

# Keysight Technologies

## N7747A and N7748A

### High-Sensitivity Optical Power Meter

Data Sheet



For more information:

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To support multichannel applications requiring low-noise measurement and monitoring of optical signals and widest dynamic range, the 2-port N7747A and 4-port N7748A bring a new level of specified performance to the Keysight Technologies, Inc. optical power meter family, in the compact N77 platform offering extended functionality of 100X more memory, faster data transfer rates, and continuous logging.

- Sensitivity to  $-110$  dBm with  $< 0.1$  pW peak-peak noise and drift
- Polarization dependence and spectral ripple  $< \pm 0.005$  dB
- In-range linearity:  $< \pm 0.005$  dB
- Continuous range of averaging time settings: 25  $\mu$ s to 10 s

With the N7747A and N7748A, the highest optical performance is now offered in the N77 platform for compact automated instrumentation. The high optical performance encompasses the highest sensitivity available with  $-110$  dBm and correspondingly low noise and high stability to accurately measure and monitor weak signals and small signal changes. This is supported by high relative power accuracy with low polarization dependence and low spectral ripple. The high sensitivity together with 9 power ranges at 10 dB spacing provides highest dynamic range with excellent linearity. A new specification that guarantees the highest linearity when the power range is not changed increases confidence in IL measurement accuracy.


Twice the ports in half the rack space. These instruments enhance the proven optical performance of the 81634B sensor modules with the large memory, fast data transfer and small footprint of the N77 series platform. Eight high-sensitivity optical power meters now fit in a single rack unit. Optical connections are made with the interchangeable 81000xl connector interface system so the instrument can be easily adapted to different fiber connector types.

Each optical port has 2 buffers of memory, each able to log up to 1M samples. With the ability to upload one buffer while the other is recording measurements, this permits continuous monitoring over extended times with sensitivity to small transients. Details for programming this logging are given in the application note 5990-3710. The functionality is the same used in the N7744A and N7745A except that the high-sensitivity models use lower bandwidth to match the low-noise performance. This includes flexible choice of averaging times to optimize sampling at any rate.

The N7747A and N7748A also include an analog output for each optical channel. This provides a 0 to 2 V signal proportional to the optical power, scaled by the selected power range and allows analog monitoring of signals with up to 5 kHz bandwidth.

The instruments have USB, LAN and GPIB interfaces for control with the SCPI command set also used for the 816x, N7744A and N7745A optical power meters. The updated versions of the N77xx Viewer user interface program and the 816x VXI Plug&Play driver can be used, also with the N7700A IL engine to measure the high dynamic range in optical filters.

**Twice the ports in half the rack space**



**4x 81634B in two 8163B vs. 8 ports in two N7748A**

## Application Performance Examples

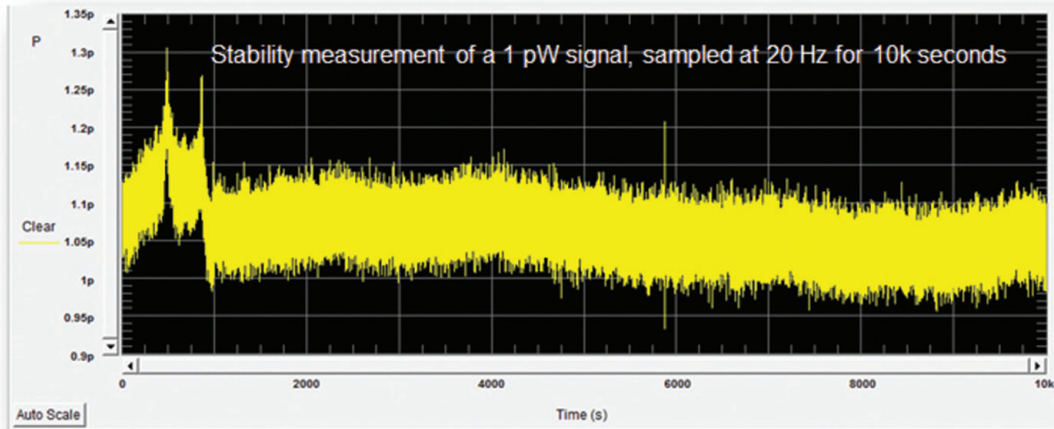


Figure 1. High power resolution, even at very low power levels, as in this measurement of a 1 pW signal, sampled at 20 Hz for 10 k seconds

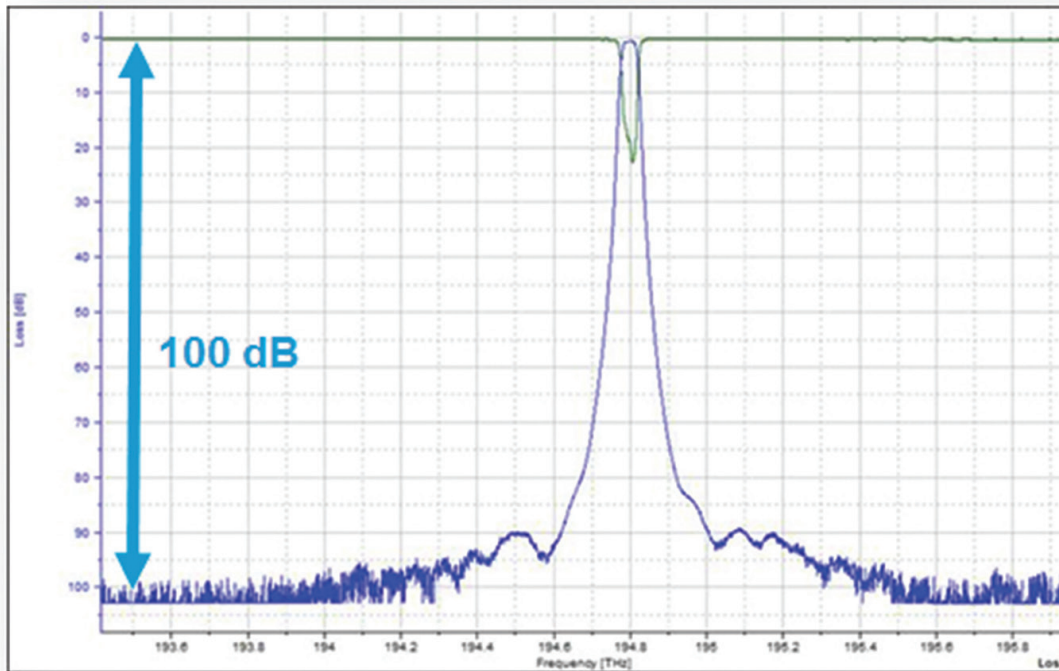


Figure 2. The large dynamic range, > 100 dB, is exhibited here with an add/drop filter measured with the N7748A and the low-SSE 81600B tunable laser, recorded with the free N7700A IL Engine software. The software stitches 3 scans using different power ranges, each range contributing > 30 dB dynamic.

# Technical Specifications

| N7747A and N7748A                                |                                     |  |
|--|-------------------------------------|--|
| Sensor element                                   |                                     | InGaAs   |
| Wavelength range                                 |                                     | 800 nm to 1700 nm  |
| Power range                                      |                                     | -110 dBm to +10 dBm  |
| Maximum safe input power                         |                                     | +16 dBm  |
| Applicable fiber type                            |                                     | Standard SM and MM, $\leq 100 \mu\text{m}$ core size, $\text{NA} \leq 0.3$   |
| Uncertainty at reference conditions <sup>1</sup> |                                     | $\pm 2.5\%$ (1000 nm to 1630 nm)   |
| Total uncertainty <sup>2,3</sup>                 |                                     | $\pm 4.5\%$ (1000 nm to 1630 nm)   |
| Polarization dependent responsivity <sup>4</sup> |                                     | $< \pm 0.005 \text{ dB}$   |
| Spectral ripple <sup>5</sup>                     | Due to interference                 | $< \pm 0.005 \text{ dB}$   |
| Linearity <sup>3,6</sup>                         |                                     | $< \pm 0.015 \text{ dB}$ (at $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ )<br>$< \pm 0.030 \text{ dB}$ (in operating temperature range)<br>$< \pm 0.005 \text{ dB}$ (fixed power range $\geq -20 \text{ dBm}$ , within 10 dB below range setting) |
| Noise <sup>7</sup>                               | Peak to peak, dark, including drift | $< 0.1 \text{ pW}$ (1200 nm to 1630 nm)  |
| Drift <sup>7</sup>                               |                                     | $< \pm 0.05 \text{ pW}$  |
| Return loss <sup>8</sup>                         |                                     | $> 55 \text{ dB}$  |
| Supplementary characteristics                    |                                     |  |
| Frequency response                               | 3 dB cutoff, also for analog output | 5.0 kHz (+10 dBm to -20 dBm range)<br>4.0 kHz (-30 dBm to -40 dBm range)<br>0.3 kHz (-40 dBm to -70 dBm range)   |
| Averaging time                                   |                                     | 25 $\mu\text{s}$ to 10 s, typ. setting resolution 0.1% down to 2 $\mu\text{s}$   |
| Data logging capability                          |                                     | 2 buffers/port, each with 1 Mio. measurement point capacity  |

## 1. Reference conditions:

- Power level 10  $\mu\text{W}$  (-20 dBm), continuous wave (CW)
- Fiber 50  $\mu\text{m}$  graded-index,  $\text{NA} = 0.2$
- Ambient temperature  $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$
- On day of calibration (add  $\pm 0.3\%$  for aging over one year, add  $\pm 0.6\%$  over two years)
- Spectral width of source  $< 10 \text{ nm}$  (FWHM)
- Wavelength setting at power sensor must correspond to source wavelength  $\pm 0.4 \text{ nm}$

## 2. Operating conditions:

- Fiber  $\leq 50 \mu\text{m}$ ,  $\text{NA} \leq 0.2$
- Connectors with 2.5 mm ferrule with flat face (fiber tip offset not more than 0.3 mm from 2.5 mm cross-section) with straight or angled polish
- Within one year after calibration, add 0.3% for second year
- Operating temperature range as specified, humidity: Non-condensing

## 3. Excluding noise and drift

4. All states of polarization at constant wavelength (1550 nm  $\pm 30 \text{ nm}$ ) and constant power, straight connector,  $T = 23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ .

For angled connector (8°) add  $\pm 0.01 \text{ dB}$  typ.

5. Test conditions: wavelength 1550 nm  $\pm 30 \text{ nm}$ , fixed state of polarization, constant power, temperature  $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ , linewidth of source  $\geq 100 \text{ MHz}$ , angled connector 8°

6. CW, -90 dBm to +10 dBm, 1000 nm to 1630 nm

7. Averaging time 1 s,  $T = 23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ ,  $\Delta T \pm 1 \text{ }^\circ\text{C}$ , observation time 300 s

8. Wavelength 1310 nm  $\pm 30 \text{ nm}$  and 1550 nm  $\pm 30 \text{ nm}$ , standard single mode fiber, angled connector 8°,  $T = 23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$

## General Characteristics

|                                  |  |
|----------------------------------|--|
| Analog output                    | 0 to 2 V in to open, 600 $\Omega$ typ. output impedance, max input voltage $\pm 10$ V              |
| Dimensions (D x W x H)           | 460 mm x 212 mm x 43 mm<br>1 RU height, half-rack width (excluding front and back rubber cushions) |
| Weight                           | N7747A: 3.5 kg ; N7748A: 4.0 kg  |
| Recommended recalibration period | 2 years  |
| Operating temperature            | 5 °C to +40 °C   |
| Operating humidity               | Noncondensing  |
| Altitude                         | 2000 m   |
| Pollution protection             | Designed for pollution Degree 2  |
| Warm-up time                     | 20 minutes   |
| Interfaces                       | The instruments can be controlled via LAN, USB or GPIB interfaces                                  |
| Power consumption                | Line power: AC 100 to 240 V $\pm 10\%$ , 50/60 Hz, 60 VA max.                                      |

### 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.

## Ordering Information

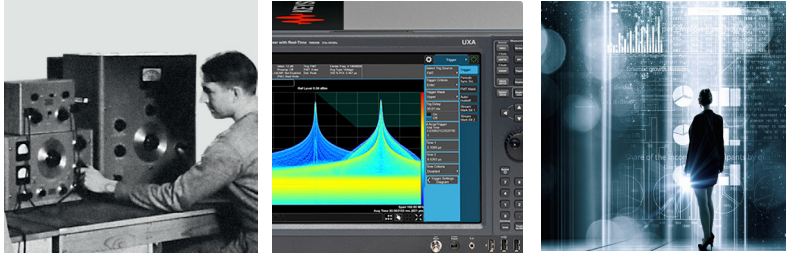
| Model number  |  |
|---|--|
| N7747A  | 2-port high-sensitivity optical power meter                    |
| N7748A  | 4-port high sensitivity optical power meter                    |
| Connector interfaces (order for each port)  |  |
| 81000FI   | FC connector   |
| 81000KI   | SC connector   |
| 81000PI   | E-2000 connector interface (sensor only)                       |
| 81000SI   | DIN 47256/4108 connector interface                             |
| 81000VI   | ST connector interface   |
| 81002LI   | LC connector interface   |
| 81002MI   | MU connector interface   |
| 81000BI   | Bare fiber interface kit                                       |
| <p>Note for LC or MU connectors: The sensors are optimized for use with 2.5 mm ferrules, for which the positioning is most repeatable. For use with LC or MU connectors with 1.25 mm ferrules, only the 81002LI for LC or 81002MI for MU should be used. The 81000LI and 81000MI should not be used. But positioning uncertainty with the 81002LI or 81002MI can still degrade the absolute power uncertainty by up to <math>\pm 1</math> dB, considering worst-case offsets within the tolerances of the connectors and adapters. For LC and MU connectors, use of the 8162x optical power heads or the N7744A and N7745A power meters with corresponding adapters is recommended for highest accuracy.</p> <p>Ferrules with conical or raised-end faces also add positioning uncertainty and are not recommended for use with the N7747A or N7748A.</p> |  |
| Accessories   |  |
| USB cable and cross-over LAN cable are included   |  |
| N7744-100   | Rack mount kit for 1 or 2 units (2 units must have same depth) |
| Calibration   |  |
| R-50C-011-3   | Keysight calibration upfront support plan 3 year coverage      |
| R-50C-011-5   | Keysight calibration upfront support plan 5 year coverage      |



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