PRIMES

Operating Manual

Translation of the original instructions

PowerMeasuringCassette PMC

PMC-BEO, PMC-YW, PMC-ALO

Revision 01/2019 EN

IMPORTANT!

READ CAREFULLY BEFORE USE.

KEEP FOR FUTURE USE.

Table of contents

1 Basic safety instructions

Intended use

The PowerMeasuringCassette PMC is used to measure power of lasers directly in the laser processing head. Alternatively, the PMC can also be operated outside the laser processing head as a „Stand-Alone“ device. Please observe and adhere to the specifications and limit values given in chapter 16, „Technical Data“, on page 36. Other forms of usage are improper. The information contained in this operating manual must be strictly observed to ensure proper use of the device.

Using the device for unspecified use is strictly prohibited by the manufacturer. By usage other than intended the device can be damaged or destroyed. This poses an increased health hazard up to fatal injuries. When operating the device, it must be ensured that there are no potential hazards to human health.

The device itself does not emit any laser radiation. During the measurement, however, the laser beam is guided onto the device which causes reflected radiation (**laser class 4**). That is why the applying safety regulations are to be observed and necessary protective measures need to be taken.

In measuring mode, the device’s safety interlock must be connected with the laser control.

Observing applicable safety regulations

Please observe valid national and international safety regulations as stipulated in ISO/CEN/TR standards as well as in the IEC-60825-1 regulation, in ANSI Z 136 “Laser Safety Standards” and ANSI Z 136.1 “Safe Use of Lasers”, published by the American National Standards Institute, and additional publications, such as the “Laser Safety Basics”, the “LIA Laser Safety Guide”, the “Guide for the Selection of Laser Eye Protection” and the “Laser Safety Bulletin”, published by the Laser Institute of America, as well as the “Guide of Control of Laser Hazards” by ACGIH.

Taking necessary safety measures

If there are people present within the danger zone of visible or invisible laser radiation, for example near laser systems that are only partly covered, open beam guidance systems or laser processing areas, the following safety measures need to be taken:

- Connect the device’s safety interlock to the laser control. Check that the safety interlock will switch off the laser properly in case of error.

- Please wear **safety goggles** adapted to the power, power density, laser wave length and operating mode of the laser beam source in use.
- Depending on the laser source, it may be necessary to wear suitable **protective clothing** or **protective gloves**.
- Please protect yourself from direct laser radiation, scattered radiation as well as from beams generated from laser radiation (e.g. by using appropriate shielding walls or by weakening the radiation to a harmless level).
- Please use beam guidance- or beam absorber elements which do not emit any hazardous particles as soon as they get in contact with laser radiation and which resist the beam sufficiently.
- Please install safety switches and/or emergency safety mechanisms which enable an immediate closure of the laser shutter.
- Please ensure a stable mounting of the device in order to prevent a relative motion of the device to the beam axis of the laser and thus to reduce the risk of stray radiation.

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, modifications and repairs

The device must not be modified, neither constructionally nor safety-related, without our explicit permission. The device must not be opened e.g. to carry out unauthorized repairs. Modifications of any kind will result in the exclusion of our liability for resulting damages.

Liability disclaimer

The manufacturer and the distributor of the measuring devices do not claim liability for damages or injuries of any kind resulting from an improper use or handling of the devices or the associated software. Neither the manufacturer nor the distributor can be held liable by the buyer or the user for damages to people, material or financial losses due to a direct or indirect use of the measuring devices.

2 Symbol explanation

The following symbols and signal words indicate possible residual risks:

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 **can** occur if necessary safety precautions are not taken.

CAUTION

means that a slight physical injury **can** occur if necessary safety precautions are not taken.

NOTICE

means that property damages **can** occur if necessary safety precautions are not taken.

The device itself or the packing bears the following symbols to indicate requirements and possible dangers:

Read and observe the operating instructions and safety guidelines before the start-up!

Further symbols that are not safety-related:

Here you can find useful information and helpful hints.

With the CE marking the manufacturer guarantees that his product is in conformity with the EC guidelines.

Call for observing (visual feedback from the device or the software).

▶ Call for action

3 Conditions at the installation site

The device must only be operated in a dry and dust free atmosphere. High levels of humidity can lead to condensation, which can affect the operation of the device. This also applies to high environmental dust exposure.
In industrial environments erroneous measurements may be triggered by strong electromagnetic fields. In this case we recommend EMC compliant shielding of the safety interlock cable.

4 Special instructions for measuring devices with rechargeable lithium ion batteries

The device is equipped with a lithium-ion battery. Note that this battery may ignite or explode at high temperatures.
To operate the device, the ambient conditions must therefore be observed and adhered to in accordance with the specifications in chapter 16, „Technical Data“, on page 36.
The lithium-ion battery is permanently installed in the device. Do not open the device to replace the lithium-ion battery, as damage to the battery may result in the escape of harmful substances.

5 System description

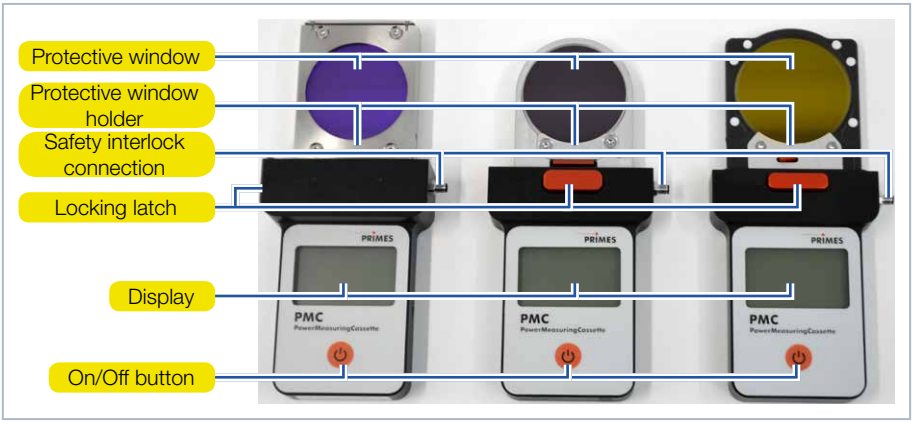


Fig. 5.1: System description of the PMC

5.1 Measuring principles

The absorber of the calorimetric measurement system is irradiated by a laser for a short period of time. The temperature difference of the absorber between start and finish of the laser pulse is measured. From the increase in temperature, the microprocessor based electronics is able to calculate laser power to a high degree of accuracy.

6 Transportation

NOTICE

Damaging/Destruction of the device

Hard impacts or dropping the device can damage the optical and electrical components.

▶ **Only transport the device in its original packaging.**

7 Installation/Removal (Laser processing head)

7.1 Installation into the laser processing head

1. Turn off the laser source.
2. Ensure that moving parts, e.g. robot arms, etc. are at a standstill and that they cannot be set in motion unintentionally.
3. Remove the protective glass cassette (part of the laser system) from the laser processing head.

- Protect the protective glass of the protective glass cassette from contamination.

NOTICE

Damage to the laser system

Contamination and fingerprints on the protective window can lead to damage or shattering or splintering of the protective window during measuring operation. Parts of the protective window can get into the laser system and damage it.

- ▶ **Do not touch the protective window.**
- ▶ **Only operate the device with a clean protective window.**

4. Remove the protective foil from the protective window of the device.
5. Insert the device into the slot of the laser processing head until the locking latch locks in place (see Fig. 5.1 on page 11).
6. Ensure a secure fit of the device in the laser processing head:

- The device must be fully seated until the locking latch engages in the laser processing head.

7. Connect the safety interlock connection cable.

7.2 Mounting position

Insert the PMC into the laser processing head so that the laser beam hits the protective window.

7.3 Removal from the laser processing head

DANGER

Serious eye or skin injury due to laser radiation

If the device is pulled out of the laser processing head during the measurement, scattered or directed reflection of the laser beam will occur.

▶ **First turn the laser source off and then remove the device from the laser processing head.**

1. Turn off the laser source.
2. Ensure that moving parts, e.g. robot arms, etc. are at a standstill and that they cannot be set in motion unintentionally.
3. Remove the safety interlock connection cable, press the locking latch (see Fig. 5.1 on page 11) and remove the device from the laser processing head.
4. Apply the protective foil to prevent contamination of the protective window.
5. Insert the protective glass cassette (part of the laser system) back into the laser processing head.

8 Installation/Removal („Stand-alone“ device)

8.1 Prepare installation

1. Turn off the laser source.
2. Ensure that moving parts, e.g. robot arms, etc. are at a standstill and that they cannot be set in motion unintentionally.

DANGER

Serious eye or skin injury due to laser radiation

If the stability of the device is not guaranteed or the inlet aperture is not centered and mounted perpendicular to the laser beam, increased scattered or directed reflection of the laser beam will occur.

- ▶ **Align the device as described in chapter 8.2 on page 14.**
- ▶ **Install the device according to chapter 8.3 on page 16 in a way that ensures, that the PMC can not shift or fall.**

CAUTION

Cutting hazard

Contamination and fingerprints on the protective window can lead to damage or shattering or splintering of the protective window during measuring operation.

- ▶ **Do not touch the protective window.**
- ▶ **Only operate the device with a clean protective window.**

8.2 Mounting position

When installed as „Stand-Alone“ device the PMC can be mounted vertically or horizontally. The PMC must be aligned to the laser beam. The laser beam must hit the inlet aperture in the middle and perpendicular. Please mind and adhere to the specifications and limit values given in chapter 16, „Technical Data“, on page 36.

Normally, the PMC is positioned underneath the focus position of the beam path for power measurement (divergent laser radiation). If this is not possible, the PMC can be positioned above the focus. Please note, that in this case the laser radiation is convergent and the permissible power density on the absorber (approx. 2 mm underneath the protective window) must not be exceeded.

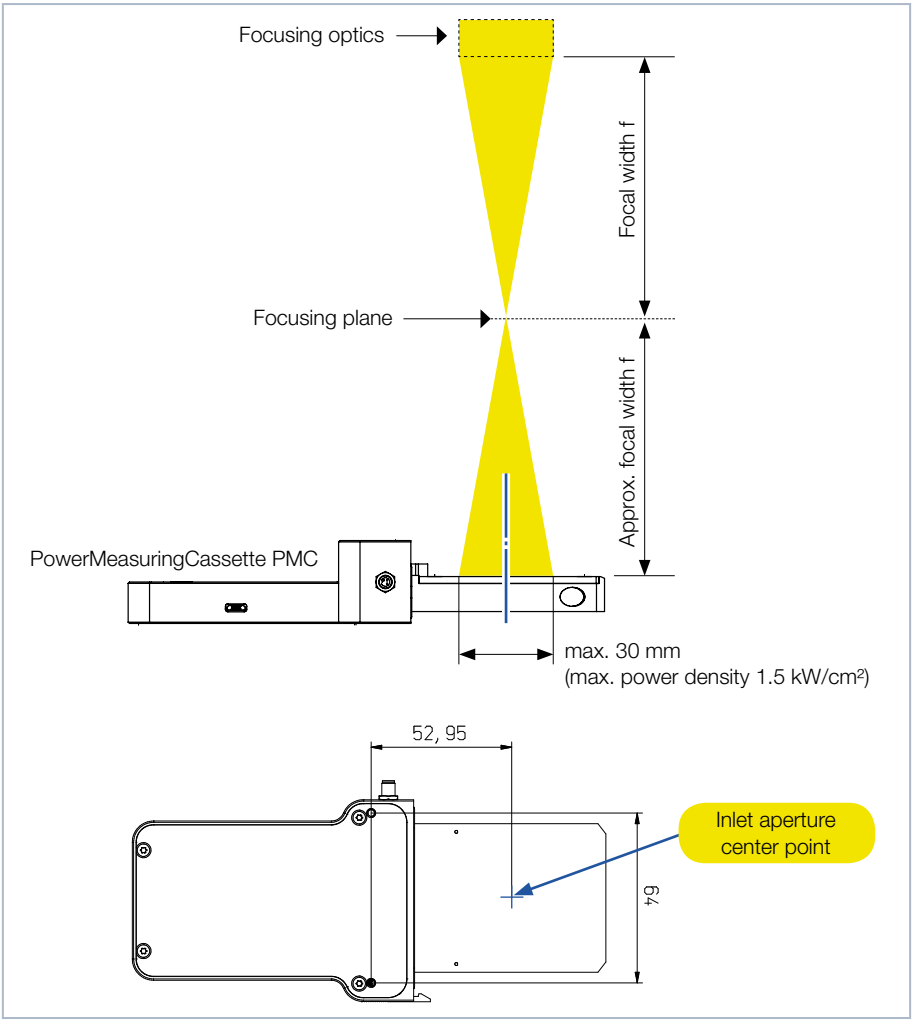


Fig. 8.1: Alignment to the laser beam (example for an BEO optics with an inlet aperture Ø = 50 mm)

8.3 Install the PMC

1. Align the device with the laser beam as described in chapter 8.2 on page 14 and Fig. 8.1 on page 15.

The distance between the entrance inlet aperture center point and the mounting threads M3 as well as the spacing of the mounting threads M3 from one another are the same for all PMC variants.

2. Install the device with the mounting threads M3 at the bottom of the device (see Fig. 8.2 on page 16).
- Observe the maximum screw-in depth of 5 mm.
3. Ensure a stable installation of the device:
- The device must not be able to move.
4. Connect the safety interlock connection cable.
5. Remove the protective foil from the protective window of the device.

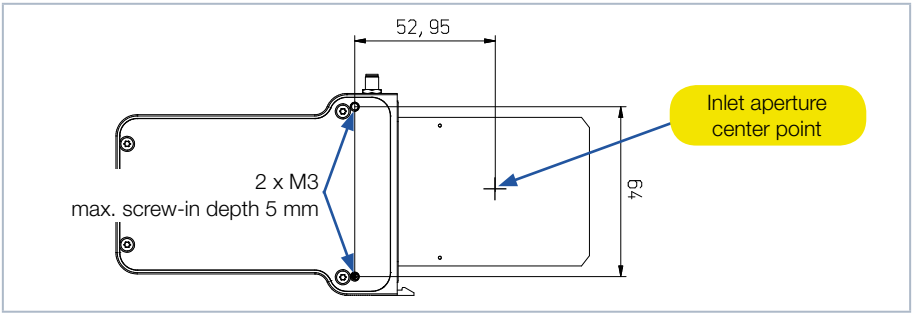


Fig. 8.2: Mounting threads, bottom view

8.4 Remove the PMC

1. Turn off the laser source.
2. Ensure that moving parts, e.g. robot arms, etc. are at a standstill and that they cannot be set in motion unintentionally.
3. Unscrew 2 screws from the 2 mounting threads M3 on the underside of the device (see Fig. 8.2 on page 16).
4. Remove the safety interlock connection cable and remove the device from the laser system.
5. Apply the protective foil to prevent contamination of the protective window.

9 Connections

Fig. 9.1: Connections (example PMC-BEO)

9.1 Safety interlock

At temperatures over 100 °C, the safety interlock is triggered in order to protect the absorber from overheating. If the absorber is hotter than 100 °C, Pin 3 and Pin 4 will connect.

Since the heat is concentrated in the area where the laser beam hits, the safety interlock may be triggered shortly after the beam comes on, since the temperature of the absorber briefly exceeds 100 °C. When the device is used in accordance with the technical specifications, this brief spike in the temperature of the absorber does not pose a risk to the absorber and does not constitute an error.

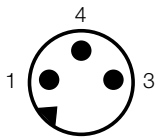
Unfortunately, it is not possible to trigger the safety interlock on a time delay, because otherwise there would be no way to ensure that it protects against overheating.
Once the absorber cools off, Pin 1 and Pin 4 of the safety interlock are connected. A suitable 2 m long connection cable is included.

NOTICE

Damaging/Destruction of the device

If the safety interlock is not connected, the device can be damaged or destroyed due to overheating.

- ▶ **When connecting the laser control, please ensure that the laser is turned off in case of an interruption of the connection.**

Pin diagram safety Interlock plug (view connector side)	Pin	Wire color	Function
	4	Black	Mutual pin
	1	Brown	Connected with pin 4 when ready for operation
	3	Blue	Connected with pin 4, when in safety interlock mode (absorber too hot)

Tab. 9.1: Pin assignment of the safety interlock plug

9.2 Micro-USB socket

You can charge the rechargeable lithium ion batteries of the measuring device by plugging them into the micro-USB socket on the PC. A suitable cable is included in the scope of delivery.
When using the optional LaserDiagnosticsSoftware LDS, the device communicates with the LDS via the micro-USB socket.
You will find the PRIMES USB-driver for all USB-capable devices on the PRIMES website at: https://www.primes.de/en/support/downloads/software.html.

10 Control elements

10.1 On/Off button

The on/off button have several functions:

	Keystroke	Function
⏻	5 seconds	Turn on/Turn off
	2 seconds	Show measuring values
	Repeated pushing for 2 seconds	Turn over measuring value display

Fig. 10.1: On/Off button

11 Display

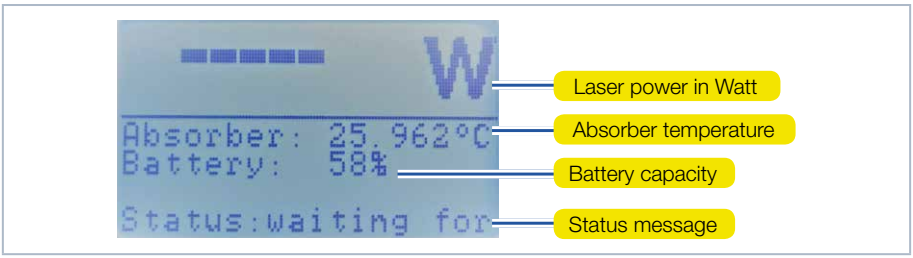


Fig. 11.1: Display

11.1 Status messages

Status Message	Meaning
Waiting for laser beam	The device is ready for operation, the laser can be turned on.
Check temp.	The temperature gradient (change in the absorber temperature/time) is checked. Please wait until the message disappears. Thereafter, the device is ready to measure again.
Thermalize	The thermalization time allows for a uniform temperature distribution in the absorber. Afterwards, the temperature is measured.
Finished	The measurement is completed.

Tab. 11.1: Status messages

11.2 Warning message

Warning Message	Reason
Safety interlock open	The absorber temperature has exceeded 100 °C. In order to protect the device, the safety circuit is open.

Tab. 11.2: Warning message

This warning message does not imply an error. The message is automatically reset as soon as the absorber temperature is below 100 °C again. Likewise, the safety circuit is then closed again.

11.3 Capacity of rechargeable lithium ion battery

The capacity of the rechargeable lithium-ion battery is displayed in percentage. The accuracy of this display is subject to various factors (such as, for example, the temperature, the battery condition, etc.). We therefore recommend charging the battery when 20 % are displayed. If the battery is fully discharged, the charging can take between 12 and 14 hours.
Please note that the charging process can only be carried out in the temperature range from 0 °C to + 45 °C to protect the battery. With a battery capacity of 100 %, the device has an operating time of approx. 8 hours (equivalent to approx. 100 measurements). When using all power saving functions (see Tab. 13.1 on page 28) approx. 20 hours.

12 Measuring and displaying with the PMC

12.1 Safety instructions

DANGER

Severe eye or skin injury due to laser radiation (when operated as a „Stand-Alone“ device)

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

- **Wear safety goggles adapted to the power, power density, laser wave length and operating mode of the laser beam source in use.**
- **Wear suitable protective clothing and protective gloves.**
- **Protect yourself from laser radiation by separating protective devices (e.g. by using appropriate shielding).**

CAUTION

Cutting hazard

Contamination and fingerprints on the protective window can lead to damage or shattering or splintering of the protective window during measuring operation.

- **Do not touch the protective window.**
- **Regularly check the condition of the protective window and exchange it in case of pollution (see chapter 14.1, „Exchanging the protective window“, on page 29).**
- **Only operate the device with a clean protective window.**

NOTICE

Damage to the laser system
(when operating the device in the laser processing head)

Contamination and fingerprints on the protective window can lead to damage or shattering or splintering of the protective window during measuring operation. Parts of the protective window can get into the laser system and damage it.

- ▶ Do not touch the protective window.
- ▶ Regularly check the condition of the protective window and exchange it in case of pollution (see chapter 14.1, „Exchanging the protective window“, on page 29).
- ▶ Only operate the device with a clean protective window.

NOTICE

Damaging/Destruction of the device

The maximum permissible energy per laser pulse is different for the different version of the PMC and depends on various variables, including the absorber temperature.

- ▶ Please observe the limit values and dependencies specified in chapter 16, „Technical Data“, on page 36 and chapter 19, „Appendix“, on page 43 before the measurement.

12.2 Laser parameter setting

12.2.1 Setting the laser rise time

The applicable measurement time is between 0.1 s and 2.0 s, which has to be transferred to the laser controller as pulse length. The maximum laser rise time for power measurement cannot exceed 100 µs. This limit has to be adhered to in order to avoid incorrect results of the power measurement.
Some laser beam sources are factory set with power ramps of up to a few 100 ms to switch on the laser beam. To achieve the correct power values the shortest possible rise time (< 100 µs) has to be set.

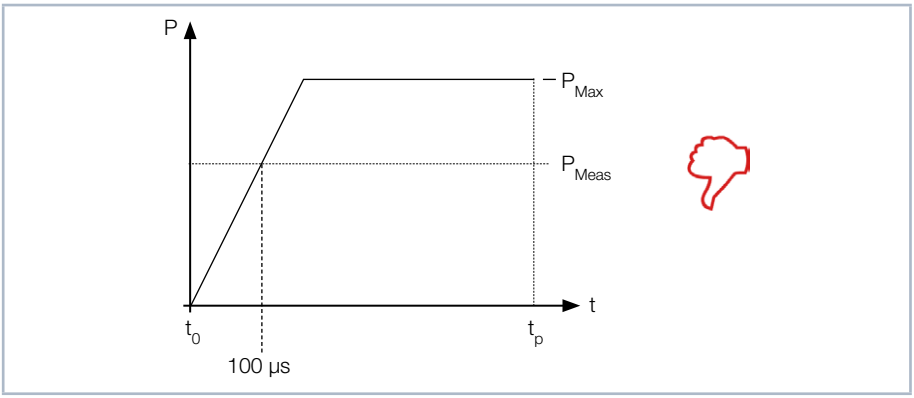


Fig. 12.1: Laser rise time > 100 µs

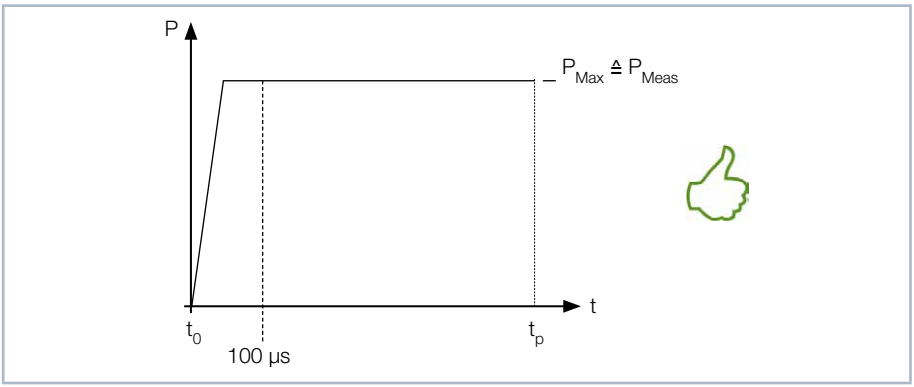


Fig. 12.2: Laser rise time < 100 µs

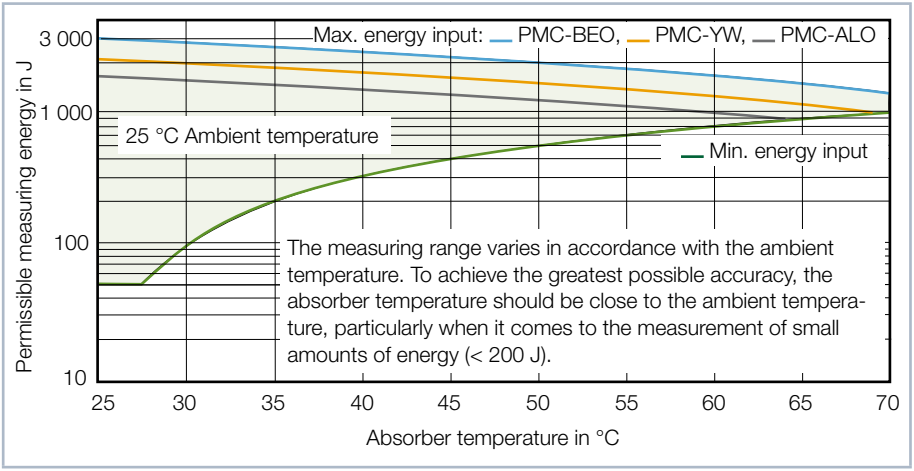
12.2.2 Minimum energy per single measurement

The energy used for the measurement must achieve a sufficiently high temperature in the absorber to be recorded with high precision. Energy of about 300 J is generally recommended, as long as the measurement duration is < 2 s.

Example: With a laser power of 1 kW and an irradiation time of 300 ms, 300 J are absorbed.

$E = P \cdot t = 1\,000\ W \cdot 0.3\ s = 300\ J$

Tab. 12.1 on page 24 shows information for selecting the energy permissible for a measurement in conjunction with the absorber temperature.

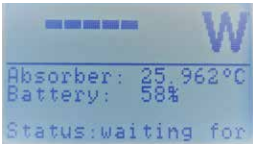
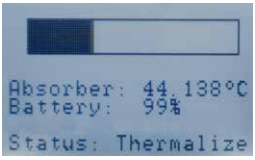
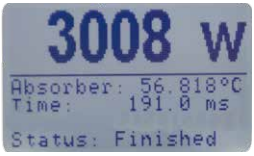


Tab. 12.1: Measuring range as a function of the absorber temperature

The minimum energy application shows the limit above which a measurement can be performed with high precision. The maximum energy application value specifies the limit at which the absorber reaches its reliable limit temperature. The energy, e.g. for multiple measurements (series measurements) can be distributed across the range shown in green (using the PMC-BEO as an example).
If the absorber temperature is greater than 70 °C, it won't be possible to take any further measurements. In this case, please wait until the temperature falls to below 50 °C (depending on the energy application selected). Please take the limit values from Tab. 12.1 on page 24.

12.3 Single measurement

Please read chapter 12.1, „Safety instructions“, on page 21 first.

▶ Press the on/off button for at least 5 seconds.	
The start menu appears.	
After approx. 5 seconds, the device is ready for operation.	
▶ Turn on the laser.	For a high measurement accuracy, we recommend an energy input of 300 J per measurement. See chapter 12.2.2, „Minimum energy per single measurement“, on page 24. Observe the information on serial measurements according to chapter 12.4 on page 26.
The thermalization is displayed by means of a progress bar (duration approx. 15 seconds).	
The measured power, the temperature, and the irradiation time are displayed.	

The device turns off automatically after approx. 10 minutes. You can also turn off the device manually by keeping the on/off button pressed for approx. 4 seconds.

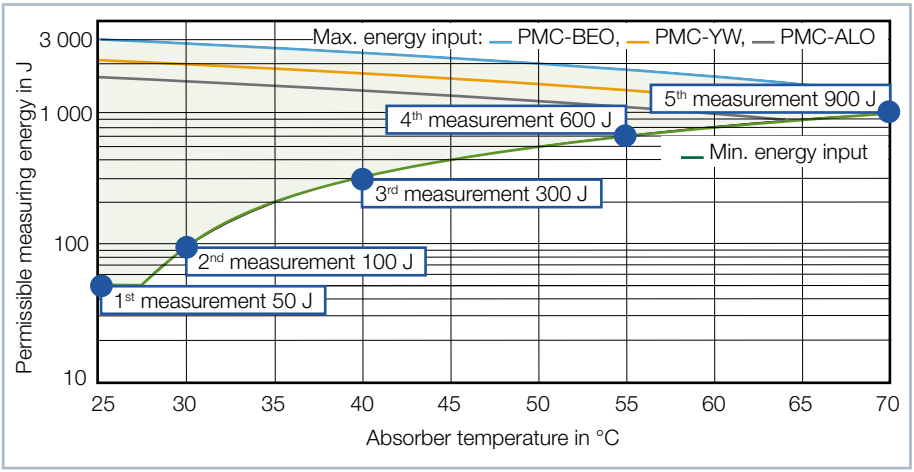
12.4 Serial measurement

Please read chapter 12.1, „Safety instructions“, on page 21 first.

Always start a measurement series with the smallest power and increase it gradually. Small amounts of energy should be measured with absorber temperatures that are close to the ambient temperature.

In general:
The minimum amount of irradiated energy should amount to approximately twenty times the difference of the absorber temperature minus room temperature, so at least 50 J.

In case of subsequent measurements, the residual capacity of the absorber for another laser pulse has to be considered. Tab. 12.2 on page 26 shows information for selecting the energy permissible for a series measurement in conjunction with the absorber temperature.



Tab. 12.2: Example of a series measurement in conjunction with the absorber temperature

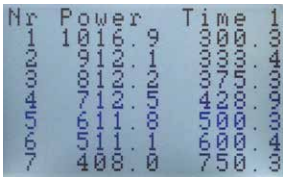
If the absorber temperature is greater than 70 °C, it won't be possible to take any further measurements. In this case, please wait until the temperature falls to below 50 °C (depending on the energy application selected). Please take the limit values from Tab. 12.2 on page 26.

12.5 Measurement with pulsed lasers

Measurements can be performed with pulsed lasers, but capabilities are limited. When it comes to pulsed laser radiation a correct exposure time measurement up to a pulse frequency of 1 kHz and a duty cycle of 50 % is possible.
In case of on/off times shorter than 500 µs a correct exposure time measurement is not possible.

12.6 Read measuring values

The last 14 measuring values can be read off the display of the PowerMeasuringCasette PMC. The last 30 measuring values can be read with the optional PRIMES Cube App for mobile Android™ devices or the optional LaserDiagnosticsSoftware LDS.

▶ Press the on/off button for approx. 2 seconds.	
The measured values and the time are displayed. ▶ Press the on/off button again for 2 seconds to have the remaining measuring values (no. 8-14) displayed.	

13 Measurement and evaluation via software

13.1 Measurement and evaluation with the LaserDiagnosticsSoftware LDS

With the optional operating and evaluation software LaserDiagnosticsSoftware LDS you can also operate the device via the PC and evaluate the measurements. The functions can be found in Tab. 13.1 on page 28.

13.2 Functions and settings via the software

Function	Possible settings
Auto ready	By default, the device automatically returns to measurement readiness after each measurement. If you uncheck the box, you will need to reset the unit after each measurement by briefly pressing the on/of button.
Power Saving Function	Continuous background on/off
	Turn off backlight after (in s). The set time only applies if the permanent backlight is switched off.
	Switch the safety interlock on/off. For safety reasons switching off the safety interlock is not recommended.
	Switch off the device after an entered time

Tab. 13.1: Functions and settings

14 Maintenance and service

The operator is responsible for determining the maintenance intervals for the measuring device.
PRIMES recommends a maintenance interval of 12 months for inspection and validation or calibration.
If the device is used only sporadically, the maintenance interval can also be extended up to 24 months.

14.1 Exchanging the protective window

The protective window in the beam entrance is a wearing part and can be replaced if necessary. Low levels of contamination of the protective window can be carefully removed when cooled with Isopropanol (observe the manufacturer‘s safety instructions). In case of heavy, non-removable contamination or damage, the protective window must be replaced with a new one.

The protective window is coated with an antireflection coating and has low reflection values of less than 1%. To avoid increased reflection values, use only original PRIMES protective window.

PMC-BEO

Protective window diameter	55 mm
Glass thickness	1.5 mm
Order number	410-070-021 (1 piece); 410-070-031 (10 pieces)

PMC-YW

Protective window diameter	50 mm
Glass thickness	1.5 mm
Order number	410-030-002 (1 piece); 410-030-006 (10 pieces)

PMC-ALO

Protective window diameter	55 mm
Glass thickness	1.0 mm
Order number	410-030-004 (1 piece); 410-030-005 (10 pieces)

14.1.1 Safety instructions

DANGER

Severe eye or skin injury due to laser radiation

If the protective window is not correctly positioned, reflections can cause directional laser radiation.

- ▶ Ensure that the new protective window is positioned evenly in the indentation.

CAUTION

Burns due to hot components

After a measurement the absorber below the protective window is hot! Unintentional contact during the protective window exchange could lead to burns.

- ▶ Do not replace the protective window directly after a measurement.
- ▶ Let the device cool down for an adequate period of time. The cooling time varies depending on the laser power and the irradiation time.

CAUTION

Cutting hazard

Contamination and fingerprints on the protective window can lead to damage or shattering or splintering of the protective window during measuring operation.

- ▶ Only replace the protective window in a dust-free environment.
- ▶ Do not touch the protective window.
- ▶ When exchanging the protective window, always wear cotton- or powder-free latex gloves.

NOTICE

Damage to the laser system
(when operating the device in the laser processing head)

Contamination and fingerprints on the protective window can lead to damage or shattering or splintering of the protective window during measuring operation. Parts of the protective window can get into the laser system and damage it.

- **Only replace the protective window in a dust-free environment.**
- **Do not touch the protective window.**
- **When exchanging the protective window, always wear cotton- or powder-free latex gloves.**

14.1.2 Exchanging the protective window on the PMC-BEO

1. Observe the safety instructions in chapter 14.1.1 on page 30.
2. Unscrew the 4 Torx screws M3 x 8 mm on the protective window holder.
3. Place the device as shown in Fig. 14.1 on page 32 and carefully remove the protective window holder upwards.

- Make sure that the inserted Teflon cord and the mirror do not fall out of the device.

4. Remove old protective window from the device and dispose of it.
5. Wear cotton or powder-free latex gloves and insert new protective window into the device.

- Ensure that the inserted Teflon cord and the mirror is not out of place.

6. Place the protective window holder according to Fig. 14.1 on page 32 with the 2 recesses towards the front.
7. Tighten the protective window holder with 4 Torx screws M3 x 8 mm.
8. Check for secure fit of the protective window holder:

- The protective window holder must lie flat against the device.

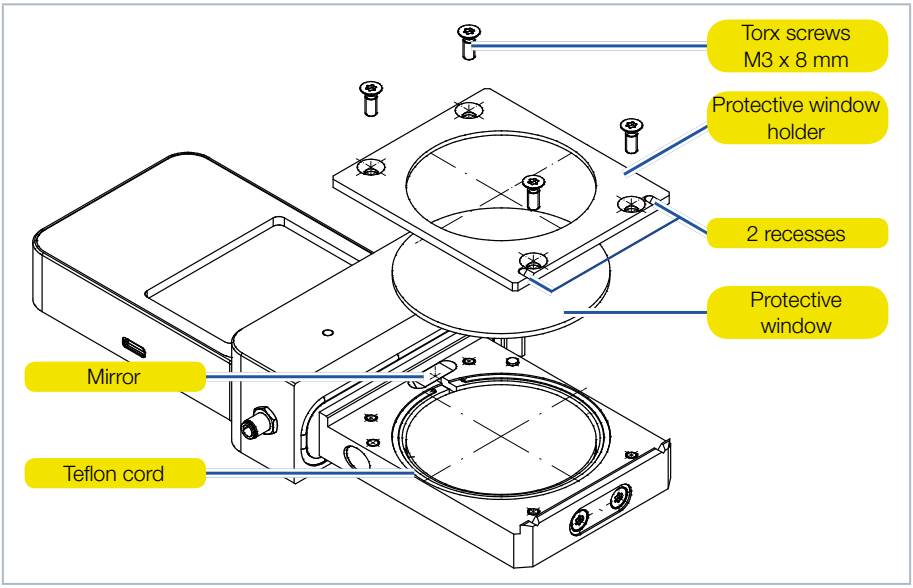


Fig. 14.1: Exchanging the protective window on the PMC-BEO

14.1.3 Exchanging the protective window on the PMC-YW

1. Observe the safety instructions in chapter 14.1.1 on page 30.
2. Unscrew 2 Torx screws M3 x 5 mm on the protective window holder.
3. Place the device as shown in Fig. 14.2 on page 33 and carefully remove the protective window holder upwards.

- Make sure that the inserted mirror do not fall out of the device.

4. Remove old protective window from the device and dispose of it.
5. Wear cotton or powder-free latex gloves and insert the new protective window into the device.

- Ensure that the inserted mirror is not out of place.

6. Place the protective window holder according to Fig. 14.2 on page 33.
7. Tighten the protective window holder with 2 Torx screws M3 x 5 mm.

8. Check for secure fit of the protective window holder:

- The protective window holder must lie flat against the device.

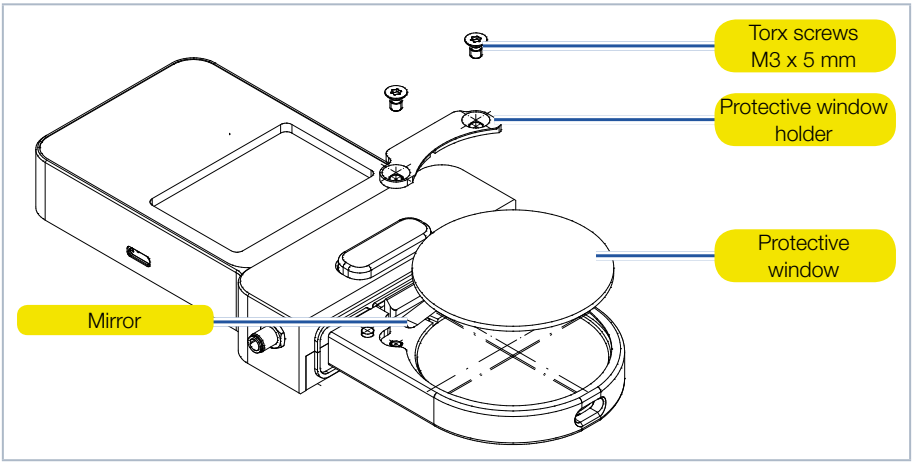


Fig. 14.2: Exchanging the protective window on the PMC-YW

14.1.4 Exchanging the protective window on the PMC-ALO

1. Observe the safety instructions in chapter 14.1.1 on page 30.
2. Unscrew 2 Torx screws M2,5 x 5 mm on the protective window holder.
3. Place the device as shown in Fig. 14.3 on page 34 and carefully remove the protective window holder upwards.

- Make sure that the inserted mirror do not fall out of the device.

4. Remove old protective window from the device and dispose of it.
5. Wear cotton or powder-free latex gloves and insert the new protective window into the device.

- Ensure that the inserted mirror is not out of place.

6. Place the protective window holder according to Fig. 14.3 on page 34.
7. Tighten the protective window holder with 2 Torx screws M2,5 x 5 mm.

8. Check for secure fit of the protective window holder:

- The protective window holder must lie flat against the device.

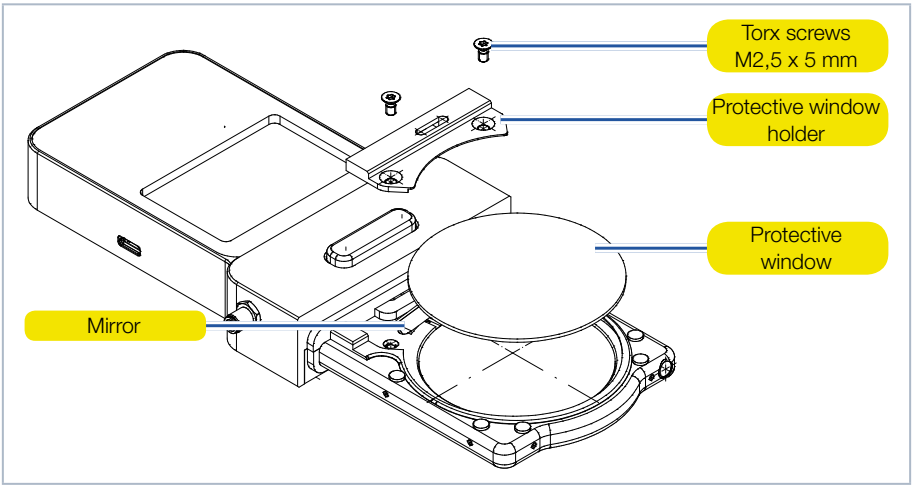


Fig. 14.3: Exchanging the protective window on the PMC-ALO

15 Measures for the product disposal

Due to the Electrical and Electronic Equipment Act (“Elektro-G“) PRIMES is obliged to dispose PRIMES measuring devices manufactured after August, 2005, free of charge. PRIMES is a registered manufacturer in the German “Used Appliances Register“ (Elektro-Altgeräte-Register “EAR“) with the number WEEE-reg.-no. DE65549202.

Provided that you are located in the EU, you are welcome to send your PRIMES devices to the following address, where they will be disposed free of charge (this service does not include shipping costs):

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

16 Technical Data

16.1 PMC-BEO with standard or advanced absorber

Measurement parameters		Standard absorber[1)]	Advanced absorber[1)]
Max. beam dimensions on the absorber		30 mm	
Wavelength range		900 – 1 090 nm	
Power range		400 – 6 000 W [2)]	400 – 12 000 W [2)]
Irradiation time		0.1 – 1 s [1)] (depending on the laser power)	
Total duration until measurement value output		< 15 s	
Nominal measuring frequency		300 J: 1 cycle/min 3000 J: 1 cycle/min	
Measuring accuracy at angles of incidence up to 5 °		± 3 %	
Reproducibility		± 1 %	
Limit values		**Standard absorber[1)]**	**Advanced absorber[1)]**
Max. absorber temperature		120 °C	
Energy per measurement		50 – 3 000 J	
Recommended energy per measurement		300 – 500 J	
Max. power density (peak) on the absorber (approx. 2 mm underneath the protective window) at beam diameters	> 10 mm	1.5 kW/cm²	4 kW/cm²
	10 – 3 mm	2.5 kW/cm²	5 kW/cm²
	3 – 1.5 mm	5 kW/cm²	10 kW/cm²
	< 1.5 mm	6 kW/cm²	12 kW/cm²
Max. laser rise time		100 µs	
Max. angle of incidence perpendicular to inlet aperture		± 5 °	
Max. centered tolerance		± 2.0 mm	

[1)] **Please read the information on the identification plate to determine if your device is equipped with a standard or advanced absorber.**

	
When nothing is marked, a standard absorber is built into the device.	When an A marking is made, an advanced absorber is built into the device.
[2] **The stated limit values are to be understood in correlation with the permitted maximum energy (E = P · t).**	
Supply data	
Power supply	Integrated lithium-ion battery, which can be charged via a micro-USB port
Temperature range for charging the lithium-Ion battery	0 – 45 °C
Communication	
Interfaces	USB
Dimensions and weight	
Dimensions (LxWxH)	179 x 84 x 31 mm
Weight (approx.)	460 g
Environmental conditions	
Operating temperature range	10 – 40 °C
Storage temperature range	5 – 50 °C
Reference temperature	22 °C
Permissible relative humidity (non-condensing)	10 – 80 %

16.2 PMC-YW/PMC-ALO with standard absorber

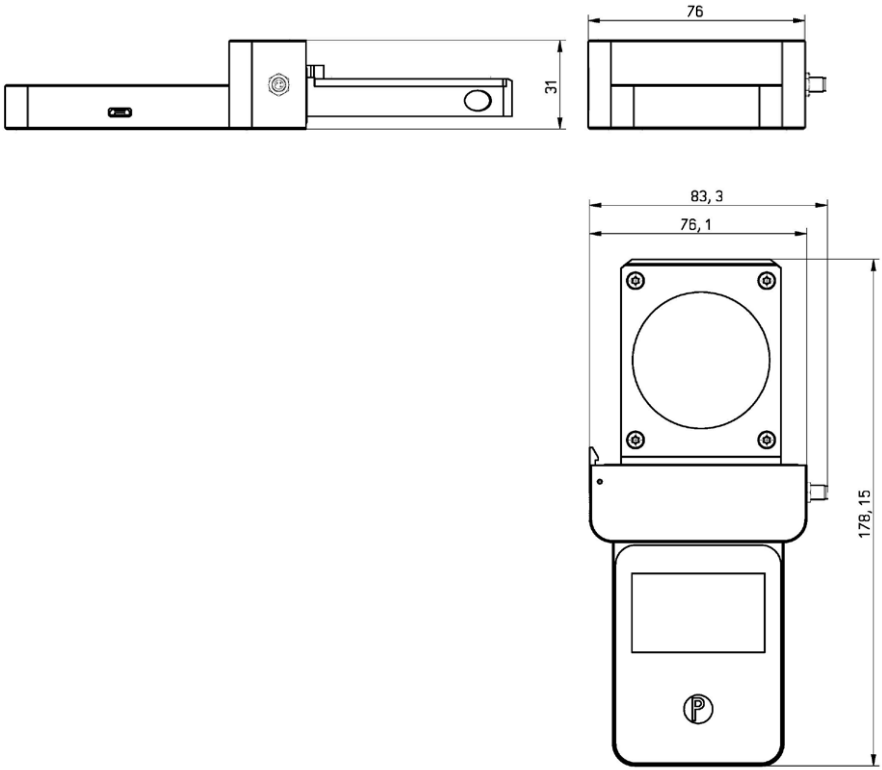
Measurement parameters		PMC-YW	PMC-ALO
Max. beam dimensions on the absorber		30 mm	
Wavelength range		900 – 1 090 nm	
Power range		400 – 6 000 W [1]	400 – 6 000 W [1]
Irradiation time		0.1 – 1 s [1] (depending on the laser power)	
Total duration until measurement value output		< 15 s	
Nominal measuring frequency		300 J: 1 cycle/min 3 000 J: 1 cycle/min	
Measuring accuracy at angles of incidence up to 5 °		± 3 %	
Reproducibility		± 1 %	
Limit values		**PMC-YW**	**PMC-ALO**
Max. absorber temperature		120 °C	
Energy per measurement		30 – 2 000 J	25 – 1 500 J
Recommended energy per measurement		300 – 500 J	
Max. power density (peak) on the absorber (approx. 2 mm underneath the protective window) at beam diameters	> 10 mm	1.5 kW/cm²	
	10 – 3 mm	2.5 kW/cm²	
	3 – 1.5 mm	5 kW/cm²	
	< 1.5 mm	6 kW/cm²	
Max. laser rise time		100 µs	
Max. angle of incidence perpendicular to inlet aperture		± 5 °	
Max. centered tolerance		± 2.0 mm	

[1] **The stated limit values are to be understood in correlation with the permitted maximum energy (E = P · t).**

Supply data		
Power supply	Integrated lithium-ion battery, which can be charged via a micro-USB port	
Temperature range for charging the lithium-Ion battery	0 – 45 °C	
Communication	**PMC-YW**	**PMC-ALO**
Interfaces	USB	
Dimensions and weight		
Dimensions (LxWxH)	171 x 84 x 24 mm	177 x 84 x 24 mm
Weight (approx.)	280 g	280 g
Environmental conditions		
Operating temperature range	10 – 40 °C	
Storage temperature range	5 – 50 °C	
Reference temperature	22 °C	
Permissible relative humidity (non-condensing)	10 – 80 %	

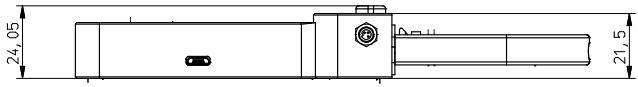
17 Dimensions

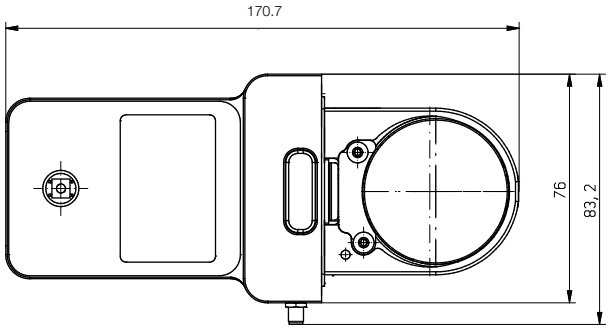
17.1 PMC-BEO



All dimensions in mm (general tolerance ISO 2768-v)

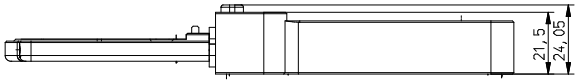
17.2 PMC-YW

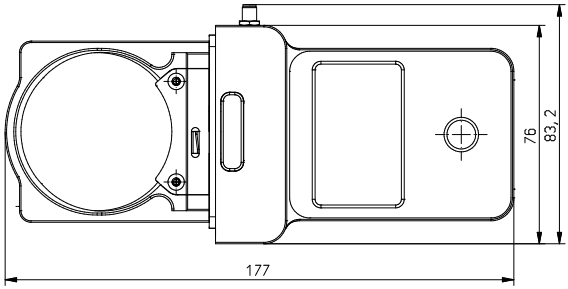




All dimensions in mm (general tolerance ISO 2768-v)

17.3 PMC-ALO





All dimensions in mm (general tolerance ISO 2768-v)

18 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:

PowerMeasuringCassette (PMC)

Types: PMC-C; PMC-BEO; PMC-YW; PMC-ALO

is in conformity with the following relevant EC Directives:

- EMC Directive EMC 2014/30/EU
- Low voltage Directive 2014/35/EU
- Directive 2011/65/EC on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment
- Radio Equipment Directive 2014/53/EU

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

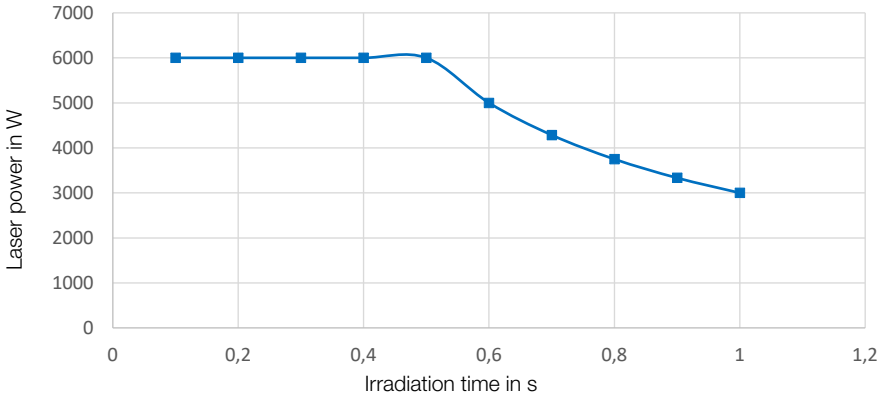
The manufacturer obligates himself to provide the national authority in charge with technical documents in response to a duly substantiated request within an adequate period of time.

Pfungstadt, April 26, 2017

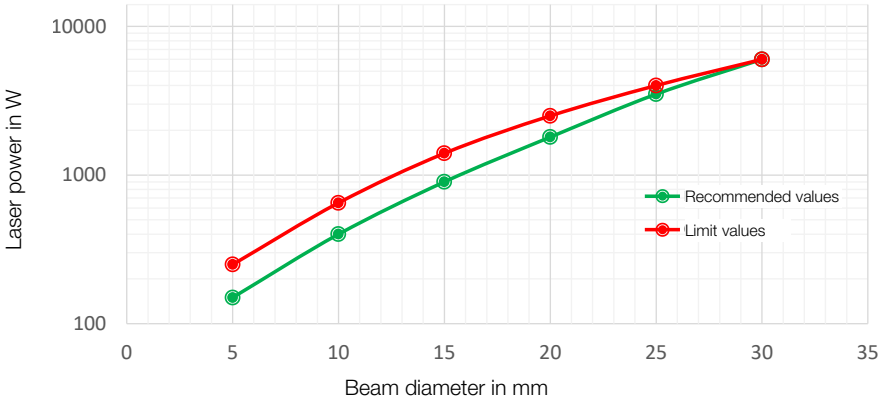
Dr. Reinhard Kramer, CEO

19 Appendix

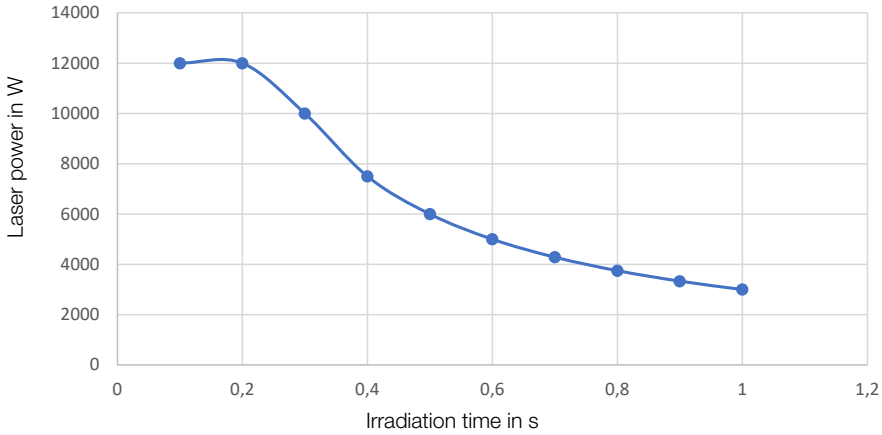
19.1 Max. laser power depending on the irradiation time for devices with standard absorber



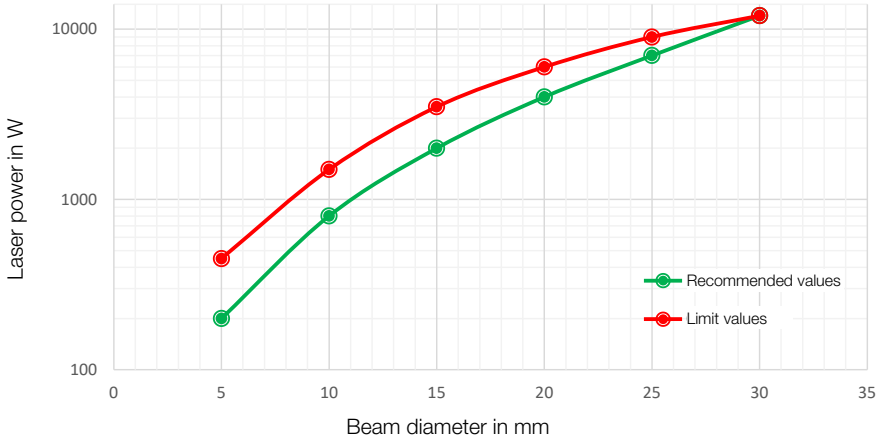
19.2 Max. laser power depending on the beam diameter for devices with standard absorber



19.3 Max. laser power depending on the irradiation time for devices with advanced absorber



19.4 Max. laser power depending on the beam diameter for devices with advanced absorber



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