

# BA Series Integrated Beam Analyzer



BA500



Beam Cube

## BA500, Beam Cube Industrial Laser Beam Analyzers

- Monitor all important beam parameters to keep tight control over process
- Powers up to 1500W, energies up to 100J and beam diameters up to 30mm or focal spots down to 50um
- Portable – can be moved from laser to laser to monitor all lasers in plant
- BA500 measures beam profile, temporal pulse shape, power, energy and frequency up to 1500W. For parallel beams only
- Beam Cube measures beam profile, focal spot position, temporal pulse shape and power, up to 150W. For measuring at or near focal spot

The BA500 and Beam Cube are comprehensive laser beam analysis systems for pulsed industrial Nd:YAG and Diode lasers for monitoring all important laser beam parameters so as to obtain reproducible laser cutting/welding process results. While intended for pulsed industrial lasers they can also accommodate cw beams.

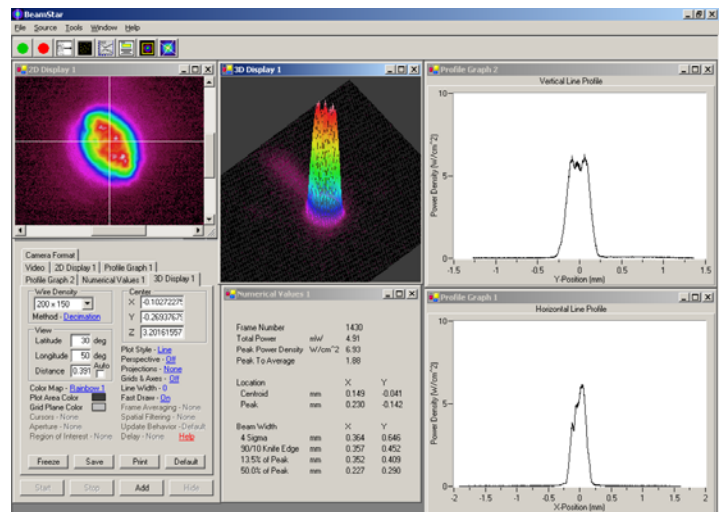
These systems measure average power, energy per pulse, spatial beam profile and temporal beam profile. All these quantities can be recorded in digital form for storage and analysis.

The Beam Cube is a self contained device that is tailored for industrial Nd:YAG or Diode laser systems of up to 150W. There is no need for the user to add any beam modifying beam splitters, attenuators or other components. The compact system easily fits into typical installations and is designed for vertical or horizontal laser beams. The Beam Cube can image the focal spot or a point on the beam not near the focus where the imaged cross section does not exceed ~3mm. It magnifies the beam 2 – 3 times depending on which lens is used so as to get the most resolution of the spot monitored. The lens is externally mounted so it can easily be switched. The lens can also be removed to measure parallel beams of up to 7mm in size.

The BA500 is a larger self contained device that is tailored for industrial Nd:YAG or Diode laser systems of up to 1500W. It is designed to image parallel beams of up to 30mm diameter and reduces the beam 7X.

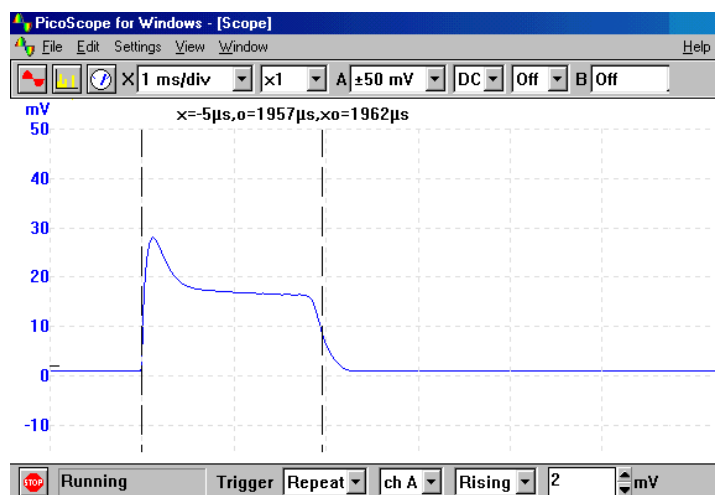
## Diagnostic Capabilities:Spatial Beam Profile

The BA500/Beam Cube show you the intensity profile of your beam in real time and allow you to adjust your laser resonator and beam delivery optical system for optimum beam quality on line. You can also measure the cross section at any point as shown. The illustration shows the intensity distribution of a pulsed Nd:YAG laser where the X and Y profiles are taken at the white lines which can be placed anywhere on the beam. This file can be saved, brought back and manipulated at any time so you can compare the present profile with a reference. These systems all have an exclusive optical system making it easy for you to adjust the intensity to get the optimum picture by just pushing and pulling the attenuating filter adjustment levers. The beam profile can also be shown in a three-dimensional form which can be rotated to different angles and elevations



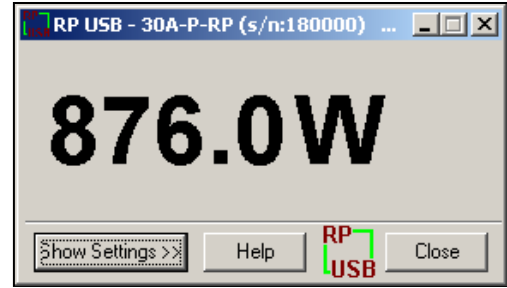
## Temporal Pulse Shape

The temporal profile of laser pulses, very important in obtaining consistent process results, can now be easily monitored. Shown to the right is the pulse shape of the same pulsed Nd:YAG laser with 2ms pulses. It is being measured with a PC oscilloscope available as an accessory. You can display the pulse shape alone or together with the beam profile on your PC. Alternately, plug the Beam Cube/BA500 output into an oscilloscope and show the temporal pulse shape profile of your laser beam.



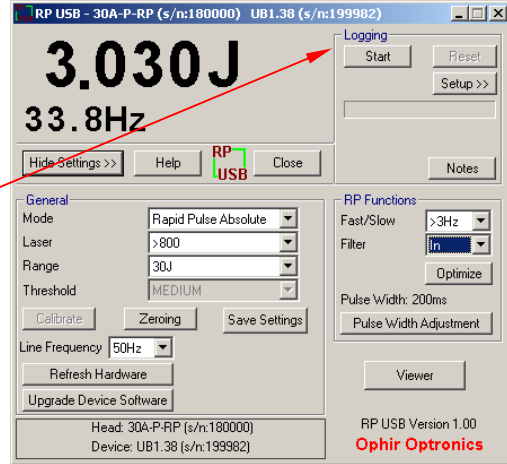
## Average Laser Power

With the Ophir USB Interface between the Beam Cube/BA500 unit and your PC or laptop, you can measure the average power of your laser to an accuracy of  $\pm 3\%$ . The BA500 RP power/energy measuring head has an exclusive damage resistant coating with a damage threshold of  $3\text{KW}/\text{cm}^2$ .



## Energy per Pulse and Frequency

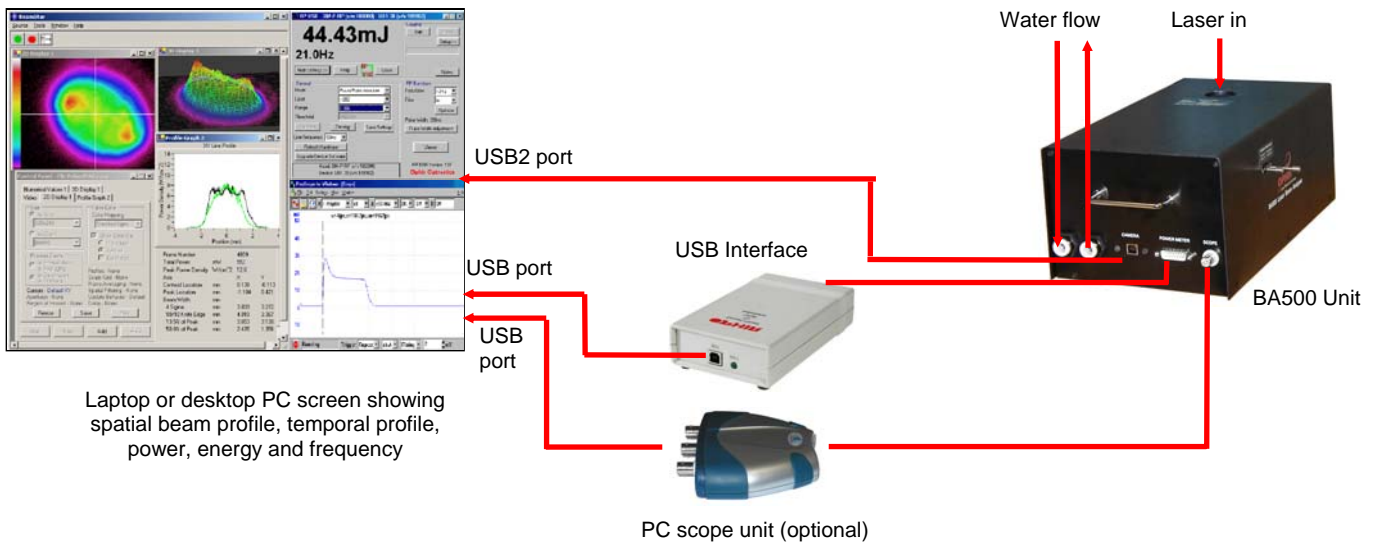
The patented RP head inside the BA500 is able to measure the energy per pulse and the frequency of the laser to high accuracy. With the USB Interface you can display this on your PC or laptop screen.



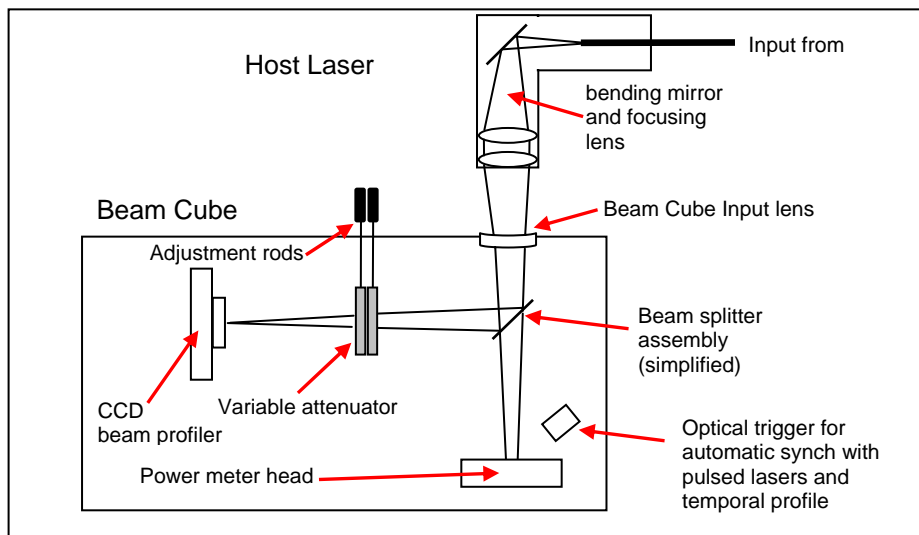
## Statistics

The Beam Cube/BA500 with USB Interface is able to record and store an unlimited number of points in your PC. The software provided has a number of ways of displaying the statistics of the data.

## Schematic setup of a BA500 system



### Simplified Schematic of Operation of Beam Cube System



# Specifications

General		Beam Cube	BA500	
Max and min average power		1W to 100W continuous and to 150W for up to 1 min	10W to 1500W	
Maximum average power density		4KW/cm <sup>2</sup> at entrance window		
Max and min energy		20mJ <sup>b</sup> to 100Joules	100mJ <sup>b</sup> to 100 Joules	
Maximum energy density and repetition rate at entrance window vs. pulse width	pulse width	max energy density	max energy density	max rep rate for energy measurement
	10ms	20J/cm <sup>2</sup>	150J/cm <sup>2</sup>	80Hz
	2ms	5J/cm <sup>2</sup>	40J/cm <sup>2</sup>	800Hz
	0.5ms	1.5J/cm <sup>2</sup>	8J/cm <sup>2</sup>	1KHz
Cooling System		Conduction cooled	Water-cooled Min flow rate: 2.5 liter/min	
Dimensions		22cm L x 16cm W x 14cm H	33cm L x 18cm W x 14cm H	
Spectral Range		400 – 1100nm (calibrated for 1064nm)	800 – 1064nm (calibrated for 1064nm and 800nm)	
<b>Beam profiler unit</b>				
Camera		Standard Beam Cube: SP503U 640x480 pixel camera with 9.9µm spacing Beam Cube 620: SP620U 800x1600 pixel camera with 4.5µm spacing	SP620U 800x1600 pixel camera with 4.5µm spacing	
PC interface		USB2		
Shutter speeds		Continuously variable 1/frame rate to 1/6,000, manual or automatic		
Gain control		0dB to 27dB in ~700 steps (each step is ~0.035dB). Manual or automatic control.		
Frame rate at 640x480 pixel ROI		Std Beam Cube: 60Hz. Auto synch with laser Beam Cube 620: 20Hz. Auto synch with laser	20Hz, auto synch with laser	
Software features		Automatic gain and shutter control. Peak and Centroid position tracking. 2D and 3D contour map. Sophisticated noise and background control. Best fit to gaussian or top hat profile 3D display viewable from any angle or elevation. Store and recall screens in single or video fashion. 3 different measures of beam width, %of peak, 4 sigma and 90/10 knife edge. Save numerical data files of profiles. Log data with time. Full on line instructions and help. Fully flexible screen format.		
Minimum PC system requirements		Pentium-4 2GHz, 256 MB Memory, Operating system, Windows XP Service Pack 2 or Vista 32.		
Intensity adjustment		Continuously variable filters actuated from outside the unit.		
<b>System optical performance</b>		<b>Beam Cube</b>	<b>BA500</b>	
Field of view		±6°	±2.5°	
Maximum beam size		φ22mm at entrance for converging beam, φ7mm for parallel beams	φ30mm	
Beam reduction or expansion		Expanded 2-3X . With no lens 1X	Reduced 7X	
Resolution		~5µm	~80µm	
<b>Power/energy / temporal profile unit</b>				
Temporal pulse shape response time into oscilloscope		200µs resp. time. Maximum peak power 1000W.	1µs resp. time. Maximum peak power 10,000W	
Software functions with USB Interface connected to PC or laptop		average power, statistics	average power, energy per pulse, pulse rate, statistics, missing pulses	
Data logging		Can send unlimited number of points in real time to PC via USB Interface at >1000 point/s. Windows software provided for data analysis.		

- Notes
- The power density limitation applies to any surface that the beam hits. For Beam Cube, since the object plane is outside the instrument, focal spots of much higher power density can be imaged as long as the power density limit on the optical surfaces is not exceeded.
  - The BA500 will not resolve pulses of energy below 100mJ unless the pulse rate is high. If the energy deposited in 1/50<sup>th</sup> of a second exceeds 100mJ, then the unit will be able to show the pulses even though the individual energies are below 100mJ. The same applies to the Beam Cube except the minimum is 20mJ.
  - If the beam power or energy density on the entrance window exceeds specifications, the window can be removed and not used, assuming that the power and energy density on the first beam splitter is below the damage threshold.

Ordering Information		
Item	Description	Ophir P/N
Beam Cube unit including internal beam profiler and RP unit	Beam Cube system for beam profile, pulse shape, power and energy including USB Interface box for transmitting power/energy information to PC . To be used with oscilloscope of user's choice. Includes -100mm lens assembly. Uses SP503 beam profiling camera	SP786015
Beam Cube 620	Same as above but with higher resolution SP620 camera	SP786016
Replacement -100mm lens assembly	Replacement -100mm lens assembly for Beam Cube	SPZ08256
-50mm lens assembly	Optional -50mm lens assembly for Beam Cube	SPZ08255
BA500-V2 unit including internal beam profiler and RP unit as well as external USB Interface	BA500-V2 system for beam profile, pulse shape, power and energy including USB Interface box for transmitting power/energy information to PC. To be used with oscilloscope of user's choice.	SP786013
Optional Carrying case for BA500	Carrying case for BA500 unit, optional Picoscope and cables.	1J02048
Optional Water circulator for BA500	Portable 30liter reservoir water circulator. For operation at 300W for up to 1Hr, at 1000W for 20 minutes. not RoHS	1Z17100
Optional PC oscilloscope	1MHz virtual oscilloscope for Beam Cube or BA500 to turn your PC into an oscilloscope displaying the temporal pulse shape. Uses PC or laptop USB port.	SPE10008