Keysight N4392A
Optical Modulation Analyzer
Compact, Portable, Affordable

Your personal test tool for
complex modulated optical signals

Data Sheet

KEYSIGHT TECHNOLOGIES

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.

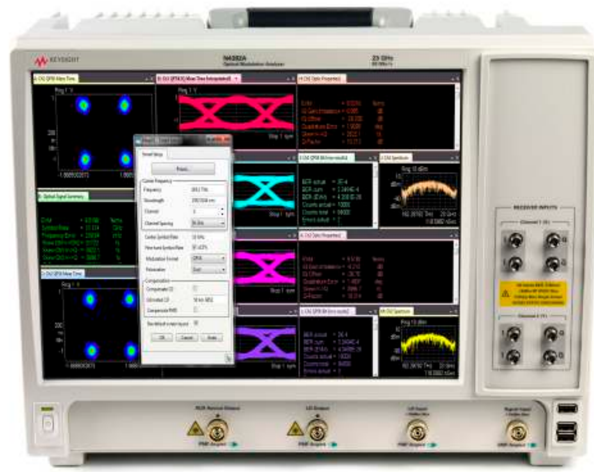
You will no longer have to ship your optical modulation analyzer to service once a year for optical performance verification and recalibration. Now the instrument does all this for you for the key optical performance parameters whenever you think it is necessary, increasing the time you can use your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

N4392A Overview

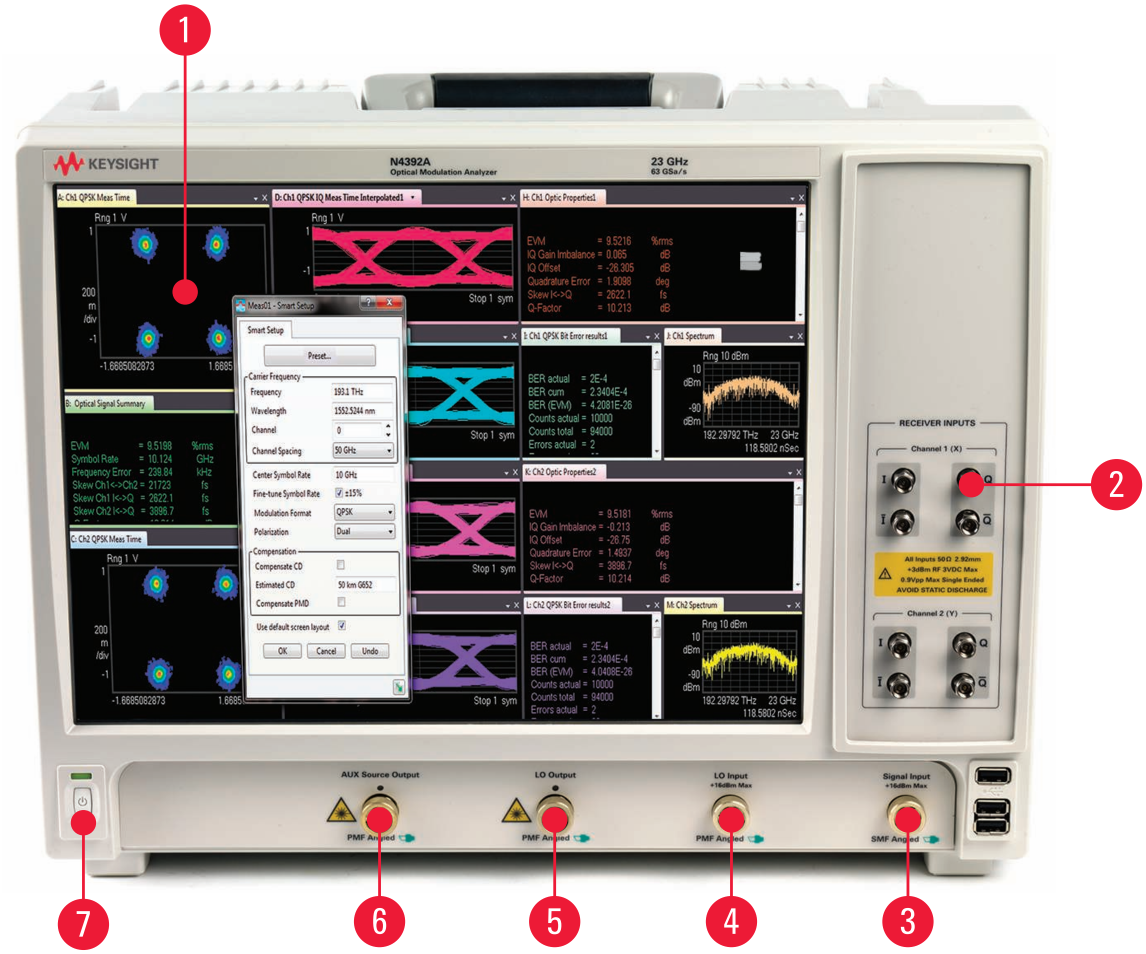


Figure 1.

1. Vector signal analysis
   Like the N4391A, the N4392A is based on the Keysight Technologies, Inc. 89601B vector signal analysis software which is extended for optical requirements. One software platform ensures exchangeability of setting files and measurement results between R&D and manufacturing. This also makes results comparable and exchangeable.
2. RF inputs
   Characterize and evaluate your own IQ demodulator with four differential RF digitizer inputs as required for OIF compliant integrated coherent receivers. (Option 310)
3. Signal input
   Feed in your signal under test at this input, for modulation analysis that gives you the highest confidence in your test results.
4. LO input
   In experiments where an extremely stable local oscillator with linewidth in the low kHz range is required, this input can be used as local oscillator (LO) input for external lasers. (Option 320)
5. LO output
   Get part of the local oscillator signal to the output for monitoring or setting up a homodyne experiment. (Option 320)
6. AUX source output
   This output (Option 320) provides you with a CW laser signal which can be used to drive your transmitter or use it as an auxiliary output to calibrate an external integrated IQ demodulator. (Option 320)
7. Power ON/OFF

N4392A Transmitter and Modulator Test

Transmitter signal integrity characterization
- Transmitter signal performance verification
- Verify optimal alignment biasing circuits and skews
- Transmitter vendor qualification
- Final pass fail test in manufacturing
- Evaluation of transmitter components for best signal fidelity

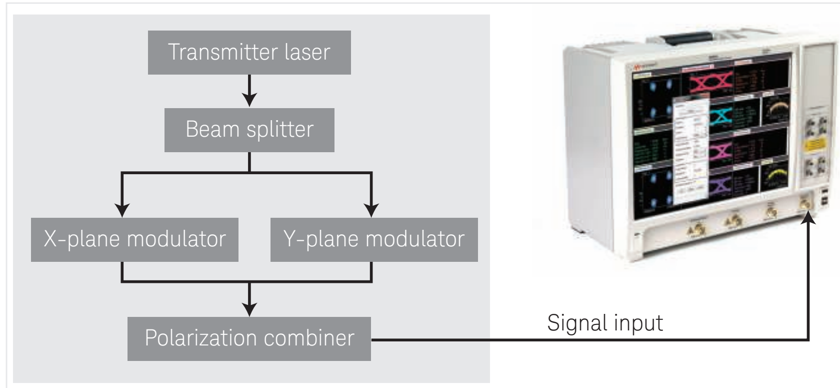


Figure 2.

Homodyne component characterization
- Component evaluation independent of carrier laser phase noise
- Modulator in system qualification
- Modulator in-application verification
- Advanced debugging to detect hidden transmitter issues

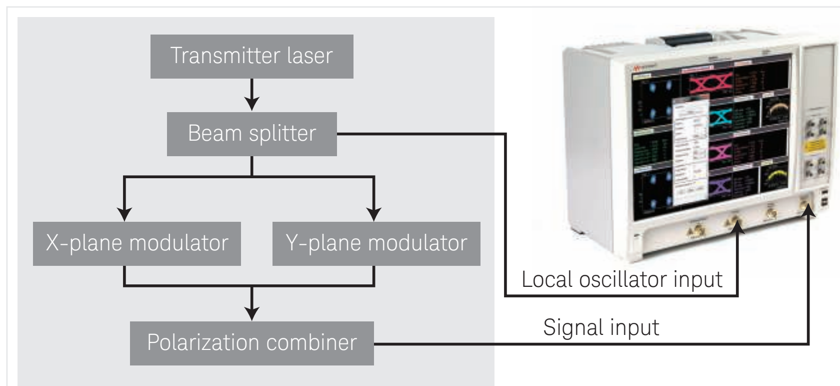


Figure 3.

Component evaluation
- Cost effective modulator evaluation
- Cost effective modulator driver evaluation
- Final specification test in application of IQ modulator
- Homodyne testsetup to evaluate influence of phase noise

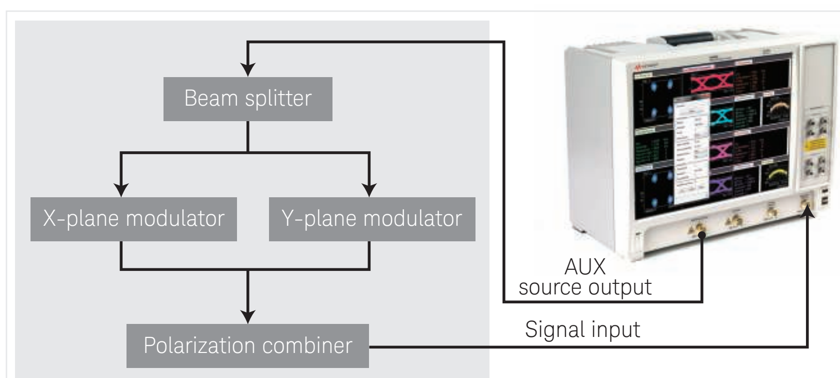


Figure 4.

N4392A Transmitter Test in Manufacturing

Optical constellation diagram

In a constellation diagram, signal information is shown only at the middle of a symbol time. This represents exactly the time stamp a real receiver will take to decide on the transmitted data. These points are commonly referred to as detection decision-points, and are interpreted as the digital symbols. Constellation diagrams help identify effects like amplitude imbalance, quadrature error, or phase noise just to mention some of them.

For calculating the BER based on statistical data a Gaussian noise distortion is required in the same way as for Q factor based BER calculation. The color coded display option gives a fast indication if this requirement for BER calculation based on noise statistics is fulfilled.

For complex modulated signals the statistic BER is calculated based on the EVM calculation of the software.

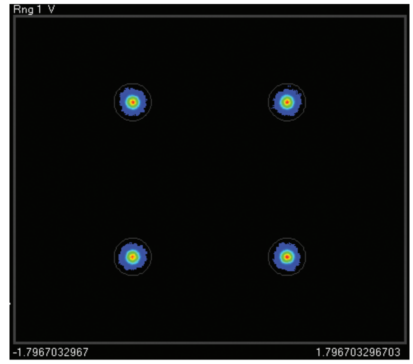


Figure 5.

Symbol table/error summary

This result table is one of the most powerful tools of the vector analysis software. With just a few scalar parameters you can get full insight in your transmitter quality and in addition get an indication on the most likely error source in coherent optical transmitter. The following list describes these parameters briefly:

- EVM to check overall transmitter signal distortions including noise
- I-Q offset for checking transmitter alignment
- Quadrature error to verify 90 degree bias point alignment in transmitter modulator
- Gain imbalance between I and Q signal path in transmitter (not displayed here)
- Signal to noise ratio based on EVM measurements

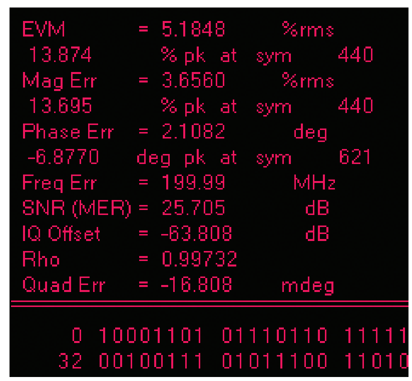


Figure 6.

EVM limit test

Error vector magnitude (EVM) is described as a scalar by calculating the rms value of the error vector of all measured symbols within one burst of data recording. A good transmitter shows a white noise like error vector distribution along all symbols. The limit test functionality can detect any violation of a customer definable value and display this in different colors on the screen as shown in figure 7. In addition a fail indication is provided by the software. For manufacturing purposes this can be controlled and queried via the easy to use SCPI software interface.

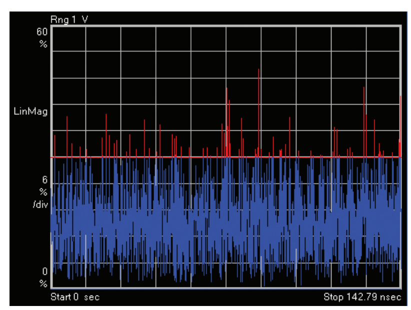


Figure 7.

N4392A Advanced Research on OFDM

Customer configurable generic OFDM demodulator

OFDM is a very complex modulation scheme as it distributes the information not only over time with sequential vectors but also over frequency via a customizable number of subcarriers. Each subcarrier can have a different modulation format. In addition in most cases pilot tones need to be detected for synchronization. With this custom configurable OFDM decoder nearly every variation of a digital ODFM signal can be set up and then detected and analyzed in various ways. Some examples are shown below.

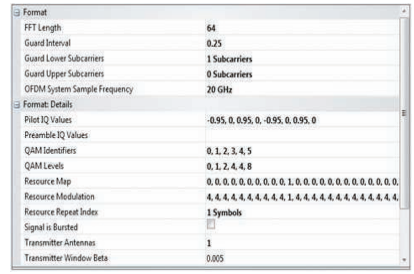
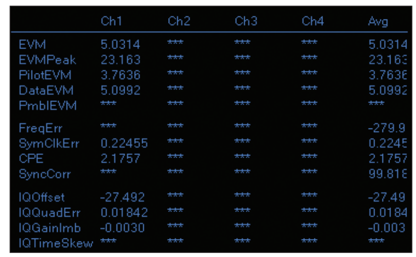


Figure 8.

OFDM error summary

Besides various graphical analysis tools like constellation diagram and EVM over symbols, a detailed error table of relevant error calculations is available. This feature offers the possibility to specify one or more OFDM signal quality parameters at the transmitter output or along the link, which might be useful for transmitter and link performance evaluation.



	Ch1	Ch2	Ch3	Ch4	Avg
EVM	5.0314	***	***	***	5.0314
EVMPeak	23.163	***	***	***	23.163
PilotEVM	3.7636	***	***	***	3.7636
DataEVM	5.0992	***	***	***	5.0992
PmblEVM	***	***	***	***	***
FreqErr	***	***	***	***	-279.9
SymClkErr	0.22455	***	***	***	0.2245
CPE	2.1757	***	***	***	2.1757
SyncCorr	***	***	***	***	99.816
IQOffset	-27.492	***	***	***	-27.49
IQQuadErr	0.01842	***	***	***	0.0184
IQGainImb	-0.0030	***	***	***	-0.003
IQTimeSkew	***	***	***	***	***

Figure 9.

EVM of a symbol

Like in a QPSK or M-QAM signal, an EVM (%rms) value can be calculated for each carrier and displayed along the horizontal axis. This gives an indication of modulation quality on all carriers. The individual bars describe the error vector of each symbol in that carrier, giving additional information about the distribution of the error symbols.

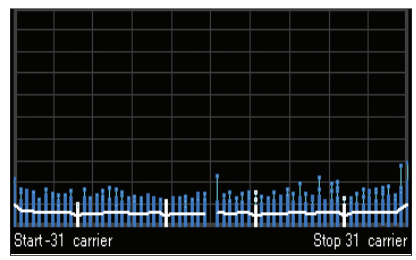


Figure 10.

OFDM high resolution spectrum

An ODFM signal is a set of carriers that are orthogonal and very closely spaced in frequency domain, which lets the spectrum appear rectangular in a perfect signal. In addition an ODFM signal often carries pilot and synchronization information at different power levels. With high resolution spectral display, a quantitative analysis of the OFDM signal can be done in parallel with the other analysis tools.

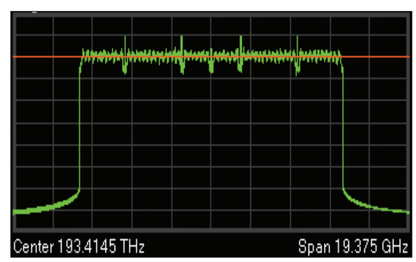


Figure 11.

N4392A Research on Modulation Formats

Customer configurable APSK demodulator

This new generic decoder allows the user to configure a custom decoding scheme in accordance with the applied IQ signal.

Up to 8 amplitude levels can be combined freely with up to 256 phase levels. This provides nearly unlimited freedom in research to define and evaluate the transmission behavior of a proprietary modulation format.

The setup is easy and straightforward. Some examples are shown below.

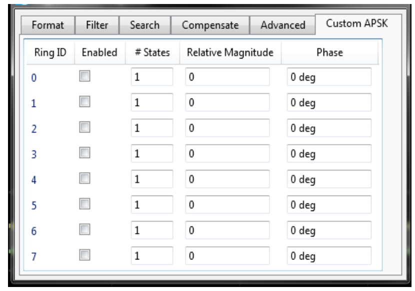


Figure 12.

Optical duobinary decoder

In 40 G transmission systems, an optical duobinary format is often used. In order to test the physical layer signal at the transmitter output or along a link, the analysis software now supports this commonly used optical format.

A predefined setting that has a preconfigured optical duo binary decoder is part of the instrument and the analysis software.

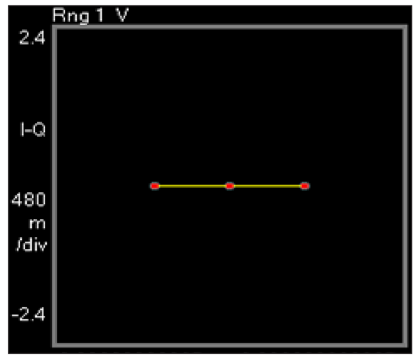


Figure 13.

Optical 8 QAM decoder

This example of a coding scheme can code 3 bits per symbol with a maximum distance between the constellation points, providing a good signal to noise ratio.

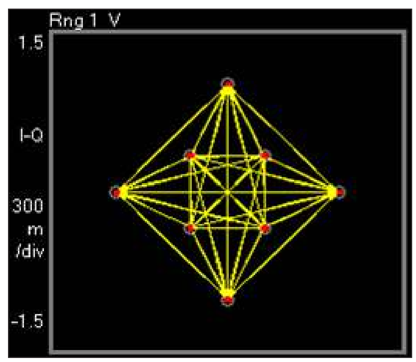


Figure 14.

Optical 16 PSK decoder

This is another example of a more complex pure phase modulated optical signal that is sometimes used in research.

With the custom-defined APSK decoder, the same analysis tools are available as in the predefined decoders.

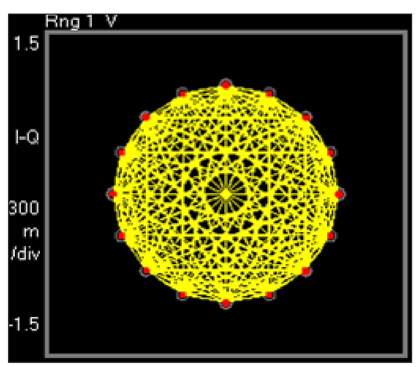


Figure 15.

N4392A Integrated Coherent Receiver (ICR) Test

Intradyne integrated coherent receiver test

For detection of complex modulated optical signals OIF defined an electro-optical component typically described as Integrated Dual Polarization intradyne coherent receiver (ICR). This component contains optical and electo-optical components in one package, as shown in figure 18 as device under test.

The hybrid contains many components that need to be integrated and perform seamless as a black box coherent receiver.

The integrated component needs to be tested in research and in manufacturing.

The N4392A offers tools, like option 310 and 430, to test this kind of device and extract parameters that characterize the behavior of the component.

With the N4392A it is possible to test the component in an environment that is identical to the final application providing highest confidence in the performance of the component.

- This test is performed with the N4392A by generating a beat signal within the detection band to the ICR optical inputs.
- This test is an excellent setup to verify the intrinsic performance of the ICR as it reflects noise impairments and all kinds of distortions.
- The IQ and constellation diagram gives an indication on the noise and the distortion of the signal of the ICR created from a nearly perfect beat signal. The same parameters that are used to quantify the signal quality (EVM, IQ offset, IQ imbalance, Quadrature error) can be used to qualify the intrinsic performance of the component.
- Image suppression in a spectral display gives a good indication of presence of imbalances between channels and PIN diodes in the coherent receiver. A good image suppression and large common mode rejection ratio indicate a well balanced receiver.

Image suppression is an excellent indication of the presence of potential distortions within the optical receiver. An image suppression in the order > 35 dB indicates high CMRR of well balanced PIN diodes and well de-skewed I-Q channels in the ICR under test.

EVM is an excellent indicator of the overall quality of a complex modulated signal. This concept is applied in that test by creating a beat signal in the ICR and analyzing it in the same way as a complex modulated signal. This emulates a kind of ideal stimulus of he ICR. With this test the EVM can be measured at a single frequency point along the receiver bandwidth of the device under test and within the digitizer bandwidth. This measurement provides additional insight to the device under test, ensuring distortion free measurements at each tested frequency point with good EVM.

Figure 16. Shows a test setup to verify performance of ICR

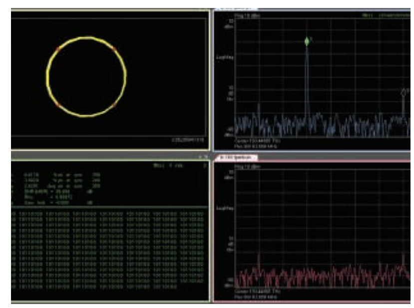


Figure 17.

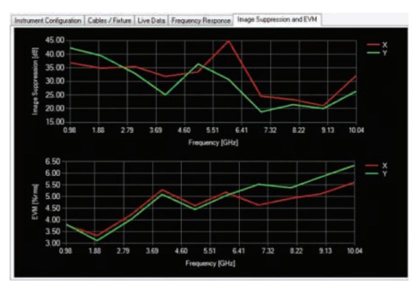


Figure 18.

N4392A Integrated Coherent Receiver (ICR) Test (continued)

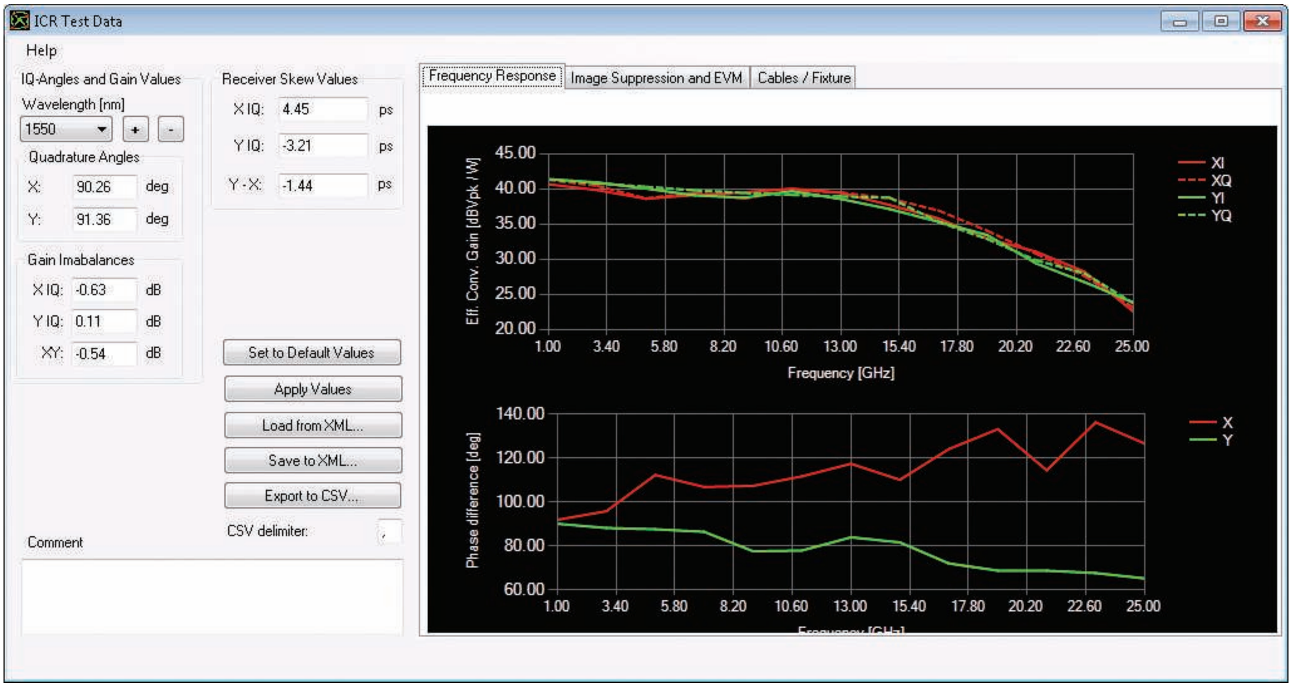


Figure 19.

Integrated coherent receiver test provides most relevant test parameters as defined by OIF to characterize integrated coherent receiver components. The following test results are provided by the software:

- Relative frequency response S21(f) for each tributary
- Phase difference between X and Y polarization as function of frequency
- Image suppression over frequency
- Error vector magnitude (EVM% rms) over frequency (in addition to OIF) requirements
- Image suppression over frequency (in addition to OIF)

The following parameter are frequency independent impairments measured by the ICR test software.

- Quadrature angles between I and Q for each polarization plane X and Y
- Gain correction values for balanced gain for each polarization plane
- Skew values between each tributary with reference to one channel

N4392A Integrated Coherent Receiver (ICR) Test (continued)

ICR test setup to characterize ICR impairments

N4392A recommended setup for this test

- Option 310 electrical receiver
- Option 430 ICR test software package
- Option 100 C-band or 110 L-band internal CW sources
- 8169A or N7786 polarization controller
- 819xA and 81600B series tunable laser

For fastest characterization within minutes a tunable laser as described is required. All external instruments are controlled by the N4392A-430 ICR test software.

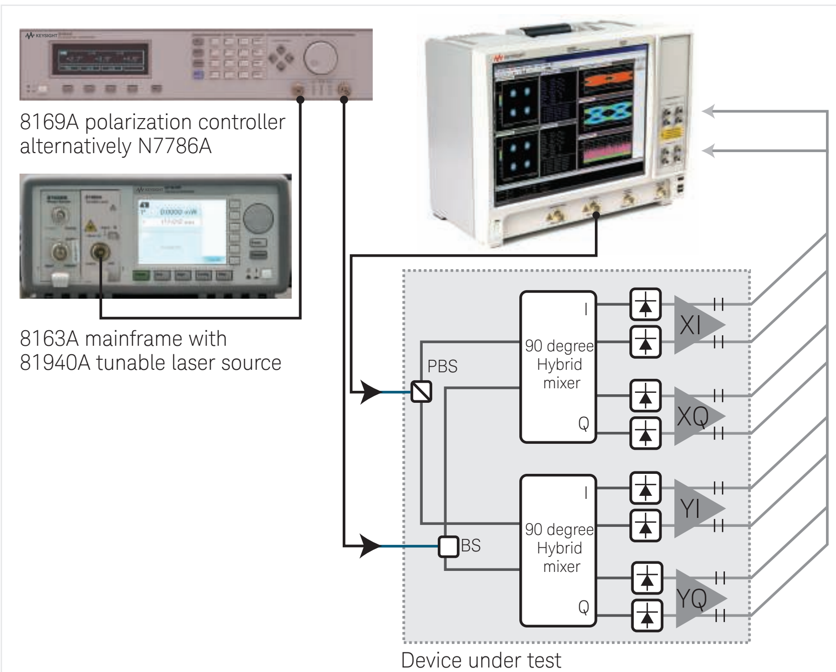


Figure 20.

Remote Control with Standard Interface

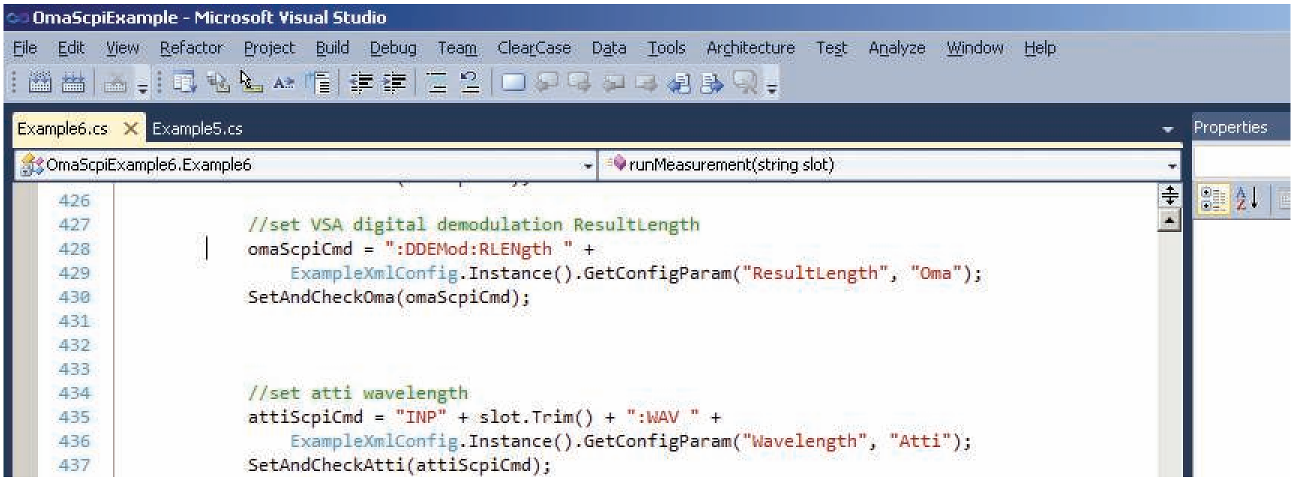


Figure 21.

The N4392A supports the “Standard Commands for Programmable Instruments” (SCPI) language for remote control. This industry standard easy to use remote control interface can be used to remote control the N4392A with various platforms like:

- Standard C# environment
- VBA on Excel or other platforms
- Keysight Vee or similar platforms

In figure 21 you can see an example from a VBA code when working in an excel environment. You can enter parameters in the excel sheet as shown in figure 22 and get the results with all analysis capabilities as provided in MS Excel as shown in figure 23.

In addition this environment can be used to create test reports in manufacturing right in your test environment.

Several programming examples are provided with the N4392A:

- Setting and reading signal quality parameter
- BER measurement
- OMA performance verification
- Measurement and reading of single quality parameter

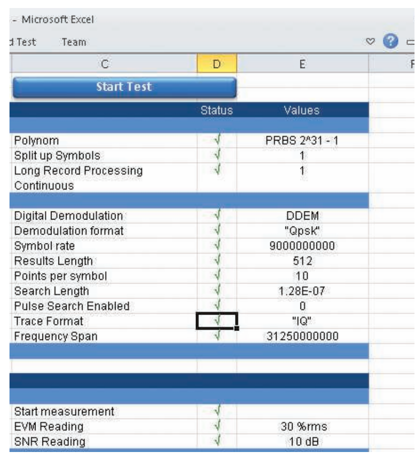


Figure 22.

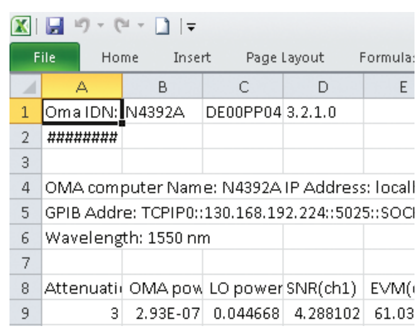


Figure 23.

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

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

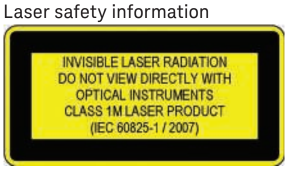
Digital demodulator settings
- QPSK demodulation
- 10 Gbaud symbol rate
- SinglePolKFPhaseTrack algorithm Q= 1E-4
- 500 symbols per analysis record

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 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]		± 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 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 [4]		–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		

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	
	1 x optical modulation analyzer N4392A including front cover 1x optical mouse USB PS2 102 1150-7799 1x mini 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 measurment 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 N4392-90100 Depending on ordered options: 1x entitlement certificate option N4392A-410 N4392-90101 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. All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007-06-24.

Configuration Guide

Configuration

- **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 410:** Additional optical modulations format package
- **Option 420:** User configurable OFDM decoder
- **Option 430:** ICR characterization software

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

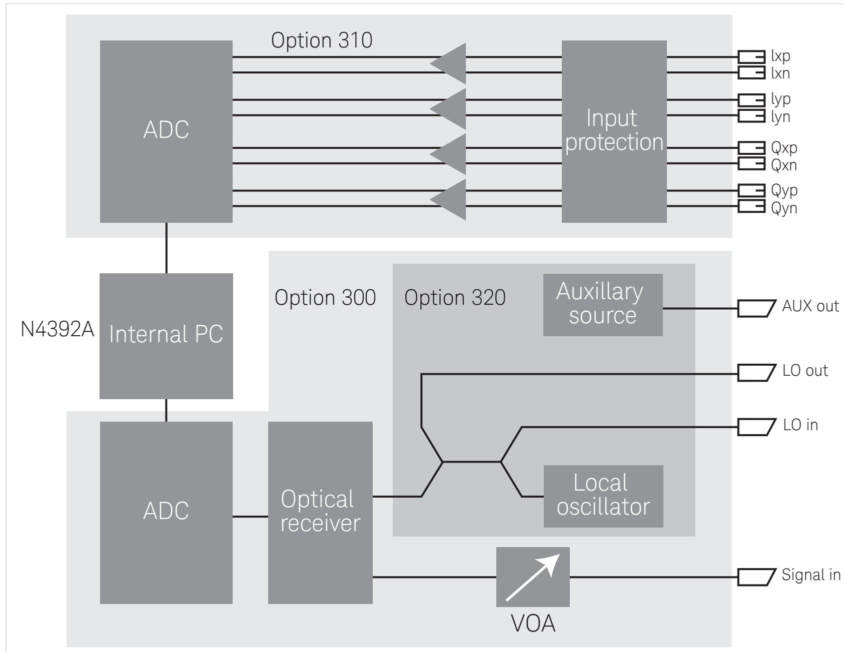


Figure 24.

Configuration

- **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 410:** Additional optical modulations format package
- **Option 420:** User configurable OFDM decoder
- **Option 430:** ICR charaterization software

Recommended application

- Transmitter and link signal qualification
- Transmitter debugging
- Signal qualification with users ICR
- ICR test with external Keysight lasers

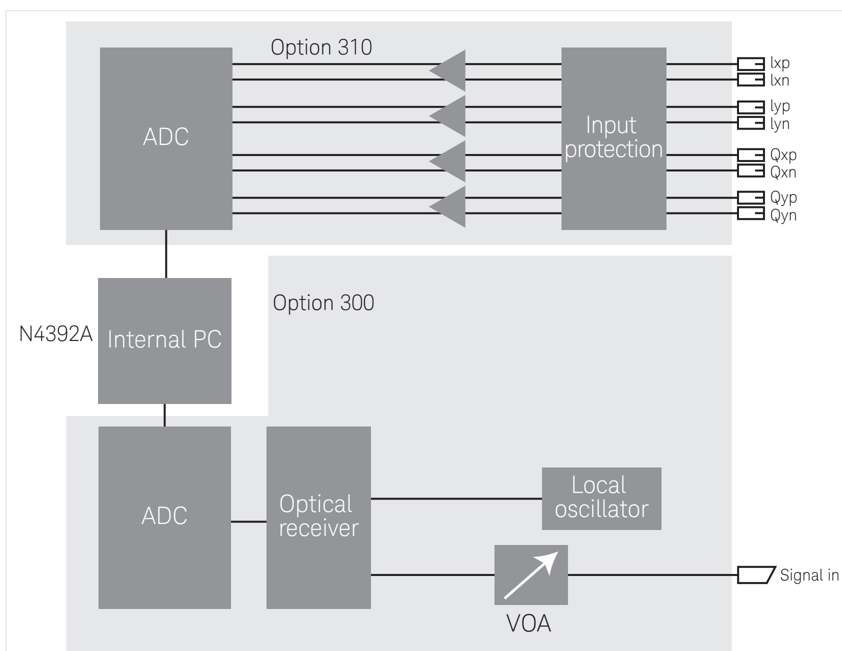


Figure 25.

Configuration Guide (continued)

Configuration

- **Option 310:** 23 GHz electrical re-ceiver includes electrical receiver without any optical components

Available Software options

- **Option 410:** Additional optical modulations format package
- **Option 420:** User configurable OFDM decoder
- **Option 430:** ICR charaterization software

Recommended application

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

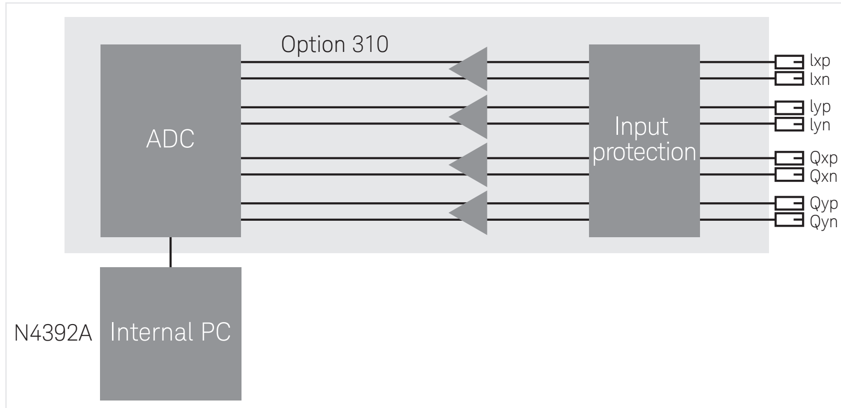


Figure 26.

Configuration

- **Option 310:** 23 GHz electrical re-ceiver includes electrical receiver without any optical components
- **Option 100:** C band optic or alternatively
- **Option 110:** L band optic adding wavelength option adds two CW laser

Available software options

- **Option 410:** Additional optical modulations format package
- **Option 420:** User configurable OFDM decoder
- **Option 430:** ICR characterization software

Recommended application

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

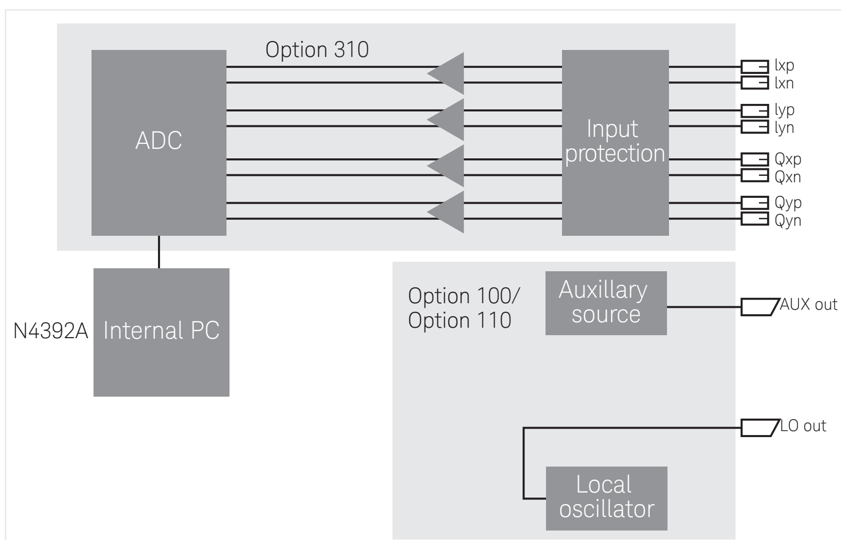


Figure 27.

Configuration Guide (continued)

Configuration

- **Option 300:** 23 GHz optical receiver includes optical coherent receiver digitizer and local oscillator

Available software options

- **Option 410:** Additional optical modulations format package
- **Option 420:** User configurable OFDM decoder

Recommended application

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

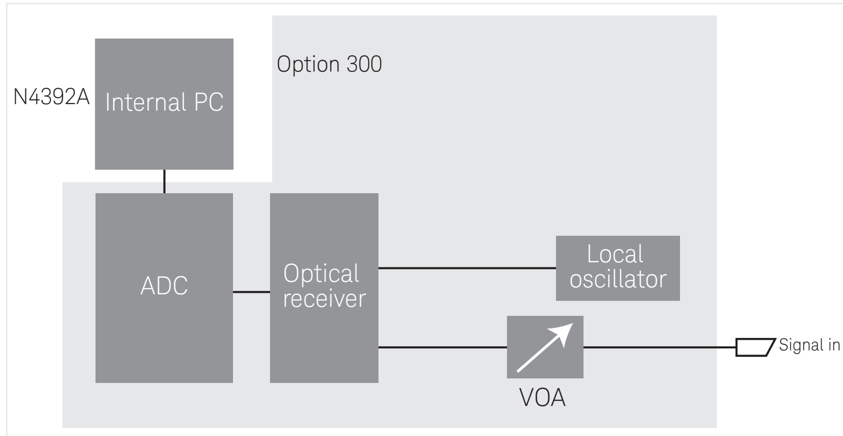


Figure 28.

Configuration

- **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 410:** Additional optical modulations format package
- **Option 420:** User configurable OFDM decoder

Recommended application

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

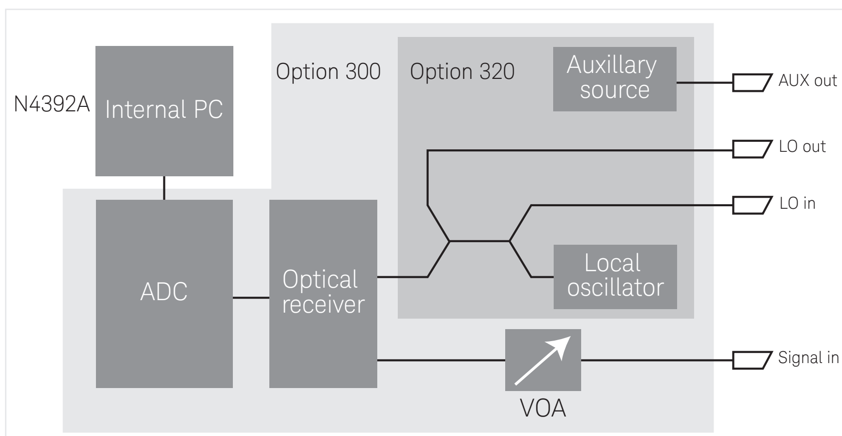


Figure 29.

Software options

- **Additional optical modulation formats package (Option 410):**
  This package extends the available demodulators from the basic configuration (BPSK, (D) QPSK, 16 QAM, user configurable APSK demodulator) with the following demodulators: BPSK, 8BPSK, VSB -8, -16, Offset QPSK, Pi/4 QPSK, 32- ,64-, 128-, 256-, 512-, 1028-, FSK 2-, 4-, 8, 16 level, DQPSK, D8PSK, MSK type 1, type 2 CPM (FM), DVB QAM 16, 32, 64, 128, 256, EDGE, APSK 16/32 (12/4 QAM)
- **User configurable OFDM demodulator (Option 420):**
  This option extends the software with a license for a user configurable OFDM decoder. 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 OIF. For details on characterized parameter and methods, please go to the ICR test section of this data sheet. As a minimum an additional Keysight, software controllable, polarization controller is required.

Optical wavelength range options

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

This 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-410	Additional optical modulation formats package
N4392A-420	Custom OFDM modulation analysis
N4392A-430	ICR characterization package
Receiver upgrade options	
N4392AU-300	Upgrade with 23 GHz optical receiver
N4392AU-310	Upgrade with 23 GHz electrical receiver, 4 differential channel input
Hardware upgrade options	
N4392AU-320	Upgrade with extended local oscillator and source package
Software upgrade options	
N4392AU-410	Additional optical modulation format package
89601B-BHF	Custom OFDM modulation analysis
N4392AU-430	ICR characterization package

N4392AU upgrade options

	Options that can be added			
Installed options	**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.

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