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User Notes

BEAMWATCH INTEGRATED

HIGH POWER INDUSTRIAL LASER MEASUREMENT AND PROFILING

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Safety

While BeamWatch Integrated itself does not present the user with any safety hazards, this instrument is intended for use with laser systems. Therefore, the user should be protected from any hazards that the laser system may present. The greatest hazards associated with laser systems are damage to the eyes and skin due to laser radiation.

Optical Radiation Hazards

BeamWatch Integrated is designed for use with high power lasers and therefore safety precautions must be taken. The user must be protected against accidental exposure. Exposure to personnel other than the user must also be considered. Hazards include direct beam exposure and reflected radiation. Protective eye shields and clothing must be worn.

Electrical Hazards

BeamWatch Integrated utilizes only low voltages, derived from the Ethernet, PROFINET, and camera power supplies. Thus there is little risk of electrical shock presented to the user.

When installing or removing any hardware from a PC, the power to the computer should always be disconnected.

The computer should always be operated with its covers in place and in accordance with its manufacture's recommendations.

The computer should always be operated with a properly grounded AC power cord.

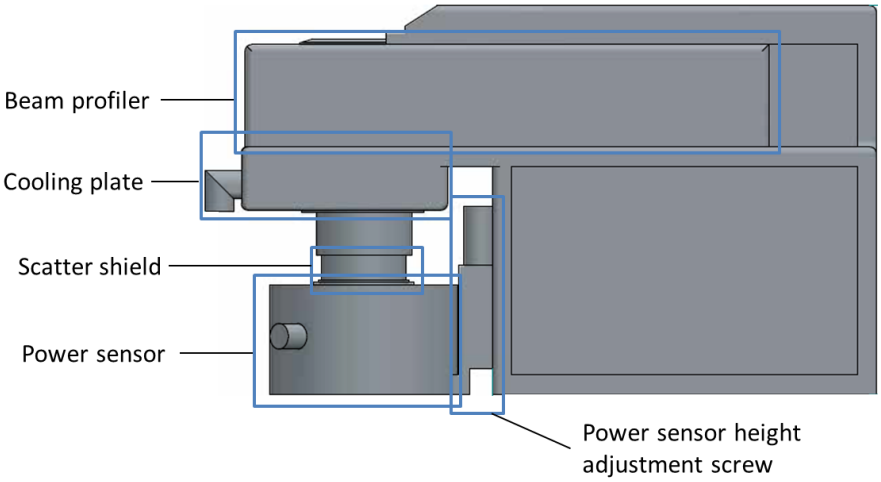
CHAPTER 1 Introduction

1.1 Description

BeamWatch Integrated combines a non-contact beam profiler with a power sensor.

The water cooling plate under the beam profiler maintains acceptable temperatures. The cooling plate also includes a flow meter and a temperature sensor.

The power sensor includes a height adjustment screw to adapt to different laser sources. This allows positioning the power sensor at the location where the laser power density is within the specifications.



1.2 Principle

1.2.1 Beam Profile Measurement

BeamWatch Integrated uses the standard BeamWatch principle. BeamWatch is the laser industry's first beam monitoring system that is completely non-interfering; i.e. there is no contact with the laser beam for the profile measurement. The measurement is made by imaging the Rayleigh scatter of the beam from the side using conventional cameras. Since nothing is inserted or scanned through the beam, it is ideal for measurement of high power lasers in the multi-kilowatt regime.

BeamWatch Integrated provides simultaneous measurement of multiple profiles along the beam caustic in the camera field-of-view (FOV). Operating at video rates, the speed of measurement allows for real-time determination of waist (focus spot) width and location, focal shift, centroid, M^2 or K, divergence, Beam Parameter Product, Rayleigh length, and power. The real-time performance also allows for measurement of dynamic focal shift during laser startup.

The technique is based on Rayleigh scattering of laser light by oxygen and nitrogen molecules in the air as the beam propagates. Measurement of this scattered light provides an equivalent slit scan of the laser beam in the direction of the view observed. The scattered light is measured using conventional CCDs and image capture systems.

1.2.2 Beam Power Measurement

BeamWatch Integrated uses a water cooled thermal power laser measurement sensor with a 45mm aperture allowing power measurements from 100W to 11,000W (measurements up to 30kW are possible on request with a different sensor).

BeamWatch Integrated has a deflecting cone and annular absorber that withstands high power densities to 10kW/cm².

1.3 Operation Example: Laser Welder in a Robotic Cell

A typical application of the BeamWatch Integrated is to check the laser parameters of a laser welder between welds. This process can be automated and optimized to take the least amount of time away from production as possible. Below is a typical sequence of events:

1. Welding production "Item A" is near complete
2. Open BeamWatch Integrated shutter and check sensor is "Ready"
3. Finish welding production "Item A"
4. Turn off laser
5. Move laser to BeamWatch Integrated
6. Turn on laser
7. Record measurement
8. Turn off laser
9. Move laser back to production
10. Start welding production "Item B"
11. Read measurement (maximum 3 seconds after laser measurement)

1.4 Inventory

- 1 BeamWatch Integrated system
- 3 cooling water tubes
- 1 mounting bracket for water tubes with stainless steel connectors
- 2 keys for the key switch
- 1 alignment tool
- 1 power cable, 24 V/ 3 A, M12 plug, 4-pole, free cable end, A-coded, 5 m
- 1 PROFINET or EtherNet/IP or CC-Link cable, M12 plug, 8-pole, RJ45 Plug, X-coded, 5 m
- 1 Ethernet cable, M12 plug, 8-pole, RJ45 Plug, X-coded, 5 m
- 1 BeamWatch software (USB stick or link to download)
- 1 manual
- 3 calibration certificates (Beam profiler, Power sensor, Power sensor interface)

1.5 Spare parts

Spare part	Description	P/N
Alignment tool	BW-I Alignment tool	SP90552
Keys	BW-I Keys (set of two)	8G08100
Communication cable	Cable Ethernet plug RJ45 to M12 5m	7E11209
Power cable	Cable M12 4 pins female unshielded 5m (open end)	7E11210
Cooling tubes	BW-I water cooling tubes	1G08178
Bracket for tubes	BW-I mounting bracket for water connectors (incl. screws)	1G08179
Case for 500 version	BW-I-500 Case with foam and silica gel	7J02169
Case for 150 version	BW-I-150 Case with foam and silica gel	7J02170
Optional power adapter	BW-I Power adapter 220/100 VAC to 24 VDC	7E05090A

1.6 Different versions

To accommodate different laser sources and industrial interfaces, BeamWatch Integrated is available in the following versions:

P/N	Description	Minimum Focus Spot Size [a]	Field of View [b]	Interface	Distance between focus and power meter
SP90512	BW-Integrated-150-NIR-155-Profinet	155 µm	33 mm	ProfiNet	150-175 mm
SP90527	BW-Integrated-500-NIR-155-Profinet	155 µm	33 mm	ProfiNet	500 mm
SP90528	BW-Integrated-150-NIR-155-Ethernet/IP	155 µm	33 mm	EtherNet/IP	150-175 mm
SP90529	BW-Integrated-500-NIR-155-Ethernet/IP	155 µm	33 mm	EtherNet/IP	500 mm
SP90537	BW-Integrated-150-NIR-155-CC-Link	155 µm	33 mm	CC-Link	150-175 mm
SP90538	BW-Integrated-500-NIR-155-CC-Link	155 µm	33 mm	CC-Link	500 mm
SP90584	BW-Integrated-150-NIR-55-Profinet	55 µm	11 mm	ProfiNet	150-175 mm
SP90585	BW-Integrated-500-NIR-55-Profinet	55 µm	11 mm	ProfiNet	500 mm
SP90586	BW-Integrated-150-NIR-55-Ethernet/IP	55 µm	11 mm	EtherNet/IP	150-175 mm
SP90587	BW-Integrated-500-NIR-55-Ethernet/IP	55 µm	11 mm	EtherNet/IP	500 mm
SP90588	BW-Integrated-150-NIR-55-CC-Link	55 µm	11 mm	CC-Link	150-175 mm
SP90589	BW-Integrated-500-NIR-55-CC-Link	55 µm	11 mm	CC-Link	500 mm

Note (a): Smaller spot sizes can be measured but might result in higher uncertainty. Please contact your local supplier for free onsite demo.

Note (b): These values represent the part of the caustic viewed by the camera. For result calculation, a smaller part is used; respectively 25.74 mm and 9.01 mm.

The sole difference between the 150-175 mm and the 500 mm versions is the distance between the laser focus and the power sensor. The 150-175 mm version is suited for most multi-mode lasers while the 500 mm version is best suited for most single-mode lasers. Contact MKS Ophir to know which version will best suit your application.

BeamWatch Integrated with 150-175 mm distance between focus position and power meter

BeamWatch Integrated with 500 mm distance between focus position and power meter

1.7 Specifications

Beam profiler and power meter

The latest specifications can be found on our website, search for BeamWatch Integrated: www.ophiropt.com.

Wavelength	980 - 1080 nm	
Power range	500 W - 9999 W (up to 30 kW on demand)	
Maximum power density at power meter [a]	**Beam diameter**	**Max power density**
	< 15 mm	10 kW/cm²
	15 - 20 mm	7 kW/cm²
	20 - 40 mm	5 kW/cm²
	40 - 45 mm	4 kW/cm²
Camera field of view inside the unit	32.17 mm x 8.55 mm	
Maximum entrance beam diameter	12.5 mm	
Communication	GigE Ethernet / PROFINET or EtherNet/IP or CC-Link	
Power supply	24 Volts DC, 5 Amps max	
Backscattered power	< 1 %	
Power sensor response time	2.7 s max for 10 kW (faster at lower powers)	
Power noise level	25 W	
Linearity with power	±2%	
Power accuracy [b]	±5%	
Waist width accuracy	±5%	
Waist location accuracy	±125 µm within the BeamWatch window	
Focal shift accuracy	±50 µm	
BPP accuracy	±3.5% RMS	
Divergence accuracy	±3.5% RMS	
M² accuracy	±3.5% RMS	
Particulate purge	Clean dry gas (Air, Nitrogen, Argon) 5-10 l/min, 6 bar	
Water cooling [c]	Clean non-corrosive water 8 l/min, 18-30 °C, 6 bar, ~2 bar pressure drop	
Weight	25 kg	

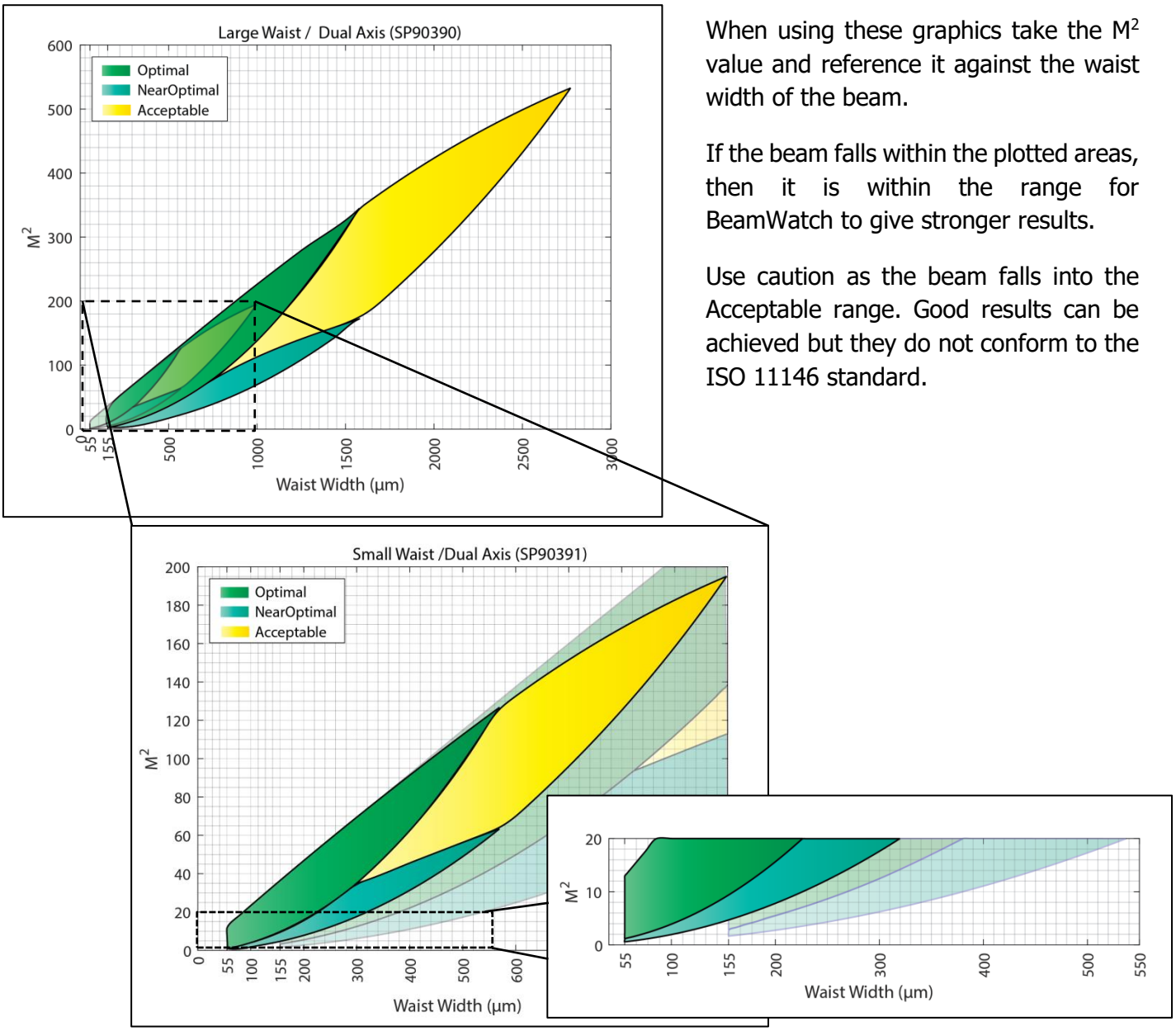
Note (a): For circular beam centered within ¼ of beam diameter. IMPROPERLY CENTERED BEAM CAN CAUSE DAMAGE TO SENSOR. Maximum tilt angle on power sensor ±5 degrees. For rectangular beam please consult MKS Ophir representative.

Note (b): Calibrated at 1.07µm and 10.6µm. For other wavelengths in the range 0.8 – 2µm add up to ±2% to the calibration error.

Note (c): Water temperature rate of change <1ºC/min. The recommended flow rate can be lowered proportionately at lower than full power but should not be below 3 l/min. The response time will be optimum with the recommended flow rate.

The plots below are intended to give a visual indication of the recommended operating space for BeamWatch Integrated. If BeamWatch Integrated 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.

- 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 one 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

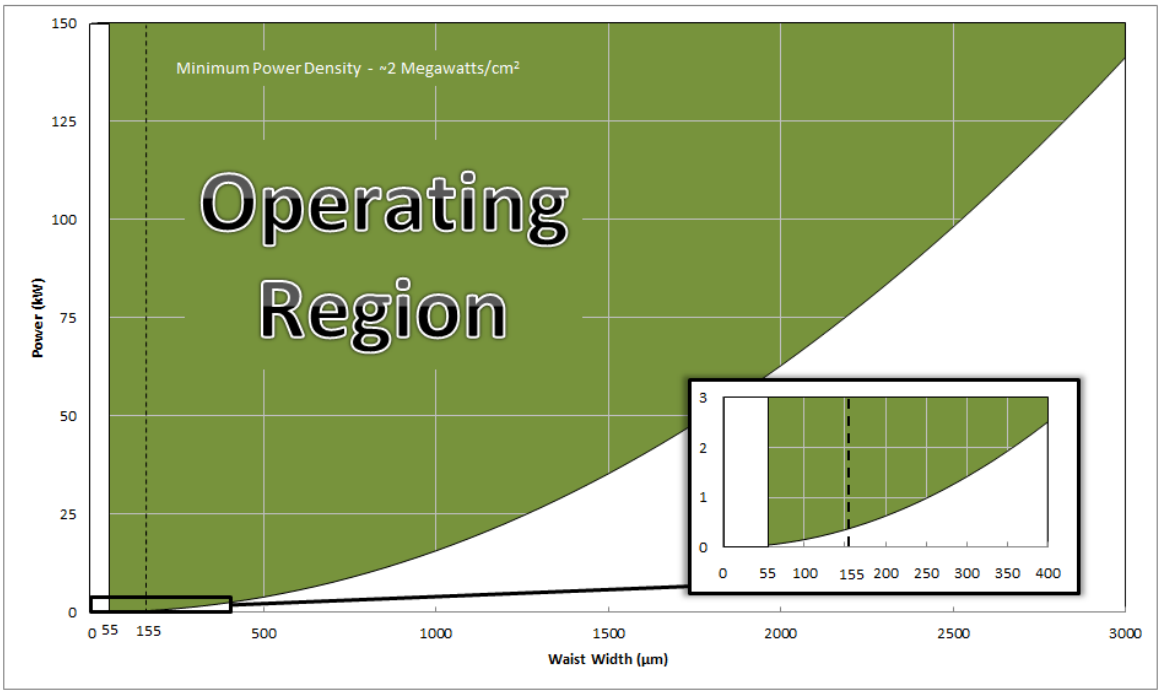


When using these graphics take the M^2 value and reference it against the waist width of the beam.

If the beam falls within the plotted areas, then it is within the range for BeamWatch to give stronger results.

Use caution as the beam falls into the Acceptable range. Good results can be achieved but they do not conform to the ISO 11146 standard.

The power density also plays a role in the operating space. The chart below shows the required power vs. focus spot size for a top hat beam.



The equation to estimate the maximum spot size is derived from the power density equation.

$$\text{Power Density} = \frac{P_{ave}}{A_{1/e^2}} \geq 2 \times 10^6 \frac{W}{cm^2}$$

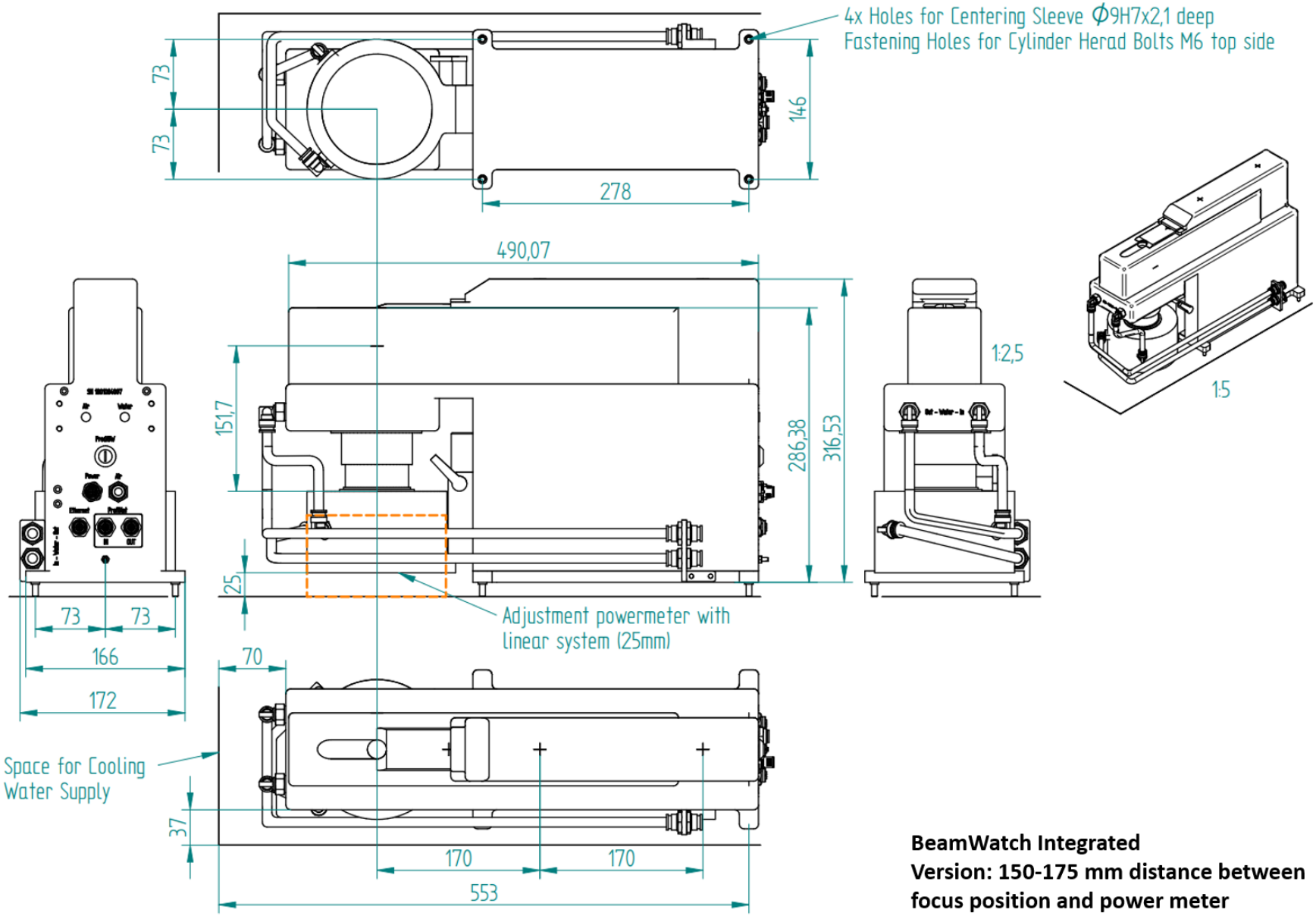
Where P_{ave} is the average beam power and A_{1/e^2} is the area of the beam at the $1/e^2$ location.

1.8 Computational Accuracy

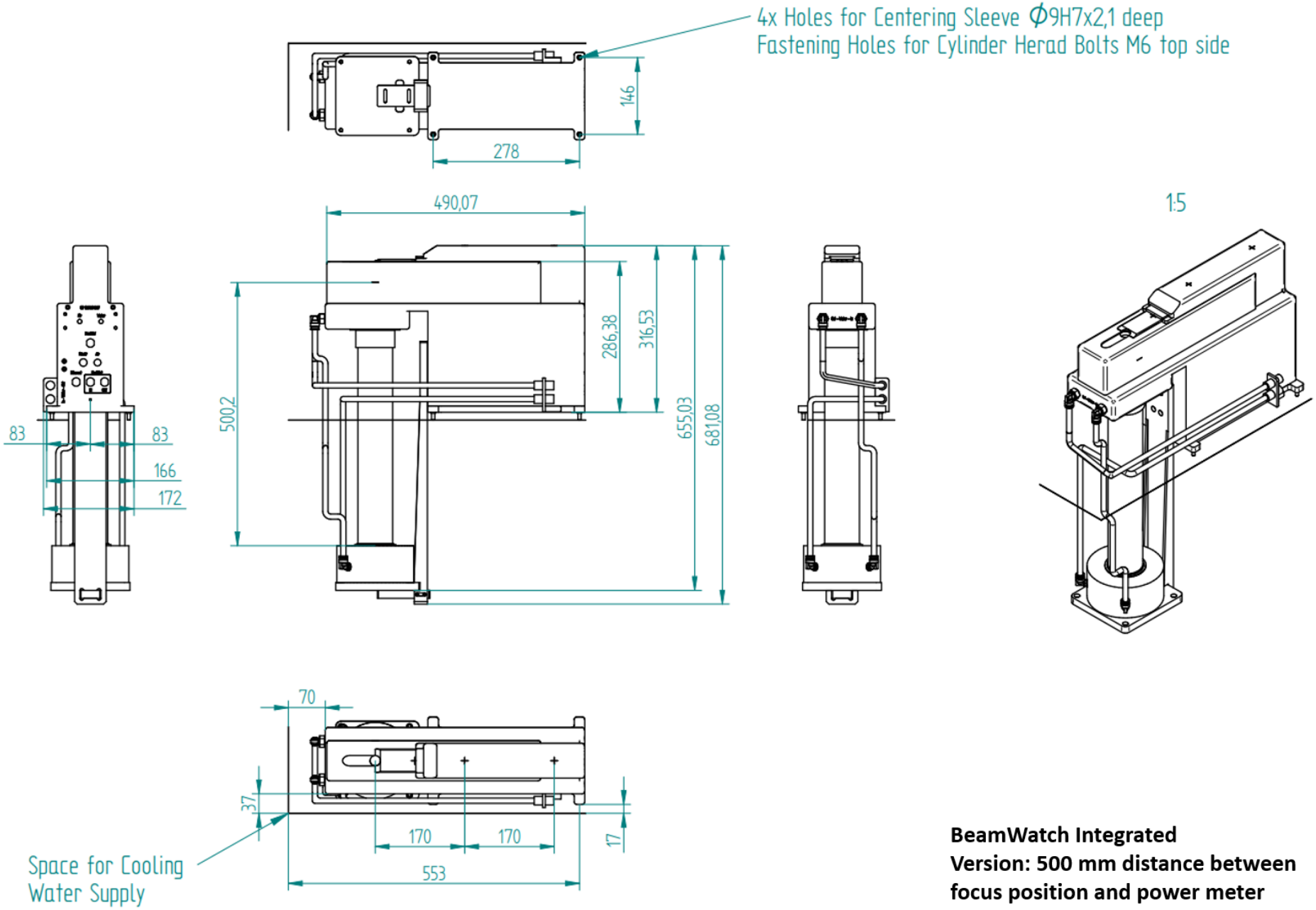
The focus spot size is calculated in milliseconds without contacting the beam. BeamWatch Integrated produces accurate results to within ±5%.

BeamWatch is the first product capable of measuring dynamic focal point shift. This focus position is measured in two dimensions; along the caustic and orthogonal to the camera viewing direction. Measurement of these at the BeamWatch Integrated video frame rate of ~6Hz provides dynamic measurement of the focal shift in near real-time. This is useful to find the behavior of the focal spot during critical startup moments and how it may vary after running for long periods of time. Within the BeamWatch Integrated measurement window, the accuracy of the focal point location is ±125µm.

1.9 Mechanical Dimensions

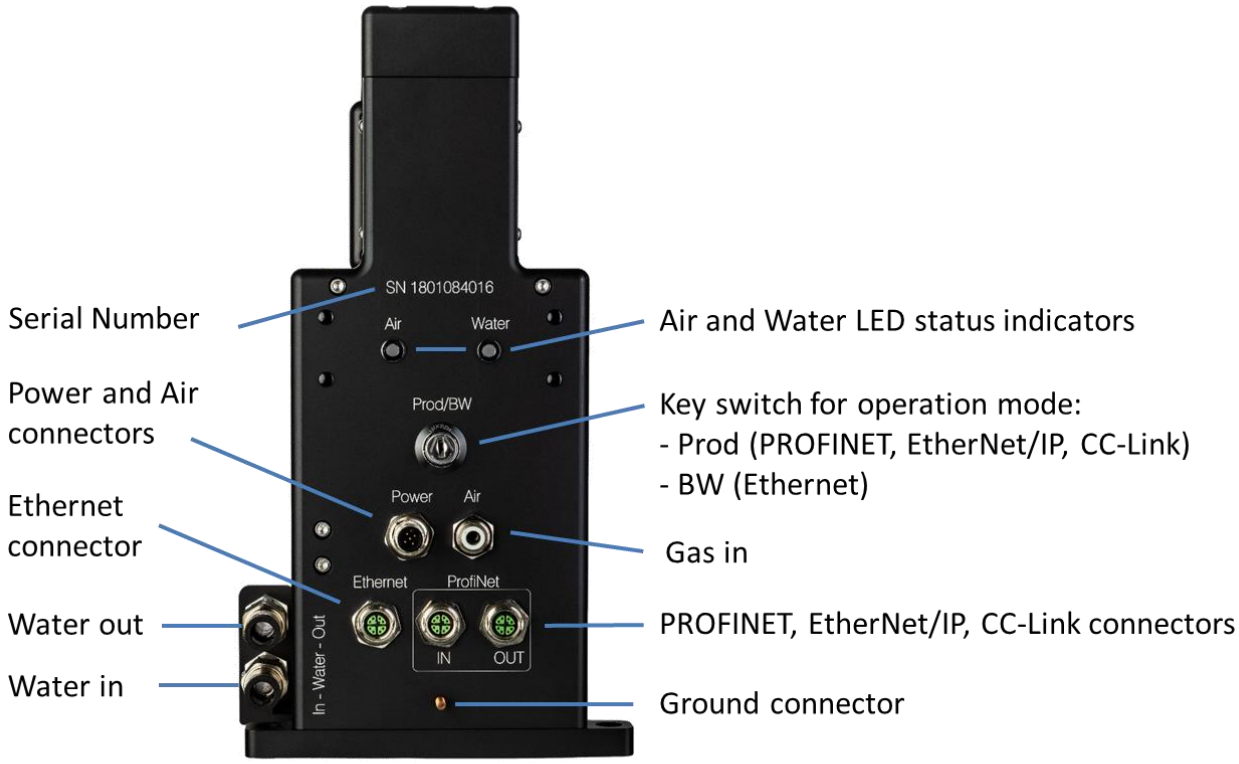


BeamWatch Integrated
Version: 150-175 mm distance between focus position and power meter



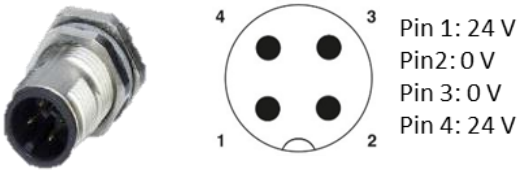
BeamWatch Integrated
Version: 500 mm distance between focus position and power meter

1.10 Connectors, LEDs, and Switch



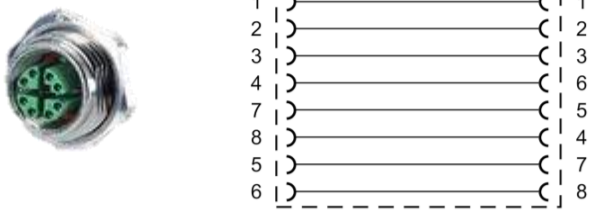
1.10.1 Power

1 x M12 SPEEDCON connector, 4 pins, A-coded, 24 VDC / 10 A
Reference: Phönix Contact SACC-DSI-MS-4CON-M12/0,5 SCO - 1551875
Compatible with (for example): Phönix Contact 1668124



1.10.2 Communication

2 x M12-RJ45 connectors, 8 pos., X-coded, PROFINET CAT6A
1 x M12-RJ45 connector, 8 pos., X-coded, ETHERNET CAT6A
Reference: Metz Connect MWN811A415
Compatible with (for example): Metz Connect 142M2X15050



1.10.3 Gas

1 x quick connector Festo type, 6 mm (1/4”) outer diameter
Dry clean air, nitrogen or argon, 6 bar / 87 PSI / 0.6 MPa, 5-10 l/min, ISO 8573-1:2010 class 1:4:2

1.10.4 Water

2 x quick connector Festo type, 10 mm (3/8”) outer diameter
Input: 6 bar / 87 PSI / 0.6 MPa, 8 l/min, 18 - 30 C° / 64 - 86 F°
Output: ~2 bar / 29 PSI / 0.2 MPa pressure drop (at 6 bar / 87 PSI / 0.6 MPa and 8 l/min)

1.10.5 LEDs Indicators

Air (compressed gas) and water status can be known by the color of the LED indicators on the back of BeamWatch Integrated:

- Air LED
  Red: no or not enough air (pressure/flow)
  Green: OK
- Water LED
  Red: no or not enough water (pressure/flow)
  Green: OK

1.10.6 Key Switch

The key switch on the back of BeamWatch Integrated allows switching between different BeamWatch Integrated interfaces (see chapter 3):

- BW (BeamWatch mode for manual measurements with the BeamWatch PC software)
- Prod (Production mode for automated measurements with PROFINET, EtherNet/IP, or CC-Link)

Important: If you want to switch the key switch back and forth, please wait about three seconds in-between.

CHAPTER 2 Hardware Configuration

2.1 Mounting

The BeamWatch Integrated should be mounted in an area where the possibility of contamination by the process is at its minimum: not in the direct trajectory of dust, sparks, splashes and vapors. If this is not possible, an additional protection again contamination should be installed - protective plate or cover.

To minimize the risk of contamination, the BeamWatch Integrated can also be mounted on the side or upside down.

The BeamWatch Integrated unit must be mounted to a stable surface. Once in the desired location, secure the unit with four M6 (or ¼-20) screws in the slots. If not mounted in a fixed position, measurement error or damage to the unit may occur.

2.2 Positioning

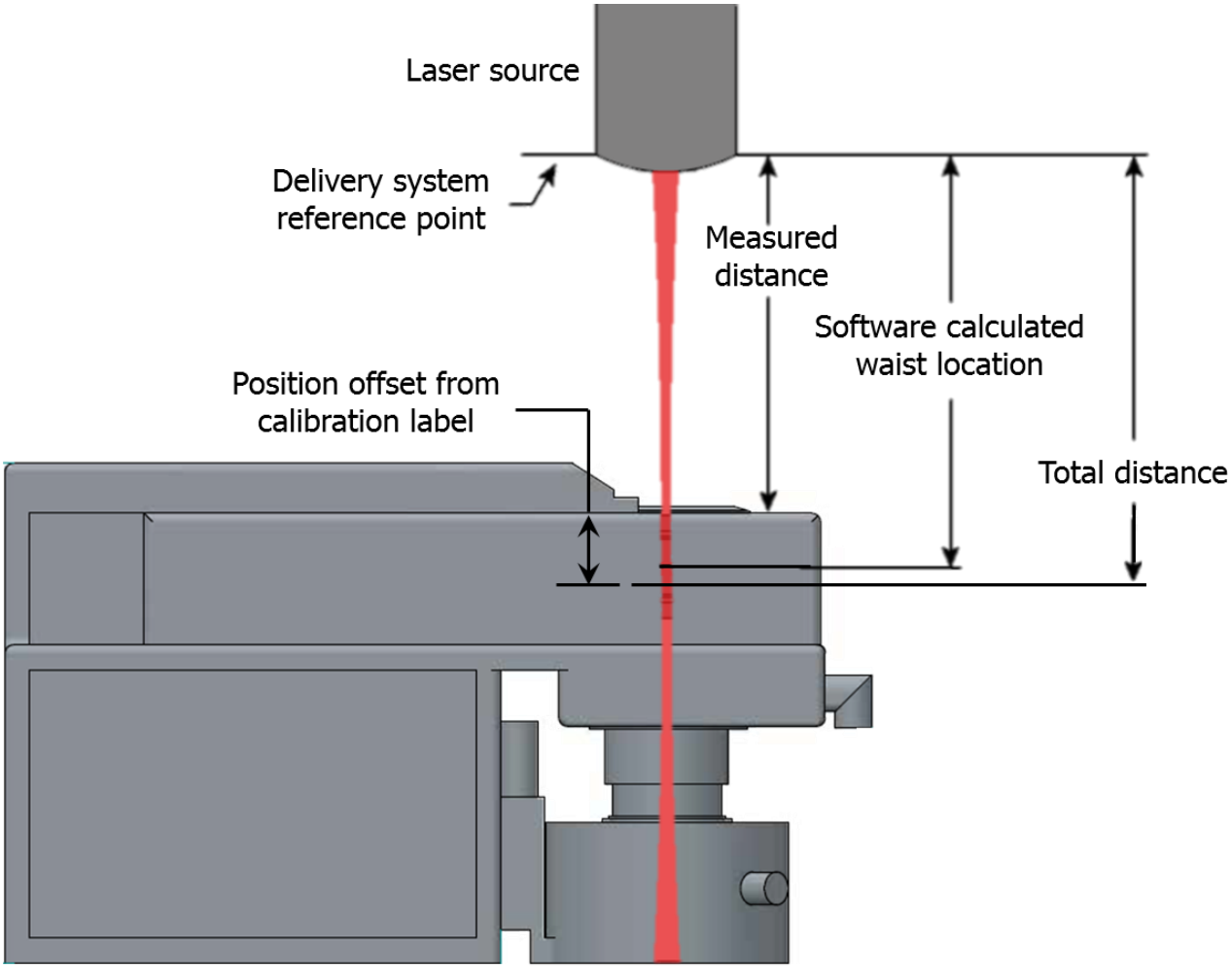
Position the BeamWatch Integrated unit in the path of the laser beam with the top of the unit facing the laser delivery head. Make sure the beam passes through the entrance aperture unobstructed.

Along the laser axis, position the BeamWatch Integrated unit at the nominal focus position. To obtain results within ±5% accuracy, the camera must be aligned perpendicular to the beam with minimal tilt (<5°) in all directions and the beam must lie in the plane of the camera focus. Use either a translation stage or the laser robotics to facilitate the positioning of the beam in the camera focus plane.

Position the BeamWatch Integrated unit so the beam waist is approximately at the scribe mark on the side of the unit (about 40mm). The calibrated distance from the top of the BeamWatch Integrated to the center of the detector array can be found on the calibration sticker.

There is no automated method for finding the major and minor axes of an elliptical beam. The BeamWatch Integrated unit must be manually rotated to find these axes. After the software is installed and the beam is centered in the BeamWatch Integrated unit, rotate the unit around the beam while viewing the Waist Width result in the software until max/min values are found. For best measurements, rotate the BeamWatch Integrated until the major and minor axes of the beam are aligned with the X and Y axes of the software. It is irrelevant which of the BeamWatch axes views the major or minor axes of the beam.

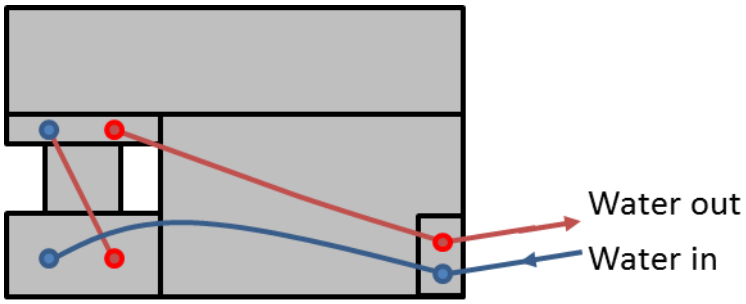
After the BeamWatch Integrated is positioned, measure the distance from any desired reference point on the laser delivery head to the top face of the BeamWatch Integrated. This value is the **Distance** of the laser and must be entered into the software during setup (see the **Laser Panel** section of the **BeamWatch User Guide**). The software automatically adds the calibrated distance from the top of the unit to the center of the camera imager. This value is used to calculate the Waist Location result as the total distance between the laser source and the focus spot. The image below displays where each measurement point is located.



2.3 Water Cooling

The quick connectors on the back plate, power sensor plate, and cooling plate are intended for 10 mm (3/8") outer diameter plastic tubing.

If it is not already done, connect the BeamWatch Integrated back plate, power meter, and cooling plate as follows:



Important note: The fittings are self-sealing, do not use Teflon tape which could obstruct the flow.

For reliable operation, be sure to use a water flow matching the measured laser power. See the specifications for more information.

At max flow rate the pressure drop across the power meter and the cooling plate is about 2 bar (29 PSI / 0.2 MPa).

The temperature of the cooling water must be between 18 and 30°C (64 - 86 F°) and must not fluctuate more than 1°C/min.

To avoid condensation, the temperature of the cooling water must not be below the ambient temperature.

Always operate the BeamWatch Integrated in a non-condensing atmosphere - where the combination of air temperature and humidity are above the dew point (the point at which condensation forms).

Water quality

Quality	Limiting values
Appearance	Limpid, clean, no sediment. Ideally deionized (DI) water.
Particle size	< 150 µm - **Important:** Install filter at water inflow.
Total dissolved solids (TDS)	< 200 ppm
Total suspended solids (TSS)	< 25 ppm
Conductivity	< 30 mS/m (300 µS/cm)
Alkalinity	< 100 ppm
Total hardness	< 100 ppm
Chlorides	< 25 ppm (50 mg/l)
Sulfates	< 25 ppm (130 mg/l)
pH-value	6.5 - 8.2

2.4 Compressed Air

Compressed air is required in order to open or close the shutter and to generate overpressure in the housing to prevent contamination.

The quick connector for gas input on the back of BeamWatch Integrated is intended for 6 mm (1/4") outer diameter plastic tubing.

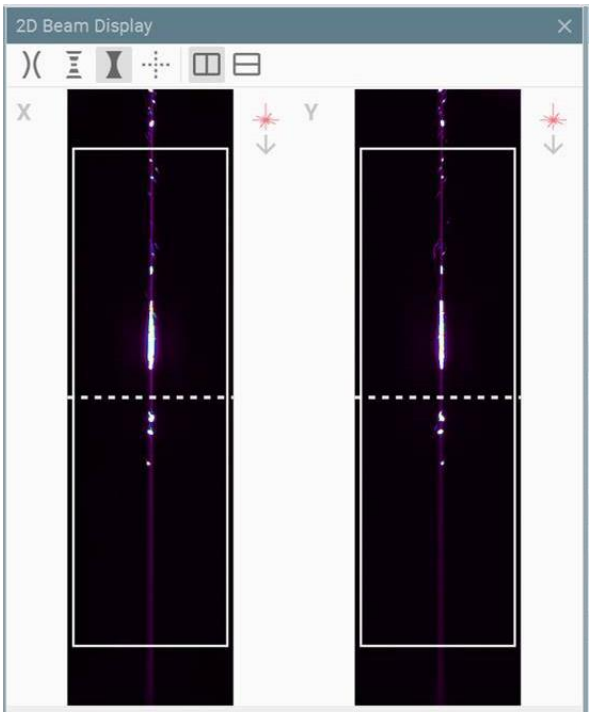
A pressure of 6 bar (87 PSI/0,6 MPa) is required.

The industrial laser environment has high levels of particulates that must be removed from the camera field of view to obtain accurate results. With BeamWatch Integrated, this is accomplished by generating a laminar flow region at the camera field of view using a clean, dry gas source (ISO 8573-1:2010 class 1:4:2). We recommend Air, Nitrogen, or Argon. Adjust the gas source until a steady flow is achieved, approximately 5 to 10 l/min.

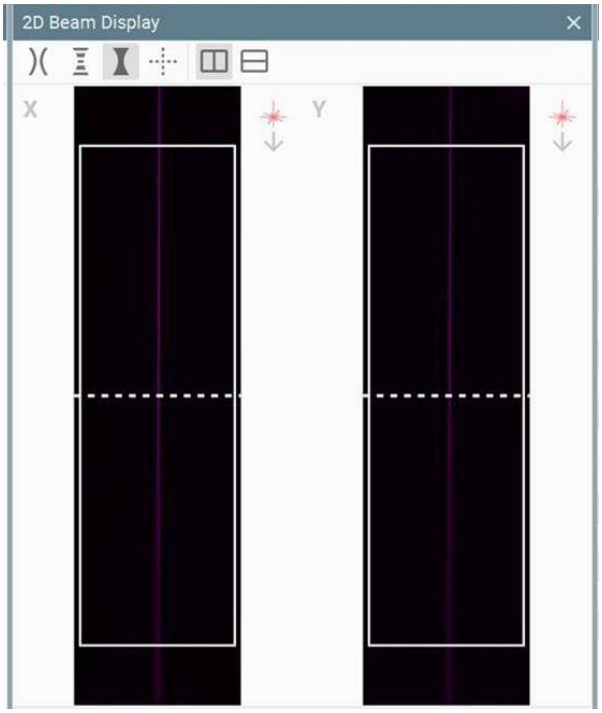
Once the BeamWatch software is installed and a laser beam is viewed, it may become apparent that the gas flow needs to be adjusted.

A weak flow will not be effective to remove particulates, and a flow that is too strong will become turbulent, both appearing in the software as a streak of high intensity light in the beam, often saturating the beam image. The sweet spot between these two positions must be found.

Example of poor gas flow adjustment:



Example of good gas flow adjustment:



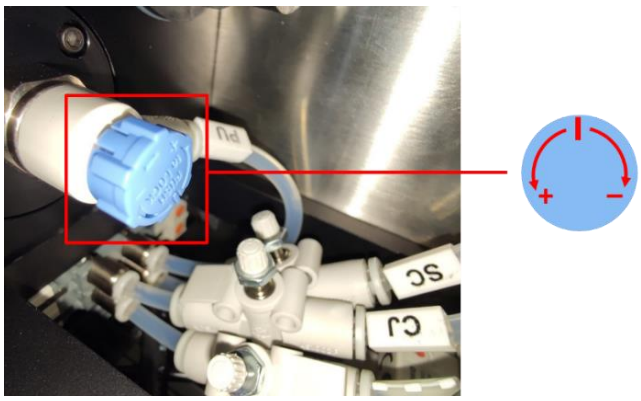
If necessary, the gas flow can be finely adjusted in the BeamWatch Integrated to achieve a satisfactory result.

To finely adjust the gas flow in the BeamWatch Integrated proceed as follows:

1. Open the small to side plate with an allen key.

2. Pull the valve blue crown to unlock it.

3. Notice the reference/start position of the blue crown.



4. Turn anticlockwise of one complete rotation to increase the flow and do a BeamWatch measurement to see if it improved the image.

5. If the beam image is better, but some streaks of high intensity light are still present, rotate again anticlockwise until the beam image looks clean. Push the blue crown back to lock it and close the small side plate.

6. If it did not improve or even worsen the beam image, turn the blue crown back (clockwise) of two complete rotations to reduce the flow and do a new BeamWatch measurement to see if it improves the beam image.

7. If the beam image is better, but some streaks of high intensity light are still present, rotate again until the beam image looks clean. Push the blue crown back to lock it and close the small side plate.

2.5 Electrical Connections

2.5.1 Power

BeamWatch Integrated can be connected to a power supply using the provided power cord, or any other compatible cable. Connect the M12 4 pin connector to BeamWatch and the other end into a 24 VDC outlet.

2.5.2 PROFINET / EtherNet/IP / CC-Link

BeamWatch Integrated includes two PROFINET/ EtherNet/IP / CC-Link connectors in case it would be used in a line (daisy-chain) arrangement, but only one is needed if used with a switch (tree, star topology). BeamWatch Integrated can be connected using the provided M12 8 pin PROFINET/ EtherNet/IP / CC-Link to Ethernet cable, or any other compatible cable.

2.5.3 Ethernet

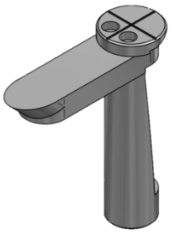
A 1000Mbit (Gigabit Ethernet LAN) connection must be achieved between BeamWatch Integrated and the computer used to do the manual measurements.

BeamWatch Integrated can be directly connected to the computer using the provided M12 8 pin PROFINET/Ethernet cable, or any other CAT-6 compatible cable.

If switches and additional cables are used to connect BeamWtach Integrated to the computer, those also must be Gigabit Ethernet LAN / CAT-6 compatible.

2.6 Laser set-up and alignment

BeamWatch integrated is delivered with an alignment tool.



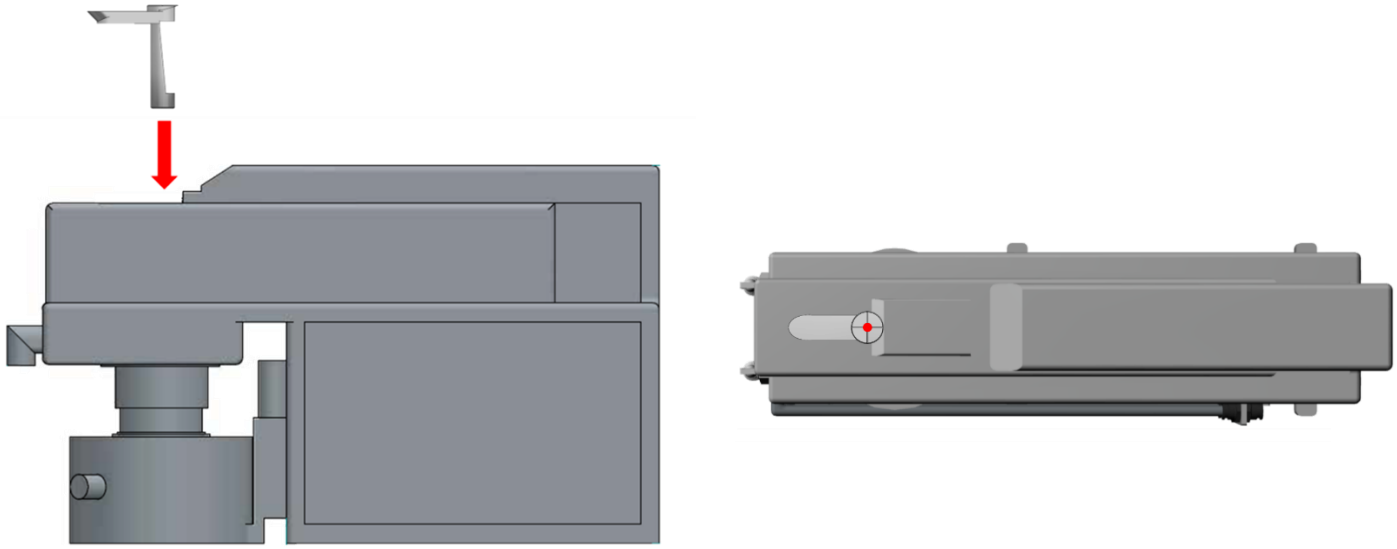
For accurate results the beam must be aligned with the center of the input aperture, perpendicular to the top of the unit. A beam offset in any direction can produce inaccurate results.

Turn the key switch on the "BW" position so that the shutter is open.

Gently insert the alignment tool in the BeamWatch Integrated aperture and ensure it is flush with the top.

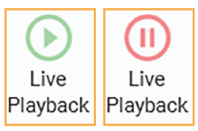
Important: The alignment tool is provided for use with low power alignment beams only. **Do not use with high power beams.**

Turn on the alignment beam - pilot laser - and center it on the alignment tool by adjusting the beam, with the beam perpendicular to the top of the BeamWatch Integrated.

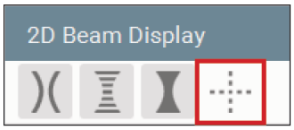


Warning: The alignment tool is intended for use with low power alignment beams only. Severe damage can occur if the high-power beam is directed when the alignment tool is in place.

After installing and launching the BeamWatch measurement software, enable **Live Playback** from the **Source** ribbon in the software.



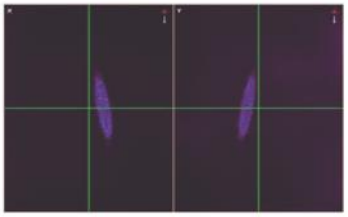
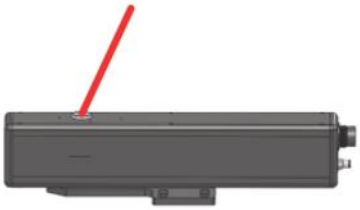
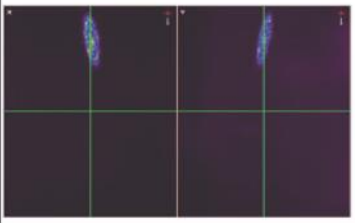
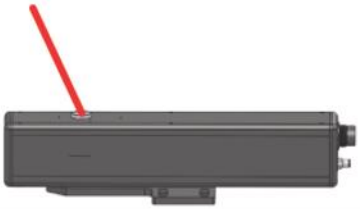
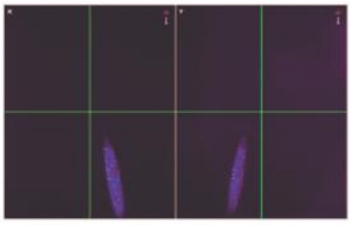
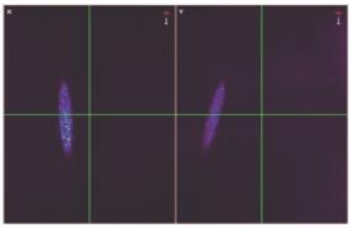
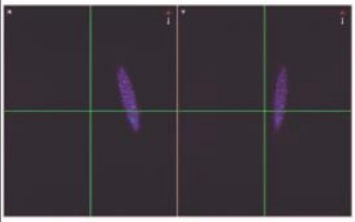
Enable the **Crosshair** located at the top of the **2D Beam Display** window.



The beam is displayed in the BeamWatch software as an ellipse as shown in the images below. It may be necessary to adjust the Exposure and/or Frame Summing to bring the alignment beam to a viewable level.

If the beam is centered on the crosshair as shown in the properly centered example, the beam is aligned. If the beam is not centered, adjust the angle the beam enters the BeamWatch. The following illustrations show beam deviations and the resulting displays.

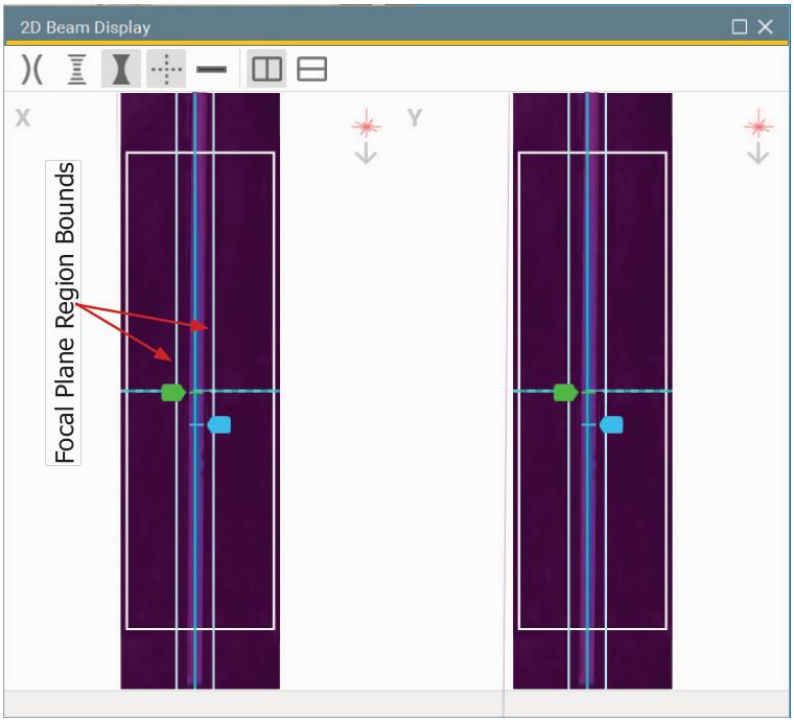
Note: The angle of the beam is exaggerated for clarity.

Alignment	Illustration	Dual Axis
Properly centered		
Beam angled away from camera		
Beam angled toward camera		
Beam angled toward the left		
Beam angled toward the right		

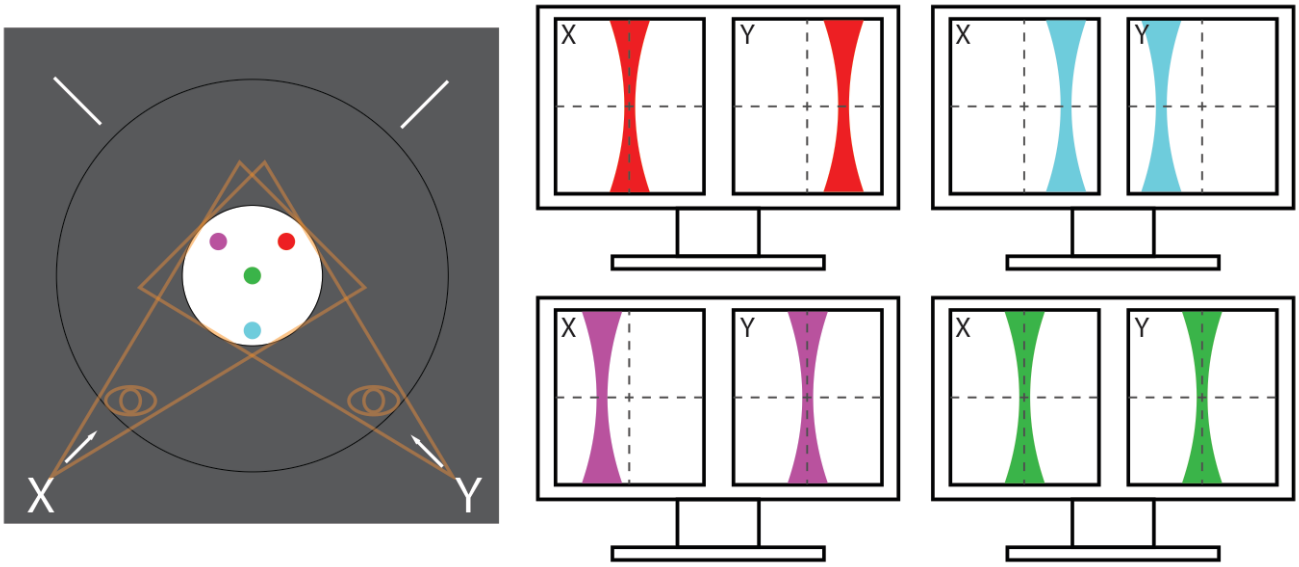
Once the beam is aligned, remove the alignment tool and switch from the guide beam to the high power beam.

Adjust the gas level until a minimum amount of particulates is seen. This may be an iterative process. Particulates appear as a streak of high intensity light when viewing the beam, often saturating the image. A weak flow is not effective, and too strong of a flow can become turbulent.

Check the **2D Beam Display** and make sure the beam falls within the **Focal Plane Region Bounds**. The beam should be aligned within these bounds, in both views, to get the strongest results.



The diagram below shows how various degrees of misaligned beams appear on the screen.



The **red** beam is off in the view of the Y axis. It needs to be moved down and left to center.

The **blue** beam is off in both axes and appears close to the insides of the views. It needs to be moved up to center.

The **purple** beam is off in the view of the X axis. It needs to be moved down and right to center.

The **green** beam represents a perfectly aligned beam.

The **orange** lines represent the field of view of each axis.

CHAPTER 3 Interfaces

There are three ways to interface with the BeamWatch Integrated

1. **BeamWatch Measurement Software** (for beam profiling and power reading)
2. **Web interface** (for PROFINET / EtherNet/IP / CC-Link / ADS measurement parameter settings and power reading)
3. **Industrial interfaces like PROFINET / EtherNet/IP / CC-Link / ADS** (for automated beam profiling and power measurement)

3.1 BeamWatch Measurement Software

The BeamWatch software can be downloaded from the BeamWatch Integrated page on the MKS Ophir website under the software section.

To use the BeamWatch software, the key switch must be turned on the "BW" (BeamWatch) position.

Thanks to a Stand-Alone mode the BeamWatch software can be used to perform a beam profiling measurement without any programming. This can be useful for pre-integration testing.

The BeamWatch measurement software is designed for use on a personal computer running Windows 7 or Windows 10 64 bit operating systems.

Please see the *BeamWatch User Guide* for information on specifications, installation, and operation. Select the Windows Start button and type "BeamWatch User Guide" to quickly access it, or if the software is installed you can select the **Help**  button from the top right corner.

To use the BeamWatch measurement software the key switch must be set to the "BW" position.

If there is an adequate supply of compressed gas the Air LED shines green and the shutter opens.

By default, the BeamWatch Integrated IP address is 192.168.100.100.

It is recommended that the network adapter is assigned a fixed IP address as follows: 192.168.100.X where X is not 100, 101, or 102, and use the Subnet mask 255.255.255.0. To do so go to *Control Panel* > *Network and sharing center* > *Change adapter settings* > *Internet protocol version 4 (TCP/IPv4)*, make the change and then restart your computer.

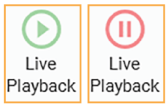
If you would like to modify the BeamWatch Integrated IP address to better suit your network, please refer to the section *Communication* in the *Settings* page.**In the computer firewall, the UDP port 11000 and TCP port 23 (Telnet mode) or TCP port 80 (HTTP mode) should be open.**

Connect BeamWatch Integrated to your computer via the Cat6 Ethernet cable.

To start the BeamWatch software, double click the desktop icon or go to the Windows taskbar and select *Start* > *All Programs* > *BeamWatch*

When BeamWatch software opens it automatically connects to the BeamWatch Integrated. The default configuration is loaded. Displays initially appear blank.

Enter the laser wavelength and the distance from the delivery head reference point to the top of the BeamWatch Integrated unit (see Positioning) in the **Laser** panel. You are now ready to start taking measurements.

Select **Live Playback** 

to start and stop data collection.

For more detailed information on the use of the BeamWatch software, the *BeamWatch User Guide* can also be downloaded from the BeamWatch Integrated page on the MKS Ophir website under the documentation section.

3.2 Web interface

It is not recommended to use the same network for the web interface (Ethernet) and the industrial interface (Profinet, Ethernet/IP or CC-Link).

Independently of the key switch position the web interface can always be accessed.

The web interface shows the current status, values and diagrams of previous measurements and allows configuring the measurement parameters.
On the web interface it is also possible to see the readings from the power sensor.

By default, the IP address of the BeamWatch Integrated web interface is set to 192.168.100.100.

By default, the web interface can be accessed with a web browser at the following addresses: http://192.168.100.100.

The connected computer must have a fixed IP address as follows: 192.168.100.X where X is not 100, 101, or 102, and use the Subnet mask 255.255.255.0. To do so go to Control Panel > Network and sharing center > Change adapter settings > Internet protocol version 4 (TCP/IPv4), make the change and then restart your computer.

If you would like to modify the BeamWatch Integrated IP address to better suit your network, please refer to the section *Communication* in the *Settings* page.

Requirements for the web browser are:

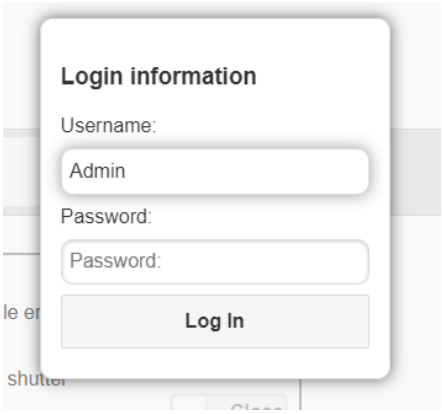
- Chrome, Edge or Firefox (Internet Explorer is not supported)
- Use incognito/private mode or empty the cache before accessing the web interface
- JavaScript must be activated

3.2.1 Access levels

The web interface can be accessed at the following levels:

- User: No login required. Data and settings can be viewed only.
- Administrator: Login required. Data can be viewed, settings can be edited, and manual inputs can be sent.

To log-in, click on the *User* button in the overview page menu.

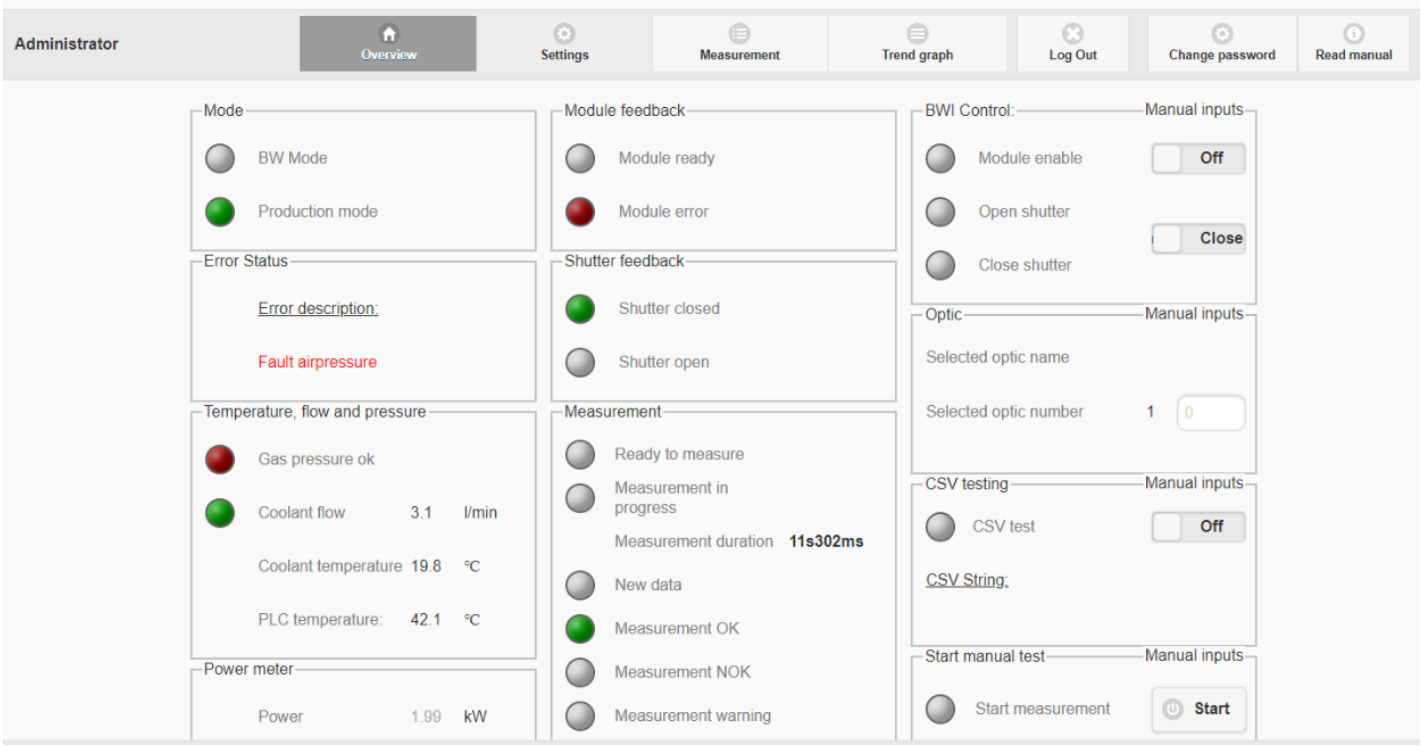


The default administrator login and password are:

- Login: Admin
- Password: PW

They should be changed in *Change Password* after the first login.

3.2.2 Overview Page



The *Overview* page displays important information like status, errors, temperatures, power and measurement duration.

On the far-right column, the manual input commands are grayed out and not accessible when not logged-in as administrator.

When logged-in as administrator, the manual input commands can be used as follow:

BWI Control:
Module enable: toggle on/off.
Shutter: toggle open/closed.

Optic:
Choose an optic number.

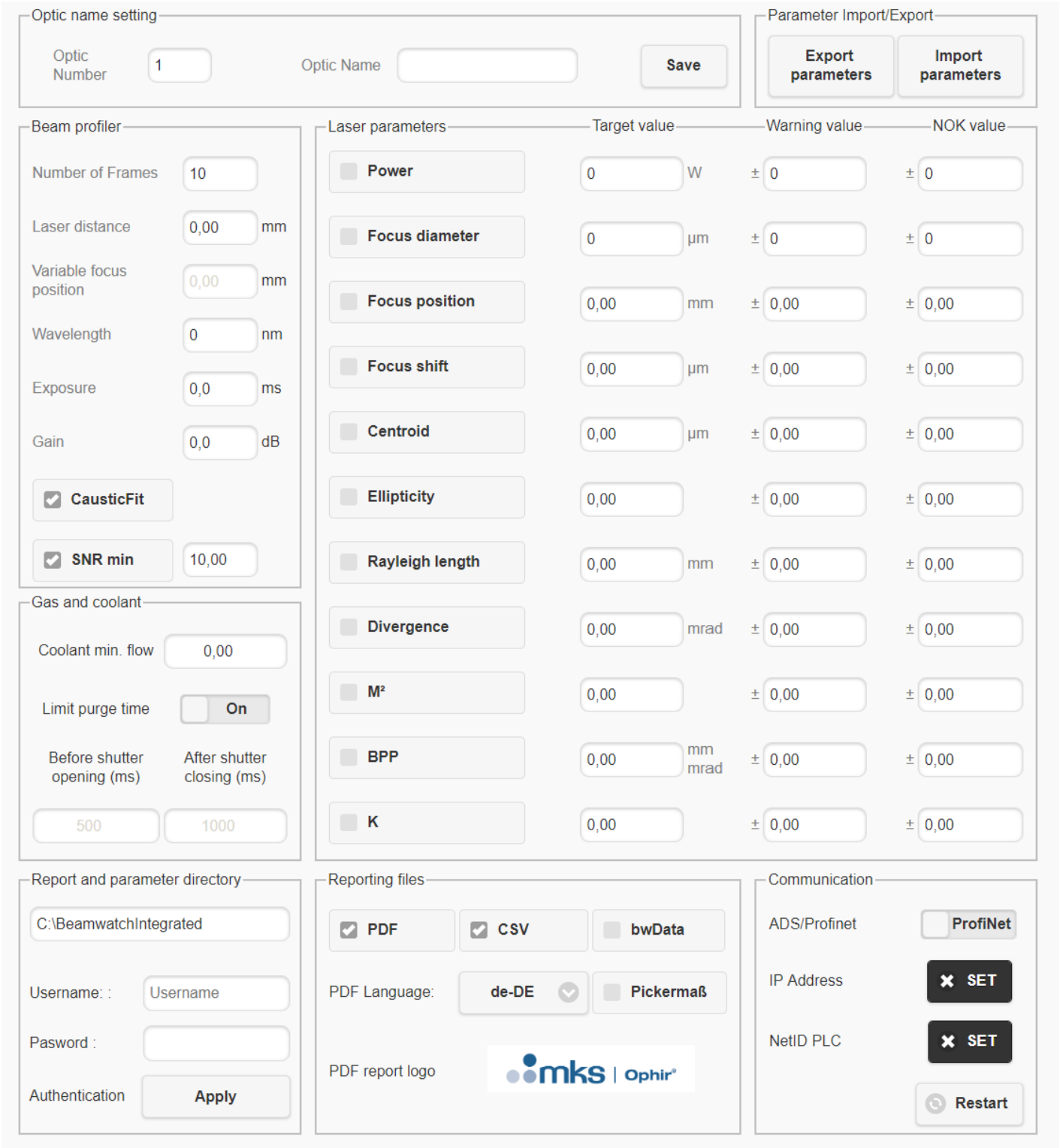
CSV testing:
Toggle on/off.

CSV test allows to run a dry test without laser. The laser values are simulated in a CSV file that can be uploaded by clicking on *CSV String*. The OK/NOK results will be calculated based on the comparison of the data in the CSV string and the target and limit values set in the *Settings* Page.

Start manual test:
Start a measurement using the CSV file.

The manual input commands only work when the key switch is in the "Prod" (Production) position.

3.2.3 Settings Page



The settings page can only be accessed when logged in as administrator.

- *Optic:*

All the settings on the setting page will be related to the optic number chosen in this filed. It is possible to define a name for the selected optic number.

- *Beam profiler:*

In this section it is possible to set the number of frames used for a measurement, the reference distance (see Positioning), the laser wavelength, and the camera gain and exposure time for the measurement. The ideal *Gain* and *Exposure* time can be determined during a manual measurement with the BeamWatch software. For more information on these parameters, please refer to the *BeamWatch User Guide* that can be downloaded from the BeamWatch Integrated page on the MKS Ophir website under the documentation section).

Variable focus position is only intended to be used to calculate the "Pickermaß" for laser delivery head equipped with a variable focus position.

Optionally it is possible to record only frames with a valid *Caustic Fit* and/or a Signal To Noise Ratio (*SNR*) above a specified value. To do so, tick the *SNR* and/or *Caustic fit* checkboxes and enter a value in the *SNR min.* field if you ticked the *SNR* checkbox. For more information on "Caustic Fit" and "SNR ratio" please refer to the *BeamWatch User Guide* that can be downloaded from the BeamWatch Integrated page on the MKS Ophir website under the documentation section.

- *Laser parameters:*

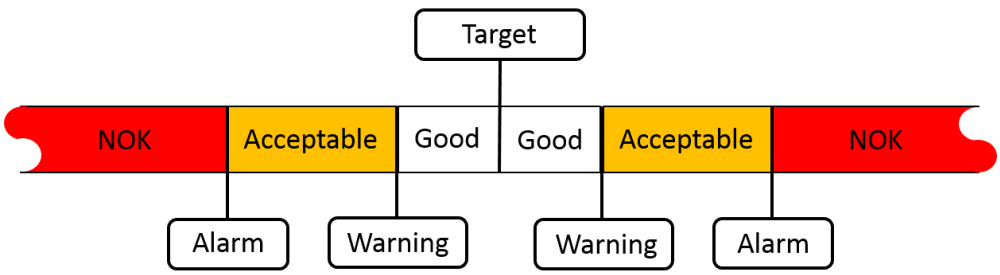
Here are the settings for the measurement values. To enable the evaluation of a parameter, tick the checkbox left of the parameter name. When the checkbox in front of a parameter is ticked, the parameter will be included in the OK/NOK calculation and displayed in the PDF report. The CSV report will include all parameters independently of them having been ticked or not.

The parameters are calculated as follow:

Result	Description	Unit
Power	Power meter reading of the **last frame**	W
Focus diameter	**Average** of the X and Y waist width of **all recorded frames**	um
Focus position	**Average** of the X and Y waist locations of **all recorded frames**	mm
Focus shift	**Average** of the X and Y focal shift of the **last frame**	mm
Centroid	**Average** of the X and Y centroids of **all recorded frames**	um
Ellipticity	**Average** of the X and Y ellipticity of **all recorded frames**	N/A
Rayleigh length	**Average** of the X and Y Rayleigh length of **all recorded frames**	mm
Divergence	**Average** of the X and Y divergence of **all recorded frames**	mrad
M^2	**Average** of the X and Y M^2 of **all recorded frames**	N/A
BPP	**Average** of the X and Y BPP of **all recorded frames**	mm mrad
K	**Average** of the X and Y K of **all recorded frames**	N/A

All raw parameters are also available in parallel via the industrial interface (Power, Waist location X, Waist location Y, Waist X, Waist Y, Centroid X, Centroid Y, Focal shift X, Focal shift Y, Rayleigh length, Ellipticity, BPP X, BPP Y, K X, K Y, Divergence X, Divergence Y, M2 X, M2 X, SNR approved portion). For more information see the section PROFINET interface.

Target, Warning, and NOK values are defined and color-coded as follow:



- *Reporting files:*

Activate or deactivate the automated generation of PDF and/or CSV reports and/or BeamWatch measurement files. In this section it is also possible to choose the language of the PDF reports. The logo used for the PDF report is also displayed. To select another logo or image please refer to Reports section.

If it is required to have the "Pickermaß" value on the PDF reports, the corresponding checkbox has to be ticked.

- *Report and parameter directory:*

This section can be used to modify the folder where the settings, reports and measurement files are saved. If the folder in which the files will be saved is password protected, it is possible to enter the login and password in the relevant fields.

- *Gas and coolant:*

It is possible to modify the minimal cooling water flow limit in liter per minute. The recommended flow rate (8 L/min at 10 kW) can be lowered proportionately at lower than full power (10 kW) but should not be below 3 L/min. The response time will be optimum with the recommended flow rate.

If the purge gas should only be used during the measurement process, the gas flow needs to be activated and its duration before the shutter opens and after it closes has to be defined.

- *Parameter Import/Export:*

Export or import all the settings on this page.

To export measurement parameters, click on *Export parameters*.

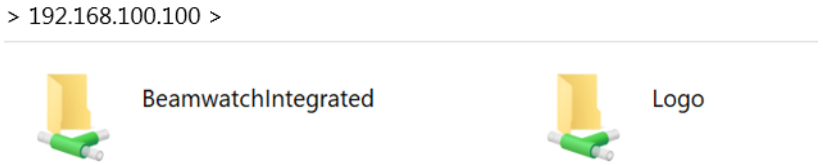
Measurement parameters are saved as a CSV file.

The file can be accessed in the *Report and parameter directory* specified on the *Settings* page. If the default location has not been modified, the file is saved on the BeamWatch Integrated memory. To access it, enter the BeamWatch Integrated IP address (by default 192.168.100.100) preceded of \\ in a file browser (for instance in the Windows Explorer address bar): \\192.168.100.100

The access is password protected:

- Login: BWI
- Password: KzE2zaJr

The parameter file can be found in the directory *BeamwatchIntegrated* (where the measurement reports are also saved, see the Reports section).



To import parameters, paste the desired parameter file in the *BeamwatchIntegrated* directory (if a parameter file already exists it should be overwritten).
In the web interface, under Settings click on *Import parameters*.

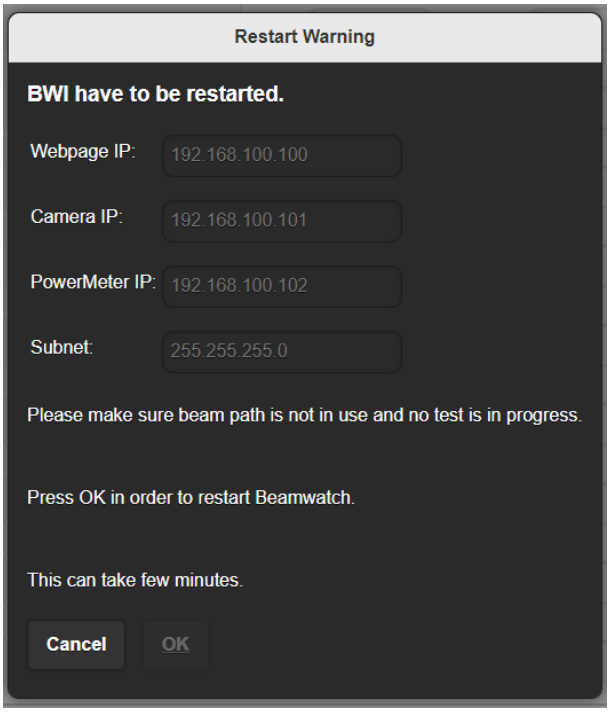
- *Communication:*

To modify communication settings the key switch must be turned on the "Prod" (Production) position.

It is possible to switch between a PROFINET or EtherNet/IP or CC-Link command to an ADS command.

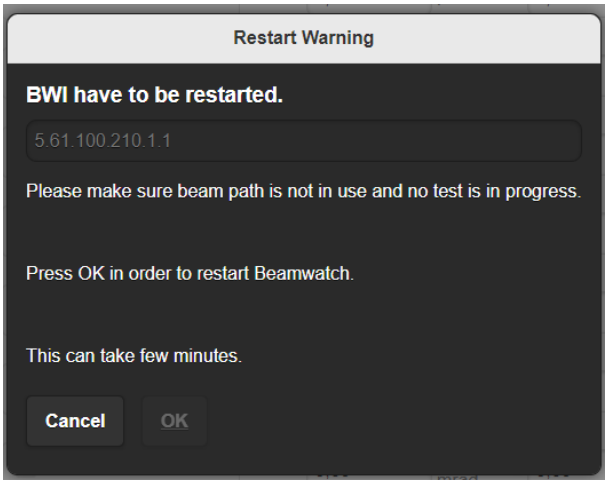
The IP addresses of the web interface and the NetID of the PLC can be modified. Clicking on the SET buttons will open the following dialog boxes:

IP modification dialog box:



When modifying the IP address of the web interface, three available IP addresses on the same network are necessary: one for the web interface, one for the beam profiler (camera) and one for the power meter.

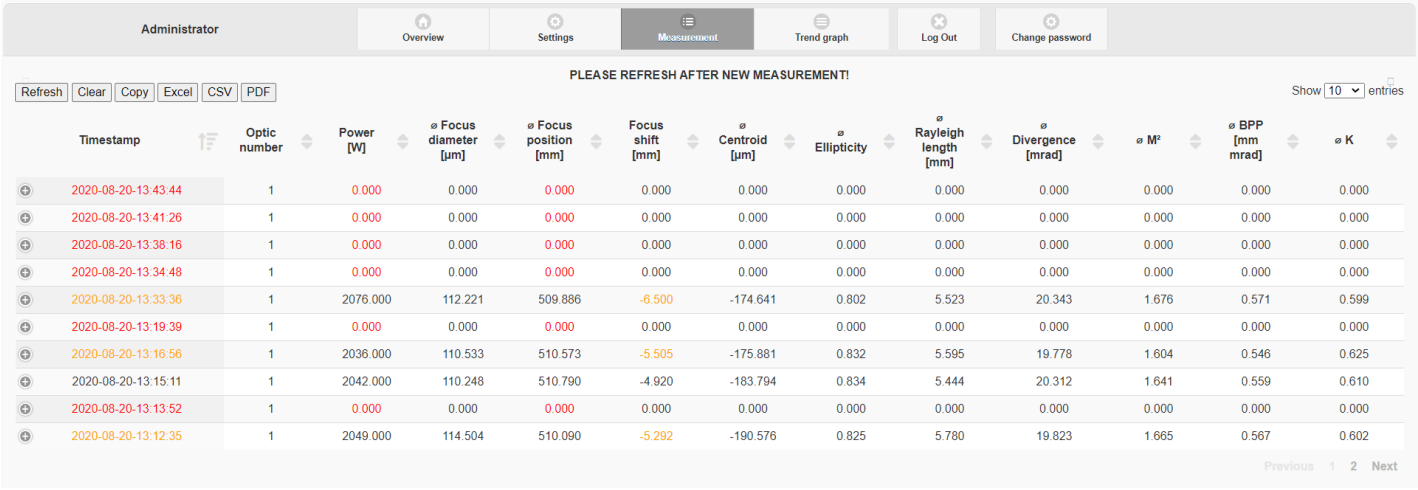
NetID modification dialog box:



After an IP and NetID change, BeamWatch Integarted PLC is restarted automatically to take the modifications into account.

Restart: This will only restart the PLC and not the whole BeamWatch Integrated including the BeamWatch beam profiler. *To restart the whole BeamWatch Integrated, the power supply must be disconnected long enough for the indicator LEDs in the back of the device to switch off (about 10 seconds), and then reconnect.*

3.2.4 Measurements Page



Timestamp	Optic number	Power [W]	⌀ Focus diameter [µm]	⌀ Focus position [mm]	Focus shift [mm]	⌀ Centroid [µm]	⌀ Ellipticity	⌀ Rayleigh length [mm]	⌀ Divergence [mrad]	⌀ M²	⌀ BPP [mm mrad]	⌀ K
2020-08-20-13:43:44	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020-08-20-13:41:26	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020-08-20-13:38:16	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020-08-20-13:34:48	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020-08-20-13:33:36	1	2076.000	112.221	509.886	-6.500	-174.641	0.802	5.523	20.343	1.676	0.571	0.599
2020-08-20-13:19:39	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020-08-20-13:16:56	1	2036.000	110.533	510.573	-5.505	-175.881	0.832	5.595	19.778	1.604	0.546	0.625
2020-08-20-13:15:11	1	2042.000	110.248	510.790	-4.920	-183.794	0.834	5.444	20.312	1.641	0.559	0.610
2020-08-20-13:13:52	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020-08-20-13:12:35	1	2049.000	114.504	510.090	-5.292	-190.576	0.825	5.780	19.823	1.665	0.567	0.602

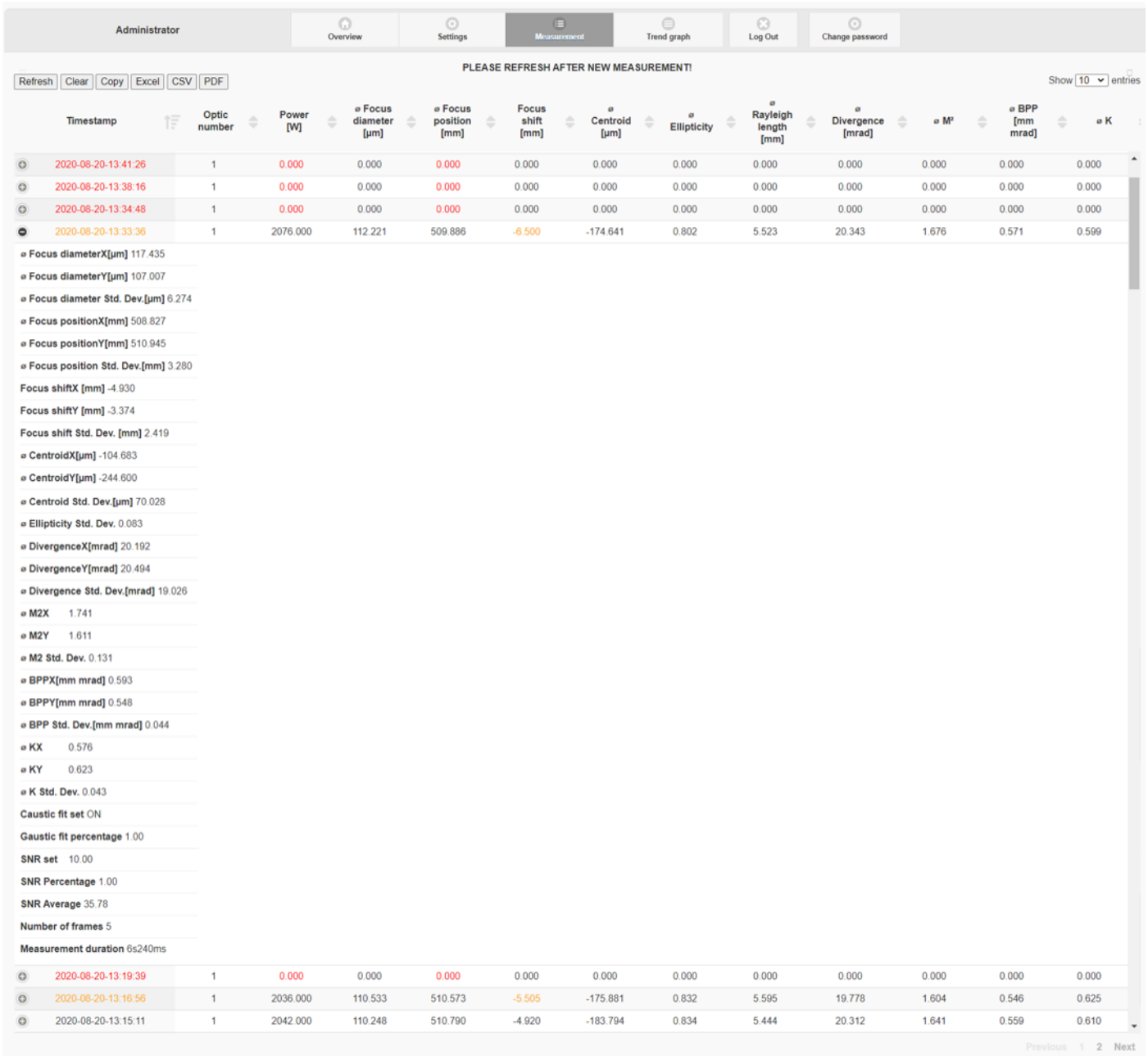
The measurements page displays a table of the past measurements.

It might be necessary to refresh the browser to display the latest measurements.

If there was a warning or an alert, the corresponding values are respectively highlighted in yellow or red.

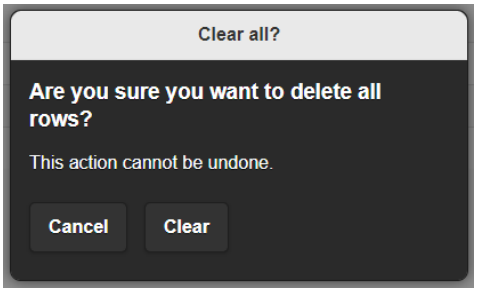
By clicking on the title of a column the values in the table are sorted increasingly according to this column. By clicking again on the same column title, the values are sorted decreasingly according to this column.

When clicking on the plus icon in front of a line, the detailed values of for the X and Y axes are displayed.

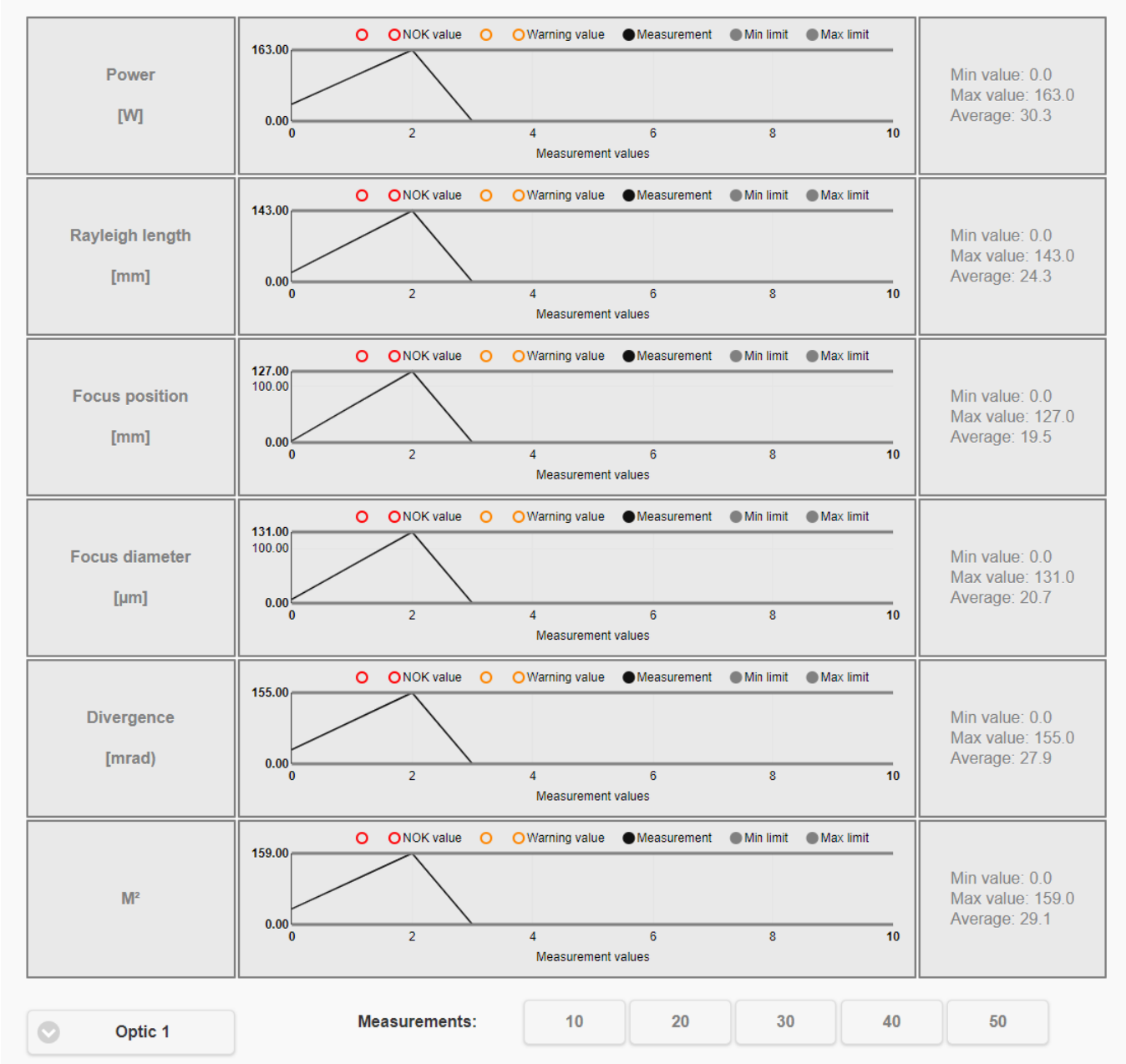


The measurement table can be cleared, copied or exported in different formats by clicking on the corresponding buttons at the top of the page.

It is necessary to be logged in to clear the measurement table. Clearing the measurement table cannot be undone and a confirmation is required.



3.2.5 Trend page



The Trend page displays six diagrams to show possible trends for Power, Rayleigh length, Focus Position, Focus diameter, Divergence, and M^2.

The warning and NOK limit can be displayed by ticking respectively the orange and green circle above each curve.

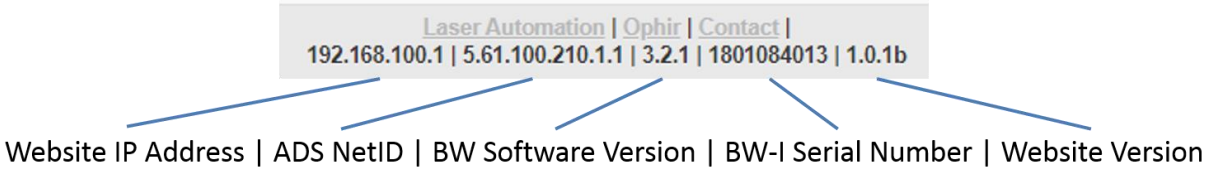
At the bottom it is possible to choose the amount of measurements used for the trending: 10, 20, 30, 40 or 50 measurements. It is also possible to select the optical head used.

3.2.6 Accessing the manual from the web interface

Clicking on the Manual button in the menu will open the manual as a PDF. A PDF reader software should be installed on the computer to be able to see the manual.

3.2.7 Footer indications

On the footer of all pages of the web interface you can find the following information:



3.3 Industrial interfaces

It is not recommended to use the same network for the industrial interface (Profinet, Ethernet/IP or CC-Link) and the web interface (Ethernet).

Industrial interfaces allow a fully automated beam profiling and power measurement.

Depending on the BeamWatch Integrated version one of the following industrial interfaces is supported:

- PROFINET
- EtherNet/IP
- CC-Link

With all versions, ADS is always available as an option.

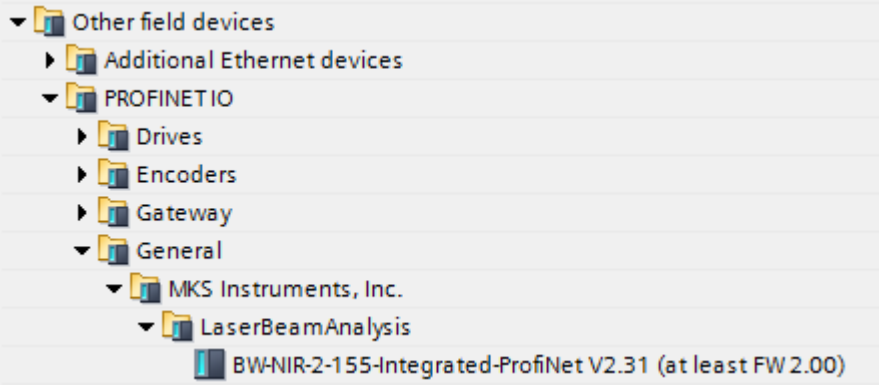
To use one of the industrial interfaces the key switch must be turned on the "Prod" (Production) position.

3.3.1 PROFINET

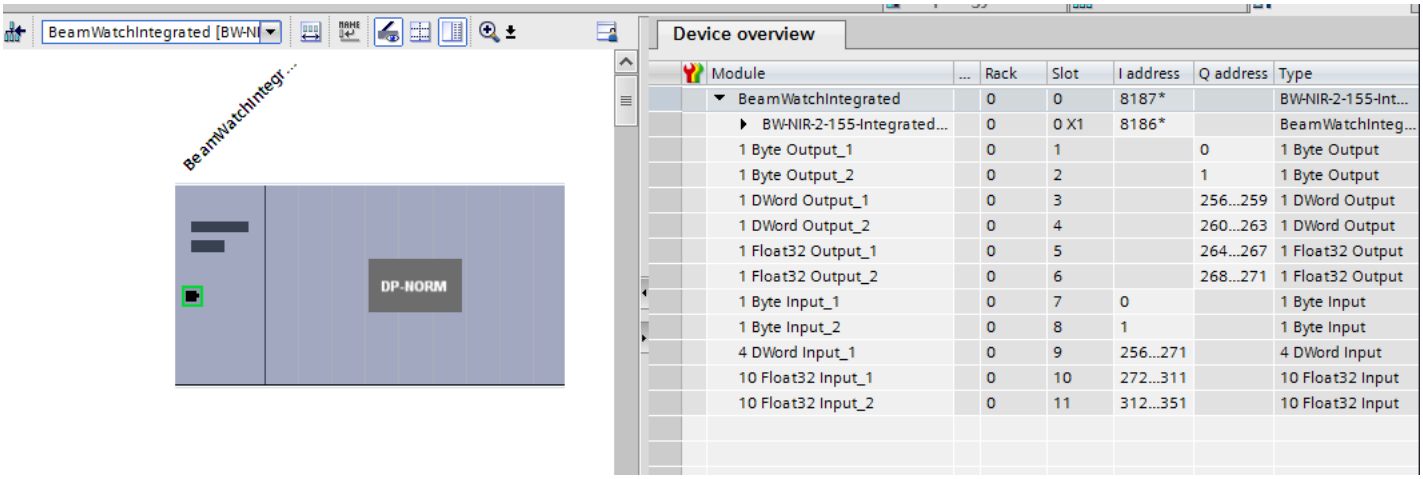
3.3.1.1 PROFINET integration

Integrate BeamWatch Integrated into the network using the provided GSDML file. The GSDML file can be downloaded from the BeamWatch Integrated page on the MKS Ophir website under the software section.

Set up the PROFINET network in the software (e.g., TIA, STEP7).



Set up device addresses.



Integrate the laser measurement into the PLC controlled software as fits your application and needs.

See the following section for more details on PROFINET setup.

Begin test measurements.

Integrate into production line routine.

3.3.1.2 PROFINET interface

Siemens DO	Siemens DI	Description German	Description English	Type
0		Freigabe Modul	Module enable	BYTE
1		Shutter öffnen	Open shutter	
2		Shutter schließen	Close shutter	
3		Messung starten	Start measurement	
4		Reserve	Spare Input	
5		Reserve	Spare Input	
6		Reserve	Spare Input	
7		Reserve	Spare Input	
0		Reserve	Spare Input	BYTE
1		Reserve	Spare Input	
2		Reserve	Spare Input	
3		Reserve	Spare Input	
4		Reserve	Spare Input	
5		Reserve	Spare Input	
6		Reserve	Spare Input	
7		Reserve	Spare Input	
0		Optik Nummer	Optic number	1 .. 10 DWORD
1		Reserve	Spare Input	
0		Reserve	Spare Input	FLOAT32
1		Reserve	Spare Input	
	0	Modul bereit	Module ready	BYTE
	1	Modul Fehler	Module failure	
	2	Shutter geschlossen	Shutter closed	
	3	Shutter offen	Shutter opened	
	4	Bereit zur Messung	Ready for measurement	
	5	Messung läuft	Measurement running	
	6	Neue Daten vorhanden	New data	
	7	Automatikmodus	Automatic mode	
	0	Messung IO	Measurement ok	BYTE
	1	Messung NIO	Measurement not ok	
	2	Messung Warnung	Measurement warning	
	3	Reserve	Spare output	
	4	Reserve	Spare output	
	5	Reserve	Spare output	
	6	Reserve	Spare output	
	7	Life Bit	Life bit	
	0	Fehlernummer	Error code	1 .. 10 4 DWORD
	1	Optik Rückmeldung	Optic return	
	2	Reserve	Spare output	
	3	Reserve	Spare output	

Siemens		Description		Type		
DO	DI	German	English			
	0	Leistung	Power	0,00 .. 99,99	kW	10 FLOAT32
	1	Fokuslage X	Waist location X	0,00 .. 999,99	mm	
	2	Fokuslage Y	Waist location Y	0,00 .. 999,99	mm	
	3	Fokusdurchmesser X	Waist X	0,00 .. 999,99	um	
	4	Fokusdurchmesser Y	Waist Y	0,00 .. 999,99	um	
	5	Schwerpunkt X	Centroid X	-999,99 .. 999,99	um	
	6	Schwerpunkt Y	Centroid Y	-999,99 .. 999,99	um	
	7	Fokusschwankung X	Focal shift X	-99,99 .. 99,99	mm	
	8	Fokusschwankung Y	Focal shift Y	-99,99 .. 99,99	mm	
	9	Rayleigh Länge	Rayleigh length	0,00 .. 9999,99	um	
	0	Elliptizität	Ellipticity	0,00 .. 1,00		10 FLOAT32
	1	BPP X	BPP X	0,00 .. 99,99	mm mrad	
	2	BPP Y	BPP Y	0,00 .. 99,99	mm mrad	
	3	K X	K X	0,00 .. 99,99		
	4	K Y	K Y	0,00 .. 99,99		
	5	Divergenz X	Divergence X	0,00 .. 999,99	mrad	
	6	Divergenz Y	Divergence Y	0,00 .. 999,99	mrad	
	7	M2 X	M2 X	0,00 .. 999,99		
	8	M2 Y	M2 X	0,00 .. 999,99		
	9	SNR Gutanteil	SNR approved portion	0,00 .. 1,00	&	

3.3.2 EtherNet/IP

3.3.2.1 EtherNet/IP integration

Integrate BeamWatch Integrated into the network using the provided ADS file. If you did not receive the ADS file, please contact your MKS Ophir representative.

3.3.2.2 EtherNet/IP interface

The EtherNet/IP interface description is similar to the PROFINET one. For more information on the interface description please refer to the PROFINET interface description.

3.3.3 CC-Link

3.3.3.1 CC-Link integration

Integrate BeamWatch Integrated into the network using the provided CSP+ file. If you did not receive the CSP+ file, please contact your MKS Ophir representative.

3.3.3.2 CC-Link interface

The CC-Link interface description is similar to the PROFINET one. For more information on the interface description please refer to the PROFINET interface description.

3.3.4 ADS

3.3.4.1 Activating ADS

To switch between a PROFINET, EtherNet/IP, CC-Link command and the Beckhoff TwinCAT ADS command, go to the BeamWatch Integrated web interface *Settings* page and toggle the *ADS/PROFINET* switch in the bottom right corner on *ADS*.

3.3.4.2

3.3.4.3 ADS interface

	Variable	Beschreibung	Description	Size		
Input	MAIN.ADSInterface.bModuleEnable	Freigabe Modul	Module enable	Bool		
	MAIN.ADSInterface.bOpenShutter	Shutter öffnen	Open shutter	Bool		
	MAIN.ADSInterface.bCloseShutter	Shutter schließen	Close shutter	Bool		
	MAIN.ADSInterface.bStartMeasurement	Messung starten	Start measurement	Bool		
	MAIN.ADSInterface.iOpticNumber	Optik Nummer	Optic number	Int	1 .. 10	
Output	MAIN.ADSInterface.bModuleReady	Modul bereit	Module ready	Bool		
	MAIN.ADSInterface.bModuleFailure	Modul Fehler	Module failure	Bool		
	MAIN.ADSInterface.bShutterClosed	Shutter geschlossen	Shutter closed	Bool		
	MAIN.ADSInterface.bShutterOpened	Shutter offen	Shutter opened	Bool		
	MAIN.ADSInterface.bReadyForMeasurement	Bereit zur Messung	Ready for measurement	Bool		
	MAIN.ADSInterface.bMeasurementRunning	Messung läuft	Measurement running	Bool		
	MAIN.ADSInterface.bNewData	Neue Daten vorhanden	New data	Bool		
	MAIN.ADSInterface.bAutomaticMode	Automatikmodus	Automatic mode	Bool		
	MAIN.ADSInterface.bMeasurementPass	Messung IO	Measurement pass	Bool		
	MAIN.ADSInterface.bMeasuremenFail	Messung NIO	Measurement fail	Bool		
	MAIN.ADSInterface.bMeasurementWarning	Messung Warnung	Measurement warning	Bool		
	MAIN.ADSInterface.bLifeBit	Life Bit	Life bit	Bool		
	MAIN.ADSInterface.iErrorCode	Fehlernummer	Error code	Int		
	MAIN.ADSInterface.sErrorText	Fehlertext	Error text	String(90)		
	MAIN.ADSInterface.iOpticReturn	Optik Rückmeldung	Optic return	Int	1 .. 10	
	MAIN.ADSInterface.rPower	Leistung	Power	Real	0,00 .. 99,99	kW
	MAIN.ADSInterface.rWaistLocation	Fokuslage	WaistLocation	Real	0,00 .. 999,99	mm
	MAIN.ADSInterface.rWaistLocationSD	Fokuslage SD	WaistLocation SD	Real	0,00 .. 999,99	mm
	MAIN.ADSInterface.rWaist	Fokusdurchmesser	Waist	Real	0,00 .. 999,99	um
	MAIN.ADSInterface.rWaistSD	Fokusdurchmesser SD	Waist SD	Real	0,00 .. 999,99	um
	MAIN.ADSInterface.rCentroid	Schwerpunkt	Centroid	Real	-999,99 .. 999,99	um
	MAIN.ADSInterface.rCentroidSD	Schwerpunkt SD	Centroid SD	Real	-999,99 .. 999,99	um
	MAIN.ADSInterface.rFocalShift	Fokusschwankung	Focal Shift	Real	-99,99 .. 99,99	mm
	MAIN.ADSInterface.rFocalShiftSD	Fokusschwankung SD	Focal Shift SD	Real	-99,99 .. 99,99	mm
	MAIN.ADSInterface.rRayleighLength	Rayleigh Länge	Rayleigh length	Real	0,00 .. 9999,99	um
	MAIN.ADSInterface.rRayleighLengthSD	Rayleigh Länge SD	Rayleigh length SD	Real	0,00 .. 9999,99	um

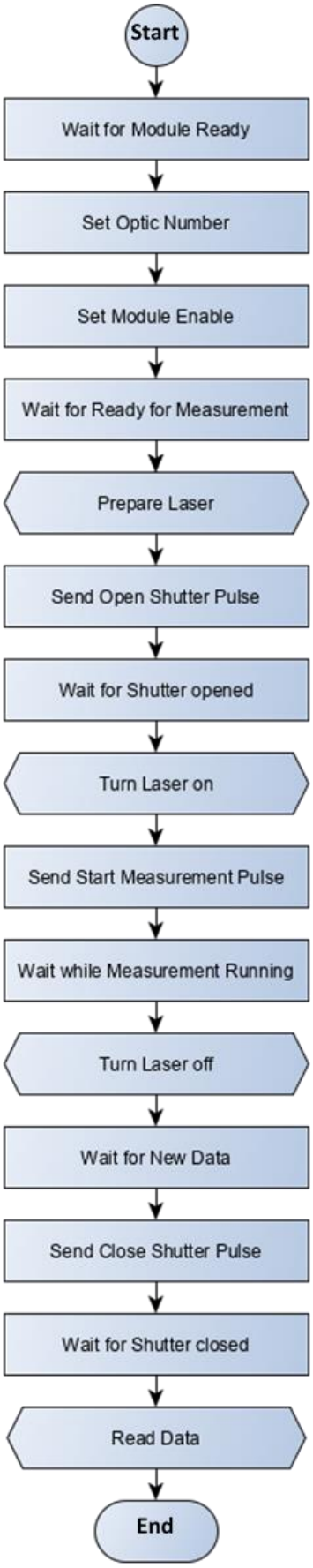
	Variable	Beschreibung	Description	Size		
Output	MAIN.ADSInterface.rEllipticity	Elliptizität	Ellipticity	Real	0,00 .. 1,00	
	MAIN.ADSInterface.rEllipticitySD	Elliptizität SD	Ellipticity SD	Real	0,00 .. 1,00	
	MAIN.ADSInterface.rBPP	BPP	BPP	Real	0,00 .. 99,99	mm mrad
	MAIN.ADSInterface.rBPPSD	BPP SD	BPP SD	Real	0,00 .. 99,99	mm mrad
	MAIN.ADSInterface.rK	K	K	Real	0,00 .. 99,99	
	MAIN.ADSInterface.rKSD	K SD	K SD	Real	0,00 .. 99,99	
	MAIN.ADSInterface.rDivergence	Divergenz	Divergence	Real	0,00 .. 999,99	mrad
	MAIN.ADSInterface.rDivergenceSD	Divergenz SD	Divergence SD	Real	0,00 .. 999,99	mrad
	MAIN.ADSInterface.rM2	M2	M2	Real	0,00 .. 999,99	
	MAIN.ADSInterface.rM2SD	M2 SD	M2 SD	Real	0,00 .. 999,99	
	MAIN.ADSInterface.rSNRApproved	SNR Gutanteil	SNR approved portion	Real	0,00 .. 1,00	

3.3.5 List of errors

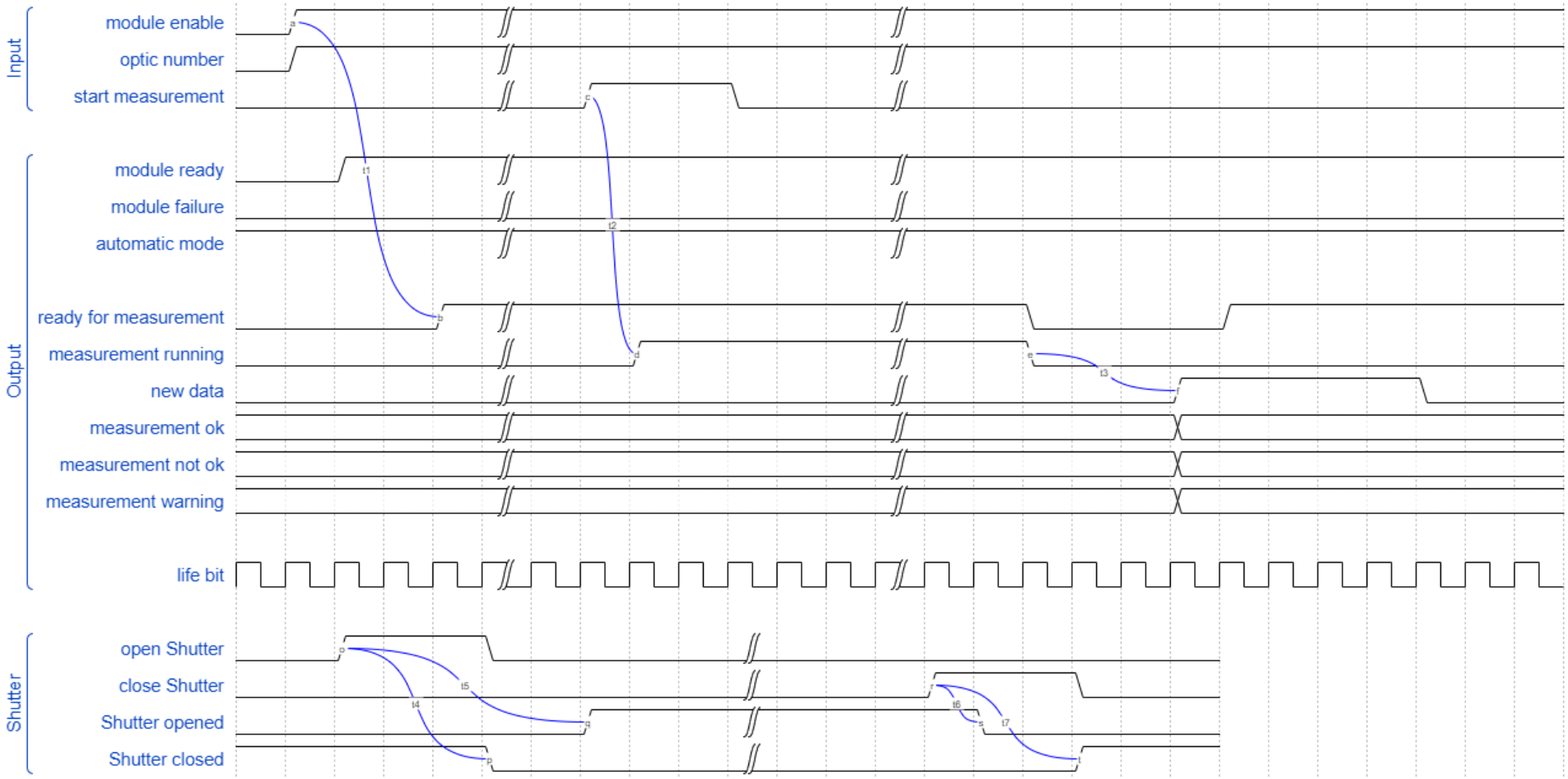
Byte	Bit	Beschreibung	Description
0	0	Fehler Kühlwasserdurchfluss	Error coolant flow
	1	Fehler Übertemperatur	Error over-temperature
	2	Fehler Druckluft gering	Error air pressure low
	3	Fehler Optikwahl	Error wrong opticnumber
	4	Fehler Kameraverbindung	Error camera
	5	Speicherpfad nicht gefunden	Storage path not found
	6	Fehler Shutterverstellung	Error shutter feedback
	7	Wenig Speicherplatz	Low storage space
1	0	Nicht verwendet	Spare
	1	Nicht verwendet	Spare
	2	Nicht verwendet	Spare
	3	Nicht verwendet	Spare
	4	Nicht verwendet	Spare
	5	Nicht verwendet	Spare
	6	Nicht verwendet	Spare
	7	Nicht verwendet	Spare
2	0	Nicht verwendet	Spare
	1	Nicht verwendet	Spare
	2	Nicht verwendet	Spare
	3	Nicht verwendet	Spare
	4	Nicht verwendet	Spare
	5	Nicht verwendet	Spare
	6	Nicht verwendet	Spare
	7	Nicht verwendet	Spare
3	0	Nicht verwendet	Spare
	1	Nicht verwendet	Spare
	2	Nicht verwendet	Spare
	3	Nicht verwendet	Spare
	4	Nicht verwendet	Spare
	5	Nicht verwendet	Spare
	6	Nicht verwendet	Spare
	7	Nicht verwendet	Spare

CHAPTER 4 Diagrams

4.1 Timing Diagram



4.2 Measurement Cycle Timing Diagram



- Time **t1** depends on the current state of the BeamWatch Integrated. It can be up to a minute after powering up BeamWatch Integrated, but it typically takes a few ms.
- Time **t2** varies typically between 100 and 500ms.
- Time **t3** depends on the number of values to be evaluated and which documents are stored. It typically takes less then 2s.
- The **shutter is controlled separately** from the rest of the BeamWatch Integrated and should only be opened shortly before the intended measurement and closed right afterwards in order to keep the internals clean.
- The time **t4** depends on the purge setting on the webpage. If it is always on, t4 is 500ms, otherwise it is the purge-on time plus 500ms.
- Times **t5**, **t6**, and **t7** depend on the setting of the air speed controllers.

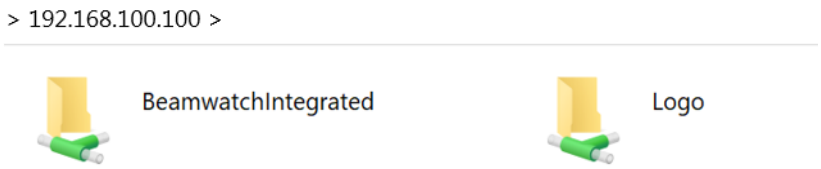
CHAPTER 5 Reports

If the CSV files, PDF reports or BeamWatch measurement files (bwData) have been activated on the *Settings* page of the web interface, they will be generated automatically for each measurement. The reports can be accessed in the *Report and parameter directory* specified on the *Settings* page. If the default location has not been modified, the file is saved on the BeamWatch Integrated memory. To access it, enter the BeamWatch Integrated IP address (by default 192.168.100.100) preceded of \\ in a file browser (for instance in the Windows Explorer address bar): \\192.168.100.100

The access is password protected:

- Login: BWI
- Password: KzE2zaJr

The reports and measurement files can be found in the *BeamwatchIntegrated* folder.



The default *BeamwatchIntegrated* folder has a limited memory space. **In case of systematic report or measurement file creation, the available memory space could be quickly filled. It is therefore recommended to modify the location where the reports and measurement files are saved.** In the *Settings* page of the web interface, the desired location can be selected. For instance, a folder on the local network.

Important note: Due to the potential large size of the BeamWatch measurement files (bwData), it is recommended to only generate them when necessary. For instance, during setup and troubleshooting.

To modify the logo used for the PDF report, open the Logo folder and replace the default MKS Ophir logo file with your own logo file.

5.1.1 PDF report

Time: 2020-04-29-14:01:58

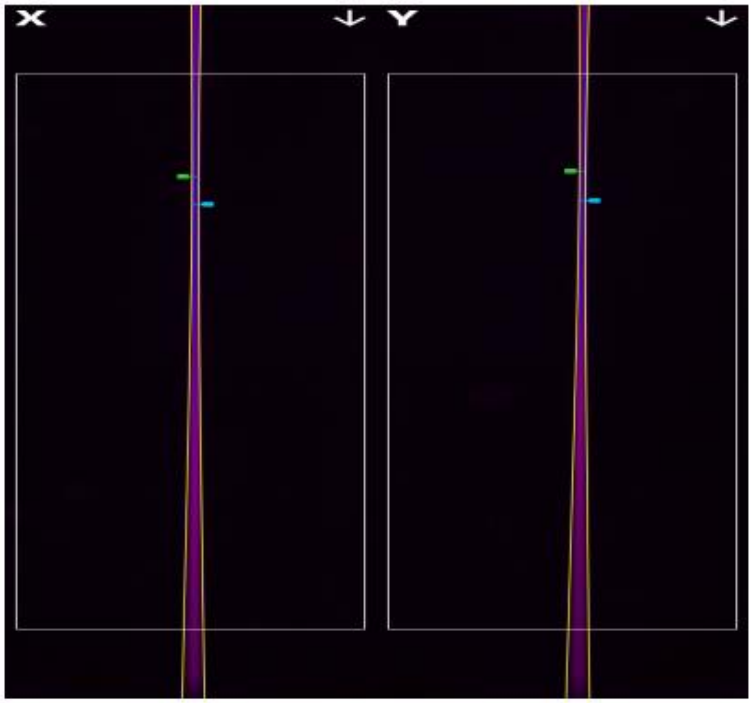
Plant info
System name: Machine1
Station name: Station1
Optic name:
Measurement device
Description: BWI-500
S/N: 191109017

Measurement settings
Number of frames : 10
Laser distance: 0.00
Variable focus position: 0.00
Exposure: 100.00
Gain: 4.00
SNR min: 10.00
CausticFit: On

Pickermaß: 0.00mm

Measurement protocol

Measurement values	Target value	Actual value	Min / Max values	Std. Dev.	Limits (Warning / NOK)
Power [W]	2000.00	1998.14	0.00 / 1998.14	---	10.00 / 20.00
Focus diameter [µm]	100.00	101.62	99.18 / 103.50	1.19	5.00 / 10.00
Focus position [mm]	535.00	537.90	536.99 / 540.39	1.04	1.00 / 2.00
Focus shift [mm]	-1.50	-2.49	-3.43 / 0.00	1.04	2.00 / 3.00
Rayleigh length [mm]	5.00	5.09	5.01 / 5.18	0.05	0.50 / 1.00
Divergence [mrad]	20.00	20.19	20.03 / 20.86	0.24	1.00 / 2.00
M²	1.50	1.64	1.60 / 1.69	0.02	0.20 / 0.30



C:\BeamwatchIntegrated\Mes-20200429-140158.pdf

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5.1.2 CSV file

BeamWatch-Integarted Measurement Report

Time	2020-10-20-15:53:53				
BeamWatch-Integarted S/N	1801084011				
Optic number	1				
Number of frames	11				
Laser distance[mm]	472.00				
Variable focus position[mm]	0.00	Pickermass	0.00		
Exposure time[ms]	400.0				
Gain	4.0				
Caustic fit	on				
Caustic fit percentage	0.91				
SNR min.	20.0				
SNR Percentage	0.91				
SNR Average	77.5				
Measurement duration[ms]	13062				
	Last frame	Mean	Min	Max	Std. Dev.
Power[W]	1987.000			1987.000	
Focus diameter[µm]	95.99	95.23	91.68	99.29	31.17
Focus diameter X[µm]		98.14			
Focus diameter Y[µm]		92.32			
Focus position[mm]	507.84	508.78	507.71	510.33	160.59
Focus position X[mm]		508.93			
Focus position Y[mm]		508.63			
Focus shift[mm]	-2.38	-2.38	-2.41	0.00	1.38
Focus shift X[mm]		-2.35			
Focus shift Y[mm]		-2.41			
Centroid[µm]	122.44	129.97	51.98	214.15	73.76
Centroid X[µm]		58.91			
Centroid Y[µm]		201.04			
Ellipticity	1.00	0.99	0.95	1.00	0.02
Rayleigh length[mm]	4.76	4.73	4.57	5.01	1.50
Divergence[mrad]	20.19	20.11	19.81	20.38	20.01
Divergence X[mrad]		20.12			
Divergence Y[mrad]		20.10			
M2	1.42	1.41	1.33	1.46	0.46
M2 X		1.45			
M2 Y		1.36			
BPP[mm mrad]	0.48	0.48	0.68	0.50	0.16
BPP X[mm mrad]		0.49			
BPP Y[mm mrad]		0.46			
K	0.70	0.71	0.69	0.75	0.22
K X		0.69			
K Y		0.73			

Notes:

Notice

Obtain the latest version of this user guide at *http://www.ophiropt.com/laser-measurement-instruments/beam-profilers/services/manuals*.

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