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PXIe-1078

VRTS Base System

Vehicle Radar Test System

This document describes the proper module placement and connections required for the Vehicle Radar Test System (VRTS). The VRTS provides automated radar measurement and obstacle simulation capabilities for 76 GHz to 81 GHz vehicle radar test systems.

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Configuration Options

NI provides several configuration options for the VRTS hardware. These setups incorporate either a monostatic or bistatic base configuration and can simulate between one and four obstacles. Refer to the *VRTS Ordering Guide* for information about your system configuration and equipment.

Required Equipment

All configurations require a combination of the following hardware:

- Variable Delay Generator for PXI (VDG)
- PXI Vector Signal Transceiver (VST)
- PXI Express controller
- PXI Express chassis:
 - Five adjacent PXI Express slots are required for the one obstacle configuration
 - Eight adjacent PXI Express slots are required for the two obstacle configuration

- Thirteen adjacent PXI Express slots are required for the three obstacle configuration
- Sixteen adjacent PXI Express slots are required for the four obstacle configuration
- mmWave Radio Head:
 - mmRH-3608 76-81 GHz Transceiver mmWave Radio Head, Bistatic
 - mmRH-3609 76-81 GHz Transceiver mmWave Radio Head, Monostatic
- Cables included in your product bundle

Preparing the Environment

Ensure that the environment you are using the VRTS Base System in meets the following specifications.

Ambient temperature range	0 °C to 45 °C
Relative humidity range	10% to 90% relative humidity, noncondensing
Pollution degree	2
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)



Notice The VRTS Base System is intended for use indoors in a chambered test environment as test and measurement equipment. This product is intended for professional use only.



Notice An Experimental Licence is required to be filed directly with the FCC if a mmWave radio head is not used inside a shielded chamber test environment. Please refer to the FCC OET Experimental Licensing System website for additional guidance.



Caution Observe all instructions and cautions in the user documentation. Using the model in a manner not specified can damage the model and compromise the built-in safety protection. Return damaged models to NI for repair.



Attention Suivez toutes les instructions et respectez toutes les mises en garde de la documentation utilisateur. L'utilisation d'un modèle de toute autre façon que celle spécifiée risque de l'endommager et de compromettre la protection de sécurité intégrée. Renvoyez les modèles endommagés à NI pour réparation.

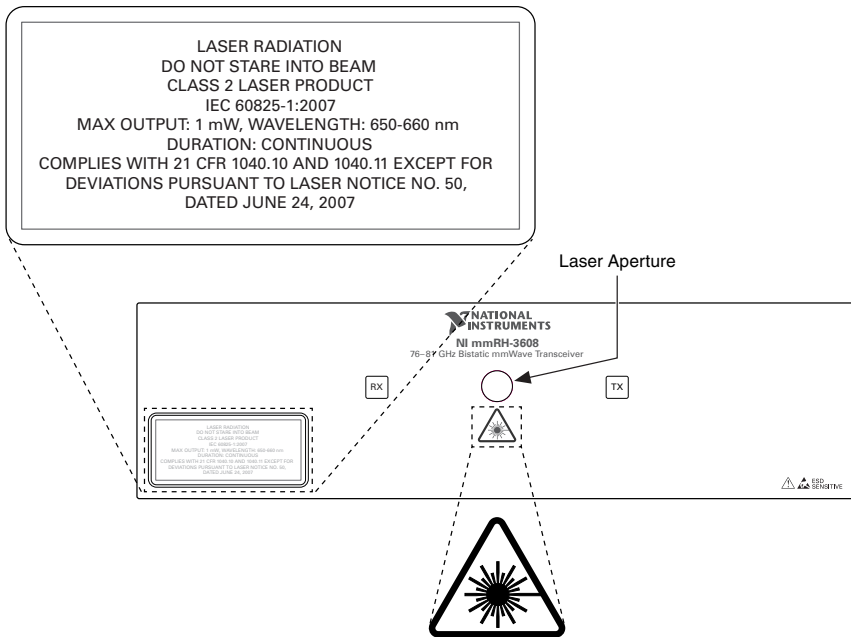


Caution This is a Class 2 (Class II) laser product and has visible laser radiation up to 1 mW emitting from the laser aperture. This product is for use as an alignment laser only, per CFR Title 21, Chapter I, Subchapter J, Part 1040.11(b). The product is safe for momentary exposures but can be hazardous for deliberate staring into the beam. DO NOT STARE INTO THE BEAM. Class 2 lasers can cause photochemical and thermal retinal injury to the eye, as well as skin reactions and burns with longer than momentary exposure. Adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. Dazzle, flash-

blindness and afterimages may be caused by a beam from a Class 2 laser product, particularly under low ambient light conditions. This may have indirect general safety implications resulting from temporary disturbance of vision or from startle reactions. Such visual disturbances could be of particular concern connected with performing safety-critical operations such as working with machines or at height, with high voltages, or driving. Users are instructed not to stare into the beam, and should perform active protective reactions by moving the head or closing the eyes and to avoid continued intentional intrabeam viewing.



Attention Ce produit est un laser de classe 2 (classe II) qui émet, par son ouverture, un rayonnement laser visible atteignant 1 mW. Ce produit doit être utilisé uniquement comme laser d'alignement, conformément au Titre 21 du CFR, chapitre I, sous-chapitre J, partie 1040.11 (b). Le produit est sans danger en cas d'exposition momentanée mais peut être dangereux lorsqu'on fixe délibérément le faisceau. **NE PAS REGARDER FIXEMENT LE FAISCEAU.** Les lasers de classe 2 peuvent provoquer des lésions rétinienne photochimiques et thermiques ainsi que des réactions cutanées et des brûlures en cas d'exposition trop longue. Les ajustements ou l'exécution de procédures autres que celles spécifiées ici peuvent entraîner une exposition à des rayonnements dangereux. Le faisceau d'un produit laser de classe 2 peut entraîner l'éblouissement, un bref aveuglement et des images rémanentes, en particulier dans des conditions de faible luminosité ambiante. Cela peut avoir des implications générales indirectes sur la sécurité résultant de perturbations temporaires de la vision ou de réactions de surprise. De telles perturbations visuelles peuvent être particulièrement préoccupantes lors de la réalisation d'opérations critiques pour la sécurité telles que le travail sur des machines ou en hauteur, le travail avec des tensions élevées ou lors de la conduite. Les utilisateurs ont pour consigne de ne pas regarder fixement le faisceau et doivent réagir de façon active pour se protéger, en bougeant la tête ou en fermant les yeux, et éviter de continuer à regarder intentionnellement le faisceau.



Installing the Software

Ensure that you have installed the latest version of Package Manager. To access the download page for NI Package Manager, go to ni.com/info and enter info code NIPMDownload.

1. Install the LabVIEW version indicated in the *NI-VRTS Readme*.
2. Install NI-RFSA, NI-RFSG, NI-RFmx SpecAn, and NI-RFmx DeMod from ni.com/downloads as described in the *NI-VRTS Readme*.
3. Install the latest NI-VRTS instrument driver using NI Package Manager. Follow the instructions in the installation prompts.

Installing the Hardware

Installing the VRTS Base System Modules



Notice To prevent damage to the VRTS Base System caused by ESD or contamination, handle the module using the edges or the metal bracket.

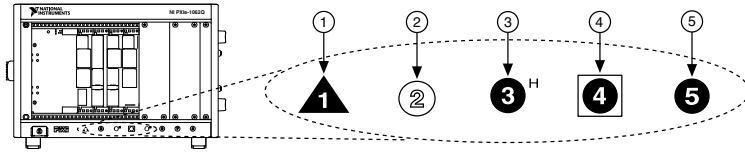
1. Ensure the AC power source is connected to the chassis before installing the module.

The AC power cord grounds the chassis and protects it from electrical damage while you install the module.

2. Power off the chassis.

3. Inspect the slot pins on the chassis backplane for any bends or damage prior to installation. Do not install a module if the backplane is damaged.
4. Identify a supported slot in the chassis. The following figure shows the symbols that indicate the slot types.

Figure 1. Chassis Compatibility Symbols



- | | |
|---------------------------------------|-----------------------------------|
| 1. PXI Express System Controller Slot | 4. PXI Express System Timing Slot |
| 2. PXI Peripheral Slot | 5. PXI Express Peripheral Slot |
| 3. PXI Express Hybrid Peripheral Slot | |

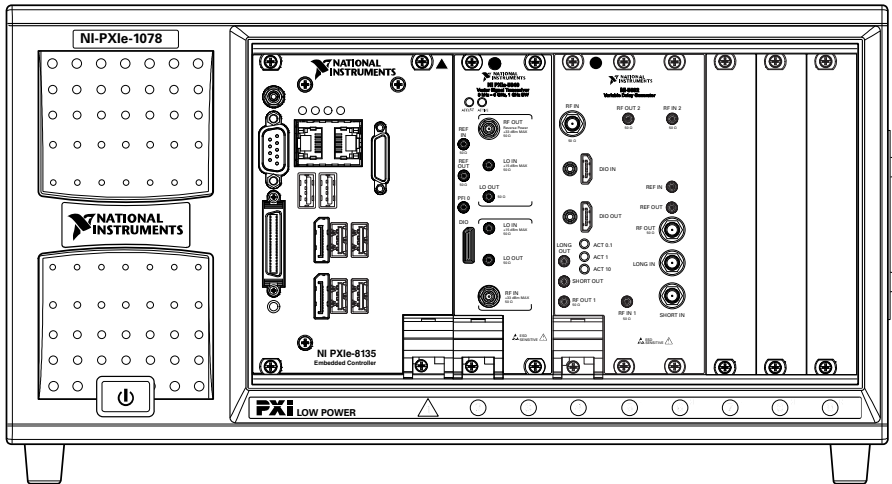


Note VRTS Base System modules can be placed in PXI Express peripheral slots, PXI Express hybrid peripheral slots, or PXI Express system timing slots.

5. Touch any metal part of the chassis to discharge static electricity.
6. Ensure that the ejector handle is in the downward (unlatched) position.
7. Place the module edges into the module guides at the top and bottom of the chassis. Slide the module into the slot until it is fully inserted.
8. Latch the module in place by pulling up on the ejector handle.
9. Cover all empty slots using EMC filler panels or fill using slot blockers to maximize cooling air flow, depending on your application.
10. Power on the chassis.

Setting Up the One Obstacle Configuration

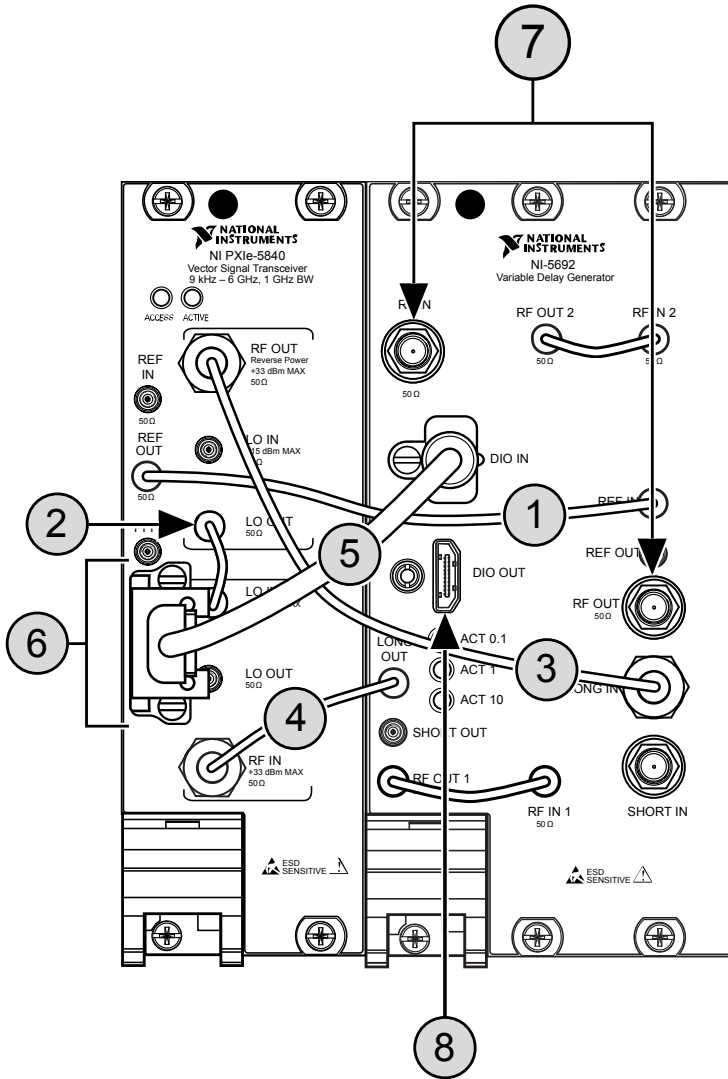
This section describes the module location and connection sequence for the one obstacle VRTS configuration. This configuration uses one VDG module and one VST module. Insert the modules into the chassis as shown in the following image. Refer to *Installing VRTS Base System Modules* for more information about inserting the modules.



To cable your modules, complete steps 1 through 8 in numerical order. Reference the subsequent figure to verify that your modules are properly cabled.

1. Use one 0.25 m MMPX-MMPX cable to connect the REF OUT port of the VST in slots 2 through 3 to the REF IN port of the VDG in slots 4 through 6.
2. Use one 0.11 m MMPX-MMPX cable to connect the LO OUT port of the VST in slots 2 through 3 to the LO IN port of the same VST.
3. Use one 0.20 m SMA-SMA cable to connect the RF OUT port of the VST in slots 2 through 3 to the LONG IN port of the VDG in slots 4 through 6.
4. Use one 0.30 m MMPX-SMA cable to connect the RF IN port of the VST in slots 2 through 3 to the LONG OUT port of the VDG in slots 4 through 6.
5. Use one NANOPITCH-MINI HDMI cable to connect the DIO port of the VST in slots 2 through 3 to the DIO IN port of the VDG in slots 4 through 6.
6. Use one Cable Retention Bracket to secure the DIO port of the VST in slots 2 through 3.
7. Use two 0.46 m SMA-SMA cables to connect the following modules:
 - a) Connect the RF IN port of the VDG in slots 4 through 6 to the RX IF OUT port of the mmWave Radio Head.
 - b) Connect the RF OUT port of the VDG in slots 4 through 6 to the TX IF IN port of the mmWave Radio Head.
8. Use one 1 m MINI HDMI-MINI HDMI cable to connect the DIO OUT port of the VDG in slots 4 through 6 to the DIO 0 port of the mmWave Radio Head.

Figure 2. One Obstacle Cabled Modules

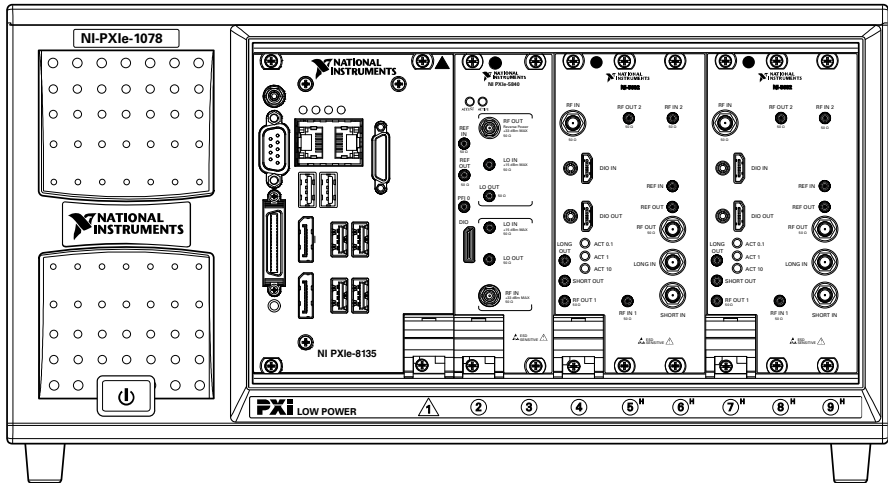


1. MMPX-MMPX, 0.25 m
2. MMPX-MMPX, 0.11 m
3. SMA-SMA, 0.20 m
4. MMPX-SMA, 0.30 m

5. NANOPITCH-MINI HDMI
6. Cable Retention Bracket
7. SMA-SMA, 0.46 m
8. MINI HDMI-MINI HDMI, 1 m

Setting Up the Two Obstacle Configuration

This section describes the module location and connection sequence for the two obstacle VRTS configuration. This configuration uses two VDG modules and one VST module. Insert the modules into the chassis as shown in the following image. Refer to *Installing VRTS Base System Modules* for more information about inserting the modules.

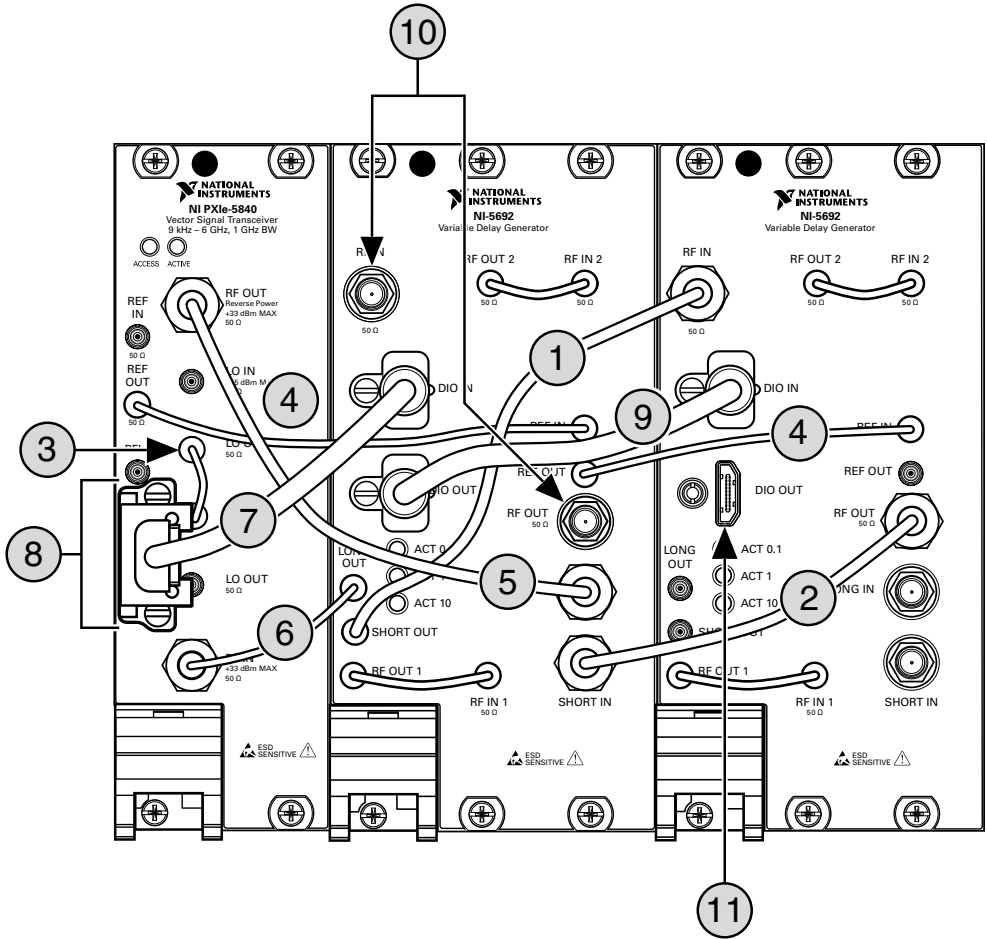


To cable your modules, complete steps 1 through 11 in numerical order. Reference the subsequent figure to verify that your modules are properly cabled.

1. Use one 0.09 m MMPX R/A-SMA R/A to connect the SHORTR OUT port of the VDG in slots 4 through 6 to the RF IN port of the VDG in slots 7 through 9.
2. Use one 0.07 m SMA R/A-SMA R/A cable to connect the SHORTR IN port of the VDG in slots 4 through 6 to the RF OUT port of the VDG in slots 7 through 9.
3. Use one 0.11 m MMPX-MMPX cable to connect the LO OUT port of the VST in slots 3 through 4 into the LO IN port of the same VST.
4. Use two 0.25 m MMPX-MMPX cables to connect the following modules:
 - a) Connect the REF OUT port of the VST in slots 2 through 3 to the REF IN port of the VDG in slots 4 through 6.
 - b) Connect the REF OUT port of the VDG in slots 4 through 6 to the REF IN port of the VDG in slots 7 through 9.
5. Use one 0.20 m SMA-SMA cable to connect the RF OUT port of the VST in slots 2 through 3 to the LONG IN port of the VDG in slots 4 through 6.
6. Use one 0.30 m MMPX-SMA cable to connect the RF IN port of the VST in slots 2 through 3 to the LONG OUT port of the VDG in slots 4 through 6.
7. Use one NANOPITCH-MINI HDMI cable to connect the DIO port of the VST in slots 2 through 3 to the DIO IN port of the VDG in slots 4 through 6.

8. Use one Cable Retention Bracket to secure the DIO port of the VST in slots 2 through 3.
9. Use one 0.25 m MINI HDMI-MINI HDMI cable to connect the DIO OUT port of the VDG in slots 4 through 6 to the DIO IN port of the VDG in slots 7 through 9.
10. Use two 0.46 m SMA-SMA cables to connect the following modules:
 - a) Connect the RF IN port of the VDG in slots 4 through 6 to the RX IF OUT port of the mmWave Radio Head.
 - b) Connect the RF OUT port of the VDG in slots 4 through 6 to the TX IF IN port of the mmWave Radio Head.
11. Use one 1 m MINI HDMI-MINI HDMI cable to connect the DIO OUT port of the VDG in slots 7 through 9 to the DIO 0 port of the mmWave Radio Head.

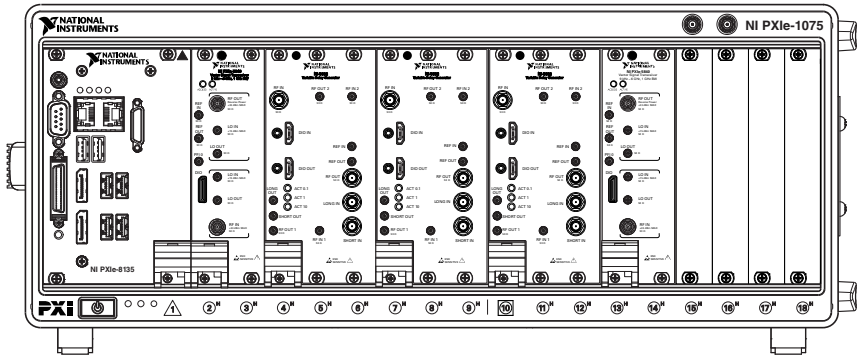
Figure 3. Two Obstacle Cabled Modules



- | | |
|-----------------------------|---------------------------------|
| 1. MMPX R/A-SMA R/A, 0.09 m | 7. NANOPITCH-MINI HDMI |
| 2. SMA R/A-SMA R/A, 0.07 m | 8. Cable Retention Bracket |
| 3. MMPX-MMPX, 0.11 m | 9. MINI HDMI-MINI HDMI, 0.25 m. |
| 4. MMPX-MMPX, 0.25 m | 10. SMA-SMA, 0.46 m |
| 5. SMA-SMA, 0.20 m | 11. MINI HDMI-MINI HDMI, 1 m |
| 6. MMPX-SMA, 0.30 m | |

Setting Up the Three Obstacle Configuration

This section describes the module location and connection sequence for the three obstacle VRTS configuration. This configuration uses three VDG modules and two VST modules. Insert the modules into the chassis as shown in the following image. Refer to *Installing VRTS Base System Modules* for more information about inserting the modules.

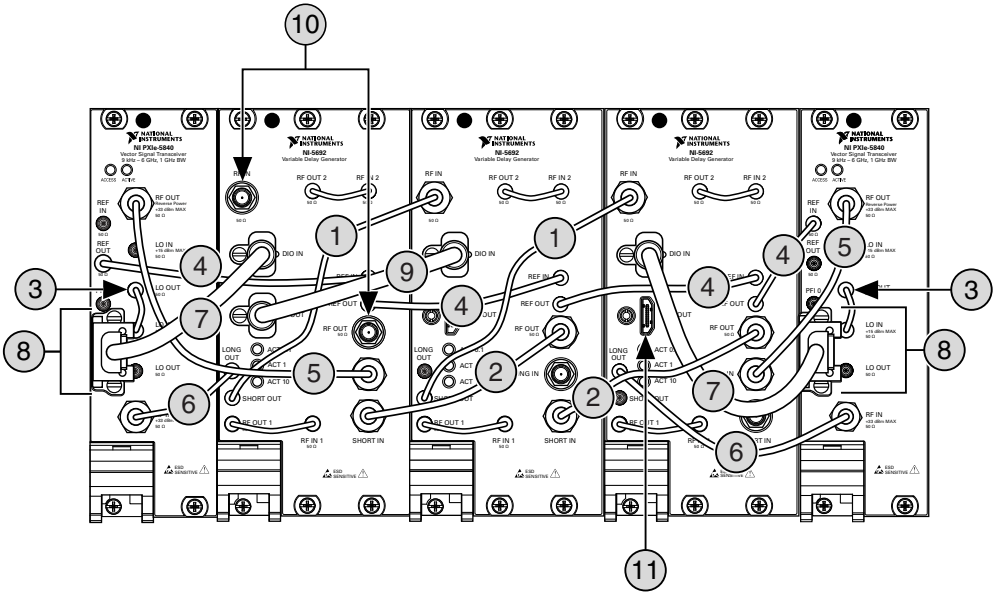


To cable your modules, complete steps 1 through 11 in numerical order. Reference the subsequent figure to verify that your modules are properly cabled.

1. Use two 0.09 m MMPX R/A-SMA R/A cables to connect the following modules:
 - a) Connect the SHORT OUT port of the VDG in slots 4 through 6 to the RF IN port of the VDG in slots 7 through 9.
 - b) Connect the SHORT OUT port of the VDG in slots 7 through 9 to the RF IN port of the VDG in slots 10 through 12.
2. Use two 0.07 m SMA R/A-SMA R/A cables to connect the following modules:
 - a) Connect the SHORT IN port of the VDG in slots 4 through 6 to the RF OUT port of the VDG in slots 7 through 9.
 - b) Connect the SHORT IN port of the VDG in slots 7 through 9 to the RF OUT port of the VDG in slots 10 through 12.
3. Use two 0.11 m MMPX-MMPX cables to connect the following modules:
 - a) Connect the LO OUT port of the VST in slots 2 through 3 into the LO IN port of the same VST.
 - b) connect the LO OUT port of the VST in slots 13 through 14 into the LO IN port of the same VST.
4. Use four 0.25 m MMPX-MMPX cables to connect the following modules:
 - a) Connect the REF OUT port of the VST in slots 2 through 3 to the REF IN port of the VDG in slots 4 through 6.
 - b) Connect the REF OUT port of the VDG in slots 4 through 6 to the REF IN port of the VDG in slots 7 through 9.
 - c) Connect the REF OUT port of the VDG in slots 7 through 9 to the REF IN port of the VDG in slots 10 through 12.
 - d) Connect the REF OUT port of the VDG in slots 10 through 12 to the REF IN port of the VST in slots 13 through 14.
5. Use two 0.20 m SMA-SMA cables to connect the following modules:
 - a) Connect the RF OUT port of the VST in slots 2 through 3 to the LONG IN port of the VDG in slots 4 through 6.
 - b) Connect the RF OUT port of the VST in slots 13 through 14 to the LONG IN port of the VDG in slots 10 through 12.

6. Use two 0.30 m MMPX-SMA cables to connect the following modules:
 - a) Connect the RF IN port of the VST in slots 2 through 3 to the LONG OUT port of the VDG in slots 4 through 6.
 - b) Connect the RF IN port of the VST in slots 13 through 14 to the LONG OUT port of the VDG in slots 10 through 12.
7. Use two NANOPITCH-MINI HDMI cables to connect the following modules:
 - a) Connect the DIO port of the VST in slots 2 through 3 to the DIO IN port of the VDG in slots 4 through 6.
 - b) Connect the DIO port of the VST in slots 13 through 14 to the DIO IN port of the VDG in slots 10 through 12.
8. Use two Cable Retention Bracket to secure the following connections:
 - a) Secure the DIO port of the VST in slots 2 through 3.
 - b) Secure the DIO port of the VST in slots 13 through 14.
9. Use one 0.25 m MINI HDMI-MINI HDMI cable to connect the DIO OUT port of the VDG in slots 4 through 6 to the DIO IN port of the VDG in slots 7 through 9.
10. Use two 0.46 m SMA-SMA cables to connect the following modules:
 - a) Connect the RF IN port of the VDG in slots 4 through 6 to the RX IF OUT port of the mmWave Radio Head.
 - b) Connect the RF OUT port of the VDG in slots 4 through 6 to the TX IF IN port of the mmWave Radio Head.
11. Use one 1 m MINI HDMI-MINI HDMI cable to connect the DIO OUT port of the VDG in slots 10 through 12 to the DIO 0 port of the mmWave Radio Head.

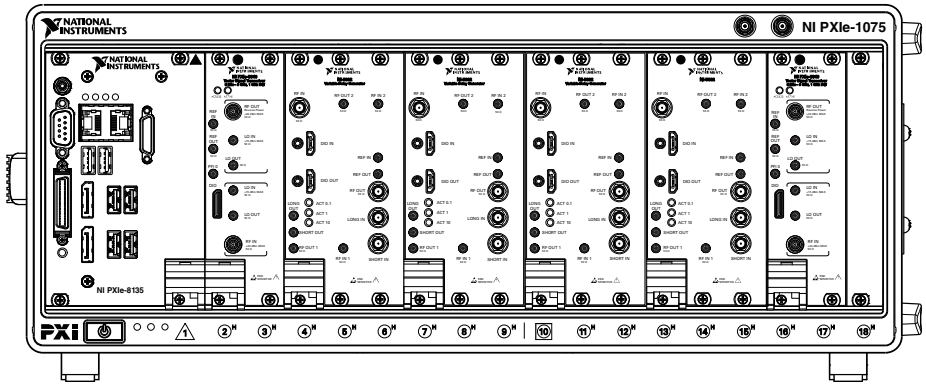
Figure 4. Three Obstacle Cabled Modules



- | | |
|-----------------------------|---------------------------------|
| 1. MMPX R/A-SMA R/A, 0.09 m | 7. NANOPITCH-MINI HDMI |
| 2. SMA R/A-SMA R/A, 0.07 m | 8. Cable Retention Bracket |
| 3. MMPX-MMPX, 0.11 m | 9. MINI HDMI-MINI HDMI, 0.25 m. |
| 4. MMPX-MMPX, 0.25 m | 10. SMA-SMA, 0.46 m |
| 5. SMA-SMA, 0.20 m | 11. MINI HDMI-MINI HDMI, 1 m |
| 6. MMPX-SMA, 0.30 m | |

Setting Up the Four Obstacle Configuration

This section describes the module location and connection sequence for the four obstacle VRTS configuration. This configuration uses four VDG modules and two VST modules. Insert the modules into the chassis as shown in the following image. Refer to *Installing VRTS Base System Modules* for more information about inserting the modules.

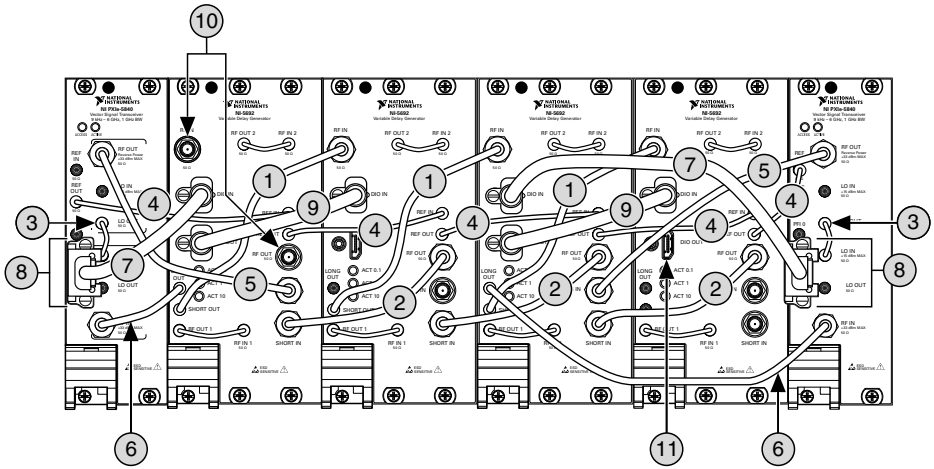


To cable your modules, complete steps 1 through 11 in numerical order. Reference the subsequent figure to verify that your modules are properly cabled.

1. Use three 0.09 m MMPX R/A-SMA R/A cables to connect the following modules:
 - a) Connect the SHORT OUT port of the VDG in slots 4 through 6 to the RF IN port of the VDG in slots 7 through 9.
 - b) Connect the SHORT OUT port of the VDG in slots 7 through 9 to the RF IN port of the VDG in slots 10 through 12.
 - c) Connect the SHORT OUT port of the VDG in slots 10 through 12 to the RF IN port of the VDG in slots 13 through 15.
2. Use three 0.07 m SMA R/A-SMA R/A cables to connect the following modules:
 - a) Connect the SHORT IN port of the VDG in slots 4 through 6 to the RF OUT port of the VDG in slots 7 through 9.
 - b) Connect the SHORT IN port of the VDG in slots 7 through 9 to the RF OUT port of the VDG in slots 10 through 12.
 - c) Connect the SHORT IN port of the VDG in slots 10 through 12 to the RF OUT port of the VDG in slots 13 through 15.
3. Use two 0.11 m MMPX-MMPX cables to connect the following modules:
 - a) Connect the LO OUT port of the VST in slots 2 through 3 into the LO IN port of the same VST.
 - b) Connect the LO OUT port of the VST in slots 16 through 17 into the LO IN port of the same VST.
4. Use five 0.25 m MMPX-MMPX cables to connect the following modules:
 - a) Connect the REF OUT port of the VST in slots 2 through 3 to the REF IN port of the VDG in slots 4 through 6.
 - b) Connect the REF OUT port of the VDG in slots 4 through 6 to the REF IN port of the VDG in slots 7 through 9.
 - c) Connect the REF OUT port of the VDG in slots 7 through 9 to the REF IN port of the VDG in slots 10 through 12.
 - d) Connect the REF OUT port of the VDG in slots 10 through 12 to the REF IN port of the VDG in slots 13 through 15.

- e) Connect the REF OUT port of the VDG in slots 13 through 15 to the REF IN port of the VST in slots 16 through 17.
5. Use two 0.20 m SMA-SMA cables to connect the following modules:
 - a) Connect the RF OUT port of the VST in slots 2 through 3 to the LONG IN port of the VDG in slots 4 through 6.
 - b) Connect the RF OUT port of the VST in slots 16 through 17 to the LONG IN port of the VDG in slots 13 through 14.
6. Use two 0.30 m MMPX-SMA cables to connect the following modules:
 - a) Connect the RF IN port of the VST in slots 2 through 3 to the LONG OUT port of the VDG in slots 4 through 6.
 - b) Connect the RF IN port of the VST in slots 16 through 17 to the LONG OUT port of the VDG in slots 10 through 12.
7. Use two NANOPITCH-MINI HDMI cables to connect the following modules:
 - a) Connect the DIO port of the VST in slots 2 through 3 to the DIO IN port of the VDG in slots 4 through 6.
 - b) Connect the DIO port of the VST in slots 16 through 17 to the DIO IN port of the VDG in slots 10 through 12.
8. Use two Cable Retention Bracket to secure the following connections:
 - a) Secure the DIO port of the VST in slots 2 through 3.
 - b) Secure the DIO port of the VST in slots 16 through 17.
9. Use two 0.25 m MINI HDMI-MINI HDMI cable to connect the following modules:
 - a) Connect the DIO OUT port of the VDG in slots 4 through 6 to the DIO IN port of the VDG in slots 7 through 9.
 - b) Connect the DIO OUT port of the VDG in slots 10 through 12 to the DIO IN port of the VDG in slots 13 through 15.
10. Use two 0.46 m SMA-SMA cables to connect the following modules:
 - a) Connect the RF IN port of the VDG in slots 4 through 6 to the RX IF OUT port of the mmWave Radio Head.
 - b) Connect the RF OUT port of the VDG in slots 4 through 6 to the TX IF IN port of the mmWave Radio Head.
11. Use one 1 m MINI HDMI-MINI HDMI cable to connect the DIO OUT port of the VDG in slots 13 through 15 to the DIO 0 port of the mmWave Radio Head.

Figure 5. Four Obstacle Cabled Modules



- | | |
|-----------------------------|---------------------------------|
| 1. MMPX R/A-SMA R/A, 0.09 m | 7. NANOPITCH-MINI HDMI |
| 2. SMA R/A-SMA R/A, 0.07 m | 8. Cable Retention Bracket |
| 3. MMPX-MMPX, 0.11 m | 9. MINI HDMI-MINI HDMI, 0.25 m. |
| 4. MMPX-MMPX, 0.25 m | 10. SMA-SMA, 0.46 m |
| 5. SMA-SMA, 0.20 m | 11. MINI HDMI-MINI HDMI, 1 m |
| 6. MMPX-SMA, 0.30 m | |

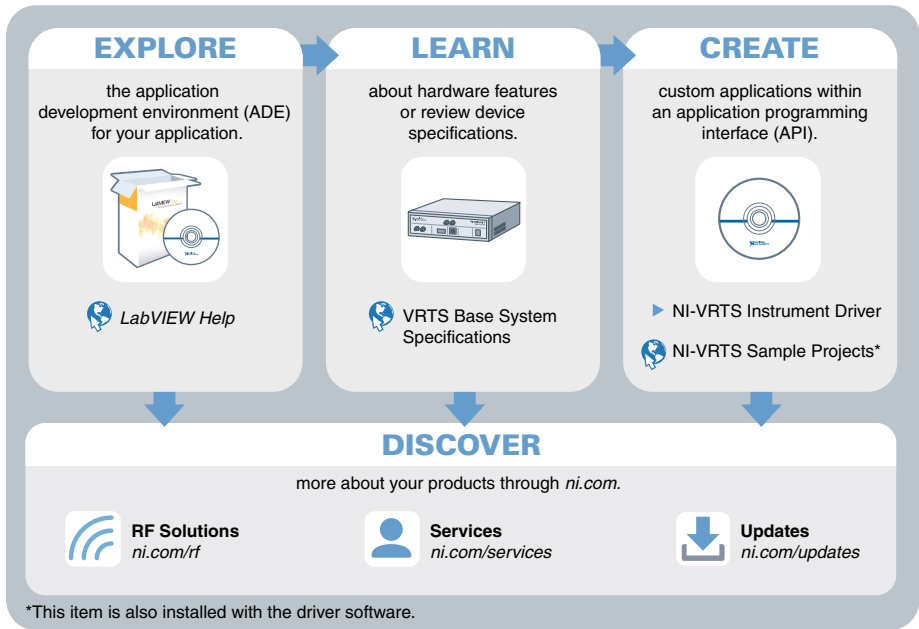
Removing the VRTS Base System Modules

To remove the VRTS Base System modules from a PXI Express chassis, complete the following steps.

1. Power off the chassis.
2. Remove any cables that may be attached to the processor module front panel.
3. Unscrew the 4 bracket-retaining screws in the front panel.
4. Press the ejector handle down.
5. Slide the unit out of the chassis.

Where to Go Next

Refer to the following figure for information about other product tasks and associated resources for those tasks.



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