

## S171C - APRIL 10, 2025

Item # S171C was discontinued on April 10, 2025. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

- ▶ Measure Power at the Sample
- ▶ Large-Area Sensor to Collect Light from High NA Objectives (up to 1.45)
- ▶ Compatible with Dry, Water Immersion, and Oil Immersion Objectives
- ▶ Options Available for Low-Power, High-Power, and Multiphoton Applications



**S175C**  
High-Power Microscope Slide Power Sensor for UV, Visible, and IR



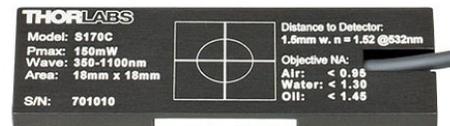
S170C Microscope Slide Power Meter Sensor used with a 1.30 NA Objective and Shown on an MLS203-1 Motorized Scanning Stage Equipped with an MLS203P2 Slide Holder

[Hide Overview](#)

### OVERVIEW

#### Features

- Compatible with Standard Upright and Inverted Microscopes
- Designed to Measure Power at the Sample Plane
- Large 18 mm x 18 mm Active Sensor Area
- Low-Power Photodiode Sensors:
  - Wavelength Range: 350 nm to 1100 nm (Item # S170C) or 400 nm to 1100 nm (Item # S171C)
  - Sensitive to Optical Powers from 10 nW to 150 mW (Item # S170C) or 1 nW to 15 mW (Item # S171C)
- High-Power Thermal Sensor (Item # S175C)
  - Wavelength Range: 300 nm to 10.6  $\mu$ m
  - Measure Optical Powers from 100  $\mu$ W to 2 W
- Second-Order Nonlinear Crystal with Photodiode Sensor for Multiphoton Microscopy (Item # NS170C)
  - Laser Wavelength Range: 780 - 1300 nm
  - Sensitive to Average Optical Powers from 0.5 - 350 mW with Max Peak Power Density of 10 TW/cm<sup>2</sup>
- Sensor Housing with the Same Footprint as Standard Microscope Slides: 76.0 mm x 25.2 mm
- Novel Optical Designs Accommodates High NA Objectives (see *Optical Design* tab)
- Information Stored in Connector:
  - Sensor Data for Automatic Calibration when Using Thorlabs' Power Meter Consoles (Sold Separately Below)
  - NIST- and PTB-Traceable Calibration Data



Click to Enlarge

The back of each microscope slide sensor housing is engraved with the sensor specifications and a crosshair for centering the beam on the sensor. This image shows the engravings on the S170C sensor; the S171C sensor has similar engravings. The engravings on the S175C and NS170C sensors are shown further below.



Click for Details

Using the engraved alignment target on the back of the sensor housing, a user can position the stage so that when the sensor is flipped, the beam strikes the center of the sensor. The S170C sensor is shown in this image.

- Recalibration Service Available

## Applications

- Measure Intensity of the Microscope Light Source at the Sample Plane
- Determine Transmission of a Fluorescence Filter Set
- Ensure Lighting Conditions are Consistent Between Experiments
- Optimize Pulse Duration at the Focus of a Multiphoton Microscope using a Femtosecond Pulse Compressor

Thorlabs' Microscope Slide Power Sensor Heads are designed to measure optical power at the sample in microscopy setups. These sensor heads have the same footprint (76.0 mm x 25.2 mm) as a standard microscope slide, feature a large 18 mm x 18 mm active area, and are compatible with most standard upright and inverted microscopes.

The low-power versions incorporate silicon photodiode sensors, while the high-power version is equipped with a thermal sensor. The S170C photodiode sensor is sensitive to wavelengths from 350 nm to 1100 nm at optical powers from 10 nW to 150 mW with 1 nW resolution. The S171C photodiode sensor is for wavelengths from 400 nm to 1100 nm at optical powers from 1 nW to 15 mW with a resolution of 0.5 pW. A  $<1 \mu\text{s}$  response time makes these sensors ideal for high-resolution measurements using lasers, but they are still well suited for measurements of broadband illumination sources, like LEDs and white light sources. The S175C thermal sensor is sensitive to wavelengths from 300 nm to 10.6  $\mu\text{m}$  at optical powers from 100  $\mu\text{W}$  to 2 W. This sensor features a flat absorptivity over the specified wavelength range, making it ideal for measurements of broadband illumination sources, like LEDs and white light sources.

The NS170C microscope slide sensor is designed to measure the relative peak power of two-photon lasers. The sensor utilizes a nonlinear  $\beta\text{-BBO}$  (beta-BaB<sub>2</sub>O<sub>4</sub>) crystal to convert femtosecond near-infrared (NIR) pulses into their second harmonic, and a silicon photodiode detector to measure the visible second harmonic signal. It can be used with femtosecond lasers with center wavelengths from 780 nm to 1300 nm and average powers from 0.5 mW to 350 mW. The maximum peak power density should not exceed 10 TW/cm<sup>2</sup> at 80 MHz repetition rate and for microscope objectives with NA > 0.5; the damage threshold will be lower for NA < 0.5. This design enables the sensor to measure the relative peak power at the focus of the microscope, making it ideal for laser pulse optimization for multiphoton imaging. Please see the *Specs* tab for more information.



Click to Enlarge  
The NS170C sensor connected to the PM400 touch screen power meter console (sold separately).

### Day-to-Day Usage

The sensors support power measurements for objectives with NAs up to 1.45, and are usable in air and with water- or oil-based immersion media (see the *Optical Design* tab for details). As seen in the image above to the right, the back of the sensor is engraved with the recommended NA for air ( $<0.95$  for the S170C, S171C, and S175C sensors, and  $<1$  for the NS170C sensor), water ( $<1.30$ ), and oil ( $<1.45$ ) objectives. The active sensor area is protected by a glass cover surface, which can be easily cleaned using compressed air or using optic tissue moistened with acetone or methanol.

As seen in the image above, the bottom of these sensors feature a laser-engraved alignment crosshair that marks the active sensor area to aid in aligning and focusing the beam. To use with a standard upright microscope, insert the housing into the beam path so that the engraved side is facing the objective of your microscope. Once the power sensor is centered under the objective, turn the slide over so that the detector is facing the beam in order to take a power measurement. For inverted microscopes, place the detector in your slide holder with the sensor facing the objective and turn on the trans-illumination lamp. Centering the beam on the engraved target will center the sensor in the optical path.

To avoid damaging the sensor, we recommend positioning it in the light path at a location where the beam is not focused. It is important not to exceed the Max Average Power Density for the S170C, S171C, and S175C sensors, or the Max Peak Power Density for the NS170C sensor (see *Specs* tab) over the beam's spot size.

### Power Meter Console and Interface Compatibility

These power sensor heads are compatible with the PM100D, PM100A, PM400, and PM5020 power meter consoles, as well as many of our C-series power and energy meter interfaces, which provide communication between the sensor and an external control unit such as a PC. The PM100A, PM100D, and PM400 consoles, which include display screens and controls, are sold below for convenience. As seen in the image to the left, a 1.5 m cable attached to the side of the sensor head leads to a D-sub 9-pin male connector. Sensor specifications for automated calibration and the NIST- and PTB-traceable calibration data are stored in non-volatile memory in the sensor connector and can be read out using compatible Thorlabs power meter consoles.

### Recalibration Service

Recalibration services are available for our power sensors and power meter consoles. We recommend your Thorlabs sensor and console be recalibrated as a pair; however, each may be recalibrated individually. Recalibration of a single-channel power and/or energy meter console or interface is included with the CAL-PD Si Photodiode, CAL-THPY Thermal Sensor, and CAL-NS Nonlinear Crystal with Si Photodiode Recalibration Services below at no additional cost. We recommend yearly recalibration to ensure accuracy and performance. Please contact Tech Support for assistance..

[Hide Specs](#)

## SPECS

### Specifications

Item #	S170C	S171C	S175C	NS170C
Detector Type	Silicon Photodiode		Thermal Absorber	Second-Order Nonlinear Crystal with Silicon Photodiode
Wavelength Range	350 - 1100 nm	400 - 1100 nm	300 nm - 10.6 $\mu$ m	Laser: 780 - 1300 nm SHG: 390 - 650 nm
Optical Power Working Range	10 nW - 150 mW	1 nW - 15 mW	100 $\mu$ W - 2 W	Laser: 0.5 - 350 mW <sup>a</sup> SHG: 10 nW - 5 mW
Max Average Power Density	20 W/cm <sup>2</sup>	10 W/cm <sup>2</sup>	200 W/cm <sup>2</sup>	-
Max Pulse Energy Density	-	-	0.1 J/cm <sup>2</sup> (1 $\mu$ s Pulse) 1 J/cm <sup>2</sup> (1 ms Pulse)	-
Max Peak Power Density <sup>b</sup>	-	-	-	10 TW/cm <sup>2</sup>
Linearity	$\pm$ 0.5%			$\pm$ 0.5% <sup>c</sup>
Resolution	1 nW <sup>d</sup>	0.5 pW <sup>e</sup>	10 $\mu$ W <sup>f</sup>	1 nW <sup>c,d</sup>
Measurement Uncertainty	$\pm$ 3% (440 - 980 nm) <sup>g</sup> $\pm$ 5% (350 - 439 nm) <sup>g</sup> $\pm$ 7% (981 - 1100 nm) <sup>g</sup>	$\pm$ 3% (440 - 980 nm) <sup>g,h</sup> $\pm$ 5% (400 - 439 nm) <sup>g,h</sup> $\pm$ 7% (981 - 1100 nm) <sup>g,h</sup>	$\pm$ 3% (1064 nm) $\pm$ 5% (300 nm - 10.6 $\mu$ m)	$\pm$ 3% (440 - 650 nm) <sup>c,i</sup> $\pm$ 5% (390 - 439 nm) <sup>c,i</sup>
Responsivity (Click for Plot)	 Raw Data	 Raw Data	-	 Raw Data
Absorption (Click for Plot)	-	-	 Raw Data	-
Typical Application	Light Measurement on the Microscope Objective Plane			GDD Optimization of a Femtosecond Laser at the Focus of a Two-Photon Microscope <sup>l</sup>
Neutral Density Filter	Reflective (OD 1.5)	Absorptive (OD 0.4)	N/A	N/A
Cooling	Convection			
Compatible Consoles <sup>k</sup>	PM100D, PM100A, PM400, and PM5020			
Compatible Interfaces <sup>k</sup>	PM101, PM101A, PM101R, PM101U, PM103, PM103A, PM103E, PM103U, and PM100USB		PM101, PM101A, PM101R, PM101U, PM102, PM102A, PM102U, and PM100USB	PM101, PM101A, PM101R, PM101U, PM103, PM103A, PM103E, PM103U, and PM100USB
Response Time	<1 $\mu$ s		<2 s	<1 $\mu$ s
Dimensions	76.0 mm x 25.2 mm x 5.0 mm (2.99" x 0.99" x 0.20")		76.0 mm x 25.2 mm x 4.8 mm (2.99" x 0.99" x 0.19")	Base: 76.0 mm x 25.2 mm x 5.0 mm (2.99" x 0.99" x 0.20") Overall: 76.0 mm x 30.0 mm x 11.0 mm (2.99" x 1.18" x 0.43")
Active Detector Area	18 mm x 18 mm			
Input Aperture	20 mm x 20 mm		18 mm x 18 mm	$\varnothing$ 4.5 mm
Working Distance	-	-	-	0.22 mm
Cable Length	1.5 m			
Connector	Sub-D 9 Pin Male			
Weight	0.07 kg (0.15 lbs)		0.05 kg (0.11 lbs)	0.08 kg (0.18 lbs)
Post Mounting	Combi Thread 8-32 and M4 x 0.7		N/A	Combi Thread 8-32 and M4 x 0.7

a. The working range provided is for lasers with a repetition rate of 80 MHz. Because the peak power and peak power density are dependent on the average power and repetition rate of the laser, the upper limit to the working average power range will be lower for lower repetition rates. Exceeding the maximum average power may result in damage to the sensor's optical components.

b. The specified damage threshold is for objectives with NA > 0.5. The damage threshold will be lower for NA < 0.5.

c. This specification is for the measured second harmonic generation (SHG) signal.

d. Measured with PM100D console in low bandwidth setting.

e. Measured with PM5020 console in low bandwidth setting.

f. Measured with the legacy PM200 console.

g. Beam Diameter > 1 mm

h. Valid for 24  $\pm$  2  $^{\circ}$ C

i. Valid for 1/e<sup>2</sup> beam diameters >1 mm at the photodiode sensor. Please note that the photodiode sensor is several millimeters below the  $\beta$ -BBO crystal and for high

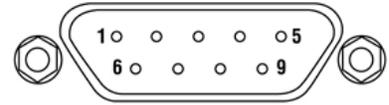
NA objectives, the beam diameter is expanded appreciably.

j. For more information, please see the full presentation for our microscope slide peak power sensor for two-photon lasers.

k. The S17xC and NS170C sensors are compatible with all currently available photodiode power meter consoles and interfaces, as well as the previous-generation PM200 and PM320E consoles; they are not compatible with other previous generation Thorlabs power meter consoles.

Pin Connections		
Pin	S170C, S171C, and NS170C	S175C
1	Not Used	
2	EEPROM Data	
3	Photodiode Anode Ground	Sensor Ground
4	Photodiode Cathode	Not Used
5	Not Used	
6	EEPROM Ground	
7	Not Used	Not Used
8	Not Used	Sensor Signal
9	Not Used	

### Sensor Connector D-type Male



#### Cleaning

The housing of these microscope slide power meter sensor heads can be cleaned using a soft damp cloth. To clean the ND filter of the S170C and S171C sensors, gently blow off any debris using compressed air. The surface may be gently wiped using an optic tissue moistened with acetone or methanol. The glass sensor cover of the S175C and NS170C sensors can be cleaned with appropriate solvents like isopropanol.

#### Calibration

The calibration of the sensors in these sensors should remain stable for over a year provided that the unit has not been exposed to excessive optical powers. We recommend yearly recalibration to ensure accuracy and performance, which may be ordered using the CAL-PD for Item #s S170C and S171C, CAL-THPY for Item # S175C, or CAL-NS for Item # NS170C. Please contact Tech Support for assistance.

[Hide Optical Design](#)

### OPTICAL DESIGN

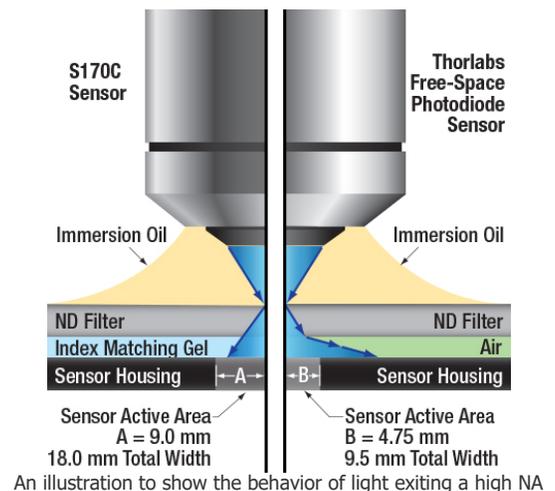
The sections below describe the various designs of Microscope Slide Power Meter Sensor Heads. Use the following links to jump to a specific section:

- [Large Active Area and Index Matching Gel](#)
- [Nonlinear Crystal with Silicon Photodiode Sensor](#)

#### Large Active Area and Index Matching Gel

The S170C, S171C, and S175C microscope slide sensor heads were designed with large-active-area detectors to accommodate high NA objectives. In addition, the S170C and S171C sensors use index matching gel in the gap between the neutral density filter and the sensor to minimize losses due to internal reflections at the air-glass interface. The S175C sensor uses a protective glass cover that features a smaller air gap than the S170C sensor (0.15 mm versus 1.5 mm) to avoid the use of index matching gel, which helps maintain a fast sensor response time.

The schematic to the right illustrates the advantages that a large-area detector like the one used in the S170C sensor provides over typical photodetectors by tracing the path of light from a high NA objective after it enters an S170C microscope slide sensor head and a typical photodiode sensor. The typical photodiode sensor shown in the drawing has an air-filled gap between the ND filter<sup>a</sup> and the sensor and a Ø9.5 mm active area, similar to our S130 slim photodiode sensors or S120 standard photodiode sensors. When light from a large NA objective reaches the interface between the ND filter and the glass, it refracts away from the



An illustration to show the behavior of light exiting a high NA

center of the sensor. Some of the light misses the edge of the small active area of the photodiode, causing erroneous power measurements.

In the S170C microscope slide sensor head, the gap between the neutral density filter and the sensor active area has been filled with an index matching gel. Compared to the ND-filter-to-air interface in typical sensor heads, the gel minimizes the amount of reflected light at the ND-filter-to-gel interface that would otherwise not reach the sensor and eliminates refraction of light exiting the ND filter, allowing the large-area detector to capture more light from the objective. Please be aware that this design cannot completely compensate for this effect for very high NA oil objectives and at certain wavelengths.

Similar results would be expected from a comparison of the S175C unit with other thermal sensors. The small 0.15 mm air gap between the protective glass plate and the thermal sensor minimizes the light refracted away from the center of the sensor, while the large 18 mm x 18 mm active area catches more of the incoming signal. Additionally, the S175C sensor has a protective glass cover plate that allows the appropriate immersion media for the objective to be applied without damaging the sensor. (Note: do not apply immersion media to Thorlabs' other thermal sensors, as it may damage to the sensor head.)

- a. Do not place immersion media directly on the ND filter of any Thorlabs' photodiode sensors, with the exception of the Microscope Slide Power Sensors that are specifically designed for this application, as the oil cannot be cleaned from the filter surface. The example used here is only intended to demonstrate the advantages of the S170C sensor's optical design.

## Nonlinear Crystal with Silicon Photodiode Sensor

The NS170C Microscope Slide Peak Power Sensor was designed to measure the relative peak power of two-photon lasers. As shown in the diagram to the right, the sensor features a 30  $\mu\text{m}$  ultrathin  $\beta$ -BBO crystal that converts incident femtosecond NIR pulses (780 – 1300 nm) into their second harmonic (390 – 650 nm). Shortpass filters underneath the  $\beta$ -BBO crystal reject the residual NIR light, allowing only the visible second harmonic light to transmit down to the large area silicon photodiode sensor.

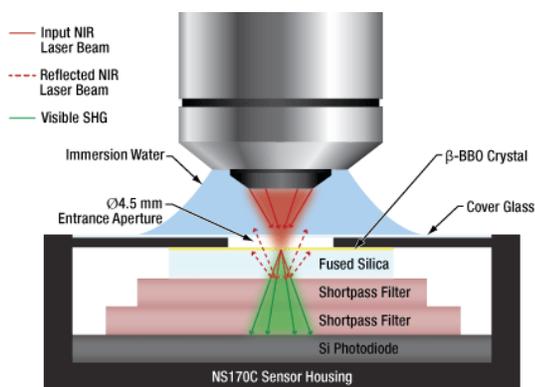
A microscope objective is shown focusing the femtosecond NIR pulses into the  $\beta$ -BBO crystal through a  $\varnothing 4.5$  mm entrance aperture. Because the SHG process requires high peak intensities, the sensor only generates detectable second harmonic light when the ultrathin  $\beta$ -BBO crystal is in the focus of the objective. This means the NS170C sensor is sensitive to the peak power density of the focused femtosecond pulses rather than the average power; therefore, the detected SHG signal can be used as a relative measurement of the lasers' peak intensity. For more details on the generation of second harmonic light using  $\beta$ -BBO crystals, please see the *SHG Tutorial* tab.

At the top of the NS170C sensor is a standard 170  $\mu\text{m}$  thick cover glass that is sealed to the housing, allowing it to be used with dry, water immersion, and oil immersion objectives. The immersion media can be placed directly on the surface of the cover glass without damaging the sensor. The working distance from the top of the cover glass to the  $\beta$ -BBO crystal is 0.22 mm. Between the cover glass and the  $\beta$ -BBO crystal is an 80  $\mu\text{m}$  air-gap, which is necessary because epoxy or index-matching gel would burn in the focus of the high-intensity femtosecond pulses. While this air-gap causes total internal reflection (TIR) of the highest spatial frequencies when using high NA objectives, the second harmonic process in the  $\beta$ -BBO crystal has a finite spatial frequency acceptance bandwidth, which is exceeded by high NA objectives. Therefore, the highest spatial frequencies rejected by TIR would not appreciably contribute to the SHG process.

The housing of the NS170C sensor shares dimensions with a microscope slide and can fit on standard microscope stages, allowing for measurements of the relative peak power at the focus of a microscope.

For more information on the NS170C sensor, please see the full presentation for our microscope slide peak power sensor for two-photon lasers.

objective after it enters the S170C microscope power sensor head vs. a typical photodiode sensor. For objectives with NAs greater than 1.0 and a detector without index matching gel in the gap, some of the light will also undergo total internal reflection at the ND filter-air interface, causing additional losses before the light reaches the sensor. (Important Note: Do not place immersion oil or other immersion media directly on the ND filter of any Thorlabs photodiode detectors other than the S170C and S171C sensors, as they were not designed for this application and the oil cannot be cleaned from the filter surface.)



Click to Enlarge  
An illustration to show the optical design of the NS170C Microscope Slide Peak Power Sensor. An ultrathin  $\beta$ -BBO crystal is used to convert femtosecond NIR laser pulses into their visible second harmonic. Shortpass filters reflect the residual NIR light, allowing only the visible second harmonic light to transmit to the silicon photodiode sensor.

[Hide Low-Power Microscope Slide Power Meter Sensor Heads](#)

## Low-Power Microscope Slide Power Meter Sensor Heads



- ▶ Large 18 mm x 18 mm Sensor Active Area
- ▶ Ideal for Measuring Light from High NA Objectives or Any Position Along the Optical Path
- ▶ Yearly Recalibration with CAL-PD Recalibration Service Recommended (For More Information, Contact Tech Support)
- ▶ Post Mountable via 8-32 (M4) Tap

Item # <sup>a</sup>	S170C	S171C
<b>Wavelength Range</b>	350 - 1100 nm	400 - 1100 nm
<b>Optical Power Working Range</b>	10 nW - 150 mW	1 nW - 15 mW
<b>Max Average Power Density</b>	20 W/cm <sup>2</sup>	10 W/cm <sup>2</sup>
<b>Resolution</b>	1 nW <sup>b</sup>	0.5 pW <sup>c</sup>

The S170C and S171C Microscope Slide Power Meter Photodiode Sensor Heads are designed to fit in the microscope slide holders of standard upright and inverted microscopes to measure the power at the sample plane. The active sensor is contained within a sealed housing, behind a neutral density (ND) filter with OD 1.5 (Item # S170C) or 0.4 (Item # S171C). A 20 mm x 20 mm indent above the ND filter accepts cover slips and immersion media. Immersion media (water, glycerol, oil, etc.) may be placed in this well directly over the ND filter, or a cover slip may be inserted first to simplify clean up. The S170C and S171C sensors use index matching gel in the gap between the neutral density filter and the sensor to minimize losses due to internal reflections at the air-glass interface. A detailed overview of these physical features is presented in the *Optical Design* tab.

With a fast response time of 1  $\mu$ s, minimum power of 10 nW, and resolution of 1 nW, the S170C photodiode sensor is ideal for high-resolution power measurements of low-power illumination. Additionally, we offer the S171C sensor, which has a minimum power of 1 nW and a high resolution of 0.5 pW. The addition of water to a water dipping/ immersion objective always results in the absorption of some of the transmitted light, particularly in the near IR region. As such, power readings recorded without water will be higher than the values recorded with water.

The back of each slide is engraved with the sensor specifications and a grid for aligning the beam. To take a power measurement, simply flip over the slide to expose the sensor to the objective. In inverted microscopes, the trans-illumination lamp can be centered on the grid to ensure the sensor is centered on the beam.

Thorlabs recommends yearly recalibration of the S170C and S171C sensors. Thorlabs offers a recalibration service for these photodiode power sensors, which can be ordered below (see Item # CAL-PD). Recalibration of a single-channel power and/or energy meter console or interface is included with the recalibration of a sensor at no additional cost.

- a. For complete specifications, please see the *Specs* tab.
- b. Measured with PM100D console in low bandwidth setting.
- c. Measured with PM5020 console in low bandwidth setting.



Click to Enlarge  
The S170C may be post mounted via the 8-32 (M4) tap in the side of the housing.

Part Number	Description	Price	Availability
S170C	Customer Inspired! Microscope Slide Power Sensor, 350 - 1100 nm, 10 nW - 150 mW	\$1,324.53	Lead Time
S171C	Customer Inspired! Microscope Slide Power Sensor, 400 - 1100 nm, 1 nW - 15 mW	\$1,324.53	Lead Time

#### [Hide High-Power Microscope Slide Power Meter Sensor Head](#)

### High-Power Microscope Slide Power Meter Sensor Head



- ▶ High-Power Thermal Sensor for 300 nm - 10.6  $\mu$ m
- ▶ Designed to Measure Optical Powers from 100  $\mu$ W to 2 W
- ▶ Large 18 mm x 18 mm Sensor Active Area
- ▶ Ideal for Measuring Light from High NA Objectives or Any Position Along the Optical Path
- ▶ Yearly Recalibration with CAL-THPY Recalibration Service Recommended (For More Information, Contact Tech Support)

Key Specifications <sup>a</sup>	
Wavelength Range	300 nm - 10.6 $\mu$ m
Optical Power Working Range	100 $\mu$ W - 2 W
Max Average Power Density	200 W/cm <sup>2</sup>
Resolution <sup>b</sup>	10 $\mu$ W

- a. For complete specifications, please see the *Specs* tab.
- b. Measured with the Legacy PM200 Console

The S175C Microscope Slide Power Meter Thermal Sensor Head is designed to fit in the microscope slide holders of standard upright and inverted microscopes to measure the power at the sample plane. The large-active-area 18 mm x 18 mm sensor is protected by a glass plate, allowing immersion media to be applied. With a <2 s response time, 100  $\mu$ W to 2 W optical power range, and 10  $\mu$ W resolution, this thermal sensor is suited for high-power measurements of broadband sources, such as LEDs or white light illumination. The addition of water to a water dipping/ immersion objective always results in the absorption of some of the transmitted light, particularly in the near IR region. As such, power readings recorded without water will be higher than the values recorded with water.



Click to Enlarge  
The back of the S175C housing is engraved with the sensor specifications and a target for centering the beam on the sensor.

The back of the slide is engraved with the sensor specifications and a target for aligning the beam, shown in the photo to the right. To take a power measurement, simply flip over the slide to expose the sensor to the objective. In inverted microscopes, the trans-illumination lamp can be centered on the target to ensure the sensor is centered on the beam.

Please be aware that thermal sensors are sensitive to air vents and strong ambient temperature changes. Measurements should be taken once the sensor has settled to the ambient temperature.

Thorlabs recommends yearly recalibration of the S175C sensor. Thorlabs offers a recalibration service for this thermal sensor, which can be ordered below (see Item # CAL-THPY). Recalibration of a single-channel power and/or energy meter console or interface is included with the recalibration of a sensor at no additional cost.

Part Number	Description	Price	Availability
S175C	Customer Inspired! Microscope Slide Thermal Power Sensor, 300 nm - 10.6 $\mu$ m, 100 $\mu$ W - 2 W	\$1,324.53	Lead Time

## Microscope Slide Power Meter Sensor Head for Multiphoton Microscopy



- ▶ Utilizes a Second-Order Nonlinear Crystal to Measure the Relative Peak Power of Two-Photon Lasers
  - ▶ Input Laser Wavelength Range: 780 - 1300 nm
  - ▶ Second-Harmonic Wavelength Range: 390 - 650 nm
- ▶ Ideal for Optimizing Laser Conditions at the Sample Plane of a Microscope
- ▶ Compatible with Dry, Water Immersion, and Oil Immersion Objectives
- ▶ Yearly Recalibration with CAL-NS Recalibration Service Recommended (For More Information, Contact Tech Support)
- ▶ See the Full Web Presentation for More Information

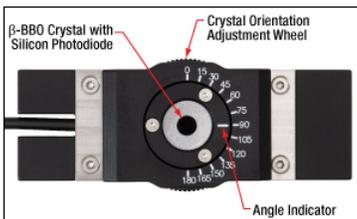
Key Specifications <sup>a</sup>	
Laser Wavelength Range	780 - 1300 nm
SHG Wavelength Range	390 - 650 nm
Laser Optical Power Working Range <sup>b</sup>	0.5 - 350 mW
SHG Optical Power Working Range	10 nW - 5 mW
Max Peak Power Density <sup>c</sup>	10 TW/cm <sup>2</sup>
Resolution <sup>d</sup>	1 nW

The NS170C sensor is designed to measure the relative peak power of two-photon lasers by utilizing a second-order nonlinear  $\beta$ -BBO crystal to convert incident ultrafast NIR pulses into their visible second harmonic. Shortpass filters underneath the  $\beta$ -BBO crystal reject the residual NIR light, allowing only the second harmonic light to transmit down to a large area silicon photodiode sensor (see *Optical Design* tab for details). Because the efficiency of second harmonic generation (SHG) is proportional to the peak power density, or peak intensity, of the NIR femtosecond pulses, the magnitude of the detected second harmonic light provides a relative measurement of the peak power of the laser.

The NS170C sensor can be used with femtosecond lasers with center wavelengths from 780 nm to 1300 nm

SHG signal, it is not sensitive to the average power of the input laser alone, but rather the peak power density of the laser pulses. The damage threshold for the peak power density is 10 TW/cm<sup>2</sup> at 80 MHz repetition rate and for microscope objectives with NA > 0.5; the damage threshold will be lower for NA < 0.5. The photodiode sensor can detect SHG light with wavelengths from 390 nm to 650 nm at optical powers from 10 nW to 5 mW with a resolution of 1 nW. Please see the *Specs* tab for more information.

The NS170C sensor has the same footprint (76.0 mm x 25.2 mm) as a standard microscope slide and is compatible with microscope slide holders of standard upright and inverted microscopes. This design enables the sensor to measure the relative peak power at the focus of the microscope, making it ideal for laser pulse optimization for multiphoton imaging. The sensor is also post-mountable via an 8-32 (M4 x 0.7) tapped hole, allowing for the relative peak power to be measured in an optical set-up of standard optomechanical components.



The NS170C sensor features a knurled phase adjustment wheel to tune the rotational orientation of the  $\beta$ -BBO crystal.

For more information on the NS170C power sensor, please see the full presentation for our microscope slide peak power sensor for two-photon lasers.

- a. For complete specifications, please see the *Specs* tab.
- b. The working range provided is for lasers with a repetition rate of 80 MHz. Because the peak power and peak power density are dependent on the average power and repetition rate of the laser, the upper limit to the working average power range will be lower for lower repetition rates. Exceeding the maximum average power may result in damage to the sensor's optical components.
- c. The specified damage threshold is for objectives with NA > 0.5. The damage threshold will be lower for NA < 0.5.
- d. Resolution of the measured SHG signal measured with a PM100D console in low bandwidth setting.



The back of the NS170C housing is engraved with the sensor specifications and a target for centering the beam on the sensor.

As shown in the photo to the left, the housing of the NS170C sensor features a knurled adjustment wheel to tune the angle between the light's polarization orientation and the  $\beta$ -BBO crystal's optical axis. At the entrance of the sensor is a 170  $\mu$ m thick cover glass sealed to the sensor housing, allowing the sensor to be used with dry, water immersion, and oil immersion objectives. The working distance from the top of the cover glass to the  $\beta$ -BBO crystal is 0.22 mm. The back of the sensor housing features a laser-engraved alignment crosshair that marks the active sensor area to aid in aligning and focusing the beam.

Thorlabs recommends yearly recalibration of the NS170C sensor. Thorlabs offers a recalibration service for this photodiode sensor, which can be ordered below (see Item # CAL-NS). Recalibration of a single-channel power and/or energy meter console or interface is included with the recalibration of a sensor at no additional cost. For more information, please contact Tech Support.

Part Number	Description	Price	Availability
NS170C	Microscope Slide Peak Power Sensor for Two-Photon Lasers, 780 - 1300 nm	\$2,650.00	Lead Time

Our most popular power meter consoles are included here for convenience. The PM100D digital power meter console features a back-lit LED screen and includes a 1 GB external SD memory card. The PM400 touch screen power meter console can perform the same functions as the PM100D with added features that include storing past power measurements in its 4 GB internal memory, inputs for external temperature and humidity sensors, programmable GPIO ports, and a capacitive touchscreen display that allows the unit to be operated with multi-touch gestures. Additionally, the PM400 allows optical power measurement data, temperature logs, spectral correction curves, and attenuation correction data can be saved by the user and transferred between the console and an external device for further analysis. These functions are particularly useful for tracking the consistency of the power at the sample plane over time. For more information, click on the part number in the table below to view the complete presentation for each power meter console.

Alternatively, the S170C, S171C, S175C, and NS170C sensors are compatible with the PM5020 and the previous-generation PM200 and PM320E consoles. All three sensors can also be used with the PM100 series and PM100USB interfaces, which provide communication between the sensor and an external control unit such as a PC. Additionally, the S170C, S171C, and NS170C power sensors are compatible with the PM103 series interfaces and the S175C with the PM102 series interfaces.

Item #	PM100A	PM100D	PM400
<b>Console Image</b> (Click the Image to Enlarge)			
<b>Display</b>	Mechanical Needle and LCD Display with Digital Readout	320 x 240 Pixel Backlit Graphical LCD Display	Projected Capacitive Touchscreen with Color Display
<b>Output</b>	Analog Needle or Digital Numeric Readout	Numerical, Bar Graph, Statistics, Simulated Analog Needle	Numerical with Bar Graph, Trend Graph (Power or Energy and Temperature), Statistics, Simulated Analog Needle
<b>Calibration Functions</b>	Wavelength Correction <sup>a</sup>	Wavelength Correction <sup>a</sup>	Wavelength Correction <sup>a</sup> ; Also Accepts User-Input Source Spectra and Attenuation Correction Data
<b>Data Storage and Transfer</b>	USB 2.0 Interface	1 GB External SD Memory Card, USB 2.0 Interface	4 GB Internal Memory Mini B USB 2.0 Interface
<b>Dimensions</b>	7.24" x 4.29" x 1.61" (184 mm x 109 mm x 41 mm)	7.09" x 4.13" x 1.50" (180 mm x 105 mm x 38 mm)	5.35" x 3.78" x 1.16" (136.0 mm x 96.0 mm x 29.5 mm)
<b>Display Dimensions</b>	1.9" x 0.5" (48.2 mm x 13.2 mm) Digital Display and 3.54" x 1.65" (90.0 mm x 42.0 mm) Analog Display	3.17" x 2.36" (81.4 mm x 61.0 mm)	3.7" x 2.1" (95 mm x 54 mm)

a. Sensor Dependent

Part Number	Description	Price	Availability
PM100A	Compact Power Meter Console, Mechanical Analog & Graphical LC Display	\$1,114.91	Lead Time
PM100D	Compact Power and Energy Meter Console, Digital 4" LCD	\$1,270.39	Lead Time
PM400	Projected Capacitive Touchscreen Optical Power and Energy Meter Console	\$1,583.35	Lead Time

[Hide Recalibration Service for Microscope Slide Power Sensors](#)

### Recalibration Service for Microscope Slide Power Sensors

Thorlabs offers recalibration services for our microscope slide power sensors. To ensure accurate measurements, we recommend recalibrating the sensors annually. Recalibration of a single-channel power and/or energy meter console or interface is included with the recalibration of a sensor at no additional cost. If you wish to calibrate one or more sensors with a dual-channel console, each sensor and console calibration service will need to be purchased individually.

Refer to the table to the right for the appropriate calibration service Item # that corresponds to your microscope slide power sensor.

Calibration Service Item #	Compatible Microscope Slide Power Sensor
CAL-PD	S170C and S171C
CAL-THPY	S175C
CAL-NS	NS170C

**Requesting a Calibration**

Thorlabs provides two options for requesting a calibration:

1. Complete the Returns Material Authorization (RMA) form. When completing the RMA form, please enter your name, contact information, the Part #, and the Serial # of the item being returned for calibration; in the *Reason for Return* field, select "I would like an item to be calibrated." All other fields are optional. Once the form has been submitted, a member of our RMA team will reach out to provide an RMA Number, return instructions, and to verify billing and payment information.
  
2. Select the appropriate sensor calibration Item # below, enter the Part # and Serial # of the sensor that requires recalibration, and then Add to Cart. If you would like a console calibrated with your sensor, repeat this process for Item # CAL-PM1 or CAL-PM2 below, entering the console Item # and Serial #. A member of our RMA team will reach out to coordinate the return of the item(s) for calibration. Note that each console calibration Item # represents the cost of calibrating a console alone; if requesting a single-channel console calibration with a sensor calibration, the appropriate discount will be applied when your request is processed. Should you have other items in your cart, note that the calibration request will be split off from your order for RMA processing.

**Please Note:** To ensure your item being returned for calibration is routed appropriately once it arrives at our facility, please do not ship it prior to being provided an RMA Number and return instructions by a member of our team.

Part Number	Description	Price	Availability
CAL-PD	Recalibration Service for Single-Power-Range Silicon Photodiode Power Sensors	\$167.48	Lead Time
CAL-NS	Recalibration Service for Second-Order Nonlinear Crystal with Silicon Photodiode Sensor	\$335.00	Lead Time
CAL-THPY	Recalibration Service for Thermal Power and Pyroelectric Energy Sensors at 1064 nm	\$212.62	Lead Time

[Hide Recalibration of Power & Energy Meter Electronics](#)

## Recalibration of Power & Energy Meter Electronics

These recalibration services are for the power and/or energy meter electronics of our consoles and interfaces. To ensure accurate measurements, we recommend recalibrating annually. Recalibration of a single-channel console or interface is included with these sensor recalibration services at no additional cost. If you wish to calibrate one or more sensors with a dual-channel console, each sensor and console calibration service will need to be purchased individually. For more details on these recalibration services, please click the Documents (  ) icons below.

Table 719A lists the power and/or energy meter consoles and interfaces that can be calibrated using the CAL-PM1 and CAL-PM2 recalibration services.

Table 719A Compatibility	
Calibration Service Item #	Compatible Consoles & Interfaces
<b>Single-Channel</b>	
CAL-PM1	PM100D, PM100A, PM400, PM100USB, PM101 Series, PM102 Series, PM103 Series
<b>Dual-Channel</b>	
CAL-PM2	PM5020, Previous-Generation PM320E

### Requesting a Calibration

Thorlabs provides two options for requesting a calibration:

1. Complete the Returns Material Authorization (RMA) form. When completing the RMA form, please enter your name, contact information, the Part #, and the Serial # of each item being returned for calibration; in the *Reason for Return* field, select "I would like an item to be calibrated." All other fields are optional. Once the form has been submitted, a member of our RMA team will reach out to provide an RMA Number, return instructions, and to verify billing and payment information.
  
2. Select the appropriate Item # below, enter the Part # and Serial # of the item that requires recalibration, and then Add to Cart. If you would like to calibrate one or more sensors with your console, repeat this process for the appropriate sensor recalibration service above, entering the console Item # and Serial #. A member of our RMA team will reach out to coordinate return of the item(s) for calibration. Note that each console calibration Item # represents the cost of calibrating a console alone; if requesting a single-channel console calibration with a sensor calibration, the appropriate discount will be applied when your request is processed. Should you have other items in your cart, note that the calibration request will be split off from your order for RMA processing.

**Please Note:** To ensure your item being returned for calibration is routed appropriately once it arrives at our facility, please do not ship it prior to being provided an RMA Number and return instructions by a member of our team.

Part Number	Description	Price	Availability
CAL-PM1	Recalibration of Single-Channel Power and/or Energy Meter Electronics	\$78.80	Lead Time

CAL-PM2

Recalibration of Dual-Channel Power and Energy Meter Electronics

\$210.12

Lead Time