



Futurecom Systems Group, ULC

DVR-LX® Installation Guide

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NOTES

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Proprietary Statement

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Commercial Warranty

Please reference Futurecom's Terms and Conditions of Sale, Section 7 regarding standard warranty (Futurecom Website > Terms and Conditions).

Declaration of Conformity

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Changes or modifications not expressly approved by Futurecom Systems Group, ULC, could void the User's authority to operate the equipment.

Important Safety Information

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

Notice to Users (FCC/ISED)

To satisfy FCC/ISED RF exposure requirements for mobile transmitting devices, refer to the RF Safety Booklet^[1] for TX – RX duty cycle and a separation distance between the antenna of this device and persons during operation. To ensure compliance, operations at closer than this distance is not allowed.

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 Booklet^[2]. 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 exposure limit for bystanders (general population).

It is the responsibility of the repeater operator to ensure that MPR 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 antenna.

^[1] Refer to RF Safety Booklet available on the Futurecom website.

^[2] Refer to RF Safety Booklet available on the Futurecom website.

Déclaration de Conformité

Cet équipement a été testé et déclaré conforme aux limites pour appareils numériques de classe A, selon la partie 15 des règlements de la FCC. Ces limites sont destinées à assurer une protection raisonnable contre les interférences nuisibles dans une installation commerciale. L'équipement génère, utilise et peut émettre de l'énergie de fréquence radio et peut causer des interférences nuisibles aux communications radio s'il n'est pas installé ou utilisé conformément au mode d'emploi. Toutefois, rien ne garantit l'absence d'interférences dans une installation particulière.

Les changements et les modifications qui n'ont pas été approuvés expressément par Futurecom Systems Group ULC pourraient faire perdre à l'utilisateur son droit à utiliser cet équipement.

Informations de Sécurité Importantes

Le répéteur DVRS est conçu pour être utilisé dans des conditions professionnelles/contrôlées, dans lesquelles les utilisateurs connaissent à fond leur exposition et peuvent exercer le contrôle nécessaire sur celle-ci pour se conformer aux limites de la FCC/ISED. Cette radio N'EST PAS autorisée pour être utilisée par le grand public, les consommateurs ou autres.

Avis Aux Utilisateurs (FCC/ISED)

Pour satisfaire les exigences de la FCC/d'ISED en matière d'exposition à l'énergie RF pour les transmetteurs mobiles, prière de consulter la Brochure Sécurité RF¹ pour obtenir le facteur d'utilisation transmission/réception et la distance de séparation entre l'antenne de cet appareil et les personnes pendant l'utilisation. Pour assurer la conformité, le fonctionnement à une distance moins élevée n'est pas autorisé.

Futurecom demande à l'opérateur du répéteur P25 DVRS de satisfaire aux exigences de la FCC/ISED en matière d'exposition à l'énergie RF. La distance minimale entre toutes les personnes possibles et une antenne omnidirectionnelle doit respecter les indications de la Brochure Sécurité RF². Tout manquement à respecter la zone d'exclusion autour de l'antenne définie par la distance correspondant à la limite d'exposition maximale peut exposer les personnes qui se trouvent dans ce rayon à une énergie RF supérieure à la limite d'exposition de la FCC pour les spectateurs (population générale).

C'est à l'opérateur du répéteur qu'il incombe de s'assurer que les limites d'exposition maximales sont respectées en tout temps pendant les transmissions du répéteur. L'opérateur du répéteur doit s'assurer en tout temps que personne ne s'approche de l'antenne à une distance inférieure à celle correspondant à la limite d'exposition minimale.

¹ Prière de consulter la Brochure Sécurité RF sur le site Web de Futurecom.

² Prière de consulter la Brochure Sécurité RF sur le site Web de Futurecom.

Introduction

The P25 Digital Vehicular Repeater (**DVR-LX**) is used to extend portable radio communications. When the DVR-LX is interfaced to a Motorola Mobile Subscriber Unit (**MSU**), the complete equipment package is referred to as Digital Vehicular Repeater System (**DVRS**).

When a Portable Subscriber Unit (**PSU**) has difficulty reaching a system tower, a DVR-LX can help by linking the PSU to a higher power mobile radio or MSU. The DVR-LX is designed to be seamlessly interfaced to:

- Remote Mount APX Series MSU with or without a Control Head (O2, O3, O5, O7, O9, or E5)
- For full list of compatible MSUs refer to compatibility chart at [Futurecom website](#) → [Support](#) → [Documentation and Software](#) → [DVR-LX/DVR/VRX1000](#)

NOTES:

- MSU must be configured as Remote Mount to be compatible with the DVR-LX.
- APX 8500 MSU may require interface kit. Please refer to the DVR-LX Ordering Guide.
- The MSU configured for DVRS operation can support up to two control heads.
- All control and status of the DVR are provided by the APX MSU control head. The control head is mounted in the front of the vehicle while the DVR-LX and associated filtering is housed in the back.

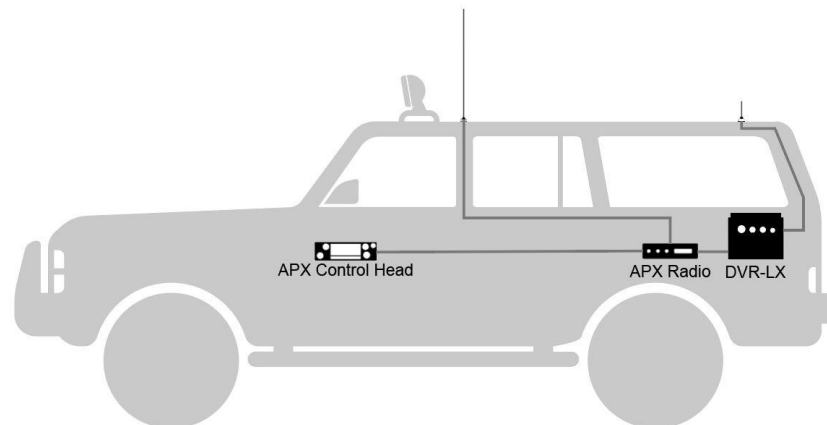


Figure 1: DVRS Equipment in Vehicle Layout

Installation Planning



Cautionary Notes & Considerations



FILTER LIMITS: The DVR-LX is shipped equipped with custom filters tuned to the specified frequency range provided by the customer. Programming the DVR-LX / 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.

TRANSMIT POWER (CROSS-BAND): The cross-band DVR-LX 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 DVRS RF Safety Booklet³.

TRANSMIT POWER (IN-BAND): 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.

Tools Required

Description	Needed For
Drill	Installer preferred mounting hardware
Center Punch (Optional)	Installer preferred mounting hardware
4mm Allen Key	6mm shoulder screws for securing DVR-LX flat mount to its mounting base
Wire Cutters and Crimping Tool	DC power cable installation
3/16" Flat Screwdriver	Cable connector screws

³ Refer to RF Safety Booklet available on the Futurecom website.

Programming Details

This section will detail programming information needed to enable certain installation options. For full instructions on how to program the DVR-LX, please refer to the VR Programming Guide⁴.

Bypass Switch

RF Bypass Switch with non-APX 8500 MSU

If installing an in-band DVR-LX, it comes equipped with an internal RF bypass switch.

- required for all inband applications
- bypasses the MSU filter when an In Band DVR Disabled channel is selected

When the DVR-LX is paired with a non-APX 8500 MSU, the switch bypasses the filtering at the output of the MSU when a DVR-LX disabled talk group (TG) is selected on the MSU control head.

MSU RF By Pass Switch Extension

- required for inband application for APX8500 w All Band antenna
- Bypasses the MSU filter when a cross band channel is selected

To enable the RF bypass switch operation, the following must be configured via Futurecom Repeater Configurator (FRC) in the Hardware Setup menu (Figure 2):

- **MSU RF Bypass Switch** = checked (enabled)
- **Relay Use- Relay 1** = MSU RF Bypass Sw.

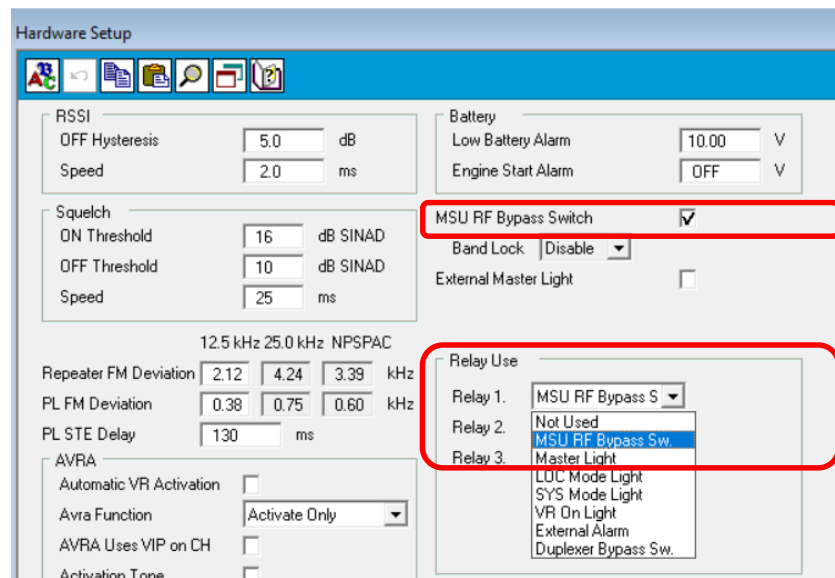


Figure 2: RF Bypass Switch Configuration

⁴ Refer to VR Programming Guide available on the Futurecom website.

RF Bypass Switch with APX 8500 MSU with Triplexer and Single Band Antennas

If installing an in-band DVR-LX, it comes equipped with an internal RF bypass switch. This switch bypasses the filtering at the output of the MSU as required to allow access to the full frequency band when DVR-LX is not enabled or to block certain frequencies when DVR-LX is active to ensure interference-free communication.

When the DVR-LX is paired with an APX 8500 MSU using a triplexer and single band antennas, the switch bypasses the filtering at the output of the MSU when a DVR-LX disabled talk group (TG) is selected on the MSU control head.

To enable the RF bypass switch operation, the following must be configured via FRC in the Hardware Setup menu (Figure 2):

- **MSU RF Bypass Switch** = checked (enabled)
- **Relay Use- Relay 1** = MSU RF Bypass Sw.

RF Bypass Switch with APX 8500 MSU and All Band Antenna

If installing an in-band DVR-LX, it comes equipped with an internal RF bypass switch. This switch bypasses the filtering at the output of the MSU as required to allow access to the full frequency band when DVR-LX is not enabled or to block certain frequencies when DVR-LX is active to ensure interference-free communication.

When the DVR-LX is paired with an APX 8500 MSU connected an all-band antenna, this switch bypasses the filtering at the output of the MSU as needed.

MSU in-band filter is in use when:

- MSU is on an in-band channel/TG AND DVR-LX is enabled

MSU in-band filter is not in use when:

- MSU is on a cross-band channel/TG OR
- MSU is on an in-band channel/TG AND DVR-LX is disabled

To enable the correct RF Switch operation, the following must be configured via FRC:

- **Hardware Setup**→ **MSU RF Bypass Switch** = checked (enabled) (See: **Figure 2: RF Bypass Switch Configuration**)
- **Hardware Setup**→ **Relay Use**→ **Relay 1** = MSU RF Bypass Sw. (See: **Figure 2: RF Bypass Switch Configuration**)
- **VR Common Setup**→ **MSU RF Bypass Switch Extension (APX 8500 and All Band Antenna)**= checked (enabled) (See:**Figure 3: RF Bypass Switch Extension Configuration**)

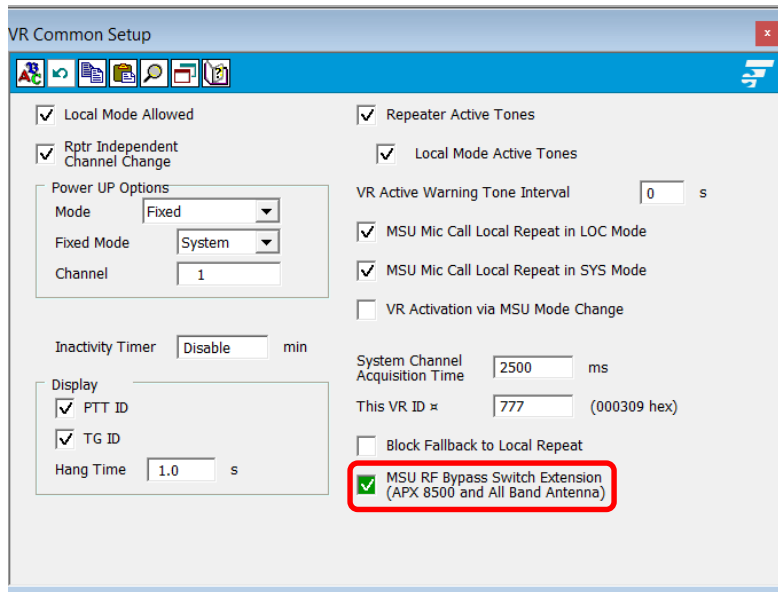


Figure 3: RF Bypass Switch Extension Configuration

NOTE: For in-band configurations where an APX 8500 interface kit is also required, the above programming is still required. Instructions on how to install an interface kit with an in-band DVRS are provided separately from this manual⁵.

⁵ Contact Futurecom to determine if an interface kit is required or to obtain an installation drawing.

External Alarm

For general DVR-LX configurations, the relay outputs map to the pins on the auxiliary port of the unit.

By selecting 'External Alarm' in Relay Use, the Temperature Alarm and Output Power Alarm can be enabled for monitoring and reporting low power or high temperature.

For Rackmount with Alarm option purchased, the 'External Alarm' selection will trigger the supplied relay switch at the back of the Rackmount unit when the conditions of temperature alarm or output power alarm are met.

The screenshot displays the 'Hardware Setup' window with various configuration options. The 'Relay Use' section is highlighted with a red box, showing 'Relay 1.' set to 'External Alarm'. Below it, another red box highlights the 'Temperature Alarm' set to 70 °C and the 'Output Power Alarm' set to OFF dB. Other visible settings include RSSI (OFF Hysteresis: 5.0 dB, Speed: 2.0 ms), Squelch (ON Threshold: 16 dB SINAD, OFF Threshold: 10 dB SINAD, Speed: 25 ms), Battery (Low Battery Alarm: 10.00 V, Engine Start Alarm: OFF V), MSU RF Bypass Switch (unchecked), Band Lock (Disable), External Master Light (unchecked), and AVRA (Automatic VR Activation: unchecked, AVRA Function: Activate Only).

Figure 4: External Alarms

Status Lights

The relay outputs on the DVR-LX can be programmed to provide several status indications – ‘Primary Light’, ‘VR On Light’, ‘LOC Mode Light’, or ‘SYS Mode Light’.

Primary & On Lights

The DVR-LX status icon located on the top right corner of the control head can be used to determine when the repeater is on and whether it is acting as a Primary or Secondary device. Due to the limited space on the control head, the icon is quite small and some users may prefer to have a more obvious light indication of the DVR-LX status.



Figure 5: Control Head Display--Status Icon

A pair of lights may be connected to the AUX port with the light colour used to indicate whether the DVR-LX is on (Secondary mode), and when it is in Primary mode.

For example, if a red light is connected to Relay 2 and a yellow light is connected to Relay 3, the following light combinations will be seen:

Primary DVR-LX – Red and Yellow lights
Secondary DVR-LX – Yellow light only

To enable the lights operation, the following must be configured via FRC in the Hardware Setup menu:

- **External Master Light** = checked (enabled)
- **Relay Use** → **Relay 2** = Master Light
- **Relay Use** → **Relay 3** = VR On Light

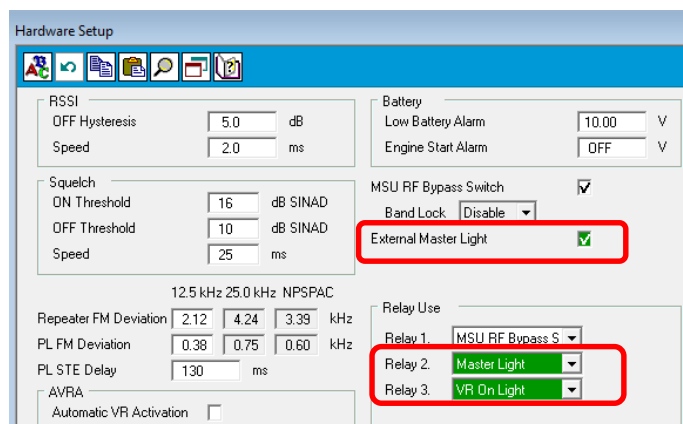


Figure 6: Primary & Lights On Configuration

System & Local Mode Lights

The top line of the control head can be used to determine whether the DVR-LX is operating in system (SYS) or local (LOC) mode. Some users may prefer to have a more obvious indication of the DVR-LX status.



Figure 7: Control Head Display--System/Local

A pair of lights may be connected to the AUX port with the light colour used to indicate whether the DVR-LX is in System or Local mode.

To enable the lights operation, the following must be configured via FRC in the Hardware Setup menu:

- **Relay Use** → **Relay 2** = SYS Mode Light
- **Relay Use** → **Relay 3** = LOC Mode Light

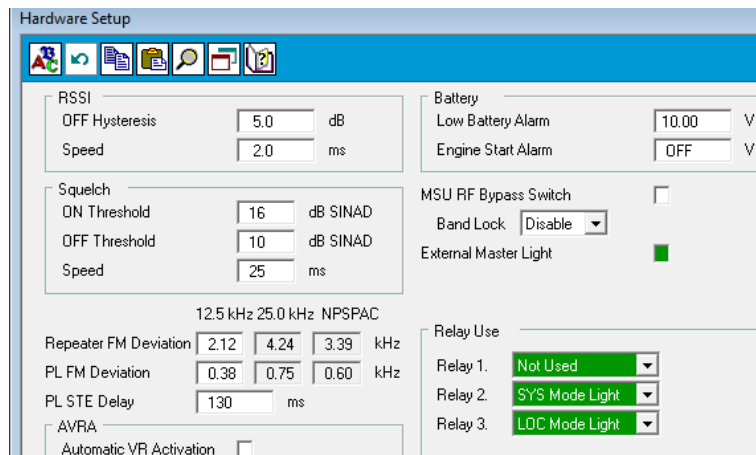


Figure 8: System and Local Mode Lights Configuration

Automated VR Activation (AVRA) and Primary/Secondary Preference Trigger

This input is used to trigger AVRA and/or Primary/Secondary Preference.

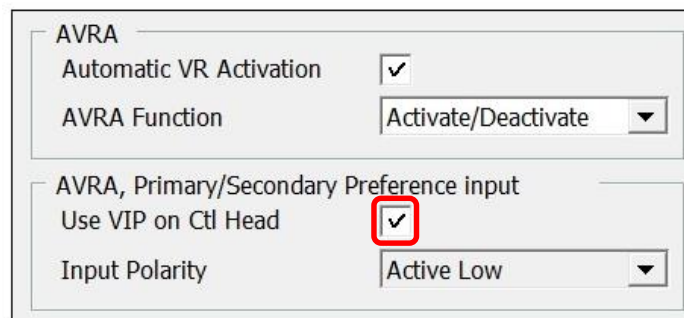
The AVRA option enables automated DVR-LX ON/OFF control triggered by an external switch – portable charger, door switch etc.

Refer to the programming instructions for Automated VR Activation (AVRA) to enable this functionality.

To enable AVRA operation, the following must be configured via FRC in the Hardware Setup menu:

Option 1: A dedicated VIP Input on the MSU Control Head or DEK⁶.

- **Automatic VR Activation** = checked
 - **Use VIP on Ctl Head** = checked
- NOTE: Input Polarity will be greyed out and corresponding VIP I/P must be enabled in the MSU⁷.



The screenshot shows a configuration window with two sections. The top section is titled 'AVRA' and contains 'Automatic VR Activation' (checked) and 'AVRA Function' (set to 'Activate/Deactivate'). The bottom section is titled 'AVRA, Primary/Secondary Preference input' and contains 'Use VIP on Ctl Head' (checked, with a red box around the checkmark) and 'Input Polarity' (set to 'Active Low').

Figure 9: AVRA VIP Configuration

Option 2: 'Switch 1 Input' on the DB15 of the DVR-LX Auxiliary Cable.

Note: With an in-band configuration, the auxiliary cable is provided for use with AVRA. For a cross-band configuration, the cable will need to be ordered separately- order number: VKN0029A.

- **Automatic VR Activation** = checked
 - **Use VIP on Ctl Head** = unchecked
- NOTE: The MSU does not require special programming related to the enabling of this option.

The **Input Polarity** field is only applicable if the "**Use VIP on Ctl Head**" field is unchecked.

⁶ For detailed instructions on VIP wiring, please refer to the MSU installation manuals available from Motorola.

⁷ Refer to programming guide provided by Motorola for detailed instructions.

- The **Input Polarity** field is only applicable if the "**Use VIP on Ctl Head**" field is unchecked.
 - If Input Polarity is set to Active High, leaving Pin 1 on the Auxiliary Cable disconnected is Active, and grounding Pin 1 is Inactive.
 - If Input Polarity is set to Active Low, grounding Pin 1 on the Auxiliary Cable is Active, and leaving Pin 1 disconnected is Inactive.

AVRA

Automatic VR Activation

AVRA Function Activate/Deactivate

AVRA, Primary/Secondary Preference input

Use VIP on Ctl Head

Input Polarity Active Low

Figure 10: AVRA Auxiliary Configuration

Monitoring Setup

Polling Data..

Transmitter Mode Tx-Enable

TX ON

PTT PTT OFF

Test Mode NO

Oper. State OFF

Repeater CAS Idle

RF Power OFF dBm

RSSI Idle

0.00 W

SqL. Idle

Ant. Sw. BL-REVERSE

RSSI -123.1 dBm

0.16 μ V

Mobile RUS idle

P25 Rx Modem Test

Mobile PTT ---

Test Mode NO

Temp 32 $^{\circ}$ C

BER 0.00 %

PA_t 30 $^{\circ}$ C

BERm 0.00 %

PL ---

SINAD --- dB

AVRA/Motion Input Inactive/Motion

Figure 11: Monitoring Setup Window

This field is useful for testing installation to ensure that the input has been connected, and configured to the correct polarity. The state of the input is updated as the DVR or VIP input signal changes.

Mounting Instructions



Cautionary Notes & Considerations



ACCESSIBILITY: 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-LX and MSU ports and access to the DVR-LX mounting screws.

CABLE RANGE: Ensure all DVRS components, including the remote mount MSU, are mounted within the interconnecting cables range.

CONTROL HEAD: Ensure control head is installed in front of the vehicle.

MSU AND ACCESSORIES: For detailed MSU and accessories installation instructions, please refer to the installation manuals available from Motorola.

Preparation

The flat mount DVR-LX is shipped with a mounting base attached by 4 screws. If a template is needed for installation, the mounting base may be removed and used for that purpose. (See **Figure 12: DVR-LX Mounting Screws--Stacked**)

When reattaching, ensure that the orientation of base to repeater is lined up by having the Futurecom logos at the same end.

Instructions

Step 1: Secure DVR-LX to mounting surface with 4 fasteners. (recommend 6mm or 1/4")

NOTES:

1. There are holes to accommodate up to 8 mounting points, with only 4 required (See **Figure 12: DVR-LX Mounting Screws--Stacked**)
2. See **APPENDIX E – DRILLING GUIDES**

4. Appendix E-1 DVR-LX Drilling Guide for details

Step 2: Repeat Step 1 for in-band filters (if applicable) and duplexer (for flat mount configuration).

Step 3: Connect all cables according to appropriate configuration.

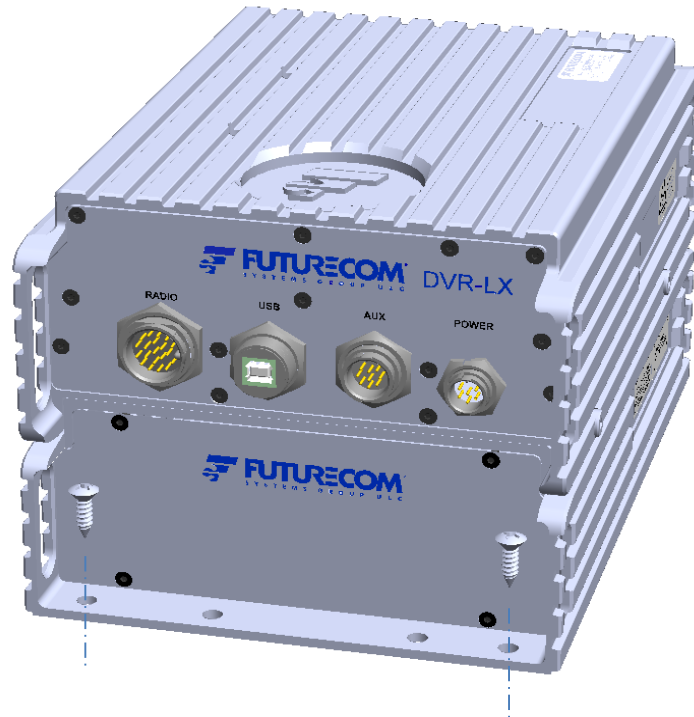
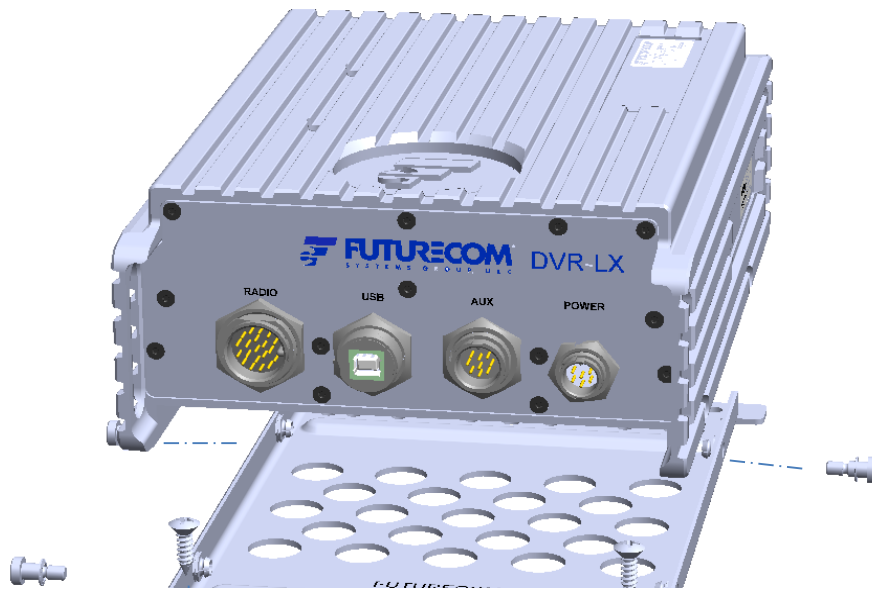


Figure 12: DVR-LX Mounting Screws--Stacked



Note: Mounting Base and Bracket must have Futurecom logo at the
Figure 13: DVR-LX Mounting Screws--Flat s

Cable Connections



Cautionary Notes & Considerations



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

GROUND POLARITY: The DVR 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 DVR but will cause the cable fuse to blow. Futurecom recommends installation of voltage surge protection to protect the car electronics to prevent spikes in the supply voltage. (fuse is 7A, 0.25"x1.25", fast-acting fuse)

VEHICLE USER MANUAL: Before installing any electrical equipment, check the vehicle manufacturer's User Manual.

Configuration Terms:

In-Band: DVR-LX operates in the same frequency band as a system frequency band.

Cross-Band: DVR-LX operates in a different frequency band than all of the system frequency bands.

Stacked: DVR-LX components are stacked one on top of the other which requires more height for installation.

Flat: DVR-LX components are provided individually allowing for a lower profile installation.

DVR-LX and Duplexer Connections

The DVR-LX typically sits on top of a duplexer, as shown in Figure 14.



Figure 14: Stacked DVR-LX with Duplexer

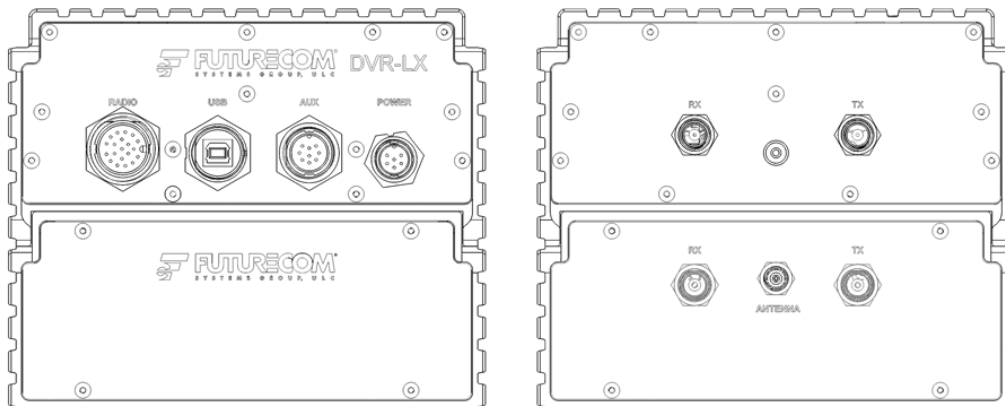


Figure 15: DVR-LX and Duplexer Connectors--Front and Back View

The front of the DVR-LX includes connections for:

- RADIO- for connection to the mobile radio
- USB- for programming cable
- AUX- for connecting optional external logic such as a Switch, Siren, AVRA or Status Lights
- POWER- for connecting to vehicle battery

The front of the duplexer has no connection options.

The back of the DVR-LX includes connections for:

- RX and TX- stacked configuration ships with cables connected to the RX and TX ports on the back of the duplexer.

NOTE: RX/TX cables shipped separately for flat mount configuration and must be connected as part of the installation.

The back of the duplexer provides the Antenna port for the DVR-LX antenna.

In-Band Notch Filter Connectors

For In-Band DVR-LX configurations, one or two notch filters are also required. Typically, the DVR-LX notch filter sits on top of the MSU notch filter, as shown in Figure 15 and each filter is connected between the DVR-LX/MSU and its antenna.



Figure 16: In-Band Notch Filters for UHF and VHF

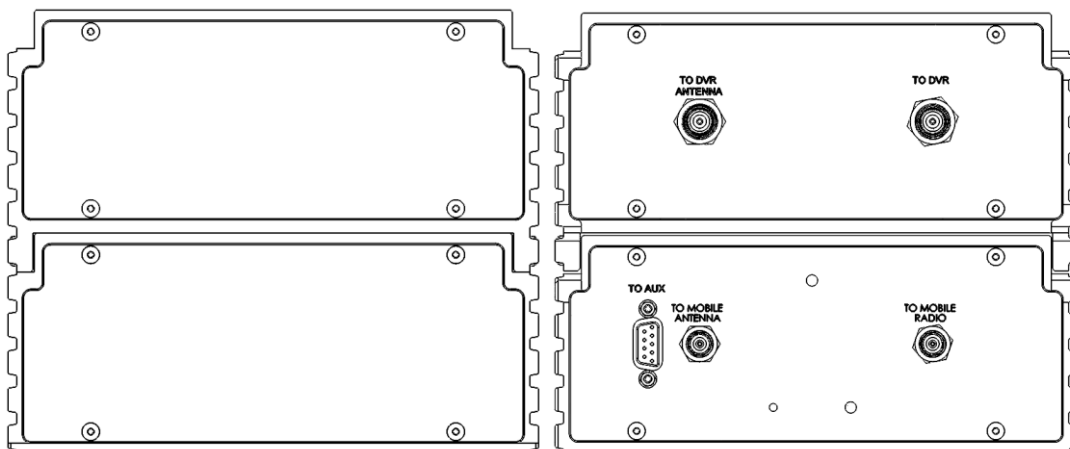


Figure 17: Notch Filter Connectors for UHF and VHF--Front and Back View



Figure 18: In-Band Notch Filter for 700/800 MHz

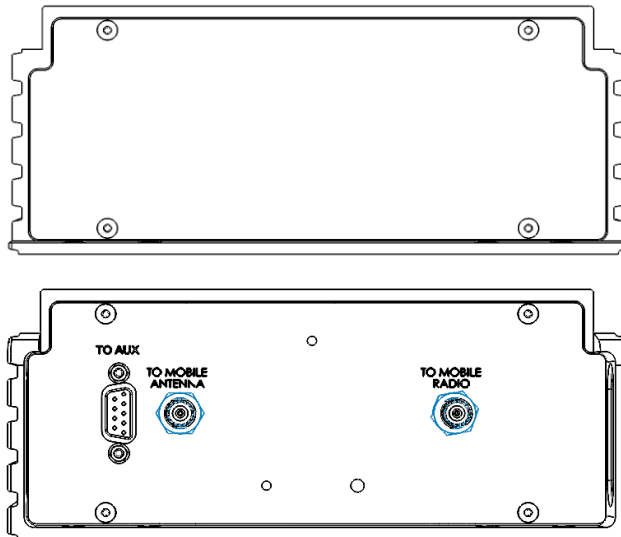


Figure 19: Notch Filter Connectors for 700/800 MHz - Front and Back View

The front of the DVR-LX and MSU notch filters have no connection options.

The back of the DVR-LX notch filter includes connections for:

- TO DVR ANTENNA- connection to DVR-LX antenna
- TO DVR- connection to the antenna port on the back of the duplexer

The back of the MSU notch filter includes connections for:

- TO AUX- when using RF By-Pass Relay, connection to DVR-LX AUX port
- TO MOBILE ANTENNA- connection to MSU antenna
- TO MOBILE RADIO- connection to MSU antenna port

Power Cable

The following steps detail how to run the power cable from the vehicle battery to the mounting location for the DVR-LX.

1. Determine power cable routing between the DVR-LX 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 DVR-LX 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. See detailed fuse holder installation steps below.
8. Connect the red lead lug to the battery positive (+) terminal.

HFB Fuse Holder Installation:

1. Lubricate ends of both wires with isopropyl alcohol or WD-40 and push one wire into each half of the fuse holder.
2. Strip 0.25" (6.3mm) of insulation from ends of both wires. Make sure that no more than 0.25" (6.3mm) of insulation is stripped.
3. Insert stripped wire into the contact clip and crimp it (2 places).
4. Recommended crimping tools:
 - a. Thomas & Betts – ERG4002
 - b. Channellock No. 909
 - c. Thomas & Betts WT-112M
5. Verify that bare wires do not extend past the crimping sleeve.
6. Seat contact clips into the fuse holder with a 0.25" (6.3mm) wood dowel.
7. Insert the fuse into one end of the fuse holder and fully close the fuse holder.
8. Loop the wires as shown in **Figure 20: HFB Fuse Holder Installation** and secure both wires together with a cable tie as shown.

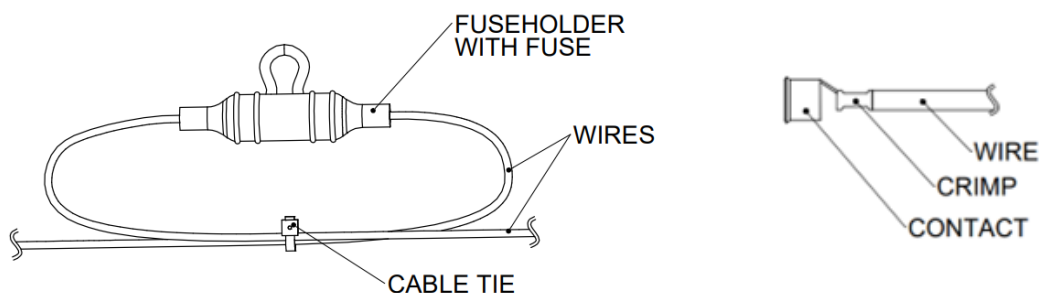


Figure 20: HFB Fuse Holder Installation

HHB Fuse Holder Installation:

1. Strip insulation from wire (approximately 10mm [3/8"]).
2. Insert wire into holder.
3. Crimp terminal through body. The recommended crimp pressure range is 160 MPa ~ 210 MPa, the preferred pressure is 180 MP. See **Figure 21: HHB Fuse Holder Installation**
4. Recommended Crimping Tools:
 - a. Thomas & Betts - ERG-2001
 - b. Channellock No. 909
 - c. General Electric – U.S. & Metric Electrical Terminal Tool
5. Repeat steps 1-3 for other half of the holder. See **Figure 21: HHB Fuse Holder Installation**
6. Insert fuse.
7. Snap housing together.
8. Loop the wires and secure both wires together with a cable tie as shown in **Figure 22: HHB Fuse Holder Assembly**.

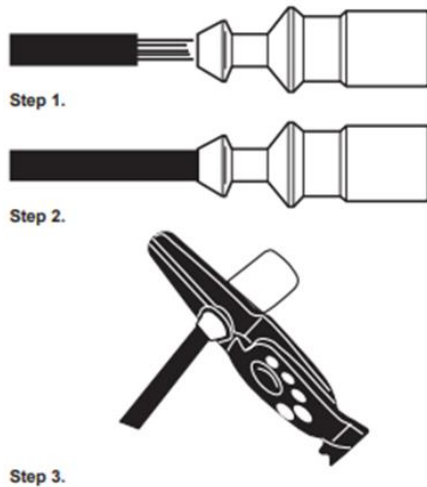


Figure 21: HHB Fuse Holder Installation

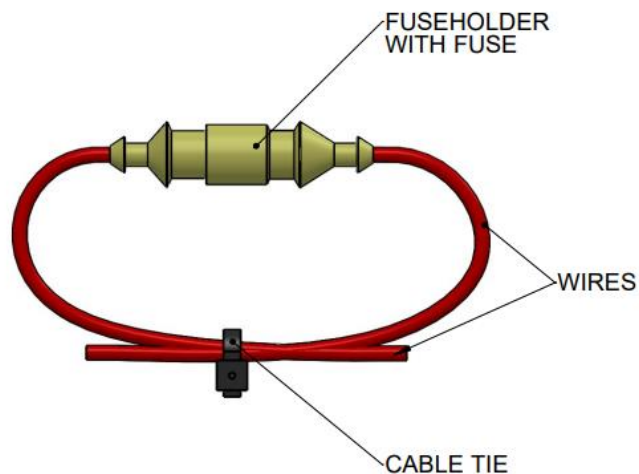


Figure 22: HHB Fuse Holder Assembly

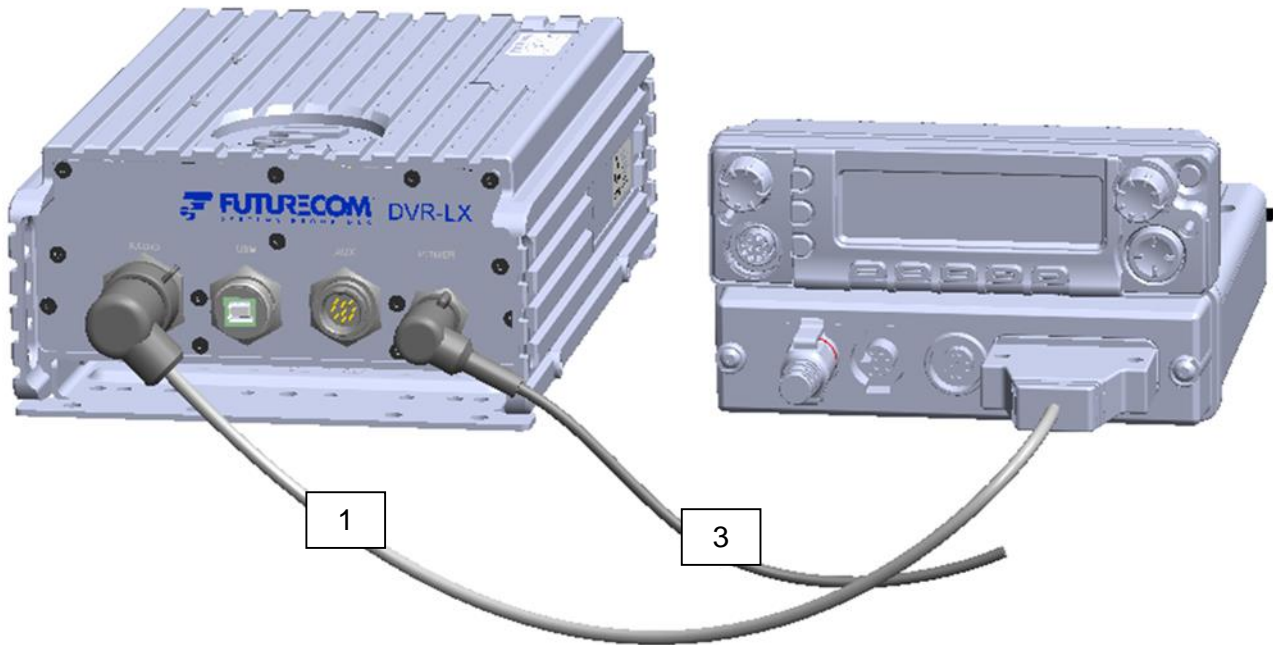


Figure 23: DVR-LX Cross-Band Simplex (Front)



Figure 24: DVR-LX Cross-Band Simplex (Back)

Configuration Identification

Using the table below, identify which configuration of DVR-LX is to be installed and refer to the appropriate configuration drawing for cabling instructions.

DVR-LX Band	In-band/Cross-band w System Freq	Stacked/Flat	Configuration #
Duplex			
700MHz	In-band	Stacked	1
		Flat	2
	Cross-band	Stacked	5
		Flat	6
800MHz	In-band	Stacked	1
		Flat	2
	Cross-band	Stacked	5
		Flat	6
VHF	In-band	Stacked	3
		Flat	4
	Cross-band	Stacked	5
		Flat	6
UHF	In-band	Stacked	3
		Flat	4
	Cross-band	Stacked	5
		Flat	6
Simplex			
VHF	In-band	Stacked	7
		Flat	8
	Cross-band	Flat	9
UHF	Cross-band	Flat	9

Standard Installation Cables

The following table outlines all of the cables that are needed for installation. It identifies the cable part number, length, connector types, and a description of what the cable connects together. All cables are provided at time of order except the auxiliary cable with cross-band configurations. The ordering code is provided for this optional cable, if needed. There is also a reference number for each cable that is used throughout the configuration drawings.

Ref #	PN	Length	Connectors	Description
1	7W083X05-01	3ft	20-Pin to DB25 Male	DVR-LX to MSU Control Cable NOTE: Custom lengths available – up to 25ft.
2	7W083X06-01	2.5ft	9-Pin to DB15 Female	DVR-LX Auxiliary Cable NOTE: Optional for Cross-Band, Ordering Code VKN0029A
3	1W083A01-01	18ft		DVR-LX Power Cable
4a	7W083X17-01	3ft	RA Mini UHF Male to RA Mini UHF Male	MSU to In-Band Filtering RF Cable NOTE: For In-Band with non APX 8500
4b	7W900X94-02	3ft	RA QMA to RA Mini UHF	MSU to In-Band Filtering RF Cable NOTE: For In-Band with APX 8500
5	7W900X04-02	2.5ft	RA TNC Male to RA TNC Male	DVR-LX to Duplexer RX/TX Cables NOTE: For Flat Mount Duplex, 2 cables provided
6	7W083X16-01	3ft	RA Mini UHF Male to RA Mini UHF Male	DVR-LX Ant to In-Band Filtering RF Cable NOTE: For VHF/UHF In-Band
7	7W083X09-01	1ft	15-Pin Male to 9-Pin Female	RF Switch Cable NOTE: For In-Band
8	Control Head cable provided by Motorola			

Installation Drawings

Configuration 1: Duplex (700 or 800MHz) In-band Stacked

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

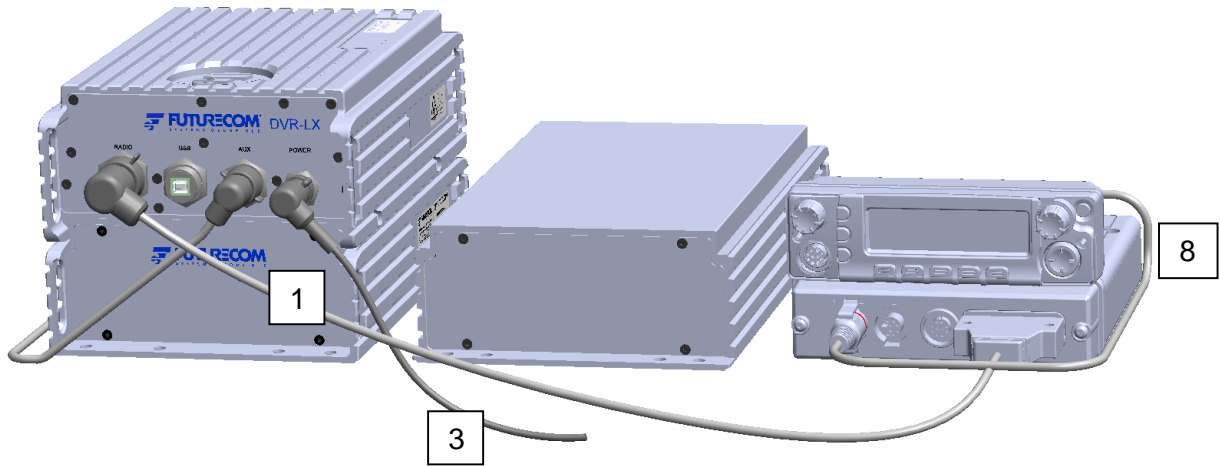


Figure 25: Configuration 1--Front View

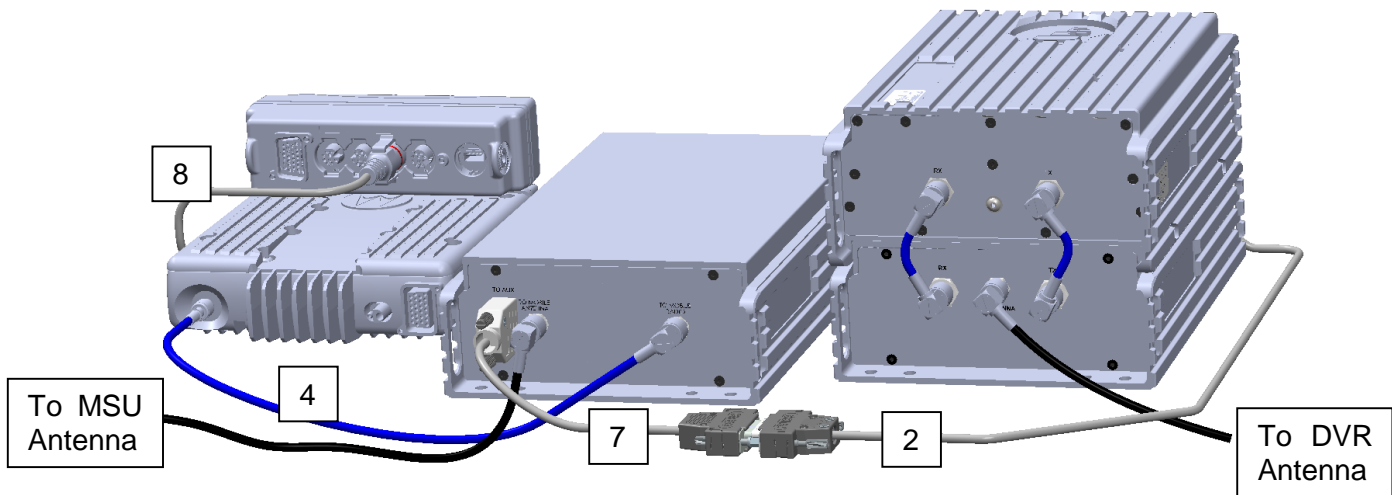


Figure 26: Configuration 1--Back View

In-Band RF Switch Cabling

To use the RF Switch for In-Band DVR-LX units, connect the cables as shown in Figures 17 and 18. To enable the RF Switch operation, refer to the programming instructions for the [Bypass Switch](#).

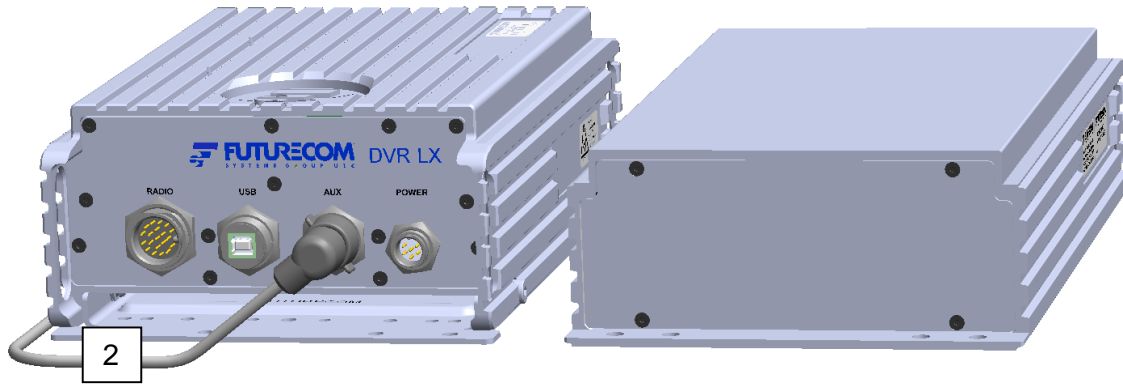


Figure 27: DVR-LX AUX--Front View

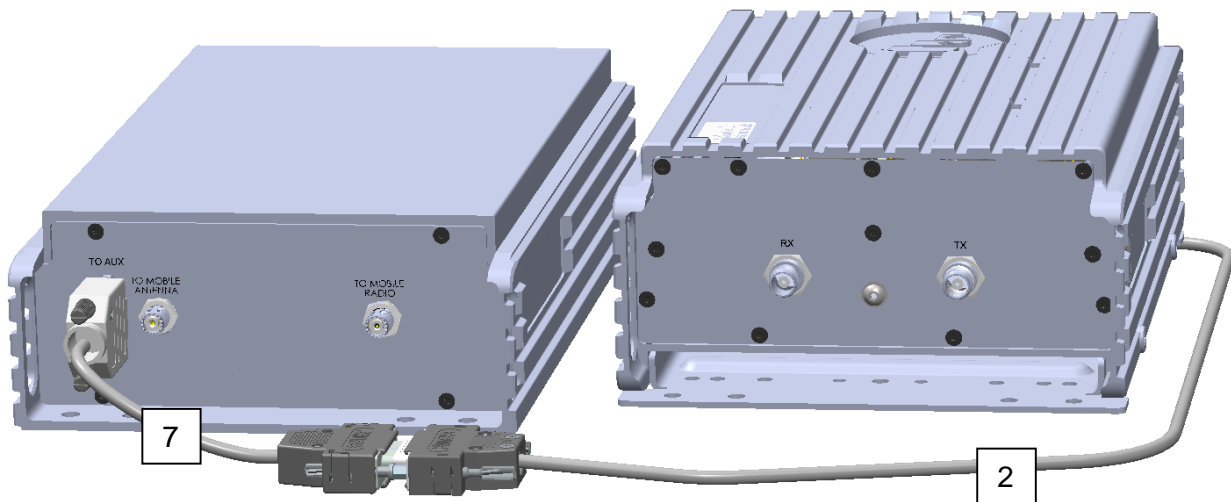


Figure 28: DVR-LX AUX--Back View

Configuration 2: Duplex (700 or 800MHz) In-band Flat

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

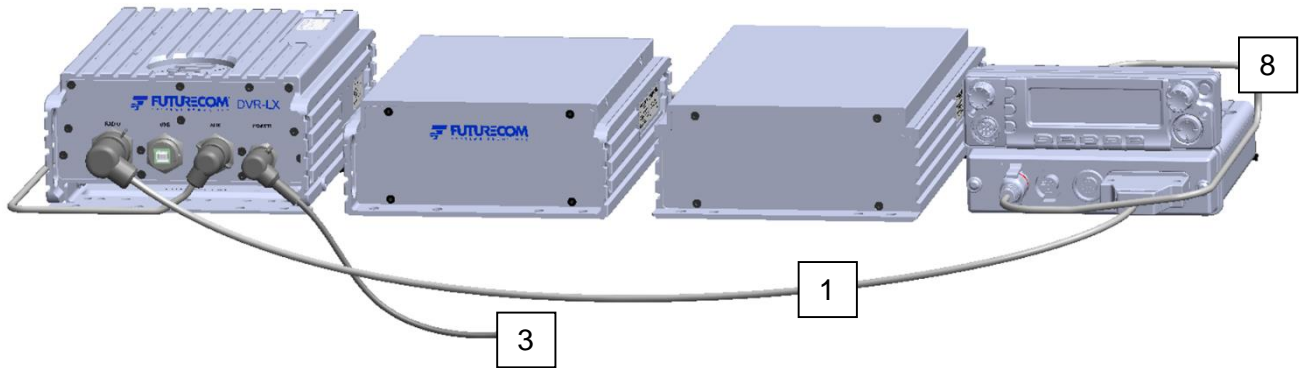


Figure 29: Configuration 2--Front View

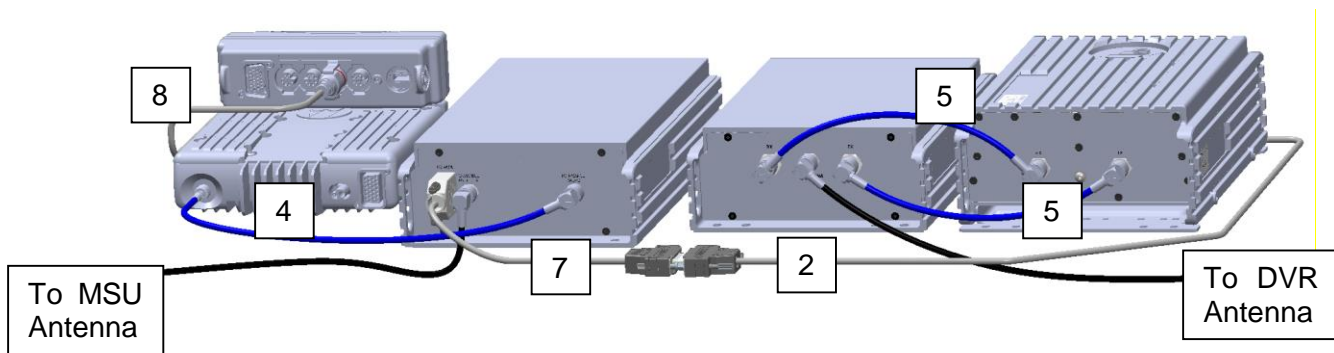


Figure 30: Configuration 2--Back View

Configuration 3: Duplex (VHF or UHF) In-band Stacked

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

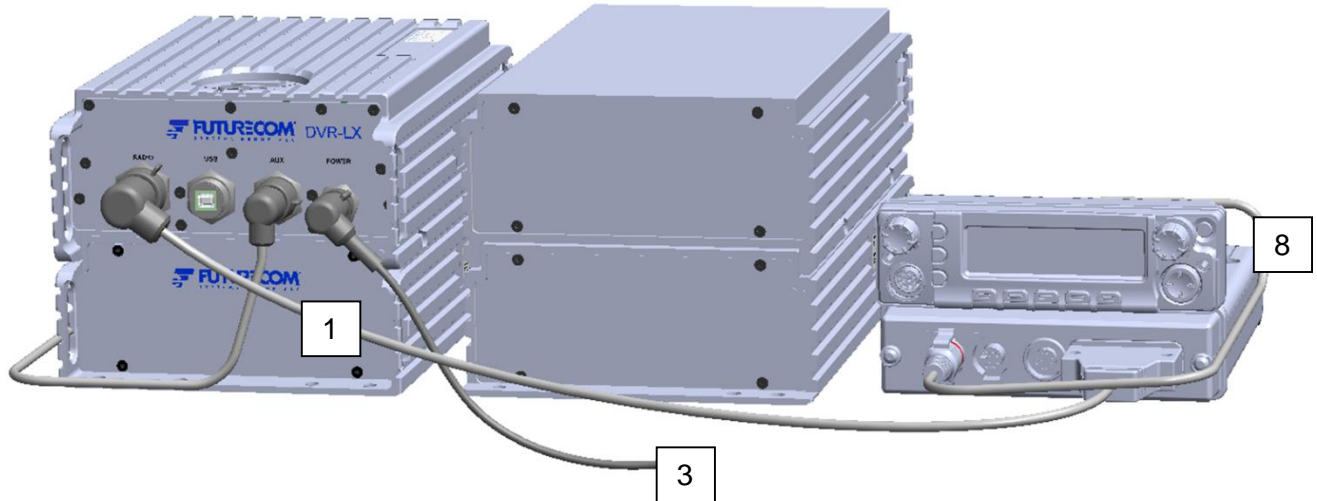


Figure 31: Configuration 3--Front View

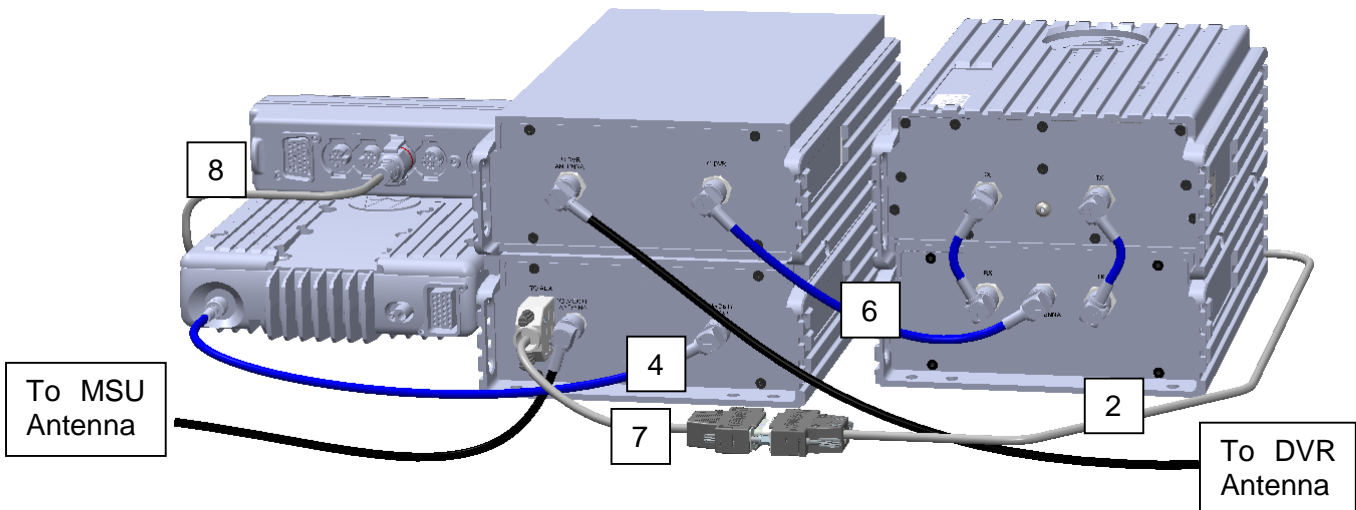


Figure 32: Configuration 3--Back View

Configuration 4: Duplex (VHF or UHF) In-band Flat

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

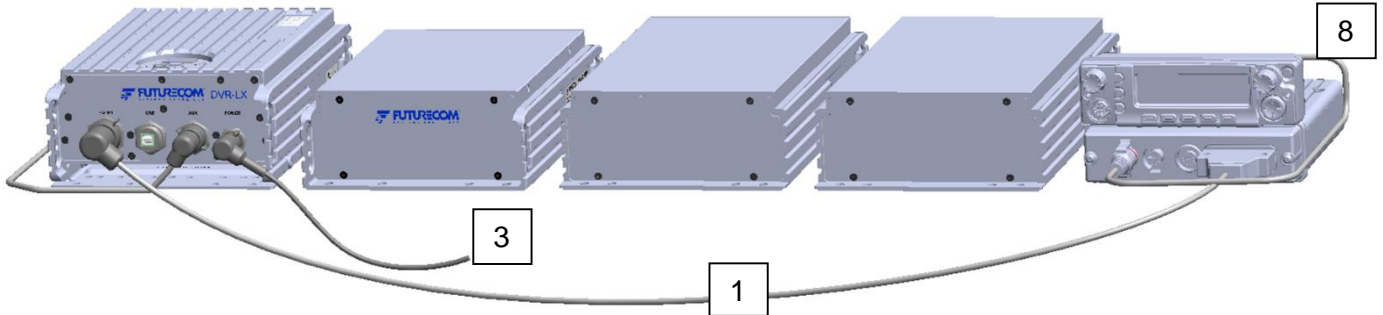


Figure 33: Configuration 4--Front View

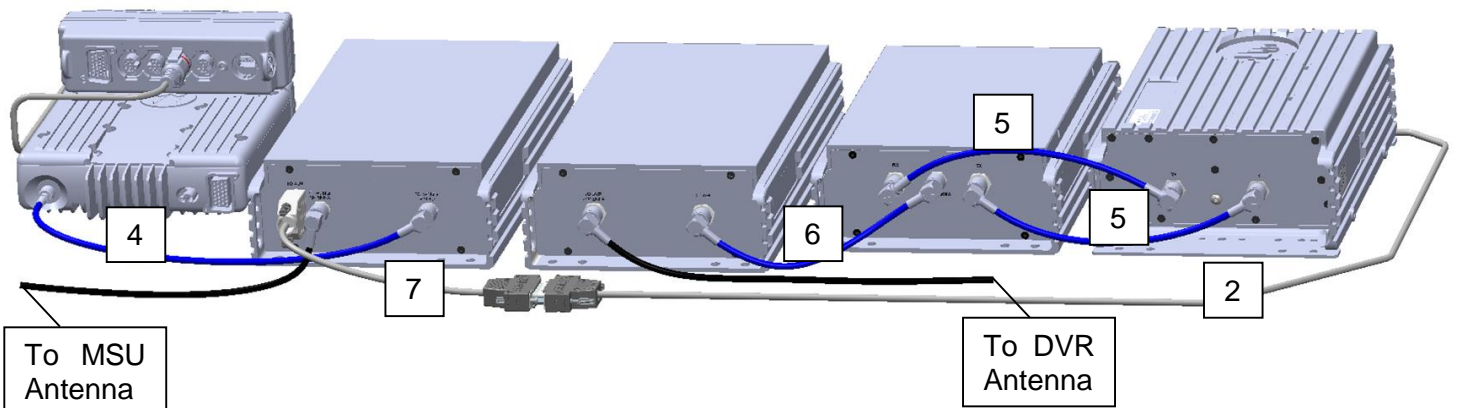


Figure 34: Configuration 4--Back View

Configuration 5: Duplex Cross-band Stacked

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

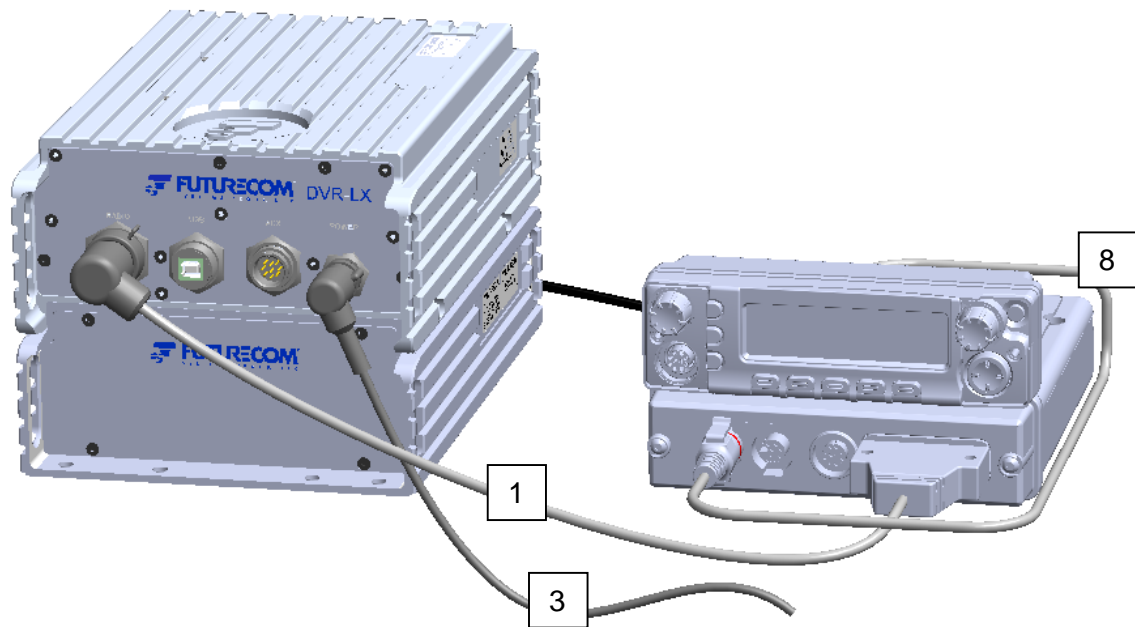


Figure 35: Configuration 5--Front View

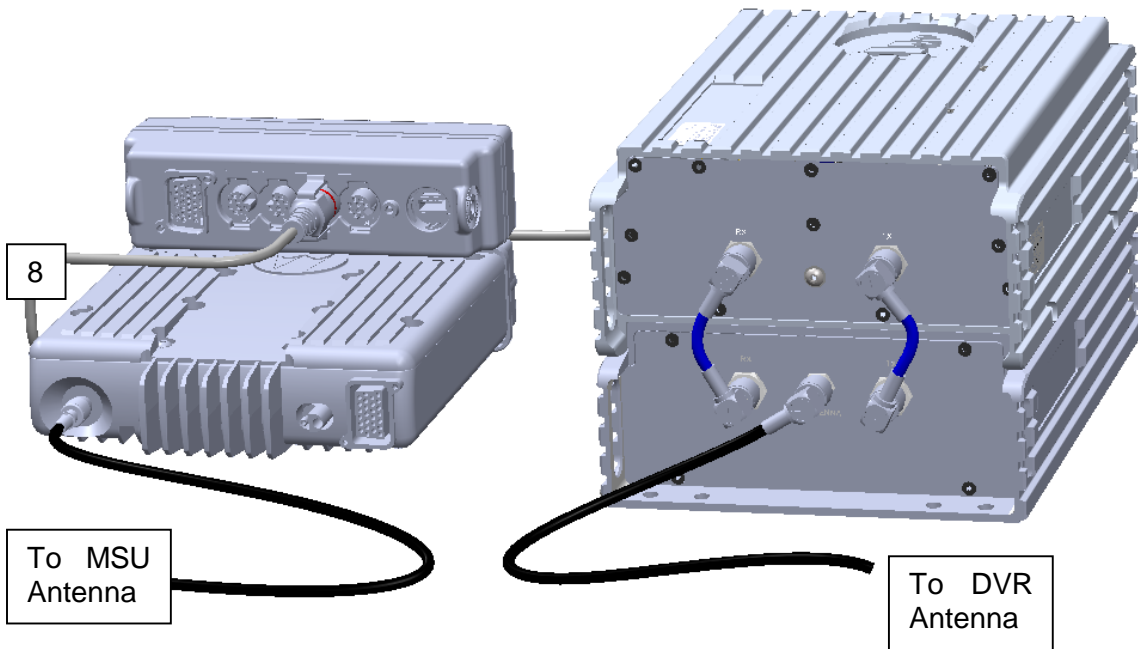


Figure 36: Configuration 5--Back View

Configuration 6: Duplex Cross-band Flat

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

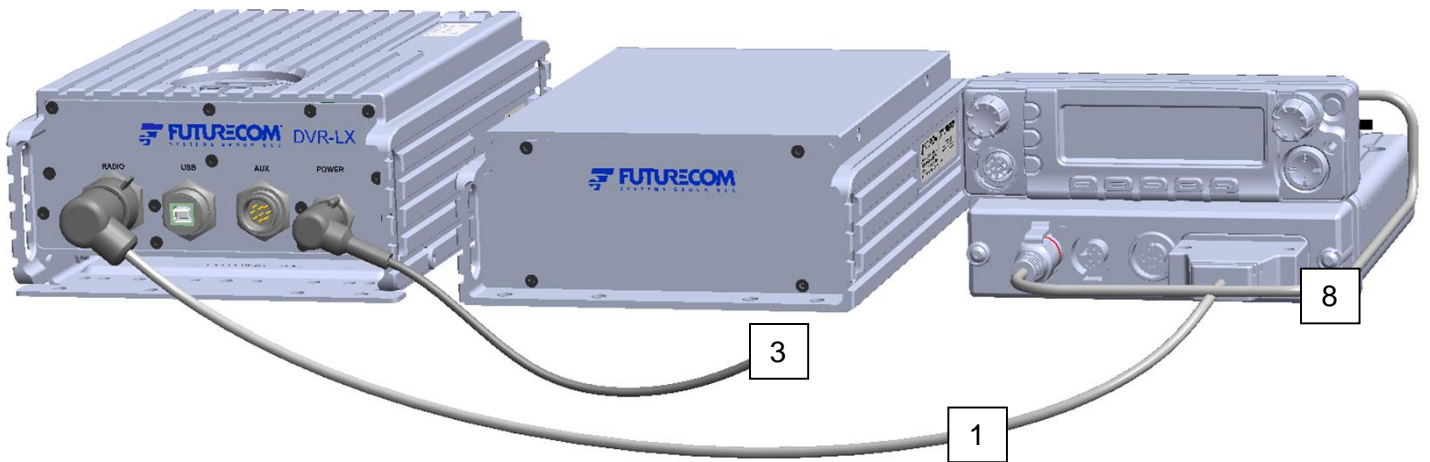


Figure 37: Configuration 6--Front View

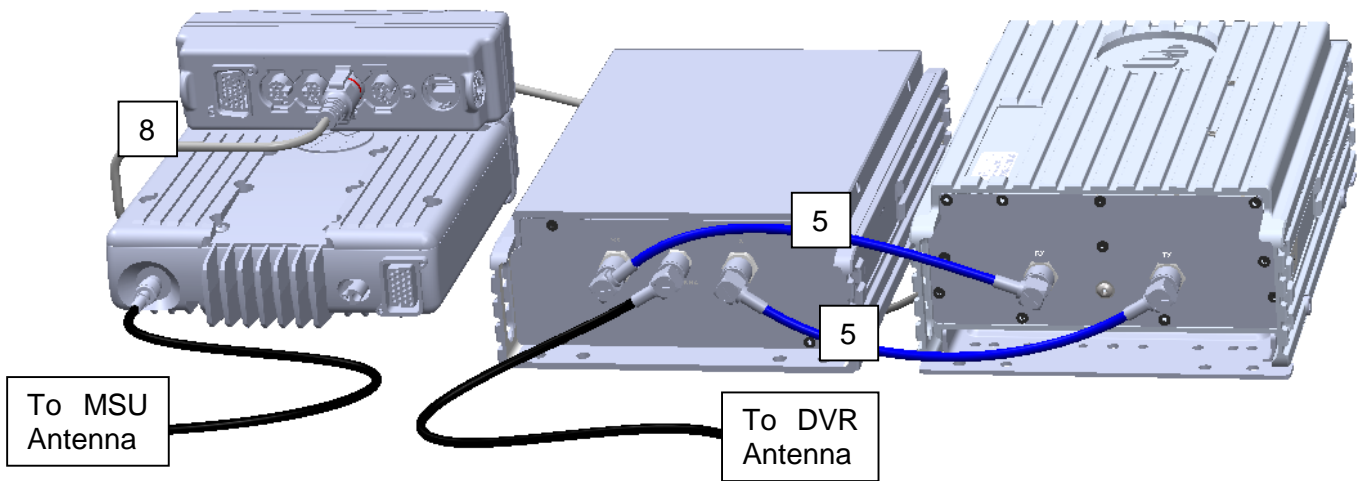


Figure 38: Configuration 6--Back View

Configuration 7: Simplex (VHF) In-band Stacked

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

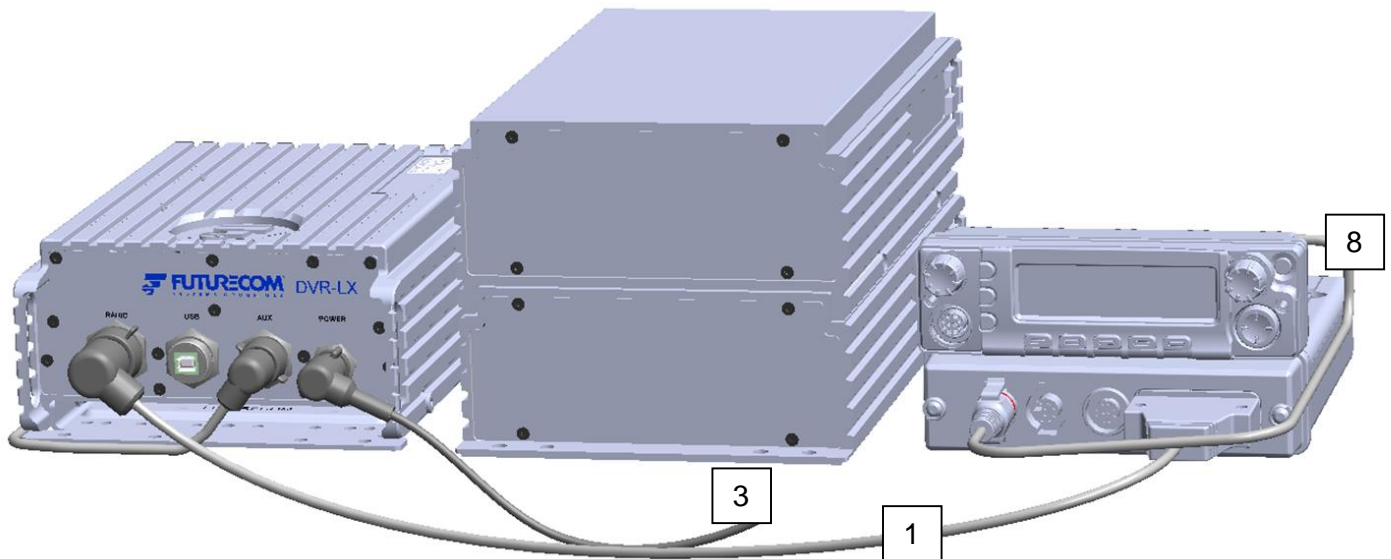


Figure 39: Configuration 7--Front View

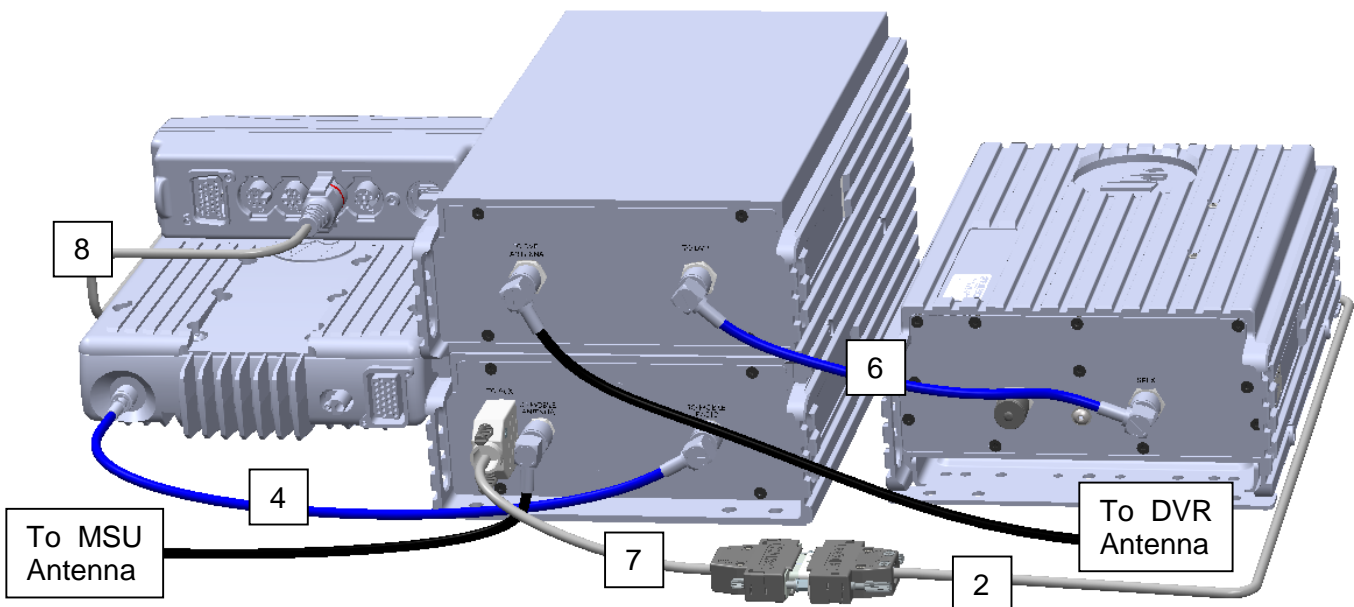


Figure 40: Configuration 7--Back View

Configuration 8: Simplex (VHF) In-band Flat

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

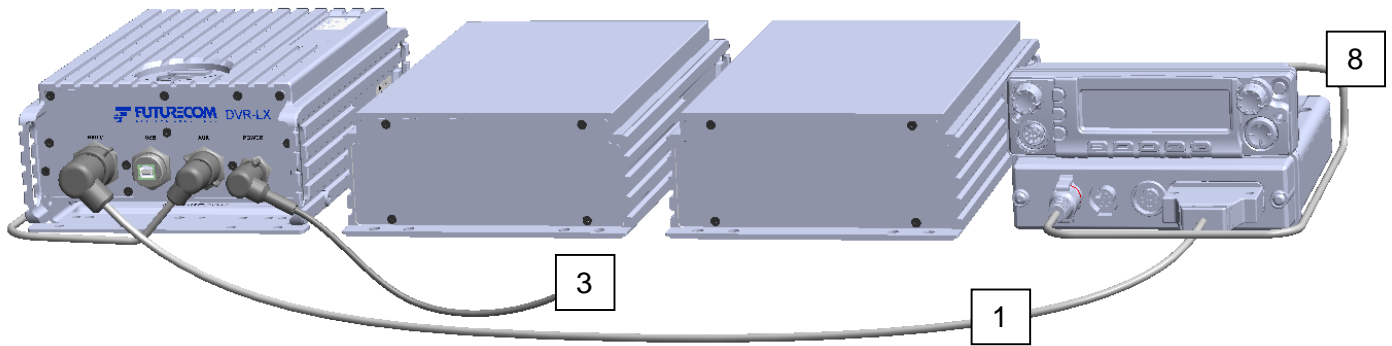


Figure 41: Configuration 8--Front View

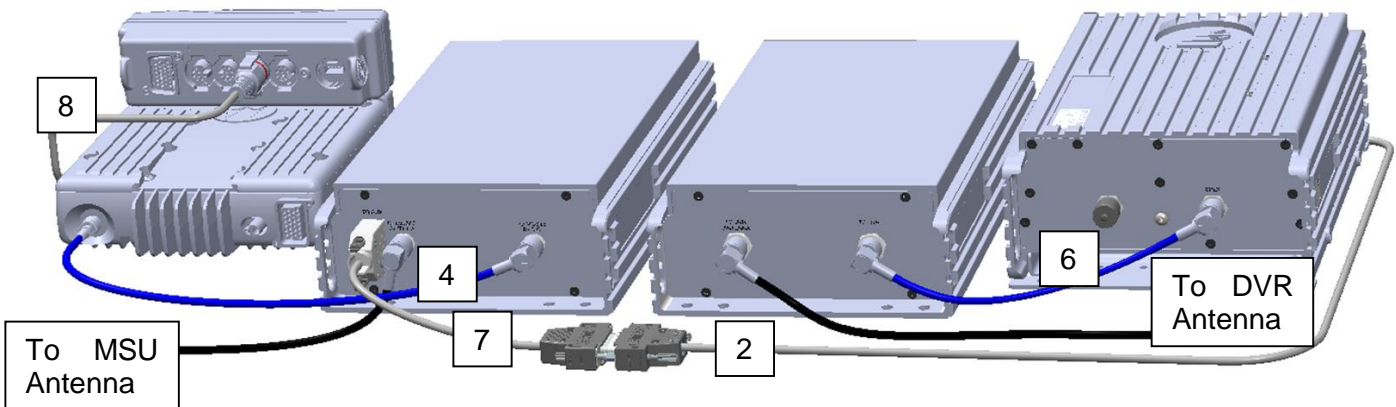


Figure 42: Configuration 8--Back View

Configuration 9: Simplex (VHF or UHF) Cross-band Flat

Refer to [Standard Installation Cables](#) section for mapping of cable diagram numbers to part numbers

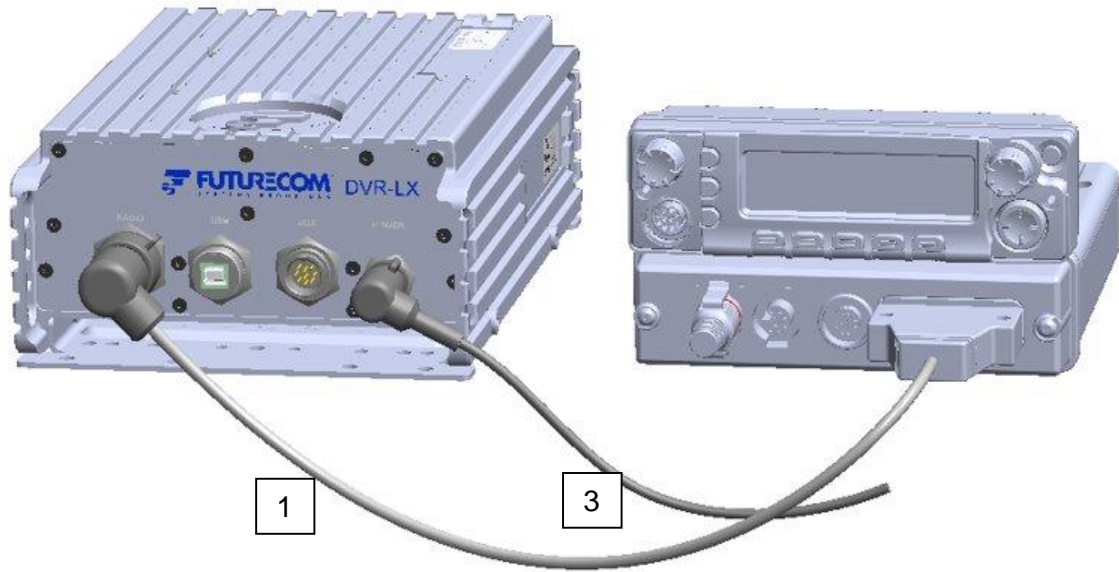


Figure 43: Simplex (VHF or UHF) Cross-Band Flat--Front View

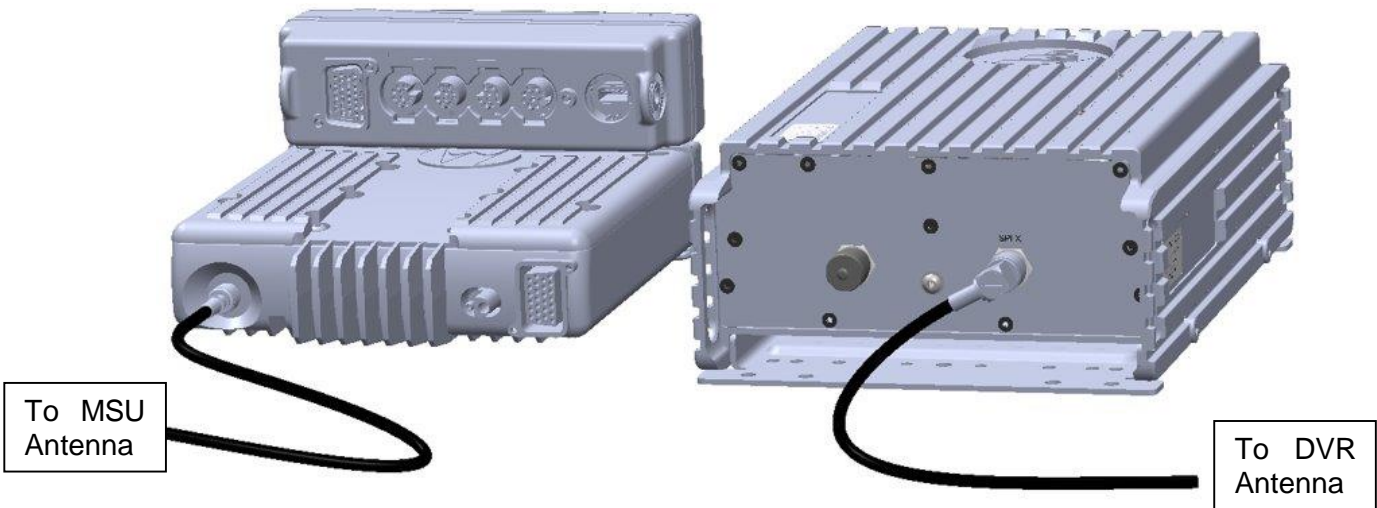


Figure 44: Simplex (VHF or UHF) Cross-Band Flat--Back View

Auxiliary Port Options

The DVR-LX auxiliary port provides three relay driver output ports and two switch contact input ports, which can be interfaced to external logic. The external logic can be easily interfaced by connecting to the correct pins on the DB15 connector of the auxiliary cable (Ref# 2, Part Number 7W083X06-01). The cable pinout details are captured in [APPENDIX A](#).

In-Band Auxiliary Cabling

For all In-Band configurations, the DVR-LX auxiliary port is required to control the RF Switch. Installation instructions are provided in the configuration diagrams. Refer to the programming instructions for the Bypass Switch.

To connect additional external logic to the DVR-LX, the DB15 male connector of the RF switch cable (Ref# 7, Part Number 7W083X09-01) can be opened and extra wires added to the corresponding pins as described in [APPENDIX A](#).

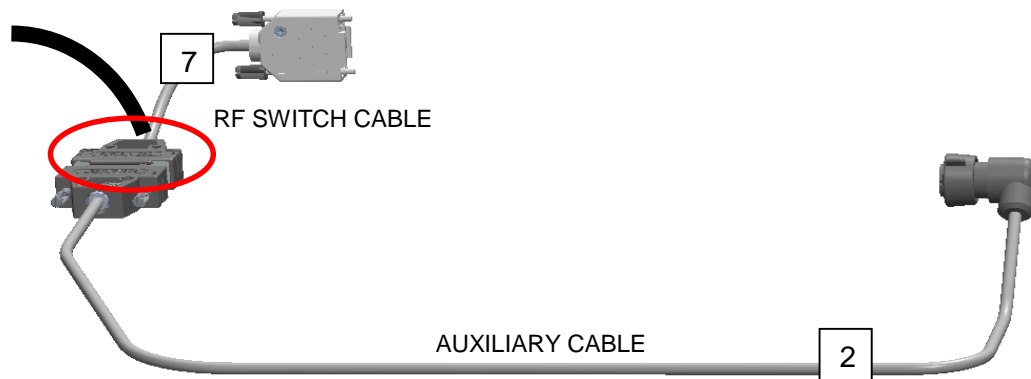


Figure 45: Customizing RF Switch Cable

Cross-Band Auxiliary Cabling

For all Cross-Band configurations, the DVR-LX auxiliary port is available for use. To connect a required external logic option cable (provided 3rd party availability), terminate the cable with a DB15 male connector with the required pin out and connect it to the DB15 female connector of the Auxiliary cable. Refer to [APPENDIX A](#) for pinout details. Possible applications for the auxiliary port include Status Lights and AVRA.



Figure 46: Auxiliary Cable Alternate Connections

Status Lights

The relay outputs in the DVR-LX can be programmed to provide several status indications – ‘Primary Light’, ‘VR On Light’, ‘LOC Mode Light’, or ‘SYS Mode Light’. The DVR-LX 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-LX.

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-LX auxiliary cable (500mA Max).

Refer to the programming instructions for **Status Lights** to enable this functionality.

External Alarm

For the Rackmount application, the external alarms option can be enabled and the corresponding relay output wired up to an external logic system for monitoring power and temperature levels.

Refer to the Programming instructions for External Alarm.

Antenna Installation



Cautionary Notes & Considerations



ANTENNA ISOLATION (IN-BAND): All DVRS models require 30dB minimum antenna isolation between the DVR-LX and MSU 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-LX antenna is mounted on the trunk.

ANTENNA PORTS: Duplex DVR-LX antenna ports are 50 Ohm mini UHF female and require antenna with matching 50 Ohm mini UHF male terminations.

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

RF ENERGY SAFETY: To ensure optimum performance and compliance with RF energy safety standards, antenna installation guidelines are limited to metal-body vehicles with appropriate ground planes and consider the potential exposure of back seat passengers and bystanders outside the vehicle.

Preparation

Any DVRS model requires the use of two or three antennas – one or two connected to the MSU and one connected to the DVR-LX. For a list of approved DVR-LX antennas, please refer to APPENDIX D - DVR-LX ANTENNAS.

The MSU and DVR-LX antennas must be installed in such way as not to cause interference. If an APX 8500 installation kit is required to achieve this, please refer to separate installation instructions provided by Futurecom (8J087X51).

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 DVRS RF Safety Booklet⁸ 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.

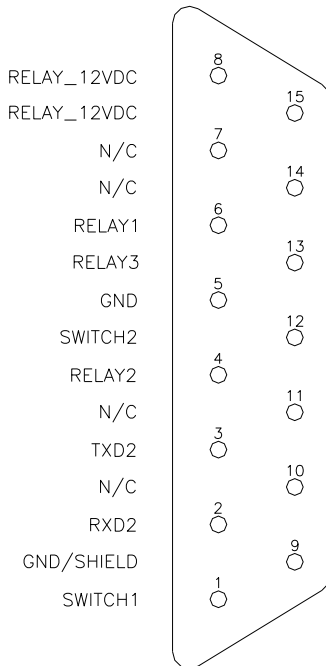
To ensure compliance with RF energy safety standards, the antenna locations, gain and maximum transmit power (for both the MSU and the DVR-LX) must be as specified in the DVRS RF Safety Booklet⁹.

⁸ Refer to RF Safety Booklet located on the Futurecom Website

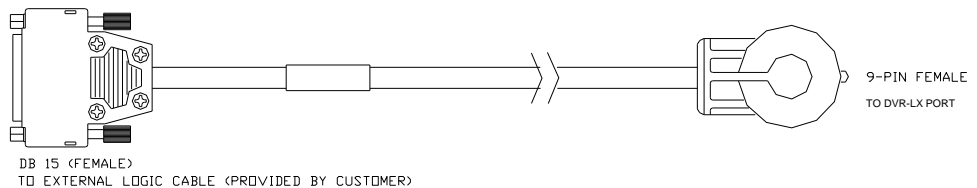
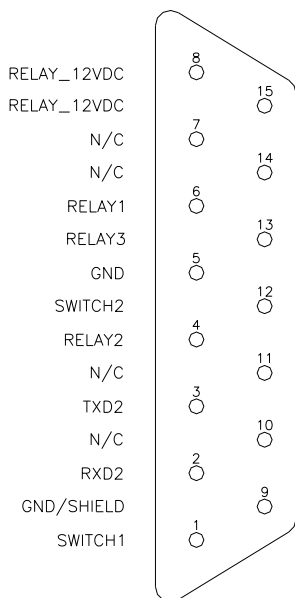
⁹ Refer to RF Safety Booklet located on the Futurecom Website

APPENDIX A - AUXILIARY CABLE

DVR-LX Auxiliary Cable (7W083X06-01)



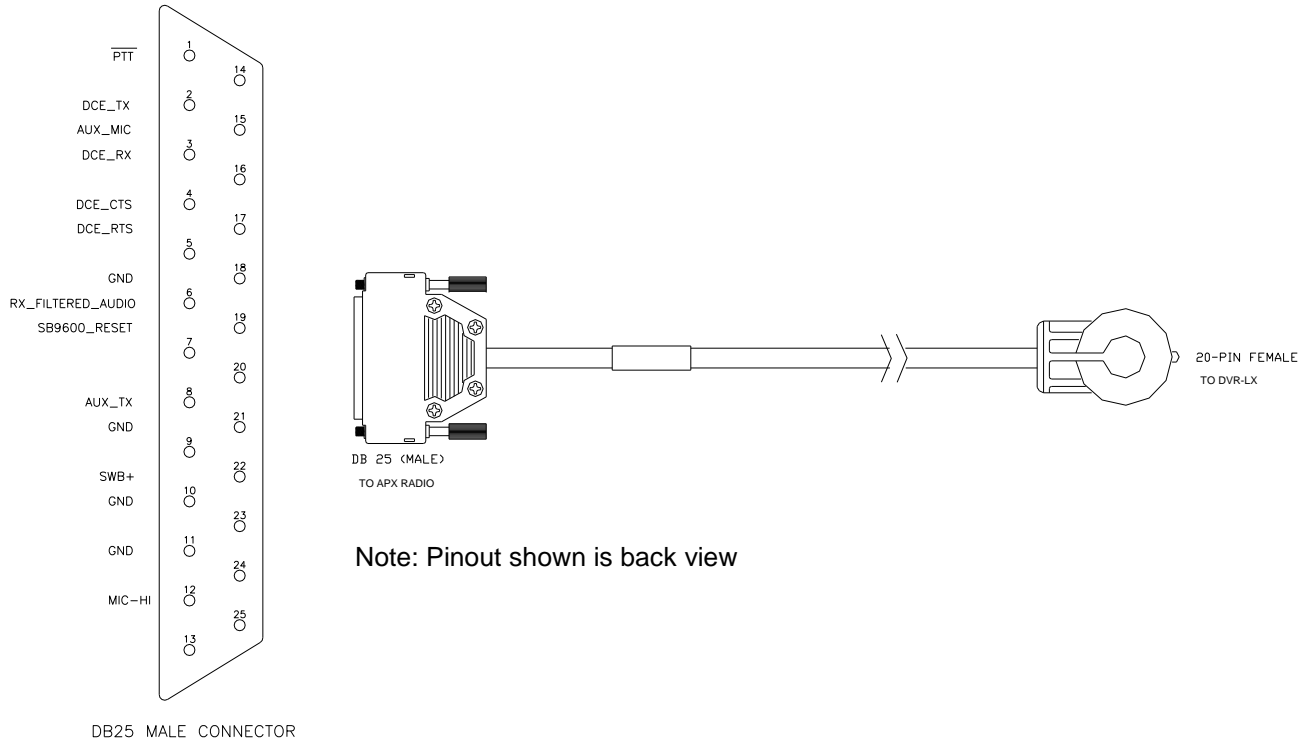
Pin #	Designation	Note
1	SWITCH 1	Alternative AVRA Input, operating as programmed in the Futurecom Repeater Configurator's Hardware Setup Screen
2	RXD2	RS232 Input
3	TXD2	RS232 Output
4	RELAY 2	Primary Light Output / as programmed
5	GND	Ground
6	RELAY 1	RF Switch Output / as programmed
7	NOT USED	-
8	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.



Note: Pinout shown is back view

APPENDIX B - CONTROL CABLE

DVR-LX to MSU Control Cable (7W083X05-01)



APPENDIX C- CABLES BY TYPE

RF Cables

Part Number	Order Code	Description	Length	Connectors	DVR-LX Models
7W083X17-01	VKN0026A	MSU to In-band Filtering Cable	36" (91.44cm)	RA Mini UHF Male to RA Mini UHF Male	All In-Band Models with non-APX 8500
7W900X94-02	VKN0040A	MSU to In-band Filtering Cable	36" (91.44cm)	RA QMA to RA Mini UHF	All In-Band Models with APX 8500
7W083X16-01	VKN0027A	DVR-LX Ant to In-band Filtering Cable	36" (91.44cm)	RA Mini UHF Male to RA Mini UHF Male	VHF & UHF In-Band Models

Control and Power Cables

Part Number	Order Code	Description	Length	Connectors	DVR-LX Models
1W083B13-01 7W083X05-XX	3ft: VKN0038A 5ft: VKN0036A 10ft: VKN0035A 15ft: VKN0034A 20ft: VKN0033A 25ft: VKN0037A	DVR-LX to MSU Cable	36" (91.44cm) Custom up to 300" (762cm) available	Over-molded 20-Pin Female to DB25 Male	Standard with all models
1W083A01-01	VKN0031A	DVR-LX Power Cable	216" (548.64cm)	Over-molded 6 -Pin female to flying leads	All models

Option Cables

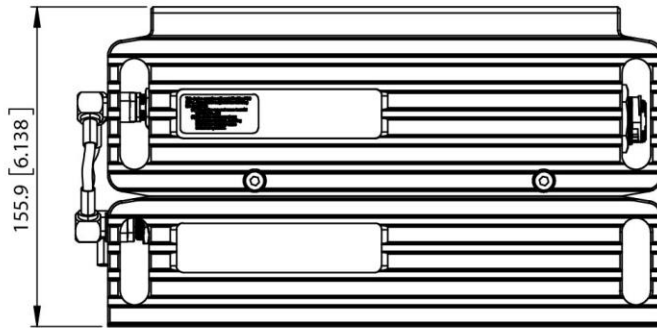
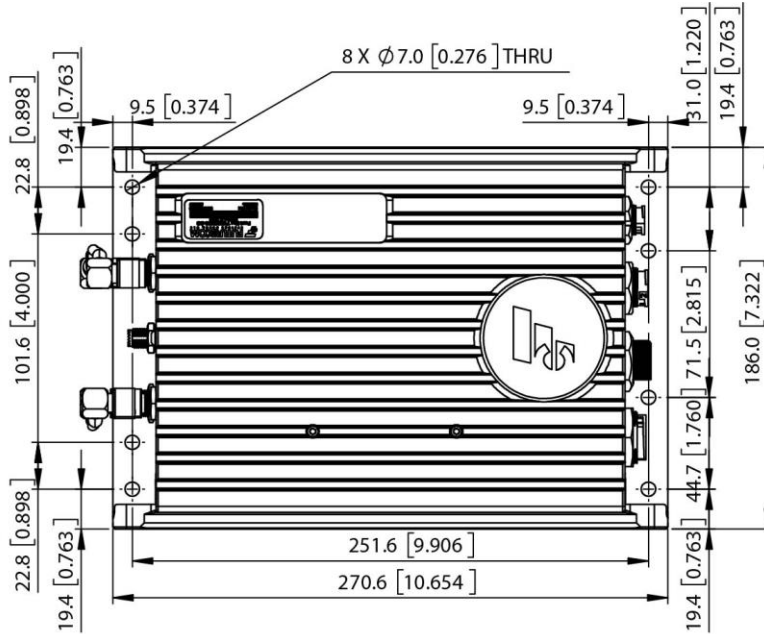
Part Number	Order Code	Description	Length	Connectors	DVR-LX Models
7W083X06-01	VKN0029A	DVR-LX Auxiliary Cable	30" (76.2cm)	9-Pin Female to DB15 Female	Standard with all in-band models, Optional for cross-band
7W083X09-01	VKN0028A	DVR-LX RF Switch Cable	12" (30.5cm)	15-Pin Male to 9-Pin Female	All in-band models
USBAB99	VKN0039A	DVR-LX Programming / Re-flashing Cable	10' (304.8cm)	USB 2.0B to USB 2.0A	Ordered separately

APPENDIX D - DVR-LX ANTENNAS

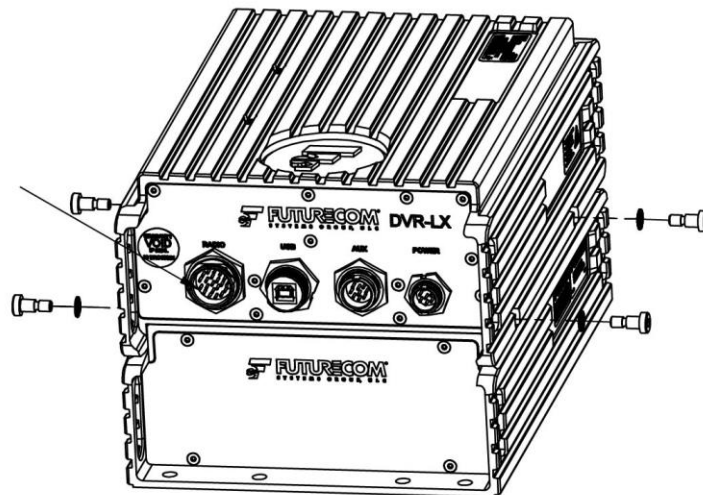
Order Code	Freq. Band [MHz]	Type	Gain dBd
HAD4006A	136-144	Roof / Trunk Mount	0 (Unity)
HAD4007A	144-150.8	Roof / Trunk Mount	0 (Unity)
HAD4008A	150.8-162	Roof / Trunk Mount	0 (Unity)
HAD4009A	162-174	Roof / Trunk Mount	0 (Unity)
HAE6012A	380-433	Roof / Trunk Mount	0 (Unity)
HAE4003A	450-470	Roof / Trunk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

APPENDIX E – DRILLING GUIDES

Appendix E-1 DVR-LX Drilling Guide



ACCOUNT FOR
SCREWS ACCESS
ROOM

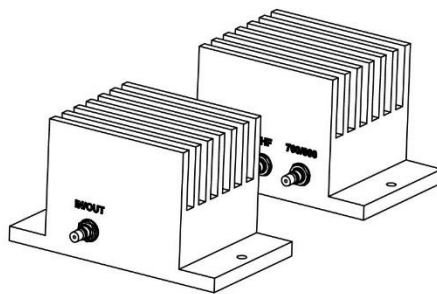
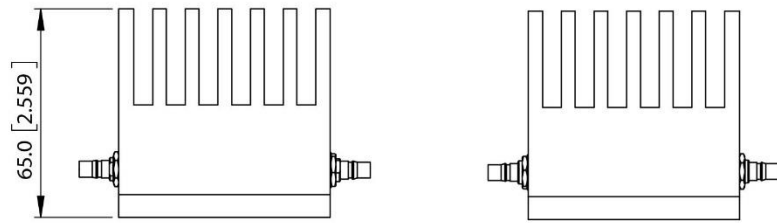
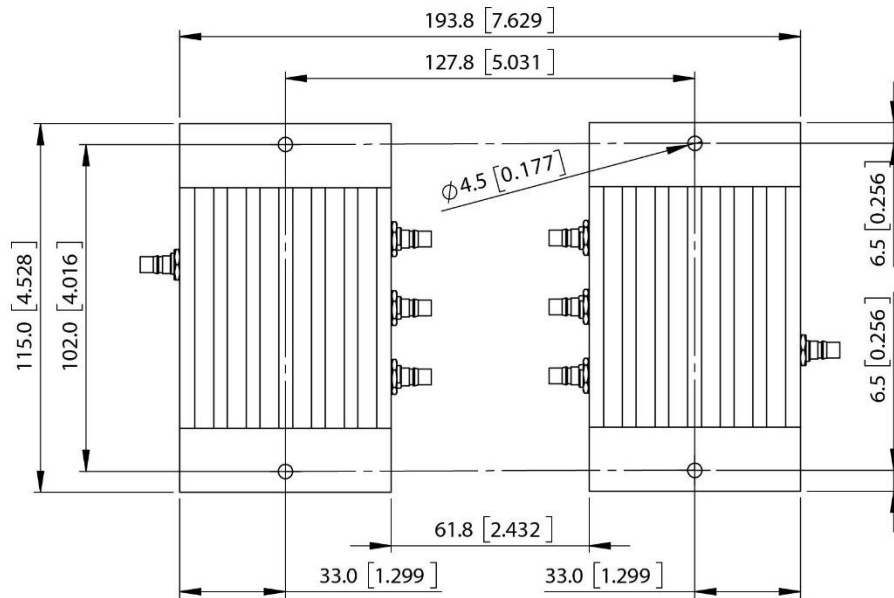


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES].

8H093B63_R01 (DVR-LX Drilling Template)

Appendix E-2 Dual Triplexer Drilling Guide

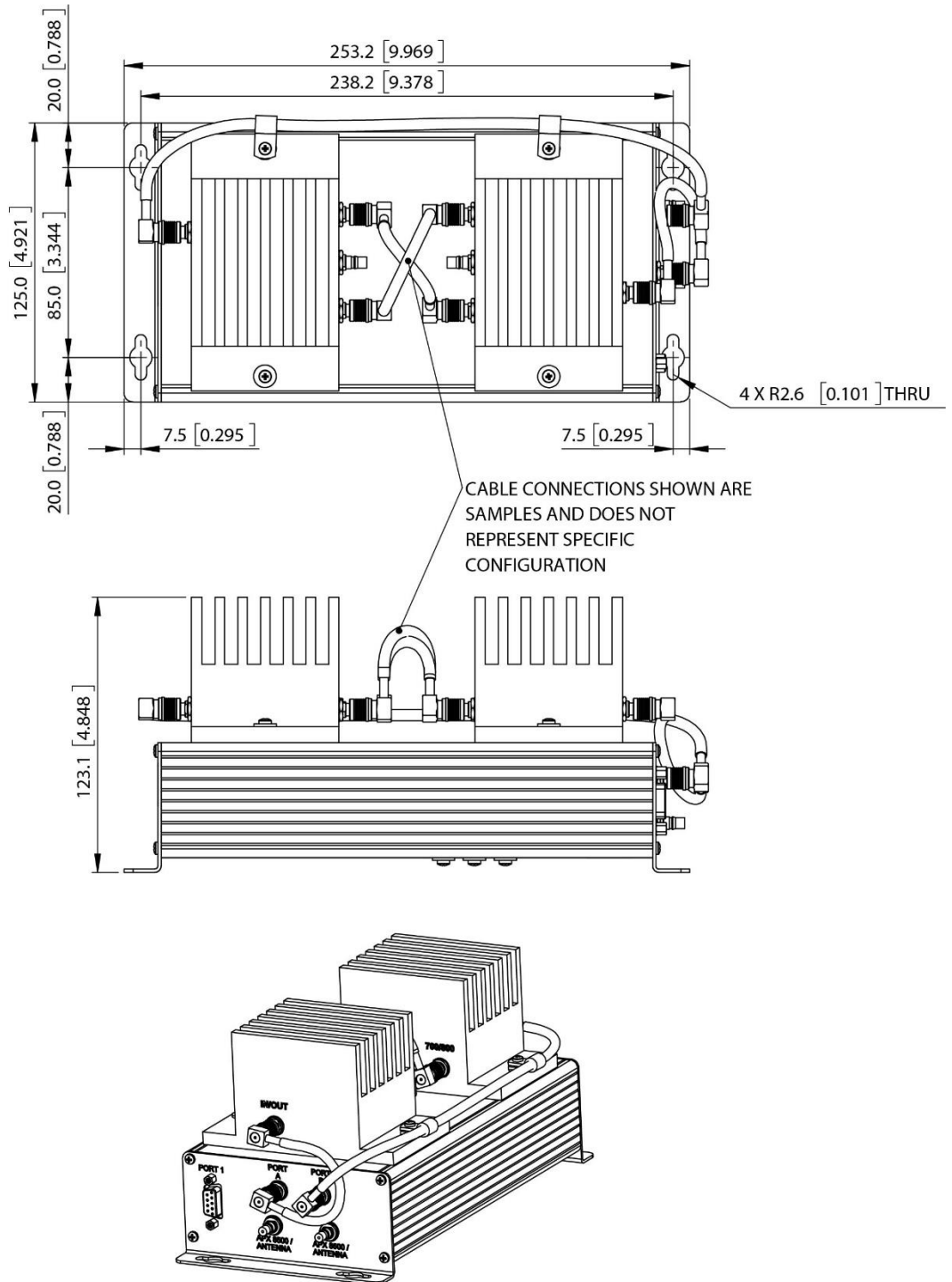


NOTES:

1. ALL DIMENSIONS ARE IN mm [INCHES]
2. CABLE INTERCONNECTIONS REMOVED FOR CLARITY.

8H093865_R00 (Dual Triplexer Drilling Template)

Appendix E-3 Dual Triplexer and RF Relay Drilling Guide

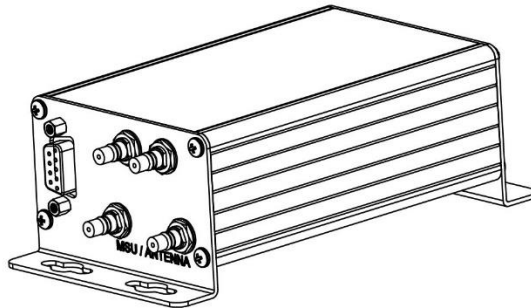
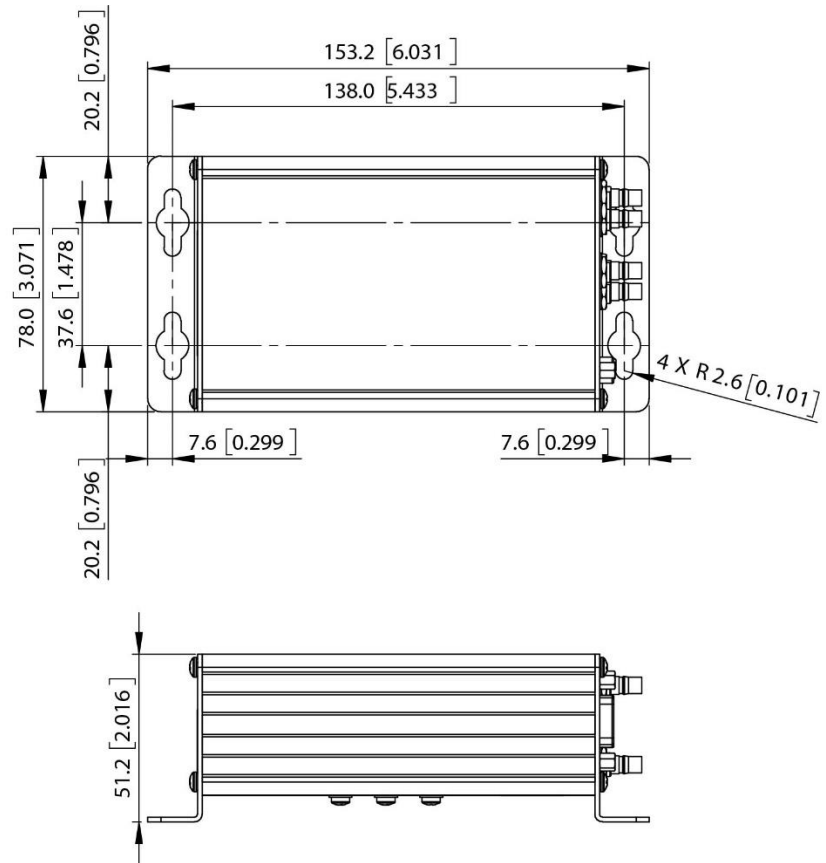


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES]

8H093866_R00 (Dual Triplexer and RF Relay Assembly Drilling Template)

Appendix E-4 RF Relay Box Drilling Guide

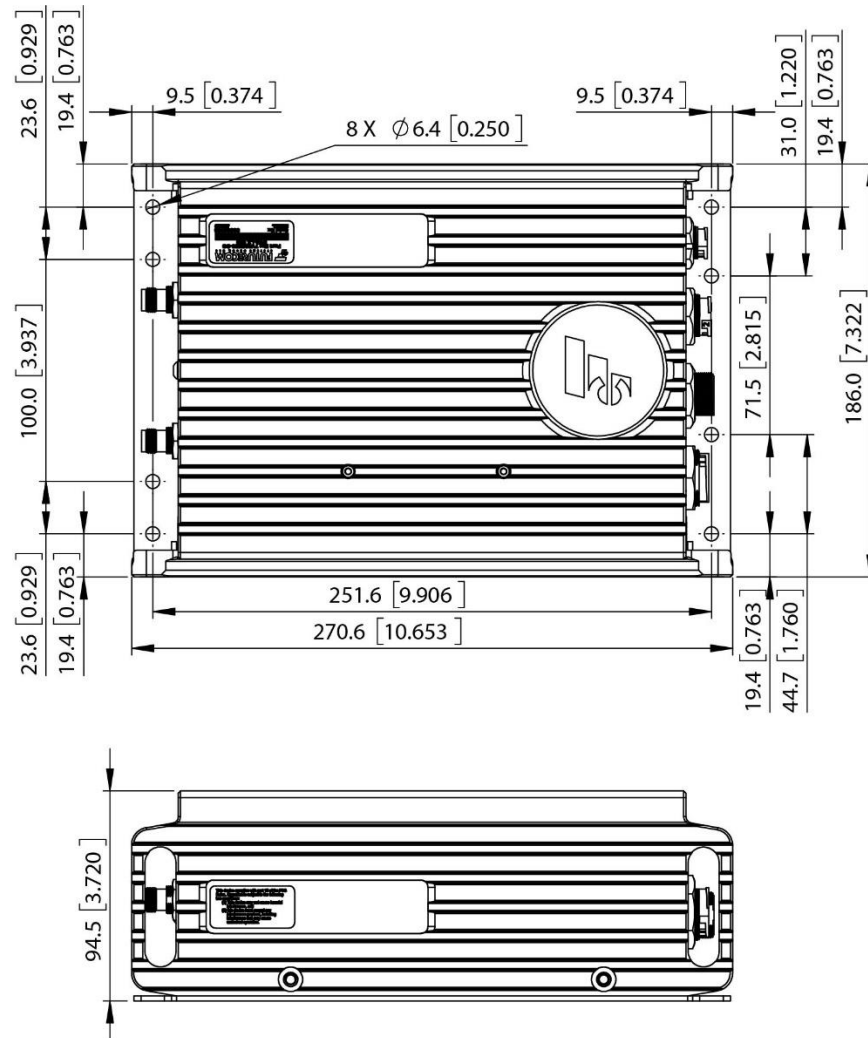


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES]

8H093B67_R00 (RF Relay Box Drilling Template)

Appendix E-5 DVR-LX Simplex Drilling Guide

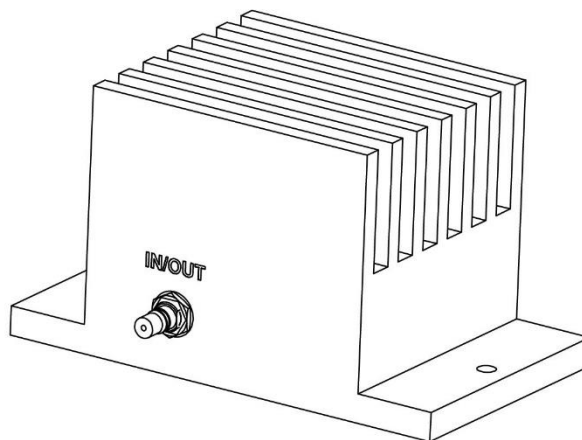
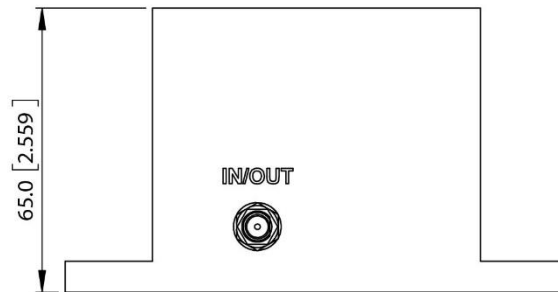
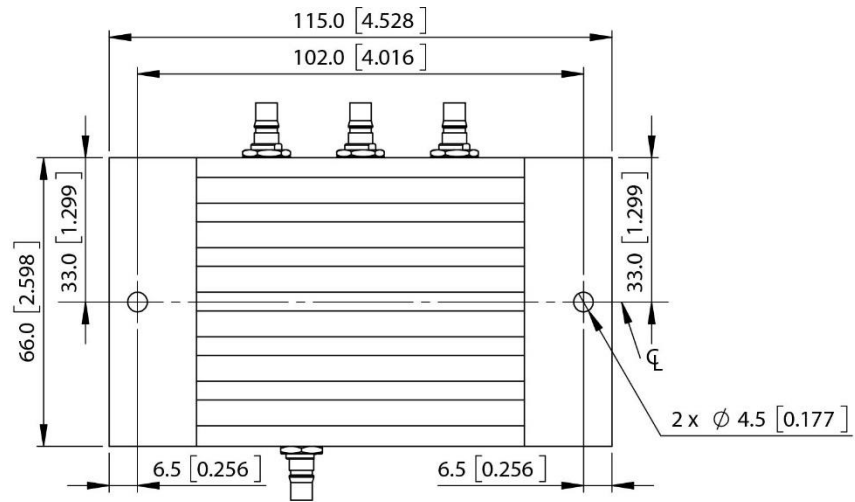


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES].

8H093868_R00 (DVR-LX Simplex Drilling Template)

Appendix E-6 Single Triplexer Drilling Guide

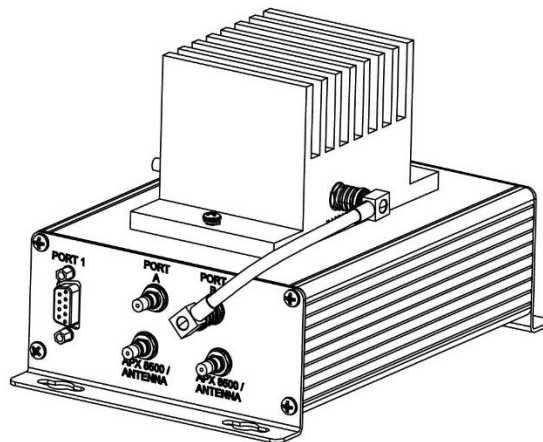
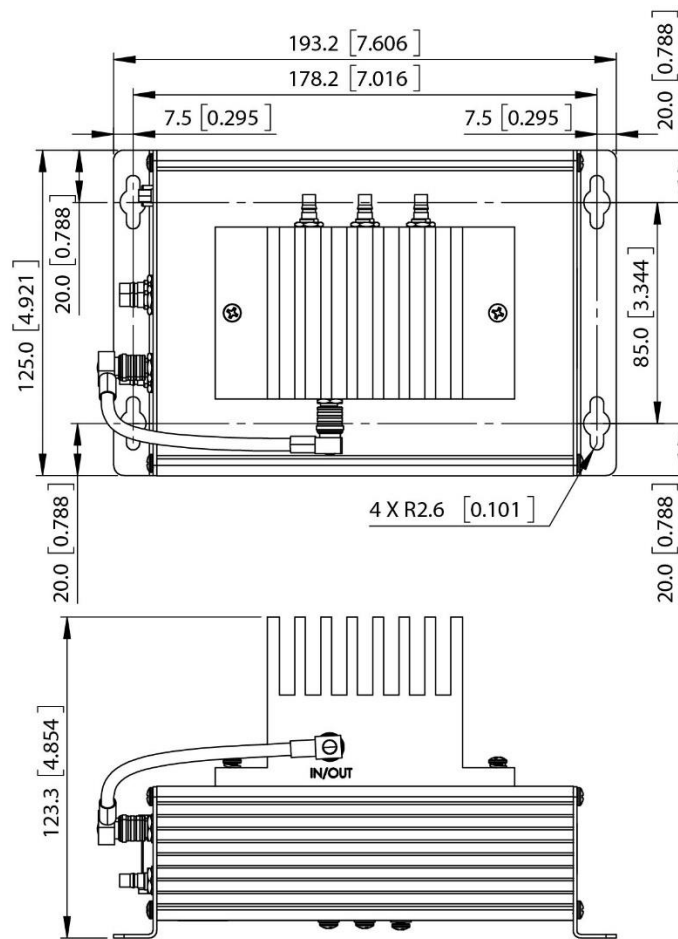


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES]

8H093869_R00 (Single Triplexer Drilling Template)

Appendix E-7 Single Triplexer and RF Relay Drilling Guide

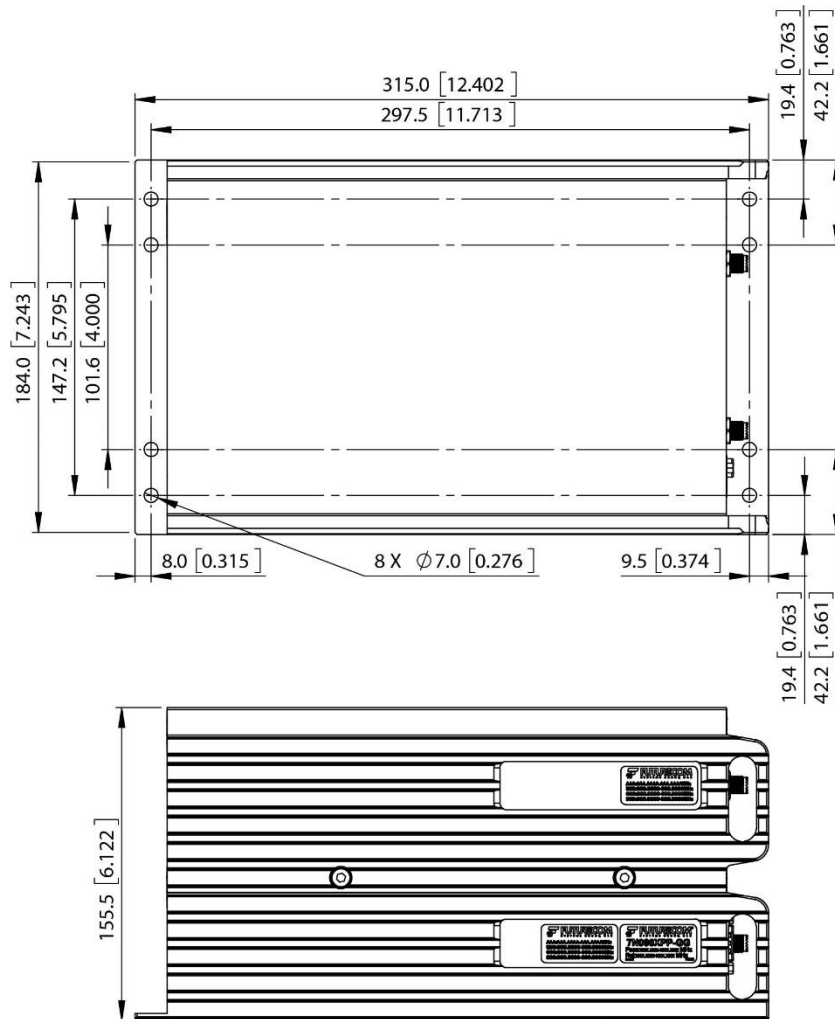


NOTE:

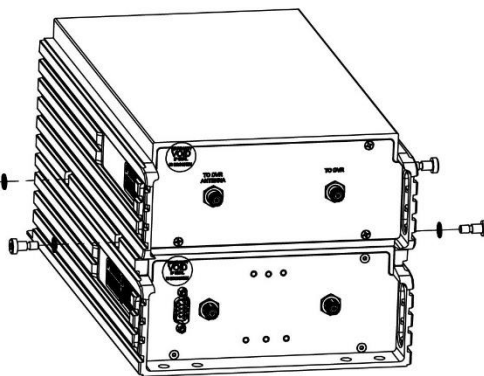
1. ALL DIMENSIONS ARE IN mm [INCHES]

8H093B70_R00 (Single Triplexer and RF Relay Assembly Drilling Template)

Appendix E-8 DVR-LX Notch Filters Drilling Guide



ACCOUNT FOR
SCREW ACCESS
ROOM

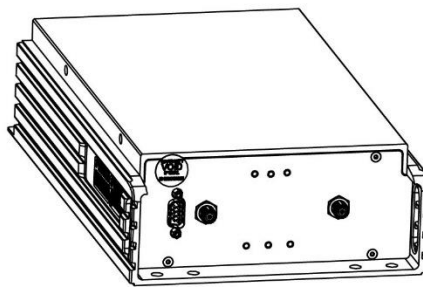
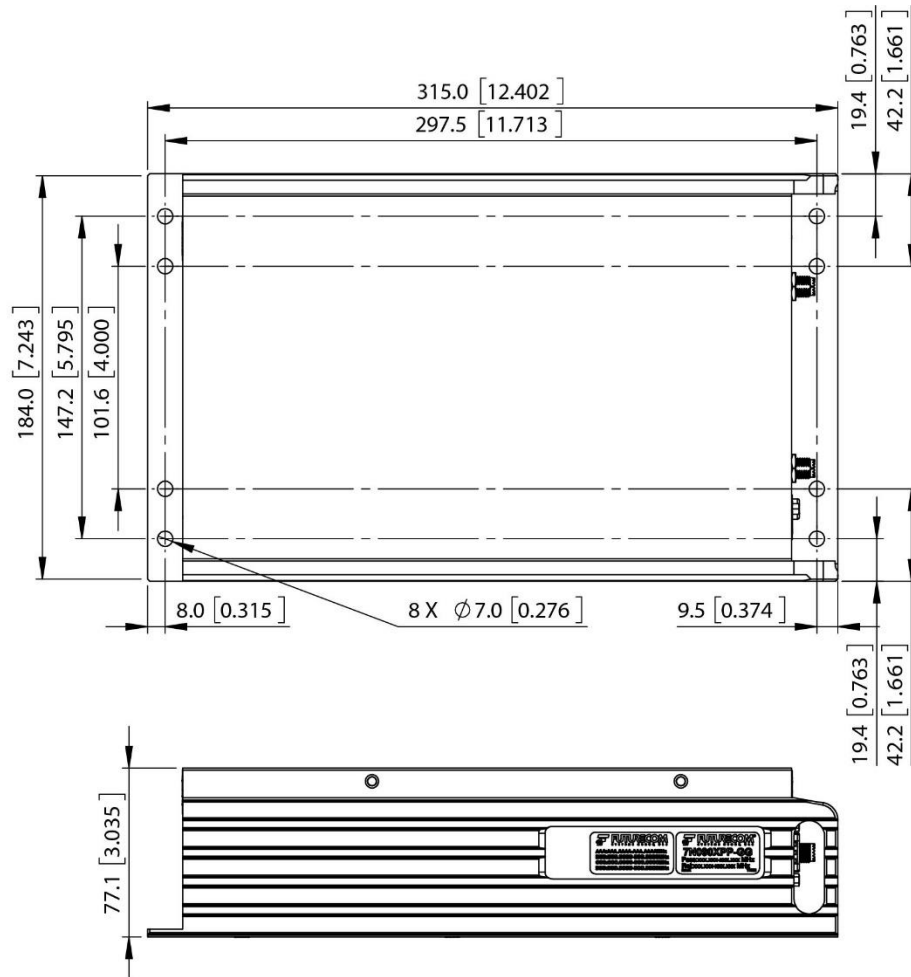


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES].

8H093871_R00 (DVR-LX Notch Filters Drilling Template)

Appendix E-9 DVR-LX Single Notch Filters Drilling Guide

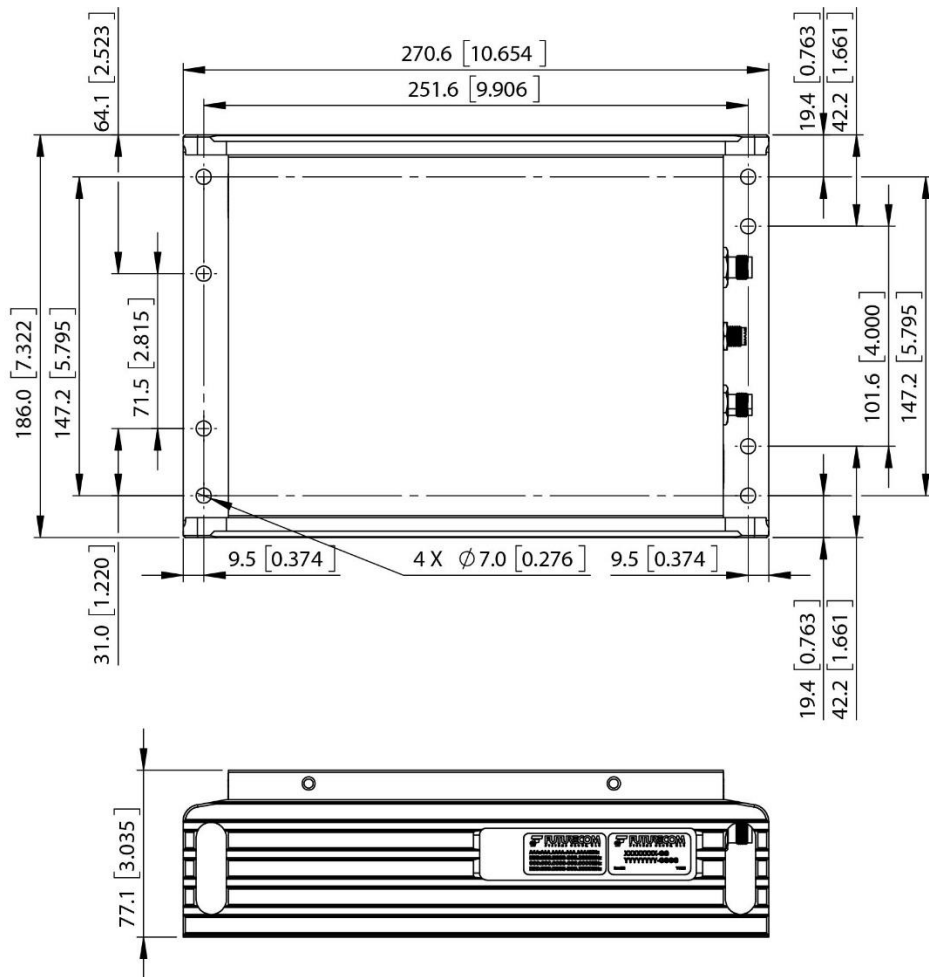


NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES].

8H093B72_R00 (DVR-LX Single Notch Filter Drilling Template)

Appendix E-10 DVR-LX Single Duplexer Drilling Guide



NOTE:

1. ALL DIMENSIONS ARE IN mm [INCHES].

8H093B73_R00 (DVR-LX Single Duplexer Drilling Template)

Glossary

Keyword	Description
AVRA	Automated VR Activation. DVR-LX option which permits automated activation of the DVR-LX by either using a VIP input on the MSU CH / DEK or a pin on the DVR-LX Auxiliary cable. Requires external logic / switch (not provided).
CH	Control Head.
Channel	The communication path between DVR-LX and PSU, or MSU and Conventional System.
Cross-band	DVR-LX operates in a different frequency band than all of the System frequency bands.
DEK	Direct Entry Keyboard.
Duplex	Data/voice can flow in two directions at the same time. DVR-LX can transmit and receive simultaneously.
DVR	Digital Vehicular Repeater.
DVRS	When a DVR-LX is interfaced with an MSU, the complete equipment package is referred to as a Digital Vehicular Repeater System (DVRS).
FCC	Federal Communications Commission.
Flat	DVR-LX components are provided individually allowing for a lower profile installation.
FRC	Futurecom Repeater Configurator. Programming software application for the DVR-LX.
In-band	DVR-LX operates in the same frequency band as a system frequency band.
ISED	Innovation, Science and Economic Development Canada.
LOC	Local Mode: DVR-LX mode which allows repeated communication between the local PSUs and MSU. If configured, can also monitor activity on the selected MSU channel.
Mode	MSU – Talk group or channel DVR-LX – Determines the communication exchange capabilities between System Users and Local Portable Users; Can be set to OFF, LOCAL or SYSTEM.
MPE	Maximum Permissible Exposure.
MSU	Mobile Subscriber Unit.
P25	Standards for interoperable digital two-way radio products.
Primary	This DVR-LX is responsible for all communications in its coverage area. All other DVR-LXs in the coverage area are in Secondary state.
PSU	Portable Subscriber Unit.
RF	Radio Frequency. Part of the general frequency spectrum 10kHz - 10,000,000 MHz.
RX	Receive.
Secondary	This DVR-LX is not responsible for communications. There is a Primary DVR-LX already present in the coverage area.
Simplex	Data/voice can only flow in one direction at a time. DVR-LX can either transmit or receive at one time.

Keyword	Description
Stacked	DVR-LX components are stacked one on top of the other which requires more height for installation.
SYS	System Mode: DVR-LX mode which enables repeated communication between the local PSUs, MSU and two-way communication with Dispatcher and System PSUs.
TG	Talkgroup: A group of radio users who communicate with each other by using the same communication path. For a Trunking System, the communication path between the MSU and the System is referred to as a Talkgroup. For a Conventional System it is referred to as a channel. Throughout this document, the term channel/TG will be used.
TX	Transmit.
VIP	Vehicular Interface Port.
VR	Futurecom line of Vehicular Repeaters. It applies to one of the following products: VRX1000, DVR and DVR-LX.

References

www.futurecom.com → Support → Documentation and Software

1. VR Functional Description:

[DVR-LX/DVR/VRX1000](#) → [Functional Description](#) → [VR Functional Description](#)

2. VR Programming Guide:

[DVR-LX/DVR/VRX1000](#) → [Installation & Programming Guide](#) → [VR Programming Guide](#)

3. RF Safety Booklet/ la Brochure Sécurité RF (Canada):

[DVR-LX/DVR/VRX1000](#) → [RF Safety Booklet](#) → [RF Safety Booklet – APX – DVRS – Canada](#)

4. RF Safety Booklet/ la Brochure Sécurité RF (USA/États-Unis):

[DVR-LX/DVR/VRX1000](#) → [RF Safety Booklet](#) → [RF Safety Booklet – APX – DVRS – US](#)

5. DVR-LX Datasheet

[Home](#) → [Products](#) → [DVR-LX Digital Vehicular Repeater](#) → [Supporting Documents](#) → [DVR-LX Datasheet](#)

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