PRIMES

Operating Manual

PowerMonitor PM 100 and PM 48

PowerMonitor PM

PM 48, PM 100, PM HP75/150

LaserDiagnosticsSoftware LDS

PowerMonitorSoftware PMS

Revision 02 EN - 04/2026

IMPORTANT!

READ CAREFULLY BEFORE USE.

KEEP FOR FUTURE USE.

Table of contents

PRIMES - the company

PRIMES is a manufacturer of measuring devices for the analysis of laser beams.

These devices are used for the diagnostics of high-power lasers. This ranges from CO_2 lasers to solid-state and fiber lasers to diode lasers and the wavelength ranges from IR to near UV.

A wide range of measuring devices is available to determine the following beam parameters:

- Laser power
- Beam dimensions and position of an unfocused beam
- Beam dimensions and position of a focused beam
- Beam quality factor M^2

Development, production and calibration of the measuring devices is performed at PRIMES. This guarantees optimum quality, excellent service, and a short reaction time, providing the basis for us to meet all of our customers' requirements quickly and reliably.

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1 Basic safety notes

Intended use

The device has been designed exclusively for measurements in the beam of high-power lasers.

Use for any other purpose is considered as not intended and is strictly prohibited. Furthermore, intended use requires that all information, instructions, safety notes and warning messages in this operating manual are observed. The specifications given in chapter 14 „Technical data“ on page 52 apply. Any given limit values must be complied with.

If not used as intended, the device or the system in which the device is installed can be damaged or destroyed. In addition, there is an increased risk to health and life. Only use the device in such a way that there is no risk of injury.

This operating manual is an integral part of the device and must be kept in the immediate vicinity of the place of use, accessible to personnel at all times.

Every person who is responsible for the installation, start-up or operation of the device must have read and understood the operating manual and, in particular, the safety instructions.

If you still have questions after reading this operating manual, please contact PRIMES or your supplier for your own safety.

Observing applicable safety regulations

Observe the safety-relevant laws, guidelines, standards and regulations in the current editions published by the state, standardization organizations, professional associations, etc. In particular, observe the regulations on laser safety and comply with their requirements.

Necessary safety measures

The device measures direct laser radiation, but does not emit any radiation itself. However, during the measurement the laser beam is directed at the device. This produces scattered or directed reflection of the laser beam (laser class 4). The reflected beam is usually not visible.

Protect yourself from direct and reflected laser radiation while working with the device by taking the following measures:

- Never leave the device unattended when taking measurements.
- Wear **safety goggles** adapted to the power, power density, laser wavelength and operating mode of the laser beam source in use.
- Wear suitable **protective clothing** or **protective gloves** if necessary.
- If possible, also protect yourself from direct laser radiation and scattered radiation by using separating protective devices that block or attenuate the radiation.
- If the device is moved from its aligned position, increased scattered or directed reflection of the laser beam occurs during measuring operation. Mount the device in such a way that it cannot be moved unintentionally, i.e. by bumping or pulling the cables
- Connect the laser control’s safety interlock to the device. Check that the safety interlock will switch off the laser properly in case of error.
- Install safety switches or emergency safety mechanisms that allow the laser to be switched off immediately.
- Use suitable beam guidance and beam absorber elements which do not emit any hazardous substances when irradiated.

Employing qualified personnel

The device may only be operated by qualified personnel. The qualified personnel must have been instructed in the installation and operation of the device and must have a basic understanding of working with high-power lasers, beam guiding systems and focusing units.

Conversions and modifications

The device may not be modified in terms of design or safety without the explicit consent of the manufacturer. The same applies to unauthorized opening, dismantling and repair. The removal of covers is only permitted within the scope of the intended use.

Liability disclaimer

Manufacturer and distributor exclude any liability for damages and injuries which are direct or indirect consequences of using the device not as intended or modifying the device or the associated software without authorization.

2 Icons and conventions

Warning messages

The following icons and signal words indicate possible residual risks in the form of warnings:

DANGER

Means that death or serious physical injuries **will** occur if necessary safety precautions are not taken.

WARNING

Means that death or serious physical injuries **may** occur if necessary safety precautions are not taken.

CAUTION

Means that minor physical injury **may** occur if necessary safety precautions are not taken.

NOTICE

Means that property damage **may** occur if necessary safety precautions are not taken.

Product safety labels

The following icons are used on the device itself to indicate imperatives and possible dangers:

Read and understand the operating manual before using the device!

Do not reach inside!

Labeling according to WEEE directive:

The device must not be disposed of with household waste, but in a separate WEEE collection in an environmentally friendly way.

Further icons and conventions in this operating manual

Here you will find useful information and helpful tips.

▶ Indicates a single instruction.

If several of these instructions appear one below the other, the order in which they are executed is irrelevant or they represent alternative courses of action.

1. A numbered list identifies a sequence of instructions that must be executed in the specified order.
2.
...

→ Indicates the result of an action to explain processes that take place in the background.

Indicates an observation prompt to draw attention to visible feedback from the device or the software.

Observation prompts make it easier to check whether an instruction was executed successfully. Often they also guide to the next instruction.

Points to a control element that is to be pressed/clicked.

Points to an element described in the text (for example an input field).

3 Transport and storage

Warning messages

WARNING

Injuries caused by lifting the PM 100 or the PM HP75/150

Lifting and positioning heavy devices can, for example, stress intervertebral disks and cause chronic changes to the lumbar or cervical spine.

- ▶ Use a lifting device to lift and position the device.
- ▶ Without available lifting equipment, the lifting and positioning of the unit must be carried out by several persons.

NOTICE

Damage/Destruction of the device

Hard hits or falls may damage the device.

- ▶ Handle the device carefully when transporting it.

NOTICE

Damage/Destruction of the device

Touching the deflection mirror can lead to burn marks at the points of contact, leading to increased scattered radiation.

- ▶ Do not reach into the entrance aperture.
- ▶ Do not touch the deflection mirror.

NOTICE

Damage/Destruction of the device

Leaking cooling water may end up inside the device and can damage the device. Even when the lines of the cooling circuit have been emptied, a small amount of residual water will remain in the device at all times.
Transporting and storing the device at temperatures near or below freezing and without emptying the cooling circuit completely can damage the device.

- ▶ Empty the lines of the cooling circuit completely.
- ▶ Close the connectors of the cooling circuit with the included sealing plugs.

NOTICE

Damage/Destruction of the flow meter

The flow meter is damaged by the use of compressed air in the cooling circuit.

- ▶ Do not use compressed air for emptying the cooling circuit.

Shipping the device

The device is equipped with permanently installed lithium metal battery. A removal of the battery is not intended.

The device is to be considered as hazardous good.

▶ Please observe the valid regulations for shipping.

Particularly in case of a damaged battery, special regulations must be observed:

Damaged batteries can cause fire! These batteries must be checked by qualified personnel and, if necessary, sorted out or repacked!

Battery details for shipping:

Cell/battery type: Lithium metal

Cell or battery: Cell

LC or Wh rating: 0,7 g

Cell/battery weight: 16g

UN-Classification: UN 3091: Lithium metal batteries contained in equipment

4 About this operating manual

This manual describes the installation and operation of the PowerMonitor PM 48, PM 100, PM HP75/150 and how to perform measurements:

- as a stand-alone-device
- using the LaserDiagnosticsSoftware LDS version 4.0 or higher
- using the PowerMonitorSoftware PMS (predecessor of the LDS, now integrated into the LDS 4.0)

The abbreviations PM, LDS and PMS are used in this operating manual.

To use the device for measurement with a PC, the LDS or PMS included in the package must be installed on the PC.

This manual includes a brief introduction on using the LDS for measurements. For a detailed description of the software installation, file management and evaluation of the measurement data, refer to the separate instructions for the LDS or the online help.

The compatibility of your device with the LDS is indicated by the LDS symbol on the identification plate. Without the LDS symbol, the device is not compatible, use the PMS instead.

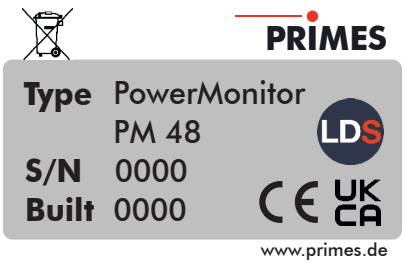


Fig. 4.1: Nameplate with LDS symbol (using the PM 48 as example)

This operating manual describes the software version valid at the time of writing.
Check whether a newer version is available using the QR code opposite or at:
www.primes.de/en/support/downloads/software.

5 Device description

5.1 Scope of delivery and optional accessories

The scope of delivery includes:

- PowerMonitor PM
- PRIMES USB flash drive, including Operating manual
- PRIMES power supply (24 V) with adapter
- USB cable (B to A connector), 5 m
- PRIMES RS485/RS232 converter:
  - 2 D-Sub cable, 1.8 m
  - Extension cable, 10 m
  - USB serial converter, 0.1 m
- Analog out cable, 5 m
- Safety interlock cable, 5 m
- 2 sealing plugs for cooling circuit (installed)
- LaserDiagnosticsSoftware LDS

The following accessories are optional:

- Transport and storage case
- Fiber adapter for PM 48, PM 100 and PM HP75/150 (see appendix D on page 59)
- Spacers PM 48 and PM 100 for FocusMonitor FM+ (see appendix F on page 61)

5.2 Explanation of the product safety labels

Potential hazard areas are marked on the device with the product safety label “Do not reach inside” and Do not use compressed air:

Product safety label “Do not reach inside”

NOTICE

Damage/Destruction of the device

Touching the deflection mirror can lead to burn marks at the points of contact, leading to increased scattered radiation.

- ▶ Do not reach into the entrance aperture.
- ▶ Do not touch the deflection mirror.

Fig. 5.1: Product safety label “Do not reach inside”

Product safety label “Do not use compressed air”

NOTICE

Damage/Destruction of the flow meter

The flow meter is damaged by the use of compressed air in the cooling circuit.

- ▶ Do not use compressed air for emptying the cooling circuit.

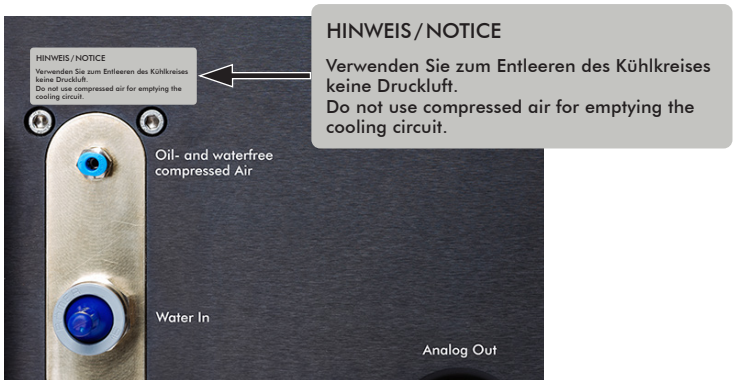


Fig. 5.2: Product safety label “Do not use compressed air”

5.3 Type overview

Type		Power range in kW	Entrance aperture in mm	Flow rate min/max	Dimensions in mm
PM 48		0,3 – 8	48	4 – 12 l/min	394×242×125
PM 100		1 – 30	100	8 – 30 l/min	580x330x215
PM HP75		3 – 80	90	25 – 150 l/min	600x330x215
PM HP150		3 – 150			

Tab. 5.1: Type overview

5.4 Functional description

The PM is a measuring device for determining the power of laser beams in the multi-kilowatt range with wavelengths in the CO_2, NIR and VIS range.

The main application is to monitor the laser power available in the processing area of CO_2, solid-state lasers or high-power diode lasers.

The device is suitable for measuring collimated, as well as divergent and convergent laser beams.

5.5 Measuring principle

The PM offers a fast power measurement using the calorimetric measuring principle with active cooling.

The laser beam hits a deflection mirror in the device. This deflects the beam through an aperture and expands it so that it irradiates as much absorber surface as possible.

The total irradiated laser power is absorbed by a water-cooled absorber in the device. The absorbed power is determined with high accuracy by measuring the flow rate of the cooling water and the temperature difference between water supply and the water return.

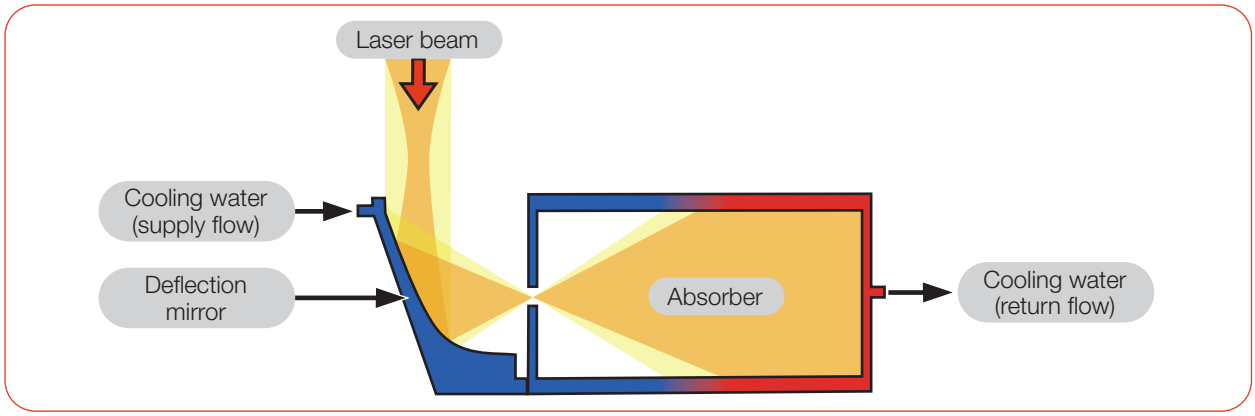


Fig. 5.3: Measuring principle (schematic)

5.6 Optical displays and acoustic signal

Display

The display shows the following measured values:

Display		Meaning
LPower 5256 W Flow 5.52 l/min Te 16.45 °C Td 14.31 K	LPower	Laser power in W
	Flow	Flow rate of the cooling water in l/min
	T_e	Cooling water temperature at the water supply in °C
	T_d	Temperature difference between water supply and water return in Kelvin

Tab. 5.2: Meaning of the abbreviations

LEDs

The LEDs indicate different states of the PM.

LED	Color	Meaning
Power	Green	Power supply is switched on.
Error	Red	The safety interlock was triggered by at least one of the following conditions: • the cooling water flow is too low (depending on device type) • the cooling water temperature at the water supply is too high • the temperature difference between water supply and water return is too large • the shutter is not (completely) open

Tab. 5.3: Meaning of the LEDs

Acoustic warning signal

If the permitted temperature of the absorber is exceeded, a warning signal will sound.

▶ Switch off the laser immediately.

The further troubleshooting procedure is described in chapter 10.3 „Acoustic warning signal“ on page 49.

6 Mounting

6.1 Conditions at the installation site

- The device must not be operated in a condensing atmosphere.
- The ambient air must be free of gases and aerosols that interfere with the laser radiation (e.g. organic solvents, cigarette smoke, sulfur hexafluoride).
- Protect the device from spray water and dust.
- Operate the device in closed rooms only.

6.2 Installation in the laser system

6.2.1 Prepare mounting

1. Switch off the laser beam.
2. Ensure that moving parts, e.g. robot arms, etc. are at a standstill and that they cannot be set in motion unintentionally.
3. Check the space available before installing the device, especially the required space for the cables and hoses.

6.2.2 Possible mounting positions

The PM can be mounted in any position.

6.2.3 Align the device

NOTICE

Damage/Destruction of the device

The deflection mirror can be damaged if the power density is too high.

▶ Make sure the focal plane is not located on the deflection mirror.

▶ Make sure that the permitted power density on the deflecting mirror is not exceeded.

The device must be aligned to the laser beam. The laser beam must hit the entrance aperture within the specified limit values according to chapter 14 „Technical data“ on page 52.

The reticle printed on the shutter can be used to center the device under the laser. Align the device using the pilot beam with the shutter closed.

Use of the device with divergent laser radiation

Normally, the device is positioned underneath the focal plane of the beam path for power measurement. If this is not possible, the device can be positioned above the focal plane.

Use of the device with convergent laser radiation

In this case, observe that the laser radiation is convergent and that the permitted power density on the deflection mirror is not exceeded.

Observe the following, depending on the device type (see chapter 14 „Technical data“ on page 52):

- the max. laser power as a function of the beam diameter according to appendix A on page 57
- the max. beam diameter at the entrance aperture
- the max. power density depending on the device type and wavelength
- the max. tolerance to the centered beam incidence
- the min. divergence full angle (convergent) /
  the max. divergence full angle (divergent)
- the max. angle of incidence perpendicular to the entrance aperture of ± 5°

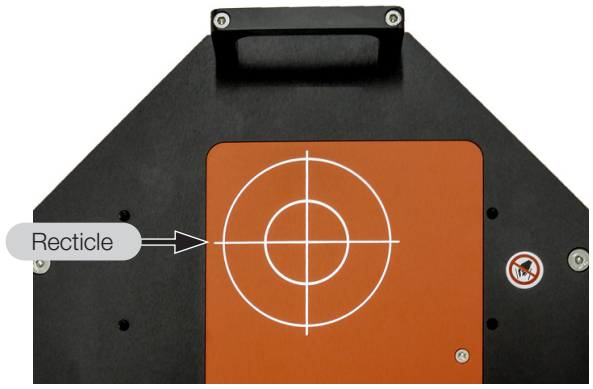


Fig. 6.1: Reticle printed on the shutter as alignment guide

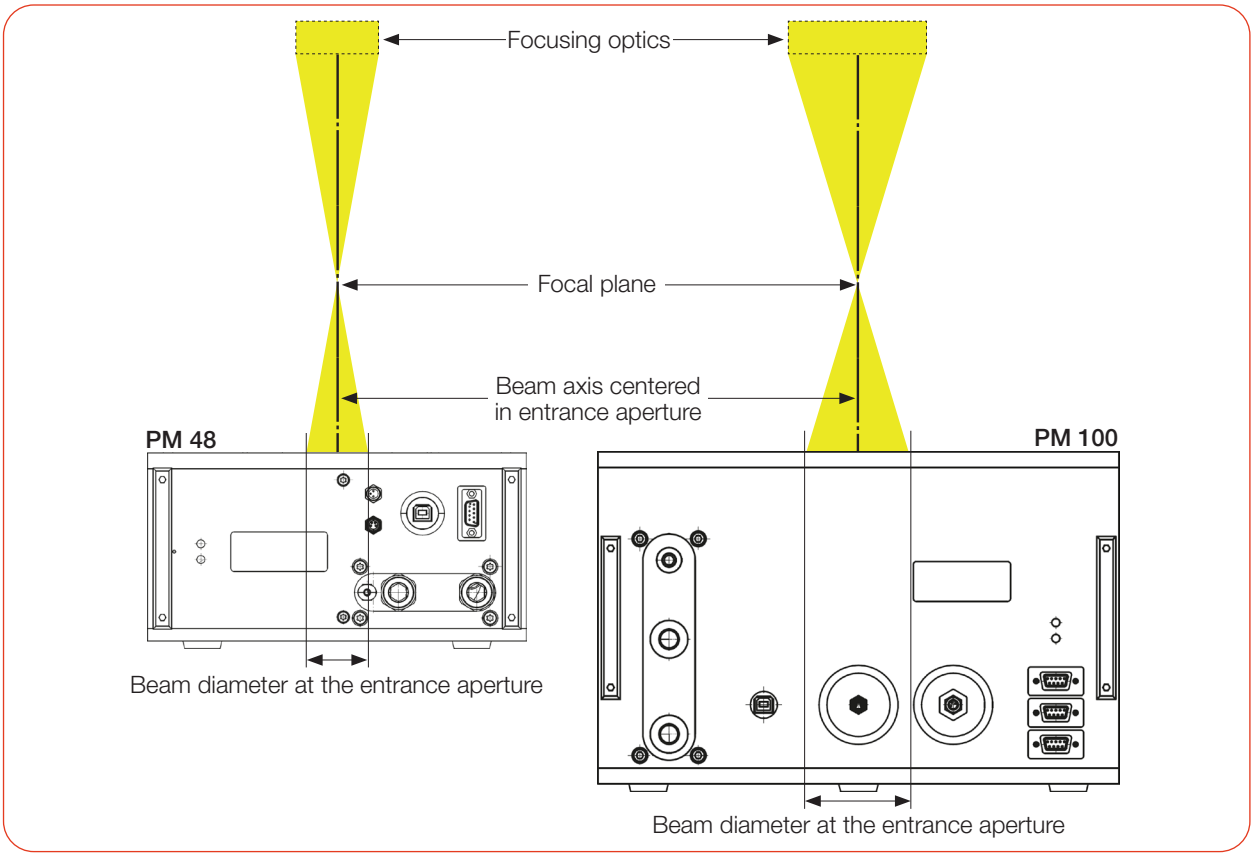


Fig. 6.2: Alignment of the PM to the laser beam using the PM 48 and PM 100 as examples (schematic)

6.2.4 Mount the device

DANGER

Serious injuries if the device falls down

If the device is not fastened securely, it may fall down.

▶ The secure fastening of the device according to the selected mounting position and the selection of the screws with appropriate tightening torque must be carried out by the customer.

DANGER

Serious eye or skin injury due to laser radiation

If the device is moved from its aligned position, increased scattered or directed reflection of the laser beam occurs during measuring operation (laser class 4).

▶ Mount the device so that it cannot be moved by an unintended push or a pull on the cables or hoses.

Mounting the PowerMonitor PM 48

1. Disconnect the device from the power supply by pulling the mains plug.
2. Unscrew the countersunk screw M3 (Torx 10).
3. Carefully slide the sheet metal housing in the guide rails in the direction of the blue arrow.
4. The baseplate has 2 through holes Ø 6.6 mm for mounting the device on a customer specific mount. If necessary, remove the device feet.
5. Place the sheet metal housing in the guide rails and push it back into the housing as far as it will go.
6. Screw in the countersunk screw M3 (Torx 10) and tighten it hand tight.

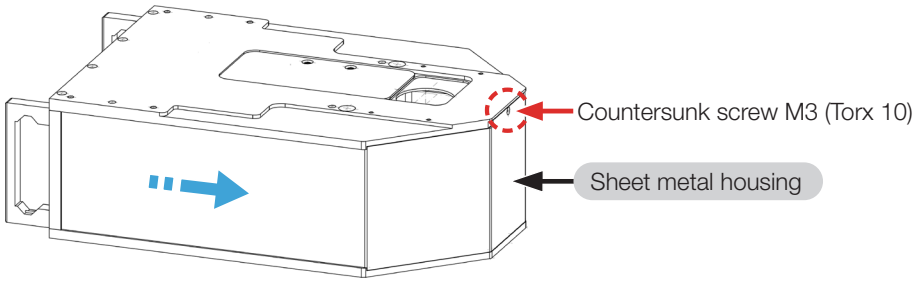


Fig. 6.3: Removing the sheet metal housing on the PM 48

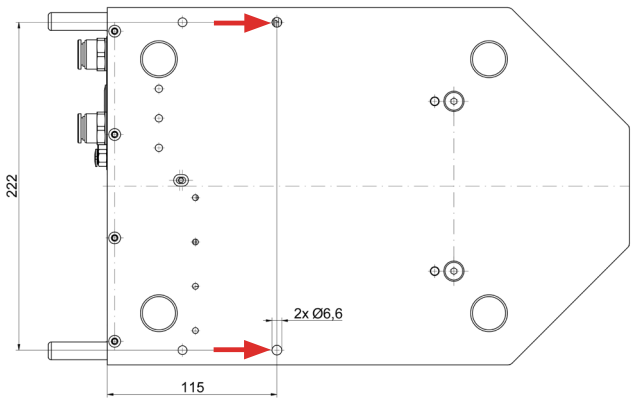


Fig. 6.4: Mounting holes on the PM 48, bottom view

Mounting the PowerMonitor PM 100 and PM HP75/150

1. Disconnect the device from the power supply by pulling the mains plug.
2. Unscrew the 2 cylinder screws M3 (Torx 10).
3. Carefully slide the sheet metal housing in the guide rails in the direction of the blue arrow.
4. The baseplate has 4 through holes Ø 11 mm for mounting the device on a customer specific mount. As a positioning aid, 2 slip fit bores Ø 10 mm H6 are provided. If necessary, remove the device feet.
5. Place the sheet metal housing in the guide rails and push it back into the housing as far as it will go.
6. Screw in the 2 cylinder screws M3 (Torx 10) and tighten them hand tight.

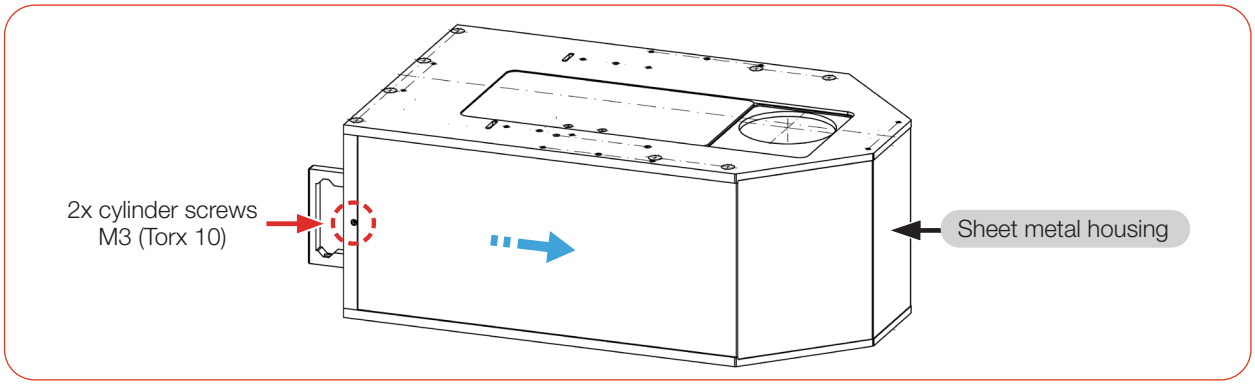


Fig. 6.5: Removing the sheet metal housing on the PM 100 and PM HP75/150

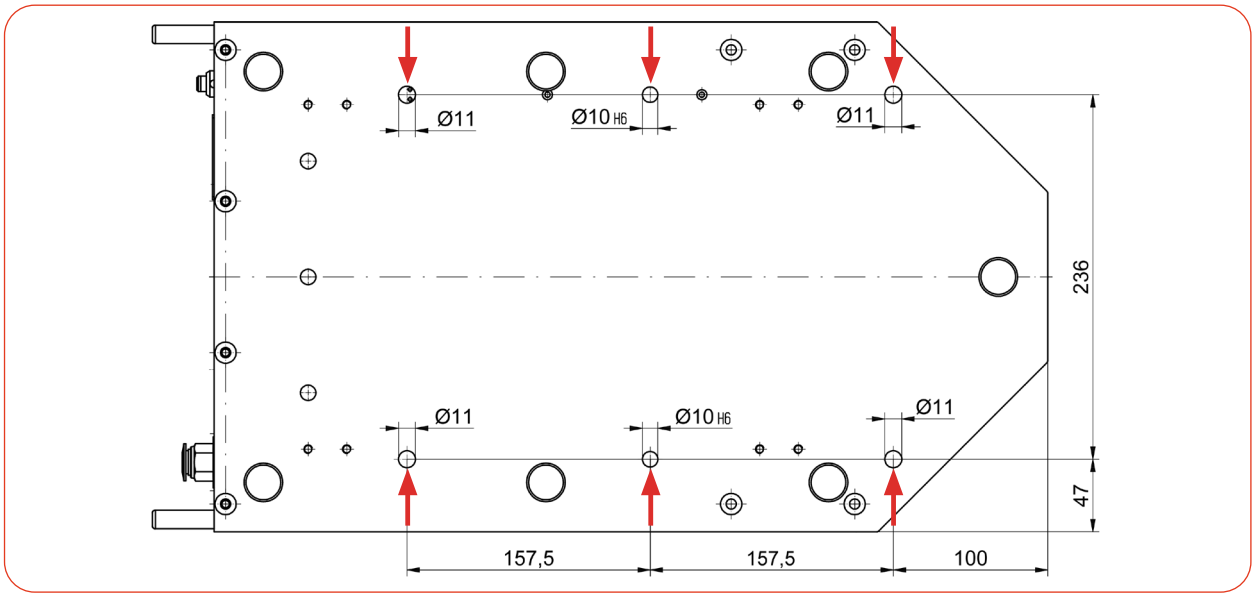


Fig. 6.6: Slip fit bores and mounting holes on the PM 100 and PM HP75/150, bottom view

6.3 Removal from the laser system

CAUTION

Eye and skin damage

If the cooling water hoses are disconnected while the water supply is on, high-pressure water may spray into the eyes.

▶ Turn off the water supply before disconnecting the cooling water hoses.

NOTICE

Damage/Destruction of the flow meter

The flow meter is damaged by the use of compressed air in the cooling circuit.

▶ Do not use compressed air for emptying the cooling circuit.

1. Switch off the laser beam.
2. Ensure that moving parts, e.g. robot arms, etc. are at a standstill and that they cannot be set in motion unintentionally.
3. Close the shutter.
4. Switch off the power supply.
5. Turn off the water supply and depressurize the cooling water hoses.
6. Remove the coolant hoses.
7. Turn off the compressed air supply.
8. Remove the compressed air hose.
9. Disconnect all connections.
10. Unscrew the fastening screws.
11. Remove the device from the laser system.
12. Drain the cooling circuit lines completely by tilting the device.
13. Seal the connectors with the supplied sealing plugs.

7 Connectors

7.1 Overview of connectors

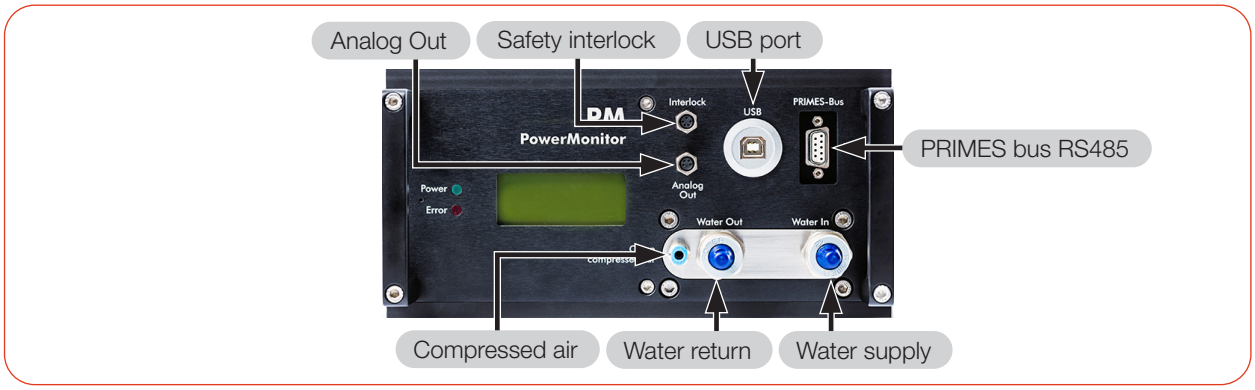


Fig. 7.1: Connectors on the PM 48

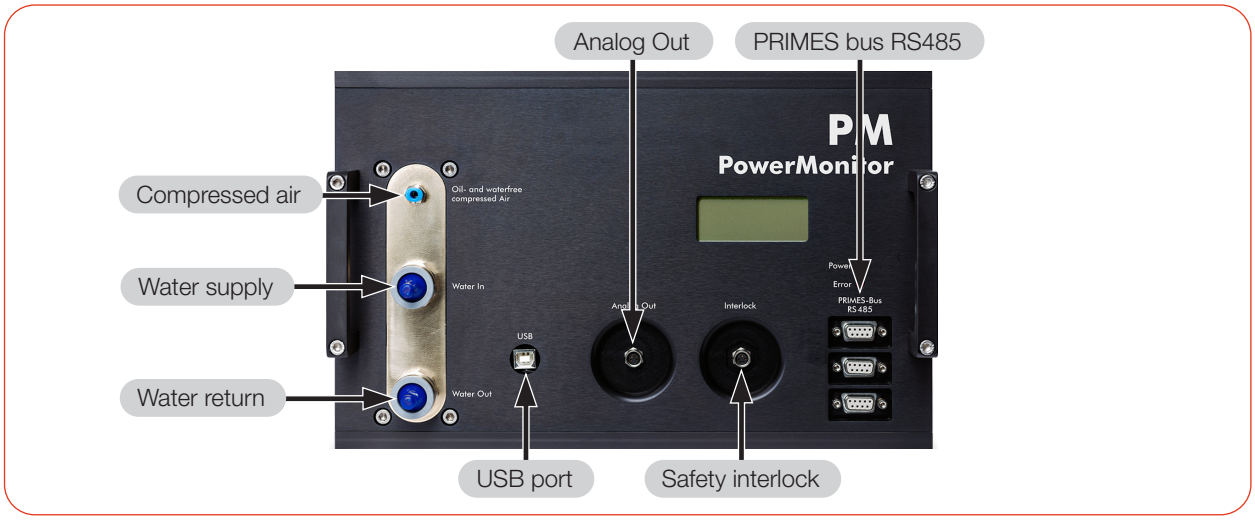


Fig. 7.2: Connectors on the PM 100

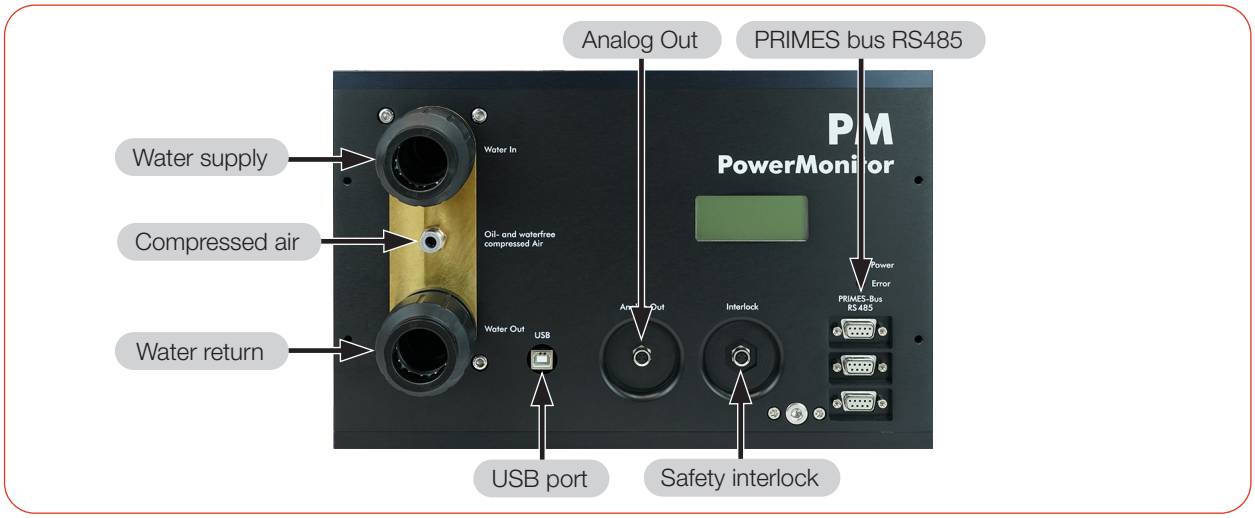


Fig. 7.3: Connectors on the PM HP75/150

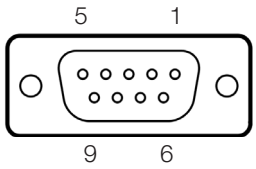
7.2 PRIMES bus RS485

The PRIMES bus is an RS485 interface with 9 pin D-Sub socket. Via the PRIMES bus:

- the device is supplied with power using the PRIMES power supply (see chapter 7.5 on page 23).
- a PC can be connected for communication. Use the PRIMES-RS485/RS232 converter for this purpose.

Pin assignment

Pin assignment (view to socket on device)



Pin	Function
1	Ground
2	RS485 (+)
3	+24 V
4	Not assigned
5	Not assigned
6	Ground
7	RS485 (–)
8	+24 V
9	Not assigned

Tab. 7.1: Pin assignment PRIMES bus

7.3 USB

USB interfaces without additional interference suppression measures is not EMC-compliant. Therefore, in industrial environments with strong sources of interference, connection interruptions and Data communication disturbances may occur.

USB port: USB-B connector type; USB 2.0 version.

When using the USB port, note the following:

- If the PC is connected to the internet, the USB driver will be installed automatically.
- If not, the USB driver must be installed manually before connecting the device.

Installing the USB driver manually

The PRIMES USB driver for all USB enabled devices can be found on the enclosed PRIMES USB flash drive or on the PRIMES website at: ***https://www.primes.de/en/support/downloads/software.html***

The USB driver can be installed from the supplied USB flash drive:

- Driver installation software ***dpinst_x64.exe*** for Windows® 7/8/10/11 (64 bit)
- Driver installation software ***dpinst_x86.exe*** for Windows® 7 (32 bit)

Administrator rights are necessary in order to install the USB driver.

1. Connect the supplied PRIMES USB flash drive to your PC.
2. Open the ***USBdriver*** folder.
3. Double-click the desired USB driver software (32- or 64 bit) to start the installation.
4. Follow the instructions on the screen.
5. Click ***Finish*** in order to complete the installation.

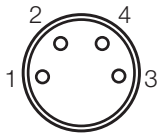
7.4 Analog Out

The PM has an analog voltage output (Analog Out) that emits a voltage value proportional to the measured laser power.

The analog output connector can be used instead of the PRIMES power supply to provide power to the device.

Pin assignment

Pin assignment M8 socket 4-pin (view to socket on device; color: wire colors of the cable)



Pin	Wire color	Function
1	Brown	24 V (input power supply)
2	White	Ground for the power supply
3	Blue	Ground for the analog signal
4	Black	Analog signal 0 – 10 V (output)

A suitable cable is included in the delivery.

Tab. 7.2: Pin assignment analog output

Output voltage and laser power

The maximum output voltage is 10 V. The output voltage is scaled to the laser power of the device. The load resistance at the analog output should not be less than 100 kOhm.

Device type	PM 48	PM 100	PM HP75/150
An output voltage of 1 V equals approx.	1 000 W	2 500 W	7 500 W

Tab. 7.3: Output voltage relative to the laser power by device types

7.5 Power supply

NOTICE

Damage/Destruction of the device

Connecting or disconnecting the bus cables when the power supply is on, can lead to voltage peaks that may destroy the communication modules of the device.

▶ Ensure all connections are made only when the power supply is turned off.

NOTICE

Damage/Destruction of the PC

The RS485-based PRIMES bus has a voltage of 24 V.
If the PC is directly connected to the PRIMES bus, the PC may be damaged.

▶ Only connect the PC to the PM via the PRIMES converter.

Only use the original PRIMES power supply with adapter.

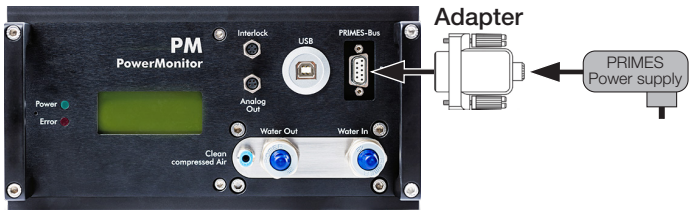
The device starts automatically after connecting the power supply. The initialization of the device takes about 1 minute. Do not remove cables during this time.

If the cable of the power supply is removed, the interlock will be triggered.

Connection options:

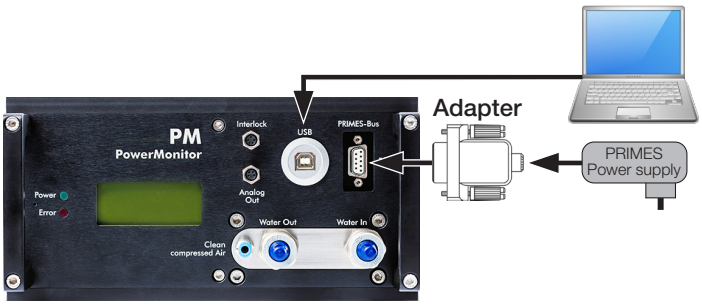
Connection option 1:

- Power is supplied via an adapter by the PRIMES power supply.
- The measured values are shown on the display of the device.



Connection option 2:

- Power is supplied via an adapter by the PRIMES power supply.
- Data communication via USB.

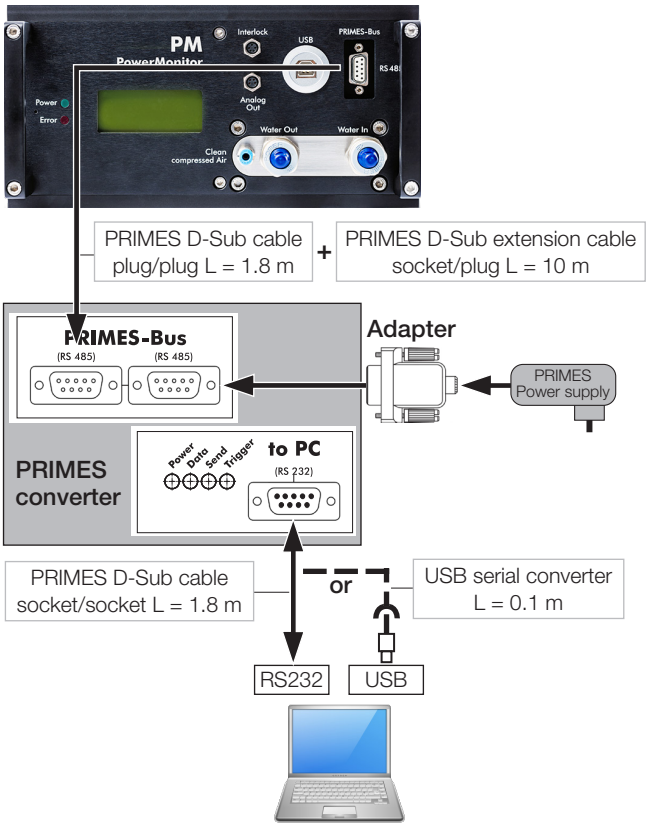


Connection option 3:

- Power is supplied via the PRIMES converter via an adapter by the PRIMES power supply.
- Data communication via the PRIMES converter by RS232 or USB serial converter.

▶ First connect the data cables and then the PRIMES power supply.

▶ When using the USB serial converter, the converter's USB driver must be installed before connecting the device.



Connection option 4:

- Power is supplied via the analog output connector.
- Data communication via analog output

For pin assignment see chapter 7.4 „Analog Out“ on page 23.

7.6 Safety interlock

DANGER

Fire hazard; Damage/Destruction of the device

The device has internal dual-channel safety monitoring. If the safety interlock is not connected, the device may be damaged by overheating or cause a fire.

- ▶ Connect the safety interlock to the safety circuit of the laser control system in such a way that the laser is switched off in the event of faulty operating conditions.
- ▶ Check that the safety interlock will switch off the laser properly in case of error.

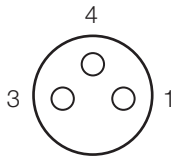
Monitored operating conditions

The safety interlock protects the device by switching off the laser beam in the following cases:

- the cooling water flow (Flow) is too low
- the cooling water temperature at the water supply is too high
- the temperature difference between water supply and water return is too high
- the shutter is not (completely) open

A potential-free switching contact is provided for integration into an existing safety circuit. In addition, a warning message is displayed in the LDS.

Pin assignment M8 3-pin (Pin: view to socket on device; Color: wire colors of the cable)



Pin	Color	Function
1	Brown	Common pin
3	Blue	NO: Connected with Pin 1 when ready for operation
4	Black	NC: Connected with Pin 1 in faulty operating conditions

A suitable connection cable with free ends is included in the delivery.

Tab. 7.4: Pin assignment of the safety interlock connector

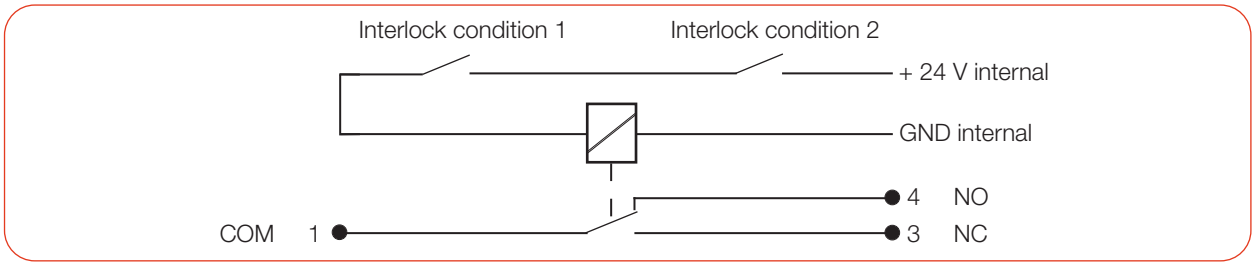


Fig. 7.4: Circuit diagram: Device in faulty operating conditions

Safety interlock specifications

- Switching voltage: 125 V AC/60 V DC
- Switching capacity: 62.5 VA/30 W
- Max. Switching current: 1 A

7.7 Cooling circuit

DANGER

Fire hazard due to overheating of the device

If there is no water cooling or insufficient water flow, the device will heat up and may catch fire.

▶ Operate the device only with a connected water cooling system and a sufficient flow rate.

CAUTION

Eye and skin damage

If the cooling water hoses are disconnected while the water supply is on, high-pressure water may spray into the eyes.

▶ Turn off the water supply and depressurize the cooling water hoses before removing them.

7.7.1 Connect/remove cooling water hoses

The water connectors are sealed with plugs to prevent residual water from leakage.

PM 48 and PM 100

Remove sealing plugs

1. Push down the release ring of the connector with two fingers of one hand and pull out the sealing plug with the other hand.

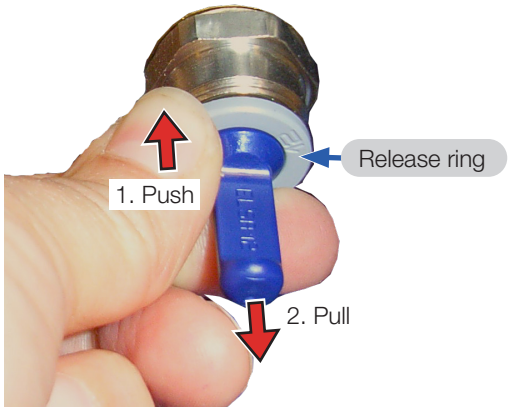
▶ Keep the plugs for closing the water connections.

Connect cooling water hoses

1. Push the water hoses into the connectors as far as they will go (approx. 2 cm).
2. Check whether the hose connections are tight.

Remove cooling water hoses

1. Push down the release ring of the connector with two fingers of one hand and pull out the water hose with the other hand.



PM HP75/150

Remove sealing plugs

1. Turn the rotating ring to the left.
2. Push down the release ring of the connector with two fingers of one hand and pull out the sealing plug with the other hand.

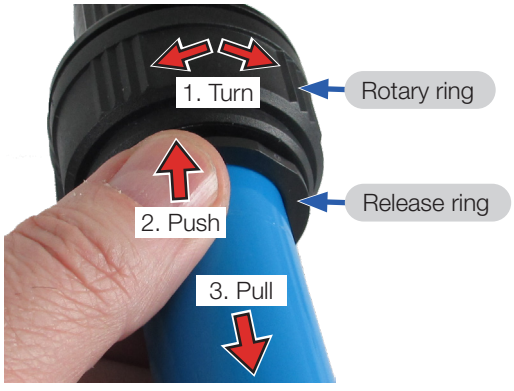
▶ Keep the plugs for closing the water connections.

Connect cooling water hoses

1. Push the water hoses into the connectors as far as they will go (approx. 2 cm).
2. Turn the rotating ring to the right to lock.
3. Check whether the hose connections are tight.

Remove cooling water hoses

1. Turn the rotating ring to the left.
2. Push down the release ring of the connector with two fingers of one hand and pull out the water hose with the other hand.



7.7.2 Damage to the device

Water quality

The device can be operated with tap water as well as demineralized water.

An operation with strongly deionized water (DI-water, conductivity < 30 µS/cm) is only possible with appropriate connection parts (stainless steel) – we will be glad to advise you as necessary.

No dirt particles/fibrous sealants

When sealing the external thread with fibrous sealant (e.g. hemp or teflon tape, make sure that no sealant residue gets into the flow.

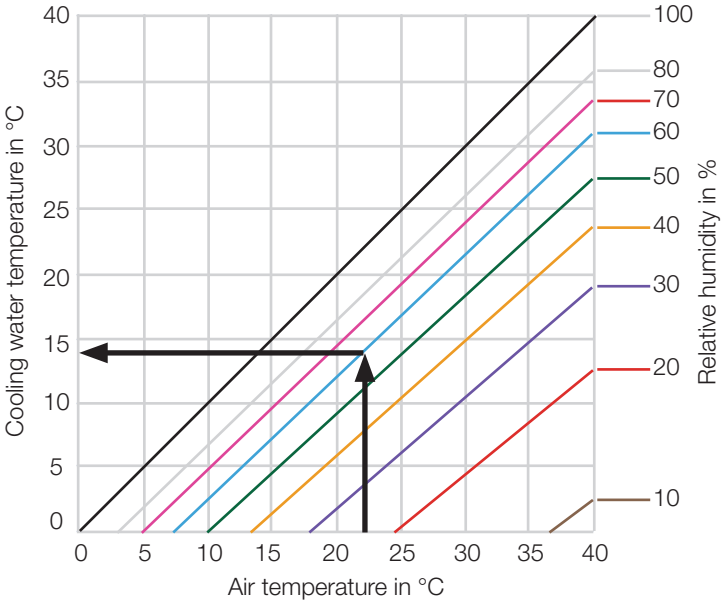
Large dirt particles or fibrous sealants may block internal cooling circuits. Therefore, please rinse the system thoroughly before connecting it.

Aluminum components

Do not operate the device on a cooling circuit in which aluminum components are installed. Otherwise, corrosion in the cooling circuit can occur, particularly when operating at high powers and power densities. In the long term, this will reduce the efficiency of the cooling circuit.

Condensates within the device

The device must not be operated in a condensing atmosphere. Check the environmental humidity levels to prevent condensates within and outside the device.



Tab. 7.5: Dew point diagram: The temperature of the cooling water must not be lower than the dew point

Example:

Air temperature: 22 °C

Relative humidity: 60 %

The cooling water temperature must not fall below 14 °C.

7.7.3 Avoid measurement inaccuracies

Antifreeze and additives

The heat capacity is one of the key parameters that is used in order to calculate the laser power. Therefore, do not operate the unit in a cooling circuit that contains antifreeze (or only after consultation with PRIMES).

Other additives - such as biocides and corrosion inhibitors - may be added to the cooling water up to a maximum concentration of 1 %.

Temperature fluctuations of the cooling water

It is important that the temperature of the inflowing water remains constant. The fluctuation of the temperature should not exceed 1 K per minute or 0.08 K per 5 seconds.

Observe the temperature display for the incoming water.

Alternatively, the power display can be observed for approx. 1 minute without the laser being switched on. The fluctuations give a first indication of the influence of the temperature fluctuations due to the chiller.

Gas bubbles in the cooling water

Gas bubbles in the cooling water can lead to measurement inaccuracies.

7.7.4 Damage to the flow meter

NOTICE

Damage/Destruction of the flow meter

The device uses a turbine for flow measurement. This can be damaged by improper handling.

▶ Observe the following requirements.

Observe flow direction

Reversing the flow direction will damage/destroy the flow meter during longer operation. If the flow direction is reversed, a negative laser power is shown.

Do not use compressed air

The turbine is damaged by the use of compressed air in the cooling circuit. Do not use compressed air to force drain the cooling water circuit.

Prevent freezing

Freezing of the cooling water must be prevented at any time by suitable precautions.

Limit cooling time

Only cool the device during measurements. PRIMES recommends starting the cooling approx. 2 minutes before the measurement and ending it approx. 1 minute after the measurement. The operating time has an influence on the service life of the flow meter.

No metal shavings/rust particles

There must not be any metal shavings/rust particles in the cooling water. The flow meter installed in the device is magnetic and attracts the metal shavings. This can lead to a build-up of debris and thus to measurement inaccuracies up to destruction of the flow meter.

7.7.5 Recommended flow rate

Per 1 kW laser power, a flow rate of approx. 1 l/min cooling water is recommended.

If water pressure is insufficient, it is possible to deviate from the rule of thumb, although this will result in lower measurement accuracy.

For the PM 48/100, you can expect 0.7 l/m per 1 kW of laser power; for the PM HP75/150, 0.5 l/m.

Observe the information in chapter 14 „Technical data“ on page 52, particularly the minimum water flow rate.

7.7.6 Temperature increase of the cooling water

The temperature increase of the cooling water as a function of the laser power and the flow rate is calculated as follows:

Temperature increase: Δ T [K]

Laser power used: P [kW]

Flow rate: Q [l/min]

$$\Delta T\,(K) = 14.3\,\frac{l \cdot K}{kJ} \cdot \frac{P\,(kW)}{Q\,\left(\frac{l}{min}\right)}$$

Formula 7.1: Calculation of the temperature increase of the cooling water

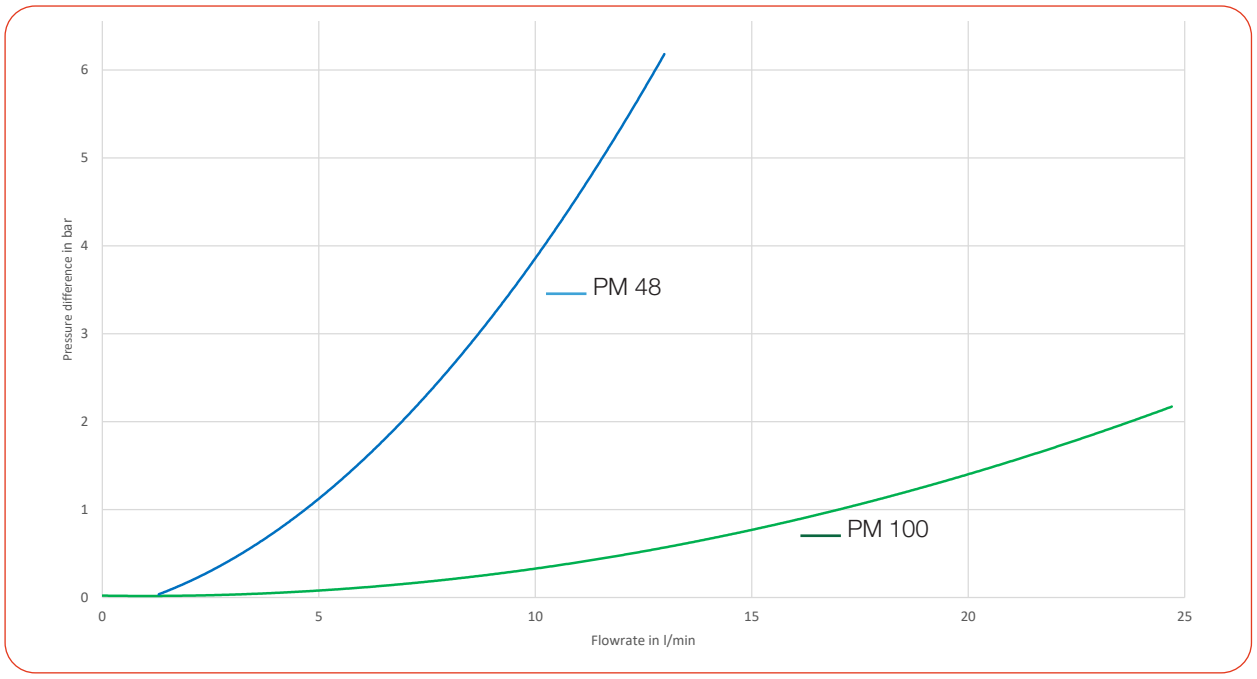
Result:

At 7 kW laser power and a flow rate of 9.5 l/min, the temperature of the cooling water increases by 10.5 °C.

7.7.7 Pressure loss

Usually, a primary pressure of 2 bar at the water supply of the device (with unpressurized outlet) is sufficient to ensure the necessary flow rate.

With the following diagram, the minimum pressure required at the cooling water supply of the unit can be determined.



Tab. 7.6: Pressure loss diagram PM 48 and PM 100

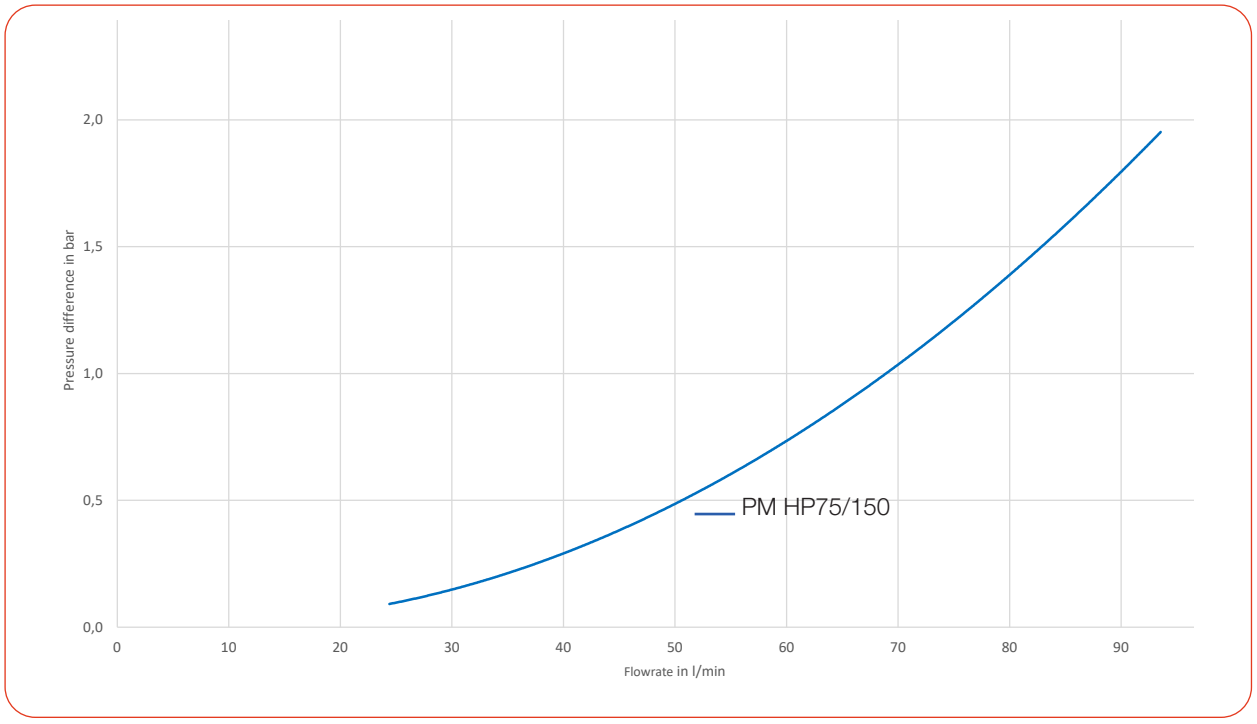


Fig. 7.5: Pressure loss diagram PM HP75/150

7.8 Compressed air

The compressed air connector is provided for automatic operation of the shutter. Only use cleaned, oil- and water-free compressed air for the compressed air connection.

Supply data	PM 48	PM 100	PM HP75/150
Hose diameter	4 mm		
Min. air pressure	2 bar		
Max. air pressure	4 bar		
Purity class	ISO 8573-1:2010 [7:4:4]		

Tab. 7.7: Parameters of compressed air connection by device types

Connect compressed air hose

▶ Push the hose into the connector as far as possible.

Disconnect compressed air hose

1. Turn off the compressed air supply.
2. Push down the release ring of the connector with two fingers of one hand and pull out the hose with the other hand.

Fig. 7.6: Compressed air connector (using the PM 100 as example)

8 Software installation

The following software can be used to operate the PM with a PC:

- LaserDiagnosticsSoftware LDS
- PowerMonitorSoftware PMS

8.1 Install LDS

The LDS is included in the scope of delivery.
PRIMES also provides a download link: www.primes.de/en/support/downloads/software.

1. Please ensure:
- System requirements are met.
- You have administrator rights.
2. Close all programs on your PC.
3. Insert the PRIMES USB flash drive into your PC and open the directory.
4. Double-click the ***LDS_Setup.exe*** file to start the installation.
5. Follow the instructions on the screen.

➔ The default storage location is: ***C:\Programs\Primes\LaserDiagnosticsSoftware***.

System requirements:

- Intel Pentium Core i3 or better
- Windows 10/11 (64-bit version)
- At least 4 GB RAM; 8 GB RAM recommended
- Display resolution: Full HD (1 920 x 1 080)
- A USB interface type A or RS232 interface

8.2 Install PMS

The PMS is included in the scope of delivery.
PRIMES also provides a download link: www.primes.de/en/support/downloads/software.

1. Please ensure:
- System requirements are met.
- You have administrator rights.
2. Close all programs on your PC.
3. Insert the PRIMES USB flash drive into your PC and open the directory.
4. Double-click the ***PMS_Setup.exe*** file to start the installation.
5. Follow the instructions on the screen.

➔ The default storage location is: ***C:\Programs\Primes\PowerMonitorSoftware***.

System requirements:

- Intel Pentium or better
- Windows 10/11 (32- or 64-bit version)
- At least 2 GB RAM; 4 GB RAM recommended
- Display resolution: XGA (1 024 x 768)
- A USB interface type A or RS232 interface

9 Measuring

9.1 Warning messages

DANGER

Serious eye or skin injury due to laser radiation

During the measurement, the laser beam is guided on the device. This causes scattered or directed reflection of the laser beam (laser class 4).

The device must not be operated without taking the following precautions:

- ▶ Connect the safety interlock to the safety circuit of the laser control system in such a way that the laser is switched off in the event of faulty operating conditions.
- ▶ Wear **safety goggles** adapted to the power, power density, laser wavelength and operating mode of the laser beam source in use.
- ▶ Wear suitable **protective clothing** and **protective gloves**.
- ▶ Protect yourself from laser radiation by using separating devices (e.g. by using appropriate shielding).

DANGER

Serious eye or skin injury due to laser radiation

If the device is moved from its aligned position, increased scattered or directed reflection of the laser beam occurs during measuring operation (laser class 4).

- ▶ Mount the device so that it cannot be moved by an unintended push or a pull on the cables or hoses.

DANGER

Fire hazard; Damage/Destruction of the device

The safety interlock monitors the operating conditions of the device. The safety interlock offers potential-free switch contacts for integrating the device into an existing safety circuit.

- ▶ Connect the safety interlock of the laser control unit in such a way, that in the event of faulty operating conditions, the laser is switched off.
- ▶ Check that the safety interlock will switch off the laser properly in case of error.

NOTICE

Damage/Destruction of the device

The deflection mirror can be damaged if the power density is too high.

- ▶ Make sure the focal plane does not reside on the deflection mirror.
- ▶ Make sure that the permitted power density on the deflecting mirror is not exceeded.

9.2 Preparing measurement readiness

1. Observe the warning messages according to chapter 9.1 „Warning messages“ on page 33.
2. Connect the safety interlock of the laser control to the device.
3. Connect the device to the power supply.

👁 The green Power LED must light up.

👁 Wait until the display lights up.

👁 The Error LED lights red after a short time.

4. Turn on the water cooling.

👁 After a few seconds, the red Error LED must turn off.

After approx. 2 minutes, the device temperature and the temperature of the cooling water are in equilibrium.

5. The PM is ready for measurement.

9.3 Measuring with the PM as a stand-alone device

The PM can also be used to measure without a PC. The measured values are shown on the display of the device. The display shows the following measured values:

Display		Meaning
LPower 5256 W Flow 5.52 l/min Te 16.45 °C Td 14.31 K	LPower	Laser power in W
	Flow	Flow rate of the cooling water in l/min
	T_e	Cooling water temperature at the water supply in °C
	T_d	Temperature difference between water supply and water return in Kelvin

Tab. 9.1: Abbreviations on the display

Get ready for measurement

1. Prepare the device according to chapter 9.2 „Preparing measurement readiness“ on page 34.

Determine zero level

2. Read the displayed value. The value must later be subtracted as zero level from the displayed laser power.

Start measurement

3. Observe the max. laser power as a function of the beam diameter according to appendix A on page 57.
4. Open the shutter completely.
5. Switch on the laser.

➔ The measured laser power is displayed after about 2 seconds. The display reaches about 99 % of the final value after:

PM 48:	18 seconds
PM 100:	35 seconds
PM HP75:	35 seconds
PM HP150:	20 seconds

6. Switch off the laser.
7. Subtract the previously recorded zero level from the displayed laser power.
8. Close the shutter completely.

9.4 Measuring with the LDS

This chapter describes measurements with the LDS. For a detailed description of the software installation, file management and evaluation of the measured data, please refer to the separate operating manual “LDS”.

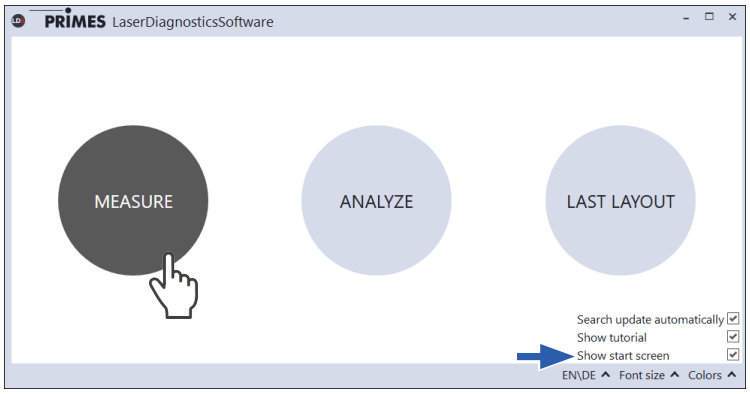
9.4.1 Connect/disconnect the LDS

Switch on the device and connect it to the LDS

1. Prepare the device according to chapter 9.2 „Preparing measurement readiness“ on page 34.
2. Start the LDS by double-clicking on the program icon LDS in the start menu group or on the desktop icon.

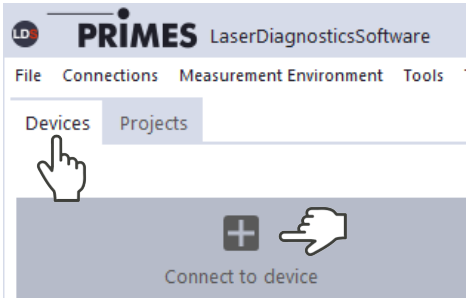
The start screen appears.

3. Select the operating mode ***Measure***.



If the ***Show start screen*** option is disabled or the window ***Connections*** is closed:

▶ Click the ***Devices*** tab and then on the ***+ Connect to device*** button.



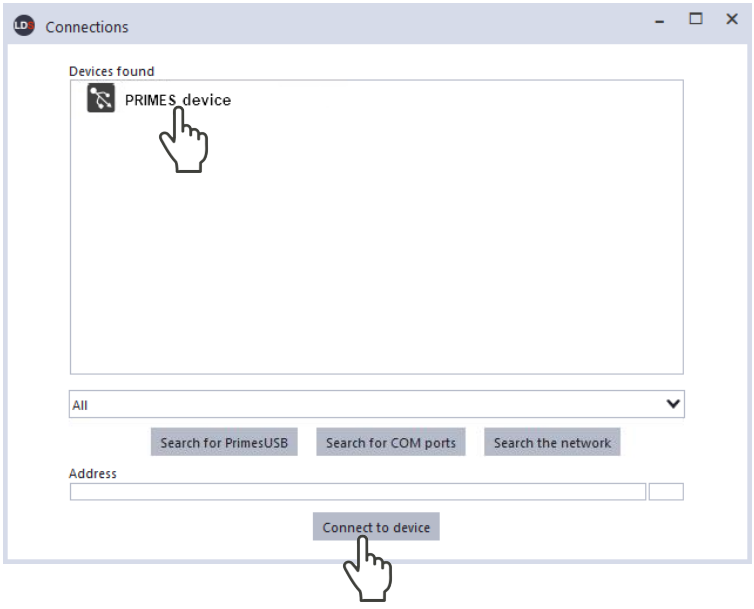
The ***Connections*** window appears.

4. Click on the desired device.
5. Click the ***Connect to device*** button.

If the device does not appear:

▶ Click on the ***Search the network*** button.

If the device still does not appear, see chapter 10.2 „Connection errors with the LDS“ on page 49.

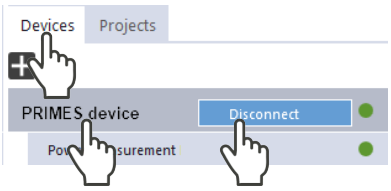


Disconnect from the LDS and switch off the device

1. Click the ***Devices*** tab.
2. Right-click on the device and select the ***Disconnect*** menu point.

➔ The device is disconnected from the LDS.

3. Turn off the device by disconnecting the power supply cable.
4. Disconnect any other electrical connections if necessary.



9.4.2 General information

Enter parameters and activate

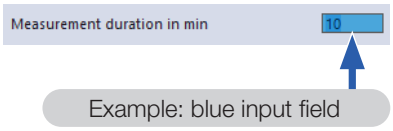
Transfer an entered parameter value with the Enter key:

1. Enter the desired value in the input field.

👁 The background color of the input field changes to blue.

2. Confirm the entry by pressing the Enter key.

👁 The field returns to its original background color.



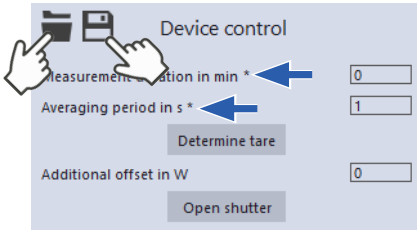
Saving options

Save data with asterisk (*) to a file/load from a file:

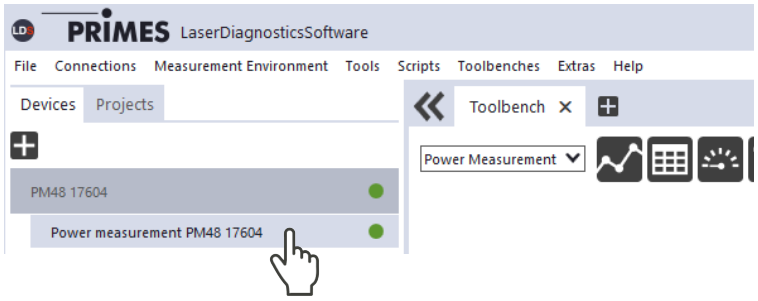
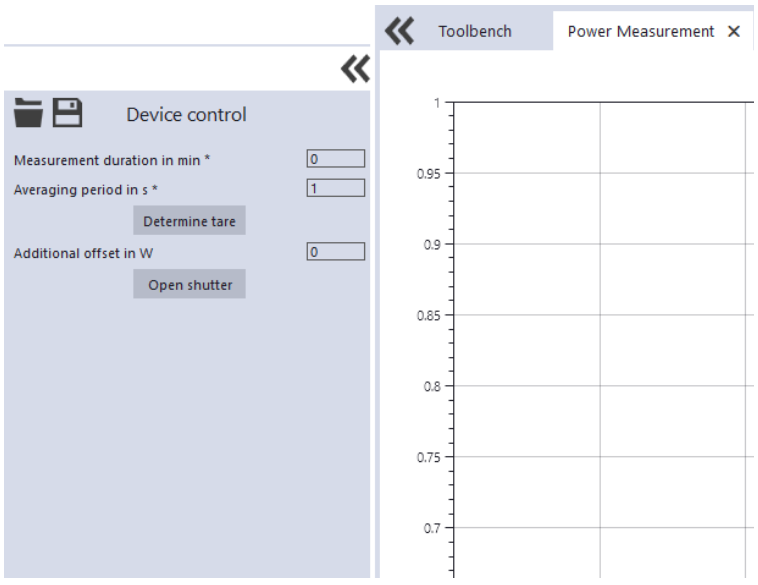
All data marked with an asterisk in the ***Device control*** menu can be saved to a preset file with the extension ***.pre*** on the PC.

▶ To save a configuration, click on the icon 💾.

▶ To load a configuration click on the icon 📂.



9.4.3 Power measurement

👁 The PM is displayed as a connected device. ▶ Click on the connected device.	
👁 The corresponding ***Device control*** opens. 👁 The ***Power Measurement*** toolbench opens.	

Settings in the device control

Option	Explanation
Measurement duration in min	▶ Enter a value in the input field. Without input, the power is measured permanently.
Averaging period in s	▶ Enter a value in the input field. The measured values are averaged over the entered time
Determine tare	▶ Click this button to adjust the value for the offset in the LDS.
Additional offset in W	▶ Enter a value that will be subtracted from the measured laser power.
Open shutter/Close shutter	▶ Click on the button: • With the compressed air supply connected, the shutter is automatically opened/closed. • Without compressed air supply, the shutter must be opened/closed manually.

Tab. 9.2: Settings in the device control

Determine device offset (Tare)

To determine the device offset, the device must go through a thermalization time.

1. Run the cooling water for approx. 2 minutes.

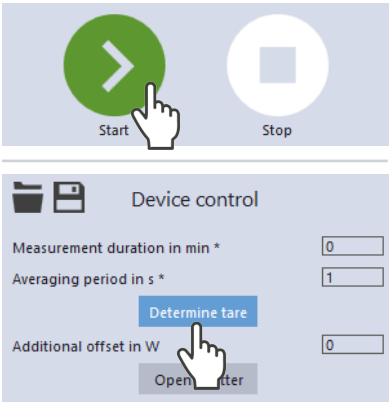
➔ After approx. 2 minutes, the device temperature and the temperature of the cooling water are in equilibrium.

2. With the laser switched off, click ***Start***.
3. Click ***Determine tare***.

➔ The offset value is determined and stored in the LDS.

👁 The display of the laser power is automatically corrected with the stored offset value.

4. Start a measurement.



Start measurement

1. Observe the max. laser power as a function of the beam diameter according to appendix A on page 57.
2. Click the ***Open shutter*** button:

- With the compressed air supply connected, the shutter is opened automatically.
- Without a compressed air connection, the shutter must be opened manually as far as it will go.

3. Switch on the laser.
4. Click the ***Start*** button.

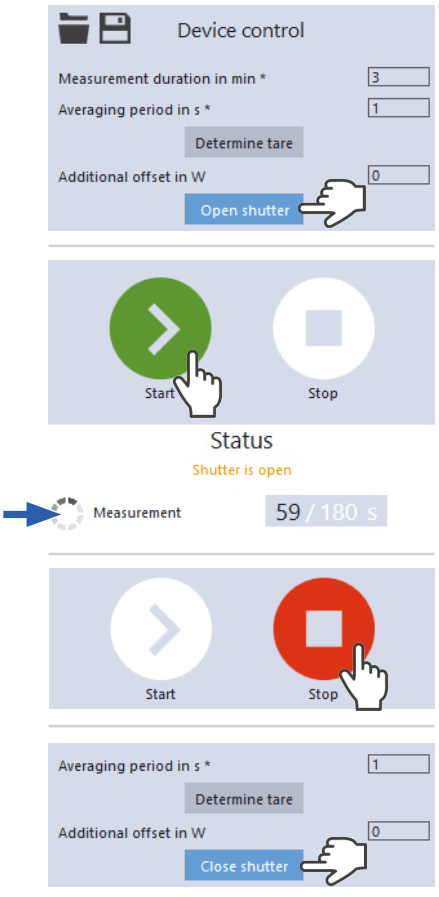
👁 The progress of the measurement is displayed in the ***Status***.

5. If you have not entered a measuring duration, click the ***Stop*** button.

➔ The measurement is finished.

6. Switch off the laser.
7. Click the ***Close shutter*** button:

- The shutter on the device is closed automatically
- Without a compressed air connection, the shutter must be closed manually as far as it will go.

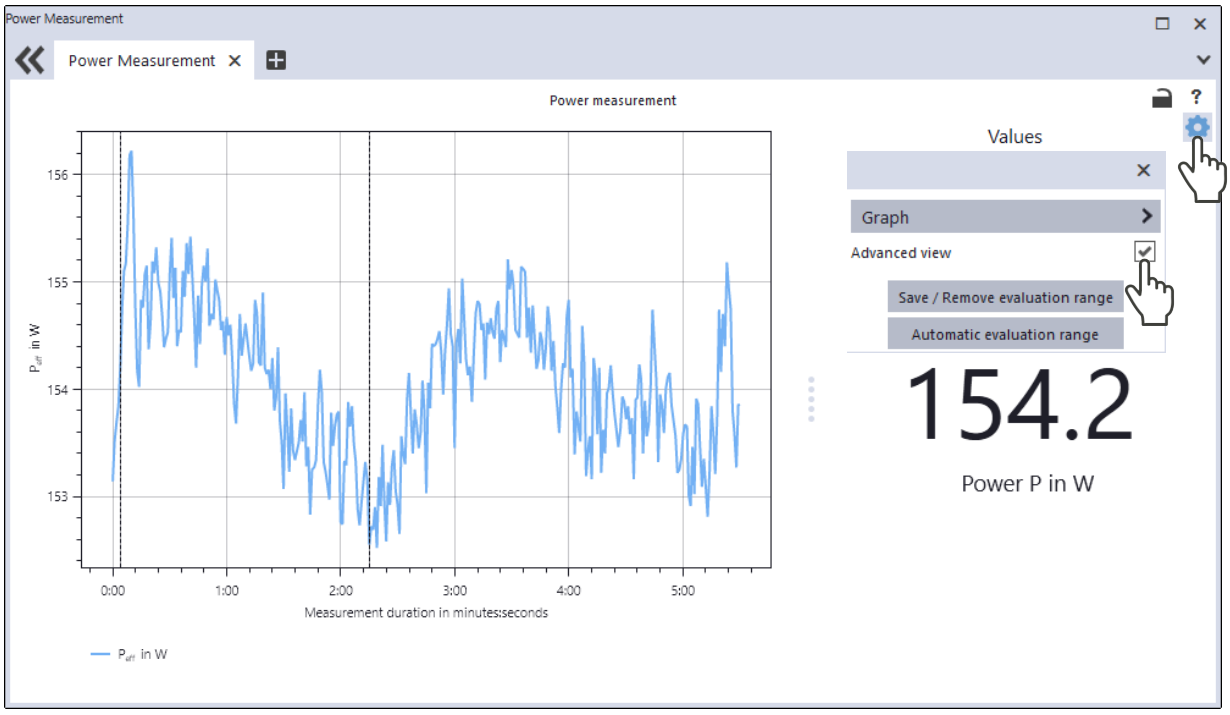


9.4.4 Measurement values display

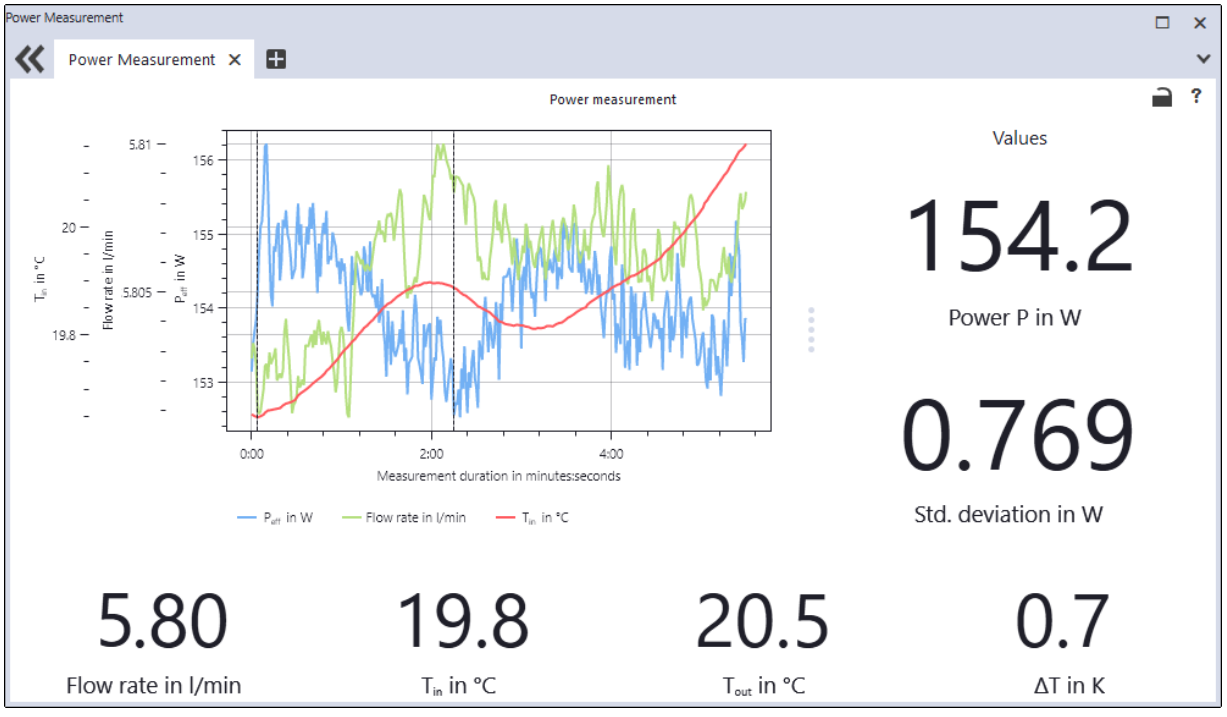
The measurement results are shown during the measurement in the opened ***Power Measurement*** tool.

The displayed parameters can be adjusted by clicking the gear icon . For example, ***Advanced view***.
The view changes to an extended display of the measured parameters.

A detailed description of the tools and the assessment of the measuring results can be found in the separate operating manual for the LDS.



Advanced view



9.5 Measuring with the PMS

9.5.1 Connect device

Switch on device and start PMS

1. Prepare the device according to chapter 9.2 „Preparing measurement readiness“ on page 34.
2. Start the PMS by double-clicking on the program icon in the start menu group or on the desktop icon.

Various dialogue windows can be called up via the menu bar.

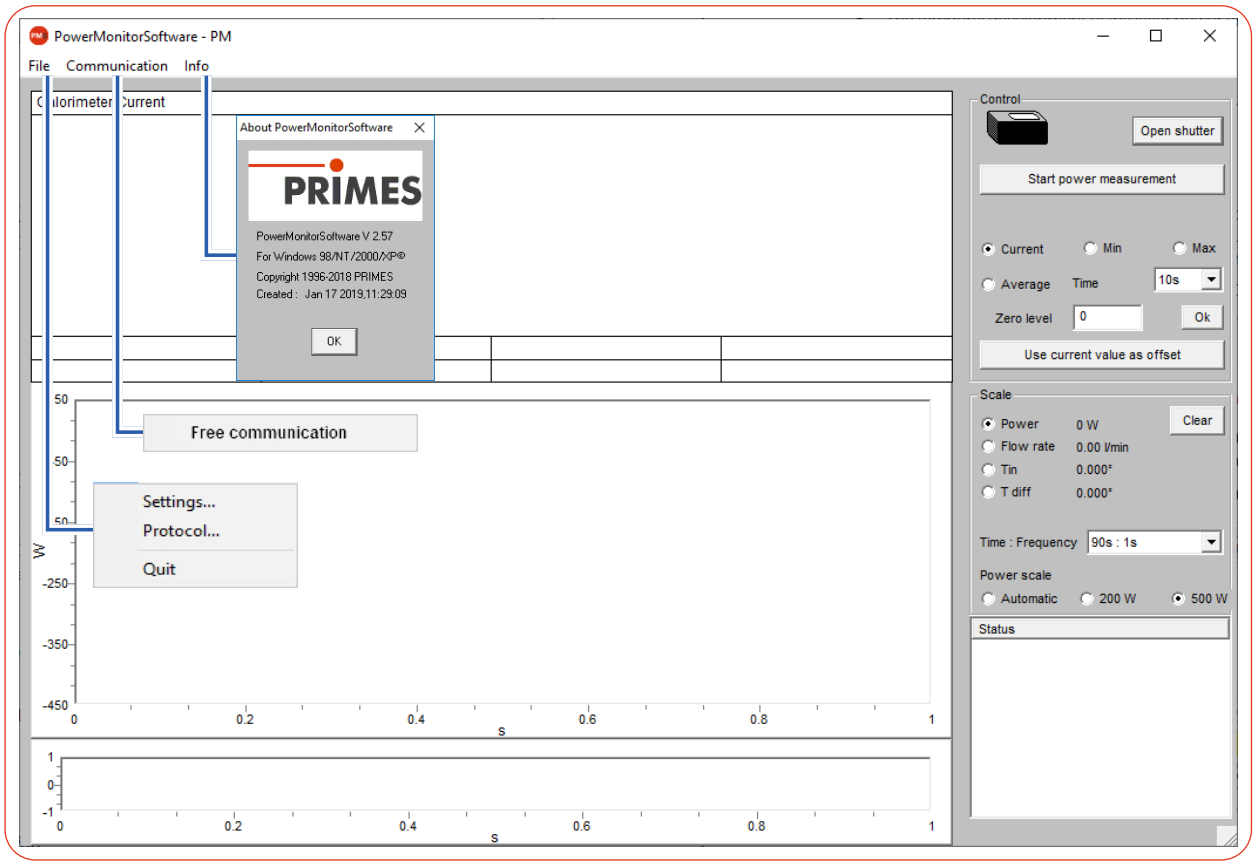


Fig. 9.1: Menu selection in the menu bar

File > Settings

A different device address can be entered here.

File > Protocol

The determined measurement results can be stored in a tab-separated text file:

1. Activate the check box ***Write*** and type in a file name or choose a file.
2. Click ***OK***.

File > Quit

Terminates the software.

Communication > Free communication

Opens the dialogue window for the communication.

Info

Provides information regarding the software.

Connect device

▶ Open the ***Communication > Free Communication*** menu.

For connection via RS232 and PRIMES converter

See chapter 7.2 „PRIMES bus RS485“ on page 22.

After the start-up, the software tries to establish a connection with the serial interface “COM2”. If “COM1” is the only available serial interface, “COM1”has to be explicitly selected in ***Com port*** in the menu ***Communication > Free Communication***.

When using the USB serial converter, please choose the operating mode ***USB2Serial***.

For connection via the USB interface

See chapter 7.3 „USB“ on page 22.

If the device was connected via USB, the operating mode ***USB*** has to be selected in the menu ***Communication > Free Communication***.

Then press the ***Scan*** button.

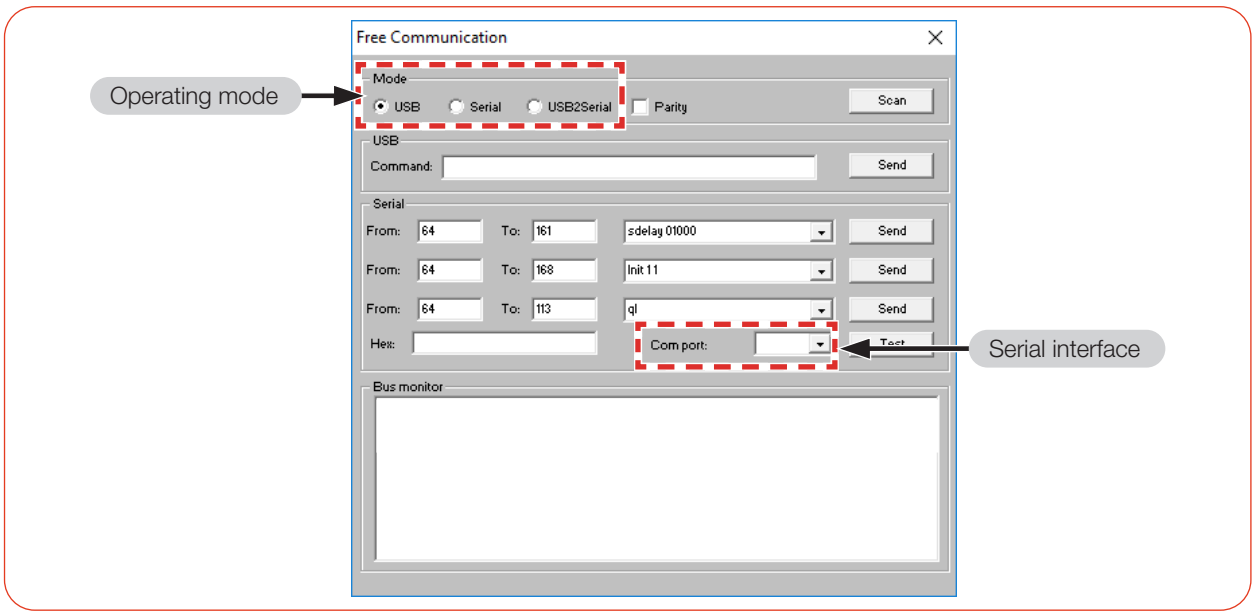


Fig. 9.2: Menu Free Communication

If no communication is established, press the ***Start power measurement / Stop power measurement*** button in the upper right hand corner a couple of times (see Fig. 9.1 on page 40).

If communication is still not possible, test the interfaces according to chapter 9.5.2 on page 42.

9.5.2 Testing the interface

After connecting the devices, the communication between PC and device can be checked in the menu ***Communication > Free Communication***.

First of all, the interface is checked by starting the software on the PC.

Possible error message:

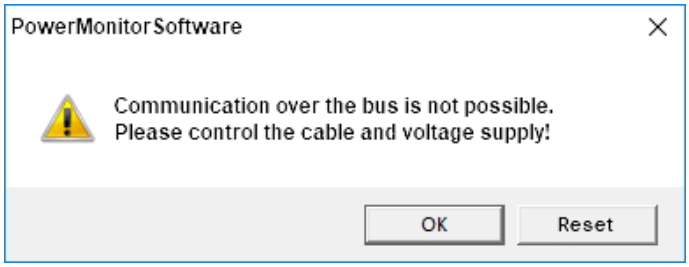


Fig. 9.3: Possible error message

Reason:

- The communication via the bus system is not possible.

Remedy:

1. Check the cabling of the devices.
2. Ensure that the power supply is connected and switched on (the communication is only possible if the PRIMES bus is supplied with 24 V direct current voltage).
3. Switch off the power supply and switch it on again.

Possible error message (only when operated with the PRIMES converter):

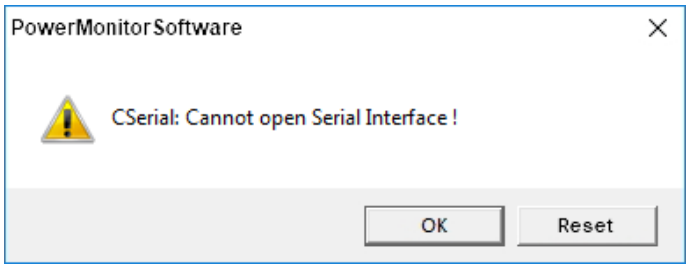


Fig. 9.4: Possible error message

Reason:

- The software cannot open the preset interface.

Remedy:

1. Check whether another software, e.g. a fax software or a parallel running LDS, is just using the interface. A serial port can only be used by one software at a time.
2. Check whether the software opens the correct port. After starting the software, the used interface can be changed in the menu ***Free Communication***. All interfaces available for the software are initially displayed here (drop down list ***Com port***).

Testing the communication of multiple devices

The communication is checked via the PC by means of the PMS. For this purpose, a certain command is sent to each device. If a device replies as stated in Tab. 9.3 on page 43 the communication works without any problems.

1. Select ***Communication > Free communication***.
   In the appearing window the address of the sender (PC) has to be entered in the field ***From***, the address of the recipient has to be entered in the field ***To*** (PRIMES device) and the command is entered in the text field on the right.
2. The command is confirmed by clicking the button ***Send***.
   The reply of the device appears below in the bus monitor.

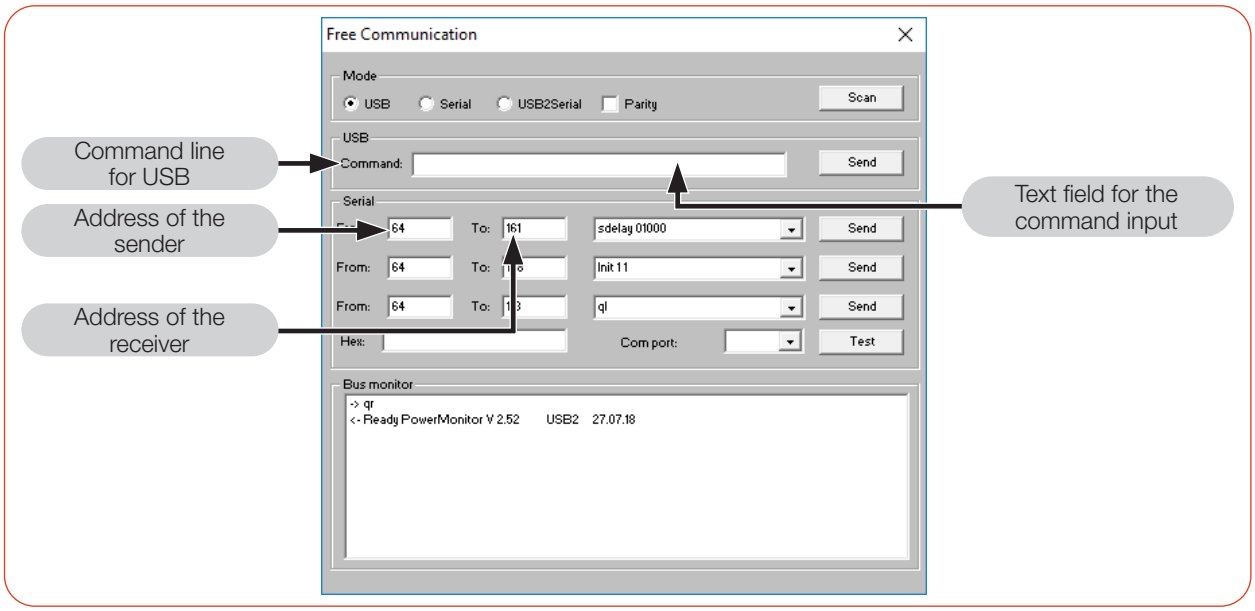


Fig. 9.5: Menu Free Communication

Device	From (PC)	To (Device)	Command	Reply
FocusMonitor FM	64	161	qr	aID FocusMonitor
BeamMonitor BM	64	144	qr	aID BeamMonitor
PowerMonitor	64	113	qr	ready PowerMonitor

Tab. 9.3: Table for the function control

The command for a query request is ***qr***.

If no reply is received from a device:

1. Switch off the power supply and switch it on again. Send the command again.
2. Check the wiring of the unit and whether all plugs are connected.
3. A device blocks the PRIMES bus. Switch off the power supply and take the corresponding device off the bus. Put the system back into operation.
4. The PC blocks the PRIMES bus: The red LED “Send“ at the PRIMES converter glows permanently. Start the PC again.

Determine device offset

To determine the device offset, the device must go through a thermalization time.

1. Run the cooling water for approx. 2 minutes.

➔ After approx. 2 minutes, the device temperature and the temperature of the cooling water are in equilibrium.

2. With the laser switched off, click ***Start power measurement***.
3. Click ***Use current value as offset***.

➔ The offset value is determined and stored in the PMS.

👁 The display of the laser power is automatically corrected with the stored offset value.

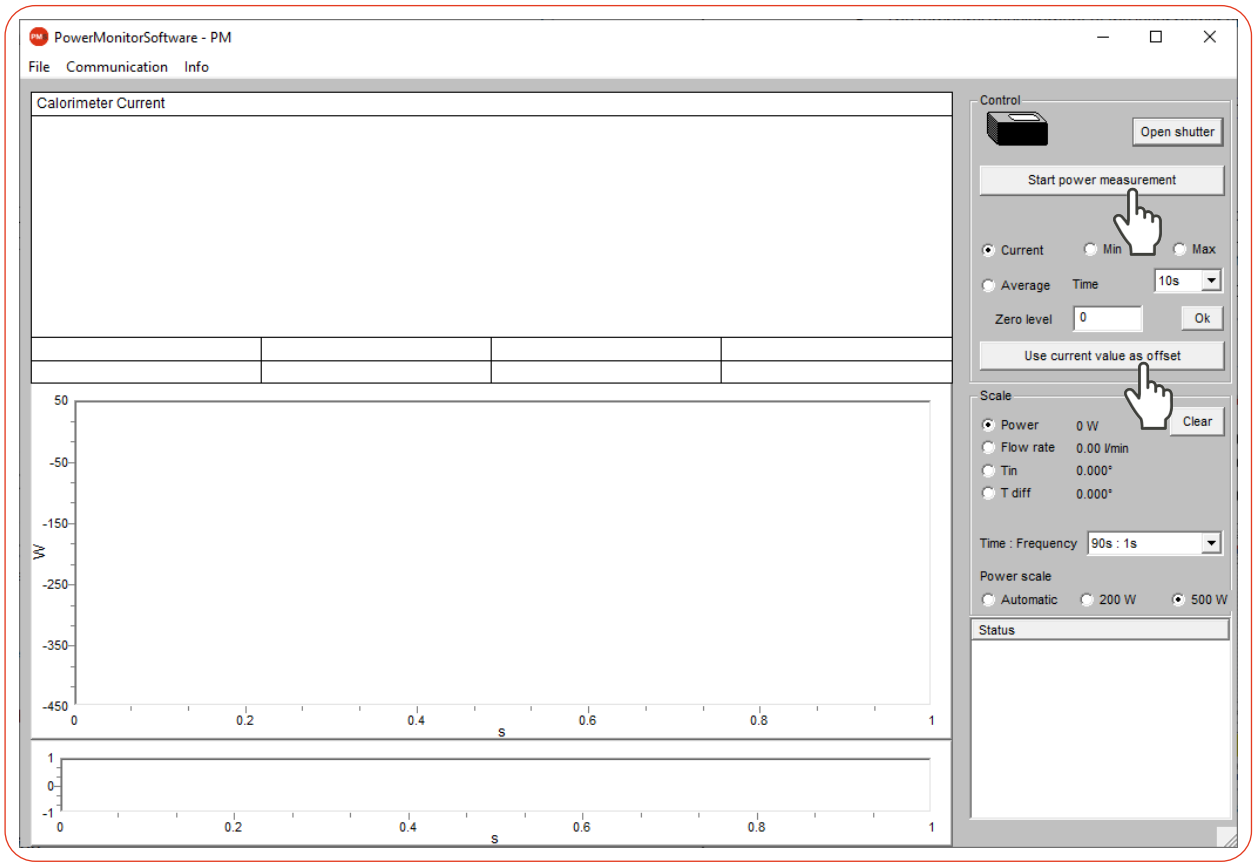


Fig. 9.6: Determine device offset

9.5.3 Power measurement

1. Observe the max. laser power as a function of the beam diameter according to appendix A on page 57.
2. Click the ***Open shutter*** button.

- With the compressed air supply connected, the shutter is opened automatically.
- Without a compressed air connection, the shutter must be opened manually as far as it will go.

If the position of the shutter is unknown or an ***Open shutter*** command has not been executed correctly, a question mark will appear on the PowerMonitor icon.

3. Switch on the laser.
4. Click the ***Start power measurement*** button.

➔ The measured laser power is displayed after about 2 seconds. The display reaches about 99 % of the final value after:

PM 48:	18 seconds
PM 100:	35 seconds
PM HP75:	35 seconds
PM HP150:	20 seconds

5. If no measurement duration has been entered in the drop down list ***Time : Frequency***, click the ***Stop*** button.

➔ The measurement is finished.

6. Switch off the laser.
7. Click the ***Close shutter*** button.

- The shutter on the device is closed automatically
- Without a compressed air connection, the shutter must be closed manually as far as it will go.

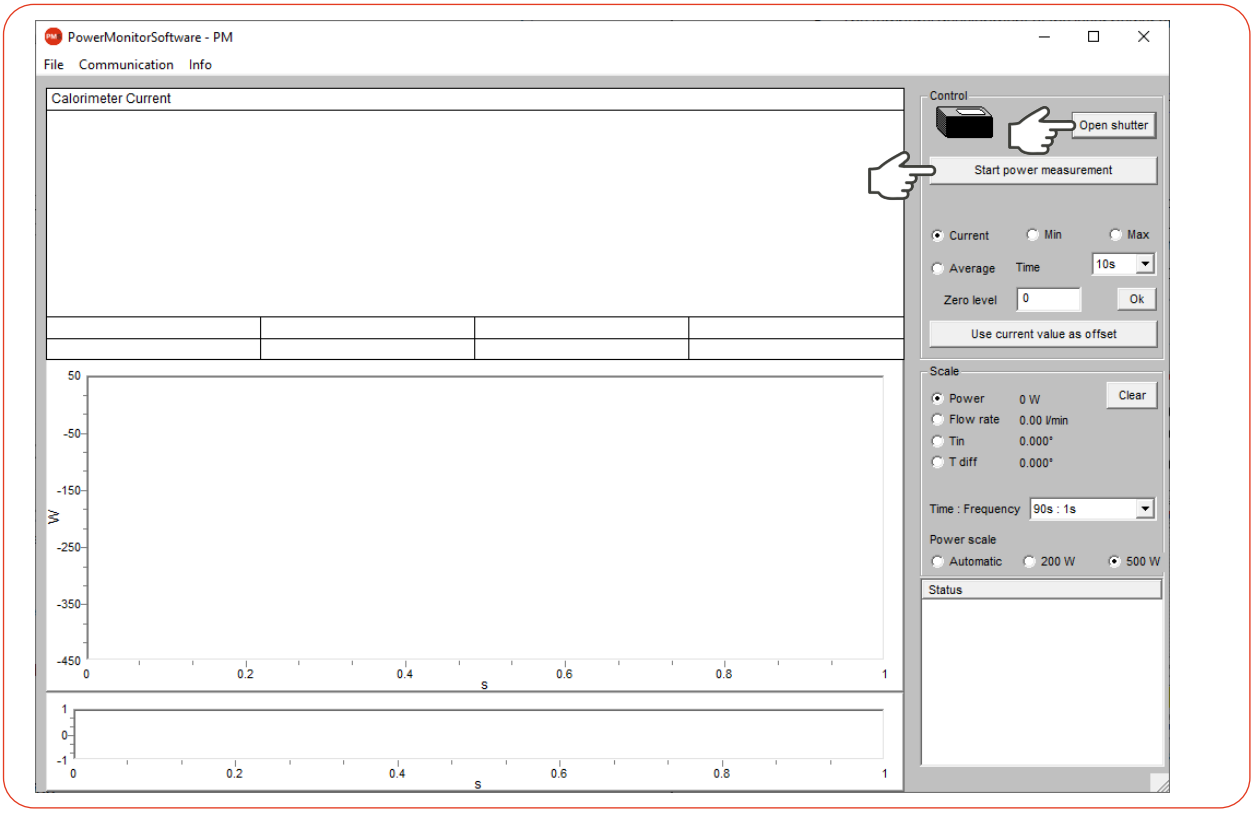


Fig. 9.7: Perform power measurement

9.5.4 Measuring values display

The graphical user interface is divided into three display parts (see Fig. 9.8 on page 46):

- Window A: The numerical display of the current measuring values
- Window B: The temporal development of the laser power or the flow rate or of the cooling water temperature
- Status window

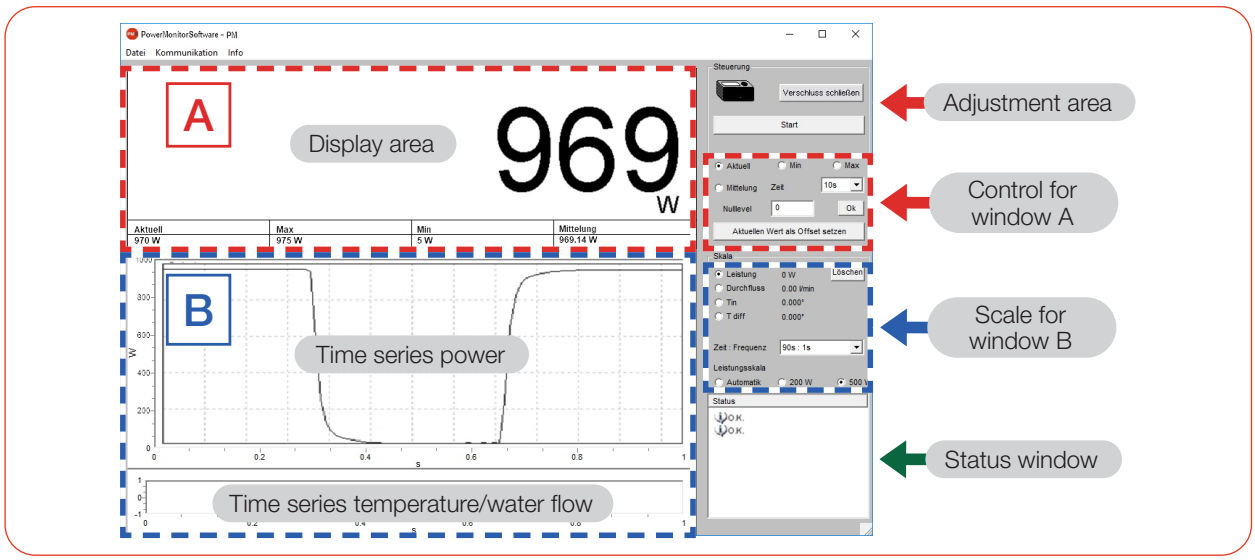


Fig. 9.8: The graphical user interface during a measurement

Window A (Numerical display)

In window A below the large display the following measured values are displayed:

- The current measuring value
- The minimum value and the maximum value
- The average value (button ***Average***) of the chosen time interval (drop down list ***Time***)

With the averaging of the power measuring values (***Time*** 10 s, 20 s, 30 s, 50 s, max = 90 s) a noise can be reduced, which enables very accurate measurements.

The option switches ***Current***, ***Min***, ***Max***, ***Average*** in the configuration range ***Control*** set which measured value is shown in large digits (see Tab. 9.4 on page 46).

Selection	Display
Current	Display of the current power
Min	Display of the minimum power measured
Max	Display of the maximum power measured
Average	Display of the average value within the chosen measurement duration

Tab. 9.4: Selection for large display of the measured value

Settings

The maximum duration (Max) for the averaging is 90 seconds.

A possible zero offset can be compensated with the button ***Use current value as offset*** or numerically via the input field ***Zero level***.

Window B (Graphical display)

In window B two time series are displayed:

Time series power

The y-axis (power) of the window can be scaled automatically or with fixed values (200 W or 500 W). In the setting ***Automatic*** the y-axis is scaled with the difference of the measured minimum and maximum value.

Time series temperature/Flow rate

The cooling water flow rate or the input temperature (T_{in}) or the temperature difference (T_{diff}) between the water supply and the water return can be controlled here. The selection is made via the option switches within the adjustment area ***Scale***.

- *Flow rate*
- T_{in}
- T_{diff}

Push button clear

Deletes all numerical and graphical displays in the windows.

Select list Time: Frequency

In this drop down list the duration of the measurement as well as the measurement rate (number of measurements per time unit) can be chosen. Possible settings:

Measurement duration	Measurement rate	
90 s	1 s	≙ 1 Hz
10 min	2 s	≙ 0,5 Hz
30 min	2 s	≙ 0,5 Hz
2 h	5 s	≙ 0,2 Hz
10 h	5 s	≙ 0,2 Hz
50 h	10 s	≙ 0,1 Hz

Tab. 9.5: Setting Time: Frequency

Status window

In the bottom right window ***Status*** of the user interface (see Fig. 9.8 on page 46) error messages can appear in red font. These errors have to be remedied before a measurement.

10 Troubleshooting

10.1 Messages in the LDS during measurement

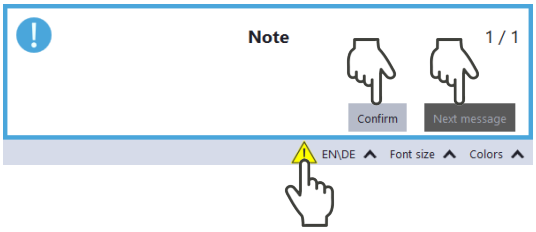
If problems occur during a measurement, the LDS displays them in different categories and different colors.

Note

Notes provide assistance in interpreting the measurement results and are displayed in a blue window.

Use one of the following options:

- ▶ Click on the warning triangle in the footer to display / hide the window.
- ▶ If applicable, click the ***Next message*** button to display more messages of the same category.
- ▶ Click the ***Confirm*** button to remove the displayed message.

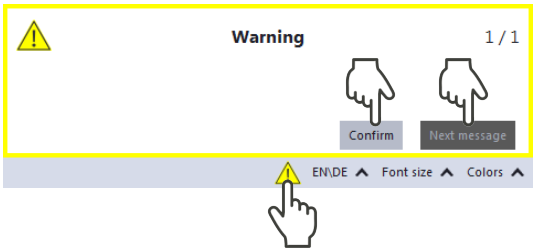


Warning

Non-safety-critical problems that influence the quality of the measurement results, for example, are displayed in a yellow window.

Use one of the following options:

- ▶ Click on the warning triangle in the footer to display / hide the window.
- ▶ If applicable, click the ***Next message*** button to display more messages of the same category.
- ▶ Click the ***Confirm*** button to remove the displayed message.



Device error

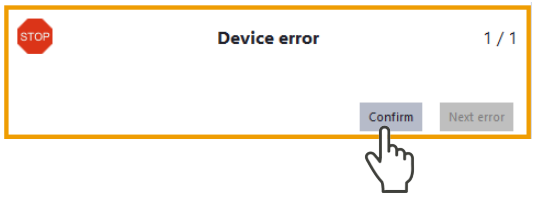
Device errors that can result in damage of the device are displayed in an orange window.

In this case, proceed as follows:

1. Fix the problem.
2. Click the ***Confirm*** button to remove the message.

The message disappears. If the problem is not fixed, then the message appears again shortly afterwards.

3. Do not proceed with the measurement until the problem is solved.



Safety critical note

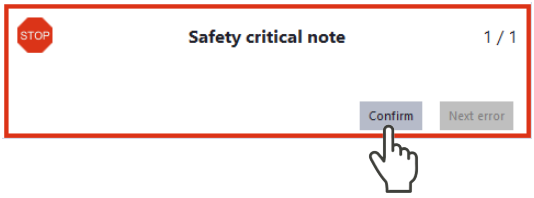
Safety-critical problems that can result in damage/destruction of the device are displayed in a red window.

In this case, proceed as follows:

1. Fix the problem immediately.
2. Click the ***Confirm*** button to remove the message.

The message disappears. If the problem is not fixed, then the message appears again shortly afterwards.

3. Do not proceed with the measurement until the problem is solved.



10.2 Connection errors with the LDS

Error	Possible cause	Solution
The USB connection between the device and the LDS can't be established.	No USB connection has been established.	▶ Connect the USB port on the device and on the PC with the USB cable.
	The PRIMES USB driver has not been installed.	A driver is required for a USB connection. ▶ Install the USB driver according to chapter 7.3 „USB“ on page 22.
The device does not turn on when connected to the PC via USB.	The USB interface on the PC can't supply the PM with sufficient power.	▶ Connect the PRIMES power supply according to chapter 7.5 „Power supply“ on page 23 to the PRIMES bus RS485.

Tab. 10.1: Connection errors when using the LDS

10.3 Acoustic warning signal

If the permitted temperature of the absorber is exceeded, a warning signal will sound.

- ▶ Switch off the laser immediately.
- ▶ The resulting overpressure in standing coolant can lead to leaks in the hoses and connectors.
- ▶ If water leaks from the device, it may be damaged and can no longer be used safely.
- ▶ In the event of a leak, please send the device to PRIMES for inspection.

If no leakage can be detected:

1. Check the flow and the correct flow rate.
2. Check the proper shutdown of the laser in the event of a fault by the safety interlock.
3. If the device stops working properly, please send the device to PRIMES for inspection.

Depending on the device type the permitted temperatures are different:

Device type	Permitted temperatures
PM 48	60 °C
PM 100	75 °C
PM HP75/150	50 °C

Tab. 10.2: Permitted temperature of the absorber by device types

10.4 Other errors

Error	Possible cause	Solution
The shown laser power on the display, the LDS or PMS has a negative prefix.	The flow direction has been reversed.	Reversing the direction of flow will damage/destroy the flow meter during longer operation. ▶ Connect the water supply and the water return according to the markings on the device.

Tab. 10.3: Other errors

11 Maintenance and service

11.1 Maintenance intervals

The operator is responsible for determining the maintenance intervals of the measuring device.
PRIMES recommends a maintenance interval of 12 months after initial operation for inspection and calibration.
If the device is used sporadically (less than once a day), the maintenance interval can be extended up to 24 months.
Please note that the safety and warning devices in the unit must be inspected regularly.

11.2 Cleaning the device surface

NOTICE

Damage/Destruction of the device

Touching the deflection mirror underneath the shutter can lead to burn marks at the points of contact, leading to increased scattered radiation.

- ▶ Do not reach into the entrance aperture.
- ▶ Do not touch the deflection mirror.

1. After a measurement let the device cool down for an adequate period of time.
2. Close all device openings.
3. Clean the device surface with clean and oil-free compressed air.
4. For further cleaning, use a mixture of distilled water and isopropanol in a ratio of approx. 5:1.
   Use lint-free cleaning cloths that do not cause scratches.

12 Measures for the product disposal

As a B2B device, this PRIMES measuring device is subject to the Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE) and the corresponding national laws.
The WEEE obliges the operating company to dispose of the device in an environmentally sound manner, not with household waste, but in a separate WEEE collection.

PRIMES gives the opportunity to return PRIMES measuring devices for free disposal within the scope of the WEEE. This service does not include shipping costs.

PRIMES measuring devices to be disposed of within the EU send to the following address:

PRIMES GmbH
Max-Planck-Str. 2
64319 Pfungstadt
Germany

If you are located outside the EU, please contact your local PRIMES distributor to discuss the disposal procedure for your PRIMES measuring device.

PRIMES is registered at the german „joint body“ for producers „Stiftung Elektro-Altgeräte Register“ (Stiftung EAR). Our number is: WEEE-reg.-no. DE65549202.

Caution batteries included!

Please note that there are 2 permanently installed lithium metal cells in the device.
These must be disposed of in accordance with applicable national and international laws if the device is not returned to PRIMES.

13 Declaration of conformity

Original EG Declaration of Conformity

The manufacturer: PRIMES GmbH, Max-Planck-Straße 2, 64319 Pfungstadt, Germany,

hereby declares that the device with the designation:

PowerMonitor (PM)

Types: PM 48, PM 100, PM HP75, PM HP150

is in conformity with the following relevant EC Directives:

- Machinery Directive 2006/42/EC
- EMC Directive EMC 2014/30/EU
- Directive 2011/65/EC on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment

Authorized for the documentation:
PRIMES GmbH, Max-Planck-Straße 2, 64319 Pfungstadt, Germany

The manufacturer obligates himself to provide the national authority in charge with technical documents in response to a duly substantiated request within an adequate period of time.

Pfungstadt, February 12, 2026

Dr. Reinhard Kramer, CEO

14 Technical data

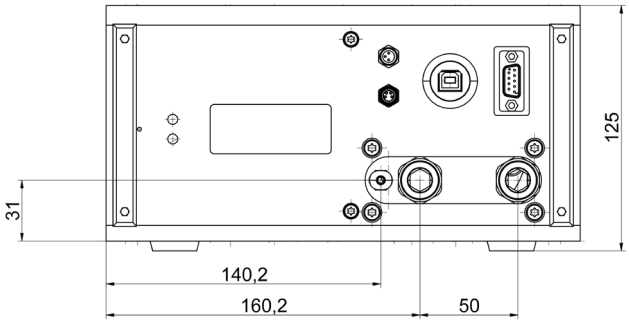
Measurement parameters		PM 48	PM 100	PM HP75/150
Power range		0,3 – 8 kW	1 – 30 kW	HP75: 3 – 80 kW HP150: 3 – 150 kW
Irradiation time		Continuous (cw)		
Wavelength range		450 nm, 515 - 532 nm, 800 – 1 100 nm, 10 600 nm		1 000 – 1 100 nm
Max. power density at wavelength	450 nm, 515 – 532 nm	10 kW/cm²	5 kW/cm²	–
	800 – 1 100 nm, 10 600 nm	15 kW/cm²	5 kW/cm²	–
	1 000 – 1 100 nm	–	–	HP75: 12 kW/cm² HP150: 20 kW/cm²
Device parameters				
Entrance aperture		48 mm	100 mm	90 mm
Min./max. beam diameter [1]		3 – 24 mm	7 – 50 mm	8 – 45 mm
Max. centered tolerance [1]		± 3 mm	± 5 mm	± 5 mm
Min. divergence full angle (convergent) Max. divergence full angle (divergent) [1]		– 50 mrad + 160 mrad	– 50 mrad + 180 mrad	– 50 mrad + 180 mrad
Max. angle of incidence perpendicular to aperture [1]		± 5°	± 5°	± 5°
Measurement accuracy at wavelength	450 nm, 515 – 532 nm	± 2.5 %	± 3.5 %	–
	800 – 1 100 nm, 10 600 nm	± 2 %	± 3 %	–
	1 000 – 1 100 nm	–	–	± 3 %
Reproducibility		± 1 %		
Time constant up to 95 % of final value		10 s bei 8 l/min	17 s bei 15 l/min	HP75: 15s bei 50 l/min HP150: 12s bei 90 l/min
Time constant up to 99 % of final value		18 s bei 8 l/min	35 s bei 15 l/min	HP75: 35s bei 50 l/min HP150: 20s bei 90 l/min
[1] All specifications apply to the respective maximum values.				
Supply data				
Power supply	PRIMES power supply	DC 24 V ± 5 %, max. 0,5 A		
Cooling water	Hose diameter	12 mm	16 mm	28 mm
	Min. flow	4 l/min	8 l/min	25 l/min
	Max. flow	12 l/min	30 l/min	150 l/min
	Min. pressure	2 bar	1 bar	1 bar
	Max. pressure	6 bar	4 bar	3 bar
	Temperature Te	Dew point temperature < Te < 30 °C		
	Stability of the temperature	< 1.0 K per minute or 0.08 K per 5 seconds		
Compressed air for opening the shutter	Hose diameter	4 mm		
	Min. air pressure	2 bar		
	Max. air pressure	4 bar		
	Purity class	ISO 8573-1:2010 [7:4:4]		

Communication	PM 48	PM 100	PM HP75/150
Interfaces	RS485/USB-B/Interlock/Analog out		
Dimensions and Weights			
Dimensions (L x W x H) in mm with connectors and device feet	394 × 242 x 125	580 x 330 x 215	600 x 330 x 215
Weight (ca.)	10 kg	44 kg	52 kg
Environmental conditions			
Operating temperature range	15 – 40 °C		
Storage temperature range	5 – 50 °C		
Reference temperature	22 °C		
Permitted relative humidity (non-condensing)	10 – 80 %		
Due to continuous product improvement, specifications are subject to change without notice.			

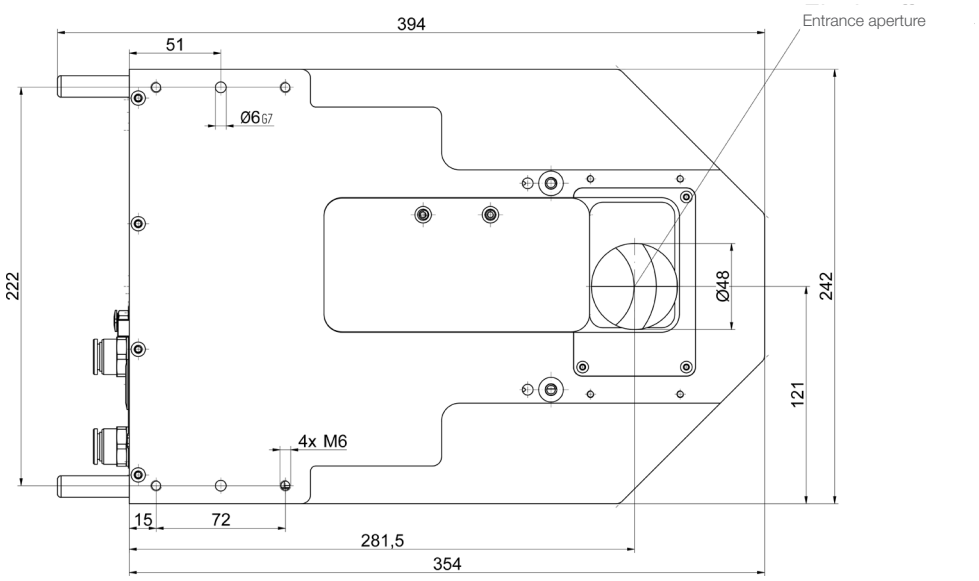
15 Dimensions

All Dimensions in mm

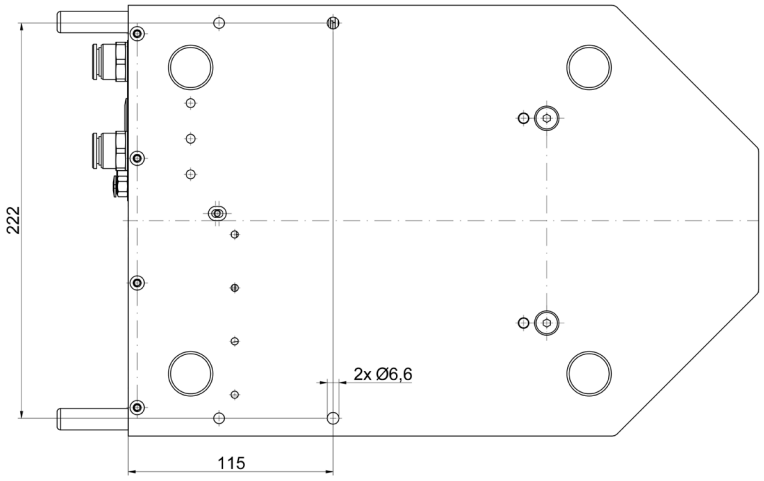
PM 48



Front view

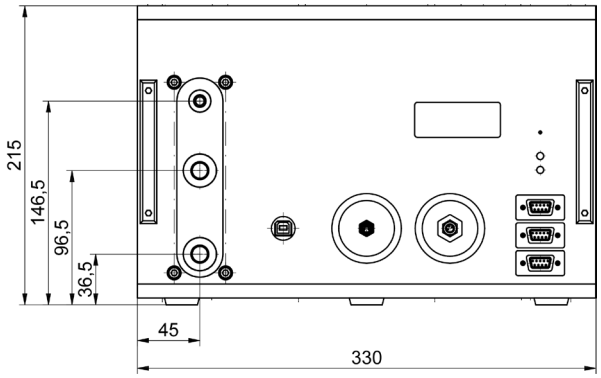


Top view

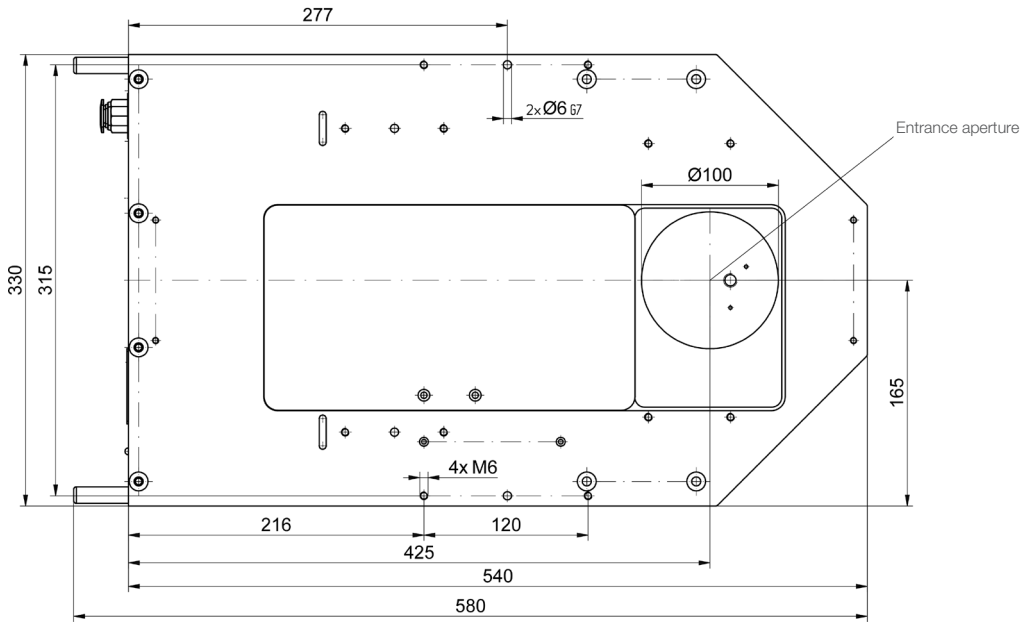


Bottom view

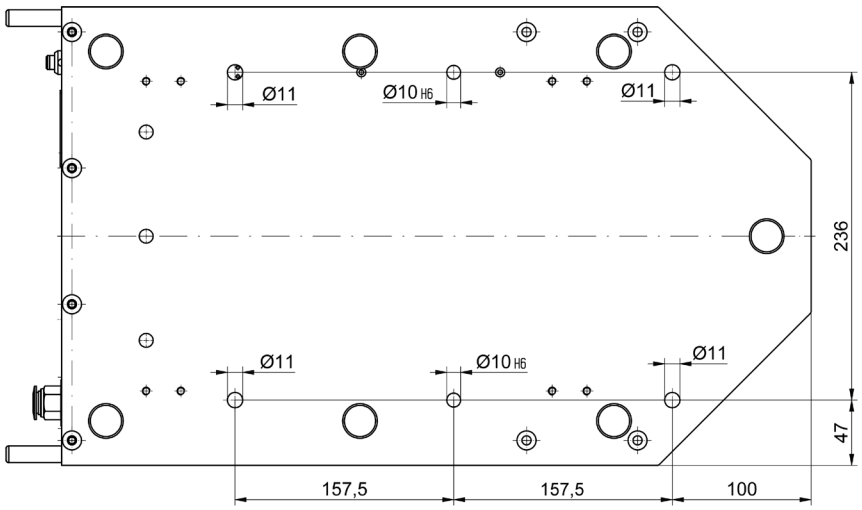
PM 100



Front view

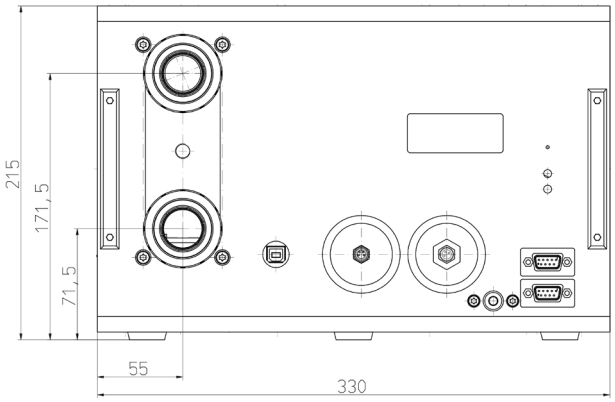


Top view

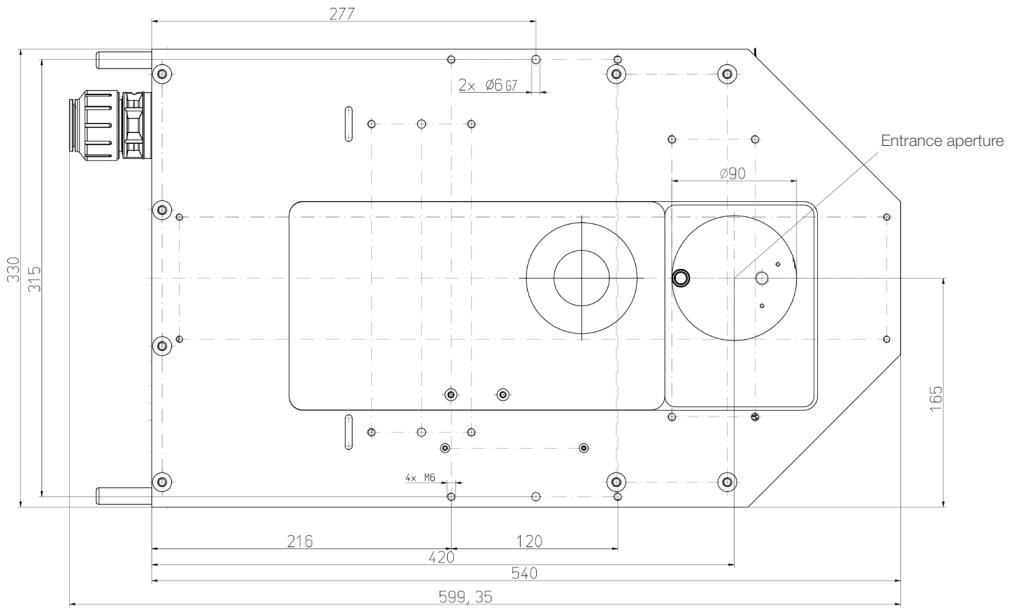


Bottom view

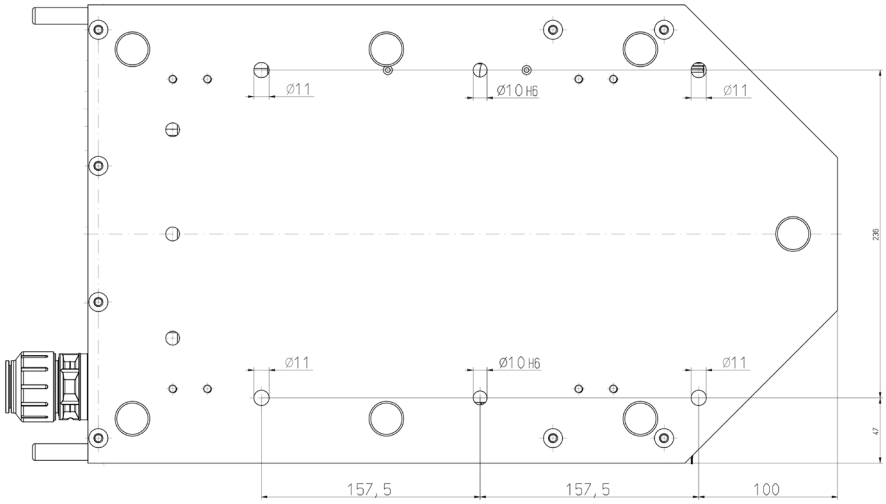
PM HP75/150



Front view



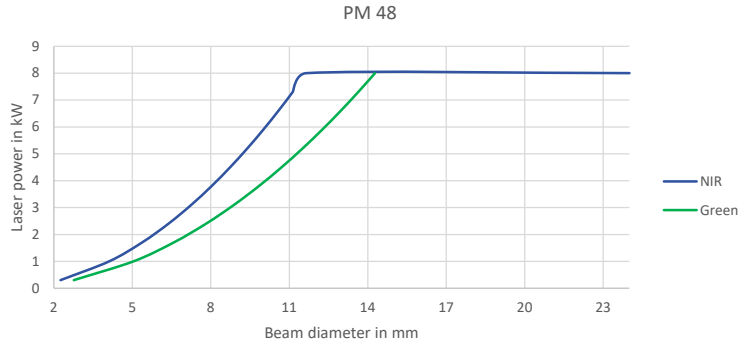
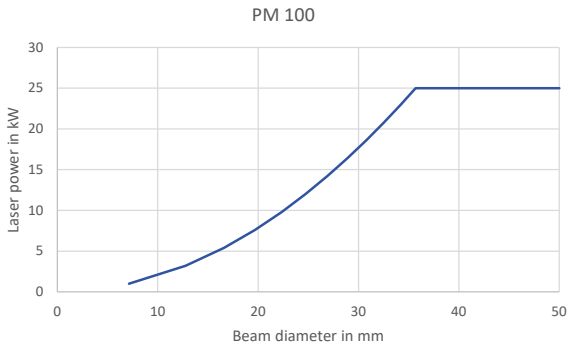
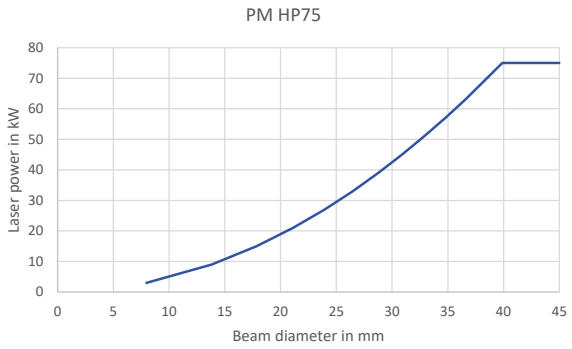
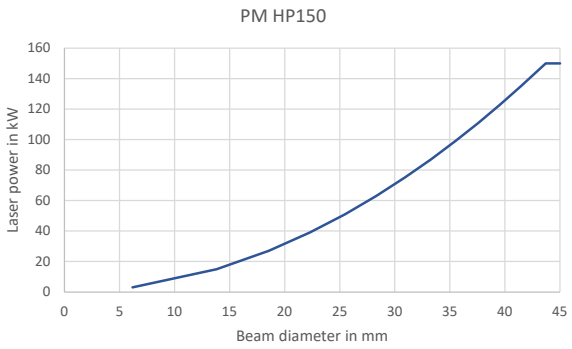
Top view



Bottom view

16 Appendix

A Diagrams of the max. laser power

Type	Diagram
PM 48	
PM 100	
PM HP75	
PM HP150	

Tab. A.1: Max. laser power PM

B GNU GPL license notice

The software of this product contains software code that is licensed subject to the GNU General Public License (GPL) Version 2 or later.

The license terms of the GNU GPL Version 2 or later are available on the following websites:

- https://www.gnu.org/licenses/old-licenses/gpl-2.0.en.html
- https://www.gnu.org/licenses/licenses.en.html

C System control (option)

In case of this device version, the shutter cannot be controlled via the LDS or PMS.

If necessary, the PowerMonitor PM can also be operated without the LDS or the PMS.

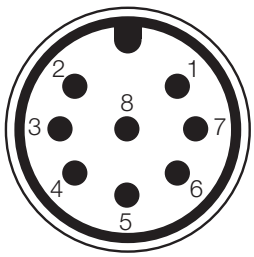
Upon request, the PowerMonitor PM can therefore be delivered with an 8-pin plug by means of which it can be connected with the system control.

The connector transmits the error and ready output signals, as well as the shutter control signal. The logic level of the system control is 24 V.

The device is powered via pin 1 (24 V) and pin 3 (GND).

An analogue signal which is proportional to the laser power is generally transmitted separately (see chapter X.X „Analog Out“ on page XX).

Pin assignment M12, 8-pin (view to plug on device)



Pin	Function
1	Powersupply +24 V
2	Output signal Error
3	Ground
4	Output signal Ready
5	Not assigned
6	Input signal Open shutter
7	Input signal Close shutter
8	Not assigned

Tab. C.1: Pin assignment of the system control connector

D Fiber adapter

The fiber adapter connects the PM to a fiber, so that power measurements at the fiber end are possible. A wide range of different fiber adapters are available.

For detailed information on the available fiber adapters, please contact PRIMES or your PRIMES distributor.

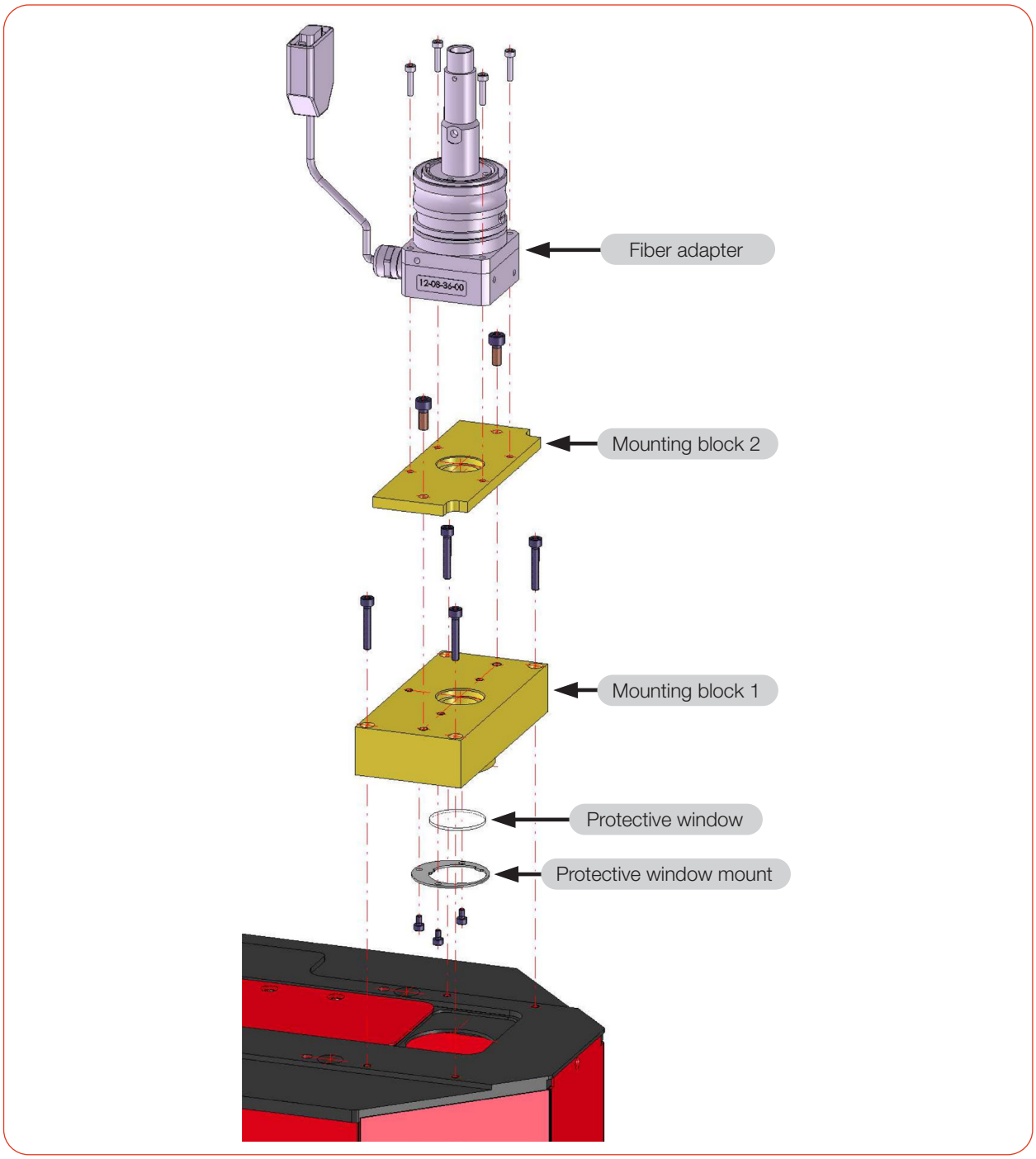


Fig. D.1: Fiber adapter (using the PM 48 with fiber adapter LLK-D as example)

E Connecting to an FM+

NOTICE

Damage/Destruction of the device

Connecting or disconnecting the bus cables when the power supply is applied leads to voltage peaks that may destroy the communication modules of the device.

▶ Only establish all connections when the power supply is switched off.

1. Connect the FM+ to the PC via Ethernet.
2. Connect the PM to the FM+ via the RS485 interfaces (PRIMES bus).
   The signal of the PM is forwarded by the FM+ via its Ethernet interface to the PC.
3. The PM is supplied with power via the PRIMES power supply on the FM+.
   Connect the PRIMES power supply to the FM+.

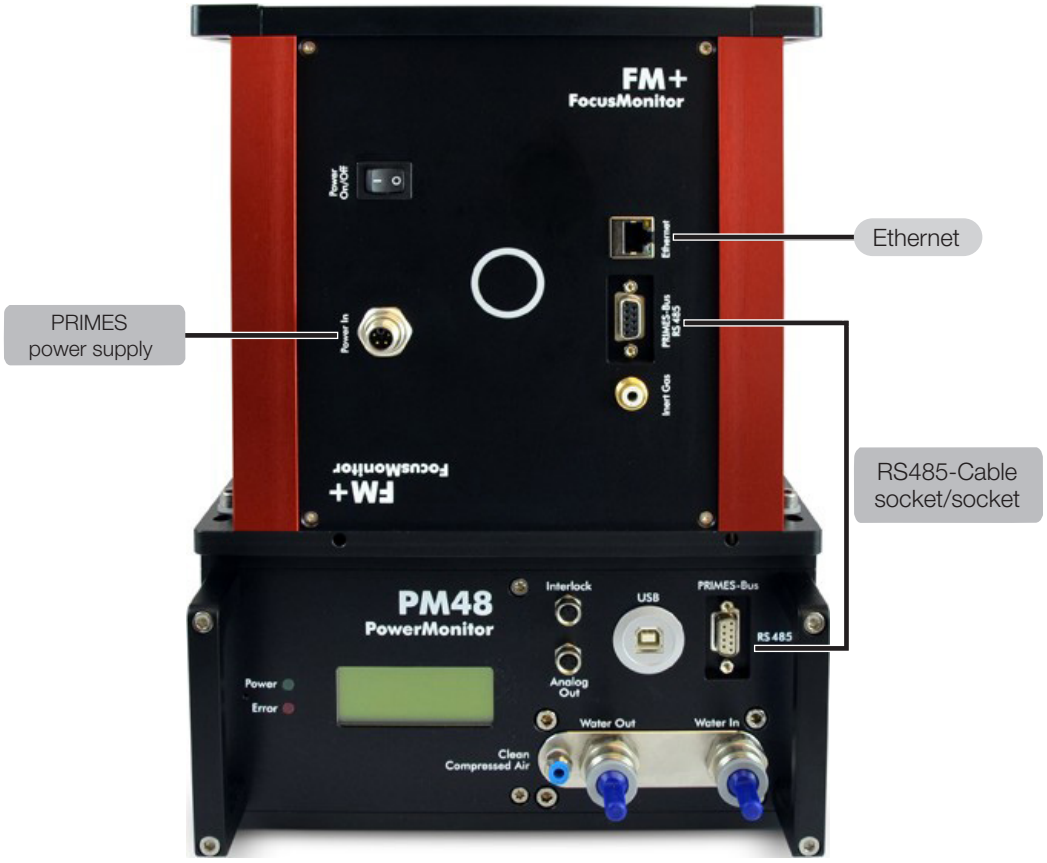
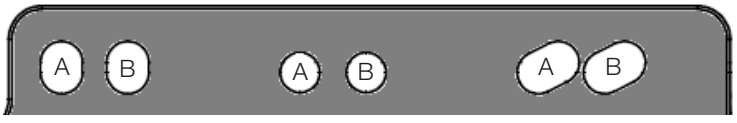


Fig. E.1: Connecting the PM to an FM+ (using the PM 48 as example)

For the 8 x 8 measuring window, select the front mounting holes (A) on the FM+.
For measuring windows 12 x 12 or 24 x 12, the rear mounting holes (B) should be selected.



F Spacers for operation with an FM+

Various spacers are available for mounting the FM+ on the PM.

During assembly, an offset of approx. 5 mm occurs.
As a result, the laser beam does not hit the center of the printed crosshairs.
The offset is within the tolerance of the PM 48/100 and has no influence on the measurement.

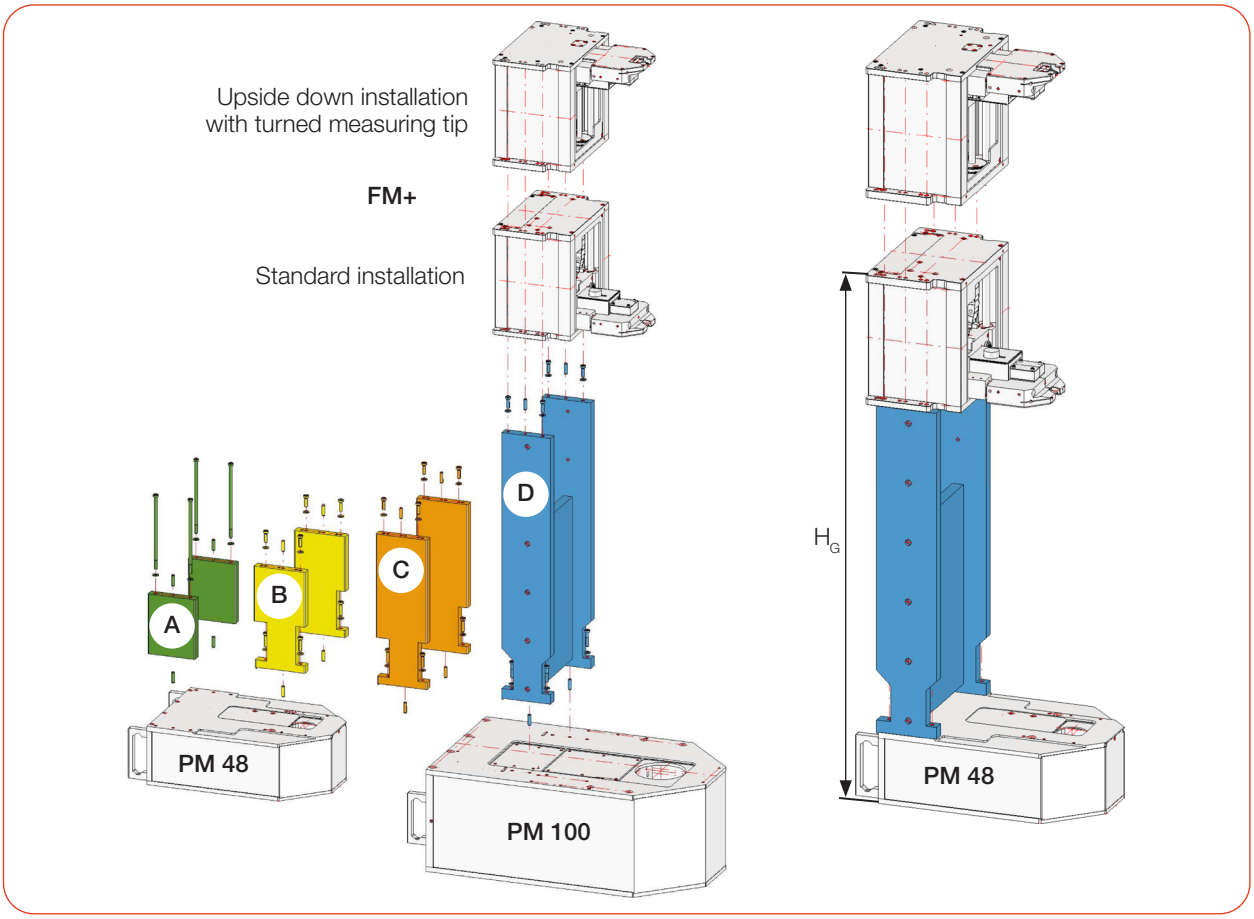
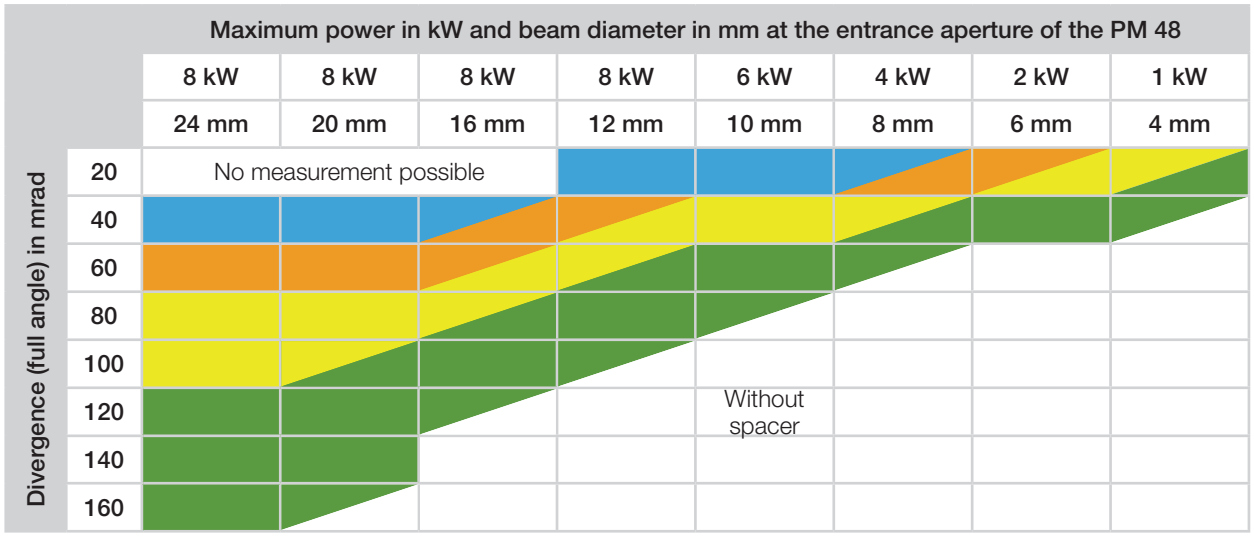


Fig. F.1: Spacer types

Spacers	Height in mm	Total height HG PM 48 in mm [1]	Total height HG PM 100 in mm [1]
A	123	461	551
B	208	546	636
C	308	646	736
D	548	886	976

[1] The total height includes the removable device feet of the PM (device feet height = 5 mm).

F.1 Selecting spacers for the PM 48

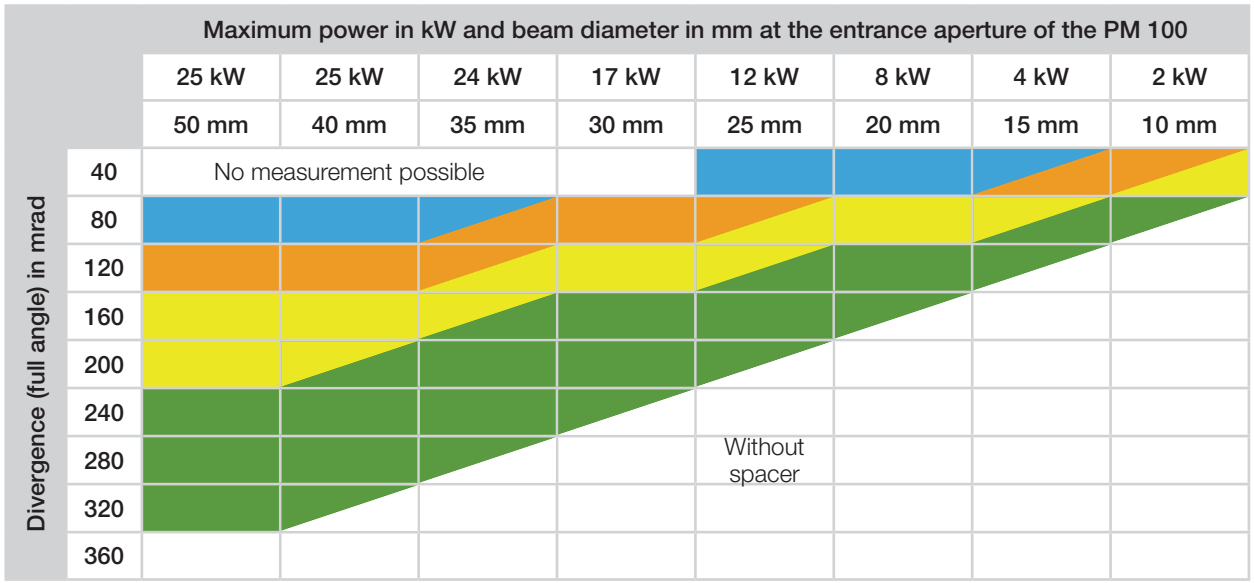


In the fields with diagonally separated colors, both spacers can be used depending on the beam parameters at the entrance aperture of the PM 48.

Without	Spacer A	Spacer B	Spacer C	Spacer D

Tab. F.1: Selecting spacers for the PM 48

F.2 Selecting spacers for the PM 100



In the fields with diagonally separated colors, both spacers can be used depending on the beam parameters at the entrance aperture of the PM 100.

Without	Spacer A	Spacer B	Spacer C	Spacer D

Tab. F.2: Selecting spacers for the PM 100