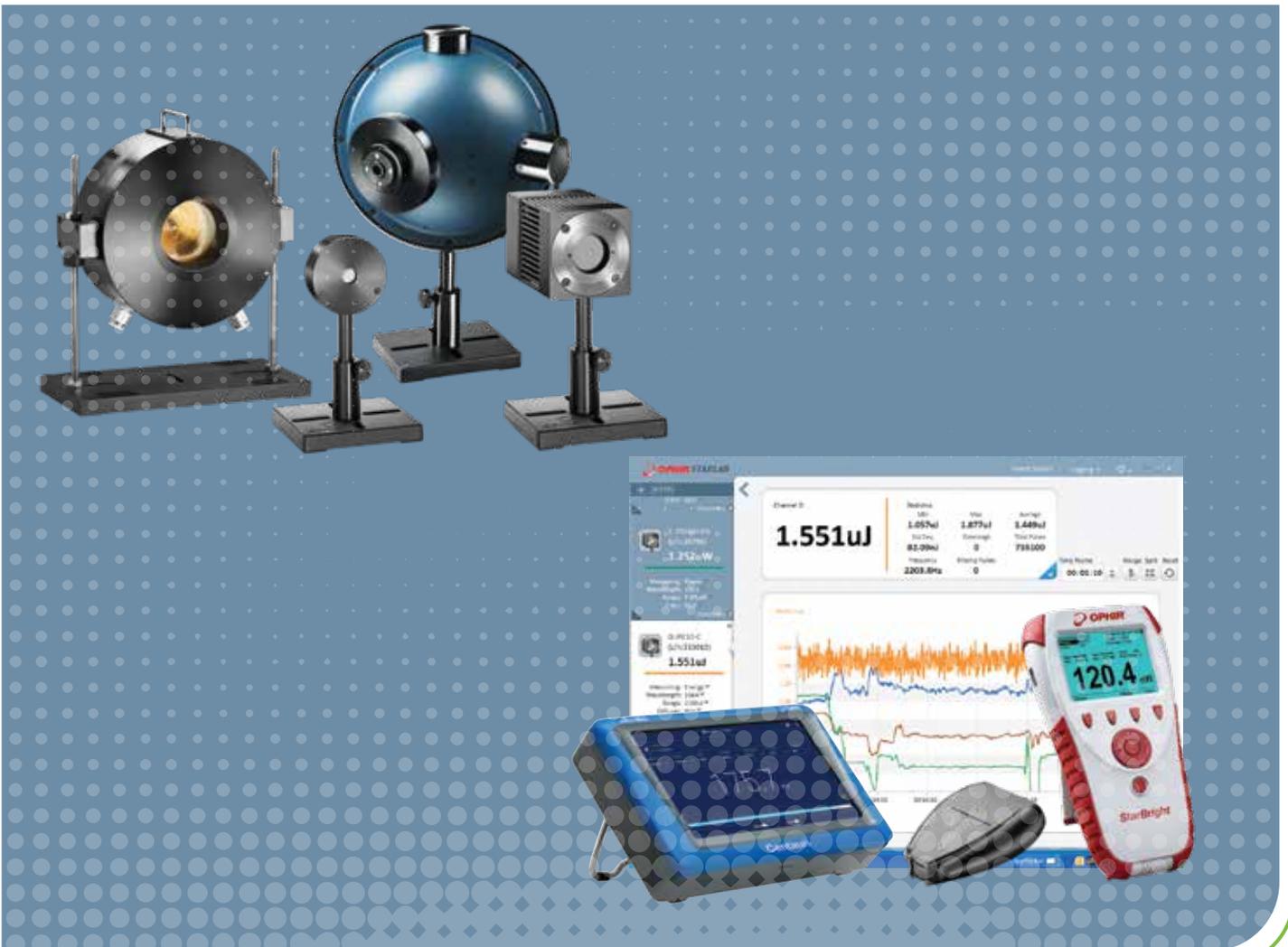
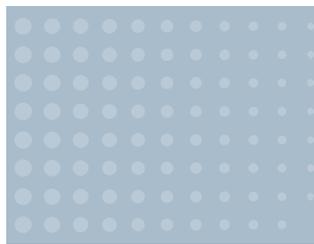
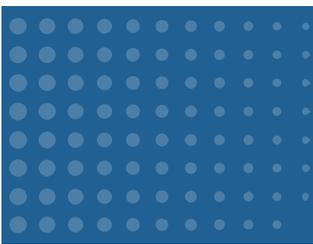


2025 SENSORS | POWER METERS



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ABOUT OPHIR OPTRONICS SOLUTIONS LTD.

Ophir Optronics Solutions Ltd., a Part of MKS instruments, Inc. was founded in 1976, as an optical coating company that has grown and diversified into other areas. Ophir employs a highly-qualified staff of over 570 engineers, technicians and skilled workers. Our company products are sold worldwide through a distribution network that includes four fully certified calibration facilities and repair centers. The majority of Ophir's laser measuring instrumentation line is exported and marketed by sales representatives in more than 35 countries around the world, the largest markets being the USA, Europe and Japan.

About MKS instruments

MKS Instruments, Inc. is a global provider of instruments, subsystems and process control solutions that measure, control, power, monitor and analyze critical parameters of advanced manufacturing processes to improve process performance and productivity. MKS's products are derived from their core competencies in pressure measurement and control, materials delivery, gas composition analysis, control and information technology, power and reactive gas generation, vacuum technology, photonics, lasers, optics and motion control. MKS's primary served markets are manufacturers of capital equipment for thin film including semiconductor devices, process manufacturing, environmental, life sciences and scientific research.

Our Facilities

Sited in an impressive 10,400 sq.m. (112,500 sq.ft.) building in Jerusalem, Israel, Ophir's main manufacturing and R&D facility is fully equipped for both the production and testing of laser measuring instrumentation, optical components and coatings. In addition, Ophir's modern facilities have in-house capability for diamond turning, aspheric optics and electronic equipment assembly.

Ophir's wide-ranging activities include:

- Production of the most complete variety of laser measurement instrumentation in existence, both off-the-shelf and Customized Solutions (OEM). Production of very high precision infrared and visible optical components: lenses, mirrors, metallic optics (spherical, aspherical and diffractive), windows, domes and prisms, suitable for military (FLIR) and industrial (CO₂) applications. Ophir, a qualified manufacturer for some of the world's leading suppliers of night vision equipment, is renowned for having developed some of the highest performing and most cost-effective optical systems in the world.
- Design and production of optical assemblies. Thin film optical coatings.
- Non-contact optical equipment for distance measurement and three-dimensional mapping of objects developed by Optimet, a company in which Ophir has a majority share. These devices are based on patented

technology called Conoscopic Holography. Applications include dentistry microelectronics, robotics, quality control and mechanical shops.

Laser Development

The history of laser development has been characterized by ever-increasing laser powers and energies and increasingly concentrated laser beams. Medical, industrial and scientific applications of these high power and energy density lasers require reliable and accurate measurement of power and energy.

Meters for relatively high powers and energies generally operate by measuring the heat deposited onto an absorbing element. The key to accurate and reliable measurement is the makeup of this absorbing surface. It must stand up to repeated use without degradation or change in calibration. Laser sources are constantly growing in power, energy and beam concentration. Ophir has an ongoing program of development of durable absorbing surfaces that will continue to stand up to the most punishing laser sources as they grow in intensity and Ophir has some of the highest damage threshold absorbers in the industry.

Ophir - Spiricon - Photon brings the same leading edge innovation to laser beam profile measurement with its famous Pyrocam, its in house designed SP and Nanoscan cameras and BeamGage software.

Ophir's Laser Measurement Group products are used in three highly competitive and sophisticated fields: medical, industrial and research. Each of these areas is further divided into end users and OEMs.

Medical

Ophir is the largest producer of laser power and energy measurement equipment for the medical market, where Ophir's power measurement devices are incorporated into laser-based instrumentation. Our products are vital to medical laser manufacturers and to the hospitals and doctors who are end-user laser purchasers.

Medical lasers cover the entire spectrum of wavelengths from the 193 nm excimer laser to the 10.6 micron CO₂ laser where the main laser wavelengths are 193, 248, 532, 694, 755, 808, 1064, 2100, 2940 and 10600 nm. These lasers are used for general surgery, eye surgery, gynecology, ORL, dermatology and other applications. They have outputs which start at mW and mJ on the low end going up to tens of joules and hundreds of watts at the high end. The trend in medical lasers is to progress to more powerful systems, especially in the dermatology field, and to introduce diode lasers and intense pulsed light (IPL) sources instead of the traditional gas or solid state lasers.

Ophir has developed special equipment that can for the first time measure the output of IPL sources.

Regulating bodies such as the FDA in the USA require the manufacturers to have at least one channel of power or



energy monitoring in each laser. Ophir's high-quality OEM products provide an extraordinarily efficient answer to this requirement.

Industrial

Industrial laser customers include both laser manufacturers and laser users in job shops and factories. Ophir answers the needs of this market by providing measurement systems that have a high damage threshold and the ability to measure high repetition rates with high accuracy. There are several main types of lasers for industrial and material processing applications: Fiber Lasers, Diode, Nd:YAG lasers and Solid-state/disk lasers in the range of 980-1070 nm with some systems in blue and green range. A significant market share still remains with CO₂ laser at 10.6 microns. They are characterized by their high power output, which ranges from 100W to 120kW, depending on the application. With its capabilities in power, energy and profile measurement, Ophir has developed many products for this market including an integrated Laser Beam Analyzer for industrial YAG lasers which measures beam profile, temporal profile, power and energy, all in one unit. A subset of the industrial market is the microelectronics industry, which uses excimer lasers for exposing the photoresist in the photolithography process. This process uses lasers with a short wavelength of 193 to 345 nm that operate at high repetition rate and high energy. The main factor influencing

the component density possible on the microchip is the wavelength of the laser already used in the process, and therefore the trend is to progress to shorter wavelengths. Ophir has a range of unique products specified for the photolithography market, including off-the-shelf and Customized Solutions (OEM) products.

RoHS

Almost all Ophir and Spiricon Laser measurement products are RoHS compliant. The few products that are not RoHS are specified as such in the ordering information or in the specification tab.

ISO/IEC 17025:2017

The ISO/IEC 17025:2017 is given to calibration laboratories who have achieved the highest standards of quality, administration, and technical operations. Standing up to ISO/IEC 17025:2017 standard provides the opportunity for Ophir to serve as an international calibration laboratory. This accreditation gives customers full confidence that Ophir works according to the highest standards, and among other things it provides for technical competence of staff, validity of methods, proper calibration and maintenance of equipment, and many other areas. Full Scope of accreditation can be found on our website. Certain products are not under ISO/IEC 17025:2017 accreditation. Additional information is available in the specification sheet for each product.

OPHIR POWER AND ENERGY METERS – VERSATILITY FOR EVERY APPLICATION

Ophir All-in-one instrument, sensor, power meter and computer interface system means that virtually any sensor can work “plug and play” with any power meter or computer interface. Ophir has the widest range of sensors on the market with the highest performance so almost any measurement needed can be accommodated. The measurement results can also be made accessible in many ways - on the power meter screen, stored on board, sent to a host computer with results presented in many ways and on several platforms.

All-in-one Sensors



IPM-10KW, Industrial-grade power sensor with built-in communications interface



Ariel with Bluetooth and USB connectivity



Helios Pro with industrial Ethernet connectivity



Pyroelectric Sensors
Energies pJ to Joules Rep rates to 25kHz (page 122)



Thermal Sensors
Powers mW to kW and single shot energy (page 44)



Photodiode Sensors
Powers pW to Watts (page 25)

Computer Interfaces with USB/Bluetooth/Ethernet/RS232



Juno compact



Juno+
Incl. An Out



Pulsar
1, 2, 4 channels



Juno-RS
RS232



EA-1
Ethernet



Quasar
wireless

Power Meters with USB/Ethernet/RS232



StarLite
basic



StarBright
added features



Vega
color



Nova
rugged



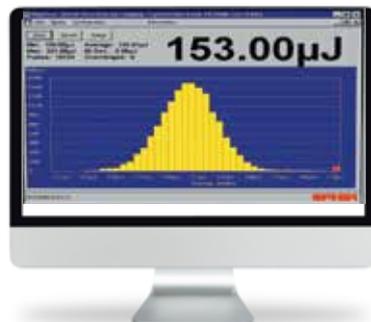
Centauri
high end

Software Solutions

StarLab, LabVIEW, StarCom, COM Object & StarViewer



StarLab Software



StarCom Software



StarViewer Android or iOS Applications

CALIBRATION CAPABILITY AT OPHIR

Calibration is perhaps the most important of our products. In order to ensure the best possible calibration of your instruments, Ophir takes a number of extra steps not taken by other vendors.

Laser absorption varies with wavelength, so it is not enough to calibrate at one wavelength. If the variation is small, then the sensors are calibrated at several laser wavelengths and each laser covers a range of wavelengths. If the absorption variation with wavelength is considerable, the sensor is provided with an absorption correction curve activated by the wavelength of use. Going one step further, Ophir checks the curve at a number of NIST and PTB traceable wavelengths and corrects it if necessary. To do this, we have a complete line of calibration lasers so that we can always calibrate at or near the customer's wavelength. These lasers include powers up to 6000W and both CW and pulsed lasers. We also have a number of sensors calibrated at NIST and PTB used as calibration standards. Below is a list of the calibration wavelengths used at Ophir in calibrating our standard catalog sensors.

In addition to calibration variation with wavelength, there are other possible sources of calibration error such as nonlinearity, variation with position on the surface and for pyroelectric sensors, pulse frequency. All of these factors are taken into consideration in the calibration and accounted for. For a complete analysis of Ophir calibration accuracy and error budget, please see our website at:

www.ophiropt.com/calibration-procedure/tutorial

Special Calibration

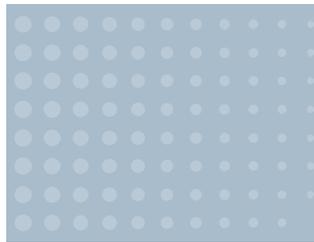
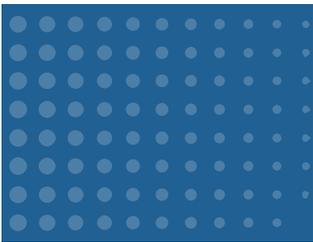
In addition to standard calibration wavelengths shown below, customers can have their Ophir sensor calibrated at additional wavelengths for more accuracy. Please consult your Ophir agent for special requests.

Wavelengths of Calibration per Sensor Type

Wavelength	193	248	254	355	360	422	488	532	633	671	755	808	830	905	975	980	1064	1310	1550	1610	2100	2940	10600	Spectral Curve	ISO/IEC 17025:2017	
Pulsed/Continuous	P	P	C	P	C	C	C	P, C	C	C	P	C	C	P	C	C	P, C	C	P, C	C	P	P	C			
Photodiode Sensors																										
PD300, PD300-UV																										
PD300-UV-193	•																									
PD300-IR																										
PD300-1W, PD300-3W, IS1.5-VIS-FPD-800																										
PD300-IRG, IS1.5-IRG-FPD-800																										
3A-IS																										
3A-IS-IRG																										
IS-1-2W																										
IS6-C-VIS, IS6-D-VIS, IS6-C-UV, IS6-D-UV																										
IS6-C-IR, IS6-D-IR																										
Thermal Sensors																										
Low Power Broadband																										
Standard Broadband <1000W																										
Standard Broadband ≥1000W																										
LP2 type <1000W																										
LP2 type ≥1000W																										
P type																										
PF type																										
PF with diffuser																										
HE type																										
HE with diffuser																										
EX type																										
SV type																										
CM type																										
Helios, 30K-W																										
Comet																										
Ariel																										
Calorimetric Sensors																										
6K-W																										
120K-W, 150K-W																										
Pyroelectric Sensors																										
PD10-C																										
PD10-IR-C																										
PE9-C																										
PE10-C																										
BF type																										
BF-DIF																										
Metallic (standard)																										
PE50BB-DIF-C																										
PE50-DIF-ER-C																										
PE50-DIF-C																										
PE100BF-DIF-C																										
PE50-DIFH2-C, PE50BF-DIFH2-C																										
PE50-UV-DIFH-C, PE50BF-UV-DIFH-C																										

Note: (a) Except PD300-CIE

2025 SENSORS



1.0 Sensors Table of Contents

Power sensors

PHOTODIODE POWER SENSORS

Standard photodiode sensors – 10pW – 3W

Sensor	Features	Aperture	Spectral Range	Power Range	Page
PD300	Automatic background subtraction	10x10mm	350-1100nm	500pW-300mW	25
PD300-1W	Automatic background subtraction	10x10mm	350-1100nm	500pW-1W	25
PD300-3W	High power	10x10mm	350-1100nm	5nW-3W	25
PD300-TP	Very thin profile (4mm only)	10x10mm	350-1100nm	50pW-1W	25
PD300-UV	Wide spectral range and low noise	10x10mm	200-1100nm	20pW-300mW	27
PD300-UV-193	PD300-UV with additional calibration at 193nm	10x10mm	200-1100nm	20pW-300mW	27
PD300-IR	Infrared	Ø5mm	700-1800nm	5nW-300mW	27
PD300-IRG	Very low noise 300 femto watts	Ø5mm (max)	900-1630nm	20pW-200mW	27

Round photodiode sensors – 20pW – 3W

Sensor	Features	Aperture	Spectral Range	Power Range	Page
PD300R	Same as PD300, circular for easy centering	Ø10mm	350-1100nm	500pW-300mW	28
PD300R-3W	Same as PD300-3W, circular geometry	Ø10mm	350-1100nm	5nW-3W	28
PD300R-UV	Same as PD300-UV, circular geometry	Ø10mm	200-1100nm	20pW-300mW	28
PD300R-UV with 10m cable	Same as PD300-UV, circular geometry	Ø10mm	200-1100nm	20pW-300mW	28
PD300R-IR	Same as PD300-IR, circular geometry	Ø5mm	700-1800nm	5nW-300mW	28

Special photodiode sensors – 50pW – 1W and 20mLux – 200kLux

Sensor	Features	Aperture	Spectral Range	Power Range	Page
PD300-MS	Measurement of light intensity at microscope slide plane	18x18mm	350-1100nm	3µW-1W	29
PD300-BB	Flat spectral response from 430 to 1000nm	10x10mm	430-1000nm	50pW-4mW	30
PD300-BB-50mW	For broadband light sources to 50mW	10x10mm	430-1000nm	50pW-50mW	30
PD300-CIE	Measurement in units of Lux or foot candles	2.4x2.8mm	400-700nm	20mLux-200kLux	30
BC20	Meter for scanned beams at up to 30,000 inch/s	10x10mm	400-1100nm	100µW-20mW	30

Accessories for photodiode sensors

Accessories for PD300 series

Accessory	Description	Page
PD300-CDRH-7mm	Ø7mm aperture adapter for CDRH measurements for PD300	33
PD300-CDRH-3.5mm	Ø3.5mm aperture adapter for CDRH measurements for PD300	33

Fiberoptics Adapters

PD300 F.O. adapters	Adapters for mounting fibers to PD300 sensors (ST, FC, SMA, SC)	33
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Accessories for PD300R series, PD300-IRG, 3A-IS, IS-1-2W series and FPD series

Accessory	Description	Page
PD300R CDRH-7mm	Ø7mm aperture adapter for CDRH measurements for PD300R	33

Fiberoptics Adapters

Accessory	Description	Page
F.O. adapters	Adapters for mounting fibers to PD300R, PD300-IRG, 3A-IS, 3A-IS-IRG, IS-1-2W and FPD series (ST, FC, SMA, SC)	33
Female SM1 to SM1 Adapter	Adapter to convert from female SM1 to male SM1	33

Integrating spheres

Sensor	Features	Aperture	Spectral Range	Power Range	Page
Small dimensions 1"-1.6"					
IS-1-2W	Calibrated 1" integrating sphere for up to 2W	Ø5mm	220-1100nm	500nW-2W	35
3A-IS	Integrating sphere for divergent beams to 3W	Ø12mm	350-1100nm	1µW-3W	35
3A-IS-IRG	Integrating sphere for divergent beams to 3W for near IR	Ø12mm	800-1700nm	1µW-3W	35
IS1.5-VIS-FPD-800	Multi-functional Integrating Sphere for VIS	Ø20mm	400-1100nm	400nW-4W	36
IS1.5-IRG-FPD-800	Multi-functional Integrating Sphere for NIR	Ø20mm	940-1640nm	600nW-3W	37
Large dimensions 5.3"					
IS6-C	5.3" integrating sphere for collimated light sources	Ø25mm	200-2200nm	Depends on detector	38
IS6-D	5.3" integrating sphere for divergent light sources	Ø63.5mm	200-2200nm	Depends on detector	38
IS6-C-VIS	5.3" integrating sphere collimated for VIS radiation	Ø25mm	400-1100nm	20µW-30W	38
IS6-C-UV	5.3" integrating sphere collimated for UV radiation	Ø25mm	200-1100nm	300nW-1W	38
IS6-C-IR	5.3" integrating sphere collimated for IR radiation	Ø25mm	700-1800nm	100µW-30W	38
IS6-C-UV-2.5"	5.3" integrating sphere collimated for large beams	Ø63.5mm	200-1100nm	300nW-2W	38
IS6-D-VIS	5.3" integrating sphere divergent for VIS radiation	Ø26mm	400-1100nm	20µW-30W	39
IS6-D-UV	5.3" integrating sphere divergent for UV radiation	Ø26mm	200-1100nm	300nW-1W	39
IS6-D-IR	5.3" integrating sphere divergent for IR radiation	Ø26mm	700-1800nm	100µW-30W	39
IS6-D-IR-170	As above for highly divergent beams (up to 170°)	Ø8mm	700-1800nm	20µW-30W	39

Accessories for IS6

Accessory	Description	Page
Port plugs		
IS-1" Port plug	White reflective plug for IS6 1" port	40
IS-2.5" Port plug	White reflective plug for IS6 2.5" port	40
Port covers		
IS-1" Port cover	Matte black non-reflective plug for IS6 1" port	40
IS-2.5" Port cover	Matte black non-reflective plug for IS6 2.5" port	40
Adapters and reducers		
1" SMA fiber adapter	SMA fiber adapter for IS6 1" port	40
1" FC fiber adapter	FC fiber adapter for IS6 1" port	40
2.5" to 1" Port reducer	Allows use of 1" port accessories on 2.5" port	40
Set of aperture masks	Ø5, Ø7, Ø10mm apertures used with 2.5" to 1" port reducer	40
Flange attachment	Dovetail flange for use with 2.5" to 1" port reducer	40
FPD (except FPS-1) to IS6 Adapter	For mounting FPD sensors to North Pole port of IS6 series	40
1" to SM1 adapter	Female SM1 thread, used for attaching FPS-1 detector to IS6	40

LED measurement – UV, VIS, NIR

LED Power Sensors 20pW - 3W

Sensor	Features	Aperture	Spectral Range	Power Range	Page
3A-IS	12mm aperture Integrating sphere for 350-1100nm, 3W	Ø12mm	350-1100nm	1µW-3W	41
PD300-UV	Photodiode with wide spectral range	10x10mm	200-1100nm	20pW-300mW	41
PD300R-UV	Same as PD300 with circular geometry for easy centering	Ø10mm	200-1100nm	20pW-300mW	41
3A	Very low powers	Ø9.5mm	190-20000nm	10µW-3W	41

LED Irradiance and Dosage Sensors 100nW/cm²-8W/cm²

Sensor	Features	Aperture	Spectral Range	Irradiance Range	Page
PD300RM-UV	Cosine corrected sensor for irradiance to 300mW/cm ²	Ø8mm	200-850nm	100nW/cm ² -250mW/cm ²	43
PD300RM-8W	Cosine corrected sensor for irradiance to 8W/cm ²	Ø8mm	350-850nm	1µW/cm ² -8W/cm ²	43
PD300RM-UVA	Cosine corrected sensor for irradiance to 15W/cm ²	Ø2.75mm	350-450nm	1.5µW/cm ² -15W/cm ²	43

THERMAL POWER SENSORS

Low noise lock in power sensors 300fW – 100mW

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
RM9	Radiometer for extremely low powers w/o chopper	Ø8mm	0.15-12µm	100nW-100mW	N.A.	45
RM9-PD	Photodiode for extremely low powers w/o chopper	Ø10mm	0.2-1.1µm	300fW-300nW	N.A.	45
RM9 sensor and RMC1 Chopper	Complete set, RM9 with chopper	Ø8mm	0.15-12µm	100nW-100mW	N.A.	45
RM9-PD sensor and RMC1 Chopper	Complete set, RM9-PD with chopper measure to 300fW	Ø10mm	0.2-1.1µm	300fW-300nW	N.A.	45

High sensitivity thermal sensors – 8µW – 12W

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
2A-BB-9	Compact, for very low powers	Ø9.5mm	0.19-20µm	20µW-2W	20µJ-2J	47
3A	Very low powers	Ø9.5mm	0.19-20µm	10µW-3W	20µJ-2J	47
3A with 10m cable	Very low powers	Ø9.5mm	0.19-20µm	10µW-3W	20µJ-2J	47
3A-QUAD	Power & position, very low powers up to 3W	Ø9.5mm	0.19-20µm	100µW-3W	20µJ-2J	55
3A-P	Low powers and energies	Ø12mm	0.15-8µm	15µW-3W	20µJ-2J	47
3A-P-QUAD	As above for short pulse lasers	Ø12mm	0.15-8µm	160µW-3W	30µJ-2J	55
3A-PF-12	As above with higher UV pulsed damage threshold	Ø12mm	0.15-20µm	15µW-3W	20µJ-2J	47
3A-P-THz	3A-P sensor calibrated for Terahertz wavelengths	Ø12mm	0.1-30THz	15µW-3W	20µJ-2J	49
3A-FS	Lowest powers, Fused Silica window	Ø9.5mm	0.19-20µm	8µW-3W	15µJ-2J	49
3A-P-FS-12	For divergent beams, window blocks infrared	Ø12mm	0.22-2.1µm	15µW - 3W	20µJ-2J	49
12A	Wide dynamic range to 12W	Ø16mm	0.19-20µm	2mW-12W	1mJ-30J	50
12A-P	Short pulse lasers to 12W	Ø16mm	0.15-8µm	2mW-12W	1mJ-30J	50

Low power thermal sensors – 10mW – 50W (Continuous) / 150W (Intermittent)

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
10A-BB-16	General purpose to 10W	Ø16mm	0.19-11µm	10mW-10W	6mJ-2J	51
10A-BB-16-PPS	Power, position & size to 10W	Ø16mm	0.19-11µm	20mW-10W	6mJ-2J	55
30A-BB-18	General purpose to 30W	Ø17.5mm	0.19-11µm	10mW-30W	6mJ-30J	51
L30A-BB-26-10MM	Thin Profile to 30W	Ø26mm	0.19-11µm	80mW-30W	20mJ-60J	51
L30A-EX-10MM	As above for excimer lasers	Ø26mm	0.15-0.7µm, 10.6µm	80mW-30W	20mJ - 30J	51
50(150)A-BB-26	General purpose to 50W, 150W intermittent	Ø26mm	0.19-11µm	40mW-150W	20mJ-100J	51
50(150)A-BB-26-QUAD	As above, power and position only	Ø26mm	0.19-11µm	40mW-150W	20mJ-100J	62
50(150)A-BB-26-PPS	Power, position & size to 50W, 150W intermittent	Ø26mm	0.19-11µm	40mW-150W	20mJ-100J	62
10A-P	Pulsed lasers up to 10W	Ø16mm	0.15-8µm	40mW-10W	10mJ-10J	53
30A-P-17	Short pulse lasers to 30W	Ø17mm	0.15-8µm	60mW-30W	40mJ-30J	53
50A-PF-DIF-18	High energy density pulsed beams	Ø17.5mm	0.24-2.2µm	140mW-50W	60mJ-200J	53
15(50)A-PF-DIF-18	As above, compact for intermittent use	Ø17.5mm	0.24-2.2µm	140mW-50W	60mJ-200J	53
30A-N-18	High power density pulsed YAG	Ø17.5mm	0.532, 1.064µm	60mW-30W	30mJ-200J	53
BT50A-15	Beam Trap for up to 50W, very low backscatter	Ø15mm	0.19-20µm	N.A.	N.A.	57

Low-medium power thermal sensors – apertures 12mm to 35mm, 10mW – 200W

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
30(150)A-BB-18	CW to 30W, intermittent to 150W	Ø17.5mm	0.19-11µm	30mW-150W	20mJ-100J	58
30(150)A-LP2-18	As above, high damage threshold for long pulses and CW	Ø17.5mm	0.25-2.2µm	30mW-150W	20mJ-300J	58
L50(150)A-BB-35	CW to 50W, intermittent to 150W	Ø35mm	0.19-11µm	100mW-150W	40mJ-300J	58
L50(150)A-BB-35 with 12m cable	CW to 50W, intermittent to 150W	Ø35mm	0.19-11µm	100mW-150W	40mJ-300J	58
L50(150)A-LP2-35	CW to 50W, intermittent to 150W high damage threshold for long pulses	Ø35mm	0.25-2.2µm	100mW-150W	40mJ-3000J	58
L50(150)A-PF-35	CW to 50W, intermittent to 150W for short pulse lasers	Ø35mm	0.15-20µm	100mW-150W	50mJ-300J	58
30(150)A-SV-17	Very high damage threshold, 30W continuous 150W intermittent	Ø17mm	0.19-11µm	100mW-150W	50mJ-300J	60
F80(120)A-CM-17	High repetition rate pulsed laser for material processing	Ø17.5mm	0.248-9.4µm	100mW-120W	50mJ-200J	60
F150(200)A-CM-16	High repetition rate pulsed laser for material processing	Ø16mm	0.248-9.4µm	300mW-200W	50mJ-200J	60
Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
30(150)A-HE-17	High energy and average power YAGs and harmonics 30W continuous 150W intermittent	Ø17mm	0.19-0.625µm, 1.064µm, 2.1µm, 2.94µm	50mW-150W	60mJ-200J	61
30(150)A-HE-DIF-17	For highly concentrated Q switched pulses to 30W, intermittent to 150W	Ø17mm	0.19-3µm except for 0.625-0.9µm	50mW-150W	60mJ-200J	61
20C-BB-12-SH	Compact smart sensor	Ø12mm	0.19-11µm	10mW-20W	6mJ-10J	64
L30C-SH	Larger aperture, smart sensor	Ø26mm	0.19-20µm	300mW-100W	30mJ-100J	64
L30C-LP2-26-SH	As above with LP2 absorber for high pulse energies	Ø26mm	0.25-2.2µm	300mW-100W	30mJ-2000J	64
100C-BB-18-SH	Slim profile, smart sensor	Ø18mm	0.19-11µm	60mW-100W	N.A.	64
150C-SH	High power, smart sensor	Ø18mm	0.19-20µm	60mW-60W	20mJ-100J	64
150W-SH	High power, water cooled smart sensor	Ø18mm	0.19-20µm	100mW-150W	50mJ-100J	64

Medium power thermal sensors – apertures 35 to 65mm, 300mW – 500W

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
L40(250)A-BB-50	CW to 35W, intermittent to 250W, large aperture	Ø50mm	0.19-11µm	300mW - 250W	100mJ-4000J	66
L40(250)A-BB-50 with 12m cable	CW to 35W, intermittent to 250W, large aperture	Ø50mm	0.19-11µm	300mW - 250W	100mJ-4000J	66
L40(250)A-LP2-50	As above, high damage threshold for long pulses	Ø50mm	0.25-2.2µm, 2.94µm	300mW - 250W	100mJ-10,000J	66
L40(200)A-EX-50	CW to 35W, intermittent to 200W for excimer lasers	Ø50mm	0.15-0.7µm, 10.6µm	300mW - 200W	100mJ-200J	66
L40(500)A-LP2-DIF-35	CW to 35W, intermittent to 500W, high damage threshold	Ø35mm	0.44-2.2µm	300mW-500W	100mJ-2000J	66
L50(250)A-BB-50	CW to 50W, intermittent to 250W	Ø50mm	0.19-11µm	300mW - 250W	100mJ-4000J	68
L50(300)A-BB-65	CW to 50W, intermittent to 300W, very large aperture	Ø65mm	0.19-11µm	400mW-300W	200mJ-300J	68
L50(300)A-LP2-65	As above, high damage threshold for CW and long pulses	Ø65mm	0.25-2.2µm	400mW-300W	200mJ-1000J	68
L50(300)A-PF-65	CW to 50W, intermittent to 300W, large beam short pulses	Ø65mm	0.15-20µm	400mW-300W	200mJ-300J	68
L100(500)A-PF-120	For short exposures, measure energies to 6000J	Ø120mm	0.15-20µm	1W-500W	6J-6000J	69A
L50(300)A-IPL	For gel and air coupled IPL sources	Ø65mm	0.5-1.3µm	400mW-300W	120mJ-1000J	70
L40(150)A-IPL	Energy meter for gel coupled IPL radiation	22x22mm	0.5-1.3µm	N.A.	100mJ-2000J	70

Medium-high power fan and water cooled thermal sensors – 10mW – 1100W

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
F50A-BB-18	General purpose to 50W, very stable reading	Ø17.5mm	0.19-11µm	10mW-50W	6mJ-50J	72
F100A-PF-DIF-33	High average power, short pulse lasers	Ø33mm	0.24-2.2µm	50mW-100W	60mJ-200J	72
F150A-BB-26	Fan cooled to 150W	Ø26mm	0.19-11µm	50mW-150W	20mJ-100J	72
F150A-BB-26-PPS	Power, position & size to 150W	Ø26mm	0.19-11µm	50mW-150W	20mJ-100J	62
FL250A-BB-35	Fan cooled to 250W	Ø35mm	0.19-20µm	150mW-250W	50mJ-300J	73
FL250A-LP2-35	As above, high damage threshold for long pulses and CW	Ø35mm	0.25-2.2µm	100mW-250W	50mJ-300J	73
FL250A-LP2-DIF-33	Fan cooled to 250W with diffuser for high power and energy density	Ø33mm	0.4-3µm	400mW-250W	400mJ-600J	73
FL250A-BB-50	Fan cooled to 250W, large aperture	Ø50mm	0.19-11µm	150mW-250W	80mJ-300J	74
FL250A-BB-50 with 5m cable	Fan cooled to 250W, large aperture	Ø50mm	0.19-11µm	150mW-250W	80mJ-300J	74
FL250A-BB-50-PPS	Power, position & size to 250W, large aperture	Ø50mm	0.19-20µm	150mW-250W	80mJ-300J	76
FL400A-BB-50	Fan cooled to 500W	Ø50mm	0.19-20µm	300mW-500W	75mJ-600J	74
FL400A-LP2-50	Fan cooled to 500W, high power densities and long pulses	Ø50mm	0.35-2.2µm, 10.6µm	100mW-500W	250mJ-600J	74
FL600A-BB-65	Fan cooled to 600W	Ø65mm	0.19-11µm	5W-600W	600mJ-600J	75
FL600A-LP2-65	Fan cooled to 600W for long pulsed lasers	Ø65mm	0.35-2.2µm	5W-600W	600mJ-600J	75
FL1100A-BB-65	Fan cooled to 1100W	Ø65mm	0.19-11µm	5W-1100W	600mJ-600J	75
FL1100A-BB-65 with 3m cable	Fan cooled to 1100W	Ø65mm	0.19-11µm	5W-1100W	600mJ-600J	75
FL1100A-LP2-65	As above for high power densities and long pulses	Ø65mm	0.35-2.2µm	5W-1100W	600mJ-1000J	75
L250W-BB-50	Thin profile, 20mm thick, water cooled to 250W	Ø50mm	0.19-11µm	1W-250W	120mJ-200J	79
L250W-BB-50 with 5m cable	Thin profile, 20mm thick, water cooled to 250W	Ø50mm	0.19-11µm	1W-250W	120mJ-200J	79
L300W-LP2-50	Thin profile, 20mm thick, water cooled to 300W	Ø50mm	0.35-2.2µm, 10.6µm	0.5W-300W	200mJ-300J	79

High power thermal sensors –1W – 30kW

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
1000W-BB-34	Water cooled to 1000W	Ø34mm	0.19-20µm	5W-1000W	400mJ-300J	80
1000W-BB-34-QUAD	Power & position, high powers up to 1000W	Ø34mm	0.19-20µm	5W-1000W	500mJ-300J	76
1000WP-BB-34	Water cooled to 1000W with non-contaminating water circuit	Ø34mm	0.19-20µm	5W-1000W	400mJ-300J	80
1000W-LP2-34	Water cooled to 1000W, high power densities and long pulses	Ø34mm	0.35-2.2µm	5W-1000W	400mJ-300J	80
L1500W-BB-50	Water cooled to 1500W	Ø50mm	0.19-20µm	15W-1500W	500mJ-200J	82
L1500W-LP2-50	As above, high power densities and long pulses	Ø50mm	0.35-2.2µm	15W-1500W	500mJ-200J	82
L2000W-BB-120	Water cooled to 2000W. Very large aperture 120mm	Ø120mm	0.19-20µm	1W-2000W	6J-6000J	83
L2000W-PF-120	As above, high damage threshold for short pulses	Ø120mm	0.3-2.2µm	1W-2000W	6J-6000J	83
5000W-BB-50	Water cooled to 5000W	Ø50mm	0.19-11µm	20W-5000W	N.A.	85
5000W-LP2-50	As above, high power densities and long pulses	Ø50mm	0.35-2.2µm	20W-5000W	N.A.	85
5000WP-LP2-50	Water cooled to 5000W for non-contaminating water flow	Ø50mm	0.35-2.2µm	20W-5000W	N.A.	85
10K-W-BB-45	Water cooled to 11,000W, very high power densities	Ø45mm	0.8-2µm, 10.6µm	100W-11kW	N.A.	86
IPM-10KW	Laser power measurement in industrial environment up to 11k	Ø45mm	0.9-1.1µm, 10.6µm	100W-11kW	60J-10kJ	94
15K-W-BB-45	Water cooled to 15,000W, high power densities	Ø45mm	0.8-2µm, 10.6µm	100W-15kW	N.A.	87
20K-W-BB-55	Water cooled to 20,000W, over temperature alarm and interlock	Ø55mm	0.8-2µm, 10.6µm	100W-20kW	N.A.	87
30K-W-BB-74	Water cooled to 30,000W, high power densities	Ø74mm	0.8-2µm	100W-30kW	N.A.	88

Calorimetric Power Meters 200W - 150kW

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
6K-W-BB-200x200	Very large aperture 198x198mm to 6000W, calorimetric measurement	198x198mm	0.19-20µm	200W-6000W	N.A.	90
70K-W	Water cooled to 70,000W, Ultra-high powers, calorimetric measurement	Ø130mm	0.8-10.6µm	2kW-70kW	N.A.	90A
120K-W	Water cooled to 120,000W, Ultra-high powers, calorimetric measurement	Ø200mm	0.9-1.1µm	10kW-120kW	N.A.	91
150K-W	Water cooled to 150,000W, Ultra-high powers, calorimetric measurement	Ø200mm	0.9-1.1µm	10kW-150kW	N.A.	91

Short exposure high power sensors

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
Helios Pro - Profinet	No water cooling meter for short exposures up to 12kW, Profinet	Ø50mm	450-550nm, 900-1100nm	100W-12kW	100J-5kJ	103
Helios Pro - Profinet, Diffuser	No water cooling meter for short exposures up to 12kW, Profinet with diffuser	Ø35mm	450-550nm, 940-1100nm	100W-12kW	100J-5kJ	103
Helios Pro - EtherNet/IP	No water cooling meter for short exposures up to 12kW, EtherNet/IP	Ø50mm	450-550nm, 900-1100nm	100W-12kW	100J-5kJ	103
Helios Pro - EtherNet/IP, Diffuser	No water cooling meter for short exposures up to 12kW, EtherNet/IP with Diffuser	Ø35mm	450-550nm, 940-1100nm	100W-12kW	100J-5kJ	103
Helios Pro - EtherNet/IP-M	No water cooling meter for short exposures up to 12kW, EtherNet/IP, M12 connector for data, Mini 7/8" connector for power	Ø50mm	450-550nm, 900-1100nm	100W-12kW	100J-5kJ	103
Helios Pro - EtherNet/IP-M, Diffuser	No water cooling meter for short exposures up to 12kW, EtherNet/IP, M12 connector for data, Mini 7/8" connector for power with Diffuser	Ø35mm	450-550nm, 940-1100nm	100W-12kW	100J-5kJ	103
Helios Pro - EtherCAT	No water cooling meter for short exposures up to 12kW, EtherCAT	Ø50mm	450-550nm, 900-1100nm	100W-12kW	100J-5kJ	103

Helios Pro - EtherCAT, Diffuser	No water cooling meter for short exposures up to 12kW, EtherCAT with Diffuser	Ø35mm	450-550nm, 940-1100nm	100W-12kW	100J-5kJ	103
Ariel	No water cooling meter for CW and short exposures up to 8kW, LCD, Bluetooth, USB.	Ø32mm	440-550nm, 900-1100nm, 2.94µm, 10.6µm	200mW-8kW	Up to 2.4kJ	106
L40(250)A-LP2-50	CW to 40W, intermittent to 250W, high power densities and long pulses	Ø50mm	0.25-2.2µm, 2.94µm	300mW-250W	100mJ-10,000J	108
L40(500)A-LP2-DIF-35	CW to 35W, intermittent to 500W, high damage threshold	Ø35mm	0.44-2.2µm	300mW-500W	100mJ-2000J	108
L30C-LP2-26-SH	Smart sensor with LP2 absorber for high pulse energies	Ø26mm	0.25-2.2µm	10W-100W	30mJ-2000J	108
Comet 1K	Portable low-cost power probe with low powers	Ø50mm	0.2-20µm	20W-1000W	N.A.	110
Comet 10K	Portable low-cost power probe with high powers	Ø100mm	0.98-1.07µm and 10.6µm	200W-10,000W	N.A.	110
Comet 10K-HD	Portable low-cost power probe with high damage threshold	Ø55mm	0.98-1.07µm and 10.6µm	200W-10,000W	N.A.	110

Beam dumps up to 11kW

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
BDFL500A-BB-50	Fan cooled beam dump up to 500W	Ø50mm	0.19-20µm	up to 500W	N.A.	98
BDFL1500A-BB-65	Fan cooled beam dump up to 1500W	Ø65mm	0.19-20µm	up to 1500W	N.A.	98
BD5000W-BB-50	Water cooled beam dump up to 5000W	Ø50mm	0.19-20µm	up to 5000W	N.A.	98
BD10K-W	Water cooled beam dump up to 11,000W	Ø45mm	0.8-20µm	up to 11kW	N.A.	98

Accessories for high power water cooled sensors

Accessory	Description	Page
IPM-Shutter10	Protective shutter for IPM-10KW, provides IP62 in industrial environment	96
IPM-COM-Profinet	Support industrial communication Profinet protocol for IPM sensor	97
IPM-COM-EtherNet/IP-M	Support industrial communication EtherNet/IP protocol for IPM sensor	97
QBH-L-Fiber adapter	Mounting fibers with QBH termination to L1500W-LP2-50, L1500W-BB-50, 5000W-LP2-50 and 5000W-BB-50 sensors, for low numerical apertures	99
QBH-S-Fiber adapter	Mounting fibers with QBH termination to L1500W-LP2-50, L1500W-BB-50, 5000W-LP2-50 and 5000W-BB-50 sensors, for high numerical apertures	99
5000W/10K-W/15K-W Protective housing with Shutter	Housing with shutter to protect 5000W, 10K-W and 15K-W sensors from contamination with debris	100
10K-W and 15K-W Scatter shield	Shield to mount on front flange of 10K-W and 15K-W sensors. Reduces backscatter of radiation by 2/3	101
20K-W Scatter shield	Shield to mount on front flange of 20K-W sensor. Reduces backscatter of radiation by 2/3	101
30K-W Scatter shield	Shield to mount on front flange of 30K-W sensor. Reduces backscatter of radiation by 2/3	101
Heavy duty stand for 10K-W/15K-W	Heavy duty stand for 10K-W and 15K-W	101
30K-W Rubber Feet Assembly	For better stability when 30K-W is used with a vertical beam	101
Metric water fittings for water cooled sensors	Water connectors for metric size tubing instead of standard inch size	102
10K-W Protective cover	Housing with shutter to protect sensors from contamination with debris	102
10K-W / 15K-W scatter shield cover	10K-W and 15K-W with Scatter Shield	102
20K-W Protective cover	Protective cover with target pattern for 20K-W (one supplied with device)	102
30K-W Protective cover	Protective cover with target pattern for 30K-W (one supplied with device)	102
30K-W Scatter shield cover	Protective cover on scatter shield for 30K-W sensor	102

BEAMTRACK - POWER / POSITION / SIZE SENSORS

Sensor	Features	Aperture	Spectral Range	Power Range	Energy Range	Page
3A-QUAD	Power & position, very low powers up to 3W	Ø9.5mm	0.19-20µm	100µW-3W	20µJ-2J	114
3A-P-QUAD	As above for short pulse laser	Ø12mm	0.15-8µm	160µW-3W	30µJ-2J	114
10A-BB-16-PPS	Power, position & size to 10W	Ø16mm	0.19-11µm	20mW-10W	6mJ-2J	114
50(150)A-BB-26-QUAD	Power & position to 50W, 150W intermittent	Ø26mm	0.19-11µm	40mW-150W	20mJ-100J	116
50(150)A-BB-26-PPS	Power, position & size to 50W, 150W intermittent	Ø26mm	0.19-11µm	40mW-150W	20mJ-100J	116
F150A-BB-26-PPS	Power, position & size to 150W	Ø26mm	0.19-11µm	50mW-150W	20mJ-100J	116
FL250A-BB-50-PPS	Power, position & size to 250W, large aperture	Ø50mm	0.19-20µm	150mW-250W	80µJ-300J	118
1000W-BB-34-QUAD	Power & position, high powers up to 1000W	Ø34mm	0.19-20µm	5W-1000W	500mJ-300J	118

ACCESSORIES FOR THERMAL SENSORS

Accessory	Description	Page
Fiberoptic adapters		
Thermal F.O. adapters	Adapters for mounting fibers to thermal sensors (ST, FC, SMA, SC)	120
Accessories for high power sensors		
Accessories		
High power QBH-fiber adapters for L1500W-LP2-50, L1500W-BB-50, 5000W-LP2-50 and 5000W-BB-50 sensors	QBH-fiber adapters for mounting fibers with QBH termination to Ophir power sensors	121
Protective Housing for 5000W, 10K-W and 15K-W sensors	Protective housing with shutter providing protection from debris of material working process	121
Scatter shield for 10K-W, 15K-W, 20K-W and 30K-W sensors	Shield to mount on front flange of the sensors. Reduces backscatter of radiation by 2/3	121
Protective covers for Scatter Shields for 10K-W, 15K-W and 30K-W	Protective cover to mount on scatter shields protecting the shield from debris of material working process	121
Protective covers with target	Protective cover with target pattern for 1000W/L1500W/5000W/10K-W/15K-W, 20K-W and 30K-W	121
Metric water connectors for water cooled sensors	Water connectors for metric size tubing instead of standard inch size	121
Heavy duty stand for 10K-W/15K-W	Heavy Duty Stand for 10K-W and 15K-W	121
30K-W Rubber Feet Assembly	For better stability when 30K-W is used with a vertical beam	121
General accessories		
Accessories		
SH to BNC adapter	Allows connection of sensor to current or voltage measuring device for measurement of raw sensor output	121
Replacement parts		
Accessories		
N polarity power supply/charger 12V 2A N-2.1x5.5	Negative polarity power supply/charger for Centauri, Vega, Nova II, LaserStar, Nova, Pulsar, Quasar, EA-1, 6K-W, 120K-W, 150K-W and fan cooled sensors	121
P polarity power supply/charger 12V 2A P-1.35x3.5	Positive polarity power supply/charger for StarLite, StarBright and RM9 Chopper	121
Push-Pull 2 Pin Power Supply 12V 2A	Push-Pull 2 Pin Power Supply for IS1.5-VIS-FPD-800 and IS1.5-IRG-FPD-800	121

Energy sensors

PHOTODIODE AND PYROELECTRIC ENERGY SENSORS

Photodiode energy sensors – 10pJ – 15μJ						
Sensor	Features	Aperture	Spectral Range	Energy Range	Maximum Frequency	Page
PD10-C	Very low energies down to nJ, Silicon photodiode	Ø10mm	0.19-1.1μm	1nJ-20μJ	20,000Hz	126
PD10-C with 10m cable	Very low energies down to nJ, Silicon photodiode	Ø10mm	0.19-1.1μm	1nJ-20μJ	20,000Hz	126
PD10-IR-C	Very low energies down to nJ, Germanium photodiode	Ø5mm	0.7-1.8μm	1nJ-600nJ	10,000Hz	127
PD10-pJ-C	Lowest energies down to pJ, Silicon photodiode	Ø10mm	0.2-1.1μm	10pJ-200nJ	20,000Hz	126
PD10-IR-pJ-C	Lowest energies down to pJ, Germanium photodiode	Ø5mm	0.7-1.8μm	30pJ-20nJ	10,000Hz	127
Pyroelectric energy sensors – 0.1μJ – 10J						
Sensor	Features	Aperture	Spectral Range	Energy Range	Maximum Frequency	Page
PE9-C	Pyroelectric for very low energies	Ø8mm	0.15-12μm	0.2μJ-1mJ	25,000Hz	128
PE9-ES-C	Pyroelectric for lowest energies	Ø8mm	0.15-12μm	0.1μJ-200μJ	20,000Hz	128
PE10-C	Pyroelectric for low energies	Ø12mm	0.15-12μm	1μJ-10mJ	25,000Hz	129
PE10BF-C	As above, high damage threshold	Ø12mm	0.15-3μm, 10.6μm	7μJ-10mJ	250Hz	129
PE10BF-C with 10m cable	As above, high damage threshold	Ø12mm	0.15-3μm, 10.6μm	7μJ-10mJ	250Hz	129
PE25-C	Medium aperture pyroelectric	Ø24mm	0.15-3μm	8μJ-10J	10,000Hz	130
PE25-C with 10m cable	Medium aperture pyroelectric	Ø24mm	0.15-3μm	8μJ-10J	10,000Hz	130
PE25BF-C	As above, high damage threshold	Ø24mm	0.15-3μm, 10.6μm	60μJ-10J	250Hz	130
PE50-C	Large aperture pyroelectric	Ø46mm	0.15-3μm	10μJ-10J	10,000Hz	130
PE50BF-C	As above, high damage threshold	Ø46mm	0.15-3μm, 10.6μm	120μJ-10J	250Hz	130
High energy pyroelectric sensors – 10μJ – 40J						
Sensor	Features	Aperture	Spectral Range	Energy Range	Maximum Frequency	Page
PE50-DIF-C	Pyroelectric with diffuser, high repetition rate. Complete calibration curve	Ø35mm	0.355-2.2μm, 2.94μm	20μJ-10J	10,000Hz	132
PE50-DIF-C with 10m cable	Pyroelectric with diffuser, high repetition rate. Complete calibration curve	Ø35mm	0.355-2.2μm, 2.94μm	20μJ-10J	10,000Hz	132
PE50-DIFH2-C	Pyroelectric with diffuser, high repetition lasers requiring high damage threshold	Ø35mm	0.355-2.2μm, 2.94μm	100μJ-10J	10,000Hz	134
PE50-UV-DIFH-C	Same as above for UV calibration	Ø35mm	0.19-0.355μm	100μJ-10J	10,000Hz	134
PE25BF-DIF-C	Pyroelectric with diffuser for high damage threshold. Complete calibration curve	Ø20mm	0.355-2.2μm	100μJ-10J	250Hz	132
PE50BF-DIF-C	Pyroelectric with diffuser for high damage threshold. Complete calibration curve	Ø35mm	0.355-2.2μm, 2.94μm	200μJ-10J	250Hz	133
PE50BF-DIFH2-C	Pyroelectric with diffuser, pulsed lasers requiring very high damage threshold	Ø35mm	0.355-2.2μm, 2.94μm	200μJ-10J	250Hz	134
PE50BF-UV-DIFH-C	Same as above for UV calibration	Ø35mm	0.19-0.355μm	200μJ-10J	250Hz	134
PE50BB-DIF-C	Pyroelectric with removable diffuser. Wide spectral range w/o diffuser	Ø46mm Ø33mm with diffuser	0.19-20μm, 0.4-2.5μm with diffuser	100μJ-40J	40Hz	133
PE50BB-DIF-C with 5m cable	Pyroelectric with removable diffuser. Wide spectral range w/o diffuser	Ø46mm Ø33mm with diffuser	0.19-20μm, 0.4-2.5μm with diffuser	100μJ-40J	40Hz	133
PE50-DIF-ER-C	Pyroelectric with removable diffuser. Especially for Erbium laser	Ø46mm Ø33mm with diffuser	0.19-3μm, 0.4-3μm with diffuser	10μJ-30J	10,000Hz	136
PE100BF-DIF-C	Largest aperture pyroelectric with removable diffuser	Ø96mm Ø85mm with diffuser	0.15-3μm, 0.4-2.5μm with diffuser	400μJ-40J	200Hz	136
FPE80BF-DIF-C	Fan cooled pyroelectric for high average powers to 200W	Ø53mm	0.355-2.2μm, 2.94μm	1mJ-40J	250Hz	138
PE80BF-DIF-C	Pyroelectric with diffuser for high power densities	Ø67mm	0.355-2.2μm, 2.94μm	4mJ-40J	250Hz	138

ENERGY SENSORS ACCESSORIES

Accessories for pyroelectric sensors		
Fiberoptic adapters		
Accessory	Description	Page
Pyroelectric F.O. Adapters	Adapters for mounting fibers to pyroelectric sensors (ST, FC, SMA, SC)	140
Accessories		
Accessory	Description	Page
Removable Heat Sink	Heat sink that is fastened to rear of PE-C sensors. Allows average power ~50-70% higher than without heat sink	140
Scope Adapter	Plugs in between the PE sensor and power meter. Provides BNC output to scope to see every pulse up to the maximum frequency of the sensor	140
Beam Splitter Assembly	Beam Splitter Assembly to measure pulsed laser sources too energetic for direct measurement. Use with the Beam Splitter can be calibrated by setting the laser to a lower energy that will not damage the sensor and swiveling between position A and B and then taking the ratio of A and B	140
Nova PE-C Adapter	The adapter plugs between the Nova D15 socket and the smart plug of the PE-C sensor to allow the Nova to operate with PE-C series sensors. See PE-C spec sheet for details	141
Damage Threshold Test Plates	Test plates with same absorber coating as the sensor. For testing that laser beam is not above damage threshold (1 such plate is included with sensor package). There are test plates of the following types: Metallic, BB and BF	141
PE-C to PE Size Adapter	The newer PE-C series sensors have a Ø62mm diameter. The older PE series sensors have a Ø85mm diameter. This adapter allows using the PE-C type sensors in jigs and setups that were originally designed for PE sensors	141
N Polarity Power Supply/Charger AC/DC 12V 2A N-2.1x5.5	Negative Polarity Power Supply/Charger for FPE80BF-DIF-C sensor	141

Pulse Characterization Sensors

PULSE CHARACTERIZATION SENSORS

Fast photodiode detectors (FPD)

Sensor	Features	Active Area	Spectral Range	Rise Time / Fall Time	Bandwidth	Page
FPS-1	For measuring temporal characteristics for UV radiation	Ø1.02mm	193-1100nm	1.5 nsec	233 MHz	144
FPD-UV-3000	As above with rise time of 3 nsec & M20x1 thread	Ø2.55mm	193-1100nm	3 nsec	>118 MHz	144
FPD-VIS-300	For measuring temporal characteristics for VIS radiation	Ø0.4mm	320-1100nm	<0.3 nsec	>1.2 GHz	144
FPD-IG-175	As above for 900-1700nm radiation & rise time of 175 psec	Ø0.1mm	900-1700nm	<0.175 nsec	>2 GHz	144
FPD-IG-25	As above for 900-1700nm radiation & rise time of 25 psec	Ø0.032mm	900-1700nm	<0.025 nsec	>15 GHz	144

Accessories for fast photodiode detector (FPD) series

Fiber Optics Adapters

Accessory	Description	Page
FPD F.O. adapters	Adapters for mounting fibers to FPD sensors (ST, FC, SMA, SC)	145

Accessories

Accessory	Description	Page
ND1 Attenuator	ND1 nom. X10 attenuator	145
ND2 Attenuator	ND2 nom. X50 attenuator	145
IS6 for FPD Adapter	Adapters for mounting FPD sensor series to IS6 integrating spheres	145
IS6 for FPS-1 Adapter	Adapters for mounting FPS-1 sensor to IS6 integrating spheres	145

Customized Solutions (OEM) Power and Energy Sensors

CUSTOMIZED SOLUTIONS (OEM) POWER AND ENERGY SENSORS

Standard customized solutions (OEM) thermal and photodiode sensors – 100pW – 600W

Sensor	Features	Aperture	Spectral Range	Power Range ^(a)	Size	Page
3A-UAF	Low power, built-in amplifier (RS232/analog)	Ø9.5mm	0.19-20µm	100µW-3W	50x50x38mm	150
PD300-UAS	Compact, photodiode, built-in amplifier (RS232/analog)	10x10mm	0.2-1.1µm	100pW-50mW	38x38x32mm	150
20C-BB-12-SH	Compact smart sensor	Ø12mm	0.19-11µm	10mW-20W	38x38x14mm	151
20C-UAS	Compact, built-in amplifier (RS232/analog)	Ø12mm	0.19-11µm	10mW-20W	38x38x34mm	151
20C-UAU	Compact, external amplifier (USB)	Ø12mm	0.19-11µm	10mW-20W	38x38x14mm	151
20C-UAE	Compact, external amplifier (Ethernet)	Ø12mm	0.19-11µm	10mW-20W	38x38x14mm	151
L30C-SH	Medium aperture, smart sensor	Ø26mm	0.19-20µm	300mW-100W	60x60x38mm	153
L30C-LP2-26-SH	As above with LP2 absorber for high pulse energies	Ø26mm	0.25-2.2µm	300mW-100W	60x60x38mm	153
L30C-UAF	Medium aperture, built-in amplifier (RS232/analog)	Ø26mm	0.19-20µm	300mW-100W	60x60x38mm	153
L30C-UAU	Medium aperture, built-in amplifier (USB)	Ø26mm	0.19-20µm	300mW-100W	60x60x38mm	153
L30C-UAE	Medium aperture, built-in amplifier (Ethernet)	Ø26mm	0.19-20µm	300mW-100W	60x60x38mm	153
100C-BB-18-SH	Low profile, smart sensor	Ø18mm	0.19-11µm	60mW-100W	48x48x14.5mm	155
100C-UAF	Low profile, separate amplifier (RS232/analog)	Ø18mm	0.19-11µm	60mW-100W	48x48x14.5mm	155
100C-UAU	Low profile, separate amplifier (USB)	Ø18mm	0.19-11µm	60mW-100W	48x48x14.5mm	155
100C-UAE	Low profile, separate amplifier (Ethernet)	Ø18mm	0.19-11µm	60mW-100W	48x48x14.5mm	155
150C-SH	High power, smart sensor	Ø18mm	0.19-20µm	60mW-150W	50.8x50.8x33mm	157
150C-UAF	High power, built-in amplifier (RS232/analog)	Ø18mm	0.19-20µm	60mW-150W	50x50x38mm	157
150C-UAU	High power, built-in amplifier (USB)	Ø18mm	0.19-20µm	60mW-150W	50x50x38mm	157
150C-UAE	High power, built-in amplifier (Ethernet)	Ø18mm	0.19-20µm	60mW-150W	50x50x38mm	157
150W-UAF	High power, built-in amplifier, water cooled (RS232/analog)	Ø18mm	0.19-20µm	100mW-150W	50x50x38mm	157
150W-UAU	High power, built-in amplifier, water cooled (USB)	Ø18mm	0.19-20µm	100mW-150W	50x50x38mm	157
150W-UAE	High power, built-in amplifier, water cooled (Ethernet)	Ø18mm	0.19-20µm	100mW-150W	50x50x38mm	157
L150C-UAF	Large aperture, built-in amplifier (RS232/analog)	Ø50mm	0.19-20µm	0.2W-150W	80x80x45mm	159
L150C-UAU	Large aperture, built-in amplifier (USB)	Ø50mm	0.19-20µm	0.2W-150W	80x80x45mm	159
L150C-UAE	Large aperture, built-in amplifier (Ethernet)	Ø50mm	0.19-20µm	0.2W-150W	80x80x45mm	159
L250W-UAF	Large aperture, built-in amplifier, water cooled (RS232/analog)	Ø50mm	0.19-20µm	0.3W-250W	80x80x58mm	159
L250W-UAU	Large aperture, built-in amplifier, water cooled (USB)	Ø50mm	0.19-20µm	0.3W-250W	80x80x58mm	159
L250W-UAE	Large aperture, built-in amplifier, water cooled (Ethernet)	Ø50mm	0.19-20µm	0.3W-250W	80x80x58mm	159
L300W-UAF	Large aperture, built-in amplifier, water cooled (RS232/ analog)	Ø50mm	0.19-20µm	0.5W-300W	80x80x58mm	159
L300W-UAU	Large aperture, built-in amplifier, water cooled (USB)	Ø50mm	0.19-20µm	0.5W-300W	80x80x58mm	159
L300W-UAE	Large aperture, built-in amplifier, water cooled (Ethernet)	Ø50mm	0.19-20µm	0.5W-300W	80x80x58mm	159
600W-UAF	High power, built-in amplifier (RS232/analog)	Ø26mm	0.35-2.2µm	5W-600W	65x65x49mm	159
600W-UAU	High power, built-in amplifier (USB)	Ø26mm	0.35-2.2µm	5W-600W	65x65x49mm	159
600W-UAE	High power, built-in amplifier (Ethernet)	Ø26mm	0.35-2.2µm	5W-600W	65x65x49mm	159

Other Sensors Ophir offers many other Customized Solutions (OEM) sensors. For your Customized Solutions (OEM) solution please fill the questionnaire on our website: www.ophiropt.com or contact us: USA: sales@ophir-spiricon.com Other: ophir.sales@ophiropt.com customer.support@ophiropt.com

Note: (a) Effective Dynamic Range for a given sensor is ~ 30:1

Standard customized solutions (OEM) pyroelectric energy sensors – 0.1µJ – 40J

Sensor	Features	Aperture	Spectral Range	Energy Range	Max. Freq.	Size	Page
PE10-C-RE	Non amplified compact sensor	Ø12mm	0.19-10.6µm	Depends on configuration	Depends on configuration	Ø22 x 7.5mm	165
PE XX-C-RE232	PE smart sensors with built-in output	Choose from standard PE-C	Choose from standard PE-C	Same as equiv. PE-C	Same as equiv. PE-C	Same as std PE-C	165
PE-C-RE	Custom smart PE sensors	Usually 10mm	0.19-10.6µm	Same as equiv. PE-C	Same as equiv. PE-C	Can be very small	165

Other Sensors Ophir offers many other Customized Solutions (OEM) sensors. For your Customized Solutions (OEM) solution please fill the questionnaire on our website: www.ophiropt.com or contact us: USA: sales@ophir-spiricon.com Other: ophir.sales@ophiropt.com customer.support@ophiropt.com

Sensor Finder Program

Finding the proper sensor(s) to meet your measurement needs has never been easier. With our sensor finder program just enter your laser parameters and the proper measuring sensors for your application will be displayed on the screen. The program calculates the power and energy density capabilities of each absorber, based on the laser wavelength, pulse length, repetition rate and other relevant parameters. It also compares all the other requirements such as maximum and minimum power, energy, beam size, etc.

In addition to finding the right sensor for your application, the Sensor Finder Program offers the following features:

- Report printing
- How close the recommended sensors are to the specified damage threshold
- Calculation of input power and energy density and average power
- Tips on further action if no solution is found

Order of Selection

The sensors are selected in terms of cost effectiveness and ease of use, i.e. photodiode sensors and thermopiles are selected first and then pyroelectric sensors. If you want to measure only power, pyro sensors will not be selected even if they could operate within all other given laser parameters.

Aperture

Since it is not practical to allow the beam to fill the entire aperture, the sensors are selected so that the sensor aperture is always at least 2mm or 10% larger than the beam. If the beam is rectangular its corners can touch the aperture.

Using the Sensor Finder Program

The Sensor Finder Program is available for use online at: www.ophiropt.com/sensor-finder

It can also be downloaded for use on your own PC at: www.ophiropt.com/sensor-finder-download

Sensor Finder Input Screen

The screenshot shows the 'Sensor Finder Input Screen' with three main sections:

- Step 1: Measurement Type**
 - Laser:** CW (radio button), Pulsed (radio button, selected)
 - Beam:** Flat-Top (radio button), Gaussian (radio button), Circular (radio button, selected), Rectangular (radio button)
 - Measurement:** Energy and Power (radio button, selected), Power Only (radio button)
- Step 2: Enter Laser Parameters**
 - Diameter (mm): 35
 - Wavelength: 1064 nm
 - Energy Range - Min to Max: 1 to 10 mJ
 - Power Range - Min to Max: [] to [] W
 - Max Rep Rate: 10 Hz
 - Pulse Width: 7 ns
 - Optional for Best Search:**
 - Exposure Time (min): []
 - Sensor Size (mm): Max Width [], Max Height [], Max Depth []
- Step 3: Find Sensor**
 - Find Sensor button
 - Power Density W/cm²: 0.01
 - Energy Density J/cm²: 1.04e-3
 - Average Power W: 0.1

1. When the program is started, the above screen appears: In Step 1, Select the laser type [CW or pulsed], the beam type [flat top or Gaussian and if flat top, circular or rectangular] and whether you wish to measure both power and energy or just laser power.
2. In Step 2, Enter the required laser parameters: beam diameter, wavelength, max/min power or max/min energy, rep rate and pulse width. If minimum power is not entered, then the program assumes the minimum is ½ the maximum. If desired, enter these optional criteria: exposure time – the maximum time the sensor measures at a time. If you only plan to measure the laser power for short periods at a time, Ophir offers more compact sensors for intermittent use. Sensor size – only sensors smaller than the specified dimensions will be selected.
3. In Step 3 click “Find Sensor”.

- The sensors that meet specified criteria will be listed in the output screen shown below. The sensor type and how close to the damage threshold are listed for each result. The input parameters are listed on top.
- In order to find compatible displays, click "Meter Finder". In order to find compatible PC interfaces click "PC Interfaces".
- To save the results, click "Save". To print the results, click "Print".

Sensor Finder Output Screen

[Another Search?](#)

Results For:
 Power & Energy | Flat-Top | Diameter 35mm | Energy Range 1mJ to 10mJ | Wavelength 1064nm | Rep Rate 10Hz |
 Pulse Width 7ns |

#	Model	Brand	% of Damage Threshold	Notes	Link
1	PE50-C	Ophir	<10	(1)	🔗
2	PE50BF-C	Ophir	<10	(1)	🔗
3	PE50-DIF-ER-C (dif out)	Ophir	<10	(1)	🔗
4	PE50BB-DIF-C (dif out)	Ophir	<10	(1)	🔗
5	FPE80BF-DIF-C	Ophir	<10	(1)	🔗
6	PE100BF-DIF-C (dif out)	Ophir	<10	(1)	🔗
7	PE50-C + Beam Splitter	Ophir	<10	(1)	🔗

(1) Operates with Vega, Nova II, StarLite and Juno. Restricted use with Laserstar, Pulsar, Quasar and USBI. Needs adapter to operate with Nova. See PDF data sheet for details.

Save
Print

Damage Threshold

Some sensors are closer to the laser damage threshold than others. Since the damage threshold can vary somewhat from case to case and also is cumulative, the Sensor Finder Program mentions how close a particular sensor is to the damage threshold. The displayed percent of damage threshold is the highest of either the power or the energy threshold. It is recommended to select a sensor that is less than 50% of the damage threshold.

Power/Energy Meters

In order to find power/energy meters or PC interfaces that are compatible with various sensors, click "Meter Finder" or "PC Interfaces". Note that some of the newer sensors, such as the Pyro-C line sensors are only compatible with the newer meters and PC interfaces.

General Introduction

Types of Power/Energy Sensors

Power and Single Shot Energy Sensors

Ophir provides two types of power sensors: Photodiode sensors and Thermal sensors. Photodiode sensors are used for low powers from picowatts up to hundreds of milliwatts and as high as 3W. Thermal sensors are for use from fractions of a milliwatt up to thousands of watts. Thermal sensors can also measure single shot energy at pulse rates not exceeding one pulse every ~5s.

Repetitive Pulse Energy Sensors

For higher pulse rates, Ophir has Pyroelectric energy sensors able to measure pulse rates up to tens of kHz. These are described in the energy sensor section, section 1.2.

Unless stated differently, all sensors are provided with a 1.5m cable.

Thermal Sensors

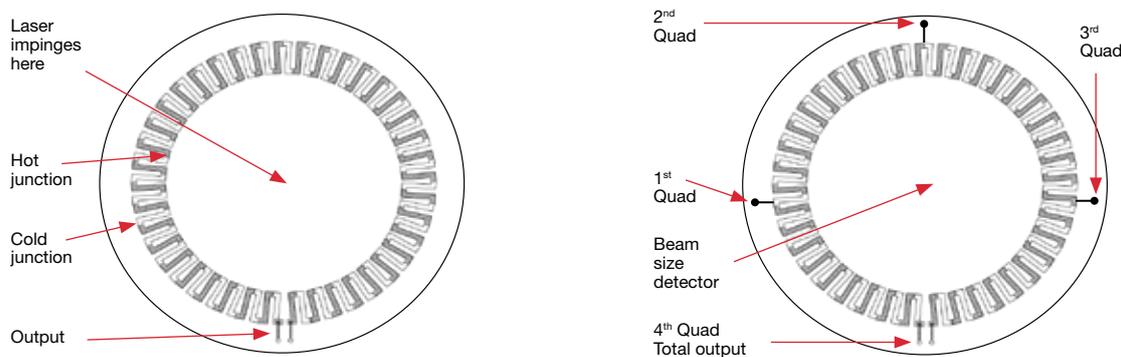
The thermopile sensor has a series of bimetallic junctions. A temperature difference between any two junctions causes a voltage to be formed between the two junctions. Since the junctions are in series and the «hot» junctions are always on the inner, hotter side, and the «cold» junctions are on the outer, cooler side, radial heat flow on the disc causes a voltage proportional to the power input. Laser power impinges on the center of the thermopile sensor disc (on the reverse side of the thermopile), flows radially and is cooled on the periphery. The array of thermocouples measures the temperature gradient, which is proportional to the incident or absorbed power. In principle, the reading is not dependent on the ambient temperature since only the temperature difference affects the voltage generated and the voltage difference depends only on the heat flow, not on the ambient temperature. Since all the heat absorbed flows through the thermocouples (as long as the laser beam is inside the inner circle of hot junctions), the response of the detector is almost independent of beam size and position. If the beam is close to the edge of the inner circle, some thermocouples become hotter than others but since the sum of all of them is measured, the reading remains the same. Generally, Ophir specifies $\pm 2\%$ uniformity of reading over the surface or better.

BeamTrack Power / Position / Size sensors

The BeamTrack Thermal sensors can measure beam position and beam size as well as power. This innovative device provides an additional wealth of information on your laser beam – centering, beam position and wander, beam size as well as power and single shot energy. The BeamTrack sensor is illustrated schematically here and works as follows: the signal coming from the sensor is now divided into 4 quadrants so by measuring and comparing the output from the 4 sections we can determine the position of the center of the beam to a high degree of accuracy. In addition to the 4 quadrants, there is now a special proprietary beam size detector. After processing outputs from these various detectors, the user is presented with the beam position as well as beam size. Note that the beam size is calibrated only for a Gaussian beam of $>3\text{mm}$ but for other beams it will give relative size information and will indicate if the beam is changing size. For more information on the BeamTrack sensors, please see section 1.1.3.

Using Power Sensors to Measure Single Shot Energy

Although Ophir Thermal power sensors are used primarily to measure power, they can measure single shot energy as well where they integrate the power over time flowing through the



disc and thus measure energy. Since the typical time it takes for the disc to heat up and cool down is several seconds, these Thermal sensors can only measure one pulse every several seconds at most. Thus they are suitable for what is called “single shot” measurement. Although the response time of the sensor discs is slow, there is no limit to how short the pulses measured are since the measurement is of the heat flowing through the disc after the pulse.

Single shot energy can also be used to measure high power laser power. The sensor is exposed to a pulse of the laser power on the order of 0.3– 2s and the energy measured is converted to a power reading. In this way, a relatively small non water cooled sensor can measure powers up to over 10,000W. See “Short Exposure High Power Sensors” section on page 108-110.

Pyroelectric Sensors

Pyroelectric type sensors are useful for measuring the energy of repetitively pulsed lasers at up to 25,000Hz and are sensitive to low energies.

They are less durable than Thermal types and therefore should not be used whenever it is not necessary to measure the energy of each pulse and average power measurement is sufficient.

Pyroelectric sensors use a Pyroelectric crystal that generates an electric charge proportional to the heat absorbed. Since the two surfaces of the crystal are metalized, the total charge generated is collected and therefore the response is not dependent on beam size or position. This charge then charges a capacitor in parallel with the crystal and the voltage difference thus generated is proportional to the pulse energy. After the energy is read by the electronic circuit, the charge on the crystal is discharged to be ready for the next pulse.

Photodiode Sensors for Lower Powers

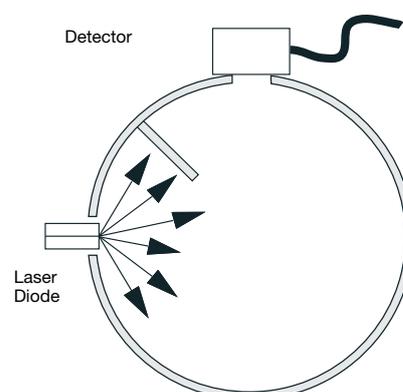
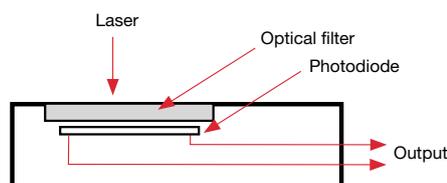
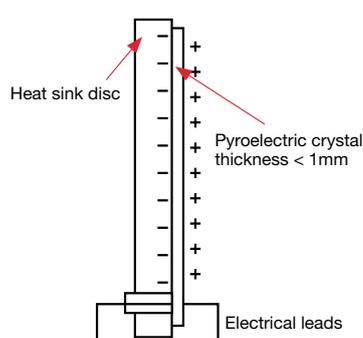
In addition to the Thermal sensors described above, Photodiode sensors are used for low powers from picowatts

up to hundreds of milliwatts and as high as 3W.

A Photodiode sensor is a semiconductor device that produces a current proportional to light intensity and has a high degree of linearity over a large range of light power levels - from fractions of a nanowatt to about 2mW. Above that light level, corresponding to a current of about 1mA, the electron density in the Photodiode becomes too great and its efficiency is reduced causing saturation and a lower reading. Most Ophir PD sensors have a built-in filter that reduces the light level on the detector and allows measurement up to 3W without saturation.

Integrating Spheres

Integrating Spheres are meant to measure divergent light sources such as LEDs. The light is introduced to the sphere through the input port, and reflected many times by the highly reflecting diffuse surface of the inner wall of the sphere until it uniformly illuminates the inner surface of the sphere. A detector samples a given small fraction of this light and thus can be used to measure the total power input into the sphere. Ophir integrating spheres have a highly reflecting diffuse white coating for high efficiency and readings that are independent of beam size, position and divergence. This integrating sphere configuration is ideal for a divergent beam such as from a laser diode. Ophir also offers integrating spheres configured for measuring collimated laser beams. Ophir has spheres of various sizes for covering UV, visible, NIR lasers up to 30 Watts. There is a North Pole auxiliary port suitable for picking off a small amount of light via an SMA fiber for wavelength measurement or any further analysis without affecting the overall system calibration. To maintain accuracy and guarantee performance, annual integrating sphere detector calibration is recommended.



2025 POWER SENSORS 1.1

SENSORS



1.1 Power Sensors

Thermal Sensors

As described in the general introduction, the thermopile sensor has a series of bimetallic junctions. A temperature difference between any two junctions causes a voltage to be formed between the two junctions. Since the junctions are in series and the «hot» junctions are always on the inner, hotter side, and the «cold» junctions are on the outer, cooler side, radial heat flow on the disc causes a voltage proportional to the power input. Laser power impinges on the center of the thermopile sensor disc (on the reverse side of the thermopile), flows radially and is cooled on the periphery. The array of thermocouples measures the temperature gradient, which is proportional to the incident or absorbed power. In principle, the reading is not dependent on the ambient temperature since only the temperature difference affects the voltage generated and the voltage difference depends only on the heat flow, not on the ambient temperature. Since all the heat absorbed flows through the thermocouples (as long as the laser beam is inside the inner circle of hot junctions), the response of the detector is almost independent of beam size and position. If the beam is close to the edge of the inner circle, some thermocouples become hotter than others but since the sum of all of them is measured, the reading remains the same. Generally, Ophir specifies $\pm 2\%$ uniformity of reading over the surface or better.

Using Power Sensors to Measure Single Shot Energy

Although Ophir Thermal power sensors are used primarily to measure power, they can measure single shot energy as well, where they integrate the power flowing through the disc over time and thus measure energy. Since the typical time it takes for the disc to heat up and cool down is several seconds, these Thermal sensors can only measure one pulse every several seconds at most. Thus they are suitable for what is called “single shot” measurement. Although the response time of the sensor discs is slow, there is no limit to how short the pulses measured are since the measurement is of the heat flowing through the disc after the pulse.

Types of Thermopile Discs

There is no single absorber which meets the needs of all applications. Ophir has developed several types for different applications, such as long pulses (0.1-10ms), short pulses ($<1\mu\text{s}$) and continuous radiation. Absorbers optimized for long pulses and CW are characterized by thin, refractory materials, since the heat can flow through the coating and into the disc during the pulse. On the other hand, heat cannot flow during short pulses, and all the energy is deposited in a thin (typically $0.1\mu\text{m}$) layer near the surface. This causes vaporization of the surface which ruins the absorber. Instead, a volume absorber that is partially

transparent and absorbs over a distance of $50\mu\text{m}$ -3mm is used. This spreads the heat over a larger volume allowing much higher energies.

Ophir thermopiles can measure from tens of microwatts to Kilowatts. Nevertheless, the Thermal range of operation of the discs is limited. If the difference between the hot and cold junction temperature exceeds tens of degrees, the constant heating/cooling of the junctions can cause premature failure in the junctions. In order to accommodate different power ranges, discs of different thicknesses and sizes are used, thick ones for high powers and thin ones for low powers.

The response time of the discs is dependent on their size and shape: larger diameters and thicker discs are slower than thin small diameter ones. The response time is in general dependent on the mass of material which has to heat up in the thin absorber region of the disc vs. the speed the heat flows out of the same region. The response time is approximately proportional to the aperture, i.e. a 50mm aperture disc is three times as slow as an 18mm aperture disc.

Thermal Surface Absorbing Sensors

A surface absorber typically consists of an optically absorbing refractory material deposited on a heat conducting substrate of copper or aluminum. When a long pulse of several hundred μs or a continuous laser beam falls on such a surface absorber, the light is absorbed in a very thin layer of the surface – typically $0.1 - 1\mu\text{m}$ thickness (see illustration A). Although the light is absorbed in a thin layer and there converted into heat, the pulse is long enough so that while energy is being deposited into the surface layer, heat is also flowing out into the heat conducting substrate and therefore the surface does not heat up excessively. Ophir standard surface absorbers can stand up to $10\text{ Joules}/\text{cm}^2$ for 2ms pulses and up to $28\text{ kW}/\text{cm}^2$ for low power continuous lasers.

Surface Absorbers for High Power Lasers and Long Pulses

The traditional surface absorbers have a much lower damage threshold at $> 1000\text{ W}$, where they can damage at $2\text{-}3\text{ kW}/\text{cm}^2$. Ophir has developed coatings that improve the damage threshold for high power lasers. These coatings are denser and have higher heat conductivity than previous coatings. This LP2 coating also has a much higher damage threshold for long pulses reaching power damage thresholds of up to $10\text{ kW}/\text{cm}^2$ and $300\text{ J}/\text{cm}^2$ for 10ms pulses. Surface absorbers are suitable for pulses longer than $\sim 100\mu\text{s}$.

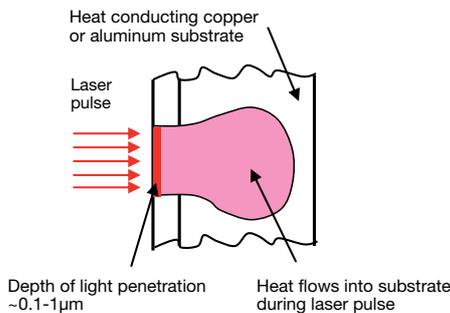
Surface vs. Volume Absorbers

When measuring a laser with short pulses of tens of μs or less, the heat is deposited in a short time and cannot flow during the pulse (see illustration B). Therefore a surface

absorber which absorbs the energy in a thin surface layer is not suitable. All the energy is deposited in a thin layer and that layer is vaporized. In this case, volume absorbers are used. These have traditionally consisted of a neutral density glass thermally bonded to a heat-conducting metallic substrate. The ND glass absorbs the light over a depth of 1-3 mm instead of fractions of a micrometer. Consequently, even with short pulses where there is no heat flow, the light and heat are deposited into a considerable depth of material and therefore the power/energy meter with a volume absorber is able to withstand much higher energy densities – up to 10 Joules/cm² (see illustration C). These ND glasses form the basis of the Ophir P type absorbers. In addition to the P absorbers, Ophir has PF and SV absorbers that can stand up to higher average powers and power densities as well as EX absorbers for the UV.

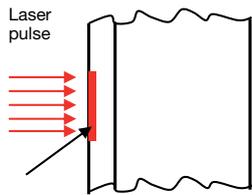
Long laser pulse (>100µs) or continuous

(A) Surface absorber

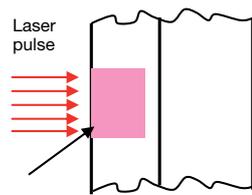


Short laser pulse <10µs

(B) Surface absorber



(C) Volume absorber

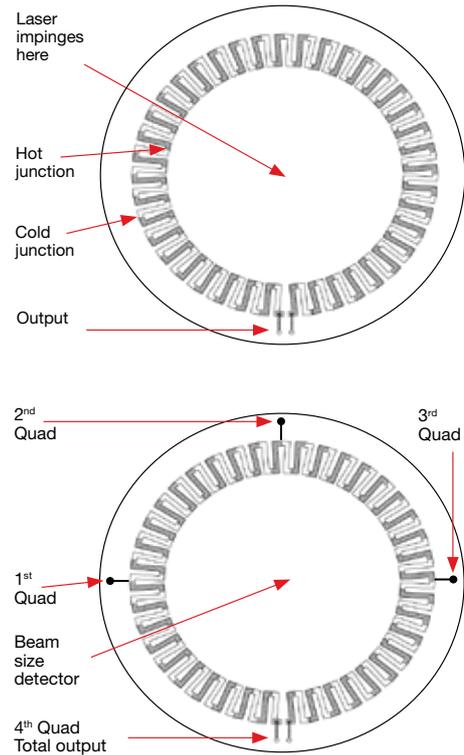


Surface absorbers work best when measuring power or energy for long laser pulses (A). Volume absorbers can measure pulses with much higher energies than surface absorbers (B), (C) can measure.

BeamTrack Power / Position / Size sensors

The BeamTrack Thermal sensors can measure beam position and beam size as well as power. This innovative device provides an additional wealth of information on your laser beam – centering, beam position and wander, beam size as well as power and single shot energy. The BeamTrack sensor is illustrated schematically here and works as follows: the signal coming from the sensor is now divided into 4 quadrants so by measuring and comparing the output from the 4 sections we can determine the position of the center

of the beam to a high degree of accuracy. In addition to the 4 quadrants, there is now a special proprietary beam size detector. After processing outputs from these various detectors, the user is presented with the beam position as well as beam size. Note that the beam size is calibrated only for a Gaussian beam of >3mm but for other beams it will give relative size information and will indicate if the beam is changing size. For more information on the BeamTrack sensors, please see section 1.1.3.



Calorimetric sensors

Ophir's calorimetric sensors are water cooled sensors which use the water flow rate and the temperature difference between the sensor's inlet (or measurement unit) and the sensor's outlet (or measurement unit) to calculate the power. The response of the detector is almost independent to beam size if the beam is properly set according to the sensor's spec.

Calibration

At Ophir's ISO/IEC 17025:2017 accredited laboratory each thermopile sensor is calibrated in a two-stage process against a NIST calibration standard. In the first stage, the responsivity of the sensor is measured and stored and in the second stage, the calibration is tested using several lasers to ensure the accuracy of the first stage. The total measurement uncertainty, expressing the accuracy of the sensor under regular operating conditions and the calibration uncertainty, which defines the uncertainty of the final calibration stage (comparing against a NIST master using lasers) are given in the specifications of each sensor.

Introduction to High Power Water Cooled Sensors

Ophir has many years of experience in supplying measurement systems for high power industrial lasers and has the highest power measuring equipment available on the market – up to 120 kilowatts. Ophir meters also have the highest damage threshold available – up to 10kW/cm² at 10kW. Ophir supplies water cooled sensors from 250W up to 120kW (and air-cooled sensors up to 1100W).

Sensors supplied by Ophir are tested at up to full power and their linearity verified over the entire power range. This is done by measuring the reading over the power range against a higher power sensor that has been previously measured and verified by NIST or PTB. The accuracy, linearity and damage specifications have been carefully verified over many years of development and use by the largest existing user base. In cases of unique and/or extreme user parameters (such a sultra high-power levels, pulse energies, unique beam profiles) Ophir has advanced simulation capabilities both thermal and optical to validate the functionality of its sensors. In addition to power meters for high powers, Ophir also has beam profilers, beam dumps and protective enclosures for industrial lasers.

Calibration Method and Estimated Accuracy for Ophir High Power Sensors

Ophir high-power sensors (models 5000W, 10K-W, IPM-10KW, 15K-W, 20K-W, Comet 10K, 30K-W, 120K-W and 150K-W) are ordinarily calibrated using moderate-power lasers, not exceeding 6000W (though in certain cases, sensors can be calibrated at up to 15,000W). In other words, we calibrate high-power sensors using laser powers that are in many cases much lower than the power rating of the sensors being calibrated. This raises the question of calibration accuracy. The following brief explanation will clarify how we know that these highest power sensors are indeed accurate to $\pm 5\%$ over their entire measurement range as specified.

Basing high-power calibration accuracy on lower power calibration measurements is valid, subject to the condition that the sensors are linear all across the full power range.

The calibration measurements themselves (using the moderate-power lasers) are all based on NIST-calibrated master references.

At the lower powers, the reference sensors are based on Photodiode detectors; Photodiode detectors are well known to be highly linear.

At the higher powers, Thermal sensors are used as the reference. A series of detailed tests have confirmed that indeed these sensors are highly linear, all the way up to the highest powers for which they are rated.



Since the Thermal sensors have been shown to be linear over the entire range of powers, it follows that if the calibration is correct at low powers, it will remain correct at high powers as well.

Some additional points:

- An additional issue is zero offset; although the output may be linear at low powers, there may be a zero offset that, due to the relatively low output at low powers, will cause an error in calibration. For example, if calibration is performed at 200W and the output of the sensor is 10 μ V/W (a typical value) and there is a zero offset of only 1 μ V, this will cause a calibration error of 10%. Ophir's calibration method includes measuring the difference between the reading with power applied and without power applied, thus eliminating error due to zero offset. This measurement is taken several times to insure accuracy.
- The above measurement method assures that the calibration inaccuracy due to measurement errors is less than 1%, comparable to the expected errors in our lower powered sensors. In order to verify this, all of our high power sensors have been measured by comparison to various calibration standards. These measurements have shown Ophir sensors to be well within the claimed limits of linearity.
- The Comet 10K series measures the heat rise of the absorbing puck when irradiated by the laser for 10s. In order to calibrate the Comet 10K, we simply irradiate with a lower power laser for longer e.g. 150W for 60s. Thus the heating effect is similar to that of a higher power laser. Tests of the Comet calibrated by this method vs. NIST traceable high power sensors have shown that it is accurate and reproducible.

For more information on calibration, please read tutorial on our website at www.ophiropt.com

Note regarding water cooling:

Most Ophir high power sensors are water cooled. Customers often have questions about our water cooled sensors such as the correct flow rate and pressure under various conditions and the quality of the water required. For further information on water cooled sensors, please see our tutorial on the subject on our website <http://www.ophiropt.com>

Photodiode Sensors

A Photodiode sensor is a semiconductor device that produces a current proportional to light intensity and has a high degree of linearity over a large range of light power levels - from fractions of a nW to about 2mW. Above that light level, corresponding to a current of about 1mA, the electron density in the Photodiode becomes too great and its efficiency is reduced causing saturation and a lower reading. Most Ophir PD sensors have a built-in filter that reduces the light level on the detector and allows measurement up to 30mW without saturation. Most sensors have an additional removable filter allowing measurement to 300mW or 3W depending on the model.

Principle of Operation

When a photon source, such as a laser, is directed at a Photodiode detector, a current proportional to the light intensity and dependent on the wavelength is created. Since many low power lasers have powers on the order of 5 to 30mW, and most Photodiode detectors saturate at about 2mW, the PD300 sensor has been constructed with a built-in filter so the basic sensor can measure up to 30mW without saturation. With the removable extra filter, the PD300 sensors series can measure up to 300mW or 3W depending on the model.

The Ophir power meter unit amplifies this signal and indicates the power level received by the sensor. Due to the superior circuitry of the Ophir power meters, the noise level is very low and the PD300 series sensors with Ophir power meter have a large dynamic range from picowatts to watts. The PD300 is shown schematically below. The PD300 and PD300-1W have the exclusive patented dual

detectors connected back to back which eliminate any signal illuminating both detectors equally (background light).

Calibration and Accuracy

The sensitivity of various photodiode sensors varies from one sensor to another as well as with wavelength. At Ophir's ISO/IEC 17025:2017 accredited laboratory each photodiode sensor is calibrated in a two-stage process against a NIST photodiode calibration standard. In the first stage the photodiode is calibrated using a monochromator over its entire spectral range, and in the second stage the calibration is tested using several lasers to ensure the accuracy of the first stage. As an example, total measurement uncertainty of $\pm 2\%$ (expressing the accuracy of the sensor under regular operating conditions) is achieved for PD300-UV at 420-980nm. The Calibration Uncertainty, which defines the uncertainty of the final calibration stage (comparing against a NIST master using lasers) is given in the following table:

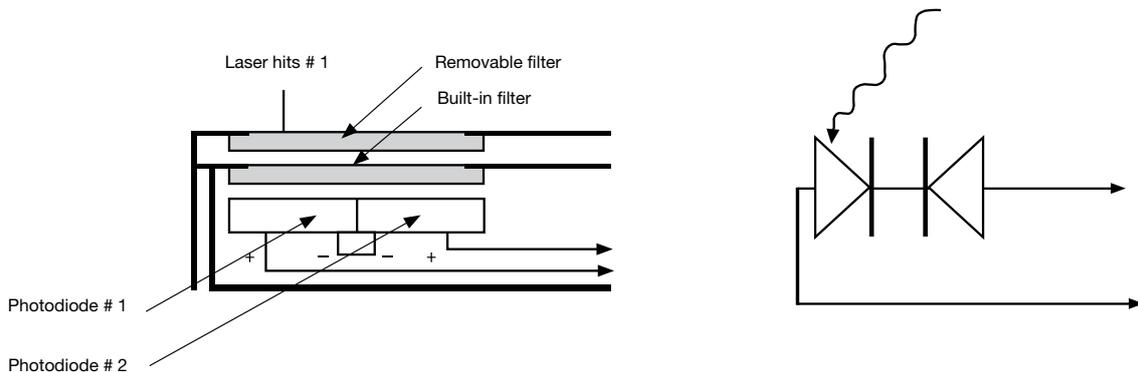
	UV & VIS Photodiode Sensors	IR Photodiode Sensors	Radiometric Sensors (PD300RM)
Calibration Uncertainty	200 to 300nm 3.2% 300 to 430nm 1.65% 430 to 1000nm 1.1% 1035 to 1065nm 4.3%	700 to 1430nm 2.4% 1430 to 1600nm 2.6%	250 to 300nm 4.5% 300 to 400nm 3.6% 400 to 1000nm 3.4%

Photodiode detectors are linear by nature, and as long as they are not operated close to saturation, measurement errors due to non-linearity can be ignored.

For more information on calibration accuracy please see our tutorial on our website:

www.ophiropt.com

All Ophir power and energy sensors come with a mounting stand.



1.1.1 Photodiode Power Sensors

1.1.1.1 Standard Photodiode Sensors

50pW to 3W

Features

- Very large dynamic range
- Swivel mount for hard to measure places
- Comes with filter in / filter out options
- Patented automatic background subtraction
- Fiber optic adapters available

PD300 with filter off



PD300 with filter installed



Model	PD300			PD300-1W			PD300-3W			PD300-TP		
Use	General			Powers to 1W			Powers to 3W			Thin profile for tight fit		
Detector Type	silicon			silicon			silicon			silicon		
Aperture	10x10mm			10x10mm			10x10mm			10x10mm		
Calibration Uncertainty ±%	1.1 430-1000nm ^(b)			1.1 430-1000nm ^(b)			1.1 430-1000nm ^(b)			1.1 430-1000nm ^(b)		
Filter Mode	Filter out	Filter in		Filter out	Filter in		Filter out	Filter in		Filter out	Filter in	
Spectral Range nm	350-1100	430-1100		350-1100	430-1100		350-1100	430-1100		350-1100	400-1100	
Power Range	500pW to 30mW	2μW to 300mW		500pW to 30mW	2μW to 1W		5nW to 100mW	2μW to 3W		50pW to 3mW	2μW to 1W	
Power Scales	30mW to 30nW and dBm	300mW to 300μW and dBm		30mW to 30nW and dBm	1W to 300μW and dBm		100mW to 300nW and dBm	3W to 300μW and dBm		3mW to 3nW and dBm	1W to 300μW and dBm	
Resolution nW	0.01	NA		0.01	NA		0.1	NA		0.001	1	
Maximum Power vs. Wavelength	nm	mW	mW	nm	mW	mW	nm	mW	mW	nm	mW	mW
	<488	30	300	<488	30	1000	<488	100	3000	350-400	3	NA
	633	20	300	633	20	1000	633	100	3000	400-500	3	1000
	670	13	200	670	13	1000	670	100	2000	600	2.5	1000
	790	10	100	790	10	600	790	100	1200	700	2	500
	904	10	100	904	10	700	904	100	1200	800-950	1.5	300
1064	25	250	1064	25	1000	1064	100	2200	1064	3	500	

Accuracy (including errors due to temp. variations)

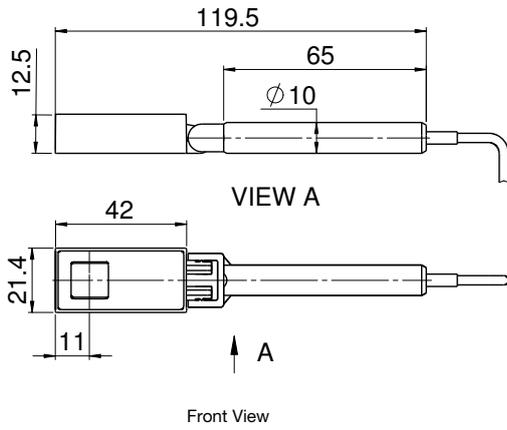
% error vs Wavelength nm	±10 360-400	NA	±10 360-400	NA	±10 360-400	NA	±7 350-400	NA	
	±3 400-980	±5 430-980	±3 400-950	±5 430-950	±3 400-950	±5 430-950	±3 400-450	±5 400-450	
	±5 980-1100	±7 980-1100	±4 950-1030	±6 950-1030	±4 950-1030	±6 950-1030	±2 450-950	±3 450-950	
			±6 1030-1100	±7 1030-1100	±6 1030-1100	±7 1030-1100	±6 950-1100	±7 950-1100	
Damage Threshold W/cm ²	10	50	10	10 ^(a)	10	30	10	50	
Max Pulse Energy μJ	3	30	3	200	30	400	1	100	
Noise Level for filter out pW	20		20		200		±2		
Response Time with Meter s	0.2		0.2		0.2		0.2		
Beam Position Dependence	±2%		±2%		±2%		±3%		
Background Subtraction	95-98% of background is cancelled automatically under normal room conditions, even when changing continuously					N.A.		N.A.	
Fiber Adapters Available (see page 33)	ST, FC, SMA, SC		ST, FC, SMA, SC		ST, FC, SMA, SC		N.A.		
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS		
Version					V1				
Part Number	7Z02410		7Z02411A		7Z02426		7Z02424		

Notes: (a) Maximum power density above which sensor may not read correctly. There will be no permanent damage until 50W/cm²
 (b) For calibration uncertainty of wavelengths outside of this range see table on page 24

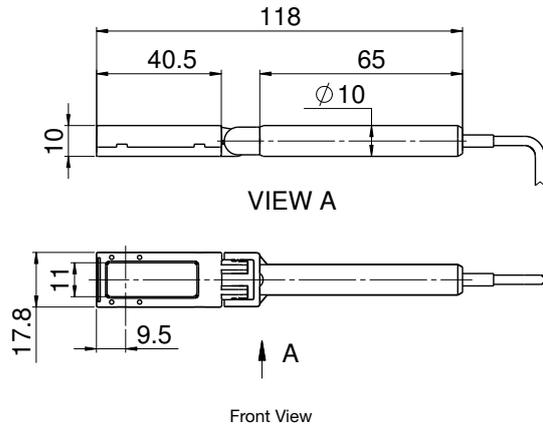
* For graphs see page 31-32

* For drawings please see page 26

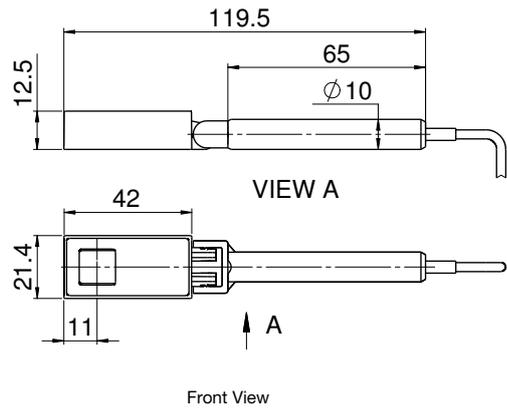
PD300 / PD300-1W filter installed



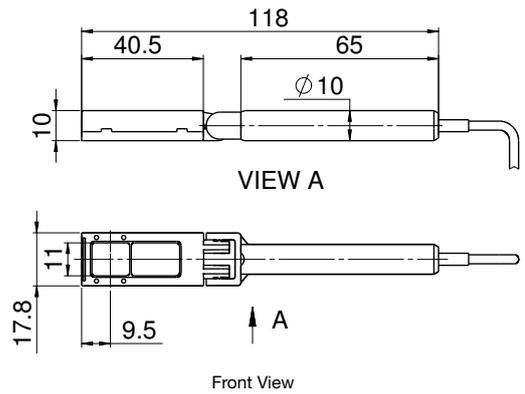
PD300 / PD300-1W filter off



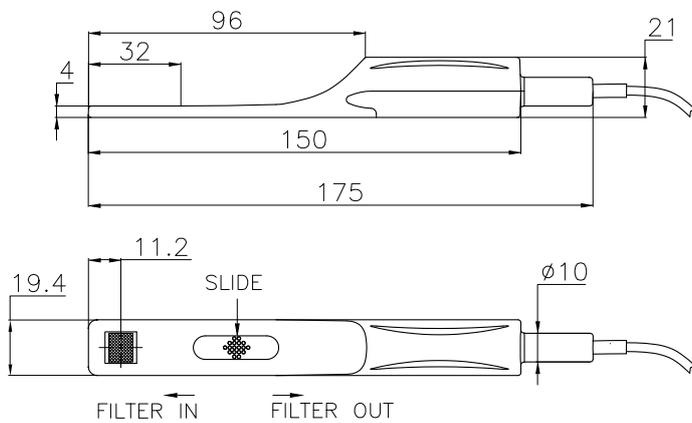
PD300-3W filter installed



PD300-3W filter off



PD300-TP



1.1.1.1 Standard Photodiode Sensors

20pW to 300mW

Features

- Spectral range including UV and IR
- Very large dynamic range
- Swivel mount for hard to measure places
- Comes with filter in / filter out options
- Fiber optic adapters available



Model	PD300-UV/ PD300-UV-193			PD300-IR			PD300-IRG		
Use	Lowest powers from 200-1100nm			Low powers from 700-1800nm			Telecom wavelength fiber and free space measurements		
Detector Type	silicon			Germanium			InGaAs		
Aperture	10x10mm			Ø5mm			Ø5mm for free space beams		
Calibration Uncertainty ±%	1.1 430-1000nm ^(c)			2.4 700-1430nm ^(c)			2.4 900-1430nm ^(c)		
Filter Mode	Filter out		Filter in	Filter out		Filter in	Filter out		Filter in
Spectral Range nm	200 - 1100		220 - 1100	700-1800		700-1800	900 - 1630		950 - 1630
Power Range	20pW to 3mW		2µW to 300mW	5nW to 30mW		2µW to 300mW	20pW to 800µW		1µW to 200mW
Power Scales	3mW to 3nW and dBm		300mW to 300µW and dBm	30mW to 30nW and dBm		300mW to 300µW and dBm	800 µW to 800pW and dBm		300mW to 30µW and dBm
Resolution nW	0.001		100	0.01		NA	0.0001		1
Maximum Power vs. Wavelength	nm	mW	mW	nm	mW	mW	nm	mW	mW
	250 - 350	3	300	800	12	120	<1000	0.8	200
	400	3	300	1000-1300	30	300	1100	0.8	200
	600	3	300	1400	30	250	1200	0.8	200
	800 - 950	2.5	150	1500	30	100	1300	0.8	200
1064	3	300	1600	30	100	1550	0.8	200	
>1600			1800	30	300	>1600	0.8	200	

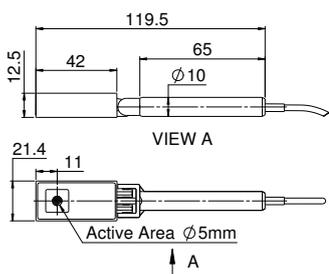
Accuracy (including errors due to temp. variations)

% error vs Wavelength nm ^(b)	±10	200-230	±10	220-300	±5	700-800	±6	700-900	±3	1000-1600	±6	1000-1600
	±7	230-300	±4	300-420	±4	800-1700	±5	900-1700	±5 ^(a)	900-1000 & 1600-1630	±8 ^(a)	900-1000 & 1600-1630
	±3	300-420	±3	420-980	±7	1700-1800	±9	1700-1800				
	±2	420-980	±7	980-1100								
	±7	980-1100										
Damage Threshold W/cm ²	10		50	10		50	5		50			
Max Pulse Energy µJ	1		50	0.75		2	1		100			
Noise Level for filter out pW	±1			200			±300fW at 1550 nm and 1s average					
Response Time with Meter s	0.2			0.2			0.2					
Beam Position Dependence	±2%			±2%			±1% over 80% of aperture					
Fiber Adapters Available (see page 33)	ST, FC, SMA, SC			ST, FC, SMA, SC			FC, FC/APC, SMA					
Compliance	CE, UKCA, China RoHS			CE, UKCA, China RoHS			CE, UKCA, China RoHS					
Version							V2					
Part Number	7Z02413/7Z02413A ^(a)			7Z02412			7Z02495					

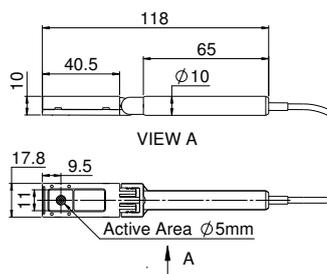
Notes: (a) Assuming temperature range between 18-26 degrees – outside of this range add additional error per temperature dependence graph
 (b) Same as above with additional calibration point at 193nm accuracy ±6%
 (c) For calibration uncertainty of wavelengths outside of this range see table on page 24

* For graphs see page 31-32

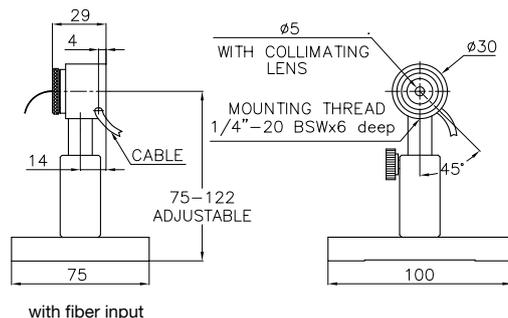
PD300-UV / PD300-IR filter installed (Ø5mm for PD300-IR only)



PD300-UV / PD300-IR filter off (Ø5mm for PD300-IR only)



PD300-IRG



1.1.1.2 Round Photodiode Sensors

20pW to 3W

Features

- Round geometry for easy centering
- Threaded to fit standard SM1 bench equipment
- Same performance as standard PD300 sensors
- Comes with removable filter as standard
- • Fiber optic adapters available

PD300R Filter Off



PD300R Filter installed



Model	PD300R		PD300R-3W		PD300R-UV		PD300R-IR				
Use	General		Powers to 3W		Lowest powers from 200-1100nm		IR wavelengths 700-1800nm				
Detector Type	silicon		silicon		silicon		Germanium				
Aperture	Ø10mm		Ø10mm		Ø10mm		Ø5mm				
Calibration Uncertainty ±%	1.1 430-1000nm ^(a)		1.1 430-1000nm ^(a)		1.1 430-1000nm ^(a)		2.4 700-1430nm ^(a)				
Filter Mode	Filter out	Filter in	Filter out	Filter in	Filter out	Filter in	Filter out	Filter in			
Spectral Range nm	350-1100	430-1100	350-1100	430-1100	200 -1100	220 -1100	700-1800	700-1800			
Power Range	500pW to 30mW	2µW to 300mW	5nW to 100mW	2µW to 3W	20pW to 3mW	2µW to 300mW	5nW to 30mW	2µW to 300mW			
Power Scales	30mW to 30nW and dBm	300mW to 300µW and dBm	100mW to 300nW and dBm	3W to 300µW and dBm	3mW to 3nW and dBm	300mW to 300µW and dBm	30mW to 30nW and dBm	300mW to 300µW and dBm			
Resolution nW	0.01		0.1		0.001		0.01				
Maximum Power vs. Wavelength	nm	mW	nm	mW	nm	mW	nm	mW			
	<488	30	300	<488	100	3000	250 - 350	3	300		
	633	20	300	633	100	3000	400	3	300		
	670	13	200	670	100	2000	600	3	300		
	790	10	100	790	100	1200	800 - 950	2.5	150		
	904	10	100	904	100	1200	1064	3	300		
	1064	25	250	1064	100	2200			1800	30	300

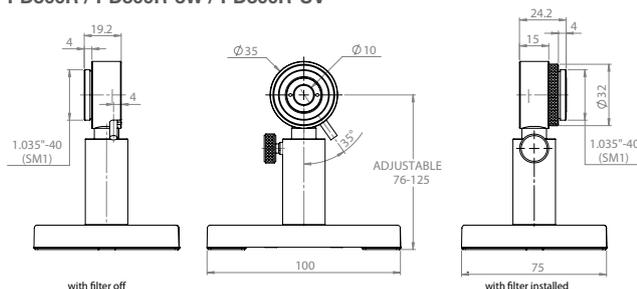
Accuracy (including errors due to temp. variations)

% error vs Wavelength nm	±10	360-400	NA	±10	360-400	NA	±10	200-230	±10	220-300	±5	700-800	±6	700-900
	±3	400-980	±5	430-980	±3	400-950	±5	430-950	±7	230-300	±4	300-420	±4	800-1700
	±5	980-1100	±7	980-1100	±4	950-1030	±6	950-1030	±3	300-420	±3	420-980	±7	1700-1800
				±6	1030-1100	±7	1030-1100	±2	420-980	±7	980-1100			
Damage Threshold W/cm ²	10		50	10		30		10		50		10		50
Max Pulse Energy µJ	3		30	30		400		1		50		0.75		2
Noise Level for filter out pW	20		200		±1		200							
Response Time with Meter s	0.2		0.2		0.2		0.2							
Beam Position Dependence	±2%		±2%		±3%		±2%							
Fiber Adapters Available (see page 33)	ST, FC, SMA, SC		ST, FC, SMA, SC		ST, FC, SMA, SC		ST, FC, SMA, SC							
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS							
Version														
Part Number: Standard Sensor	7Z02436		7Z02437		7Z02438 (1.5m cable)		7Z02439							
Sensor with different cable length					7Z02438C (10m cable)									

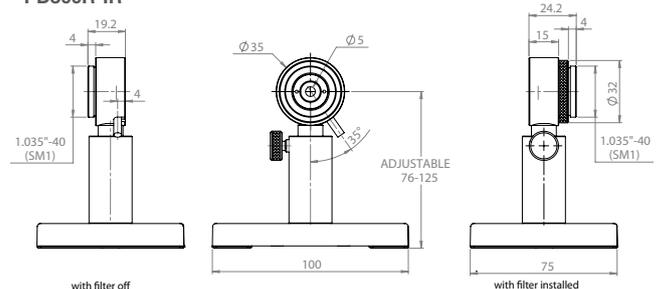
Note: (a) For calibration uncertainty of wavelengths outside of this range see table on page 24

* For graphs see page 31-32

PD300R / PD300R-3W / PD300R-UV



PD300R-IR



1.1.1.3 Special Photodiode Sensors

3µW to 1W

Features

- PD300-MS for measurement of optical intensity after the microscope objective.
- Low angular dependence for high N.A. objectives.
- Can be used with air, water or oil immersion objectives.

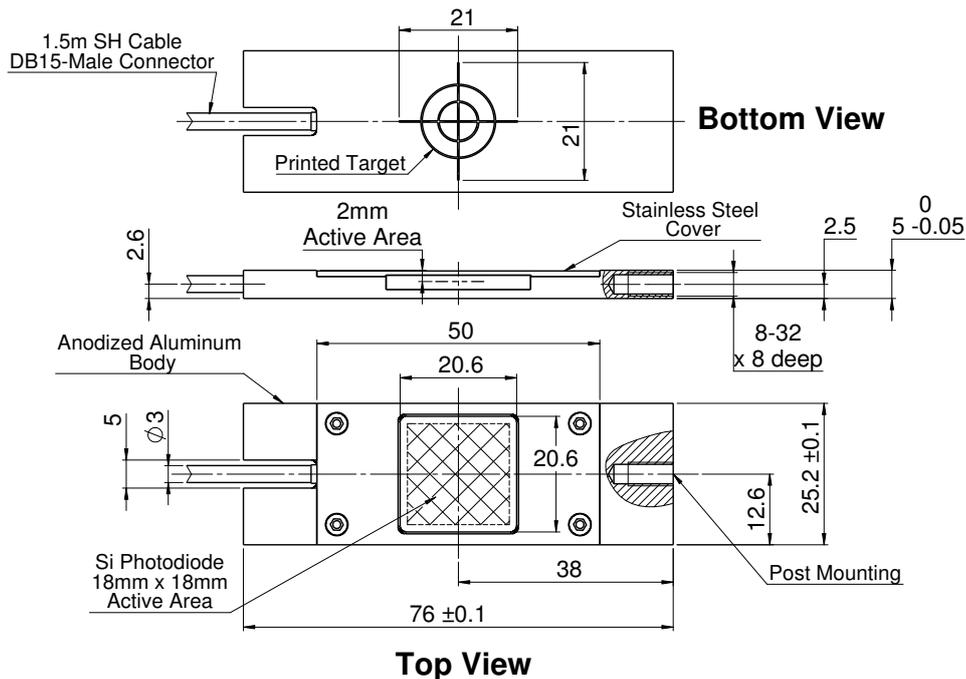
PD300-MS



Model	PD300-MS	
Use	Measurement of light intensity at microscope slide plane	
Detector Type	Silicon with filter	
Aperture	18x18mm	
Spectral Range nm	350-1100	
Power Range	3µW to 1W (see wavelength dependency below)	
Power Scales	100µW to 1W and dBm	
Resolution µW	0.1	
Calibration Uncertainty ±%	1.1 430-1000nm ^(b)	
Maximum Power vs. Wavelength	Wavelength, nm	Power Range
	350 - 650	6µW to 1W
	650 - 800	3µW to 800mW
	800 - 1000	3µW to 600mW
Accuracy (including errors due to temp. variations)	>1000	6µW to 700mW
	±7 350 - 400	
% error vs Wavelength nm ^(a)	±5 400 - 1100	
Linearity	1%	
Additional Error with Converging Beam	3% for N.A. 0.9	
Damage Threshold W/cm ²	20	
Noise Level	300nW at 350nm, 150nW at 960nm	
Response Time with Meter s	0.2	
Compliance	CE, UKCA, China RoHS	
Version		
Part Number	7Z02482	

Note: (a) For beam centered on sensor ±2 mm
 (b) For calibration uncertainty of wavelengths outside of this range see table on page 24

PD300-MS



1.1.1.3 Special Photodiode Sensors

Features

- PD300-BB for broadband light sources - radiometry (PD300-BB-50mW option up to 50mW)
- PD300-CIE for human visual perception Lux measurements
- BC20 for measuring scanned beams such as bar code light sources



Model	PD300-BB	PD300-BB-50mW	PD300-CIE ^(a)	BC20
Use	Radiometry-broad spectrum	Same as PD300-BB with removable attenuator for use to 50mW	Eye adjusted measurement in Lux	Scanned beams e.g. bar code with continuous wavelength curve
Detector Type	Silicon with special filter	Silicon with special filter	Silicon with special filter	Silicon with peak and hold circuit
Aperture	10x10mm	10x10mm	Active area 2.4 x 2.8mm	10x10mm
Spectral Range nm	430 - 1000 (see graph)	430 - 1000 (see graph)	400 - 700 (see graph)	400 - 1100 (see graph) ^(c)
Calibration Uncertainty $\pm\%$	1.1 430-1000nm ^(d)	1.1 430-1000nm ^(d)	NA	NA
Filter Mode		Filter out	Filter in	
Power Range	50pW to 4mW	50pW to 4mW	1nW to 50mW	20mLux to 200kLux
Power Scales	4mW to 8nW and dBm	4mW to 8nW and dBm	50mW to 80nW and dBm	200kLux to 200mLux
Resolution	1pW	1pW	10pW	1mLux
Accuracy	Maximum deviation from flat spectrum (see graph) $\pm 10\%$	Maximum deviation from flat spectrum (see graph) $\pm 10\%$	Maximum deviation from flat spectrum (see graph) 430-910nm, $\pm 12\%$ flatness (see graph)	$\pm 3\%$ for $>10\%$ of full scale. Deviation from calibration -3% at 30,000 inch/s scan rate on sensor
Damage Threshold W/cm ²	10	10	100	10
Max Pulse Energy μ J	1	1	10	1
Noise Level pW	2	2	30	± 1 mLux
Response Time with Meter s	0.2	0.2	0.2	0.2
Beam Position Dependence	$\pm 2\%$ for broadband light sources	$\pm 2\%$ for broadband light sources	$\pm 3\%$ for broadband light sources	NA – source overfills detector
Background Subtraction	NA	NA	NA	NA
Fiber Adapters Available (see page 33)	NA	ST, FC, SMA, SC	NA	NA
Compatible Meter / Interface	All Meters & Interfaces	All Meters & Interfaces	Centauri, StarBright, Vega, Nova II, Juno, Juno+, Juno-RS, LaserStar and Nova	StarBright, Vega, Nova II, Juno, Juno+, LaserStar and Nova
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version				V1
Part Number	7Z02405	7Z02440	7Z02406	7Z02481 ^(b)

Notes: (a) The PD300-CIE sensor is not under ISO/IEC 17025:2017 accreditation

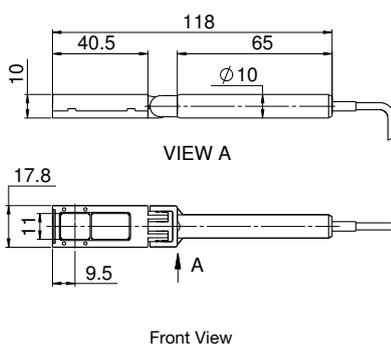
(b) Swivel stand for BC20 sensor P/N 1Z09004

(c) The user can select up to 5 wavelengths from the spectral range. When used with the Nova or LaserStar meters, the sensor will only have the discrete wavelengths 405nm, 633nm, 650nm, 675nm and 780nm

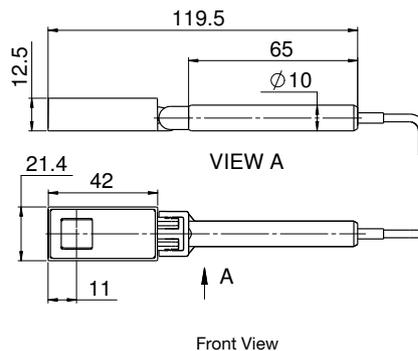
(d) For calibration uncertainty of wavelengths outside of this range see table on page 24

* For graphs see page 31-32

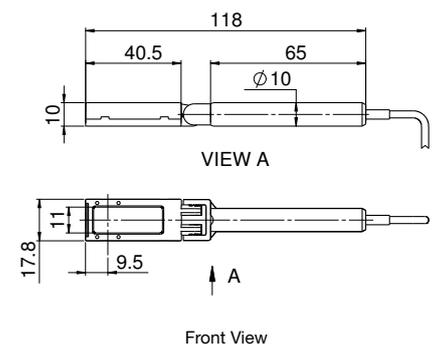
PD300-CIE / PD300-BB / PD300-BB-50mW with filter off



PD300-BB-50mW with filter installed

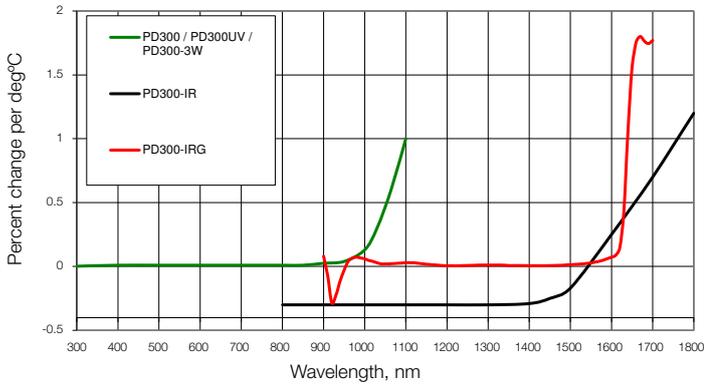


BC20

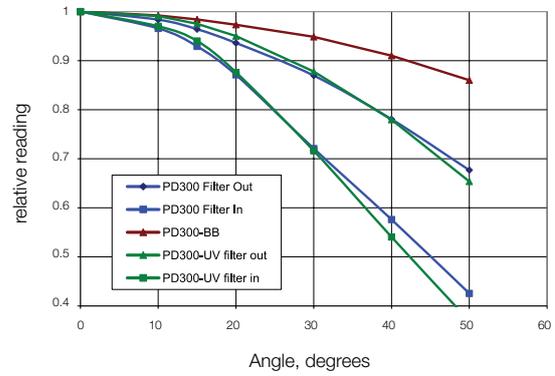


1.1.1.4 Graphs

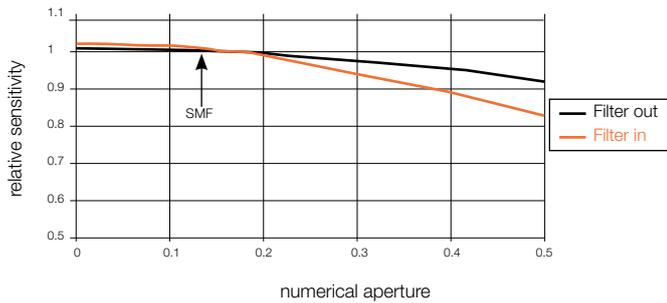
Temperature Coefficient of Sensitivity



PD300 Angle Dependence

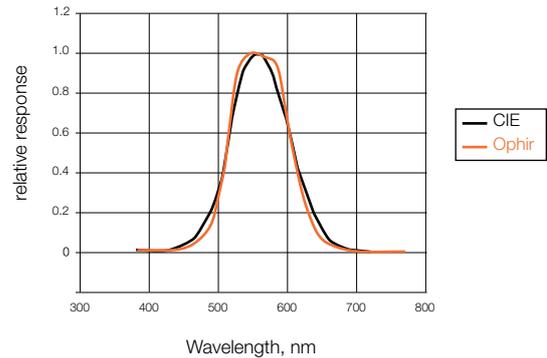


Dependence of Sensitivity on Numerical Aperture (PD300 - IRG)

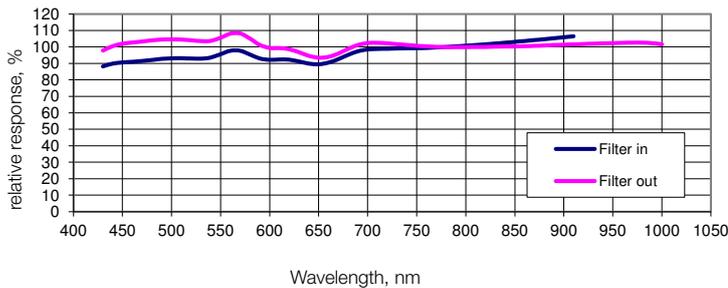


- Note:
1. Graph assumes equal intensity into all angles up to maximum N.A.
 2. Calibration is done with SMF, N.A. 0.13

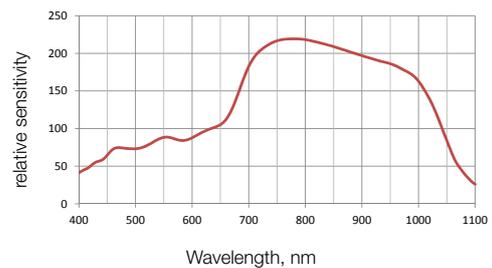
PD300-CIE Spectral Response vs. CIE Curve



Typical Sensitivity Curve of PD300-BB Sensors



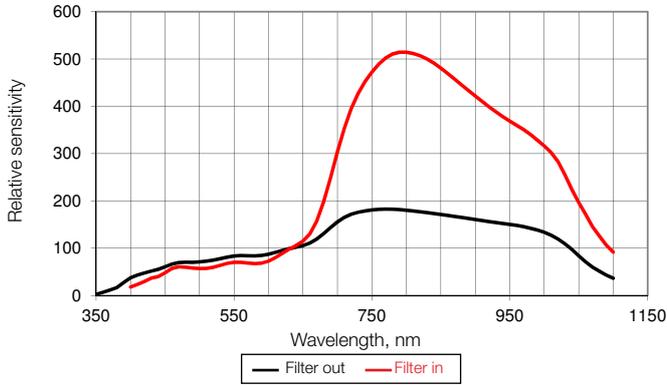
BC20 Relative Spectral Response



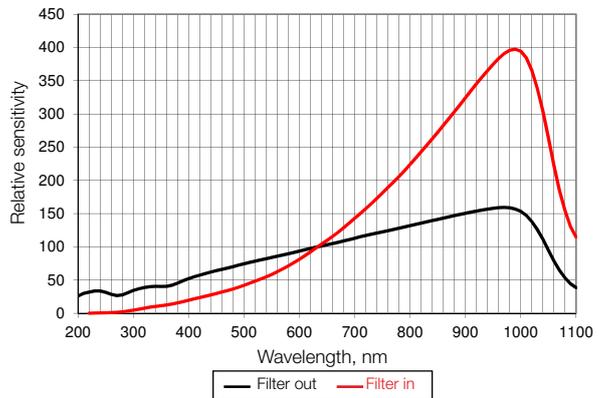
Approximate Spectral Response

Relative to 633nm or 1550nm

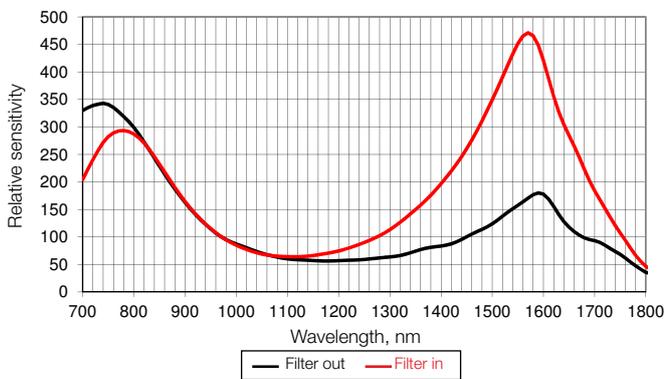
PD300 / PD300R



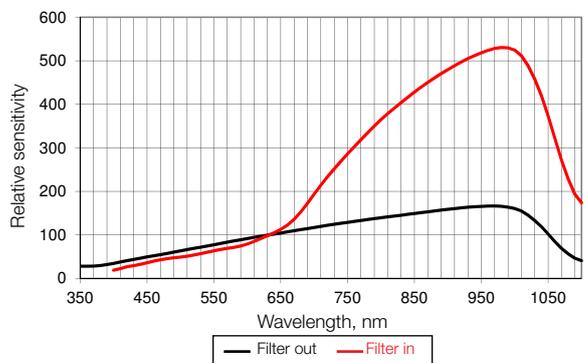
PD300-UV / PD300R-UV



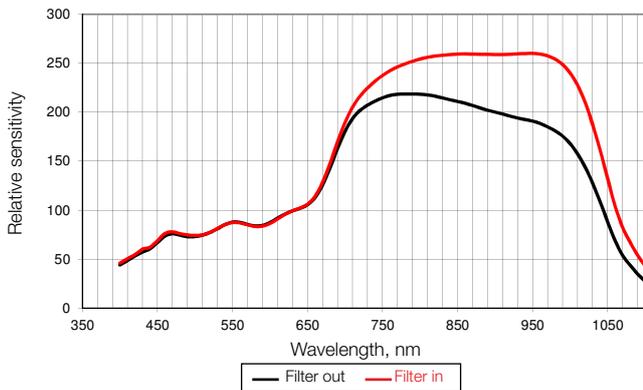
PD300-IR / PD300R-IR



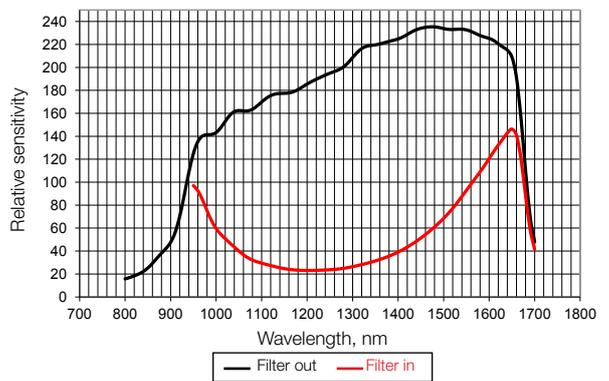
PD300-TP



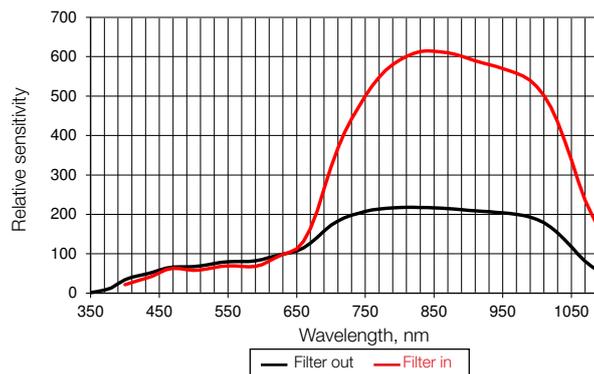
PD300-3W / PD300R-3W



PD300-IRG



PD300-1W



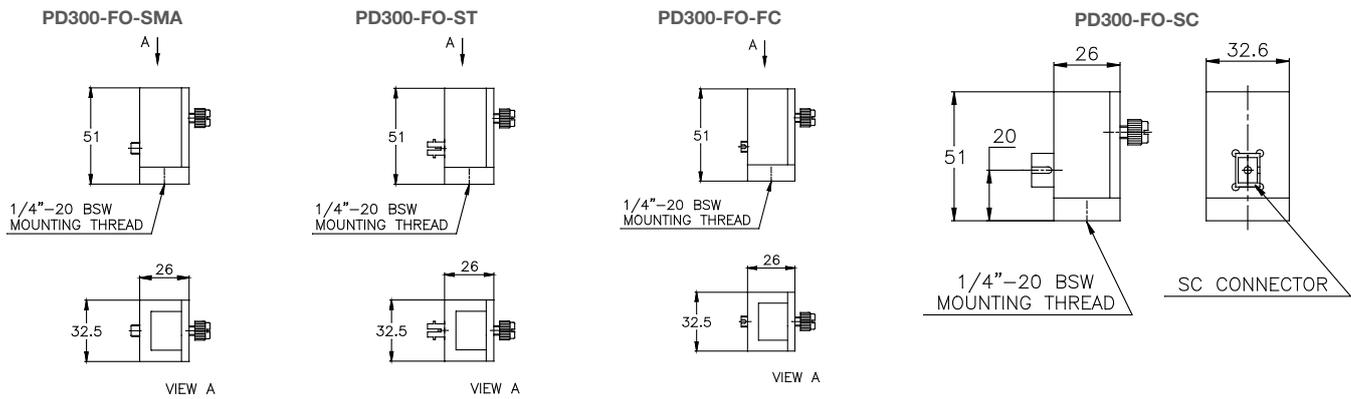
1.1.1.5 Accessories for Photodiode Sensors

Fiberoptic Adapters and Other Accessories

Accessories and Fiberoptic Adapters for PD300 series

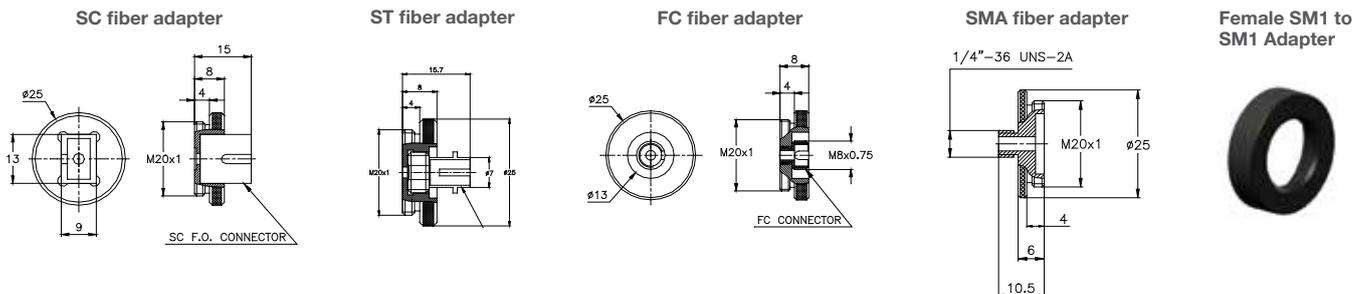
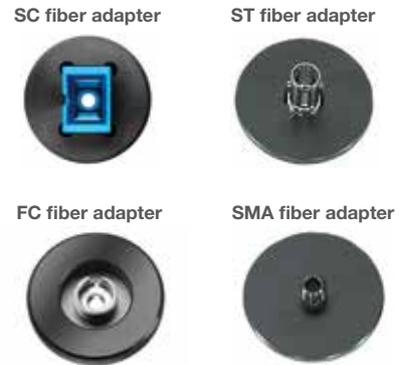
Accessory	Description	Part number			
PD300-CDRH-7mm	Ø7mm aperture adapter for CDRH measurements for PD300	7Z02418			
PD300-CDRH-3.5mm	Ø3.5mm aperture adapter for CDRH measurements for PD300	7Z08336			
Fiber Adapters for Sensor Series	Adapters for mounting fibers to PD300 sensors as shown below	SC type	ST type	FC, FC / APC type	SMA type
PD300 Series		7Z08221	7Z02210	7Z02213	7Z02212

PD300 with F.O. Adapter Mounted



Accessory	Description	Part number			
PD300R-CDRH-7mm	Ø7mm aperture adapter for CDRH measurements for PD300R	7Z08347			
Fiber Adapters for Sensor Series	Fiber adapter mounting bracket (1 bracket fits all fiber adapters)	SC type	ST type	FC, FC / APC type	SMA type
FPS Series	1G02259 - not needed except for FPS-1	7Z08227	7Z08226	7Z08229	1G01236A
PD300R Series	1G02259	7Z08227	7Z08226	7Z08229	1G01236A
3A-IS / 3A-IS-IRG	7Z08213	7Z08227	7Z08226	7Z08229	1G01236A
IS-1-2W	7Z08331	7Z08227	7Z08226	7Z08229	1G01236A
PD300-IRG	not needed			7Z08216	7Z08222
Female SM1 to SM1 Adapter	For mounting PD300R series, PD300RM-UV & PD300RM-8W and FPS-1 sensors to SM1 optical components and systems				1G02260

Accessories and Fiberoptic Adapters for PD300R series, PD300-IRG, 3A-IS, IS-1-2W and FPD series



1.1.1.6 Integrating Spheres

Introduction

Ophir Integrating Sphere sensors are used for measuring divergent light sources such as LEDs, VCSELs and other lasers. Integrating sphere detectors are also used for measuring large beams that do not fit in a PD300 photodiode sensor. The light is introduced to the sphere through the input port, it is reflected many times by the highly reflecting diffuse coating on the inner wall of the sphere until it uniformly illuminates the inner surface of the sphere. A detector samples a small fraction of this light and thus can be used to measure the total power input into the sphere.

Ophir integrating spheres have a highly reflecting diffuse white coating for high efficiency and readings that are independent of beam size, position and divergence.

Diverging and Collimated Beams Measurement Considerations

Ophir Integrating Spheres can be used either with diverging or collimated beams as shown below. In order for an integrating sphere sensor to operate properly, the beam should never directly hit the detector and the detector should only see rays reflected from the wall. The diagram below shows how the sphere can be used with either a collimated or diverging beams. The unused port is closed with a reflective plug.

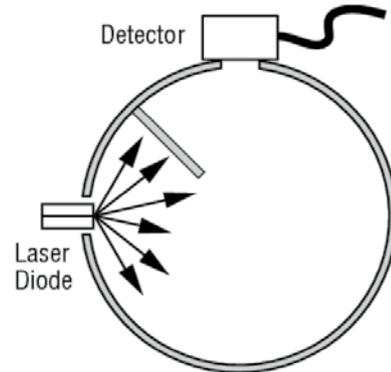
Ophir offers small spheres with 1" to 1.6" diameter and 5.3" spheres. Photodiode detectors provide calibrated power measurement of up to 30W between 200nm and 1800nm. Many accessories are available for Ophir Integrating Spheres such as fiber adapters and fast photodiode detectors for pulse shape monitoring. In order to maintain accuracy and guarantee performance, annual integrating sphere detector calibration is recommended.

Note that the system calibration is no longer valid if any component is changed from the original calibrated configuration.

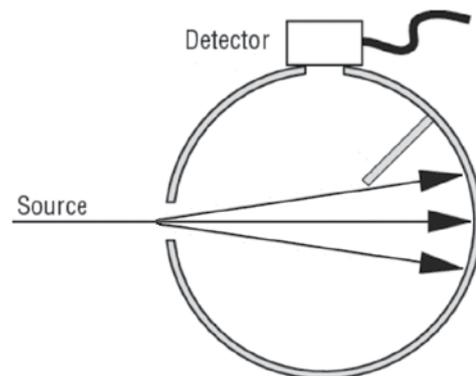
Related Product

Ophir also offers an integrating sphere sensor that has an FPD pulse characterization detector built in.

See our **IS1.5-VIS-FPD-800, 1.5" High Speed Response, Multi-functional Integrating Sphere** on page 36.



This integrating sphere configuration is ideal for a diverging beam



This integrating sphere configuration is ideal for a collimated beam

IS1.5-VIS-FPD-800 (see p. 36)



1.1.1.6 Integrating Spheres

1.1.1.6.1 Small Dimensions 1"-1.6"

500nW to 3W

Features

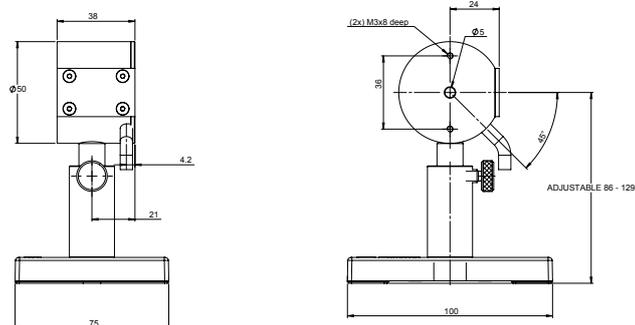
- Integrating sphere for divergent beams (LEDs, VCSELs, etc.)
- Up to Ø12mm aperture
- Fiber or free space input



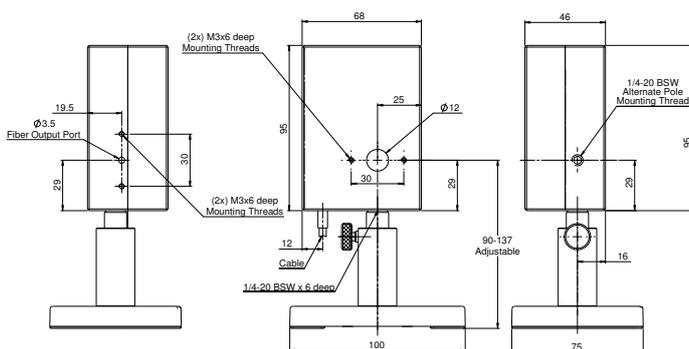
Model	IS-1-2W	3A-IS	3A-IS-IRG
Use	Divergent beams to 2W for UV to NIR	Divergent beams to 3W for visible and NIR	Divergent beams to 3W for IR
Detector Type	Si	Si	InGaAs
Input Port Aperture mm	Ø5mm	Ø12mm	Ø12mm
Spectral Range µm	0.22 - 1.1	0.35 - 1.1	0.8 - 1.7
Power Range	500nW – 2W	1µW – 3W	1µW – 3W
Power Scales	2W to 20µW and dBm	3W to 3µW and dBm	3W to 3µW and dBm
Calibration Uncertainty ±%	1.1 430-1000nm ^(b)	1.1 430-1000nm ^(b)	2.4 800-1430nm ^(b)
% Error vs Wavelength nm	±7 220-250 ±5 250-420 ±4 420-950 ±7 950-1100	±5 350-1000 ±10 1000-1100	±5
Linearity with Power ±%	1	1	1
Damage Threshold kW/cm ²	1 on integrating sphere surface	0.2 on integrating sphere surface	0.2 on integrating sphere surface
Maximum Pulse Energy µJ	600	100	500
Power Noise Level nW	20	20	20
Response Time with Meter s	0.2	0.2	0.2
Maximum Beam Divergence	±40 degrees for fan shaped beam, ±50 degrees for circular beam	±40 degrees	±40 degrees
Sensitivity to Beam Size and Angle	±2%	±2%	±2%
Cooling	convection	convection	convection
Fiber Adapters Available (see page 33)	ST, FC, SMA, SC	ST, FC, SMA ^(a) , SC	ST, FC, SMA ^(a) , SC
Weight kg	0.25	0.6	0.6
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		V1	
Part Number	7Z02484	7Z02404	7Z02403

Notes: (a) One fiber output port available with output = 2E-4 of input power/mm² of fiber area
(b) For calibration uncertainty of wavelengths outside of this range see table on page 24

IS-1-2W



3A-IS / 3A-IS-IRG

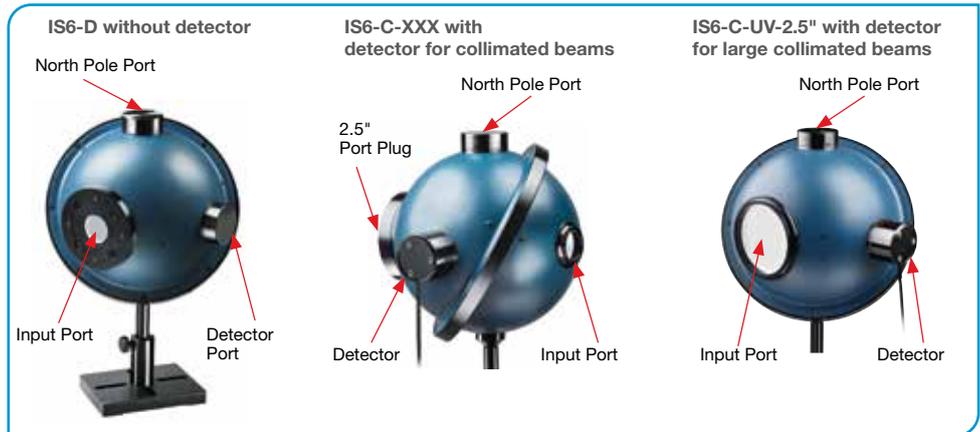


1.1.1.6 Integrating Spheres

1.1.1.6.4 Large Dimensions 5.3"

Features

- 4 port Integrating spheres for collimated and divergent beams (LEDs, VCSELs, etc.)
- Up to 170° acceptance angle
- Ø63.5mm (2.5") aperture
- Fiber or free space input
- Can be ordered with or without detectors



Model	IS6		
Use	For use with customer detector or as light source		
Detector	None – see below for detector versions		
Spectral Range μm	0.2 – 2.2		
Source Geometry ^(a) (see introduction)	Divergent		Collimated
Input Port Aperture mm	Ø63.5 ^(b)		Ø25
Maximum Beam Divergence deg°	± 60 ^(d)		± 15
Sensitivity to Beam Divergence $\pm\%$	3 ^(c)		1
Power Range	Depends on detector – see below		
Damage Threshold kW/cm^2	1 on integrating sphere surface		
Cooling	Convection		
Weight kg	1.4		
Type	P/N	Version	Compliance
IS6-D For divergent beams (input from 2.5" side)	7Z02487	V1	RoHS, China RoHS
IS6-C For collimated beams (input from 1" side)	7Z02474		RoHS, China RoHS
Supplied Port Accessories (see page 40)	IS6-D: 2.5" to 1" reducer w/cover + 1" port plug + 2 ea. 1" port covers IS6-C: 2.5" port plug + 3 ea. 1" port covers		

Notes: (a) In each configuration, the opposing port is closed with a port plug. See diagram in introduction page 34.
 (b) The sphere is supplied with the 2.5" to 1" reducer.
 (c) For beams up to 30deg divergence, variation with beam size is $\pm 1\%$.
 (d) For central 5mm of aperture, for 10mm aperture maximum beam divergence is $\pm 66^\circ$.

IS6 with Detectors for Collimated Beams - calibrated - VIS, UV & IR types

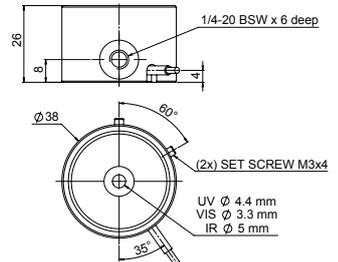
-Recommended for beam divergence $< 15^\circ$

-Comes with calibrated wavelength curve

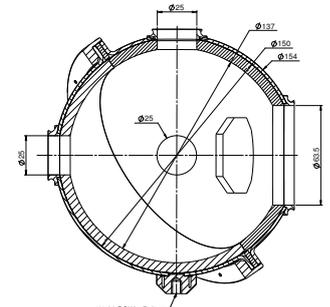
Model	IS6-C-VIS		IS6-C-UV		IS6-C-IR		IS6-C-UV-2.5"	
Detector type	VIS		UV		IR		UV	
Use	High powers		Low powers		Low powers		Large beams	
Type	Si with filter		Si		Germanium		Si	
Spectral Range μm	0.4 – 1.1		0.2 – 1.1		0.7 – 1.8		0.2 – 1.1	
Power Range (approx.)	20 μW to 30W		300nW to 1W		100 μW to 30W		300nW to 2W	
Power Scales	30W to 300 μW		1W to 3 μW		30W to 300 μW		2W to 3 μW	
Linearity with Power $\pm\%$	1							
Power Noise Level	1 μW		15nW		5 μW		15nW	
Calibration Uncertainty $\pm\%$	1.1 430-1000nm ^(b)		1.1 430-1000nm ^(b)		2.4 700-1430nm ^(b)		1.1 430-1000nm ^(b)	
Maximum Pulse Energy mJ	5		0.1		0.3		0.3	
Input Port Aperture mm	Ø25						Ø63.5	
Sensitivity to Beam Size %	± 1						± 1 ^(a)	
Maximum Power vs. Wavelength	nm	W	nm	W	nm	W	nm	W
	<670	30	<600	0.7	<1400	30	<600	1.5
	790	20	800-1000	0.3	1400-1650	15	800-1000	1
	904	15	1064	0.5	>1650	30	1064	2
	1064	25						
Accuracy vs Wavelength	nm	%	nm	%	nm	%	nm	%
	360 - 410	± 10	200 - 270	± 10	700-1650	± 5	200 - 270	± 10
	410 - 950	± 5	270 - 950	± 5	1650-1800	± 7	270 - 950	± 5
	950 - 1100	± 7	950 - 1100	± 7			950 - 1100	± 7
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS	
Part Number	7Z02470		7Z02472		7Z02476		7Z02485	
Supplied Port Accessories (see page 40)	IS6-C-XXX: 2.5" port plug + 2 ea. 1" port covers IS6-C-UV-2.5": 2.5" port cover + 1" port plug + 1" port cover							

Notes: (a) Over central 40mm, $\pm 2\%$ over central 50mm
 (b) For calibration uncertainty of wavelengths outside of this range see table on page 24

Incorporated Detectors: IS6-C-VIS / IS6-C-UV IS6-C-IR / IS6-C-UV-2.5"



IS6



1.1.1.6.5 Accessories for IS6

All accessories can be attached to 1" ports unless otherwise noted.

Accessory	Description	Part number
Port plugs		
IS-1" Port plug	Port plugs close ports with white sphere material, eliminating the port from the sphere geometry	
IS-1" Port plug	White reflectance material, PTFE, Ø25.4mm plug	7Z08280A
IS-2.5" Port plug	White reflectance material, PTFE, Ø63.5mm plug, for 2.5" port	7Z08283A
Port Covers		
	Port Covers close ports with a black matte surface. They prevent extraneous light from entering the sphere without changing the sphere configuration. These covers can also be used as blanks for making specialized port adapters	
IS-1" Port cover	Matte black coated Ø25.4mm cover	7Z08282A
IS-2.5" Port cover	Matte black coated Ø63.5mm cover, for 2.5" port	7Z08281A
Adapters and Reducers		
	The adapters are black coated and the reducers white coated	
1" SMA fiber adapter	SMA fiber input/output	7Z08285
1" FC fiber adapter	FC fiber input/output	7Z08286
FPD (except FPS-1) to IS6 adapter	For mounting FPD sensor series to North Pole port of IS6 series	7Z08350
1" to SM1 adapter	Female SM1 thread, used for attaching FPS-1 detector to IS6	7Z08289
2.5" to 1" port reducer	Convert the 2.5" port into a 1" port PTFE	7Z08305A
Set of aperture masks	Ø5, Ø7, Ø10mm apertures, for use with 2.5" to 1" port reducer P/N 7Z08305A ^(a) ^(c)	7Z08307
Flange attachment	Dovetail flange for use with 2.5" to 1" port reducer P/N 7Z08305A ^(b) ^(c)	7Z08306

Notes: (a) This accessory is held on to port reducer 7Z08305A magnetically.
 (b) This accessory is mounted to port reducer 7Z08305A with the included screws.
 (c) IS6 P/N's 7Z02471, 7Z02473, 7Z02475, 7Z02477 incorporate an earlier version of the 2.5" to 1" port reducer that is not compatible with this accessory. That port reducer can be replaced with the current version, P/N 7Z08305A, in order to use the new accessories.

<p>IS-2.5" Port Plug</p> 	<p>IS-1" Port Plug</p> 	<p>IS-2.5" Port Cover</p> 	<p>IS-1" Port Cover</p> 	<p>FPD to IS6 Adapter</p> 
<p>2.5" to 1" Port Reducer</p> 	<p>Aperture Mask</p> 	<p>Flange Attachment</p> 	<p>1" FC Fiber Adapter</p> 	<p>1" to SM1 Adapter</p> 

1.1.1.7 LED measurement – UV, VIS, NIR

Introduction

UV, VIS and IR LEDs are replacing traditional light sources and thus enabling new applications. Ophir offers a number of choices for LED measurement. There are a number of sources for measuring the power of divergent LED beams

as presented in section 1.1.1.6. There are also radiometer sensors for measuring the irradiance of large area illumination in units of Watts/cm² as presented in section 1.1.1.7.2

1.1.1.7.1 LED Power Sensors

20pW to 3W

Features

- 20pW to 3W
- 200nm to 1100nm
- Photodiode detectors – spectrally calibrated for LEDs and lasers
- Thermal sensors – power measurement is insensitive to wavelength
- Fiber or free space input
- Compatible with all Ophir meters, acquisition devices and StarLab PC software

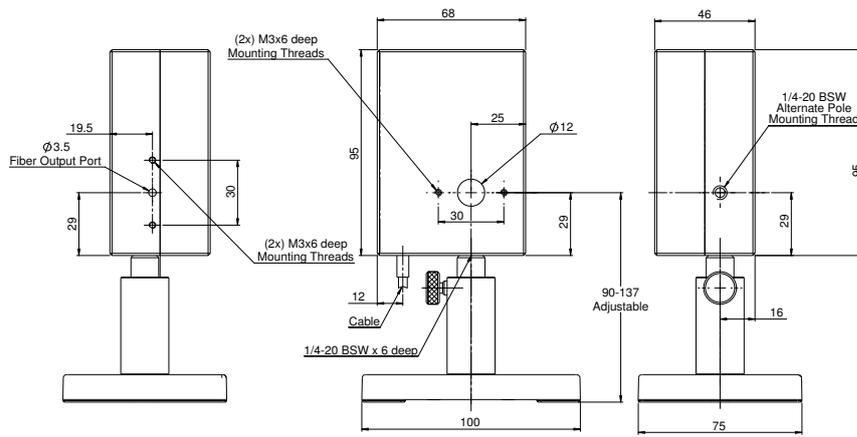


Model	3A-IS	PD300-UV		PD300R-UV		3A
Use	Compact integrating sphere	Standard photodiode sensor for UV-NIR		Round photodiode sensor for UV-NIR		Thermal sensor. Flat spectrum response. For fiber coupled source
Detector Type	Silicon	Silicon		Silicon		Thermal
Input Port Aperture mm	Ø12	10x10		Ø10		Ø9.5
Filter Mode		Filter out	Filter in	Filter out	Filter in	
Spectral Range µm	0.35 – 1.1	0.2-1.1	0.22-1.1	0.2-1.1	0.22-1.1	0.19-20
Power Range	1µW – 3W	20pW-3mW	2µW-300mW	20pW-3mW	2µW-300mW	10µW-3W
Power Scales	3W to 3µW and dBm	3mW to 3nW and dBm	300mW to 300µW and dBm	3mW to 3nW and dBm	300mW to 300µW and dBm	3W-300µW
Resolution nW	1	0.001	100	0.001	100	100
Maximum Power	3W	3mW	300mW	3mW	300mW	3W
Accuracy (including error due to temp variations)						
% Error vs Wavelength nm	±5 350 – 1000 ±10 1000 – 1100	±10 200-230 ±7 230-300 ±3 300-420 ±2 420-980 ±7 980-1100	±10 220-300 ±4 300-420 ±3 420-980 ±7 980-1100	±10 200-230 ±7 230-300 ±3 300-420 ±2 420-980 ±7 980-1100	±10 220-300 ±4 300-420 ±3 420-980 ±7 980-1100	±3%
Damage Threshold W/cm ²	200	10	50	10	50	1000
Max Pulse Energy	5mJ	0.4 µJ	15 µJ	0.4 µJ	15 µJ	2J
Noise Level for Filter Out	20nW	1pW		1pW		2µW
Response Time with Meter s	0.2	0.2		0.2		1.8
Beam Position Dependence	N.A.	±2%		±2%		±2%
Calibration Uncertainty ±%	1.1 430-1000nm ^(b)	1.1 430-1000nm ^(b)		1.1 430-1000nm ^(b)		1.9
Linearity with Power ±%	1	0.5		0.5		1.5
Fiber Adapters Available (see page 33 & 120)	ST, FC, SMA ^(a) , SC	ST, FC, SMA, SC		ST, FC, SMA, SC		ST, FC, SMA, SC
Weight kg	0.6	0.07		0.11		0.2
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS
Version	V1					
Part Number	7Z02404	7Z02413		7Z02438		7Z02621

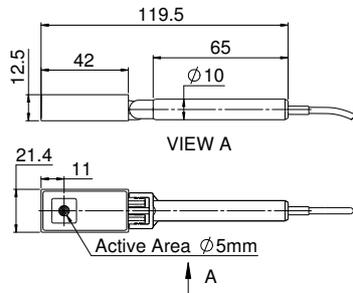
Notes: (a) One fiber output port available with output = 2E-4 of input power/mm² of fiber area.
(b) For calibration uncertainty of wavelengths outside of this range see table on page 24

* For sensors drawings please see page 42

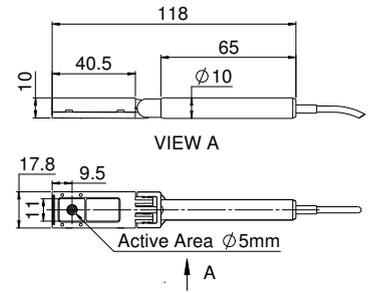
3A-IS



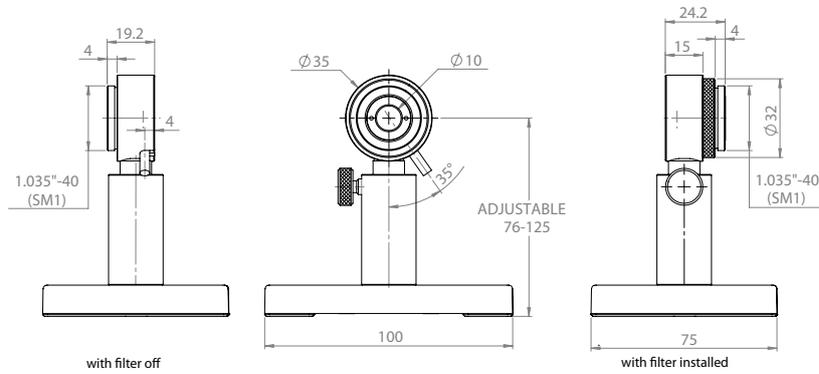
PD300-UV / PD300-IR Filter installed
(Ø5mm for PD300-IR only)



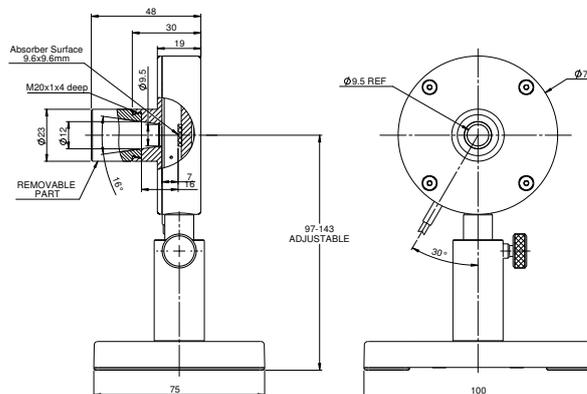
PD300-UV / PD300-IR Filter off
(Ø5mm for PD300-IR only)



PD300R-UV



3A



1.1.1.7.2 LED Irradiance and Dosage Sensors

100nW/cm² to 15W/cm²

Features

- Measure irradiance in W/cm² and dosage in J/cm²
- Cosine corrected
- 200nm to 850nm
- Ø2.75mm and Ø8mm aperture
- For lasers and LEDs

PD300RM-UV / PD300RM-8W

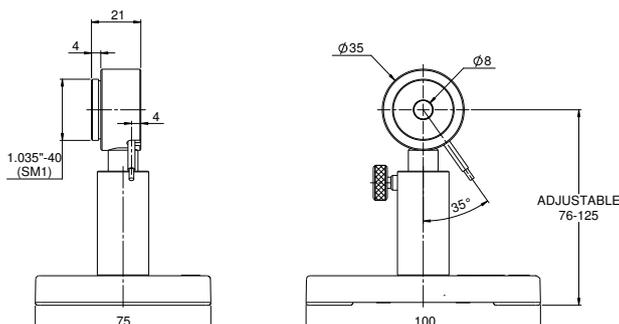
PD300RM-UVA



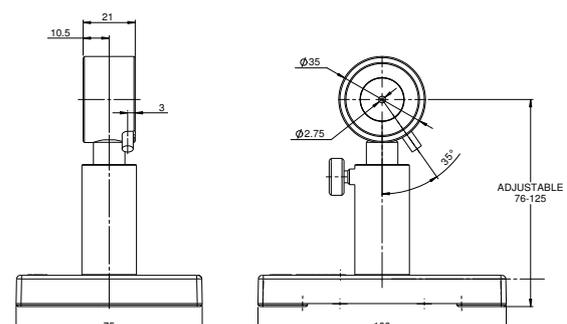
Model	PD300RM-UV	PD300RM-8W	PD300RM-UVA
Detector Type	Silicon	Silicon	Silicon
Input Port Aperture mm	Ø8	Ø8	Ø 2.75
Spectral Range nm	200-850	350-850	350-450
Functions	Irradiance [W/cm ²] Dosage [J/cm ²]	Irradiance [W/cm ²] Dosage [J/cm ²]	Irradiance [W/cm ²] Dosage [J/cm ²]
Irradiance Range	100nW/cm ² – 250mW/cm ²	1µW/cm ² – 8W/cm ² (d)	1.5µW/cm ² – 15W/cm ² (d)
Irradiance Scales	300mW/cm ² to 300nW/cm ² (7 scales), Auto ranging	30W/cm ² to 30µW/cm ² (7 scales), Auto ranging	30W/cm ² to 30µW/cm ² (7 scales), Auto ranging
Resolution nW/cm ²	0.1	10	10
Maximum Irradiance	200nm-400nm, 250mW/cm ² 400nm-550nm, 100mW/cm ² 550nm-850nm, 40mW/cm ²	350nm-650nm, 8W/cm ² 650nm-850nm, 4W/cm ²	350nm-450nm, 15W/cm ²
Dosage Sample Rate	500 samples per second	500 samples per second	500 samples per second
Calibration Uncertainty ±% (e)	3.4 400-850nm	3.4 400-850nm	3.6 350-400nm 3.4 400-450nm
Deviation from Flatness Accuracy	N.A.	N.A.	±3%, 350-400nm, 400-450nm
% error vs Wavelength nm (c)	±10% 200-250nm ±7.5% 250-300nm ±5% 300-400nm ±4% 400-850nm (a)	±5% 350-400nm ±4% 400-850nm (a)	±6% 350-400nm ±5% 400-450nm (b)
Thermal Coefficient %/°C	-0.03	-0.03	-0.03
Damage Threshold W/cm ²	10	50 (d)	50 (d)
Max Pulse Energy (for laser ns pulse) µJ	0.4	20	20
Noise Level nW/cm ²	5	45	65
Response Time with Meter s	0.2	0.2	0.2
Linearity %	±0.5	±0.5	±0.5
f ² Cosine Correction Factor Accuracy	5%	5%	6.5% (f)
Size	Ø35 x 21mm see drawing	Ø35 x 21mm see drawing	Ø35 x 21mm see drawing
Weight	110g	110g	110g
Compatible Meter (g)	Centauri, StarBright and StarLite with or without StarLab, Juno+, Juno-RS	Centauri, StarBright and StarLite with or without StarLab, Juno+, Juno-RS	Centauri, StarBright and StarLite with or without StarLab, Juno+, Juno-RS
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			
Part number	7Z02479	7Z02480	7Z02492

Notes: (a) Accuracy given for lasers. Accuracy for LEDs depends on peak wavelength and bandwidth. Contact Ophir for more details.
 (b) Applicable to lasers and LEDs, includes deviation from flatness.
 (c) Accuracy includes uncertainty of NIST calibrated reference.
 (d) Do not exceed 30 seconds of continuous exposure at > 5W/cm².
 (e) For calibration uncertainty of wavelengths outside of this range see table on page 24.
 (f) Up to 70 degrees.
 (g) Support of Centauri for irradiance sensors is from firmware version 5.02 and up.

PD300RM-UV / PD300RM-8W



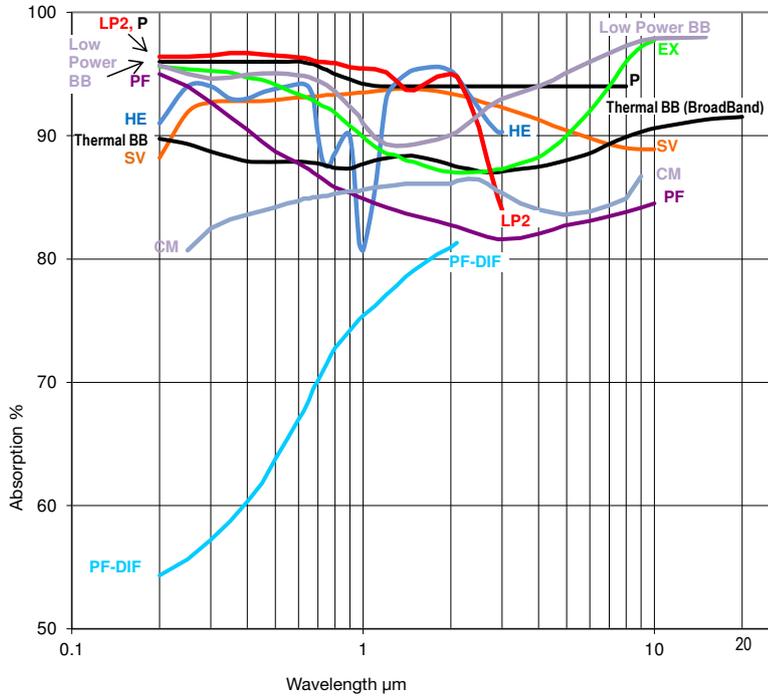
PD300RM-UVA



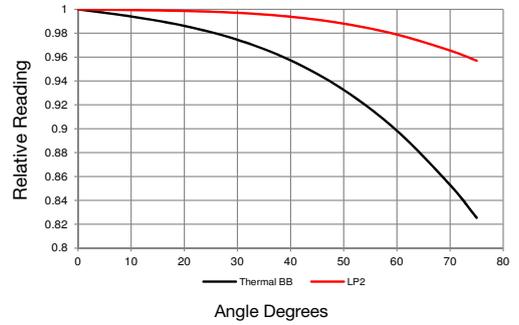
1.1.2 Thermal Power Sensors

Absorption, Angle Dependence and Damage Graphs for Thermal Sensors

Absorption vs. Wavelength

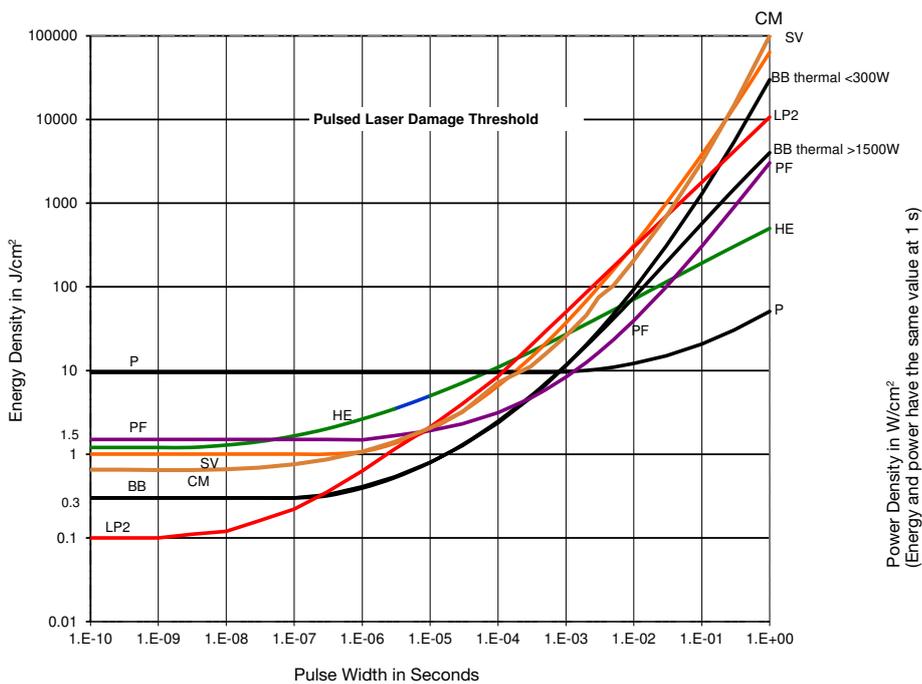


Response vs. Incidence Angle



Damage Threshold vs. Pulse Width

Note: The CW power damage threshold in W/cm^2 is found on the right hand side of the table at the 1 s pulse width value



Power Density in W/cm^2
(Energy and power have the same value at 1 s)

1.1.2.1 Low Noise Lock In Power Sensors

300fW to 100mW

Features

- Chopper and lock in amplifier for lowest noise and drift
- Wavelength range from UV to deep IR
- RM9 pyro is not sensitive to background radiation



The RM9 series Radiometers use a pyroelectric or photodiode sensor in conjunction with chopped CW or quasi CW radiation, using a digitally synthesized lock-in amplifier to reduce external noise to a minimum. The signal is passed through the 18Hz chopper and the chopped signal is detected by the sensor. All signals not at this 18Hz frequency

are suppressed. The output of the sensor is displayed on a standard Ophir meter or PC interface. The chopper may be placed at any convenient location but preferably close to the signal source so as to eliminate interference from all unchopped radiation. The chopper is to be oriented with the indicated side toward the sensor.

Specifications

Model	RM9	RM9-PD
Use	Low level signals	Very low level signals
Detector Type	Pyroelectric	Si Photodiode
Spectral Range	0.15 - 12 μ m ^(a)	0.2 - 1.1 μ m ^(b)
Aperture mm	Ø8mm	Ø10mm
Surface Reflectivity % approx.	50	50
Power Range ^(c)	100nW – 100mW	300fW – 300nW
Power Scales	100mW to 3 μ W	300nW to 3pW
Power Noise Level ^(d)	~30nW	30fW
Minimum Frequency for Pulsed Sources	200Hz	200Hz
Thermal Drift (20min) ^(e)	~30nW	N.A.
Power Accuracy	±5% ^(a)	±5% ^(b)
Damage Threshold W/cm ²	5	5
Response Time with Meter (0-95%) s	3.5s	3.6s
Linearity with Power	±2%	±2.5%

Connections:

1. 1.5 meter cable hard wired to interface module.
2. BNC connector on module for connection to chopper (2 meter BNC to BNC cable included). Perform zeroing with BNC cable removed.
3. 0.5 meter cable from module terminated in DB15 connector.

Cooling	convection	convection
Weight kg	0.37	0.37
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part Number for RM9 Series with RMC1 Chopper ^(f)	7Y70669	7Y70672
Part Number for RM9 Series Sensors	7Z02952	7Z02953

Note: (a) At calibrated wavelengths 500 – 1100nm. At other wavelengths, there is an additional error as follows: <500nm add ±8%, 1100 – 3000nm add ±5%, 10.6 μ m add ±15%

Note: (b) At calibrated wavelengths 200 – 1100nm. For <700nm add ±2% additional error

Note: (c) For LaserStar, Pulsar, USBI, Quasar and Nova, upper limit is 1mW for RM9 and 90nW for RM9-PD. For these models, accuracy may also be less than values given above

Note: (d) Averaged over 10s

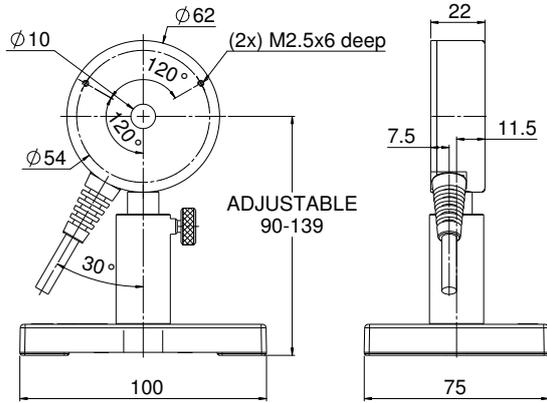
Note: (e) In a typical laboratory environment

Note: (f) The RMC1 or another chopper unit that can be set to 18Hz is required for operation of the RM9 series sensors

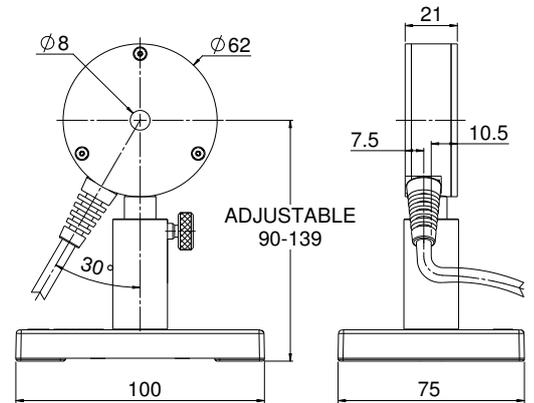
* For drawings please see page 46

Model	RMC1 Chopper
Use	Chopper for RM9 series
Aperture	Ø22mm
Chopping Frequency ^(a)	18Hz
Power Consumption	85mA
Connections:	
1. BNC to interface module	
2. 12V wall cube power supply (included)	
3. Mini USB connector (factory use only)	
Note: (a) not adjustable by user.	

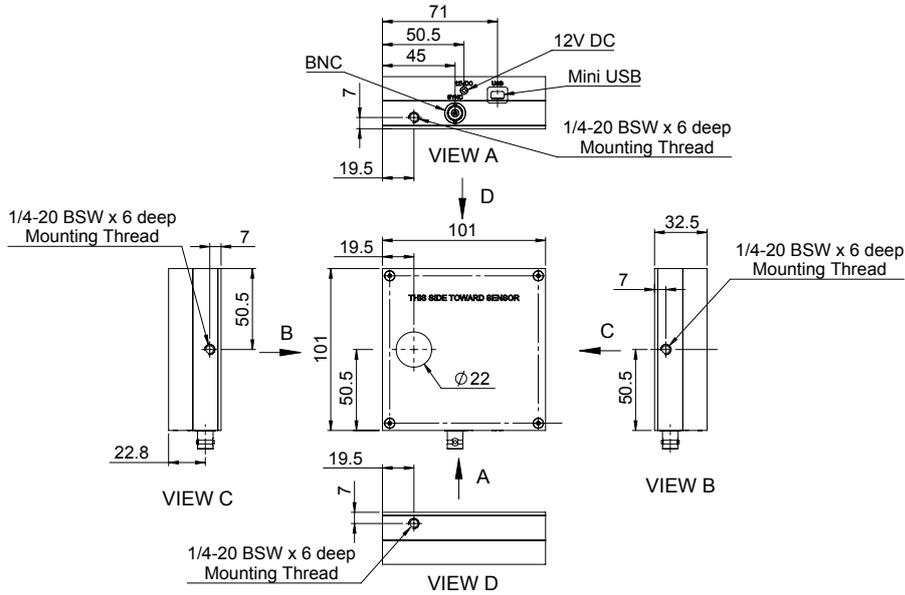
RM9-PD Sensor



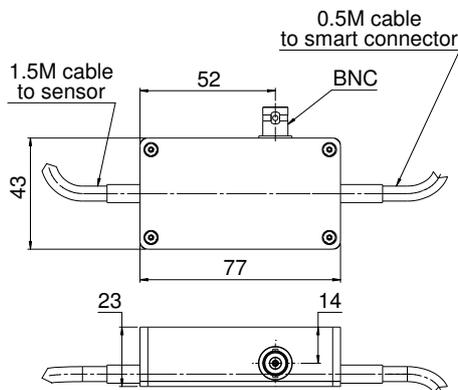
RM9 Sensor



Radiometer-Chopper



Interface Module



1.1.2.2 High Sensitivity Thermal Sensors

10μW to 3W

Features

- Very low noise and drift for measurement of very low powers and energies
- PF absorber has high damage threshold for CW and pulses
- Up to 3W



Model	2A-BB-9	3A	3A-P	3A-PF-12
Use	General purpose	General purpose	Short pulses	Short Pulses UV
Absorber Type	Low power broadband	Low power broadband	P type	PF type
Spectral Range μm	0.19 - 20	0.19 - 20	0.15 - 8	0.15 - 20
Aperture mm	Ø9.5mm	Ø9.5mm	Ø12mm	Ø12mm
Maximum Beam Divergence	NA	NA	NA	NA
Power Mode				
Power Range ^(a)	20μW - 2W	10μW - 3W	15μW - 3W	15μW - 3W
Power Scales	2W to 200μW	3W to 300μW	3W to 300μW	3W to 300μW
Power Noise Level	1μW	1μW	3μW	3μW
Thermal Drift (30min) ^(a)	5 - 20μW	5 - 20μW	5 - 30μW	5 - 30μW
Maximum Average Power Density kW/cm ²	1	1	0.05	3
Response Time with Meter (0-95%) typ. s	1.8	1.8	2.5	2.5
Calibration Uncertainty ±%	1.9	1.9	1.9	1.9
Power Accuracy ±% ^(d)	3	3	3	3 ^(c)
Linearity with Power ±%	1	1	1	1
Energy Mode				
Energy Range	20μJ - 2J	20μJ - 2J	20μJ - 2J	20μJ - 2J
Energy Scales	2J to 200μJ	2J to 200μJ	2J to 200μJ	2J to 200μJ
Minimum Energy	20μJ	20μJ	20μJ	20μJ
Maximum Energy Density J/cm ² ^(b)				
<100ns	0.3	0.3	1	1.5
0.5ms	1	1	1	7
2ms	2	2	1	15
10ms	4	4	1	40
Cooling	Convection	Convection	Convection	Convection
Weight kg	0.2	0.2	0.2	0.2
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			V1	
Part number: Standard Sensor	7Z02767	7Z02621 (1.5m cable)	7Z02622	7Z02720
BeamTrack Sensor: Beam Position & Size (p. 55)		7Z07934	7Z07935	
Sensor with different cable length		7Z02621C (10m cable)		

Note: (a)

Depending on room airflow and temperature variations. Lowest measurable powers are achieved by thermally quiet room conditions, using removable snout (for 3A, 3A-P, 3A-PF-12 sensors), averaging and offset subtraction.

Note: (b) For P and PF types and shorter wavelengths derate maximum energy density as follows:

Wavelength	P type	PF type
1064nm	Derate to value	Derate to value
532nm	Not derated	Not derated
355nm	40% of stated value	70% of stated value
266nm	5% of stated value	15% of stated value
193nm	10% of stated value	5% of stated value

Note: (c)

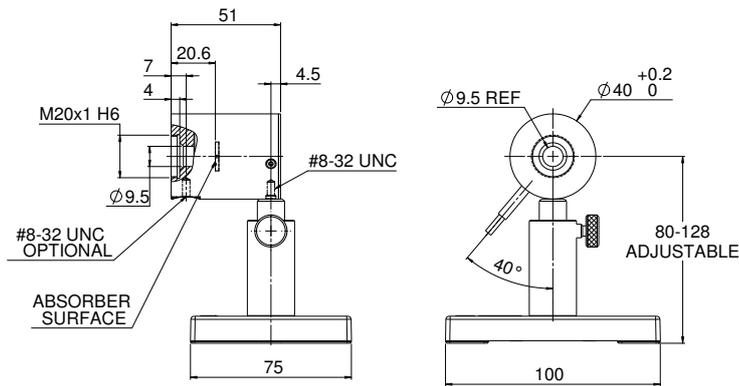
Calibrated from 193nm to 2.2μm and at 10.6μm. There is an additional error of ±1% from 450nm to 650nm.

Note: (d)

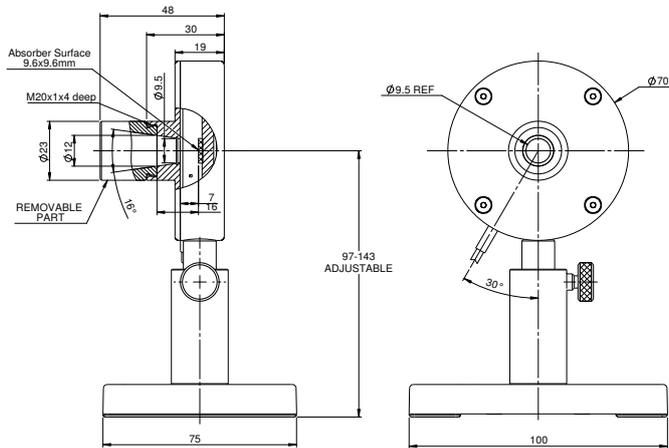
The 3A and 2A-BB-9 sensors have a relatively large spectral variation in absorption and has a calibrated spectral curve at all wavelengths in its spectral range to the above specified accuracy. Nova and LaserStar meters do not support this feature and when used with those meters, the accuracy will be ±3% as above for 532nm, 905nm, 1064nm and 10.6μm but there will be an additional error of up to 3% at other wavelengths in the spectral range 190 – 3000nm.

* For drawings please see page 48

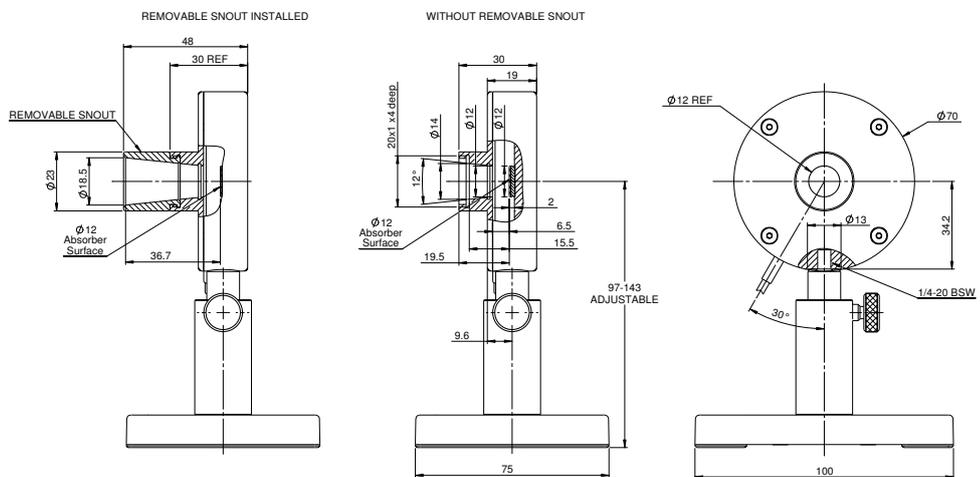
2A-BB-9



3A



3A-P / 3A-PF-12



1.1.2.2 High Sensitivity Thermal Sensors

8μW to 3W

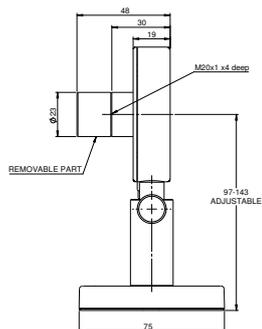
Features

- Very low noise and drift to measure very low powers and energies
- Broadband and P absorbers for CW and short pulses
- Up to 3W
- Version for Terahertz

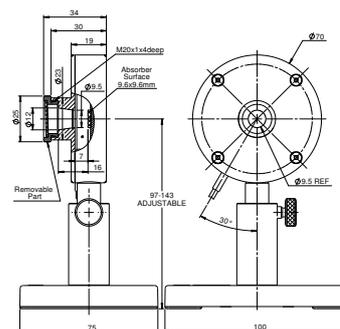


Model	3A-P-THz	3A-FS	3A-P-FS-12
Use	Calibrated for Terahertz radiation	With removable window	For divergent beams, window blocks infrared
Absorber Type	P type	Broadband + F.S. window	P type + F.S. window
Spectral Range μm	0.1THz - 30THz ^(c)	0.19 - 20 ^(b)	0.22 - 2.1
Aperture mm	Ø12mm	Ø9.5mm	Ø12mm
Maximum Beam Divergence	NA	NA	±40 degrees
Power Mode			
Power Range ^(f)	15μW - 3W	8μW - 3W	15μW - 3W
Power Scales	3W to 300μW	3W to 300μW	3W to 300μW
Power Noise Level	4μW ^(d)	2μW	6μW
Thermal Drift (30min) ^(a)	5 - 30μW	2 - 10μW	20 - 40μW
Maximum Average Power Density kW/cm ²	0.05	1	0.05
Response Time with Meter (0-95%) typ. s	2.5	1.8	2.5
Calibration Uncertainty ±%	1.9	1.9	1.9
Power Accuracy ±%	8 ^(c)	3	3
Linearity with Power ±%	1	1	1
Energy Mode			
Energy Range	20μJ - 2J	15μJ - 2J	20μJ - 2J
Energy Scales	2J to 200μJ	2J to 200μJ	2J to 200μJ
Minimum Energy	20μJ	15μJ	20μJ
Maximum Energy Density J/cm ² ^(e)			
<100ns	1	0.3	1
0.5ms	1	1	1
2ms	1	2	1
10ms	1	4	1
Cooling	Convection	Convection	Convection
Weight kg	0.2	0.2	0.15
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	NA
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			
Part number	7Z02742	7Z02628	7Z02687
Note: (a)	Depending on room airflow and temperature variations		
Note: (b)	Remove window for measurement beyond 2.2μm		
Note: (c)	2 sigma standard lab traceable calibration for 0.6THz - 10THz. For 0.3 - 0.5THz add 4% to error. Outside this region the sensor will measure but is not calibrated.		
Note: (d)	Back reflections from meter can sometimes cause interference effects with source. Unit should be tilted ~10° in this case		
Note: (e)	For P type and shorter wavelengths derate maximum energy density as follows:	Derate to value	
Note: (f)	Lowest measurable powers are achieved by thermally quiet room conditions, using removable snout, averaging and offset subtraction		
	Wavelength	Derate to value	
	1064nm	Not derated	
	532nm	Not derated	
	355nm	40% of stated value	
	266nm	5% of stated value	
	193nm	10% of stated value	

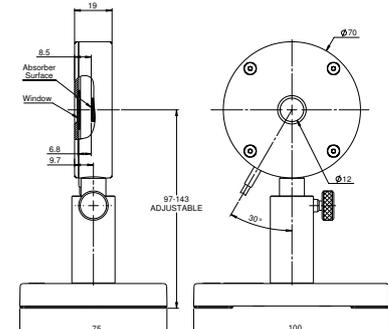
3A-P-THz



3A-FS



3A-P-FS-12



1.1.2.2 High Sensitivity Thermal Sensors

2mW to 12W

Features

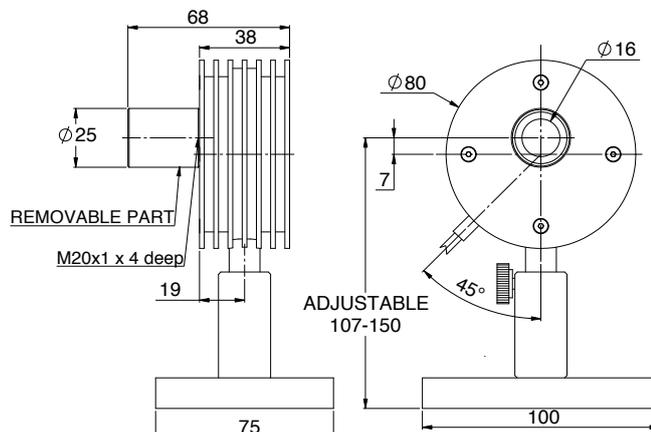
- Very low noise and drift to measure very low powers and energies
- Broadband and P absorbers for CW and short pulses
- Up to 12W
- Spectrally flat

12A / 12A-P



Model	12A	12A-P
Use	General purpose	Short pulses
Absorber Type	Broadband	P type
Spectral Range μm	0.19 - 20	0.15 - 8
Aperture mm	$\varnothing 16\text{mm}$	$\varnothing 16\text{mm}$
Power Mode		
Power Range	2mW - 12W	2mW - 12W
Power Scales	12W to 20mW	12W to 20mW
Power Noise Level	50 μW	50 μW
Thermal Drift (30min) ^(a)	40 - 150 μW	40 - 150 μW
Maximum Average Power Density kW/cm ²	25	0.05
Response Time with Meter (0-95%) typ. s	3	3.5
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	3	3
Linearity with Power $\pm\%$	1.5	1.5
Energy Mode		
Energy Range	1mJ - 30J	1mJ - 30J
Energy Scales ^(b)	30J to 30mJ	30J to 30mJ
Minimum Energy mJ	1	1
Maximum Energy Density J/cm ² ^(c)		
Pulse rate:		Single
<100ns	0.3	10
0.5ms	5	10
2ms	10	10
10ms	30	10
Cooling	convection	convection
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC
Weight kg	0.35	0.35
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1	
Part number	7Z02638	7Z02624
Note: (a)	Depending on room airflow and temperature variations	
Note: (b)	For the 30mJ energy scale measurements it is recommended to use the screw on barrel supplied with the sensor to protect from direct air flow	
Note: (c) For P type and shorter wavelengths derate maximum energy density as follows:	Wavelength	Derate to value
	1064nm	Not derated
	532nm	Not derated
	355nm	40% of stated value
	266nm	10% of stated value
	193nm	10% of stated value

12A / 12A-P



1.1.2.3 Low Power Thermal Sensors

10mW to 50W

Features

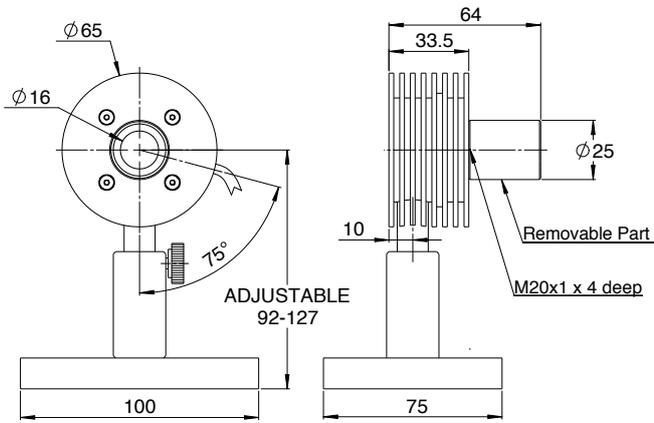
- Convection air cooled
- Broadband or Excimer absorbers
- Ø16mm to Ø26mm apertures
- Fast response time



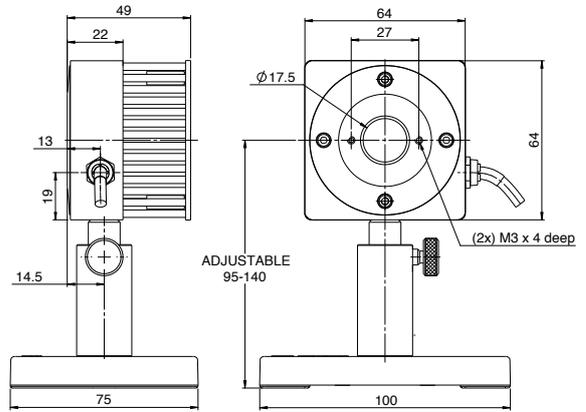
Model	10A-BB-16	30A-BB-18	L30A-BB-26-10MM	L30A-EX-10MM	50(150)A-BB-26
Use	Low power	General purpose	Thin profile	Thin profile Excimer	General purpose
Absorber Type	Broadband	Broadband	Broadband	EX	Broadband
Spectral Range μm	0.19 - 11	0.19 - 11	0.19 - 11	0.15 - 0.7, 10.6	0.19 - 11
Aperture mm	Ø16mm	Ø17.5mm	Ø26mm	Ø26mm	Ø26mm
Power Mode					
Power Range	10mW - 10W	10mW - 30W	80mW - 30W	80mW - 30W	40mW - 150W
Maximum Power Intermittent	N.A.	N.A.	8W free standing, 30W heat sinked	8W free standing, 30W heat sinked	150W for 1.5min, 100W for 2.2min, 50W continuous
Power Scales	10W / 5W / 0.5W	30W / 5W / 0.5W	30W / 3W	30W / 5W	150W / 50W / 5W
Power Noise Level	0.2mW	0.5mW	4mW	4mW	2mW
Maximum Average Power Density kW/cm^2	28	20 at 30W 28 at 10W	20 at 30W 28 at 10W	1.5	12 at 150W 17 at 50W
Response Time with Meter (0-95%) typ. s	0.8	0.8	1.5	1.5	1.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(a)	3 ^(a)	3 ^(a)	3	3 ^(a)
Linearity with Power $\pm\%$	1	1	1	1	1.5
Energy Mode					
Energy Range	6mJ - 2J	6mJ - 30J	20mJ - 60J	20mJ - 30J	20mJ - 100J
Energy Scales	2J / 200mJ	30J / 3J / 300mJ	60J / 20J / 2J / 200mJ	30J / 3J / 300mJ	100J / 30J / 3J / 300mJ
Minimum Energy mJ	6	6	20	20	20
Maximum Energy Density J/cm^2					
<100ns	0.3	0.3	0.3	0.5	0.3
0.5ms	2	2	5	6	5
2ms	2	2	10	12	10
10ms	2	2	30	25	30
Cooling	convection	convection	convection / conduction	convection / conduction	convection
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	NA	NA	ST, FC, SMA, SC
Weight kg	0.2	0.3	0.1	0.1	0.3
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V2	V1	V1		V1
Part number: Standard Sensor	7Z07128	7Z07124	7Z07130	7Z02686	7Z07123
BeamTrack Sensor: Beam Position & Size (p. 55/62)	7Z07905				7Z07907
Notes: (a) $\pm 4\%$. For wavelengths <240nm					

* For drawings please see page 52

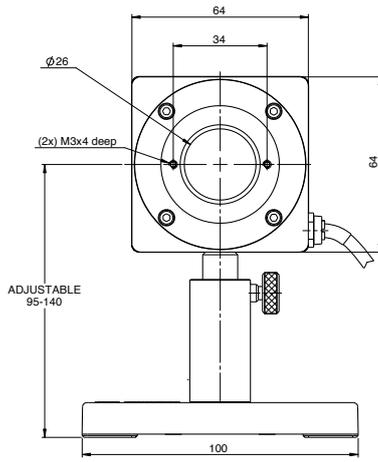
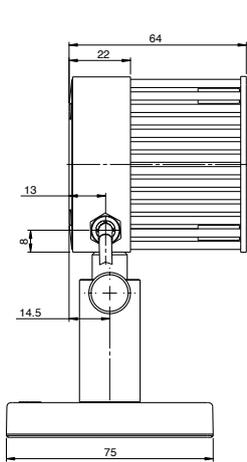
10A-BB-16



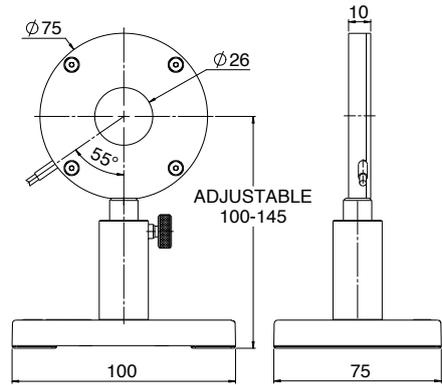
30A-BB-18



50(150)A-BB-26



L30A-BB-26-10MM / L30A-EX-10MM



1.1.2.3 Low Power Thermal Sensors

40mW to 50W

Features

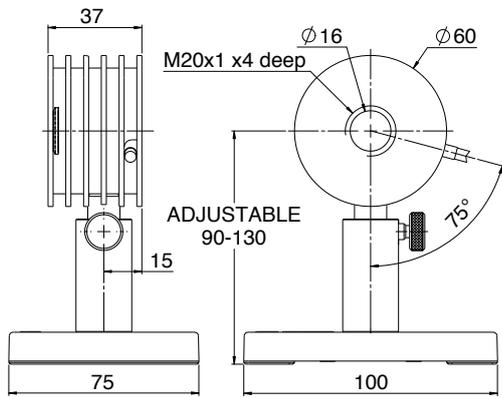
- Convection air cooled
- P, PF and N type absorbers for short pulses
- Ø16mm to 17.5mm apertures



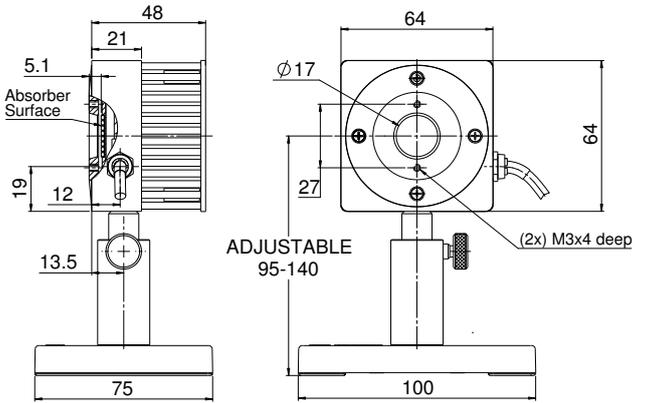
Model	10A-P	30A-P-17	15(50)A-PF-DIF-18/ 50A-PF-DIF-18	30A-N-18
Use	Short pulse to 10W	Short pulse to 30W	High energy density pulsed beams	High power density pulsed YAG
Absorber Type	P type	P type	PF type + diffuser	N type
Spectral Range μm	0.15 - 8	0.15 - 8	0.24 - 2.2	0.532, 1.064
Aperture mm	Ø16mm	Ø17mm	Ø17.5mm	Ø17.5mm
Power Mode				
Power Range	40mW - 10W	60mW - 30W	140mW - 50W	60mW - 30W
Maximum Intermittent Power W	N.A.	N.A.	(for 15(50)A-PF-DIF-18 only) 50W for 5min, 15W continuous	N.A.
Power Scales	10W / 2W / 200mW and dBm	30W / 3W	50W / 5W	30W / 3W
Power Noise Level	2mW	3mW	7mW	3mW
Maximum Average Power Density kW/cm ²	0.05	0.05	>10	5
Response Time with Meter (0-95%) typ. s	3.5	2.5	2	2
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3	3	5	3
Linearity with Power $\pm\%$	1.5	1.5	1.5	1
Energy Mode				
Energy Range	10mJ - 10J	40mJ - 30J	60mJ - 200J	30mJ - 200J
Energy Scales	10J / 2J / 200mJ	30J / 3J	200J / 30J / 3J	200J / 30J / 3J
Minimum Energy mJ	10	40	60	30
Maximum Energy Density J/cm ² (a)				
Pulse rate:	Single 10 - 30Hz	Single 10 - 30Hz	10 - 50Hz	10 - 50Hz
<1 μs	10 1	10 1	4	1
0.5ms	10 1	10 1	15	20
5ms	10 1	10 1	50	>100
Cooling	convection	convection	convection	convection
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	NA	ST, FC, SMA, SC
Weight kg	0.2	0.3	0.35	0.3
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V3			
Part number	7Z02649	7Z02693	7Z02740/ 7Z02738	7Z02695
Note: (a) For shorter wavelengths derate maximum energy density as follows:	Wavelength 1064nm 532nm 355nm 266nm 193nm	Derate to value Not derated Not derated 40% of stated value 10% of stated value 10% of stated value	Wavelength 1064nm 532nm 355nm 266nm 193nm	Derate to value Not derated 80% of stated value 60% of stated value 40% of stated value N.A.

* For drawings please see page 54

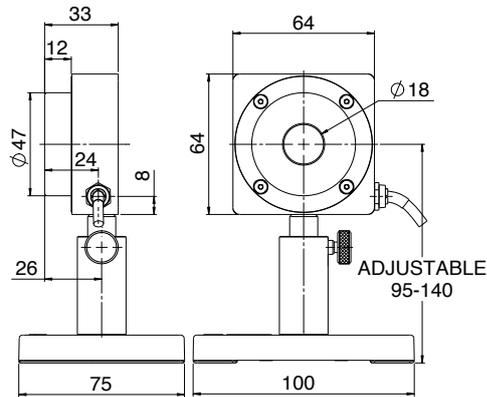
10A-P



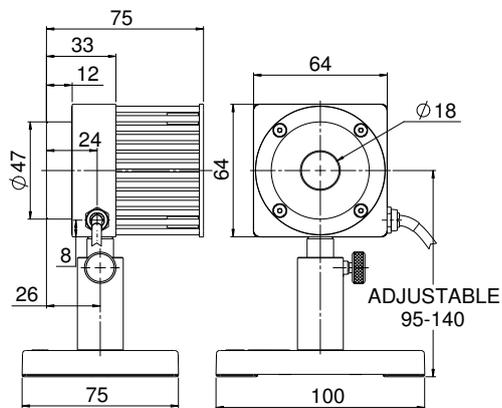
30A-P-17



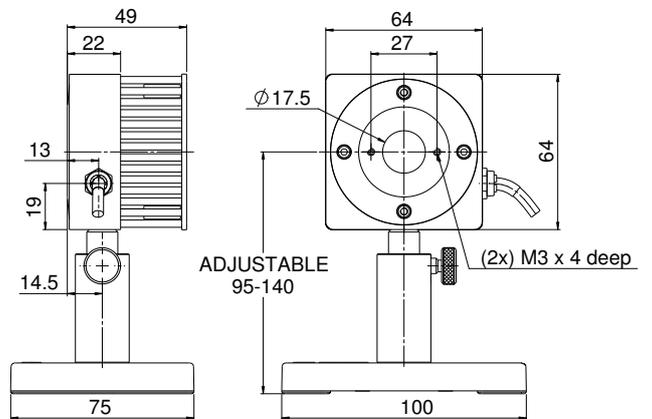
15(50)A-PF-DIF-18



50A-PF-DIF-18



30A-N-18



1.1.2.3 Low Power Thermal Sensors

1.1.2.3.1 Low Power BeamTrack-Power / Position / Size Sensors

100µW to 10W

Features (see introduction in pages 111-113)

- All the features of standard power sensors plus...
- Accurate tracking of beam position to fractions of a mm
- Monitoring of the laser beam size

3A-QUAD / 3A-P-QUAD



10A-BB-16-PPS



Model	3A-QUAD ^(a)	3A-P-QUAD ^(a)	10A-BB-16-PPS ^(a)
Use	General purpose	Short pulses	Low power
Functions	Power / Energy / Position	Power / Energy / Position	Power / Energy / Position / Size
Absorber Type	Low power broadband	P type	Broadband
Spectral Range µm	0.19 - 20	0.15 - 8	0.19 - 11
Aperture mm	Ø9.5mm	Ø12mm	Ø16mm
Power Mode			
Power Range	100µW - 3W	160µW - 3W	20mW - 10W
Power Scales	3W to 300µW	3W to 300µW	10W / 5W / 0.5W
Power Noise Level	5µW	10µW	1mW
Thermal Drift (30min)%	10 - 40µW ^(b)	10 - 40 µW ^(b)	NA
Maximum Average Power Density kW/cm ²	1	0.05	28
Response Time with Meter (0-95%) typ. s	1.8	2.5	0.8
Calibration Uncertainty ±%	1.9	1.9	1.9
Power Accuracy ±% ^(g)	3	3	3 ^(h)
Linearity with Power ±%	1	1	1
Energy Mode			
Energy Range	20µJ - 2J	30µJ - 2J	6mJ - 2J
Energy Scales	2J to 200µJ	2J to 200µJ	2J / 200mJ
Minimum Energy	20µJ	30µJ	6mJ
Maximum Energy Density J/cm ²			
<100ns	0.3	1 ^(f)	0.3
0.5ms	1	1 ^(f)	2
2ms	2	1 ^(f)	2
10ms	4	1 ^(f)	2
Beam Tracking Mode			
Position			
Beam Position Accuracy mm ^(c)	0.15	0.15	0.15
Beam Position Resolution mm	0.02	0.02	0.02
Min Power for Position Measurement	300µW	400µW	50mW
Size ^(d)			
Size Accuracy ^(e)	NA	NA	±(5%+50µm) for centered beam
Size Range mm (4σ beam diameter)	NA	NA	1.5 - 10
Min Power for Size Measurement	NA	NA	50mW
Cooling	Convection	Convection	Convection
Weight kg	0.3	0.3	0.3
Fiber Adapter Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			V1
Part number	7Z07934	7Z07935	7Z07905

Note: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, Nova II and Vega meters, Juno, Juno+, Juno-RS and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Note: (b) Depending on room airflow and temperature variations.

Note: (c) For position within inner 30% of aperture. Position measuring center corresponds to geometrical center within <1mm. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

Note: (d) Assumes laser beam with circular Gaussian (TEM₀₀) distribution. For other modes, size measurement is relative.

Note: (e) Accuracy spec will be maintained for beams ≥1.8 mm not deviating from center by more than 15% of beam diameter.

Note: (f) For P type and shorter wavelengths derate maximum energy density as follows:

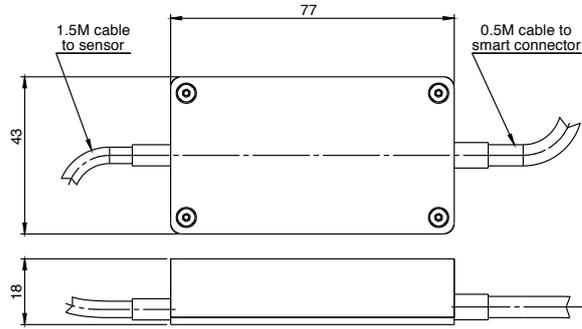
Wavelength	Derate to value
1064nm	not derated
532nm	not derated
355nm	40% of stated value
266nm	10% of stated value
193nm	10% of stated value

Note: (g) The 3A-QUAD has a relatively large spectral variation in absorption and has a calibrated spectral curve at all wavelengths in its spectral range to the above specified accuracy. Nova and LaserStar meters do not support this feature and when used with those meters, the accuracy will be ±3% as above for 532nm, 905nm, 1064nm and 10.6µm but there will be an additional error of up to 3% at other wavelengths in the spectral range 190 - 3000nm.

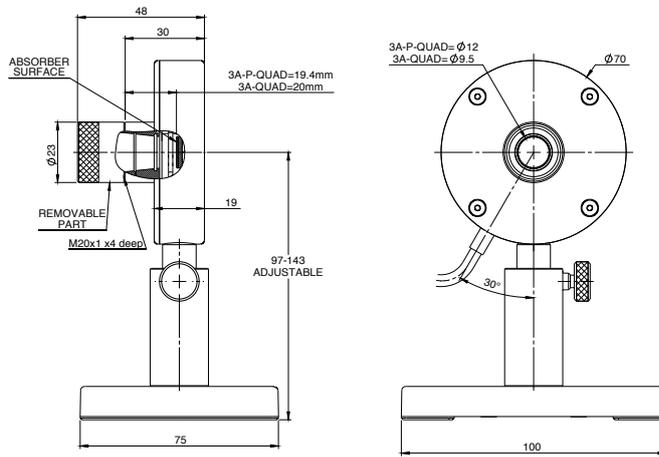
Note: (h) ±4%. For wavelengths <240nm

* For drawings please see page 56

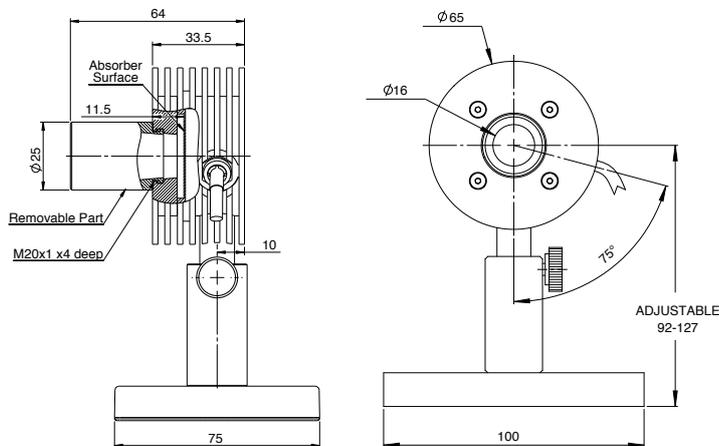
Interface Module on cable



3A-QUAD / 3A-P-QUAD



10A-BB-16-PPS



1.1.2.3 Low Power Thermal Sensors

1.1.2.3.2 Beam Trap

Up to 50W

Features

- Does not measure power, traps beam only
- Power capacity up to 50W
- Backscattered power 0.05%
- Pulsed damage threshold 4J/cm²
- Average power density up to 16kW/cm²
- Ø15mm aperture

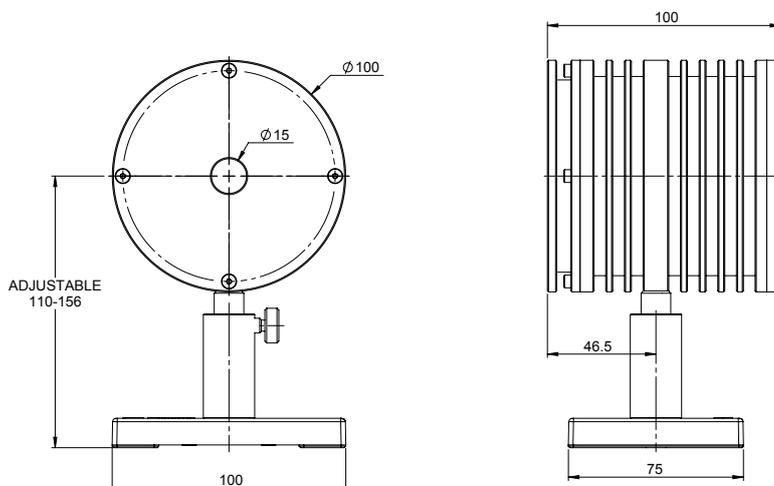


The BT50A-15 absorbs a laser beam that is inserted into the entrance aperture parallel to the unit's optic axis. The beam trap is designed that only a very small fraction of the light is backscattered. The BT50A-15 does not measure power. It is a beam trap only.

When operated at full power, the BT50A-15 can heat up to over 100degC. Note that the absorbing element of the beam trap is graphite which may not be suitable for some environments.

Model	BT50A-15	
Use	Beam trap for CW and pulsed lasers up to 50W average power	
Absorber Type	Broadband graphite absorber	
Spectral Range μm	0.19 - 20	
Backscatter	0.05% or less, typical	
Aperture mm	Ø15mm	
Maximum Acceptance Angle	± 10 degrees	
Maximum Incident Power	50W	
Maximum Average Power Density	16kW/cm ²	
Maximum Energy Density	<100ns pulses	4J/cm ²
	2ms pulses	100J/cm ²
Cooling	convection	
Dimensions	See drawing below	
Weight kg	0.9	
Compliance	RoHS, China RoHS	
Version		
Part number	7Z17204	

BT50A-15



1.1.2.4 Low - Medium Power Thermal Sensors - Apertures to 35mm

30mW to 150W

Features

- Convection air cooled
- CW to 30W or 50W, intermittent to 150W
- Ø17.5mm and Ø35mm apertures
- Measure powers up to 4000W by short exposures to laser

30(150)A-BB-18



30(150)A-LP2-18

L50(150)A-BB-35
L50(150)A-PF-35

L50(150)A-LP2-35



Model	30(150)A-BB-18	30(150)A-LP2-18	L50(150)A-BB-35	L50(150)A-LP2-35	L50(150)A-PF-35
Use	General purpose	High power density and long pulse lasers	General purpose	High power density and long pulse lasers ^(b,c)	Short pulse lasers
Absorber Type	Broadband	LP2	Broadband	LP2	PF
Spectral Range μm	0.19 - 11	0.25 - 2.2	0.19 - 11	0.25 - 2.2	0.15-20
Absorption	>85%	>94% from 0.25 to 1.1 μm	>85%	>94% from 0.25 to 1.1 μm	>85%
Aperture mm	Ø17.5mm	Ø17.5mm	Ø35mm	Ø35mm	Ø35mm
Power Mode					
Power Range	30mW - 150W	30mW - 150W	100mW - 150W	100mW - 150W ^(b,c)	100mW - 150W
Maximum Intermittent Power W	150W for 1.5min, 100W for 2.2min, 30W continuous		150W for 1.5min, 100W for 2.5min, 50W continuous	For L50(150)A-LP2-35: 4000W for 0.4s exposure ^(b,c)	
Power Scales	150W / 30W / 3W	150W / 30W / 3W	150W / 50W / 5W	150W / 50W / 5W	150W / 50W / 5W
Power Noise Level	2mW	2mW	4mW	4mW	4mW
Maximum Average Power Density kW/cm ²	12 at 150W 20 at 30W	33 at 150W 50 at 30W	12 at 150W 17 at 50W	33 at 150W 50 at 50W	3
Response Time with Meter (0-95%) typ. s	1.2	1.2	2	2	2
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(g)	3 ^(a)	3 ^(g)	3 ^(a)	4 ^(d)
Linearity with Power $\pm\%$	1	1	1	1	1
Energy Mode					
Energy Range	20mJ - 100J	20mJ - 300J	40mJ - 300J	40mJ - 3000J	50mJ - 300J
Energy Scales	100J / 30J / 3J	300J / 30J / 3J	300J / 30J / 3J	3000J / 300J / 30J / 3J	300J / 30J / 3J
Minimum Energy mJ	20	20	40	40	50
Maximum Energy Density J/cm ²					Single ^(e) 10-50Hz ^(e)
<100ns	0.3	0.1	0.3	0.1	3 ^(f) 1.5
0.5ms	5	50	5	50	7 7
2ms	10	130	10	130	15 15
10ms	30	400	30	400	40 40
>300 ms	NA	NA	NA	See below ^(b,c)	NA NA
Cooling	convection	convection	convection	convection	convection
Fiber Adapters Available (p. 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Weight kg	0.3	0.3	0.35	0.35	0.35
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1		V1		
Part number: Standard Sensor	7Z07122	7Z02786	7Z07118 (1.5m cable)	7Z02785	7Z02737
Sensor with different cable length			7Z07118D (12m cable)		

Notes: (a) Above 1.1 μm there is an additional calibration uncertainty of up to 2%.

Notes: (b) Long pulses (0.5 – 4s) can be used to measure power of high power lasers by measuring the energy of a short exposure. The StarBright, Juno, Juno+, Juno-RS and Centauri meters have a Pulsed Power mode where the user may specify the pulse width and get a reading directly in units of power for this short exposure energy measurement. See also page 108

Notes: (c) Powers up to 4000W can be measured.

Recommended exposure times and 1/e² Gaussian beam diameters for very long pulses. Total energy for a series of measurements should not exceed 15kJ. Recommended time between shots 12s.

Laser Power W	Recommended Exposure s	Number of shots before cooling down	Min 1/e ² beam dia mm
100	4	20	9
500	1	20	9
1000	1	10	13
2000	1	7	17
4000	0.4	7	20

Notes: (g) $\pm 4\%$. For wavelengths <240nm

Notes: (d) Calibrated for 0.25 – 2 μm , 10.6 μm

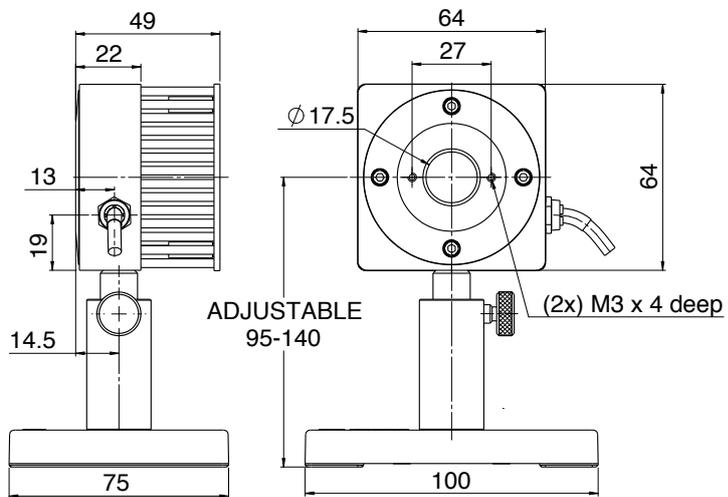
Notes: (e) For 10-50Hz, derate as follows:

Wavelength	Derate to value
1064nm	Not derated
532nm	Not derated
355nm	70% of stated value
266nm	15% of stated value
193nm	10% of stated value

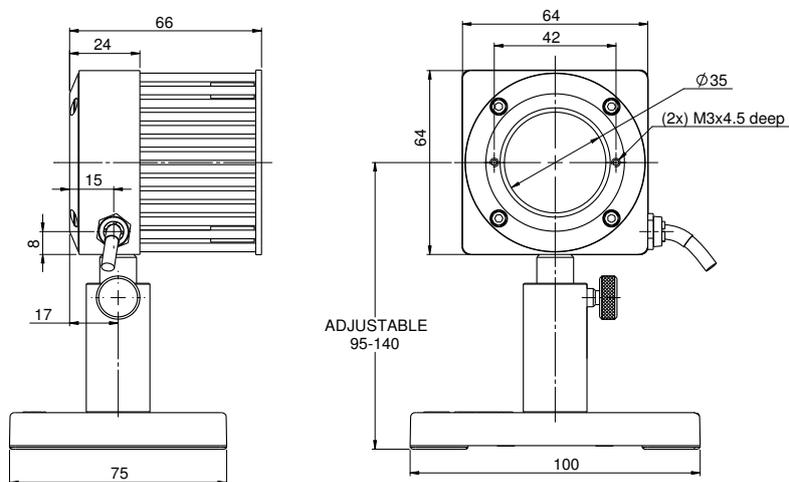
Notes: (f) Damage threshold 1.5J/cm² for wavelengths <500nm

* For drawings please see page 59

30(150)A-BB-18 / 30(150)A-LP2-18



L50(150)A-BB-35 / L50(150)A-LP2-35 / L50(150)A-PF-35



1.1.2.4 Low - Medium Power Thermal Sensors - Apertures to 17.5mm

100mW to 200W

Features

- High repetition rate pulsed lasers for material processing
- Air and fan cooled
- CW to 80W, intermittent to 200W

F80(120)A-CM-17 /
F150(200)A-CM-16



30(150)A-SV-17

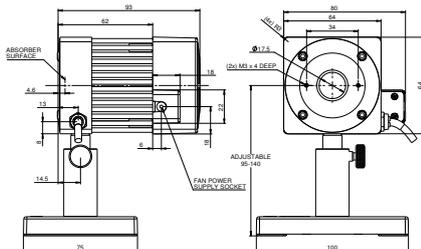


Model	F80(120)A-CM-17	F150(200)A-CM-16	30(150)A-SV-17
Use	High repetition rate pulsed lasers for material processing	High repetition rate pulsed lasers for material processing	High repetition rate pulsed lasers for material processing
Absorber Type	CM	CM	SV
Spectral Range μm	0.248 – 9.4 ^(b)	0.248 – 9.4 ^(b)	0.19 - 11
Aperture mm	\varnothing 17.5mm	\varnothing 16mm	\varnothing 17mm
Power Mode			
Power Range	100mW - 120W	300mW - 200W	100mW - 150W
Maximum Intermittent Power W	120W for 1min, 80W continuous	200W for 1 min, 150W continuous	150W for 1.5min, 100W for 2.2min, 30W continuous
Power Scales	120W / 80W / 8W	200W / 80W / 8W	150W / 30W / 3W
Power Noise Level	5mW	15mW	5mW
CW Maximum Power Density kW/cm^2	7 at 80W (& at 120W for 1 min), 100 at 10W ^(c)	2 at 200W, 3 at 150W, 7 at 80W, 100 at 10W ^(c)	60 at 150W
Pulsed Maximum Average Power Density kW/cm^2 ^(d)	35 at 25W for ns pulses 7 at 20W for ps pulses	35 at 25W for ns pulses 7 at 20W for ps pulses	100 at 25W for ns pulses 20 at 20W for ps pulses
Response Time with Meter (0-95%) typ. s	2	3	1.7
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9
Power Accuracy $\pm\%$	3	3	3
Linearity with Power $\pm\%$	1.5	1.5 ^(e)	1
Energy Mode			
Energy Range	50mJ – 200J	50mJ – 200J	50mJ - 300J
Energy Scales	200J / 30J / 3J	200J / 30J / 3J	300J / 30J / 3J
Minimum Energy mJ	50	50	50
Maximum Energy Density J/cm^2	Pulse width ^(a)	Pulse width ^(a)	Pulse width ^(a)
	<100ns	<100ns	<100ns
	0.5ms	0.5ms	0.5ms
	2ms	2ms	2ms
	0.7	0.7	1
	16	16	20
	45	45	50
Cooling	Fan	Fan	Convection
Fiber Adapters Available (see page 120)	NA	NA	ST, FC, SMA, SC
Weight kg	0.54	0.54	0.3
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			
Part number	7Z07103	7Z07107	7Z02724

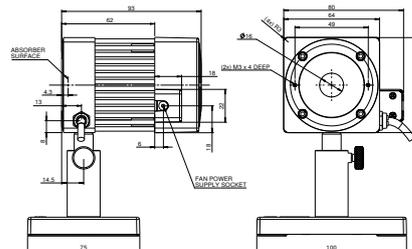
Notes:

- (a) At 1064nm. For shorter wavelengths derate maximum energy density to:
 355nm 50% of above values
 266nm 50% of above values (for CM type 30% of above values)
 193nm 10% of above values
 (b) The sensor is only calibrated in the spectral range 0.25-2.2 μm
 (c) At 1064nm
 (d) For repetition rates \geq 100kHz
 (e) At 200W add additional linearity error of \pm 0.5%

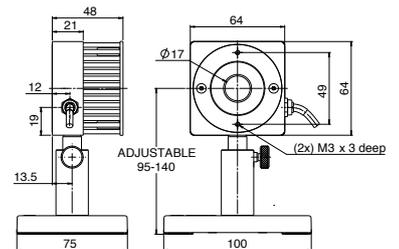
F80(120)A-CM-17



F150(200)A-CM-16



30(150)A-SV-17



1.1.2.4 Low - Medium Power Thermal Sensors - Apertures to 17mm

50mW to 150W

Features

- Special purpose SV and HE absorbers
- For concentrated beams and pulses
- Convection air cooled
- CW to 30 or 50W, intermittent to 150W
- Ø17mm aperture



Model	30(150)A-HE-17		30(150)A-HE-DIF-17				
Use	High energy pulsed lasers		Concentrated beam high energy pulsed lasers - has removable diffuser				
Absorber Type	HE		HE				
Spectral Range μm	0.19 - 0.625, 1.064, 2.1, 2.94		0.19 - 3 except for 0.625 - 0.9 ^(b)				
Aperture mm	Ø17mm		Ø17mm				
Power Mode							
Power Range	50mW - 150W		50mW - 150W				
Maximum Intermittent Power W	150W for 1.5min, 100W for 2.2min, 30W continuous		150W for 1.5min, 100W for 2.2min, 30W continuous				
Power Scales	150W / 30W / 3W		150W / 30W / 3W				
Power Noise Level	3mW		3mW				
CW Maximum Power Density kW/cm ²	0.5		0.5				
Pulsed Maximum Average Power Density kW/cm ² ^(c)	NA		NA				
Response Time with Meter (0-95%) typ. s	3.8		3.8				
Calibration Uncertainty $\pm\%$	1.9		1.9				
Power Accuracy $\pm\%$	3		5 ^(b)				
Linearity with Power $\pm\%$	1.5		1.5				
Energy Mode							
Energy Range	60mJ - 200J		60mJ - 200J				
Energy Scales	200J / 30J / 3J		200J / 30J / 3J				
Minimum Energy mJ	60		60				
Maximum Energy Density J/cm ²	Pulse width ^(a)	Single	10-50Hz				
		<100ns	5	2	Wavelength	DIF IN	DIF OUT
		0.5ms	100	25	1064nm	5	2
		2ms	150	40	532nm	4	2
				355nm	1.5	1	
Cooling	Convection		Convection				
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC		NA				
Weight kg	0.3		0.4				
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS				
Version							
Part number	7Z02722		7Z02729				

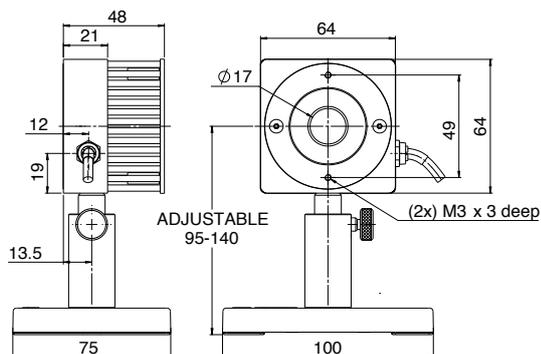
Notes: (a) At 1064nm. For shorter wavelengths derate maximum energy density to:

355nm 50% of above values
266nm 50% of above values
193nm 10% of above values

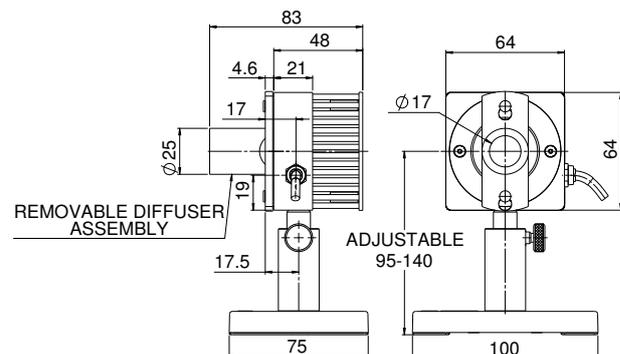
(b) With diffuser in, sensor is only calibrated for 1064nm, 532nm and 355nm wavelengths

(c) For repetition rates $\geq 100\text{kHz}$

30(150)A-HE-17



30(150)A-HE-DIF-17



1.1.2.4 Low - Medium Power Thermal Sensors - Apertures to 26mm

1.1.2.4.1 Medium Power BeamTrack-Power / Position / Size Sensors

40mW to 150W

Features (see introduction in pages 111-113)

- All the features of standard power sensors plus...
- Accurate tracking of beam position to fractions of a mm
- Monitoring of the laser beam size

50(150)A-BB-26-QUAD
/ 50(150)A-BB-26-PPS



F150A-BB-26-PPS



Model	50(150)A-BB-26-QUAD ^(a)	50(150)A-BB-26-PPS ^(a)	F150A-BB-26-PPS ^(a)
Use	General purpose	General purpose	General purpose
Functions	Power / Energy / Position	Power / Energy / Position / Size	Power / Energy / Position / Size
Absorber Type	Broadband	Broadband	Broadband
Spectral Range μm	0.19 - 11	0.19 - 11	0.19 - 11
Aperture mm	\varnothing 26mm	\varnothing 26mm	\varnothing 26mm
Power Mode			
Power Range	40mW - 150W	40mW - 150W	50mW - 150W ^(b)
Maximum Intermittent Power	150W for 1.5min, 100W for 2.2min, 50W continuous	150W for 1.5min, 100W for 2.2min, 50W continuous	N.A.
Power Scales	150W / 50W / 5W	150W / 50W / 5W	150W / 30W / 3W
Power Noise Level	2mW	2mW	8mW ^(b)
Maximum Average Power Density kW/cm ²	12 at 150W, 17 at 50W	12 at 150W, 17 at 50W	12 at 150W, 17 at 50W
Response Time with Meter (0-95%) typ. s	1.5	1.5	1.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(f)	3 ^(f)	3 ^(f)
Linearity with Power $\pm\%$	1.5	1.5	1
Energy Mode			
Energy Range	20mJ - 100J	20mJ - 100J	20mJ - 100J
Energy Scales	100J / 30J / 3J / 300mJ	100J / 30J / 3J / 300mJ	100J / 30J / 3J / 300mJ
Minimum Energy mJ	20	20	20 ^(b)
Maximum Energy Density J/cm ²			
<100ns	0.3	0.3	0.3
0.5ms	5	5	5
2ms	10	10	10
10ms	30	30	30
Beam Tracking Mode			
Position			
Beam Position Accuracy mm ^(c)	0.1 + 5% of distance from center	0.1 + 5% of distance from center	0.1 + 5% of distance from center
Beam Position Resolution mm	0.1	0.1	0.1
Min Power for Position Measurement	1W	1W	1W
Size ^(d)			
Size Accuracy mm ^(e)	N.A.	\pm 5% for centered beam	\pm 5% for centered beam
Size Range mm (4 σ beam diameter)	N.A.	\varnothing 3 - 20	\varnothing 3 - 20
Min Power Density for Size Measurement	N.A.	1 W/cm ²	1 W/cm ²
Cooling	Convection	Convection	Fan
Fiber Adapter Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Weight Kg	0.4	0.4	0.45
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1	V1	V1
Part number	7Z07938	7Z07907	7Z07906

Note: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, Nova II and Vega meters, Juno, Juno+, Juno-RS and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Note: (b) For powers up to 30W it is recommended to work with the fan off and then the noise level is ~3 times lower. It is also recommended to measure energy with the fan off.

Note: (c) Position accuracy for the central 10mm of the aperture as limited by beam position resolution. Position can be tracked with \pm 1mm accuracy over the entire aperture. Accuracy is reduced by a factor of 3 at minimum power. Position measuring center corresponds to geometrical center within <1mm. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

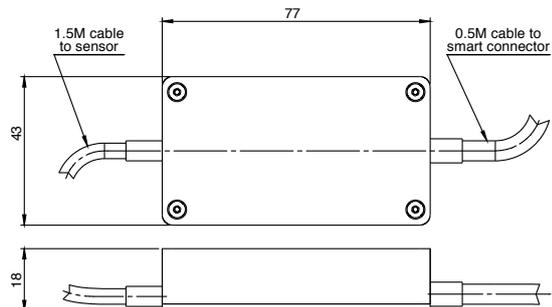
Note: (d) Assumes laser beam with Gaussian (TEM₀₀) distribution. For other modes, size measurement is relative.

Note: (e) Accuracy spec will be maintained for beams from 3.5 to 17mm not deviating from center more than 15% of beam diameter. For beams below 8mm in size and powers above 75W error in size can reach \pm 10%.

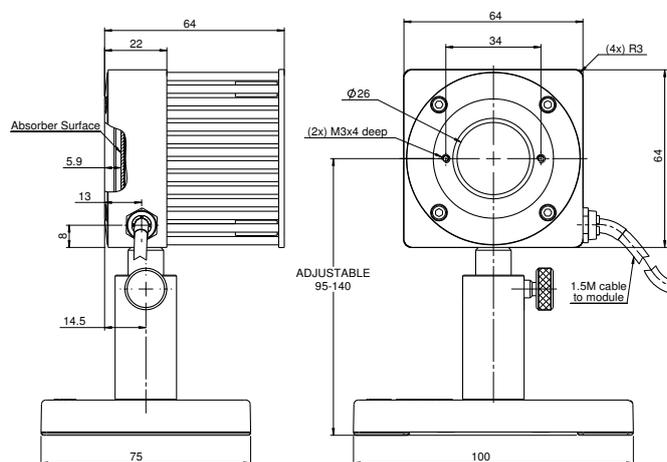
Note: (f) \pm 4%. For wavelengths <240nm

* For drawings please see page 63

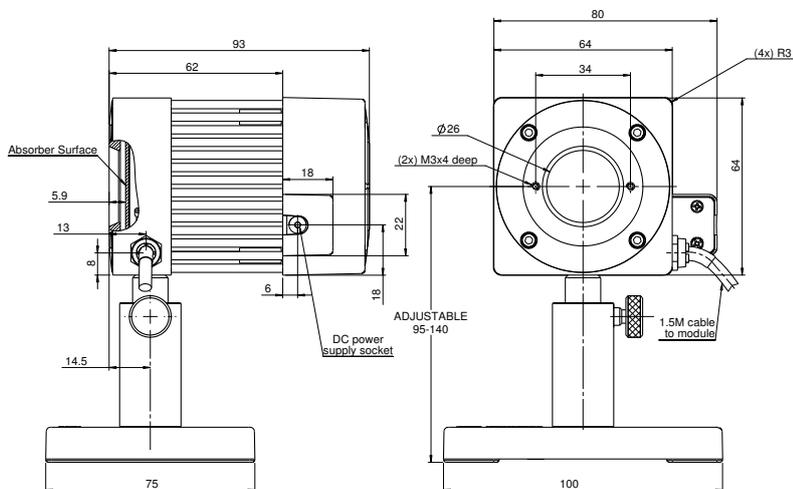
Interface Module on cable



50(150)A-BB-26-QUAD / 50(150)A-BB-26-PPS



F150A-BB-26-PPS



1.1.2.4 Low - Medium Power Thermal Sensors - Apertures to 26mm

1.1.2.4.2 Standard OEM Smart Sensors

10mW to 150W

Features

- Sensors come with threaded holes for mounting to host system
- Compact
- Up to 150W
- Ø12 to Ø26mm apertures



Model	20C-BB-12-SH	L30C-SH	L30C-LP2-26-SH	100C-BB-18-SH	150C-SH / 150W-SH
Use	Compact	Larger aperture	High pulse energy and intermittent power	Slim profile	Compact higher power
Absorber Type	Broadband	Broadband	LP2	Broadband	Broadband
Spectral Range μm	0.19 - 11	0.19 - 20	0.25 - 2.2	0.19 - 11	0.19 - 20
Absorption	~88%	~88%	>94% from 0.25 to 1.1 μm	~88%	~88%
Aperture mm	Ø12	Ø26	Ø26	Ø18	Ø18
Power Mode					
Minimum power	10mW	300mW	300mW	60mW	60mW / 100mW
Maximum power free standing	4W continuous, 20W for 1.8min	10W continuous, 100W for 2min	10W continuous, 100W for 2min	4W	5W continuous, 150W for 1min
Maximum power heat sinked	20W	100W	100W	100W	60W cond. / 150W water
Power Scales	20W / 3W	100W / 10W	100W / 10W	100W / 30W / 3W	150W / 30W
Power Noise Level	0.2mW	15mW	15mW	3mW	3mW / 5mW
Maximum Average Power Density kW/cm ²	23 at 20W, 35 at 4W	14 at 100W, 28 at 10W	42 at 100W	30 at 4W, 14 at 100W	30 at 5W, 20 at 60W / 12 at 150W
Response Time with Meter (0-95%), typ. s	0.8	1.5	1.5	1.2	1.2
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3	3	3 ^(b)	3	3
Linearity with Power $\pm\%$	1	1.5	1.5	1	1
Energy Mode					
Energy Range	6mJ-10J	30mJ-100J	30mJ-2000J	NA	20mJ-100J / 50mJ-100J
Energy Scales	10J / 1J	100J / 30J / 3J / 300mJ	2kJ / 300J / 30J / 3J / 300mJ	NA	100J / 30J / 3J
Minimum Energy mJ	6	30	30	NA	20
Maximum Energy Density J/cm ²					
<100ns	0.3	0.3	0.1	0.3	0.3
0.5ms	2	5	50	5	5
2ms	2	10	130	10	10
10ms	2	30	400	30	30
>300ms	NA	NA	See below ^(c, d)	NA	NA
Cooling	Conduction	Conduction	Conduction	Conduction	Conduction / Water
Weight kg	0.2	0.3	0.3	0.2	0.3
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1			V1	
Part number	7Z07129	773434	7Z02775	7Z07126	7N77023^(a) / 771001

Note: (a) P/N 7N77023 replaces P/N 77023

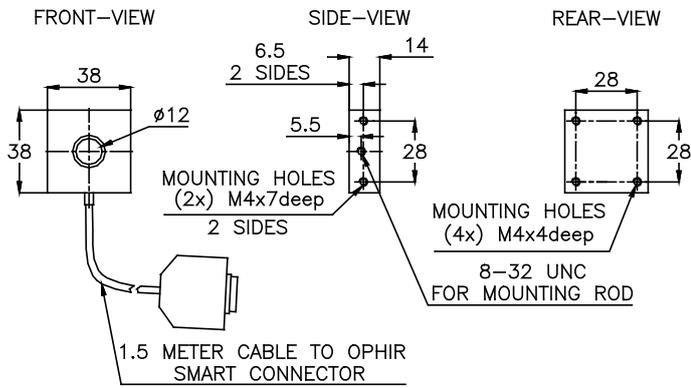
Note: (b) Above 1.1 μm there is an additional calibration uncertainty of up to 2%

Note: (c) Long pulses (0.5 – 4s) can be used to measure power of high power lasers by measuring the energy of a short exposure. The StarBright, Juno, Juno+, Juno-RS and Centauri meters have a Pulsed Power mode where the user may specify the pulse width and get a reading directly in units of power for this short exposure energy measurement. See also page 108

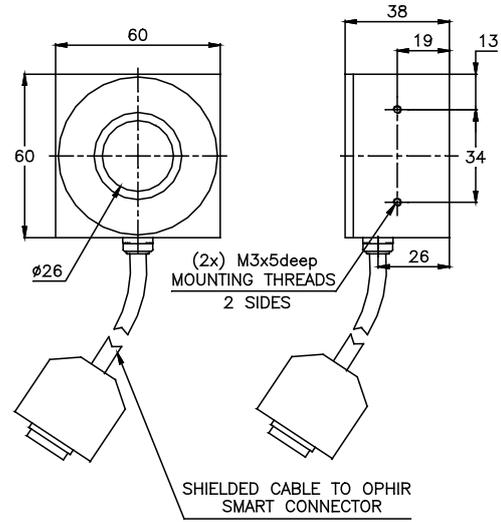
Note: (d) Recommended exposure times and 1/e ² Gaussian beam diameters for very long pulses. Total energy for a series of measurements should not exceed 2kJ. Recommended time between shots 12s.	Laser Power W	Recommended Exposure s	Number of shots before cooling down	Min 1/e ² beam dia. mm
	100	4	20	9
	500	1	20	9
	1000	1	10	13
	2000	1	5	17
	4000	0.5	5	22

* For drawings please see page 65

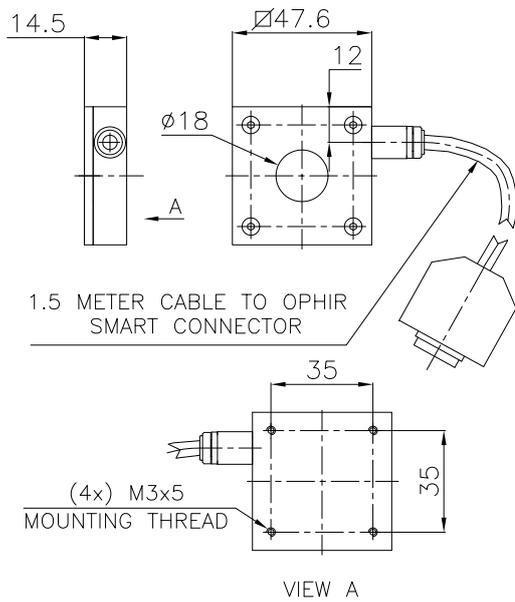
20C-BB-12-SH



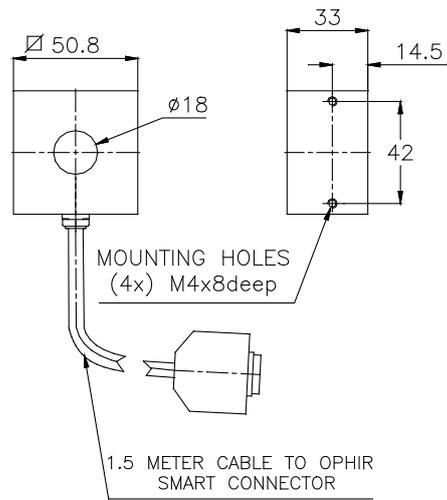
L30C-SH / L30C-LP2-26-SH



100C-BB-18-SH



150C-SH

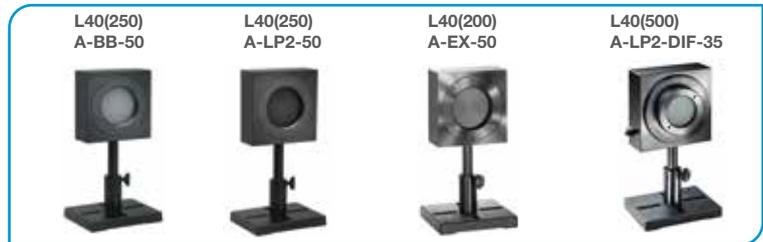


1.1.2.5 Medium Power Large Aperture Thermal Sensors - Apertures 50mm

300mW to 500W and up to 10kJ

Features

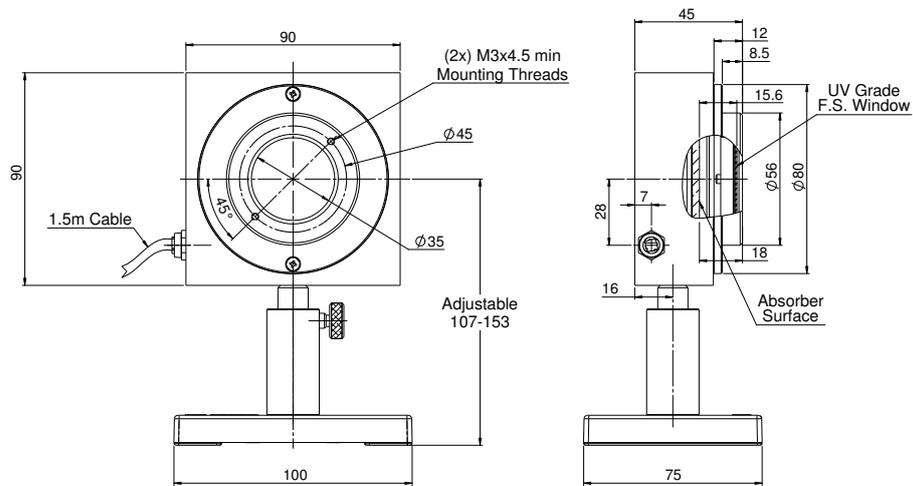
- Thin profile
- CW to 40W, intermittent to 500W
- Pulse energies up to 10,000 Joules
- For continuous, long pulse and Excimer lasers
- Measure high power lasers by 0.5-4s exposures



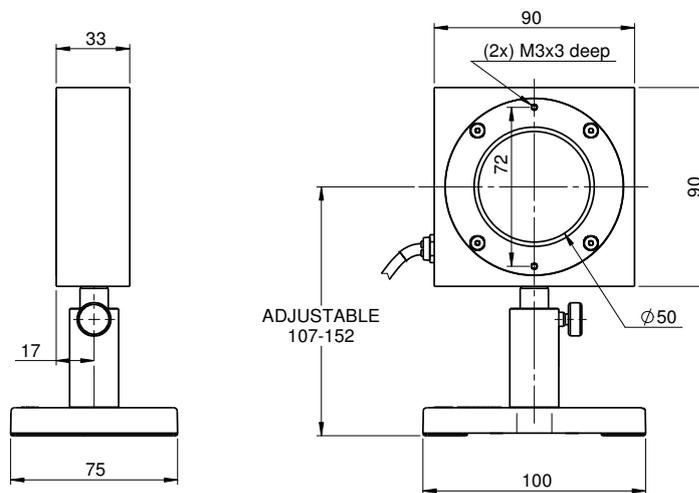
Model	L40(250)A-BB-50	L40(250)A-LP2-50	L40(200)A-EX-50	L40(500)A-LP2-DIF-35
Use	General purpose	CW and Long Pulse Lasers	Excimer lasers	Concentrated Beams
Absorber Type	Broadband	LP2	EX	LP2 + Diffuser
Spectral Range μm	0.19 - 11	0.25 - 2.2, 2.94	0.15 - 0.7, 10.6	0.44 - 2.2 ^(c)
Absorption	~88%	>94% from 0.25 to 1.1 μm	~95%	~14% backscatter from diffuser
Aperture mm	\varnothing 50mm	\varnothing 50mm	\varnothing 50 mm	\varnothing 35mm
Power Mode				
Power Range	300mW - 250W ^(b)	300mW - 250W ^(b)	300mW - 200W	300mW - 500W ^(b)
Maximum Intermittent Power	250W for 1.5min, 150W for 3min, 80W for 6min, 35W continuous ^(b)	250W for 1.5min, 150W for 3min, 80W for 6min, 40W continuous ^(b)	200W for 1.5min, 150W for 3min, 80W for 6min, 35W continuous	500W for 45s, 250W for 1.5min, 150W for 3min, 80W for 6min, 40 continuous ^(b)
Power Scales	250W / 30W	250W / 30W	200W / 20W	500W / 50W
Power Noise Level	15mW	15mW	15mW	20mW
Maximum Average Power Density kW/cm ²	10 at 250W 20 at 35W	20 at 250W 50 at 40W	1.5	>150 at 500W
Response Time with Meter (0-95%) typ. s	2.5	2.5	2.5	2.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(f)	3 ^(a)	3	3
Linearity with Power $\pm\%$	1	1	1	1
Beam Size Dependence	<1% for beams up to 35mm diameter			
Max Beam Diameter for Gaussian beam	\varnothing 35mm	\varnothing 35mm for up to 30deg incidence	\varnothing 35mm	\varnothing 25mm for normal incidence \varnothing 15mm for 20deg incidence ^(d) \varnothing 10mm for 30deg incidence ^(d)
Energy Mode				
Energy Range	100mJ - 4000J	100mJ - 10,000J	100mJ - 200J	100mJ - 2000J
Energy Scales	4kJ / 400J / 40J / 4J	10kJ / 1kJ / 100J / 10J	200J / 30J / 3J	2kJ / 200J / 20J / 2J
Energy Accuracy	\pm 5%	\pm 5% 700 - 1100nm ^(a, b)	\pm 5%	\pm 5% 900 - 1100nm ^(b)
Maximum Exposure Before Cooling Down is Necessary	NA	See page 108	NA	See page 108
Minimum Energy mJ	100	100	100	100
Maximum Energy Density J/cm ²				
<100ns	0.3	0.1	0.5	3
1 μ s	0.4	0.9	0.6	3
0.5ms	5	50	6	10
2ms	10	130	12	20
10ms	30	400	25	30
>300ms	See below ^(b, e)	See below ^(b, e)	NA	See below ^(b, e)
Cooling	Convection	Convection	Convection	Convection
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	NA	NA
Weight kg	0.6	0.8	0.6	0.6
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1			
Part number: Standard Sensor	7Z07110 (1.5m cable)	7Z02794	7Z02795	7Z02797
Sensor with different cable length	7Z07110D (12m cable)			
Notes: (a) Above 1.1 μm there is an additional calibration uncertainty of up to 2% except at the additional calibration point of 2.94 μm where the additional uncertainty is 1%.				
Notes: (b) Long pulses (0.5 - 4s) can be used to measure power of high power lasers by measuring the energy of a short exposure. The StarBright, Juno, Juno+, Juno-RS and Centauri meters have a Pulsed Power mode where the user may specify the pulse width and get a reading directly in units of power for this short exposure energy measurement. See also page 108				
Notes: (c) Calibrated for 900 - 1100nm				
Notes: (d) At large angles of incidence, the position the beam hits the absorber should be offset into the direction of incidence by 5-10mm for correct reading and at 20deg incidence the reading will be 5% lower and at 30deg incidence 10% lower				
Notes: (e) Recommended exposure times and 1/e ² Gaussian beam diameters for very long pulses. Total energy for a series of measurements should not exceed 20kJ (*8kJ). Cooling down time before another 20kJ (*8kJ) series, 10min. Recommended time between shots 12s.				
Notes: (f) \pm 4%. For wavelengths <240nm	Lasers Power W	Recommended Exposure s	Number of shots before cooling down	Min 1/e ² beam dia. mm
		Non- Diffuser		L40(250)A-BB-50
		Diffuser		L40(250)A-LP2-50
				L40(500)A-LP2-DIF-35
	100	4	20	14
	500	2	20	14
	1000	1	20	14
	2000	1	10	21
	4000	1	5	32
	5000	1	4	NA
	10000	0.3	4	NA

* For drawings please see page 67

L40(500)A-LP2-DIF-35



L40(250)A-BB-50 / L40(250)A-LP2-50 / L40(200)A-EX-50



1.1.2.5 Medium Power Large Aperture Thermal Sensors - Apertures to 65mm

300mW to 300W

Features

- Thin profile, very large aperture
- CW to 50W, intermittent to 300W
- Ø50mm to Ø65mm apertures

For L50(250)A-BB-50:

- Pulse energies up to 4,000 Joules
- Measure high power lasers by 0.5-4s exposures

L50(250)A-BB-50



L50(300)A-LP2-65

L50(300)A-BB-65 /
L50(300)A-PF-65

Model	L50(250)A-BB-50	L50(300)A-BB-65	L50(300)A-LP2-65	L50(300)A-PF-65
Use	General purpose	General purpose	Long pulse lasers	Large beam short pulsed lasers
Absorber Type	Broadband	Broadband	LP2	PF type
Spectral Range μm	0.19 - 11	0.19 - 11	0.25 - 2.2	0.15 - 20
Absorption	~88%	~88%	>94% from 0.25 to 1.1 μm	~85%
Aperture mm	Ø50mm	Ø65mm	Ø65mm	Ø65mm
Power Mode				
Power Range	300mW - 250W ^(a)	400mW - 300W	400mW - 300W	400mW - 300W
Maximum Intermittent Power	250W for 1.5min, 150W for 3min, 80W for 6min, 50W continuous ^(a)	300W for 2min, 150W for 4.5min, 50W continuous		
Power Scales	250W / 30W	300W / 30W	300W / 30W	300W / 30W
Power Noise Level	15mW	20mW	20mW	20mW
Maximum Average Power Density kW/cm ²	10 at 250W 17 at 50W	9.5 at 300W 17 at 50W	17 at 300W 50 at 50W	3
Response Time with Meter (0-95%) typ. s	2.5	3	3	3
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(g)	3 ^(g)	3 ^(g)	4 ^(c)
Linearity with Power $\pm\%$	1	1	1	1
Beam Size Dependence	<1% for beams up to 35mm diameter	NA	NA	NA
Energy Mode				
Energy Range	100mJ - 4000J	200mJ - 300J	200mJ - 1000J	200mJ - 300J
Energy Scales	4kJ / 400J / 40J / 4J	300J / 60J / 6J	1000J / 600J / 60J / 6J	300J / 60J / 6J
Minimum Energy mJ	100	200	200	200
Maximum Energy Density J/cm ²				Single ^(d) 10-50Hz ^(d)
<100ns	0.3	0.3	0.1	3 ^(e) 1.5
1 μs	0.4	0.4	0.9	3 ^(e) 1.5
0.5ms	5	5	50	7 7
2ms	10	10	130	15 15
10ms	30	30	400	40 40
>300ms	See below ^{(a), (f)}	NA	NA	NA
Cooling	convection	convection	convection	convection
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	NA	NA	NA
Weight kg	0.6	0.9	0.9	0.9
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1	V1		
Part number	7Z07109	7Z07127	7Z02782	7Z02743

Note: (a) Long pulses (0.5 – 4s) can be used to measure power of high power lasers by measuring the energy of a short exposure. The StarBright, Juno, Juno+, Juno-RS and Centauri meters have a Pulsed Power mode where the user may specify the pulse width and get a reading directly in units of power for this short exposure energy measurement. See also page 108

Note: (b) Above 1.1 μm there is an additional calibration uncertainty of up to 2%

Note: (c) Calibrated for 0.25 – 2 μm , 10.6 μm

Note: (d) For 10-50Hz, derate as follows:

Wavelength	Derate to value
1064nm	Not derated
532nm	Not derated
355nm	70% of stated value
266nm	15% of stated value
193nm	10% of stated value

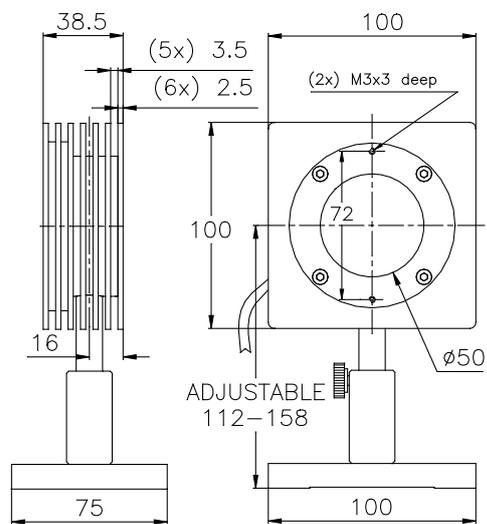
Note: (e) Damage threshold 1.5J/cm² for wavelengths <500nm

Note: (f) Recommended exposure times and 1/e ² Gaussian beam diameters for very long pulses. Total energy for a series of measurements should not exceed 20kJ. Cooling down time before another 20kJ series, 10min. Recommended time between shots 12s.	Laser Power W	Recommended Exposure s	Number of shots before cooling down	Min 1/e ² beam dia. mm
	500	2	20	14
	1000	1	20	14
	2000	1	10	21
	4000	1	5	32
	5000	1	4	NA
	10000	0.3	4	NA

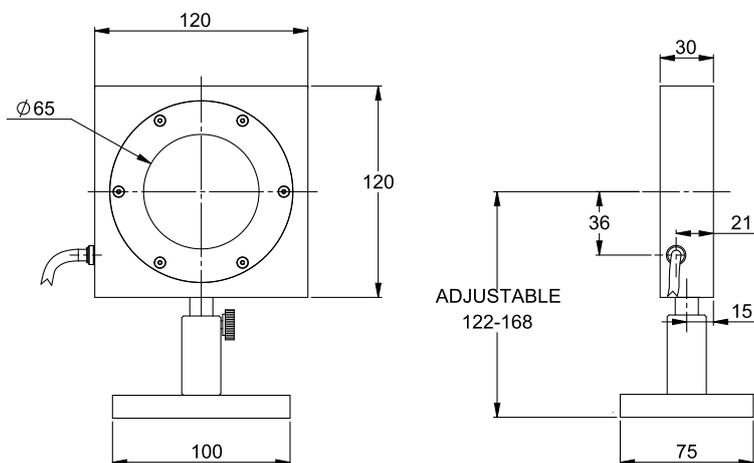
Note: (g) $\pm 4\%$. For wavelengths <240nm

* For drawings please see page 69

L50(250)A-BB-50



L50(300)A-BB-65 / L50(300)A-LP2-65 / L50(300)A-PF-65



1.1.2.5 Medium Power Large Aperture Thermal Sensors – Apertures to 120mm

1W to 500W

Features

- Very large aperture
- Pulsed absorber
- Up to 500W
- Ø120mm aperture

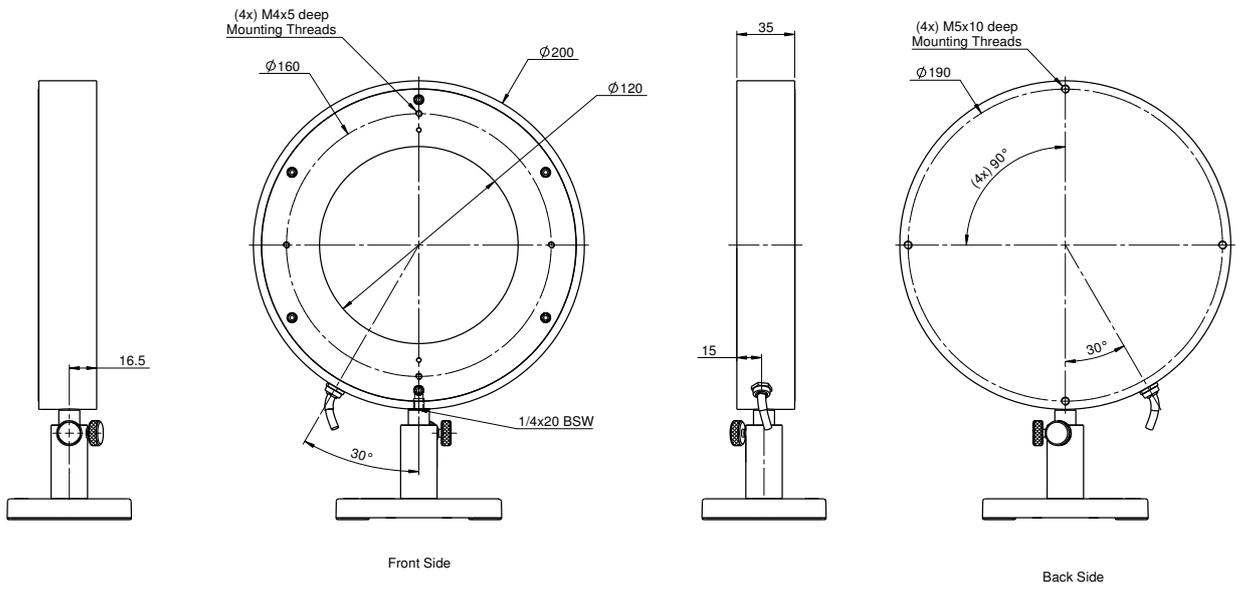
L100(500)A-PF-120



Model	L100(500)A-PF-120	
Use	High peak power, high energy measurements	
Absorber Type	PF volume absorber	
Spectral Range μm	0.15 – 20	
Aperture mm	Ø120mm	
Power Mode		
Power Range	1W – 500W	
Maximum Intermittent Power	500W for 2min, 100W continuous, 500W continuous if heat sinked on rear	
Power Scales	500W / 50W	
Power Noise Level	50mW	
Maximum Average Power Density W/cm^2	2000	
Response Time with Meter (0-95%) typ. s	7	
Calibration Uncertainty $\pm\%$	1.9	
Power Accuracy $\pm\%$	4 ^(a)	
Linearity with Power $\pm\%$	2	
Energy Mode		
Energy Range	6J – 6000J	
Energy Scales	6kJ / 600J / 60J	
Minimum Energy	6J	
Maximum Energy Density J/cm^2	Single	10-50Hz ^(b)
<100ns	3 ^(c)	1.5
1 μs	3 ^(c)	1.5
0.5ms	7	7
2ms	15	15
10ms	40	40
1s	3000	NA
Cooling	Convection or conduction	
Fiber Adapters	Consult Ophir representative	
Accessories for High Power Sensors	See pages 99-102	
Weight kg	4.4	
Compliance	CE, UKCA, China RoHS	
Version		
Part number	7Z02765	
Notes: (a)	Calibrated for 0.25 – 2 μm	
Notes: (b)	For 10-50Hz derate as follows: 1064nm not derated 532nm not derated 355nm 70% of stated value 266nm 15% of stated value 193nm 10% of stated value	
Notes: (c)	Damage threshold 1.5J/cm ² for wavelengths <500nm	

* For drawings please see page 69B

L100(500)A-PF-120



1.1.2.5 Medium Power Large Aperture Thermal Sensors - Apertures 65mm

1.1.2.5.1 Sensors for Intense Pulsed Light IPL

100mJ to 2000J

Features

- L50(300)A-IPL: Large aperture with glass for gel coupling
- L40(150)A-IPL: Designed for gel coupled sources
- L50(300)A-LP2-65: Large aperture and low angle dependence

L50(300)A-IPL



L40(150)A-IPL



L50(300)A-LP2-65



Model	L50(300)A-IPL	L40(150)A-IPL	L50(300)A-LP2-65
Use	Gel and Air coupled IPL and laser sources	Gel coupled IPL sources and laser sources	Air coupled IPL and laser sources
Absorber Type	LP2 + coated window ^(a)	LP2 + pyramid coupling to capture large output light angles	LP2
Spectral Range μm	0.5 - 1.3	0.5 - 1.3	0.25 – 2.2
Absorption	86%	92%	>94% from 0.25 to 1.1 μm
Aperture mm	\varnothing 65mm	22x22mm ^(b)	\varnothing 65mm
Power Mode			
Power Range	400mW - 300W	NA	400mW - 300W
Maximum Intermittent Power	300W for 2 min, 150W for 4.5min, 50W continuous	NA	300W for 2min, 150W for 4.5min, 50W continuous
Power Scales	300W / 30W	NA	300W / 30W
Power Noise Level	20mW	NA	20mW
Maximum Average Power Density kW/cm ²	17 at 300W 50 at 50W	NA	17 at 300W 50 at 50W
Response Time with Meter (0-95%) typ. s	3	NA	3
Calibration Uncertainty $\pm\%$	1.9	NA	1.9
Power Accuracy $\pm\%$	6 for most gel or air coupled IPL sources	NA	3 ^(e)
Linearity with Power $\pm\%$	1	NA	1
Energy Mode			
Energy Range	120mJ - 1000J	100mJ - 2000J	200mJ – 1000J
Energy Scales	1000J / 600J / 60J / 6J	2000J / 600J / 60J / 6J	1000J / 600J / 60J / 6J
Minimum Energy mJ	120	100	200
Damage Threshold	Maximum Energy Density J/cm ²	Maximum Energy J	Maximum Energy Density J/cm ²
<100ns	0.1	1	0.1
1 μs	0.9	9	0.9
0.5ms	50	500	50
2ms	130	1300	130
10ms	400	2000	400
Energy Accuracy $\pm\%$	8 for gel coupled source ^(c) 5 for air coupled source	8 for gel coupled source ^(c)	5 for air coupled source ^(d)
Cooling	convection / ballistic	convection / ballistic	convection / ballistic
Weight kg	1.0	1.0	0.9
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1		
Part number	7Z02780	7Z02771	7Z02782

Note: (a) Sensor has a window for gel coupled IPL sources where IPL source is coupled to window with gel or water for measurement. Can also measure air coupled IPLs.

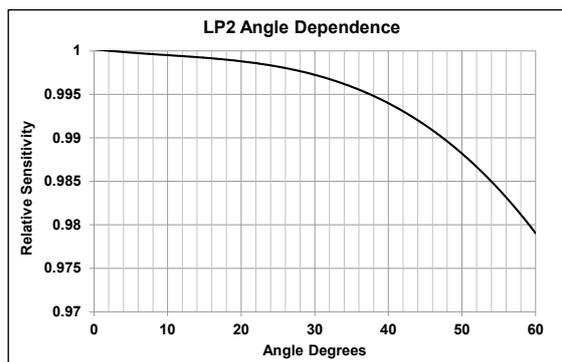
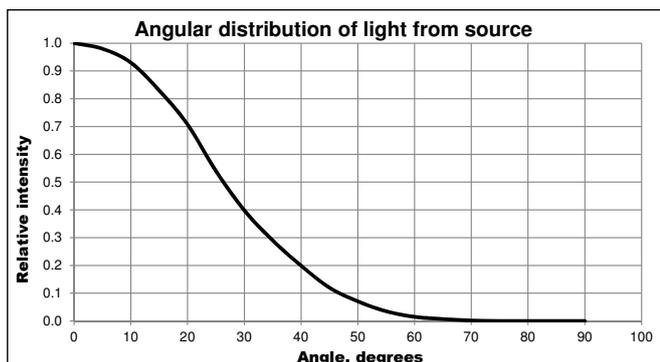
Note: (b) If the source is longer than the aperture, it can overfill and the output can be calculated proportionately.

Note: (d) Accurate measurement of air coupled sources due to low angular dependence of LP2 coating. See graph on page 71.

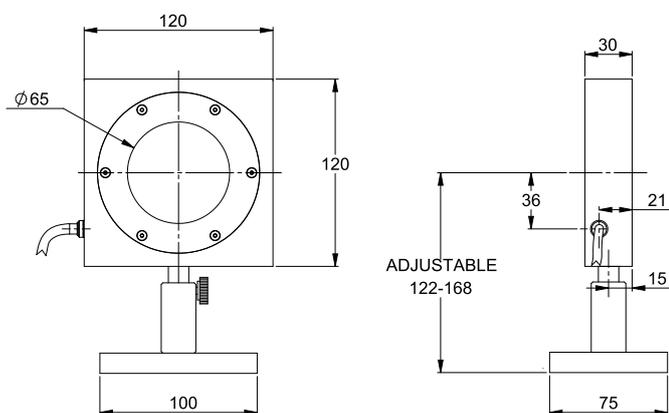
Note: (e) Above 1.1 μm there is an additional calibration uncertainty of up to 2%.

Note: (c) The assumed angular distribution of the IPL light is given below. The angle dependence of the LP2 coating is shown on page 71.

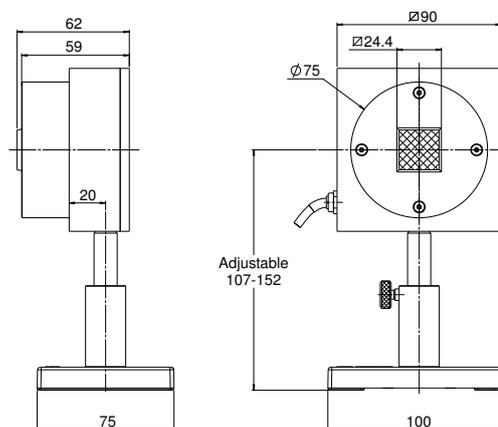
* For drawings and graphs please see page 71



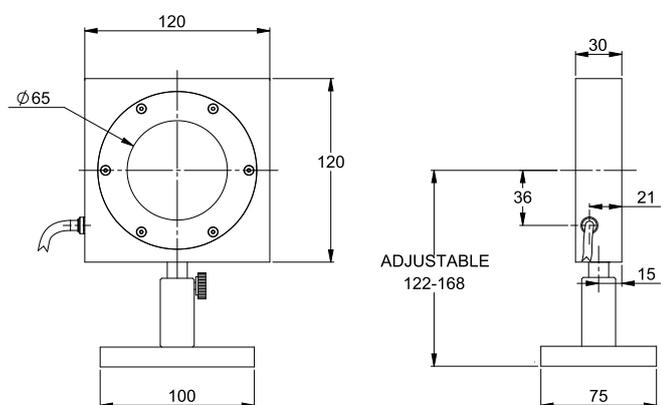
L50(300)A-IPL



L40(150)A-IPL



L50(300)A-LP2-65



1.1.2.6 Medium - High Power Fan Cooled Thermal Sensors

10mW to 150W

Features

- General purpose and high damage threshold
- Fan cooled
- Powers to 150W
- Ø17.5mm to Ø35mm apertures
- F50A-BB-18 very stable reading and wide dynamic range

F50A-BB-18



F100A-PF-DIF-33



F150A-BB-26



Model	F50A-BB-18	F100A-PF-DIF-33	F150A-BB-26
Use	Monitoring stability of power	Short pulse lasers	General purpose
Absorber Type	Broadband	PF type + diffuser	Broadband
Spectral Range μm	0.19 - 11	0.24 - 2.2	0.19 - 11
Aperture mm	Ø17.5mm	Ø33mm	Ø26mm
Power Mode			
Power Range	10mW - 50W ^(a)	50mW - 100W ^(d)	50mW - 150W ^(d)
Power Scales	50W / 5W / 500mW	100W / 30W / 3W	150W / 30W / 3W
Power Noise Level	0.5mW	6mW ^(c)	3mW ^(c)
Maximum Average Power Density kW/cm ²	17 at 50W 28 at 10W	>6	12 at 150W 17 at 50W
Response Time with Meter (0-95%) typ. s	0.8	2.5	1.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(e)	5 ^(c)	3 ^(e)
Linearity with Power $\pm\%$	1	1.5	1
Energy Mode			
Energy Range	6mJ - 50J ^(a)	60mJ - 200J	20mJ - 100J
Energy Scales	50J / 5J / 500mJ	200J / 30J / 3J	100J / 30J / 3J / 300mJ
Minimum Energy mJ	6	60 ^(d)	20 ^(d)
Maximum Energy Density J/cm ²			
<100ns	0.3	4 ^(b)	0.3
0.5ms	2	15 ^(b)	5
2ms	2	35 ^(b)	10
10ms	2	50 ^(b)	30
Cooling	fan	fan	fan
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	NA	ST, FC, SMA, SC
Weight kg	0.35	0.8	0.35
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1		V1
Part number: Standard Sensor	7Z07121	7Z02744	7Z07120
BeamTrack Sensor: Beam Position & Size (p. 62)			7Z07906

Notes: (a) Fan should be on for power above 3W. Fan should be off for measuring very low power and for energy measurement.

Notes: (b) For shorter wavelengths derate maximum energy density as follows: Wavelength Derate to value:

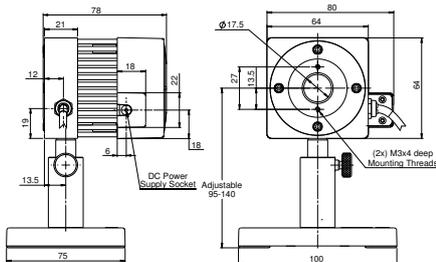
1064nm	not derated	355nm	60% of stated value
532nm	80% of stated value	266nm	40% of stated value
		193nm	NA

Notes: (c) Calibrated at specified wavelengths only: 266nm, 355nm, 532nm, 1064nm and 2100nm only

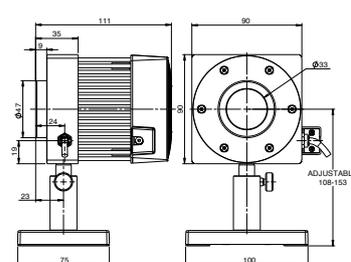
Notes: (d) For lower powers up to 30W it is recommended to work with the fan off and then the noise level is ~3 times lower. It is also recommended to measure energy with the fan off.

Notes: (e) $\pm 4\%$. For wavelengths <240nm

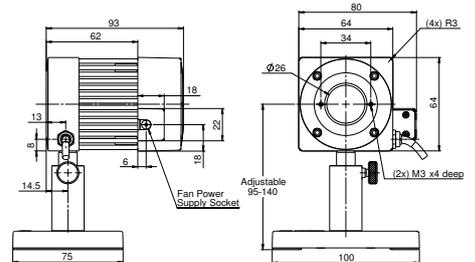
F50A-BB-18



F100A-PF-DIF-33



F150A-BB-26



1.1.2.6 Medium - High Power Fan Cooled Thermal Sensors

100mW to 250W

Features

- General purpose and high damage threshold
- Fan cooled
- Up to 250W
- Up to Ø35mm apertures



Model	FL250A-BB-35	FL250A-LP2-35	FL250A-LP2-DIF-33
Use	General purpose	High power density and long pulse lasers	Diffuser for highest energy densities
Absorber Type	Broadband	LP2	LP2 + diffuser
Spectral Range μm	0.19 - 20	0.25 - 2.2	0.4 - 3
Absorption	~88%	>94% from 0.25 to 1.1 μm	20%
Aperture mm	Ø35mm	Ø35mm	Ø33mm
Power Mode			
Power Range ^(c)	150mW - 250W	100mW - 250W	400mW - 250W
Power Scales	250W / 30W	250W / 30W	250W / 30W
Power Noise Level ^(c)	15mW	10mW	20mW ^(d)
Maximum Average Power Density kW/cm ²	10 at 250W 12 at 150W	20 at 250W 33 at 150W	2
Response Time with Meter (0-95%) typ. s	2	2	2.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9
Power Accuracy $\pm\%$	3	3 ^(b)	3 ^(b)
Linearity with Power $\pm\%$	1	1	1.5
Energy Mode			
Energy Range	50mJ - 300J	50mJ - 300J	400mJ - 600J
Energy Scales	300J / 30J / 3J	300J / 30J / 3J	600J / 60J
Minimum Energy mJ ^(d)	50	50	400
Maximum Energy Density J/cm ²			
<100ns	0.3	0.1	0.5
0.5ms	5	50	200
2ms	10	130	400
10ms	30	400	1000
Cooling	fan	fan	fan
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	NA
Weight kg	0.4	0.4	0.45
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			
Part number	7Z02728	7Z02777	7Z02787

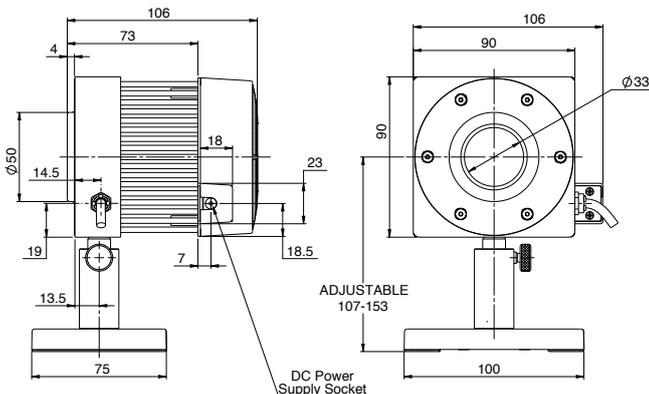
Notes: (a) Calibrated at specified wavelengths only: 532nm, 755nm, 1064nm and 2940nm

Notes: (b) Above 1.1 μm there is an additional calibration uncertainty of up to 2%

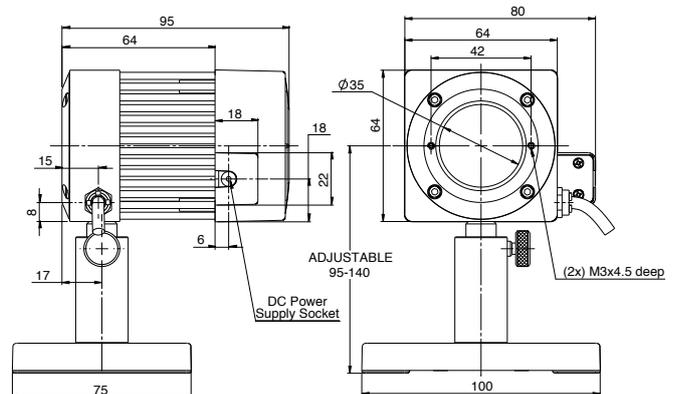
Notes: (c) For lower powers up to 30W it is recommended to work with the fan off and then the noise level is ~5 times lower. It is also recommended to measure energy with the fan off

Notes: (d) When sensor is hot, there can be large zero offset up to 300mW

FL250A-LP2-DIF-33



FL250A-BB-35 / FL250A-LP2-35



1.1.2.6 Medium - High Power Fan Cooled Thermal Sensors

100mW to 500W

Features

- High powers and energies, large apertures
- Fan cooled
- Up to 500W
- Ø50mm aperture

FL250A-BB-50 /
FL400A-BB-50



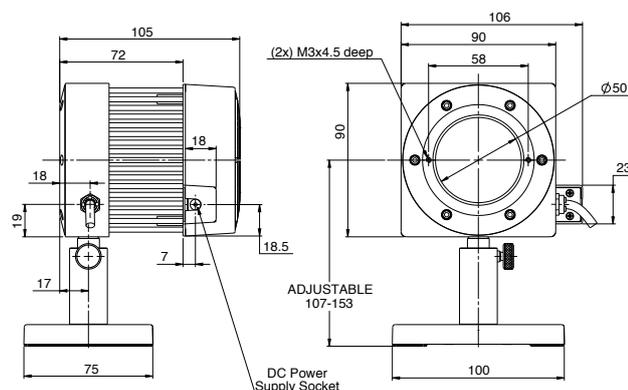
FL400A-LP2-50



Model	FL250A-BB-50	FL400A-BB-50	FL400A-LP2-50
Use	General purpose	General purpose	High power densities and long pulses
Absorber Type	Broadband	Broadband	LP2
Spectral Range μm	0.19 - 11	0.19 - 20	0.35 - 2.2, 10.6 ^(b)
Absorption	~88%	~88%	>96% from 0.35 to 1.1 μm , 75% for 10.6 μm
Aperture mm	Ø50mm	Ø50mm	Ø50mm
Power Mode			
Power Range ^(a)	150mW - 250W	300mW - 500W	100mW - 500W
Maximum Intermittent Power	NA	500W for 1 min, 400W continuous	500W for 1 min, 400W continuous
Power Scales	250W / 30W	500W / 50W	500W / 50W
Power Noise Level ^(a)	10mW	40mW	15mW
Maximum Average Power Density kW/cm ²	10 at 250W 12 at 150W	8.5 at 400W 12 at 150W	10 at 400W 20 at 150W
Response Time with Meter (0-95%) typ. s	2.5	4	4
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(c)	3	3 ^(b)
Linearity with Power $\pm\%$	1	1.5	1.5
Energy Mode			
Energy Range	80mJ - 300J	75mJ - 600J	250mJ - 600J
Energy Scales	300J / 30J / 3J	600J / 60J / 6J	600J / 60J / 6J
Minimum Energy mJ ^(a)	80	75	250
Maximum Energy Density J/cm ²			
<100ns	0.3	0.3	0.07
1 μs	0.4	0.4	0.6
0.5ms	5	5	35
2ms	10	10	90
10ms	30	30	270
Cooling	fan	fan	fan
Fiber Adapters Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Weight kg	0.8	0.9	0.9
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1		
Part number: Standard Sensor	7Z07116 (1.5m cable)	7Z02734	7Z02778
BeamTrack Sensor: Beam Position & Size (p. 76)	7Z07902		
Sensor with different cable length	7Z07116B (5m cable)		

Notes: (a) For lower powers up to 30W it is recommended to work with the fan off and then the noise level is ~5 times lower. It is also recommended to measure energy with the fan off.
Notes: (b) This LP2 sensor is calibrated for 0.35-1.1 μm and 10.6 μm . For other wavelengths in the spectral range 1100 - 2200nm there is an additional calibration uncertainty of up to 1%.
Notes: (c) $\pm 4\%$. For wavelengths <240nm

FL250A-BB-50 / FL400A-BB-50 / FL400A-LP2-50



1.1.2.6 Medium - High Power Fan Cooled Thermal Sensors

5W to 1100W

Features

- High powers and energies, large apertures
- Fan cooled
- Up to 1100W
- Ø65mm aperture

FL600A-BB-65 /
FL1100A-BB-65



FL600A-LP2-65 /
FL1100A-LP2-65



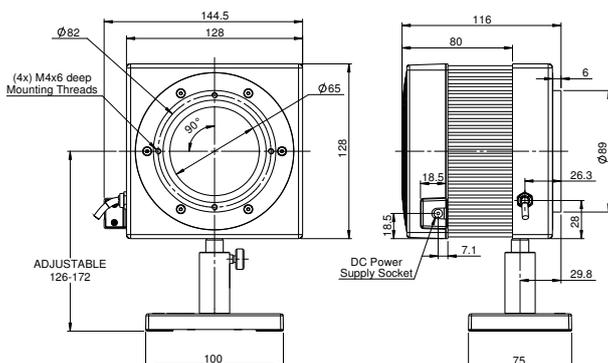
Model	FL600A-BB-65	FL600A-LP2-65	FL1100A-BB-65	FL1100A-LP2-65
Use	General purpose	Long pulses	Highest power fan cooled	Long pulses
Absorber Type	Broadband	LP2	Broadband	LP2
Spectral Range μm	0.19 - 11	0.35 - 2.2	0.19 - 11	0.35 - 2.2
Absorption	~88%	>94% from 0.35 to 1.1 μm	~88%	>94% from 0.35 to 1.1 μm
Aperture mm	Ø65mm	Ø65mm	Ø65mm	Ø65mm
Power Mode				
Power Range	5W - 600W	5W - 600W	5W - 1100W	5W - 1100W
Power Scales	600W / 60W	600W / 60W	1100W / 500W / 50W	1100W / 800W / 80W
Power Noise Level	200mW	200mW	200mW	200mW
Maximum Average Power Density kW/cm ²	12 at 150W 7 at 600W	33 at 150W 11 at 600W	8 at 500W 5.5 at 1100W	33 at 150W 11 at 600W 9 at 1100W
Response Time with Meter (0-95%) typ. s ^(c)	4	4	4	4
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$	3	3 ^(b)	3	3 ^(b)
Linearity with Power $\pm\%$	1.5	1.5	1.5	1.5
Energy Mode^(a)				
Energy Range	600mJ - 600J	600mJ - 600J	600mJ - 600J	600mJ - 1000J
Energy Scales	600J / 60J / 6J	600J / 60J / 6J	600J / 60J / 6J	1000J / 600J / 60J / 6J
Minimum Energy mJ	600	600	600	600
Maximum Energy Density J/cm ²				
<100ns	0.3	0.1	0.3	0.1
1 μs	0.4	0.9	0.4	0.9
0.5ms	4	50	4	50
2ms	10	130	10	130
10ms	30	400	30	400
Cooling	fan	fan	fan	fan
Fiber Adapters	Consult Ophir representative	Consult Ophir representative	Consult Ophir representative	Consult Ophir representative
Weight kg	2.4	2.4	2.4	2.6
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version				
Part Number: Standard Sensor	7Z02762	7Z02779	7Z02761	7Z02784
Sensor with different cable lengths			7Z02761A (3m cable)	

Notes: (a) It is recommended to measure energy with the fan off.

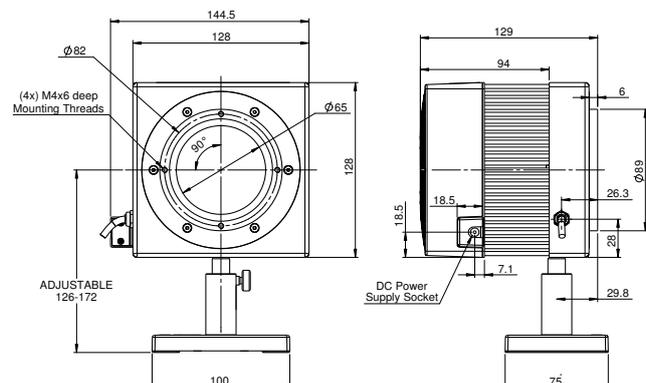
Notes: (b) Above 1.1 μm there is an additional calibration uncertainty of up to 2%.

Notes: (c) Time to reach 98% of final reading is ~30s. 99% within ~2minutes. This time may be longer at low powers less than 20W.

FL600A-BB-65 / FL600A-LP2-65



FL1100A-BB-65 / FL1100A-LP2-65



1.1.2.6 Medium - High Power Thermal Sensors

1.1.2.6.1 Medium - High Power BeamTrack-Power / Position / Size Sensors

150mW to 1000W

Features (see introduction in pages 111-113)

- All the features of standard power sensors plus...
- Accurate tracking of beam position to fractions of a mm
- Monitoring of the laser beam size

FL250A-BB-50-PPS



1000W-BB-34-QUAD



Model	FL250A-BB-50-PPS ^(a)	1000W-BB-34-QUAD ^(a)
Use	General purpose	General purpose
Functions	Power / Energy / Position / Size	Power / Energy / Position
Absorber Type	Broadband	Broadband
Spectral Range μm	0.19 - 20	0.19 - 20
Aperture mm	\varnothing 50mm	\varnothing 34mm
Power Mode		
Power Range	150mW - 250W ^(b)	5W - 1000W
Power Scales	250W / 30W	1000W / 200W
Power Noise Level	15mW	200mW
Maximum Average Power Density kW/cm ²	10 at 250W, 12 at 150W	10 at 500W, 7 at 1000W
Response Time with Meter (0-95%) typ. s	2.8	2.5
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	3	3 ^(f)
Linearity with Power $\pm\%$	1.5	2
Energy Mode		
Energy Range	80mJ - 300J	500mJ - 300J
Energy Scales	300J / 30J / 3J	300J / 30J
Minimum Energy mJ	80	500mJ
Maximum Energy Density J/cm ²		
<100ns	0.3	0.3
1 μs	0.4	0.4
0.5ms	5	5
2ms	10	10
10ms	30	30
Beam Tracking Mode		
Position		
Beam Position Accuracy	0.3mm + 7% of distance from center ^(c)	0.6mm + 6% of distance from center ^(h)
Beam Position Resolution mm	0.1	0.1
Min Power for Position Measurement	2W	10W
Size ^(d)		
Size Accuracy mm ^(e)	\pm 5% for centered beam	NA
Size Range mm (4 σ beam diameter)	\varnothing 5-35	NA
Min Power Density for Size Measurement	3W/cm ²	NA
Cooling	Fan	Water
Minimum and Recommended Water Flow Rate at Full Power	NA	3 liter/min 6 liter/min ^(g)
Fiber Adapter Available (see page 120)	ST, FC, SMA, SC	Consult Ophir representative
Accessories for High Power Sensors	NA	See pages 99-102
Weight kg	0.9	0.9
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part number	7Z07902	7Z07936

Note: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, Nova II and Vega meters, Juno, Juno+, Juno-RS and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Note: (b) For powers up to 30W it is recommended to work with the fan off and then the noise level is ~3 times lower. It is also recommended to measure energy with the fan off.

Note: (c) Position accuracy for the central 20mm of the aperture as limited by beam position resolution. Position can be tracked with \pm 1mm accuracy over central 32mm of the aperture. Accuracy is reduced by a factor of 3 at minimum power. Position measuring center corresponds to geometrical center within <1mm. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

Note: (d) Assumes laser beam with Gaussian (TEM₀₀) distribution. For other modes, size measurement is relative.

Note: (e) Accuracy spec will be maintained for beams from 6 to 35mm not deviating from center more than 15% of beam diameter.

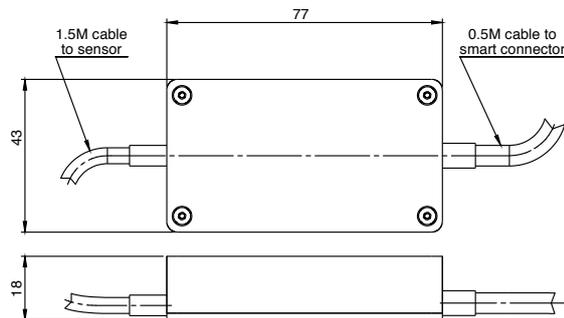
Note: (f) Calibrated for ~0.8 μm , 1.064 μm and 10.6 μm

Note: (g) Water temperature range 18-30°C, Water temperature rate of change <1°C/min. Pressure drop across sensor 0.03MPa.

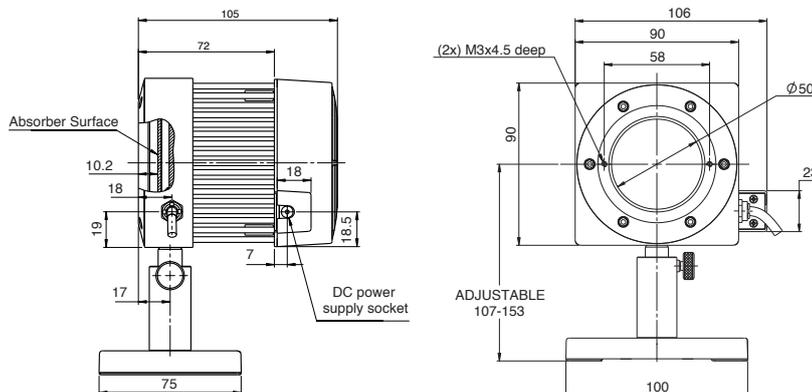
Note: (h) Position accuracy for the central 10 mm of the aperture as limited by beam position resolution. Position measuring center corresponds to geometrical center within <1mm. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

* For drawings please see page 77

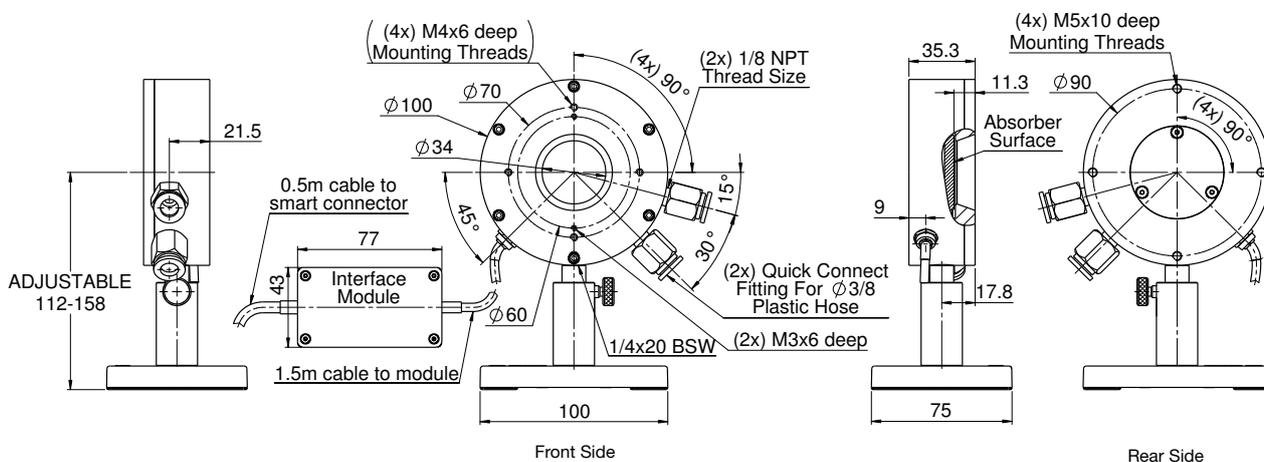
Interface Module on cable



FL250A-BB-50-PPS



1000W-BB-34-QUAD



1.1.2.7 High Power Thermal Sensors

1.1.2.7.1 Introduction

Introduction to High Power Water Cooled Sensors

Ophir has many years of experience in supplying measurement systems for high power industrial lasers and has the highest power measuring equipment available on the market – up to 120 kilowatts. Ophir meters also have the highest damage threshold available – up to $10\text{kW}/\text{cm}^2$ at 10kW. Ophir supplies water cooled sensors from 250W up to 120kW (and air-cooled sensors up to 1100W).

Sensors supplied by Ophir are tested at up to full power and their linearity verified over the entire power range. This is done by measuring the reading over the power range against a higher power sensor that has been previously measured and verified by NIST or PTB. The accuracy, linearity and damage specifications have been carefully verified over many years of development and use by the largest existing user base. In cases of unique and/or extreme user parameters (such as ultra high-power levels, pulse energies, unique beam profiles) Ophir has advanced simulation capabilities both thermal and optical to validate the functionality of its sensors. In addition to power meters for high powers, Ophir also has beam profilers, beam dumps and protective enclosures for industrial lasers.

Calibration Method and Estimated Accuracy for Ophir High Power Sensors

Ophir high-power sensors (models 5000W, 10K-W, IPM-10KW, 15K-W, 20K-W, Comet 10K, 30K-W, 120K-W and 150K-W) are ordinarily calibrated using moderate-power lasers, not exceeding 6000W (though in certain cases, sensors can be calibrated at up to 15,000W). In other words, we calibrate high-power sensors using laser powers that are in many cases much lower than the power rating of the sensors being calibrated. This raises the question of calibration accuracy. The following brief explanation will clarify how we know that these highest power sensors are indeed accurate to $\pm 5\%$ over their entire measurement range as specified.

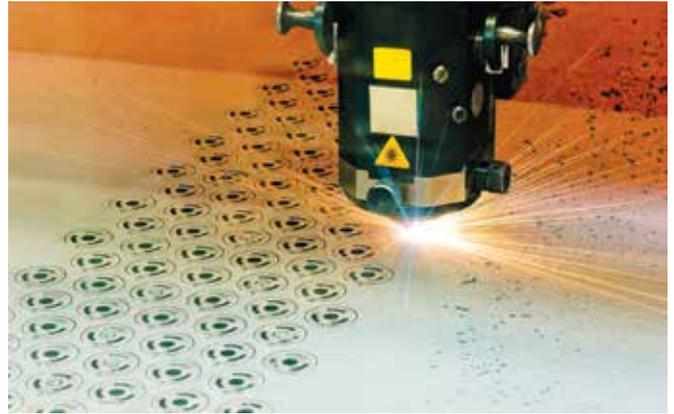
Basing high-power calibration accuracy on lower power calibration measurements is valid, subject to the condition that the sensors are linear all across the full power range.

The calibration measurements themselves (using the moderate-power lasers) are all based on NIST-calibrated master references.

At the lower powers, the reference sensors are based on photodiode detectors; photodiode detectors are well known to be highly linear.

At the higher powers, thermal sensors are used as the reference. A series of detailed tests have confirmed that indeed these sensors are highly linear, all the way up to the highest powers for which they are rated.

Since the thermal sensors have been shown to be linear over the entire range of powers, it follows that if the calibration is correct at low powers, it will remain correct at high powers as well.



Some additional points:

1. An additional issue is zero offset; although the output may be linear at low powers, there may be a zero offset that, due to the relatively low output at low powers, will cause an error in calibration. For example, if calibration is performed at 200W and the output of the sensor is $10\mu\text{V}/\text{W}$ (a typical value) and there is a zero offset of only $1\mu\text{V}$, this will cause a calibration error of 10%. Ophir's calibration method includes measuring the difference between the reading with power applied and without power applied, thus eliminating error due to zero offset. This measurement is taken several times to insure accuracy.
2. The above measurement method assures that the calibration inaccuracy due to measurement errors is less than 1%, comparable to the expected errors in our lower powered sensors. In order to verify this, all of our high power sensors have been measured by comparison to various calibration standards. These measurements have shown Ophir sensors to be well within the claimed limits of linearity.
3. The Comet 10K series measures the heat rise of the absorbing puck when irradiated by the laser for 10s. In order to calibrate the Comet 10K, we simply irradiate with a lower power laser for longer e.g. 150W for 60s. Thus the heating effect is similar to that of a higher power laser. Tests of the Comet calibrated by this method vs. NIST traceable high power sensors have shown that it is accurate and reproducible.

For more information on calibration please read tutorial on our website at www.ophiropt.com

Note regarding water cooling:

Most Ophir high power sensors are water cooled. Customers often have questions about our water cooled sensors such as the correct flow rate and pressure under various conditions and the quality of the water required. For further information on water cooled sensors, please see our tutorial on the subject on our website: <http://www.ophiropt.com>

1.1.2.7 High Power Thermal Sensors

1.1.2.7.2 Medium Power Water Cooled Thermal Sensors

0.5W to 300W

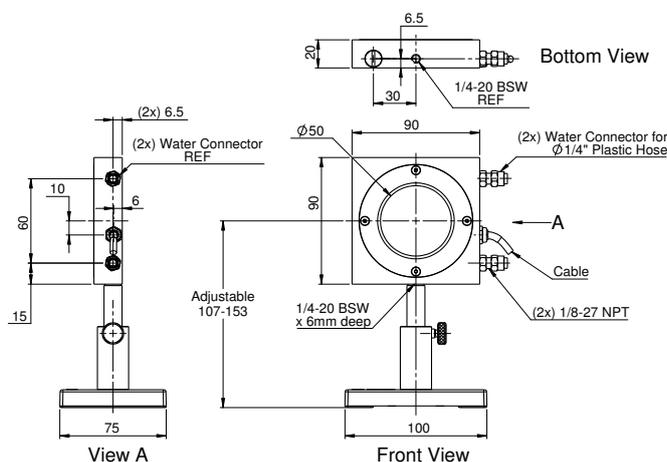
Features

- High powers
- Water cooled
- Up to 300W
- Ø50mm aperture



Model	L250W-BB-50	L300W-LP2-50
Use	General purpose	High power densities and long pulses
Absorber Type	Broadband	LP2
Spectral Range μm	0.19 - 11	0.35-2.2, 10.6 ^(a)
Absorption	~88%	>96% from 0.35 to 1.1 μm , 75% for 10.6 μm
Aperture mm	Ø50mm	Ø50mm
Power Mode		
Power Range	1W - 250W	0.5W - 300W
Power Scales	250W / 30W	300W / 30W
Power Noise Level	50mW	20mW
Maximum Average Power Density kW/cm ²	10 at 250W 14 at 100W	12 at 300W 20 at 150W
Response Time with Meter (0-95%) typ. s	2.5	2.5
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	3 ^(c)	3 ^(a)
Linearity with Power $\pm\%$	2	1.5
Energy Mode		
Energy Range	120mJ - 200J	200mJ - 300J
Energy Scales	200J / 30J / 3J	300J / 30J / 3J
Minimum Energy mJ	120	200
Maximum Energy Density J/cm ²		
<100ns	0.3	0.07
1 μs	0.4	0.6
0.5ms	5	35
2ms	10	90
10ms	30	270
Cooling	water	water
Recommended water flow at full power ^(b)	3 liter/min	3 liter/min
Accessories for High Power Sensors	See pages 99-102	See pages 99-102
Weight kg	0.6	0.6
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1	
Part number: Standard Sensor	7Z07125 (1.5m cable)	7Z02776
Sensor with different cable length	7Z07125B (5m cable)	
Notes: (a)	This LP2 sensor is calibrated for 0.35 - 1.1 μm and 10.6 μm . For other wavelengths in the spectral range 1100 - 2200nm there is an additional calibration uncertainty of up to 1%.	
Notes: (b)	Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.03MPa.	
Notes: (c)	±4%. For wavelengths <240nm	

L250W-BB-50 / L300W-LP2-50



1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

5W to 1000W

Features

- High powers
- Water cooled
- Up to 1000W
- Ø34mm aperture
- 1000WP for non-contaminating water flow

1000W-BB-34



1000WP-BB-34



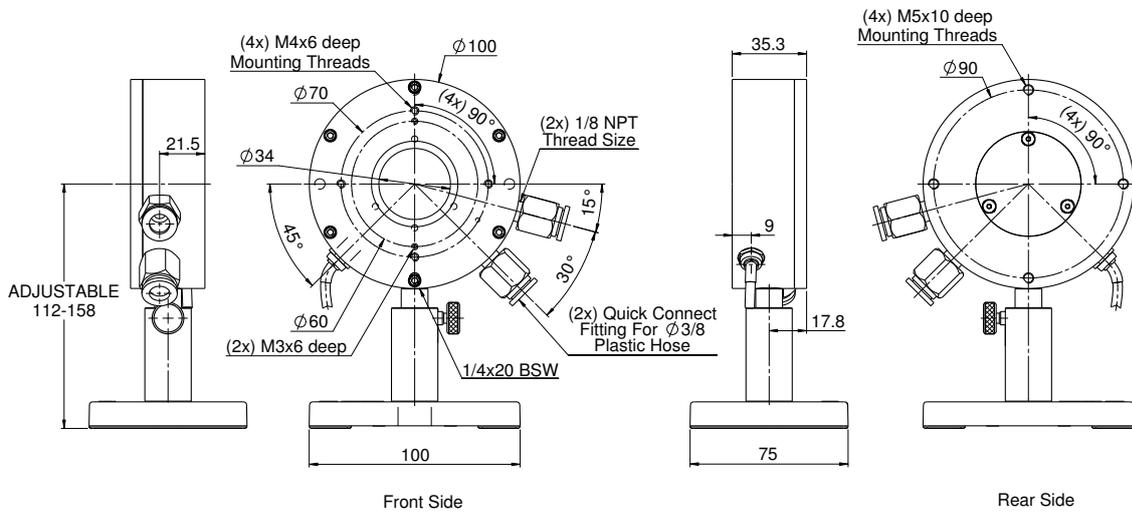
1000W-LP2-34



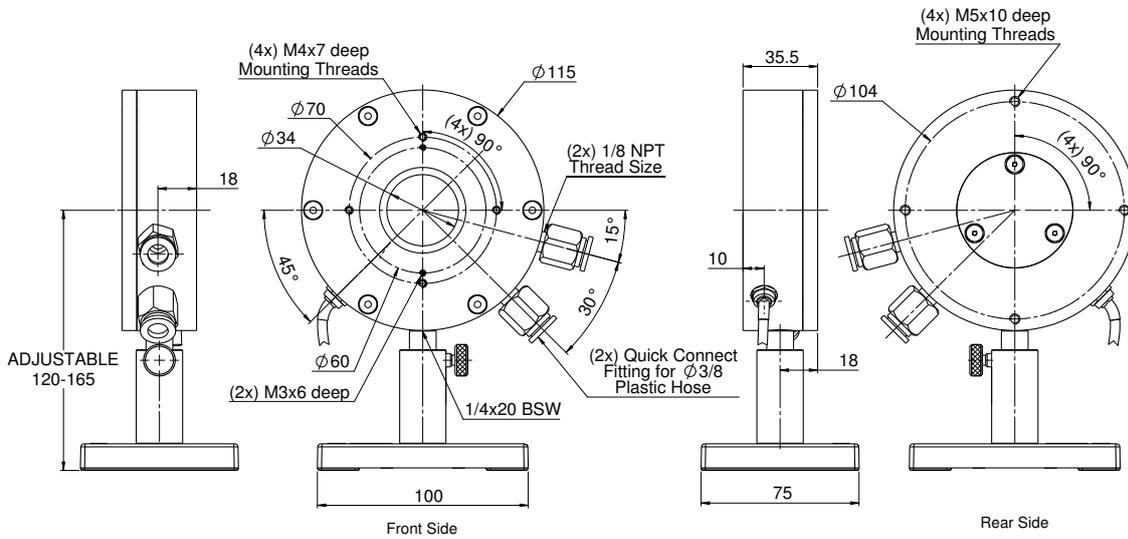
Model	1000W-BB-34 / 1000WP-BB-34	1000W-LP2-34
Use	General purpose and CO ₂ laser / Controlled materials in contact with water flow ^(c)	High power densities and long pulses
Absorber Type	Broadband	LP2
Spectral Range μm	0.19 - 20	0.35 - 2.2
Absorption	~88%	>94% from 0.35 to 1.1 μm
Aperture mm	Ø34mm	Ø34mm
Power Mode		
Power Range	5W - 1000W	5W - 1000W
Power Scales	1000W / 200W	1000W / 200W
Power Noise Level	200mW	200mW
Maximum Average Power Density kW/cm ²	10 at 500W 7 at 1000W	12 at 500W 10 at 1000W
Response Time with Meter (0-95%) typ. s	2.5	2.5
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	3 ^(a)	3 ^(a)
Linearity with Power $\pm\%$	2	2
Energy Mode		
Energy Range	400mJ - 300J	400mJ - 300J
Energy Scales	300J / 30J	300J / 30J
Minimum Energy mJ	400mJ	400mJ
Maximum Energy Density J/cm ²		
<100ns	0.3	0.1
1 μs	0.4	0.9
0.5ms	5	50
2ms	10	130
10ms	30	400
Cooling	water	water
Minimum and Recommended water flow at full power ^(b)	3 liter/min 6 liter/min	3 liter/min 6 liter/min
Fiber Adapters	Consult Ophir representative	Consult Ophir representative
Accessories for High Power Sensors	See pages 99-102	See pages 99-102
Weight kg	0.8 / 0.9	0.8
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V3 / NA	
Part number: Standard Sensor	7Z02750 / 7Z02753	7Z02774
BeamTrack Sensor: Beam Position & Size (p. 76)	7Z07936	
Notes: (a)	Calibrated for ~0.8 μm , 1.064 μm and 10.6 μm	
Notes: (b)	Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.03MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below the minimum. When used at full power with substantially below the recommended flow rate, the damage threshold may be as much as 20% lower. The response time will be optimum with the recommended flow rate.	
Notes: (c)	The 1000WP-BB-34 has a nylon rear housing and nothing but nylon and copper in contact with the water flow. This prevents contamination of the water flow with aluminum and prevents the possibility of corrosion.	

* For drawings please see page 81

1000W-BB-34 / 1000W-LP2-34



1000WP-BB-34



1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

15W to 1500W

Features

- High powers
- Water cooled
- Up to 1500W
- Ø50mm aperture

L1500W-BB-50

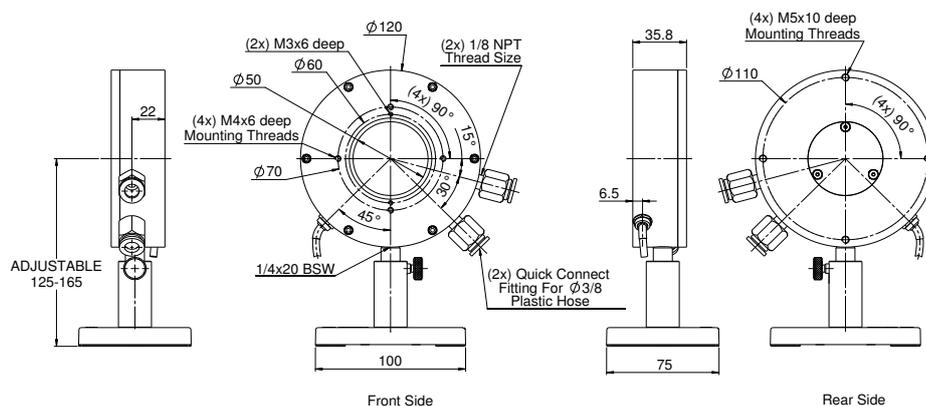


L1500W-LP2-50



Model	L1500W-BB-50	L1500W-LP2-50
Use	General purpose and CO ₂ laser	High power densities and long pulses
Absorber Type	Broadband	LP2
Spectral Range μm	0.19 - 20	0.35 - 2.2
Absorption	~88%	>94% from 0.35 to 1.1 μm
Aperture mm	Ø50mm	Ø50mm
Power Mode		
Power Range	15W - 1500W	15W - 1500W
Power Scales	1500W / 300W	1500W / 300W
Power Noise Level	700mW	700mW
Maximum Average Power Density kW/cm ²	7 at 1000W 4 at 1500W	10 at 1000W 5.5 at 1500W
Response Time with Meter (0-95%) typ. s	2.7	2.7
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	4 ^(a)	4 ^(a)
Linearity with Power $\pm\%$	2	2
Energy Mode		
Energy Range	500mJ - 200J	500mJ - 200J
Energy Scales	200J / 20J	200J / 20J
Minimum Energy mJ	500mJ	500mJ
Maximum Energy Density J/cm ²		
<100ns	0.3	0.1
1 μs	0.4	0.9
0.5ms	5	50
2ms	10	130
10ms	30	400
Cooling	water	water
Minimum and Recommended water flow at full power ^(b)	3.5 liter/min 6 liter/min	3.5 liter/min 6 liter/min
Fiber Adapters	QBH-Fiber Adapter (see page 99)	QBH-Fiber Adapter (see page 99)
Accessories for High Power Sensors	See pages 99-102	See pages 99-102
Weight kg	1.2	1.2
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V2	
Part number	7Z02752	7Z02772
Notes: (a)	Calibrated for ~0.8 μm , 1.064 μm and 10.6 μm	For spectral range 0.35 to 1.1 μm
Notes: (b)	Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.03MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below the minimum. When used at full power with substantially below the recommended flow rate, the damage threshold may be as much as 20% lower. The response time will be optimum with the recommended flow rate.	

L1500W-BB-50 / L1500W-LP2-50



1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

1W to 2000W

Features

- Very large aperture
- Broadband or Pulsed absorber
- Up to 2000W
- Ø120mm aperture

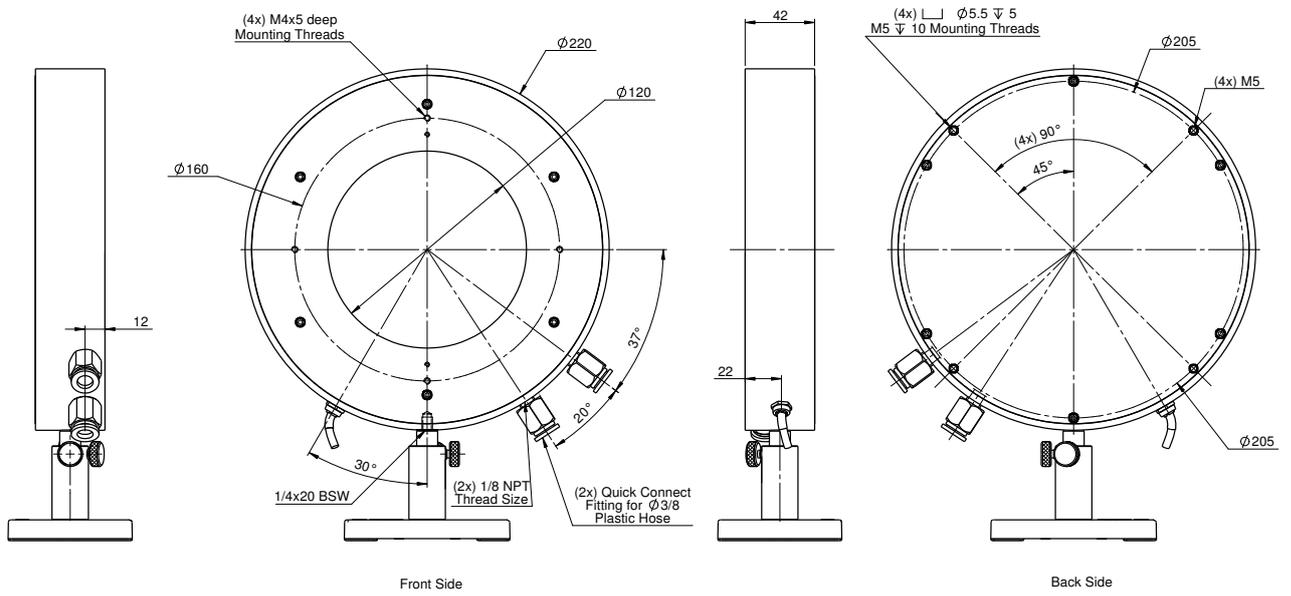
L2000W-BB-120 / L2000W-PF-120



Model	L2000W-BB-120	L2000W-PF-120
Use	Very large beams	Very large beams, short pulses, high average power
Absorber Type	Broadband	PF volume absorber
Spectral Range μm	0.19 – 20	0.3 – 2.2
Aperture mm	Ø120mm	Ø120mm
Power Mode		
Power Range	1W – 2000W	1W – 2000W
Maximum Intermittent Power	NA	NA
Power Scales	2000W / 200W	2000W / 200W
Power Noise Level	50mW	50mW
Maximum Average Power Density W/cm^2	700 at 1000W, 150 at 1500W, 60 at 2000W	600
Response Time with Meter (0-95%) typ. s	7	7
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	3 ^(a)	3 ^(a)
Linearity with Power $\pm\%$	2	2
Energy Mode		
Energy Range	6J – 6000J	6J – 6000J
Energy Scales	6kJ / 600J / 60J	6kJ / 600J / 60J
Minimum Energy	6J	6J
Maximum Energy Density J/cm^2		Single 10 – 50Hz ^(c)
<100ns	0.3	3 ^(d) 1.5
1 μs	0.4	3 ^(d) 1.5
0.5ms	5	7 7
2ms	10	15 15
10ms	30	40 40
1s	4000	3000 NA
Cooling	Water	Water
Minimum and Recommended Water Flow Rate at Full Power	3.5 liter/min 6 liter/min ^(b)	3.5 liter/min 6 liter/min ^(b)
Fiber Adapters	Consult Ophir representative	Consult Ophir representative
Accessories for High Power Sensors	See pages 99-102	See pages 99-102
Weight kg	4.5	4.5
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part number	7Z02751	7Z02792
Notes: (a)	Calibrated for $\sim 0.8\mu\text{m}$, $1.064\mu\text{m}$ and $10.6\mu\text{m}$	Calibrated for $1.07\mu\text{m}$. Max additional error at other wavelengths not specified above: $\pm 1\%$
Notes: (b)	Water temperature range 18-30°C. Water temperature rate of change $< 1^\circ\text{C}/\text{min}$. Pressure drop across sensor 0.06MPa.	Water temperature range 18-30°C. Water temperature rate of change $< 1^\circ\text{C}/\text{min}$. Pressure drop across sensor 0.06MPa.
Notes: (c)		For 10-50Hz derate as follows: 1064nm not derated 532nm not derated 355nm 70% of stated value 266nm 15% of stated value 193nm 10% of stated value
Notes: (d)		Damage threshold $1.5\text{J}/\text{cm}^2$ for wavelengths $< 500\text{nm}$

* For drawings please see page 84

L2000W-BB-120 / L2000W-PF-120



1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

20W to 5000W

Features

- Powers up to 5000W
- Water cooled
- Ø50mm aperture
- 5000WP for non-contaminating water flow

5000W-BB-50



5000W-LP2-50

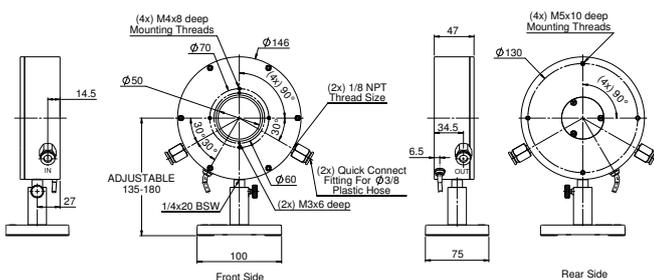


5000WP-LP2-50

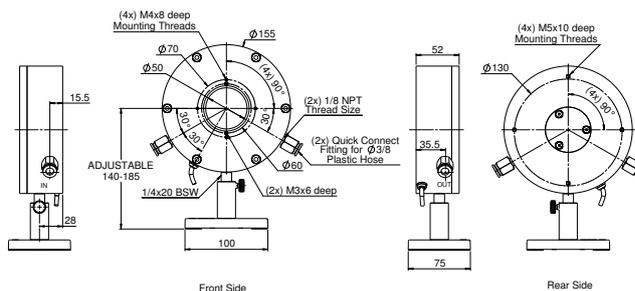


Model	5000W-BB-50	5000W-LP2-50 / 5000WP-LP2-50
Use	General purpose and CO ₂ laser	High power densities and long pulses lasers / Controlled materials in contact with water flow ^(c)
Absorber Type	Broadband	LP2
Spectral Range μm	0.19 - 11	0.35 – 2.2
Absorption	~88%	>94% from 0.35 to 1.1 μm
Aperture mm	Ø50mm	Ø50mm
Power Mode		
Power Range	20W - 5000W	20W - 5000W
Power Scales	5000W / 500W	5000W / 500W
Power Noise Level	1W	1W
Maximum Average Power Density kW/cm ²	3 at 3kW 1.7 at 5kW	5 at 3kW 2.5 at 5kW
Response Time with Meter (0-95%) typ. s	3	3
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	4 ^(a)	4 ^(a)
Linearity with Power $\pm\%$	2	2
Energy Mode		
Energy Range	NA	NA
Energy Scales	NA	NA
Minimum Energy mJ	NA	NA
Maximum Energy Density J/cm ²		
<100ns	0.3	0.1
1 μs	0.4	0.9
0.5ms	5	50
2ms	10	130
10ms	30	400
Cooling	water	water
Fiber Adapters	QBH-Fiber Adapter (see page 99)	For 5000W-LP2-50: QBH-Fiber Adapter (see page 99)
Accessories for High Power Sensors	See pages 99-102	See pages 99-102
Minimum and Recommended water flow at full power ^(b)	5 liter/min 8 liter/min	5 liter/min 8 liter/min
Cable Length	1.5 meters	1.5 meters
Weight kg	2.8	2.8 / 3
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V2	V2 / NA
Part number: Standard Sensor	7Z07111 (1.5m cable)	7Z07135 / 7Z02788
Sensor with different cable length	7Z07111B (5m cable)	
Notes: (a)	Calibrated for ~0.8 μm , 1.064 μm and 10.6 μm For spectral range 0.35 to 1.1 μm	
Notes: (b)	Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.06MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below the minimum. When used at full power with substantially below the recommended flow rate, the damage threshold may be as much as 20% lower. The response time will be optimum with the recommended flow rate.	
Notes: (c)	The 5000WP-LP2-50 has nylon rear housing and nothing but nylon and copper in contact with the water flow. This prevents contamination of the water flow with aluminum and prevents the possibility of corrosion.	

5000W-BB-50 / 5000W-LP2-50



5000WP-LP2-50



1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

100W to 11kW

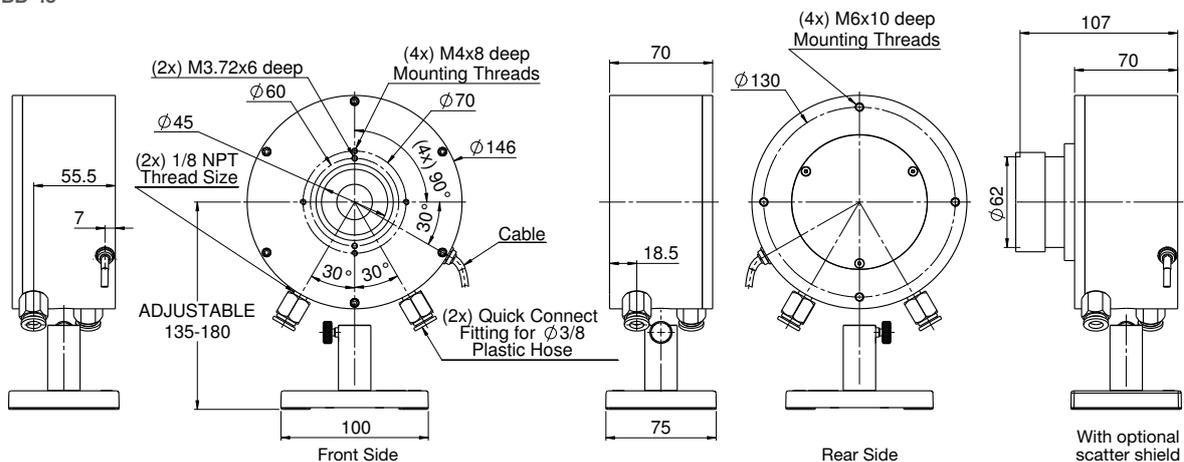
Features

- High powers
- Water cooled
- Up to 11kW
- Up to Ø45mm apertures



Model	10K-W-BB-45																												
Use	High power up to 11kW																												
Absorber Type	Beam deflector + broadband absorber																												
Spectral Range μm ^(a)	0.8 - 2, 10.6																												
Aperture mm	Ø45mm																												
Power Range	100W – 11kW																												
Power Scales	11kW / 6kW / 600W																												
Power Noise Level	1W																												
Backscattered Power ^(b, c)	~3.5% without Scatter Shield, ~1% with Scatter Shield																												
Maximum Average Power Density kW/cm ²	See note ^(c) and table ⁽¹⁾ below																												
Response Time with Meter (0-95%) typ. s	2.7																												
Calibration Uncertainty $\pm\%$	1.9																												
Power Accuracy $\pm\%$	5 ^(a)																												
Linearity with Power $\pm\%$	2																												
Cooling	water ^(d)																												
Minimum Water Flow Rate	8 liter/min at full power ^(d)																												
Water Connectors ^(e)	Quick connector for 3/8" OD nylon tubing																												
Cable Length	5 meters																												
Optional Scatter Shield Accessory ^(e)	10K-W / 15K-W Scatter Shield (P/N 7Z08295)																												
Weight kg	4.5																												
Compliance	CE, UKCA, China RoHS																												
Version	V4																												
Part number	7Z07102																												
IPM-10KW Ruggedized Industrial Version	7Z07106 see page 94																												
Note: (a)	Calibrated at 1.07 μm and 10.6 μm . For other wavelengths in the ranges of 0.8 - 0.95 μm & 1.1 - 2 μm add up to $\pm 2\%$ to the calibration error.																												
Note: (b)	When scatter shield is installed, use the NIRS setting to compensate for slightly higher reading. When not installed, use the NIR setting.																												
Note: (c)	For circular beam centered within 1/4 of beam diameter. IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR. Maximum tilt angle ± 5 degrees. For rectangular beam please consult Ophir representative.																												
Note: (d)	Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.1MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below 3 liter/min. The response time will be optimum with the recommended flow rate. For solutions for prolonged usage with untreated water (tap water, non DI water), please contact Ophir.																												
Note: (e)	Heavy duty stand is available as optional extra. For further information and other options see Accessories for High Power Sensors on pages 99-102.																												
Table: (1)	<table border="1"> <thead> <tr> <th rowspan="2">Beam diameter</th> <th rowspan="2">Max power density</th> <th colspan="3">Max energy density</th> </tr> <tr> <th>1ms pulse width</th> <th>3ms pulse width</th> <th>10ms pulse width</th> </tr> </thead> <tbody> <tr> <td><15mm</td> <td>10kW/cm²</td> <td>30J/cm²</td> <td>60J/cm²</td> <td>150J/cm²</td> </tr> <tr> <td>15 - 20mm</td> <td>7kW/cm²</td> <td>20J/cm²</td> <td>40J/cm²</td> <td>100J/cm²</td> </tr> <tr> <td>20 - 40mm</td> <td>5kW/cm²</td> <td>15J/cm²</td> <td>30J/cm²</td> <td>70J/cm²</td> </tr> <tr> <td>40 - 45mm</td> <td>4kW/cm²</td> <td>12J/cm²</td> <td>25J/cm²</td> <td>60J/cm²</td> </tr> </tbody> </table>	Beam diameter	Max power density	Max energy density			1ms pulse width	3ms pulse width	10ms pulse width	<15mm	10kW/cm ²	30J/cm ²	60J/cm ²	150J/cm ²	15 - 20mm	7kW/cm ²	20J/cm ²	40J/cm ²	100J/cm ²	20 - 40mm	5kW/cm ²	15J/cm ²	30J/cm ²	70J/cm ²	40 - 45mm	4kW/cm ²	12J/cm ²	25J/cm ²	60J/cm ²
Beam diameter	Max power density			Max energy density																									
		1ms pulse width	3ms pulse width	10ms pulse width																									
<15mm	10kW/cm ²	30J/cm ²	60J/cm ²	150J/cm ²																									
15 - 20mm	7kW/cm ²	20J/cm ²	40J/cm ²	100J/cm ²																									
20 - 40mm	5kW/cm ²	15J/cm ²	30J/cm ²	70J/cm ²																									
40 - 45mm	4kW/cm ²	12J/cm ²	25J/cm ²	60J/cm ²																									

10K-W-BB-45



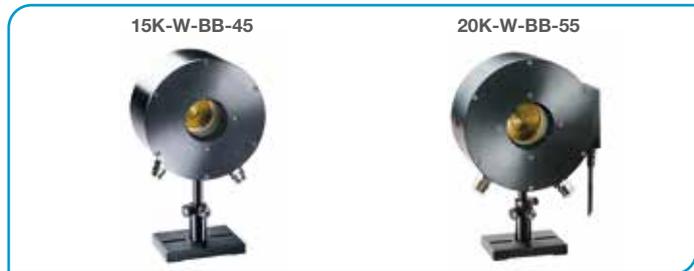
1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

100W to 20kW

Features

- High powers
- Water cooled
- Up to 20kW
- Up to Ø55mm apertures
- Over temperature alarm and interlock



Model	15K-W-BB-45	20K-W-BB-55
Use	High power up to 15kW	High power up to 20kW, larger aperture, over temperature alarm and interlock
Absorber Type	Beam deflector + broadband absorber	Beam deflector + broadband absorber
Spectral Range μm ^(a)	0.8 - 2, 10.6	0.8 - 2, 10.6
Aperture mm	Ø45mm	Ø55mm
Power Range	100W - 15kW	100W - 20kW ^(f)
Power Scales	15kW / 4kW / 400W	20kW / 5kW / 500W
Power Noise Level	1W	1W
Backscattered Power ^(b, e)	~3.5% without Scatter Shield, ~1% with Scatter Shield	~3.5% without Scatter Shield, ~1% with Scatter Shield
Maximum Average Power Density kW/cm ²	See note ^(c) and table ⁽¹⁾ below	See note ^(c) and table ⁽¹⁾ below
Response Time with Meter (0-95%) typ. s	3.5	3.5
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	5 ^(a)	5 ^(a)
Linearity with Power $\pm\%$	2	2
Variation with Beam Size	$\pm 1.7\%$ from 15 to 30mm	$\pm 1\%$ from 10 to 35mm
Cooling	water ^(d)	water ^(d)
Minimum Water Flow Rate	12 liter/min at full power ^(d)	20 liter/min at full power ^(d)
Water Pressure Requirements at Max Flow Rate	Pressure drop across sensor ~0.2MPa	Pressure drop across sensor at full flow rate <0.1MPa
Water Connectors ^(e)	Quick connector for 3/8" OD nylon tubing	Quick connector for 1/2" OD nylon tubing
Over Temperature Warning / Interlock	N.A.	Module on sensor near output cable with over temperature LED, loud audible signal and M8 3 connector interlock
Cable Length and Connections	5 meters terminated in Ophir DB15 smart connector	Signal: 5 meters terminated in DB15 Interlock: M8 connector with 1.5 meter cable terminated in flying leads: Brown - common, Black - N.C., Blue - N.O.
Optional Scatter Shield Accessory ^(g)	10K-W / 15K-W Scatter Shield (P/N 7Z08295)	20K-W Scatter Shield (P/N 7Z08355) ^(g)
Weight kg	6	8
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V2	
Part number	7Z07133	7Z07149

Note: (a) Calibrated at 1.07 μm and 10.6 μm .
For other wavelengths in the ranges of 0.8 - 0.95 μm & 1.1 - 2 μm , the calibration error may be up to $\pm 2\%$ more.

Note: (b) When scatter shield is installed, use the NIRS setting to compensate for slightly higher reading. When not installed, use the NIR setting.

Note: (c) For circular beam centered within 1/4 of beam diameter. IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR. Maximum tilt angle ± 5 degrees. For rectangular beam please consult Ophir representative.

Note: (d) Water temperature range 18-30°C. Water temperature rate of change <1°C/min. The recommended flow rate can be lowered proportionately at lower than full power but should not be below 3 liter/min. The response time will be optimum at near 12 liter/min flow rate. For solutions for prolonged usage with untreated water (tap water, non DI water), please contact Ophir.

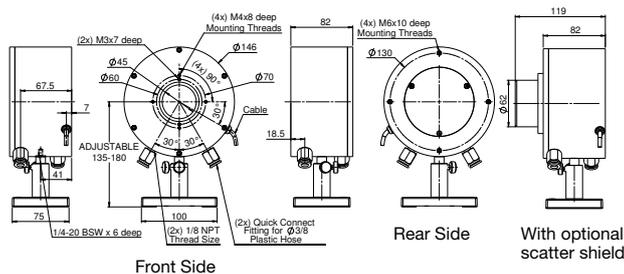
Note: (e) For further information and other options see **Accessories for High Power Sensors** on pages 99-102.

Note: (f) With scatter shield full power is 18kW.

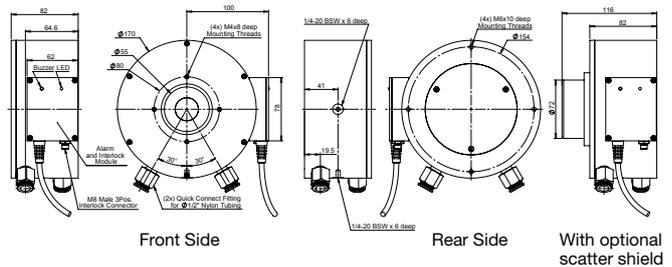
Note: (g) The scatter shield is compatible also with the 16K-W-BB-55 sensor P/N 7Z07131

Beam diameter	Max power density		Max energy density	
	1ms pulse width	3ms pulse width	10ms pulse width	10ms pulse width
<15mm	10kW/cm ²	30J/cm ²	60J/cm ²	150J/cm ²
15 - 20mm	7kW/cm ²	20J/cm ²	40J/cm ²	100J/cm ²
20 - 40mm	5kW/cm ²	15J/cm ²	30J/cm ²	70J/cm ²
40 - 45mm	4kW/cm ²	12J/cm ²	25J/cm ²	60J/cm ²

15K-W-BB-45



20K-W-BB-55



1.1.2.7 High Power Thermal Sensors

1.1.2.7.3 High Power Water Cooled Thermal Sensors

100W to 30kW

Features

- High powers
- Water cooled
- Up to 30kW
- Ø74mm aperture

30K-W-BB-74



Model	30K-W-BB-74
Use	High power up to 30kW
Measurement Type	Beam deflector + broadband absorber
Spectral Range μm	0.8 - 2
Aperture mm	Ø74mm
Power Range for Calibrated Reading	100W – 30kW
Power Noise Level	1W
Backscattered Power	~4.3% without Scatter Shield, ~1.3% with Scatter Shield ^(b, c)
Maximum Average Power Density kW/cm ²	10kW/cm ² anywhere in the beam
Beam Centering Requirements IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR	For circular beam centered within ¼ of beam diameter. Maximum tilt angle ± 5 degrees. For rectangular beam please consult Ophir representative
Response Time 0-95% typ	7s
Calibration Uncertainty $\pm\%$	1.9
Power Accuracy $\pm\%$	5 ^(a)
Linearity with Power $\pm\%$	2
Variation with Beam Size $\pm\%$	1 from 20 to 40 mm 1.5 from 15 to 20 mm and 40 to 45 mm
Cooling Requirements	25 liter/min at full power, proportionally less at lower power. Min flow rate 6 liter/min. Water temperature range 15-30°C. Water temperature rate of change $<1^\circ\text{C}/\text{min}$ ^(d)
Water Pressure Drop across Beam Absorber	Pressure drop across sensor ~0.2MPa. Pressure drop across 8 meters of ½" tubing with 9.5mm ID is ~0.3MPa
Water Connections	Quick connector for ½" OD nylon tubing ^(c)
Outputs	10 meter cable terminated in DB15 smart connector
Optional Accessories ^(c)	30K-W Scatter Shield (P/N 7Z08293) 30K-W Rubber Feet Assembly (P/N 7Z08217)
Dimensions	See drawing on next page
Weight kg	19
Compliance	CE, UKCA, China RoHS
Version	V4
Part number	7Z07136
Note: (a) Calibrated at 1.07 μm . For other wavelengths in the ranges of 0.8 - 0.95 μm & 1.1 – 2 μm add up to $\pm 2\%$ to the calibration error	
Note: (b) When scatter shield is installed, use the 107S laser setting to compensate for the slightly higher reading. When not installed, use the 107 setting	
Note: (c) For further information and options see Accessories for High Power Sensors on pages 99-102	
Note: (d) For solutions for prolonged usage with untreated water (tap water, non DI water), please contact Ophir	

* For drawings please see page 89

1.1.2.8 Calorimetric Power Meters

1.1.2.8.1 High Power Water Cooled Calorimetric Sensor

200W to 6000W

Features

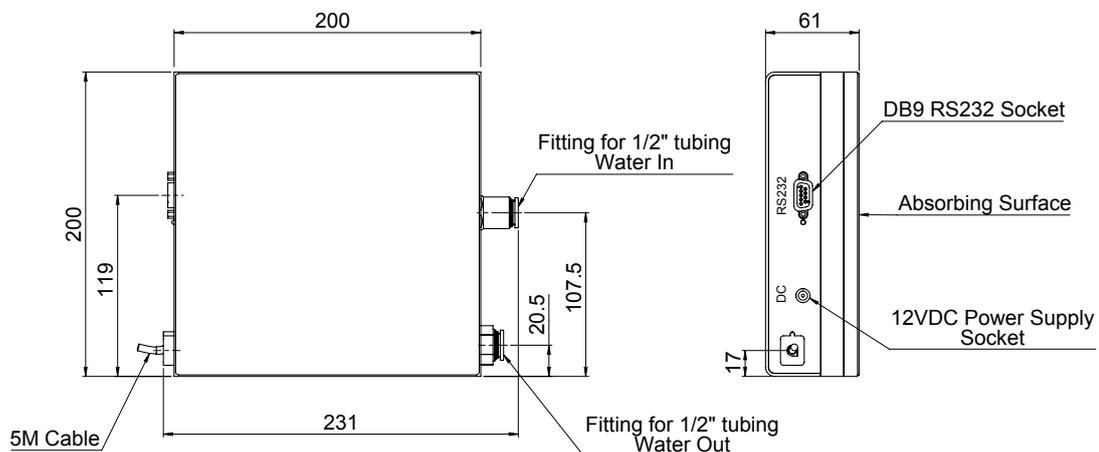
- Very large aperture 200mm x 200mm
- Water cooled
- Up to 6000W
- Smart sensor or RS232 interface

6K-W-BB-200 x 200



Model	6K-W-BB-200x200
Use	Largest size beams to 6kW
Measurement Method	Calorimetric, measure water temperature rise and flow rate
Absorber Type	Broadband
Spectral Range μm ^(a)	0.19 - 20
Aperture mm	198 x 198mm
Power Mode	
Power Range	200W – 6000W
Power Scales	6kW / 1kW
Power Noise Level	5W
Maximum Average Power Density kW/cm ²	1.5 at 1000W 0.4 at 6000W
Response Time with Meter (0-95%) typ. s	50
Calibration Uncertainty $\pm\%$	1.9
Power Accuracy $\pm\%$	4 ^(a) ^(b)
Linearity with Power $\pm\%$	2 ^(b)
Maximum Energy Density J/cm²	
<100ns	0.3
1 μs	0.4
0.5ms	5
2ms	10
10ms	30
1s	4000
Cooling	Water
Recommended Flow Rates	6 liter/min ^(b)
Outputs	1. 5 meter cable terminated in DB15 Smart Connector measuring power only. 2. RS232 with supplied WaterFlowMeter PC Application measuring power, water temp. and water flow rate. In RS232 mode, the sensor is powered by the supplied 12V wall cube.
Fiber Adapters	N.A.
Dimensions	See drawing
Weight kg	3.6
Compliance	CE, UKCA, China RoHS
Version	
Part number	7Z02764
Notes: (a)	Calibrated for $\sim 0.8\mu\text{m}$ and $1.08\mu\text{m}$ at flow rate of 6 liters/min. Calibration for $10.6\mu\text{m}$ available
Notes: (b)	Min flow rate at maximum power 6 liter/min. Flow rate may be proportionately less at lower power. Flow rate dependence of reading is $\pm 2\%$ for flow rates between 4 and 8 liters/min. Water temperature range 15-25°C. Water temperature rate of change $< 1^\circ\text{C}/\text{min}$, at max power, proportionately less at lower power. Pressure drop across sensor 0.05MPa. Water should be filtered with a $< 50\mu\text{m}$ filter.

6K-W-BB-200 x 200



1.1.2.8 Calorimetric Power Meters

1.1.2.8.2 Ultra-High Power Water Cooled Calorimetric Sensors

2kW to 70kW

Features

- Ultra-high powers
- Calorimetric
- Up to 70kW
- Ø130mm aperture

70K-W



Model	70K-W
Use	High power up to 70kW
Interfaces	24v power: M12 male RS232: M12 female Ethernet (48V PoE capable ^(a)): M12 female Interlock: M8 male Analog output: BNC
Measurement Type	Calorimetric
Spectral Range μm	0.8-10.6
Aperture mm	Ø130
Reflector Usable Clear Aperture mm	Ø150
Power Range for Calibrated Reading	2kW – 70kW
Typical Power Noise Level	20W
Backscattered Power	<0.5%
Maximum CW/QCW Power Density at Max Power kW/cm²	2 kW/cm ² for Flat top beam 4 kW/cm ² for Gaussian beam (Equivalent to 65 mm diameter beam at 70 kW)
Beam Divergence and Centering Requirements^(b)	Collimated beams: Max decenter 5mm, max tilt 5° Diverging beams: Up to 0.22NA
Response Time 0-99% (typical)	45s at flow rate of 35 L/min
Power Accuracy $\pm\%$	Calibration uncertainty 1.9 Accuracy 3 ^(c)
Linearity with Power $\pm\%$	2
Photodiode Spectral Range μm	0.8-1.6
Photodiode Monitor Responsivity	70mV at 70kW, 1070nm (typical, uncalibrated)
Cooling Requirements	35 liter/min at max power proportionally lower down to 10 L/min. Absolute minimum flowrate 7.5 LPM with additional measurement error >5%
Cooling Water	Tap water, DI water
Water Pressure Drop Across Sensor Beam Absorber	0.3 MPa (3 Bar) at 35 LPM
Water Connections	16mm, 5/8"
Dimensions	467 x 396 x 427 LxWxD mm
Weight kg	42kg dry
Compliance	CE, China RoHS, UKCA
Version	
Part number	7Z07141

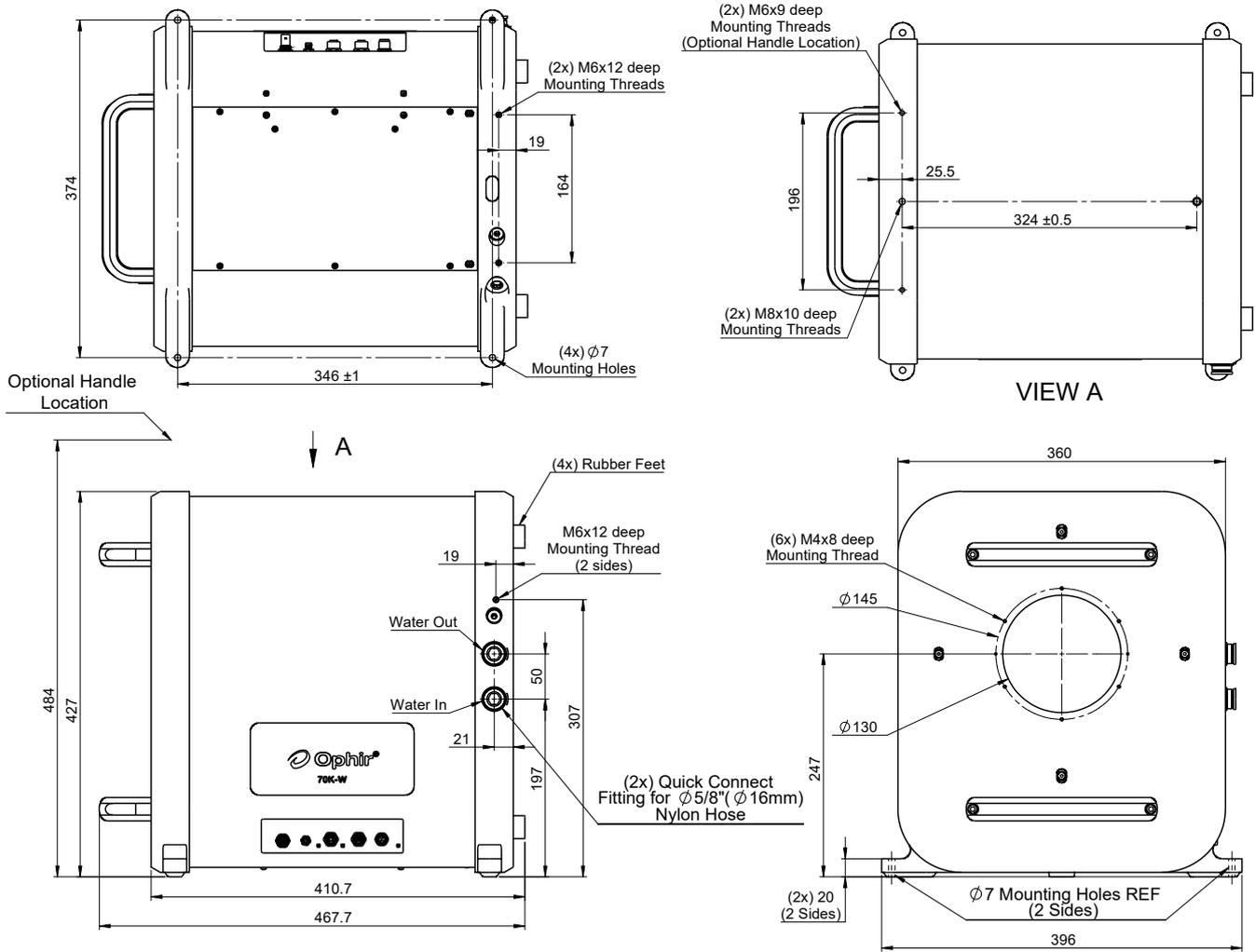
Note: (a) Compliant with IEEE803.2af

Note: (b) Divergent sources (fibers) must be positioned correctly such that the beam does not exceed the usable reflector diameter. Consult Ophir for more information

Note: (c) Calibrated at 1070nm

* For drawings please see page 90B

70K-W



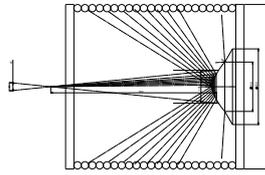
1.1.2.8 Calorimetric Power Meters

1.1.2.8.2 Ultra-High Power Water Cooled Calorimetric Sensors

100W to 150kW

Features

- Highest powers
- Calorimetric
- Up to 150kW
- Ø200mm aperture



Laser Beam Path

120K-W / 150K-W



Model	120K-W	150K-W
Use	Measuring Highest powers to 120kW	Measuring Highest powers to 150kW
Measurement Type	Calorimetric, water cooled beam absorber chamber with deflecting cone. Separate power measuring unit monitoring input and output cooling water flow and temperature	Calorimetric, water cooled beam absorber chamber with deflecting cone. Separate power measuring unit monitoring input and output cooling water flow and temperature
Spectral Range μm	0.9 – 1.1 ^(a)	0.9 – 1.1 ^(a)
Aperture mm	Ø200	Ø200
Power Range for Calibrated Reading	10kW – 120kW	10kW – 150kW
Power Noise Level	±20W with stable water temperature	±20W with stable water temperature
Backscattered Power	Less than 1%	Less than 1%
Maximum Average Power Density kW/cm ²	Designed for near Gaussian beam. The 1/e ² beam diameter should have a divergence of 0 to 6 degrees and should be Ø100mm in diameter at the reflecting cone (see sketch above where the beam may also be collimated and not divergent as long as beam diameter requirement is met).	Designed for near Gaussian beam. The 1/e ² beam diameter should have a divergence of 0 to 6 degrees and should be Ø100mm in diameter at the reflecting cone (see sketch above where the beam may also be collimated and not divergent as long as beam diameter requirement is met).
Beam Centering Requirements IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR	Beam to be centered on deflecting cone ±5mm and parallel ±2degrees	Beam to be centered on deflecting cone ±5mm and parallel ±2degrees
Response Time 0-95% typ	40s at flow rate 60 liter/min and 60s at flow rate 20 liter/min	<40s at flow rate 75 liter/min and 60s at flow rate 20 liter/min
Calibration Uncertainty ±%	1.9	1.9
Power Accuracy ±%	5 ^(a)	5 ^(a)
Linearity with Power ±%	2	2
Variation with Beam Size ±%	NA	NA
Cooling Requirements	Water flow rate, 60 liters/min at max power. Inlet temperature 15-20degC. Inlet water temperature rate of change <0.3degC/min at full power, proportionately less at lower power ^(b, c)	Water flow rate, 75 liters/min at max power. Inlet temperature 15-20degC. Inlet water temperature rate of change <0.5degC/min
Water Pressure Drop across Beam Absorber	0.4MPa at 60 liter/min flow rate	0.45MPa at 75 liter/min flow rate
Water Connections	Up to 4 meters in each direction of 1" OD 13/16" ID flexible nylon tubing	Up to 4 meters in each direction of 1" OD 13/16" ID flexible nylon tubing
Outputs	1. Cable terminated in DB9 plug with RS232 ASCII output reading power, flow rate and temperature on PC (using WaterFlowMeter PC App). Cable lengths 10 meters (recommended for access to full data). 2. Cable terminated in DB15 Ophir smart plug reading power.	1. Cable terminated in DB9 plug with RS232 ASCII output reading power, flow rate and temperature on PC (using WaterFlowMeter PC App). Cable lengths 10 meters (recommended for access to full data). 2. Cable terminated in DB15 Ophir smart plug reading power.
Dimensions	See drawing on next page	See drawing on next page
Weight kg	Beam Absorber 50kg. Power measuring unit 10kg	Beam Absorber 50kg. Power measuring unit 10kg
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part number	7Z02691	7Z07152

Note: (a) Calibrated for 1.07 μm

Note: (b) Minimum flow rate should not be below 20 liter/min. It is recommended that the user install a safety interlock flow switch on the return water line (after beam dump) to immediately shut down the laser if flow rate drops

Note: (c) For solutions for prolonged usage with untreated water (tap water, non DI water), please contact Ophir

* For drawings please see page 92

1.1.2.9 IPM Industrial High Power Sensor

Introduction

Based on the tried-and-true 10K-W sensor, the new IPM modular industrial sensor for measuring the average power of high-power lasers up to 11kW is ideal for tough industrial use. Ruggedized by design, it has all the features needed for reliable, fail-safe operation in a tough operational environment. Its modular design provides the flexibility needed to address customers' specific needs. The IPM-10KW has heavy duty connectors and an interlock output. For more protection, the user can order the

IPM-Shutter10 which provides an automated shutter with a field replaceable anti reflective coated window (see next section). Integration into modern automation systems is available with the IPM-COM communication module (Ethernet and Profinet). With its modular architecture and ruggedness, it is ideal for high power applications such as welding and cutting and more. It is targeting machine manufacturers (R&D, production, and service) and laser-based machine users.

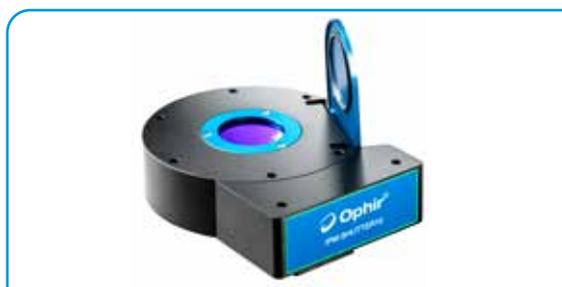
IPM-10K Base Unit - Main Features

- Measures power from 100W up to 11kW
- Wavelengths: 900 – 1100nm, 10.6µm
- Beam incidence angle, up to $\pm 5^\circ$
- IP62 rating when used with IPM-Shutter10
- Direct connection to host using RS232 or communication module
- Interlock output reducing risk for damage due to sensor over heating
- Water cooled
- Interface for external flow meter



IPM-Shutter10 (Optional) - Main Features

- Modular, motorized shutter unit
 - Field replaceable protective window
 - Scatter shield
- Robust, dust proof, splash water resistant (IP62)
- Supports vertical (or up-side-down) installation



IPM-COM - Communication Modules (Optional) - Main Features

- Easy integration with modern automation systems
 - Profinet with AIDA connectors for power and data
 - EtherNET/IP with 7/8" connectors for power and M12 for data
- Two communication ports for daisy chain connection or local configuration and monitoring
- Two power connectors for power chaining



1.1.2.9 IPM Industrial High Power Sensor

1.1.2.9.1 IPM-10KW – Industrial Sensor

Features

- ISO/IEC 17025:2017, NIST traceable calibration
- Measure up to 11kW
- Modular architecture
- Heavy duty design with industrial interface and connectors
- Interlock to protect from overpower or cooling water failure
- Real time visibility, traceability and logging for predictive maintenance

IPM-10KW



Model	IPM-10KW	
Use	Laser power measurement in industrial environment up to 11kW	
Control	RS232	
Absorber Type	Beam deflector + broadband absorber	
Spectral Range μm ^(a)	0.9-1.1, 10.6	
Aperture mm	\varnothing 45mm	
Power Mode		
Power Range	100W – 11kW	
Power Scales	11kW / 6kW / 600W	
Power Noise Level W	5	
Backscattered Power	With IPM-SHUTTER10 or 10K-W/15K-W Scatter Shield, ~1% ^(b) Without IPM-SHUTTER10 or 10K-W/15K-W Scatter Shield 3.5 ^(b)	
Maximum Average Power Density kW/cm ²	See note ^(c) and table ⁽¹⁾ below	
Response Time with Meter (0-95%) typ. s	2.7	
Response Time with Meter (0-99%) typ. s	10	
Calibration Uncertainty $\pm\%$	1.9	
Power Accuracy $\pm\%$	5 ^(a)	
Repeatability $\pm\%$	0.4	
Linearity with Power $\pm\%$ (0-100% range)	2	
Linearity with Power $\pm\%$ (0-90% range)	1.5	
Energy Mode		
Energy Range	60J – 10kJ	
Energy Scales	10kJ / 5kJ / 500J	
Energy Accuracy	Additional 2% error to power accuracy	
Minimum Energy J	60	
Maximum Energy Density J/cm ²	See table ⁽¹⁾ below	
Cooling	Water ^(d)	
Minimum Water Flow Rate	8 liter/min at full power ^(d)	
Water Connectors	Quick connector for 12mm OD nylon tubing (see page 102)	
Weight kg	5	
Connectors ^(e)	 Interlock, M8 male, 3-pin RS232, M12 female 5-pin Flow meter – M8 female, 6-pin Power/IPM-COM, M12 male, 5-pin	
Cables ^(e)	Part	P/N
	RS232 cable, M12 male 5-pin to D9 female, 1.8m (supplied with sensor)	7Z10532
	Power cable, M12 female 5-pin to flying leads, 1.5m (supplied with sensor)	7E01519
	Interlock cable, M8 female 3-pin to flying leads, 1.5m (not supplied)	7E01513
	Water Flow Meter cable, M8 male 6-pin to flying leads, 1.5m (not supplied)	7E01536
Related Products ^{(a) (b)}	Name	Description
	IPM-SHUTTER10	Combined protective shutter with built in scatter shield, IP62 rated
	IPM-SHUTTER10 Window replacement kit	Replacement anti reflective coated window
	10K-W / 15K-W Scatter Shield	Scatter Shield for mounting on front flange
	IPM-COM-Profinet	Profinet communications adapter with AIDA connectors
	IPM-COM-EtherNet/IP-M	EtherNet/IP communications adapter with circular connectors (M12 & 7/8)
Compliance	CE, UKCA, China RoHS	
Part number	7Z07106	

Note: (a) Calibrated at 1.07 μm and 10.6 μm . When working at 10.6 μm (CO₂), if using the SHUTTER10 unit, the window should be removed. IPM without the IPM-SHUTTER10: For other wavelengths in the ranges of 0.8 - 0.95 μm and 1.1 - 2 μm , add up to \pm 2% to the calibration error.

Note: (b) IPM-SHUTTER10: When installed, use the NIRS or CO₂S setting to compensate for slightly higher reading.

10K-W / 15K-W Scatter Shield: When installed, use the NIRS setting to compensate for slightly higher reading. When not installed, use the NIR setting.

Note: (c) For circular beam centered within 25% of beam diameter. IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR. Maximum tilt angle \pm 5 degrees. For rectangular beam please consult Ophir representative.

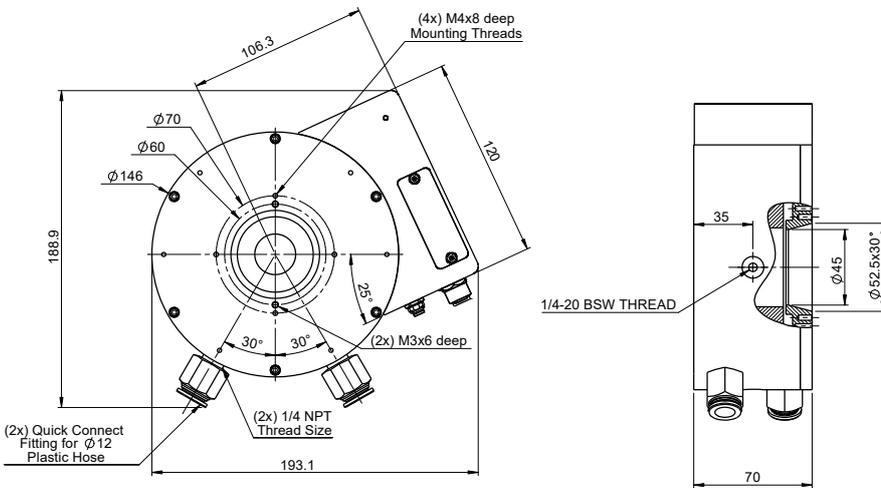
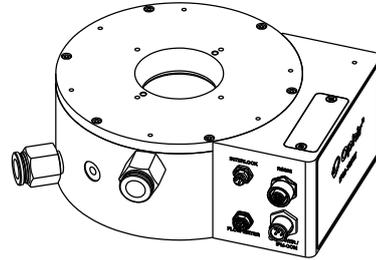
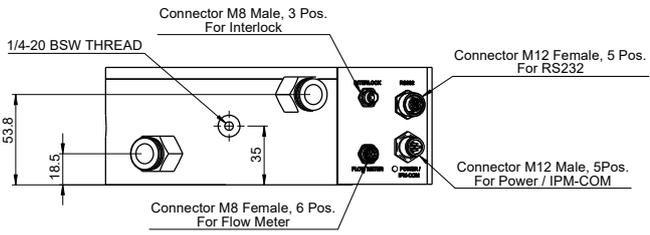
Note: (d) Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.1MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below 3 liter/min. The response time will be optimal with the recommended flow rate. For solutions for prolonged usage with untreated water (tap water, non DI water), please, contact Ophir.

Note: (e) See IPM User Manual for details of connectors and cables

Table (1)	Beam diameter	Max power density	Max energy density – by pulse width			
			1ms PW	3ms PW	10ms PW	100ms PW
	<15mm	10kW/cm ²	30J/cm ²	60J/cm ²	150J/cm ²	1350 J/cm ²
	15 – 20mm	7kW/cm ²	20J/cm ²	40J/cm ²	100J/cm ²	900 J/cm ²
	20 – 40mm	5kW/cm ²	15J/cm ²	30J/cm ²	70J/cm ²	600 J/cm ²
	40 – 45mm	4kW/cm ²	12J/cm ²	25J/cm ²	60J/cm ²	500 J/cm ²

* For drawings please see page 95

IPM-10KW



1.1.2.9 IPM Industrial High Power Sensor

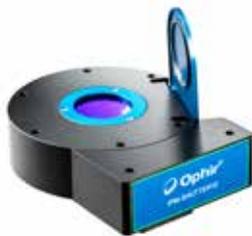
1.1.2.9.2 IPM-SHUTTER10 Shutter Assembly for IPM-10KW

For usage in a dirty industrial environment, the IPM-10KW can be fitted with an automated dust tight shutter assembly to protect the unit from dust and debris. The shutter unit has a built-in scatter shield and includes a field replaceable antireflection coated protective window.

Features

- Built-in scatter shield
- Antireflective coated window ^(a)
- Motorized dust-resistant shutter
- IP62 rated

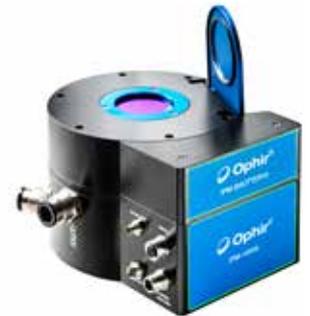
IPM-Shutter10



IPM-10KW with IPM-Shutter10



With shutter open

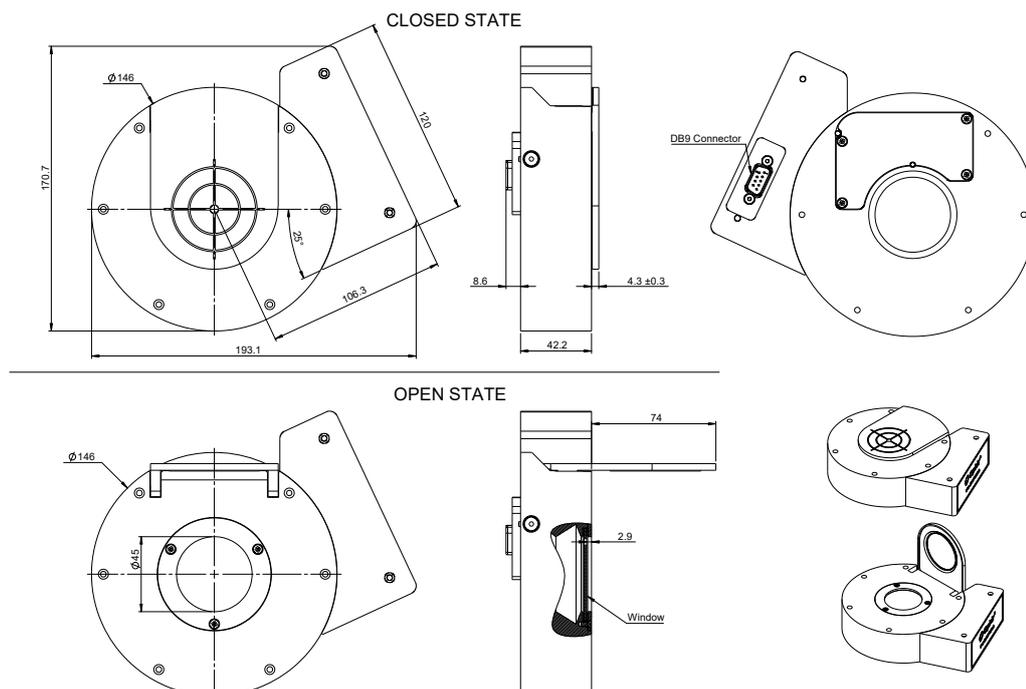


Model	IPM-SHUTTER10		
Use	Enhances IPM-KW sensor with IP62 ingress protection, and additional reduction of back		
Control	Via host IPM-10KW unit		
Aperture mm	Ø45mm		
Backscattered Power ^(b)	~1%		
Weight kg	2		
Connectors	Connection to IPM-10KW unit – D9		
Part Numbers and Optional Accessories	Name	Description	P/N
	IPM-SHUTTER10	Combined protective shutter. Includes built in scatter shield	7Z08409
	IPM-SHUTTER10 Window replacement kit	Replacement anti reflective coated window	7Z08411
Related Products	Name	Description	P/N
	IPM-10KW	IPM industrial laser power sensor	7Z07106
	IPM-COM-Profinet	Profinet communications adapter with AIDA connectors	7Z08404
	IPM-COM-EtherNet/IP-M	EtherNet/IP communications adapter with M connectors	7Z08405

Note: (a) When working at 10.6µm (CO₂), the window should be removed.

Note: (b) Using built in scatter shield, use the NIRS or CO₂S setting to compensate for slightly higher reading.

IPM-SHUTTER10



1.1.2.9 IPM Industrial High Power Sensor

1.1.2.9.3 IPM-COM – IPM adapter for industrial protocols

Modern automation systems integrate equipment from multiple vendors into a common Ethernet infrastructure. The IPM-COM is an industrial communication module enabling the integration of the IPM industrial sensor into Profinet or EtherNet/IP automation systems. For additional protocols please approach your local Ophir sales representative.

Features

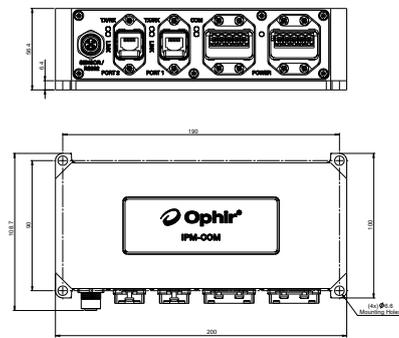
- Connects to the IPM sensor to provide industrial communication protocols
- Supports communication and power daisy chaining
- Supports Profinet, EtherNet/IP
- Industrial ruggedized housing and connectors
- Two connector options: M12 & Mini 7/8", or AIDA



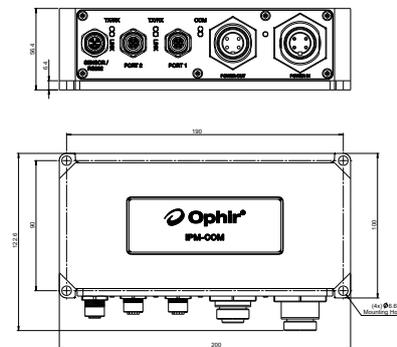
Model	IPM-COM				
Use	Support industrial communication protocols for IPM sensor				
Connectors	2x Industrial Ethernet connectors, 2x 24V power connectors, 1x M12 interconnection with the IPM sensor				
Cables	Cable to IPM sensor, M12 male to M12 female, 5-pin, 1.5m (P/N 7E01540, supplied)				
Weight kg	2				
Part Numbers	Name	Protocol ^(a)	Data Connector ^(b)	Power Connector	P/N
	IPM-COM-Profinet	Profinet	AIDA RJ45	AIDA Power	7Z08404
	IPM-COM-EtherNet/IP-M	EtherNet/IP	M12	Mini 7/8"	7Z08405
Related Products	Name				P/N
	IPM-10KW sensor				7Z07106
	Combined protective shutter and scatter shield IPM-SHUTTER10				7Z08409
Optional Accessories	Name				P/N
	Power Cable, Mini 7/8" female, 4-pin, to flying leads, 2m (not supplied)				7E01535
	Power Cable, AIDA female, 4-pin, to flying leads, 5m (not supplied)				7Z10458A
	Profinet Cable, RJ45 AIDA to RJ45, 5m (not supplied)				7E01298
	EtherNet/IP Cable, M12-D to RJ45, 3m (not supplied)				7E11211

Notes: (a) Other protocols (EtherCAT, CC-link) can be supported, contact Ophir for more information
 Notes: (b) Other combinations of protocol and connector types are possible, contact Ophir for more information

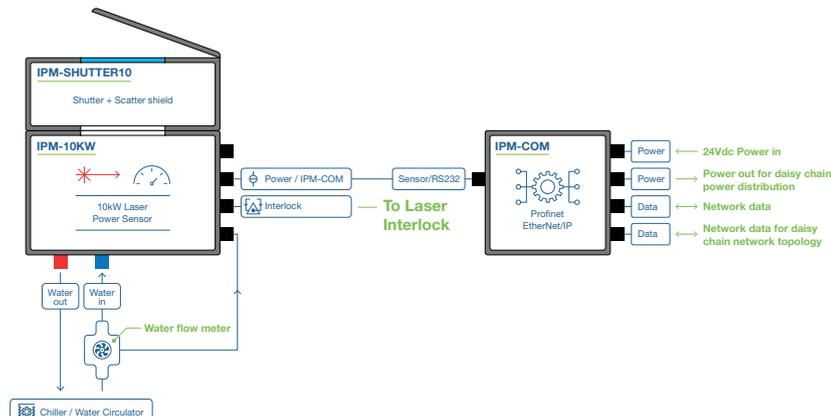
IPM-COM-Profinet (AIDA)



IPM-COM-EtherNet/IP-M (M12, Mini 7/8")



1.1.2.8.4 Full IPM System Setup



1.1.2.11 Accessories for High Power Water Cooled Sensors

1.1.2.11.1 Fiber Adapter for Ophir High Power Sensors

Adapters for high power fiber connectors are available for Ophir sensors L1500W and 5000W for use in industrial environments.

The fiber adapters allow mounting of QBH fiber terminators to Ophir sensors. When using an adapter, the fiber output is centered on the sensor surface and is isolated from surrounding dust and contaminants.

Choice of the correct adapter model depends on the power and divergence angle of the laser being measured, see specs below.



Description	QBH fiber adapter for high power sensors models	
Use	Adapter for direct measurement of QBH fiber output	
Sensors Supported	L1500W-LP2-50, L1500W-BB-50, 5000W-LP2-50 and 5000W-BB-50 ^(a)	
Added Error	1% for BB type coatings	
Housing Temperature at Max Power	55°C ^(b)	
Cooling	Water, maximum temperature 30°C	
Fiber Adapter Water Flow Requirements	2 liter/min, minimum ^(c)	
Water Connectors	(2x) Quick Connect Fitting For Ø3/8 Plastic Hose ^(d)	
Model	QBH-L-Fiber Adapter	QBH-S-Fiber Adapter
Maximum Beam Divergence Half Angle ^(e)	120 mrad (180 mrad)	180 mrad (270 mrad)
Minimum Beam Divergence Half Angle	See note ^(f)	See note ^(f)
Dimensions	See drawing below	See drawing below
Part number	7Z08348	7Z08349

Note: (a) Please note that older versions of the above sensors do not have the requisite 4 threads on Ø70mm circle on their front flange and cannot be used with the QBH adapter.

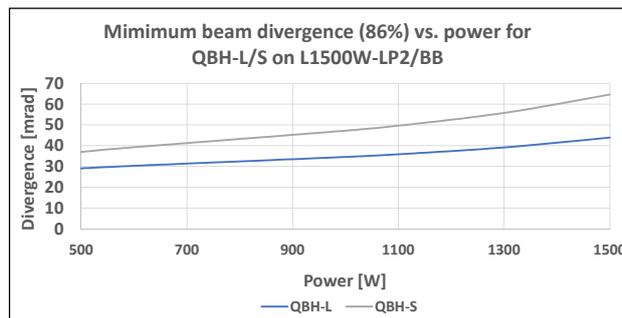
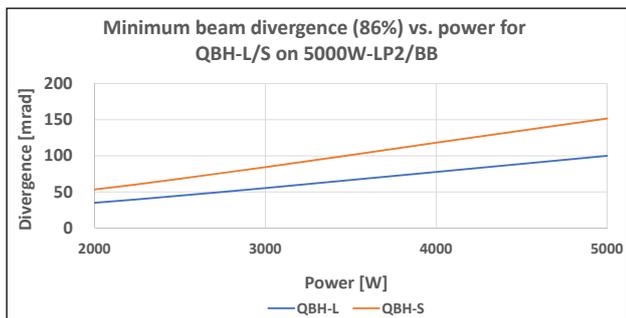
Note: (b) When using BB type coatings temperature may reach 80°C at midpoint of adapter.

Note: (c) The water flow requirements of the fiber adapter are much lower than that of the water-cooled sensor (see the sensor data sheet for details). Therefore, the fiber adapter can be connected in series with the sensor water supply but then the water flow rate of both will have to meet the sensor minimum water flow rates.

Note: (d) For Metric water connectors see page 102.

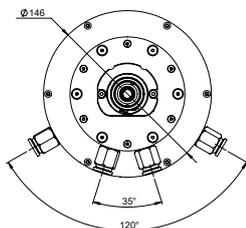
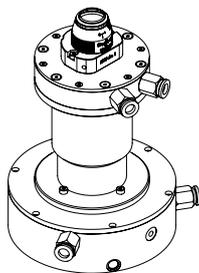
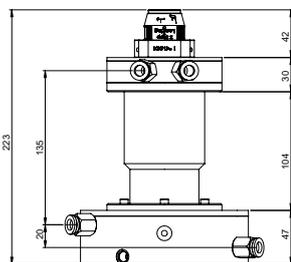
Note: (e) Divergence angle given defines radius of beam containing 86% of power, the divergence of 98% of the power is given in brackets.

Note: (f) Graphs of beam divergence:

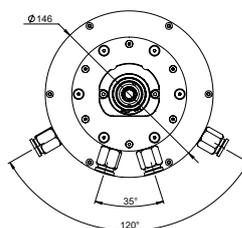
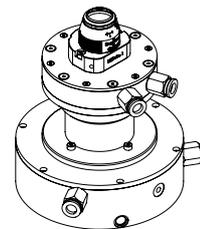
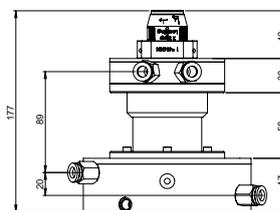


High Power QBH-Fiber Adapter Mounted on a 5000W-LP2-50 Sensor

QBH-L-Fiber Adapter



QBH-S-Fiber Adapter



1.1.2.11 Accessories for High Power Water Cooled Sensors

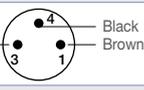
1.1.2.11.2 Protective Housing for 5000W, 10K-W and 15K-W Series Sensors

For use with 5000W, 10K-W and 15K-W sensors in industrial environments where sensors may be contaminated by debris from material working process.

The protective housing and shutter prevent contamination of the sensor, particularly the absorbing surface, by this debris. The housing has a solenoid actuated shutter that can be opened when needed for measuring and be closed otherwise. The protective housing is fastened to the front flange of the sensor ^(a).

Protective Housing for 5000W / 10K-W / 15K-W
Mounted on Sensor (shutter open)
Rear view (cables and water connector)

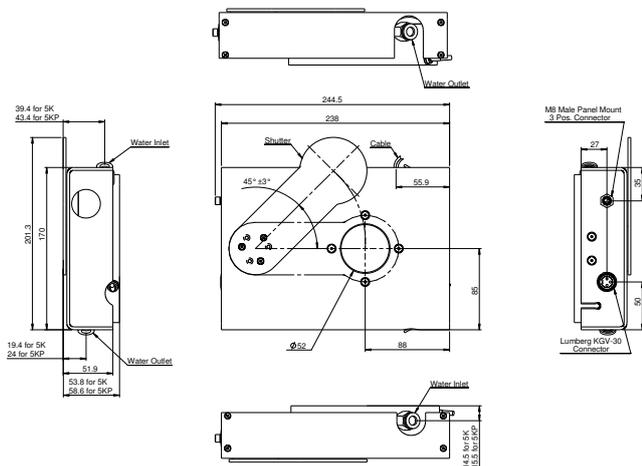


Model	5000W / 10K-W / 15K-W Protective Housing	
Use	Protection from debris of material working process	
Sensors Supported	For 5000W, 10K-W and 15K-W. Needs threaded front flange ^(a)	
Aperture	Exposes full aperture of sensors	
Solenoid Actuating Power	24VDC 1A, Shutter is normally Closed	
Electrical Connection	Lumberg SV30 male connector with 2m cable (P/N 7Z10377) as supplied. Black wire (pin3) is ground, Red wire (pin1) is +24VDC, no wire connected (pin 2)	
Interlock	Interlock switch is open if shutter is closed. This can be used to protect the shutter from accidental exposure to the laser	
Electrical Connection for Interlock	M8-3 Pin male connector (pin 1,4 connected to switch contacts). 1.5m cable (P/N 7E01513A) included, brown and black wires are the switch contacts. Pin 3 - no wire connected	Cable Plug (Female) Not connected 
Dimensions	See drawing below	
Housing Material	Sheet aluminum	
Version	V1	
Part number	7Z08344	

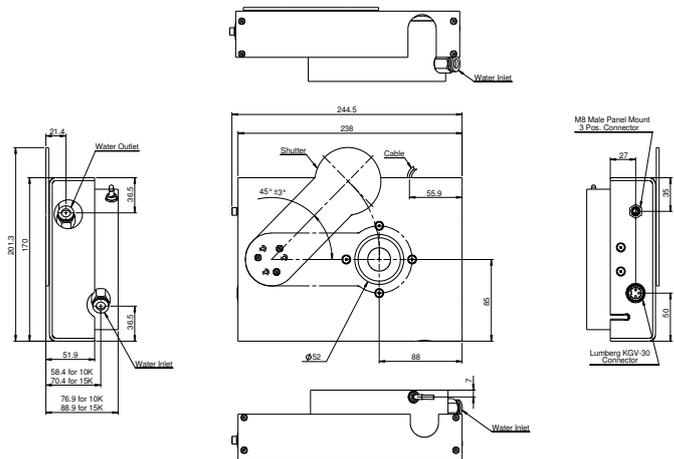
Note: (a) When fitting the housing to previous versions of the above sensors not having the requisite threads on their front flange, it will be necessary to exchange the front flange of the sensor with a new one having the requisite mounting threads. For details, consult Ophir representative.

Protective Housing for 5000W, 10K-W and 15K-W

As mounted on 5000W



As mounted on 10K-W / 15K-W



1.1.2.11 Accessories for High Power Water Cooled Sensors

1.1.2.11.6 Metric Water Connectors for Water Cooled Sensors

The standard water connection supplied with Ophir water cooled sensors are quick connect fittings for 3/8" and 1/2" plastic tubing. Metric water connectors are available as follows:

Connector (set of 2 ea.)	For use with	Part Number
1/4" NPT to 12mm O.D. tubing	20K-W & 30K-W	7Z08352 ^(a)
1/8" NPT to 10mm O.D. tubing	All other water cooled sensors & QBH Adapters	7Z08353

Note: (a) The water connector is compatible also with the 16K-W-BB-55 sensor P/N 7Z07131



1.1.2.11.7 Protective Covers with Target Pattern for High Power Sensors and for Scatter Shields

All the protective covers are made of black anodized aluminum, and have a cross pattern for alignment. Sensors: The 5000W, 10K-W, 15K-W sensors are supplied with the 10K-W Protective Cover. This protective cover also fits the 1000W and L1500W sensors, but is not supplied with these sensors. The protective cover can be ordered separately for these sensors. The 20K-W sensor is supplied with the 20K-W Protective Cover. The 30K-W sensor is supplied with the 30K-W Protective Cover.

Scatter Shields: 10K-W / 15K-W Scatter Shield (P/N 7Z08295), 20K-W scatter shield (P/N 7Z08355) and 30K-W Scatter Shield (P/N 7Z08293) are supplied with their respective protective covers (P/N 7Z08345 for 10K-W / 15K-W and P/N 7Z08346 for 30K-W).

For more information on scatter shields see page 101.

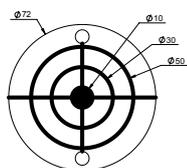
All protective covers can also be ordered separately (see table below).



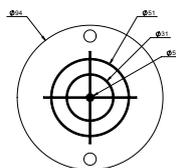
Protective Cover	For use with	Part Number
10K-W Protective Cover	15K-W, 10K-W, 5000W, L1500W, 1000W without scatter shield	1G01332
10K-W / 15K-W Scatter Shield Cover	10K-W and 15K-W with Scatter Shield	7Z08345
20K-W Protective Cover	20K-W without Scatter Shield	1G02813 ^(b)
30K-W Protective Cover	30K-W without Scatter Shield	1G02406
30K-W Scatter Shield Cover	30K-W with Scatter Shield	7Z08346

Note: (b) The protective cover is compatible also with the 16K-W-BB-55 sensor P/N 7Z07131

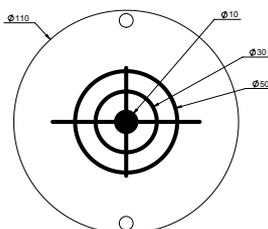
10K-W Protective Cover



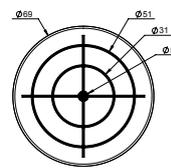
20K-W Protective Cover



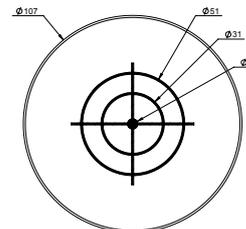
30K-W Protective Cover



10K-W / 15K-W Scatter Shield Cover



30K-W Scatter Shield Cover



1.1.2.12 Short Exposure High Power Sensors

1.1.2.12.1 Helios Pro

100W to 12,000W

Features

- No water cooling, up to 12,000W
- Profinet / EtherNet/IP / EtherCAT and RS232 interfaces
- Remote actuated protective cover
- Dual wavelength range IR & visible spectrum
- Optional Diffuser for small beam sizes
- Field replaceable protective window
- Pulse characterization: Rise time, power at the end of the pulse, stabilization of the pulse and pulse shape

Helios Pro



The Helios Pro measures high power industrial lasers of up to 12kW by measuring the energy of a short time exposure to this power. The laser is set to a pulse of from 0.3 to several seconds. The Helios Pro measures the energy and exposure time of this sample of the power, and from this calculates the power. Helios Pro provides additional characteristics of the pulse such as: rise time, power and level of stability of the pulse in the last 50 milliseconds and can also display the shape of the pulse. In the version with a diffuser Helios Pro can handle small beam size down to 2 mm. By keeping the pulse energy under 5kJ, there is no need for water cooling and the sensor can be kept to a compact size. It works in two wavelength ranges:

900-1100nm (Near IR) and 450-550nm (Blue-Green). The sensor is housed in a dust-resistant industrial body to keep the Helios Pro in clean working order even under harsh factory conditions. Its protective cover can be opened and closed remotely to protect the sensor when not in use. Its protective window is antireflection coated to reduce back reflection from high power beams. The Helios Pro offers three industrial communication protocols: Profinet, EtherNet/IP and EtherCAT, with an additional RS232 interface. It is equipped with two power and two data ports for easy integration into existing line or ring topologies as well as an RS232 connection. The Helios Pro comes with a simple PC application for easier integration into the customer's system.

Helios Pro Model Table:

Model	Description	Communication	Data connectors	Power connectors	P/N
Helios Pro - Profinet	Profinet, AIDA compatible connectors for power and data	Profinet, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	7Z07146
Helios Pro - Profinet, Diffuser	Profinet, AIDA compatible connectors for power and data	Profinet, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	7Z07147
Helios Pro - EtherNet/IP	EtherNet/IP, AIDA compatible connectors for power and data	EtherNet/IP, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	7Z07142
Helios Pro - EtherNet/IP, Diffuser	EtherNet/IP, AIDA compatible connectors for power and data	EtherNet/IP, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	7Z07143
Helios Pro - EtherNet/IP-M	EtherNet/IP, M12 connector for data, Mini 7/8" connector for power	EtherNet/IP, RS232	2x M12 D - coded connectors, 1x RS232 - DB9 connector	2x Mini 7/8" connectors (male / female)	7Z07140
Helios Pro - EtherNet/IP-M, Diffuser	EtherNet/IP, M12 connector for data, Mini 7/8" connector for power	EtherNet/IP, RS232	2x M12 D - coded connectors, 1x RS232 - DB9 connector	2x Mini 7/8" connectors (male / female)	7Z07139
Helios Pro - EtherCAT	EtherCAT, AIDA compatible connectors for power and data	EtherCAT, RS232	2x AIDA compatible RJ45 connectors	2x AIDA compatible connectors	7Z07144
Helios Pro - EtherCAT, Diffuser	EtherCAT, AIDA compatible connectors for power and data	EtherCAT, RS232	2x AIDA compatible RJ45 connectors, 1x RS232 - DB9 connector	2x AIDA compatible connectors	7Z07145

* For specifications please see page 104 and for drawings see page 105

Specifications of Helios Pro (following the Model Table on page 103)

Use	High power industrial laser measurement			
Absorber Type	LP2, absorption ~94%			
Power Range	100W - 12kW			
Energy Range	100J - 5kJ			
Exposure Time (see table below)	0.3- 4s ^(a)			
Wavelength	Without Diffuser 450 - 550nm, 900 - 1100nm With Diffuser 450-550nm, 940-1100nm			
Aperture	Without Diffuser ϕ 50mm With Diffuser ϕ 35 mm			
Max Beam Diameter	Without Diffuser 35mm With Diffuser 20mm			
Calibration Uncertainty $\pm\%$	1.9			
Accuracy ^(b)	Without Diffuser: $\pm 3\%$ (900 - 1100nm, 532nm); $\pm 3.5\%$ (450 - 550nm) With Diffuser: $\pm 3\%$ (940 - 1100nm); $\pm 4\%$ (450 - 550nm)			
Linearity with Energy	$\pm 1.5\%$ ^(c)			
Reproducibility	$\pm 1\%$			
Response Time	3s			
Waiting Time for Next Measurement	12s			
Pro mode: Power range Rise time Slope Instability	100W - 12kW ^(d) 0-95% % of measured (Pro Mode) power ^(e)			
Maximum Exposure Before Cooling Down is Necessary	Maximum operating temperature of 60°C will be reached after exposure to 30kJ (e.g. 6 shots at 5000W, 1s). Cooling down time before another 5kJ shot, 3min.			
Power Supply	24 VDC $\pm 5\%$, max 2A (for daisy-chaining)			
Power Consumption	4.8W			
Dimensions	Model: Profinet, EtherNet/IP, EtherCAT - (L x W x H) mm - 200 x 103 x 86 (closed); 200 x 114 x 146 (open) Model: EtherNet/IP-M - (L x W x H) mm - 200 x 125 x 86 (closed, connectors included); 200 x 135 x 146 (open, connectors included)			
Position of Mounting Holes	6.6 mm holes spaced at 90x190 mm			
Weight	Model: Profinet, EtherNet/IP, EtherCAT - 2.5kg, EtherNet/IP-M - 2.7 kg			
Indicators	7 indicator LEDs			
Operating Temperature	10 - 60°C			
Humidity	10 - 80%			
Recommended exposure times and 1/e ² Gaussian beam diameters	Laser Power W	Recommended Exposure s	Min 1/e ² beam dia. Without diffuser [mm]	Min 1/e ² beam dia. With diffuser (max dia. is 20mm) [mm]
	50	2	9	2
	100	2	9	2
	500	2	9	2
	1000	1	9	2
	2000	1	12	2
	5000	1	18	6
	10000	0.3	22	11
	12000	0.3	25	11
Cover	Motor driven cover opens sideways			
Accessories Supplied with Helios Pro	Model: Profinet, EtherNet/IP, EtherCAT - 1. Power Supply Cable, AIDA to flying leads termination 5m (P/N 7Z10458A) 2. Data Cable, Ethernet AIDA to RJ-45 5m (P/N 7E01299) Model: EtherNet/IP-M - 1. Power Supply Cable, 7/8" to flying leads termination 2m (P/N 7E01535) 2. D9F to D9M Shielded 3m RS232 Cable (P/N 7E11216A)			
Optional Accessories	Model: EtherNet/IP-M For all Modes: - 1. Data Cable, Ethernet M12 to RJ-45 plug IP67 3m Cable (P/N 7E11211) - 1. D9F to D9M Shielded 3m RS232 Cable (P/N 7E11216A) 2. D9F to D9M Shielded 10m RS232 Cable (P/N 7E01209) 3. Helios Pro Window Replacement Kit (P/N 7Z08447)			
Compliance	CE, UKCA, China RoHS			
Part number	See P/Ns in Helios Pro Model Table on previous page			

Notes: (a) Repetitive pulses can also be measured as long as the total exposure time is within this range.

(b) The power is calculated by measuring the energy and exposure time. The laser pulse is assumed to be rectangular for this calculation.

(c) For pulse widths in the range 0.3 – 4s.

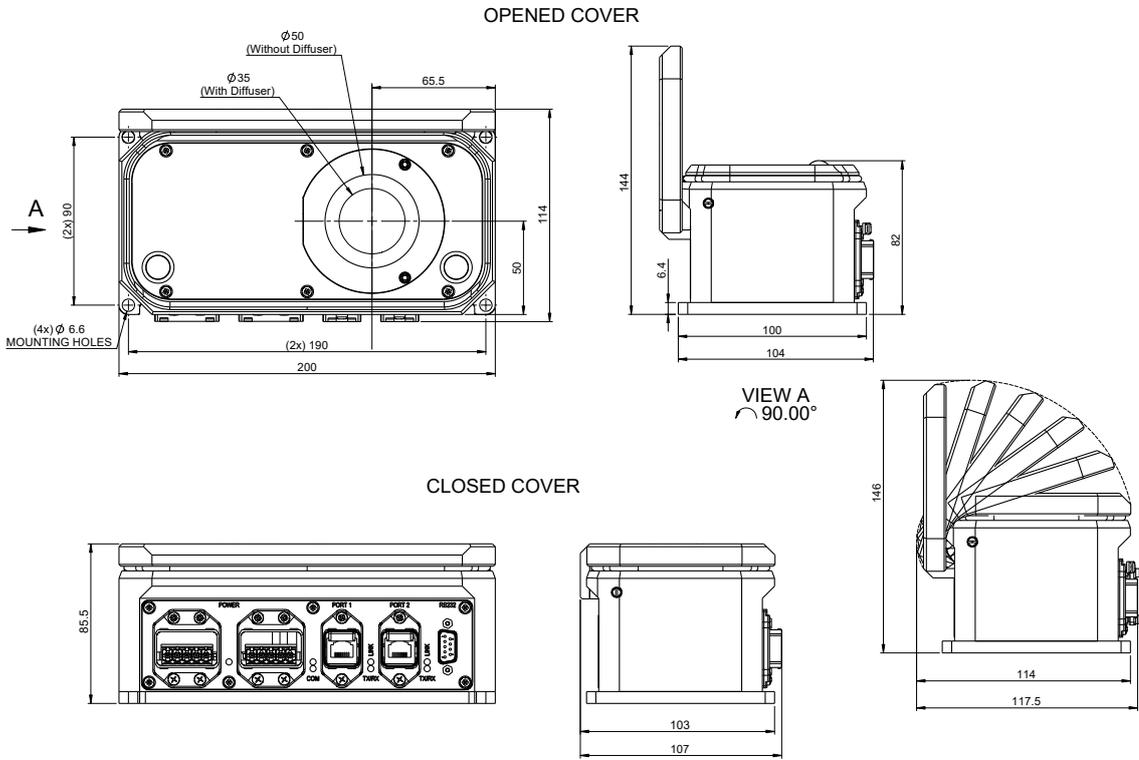
(d) Calculated for the last 50ms before the end of the pulse, the pulse shape is obtained without noise from the 300W and up.

(e) The slope is calculated as the best fit straight line through the pulse data for the last 50ms before the end of the pulse. It is in units of percentage of the Pro Mode power measurement and the value returned is limited to max/min values of +12.8% and -12.7%, if the measured slope goes beyond any measured values beyond these values will return the max or min values.

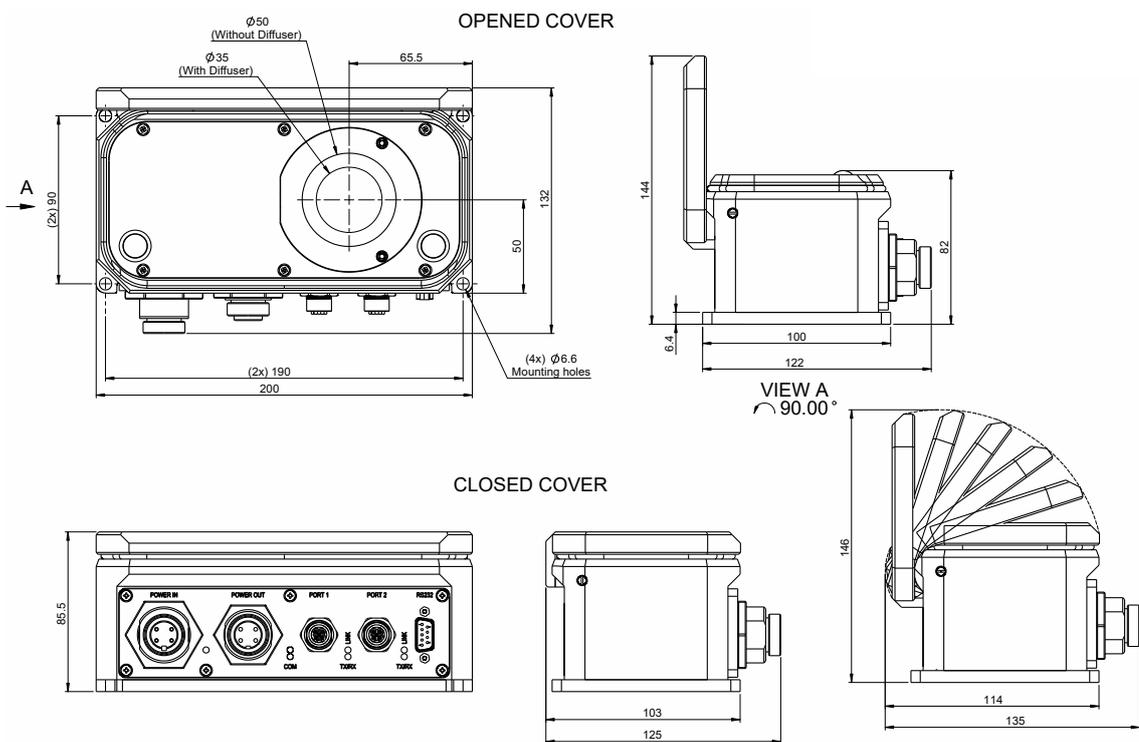
* For drawings please see page 105

Helios Pro Drawings

Helios Pro - Profinet / Helios Pro - EtherNet/IP / Helios Pro - EtherCAT



Helios Pro - EtherNet/IP-M



1.1.2.12 Short Exposure High Power Sensors

1.1.2.12.2 Ariel

200mW to 8000W

Features

- Measures up to 8000W
- Wavelengths: 440 - 550nm, 900 - 1100nm, 2.94µm, 10.6µm
- No Water Cooling IP62 rated
- Only 3 seconds to display measurement
- High thermal capacity of 14KJ for uninterrupted consecutive measurements

Ariel with window attached



The Ariel measures high power industrial lasers of up to 8kW by measuring the energy of a short exposure to this power. The laser is set to deliver a pulse of from 0.05 to several seconds. It then measures the energy and duration of the

laser pulse and calculates the power. Ariel can also measure continues power up to 500W intermittently. It is ideal for usage in tight spaces such as additive manufacturing chambers as well as for production process quality control and R&D.

Model	Ariel			
Use	High power laser measurement by short exposure			
Absorber Type	LP2			
Power Range	200mW - 8,000W			
Exposure Time (see table below)	Pulsed Mode: 0.05 - 2s. ^(a) CW mode: 10s to continuous depending on power level			
Wavelength	Window: 440 - 550nm, 900 - 1100nm ^(b) Diffuser: 440 - 550nm, 940 - 1100nm ^(b) Without window or diffuser: 2.94µm ^(c) , 10.6µm ^(c)			
Aperture	Ø32mm. Maximum beam diameter for Gaussian beam 22mm. With diffuser Maximum beam diameter for Gaussian beam 10mm.			
Calibration Uncertainty ±%	1.9			
Power Accuracy	900 - 1100nm, 2.94µm, 10.6µm: ±3%; 440 - 550nm: ±3.5% ^(a) ^(b)			
Minimum Power for Pulse Width Measurement	440 - 800nm, >20W; 800 - 1100nm, >10W; >1100nm, not available ^(c)			
Maximum Beam Incidence Angle	Without diffuser: ±30 degrees for <12mm Gaussian beam, With diffuser: ±25 degrees for <10mm Gaussian beam ^(d)			
Backscattered Power	LP2 absorber: <2200nm: 4%; 2940nm: 10%; 10.6µm: 25% With window: 5% With Diffuser: 25%			
Reproducibility	±1%			
Power Range vs. Irradiation Time	200mW - 30W: CW; 500W: up to 20s; 1,000W - 8,000W: 0.05 - 1s.			
Linearity	±1.5%			
Time to Reading	3s after end of exposure			
Waiting Time for Next Measurement	12s			
Maximum Energy for Single Pulse	2.4kJ ^(e)			
Maximum Exposure Before Cooling Down is Necessary	Maximum operating temperature of 60°C will be reached after exposure to 14kJ (e.g. 10 shots at 2,000W, 0.7s) ^(e) . Cooling down time before another 14kJ series of shots is ~10 minutes ^(f) .			
Over Temperature Warning	Flashing display			
Cooling	Convection ^(f)			
Battery	Rechargeable, 1100mAh, lifetime >15 hours			
Interface	128x64 pixel LCD Display, Bluetooth 5.1 (compatible with Bluetooth 4 and above), USB-C			
Dimensions (L x W x H)	70 x 70 x 80 mm (see drawing)			
Weight	0.8kg			
Operating Temperature	10 - 40°C			
Permissible Relative Humidity (non-condensing)	10 - 80%			
Ingress Protection	IP62			
Compatible Client Applications	StarLab (PC, USB), StarViewer (iOS or Android, Bluetooth)			
Recommended Exposure Times and 1/e ² Gaussian Beam Diameters	Laser Power W	Recommended Exposure s	Min 1/e ² beam dia. Without diffuser [mm]	Min 1/e ² beam dia. With diffuser (max dia. is 10mm) [mm]
Continuous Power Measurement	30	Continuous ^(f)	1	0.3
	500	20 ^(f)	4	2
	500	2	4	1
	1000	1	6	1
Power Measurement from Short Exposure	2000	0.7	10	1.5
	4000	0.5	16	3.5
	8000	0.3	22	N.A.
Compliance	CE, UKCA, China RoHS			
Version	V2			
Part number	7Z07137			

Notes: (a) The power is calculated by measuring the pulse energy and exposure time. A rectangular pulse is assumed for this calculation. Diffuser mode is calibrated with protective window, working without window may have small effect on measurement results.

(b) May be used at 550 - 900nm with decreased accuracy and higher reflection (up to 10%).

(c) Use without window or diffuser. The sensor does not measure pulse width above 1100nm. For pulsed power measurement at >1100nm, a short pulse with known duration should be applied. A pulse energy measurement is performed and divided by the known pulse width to obtain the power. When working without window and without diffuser, the sensor is not sealed against dust or water.

(d) With diffuser, reading will be up to 10% lower than vertical beam and beam should be offset from center in opposite direction to beam incidence by ~10mm.

(e) At room temperature.

(f) Faster cooling can be achieved by attaching the Ariel to a heat sink using the mounting threads at the bottom.

* For drawings and pictures please see page 107

1.1.2.12 Short Exposure High Power Sensors

1.1.2.12.3 Pulsed Power Mode

300mW to 10,000W

Features

- No water cooling
- Measure up to 10kW
- Cost Effective
- Diffuser for concentrated beams

L40(250)A-LP2-50



L40(500)A-LP2-DIF-35



L30C-LP2-26-SH



If the full features of the Helios Pro or Ariel including protective cover, Profinet interface and pulse width measurement are not needed, similar performance can be obtained with the L40(250)A-LP2-50 and L40(500)A-LP2-DIF-35. The L40(250)A-LP2-50 has the same sensor as the Helios Pro. It can measure powers from short exposure from 500W up to 10,000W. The user measures the energy of the pulse and knowing the pulse width calculates the power (e.g. 5000J in a 0.5s pulse = 10,000W). If using the Centauri and

StarBright meters or Juno/Juno+/Juno-RS PC interfaces this can be calculated directly by inputting the laser pulse width into the Pulsed Power screen of the Meter/Interface or the equivalent StarLab screen and exposing the sensor to the power for the requisite pulse width. The meter will then directly give the power reading from the pulse energy measured. For lower powers, the L30C-LP2-26-SH will give similar performance for energies up to 2000J. For further information see pages 66 & 153.

Model	L40(250)A-LP2-50	L40(500)A-LP2-DIF-35	L30C-LP2-26-SH						
Absorber Type	LP2	LP2 + Diffuser	LP2						
Spectral Range	0.25 – 2.2µm, 2.94µm	0.44 – 2.2µm ^(e)	0.25 – 2.2µm						
Aperture	Ø50mm	Ø35mm	Ø26mm						
Absorption	>94% from 0.25 to 1.1µm	~14% backscatter from diffuser	>94% from 0.25 to 1.1µm						
Power Range for continuous use	300mW - 40W	300mW - 40W	300mW - 10W						
Maximum Intermittent CW power	250W for 1.5min, 150W for 3min, 80W for 6min, 40W continuous	500W for 45s, 250W for 1.5min, 150W for 3min, 80W for 6min, 40W continuous	10W continuous, 100W for 2min, 100W heat sunked						
Maximum CW power density	20kW/cm ² at 250W	>150kW/cm ² at 500W	42kW/cm ² at 100W						
Aperture	Ø50mm	Ø35mm	Ø26mm						
Max Beam Diameter for Gaussian beam	Ø35mm for up to 30deg incidence	Ø25mm for normal incidence Ø15mm for 20deg incidence ^(f) Ø10mm for 30deg incidence ^(f)	Ø17mm for up to 30deg incidence						
Pulsed Power Mode									
Exposure Time For Pulsed Power Mode (see table below)	0.3s - 2s ^(b)	0.3s - 4s ^(b)	0.5s - 4s ^(b)						
Energy Range	100mJ – 10,000J	100mJ – 2000J	30mJ – 2000J						
Energy Accuracy	±5% 700 – 1100nm ^{(a), (c)}	±5% 900 – 1100nm ^(c)	±5% 700 – 1100nm ^{(a), (c)}						
Linearity with Energy	±1.5% ^(d)	±1.5% ^(d)	±1.5% ^(d)						
Reproducibility	±1%	±1%	±1%						
Response Time	2.5s	2.5s	1.5s						
Waiting Time for Next Measurement	12s	12s	12s						
Maximum Exposure Before Cooling Down is Necessary	20kJ (e.g. 4 shots of 5000Wx1s). Cooling down time before another 20kJ series, 10min.	8kJ (e.g. 4 shots of 2000Wx1s). Cooling down time before another 8kJ series, 10min.	10kJ (e.g. 5 shots of 2000Wx1s). Cooling down time before another 10kJ series, 10min.						
Recommended Exposure Times and Beam Diameters	Laser Power W	Recommended Exposure s	Min 1/e ² beam dia. mm	Laser Power W	Recommended Exposure s	Min 1/e ² beam dia. mm	Laser Power W	Recommended Exposure s	Min 1/e ² beam dia. mm
	500	2	9	100	4	1	100	4	9
	1000	1	9	500	1	1	500	1	9
	2000	1	12	1000	1	1	1000	1	13
	4000	1	16	2000	1	1.5	2000	1	17
	5000	1	18	4000	0.4	3.5	4000	0.5	22
10000	0.3	22							
Compatible Meter/PC interface	Centauri, StarBright, Juno/Juno+/Juno-RS with StarLab	Centauri, StarBright, Juno/Juno+/Juno-RS with StarLab	Centauri, StarBright, Juno/Juno+/Juno-RS with StarLab						
Weight kg	0.6	0.6	0.3						
Operating Temperature	15-60°C	15-60°C	15-60°C						
Connections	DB15 Smart Plug	DB15 Smart Plug	DB15 Smart Plug						
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS						
Part Number	7Z02794 (see page 66)	7Z02797 (see page 66)	7Z02775 (see page 153)						

Notes: (a) Above 1100nm there is an additional 1% uncertainty

(b) Repetitive pulses can also be measured as long as the total exposure time is within this range

(c) The power is calculated by measuring the energy and exposure time. The laser pulse is assumed to be rectangular for this calculation

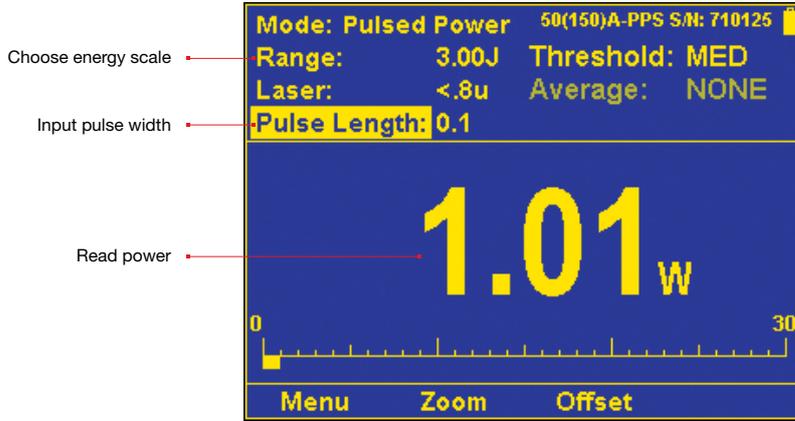
(d) For pulse widths in the range 0.3 – 4s

(e) Calibrated for 900 – 1100nm

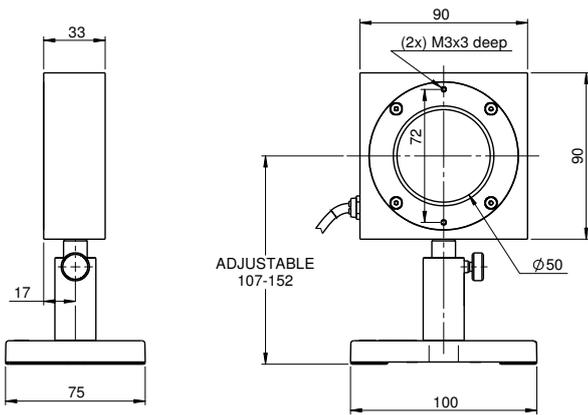
(f) At large angles of incidence, the position the beam hits the absorber should be offset into the direction of incidence by 5-10mm for correct reading and at 20deg incidence the reading will be 5% lower and at 30deg incidence 10% lower

* For drawings please see page 109

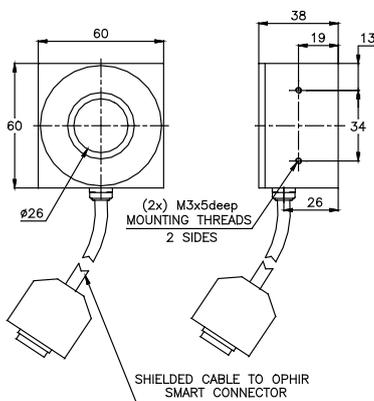
Pulsed Power Mode Screen:



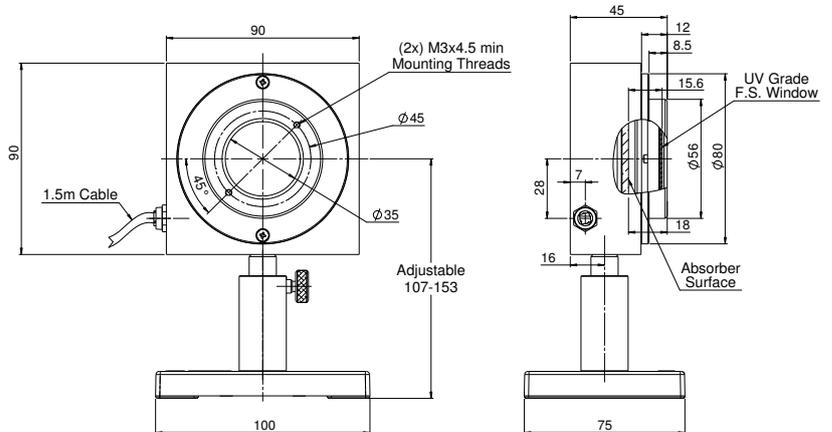
L40(250)A-LP2-50



L30C-LP2-26-SH



L40(500)A-LP2-DIF-35



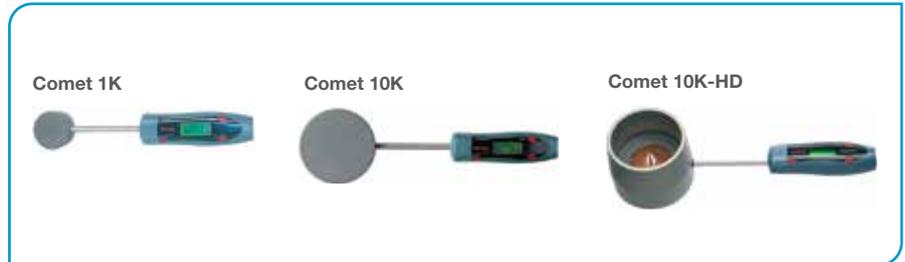
1.1.2.12 Short Exposure High Power Sensors

1.1.2.12.4 Comet Power Pucks

20W to 10kW

Features

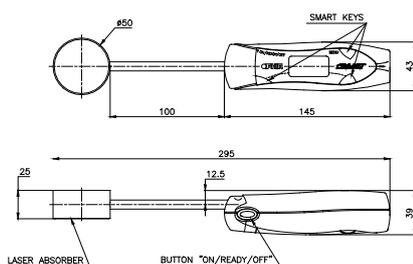
- Comet power pucks measure heat rise from 10s exposure to laser
- Accurate, built in temperature compensation algorithm
- Up to 10kW
- Up to 100mm apertures



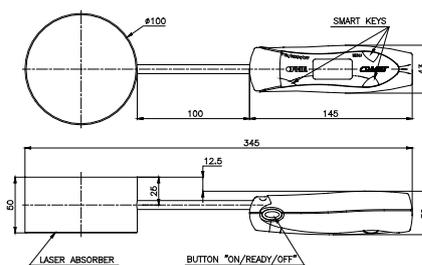
Model	Comet 1K ^(a)		Comet 10K ^(a)		Comet 10K-HD ^(a)	
Use	For powers to 1kW		For powers to 10kW		For high power density beams	
Absorber Type	Broadband		Broadband		Broadband with reflective cone beam spreader	
Spectral Range μm	0.2 - 20		0.98-1.07 and 10.6		0.98-1.07 and 10.6	
Aperture mm	$\varnothing 50\text{mm}$		$\varnothing 100\text{mm}$		$\varnothing 55\text{mm}$	
Power Mode						
Power Range	20W to 1kW		200W to 10kW		200W to 10kW	
Repeatability	$\pm 1\%$ for same initial temperature		$\pm 1\%$ for same initial temperature		$\pm 1\%$ for same initial temperature	
Maximum Average Power Density kW/cm^2	Power	Damage Threshold	Power	Damage Threshold	Power	Damage Threshold
					Beam dia <40	Beam dia >40
	100W	10	1kW	3.5	1kW	10
	200W	8	2kW	2.8	2kW	10
	300W	6	3kW	2.5	3kW	8
	500W	5	5kW	1.5	5kW	6
	1kW	4	10kW	1	10kW	4
Power Accuracy $\pm\%$	5		5		5	
Linearity with Power $\pm\%$	$\pm 2\% \pm 1\text{W}$ from 20W to 1kW		$\pm 2\%$ from 1kW to 10kW		$\pm 2\%$ from 1kW to 10kW	
Number of readings before probe must be cooled (for 25°C starting temp.)	100W	4	1kW	4	1kW	4
	300W	3	3kW	3	3kW	3
	400W	2	4kW	2	4kW	2
	1kW	1	10kW	1	10kW	1
Maximum Energy Density J/cm^2						
<100ns	0.3		0.3		1	
10 μs	0.8		0.8		3	
1ms	10		10		30	
10ms	50		50		150	
Time to Reading	Initial reading 10s after exposure, final reading 20s after exposure		Initial reading 20s after exposure, final reading 40s after exposure		Initial reading 30s after exposure, final reading 70s after exposure	
Temperature Compensation	Temperature compensated to give accurate readings independent of starting probe temperature					
Maximum Permitted Probe Temperature	70°C before measurement, 140°C after measurement					
Display	2x8 character LCD. Character height 5mm. CE Approved.					
Operation Mode	AUTO: Automatic measurement with laser set to 10s timed exposure. Unit senses temperature rise and measures automatically. MANUAL: User places probe in front of beam for 10s. Unit beeps to indicate start and stop measurement points. History: Stores last three readings. Calibration: Can be recalibrated by user.					
Battery	2 x AA. Lifetime in normal use approximately 1 year.					
Weight kg	0.3		1.2		1.2	
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS		CE, UKCA, China RoHS	
Version			V1		V2	
Part number	7Z02702		7Z02705		7Z02706	

Notes: (a) The Comet 1K, Comet 10K & Comet 10K-HD sensors are not under ISO/IEC 17025:2017 accreditation.

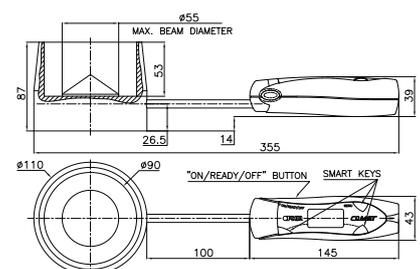
Comet 1K



Comet 10K



Comet 10K-HD

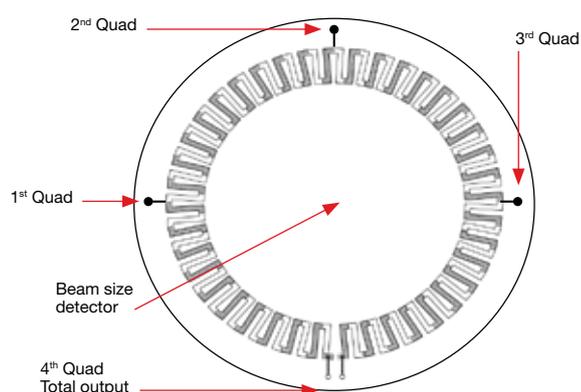


1.1.3 BeamTrack Power / Position / Size Sensors

1.1.3.1 Introduction

Ophir offers the BeamTrack line of thermal sensors that can measure beam position and beam size while measuring power. This innovative device will provide an additional wealth of information on your laser beam – centering, beam position, beam wander, beam size as well as power and single shot energy. The BeamTrack sensor is illustrated schematically here and works as follows: the signal coming from the sensor is divided into 4 quadrants so by measuring and comparing the output from the 4 sections we can

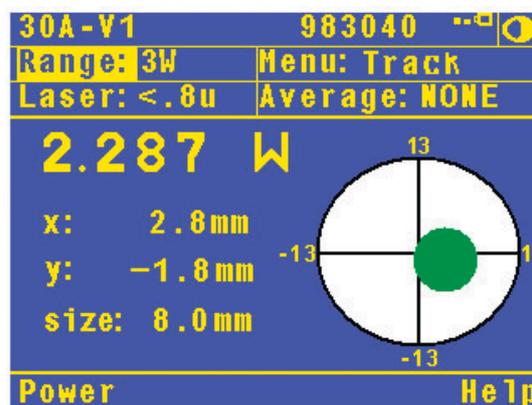
determine the position of the center of the beam to a high degree of accuracy. In addition to the 4 quadrants, there is now a special patented beam size detector. After processing outputs from these various detectors, the user is presented with the beam position as well as beam size. Note that the beam size is calibrated only for Gaussian beams but for other beams it will give relative size information and will indicate if the beam is changing size.



Operation of BeamTrack Sensors

BeamTrack sensors look similar to Ophir thermal sensors of the same type except that there is a small electronics module on the cable from the sensor to the smart plug. When BeamTrack sensors are plugged into compatible displays or PC interfaces (Centauri, StarBright, StarLite, Nova II, Vega, Juno, Juno+, Juno-RS and EA-1), along with the power measurement, there is a visual display of the beam position and beam size. The beam position can be accurately tracked and logged for beam wander measurements.

The beam size is calibrated only for Gaussian beams but other beams may be measured and the sensor will give a repeatable measurement of the relative beam size for tracking changes in the size of the beam over time.



Model	Sensor Type	Max Power [W]	Position	Size
3A-QUAD	TH	3	√	
3A-P-QUAD	TH	3	√	
10A-BB-16-PPS	TH	10	√	√
50(150)A-BB-26-QUAD	TH	50 (150 intermittent)	√	
50(150)A-BB-26-PPS	TH	50 (150 intermittent)	√	√
F150A-BB-26-PPS	TH	150	√	√
FL250A-BB-50-PPS	TH	250	√	√
1000W-BB-34-QUAD	TH	1000	√	

PD = Photodiode, TH = Thermal

1.1.3.2 BeamTrack Device Software Support

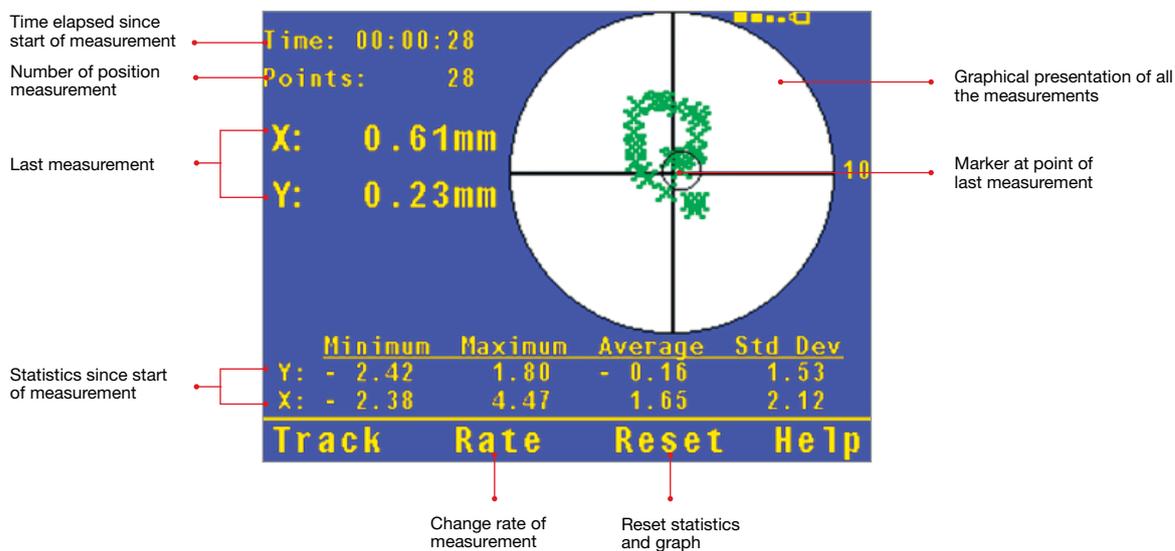
Features

- BeamTrack sensors are fully supported by the Centauri, StarBright, StarLite, Vega, Nova II, Juno, Juno+, Juno-RS and EA-1 devices
- Attach the sensor to the meter. On startup, it will be recognized as a BeamTrack sensor and tracking options will be enabled
- Use the Track screen to measure power, position and size simultaneously
- Use the Stability screen to measure pointing stability (also known as beam wander) over time

Track Screen of Centauri



Pointing Stability Screen of Vega



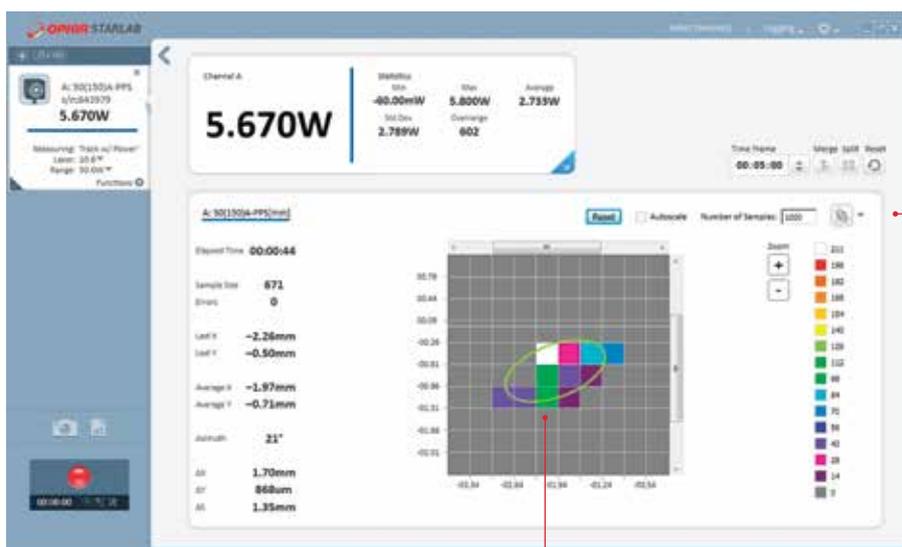
1.1.3.3 BeamTrack PC Software Support

Features

- StarLab
- COM Object for System Integrators including demo applications in VB, VC+ and MatLab the Track screen to measure power, position and size simultaneously
- LabVIEW Demo Application

Examples of some StarLab Screens

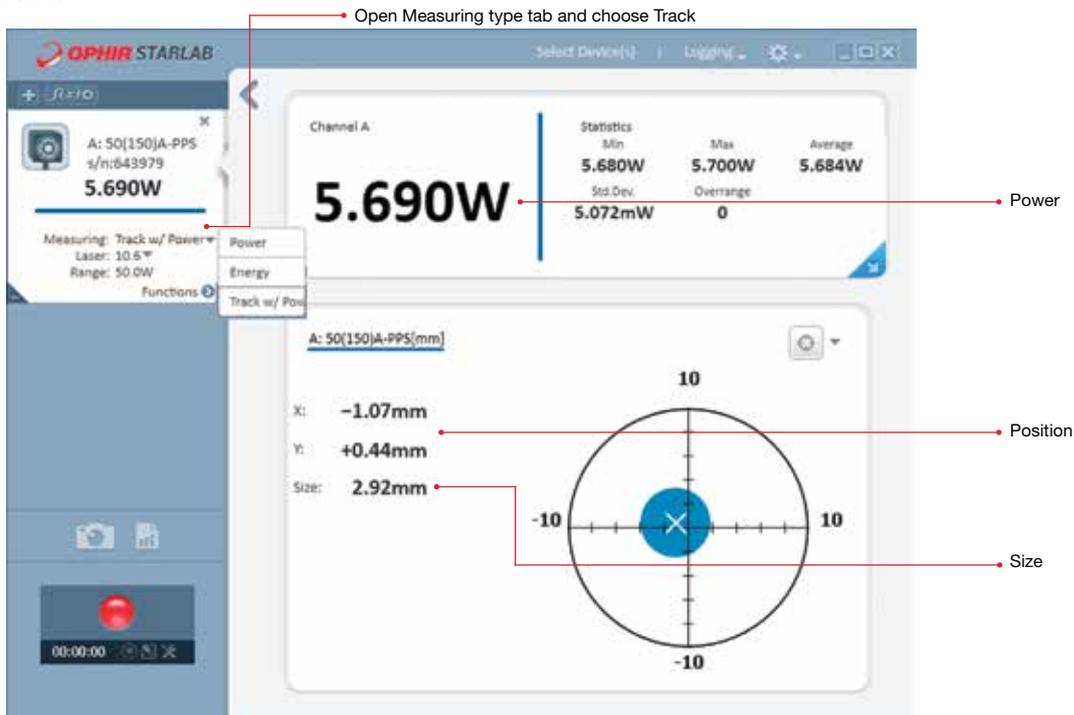
Stability Screen



Position stability screen

Displays beam center wander weighted for dwell time at each position

Position & Size Screen



Power / Position / Size screen

1.1.3.4 Low Power BeamTrack-Power / Position / Size Sensors

100 μ W to 10W

Features

- All the features of standard power sensors plus...
- Accurate tracking of beam position to fractions of a mm
- Monitoring of the laser beam size

3A-QUAD / 3A-P-QUAD



10A-BB-16-PPS



Model	3A-QUAD ^(a)	3A-P-QUAD ^(a)	10A-BB-16-PPS ^(a)
Use	General purpose	Short pulses	Low power
Functions	Power / Energy / Position	Power / Energy / Position	Power / Energy / Position / Size
Absorber Type	Low power broadband	P type	Broadband
Spectral Range μ m	0.19 - 20	0.15 - 8	0.19 - 11
Aperture mm	\varnothing 9.5mm	\varnothing 12mm	\varnothing 16mm
Power Mode			
Power Range	100 μ W - 3W	160 μ W - 3W	20mW - 10W
Power Scales	3W to 300 μ W	3W to 300 μ W	10W / 5W / 0.5W
Power Noise Level	5 μ W	10 μ W	1mW
Thermal Drift (30min)%	10 - 40 μ W ^(b)	10 - 40 μ W ^(b)	NA
Maximum Average Power Density kW/cm ²	1	0.05	28
Response Time with Meter (0-95%) typ. s	1.8	2.5	0.8
Calibration Uncertainty \pm %	1.9	1.9	1.9
Power Accuracy \pm % ^(g)	3	3	3 ^(h)
Linearity with Power \pm %	1	1	1
Energy Mode			
Energy Range	20 μ J - 2J	30 μ J - 2J	6mJ - 2J
Energy Scales	2J to 200 μ J	2J to 200 μ J	2J / 200mJ
Minimum Energy	20 μ J	30 μ J	6mJ
Maximum Energy Density J/cm ²			
<100ns	0.3	1 ^(f)	0.3
0.5ms	1	1 ^(f)	2
2ms	2	1 ^(f)	2
10ms	4	1 ^(f)	2
Beam Tracking Mode			
Position			
Beam Position Accuracy mm ^(c)	0.15	0.15	0.15
Beam Position Resolution mm	0.02	0.02	0.02
Min Power for Position Measurement	300 μ W	400 μ W	50mW
Size ^(d)			
Size Accuracy ^(e)	NA	NA	\pm (5%+50 μ m) for centered beam
Size Range mm (4 σ beam diameter)	NA	NA	1.5 - 10
Min Power for Size Measurement	NA	NA	50mW
Cooling	Convection	Convection	Convection
Weight kg	0.3	0.3	0.3
Fiber Adapter Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version			V1
Part number	7Z07934	7Z07935	7Z07905

Note: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, Nova II and Vega meters, Juno, Juno+, Juno-RS and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Note: (b) Depending on room airflow and temperature variations.

Note: (c) For position within inner 30% of aperture. Position measuring center corresponds to geometrical center within <1mm. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

Note: (d) Assumes laser beam with circular Gaussian (TEM₀₀) distribution. For other modes, size measurement is relative.

Note: (e) Accuracy spec will be maintained for beams \geq 1.8 mm not deviating from center by more than 15% of beam diameter.

Note: (f) For P type and shorter wavelengths derate maximum energy density as follows:

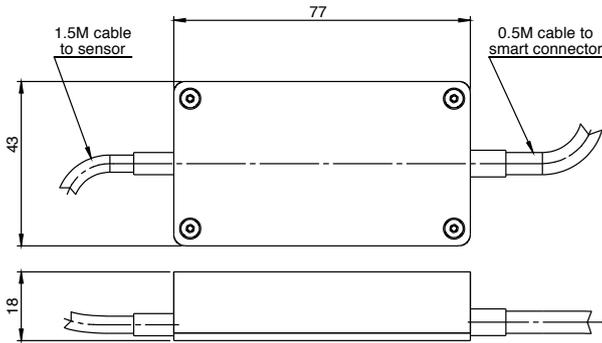
Wavelength	Derate to value not derated
1064nm	not derated
532nm	not derated
355nm	40% of stated value
266nm	10% of stated value
193nm	10% of stated value

Note: (g) The 3A-QUAD has a relatively large spectral variation in absorption and has a calibrated spectral curve at all wavelengths in its spectral range to the above specified accuracy. Nova and LaserStar meters do not support this feature and when used with those meters, the accuracy will be \pm 3% as above for 532nm, 905nm, 1064nm and 10.6 μ m but there will be an additional error of up to 3% at other wavelengths in the spectral range 190 - 3000nm.

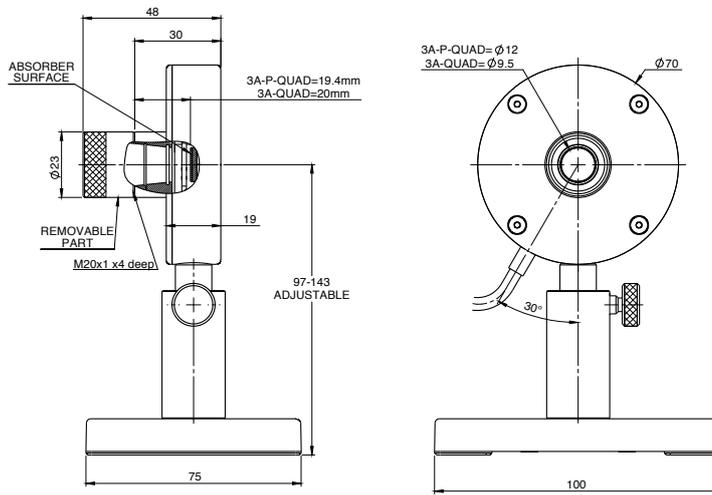
Note: (h) \pm 4%. For wavelengths <240nm

* For drawings please see page 115

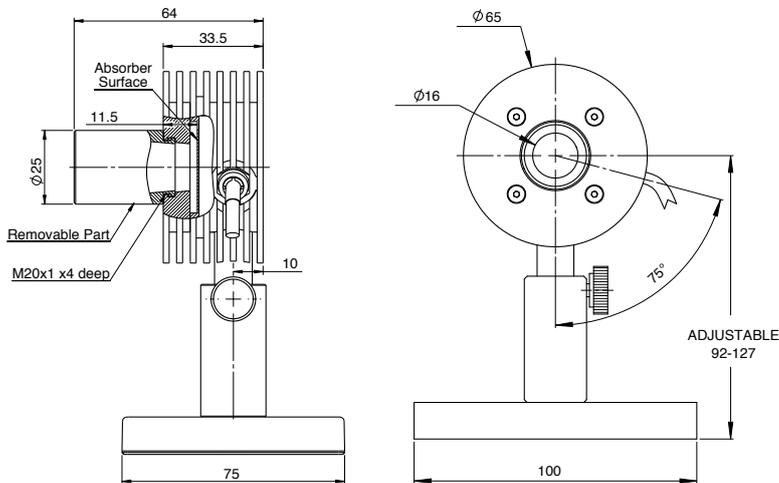
Interface Module on cable



3A-QUAD / 3A-P-QUAD



10A-BB-16-PPS



1.1.3.5 Medium Power BeamTrack-Power / Position / Size Sensors

40mW to 150W

Features

- All the features of standard power sensors plus...
- Accurate tracking of beam position to fractions of a mm
- Monitoring of the laser beam size

50(150)A-BB-26-QUAD /
50(150)A-BB-26-PPS



F150A-BB-26-PPS



Model	50(150)A-BB-26-QUAD ^(a)	50(150)A-BB-26-PPS ^(a)	F150A-BB-26-PPS ^(a)
Use	General purpose	General purpose	General purpose
Functions	Power / Energy / Position	Power / Energy / Position / Size	Power / Energy / Position / Size
Absorber Type	Broadband	Broadband	Broadband
Spectral Range μm	0.19 - 11	0.19 - 11	0.19 - 11
Aperture mm	$\varnothing 26\text{mm}$	$\varnothing 26\text{mm}$	$\varnothing 26\text{mm}$
Power Mode			
Power Range	40mW - 150W	40mW - 150W	50mW - 150W ^(b)
Maximum Intermittent Power	150W for 1.5min, 100W for 2.2min, 50W continuous	150W for 1.5min, 100W for 2.2min, 50W continuous	N.A.
Power Scales	150W / 50W / 5W	150W / 50W / 5W	150W / 30W / 3W
Power Noise Level	2mW	2mW	8mW ^(b)
Maximum Average Power Density kW/cm ²	12 at 150W, 17 at 50W	12 at 150W, 17 at 50W	12 at 150W, 17 at 50W
Response Time with Meter (0-95%) typ. s	1.5	1.5	1.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9
Power Accuracy $\pm\%$	3 ^(f)	3 ^(f)	3 ^(f)
Linearity with Power $\pm\%$	1.5	1.5	1
Energy Mode			
Energy Range	20mJ - 100J	20mJ - 100J	20mJ - 100J
Energy Scales	100J / 30J / 3J / 300mJ	100J / 30J / 3J / 300mJ	100J / 30J / 3J / 300mJ
Minimum Energy mJ	20	20	20 ^(b)
Maximum Energy Density J/cm ²			
<100ns	0.3	0.3	0.3
0.5ms	5	5	5
2ms	10	10	10
10ms	30	30	30
Beam Tracking Mode			
Position			
Beam Position Accuracy mm ^(c)	0.1 + 5% of distance from center	0.1 + 5% of distance from center	0.1 + 5% of distance from center
Beam Position Resolution mm	0.1	0.1	0.1
Min Power for Position Measurement	1W	1W	1W
Size ^(c)			
Size Accuracy mm ^(e)	N.A.	$\pm 5\%$ for centered beam	$\pm 5\%$ for centered beam
Size Range mm (4 σ beam diameter)	N.A.	$\varnothing 3 - 20$	$\varnothing 3 - 20$
Min Power Density for Size Measurement	N.A.	1 W/cm ²	1 W/cm ²
Cooling	Convection	Convection	Fan
Fiber Adapter Available (see page 120)	ST, FC, SMA, SC	ST, FC, SMA, SC	ST, FC, SMA, SC
Weight Kg	0.4	0.4	0.45
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version	V1	V1	V1
Part number	7Z07938	7Z07907	7Z07906

Note: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, Nova II and Vega meters, Juno, Juno+, Juno-RS and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Note: (b) For powers up to 30W it is recommended to work with the fan off and then the noise level is ~3 times lower. It is also recommended to measure energy with the fan off.

Note: (c) Position accuracy for the central 10mm of the aperture as limited by beam position resolution. Position can be tracked with $\pm 1\text{mm}$ accuracy over the entire aperture.

Accuracy is reduced by a factor of 3 at minimum power. Position measuring center corresponds to geometrical center within $<1\text{mm}$. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

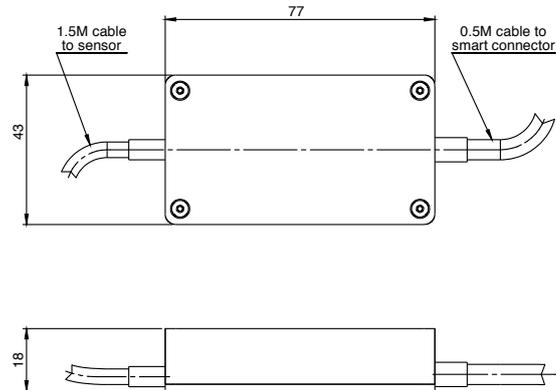
Note: (d) Assumes laser beam with Gaussian (TEM₀₀) distribution. For other modes, size measurement is relative.

Note: (e) Accuracy spec will be maintained for beams from 3.5 to 17mm not deviating from center more than 15% of beam diameter. For beams below 8mm in size and powers above 75W error in size can reach $\pm 10\%$.

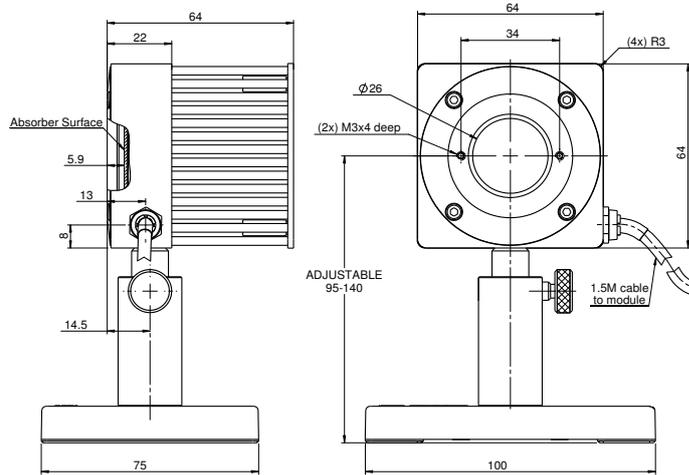
Note: (f) $\pm 4\%$. For wavelengths $< 240\text{nm}$

* For drawings please see page 117

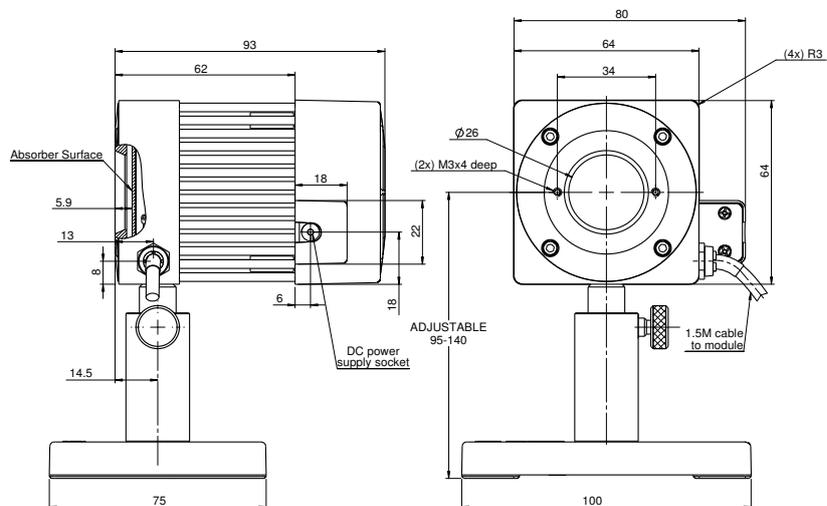
Interface Module on cable



50(150)A-BB-26-QUAD / 50(150)A-BB-26-PPS



F150A-BB-26-PPS



1.1.3.6 Medium - High Power BeamTrack-Power / Position / Size Sensors

150mW to 1000W

Features

- All the features of standard power sensors plus...
- Accurate tracking of beam position to fractions of a mm
- Monitoring of the laser beam size

FL250A-BB-50-PPS



1000W-BB-34-QUAD



Model	FL250A-BB-50-PPS ^(a)	1000W-BB-34-QUAD ^(a)
Use	General purpose	General purpose
Functions	Power / Energy / Position / Size	Power / Energy / Position
Absorber Type	Broadband	Broadband
Spectral Range μm	0.19 - 20	0.19 - 20
Aperture mm	$\varnothing 50\text{mm}$	$\varnothing 34\text{mm}$
Power Mode		
Power Range	150mW - 250W ^(b)	5W - 1000W
Power Scales	250W / 30W	1000W / 200W
Power Noise Level	15mW	200mW
Maximum Average Power Density kW/cm^2	10 at 250W, 12 at 150W	10 at 500W, 7 at 1000W
Response Time with Meter (0-95%) typ. s	2.8	2.5
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$	3	3 ^(f)
Linearity with Power $\pm\%$	1.5	2
Energy Mode		
Energy Range	80mJ - 300J	500mJ - 300J
Energy Scales	300J / 30J / 3J	300J / 30J
Minimum Energy mJ	80	500mJ
Maximum Energy Density J/cm^2		
<100ns	0.3	0.3
1 μs	0.4	0.4
0.5ms	5	5
2ms	10	10
10ms	30	30
Beam Tracking Mode		
Position		
Beam Position Accuracy	0.3mm + 7% of distance from center ^(c)	0.6mm + 6% of distance from center ^(h)
Beam Position Resolution mm	0.1	0.1
Min Power for Position Measurement	2W	10W
Size ^(d)		
Size Accuracy mm ^(e)	$\pm 5\%$ for centered beam	NA
Size Range mm (4σ beam diameter)	$\varnothing 5-35$	NA
Min Power Density for Size Measurement	$3\text{W}/\text{cm}^2$	NA
Cooling		
Minimum and Recommended Water Flow Rate at Full Power	Fan	Water
Fiber Adapter Available (see page 120)	ST, FC, SMA, SC	3 liter/min 6 liter/min ^(g)
Accessories for High Power Sensors	NA	Consult Ophir representative
Weight kg	0.9	0.9
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part number	7Z07902	7Z07936

Note: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, Nova II and Vega meters, Juno, Juno+, Juno-RS and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Note: (b) For powers up to 30W it is recommended to work with the fan off and then the noise level is ~3 times lower. It is also recommended to measure energy with the fan off.

Note: (c) Position accuracy for the central 20mm of the aperture as limited by beam position resolution. Position can be tracked with $\pm 1\text{mm}$ accuracy over central 32mm of the aperture. Accuracy is reduced by a factor of 3 at minimum power. Position measuring center corresponds to geometrical center within $<1\text{mm}$. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

Note: (d) Assumes laser beam with Gaussian (TEM_{00}) distribution. For other modes, size measurement is relative.

Note: (e) Accuracy spec will be maintained for beams from 6 to 35mm not deviating from center more than 15% of beam diameter.

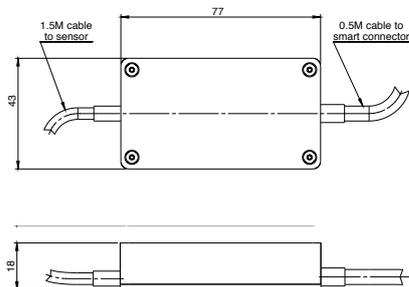
Note: (f) Calibrated for $-0.8\mu\text{m}$, $1.064\mu\text{m}$ and $10.6\mu\text{m}$

Note: (g) Water temperature range 18-30°C, Water temperature rate of change $<1^\circ\text{C}/\text{min}$. Pressure drop across sensor 0.03MPa.

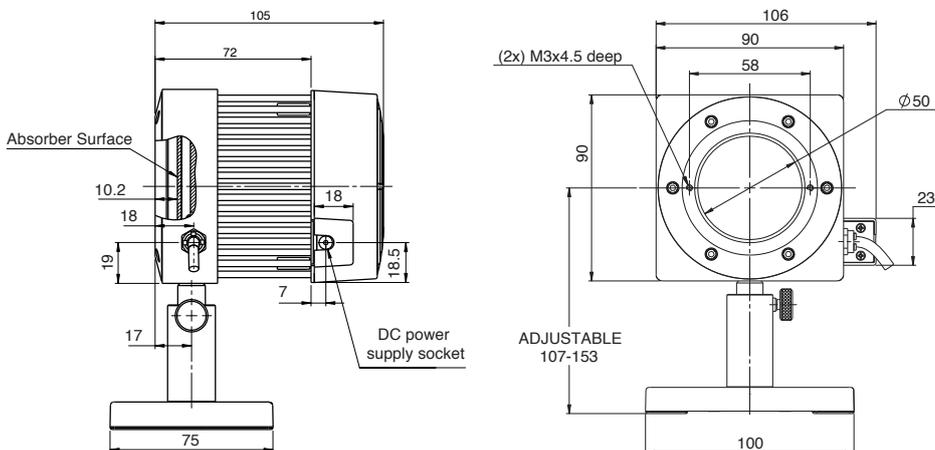
Note: (h) Position accuracy for the central 10 mm of the aperture as limited by beam position resolution. Position measuring center corresponds to geometrical center within $<1\text{mm}$. Position center can be software reset to geometric center or other desired position with Centauri, StarBright or StarLab.

* For drawings please see page 119

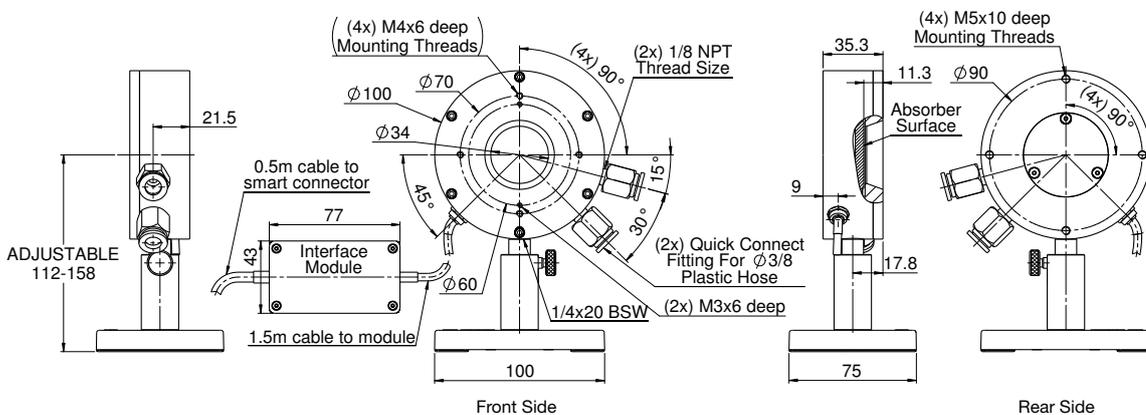
Interface Module on cable



FL250A-BB-50-PPS



1000W-BB-34-QUAD



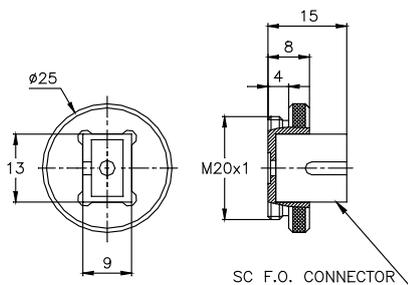
1.1.4 Accessories for Thermal Sensors

1.1.4.1 Fiberoptic Adapters

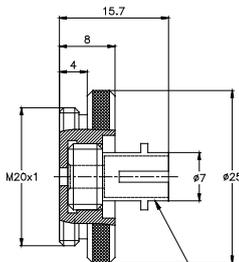
Sensor Series	Fiber adapter mounting bracket (1 bracket fits all fiber adapters)	SC fiber adapter	ST fiber adapter	FC, FC/APC fiber adapter	SMA fiber adapter
Thermal Sensors					
2A-BB-9 / 3A / 3A-QUAD / 3A-P / 3A-P-QUAD / 3A-PF-12 / 3A-FS / 3A-P-THz	not needed				
10A / 10A-BB-16-PPS / 10A-P	not needed				
12A / 12A-P	not needed				
30A-BB-18 / 30A-N-18 / 30(150)A-BB-18 / 30(150)A-LP2-18 / F50A-BB-18	7Z08211				
50(150)A-BB-26 / 50(150)A-BB-26-PPS / 50(150)A-BB-26-QUAD / F150A-BB-26 / F150A-BB-26-PPS	7Z08210	7Z08227	7Z08226	7Z08229	1G01236A
L50(150)A-BB-35 / L50(150)A-LP2-35 / L50(150)A-PF-35 / FL250A-BB-35 / FL250A-LP2-35	7Z08265				
30A-P-17 / 30(150)A-SV-17 / 30(150)A-HE-17	7Z08230				
L40(250)A-BB-50 / L40(250)A-LP2-50 / L50(250)A-BB-50	7Z08238 ^(a)				
FL250A-BB-50 / FL250A-BB-50-PPS / FL400A-BB-50 / FL400A-LP2-50	7Z08212				
L100(500)A-PF-120 / FL600A-BB-65 / FL600A-LP2-65 / 1000WP-BB-34 / 1000W-BB-34 / 1000W-BB-34-QUAD / 1000W-LP2-34 / FL1100A-BB-65 / FL1100A-LP2-65 / L1500W-BB-50 / L1500W-LP2-50 / L2000W-BB-120 / L2000W-PF-120 / 5000W-BB-50 / 5000W-LP2-50 / 5000WP-LP2-50	Threaded holes exist	Consult Ophir representative			

Note: (a) The fiber mounting bracket for these sensors is a triple adapter for mounting up to three different fibers looking at same spot

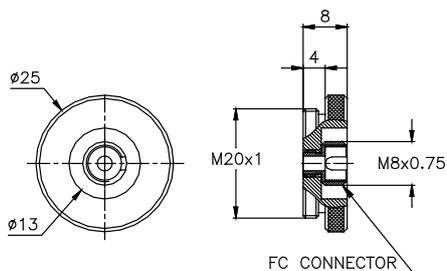
SC fiber adapter



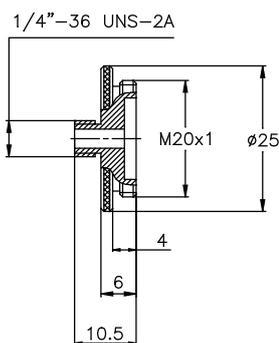
ST fiber adapter



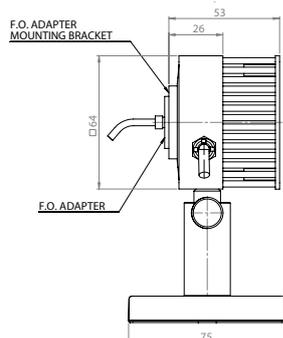
FC fiber adapter



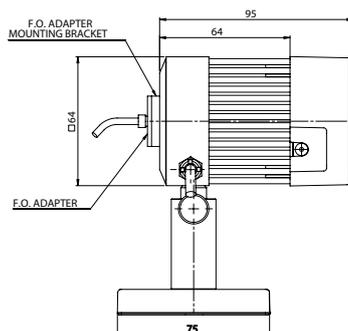
SMA fiber adapter



30A with F.O. input



FL250A with F.O. input



SC fiber adapter



ST fiber adapter



FC fiber adapter



SMA fiber adapter



1.1.4.2 Other Accessories

Accessories for High Power Sensors	Description	P/N	Ref
High Power QBH-Fiber Adapters for L1500W-LP2-50, L1500W-BB-50, 5000W-LP2-50 and 5000W-BB-50 Sensors	QBH-Fiber Adapters for mounting fibers with QBH termination to Ophir power sensors	7Z08348 (QBH-L-Fiber Adapter model) 7Z08349 (QBH-S-Fiber Adapter model)	See page 99
Protective Housing for 5000W, 10K-W and 15K-W Sensors	Protective Housing with shutter to protect from debris	7Z08344 (for 5000W / 10K-W / 15K-W)	See page 100
Scatter Shield for 10K-W, 15K-W, 20K-W and 30K-W Sensors	Scatter Shield to reduce backscattered power (including protective cover)	7Z08295 (for 10K-W / 15K-W) 7Z08355 (for 20K-W) ^(a) 7Z08293 (for 30K-W)	See page 101
Protective Covers for Scatter Shields with Target Pattern for 10K-W, 15K-W and 30K-W sensors	Protective Covers for Ophir scatter shields. The cover has a target pattern for directing the beam using a pointer	7Z08345 (for 10K-W / 15K-W) 7Z08346 (for 30K-W)	See page 102
Protective Covers with Target Pattern for 1000W, L1500W, 5000W, 10K-W, 15K-W, 20K-W and 30K-W Sensors	Black anodized aluminum cover with a target pattern for directing the beam using a pointer	1G01332 (all except 20K-W & 30K-W) 1G02813 (for 20K-W) ^(a) 1G02406 (for 30K-W)	See page 102
Metric Water Connectors for Water Cooled Sensors	Metric Water Connectors are quick connect fittings for 3/8" and 1/2" plastic tubing (set of 2 ea.)	7Z08353 (all except 20K-W & 30K-W) 7Z08352 (for 20K-W & 30K-W)	See page 102
Heavy Duty Stand for 10K-W and 15K-W	For continuous use in vertical position, heavy duty stand is recommended	7Z08330	See page 101
30K-W Rubber Feet Assembly	The rubber feet make it possible to lean the sensor on its rear side for better stability when used with a vertical beam. The kit has 4 feet which can be screwed into the existing threads	7Z08217	See page 101
General Accessories			
SH to BNC Adapter	Allows connection of sensor to current or voltage measuring device for measurement of raw sensor output. Current meter should be used for photodiode sensors. Current or voltage meter can be used for thermal sensors	7Z11010	
Replacement Parts			
N Polarity Power Supply/Charger 12V 2A N-2.1x5.5	Application	P/N	
	For: Centauri, Vega, Nova II, Nova, EA-1, Pulsar, Quasar, LaserStar, 6K-W, 120K-W, 150K-W, Fan Cooled Sensors	7E05029	
P Polarity Power Supply/Charger 12V 2A P-1.35x3.5	For: StarLite, StarBright, RM9 Chopper	7E05047	
Push-Pull 2 Pin Power Supply 12V 2A	For: IS1.5-VIS-FPD-800, IS1.5-IRG-FPD-800	7E05047A	
Note: (a) The scatter shield and protective cover are compatible also with the 16K-W-BB-55 sensor P/N 7Z07131			

Protective Housing



7Z08352 1/4" - 12mm

30K-W Scatter Shield



7Z08353 1/8" - 10mm

Protective Cover on Scatter Shield



QBH-Fiber Adapter



10K-W with 34-50mm Aperture Protective Cover



Heavy Duty Stand for 10K-W and 15K-W (Shown with a 15K-W Sensor)

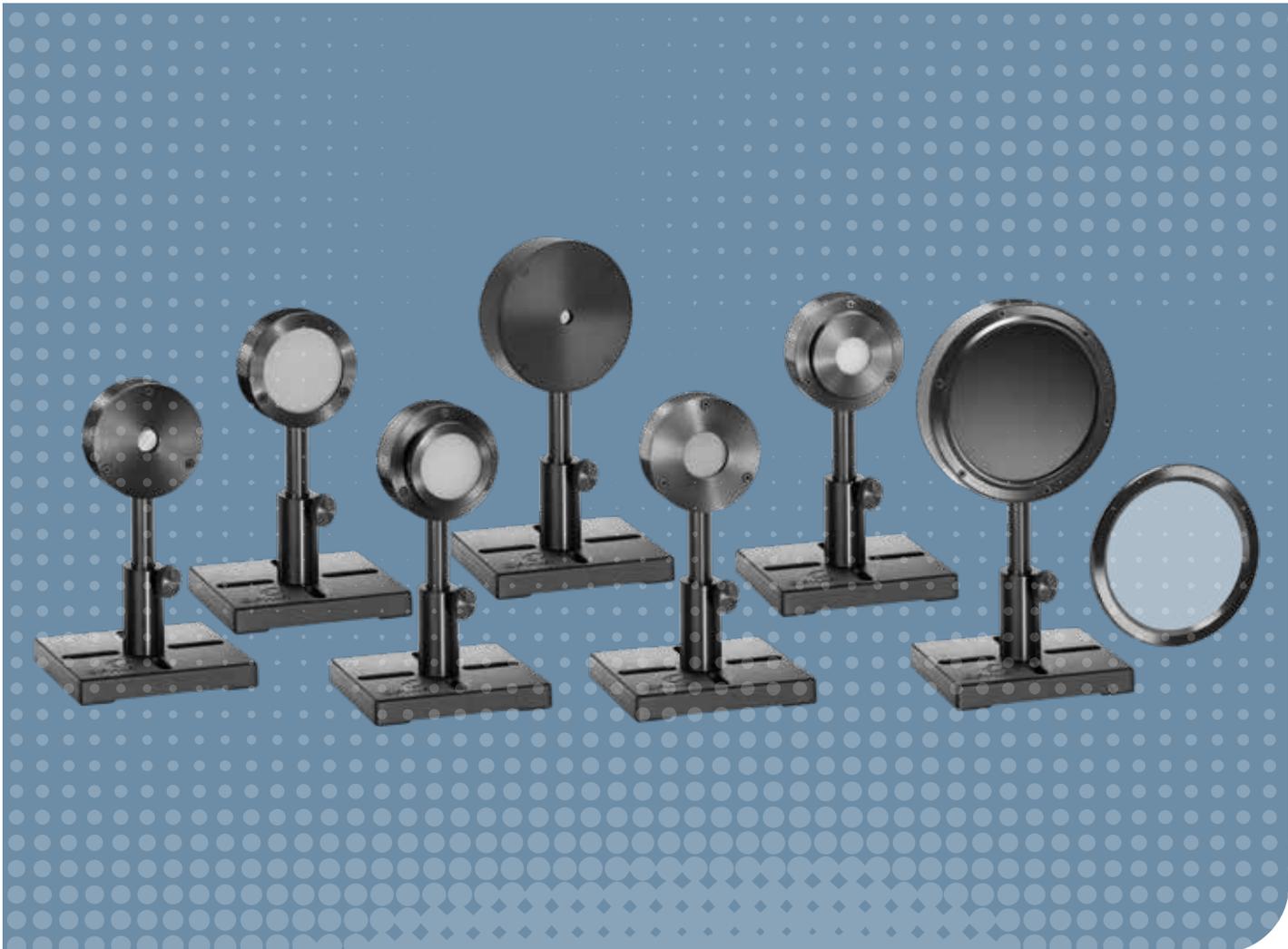


SH to BNC Adapter

N Polarity Power Supply/Charger
P Polarity Power Supply/Charger
Push-Pull 2 Pin Power Supply

2025 ENERGY SENSORS 1.2

SENSORS



1.2 Energy Sensors

Introduction

Pyroelectric sensors are for measuring repetitive pulse energies and average powers at pulse rates up to 25000 pulses per second and pulse widths up to 20ms. Note that single shot energy with pulse rates less than one pulse every 5s or so can be measured with thermal sensors described in the power sensor section.

Pyroelectric Sensors

Pyroelectric type sensors are useful for measuring the energy of repetitively pulsed lasers at up to 25,000Hz and are sensitive to low energies.

They are less durable than thermal types and therefore should not be used whenever it is not necessary to measure the energy of each pulse and average power measurement is sufficient.

Pyroelectric sensors use a pyroelectric crystal that generates an electric charge proportional to the heat absorbed. Since the two surfaces of the crystal are metalized, the total charge generated is collected and therefore the response is not dependent on beam size or position. This charge then charges a capacitor in parallel with the crystal and the voltage difference thus generated is proportional to the pulse energy. After the energy is read by the electronic circuit, the charge on the crystal is discharged to be ready for the next pulse. The response time of the pyroelectric sensor depends on the time it takes for the heat to enter the crystal and heat it up. For metallic type pyro detectors, this time is tens of μs and thus the metallic type can run at a high repetition rate. For the BF and BB types, the response time is hundreds of μs with a correspondingly lower repetition rate.

Ophir pyroelectric detectors have unique and proprietary circuitry that allow them to measure long pulses as well as short pulses and work at a high duty cycle, i.e. where the pulse width is as much as 30% of the total cycle time.

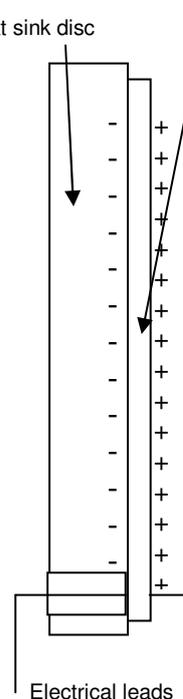
Ophir came out with the compact C line of pyroelectric sensors that replaced previous models. The electronics and mechanics have been completely upgraded and the current sensors are superior in every way: more compact, wider dynamic range, have higher repetition rates and measure longer pulses. Through constant development, Ophir again brings you the best performance in the market.

Note: Older line of Pyroelectric sensors is not supported by the Centauri, StarBright and StarLite meters, and Juno+, Juno-RS and EA-1 interfaces.

All Ophir power and energy sensors come with a mounting stand.

Pyroelectric crystal – thickness <1mm

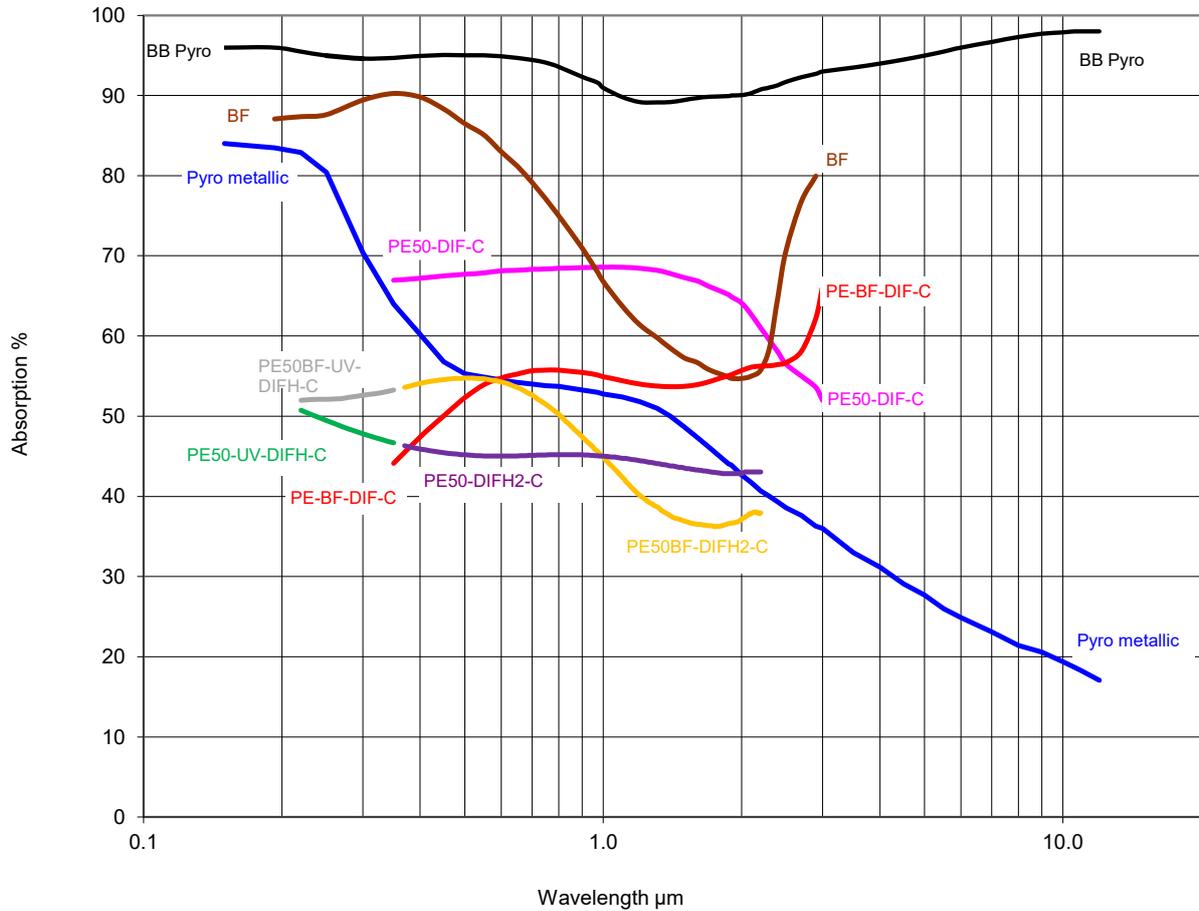
Heat sink disc



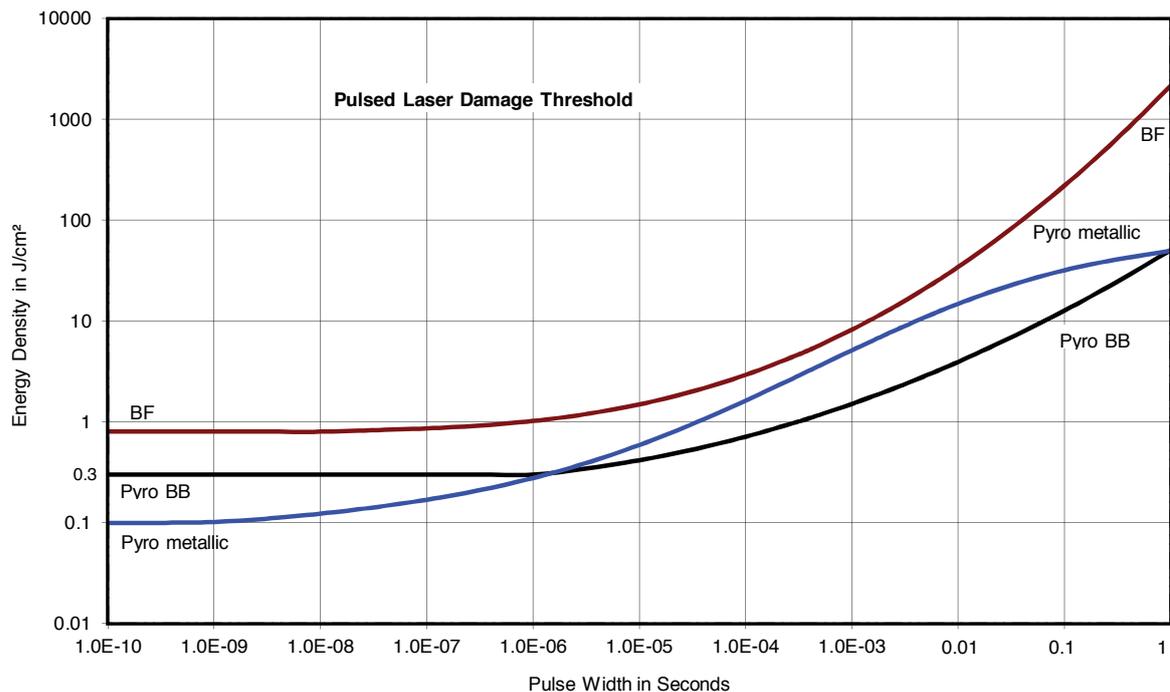
Electrical leads

Absorption and Damage Graphs for Pyroelectric Sensors

Absorption vs. Wavelength

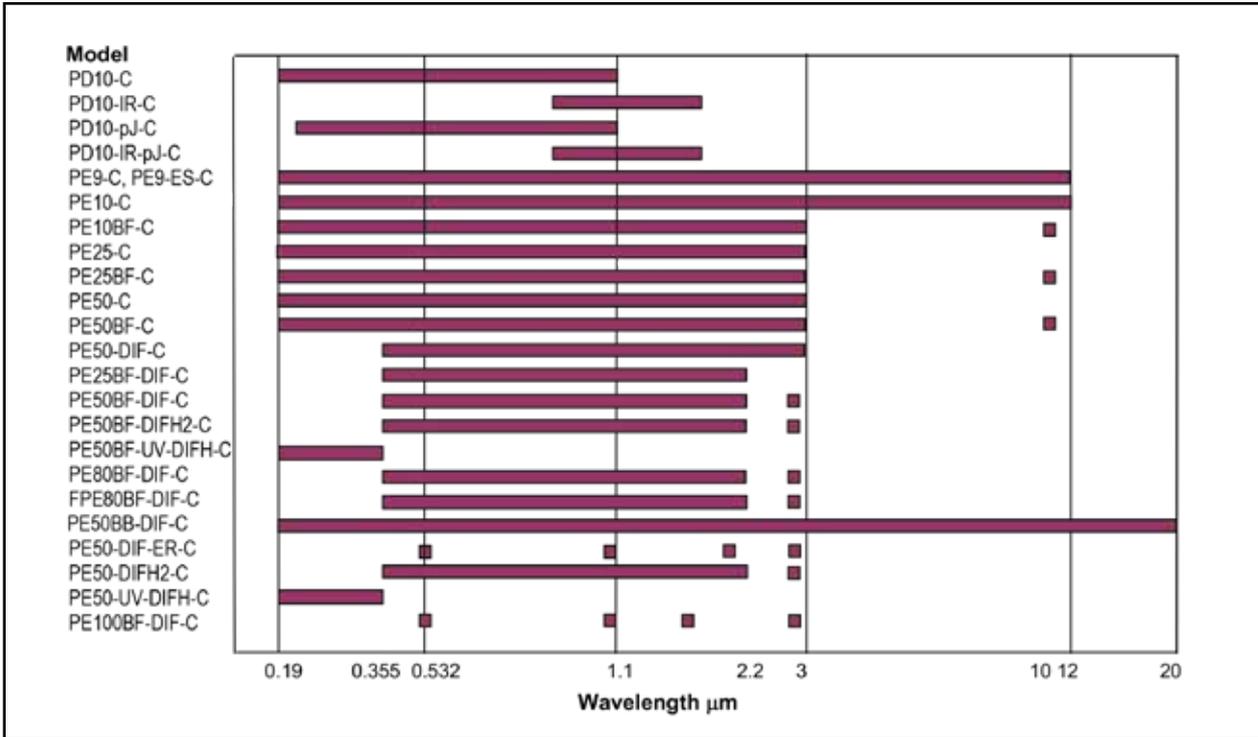


Damage Threshold vs. Pulse Width

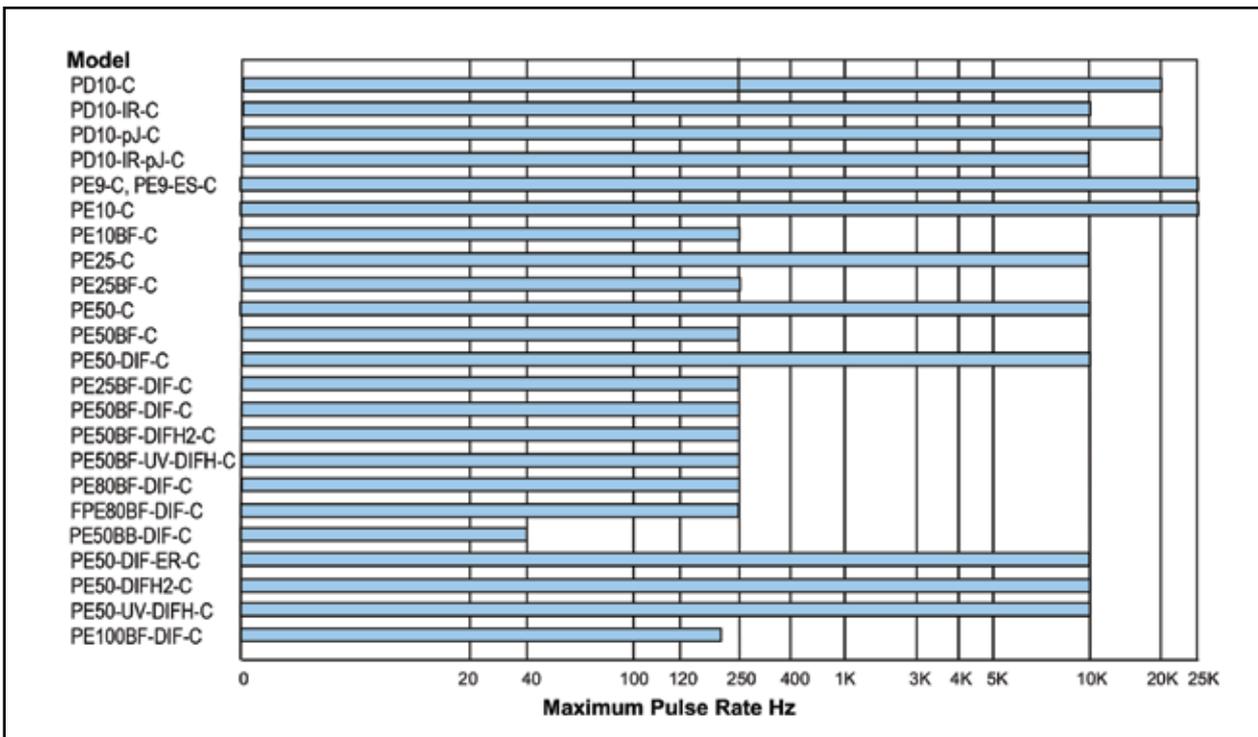


Wavelength Range and Repetition Rate for Energy Sensors

Wavelength Range



Repetition Rate Range



1.2.1 Photodiode Energy Sensors

10pJ to 15μJ

Features

- Silicon detectors
- Very sensitive - down to 10pJ
- Repetition rates to 20kHz
- Wide spectral range

PD10-C /
PD10-pJ-C



Model	PD10-C ^(b)		PD10-pJ-C ^(b)					
Use	Low energies		Lowest energies					
Aperture mm	Ø10		Ø10					
Absorber Type	Si photodiode		Si photodiode					
Spectral Range μm ^(a)	0.19 - 1.1		0.2 - 1.1					
Surface Reflectivity % approx.	50		30					
Calibration Uncertainty ±% ^(a)	5		5					
Max Pulse Width Setting	2μs	5μs	2μs	5μs				
Energy Scales	20μJ to 20nJ	20μJ to 20nJ	200nJ to 200pJ	200nJ to 200pJ				
Lowest Measurable Energy nJ ^(c)	1 at 900nm	1 at 900nm	0.01 at 900nm	0.01 at 900nm				
Max Pulse Width ms ^(d)	0.002		0.002					
Maximum Pulse Rate pps	20kHz	20kHz ^(e)	20kHz	20kHz ^(g)				
Noise on Lowest Range nJ	0.05		0.001					
Additional Error with Frequency %	±1% to 10kHz ±1.5% to 20kHz	±1% to 20kHz ^(f)	±1% to 20kHz	±1% to 20kHz ^(h)				
Linearity with Energy for > 10% of full scale ^(c)	±1.5%		±1.5%					
Damage Threshold J/cm ²	0.1		0.1					
Maximum Average Power mW	50 at 800nm		0.5					
Maximum Average Power Density W/cm ²	50		5					
Maximum Energy vs. Wavelength	Wavelength	Max Energy	Wavelength	Max Energy	Wavelength	Max Energy	Wavelength	Max Energy
	<300nm	5μJ	<300nm	13μJ	<300nm	80nJ	<300nm	180nJ
	350-550nm	2μJ	350-550nm	6μJ	350-550nm	30nJ	350-550nm	70nJ
	>800nm	1.1μJ	>800nm	3μJ	>800nm	17nJ	>800nm	40nJ
Fiber Adapters Available (see page 140)	ST, FC, SMA, SC		ST, FC, SMA, SC					
Weight kg	0.25		0.25					
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS					
Version								
Part number: Standard Sensor	7Z02944 (1.5m cable)		7Z02945					
Sensor with different cable length	7Z02944C (10m cable)							
Note: (a) This is basic calibration accuracy. In certain wavelength regions calibration there is additional error as tabulated here.	<250nm	add ±3%	>950nm	add ±2%	<250nm	add ±2%	>950nm	add ±2%

Note: (b) The PD10-C & PD10-pJ-C sensors are not under ISO/IEC 17025:2017 accreditation.

Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >10% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PD-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments.

For further information, see the FAQs on our Website.

Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter, the pulse width settings are displayed as follows: 10μs (for 2μs setting) and 20μs (for 5μs setting).

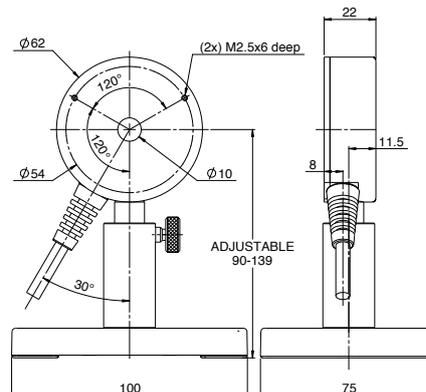
Note: (e) For energies up to 2μJ

Note: (f) Additional Error with Frequency of ±1% only for energy scales up to 2μJ. For higher energies ±1% up to 5kHz, -6% at 10kHz.

Note: (g) For energies up to 20nJ

Note: (h) Additional Error with Frequency of ±1% only for energy scales up to 20nJ. For higher energies ±1% up to 5kHz, -6% at 10kHz.

PD10-C / PD10-pJ-C



1.2.1 Photodiode Energy Sensors

30pJ to 600nJ

Features

- Germanium detectors
- Very sensitive - down to 30pJ
- Repetition rates to 10kHz
- Wide spectral range

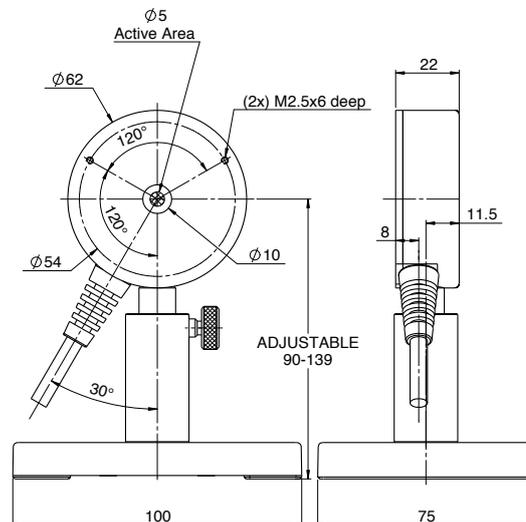
PD10-IR-C /
PD10-IR-pJ-C



Model	PD10-IR-C ^(b)		PD10-IR-pJ-C ^(b)	
Use	Infrared		Infrared, lowest energies	
Aperture mm	Ø5		Ø5	
Absorber Type	Ge photodiode		Ge photodiode	
Spectral Range μm ^(a)	0.7 - 1.8		0.7 - 1.8	
Surface Reflectivity % approx.	30		30	
Calibration Uncertainty $\pm\%$ ^(a)	5		5	
Energy Scales	600nJ to 6nJ		20nJ to 200pJ	
Lowest Measurable Energy nJ ^(c)	1 at 1550nm		0.03 at 1550nm	
Max Pulse Width ms	0.005		0.005	
Maximum Pulse Rate pps	10kHz		10kHz	
Noise on Lowest Range nJ	0.2		0.01	
Additional Error with Frequency %	$\pm 1.5\%$ to 10kHz		$\pm 1.5\%$ to 10kHz	
Linearity with Energy for > 10% of full scale ^(c)	$\pm 1.5\%$		$\pm 1.5\%$	
Damage Threshold J/cm ²	0.1		0.1	
Maximum Average Power mW	6		0.2	
Maximum Average Power Density W/cm ²	50		5	
Maximum Energy vs. Wavelength	Wavelength	Max Energy	Wavelength	Max Energy
	800 - 900nm	600nJ	800 - 900nm	14nJ
	1000 - 1300nm	240nJ	1000 - 1300nm	7nJ
	1300 - 1400nm	200nJ	1300 - 1400nm	6.5nJ
	1480 - 1560nm	170nJ	1480 - 1560nm	6nJ
Fiber Adapters Available (see page 140)	ST, FC, SMA, SC		ST, FC, SMA, SC	
Weight kg	0.25		0.25	
Compliance	CE, UKCA, China RoHS		CE, UKCA, China RoHS	
Version				
Part number	7Z02955		7Z02946	
Note: (a) This is basic calibration accuracy. In certain wavelength regions calibration there is additional error as tabulated here.	<900nm	add $\pm 2\%$	<900nm	add $\pm 2\%$
	>1700nm	add $\pm 2\%$	>1700nm	add $\pm 2\%$

Note: (b) The PD10-IR-C & PD10-IR-pJ-C sensors are not under ISO/IEC 17025:2017 accreditation.
 Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >10% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USB1 and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PD-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments.
 For further information, see the FAQs on our Website.

PD10-IR-C / PD10-IR-pJ-C



1.2.2 Pyroelectric Energy Sensors

0.1µJ to 1mJ

Features

- Ø8mm aperture
- Repetition rates up to 20,000Hz
- High sensitivity sensors
- Pulse widths up to 20µs

PE9-C / PE9-ES-C



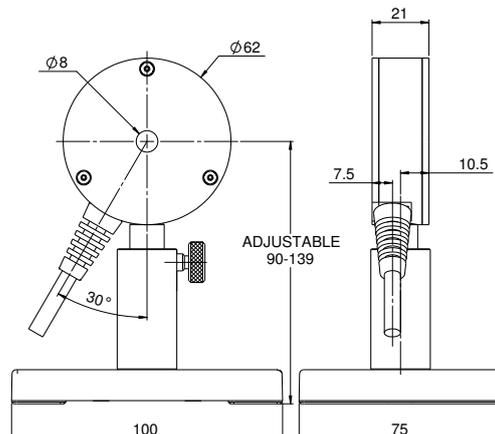
Model	PE9-C ^(b)			PE9-ES-C ^(b)		
Use	Very Sensitive			Most Sensitive		
Aperture mm	Ø8			Ø8		
Absorber Type	metallic			metallic		
Spectral Range µm ^(a)	0.15 - 12			0.15 - 12		
Surface Reflectivity % approx.	50			50		
Calibration Uncertainty ±% ^(a)	3			3		
Max Pulse Width Setting ^(d)	1µs	2µs	20µs	1µs	2µs	20µs
Energy Scales	1mJ to 2µJ	1mJ to 2µJ	1mJ to 20µJ	200µJ to 200nJ	200µJ to 200nJ	200µJ to 2µJ
Lowest Measurable Energy µJ ^(c)	0.5	0.2	0.5	0.1	0.1	0.1
Max Pulse Width µs	1	2	20	1	2	20
Maximum Pulse Rate pps	25kHz	15kHz	10kHz	20kHz	15kHz	10kHz
Noise on Lowest Range µJ	0.04	0.05	0.1	0.01	0.01	0.02
Additional Error with Frequency %	±1% to 15kHz, ±6% to 25kHz	±1% to 15kHz	±1% to 10kHz	±1.5% to 20kHz	±1.5% to 15kHz	±1.5% to 10kHz
Damage Threshold J/cm ²						
<100ns	0.1			0.1		
1µs	0.2			0.2		
300µs	3			3		
Linearity with Energy ^(c)	±1%			±1.5%		
Maximum Average Power W	2			2		
Maximum Average Power Density W/cm ²	30			30		
Fiber Adapters Available (see page 140)	ST, FC, SMA, SC			ST, FC, SMA, SC		
Weight kg	0.25			0.25		
Compliance	CE, UKCA, China RoHS			CE, UKCA, China RoHS		
Version						
Part Number	7Z02933			7Z02949		
Note: (a) Calibrated curve is checked and adjusted at the following wavelengths (µm) For other wavelengths in the curve there is additional calibration error as stated	0.193, 0.355, 1.064, 1.48-1.6 240-800nm add ±4%, 2-3µm add ±8%, 10.6µm add ±15%			0.355, 1.064, 1.48-1.6 240-800nm add ±4%, 2-3µm add ±8%, 10.6µm add ±15%. <240nm not calibrated		
	In order to avoid measurement degradation at UV wavelengths extra care must be taken to protect sensor from contaminants			In order to avoid measurement degradation at UV wavelengths extra care must be taken to protect sensor from contaminants		

Note: (b) The PE9-C & PE9-ES-C sensors are not under ISO/IEC 17025:2017 accreditation.

Note: (c) With "user threshold" setting set to minimum. For >7% (>10% for PE9-ES-C) of full scale. For other settings, the spec is for >7%/>10% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.

Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter, only 2 out of 3 pulse widths settings are available; the 1µs (displayed as "10µs") and the 2µs (displayed as "20µs").

PE9-C / PE9-ES-C



1.2.2 Pyroelectric Energy Sensors

1μJ to 10mJ

Features

- Ø12mm apertures
- Repetition rates up to 25,000Hz
- High sensitivity sensors
- Pulse widths up to 5ms

PE10-C / PE10BF-C



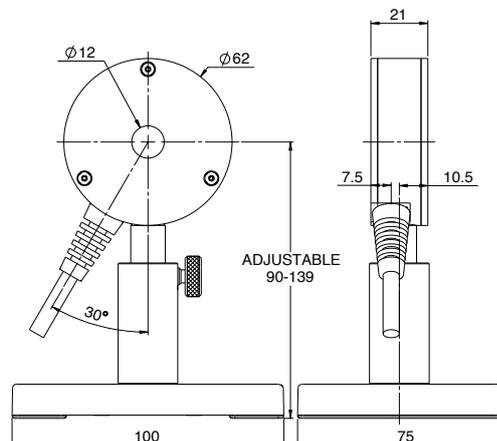
Model	PE10-C	PE10BF-C
Use	Sensitive	High damage threshold
Aperture mm	Ø12	Ø12
Absorber Type	metallic	BF
Spectral Range μm ^(a)	0.15 - 12	0.15 - 3, 10.6 ^(a)
Surface Reflectivity % approx.	50	20
Calibration Uncertainty ±% ^(a)	4	3
Max Pulse Width Setting ^(e)	1μs	30μs
Energy Scales	10mJ to 2μJ	10mJ to 20μJ
Lowest Measurable Energy μJ ^(c)	1	7
Max Pulse Width μs	1	30
Maximum Pulse Rate pps	25kHz	5kHz
Noise on Lowest Range μJ	0.1	0.15
Additional Error with Frequency %	±2% to 15kHz ±3% to 25kHz	±1% to 5kHz
Damage Threshold J/cm ²		
<100ns	0.1	0.8 ^(b)
1μs	0.2	1 ^(b)
300μs	3	4 ^(b)
Linearity with Energy for >7% of full scale ^(c)	±1.5%	±2%
Maximum Average Power W	2	3
Maximum Average Power Density W/cm ²	50	50
Fiber Adapters Available (see page 140)	ST, FC, SMA, SC	ST, FC, SMA, SC
Weight kg	0.25	0.25
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part Number: Standard Sensor	7Z02932	7Z02938 (1.5m cable)
Sensor with different cable length		7Z02938C (10m cable)
Note: (a) Calibrated curve is checked and adjusted at the following wavelengths (μm)	1.064, 0.355	0.193, 0.248, 0.355, 0.532, 1.064
For other wavelengths in the curve there is additional calibration error as stated	240 - 800nm add ±4%, 2-3μm add ±8%, 10.6μm add ±15%. <240nm not calibrated	0.2-3μm ±2%, 10.6μm ±5%
	In order to avoid measurement degradation at UV wavelengths extra care must be taken to protect sensor from contaminants	

Note: (b) For wavelengths below 600nm, derate damage threshold to 60% of given values. Below 300nm, derate to 40% of given values.

Note: (c) With "user threshold" setting set to minimum. For other settings, the spec is for >7% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.

Note: (d) The absorption at 675nm is approximately the same as at 10.6μm. Therefore, to measure a CO₂ laser, set to the 675nm setting. The additional error for measuring 10.6μm is ±5%. Note: (e) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter, for the PE10-C model the 1μs pulse width setting is displayed as "10μs".

PE10-C / PE10BF-C



1.2.2 Pyroelectric Energy Sensors

8μJ to 10J

Features

- Ø24mm apertures
- Metallic coating for high rep rates
- BF coating for highest damage threshold
- Rep rates up to 10kHz
- Measure lasers with pulse widths up to 20ms



Model	PE25-C					PE25BF-C				
Use	High rep rate					High damage threshold				
Aperture mm	Ø24					Ø24				
Absorber Type	metallic					BF				
Spectral Range μm ^(a)	0.15 - 3					0.15 - 3, 10.6 ^(e)				
Surface Reflectivity % approx.	50					20				
Calibration Uncertainty ±% ^(a)	3					3				
Max Pulse Width Setting ^(d)	2μs	30μs	500μs	1ms	5ms	1ms	2ms	5ms	10ms	20ms
Energy Scales	10J to 200μJ	10J to 200μJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ
Lowest Measurable Energy μJ ^(c)	8	10	60	80	100	60	100	400	400	400
Max Pulse Width ms	0.002	0.03	0.5	1	5	1	2	5	10	20
Maximum Pulse Rate pps	10kHz	5kHz	900Hz	450Hz	100Hz	250Hz	100Hz	50Hz	40Hz	20Hz
Noise on Lowest Range μJ	0.5	1	6	10	20	10	20	40	40	50
Additional Error with Frequency %	±2% to 5kHz ±4% to 10kHz	±1.5%	±2% to 750Hz	±1.5% to 400Hz	±1.5% to 80Hz	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 250Hz	±1%	±1%	±1%	±2%
Linearity with Energy for >7% of full scale ^(c)	±1.5%					±2%				
Damage Threshold J/cm ² ^(b)										
<100ns	0.1					0.8				
1μs	0.2					1				
300μs	2					4				
2ms	6					10				
Maximum Average Power W	15, 25 with optional heat sink (P/N 7Z08267)					15, 25 with optional heat sink (P/N 7Z08267)				
Maximum Average Power Density W/cm ²	20					20				
Uniformity over surface	±2% over central 50% of aperture					±2% over central 50% of aperture				
Fiber Adapters Available (see page 140)	ST, FC, SMA, SC					ST, FC, SMA, SC				
Weight kg	0.25					0.25				
Compliance	CE, UKCA, China RoHS					CE, UKCA, China RoHS				
Version										
Part Number: Standard Sensor	7Z02937 (1.5m cable)					7Z02935				
Sensor with different cable length	7Z02937C (10m cable)									
Note: (a) Calibration curve is verified and adjusted at specified wavelengths.	Specified wavelengths: 248-266nm, 355nm, 1064nm and 2940nm.					Specified wavelengths: 193nm, 248-266nm, 355nm, 532nm and 1064nm.				
At other wavelengths, there may be an additional error up to the value given.	Max additional error at other wavelengths: ±2%. <240nm not calibrated.					Max additional error at 2940nm ±3%. Max additional error at other wavelengths: ±2%.				
Note: (b)						For wavelengths below 600nm, derate damage threshold to 60% of given values. Below 300nm, derate to 40% of given values.				

Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >7% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.

Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter, only 2 out of 5 pulse widths settings are available; for the PE25-C model the 2μs (displayed as "10μs") and 1ms settings, and for the PE25BF-C model the 1ms and 10ms settings.

Note: (e) If the sensor is set to the 1064nm wavelength, then when measuring 10.6μm pulses, the reading will be approximately 1.19X the correct reading. If you use the attenuate function and set the attenuation to read 0.84, then you will have the correct reading at 10.6μm. The additional error at 10.6μm is ±5%.

* For drawings please see page 135

1.2.2 Pyroelectric Energy Sensors

10µJ to 10J

Features

- Ø46mm apertures
- Metallic coating for high rep rates
- BF coating for highest damage threshold
- Rep rates up to 10kHz
- Measure lasers with pulse widths up to 20ms



Model	PE50-C					PE50BF-C				
Use	High rep rate					High damage threshold				
Aperture mm	Ø46					Ø46				
Absorber Type	metallic					BF				
Spectral Range µm ^(a)	0.15 - 3					0.15 - 3, 10.6 ^(e)				
Surface Reflectivity % approx.	50					20				
Calibration Uncertainty ±% ^(a)	3					3				
Max Pulse Width Setting ^(d)	2µs	30µs	500µs	1ms	5ms	1ms	2ms	5ms	10ms	20ms
Energy Scales	10J to 200µJ	10J to 200µJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ
Lowest Measurable Energy µJ ^(c)	10	10	60	80	100	120	300	600	600	600
Max Pulse Width ms	0.002	0.03	0.5	1	5	1	2	5	10	20
Maximum Pulse Rate pps	10kHz	5kHz	900Hz	450Hz	100Hz	250Hz	100Hz	50Hz	40Hz	20Hz
Noise on Lowest Range µJ	0.5	1	6	10	20	30	60	100	100	100
Additional Error with Frequency %	±2% to 2kHz ±4.5% to 5kHz	±2%	±2% to 750Hz	±2% to 400Hz	±1% to 80Hz	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 250Hz	±1%	±1%	±1%	±2%
Linearity with Energy for >7% of full scale ^(c)	±1.5%					±2%				
Damage Threshold J/cm ² ^(b)										
<100ns	0.1					0.8				
1µs	0.2					1				
300µs	2					4				
2ms	6					10				
Maximum Average Power W	15, 25 with optional heat sink (P/N 7Z08267)					15, 25 with optional heat sink (P/N 7Z08267)				
Maximum Average Power Density W/cm ²	20					20				
Uniformity over surface	±2% over central 50% of aperture					±2% over central 50% of aperture				
Fiber Adapters Available (see page 140)	ST, FC, SMA, SC					ST, FC, SMA, SC				
Weight kg	0.25					0.25				
Compliance	CE, UKCA, China RoHS					CE, UKCA, China RoHS				
Version										
Part Number	7Z02936					7Z02934				
Note: (a) Calibration curve is verified and adjusted at specified wavelengths. At other wavelengths, there may be an additional error up to the value given.	Specified wavelengths: 248-266nm, 355nm and 1064nm. Max additional error at 2940nm ±3%. Max additional error at other wavelengths: ±2%. <240nm not calibrated.					Specified wavelengths: 193nm, 248-266nm, 355nm, 532nm and 1064nm. Max additional error at 2940nm ±3%. Max additional error at other wavelengths: ±2%.				
Note: (b)	In order to avoid measurement degradation at UV wavelengths extra care must be taken to protect sensor from contaminants.					For wavelengths below 600nm, derate damage threshold to 60% of given values. Below 300nm, derate to 40% of given values.				
Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >7% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.										
Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter, only 2 out of 5 pulse widths settings are available; for the PE50-C model the 2µs (displayed as "10µs") and 1ms settings, and for the PE50BF-C model the 1ms and 10ms settings.										
Note: (e) If the sensor is set to the 1064nm wavelength, then when measuring 10.6µm pulses, the reading will be approximately 1.19X the correct reading. If you use the attenuate function and set the attenuation to read 0.84, then you will have the correct reading at 10.6µm. The additional error at 10.6µm is ±5%.										

* For drawings please see page 135

1.2.3 High Energy Pyroelectric Sensors

20µJ to 10J

Features

- Sensors with diffuser for high energies and high energy densities
- Metallic coating for high repetition rates up to 10kHz
- High damage threshold
- Wide spectral range. Measure YAG and harmonics, 355nm and many more
- Measure lasers with pulse widths up to 20ms

PE50-DIF-C



PE25BF-DIF-C



Model	PE50-DIF-C					PE25BF-DIF-C				
Use	High rep rate. Complete calibration curve					Complete calibration curve. High damage threshold				
Aperture mm	Ø35					Ø20				
Absorber Type	Metallic with diffuser					BF with diffuser				
Spectral Range µm ^(a)	0.355 - 2.2, 2.94					0.355 - 2.2				
Surface Reflectivity % approx.	25					25				
Calibration Uncertainty ±% ^(a)	3					3				
Max Pulse Width Setting ^(d)	2µs	30µs	500µs	1ms	5ms	1ms	2ms	5ms	10ms	20ms
Energy Scales	10J to 200µJ	10J to 200µJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ
Lowest Measurable Energy µJ ^(c)	20	20	100	120	200	100	150	200	200	300
Max Pulse Width ms	0.002	0.03	0.5	1	5	1	2	5	10	20
Maximum Pulse Rate pps	10kHz	5kHz	900Hz	450Hz	100Hz	250Hz	100Hz	50Hz	40Hz	20Hz
Noise on Lowest Range µJ	1	2	20	20	40	15	30	40	40	60
Additional Error with Frequency %	±2% to 2kHz ±4.5% to 5kHz	±2%	±1% to 750Hz	±2% to 400Hz	±1% to 80Hz	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 250Hz	±1%	±1%	±1%	±2%
Linearity with Energy for >10% of full scale ^(c)	±1.5%					±2%				
Damage Threshold J/cm ² ^(b)										
<100ns	1					4				
1µs	2					5				
300µs	20					20				
2ms	40					60				
Maximum Average Power W	25, 40 with optional heat sink (P/N 7Z08267)					20, 30 with optional heat sink (P/N 7Z08267)				
Maximum Average Power Density W/cm ²	100					120				
Uniformity over surface	±2.5% over central 20mm					±2.5% over central 10mm				
Weight kg	0.25					0.25				
Compliance	CE, UKCA, China RoHS					CE, UKCA, China RoHS				
Version										
Part Number: Standard Sensor	7Z02939 (1.5m cable)					7Z02941				
Sensor with different cable length	7Z02939C (10m cable)									
Note: (a) Calibration curve is verified and adjusted at specified wavelengths.	Specified wavelengths: 355nm, 532nm, 1064nm and 2100nm.					Specified wavelengths: 355nm, 532nm, 1064nm and 2100nm.				
At other wavelengths, there may be an additional error up to the value given.	Max additional error at other wavelengths not specified above: ±2%. <250nm not calibrated.					Max additional error at other wavelengths not specified above: ±2%. <250nm not calibrated.				
Note: (b)	For wavelengths >2.1µm, derate to 40% of above values. For beam size ≤5mm. For 10mm beam, derate to 40% of above value.					For wavelengths below 600nm, derate to 60% of given values. For beam size ≤4mm. For 8mm beam, derate to 50% of above values.				
Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >10% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.										
Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter, only 2 out of 5 pulse widths settings are available; for the PE50-DIF-C model the 2µs (displayed as "30µs") and 1ms settings, and for the PE25BF-DIF-C model the 1ms and 10ms settings.										

* For drawings please see page 135

1.2.3 High Energy Pyroelectric Sensors

100µJ to 40J

Features

- Sensors with diffuser for high energies and high energy densities
- BF coating for highest damage threshold
- BB coating for spectral flatness
- Wide spectral range. Measure YAG and harmonics and many more.
- Rep rates up to 250Hz
- Measure lasers with pulse widths up to 20ms

PE50BF-DIF-C



PE50BB-DIF-C

DIFFUSER IN DIFFUSER OUT



Model	PE50BF-DIF-C					PE50BB-DIF-C					
Use	Complete calibration curve. Highest damage threshold					Removable diffuser. Spectrally flat					
Diffuser	Fixed					Diffuser out			Diffuser in		
Aperture mm	Ø35					Ø46			Ø33		
Absorber Type	BF with diffuser					BB			BB with diffuser		
Spectral Range µm ^(a)	0.355 – 2.2, 2.94					0.19 – 20			0.4 – 2.5		
Surface Reflectivity % approx.	25					5			15		
Calibration Uncertainty ±% ^(a)	3					3			3		
Max Pulse Width Setting ^(d)	1ms	2ms	5ms	10ms	20ms	3ms	10ms	20ms	3ms	10ms	20ms
Energy Scales	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	40J to 8mJ	40J to 8mJ	40J to 8mJ
Lowest Measurable Energy mJ ^(c)	0.2	0.4	0.8	0.8	0.8	0.1	0.1	0.2	0.5	5	5
Max Pulse Width ms	1	2	5	10	20	3	10	20	3	10	20
Maximum Pulse Rate pps	250Hz	100Hz	50Hz	40Hz	20Hz	40Hz	10Hz	5Hz	40Hz	10Hz	5Hz
Noise on Lowest Range µJ	40	80	200	200	200	15	15	20	40	60	80
Additional Error with Frequency %	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 250Hz	±1%	±1%	±2%	±2%	±1%	±1%	±1%	±1%	±1%	±1%
Linearity with Energy for >7% of full scale ^(c)	±2%					±2%					
Maximum Energy Density J/cm ² ^(b)						Diffuser out			Diffuser in		
<100ns	4					0.3			3		
1µs	5					0.3			3		
300µs	20					1			10		
2ms	60					2			20		
Maximum Average Power W	25, 40 with optional heat sink (P/N 7Z08267)					10, 15 with optional heat sink (P/N 7Z08267)			30, 50 with optional heat sink (P/N 7Z08267)		
Maximum Average Power Density W/cm ²	200					10			500		
Uniformity over surface	±2.5% over central 20mm					±2% over 70% of diameter			±2.5% over central 20mm		
Weight kg	0.25					0.25					
Compliance	CE, UKCA, China RoHS					CE, UKCA, China RoHS					
Version											
Part Number: Standard Sensor	7Z02940					7Z02947 (1.5m cable)					
Sensor with different cable length						7Z02947B (5m cable)					
Note: (a) Calibration accuracy at various wavelengths as specified here.	Specified wavelengths: 355nm, 532nm, 1064nm and 2100nm.					Calibrated at 1064nm			Calibrated at 1064nm, 532nm and 2100nm only. Calibration accuracy at 2100nm, ±5%.		
At other wavelengths, there may be an additional error up to the value given.	Max additional error at other wavelengths not specified above: ±2%. <250nm not calibrated					Max additional error at other wavelengths is ±2%					
Note: (b)	For wavelengths >2.1µm, derate to 10% of above values. For wavelengths below 600nm, derate to 60% of given values (for DIFH 50% of given values). For wavelengths below 240nm, derate to 1J/cm ² . For beam size ≤5mm. For 10mm beam, derate DIF to 80% and DIFH to 70% of above.										
Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >7% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.											
Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter only 2 of the pulse width settings are available. For the PE-BF models the 1ms and 10ms settings and for the PE-BB model the 3ms and 10ms settings. Furthermore, with the diffuser mounted, the sensor may saturate at lower than the maximum energy in some cases. Therefore it is recommended to use these sensors with the newer meters/PC interfaces.											

* For drawings please see page 135

1.2.3 High Energy Pyroelectric Sensors

100µJ to 10J

Features

- Premium DIFH & DIFH2 energy sensors BF coating for highest damage threshold
- Metallic coating for high repetition rates up to 10kHz
- Measure lasers with pulse widths up to 20ms
- Flavors focusing on UV and others focusing on VIS-IR

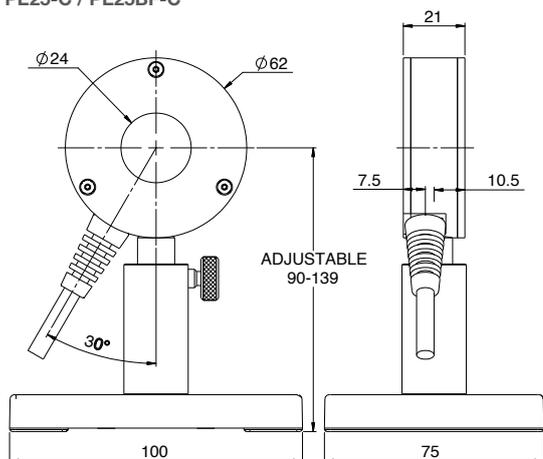
PE50-DIFH2-C,
PE50BF-DIFH2-C,
PE50-UV-DIFH-C,
PE50BF-UV-DIFH-C



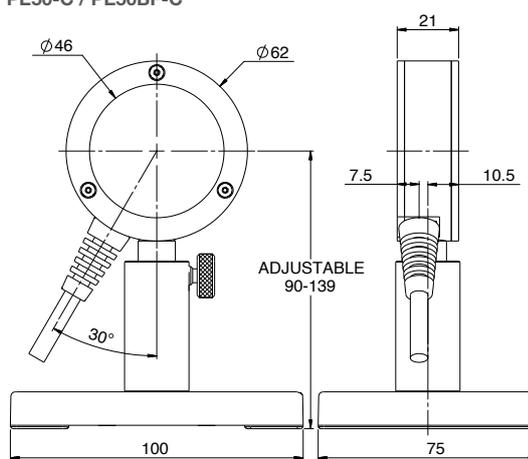
Model	PE50-DIFH2-C					PE50BF-DIFH2-C					PE50-UV-DIFH-C					PE50BF-UV-DIFH-C				
Use	High repetition lasers requiring high damage threshold					Pulsed lasers requiring very high damage threshold					High repetition lasers requiring high damage threshold					Pulsed lasers requiring very high damage threshold				
Aperture mm	Ø35					Ø35					Ø35					Ø35				
Absorber Type	Metallic with diffuser					BF with diffuser					Metallic with UV diffuser					BF with UV diffuser				
Spectral Range µm ^(a)	0.355 – 2.2, 2.94					0.355 – 2.2, 2.94					0.193 - 0.355					0.193 - 0.355				
Surface Reflectivity % approx.	35					35					25					25				
Calibration Uncertainty ±% ^(a)	3					3					3					3				
Max Pulse Width Setting ^(d)	2µs	30µs	500µs	1ms	5ms	1ms	2ms	5ms	10ms	20ms	2µs	30µs	500µs	1ms	5ms	1ms	2ms	5ms	10ms	20ms
Energy Scales	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 2mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ
Lowest Measurable Energy mJ ^(c)	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.8	0.8	0.8	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.8	0.8	0.8
Max Pulse Width ms	0.002	0.03	0.5	1	5	1	2	5	10	20	0.002	0.03	0.5	1	5	1	2	5	10	20
Maximum Pulse Rate pps	10kHz	5kHz	900Hz	450Hz	100Hz	250Hz	100Hz	50Hz	40Hz	20Hz	10kHz	5kHz	900Hz	450Hz	100Hz	250Hz	100Hz	50Hz	40Hz	20Hz
Noise on Lowest Range µJ	10	10	10	10	20	40	80	200	200	200	10	10	10	10	20	40	80	200	200	200
Additional Error with Frequency %	±1.5%	±1.5%	±1% to 900Hz	±1% to 450Hz	±1% to 100Hz	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 250Hz	±1%	±1%	±2%	±2%	±1.5%	±1.5%	±1% to 900Hz	±1% to 450Hz	±1% to 100Hz	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 250Hz	±1%	±1%	±2%	±2%
Linearity with Energy for >10% of full scale (for Metallic) and >7% of full scale (for BF) ^(c)	±1.5%					±2%					±1.5%					±2%				
Maximum Energy Density J/cm ² ^(b)																				
<100ns (7ns)	3					8					2					3				
1µs	15					17					8					8				
300µs	75					75					35					35				
2ms	200					200					95					95				
Maximum Average Power W	25, 40 with optional heat sink (P/N 7Z08267)					25, 40 with optional heat sink (P/N 7Z08267)					25, 40 with optional heat sink (P/N 7Z08267)					25, 40 with optional heat sink (P/N 7Z08267)				
Maximum Average Power Density W/cm ²	200					200					200					200				
Uniformity over surface	±2.5% over central 20mm					±2.5% over central 20mm					±2.5% over central 20mm					±2.5% over central 20mm				
Weight kg	0.25					0.25					0.25					0.25				
Compliance	CE, UKCA, China RoHS					CE, UKCA, China RoHS					CE, UKCA, China RoHS					CE, UKCA, China RoHS				
Version																				
Part Number	7Z02958					7Z02959					7Z02960					7Z02961				
Note: (a) Calibration curve is verified and adjusted at specified wavelengths.	Specified wavelengths: 355nm, 532nm, 1064nm, 2100nm and 2940nm.					Specified wavelengths: 355nm, 532nm, 1064nm, 2100nm and 2940nm.					Specified wavelengths: 193nm, 248-266nm and 355nm.					Specified wavelengths: 193nm, 248-266nm and 355nm.				
At other wavelengths, there may be an additional error up to the value given.	Max additional error at other wavelengths not specified above: ±2%.					Max additional error at other wavelengths not specified above: ±2%.					Max additional error at 193nm ±4%. Max additional error at other wavelengths not specified above: ±2%. 193nm reading may need 1min irradiation to stabilize.					Max additional error at 193nm ±4%. Max additional error at other wavelengths not specified above: ±2%.				
Note: (b)	For wavelengths >2.2µm, derate to 10% of above values. For wavelengths below 500nm, derate to 40% of given values. For beam size ≤5mm. For 10mm beam, derate to 60% of above values.					For wavelengths >2.2µm, derate to 10% of above values. For wavelengths below 500nm, derate to 40% of given values. For beam size ≤5mm. For 10mm beam, derate to 60% of above.					For wavelengths <300nm, derate to 50% of given values. For beam size ≤5mm. For 10mm beam, derate to 60% of above.					For wavelengths <300nm and pulses <100ns (7ns), derate to 33% of given values, for longer pulses derate to 50% of given values. For beam size ≤5mm. For 10mm beam, derate to 60% of above.				
Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >10%/>7% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USB1 and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.																				
Note: (d) With the LaserStar, Pulsar, USB1, Quasar and Nova with adapter only 2 out of 5 pulse width settings are available. For PE50BF-DIFH2-C & PE50BF-UV-DIFH-C sensors the 1ms and 10ms settings and for PE50-DIFH2-C & PE50-UV-DIFH-C sensors the 2µs (displayed as "30µs") and 1ms settings. Furthermore, with the diffuser mounted, the sensor may saturate at lower than the maximum energy in some cases. Therefore it is recommended to use these sensors with the newer meters/PC interfaces.																				

* For drawings please see page 135

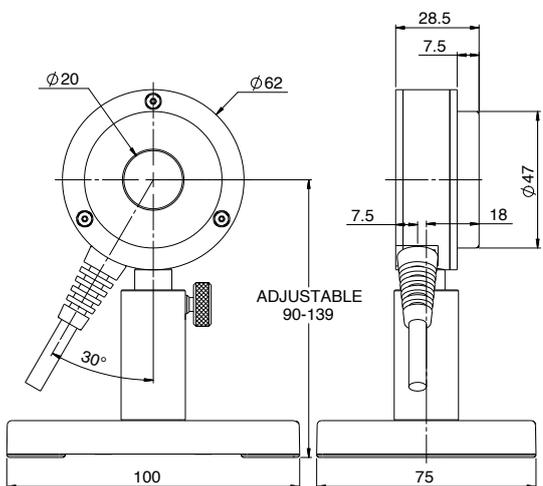
PE25-C / PE25BF-C



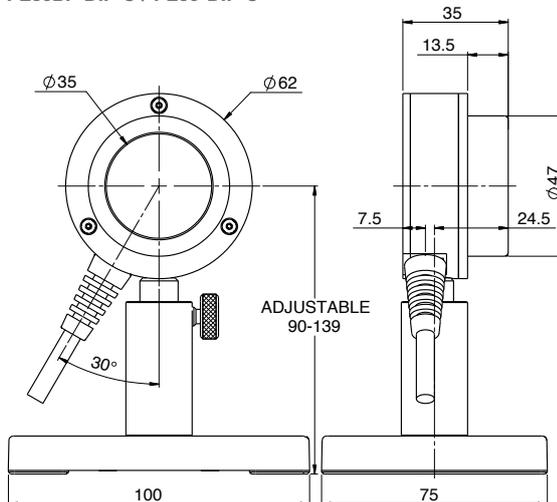
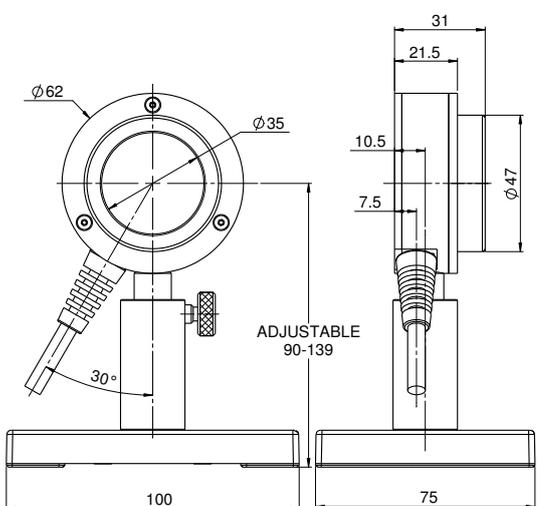
PE50-C / PE50BF-C



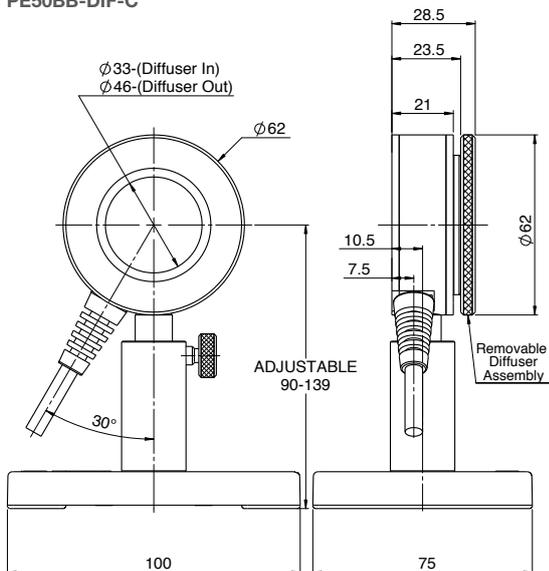
PE25BF-DIF-C



PE50BF-DIF-C / PE50-DIF-C

PE50-DIFH2-C / PE50BF-DIFH2-C /
PE50-UV-DIFH-C / PE50BF-UV-DIFH-C

PE50BB-DIF-C



1.2.3 High Energy Pyroelectric Sensors

10µJ to 40J

Features

- Removable diffusers
- PE50-DIF-ER-C mainly for NIR lasers
- E100BF-DIF-C for very large beams
- Rep rates up to 10kHz
- Measure lasers with pulse widths up to 20ms



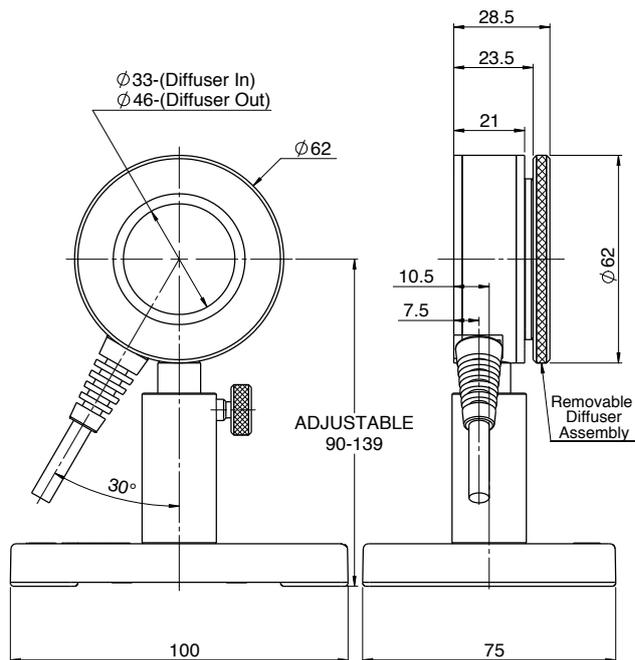
Model	PE50-DIF-ER-C										PE100BF-DIF-C									
Use	Mainly for 1064nm, 2.1µm and 2.94µm										Very large aperture									
Diffuser	Diffuser out					Diffuser in					Diffuser out					Diffuser in				
Aperture mm	Ø46					Ø33					Ø96					Ø85				
Absorber Type	Metallic					Metallic with diffuser					BF					BF with diffuser				
Spectral Range µm ^(a)	0.19 - 3					0.4 - 3					0.15 - 3					0.4 - 2.5				
Surface Reflectivity % approx.	50					50					20					50				
Calibration Uncertainty ±% ^(a)	3					4					3					4				
Max Pulse Width Setting ^(c)	2µs	30µs	500µs	1ms	5ms	2µs	30µs	500µs	1ms	5ms	1ms	2ms	5ms	10ms	20ms	1ms	2ms	5ms	10ms	20ms
Energy Scales	10J to 200µJ	10J to 200µJ	10J to 2mJ	10J to 2mJ	10J to 2mJ	30J to 600µJ	30J to 600µJ	30J to 6mJ	30J to 6mJ	30J to 6mJ	10J to 2mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ	10J to 20mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ
Lowest Measurable Energy mJ ^(b)	0.01	0.01	0.06	0.08	0.1	0.05	0.05	0.3	0.4	0.5	0.4	0.7	1.5	1.5	1.5	2	3	5	5	5
Max Pulse Width ms	0.002	0.03	0.5	1	5	0.002	0.03	0.5	1	5	1	2	5	10	20	1	2	5	10	20
Maximum Pulse Rate pps	10kHz	5kHz	800Hz	400Hz	100Hz	10kHz	5kHz	800Hz	400Hz	100Hz	200Hz	100Hz	50Hz	35Hz	25Hz	200Hz	100Hz	50Hz	35Hz	25Hz
Noise on Lowest Range µJ	1	1	6	10	20	5	5	30	50	100	80	150	250	200	200	300	500	1000	600	600
Additional Error with Frequency %	±2% to 2kHz ±4.5% to 5kHz	±2%	±2%	±2%	±1% to 80Hz	±2% to 2kHz ±4.5% to 5kHz	±2%	±2%	±2%	±1% to 80Hz	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 200Hz	±1%	±1%	±1%	±1%	±1% to 100Hz ±2.5% to 150Hz ±4.5% to 200Hz	±1%	±1%	±1%	±1%
Linearity with Energy for > 10% of full scale ^(b)	±1.5%										±1%									
Maximum Energy Density J/cm ²																				
<100ns	0.1					1.5					0.8					3				
1µs	0.2					3					1					3				
300µs	2					20					5					10				
2ms	6					60					10					25				
Maximum Average Power W	15, 25 with optional heat sink (P/N 7Z08267)					40, 60 with optional heat sink (P/N 7Z08267)					25					50				
Maximum Average Power Density W/cm ²	20					500					20					500				
Weight kg	0.3										1.2									
Compliance	CE, UKCA, China RoHS										CE, UKCA, China RoHS									
Version																				
Part Number: Standard Sensor	7Z02948 (1.5m cable)										7Z02942 (1.5m cable)									
Sensor with different cable length	7Z02948B (5m cable)										7Z02942B (5m cable), 7Z02942C (10m cable)									
Note: (a)	Calibrated at 532nm and 1064nm only					Calibrated at 1064nm, 2100nm and 2940nm					Calibrated at 532nm and 1064nm only					Calibrated at 532nm, 1064nm and 1550nm only				

Note: (b) With the "user threshold" setting set to minimum. For other settings, the spec is for >10% of full scale or greater than twice the "user threshold", whichever is greater. For use with Centauri, StarBright, StarLite, Nova II, Vega, Juno, Juno+, Juno-RS and EA-1. The sensors will operate with older Ophir meters and PC interfaces but do not support the threshold function and may give inaccurate readings with the diffuser in and therefore it is not recommended to use these sensors with older Ophir meters and PC interfaces. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.

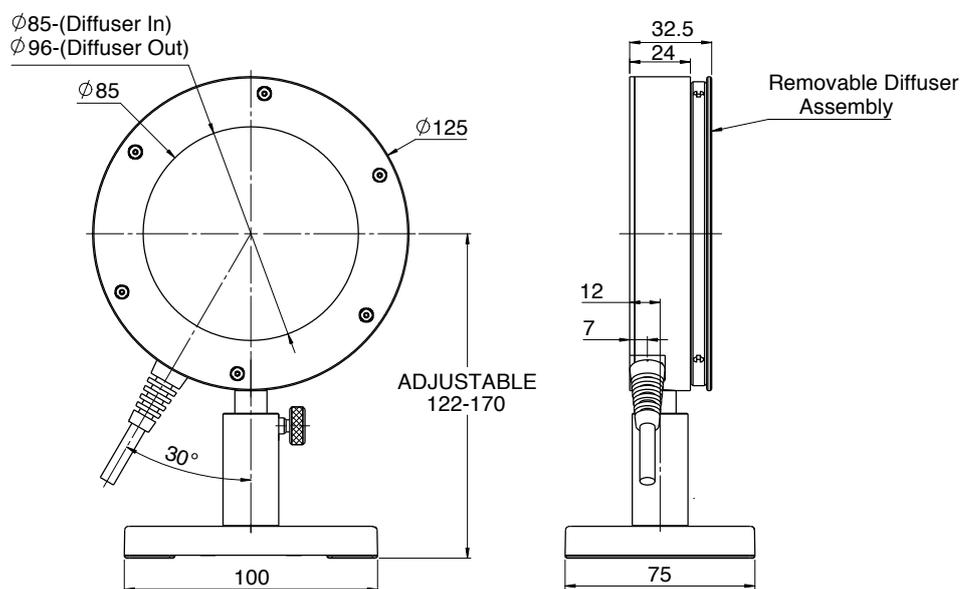
Note: (c) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter only 2 of the 5 pulse width settings are available. For the PE50-DIF-ER-C, the 30µs and 1ms settings and for the PE100BF-DIF-C, the 1ms and 10ms settings. Furthermore, with the diffuser mounted, the sensor may saturate at lower than the maximum energy in some cases. Therefore it is recommended to use these sensors with the newer meters/PC interfaces.

* For drawings please see page 137

PE50-DIF-ER-C



PE100BF-DIF-C



1.2.3 High Energy Pyroelectric Sensors

1mJ to 40J

Features

- Fan or conduction cooled for high average power capability
- BF coating with diffuser for highest damage threshold
- Wide spectral range. Measure YAG and harmonics and many more
- Rep rates up to 250Hz
- Measure lasers with pulse widths up to 20ms

FPE80BF-DIF-C



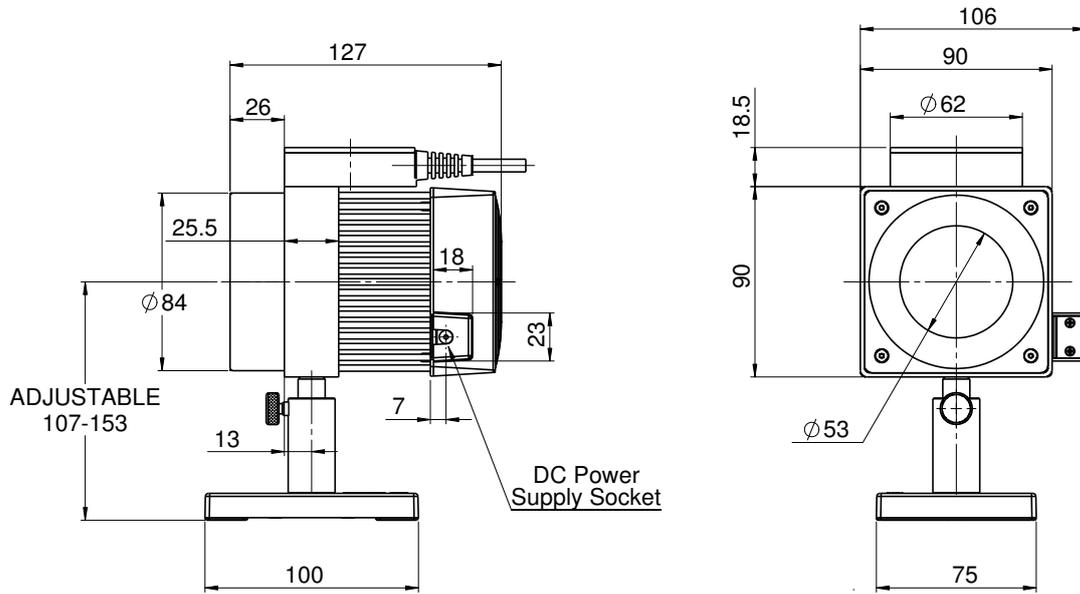
PE80BF-DIF-C



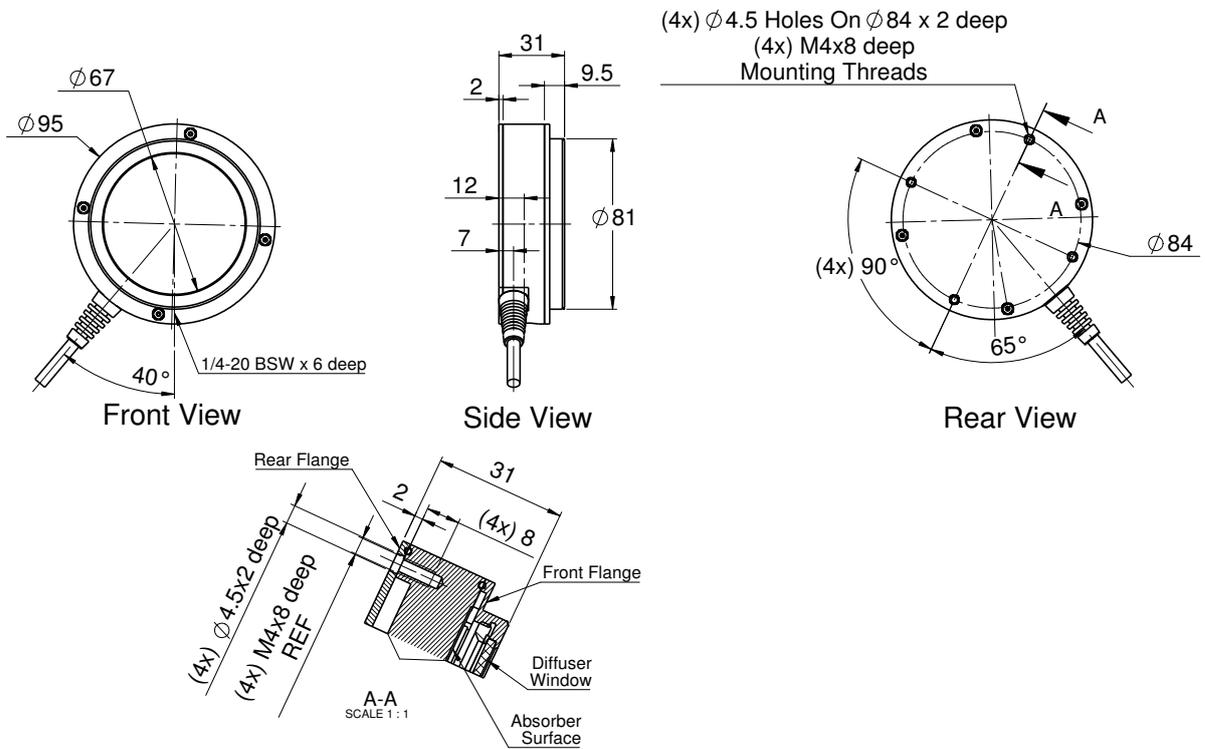
Model	FPE80BF-DIF-C					PE80BF-DIF-C				
Use	High average power pulsed lasers					Large aperture pulsed lasers				
Diffuser	Fixed					Fixed				
Aperture mm	Ø53					Ø67				
Absorber Type	BF with diffuser					BF with diffuser				
Spectral Range μm ^(a)	0.355 – 2.2, 2.94					0.355 – 2.2, 2.94				
Surface Reflectivity % approx.	25					25				
Calibration Uncertainty $\pm\%$ ^(a)	3					3				
Max Pulse Width Setting ^(c)	1ms	2ms	5ms	10ms	20ms	1ms	2ms	5ms	10ms	20ms
Energy Scales	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ	40J to 40mJ
Lowest Measurable Energy mJ ^(c, f)	1	1	1	2	2	4	4	4	4	4
Max Pulse Width ms	1	2	5	10	20	1	2	5	10	20
Maximum Pulse Rate pps	250Hz	100Hz	50Hz	40Hz	20Hz	250Hz	100Hz	50Hz	40Hz	20Hz
Noise on Lowest Range μJ	200	300	300	300	300	100	200	200	200	200
Additional Error with Frequency %	$\pm 1.5\%$ to 100Hz $\pm 2.5\%$ to 150Hz $\pm 4.5\%$ to 250Hz	$\pm 1.5\%$ to 100Hz $\pm 2.5\%$ to 150Hz $\pm 4.5\%$ to 250Hz	$\pm 1.5\%$	$\pm 1.5\%$	$\pm 1.5\%$	$\pm 1.5\%$				
Linearity with Energy for >10% of full scale ^(c)	$\pm 1.5\%$					$\pm 2\%$				
Damage Threshold J/cm^2 ^(b)										
<100ns	4					4				
1 μs	8					5				
300 μs	30					20				
2ms	50					60				
Maximum Average Power W	200					40				
Maximum Average Power Density at Maximum Power W/cm^2	120 ^(e)					200 ^(e)				
Uniformity over surface	$\pm 2\%$ over central 40mm					$\pm 2\%$ over central 60mm				
Cooling	fan (see page 141 for details)					conduction				
Weight kg	1.2					0.5				
Compliance	CE, UKCA, China RoHS					CE, UKCA, China RoHS				
Version										
Part Number	7Z02950					7Z02954				
Note: (a) Calibration accuracy at various wavelengths as specified here. At other wavelengths, there may be an additional error up to the value given.	Specified wavelengths: 355nm, 532nm, 1064nm, 2100nm and 2940nm. Max additional error at other wavelengths not specified above: $\pm 2\%$. <250nm not calibrated.									
Note: (b)	For wavelengths >2.1 μm , derate to 10% of above values. For wavelengths below 600nm, derate to 60% of given values. For wavelengths below 240nm, derate to 1J/cm ² . For beam size $\leq 16\text{mm}$. For 32mm beam, derate to 50% of above values.									
Note: (c) With the "user threshold" setting set to minimum. For other settings, the spec is for >10% of full scale or greater than twice the "user threshold", whichever is greater. The user threshold is not available with LaserStar, Nova, Pulsar, USBI and Quasar. For these meters, the threshold is set to minimum and the linearity spec is >10% of full scale. The PE-C series will only operate with Nova meter with an additional adapter Ophir P/N 7Z08272 (see page 141). The adapter can introduce up to 1% additional measurement error. The user threshold feature allows adjustment of the internal threshold up to 25% of full scale if desired to avoid false triggering in noisy environments. For further information, see the FAQs on our Website.										
Note: (d) With the LaserStar, Pulsar, USBI, Quasar and Nova with adapter only 2 of the pulse width settings are available, the 1ms and 10ms settings.										
Note: (e) For maximum power. For lower powers the damage threshold is correspondingly higher.										
Note: (f) For powers below 50W it is recommended to work with the fan off. If working with the fan on, the threshold must be set to 6% and the lowest measurable energies will be as follows:										
Max Pulse Width Setting	1ms	2ms	5ms	10ms	20ms					
Lowest Measurable Energy mJ	4mJ	4mJ	4mJ	4mJ	4mJ					

* For drawings please see page 139

FPE80BF-DIF-C



PE80BF-DIF-C



1.2.4 Energy Sensors Accessories

1.2.4.1 Accessories for Pyroelectric Sensors

Fiberoptic Adapter for Pyroelectric Sensors



Oscilloscope Adapter for Pyroelectric Sensors



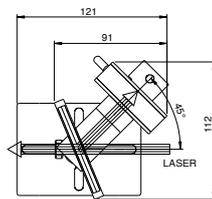
Heat Sink for PE-C Series Sensors



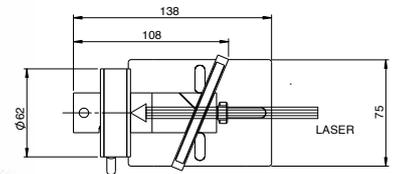
Beam Splitter Assembly



Beam splitter installed – reflected beam on sensor



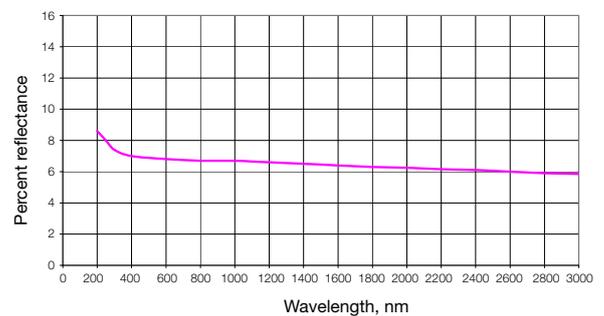
Beam Splitter removed – direct beam on sensor



Beam Splitter Specifications

Material	UV grade fused silica	
Spectral range	0.19 - 2.2 μ m	
Aperture	\varnothing 60mm	
Damage threshold for pulses	< 10ns PW	>300 μ s PW
	5J/cm ²	>200J/cm ²
Fraction split off	See graph	

F.S. Beam Splitter, 2 sided reflection unpolarized light



Accessory	Description	Part number			
Heat Sink	Heat sink that screws onto rear of PE25 and PE50 series sensors and allows working at over 50% higher average powers.	7Z08267			
Scope Adapter	Plugs in between the PE sensor and power meter. Provides BNC output to scope to see every pulse up to the maximum frequency of the sensor.	7Z11012			
Fiber Adapters	To mount fibers to sensors you need an adapter bracket and fiber adapter. All fiber adapters are compatible with the adapter bracket selected.				
Fiber Adapter Brackets	Mounting brackets to allow mounting fiber adapters to pyroelectric sensors.				
PE Sensor Family Type		Bracket P/N		Distance from fiber to detector	
PD10-C / PD10-IR-C / PD10-pJ-C PD10-IR-pJ-C		7Z08275		10mm	
PE50-C / PE50BF-C		7Z08270		15mm	
PE9-C / PE9-ES-C / PE10-C / PE10BF-C / PE25-C / PE25BF-C		7Z08269		10mm	
Fiber Adapters	Fiber adapters for mounting to above brackets	SC type	ST type	FC type	SMA type
For all PE sensors above		7Z08227	7Z08226	7Z08229	1G01236A
Beam Splitter Assembly	Beam Splitter Assembly to measure pulsed laser sources too energetic for direct measurement. The reading with the Beam Splitter can be calibrated by setting the laser to a lower energy that will not damage the sensor and then taking a measurement with the beam splitter and without and taking the ratio.	7Z17001			

1.2.4.1 Accessories for Pyroelectric Sensors - Continued

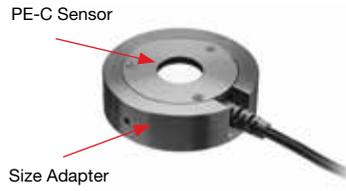
Damage Threshold Test Plates



Nova PE-C Adapter



PE-C to PE Size Adapter



Negative Polarity Power Supply/Charger

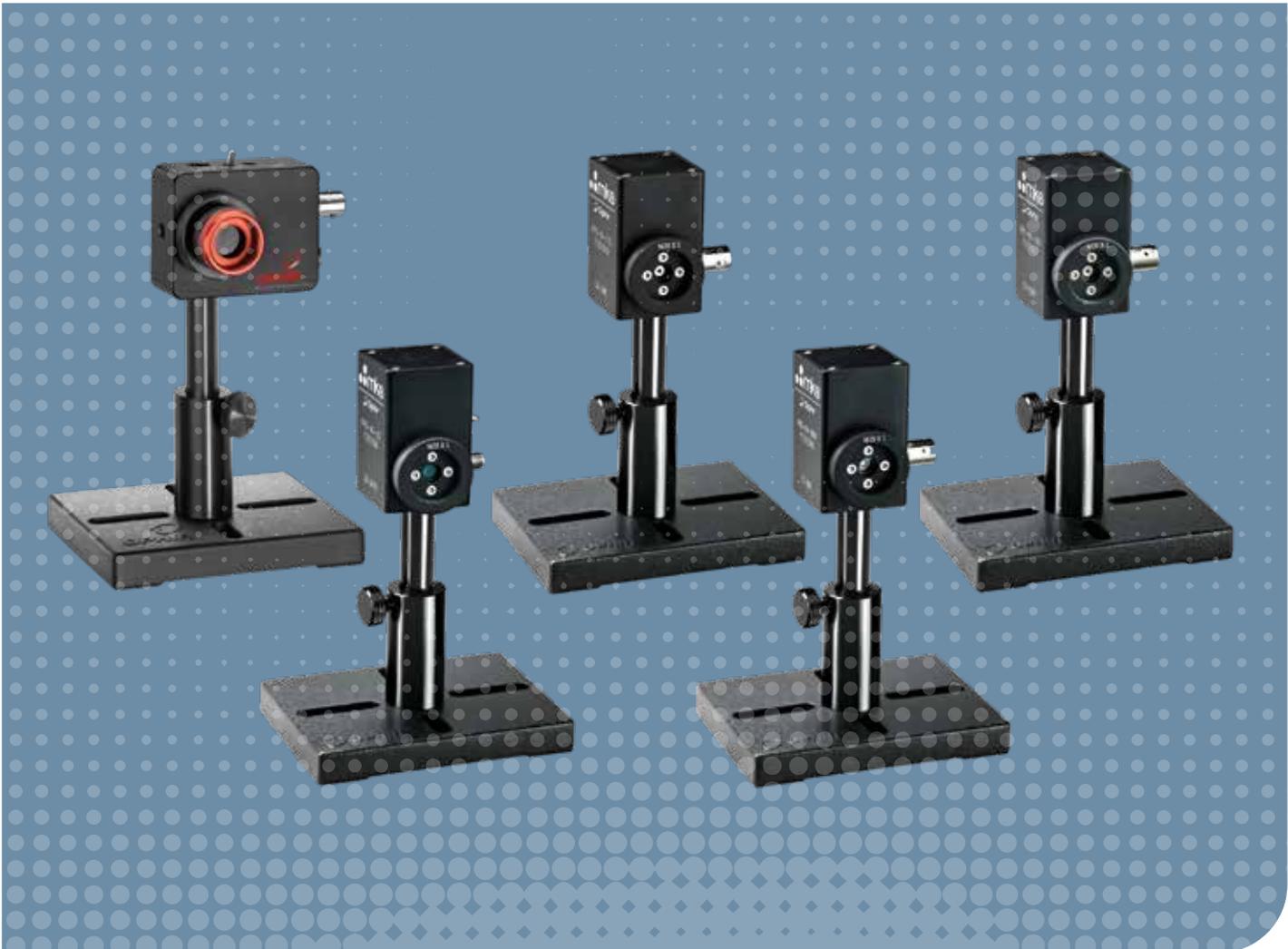
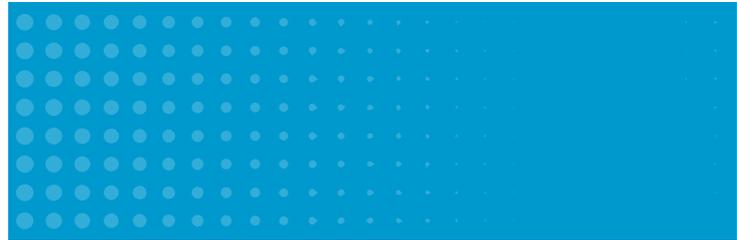


Accessory	Description	Part number		
		Metallic type	BF type	BB type
Damage Threshold Test Plates	Test plates with same absorber coating as the sensor. For testing that laser beam is not above damage threshold	7E06031A	7E06031D	7E06031C
	Dimensions	26x26x1mm	76x26x1mm	76x26x1mm
Nova PE-C Adapter	The adapter plugs between the Nova D15 socket and the smart plug of the PE-C sensor to allow the Nova to operate with PE-C series sensors. See PE-C spec sheet for details.	7Z08272		
PE-C to PE Size Adapter	The newer PE-C series sensors have a Ø62mm diameter. The older PE series sensors have a Ø85mm diameter. This adapter allows using the PE-C type sensors in jigs and setups that were originally designed for PE sensors.	7Z08273		
N Polarity Power Supply/Charger AC/DC 12V 2A N-2.1x5.5	For FPE80BF-DIF-C sensor (1 unit supplied with the sensor)	7E05029		

2025

PULSE CHARACTERIZATION SENSORS 1.3

SENSORS



1.3 Pulse Characterization Sensors

Introduction

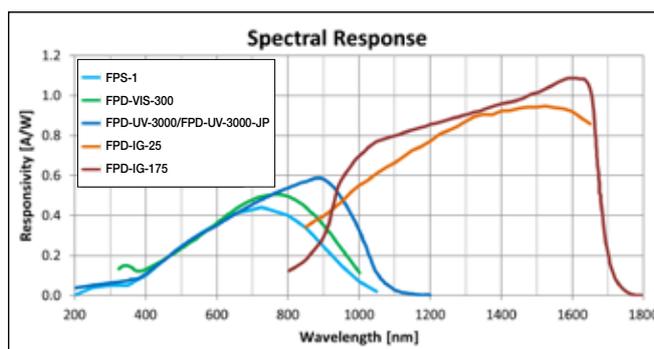
Ophir's high speed, biased PIN **Fast Photodiode Detectors (FPD series)** convert fast optical pulses into electrical signals. When terminated into 50Ω into an oscilloscope or spectrum analyzer, the temporal characteristics of lasers pulses can be viewed and measured. A selection of models covers the spectrum from 190nm to 1700nm and a range of rise times and sensitivities. The photodiode bias voltage is supplied by internal batteries and/or external power supply depending on the model. Ophir's Pulse Characterization Sensors do not require calibration.

In order to achieve minimal response times, the photodiodes used in these detectors are relatively small. This reduces their capacitance and increases their electrical bandwidth. This makes them ideal for sampling a portion of the laser beam by placing them directly in the beam path or by picking up reflections bouncing off a nearby target.

When it is important to capture the entire beam, the temporal sensor can be attached to an integrating sphere. The laser beam enters the integrating sphere, and the temporal

detector attached at the side will sample a small portion of the laser beam's energy which is scattered inside the sphere. When additional amplification of the detected signal is needed, for example, in order to feed the detected signal into a digital acquisition system, a trans-impedance amplifier should be used. For best performance a trans-impedance amplifier with 50Ω input resistance and bandwidth equal to or larger than that of the sensor should be used.

Accessories available include attenuators, fiber optic adapters and adapters for attaching to integrating spheres.



Related Product

For an FPD detector built into an integrating sphere sensor, see our **IS1.5-VIS-FPD-800, 1.5" High Speed Response, Multi-functional Integrating Sphere** on page 36.

IS1.5-VIS-FPD-800 (see p. 36)



1.3.1 Fast Photodiode Detectors (FPD)

Features

- Fast response time down to 25 psec
- Measure temporal pulse shape
- Spectral coverage from 193 to 1700 nm
- Optional attenuators, fiber optic adapters and integrating sphere adapters available



Description

Ophir's high speed, biased PIN photodiode detectors convert fast optical pulses into electrical signals. When terminated into 50Ω into an oscilloscope or spectrum analyzer, the temporal characteristics of lasers can be viewed and measured. A selection of models covers the spectrum from 190nm to 1700nm and a range of rise times and sensitivities. The photodiode bias voltage is supplied by internal batteries and/or external power supply depending

on the model. Ophir's Pulse Characterization Sensors do not require calibration.

Accessories available include attenuators, fiber optic adapters and adapters for attaching to integrating spheres.

For an FPD detector built into an integrating sphere sensor, see our IS1.5-VIS-FPD-800, 1.5" High Speed Response, Multi-functional Integrating Sphere on page 36.

Model ^(a)	FPS-1	FPD-UV-3000 / FPD-UV-3000-JP ^(d)	FPD-VIS-300	FPD-IG-175	FPD-IG-25
Detector Type	UV-Si	UV-Si	Si	InGaAs	InGaAs
Rise Time/Fall Time nsec	1.5	3	<0.3	<0.175	<0.025
Spectral Range nm (see graph on next page)	193-1100	193-1100	320-1100	900-1700	900-1700
Active Area Diameter mm	1.02	2.55	0.4	0.1	0.032
Detector Area mm ²	0.8	5.11	0.13	0.0079	0.00080
Wavelength of Peak Sensitivity nm	720	890	770	1600	1500
Responsivity at Peak Wavelength A/W	0.45	0.58	0.5	1.1	0.95
Responsivity (Irradiance) at Peak Wavelength V/(W/cm ²)	0.18	1.5	31 x 10 ⁻³	4.3 x 10 ⁻³	0.19 x 10 ⁻³
Bias Voltage VDC	12	24	9	6	6
Bias Voltage Source	External or Battery	External	Batteries	Batteries	Batteries
Bandwidth	233 MHz	>118 MHz	>1.2 GHz	>2 GHz	>15 GHz
Dark Current nA	0.3 typ, 1.0 max	<10	<0.1	<2	<3
Noise Equivalent Power ^(b) pW/√Hz	0.05	<0.10	<0.01	<0.03	20
Maximum Average Power Input ^{(b), (c)} mW	3	15	25	10	10
Mounting (Tapped Holes)	1/4-20	8-32 & M4	8-32 & M4	8-32 & M4	8-32 & M4
Output Connector	BNC	BNC	BNC	BNC	SMA
Accessory Threads	SM-1	M20x1	M20x1	M20x1	M20x1
Version					
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Part Number	7Z02505	7Z02506 / 7Z07153	7Z02507	7Z02509	7Z02508

Note: (a) All specs are with 50 ohm load

Note: (b) At wavelength of peak sensitivity

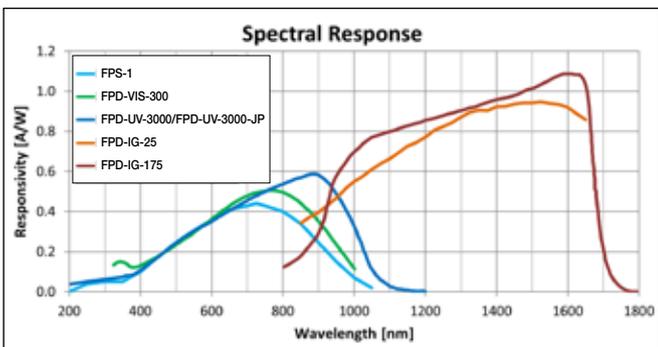
Note: (c) Maximum peak power is twice the average power for 10 nsec pulses

Note: (d) The FPD-UV-3000-JP is sold exclusively in Japan

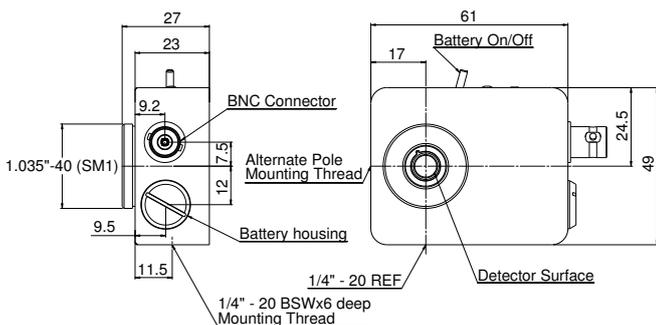
* For drawings please see page 145

Fiber Adapters ^(d) - see page 33				ND Attenuators ^(d)		IS6 Integrating Sphere Adapters - see page 40	
SC type	ST type	FC type	SMA type	ND1 nom. X10 attenuator	ND2 nom. X50 attenuator	For FPD	For FPS-1
7Z08227	7Z08226	7Z08229	1G01236A	7Z08200	7Z08201	7Z08350	7Z08289

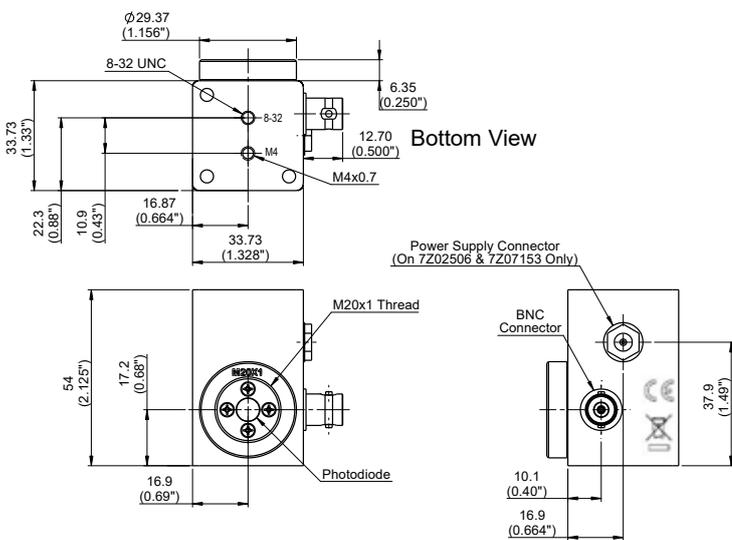
Note: (d) FPS-1 sensor requires also a SM1 to M20 mounting bracket adapter P/N 1G02259



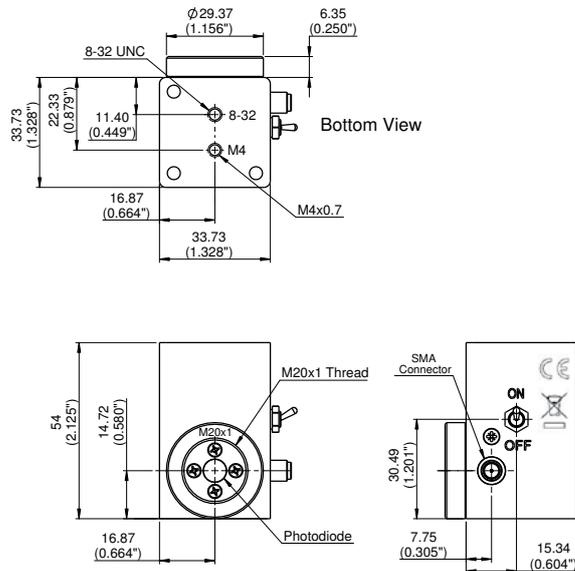
FPS-1



FPD-UV-3000 / FPD-UV-3000-JP / FPD-VIS-300 / FPD-IG-175



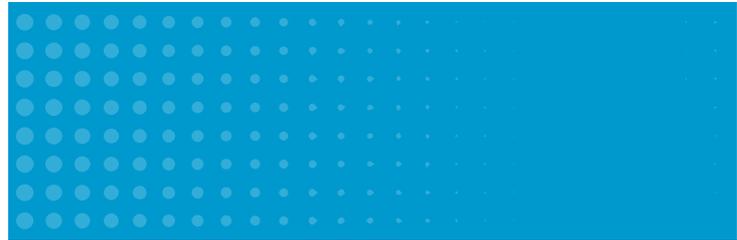
FPD-IG-25



2025

CUSTOMIZED SOLUTIONS (OEM) 1.4

SENSORS



1.4 Customized Solutions (OEM)

1.4.1 Introduction

Ophir – The World Leading Source for Custom Designed Laser Measurement Solutions

Many laser systems manufacturers need to have a measuring capability built into their systems.

Ophir is the world's leading supplier of Customized Solutions (OEM) laser power/energy measurement instrumentation which can be built into host systems (such as medical, industrial, etc.). With extensive experience accumulated in the field, Ophir offers the largest variety of Customized Solutions (OEM) products and is therefore best able to satisfy customer requirements.

Many configurations possible

A Customized Solutions (OEM) product is usually needed to monitor laser performance in the system, and possibly to provide fast feedback for system control. Depending on your application, various configurations can be used, such as:

- Just a sensor, with raw analog output
- Sensor with electronics providing an amplified analog or digital output

- Complete instrument, including numeric display and/or PC interface
- Custom designed solution for special requirements

In the following pages, you will see a range of "standard" Customized Solutions (OEM) sensors available; these are actually families of existing Customized Solutions (OEM) sensors with typical specifications shown. They can be tailored as needed to fit your specific requirements.

In addition to the products described in this chapter, Ophir has developed hundreds of other Customized Solutions (OEM) products. Simply contact your Ophir representative and specify your needs.

1.4.2 Thermal and Photodiode Customized Solutions (OEM) Sensors

1.4.2.1 Sensor Usage

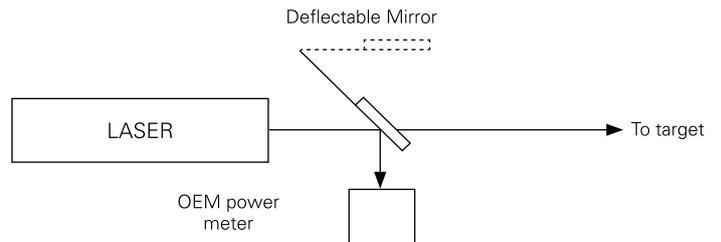
Ophir pioneered compact self-contained laser power meter sensors with built-in amplifiers. These sensors are easy to install and give a calibrated voltage proportional to power. They contain all the electronics needed including a speed up

circuit to increase the speed of response of the sensor to the order of 1s, 0-95%. Connections to the sensors are simple, with the host providing

In most cases, the sensor is used in one of three ways:

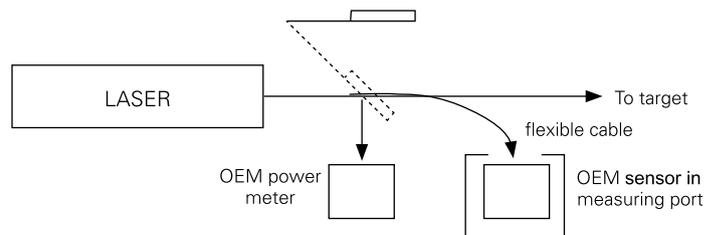
1. Beam Dump Mode

For lasers, such as surgical lasers, which are used in short bursts, the sensor is a beam dump with full power on it at all times except for the short periods of beam use when the beam is deflected to the work area.



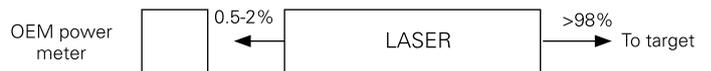
2. Sampling Mode

In this mode, the laser is usually available to the user and is only deflected to the monitor for short times when the beam is sampled by the sensor. Sampling is performed with a deflection mirror or with an output fiber optic cable which is inserted into the measuring port from time to time.



3. Rear Leak Mode

In this mode, a small fraction (0.5-2%) of the laser beam “leaks” out of the rear mirror of the laser and is constantly monitored by the sensor.



1.4.2.2 Advantages of Ophir Thermal and Photodiode Customized Solutions (OEM) Sensors

Compactness

Available in various sizes down to 38x38x25mm as described here and in addition even more compact designs for applications with more limited space.

Versatility

Ophir offers OEM sensors for almost any type of laser, for any power or configuration. These sensors can measure from pW or μJ to Kilowatts or hundreds of Joules, and can be cooled with water, air or conduction. Ophir offers a large selection of standard OEM sensors at competitive prices and with excellent delivery times. If required, the package, including the connectors, can be customized to customer specifications.

Reliability and accuracy

Ophir's thermal measuring sensors use the reliable and accurate thermopile disc principle: the output is a low impedance voltage proportional to power. Suitable absorbers which will not burn out or change reading with high power density lasers are available for any application. Ophir photodiode OEM sensors have very wide dynamic range and with software switchable ranges, one can easily cover 5 decades of intensity.

Calibration

Ophir is an accredited calibration laboratory per ISO/IEC 17025:2017. With a wide variety of calibration sources, Ophir sensors can be factory calibrated at most user required wavelengths.

In addition to the sensors described below, Ophir offers a number of other OEM sensors with larger aperture, diffusers in front, special absorbers and other special features. Ophir also offers an OEM measuring set consisting of a sensor and smart meter.

Possible configurations of thermal or photodiode Customized Solutions (OEM) products include:

- Sensor with amplified analog output – purchasing a sensor mounted into a housing with amplifier reduces noise and allows you to get a factory calibrated unit with optimized response time acceleration
- Sensor with RS232 interface – for direct RS232 interface of the Customized Solutions (OEM) sensor with the host computer
- Sensor with USB interface – for direct USB interface of the Customized Solutions (OEM) sensor with the host computer
- Sensor with Ethernet interface – for direct Ethernet interface of the Customized Solutions (OEM) sensor with the host computer. Requires separate power supply connection from rear of sensor
- Complete solution including sensor and meter – this provides a visual display for the operator (numeric, Go/No Go, etc.). This can also be in addition to the RS232 or USB output
- Disc with raw analog output – the lowest cost solution when there is no need for an amplified signal, and a relative measurement is enough. Typical output voltage is on the order of mV/W
- Disc with separate amplifier board – when space is critical, and amplified analog output is needed

1.4.2.3 Standard Customized Solutions (OEM) Thermal and Photodiode Sensors

100pW to 3W

Features

- Conduction cooled
- Thermal sensors are spectrally flat
- Analog or RS232 output
- UAF version can give analog voltage output or digital RS232 output and can measure power or energy. Can also have multiple switchable ranges and/or multiple switchable wavelengths
- Wide dynamic range, switchable ranges
- Selectable wavelengths



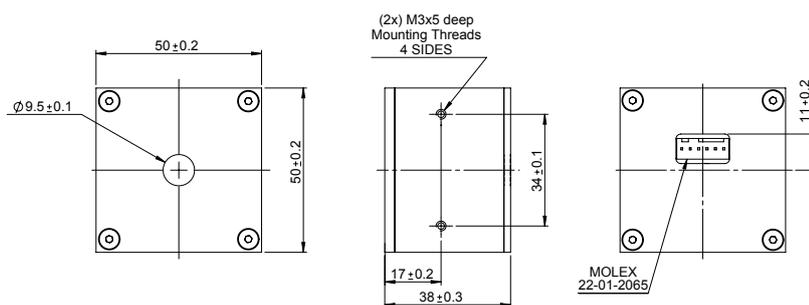
These specifications refer to standard OEM sensors, and are to be understood as generic, describing sensor families.

Ophir will be happy to help you with a specific solution for your particular application.

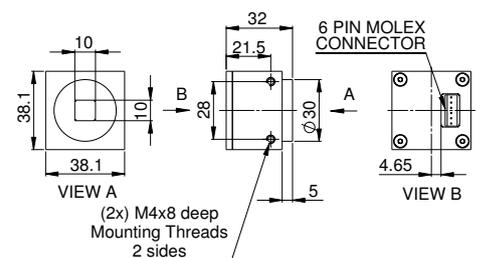
Model	3A-UAF	PD300-UAS
Type	RS232 or Analog output	RS232 or Analog output
Features	Measures very low power, built in amplifier	Small size, built in amplifier, wide dynamic range, detector can be flush with top
Absorber Type	Broadband	Photodiode
Spectral Range μm	0.19 – 20 ^(c)	0.2 – 1.1 ^(c)
Aperture mm	$\varnothing 9.5$	10x10
Maximum Power ^(a)	3W	Up to 50mW
Power Mode		
Minimum Power	100 μW	As low as 100pW
Power Noise Level	<8 μW RMS ^(d)	As low as 1pW
Thermal Drift (over 30 minutes)	< $\pm 10\mu\text{W}$ ^(d)	
Maximum Average Power Density W/cm ²	1000	~ 50
Response Time (0-95%), typ. (sec)	1.8	0.2
Calibration Uncertainty $\pm\%$	1.9	1.1 430-1000nm ^(e)
Power Accuracy $\pm\%$ at Calibrated Wavelength	3	3
Linearity with Power $\pm\%$	1.5	1
Amplifier Power Supply	+6V to +24V	+6V to +24V
Energy Mode		
Maximum Energy	2J	NA
Minimum Energy	20 μJ	NA
Energy Accuracy $\pm\%$ at calibrated wavelength	5	NA
Maximum Energy Density J/cm ²		
<10ns	0.3	NA
0.5ms	1	NA
2ms	2	NA
10ms	4	NA
Cooling	Conduction	Conduction
Connections	6 pin Molex ^(b)	6 pin Molex ^(b)
Dimensions	50x50x38mm	38x38x32mm
Compliance	RoHS, China RoHS	RoHS, China RoHS
Part number	Consult Ophir Representative	Consult Ophir Representative

Notes: (a) With analog "UAS" version, maximum power is also limited by maximum output voltage where output voltage is at most 2V less than input voltage. With analog "UAF" versions, sensor voltage output is accurate up to 2v below lowest level of supply voltage, taking into account supply voltage ripple
 (b) 6 pin Molex connections: RS232 input, Ground, +Voltage, Analog signal out, high/low voltage or switch input when used, RS232 output
 (c) Calibrated at customer selected wavelength or wavelengths
 (d) In a quiet thermal environment with FOV limiting
 (e) For calibration uncertainty of wavelengths outside of this range see table on page 24

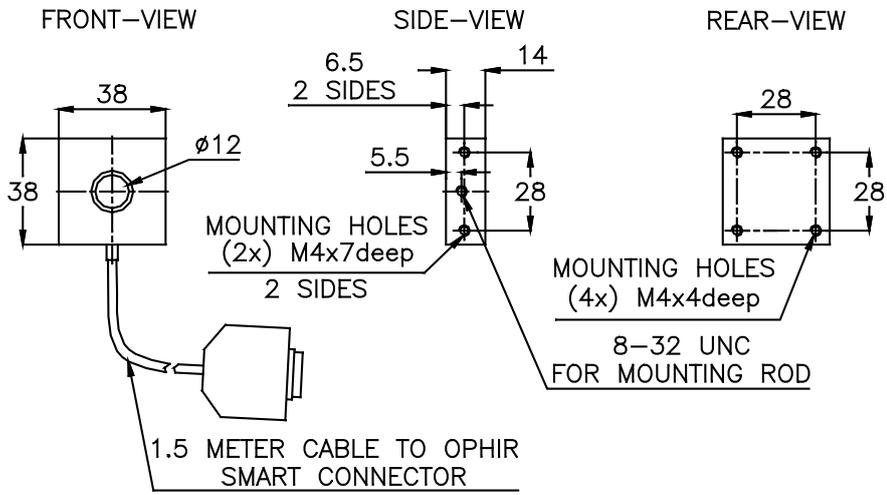
3A-UAF



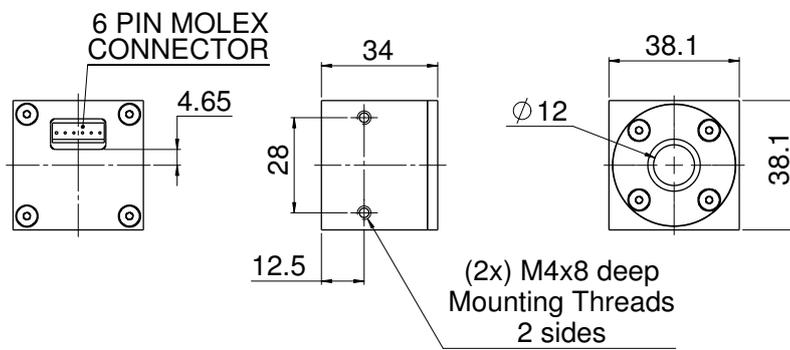
PD300-UAS



20C-BB-12-SH



20C-UAS



1.4.2.3 Standard Customized Solutions (OEM) Thermal Sensors

300mW to 100W

Features

- Conduction cooled
- UAF version can give analog voltage output or digital RS232 output and can measure power or energy. Can also have multiple switchable ranges and/or multiple switchable wavelengths
- UAU and UAE versions are similar to the UFA version but UAU operates via the USB terminal of the PC and UAE via an Ethernet connection

L30C-SH / UAF /
UAU / UAE



L30C-LP2-26-SH



These specifications refer to standard OEM sensors, and are to be understood as generic, describing sensor families. Ophir will be happy to help you with a specific solution for your particular application.

Model	L30C-SH	L30C-LP2-26-SH	L30C-UAF	L30C-UAU / L30C-UAE
Type	Smart sensor	Smart sensor for high powers and energies	RS232 or Analog output	UAU – USB compatible output UAE – Ethernet output
Features	Medium aperture smart sensor	High pulse energy and intermittent power	Medium aperture, built in amplifier	Medium aperture, built in amplifier
Absorber Type	Broadband	LP2	Broadband	Broadband
Spectral Range μm	0.19 - 20	0.25 – 2.2	0.19 - 20 ^(c)	0.19 - 20 ^(c)
Absorption	~88%	>94% from 0.25 to 1.1 μm	~88%	~88%
Aperture mm	$\varnothing 26$	$\varnothing 26$	$\varnothing 26$	$\varnothing 26$
Power Mode				
Maximum power ^(a)	free standing heat sinked	10W continuous, 100W for 2 min 100W	10W continuous, 100W for 2 min 100W	10W continuous, 100W for 2 min 100W
Minimum power	300mW	300mW	300mW	300mW
Power Noise Level	15mW	15mW	15mW	15mW
Maximum Average Power Density kW/cm ²	14 at 100W 28 at 10W	42 at 100W	14 at 100W 28 at 10W	14 at 100W 28 at 10W
Response Time (0-95%), typ. (sec)	1.5	1.5	1.5	1.5
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	1.9
Power Accuracy $\pm\%$ at calibrated wavelength	3	3 ^(d)	3	3
Linearity with Power $\pm\%$	1.5	1.5	1.5	1.5
Amplifier power supply	NA	NA	+6V to +24V	UAU - Via Host USB UAE +6V to +24V
Energy Mode				
Maximum Energy	100J	2000J	100J	100J
Minimum Energy	30mJ	30mJ	30mJ	30mJ
Energy Accuracy $\pm\%$ at calibrated wavelength	5	5 ^(e)	5	5
Maximum Energy Density J/cm ²				
<100ns	0.3	0.1	0.3	0.3
0.5ms	5	5	5	5
2ms	10	130	10	10
10ms	30	400	30	30
>300ms	NA	See below ^(f, g)	NA	NA
Cooling	Conduction	Conduction	Conduction	Conduction
Connections	Ophir smart plug	Ophir smart plug	6 pin Molex ^(b)	UAU - Mini B USB connector UAE - Ethernet for communication M12 5 pin for power
Dimensions	60x60x38mm	60x60x38mm	60x60x38mm	60x60x38mm
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS	RoHS, China RoHS	RoHS, China RoHS
Part number	773434	7Z02775	Consult Ophir Representative	Consult Ophir Representative

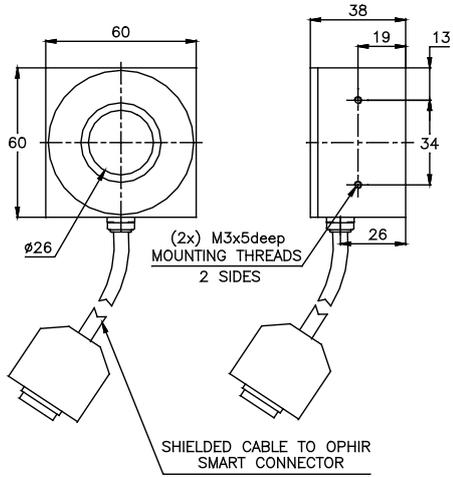
Note: (a) With analog "UAF" versions, sensor voltage output is accurate up to 2v below lowest level of supply voltage, taking into account supply voltage ripple
 Note: (b) 6 pin Molex connections: RS232 input, Ground, +Voltage, Analog signal out, high/low voltage or switch input when used, RS232 output
 Note: (c) Calibrated at customer selected wavelength
 Note: (d) Above 1.1 μm there is an additional calibration uncertainty of up to 2%
 Note: (e) From 20J to 2000J
 Note: (f) Long pulses (0.5 – 4s) can be used to measure power of high power lasers by measuring the energy of a short exposure. The StarBright, Juno, Juno+, Juno-RS and Centauri meters have a Pulsed Power mode where the user may specify the pulse width and get a reading directly in units of power for this short exposure energy measurement. See also page 108
 Note: (g) Recommended exposure times and 1/e² Gaussian beam diameters for very long pulses.

Lasers Power W	Recommended Exposure s	Number of shots before cooling down	Min 1/e ² beam dia. mm
100	4	20	9
500	1	20	9
1000	1	10	13
2000	1	5	17
4000	0.5	5	22

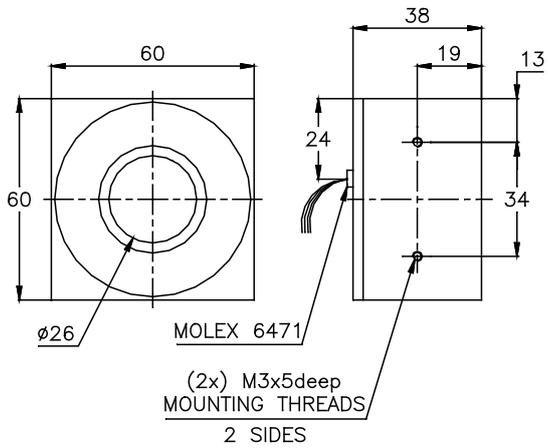
* For drawings please see page 154

* For UAE & UAU drawings please see pages 161-162

L30C-SH / L30C-LP2-26-SH



L30C-UAF



1.4.2.3 Standard Customized Solutions (OEM) Thermal Sensors

60mW to 100W

Features

- Conduction cooled
- Spectrally flat
- Standard UAF version can give analog voltage output or digital RS232 output and can measure power or single shot energy. Can also have multiple switchable ranges and/or multiple switchable wavelengths
- UAU and UAE versions are similar to the UAF version but UAU operates via the USB terminal of the PC and UAE via an Ethernet connection

100C-BB-18-SH / 100C-UAF / 100C-UAU / 100C-UAE



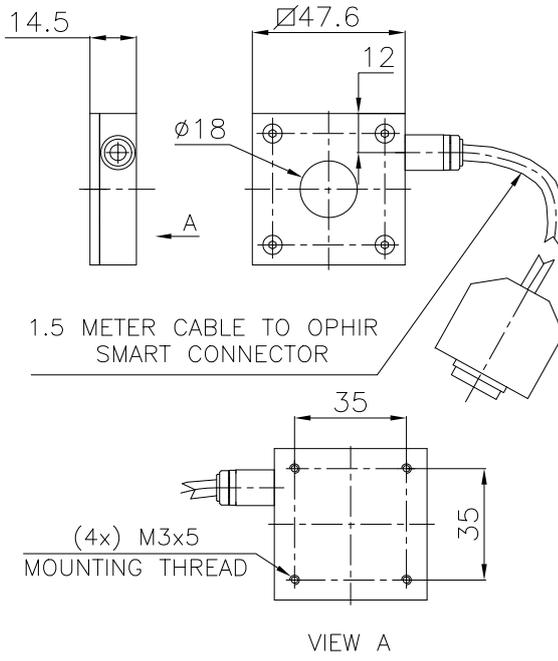
These specifications refer to standard OEM sensors, and are to be understood as generic, describing sensor families. Ophir will be happy to help you with a specific solution for your particular application.

Model	100C-BB-18-SH	100C-UAF / 100C-UAU / 100C-UAE
Type	Smart sensor	UAF – Analog or RS232 output UAU – USB compatible output UAE – Ethernet output
Features	Low profile, smart sensor	Low profile, various outputs
Absorber Type	Broadband	Broadband
Spectral Range μm	0.19 - 11	0.19 - 11 ^(c)
Absorption	~88%	~88%
Aperture mm	$\varnothing 18$	$\varnothing 18$
Power Mode		
Maximum power ^(a)	4W continuous, 20W for 1.8 min	4W continuous, 20W for 1.8 min
free standing	100W	100W
heat sinked	60mW	60mW
Minimum power	60mW	60mW
Power Noise Level	3mW	3mW
Maximum Average Power Density kW/cm ²	30 at 4W 14 at 100W	30 at 4W 14 at 100W
Response Time (0-95%), typ. (sec)	1.2s	1.2s
Calibration Uncertainty $\pm\%$	1.9	1.9
Power Accuracy $\pm\%$ at calibration wavelength	3 ^(d)	3 ^(d)
Linearity with Power $\pm\%$	1	1
Amplifier power supply	NA	UAF +6V to +24V UAU - Via Host USB UAE +6V to +24V via separate connector
Energy Mode		
Maximum Energy	NA	NA
Minimum Energy	NA	NA
Maximum Energy Density J/cm ²		
<100ns	0.3	0.3
0.5ms	5	5
2ms	10	10
10ms	30	30
Cooling	Conduction	Conduction
Connections	Ophir smart plug	UAF - 6 pin Molex ^(b) UAU - Mini B USB connector UAE - Ethernet for communications and 5 pin for power
Dimensions	48x48x14.5mm	48x48x14.5mm
Compliance	CE, UKCA, China RoHS	RoHS, China RoHS
Version	V1	
Part number	7Z07126	Consult Ophir Representative
Note: (a)	With analog "UAF" versions, sensor voltage output is accurate up to 2v below lowest level of supply voltage, taking into account supply voltage ripple	
Note: (b)	6 pin Molex connections: RS232 input, Ground, +Voltage, Analog signal out, high/low voltage or switch input when used, RS232 output	
Note: (c)	Calibrated at customer selected wavelength	
Note: (d)	$\pm 4\%$. For wavelengths <240nm	

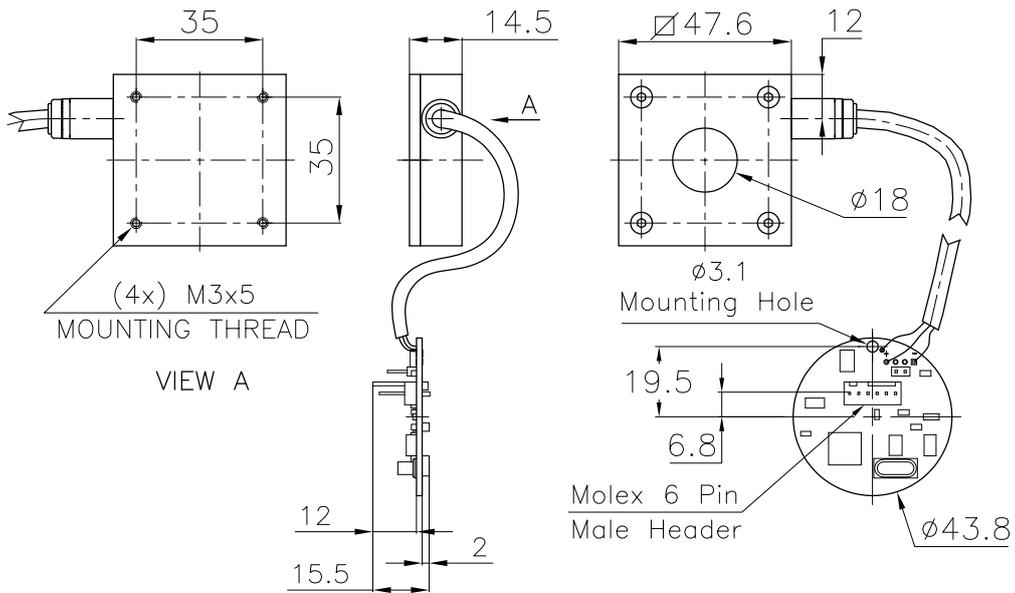
* For drawings please see page 156

* For UAE & UAU drawings please see pages 161-162

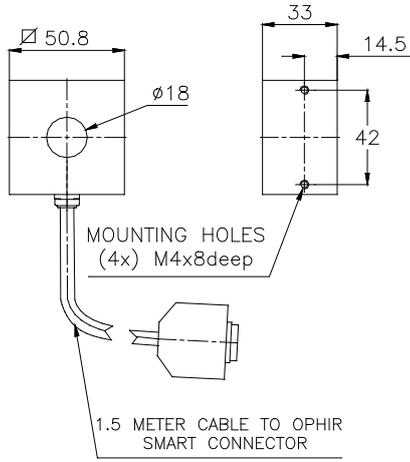
100C-BB-18-SH



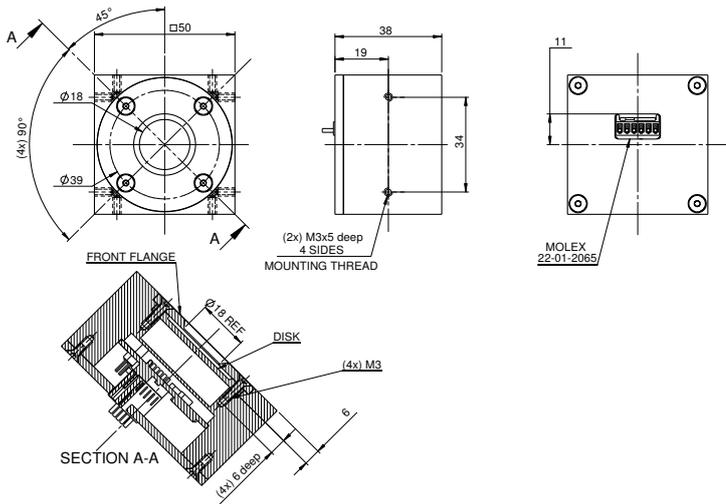
100C-UAF



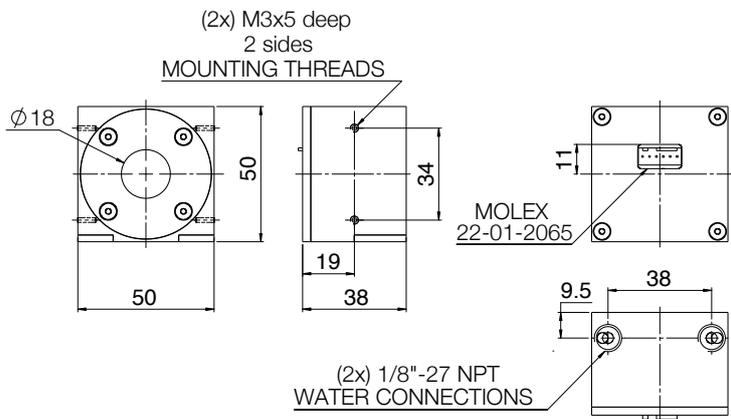
150C-SH



150C-UAF



150W-UAF



1.4.2.3 Standard Customized Solutions (OEM) Thermal Sensors

0.2W to 600W

Features

- Conduction and water cooled
- Spectrally flat
- UAF version can give analog voltage output or digital RS232 output and can measure power or energy. Can also have multiple switchable ranges and/or multiple switchable wavelengths
- UAU and UAE versions are similar to the UAF version but UAU operates via the USB terminal of the PC and UAE via an Ethernet connection

L150C-UAF / UAU / UAE



L250W-UAF / UAU / UAE
L300W-UAF / UAU / UAE



600W-UAF / UAU / UAE



These specifications refer to standard OEM sensors, and are to be understood as generic, describing sensor families. Ophir will be happy to help you with a specific solution for your particular application.

Model	L150C-UAF	L250W-UAF / L300W-UAF	600W-UAF	UAU / UAE versions
Type	RS232 or Analog output	RS232 or Analog output	RS232 or Analog output	Same as UAF but with: UAU – USB compatible output UAE – Ethernet output
Features	Large aperture, built-in amplifier	Large aperture, built-in amplifier, water cooled	High power, built-in amplifier, water cooled	
Absorber Type	Broadband	Broadband	LP2	
Spectral Range μm	0.19 - 20 ^(c)	0.19 - 20 ^(c)	0.35 - 2.2	
Absorption	~88%	~88%	>94% from 0.35 to 1.1 μm	
Aperture mm	\varnothing 50	\varnothing 50	\varnothing 26	
Power Mode				
Maximum power ^(a) free standing	20W for 3 minutes	250W / 300W water cooled	600W water cooled	
heat sinked	150W	60W	NA	
Minimum power	0.2W	0.3W / 0.5W	5W	
Power Noise Level	10mW	15mW / 25mW	200mW	
Maximum Average Power Density kW/cm ²	27 at 20W 12 at 150W	10 / 9 at max power	11 at max power	
Response Time (0-95%), typ. (sec)	2.5	2.5	2.5	
Calibration Uncertainty $\pm\%$	1.9	1.9	1.9	
Power Accuracy $\pm\%$ at calibration wavelength	3	3	3	
Linearity with Power $\pm\%$	1	2	2	
Amplifier power supply	+6V to +24V	+6V to +24V	+6V to +24V	UAU - Via Host USB UAE +6V to +24V
Energy Mode				
Maximum Energy	100J	200J / 300J	300J	
Minimum Energy	80mJ	120mJ / 200mJ	500mJ	
Energy Accuracy $\pm\%$ at calibrated wavelength	5	5	5	
Maximum Energy Density J/cm ²				
<100ns	0.3	0.3	0.1	
0.5ms	5	5	50	
2ms	10	10	130	
10ms	30	30	400	
Cooling	Conduction	Water	Water	
Minimum and Recommended water flow at full power ^(d)	NA	3 liter/min	3 liter/min 4.5 liter/min	
Connections	6 pin Molex ^(b)	5 pin Round connector	6 pin Molex ^(b)	UAU - Mini B USB connector UAE - Ethernet for communication M12 5 pin for power
Dimensions	80x80x45mm	80x80x58mm	65x65x49mm	
Compliance	RoHS, China RoHS	RoHS, China RoHS	RoHS, China RoHS	RoHS, China RoHS
Part number	Consult Ophir Representative	Consult Ophir Representative	Consult Ophir Representative	Consult Ophir Representative

Note: (a) With analog "UAF" versions, sensor voltage output is accurate up to 2v below lowest level of supply voltage, taking into account supply voltage ripple

Note: (b) 6 pin Molex connections: RS232 input, Ground, +Voltage, Analog signal out, high/low voltage or switch input when used, RS232 output

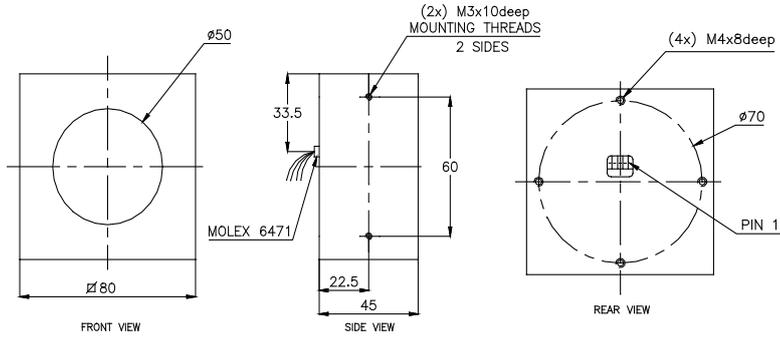
Note: (c) Calibrated at customer selected wavelength

Note: (d) Water temperature range 18-30°C. Water temperature rate of change <1°C/min. Pressure drop across sensor 0.03MPa. The recommended flow rate can be lowered proportionately at lower than full power but should not be below the minimum. When used at full power with substantially below the recommended flow rate, the damage threshold may be as much as 20% lower and the response time may not be optimum

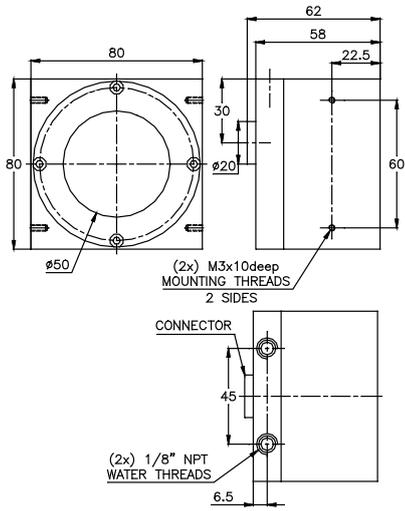
* For drawings please see page 160

* For UAE & UAU drawings please see pages 161-162

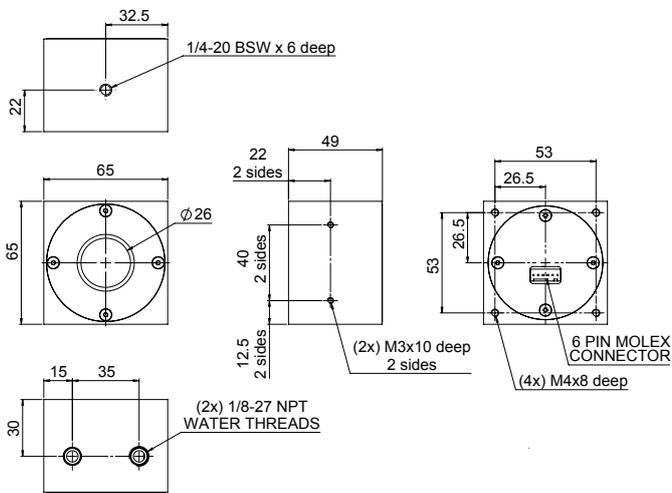
L150C-UAF



L250W-UAF / L300W-UAF

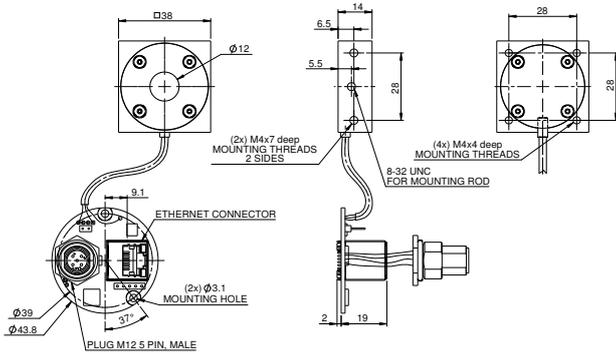


600W-UAF

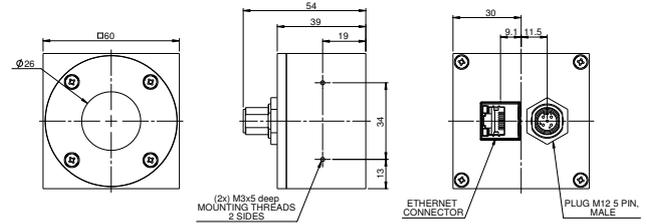


UAE Drawings

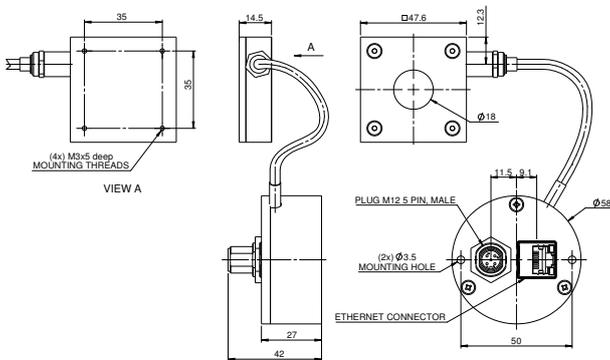
20C-UAE



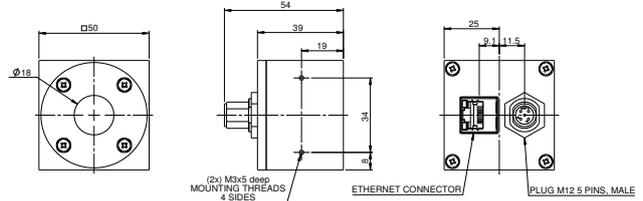
L30C-UAE



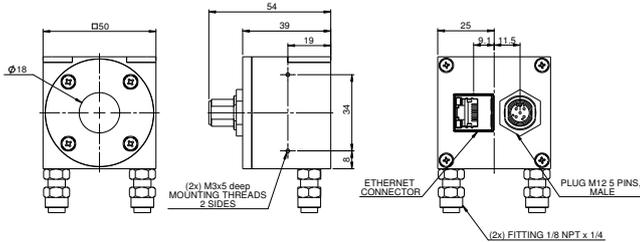
100C-UAE



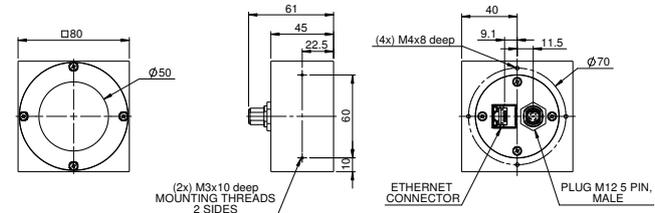
150C-UAE



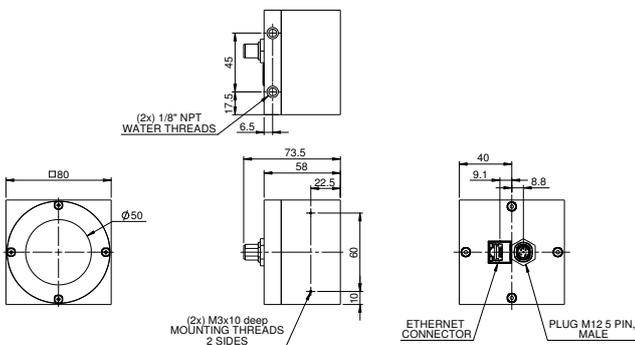
150W-UAE



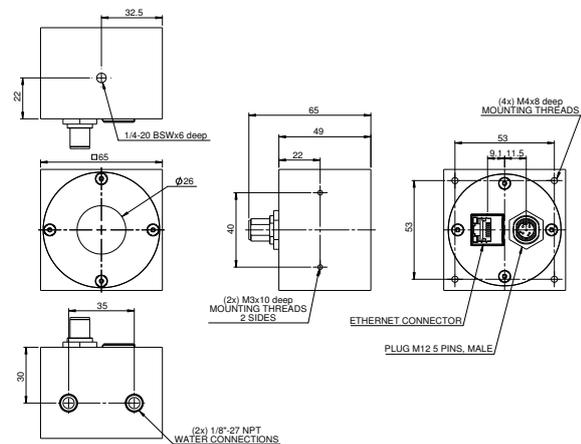
L150C-UAE



L250W-UAE / L300W-UAE

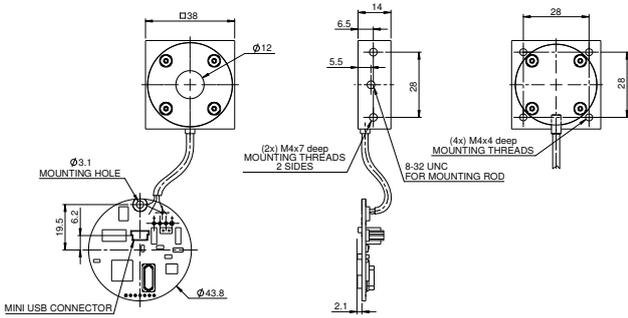


600W-UAE

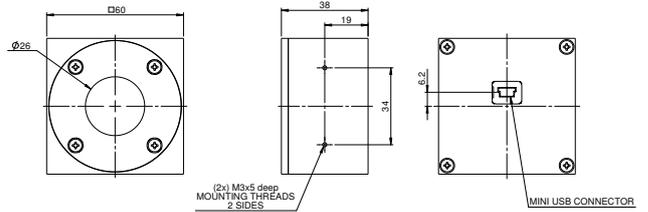


UAU Drawings

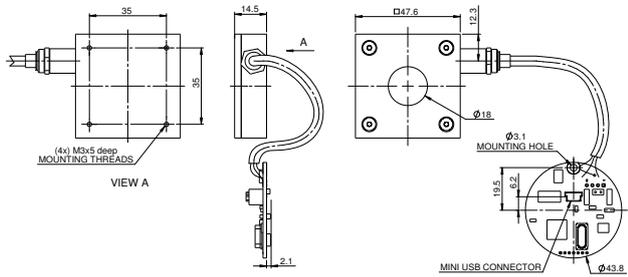
20C-UAU



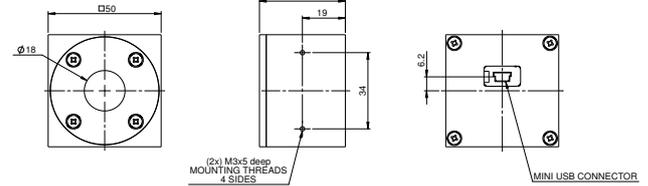
L30C-UAU



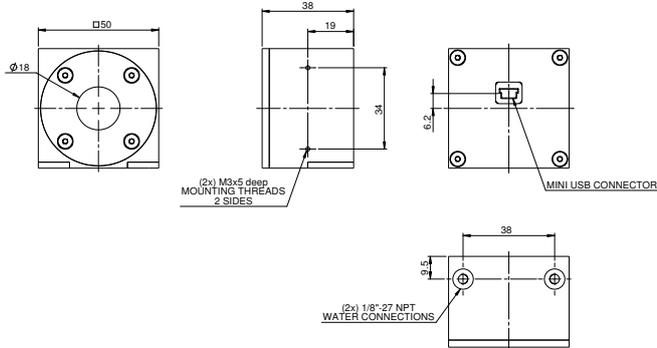
100C-UAU



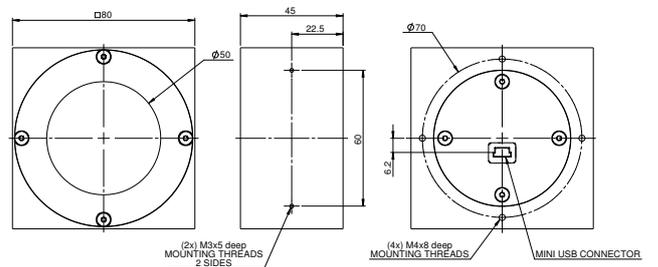
150C-UAU



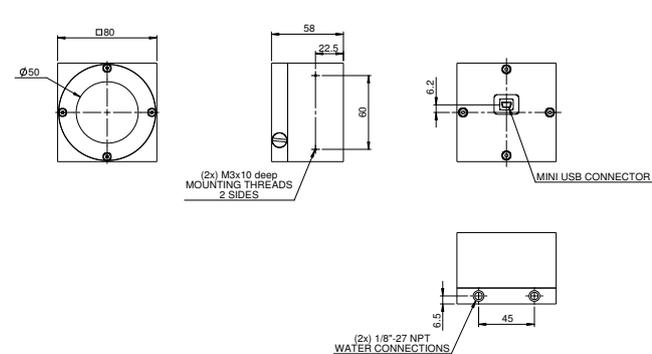
150W-UAU



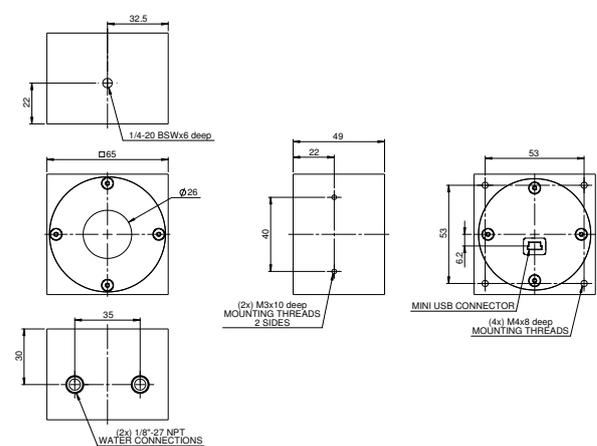
L150C-UAU



L250W-UAU / L300W-UAU



600W-UAU



1.4.2.4 Examples of Custom OEM Thermal and Photodiode Sensor Solutions

In addition to the standard OEM products described above, Ophir has accumulated over 25 years of experience in developing products which are tailored to precise physical configurations provided by the OEM customer. These

products include custom discs (with or without electronics), specially configured thermal or photodiode-based power sensors, and much more. A number of these special OEM products are shown below.

Flat Profile Thermal Sensor

This sensor with 50mm aperture is used as an exposure detector for photolithography and is only 10mm thick.



Super Compact Thermal Sensor

Thermal Customized Solutions (OEM) sensor designed to be cemented into user system. Dimensions are under 10mm x 20mm footprint and 4mm height. The sensor can be connected to an Ophir smart meter to measure power or energy or can be used directly with voltage output.



Compact, hand held thermal Smart Sensor

This thermal sensor is only 20mm thick to enable probing in hard to reach locations. It can measure up to 25W. It is designed specifically to be hand held, and works with any Ophir Smart Meter.



High Power OEM Sensors

Ophir offers OEM sensors for higher powers than listed above up to 5000W and above. The sensors have a built in electronics module on the rear of the sensor and can be configured to give RS232, USB or Ethernet output.



Special Requirements and Mechanical Designs

Ophir can design made to order mechanical designs to fit the customer's requirements. In addition the design can include clean room requirements, vacuum requirements and special connectors.



OEM BeamTrack or Quad sensor with RS232 output

The BeamTrack sensor showing power, X position, Y position as well as size or Quad showing power, X position and Y position is now available as an OEM version with RS232 of all parameters.



Industrial Type Designs – Ethernet IP/Profinet

Ophir offers industrial designs with industrial type connectors as well as industrial interface protocols such as Ethernet IP/Profinet

Ordering Information:

The products shown above are examples of OEM solutions products developed for specific customer applications. Please consult with your Ophir representative who will be happy to help you with any requirements you may have.

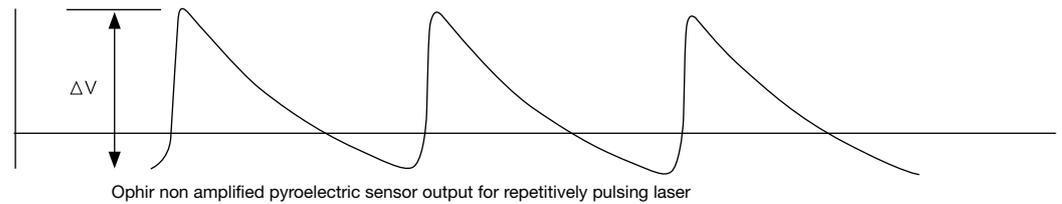
1.4.3 Pyroelectric Customized Solutions (OEM) Sensors

1.4.3.1 Standard Pyroelectric OEM Sensors - Introduction

Ophir manufactures three main types of pyroelectric OEM sensors:

- Compact pyro sensors with no electronics with output connected to the host electronics. Since the energy of pyro sensors is proportional to the peak to valley voltage output and not the maximum voltage output, the user has to take this into account in designing the electronic interface (see below)
- Pyroelectric sensors identical with standard PE-C sensors but with RS232 or analog output instead of connection to smart sensor
- Compact smart PE-C sensors with the electronics in a separate electronics module

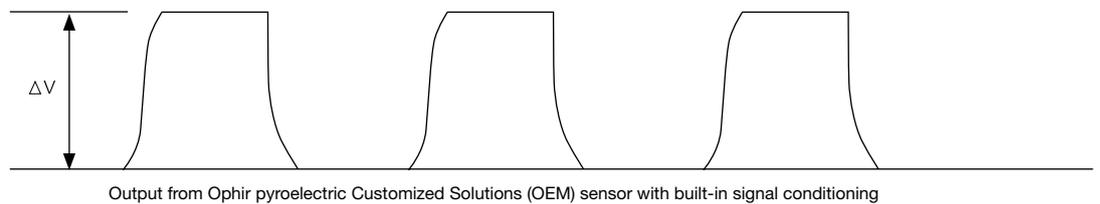
Typical output from a non-amplified pyroelectric sensor appears as follows:



In the example shown above using a non amplified sensor, note that energy is proportional to ΔV and not to the voltage above the zero level. Note also that the peak rapidly decays and therefore the output depends on pulse rate and duration. It follows therefore that in order to measure

pyroelectric pulses, the voltage level must be known before the pulse and must also compensate for pulse rate (or work at a low enough pulse rate for the correction to be rendered negligible).

When using a sensor with built-in electronics, typical output appears as follows:



Note that the output voltage is now proportional to the energy and since the voltage is held for a fixed time, the output is much less dependent on pulse rate or duration. In the above example, the user does not need to perform

any signal conditioning but simply has to read the voltage level or get the output in digital form to determine the energy. The output is also available in digital form via RS232.



1.4.3.2 Standard Pyroelectric Customized Solutions (OEM) Sensors

<0.1µJ to 40J

Features

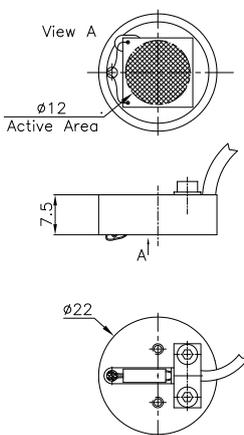
- Performance identical to standard PE-C sensors (see section 1.2)
- Analog or RS232 output
- Wide dynamic range, switchable ranges
- Selectable wavelengths
- Compact non amplified versions available



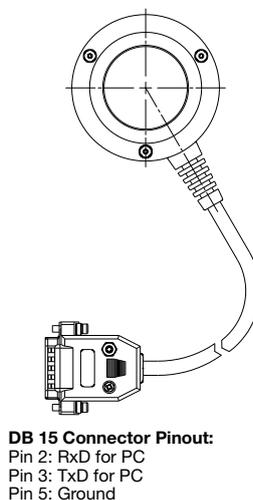
Pyroelectric Customized Solutions OEM products – Examples only – many variations are possible

Category	Non amplified sensor. Can be very compact	Standard PE-C with built in digital or analog output. No need for meter or PC interface	PE-C smart sensor with remote electronics module allowing very compact sensor head
Model	PE10-C-RE	PE XX-C-RS232	PE-C-RE
Features	Very compact	Digital output with no need for meter or PC interface	Possibility of smart sensor with very compact sensing head
Absorber Type	Metallic with AR coating	Choose from std PE-C	Metallic or BF
Aperture mm	Ø12	Choose from std PE-C	Usually 10mm
Spectral Range µm ^(a)	0.19 – 10.6µm	Same as std PE-C	0.19 – 10.6µm
Calibration Accuracy ±% at calibrated wavelength	Usually customer calibrated	3	3
Max Pulse Width	Configurable ^(b)	Same as std PE-C	Same as similar std PE-C
Max Repetition Rate	Configurable ^(b)	Same as std PE-C	Same as similar std PE-C
Sensitivity	Typical 40V/J	Same as std PE-C	Same as similar std PE-C
Noise Equivalent Energy	~100nJ	Same as std PE-C	Same as similar std PE-C
Max energy density for 10ns pulses	100mJ/cm ² typical	Same as std PE-C	Same as similar std PE-C
Max Average Power Density	3W/cm ²	3W/cm ²	3W/cm ²
Power Supply Requirements	NA	7 – 12VDC (in special cases up to 24V)	Power supplied by smart meter or PC interface
Cooling	Conduction	Air or Conduction	Air or Conduction
Output	Flying leads typical	RS232 or analog	DB15 smart connector
Dimensions	Ø22 x 7.5mm	Same as std PE-C	Sensor head can be very small, see example below. Remote electronics module dimensions
Compliance	RoHS, China RoHS	RoHS, China RoHS	RoHS, China RoHS
Part Number	Consult Ophir Representative	Consult Ophir Representative	Consult Ophir Representative
Note: (a)	Unit can be calibrated for one or more wavelengths in this range		
Note: (b)	By choosing circuit capacitance and resistance, maximum pulse rate and width can be optimized. This is usually limited by the condition (max pulse width)*(max pulse rate) < 0.1		

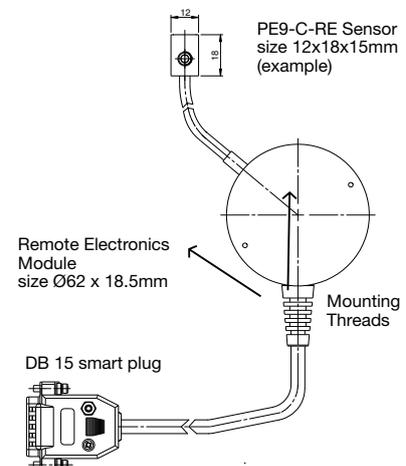
PE10-C-RE (example)



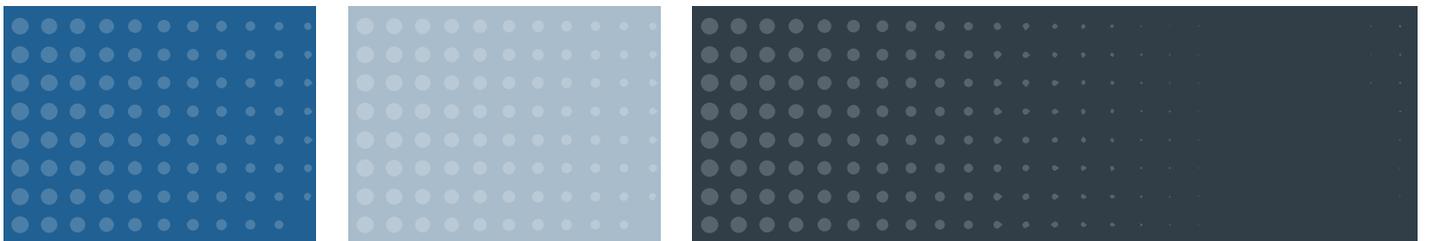
PE XX-C-RS232 (example)



Miniature PE9-C-RE (example)



2025 POWER METERS



The screenshot displays the OPHIR STARLAB software interface with the following data:

Channel D	Statistics
1.551uJ	Min: 1.057uJ
	Max: 1.877uJ
	Average: 1.449uJ
	Std. Dev: 82.09nJ
Frequency: 2203.8Hz	Overrange: 0
	Missing Pulses: 0
	Total Pulses: 735100

Additional software details include: Measuring: Power, Wavelength: 1064, Range: 3.00uW, Filter: DUT. A graph shows power fluctuations over time (00:04:40 to 00:05:10).

Physical devices shown include:

- Centauri**: A blue handheld power meter displaying 175.7 uJ.
- StarBright**: A red and white handheld power meter displaying 120.4 nW.
- A small black handheld device with the Ophir logo.

2.0 Power Meters & Interfaces

Power Meter Finder

The table below lists the specs and features of Ophir Power Meters and PC Interfaces



	Centauri Single & Dual Channel	StarBright	Vega	Nova II	StarLite	Nova
Digital Display	Yes	Yes	Yes	Yes	Yes	Yes
Display Color	Color	Color	Color	Monochrome	Monochrome	Monochrome
Analog Display	Yes	Yes	Yes	Yes	Yes	No
Rechargeable Battery	Yes	Yes	Yes	Yes	Yes	Yes
Detector Support (see compatibility table below)						
Thermal Sensors	Yes	Yes	Yes	Yes	Yes	Yes
Photodiode Sensors	Yes	Yes	Yes	Yes	Yes	Yes
Pyroelectric Sensors	Yes	Yes	Yes	Yes	Yes	Yes
BeamTrack Sensors	Yes	Yes	Yes	Yes	Yes	No
Measurement Options						
Average Power	Yes	Yes	Yes	Yes	Yes	Yes
Energy per Pulse (Pyro. Sensors)	Yes	Yes	Yes	Yes	Yes	Yes
Single Shot Energy (Thermal Sensors)	Yes	Yes	Yes	Yes	Yes	Yes
Statistics	Yes	Yes	Yes	Yes	No	Yes
Analog Out	1V,2V,5V,10V	1V,2V,5V,10V	1V,2V,5V,10V	1V,2V,5V,10V	1V	1V
Trigger input & output	Yes	No	No	No	No	No
Real-Time Logging						
RS232	30Hz	30Hz	30Hz	30Hz	N/A	10Hz
USB	25,000Hz	5000Hz	2000Hz	2000Hz	20Hz*	N/A
Bluetooth	N/A	N/A	N/A	N/A	N/A	N/A
Ethernet	Yes	N/A	N/A	N/A	N/A	N/A
On-Board Data Storage	2GB	>10MB**	250kB	50kB	No	1kB
Automation Interface	Yes	Yes	Yes	Yes	Yes*	No
LabVIEW VI's	Yes	Yes	Yes	Yes	Yes*	Yes
Part number	7Z01700/ 7Z01701	7Z01580	7Z01560	7Z01550	7Z01565	7Z01500
Page in the catalog	173	175	177	179	181	183

* StarLite with USB enabled prestored (P/N 7Z01569) or with activation code (P/N 7Z11049) see page 182

** Depends on size of USB Flash Drive

Compatibility Table

Meter / Interface	Centauri	StarBright	Vega/ Nova II	StarLite	Nova	Juno	Juno+	Juno-RS	EA-1	Pulsar	Quasar	Legacy LaserStar
Sensor												
Supports full calibration curve for sensors so calibrated *	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no
BeamTrack sensors	yes	yes	yes	yes	Power/Energy only	yes	yes	yes	yes	Power/Energy only	Power/Energy only	Power/Energy only
BC20 sensor	no	yes	yes	no	yes	yes	yes	no	no	no	no	yes
PD300-CIE sensor	yes	yes	yes	no	yes	yes	yes	yes	no	no	no	yes
PD300RM sensors	yes	yes	no	yes	no	no	yes	yes	no	no	no	no
PE-C Pyroelectric sensors	yes	yes	yes	yes	Needs adaptor (P/N 7Z08272) Limited functions. See sensor page	yes	yes	yes	yes	Limited functions. See sensor page	Limited functions. See sensor page	Limited functions. See sensor page
Legacy												
LP1 type Thermal sensors	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Previous generation Pyroelectric sensors (non PE-C)	no	no	yes	no	yes	yes	no	no	no	yes	yes	yes

* Some sensors are calibrated with a full spectral curve and the user selects any discreet, specific wavelength within the range. For other sensors, the specified spectral range is divided into regions, and the user is prompted to select the region (such as "<800nm"). For those sensors having the full curve, the table above shows which meters support the curve and prompt the user to select specific discreet wavelengths. When using meters that do NOT support this function, the user will only be able to select a number of specific wavelengths from within the range.



Juno	Juno+	Juno-RS	EA-1	Pulsar-1/2/4	Wireless Interface Quasar
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A
Powered from USB	Powered from USB	12V	12V or PoE	12V	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No	No
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
No	1V, 2V, 5V, 10V	1V, 2V, 5V, 10V	No	No	No
No	No	No	No	Yes	No
N/A	N/A	500Hz	N/A	N/A	N/A
10,000Hz	10,000Hz	N/A	N/A	25,000Hz	N/A
N/A	N/A	N/A	N/A	N/A	500Hz
N/A	N/A	N/A	25,000Hz	N/A	N/A
No	No	N/A	N/A	No	No
Yes	Yes	Yes	Yes	Yes	No
Yes	Yes	No	No	Yes	No
7Z01250	7Z01252	7Z01254	7Z01240	7Z01203 / 7Z01202 / 7Z01201	7Z01300
187	188	189	190	191	192

Ophir power meters are true plug-and-play instruments. With all sensor information and calibration stored in the sensor plug, just plug in any one of over 150 Ophir sensors and the instrument is calibrated and configured to measure laser power and energy with that sensor.

Comparison of Hand Held Meters

Meter	Centauri	StarBright	Vega	Nova II	StarLite	Nova
Supported Sensors						
Standard Thermopile, Photodiode, PyroC sensors	X	X	X	X	X	"X (with adaptor)"
BeamTrack	X	X	X	X	X	
BC20		X	X	X		X
PD300-CIE	X	X	X	X		X
PD300RM	X	X			X	
Measurement Capabilities						
Parameter Configuration	X	X	X	X	X	X
Power & Energy	X	X	X	X	X	X
Exposure with Pyro	X	X	X	X		X
Position and Size with BeamTrack Sensors	X	X	X	X	X	
Beam Stability with BeamTrack Sensors	X	X	X	X		
Power From Pulse	X	X				
Irradiance		X			X	
Dosage		X			X	
Exposure with PD	X	X				
FAST Power	X					
POWER_SYNC (LowFreqPulse)	X	X				
Density	X	X	X	X		X
Scale Factor	X	X	X	X		X
Normalize	X	X	X	X		
Fixed Offset	X	X				
Mixing Functions Together	X	X				
Showing Function Results in Graphical Display	X	X	X	X	X	
PC Communication						
StarLab Support	X	X	X	X	X	
RS232	X	X	X	X		X
USB Communication	X	X	X	X	X ^(a)	
Ethernet	X					
LabVIEW Library	X	X	X	X	X	X
Max Real Time Delivery (points/s)	10,000 X 2 (PD) 25,000 X 2 (Pyro)	5,000	2,000	2,000	20	15
Graphical Displays Available at All Times						
Bargraph	X	X	X	X	X	X
Simulated Analog Needle	X	X	X	X	X	
Pass/Fail	X	X	X	X		
Line Graph for Both Power and Energy	X	X				
Pulse Chart for Both Power and Energy	X	X				
Real Time Statistics (not just when logging)	X	X				
Screen Specs						
Screen Size	7"	3.5"	3.5"	4"	3.5"	2"
Color Screen	X	X	X		X	
Other Features						
Analog Output (in Volts)	1, 2, 5, 10	1, 2, 5, 10	1, 2, 5, 10	1, 2, 5, 10	1	1
Raw Analog Output	X					
External Trigger	X					
TTL OUT	X					
Calibration Reminder	X	X	X	X		
Time Stamp	X	X				
Japanese	X	X	X	X	X	
Russian and Chinese	X	X			X	
French, Spanish, Italian, German, Korean	X					
Built in Help		X	X	X		

Note: (a) StarLite with USB enabled prestored (P/N 7Z01569) or with activation code (P/N 7Z11049) see page 182

Measuring Modes Available: Sensor Type / Device

Device	Sensor Type		
	Photodiode	Thermopile / BeamTrack*	Pyroelectric
Centauri	Power Exposure Fast Power Low Freq Power	Power / Track* Energy Pulsed Power	Power Energy Exposure
StarBright	Power Exposure Low Freq Power	Power / Track* Energy Pulsed Power	Power Energy Exposure
Juno+	Power Low Freq Power	Power / Track* Energy Pulsed Power	Power Energy Exposure
Juno-RS	Power Low Freq Power	Power / Track* Energy Pulsed Power	Power Energy Exposure
Juno	Power Low Freq Power	Power / Track* Energy Pulsed Power	Power Energy Exposure (PyroC only)
EA-1	Power Low Freq Power	Power / Track* Energy	Power Energy
Nova II	Power	Power / Track* Energy	Power Energy Exposure
Vega	Power	Power / Track* Energy	Power Energy Exposure
StarLite	Power	Power / Track* Energy	Power Energy
Nova	Power	Power Energy	Power Energy
Pulsar	Power	Power Energy	Power Energy
Quasar	Power	Power Energy	Power Energy

* BeamTrack is the trademark name of the sensors that measure power, position and size. They include the Track measuring mode.

Terminology:

Energy - Measurements in Joules.

Exposure - Used to measure the sum of the energy (for Pyroelectric and Photodiode sensors).

Fast Power - Power measurement mode using fast sampling rate; used to measure laser modulation and flicker of LED light sources (for Photodiode sensors).

Low Freq Power - Power measurement mode optimized for VCSELs and similar pulsed sources, where low pulse rate and high pulse peak power would cause problems if measuring in regular power mode.

Power - Measurements in Watts.

Pulsed Power - Can display instantaneous power of a laser pulse. Power is calculated from energy when the length of the pulse is known (for Thermopile sensors).

Track - Used to measure beam position and beam size while measuring power (for Thermopile sensors).

Power Meters and PC Interfaces

Ophir power meters and PC interfaces work on the smart plug principle. This means that almost any Ophir power meter or PC interface can work – plug and play – with almost any of the wide range of Ophir sensors. Ophir power meters are also the most sensitive, lowest noise, most precisely calibrated units on the market thus giving the utmost

performance from our smart sensors. As for ease of use, only Ophir power meters have smart keys to give the easiest and most convenient user interface. The units also come with a versatile range of software to use seamlessly either with the Ophir software or the user's own.



Photodiode Sensors
Powers pW to Watts



Thermal Sensors
Powers mW to kW and single shot energy



Pyroelectric Sensors
Energies pJ to Joules
Rep rates to 25kHz

Power Meters
with USB/Ethernet/RS232



StarLite
basic



StarBright
added features



Vega
color



Nova
rugged



Centauri
high end

Computer Interfaces
with USB/Bluetooth/Ethernet/RS232



Juno
compact



Juno+
Incl. An Out



Pulsar
1, 2, 4 channels



Juno-RS
RS232



EA-1
Ethernet



Quasar
wireless

Software Solutions
StarLab, LabVIEW, StarCom, COM Object & StarViewer



LabVIEW



StarLab Software



StarViewer Android or iOS Applications

2.1 Power Meters

2.1.1 Centauri

Feature Rich Touchscreen Laser Power/Energy Meter

- Compatible with all standard Ophir Thermal, BeamTrack, Pyroelectric and Photodiode sensors
- Large 7" Full Color Touch Display
- Multilingual interface – English, French, Spanish, Italian, German, Russian, Japanese, Chinese and Korean
- Single and Dual Channel models available
- Various Displays: Bargraph, Analog Needle, Line Plot, Pulse Chart, Pass/Fail, Position, Stability, and Real Time Statistics
- Dual Channel Instrument supports Split and Merged Graphical Displays
- Sophisticated power and energy logging, including logging every pulse at up to 25000Hz with Pyro sensors
- Math functions: Density, Scale Factor, Normalize against base line, etc. Functions can be mixed together, displayed graphically, and can also be logged
- Math Channel allows comparison of two measurements
- Field upgrading of embedded software via USB Flash Drive
- 2GB internal storage and USB Flash Drive for ample data storage^(a)
- USB, Ethernet and RS232 interfaces with StarLab PC application and User Commands document
- LabVIEW driver and COM Object Interface



- Pulsed Power measurements with Thermopile sensors
- Low Frequency Power with Photodiode sensors - power measurement based on pulse cycle (for VCSEL)
- Fast Power (10kHz) logging with Photodiode sensors
- Exposure measurement (Energy Summing) with Photodiode and Pyroelectric sensors
- Scalable Analog Output, TTL Output and External Trigger Input
- Loudspeaker for Audio Warnings

Centauri is the most feature rich desktop laser power/energy meter on the market. Just plug in one of the many Ophir sensors and you have a whole measurement laboratory at your fingertips. The bright color display gives unparalleled legibility and ease of interpreting information. Centauri has many on board features such as laser tuning, data logging, graphing, normalize, power or energy density, attenuation scaling, max and min limits. Centauri can also display the power or energy as a high resolution simulated analog needle display.

Centauri can be either battery operated or from an AC source with the charger plugged in at all times. Its bright display and user-selectable color format enables ease of use in dark room conditions or when wearing protective glasses.

The built-in USB, Ethernet and RS232 interfaces and StarLab PC software allow display and processing of data either in real time or from previously stored data. Results are displayed graphically on a PC. To support PC interfacing, LabVIEW drivers, a COM Object Interface and demo source code are provided.



The Centauri's dual channel capabilities enable the user to simply plug in any of Ophir's thermal, pyroelectric or photodiode sensors and measure the two channels independently, or a comparison between the two channels.

Centauri Screen Layout

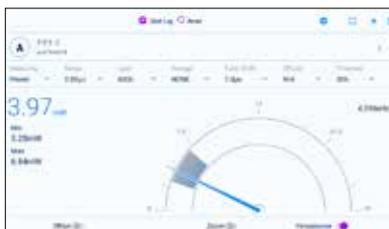
The Centauri's 7" touch-screen provides ease-of-use at the tap of a finger. The display is carefully designed to provide easy reading of the laser measurement, quick access to configuration parameters as well as the ability to set up for more advanced work.



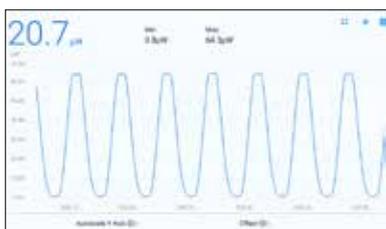
- Info Panel. Includes channel (A or B), sensor name, and serial number. Tap the menu icon at the right to easily access more functionality.
- Sensor Settings. Displayed on screen and easily updated. Tap on a parameter to open a window that displays all of the options. Tap on the desired setting to reconfigure and get back to work. Settings are stored in the sensor's memory as the startup settings for the next measurement session.
- Measurements. Numeric and Graphical display of reading. Tap Offset to reduce ambient environmental effects on the readings. Tap Zoom to focus the bargraph around the present measurement.

(a) USB Flash Drives of up to 32GB and FAT32 format only (Not exFAT nor NTFS formats).

Selected Screens



Analog needle display of power Persistence and min/max tracking.



Line graph display of power.



Pulse chart display of energy.



Display statistics of the present measurement session.



Pass/Fail screen. Excellent for QA purposes.



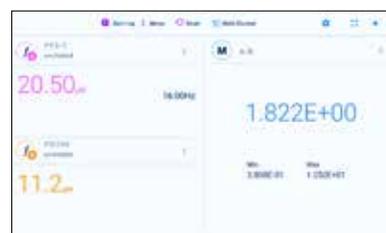
Power, Position, and Size measured with a BeamTrack sensor.



Two independent channels of measurement.



Two channels merging into one graph.



Two channels with a math comparison channel.

Specifications

Power Meter	Brilliant color touch-screen TFT 1064 x 600 pixel graphics LCD. Large 16mm digits.
Features	Many screen features including power with bar graph, energy, average, exposure, frequency, graphs, scaling, special units, and more.
I/O's	USB, Ethernet, RS232 and user selectable 1,2,5 and 10 Volt full scale analog output; TTL Output; External Trigger Input; Loudspeaker for Audio Warnings
Screen Refresh	15 times/sec
Case	Molded high impact plastic with optimized angle kickstand. Rubberized sides for easy grip and protection against damage.
Size	Compact 47mm L x 200mm W x 130mm
Weight	1kg
Battery	Rechargeable Li-ion batteries with typically 6 hours between charges. The charger also functions as an AC adapter.
Multisensor Option	Two sensors can be connected and measure independently, and with a mathematical comparison.
Data Handling	Data can be viewed on board or transferred to PC: On Board: Data stored to USB Flash Drive (Thumb Drive) at rates up to 25,000 points/s.
Sensor Features	Works with Thermopile, BeamTrack, Pyroelectric (PE-C series) and Photodiode sensors ^(a) .
Program Features	Preferred start up configuration can be set by user.
Compliance	CE, UKCA, China RoHS

Note: (a) Not including BC20 sensor

Ordering Information

Item	Description	Ophir P/N
Centauri Single Channel	Centauri high end power meter for Thermal, BeamTrack, Pyroelectric and Photodiode sensors	7Z01700
Centauri Dual Channel	Dual Channel high end power meter for Thermal, BeamTrack, Pyroelectric and Photodiode sensors	7Z01701
Centauri Dual Channel Activation Code	Software activation code to field upgrade a Single Channel Centauri to Dual Channel capabilities	7Z11056
Centauri USB Cable	USB-A to MICRO-B cable (1 unit supplied with Centauri)	7E01279
Centauri RS232 Cable	D9 to 3.5mm plug cable (1 unit supplied with Centauri)	7E01213
N Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with Centauri)	7E05029
General Purpose I/O Connector	Used as analog output, external trigger output and TTL output plug (3 units supplied with Centauri)	7E02008

2.1.2 StarBright

Feature Rich Laser Power/Energy Meter

- Compatible only with all standard Ophir thermal, BeamTrack, pyroelectric (PE-C series only) and photodiode sensors
- Brilliant color large size TFT 320x240 display
- Choose between Digital with Bargraph, Analog Needle, Line Plot (for laser tuning), Pulse Chart, Pass/Fail, Position, Stability, Real Time Statistics displays
- Sophisticated power and energy logging, including logging every point at up to 5000Hz with Pyro sensors
- Math functions for advanced processing such as Density, Scale Factor, Normalize against base line, etc.
- Can mix functions together and display the results graphically. Function results can also be logged
- USB Flash Drive for nearly unlimited data storage
- USB and RS232 interfaces with StarLab PC application and User Commands (see User Commands document in website)
- LabVIEW driver and COM Object Interface
- Pulsed Power measurements with Thermopile detectors
- Low Frequency Power - power measurement from pulse cycle energy (for VCSEL)
- Exposure measurement (Energy Summing) with Photodiode and Pyroelectric sensors
- Select between English, Japanese, Russian, and Chinese interfaces
- Soft keys and menu driven functions with context sensitive help
- Compact handheld design with rubberized bumpers and optimized kickstand
- Backlighting and rechargeable battery
- Scalable Analog Output



StarBright is the most feature rich handheld laser power/energy meter on the market. Just plug in one of the many Ophir sensors and you have a whole measurement laboratory at your fingertips. The bright color display gives unparalleled legibility and ease of interpreting information. StarBright has many on board features such as laser tuning, data logging, graphing, normalize, power or energy density, attenuation scaling, max and min limits. StarBright can also display the power or energy as a high resolution simulated analog needle display.

StarBright can be either battery operated or from an AC source with the charger plugged in at all times. Its bright display and user-selectable color format enables ease of use in dark room conditions or when wearing protective glasses.

The built-in USB and RS232 interfaces and StarLab PC software allow display and processing of data either in real time or from previously stored data.

Results are displayed graphically on a PC. To support PC interfacing, LabVIEW drivers, a COM Object Interface and demo source code are provided.



StarBright Screen Layout

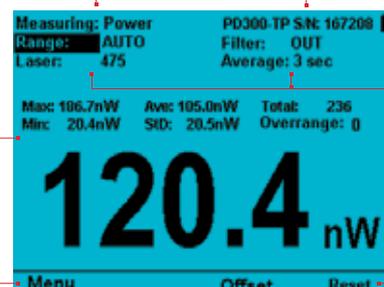
StarBright screen ergonomics raise the user experience to new levels. The display is carefully designed to provide easy reading of the laser measurement, quick access to configuration parameters as well as the ability to set up for more advanced work.

Measurement display area. User can select the display type. In this example, the user has chosen large numeric readout with real time statistics.

Press the Menu key to access additional StarBright functions including logging, pass/fail inspection and math processing.

Select measurement mode (power, energy, etc.)

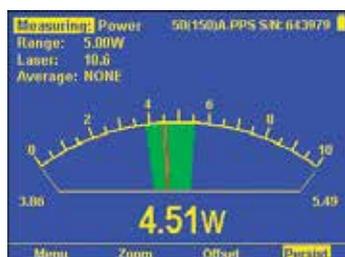
Sensor name and serial number



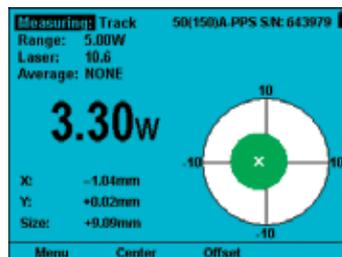
Configuration parameters for laser measurement. These settings are sensor specific and saved in the sensor's memory.

Softkeys for additional display functionality. In this example, press Offset to remove background noise from the measurement. Press Reset to clear the statistics and start over.

Selected Screens



Analog needle display of power Persistence and min/max tracking.



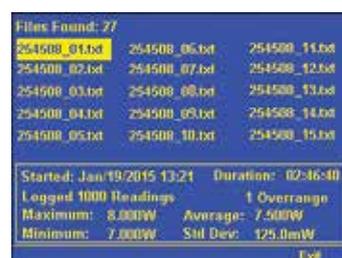
Power, Position, and Size measured with a BeamTrack sensor.



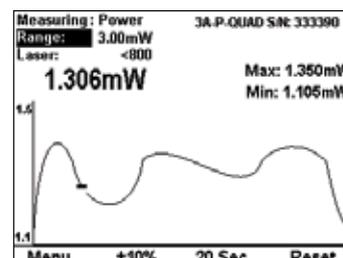
Bargraph display of energy. Colors set for work with protective glasses.



Power density measured after rescaling the power measurement.



Data logs filed to USB Flash Drive. Can be viewed in StarLab or Excel.



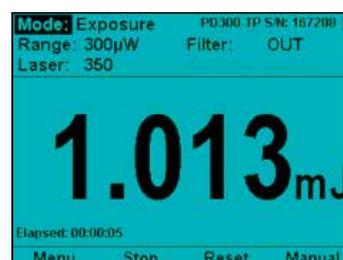
Line graph display of power. Wraps back to start for continuous display.



Pulse chart display of power.



Power measurement of laser pulse. For use with high-power pulsed lasers.



Exposure measurement (energy summing) with photodiode sensor.

Specifications

Power Meter	Brilliant color TFT 320 x 240 pixel graphics LCD. Large 16mm digits.
Features	Many screen features including power with multicolor bar graph, energy, average, exposure, frequency, graphs, scaling, special units, and more.
Outputs	USB, RS232 and user selectable 1, 2, 5 and 10 Volt full scale analog output.
Screen Refresh	15 times/sec
Case	Molded high impact plastic with optimized angle kickstand. Rubberized sides for easy grip and protection against damage.
Size	Folds to a compact 212mm L x 114mm W x 40mm H
Weight	0.470 kg
Battery	Rechargeable Li-ion batteries with typically 8 hours between charges. The charger can be ordered from your local distributor. The charger also functions as an AC adapter.
Data Handling	Data can be viewed on board or transmitted to PC: On Board: Data stored to USB Drive (Thumb Drive) at rates up to 5000 points/s.
Sensor Features	Works with Thermopile, BeamTrack, Pyroelectric (PE-C series) and Photodiode sensors. Works with our PD300RM sensors.
Program Features	Preferred start up configuration can be set by user. User can recalibrate power, energy, response time and zero offset.
Compliance	CE, UKCA, China RoHS

Ordering Information

Item	Description	Ophir P/N
StarBright	StarBright universal power meter for Thermal, BeamTrack, Pyroelectric and Photodiode sensors	7Z01580
Carrying Case	Carrying case 38x30x11 cm. For power meter and up to 3 sensors	1J02079
StarBright USB Cable	USB-A to MICRO-B cable (1 unit supplied with StarBright)	7E01279
StarBright RS232 Cable	D9 to 3.5mm plug cable (1 unit supplied with StarBright)	7E01213
StarBright Battery Pack	Replacement battery pack for StarBright	7E14008
P Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A P-1.35x3.5 (1unit supplied with StarBright)	7E05047
Standard Analog Output Connector	2.5mm mono jack (1unit supplied with StarBright)	7E02008

2.1.3 Vega

Color Screen Laser Power/Energy Meter

- Compatible with all standard Ophir thermal, BeamTrack, pyroelectric and photodiode sensors
- Brilliant color large size TFT 320x240 display
- Compact handheld design with rubberized bumpers and optimized 2 position kickstand
- Choice of digital or analog needle display
- Illuminated keys for working in the dark
- Select between English and Japanese interfaces
- Analog output
- Log every point at up to 4000Hz with pyro sensors
- Non-volatile data storage up to 250,000 points
- Laser tuning screen and power and energy log
- USB and RS232 interfaces with StarLab and StarCom PC applications, LabVIEW driver and COM Object Interface (see pages 194-200)
- Soft keys and menu driven functions with on line help
- Many software features such as density, min/max, scaling etc.



The Vega is a very versatile and sophisticated handheld laser power/energy meter. Just plug in one of the many Ophir sensors and you have a whole measurement laboratory at your fingertips. The bright color display gives unparalleled legibility and ease of interpreting information. The Vega has many on board features such as laser tuning, data logging, graphing, normalize, power or energy density units, attenuation scaling, max and min limits. The Vega can also display the power or energy with a high resolution simulated analog needle display.

The Vega can be operated either by battery or from an AC source with the charger plugged in at all times. Its bright display and backlit keys allow easy use in dark room conditions or with laser glasses on.

The built-in USB and RS232 interfaces and StarLab and StarCom PC software allow on-line processing of data or processing previously stored data; results are displayed graphically on a PC. To support PC interfacing, LabVIEW drivers and COM Object Interface are provided.



StarLab Software

Selected Screens

Digital Power Screen and Color Functions

- Choice of bright on dark or dark on bright characters
- Optimize colors for use with laser eye protection glasses
- Can average over selected period. Useful for unstable lasers
- Bar graph can show max / min / average in different colors

Standard Power Screen

- Sensor type and S/N
- Choice of bright on dark or dark on bright characters
- Go to energy screen
- Zoom bar graph can show max/min/ave
- Subtract offset
- Access further functions
- Average period
- Power range
- Detailed help

BeamTrack Power/Position/Size Screen

- Monitoring of laser beam size
- Accurate tracking of beam position to fractions of a mm
- Beam position and wander
- All the other features of standard power/energy meters

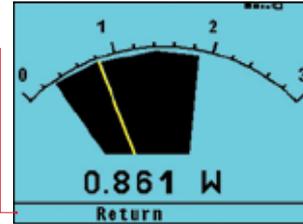
BeamTrack Power/Position/Size Screen

- Sensor type and S/N
- Power measurement
- Position and size measurement with BeamTrack sensor
- Soft Keys
- Measurement parameters
- Position and size graph

Analog Power Screen

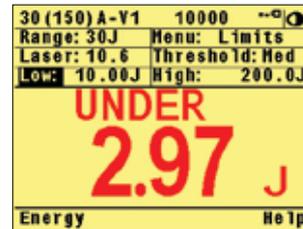
- Perfect for adjusting and maximizing laser power
- Persistent graphical display allows tracking of minimum maximum values measured
- Large analog needle with small digital display as well

Choice of smaller display with range, menu, laser and average headers.



Energy/Limits Screen

- Pulsed energy sensors (single or repetitive) and thermal sensors (single shot only)
- Frequency measurement with pulsed energy sensors
- Limits screen with bright colored warning



Energy threshold

Energy range

Energy Logging Screen

- Pyroelectric and thermal sensors
- Continuous scroll with up to 100 points on screen
- Full statistics
- Store data onboard and recall



Enlarge variation pulse to pulse

Additional Functions

- Press the menu choice on the main screen and many more options pop up as shown

Choose analog needle screen

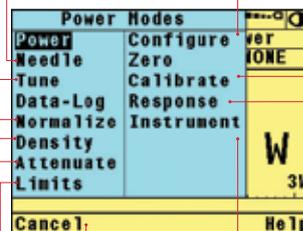
Laser tune screen with continuous graph

Normalize so present reading is 1.00

Enter beam diameter and read in units of W/cm² or J/cm²

Put in factor to read input power with attenuator or beam splitter

Set for alarm if preset min or max limits exceeded



Set startup configuration

Adjust sensor calibration

Adjust sensor response time

Adjust power meter parameters

Return to previous menu

Specifications

Power Meter	Brilliant color TFT 320 x 240 pixel graphics LCD. Large 16mm digits. High resolution analog needle also can be chosen.
Features	Many screen features including power with multicolor bar graph, energy, average, exposure, frequency, graphs, scaling, special units, and more. Complete on line context sensitive help screens.
Outputs	USB, RS232 and user selectable 1, 2, 5 and 10 Volt full scale analog output.
Screen Refresh	15 times/sec
Case	Molded high impact plastic with optimized angle two level kickstand. Rubberized sides for easy grip and protection against damage.
Size	Folds to a compact 210mm L x 109mm W x 36mm H
Weight	0.470 kg
Battery	Rechargeable NiMH batteries with typically 18 hours between charges. The charger can be ordered from your local distributor. The charger also functions as an AC adapter.
Data Handling	Data can be viewed on board or transmitted to pc: On Board: Non-volatile storage of up to 250,000 data points in up to 10 files. Max onboard data logging rate 4000 ^(a) points/s and Max data logging rate to the PC 2000 ^(a) points/s.
Sensor Features	Works with Thermopile, BeamTrack, Pyroelectric (PE-C series) and Photodiode sensors ^(b) .
Program Features	Preferred start up configuration can be set by user. User can recalibrate power, energy, response time and zero offset.
Compliance	CE, UKCA, China RoHS

Note: (a) The above refers to the rate of logging every single point in turbo mode. Above that rate, the instrument will sample points but not log every single point
Note: (b) Not including PD300RM sensors

Ordering Information

Item	Description	Ophir P/N
Vega	Vega color universal power meter for standard thermal, BeamTrack, pyroelectric and photodiode sensors	7Z01560
Carrying Case	Carrying case 38x30x11 cm. For power meter and up to 3 sensors	1J02079
USB Cable for Vega	USB to mini DIN cable (1 unit supplied with Vega)	7E01205
RS232 Cable for Vega	D9 to mini DIN cable (1 unit supplied with Vega)	7E01206
Battery Pack for Vega	Replacement battery pack for the Vega	7E14007A
N Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with Vega)	7E05029
Standard Analog Output Connector	2.5mm mono jack (1 unit supplied with Vega)	7E02008

2.1.4 Nova II

Versatile Laser Power/Energy Meter

- Compatible with all standard Ophir thermal, BeamTrack, pyroelectric and photodiode sensors
- Large high definition LCD display
- Choice of digital or analog needle display
- 2 position kickstand
- Backlighting and rechargeable battery
- Select between English and Japanese interfaces
- Analog output
- Log every point at up to 4000Hz with pyro sensors
- Non-volatile data storage up to 59,400 points
- Laser tuning screen and power and energy log
- USB and RS232 interfaces with StarLab and StarCom PC applications, LabVIEW driver and COM Object Interface (see pages 194-200)
- Soft keys and menu driven functions with on line help
- Many software features such as density, min/max, scaling etc.



The Nova II is a very versatile and sophisticated handheld laser power/energy meter. Just plug in one of the many Ophir sensors and you have a whole measurement laboratory at your fingertips. The Nova II has many on-board features such as laser tuning, data logging, graphing, normalize, power or energy density units, attenuation scaling, max and min limits. The Nova II can also display the power or energy with a high resolution simulated analog needle display. The Nova II can be operated either by battery or from an AC source with the charger plugged in at all times. Its backlight allows illumination of the power meter in low light conditions. The built-in USB and RS232 interfaces and StarLab

and StarCom PC software allow on-line processing of data or processing previously stored data; results are displayed graphically on a PC. To support PC interfacing, LabVIEW drivers and COM Object Interface are provided.

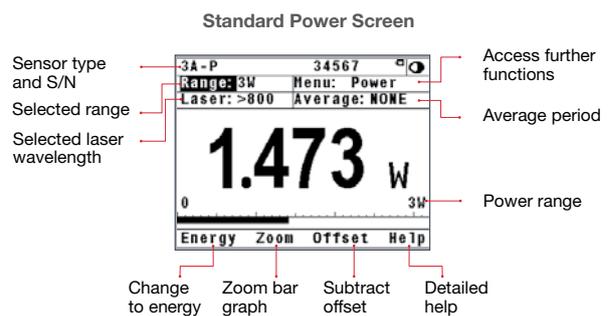


StarLab Software

Selected Screens

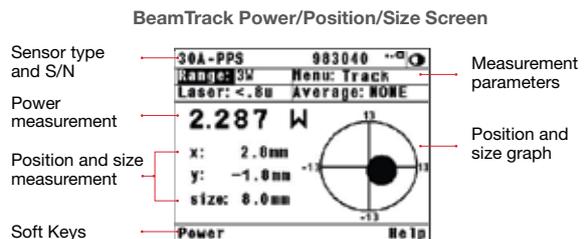
Digital Power Screen

- CW industrial, medical and scientific lasers
- pW to Multi kW with appropriate sensors
- Can average over selected period. Useful for unstable lasers
- Fast response bar graph



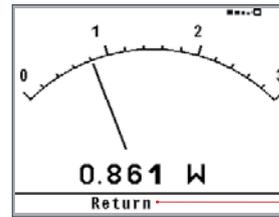
BeamTrack Power/Position/Size Screen

- Monitoring of laser beam size
- Accurate tracking of beam position to fractions of a mm
- Beam position and wander
- All the other features of standard power/energy meters



Analog Power Screen

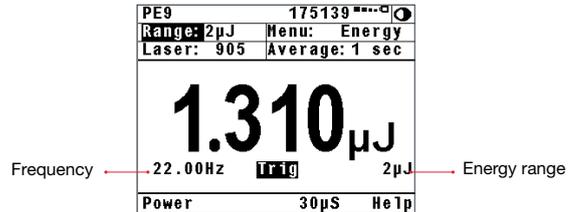
- Perfect for adjusting and maximizing laser power
- Large analog needle with small digital display as well



Choice of smaller display with range, menu, laser and average headers

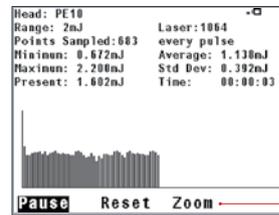
Energy Screen

- Pulsed energy sensors (single or repetitive) and thermal sensors (single shot only)
- Frequency measurement with pulsed energy sensors



Energy Logging Screen

- Pyroelectric and thermal sensors
- Continuous scroll with up to 100 points on screen
- Full statistics
- Store data onboard and recall



Enlarge variation pulse to pulse

Additional Functions

- Press the menu choice on the main screen and many more options pop up as shown

Choose analog needle screen

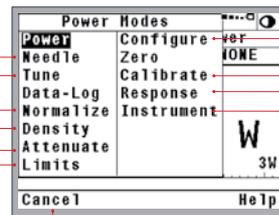
Laser tune screen with continuous graph

Normalize so present reading is 1.00

Enter beam diameter and read in units of W/cm² or J/cm²

Put in factor to read input power with attenuator or beam splitter

Set for alarm if preset min or max limits exceeded



Set startup configuration

Adjust sensor calibration

Adjust sensor response time

Adjust power meter parameters

Return to previous menu

Specifications

Power Meter	High legibility 320 x 240 pixel graphics LCD with switchable electroluminescent backlight. Large 18mm digits. High resolution analog needle also can be chosen.
Features	Many screen features including power with bar graph, energy, average, exposure, frequency, graphs, scaling, special units, and more. Complete on line context sensitive help screens.
Outputs	USB, RS232 and 1, 2, 5 and 10 volt full scale analog output.
Screen Refresh	15 times/sec
Case	Molded high impact plastic with two level kickstand.
Size	Folds to a compact 208mm Lx 110mm Wx 43mm H
Weight	0.550 kg
Battery	Rechargeable NiMH batteries with typically 18 hours between charges. The charger can be ordered from your local distributor. The charger also functions as an AC adapter.
Data Handling	Data can be viewed on board or transmitted to PC: On Board: Non-volatile storage of up to 54000 data points in up to 10 files. Max onboard data logging rate 4000 ^(a) points/s and Max data logging rate to the PC 2000 ^(a) points/s.
Sensor Features	Works with Thermopile, BeamTrack, Pyroelectric (PE-C series) and Photodiode sensors ^(b) .
Program Features	Preferred startup configuration can be set by user. User can recalibrate power, energy, response time and zero offset.
Compliance	CE, UKCA, China RoHS

Note: (a) The above refers to the rate of logging every single point in turbo mode. Above that rate, the instrument will sample points but not log every single point

Note: (b) Not including PD300RM sensors

Ordering Information

Item	Description	Ophir P/N
Nova II	Nova II universal power meter for standard thermal, BeamTrack, pyroelectric and photodiode sensors	7Z01550
Carrying Case	Carrying case 38x30x11 cm. For power meter and up to three sensors	1J02079
Nova II USB Cable	USB to mini DIN cable (1 unit supplied with Nova II)	7E01205
Nova II RS232 Cable	D9 to mini DIN cable (1 unit supplied with Nova II)	7E01206
Battery Pack	Replacement battery pack for the Nova II	7E14007A
N Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with Nova II)	7E05029
Standard Analog Output Connector	2.5mm mono jack (1 unit supplied with Nova II)	7E02008

2.1.5 StarLite

Low Cost Laser Power / Energy Meter

- Compatible with all standard Ophir Thermal, BeamTrack, Pyroelectric (PE-C series only) and Photodiode sensors
- Brilliant large size TFT 320x240 display
- Compact handheld design with rubberized bumpers and optimized kickstand
- Choice of digital or analog needle display
- Select between English, Japanese, Russian and Chinese interfaces
- Analog output
- Easy to use soft keys
- Easy measurement configuration with context sensitive help
- Backlighting and rechargeable battery
- Single shot energy measurement with thermal sensors
- Power averaging
- Resizable Screen graphics
- EMI rejection
- Optional software package for USB communication with our StarLab PC suite. For USB options see "Ordering Information" table in the next page



StarLite is a low cost power / energy meter capable of measuring power or energy from pJ and pW to hundreds of Joules and thousands of Watts. It also supports position and size measurement with the BeamTrack family of sensors. StarLite can also display the power or energy with a high resolution simulated analog needle display.

All StarLite measurement screens can be configured to either show the measurement parameters or to hide them in order to maximize the graphical and numeric displays. StarLite can be operated either by battery or from an AC source with the charger plugged in at all times. Its backlight allows illumination of the power meter in low light conditions.

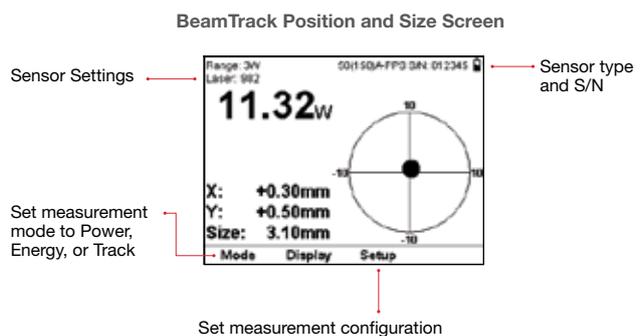
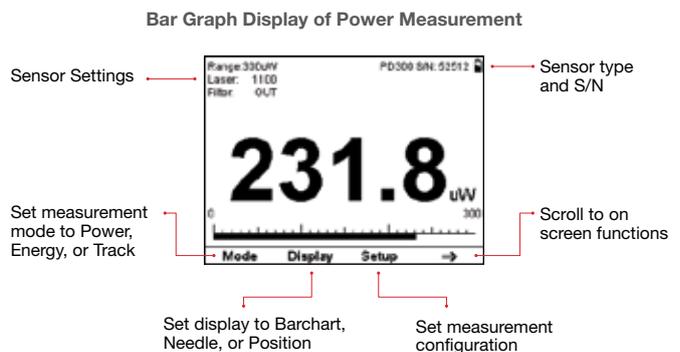
Selected Screens

Digital Power Screen

- CW industrial, medical and scientific lasers
- pW to Multi kW with appropriate sensors
- Can average over selected period. Useful for unstable lasers
- Fast response bar graph

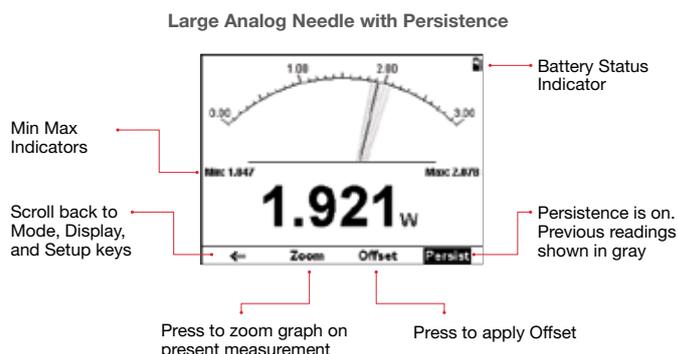
BeamTrack Power/Position/Size Screen

- Monitoring of laser beam size
- Accurate tracking of beam position to fractions of a mm
- Power measured at the same time



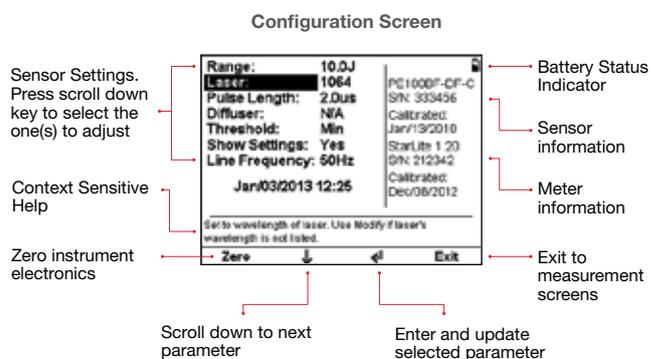
Analog Needle Screen

- Perfect for adjusting and maximizing laser power or energy
- Persistent graphical display allows tracking of minimum maximum values measured
- Large analog needle with small digital display as well



Configuration Screen

- Easy adjustment of all measurement configuration parameters
- Context sensitive help for selected parameter
- Sensor and meter information provided



Specifications

Power Meter	High legibility TFT 320 x 240 pixel graphics LCD. Large 16mm digits. High resolution analog needle also can be chosen.
Features	Power, single shot energy, energy and frequency of high rep rate lasers, position, and size.
Outputs	1V Full Scale analog output.
Screen Refresh	15 times/sec
Case	Molded high impact plastic with optimized angle kickstand. Rubberized sides for easy grip and protection against damage.
Size	Folds to a compact 211mm L x 114mm W x 40mm H
Weight	0.470 kg
Battery	Rechargeable Li-ion batteries with typically 8 hours between charges. The charger can be ordered from your local distributor. The charger also functions as an AC adapter.
Sensor Features	Automatic continuous background cancellation with PD300 sensors. Submicrojoule and multikilohertz capability with pulsed energy sensors.
Sensor Compatibility	Works with standard Thermopile, BeamTrack, Photodiode and Pyroelectric (PE-C series) ^(a) sensors. Works with our PD300RM sensors.
Compliance	CE, UKCA, China RoHS

Note: (a) Not including BC20 and PD300-CIE sensors

Ordering Information

Item	Description	Ophir P/N
StarLite	StarLite universal power meter for Thermal, BeamTrack, Pyroelectric and Photodiode sensors	7Z01565
StarLite with USB enabled	StarLite universal power meter with USB enabled	7Z01569
StarLite USB Activation Code	Software Activation Code that enables the StarLite meter to communicate in USB with our StarLab software suite	7Z11049
Carrying Case	Carrying case 38x30x11 cm. For power meter and up to 3 sensors	1J02079
USB Cable for StarLite	USB-A to MICRO-B cable (1 unit supplied with StarLite)	7E01279
Battery Pack for StarLite	Replacement battery pack for the StarLite	7E14008
P Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A P-1.35x3.5 (1 unit supplied with StarLite)	7E05047
Standard Analog Output Connector	2.5mm mono jack (1 unit supplied with StarLite)	7E02008

2.1.6 NOVA

Compact and Durable Power / Energy Meter

- Compact and durable
- Compatible with all standard Ophir sensors: thermal, pyroelectric* and photodiode
- Single shot energy measurement with thermal sensors
- Optional RS232 interface with StarCom PC application and LabVIEW driver (see pages 194-200)
- Power and energy logging with graphical display and statistics
- Power averaging
- Easy to use soft keys, menu-driven
- Screen graphics
- Backlight and rechargeable battery
- Analog output
- EMI rejection

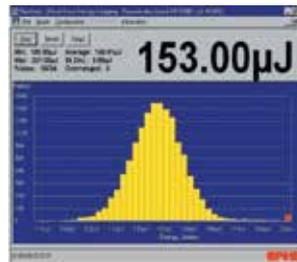


Compatible with the complete range of Ophir thermal (power and energy), pyroelectric and photodiode sensors, Nova is truly versatile: measuring power or energy from pJ and pW to hundreds of Joules and thousands of Watts. With the optional scope adapter, you can connect your pyro sensor to an oscilloscope and see every pulse up to the maximum frequency permitted by the sensor.

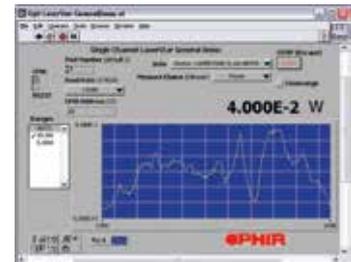
Smart connector sensors automatically configure and calibrate Nova when plugged in. Soft keys guide you through the screen graphics. Finished working? Your configuration can be saved for future use.

Nova's autoranging tune screen displays laser power graphically and displays maximum power. Zoom and time scale can be adjusted by user.

The optional RS232 interface and StarCom PC software allow on-line processing of data or processing previously stored data; results are displayed graphically on a PC. To support PC interfacing, LabVIEW drivers are provided.



StarCom Software



LabVIEW

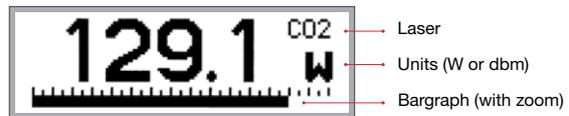
Selected Screens

Digital Power Screen

- CW industrial, medical and scientific lasers
- pW to multi kW with appropriate sensors

Laser Tuning Screen or Power Log Screen (not shown)

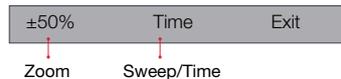
- Maximizing laser power
- User selected time period and zoom



Press Menu button or soft keys to make legends visible (not shown).



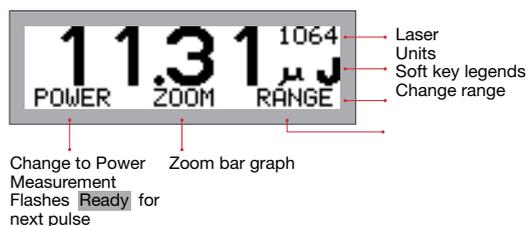
Press Menu button or soft keys to make legends visible.



* PE-C series of pyroelectric sensors are compatible with Nova, when used with an additional adapter (P/N 7Z08272) – see page 141.

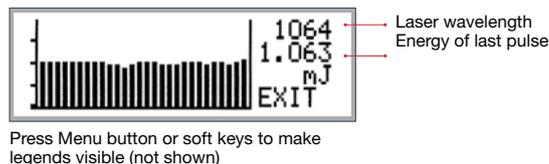
Energy Measurement Screen

- Pyroelectric and thermopile sensors-single pulse
- Pyroelectric frequency measurement (not shown)



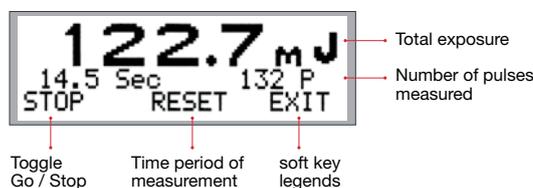
Energy Log Screen

- Pyroelectric sensors
- Thermopile sensors-successive single pulses
- Continuous scroll
- Energy statistics



Pyroelectric Exposure Screen

- Sum or average energies over user selected time period / number of pulses
- Medicine, photolithography



Average Screen

- Thermopile, photodiode and pyroelectric sensors (Does not operate with PE-C series of pyroelectric sensors)
- Periodic (1/3 sec to 30 sec) or continuous (10 sec to 1 hour) average for fast-changing or slow-changing laser



Specifications

Power Meter	High legibility 32 x 122 pixel graphics supertwist LCD with switchable electroluminescent backlight. Large 12mm digits.
Features	Many screen features: including power with bar graph, energy, average, exposure, frequency, graphs, and more.
Outputs	RS232 and analog output 1V f.s. (optional)
Screen Refresh	15 times / sec.
Case	Molded high-impact plastic with kickstand and EMI conductive shielding, to allow use even in proximity to pulsed lasers.
Size	Very compact: 205mm L x 95mm W x 39mm H.
Weight	0.550 kg
Battery	Rechargeable 12 volts. 22 hours use between charges. The charger can be ordered from your local distributor. The charger also functions as AC adapter.
Data Handling	Data can be viewed on board or transmitted to PC: On Board: Max data logging rate >10 points/s Transmitted to PC: Data transmission rate of ~50 points/s. RS232 baud rate of 19200
Sensor features	Works with standard Thermal ^(a) , Pyroelectric ^(b) and Photodiode ^(c) sensors.
Program features	Preferred startup configuration can be set by user. User can recalibrate power or energy. Response time. Zero offset.
Compliance	CE, UKCA, China RoHS

Note: (a) When operating with BeamTrack sensors, measures Power & Energy only

Note: (b) In order to operate with the new Pyroelectric (PE-C series) sensors, Nova needs an adapter (see ordering information below)

Note: (c) Not including PD300RM sensors

Ordering Information

Item	Description	Ophir P/N
Nova	Nova power meter for standard thermal, pyroelectric and photodiode sensors	7Z01500
Nova PE-C Adapter	Adapter to allow Nova to operate with PE-C series pyroelectric sensors. Plugs between Nova D15 socket and PE-C D15 plug	7Z08272
Carrying Case	Carrying case 38x30x11cm. For display and up to three sensors	1J02079
Nova RS232 assemblies - allow Nova power meter to communicate with PC and be controlled by PC		
Nova RS232 Assembly	RS232 adapter with standard 2 meter cable (including software) (see page 185)	7Y78105 ^(a)
Nova RS232 Assembly	RS232 adapter with 5 meter cable (including software)	7Y71052 ^(b)
Nova RS232 Assembly	RS232 adapter with 8 meter cable (including software)	7Y71051 ^(c)
Battery Pack	Replacement battery pack for Nova	7E14005A
N Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with Nova)	7E05029
Standard Analog Output Connector	2.5mm mono jack (1 unit supplied with Nova)	7E02008

Note: (a) P/N 7Y78105 replaces P/N 78105

Note: (b) P/N 7Y71052 replaces P/N 781052

Note: (c) P/N 7Y71051 replaces P/N 781051

2.1.7 Accessories

Power Supply/Charger

Negative Polarity Power Supply/Charger for Centauri, Vega, Nova II, LaserStar, Nova, EA-1, Pulsar and Quasar
 Positive Polarity Power Supply/Charger for StarBright and StarLite & Power Supply/Charger for Juno-RS
 Push-Pull 2 Pin Power Supply for IS1.5-VIS-FPD-800 & IS1.5-IRG-FPD-800



Analog Output Connectors & Cables

Replacement standard analog output plug for most Ophir meters.
 Replacement analog output plug for LaserStar and for Juno-RS.



StarLite USB Activation Code

Software Activation Code that enables the StarLite meter to communicate in USB with our StarLab software suite.



Centauri Dual Channel Activation Code

Software activation code to field upgrade a Single Channel Centauri to Dual Channel capabilities.



USB Cables for Meters & Interfaces

Cables for communicating with the PC in USB – for use with our StarLab application, COM Objects, LabVIEW and to upgrade Firmware files.



Ethernet Cable

Ethernet cross cable for communicating with an Ethernet network or direct to a PC for initial setup of the device – can be used with our StarLab or OphirEthernetApp applications or with customer's own software.



RS232 Cables for Meters & Interfaces

Cables for communicating with the PC in RS232 – for use with our StarCom application or to use our RS232 command set.



RS232 Module for Nova

Plug in module allows transfer of power and energy data to PC and remote control of power meters from PC. Includes manual and StarCom application program (refer to page 199).



Carrying Cases

Carrying case for StarBright, StarLite, Vega, Nova II or Nova power meters and up to 3 sensors.



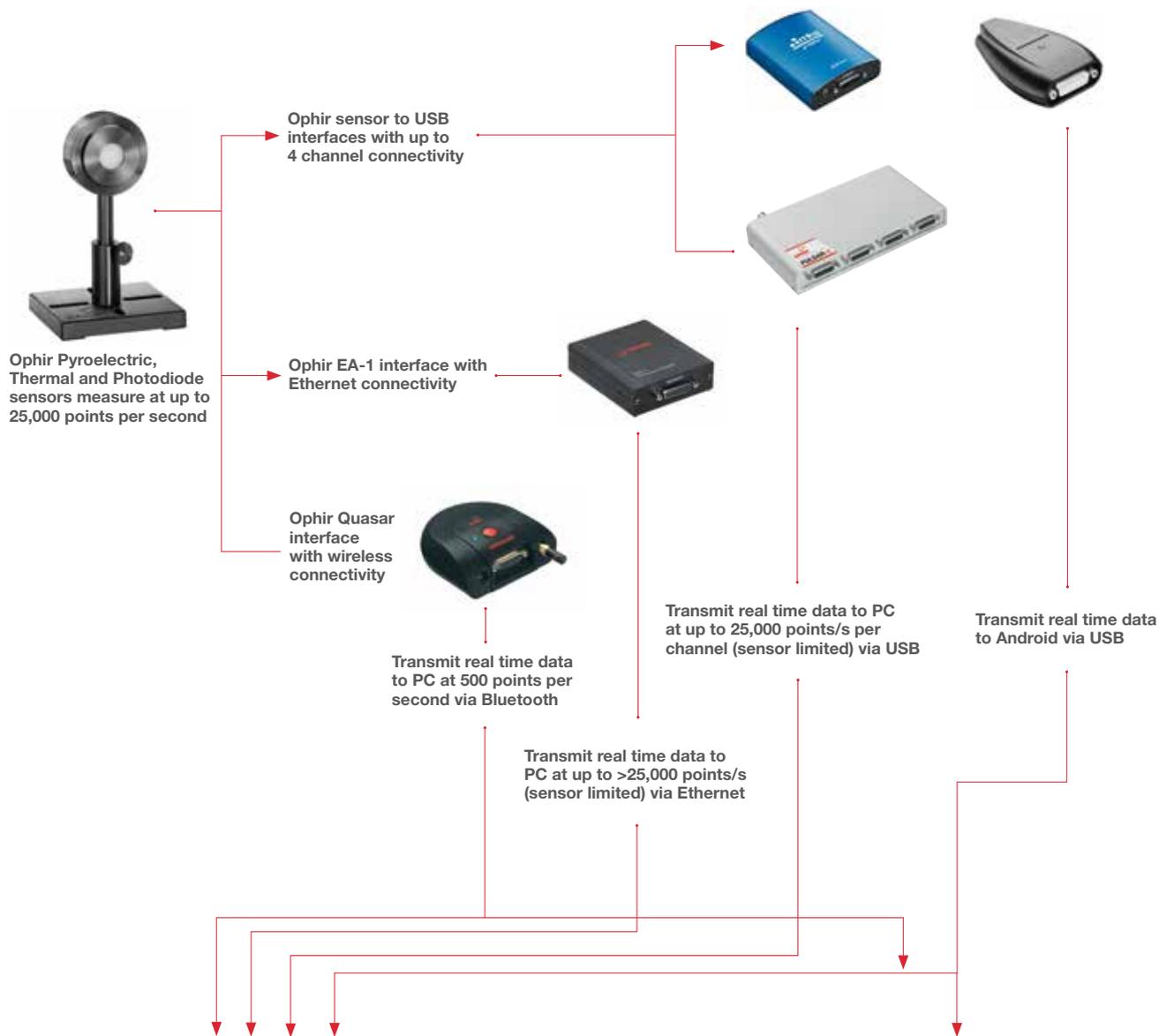
Ordering Information

Item	Description	Ophir P/N
N Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5	7E05029
P Polarity Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A P-1.35x3.5	7E05047
Push-Pull 2 Pin Power Supply	Push-Pull 2 Pin Power Supply 12V 2A	7E05047A
Juno-RS Power Supply/Charger	Power Supply/Charger AC/DC 12V 2A 2.5x5.5x13.8 S	7E05093
Standard Analog Output Connector	2.5mm mono jack	7E02008
LaserStar Analog Output Connector	Analog Output plug for LaserStar	7Z11004
Juno-RS Analog Output Cable	Cable Coax BNC-M to SMA-M RG-174 2 meter	7E01541
StarLite USB Activation Code	Software Activation Code that enables the StarLite meter to communicate in USB with our StarLab software suite	7Z11049
Centauri Dual Channel Activation Code	Software activation code to field upgrade a Single Channel Centauri to Dual Channel capabilities	7Z11056
Centauri / StarBright / StarLite USB Cable	USB-A to MICRO-B cable	7E01279
Nova II / Vega USB Cable	USB to mini DIN cable	7E01205
Juno / Juno+ / EA-1 USB Cable	USB-A to MINI-B Cable	7E01217
Pulsar USB Cable	USB-A to B cable	7E01202
Ethernet Cable	Ethernet Cross Cable	7E01192
Juno-RS RS232 Cable	D9 Male/Female 1.8-2 meter	7E11216
Centauri / StarBright RS232 Cable	D9 to 3.5mm plug cable	7E01213
Nova II / Vega RS232 Cable	D9 to mini DIN cable	7E01206
Nova RS232 Module	RS232 adapter with 2 / 5 / 8 meter cable (including software)	7Y78105 / 7Y71052 / 7Y71051 ^(a)
LaserStar RS232 Cable	RS232 D9 to D25 Cable	7E01121
Carrying Case for StarBright, StarLite, Vega, Nova II and Nova	Carrying case 38x30x11 cm. For Power Meter and up to three sensors	1J02079

Note: (a) 7Y78105 (was 78105), 7Y71051 (was 781051), 7Y71052 (was 781052), 7Y78300 (was 78300)

2.2 PC Interfaces

2.2.1 PC Connectivity Options for Power/Energy Measurement



StarLab Software (data transmitted via USB, Ethernet or Bluetooth)



StarLab Software

StarViewer Application (data transmitted via Bluetooth and USB)



StarViewer Android Application

2.2.2 Compact Juno USB Interface

Convert your PC or Android device into an Ophir sensor power/energy meter

- **From sensor to interface to PC - powered from USB**
 - Plug and play with all standard Ophir smart sensors
 - Position & size measurement with BeamTrack sensors
 - Record every energy pulse at up to 10kHz
 - Log power and energy, average, statistics, histograms and more with included StarLab application
 - Pulsed Power measurements with Thermopile detectors
 - Low Frequency Power - power measurement from pulse cycle energy (for VCSEL)
 - LabVIEW VIs and COM Object interface
- **From sensor to interface to Android Device - powered from USB**
 - Plug and play with all standard Ophir smart sensors
 - Measure power and energy, average, statistics and more with included Android StarViewer application
- **Very compact - is just an extension of the smart plug**



Smart Sensor to Juno to PC

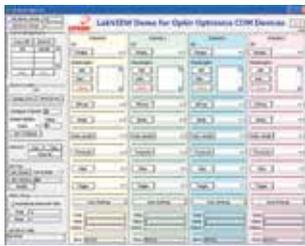
Ophir's basic smart compact Juno module turns your PC or Laptop into a full-fledged Ophir laser power/energy meter. Just install the software, plug the sensor into the Juno module and connect the Juno with a standard USB cable to the PC USB port. You can connect several Juno modules to the PC.

Smart Sensor to Juno to Android device

Ophir's basic smart compact Juno module turns your Android device into a full-fledged Ophir laser power/energy meter. Just install the StarViewer Android application, plug the sensor into the Juno module and connect the Juno with a standard USB cable to the device USB port.



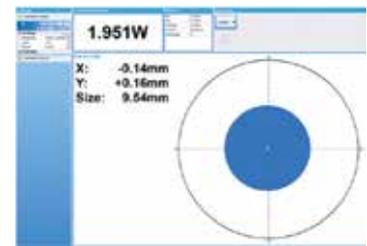
Juno with StarViewer



LabVIEW



Juno operating with StarLab software



Juno with BeamTrack sensor and StarLab showing beam power, position and size

Specifications

Power Measurement	
Power log period	1s to Unlimited
Energy Measurement	
Max logging rate	10,000Hz ^(a)
Trigger input and output	N.A.
Timing	Supports time stamp for each pulse - resolution 1µs
General	
Number of sensors supported	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC
Compatible sensors	Supports all standard Ophir Pyroelectric, Thermal, BeamTrack and Photodiode sensors ^(b)
Power supply	Powered from USB
Dimensions	77mm L x 55mm W x 23mm H
Weight	0.1 kg
Compliance	CE, UKCA, China RoHS

Notes: (a) This is the data logging rate for every single point in turbo mode. Above that rate, the instrument will sample points but not log every single point
(b) Not including PD300RM sensors

Ordering Information

Item	Description	Ophir P/N
Juno	Compact module to operate one Ophir sensor from your PC USB port. Comes with software	7Z01250
Juno USB cable	USB-A to MINI-B Cable (1 unit supplied with Juno)	7E01217

2.2.3 Juno+ USB Interface

Convert your laptop or desktop PC into an Ophir sensor power/energy meter

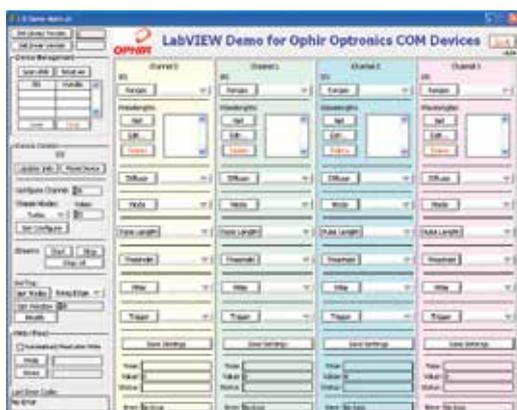
- From sensor to interface to PC - powered from USB
- Autonomous mode: Outputs voltage relative to measurement while connected via USB to a standalone power supply and not a PC
- Plug and play with all standard Ophir smart sensors
- Position & size measurement with BeamTrack sensors
- Record every energy pulse at up to 10kHz
- Analog output
- Log power and energy, average, statistics, histograms and more with included StarLab application
- Pulsed Power measurements with Thermopile detectors
- Low Frequency Power - power measurement from pulse cycle energy (for VCSEL)
- LabVIEW VIs and COM Object interface



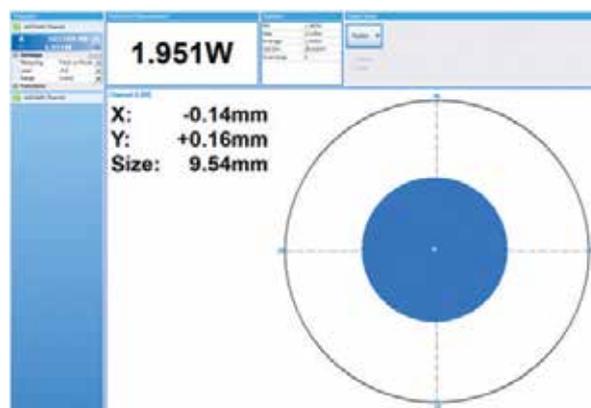
Smart Sensor to Juno+ to PC

Ophir's basic smart compact Juno+ module turns your PC or laptop into a full-fledged Ophir laser power/energy meter. Just install the software, plug the sensor into the Juno+

module and connect the Juno+ with a standard USB cable to the PC USB port. You can connect several Juno+ modules to the PC.



LabVIEW



Juno+ with BeamTrack sensor and StarLab showing beam power, position and size

Specifications

Power Measurement	
Power log period	1s to Unlimited
Energy Measurement	
Max logging rate	10,000Hz ^(a)
Trigger input and output	N.A.
Timing	Supports time stamp for each pulse - resolution 1μs
General	
Number of sensors supported	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC
Compatible sensors	Supports all standard Ophir Pyroelectric (PE-C series), Thermal, BeamTrack and Photodiode sensors. Works with our PD300RM sensors.
Power supply	Powered from USB
Outputs	USB and user selectable 1, 2, 5 and 10 Volt full scale analog output
Dimensions	105mm L x 80mm W x 29mm H
Weight	0.164 kg
Compliance	CE, UKCA, China RoHS
Note:	(a) This is the data logging rate for every single point in turbo mode. Above that rate, the instrument will sample points but not log every single point

Ordering Information

Item	Description	Ophir P/N
Juno+	Module to operate one Ophir sensor from your PC USB port. Comes with software	7Z01252
Juno+ USB cable	USB-A to MINI-B Cable (1 unit supplied with Juno+)	7E01217
Standard Analog Output Connector	2.5mm mono jack (1 unit supplied with Juno+)	7E02008

2.2.4 Juno-RS Interface

Virtual meter (PC-Interface) allowing connectivity of Ophir's smart (DB-15) power and energy sensors to automation systems and computers using RS-232 communication

- Plug and play with all standard Ophir smart sensors
- Analog output in autonomous mode: Outputs voltage relative to measurement while connected standalone to a sensor
- Robust connectors, suited for semi-industrial environment
- Advanced logging and data processing with included StarLab application
- Pulsed Power measurements with Thermopile detectors
- Low Frequency Power - power measurement from pulse cycle energy (for VCSEL)

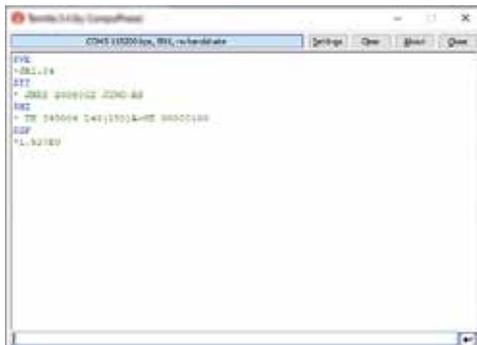


Smart Sensor to Juno-RS to PC

Ophir's Juno-RS, virtual meter provides easy integration into automation systems (e.g. PLC) using RS-232 in their communication infrastructure. It also allows turning the customer's PC or laptop into a full-fledged Ophir laser power/energy meter.

The sensor is connected to the Juno-RS which sends the measurement results to the PLC or the destination computer.

The Juno-RS has an analog output which provides an output voltage proportional to the power/energy measured. When using the Juno-RS with a PC/Laptop, just install the StarLab software, plug the sensor into the Juno-RS module and connect the Juno-RS with a standard RS-232 cable to a PC serial port or USB to RS-232 adapter. You can connect several Juno-RS modules to the PC at the same time.



RS-232 Terminal



Juno-RS with BeamTrack sensor and StarLab showing beam power, position and size

Specifications

Power Measurement	
Power log period	Unlimited
Energy Measurement	
Max logging rate	500Hz @ baud rate 115200 (a)
Trigger input and output	N.A.
Timing	Supports time stamp for each pulse - resolution 1µs
General	
Number of sensors supported	One sensor per unit. Can combine several units with StarLab software for display of up to 8 sensors on one PC
Compatible sensors	Supports all standard Ophir Pyroelectric (PE-C series), Thermal, BeamTrack and Photodiode sensors. Works with our PD300RM sensors
Power supply	Industrial +12V wall cube power supply, plugs into jack on rear. The power supply is supplied with the device or can be ordered from your local distributor
Power consumption	100mA max at 12V
Power input voltage	11V min to 25V max (if using alternative to provided power supply)
Outputs	RS-232; Analog output with user selectable full-scale of 1, 2, 5 or 10V
Dimensions	114mm L x 80mm W x 29mm H
Weight	0.174 kg
Compliance	CE, UKCA, China RoHS
Note:	(a) This is the data logging rate for every single point in turbo mode. Above that rate, the instrument will sample points but not log every single point

Ordering Information

Item	Description	Ophir P/N
Juno-RS	Module to operate one Ophir sensor from your PC RS-232 port. Comes with software	7Z01254
Juno-RS RS-232 Cable	D9 Male/Female 1.8-2 meter (1 unit supplied with Juno-RS)	7E11216
Juno-RS Power Supply	Power Supply AC/DC 12V 2A 2.5x5.5x13.8 S (1 unit supplied with Juno-RS)	7E05093
Juno-RS Analog Output Cable	Coax BNC-M to SMA-M RG-174 Cable 2 meter	7E01541

2.2.5 EA-1 Compact Ethernet Adapter

Connects your Ophir sensor to an Ethernet bus

- From sensor direct to Ethernet with no PC connection
- Powers directly from the Ethernet bus or 12V power supply
- Supports thermal, photodiode and pyroelectric smart sensors
- Low Frequency Power - power measurement from pulse cycle energy (for VCSEL)
- Software support via StarLab application or 'Ophir Ethernet App' PC application software package, both included
- Allows remote monitoring via Telnet, HTTP or UDP protocols



DB15 connector

Mini-USB connector;
Ethernet RJ45 connector;
12V power connector

Smart Sensor to EA-1 to Ethernet to PC

The EA-1 is suitable for customers who desire Ethernet connectivity and want to remotely monitor and control the sensor via their own custom software or the Ophir provided PC application. The EA-1 is designed to connect an Ophir smart sensor to your Ethernet. Standard thermopile, pyroelectric and photodiode sensors are supported. The unit is powered directly from the Ethernet bus if Power Over Ethernet (PoE) is available, or from a standard Ophir 12V power supply if not. The sensor can be monitored remotely over the Ethernet bus, allowing remote connections from distances far in excess of those allowed via RS232 or USB.

The device is suitable for industrial or other environments where the bus of choice is Ethernet. Telnet, HTTP and UDP protocols are supported.

Installation and choosing an IP address are simplified via the simple Ophir Ethernet App PC application supplied with the unit. The PC application allows setup and basic functionality such as monitoring power and energy and changing measurement scales or wavelengths. Configuration of the IP address is via the Ethernet or a separate USB connection. The PC operating screen is shown below measuring power and energy.



PC application power screen



PC application energy screen

Additional features such as logging power or energy graphically are provided by the StarLab PC application which also supports the EA-1 device.

Specifications

Model	EA-1 Ethernet Adapter
Use	Monitoring Ophir Sensors via Ethernet
Measurement Parameters	As defined by sensor
Supported Sensors	Thermal ^(a) , Photodiode ^(b) and Pyroelectric (PE-C series)
Number of Sensors Supported	One sensor per unit
Data Logging	Thermophile and Photodiode sensors: logging of power at 15Hz into log file Pyroelectric and PD-C sensors: via Ophir Ethernet App – logging of energy at up to ~400Hz into log file Pyroelectric and PD-C sensors: via StarLab or direct Ethernet connection – logging of energy at up to ~40kHz
Instruction Set	Supports entire Ophir instruction set for controlling and monitoring sensor
Power Supply	Power over Ethernet or separate 12V power supply
Dimensions	93mm L x 73mm W x 29mm H
Weight	0.1 kg
Compliance	CE, UKCA, China RoHS
Notes:	(a) BeamTrack functions are only supported via user commands or StarLab, but not with the PC application (b) Not including BC20, PD300-CIE and PD300RM sensors

Ordering Information

Item	Description	Ophir P/N
EA-1	Compact module to operate Ophir sensors over the Ethernet. Comes with basic PC software	7Z01240
EA-1 USB cable	USB-A to MINI-B Cable (1 unit supplied with EA-1)	7E01217
EA-1 Ethernet cable	Ethernet Cross Cable (1 unit supplied with EA-1)	7E01192
N Polarity power supply/charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with EA-1)	7E05029

2.2.6 Pulsar Multichannel and Triggered USB Interfaces

Convert your laptop or desktop PC into a multichannel power/energy meter

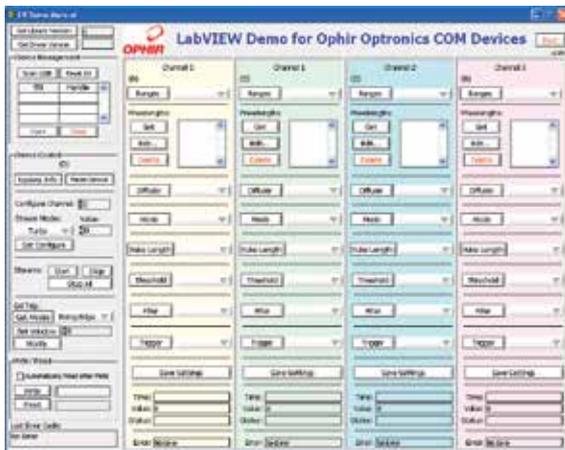
- From sensor to interface to PC
- 1, 2 and 4 channel models
- Plug and play with most Ophir sensors
- Record every energy pulse at up to 25kHz
- Measure missing pulses & trigger output with external trigger
- Log power and energy, average, statistics, histograms and more with included StarLab application
- LabVIEW VIs and COM Object Interface included



Smart Sensor to Pulsar to PC

Ophir's 1-4 channel Pulsar interface turns your PC or laptop into a full-fledged Ophir multi-channel laser power/energy meter. Just install the software, plug the sensor into the

Pulsar and the USB cable from the Pulsar to the PC USB port. With the Pulsar series, you can connect up to 4 sensors to each module, monitor each pulse at up to 25kHz and utilize external trigger.



LabVIEW



Pulsar-4 operating with StarLab software

Specifications

Power Measurement	
Power log period	1s to Unlimited
Energy Measurement	
Max logging rate	25,000Hz ^(a)
Trigger input and output	BNC trigger input to enable measurement of missing pulses or to select specific pulses. Can also be configured to give trigger output
Timing	Supports time stamp for each pulse - resolution 1µs
General	
Number of sensors supported	4 / 2 / 1 sensors per unit. Can combine several units with software for display of up to 8 sensors on one PC
Compatible sensors	Supports all standard Ophir Pyroelectric, Thermal ^(b) and Photodiode ^(c) sensors
Power supply	12V wall cube power supply plugs into jack on rear. The power supply can be ordered from your local distributor.
Dimensions	103mm L x 190mm W x 33mm H
Weight	0.650 kg
Compliance	CE, UKCA, China RoHS

Notes:

- (a) Limited by the maximum repetition rate of the sensor.
 (b) When operating with BeamTrack sensors, measures Power & Energy only.
 (c) Not including BC20, PD300-CIE and PD300RM sensors.

Ordering Information

Item	Description	Ophir P/N
Pulsar-4	Module to operate up to 4 Ophir sensors from your PC USB port. Comes with software. Max repetition rate for every pulse 25kHz. Has external trigger capability. Powered from wall cube power supply (can be ordered from your local distributor)	7Z01201
Pulsar-2	Same as above but for 2 channels only	7Z01202
Pulsar-1	Same as above but for 1 channel only	7Z01203
Pulsar USB cable	USB-A to B cable (1 unit supplied with Pulsar)	7E01202
N Polarity power supply/charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with Pulsar)	7E05029

2.2.7 Quasar Wireless Bluetooth Interface

Straight from your measuring sensor to your PC or Android device with no cables

- Quasar wireless interface connects to any Ophir sensor and broadcasts to your PC or your Android device running StarViewer
- Wireless range of 10-30 meters depending on surroundings
- Operates from rechargeable battery with typically >40 hours lifetime
- Powerful USB interface with StarLab PC application software included or StarViewer Android application
- Converts your PC or your android Device into a complete laser power/energy meter
- Log power and energy, average, statistics, histograms and more (only in PC)
- Monitor up to 7 Quasars simultaneously on one PC (only in PC)



Quasar Bluetooth Wireless Sensor to PC Interface



Quasar module connects to any Ophir sensor, thermal, pyroelectric or photodiode

Any PC, laptop or Android device connects to Quasar module via Bluetooth adapter and operates as a power/energy meter/data logger

Specification

Sensor Compatibility	All Ophir standard sensors, Thermal ^(a) , Photodiode ^(b) and Pyroelectric
Number of Sensors on One PC	Up to 7 Quasars can operate simultaneously and be displayed at the same time on one PC
Operating Range	10-30 meters depending on surroundings when used with built in laptop Bluetooth or Ophir recommended adapter
Power	Powered by rechargeable NiMH battery. Battery life typical 40 hours, 20 hours for pyro sensors. Automatically goes into sleep mode when not connected to PC. Low batt indication. Charges from 12VDC either polarity. The charger can be ordered from your local distributor.
LED Indicator	LED indicator indicates whether connected, in standby or off
Bluetooth Standard	Bluetooth class 1. Connection to PC is transparent to user. Will work with built in laptop Bluetooth and most add on USB to Bluetooth adapters.
Data Transfer Rate for Pyro Sensors	500Hz
Dimensions	94mm L x 96mm W x 36mm H not including antenna
Weight	0.164 kg
Connections	15 pin D type sensor connector standard Ophir 12V charger input
Compliance	CE, UKCA, China RoHS
Notes:	(a) When operating with BeamTrack sensors, measures Power & Energy only. (b) Not including BC20, PD300-CIE and PD300RM sensors.

Ordering Information

Item	Description	Ophir P/N
Quasar Bluetooth Interface	Module to operate one Ophir sensor from your PC via Bluetooth wireless interface. Comes with software. Max repetition rate for every pulse 500Hz. Powered from built in rechargeable battery. Comes with power supply. Bluetooth adapter required when not available on PC. See next line	7Z01300
Battery Pack for Quasar	Replacement battery pack for Quasar	7E14007A
N Polarity power supply/charger	Power Supply/Charger AC/DC 12V 2A N-2.1x5.5 (1 unit supplied with Quasar)	7E05029

2.2.8 Summary of Computer Options for Ophir Meters and Interfaces

Communications

With Ophir RS232, Bluetooth, USB and Ethernet communication options you can transfer data from the sensor to the computer in real time or offline. You can also control your Ophir power meter from the computer.

- USB on Nova II, Vega, StarBright, Centauri (optional on StarLite) power meters and Juno, Juno+, Pulsar PC interfaces
- Bluetooth wireless on Quasar interface
- RS232 on Nova II, Vega, StarBright, Centauri and Juno-RS optional on Nova
- Ethernet on EA-1 interface and Centauri power meter

Ophir Power Meter and Interface Specifications

Model	Centauri	StarBright	Nova II / Vega	StarLite	Nova	Juno / Juno+	Juno-RS	Pulsar-1, 2 or 4	EA-1	Quasar Bluetooth	
Communication method	USB / RS232 / Ethernet	USB / RS232	USB / RS232	USB ^(c)	RS232	USB	RS232	USB	Ethernet	Bluetooth	
Power Measurement											
Power log period	1s to 1000hr.	1s to 1000hr.	12s to 600hr.	N.A	5s to 24hr.	1s to Unlimited	1s to Unlimited	1s to Unlimited	1s to Unlimited	1s to Unlimited	
Max points stored onboard	Unlimited	Unlimited	Nova II 5400 Vega 27000	N.A	300	N.A	N.A	N.A	N.A	N.A	
Max points direct on PC	Unlimited	Unlimited	Unlimited	N.A	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	
Analog output	1V, 2V, 5V, 10V F.S.	1V, 2V, 5V, 10V F.S.	1V, 2V, 5V, 10V F.S.	1V F.S.	1V F.S.	N.A / 1V, 2V, 5V, 10V F.S.	1V, 2V, 5V, 10V	N.A	N.A	N.A	
Energy Measurement											
Max logging rate	25,000Hz USB 30Hz RS232	5000Hz USB 30Hz RS232	>2000Hz USB ^(a) >30Hz RS232	20Hz ^(c)	>10Hz	10,000Hz ^(a)	500Hz ^(a)	25,000Hz ^(a)	>25,000Hz ^(a)	500Hz	
Max onboard data logging rate	25,000Hz	5000Hz	4000Hz ^(a)	N.A	>10Hz	N.A	N.A	N.A	N.A	N.A	
Max points stored USB/onboard	Unlimited	Unlimited	Nova II 59,400 Vega 250,000	N.A	1000	N.A	N.A	N.A	N.A	N.A	
Trigger input and output	Trigger input to synchronize measurement of pulses	N.A	N.A	N.A	N.A	N.A	N.A	BNC trigger input to enable measurement of missing pulses. Can also be configured to give trigger output	N.A	N.A	
Timing - time stamp for each pulse	resolution 1µs	resolution 1µs	N.A	N.A	N.A	resolution 1µs	resolution 1µs	resolution 1µs	resolution 1µs	resolution 10ms	
General											
Com Object	yes	yes	yes	yes ^(c)	no	yes	no	yes	yes	no	
LabVIEW VIs	yes	yes	yes	yes ^(c)	yes	yes	no	yes	no	no	
Maximum baud rate	115200	115200	38400	N.A	19200 ^(b)	N.A.	115200	N.A.	N.A.	N.A.	
PC file format	Text files, spreadsheet compatible ASCII										
TTL Out	yes	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	
Number of sensors supported	2 / 1 sensors per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit	4 / 2 / 1 sensors per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit. Can combine several units with software for display of up to 8 sensors on one PC	One sensor per unit. Can combine several units with software for display of up to 7 Quasars on one PC
Compatible sensors	Supports most Ophir pyroelectric, thermal and photodiode sensors										
Power supply	Powered from internal rechargeable battery power supply	Powered from internal rechargeable battery power supply	Powered from internal rechargeable battery power supply	Powered from internal rechargeable battery power supply	Powered from internal rechargeable battery power supply	Powered from USB	12V wall cube plugs into jack on rear	12V wall cube plugs into jack on rear	12V wall cube plugs into jack or PoE	Powered from internal rechargeable battery power supply	
Dimensions	47 x 200 x 130mm	212 x 114 x 40mm	208 x 110 x 43mm / 210 x 109 x 36mm	211 x 114 x 40mm	205 x 95 x 39mm	77 x 55 x 23mm / 105 x 80 x 29mm	114 x 80 x 29mm	103 x 190 x 33mm	93 x 73 x 29mm	94 x 96 x 36mm	

Notes: (a) The above refers to the rate for logging every single point in turbo mode. Above that rate, the instrument will sample points but not log every single point.
 (b) For pyroelectric sensors, maximum guaranteed baud rate is 9600.
 (c) StarLite must be USB enabled in order to work with StarLab. If your StarLite has not been USB enabled, please contact your Ophir distributor in order to obtain a USB Activation Code. Now available: StarLite with USB enabled (P/N 7Z01569)

2.3 Software Solutions

2.3.1 StarLab

StarLab turns your PC into a laser power/energy multi-channel station

Extensive Graphic Display of Data

- Line Plot, Histogram, Bar chart, Simulated Analog Needle
- Multiple data sets on one graph or separate graphs on the same screen

Advanced Measurement Processing

- Power/Energy Density, Scale Factor, Normalize against a reference
- Multi-channel comparisons
- User defined mathematical equations: channels A/B, (A-B)/C etc.
- Position & size measurement with BeamTrack sensors

Data Logging for Future Review

- Can be displayed graphically or saved in text format
- Easily exported to an Excel spreadsheet

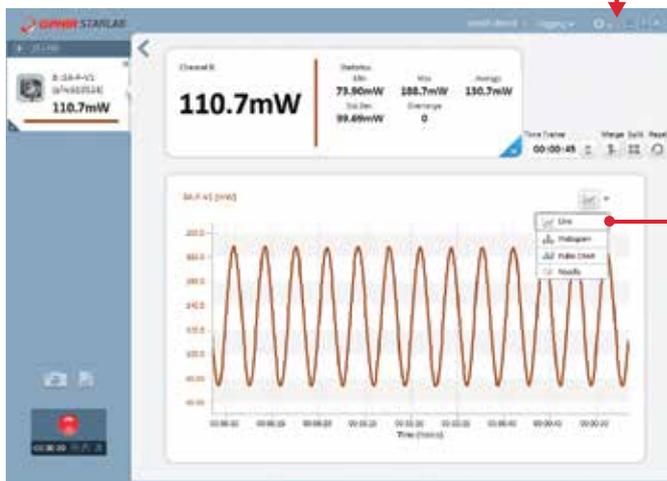
Fully supports IPM, Ariel, Centauri, StarBright, StarLite, Vega, Nova II, Pulsar, Juno, Juno+, Juno-RS, Quasar and EA-1 devices with all standard Ophir sensors

Flexible Display Options with StarLab

Choose which channels to display



Setup screen



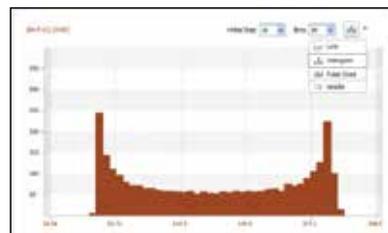
One of the above screens is maximized

You may choose to display them separately

Maximize one of the sources



Choose line graph



or histogram



or needle display

Multiple Sensors displayed together

- Click on one of the channels
- The numerical values are from the channel chosen



Here multi line graph display has been chosen

- Settings and functions may be opened to adjust then minimized as needed
- Additional functions are available from the "Functions" tab



Here multi line histogram display has been chosen

Functions and Logging

Functions

Click on f(x) to open another trace combining measured values



Define function combining measured values

New trace is now added per defined function

Files are stored here. They may be viewed graphically OR numerically

Logging

Click on log button and logging of values starts



```

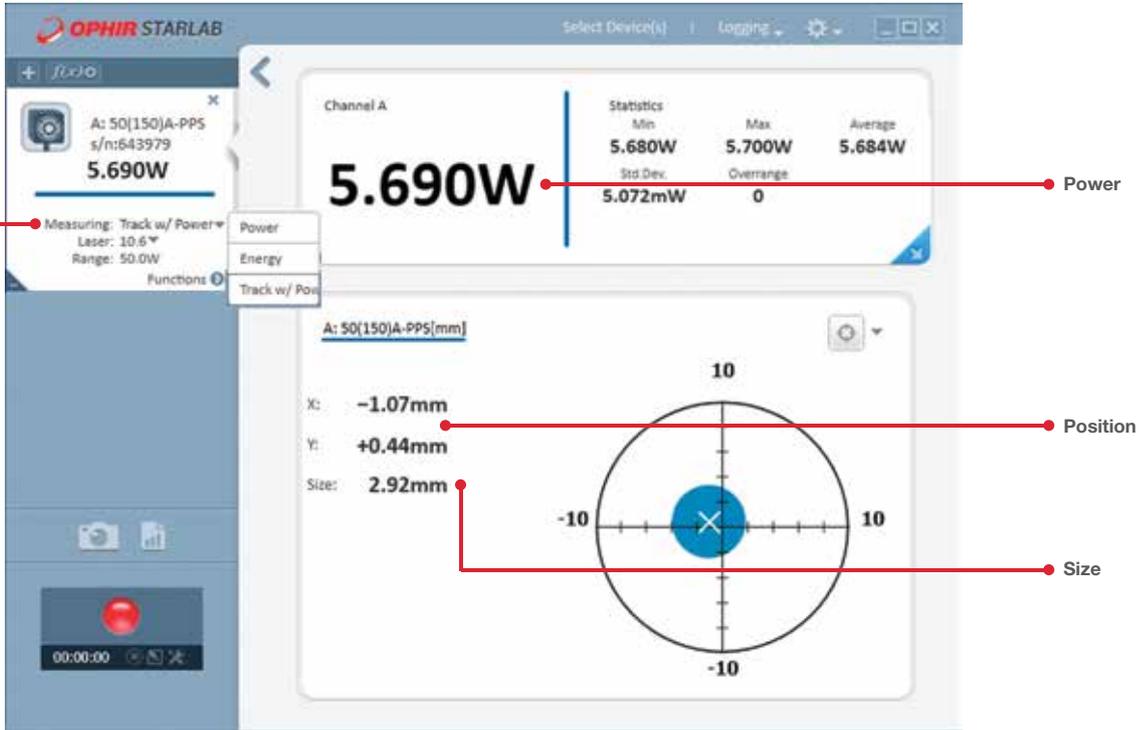
:PC Software:StarLab version 3.00 build 19
:Logged:25/05/2014 at 09:33:22
:Channel B:vega Thermopile 3A-P-V1 (s/n:999999) VG2.31 (s/n:657028)
:Channel A:Juno Photodiode P0300 (s/n:694646) JNL.24 (s/n:606180)
:Math M:(A-B)^2
:Channel B:Statistics
:Min:3.440mW
:Max:12.22mW
:Average:7.882mW
:Std.Dev.:3.078mW
:Overrange:0
:First Pulse Arrived : 25/05/2014 at 09:33:22.562000

```

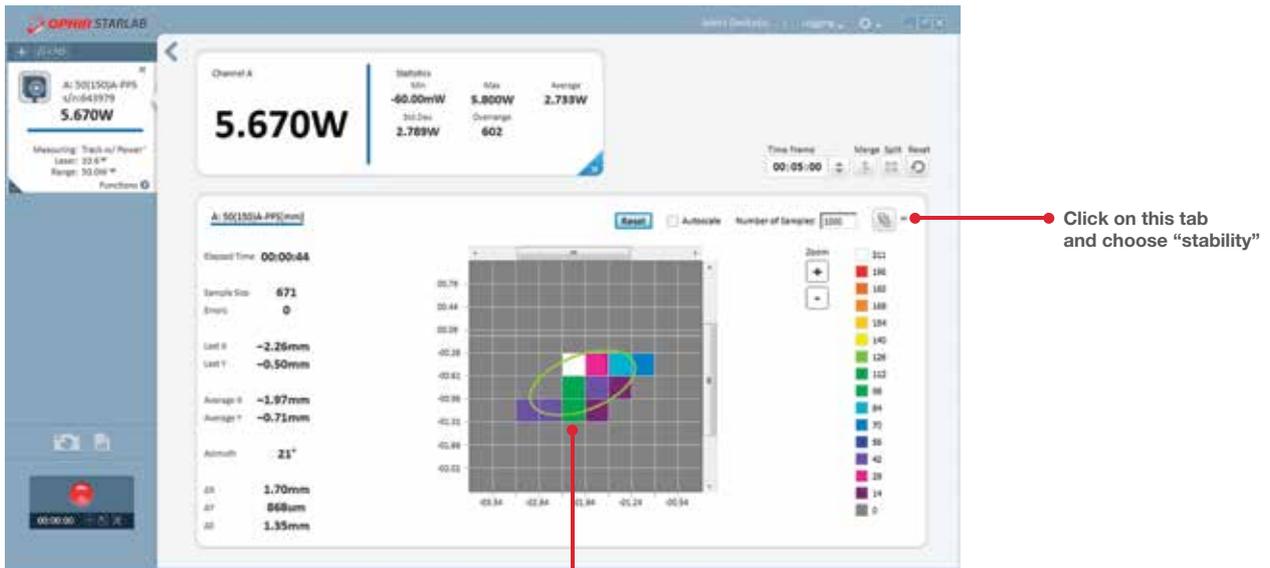
Timestamp	Channel B	F(B)	Channel A	Math M
0.000	1.762e-002	6.620e-003		
0.064	1.836e-002	7.350e-003		
0.128	1.911e-002	8.110e-003		
0.136			1.067e-002	6.554e-006
0.193	1.986e-002	8.860e-003	8.480e-003	1.444e-007
0.203			6.540e-003	9.181e-006
0.256	2.057e-002	9.570e-003		
0.269	2.123e-002	1.023e-002	4.900e-003	2.841e-005
0.321	2.182e-002	1.082e-002	3.550e-003	5.285e-005
0.354				
0.384	2.232e-002	1.132e-002		
0.406	2.291e-002	1.191e-002	3.400e-004	1.339e-004
0.449	2.258e-002	1.158e-002	3.600e-004	1.259e-004
0.593	2.216e-002	1.116e-002	4.800e-004	1.141e-004
1.003	2.164e-002	1.064e-002	7.600e-004	9.761e-005
1.056				
1.070	2.104e-002	1.004e-002	1.340e-003	7.569e-005
1.120				
1.136	2.038e-002	9.380e-003	2.370e-003	4.914e-005
1.184				
1.203				
1.664	1.558e-002	4.580e-003		

BeamTrack Power/Position/Size Screens

Open Measuring type tab and choose Track



Power / Position / Size screen



Position stability screen

Displays beam center wander weighted for dwell time at each position

2.3.2 System Integrator Solutions

Besides their use as stand-alone, fully featured laser power/energy meters, Ophir devices are easily incorporated into larger end-user applications. This allows system integrators to leverage Ophir's excellence in measurement capabilities with legacy analysis packages.

Communication Protocols

All Ophir devices support one or two forms of communication with the PC.

Device	USB	RS232	Bluetooth	Ethernet
Centauri	•	•		•
StarBright	•	•		
Vega	•	•		
Nova II	•	•		
*StarLite	•			
Nova		•		
Juno / Juno+	•			
Juno-RS	•	•		
EA-1	•			•
Pulsar	•			
Quasar			•	

* StarLite with USB enabled prestored (P/N 7Z01569) or with activation code (P/N 7Z11049) see page 182

USB

Ophir provides a common interface for communication and control of all of our USB speaking devices. OphirLMMMeasurement is a COM object that is included as part of the StarLab installation that allows the system integrator to take control of the Centauri, StarBright, StarLite, Juno, Juno+, Nova II and Vega devices; integrating them into his in-house measurement and analysis package.

For communication via USB, device drivers and additional support software must be installed on your PC. These components are installed as part of the StarLab application's installation process.

System Integrators will need the following components:

- OphirLMMMeasurement COM Object (found in Ophir website or with StarLab installation) lists and describes the methods and events available for configuring, controlling and uploading measurements from Ophir devices.
- OphirLMMMeasurement.dll. COM object component developed and supplied by Ophir for communication with the Centauri, StarBright, StarLite, Juno, Juno+, Nova II, Pulsar and Vega devices. The COM object is registered when the application is installed. OphirLMMMeasurement COM Object.pdf describes how to register it on another PC where the Ophir application has not been installed.
- Standard USB cable (P/N 7E01202) for use with the Pulsar device (included).
- Standard mini-B USB cable (P/N 7E01217) for use with the Juno and Juno+ devices (included).
- Nova II / Vega USB cable (P/N 7E01205) for use with the Nova II and Vega devices (included).
- StarBright / StarLite / Centauri micro-B USB cable (P/N 7E01279) for use with StarBright, StarLite and Centauri devices (included).

- Ophir provides example projects of COM Object clients in C++, C#, VB.NET, Java, Python, MATLAB, and LabVIEW. These are found in the Automation Examples subdirectory of our StarLab PC Application.

RS232

RS232 communication is the simplest to integrate into your Customized Solutions (OEM) application. Integrated Development Environments (IDE's) such as Microsoft Visual Studio provide functions and methods for accessing the PC's com port.

The following is all that you need to get your RS232 applications up and running

- User Commands document (found in Ophir website or with StarLab installation) contains an alphabetical listing and detailed description of all commands available with the Centauri, StarBright, Vega, Nova II and Juno-RS devices.
- Appendix A5 of the StarCom User Manual contains an alphabetical listing and detailed description of all commands available with the Nova device.
- Appendix A4 of the StarCom User Manual gives an example of polling the Nova device for measurements. This was written in VB6.
- An appropriate RS232 assembly
- Nova RS232 Assembly (P/N 7Y78105 ^(a)) for use with the Nova device
- Nova II / Vega RS232 cable (P/N 7E01206) for use with the Nova II and Vega devices (included with the Nova II / Vega)
- StarBright / Centauri RS232 cable (P/N 7E01213, included with the StarBright and Centauri)
- Juno-RS RS232 cable (P/N 7E11216, included with the Juno-RS)

Bluetooth

Bluetooth system integration for the Quasar is easily accomplished, in a similar way to our RS232 devices. For more information (and a list of commands), please contact Ophir.

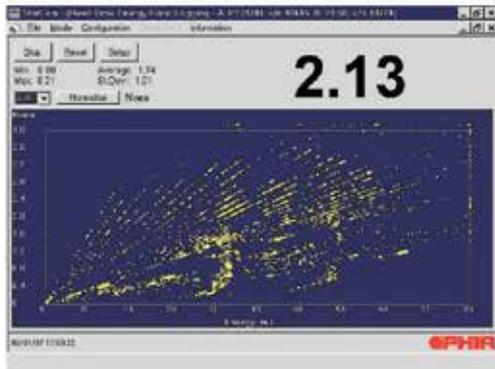
Ethernet

The EA-1 Ethernet Adapter device provides system integration using a Telnet connection over an Ethernet network. A list of user commands is provided, similar to the RS232 commands described above. See the EA-1 User Manual for more details, available on the website. The Centauri meter can be controlled via TCP/IP over an Ethernet network using ascii commands documented in the Ophir User Commands document (found in Ophir website or with StarLab installation).

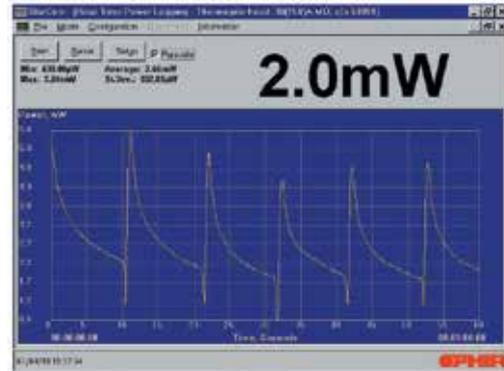
Note: (a) P/N 7Y78105 replaces P/N 78105

2.3.3 StarCom

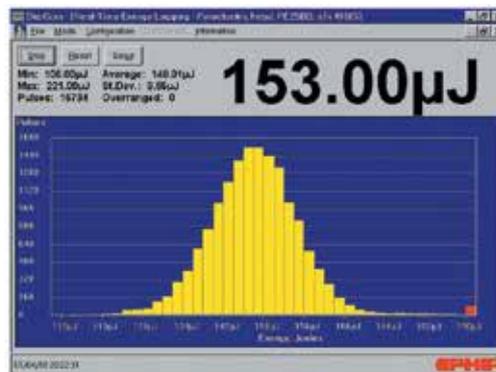
This software is supplied with the Nova II, LaserStar, Vega and Nova with RS232 option. It allows you to measure, analyze and record power and energy from any Ophir sensor. You can log the data from each sensor simultaneously to file.



Plot of ratio of energy B/A vs. energy A



Plot of power vs. time



Histogram plot of energy distribution

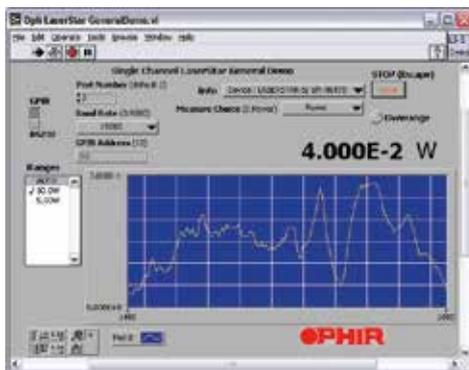
2.3.4 LabVIEW Solutions

Ophir has long recognized the growing LabVIEW community of developers. For over 10 years, we have been providing LabVIEW libraries for all of our devices. These are full open-source applications that can be used as is or tailored by the LabVIEW programmer to his specific needs.

These starter applications are basic software only that allows the LabVIEW programmer to experiment freely to fully feel the strength of our devices' respective command sets. These applications contain VIs (Virtual Instruments) to

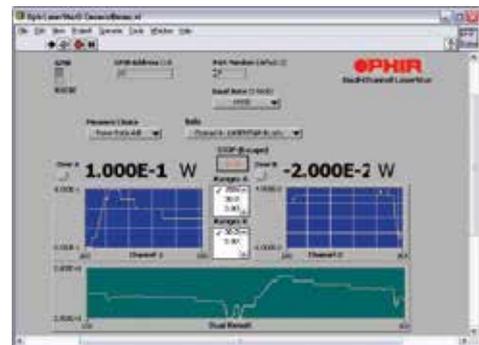
control the instrument. You can combine VIs to create successively larger and more versatile larger VIs by simply connecting them together. Users can create sophisticated, custom applications in minutes. In most cases, applications can be built and tested even before the instrument even arrives. The versatility of these tools is limitless.

All of our LabVIEW libraries can be downloaded from our web site: www.ophiropt.com



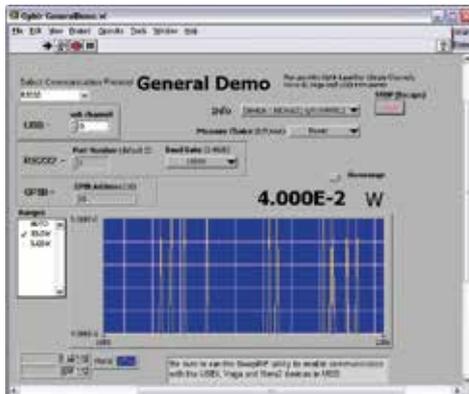
VI Libraries Ophnova.lib

Library supplied for use with the Nova. Communication is in RS232 and is based on NI-VISA.



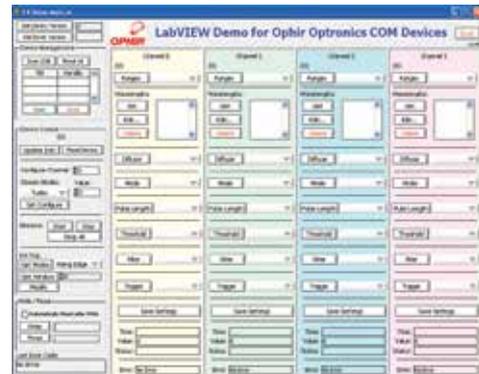
Ophistrd.lib

Library supplied for use with the Dual-Channel LaserStar. Communication can be set to RS232 or GPIB and is based on NI-VISA.



OphInstr.lib

This library can be configured to work with the Nova II, Vega, or Single-Channel LaserStar devices. It can also work with the Juno or Juno+ with a Thermopile or Photodiode sensors. It can be set to RS232, USB or GPIB. It is based on NI-VISA for all 3 communication protocols.



LabVIEW COM Demo.lib

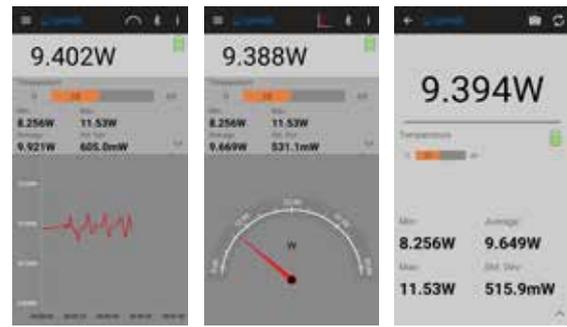
Library supplied for use with all of our USB speaking devices (Ariel, Centauri, StarBright, StarLite, Juno, Juno+, Nova II, Pulsar, Vega). Makes use of our COM object. Included with our StarLab application.

2.3.5 StarViewer

Description:

- Turn your smartphone or tablet into a laser power / energy meter
- Works a selection of Ophir devices
- Display measurements as line graph, simulated analog needle, or full screen numeric display with statistics
- Screen Capture and Share built into the application
- Measurement settings fully configurable to match your laser measurement needs
- Great for field technicians who make service calls

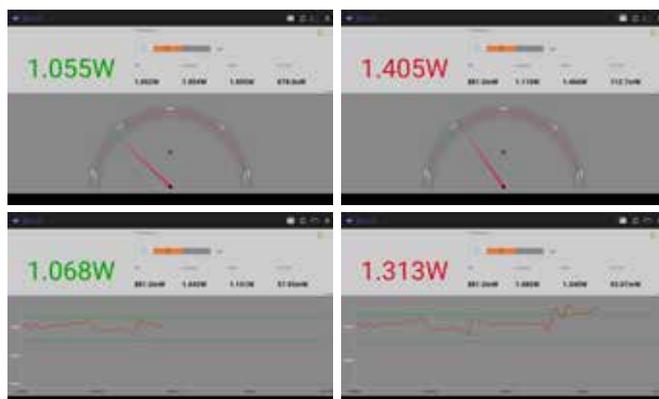
StarViewer brings laser power and energy measurement to your Smartphone / Tablet from selected Ophir devices. It is an intuitive easy-to-learn application. Just install it, connect to your device, and get started immediately. You can also perform a screen capture and share it. Great for field technician's reporting results back to the lab.



StarViewer (Android app)

Overview:

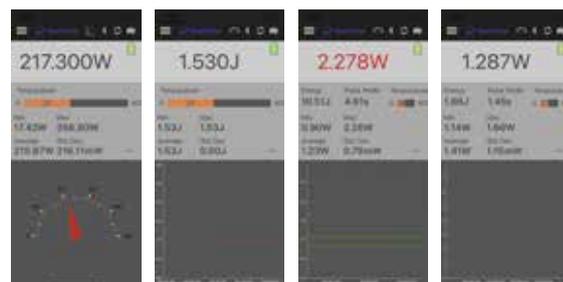
- (Android version 7 or higher). Available on Google Play or from the Ophir website here
- Works with Ariel/Juno/Quasar devices
- StarViewer brings laser power and energy measurement to your Smartphone / Tablet from our Ariel, Juno & Quasar devices
- Use latest release from Google store



StarViewer (iOS app)

Overview:

- (iOS version 8 or higher). Available on Apple's App Store
- Works with Ariel
- StarViewer brings laser power and energy measurement to your Smartphone / Tablet from our Ariel device
- Use latest release from Apple store



StarViewer (Android app)

Connectivity:

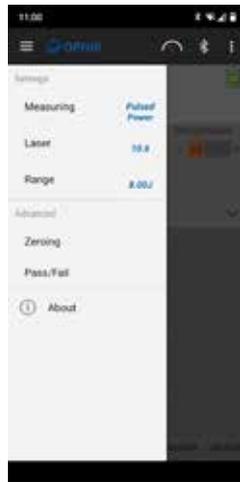
- StarViewer can be used with any standard Ophir Thermopile, Photodiode, or Pyroelectric PE-C sensor
- StarViewer can be used with the Juno via your device's USB on-the-go (OTG) port, or with the Quasar and Ariel via Bluetooth



The measurement settings are fully configurable by opening the settings panel at the left of the screen

For use with the Ariel:

- Bluetooth: Minimum version 4.0 required, 5.1 recommended
- Ariel firmware version 1.33 or higher (available here)
- StarViewer supports and leverages Ariel's measurement capabilities to display Continuous Power, Single Pulse Energy, and Pulsed power together with Pulse width, Battery level and temperature



Note: The Ariel you are using might have a lower F/W version, please update it to v1.33

For use with the Juno:

- Smartphone / tablet with an OTG port, capable of providing 100mA or more downstream current
- Optional - OTG adapter - from USB connector on your device to USB Type A Female Adapter (for Juno cable)
- Juno firmware version 1.39 or higher (available here)

For use with the Quasar:

- Bluetooth capability
- Quasar version 1.25 or higher (available here)
- PIN code for Bluetooth pairing is 1234

Note: StarViewer does not support measurement with Pyroelectric sensors with the Quasar

Requirements:

- Android version 7 or higher
- Available on Google Play or from the Ophir website here



Ophir StarViewer Android App

StarViewer (iOS app)

Connectivity:

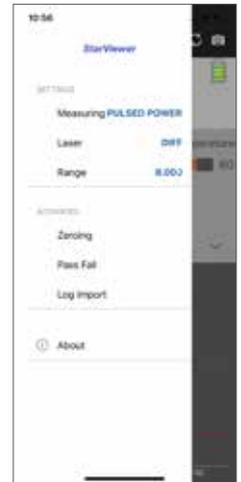
- StarViewer can be used with Ariel via Bluetooth



The measurement settings are fully configurable by opening the settings panel at the left of the screen

For use with the Ariel:

- Bluetooth: Minimum version 4.0 required, 5.1 recommended
- Ariel firmware version 1.33 or higher (available here)
- StarViewer supports and leverages Ariel's measurement capabilities to display Continuous Power, Single Pulse Energy, and Pulsed power together with Pulse width, Battery level and temperature



Note: The Ariel you are using might have a lower F/W version, please update it to v1.33

Requirements:

- iOS version 8 or higher
- Available on Apple's App Store



Ophir StarViewer iOS App

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Malta	Suratek Ltd	356 215 74385	ktech1@maltanet.net	•	•
Mexico	Newport Corporation, Ophir USA	435-753-3729	timothy.cheng@mksinst.com	•	•
Middle East	Newport Corporation, Ophir USA	435-753-3729	timothy.cheng@mksinst.com	•	•
Netherlands	Ophir Spiricon Europe	49-6151-708-0	ose-sales@mksinst.com	•	•
Norway	4Photonics AB	46 701 911 820	info@4photonics.com	•	•
Poland	Scitec Instruments Polska	48-22-254-9218	dorota.siwiec@scitecinstruments.pl	•	•
Portugal	M.T.Brandão, Lda.	351 2261 67370	mtb@mtbrandao.com	•	•
Romania	Electro-Total.	40-21-252-5781	anca.movila@electro-total.com	•	•
Russia	ElektroSteklo Crystaltechno	7-495-234-5952	ambukov@crystaltechno.com	•	•
Serbia	LRM	386 8 200 3155	robert.s@lrm.si	•	•
Singapore	Newport Opto-Electronics Technologies (Singapore) Pte. Ltd.	65-6451-1062	sales.sg@mksinst.com	•	•
Slovakia	Kvant spol. s r.o.	421-2-6541-1344	Milan.Grigel@kvant.sk	•	•
Slovenia	LRM	386-8 200 3155	robert.s@lrm.si	•	•
South Africa	Hitech Laser Systems	27-12-349-1250	hls@hitechlasers.co.za	•	•
Spain - Excluding Catalonia	Lasing	34-913775006	alvaro.guadano@lasing.com	•	•
Spain - Catalonia	Ophir Spiricon Europe	49-6151-708-0	ose-sales@mksinst.com	•	•
Sweden	4Photonics AB	46 701 911 820	info@4photonics.com	•	•
Switzerland	Ophir Spiricon Europe	49-6151-708-0	ose-sales@mksinst.com	•	•
Taiwan	Unice E-O Services Inc.	886-3-462-6569	brianh@unice.com.tw	•	•
Taiwan	Titan Electro Optics Co.	886-2-2655-2200	sales@teo.com.tw	•	•
Thailand	Hakuto (Thailand)	66-2-255 8910	rachata@hakutothailand.com	•	•
Turkey	Mitra A.S.	90-212-347-4740	info@mitralaser.com	•	•
UK	Ophir Spiricon Europe	49-6151-708-0	ose-sales@mksinst.com	•	•
Ukraine	IVL Equipment & Engineering, Ltd	380- 44 499 2132	ivl@ivl.ua	•	•
USA - Southern Regional Sales Manager AR, TX, LA, OK, KS, FL, GA, MS, SC, AL, NC	Newport Corporation, Ophir USA	435-753-3729	chuck.reagan@mksinst.com	•	•
USA - Pacific Northwest, Mountain States, and Latin American Sales Manager Alaska, Colorado, Hawaii, Idaho, Montana, Oregon, Utah, Washington, Wyoming, Latin America (including Puerto Rico), Western Canada	Newport Corporation, Ophir USA	435-753-3729	Timothy.Cheng@mksinst.com	•	•
USA - Mid-Atlantic Regional Sales Manager NY, CT, RI, VT, NH, ME	Newport Corporation, Ophir USA	435-753-3729	joshua.blackstock@mksinst.com	•	•
USA - ND, SD, NE, MN, IA, WI, MO, VA WV, PA, MD, NJ, DE, DC	Newport Corporation, Ophir USA	435-753-3729	mark.szorik@mksinst.com	•	•
USA - IL, IN, OH, MI, KY	Newport Corporation, Ophir USA	435-753-3729	John.McCauley@mksinst.com	•	•
USA - Santa Barbara / Los Angeles Area, AZ, NM	Newport Corporation, Ophir USA	435-753-3729	dan.ford@mksinst.com	•	•
USA - Northern California / San Diego County	Newport Corporation, Ophir USA	435-753-3729	Nathan.Brouwer@mksinst.com	•	•
Vietnam	MTC Equipment	24 3719 8669	khoi.ng@mtc.vn	•	•