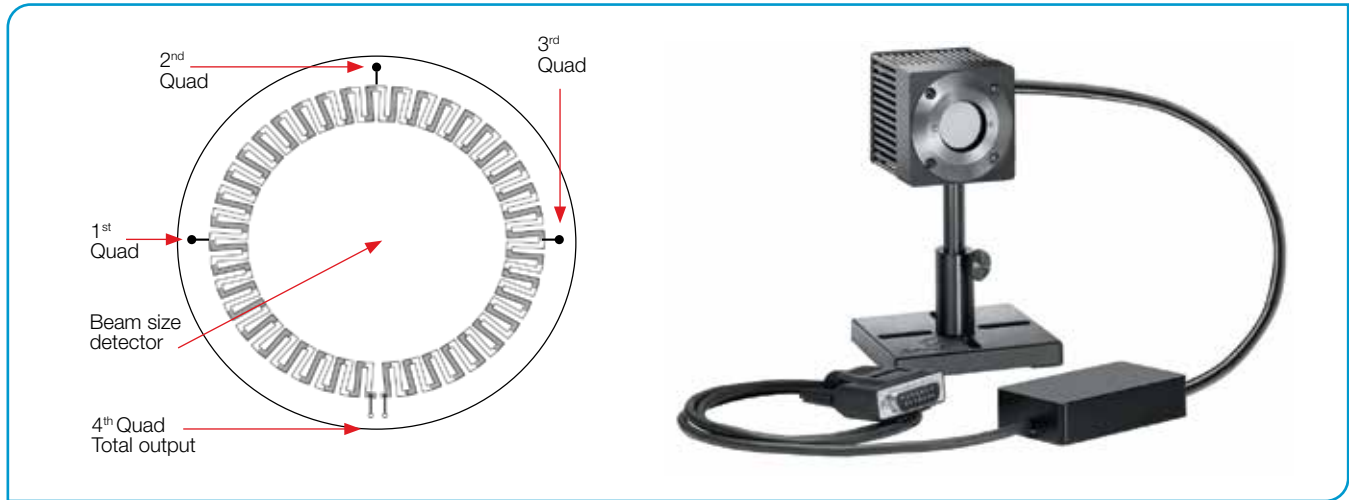


1.1.3 BeamTrack Power / Position / Size Sensors

1.1.3.1 Introduction

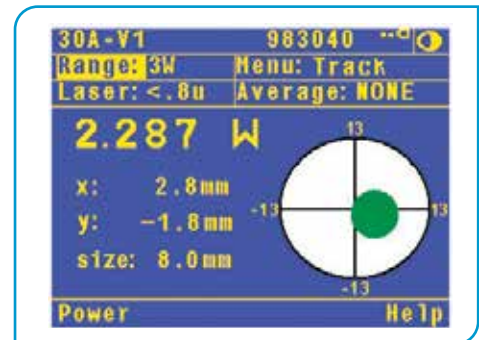
Ophir offers the BeamTrack line of thermal sensors that can measure beam position and beam size while measuring power. This innovative device will provide an additional wealth of information on your laser beam – centering, beam position, beam wander, beam size as well as power and single shot energy. 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+ 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-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

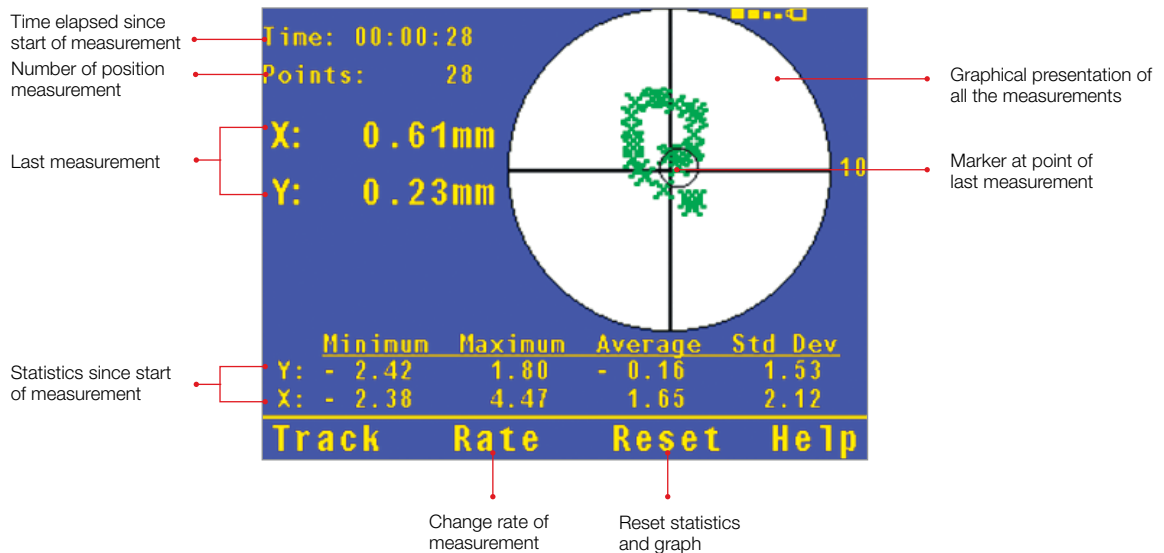
1.1.3.2 BeamTrack Device Software Support

- BeamTrack sensors are fully supported by the Centauri, StarBright, StarLite, Vega, Nova II, Juno, Juno+ 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

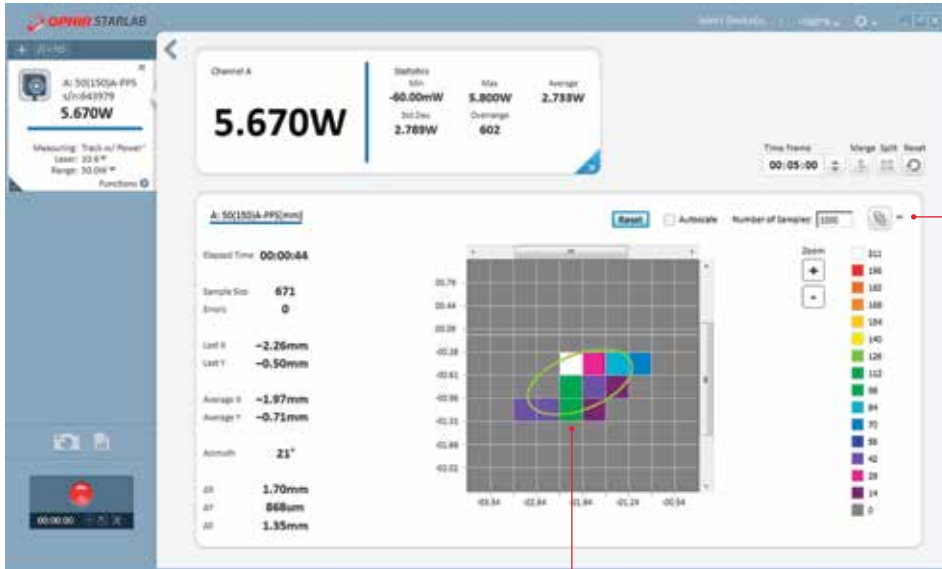


1.1.3.3 BeamTrack PC Software Support

- 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

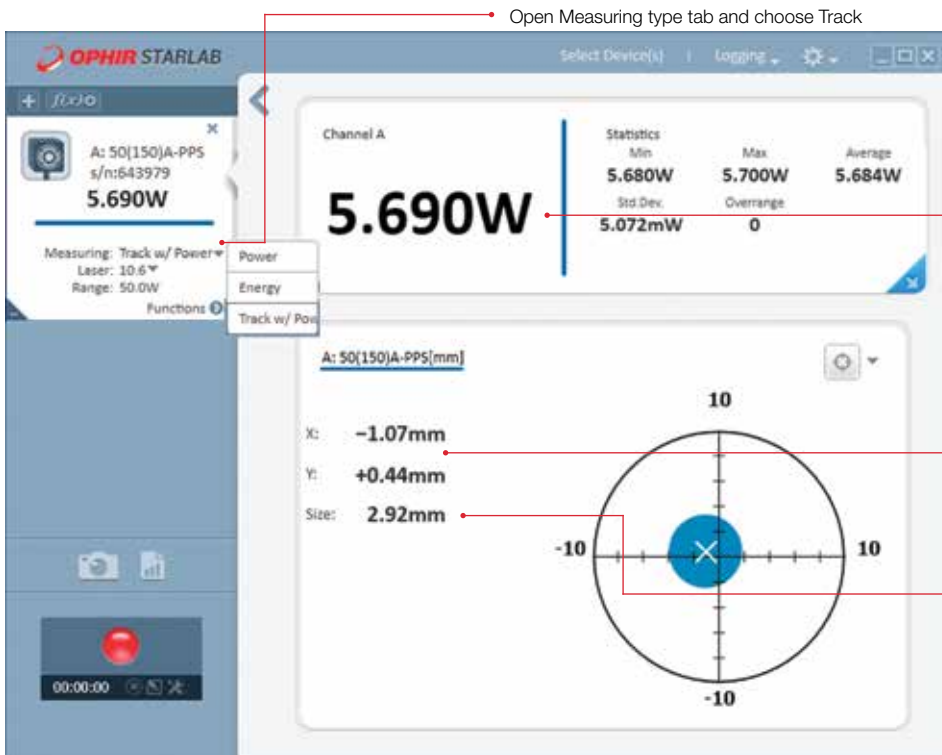


Click on this tab and choose "stability"

Position stability screen

Displays beam center wander weighted for dwell time at each position

Position & Size Screen



Open Measuring type tab and choose Track

Power

Position

Size

Power / Position / Size screen

1.1.3.4 Low Power BeamTrack-Power / Position / Size Sensors

100µW 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-PPS



Model	3A-QUAD ^(a)	3A-P-QUAD ^(a)	10A-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 - 20
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
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 93)	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
Part number	7Z07934	7Z07935	7Z07904

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

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

Notes: (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.

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

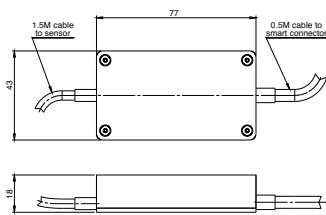
Notes: (e) Accuracy spec will be maintained for beams ≥1.8 mm not deviating from center by more than 15% of beam diameter.

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

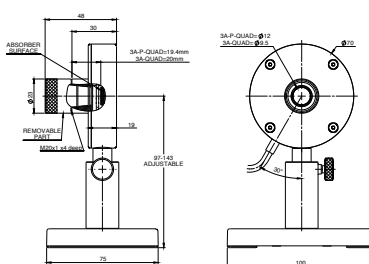
Wavelength	Derate to value
1064nm	not derated
532nm	not derated
355nm	40% of stated value
266nm	10% of stated value
193nm	10% of stated value

Notes: (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, Orion 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.

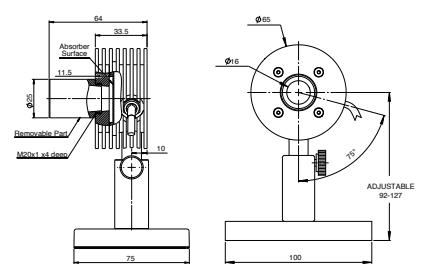
Interface Module on cable



3A-QUAD / 3A-P-QUAD



10A-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 - 20	0.19 - 20	0.19 - 20
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 ^(c)
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	3	3
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	0.1	0.1
Beam Position Resolution mm	2.5% of beam size	2.5% of beam size	2.5% of beam size
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 93)	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			
Part number	7Z07937	7Z07900	7Z07901

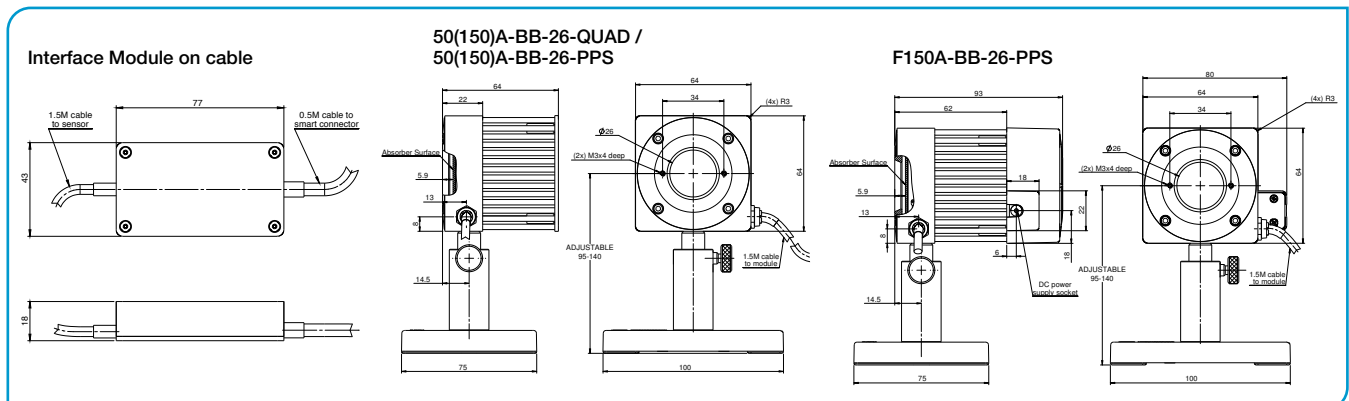
Notes: (a) The BeamTrack features are supported by Centauri, StarBright, StarLite, StarLite, Nova II and Vega meters, Juno, Juno+ and EA-1 interfaces and StarLab application. Position and Size measurements work only in Power mode (but not in single shot Energy mode).

Notes: (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.

Notes: (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 geometrical center or other desired position with Centauri, StarBright or StarLab.

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

Notes: (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 $\pm 10\%$.



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	0.2mm + 5% of distance from center ^(c)	0.5mm ^(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)	$\varnothing 5\text{-}35$	NA
Min Power Density for Size Measurement	$3\text{W}/\text{cm}^2$	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 93)	ST, FC, SMA, SC	Consult Ophir representative
Accessories for High Power Sensors	NA	See pages 82-86
Weight kg	0.9	0.9
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Version		
Part number	7Z07902	7Z07936

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

Notes: (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.

Notes: (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.

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

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

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

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

Notes: (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.

