

# Keysight N4391A/N4392A Optical Modulation Analyzer

Getting Started

# Notices

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## Safety Notices

### 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

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 or operating instructions in the product manuals violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements. Product manuals are provided with your instrument on CD-ROM and/or in printed form. Printed manuals are an option for many products. Manuals may also be available on the Web. Go to [www.keysight.com](http://www.keysight.com) and type in your product number in the Search field at the top of the page.

General	<p>This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.</p> <p>All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.</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 at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.</p> <p>Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.</p>
Before Applying Power	<p>Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.</p>
Ground the Instrument	<p>To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.</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.</p> <p>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>

## Compliance and Environmental Information

**Table 1 Compliance and Environmental Information**

Safety Symbol	Description
 	<p>This product complies with WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.</p> <p>Product Category: With reference to the equipment types in WEEE Directive Annex I, this product is classed as a “Monitoring and Control instrumentation” product.</p> <p>Do not dispose in domestic household waste.</p> <p>To return unwanted products, contact your local Keysight office, or see <a href="http://www.keysight.com/environment/product/">www.keysight.com/environment/product/</a> for more information.</p>

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# 1 Introduction

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## Documentation

### N4391A Documentation

The documentation for the Keysight N4391A Optical Modulation Analyzer consists of

- The documentation for the Keysight Infiniium Digital Signal Analyzer. This documentation is supplied with the digital signal analyzer, including extensive online help. Refer to it for using the digital signal analyzer for modulation measurements, or for configuring the digital signal analyzer.
- The documentation for the optical modulation analyzer and the software application. This consists of
  - This booklet, which contains the information you need to get your Optical Modulation Analyzer running, and to perform a first measurement.
  - The online help, which provides the instructions for use.
  - The online help for the 89601B vector signal analysis software.

### N4392A Documentation

The documentation for the Keysight N4392A Optical Modulation Analyzer consists of

- This booklet, which contains the information you need to get your Optical Modulation Analyzer running, and to perform a first measurement.
- The online help, which provides the instructions for use.
- The online help for the 89601B vector signal analysis software.

### Instructions for use

For further information, please refer to the online help.

You can refer to the online help for the Optical Modulation Analyzer by selecting “Help/Show OMA Help” in the 89600 VSA software interface.

## General Safety Considerations

This product has been designed and tested in accordance with the standards listed on the manufacturer's Declaration of Conformity (see [Declaration of Conformity](#) on page 86), 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.

### Intended use

This instrument is intended to use in an office or laboratory environment, under the environmental conditions listed in the specifications.

### Safety symbols

#### CAUTION

The *caution* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

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#### WARNING

The *warning* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.

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### Instrument markings



The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.



The laser radiation symbol. This warning symbol is marked on products which have a laser output.



The electrostatic discharge symbol. This warning symbol is marked on products which have components that can be damaged by an electrostatic discharge.



The recycling symbol indicates the general ease with which the instrument can be recycled.



The C-Tick mark is the certification mark of the Australian Communications Authority.



The CE mark is the conformity marking of the European Community.



The CSA mark is a the certification mark of the Canadian Standards Association.



The earthing symbol marks a connection that is connected, through the instrument, to the earth of the line power.

**WARNING**

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

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**WARNING**

No operator serviceable parts inside. Refer servicing to qualified service personnel. To prevent electrical shock do not remove covers.

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**WARNING**

This is a Safety Class 1 Product (provided with protective earth). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

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**WARNING**

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

---

**WARNING**

Using controls or adjustments or performing procedures other than those specified in the documentation supplied with your equipment can result in hazardous radiation exposure.

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**CAUTION**

This product complies with over-voltage Category II and Pollution Degree 2.

---

**CAUTION**

Ventilation requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4 °C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

---

**CAUTION**

Install the instrument so that the power cords are readily identifiable and is easily reached by the operator. This is how the instruments are disconnected. They disconnect the mains circuit from the mains supply before other parts of the instrument.

Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

---

**CAUTION**

Always use the three-prong AC power cords supplied with this instrument. Failure to ensure adequate earth grounding by not using these cords may cause instrument damage.

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**CAUTION**

This instrument has autoranging line voltage input. Be sure the supply voltage is within the specified range.

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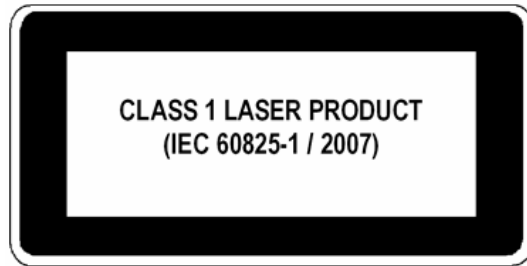
### Initial Safety Information

The laser sources classified by this guide are classified as Class 1M according to IEC 60825-1 (2007).

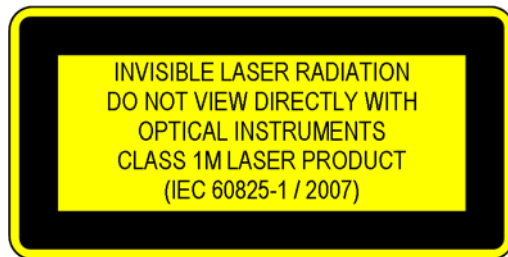
All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007-June-24.

### Laser Safety

#### Laser class 1M label (not applied to the product)



#### Laser class 1M label



A sheet of laser safety labels is included. In order to meet the requirements of IEC 60825-1 we recommend that you stick the laser safety labels, in your language, onto a suitable location on the outside of the instrument where they are clearly visible to anyone using the instrument

N4391A	Option 220
Laser wavelength range	1528 nm to 1630 nm
Laser Type	Booster Optical Amplifier
Laser Class according to IEC 60825-1	1M
Maximum CW output power of the Optical Modulation Analyzer* †	< 100 mW
Maximum permissible CW output power	163 mW
Numerical aperture	0.1
Beam waist diameter	< 10 $\mu$ m

\* CW output power is defined as the highest possible optical output power that the laser source can produce at the output connector

† For power levels at "LOInput"  $\leq$  20dBm

N4392A	Options 100+310 or 110+310 or 100+300+320 or 110+300+320 or 100+300+310+320 or 110+300+310+320	Options 100+300 or 110+300 or 100+300+310 or 110+300+310	Option 310
Max. CW output power*	< 100 mW	- (internal Laser only)	-
Beam waist diameter	< 10 $\mu$ m	-	-
Numerical aperture	0.1	-	-
Laser class according to IEC 60825-1 (2001)	Class 1M	Class 1	-
Max. permissible CW output power†	163 mW	10 mW	-

\* Max. CW output power is defined as the highest possible optical CW power that the laser source can produce at its output.

† Max. permissible CW output power is defined as the highest optical power that is permitted within the appropriate IEC laser class.

**WARNING**

Please pay attention to the following laser safety warnings:

- Under no circumstances look into the end of an optical cable attached to the optical output when the device is operational. The laser radiation can seriously damage your eyesight.
  - Do not enable the laser when there is no fiber attached to the optical output connector.
  - The laser is enabled by the software. The laser is on when the green LED above the LO Output connector is lit.
  - The use of the instruments, such as microscopes or spectacles, with this product will increase the hazard to your eyes.
  - The laser module has built-in safety circuitry which will disable the optical output in the case of a fault condition.
  - Refer servicing *only* to qualified and authorized personnel.
- 

## Line power requirements

**CAUTION**

The Keysight N4391A Optical Modulation Analyzer complies with overvoltage category II and pollution degree 2. It can operate from the single-phase AC power source that supplies between 100 V and 240 V (max. voltage fluctuation 10%) at a frequency in the range of 50 to 60 Hz. The maximum power consumption of the optical modulation analyzer is 40 VA (N4391A) or 375 VA (N4392A) with all options installed.

Please refer to the documentation for your digital signal analyzer for information on its line power requirements.

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## Line power connectors

In accordance with international safety standards, the instrument has a three-wire power cable. When connected to an appropriate AC power receptacle, this cable earths the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination.



**WARNING**

To avoid the possibility of injury or death, you must observe the following precautions before switching on the instrument.

- Insert the power cable plug only into a socket outlet provided with a protective earth contact. Do not use an extension cord without a protective conductor. Using an extension cord without a protective conductor means the instrument is not earthed.
- Do not interrupt the protective earth connection intentionally.
- Do not remove protective covers. Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified service 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.
- Defective, damaged, or malfunctioning instruments must be returned to an Keysight Technologies Service Center.
- Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

## Environmental Information

This product is intended for indoor use only.

This product complies with the WEEE Directive (2002/96/EC) marking 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 Annex 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 [www.keysight.com/environment/product/](http://www.keysight.com/environment/product/) for more information.

## N4391A/N4392A Shipping Contents

Unpack your shipment.

- Inspect the shipping containers for damage.
- Inspect the instruments.
- Verify that you received the options and accessories that you ordered.

Keep the shipping containers and cushioning material until you have inspected the contents of the shipment for completeness and have checked the equipment mechanically and electrically.

### N4391A Contents

#### Contents for all options

1x	optical modulation analyzer	N4391A
1 to 3x	FC/APC connector interface (quantity depends on options ordered)	81000NI
1x	language labels sheet	81645-44309
1x	torque wrench, 8lb-in, 5/16 inch	8710-1765
1x	wrench, open-end, 8mm, steel hard chrome finish	8710-2466
1x	calibration certificate	9230-0333
1x	wrist strap with cord 6-lg blue	9300-1405
1x	China RoHS addendum for photonic test and measurement products	9320-6654
1x	UK6 report	E5525-10285
1x	Getting started guide for the N4391A	N4391-90Axx
1x	Safety-booklet	9320-6792
1x	power cord (country dependent)	

#### Contents for data acquisition

0 to 1x	Scope including all standard accessories	
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### Contents for option M33

1x	cable-assembly USB-plug A to B 4-COND 500 mm	8121-1695
8x	screw, pan-head, Torx-T15, M3.5X0.6 8mm-long	0515-1402
3x	screw, 90-deg-flat-head, Torx-T10, M3X0.5 10 mm-long	0515-2033
1x	plate scope interface	N4391-04106
1x	adapter plate for scope type B	N4391-04108
1x	bracket rear for scope type B	N4391-04109
2x	bracket rear	N4391-25073
1x	RF cable kit for single scope setup type B	N4391-61663

### Contents for options Z20, Z25, Z33

1x	optical mouse, USB/PS2	1150-7799
1x	104 key standard keyboard with USB connector	1150-7896
1x	stylus-pen, cushion grip	1150-7997
1x	cable, calibration	54916-61626
1x	cable-Assembly USB-Plug A TO B 4-COND 500mm	8121-1695
1x	connector saver collars kit of 10	54916-60003
1x	connector Assembly- 3.5mm female to female-kit of 5	54916-68717
1x	quick start guide (English)	54932-92000
1x	software/firmware addendum	5190-1894
1x	China RoHS addendum for oscilloscope	9320-6678
8x	screw, pan-head, Torx-T15, M3.5X0.6 8mm-long	0515-1402
3x	90-deg-flat-head, Torx-T10, M3X0.5 10mm-long	0515-2033
1x	plate scope interface	N4391-04106
1x	adapter plate for scope type B	N4391-04108

1x	bracket rear for scope type B	N4391-04109
2x	bracket rear	N4391-25073
1x	RF cable kit for single scope setup type B (content see below)	N4391-61663

#### Contents of the RF cable kit for single scope setup (N4391-61663)

1x	RF cable, receiver to scope 1 port 1	N4391-61641
1x	RF cable receiver to scope 1 port 2	N4391-61642
1x	RF cable receiver to scope 1 port 3	N4391-61643
1x	RF cable receiver to scope 1 port 4	N4391-61644

Refer also to the contents list of the digital signal analyzer.

If anything is missing or defective, contact your nearest Keysight Technologies sales office. If the shipment was damaged, contact the carrier, then contact the nearest Keysight Technologies sales office.

## N4392A Contents

## Contents for all options

1x	Optical Modulation Analyzer	N4392A
1x	Optical Mouse USB PS2 102	1150-7799
1x	Mini Keyboard 319x157x20mm	0960-2929
0 to 4x	81000NI FC/APC connector interface (quantity depends on options ordered)	08154-61723
1x	language labels sheet	81645-44309
1x	calibration certificate	9230-0333
1x	wrist strap with cord 6-1g blue	9300-1405
1x	STYLUS-PEN Cushion Grip 5.54-in-LG 0.44-in-DIA	1150-7997
1x	RoHS addendum for photonic test and measurement products	9320-6654
1x	UK6 report	E5525-10285
1x	Getting started guide	N4392-90Axx
1x	Safety-booklet	9320-6792
1x	power cord (country dependent)	
1x	Entitlement certificate Basic N4392A software package	N4392-90100

## Contents for option 310

1x	torque wrench, 8lb- in, 5/16 inch	8710- 1765
1x	wrench, open- end, 8mm, steel hard chrome finish	8710- 2466

Depending on the options you order, you should also receive.

1x	Entitlement certificate option N4392A-410	N4392-90101
1x	Entitlement certificate option N4392A-420	N4392-90103
1x	Entitlement certificate option N4392A-430	N4392-90104

If anything is missing or defective, contact your nearest Keysight Technologies sales office. If the shipment was damaged, contact the carrier, then contact the nearest Keysight Technologies sales office.

# 2 Getting Started

Mounting an Infiniium 90000 Z-Series High-Performance Oscilloscope  
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Concluding the setup for all options / 29

Creating Your First Trace on the OMA / 32

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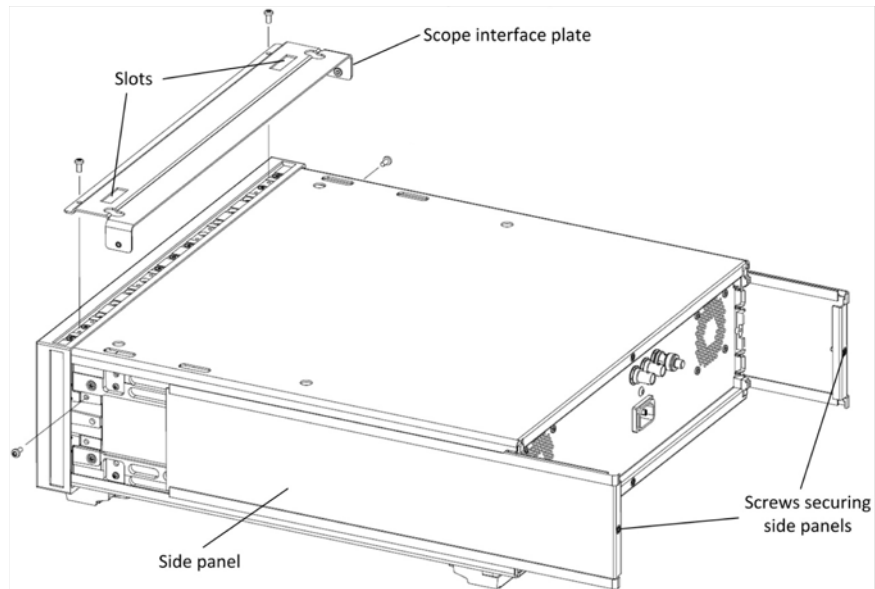
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## Mounting an Infiniium 90000 Z-Series High-Performance Oscilloscope (option #M33, #Z20, #Z25, #Z33) on the Optical Test Set

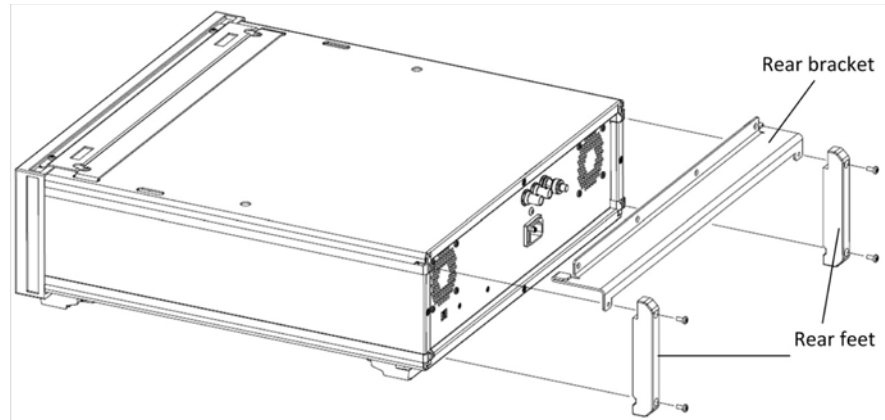
If you do not have one of these options, please proceed to the next section.

- 1 Prepare the optical coherence receiver.
  - a Using a Torx T15 screwdriver, loosen the screws holding the side panels on the optical coherence receiver.
  - b Slide the side panels half-way to the rear.

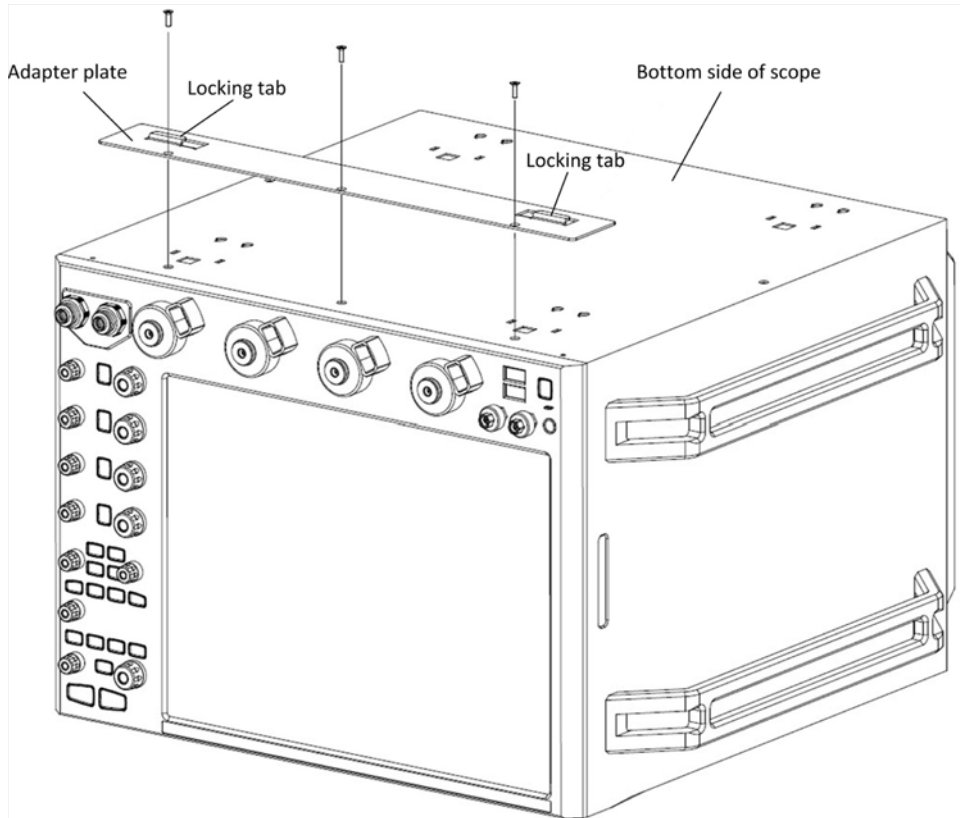


- c Using a Torx T15 screwdriver, mount the scope interface plate (N4391- 04106) on the top front side of the optical coherence receiver.
    - d Slide the side panels of the optical coherence receiver back into place and secure with captive screws.
    - e Remove the rear feet from the optical coherence receiver using a Torx T15.

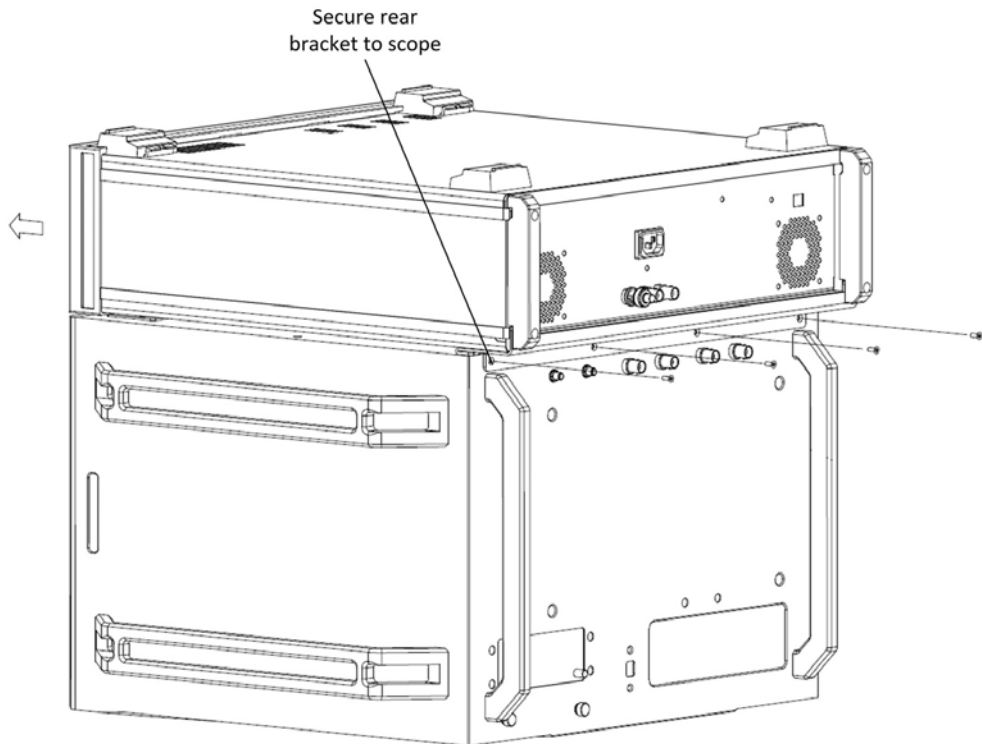




- f* Place the rear bracket (N4391- 04109) on the top rear side of the optical coherence receiver.
  - g* Using the screws from the rear feet (N4391- 25073), secure rear feet and rear bracket to the rear of the optical coherence receiver.
- 2 Prepare the oscilloscope.
- a* Place the oscilloscope upside down, and lay it on its top on the work surface.
  - b* Remove the 4 feet from the bottom of the oscilloscope.
  - c* Using a Torx T10 screwdriver, mount the adapter plate (N4391- 04108) on the bottom of the oscilloscope and secure using longer screws (0515- 2033) supplied.

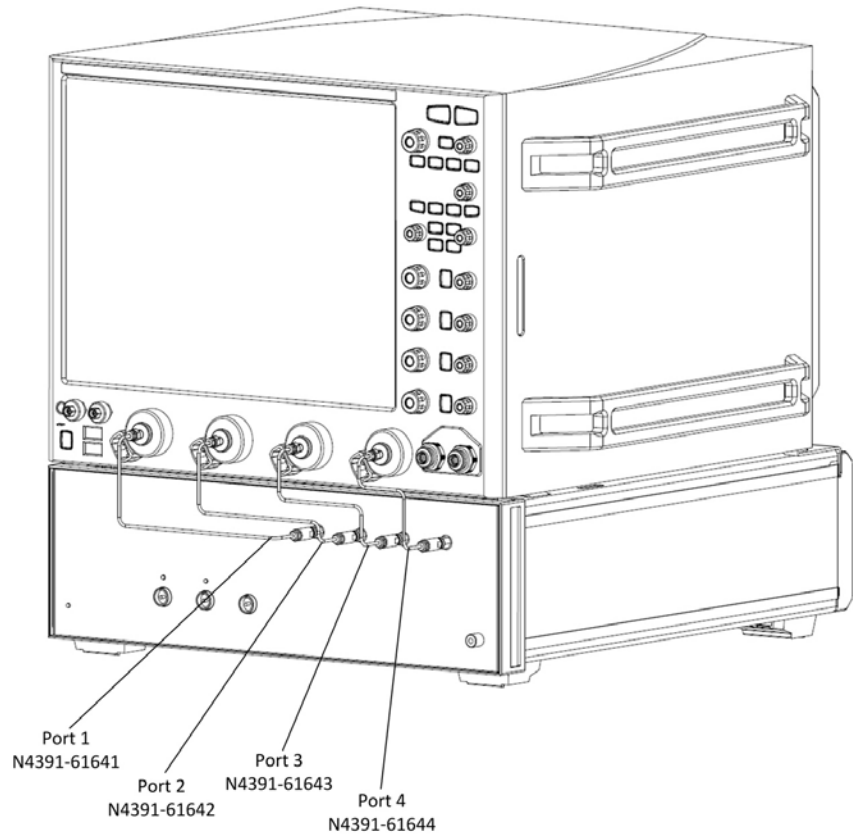


- 3 With the oscilloscope still on its top, mount the optical coherence receiver.
  - a Remove the four screws on the bottom rear edge of the oscilloscope. This is where the rear bracket on the optical coherence receiver will be secured to the oscilloscope.
  - b With the optical coherence receiver upside down, lock it onto the adapter plate. Ensure that the adapter plate locking tabs slide into the slots in the scope interface plate.



- c Using a Torx T10 screwdriver and the screws from the oscilloscope, secure the rear bracket of the optical coherence receiver to the rear of the oscilloscope.
- 4 Turn the assembly the right way up.

- 5 Using the torque wrench supplied with the optical coherence receiver (part number 8710-1765) and the cables from the cable set (part number N4391-61663), connect the RF cables.
  - a Connect RF cable N4391- 61641 from Port 1 of the optical coherence receiver to Port 1 of the oscilloscope.
  - b Connect RF cable N4391- 61642 from Port 2 of the optical coherence receiver to Port 2 of the oscilloscope.
  - c Connect RF cable N4391- 61643 from Port 3 of the optical coherence receiver to Port 3 of the oscilloscope.
  - d Connect RF cable N4391- 61644 from Port 4 of the optical coherence receiver to Port 4 of the oscilloscope.



## Concluding the setup for all options

- 1 At the rear of the instrument,
  - a Connect the mouse and keyboard to the digital signal analyzer.
  - b Using the USB cable supplied, connect the optical modulation analyzer to the digital signal analyzer.
  - c Using the two power cables supplied, connect the power cables to the digital signal analyzer (the power socket with the notch), and the optical coherent analyzer.
  - d If necessary, connect your LAN cable to the digital signal analyzer.
- 2 At the front of the instrument, put the electrostatic discharge band around your wrist, and plug it into the earthed connector at the bottom right of the instrument.
- 3 Working from one side to the other (left to right or right to left), attach the rigid cables between the digital signal analyzer and the optical modulation analyzer.

Note: you may find this easier if you move the front of the instrument so it is at the front edge of the table or bench you are working on.

  - a Remove the protective cap from the signal input on the optical modulation analyzer.
  - b Make sure you have the rigid cable with the same number as the connector on the digital signal analyzer.
  - c Remove the protective cap from the smaller connector on the rigid cable.
  - d Connect the BNC connector to the digital signal analyzer. Tighten the connector until it is finger tight.
  - e Connect the rigid cable to the connector on the optical modulation analyzer.

**NOTE**

The connectors on the optical modulation analyzer tighten anti-clockwise.

- f Using the spanner wrench supplied, holding the end of the rigid cable, and use the torque wrench supplied to tighten the connector.

**CAUTION**

Always use patchcords to connect to your DUT. This protects the connectors of the optical modulation analyzer, by minimizing the number of connector changes.

---

**CAUTION**

The contact connector on the optical modulation analyzer is angled. If you are using a patchcord with straight and angled connectors, make sure you connect the angled connector to the optical modulation analyzer. Connecting to the optical modulation analyzer with a straight connector will damage it.

---

**CAUTION**

Before you connect any fiber-optic cable to the Optical Modulation Analyzer, please ensure it has been properly cleaned. Fiber-optic connectors are easily damaged when connected to dirty or damaged cables and accessories. When you use improper cleaning and handling techniques, you risk expensive instrument repairs, damaged cables, and compromised measurements.

---

- 4 Remove the protective covers from the connector interfaces on the front of the instrument and from the patchcord connectors.
- 5 Connect the optical patchcord.
- 6 Turn on the instrument, by pressing the power button at the lower left corner of the front panel.

Using the correct connectors

**CAUTION**

Always use patchcords to connect to your DUT. This protects the connectors of the optical modulation analyzer, by minimizing the number of connector changes.

---

**CAUTION**

The contact connector on the optical modulation analyzer is angled. If you are using a patchcord with straight and angled connectors, make sure you connect the angled connector to the optical modulation analyzer. Connecting to the optical modulation analyzer with a straight connector will damage it.

---

**CAUTION**

Before you connect any fiber-optic cable to the Optical Modulation Analyzer, please ensure it has been properly cleaned. Fiber-optic connectors are easily damaged when connected to dirty or damaged cables and accessories. When you use improper cleaning and handling techniques, you risk expensive instrument repairs, damaged cables, and compromised measurements.

---

Using the patchcords also keeps service costs down, as the adaptor patchcord can be exchanged easily.

Angled contact connectors have up to 30dB higher return loss than straight connectors, and we recommend them for best performance results. With angled fiber endfaces, reflected light tends to reflect into the cladding, reducing the amount of light that reflects back to the source.

#### Enabling and disabling the laser output

After the Optical Modulation Analyzer application running on the digital signal analyzer has initialized it, the green LED above the laser output indicates whether the laser is emitting radiation.


The laser is enabled and disabled by the software.

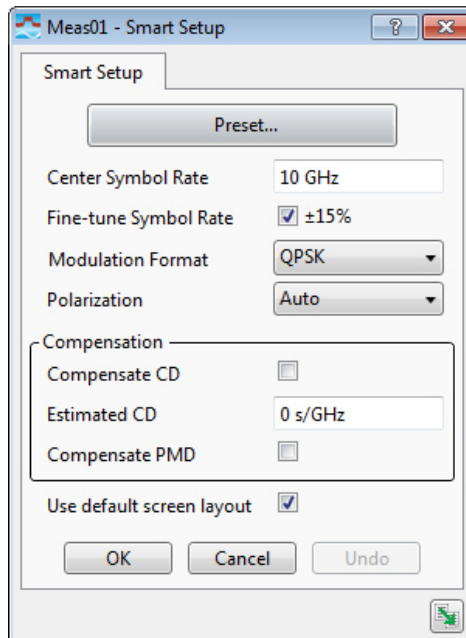
If the Laser output is on, the green LED on the front panel of the module is lit. If the Laser output is off, the green LED on the front panel of the module is not lit.

## Creating Your First Trace on the OMA

The following procedure will familiarize you with the OMA by loading a recorded demo then using the Smart Setup dialog to ensure that the parameters are set properly.

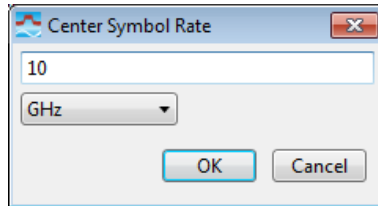
The recorded demo is a PRBS 15 dual polarization signal with a performance that is typically achieved on optical coherent long-haul transmitters. This signal has incorporated bit errors inserted into the transmitter PRBS generation.

- 1 Power on the equipment.
- 2 Start the Keysight 89600 VSA Software interface by double-clicking on the Keysight OMA icon ()
- 3 In the Keysight 89600 VSA Software interface, select **File > Recall > Recall Demo**.
- 4 In the **Recall Demo** dialog, open the **\Optical Signals\Generic\DP-QPSK\_10.12 GHz\_with\_errors.htm** file.
- 5 Select the **Smart Setup** menu.

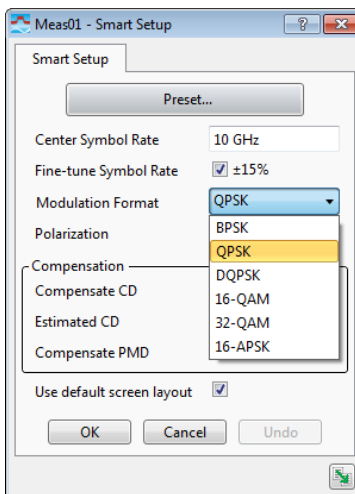




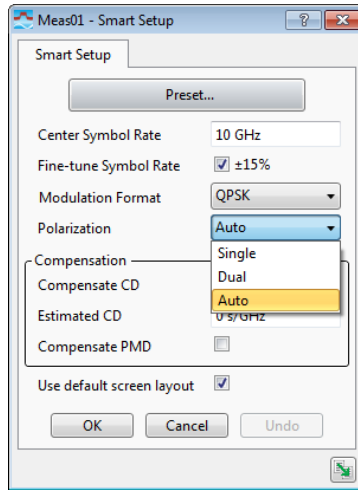
- 6 Ensure that the **Center Symbol Rate** is set to 10 GHz. If not, double-click in the **Center Symbol Rate** field then enter the value. The **Fine-tune symbol Rate** selection ensures that the symbol rate is adjusted to within the displayed range.



- 7 Ensure that the **Modulation Format** is set to **QPSK**. If not, select it from the **Modulation Format** list.



- 8 Ensure that **Polarization** is set to **Auto**. If not, select it from the **Polarization** list. **Smart Setup** will determine the polarization automatically (single or dual) when set to **Auto**.



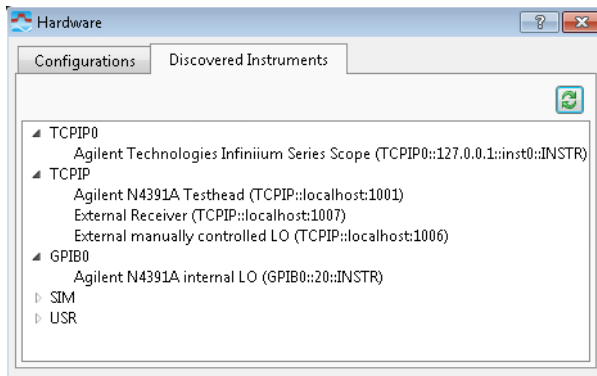
- 9 Ensure that **Compensate CD** (chromatic dispersion) and **Compensate PMD** (polarization mode dispersion) are deselected.
- 10 Ensure that **Use default screen layout** is selected to use the default layout which provides a wide variety of results. If not selected, the current layout will be used.
- 11 Click on the **OK** button.
- 12 Select the **Restart** button (▶) in the tool bar to start the measurement.
- 13 You should see results similar to the following.



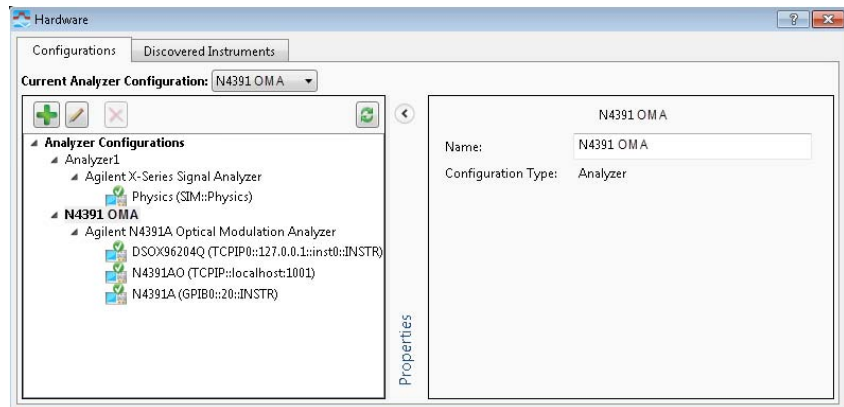
## How to Reconfigure Your N4391A Hardware


A standard setup according to ordered options is configured at the factory. This section shows how to modify the N4391A standard factory configuration.

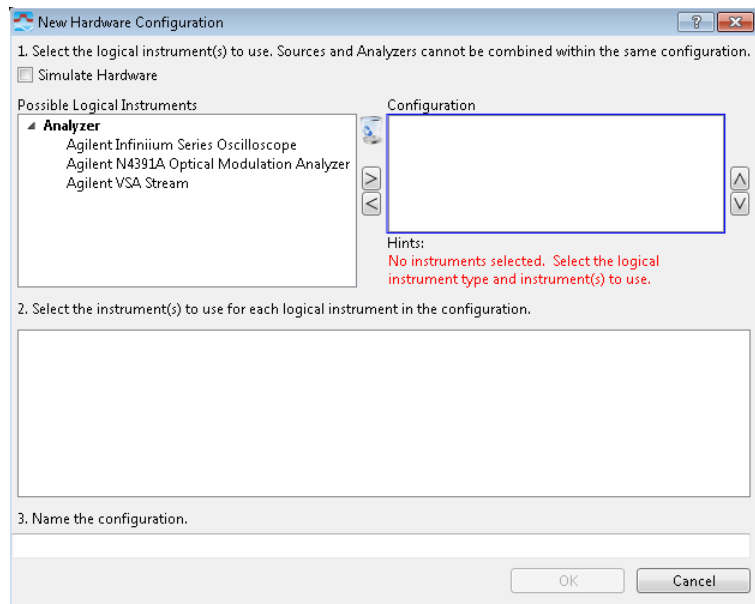
- 1 In the Keysight 89600 VSA Software interface, select **Utilities** > **Hardware** > **Discovered Instruments** to view the list of the available instruments found by the software. A screen similar to the following is displayed.




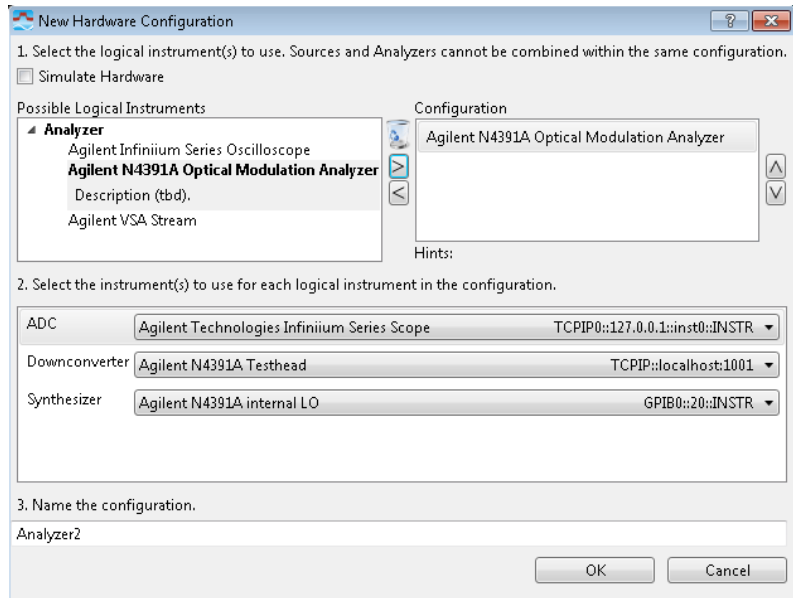
- 2 Click on the **Configurations** tab.



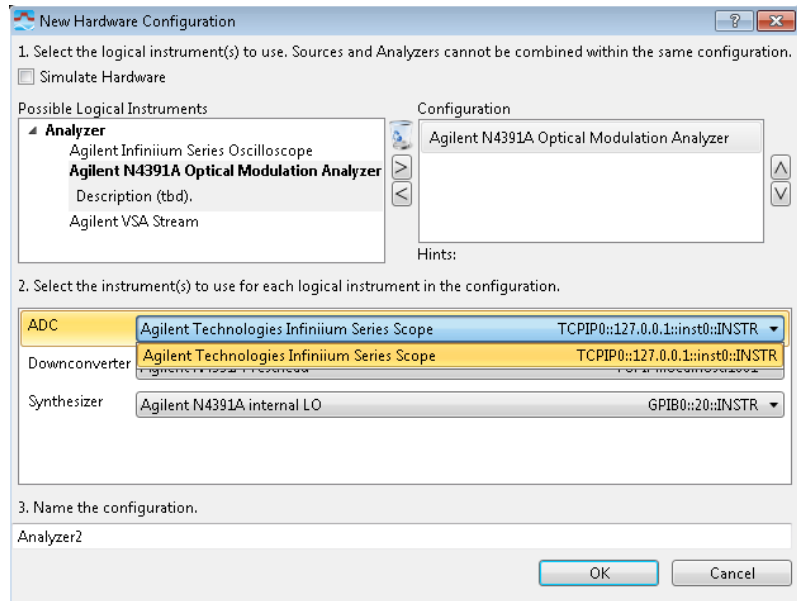
3 Click on the plus () button.



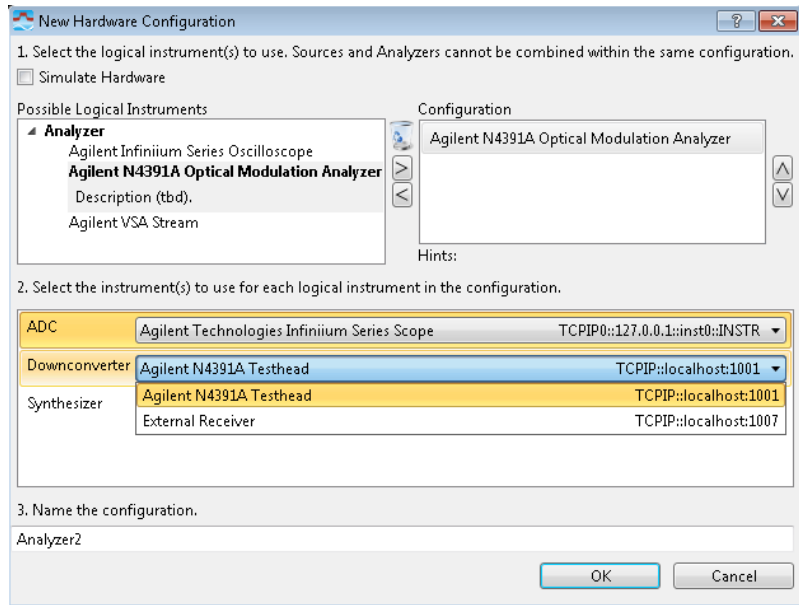
4 From the **Possible Logical Instruments** list, select **Keysight N4391A Optical Modulation Analyzer** (based on the type of OMA) then click on the  button to add it to the **Configuration** list.



- 5 In the **ADC** selection, click on the down arrow and select the oscilloscope configured with the N4391A.

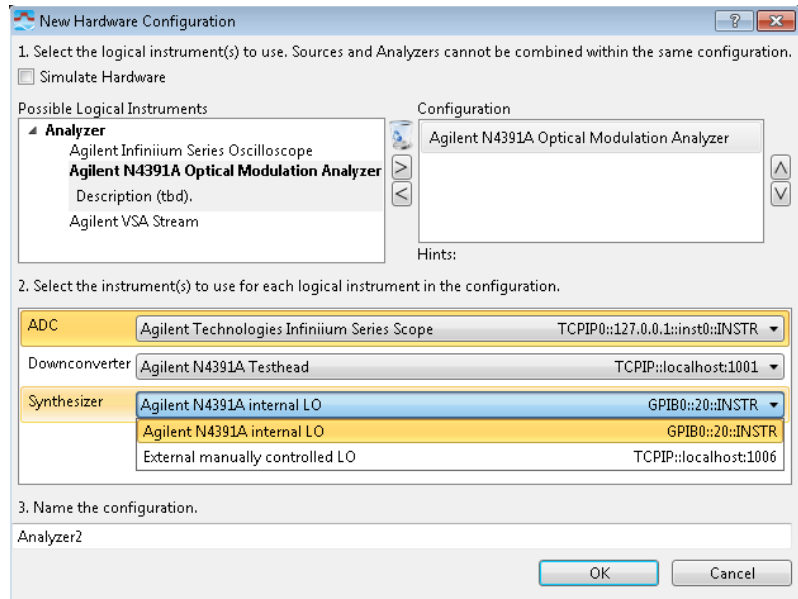


- 6 In the **Downconverter** selection, click on the down arrow and select the N4391A.

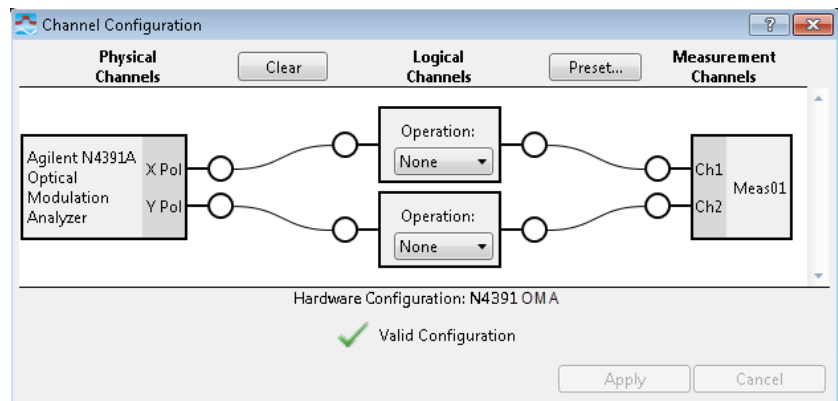


- 7 In the **Synthesizer** selection, click on the down arrow and select the LO configuration (internal or external LO).

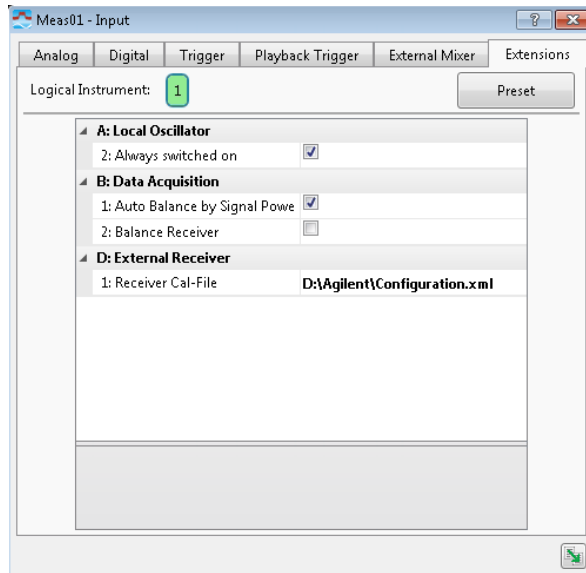




- 8 In the name field, enter the desired name for this configuration then click on the **OK** button.
- 9 Repeat this procedure to add more configurations.
- 10 Select **Input > Channels > Custom** and review the channel mapping from the physical hardware input ports to the VSA measurement channel inputs.



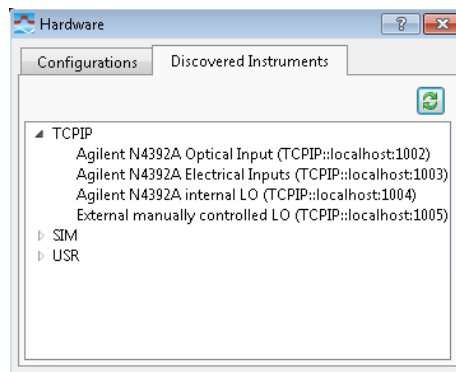
- 11 Select **Input > Extensions** and review the measurement hardware input extension parameters. The Extensions tab shows which logical instrument is currently active, and shows the available hardware extension parameters for the selected logical instrument (front-end hardware configuration).



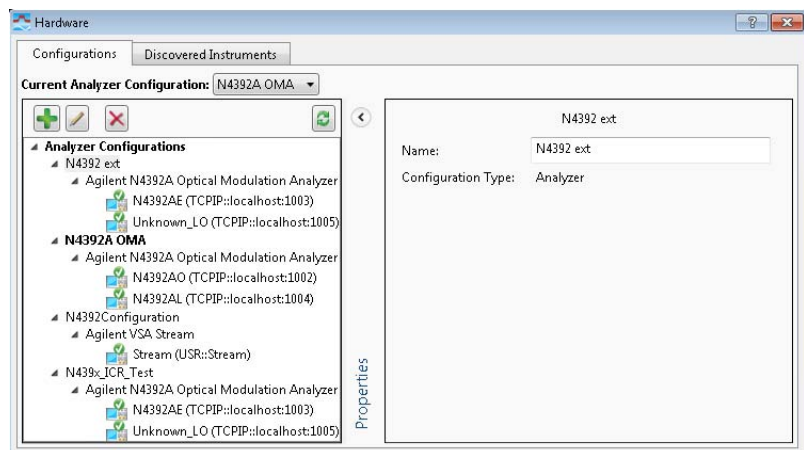
## How to Reconfigure Your N4392A Hardware

A standard setup according to ordered options is configured at the factory. This section shows how to modify the N4392A standard factory configuration.

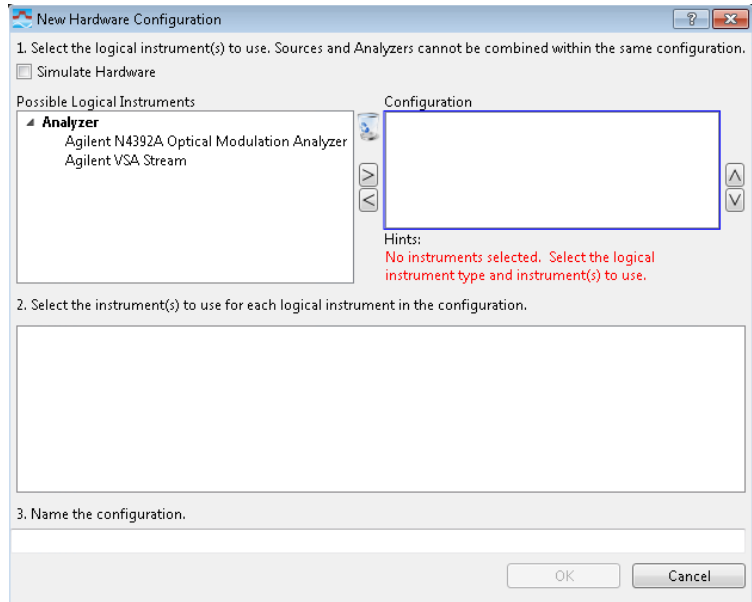
- 1 In the Keysight 89600 VSA Software interface, select **Utilities** > **Hardware** > **Discovered Instruments** to view the list of the available instruments found by the software. A screen similar to the following is displayed.




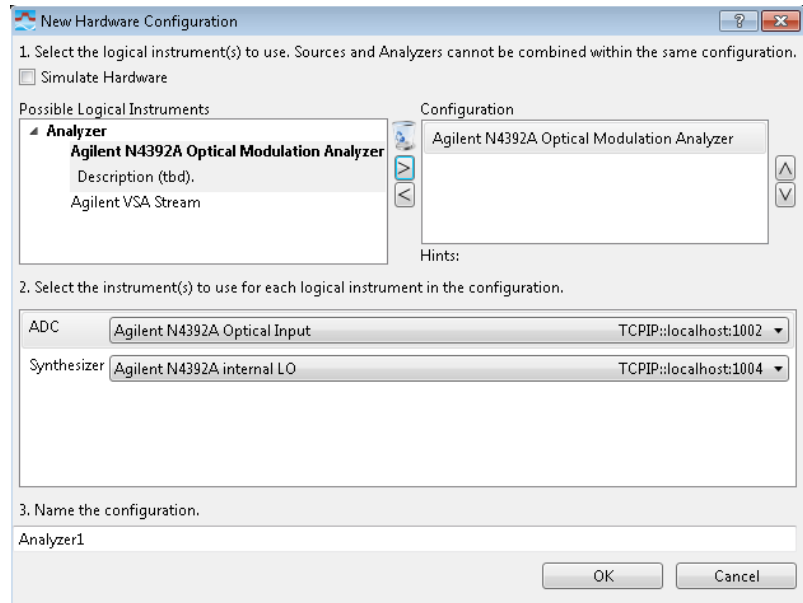
- 2 Click on the **Configurations** tab.



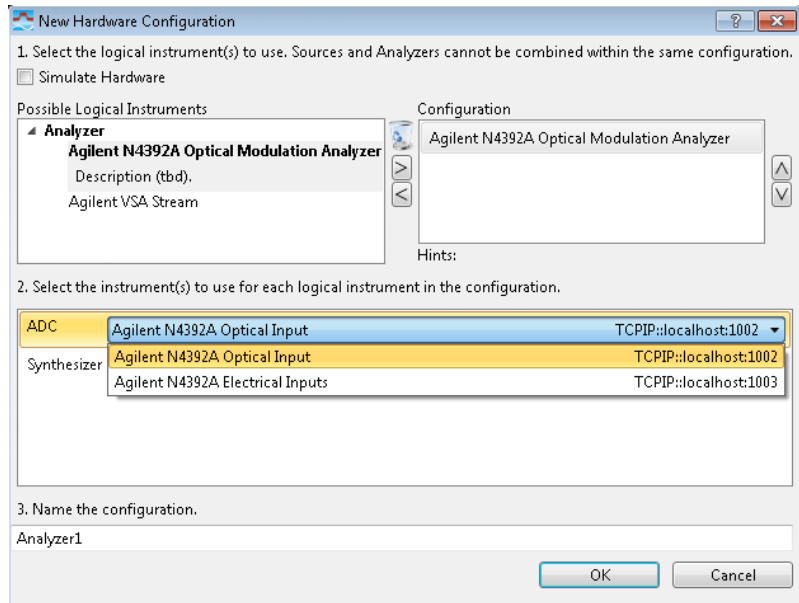
3 Click on the plus (+) button.



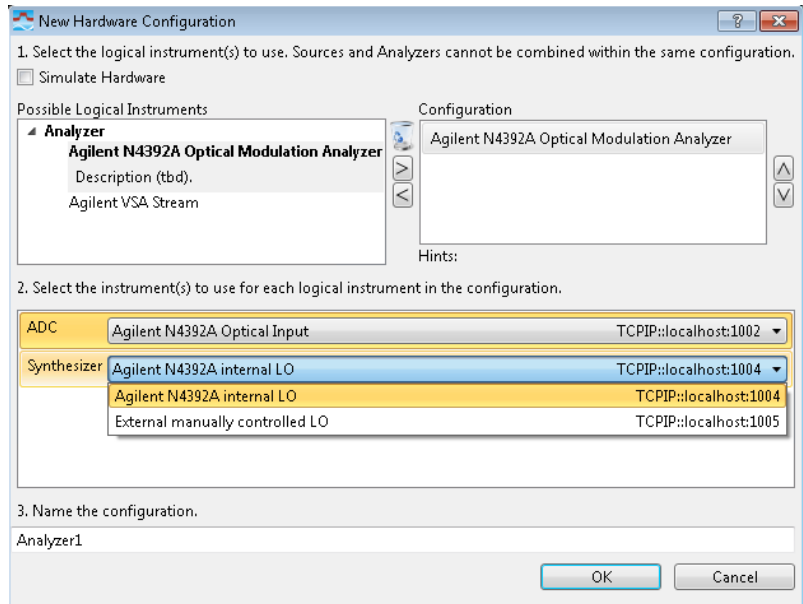
4 From the **Possible Logical Instruments** list, select **Keysight N4392A Optical Modulation Analyzer** (based on the type of OMA) then click on the  button to add it to the **Configuration** list.



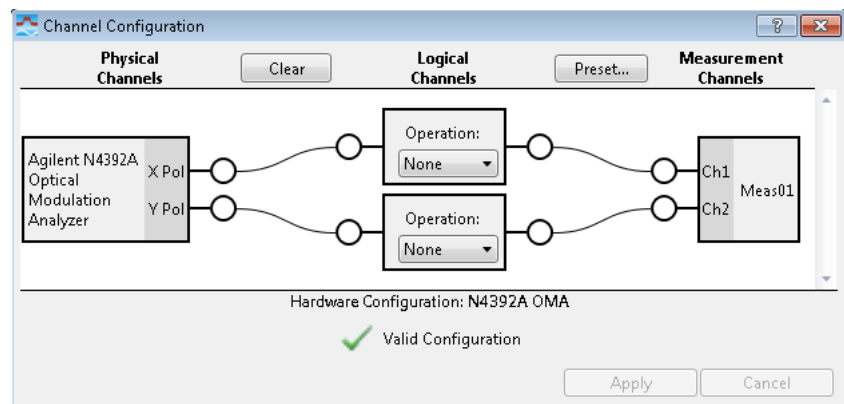
- 5 In the **ADC** selection, click on the down arrow and select the instrument and input configuration (electrical or optical).



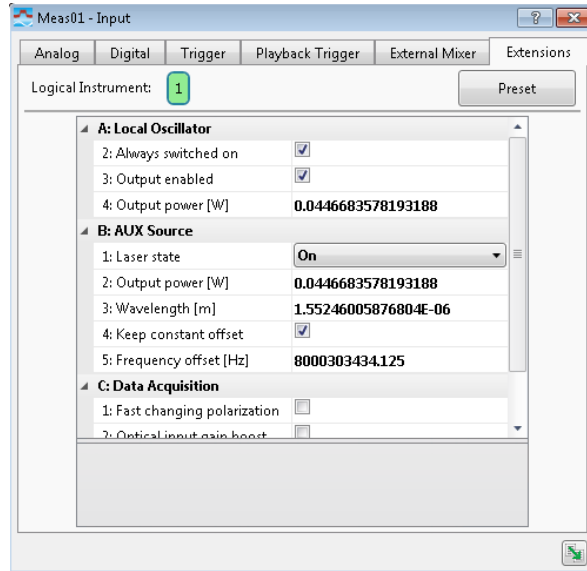
- 6 In the **Synthesizer** selection, click on the down arrow and select the LO configuration (internal or external LO).



- In the name field, enter the desired name for this configuration then click on the **OK** button.
- Repeat this procedure to add more configurations.
- Select **Input > Channels > Custom** and review the channel mapping from the physical hardware input ports to the VSA measurement channel inputs.



- 10 Select **Input > Extensions** and review the measurement hardware input extension parameters. The **Extensions** tab shows which logical instrument is currently active, and shows the available hardware extension parameters for the selected logical instrument (front-end hardware configuration).

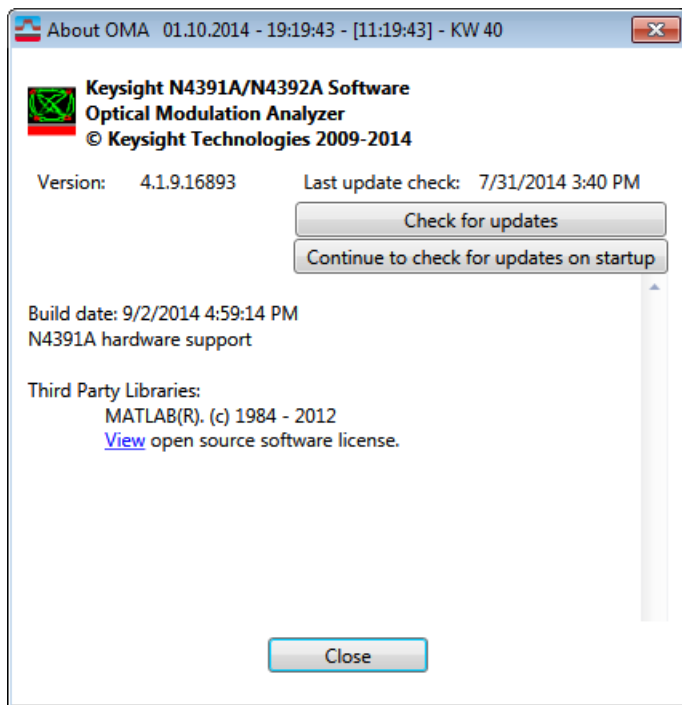




## Installing Software Components

All software components are pre-installed at the factory. However, this section provides installation instructions if it becomes necessary to reinstall some or all of the software components.

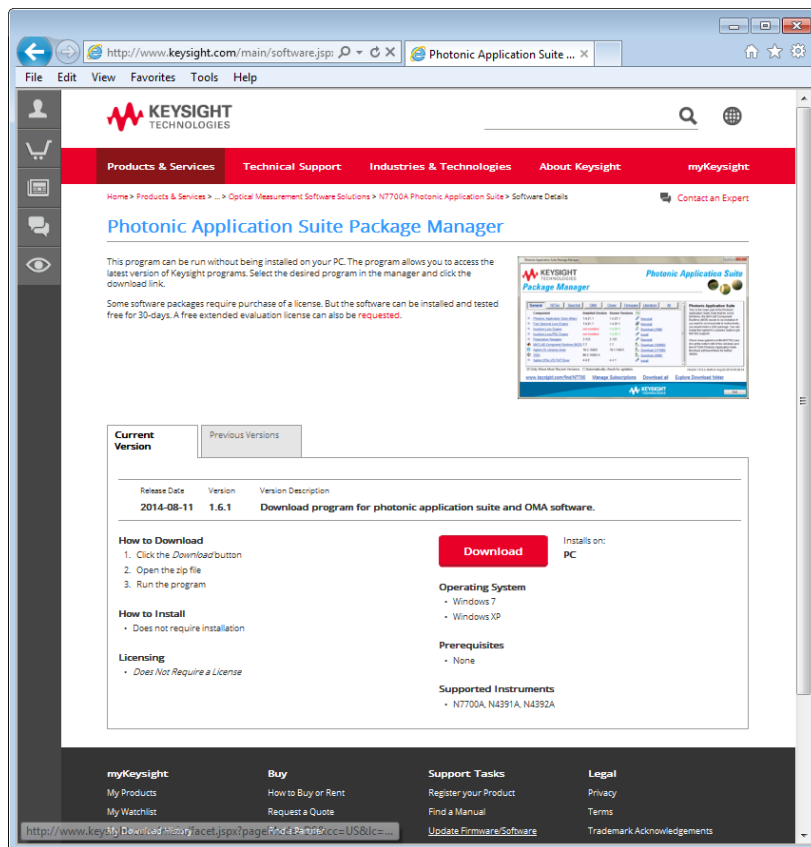
You can search for updates through the VSA interface by selecting **Help** > **About OMA** then clicking on the **Check** for updates button. Refer to the following screen.



## Downloading the Photonic Application Suite Package Manager

The Photonic Application Suite (PAS) Package Manager is used to select and download software packages for proper operation of the OMA.

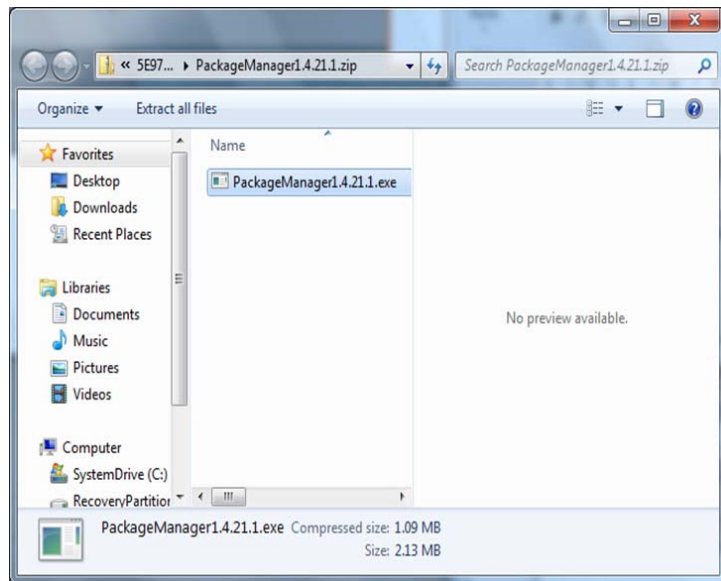
- 1 Visit the PAS Package Manager web page at [www.keysight.com/find/N7700A](http://www.keysight.com/find/N7700A), click on the Technical Support link, select the Drivers, Firmware & Software tab, then click on the Download button to start the download process.



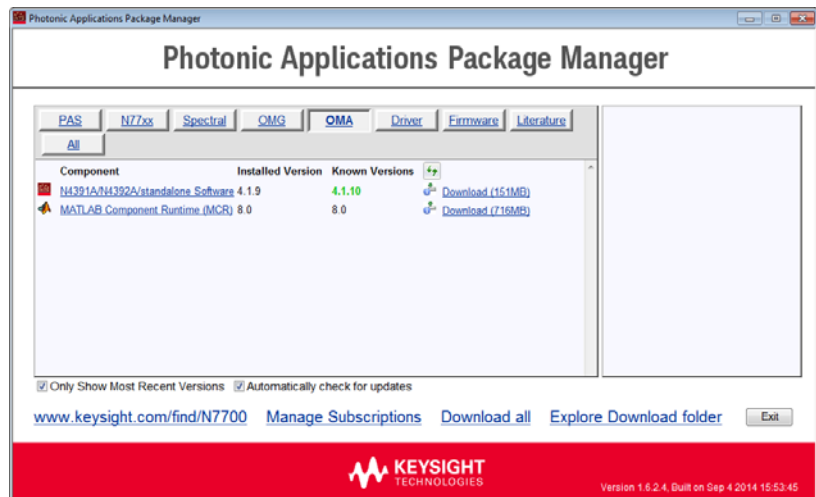
- 2 Click on the **Open** button to open the zip file.



- 3 Double-click on the executable file to run the **PAS Package Manager**.

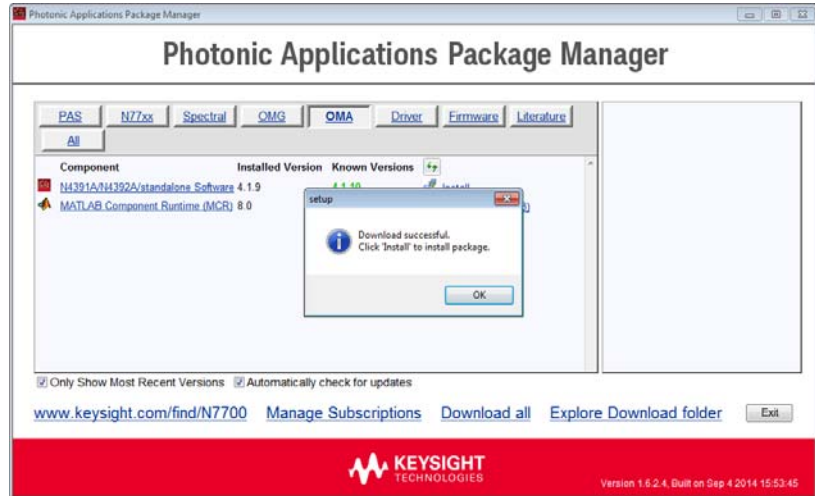


- 4 Start the **PAS Package Manager** as administrator and select the OMA tab to see all possible OMA packages.

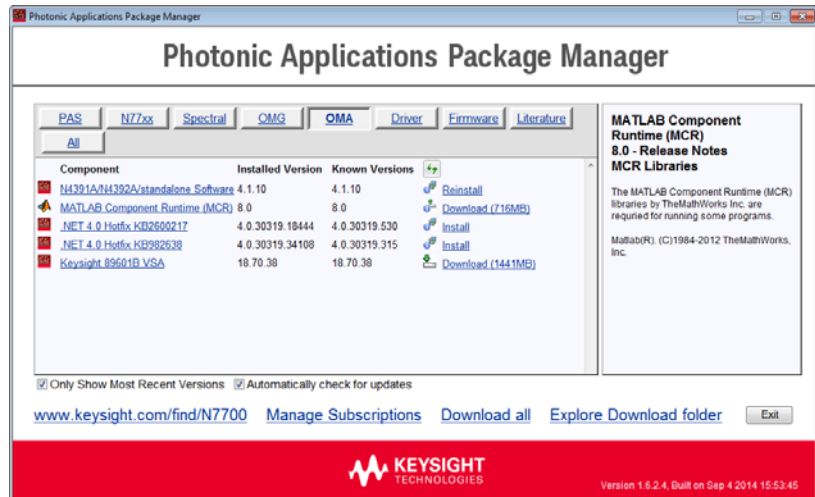


## Installing the Keysight N439xA Software

- 1 Select the “**Keysight N439x Processing Extensions**” package which matches your licensed version.
- 2 Click on the **Download** link.



- 3 Continue following the installation instructions and always select the default settings. The **PAS Package Manager** will install drivers and software which are required to install the **OMA** software. During the **OMA** installation itself select your installation type. You can postpone system restarts until the complete installation is finished.
- 4 After all installations have been finished, verify that the **PAS Package Manager** lists them with an “**Installed Version**”. If the installations are not listed, launch the installation of the missing package again. Likely it was interrupted by a system restart.





# 3 Performance Verification

N4391A Performance Verification / 56

N4392A Performance Verification / 56

Returning the Instrument / 56

## N4391A Performance Verification

Refer to the topic called “N4391A Performance Verification” in the OMA Help for the performance verification procedure.

## N4392A Performance Verification

Refer to the topic called “OMA Calibration” in the OMA Help for the performance verification procedure. Selecting **Utilities > OMA Calibration** in the VSA software interface opens the dialog for performing N4392A verification.

## Returning the Instrument

If the performance verification fails and you cannot correct the problem, return the N4391A/N4392A to Keysight for repair following the steps shown below:

- 1 Record all symptoms.
- 2 Contact Keysight at <http://www.keysight.com/find/assist>.
- 3 Use the original packing material or comparable packing material to ship the instrument to Keysight.

### NOTE

The N4391A optical modulation analyzer and the digital signal analyzer are two parts of one instrument.

If you are returning the N4391A to Keysight support, you must return the full instrument, consisting of both parts.

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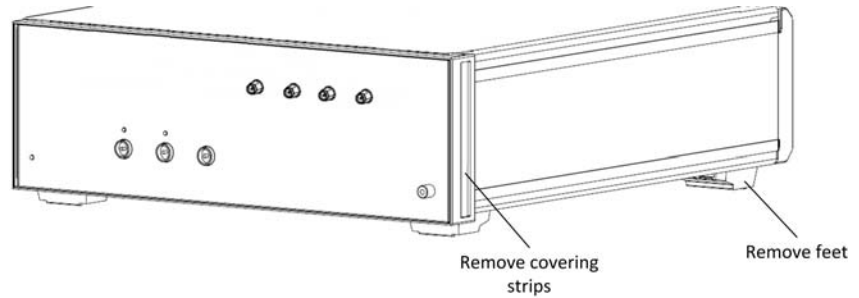


# 4 Rack Mount

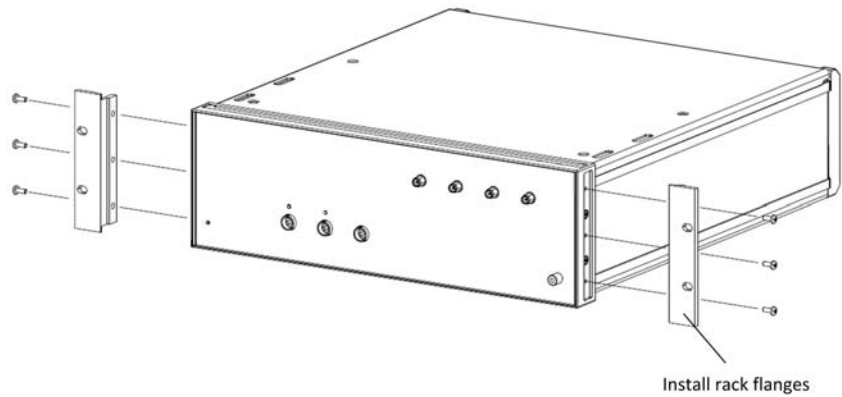
Rack Mounting N4391A Z-Series Oscilloscopes / 58

## Rack Mounting N4391A Z-Series Oscilloscopes

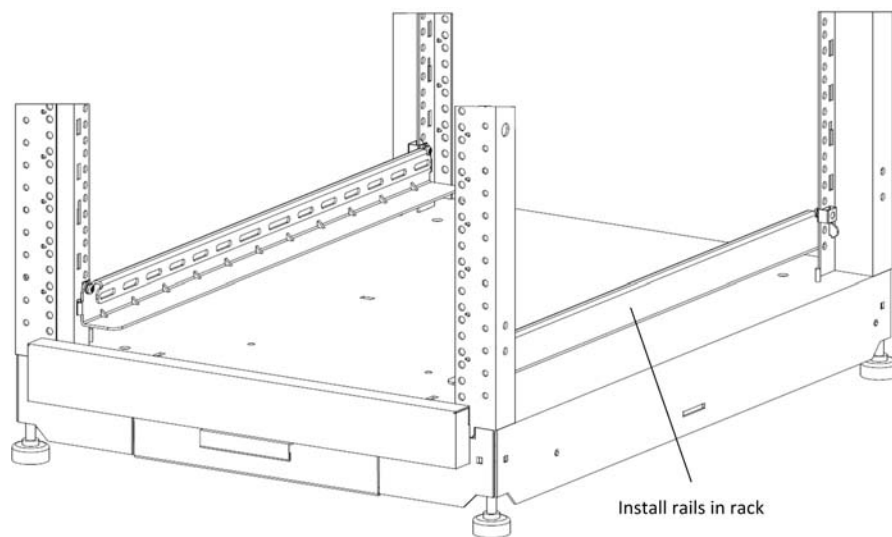
- 1 Prepare the optical modulation analyzer for rack mounting.
  - a Remove the four feet from the bottom of the optical modulation analyzer.



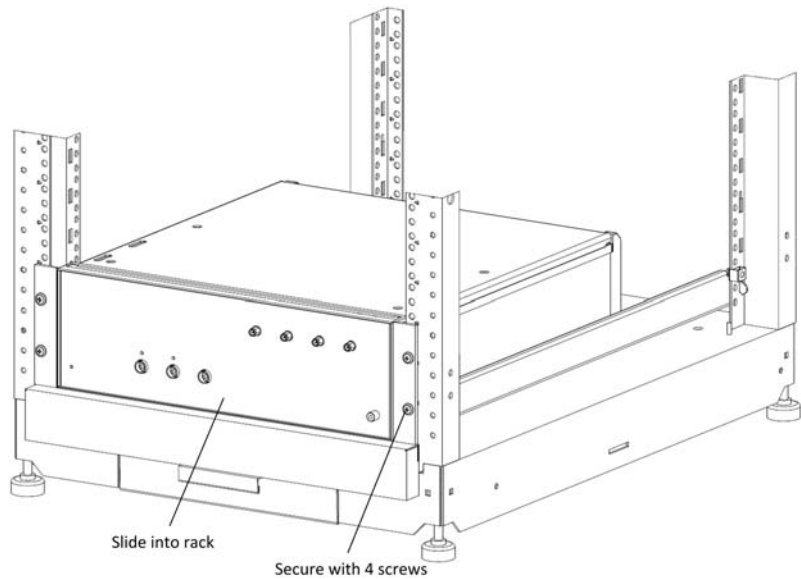
- b At the front of the optical modulation analyzer, remove the covering strips at the left and right edges of the front panel.
    - c Using parts from the rack mount kit (part number 5063-9214), mount a rack flange at the left and right of the optical test head.



- Using a Torx T25 screwdriver, mount the rails in the rack.

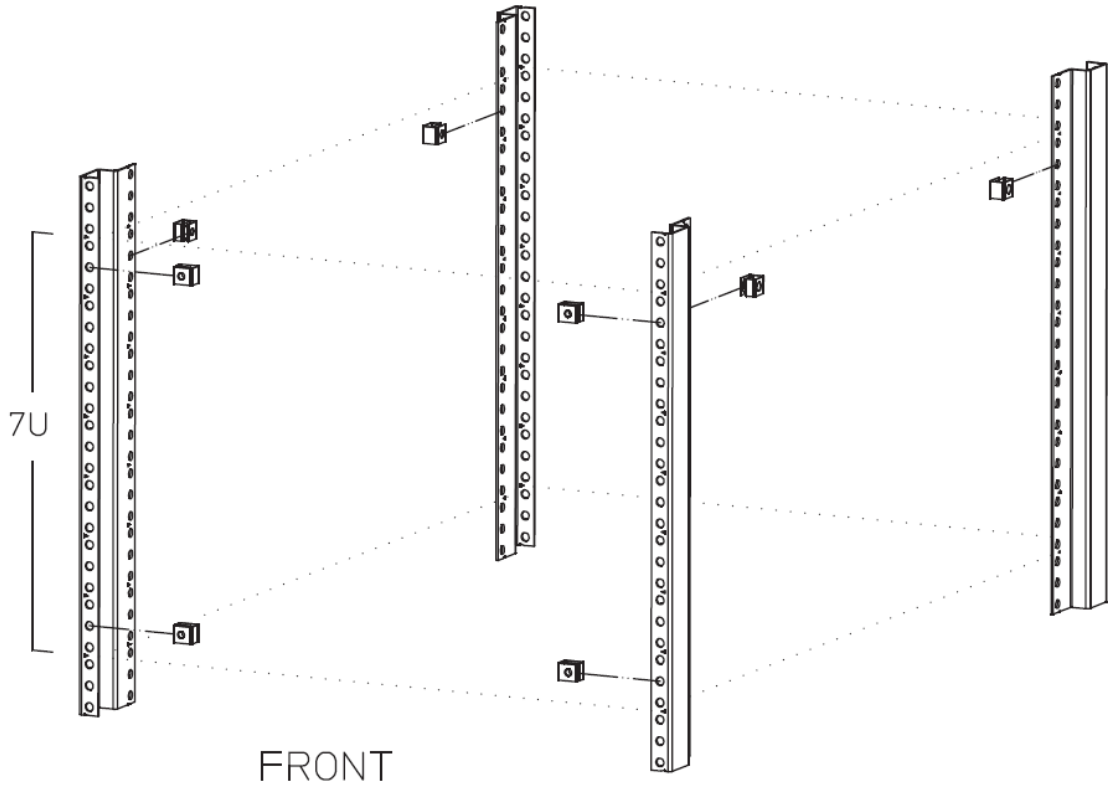


- 3 Mount the optical modulation analyzer in the rack.
  - a Slide the optical modulation analyzer onto the rails in the rack.
  - b Using a cross-recess Phillips screwdriver, and the screws from the rack mount kit (screw part number 0570-1577), screw the flanges at the left and right of the optical modulation analyzer to the rack.

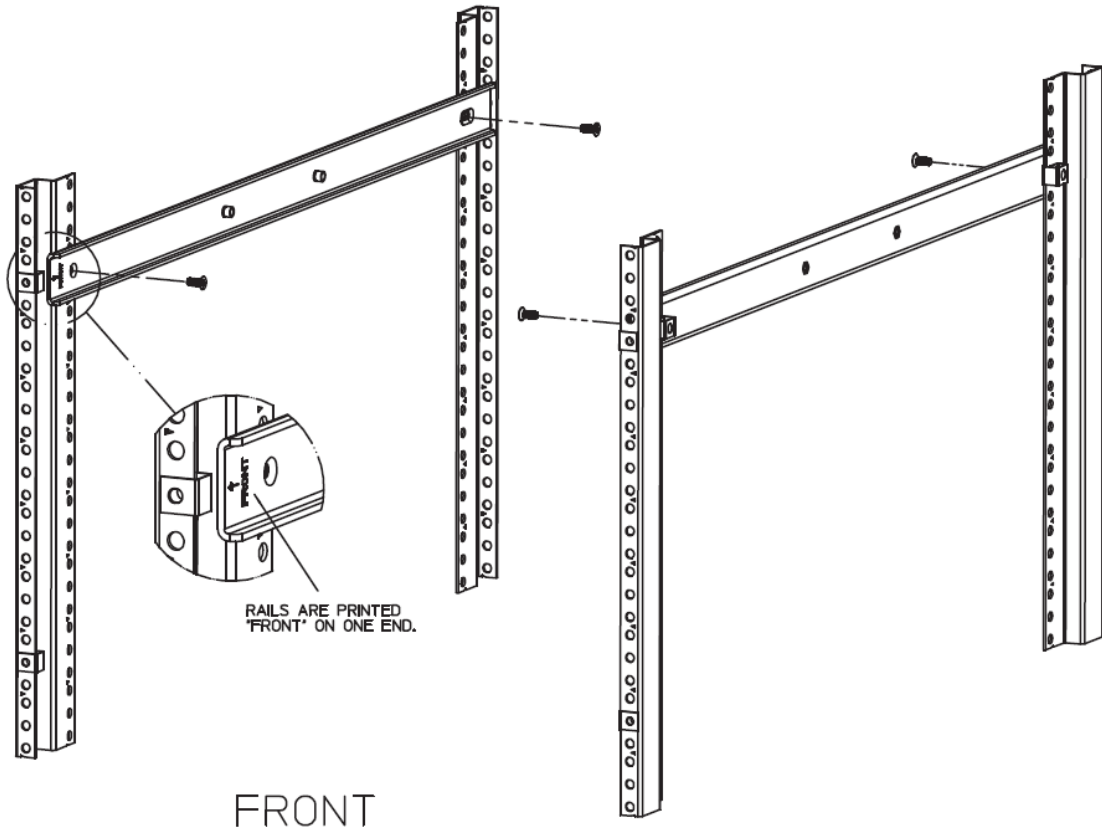


- 4 Mount the oscilloscope in the rack according to the procedure in the 90000 Z-Series Oscilloscope Rack Mount Kit Installation Guide (N2759-93101). Mount the oscilloscope directly above the optical modulation analyzer.

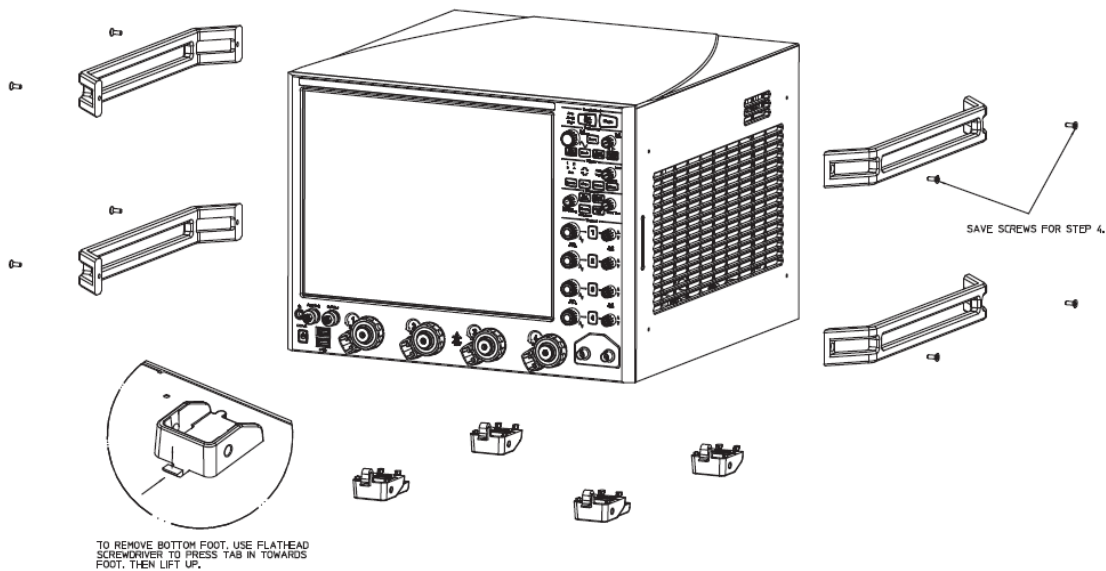
- 5 Identify 7U of rack space for instrument.  
Snap on sheet metal fasteners 0590-0804 in the eight locations shown.



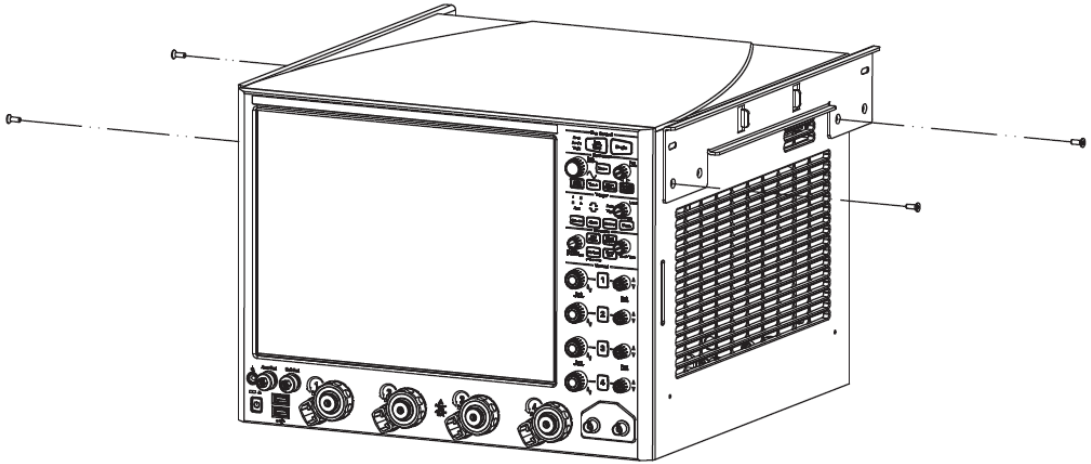
- 6 Attach rails to rack.  
Attach rails N2759-03702 as shown using four of the #10-32 flathead fasteners 2510-0283. Ends marked "front" must be aligned as shown towards the front of the rack.



7 Remove handles and bottom feet from the instrument.

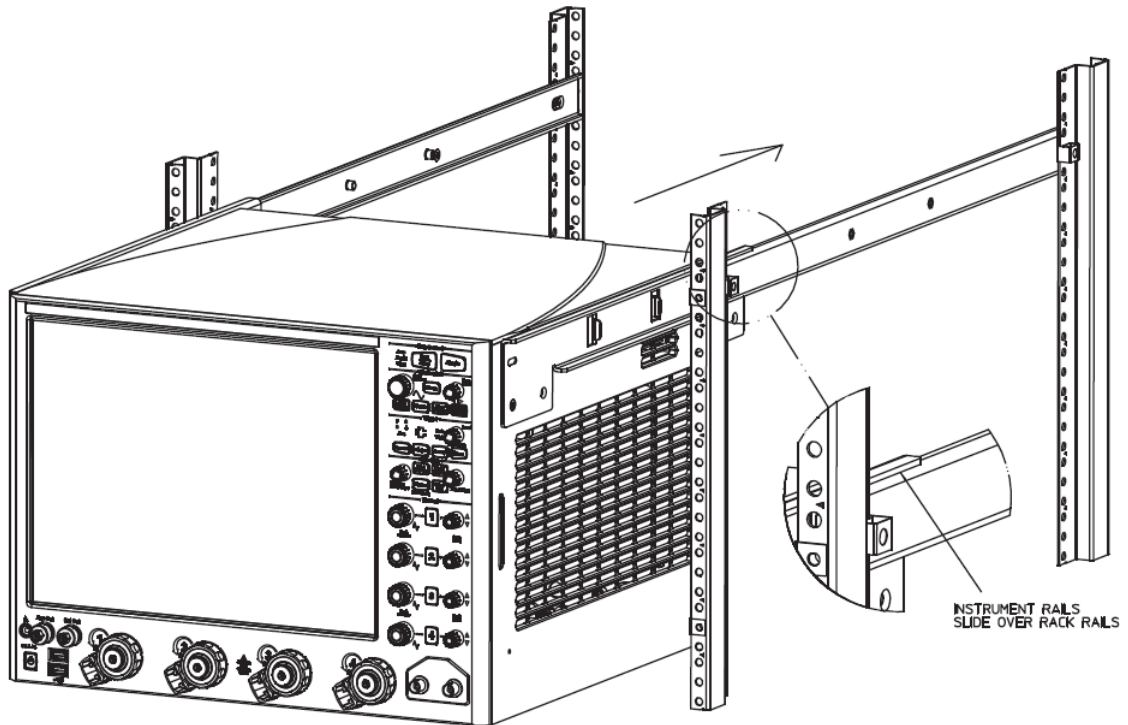


- 8 Attach rails to instrument.  
Attach rails N2759-03701 to the instrument's top handle holes using four of the screws from Step 7.



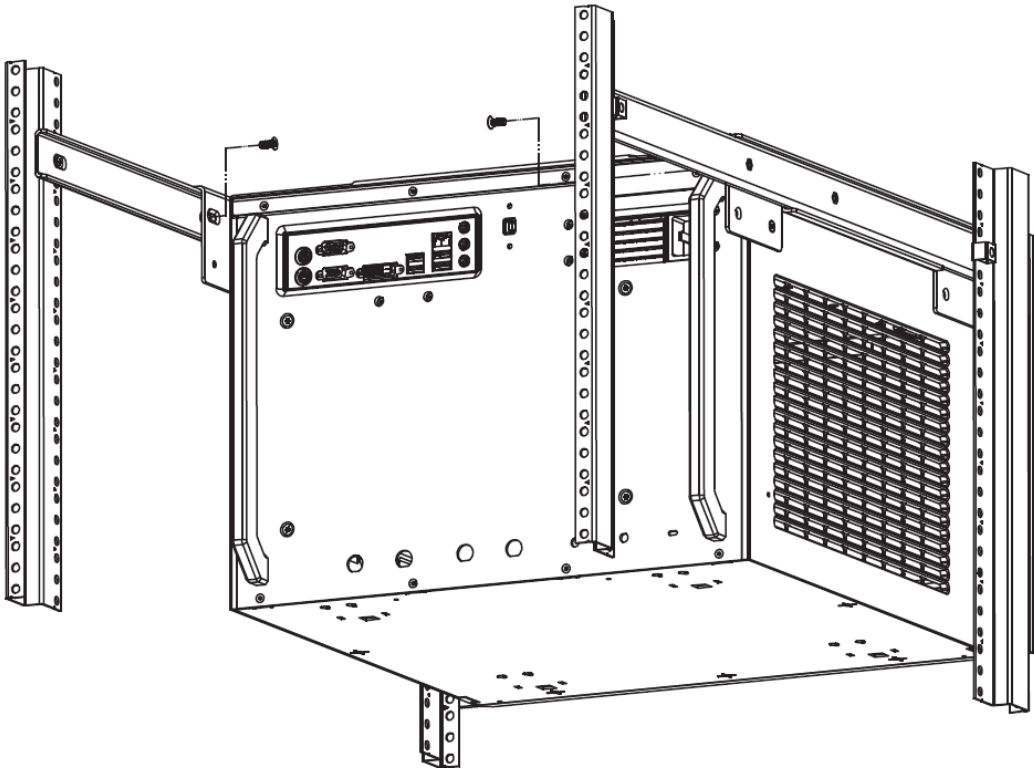


- Slide the instrument into the rack as shown. The instrument will stop when it reaches the proper depth.

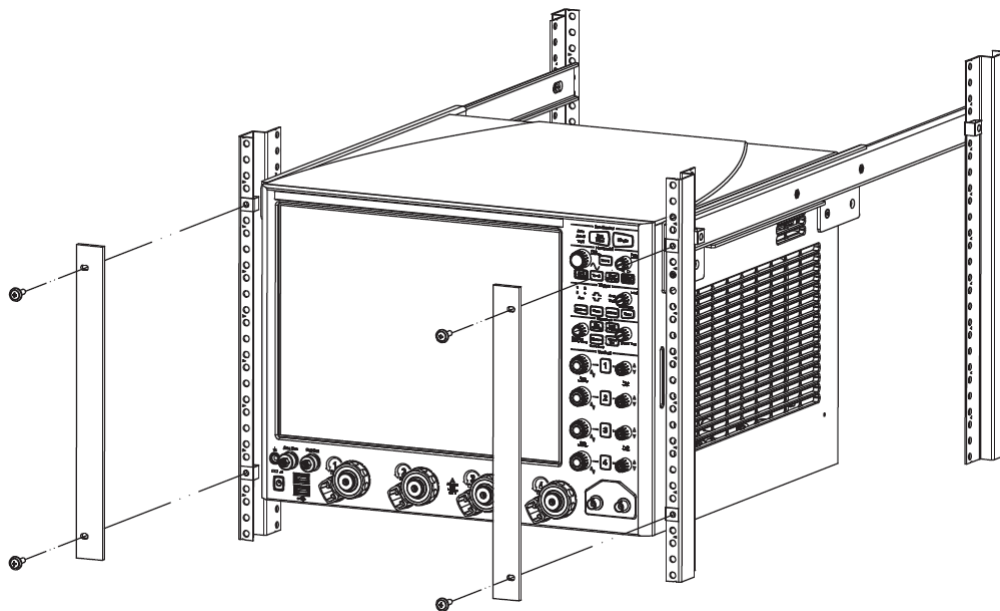
**CAUTION**

Two people are required to lift the instrument.

10 Secure the rear of the instrument as shown using two of the #10-32 flathead fasteners 2510-0283.



- 11 Attach trim plates.  
Attach trim plates N2759-24101 using four decorative fasteners 0570-1366.





# 5 Technical Specifications

Specifications Terms and Conditions (N4391A) / 70  
N4391A Specifications / 71  
Specifications Terms and Conditions (N4392A) / 78  
N4392A Specifications / 80

## Specifications Terms and Conditions (N4391A)

### Definitions

Generally, all specifications are valid at the stated operating and measurement conditions and settings, with uninterrupted line voltage.

### Specifications (Guaranteed)

Describes warranted product performance that is valid under the specified conditions.

Specifications include guard bands to account for the expected statistical performance distribution, measurement uncertainties changes in performance due to environmental changes and aging of components.

### Typical Values (Characteristics)

Characteristics describe the product performance that is usually met but not guaranteed. Typical values are based on data from a representative set of instruments.

### General Characteristics

Give additional information for using the instrument. These are general descriptive terms that do not imply a level of performance.

### Digital demodulation measurement conditions

- Data acquisition: DSO and DSA Z series Oscilloscopes (N4391A)
- Office environment 25 °C ± 5 °C
- Signal power (N4391A) +7.5 dBm at signal input port
- Vector analyzer I-Q bandwidth set to 12.5 GHz
- QPSK demodulation
- 2.5 GHz beat frequency
- 10 Gbaud symbol rate
- SinglePolKFPhaseTrack algorithm  $Q = 1E-4$
- 500 symbols per analysis record

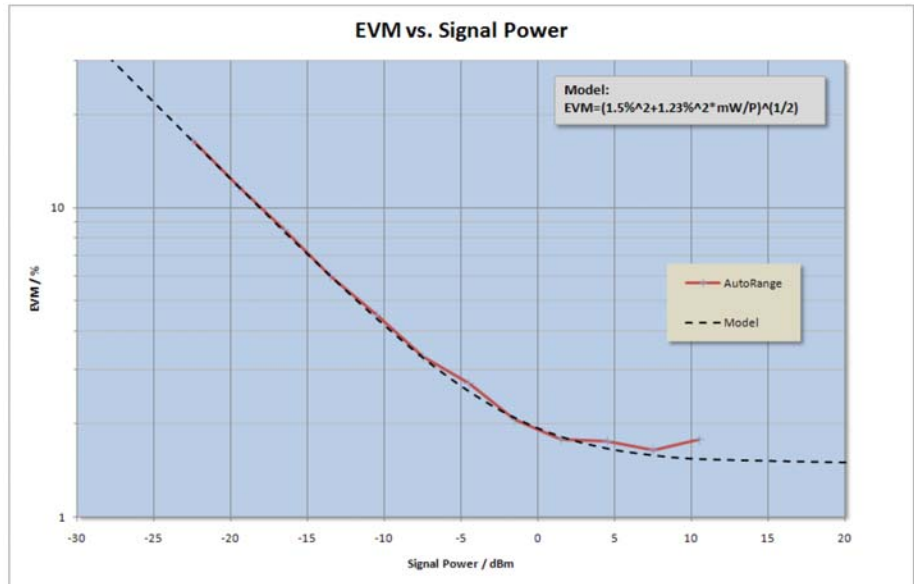
## N4391A Specifications

The following specifications are typical, if not stated otherwise.

Optical modulation analyzer		
Maximum detectable baud rate	Up to 62 Gbaud	
Sample rate	4 x 80 Gs/s	
Number of polarization alignment algorithms	6	
Digital demodulation uncertainty		
Error vector magnitude noise floor	1.8 %rms	
Amplitude error	1.1 %rms	
Phase error	0.9°	
Quadrature error	0.05°	
Gain imbalance between I and Q	< 0.007 dB	
Image suppression	> 35 dB	
S/N	> 60 dB	
Sensitivity	-20 dBm	
Supported modulation formats		
BPSK, 8BPSK, VSB -8, -16,	FSK 2-, 4-, 8, 16 level	EDGE
Offset QPSK, QPSK, Pi/4 QPSK	DQPSK, D8PSK	DVB QAM 16, 32, 64, 128, 256
QAM 16-, 32-, 64-, 128-, 256-, 512-, 1028-	MSK type 1, type 2 CPM (FM)	APSK 16/32 (12/4 QAM)
StarQAM -16, -32	Generic APSK decoder	

Coherent reference receiver		
Optical DUT input		
Optical input wavelength range		1528 nm to 1630 nm
Maximum input power		+14 dBm
Maximum input power, damage level		+20 dBm
Receiver polarization extinction ratio		> 40 dB
Average input power monitor accuracy		$\pm 0.5$ dB
Optical local oscillator output		
Optical CW output power		> +14 dBm
Wavelength		1528 nm to 1630 nm
External local oscillator input		
Optical input wavelength range		1528 nm to 1630 nm
External local oscillator input power range		0 dBm to +14 dBm
Maximum input peak power (damage level)		+20 dBm
Small signal gain, external laser input to local oscillator output (−20 dBm LO input power)		28 dB @ 1550 nm
Saturation output power @ −3 dB compression		15 dBm
Other		
Electrical bandwidth	Standard version	43 GHz, 37 GHz guaranteed
	Light version (software upgradable)	22 GHz
Optical phase angle of I-Q mixer after correction (1529 nm to 1630 nm)		$90^\circ \pm 0.5^\circ$
Relative skew after correction (1529 nm to 1630 nm)		$\pm 1$ ps





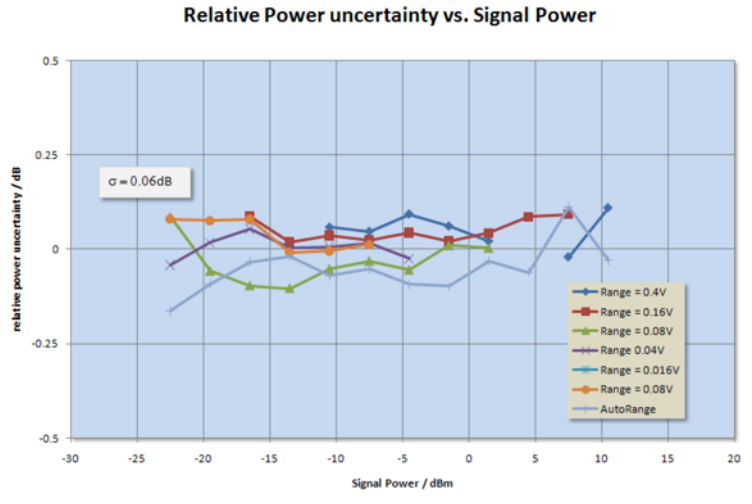
EVM %rms is dependent upon average optical input power.

This graph above shows the %rms Error Vector Magnitude (EVM) normalized to the highest error vector within an analysis record of 500 symbols as a function of signal input power. The EVM %rms level at higher power levels results from the instrument noise level. The increase at lower signal power levels is a result of decreasing signal to noise ratio. The fitted model reveals the EVM %rms noise floor in the offset term.

Data acquisition (for Keysight 90000-X and 90000-Q series oscilloscopes)	
Sample rate	Up to 80 GSa/s on each channel
Data acquisition bandwidth	16/20/25/32 GHz upgradable
Jitter between channels	Typ 700 fs
Noise	0.6 mV rms @ 10 mV range, 32 GHz bw
ADC resolution	8 bit/16 bit (interpolated)
Sample memory per channel	Up to 2 Gs/channel

Local oscillator (guaranteed specification if not mentioned otherwise)			
		Option -500, 501	Option -510
Wavelength range	Option 500	1527.6 to 1565.5 nm (196.25 to 191.50 THz)	1528 nm to 1630 nm
	Option 501	1570.0 to 1608.8 nm (190.95 to 186.35 THz)	
Minimum wavelength step		25 GHz	1 nm
Tuning time/sweep speed		< 30 s	50 nm/s
Absolute wavelength accuracy		±22 nm	±20 nm, ±5 nm typical
Stability (short term)		100 kHz	100 kHz
Sidemode suppression ratio		50 dB typical	≥ 50 dB
RIN		−145 dB/Hz (10 MHz to 40 GHz) typical	−145 dB/Hz (0.1 to 6 GHz) typical

High resolution spectrometer	
Maximum frequency span	31.25/40/50/62.5 GHz
LO wavelength range	1528 nm to 1630 nm
Image suppression	> 35 dB
Number of FFT points	409601
Minimum RBW (record length 10 <sup>6</sup> points)	4 kHz
Signal to noise ratio	60 dB @ 7.5 dBm signal input power
Frequency accuracy	Absolute ±5 nm



The graph above shows the relative power uncertainty of the N4391A.

## N4391A General Characteristics

Dimensions (Wide x Tall x Deep)		
Z series based N4391A system		51 cm (20.0") x 47 cm (18.5") x 52 cm (20.5")
DSOX9xx04Z oscilloscope		51 cm (20.0") x 34 cm (13.3") x 49 cm (19.4")
Optical receiver		48 cm (18.9") x 13 cm (5.2") x 49 cm (19.4")
Packaged dimensions		
DSOX9xx04Z		69 cm x 48 cm x 81 cm
Optical receiver		65 cm x 49 cm x 79 cm
Weight		
Product net weight	DSOZ xxxA	32 kg (71 lbs)
	DSOZxxxA N4391A system	48 kg (106 lbs)
Packaged product		60 kg (132 lbs)
Power requirements		
100 to 240 V~, 50 to 60 Hz		
Optical receiver		Max. 300 VA
Storage temperature range		
-40° C to +70° C		
Operating temperature range		
+5° C to +35° C		
Humidity		
15% to 80% relative humidity, non-condensing		
Altitude (operating)		
0 ... 2000 m		
Recommended re-calibration period		
1 year		
Coherent receiver optical input		

DUT input	+20 dBm max
	9 μm single-mode angled
	81000 connector interfaces

LO input	+20 dBm
	9 μm PMF angled
	81000 connector interfaces

**Coherent receiver optical input**

LO output	+20 dBm max
	9 μm PMF angled
	81000 connector interfaces

**Laser safety information**

All laser sources listed above are classified as Class 1M according to IEC 60825-1/2007.  
 All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007-06-24.



## Specifications Terms and Conditions (N4392A)

### Definitions

Generally, all specifications are valid at the stated operating and measurement conditions and settings, with uninterrupted line voltage.

### Specifications (Guaranteed)

Describes warranted product performance that is valid under the specified conditions.

Specifications include guard bands to account for the expected statistical performance distribution, measurement uncertainties changes in performance due to environmental changes and aging of components.

### Typical Values (Characteristics)

Characteristics describe the product performance that is usually met but not guaranteed. Typical values are based on data from a representative set of instruments.

### General Characteristics

Give additional information for using the instrument. These are general descriptive terms that do not imply a level of performance.

### Reference Conditions

Office environment  $25\text{ }^{\circ}\text{C} \pm 5$

### Reference Conditions for Error Vector Magnitude Noise Floor

Optical continuous wave signal at optical input port

- Signal power  $> 0\text{ dBm}$
- Optical frequency is offset by 2.5 GHz from local oscillator frequency

Span setting

- Vector analyzer I-Q spectrum span set to 12.5 GHz
- Digital demodulator settings
- QPSK demodulation

- 10 Gbaud symbol rate
- SinglePolKFPhaseTrack algorithm  $Q=1E-4$
- 500 symbols per analysis record

## N4392A Specifications

The following specifications are typical, if not stated otherwise.

Optical modulation analyzer (Option 300)		
	Specification	Typical Value
Maximum detectable baud rate		46 Gbaud
Maximum detectable bit rate for DP-QPSK		184 Gbit/s
Maximum detectable bit rate for DP-16 QAM		368 Gbit/s
Sample rate		63 Gs/s
Maximum record length per channel		16000 samples
ADC resolution		8 bit
Optical receiver frequency range		31 GHz
Optical receiver signal bandwidth	> 22 GHz	> 23 GHz
Optical wavelength range (Option 100)		1527.6 to 1565.5 nm (196.25 to 191.50 THz)
Optical wavelength range (Option 110)		1570.01 to 1608.76 nm (190.95 to 186.35 THz)
Absolute wavelength accuracy (with internal local oscillator)	± 3 pm	± 2 pm
Average input power monitor accuracy		±0.5 dB
Optical phase angle of I-Q mixer after correction (1527.6 to 1565.5 nm)		90° ±1.0°
Relative skew after correction (1527.6 to 1565.5 nm)*		±1 ps
Image suppression†		> 30 dB
Error vector magnitude noise floor		< 2.4% EVM rms
Sensitivity		−22 dBm
High resolution spectrum analyzer (Option 300)		
Maximum optical frequency span		> 49 GHz
Minimum RBW (record length 16 k points)		4 MHz
Absolute frequency accuracy	± 3 pm	± 2 pm
Differential RF digitizer inputs (Option 310)		
RF digitizer inputs		4 channels, differential inputs
Sample rate		63 GS/s
Maximum record length per channel		16000 samples



Optical modulation analyzer (Option 300)	
ADC resolution	8 bit
Digitizer frequency range	31 GHz
Input band width	> 21 GHz > 23 GHz
Skew between different input channels (I and Q)	± 2 ps
Skew between differential inputs (p and n)	± 2 ps
Input amplitude range (single ended)	0.9 Vpp
Impedance	50 Ohm
Damage level	3 V DC, +3 dBm RF
Connector type	2.92 mm (m)
Local oscillator input (Option 320)	
Optical wavelength range (Option 100)	1527.6 to 1565.5 nm (196.25 to 191.50 THz)
Optical wavelength range (Option 110)	1570.01 to 1608.76 nm (190.95 to 186.35 THz)
External local oscillator input power range	-3 to + 16 dBm
Maximum input peak power (damage level)	+ 20 dBm
Basic modulation formats (Options 300, 310)	
BPSK, QPSK, DQPSK, QAM16	
DP-BPSK, DP-DPSK, DP-QPSK, DP-DQPSK, DP-16QAM	
Additional modulation formats Option 410 (single and dual polarization)	
Generic APSK decoder, 8BPSK, VSB -8, -16, FSK 2-, 4-, 8, 16 level, EDGE, D8PSK	
DVB 16, 32, 64, 128, 256, QAM, 32, 64, 128, 256, 512, 1028	
MSK type 1, type 2 CPM (FM), APSK 16/32 (12/4 QAM), StarQAM -16, -32	

\* < 17 GHz, 2 ps < 23 GHz.

† Reference conditions.

@ EVM = 32.5 % for 32 GBaud DP-QPSK corresponding to raw BER=1E-3, boost mode off.

## N4392A General Characteristics

Display	
Display type	15 inch color XGA TFT-LCD
Resolution	1024 pixels horizontally x 768 pixels vertically
Dimensions (Height x Width x Depth)	
Product dimensions	33 x 43 x 23 cm (12.9 x 16.8 x 9 in)
Weight	
Product net weight	13 kg (28.7 lbs)
Power requirements	
Voltage levels	100 to 240 V, AC
Net frequency range	50 to 60 Hz
Power requirement	375 VA
Storage temperature range	
-40° C to +70° C	
Operating temperature range	
+5° C to +35° C	
Humidity	
15% to 80% relative humidity, non-condensing	
Altitude (operating)	
0 ... 2000 m	
Optical connectors	
Signal input	9 μm single-mode angled
(Option 300)	81000 connector interfaces
LO input	9 μm PMF angled
(Option 320 only)	81000 connector interfaces
LO output	9 μm PMF angled
(Option, 320, 310 with 100/110)	81000 connector interfaces
Auxiliary source	9 μm PMF angled
(Option, 320, 310 with 100/110)	81000 connector interfaces

**Laser safety information**

All laser sources listed above are classified as Class 1M according to IEC 60825-1/2007.

All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007-06-24.








# 6 Regulatory Information

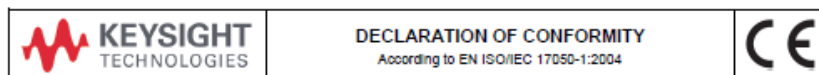
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# Declaration of Conformity

	<b>DECLARATION OF CONFORMITY</b> According to EN ISO/IEC 17050-1:2004	
<p><b>Manufacturer's Name:</b> Keysight Technologies Deutschland GmbH  <b>Manufacturer's Address:</b> Herrenberger Strasse 130                  D-71034 Boeblingen                  Germany</p>		
<p><b>Declares under sole responsibility that the product as originally delivered</b></p>		
<p><b>Product Name:</b> Optical Modulation Analyzer  <b>Model Number:</b> N4391A</p>		
<p><b>Product Options:</b> <i>This declaration covers all options of the above system.</i></p>		
<p>complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:</p> <ul style="list-style-type: none"> <li>• <i>The Low Voltage Directive 2006/95/EC</i></li> <li>• <i>The EMC Directive 2004/108/EC</i></li> </ul>		
<p>and conforms with the following product standards:</p>		
<b>EMC</b>	<p><i>Standard</i>                  IEC 61326-1:2012 / EN 61326-1:2013                  Canada: ICES/NMB-001:2006                  Australia/New Zealand: AS/NZS CISPR 11:2011</p>	
<b>Safety</b>	<p>IEC 61010-1:2010 / EN 61010-1:2010                  IEC 60825-1:2007 / EN 60825-1:2007                  Canada: CAN/CSA-C22.2 No. 61010-1-04                  USA: ANSI/UL 61010-1:2004</p>	
<p><b>Supplementary Information:</b></p> <p>FDA Accession Number 9521220                  The product was tested in a typical configuration with Agilent Technologies test systems.                  This DoC applies to above-listed products placed on the EU market after:</p>		
<p>2014-August-01 Date</p>	 Hans-Martin Fischer Product Quality & Compliance	
<p>For further information, please contact your local Keysight Technologies sales office, agent or distributor.                  Or Keysight Technologies Deutschland GmbH, Herrenberger Strasse 130, 71304 Boeblingen, Germany</p>		
<p>Year of first marking: 2009</p>		<p>Revision: A</p>



**Manufacturer's Name:** Keysight Technologies Deutschland GmbH  
**Manufacturer's Address:** Herrenberger Strasse 130  
 D-71034 Boeblingen  
 Germany

**Declares under sole responsibility that the product as originally delivered**

**Product Name:** Optical Modulation Analyzer  
**Model Numbers:** N4392A

**Product Options:** *This declaration covers all options of the above system.*

**complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:**

- *The Low Voltage Directive 2006/95/EC*
- *The EMC Directive 2004/108/EC*


**and conforms with the following product standards:**

<b>EMC</b>	<b>Standard</b> IEC 61326-1:2012 / EN 61326-1:2013 Canada: ICES/NMB-001:2005 Australia/New Zealand: AS/NZS CISPR 11:2011
<b>Safety</b>	IEC 61010-1:2010 / EN 61010-1:2010 IEC 60825-1:2007 / EN 60825-1:2007 Canada: CAN/CSA-C22.2 No. 61010-1-12 USA: ANSI/UL 61010-1:2012

**Supplementary Information:**

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2014-August-01  
 Date

  
 Hans-Martin Fischer

Product Quality & Compliance

For further information, please contact your local Keysight Technologies sales office, agent or distributor.  
 Or Keysight Technologies Deutschland GmbH, Herrenberger Strasse 130, 71304 Boeblingen, Germany

## Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Lärmangabe nach der Maschinenlärmverordnung–3.GSGV Deutschland).

Acoustic Noise Emission	Geräuschemission
LpA < 70 dB	LpA < 70 dB
Operator position	am Arbeitsplatz
Normal operation	normaler Betrieb
Per ISO 7779/ISO 3744	nach ISO 7779/ISO 3744

## Compliance with Canadian EMC Requirements

This ISM device complies with Canadian ICES- 001.  
Cet appareil ISM est conforme a la norme NMB-001 du Canada.



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