

## Operating Manual

Translation of the original instructions



## Power Measuring Cassette PMC

PMC-C



**IMPORTANT!**

**READ CAREFULLY BEFORE USE.**

**KEEP FOR FUTURE USE.**

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## 1 Basic safety instructions

### Intended use

The PowerMeasuringCassette-Compact PMC-C is used to measure the power of lasers directly in the BEO laser processing head. Please observe and adhere to the specifications and limit values given in chapter 17, „Technical data“, on page 45. 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.

### 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:

- 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.

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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 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 17, „Technical data“, on page 45.

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

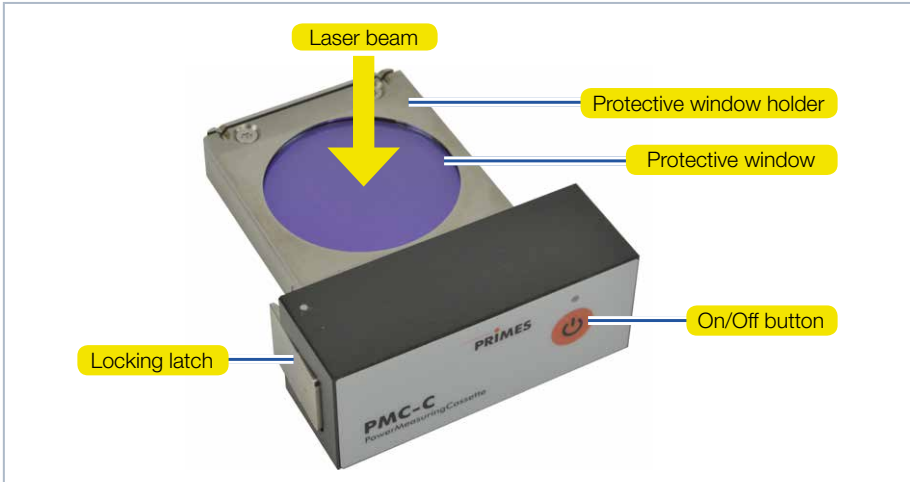


Fig. 5.1: System description of the PMC-C

### 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.

## 5.2 Display of measured values

The PMC-C does not have its own display. To display the measured values, an operating software is required:

### 5.2.1 PRIMES Cube App

The PRIMES Cube App operating software displays the measured values with a smartphone or tablet with Android™. The PRIMES Cube App is available in the Google Play Store/Tools. The connection of the PMC-C with the smartphone or tablet with Android™ is made via a Bluetooth interface.

See chapter 12, „Description of the PRIMES Cube App“, on page 18 and chapter 13, „Measuring and displaying with the PRIMES Cube App“, on page 33.

### 5.2.2 LaserDiagnosticsSoftware LDS

With the optional operating and evaluation software LaserDiagnosticsSoftware LDS you can also operate the device via the PC and evaluate the measurements. When using the optional LaserDiagnostics software LDS, the device communicates with the LDS via the micro-USB socket.

See chapter 14, „Measurement and evaluation with the LaserDiagnosticsSoftware LDS“, on page 40.

## 6 Transportation

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### **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

### 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.

## 7.2 Mounting position

Insert the PMC-C 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. 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 window cassette (part of the laser system) back into the laser processing head.

## 8 Connections



Fig. 8.1: Micro-USB-Socket

### 8.1 Micro-USB socket

You can charge the rechargeable lithium ion battery of the measuring device by plugging it 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>.

### 8.2 Bluetooth


A class 1 Bluetooth interface was integrated in the PMC-C. This enables a wireless connection with the PC, tablet or the smartphone. When connected to a PC with a class 1 Bluetooth stick, the range under free space conditions is approx. 100 m. After switching on the device, the Bluetooth connection is permanently active.

The PMC-C can be controlled entirely via the Bluetooth connection, and it is also possible to transmit the measuring values. When the Bluetooth connection is activated, the USB interface is deactivated.

When using the PRIMES Cube App for mobile devices with Android™ (not included in delivery), the device communicates with the app via Bluetooth.

## 9 Control elements

### 9.1 ON/Off button

Keystroke	Function
 5 seconds	Turn on/Turn off

Tab. 9.1: On/off button

Power up is indicated by a flashing LED above the on/off button. If the LED is permanently green, the device is ready to measure. When switched off, the LED goes out.

## 10 LED display

The multi-color LED indicates different operating states.

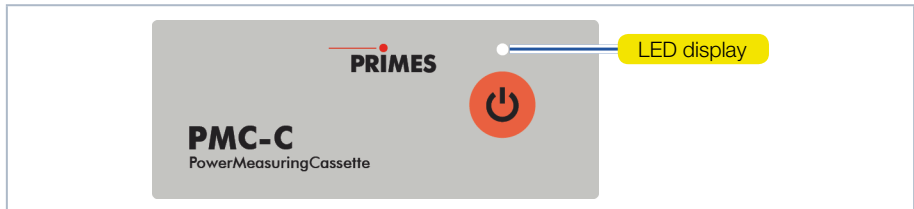


Fig. 10.1: LED display

LED Color	Meaning
Blue	Ready for operation (after booting)
Green	Waiting for Laser
Yellow	Thermalization
White	Measurement finished
Red	Error (configuration)

Tab. 10.1: Meaning of the LED colors



## 11 Capacity of the 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. 3 hours (equivalent to approx. 100 measurements). When using all power saving functions (see Tab. 14.1 on page 40) approx. 7 hours.

## 12 Description of the PRIMES Cube App

### 12.1 Application

The PRIMES Cube App is an application for smartphones/tablets with Android™ used for mobile measurement of laser power.

A bluetooth connection with the PRIMES measuring device makes it possible to read out and graphically display the measured values (laser power, pulse length, and energy per pulse) with the mobile end device. The app also shows an overview of the device status (temperature, capacity, status notifications).

Other functions: Setpoint values can be entered by the user and stored in a table as default settings. When a measurement is performed, the actual measured values of the PRIMES measuring device are added to the table, thus enabling a tabular and graphic comparison of the target and measured values as well as a graphic illustration of the percentage of deviation of the measured value from the setpoint value.

### 12.2 System requirements

The PRIMES Cube App can be used on a smartphone/tablet with an Android 4.1 operating system or higher and a display resolution of HVGA 320x480 or higher.

### 12.3 Download

The PRIMES Cube App can be downloaded from the Google Play Store/Apps for free. You will need a Google account for this. Enter the search term “Primes Cube App” in the search bar of the Google Play Store.



Fig. 12.1: Icon for the PRIMES Cube App

### 12.4 Install/uninstall

How the PRIMES Cube App is installed or uninstalled depends on the device. Please read the operating instructions of your smartphone/tablet for this.

## 12.5 Operation

As with any app on a smartphone, you can operate the app by tapping, swiping, and sliding along the screen.

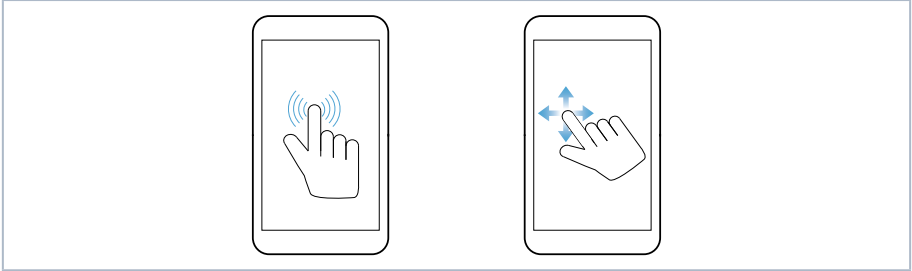


Fig. 12.2: Operating the PRIMES Cube App

## 12.6 Connect device

When you open the PRIMES Cube App, the **Devices** page will appear on the screen. Tap the **Start Device Search** button. All of the devices found will be displayed on the screen.

Tap on the device names in order to establish a connection and confirm the query with **OK**.

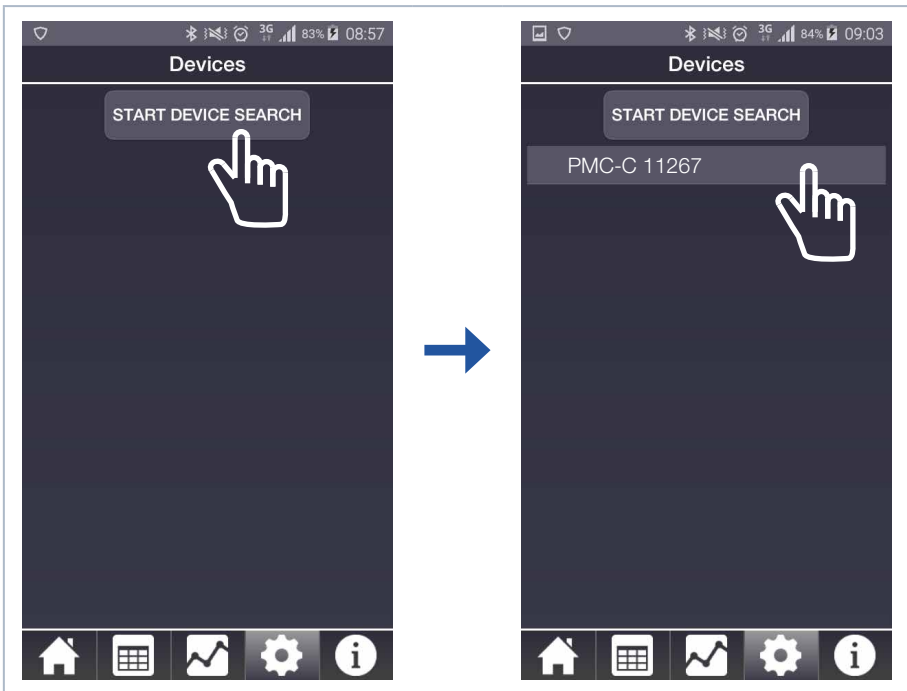



Fig. 12.3: Search for device/select

Once you have connected successfully, the connection icon  will appear to the left of the device name. The device settings now appear (see Fig. 12.4 on page 21).

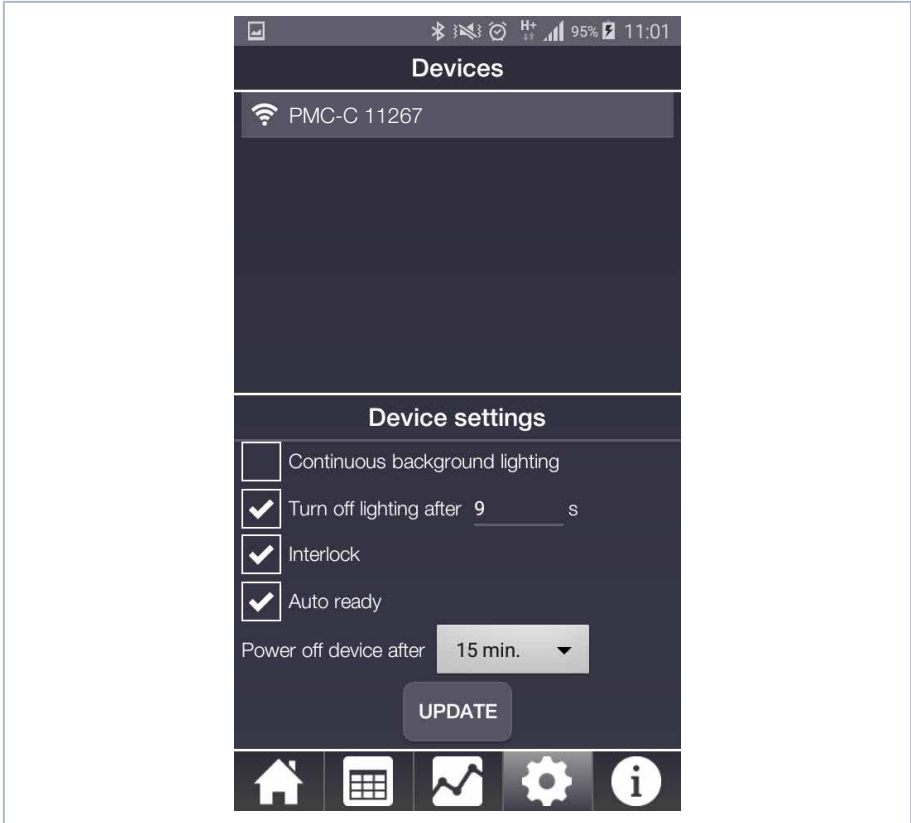


Fig. 12.4: Connected device and its device settings

Additional information on device settings can be found in chapter 12.8.1, „Measuring operation“, on page 25.

## 12.7 Composition of the graphic user interface

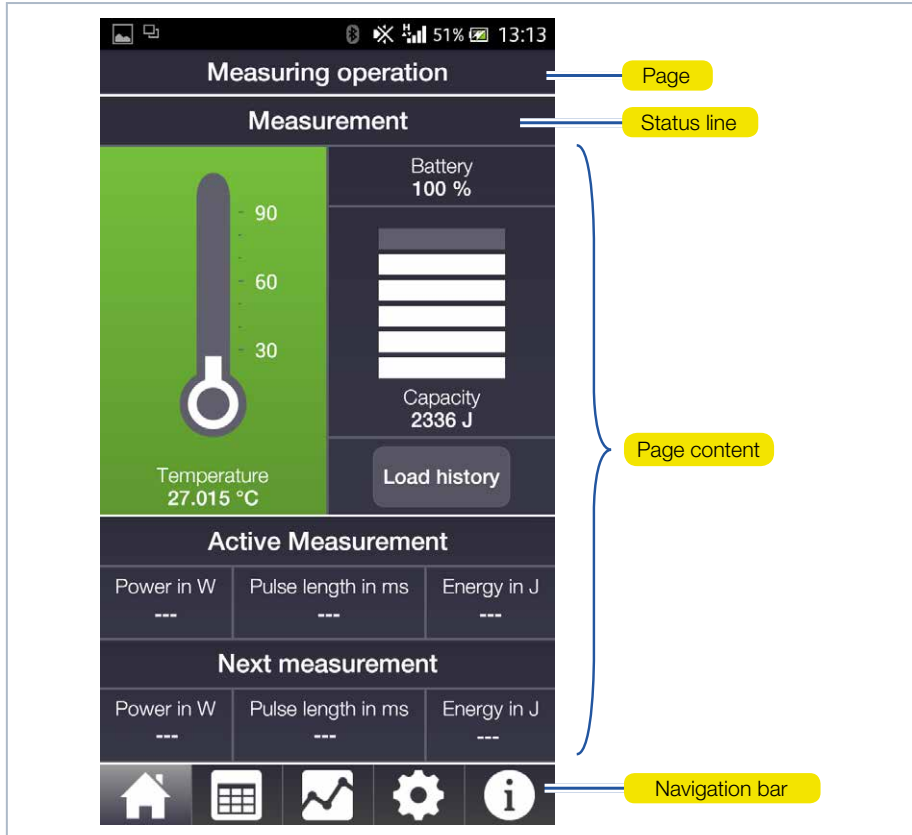


Fig. 12.5: Composition of the graphic user interface

The graphic user interface consists of the following pages:

- Measuring operation
- Measuring data selection
- Evaluation
- Devices/settings
- Info

### 12.7.1 Navigation

You can gain quick access to individual pages in the navigation bar. Tapping on the icon in the navigation bar will pull up the corresponding page. You can leaf through the pages by swiping horizontally. Depending on the size of your mobile device's display, you may also be able to see two pages displayed next to each other (e.g. on tablets).

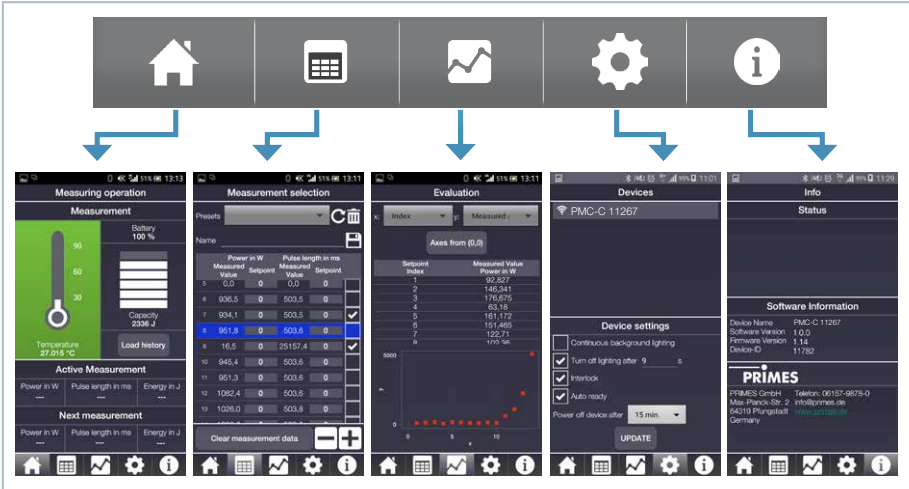













Fig. 12.6: Navigation bar

## 12.7.2 Icons

Symbol	Function
	Temperature, capacity, and measured value display Entry of setpoint values for the next measurement
	Tabular display of target and measured values Storage/loading of setpoint values
	Graphic display of target and measured values
	Process device settings
	Information on software and status information
	A current status notification can be seen on the "Information" page
	Bluetooth connection with device is active
	Save setpoint values
	Delete loaded setpoint value
	Checkbox for activating/deactivating a function
	Update default settings

Tab. 12.1: Icons and their function



## 12.8 Pages

### 12.8.1 Measuring operation



Fig. 12.7: Measuring operation

## 12.8.2 Measured data selection

The target and measured values given on the **Measuring operation** page are listed here in a table. Here you can edit setpoint values and then save them under a freely definable name. You can also load or delete setpoint value lists that have already been saved.

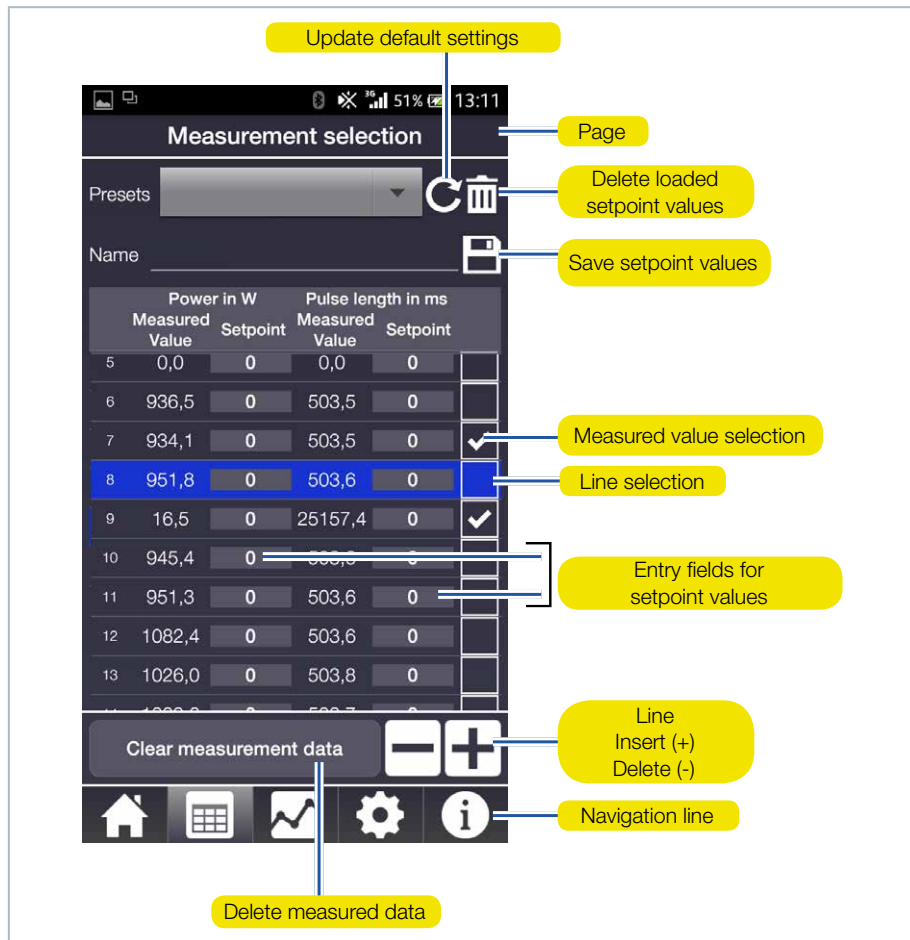


Fig. 12.8: Measured data selection

You can enter setpoint values for power and pulse length in the table. The setpoint values for the next measurement are then shown on the **Measuring operation** page under **Next measurement**.

Once the measurement is completed, the measured values for power and pulse length are displayed in the active line of the table as measured values. If you don't want the measured values to be included in the graphic evaluation, you must remove the check from the checkbox in the corresponding line by tapping on the box.

The **Clear measurement data** button will delete all measured values in the table. The measured data in the PRIMES measuring device is not deleted in the process. Once you tap on a setpoint value window, a numeric keyboard will appear. Enter the setpoint value and confirm with **OK**.

You want to...	Action
...select a line	Tap on a measured value (the line will be highlighted in blue)
...add a line	Tap the (+) button
...delete a line	Select the line, it will be highlighted in blue. Tap on the (-) button
...insert a line at a certain location	Tap on a measured value at the desired location (the line will be highlighted in blue) and then tap on (+), a new line will be created under the selected line
...Enter a setpoint value	Tap on a setpoint value field (the numeric keyboard will appear) and enter the desired value. Confirm with OK

Tab. 12.2: Entries in the table

If no line is marked, the +/- buttons can be used to expand the table on the bottom or delete lines one by one starting from the bottom.

### 12.8.3 Evaluation

This page graphically displays select measured values or entire measurement series. Selected setpoint values are displayed on the x-axis and measured values or the percentage of deviation of the measured values from the setpoint values are displayed on the y-axis.

If setpoint values aren't entered ahead of time, the measured values will also be entered into the setpoint value list for graphic illustration. You can select either the power, pulse length, or energy on both axes.

You can enlarge/shrink the view in the graph by pulling with two fingers.

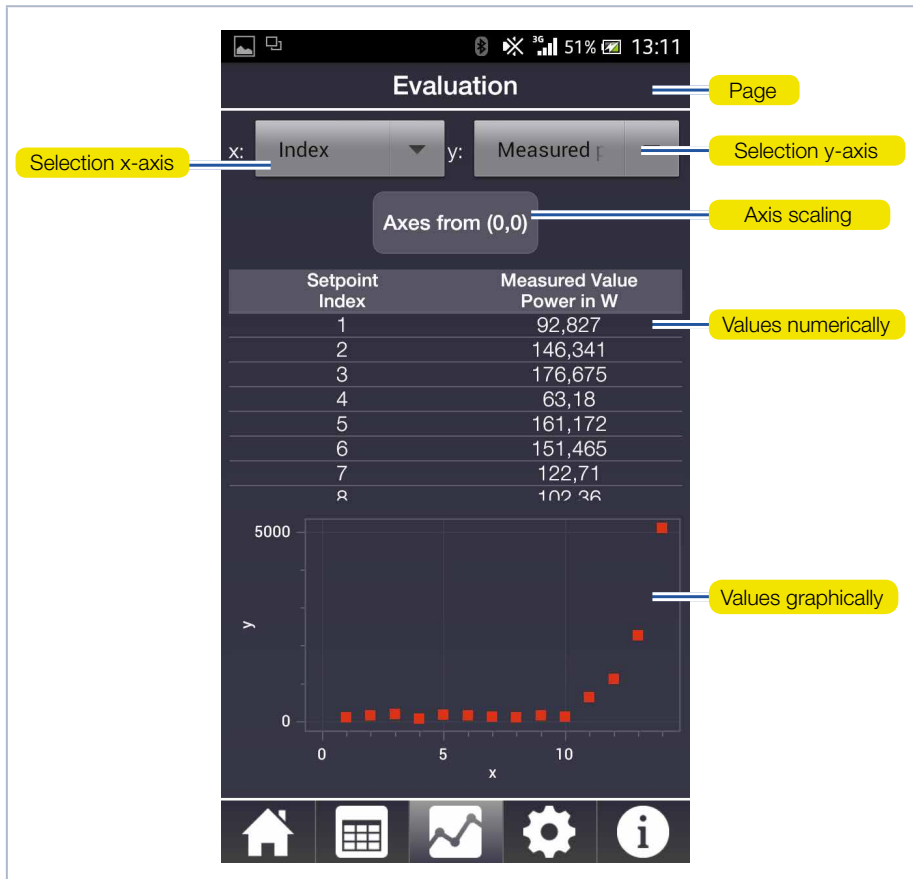


Fig. 12.9: Evaluation



If the minimum values are located in the upper or right part of the graph, you can use the **Axes from (0,0)** button to shift the origin of the coordinate system in order to optimize the display.

### 12.8.4 Devices

In the lower part of the page, you can configure various device settings, mainly to conserve power.

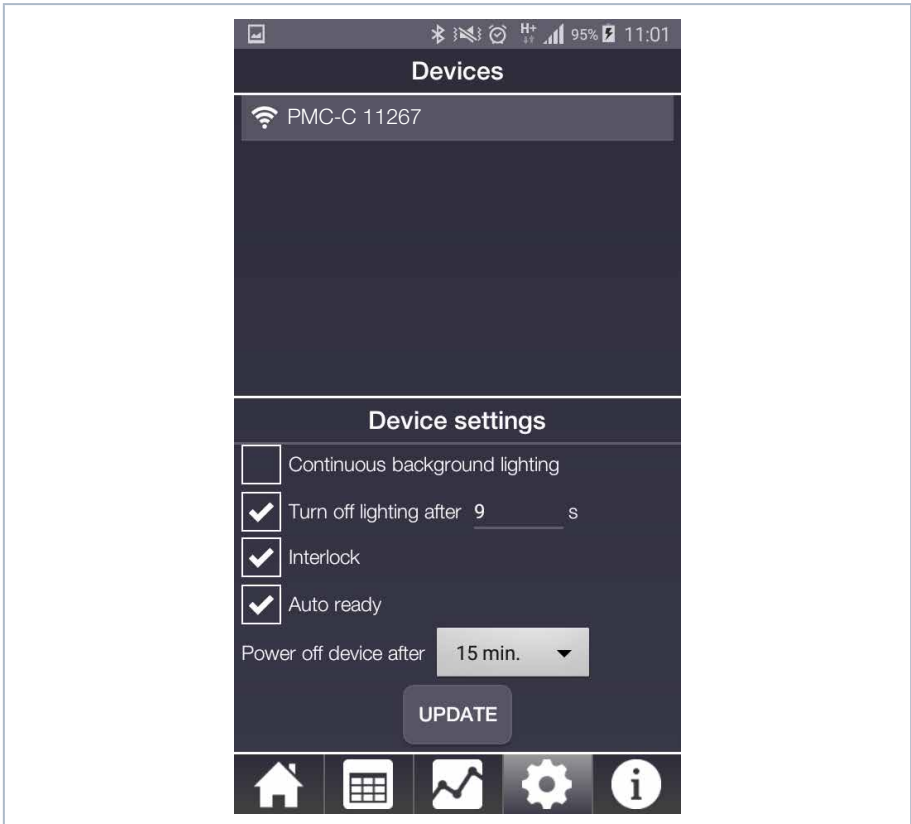


Fig. 12.10: Devices


Function	Possible settings
Auto ready	The device will automatically switch to be ready for the next measurement by default. If you remove the check mark, you will have to put the device back into ready mode after each measurement by quickly pressing the activation button.
Energy-saving features	Continuous background lighting on/off.
	Turn off lighting after(in s). The set time only applies when continuous background lighting is turned off.
	Turn interlock on/off. For security reasons, it is not recommended that you turn interlock off.
	Turn the device off after a specified period of time.

Tab. 12.3: Functions

Every time you change the settings, you must tap on the **Update** button in order to save the desired settings on the device (it may take a few minutes for the device to accept the settings).

### 12.8.5 Info

This page gives information, among other things, on the firmware and software versions used on the PRIMES measuring device. In the status area you will find any error messages and warning notices or information on the status of the connection with the device.

Regardless of which page you have selected, the navigation bar will alert you when a status report has been released by displaying an exclamation point in the info icon . At the same time, the temperature display and info symbol on the *Measuring operation* page will be shown in red.

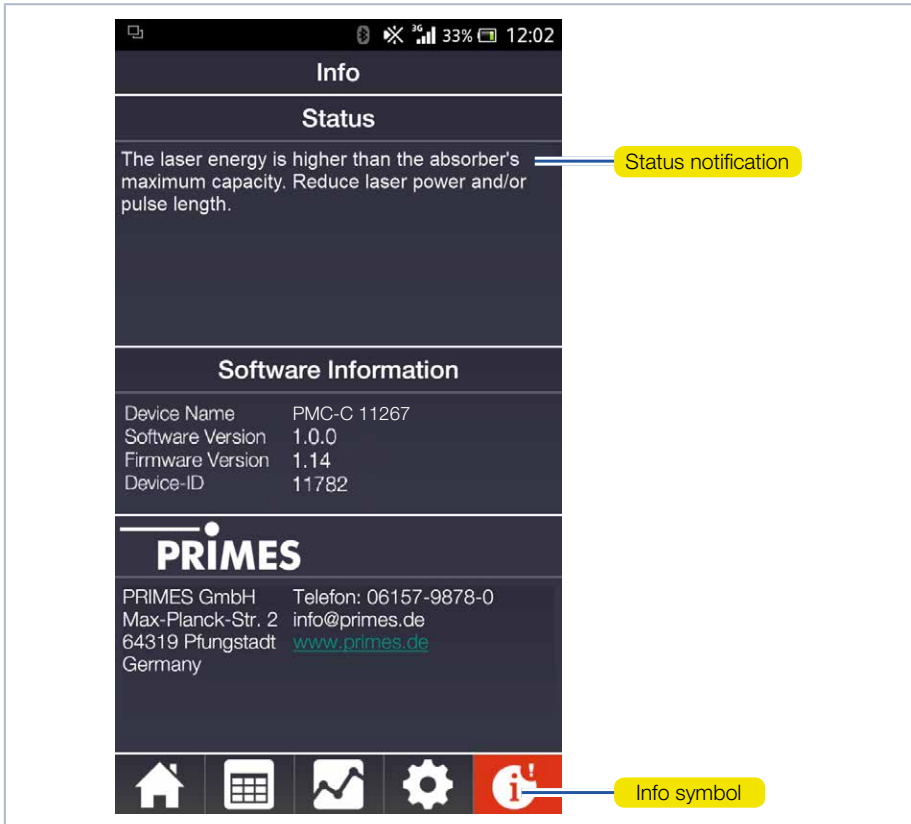


Fig. 12.11: Info

**Status reports**

In order to prevent damage to the absorber, power levels and pulse lengths can be no more than 8 000 W and 2 000 ms.

The energy input exceeds the maximum capacity of the absorber. Reduce the power and/or pulse length.

The energy input exceeds the remaining capacity of the absorber. Reduce the power and/or pulse length or wait until the absorber has cooled.

The current absorber temperature is over 70 °C, wait until the absorber has cooled down before you make another measurement.

The energy input is too low to obtain a reliable measuring result. Increase the power and/or pulse length.

Tab. 12.4: Status reports



## 13 Measuring and displaying with the PRIMES Cube App

### 13.1 Safety Instructions



#### 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 15.1, „Exchanging the protective window“, on page 41).
- ▶ Only operate the device with a clean protective window.

#### NOTICE

##### Damaging/Destruction of the device

The maximum permissible energy per laser pulse depends on various variables, including the absorber temperature.

- ▶ Please mind the limit values and dependencies given in chapter 17, „Technical data“, on page 45 and chapter 20, „Appendix“, on page 49 before performing the measurement.

#### 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.

- ▶ Regularly check the condition of the protective window and exchange it in case of pollution (see chapter 15.1, „Exchanging the protective window“, on page 41).
- ▶ Only operate the device with a clean protective window.

## 13.2 Laser parameter setting

### 13.2.1 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 measuring the power cannot exceed  $100\ \mu\text{s}$ . 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 ( $< 100\ \mu\text{s}$ ) has to be set.

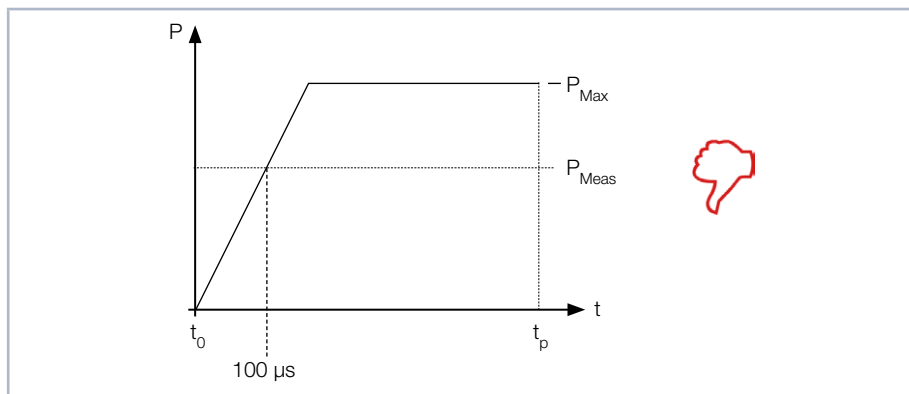


Fig. 13.1: Laser rise time  $> 100\ \mu\text{s}$

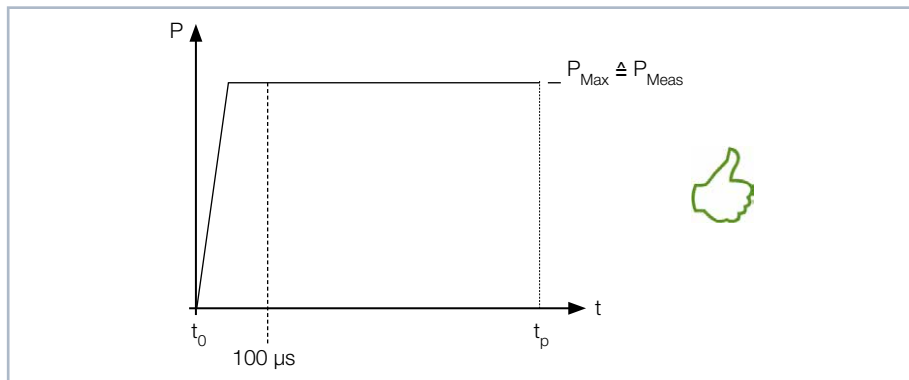


Fig. 13.2: Laser rise time  $< 100\ \mu\text{s}$

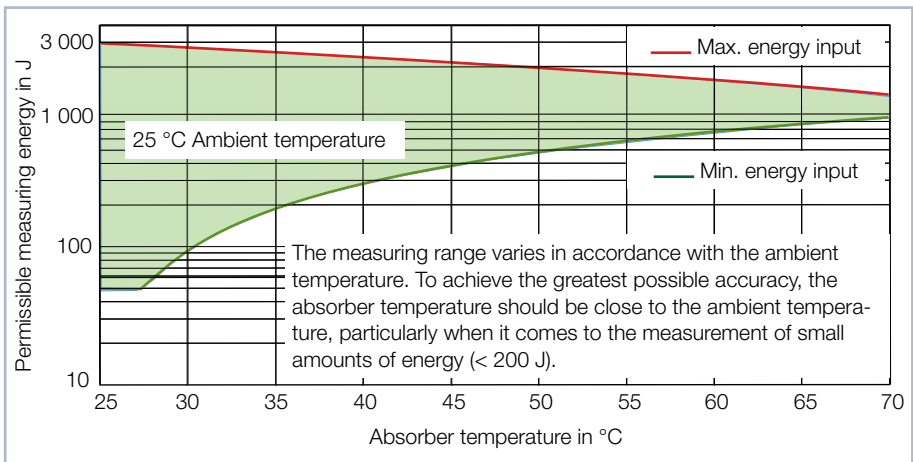
### 13.2.2 Minimum energy per single measurement

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.

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

Tab. 13.1 on page 35 shows information for selecting the energy permissible for a measurement in conjunction with the absorber temperature.




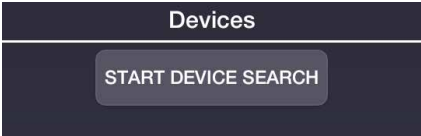
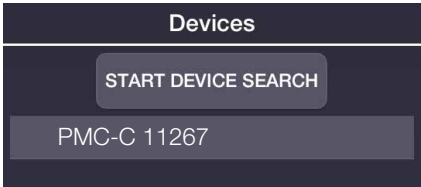
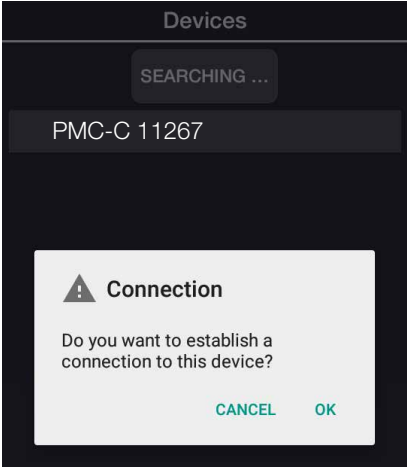

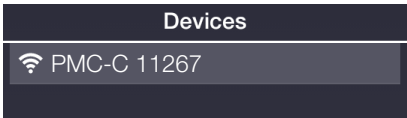
Tab. 13.1: Measuring range as a function of the absorber temperature

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.

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. 13.1 on page 35.

## 13.3 Prepare measurement

Please read chapter 13.1, „Safety Instructions“, on page 33 first.

<ul style="list-style-type: none"> <li>▶ Tap the Cube icon to start the app.</li> </ul>	
<ul style="list-style-type: none"> <li>▶ The <b>Devices</b> page is opened.</li> <li>▶ Tap the <b>Start Device Search</b> button.</li> </ul>	
<ul style="list-style-type: none"> <li>👁 The devices found are displayed.</li> </ul>	
<ul style="list-style-type: none"> <li>▶ Tap on the desired device in order to establish a connection and confirm the query with <b>OK</b>.</li> </ul>	
<ul style="list-style-type: none"> <li>👁 The bluetooth connection to the device is displayed .</li> </ul>	

<p>▶ Configure the desired device settings and tap on <b>Update</b>.</p>	
<p>▶ Switch to the <b>Measuring operation</b> page.</p>	
<p>▶ Enter the desired power and pulse length under <b>Next measurement</b>.</p>	
<p>▶ Set the desired power and pulse length on the laser.</p>	<p>For a high measurement accuracy, we recommend an energy input of 300 J per measurement. See chapter 13.2.2, „Minimum energy per single measurement“, on page 35.</p> <p>Observe the information on serial measurements according to chapter 13.4 on page 38.</p> <p>Note: The PRIMES measuring device and PRIMES Cube App WILL NOT transfer any data to the laser!</p>

### 13.4 Serial measurement

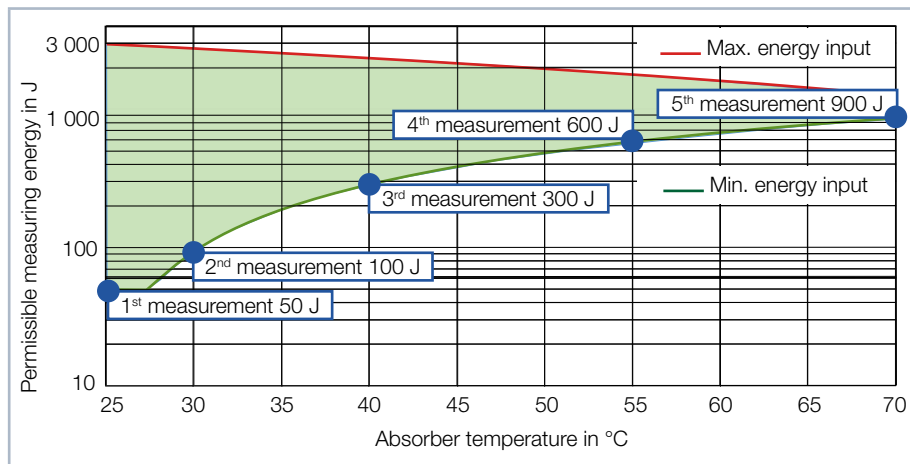
Please read chapter 13.1, „Safety Instructions“, on page 33 first.

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. 13.2 on page 38 shows information for selecting the energy permissible for a series measurement in conjunction with the absorber temperature.



Tab. 13.2: 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. 13.2 on page 38.

### **13.5 Measurement with pulsed lasers**

Limited measurement with pulsed lasers is possible. 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  $\mu$ s a correct exposure time measurement is not possible.

## 14 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. 14.1 on page 40.

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 interlock on/off (no function on the PMC-C).
	Switch off the device after an entered time

Tab. 14.1: Functions and settings



## 15 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.

### 15.1 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.

Protective window diameter 55 mm

Glass thickness 1.5 mm

Order number 410-070-021 (1 piece); 410-070-031 (10 pieces)

#### 15.1.1 Safety instructions



#### **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**

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.
-

1. Observe the safety instructions in chapter 15.1.1 on page 41.
2. Unscrew the 4 Torx screws M3 x 8 mm on the protective window holder.
3. Place the device as shown in Fig. 15.1 on page 43 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. 15.1 on page 43 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.

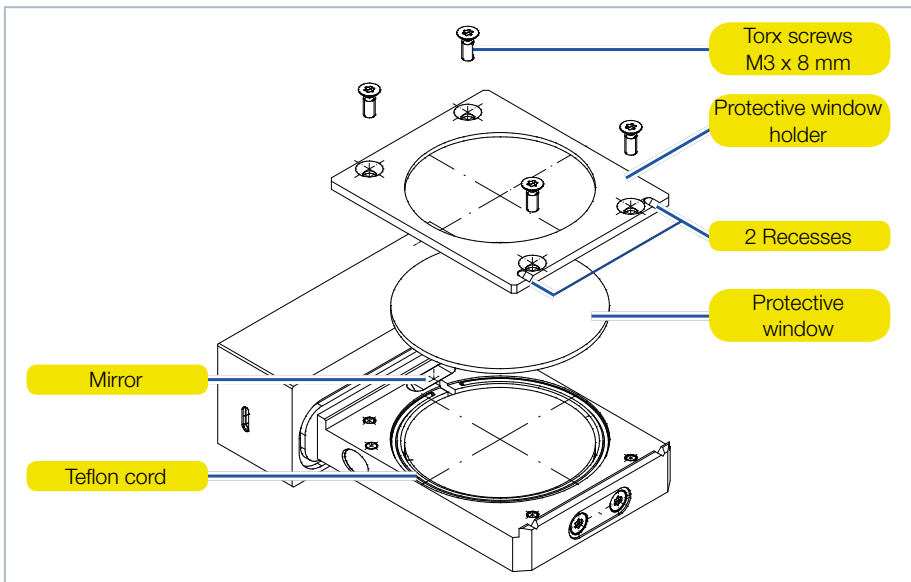


Fig. 15.1: Exchanging the Protective Window

## 16 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):

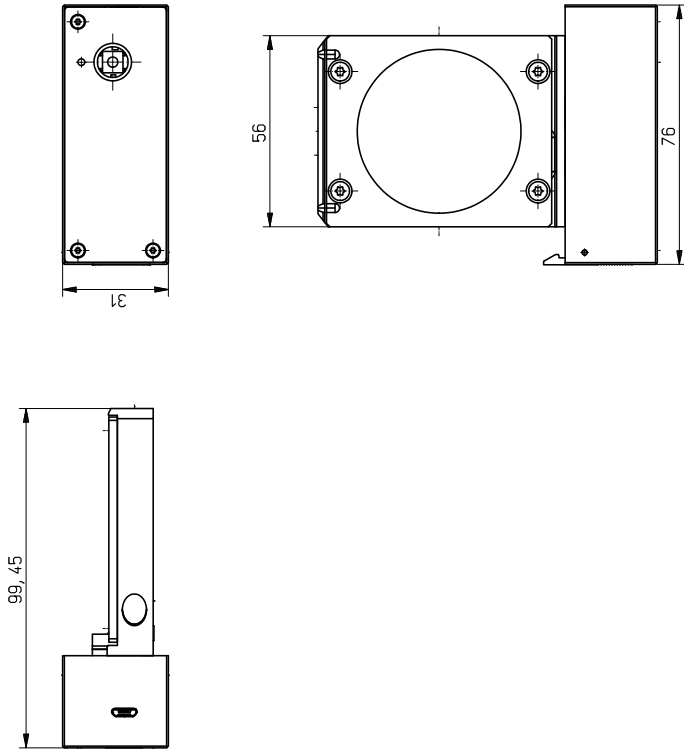
PRIMES GmbH  
Max-Planck-Str. 2  
64319 Pfungstadt  
Deutschland

## 17 Technical data

Measurement Parameters	Standard absorber <sup>1)</sup>	Advanced absorber <sup>1)</sup>	
Max. beam dimensions on the absorber	30 mm		
Wavelength range	900 – 1 090 nm		
Power range	400 – 6 000 W <sup>1)</sup>	400 – 12 000 W <sup>2)</sup>	
Irradiation time	0.1 – 1 s <sup>1)</sup> (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/15 min		
Measuring accuracy at angles of incidence up to 5 °	± 3 %		
Reproducibility	± 1 %		
Limit Values	Standard absorber <sup>1)</sup>	Advanced absorber <sup>1)</sup>	
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/cm <sup>2</sup>	4 kW/cm <sup>2</sup>
	10 – 3 mm	2.5 kW/cm <sup>2</sup>	5 kW/cm <sup>2</sup>
	3 – 1.5 mm	5 kW/cm <sup>2</sup>	10 kW/cm <sup>2</sup>
	< 1.5 mm	6 kW/cm <sup>2</sup>	12 kW/cm <sup>2</sup>
Max. laser rise time	100 µs		
Max. angle of incidence perpendicular to inlet aperture	± 5 °		
Max. centered tolerance	± 2.0 mm		
<sup>1)</sup> Please read the information on the identification plate to determine if your device is equipped with a standard or advanced absorber.			

	
<b>Type</b> PowerMeasuringCassette PMC-C <b>S/N</b> 11894 <b>Built</b> 2018 <b>CE</b> www.primes.de	<b>Type</b> PowerMeasuringCassette <b>A</b> PMC-C <b>S/N</b> 11894 <b>Built</b> 2018 <b>CE</b> www.primes.de
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.
<sup>2)</sup> <b>The stated limit values are to be understood in correlation with the permitted maximum energy (E = P · t).</b>	
<b>Supply Data</b>	
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
<b>Communication</b>	
Interfaces	USB/Bluetooth
<b>Dimensions and Weight</b>	
Dimensions (LxWxH)	100 x 76 x 31 mm
Weight (approx.)	350 g
<b>Environmental Conditions</b>	
Operating temperature range	10 – 40 °C
Storage temperature range	5 – 50 °C
Reference temperature	22 °C
Permissible relative humidity (non-condensing)	10 – 80 %

## 18 Dimensions



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

## 19 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

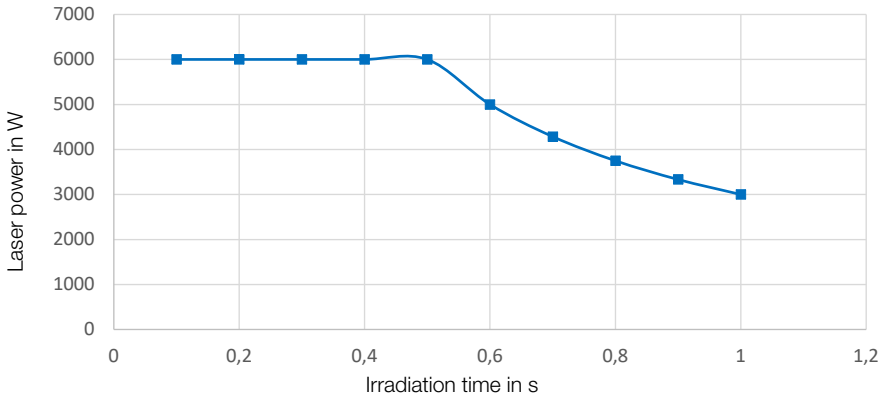
  
\_\_\_\_\_  
Dr. Reinhard Kramer, CEO



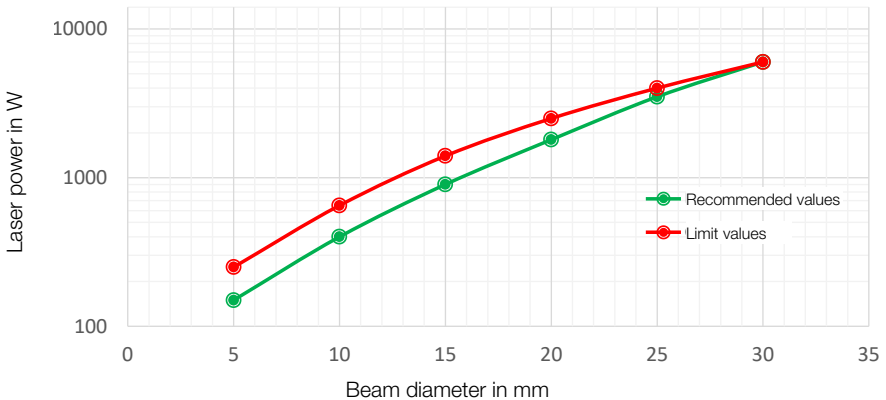
20 Appendix

21 Appendix

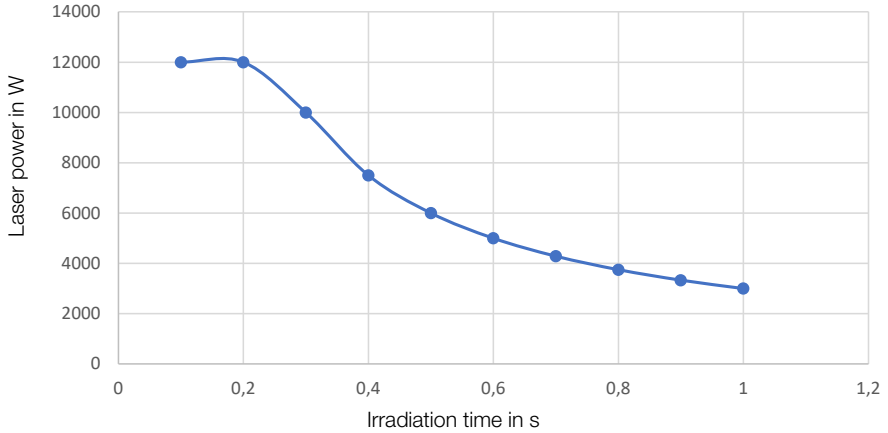
21.1 Max. laser power depending on the irradiation time for devices with standard absorber



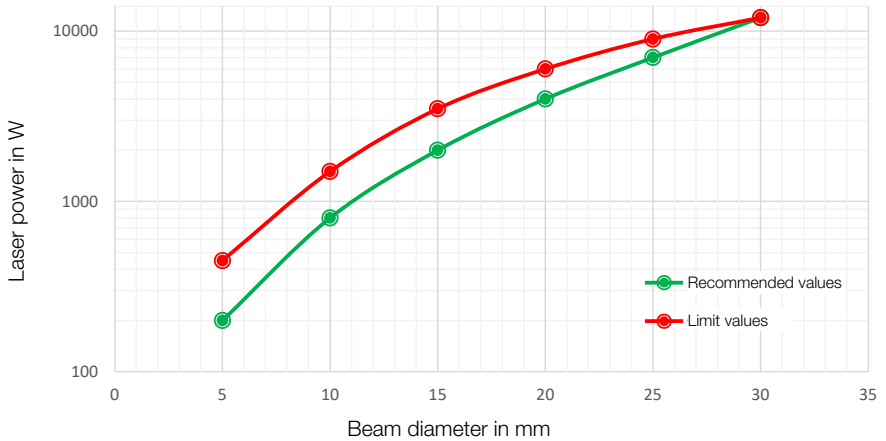
21.2 Max. laser power depending on the beam diameter for devices with standard absorber



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



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





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