

## Startup Guide

# Keysight LTE/LTE-A Multi-Channel Reference Solution

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### CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

### WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

The following safety precautions should be observed before using this product and any associated instrumentation.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid

possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product.

#### **WARNING**

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

The types of product users are:

- Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring operators are adequately trained.
- Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.
- Maintenance personnel perform routine procedures on the product to keep it operating properly (for example, setting the line voltage or replacing consumable materials). Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.
- Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

#### **WARNING**

Operator is responsible to maintain safe operating conditions. To ensure safe operating conditions, modules should not be operated beyond the full temperature range specified in the Environmental and physical specification. Exceeding safe operating conditions can result in shorter lifespans, improper module performance and user safety issues. When the modules are in use and operation within the specified full

temperature range is not maintained, module surface temperatures may exceed safe handling conditions which can cause discomfort or burns if touched. In the event of a module exceeding the full temperature range, always allow the module to cool before touching or removing modules from chassis.

Keysight products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Measurement Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the user documentation.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are

intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions, or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits – including the power transformer, test leads, and input jacks – must be purchased from Keysight. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keysight to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call an Keysight office for information.

#### WARNING

**No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers. For continued protection against fire hazard, replace fuse with same type and rating.**

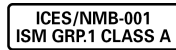
#### PRODUCT MARKINGS:



The CE mark is a registered trademark of the European Community.



Australian Communication and Media Authority mark to indicate regulatory compliance as a registered supplier.



This symbol indicates product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001). It also identifies the product is an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).



South Korean Class A EMC Declaration. This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home. A 급 기기 (업무용 방송통신기자재) 이 기기는 업무용 (A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.



This product complies with the WEEE Directive marketing requirement. The affixed product label (above) indicates that you must not discard this electrical/electronic product in domestic household waste. **Product Category:** With reference to the equipment types in the WEEE directive Annex 1, this product is classified as “Monitoring and Control instrumentation” product. Do not dispose in domestic household waste. To return unwanted products, contact your local Keysight office, or for more information see

<http://about.keysight.com/en/companyinfo/environment/takeback.shtml>.



This symbol indicates the instrument is sensitive to electrostatic discharge (ESD). ESD can damage the highly sensitive components in your instrument. ESD damage is most likely to occur as the module is being installed or when cables are connected or disconnected. Protect the circuits from ESD damage by wearing a grounding strap that provides a high resistance path to ground. Alternatively, ground yourself to discharge any built-up static charge by touching the outer shell of any grounded instrument chassis before touching the port connectors.



This symbol on an instrument means caution, risk of danger. You should refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.



This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

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# Multi-Channel Reference Solution Introduction

This multi-channel reference solution can be used in particular to test:

- Multi-antenna techniques that are used in diversity
- Spatial multiplexing multiple-in, multiple-out (MIMO)
- Beamforming in cellular and wireless LAN applications
- Carrier aggregation

For further details refer to [www.keysight.com/find/pxi-mimo](http://www.keysight.com/find/pxi-mimo).

Multi-channel transmitter and receiver testing may require synchronization of multiple signal generators and/or signal analyzers in time and frequency. For example, wireless LAN transmitters can be measured by multiple receivers operating at the same frequency and with acquisition timing aligned, and receivers can be tested using synchronized signal generators.

The M9381A VSG and M9391A VSA can be configured to operate in multi-channel configurations with a shared 100 MHz frequency reference, and an independent, or shared local oscillator (synthesizer) for each channel. This allows them to operate at the same frequency for multi-channel operation, and at different frequencies for modes in which multiple carriers are used, but baseband timing alignment is still required.

The arbitrary waveform playback of the M9381A VSG can be synchronized using backplane triggering of the PXIe chassis. The IQ acquisitions made by the M9391A PXIe VSA for demodulating multi-channel waveforms can be synchronized using a synchronization technique using the backplane of the PXIe chassis. For additional information on multi-channel systems, refer to [www.keysight.com/find/pxi-mimo](http://www.keysight.com/find/pxi-mimo).

**NOTE**

**The LTE/LTE-A Reference Solution can be assembled to make up to 8x8 channel phase coherent measurements**

## What is in this Manual

The scope of this document is to present the processes of receiving and verifying operation of the Keysight Multi-Channel Reference Solution (see [www.keysight.com/find/pxi-mimo](http://www.keysight.com/find/pxi-mimo)). The overall process is as follows:

1. Unpack and inspect your solution.
2. Verify the contents of each box in your shipment matches the respective box content list.
3. Install the software.
4. Install and cable the modules.

5. Redeem your software licenses.
6. Complete the configuration of a simple multi-channel solution and verify operability.
7. Installation is complete. Proceed to use the multi-channel software tools ,to automate alignments and and configure a complex multi-channel solution. Develop your control programs with the help of the Multi-channel Demo Tool source code and the product drivers.

For more information on LTE/LTE-A Multi-Channel Systems see:

- Solution Brochure 5991-4684EN
- Configuration Guide 5991-0897EN



## Follow the Startup Sequence

**WARNING**

Closely follow the startup process flow in this document. Deviating from the sequence can cause unpredictable system behavior, damage your system, and may cause personal injury.

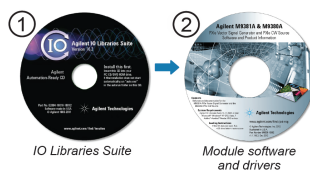
Step 1: Unpack and Inspect



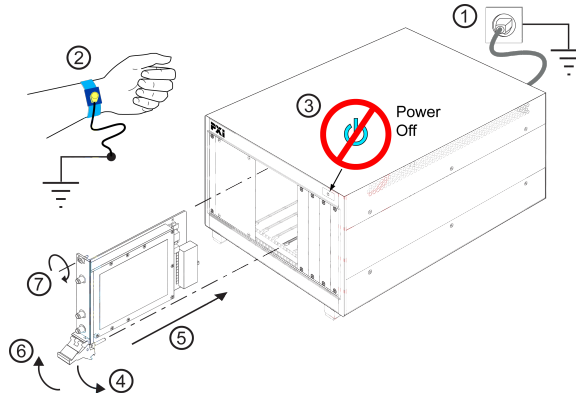
Step 2: Verify Shipment



Step 3: Install Drivers and Multi-Channel Tools Software



Step 4: Install Modules and Assemble the Multi-Channel System



Step 5: Make Quick Start Measurements.

## Related Documentation

This document can be found at: <http://literature.cdn.keysight.com/litweb/pdf/Y1299-90001.pdf>.

### M9381A Related Documentation

The documentation associated with this product is available at the respective product pages on keysight.com (go to Document Library > Manuals).

M9381A (see [www.keysight.com/find/M9381A](http://www.keysight.com/find/M9381A))

- M9381A Soft Front Panel help system
- M9381A Startup Guide (this document)
- M9381A VSA Programming Guide
- M9381A device driver API references (IVI-C/IVI-COM)
- M9381A Data Sheet
- M9381A Security Guide

### M9391A Related Documentation

The documentation associated with this product is available at the respective product pages on keysight.com (go to Document Library > Manuals).

M9391A (see [www.keysight.com/find/M9391A](http://www.keysight.com/find/M9391A))

- M9391A Soft Front Panel help system
- M9391A Startup Guide
- M9391A VSA Programming Guide
- M9391A device driver API references (IVI-C/IVI-COM)
- M9391A Data Sheet
- M9391A Security Guide

### Other Product Related Documentation

Depending upon your particular order, you may find the following product documentation useful.

Additional Related Documentation at [www.keysight.com](http://www.keysight.com)

- M9018A PXIe Chassis (see [www.keysight.com/find/M9018A](http://www.keysight.com/find/M9018A))
- M9018A PXIe Chassis Startup Guide (see [M9018 Startup Guide](#))
- M9036A PXIe Embedded Controller
- M9036A PXIe Embedded Controller Startup Guide (optional)
- M9037A PXIe Embedded Controller

- M9037A PXIe Embedded Controller Startup Guide
- M9021A PCIe Cable Interface
- Keysight M9021A PCIe Cable Interface Module Installation Guide (optional)
- Download and save this CHM file from [www.keysight.com/find/pxie-multichassis](http://www.keysight.com/find/pxie-multichassis)

**NOTE**

If you ordered the M9391A PXIe VSA with the M9300A PXIe Frequency Reference (order option M9391A-300) and did not order the M9381A PXIe VSG be aware that the M9300A software and documentation are not installed with the M9391A installer. To install the M9300A software and documentation, run the M938x installer, available at [www.keysight.com/find/M9381A-driver](http://www.keysight.com/find/M9381A-driver). (When you run the M938x installer, you have the option to install only the M9300A-related files.b)

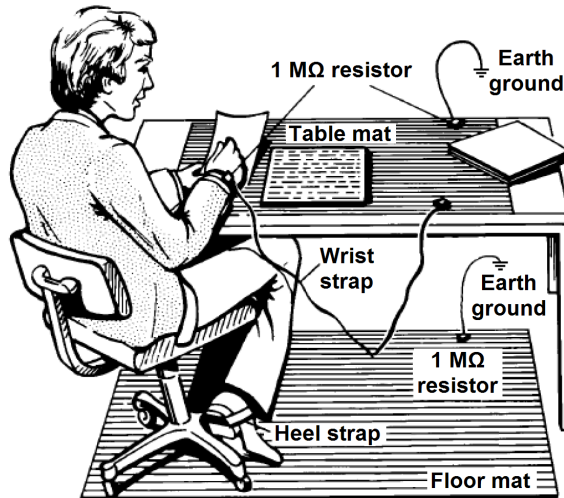
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## Step 1 - Unpack and Inspect the Modules

### CAUTION

The modules are shipped in materials which prevent damage from static. Modules should only be removed from the packaging in an anti-static area ensuring that correct anti-static precautions are taken. Store all modules in anti-static envelopes when not in use.

---



Electrostatic discharge (ESD) can damage or destroy electronic components. Use a static-safe work station to perform all work on electronic assemblies. The figure (left) shows a static-safe work station using two types of ESD protection: conductive table-mat and wrist-strap combination, and conductive floor-mat and heel-strap combination. Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground.

### WARNING

DO NOT use these techniques for a static-safe work station when working on circuitry with a voltage potential greater than 500 volts

---

## Inspect for Damage

After unpacking an instrument, inspect it for any shipping damage. Report any damage to the shipping agent immediately, as such damage is not covered by the warranty (see warranty information at beginning of this document).

See also: [Appendix A - Return Instrument for Repair \(page 100\)](#)

### CAUTION

To avoid damage when handling a module, do not touch exposed connector pins.

---

NOTE

See [www.keysight.com/find/tips](http://www.keysight.com/find/tips) for information on preventing damage to your keysight equipment.

---

## Step 2 - Verify Shipment Contents and Model Options

### Chassis and General Modules

Qty	Keysight Part Number	Description
1	M9018A	M9018A PXIe Chassis (see <a href="http://www.keysight.com/find/M9018A">www.keysight.com/find/M9018A</a> )
1	M9036A or M9037A	PXIe Embedded Controller
1 - 5	M9021A	PCIe Cable Interface

### M9381A Shipment Contents

The Keysight M9381A PXIe Vector Signal Generator is a multi-module instrument (MMI), housed in a PXIe chassis. The minimum Vector Signal Generator consists of the software, chassis, a Keysight M9301A PXIe Synthesizer, a Keysight M9310A PXIe Source Output, a Keysight M9311A PXIe Digital Vector Modulator and a Keysight M9300A PXIe Frequency Reference. The M9300A may be used in this and other configurations.

Items in this table are included in a single Keysight M9381A PXIe Vector Signal Analyzer Shipment. MultiChannel shipments have line item quantities adjusted to accommodate the number of channels.

Qty	Keysight Part Number	Description
1	M9300-10002	Software and Product Information CD, contains: Soft Front Panels, drivers, and all printed documentation in PDF format (also available at <a href="http://www.keysight.com/find/m9381a">http://www.keysight.com/find/m9381a</a> )
1	E2094-60003	Keysight IO Libraries Suite CD
1	M9300-90090	Keysight M9391A PXIe Vector Signal Analyzer and M9381A PXIe Vector Signal Generator Startup Guide in hard copy
1	5023-1450	Wrench, socket, extension, 5/16 inch, SMA
1	5002-3361	SMB/MMCX Cable Removal Tool
3	1810-0118	SMA (m) straight, 50 $\Omega$ termination. These are attached to the M9301A RF/LO ports.
1 *	M9300A	(Optional) Keysight M9300A PXIe Frequency Reference
1 *	M9300-90001	(Optional) M9300A Startup Guide (ships with M9300A)

Qty	Keysight Part Number	Description
1	M9301A	Keysight M9301A PXIe Synthesizer
1	M9310A	Keysight M9310A PXIe Source Output
1	M9311A	Keysight M9311A PXIe Digital Vector Modulator
1	5972-3335	PXI Modular Product Startup Guide Reference
1	9320-6691	China ROHS Addendum for Signal Generator
1	5962-0476	Certificate of Calibration
1	5959-4660	Recommended Due Date for Adjustment/Calibration
1 *	8121-2063	(Optional) Cable, coaxial, BNC/male-SMB/female, 1200 mm (ships with M9300A)
1	8121-2175	Cable, coaxial, SMB/female SMB/female (300 mm)
4	8120-5091	Cable, coaxial, SMB-SMB (120 mm)
1	1250-2316	Adaptor, coaxial, straight, SMA (f) to SMA (m)
1	W1312-20266	Cable, semi-rigid, (SMA-SMA)
1	W1312-20267	Cable, semi-rigid, (SMA-SMA)
4	W1312-20265	Cable, coaxial, SMB-SMB (85 mm)

\*The Keysight M9300A PXIe Frequency Reference is required to configure a Keysight M9381A PXIe Vector Signal Generator. It is an option to the M9381A because it may be ordered in, and shared by other instruments including the M9391A.

See also: [Appendix B - Options \(page 101\)](#)

## M9391A Shipment Contents

Items in this table are included in a single Keysight M9391A PXIe Vector Signal Analyzer Shipment. MultiChannel shipments have line item quantities adjusted to accomodate the number of channels.

Qty	Keysight Part Number	Description
1	M9300-10002	Software and Product Information CD, contains: Soft Front Panels, drivers, and all printed documentation in PDF format (also available at <a href="http://www.keysight.com/find/m9391a">www.keysight.com/find/m9391a</a> )
1	E2094-60003	Keysight IO Libraries Suite CD
1	M9300-90090	Keysight M9391A PXIe Vector Signal Analyzer and M9381A PXIe Vector Signal Generator Startup Guide in hard copy
1	5962-0476	Certificate of Calibration
1	5959-4660	Recommended Due Date for Adjustment/Calibration
1	5023-1450	Wrench, socket,extension, 5/16 inch, SMA
1	5002-3361	Cable removal tool, SMB/MMCX
1	5972-3335	PXI Modular Product Startup Quick Reference
1	9320-6698	China RoHS Addendum for Vector Signal Analyzer
1	M9300A	(Optional) Keysight M9300A PXIe Frequency Reference
1	M9300-90001	(Optional) M9300A Startup Guide (ships with M9300A)
3	1810-0118	SMA (m) straight, 50 $\Omega$ termination. These are attached to the M9301A RF/LO ports.
1	M9301A	Keysight M9301A PXIe Synthesizer
1	M9350A	Keysight M9350A PXIe Downconverter
1	M9214A	Keysight M9214A PXIe IF Digitizer
1	8121-2063	(Optional) Cable, coaxial, BNC/male-SMB/female, 1200 mm (ships with M9300A)
4	8120-5091	Cable, coaxial, SMB/female-SMB/female (120 mm)
1	8121-2100	Cable, coaxial SMB/female SMB/female (85 mm)
1	8121-2175	Cable, coaxial, SMB/female SMB/female (300 mm)
1	W1312-20237 or W1312-20271	Cable, semi-rigid, SMA/male-SMA/male, 32mm
3	1250-2316	Adaptor, coaxial straight, male-SMA to female SMA



## Step 3 - Install the Software

### System Requirements

Topic	Windows 7 Requirements
Operating system	Windows 7 (32 bit and 64 bit), WES7
Processor speed	1 GHz 32-bit (x86), 1 GHz 64-bit (x64), no support for Itanium64
Available memory	4 GB minimum (8 GB recommended for 64-bit operating systems)
Available disk space	1.5 GB available hard disk space, includes: <ul style="list-style-type: none"><li>– 1 GB available for Microsoft .NET Framework 3.5 SP1</li><li>– 100 MB for Keysight IO Libraries Suite</li></ul>
Video	Support for DirectX 9 graphics with 128 MB graphics memory recommended (Super VGA graphics is supported)
Browser	Microsoft Internet Explorer 7.0 or greater

## Hardware Requirements

Topic	Requirements
Chassis	PXle or PXI-H chassis slot. The Keysight M9018A chassis is recommended for phase coherent operation.
Controllers	A PXI or PXI Express embedded controller or remote controller (external PC connected to the chassis by a PCI-to-PXI interface) is required.
Embedded controller	Keysight <b>M9036A</b> or <b>M9037A</b> or an embedded controller that meets the following requirements: <ul style="list-style-type: none"> <li>– PXle system controller (PXI-1 embedded controllers are not compatible) Utilize a 2x4, or 4x4 PXle system slot link configuration. Run one of the operating systems listed in System Requirements (above).</li> </ul>
Remote controller	(for Keysight M9018A chassis use only) A PC running one of the operating systems listed in System Requirements above and a Keysight M9021A Cable Interface x8 with one of the following PC interface options: <ul style="list-style-type: none"> <li>– Keysight <b>M9045B</b> PCIe ExpressCard Adaptor x1, with cable (for a laptop PC) Keysight <b>M9048A</b> PCIe Desktop Adaptor x8, with cable (for desktop PCs)</li> </ul>

## Chassis Requirements

Recommended best practices to ensure proper and safe module operating conditions:

- Ensure proper chassis air flow is maintained
- Select a chassis that provides thermal protection if fans become inoperable or forced air cooling is obstructed
- Use slot blockers (Keysight model **Y1212A**, 5 per kit) and EMC filler panels in empty module slots to ensure proper operating temperatures. Keysight chassis **Keysight M9018A chassis** and slot blockers optimize module temperature performance and reliability of test.
- Set chassis fans to high or auto. Do not disable fans.
- Position chassis to allow plenty of space around chassis air intake and fan exhaust.
- At environment temperatures above 45 °C, set chassis fan speed to high.

## M9018A Chassis Air Flow



The M9018A has multiple air intakes. They are located at the lower sides, lower front, and bottom of the chassis.

## Power up the Controller

**CAUTION** If you are using a remote controller and you have installed the interface cable, you must power up the chassis **BEFORE** you power up the PC. When you power down your chassis, Shut Down the PC **BEFORE** you power down the chassis.

If you are using an embedded controller, complete the following steps:

1. Install the embedded controller module into the chassis. The Keysight M9036A/37A PXIe Embedded Controller and Keysight M9018A PXIe Chassis are recommended. Please refer to the embedded controller and chassis documentation for further details.
2. Connect peripherals (mouse, keyboard, monitor).
3. Power up the chassis.

## Software Installation Overview

This installation includes the following:

- Keysight IO Libraries Suite (IOLS), which includes the Keysight Connection Expert. This software is included with your shipment, and is also available at: [www.keysight.com/find/iosuite](http://www.keysight.com/find/iosuite). This software must be installed first.

**NOTE** Version 17.0 (or newer) of the Keysight IO Libraries Suite is required.

**NOTE** The embedded controllers coming from the factory, already have the IO Library Suite installed.

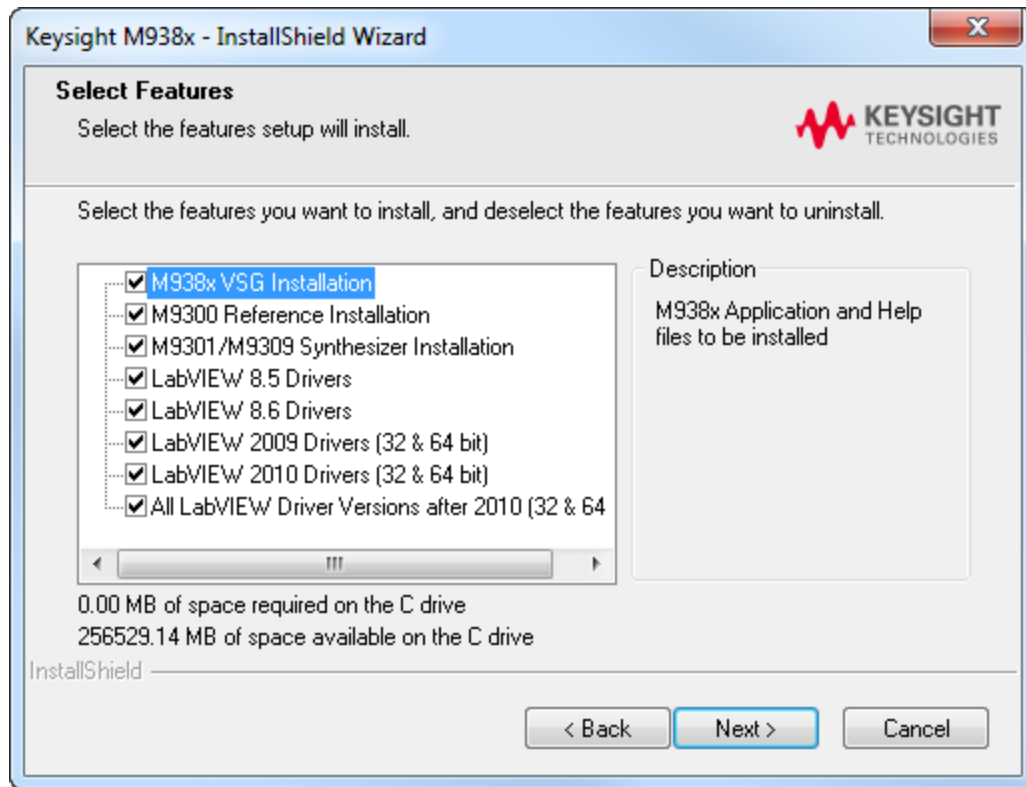
- Instrument software, which includes the soft front panel (SFP), device drivers (IVI-C, IVI-COM, and LabVIEW G) and documentation for the M9381A PXIe Vector Signal Generator and M9391A PXIe Vector Signal Analyzer. This software is included with your shipment and is also available at:

[www.keysight.com/find/M9391A](http://www.keysight.com/find/M9391A)

[www.keysight.com/find/M9381A](http://www.keysight.com/find/M9381A)

## Software Installation Procedure

1. Install the Keysight IO Libraries Suite. Follow the installer prompts to install the IO libraries.
2. Install the product software.  
If you have both Keysight PXIe VSA and VSG, repeat the procedure with the respective installer.
  - a. Launch the software installer.

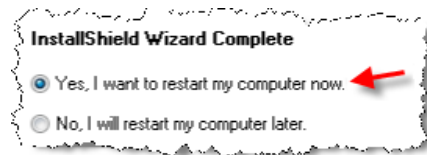


- b. Follow the installer prompts. Choose a "Complete" installation to install all software and documentation, or a "Custom" installation to select from a listing of modules and other features.

## 3. Complete the installation.

Embedded controller (M9036A, M9037A):

1. Select "Yes, I want to restart my computer now." This is the default selection.



2. Click on Finish.
3. Wait for the system to restart.

Remote controller:

(Follow these steps in order, or else instrument damage may result.)

1. Select "No, I will restart my computer later."



2. Click on Finish.
3. Shut down the remote controller PC.  
Use Start > Shut down.
4. Power down the chassis.
5. Power up the chassis.
6. Power up the remote controller PC.

**NOTE**

.Keysight application software such as Signal Studio and the 89600 can be loaded at this point.

## Installing the Multi-Channel Tools

On the Y1299-10001 DVD that accompanies your order is a set of four programs designed to configure, align and correct phase and timing in the multi-channel system. This program set is the the named the Multi-Channel Tools.

## Software

Verify that the following software is installed on the embedded controller:

- 1) 89600 VSA version 19
- 2) Signal Studio (N7624B LTE/LTE-Advanced FDD & N7625B LTE/LTE-Advanced TDD used in this demo guide)
- 3) M9391 version (2.0.280 or newer)
- 4) M938x version (2.0.333 or newer)
- 5) M9018A version (1.4.397.1 or newer).

6) FPGA version (1.05 or newer). A software tool for upgrading to version 1.07 can be obtained [here](#).

7) Multi-channel toolkit (1.0.4 or newer)

## Installing the programs

1. Insert the Y1299-10001 DVD and launch it on your PC
2. In the browser that appears, select the single button to install the utility programs on your PC
3. Follow the instructions to install the programs.
4. Once installed, goto Start >All Programs > Keysight > Multi-Channel Tools

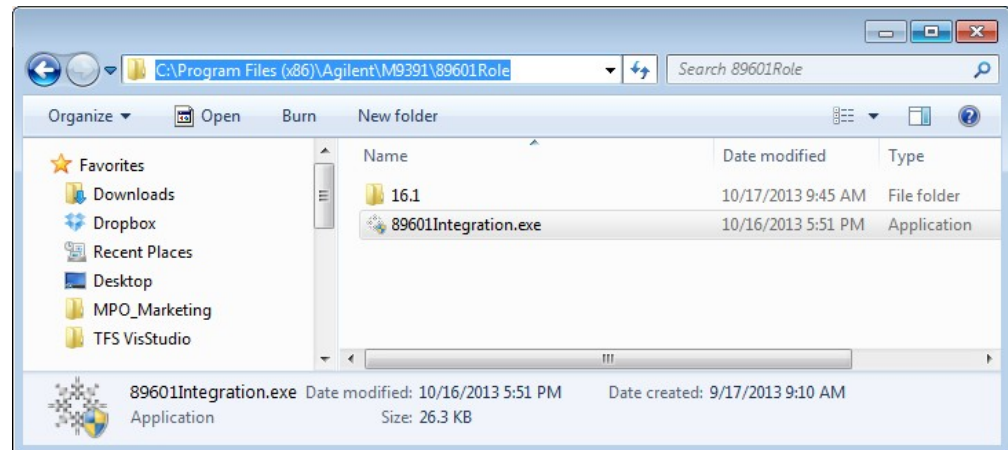
In the Multi-Channel Tools folder will be four programs:

- Multi-Channel PXIe Config Utility: This program configures the backplane triggering, alignments, self-test and 89600 VSA software-hardware configuration.
- VSG Multi-Channel Demo Tool: This program provides control of the multi-channel VSG, loading of corrections and waveforms, and playback.
- VSG Correction Utility: This program determines phase and timing offsets between channels and provides correction values.
- VSA Correction Utility: This program determines phase and timing offsets between channels and loads correction values into the 89600 VSA software.
  
- Licenses are required to play waveforms generated from any Keysight Signal Studio applications. To obtain a temporary license to run the program on a non-Keysight owned computer, please contact your local Keysight representative or obtain a trial license from [Keysight.com](http://Keysight.com).

You can download a temporary license from the Keysight website:

[www.keysight.com/find/free\\_trials](http://www.keysight.com/find/free_trials)

If the 89600 VSA software was installed after the M9391A drivers, you will need to run the 89601Integration.exe application available in the M9391A install directory under the folder 89601Role.



## Step 4 - Install the Modules

**CAUTION** PXI hardware does not support "hot-swap" (changing modules while power is applied to the chassis) capabilities. Before installing or removing a module to/from the chassis, power off the chassis to prevent damage to the module

**NOTE** All component modules for an M9381A or M9391A instrument are factory tested, aligned, calibrated and shipped as a "bundle". It is important that you maintain the bundle when installing modules or returning an instrument for repair

**NOTE** All component modules for an M9381A or M9391A instrument are factory tested, aligned, calibrated and shipped as a "bundle". It is important that you maintain the bundle when installing modules or returning an instrument for repair.

**NOTE** These modules can be used in a chassis with PXIe or PXI-H chassis slots.

## Module Installation Process Overview

There are four standard multi-channel configurations. See [Appendix C - Standard Configurations \(page 103\)](#) for details.

**7** The module can be installed in any PXIe or hybrid PXI slot marked with a peripheral slot compatibility image (solid black circle for PXIe, or solid black circle with the letter -H- for hybrid).

1. Make sure that the line cord is plugged in to establish earth ground and that the chassis power switch is Off.

2. If the chassis has multiple fan speed settings, ensure that the fan switch is set to AUTO and the inhibit switch is set to DEF.



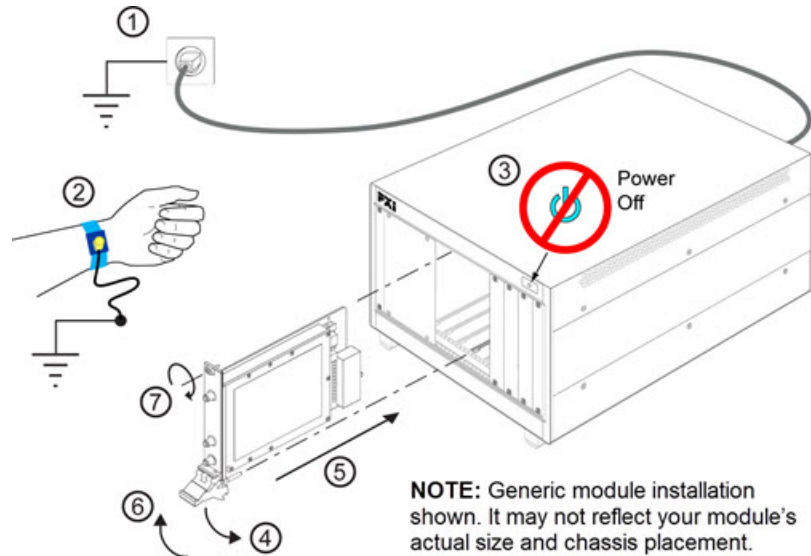
3. Position the chassis to provide ample space around the chassis fan intake and exhaust vents. Blockage by walls or obstructions affects the air flow needed for cooling. (Refer to the chassis documentation for more information about cooling).
4. Before inserting a module into the chassis, back the mounting screws out to ensure that there is no interference between the screws and the mounting rails.
5. See [2x2 M9391A and M9381A Instrument Connections \(page 33\)](#) for configuring two VSAs and two VSGs in a single chassis.  
 See [M9391A Instrument Connections \(page 26\)](#) for positioning the M9391A modules in a single chassis.  
 See [M9381A Instrument Connections \(page 22\)](#) for positioning the M9381A modules in a single chassis.

**NOTE**

When using the Keysight M9018A Chassis you will achieve the highest data throughput for the Keysight M9391A PXIe Vector Signal Analyzer by using Slots 2, 6, 11 or 15 for the Keysight M9214A PXIe IF Digitizer. They are "x8" slots and the others are "x4". For further details see the [Keysight M9018A Chassis documentation](#). If you are using a non-Keysight chassis, consult your manufacturer's documentation.

6. Holding the module by the injector/ejector handle, slide it into an available PXI (or hybrid) slot, as shown in the following figure.





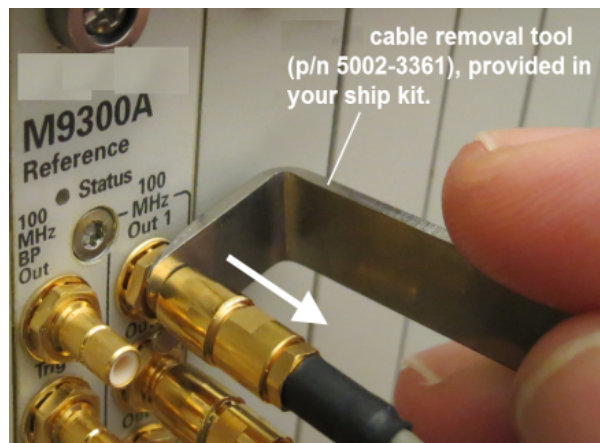
- a. Install the module into the slot of the chassis by placing the module card edges into the front module guides (top and bottom).
  - b. Slide the module to the rear of the chassis and ensure that the injector/ejector handle is pushed down in the unlatched (downward) position.
  - c. Slide the module completely into the chassis. When you begin to feel resistance, pull up on the injector/ejector handle to fully inject the module into the chassis.
7. Secure all modules to the chassis using the module mounting screws. Use a #1 Pozidriv® or a slotted screwdriver and torque to 5 Lb-In (0.57 N-m). Performance may suffer if the screws are not tightened properly.
  8. Verify that the PXI chassis fans are operable and free of dust and other contaminants that may restrict airflow.
  9. Install filler panels and slot blockers after installing the modules. Missing filler panels or slot blockers may disrupt air circulation in the chassis. The left-most slot does not accept a slot blocker.
  10. Your shipment included an Keysight M9310A PXIe Source Output and an Keysight M9350A PXIe Downconverter. With these modules you received a straight, coaxial adapter (1250-2316) (SMA female to SMA male). Connect this adapter to the RF Out connector of each M9310A and the RF In connector of each M9350A, and torque to 8 Lb-In (0.904 Nm). This will extend the life of these often-used connectors.
  11. Use the [M9391A and M9381A Instrument Connections \(page 31\)](#) to attach the cables to the instrument. The torque specification for SMA connectors is 8 Lb-In (0.904 Nm).

12. If you are using a PCIe Cable Interface, such as the Keysight M9021, connect the Cable Interface in the chassis to the PC host per the instructions that came with the Cable Interface.
13. Power up the PXI chassis.
14. Remap the backplane triggers, if necessary. See [Hardware Configuration Considerations \(page 1\)](#).
15. If you are using a remote PC, reboot the PC host.

## Cable and Connector Care

Use the Keysight Cable Removal Tool to disconnect push-on cables from the module front panel connectors.

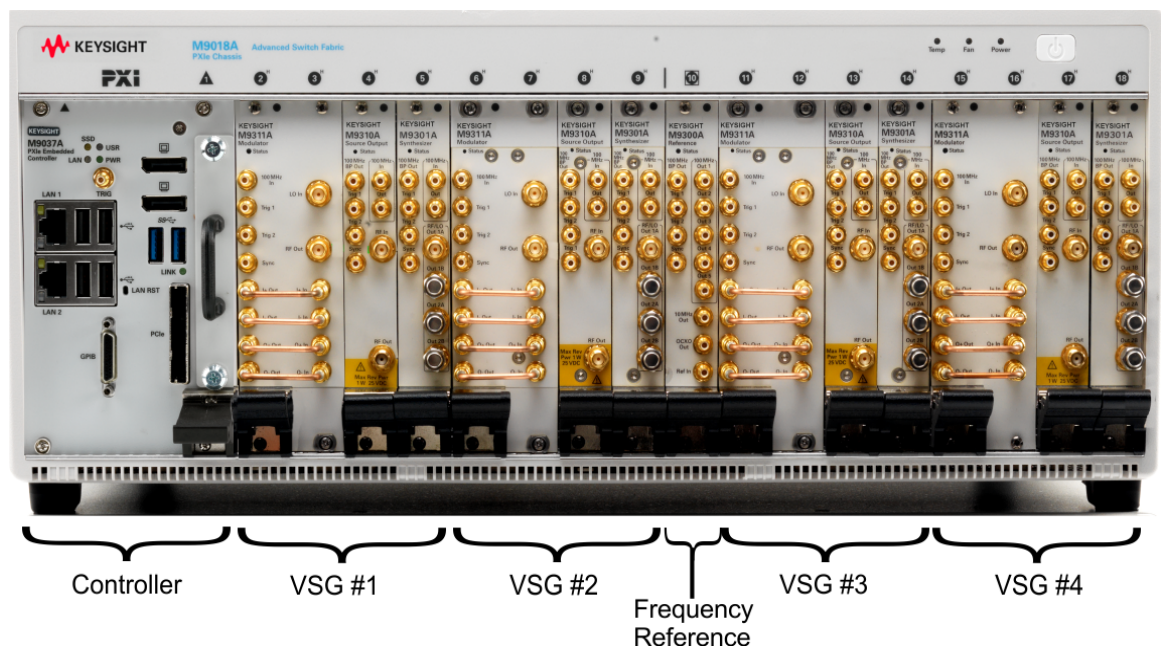
**CAUTION** To avoid damage to the cables or connectors, pull the cable straight away from the connector. Do not use the tool as a pry bar.



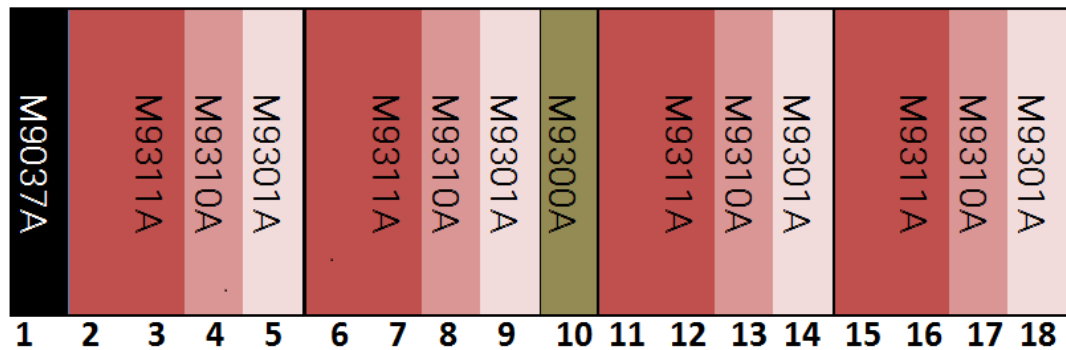
## M9381A Instrument Connections

### Multiple M9381A PXIe VSGs in a Chassis

Up to four M9381A PXIe VSGs can be installed in a single M9018A 18-slot PXIe Chassis, sharing a single embedded controller, as shown here. These PXI VSGs share one M9300A PXIe Frequency Reference and can be time-synchronized with backplane triggering to generate test stimulus for multi-channel receiver devices. The PXI VSGs can also be configured to be phase coherent with Option 012 and cabling all channels to use a single M9301A PXIe Synthesizer module with Y1243A cable kit.



The recommended multiple PXI VSG system is configured as follows:



Other module and instrument placements can be used, but this configuration optimizes speed and makes cabling simpler for phase coherent configuration.

**NOTE**

The M9300A frequency reference module must be installed in slot 10 for proper time synchronization between instruments.

Cabling is different for time-synchronization-only (independent LO) configuration and phase-coherent (shared LO) configuration.

#### Time-Synchronized, Multi-Channel PXI VSG (Independent LO)

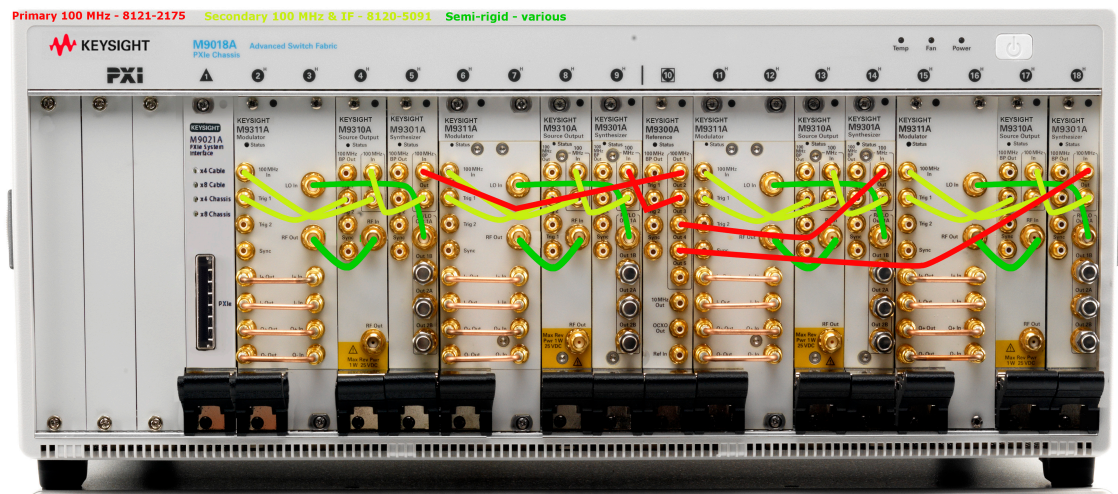
When phase coherence is not required, cable the instrument as follows for time synchronized multi-channel operation for independently tunable channels.

##### 4 Independent LO Cable Connections:

- ■ Primary 100 MHz connection (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz connections (8120-5091, short SMB-SMB)
- ■ Semi-rigids

**NOTE**

Some cabling diagrams that follow show a cable from Trig1 to Trig1 between the M9391A modules. These cables are optional, and are only used for the IF Flatness field calibration.



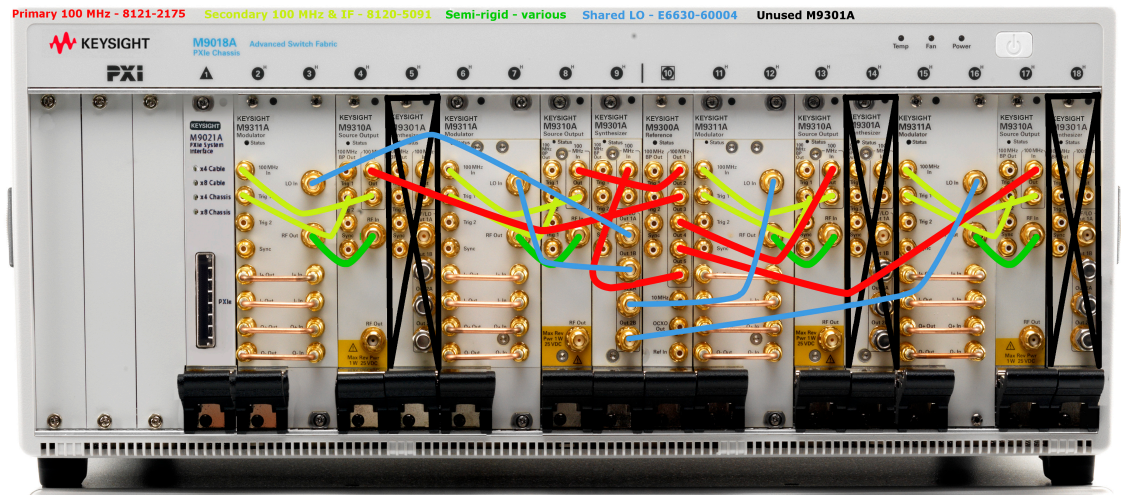
#### Phase-Coherent, Multi-Channel PXI VSG (Shared LO)

When the carrier phase must be aligned between channels (beamforming, relative phase measurements), cable the instrument as follows:

- ■ Primary 100 MHz connections (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz & IF connections (8120-5091, short SMB-SMB)

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- Keysight Y1299A-001 Reference Solution User's Guide

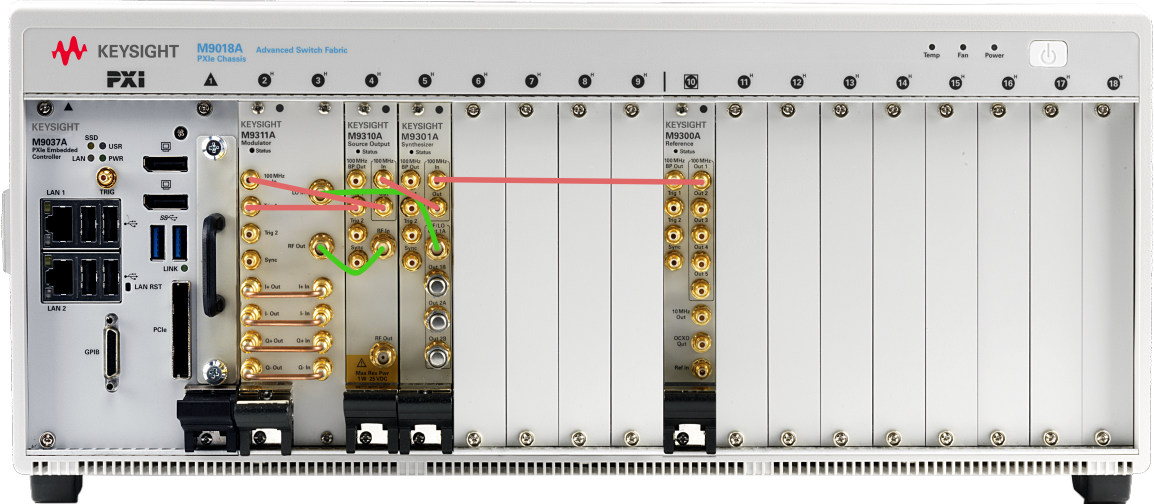




Single M9381A VSG

NOTE

If you are building an M9381A PXIe VSA plus an M9391A PXIe VSG, see [M9391A and M9381A Instrument Connections \(page 31\)](#).



The recommended single PXI VSG system is configured as follows:

VSG: M9381A	REF: M9300A
M9311A in slot 2/3	M9300A in slot 10
M9310A in slot 4	
M9301A in slot 5	

VSG: M9381A	REF: M9300A
M9311A in slot 2/3	M9300A in slot 10
M9310A in slot 4	
M9301A in slot 5	

Recommendation: Install the semi-rigid cables first.  
Torque specification for all SMA connectors is 8 Lb-In (0.904 Nm).

M9381A Cable and Module Table

Part Number	Connection	Cable Description
8120-5091	M9300A 100 MHz Out 1 to M9301A 100 MHz In	Cable, coaxial, SMB (female)-SMB (female)
8120-5091	M9301A 100 MHz Out to M9310A 100 MHz In	Cable, coaxial, SMB (female)-SMB (female)

Part Number	Connection	Cable Description
8120-5091	M9310A 100 MHz Out to M9311A 100 MHz In	Cable, coaxial, SMB (female)-SMB (female)
8120-5091	M9310A Trig 1 to M9311A Trig 1 for Pulse Modulation	Cable, coaxial, SMB (female)-SMB (female)
W1312-20266	M9301A RF/LO Out 1A to M9311A LO In	Cable, semi-rigid, SMA (male) - SMA (male)
W1312-20267	M9311A RF Out to M9310A RF In	Cable, semi-rigid, SMA (male) - SMA (male)
8121-2063	This cable can be used to direct an External Reference into the M9300A Ref In connector.	Cable, coaxial, BNC (male) - SMB (female), 1200 mm
1250-2316	M9310A RF Out connector saver	Adaptor, coaxial, straight SMA (male) - SMA (female)
8121-2175	M9311A Trig 2 to M9214A Trig 1 *	Cable, coaxial, SMB (female)-SMB (female) 300 mm

**NOTE**

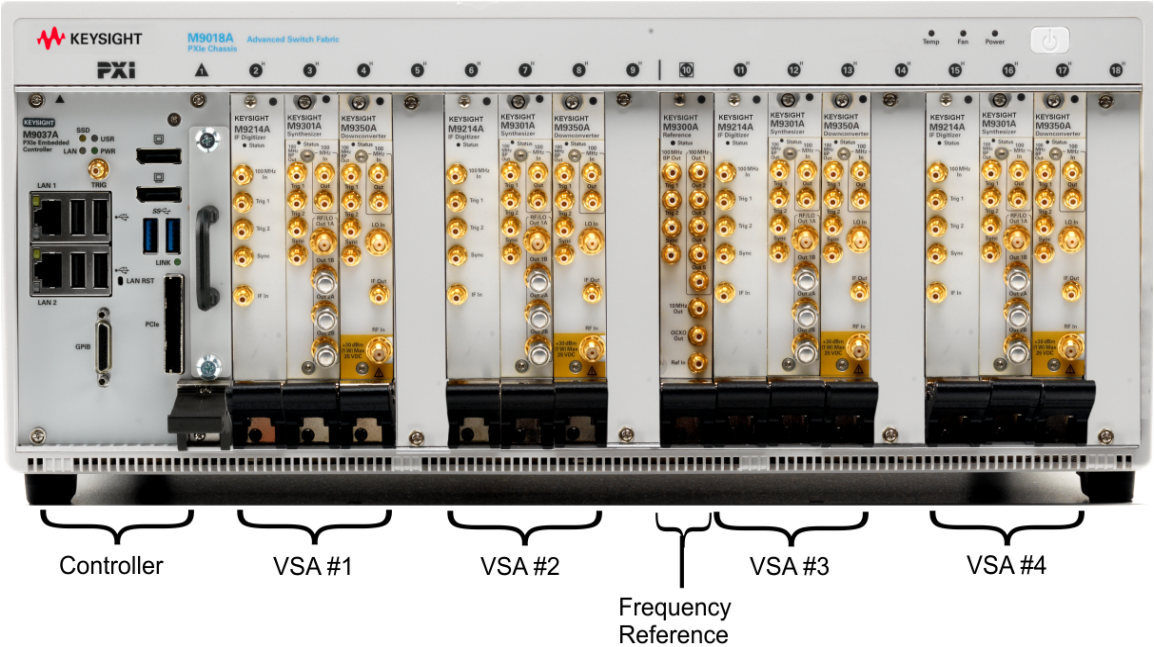
\*The 8121-2175 cable is not required for standard M9381A operation. It is useful for power amplifier (PA) testing with the M9391A. This cable improves repeatability by enabling you to consistently measure the same portion of the input signal.

## M9391A Instrument Connections

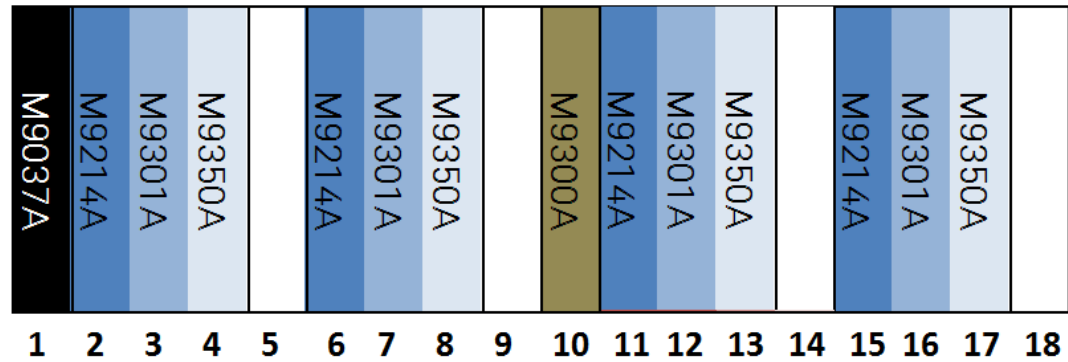
### Multiple M9391A PXIe VSAs in a Chassis

Up to four M9391A PXIe VSAs can be installed in a single M9018A 18-slot PXIe Chassis, sharing a single embedded controller as shown here. These PXI VSAs share one M9300A PXIe Frequency Reference and can be time-synchronized with backplane triggering to measure multi-channel transmitters and analyze multiple channel devices. The PXI VSAs can also be configured to be phase coherent with Option 012 and cabling all channels to use a single M9301A PXIe Synthesizer module with Y1243A cable kit. Slot blockers and EMC filler panels are installed in the empty slots.





The recommended multiple PXI VSA system is configured as follows:



Other module and instrument placements can be used, but this configuration optimizes speed and makes cabling simpler for phase coherent configuration.

**NOTE**

The M9300A PXIe Frequency Reference must be installed in slot 10 for proper time synchronization between instruments.

Cabling is different for time-synchronization-only (independent LO) configuration and phase-coherent (shared LO) configuration. See the following sections for cabling information.

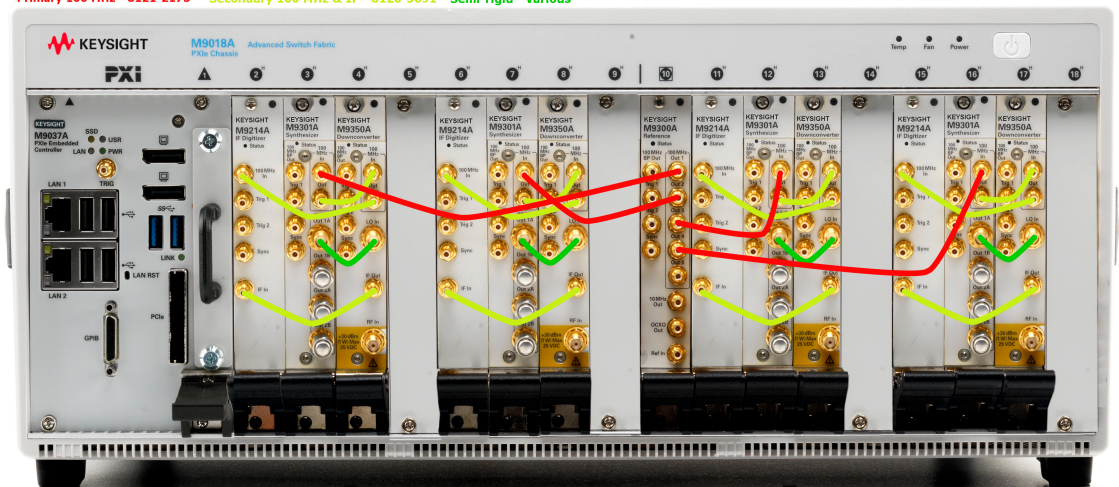
#### Time-Synchronized, Multi-Channel PXI VSA (Independent LO)

When phase coherence is not required, cable the instrument as follows for time synchronized multi-channel operation for independently tunable channels.

4 Independent LO Cable Connections:

- ■ Primary 100 MHz connection (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz connections (8120-5091, short SMB-SMB)
- ■ Semi-rigids

Primary 100 MHz - 8121-2175 Secondary 100 MHz & IF - 8120-5091 Semi-rigid - various



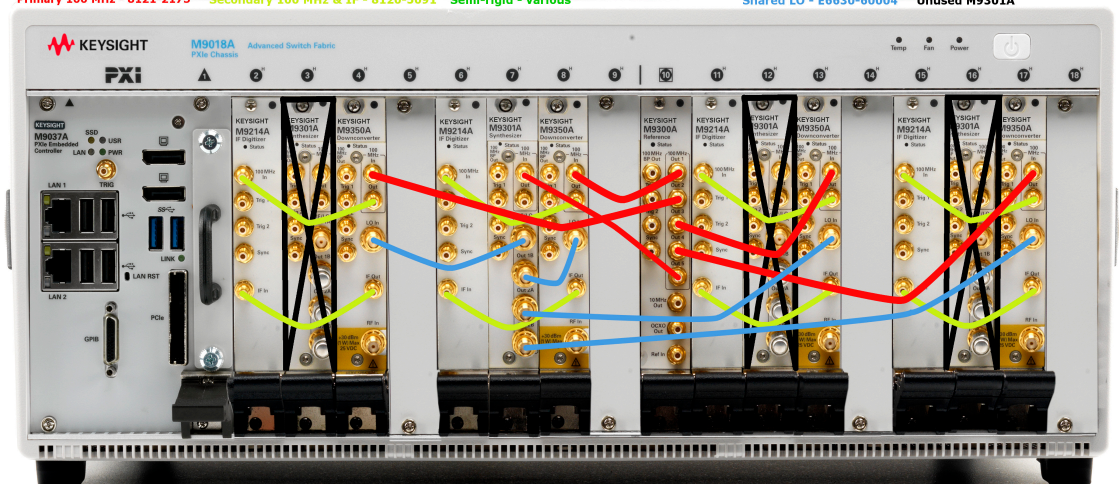
### Phase-Coherent, Multi-Channel PXI VSA (Shared LO)

When the carrier phase must be aligned between channels (beamforming, relative phase measurements), cable the instrument as follows:

- ■ Primary 100 MHz connections (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz & IF connections (8120-5091, short SMB-SMB)
- ■ LO distribution connections (E6630-60004, SMA-SMA)
- Unused M9301A modules

Primary 100 MHz - 8121-2175 Secondary 100 MHz & IF - 8120-5091 Semi-rigid - various

Shared LO - E6630-60004 Unused M9301A



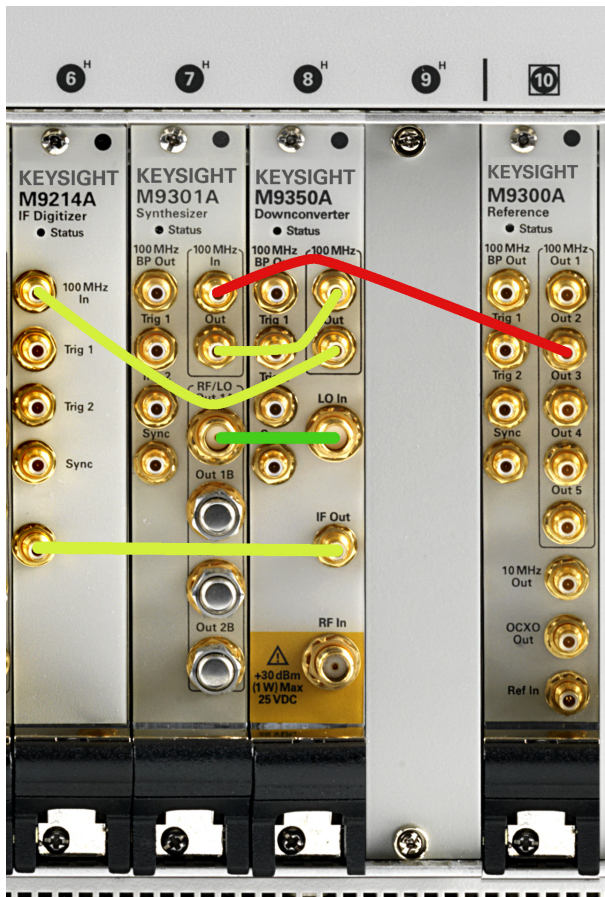
### Single M9391A VSA

**NOTE**

If you are building an M9381A PXIe VSA plus an M9391A PXIe

NOTE

VSG, see [M9391A and M9381A Instrument Connections \(page 31\)](#).



The recommended single PXI VSA system is configured as follows:

VSA: M9391A

REF: M9300A

- M9214A in slot 6
- M9301A in slot 7
- M9350A in slot 8
- M9300A in slot 10

Recommendation: Install the semi-rigid cable first.  
Torque specification for all SMA connectors is 8 Lb-In (0.904 Nm).

M9391A Cable and Module Table

Part Number	Connection	Cable Description
8120-5091	M9300A 100 MHz Out 1 to M9301A 100 MHz In	Cable, coaxial, SMB (female) - SMB (female) 120 mm
8120-5091	M9301A 100 MHz Out to	Cable, coaxial,

Part Number	Connection	Cable Description
	M9350A 100 MHz In	SMB (female) - SMB (female) 120 mm
8120-5091	M9350A 100 MHz Out to M9214A 100 MHz In	Cable, coaxial, SMB (female) - SMB (female) 120 mm
8120-5091	M9350A IF Out to M9214A IF In	Cable, coaxial, SMB (female) - SMB (female) 120 mm
W1312-20237 or W1312-20271	M9301A RF/LO Out 1A to M9350A LO In	Cable, semi-rigid, SMA (male) - SMA (male)
1250-23161	M9350A RF In connector saver	Adaptor, coaxial straight SMA (male) - SMA (female)
8121-20631	This cable can be used to direct an External Reference into the M9300A Ref In connector.	Cable, coaxial, BNC (male) - SMB (female) 1200 mm

## M9391A and M9381A Instrument Connections

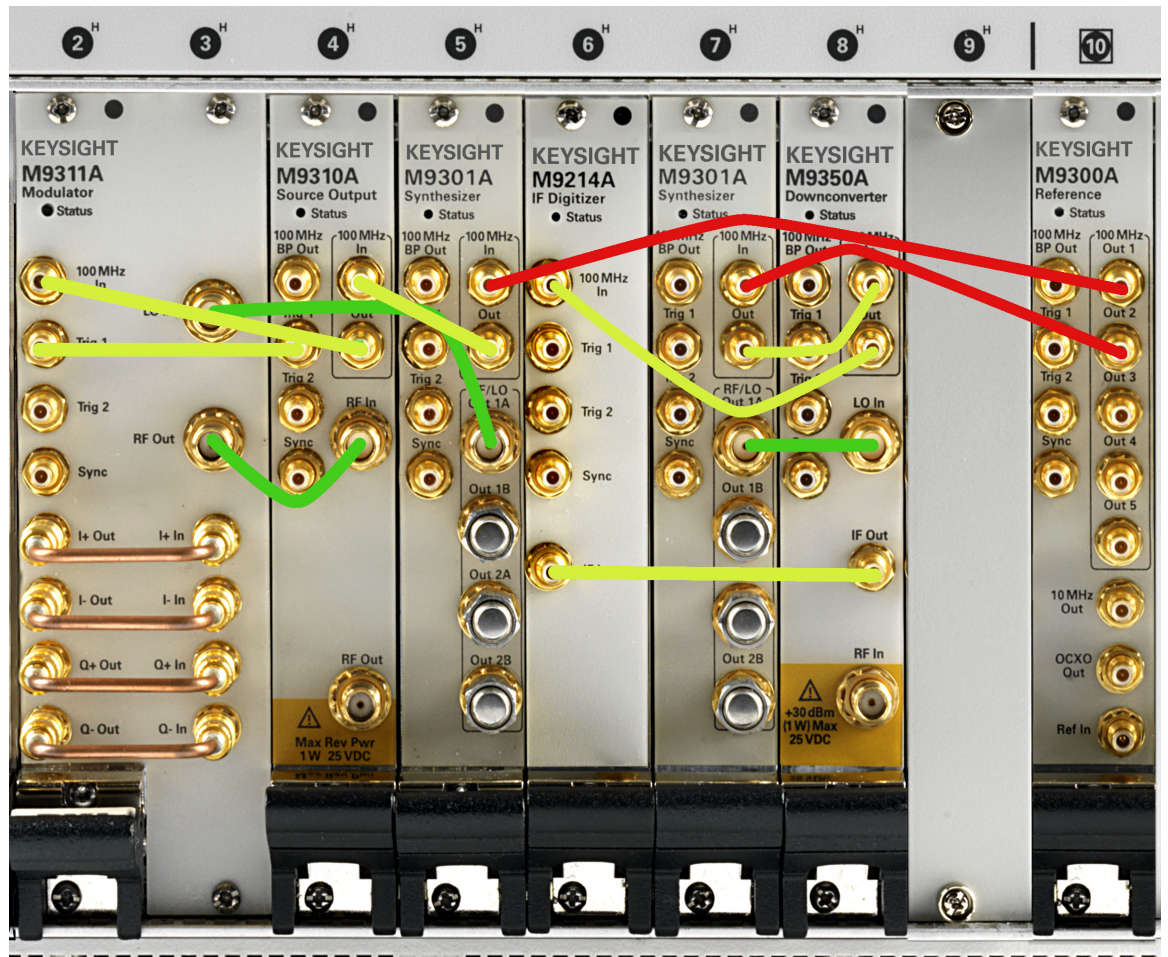
This section contains a cabling diagram for the Keysight M9391A PXIe Vector Signal Analyzer with a Keysight M9381A PXIe Vector Signal Generator. For cable part numbers, see [M9391A Instrument Connections \(page 26\)](#) and [M9381A Instrument Connections \(page 22\)](#).

### NOTE

The M9300A PXIe Frequency Reference module must be installed in slot 10 for proper time synchronization between instruments.

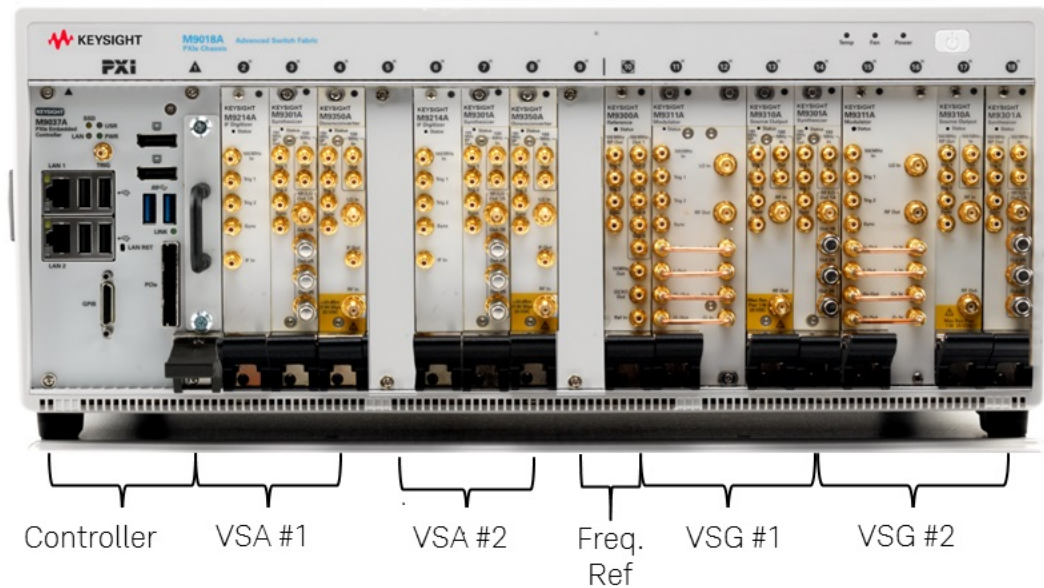


Step 4 -Install the Modules

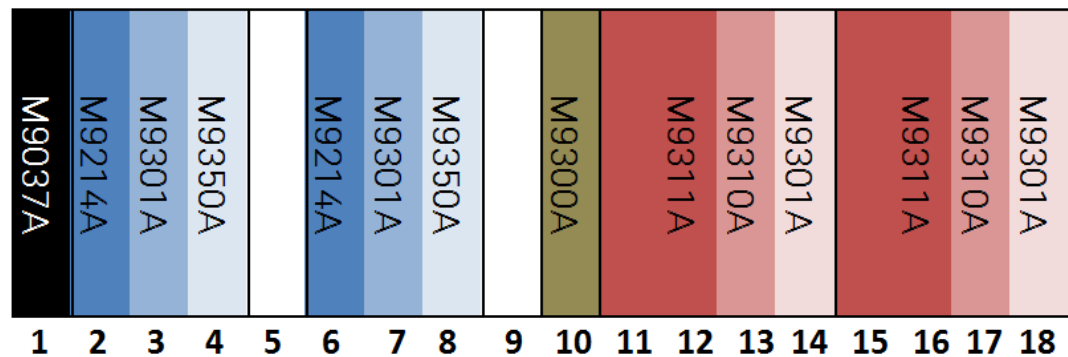


## 2x2 M9391A and M9381A Instrument Connections

Two M9381A PXIe VSGs and two M9391A PXIe VSAs can be installed together in a single M9018A 18-slot PXIe Chassis, sharing a single embedded controller, as shown here. The PXI VSGs and PXI VSAs share one M9300A PXIe Frequency Reference and backplane triggering is used to create a 2-channel source and a 2-channel analyzer for testing 2x2 multi-channel devices. Slot blockers and EMC filler panels are installed in the empty slots.



The recommended 2x2 system is configured as follows:



Other module and instrument placements can be used, but this configuration optimizes speed and makes cabling simpler for phase coherent configuration.

**NOTE**

The M9300A PXIe Frequency Reference module must be installed in slot 10 for proper time synchronization between instruments.

Cabling is different for time-synchronization-only (independent LO) configuration and phase-coherent (shared LO) configuration. See the following sections for cabling information.

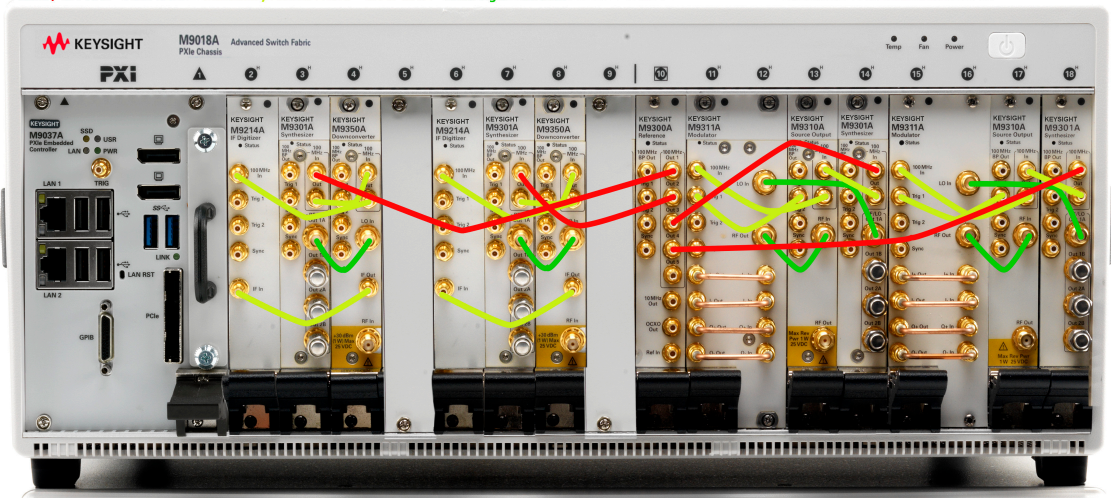
### Time-Synchronized, Multi-Channel PXI VSA & VSG (Independent LO)

When phase coherence is not required, cable the instrument as follows for time synchronized multi-channel operation for independently tunable channels.

2x2 Independent LO Cable Connections:

- ■ Primary 100 MHz connection (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz and IF connections (8120-5091, short SMB-SMB)
- ■ Semi-rigids

Primary 100 MHz - 8121-2175    Secondary 100 MHz & IF - 8120-5091    Semi-rigid - various






### Phase-Coherent, Multi-Channel PXI VSA & VSG (Shared LO)

When the carrier phase must be aligned between channels (beamforming, relative phase measurements), cable the instrument as follows:

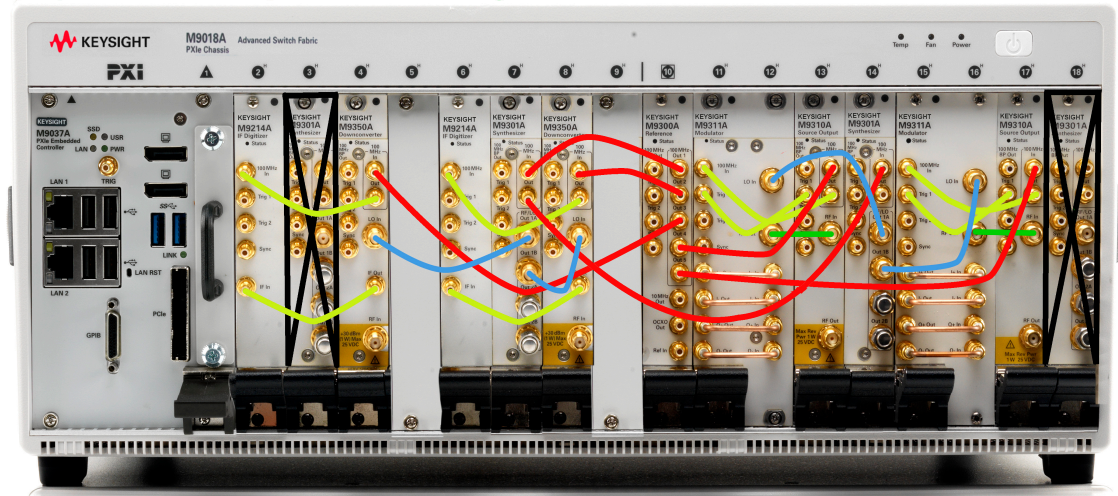
2x2 Shared LO Cable Connections:

- ■ Primary 100 MHz connections (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz & IF connections (8120-5091, short SMB-SMB)



-  Semi-rigids
-  LO distribution connections (E6630-60004, SMA-SMA)
-  Unused M9301A modules

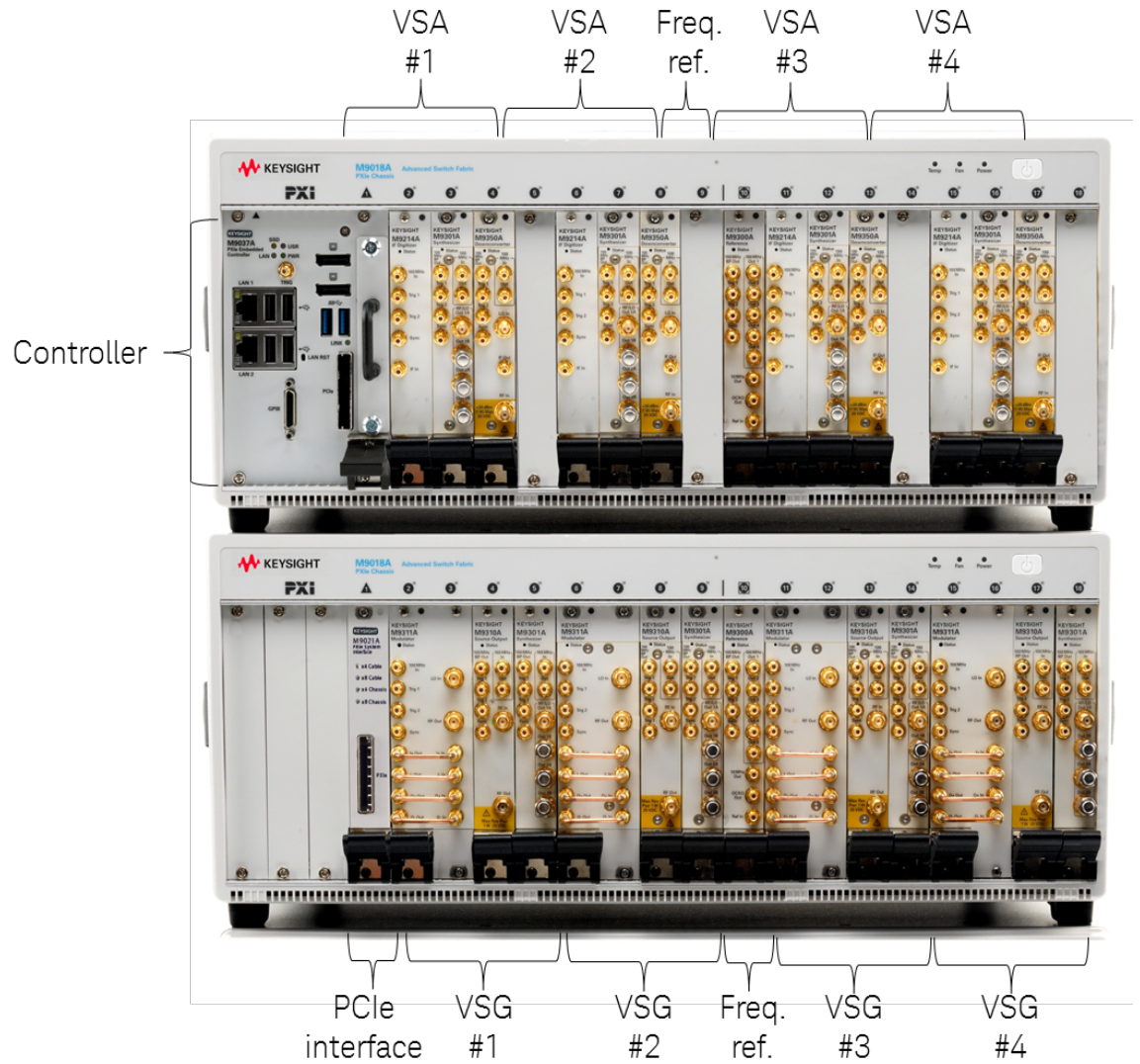
Primary 100 MHz - 8121-2175    Secondary 100 MHz & IF - 8120-5091    Semi-rigid - various    Shared LO - E6630-60004    Unused M9301A



## Up to 4-Channel M9391A and M9381A Instrument Connections

The following example shows a 4-channel M9381A PXIe VSG and 4-channel M9391A PXIe VSA. This can be configured using a single (M9036A or M9037A) embedded controller, M9021A PCIe cable interface modules (2 with M9036A and 1 with M9037A) and PCIe cable to connect the two M9018A 18-slot PXIe Chassis. One M9300A PXIe Frequency Reference is installed per chassis and shared between all instruments in that chassis. All channels within a chassis are synchronized with backplane triggering and phase coherency is enabled with Option 012 and Y1243A cable kit to use one M9301A PXIe Synthesizer for the PXI VSAs and one for the PXI VSGs. Slot blockers and EMC filler panels are installed in the empty slots.

Step 4 -Install the Modules



The recommended 4x4 system is configured as follows:

#### Chassis #1

M9037A	M9214A	M9301A	M9350A		M9214A	M9301A	M9350A		M9300A	M9214A	M9301A	M9350A		M9214A	M9301A	M9350A	
M9021A	M9311A	M9310A	M9301A		M9311A	M9310A	M9301A		M9300A	M9311A	M9310A	M9301A		M9311A	M9310A	M9301A	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

#### Chassis #2

If you use an M9036A Controller, you will need to install an additional M9021A PCIe interface in chassis 1, slot 2 to connect chassis 1 to chassis 2. In that case, VSA #1 will need to occupy slots 3, 4, and 5.

Other module and instrument placements can be used, but this configuration optimizes speed and makes cabling simpler for phase coherent configuration.

#### NOTE

The M9300A PXIe Frequency Reference must be installed in slot 10 for proper time synchronization between instruments. For more information.

Cabling is different for time-synchronization-only (independent LO) configuration and phase-coherent (shared LO) configuration. See the following sections for cabling information:

#### Time-Synchronized, Multi-Channel PXI VSA & VSG (Independent LO)

When phase coherence is not required, cable the instrument as follows for time synchronized multi-channel operation for independently tunable channels.

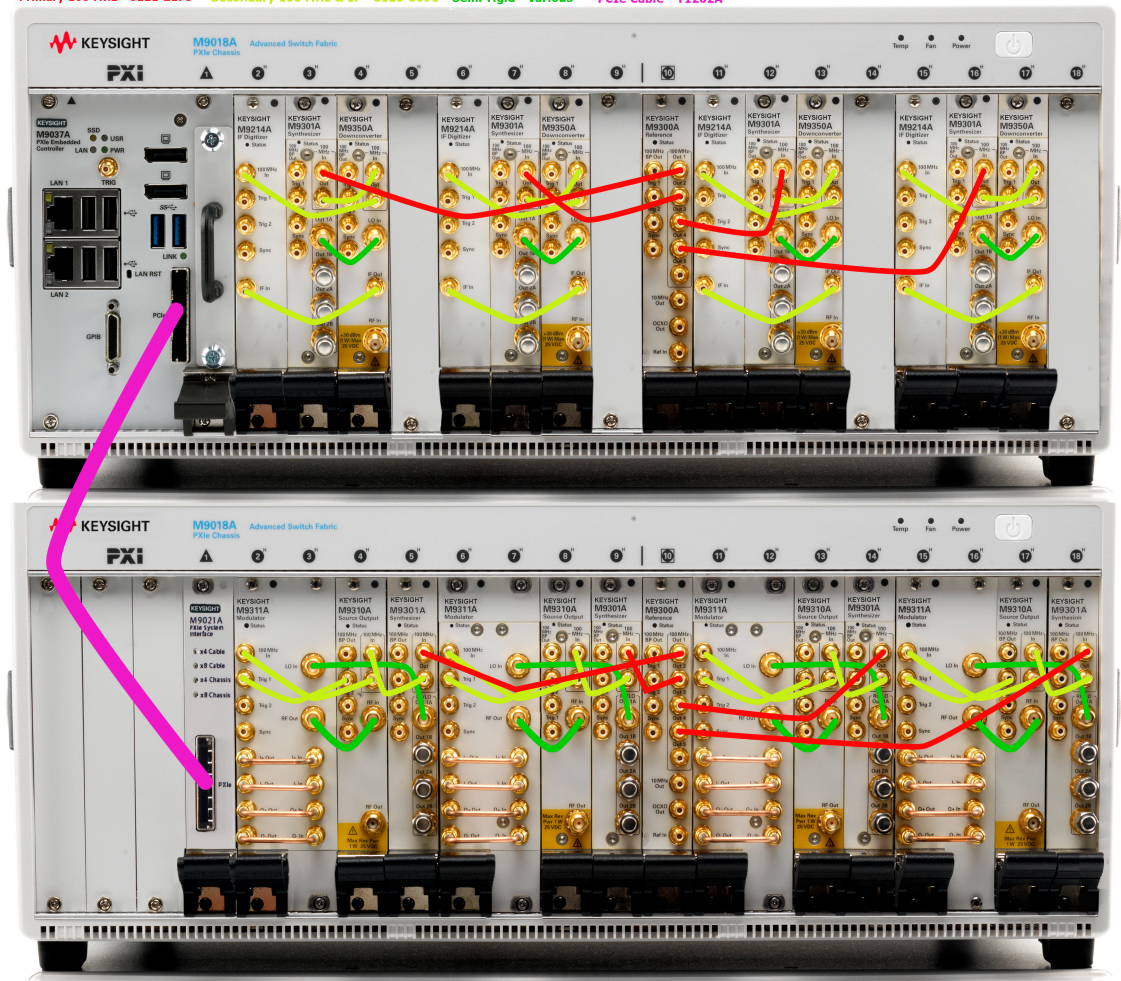
4x4 Independent LO Cable Connections:



## Step 4 -Install the Modules

- ■ Primary 100 MHz connection (8121-2175, long SMB-SMB)
- ■ Secondary 100 MHz and IF connections (8120-5091, short SMB-SMB)
- ■ Semi-rigids
- ■ PCIe cable (Y1202A)







Primary 100 MHz - 8121-2175    Secondary 100 MHz & IF - 8120-5091    Semi-rigid - various    PCIe Cable - Y1202A

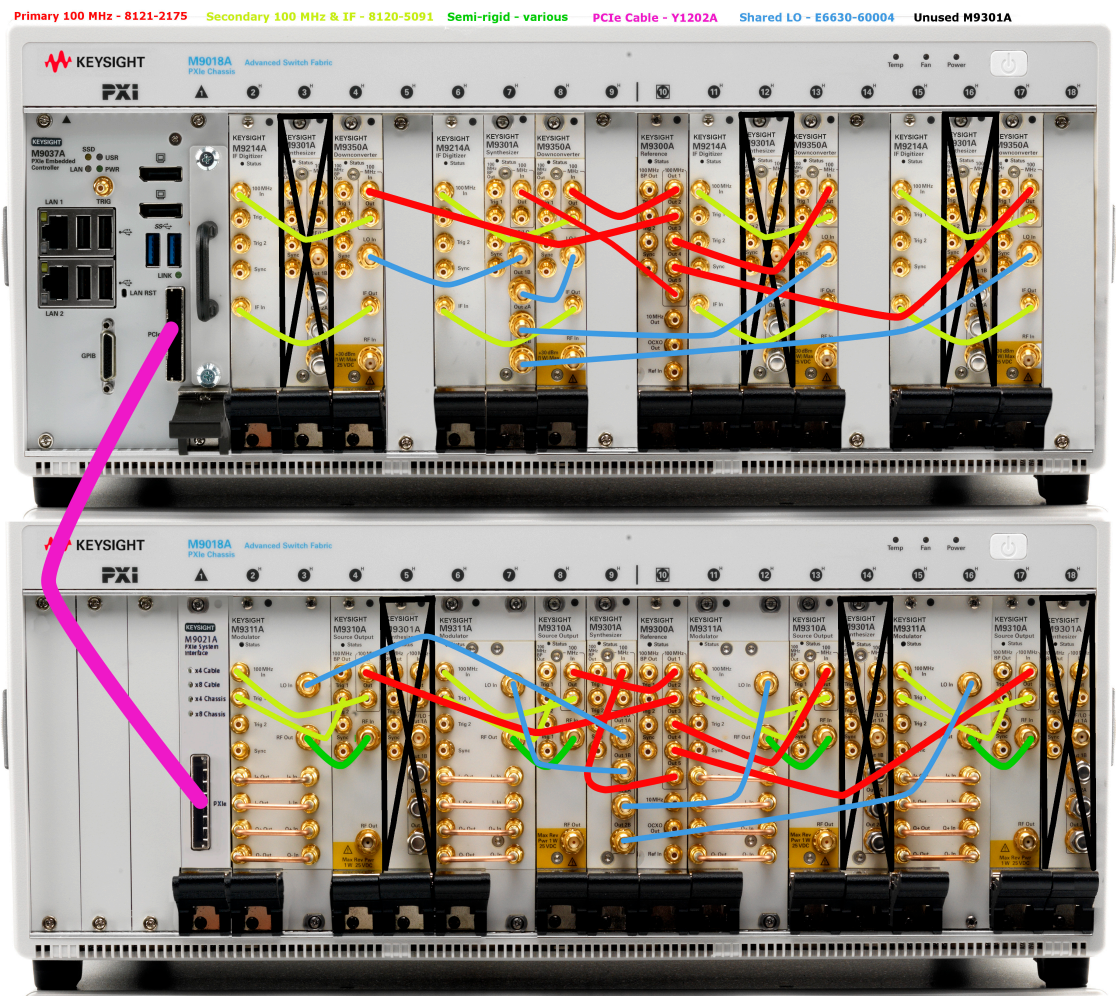


## Phase-Coherent, Multi-Channel PXI VSA & VSG (Shared LO)

When the carrier phase must be aligned between channels (beamforming, relative phase measurements), cable the instrument as follows:

4x4 Shared LO Cable Connections:

-  Primary 100 MHz connections (8121-2175, long SMB-SMB)
-  Secondary 100 MHz & IF connections (8120-5091, short SMB-SMB)
-  Semi-rigids
-  LO distribution connections (E6630-60004, SMA-SMA)
-  PCIe cable (Y1202A)
-  Unused M9301A modules



## 8x8 M9391A and M9381A Instrument Connections

A set of 8-channel M9381A PXIe VSGs installed in two M9018A 18-slot chassis and a set of 8-channel M9391A PXIe VSAs installed in another pair of M9018A 18-slot chassis can be configured for multi-channel testing by using a single (M9036A or M9037A) embedded controller, M9021A PCIe cable interface modules (6 with M9036A and 5 with M9037A) and 3 PCIe cables to connect the four chassis. Each chassis has its own M9300A PXIe Frequency Reference that is shared by all the instruments in that chassis. The M9300A PXIe Frequency Reference must be installed in slot 10 of each chassis. For recommended configuration, the 10 MHz reference signal for each pair of chassis (containing 8-channel M9381A or 8-channel M9391A) is provided by the M9300A in the master chassis from the OCXO Out connector. Alternatively, you can use an external 10 MHz reference signal. For recommended configuration, the OCXO output is split and distributed to the two Reference modules using equal length cables, as shown below. It is critical to synchronize chassis within each chassis group if timing and/or phase synchronization is important to your measurements. For more information on how to set up the 10 MHz reference, refer to [Synchronizing Multiple Chassis](#).

The M9037A embedded controller is recommended for multi-chassis configurations. The M9036A embedded controller or standalone PC are both supported. Not all standalone personal computers work with four chassis configuration. For a list of personal computers that have been tested to be compatible with the M9018A chassis, refer to [PC Tested Configurations with PXI/AXIe Chassis – Technical Overview](#). Similarly, using M9037A or M9036A has several prerequisites. For more information, please contact your local Keysight Technologies Inc. representative.

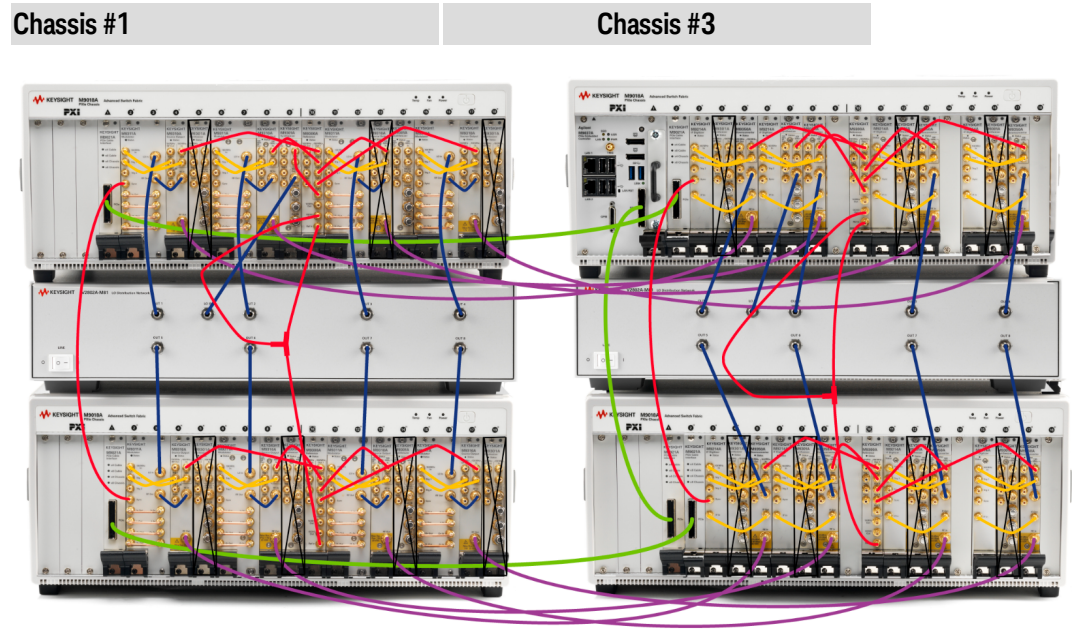
The Keysight M9021A PCIe cable interface modules are connected from one chassis to the other, as shown in the image below. In the M9381A chassis group, the Sync connector of the first M9311A PXIe Digital Vector Modulator of each chassis must be connected to each other. Similarly, in the M9391A chassis group, the Sync connector of the first M9214A PXIe Digitizer of each chassis must be connected to each other. Multi-channel operation requires proper configuration of the chassis backplane trigger lines. The PXIe VSGs or PXIe VSAs can also be configured to be phase coherent with Option 012 and by cabling all channels in the chassis group to use a single M9301A PXIe Synthesizer module via the [M9381A Instrument Connections \(page 22\)](#). See the image below. Slot blockers and EMC filler panels are installed in the empty slots.

### NOTE

The Multi-Channel PXIe Config Utility program will recognise the module placement within each chassis, and whether the system is cabled for shared or independent LO. Use the readings given by this program with the diagrams in this manual to check for system configuration accuracy.



## 8x8 configuration with V2802A shared LO



The recommended 8x8 system is configured as follows:

Chassis #1

M9021A		M9311A	M9310A	M9301A		M9311A	M9310A	M9301A	M9300A		M9311A	M9310A	M9301A		M9311A	M9310A	M9301A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Chassis #2

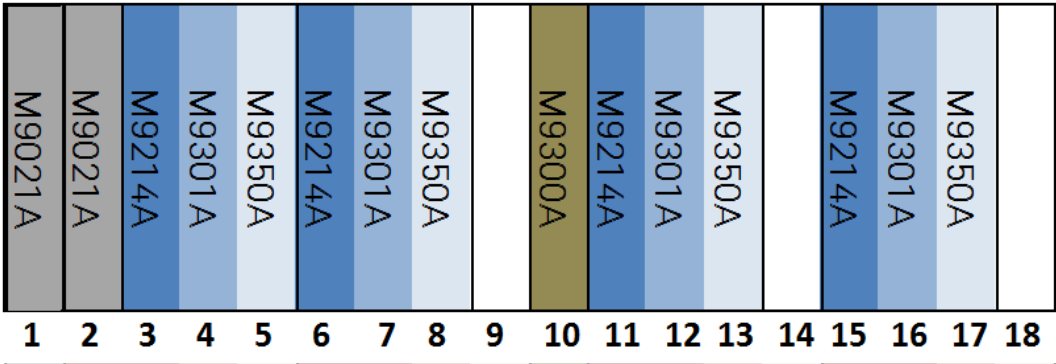
M9021A		M9311A	M9310A	M9301A		M9311A	M9310A	M9301A	M9300A		M9311A	M9310A	M9301A		M9311A	M9310A	M9301A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Chassis #3

M9037A	M9021A	M9214A	M9301A	M9350A		M9214A	M9301A	M9350A		M9300A	M9214A	M9301A	M9350A		M9214A	M9301A	M9350A
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Chassis #4





Other module and instrument placements can be used, but this configuration optimizes speed and makes cabling simpler for phase coherent configuration.

NOTE

The M9300A PXIe Frequency Reference must be installed in slot 10 for proper time synchronization between instruments. For more information, see [Sharing the M9300A Frequency Reference](#).

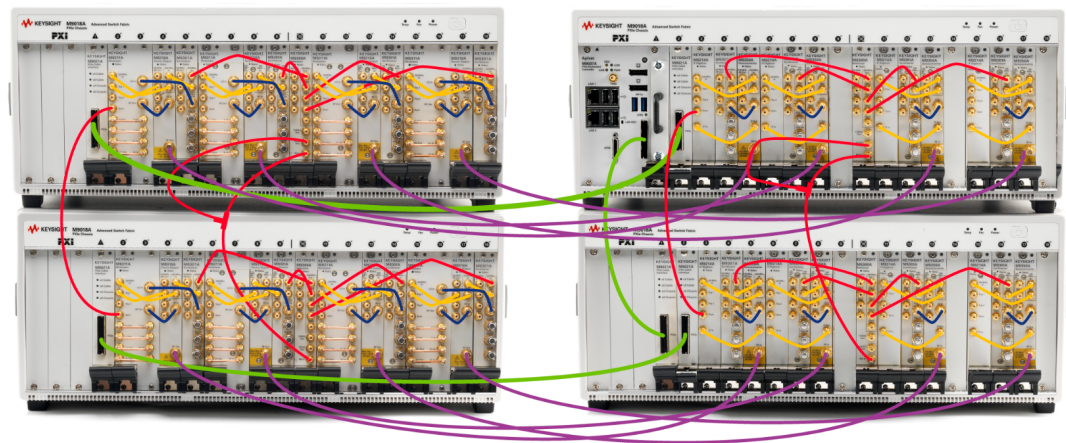
Cabling is different for time-synchronization-only (independent LO) configuration and phase-coherent (shared LO) configuration. See the following sections for cabling information:

## Time-Synchronized Only, Multi-Channel PXIe VSA & VSG (Independent LO)

When phase coherence is not required, cable the instrument as follows for time synchronized multi-channel operation for independently tunable channels.

8x8 Independent LO Cable Connections:

- ■ – Primary 100 MHz connection (8121-2175, long SMB-SMB); chassis sync; 10 MHz distribution
- ■ – Secondary 100 MHz and IF connections (8120-5091, short SMB-SMB); trigger cables
- ■ – LO distribution connections; semi-rigids (W1312-20266 and W1312-20267 for M9381A VSGs and W1312-20237 for M9391A VSAs)
- ■ – PCIe cables (Y1202A)
- ■ – RF loopback



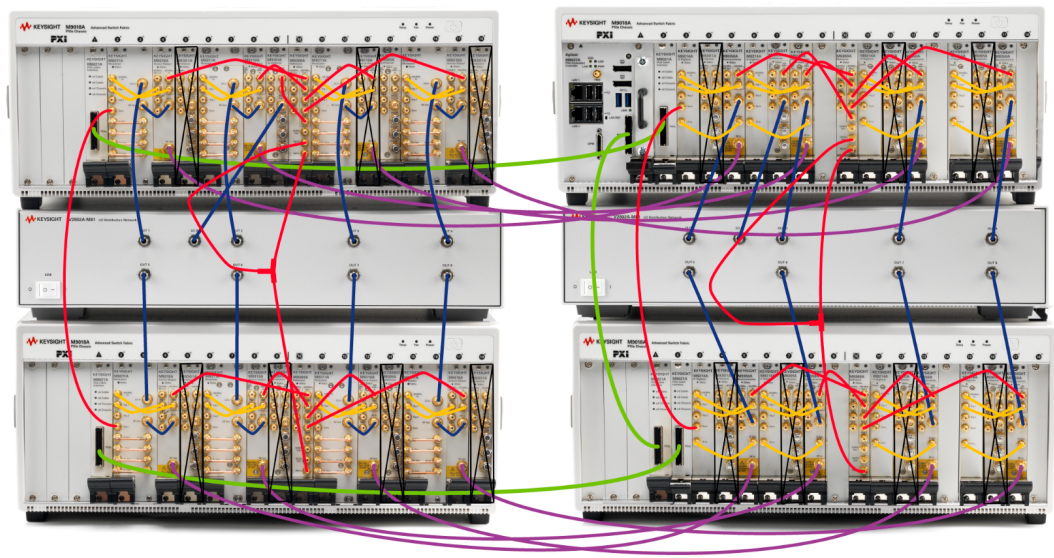
## Phase-Coherent, Multi-Channel PXIe VSA & VSG (Shared LO)

Unlike the independent LO use case, phase-coherency requires the V2802A LO Distribution Network to be placed between each pair of chassis. For more information, refer to [M9381A Instrument Connections \(page 22\)](#).

When the carrier phase must be aligned between channels (beamforming, relative phase measurements), cable the instrument as follows:

8x8 Shared LO Cable Connections:

- ■ – Primary 100 MHz connection (8121-2175, long SMB-SMB); chassis sync; 10 MHz distribution
- ■ – Secondary 100 MHz and IF connections (8120-5091, short SMB-SMB); trigger cables
- ■ – LO distribution connections; Semi-rigids (V2800-20006, V2800-20008, V2800-20009 for VSGs and V2800-20010, V2800-20011, V2800-20007 for VSAs)
- ■ – PCIe cables (Y1202A)
- ■ – RF loopback
- □ – Unused M9301A modules



## Step 5 - Quick Start Measurements

This multi-channel reference solution is used in particular to test:

- Multi-antenna techniques that are used in diversity
- Spatial multiplexing multiple-in, multiple-out (MIMO)
- Beamforming in cellular and wireless LAN applications

For further details refer to [www.keysight.com/find/pxi-mimo](http://www.keysight.com/find/pxi-mimo).

Multi-channel transmitter and receiver testing may require synchronization of multiple signal generators and/or signal analyzers in time and frequency. For example, wireless LAN transmitters can be measured by multiple receivers operating at the same frequency and with acquisition timing aligned, and receivers can be tested using synchronized signal generators.

The M9381A VSG and M9391A VSA can be configured to operate in multi-channel configurations with a shared 100 MHz frequency reference, and an independent, or shared local oscillator (synthesizer) for each channel. This allows them to operate at the same frequency for multi-channel operation, and at different frequencies for modes in which multiple carriers are used, but baseband timing alignment is still required.

For more information on LTE/LTE-A Multi-Channel Systems see:

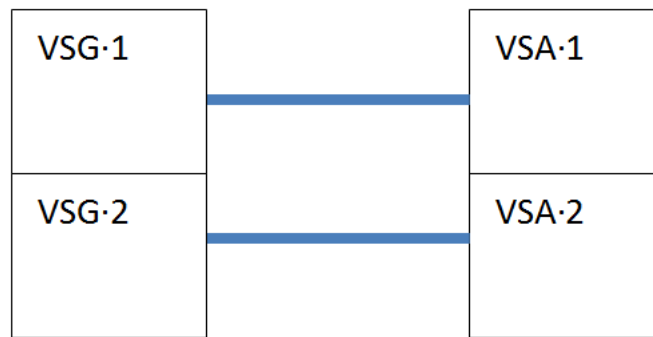
- Solution Brochure 5991-4684EN
- Configuration Guide 5991-4647EN

## Quick Start to First Measurement

This section is meant to help you get to a first measurement and confirm proper operation of your equipment. All PXI modules should have been installed and cabled up according to the previous sections. All required software should have been installed as well.

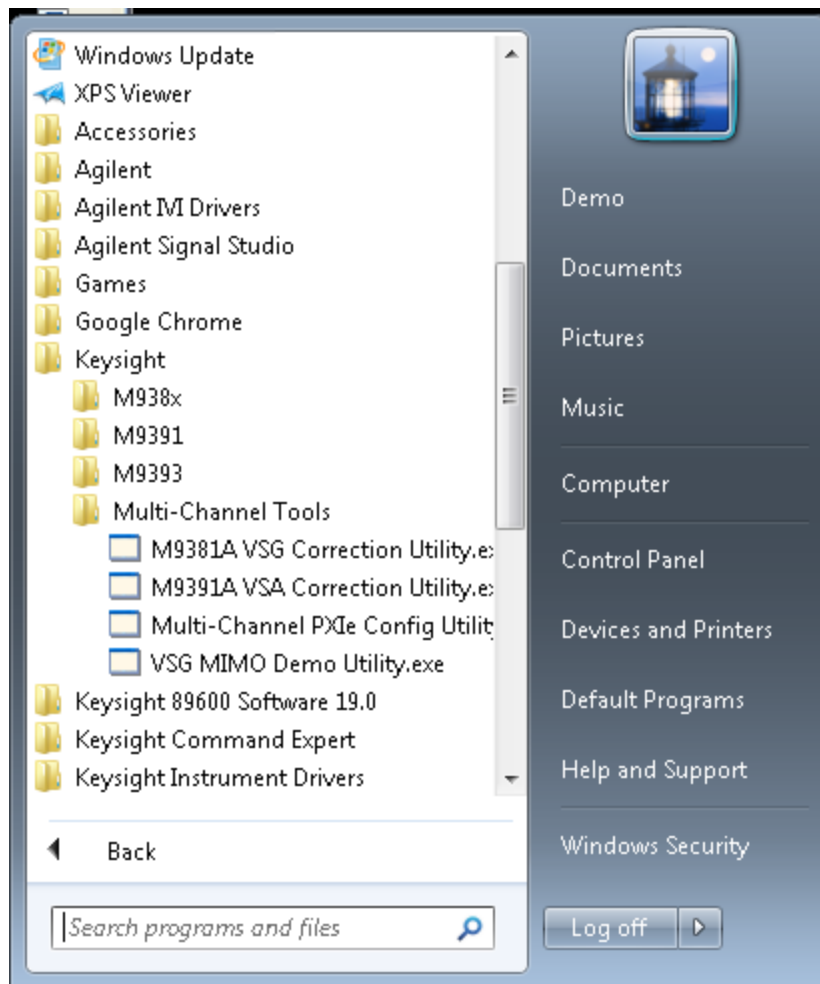
The following instructions are applicable for any configuration up to the 8x8 configuration.

Connect your system into a “Loopback” configuration, where each VSG is connected directly to its corresponding VSA.



This will allow us to verify the operation of the VSGs and VSAs without any additional hardware.

Start the Multi-Channel PXIe Config Utility from your Start menu under All Programs > Keysight > Multi-Channel Tools.

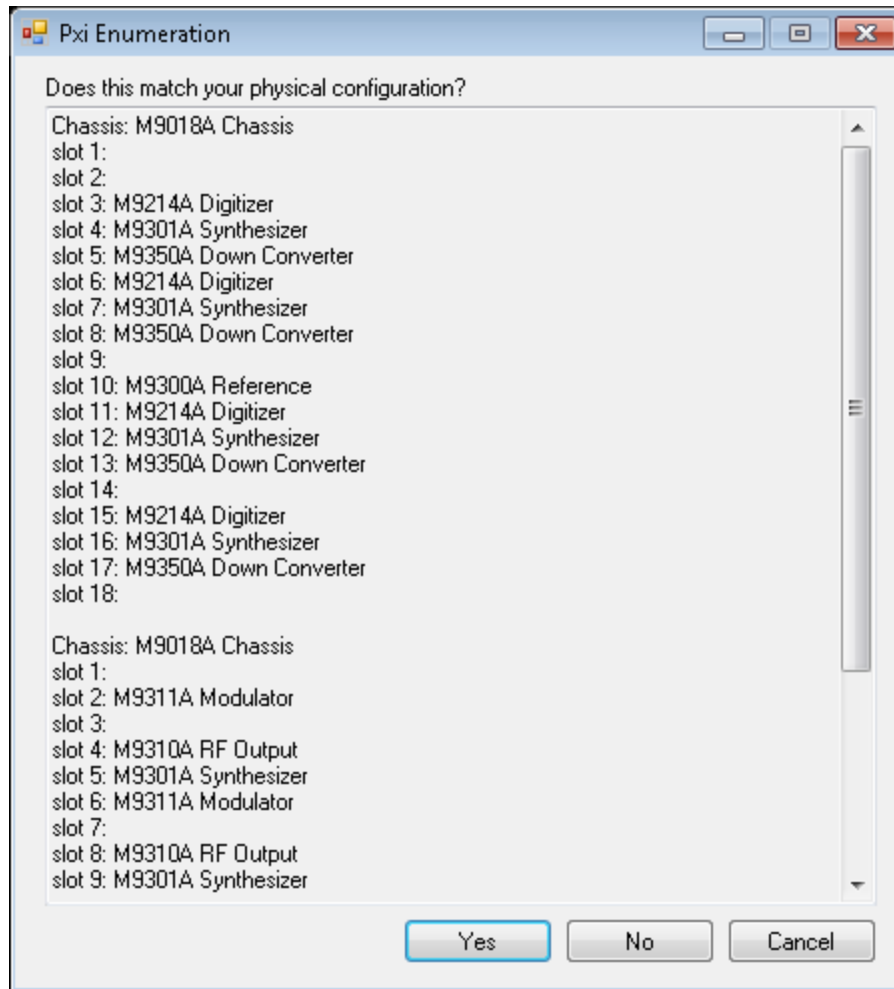


We will be using the Config Utility to:

- Configure the M9018A chassis backplane triggers to support device communication

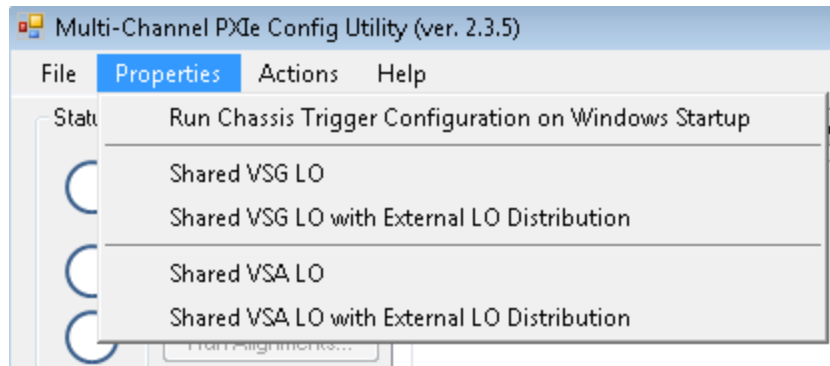
- Run any IF Flatness and LO Level alignments needed
- Run Self-Test on the complete system. This can take up to nine minutes on an 8x8 configuration.
- Setup a new Hardware Configuration in the 89600 VSA Software
- Verify VSG playback

The first time the Config Utility is started you will see the Pxi Enumeration window.



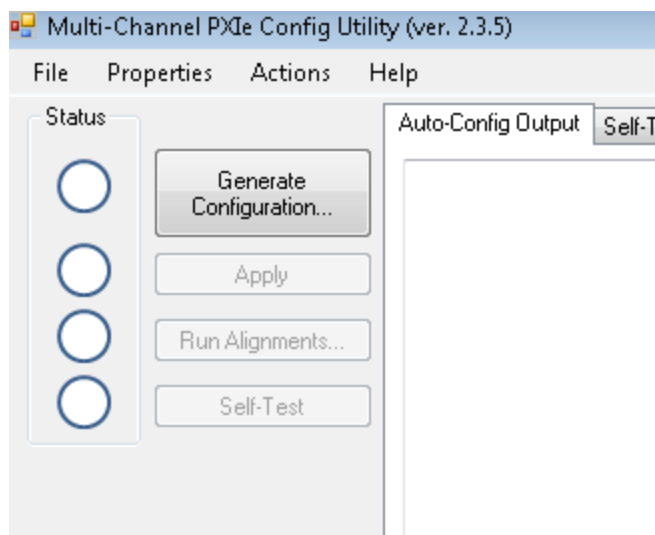
This is a text representation of all the PXI modules that are currently available to you software environment. Verify that all modules installed into your chassis are represented in the list. If any items are missing, click the 'No' button and follow the instructions. Otherwise, click 'Yes'.

You will now provide information on the physical configuration of the Config Utility. Under the 'Properties' menu you will find the settings that reflect how you have cabled your Synthesizer (M9301A) modules.



- If you have cabled your system into a shared LO/Synthesizer configuration (all VSGs are connected to the same M9301A module and all VSAs are connected to the same M9301A module) then make sure you check 'Shared VSG LO' and 'Shared VSA LO' options.
- If you are routing the LO Out of the M9301A modules into V2802A LO Distribution boxes, check the 'Shared VSG LO with External LO Distribution' and 'Shared VSA LO with External LO Distribution'.
- If each VSG and VSA is using its own independent M9301A Synthesizer module, make sure none of the Shared LO options are checked

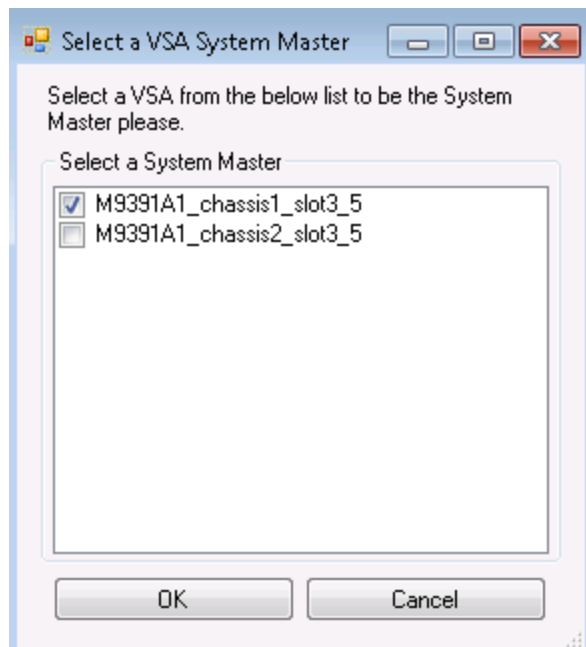
Once you have finished selecting LO options, click on the 'Generate Configuration...' button.



The 'Select Multi-Channel Devices' dialog window will be displayed. By default, all VSGs and VSAs are selected to be part of the multi-channel configurations. Leave everything selected for your configuration and click 'OK'.

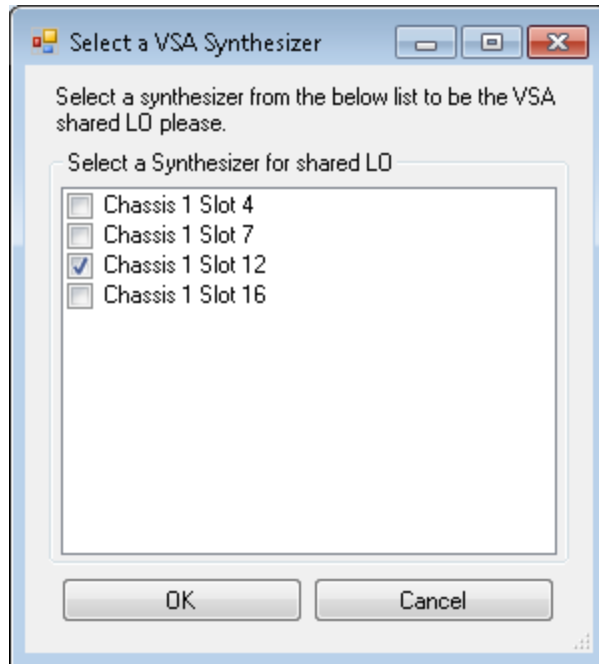


If your VSGs or VSAs span multiple chassis, you will need to specify a device to be a VSG System Master or VSA System Master in the 'Select a VSG System Master' or 'Select a VSA System Master' windows respectively.



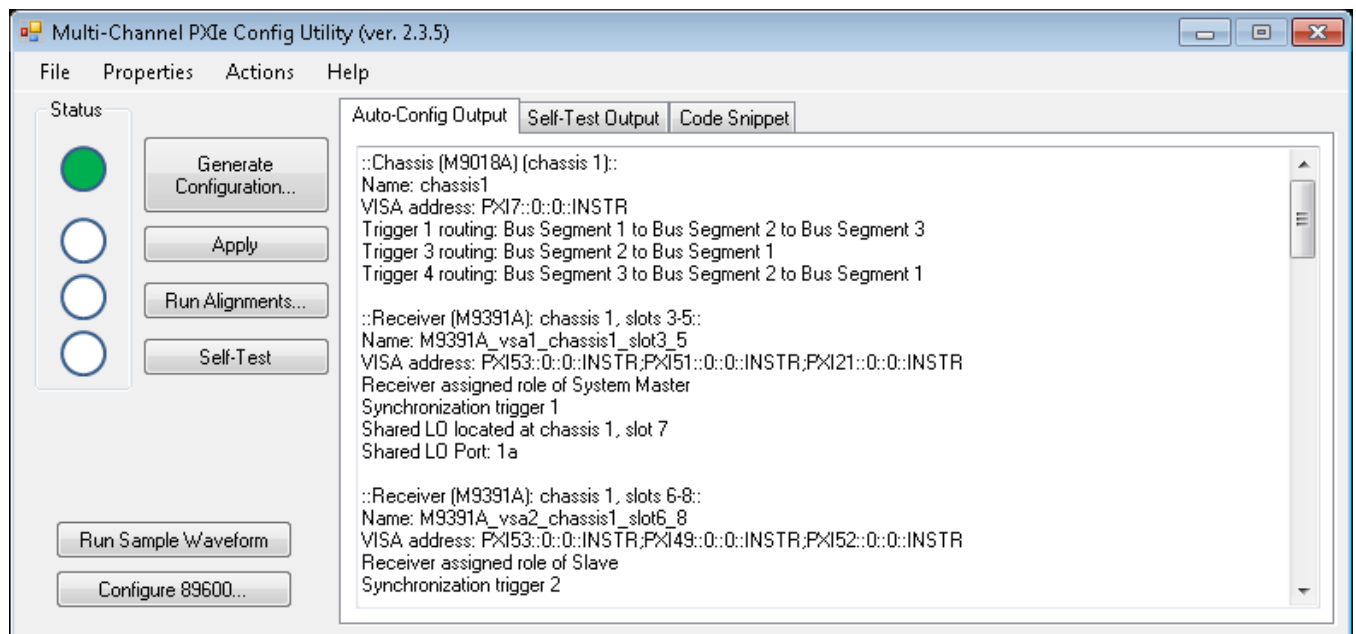


If you are setting up a system with a shared synthesizer, you may also have to select which synthesizer is being shared by either your VSGs or VSAs in the 'Select a VSG Synthesizer' or 'Select a VSA Synthesizer' windows respectively.



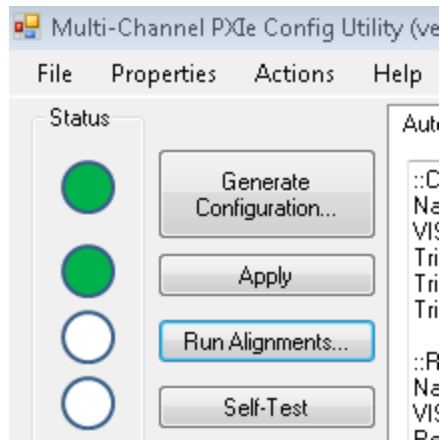
Select the M9301A Synthesizer module that you cabled as your shared synthesizer and click 'OK'.

After you have finished with the dialog windows, a text output of the system settings will be displayed in the 'Auto-Config Output' tab. Click 'Apply' to commit these changes.

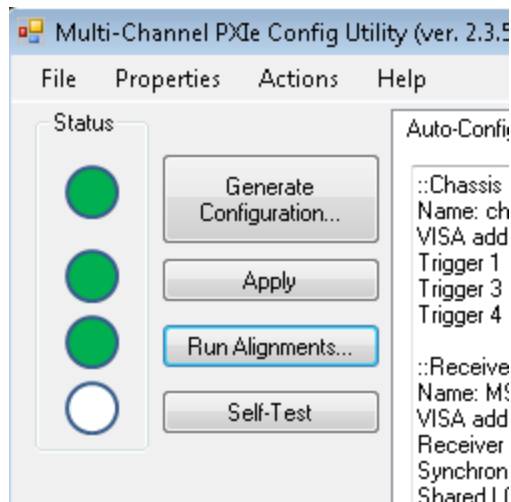


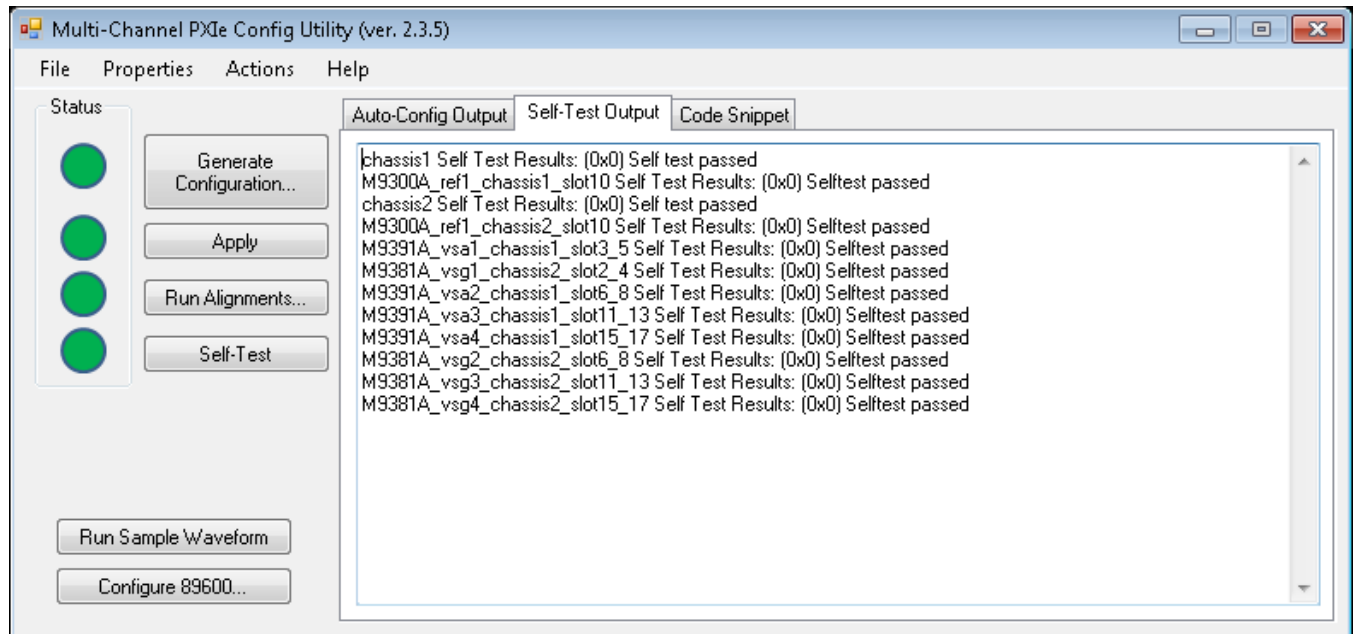
After clicking the 'Apply' button, the Config Utility will route the backplane trigger lines to the M9018A chassis and configure the [M9300A reference modules based on your configuration.

Click on the 'Run Alignments...' button and follow the cabling prompts in order to perform any IF Flatness and LO Level alignments needed by your system.

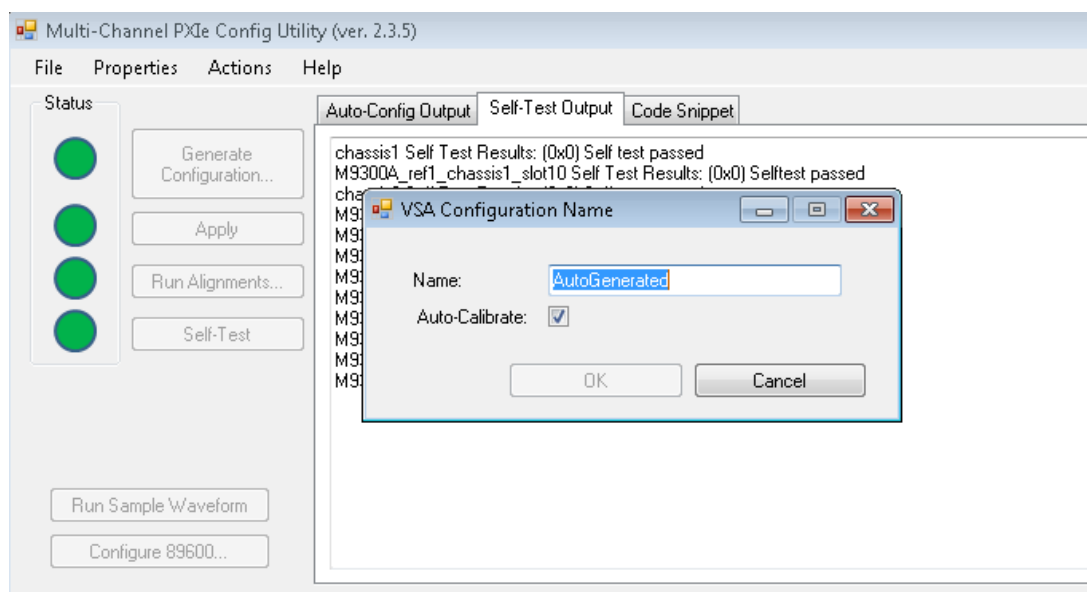


Click on the 'Self-Test' button. This will run self-test on all VSGs, VSAs, reference modules, and chassis in your system. If self-test reports any errors with your system, please see the corresponding M938x or M9391A documentation for help resolving the issues.





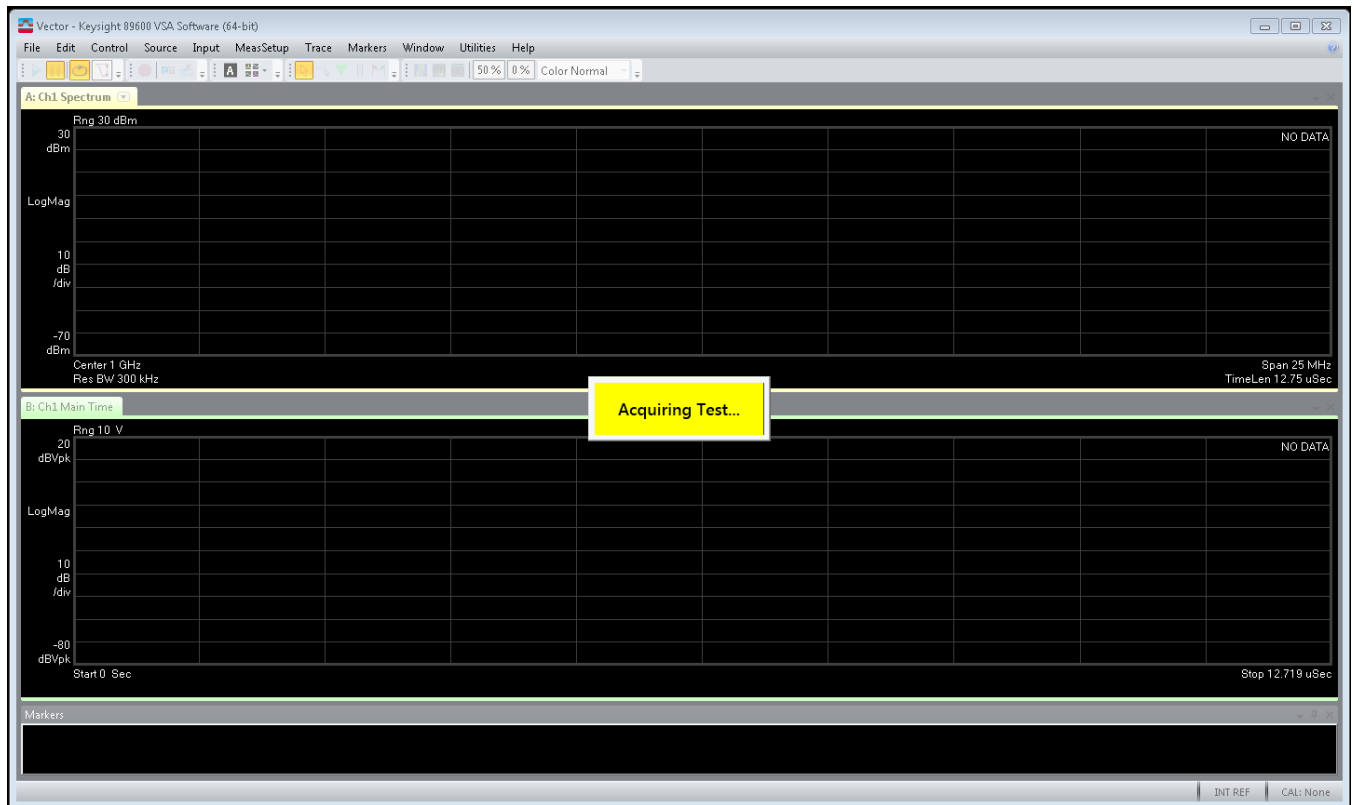
After Self-Test completes, click on the 'Configure 89600...' button.



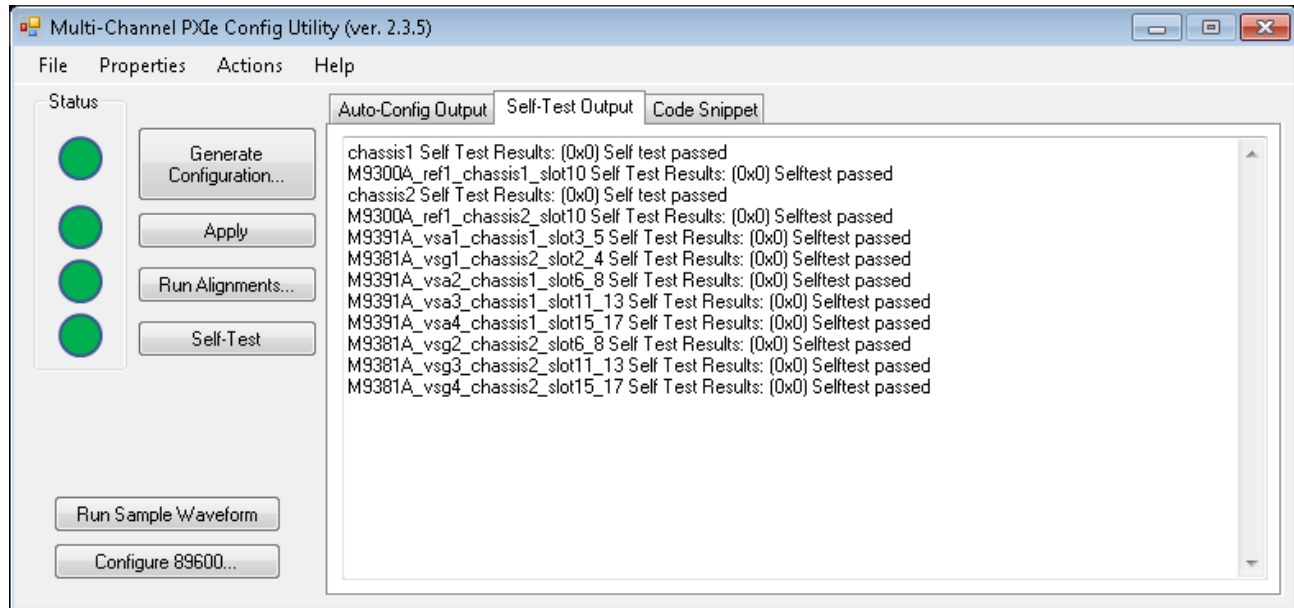
Provide a name for the new Hardware Configuration that will be created by the Config Utility in the 89600 VSA Software. Uncheck the 'Auto-Calibrate' checkbox, then click 'OK'.

The Config Utility will start the 89600 VSA Software, create the new Hardware Configurations, and connect to the VSA hardware. Note: the 89600 Splash Screen will not be displayed while the software loads.

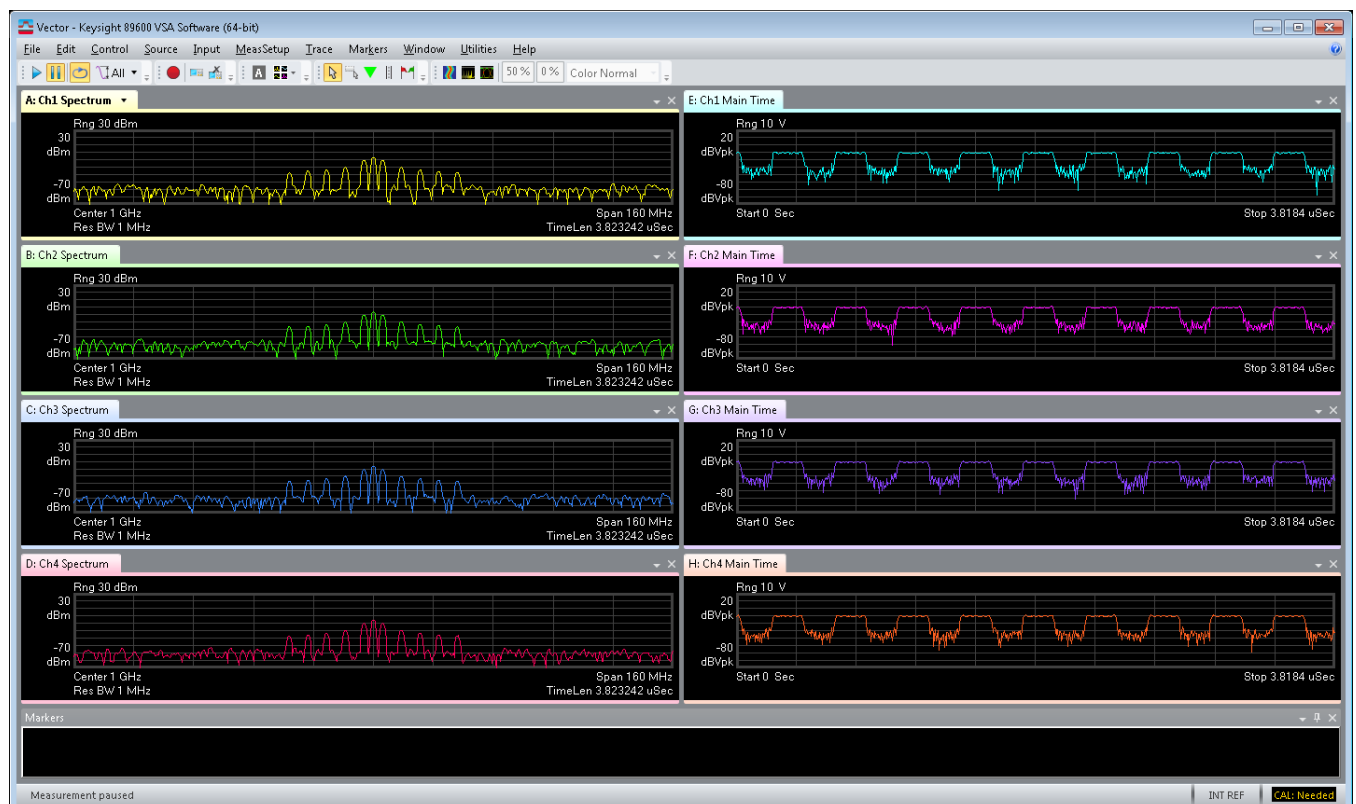
## Step 5 - Quick Start Measurements



Click on 'Run Sample Waveform' in the Config Utility. This will connect to the VSGs and play a simple square wave.



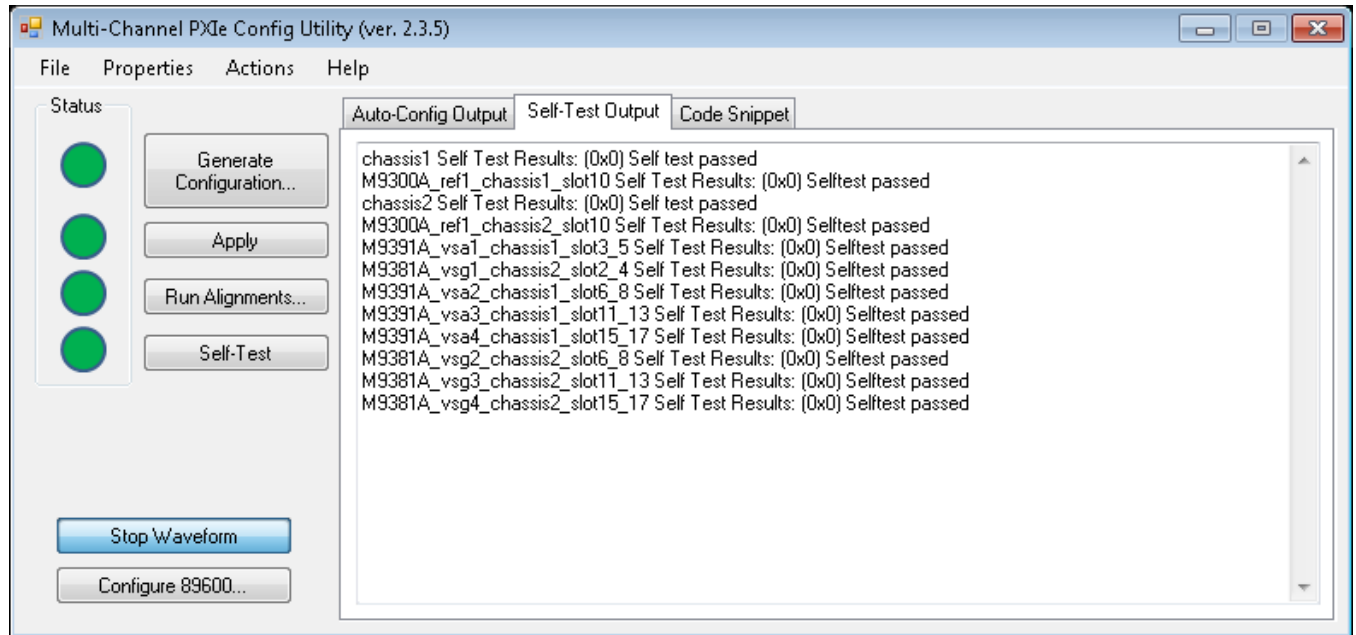
After the VSGs begin playback, pause acquisition in the 89600 VSA Software.



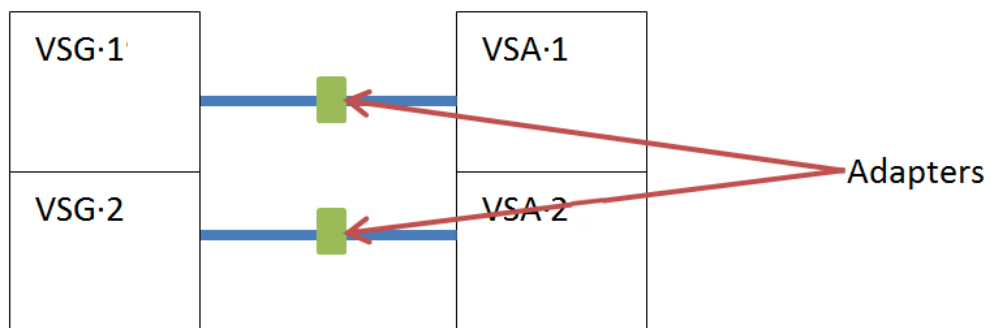
Verify that the rising edges on each channel are aligned. Congratulations, you've made your first multi-channel measurement!

## Quick Start to Beamforming Measurement (Shared LO Only)

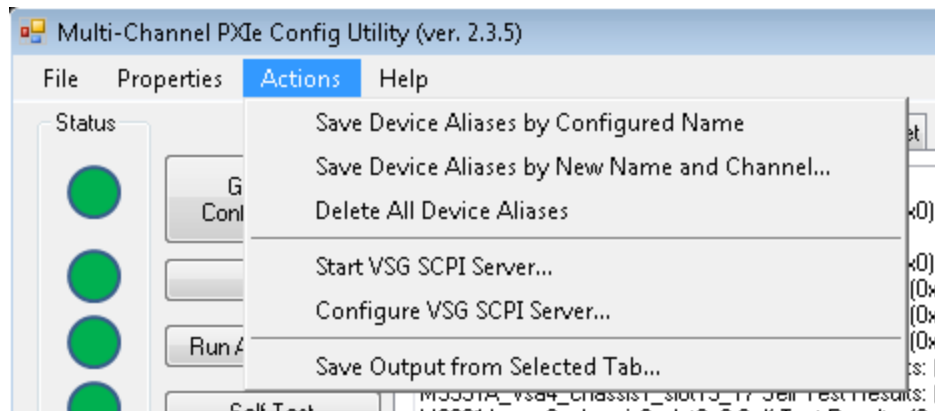
If you have just finished the previous section, click on 'Stop Waveform' in the Config Utility.



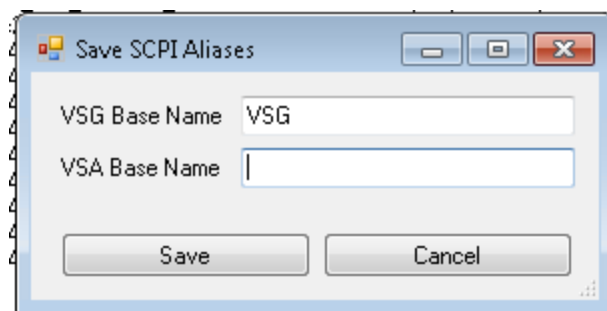
You will need to re-cable your system into a “Loopback” configuration where each VSG and VSA has its own, independent RF cable. RF cables can then be connected through an adapter in order to create the loopback.



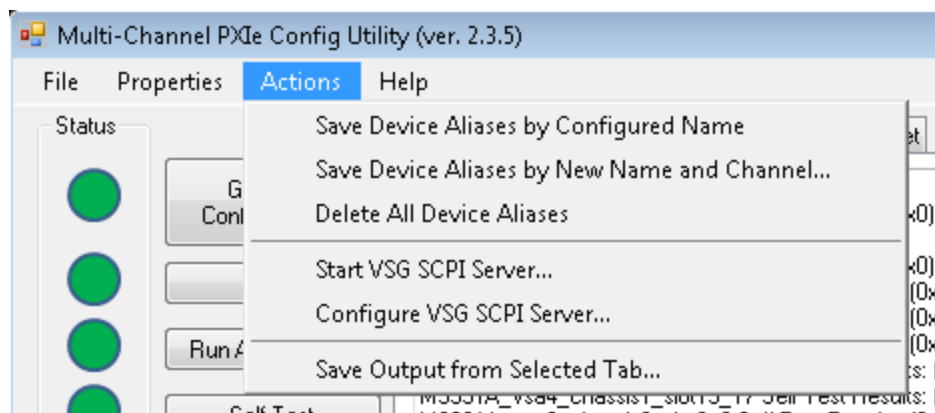
From the 'Actions' menu, select the 'Save Device Aliases by New Name and Channel...' option.



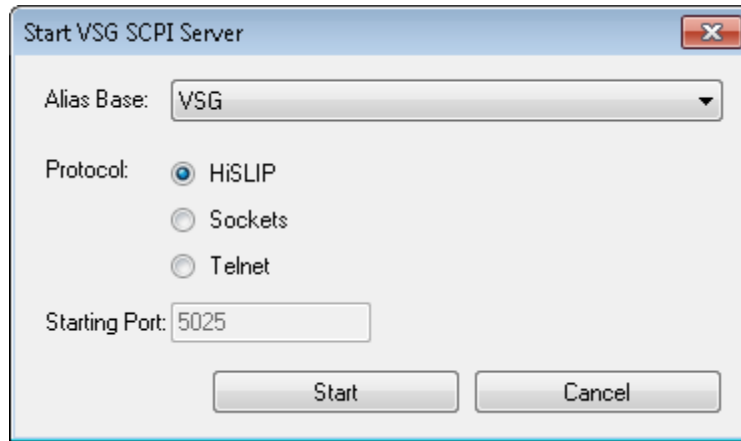
In the 'Save SCPI Aliases' window, type "VSG" into 'VSG Base Name'. Leave 'VSA Base Name' empty and click 'Save'.



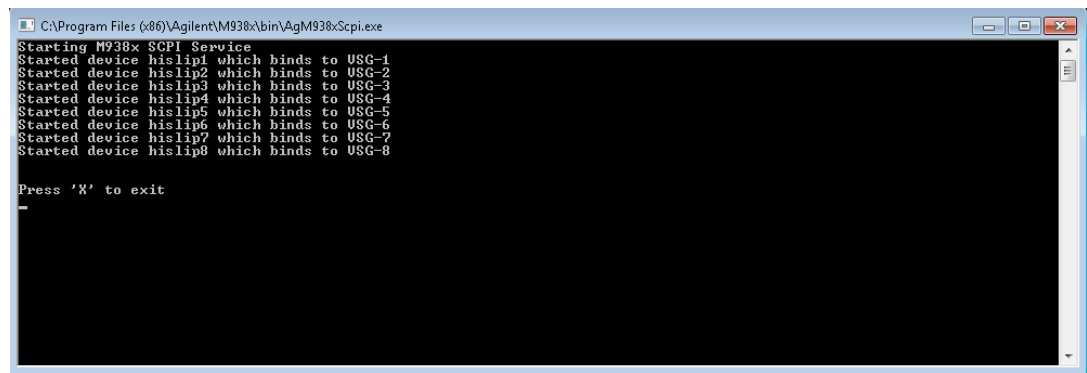
Go back to the 'Actions' menu and select 'Start VSG SCPI Server...'



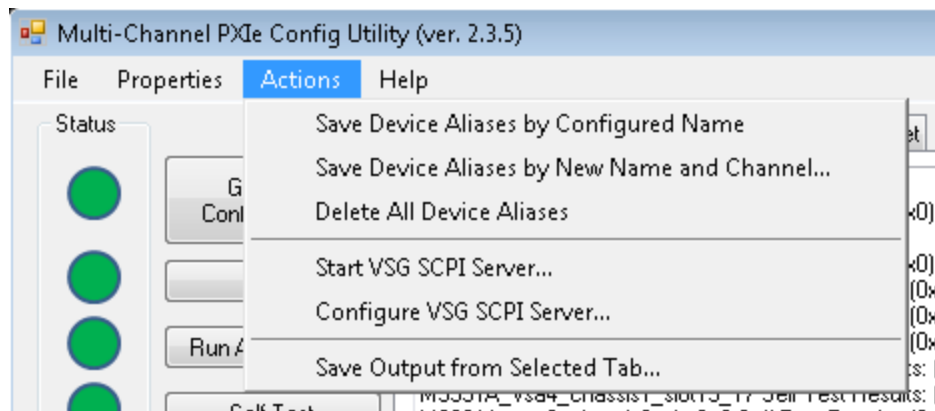
In the 'Start VSG SCPI Server' select 'VSG' as your 'Alias Base' (the value you entered into the 'VSG Base Name' text box above). Leave HiSLIP selected and click 'Start'.



Wait for all of your VSGs to start in the SCPI server console window, and do not close the window.

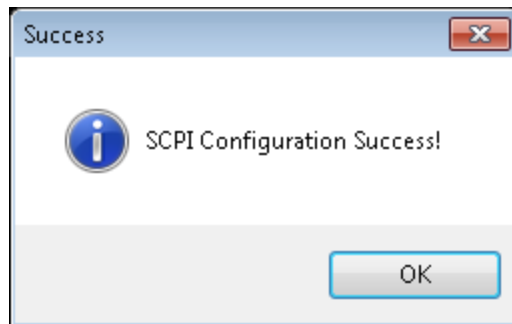
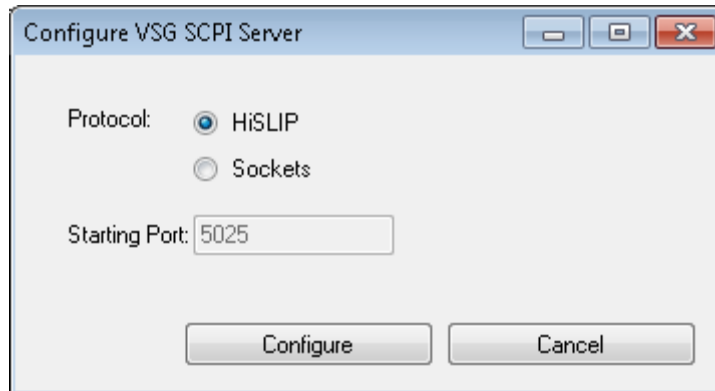


Open the 'Actions' menu again and select 'Configure VSG SCPI Server...'

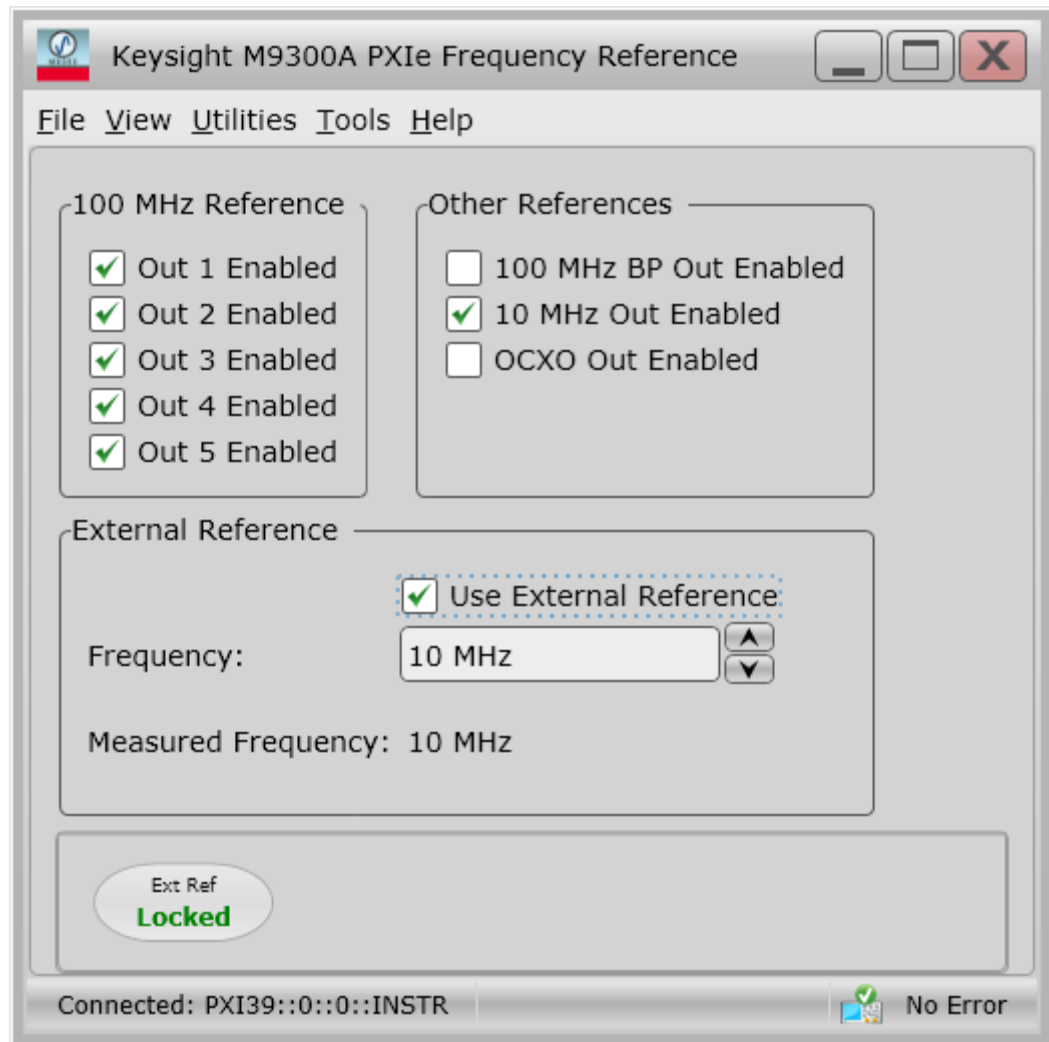




Leave HiSLIP selected and click 'Configure'. After the success dialog is displayed, click 'OK'

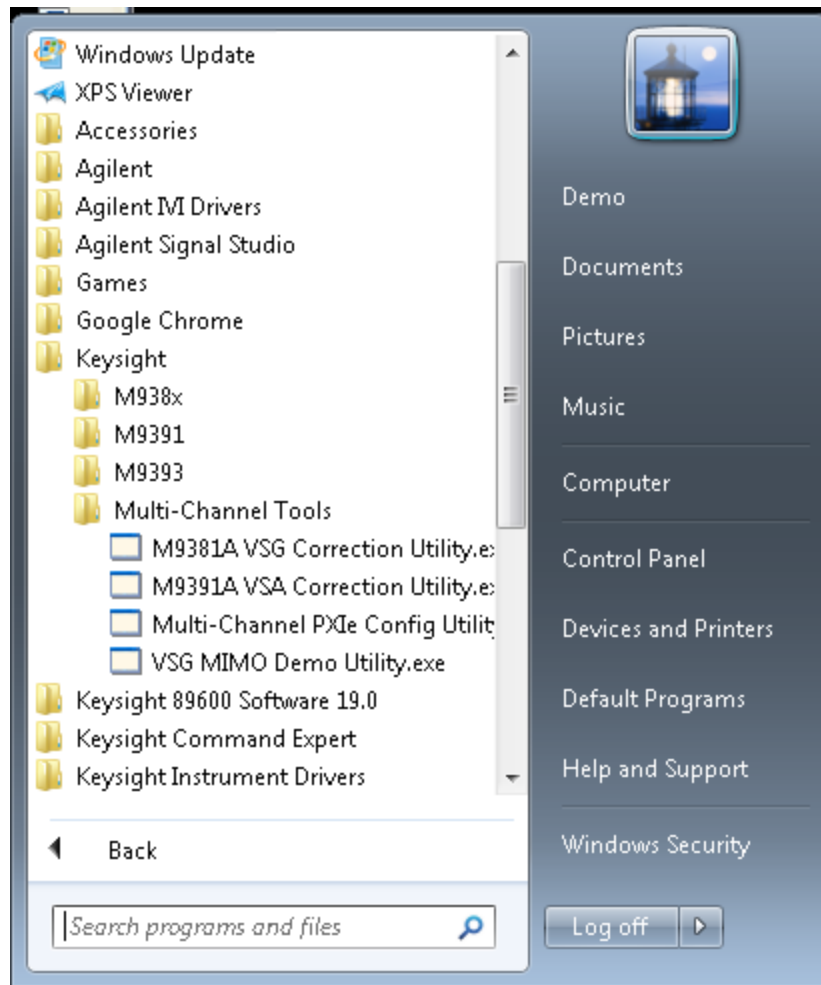


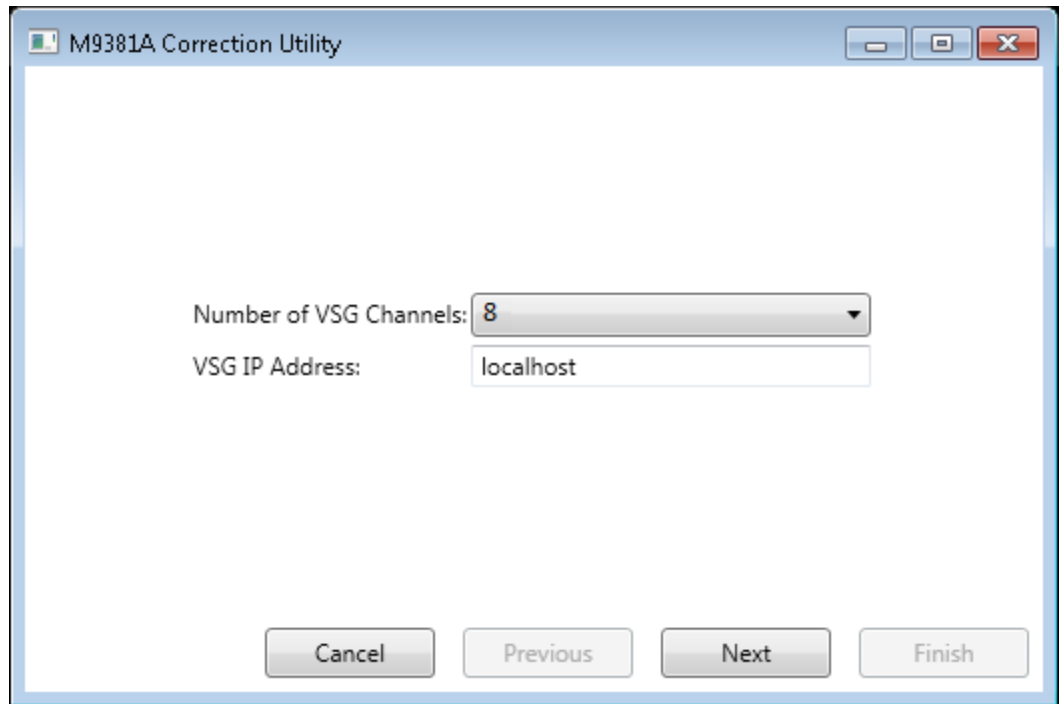
If your system is a 4x4 or an 8x8 system, connect the 10 MHz Out of the M9300A for the VSA chassis and connect it to the M9300A Ref In for each VSG chassis. 4x4 systems can accomplish this by a direct connection; for 8x8 systems, you will need to disconnect the OCXO Out cable for the VSG chassis and connect it to the 10 MHz Out of the M9300A for a VSA chassis. Open the M9300A Soft Front Panel in each VSG chassis and check 'Use External Reference'.



## M9381A VSG Correction

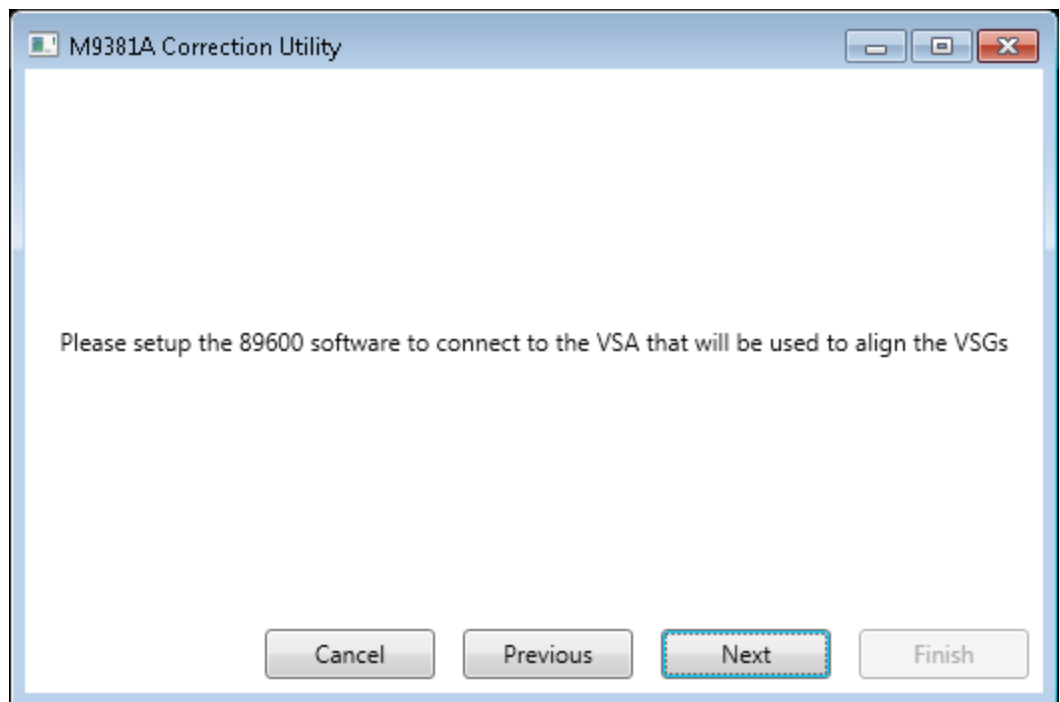
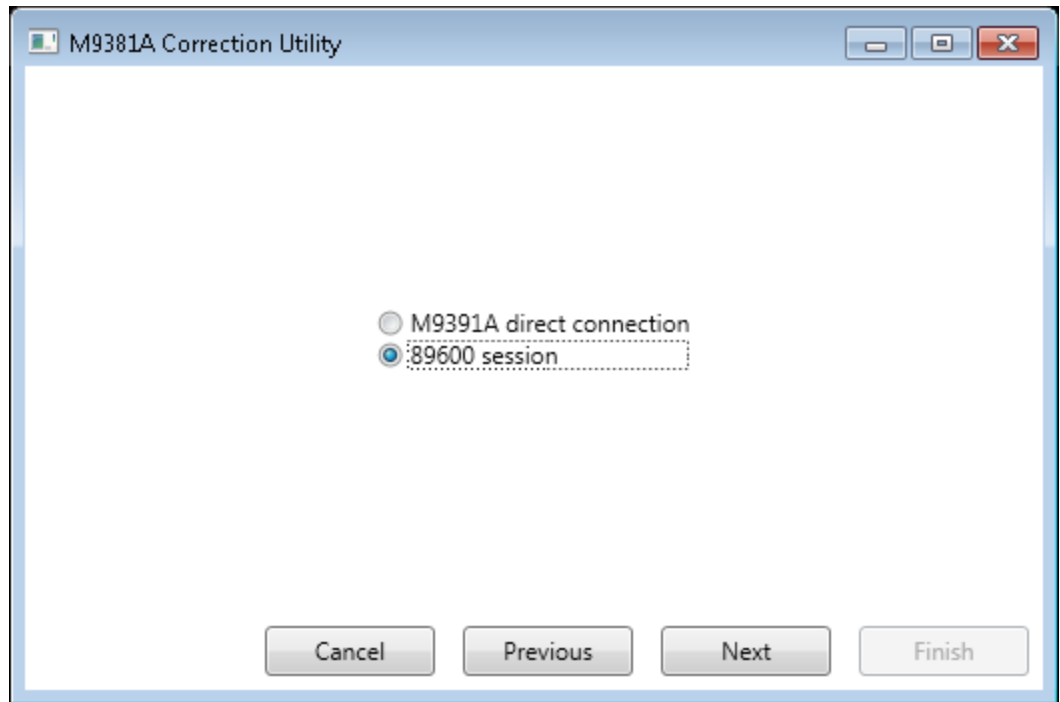
Start the M9381A VSG Correction Utility from your Start menu under All Programs > Keysight > Multi-Channel Tools. You will use this tool to measure the time and phase offsets between your VSGs. Later, this data will be applied to the VSGs in order to align them.



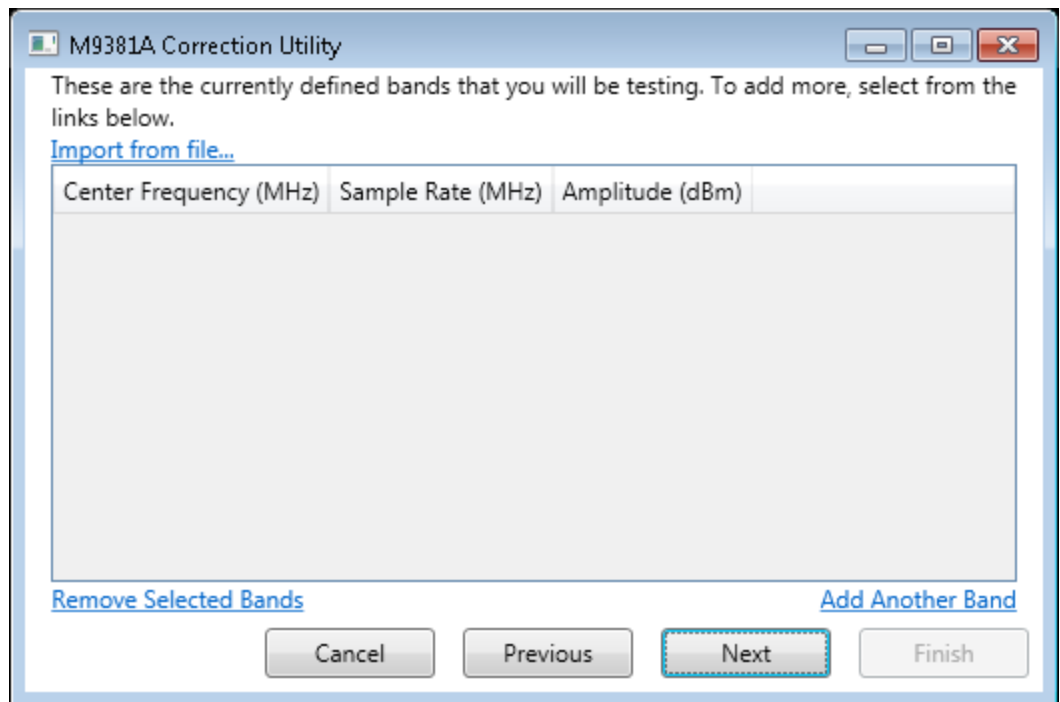
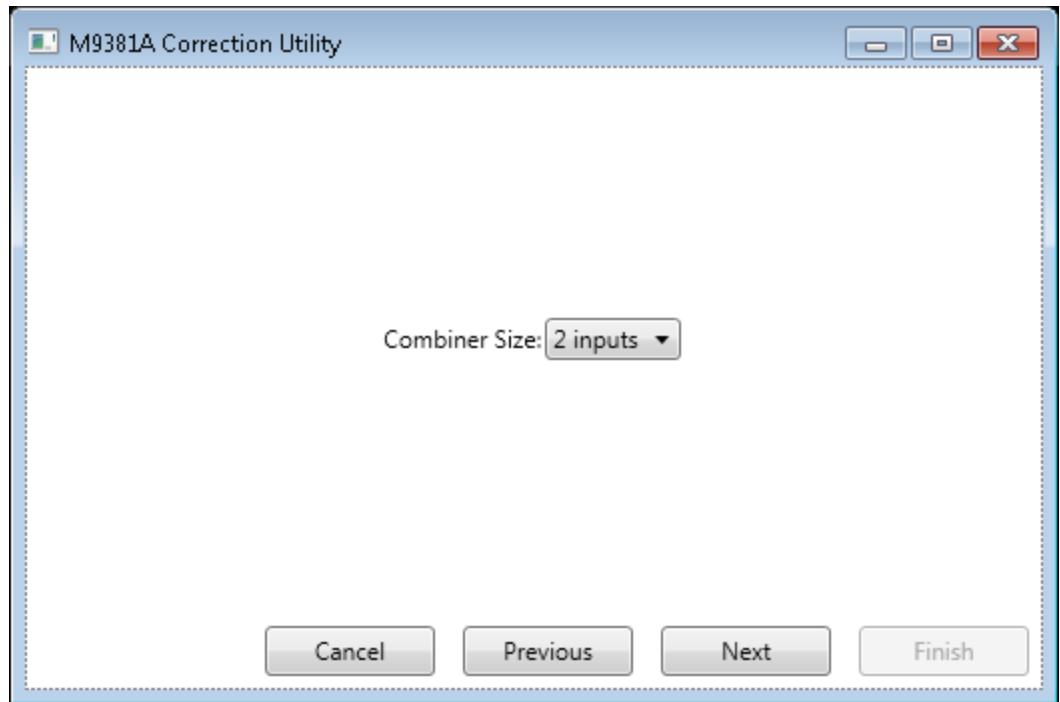


In the dropdown box, select the number of VSGs that were started in the SCPI server console window (the example picture has 4). Leave VSG IP Address as 'localhost' and click 'Next'. The Correction Utility will then connect to the VSG SCPI server.

Select the 89600 session radio button option and click 'Next'. Make sure you still have the 89600 VSA Software session open from the previous section (if not, start the 89600 VSA Software now and connect to the hardware configuration you created in the previous section). Then click 'Next' again.



You will then need to select the signal combiner size you will be using to correct the VSGs. You will also need to re-cable your system with the combiner. For more information on splitter and combiner considerations, please see the User's Guide. Select 'Next'.



On this page, click on 'Add Another Band' in the lower right hand corner. For example enter "1000" for the center frequency, 15.36 for the sample rate, and -10 for the amplitude. Then select 'Next' twice.

M9381A Correction Utility

Center Frequency (MHz): 1000

Sample Rate (MHz): 15.36

Amplitude (dBm): -10

Cancel Previous Next Finish

M9381A Correction Utility

These are the currently defined bands that you will be testing. To add more, select from the links below.

[Import from file...](#)

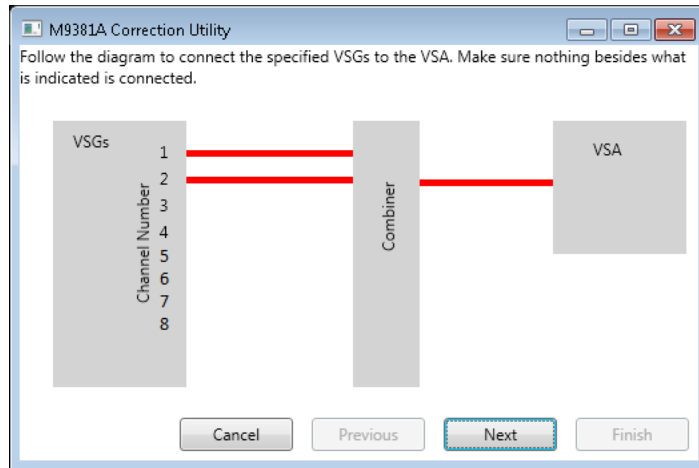
Center Frequency (MHz)	Sample Rate (MHz)	Amplitude (dBm)
1000	15.36	-10

[Remove Selected Bands](#) [Add Another Band](#)

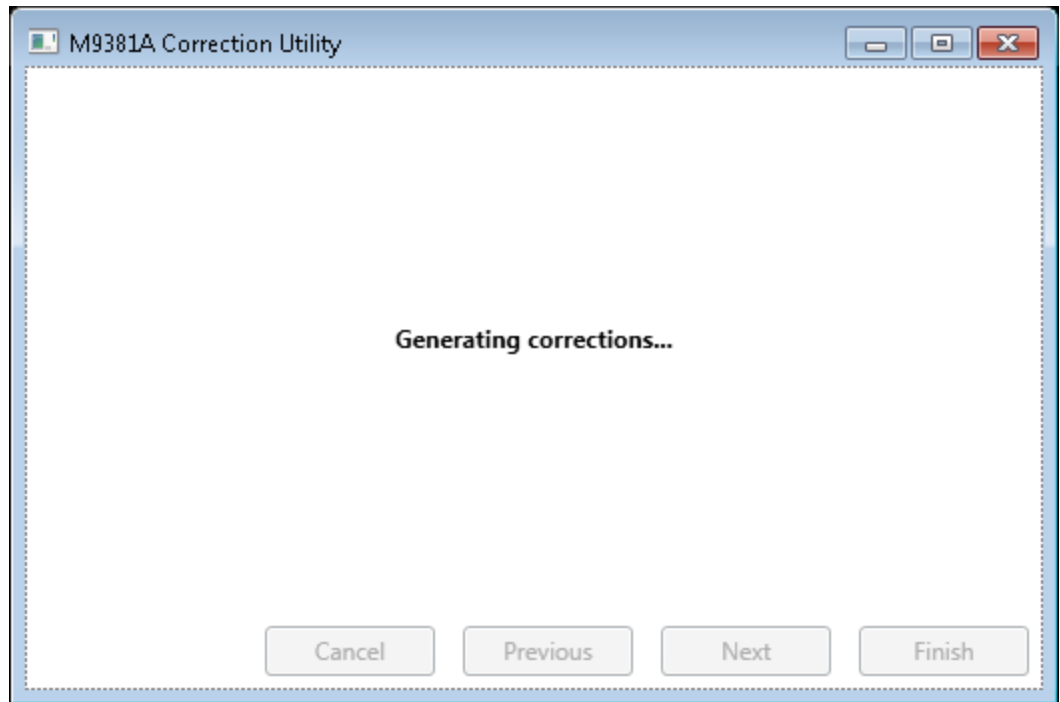
Cancel Previous Next Finish

You will then need to follow the diagram to re-cable your system to include the combiner. Disconnect your RF cables from the adapters and add the combiner as indicated. The VSA in the diagram is your VSA channel 1 (the VSA assigned the role of

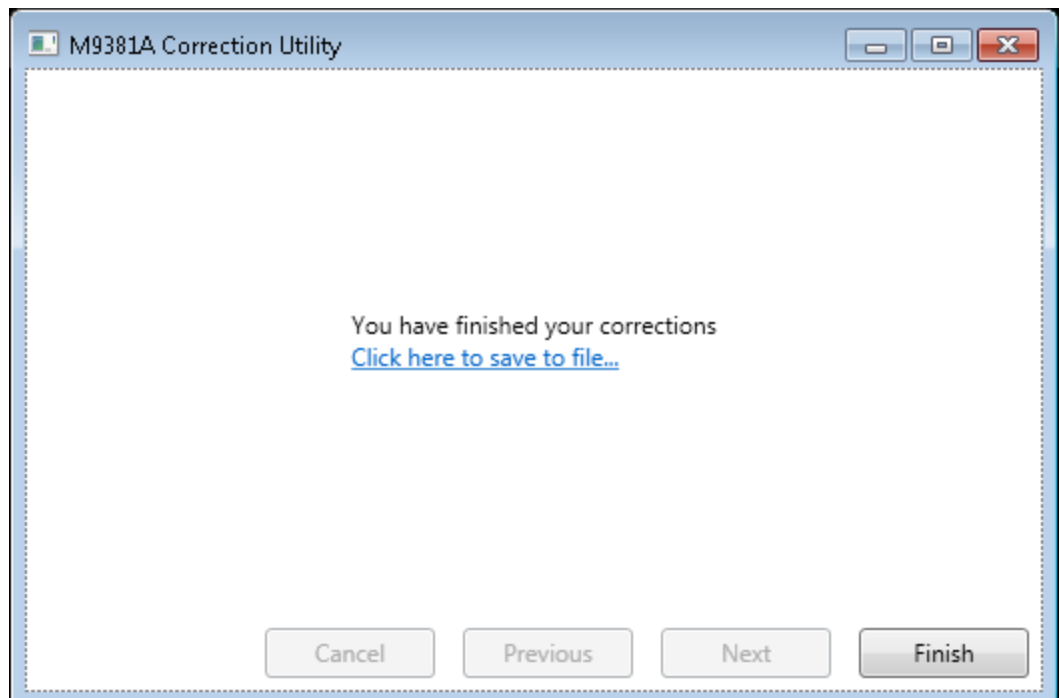
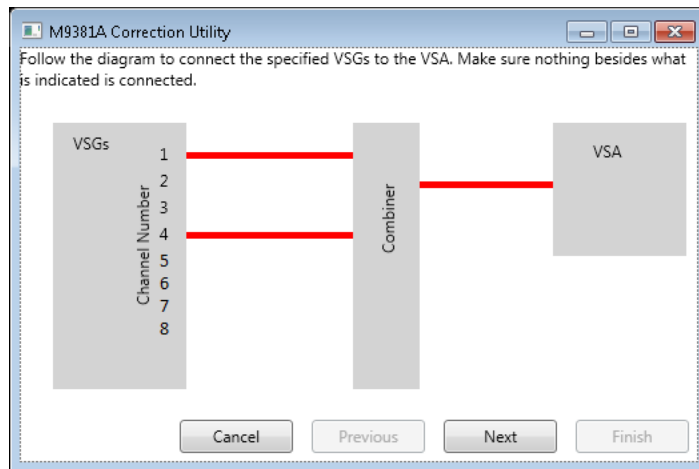
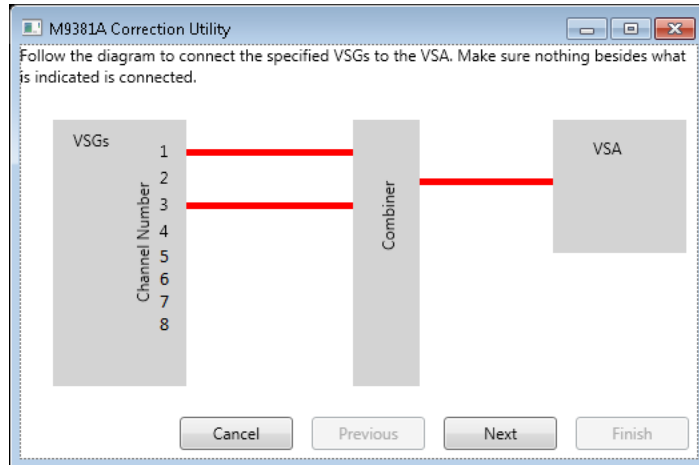
System Master in the 'Auto-Config Output' tab in the Config Utility). Then select 'Next'.



The Correction Utility will then measure the time and phase differences between your VSGs. If your combiner doesn't have enough inputs for each VSG, you will have to re-cable.



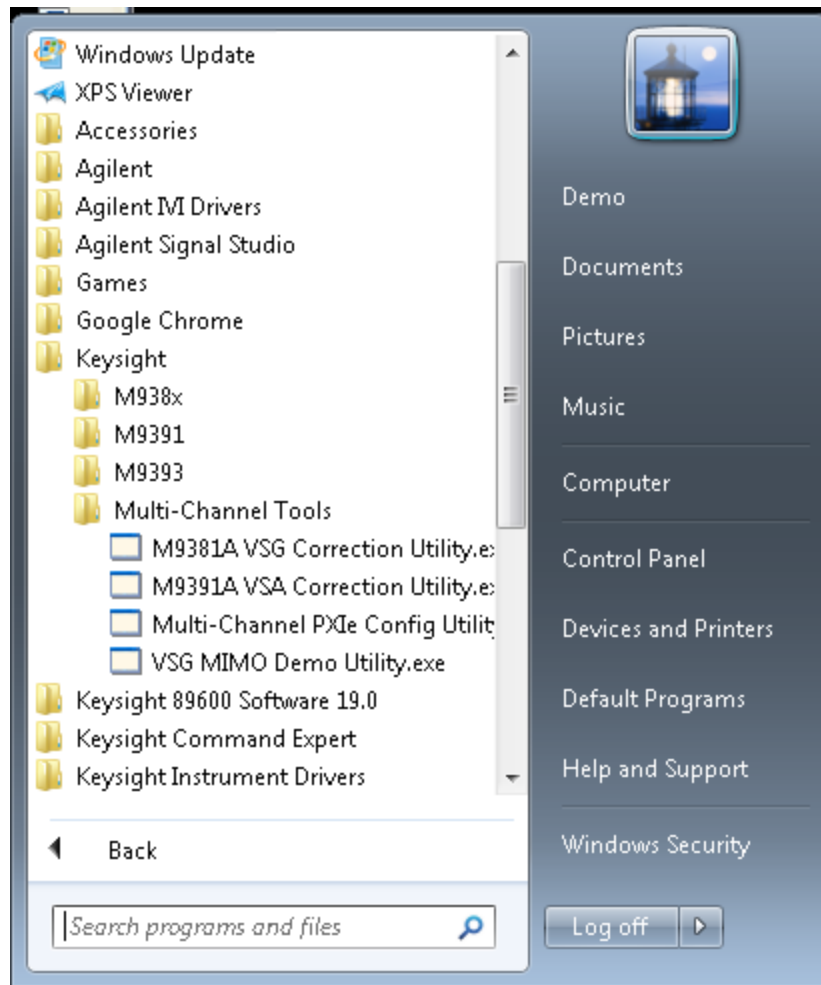


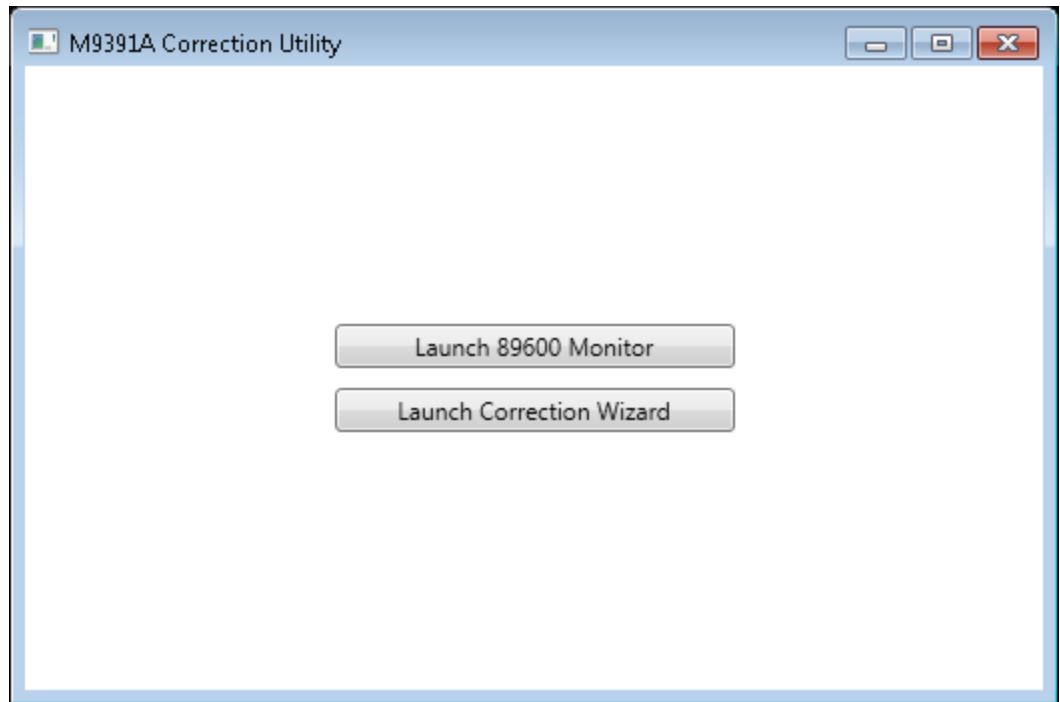


Save the results by clicking the link in the center of the window. Then click 'Finish'.

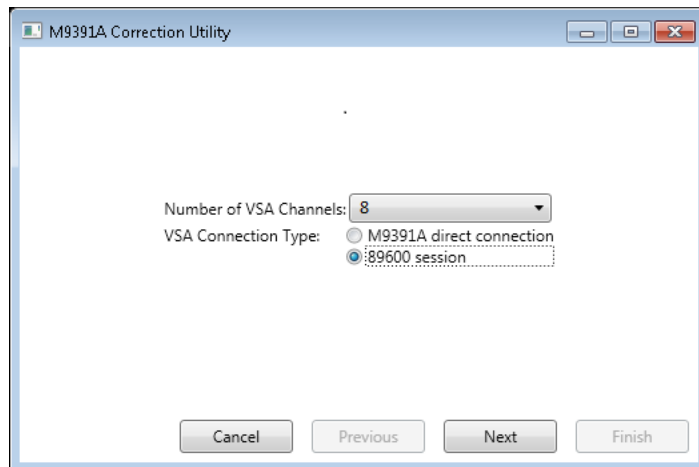
## M9391A VSA Correction Utility

Start the M9391A VSA Correction Utility from your Start menu under All Programs > Keysight > Multi-Channel Tools. You will use this tool to measure the time and phase offsets between your VSAs. Later, this data will be applied to the 89600 VSA Software in order to align them.



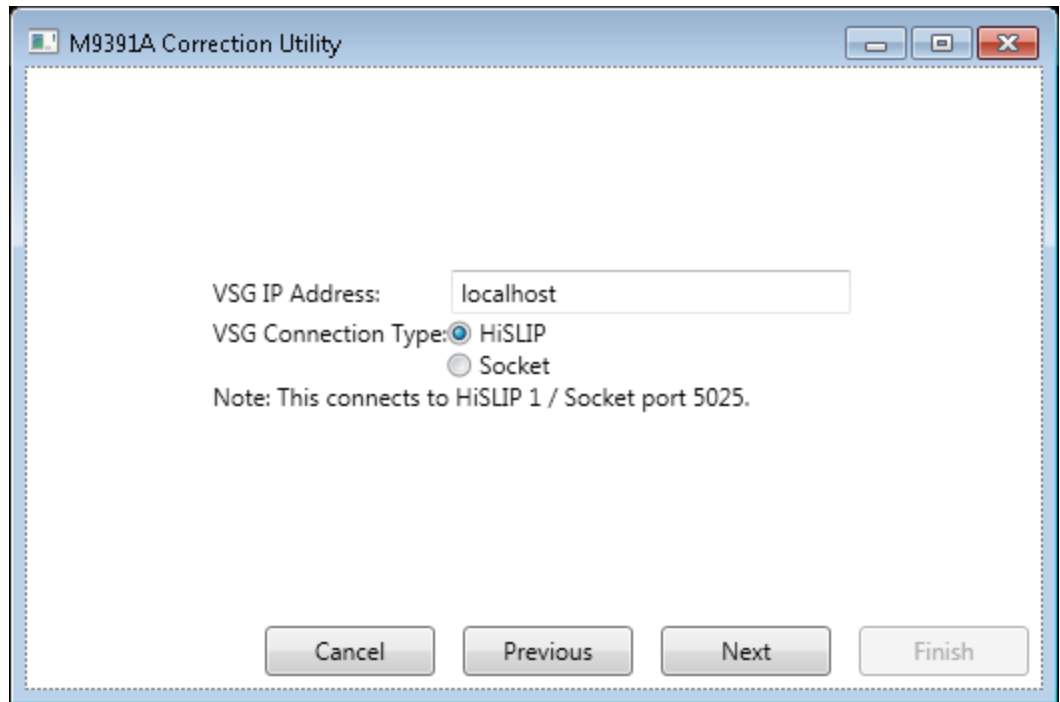


Select the 'Launch Correction Wizard' button. Select the number of VSAs that make up your Hardware Configuration in the 89600 VSA Software. Select '89600 session' as the VSA Connection Type and select 'Next' twice.

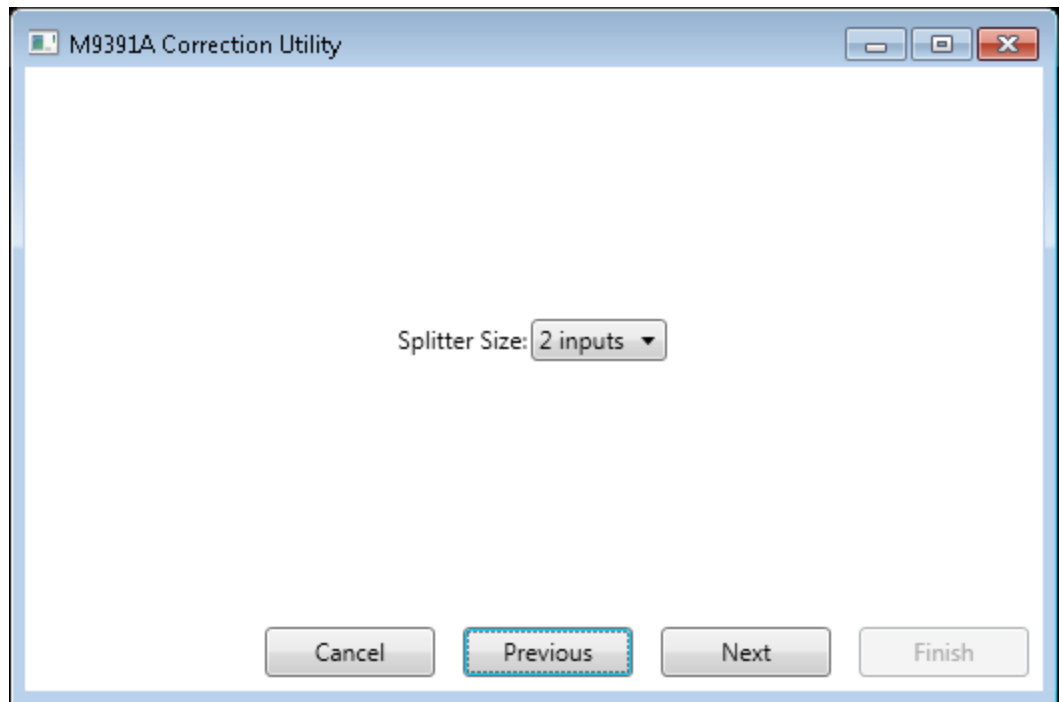


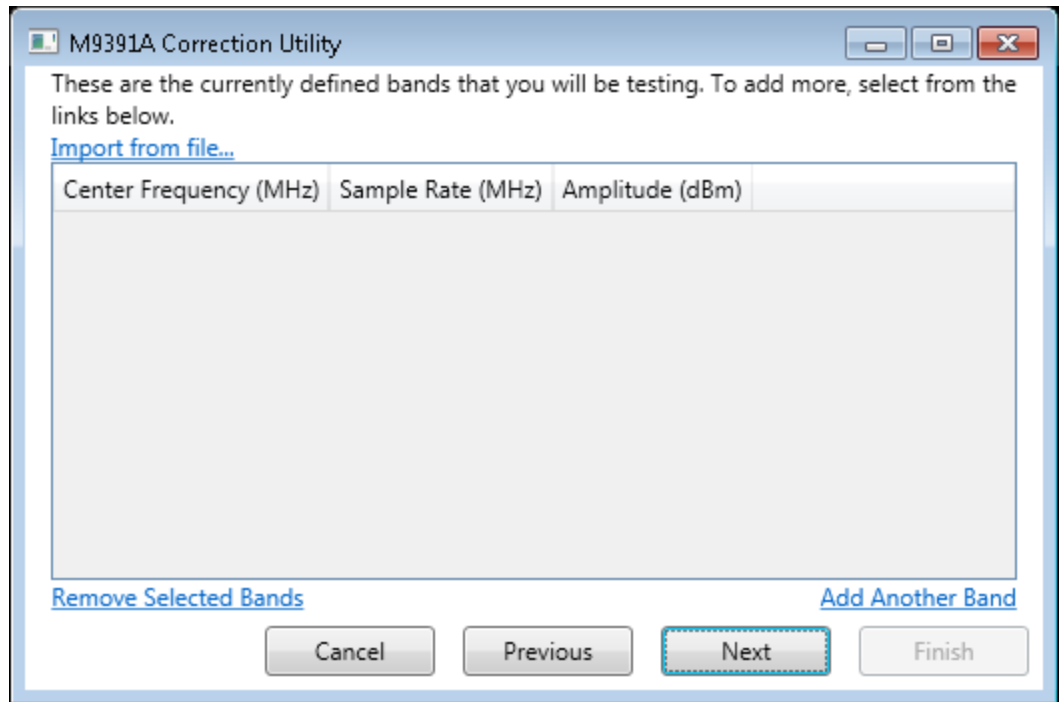
Your 89600 will be configured to run correction measurements.

Leave 'localhost' as the VSG IP address and HiSLIP as the VSG Connection Type and click 'Next'.



You will then need to select the signal splitter size you will be using to correct the VSAs. For more information on splitter and combiner considerations, please see the User's Guide. Select 'Next'.





On this page, click on 'Add Another Band' in the lower right hand corner. For example, enter "1000" for the center frequency, 15 for the sample rate, and 8 for the amplitude. Then select 'Next' twice.

M9391A Correction Utility

Center Frequency (MHz): 1000

Sample Rate (MHz)\*: 15

Amplitude (dBm): 8

(\*) For the M9391A VSA in the 89600 software, the sample rate is equal to 1.25 times the span.

Buttons: Cancel, Previous, Next, Finish

M9391A Correction Utility

These are the currently defined bands that you will be testing. To add more, select from the links below.

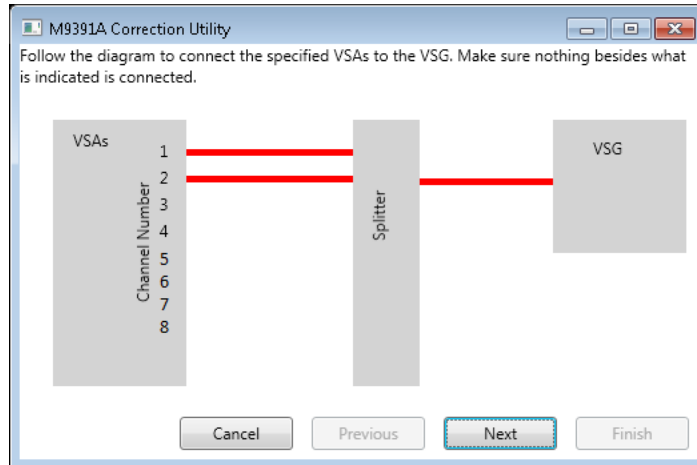
[Import from file...](#)

Center Frequency (MHz)	Sample Rate (MHz)	Amplitude (dBm)
1000	15	8

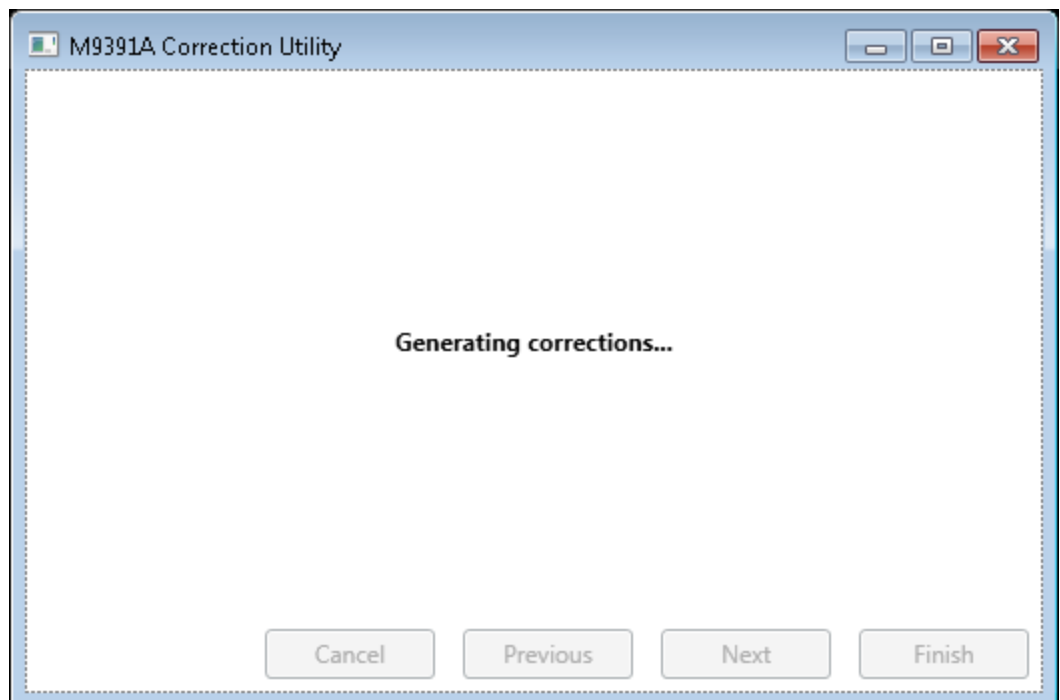
[Remove Selected Bands](#) [Add Another Band](#)

Buttons: Cancel, Previous, Next, Finish

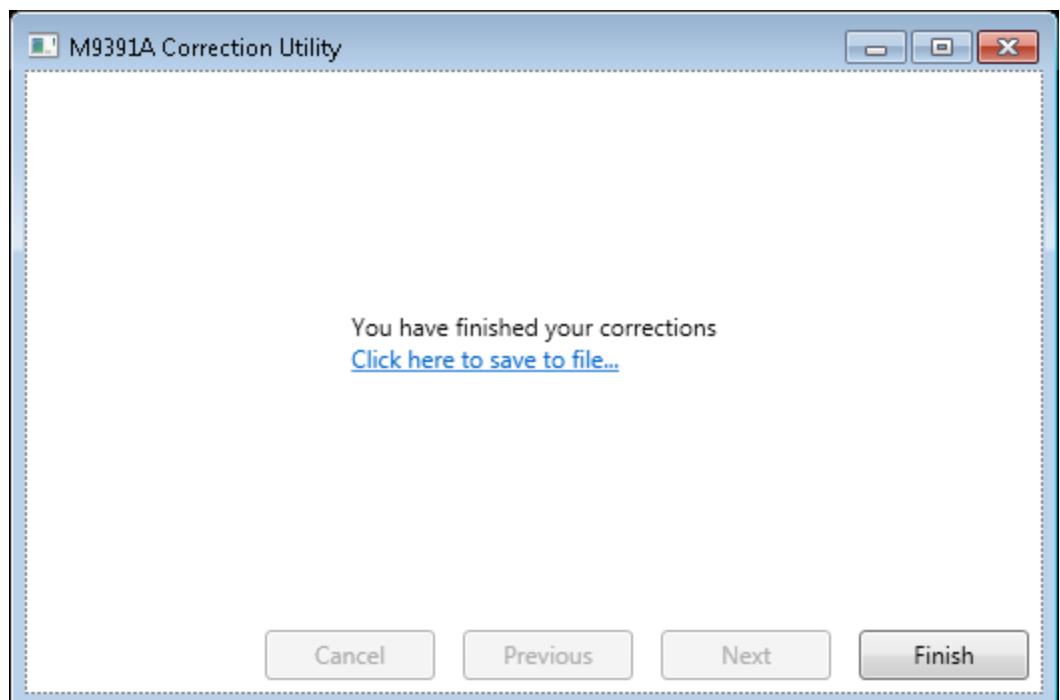
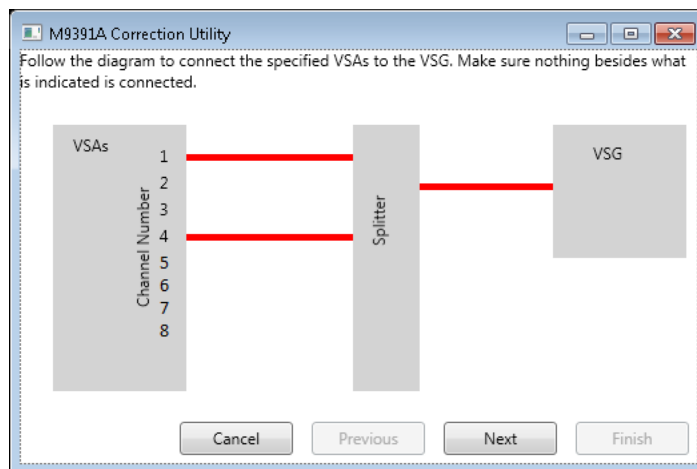
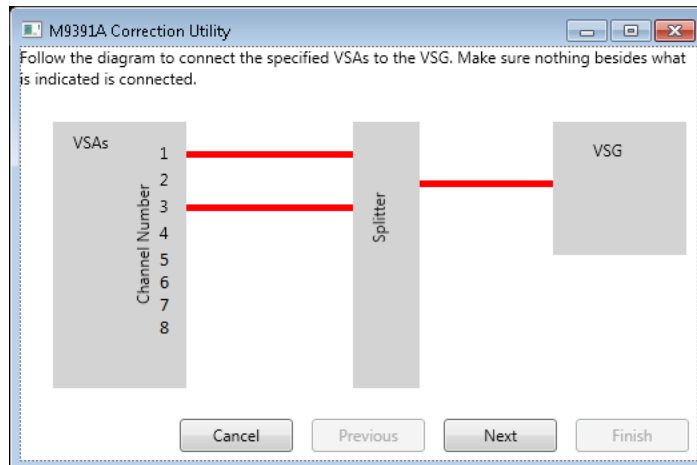
You will then need to follow the diagram to re-cable your system to include the combiner. The VSG in the diagram is your VSG channel 1 (the VSG assigned the role of System Master in the 'Auto-Config Output' tab in the Config Utility). Then select 'Next'.



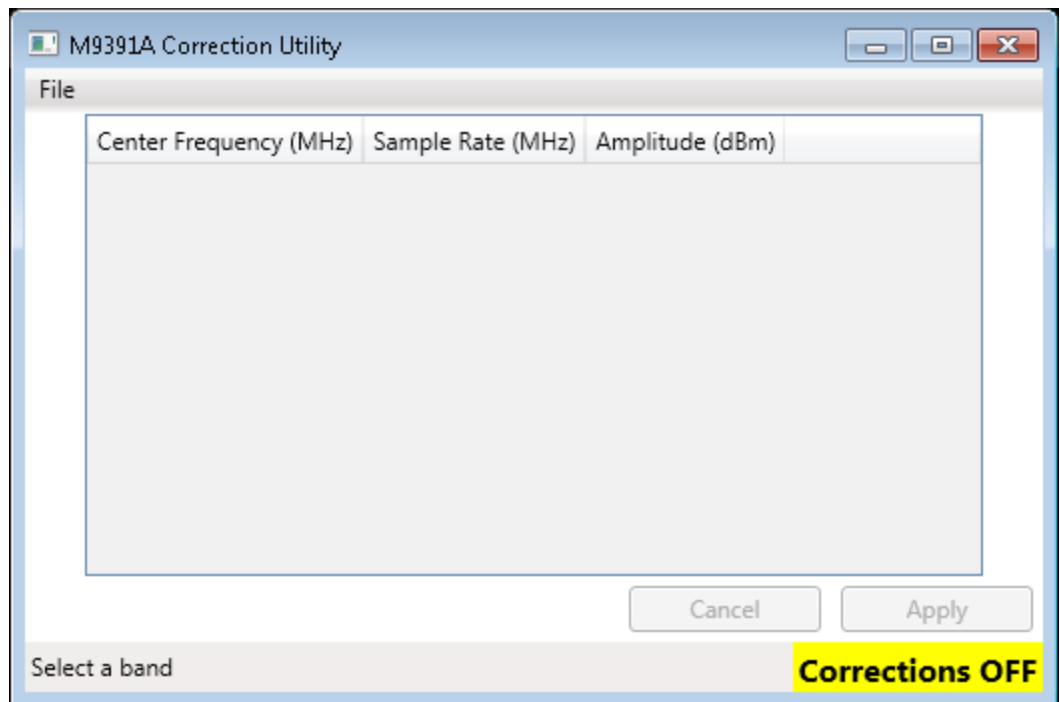
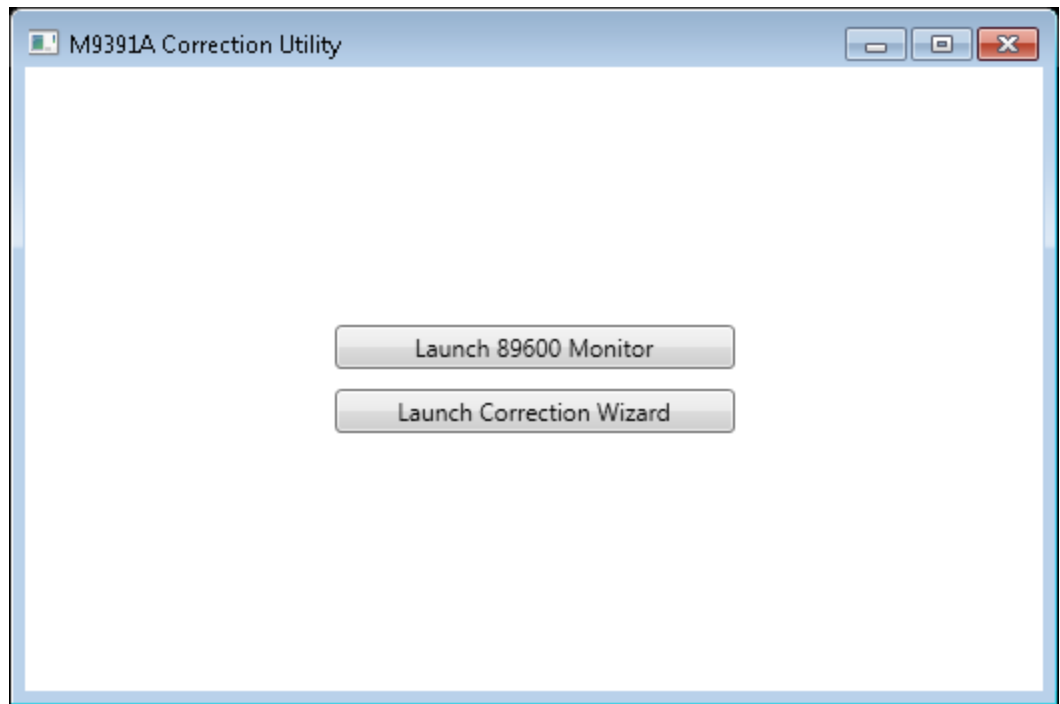
The Correction Utility will then measure the time and phase differences between your VSGs. If your combiner doesn't have enough inputs for each VSG, you will have to re-cable.



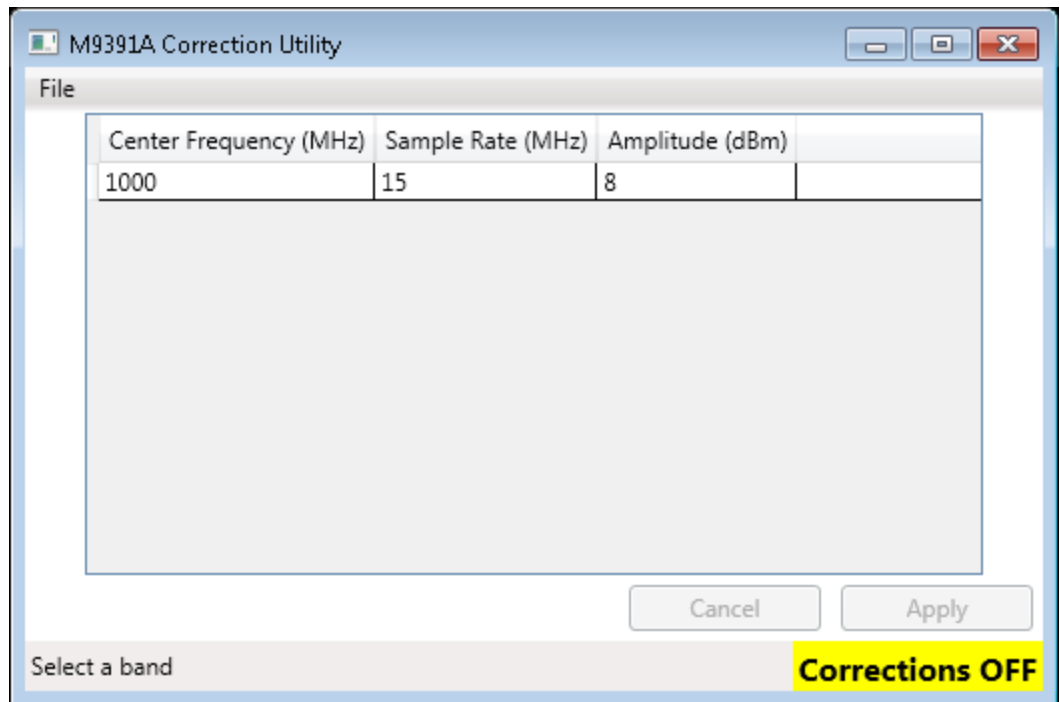




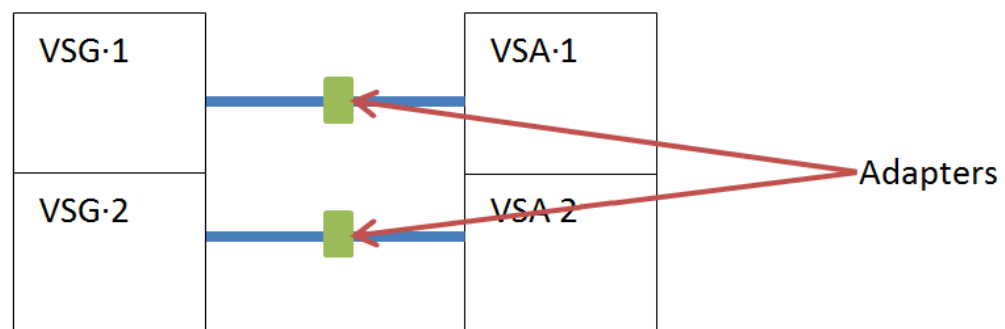
Save the results by clicking the link in the center of the window. Then click 'Finish'. Select the 'Launch 89600 Monitor' button.



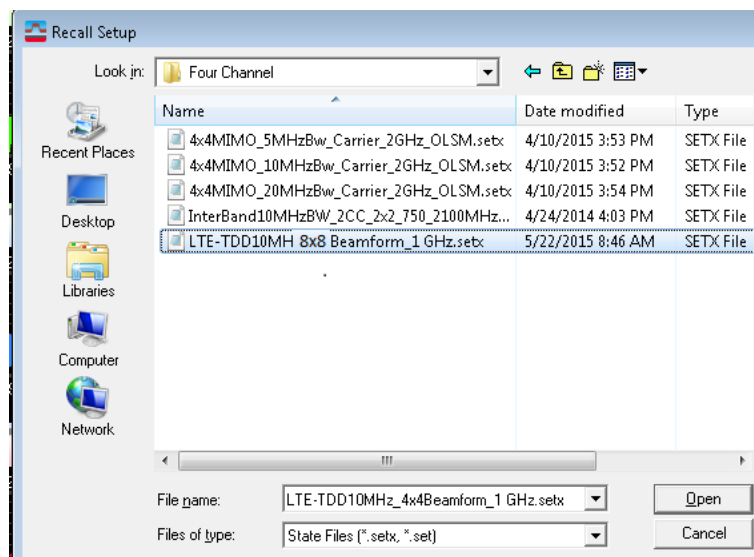
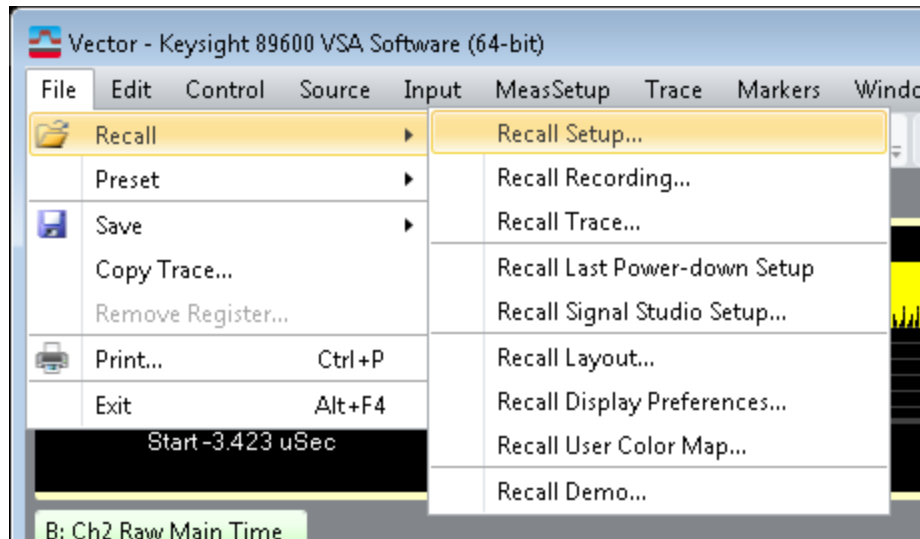
Go to the 'File' menu and select 'Open'. Open the VSA corrections file you saved in the previous step. You should now have the correction data you generated previous available in the table.



Re-cable your system into the "Loopback" configuration with the adapter between the cables from the VSG to the VSA.

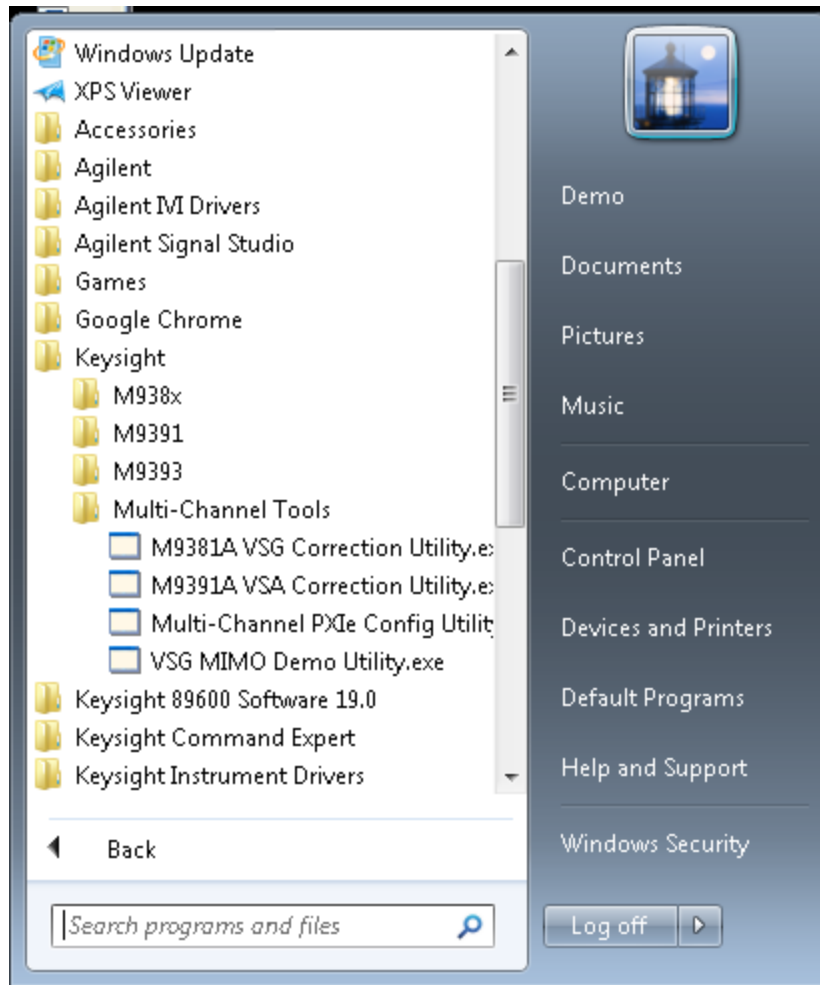


Load in the appropriate beamforming setup file in the 89600 VSA Software by selecting the File menu > Recall, Recall Setup... then navigating to the Multi-Channel Utilities install location and going to Setup Files/LTE/{Dual Channel | Four Channel (depending on your channel count)}/LTE-TDD10MHz\_XxXbeamforming\_1GHz.setx. Load that file by clicking 'Open'.



## VSG MIMO Demo Utility

Start the VSG MIMO Demo Utility from your Start menu under All Programs > Keysight > Multi-Channel Tools. This tool is used as a soft front panel for multi-channel VSGs.



Set the '# of VSG Channels' to the number of VSGs running in the SCPI server, make sure 'Write Changes to HW on Init' is checked, leave 'localhost' as the TCP-IP address, and click 'Init'.

The screenshot shows the 'MIMODemoGUI' window with the 'Hardware Configuration' tab selected. The 'Init' button is highlighted. The '# of VSG Channels' is set to 8. The 'TCP-IP address' is 'localhost'. The 'Write Changes to HW on Init' checkbox is checked. The 'Simulated Hardware', 'Send error queries to VSG', and 'Log SCPI commands' checkboxes are unchecked.

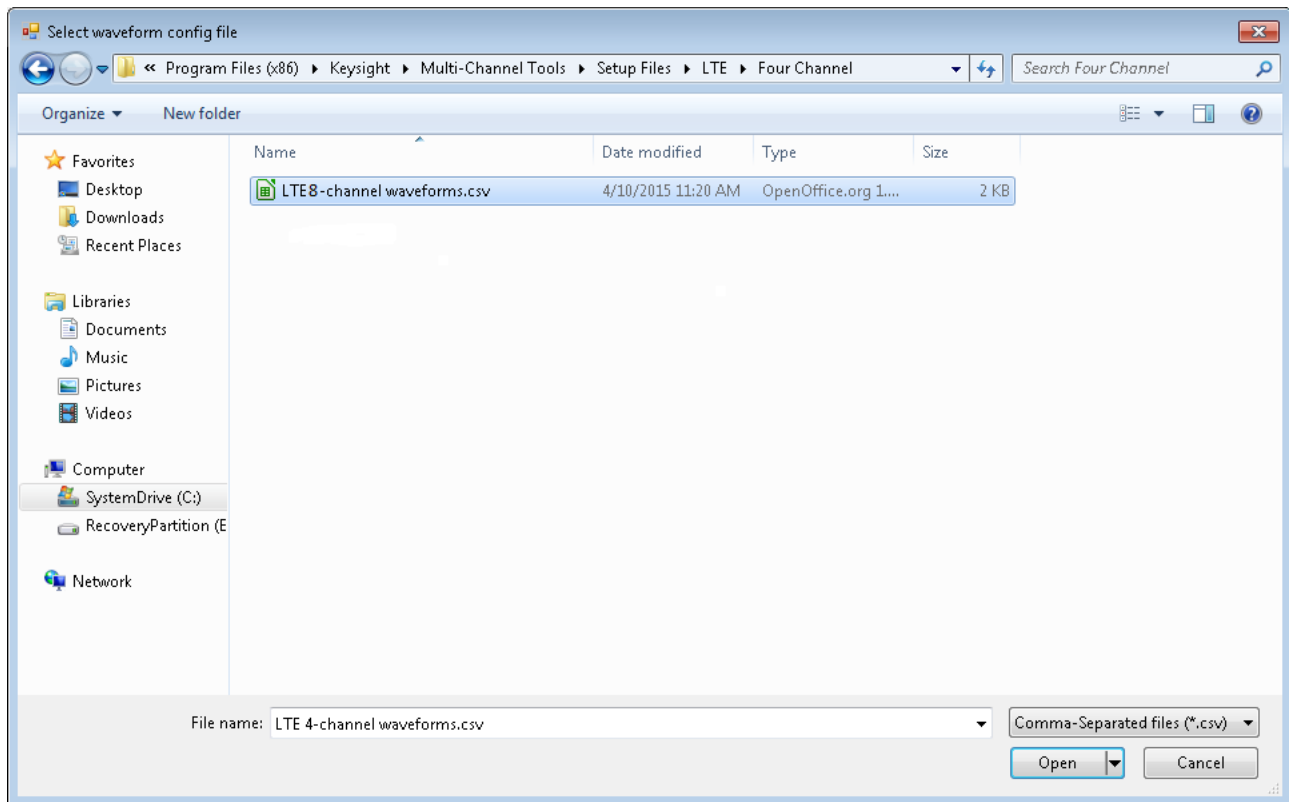
Hardware Configuration	Waveforms	Generator Settings
<div> <div>Init</div> <div>Close</div> </div> <div> <div># of VSG Channels</div> <div>8</div> </div> <div> <div>TCP-IP address</div> <div>localhost</div> </div> <div> <div><input type="checkbox"/> Simulated Hardware</div> <div><input checked="" type="checkbox"/> Write Changes to HW on Init</div> </div> <div> <div><input type="checkbox"/> Send error queries to VSG</div> <div><input type="checkbox"/> Log SCPI commands</div> </div>		

Go to the 'Waveforms' tab and select the 'Load Waveforms From Config File' button.

The screenshot shows the 'MIMODemoGUI' window with the 'Waveforms' tab selected. The 'User Waveforms' section contains a 'Waveform Alias' field, eight 'Chan X FileName' fields, and a 'Waveform Config FileName' field. The 'Load User Waveform Files' and 'Load Waveforms From Config File' buttons are visible.

Hardware Configuration	Waveforms	Generator Settings
<div>User Waveforms</div> <div> <div>Waveform Alias</div> <div>Chan 1 FileName</div> <div>Chan 2 FileName</div> <div>Chan 3 FileName</div> <div>Chan 4 FileName</div> <div>Chan 5 FileName</div> <div>Chan 6 FileName</div> <div>Chan 7 FileName</div> <div>Chan 8 FileName</div> </div> <div> <div>Waveform Config FileName</div> </div> <div> <div>Load User Waveform Files</div> <div>Load Waveforms From Config File</div> </div>		

Then navigating to the Multi-Channel Utilities install location and going to Setup Files/LTE/{Dual Channel | Four Channel (depending on your channel count)}/LTE X-channel waveforms.csv. Load that file by clicking 'Open'.



Using these waveforms do require a signal studio license. You can get a temporary license from:

[www.keysight.com/find/free\\_trials](http://www.keysight.com/find/free_trials)

Go to the 'Generator Settings' tab. Set all frequencies, amplitudes, IQ delays, and IQ phases for each channel number (up to the number of channels in your system) to 1000, -10, 0, and 0 respectively. Note: you may need to uncheck 'Track Frequency Changes' and 'Track Amplitude Changes' to accomplish this.

The screenshot shows the 'Generator Settings' tab with the following configuration:

**Hardware Configuration | Waveforms | Generator Settings**

**RF/Baseband settings | Playback/Trigger Settings**

**RF Settings**

- ☒ Track Frequency Changes
- | Chan 1 Freq   | Chan 2 Freq   | Chan 3 Freq   | Chan 4 Freq   |
|---------------|---------------|---------------|---------------|
| 1,000.000 MHz | 1,000.000 MHz | 1,000.000 MHz | 1,000.000 MHz |
| Chan 5 Freq   | Chan 6 Freq   | Chan 7 Freq   | Chan 8 Freq   |
| 5,200.000 MHz | 5,200.000 MHz | 5,200.000 MHz | 5,200.000 MHz |
- ☒ Track Amplitude Changes
- | Ch1 Amplitude | Ch2 Amplitude | Ch3 Amplitude | Ch4 Amplitude |
|---------------|---------------|---------------|---------------|
| -10.00 dBm    | -10.00 dBm    | -10.00 dBm    | -10.00 dBm    |
| Ch5 Amplitude | Ch6 Amplitude | Ch7 Amplitude | Ch8 Amplitude |
| -2.00 dBm     | -2.00 dBm     | -2.00 dBm     | -2.00 dBm     |
- ☒ Modulation Enable ☒ Narrow B/W PLL
- ☒ RF Enable

**Baseband Adjustments**

Chan 1 IQ Delay	Chan 2 IQ Delay	Chan 3 IQ Delay	Chan 4 IQ Delay
0.000 ps	0.000 ps	0.000 ps	0.000 ps
Chan 5 IQ Delay	Chan 6 IQ Delay	Chan 7 IQ Delay	Chan 8 IQ Delay
0.000 ps	0.000 ps	0.000 ps	0.000 ps

Chan 1 IQ Phase	Chan 2 IQ Phase	Chan 3 IQ Phase	Chan 4 IQ Phase
0.000 deg	0.000 deg	0.000 deg	0.000 deg
Chan 5 IQ Phase	Chan 6 IQ Phase	Chan 7 IQ Phase	Chan 8 IQ Phase
0.000 deg	0.000 deg	0.000 deg	0.000 deg

**ALC Settings**

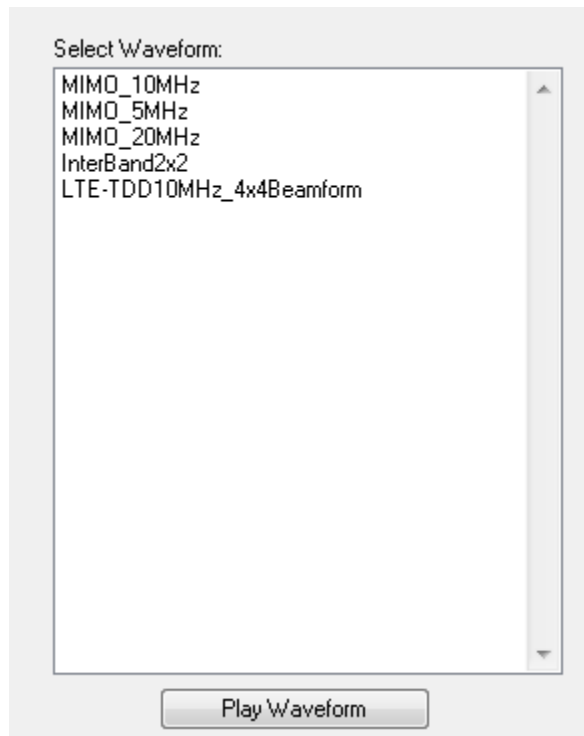
- ☐ ALC Enabled
- ALC Hold Mode
  - ☒ Off
  - ☐ Track on Marker
  - ☐ Hold on Marker

**Pulse Blank Mode**

- ☒ Off
- ☐ On with Marker
- ☐ Off with Marker



Select 'LTE-TDD10MHz\_XxXBeamform' in the 'Select Waveform' box and click 'Play Waveform'.

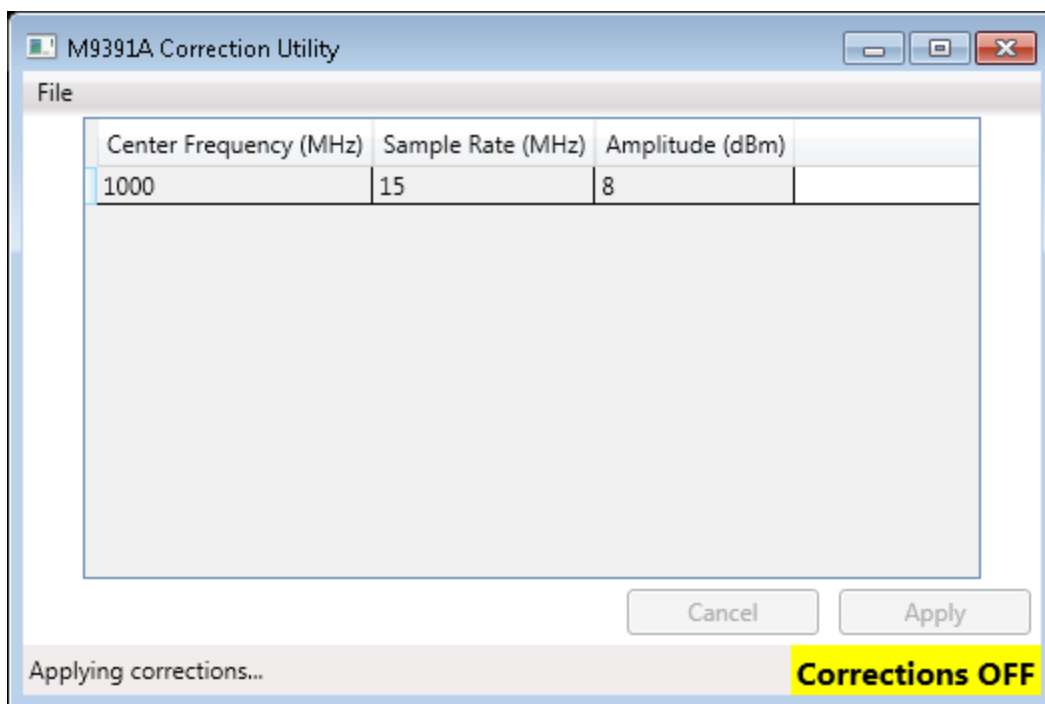
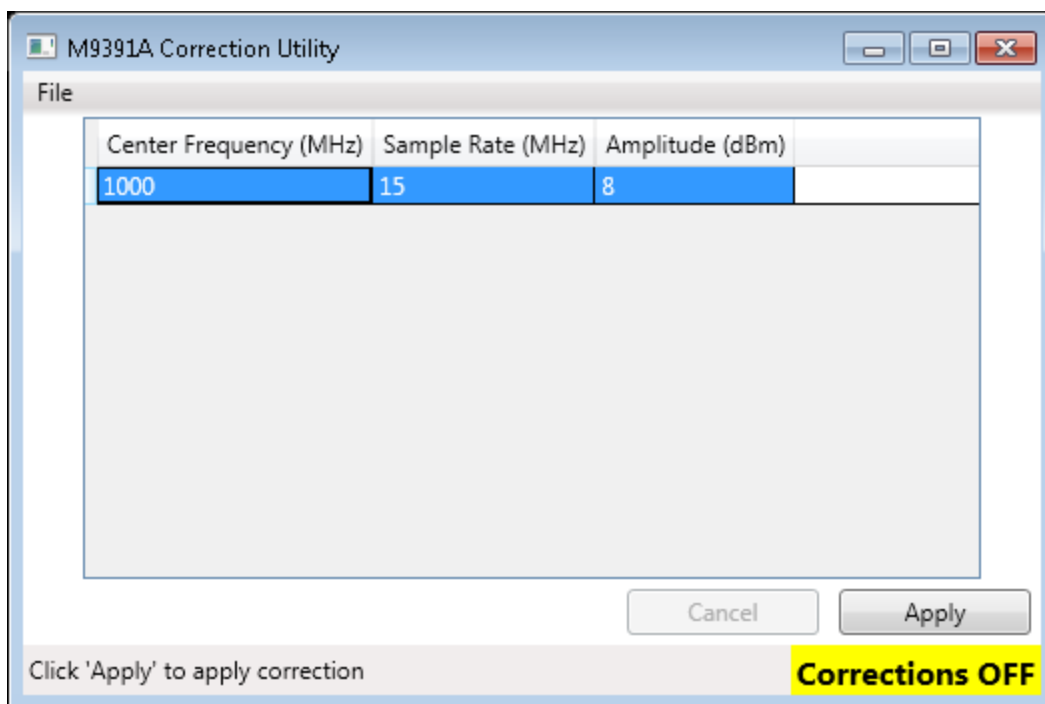


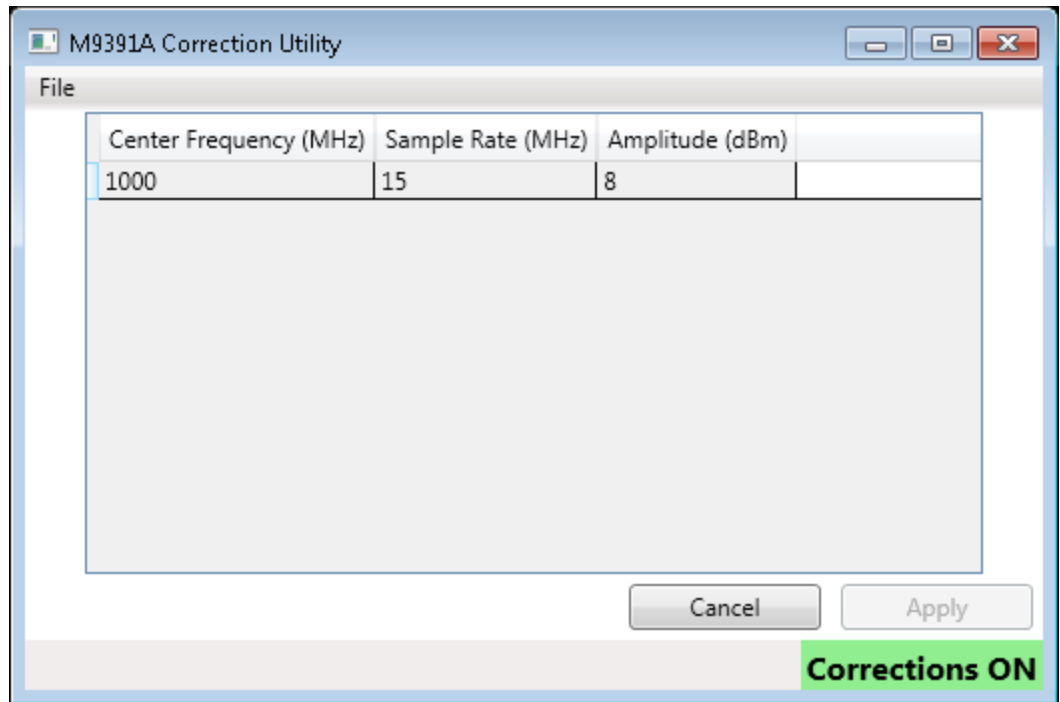
## Step 5 - Quick Start Measurements

Look at your 89600 VSA Software window. You will see an uncorrected beamforming example.

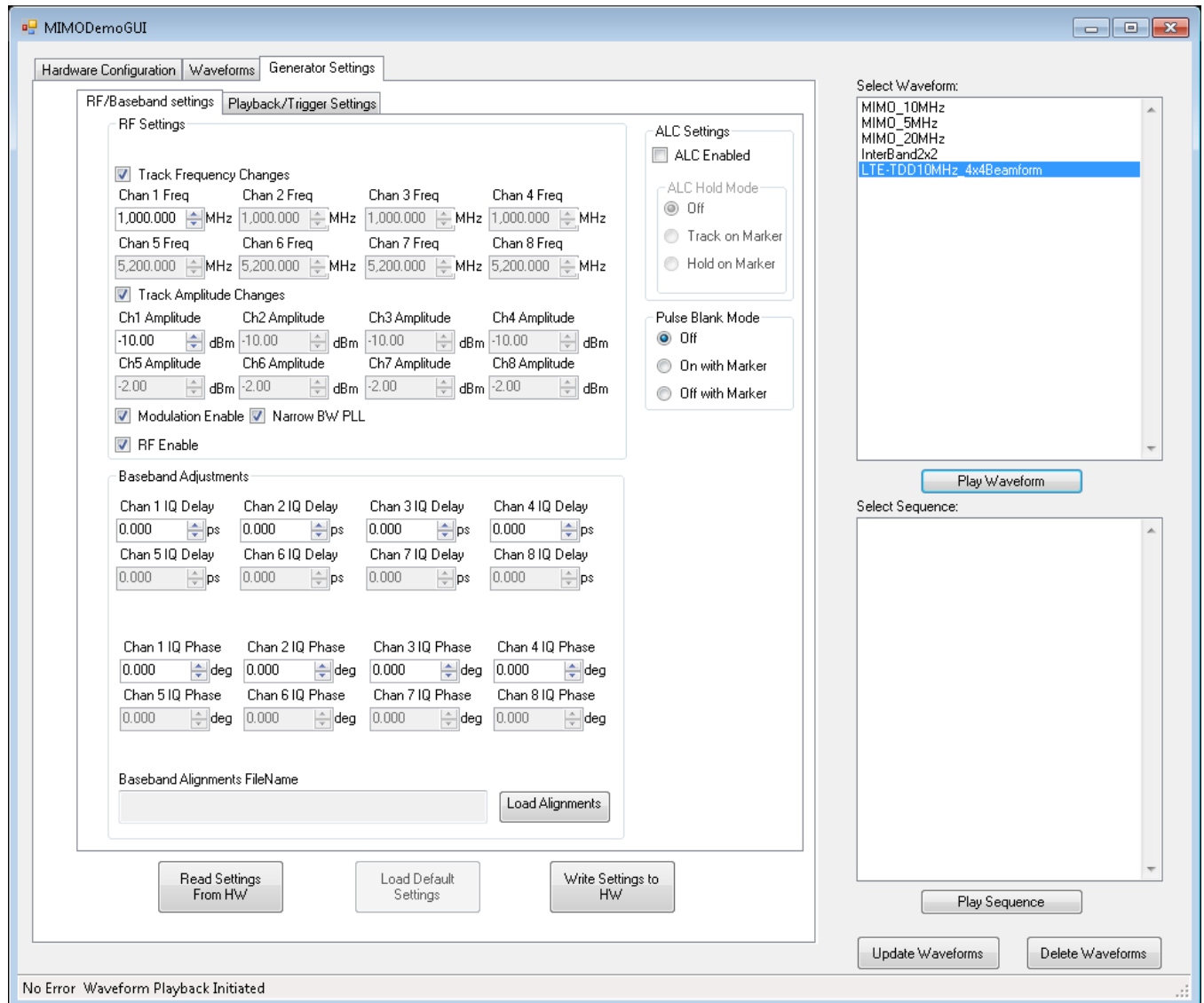


Bring your M9391A Correction Utility back up, select the single item in the table and click 'Apply'. This will apply the corrections to your VSAs so that your VSAs are aligned. This operation may take up to a minute.



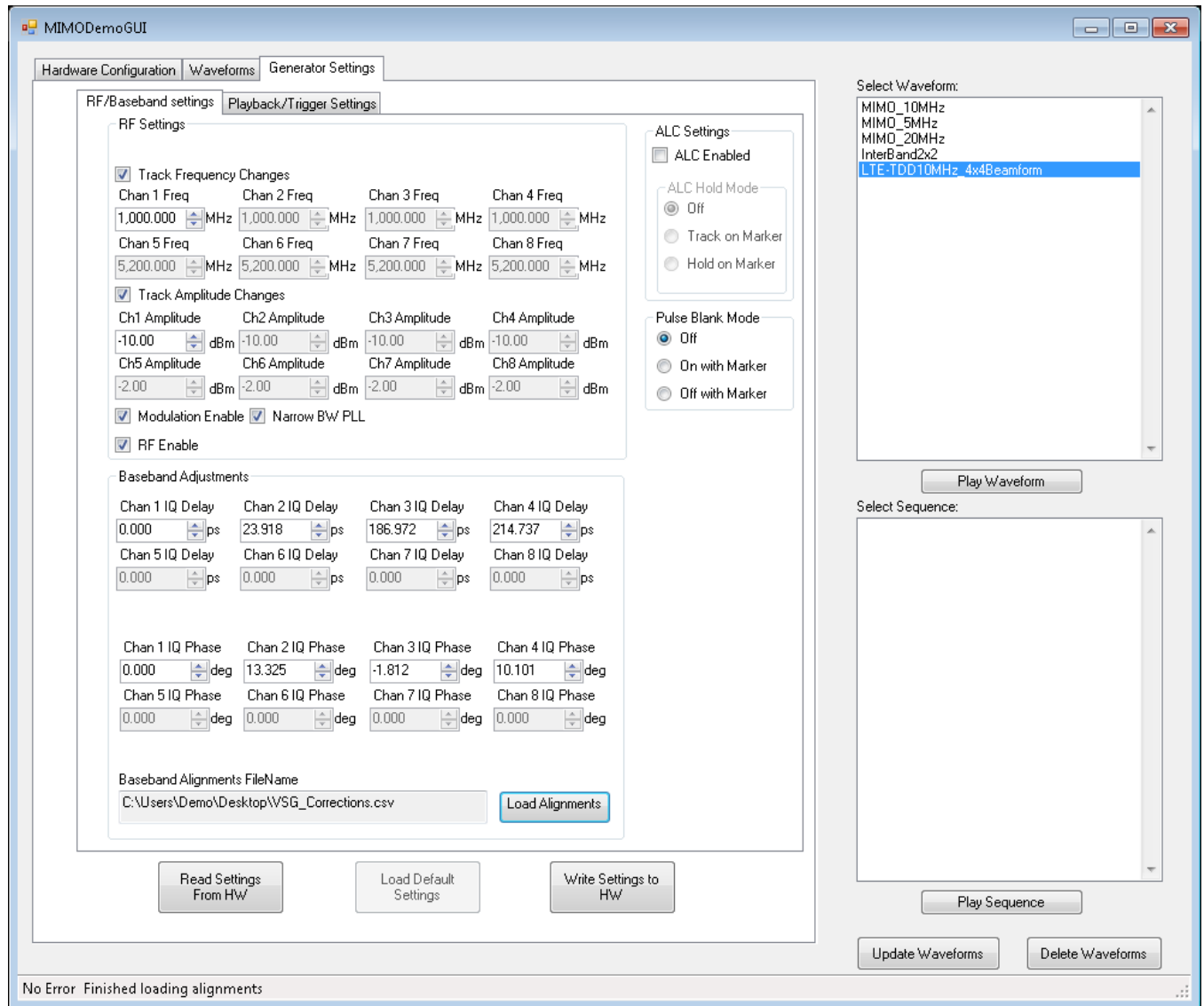


Now bring the VSG MIMO Demo Tool back up and click the 'Load Alignments' button.



Select the VSG corrections file you saved previous while running the M9381A Correction Utility and open it. Correction data should automatically be loaded into the tool.

## Step 5 - Quick Start Measurements



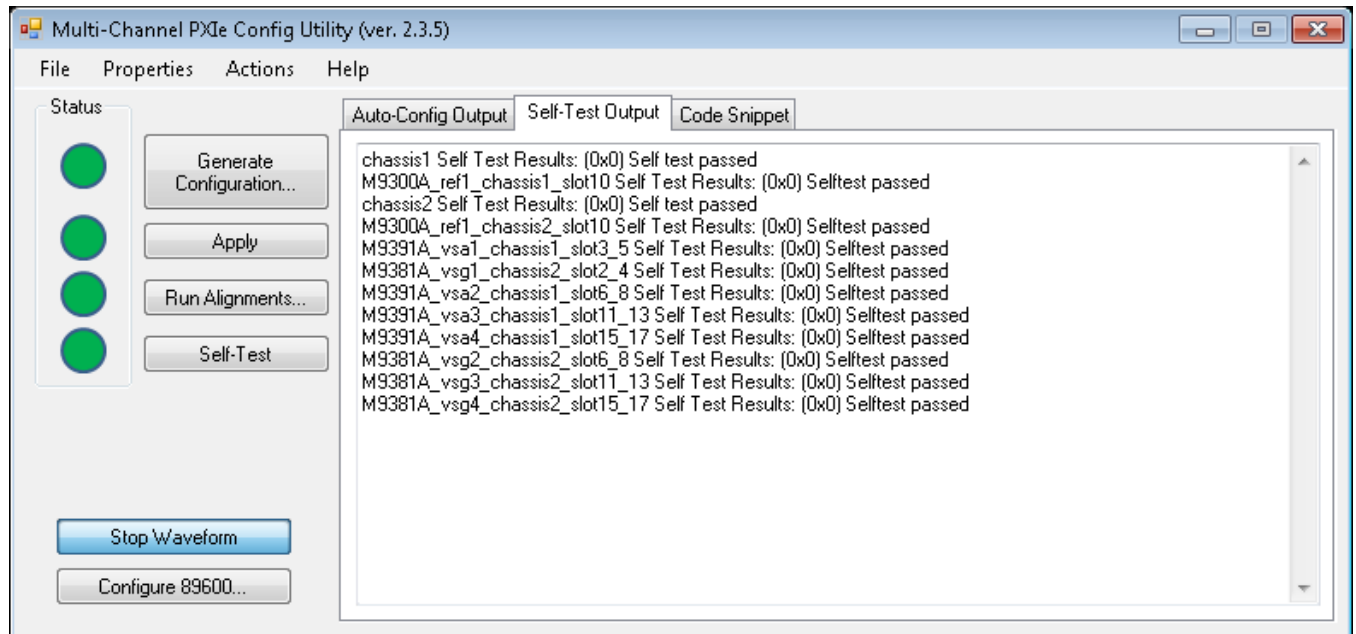
Go back to the 89600 VSA Software. After applying corrections to both the VSGs and VSAs, your beamforming waveform should now be corrected and look similar to below.



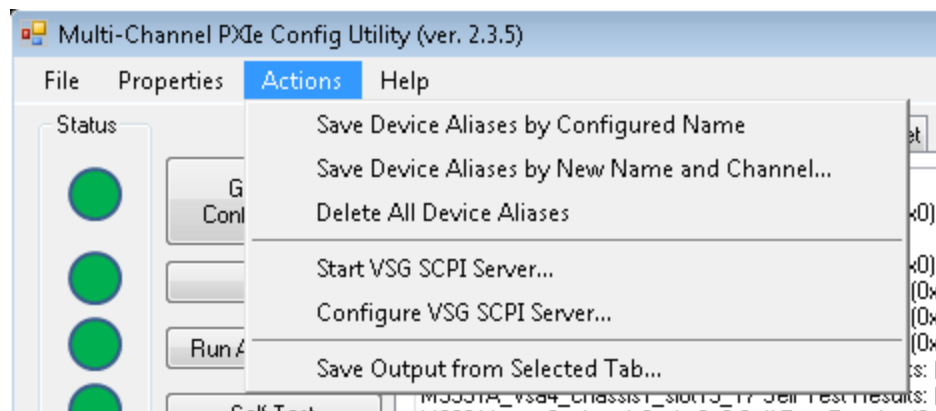
## Quick Start to MIMO Measurement (Independent LO)

This section assumes you have completed the 'Quick Start to First Measurement' section, but you did not perform the 'Quick Start to Beamforming Measurement' section.

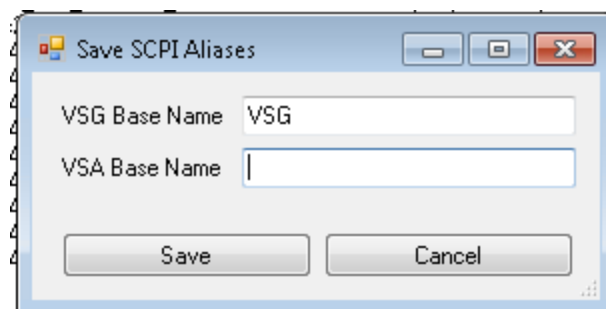
If you have just finished the previous section, click on 'Stop Waveform' in the Config Utility.



From the 'Actions' menu, select the 'Save Device Aliases by New Name and Channel...' option.

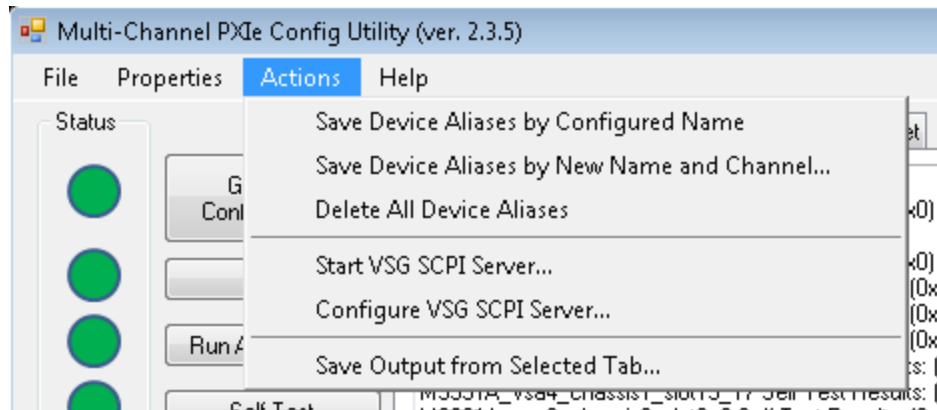


In the 'Save SCPI Aliases' window, type "VSG" into 'VSG Base Name'. Leave 'VSA Base Name' empty and click 'Save'.

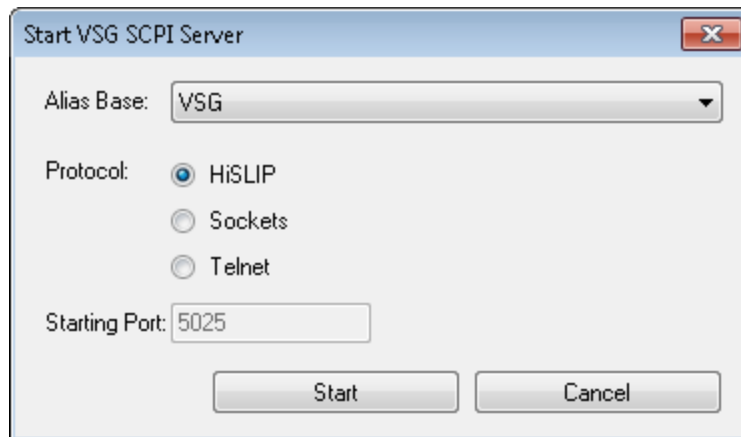


Go back to the 'Actions' menu and select 'Start VSG SCPI Server...'

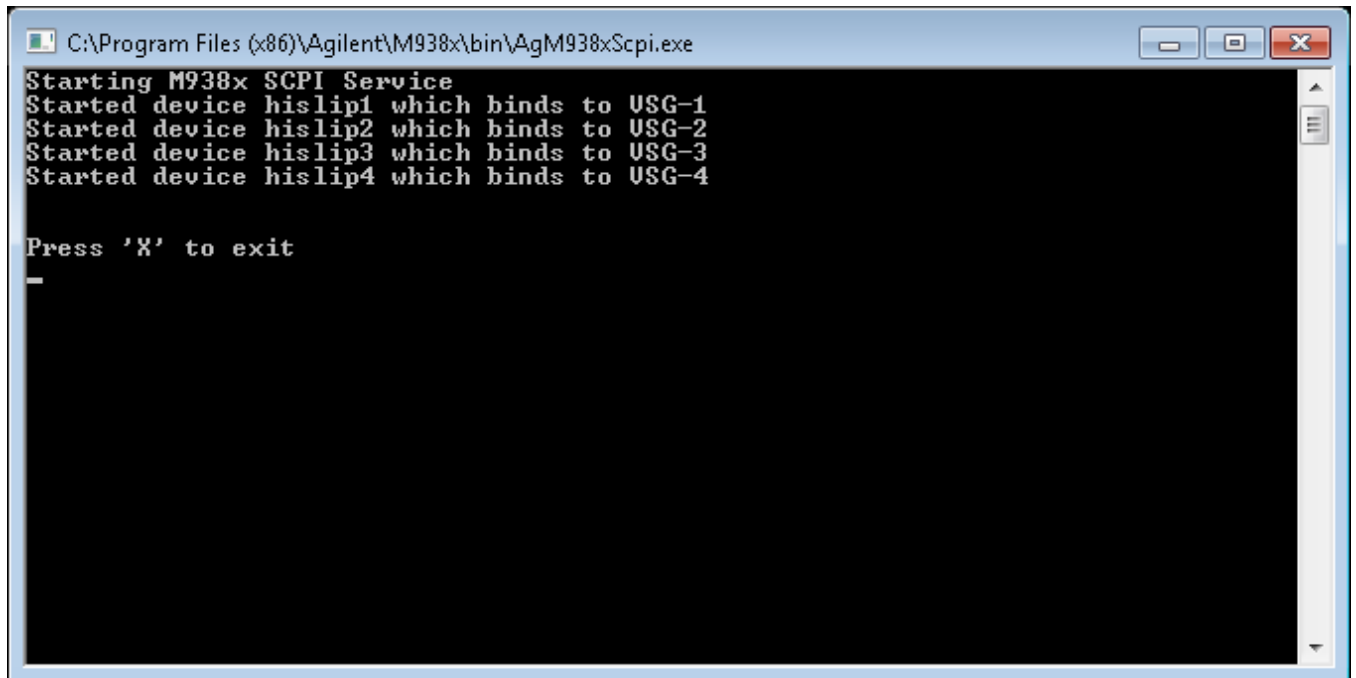




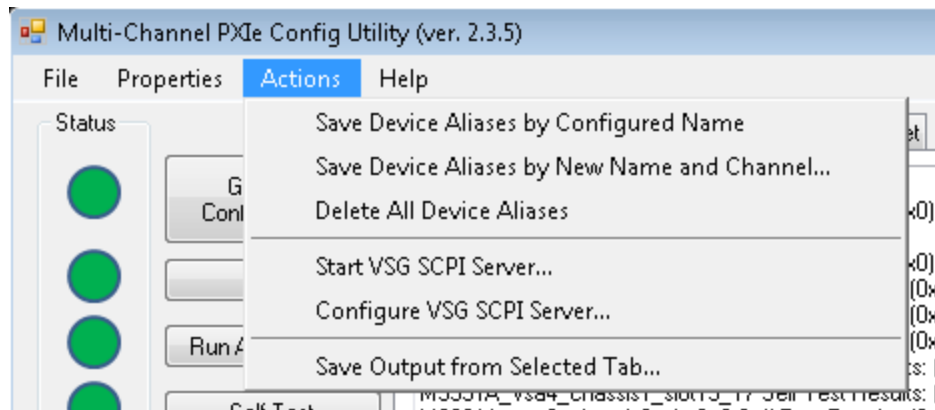
In the 'Start VSG SCPI Server' select 'VSG' as your 'Alias Base' (the value you entered into the 'VSG Base Name' text box above). Leave HiSLIP selected and click 'Start'.



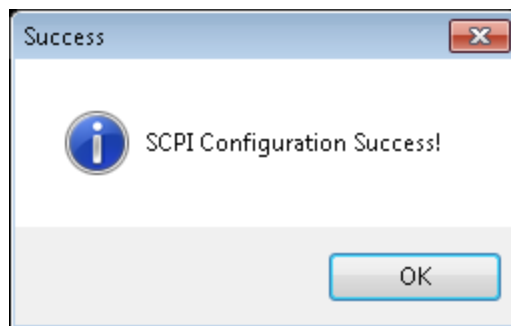
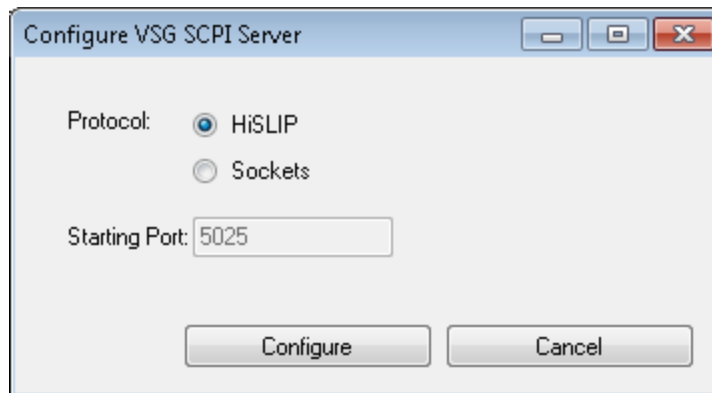
Wait for all of your VSGs to start in the SCPI server console window.



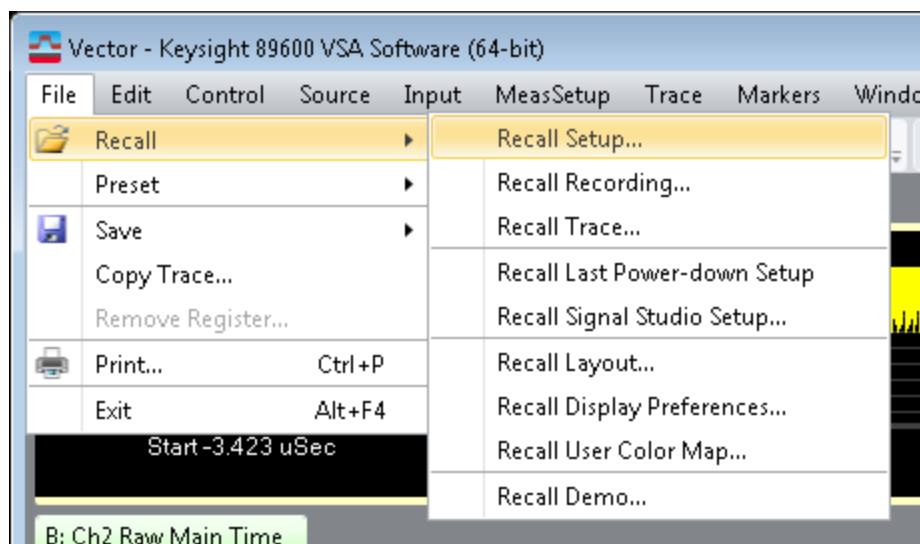
Open the 'Actions' menu again and select 'Configure VSG SCPI Server...'

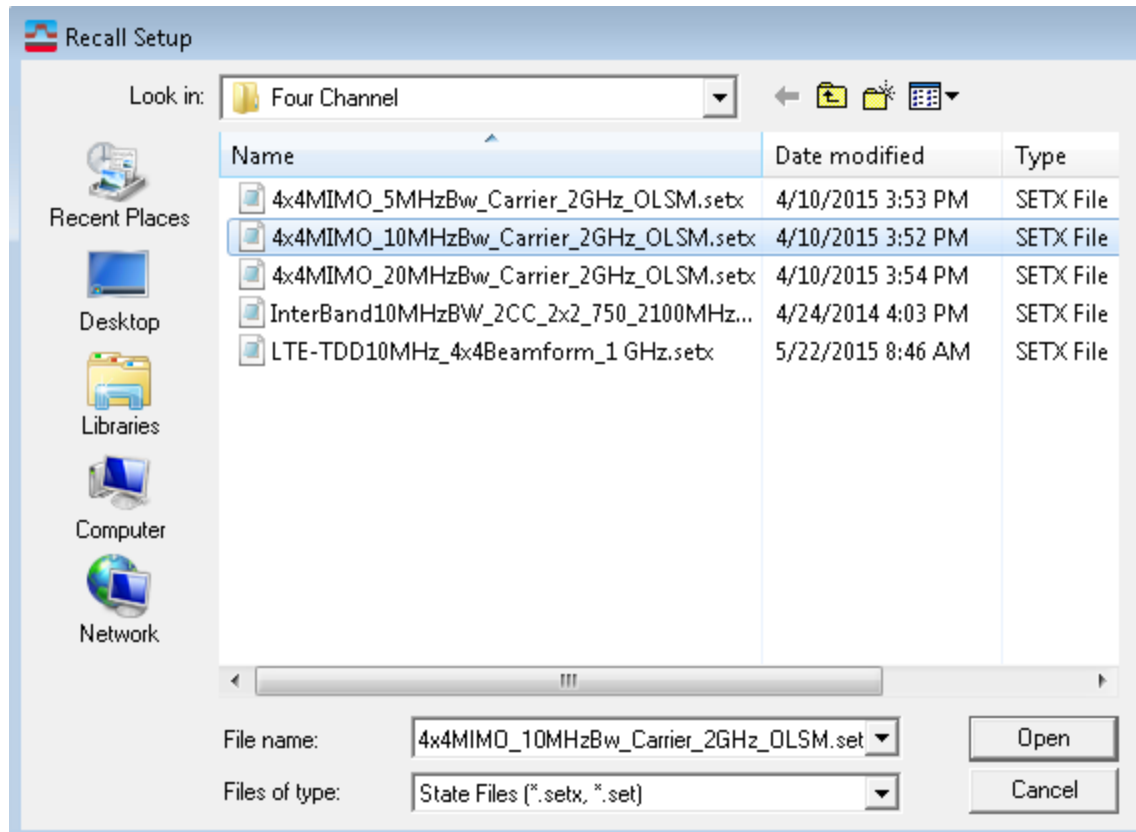


Leave HiSLIP selected and click 'Configure'. After the success dialog is displayed, click 'OK'

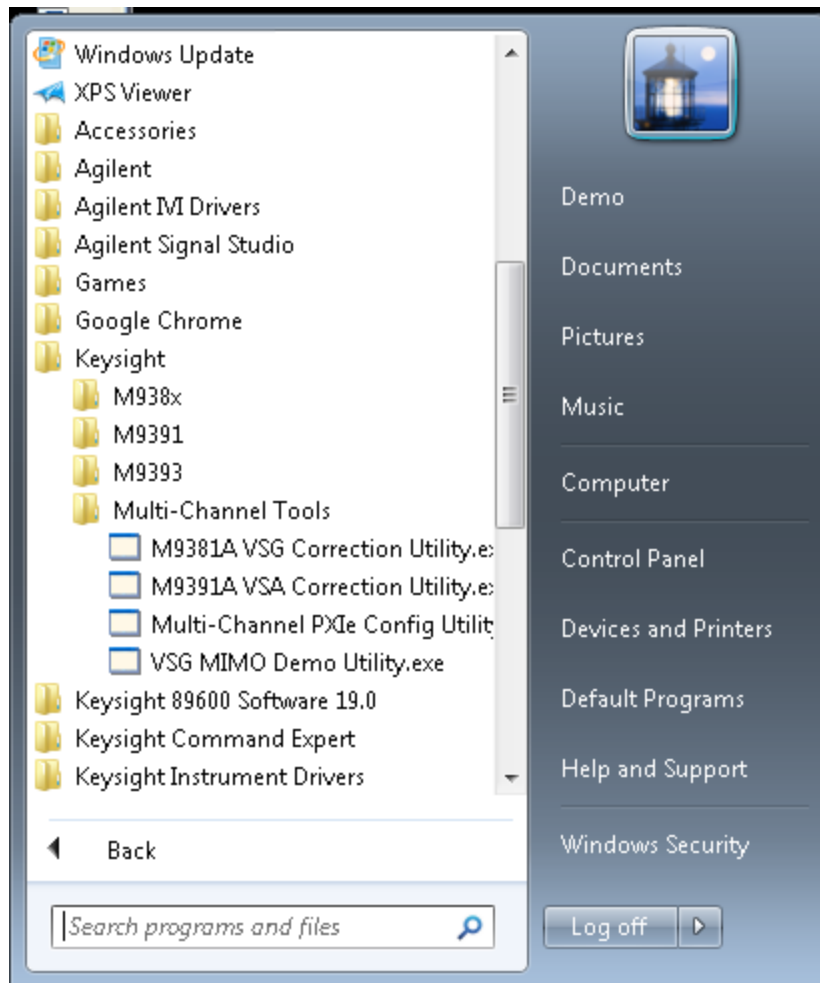


Load in the appropriate multi-channel setup file in the 89600 VSA Software by selecting the File menu > Recall, Recall Setup... then navigating to the Multi-Channel Utilities install location and going to Setup Files/LTE/{Dual Channel | Four Channel (depending on your channel count)}/XxXMIMO\_10MHzBw\_Carrier\_2GHz\_OLSM.setx. Load that file by clicking 'Open'.

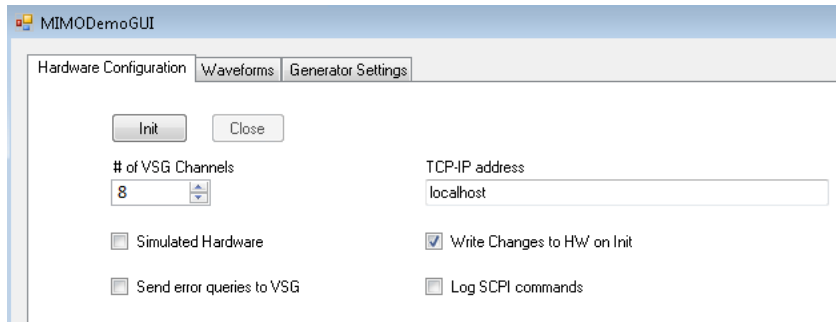




Start the VSG MIMO Demo Utility from your Start menu under All Programs > Keysight > Multi-Channel Tools. This tool is used as a soft front panel for multi-channel VSGs.

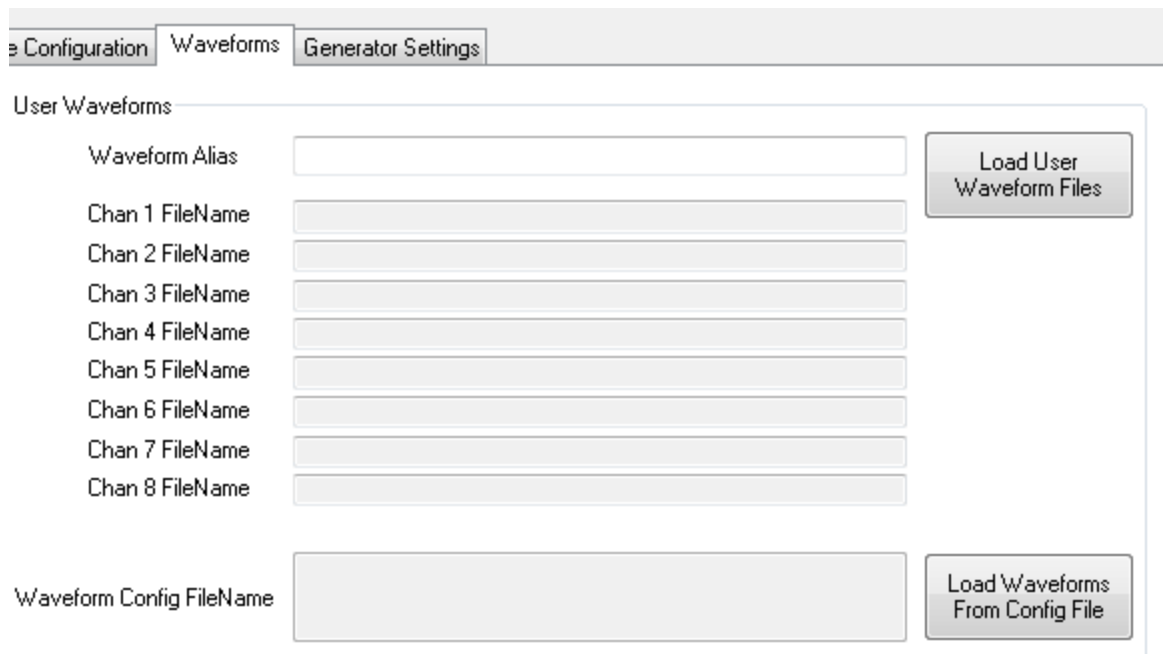


Set the '# of VSG Channels' to the number of VSGs running in the SCPI server, make sure 'Write Changes to HW on Init' is checked, leave 'localhost' as the TCP-IP address, and click 'Init'.



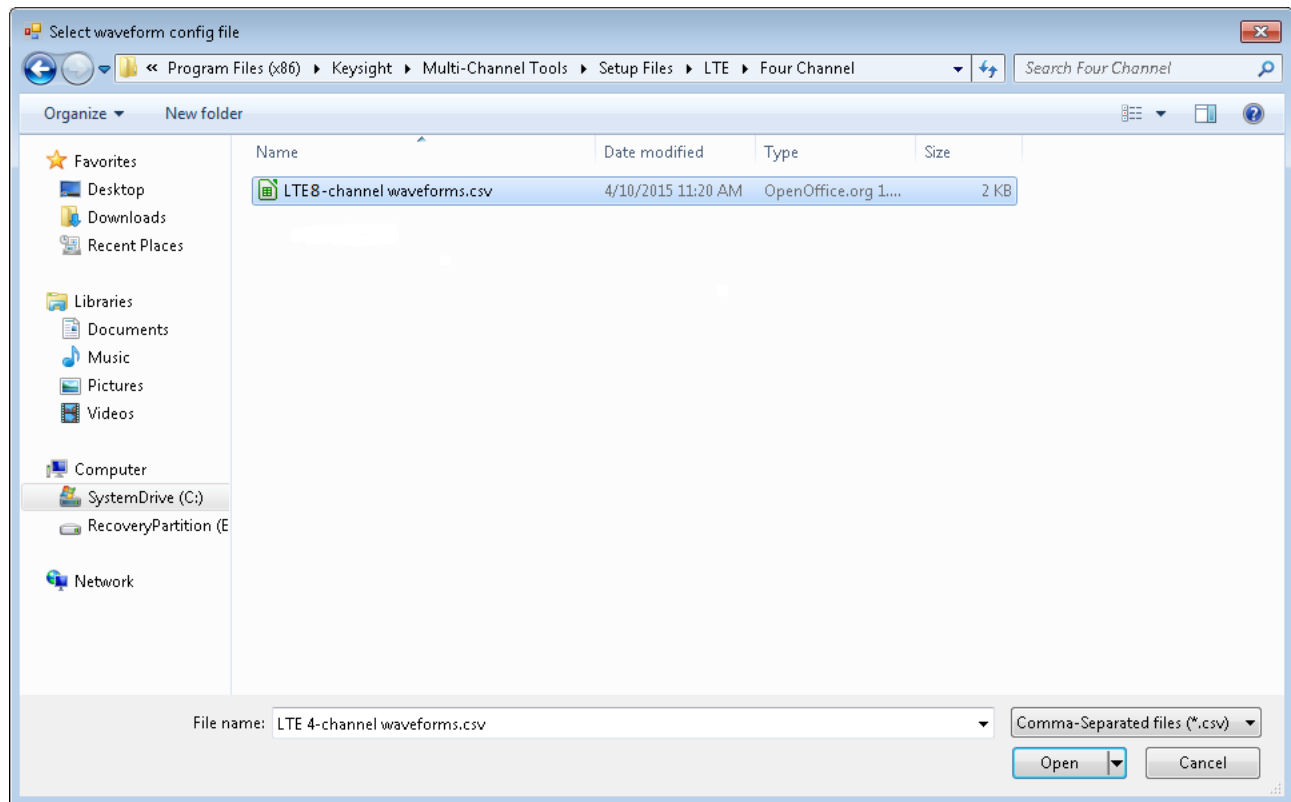
The screenshot shows the 'MIMODemoGUI' window with the 'Hardware Configuration' tab selected. It features an 'Init' button and a 'Close' button. Below these, there are two input fields: '# of VSG Channels' with a value of '8' and 'TCP-IP address' with a value of 'localhost'. There are also four checkboxes: 'Simulated Hardware' (unchecked), 'Send error queries to VSG' (unchecked), 'Write Changes to HW on Init' (checked), and 'Log SCPI commands' (unchecked).

Go to the 'Waveforms' tab and select the 'Load Waveforms From Config File' button.



The screenshot shows the 'MIMODemoGUI' window with the 'Waveforms' tab selected. It displays a 'User Waveforms' section with a 'Waveform Alias' input field and a 'Load User Waveform Files' button. Below this, there are eight 'Chan' input fields labeled 'Chan 1 FileName' through 'Chan 8 FileName'. At the bottom, there is a 'Waveform Config FileName' input field and a 'Load Waveforms From Config File' button.

Then navigating to the Multi-Channel Utilities install location and going to Setup Files/LTE/{Dual Channel | Four Channel (depending on your channel count)}/LTE X-channel waveforms.csv. Load that file by clicking 'Open'.



Go to the 'Generator Settings' tab. Set all frequencies, amplitudes, IQ delays, and IQ phases for each channel number (up to the number of channels in your system) to 2000, -10, 0, and 0 respectively. Note: you may need to uncheck 'Track Frequency Changes' and 'Track Amplitude Changes' to accomplish this.

The screenshot shows the 'Generator Settings' tab with the following configuration:

- Hardware Configuration** | **Waveforms** | **Generator Settings**
- RF/Baseband settings** | **Playback/Trigger Settings**
- RF Settings**
  - ☒ Track Frequency Changes
 

Chan 1 Freq	Chan 2 Freq	Chan 3 Freq	Chan 4 Freq
2,000.000 MHz	2,000.000 MHz	2,000.000 MHz	2,000.000 MHz
Chan 5 Freq	Chan 6 Freq	Chan 7 Freq	Chan 8 Freq
5,200.000 MHz	5,200.000 MHz	5,200.000 MHz	5,200.000 MHz
  - ☒ Track Amplitude Changes
 

Ch1 Amplitude	Ch2 Amplitude	Ch3 Amplitude	Ch4 Amplitude
-10.00 dBm	-10.00 dBm	-10.00 dBm	-10.00 dBm
Ch5 Amplitude	Ch6 Amplitude	Ch7 Amplitude	Ch8 Amplitude
-2.00 dBm	-2.00 dBm	-2.00 dBm	-2.00 dBm
  - ☒ Modulation Enable ☒ Narrow BW PLL
  - ☒ RF Enable
- Baseband Adjustments**

Chan 1 IQ Delay	Chan 2 IQ Delay	Chan 3 IQ Delay	Chan 4 IQ Delay
0.000 ps	0.000 ps	0.000 ps	0.000 ps
Chan 5 IQ Delay	Chan 6 IQ Delay	Chan 7 IQ Delay	Chan 8 IQ Delay
0.000 ps	0.000 ps	0.000 ps	0.000 ps

Chan 1 IQ Phase	Chan 2 IQ Phase	Chan 3 IQ Phase	Chan 4 IQ Phase
0.000 deg	0.000 deg	0.000 deg	0.000 deg
Chan 5 IQ Phase	Chan 6 IQ Phase	Chan 7 IQ Phase	Chan 8 IQ Phase
0.000 deg	0.000 deg	0.000 deg	0.000 deg

**ALC Settings**☐ ALC Enabled**ALC Hold Mode**

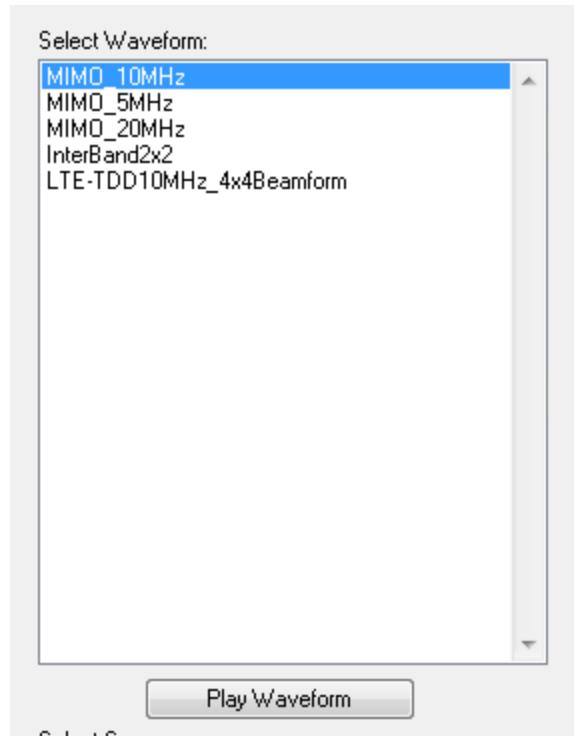
- ☒ Off
- ☐ Track on Marker
- ☐ Hold on Marker

**Pulse Blank Mode**

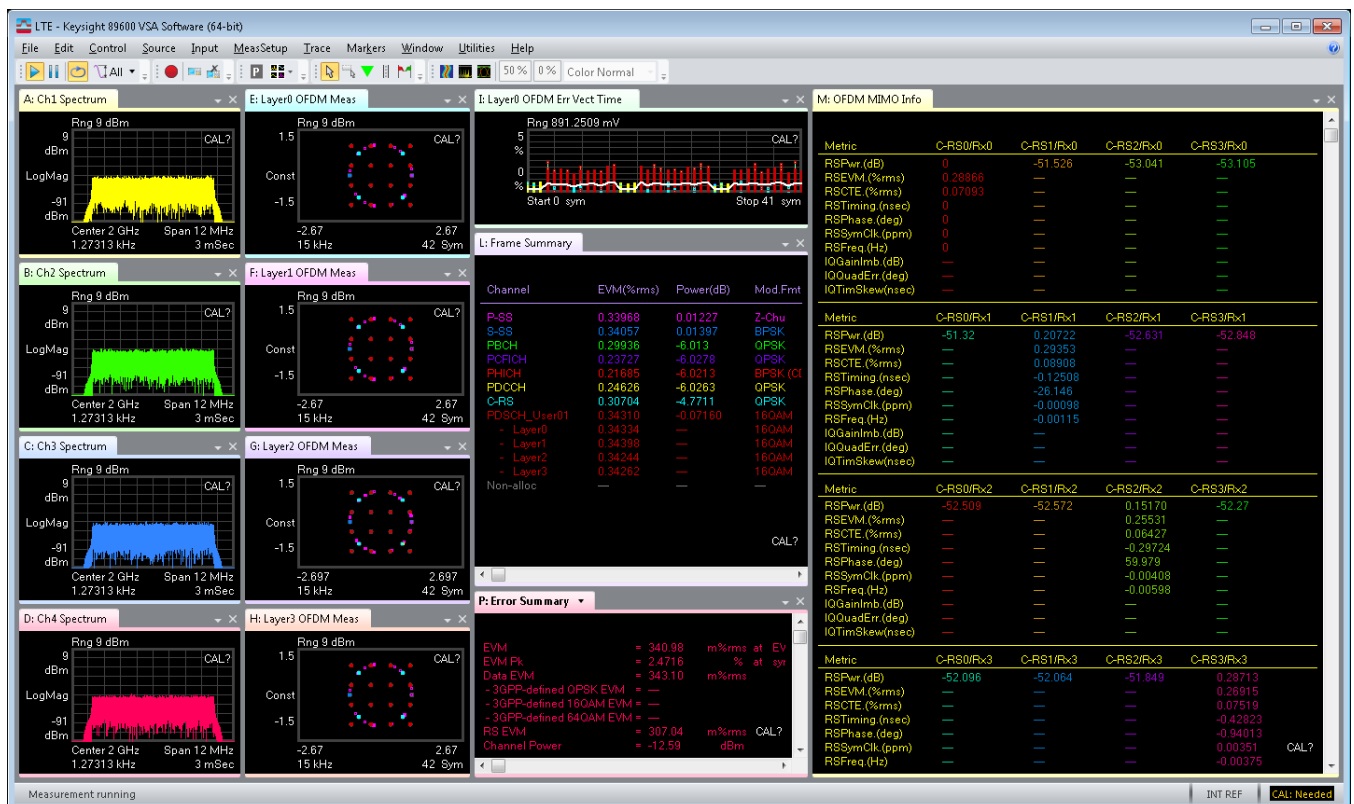
- ☒ Off
- ☐ On with Marker
- ☐ Off with Marker



Select 'MIMO\_10MHz' in the 'Select Waveform' box and click 'Play Waveform'.



Look at your 89600 VSA Software window. You will now see an example wireless signal.



## Appendix A – Return Instrument for Repair

### Return an Instrument for Service

Should it become necessary to return an instrument for repair or service, follow the steps below:

**NOTE**

It is recommended that you return all modules and cables of the M9381A or M9391A instrument for repair and calibration. If your Keysight M9300A PXIe Frequency Reference is operating properly, you need not send it in with the other modules because your instrument may be repaired and calibrated without your M9300A. Doing so, however, will effect your calibration schedule, since repairs are followed by calibration. The Calibration Due Date for your M9300A will not match the date of your other modules.

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1. Review the warranty information shipped with your product.
2. Contact Keysight to obtain a Return Material Authorization (RMA) and return address. For assistance finding Keysight contact information, go to [www.keysight.com/find/assist](http://www.keysight.com/find/assist).
3. Write the following information on a tag and attach it to the malfunctioning equipment:
  - Name and address of owner. A P.O. box is not acceptable as a return address.
  - Module serial number(s). The serial number label is located on the side panel of the module. The serial number can also be read from the Soft Front Panel interface - after the hardware is installed.
  - Description of failure or service required.
4. Pack the instrument in its original packaging. Include all cables. If the original packaging material is not available, use anti-static bubble wrap or packing peanuts and place the instrument in a sealed container and mark the container -FRAGILE-.
5. On the shipping label, write ATTENTION REPAIR DEPARTMENT and the RMA number.

**NOTE**

In your correspondence, refer to the modules by serial number and the instrument by model number.

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## Appendix B – Options

Model – Option List for the Keysight M9381A PXIe Vector Signal Generator.

<b>M9381A</b>	<b>Description</b>
M9381A	PXIe VSG: 1 MHz to 3 GHz or 6 GHz
M9381A-F03	Frequency Range, 1 MHz to 3 GHz
M9381A-F06	Frequency Range: 1 MHz to 6 GHz
M9381A-1EA	High Output Power
M9381A-UNZ	Fast Switching
M9381A-B04	RF Modulation Bandwidth, 40 MHz
M9381A-B10	RF Modulation Bandwidth, 100 MHz
M9381A-B16	RF Modulation Bandwidth, 160 MHz
M9381A-M01	Memory, 32 MSa
M9381A-M05	Memory, 512 MSa
M9381A-M10	Memory, 1024 MSa
M9381A-UNT	Analog Modulation
M9381A-300	Keysight M9300A PXIe Frequency Reference: 10 MHz and 100 MHz
M9381A-UK6	Commercial calibration certificate with test data
M9381A-012	LO Sharing for Phase Coherency

## Model – Option List for the Keysight M9391A PXle Vector Signal Analyzer

<b>M9391A</b>	<b>Description</b>
M9391A	PXle Vector Signal Analyzer: 1 MHz to 3 GHz or 6 GHz
M9391A-F03	Frequency Range, 1 MHz to 3 GHz
M9391A-F06	Frequency Range: 1 MHz to 6 GHz
M9391A-UNZ	Fast Switching
M9391A-B04	Analysis Bandwidth, 40 MHz
M9391A-B10	Analysis Bandwidth, 100 MHz
M9391A-B16	Analysis Bandwidth, 160 MHz
M9391A-M01	Memory, 32 MSa
M9391A-M05	Memory, 512 MSa
M9391A-M10	Memory, 1024 MSa
M9391A-300	Add Keysight M9300A PXle Frequency Reference: 10 MHz and 100 MHz
M9391A-UK6	Commercial calibration certificate with test data
M9391A-012	LO Sharing for Phase Coherency

## Appendix C – Standard Configurations

LTE Standard Configurations can be found at the following link for:

- 2x2 LTE/LTE-A Solution (2 Sources and 2 Analyzers)
- 4-Channel LTE/LTE-A Signal Generation (4 Sources)
- 4-Channel LTE/LTE-A Signal Analysis (4 Analyzers)
- 4x4 LTE/LTE-A Solution (4 Sources and 4 Analyzers)
- 4x4 LTE/LTE-A Phase-Coherent Solution (4 Sources & 4 Analyzers)
- 8x8 LTE/LTE-A Solution (8 Sources and 8 Analyzers)
- 8x8 LTE/LTE-A Phase-Coherent Solution (8 Sources & 8 Analyzers)

At the following link, select the Standard Configurations tab for details on each configuration.

<http://www.keysight.com/find/solution-lte>

For more information on LTE/LTE-A Multi-Channel Systems see:

- Solution Brochure 5991-4684EN
- Configuration Guide 5991-4647EN



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