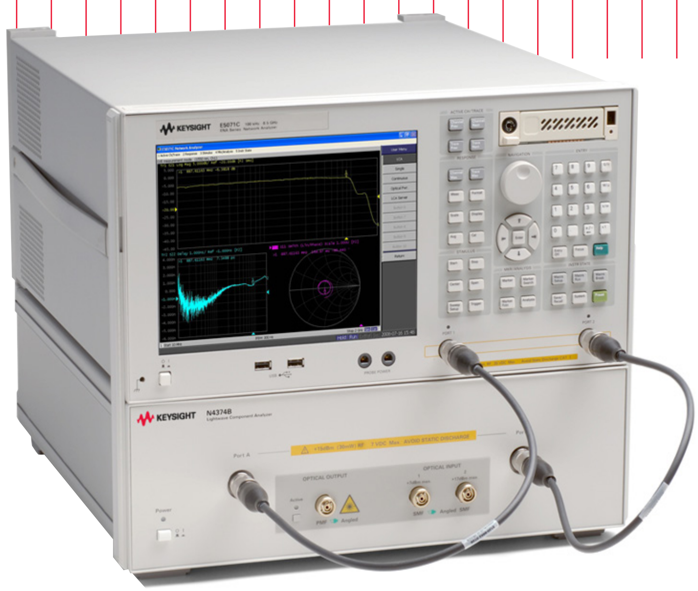
Keysight N4374B
4.5 GHz Single-Mode Lightwave Component Analyzer for CATV and Radio over Fiber

Data Sheet



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

General Information

The Keysight Technologies, Inc. N4374B Lightwave Component Analyzer (LCA) is optimized for the electro-optical S-parameter measurement for Cable TV (CATV) and Radio over Fiber (RoF) or radio frequency over Glass (RFoG) applications.

In modern CATV or RoF/RFoG transmission systems analog signals are directly transmitted over optical fiber. This requires very low distortion of the electro-optical devices at the transmitter and the receiver side. Therefore it is necessary to have very flat transfer characteristic in amplitude and delay. The N4374B LCA is the tool of choice to optimize your design for these parameters.

For frequency dependent responsivity measurements the N4374B is the successor of the industry standard 8702 LCA series. It supports 75 Ohm test with a minimum loss pad (MLP).

With a completely new design of the optical test set together with the newest ENA based network analyzer, the N4374B guarantees excellent electro-optical measurement performance. It's the excellent accuracy that improves the yield from tests performed with the N4374B, by narrowing margins needed to pass the tested devices. NIST traceability ensures world-wide comparability of test results.

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

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.

By optimizing the electrical and optical design of the N4374B for lowest noise and ripple, the accuracy has been improved by more than a factor of 5 compared to the 8702 series LCA and is now independent of the electrical reflection coefficient of the device under test.

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 N4374B Lightwave Component Analyzer from 100kHz to 4.5 GHz.

The network analyzer

The N4374B is based on the newest E5071C ENA network analyzer series. The network analyzer includes a Bias-T for biasing the electro-optical components.

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 a unique new calibration process leads to lower cost of test.
- 75 Ohm support
- Specified phase uncertainty
- More than 5 times faster than predecessor 8702 series speeds up every test procedure
- Identical LCA software and remote control across the N437xB family simplifies integration
- Bias-T included in Network Analyzer

Relative frequency response uncertainty:

± 0.6 dB @ 4.5GHz (typ)

Absolute frequency response uncertainty:

± 1.3 dB @ 4.5GHz (typ)

Noise floor:

-103 dB W/A for E/O measurements @ 4.5 GHz
-90 dB A/W for O/E measurements @ 4.5 GHz

Typical phase uncertanty:

±1.5° max

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.

Keysight N4374B Applications

In photonic CATV or RoF transmission systems, it is necessary to design and qualify subcomponents like direct modulated lasers 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 function

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 N4374B 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.

Keysight N4374B 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 N4374B 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 N4374B.

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 N4374B, the tasks that have to be done by the user are reduced to one pure electrical calibration. The calibration with an electrical calibration module is automated and needs only minimal manual interaction. With the minimum loss pad (MLP) which is part of the LCA shipment the impedance match from 50 Ohm LCA system to 75 Ohm test device can be realized in an easy way. The correction for the 75 Ohm impedance is enabled with one button in the LCA software which uses default data to correct the MLP transfer behavior. For higher accuracy an individual calibration of the MLP can be realized with the adaptor removal tool which is part of each ENA-C

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 N4374B'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. This interface is identical for all LCA of the N437xB/C series.

Based on programming examples for VBA with Excel, Keysight 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 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

External optical source input

For applications where test of opto-electric devices need to be done at a specific optical wavelength, the N4374B-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 internal modulator.

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.

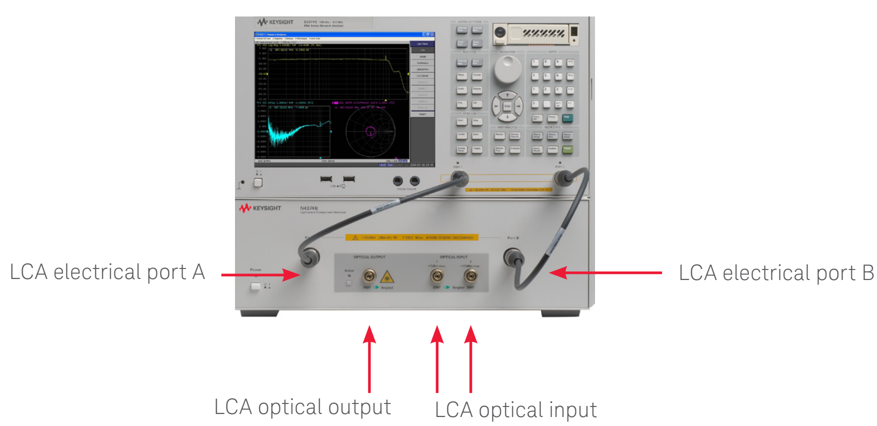
Frequency response repeatability

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

Keysight N4374B Specifications

Measurement conditions

- Modulation frequency range from 10 MHz to 4.5 GHz
- Foreward and reverse RF power +5 dBm
- Number of points 899
- Number of averages: 1
- IFBW 300 Hz
- Network analyzer set to “stepped sweep – sweep moves in discrete steps”
- After full two-port electrical calibration using an Electronic Calibration Module, Keysight 85092C, 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 supplied RF cables (8120-8862)

Transmitter and Receiver Specifications

Optical Test set		**Option -332, -362**
Operation frequency range		100 kHz to 4.5 GHz
Connector type	optical input optical output	SMF angled with Keysight versatile connector interface
	optical source input (rear)	PMF angled, with Keysight versatile connector interface, polarization orientation aligned with connector key
	RF	N type, female
LCA optical input		
Operating input wavelength range		1250 nm to 1640 nm [4]
Maximum linear average input power [1]		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.) [1]		> 27 dBo
Average power measurement range [1]		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.) [1]		±0.5 dBo
LCA optical output (internal source)		
Optical modulation index (OMI) at 1 GHz (typ.)		> 30 % @ +5 dBm 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.) [2]		±0.5 dBo
Average output power stability, 15 minutes (typ.)		±0.5 dBo
External optical source input (-050)		
Optical input power range for typical performance		+8 dBm to +15dBm
Optical input damage level		+20 dBm
Typical loss at quadrature bias point		9 dB
Operating input wavelength range		1290 nm to 1640 nm [4]
LCA RF test port input		
Maximum safe input level at port A or B		+15 dBm RF, 7V DC

1. Wavelength within range as specified for LCA optical output
2. After modulator optimization
3. Required source characteristics: SMSR : >35 dB, line width <10 MHz, power stability < 0.1 dB, PER > 20dB, unmodulated, single mode
4. Excluding water absorption wavelength

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

N4374B system with network analyzer E5071C -245

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

System performance		10 MHz to 50 MHz	50 MHz to 0.7 GHz	0.7 GHz to 4.5 GHz
Relative frequency response uncertainty	DUT response			
	≥ -18 dB(W/A) [1]	±0.5 dBe typ.	±0.7 dBe (±0.5 dBe typ.)	±0.8 dBe (±0.6 dBe typ.)
	≥ -38 dB(W/A)	±0.5 dBe typ.	±0.5 dBe typ	±0.6 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -18 dB(W/A) [1]	±1.3 dBe typ	±2.2 dBe (±1.3 dBe typ.)	±2.2 dBe (±1.3 dBe typ.)
Frequency response repeatability (typ.)	DUT response			
	≥ -38 dB(W/A) [1]	±0.02 dBe	±0.02 dBe	±0.02 dBe
Minimum measurable frequency response (noise floor) [2, 4]		-98 dB(W/A) typ.	-103 dB(W/A)	-103 dB(W/A)
Phase uncertainty (typ.) [3]	DUT response			
	≥ -38 dB(W/A) [1]	-	±1.5°	±1.5°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±1.0° & ±8 ps (0.5 GHz aperture)		

1. For DUT optical peak output power ≤ +7 dBm.
2. IFBW = 100 Hz.
3. Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a frequency 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 Δf = 360° × ΔGD × fmod (in deg).
4. Average value over frequency range

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

N4374B system with network analyzer E5071C -245

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

System performance		10 MHz to 50 MHz	50 MHz to 0.7 GHz	0.7 GHz to 4.5 GHz
Relative frequency response uncertainty	DUT response			
	≥ -18 dB(W/A) [1]	±0.5 dBe typ.	±0.7 dBe (±0.5 dBe typ.)	±0.8 dBe (±0.6 dBe typ.)
	≥ -38 dB(W/A)	±0.5 dBe typ.	±0.5 dBe typ	±0.6 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -18 dB(W/A) [1]	±1.3 dBe typ	±2.2 dBe (±1.3 dBe typ.)	±2.2 dBe (±1.3 dBe typ.)
Frequency response repeatability (typ.)	DUT response			
	≥ -38 dB(W/A [1]	±0.02 dBe	±0.02 dBe	±0.02 dBe
Minimum measurable frequency response (noise floor) [2, 4]		-100 dB(W/A) typ.	-103 dB(W/A)	-103 dB(W/A)
Phase uncertainty (typ.) [3]	DUT response			
	≥-38 dB(W/A) [1]	-	±1.0°	±1.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±1.0° & ±8 ps (0.5 GHz aperture)		

1. For DUT optical peak output power ≤ +7 dBm.
2. IFBW = 100 Hz.
3. Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a frequency 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 Δf = 360° × ΔGD × fmod (in deg).
4. Average value over frequency range.

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

N4374B system with network analyzer E5071C -245

Specifications are valid under the stated measurement conditions.

- With external optical source input all specifications are typical [2, 6, 7]
- For wavelength: (1310 ±20) nm (option -100, 102)

System performance		10 MHz to 50 GHz	50 MHz to 0.7 GHz	0.7 GHz to 4.5 GHz
Relative frequency response uncertainty [2]	DUT response			
	≥ -36 dB(A/W) [1]	±0.5 dBe typ.	±0.7 dBe (±0.5 dBe [8]	±0.8 dBe (±0.6 dBe [8])
	≥ -46 dB(A/W)	±0.5 dBe typ.	±0.5 dBe typ.	±0.6 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -36 dB(A/W) [1]	±1.2 dBe typ	±1.8 dBe (±1.2 dBe [8])	±1.8 dBe (±1.2 dBe [8])
Frequency response repeatability (typ.) [2]	DUT response			
	≥ -46 dB(A/W) [1]	±0.02 dBe	±0.02 dBe	±0.03 dBe
Minimum measurable frequency response (noise floor) [2,3,5]		-83 dB(A/W) typ.	-92 dB(A/W)	-92 dB(A/W)
Phase uncertainty (typ.) [2,4]	DUT response			
	≥ -36 dB(A/W) [1]	-	±1.0°	±1.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±1.0° & ±8 ps (0.5 GHz aperture)		

1. For DUT response max. +10 dB (A/W).
2. For +4 dBm average output power from LCA optical output
3. IFBW = 100 Hz.
4. Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a frequency 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 $\Delta f = 360° \times \Delta GD \times$ fmod.(in deg).
5. Average value over frequency range.
6. After CW responsivity and user calibration with external source.
7. Requires option -100 or -102.
8. Typical with internal source.

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

N4374B system with network analyzer E5071C -245

Specifications are valid under the stated measurement conditions.
- With external optical source input all specifications are typical [2, 6, 7]
- For wavelength: (1550 ±20) nm (option -101, 102)

System performance		10 MHz to 50 MHz	50 MHz to 0.7 GHz	0.7 GHz to 4.5 GHz
Relative frequency response uncertainty [2]	DUT response			
	≥ -36 dB(A/W) [1]	±0.5 dBe typ.	±0.7 dBe (±0.5 dBe [8])	±0.8 dBe (±0.6 dBe [8])
	≥ -46 dB(A/W)	±0.5 dBe typ.	±0.5 dBe typ.	±0.6 dBe typ.
Absolute frequency response uncertainty	DUT response			
	≥ -36 dB(A/W) [1]	±1.2 dBe typ	±2.0 dBe (±1.2 dBe [8])	±2.1 dBe (±1.2 dBe [8])
Frequency response repeatability (typ.) [2]	DUT response			
	≥ -46 dB(A/W) [1]	±0.02 dBe	±0.02 dBe	±0.03 dBe
Minimum measurable frequency response (noise floor) [2, 3, 5]		-83 dB(A/W) typ.	-92 dB(A/W)	-90 dB(A/W)
Phase uncertainty (typ.) [2, 4]	DUT response			
	≥ -36 dB(A/W) [1]	-	±1.0°	±1.0°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±1.0° & ±8 ps (0.5 GHz aperture)		

1. For DUT response max. +10 dB (A/W).
2. For +4 dBm average output power from LCA optical output
3. IFBW = 100 Hz.
4. Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a frequency 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 $\Delta f = 360° \times \Delta GD \times fmod$.(in deg).
5. Average value over frequency range.
6. After CW responsivity and user calibration with external source.
7. Requires option -101 or -102.
8. Typical with internal source.

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

N4374B system with networrk analyzer E5071C -245

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 typically the same for 10 dB higher incident average and modulated optical power.
- With external optical source input all specifications are typical [2, 6, 7]
- For wavelength: (1310 ±20) nm (option -100, 102).

System performance		10 MHz to 50 MHz	50 MHz to 0.7 GHz	0.7 GHz to 4.5 GHz
Relative frequency response uncertainty [2]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [4]	±0.25 dBe, (typ.) (±0.125 dBo), (typ.)	±0.25 dBe (±0.125 dBo)	±0.25 dBe (±0.125 dBo)
Absolute frequency response uncertainty [2]	DUT response	.		
	≥ -13 dBe [4] (≥-6.5 dBo)	±1.0 dBe typ. (±0.5 dBo typ.)	±1.0 dBe (±0.5 dBo)	±1.0 dBe (±0.65dBo)
Frequency response repeatability (typ.) [2]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [4]	±0.02 dBe	±0.02 dBe	±0.02 dBe
Minimum measurable frequency response (noise floor) [1, 3, 5]		-76 dBe typ. (-38 dBo)	-82 dBe (-41 dBo)	-80 dBe (-40 dBo)
Phase uncertainty (typ.) [2, 3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [4]	-	±0.5°	±0.5°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±1.0° & ±8 ps (0.5 GHz aperture)		

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

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

N4374B system with networrk analyzer E5071C -245

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 typically the same for 10 dB higher incident average and modulated optical power.
- With external optical source input all specifications are typical [2, 6, 7]
- For wavelength: (1550 ±20) nm (option -101, 102).

System performance		10 MHz to 50 MHz	50 MHz to 0.7 GHz	0.7 GHz to 4.5 GHz
Relative frequency response uncertainty [2]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [4]	±0.25 dBe, (typ.) (±0.125 dBo), (typ.)	±0.25 dBe (±0.125 dBo)	±0.25 dBe (±0.125 dBo)
Absolute frequency response uncertainty [2]	DUT response			
	≥ -13 dBe [4] (≥-6.5 dBo)	±1.0 dBe typ. (±0.5 dBo typ.)	±1.0 dBe (±0.5 dBo)	±1.0 dBe (±0.65dBo)
Frequency response repeatability (typ.) [2]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [4]	±0.02 dBe	±0.02 dBe	±0.02 dBe
Minimum measurable frequency response (noise floor) [1, 3, 5]		-76 dBe typ. (-38 dBo)	-82 dBe (-41 dBo)	-80 dBe (-40 dBo)
Phase uncertainty (typ.) [2, 3]	DUT response			
	≥ -13 dBe (≥-6.5 dBo) [4]	-	±0.5°	±0.5°
Group delay uncertainty		Derived from phase uncertainty, see section "Group delay uncertainty". Example: ±1.0° & ±8 ps (0.5 GHz aperture)		

1. IFBW = 100 Hz.
2. For +4 dBm average output power from LCA optical output.
3. Except phase wrap aliasing (example: a DUT group delay of 5 ns (1 m cable length) requires a frequency step size of ≤ 0.2 GHz to avoid phase wraps).
4. For DUT response maximum +6 dBe (+3dBo) gain.
5. Average value over frequency range.
6. After CW responsivity and user calibration with external source.
7. Requires option -101 or -102.

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

All specifications of the E5071C -245 Network Analyzer apply.
Please see the corresponding Network Analyzer data sheet and User's Guide

Group delay uncertainty

For more details see specifications of the E5071C.

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)

37.1 cm x 43.8 cm x 47.3 cm,
(12.5 in x 17.3 in x 18.7 in)

Weight

Product net weight:
27.3 kg (lbs)

Packaged product:
47.3 kg (104.3 lbs)

Power Requirements

90 to 132 V AC, or 198 to 264V AC
Automatic switched
47 to 63 Hz

2 power cables

E5071C	max. 350 VA
Optical test set:	max. 40 VA

Network analyzer

Option 332	E5071C -245

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

Shipping contents

1x Network-analyzer E5071C-245
1x N4374B optical test set
3x 81000 NI optical adapter
1x 4374B-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
2x 8120-8862 N-type male-male RF cable (0.5m)
1x 9320-6677 RoHS addendum for Photonic accessories
1x 9320-6654 RoHS addendum for Photonic T&M products
1x 11852B-CFG001 Minimum loss pad

Additional, option dependent shipping contents:

-021 straight connector:
2x N4373-87907 0.5m FC/APC to FC/PC patch cord
1x 1005-0256 FC/PC feedthrough
-022 angled connector:
2x N4373-87906 0.5m FC/APC to FC/APC patch cord
1x 1005-1027 FC/PC adapter for APC
-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

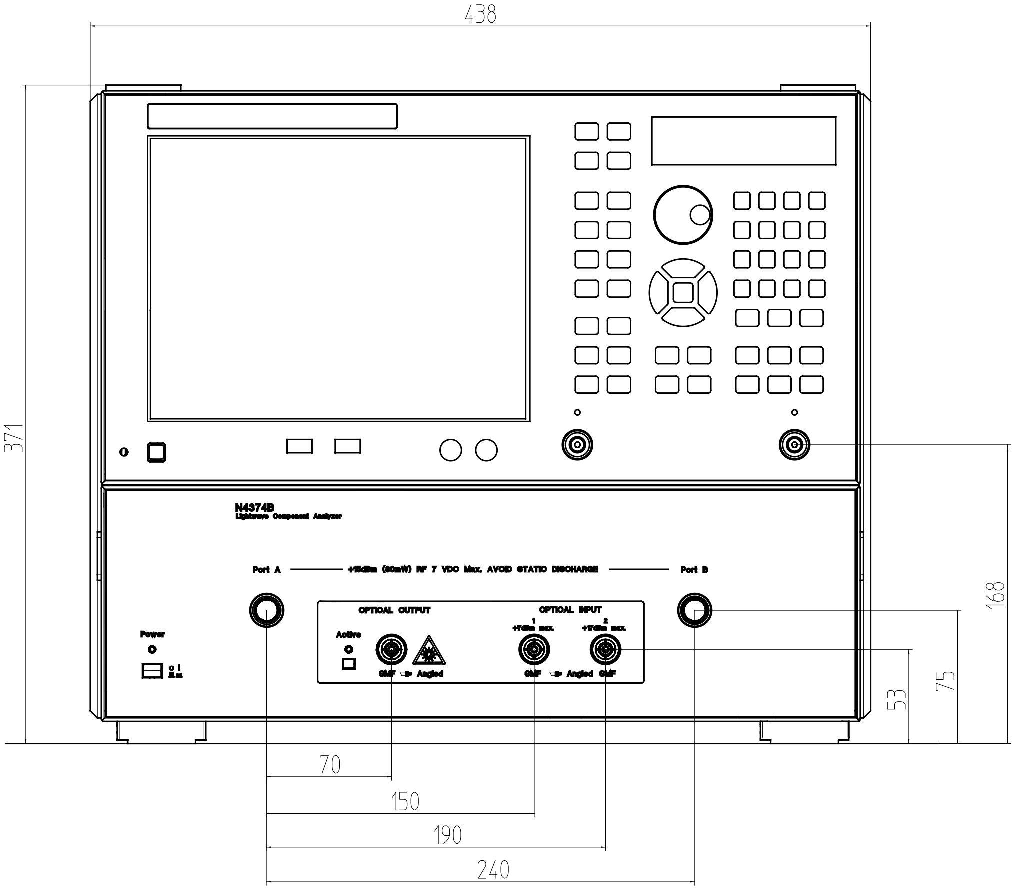
LCA electrical input	Type N (f)
LCA electrical output	Type N (f)
LCA optical input 1	9um single-mode angled [1], with Keysight universal adapter
LCA optical input 2	9um single-mode angled [1], with Keysight universal adapter
LCA optical output	9um single-mode angled [1], with Keysight universal adapter
LCA external TX input (option -050 only)	9um polarization maintaining single-mode angled, with Keysight universal adapter

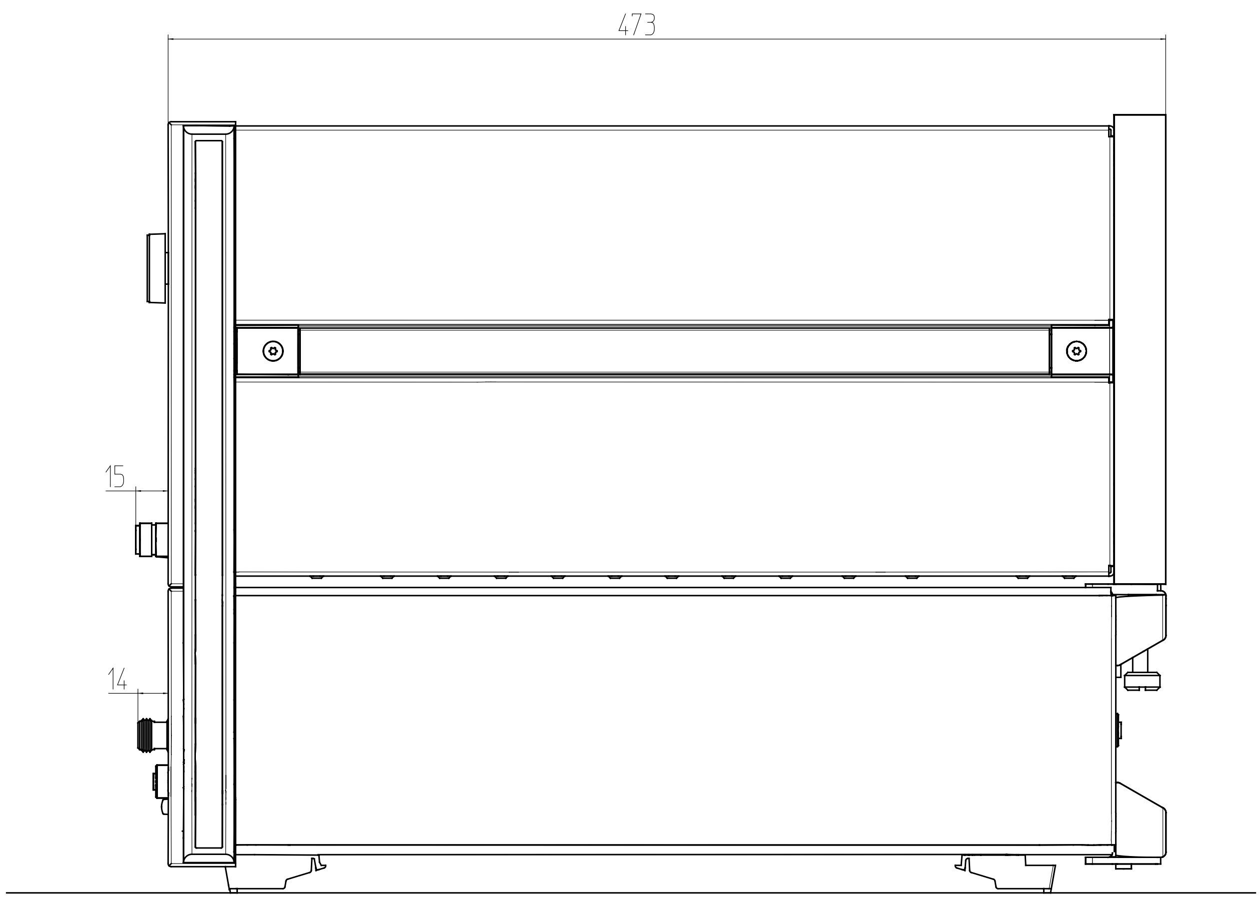
1. The optical test set always has angled connectors.
Depending on the selected option (-012 straight, -022 angled) the appropriate jumper cable will be delivered.
This jumper cable must always be used in front to the optical test set to protect the connectors at the optical test set

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.

INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS
CLASS 1M LASER PRODUCT
(IEC 60825-1 / 2001)

Mechanical Outline Drawings, option -332, -362 (all dimensions in mm)





Ordering Information

The N4374B consists of an optical test set and an electrical network analyzer which are mechanically connected.
To protect your network analyzer investment, Keysight offers the integration of an already owned ENA-C with the optical test set as listed below.

N4374B LCA ordering options	
Network-analyzer options	
N4374B - 332	4.5 GHz LCA based on E5071C -245 , including Bias-T
Network-analyzer integration options	
N4374B - 362	Integration of customer ENC-C - E5071C -240,-245 - all other NWA call factory
Optical wavelength options	
N4374B-100	1310 nm source optical test set
N4374B-101	1550 nm source optical test set
N4374B-102	1310 nm and 1550 nm source optical test set
Configuration independent options	
N4374B-010	Time domain option
N4374B-050	External optical source input
N4374B-021	Straight connector interface (external 0.5 m patch cord)
N4374B-022	Angled connector interface (external 0.5 m patch cord)
Service and Repair	
R1282A	Keysight calibration up front support plan 3 or 5 year coverage
Required accessories (to be ordered separtely)	
85092C	2 port electrical calibration module (#00F or #00A recommended)
Recommended accessories	
Rack mount kit for network analyzer	
1CM042A	Rack mount flange kit - 265.9 mm height for installation without handles
E3663AC	Basic rail kit (for system II instruments)
Rack mount kit for LCA test set	
34192A	Rack mount flange kit - 132.6 mm height for installation without handles
E3663AC	Basic rail kit (for system II instruments)

Optical instruments online information

Optical test instruments
www.keysight.com/find/oct

Lightwave Component Analyzers
www.keysight.com/find/lca

Polarization solutions
www.keysight.com/find/pol

Spectral analysis products
www.keysight.com/find/octspectral

Electro-optical converters
www.keysight.com/find/ref

Optical test instruments accesories
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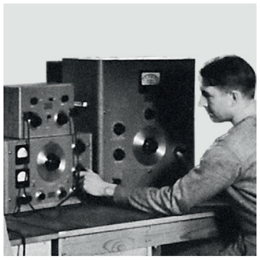
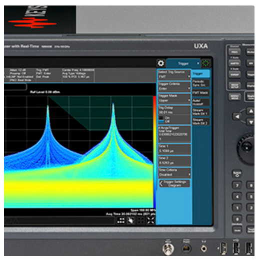


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Hong Kong	800 938 693
India	1 800 11 2626
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Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

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Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
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