PRELIMINARY
DATA SHEET

Keysight N777xC Family of Tunable Laser Sources

Introduction

The Keysight Technologies N777xC Family of Tunable Laser Sources offers the full wavelength range from 1240 nm to 1650 nm with no wavelength gaps.

The N777xC tunable laser sources realize the cost efficiency and performance required to test components for coarse and dense wavelength division multiplexing (CWDM, DWDM, 100GBASE-LR4) and passive optical networks (PON). Whether you need to verify the design of demanding optical components or adjust more wavelength-selective switches per hour, or you simply need a stable, tunable optical source, the N777xC family of tunable lasers offers a suitable model.

All N777xC models are based on a common cavity and laser module design and share a narrow linewidth, excellent long-term stability and low spontaneous emission level. They are software compatible with the 8160xA and 81600B lasers, the industry standards for more than a decade, but occupy 1 height unit less rack space.

The remote user interface on the instrument is accessible with just a web browser, either via LAN or via USB connection. An optional touch-screen display provides local operator access and displays current operating parameters.

Compared to the top line model N7776C, the N7778C value line models and the N7779C basic line models offer additional price-performance options based on output power, tuning speed, wavelength accuracy and repeatability.

Web User Interface but no LAN?

Connect instrument and PC via USB. The instrument shows up as a new drive: double-click the shortcut on that drive. This lets the default browser open an RNDIS connection to the instrument: the graphical user interface appears. It's as simple as that!

Specified performance in the fast, two-way continuous sweep mode

As manufacturing yield expectations become more and more stringent, it is important that all instruments deliver optimum performance under all measurement conditions.

The N7776C top line models and the N7778C value line models can perform two-way sweeps with up to 200 nm/s to accelerate wavelength-dependent alignment processes and the automated calibration of wavelength-selective devices. Shorter time to testing and faster swept-wavelength tests help reduce test cost per device, improve test margins and lower the cost of ownership. The dynamic specifications for swept operation apply in both directions, independent from the sweep speed.
The N7779C basic line model tunes in wavelength steps of 0.1 pm resolution.

KEYSIGHT TECHNOLOGIES

The Keysight N7776C Top-Line Tunable Laser Source

The new Keysight N7776C top line tunable laser source is designed to reach best-in-class accuracy and sub-picometer repeatability in static and swept operation for outstanding test efficiency.

With the product family's lowest spontaneous emission level, the N7776C enables the validation of extremely deep filters. It also offers the best wavelength accuracy in the family – enabled by its high-resolution wavelength reference unit that provides real-time tracking and control and includes a gas cell for excellent long-term stability and self-adjustment capability.

The Keysight N7778C Value Line Tunable Laser Sources

The new N7778C value line tunable laser source offers a peak output power of more than +12 dBm, at least 75 dB/nm above its spontaneous emission level. It features a typical wavelength repeatability of ±1.5 pm at two-way sweeps up to 200 nm/s. The N7778C's balance of features, performance and price makes it suitable for cost-effective, high-throughput manufacturing-floor component testing as well as for coherent transmission experiments.

The Keysight N7779C Basic Line Step-Tunable Laser Source

The new N7779C basic line tunable laser source, like the other new N777xC models, can step quickly to discrete wavelengths with a resolution of 0.1 pm and a typical wavelength repeatability of ±3 pm, making it ideal for cost-effective testing of broadband optical devices. With wavelength setting times like 300 ms, rapid stepped sweeps are possible. Like the other lasers in the N777xC family, it delivers more than +12 dBm peak output power with low spontaneous emission levels. At ±0.01 dB power stability over an hour, it can also serve as a static local oscillator with a wide tuning range for receiver testing or transmission experiments.

O-band option for Silicon Photonics/ Integrated Photonics Applications

The N777xC option 113 covers the wavelength range from 1240 nm to 1380 nm for an important set of applications. Equipped with PMF output fiber, these are a good match for testing and developing components with Silicon Photonics technology. Verifying the spectral responsivity and the sensitivity of receiver optical subassemblies (ROSA) for 100G Ethernet benefit from more than +10 dBm output power - enough to allow for external modulation in BER testing. Combined with very low SSE levels, Option 113 is ideal for testing wavelength filters for LR4 components.

E-band option for CWDM8 Component Testing

The N777xC option 114 covers the wavelength range from 1340 nm to 1495 nm. Combined with the other options, this allows measurements over all CWDM channels, such as for CWDM8 devices. Components for Raman amplification also use this wavelength range.

Integrated solutions for swept-wavelength spectral measurements covering 1240 nm to 1650 nm

The N777xC family is supported with the photonic application software suite for spectral measurements of insertion loss, polarization dependent loss and polarization mode dispersion in combination with Keysight power meters and polarization instruments. These provide optimal measurement performance and quick time-to-measurement by simplifying system integration. The photonic application software suite has a measurement engine for IL and PDL that can combine the sweeps of up to 3 tunable laser wavelength ranges. Such a setup can be used for testing wideband multiplexers and PON devices.

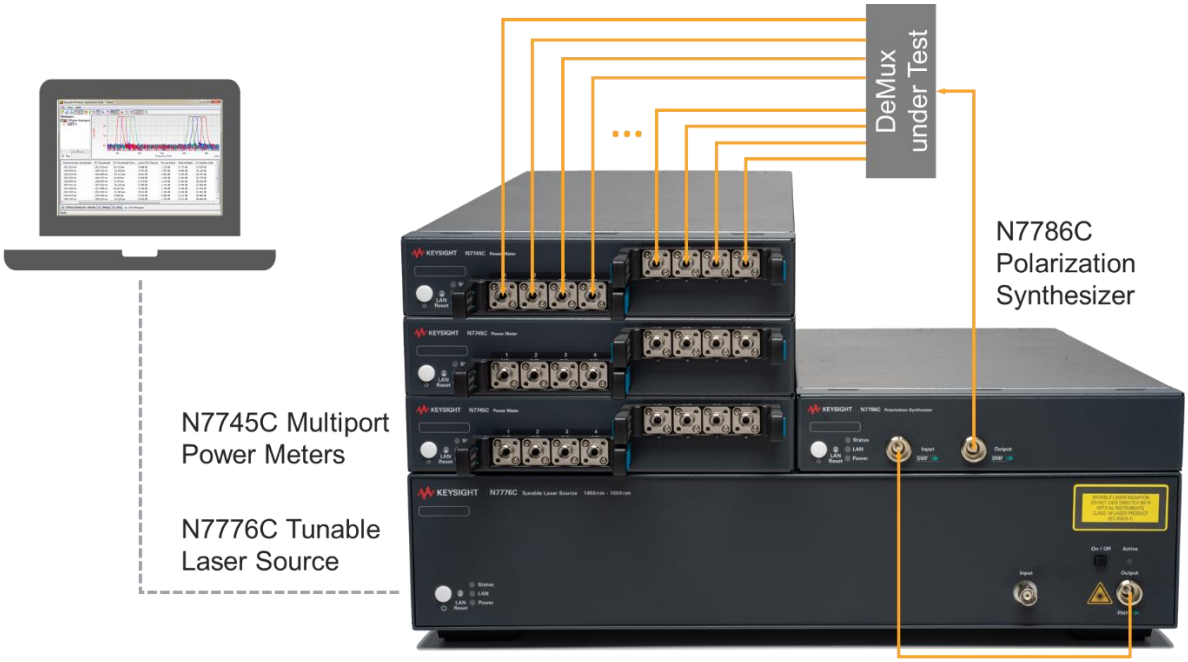

Figure 1: Test setup for swept-wavelength, IL/PDL measurements of a demultiplexer

Low SSE output for high dynamic range

A laser signal with low source spontaneous emission (SSE) is required for accurate crosstalk measurement of DWDM, CWDM and PON wavelength filtering components by producing light only at the desired wavelength. The N7776C features a single optical output with more than +12 dBm output power. It combines the highest power level with the lowest SSE level in the family, 80 dB/nm below the signal. The N7778C and N7779C come with more than +12 dBm output power, 75 dB/nm above their spontaneous emission level. The excellent low-SSE performance of better than 80 dB/nm signal-to-source spontaneous emission ratio (signal-to-SSE ratio) and the high signal power permit measurements of wavelength isolation to 100 dB, most often limited only by power meter sensitivity.

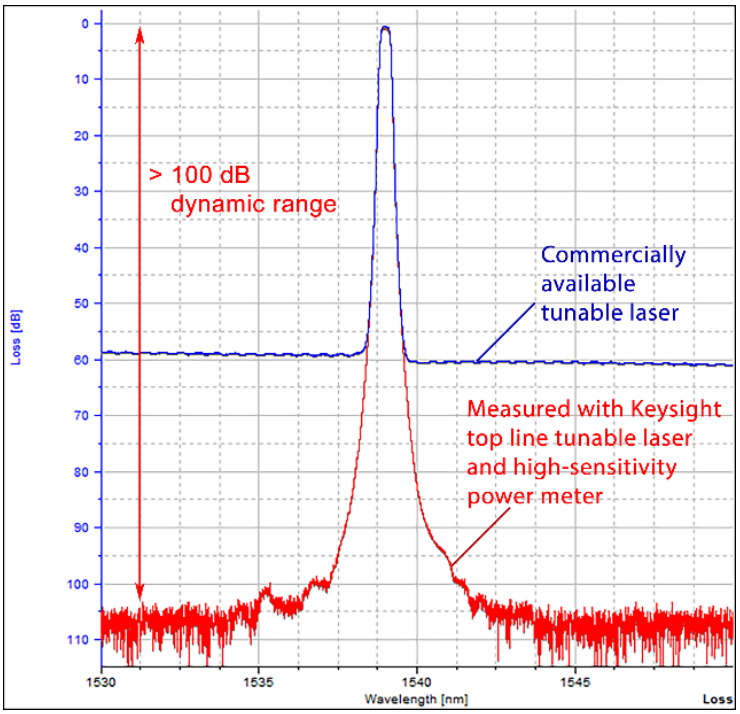

Figure 2: Crosstalk of a 50 GHz DWDM filter, measured with the N7747A high-sensitivity power meter

For all N777xC models, the output power can be adjusted between the maximum power and 0 dBm. Such adjustment can be used to optimize the dynamic range of a measurement by matching the signal range output from the device under test to the best-fitting power range of the optical power meter.

Built-in wavelength meter for optimum tuning precision

The Keysight N777xC Family of Tunable Laser Sources includes a built-in real time wavelength meter which realizes the family's excellent absolute and relative wavelength accuracy and delivers wavelength logging data after each sweep.

The new Keysight N7776C takes this concept even further by adding a gas cell for long-term stability and absolute referencing. The wavelength reference unit's faster response and finer wavelength resolution enable the N7776C to sweep with sub-picometer repeatability. It is the key to the N7776C's superior accuracy and temperature stability, and it enables a greater degree of self-diagnosis than previously possible. The Keysight N7778C and N7779C share the N7776C's long-term stability due to the built-in gas cell yet mark different performance levels with respect to wavelength accuracy and repeatability.

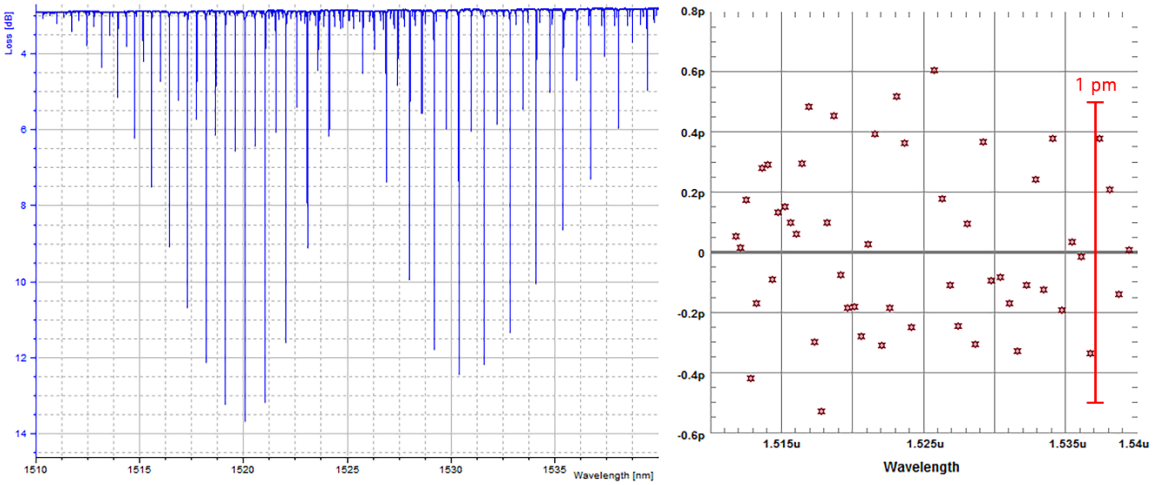

Figure3: Deviation of C_2H_2 absorption wavelengths from literature, measured at 200 nm/s sweep speed

Realize the cost efficiency and performance benefits in WDM component tests

The testing of optical filters is based on a generic principle, namely the stimulus-response test. The state-of-the-art approach is a wavelength-resolved stimulus-response measurement utilizing a tunable laser source that is capable of fast and precise sweeps across the entire wavelength range, and optical power meters.

For DWDM components, high wavelength accuracy and dynamic range are critical. For CWDM and PON components, a wide wavelength range, dynamic range and tight costing are key targets. If the investment in the test solution can be shared among many different types of filters, the contribution to each individual filter is minimized. In this way, cost targets for CWDM and PON components can be met without sacrificing accuracy.

Investing in the Keysight N777xC Family of Tunable Laser Sources can realize both the cost efficiency and performance benefits required.

Polarization maintaining fiber for the test of integrated optical devices

The N777xC Family of Tunable Laser Sources is ideal for characterizing integrated optical devices. Its PMF output ports provide a well-defined state of polarization to ensure constant measurement conditions for waveguide devices. A PMF cable easily connects to an external optical modulator.

Eliminating the influence of the atmosphere

The high selectivity of the laser cavity of the N777xC family makes it possible to detect water molecules in the atmosphere. If measurements are carried out in wavelength areas with a high density of water absorption lines, such as 1360 nm to 1450 nm, it is recommended to purge the laser with dry air or Nitrogen. This eliminates the influence of the atmosphere on the laser's wavelength accuracy and repeatability.

Certified Quality

The N777xC TLS are produced to the ISO 9001 international quality system standard as part of Keysight's commitment to continually increasing customer satisfaction through improved quality control. Specifications describe the instrument's warranted performance. They are verified at the end of a 2-meter-long patch cord and are valid after warm-up, and for the stated output power and wavelength ranges.
Every instrument is delivered with a commercial certificate of calibration and a detailed test report.

Specifications

Describe guaranteed product performance that is valid under stated conditions. The confidence level is 95%, as recommended by the ISO standard.

Typical values and supplementary performance characteristics

Describe product performance that is usually met but not guaranteed. Because of the modular nature of the instrument, these performance specifications apply to these modules rather than the mainframe unit.

For further details on specifications, refer to Chapter 3 in the Keysight N777xC Family of Tunable Lasers User's Guide.

N777xC Family of Tunable Lasers, Wavelength Options

Wavelength range	**N7776C, N7778C, N7779C**	
	1240 nm to 1380 nm (Option 113) 1340 nm to 1495 nm (Option 114) 1490 nm to 1640 nm (Option 116) 1450 nm to 1650 nm (Option 216)	
Maximum output power	**Option 113**	
	> +13 dBm peak > +11 dBm (1290 nm – 1340 nm) > +10 dBm (1260 nm – 1360 nm) > +5 dBm (1240 nm – 1380 nm)	
Maximum output power	**Option 114**	**Option 116**
	> +12 dBm peak > +11 dBm (1410 nm – 1470 nm) > +8 dBm (1370 nm – 1490 nm) > +5 dBm (1340 nm – 1495 nm)	> +12 dBm peak > +11 dBm (1515 nm – 1620 nm) > +8 dBm (1490 nm – 1640 nm)
Maximum output power	**Option 216**	
	> +12 dBm peak > +11 dBm (1515 nm – 1620 nm) > +9 dBm (1480 nm – 1630 nm) > +5 dBm (1450 nm – 1650 nm)	
Minimum output power setting	**N7776C, N7778C, N7779C**	
	0 dBm	

Wavelength Tuning and Spectral Performance

Wavelength tuning	N7776C, N7778C	N7779C
Wavelength resolution	0.1 pm (17.5 MHz at 1310 nm, 14.3 MHz at 1450 nm, 12.5 MHz at 1550 nm)	
Continuous tuning range	Full wavelength range, mode-hop free	
Tuning time (characteristic) [1]	300 ms (1 nm step, max. output power) 1.5 s (100 nm step, max. output power)	
Continuous sweep range	Full wavelength range [6 7], continuous power during sweep	not applicable
Max. sweep speed	200 nm/s, bidirectional	not applicable
Spectral performance	**N7776C**	**N7778C, N7779C**
Side-mode suppression ratio (SMSR) (typical) [2]	≥ 70 dB [3] ≥ 60 dB [4]	≥ 70 dB [3] ≥ 60 dB [4]
Relative intensity noise (RIN) (typical, 0.1 to 6 GHz) [2, 3]	< -150 dB/Hz	< -150 dB/Hz
Signal to source spontaneous emission ratio [2, 5]	≥ 80 dB/nm ≥ 90 dB/0.1 nm	≥ 75 dB/nm ≥ 85 dB/0.1 nm
Signal to total source spontaneous emission ratio [2, 5]	≥ 75 dB	≥ 70 dB
Linewidth (typical), coherence control off	< 10 kHz	< 10 kHz
Effective linewidth (typical), coherence control on [2, 3]	not applicable	> 50 MHz

1 Including power stabilization. When “step finished” trigger is received.
2 At maximum output power.
3 1290 nm – 1340 nm (Option 113), 1410 nm – 1470 nm (Option 114), 1515 nm – 1620 nm (Options 116, 216).
4 1250 nm – 1380 nm (Option 113), full wavelength range (Options 114, 116, 216)
5 1320 nm – 1350 nm (Option 113), 1410 nm – 1460 nm (Option 114), 1520 nm – 1580 nm (Options 116, 216).
6 Full wavelength range for sweep speeds ≤ 50 nm/s.
Full wavelength range reduced by 0.5 nm on both ends for 80 nm/s sweep speed.
Full wavelength range reduced by 3 nm on both ends for sweep speeds ≥ 100 nm/s and ≤ 150 nm/s.
Full wavelength range reduced by 5 nm on both ends for ≥ 160 nm/s sweep speed.
7 Mode-hop free tunable across the full wavelength range.
Stop wavelength below 1345 nm (Option 113).
Start wavelength above 1420 nm (Option 114).

N7776C Tunable Laser Source, Top Line, High Power with Low SSE

Wavelength accuracy	Stepped mode	Continuous sweep mode, both directions (typical) [3] [4]
Absolute wavelength accuracy [1]	± 2 pm typical ± 1.5 pm	± 1.5 pm
Relative wavelength accuracy [1]	± 1.5 pm typical ± 1 pm	± 1 pm
Wavelength repeatability	± 0.5 pm typical ± 0.2 pm	± 0.3 pm
Wavelength stability [2]	≤ ± 0.5 pm, 24 hours (typical)	not applicable
Power repeatability (typical)	± 0.002 dB	not applicable
Power stability [2]	± 0.01 dB, 1 hour typical ± 0.025 dB, 24 hours	not applicable
Power linearity	± 0.05 dB	not applicable
Power flatness versus wavelength	± 0.25 dB typical ± 0.1 dB, Options 116, 216 typical ± 0.15 dB, Options 113, 114	not applicable
Dynamic power reproducibility	not applicable	± 0.01 dB
Dynamic relative power flatness	not applicable	± 0.02 dB [5]

1 Valid for 24 hours and within ± 5 K temperature range after wavelength zeroing.
2 At constant temperature ± 1 K.
3 Full wavelength range for sweep speeds ≤ 50 nm/s.
Full wavelength range reduced by 0.5 nm on both ends for 80 nm/s sweep speed.
Full wavelength range reduced by 3 nm on both ends for sweep speeds ≥ 100 nm/s and ≤ 150 nm/s.
Full wavelength range reduced by 5 nm on both ends for ≥ 160 nm/s sweep speed.
Mode-hop free tunable across the full wavelength range.
Stop wavelength below 1345 nm (Option 113)
4 Mode-hop free tunable across the full wavelength range.
Stop wavelength below 1345 nm (Option 113).
Start wavelength above 1420 nm (Option 114).
5 Add ± 0.01 dB for sweep speeds > 80 nm/s.

N7778C Tunable Laser Source, Value Line, High Power with Low SSE

Wavelength accuracy	Stepped mode	Continuous sweep mode, both directions (typical) [3] [4]
Absolute wavelength accuracy [1]	± 20 pm typical ± 5 pm	± 10 pm
Relative wavelength accuracy [1]	± 10 pm typical ± 3 pm	± 5 pm
Wavelength repeatability	± 2.5 pm typical ± 1 pm	± 1.5 pm
Wavelength stability [2]	≤ ± 2.5 pm, 24 hours (typical)	not applicable
Power repeatability (typical)	± 0.01 dB	not applicable
Power stability [2]	± 0.01 dB, 1 hour typical ± 0.03 dB, 24 hours	not applicable
Power linearity	± 0.1 dB	not applicable
Power flatness versus wavelength	± 0.25 dB typical ± 0.1 dB, Options 116, 216 typical ± 0.15 dB, Options 113, 114	not applicable
Dynamic power reproducibility	not applicable	± 0.01 dB
Dynamic relative power flatness	not applicable	± 0.02 dB [5]

1 Valid for 24 hours and within ± 5 K temperature range after wavelength zeroing.
2 At constant temperature ± 1 K.
3 Full wavelength range for sweep speeds ≤ 50 nm/s.
Full wavelength range reduced by 0.5 nm on both ends for 80 nm/s sweep speed.
Full wavelength range reduced by 3 nm on both ends for sweep speeds ≥ 100 nm/s and ≤ 150 nm/s.
Full wavelength range reduced by 5 nm on both ends for ≥ 160 nm/s sweep speed.
Mode-hop free tunable across the full wavelength range.
Stop wavelength below 1345 nm (Option 113).
4 Mode-hop free tunable across the full wavelength range.
Stop wavelength below 1345 nm (Option 113).
Start wavelength above 1420 nm (Option 114).
5 Add ± 0.01 dB for sweep speeds > 80 nm/s.

N7779C Step-Tunable Laser Source, Basic Line, High Power with Low SSE

Wavelength accuracy	
Absolute wavelength accuracy [1]	± 30 pm; typical ± 10 pm
Relative wavelength accuracy [1]	± 15 pm; typical ± 5 pm
Wavelength repeatability	± 5 pm; typical ± 3 pm
Wavelength stability [2]	≤ ± 5 pm, 24 hours (typical)
Power repeatability (typical)	± 0.01 dB
Power stability [2]	± 0.01 dB, 1 hour typical ± 0.03 dB, 24 hours
Power linearity	± 0.1 dB
Power flatness versus wavelength	± 0.25 dB typical ± 0.1 dB, Options 116, 216 typical ± 0.15 dB, Options 113, 114

1 Valid for 24 hours and within ± 5 K temperature range after wavelength zeroing.
2 At constant temperature ± 1 K.

Specification Conditions

Environmental conditions	
Storage temperature	–40 °C to +70 °C
Operating temperature	+10 °C to +35 °C
Humidity	< 80% R.H. at +10 °C to +35 °C, non-condensing
Max. operating altitude	2000 m (6600 ft)
Specifications apply for wavelengths not equal to any water absorption line. Note: if the laser is operated in a dry box filled with dry air or nitrogen, specifications also apply at water absorption lines.	
All specifications are typical at wavelengths < 1250 nm	
Warm-up time	60 minutes; immediate operation after boot-up; 30 minutes if previously stored at the same temperature.
Sweep speed	**Continuous sweep range (N7776C, N7778C)**
≤ 50 nm/s	Full wavelength range
80 nm/s	Full wavelength range reduced by 0.5 nm on both ends
≥ 100 nm/s and ≤ 150 nm/s	Full wavelength range reduced by 3 nm on both ends
≥ 160 nm/s	Full wavelength range reduced by 5 nm on both ends

Supplementary Performance Characteristics

External wavelength locking	**N7776C**
Modulation depth	> ± 70 pm at 10 Hz > ± 7 pm at 100 Hz
Modulation input	± 5 V
Coherence control	**N7778C, N7779C**
For measurements on components with 2 m long patch cords and connectors with 14 dB return loss, the effective linewidth results in a typical power stability of < ± 0.025 dB over 1 minute by significantly reducing interference effects in the test setup. Available at max. output power, for wavelength range 1290 nm – 1340 nm (Option 113), 1420 nm – 1470 nm (Option 114), 1515 nm – 1620 nm (Options 116, 216).	
Output isolation	**N7776C, N7778C, N7779C**
	Built-in optical isolator

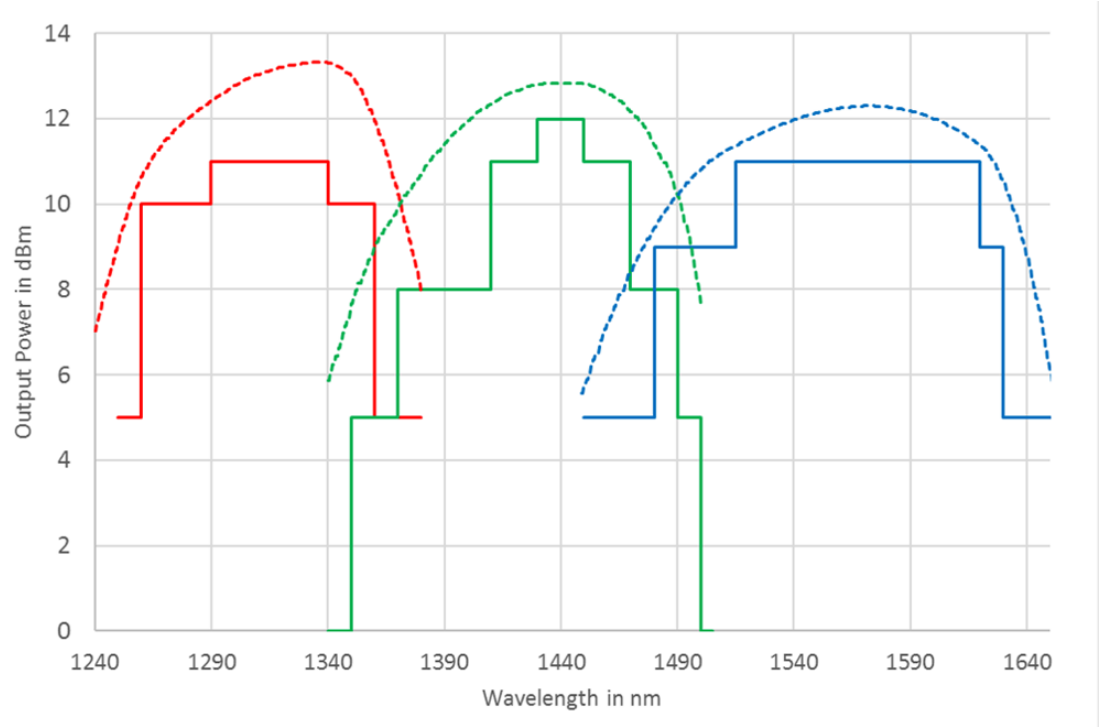

Figure 4: Wavelength coverage of options 113 (red), 114 (green) and 216 (blue).
Typical maximum output power (dotted line) vs. specified output power (solid lines)

General Specifications

Return loss	**N7776C, N7778C, N7779C**
Return loss, typical	60 dB
Optical connector	**N7776C, N7778C, N7779C**
	All modules come with PMF, angled contact output connector
Polarization maintaining fiber	**N7776C, N7778C, N7779C**
Fiber type	Panda
Orientation	Electrical field is oriented in slow axis, in line with the connector key
Polarization extinction ratio	16 dB typical
Re-calibration	**N7776C, N7778C, N7779C**
Recommended re-calibration period	2 years
Laser safety information	**N7776C, N7778C, N7779C**
All laser sources specified by this data sheet are classified as Class 1M according to IEC 60825-1 (2017)	
All laser sources comply with 21 CFR 1040.10 except for deviations pursuant to Laser Notice No. 50, dated 2007, June 24.	

Power	N7776C, N7778C, N7779C
	AC 100 to 240 V ± 10%, 50/60 Hz, 200 VA max.
Dimensions	**N7776C, N7778C, N7779C**
Dimensions (height x width x length)	88 mm x 426 mm x 545 mm (3.5” x 16.9” x 21.6”)
Weight	approx. 8.5 kg net (17 lbs); shipping 13 kg (26 lbs)
Connectivity	**N7776C, N7778C, N7779C**
USB	USB 2.0 (mass storage device, USB to Ethernet interface)
Local Area Network (LAN)	10/100/1000BASE-T Ethernet port; host name printed on instrument label; DHCP optional
Trigger	BNC
User Interface	**N7776C, N7778C, N7779C**
LAN Access	IP address via browser
USB Access	Remote NDIS access via browser
Data Input/ Output	**N7776C, N7778C, N7779C**
Optical power	linear (Watt) and logarithmic (dBm), digital and analog
Wavelength	m, µm, nm
Frequency	Hz, THz
Sampling resolution	0.01 pm; 0.01 dB; 0.1 mW

Ordering Information

Tunable laser module: N7776C top-line, ±1.5 pm typical wavelength accuracy (choose one of the following)	
N7776C-113	Tunable laser source 1240 nm to 1380 nm, top-line, high power with lowest SSE
N7776C-114	Tunable laser source 1340 nm to 1495 nm, top-line, high power with lowest SSE
N7776C-116	Tunable laser source 1490 nm to 1640 nm, top-line, high power with lowest SSE
N7776C-216	Tunable laser source 1450 nm to 1650 nm, top-line, high power with lowest SSE
Tunable laser module: N7778C value line, ±5 pm typical wavelength accuracy (choose one of the following)	
N7778C-113	Tunable laser source 1240 nm to 1380 nm, value line, high power with low SSE
N7778C-114	Tunable laser source 1340 nm to 1495 nm, value line, high power with low SSE
N7778C-116	Tunable laser source 1490 nm to 1640 nm, value line, high power with low SSE
N7778C-216	Tunable laser source 1450 nm to 1650 nm, value line, high power with low SSE
Tunable laser module: N7779C basic line, ±10 pm typical wavelength accuracy (choose one of the following)	
N7779C-113	Step-tunable laser source 1240 nm to 1380 nm, basic line, high power with low SSE
N7779C-114	Step-tunable laser source 1340 nm to 1495 nm, basic line, high power with low SSE
N7779C-116	Step-tunable laser source 1490 nm to 1640 nm, basic line, high power with low SSE
N7779C-216	Step-tunable laser source 1450 nm to 1650 nm, basic line, high power with low SSE

Tunable laser module: 81602A top line, +18 dBm peak power, ±1.5 pm typical wavelength accuracy	
81602A-013 [1]	Extra high-power tunable laser source 1250 nm to 1370 nm, top line
Custom-made tunable laser	
Additional wavelength ranges or higher output power are available on request. Please contact your local Keysight Sales Office.	
Required Accessories	
Connector interface	One Keysight 81000xI-series connector interface is required per instrument
Recommended Accessories	
N7799C-2CM	Rack mount kit for 2 rack height units

1 For specifications please refer to the 81602A technical data sheet (publication number 5992-1472EN).

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus