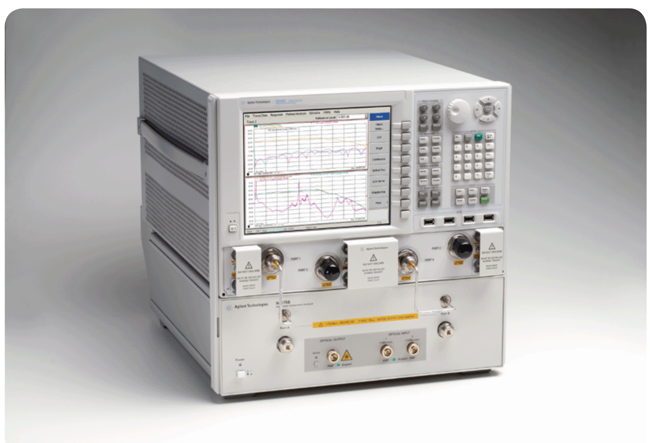
Agilent
N4375B
20 GHz and 26.5 GHz Single-Mode Lightwave Component Analyzer for 10GbE -LR, OC 192, FCx8, FCx17(16)

Data Sheet



Agilent Technologies

General Information

Agilent's N4375B Lightwave Component Analyzer (LCA) is the instrument of choice to test 10G Ethernet, FCx8, FCx10 and FCx16 electro-optical components, with up to 20 or 26.5 GHz modulation range.

Modern optical transmission systems require fast, accurate and repeatable characterization of the core electro-optical components, the transmitter, receiver, and their subcomponents (lasers, modulators and detectors), to guarantee performance with respect to modulation bandwidth, jitter, gain, and distortion of the final transceiver.

For frequency dependent responsivity measurements the N4375B is the successor of the industry standard 8703A/B LCAs.

With a completely new design of the optical test set and a new RF-switched architecture, together with the latest PNA family of network analyzers, the N4375B guarantees excellent electro-optical measurement performance. In addition a unique new calibration concept significantly reduces time from powering up the LCA until the first calibrated measurement can be made. This increases productivity in R&D and on the manufacturing floor.

The fully integrated "turnkey" solution reduces time to market, compared to the time-consuming development of a self-made setup.

By optimizing the electrical and optical design of the N4375B for lowest noise and ripple, the accuracy has been improved by more than a factor of 3 and is now independent of the electrical reflection coefficient of the device under test.

It's the excellent accuracy that improves the yield from tests performed with the N4375B, by narrowing margins needed to pass the tested devices. NIST traceability ensures worldwide comparability of test results.

The advanced optical design together with temperature-stabilized transmitter and receiver ensures repeatable measurements over days without recalibration.

Using the advanced measurement capabilities of the network analyzer, all S-parameter related characteristics of the device under test, like responsivity, ripple, group delay and 3dB-cutoff frequency, can be qualified with the new N4375B Lightwave Component Analyzer from 10 MHz to 20 GHz.

The network analyzer

The N4375B comes in two basic versions. The economic line is based on a PNA-L network-analyzer and is available as a 2 port system. The high end version is based on the new PNA-X and offers true balanced measurements, extended optical modulation index (OMI) and is available with 2 or 4 ports. Both versions have the same specifications up to 20 GHz. The PNA-X based LCA is calibrated up to 26.5 GHz.

Key benefits

- **High absolute and relative accuracy measurements improve the yield of development and production processes. With the excellent accuracy and reproducibility, measurement results can be compared among test locations world wide.**
- **High confidence and fast time-to-market with a NIST-traceable turnkey solution.**
- **Significantly increased productivity using the fast and easy measurement setup with an unique new calibration process leads to lower cost of test.**
- **More than 3 times faster than predecessor 8703A/B series speeds up every test procedure**
- **New switched architecture of optical test set for long-term reliability and stability of test results.**
- **Identical LCA software and remote control across the N437xB family simplifies integration**

Relative frequency response uncertainty:
± 0.5 dB @ 20GHz (typ)

Absolute frequency response uncertainty:
± 1.5 dB @ 20GHz (typ)

Noise floor:
-86 dB W/A for E/O measurements @ 20 GHz
-76 dB A/W for O/E measurements @ 20 GHz

Typical phase uncertainty:
±2.0°

Transmitter wavelength:
1550nm ± 20 nm
1310nm ± 20 nm
1290 - 1610 nm with external source input

Built-in optical power meter
For fast transmitter power verification

Powerful remote control:
State of the art programming interface based on Microsoft .NET or COM.

Warranty:
1 year warranty is standard for N4375B Lightwave Component Analyzer;
Extension to 3 years available.

Agilent N4375B Applications

In digital photonic transmission systems, the performance is ultimately determined by bit error ratio test (BERT), which parameter describes the performance of the whole system. However it is necessary to design and qualify subcomponents like modulators and receivers, which are analog by nature, with different parameters. Those parameters are core to the overall system performance.

These electro-optical components significantly influence the overall performance of the transmission system via the following parameters:

- 3dB bandwidth of the electro-optical transmission
- Relative frequency response, quantifying the electro-optical shape of the conversion.
- Absolute frequency response, relating to the conversion efficiency of signals from the input to the output, or indicating the gain of a receiver.
- Electrical reflection at the RF port
- Group delay of the electro-optical transfer funktion

Only a careful design of these electro-optical components over a wide modulation signal bandwidth guarantees successful operation in the transmission system.

Electro-optical components

The frequency response of amplified or unamplified detector diodes, modulators and directly modulated lasers typically depends on various parameters, like bias voltages, optical input power, operating current and ambient temperature. To determine the optimum operating point of these devices, an LCA helps by making a fast characterization of the electro-optic transfer function while optimizing these operating conditions. In parallel the LCA also measures the electrical return loss.

In manufacturing it is important to be able to monitor the processes regularly to keep up the throughput and yield. In this case the LCA is the tool of choice to monitor transmission characteristics and absolute responsivity of the manufactured device. The remote control of the N4375B offers another tool to improve the productivity by making automated measurements and analysis of the measured data.

Electrical components

Electrical components such as amplifiers, filters and transmission lines are used in modern transmission systems and require characterization to ensure optimal performance. Typical measurements are bandwidth, insertion loss or gain, impedance match and group delay. The new switched architecture offers direct access to the electrical outputs and inputs of the network-analyzers just by selecting electrical- to electrical measurement mode in the LCA user interface.

Agilent N4375B Features

Turnkey solution

In today's highly competitive environment, short time-to-market with high quality is essential for new products. Instead of developing a home-grown measurement solution which takes a lot of time and is limited in transferability and support, a fully specified and supported solution helps to focus resources on faster development and on optimizing the manufacturing process.

In the N4375B all optical and electrical components are carefully selected and matched to each other to minimize noise and ripple in the measurement traces. Together with the temperature stabilized environment of the core components, this improves the repeatability and the accuracy of the overall system. Extended factory calibration data at various optical power levels ensures accurate and reliable measurements that can only be achieved with an integrated solution like the N4375B.

Easy calibration

An LCA essentially measures the conversion relation between optical and electrical signals. This is why user calibration of such systems can evolve into a time consuming task. With the new calibration process implemented in the N4375B, the tasks that have to be done by the user are reduced to one pure electrical calibration. The calibration with an electrical microwave calibration module is automated and needs only minimal manual interaction.

Built-in performance verification

Sometimes it is necessary to make a quick verification of the validity of the calibration and the performance of the system. The N4375B's unique calibration process allows the user to perform a self-test without external reference devices. This gives full confidence that the system performance is within the user's required uncertainty bands.

State-of-the-art remote control

Testing the frequency response of electro-optical components under a wide range of parameters, which is often necessary in qualification cycles, is very time consuming. To support the user in minimizing the effort for performing this huge number of tests, all functions of the LCA can be controlled remotely via LAN over the state-of-the-art Microsoft .NET or COM interface.

Based on programming examples for VBA with Excel, Agilent VEE and C++, it is very easy for every user to build applications for their requirements.

These examples cover applications like integration of complete LCA measurement sequences.

Integrated optical power meter

In applications where optical power dependence characterization is needed, the average power meter can be used to set the exact average output power of the LCA transmitter by connecting the LCA optical transmitter output, optionally through an optical attenuator, to the LCA optical receiver input. By adjusting the transmitter output power in the LCA user interface or the optical attenuation, the desired transmitter optical power can be set.

In cases where an unexpectedly low responsivity is measured from the device under test, it is very helpful to get a fast indication of the CW optical power that is launched into the LCA receiver. The cause might be a bad connection or a bent fiber in the setup. For this reason too, a measurement of the average optical power at the LCA receiver is very helpful for fast debugging of the test setup.

Selectable output power of the transmitter

Most PIN diodes and receiver optical subassemblies (ROSA's) need to be characterized at various average optical power levels. In this case it is necessary to set the average input power of the device under test to the desired value. The variable average optical output power of the LCA transmitter offers this feature. Together with an external optical attenuator, this range can be extended to all desired optical power levels.

Group delay and length measurements

In some applications it is necessary to determine the electrical or optical length of a device. With the internal length calibration of the electro-optical paths with reference to the electrical and optical inputs or outputs, it is possible to determine the length of the device under test

Large signal measurements

LCA S21 measurements are typically small-signal linear transfer function measurements. If an electro-optical component must be tested under large signal conditions, normal balanced measurements might lead to wrong measurement results.

The PNA-X based version of the LCA offers true balanced measurements for differential ports by offering two independent high power RF sources. With this setup the LCA measures the correct S21 transfer function of E/O components, even in the nonlinear regime.

To stimulate O/E components like PIN-TIA receivers under optical large signal conditions, the PNA-X based LCA offers a variable optical modulation index up 50%.

External optical source input

For applications where test of opto-electric devices need to be done at a specific optical wavelength, the N4375B-050 offers an external optical input to the internal modulator where an external tunable laser can be applied. As modulators are polarization sensitive devices, this input is a PMF input to a PMF optical switch to maintain the polarization at the modulator input.

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.

Explanation of terms

Responsivity

For electro-optical devices (e.g. modulators) this describes the ratio of the optical modulated output signal amplitude compared to the RF input amplitude of the device.
For opto-electrical devices (e.g. photodiodes) this describes the ratio of at the RF amplitude at the device output to the amplitude of the modulated optical signal input. .

Relative frequency response uncertainty

Describes the maximum deviation of the shape of a measured trace from the (unknown) real trace. This specification has strong influence on the accuracy of the 3-dB cut-off frequency determined for the device under test.

Absolute frequency response uncertainty

Describes the maximum difference between any amplitude point of the measured trace and the (unknown) real value. This specification is useful to determine the absolute responsivity of the device versus modulation frequency.

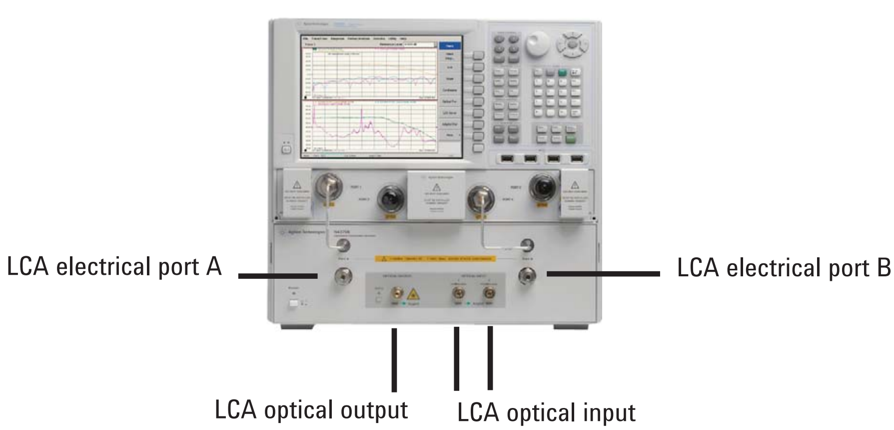
Frequency response repeatability

Describes the deviation of repeated measurement without changing any parameter or connection relative to the average of this measurements.

Minimum measurable frequency response

Describes the average measured responsivity when no modulation signal is present at the device under test. This represents the noise floor of the measurement system.

Definition of LCA input and output names



Measurement capabilities

3dB cut-off frequency (S21),
Responsivity (S21),
Electrical reflection (S11 or S22),
Group Delay vs. frequency,
Insertion Loss (IL),
Transmission bandwidth,
all electrical S-parameter measurements.

Target test devices

Transmitter (E/O)
- Mach-Zehnder modulators
- Electro-absorption modulators (EAM)
- Directly modulated lasers
- Transmitter optical subassemblies (TOSA)

Receiver (O/E)
- PIN diodes
- Avalanche photodiodes (APD)
- Receiver optical subassemblies (ROSA)

Optical (O/O)
- Passive optical components
- Optical fibers and filters
- Optical transmission systems

Agilent N4375B Specifications

Measurement conditions
- Modulation frequency range from 10 MHz to 20.0 GHz
- Foreward RF power +5 dBm, option -312, -314, -392, -394
- Foreward RF power +3 dBm, option -322, -382
- Reverse RF power 0 dBm
- Number of averages: 1
- 100 Hz IFBW (“Reduce IF bandwidth at low frequency” enabled) with modulation frequency step size 10 MHz and measurement points on a 10 MHz raster (if not differently stated)
- Network analyzer set to “stepped sweep – sweep moves in discrete steps”
- All network-analyzer ports configured in standard coupler configuration (“CPLR ARM” to “RCVB B in”, “SOURCE OUT” to “CPLR THRU”)
- After full two-port electrical calibration using an Electronic Calibration Module, Agilent N4691B, at constant temperature (±1° C)
- Modulator bias optimization set to “every sweep”
- Measurement frequency grid equals electrical calibration grid
- DUT signal delay ≤ 0.1/IF-BW
- Specified temperature range: +20° C to +26° C.
- After warm-up time of 90 minutes
- Using high quality electrical and optical connectors and RF cables in perfect condition
- Using internal laser source

Transmitter and Receiver Specifications

Optical Test set		Option -322, -382	Option -312, -314, -392, -394
Operation frequency range		10 MHz to 20 GHz	10 MHz to 26.5 GHz
Connector type	optical input	SMF angled with Agilent versatile connector interface	
	optical output		
	optical source input (rear)	PMF angled, with Agilent versatile connector interface, polarization orientation aligned with connector key	
	RF	3.5 mm male	
LCA optical input			
Operating input wavelength range		1250 nm to 1640 nm [f4]	
Maximum linear average input power [f1]		Optical input 1: +4 dBm Optical input 2: +14 dBm	
Maximum safe average input power		Optical input 1: +7 dBm Optical input 2: +17 dBm	
Optical return loss (typ.) [f1]		> 27 dBo	
Average power measurement range[f1]		Optical input 1: -25 dBm to +4 dBm on optical input 1 Optical input 2: -15 dBm to +14 dBm on optical input 2	
Average power measurement uncertainty (typ.) [f2]		±0.5 dBo	
LCA optical output			
Optical modulation index (OMI) at 10 GHz (typ.)		> 27 % @ +5dBm RF	> 27 % @ +5dBm RF power > 47 % @ +10dBm RF power
Output wavelength	option -100, -102 option -101, -102	(1310 ± 20) nm (1550 ± 20) nm	
Average output power range		-2 dBm to +4 dBm	
Average output power uncertainty (typ.) [f2]		±0.5 dBo	
Average output power stability, 15 minutes (typ.)		±0.5 dBo	
External optical source input (-050)			
Recommended optical input power [f3]		+8 to + 15 dBm	
Optical input power damage level		+20 dBm	
Typical loss at quadrature bias point		9 dB	
Operating input wavelength range		1290 nm to 1610 nm [4]	
LCA RF test port input			
Maximum safe input level at port A or B		+15 dBm RF, 7V DC	

[f1] Wavelength within range as specified for LCA optical output
[f2] After modulator optimization
[f3] Required source characteristics: SMSR > 15 dB, linewidth <10 MHz ,power stability < 0.1dB pp , PER >20 dB, unmodulated, single mode
[f4] Excluding water absprption wavelength

Specifications for electro-optical measurements at 1310 nm (E/O mode)

N4375B system with network analyzer N5230C -225
N5242A -200
N5242A -400

Specifications are valid under the stated measurement conditions.

- At optical input 1 ("+ 7 dBm max"). At optical input 2 ("+ 17 dBm max"), specifications are typicaly the same for 10 dB higher incident average and modulated optical power.
- For wavelength: (1310 ±20) nm (option -100, 102).

System performance		0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz
Relative frequency response uncertainty	DUT response			
	≥ -22 dB(W/A) [f1]	±0.7 dBe typ.	±0.7 dBe (±0.5 dBe typ.)	±0.7 dBe (±0.5 dBe typ.)
	≥ -32 dB(W/A)	±0.7 dBe typ.	±0.5 dBe typ.	±0.5 dBe typ.
	≥ -42 dB(W/A)	±0.8 dBe typ.	±0.6 dBe typ	±0.6 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -22 dB(W/A) [f1]	±1.7 dBe typ	±2.2 dBe (±1.5 dBe typ.)	±2.2 dBe (±1.5 dBe typ.)
Frequency response repeatability (typ.)	DUT response			
	≥ -22 dB(W/A) [f1]	±0.1 dBe	±0.1 dBe	±0.12 dBe
	≥ -32 dB(W/A)	±0.1 dBe	±0.1 dBe	±0.12 dBe
	≥ -42 dB(W/A)	±0.19 dBe	±0.15 dBe	±0.17 dBe
Minimum measurable frequency response (noise floor) [f2] [f4]		-60 dB(W/A)	-86 dB(W/A)	-86 dB(W/A)
Phase uncertainty (typ.) [f3]	DUT response			
	≥ -42 dB(W/A) [f1]	-	±2.0°	±2.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±2.0° ⟶ ±8 ps (1 GHz aperture)		

[f1] For DUT optical peak output power ≤ +7 dBm.
[f2] IFBW = 10 Hz.
[f3] Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a wavelength step size of ≤ 0.2 GHz to avoid phase wraps). Excluding a constant group delay offset of <±0.3 ns typ. (cable length uncertainty < ±0.06 m). A constant group delay offset leads to a phase offset $\Delta\phi = 360° \times \Delta GD \times fmod$ (in deg).
[f4] Average value over frequency range

Specifications for electro-optical measurements at 1550 nm (E/O mode)

N4375B system with network analyzer N5230C -225
N5242A -200
N5242A -400

Specifications are valid under the stated measurement conditions.

- At optical input 1 ("+ 7 dBm max"). At optical input 2 ("+ 17 dBm max"), specifications are typicaly the same for 10 dB higher incident average and modulated optical power.
- For wavelength: (1550 ±20) nm (option -101, 102).

System performance		0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz
Relative frequency response uncertainty	DUT response			
	≥ -22 dB(W/A) [f1]	±0.7 dBe typ.	±0.7 dBe (±0.5 dBe typ.)	±0.7 dBe (±0.5 dBe typ.)
	≥ -32 dB(W/A)	±0.7 dBe typ.	±0.5 dBe typ.	±0.5 dBe typ.
	≥ -42 dB(W/A)	±0.8 dBe typ.	±0.6 dBe typ	±0.6 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -22 dB(W/A) [f1]	±1.7 dBe typ	±1.7 dBe (±1.5 dBe typ.)	±1.8 dBe (±1.5 dBe typ.)
Frequency response repeatability (typ.)	DUT response			
	≥ -22 dB(W/A) [f1]	±0.02 dBe	±0.02 dBe	±0.05 dBe
	≥ -32 dB(W/A)	±0.06 dBe	±0.02 dBe	±0.05 dBe
	≥ -42 dB(W/A)	±0.17 dBe	±0.03 dBe	±0.07 dBe
Minimum measurable frequency response (noise floor) [f2] [f4]		-60 dB(W/A)	-86 dB(W/A)	-86 dB(W/A)
Phase uncertainty (typ.) [f3]	DUT response			
	≥-42 dB(W/A) [f1]	-	±2.0°	±2.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±2.0° ⟶ ±8 ps (1 GHz aperture)		

[f1] For DUT optical peak output power ≤ +7 dBm.
[f2] IFBW = 10 Hz.
[f3] Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a wavelength step size of ≤ 0.2 GHz to avoid phase wraps). Excluding a constant group delay offset of <±0.3 ns typ. (cable length uncertainty < ±0.06 m). A constant group delay offset leads to a phase offset $\Delta\phi = 360° \times \Delta GD \times fmod$ (in deg).
[f4] Average value over frequency range.

Specifications for opto-electrical measurements at 1310 nm (O/E mode)

N4375B system with network analyzer N5230C -225
N5242A -200
N5242A -400

Specifications are valid under the stated measurement conditions.

- With external source optical input all specifications are typical [f2][f6][f7]
- For wavelength: (1310 ±20) nm (option -100, 102)

System performance		0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz
Relative frequency response uncertainty[f2]	DUT response			
	≥ -36 dB(A/W) [f1] [f2]	±0.7 dBe typ.	±0.7 dBe (±0.5 dBe [f8])	±0.8 dBe (±0.5 dBe [f8])
	≥ -46 dB(A/W)	±0.8 dBe typ.	±0.7 dBe typ.	±0.8 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -36 dB(A/W) [f1][f2]	±1.7 dBe typ	±2.0 dBe (±1.6 dBe [f8])	±2.1 dBe (±1.7 dBe [f8])
Frequency response repeatability (typ.) [f2]	DUT response			
	≥ -36 dB(A/W) [f1] [f2]	±0.15 dBe	±0.1 dBe	±0.12 dBe
	≥ -46 dB(A/W)	±0.25 dBe	±0.15 dBe	±0.17 dBe
Minimum measurable frequency response (noise floor) [f2] [f3] [f5]		-49 dB(A/W)	-72 dB(A/W)	-76 dB(A/W)
Phase uncertainty (typ.) [f2][f4]	DUT response			
	≥ -36 dB(A/W) [f1]	-	±2.0°	±2.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±2.0° ⟶ ±8 ps (1 GHz aperture)		

[f1] For DUT response max. +10 dB (A/W).
[f2] For +4 dBm average output power from LCA optical output.
[f3] IFBW = 10 Hz.
[f4] Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a wavelength step size of ≤0.2 GHz to avoid phase wraps). Excluding a constant group delay offset of <±0.3 ns typ. (cable length uncertainty <±0.06 m). A constant group delay offset leads to a phase offset $\Delta\phi = 360° \times \Delta GD \times f_{mod}$ (in deg).
[f5] Average value over frequency range.
[f6] After CW responsivity and user calibration with external source.
[f7] Requires option -100 or -102.
[f8] Typical with internal source.

Specifications for opto-electrical measurements at 1550 nm (O/E mode)

N4375B system with network analyzer N5230C -225
N5242A -200
N5242A -400

Specifications are valid under the stated measurement conditions.

- With external source optical input all specifications are typical [f2][f6][f7]
- For wavelength: (1550 ±20) nm (option -101, 102)

System performance		0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz
Relative frequency response uncertainty[f2]	DUT response			
	≥ -36 dB(A/W) [f1] [f2]	±0.7 dBe typ.	±0.7 dBe (±0.5 dBe [f8])	±0.8 dBe (±0.5 dBe [f8])
	≥ -46 dB(A/W)	±0.8 dBe typ.	±0.7 dBe typ.	±0.8 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -36 dB(A/W) [f1][f2]	±1.5 dBe typ	±1.8 dBe (±1.5 dBe [f8])	±1.8 dBe (±1.5 dBe [f8])
Frequency response repeatability (typ.) [f2]	DUT response			
	≥ -36 dB(A/W) [f1] [f2]	±0.15 dBe	±0.05 dBe	±0.05 dBe
	≥ -46 dB(A/W)	±0.25 dBe	±0.1 dBe	±0.1 dBe
Minimum measurable frequency response (noise floor) [f2] [f3] [f5]		-49 dB(A/W)	-72 dB(A/W)	-76 dB(A/W)
Phase uncertainty (typ.) [f2][f4]	DUT response			
	≥ -36 dB(A/W) [f1]	-	±2.0°	±2.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±2.0° ⟶ ±8 ps (1 GHz aperture)		

[f1] For DUT response max. +10 dB (A/W).
[f2] For +4 dBm average output power from LCA optical output.
[f3] IFBW = 10 Hz.
[f4] Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a wavelength step size of ≤0.2 GHz to avoid phase wraps). Excluding a constant group delay offset of <±0.3 ns typ. (cable length uncertainty <±0.06 m). A constant group delay offset leads to a phase offset Δφ = 360° × ΔGD × fmod.(in deg).
[f5] Average value over frequency range.
[f6] After CW responsivity and user calibration with external source.
[f7] Requires option -101 or -102.
[f8] Typical with internal source.

Specifications for optical to optical measurements at 1310 nm (O/O mode)

N4375B system with networrk analyzer N5230C -225
N5242A -200
N5242A -400

Specifications are valid under the stated measurement conditions and after user calibration with LCA optical output set to maximum average power (+4 dBm)

- At optical input 1 ("+ 7 dBm max"). At optical input 2 ("+ 17 dBm max"), specifications are typicaly the same for 10 dB higher incident average and modulated optical power.
- With external source optical input all specifications are typical [f2][f6][f7]
- For wavelength: (1310 ±20) nm (option -100, 102).

System performance		0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz
Relative frequency response uncertainty[f3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [f4]	±0.25 dBe, (typ.) (±0.125 dBo), (typ.)	±0.25 dBe (±0.125 dBo)	±0.25 dBe (±0.125 dBo)
Absolute frequency response uncertainty[f3]	DUT response	.		
	≥ -13 dBe [f4] (≥-6.5 dBo)	±1.2 dBe typ. (±0.6 dBo typ.)	±1.2 dBe (±0.6 dBo)	±1.2 dBe (±0.6 dBo)
Frequency response repeatability (typ.) [f3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [f4]	±0.1 dBe	±0.1 dBe	±0.1 dBe
Minimum measurable frequency response (noise floor) [f1] [f3][f5]		-35 dBe (-17.5 dBo)	-60 dBe (-30 dBo)	-64 dBe (-32 dBo)
Phase uncertainty (typ.) [f2][f3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [f4]	-	±2.0°	±2.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±2.0° ⟶ ±8 ps (1 GHz aperture)		

[f1] IFBW = 10 Hz.
[f2] Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a wavelength step size of ≤ 0.2 GHz to avoid phase wraps).
[f3] For +4 dBm average output power from LCA optical output.
[f4] For DUT response maximum +6 dBe (+3dBo) gain.
[f5] Average value over frequency range.
[f6] After CW responsivity and user calibration with external source.
[f7] Requires option -100 or -102.

Specifications for optical to optical measurements at 1550 nm (O/O mode)

N4375B system with networrk analyzer N5230C -225
N5242A -200
N5242A -400

Specifications are valid under the stated measurement conditions and after user calibration with LCA optical output set to maximum average power (+4 dBm)

- At optical input 1 ("+ 7 dBm max"). At optical input 2 ("+ 17 dBm max"), specifications are typicaly the same for 10 dB higher incident average and modulated optical power.
- With external source optical input all specifications are typical [f2][f6][f7]
- For wavelength: (1550 ±20) nm (option -101, 102).

System performance		0.05 GHz to 0.2 GHz	0.2 GHz to 0.7 GHz	0.7 GHz to 20 GHz
Relative frequency response uncertainty[f3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [f4]	±0.25 dBe, (typ.) (±0.125 dBo), (typ.)	±0.25 dBe (±0.125 dBo)	±0.25 dBe (±0.125 dBo)
Absolute frequency response uncertainty[f3]	DUT response			
	≥ -13 dBe [f4] (≥-6.5 dBo)	±1.2 dBe typ. (±0.6 dBo typ.)	±1.2 dBe (±0.6 dBo)	±1.2 dBe (±0.6 dBo)
Frequency response repeatability (typ.) [f3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [f4]	±0.06 dBe	±0.02 dBe	±0.04 dBe
Minimum measurable frequency response (noise floor) [f1] [f3][f5]		-35 dBe (-17.5 dBo)	-60 dBe (-30 dBo)	-64 dBe (-32 dBo)
Phase uncertainty (typ.) [f2][f3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [f4]	-	±2.0°	±2.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±2.0° ⟶ ±8 ps (1 GHz aperture)		

[f1] IFBW = 10 Hz.
[f2] Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a wavelength step size of ≤ 0.2 GHz to avoid phase wraps).
[f3] For +4 dBm average output power from LCA optical output.
[f4] For DUT response maximum +6 dBe (+3dBo) gain.
[f5] Average value over frequency range.
[f6] After CW responsivity and user calibration with external source.
[f7] Requires option -101 or -102.

Specifications for electrical-electrical measurements (E/E mode)

For detailed specification of the network analyzer see corresponding data sheet.

N4375B: option -322, -382	N5230C -225
option -312, -392	N5242A -200
option -314, -394	N5242A -400

Optical test set

Electrical loss of optical test set	< 2.0 dBe (typ.)

Group delay uncertainty

For more details see specifications of the N5230C and N5242A.

Group delay

Group delay is computed by measuring the phase change within a specified aperture (for aperture see below.

$$GD\ [s] = \frac{\text{Phase change [deg]}}{\text{Aperture [Hz]} * 360} \qquad (1)$$

Group delay uncertainty

Is calculated from the specified phase uncertainty and from the aperture (for aperture see below):

$$GD\ [\pm s] = \frac{\text{Phase uncertainty } [\pm\text{deg}]}{\text{Aperture [Hz]} * 360} * \text{sqrt}(2) \qquad (2)$$

Aperture

Determined by the frequency span and the number of points per sweep

Aperture: (frequency span) / (number of points–1)

GD Range

The maximum group delay is limited to measuring no more than ±180 degrees of phase change within the selected aperture (see Equation 1).

General Characteristics

Assembled dimensions: (H x W x D)

-322	41.3 cm x 43.8 cm x 47.3 cm, (16.3 in x 17.3 in x 18.7 in)
-312, -314	41.3 cm x 43.8 cm x 53.8 cm, (16.3 in x 17.3 in x 21.2 in)

Weight

Product net weight:

-322	34 kg (74.9 lbs)
-312	36 kg (79.4 lbs)
-314	46 kg (101.4 lbs)

Packaged product:

-322	54 kg (119 lbs)
-312	56 kg (123.5 lbs)
-314	66 kg (145.7 lbs)

Power Requirements

100 to 240 V~, 50 to 60 Hz

2 power cables

N5230C	max. 350 VA
N5242A	max 450 VA
Optical test set:	max. 40 VA

Network-analyzer

Option 322	N5230C -225
Option 312	N5242A -200
Option 314	N5242A -400

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

Laser Safety Information

All laser sources listed above are classified as Class 1M according to IEC 60825 1 (2001).
All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2001-July-26

Shipping contents

1x Network-analyzer depending on option selected option
1x N4375B optical test set
3x 81000NI FC connector interface narrow key
1x N4373-6127 f 3.5 mm - f 3.5 mm RF short cut cable
1x 4375B-90A01 Getting started
1x 4373B-90CD1 LCA support CD
1x 1150-7896 Keyboard
1x 1150-7799 Mouse
1x 8121-1242 USB cable
1x E5525-10285 UK6 report
1x N4373-61627 electrical short cut cable
1x 9320-6677 RoHS addendum for Photonic accessories
1x 9320-6654 RoHS addendum for Photonic T&M products

Additional, option dependent shipping contents:

-021 straight connector[1]
2x N4373-87907 0.5m FC/PC -FC/APC patch cord
1x 1005-0256 FC/FC adaptor
-022 angled connector [1]
2x N4373-87906 0.5m FC/APC - FC/APC patch cord
1x 1005-1027 FC/FC adaptor
-322, 312, -382,-392 2 port LCA:
1x E7342-60004 0.5 m (m) to (f) high performance RF cable
-314, -394 4 port LCA:
2x E7342-60004 0.5 m (m) to (f) high performance RF cable
-050 external optical source input
1x PMF patchcord 1.0m FC/APC narrow key
1x 81000NI optical adapter FC

LCA connector types at optical testset

LCA electrical input	3.5 mm (m)
LCA electrical output	3.5 mm (m)
LCA optical input 1	9um single-mode angled [1], with Agilent universal adapter
LCA optical input 2	9um single-mode angled [1], with Agilent universal adapter
LCA optical output	9um single-mode angled[1], with Agilent universal adapter
LCA external TX input (option -050 only)	9um polarization maintaining single-mode angled, with Agilent universal adapter

[1] The optical test set always has angled connectors. Depending on the selected option (-012 straight, -022 angled) the appropriate jumper cable will be delivered.
This jumper cable must always be used in front to the optical test set to protect the connectors at the optical test set

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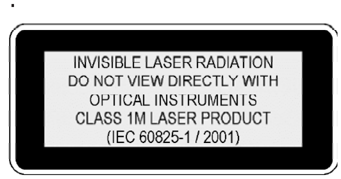
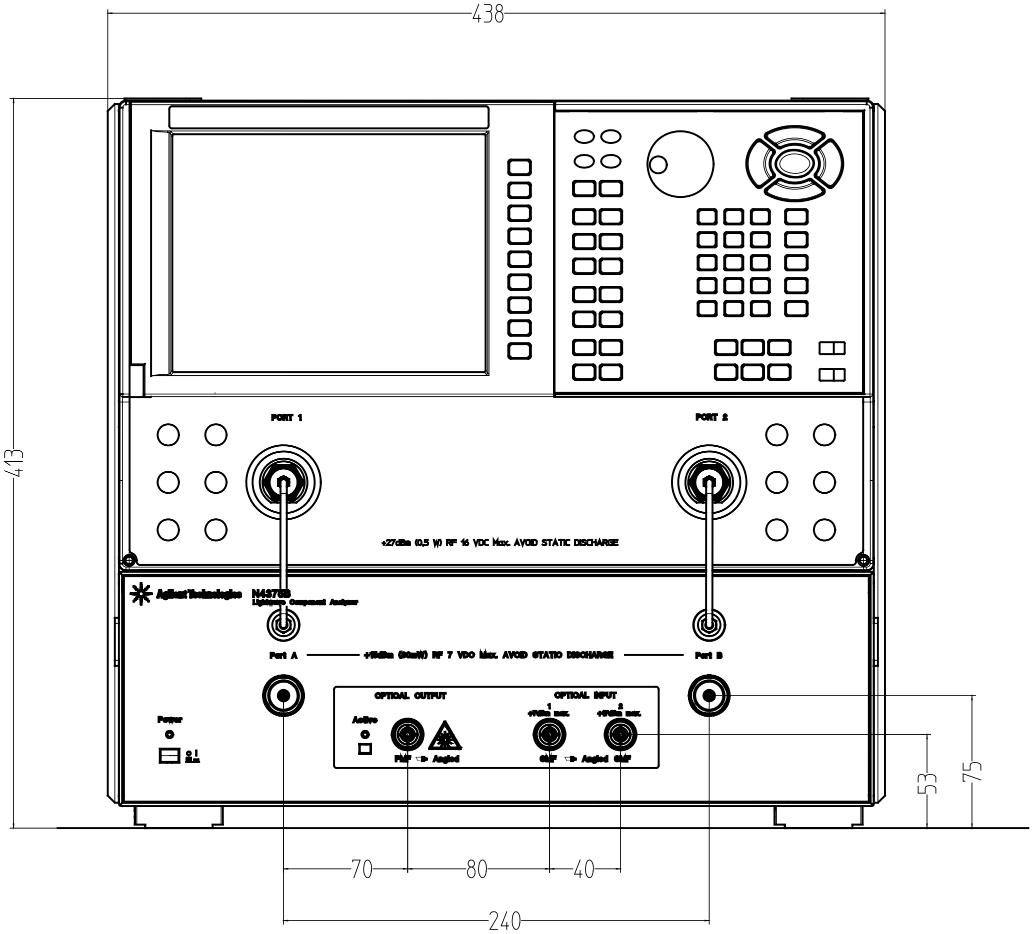
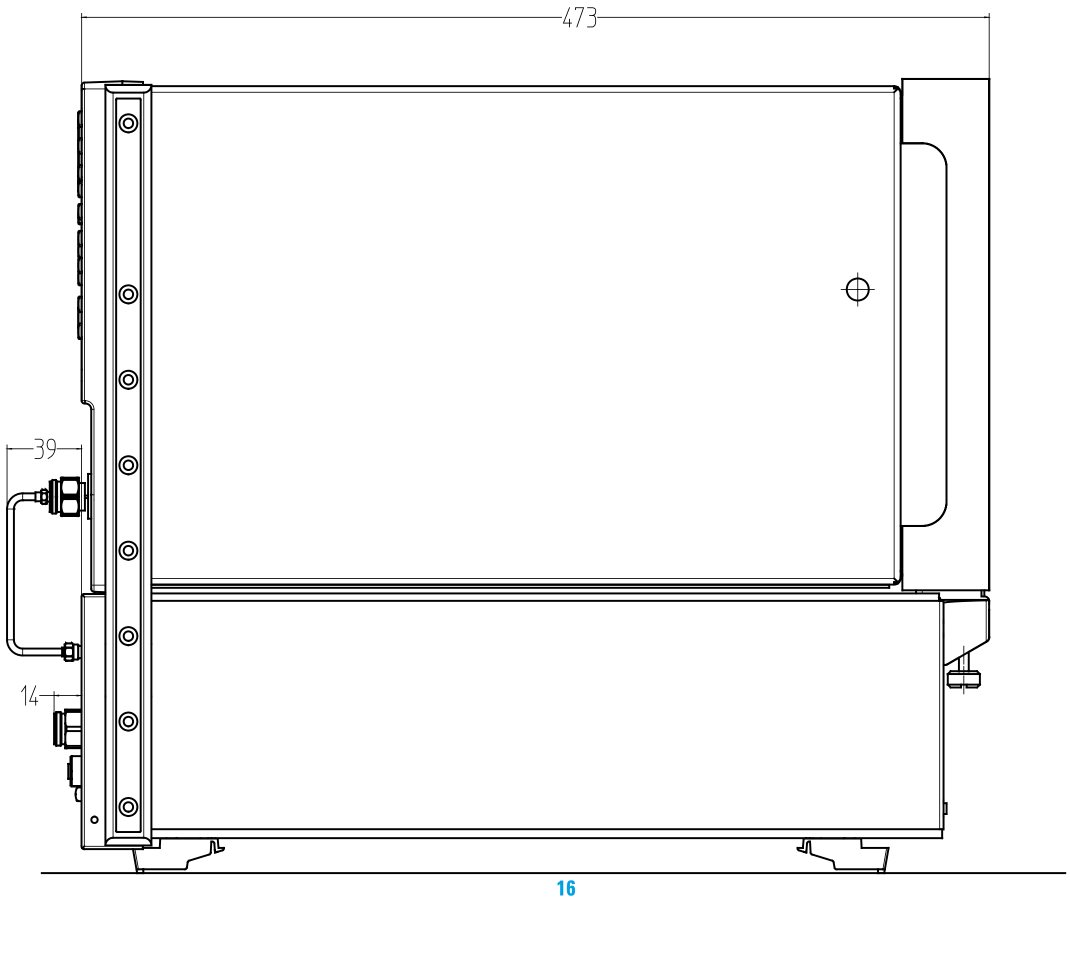
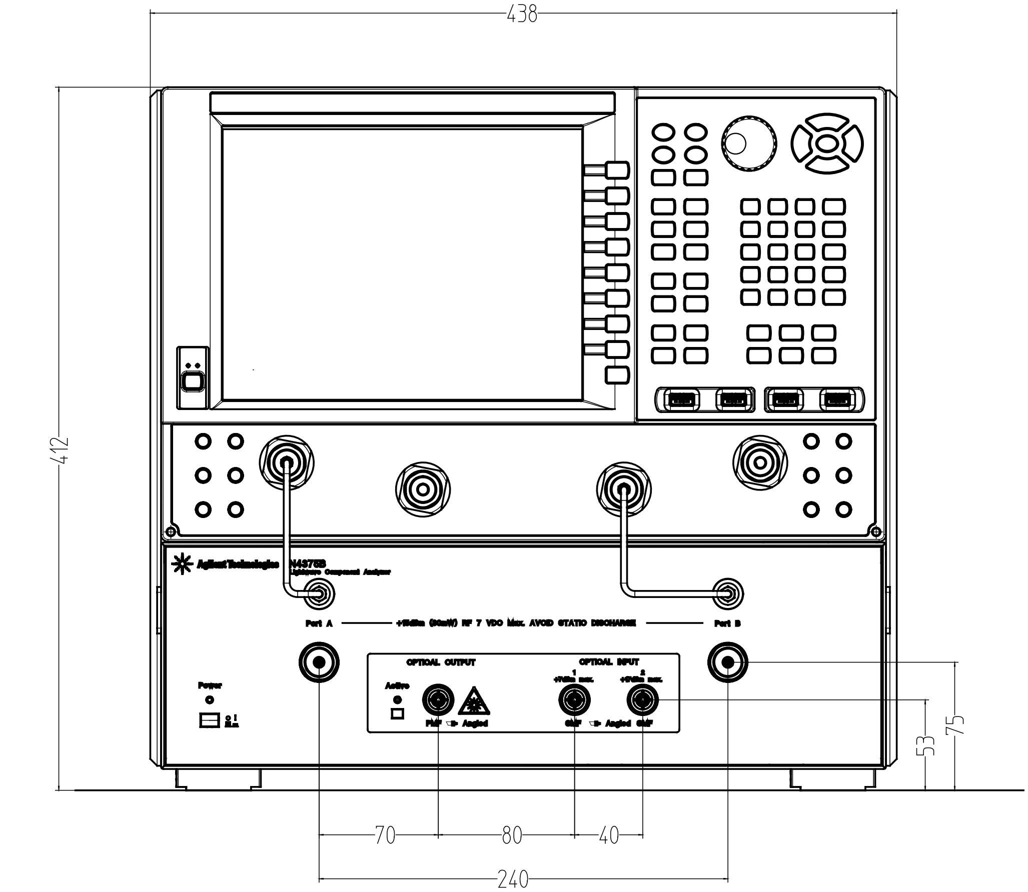


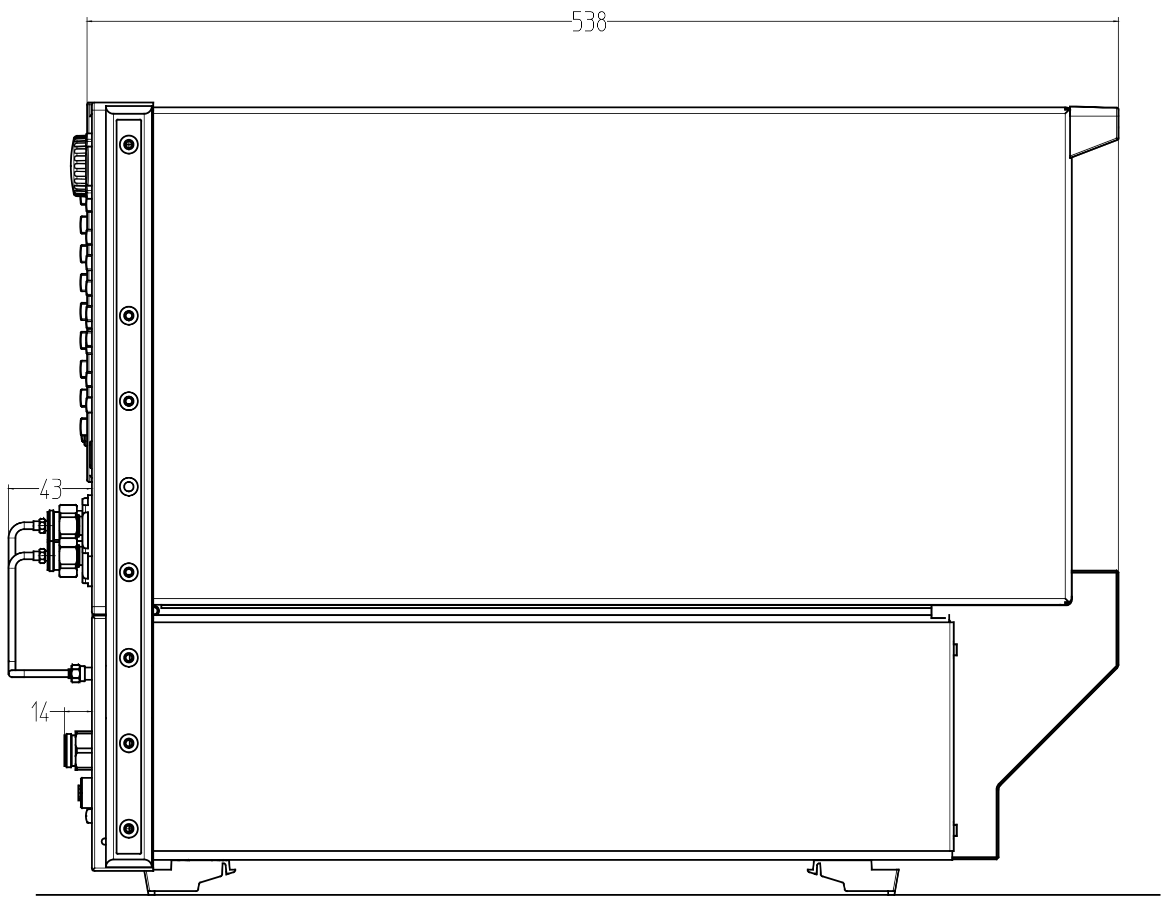
Mechanical Outline Drawings, option -322, -382 (all dimensions in mm)





Mechanical Outline Drawings, option -312, -314, -392, -394 (all dimensions in mm)





Ordering informations

The N4375B consists of an optical test set and an electrical network analyzer which are mechanically connected.
To protect your network analyzer investment, Agilent offers the integration of an already owned PNA-L or PNA-X with the optical test set as listed below.
All systems have 1 year warranty.

N4375B LCA ordering options

Network-analyzer options	
N4375B - 322	20 GHz 2 port LCA based on N5230C -225
N4375B - 312	20/26.5 GHz 2 port LCA based on N5242A -200
N4375B - 314	20/26.5 GHz 2 port LCA based on N5242A -400

Network-analyzer integration options	
N4375B - 382	Integration of customer PNA-L - N5230A/C -220, -225 - for other NWA call factory
N4375B - 392	Integration of customer PNA- X - N5242A -200, - N5242A -219 (all specifications typical) - for other NWA call factory
N4375B - 394	Integration of customer PNA- X - N5242A -400, - N5242A -419 (all specifications typical) - for other NWA call factory

Optical wavelength options	
N4375B-100	1310 nm source optical test set
N4375B-101	1550 nm source optical test set
N4375B-102	1310 nm and 1550 nm source optical test set

Configuration independent options	
N4375B-010	Time domain
N4375B-050	External optical source input
N4375B-021	Straight connector interface (external 0.5 m patch cord)
N4375B-022	Angled connector interface (external 0.5 m patch cord)

Service and Repair	
R1280A	1 year Return-to-Agilent warranty extended to 3 or 5 years
R1282A	Calibration up front support plan 3 or 5 year coverage

Required accessories (to be ordered separately!)	
N4691B	2 port microwave electrical calibration module (-00F recommended)

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