



EC-PowerMonitor PowerMonitorSoftware

Version 2.48

Operating Manual

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1. Laser safety precautions

Note!

The EC-LaserQualityMonitor is designed to run measurements inside or near the beam path of high power laser beams.

The device itself does not emit any laser radiation. However, laser radiation is guided through and may be scattered from the device.







Any user must have extensive prior technical training and must possess the basic knowledge required to perform any kind of measurement or alignment procedure of laser beam sources, beam guiding equipment or focussing devices in a safe manner.

Use of the PRIMES measuring devices LaserQualityMonitor, BeamScanner, BeamMonitor, FocusMonitor, PolarizationMonitor, PowerMonitor, PocketMonitor, CompactPowerMonitor, MicroSpotMonitor or EC-PowerMonitor for any purpose other than the appropriate form of use specified by the manufacturer is not permitted, and may cause potentially life threatening injuries or death. The various types of monitors may not be used in a manner which may cause a potential risk to personnel.

Personal protection is required when working in areas of uncovered visible/invisible laser radiation, uncovered laser beam systems, beam guiding systems, or process regions. This holds true for use of this equipment. During measurement procedures, there is always the risk of laser radiation through direct or reflected emissions. Safety requirements are described in: IEC-60825-1, ANSI Z 136 "Laser Safety Standards" and ANSI Z 136.1 "Safe Use of Lasers" published by the American National Standards Institute; "Laser Safety Basics", "LIA Laser Safety Guide", "Guide for the Selection of Laser Eye Protection", and "Laser Safety Bulletin" published by the Laser Institute of America (Tel: 1-407-380-1553) and; "Guide for the Control of Laser Hazards" from ACGIH, 6500 Glenway Avenue D-5, Cincinnati, OH 45211.

The proper and safe use of any monitoring device inside or nearby the laser beam core diameter

REQUIRES ALL OF THE FOLLOWING:

-  competent professional knowledge of the type of laser source present.
-  competent knowledge and understanding of the measurement device
-  laser safety goggles adapted to the existing wavelength of the laser in use.
-  protection to reduce direct laser radiation, back reflection and associated optical radiation to a safe level.
-  Safeguard and or emergency safety mechanisms which allow immediate closing of the laser shutter of any free running or focused beam.
-  A solid mounting surface for the measurement device itself, to reduce the risk of back reflection and avoid any relative movement of the Monitor in relation to the laser beam axis (This is also necessary to ensure the highest possible performance).

Adequate protection procedures and equipment are required in order to comply with national and international regulations; particularly the accident prevention regulations for use, control, and alignment of high power laser beams. These are, for example: use of shielding screens,

protective laser safety goggles, or beam guiding elements and/or traps which do not contain any dangerous materials that can release gases or vapors when heated.

The manufacturer and the suppliers of the monitoring equipment accept no liability for damage or injury of any kind arising from the use of the monitor or associated software. The purchaser and user agree to hold harmless both manufacturer and suppliers of any liability for injury to equipment or person, or loss of business revenue, caused directly or indirectly through use of this equipment.

2. Introduction

The EC-PowerMonitor is a precision instrument to measure the beam power of different laser sources in the multi-kilowatt range. The main application is to measure the available power at the work piece of the CO₂-YAG and HP-diode lasers. It can operate with focussed and unfocussed beams with a maximum beam diameter of approx. 35 mm.






The maximum power density should not be higher than: 12 kW/cm² (CO₂ laser) and 9 kW/cm² (YAG).

2.1 Operational safety

It is absolutely necessary to consider carefully all safety references – as described in chapter 1 – in order to avoid any endangerment for the operator or indifferent ones. If any characteristics arise during a measurement (fires, smoke or uncontrolled reflected radiation etc.), the laser must be switched-off immediately.

2.2 PRIMES - the company

PRIMES is a manufacturer of laser measuring devices. These devices are used to measure laser beam parameters of high-power CO₂, solid-state, and diode lasers. A wide selection of devices is available for the measurement of:

-  the laser power
-  the beam diameter and beam position of the unfocussed beam
-  the beam diameter and beam position of the focussed beam
-  the polarization of the laser beam
-  temporal stability of the laser power

PRIMES does all engineering and production itself to ensure the best quality, excellent service, and responsiveness to meet our customers' demands.



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3. Measurement

3.1 Performing a Power Measurement with the PowerMonitorSoftware

- 1) Make sure that cables are connected and power is turned on. Turn on cooling water and adjust flow rate to 4-12 l/min (with at least 0.8 l/min per kW laser power).
- 2) Align the laser beam to the center of the aperture of the PM/EC-PM. Make sure that the power density does not exceed 10kW/cm² - a good approximation is to adjust the distance to the focussing optics in such a way that the beam diameter on the mirror in the aperture is 16-25 mm. The beam should be perpendicular to the cover of the device.
- 3) After the cooling water has been running for ca. 1-2 min, adjust the zero level by pressing the corresponding button.

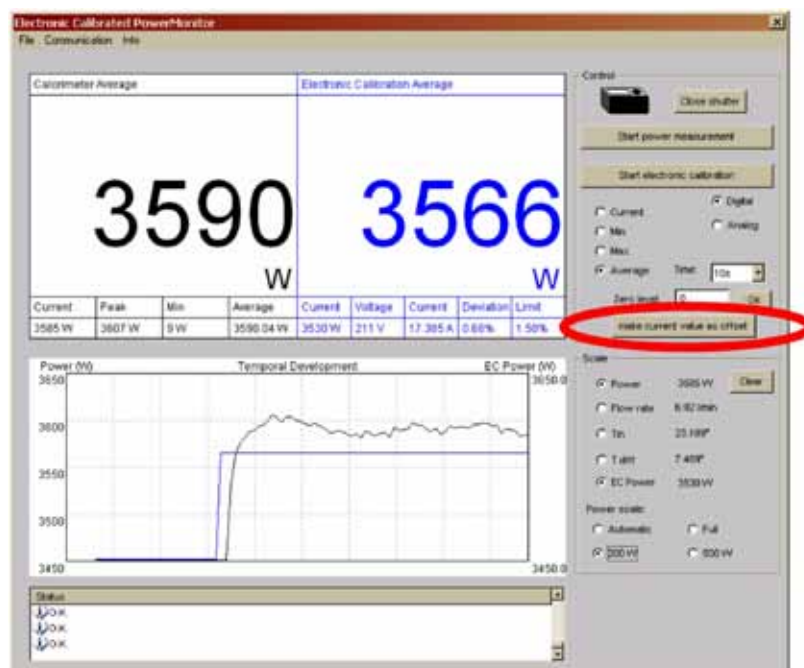


Fig. 1 Graphical user interface

- 4) Start the laser and after 25s – 60s read off the measurement results. During that time, the graph is rising marginally due to the system. Thus, the exact value is calculated after 60sec. For most measurements it is recommended to use the 10 sec - average value instead of the instantaneous display

Under following water cooling supply conditions, the measurement situation is harder:

- mean conductivity of the water under 60 μ S
- pressure fluctuations or temperature variations of cooling water with 1°C/ min gradient

Should this case occur, increase the averaging to 30sec- 90sec.

3.2 Running an EC-measurement

1. See No.1 + 3 mentioned above (connect the device, adjust zero level)
2. Start EC-measurement. A message reminds you to switch off the laser

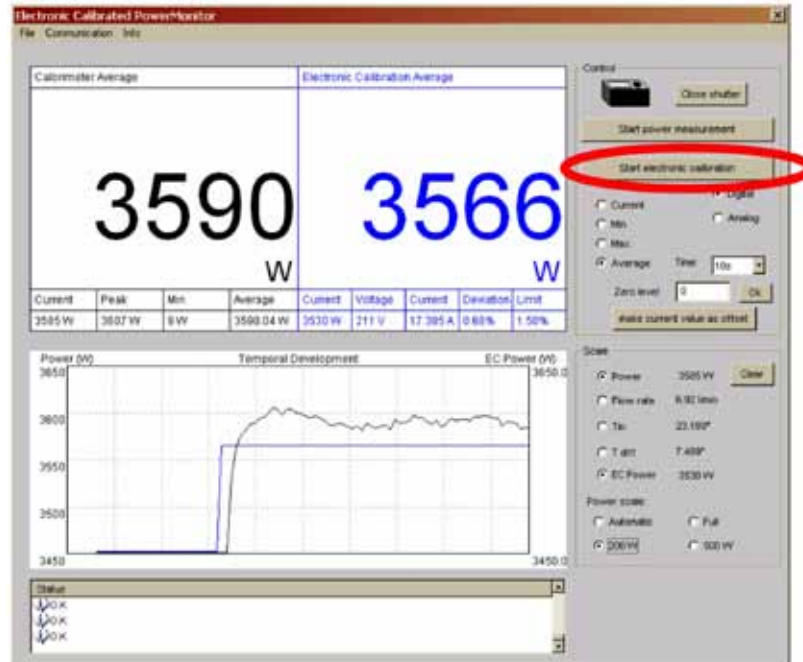


Fig 2 Graphical user interface

When the internal heating cartridge is activated, the electrical power consumed by the cartridge as well as the heat flow into the absorber is displayed simultaneously. A countdown is shown until a thermal balance has been reached.





Afterwards, the actual measurement is done within 10 sec. The result of the calorimeter-measurement is shown on the left; the result of the electrical measurement is shown on the right.

Fix an error

Zero level varies periodically with constant flow rate	The compressor of the radiator is switching itself on and off. Thus, a periodic gradient occurs in the cooling water temperature. Increase integration time or connect a water tank ahead with ca. 30-50 litre.
Flow rate signal varies periodically	Shows the behaviour of a pump in circuit.
Flow rate signal varies statistically	Noise in the flow rate signal. Caused by cooling water of low conductivity (<100 µS)
Noticeable difference between calorimeter and electrical value with EC measurement	Check zero level. Check water conductivity.

4. Setting up and installation of the EC-PowerMonitors

To make reliable measurements the EC-PowerMonitor has to be set up correctly. The following preparations are necessary:

-  **Water supply**
-  **Electrical connection**
-  **Computer setup**
-  **Laser beam alignment**

In the following chapters the setups are described in detail.

4.1. Water supply

The EC-PowerMonitor needs a flow rate minimum of 5l/min for a safe reliable operation and will typically be operated at a flow rate of 5-12 l/min. The flow rate direction indicated on the device has to be ensured. The fluctuation of the temperature of the coolant at the entrance of the device should be below 0,5 degree/ minute to ensure the specified accuracy.

Typical flow rates and temperature rises Tab.1

Durchflussrate [l/min]	Strahlleistung / [kW]									
	8	7	6	5	4	3	2	1,5	1	0,5
12	9,55	8,36	7,17	5,97	4,78	3,58	2,39	1,79	1,19	0,60
11	10,42	9,12	7,82	6,51	5,21	3,91	2,61	1,95	1,30	0,65
10	11,46	10,03	8,60	7,17	5,73	4,30	2,87	2,15	1,43	0,72
9	12,74	11,15	9,55	7,96	6,37	4,78	3,18	2,39	1,59	0,80
8	14,33	12,54	10,75	8,96	7,17	5,37	3,58	2,69	1,79	0,90
7	16,38	14,33	12,28	10,24	8,19	6,14	4,09	3,07	2,05	1,02
6	19,11	16,72	14,33	11,94	9,55	7,17	4,78	3,58	2,39	1,19
5	22,93	20,06	17,20	14,33	11,46	8,60	5,73	4,30	2,87	1,43
	Temperaturerhöhung [°C]									

Tab. 1 Table Flow rate / increase of temperature / optical power-
a linear extrapolation up to 10 kW is allowed

Remarks about installation of the coolant circuit.

The EC-PowerMonitor equipped with contact-free, magnetic inductive flow rate sensor tolerating particles and fibers of Teflon band in the cooling water. The following has to be ensured:

1. No bubbles (volume share >2 per cent) in the coolant
2. the conductivity of the cooling water should be >50 $\mu\text{S/cm}$ (with slightly higher uncertainty of measurement >30 $\mu\text{S/cm}$)

The components of the EC-PowerMonitor which are in contact with the coolant are made of copper, brass or stainless steel. Therefore, the user should avoid mixing the coolant circuit of the EC-PowerMonitor with aluminium components. This may lead to corrosion of the aluminium because of the different chemical potentials. Please note that the addition of additives like antifreezing compounds in the coolant does change the heat capacity of the cooling water significantly. This causes falsified measurement results.

4.2. Electrical connections

All PRIMES measuring systems can be operated with our common serial bus. Fig. 3 shows the connection to the PC via RS232/ 485. Fig.4 shows the connection of the EC-PowerMonitor to a PC via USB.

! Do not unplug the cables when the power is on !
! PC and measuring system can only be connected by the RS232-connector or by USB on the PRIMES-converter !

After connecting all the cables, the power supply can be switched on. The green power control light on the backside of the EC-PowerMonitor starts lightning. If the red ERROR light is lightning, two risks are possible:

- 1) Cooling water flow rate is at least 4l/ min the orange
- 2) Shutter is closed

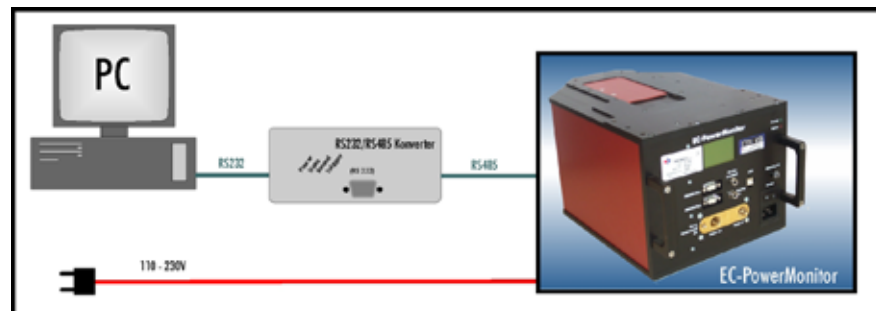


Fig. 3 The connection via RS232/ 485

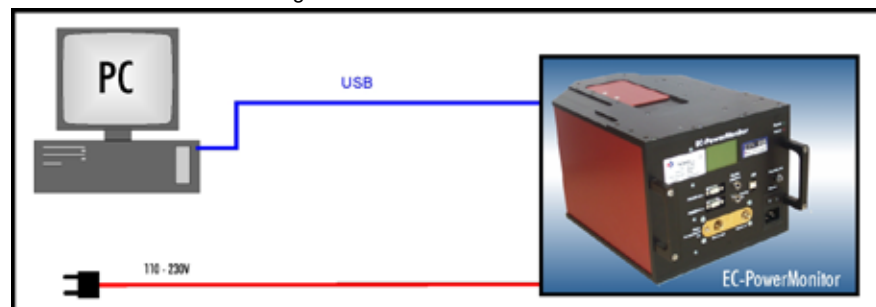


Fig. 4 Connection via USB

4.3 Computer setup

4.3.1 Installing software

To run the EC-PowerMonitor, it is necessary to install the PowerMonitorSoftware. The LaserDiagnoseSoftware (Version 2.7 or later) sustains already the direct operation of the PowerMonitor.

(See FocusMonitor Manual, chapter 6.2)

4.3.1.1 The EC-PM is connected with a computer for the first time via USB

Make sure, that the power cord (230 V) is connected and the power switch is turned on. Now, connect the EC-PM and the computer via USB. The Hardware-Wizards starts automatically after the connection with the EC-PM.





1) Activate **No, not this time**



2. Activate **Install from a list or specific location**



3) Activate **include this location in the search path**, click on **Browse** and choose the CD with the driver.





4) Click on **continue anyway**



5) Click on **Finish** to complete the installation of the USB-driver.



Once the driver is installed on this computer, it will automatically recognize the EC-PM whenever it is connected.

You can confirm that it is installed properly by looking up the USB properties in the Control Panel (Control Panel / System / Hardware / Device Manager / Universal Serial Bus Controllers). The EC-PM will appear there.

4.3.2 Starting the software

The software can be started by a double click on the PM.exe icon. After start up, the program tries to make a connection via serial port or USB. The explicit selection can be done in the menu item **Communication-free communication**.

Normally, the program runs automatically when the EC-PM is switched on.

4.4. Communication

After the physical connection of the devices – see chapter 3.1, 3.2 and 3.3- the communication between the computer and the measuring device can be checked.

4.4.1 Testing of the interface

By starting the program on the PC, the interface will be tested on the computer.



Possible error messages:

Reason:

Communication via bus system is not possible.

Remedy:

- Check the wiring of the devices.
- If the system is connected to the bus via a RS232-RS485 converter, missing power supply could be the reason. Communication is only possible if the bus is supplied with 24V d.c. voltage.
- Switch the power supply of the device off and on.



Reason:

The program can not open the preset interface.

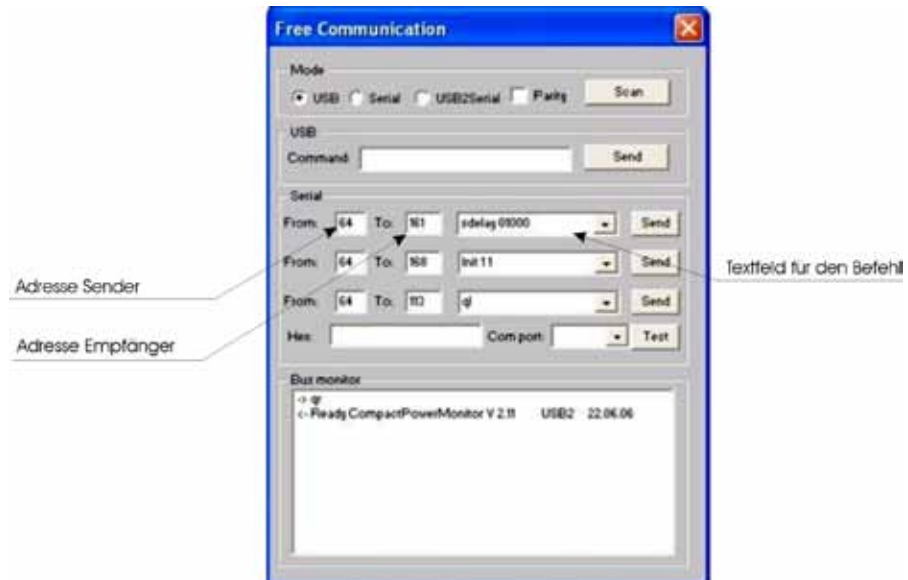
Remedy:

Please check, if there is another program, e.g. fax software, already using the interface. A serial port can only be used by one program at a time.

Please check, if the program opens the correct port. After starting the program, the used interface can be changed in the menu **communication/port**. All interfaces available for the program are shown there.

4.4.2. Communication to the devices

The communication test is done by the PC and the control program. A certain instruction is sent to each equipment. If equipment answers as indicated in the following table, communication works error free.



For dispatching an instruction on the PC, the PRIMES program is started and selected in the menu **Communication/Data sending**. In the appearing window in the field **OF**, the address of the transmitter is registered; in the field **TO**, the address of the receiver and in the text field on the right the instruction has to be registered. By selecting the button **sending** the instruction is sent. The answer of the equipment appears in the window below.

The following table represents the values which can be registered to the function control and the correct answers- a complete list is to be found in chapter 4.4:

<i>Equipment</i>	<i>FROM:</i>	<i>TO:</i>	<i>Instruction</i>	<i>Answer</i>
<i>FocusMonitor</i>	64	161	qr	aID FocusMonitor
<i>BeamMonitor</i>	64	144	qr	aID BeamMonitor
<i>EC-PowerMonitor</i>	64	113	qr	ready EC-PowerMonitor

If no message returns from the addressed equipment, then something is not correct with the device. The following measures can be seized in this case:

- Switch off and restart the 24V voltage power supply.
- Check the wiring of the equipment. Are all plugs connected and bolted?
- A device blocks the PRIMES-bus. If necessary, disconnect the incorrect device from the bus after switching- off the power. But still use the remainder system.
- The PC blocks the bus. This is recognizable from the fact that the red LED at the interface's converter (the RTS-signal - ready to send - is led out here) shines permanently.

4.4.3 Parallel operation of ElectronicCalibratedPowerMonitor and FocusMonitor

The FocusMonitor and the EC-PowerMonitor can be driven parallel by the LDS software. This requires to supply both devices by their standard power supply. Additionally a cable connection between the RS 485 socket of both devices is necessary.

The Power measurement can be activated by clicking on the PM symbol in the header of the Graphical user interface. A small presentation is available within item Measurement – PowerMeasurement.



If the LaserDiagnoseSoftware and the PowerMonitorSoftware are started simultaneously, they will both try to access the serial port at the same time, which will fail. Only if they are assigned to different serial ports (COM1 or COM2) both programs will run in parallel. Assign the ports using the **communication/free communication** menu.

Exception: the operation of the EC-PM via USB. In this case, both systems run parallel without selecting a serial port explicitly. The logical address of the EC-PM is 112 or 113. The user interface is shown in fig. 5.

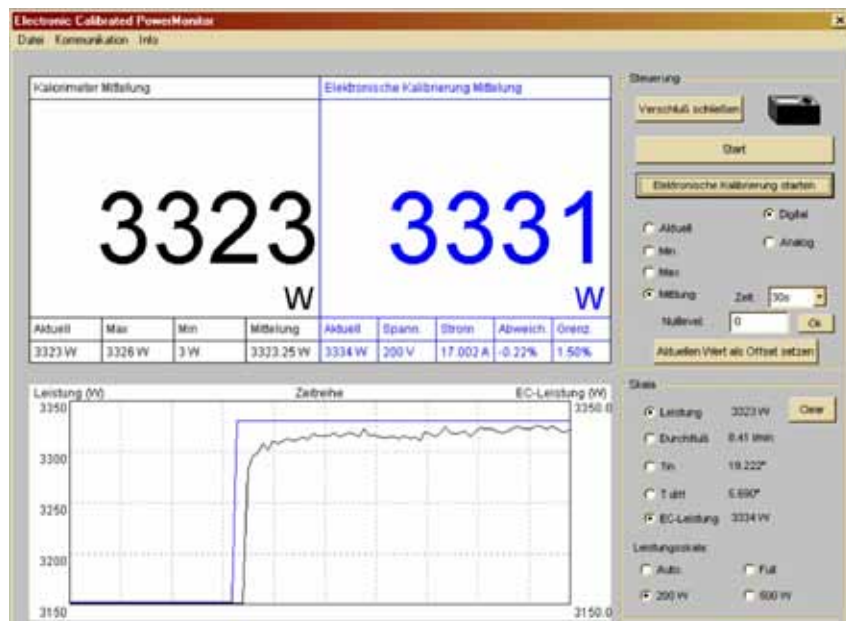


Fig. 5 The graphical interface of the EC-PowerMonitor

4.5. Correct position of the device in relation to the laser

The beam should hit the center of the entrance aperture. Please note, that the beam diameter, power and power density should not be above the stated limit values given in the appendix. With strongly divergent radiation, the beam has to be recollimated with an additional lens. For correct setup, please take note of fig. 3. (Particularly with divergent radiation behind the focussing optics)

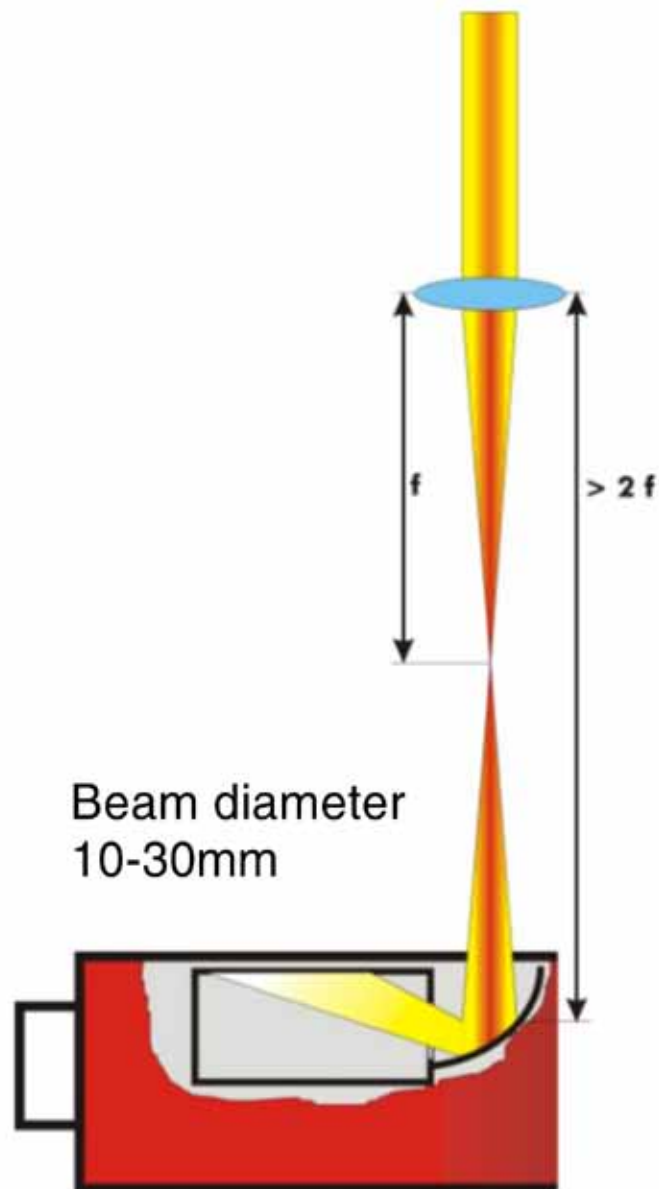


Fig. 6 Setup

Measuring divergent radiation behind focus point. It can be used with collimated beams, also.

5. Operation of the PowerMonitor

After starting the software, the graphical user-interface of the EC-PM appears (see fig. 7).

If the communication is established, the different measured values are displayed. If there is no communication, press the start/stop button twice. If there is still no communication, check the selected serial port (COM1, COM2 or USB) and the cabling and the power supply.

The laser beam power is displayed by the EC-PM. There are two possibilities for presentation:

- 1.) The display of the actual power reading
- 2.) The temporal development of the laser power

The menu „**temporal development**” shows in parallel: the mean-value and a maximum-value from the selected time-interval and also the current measurement reading in combination with a graphic power versus time. The scaling is automatically adjusted or can be selected by user. In the display different measured values are displayed:

Flow rate: Current flow rate of the cooling water in liters per minute
Te: Temperature of the entering cooling water
Td: Temperature difference between the outgoing and incoming water temperature.

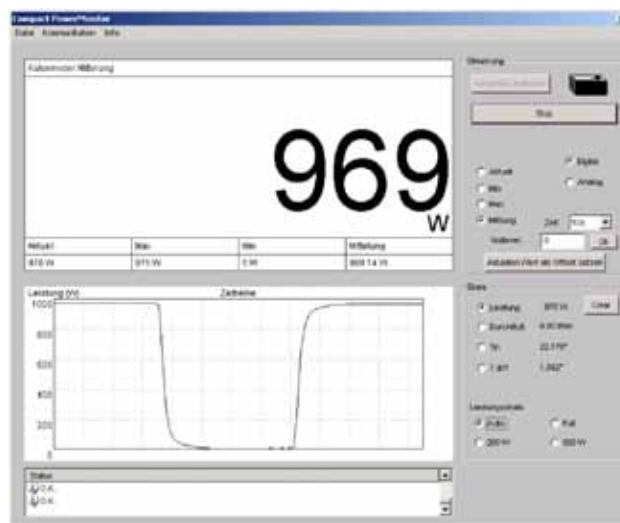


Fig. 7 The graphical user-interface of PowerMonitor during measurement

The menu item **file/settings** is used to determine the temporal interval between single measurements and the selection of a measuring device via the logical address at the bus. In the case of just one connected device, mostly 113 is used.

Starting measurements

Press the START Button to begin a power measurement. After 15-20 seconds of irradiation, the final value will be shown in the display.

Analogue Output Signal

The EC-PowerMonitor generates a voltage signal which is proportional to the laser power. 1 V corresponds to 1 kW laser power. Use a high-impedance voltmeter input to measure the voltage.

Internal display

The internal display shows laser power, flow rate and temperature difference.

External display (optional)

By option also an external display is available. The display is driven by a standard PRIMES-bus and enables a power measurement without a PC.

Protocol

All the measured values, laser power, flow rate, temperature difference etc. can be monitored by the item File/Protocol. All the data will be written to a tab-separated text file.

Technical principle

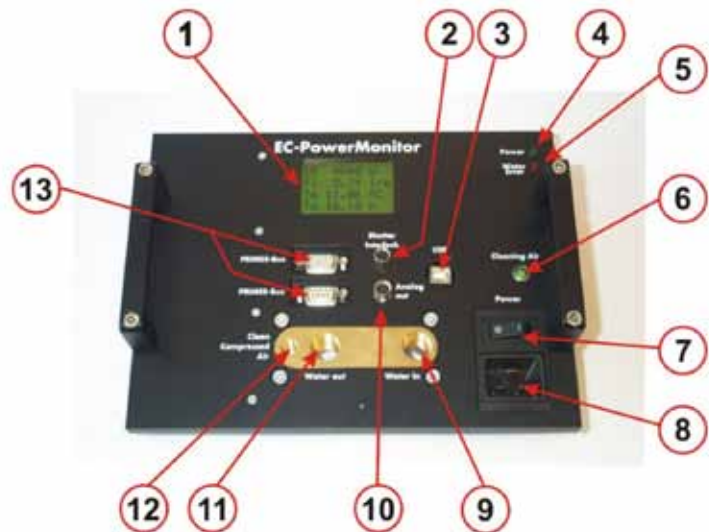
The EC-PowerMonitor measures the laser power by a calorimetric principle. That means, the whole incident laser power is absorbed within the device by a water cooled absorber. The absorbed power is determined by measuring the flow rate and the temperature rise of the water.

$$P = \dot{m} \cdot C \cdot \Delta T$$

To achieve the specified accuracy, it is necessary to use either tap water or mildly deionized water for cooling. It is not possible to use water with a large amount additives like antifreeze, because the heat capacity of the water would be modified. As a result, the EC-PowerMonitor would show false readings.

During the measurement, the temperature of the incoming cooling water is not absolutely constant. Due to the transition time of the cooling water through the EC-PM temperature between the incoming and outgoing cooling water is different. As a result, "positive" and "negative" beam power is calculated. This is only an effect of the measuring principle because no laser beam hits the absorber. To keep this zero point movement low, it is necessary that the temperature of the incoming cooling water changes less than 0.5 K/min or less 0.05 K within 5 seconds. In this case, the zero point should be stable within less than ± 50 Watt.

5.1 Front of the device



1. Display

Display of the current values

1. Line: Laser power
2. Line: Flow rate in liters per minute [l/min]
3. Line: Water temperature in degree Celsius [C°]
4. Line: Temperature difference water out/in

2. Shutter Interlock

Free potential shutter to avoid any damage to the PM. Included in delivery: three wire cable:

- brown-blue -> ready,
- brown-black-> error (see 5)

3. USB Interface 2.0

Communication with the connected PC. The PM, however, needs an additional 110/220V power supply (see 8).

The electronics can be supplied via analog out (see 9) or via PRIMES-bus (see 13) as well, but then the EC- functions can not be used anymore.

4. Power-LED

This LED (yellow) shows that the mainboard is supplied with power and the processor is running properly.

5. Water-Error-LED

This LED (red) shows errors. Possible errors are:

- Flow rate is smaller than 4 l/min
- Shutter is not opened completely
- The measured data is more than 10kW

In case of an error, the red LED is on, and the Shutter Interlock switches to "Error".

6. Cleaning Air-Switch

Working in dusty environment, you can puff the mirror of the PM clean before measurements, provided that clean and oil-free compressed air is connected (see 12).

7. Power Switch

If a power cord is connected to the PowerMonitor, you can switch it off using the Power Switch. If the power is supplied via PRIMES-bus or analog-out, display and electronics are still operating but the EC-function cannot be used anymore.

8. Power Plug

The device needs a supply voltage between 100 V and 250 V. A power supply connected to the grid is necessary for an electrical calibration. Therefore, instead of a laser, electrical power is used to heat the water flowing through the absorber. This electrical power can be determined with high accuracy. Moreover, this power can be compared to power determined by the calorimeter. The electrical power depends on the applied voltage. With 100 V the electrical power is 850 W, but with 250 V, 3500 W power can be achieved.

Due to this high connection power, the used socket has to be secured with 16A. Additionally, no other devices should be connected to this electric circuit. The provided power cable must be used and it is not allowed to connect extension cables unless these have a high wire diameter.

9. Water in

The device requires water cooling for the dissipation of laser power. The flow rate should be more than 4 l/min. Due to specification of the flow rate sensor in the PowerMonitor, the cooling water must have a minimum conductivity of 50 μ S. Connecting thread is 3/8 inch, straight inside thread.

10. Analog out

The analog interface provides an output voltage proportional to the measured power. The proportionality factor is 1 V / kW. Furthermore, the PM can be powered via the analog interface (no EC-function). The connection is done via a provided cable:

- Black – analog ground
- Blue – analog out
- White – ground power supply
- Brown – power supply 24 V

11. Water out

The outflow of the cooling water with the same screw thread as the inflow (3/8 inch straight thread).

12. Compressed Air

Compressed air thread to clean the mirrors and for pneumatic operation of the shutter top. If connected to oil-free pressurized air, the shutter can be remote-controlled via the PC.

13. PRIMES-Bus

The PRIMES-bus is to be used in connection with a FocusMonitor.

It is used for communication with the connected PC via RS485 / RS232 interface. An interface-converter is to be used for the conversion from RS485 (24 V differential signal enables the use of long cables) to RS232 (5V, not differential). This converter is included in the delivery of the FocusMonitor.

The PRIMES-bus enables the connection of several PRIMES measurement devices. The power supply of the EC-PowerMonitor is bi-directional. That means that the EC-PM is able to energize other PRIMES devices, too. Or the EC-PM can be supplied by a power supply of an other PRIMES measuring device. This does not apply to the FocusMonitor as it has high current requirements.

Corresponding power supplies are included in the delivery of the PRIMES devices for beam analyzing (FocusMonitor, BeamMonitor, BeamScanner). The EC-PM is provided without an external power supply as it has a built-in 100-250 V adapter.

Please note:

NEVER connect the PRIMES-Bus cable to the computer directly (e.g. to COM1). The supply voltage of 24 V is going to damage the computer port. Even the whole computer can be damaged! ALWAYS connect the RS232 side of the converter with the computer!

6. Errors during operation

At the bottom of the graphical user interface of the EC-PowerMonitor (see fig. 2) some of the possible errors in operation are displayed if necessary. The messages are displayed in red color. All the errors have to be eliminated before starting any measurement.

For example:

WARNING:

Flow rate too low -> control and if necessary increase of the flow rate

Cserial no Echo-> Check the connection of the cables, open the port

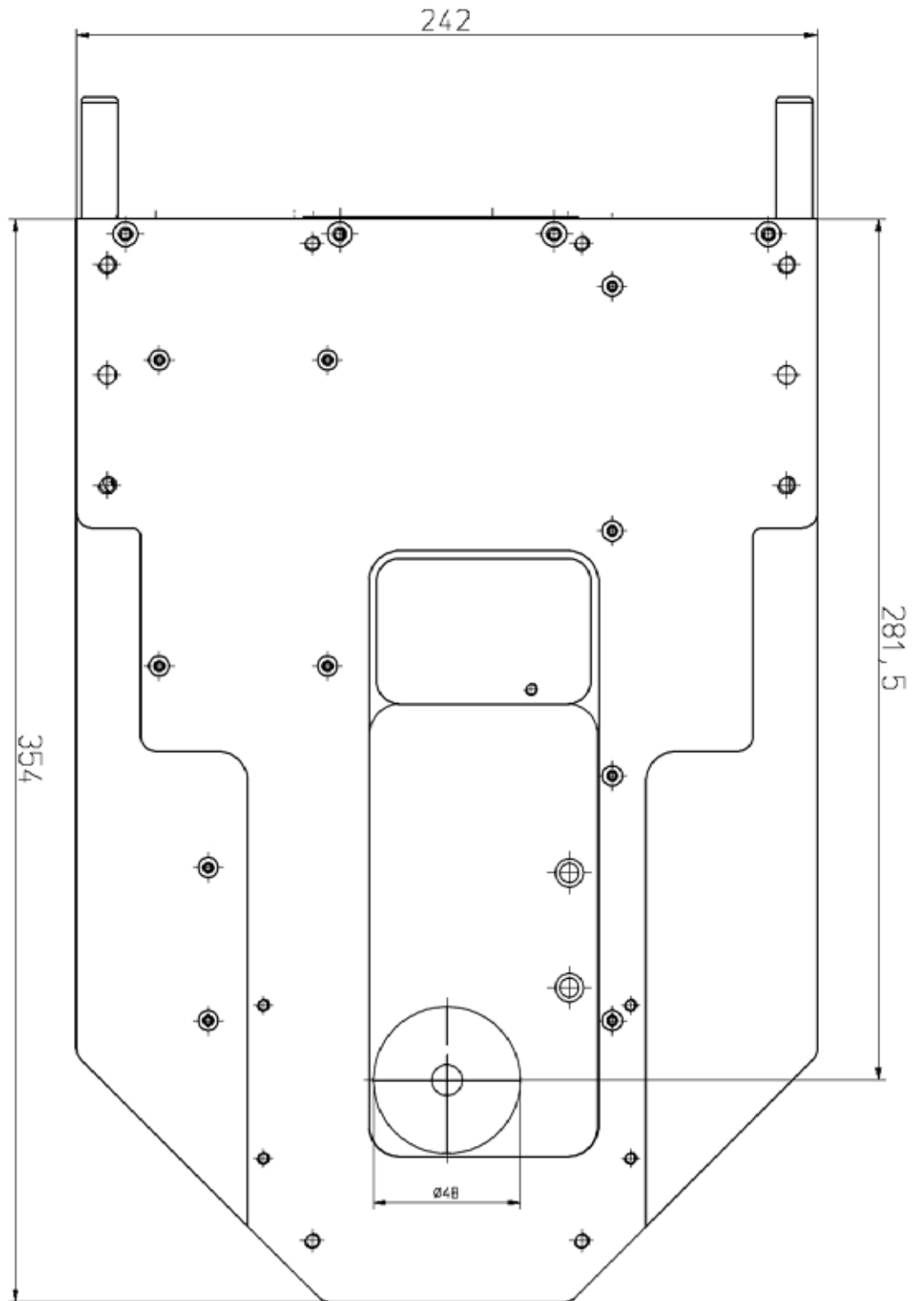
If the error messages do not disappear, the port has to be closed and reopened (in the menu **Cummunication**) or the program has to be terminated and started again.

7. Technical Data

7.1 Accuracy and operation conditions:

Power range:	500 W up to 10 kW
Max. power density:	12 kW/cm ²
Reproducibility:	± 1%
Absolute accuracy:	± 2%
Time constant:	15 seconds up to 99 % of the final value
Flow rate:	min. 5 litre per minute
Free aperture:	48 mm
Dimensions (height x depth x length)	250 mm x 242 mm x 400 mm
Power supply:	24 V RS485 just for power measurement 240 V for self-function
Weight:	16 kg

7.2 Drawing of EC-PowerMonitor



8. Options

8.1 Operation of the EC-PowerMonitor with external display, without PC

At buyer's option, there is a control panel display available for the operation of the system.

To run the system, please connect the display and the EC-PowerMonitor with the 9-pin cable for the PRIMES bus/RS485.

Then, connect the 24 V power supply to the external display. You can use the 9-pin-d-sub-min RS 485/Primes bus or the direct connection at the back of the housing.

Pin configuration:

Pin 1 and 6	ground
Pin 2 and 7	RS485+ and RS485-
Pin 3 and 8	+24 V
Pin 4, 5 and 9	not configured



8.2 Fiber Adaptor

The fiber adaptor allows connecting a fiber directly with a PRIMES power meter (PowerMonitor PM48, EC-PowerMonitor, CPM-F). This way, power measurements directly behind the fiber end/ in front of the focussing optics are possible. As a fiber plug, the types LLK-B, LLK-D (TRUMPF) and QBH (OptoSkand) can be used.

There are 3 different types of fiber adaptors:

Fiber adaptor PM48 / EC-PM to LLK-B (TRUMPF)	article no. 130-006-006
Fiber adaptor PM48 / EC-PM to LLK-D (TRUMPF)	article no. 130-006-007
Fiber adaptor PM48 / EC-PM to QBH	article no. 130-006-009

Using the Fiber Adaptor

Safety Precautions

When using the fiber adaptor, the same rules apply that must be observed whenever using a laser (wear safety goggles, use the laser and the fiber according to the instructions of the manufacturer).

Even though the shielding of stray light was taken into account very carefully during the construction of the fiber adaptor, any set-up with this device should be regarded as laser safety class 4.

Set-up and Operation

The mechanical set-up can be seen in the attached drawing.

- Please make sure, when using a PowerMonitor or an EC-PM, the shutter of the power meter needs to be open.
- Remove any protective foil (if applicable) or protective lid.
- Fasten the fiber adaptor on the power meter with the screws.
- Connect the cable with the Shutter-Interlock output of the power meter.
- The fiber of the laser will only be activated if enough cooling water is flowing through the power meter and (if a PM48 or EC-PM is used) the shutter of the power meter is open.
- Remove the protective foil and plug the fiber into the adaptor.

Whenever the fiber is plugged: proceed as carefully as possible, to ensure that the sensitive ends of the fiber are never contaminated with dust or fingerprints. This will destroy the fiber. Please mind the instructions of the manufacturer of the fiber. Sometimes, dust falling down from the cabling above, can pose a hazard when the cables are moved during the plugging process.

After the Measurement

After the measurement, the fiber adaptor must be sealed with the protective lid to ensure that no dust can enter the inside.

Handling Protective Windows (only Fiber Adaptor for PM48 / EC-PM)

Generally, the protective windows of the fiber adaptor must be handled like any other protective window, e.g. those in a focussing optics. They should be touched only at the very edge, and they must be kept free of dust and fingerprints. Before a measurement is done, they must be checked for contaminations, to make sure that these contaminations are not burned into the surface.

For light contaminations with dust, it can be sufficient to remove the dust with a stream of oil-free pressurized air (while the fiber end is exposed, pressurized air must not be used, as dust could be blown onto the fiber!).

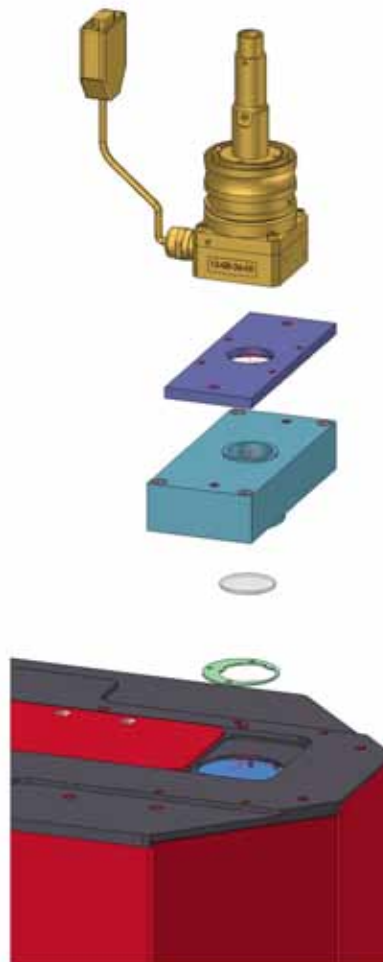
In the case of stronger contamination:

Optics paper and acetone can be used for cleaning purposes. Remove the protective window from the fiber adaptor (3 screws) and place it onto an optics paper. Place a second optics paper on top of the protective window. Apply ca. 3-4 drops of acetone to the upper optics paper. Thus, the protective window is wetted. Pull the upper optics paper to the side, so no drying-spots can remain. Turn the protective window around, and clean the other surface in the same way. If you see any drying-spots, you should repeat the procedure. If the protective window shows burn-ins, it must be replaced with a new one.

Error Message

Message from laser software ,fiber defect / broken'

- Check whether the cable is connected with the Shutter-Interlock plug of the power meter. Verify that enough cooling water (4-12 l/min) is supplied.
- The shutter (PM48 and EC-PM) must be open.



*PowerMonitor with
fiber adaptor PM48/EC-PM
on LLK-B or LLK-D*