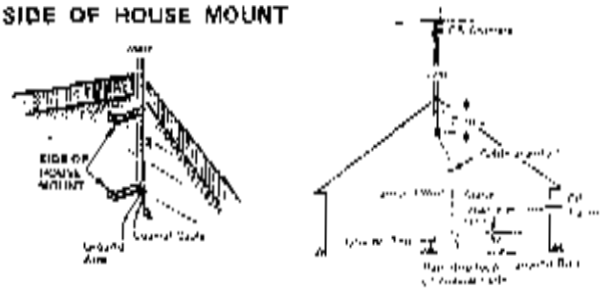
The minimum safe diameter mast for this antenna is specified on the antenna assembly instructions. Guy lines should be equally spaced (see below) in at least three directions. Use at least three guy wires for each 10 foot length of mast.

TOP VIEW

Follow suitable mounting methods and limitations described in the instructions supplied with the tower or mast.

The safe distance from power lines is at least twice the height of the antenna and mast combined.

SIDE OF HOUSE MOUNT



Where roof overhang is not excessive, the side of the house provides a convenient mounting. Position the brackets over a stud if possible, one above the other, and space two or three feet apart. For metal siding, first mark mounting holes; then, drill pilot holes through the siding to accept mounting screws.

Follow suitable mounting methods and limitations described in the instructions supplied with the mount.

The safe distance from power lines is at least twice the height of the antenna and mast combined.

GENERAL INSTALLATION DIRECTIONS FOR MAST MOUNTED ANTENNAS

1. Additional material needed to complete installation is described in antenna assembly instructions.

2. Assemble the antenna on the ground at the installation site. Keep the assembly instructions that come with the antenna separate from other instructions (for mount, cable, etc.).

3. On the ground, clamp antenna to mast, pull enough coaxial cable and connect to antenna.

4. Various methods of raising an antenna (or mast), such as "walking up" or the use of an "X frame" can be found in manuals and handbooks available at most dealers. To insure that a mast does not fall the "wrong way" if it should get away during installation or take-down, durable non-conductive rope should be secured at each ten foot level as the mast is raised. The boss stands in a position where he can yank or pull the ropes if the need arises to deflect the falling mast away from hazards (such as power lines) into a "safe fall" (such as a yard or driveway). The ropes are tied taut at the base of the mast after installation and in place at the various levels.

5. Install selected mount following instructions supplied with it. Note any limitations and follow recommended installation procedures.

6. When using guy lines:

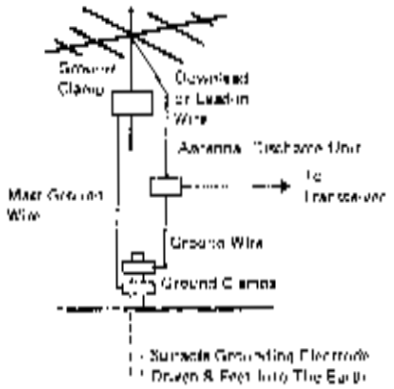
   Install guy anchor bolts
   Estimate length of guy wire and cut.
   Attach guy line ring to mast.
   Attach guy lines to mast and anchor securely.

7. Carefully take antenna and mast assembly to mounting bracket and mast. Tighten clamp bolts. In case of guyed installation, it will be necessary to have at least a second person hold the mast upright while the guy lines are attached and tightened to the anchor bolts.

8. Install self-adhering "DANGER" label, packaged with antenna, on the mast.

9. Install ground rod to drain off static electricity buildup and connect ground wire to mast and ground rod. Use special ground rods – not a spare piece of pipe.

EXAMPLE OF ANTENNA GROUNDING AS PER NATIONAL ELECTRICAL CODE INSTRUCTIONS



1. Use No. 10 AWG copper or No. 8 AWG aluminum or No. 17 AWG copper-clad steel or bronze wire, or larger as ground wires for both mast lead-in. Securely clamp the wire to the bottom of the mast.

2. Secure lead-in wire from antenna to antenna discharge unit and mast ground wire to house with stand off insulators spaced from 4 feet (1.22 meters) to 6 feet (1.83 meters) apart.

3. Mount antenna discharge unit as close as possible to where the lead-in wire enters the house.

4. Drill a hole in wall near set just large enough to permit entry of cable.

5. Push cable through hole and form a rain drip loop close to where it enters house. (Careful! There are wires in that wall!)

6. Put a small amount of caulking around cable where it enters house to keep out drafts.

7. Install static electricity discharge unit. The grounding conductor shall be run in as straight a line as practicable from the antenna mast and/or the antenna discharge unit to the grounding electrode.

8. Connect antenna cable to set.

You should not attempt to raise or lower a mast in excess of 30 feet in height/length (not including the antenna proper) in a fully extended condition. Thirty to fifty foot tubular masts must be raised or lowered a section at a time with the base or outer section secured in place with guy lines. GET PROFESSIONAL HELP.

Keep this installation instruction booklet for future reference when removing the antenna. Remember, use similar cautions when disassembling -- the same electrical hazards exist. IF YOU ARE IN DOUBT – GET COMPETENT PROSSIONAL ASSISTANCE.

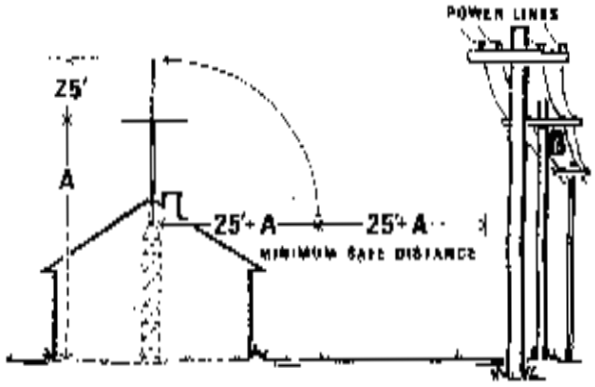
ANTENNA REMOVAL

FOR YOUR SAFETY, READ THE FOLLOWING DIRECTIONS BEFORE STARTING TO REMOVE AN ANTENNA

CHECK FOR SURROUNDING HAZARDS

Most important, CHECK FOR LOCATION OF POWER LINES. Their closeness to the antenna may not have been considered when it was put up or new lines may have been installed after the antenna was.

Remember, whatever the length of the antenna and mast is combined – DOUBLE IT – that's the safe distance ANY power line must be from the antenna. Refer to the illustration below.



IF POWER LINES ARE NOT AT LEAST THIS SAFE DISTANCE FROM THE ANTENNA – STOP ! CONTACT YOUR POWER COMPANY OR PROFESSIONALS THAT DO THIS TYPE OF WORK.

Are there other antennas nearby or on the same mast that may get in the way?

Are there other objects that may interfere with antenna removal such as trees, air conditioning units, chimneys, dormers, etc.

CHECK THE CONDITION OF THE ANTENNA

The condition of the antenna has changed since it was put up. The weather may have caused rust and corrosion. Some parts may be weak, cracked or broken.

If possible, inspect radials, elements, brackets, etc. and remove any broken or loose pieces that may unexpectedly fall off during disassembly and cause injury.

CAREFULLY DISASSEMBLE AND REMOVE ANTENNA

DO NOT remove an antenna on a windy day or during bad weather. Especially during electrical storms or when there is thunder and lightening in the area.

Have at least one other person to assist you, two would be even better.

Hand tools usually required are pliers, screw driver and adjustable wrench. However, since each situation is different, other equipment may be needed. Use penetrating oil to loosen any rusted screws and nuts.

Disconnect all cables from equipment and power sources first. Then disconnect all cables at the antenna.

If any radials or elements can be easily removed while the antenna is still mounted, do so.

Be careful not to let the antenna, parts or tools fall that could cause damage or injury.

Most antennas are not heavy, but they can be difficult to handle. Use strong rope (nylon or hemp) securely attached to the antenna to help control it while it is being removed.

Remember, if you are unsure about what to do or are doubtful about whether you can handle the job -- STOP -- get professional help.

C—Base Station Antennas

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UHF BASE STATION ANTENNA

ASPR659 SERIES

406–420 MHz 450–470 MHz 470–494 MHz 494–512 MHz

INSTALLATION INSTRUCTIONS

The use of PTFE or similar lubricant on the threaded portions of the antenna, prior to assembly, will protect from weather and ease future disassembly.

1. Attach radials to bracket and cable assembly as shown in FIG. 1 and tighten securely.
2. Screw transformer and whip adapter onto mount and hand tighten securely.
3. Place whip into adapter. Tune antenna to specific frequency within its range by cutting bottom end per charts on reverse side. Grind a flat on rod where the set screw will bear and tighten securely.
4. Mount antenna on 3/4" pipe or 1" tubing (not supplied) with "U" bolt, lockwashers and hex nuts provided. Tighten securely.
5. Route a cable with a male UHF connector (PL 259 or equal) on the antenna end (cable and connector not supplied) and connect to "pig-tail" cable connector. Apply Self Fusing Tape over connections to protect from weather. Secure to mounting pipe with strap or plastic tape to avoid strain on cable connectors.

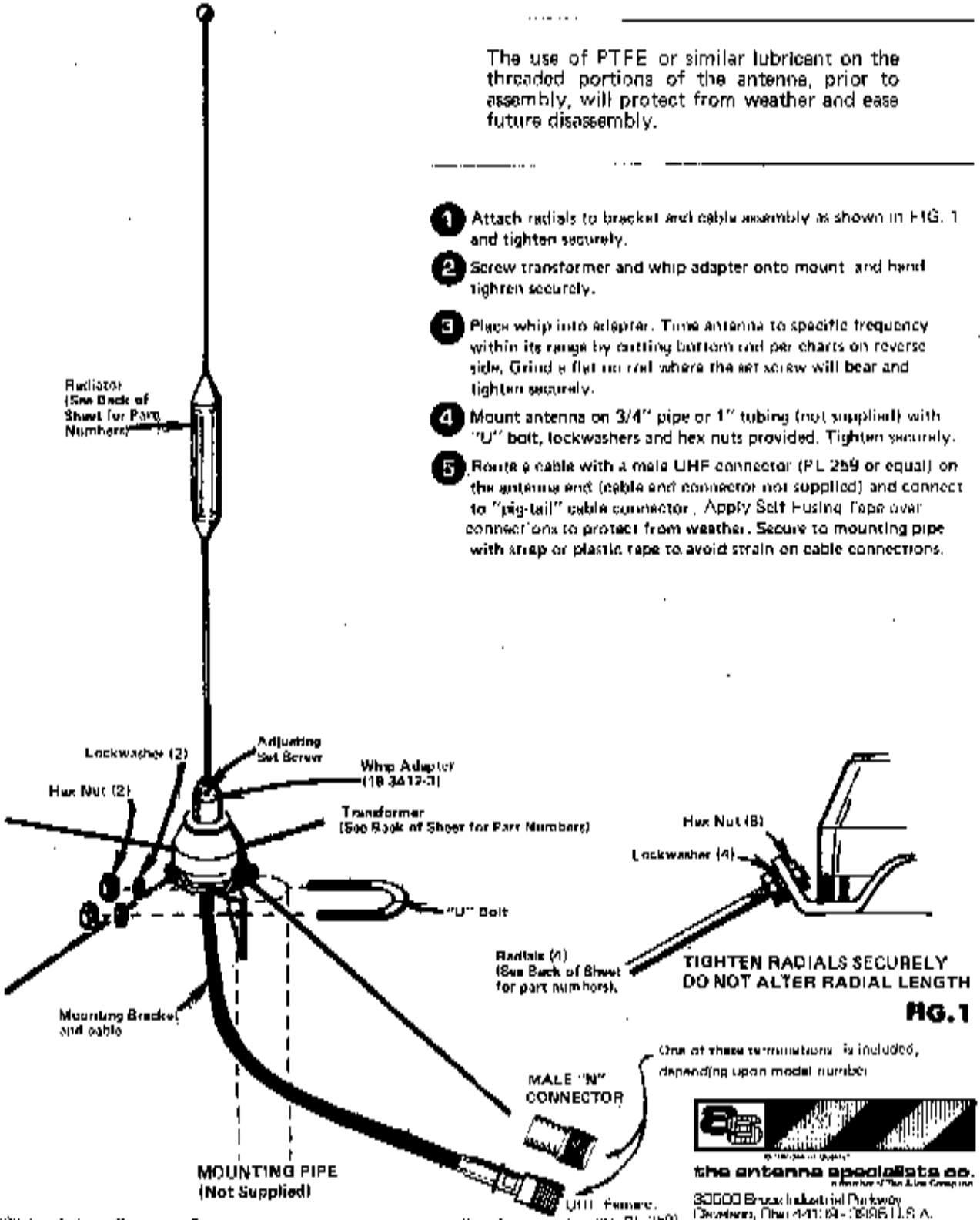


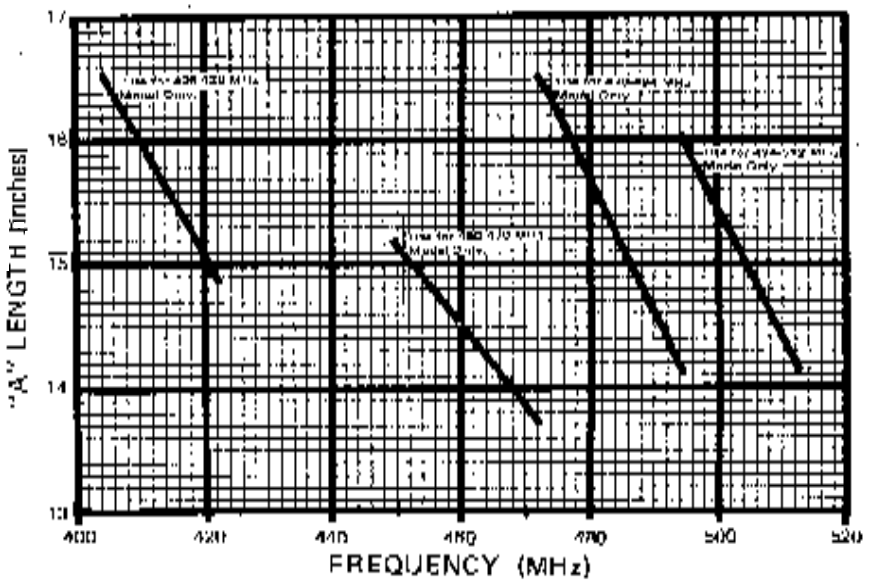
FIG. 1

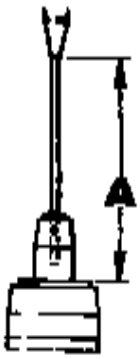
the antenna specialists co.
a division of The Allen Group Inc.
30500 Bruce Industrial Parkway
Cleveland, Ohio 44139-3985 U.S.A.

TUNING

Chart is approximate for typical applications; some mounting locations may require slightly different lengths than shown. Use only the chart corresponding to the frequency range of model being used.

Cut the whip, from the bottom, to the length shown for the desired operating frequency. If available use an in-line wattmeter to fine tune.





Frequency (MHz)	406-420	450-470	470-494	494-512
Replacement Radiator	19-2194 6	19 2194 22	19 2194 25	19-2194-25
Replacement Radial	19-322-9	19-322-10	19-322-11	19 322 11
Radial Lg.(do not alter)	7-5/16"	6-13/16"	6"	6"
Transformer	K 222	K-222	K-222	19-3372-9

WEATHERPROOFING COAXIAL CONNECTIONS

WRAP OTHER TYPE CONNECTION SUCH AS A PIGTAIL CONNECTION TO AN ANTENNA IN THE SAME MANNER AS DESCRIBED BELOW.

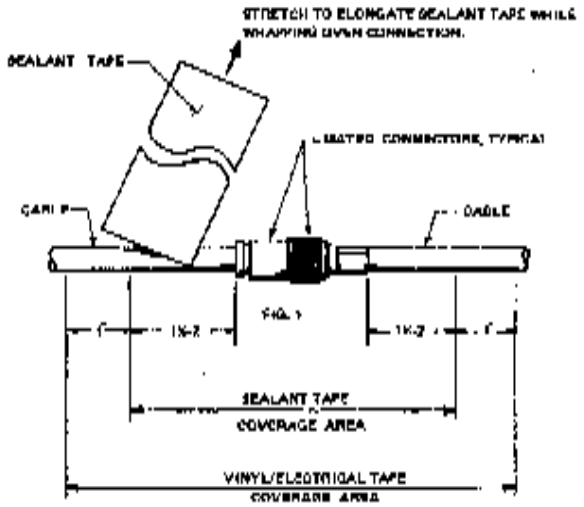


FIG. 1

1. BEGINNING AS SHOWN IN FIG. 1 BY OVERLAPPING HALF WIDTH, WRAP SEALANT TAPE [illegible] CONNECTION.

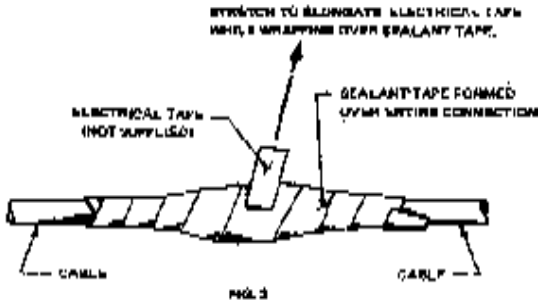
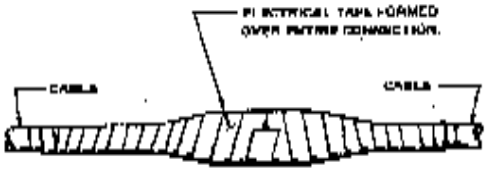


FIG. 2

2. GENTLY PRESS ON THE SEALANT TAPE FORMING IT TO THE CONNECTION, CABLE AND THE CABLE JACKETS, AS SHOWN IN FIG. 2.



ELECTRICAL TAPE WRAPPED TIGHTLY AGAINST CABLE JACKET TYP. BOTH ENDS.

FIG. 3

3. AT OVERLAP, APPLY HALF WIDTH, WRAP ELECTRICAL TAPE (NOT SUPPLIED) OVER THE END OF THE SEALANT TAPE CONNECTION; THEN, BEGINNING (with) TAPE, APPLY AT CENTER OF FORMED SEALANT TAPE AND WRAP TOWARDS ONE END APPROXIMATELY ONE INCH BEYOND END OF SEALANT TAPE. INSURE TIGHT ELECTRICAL TAPE COVERAGE ONTO CABLE JACKET WITHOUT BREAKING ELECTRICAL TAPE, REVERSE DIRECTION AND WRAP TO OTHER END, AGAIN EXTENDING APPROXIMATELY ONE INCH BEYOND END OF SEALANT TAPE. [illegible] ONTO CABLE JACKET. REVERSE DIRECTION AGAIN AND WRAP ELECTRICAL TAPE TO [illegible] AND STOP.

D—Mobile Antennas

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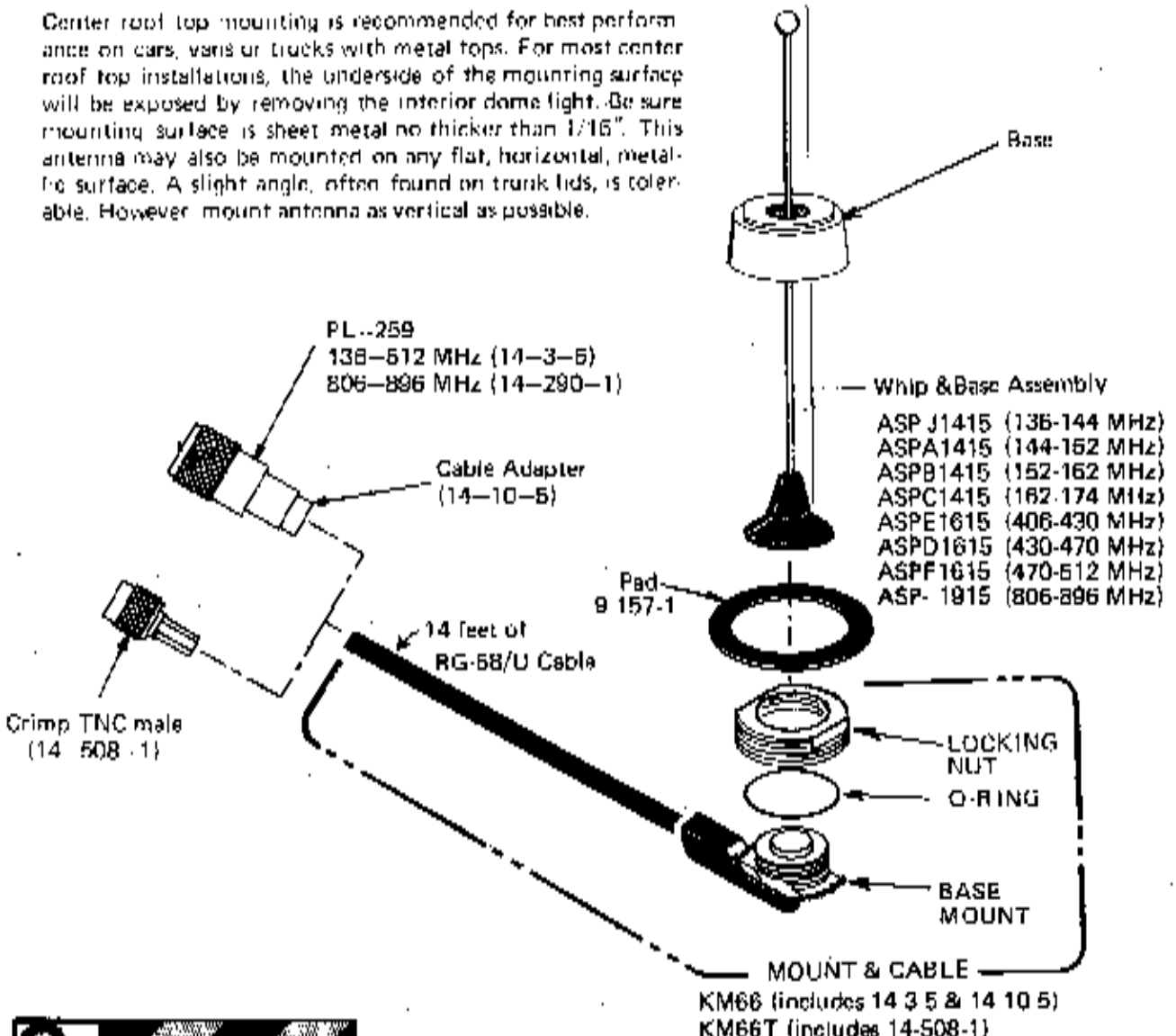
ROOF MOUNT ANTENNA

for VHF 136-174 MHz, UHF 406-512 MHz & 806-896 MHz

ASP-1410 series
ASP-1610 series
ASP-1910

WHERE TO MOUNT THE ANTENNA

Center roof top mounting is recommended for best performance on cars, vans or trucks with metal tops. For most center roof top installations, the underside of the mounting surface will be exposed by removing the interior dome light. Be sure mounting surface is sheet metal no thicker than 1/16". This antenna may also be mounted on any flat, horizontal, metallic surface. A slight angle, often found on trunk lids, is tolerable. However mount antenna as vertical as possible.



the antenna specialists co.
a member of The Allen Group Inc.

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The use of a PTFE or similar lubricant on the threaded portion of the antenna, prior to assembly, will protect from weather and ease future disassembly.

INSTALLING THE MOUNT

1. Using a sheet metal drill or hole saw cut a ¾" diameter hole at the selected mounting location. THE USE OF A TWIST DRILL MAY TEAR UPHOLSTERY.

2. Scrape the underside of mounting surface to expose metal. The area around hole must be free of paint, undercoating, etc. to provide a good electrical ground.

3. If underside of mounting surface is accessible, begin by routing cable from mounting hole location inside vehicle, to radio. If underside of mounting surface is NOT accessible, first route cable through mounting hole from outside vehicle, then to radio.

4. Loosen the locking nut to within one or two turns of disengagement.

5. Insert the base mount into mounting hole by tilting it slightly as shown in FIG. 1.

6. While holding the base mount steady, tighten the locking nut onto it finger tight. Make sure the toggle is centered in the hole, and seated properly with both shoulders on the edge of the mounting hole. Be sure the O-Ring is seated in the groove of the locking nut before tightening.

7. Using a 15/16" open-end wrench, tighten the locking nut firmly against the rooftop (FIG. 2). If the base mount should slip or rotate while tightening, insert the tips of a long-nose pliers into the two holes on top of the base mount. Apply enough force to prevent slippage until the locking nut is tight.

8. Assemble Base, Whip Assembly, and Pad as shown on page 1. Tighten securely.

9. Attach connector, as required, and connect to radio.

10. Antenna, as supplied will operate satisfactorily within the frequency range indicated on the package label. No further tuning or cutting should be required.

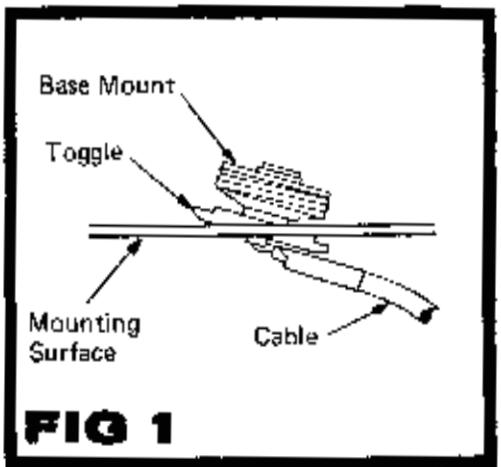


FIG 1

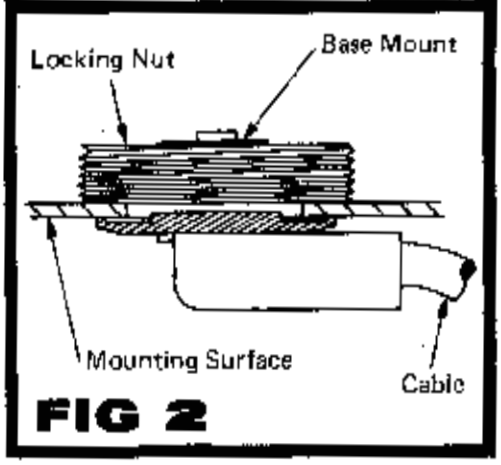
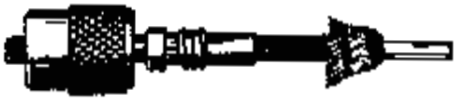


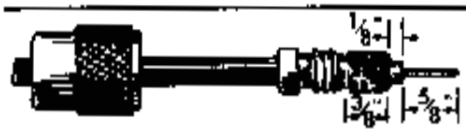
FIG 2

PL-259 CONNECTOR ASSEMBLY INSTRUCTIONS

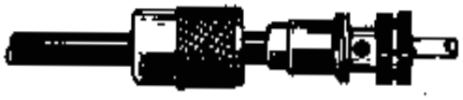
Cut end of cable even. Remove vinyl jacket 3/4". Slide coupling ring and adapter on cable. BE SURE TO HAVE CORRECT ADAPTER FOR CABLE SIZE.



Fan braid slightly and fold back as shown.



Position adapter to dimension shown. Press braid down over body of adapter and trim to 3/8". Bare 5/8" of conductor. Tin exposed center conductor.



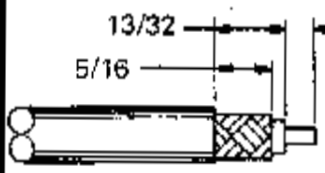
Screw plug sub-assembly on adapter. Solder braid to shell through solder holes. Use enough heat to create bond of braid to shell. Solder conductor to contact.

For final assembly, screw coupling ring on plug sub-assembly.

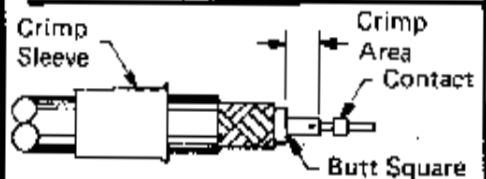
TNC CRIMP CONNECTOR ASSEMBLY INSTRUCTIONS

(For information regarding crimp tool contact Antenna Specialists.)

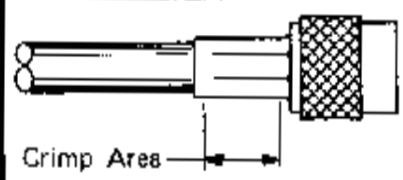
Crimp Sleeve | Contact | Connector Housing



Trim cable to dimensions shown, taking care not to nick the inner conductor or the braid.



Slip crimp sleeve over cable. Place inner conductor into contact. Note that the end of contact and inner dielectric must be butting and square. Crimp with appropriate tooling.



Flair outer braid and gently but firmly push the contact into the connector housing until a gentle snap is felt, indicating the contact is in place. Slip the crimp sleeve in place, butting the flange against the connector housing, and crimp with appropriate tooling.

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E—RF Connector Installation

The following information is provided to properly terminate the RF connectors that may be needed for a *Mobile Map Plus* installation.

This information applies directly to connectors made by Amphenol. Connectors manufactured by other manufacturers may differ slightly. Consult the assembly instructions for the connector you are using.

Information is provided on the following connectors:

BNC; MIL-CLAMP I & II

Type N; MIL-CLAMP I & II

UHF; UG Standard

If you are not experienced with installing radio frequency connectors, refer this portion of your installation to a qualified technician.

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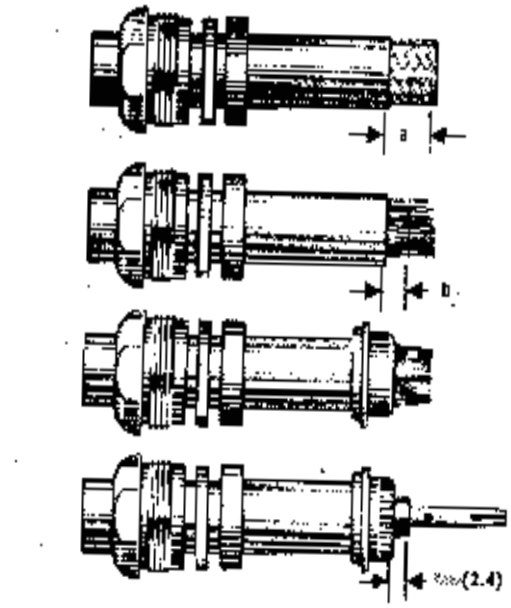
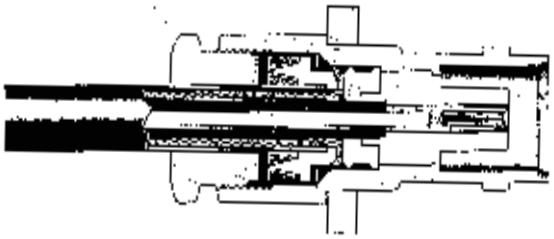
BNC ASSEMBLY INSTRUCTIONS

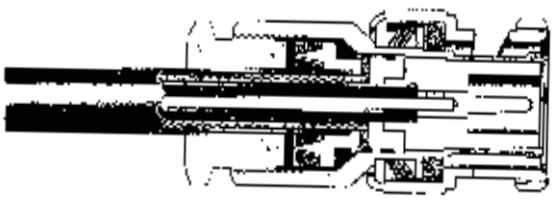
MIL-CLAMP I & MIL-CLAMP II

✦ THIS PART IS USED ONLY WITH RG-62, 71 OR 210 CABLE

△ ONLY THE 31-2XXX and 31-3XXX CONNECTORS CONTAIN THIS WASHER







Place nut, washer and gasket over cable and cut jacket to dimension shown.

Stripping dims. inches (millimeters)	a ± 1/64(0.4)	b ± 1/64(0.4)
MIL-Clamp I	5/16(7.9)	13/64(5.2)
MIL-Clamp II		
31-3301, 3302, 3303	1/4(6.4)	5/32(4.0)
31-319, 3321, 3335	19/64(7.5)	11/64(4.4)
31-5, 19, 22, 201, 202, 205, 206, 207, 211, 215, 2201, 2202, 2205, 2206, 2207, 2211, 2212, 2215, 3202, 3206, 3207, 3212, 3320, 3333, 3334, 3347, 3348	19/64(7.5)	3/16(4.8)
3361	9/32(7.2)	11/64(4.3)

Comb out braid and fold out. Cut cable dielectric to dimension shown. Tin center conductor.

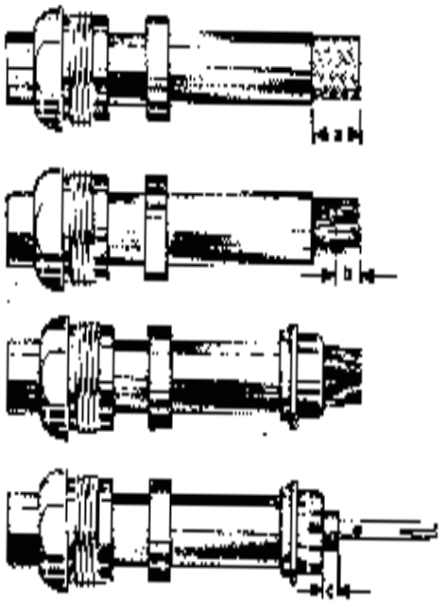
Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.

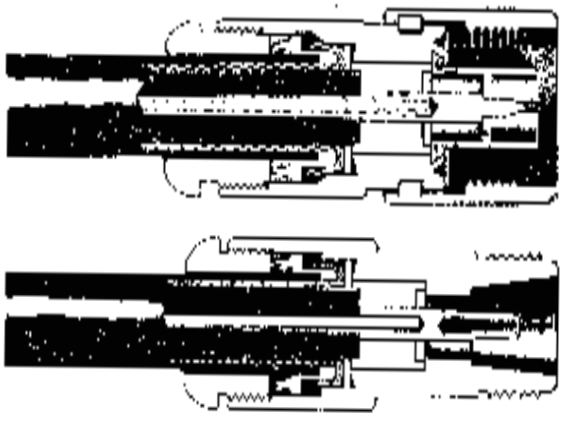
Fold back braid wires as shown, trim to proper length (1/8",3.2mm) and form over clamp as shown. For RG-62, 71 and 210/U cable, trim to 3/32"(2.4) dimension as shown and add bushing. Solder contact to center conductor.

Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut.

MIL-CLAMP® I & MIL-CLAMP® II

N
ASSEMBLY INSTRUCTIONS





Stripping dims. ±1/64(0.4) Inches (millimeters)	a	b	c (ref.)
MIL-CLAMP I			
35250	9/32(7.1)	5/32(4.0)	.045(1.2)
35275	29/64(11.5)	3/16(4.8)	.130(3.3)
	9/16(14.3)	11/64(4.4)	.272(6.9)
MIL-CLAMP II			
82-4352-1, 82-4356-1, 82-4360-1, 82-4364, 82-4357 & 82-4362	9/32(7.1)	5/32(4.0)	.045(1.2)
82-4352, 82-4356, 82-4360, 82-4365 & 82-4368	23/64(9.1)	15/64(6.0)	.045(1.2)

Place nut and gasket, with "V" groove toward clamp, over cable and cut off jacket to dim. a.

Comb out braid and fold out. Cut off cable dielectric to dim. b as shown.

Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.

Fold back braid wires as shown, trim to proper length and form over clamp as shown. Solder contact to center conductor.

Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut.

NOTE: For armored cable slide cap over armor first. Push armor and cap back out of way and proceed with assembly as directed above using armor clamp in place of standard clamp nut. When assembly is complete straighten bulge in armor and trim so it can be clamped between nut and cap.

UHF ASSEMBLY INSTRUCTIONS

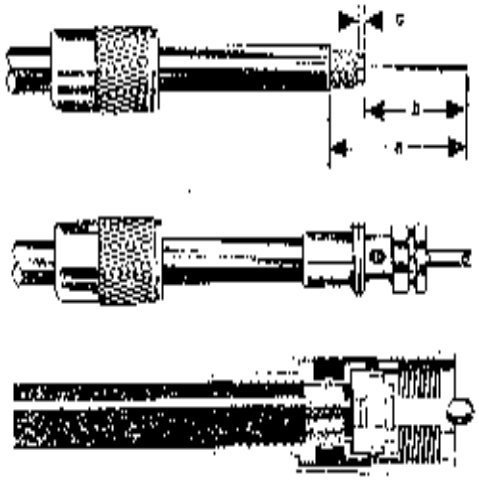
UG STANDARD

COUPLING RING

83-168 OR 83-185 REDUCING ADAPTER (WHEN REQUIRED)

PLUG SUB-ASSEMBLY

PLUGS 83-1SP, 83-5SP, 83-21SP, 83-59, 83-67, 83-822



Cut end of cable even and strip jacket, braid, and dielectric to dimensions shown in table. All cuts are to be sharp and square. Do not nick braid, dielectric or center conductor. Tin exposed center conductor and braid, avoiding excessive heat.

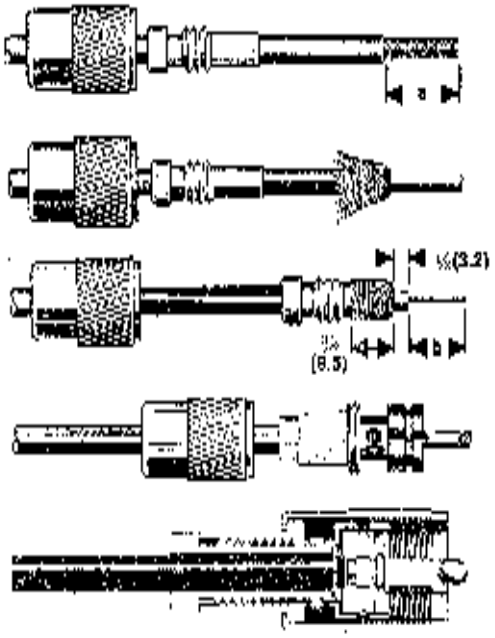
Stripping dims. inches (mm)	a ±1/64(0.4)	b ±1/64(0.4)	c ±1/64(0.4)
83-1SP, 83-5SP	1¼(31.8)	9/16(15.9)	1/16(1.6)
83-21SP	1(25.4)	11/16(17.5)	1/8(3.2)
83-59, 83-67	27/32(21.4)	¼(6.4)	1/64(0.6)
83-822	1 1/8(28.6)	9/16(15.9)	1/16(1.6)

STRAIGHT PLUGS (except 83-5SP). Slide coupling ring on cable. Screw the plug sub-assembly on cable. Solder assembly to braid through solder holes, making a good bond between braid and shell. Solder conductor to contact. Do not use excessive heat. For final assembly, move coupling ring forward and screw in place on plug sub-assembly.

83-5SP PUSH-ON PLUG. Screw the plug sub-assembly on cable and solder to braid as described above. Screw coupling ring in place over plug sub-assembly until threads bottom.

ANGLE PLUGS. Screw plug body assembly on cable. Solder assembly to braid as above. Solder conductor to contact through hole in back of connector. Screw cap into place

PLUGS 83-1SP, 83-59, 83-67, 83-222, 83-750 USING 83-168 OR 83-185 REDUCING ADAPTER



Cut end of cable even. Remove vinyl jacket to dimension a in table below. Slide coupling ring and adapter on cable.

Stripping dims. inches (mm)	a ±1/64(0.4)	b ±1/64(0.4)
83-1SP, 83-822, 83-750	3/4(19.1)	5/16(7.9)
83-59, 83-67	½(12.7)	5/16(7.9)

Fan braid slightly and fold back as shown.

Position adapter flush with cable jacket. Press braid down over body of adapter and trim to 5/16"(8.5). Bare conductor to dimension b. Tin exposed center conductor.

Screw plug sub-assembly on adapter. Solder braid to shell through solder holes. Use enough heat to create bond of braid to shell. Solder conductor to contact.

For final assembly, screw coupling ring on plug sub-assembly.

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F—Remote Alarm Connections

The *MMP* alarm encoder can be easily connected to the Perimeter Products MX-1000 system using the 60-pin IDC connector mounted on the left edge of the encoder circuit board.

The *MMP* connects to the MX-1000 via the MX-1000 MMI decoder board. While the MX-1000 MMI is usually used for driving relay outputs, the *MMP* encoder has been configured to connect to the MX-1000 MMI decoder, eliminating the need for the relay board.

The MX-1000 MMI decoder board can be mounted in the *MMP* enclosure, also eliminating the need for field-installed interconnecting cable. If the MMI decoder and *MMP* encoder are mounted in the same enclosure, the alarm input connections are reduced to plugging one 25-pair ribbon cable from the MX-1000.

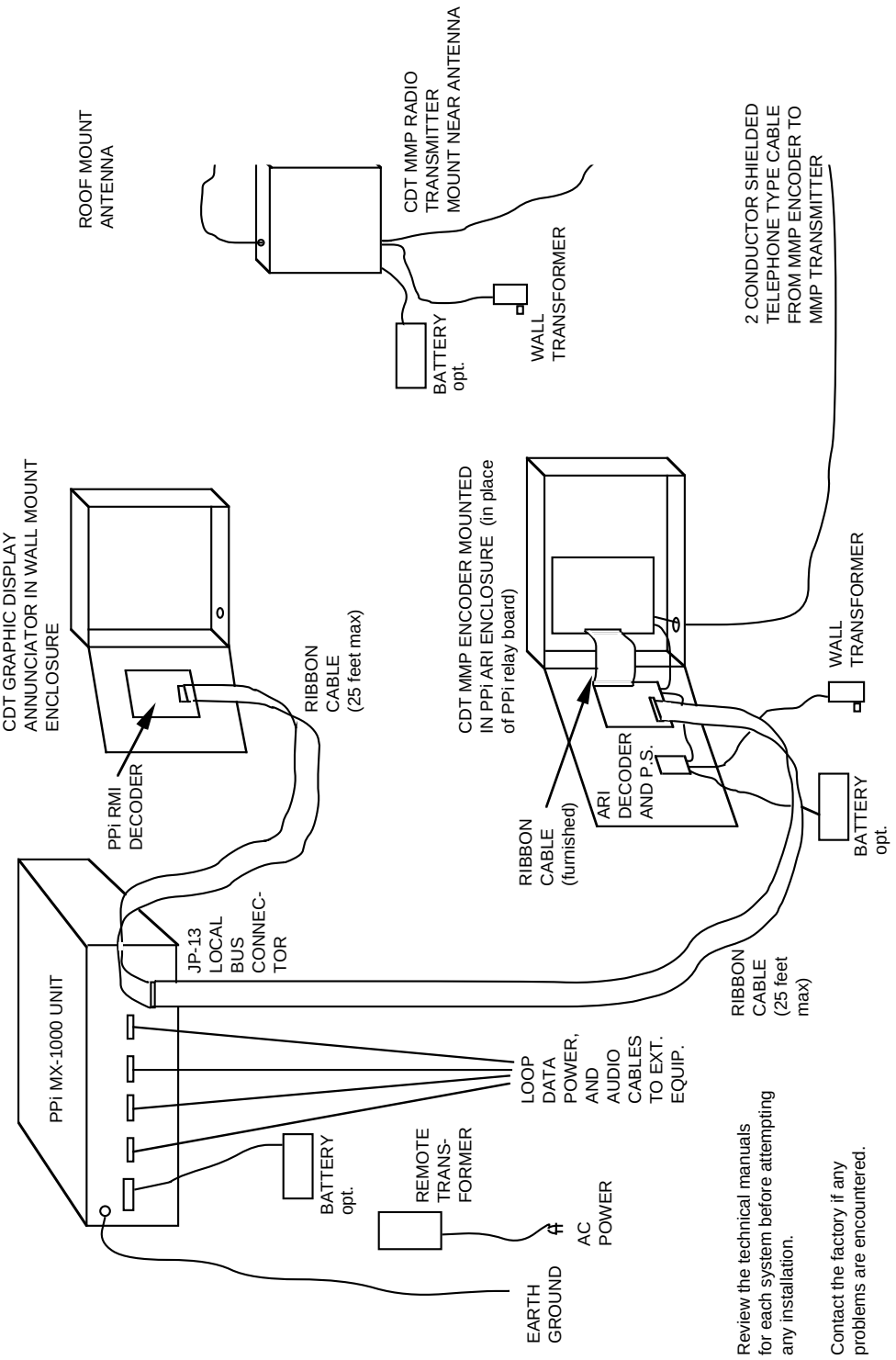
The MX-1000 MMI decoder will still require the MMI power supply circuit card and plug-in transformer. Refer to Appendix C of the MX-1000 Installation and Operations Manual for further interconnect and programming information.

In most cases, the MMI power supply circuit card and plug-in transformer will provide power for both the MMI decoder and the *MMP* alarm encoder. When interconnected, the *MMP* encoder will automatically follow the MX-1000 programmed zones from zone 1 through zone 48. Programming of the MX-1000 is not affected; however, be sure the MX-1000 relay outputs are programmed correctly. You can choose either output on alarm or alarm and tamper. The *MMP* encoder will respond to the MX-1000 program.

Figure F-1 shows the typical interconnection of the MX-1000 to the *MMP* system. If you wish, the factory will mount the *MMP* encoder in the Perimeter Products MMI enclosure and test it for you.

If you have any questions, please contact our engineering department.

Figure F-1 MX-1000/MMP Interconnection



G—Mobile Display Internal Wiring Connections

Field repair of the *Mobile Map Plus™ (MMP)* Radio-Graphic Displays is not recommended unless the technician has received factory training.

The *MMP* Mobile Display faceplate requires a special screwdriver and threaded extraction tools. It is recommended that a suspected defective Mobile Display be returned to the factory for repair.

The diagram included herein is provided for reference to field repair stations only.

Figure G-1 Decoder Circuit Card

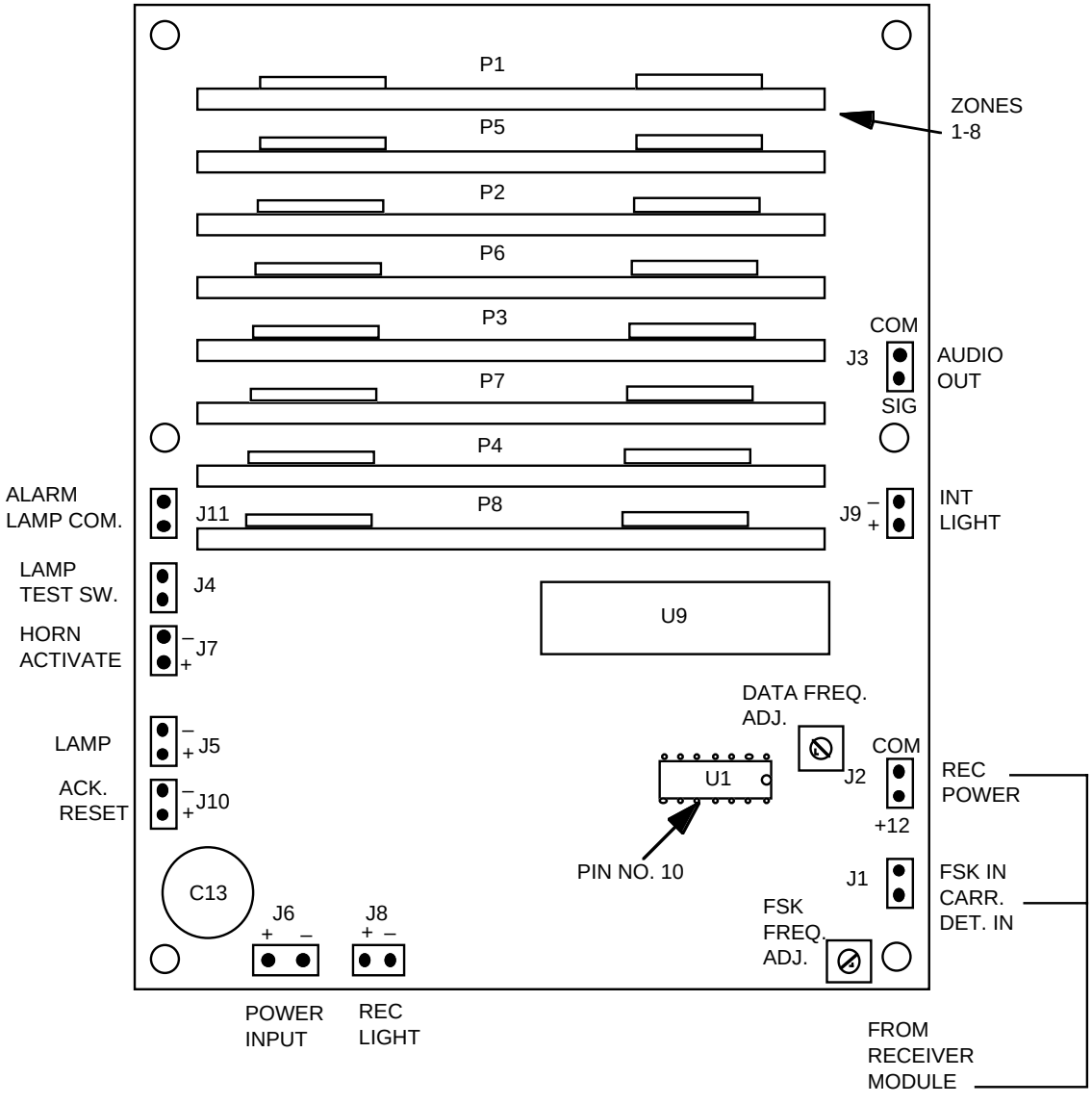
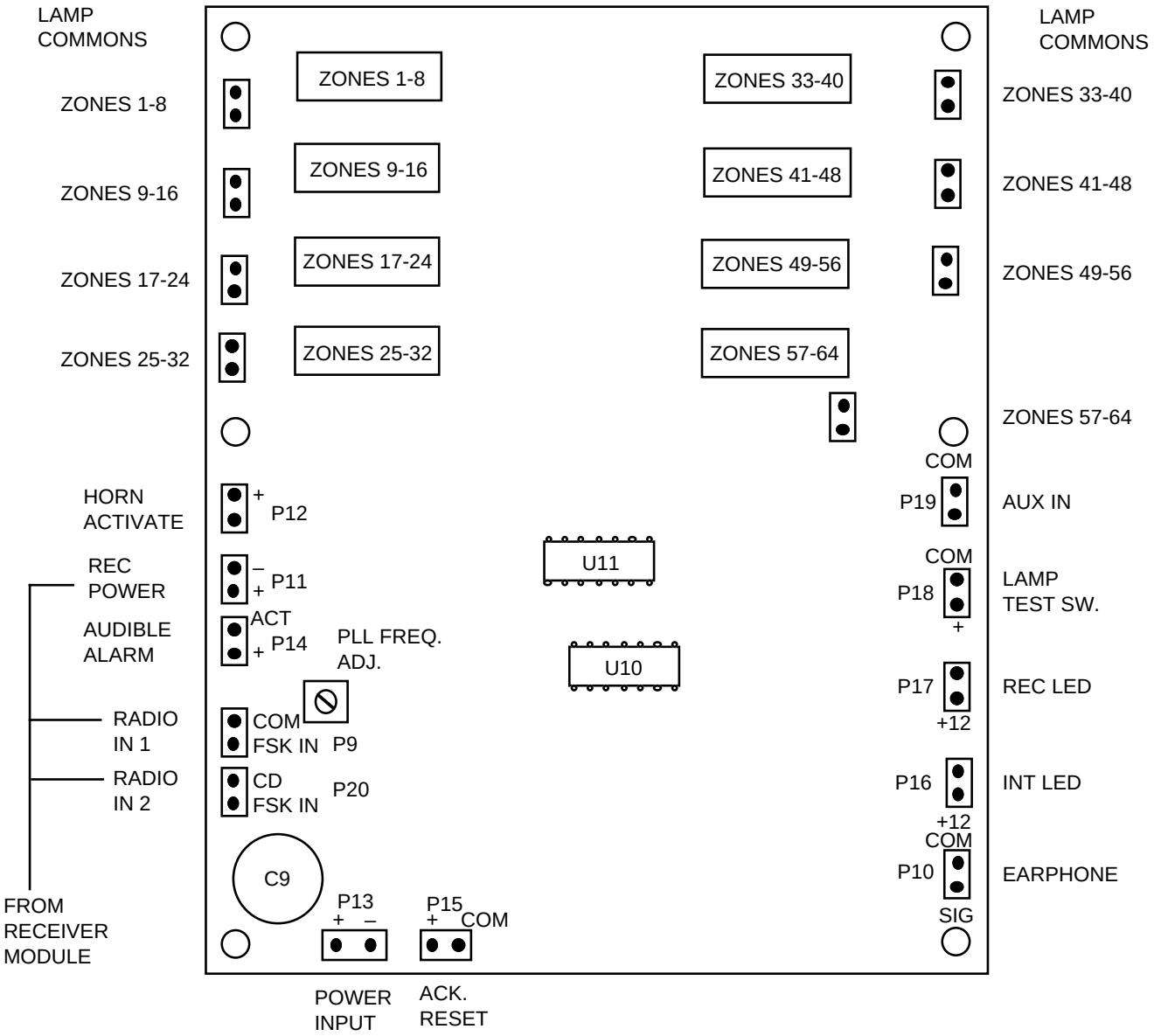


Figure G-2 Decoder Circuit Card



Serial Numbers 191389 and later