Futurecom Systems Group, ULC

DVR Installation Guide

NOTES

Related Publications

Publication Number	Description
8A083X30	**DVRS User's Manual, APX Series Interface**
8A083X20	**DVRS User's Manual, XTL2500 / XTL5000 Interface**
8A083X21	**Tactical DVR User's Manual**
8M083X02	**Tactical DVR Installation and Programming Guide**
8F083X03	**DVRS - Product & RF Safety Booklet**
8F083X14	**Indoor Cabinet Mount DVRS – Installation Guide**
8F083X15	**Outdoor Cabinet Mount DVRS – Installation Guide**
8F083X16	**Suitcase Mount DVRS – Installation Guide**

Manual Revisions

Rev #	Date	Notes & References
0	November 23, 2020	Original Release

Foreword

Futurecom Vehicular Repeater (**VR**) is designed to be seamlessly interfaced to:

- Remote Mount APX Series **MSU** with or without control head

When the VR is interfaced to a Remote Mount Motorola APX Mobile Radio, the complete equipment package is referred to as Digital Vehicular Repeater System (**DVRS**). APX Mobile Radios operating through a VR, utilizing the enhanced DVR digital feature set require option **GA00631**.

APX & APXNext Portable Radios operating through a VR, utilizing the enhanced DVR digital feature set require subscriber option **QA00631**.

See https://futurecom.com/upl/downloads/resources/support-resources/firmware-compatibility-chart.pdf about version requirements for compatible Mobile and Portable radios.

For details on the APX series Mobile or Portable Radios operation, please refer to the applicable Manuals available from Motorola.

For details on the DVRS Operation, please refer to the VR User's Guides **8A093X01**.

The DVRS Operation described in this Document requires the following Firmware:

APX Series Mobile Radios - firmware release: **Host R21.40.00 or later.**
APX Mobile Radios operating as the host mobile for the VR require subscriber option **GA00631** for operation.

APX2000 / APX4000 / APX6000 / APX7000 /APX8000– firmware release **R21.40.00 or later.**

APX Portable Radios operating through a VR, utilizing the enhanced DVR digital feature set require subscriber option **QA00631.**

VR must be loaded with firmware release:
Application 4C083X11 – **1.62 or later.**
Futurecom Repeater Configurator (FRC) APX Repeater **6A083X05** – **2.07 or later.**

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Futurecom's warranty hereunder DOES NOT cover the following:

(i) Defects or damage resulting from use of the product in other than its normal and customary manner.

(ii) Defects or damage from improper installation, testing, operation, or maintenance.

(iii) Defects or damage due to alterations, modifications or adjustments carried out by the Buyer without Futurecom's explicit approval.

(iv) Defects or damage from misuse, accident, water or neglect.

(v) Freight costs to the repair depot.

(vi) Scratches or other cosmetic damage to the product surfaces that does not affect the operation of the product.

(vii) Normal wear and tear.

The warranty set forth herein is conditioned upon proper storage, installation, use and maintenance in accordance with applicable written recommendation of Futurecom. The warranty furnished hereunder does not extend to damage to items purchased hereunder resulting in whole or in part from the use of components, accessories, parts of supplies not furnished by Futurecom Systems Group, ULC.

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To exercise this warranty, please contact Futurecom's Administration Department in Concord, Ontario, Canada at 1-800 701 9180 to obtain a return material authorization (RMA) and shipping instructions. No product will be accepted for return without an RMA. The repair of a product by Futurecom pursuant to this warranty is warranted for the balance of the original warranty period, or at least 90 days from date of shipment to Buyer of the repaired product.

If Extended Warranty is required, it must be purchased either at the time of original purchase or while the unit is under the standard first year warranty coverage.

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RF Energy Exposure Compliance, Awareness and Control Information and Operational Instructions

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

ATTENTION!
Changes or modifications not expressly approved by Futurecom Systems Group, ULC. could void the User's authority to operate the equipment. To satisfy FCC/ISED/IC RF exposure requirements for mobile transmitting devices, the minimum separation distances specified in the "RF Safety" Book 8F083X03 (FCC) or 8F083X05(ISED)shipped with the DVRS should be maintained. To ensure compliance, operations at closer than this distance is not allowed.

ATTENTION!
Futurecom requires the P25 DVRS operator to ensure FCC/ISED Requirements for Radio Frequency Exposure are met. The minimum distance between all possible personnel and the body of the DVRS equipped vehicle is specified in the "RF Safety" book shipped with the DVR. Failure to observe the Maximum Permissible Exposure (MPE) distance exclusion area around the antenna may expose persons within this area to RF energy above the FCC/ISED exposure limit for bystanders (general population). It is the responsibility of the repeater operator to ensure MPE limits are observed at all times during repeater transmissions. The repeater operator must ensure at all times that no person comes within MPE distance from the vehicle body.

ATTENTION!
The Suitcase Mount DVRS ships without an APX Mobile radio. Once an APX Mobile radio is installed, refer to the Product Safety and RF Exposure booklet 8F083X03 enclosed with your DVRS. Refer to the vehicle installation guidelines for vehicle installation. For fixed site installation, refer to the Fixed DVRS Site Antennas section.

Introduction

The P25 Digital Vehicular Repeater (DVR) is designed to be seamlessly interfaced to:

- Remote Mount APX Series Mobile Radios with or without a control head (O2, O3, O5, O7 or O9)

Mobile Radio Model	Firmware Requirements	Notes
APX6500	R21.40.00 or later	Requires option **GA00631**
APX7500	R21.40.00 or later	Requires option **GA00631**
APX8500	R21.40.00 or later	Requires option **GA00631**
NOTE: Mobile Radio must be configured as Remote Mount in order to be compatible with the DVRS.		

IMPORTANT!
This manual described the DVR models that are interfaced to the APX Series Mobile Radios via P25 Interface. The MSU configured for DVRS operation can support up to two Control Heads.

The P25 DVRS allows Portable Subscriber Units (**PSU**) to be used in areas where only Mobile Subscriber Unit (**MSU**) coverage is available and portable radio coverage is either intermittent or completely absent. Installed in the trunk of a car, fire truck, armored vehicle, ambulance, the P25 DVRS extends radio communications to the PSU users who are outside of the vehicle, inside a nearby building or in any marginal portable radio coverage areas. The DVRS extends voice (analog or digital, clear or encrypted) communications and supports key Trunking system features. The DVRS can be configured to provide various advanced options to the users.

Table 1 provides information on the DVRS infrastructure compatibility options.

FIXED NETWORK TYPE / MOBILE RADIO MODE					
Portable Radio Type / Mode	**Conventional Analog incl. Mixed Receive**	**Conventional P25 incl. Mixed Receive**	**3600 Analog / Digital Trunking**	**9600 P25 Trunking FDMA**	**9600 P25 Trunking TDMA**
Conventional Analog	**YES** A/M	**YES** A/M	**YES** A/M	**YES** A/M	**YES** A/M
P25 Conventional Generic	**NO**	**YES** D/M/FA	**NO**	**YES** D/M/FA	**NO**
P25 Conventional 'DVRS Enabled'	**YES** FA/FA-All	**YES** D/FA/FA-All/M	**YES** FA/FA-All	**YES** D/FA/FA-All/M	**YES *** D/FA/FA-All/M

Table 1 DVRS vs Infrastructure Compatibility

DVRS Channel Types:
A = Analog, D = Digital, M = Mixed, FA = Forced Analog, FA-All=Forced Analog All
(See Part II of this manual)

*Applies to APX Portables only

Identifying Your DVRS Model

Frequency Band of Operation

Depending on the frequency band of operation of the APX Mobile Subscriber Unit (MSU) and DVR, the DVRS models are classified as follows:

- **In-Band** – when the MSU and DVR operate in the same frequency band.
- **Cross-Band** – when the MSU and DVR operate in two different frequency bands.

Cross-Band

Cross-Band DVRS models do not include any filters on the MSU side since the MSU and DVR are not intended to simultaneously operate in the same frequency band. In single band MSU configurations the MSU and DVR operate in different frequency bands.
In dual band MSU configuration either the MSU & DVR operate in 3 different frequency bands or one of the MSU frequency bands is locked out when DVR operation is enabled as shown on **Figure 1**.

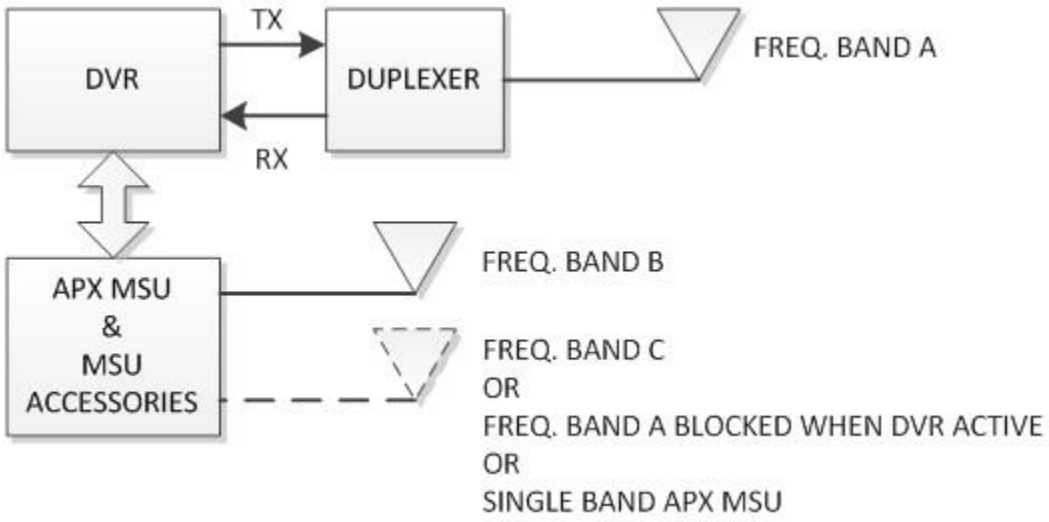


Figure 1 Cross-Band Full Duplex & Simplex Capable DVRS - Conceptual Diagram

The Cross-Band DVRS typically includes a duplexer which can accommodate full duplex and simplex DVR operation as shown on **Figure 1.** The cross-band duplexer however has a limited pass-band window and is tuned to the DVR frequencies provided on the purchase order.
APX8500 may require the interface kit. Please refer to the DVR/VRX1000 Ordering Guide.

As an option, a cross-band DVRS can be configured for simplex **only** operation as shown on **Figure 2**. In this case the DVRS does not utilize any filters.

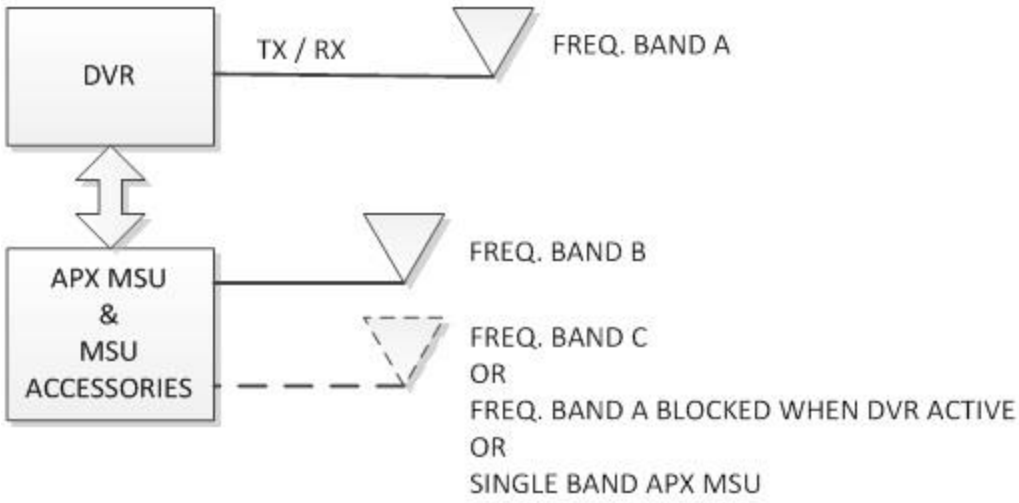


Figure 2 Cross-Band Simplex Only Capable DVRS - Conceptual Diagram

APX8500 may require interface kit. Please refer to the DVR/VRX1000 Ordering Guide.

NOTE:
The vehicular (side-by-side) mount Cross-Band DVR can be interfaced to a high power MSU, however, the transmit power of the MSU must be reduced to comply with the maximum power restrictions described in the **RF Safety Booklet 8F083X03**, which is provided with the DVR.

IMPORTANT!
The DVRS is shipped equipped with custom filters tuned to the specified frequency range provided by the customer. Programming the DVR / MSU to operate on frequencies outside of the original specified bands may result in intermittent or complete loss of communications. Frequency changes may require filter retuning or replacement.

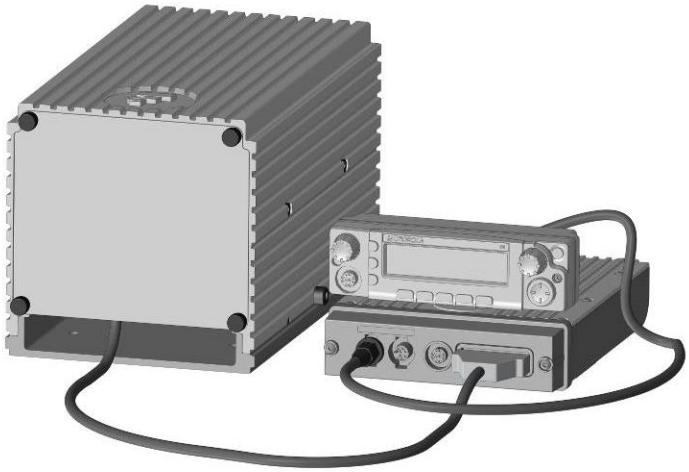


Figure 3 Vehicular Mount Cross Band DVRS Model – Full Duplex & Simplex Capable

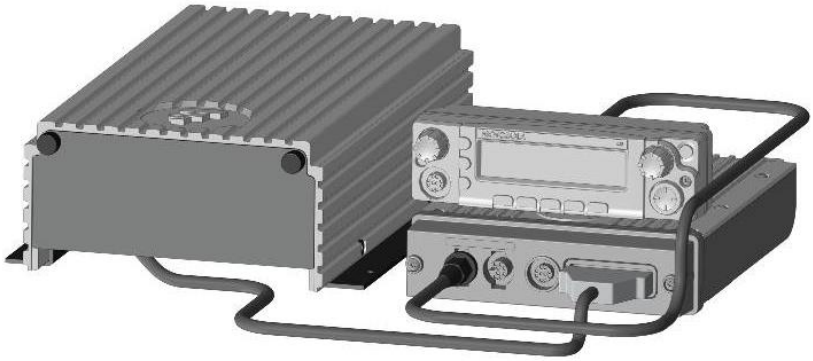


Figure 4 Vehicular Mount Cross Band DVRS Model - Simplex Only Capable

In-Band

The in-band DVRS models are equipped with two sets of filters, which are required in order to ensure interference-free operation when both the MSU and DVR are transmitting and receiving simultaneously in the same frequency band. The DVR is a full duplex capable repeater, equipped with a duplexer, which provides sufficient isolation to prevent desense during DVR repeat activation. The DVR duplexer also provides 40 dB isolation on the Mobile radio transmit / receive frequencies. The filters installed at the output of the MSU are designed to provide 40 dB isolation on the DVR transmit and receive frequencies.

IMPORTANT!
The above filter isolation must be complemented by 30dB minimum antenna isolation (between the DVR and Mobile Radio antennas) in order to ensure interference-free operation. It is recommended that the MSU in-band antenna is mounted on the roof top of the vehicle while the DVR antenna is mounted on the trunk. Each DVRS is shipped equipped with custom filters tuned to the specified frequency bands – note the frequency range specified on the filter labels. Programming the DVR / MSU radio to operate on frequencies outside of the original specified bands may result in intermittent or complete loss of communications. Frequency changes may require filter retuning or replacement.

The In-Band DVRS models are also equipped with an RF Bypass Switch, which bypasses the filtering at the output of the MSU when a “DVR – Disabled” TG is selected on the MSU Control Head (see **Figure 5**).

When a “DVR – Enabled” mode is selected on the MSU CH, the RF Switch connects the extra filters between the MSU Antenna port and the MSU antenna to ensure interference-free operation. The complex in-band filtering is only feasible if sufficient frequency gap is present between the DVR frequencies and the MSU frequencies associated with the “DVR - Enabled” TGs.
For more information on the feasible filtering options, please refer to the **DVRS Ordering Guides**.
As an option, an in-band DVRS can also be configured as simplex only (**Figure 6**). The simplex in-band configuration however still requires DVR and In-Band filters.

NOTE:
The DVR and MSU require two or three (in the case of dual band MSU) separate antennas.

IMPORTANT!
In all In-Band DVRS configurations, the MSU Transmit power must not exceed 50 Watts on DVRS Enabled MSU Modes due to the in-band filters power rating.
The in-band filters connected to the MSU have typical insertion loss of 1.5dB.

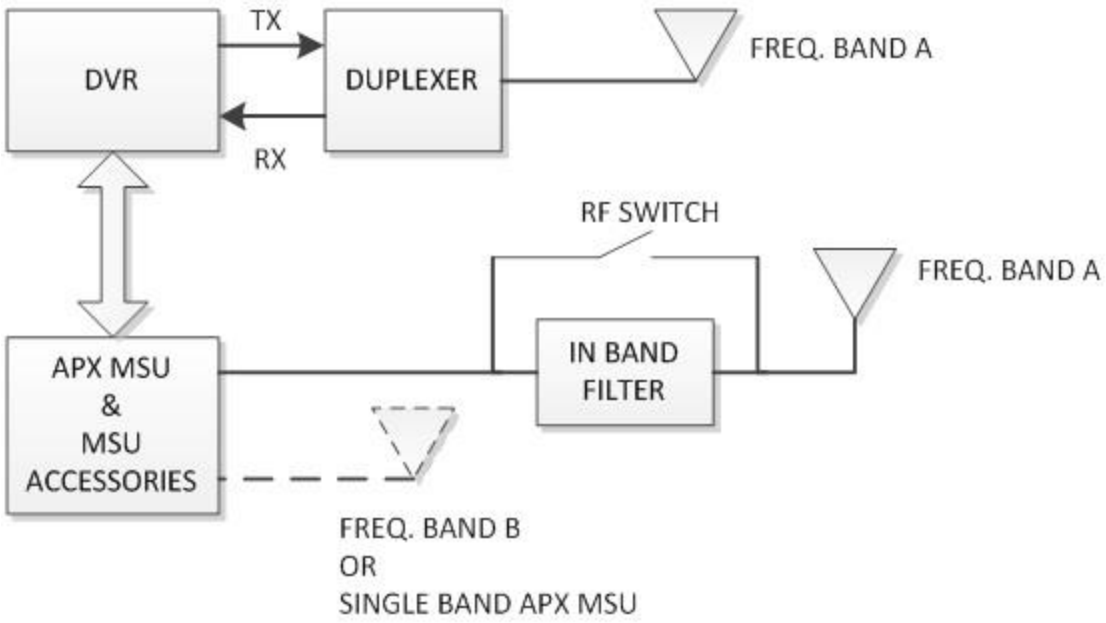


Figure 5 In-Band Full Duplex / Simplex Capable DVRS - Conceptual Diagram

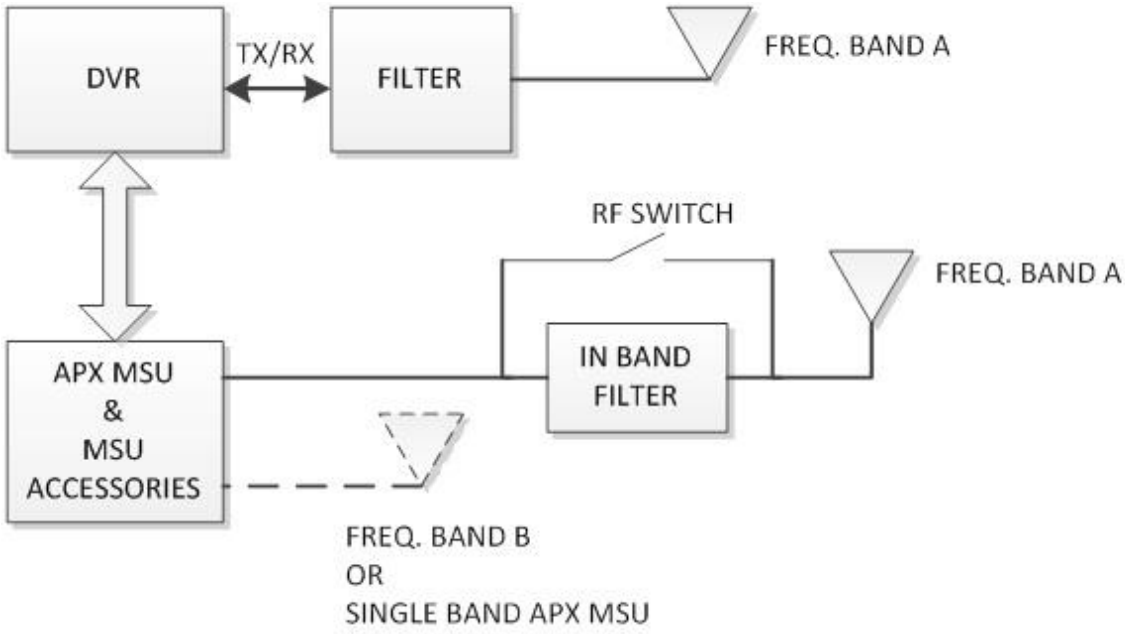


Figure 6 In-Band Simplex Only Capable DVRS - Conceptual Diagram

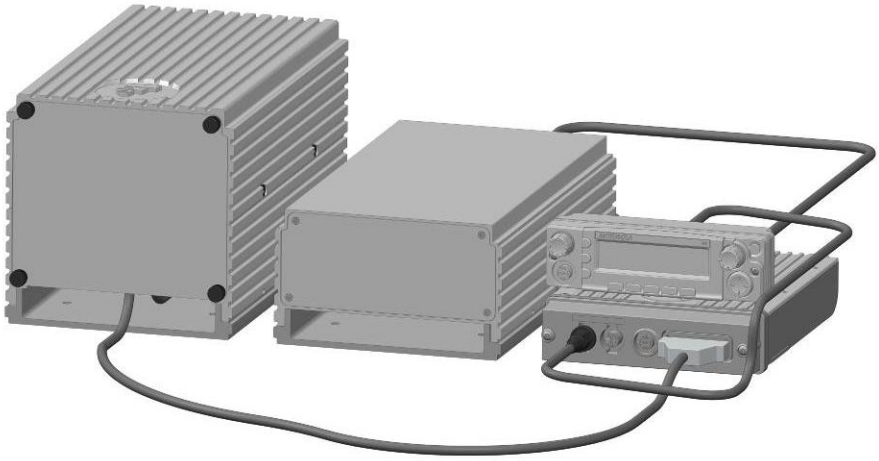


Figure 7 Vehicular Mount In-Band 700 or 800MHz DVRS Model - Full Duplex & Simplex Capable

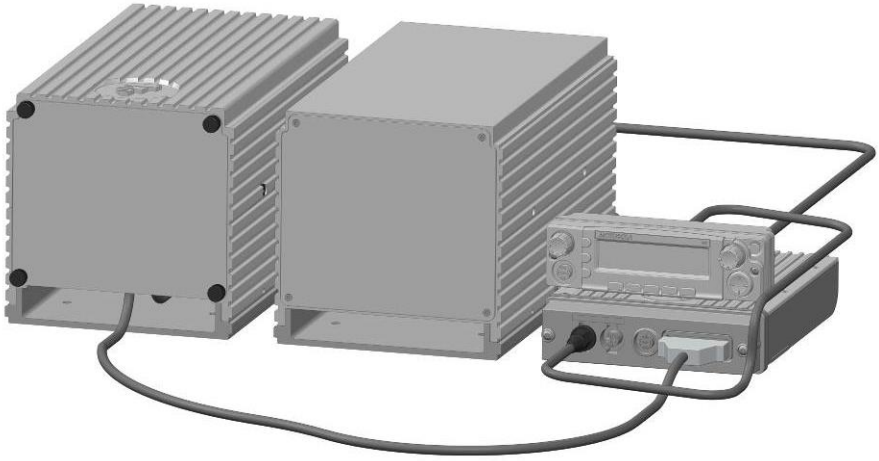


Figure 8 Vehicular Mount In-Band VHF or UHF DVRS Model - Full Duplex & Simplex Capable

More complex RF Bypass Switch algorithm is needed for APX8500 radios which have single antenna port for multiple bands, and the optional external antenna triplexer is not installed. New algorithm would assure that MSU In-band filter is in use only when MSU is operating on the zone/channel that is in the same band as DVR. Therefore, the following change of DVR algorithm was made for DVR:

- MSU In-Band Filter to be in use when DVR is enabled AND mobile is on an In-Band channel
- In all other cases (MSU is on Cross-Band channel or on Multiband channel that is not affecting/crossing into DVR band) MSU In-Band filter should be bypassed

Here is a simple table of possible MSU /DVR channel band configurations:

MSU	DVR	MSU In-Band Filter
Single Band	In-Band	IN
Single Band	Cross-Band	OUT
Multiband	In-Band	IN
Multiband	Cross-Band	OUT

APX MSU Model	VHF (136-174MHz) DVRS Models	Reference
Dual Band APX MSU 700/800MHz & VHF	• X-Band with band locked VHF, Full Duplex • X-Band with band locked VHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU 700/800MHz & UHF R1	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU 700/800MHz & UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU UHF R1 & VHF	• X-Band with band locked VHF, Full Duplex • X-Band with band locked VHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU UHF R2 & VHF	• X-Band with band locked VHF, Full Duplex • X-Band with band locked VHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU UHF R1 & UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU VHF	• In-Band Full Duplex • In-Band Simplex	Fig. 5 & 7 Fig. 6 & 8
Single Band APX MSU UHF R1	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU 700 / 800MHz	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4

Table 2 VHF DVRS Configurations

APX MSU Model	UHF (380-430; 450-470; 470-512MHz) DVRS Models	Reference
Dual Band APX MSU 700/800MHz & VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU 700/800MHz & UHF R1	• X-Band with band locked UHF, Full Duplex • X-Band with band locked UHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU 700/800MHz & UHF R2	• X-Band with band locked UHF, Full Duplex • X-Band with band locked UHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU UHF R1 & VHF	• X-Band with band locked UHF, Full Duplex • X-Band with band locked UHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU UHF R2 & VHF	• X-Band with band locked UHF, Full Duplex • X-Band with band locked UHF, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 8
Dual Band APX MSU UHF R1 & UHF R2	• In-Band Full Duplex • In-Band Simplex	Fig. 5 & 7 Fig. 6 & 8
Single Band APX MSU VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU UHF R1	• In-Band Full Duplex • In-Band Simplex	Fig. 5 & 7 Fig. 6 & 8
Single Band APX MSU UHF R2	• In-Band Full Duplex • In-Band Simplex	Fig. 5 & 7 Fig. 6 & 8
Single Band APX MSU 700 / 800MHz	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4

Table 3 UHF DVRS Configurations

APX MSU Model	700MHz DVRS Models	Reference
Dual Band APX MSU 700/800MHz & VHF	• X-Band with band locked 700/800, Full Duplex • X-Band with band locked 700/800, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 7
Dual Band APX MSU 700/800MHz & UHF R1	• X-Band with band locked 700/800, Full Duplex • X-Band with band locked 700/800, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 7
Dual Band APX MSU 700/800MHz & UHF R2	• X-Band with band locked 700/800, Full Duplex • X-Band with band locked 700/800, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 7
Dual Band APX MSU UHF R1 & VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU UHF R2 & VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU UHF R1 & UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU UHF R1	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU 700 / 800MHz	• In-Band Full Duplex • In-Band Simplex	Fig. 5 & 7 Fig. 6 & 7

Table 4 700MHz DVRS Configurations

APX MSU Model	800MHz DVRS Models	Reference
Dual Band APX MSU 700/800MHz & VHF	• X-Band with band locked 700/800, Full Duplex • X-Band with band locked 700/800, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 7
Dual Band APX MSU 700/800MHz & UHF R1	• X-Band with band locked 700/800, Full Duplex • X-Band with band locked 700/800, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 7
Dual Band APX MSU 700/800MHz & UHF R2	• X-Band with band locked 700/800, Full Duplex • X-Band with band locked 700/800, Simplex • In-Band & X-Band Capable, Full Duplex • In-Band & X-Band Capable, Simplex	Fig. 1 & 3 Fig. 2 & 4 Fig. 5 & 7 Fig. 6 & 7
Dual Band APX MSU UHF R1 & VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU UHF R2 & VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Dual Band APX MSU UHF R1 & UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU VHF	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU UHF R1	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU UHF R2	• X-Band Full Duplex • X-Band Simplex	Fig. 1 & 3 Fig. 2 & 4
Single Band APX MSU 700 / 800MHz	• In-Band Full Duplex • In-Band Simplex	Fig. 5 & 7 Fig. 6 & 7

Table 5 800MHz DVRS Configurations

DVR Dimensions

Cross-Band DVR Dimensions

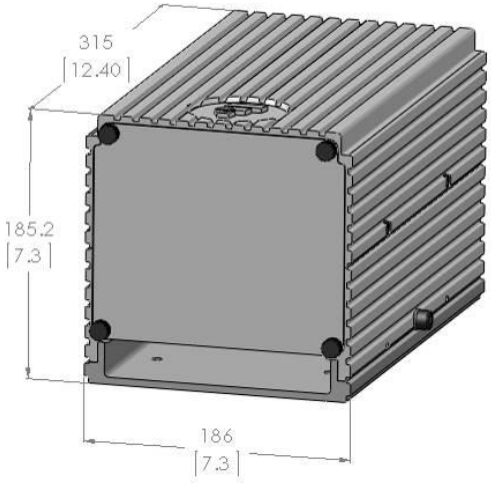


Figure 9 Cross-Band DVR (Full Duplex and Simplex Capable) - Dimensions mm / [in]

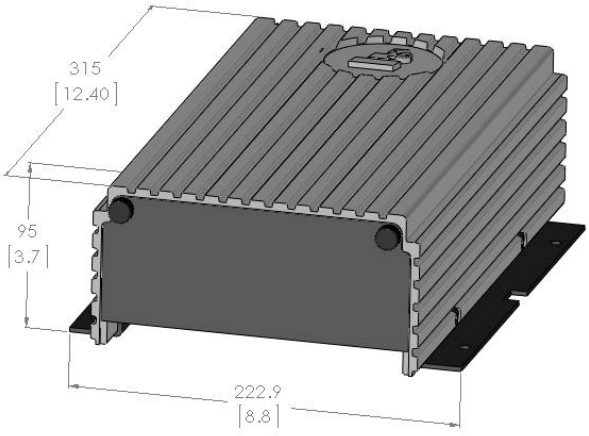


Figure 10 Cross-Band Simplex Only Capable - Dimensions mm / [in]

In-Band DVR Dimensions

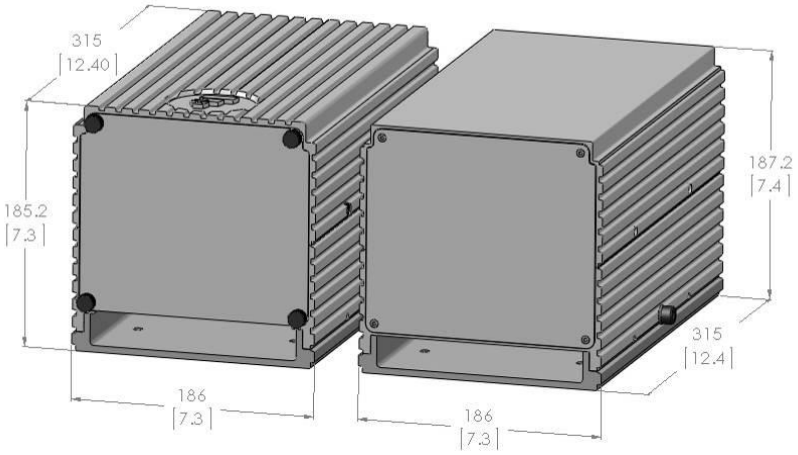


Figure 11 Typical VHF/UHF In-Band DVR (Full Duplex & Simplex) - Dimensions mm / [in]

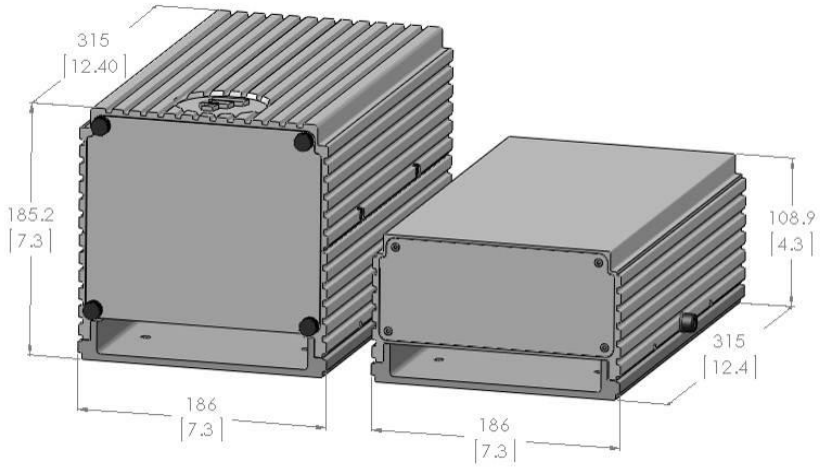


Figure 12 Typical 700 / 800 In-Band DVR (Full Duplex & Simplex) - Dimensions mm / [in]

DVRS Installation Basics

Planning the Installation

Before starting the installation, inspect the vehicle and determine how and where you intend to mount the DVRS antennas (one or two connected to the Mobile Radio and one to the DVR), the DVR components, MSU, Control Head, MSU accessories. Ensure to provide adequate separation between the Mobile radio antennas and the DVR antenna, especially in in-band configurations.

When planning the DVRS installation, make sure to leave adequate room around all DVRS modules to allow for easy RF and Control cabling connections, to enable programming / re-flashing access to both the DVR and MSU ports and access to the DVR mounting screws.

Ensure all DVRS components are mounted within the interconnecting cables range.

The DVRS operates only in negative ground, +12VDC electrical systems. Before starting the installation, make sure that the ground polarity of the vehicle is correct. Accidentally reversing the polarity will not damage the radio but will cause the cable fuses to blow.
Futurecom recommends installation of voltage surge protection to protect the car electronics to prevent spikes in the supply voltage.

CAUTION!
Before installing any electrical equipment, check the vehicle manufacturer's User Manual.

Installation Tools Required

Description	Needed for:
Drill	Mounting base installation screws.
Center Punch	Mounting base installation screws.
6mm Allen Key	Tightening the 8mm machine screws for securing DVR/Filters to their mounting bases.
Wire Cutters and Crimping Tool	DC power cable installation.
#1 Philips Screwdriver	Tightening of cover screws.
3/16" Flat Screwdriver	Tightening of connector screws.

Mounting the DVR

Cross-Band DVRS Mounting

1. Select the locations of the DVR and MSU such that the interconnecting cable can reach and there is enough space for securing the side thumbscrews of the DVR.
2. Using the mounting base as a template, mark the positions of the 6 holes on the mounting surface.
3. Center-punch the spots you have marked and realign the mounting base in position.
4. Secure the mounting base with six self-drilling screws. 6mm or ¼" screws are recommended.
5. Leave enough room for adequate access to the DVR connectors and screws.
6. Route the cables through the mounting base as required.
7. Drop the DVR Assembly into the mounting base and slide it back.
8. Secure the DVR assembly with the two 8mm machine screws and split spring lock washers provided.
9. Tighten the 8mm machine screws with the 6mm Allen Key. The required tightening torque is 21.7 Nm (16 lb in).
10. Connect all cables and then secure the front and rear DVR covers by tightening the 4 thumbscrews provided.

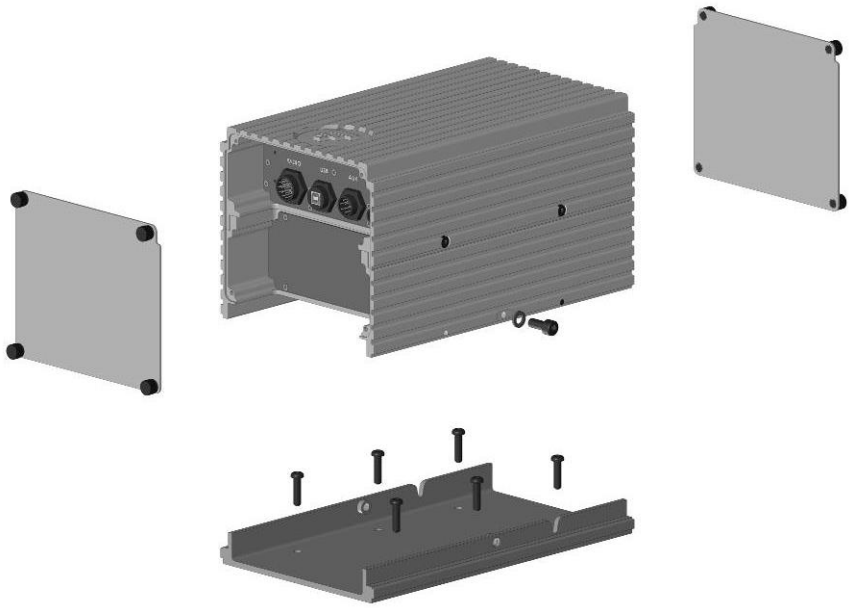


Figure 13 DVR Mounting Details – Full Duplex (With Duplexer)

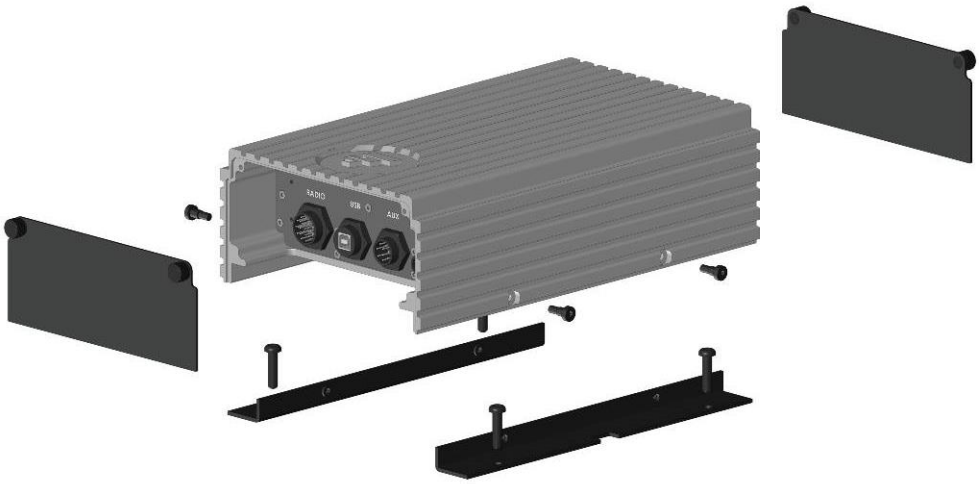


Figure 14 DVR Mounting Details – Simplex Only Capable (No Duplexer)

In-Band DVRS Mounting

1. Select the locations of the DVR, in-band filters and MSU such that the interconnecting cables can reach and there is enough space for securing the side thumbscrews.
2. Using the mounting base as a template, mark the positions of the 12 holes on the mounting surface.
3. Center-punch the spots you have marked and realign the mounting base in position.
4. Secure the mounting bases with six self-drilling screws. 6mm or ¼" screws are recommended.
5. Leave enough room for adequate access to the DVRS connectors and screws.
6. Route the cables through the mounting bases as required.
7. Drop the DVR and the Notch Filter Assemblies into the mounting bases and slide each back.
8. Secure the DVR assembly with the two 8mm machine screws and split spring lock washers provided.
9. Tighten the two 8mm machine screws with the 6mm Allen Key. The required tightening torque is 21.7 Nm (16 lb in).
10. Repeat step 9 to install the Notch filter assembly.
11. Connect all cables and then secure the front and rear DVR covers by tightening the 4 thumbscrews provided.
12. Secure the rear Notch Filter cover by tightening the 4 thumbscrews provided.

Mounting the Mobile Radio

For detailed Mobile Radio and accessories Installation Instructions, please refer to the Installation Manuals available from Motorola. Ensure the Remote Mount MSU is mounted beside the DVR within the range of the DVRS cabling.

NOTE:
Unless special cabling length is specified upon placing an order, the DVR is shipped with a standard 3ft-long interconnect cable between the MSU and DVR.

Connecting the DVRS Cables

NOTE:
The DVRS antenna ports (both DVR and APX sides) are mini UHF female and require antennas with matching mini UHF male terminations. Simplex Cross-Band Models (without any filters) require an antenna with TNC male connector.

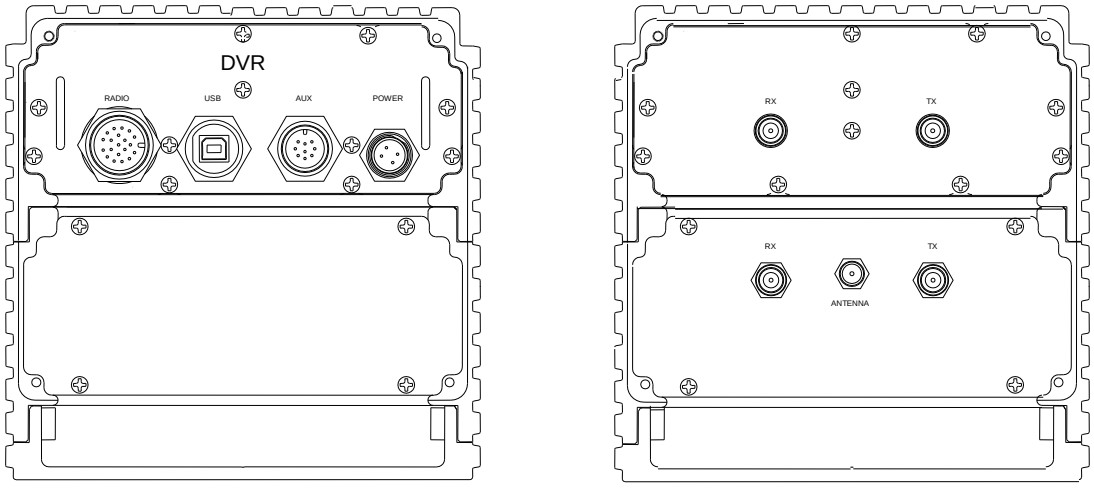


Figure 15 DVR Connectors - Front and Back View (With Duplexer)

Power Cable

IMPORTANT!
The DVRS operates only in negative ground, +12VDC electrical systems. Before starting the installation, make sure that the ground polarity of the vehicle is correct.

1. Determine power cable routing between the VRS mounting location and the vehicle battery.
2. Locate an existing hole with a grommet in the vehicle firewall. If a firewall hole does not exist, drill an access hole in the firewall for cable passage. Install a grommet in the hole to avoid damage to the power cable.
3. From the inside of the vehicle, feed the red lead (without lug attached) through the access hole into the engine compartment.
4. Find a grounding point close to the VRS location. Shorten the black lead.
5. Strip the end of the black lead as required. Crimp the large lug on the black lead and connect it to the vehicle chassis ground.
6. Trim the red lead to the proper length. Strip the end of the red lead as required. Crimp the large lug on the red lead.

7. Locate the fuse holder as close to the battery as possible and away from hot engine parts. Cut the red lead at this location and pull both cut ends through the fuse holder holes. Strip both ends and crimp the metal fuse holder ends on both ends. Install the fuse and close the fuse holder.
8. Connect the red lead lug to the battery positive (+) terminal.

RF Cables

The following RF cables are provided with the respective In-Band DVR Models:

PN	Order Code	Description	Length	Connectors	DVR Models
7W083X17-01	DDN9034	MSU to in-band filtering	3 feet	Mini UHF male	All In-Band Models.
7W083X16-01	DDN9033	DVR Ant to In-Band Filtering	3 feet	Mini UHF male	VHF & UHF In-Band Models.
7W900X94-02	DDN2719A	APX8500 to Notch filter	3 feet	QMA/Mini UHF	All In-Band Models.

Table 6 DVRS RF Cables

Control Cables

The following Control Cable types are available:

Part Number:	**7W083X05-01**	**1W083B09-01**
Order Code	**DDN9028**	**DDN9029**
Description	Standard MSU – DVR Control Cable	Optional MSU – DVR Control Cable. Used when the MSU is interfaced to Siren HLN1439C
Connector Type - Mobile Radio End	DB25 Male	DB25 Male → to MSU DB25 Female → to Siren Cable
Connector Type - DVR End	Over-molded 20-PIN Female	Over-molded 20-PIN Female
Length	915mm (36”) (Custom lengths up to 7620mm = 300” are available)	915mm (36”)

Table 7 DVRS Control Cable Types

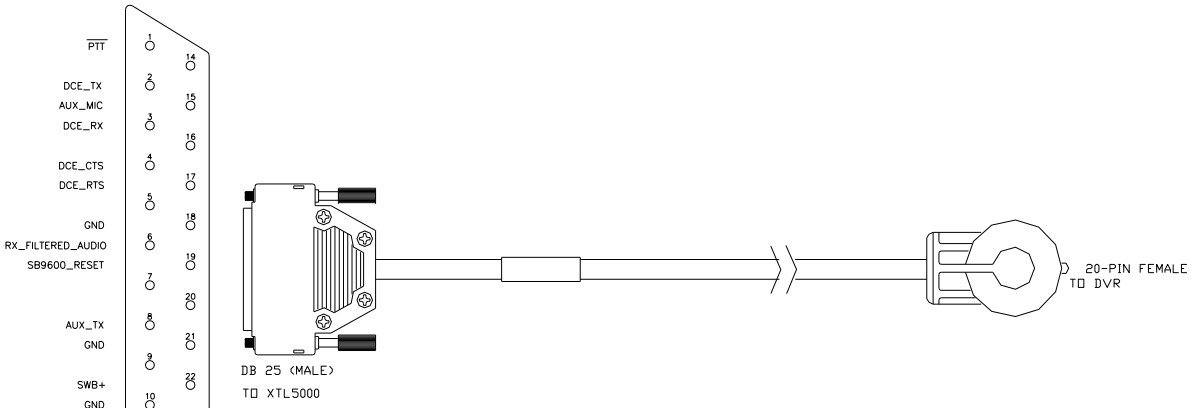


Figure 16 DVR-to- MSU Control Cable 7W083X05-01

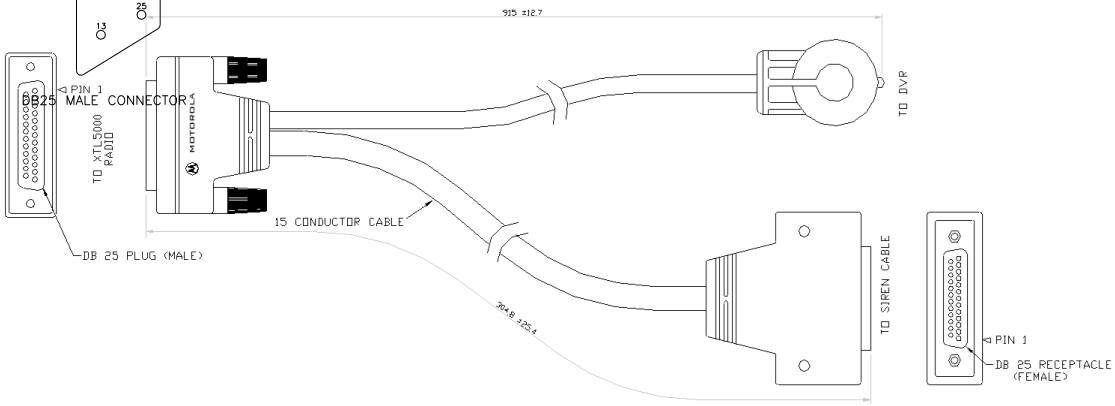


Figure 17 DVR-to- MSU (with Siren) Control Cable 1W083B09-01

NOTE:
Only one of the above Control Cables (shown on **Figure 16** and **Figure 17**) is required per DVRS Installation.

Option Cables

The DVR Auxiliary port provides three Relay Driver Output Ports and two Switch Contact Input Ports, which can be interfaced to external logic. The DVR Auxiliary port is extended by the DVR Auxiliary jumper cable **PN 7W083X06**.

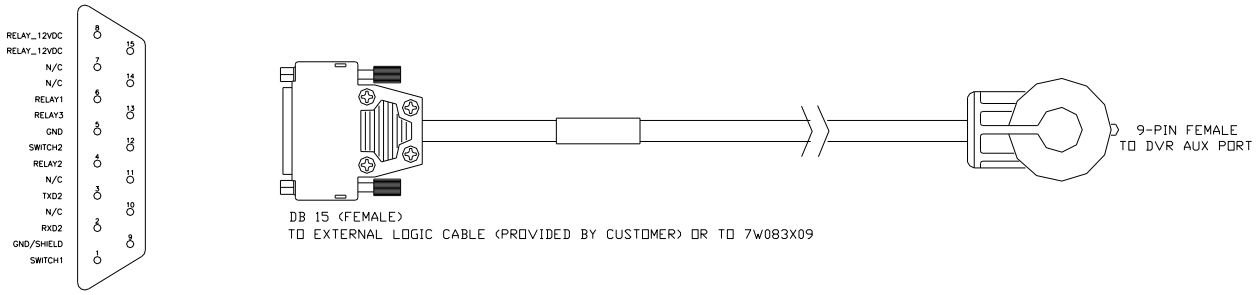


Figure 18 DVR Auxiliary Cable - 7W083X06-01

In-Band DVRS Option Cables

RF Switch Cable

Connect the DB9 Female connector of the **7W083X09** cable to the DB9 male port labeled '**TO AUX'** which is located on the DVRS In-Band filtering shelf.
Connect the other end of the **7W083X09** cable to the matching DB15 connector of the **7W083X06** cable.
Connect the over-molded 9-pin connector of **7W083X06** to the matching DVR connector labeled '**AUX'**.
To enable the RF Switch operation, the '***MSU RF Bypass Switch***' box in the DVRS Hardware Setup menu must be checked.

Other Option Cables

To connect other external logic to the DVR, the DB15 connector of the RF Switch cable **7W083X09** can be opened and extra wires added to the corresponding pins as described in the **DVR Options** section of this document.

Cross-Band DVRS Option Cables

Connect the over-molded 9-pin connector of cable PN **7W083X06** to the matching DVR connector labeled '**AUX**'.
Terminate the required external logic option cable (provided by others) with a DB15 male connector with the required pin out and connect it to the DB15 female connector of the **7W083X06** cable.
The external logic options must be enabled in the DVR personality as described in the **DVR Options** section of this document.

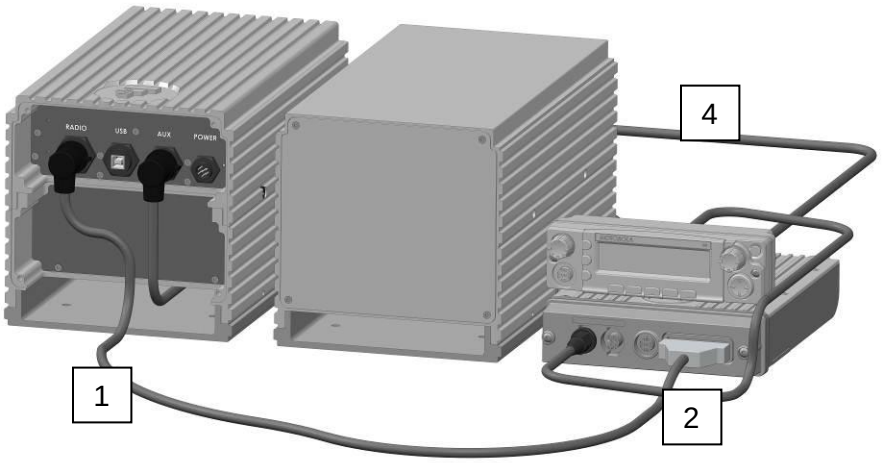


Figure 19 In-Band VHF or UHF DVRS Interconnect Cabling - Front

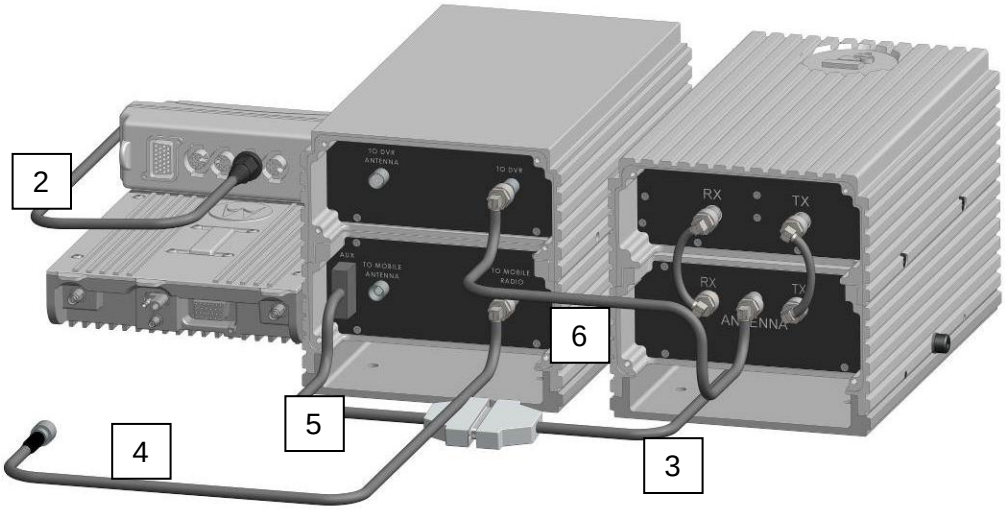


Figure 20 In-Band VHF or UHF DVRS Interconnect Cabling - Back

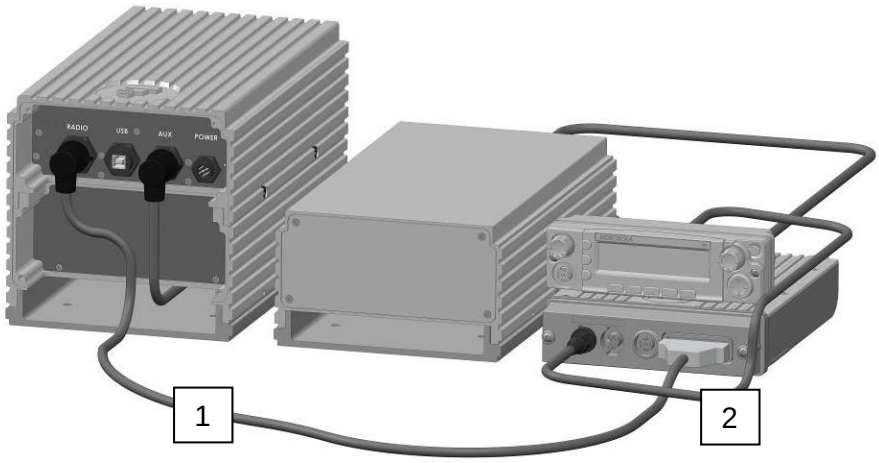


Figure 21 In-Band DVRS (700 or 800MHz) Interconnect Cabling - Front

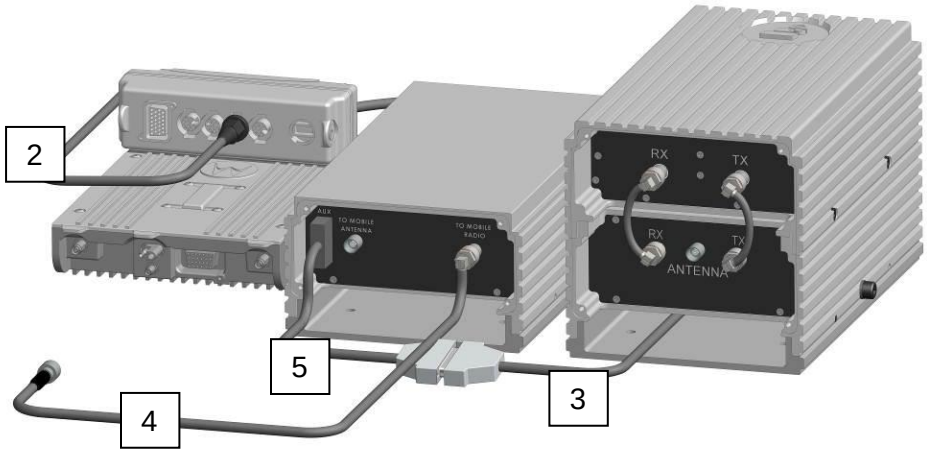


Figure 22 In-Band DVRS (700 or 800MHz) Interconnect Cabling - Back

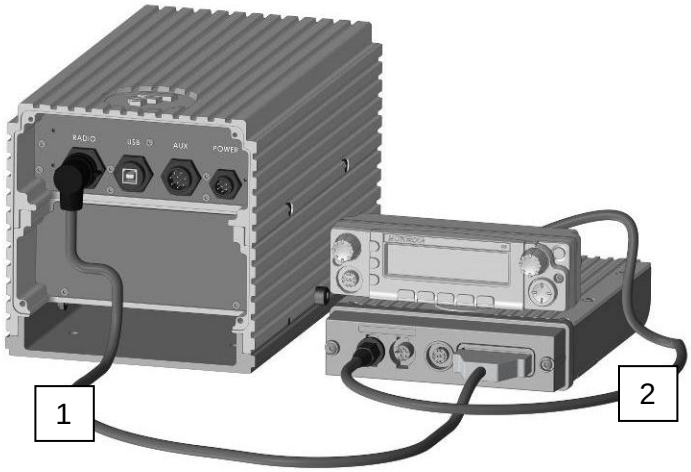


Figure 23 Cross-Band Full Duplex & Simplex Capable DVRS Interconnect Cabling - Front

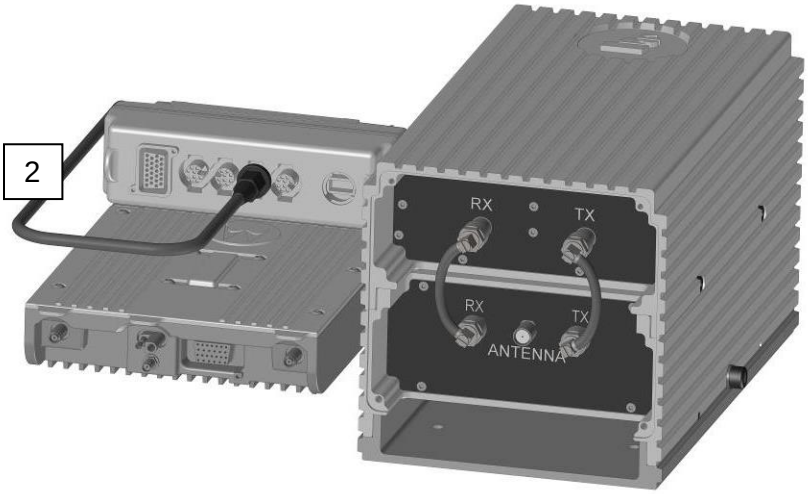


Figure 24 Cross-Band Full Duplex & Simplex Capable DVRS Interconnect Cabling – Back

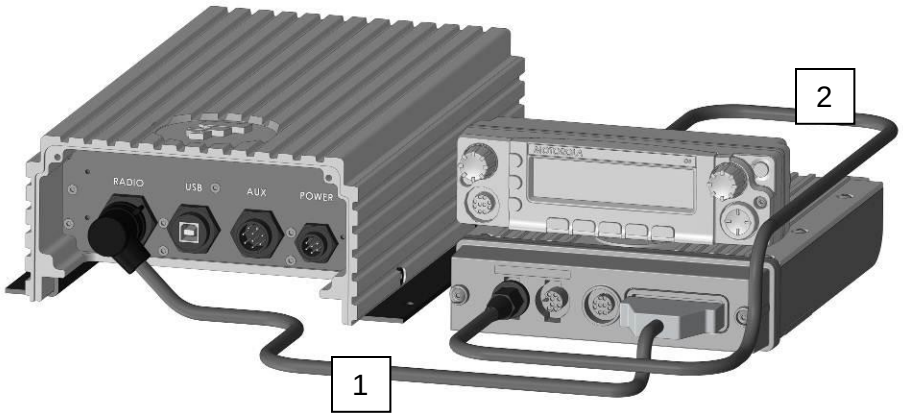


Figure 25 Cross-Band Simplex Only Capable DVRS Interconnect Cabling – Front

Figure 26 Cross-Band Simplex Only Capable DVRS Interconnect Cabling – Back

Ref #	PN	Length	Order Code	Notes
1a	7W083X05-01	3ft	DDN9028	DVR to MSU Control Cable Custom lengths available – up to 25ft.
1b	1W083B09-01	3ft	DDN9029	Replaces 1a if a Motorola Siren is to be interfaced to the MSU.
2	Control Head cable provided by Motorola			
3	7W083X06-01	2.5ft	DDN9031	Auxiliary Cable.
4a	7W083X17-01	3ft	DDN9034	MSU to In-Band Filtering RF Cable
4b	7W900X94-02	3ft	DDN2719A	APX8500 to In-Band Filtering RF Cable
5	7W083X09-01	1ft	DDN9032	RF switch option cable
6	7W083X16-01	3ft	DDN9033	DVR to In-Band Filtering RF Cable
	1W083A01-01	18ft	DDN9030	DVR Power cable

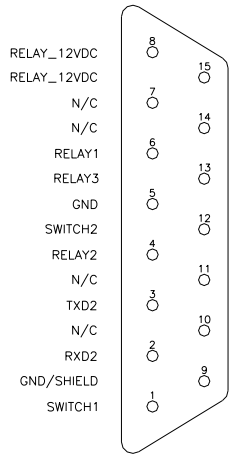
Table 8 Summary of DVRS Control and RF Cables

DVR Options

The DVR Auxiliary port provides three relay driver output ports and two switch contact input ports, which can be interfaced to external logic. The DVR Auxiliary port is extended by the DVR jumper cable PN **7W083X06**. The external logic can be easily interfaced by connecting to the correct pins on the DB15 connector as described in the next paragraph.

DVR Auxiliary Cable

The DVR Auxiliary Cable (PN **7W083X06**) extends the DVR AUX port pins to a DB15 connector for easy connection to the required external logic. The DB15 pinout is shown below.



(7W083X06-01) DB15 Pinout

Figure 27 Auxiliary Cable

Pin #	Designation	***Note***
1	SWITCH 1	*Alternative AVRA Input, operating as programmed in the Futurecom Repeater Configurator's Hardware Setup Screen*
2	RXD2	*RS232 Input*
3	TXD2	*RS232 Output*
4	RELAY 2	*Primary Light Output / as programmed*
5	GND	*Ground*
6	RELAY 1	*RF Switch Output / as programmed*
7	NOT USED	-
8	RELAY_12VDC	*12VDC for powering up relay coil. Max current draw is 750mA TOTAL from both pins 8 & 15.*
9	GND/SHIELD	*Ground / Shield*
10	NOT USED	-
11	NOT USED	-
12	SWITCH 2	*For future use*
13	RELAY 3	*As programmed*
14	NOT USED	-
15	*RELAY_12VDC*	*12VDC for powering up relay coil. Max current draw is 750mA TOTAL from both pins 8 & 15.*

AVRA

The Automated VR Activation (AVRA) option enables automated DVR ON/OFF control triggered by an external switch – portable charger, door switch etc.

If this option is desired, the external switch (provided by others) needs to be wired to one of the following:

A dedicated VIP Input on the MSU Control Head or DEK.

- The 'Automatic VR Activation' and 'AVRA Uses VIP on CH' selection boxes in the DVRS Hardware Setup menu must be checked.
- The corresponding VIP I/P must be enabled in the MSU – refer to the programming guide provided by Motorola for detailed instructions.

For detailed instructions on VIP wiring, please refer to the MSU installation manuals available from Motorola.

'Switch 1 Input' on the DB15 of the DVR Auxiliary Cable (PN **7W083X06**).

- The 'Automatic VR Activation' selection box in the DVRS Hardware Setup Menu must be checked.
- The 'AVRA Uses VIP on CH' selection box in the DVRS Hardware Setup menu must be left blank (unchecked).
- The MSU does not require special programming related to the enabling of this option.

Status Lights

The Status Lights option provides status identification capabilities. The relay outputs in the DVRS can be programmed to provide several status indications – 'Master Light', 'LOC Mode Light', 'SYS Mode Light' or 'DVR ON Light'.
The DVR then provides control input to an external switch which in turn toggles an external light. The external switch and light are not included with the DVR.
The Light Switch Relay Coil "+" must be wired to +12V DC and the "-" to the corresponding Relay Output on the DB15 connector of the DVR Auxiliary cable PN **7W083X06** (500mA Max).

External Alarm

In applications where the DVR is installed in a fixed 19" rack, the external alarms option can be enabled and the corresponding relay output wired up to an external logic system for monitoring and reporting of 'low power' or 'overt temperature' combined alarms.

DVRS Antenna Installation

Any DVRS model requires the use of two or three antennas – one or two connected to the MSU and one connected to the DVR. For a list of approved DVR antennas, please refer to **Appendix 12.**

IMPORTANT!
To assure optimum performance and compliance with RF Energy Safety standards, these antenna installation guidelines are limited to metal-body vehicles with appropriate ground planes and take into account the potential exposure of back seat passengers and bystanders outside the vehicle.

The MSU and DVR antennas must be installed in such way as not to cause interference.

IMPORTANT!
All DVRS models require 30dB minimum Antenna Isolation between the DVR and MSU Antennas.

Before installing an antenna on the trunk lid:

- Ensure the distance from the antenna to the front surface of the rear back seat is greater than the minimum distance specified in the “Product and RF Safety” booklet for the specific DVRS model and frequency band.
- Ensure the trunk lid is grounded by connecting grounding straps between the trunk lid and the vehicle chassis.

To ensure compliance with RF Energy Safety standards, the antenna locations, gain and maximum transmit power (for both the MSU and the DVR) must be as specified in the “Product and RF Safety” Booklet shipped with the DVR.

NOTE:
The DVRS antenna ports are mini UHF female and require antennas with matching mini UHF male terminations. Simplex ONLY DVRS configurations feature TNC female connector on the DVR side.

Appendix 1 – DVR Specifications

General Specifications				
Dimensions: Height / Width / Depth	185mm (7.28”) / 186mm (7.32”) / 315mm (12.41”)			
Weight (DVR Only, without filtering)	10.3kg (22.7lb)			
Channel Spacing	12.5 or 25 kHz programmable			
Number of Channels	Up to 192			
CTCSS/DCS	Programmable per Channel			
Power Supply	13.8V DC +/- 20%			
DC Current Drain				
RPTR Off	0.01 A Max			
Standby/Receive	0.8 A Max			
Transmit	4.5 A Max			
Operating Temperature	-30ºC to +60ºC			
Protection Against Liquids	IP54			
Antenna Impedance	50 Ohms			
Duty Cycle	Continuous			
External Connectors				
Antenna	Mini UHF			
Computer Interface	USB			
Equipment Type Acceptance	**VHF**	**UHF**	**700**	**800**
FCC	LO6-DVRSVHF	LO6-DVRSUHF	LO6-DVRS700	LO6-DVRS800
ISED	2098B-DVRSVHF	2098B-DVRSUHF	2098B-DVRS700	2098B-DVRS800
Transmitter Specification	**VHF**	**UHF**	**700**	**800**
Frequency Band [MHz]	136-174	380-430 450-470 470-512	764-776	851-870
Power Output @ Antenna Port	10W (programmable per channel from 1W to 10W)			
CCT Option	15 sec to 15 min or Disabled			
Max Spurious Output	-20dBm			
Frequency Stability	+/- 1.5ppm			
FM Hum and Noise 12.5 / 25 kHz	37 dB / 43 dB			
Audio Response	+1, -3 dB of 6 dB / octave pre-emphasis characteristic over 300 Hz – 3 kHz			
Audio Distortion	<2%			
Receiver Specification	**VHF**	**UHF**	**700**	**800**
Frequency Band [MHz]	136-174	380-430 450-470 470-512	794-806	806-825
Receiver Sensitivity	-115 dBm			
Frequency Stability	+/- 1.5ppm			
Selectivity 12.5 / 25 kHz	60 dB / 75 dB			
Intermodulation	70 dB			
Deviation 12.5 / 25 kHz	+/-2.5 kHz / +/-5 kHz			
FM Hum and Noise 12.5 / 25 kHz	37 dB / 43 dB			
Audio Output (Repeater Detect Audio)	600 mV RMS nominal, flat response			
Audio Response	+1, -3 dB of 6 dB / octave de-emphasis characteristic over 300 Hz – 3 kHz			
Audio Distortion	<2%			

Appendix 2 – Accessories

DVR Antennas – Vehicular Mount

Order Code	Freq. Band [MHz]	Type	Gain dBd
HAD4006A	136-144	Roof / Trunk Mount	0 (Unity)
HAD4007A	144-150.8	Roof / Trunk Mount	0 (Unity)
HAD4008A	150.8-162	Roof / Trunk Mount	0 (Unity)
HAD4009A	162-174	Roof / Trunk Mount	0 (Unity)
HAE6012A	380-433	Roof / Trunk Mount	0 (Unity)
HAE4003A	450-470	Roof / Trunk Mount	0 (Unity)
HAE4004A	470-512	Roof / Trunk Mount	0 (Unity)
HAF4016A	764-870	Roof / Trunk Mount	0 (Unity)

Cables

Order Code	PN	Length	Notes
DDN9028	7W083X05-01	3ft	DVR-to- MSU Control Cable. Custom lengths available – up to 25ft.
DDN9029	1W083B09-01	3ft	Replaces 1 if a Siren is to be interfaced to the MSU.
DDN9030	1W083A01-01	-	DVR Power Cable
DDN9031	7W083X06-01	2.5ft	Options Cable.
DDN9034	7W083X17-01	3ft	MSU to In-Band Filtering RF Cable
DDN9032	7W083X09-01	1ft	RF switch option cable
DDN9033	7W083X16-01	3ft	DVR to In-Band Filtering RF Cable
DDN9025	USBAB99	10ft	USB DVR Programming / Re-flashing Cable

Contact Information

Technical Support

905-660-5548
support@futurecom.com

Orders

Please contact Motorola / Drop Ship

Return Authorizations

1-800-701-9180

Head Office and Manufacturing

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Concord, Ontario L4K 5P8
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www.futurecom.com

Index

Glossary

Keyword	Description
ACK	Acknowledgement of communications.
AVRA	Automated VR / DVR Activation. DVR Option which permits automated activation of the DVR by either using a VIP input on the MSU CH / DEK or a pin on the DVR Auxiliary cable. Requires external logic / switch, not provided with the DVRS hardware.
Authentication	To prevent unauthorized access for Conventional DVRS PSU, Authentication key can be loaded on the authentication capable DVRS PSU.
Band Lock	When enabled, causes the MSU to block usage of the same frequency band as the DVR while the DVR is active. Enabled by default when no in-band filter is present.
BL	Busy Lockout – dynamic voting phase (follows the static Primary / Secondary phase) of the DVR simulcast prevention algorithm.
Channel	A group of characteristics, such as transmit / receive frequency pairs, radio parameters, encryption encoding etc.
Coded Squelch	Tone Private-Line (PL) or Digital Private-Line (DPL). Used on conventional channels for signal validation.
Conventional	Refers to radio-to-radio communications, sometimes through a base station repeater or vehicular repeater.
Dispatcher	An individual who has radio system management duties.

Keyword	Description
DPD File	DVR personality file saved as **file_name.dpd**.
DPL Coded Squelch	A continuous sub-audible data signal transmitted with the carrier. See Coded Squelch.

Keyword	Description
DVR	Digital Vehicular Repeater.
DVR Mode	Determines the communication exchange capabilities between System Users and Local Portable Users; Can be set to OFF, LOCAL or SYSTEM.
DVRS	When a Vehicular Repeater (VR) is interfaced with an MSU, the complete equipment package is referred to as a Digital Vehicular Repeater System (DVRS).
'DVRS Enabled' PSU	APX™4000, APX™6000 or APX™7000 Portable Radio with enabled DVRS operation.
EPR File	File containing DVR personality (dpd) and calibration data of the specific DVR unit. Typically saved in the following format xxxxxxxx.epr where xxxxxxxx is the SN of the specific DVR.
FCC	Federal Communications Commission.

Keyword	Description
FNE	Fixed Network Equipment – Trunking or Conventional System Infrastructure
Forced Analog Mode	Hybrid DVR Mode of operation where communications between the DVR and the P25 'DVRS enabled' PSUs are digital while the voice communications are forced to be analog when a non-P25 channel / TG is selected on the MSU. When a P25 channel / TG is selected on the MSU the DVR operates in Digital mode. Applicable only to 'DVRS Enabled' PSUs.
Forced Analog All Mode	Hybrid DVR Mode of operation where communications between the DVR and the P25 'DVRS enabled' PSUs are digital while the voice communications are forced to be analog for all types of channels selected on the MSU. Applicable only to 'DVRS Enabled' PSUs.
Heart Beat	P25 Message periodically sent by a Primary DVR to other DVRs during Primary/Secondary processing.
HUB	Hang Up Box – refers to the MSU Microphone being on hook or off hook.
ICM	In Car Monitor – when enabled in the MSU, allows the MSU user to monitor voice traffic to and from the local PSU
Inbound Call	A Call transmitted by Local PSU and received by the DVR.
Local Mode	DVR Mode which provides extended portable-to-portable voice and data range by repeating Local PSU (optionally MSU) communications without keying up the Mobile radio interfaced to the DVR.
Local PSU	PSU switched to the DVR channel and used for communication with the DVR
Local Tx Fallback	When enabled, the MSU mic audio is routed and transmitted locally by the DVR.
Mode	**MSU / PSU** - A programmed combination of operating parameters. **DVR** – OFF, SYSTEM or LOCAL (see **DVR Mode**)
MPE	Maximum Permissible Exposure.
MSU	Mobile Subscriber Unit

Keyword	Description
NAC	Network Access Code – used in P25 mode for validation of P25 radio communications, similar to the use of PL/DPL in analog mode. Also used for DVRS Steering.
NID	Network ID - see Network Access Code (NAC)
Outbound Call	System Call received by the MSU.
Over The Air Programming (OTAP)	Over the Air Programming of the DVR using Mobile Radio CPS.
PSU	Portable Subscriber Unit.
PSU Scan	This feature allows a scan list to be attached to PSU that is configured with DVRS as its system type. This enables an Enhanced PSU to support conventional scan feature.
PTT	Push to talk. The PTT engages the transmitter (of the Portable or Mobile radio and / or DVR) when pressed.
RF	Radio Frequency. Part of the general frequency spectrum 10kHz - 10,000,000 MHz.
RSSI	Received Signal Strength Indicator.
System Mode	DVR mode which provides extended voice and signaling communications between System Users and Local Portable Users over the selected DVR channel / Mobile Radio Mode.
Talk Group	A group of radio users who communicate with each other by using the same communication path.
Talk Group Translation	Feature where the PSU talkgroup is translated by the DVR to match the currently selected MSU talkgroup.
Trunking	The automatic sharing of radio frequencies by large number of users based on communication path sharing for the length of a conversation.
Futurecom Repeater Configurator	Vehicular Repeaters (VR) Programming Software Application
VR	Futurecom line of Vehicular Repeaters. It applies to one of the following products: VRX1000, DVR and DVR-LX.

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