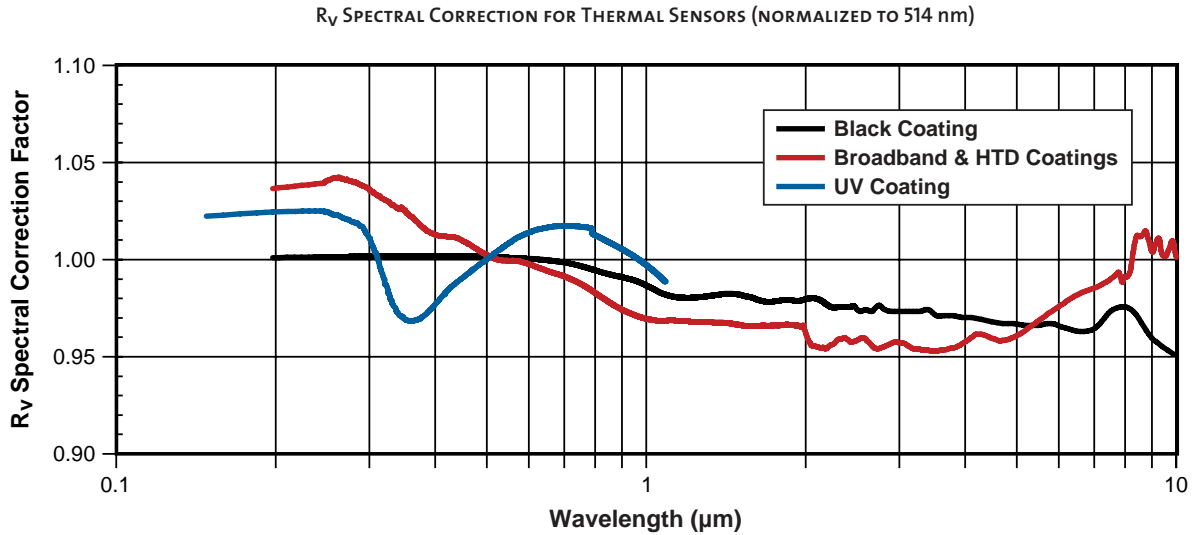


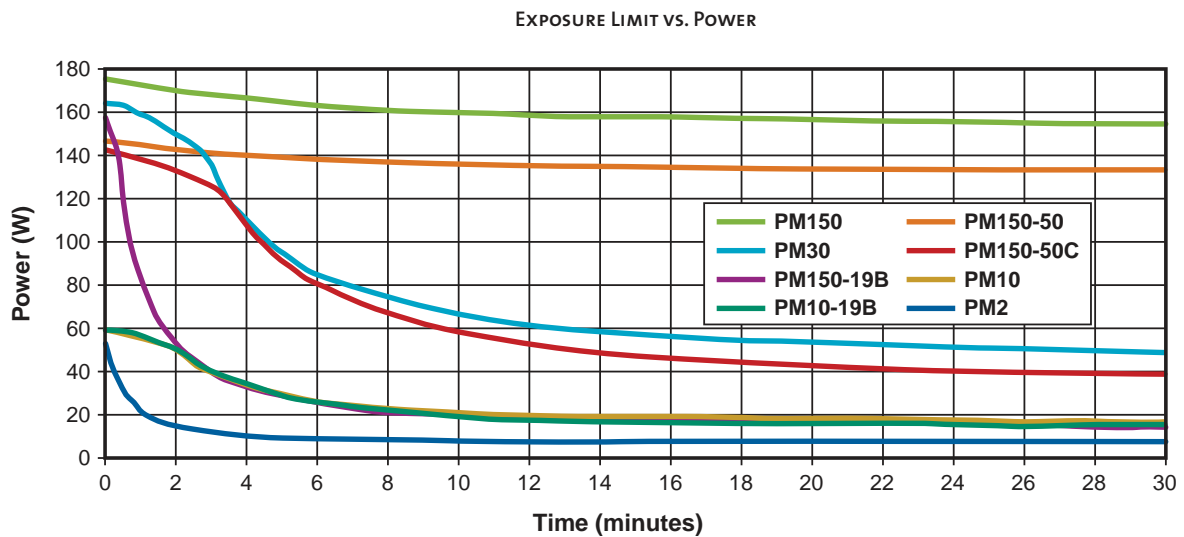
# Power Sensors Introduction

## Introduction and Selection Charts

Coherent uses three primary coatings to capture the incident radiation on our thermal sensors. The specifications for each sensor list which coating is used. Typical wavelength ranges and response curves for these coatings are shown in the chart below. Each sensor contains a spectral curve generated from reflectance measurements taken with spectrometers. The reflectance data are converted into a wavelength compensation look-up table that is loaded into the sensor. This data is accessed by selecting a wavelength of operation in the meters.



Many of our thermal sensors can measure power at levels greater than the maximum power rating for limited amounts of time. The following chart outlines how much power can be measured over a range of exposure times (Note: Water-cooled sensors are power-rated in air-cooled mode in this chart).



# Power Sensors Introduction

## Long-Pulse Energy Measurement with a Thermopile



Models PM10-19C, PM150-50C and PM150-50XC

### Application Example 1

Laser Pulse Width	50 ms
Maximum Energy	10J
Solution	Choose a PM10

### Application Example 2

Laser Pulse Width	300 ms
Maximum Energy	80J
Solution	Choose a PM150 or PM150-50C*

\* Specific sensor choice depends upon aperture and mechanical constraints.

Thermopile sensors are most commonly used for average power measurements on pulsed and CW lasers. Thermopiles are also capable of integrating long pulse widths. This allows the thermopile to measure the energy of single pulses between 1 millisecond and 10 seconds in length, and with energies from millijoules to hundreds of Joules. Long-pulse measurement is only possible when the thermopiles are used in conjunction with LabMax-TOP, LabMax-TO, or FieldMaxII-TOP meters.

This ability to integrate relatively long laser pulses with a thermopile is necessary when the laser pulse width exceeds the maximum pulse width rating of pyroelectric sensors. Pyroelectric sensors are typically limited to maximum pulse widths in the millisecond range. When the pulse width exceeds milliseconds, a thermopile is a good solution.

A good “rule of thumb” for using a thermopile for this type of measurement is to compare the maximum pulse energy you need to measure with the maximum power rating of a sensor (maximum power ratings can be found in the Power Sensor Summary Specifications on pages 20 to 21 or in the detailed product specifications contained on pages 22 to 37).

Common applications for this type of measurement are in the medical field, especially skin resurfacing and hair removal, and in material processing applications such as laser welding. These laser systems often utilize high-energy diode lasers that have large beam sizes and relatively long pulses. A detector like the PM150-50C is ideal for these measurements. It features a large 50 mm aperture size, can handle pulse energies up to 150J, and can be used air-cooled for single pulse energy measurements (a PM150-50C will normally need to be water-cooled for continuous power measurements).

Using a LabMax power/energy meter expands the range of long-pulse Joule measurements down into the low millijoule level when used with thermopiles such as the PS10, PS10Q, PS19, and PS19Q sensors.

Long-pulse measurements are limited to single pulses in order to achieve the most accurate measurements.

- POWER & ENERGY
- Power & Energy Meters
- Power Sensors
- Energy Sensors
- Custom & OEM
- BEAM DIAGNOSTICS
- CALIBRATION & SERVICE
- INDICES
- Laser Cross-Reference Index
- Product Name Index

# Power Sensors Introduction

## Summary of Specifications

Part Number	Description	Wavelength Range (μm)	Power			Long-Pulse Energy Range (J)	Detector Diameter (mm)	Detector Coating	Detector Type	Calibration Wavelength (nm)	Calibration Uncertainty (±%)	Connector
			Min.	Max.	Resolution							
<b>High-Sensitivity Semiconductor Sensors (to 50 mW)</b>												
1098401	OP-2 UV	0.25 to 0.4	10 nW	30 mW	1 nW	–	6.0	–	Silicon	–	8	OP DB-25
1098313	OP-2 VIS	0.4 to 1.064	10 nW	50 mW	1 nW	–	7.9	–	Silicon	–	5	OP DB-25
1098416	OP-2 IR	0.8 to 1.8	10 nW	10 mW	1 nW	–	5.0	–	Germanium	–	4.5	OP DB-25
1098390	LM-2 UV	0.25 to 0.4	10 nW	30 mW	1 nW	–	6.0	–	Silicon	–	8	LM DB-25
1098298	LM-2 VIS	0.4 to 1.064	10 nW	50 mW	1 nW	–	7.9	–	Silicon	–	5	LM DB-25
1098342	LM-2 IR	0.8 to 1.55	10 nW	10 mW	1 nW	–	5.0	–	Germanium	–	4.5	LM DB-25
<b>High-Sensitivity Thermopile Sensors (to 2W)</b>												
1098350	PS10	0.3 to 11.0	100 μW	1W	10 μW	0.001 to 1	10	Black	–	514	1	PM DB-25
1098400	PS10Q	0.3 to 2.0	100 μW	1W	10 μW	0.001 to 1	10	Black	–	514	1	PM DB-25
1098413	PS19	0.3 to 11.0	100 μW	1W	10 μW	0.001 to 1	19	Black	–	514	1	PM DB-25
1098341	PS19Q	0.3 to 2.0	100 μW	1W	10 μW	0.001 to 1	19	Black	–	514	1	PM DB-25
1098336	PM3	0.3 to 11.0	500 μW	2W	50 μW	–	19	Black	–	514	1	PM DB-25
1098419	PM3Q	0.3 to 2.0	500 μW	2W	50 μW	–	10	Black	–	514	1	PM DB-25
<b>Air-Cooled Thermopile Sensors (to 150W)</b>												
1098329	PM2	0.19 to 11.0	10 mW	2W	1 mW	0.5 to 2	19	Broadband	–	514	1	PM DB-25
1098457	PM2X	0.15 to 1.0	10 mW	2W	1 mW	0.5 to 2	19	UV	–	514	1	PM DB-25
1097901	PM10	0.19 to 11.0	10 mW	10W	1 mW	0.5 to 10	19	Broadband	–	514	1	PM DB-25
1098423	PM10X	0.15 to 1.0	10 mW	10W	1 mW	0.5 to 10	19	UV	–	514	1	PM DB-25
1098314	PM30	0.19 to 11.0	100 mW	30W	10 mW	0.5 to 50	19	Broadband	–	514	1	PM DB-25
1098498	PM30X	0.15 to 1.0	100 mW	30W	10 mW	0.5 to 50	19	UV	–	514	1	PM DB-25
1098483	PM100-19C	0.19 to 11.0	300 mW	100W	30 mW	1 to 100	19	Broadband	–	514	1	PM DB-25
1098407	PM150	0.19 to 11.0	300 mW	150W	30 mW	1 to 150	19	Broadband	–	514	1	PM DB-25
1098398	PM150-50	0.19 to 11.0	300 mW	150W	30 mW	1 to 150	50	Broadband	–	514	1	PM DB-25
1098455	PM150X	0.15 to 1.0	300 mW	150W	30 mW	1 to 150	50	UV	–	514	1	PM DB-25
<b>Water-Cooled Thermopile Sensors (to 300W)</b>												
1098397	PM10-19C	0.19 to 11.0	10 mW	10W	1 mW	0.5 to 10	19	Broadband	–	514	1	PM DB-25
1098444	PM150-19C	0.19 to 11.0	300 mW	150W	30 mW	1 to 150	19	Broadband	–	514	1	PM DB-25
1098412	PM150-50C	0.19 to 11.0	300 mW	150W	30 mW	1 to 150	50	Broadband	–	514	1	PM DB-25
1098443	PM150-50XC	0.15 to 1.0	300 mW	150W	30 mW	1 to 150	50	UV	–	514	1	PM DB-25
1141474	PM300	0.19 to 11.0	1W	300W	0.1W	–	19	Broadband	–	514	1	PM DB-25
<b>Fan-Cooled Thermopile Sensors (to 300W)</b>												
1098480	PM200F-19	0.19 to 11.0	1W	200W	100 mW	1 to 200	19	Broadband	–	514	1	PM DB-25
1098472	PM200F-50	0.19 to 11.0	1W	200W	100 mW	1 to 200	50	Broadband	–	514	1	PM DB-25
1113493	PM200F-50X	0.15 to 1.0	1W	200W	100 mW	1 to 200	50	UV	–	514	1	PM DB-25
1098509	PM300F-19	0.19 to 11.0	1W	300W	100 mW	1 to 300	19	Broadband	–	514	1	PM DB-25
1098417	PM300F-50	0.19 to 11.0	1W	300W	100 mW	1 to 300	50	Broadband	–	514	1	PM DB-25
1098481	PM300F-50X	0.15 to 1.0	1W	300W	100 mW	1 to 300	50	UV	–	514	1	PM DB-25

# Power Sensors Introduction

## Summary of Specifications

Part Number	Description	Wavelength Range (μm)		Power		Resolution (W)	Long-Pulse Energy Range (J)	Detector Diameter (mm)	Detector Coating	Calibration Wavelength (nm)	Calibration Uncertainty (±%)	Connector
		Min. (W)	Max. (W)									
<b>High-Power Water-Cooled Thermopile Sensors (to 5 kW)</b>												
1098392	PM1K	0.19 to 11.0	100	1000	1	–	50	Broadband	1064	5	PM DB-25	
1098462	PM3K	0.19 to 11.0	100	3000	1	–	50	Broadband	1064	5	PM DB-25	
1098454	PM5K	0.19 to 11.0	100	5000	1	–	50	Broadband	1064	5	PM DB-25	
<b>Large-Area High-Power Water-Cooled Thermopile Sensors (to 5 kW)</b>												
1098490	PM1K-100	0.19 to 11.0	100	1000	1	–	100	Broadband	1064	5	PM DB-25	
1098506	PM3K-100	0.19 to 11.0	100	3000	1	–	100	Broadband	1064	5	PM DB-25	
1098461	PM5K-100	0.19 to 11.0	100	5000	1	–	100	Broadband	1064	5	PM DB-25	
1098505	PM5K-200	0.19 to 11.0	100	5000	1	–	200	Broadband	1064	5	PM DB-25	
<b>Position-Sensing Air-Cooled Thermopile Sensors (to 200W)</b>												
1098328	LM-3	0.25 to 10.6	0.01	3	0.001	0.5 to 10	19	HTD	10600	5	LM DB-25	
1098304	LM-10	0.25 to 10.6	0.01	10	0.001	0.5 to 10	16	HTD	10600	5	LM DB-25	
1098456	LM-20	0.25 to 10.6	0.1	20	0.01	0.5 to 10	19	HTD	10600	5	LM DB-25	
1098320	LM-45	0.25 to 10.6	0.1	45	0.01	0.5 to 10	19	HTD	10600	5	LM DB-25	
1098346	LM-100	0.25 to 10.6	0.1	100	0.01	0.5 to 10	19	HTD	10600	5	LM DB-25	
1098394	LM-150 FS	0.25 to 10.6	0.1	150	0.01	0.5 to 10	19	HTD	10600	5	LM DB-25	
1098452	LM-150 LS	0.25 to 10.6	0.1	150	0.01	0.5 to 10	19	HTD	10600	5	LM DB-25	
1098450	LM-200 220V	0.25 to 10.6	0.1	200	0.01	0.5 to 100	19	HTD	10600	5	LM DB-25	
1098440	LM-200 110V	0.25 to 10.6	0.1	200	0.01	0.5 to 100	19	HTD	10600	5	LM DB-25	
<b>Position-Sensing Water-Cooled Thermopile Sensors (to 5 kW)</b>												
1098409	LM-1000	0.25 to 10.6	100	1000	1	–	38	Broadband	10600	5	LM DB-25	
1098437	LM-2500	0.25 to 10.6	100	2500	1	–	55	Broadband	10600	5	LM DB-25	
1098421	LM-5000	0.25 to 10.6	100	5000	1	–	55	Broadband	10600	5	LM DB-25	
<b>High-Peak-Power Thermopile Sensors (to 30W)</b>												
1098338	PM10V1	0.25 to 3.0	0.01	10	0.001	–	19	Volume Absorber	514	1	PM DB-25	
1098429	PM30V1	0.25 to 3.0	0.1	30	0.01	–	19	Volume Absorber	514	1	PM DB-25	
1098414	PM30V1Q	0.25 to 3.0	0.1	30	0.01	–	19	Volume Absorber	514	1	PM DB-25	
<b>Off-the-Shelf OEM Power Sensors (to 1 kW)</b>												
1098334	PM10-19A	0.19 to 11.0	0.1	10	0.01	–	19	Broadband	514	1	4-pin connector	
1098343	PM10-19B	0.19 to 11.0	0.1	10	0.01	–	19	Broadband	514	1	BNC-terminated	
1098418	PM150-19A	0.19 to 11.0	0.3	150	0.03	–	19	Broadband	514	1	4-pin connector	
1098321	PM150-19B	0.19 to 11.0	0.3	150	0.03	–	19	Broadband	514	1	BNC-terminated	
1098510	PM150-50A	0.19 to 11.0	0.3	150	0.03	–	50	Broadband	514	1	4-pin connector	
1098415	PM150-50B	0.19 to 11.0	0.3	150	0.03	–	50	Broadband	514	1	BNC-terminated	
1098441	PM150-50XB	0.15 to 1.0	0.3	150	0.03	–	50	UV	514	1	BNC-terminated	
1098333	PM1K-36B	0.19 to 11.0	100	1000	1	–	36	Broadband	1064	5	BNC-terminated	
1098427	BeamFinder	0.25 to 10.6	100	1000	1	–	35	Broadband	10600	5	LM DB-25	

- POWER & ENERGY
- Power & Energy Meters
- Power Sensors
- Energy Sensors
- Custom & OEM
- BEAM DIAGNOSTICS
- CALIBRATION & SERVICE
- INDICES
- Laser Cross-Reference Index
- Product Name Index

# Beam Position Sensing Thermopile Sensors

10 mW to 45W



Models LM-3, LM-10, LM-45

## Features

- Spectrally flat from 0.19 to 11  $\mu\text{m}$
- 10 mW to 100 mW resolution
- 16 mm to 19 mm apertures
- FC and SMA fiber connectors available (see page 38)

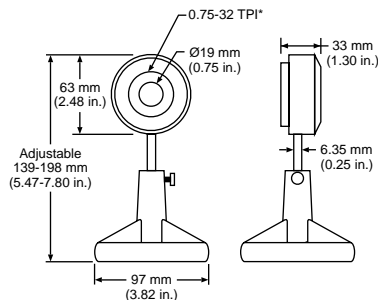


Use with LabMax, Ultima, or LaserPAD (see pages 10-16)

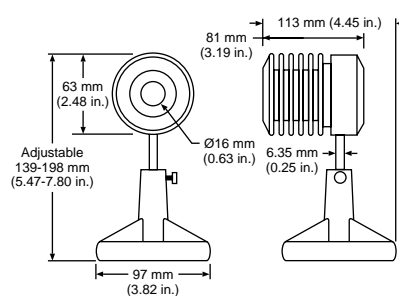
These unique thermopiles incorporate a quadrant thermopile disk that enables them to sense the position of the beam on the detector surface. This information is displayed by meters such as LabMax. All Coherent products which incorporate this position sensing technology are identified with the logo shown on the right.

Device Specifications	Model	LM-3	LM-10	LM-45
Wavelength Range ( $\mu\text{m}$ )			0.25 to 10.6	
Power Range		10 mW to 3W	10 mW to 10W	100 mW to 45W
Long-Pulse Joules Range (J)			0.5 to 10	
Resolution (mW)		10		100
Max. Power Density			6 kW/cm <sup>2</sup>	
Max. Energy Density			0.5 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Detector Coating			HTD	
Detector Diameter (mm)		19	16	19
Dimensions (mm)		$\varnothing 63 \times 33$ (2.4 x 1.2 in.)	$\varnothing 63 \times 81$ (2.4 x 3.1 in.)	$\varnothing 64 \times 86$ (2.5 x 3.3 in.)
Calibration Uncertainty (%)			$\pm 2$	
Calibration Wavelength ( $\mu\text{m}$ )			10.6	
Cooling Method			Air-cooled	
Cable Type			LM DB-25	
Cable Length (m)			1.8	
Part Number		1098328	1098304	1098320

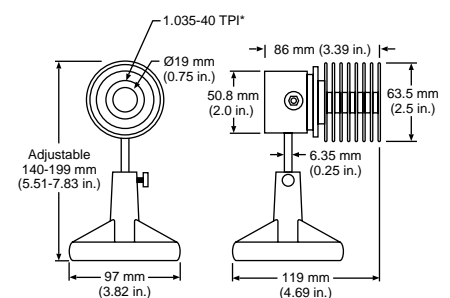
LM-3



LM-10



LM-45



\* Threads per inch

# Beam Position Sensing Thermopile Sensors

100 mW to 200W



Models LM-100, LM-200

## Features

- Spectrally flat from 0.19 to 11  $\mu\text{m}$
- 10 mW resolution
- 19 mm apertures
- FC and SMA fiber connectors available (see page 38)

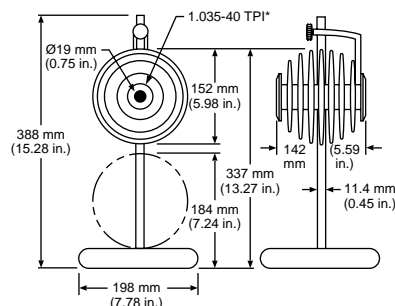


Use with LabMax, Ultima, or LaserPAD (see pages 10-16)

The LM-100 sensor is convectively-cooled for powers up to 100W. The LM-200 sensor is fan-cooled and is available in 110 VAC and 220 VAC configurations.

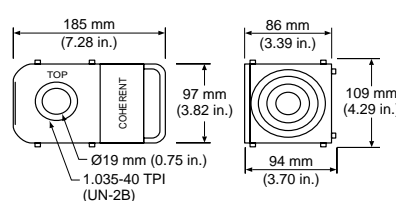
Device Specifications	Model	LM-100	LM-200
Wavelength Range ( $\mu\text{m}$ )		0.25 to 10.6	
Power Range (water-cooled)		100 mW to 100W	100 mW to 200W
Long-Pulse Joules Range (J)		0.5 to 10	
Resolution (mW)		10	
Max. Power Density		6 kW/cm <sup>2</sup>	
Max. Energy Density		0.5 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Detector Coating		HTD	
Detector Diameter (mm)		19	
Dimensions (mm)		$\varnothing 152 \times 142$ (5.9 x 5.5 in.)	185 x 94 x 109 (7.3 x 3.7 x 4.3 in.)
Calibration Uncertainty (%)		$\pm 2$	$\pm 5$
Calibration Wavelength ( $\mu\text{m}$ )		10.6	
Cooling Method		Air-cooled	Fan-cooled
Cable Type		LM DB-25	
Cable Length (m)		1.8	
Part Number		1098346	1098440 (110VAC) 1098450 (220 VAC)

LM-100



\*Threads per inch

LM-200



# Beam Position Sensing Thermopile Sensors

100 mW to 150W



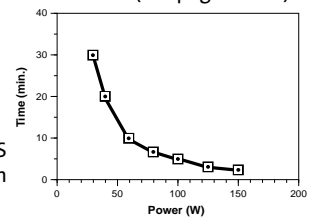
Models LM-150LS, LM-150FS, LM-20

## Features

- Spectrally flat from 0.19 to 11  $\mu\text{m}$
- 10 mW to 100 mW resolution
- 19 mm apertures



Use with LabMax, Ultima, or LaserPAD (see pages 10-16)

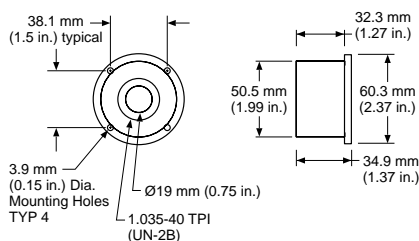


The LM-20 is designed for embedded use and must be mounted on a heat sink. The LM-150 FS and LS sensors are designed for intermittent operation.

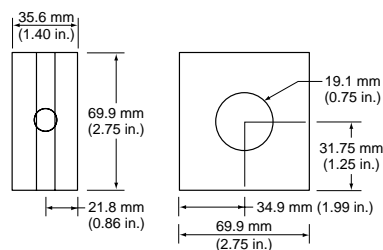
LM-150 FS and LS Power Duration

Device Specifications	Model	LM-20	LM-150 LS	LM-150 FS
Wavelength Range ( $\mu\text{m}$ )			0.25 to 10.6	
Power Range		100 mW to 20W	100 mW to 150W	100 mW to 150W
Long-Pulse Joules Range (J)			0.5 to 10	
Resolution (mW)			10	
Max. Power Density			6 kW/cm <sup>2</sup>	
Max. Energy Density			0.5 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Detector Coating			HTD	
Detector Diameter (mm)			19	
Dimensions (mm)		$\varnothing 60 \times 32$ (2.4 x 1.3 in.)	70 x 70 x 36 (2.8 x 2.8 x 1.4 in.)	$\varnothing 89 \times 38$ (3.5 x 1.4 in.)
Calibration Uncertainty (%)			$\pm 2$	
Calibration Wavelength ( $\mu\text{m}$ )			10.6	
Cooling Method		Conductive-cooled		Air-cooled
Cable Type			LM DB-25	
Cable Length (m)			1.8	
Part Number		1098456	1098452	1098394

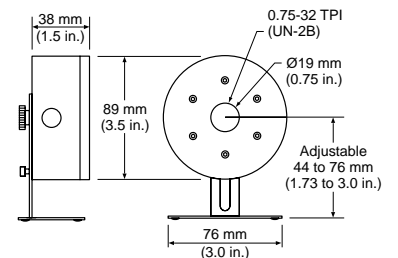
LM-20



LM-150 LS



LM-150 FS



\* Threads per inch

# Beam Position Sensing Thermopile Sensors

100W to 5 kW



Models LM5000, BeamFinder

## Features

- Water-cooled
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$
- 1W resolution
- 35 mm to 55 mm apertures



Use with LabMax, Ultima, or LaserPAD (see pages 10-16)

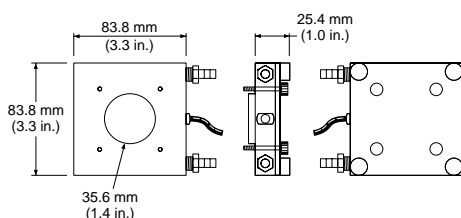
These kilowatt thermopile sensors are water-cooled for measuring output over 100W and are excellent for use with CO<sub>2</sub> and Nd:YAG lasers.

Tap or distilled cooling water is recommended with these sensors – DI water can not be used. Flow rates are power dependent and range from 0.5 to 4 gallons per minute; pressure depends upon flow rate and ranges from 3 to 40 PSI (visit product pages at [www.Coherent.com/LMC](http://www.Coherent.com/LMC) for more technical details).

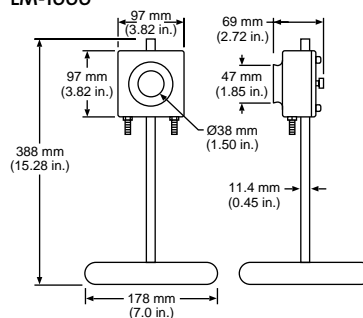
Device Specifications	Model	BeamFinder	LM-1000	LM-2500	LM-5000
Wavelength Range ( $\mu\text{m}$ )		0.3 to 10.6		0.25 to 10.6	
Power Range (W)		100 to 1000		100 to 2500	100 to 5000
Resolution (W)		1			
Max. Power Density <sup>1</sup>		1 to 2.5 kW/cm <sup>2</sup>			
Max. Energy Density		0.5 J/cm <sup>2</sup> , 1064 nm, 10 ns			
Detector Coating		H			
Active Area Diameter (mm)		35	38	55	
Dimensions (mm)		84 x 84 x 25.4 (3.3 x 3.3 x 1.0 in.)	97 x 97 x 69 (3.8 x 3.8 x 2.7 in.)	122 x 122 x 69 (4.8 x 4.8 x 2.7 in.)	
Calibration Uncertainty (%)		±5			
Calibration Wavelength ( $\mu\text{m}$ )		10.6			
Cooling Method		Water-cooled			
Cable Type		LM DB-25			
Cable Length (m)		6			
Part Number		1098427	1098409	1098437	1098421

<sup>1</sup> The damage resistance of the coating is dependent upon the beam size and profile, the average power level, and the water flow rate. Contact Coherent or your local representative for details related to your application.

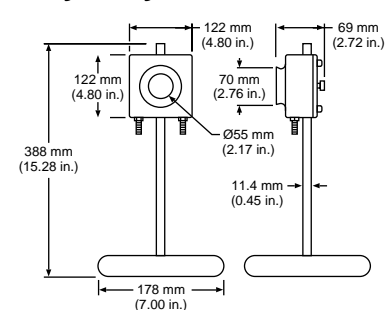
## BeamFinder



## LM-1000



## LM-2500/LM-5000



- POWER & ENERGY
- Power & Energy Meters
- Power Sensors
- Energy Sensors
- Custom & OEM
- BEAM DIAGNOSTICS
- CALIBRATION & SERVICE
- INDICES
- Laser Cross-Reference Index
- Product Name Index

# High-Sensitivity Optical Power Sensors

10 nW to 50 mW, CW



Model OP-2/LM-2

## Features

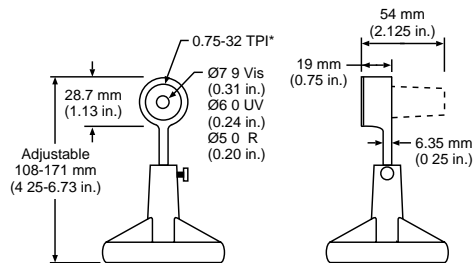
- Si, Ge photodiodes
- Spectral range: 250 nm to 1800 nm
- Fiber-optic connector (optional, see page 38)
- 1000:1 attenuator for measurement to 5W (optional, see page 38)

These high-sensitivity semiconductor sensors are ideal for CW laser measurements in the nW to low mW level. They typically saturate in the 10 to 50 mW level, depending upon the model. For linear operation up to a maximum of 5 Watts, an optional 1000:1 attenuator is used.

Device Specifications	Model	OP-2/LM-2 UV	OP-2/LM-2 VIS	OP-2/LM-2 IR
Detector Material		Silicon		Germanium
Wavelength Range (µm)		0.25 to 0.4	0.4 to 1.06	0.8 to 1.80/0.8 to 1.5 <sup>1</sup>
Power Range		10 nW to 30 mW	10 nW to 50 mW	10 nW to 10 mW
Resolution (nW)		1		
Active Area Diameter (mm)		6	7.9	5
Dimensions (mm)		Ø29 x 54 (1.1 x 2.1 in.)		
Calibration Uncertainty (%)		±8	±5	±4.5
Calibration Wavelength (nm)		Monochromator calibration across wavelength range		
Cooling Method		Air-cooled		
Connector Type		OP DB-25/LM DB-25		
Cable Length (m)		1.8		
Part Number				
	OP-2	1098401	1098313	1098416
	LM-2	1098390	1098298	1098342

<sup>1</sup> OP-2 IR and LM-2 IR have different spectral ranges.

## OP-2 UV/OP-2 VIS/OP-2 IR LM-2 UV/LM-2 VIS/LM-2 IR



\* Threads Per Inch

## Accessories



1000:1 Attenuator



Fiber-Optic Connector Adapters

# High-Sensitivity Thermopile Power Sensors

100  $\mu$ W to 2W



Models PS19Q, PS19, PS10, PM3

## Features

- Thermally stabilized designs
- Spectrally flat from 0.3  $\mu$ m to 11  $\mu$ m
- 10  $\mu$ W resolution
- Fiber-optic connectors (optional, see page 38)

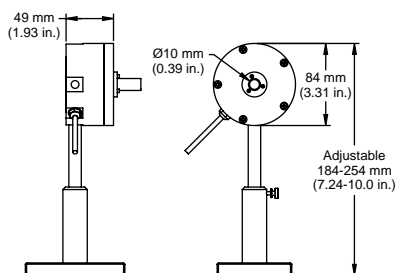
The PS10 and PS19 model sensors are thermally stabilized, amplified thermopile power sensors with a broad spectral response, high sensitivity, and a large active area. These sensors are ideal for measuring laser diodes, HeNe and HeCd lasers, and small ion lasers. The PS10 model includes a light tube mounted to the front of the housing, which minimizes the effects of background radiation. The light tube can be removed and replaced by FC or SMA fiber connectors (see Accessories - page 38). Where optimum stability is required, specify the PS10Q or PS19Q, which include a wedged quartz window for applications from 0.3 to 2.0  $\mu$ m. The quartz window more effectively eliminates thermal background radiation and the effects of air currents.

Device Specifications	Model	PS10 <sup>2</sup>	PS10Q	PS19	PS19Q	PM3 <sup>2</sup>	PM3Q
Wavelength Range ( $\mu$ m)		0.3 to 11	0.3 to 2	0.3 to 11	0.3 to 2	0.3 to 11	0.3 to 2
Power Range		100 $\mu$ W to 1W				500 $\mu$ W to 2W	
Resolution ( $\mu$ W)		10				50	
Max. Thermal Drift <sup>1</sup>		$\pm 40$ $\mu$ W	$\pm 20$ $\mu$ W	$\pm 400$ $\mu$ W	$\pm 20$ $\mu$ W	$\pm 1$ mW	$\pm 500$ $\mu$ W
Max. Avg. Power Density		0.5 kW/cm <sup>2</sup>					
Max. Pulse Energy Density		50 mJ/cm <sup>2</sup> , 10 ns, 1064 nm					
Response Time (sec.)		2					
Detector Coating		Black					
Quartz Filter Window		No	Yes	No	Yes	No	Yes
Active Area Diameter (mm)		10		19		19	10
Dimensions (mm)		$\varnothing 84 \times 49$ (3.3 x 1.9 in.)				$\varnothing 63 \times 36$ (2.4 x 1.4 in.)	
Calibration Uncertainty (%)		$\pm 1$					
Calibration Wavelength (nm)		514					
Cooling Method		Air-cooled					
Cable Type		PM DB-25					
Cable Length (m)		2					
Part Number		1098350	1098400	1098413	1098341	1098336	1098419

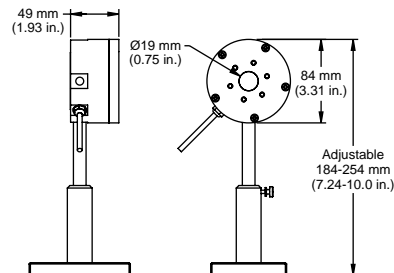
<sup>1</sup> Power stability over 30 minutes in a typical lab environment.

<sup>2</sup> Light tube supplied with PS10 and PM3 models only.

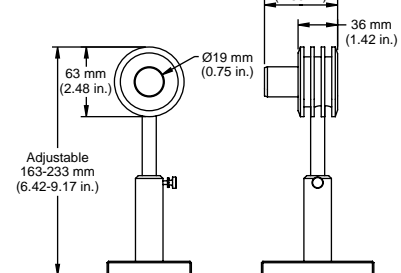
### PS10/PS10Q



### PS19/PS19Q



### PM3/PM3Q



- POWER & ENERGY
- Power & Energy Meters
- Power Sensors
- Energy Sensors
- Custom & OEM
- BEAM DIAGNOSTICS
- CALIBRATION & SERVICE
- INDICES
- Laser Cross-Reference Index
- Product Name Index

# Air-Cooled Thermopile Sensors

10 mW to 30W



Models PM2, PM10, PM30

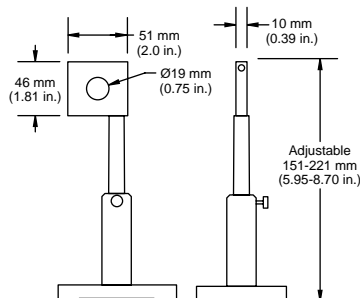
## Features

- Convective air-cooled
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$
- 1 to 10 mW resolution
- 19 mm aperture

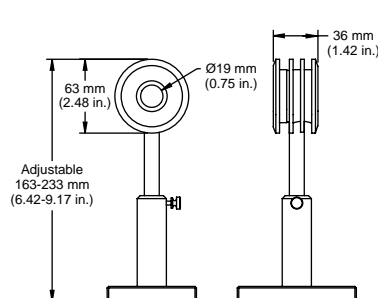
These thermopile sensors are used to measure CW and pulsed lasers from 10 mW up to 30W average power output. These sensors are able to dissipate heat via convection cooling, which makes them convenient to use.

Device Specifications	Model	PM2	PM10	PM30
Wavelength Range ( $\mu\text{m}$ )			0.19 to 11	
Power Range		10 mW to 2W	10 mW to 10W	100 mW to 30W
Long-Pulse Joules Range (J)		0.5 to 2	0.5 to 10	0.5 to 50
Max. Intermittent Power (<5 min.)(W)		5	30	50
Resolution (mW)			1	10
Max. Power Density			26 kW/cm <sup>2</sup>	
Max. Energy Density			0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Response Time (sec.)			2	
Detector Coating			Broadband	
Active Area Diameter (mm)			19	
Dimensions (mm)		46 x 51 x 10 (1.8 x 2.0 x 0.3 in.)	$\varnothing$ 63 x 36 (2.4 x 1.4 in.)	$\varnothing$ 101 x 56 (3.9 x 2.2 in.)
Calibration Uncertainty (%)			$\pm 1$	
Calibration Wavelength (nm)			514	
Cooling Method			Air-cooled	
Cable Type			PM DB-25	
Cable Length (m)			2	
Part Number		1098329	1097901	1098314

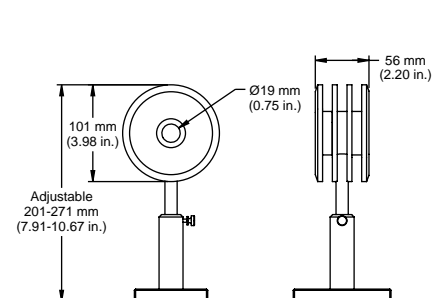
PM2



PM10



PM30



# Air-Cooled Thermopile Sensors

300 mW to 150W



Models PM150-50, PM150, PM100-19C

## Features

- Convective air-cooled
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$
- 30 mW resolution
- 19 mm and 50 mm apertures

POWER & ENERGY

Power & Energy Meters

Power Sensors

Energy Sensors

Custom & OEM

BEAM DIAGNOSTICS

CALIBRATION & SERVICE

INDICES

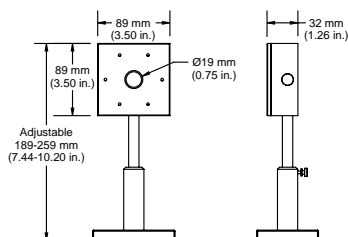
Laser Cross-Reference Index

Product Name Index

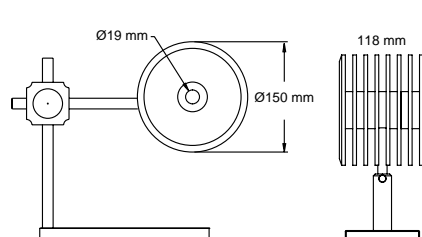
Device Specifications	Model	PM100-19C <sup>1</sup>	PM150	PM150-50
Wavelength Range ( $\mu\text{m}$ )			0.19 to 11	
Power Range		300 mW to 100W	300 mW to 150W	
Long-Pulse Joules Range (J)		1 to 100	1 to 150	
Max. Intermittent Power (<5 min.)(W)		100	300	
Resolution (mW)			30	
Max. Power Density			26 kW/cm <sup>2</sup>	
Max. Energy Density			0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Response Time (sec.)		2		5
Detector Coating		Broadband		
Active Area Diameter (mm)		19	50	
Dimensions (mm)		89 x 89 x 32 (3.5 x 3.5 x 1.2 in.)	$\varnothing$ 150 x 118 (5.9 x 4.6 in.)	
Calibration Uncertainty (%)		$\pm$ 1		
Calibration Wavelength (nm)		514		
Cooling Method		Air-cooled		
Cable Type		PM DB-25		
Cable Length (m)		2		
Part Number		1098483	1098407	1098398

<sup>1</sup> This sensor is designed for intermittent use only.

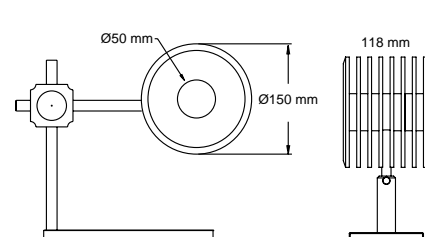
PM100-19C



PM150



PM150-50



# Water-Cooled Thermopile Sensors

10 mW to 300W



Models PM300, PM150-50C, PM150-19C

## Features

- Water-cooled
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$
- 1 mW to 100 mW resolution
- 19 mm and 50 mm apertures

These compact sensors are ideal in tight spaces, but must be water-cooled in order to achieve their full power specification during continuous operation. They can also be mounted to a heat sink or used standalone for intermittent use. Tap or distilled cooling water is recommended with these sensors – DI water can not be used. Flow rates are power dependent and range from 0.5 to 4 gallons per minute; pressure depends upon flow rate and ranges from 3 to 40 PSI (visit product pages at [www.Coherent.com/LMC](http://www.Coherent.com/LMC) for more technical details).

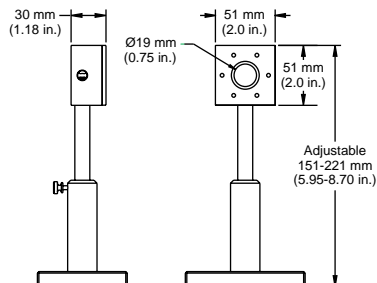
OEM versions of these sensors with passive and amplified outputs can be found on page 53.

Device Specifications	Model	PM10-19C	PM150-19C	PM150-50C	PM300
Wavelength Range ( $\mu\text{m}$ )		0.19 to 11			
Power Range (water-cooled)		10 mW to 10W	300 mW to 150W		1 W to 300W
Max. Intermittent Power ( $\leq 5$ min.) (W)		5W <sup>1</sup>	20W <sup>1</sup>	80W <sup>1</sup>	450W <sup>2</sup>
Long-Pulse Joules Range (J)		0.5 to 10	1 to 150		–
Resolution (mW)		1	30		100
Max. Power Density		26 kW/cm <sup>2</sup>			
Max. Energy Density		0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns			
Response Time (sec.)		2		5	
Detector Coating		Broadband			
Active Area Diameter (mm)		19	50		19
Dimensions (mm)		51 x 51 x 30 (2.0 x 2.0 x 1.1 in.)	89 x 89 x 32 (3.5 x 3.5 x 1.2 in.)		$\varnothing 76$ x 56 (2.9 x 2.2 in.)
Calibration Uncertainty (%)		$\pm 1$			
Calibration Wavelength (nm)		514			
Cooling Method		Water-cooled			
Cable Type		PM DB-25			
Cable Length (m)		2			
Part Number		1098397	1098444	1098412	1141474

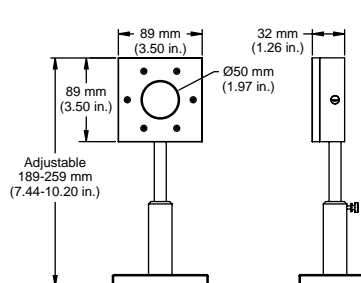
<sup>1</sup> This intermittent power rating is for when the sensor is used without water-cooling.

<sup>2</sup> This intermittent power rating is for when the sensor is used with water-cooling.

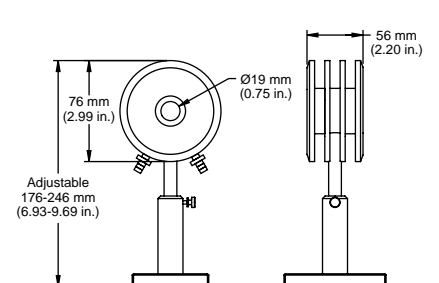
PM10-19C/PM150-19C



PM150-50C



PM300



# Fan-Cooled Thermopile Sensors

1W to 300W



Models PM200F-50, PM300F-50

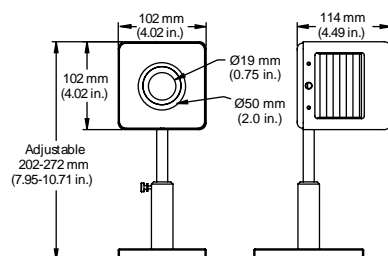
## Features

- Fan-cooled
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$
- 100 mW resolution
- 19 mm and 50 mm apertures

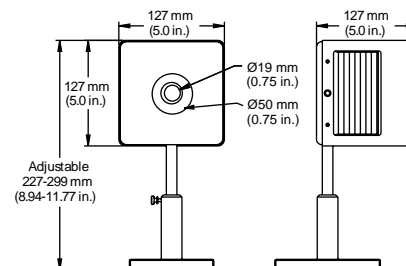
Fan-cooled sensors are an excellent choice for measuring high-power lasers when water-cooling is not possible. A compact power supply provides the 12 VDC required to power the fan.

Device Specifications	Model	PM200F-19	PM200F-50	PM300F-19	PM300F-50
Wavelength Range ( $\mu\text{m}$ )		0.19 to 11			
Power Range (W)		1 to 200		1 to 300	
Long-Pulse Joules Range (J)		1 to 200		1 to 300	
Max. Intermittent Power (<5 min.)(W)		300		450	
Resolution (mW)		100			
Max. Power Density		26 kW/cm <sup>2</sup>			
Max. Energy Density		0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns			
Response Time (sec.)		2	5	2	5
Detector Coating		Broadband			
Active Area Diameter (mm)		19	50	19	50
Dimensions (mm)		102 x 102 x 114 (4.0 x 4.0 x 4.4 in.)		127 x 127 x 127 (5 x 5 x 5 in.)	
Calibration Uncertainty (%)		±1			
Calibration Wavelength (nm)		514			
Cooling Method		Fan-cooled			
Cable Type		PM DB-25			
Cable Length (m)		2			
Part Number		1098480	1098472	1098509	1098417

PM200F-19/PM200F-50



PM300F-19/PM300F-50



- POWER & ENERGY
- Power & Energy Meters
- Power Sensors
- Energy Sensors
- Custom & OEM
- BEAM DIAGNOSTICS
- CALIBRATION & SERVICE
- INDICES
- Laser Cross-Reference Index
- Product Name Index

# Water-Cooled Thermopile Sensors

100W to 5 kW



Model PM1K

## Features

- Water-cooled
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$
- 1W resolution
- 50 mm apertures

These water-cooled sensors are used to measure lasers over 300W average power output. They are excellent choices for measuring CO<sub>2</sub> and Nd:YAG lasers. Larger-area versions are available on the next page.

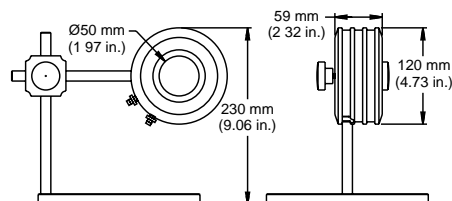
Tap or distilled cooling water is recommended with these sensors – DI water can not be used. Flow rates are power dependent and range from 0.5 to 4 gallons per minute; pressure depends upon flow rate and ranges from 3 to 40 PSI (visit product pages at [www.Coherent.com/LMC](http://www.Coherent.com/LMC) for more technical details).

Device Specifications	Model	PM1K	PM3K	PM5K
Wavelength Range ( $\mu\text{m}$ )			0.19 to 11	
Power Range (W)		100 to 1000	100 to 3000	100 to 5000
Max. Intermittent Power ( $\leq 5$ min.)(W) <sup>1</sup>		3000	5000	10000
Resolution (W)			1	
Max. Power Density <sup>2</sup>			1 to 10 kW/cm <sup>2</sup>	
Max. Energy Density			0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Response Time (sec.)			30	
Detector Coating			Broadband	
Active Area Diameter (mm)			50	
Dimensions (mm)			$\varnothing 120 \times 59$ (4.7 x 2.3 in.)	
Calibration Uncertainty (%)			$\pm 5$	
Calibration Wavelength (nm)			1064	
Cooling Method			Water-cooled	
Cable Type			PM DB-25	
Cable Length (m)			2	
Part Number		1098392	1098462	1098454

<sup>1</sup> Intermittent power levels may be sustainable for longer than 5 minutes when used with lasers with large diameter, non-Gaussian beam profiles. Monitor closely for coating damage if used longer than five minutes at higher powers.

<sup>2</sup> The damage resistance of the coating is dependent upon the beam size and profile, the average power level, and the water flow rate. Contact Coherent or your local representative for details related to your application.

## PM1K/PM3K/PM5K



# Large-Area High-Power Water-Cooled Thermopile Sensors

10 mW to 5 kW



Models PM5K-200, PM3K-100

## Features

- Water-cooled
- 100 mm and 200 mm apertures
- Spectrally flat from 0.19  $\mu\text{m}$  to 11  $\mu\text{m}$

These large-area, water-cooled thermopiles are designed to measure large laser diode stacks and arrays, and other high-power divergent sources.

POWER & ENERGY

Power & Energy Meters

Power Sensors

Energy Sensors

Custom & OEM

BEAM DIAGNOSTICS

CALIBRATION & SERVICE

INDICES

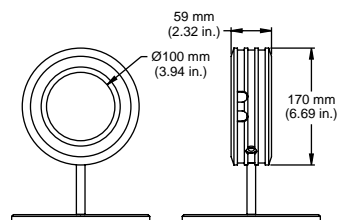
Laser Cross-Reference Index

Product Name Index

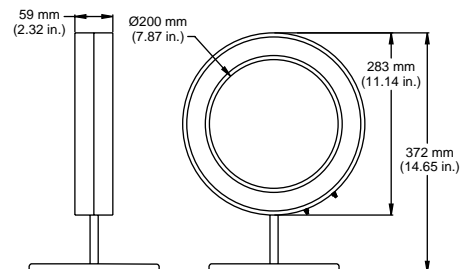
Device Specifications	Model	PM1K-100	PM3K-100	PM5K-100	PM5K-200
Wavelength Range ( $\mu\text{m}$ )		0.19 to 11			
Power Range (W)		100 to 1000	100 to 3000	100 to 5000	100 to 5000
Max. Intermittent Power (<5 min.)(W)		1500	4000	7500	7500
Resolution (W)		1			
Max. Power Density <sup>1</sup>		1 to 10 kW/cm <sup>2</sup>			
Max. Energy Density		0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns			
Response Time (sec.)		45			
Detector Coating <sup>1</sup>		Broadband			
Detector Diameter (mm)		100			200
Dimensions (mm)		$\varnothing 170 \times 59$ (6.6 x 2.3 in.)			$\varnothing 283 \times 59$ (11.1 x 2.3 in.)
Calibration Uncertainty (%)		$\pm 5$			
Calibration Wavelength (nm)		1064			
Cooling Method		Water-cooled			
Cable Type		PM DB-25			
Cable Length (m)		2			
Part Number		1098490	1098506	1098461	1098505

<sup>1</sup> The damage resistance of the coating is dependent upon the beam size and profile, the average power level, and the water flow rate. Contact Coherent or your local representative for details related to your application.

PM1K-100/PM3K-100/PM5K-100



PM5K-200



# High-Peak-Power Thermopile Sensors

10 mW to 30W



Models PM30V1Q, PM30V1, PM10V1

## Features

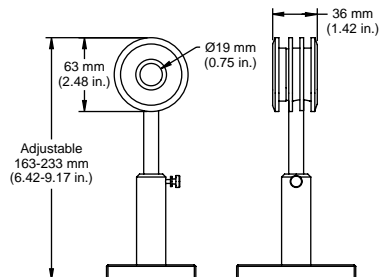
- Volume absorber
- 5.0 J/cm<sup>2</sup> @ 1064 nm

These sensors are designed for use with high-peak-power, low repetition rate, Q-switched Nd:YAG lasers. A volume-absorbing substrate mounted in front of the detector absorbs the bulk of the laser energy rather than all of the energy striking the front surface of the detector element. This results in a much higher damage threshold, approaching 2 J/cm<sup>2</sup>, at relatively low repetition rates of approximately 10 pps. For damage thresholds approaching 5 J/cm<sup>2</sup> the PM30V1Q uses an additional quartz diffuser to help scatter the beam before it hits the absorber surface. A removable front aperture allows easy replacement of the volume-absorbing substrate should it be damaged (replacement absorbers may be ordered using part number 0011-8935, PMV1-KIT).

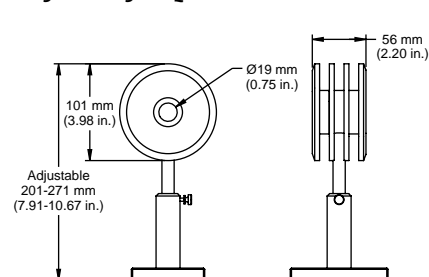
Device Specifications	Model	PM10V1	PM30V1	PM30V1Q
Wavelength Range (μm)		0.25 to 3		0.266 to 1.064 <sup>1</sup>
Power Range		10 mW to 10W	100 mW to 30W	
Max. Intermittent Power (<5 min.)(W)		15	50	
Resolution (mW)		1	10	
Max. Power Density		50 W/cm <sup>2</sup>		
Max. Energy Density		2 J/cm <sup>2</sup> , 1064 nm, 10 ns		5 J/cm <sup>2</sup> , 1064 nm, 10 ns
Response Time (sec.)		3		
Detector Coating		Volume Absorbing		
Active Area Diameter (mm)		19		
Dimensions (mm)		Ø63 x 36 (2.4 x 1.4 in.)	Ø101 x 56 (3.9 x 2.2 in.)	
Calibration Uncertainty (%)		±1		
Calibration Wavelength (nm)		514		514 <sup>1</sup>
Cooling Method		Air-cooled		
Cable Type		PM DB-25		
Cable Length (m)		2		
Part Number		1098338	1098429	1098414

<sup>1</sup> Diffuser transmission calibrated at 266 nm, 355 nm, 532 nm and 1064 nm.

PM10V1



PM30V1/PM30V1Q



# Thermopile Sensors with UV Coating

10 mW to 30W



Model PM2X, PM10X, PM30X

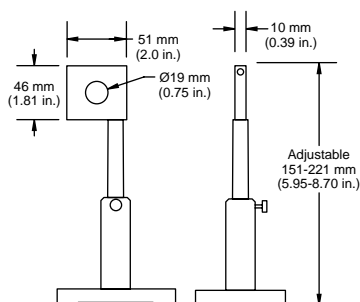
## Features

- UV coating is optimized for DUV
- Spectral range: 0.15  $\mu\text{m}$  to 1  $\mu\text{m}$
- 1 mW to 10 mW resolution
- 19 mm

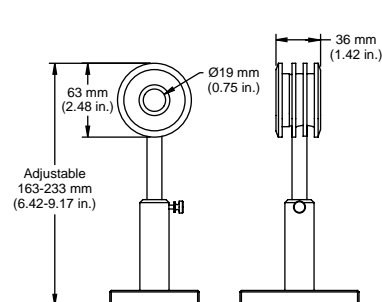
The following sensors are similar to models shown on previous pages, except they incorporate a UV coating that is optimized for use at ultraviolet wavelengths. Spectral compensation allows the sensors to be used from 157 nm to 1064 nm.

Device Specifications	Model	PM2X	PM10X	PM30X
Wavelength Range ( $\mu\text{m}$ )			0.15 to 1	
Power Range		10 mW to 2W	10 mW to 10W	100 mW to 30W
Long-Pulse Joules Range (J)		0.5 to 2	0.5 to 10	0.5 to 50
Max. Intermittent Power (<5 min.) (W)		3	30	50
Resolution (mW)		1	1	10
Max. Power Density			26 kW/cm <sup>2</sup>	
Max. Energy Density			0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Response Time (sec.)			2	
Detector Coating			UV	
Active Area Diameter (mm)			19	
Dimensions (mm)		46 x 51 x 10 (1.8 x 2.0 x 0.3 in.)	$\varnothing 63$ x 36 (2.4 x 1.4 in.)	$\varnothing 101$ x 56 (3.9 x 2.2 in.)
Calibration Uncertainty (%)			$\pm 1$	
Calibration Wavelength (nm)			514	
Cooling Method			Air-cooled	
Cable Type			PM DB-25	
Cable Length (m)			2	
Part Number		1098457	1098423	1098498

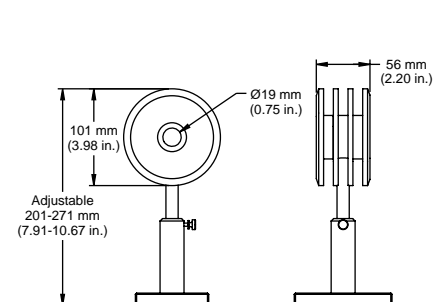
PM2X



PM10x



PM30x



- POWER & ENERGY
- Power & Energy Meters
- Power Sensors
- Energy Sensors
- Custom & OEM
- BEAM DIAGNOSTICS
- CALIBRATION & SERVICE
- INDICES
- Laser Cross-Reference Index
- Product Name Index

# Thermopile Sensors with UV Coating

300 mW to 150W



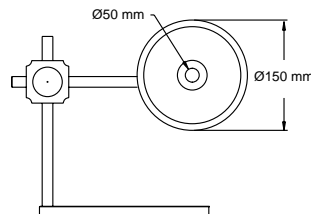
Model PM150X, PM150-50XC

### Features

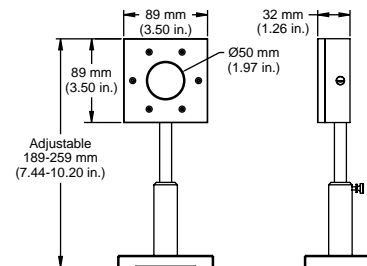
- UV coating is optimized for DUV
- Spectral Range: 0.15  $\mu\text{m}$  to 1  $\mu\text{m}$
- 30 mW resolution
- 50 mm apertures

Device Specifications	Model	PM150X	PM150-50XC
Wavelength Range ( $\mu\text{m}$ )		0.15 to 1	
Power Range		300 mW to 150W	
Long-Pulse Joules Range (J)		1 to 150	
Max. Intermittent Power ( $\leq 5$ min.)(W)		300	80 (air-cooled)
Resolution (mW)		30	
Max. Power Density		26 kW/cm <sup>2</sup>	
Max. Energy Density		0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns	
Response Time (sec.)		5	
Detector Coating		UV	
Active Area Diameter (mm)		50	
Dimensions (mm)		150 x 118 (5.9 x 4.6 in.)	89 x 89 x 32 (3.5 x 3.5 x 1.2 in.)
Calibration Uncertainty (%)		$\pm 1$	
Calibration Wavelength (nm)		514	
Cooling Method		Air-cooled	Water-cooled
Cable Type		PM DB-25	
Cable Length (m)		2	
Part Number		1098455	1098443

PM150X



PM150-50XC



# Thermopile Sensors with UV Coating

1W to 1 kW



Model PM200F-50X, PM300F-50X, PM1KX

## Features

- UV coating is optimized for DUV
- Spectral Range: 0.15  $\mu\text{m}$  to 1  $\mu\text{m}$
- 100 mW to 1W resolution
- 50 mm apertures

POWER & ENERGY

Power & Energy Meters

Power Sensors

Energy Sensors

Custom & OEM

BEAM DIAGNOSTICS

CALIBRATION & SERVICE

INDICES

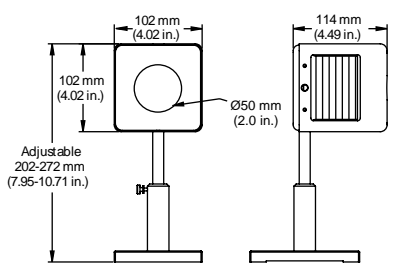
Laser Cross-Reference Index

Product Name Index

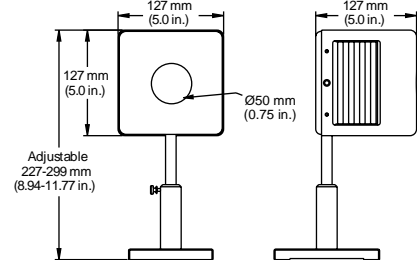
Device Specifications	Model	PM200F-50X	PM300F-50X	PM1KX
Wavelength Range ( $\mu\text{m}$ )		0.15 to 1		0.15 to 1
Power Range (W)		1 to 200	1 to 300	100 to 1000
Long-Pulse Joules Range (J)		1 to 200	1 to 300	–
Max. Intermittent Power (<5 min.)(W)		300	450	1500
Resolution (mW)		100	100	1000
Max. Power Density		26 kW/cm <sup>2</sup>		1 to 10 kW/cm <sup>2</sup> <sup>1</sup>
Max. Energy Density		0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns		0.6 J/cm <sup>2</sup> , 1064 nm, 10 ns
Response Time (sec.)		5		30
Detector Coating		UV		UV
Active Area Diameter (mm)		50		50
Dimensions (mm)		102 x 102 x 114 (4.0 x 4.0 x 4.4 in.)	127 x 127 x 127 (5 x 5 x 5 in.)	$\varnothing$ 120 x 59 (4.7 x 2.3 in.)
Calibration Uncertainty (%)		$\pm 1$		$\pm 5$
Calibration Wavelength (nm)		514		1064
Cooling Method		Fan-cooled		Water-cooled
Cable Type		PM DB-25		PM DB-25
Cable Length (m)		2		2
Part Number		1113493	1098481	1115484

<sup>1</sup> The damage resistance of the coating is dependent upon the beam size and profile, the average power level, and the water flow rate. Contact Coherent or your local representative for details related to your application.

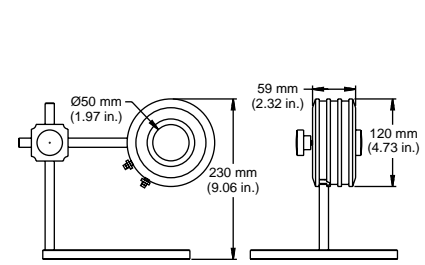
PM200F-50X



PM300F-50X



PM1KX



# Power Sensor Accessories

## Thermal SmartSensor Adapter



The Thermal SmartSensor Adapter converts LM-model position-sensing thermopiles and LM-2 optical sensors for use with FieldMaxII, FieldMate and EPM2000 meters.

Designed for use with multiple sensors, this adapter can read the sensor EEPROM contents and program itself when powered up via the meter connection.

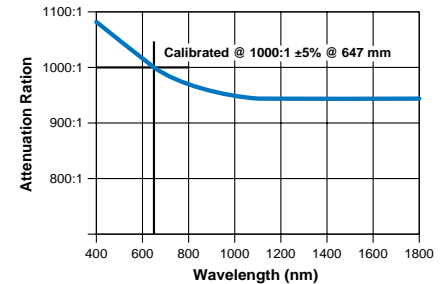
Note: Beam position information is not available when using these meters.

Part Number	Description
1056827	Thermal SmartSensor Adapter

## 1000:1 Attenuator



This attenuator is used with OP-2 VIS, LM-2 VIS, OP-2 IR and LM-2 IR sensors to allow operation up to 5W in the visible and 3W in the infrared regions. The attenuator threads into the sensor in place of the light shield to provide from 1100:1 to 950:1 attenuation. Each attenuator is calibrated for 1000:1 ±5% at 647 nm and is supplied with a calibration certificate. The useful spectral range is 400 to 1800 nm.



Part Number	Description
1098318	1000:1 Attenuator for OP-2 and LM-2 Sensors

## Fiber-Optic Connector Adapters



The following fiber-optic adapters can be mounted directly onto the 3/4-32 threads on the front of LM-2, OP-2, LM-3, LM-10, and LM-150FS sensors. These fiber adapters can also be used with our 1.035-40M adapter ring to fit on the LM-20, LM-45, LM-100, LM-150 LS, and LM-200 sensors.

Part Number	Description	Sensors
1098589	SMA-Type Connector	LM-2, OP-2, LM-3, LM-10, LM-150 FS
1098339	FC/PC-Type Connector	LM-2, OP-2, LM-3, LM-10, LM-150 FS
33-9432-000	1.035-40M Adapter Ring	LM-20, LM-45, LM-100, LM-150 LS, LM-200



The following fiber adapters can be mounted onto the front of the PS10 sensor in place of the removable light tube.

Part Number	Description	Sensors
0012-3860	PS-SMA-Type Connector	PS10
0012-3863	PS-FC-Type Connector	PS10