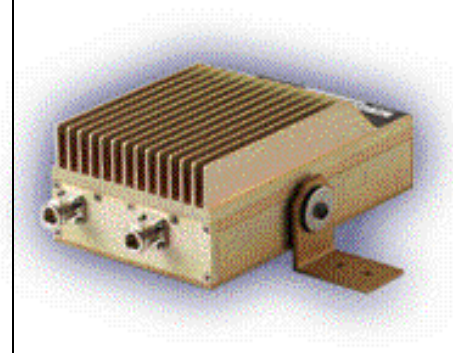
IPMOBILENET™
NETWORKING IN MOTION

INSTALLATION GUIDE

INVADR^{tm} MOBILE RADIO SYSTEM



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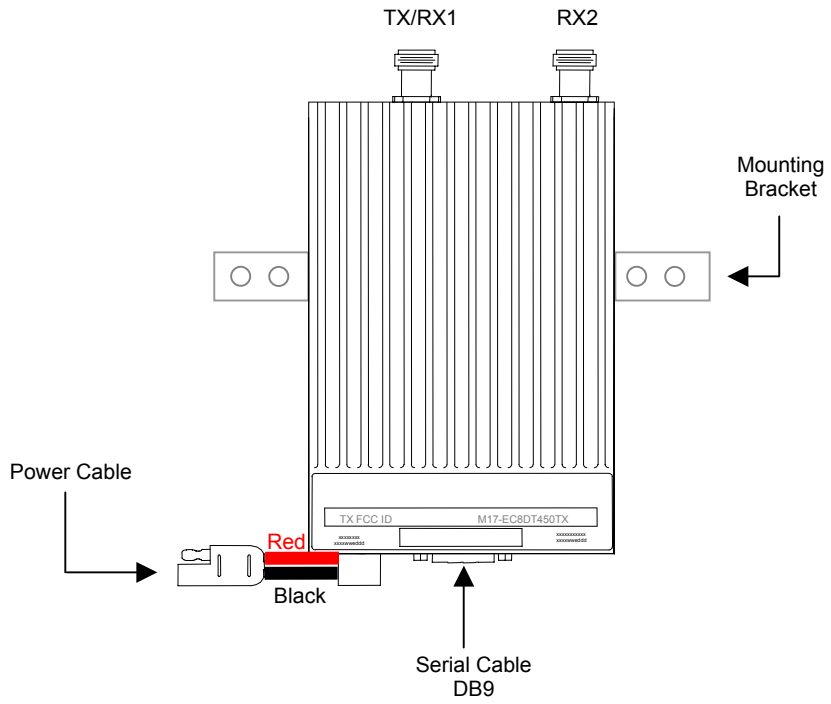
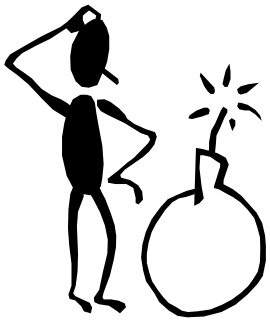
INVADR[tm] Mobile Radio Illustration



Installation Overview

This guide will provide standard steps involved in the installation process of an INVADR[tm] Mobile Radio. This guide includes wire routing and connections between the radio, other components, and the vehicle's power.

Safety Reminder



1. To prevent personal injury and vehicle damage, exercise extreme caution throughout this installation process.
   - ❑ Follow safety precautions for handling wiring, tools, and a vehicle's engine.
   - ❑ Handle the vehicle's battery with extreme caution to avoid burns.
   - ❑ Do not alter the components listed in the Installation Requirements on page 3 unless substitutions are noted within this document.
   - ❑ Once the antennas are installed, as directed within this guide on page 8 of 14, all persons must maintain a distance of no less than 39 inches from the antennas.

INSTALLATION REQUIREMENTS

PL502-82019-51 - INVADR MOBILE ACCESSORY KIT -- An INVADR Mobile Radio includes the following components (part of mobile top assembly):

Qty	Description	IPMN Part Number
1	Cable, Power Extension	502-82020-53
2	'L' Brackets	50026749
2	Screws Skt Cap Button Head 10-32 X 5/8	37081032-10
6	Washers Split Lock #10	271-0062-010
2	Washers Fender 1" O.D. X .28 I.D. X .05 THK	271-0059-001
4	Washers Rubber 1" O.D. X .65 I.D. X .12 THK	36040001
2	Hoses, Rubber Black .380 O.D. X .191 I.D. X .3	34010295
4	Screws Self-Tapping #10 X 5/8	37040010-10
0	Installation Manual	516-80307
0	Technical Manual	516-82025

PL502-80208-51 - INSTALLATION KIT – The following components are required for an INVADR Mobile Radio Installation and are available for purchase through IPMobileNet, Inc.

Qty	Description	IPMN Part Number
1	EMI Filter	127-0020-001
1	Timer, 2 hours	150-0127-001
1	Relay	128-0117-001
1	Relay Socket	128-0116-001
2	Butt Connectors #8 AWG	120-0256-001
1	Terminal, Ring #8 AWG, #10 Screw Insulated	120-0127-001
4	Terminal, Ring #18-22 AWG, #10 Screws Insulated	120-0250-004
4	Terminal, Ring #10-12 AWG, #10 Screws Insulated	120-0250-005
4	Terminal, Disconnect #14-16 F	120-0244-002
18	Terminal, Disconnect #10-12 F	120-0244-003
2	Disconnect Tab, Quad Male	200-1377-001
1	Wire, 12 AWG Black, order 5 ft.	156-0242-001
1	Wire, 12 AWG Red, order 44 ft.	156-0242-003
1	Fuse, 30 AMPS ATO	122-0042-001
1	Fuse Holder, 30 AMPS	120-0253-001
1	Switch, Toggle DPST	144-0136-001
1	Diagram, Mobile Installation without VIU	502-80259
1	Diagram, Mobile Installation with VIU	502-80260
1	Diagram, Mobile Installation with Data 911 and VIU	502-80306

OPTIONAL INSTALLATION SUPPLIES – Order each item individually:

Qty	Description	IPMN Part Number
1	Serial Cable (DB9MF), 20 ft.	156-0245-020
1	Wire, 8 (133/29) AWG VW-1 Red, by foot, order 19.5 ft.	156-0243-003
1	Wire, 8 (133/29) AWG VW-1 Black, by foot, order 19.5 ft.	156-0243-001
2	RG58U Cable and Mount, VHF, 17 ft. (incl ¾" Brass Mount and N Male Crimp)	102-0200-001
2	RG8X Cable and Mount, UHF & 800 MHz, 17 ft. (incl ¾" Brass Mount & N Male Crimp)	102-0200-002
2	Antenna, Radome Type, 142-164 MHz, Unity Gain (requires 1 MB8UN for ea antenna)	102-0205-001
2	Antenna, Radome Type, 150-174 MHz, Unity Gain (requires 1 MB8UN for ea antenna)	102-0205-002
2	Antenna, Radome Type, 410-430 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0206-001
2	Antenna, Radome Type, 430-450 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0206-002
2	Antenna, Radome Type, 450-470 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0206-003
2	Antenna, Radome Type, 470-490 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0206-004
2	Antenna, Radome type, 806-866 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0207-001
2	Antenna, Radome Type 821-896 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0207-002
2	Antenna, 5/8 Wave, 406-430 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0199-003
2	Antenna, 5/8 Wave, 430-450 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0199-004
2	Antenna, 5/8 Wave, 450-470 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0199-005
2	Antenna, 5/8 Wave, 470-490 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0199-002
2	Antenna, 5/8 Wave 490-512 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0199-006
2	Antenna, 5/8 Wave, 806-866 MHz, 3dB Gain (requires 1 MB8XN for ea antenna)	102-0199-001
2	Antenna, ¼ Wave, 136-144 MHz, Unity Gain (requires 1 MB8UN for ea antenna)	102-0204-001
2	Antenna, ¼ Wave, 144-152 MHz, Unity Gain (requires 1 MB8UN for ea antenna)	102-0204-002
2	Antenna, ¼ Wave, 152-162 MHz, Unity Gain (requires 1 MB8UN for ea antenna)	102-0204-003
2	Antenna, ¼ Wave, 162-174 MHz, Unity Gain (requires 1 MB8UN for ea antenna)	102-0204-004
2	Antenna, ¼ Wave, 406-430 MHz, Unity Gain (requires 1 MB8XN for ea antenna)	102-0204-005
2	Antenna, ¼ Wave, 430-450 MHz, Unity Gain (requires 1 MB8XN for ea antenna)	102-0204-006
2	Antenna, ¼ Wave, 450-470 MHz, Unity Gain (requires 1 MB8XN for ea antenna)	102-0204-007
2	Antenna ¼ Wave, 470-490 MHz, Unity Gain (requires 1 MB8XN for ea antenna)	102-0204-008
2	Antenna, ¼ Wave, 490-512 MHz, Unity Gain (requires 1 MB8XN for ea antenna)	102-0204-009
2	Antenna, ¼ Wave, 806-896 MHz, Unity Gain (requires 1 MB8XN for ea antenna)	102-0204-010

INSTALLATION INSTRUCTIONS

Pre-Installation Guidelines

1. Prior to installing new equipment, remove existing equipment and all related components to include stock clips on radio wiring harness and antenna.

2. Mounting of the radio, delay timer, relay, and filter will take place in the trunk compartment (see Fig. 1) unless installing in a vehicle without a trunk.

TRUNK COMPARTMENT

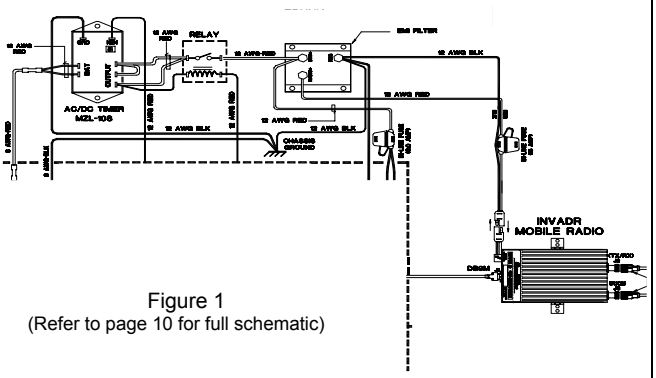


Figure 1
(Refer to page 10 for full schematic)

NOTE: Removal of seats, rubber mats, and other obstructions, from inside the driver compartment, may be necessary to facilitate routing of wires to the engine and trunk compartments.

3. To ensure appropriate cable and wire routing, exercise the following precautions:

   - ❑ Route cables away from sharp edges that can penetrate cable insulation and damage wires.
   - ❑ Protect wires with silicone rubber grommets when routing through the engine compartment firewall or through other holes with sharp edges.
   - ❑ Use high-quality electrical tape when covering exposed wires in the engine compartment.
   - ❑ Avoid routing cables through areas exposed to extreme heat, such as the exhaust system.
   - ❑ Keep wires routed through the engine compartment away from hot and/or moving parts.

4. Prior to drilling holes in the engine compartment firewall, inspect both sides to avoid obstructions.

5. For grounding point, use the engine block or the negative (-) terminal of the vehicle battery. Ground connection surfaces must be free of paint, rust, and other corrosion to maximize performance and avoid damage.

6. To simplify troubleshooting problems, label all connecting points and wires.

Mounting the INVADR^{tm} Mobile Radio

To mount the radio, perform the following steps:

Step 1 Secure the radio into the trunk compartment. Insert four (4) sheet metal screws in the radio brackets; two (2) screws on either side of the radio (see Fig. 2).

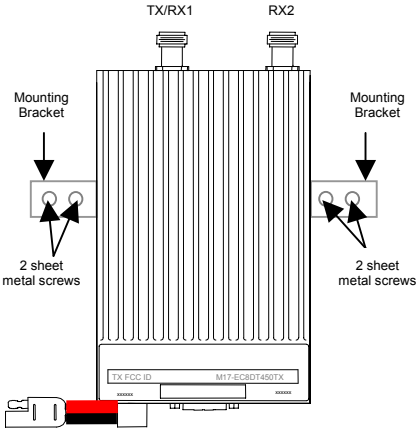


Figure 2

CAUTION:

If less than four (4) screws are used, the radio can become loose in the trunk compartment. This may cause the radio not to function properly.

When inserting screws, be careful not to disturb the vehicle gas tank.

Serial Cable Connection and Routing

(IPMN p/n: 156-0245-020)

The serial cable connects the radio to the Mobile Data Computer (MDC) located in the driver compartment.

To connect the serial cable, perform the following steps:

Step 1 Attach the 20-foot serial cable male connector (DB9M – see Fig. 3) to the radio.

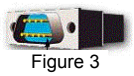


Figure 3

Step 2 Route the female connector (DB9F – see Fig. 4) to the driver compartment and connect to the serial port located on the rear of the MDC.

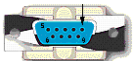


Figure 4

NOTE: Route the serial cable to minimize foot pressure and other potential stresses. Use split loom tubing and nylon cable ties for cable protection.

(If connecting a Voice Interface Unit, see page 8 for instructions).

EMI Filter Installation

(IPMN p/n: 127-0020-001)

NOTE: The EMI Filter protects the radio and filters out noise.

To install the filter, perform the following steps:

Step 1 Secure the EMI Filter in the trunk compartment of the vehicle (see Fig. 5) near radio mounting location.

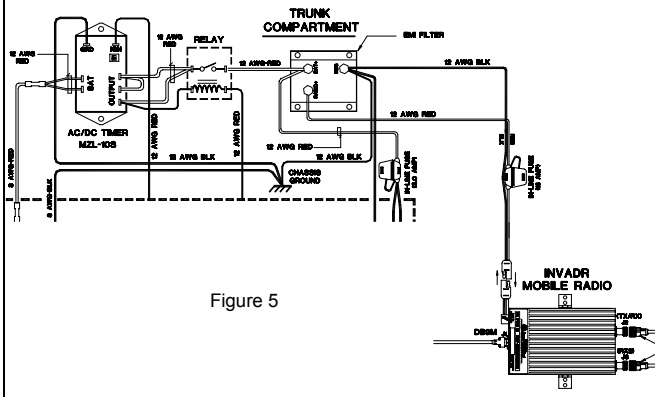


Figure 5

NOTE: For proper wire connections, perform the steps for the following components:

- Radio Power Supply Installation, page 6
- MDC Power Supply Installation, page 6
- Carling Switch Installation, page 7
- Delay Time Installation, page 7

Radio Power Supply Installation

To install the radio power connection, perform the following steps:

Step 1 Connect the radio power cable to the power cable extension (see Fig. 6).

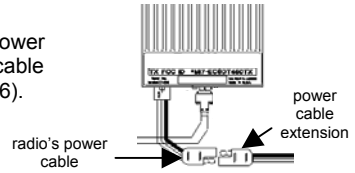


Figure 6

Step 2 Route and wire the power cable extension red wire (#12 AWG), via the 15 AMP in-line fuse, to the radio (+) terminal connection on the EMI Filter (see Fig. 7).

Step 3 Route and wire the power cable extension black wire (#12 AWG) to the EMI Filter's negative (-) terminal.

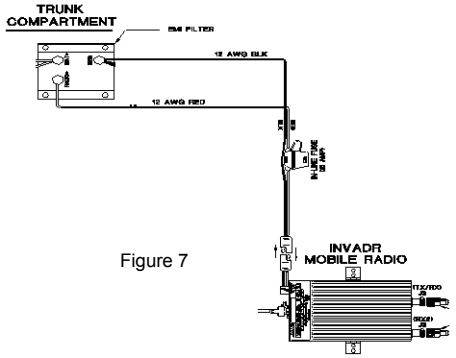


Figure 7

MDC Power Supply Installation

To install the MDC power connection, perform the following steps:

Step 1 Connect the MDC power cable to the MDC.

Step 2 Route and wire the red and clear MDC power wires via a 3 AMP in-line fuse, routing the red wire (#12 AWG) to the battery (+) terminal connection on the EMI Filter (see Fig. 8).

Step 3 Route and wire the black MDC power wire to the negative (-) terminal on the EMI Filter (see Fig. 8).

NOTE: A black wire (#12 AWG) is grounded from the negative (-) terminal connection on the EMI Filter to the vehicle chassis.

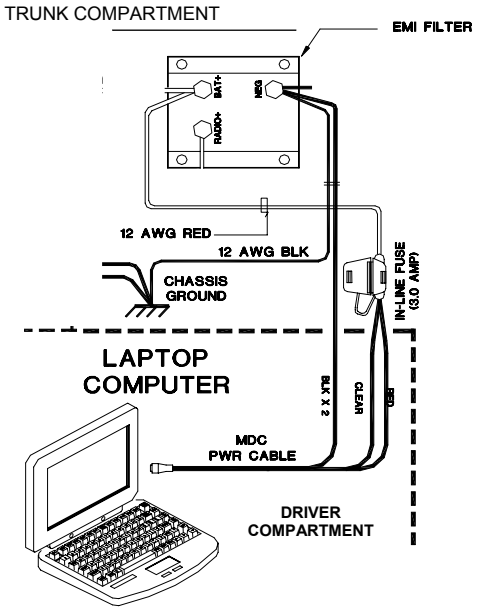


Figure 8

Carling Switch Installation
(DPST Heavy Duty Toggle)
(IPMN p/n: 144-0136-001)

To install the switch, perform the following steps:

Step 1 Mount the switch in the selected location.

Step 2 Route and wire a red wire (#12 AWG) from of the switch to the Automotive Power Relay (see Fig. 9).

Step 3 Ground the switch by routing and wiring a black wire from the switch to the vehicle chassis.

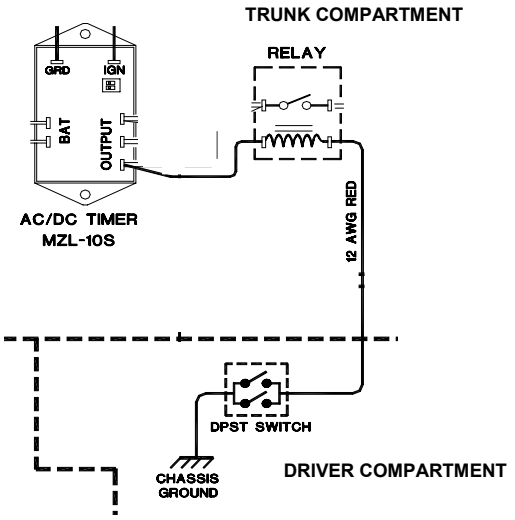


Figure 9

NOTE: Install switch in a location convenient to the driver ensuring that the switch cannot be inadvertently moved to the Off position.

Delay Timer Installation
(IPMN p/n: 150-0127-001)

To install the Delay Timer, perform the following steps:

Step 1 Secure Delay Timer to the trunk compartment of the vehicle.

NOTE: When inserting screws be careful not to puncture the vehicle gas tank.

Step 2 Route the black wire (#12 AWG) from ground connection on the Delay Timer to the vehicle chassis (see Fig. 10).

Step 3 Route and wire red wire (#8 AWG) from the positive (+) terminal connection on the vehicle battery connection via a 30 AMP in-line fuse toward the battery connection on the Delay Timer.

Connect the red wire (#8 AWG) to the two red wires (#12 AWG). Route and wire the red (#12 AWG) wires to the two (2) battery connections on the Delay Timer.

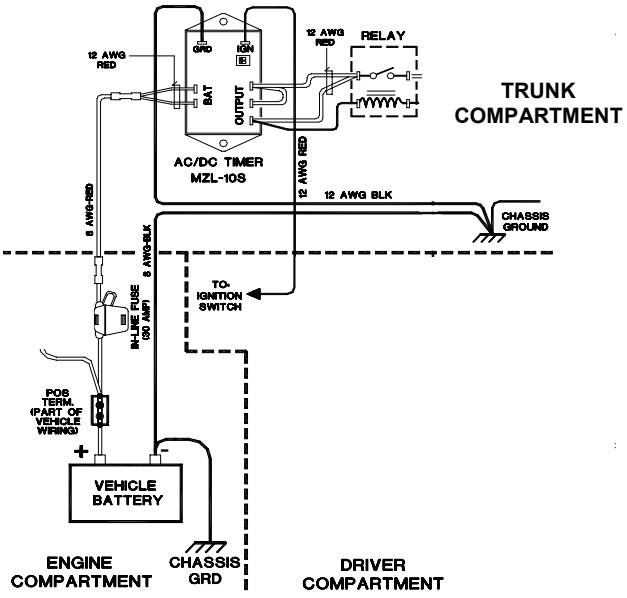


Figure 10

Step 4 Route a red wire (#12 AWG) from the ignition connection on the Delay Timer to the ignition switch in the driver compartment (see Fig. 10).

Step 5 Route a red wire (#12 AWG) from the first and last output connections on the Delay Timer to the Automotive Power Relay.

Step 6 Route and wire a red (#12 AWG) wire from the second output connection on the Delay Timer to the last output connection on the Delay Timer.

Step 7 Route and wire a red (#12 AWG) wire from the last output connection on the Delay Timer to the Automotive Power Relay coil at the position shown in Figure 10.

Step 8 Route and wire a black (#8 AWG) wire from the vehicle chassis in the trunk compartment to the negative (-) terminal on the vehicle battery.

Antenna Installation

NOTE: Two (2) antennas are mounted and installed on the roof of the vehicle using specific measurements for distance.

To mount and install the antennas, perform the following steps:

Step 1 Install antennas (see sample drawing DT450-10-0201 and Fig. 11 below).

Observe correct separation between antennas (refer to the Mobile Antenna Distance Matrix for midpoint distance calculations on page 11) and minimum Near Field Exclusion Zone (NFEZ) for proper diversity reception operation.

Step 2 Cut a mounting hole in the roof of the vehicle using an electric drill or hole saw.

NOTE: The antenna-mounting hole provides ground connection to the antenna. Ensure that a metal-to-metal connection between the antenna shields exists.

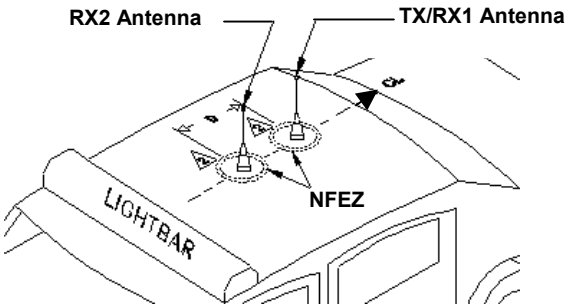


Figure 11

NOTE: Figure 11 represents the recommended front-to-rear antenna installation. The receiver antenna (RX2) should be the antenna nearest to the light bar.

Step 3 All antenna mounts must be environmentally tight. Install or use O-rings to seal the antenna base to the rooftop of the vehicle.

Step 4 Route the coaxial cables to the radio through one of the hollow spaces in the roof supports into the trunk compartment where the radio is mounted.

NOTE: Both antennas should be checked and tested to ensure they are functioning properly.

If these installation guidelines are followed, it is safe for persons to stand at a distance no less than 39 inches from the antennas.

VIU Connections

If connecting a VIU, an additional serial cable is required.

- 10-ft serial cable (IPMN p/n: 156-0245-010) included with VIU

To connect the serial cables, perform the following steps:

Step 1 Attach 20-ft serial cable male connector (DB9M) to the radio.

Step 2 Route the female connector (DB9F) to the driver compartment and connect to the serial port located on the rear of the VIU near the microphone hang up clip.

Step 3 Attach the 10-foot serial cable male connector (DB9M) to the other serial port located on the rear of the VIU.

Step 4 Route the female connector (DB9F) serial cable to the serial port located on the rear of the MDC.

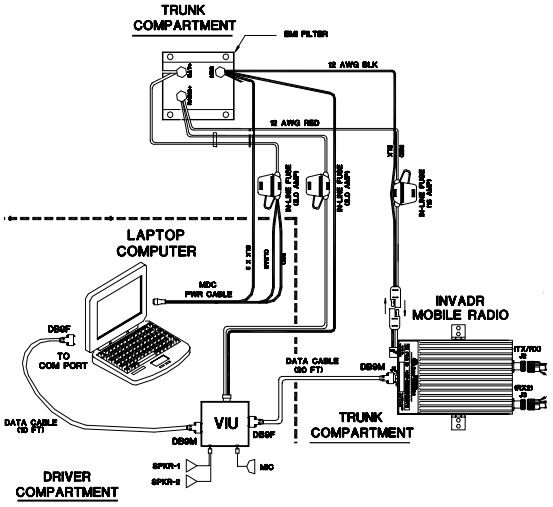


Figure 12

To connect the VIU power supply, perform the following steps:

Step 1 Route the VIU's power supply cable from the driver compartment to the trunk compartment.

Step 2 Connect the black (#18 AWG) wire from the VIU power cable to the negative (-) terminal on the EMI Noise Filter.

Step 3 Attach the red (#18 AWG) wire of the VIU power cable via the 3 AMP in-line fuse to the radio connection on the EMI Noise Filter.

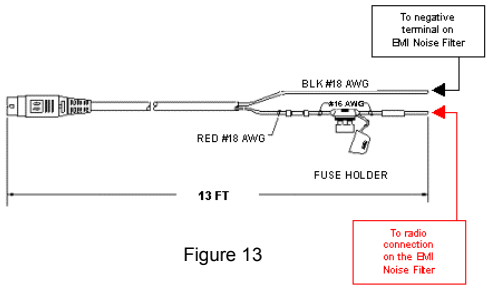


Figure 13

INVADR™ Mobile Radio Testing

1. To verify that the *INVADR*tm Mobile Radio setup works properly, use a wattmeter and a service monitor.

   NOTE: If a wattmeter and a service monitor are not available, begin test from Step 3 through 6 and 10 through 12.

2. Connect the wattmeter between the radio and the coax connector.

3. Connect the radio to a computer with the IPMobileNet IP Message Utility program loaded. See the following documents for further details:

   - *INVADR™ VIU Forwarding – IPMN p/n: 516-80309*
   - *INVADR™ Mobile Data Computer for Communication with the INVADR™ Mobile Radio – IPMN p/n: 516-80310*

4. Double click on the **SLIP2INVADR** icon to start the dial-up connection.

5. Double click on the **IP Message** shortcut.

6. In the **To:** field, enter the radio's **IP address** and click on the **Send** button and the radio's configuration will list in the upper message screen.

7. Tune the service monitor to the assigned transmitter frequency.

8. On the computer, in the lower message screen of the IP Message Utility, type **unlock=password** (entering the appropriate password to unlock the radio).

9. In the lower message screen, type **x=2000, 19** and click on the **Send** button to key the transmitter and measure the forward power and reflected power.

10. Measure the transmitted frequency and the modulation level.

11. At the computer, using the IP Message Utility program, in the lower message window, type **V** and click on the **Send** button to enable verbose.

12. Ping the IPNC via MS-Dos using the following command:

    Ping (IPNC IP address) –n 20 –l 500

    Performance statistics showing TX data, RX data quality (DQ) and signal levels (RSSI) will display on the IP Message window.

Installation Checklist

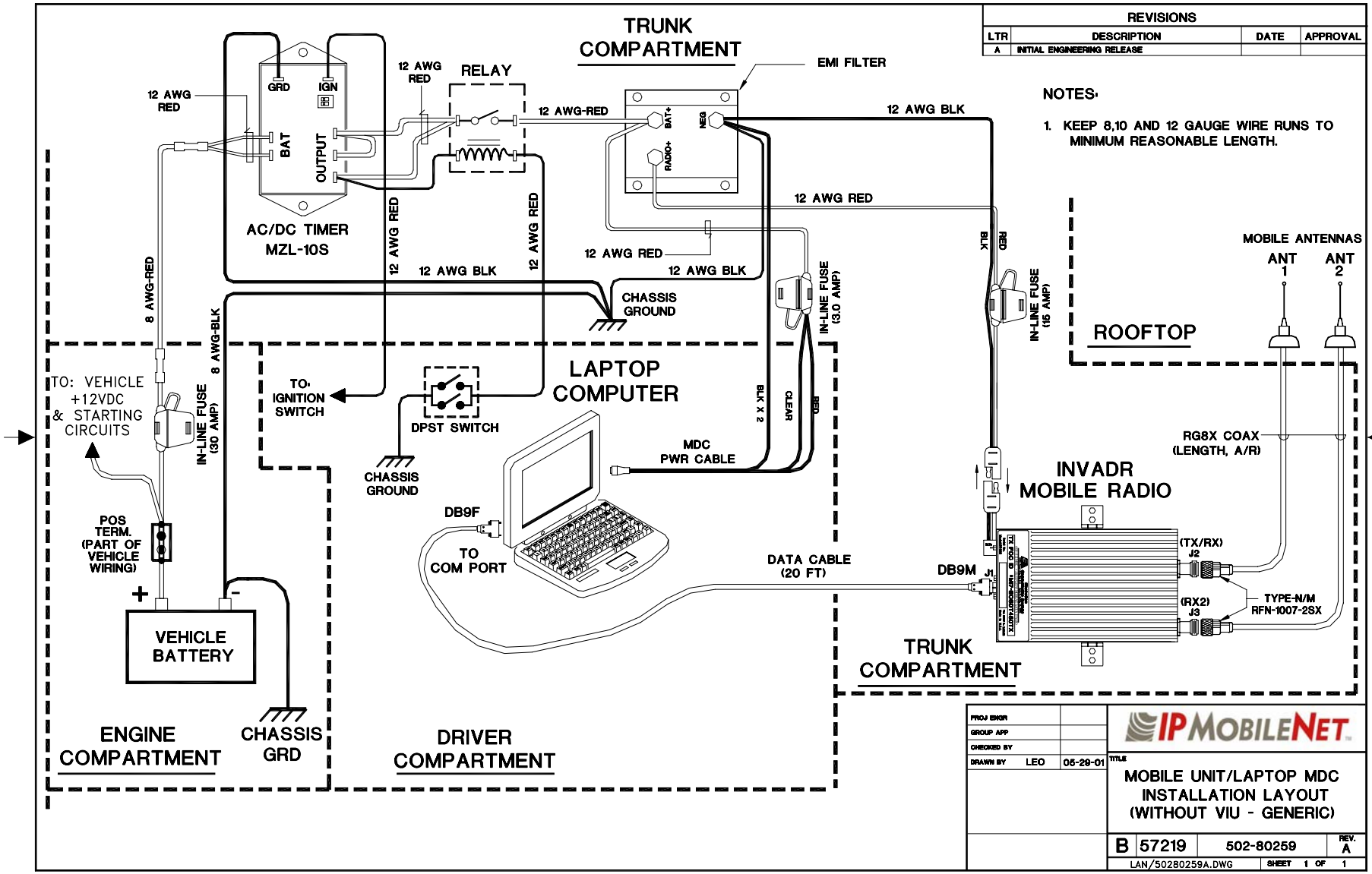
Throughout the installation process and once the installation is complete, make sure to perform the following tasks:

- ❑ Thoroughly scope out the vehicle to find any obvious problem areas.
- ❑ Check wiring for safety concerns.
- ❑ Use tie wraps to ensure that all wires routed in parallel are bundled together.
- ❑ Check to see if any wires are exposed.
- ❑ If any wires are exposed, use electrical tape to cover.

REMINDER: When covering wires in the engine compartment, use high-quality electrical tape.

- ❑ Perform appropriate testing as described in this guide to ensure radio works properly.
- ❑ Once installation is completed, remove all debris and restore dismantled parts and rubber mats to appropriate locations.

VEHICLE UNIT WIRING INTERCONNECTION LAYOUT



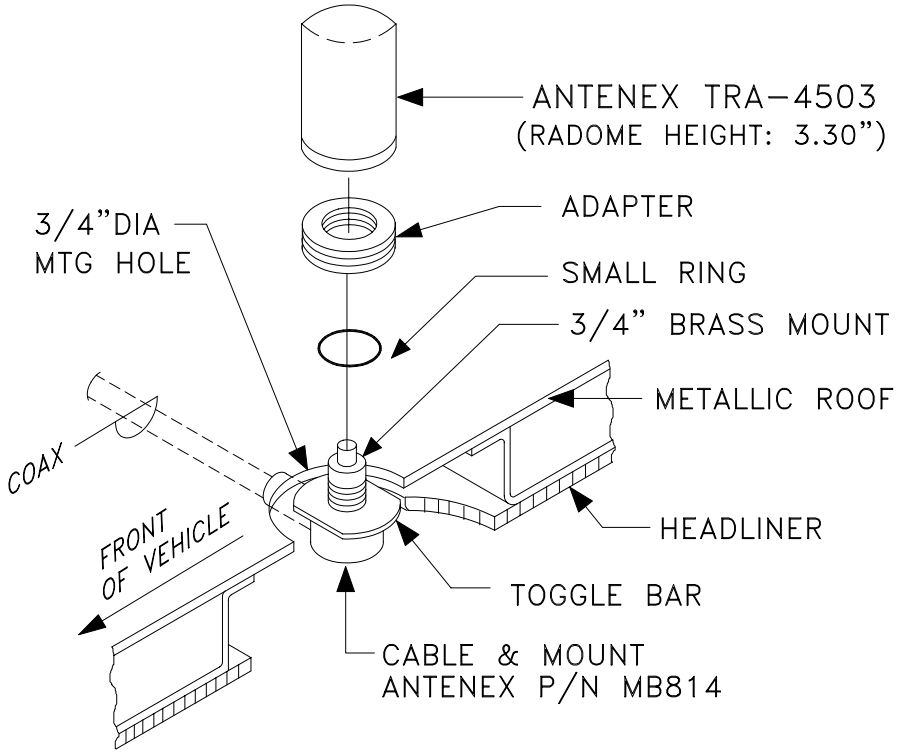
MOBILE ANTENNA DISTANCE MATRIX

Frequency Band in MHz	Center Frequency in MHz	Antenna Spacing** @ ¼ Wavelength	Antenna Spacing** @ ¾ Wavelength	NFEZ* in inches for Radome Antenna	NFEZ* in inches for ¼ Wavelength Whip	NFEZ* in inches for "⅝" Wavelength Whip	Wavelength in Inches
130-140	135.000	21.87	N/A	0.25	10.94	N/A	87.49
140-150	145.000	20.36	N/A	0.27	10.18	N/A	81.46
150-160	155.000	19.05	N/A	0.29	9.53	N/A	76.20
160-174	162.000	18.23	N/A	0.30	9.11	N/A	72.91
400-430	415.000	N/A	21.35	0.77	3.56	11.88	28.46
430-450	440.000	N/A	20.13	0.81	3.36	10.37	26.84
450-470	460.000	N/A	19.26	0.85	3.21	9.43	25.68
470-490	480.000	N/A	18.45	0.89	3.08	9.31	24.61
490-512	501.000	N/A	17.68	0.92	2.95	9.35	23.57
806-866	836.000	N/A	10.60	1.54	1.77	3.36	14.13

*NFEZ = Minimum Near Field Exclusion Zone

**Round antenna spacing to the nearest ⅛"

DIVERSITY ANTENNA MOBILE INSTALLATION DETAIL
(Typical installation)



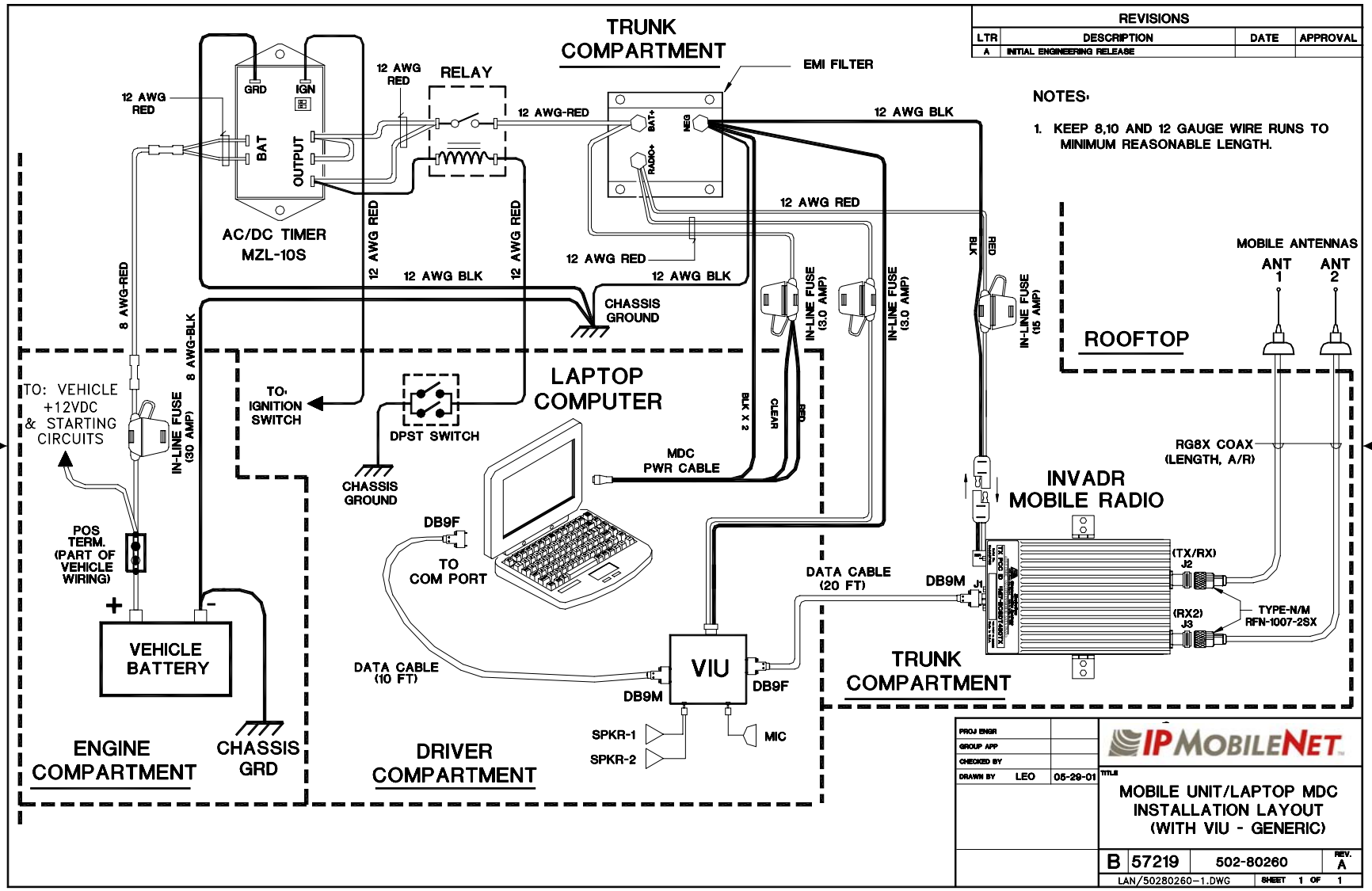
DETAIL A

NOTES:

1. THE MB8X14 BRASS MOUNT REQUIRES A 3/4" HOLE IN A METAL FLAT AREA WITH A THICKNESS BETWEEN .040" AND .075".
2. FEED THE COAXIAL CABLE THROUGH THE HOLE UNTIL THE ASSEMBLY IS IN A POSITION TO DROP IN THE HOLE.
3. BE SURE THAT THE SMALL RING IS IN THE LOCK-NUT GROOVE.
4. THEN THREAD THE ADAPTER ONTO THE BUSHING. THE ADAPTER SHOULD BE TIGHTENED UNTIL IT COMES IN CONTACT WITH THE ROOF METAL SURFACE AND THE SMALL RING IS COMPRESSED.
5. THEN THREAD THE ANTENNA ONTO THE ADAPTER. MAKE SURE IT IS HAND TIGHTENED.
6. ROUTE THE CABLE TO THE RADIO. CUT OFF ANY EXCESS CABLE.
7. ATTACH THE N-MALE, CRIMP CONNECTOR, CN58, TO THE CABLE.

CAD GENERATED FILE, DO NOT MANUALLY CHANGE REVISIONS		IP MOBILENET
DRAWN LEO	DATE 06-06-01	TITLE: 450MHz DIVERSITY ANTENNA MOBILE INSTALLATION (ANTENEX MODEL TRA-4503)
CHECKED		
DESIGN		
APPROVED		SIZE B · CODE IDENT NO. 57219 · DWG NO. DT450-10-0201 · REV 00
RELEASED		SCALE NONE · 40201-5A.DWG · SHEET 5 OF 8

VEHICLE UNIT WIRING INTERCONNECTION LAYOUT
(with Voice Interface Unit – VIU)



VEHICLE UNIT WIRING INTERCONNECTION LAYOUT
(Data 911 with Voice Interface Unit – VIU)