3.8 BeamWatch® Family

The BeamWatch family of products is the first to make use of Rayleigh scattering measurement to perform non-contact measurement of high power lasers.

3.8.1 Introduction To Rayleigh Scattering Measurement Technology

Disruptive Technology

BeamWatch is the first device to measure a laser without coming in contact with its beam which allows it to be the first laser quality measurement product in history to have no upper limit on the lasers which it can measure. BeamWatch provides high-power industrial laser users with data never before seen such as the dynamic measurement of focus shift caused by thermal effects on the laser system. BeamWatch also provides the industrial laser user with measurement of other key laser operating parameters in real-time.

The system measures the signal generated from Rayleigh scattering around the laser's beam waist, where the power density is the highest. Rayleigh scattering is a physical property of light caused by light scattering off of air molecules. Unlike traditional beam measurement systems, the beam passes directly through BeamWatch and is not disrupted, mechanically or optically. In addition, BeamWatch has no moving parts so there is no need for cooling of any components. Specialized system software dynamically measures the signal multiple times per second, allowing the laser user to key in on critical operational laser attributes, such as beam waist size and position with respect to the material being processed.

BeamWatch User Interface

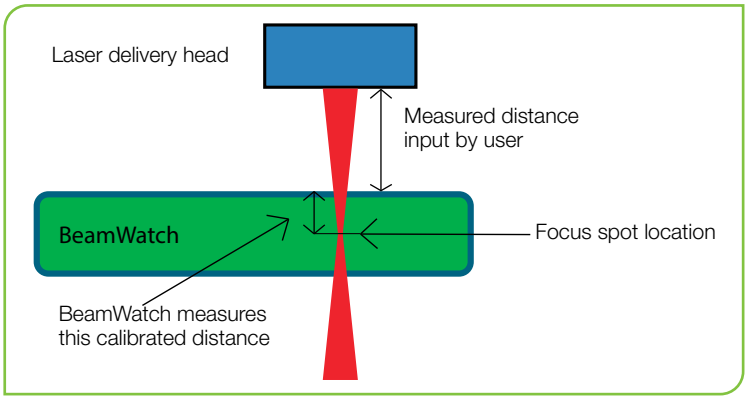
The user has access to those tools needed for start-up and advanced beam diagnostics.

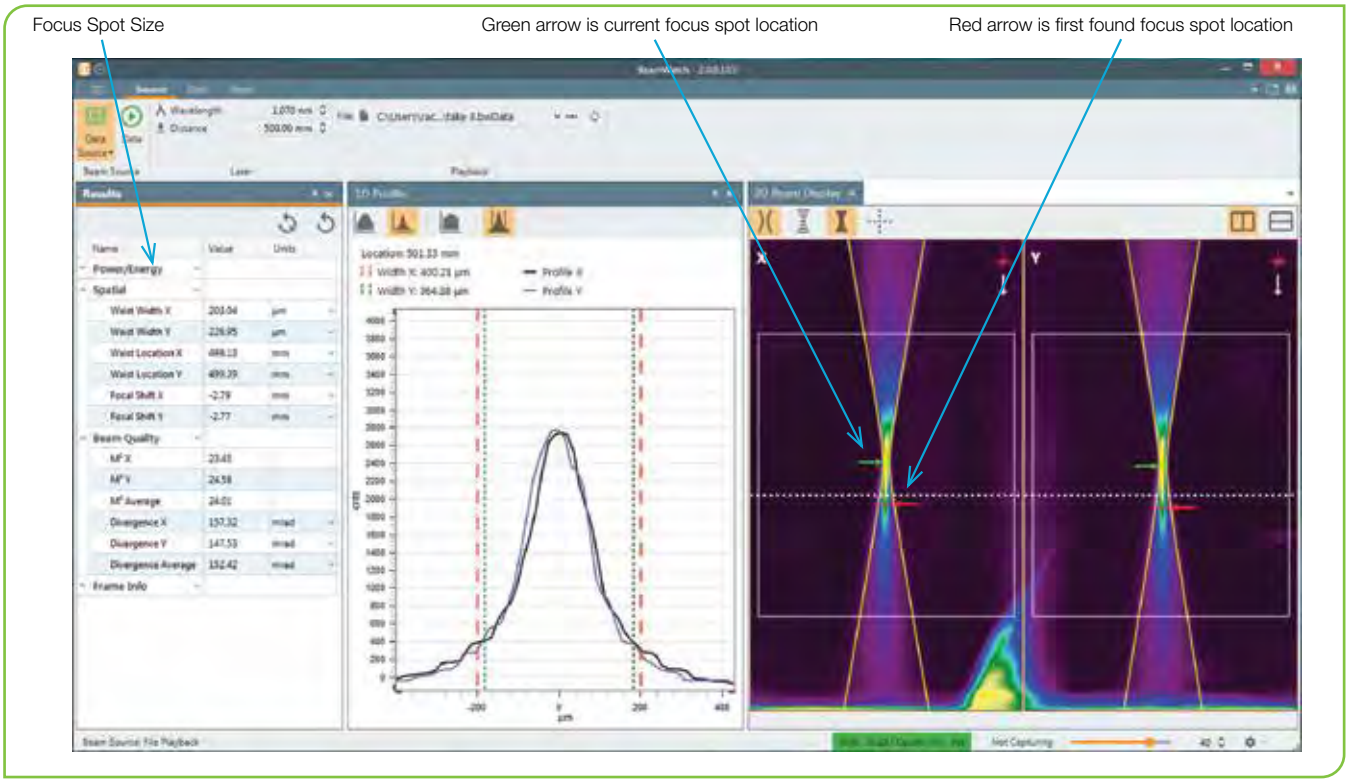
Focus Spot Size (Waist Width)

BeamWatch images the full beam caustic measuring the waist at its smallest point, many times per second.

Focus Spot Location

Now you can precisely know the dynamic behavior of focal spot shift throughout the laser duty cycle. By inputting the known distance from the laser delivery head to a precise datum on BeamWatch the focal spot distance is constantly measured and tracked with millisecond updates.





Assured Process Consistency

Measure as often as needed to assure repeatable and consistent process uniformity. Mount BeamWatch into the process or manually insert BeamWatch and make periodic measurements.
You can also automatically compare to initial process validation measurements and utilize automated pass/fail.

Automation Interface

BeamWatch includes the tools to support Automation Clients written in Visual Basic for Applications (VBA), C++ CLI, or any .Net compliant environment, such as Microsoft Excel or National Instruments' LabVIEW.

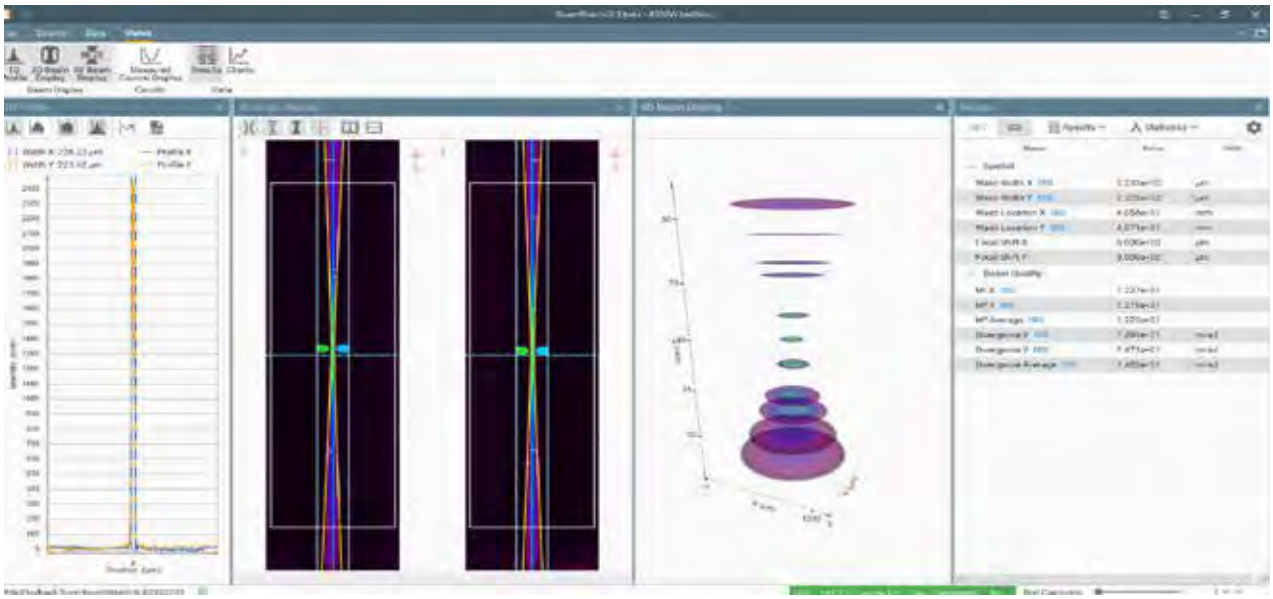
Software Features

Features	Dual Axis
Results - Power/Energy	Relative Power (Absolute Power when configured with Juno and an Ophir Power Meter)
Results - Spatial	Waist Width X & Y
	Waist Location X & Y
	Focal Shift X & Y
	Centroid X & Y
	Width at Cursor X & Y
	Ellipticity at Cursor
	Rayleigh Length X & Y
	Waist to Cursor X & Y
Results - Beam Quality	M^2 X & Y
	M^2 Average
	K X & Y
	K Average
	BPP X & Y
	BPP Average
	Divergence X & Y
	Divergence Average
Results	All results can be shown/hidden.
Frame Info	Frame ID
	Timestamp
1D Profile	Logarithmic or Linear
	Control to enable/disable the beam width markers
	Profiles are drawn at the cursor location. Cursor is controlled in the 2D display
	Display shows current cursor location and width at cursor results
	The X and Y profiles are overlapped in a single display
2D Beam Display	Overlays that can be enabled/disabled
	Fitted caustic and drawn beam area
	Raw data points
	Beam Image
	Alignment Crosshair – Marks the center of the display for each axis
	Beam can be displayed vertically or horizontally on the screen
	Labels indicate X and Y axis and the direction of beam propagation
	Cursor can be moved to any point along the beam
	Focal point indicators – one shows current waist position, another shows first found waist position
Statistics	Mean, Std Dev, Max, Min, and Sample Size
System Requirements	PC computer running Windows 7 (64) and Windows 10 Laptop or Desktop:
	GHz Pentium style processor, dual core recommended
	Minimum 2GB RAM
	Accelerated Graphics Processor
	Hard drive space suitable to hold the amount of video data you expect to store (50-100 GB recommended)

3.8.2 BeamWatch® Non-contact, Focus Spot Size and Position Monitor for high power YAG, Diode and Fiber lasers

- Instantly measure focus spot size
- Dynamically measure focal plane location during start-up
- From 400W and up – no upper limit (So far we have measured up to 100kW)
- Non-contact, laser beam is completely pass-through
- Automation Control Interface for System Integration
- GigE camera interface for local network installation
- Patented

BeamWatch utilizes disruptive technology to measure laser beam characteristics of very high power lasers. By not intercepting the beam and yet providing instantaneous measurements, you can now monitor the beam at frequent intervals without having to shut down the process or remove tooling and fixtures to get access. In addition, you can now measure focal spot location at several times per second and know if there is any focal spot shift during those critical start-up moments.

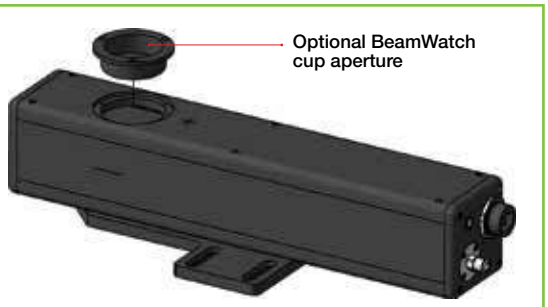


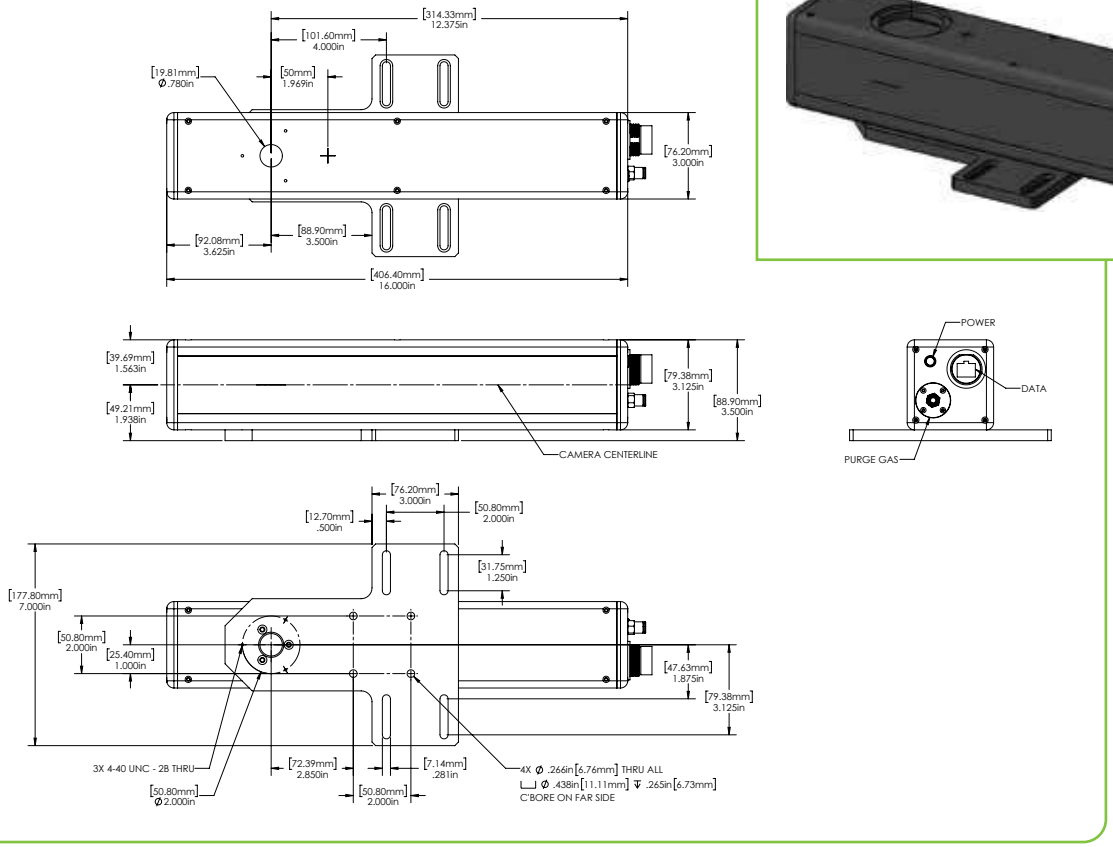
Specifications

Model	BW-NIR-2-155	BW-NIR-2-55
Beam Profiling		
Wavelengths	980-1080nm	980-1080nm
Minimum power density	2 Megawatts/cm^2	2 Megawatts/cm^2
Minimum spot size	155 microns	55 microns
Depth of filed (DOF)	25.74mm	9.01mm
DOF resolution	16.5µm	5.5µm
Maximum beam diameter at entrance/exit	12.5mm	12.5mm
Accuracy		
Waist width (Spot size)	±5%	±5%
Waist location	±125 micrometers within the BeamWatch window	±125 micrometers within the BeamWatch window
Focal shift	±50 microns	±50 microns
Beam parameter product	±3.5% RMS	±3.5% RMS
Divergence	±3.5% RMS	±3.5% RMS
M2	±3.5% RMS	±3.5% RMS
General		
Communication to PC	GigE	GigE
Power supply	12 Volts DC, 1.67 Amps max, 100-240V AC	12 Volts DC, 1.67 Amps max, 100-240V AC
Particulate purge	Clean Dry Gas, approximately 10 LPM	Clean Dry Gas, approximately 10 LPM
Weight	3.9 Kg	3.9 Kg
Dimensions	16in x 7in x 35in	16in x 7in x 35in
	406.4mm x 177.8mm x 88.9mm	406.4mm x 177.8mm x 88.9mm
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS
Ordering information		
Part Number	**SP90390**	**SP90391**

Suggested Add-Ons

Item	Description	P/N
Cup aperture	For those applications where the standard flat aperture does not position the delivery head close enough to the measurement centerline. Includes alignment tool SP90475	**SP90476**
Rotation Mount	Add-on 180° manual rotation mount to bottom of BeamWatch	**SP90346**
Locking Ethernet Cable	Replace standard Ethernet cable with one that locks into place, IP67 rated	**SP90394**
5000W-BB-50	5kW water cooled power sensor	**7Z02754**
10K-W-BB-45-V4	10kW water cooled power sensor	**7Z07102**
30K-W-BB-74	30kW water cooled power sensor	**7Z02757**
120K-W	100kW water circulated power sensor for laser with an approximately Gaussian beam and fiber output	**7Z02691**
Juno	Compact module to operate one Ophir sensor from your PC USB port	**7Z01250**
Vega	Hand held color universal power meter	**7Z01560**





Operating Space Charts

The plots are intended to give a visual indication of the recommended operating space for BeamWatch. If BeamWatch is operated outside of this space, it may be more difficult to see the curvature of the caustic or the beam may be large enough at the edges of the image that it is out of focus.
The maximum waist is dependent on the power density and M^2 of the beam. Specified is a minimum power density of 2 megawatts/cm^2 and the M^2 vs waist width is shown in the corn-looking graphs. Following these charts also covers the 12.5mm max beam size as it enters and exits the unit.

The 12.5mm maximum beam size at entrance and exit is the physical clear aperture of unit, and is the same for all models.

- Optimal has at least 3 Rayleigh lengths on both sides of the waist, with the waist at the center of the image
- Near Optimal has at least 3 Rayleigh lengths on 1 side of the waist, with the waist at the end of the image
- Acceptable has at least 1.5 Rayleigh lengths on both sides of the waist, with the waist at the center of the image