

Keysight Technologies

N4392A Optical Modulation Analyzer

Compact, Portable, Affordable

Data Sheet



Your personal test tool for complex modulated optical signals

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Need a Compact Optical Modulation Analyzer?

You will no longer have to share an optical modulation analyzer among colleagues or even departments because of its high initial investment price.

You will no longer have to move your device under test to another location because it's too hard to move the analyzer, just to perform a short measurement.

You will no longer have to ship your optical modulation analyzer to service once a year for optical performance verification and recalibration. Now the instrument does all this for you for the key optical performance parameters whenever you think it is necessary, increasing the time you can use your instrument.

The N4392A is the next generation of optical modulation analyzers in a compact housing of a mid-size oscilloscope. With 15" screen size, even more analysis parameters can be visualized at the same time, leading to faster debugging results.

Compact

Integration of a digitizer, optics and analysis PC leads to a compact turn-key instrument. It also avoids any external cabling, making the instrument robust and easy to set up wherever needed.

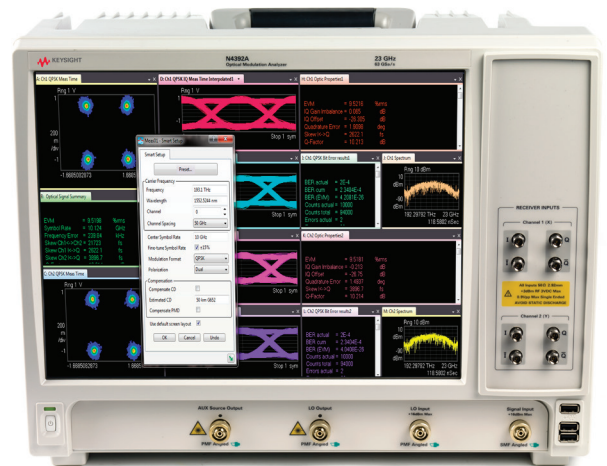
Despite the smaller size, the new N4392A offers a big laptop-size screen, giving you more insight in your signal for understanding and debugging your signals even faster.

Portable

The integration in a compact mid-size oscilloscope housing results in a lightweight instrument, which can be easily moved to any location in a lab or on the manufacturing floor. Operators who need to analyze and debug signals at the physical layer will enjoy this feature as well.

Affordable

The N4392A is designed for best price-performance balance, achieved by combining advanced integration technologies with built-in optical calibration and performance verification tools. This leads to longer intervals between recalibration, extending uptime in research and manufacturing and resulting in reduced cost of ownership without leaving any doubt about the performance of the instrument.



Specifications Terms and Conditions

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 °C ± 5 °C

Reference conditions for error vector magnitude noise floor

Optical continuous wave signal at optical input port

- Signal power > 0 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
- PolStokesAlign set to Single Polarization
- KFPhaseTrack with Carrier Phase Variance set to 1E-4
- Result Length set to 500 Symbols

System Performance

	Specification	Typical value
Optical modulation analyzer (Option 300)		
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 operating range (Option 100)		1527.6 to 1570.01 nm (196.25 to 190.95 THz)
Optical wavelength operating 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)		$90^\circ \pm 1.0^\circ$
Relative skew after correction (1527.6 to 1565.5 nm) ¹		± 1 ps
Image suppression ²		> 30 dB
Error vector magnitude noise floor ²		< 2.4% EVM rms
Sensitivity ³		-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
ADC resolution		8 bit
Digitizer frequency range		31 GHz
Input bandwidth	> 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 Ω
Damage level		3 V DC, +3 dBm RF
Connector type		2.92 mm (m)
Local oscillator input (Option 320)		
Optical wavelength operating range (Option 100)		1527.6 to 1570.01 nm (196.25 to 190.95 THz)
Optical wavelength operating range (Option 110)		1570.01 to 1608.76 nm (190.95 to 186.35 THz)
External local oscillator input power range ⁴		-3 to + 16 dBm
Maximum input peak power (damage level)		+ 20 dBm
Modulation formats, single and dual polarization (Options 300, 310)		
BPSK, QPSK, DQPSK, 16-QAM		
8BPSK, Offset QPSK, Pi/4 QPSK, 32-QAM, 64-QAM, 128-QAM, 256-QAM, 512-QAM, 1024-QAM, 2048-QAM, 4096-QAM		
Custom APSK demodulator, FSK 2-, 4-, 8-, 16-level, DQPSK, D8PSK, APSK 16/32 (12/4 QAM)		

1. < 17 GHz, 2 ps < 23 GHz

2. @ reference conditions (see page 12)

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

4. P_signal [dBm] + P_LO [dBm] > 4 dBm recommended

General Characteristics

Display	
Display type	15 inch color XGA TFT-LCD
Resolution	1024 pixels horizontally x 768 pixels vertically
Assembled dimensions (H x W x D)	
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
Shipping contents	
	<ul style="list-style-type: none"> 1 x optical modulation analyzer N4392A including front cover 1x optical USB mouse 1150-7799 1x mini USB keyboard 319 x 157 x 20 mm 0960-2929 1 to 4x 81000NI FC/APC connector interface (quantity depends on options ordered) 08154-61723 1x language labels sheet 81645-44309 1x torque wrench, 8 lb-in, 5/16 inch 8710-1765 1x wrench, open-end, 8 mm, steel hard chrome finish 8710-2466 1x calibration certificate 9230-0333 1x wrist strap with cord 6-lg 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 for the N4392A N4392-90A01 1x power cord (country dependent) 1x entitlement certificate basic N4392A software package N4392-90115 1x entitlement certificate VSA software (contains 89601B-200 and 89601B-AYA) 89600-90181 <p>Depending on ordered options:</p> <ul style="list-style-type: none"> 1x entitlement certificate option N4392A-420 N4392-90103 1x entitlement certificate option N4392A-430 N4392-90104
Optical connectors	
Signal input (Option 300)	9 µm single-mode angled 81000 connector interface
LO input (Option 320 only)	9 µm PMF angled 81000 connector interface
LO output (Option 320, 310 with 100/110)	9 µm PMF angled 81000 connector interface
Auxiliary source (Option 320, 310 with 100/110)	9 µm PMF angled 81000 connector interface
Laser safety information	All laser sources listed above are classified as Class 1M according to IEC 60825-1/2007.
<div style="border: 2px solid black; padding: 5px; width: fit-content;"> <p style="text-align: center; margin: 0;">INVISIBLE LASER RADIATION DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS CLASS 1M LASER PRODUCT (IEC 60825-1 / 2007)</p> </div> <p>All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007-06-24.</p>	

Configuration Guide

Configuration 1: optical & electrical receiver with extended LO & source package

Full featured configuration with all analysis and test capabilities provided by the instrument.

Options

Wavelength option: adds two CW lasers

- **Option 100:** C-band optics and sources (adds two C-band CW lasers)
Or alternatively
- **Option 110:** L-band optics and sources (adds two L-band CW lasers)
- **Option 300:** 23 GHz optical receiver includes optical coherent receiver, digitizer and local oscillator
- **Option 310:** 23 GHz electrical receiver includes electrical receiver without any optical components
- **Option 320:** Extended local oscillator and source package adds the auxiliary source and local oscillator external input and output.

Available software options

- **Option 420:** User configurable OFDM demodulator
- **Option 430:** ICR characterization software
- **89601B-BHF:** Custom OFDM modulation analysis
- **89601B-BHK:** Custom IQ demodulator

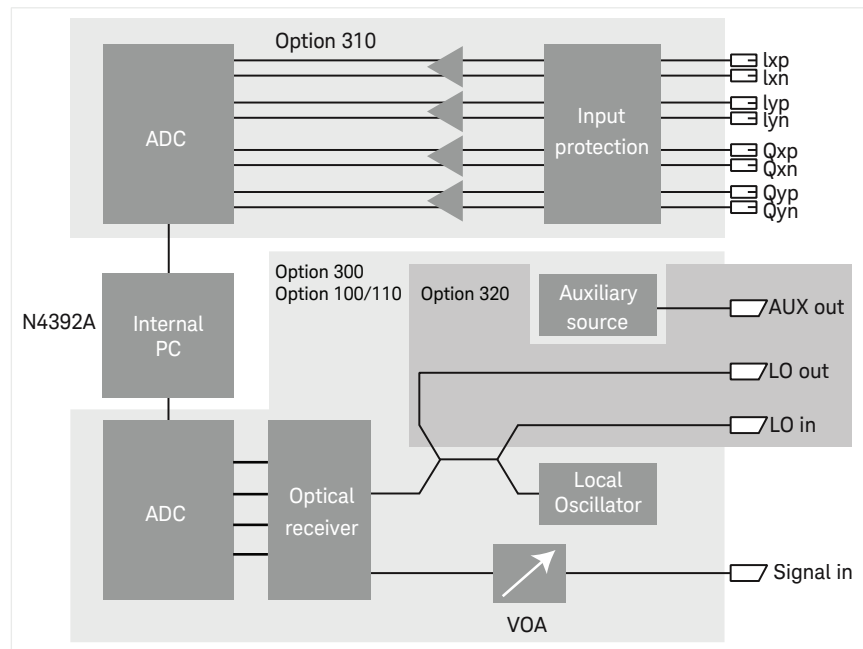


Figure 1. Optical & electrical receiver with extended LO & source package

Configuration Guide (continued)

Configuration 2: basic optical & electrical receiver

Configuration with all analysis and test capabilities without optical sources

Recommended application

- Transmitter and link signal qualification
- Transmitter debugging
- Signal qualification with user ICR (external laser sources needed)
- ICR test with external Keysight lasers
- CFP2-ACO Testing (Tx and Rx, requires additional instruments & components)

Options

wavelength option: adds two CW lasers

- **Option 100:** C-band optics and sources (adds two C-band CW lasers) or alternatively
- **Option 110:** L-band optics and sources (adds two L-band CW lasers)
- **Option 300:** 23 GHz optical receiver includes optical coherent receiver, digitizer and local oscillator
- **Option 310:** 23 GHz electrical receiver includes electrical receiver without any optical components

Available software options

- **Option 420:** User configurable OFDM demodulator
- **Option 430:** ICR characterization software
- **89601B-BHF:** Custom OFDM modulation analysis
- **89601B-BHK:** Custom IQ demodulator

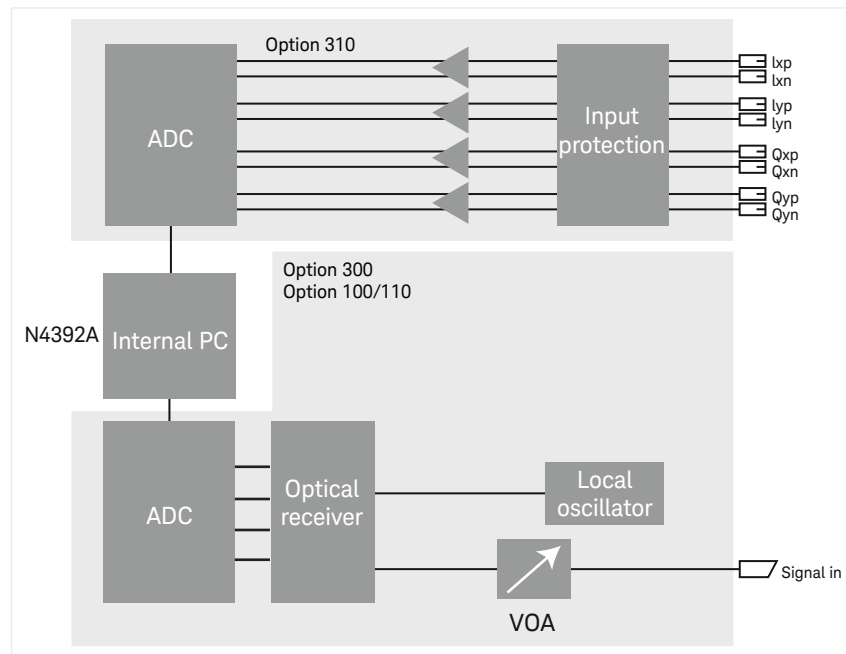


Figure 2. Basic optical & electrical receiver

Configuration Guide (continued)

Configuration 3: basic configuration with electrical receiver

Recommended application

- Signal qualification with user's ICR
- ICR test with external Keysight lasers
- ICR vendor qualification

Options

- **Option 310:** 3 GHz electrical receiver includes electrical receiver without any optical components.

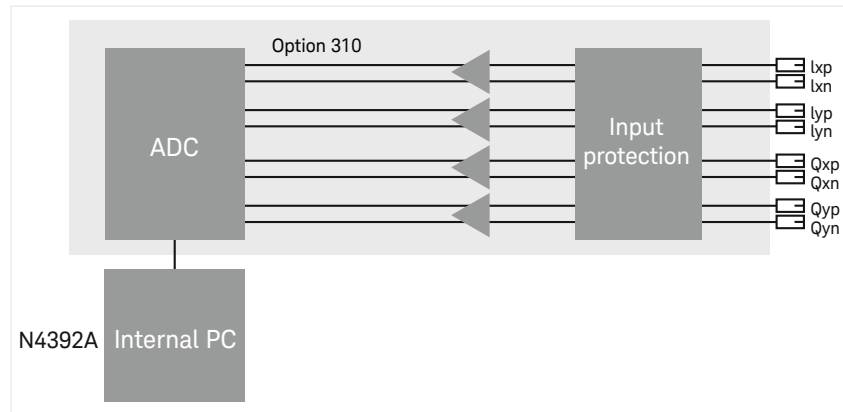


Figure 3. Basic configuration with electrical receiver

Available software options

- **Option 420:** User configurable OFDM demodulator
- **Option 430:** ICR characterization software

Configuration 4: electrical configuration with optical sources

Recommended application

- Signal qualification with user's ICR
- ICR test with internal lasers
- ICR vendor quantification

Options

- wavelength option: adds two CW lasers
- **Option 100:** C-band optics and sources (adds two C-band CW lasers) or alternatively
- **Option 110:** L-band optics and sources (adds two L-band CW lasers)
- **Option 310:** 23 GHz electrical receiver includes electrical receiver without any optical components

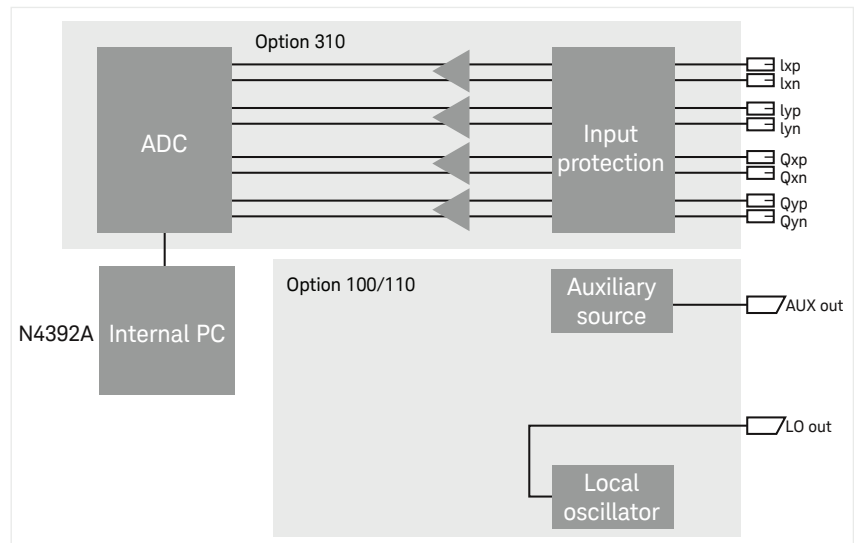


Figure 4. Electrical configuration with optical sources

Available software options

- **Option 420:** User configurable OFDM demodulator
- **Option 430:** ICR characterization software
- **89601B-BHF:** Custom IQ demodulator modulation analysis
- **89601B-BHK:** Custom IQ

Configuration Guide (continued)

Configuration 5: basic configuration with optical receiver

Recommended application

- Transmitter test in manufacturing
- Link signal qualification in commissioning
- Economic transmitter debugging

Options

wavelength option: adds two CW lasers

- **Option 100:** C-band optics and sources (adds two C-band CW lasers) or alternatively
- **Option 110:** L-band optics and sources (adds two L-band CW lasers)
- **Option 300:** 23 GHz optical receiver includes optical coherent receiver, digitizer and local oscillator

Available software options

- **Option 420:** User configurable OFDM demodulator
- **89601B-BHF:** Custom OFDM modulation analysis
- **89601B-BHK:** Custom IQ demodulator

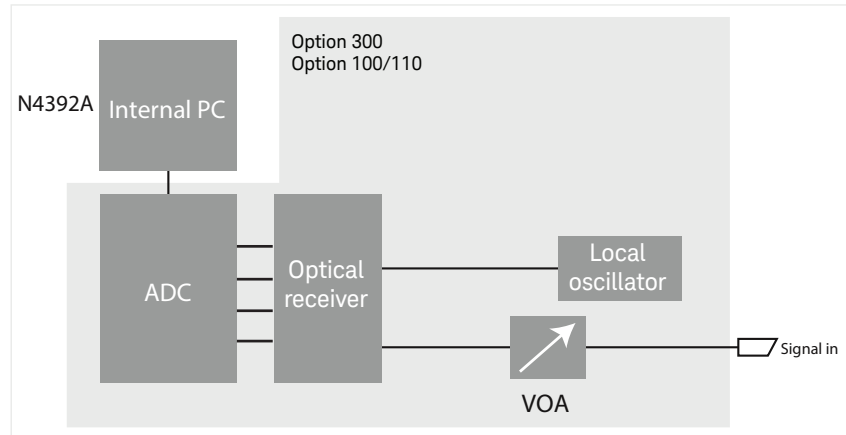


Figure 5. Basic configuration with optical receiver

Configuration Guide (continued)

Configuration 6: optical configuration with LO & Aux sources optical configuration with LO & Aux sources

Recommended application

- Transmitter test in research
- Link test in research
- Transmitter debugging in prototype phase
- General research applications

Options

- wavelength option: adds two CW lasers
- **Option 100**: C-band optics and sources (adds two C-band CW lasers) or alternatively
 - **Option 110**: L-band optics and sources (adds two L-band CW lasers)
 - **Option 300**: 23 GHz optical receiver includes optical coherent receiver, digitizer and local oscillator
 - **Option 320**: Extended local oscillator and source package adds the auxiliary source and local oscillator external input and output.

Available software options

- **Option 420**: User configurable OFDM demodulator
- **89601B-BHF**: Custom OFDM modulation analysis
- **89601B-BHK**: Custom IQ demodulator

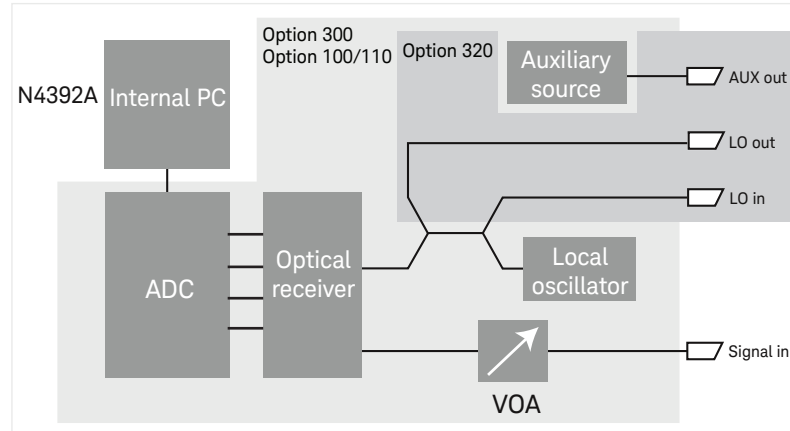


Figure 6. Optical configuration with optical sources

Software options

- **User configurable OFDM demodulator (Option 420):**
This option extends the software with a license for a user configurable OFDM demodulator. It is identical with the 89601B-BHF features for later upgrade please order the 89601B-BHF.
- **ICR characterization package (Option 430):**
Is an additional software license that requires Option 310 to characterize integrated intradyne coherent receiver (ICR) as defined by the OIF. At minimum an additional Keysight, software controllable, polarization controller is required. For details on characterized parameter and methods, please see the ICR test section of N439xA brochure.
- **Upgrade OMA software from version 4.x to version 5.x (N4392AU-UG1):**
Upgrade OMA software from version 4.x to version 5.x, fixed perpetual license. It contains the following analysis features:
 - Laser Line width
 - PMD and Phase noise analysis
 - Supports measurement of second order PMD and DGD over frequency
 - Contains Modulation Format Transparent Pre-Processing
 - Offers Optical Signal Statistics Table
 - Allows 3D Stokes Space Pre-adjustment as VSA trace
 - Allows 3D Stokes Space Trajectory trace as VSA trace
 - OMA Revision 5 requires a valid VSA 20 license and higher, available separately
- **Custom IQ demodulator (89601B-BHK):**
Custom IQ Modulation Analysis adds Custom IQ demodulation and analysis capability to your OMA software. Option BHK lets you perform modulation analysis on non-standard user defined IQ signals. Custom IQ modulation analysis provides a simple process to configure the OMA to demodulate and analyze a user defined custom IQ signal with more than 4096 symbols (depending on HW used).

Optical wavelength range options

- Option 100 selects all optical components operate in C-Band
- Option 110 selects all optical components operate in L-Band

These options can only be selected alternatively and can be combined with any other Option 3xx.

Ordering Information

Optical modulation analyzer product configuration	
N4392A	Optical modulation analyzer with mainframe and vector signal analysis software
Optical source and wavelength options	
N4392A-100	C band sources and optics
N4392A-110	L band sources and optics
Receiver options	
N4392A-300	23 GHz optical receiver
N4392A-310	23 GHz electrical receiver, 4 differential inputs
Hardware options	
N4392A-320	Extended local oscillator and source package
Software licenses	
N4392A-420	Custom OFDM modulation analysis
N4392A-430	ICR characterization package
Hardware upgrade options	
N4392AU-100	Upgrade with C-Band Sources and Optics
N4392AU-110	Upgrade with L-Band Sources and Optics
N4392AU-E02	Upgrade to extended wavelength range 1527.6 to 1570.01 nm (196.25 to 190.95 THz)
N4392AU-430	Upgrade N4392A with ICR characterization License
N4392AU-300	Upgrade with 23 GHz optical receiver
N4392AU-310	Upgrade with 23 GHz electrical receiver, 4 differential channel input
N4392AU-320	Upgrade with extended local oscillator and source package
Software upgrade options	
N4392AU-410	Upgrade N4392A with additional Optical Modulation Format License
89601B-BHF	Custom OFDM modulation analysis
89601B-BHK	Custom IQ
N4392AU-UG1	Upgrade OMA Software from Version 4.x to Version 5.x, fixed perpetual license

N4392AU Hardware Upgrade Options and Compatibility

Installed options	Options that can be added			
	300	310	320	1x0
300/1x0	No	Yes	Yes	No
300/320/1x0	No	Yes	No	No
300/310/1x0	No	No	Yes	No
310 only	Yes	No	300+320	Must
310/1x0	Yes	No	300+320	No

1x0: Describes installed wavelength option in the instrument to be upgraded.

