

Keysight M8196A Arbitrary Waveform Generator

Getting Started Guide

Notices

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ESD Sensitive Device

All front-panel connectors of the M8196A are sensitive to Electrostatic discharge (ESD). We recommend to operate the instrument in an electrostatic safe environment.

There is a risk of instrument malfunction when touching a connector.

Please follow this instruction:

Before touching the front-panel connectors, discharge yourself by touching the properly grounded mainframe.

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Safety Information

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.

Safety Summary

General Safety Precautions	<p>The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. For safe operation the general safety precautions for the M9502A and M9505A AXIe chassis, must be followed. See: http://www.keysight.com/find/M9505A Keysight Technologies Inc. assumes no liability for the customer's failure to comply with these requirements. Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.</p>
Initial Inspection	<p>Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically. The Performance Tests give procedures for checking the operation of the instrument. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Keysight Technologies Sales/Service Office.</p> <p>WARNING To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).</p>
General	<p>This product is a Safety Class 3 instrument. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.</p>
Environment Conditions	<p>This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate within a temperature range of 0 °C – 40 °C (32 °F – 105 °F) at a maximum relative humidity of 80% and at altitudes of up to 2000 meters.</p> <p>This module can be stored or shipped at temperatures between -40 °C and +70 °C. Protect the module from temperature extremes that may cause condensation within it.</p>
Before Applying Power	<p>Verify that all safety precautions are taken including those defined for the mainframe.</p>
Line Power Requirements	<p>The Keysight M8196A operates when installed in an Keysight AXIe mainframe.</p>
Do Not Operate in an Explosive Atmosphere	<p>Do not operate the instrument in the presence of flammable gases or fumes.</p>
Do Not Remove the Instrument Cover	<p>Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel. Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.</p>

Safety Symbols

Table 1 Safety Symbol








Symbol	Description
	Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.
	C-Tick Conformity Mark of the Australian ACA for EMC compliance.
	
	CE Marking to state compliance within the European Community: This product is in conformity with the relevant European Directives.
	General Recycling Mark

Table 2 Compliance and Environmental Information

Symbol	Description
	This product complies with the WEEE Directive (2002/96/EC) marketing requirements. The affixed label 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 Annexure I, this product is classed as a "Monitoring and Control instrumentation" product.
	Do not dispose in domestic household waste.
	To return unwanted products, contact your local Keysight office, or see http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

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1 Introduction

Introduction

The Keysight M8196A is a 92 GSa/s Arbitrary Waveform Generator with highest bandwidth and channel density. It offers up to 4 x 512 kSa waveform memory. The M8196A is ideally suited to address following key applications:

- Coherent optical – a single M8196A module can generate 2 independent I/Q baseband signals (dual polarization = 4 channels) at 64 Gbaud and beyond.
- Multi-level / Multi-channel digital signals – generate NRZ, PAM4, PAM8, DMT, etc. signals at up to 56 Gbaud. Embed/De-embed channels, add Jitter, ISI, noise and other distortions.
- Physics, chemistry, and electronics research – generate any mathematically defined arbitrary waveforms, ultra-short yet precise pulses and extremely wideband chirps.
- Wideband RF/ μ W – generate extremely wideband RF signals with an instantaneous bandwidth of DC to 32 GHz for aerospace/defense/communication applications.

Features and Benefits

The M8196A is an arbitrary waveform generator with highest sample rate, bandwidth, and channel density:

- Sample rate up to 92 GSa/s (on each channel)
- Analog bandwidth: 32 GHz
- Vertical resolution: 8 bits
- 1, 2, or 4 differential channels per 1-slot high AXIe module (number of channels is software upgradable)
- Built-in frequency and phase response calibration
- Amplitude up to 1 V_{pp} (single ended) (2 V_{pp} (differential))
- $V_{T_{\text{Rise}},20\% \dots 80\%} T_{F_{\text{Fall}},20\% \dots 80\%} : 9 \text{ ps (typ.)}$
- Ultra low intrinsic Random Jitter $RJ_{\text{rms}} < 130 \text{ fs}$
- Form factor: 1-slot AXIe module controlled via external PC or embedded AXIe system controller M9536A

Getting Started with M8196A

The M8196A is a modular instrument packaged in the AXIe form factor. AXIe is an open standard for high-performance modular instrumentation. Different form factors of AXIe chassis are available: 13-slot, 5-slot and 2-slot AXIe chassis.

An M9536A AXIe embedded controller can control one or multiple M8196A AWG. This embedded controller consumes one module slot of the AXIe chassis. Besides using an embedded controller, the M8196A AWG can be controlled by an external desktop PC or an external laptop as well through PCIe or USB port. In case of PCIe, a PCIe adapter card and PCIe cable are needed whereas USB connection simply requires a USB cable.

When the M8196A AWG, AXIe chassis, PCIe cable, PCIe adapter card and PC are ordered separately the different components come in different packages and need to be installed. Please follow the instructions given in chapter 3 of M8196A user's guide or the instructions given in the user's guide of the AXIe chassis.

In case an M9536A embedded controller has been ordered as part of the M8196A-BUx system configuration, the M8196A firmware is already installed and configured on the embedded controller.

User set up:

- Username: M8196a_admin
- Password: admin!123

Directory of the software:

- Firmware:
C:\Program Files (x86)\Keysight\M8196\bin

Additional Documents

Additional documentation can be found at:

- <http://www.keysight.com/find/M9514A> for 13-slot chassis related documentation.
- <http://www.keysight.com/find/M9505A> for 5-slot chassis related documentation.
- <http://www.keysight.com/find/M9502A> for 2-slot chassis related documentation.
- <http://www.keysight.com/find/M9047A> for PCIe desktop adapter card related documentation.
- <http://www.keysight.com/find/M9536A> for embedded AXIe controller related documentation.
- <http://www.keysight.com/find/M8196A> for AXIe based AWG module related documentation.

2 M8196A Software Installation

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This chapter explains the steps required to install M8196A software package.

2.1 Pre-Requisites

The following are the pre-requisites for installing Keysight M8196A software:

- The supported operating systems are:
 - Window 10 (32 bit or 64 bit)
 - Windows 8.1 (32 bit or 64 bit)
 - Windows 8 (32 bit or 64 bit)
 - Windows 7 (32 bit or 64 bit)
- Ensure that you have Keysight IO Libraries Suite Version 16.3 or higher installed on your system. The Keysight IO Libraries Suite can be found on the CD that is part of shipment content or at <http://www.keysight.com/find/iosuite>.

NOTE

Even if a non-Keysight I/O library is already installed on your PC, it is still necessary to install the Keysight I/O library. The Keysight I/O library will install as “secondary” I/O library in this case. This use case is fully supported. There only needs to be some additional considerations when doing SCPI remote programming. For more information on SCPI remote programming, refer to M8196A User's Guide.

2.2 Installation Process

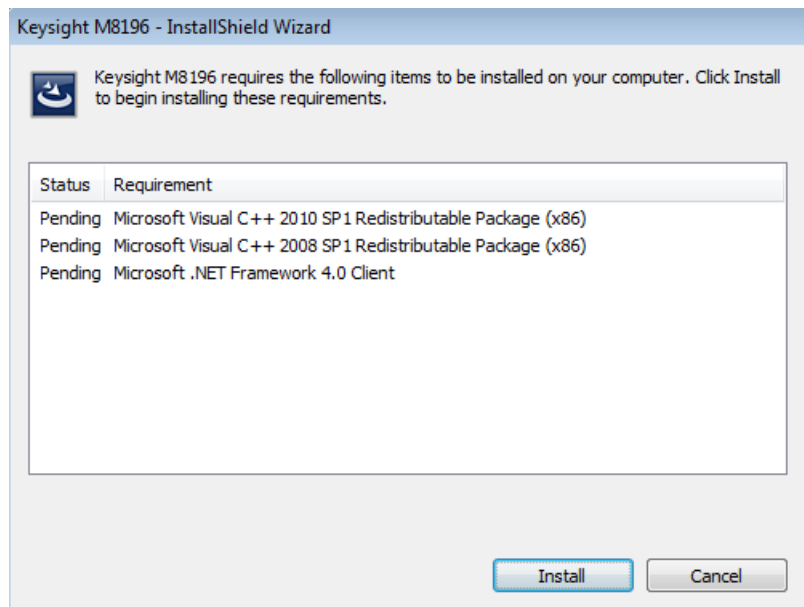
Follow the given steps to install **Keysight M8196A** software on your system:

1. Double-click the executable (M8196_Setup.exe). This executable file is available either on CD or Web.

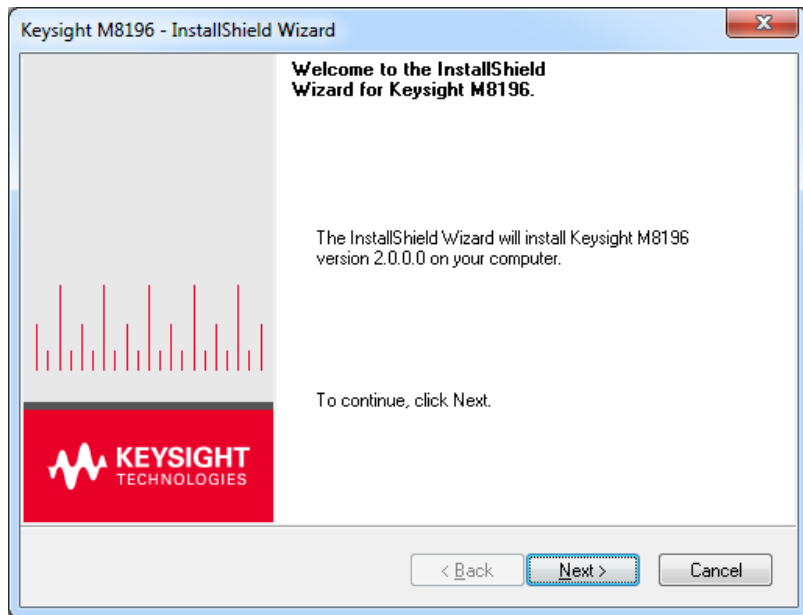
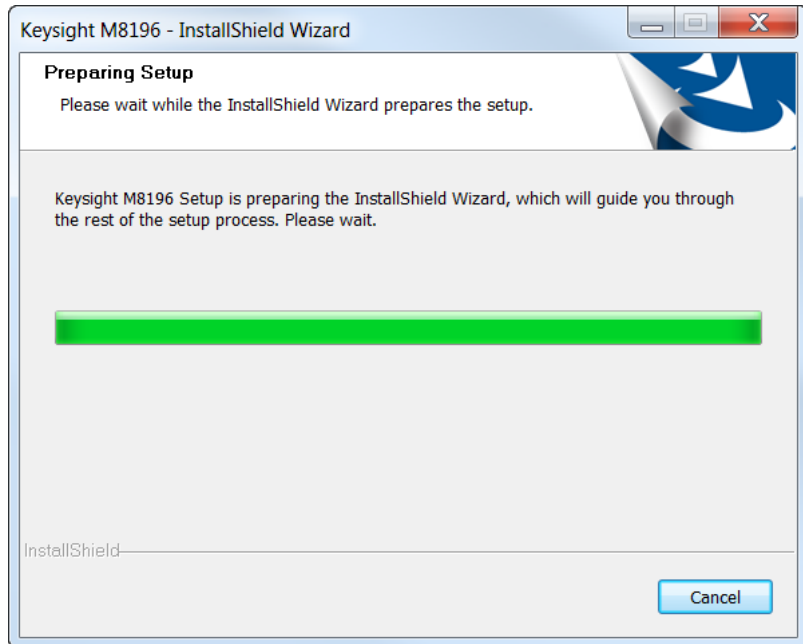


NOTE

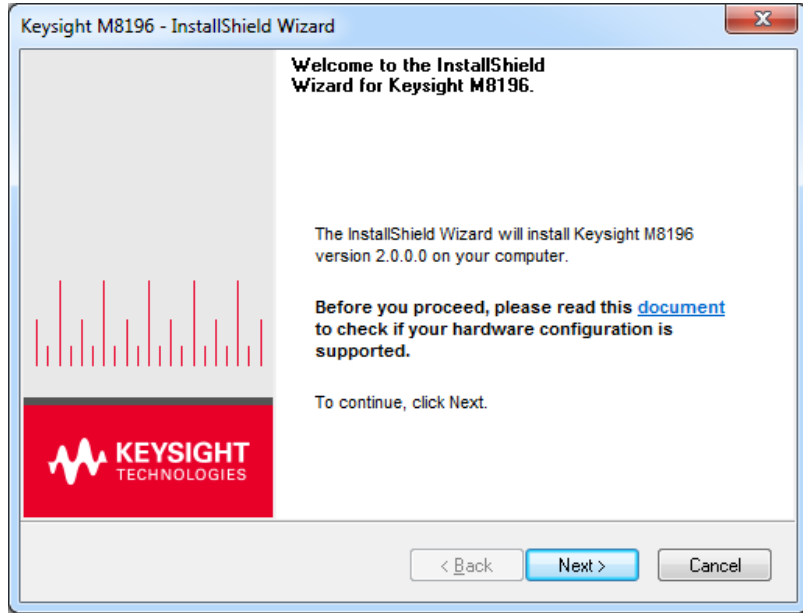
The installer will first check and list some pre-requisites. Click **Install** to install them. Your PC may request a reboot during this step. Reboot your PC, if requested.



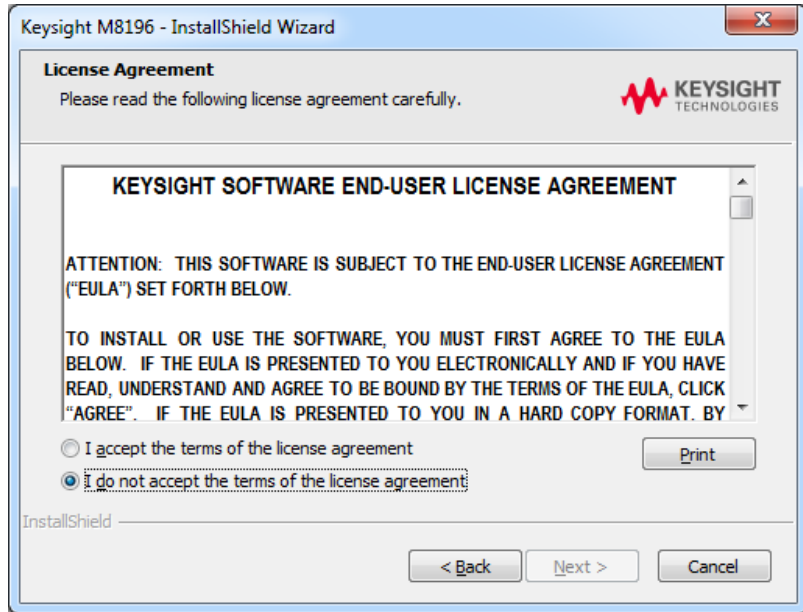
2. The Keysight **M8196A Setup** will prepare the **InstallShield Wizard** for the installation process. The following windows will appear.



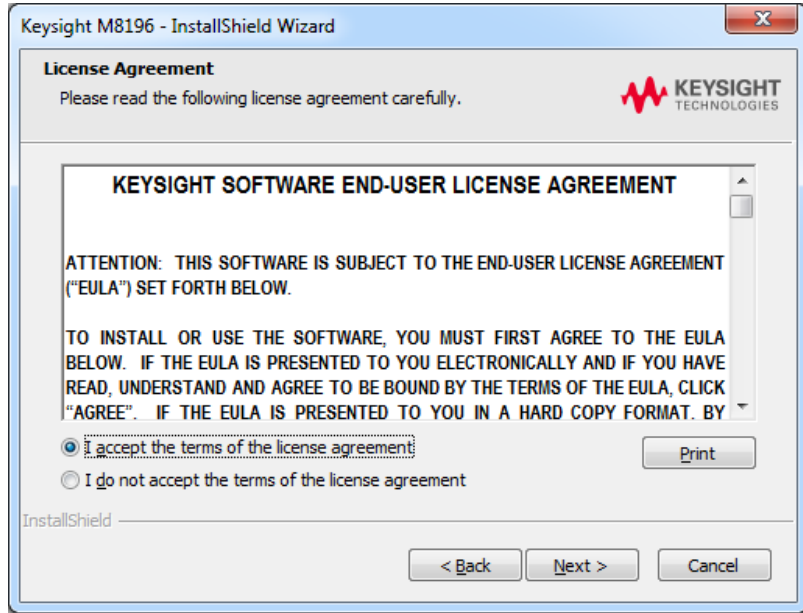
3. Click **Next**.



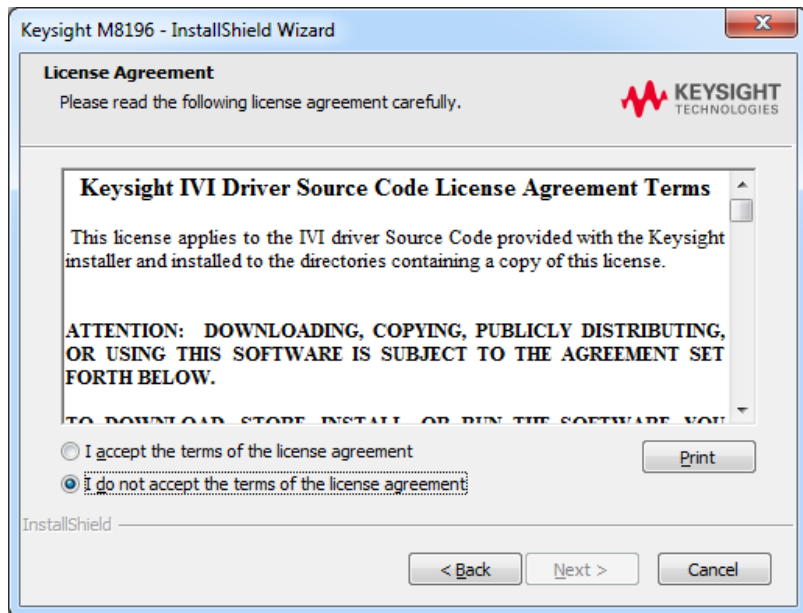
4. We recommend you to read the document to check if your hardware configuration is supported.
Click **Next** to proceed to the license agreements.



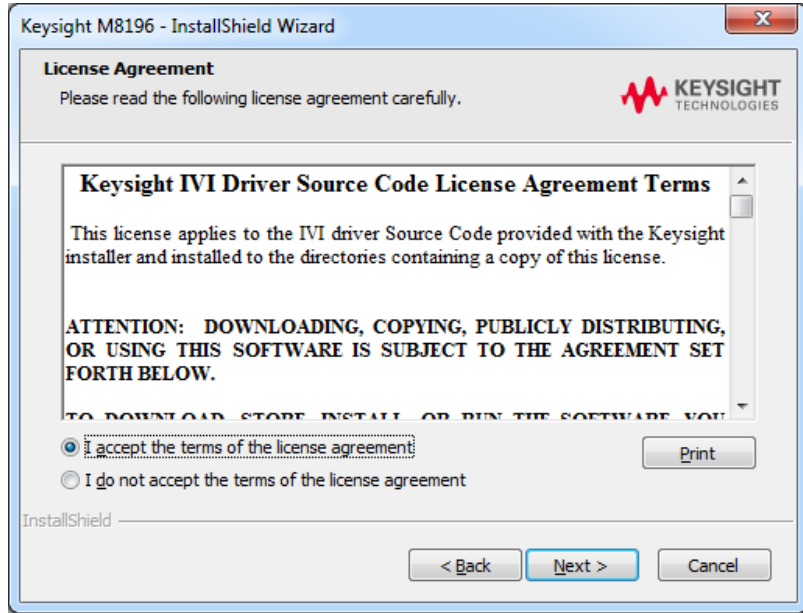
5. Accept the terms of 'Keysight Software End-User License Agreement'.



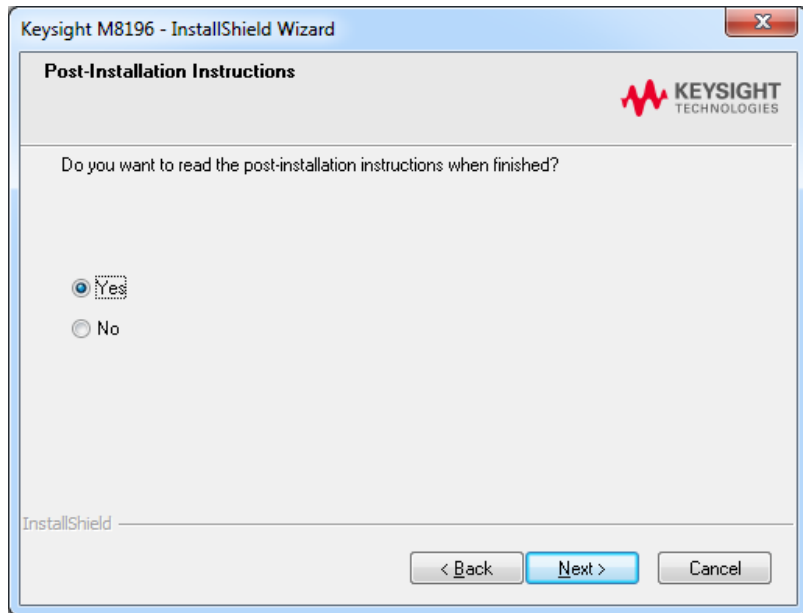
6. Click Next.



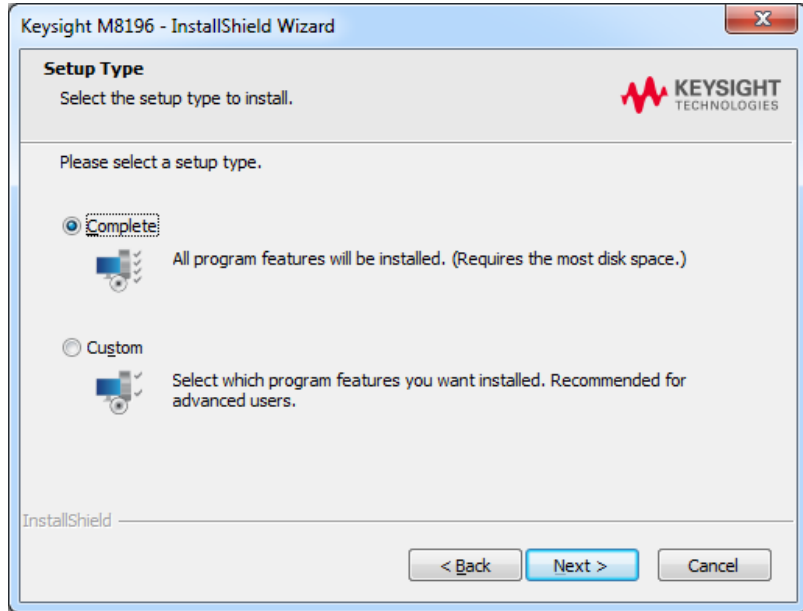
7. Accept the "Keysight IVI Driver Source Code License Agreement Terms".



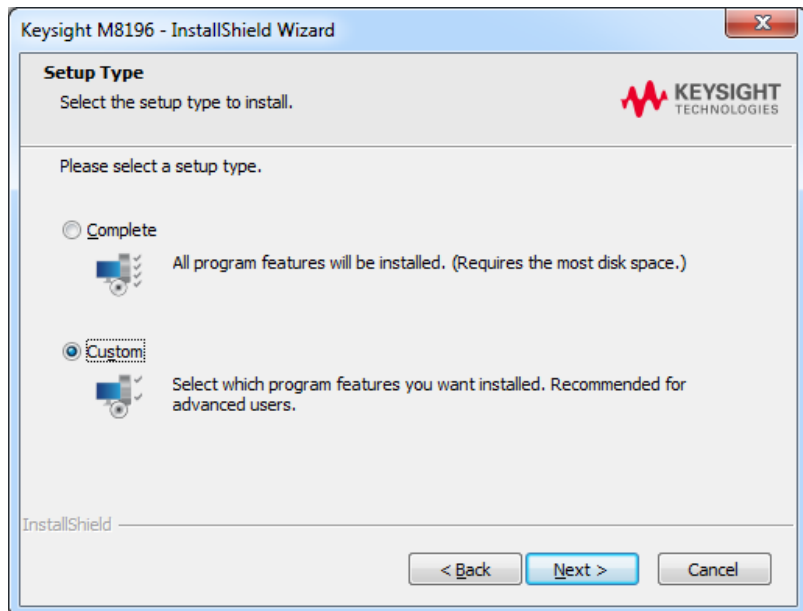
8. Click **Next**.

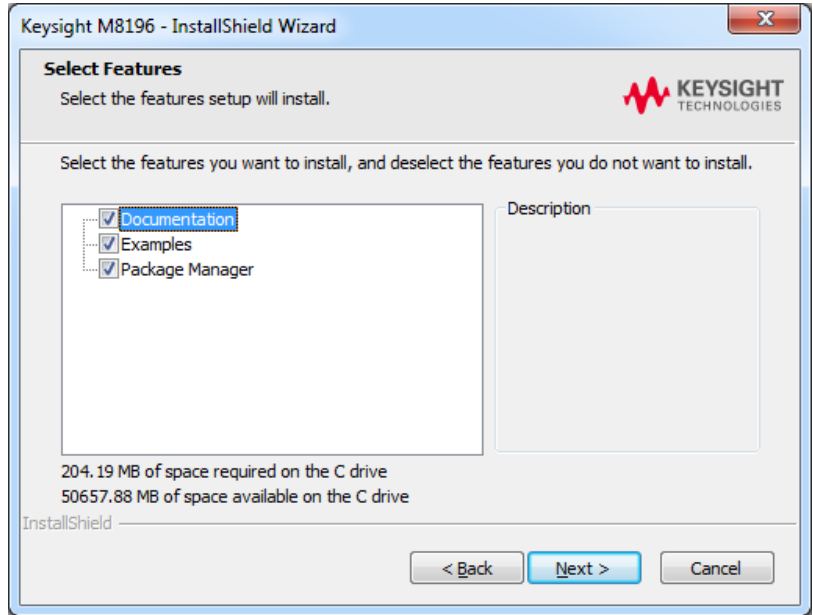


9. Select **Yes** if you want to read the post-installation instructions. Click **Next** to select setup type.

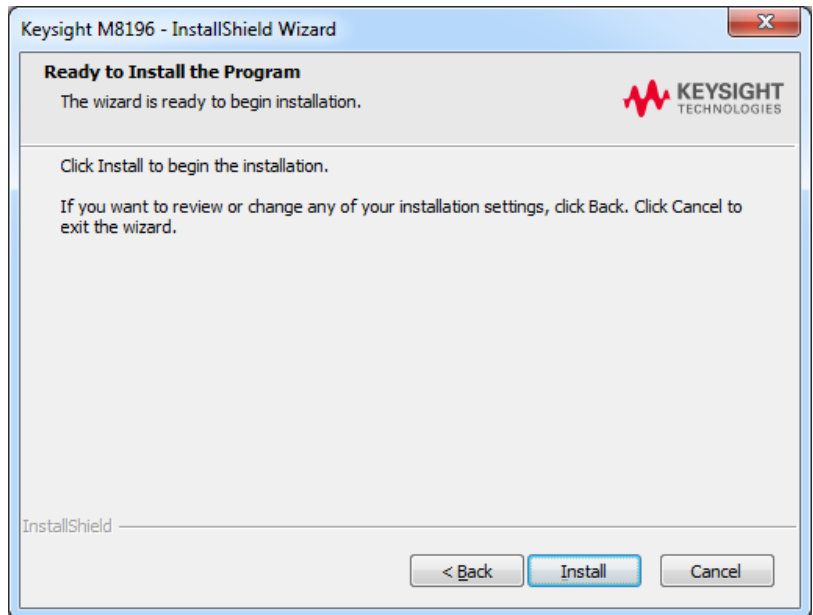


10. Select a setup type either **Complete** or **Custom**.
If you select **Custom**, you can specify which optional features will be installed.

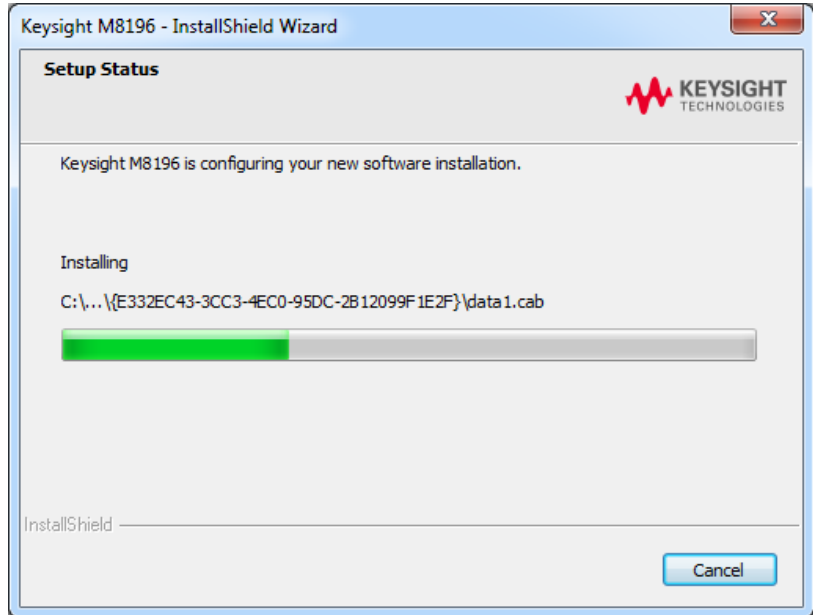




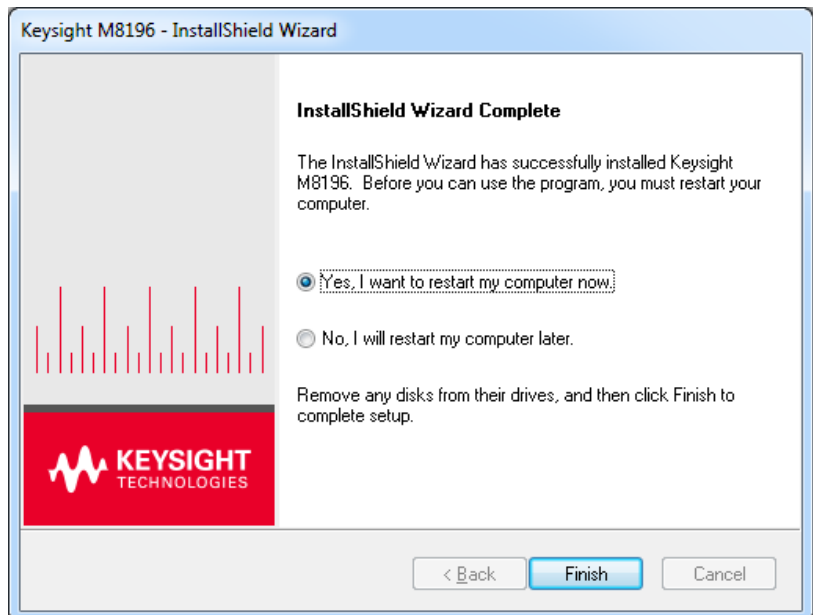
11. Click **Next**.



12. Click **Install** to begin the installation. The **Setup Wizard** will now install M8196.



13. The following screen will appear once the **Keysight M8196A** software is successfully installed on your system.



14. Click **Finish** to restart your system. Do not connect the AXIe chassis to your system using the PCIe or USB cable during this reboot.

This completes the Keysight M8196A software installation.

2.3 Post Installation Steps

Follow the post installation steps as shown below:

NOTE

If M8196A is already powered up and connected to PC using the PCIe, just reboot the PC and start with step 5. No such reboot step is required in case of USB connection.

1. Shut down PC and instrument.
2. Connect the instrument to the PC using the PCIe or USB cable.
3. Switch on the instrument. Wait until the 'Access' LED of the M8196A has switched from red to green.
4. Switch on the PC.
5. The PC should automatically recognize the instrument.

Check this in the device manager; e.g. via **Start > Control Panel > Device Manager**, or right-click **Computer > Manage > Device Manager**:

- In case of PCIe:
The instrument should be visible in the device tree as **Keysight Technologies Modular Devices > M8196A**
- In case of USB:
The instrument should be visible in the device tree as **Keysight Modular Platform (AMP/AXIe) > Keysight Technologies USB AMP/AXIe Chassis**.

NOTE

In case of PCIe, post installation steps must be followed strictly in the same order as mentioned for successful connection of the PC with M8196A. However, in case of USB no such restriction is applicable i.e. the PC can be powered before the M8196 is turned ON.

NOTE

Your PC might request a reboot. Reboot your PC, if requested.

6. Check if the M8196 is also visible in the Connection Expert. The connection expert can be opened by clicking its icon in the system tray.
If something went wrong and the instrument is not showing in the PXI section, it may be necessary to reboot the PC once more.

2.4 How to use the Instrument

In order to use the instrument:

1. If you use a PCIe link to control the M8196A, the AXIe chassis must be switched on before you start the PC. If you use an USB link to control the M8196A, it's not mandatory that the AXIe chassis is powered and has booted prior to turn-on the PC.
2. Start the **M8196A Soft Front Panel (Start > All Programs > Keysight M8196 > Keysight M8196 Soft Front Panel)**. The user interface will display the VISA resource strings for different kinds of connection.
3. Using the appropriate VISA resource string you can:
 - Start the Soft Front Panel (**Start > All Programs > Keysight M8196 > Keysight M8196 Soft Front Panel**).
 - Control the instrument with your own application using the M8196 IVI Drivers or add it as a LAN instrument in the Keysight Connection Expert (TCPIP0::localhost::...) and control it using SCPI (with e.g. the VISA Assistant or your own application).

You must start the M8196A Soft Front Panel in order to send SCPI commands to the instrument.

NOTE

The M8196 IVI Drivers start the M8196A Soft Front Panel automatically.

3 AXle Chassis

3.1 ESM Front Panel Connector / 21

Introduction

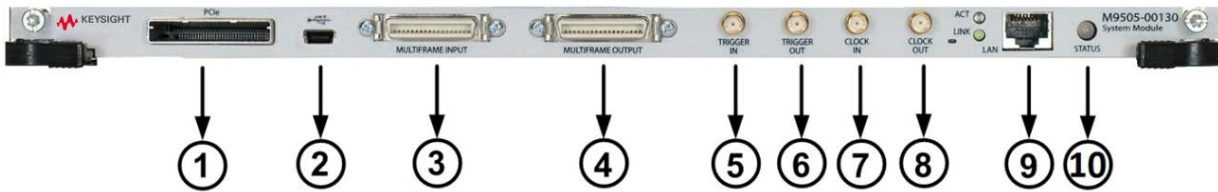
This chapter describes the usage of the AXle chassis in combination with the M8196A.

The detailed documentation for the AXle chassis can be found at:

- <http://www.keysight.com/find/M9514A> for 13-slot chassis
- <http://www.keysight.com/find/M9505A> for 5-slot chassis
- <http://www.keysight.com/find/M9502A> for 2-slot chassis

3.1 ESM Front Panel Connector

The ESM Front Panel Connector is shown in the figure below:



1	PCIe	Connects a host PC to the chassis via PCIe.
2	USB	Connects a host PC to the chassis via USB 2.0. The USB 2.0 port is only available for AXle chassis with option -U20.
3	Multiframe Input	Synchronizes timing signals with multiple daisy-chained chassis.
4	Multiframe Output	
5	Trigger In	External Trigger connections.
6	Trigger Out	The Trigger In of the AXle ESM cannot be used to trigger the M8196A. The Trigger Out of the AXle ESM cannot be controlled by the M8196A.
7	Clock In	External clock connections.
8	Clock Out	
9	LAN	Connects the host PC to the chassis, via 10/100/1000 Ethernet. In particular, the LAN connector is used for ESM configuration, but NOT to communicate to the M8196A.
10	Status Light	Indicates the chassis status.

4 M8196A Maintenance

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Introduction

This chapter explains how to install and maintain the M8196A. It covers the following topics:

- ESD Protection
- Power & Ventilation Requirements
- Thermal Protection
- Battery
- Operating Environment
- Cleaning Recommendation

4.1 ESD Protection

CAUTION

All the connectors are very sensitive to electrostatic discharge (ESD). When you connect a device or cable that is not fully discharged to these connectors, you risk damage to the instrument and expensive instrument repairs.

CAUTION

Electrostatic discharge (ESD) can damage the circuits of the M8196A. Avoid applying static discharges to the front-panel connectors. Before connecting any coaxial cable to the connectors, momentarily short the center and outer conductors of the cable together. Avoid touching the front-panel connectors without first touching the frame of the instrument. Be sure the instrument and all connected devices (DUT, etc.) are properly earth-grounded (to a common ground) to prevent buildup of static charge and electrical over-stress.

4.2 Power and Ventilation Requirements

For power and ventilation requirements, refer to:

- <http://www.keysight.com/find/M9514A> for 13-slot chassis related documentation.
- <http://www.keysight.com/find/M9505A> for 5-slot chassis related documentation.
- <http://www.keysight.com/find/M9502A> for 2-slot chassis related documentation.

4.3 Thermal Protection

Overheating Detection

The instrument monitors its internal temperature. If the temperature exceeds approximately 80°C the power supply is switched off. The instrument will not turn on automatically if the temperature is decreasing again.

Fan Failure

If a fan is broken or prevented from operating by a blockage the temperature will increase. When the temperature exceeds approximately 80°C the overheating detection switches off the instrument for safety reasons. For reliability it is recommended to send instruments with broken or defective fans immediately to Keysight Service for repair.

4.4 Battery

The M8196A does not have a battery.

4.5 Cleaning Recommendation

WARNING

To prevent electrical shock, disconnect the instrument from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean external case parts. Do not attempt to clean internally.

5 Characteristics

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5.1 Performance Specification

The performance specification can be found in the Data Sheet of the M8196A at:
<http://www.keysight.com/find/M8196A>

5.2 Operating Environment

Storage Temperature	-40 °C to +70 °C
Operating Temperature	0 °C to 40 °C
Operating Humidity	5% to 80% relative humidity, non-condensing
Operating Altitude	Up to 2000 m
Installation	Category II
Pollution	Degree 2

5.3 General

Power consumption	50 W (nom), 92 GSa/s operation
Safety designed to	IEC61010-1, UL61010, CSA22.2 61010.1 tested
EMC tested to	IEC61326-1
Warm-up time	30 min
Calibration interval	2 years recommended
Cooling Requirements	When operating the M8196A choose a location that provides at least 80 mm of clearance at rear, and at least 30 mm of clearance at each side for the AXIe chassis.

This information is subject to change without notice.
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