Keysight M9241/42/43A PXIe Oscilloscopes and M9240A AutoProbe Power Module

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Startup Guide

Notices

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Warranty

Technology License

U.S. Government Rights

Safety Notices

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

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.

Contents

1 Introduction

The purpose of this Startup Guide is to detail the processes of receiving and installing the Keysight M9241/42/43A PXIe oscilloscope modules and the Keysight M9240A AutoProbe power module.

The chapters in this guide cover the basics of setting up and configuring a PXIe oscilloscope system, as well as installing the required software.

If you have any questions after reviewing this information, please contact your local Keysight Technologies representative or contact us through our website at www.keysight.com/find/pxi-digitizers.

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.**

1 Unpack and inspect. See: Chapter 2, "Unpack and Inspect the Module," starting on page 11

2 Verify the shipment. See: Chapter 3, "Verify Shipment Contents and Model Options," starting on page 15

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3 Install modules. See: Chapter 4, "Install the Modules," starting on page 17
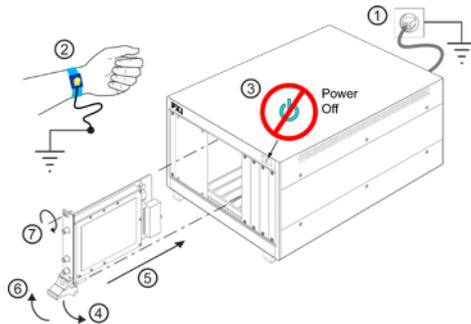
4 Install drivers and software. See: Chapter 5, "Install the Software," starting on page 25

5 Verify operation with the Soft Front Panel (SFP). See: Chapter 6, "Verify Operation," starting on page 29

6 Make a measurement. See: Chapter 7, "Make a Measurement," starting on page 35

7 (Optional) If you want to coordinate acquisitions between multiple PXIe oscilloscope modules, see: Chapter 8, "Coordinating Multiple PXIe Oscilloscope Modules," starting on page 45

8 Installation is complete. Proceed to program your product through the API. See: Chapter 9, "Applications Programming Interface (API) Overview," starting on page 61

Related Documentation

To access documentation related to the Keysight M9241/42/43A PXIe oscilloscope modules and the Keysight M9240A AutoProbe power module, use one of the following methods:

· The related documents are available on the product CD:

Document	Description	File name	Format
Startup Guide (this manual)	Includes procedures to help you to unpack, inspect, install (hardware and software), verify operation, and make a basic measurement.	M924x_StartupGuide.pdf	PDF
Soft Front Panel (SFP) User's Guide	Shows how to use the InfiniiVision M9241/42/43A PXIe oscilloscope's Soft Front Panel (SFP) user interface.	M924x_SFP_Users_Guide.pdf	PDF
		M924x_SFP_Users_Guide.chm	CHM (Microsoft Help Format)
SCPI Programmer's Guide	Shows how to program the M9241/42/43A PXIe oscilloscopes using SCPI commands.	M924x_SCPI_Programmers_Guide.chm	CHM (Microsoft Help Format)
		M924x_SCPI_Programmers_Guide.pdf	PDF
IVI Programming Guide	Shows you how to use Visual Studio 2010 with the .NET Framework to write IVI-COM Console Applications in Visual C#.	M924x_IVI_ProgrammingGuide.pdf	PDF
IVI Driver reference (help system)	Provides detailed documentation of the IVI-COM and IVI-C driver API functions, as well as information to help you get started with using the IVI drivers in your application development environment.	AgInfiniiVision.chm	CHM (Microsoft Help Format)
LabVIEW Driver Reference	Provides detailed documentation of the LabVIEW G Driver API functions.	KtInfiniiVision_LabVIEW_Help.chm	CHM (Microsoft Help Format)

- To find the latest versions of the user documentation, go to www.keysight.com/manuals/M9241A.

See Also   The data sheet introduces the product and provides full product specifications. You can find the data sheet at: www.keysight.com/products/M9241A

The Keysight M9241/42/43A PXIe Oscilloscopes and M9240A AutoProbe Power Module Security Guide is available at www.keysight.com/find/security.

2 Unpack and Inspect the Module

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 following figure shows a static-safe work station using two types of ESD protection: conductive table-mat and wriststrap combination, and conductive floor-mat and heelstrap 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.

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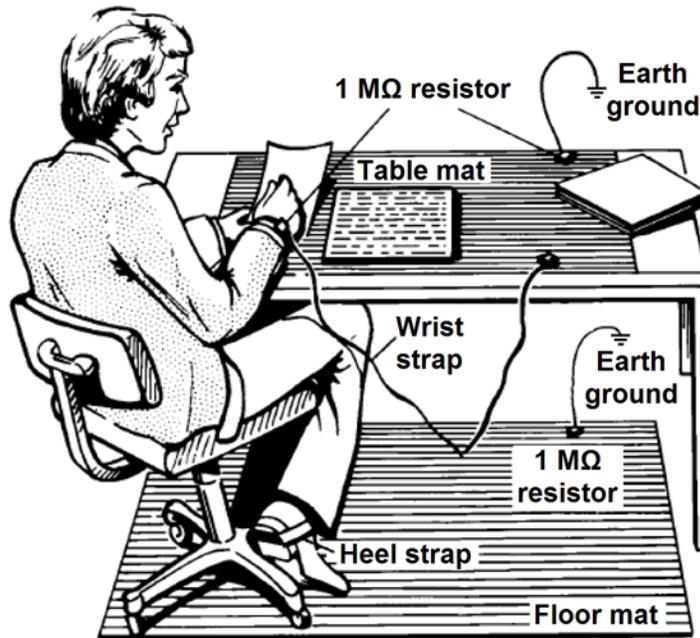
WARNING   **DO NOT use these techniques for a static-safe work station when working on circuitry with a voltage potential greater than 500 volts.**

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.

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

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 M924xA instrument for repair and calibration.

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.

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.

3 Verify Shipment Contents and Model Options

M9241/42/43A PXIe Oscilloscope Shipment Contents

Items included in your M9241/42/43A PXIe oscilloscope shipment:

Qty	Keysight Part Number	Description
1	M9241A, M9242A, or M9243A	200 MHz, 500 MHz, or 1 GHz PXIe oscilloscope module
1	5991-3402	End User License Agreement
1	75045-61610	RF Cable MMCX to BNC 600 mm
1	9230-0333	Envelope-Calibration Certificate (230 mm x 153 mm)
1	9320-6678	China RoHS Addendum for Oscilloscope
1	9320-6797	Manual Safety-booklet Keysight branded
1	E2094-60003	CD-ROM, IO Libraries Media Suite
1	M9240-94xxx	Software and Product Information CD, contains: Soft Front Panels, drivers, and all printed documentation in PDF format (also available at http://www.keysight.com/support/M9241A)
1	M9240-97xxx	Keysight M9241/42/43A PXIe Oscilloscopes and M9240A AutoProbe Power Module Startup Guide in hard copy

Model-option list for the M9241/42/43A PXIe oscilloscope:

Model Number	Description
M9240EMBA	Embedded Serial Triggering and Analysis (I2C)
M9240MSKA	Mask Limit Testing

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Model Number	Description
M9240PWRA	Power Analysis Application
M9240AROA	MIL-STD 1553 and ARINC 429 Serial Triggering and Analysis
M9240VIDA	Enhanced Video/TV Triggering Application Package
M9240AWGA	WaveGen 20 MHz Function/Arbitrary Waveform Generator
M9240CMPA	Computer Serial Triggering and Analysis (RS232/422/485/UART)
M9240ATOA	Automotive Serial Triggering and Analysis (CAN, CAN-dbc, CAN FD, LIN)
M9240SNSA	SENT (Single Edge Nibble Transmission) Triggering and Analysis
M9240CXPA	CXPI Trigger and Decode
M9240FRAA	Frequency Response Analyzer
M9240NFCA	NFC Automated Test for X-Series Oscilloscopes
M9241A-808, M9242A-808, or M9243A-808	Qty 2 of the N2843-60001 (N2843A passive probe - 500 MHz 10:1)

M9240A AutoProbe Power Module Shipment Contents

Items included in your M9241/42/43A PXIe oscilloscope shipment:

Qty	Keysight Part Number	Description
1	M9240A	AutoProbe power module, includes one faceplate for oscilloscope module in slot to the left and one faceplate for oscilloscope module in slot to the right
1	5185-1605	Envelope-Calibration Certificate (230 mm x 153 mm)
1	5991-3402	End User License Agreement
1	9320-6678	China RoHS Addendum for Oscilloscope
1	9320-6797	Manual Safety-booklet Keysight branded
1	E2094-60003	CD-ROM, IO Libraries Media Suite
1	M9240-94xxx	Software and Product Information CD, contains: Soft Front Panels, drivers, and all printed documentation in PDF format (also available at http://www.keysight.com/support/M9241A)
1	M9240-97xxx	Keysight M9241/42/43A PXIe Oscilloscopes and M9240A AutoProbe Power Module Startup Guide in hard copy

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

Module Installation Process Overview

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 between 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 If using a remote PC controller, install the system interface card into the PC and connect the chassis to the host PC.

5 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.

CAUTION The M924xA PXIe oscilloscope can use peer-to-peer (module-to-module) triggering across the PXI Express chassis backplane. Therefore, be sure to install the M924xA modules into a chassis that supports peer-to-peer PXI Express I/O switch topology. When using the Keysight M9018A PXIe 18-Slot Chassis, install the M924xA modules into one of its three slot groups: 1 through 6, 7 through 12, or 13 through 18. For more information on coordinating multiple M924xA PXIe oscilloscope modules, see Chapter 8, "Coordinating Multiple PXIe Oscilloscope Modules," starting on page 45.

If you are using a non-Keysight chassis, consult your manufacturer's documentation.

NOTE When using the Keysight M9018A Chassis you will achieve the highest data throughput for the Keysight M9241/42/43A PXIe oscilloscopes by using Slots 2, 6, 11 or 15. 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.
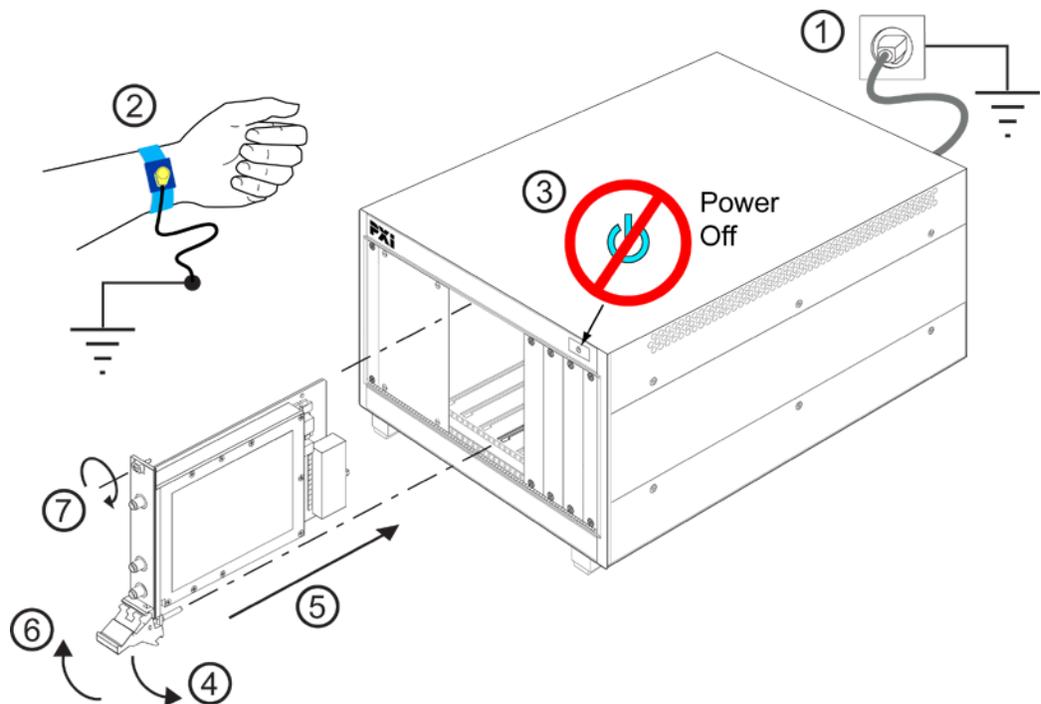
a   Install the module into the slot of the chassis by placing the module card edges into the front module guides (top and bottom).

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 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.

11 Power up the PXI chassis.

12 If you are using a remote PC controller, reboot the PC host controller.

13 Proceed to Chapter 6, "Verify Operation," starting on page 29.

Front Panel Features

This section describes the front panel features, that is, connectors and LEDs, for the M9241/42/43A PXIe oscilloscope and the M9240A AutoProbe power module.

Run state LED
(green = runing,
red = stopped,
amber = waiting for
single acquisition
to complete)

Chassis ground terminal

Probe Comp terminal

Channel 1 BNC input

Channel 2 BNC input

External trigger input

Waveform generator output

WaveGen/Identify LED
(blue = WaveGen output enabled,
blinking blue = identify PXI module)

AutoProbe support interface

Auxiliary output (trigger, mask,
WaveGen sync pulse, etc.)

10 MHz Ref input/output

Left/Right module
AutoProbe power LED
(green = power supplied,
red = power not supplied)

LED Operation

LEDs for the M9241/42/43A PXIe oscilloscope module and the M9240A AutoProbe power module are described in the following table.

LED	Color	When
Run state LED	Green	Acquisitions are running
	Red	Acquisitions are stopped
	Amber	Waiting for a single acquisition to complete
	Off	No driver is connected and the hardware is shut down
WaveGen/Identify LED	Blue	The WaveGen output is enabled
	Blinking blue	The "Identify PXI Module" feature is on
	Off	The WaveGen output is disabled
AutoProbe power LED (Left/Right module)	Red	Either of the following conditions is true: ▪ There is a power fault. ▪ The associated module is shut down (that is, no driver is connected).
	Green	Neither of the red conditions is true

AutoProbe Interface

The M9240A AutoProbe power module comes with two faceplates, one for an oscilloscope module to the left, and one for an oscilloscope module to the right. The faceplates have connectors that go between the AutoProbe power module and the oscilloscope's AutoProbe Support connector. Once the faceplate connections have been established, tighten the faceplate's thumbscrew to secure it.
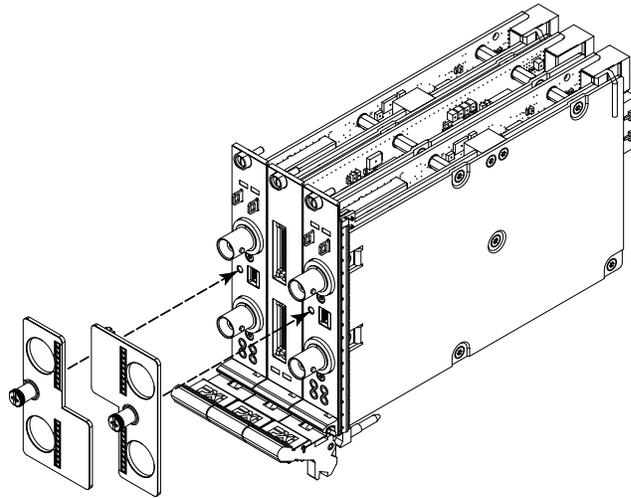
When the M9240A AutoProbe power module faceplates are connected, the oscilloscope input channels have AutoProbe interface connectors.

AutoProbe interfaces, left module

AutoProbe interfaces, right module
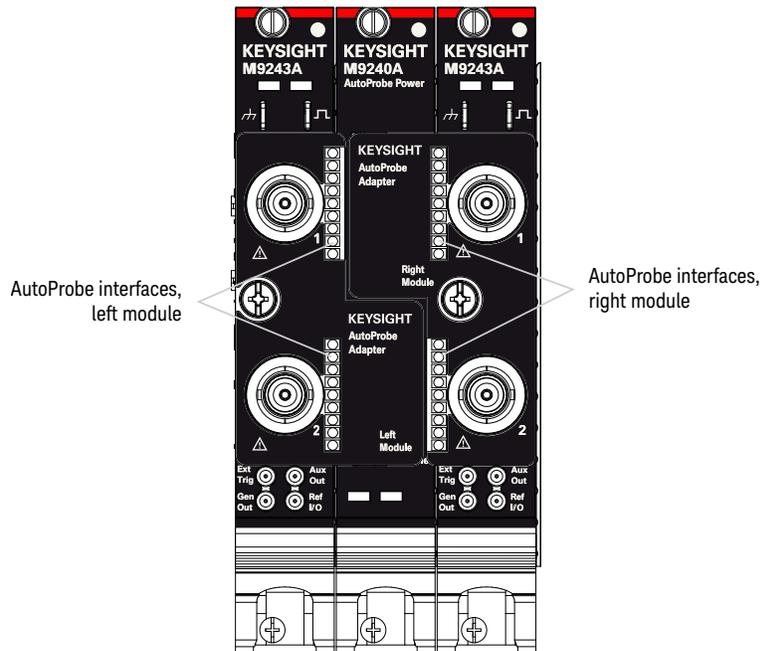
Inputs and Outputs

The M9241/42/43A PXIe oscilloscope modules have the following inputs and outputs.

Channel 1 and 2 inputs

CAUTION	⚠ **Maximum input voltage at analog inputs**

135 Vrms

50Ω input: 5 Vrms Input protection is enabled in 50 Ω mode and the 50 Ω load will disconnect if greater than 5 Vrms is detected. However the inputs could still be damaged, depending on the time constant of the signal. The 50 Ω input protection only functions when the oscilloscope is powered on.

CAUTION	When measuring voltages over 30 V, use a 10:1 probe.

Ext Trig input

| CAUTION | ⚠ **Maximum voltage at oscilloscope external trigger input** |

30 Vrms, 60 Vdc

1M ohm input: For steady-state sinusoidal waveforms derate at 20 dB/decade above 100 kHz to a minimum of 5 Vpk

For information on using the Ext Trig input, see the *Keysight M9241/42/43A PXIe Oscilloscopes Soft Front Panel (SFP) User's Guide*.

Probe Comp output terminal, chassis ground terminal

The Probe Comp and chassis ground terminals are used when compensating passive probes (see "Compensate Passive Probes" on page 39).

| WARNING | **If you should inadvertently connect the M9241/42/43A PXIe oscilloscope's chassis ground terminal to a Hazardous Live voltage and the Protective Earth Ground of the Agency Certified PXI Chassis has been defeated or is non-existent, then the chassis of the measuring equipment will also be connected to the Hazardous Live voltage and you or a bystander could receive an electrical shock from the chassis.** |

Gen Out output

The Gen Out MMCX connector is for the waveform generator output. For information on using the waveform generator, see the *Keysight M9241/42/43A PXIe Oscilloscopes Soft Front Panel (SFP) User's Guide*.

Aux Out output

The Aux Out MMCX connector can be used for trigger output, NFC trigger status, mask testing status, waveform generator sync pulse, or calibration signal. For more information, see the *Keysight M9241/42/43A PXIe Oscilloscopes Soft Front Panel (SFP) User's Guide*.

Ref I/O input/output

| CAUTION | ⚠ **Maximum input voltage at Ref I/O connector** |

Do not apply more than 20 dBm Max (6.32 Vpp Max) at the Ref I/O MMCX connector or damage to the instrument may occur.

When used for the 10 MHz reference output signal, the amplitude is 5 Vpp into a high impedance or 2.5 Vpp into 50 Ohms. It is capable of driving into lower impedances, but the output will be reduced because of the 50 Ohm source impedance.

For information on using Ref I/O as an input or output, see the *Keysight M9241/42/43A PXIe Oscilloscopes Soft Front Panel (SFP) User's Guide*.

Cleaning the Instrument

1   Remove power from the instrument.

2   Clean the external surfaces of the oscilloscope with a soft cloth dampened with a mixture of mild detergent and water.

3   Make sure that the instrument is completely dry before reconnecting it to a power source.

5 Install the Software

System Requirements

Item	Requirements
Operating system	Windows 7 (32 bit and 64 bit) or later
Processor speed	1.5 GHz 32-bit (x86), 1.5 GHz 64-bit (x64), 2.4 GHz recommended, 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: ▪ 1 GB available for Microsoft .NET Framework 3.5 SP1 ▪ 100 MB for Keysight IO Libraries Suite
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

Item	Requirements
Chassis	PXIe or PXI-H chassis slot
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.

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Item	Requirements
Embedded controller	Keysight M9036A or M9307A or an embedded controller that meets the following requirements: ▪ PXIe system controller (PXI-1 embedded controllers are not compatible). ▪ Utilize a 2x8, or 4x4 PXIe system slot link configuration. ▪ Run one of the operating systems listed in System Requirements (above).
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: ▪ Keysight M9045B PCIe ExpressCard Adapter x1, with cable (for a laptop PC) ▪ Keysight M9048A PCIe Desktop Adapter x8, with cable (for desktop PCs)

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.

Air Intake   Fan Exhaust

Figure 1   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 compatible chassis. The Keysight M9036A 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. This software must be installed first.

NOTE   Version 17.2 (or later) of the Keysight IO Libraries Suite is required.

- Instrument software, which includes the soft front panel (SFP), device drivers (IVI-C, IVI-COM, and LabVIEW G) and documentation for the Keysight M9241/42/43A PXIe oscilloscopes and M9240A AutoProbe power module. This software is included with your shipment and is also available at www.keysight.com/products/M9241A.

CAUTION   When installing the IO Libraries Suite and instrument software, either use the two CDs shipped with the product OR the two download files from keysight.com. Installing a mix of CD and keysight.com download files can result in incompatible software versions.

Software Installation Procedure:

1 Install the Keysight IO Libraries Suite. Follow the installer prompts to install the IO libraries.

2 Install the M924x InfiniiVision Oscilloscope software.

There are separate install packages for 64-bit and 32-bit Windows operating systems. Be sure to choose the one that is appropriate for your chassis controller PC.

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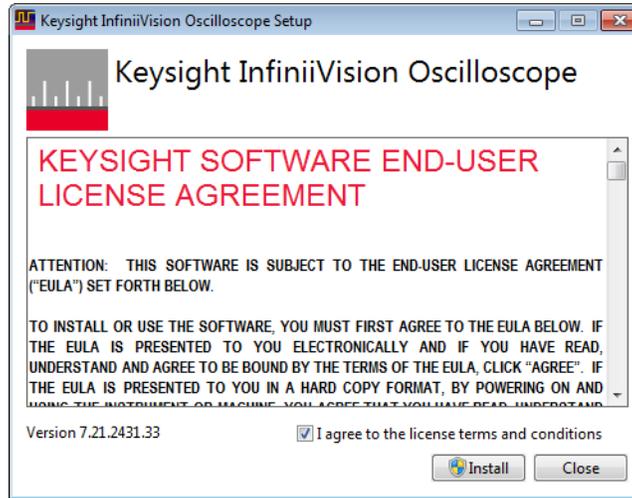
b Follow the installer prompts. Choose a "Complete" installation to install all software and documentation, or a "Custom" installation to select from a listing of modules and other features.

3 Complete the installation.

Updating Module Firmware as New Modules Are Installed

The software installation process includes FPGA updates to M924x InfiniiVision oscilloscope modules that are installed in the chassis. Because you can install new modules after the main software installation, there is a way to perform FPGA updates separately:

- From the Windows **Start** menu, choose **All Programs > Keysight InfiniiVision Oscilloscope > Update Keysight InfiniiVision Firmware**.

6 Verify Operation

Open the M924xA Oscilloscope Soft Front Panel (SFP)

There are two ways to open the M924xA Oscilloscope Soft Front Panel (SFP):

· Using the Keysight Connection Expert.
· Using the Keysight InfiniiVision Launcher.

Keysight Connection Expert Method

1 Click the Keysight IO Libraries Suite icon in the task bar and choose **Connection Expert** from the popup menu.
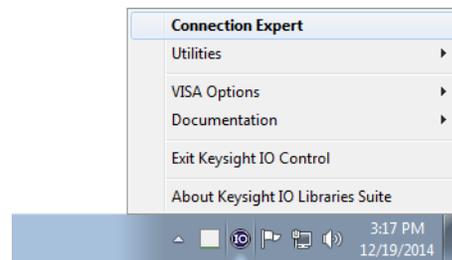
2 In the Keysight Connection Expert window, select the PXI/AXIe Chassis tab; then, for the oscilloscope module whose SFP you want to start, click the **Start Soft Front Panel** link.
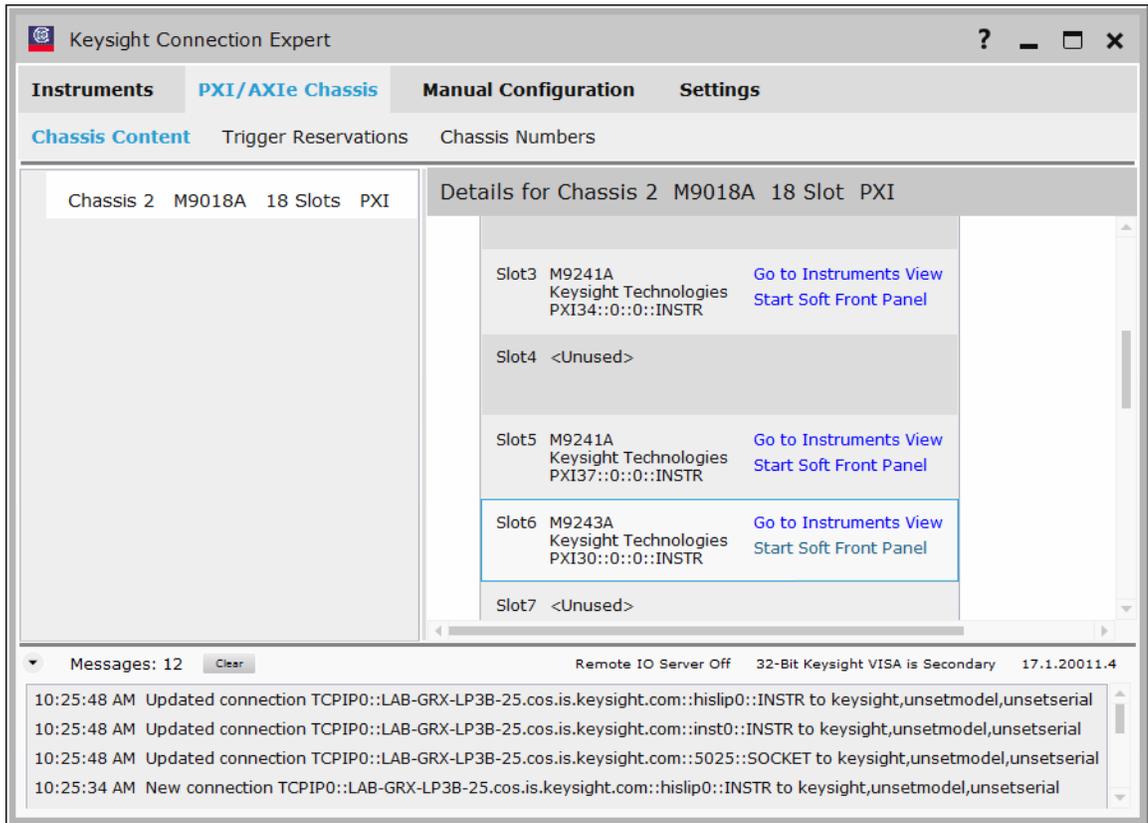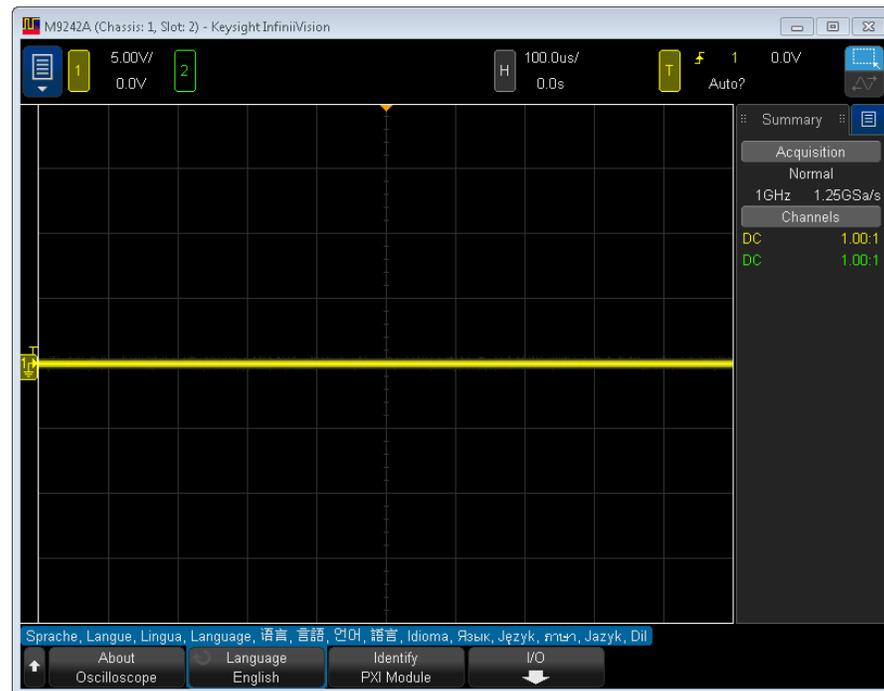
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The Keysight InfiniiVision M924xA SFP will open:

The Keysight InfiniiVision M924xA SFP has the same user interface as other standalone Keysight InfiniiVision oscilloscopes.

Keysight InfiniiVision Launcher Method

1 From the Windows operating system Start menu, choose **Start > All Programs > Keysight InfiniiVision Oscilloscope > Keysight InfiniiVision SFP**.

2 In the Keysight InfiniiVision Launcher window, select the oscilloscope module whose SFP you want to start; then, click the **Show Front Panel** button.

The Keysight InfiniiVision M924xA SFP will open:

The Keysight InfiniiVision M924xA SFP has the same user interface as other standalone Keysight InfiniiVision oscilloscopes.
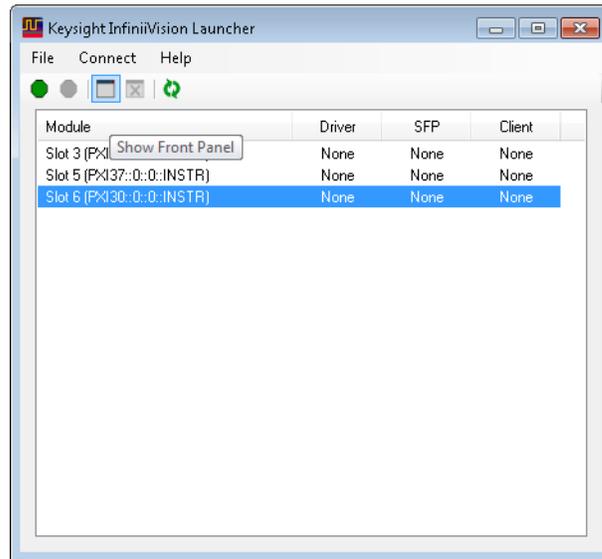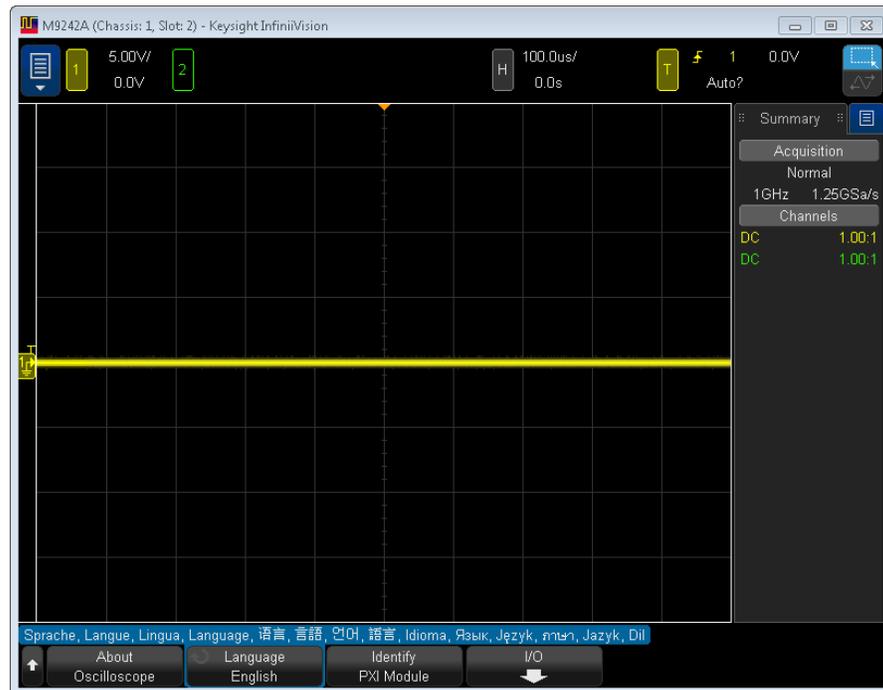
If not all modules and their slot locations are visible in the Keysight InfiniiVision Launcher window:

1   Close the Keysight InfiniiVision Launcher.

2   Start the Keysight Connection Expert, by selecting **Start > All Programs > Keysight Connection Expert**. If any or all modules and their slot locations are still not visible, in the Instruments tab, click **Rescan**.

3   Restart the Keysight InfiniiVision Launcher.

Run the Oscilloscope's Hardware Self Test

1   Keysight InfiniiVision M924xA SFP interface, click the top left blue menu icon, and choose **Utilities > Service Menu**.
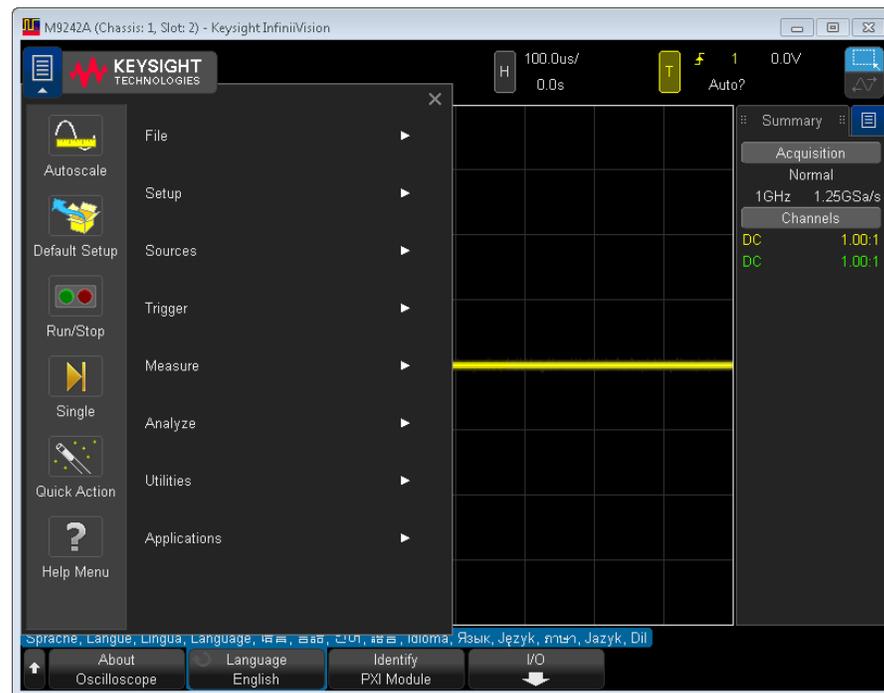
2   In the Service Menu, click **Hardware Self Test**.
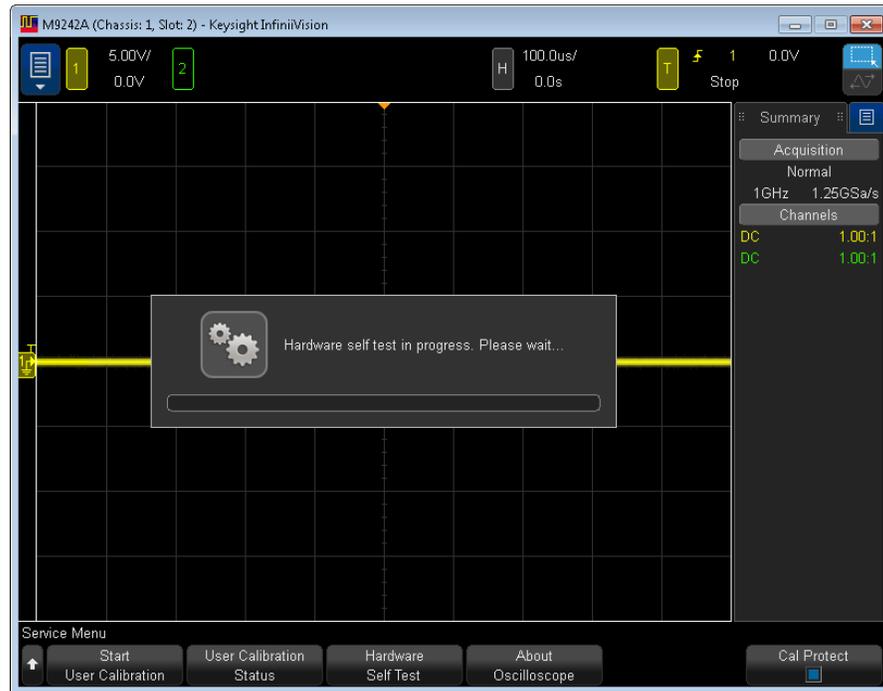
Hardware Self Test performs a series of internal procedures to verify that the oscilloscope is operating properly. Successfully passing Hardware Self Test does not guarantee 100% of the oscilloscope's functionality. Hardware Self Test is designed to provide an 80% confidence level that the oscilloscope is operating properly.

If the Hardware Self Test fails   See: "Return an Instrument for Service" on page 12

If there are communications problems

If you are unable to communicate with the M924xA, verify that the following installations are correct:

- Keysight IO Libraries Suite
- M924xA SFP programs
- Module and chassis drivers
- System Interface Card, cable and PC PXIe card connections, if you are using an external host PC

7 Make a Measurement

This chapter assumes you are using the Keysight InfiniiVision M924xA Soft Front Panel (SFP). If you have not already opened the SFP, see "Open the M924xA Oscilloscope Soft Front Panel (SFP)" on page 29.

Connect Probes to the Oscilloscope

1 Connect the oscilloscope probe to an oscilloscope channel BNC connector.

2 Connect the probe's retractable hook tip to the point of interest on the circuit or device under test. Be sure to connect the probe ground lead to a ground point on the circuit.

CAUTION   ⚠ **Maximum input voltage at analog inputs**

135 Vrms

50Ω input: 5 Vrms Input protection is enabled in 50 Ω mode and the 50 Ω load will disconnect if greater than 5 Vrms is detected. However the inputs could still be damaged, depending on the time constant of the signal. The 50 Ω input protection only functions when the oscilloscope is powered on.

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Input a Signal

The first signal to input to the oscilloscope is the Probe Comp signal. This signal is used for compensating probes.

1 Connect an oscilloscope probe from channel 1 to the Probe Comp terminal on the front panel.

2 Connect the probe's ground lead to the ground terminal (next to the Probe Comp terminal).

Using the Soft Front Panel (SFP) Interface

The Keysight InfiniiVision M924xA SFP has the same user interface as other standalone Keysight InfiniiVision oscilloscopes. While standalone oscilloscopes have keys, softkeys, and knobs—obviously different than the modular oscilloscopes—the display interface was also designed to be used with touch screens and connected USB mice, and it is just as easy to use with a mouse on the Windows operating system.

The main differences between using the interface on a standalone oscilloscope and a modular oscilloscope are:

· Instead of pressing front panel keys to open softkey menus, you use the top-left blue **Main Menu** button.

· Instead of pressing softkeys, you click the softkey label buttons.

· Instead of turning knobs to adjust scales, offets, delay positions, trigger levels, and cursor positions, there are clickable up/down, increase/decrease icon buttons that appear after clicking these values. Also, you can drag waveforms, trigger levels, and cursors.

Access the Built-In Quick Help

Soft Front Panel (SFP) help for the PXIe oscilloscope is different than in a traditional Windows application. Instead of a Windows HTML Help file you access through a Help menu, the PXIe oscilloscope's SFP help is the same quick help information that is built-in to standalone InfiniiVision oscilloscopes.

To access the built-in quick help, press and hold the left-mouse button over a softkey label button.
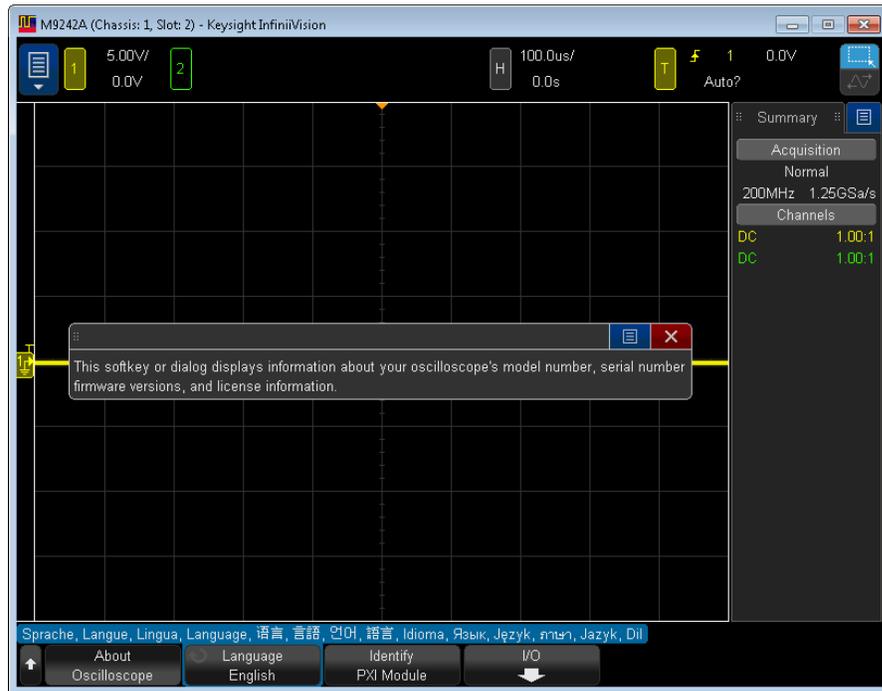
Quick Help remains on the screen until you close the help dialog box or open another one.

Select the User Interface Language

Another benefit of having the same user interface as standalone InfiniiVision oscilloscopes is that you have a localized user interface and built-in quick help.

To select the user interface language:

1 Choose **Main Menu > Help Menu**.

2 In the Help Menu, click the **Language** softkey label button.

3 In the Language popup menu, select the desired language.

The following languages are available: Czech, English, French, German, Italian, Japanese, Korean, Polish, Portuguese, Russian, Simplified Chinese, Spanish, Thai, Traditional Chinese, and Turkish.

Recall the Default Oscilloscope Setup

To recall the default oscilloscope setup:

1 Choose **Main Menu > Default Setup**.

The default setup restores the oscilloscope's default settings. This places the oscilloscope in a known operating condition. The major default settings are:

Table 1   Default Configuration Settings

| Horizontal	Normal mode, 100 µs/div scale, 0 s delay, center time reference.
Vertical (Analog)	Channel 1 on, 5 V/div scale, DC coupling, 0 V position, 1 MΩ impedance.
Trigger	Edge trigger, Auto trigger mode, 0 V level, channel 1 source, DC coupling, rising edge slope, 40 ns holdoff time.
Display	Persistence off, 20% grid intensity, 50% waveform intensity.
Other	Acquire mode normal, **Run/Stop** to Run, cursors and measurements off.
Labels	All custom labels that you have created in the Label Library are preserved (not erased), but all channel labels will be set to their original names.

In the Default Menu, there are also options for restoring the complete factory settings.

Use Autoscale

Use Autoscale to automatically configure the oscilloscope to best display the input signals.

1   Choose **Main Menu > Autoscale**.

You should see a waveform on the oscilloscope's display similar to this:
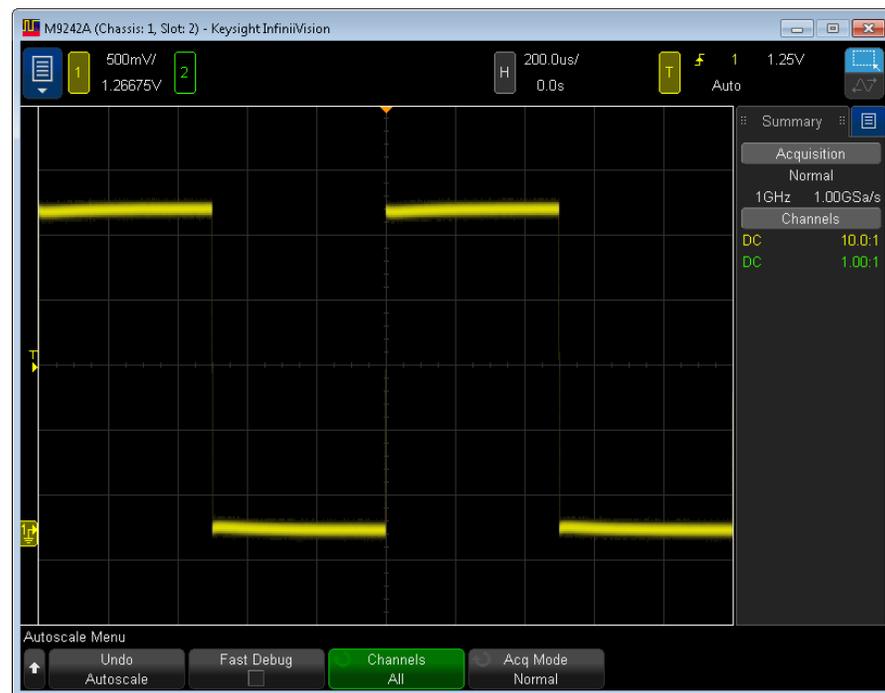
2 If you want to return to the oscilloscope settings that existed before**,** click **Undo Autoscale**.

3 If you want to enable "fast debug" autoscaling, change the channels autoscaled, or preserve the acquisition mode during autoscale, click **Fast Debug**, **Channels**, or **Acq Mode**.

These are the same softkeys that appear under **Main Menu > Utilities > User Options Menu > Preferences > Autoscale**.

If you see the waveform, but the square wave is not shaped correctly as shown above, perform the procedure "Compensate Passive Probes" on page 39.

If you do not see the waveform, make sure the probe is connected securely to the front panel channel input BNC and to the left side Probe Comp terminal.

How Autoscale Works

Autoscale analyzes any waveforms present at each channel and at the external trigger input.

Autoscale finds, turns on, and scales any channel with a repetitive waveform that has a frequency of at least 25 Hz, a duty cycle greater than 0.5%, and an amplitude of at least 10 mV peak-to-peak. Any channels where no signal is found are turned off.

The trigger source is selected by looking for the first valid waveform starting with external trigger, then continuing with the lowest number analog channel up to the highest number analog channel.

During Autoscale, the delay is set to 0.0 seconds, the horizontal time/div (sweep speed) setting is a function of the input signal (about 2 periods of the triggered signal on the screen), and the triggering mode is set to Edge.

Compensate Passive Probes

Each oscilloscope passive probe must be compensated to match the input characteristics of the oscilloscope channel to which it is connected. A poorly compensated probe can introduce significant measurement errors.

1 Input the Probe Comp signal (see "Input a Signal" on page 36).

2 Choose **Main Menu > Default Setup** to recall the default oscilloscope setup (see "Recall the Default Oscilloscope Setup" on page 37).

3 Choose **Main Menu > Autoscale** to automatically configure the oscilloscope for the Probe Comp signal (see "Use Autoscale" on page 38).

4 Click the channel button to which the probe is connected (color-coded **1**, **2**, etc. at the top of the SFP window).

5 In the Channel Menu, click **Probe**.

6 In the Channel Probe Menu, click **Probe Check**; then, follow the instructions on-screen.

If necessary, use a nonmetallic tool (supplied with the probe) to adjust the trimmer capacitor on the probe for the flattest pulse possible.

On N2894A probes, the trimmer capacitor is located on the probe BNC connector.

Perfectly compensated

Over compensated

Under compensated
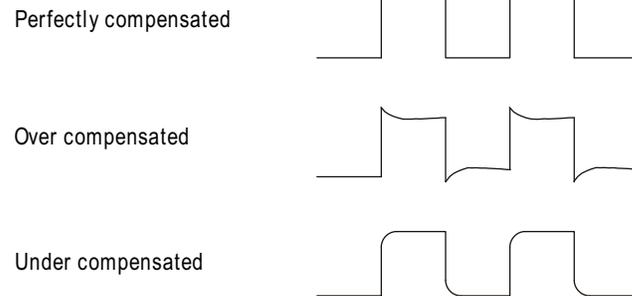
7 Connect probes to all other oscilloscope channels (that is, channel 2 of a 2-channel oscilloscope).

8 Repeat the procedure for each channel.

NOTE	After a Default Setup, the Probe Comp signal is output to the Probe Comp terminal. However, the oscilloscope can also output training signals on this terminal. See: **Main Menu > Training Signals > Training Signals**. On InfiniiVision M924xA oscilloscope modules, the Probe Comp terminal is also the Demo 1 terminal. There is no Demo 2 terminal (unlike some other InfiniiVision X-Series oscilloscopes).

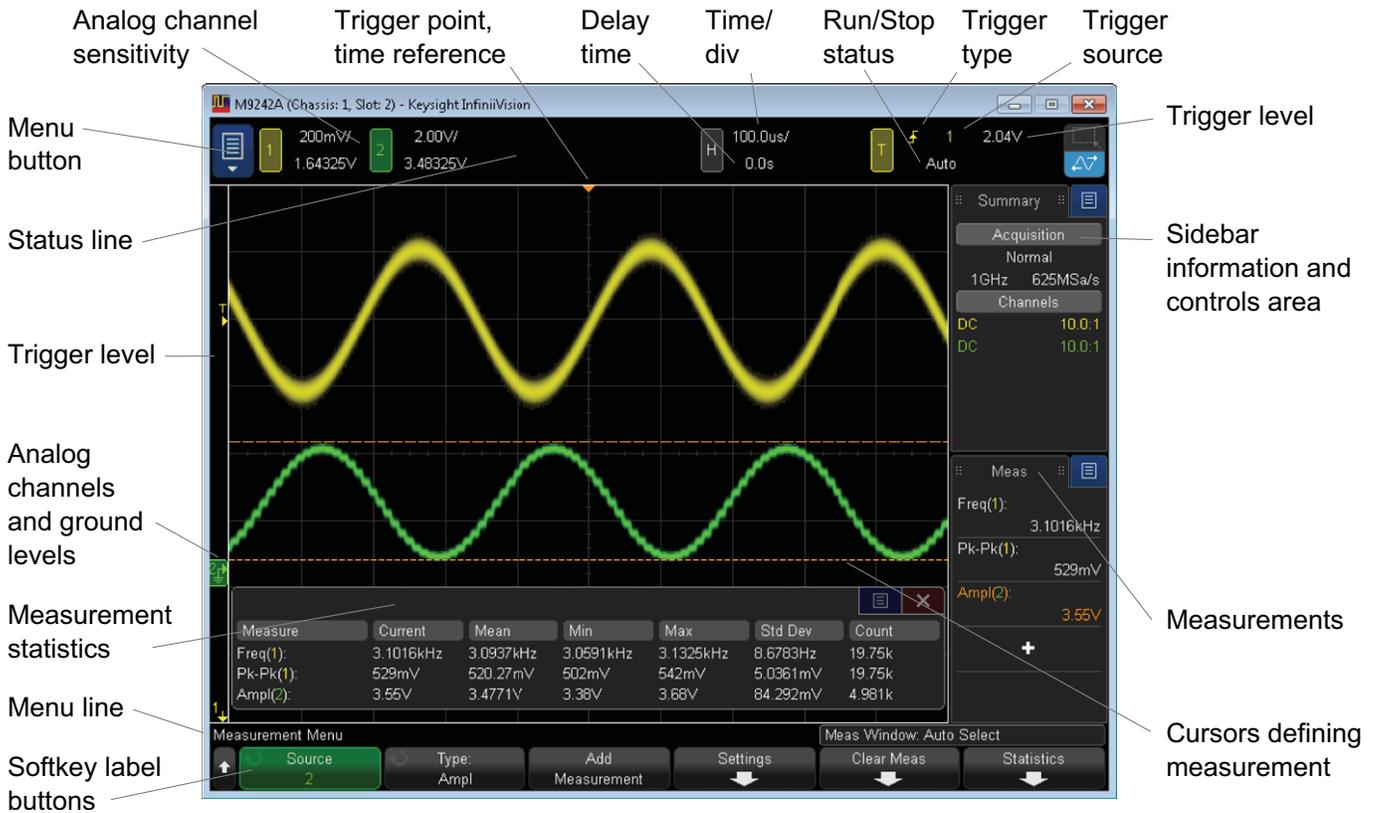## Turn On Measurements and Statistics

1 To turn on measurements, choose **Main Menu > Measure > Measurements**.

2 To turn on measurement statistics, choose **Main Menu > Measure > Statistics**.

You should see a display similar to this:
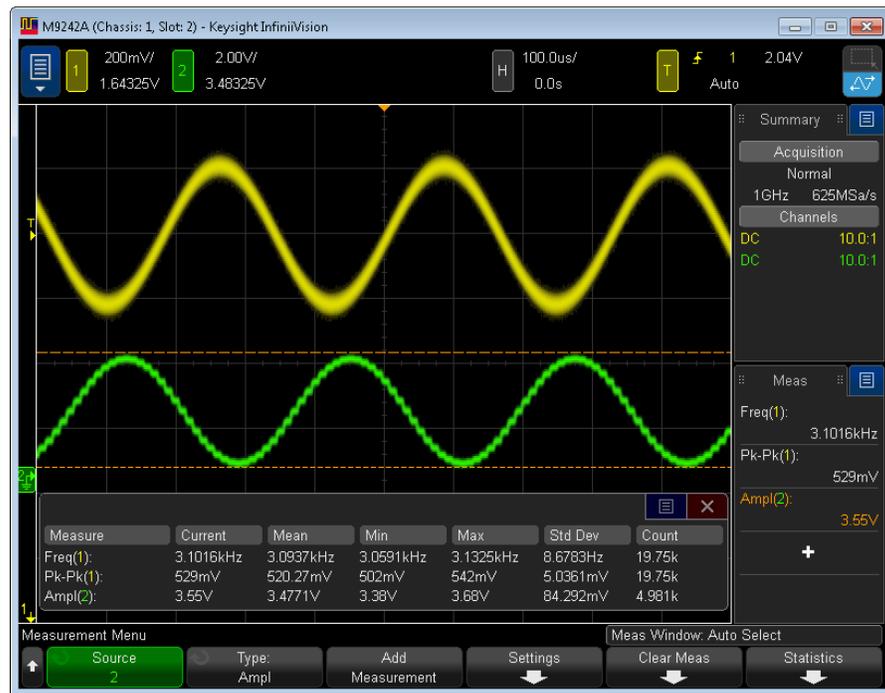
Learn the Oscilloscope Display

The oscilloscope display contains acquired waveforms, setup information, measurement results, and the softkey definitions.

Status line	The top line of the display contains vertical, horizontal, and trigger setup information.
Display area	The display area contains the waveform acquisitions, channel identifiers, and analog trigger, and ground level indicators. Each analog channel's information appears in a different color.
	Signal detail is displayed using 256 levels of intensity. To adjust waveform intensity, choose **Main Menu > Setup > Waveform Intensity**.
	To adjust other display modes and settings, choose **Main Menu > Setup > Display Menu**.
Sidebar information and controls area	The sidebar information area can contain summary, cursors, measurements, or digital voltmeter information dialogs or it can contain navigation and other control dialogs.
	To select the type of information or controls you want to see in the sidebar, click the blue menu icon next to the sidebar dialog box title.
	To undock or redock sidebar dialog boxes, drag the dialog box titles out of or back into the sidebar information area.

Menu line	This line normally contains menu name or other information associated with the selected menu.
Softkey labels	These labels describe softkey functions. Typically, softkeys let you set up additional parameters for the selected mode or menu. At the top of the menu hierarchy, clicking the left-side up-arrow button turns off softkey labels and displays additional status information describing channel offset and other configuration parameters.

8 Coordinating Multiple PXIe Oscilloscope Modules

You can synchronize acquisitions between multiple M924xA oscilloscope modules by using the PXI Trigger Menu to set up coordinated arming and triggering.

Among all the oscilloscope modules to be synchronized, one module must be the master and all other modules must be slaves. The **PXI Trigger Mode** softkey makes the master or slave selection for a module (or turns off PXI triggering for the module, making it a standalone module).

The Trigger Menu on the master oscilloscope module is used to define the trigger condition. The master module outputs its trigger signal to one of the chassis PXI_TRIG lines (0-7). All slave modules receive the trigger signal over the same PXI_TRIG line, and their Trigger Menus simply show that they are PXI slaves.

There is a separate "armed" signal from each slave module so that the master can wait until each slave is ready before triggering. The remaining PXI_TRIG lines can be used for the arm lines from the slave modules. With arming control, there can be up to seven slave modules. (With software arming in remote programs, there can be more than eight modules in a multiple-module system.)

Arming control is not required; however, if it is not used, a slave module may miss trigger events from the master module (because the master module may send triggers when the slave module is not armed).

This chapter assumes you are using the Keysight InfiniiVision M924xA Soft Front Panel (SFP). If you have not already opened the SFP, see "Open the M924xA Oscilloscope Soft Front Panel (SFP)" on page 29.

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Step 1: (Optional) Update the Calibration Factors

This step is optional because there are default calibration factors installed with the M924x InfiniiVision Oscilloscope software. However, to get the most accurate calibration factors for your PXIe oscilloscope modules and chassis, you will want to update the calibration factors.

Calibration factors are updated and saved using the KtScopeCal.exe application on the chassis controller.

The KtScopeCal.exe application is installed with the M924x InfiniiVision Oscilloscope software.

NOTE   To perform trigger routing, the KtScopeCal.exe application requires KtMTrig, which is included in PXIe chassis driver version 1.6.242.1 and above. You can find PXIe chassis driver software on the CD that ships with the chassis or at: www.keysight.com/find/pxie-chassis-driver

NOTE   For the best calibration accuracy, the chassis should be powered on and the oscilloscope modules enabled with a default setup for at least 30 minutes to stabilize the operating temperature before running KtScopeCal.exe.

The KtScopeCal.exe application is run in a Command Prompt window. Command usage information is displayed when the program is run without any arguments or when the "/?" option is supplied as an argument. For example:

```
C:\Program Files (x86)\Keysight\InfiniiVision>KtScopeCal.exe /?
This app performs PXI trigger delay calibrations between master and slave
modules.  Hardware connection is required from the Aux out of master module
to channel 1 of both master and slave modules using BNC tee adapter with
50ohm cables of equal length.

Usage:
KtScopeCal PXI[a]::[b]::INSTR slot[c] trig[d] <bus[e]-[f]>

  [a]    Chassis bus number.
  [b]    Master module slot number.
  [c]    Slave module slot number.
  [d]    Trigger line number (0-7).
  <bus> Optional to configure trigger routing across trigger bus segments.
       Keysight PXIe chassis will be configured automatically.
  [e]    Bus segment number where master module is located.
  [f]    Bus segment number where slave module is located.

Trigger bus segments are assigned as follows:
  18-Slot Chassis
  Slots 1-6:    Trig bus segment number 1
  Slots 7-12:   Trig bus segment number 2
```

```
      Slots 13-18:  Trig bus segment number 3
      10-Slot Chassis
      Slots 1-5:    Trig bus segment number 1
      Slots 6-10:   Trig bus segment number 2


Sync Mode:
KtScopeCal -a
Align the reference clock signals for all modules and save factors.
Perform this action once for new or modified system.


KtScopeCal -p
Align the reference clock signals for all modules.
Perform this action each time InfiniiVision driver is connected.


KtScopeCal -r
Reset the reference clock signals for all modules.
Perform this action only when PXIe 100MHz reference clock is turned off.
This action is not required if -a or -p has been performed.


KtScopeCal -s PXI[a]::[b]::INSTR slot[c] trig[d] <bus[e]-[f]>
Calibrate trigger delay and save factors.
Perform this action after reference clock signals are aligned.


C:\Program Files (x86)\Keysight\InfiniiVision>
```
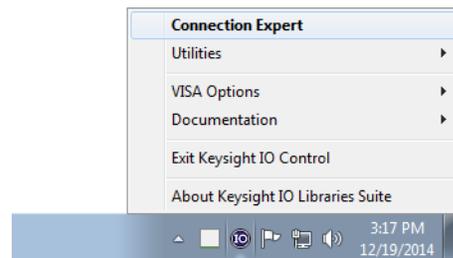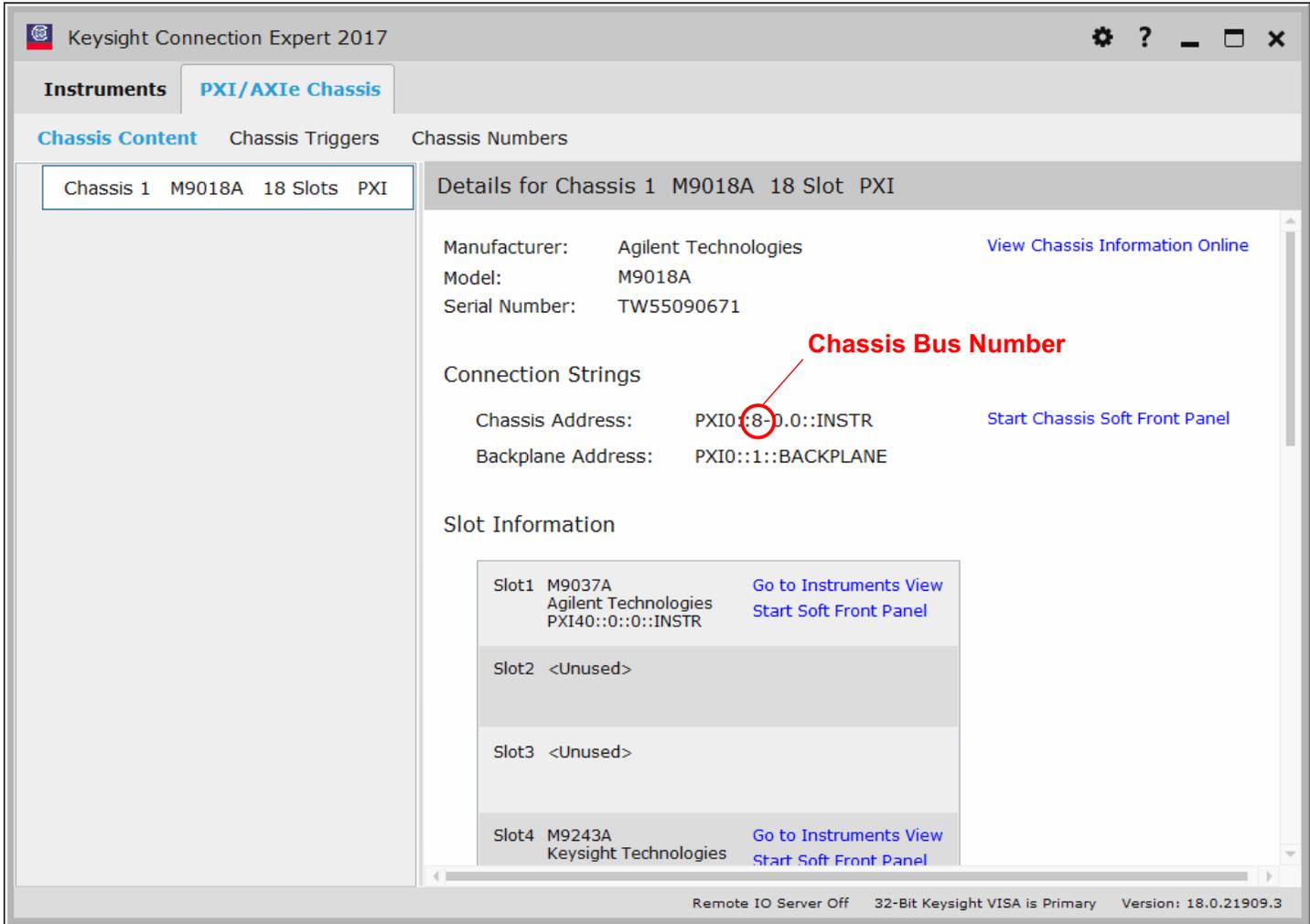
The chassis bus number can be found in the Keysight Connection Expert window:

1 Click the Keysight IO Libraries Suite icon in the task bar and choose **Connection Expert** from the popup menu.

2 In the Keysight Connection Expert window, **PXI/AXIe Chassis > Chassis Content** tab, find the chassis bus number in the **Chassis Address** string:

For each master module, slave module, and trigger line combination that will be used:

1 Connect a MMCX-to-BNC cable from the master module Aux Out output to a BNC tee adapter.

2 From the tee adapter, connect equal length cables to the master module channel 1 input and the slave module channel 1 input.

3 Run the KtScopeCal.exe program.

For example:

```
C:\Program Files (x86)\Keysight\
InfiniiVision>KtScopeCal.exe PXI8::5::INSTR slot6 trig0

Trigger line PXI TRIG 0 bus segment configured: Isolated

Connect Aux Out from master module at slot 5 to channel 1 of master m
odule
```

```
and channel 1 of slave module at slot 6 using BNC tee adapter with
50ohm cables of equal length.

Press enter to start calibration...

Calibration passed. Master slot 5, Slave slot 6, Trigger line 0.


C:\Program Files (x86)\Keysight\InfiniiVision>
```

The calibration information is saved on the chassis controller, so it needs to be run just once for each combination. However, if you change anything about the multiple module setup, you should re-run the program.

> **NOTE**   Because calibration factors are saved per master/slave/trigger line combination, you could run the KtScopeCal.exe program for every possible combination of master and slave modules that would ever be used, not just the combination you are planning to use next.

Step 2: Set Up the Slave Modules

For each slave module in the multiple-oscilloscope system:

1   Choose **Main Menu > Trigger > PXI Trigger Menu**.

2   In the PXI Trigger Menu, click the **PXI Trigger Mode** softkey button, and select **Slave**.

3   Click the **Trigger Line** softkey, and select the PXI_TRIG line (0-7) to be used for the multi-module trigger signal.

The master module and all slave modules must select the same trigger line.

If the modules are in different chassis trigger bus segments (which are isolated by default), you must use the chassis Soft Front Panel (SFP) application to connect the selected PXI_TRIG line between trigger bus segments. See "Step 4: (When Necessary) Connect Chassis Bus Segments" on page 51.

4   Click the **Arm Line** softkey to select the PXI_TRIG line (0-7) to be used for the slave module's arm signal.

Each slave module must use a different PXI_TRIG line for its arm signal.

If the modules are in different chassis trigger bus segments (which are isolated by default), you must use the chassis Soft Front Panel (SFP) application to connect the selected PXI_TRIG line between trigger bus segments. See "Step 4: (When Necessary) Connect Chassis Bus Segments" on page 51.

5   Click the **Master Slot #** softkey; then, enter the slot number of the master M924xA oscilloscope module.

It is important to select the correct master slot number because it identifies the proper set of calibration factors to use when aligning waveforms.

Calibration factors are created and saved using the KtScopeCal.exe application on the chassis controller. See "Step 1: (Optional) Update the Calibration Factors" on page 46.

As a slave module in a multiple M924xA oscilloscope module system, this module gets it trigger signal from the master module. As a result, the **Trigger Type** softkey in the Trigger Menu simply shows that it is a PXI Slave.

Step 3: Set Up the Master Module

For the master module in the multiple-oscilloscope system:

1   Choose **Main Menu > Trigger > PXI Trigger Menu**.

2   In the PXI Trigger Menu, click the **PXI Trigger Mode** softkey button, and select **Master**.

3   Click the **Trigger Line** softkey, and select the PXI_TRIG line (0-7) to be used for the multi-module trigger signal.

The master module and all slave modules must select the same trigger line.

If the modules are in different chassis trigger bus segments (which are isolated by default), you must use the chassis Soft Front Panel (SFP) application to connect the selected PXI_TRIG line between trigger bus segments. See "Step 4: (When Necessary) Connect Chassis Bus Segments" on page 51.

4   Click the **Arm Lines** softkey to select the PXI_TRIG lines (0-7) used for the arm signals of the slave modules in the multiple-module system. Select the line and then click it again to enable or disable it.

Each slave module must use a different PXI_TRIG line for its arm signal.

The master module will wait until all slave modules are armed before triggering.

If the modules are in different chassis trigger bus segments (which are isolated by default), you must use the chassis Soft Front Panel (SFP) application to connect the selected PXI_TRIG lines between trigger bus segments. See "Step 4: (When Necessary) Connect Chassis Bus Segments" on page 51.

The Trigger Menu on the master oscilloscope module is used to define the trigger condition. You can select from all the usual trigger types (Edge, Edge Then Edge, Pulse Width, etc.). You are limited to master module input sources.

## Step 4: (When Necessary) Connect Chassis Bus Segments

If the PXI oscilloscope modules are in different chassis trigger bus segments (which are isolated by default), you must use the chassis Soft Front Panel (SFP) application to connect the selected PXI_TRIG lines between trigger bus segments.

For example, if:

- The master module is in segment 1 and it is using PXI TRIG 0 as the trigger line.
- Two slave modules are in segment 3 and they will use PXI TRIG 1 and PXI TRIG 2 as arm lines.

You would fllow these steps:

1 Click the Keysight IO Libraries Suite icon in the task bar and choose **Connection Expert** from the popup menu.
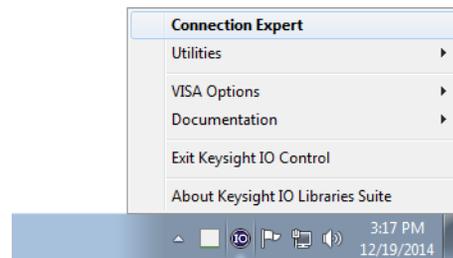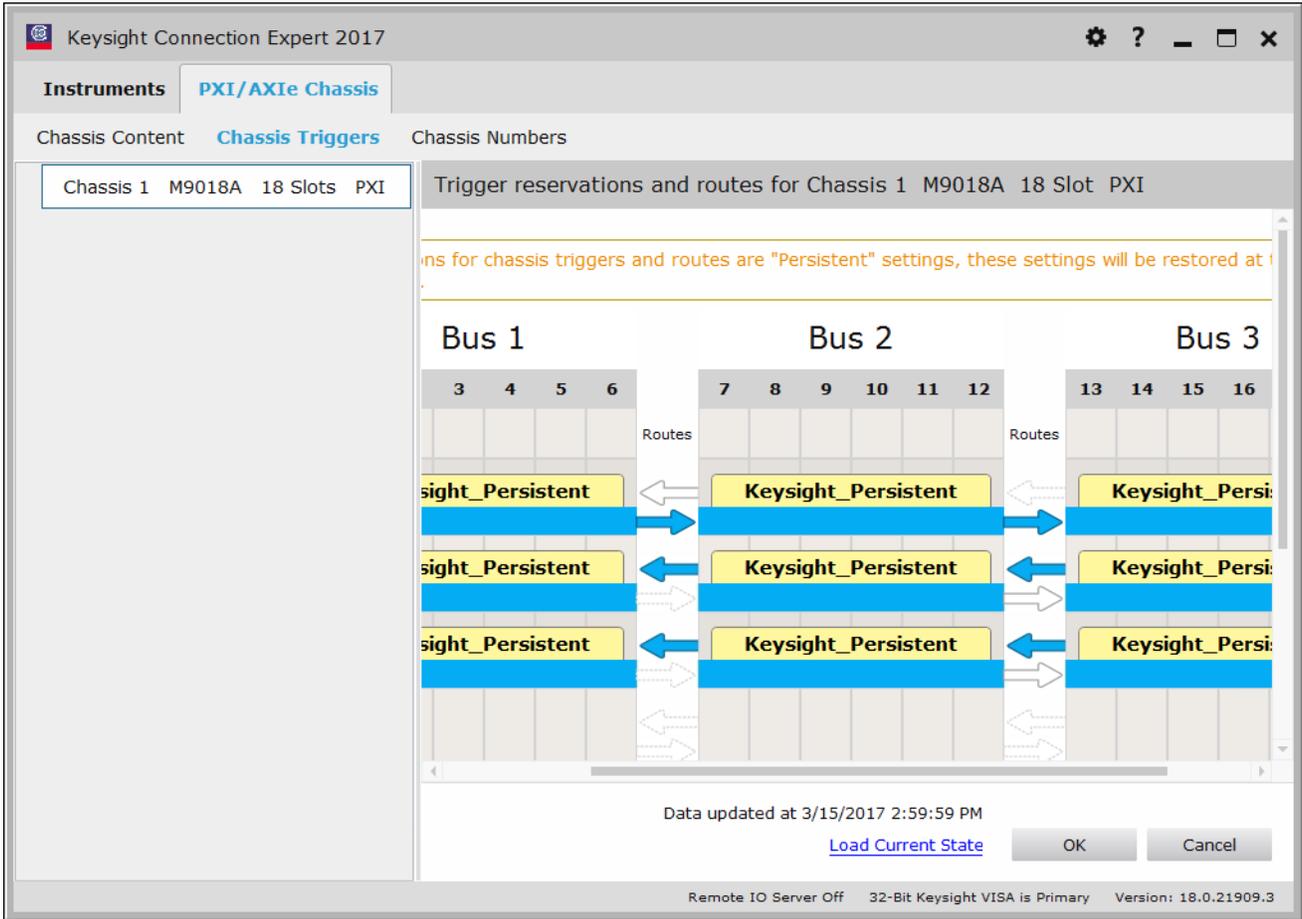

2 In the Keysight Connection Expert window, **PXI/AXIe Chassis > Chassis Triggers** tab, hover over the lines in the bus segments you would like to reserve, and then click **Click to reserve**.
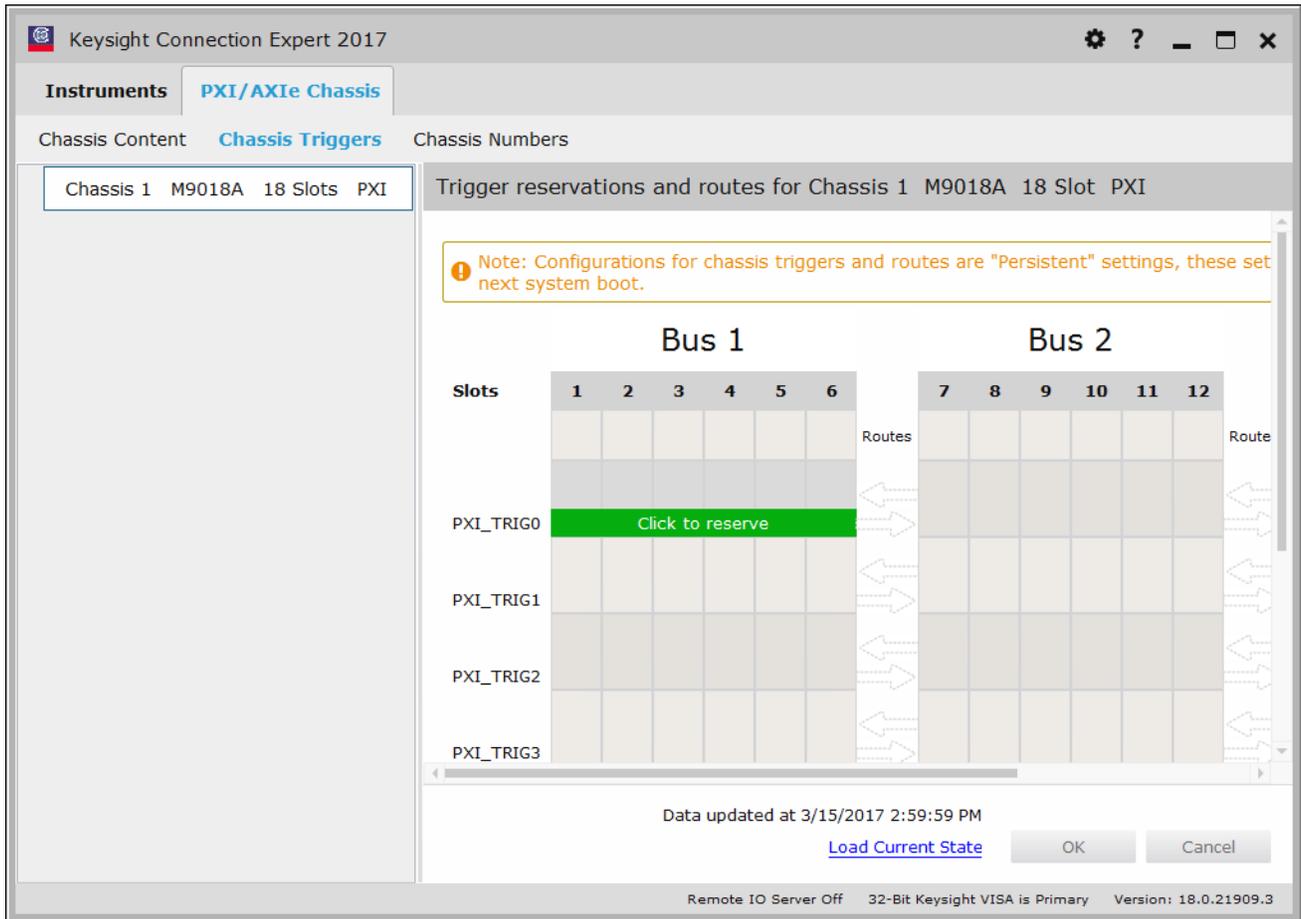
When lines in bus segments are reserved, it will look something like:
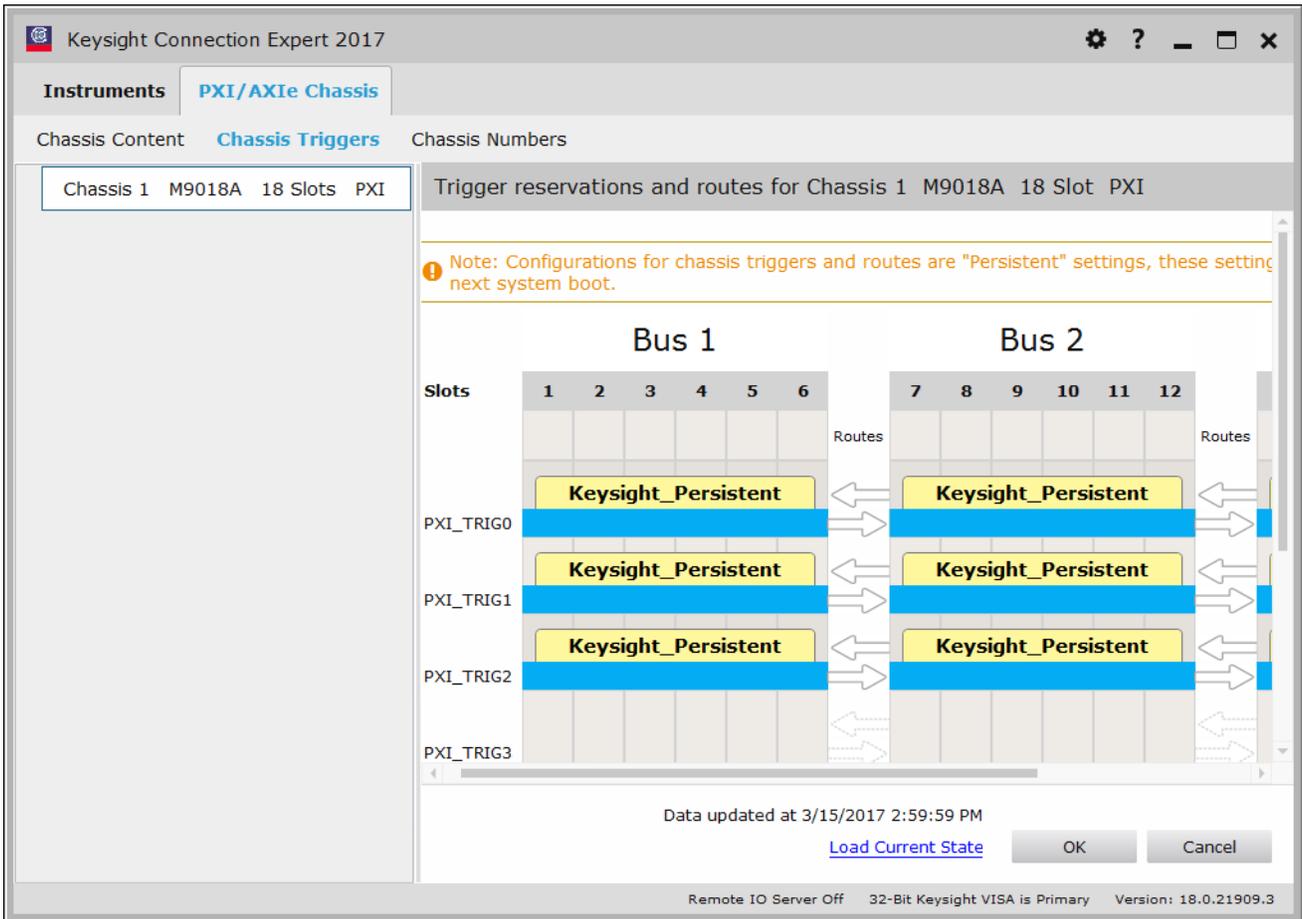
3 Next, click the route directions to be used:

4   Finally, click **OK**.

CAUTION   The Keysight M9018A PXIe Chassis does not remember the trigger bus configuration upon cycling power. After a power cycle, you must reconfigure the bus triggers by using the M9018A Soft Front Panel (SFP) or by creating a persistent configuration by using the AgM9018 API.

Step 5: (Recommended) Phase-Lock Oscilloscope Sampling Clocks

It is also recommended that each module in the system phase-lock its timebase to the PXIe 100 MHz reference.

For each module in the multiple-oscilloscope system:

1   Choose **Main Menu > Utilities > User Options Menu**.

2   In the User Options Menu, click the **Auxiliary I/O** softkey button.

3   In the Auxiliary I/O Menu, click the **10MHz Ref Signal** softkey button, and select **PXIe 100MHz**.

Step 6: (Optional) Turn On Sync Mode

Optionally, to lessen the jitter between channels in different modules so that it is more like the jitter between channels within a single module, you can turn on Sync mode. Sync mode uses the trigger system in the master module for all modules.

When Sync mode is off, this is called Asynchronous mode. Asynchronous mode uses the trigger systems in all modules where the trigger output from the master module is fed to the trigger input of the slave modules.

To turn on and set up Sync mode:

1   For each M924xA oscilloscope module in the multi-module system (that is, the master module and the slave modules), click the **Sync** softkey button to enable Sync mode.

When you turn on Sync mode for the first time (after InfiniiVision software start-up), there is a red unlocked image shown in the top right of the screen. For example:

·   On the master module, you see:

·   On the slave modules, you see:

This red unlocked image indicates that the clock phase for the Sync mode trigger is not aligned.

2   Open a Command Prompt window on the chassis controller.

3   To align the reference clock signals, you must run the KtScopeCal.exe application using the "-a" or "-p" option:

·   If setting up Sync mode triggers on a new or modified system, use the `KtScopeCal -a` command. For example:

```
C:\Program Files (x86)\Keysight\InfiniiVision>KtScopeCal.exe -a

Searching for connected modules...
Measuring PLL Band for module at slot 6...
Band = 3
PLL Band measurement completed.
Measuring PLL Band for module at slot 5...
Band = 2
PLL Band measurement completed.
Calibration signal reset completed.
Performing clock phase alignment for module at slot 5...
Median = 2883
Iteration = 1
Mean = 1
Iteration = 2
Mean = 2439
Iteration = 3
Mean = 3081
Temperature = 52.25
Clock phase alignment completed.
Performing clock phase alignment for module at slot 6...
Median = 2927
Mean = 3117
Temperature = 52.00
Clock phase alignment completed.

C:\Program Files (x86)\Keysight\InfiniiVision>
```

- If the system is not new or modified but you have reconnected the InfiniiVision driver, use the `KtScopeCal -p` command. For example:

```
C:\Program Files (x86)\Keysight\InfiniiVision>KtScopeCal.exe -p

Searching for connected modules...
Calibration signal reset completed.
Performing clock phase reset for module at slot 5...
Temperature change = 0.25
XML mean = 3081
Target = 3080
Iteration = 1
Mean = 2916
Mean change = -165
Iteration = 2
Mean = 2439
Mean change = -642
Iteration = 3
Mean = 4031
Mean change = 950
Iteration = 4
Mean = 4031
Mean change = 950
Iteration = 5
Mean = 3717
Mean change = 636
Iteration = 6
Mean = 2595
Mean change = -486
```

```
Iteration = 7
Mean = 4031
Mean change = 950
Iteration = 8
Mean = 4031
Mean change = 950
Iteration = 9
Mean = 3551
Mean change = 470
Iteration = 10
Mean = 2271
Mean change = -810
Iteration = 11
Mean = 3717
Mean change = 636
Iteration = 12
Mean = 3717
Mean change = 636
Iteration = 13
Mean = 2270
Mean change = -811
Iteration = 14
Mean = 3873
Mean change = 792
Iteration = 15
Mean = 3078
Mean change = -3
Clock phase reset completed.
Performing clock phase reset for module at slot 6...
Temperature change = 0.25
XML mean = 3117
Target = 3116
Iteration = 1
Mean = 3110
Mean change = -7
Clock phase reset completed.

C:\Program Files (x86)\Keysight\InfiniiVision>
```

When running the KtScopeCal.exe application with the Sync mode options "-a", "-p", or "-r", the oscilloscope modules automatically phase-lock their timebases to the chassis' PXIe 100 MHz reference. Using the PXIe 100 MHz reference signal is a requirement for Sync mode triggering (see).

If you turn off the PXIe 100MHz ref signal on any module, clock phase alignment between modules is lost, and the red unlocked image will re-appear.

· When clock phase alignment is lost, use the `KtScopeCal -r` command to reset/realign the clock phase. For example:

```
C:\Program Files (x86)\Keysight\InfiniiVision>KtScopeCal.exe -r

Searching for connected modules...
Clock phase reset for module at slot 5...
Temperature change = 0.00
XML mean = 3081
Target = 3081
Iteration = 1
Mean = 3400
Mean change = 319
Iteration = 2
Mean = 2273
Mean change = -808
Iteration = 3
Mean = 3080
Mean change = -1
Clock phase reset completed.
Clock phase reset for module at slot 6...
Temperature change = 0.00
XML mean = 3117
Target = 3117
Iteration = 1
Mean = 4070
Mean change = 953
Iteration = 2
Mean = 3273
Mean change = 156
Iteration = 3
Mean = 2305
Mean change = -812
Iteration = 4
Mean = 1986
Mean change = -1131
Iteration = 5
Mean = 3109
Mean change = -8
Clock phase reset completed.

C:\Program Files (x86)\Keysight\InfiniiVision>
```

The red unlocked image will disappear.

4 Finally, to perform Sync mode trigger delay calibration on each trigger line and save the calibration factors, run the `KtScopeCal -s` command. The options are the same as when using the `KtScopeCal` command in Asynchronous mode. For example:

```
C:\Program Files (x86)\Keysight\
InfiniiVision>KtScopeCal.exe -s PXI8::5::INSTR slot6 trig0

Trigger line PXI TRIG 0 bus segment configured: Isolated
Arm line PXI TRIG 1 bus segment configured: Isolated

Connect Aux Out from master module at slot 5 to channel 1 of master m
odule
and channel 1 of slave module at slot 6 using BNC tee adapter with
50ohm cables of equal length.
```

```
Press enter to start calibration...

Mean change = -2926
Mean change = -2926
Mean change = 1192
Mean change = 1167
Mean change = 1134
Mean change = 1108
Mean change = 1073
Mean change = 1051
Mean change = 1017
Mean change = 992
Mean change = 957
Mean change = 933
Mean change = 899
Mean change = 872
Mean change = 837
Mean change = 810
Mean change = 774
Mean change = 747
Mean change = 711
Mean change = 685
Mean change = 652
Mean change = 631
Mean change = 600
Mean change = 576
Mean change = 542
Mean change = 517
Mean change = 481
Mean change = 457
Mean change = 422
Mean change = 402
Mean change = 367
Mean change = 341
Mean change = 305
Mean change = 281
Mean change = 247
Mean change = 224
Mean change = 185
Mean change = 163
Mean change = 125
Mean change = 99
Iteration = 40
OutSel = 0
Tdelay = 39
Sync mode calibration passed. Master slot 5, Slave slot 6, Trigger li
ne 0.


C:\Program Files (x86)\Keysight\InfiniiVision>
```

Step 7: Make Coordinated Acquisitions

After calibration factors are updated, trigger and arm lines are properly configured, the master slot is identified in all slaves, and the PXIe 100 MHz reference signal is selected, you are ready to use the multiple-oscilloscope system to make coordinated acquisitions.

If arming control is used, follow this sequence to keep acquisitions correlated:

1   Stop all M924xA oscilloscope modules.

2   Start acquisitions (single or run) on the slave module (it will wait for triggers from the master).

3   Start acquisitions (single or run) on the master module.

4   When running, stop acquisitions on the master module first. Then, stop acquisitions on the slave modules.

   · If running, and you want to change settings on the master module (such as time/div, volts/div, or the trigger setting), stop the master module before changing its settings. The slave modules do not need to be stopped.

   · If running, and you want to change settings on slave modules (such as time/div or volts/div), stop the master module first. Then, stop the slave modules and make their setting changes.

CAUTION	When you are using remote programs to control multi-module systems and data synchronization is important, not only must you stop acquisitions in the proper order, but you must also query a module's run status to make sure that acquisitions have completed and are truly stopped.

Single Acquisitions for Deep Data	For the deepest acquisitions possible, use single acquisitions. When you stop running acquisitions in a multi-module configuration, the data length can be smaller (depending on the setup) than when stopping a running acquisition in a single module.
Messages When Stopping Acquisitions	When stopping acquisitions, particularly acquisitions that take a long time, you may see this message:

```
Please wait...
To abort, press Stop.
```

This message means a "soft stop" is in progress. When stopping multi-module acquisitions, "soft stop" makes sure that data across the multiple modules are from the same trigger.

CAUTION	If you abort a "soft stop", be aware that the module's data may not be from the same trigger as other modules' data.

9 Applications Programming Interface (API) Overview

When you have completed installation, you can use the oscilloscope Soft Front Panel (SFP) or program the instrument using the applications programming interface (API) for the supplied drivers.

IVI Drivers

Keysight's IVI drivers simplify the creation and maintenance of instrument control applications in a variety of development environments; they allow programmatic control of instrumentation while providing a greater degree of instrument interchangeability and code reuse. IVI drivers currently come in two basic types: IVI-COM and IVI-C. Although the functionality offered by both types of drivers is often very similar, the fundamental differences in interface technology results in a very different end-user experience. The IVI drivers support compiling application programs for 32- or 64-bit platforms.

Supported ADEs (application development environments) Arguably the most important consideration in comparing IVI-COM and IVI-C drivers is the end user experience in various ADEs. Because IVI-COM drivers are based on Microsoft COM technology, it is not surprising that IVI-COM drivers offer the richest user experience in Microsoft ADEs. Users working in Visual C++, Visual C#, Visual Basic.NET, and Visual Basic 6 enjoy a host of features, such as object browsers, IntelliSense, and context-sensitive help.

When you install the product software, the IVI driver files are installed in the standard IVI Foundation directories (for example, C:\Program Files\IVI Foundation\ IVI\Drivers\).

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Example programs are provided to demonstrate most driver functionality (for example, C:\Program Files\IVI Foundation\IVI\Drivers\AgInfiniiVision\Examples).

The reference material for the driver functions (a Microsoft HTML Help .chm file) is installed with the IVI driver and is available for Microsoft Visual Studio's IntelliSense context linking. In addition, you can directly access the .chm file (AgInfiniiVision.chm) from this Start menu location: **Start > All Programs > Keysight Instrument Drivers > IVI-COM-C AgInfiniiVision Oscilloscope**.

LabVIEW Driver

In addition to the IVI drivers, Keysight provides a LabVIEW driver that includes all the functionality of the IVI-C driver.

When you install the product software, the LabVIEW driver is installed to each LabVIEW instr.lib directory for each version of LabVIEW you have on your computer (for example, C:\Program Files (x86) \National Instruments\<LabVIEW version>\instr.lib\<Keysight product model>).

If you install LabVIEW drivers before you install LabVIEW itself, the drivers will be installed in the Keysight directory instead of the National Instruments directory (for example, C:\Program Files (x86)\Keysight\<Keysight product model>\ LabVIEW Driver\<LabVIEW version>\...).

Example programs are provided to demonstrate most driver functionality.

The reference information for the driver (a Microsoft HTML Help file named KtInfiniiVision_LabVIEW_Help.chm) is also installed with the driver, and the content is available from LabVIEW's context Help menu or in the LabVIEW help directory.

SCPI Interface (M9241/42/43A PXIe Oscilloscope Only)

When the M9241/42/43A PXIe oscilloscope's Soft Front Panel (SFP) is running, you can access the oscilloscope's SCPI interface. See "Open the M924xA Oscilloscope Soft Front Panel (SFP)" on page 29.

You can find the *SCPI Programmer's Guide* in these locations:

- On the product CD.
- On the website at: www.keysight.com/manuals/M9241A

Using the SFP and the Remote API at the Same Time

In general, you can use the Soft Front Panel (SFP) and the remote applications programming interface (API) together, at the same time. This can be useful, for example, because it lets you change oscilloscope settings while debugging remote programs.

However, the SFP can become "locked out" while the oscilloscope waits for a waveform to become fully acquired. This can happen, for example, after these SCPI commands/queries: :WAVeform:DATA?, :WAVeform:PREamble?, :LISTer:DATA?, :SEARch:COUNt?, :DIGitize, or :SINGle. In these situations, you can clear the remote operation in progress by sending a Device Clear to the remote user interface.

Sending a Device Clear to the Remote Interface

Every remote programming library gives you a way to send an IEEE 488.1-style Device Clear. For example, the IVI-COM library provides the System2.ClearIO method. Another easy way to send a Device Clear is through the IO Libraries Suite's Interactive IO application.

1 On a networked PC that has the IO Libraries Suite installed, click the Keysight IO Control icon in the taskbar and choose **Utilities > Interactive IO** from the popup menu.
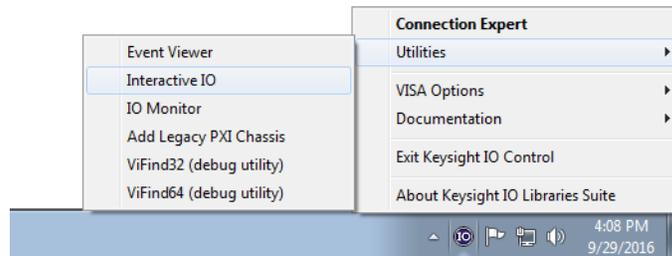
2 In the Keysight Interactive IO application, choose **Connect > Connect...**.

3 In the Connect dialog box, enter the oscilloscope's HiSLIP address into the **Resource Name** field and click **OK**.
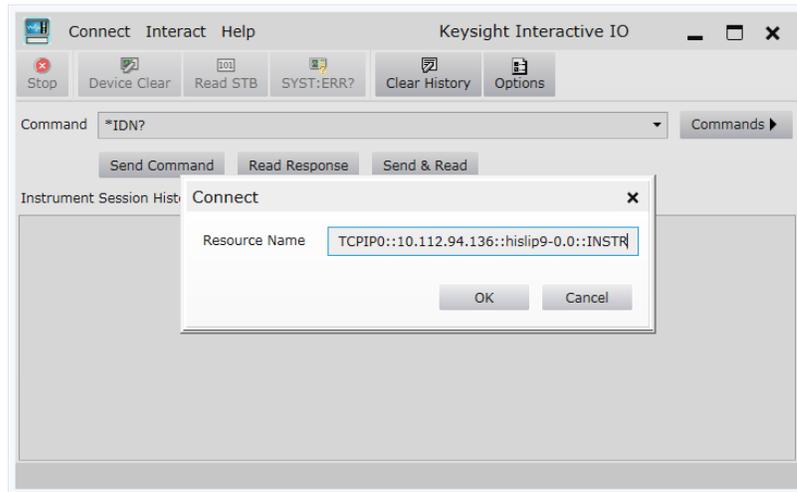
The oscilloscope's HiSLIP address can be cut-and-pasted from your remote program or you can piece it together from the controller PC's IP address (or hostname) and the oscilloscope's PXI address. For example if the controller PC's IP address is "10.112.93.141" (or hostame is "lab-pxi-3.cos.is.keysight.com") and the oscilloscope's PXI address is "PXI37::0::0::INSTR", the oscilloscope's HiSLIP address is "TCPIP0::10.112.93.141::hislip37-0.0::INSTR" (or "TCPIP0::lab-pxi-3.cos.is.keysight.com::hislip37-0.0::INSTR").

If you are running the Interactive IO application on the controller PC, you can use the "127.0.0.1" localhost IP address, for example, "TCPIP0::127.0.0.1::hislip37-0.0::INSTR".

4 When connected, click **Device Clear**.
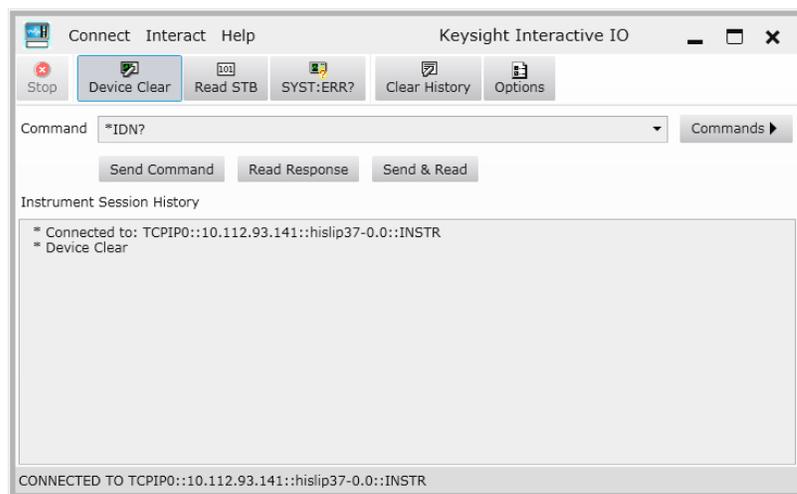
5 To exit the Keysight Interactive IO application, choose **Connect > Exit** from the menu.

10 Reference

Environmental Conditions

The Keysight M9241/42/43A PXIe oscilloscopes and M9240A AutoProbe power module products have been safety-evaluated to the M9018A PXIe 18-slot chassis environmental characteristics.

Environment	Indoor use only.
Ambient temperature	Operating: 0 °C to +55 °C Non-operating: –40 °C to +70 °C
Humidity	95% rH, non-condensing to temperatures up to 40 °C decreasing linearly to 50% rH at 55 °C
Altitude	Operating: 3,000 m (9,842 ft) Non-operating: 4,500 m (14,764 ft)
Pollution Degree	The InfiniiVision M9241/42/43A PXIe oscilloscopes may be operated in environments of Pollution Degree 2 (or Pollution Degree 1).
Pollution Degree Definitions	Pollution Degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence. Example: A clean room or climate controlled office environment. Pollution Degree 2. Normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation may occur. Example: General indoor environment. Pollution Degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. Example: Sheltered outdoor environment.

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Probes and Accessories

For a list of the probes and accessories that are compatible with the M9241/42/43A PXIe oscilloscopes, see the data sheet at: www.keysight.com/products/M9241A

AutoProbe Interface   The AutoProbe interface is enabled with the M9240A AutoProbe power module.

Most Keysight single-ended active, differential, and current probes are compatible with the AutoProbe interface. Active probes that do not have their own external power supply require substantial power from the AutoProbe interface.

If too much current is drawn from the AutoProbe interface, an error message will be displayed, indicating that you must momentarily disconnect all probes to reset the AutoProbe interface, then connect only the supported quantity of active probes.

See Also   For more information on probes and accessories, see www.keysight.com for:

- Probes and Accessories Selection Guide (5989-6162EN)
- InfiniiVision Oscilloscope Probes and Accessories Selection Guide Data Sheet (5968-8153EN)
- For compatibility information, manuals, application notes, data sheets, selection guides, SPICE models, and more for oscilloscope probes, see the Probe Resource Center at: www.keysight.com/find/PRC

Specifications and Characteristics

Please see the InfiniiVision oscilloscope data sheets for complete, up-to-date specifications and characteristics. To download the data sheet for the M9241/42/43A PXIe oscilloscopes and M9240A AutoProbe power module, please visit: www.keysight.com/products/M9241A

Measurement Category

- "Oscilloscope Measurement Category" on page 68
- "Measurement Category Definitions" on page 69

Oscilloscope Measurement Category

The InfiniiVision oscilloscopes are not intended to be used for measurements in Measurement Category II, III, or IV.

WARNING **Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV). No transient overvoltages allowed.**

Measurement Category Definitions

The "Not rated for CAT II, III, IV" measurement category is for measurements performed on circuits not directly connected to MAINS. Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS derived circuits. In the latter case, transient stresses are variable; for that reason, the transient withstand capability of the equipment is made known to the user.

Measurement category II is for measurements performed on circuits directly connected to the low voltage installation. Examples are measurements on household appliances, portable tools and similar equipment.

Measurement category III is for measurements performed in the building installation. Examples are measurements on distribution boards, circuit-breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to the fixed installation.

Measurement category IV is for measurements performed at the source of the low-voltage installation. Examples are electricity meters and measurements on primary overcurrent protection devices and ripple control units.

Product Markings

These symbols are used on the M9241/42/43A PXIe oscilloscopes.

Symbol	Description
⚠	Caution, refer to accompanying documentation
🔥	Caution, hot surface
⚡	Avoid static discharge
♻	This symbol indicates separate collection for electrical and electronic equipment mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive 2002/96/EC).

Symbol	Description
MSIP-REM-Kst-1A16182	South Korean Certification (KC) mark; includes the marking's identifier code which follows this format: MSIP-REM-YYY-ZZZZZZZZZZZZZZZZ.
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
40	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.
CE **ICES/NMB-001 ISM GRP 1-A**	The CE mark is a registered trademark of the European Community. ICES / NMB-001 Cet appareil ISM est conforme a la norme NMB du Canada. This is a marking to indicate product compliance with the Industry Canadian Interference-Causing Equipment Standard (ICES-001). This is also a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).
C US ®	The CSA mark is a registered trademark of the CSA International.

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