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Manual Roughness Tester PCE-RT 2200



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Thank you for purchasing a Roughness Tester from PCE Instruments.

1 Safety notes

Please read this manual carefully and completely before you use the device for the first time. The device may only be used by qualified personnel and repaired by PCE Instruments personnel. There is no warranty of damages or injuries caused by non-observance of the manual.

- This device may only be used in the way specified in this manual. If used otherwise, this may cause dangerous situations.
- Do not expose the device to extreme temperatures, direct sunlight, extreme air humidity or moisture.
- The case should only be opened by qualified personnel of PCE Instruments.
- Do not touch the instrument with wet hands.
- You should not make any technical changes to the device.
- The appliance should only be cleaned with a damp cloth / use only pH-neutral cleaner without solvents or abrasives.
- The device must only be used with original PCE accessories or equivalent.
- Before each use, please inspect the case for damage. In case of any visible damage, please do not use the device.
- The device must not be used when the environmental conditions (temperature, air humidity,...) are outside the limit values stated in the specifications.
- Do not expose the instrument to explosive atmospheres.
- The instrument should never be placed with the user interface facing an object (e. g. keyboard side on a table).
- Do not touch the sensor of the device and do not expose the device or its sensor to shocks or strong vibrations. This might cause damage to the device and affect the accuracy of the readings. Be careful when connecting or disconnecting the sensor. After removing it, store it in the provided box.
- Keep the calibration standard clean and avoid scratches on the surface.

This user's handbook is published by PCE Instruments without any guarantee.

We expressly point to our general guarantee terms which can be found in our general terms of business.

If you have any questions please contact PCE Instruments.

2 Specifications

2.1 Technical specifications

Measured parameters	Ra, Rz/Ry(JIS), Rq, Rt/Rmax, Rp, Rv, R3z, R3y, Rz(JIS), Rs, Rsk, Rku, Rsm, Rmr
Measuring range	Ra, Rq: 0.005 ... 16 µm Rz, R3z, Ry, Rt, Rp, Rm: 0.02 ... 160 µm Sk: 0 ... 100 % S, Sm: 1 mm Tp: 0 ... 100 %
Resolution	0.01 µm in the range of ±20 µm 0.02 µm in the range of ±40 µm 0.04 µm in the range of ±80 µm
Filter	RC, PC-RC, Gauss, D-P
Traversing length	17.5 mm
Sampling length/cutoff wavelength $l_r = \lambda_c$	0.25, 0.8, 2.5 mm
Measuring length l_n	$l_n = l_r * n$ $n = 1 \dots 5$
Measuring principle	inductive
Stylus	Natural diamond, 90° cone angle, 5 µm tip radius
Force	< 4 mN
Skid	Ruby, Ø 40 mm
Traversing speed	$l_r = 0.25 \text{ mm}$: $V_t = 0.135 \text{ mm/s}$ $l_r = 0.8 \text{ mm}$: $V_t = 0.5 \text{ mm/s}$ $l_r = 2.5 \text{ mm}$: $V_t = 1 \text{ mm/s}$ Return: 1 mm/s
Accuracy	± 10 %
Repeatability	± 6 %
Graphic chart	Material ratio curve
Standards	ISO, ANSI, DIN, JIS
Power supply	Built-in 3,7 V Li-ion battery (rechargeable) Charger: 5 V DC, 800 mA
Battery life	> 20 hours
Operating conditions	Temperature: -20 ... +40 °C Humidity: < 90 % RH
Storing conditions	Temperature: -40 ... +60 °C Humidity: < 90 RH
Dimensions	141 x 55 x 40 mm
Weight	400 g

2.2 Delivery contents

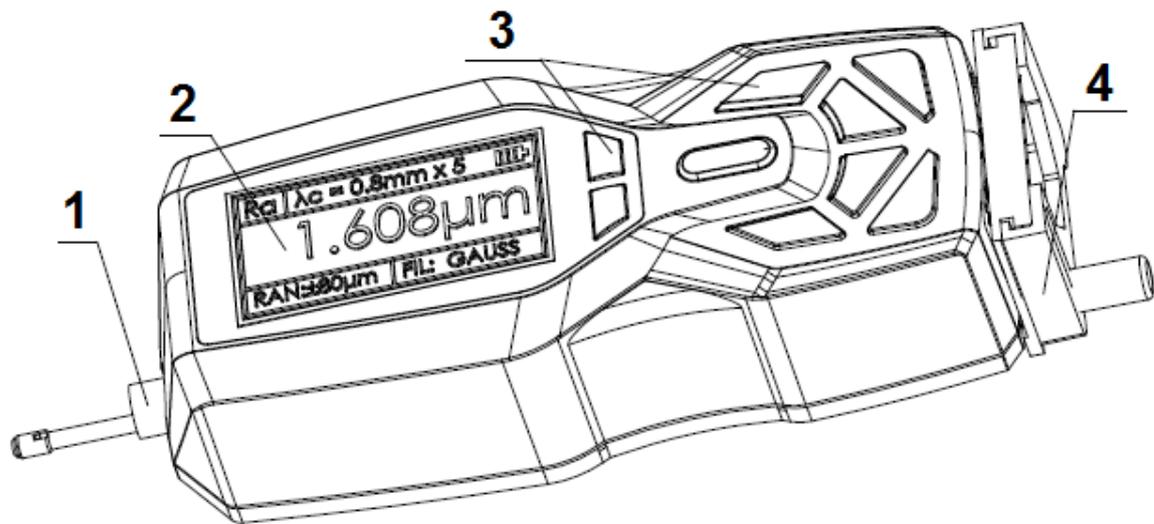
- 1 x roughness tester PCE-RT 2200 (incl. battery)
- 1 x sensor
- 1 x sensor protection
- 1 x adjustable support
- 1 x screw driver
- 1 x calibration standard
- 1 x bracket for calibration standard
- 1 x charging adaptor
- 1 x USB cable
- 1 x instruction manual
- 1 x carrying case

2.3 Optional accessories

PCE-RP-100	Spare sensor
PCE-RP-110	Sensor for curved surfaces (curvature radius > 3mm)
PCE-RP-120	Sensor for holes (> Ø 2 mm)
PCE-RP-131	Sensor for grooves (width: min. 3 mm; depth: max. 10 mm)
PCE-RTS 520	Test stand
PCE-RTS 620	Test stand

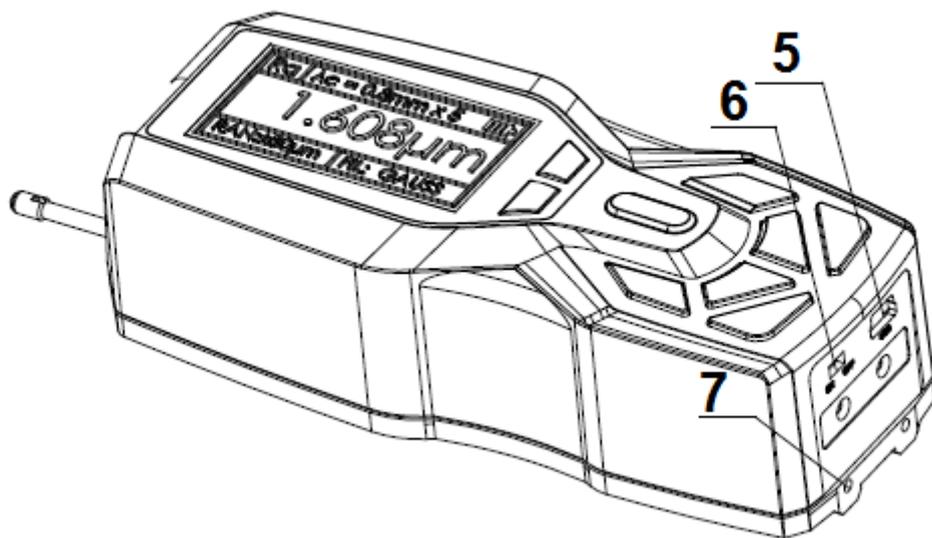
3 System description

3.1 Device



- 1. Sensor
- 2. Display

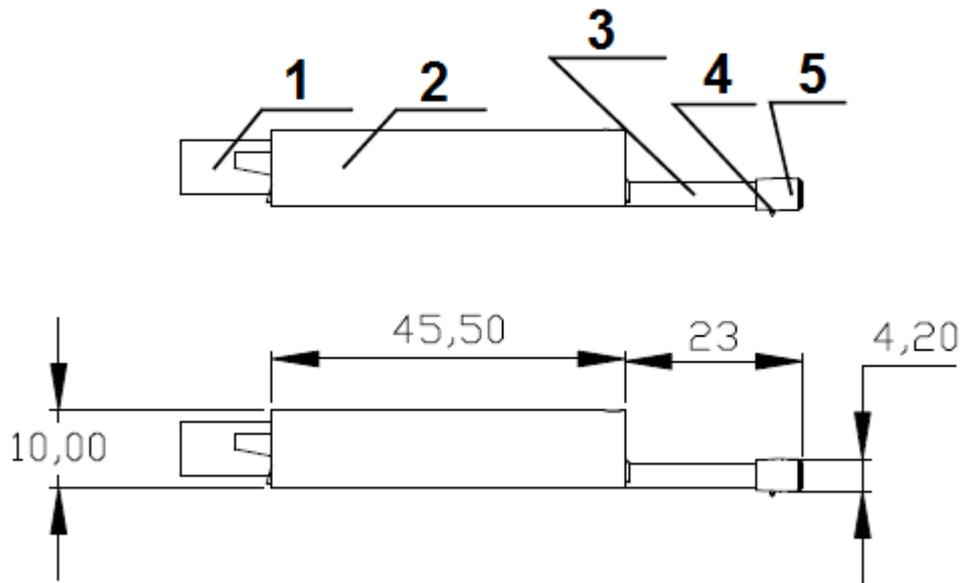
- 3. Function keys
- 4. Adjustable support



- 5. USB interface
- 6. Power switch

- 7. Mounting hole (for adjustable support)

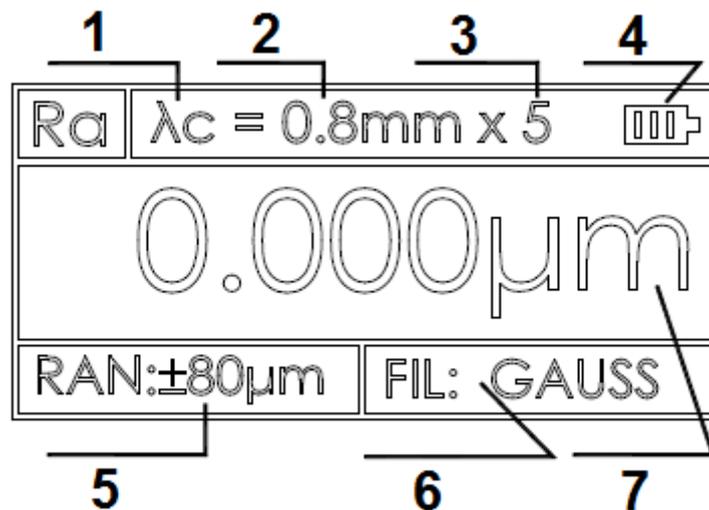
Sensor



- | | | | |
|----|-----------------|----|--------|
| 1. | Connection | 4. | Stylus |
| 2. | Main body | 5. | Skid |
| 3. | Protective tube | | |

3.2 Display and function keys

Display



- | | | | |
|----|------------------|----|----------------|
| 1. | Measuring length | 5. | Range |
| 2. | Sampling length | 6. | Filter |
| 3. | Multiplier | 7. | Measuring unit |
| 4. | Battery status | | |

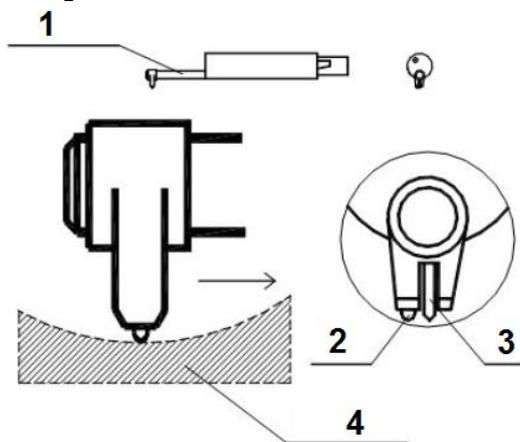
Function keys

Button	Name	Function
	“Power” button	Press and hold for 2 seconds to turn the device on/off.
	“Stylus position” button	Press to open stylus position display.
	“Start” button	Press to start a measurement.
	“Parameter selection” button	Press to display more measuring parameters.
	“Save/print” button	Press to save or print the readings.
	“Up” button	Press to move the selection upwards.
	“Down” button	Press to move the selection downwards.
	“Enter/menu” button	Press to open the menu or to confirm the selection.
	“Escape/cancel” button	Press to exit the menu or to cancel.

3.3 Optional accessories

Sensor for curved surfaces (PCE-RP-110)

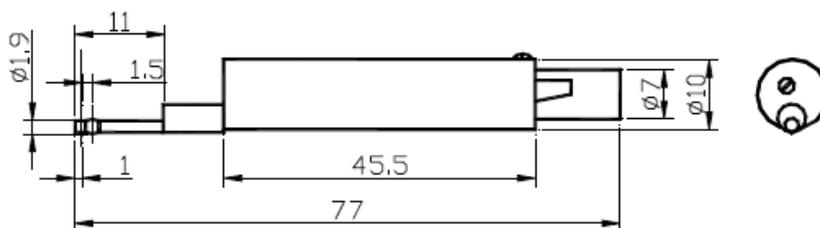
The sensor PCE-RP-110 is suited for measuring convex or concave surfaces with a curvature radius of 3 mm or more. We recommend using the sensor in combination with the PCE-RTS 620 test stand.



- 1. Sensing element
- 2. Skid
- 3. Stylus
- 4. Measuring object

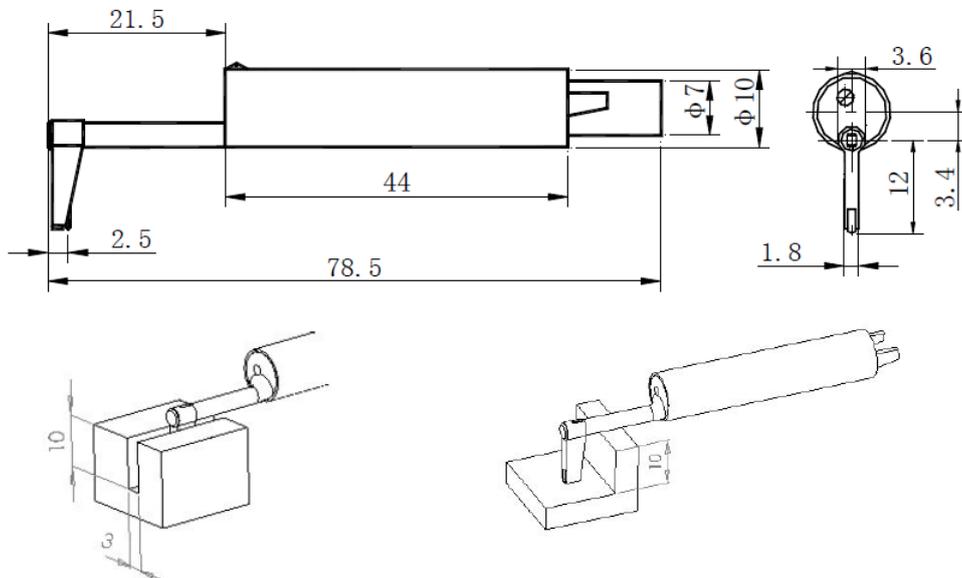
Sensor for holes (PCE-RP-120)

The sensor PCE-RP-120 is suited for measuring surfaces in holes with a diameter of 2 mm or more.



Sensor for grooves (PCE-RP-131)

The sensor PCE-RP-131 is suited for measuring surfaces in grooves with a minimum width of 3 mm and a maximum depth of 10 mm. We recommend using the sensor in combination with a PCE-RTS 620 test stand.

**Test stands PCE-RTS 520 and PCE-RTS 620**

By using the test stands PCE-RTS 520 and PCE-RTS 620, you can improve the accuracy of your readings. The accurate height adjustment enables you to adjust the stylus position precisely. The roughness tester also stays stable during the whole measurement procedure.

We especially recommend using the test stands for surfaces with very low Ra values.



PCE-RTS 520



PCE-RTS 620

4 Getting started

4.1 Charging the battery

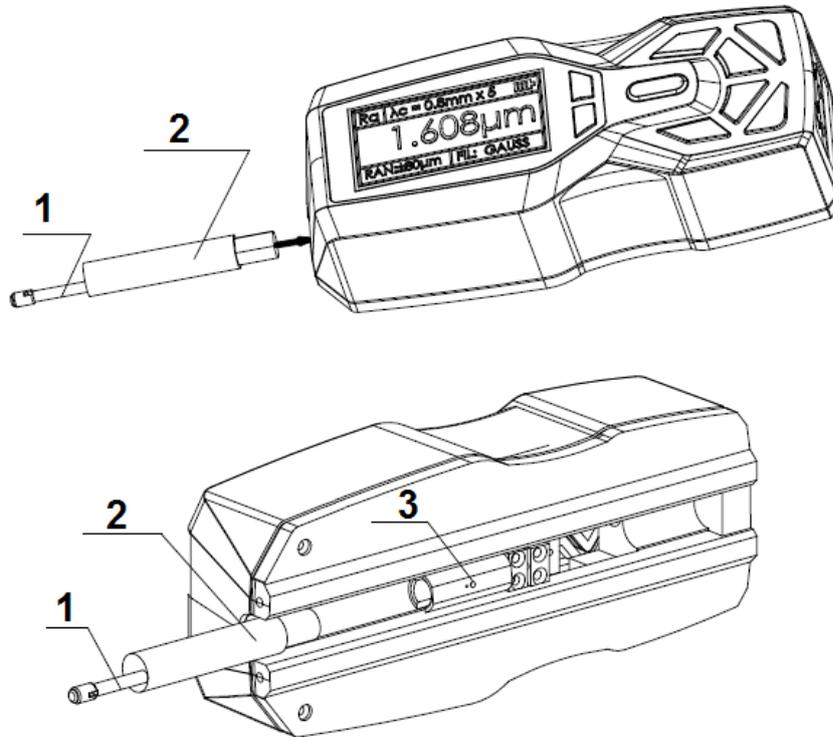
When the battery voltage is low, a low battery indication appears on the display . In this case, please recharge the battery as soon as possible. The battery is charged via the USB interface of the device. You can connect the device to a computer by using the USB cable or you can use the charging adaptor for wall sockets.

It takes about 2.5 hours to fully charge the battery. During the charging, the display shows a charging animation.

The built-in battery is a rechargeable Lithium ion battery without memory effect. This means that you can charge the battery at any time without affecting the operational capability of the device.

4.2 Mounting

Connecting/disconnecting the sensor



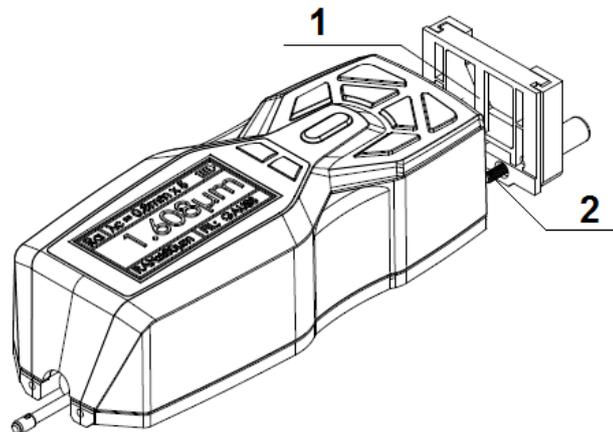
1. Protective tube
2. Main body
3. Sensor jack

To connect the sensor, hold it at its main body and plug it in the sensor jack carefully as far as it will go. To disconnect the sensor, hold it at its main body and pull it out of the jack carefully.

Note: Do not touch the stylus of the sensor while connecting or disconnecting it. Only hold the sensor at its main body.

Mounting the adjustable support

Screw on the adjustable support as seen on the picture below.



1. Adjustable support
2. Screws

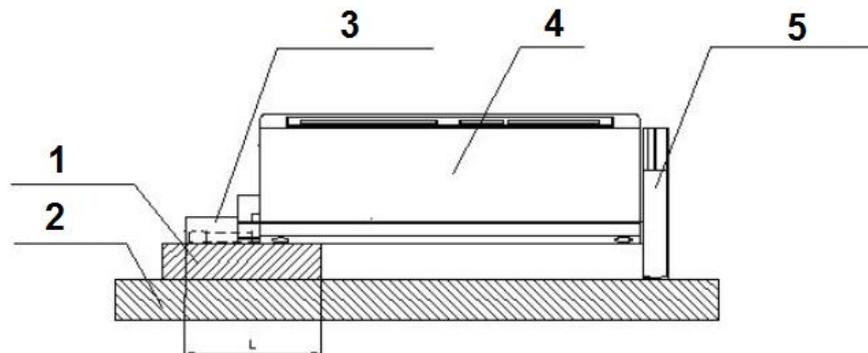
5 Operation

5.1 Taking a measurement

Switch the Power switch into the “On” position and press and hold the “Power” button  for 2 seconds to turn on the device. After booting up, you are on the main screen.

Measurement preparations

- Check the battery voltage
- Clean the measuring spot
- Place the on the surface, so that it lies safely and steadily.

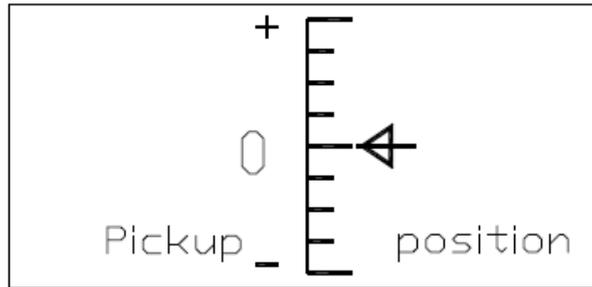


- | | |
|---------------------|-----------------------|
| 1. Measuring object | 4. Measuring device |
| 2. Working surface | 5. Adjustable support |
| 3. Sensor | |

Note: The distance L on the picture above may not be shorter than the traversing length. Make sure, that the adjustable support is fixed properly.

Stylus Position

Press the “Stylus position” button  to go to the stylus position screen.

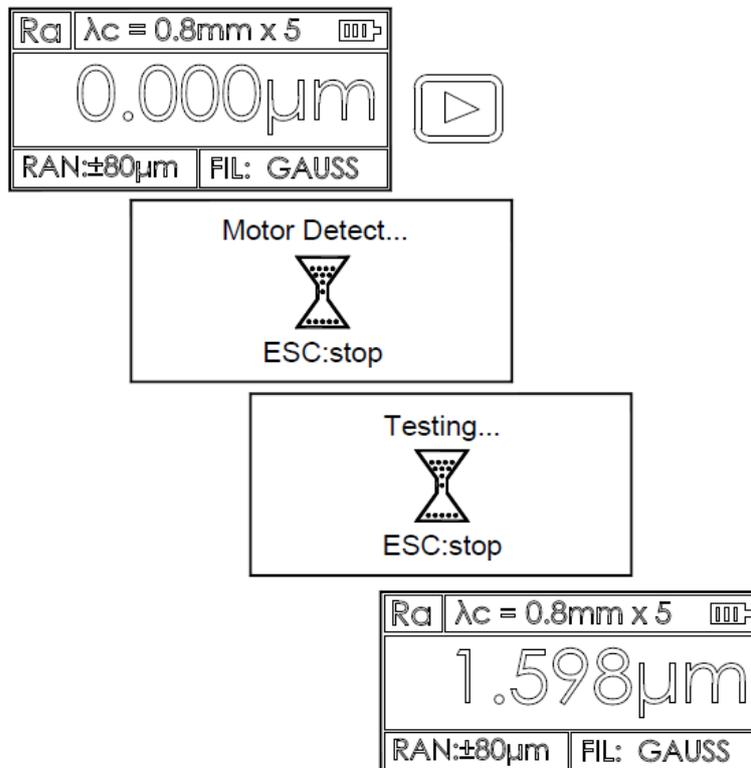


The stylus position is ideal when the arrow indicates “0”. Use the adjustable support to adjust the stylus position.

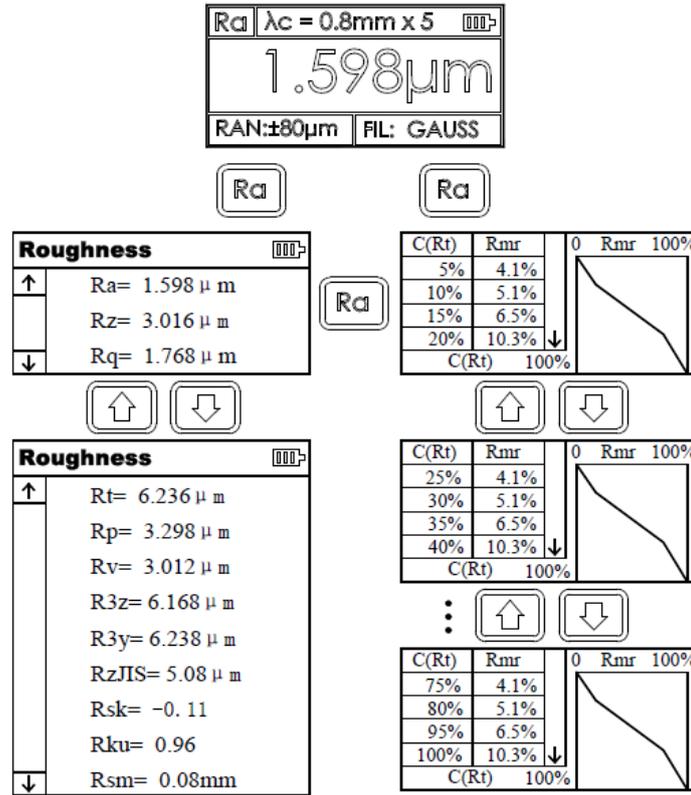
Press the “Stylus position” button  again to return to the main screen.

Starting a measurement

To start a measurement, press the “Start” button .



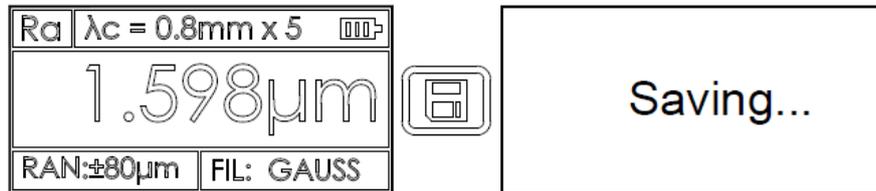
The stylus moves along the measuring distance and back to its starting position. After that, the readings are shown on the display. Use the “Parameter selection” button  to view further measuring parameters.



5.2 Further functions

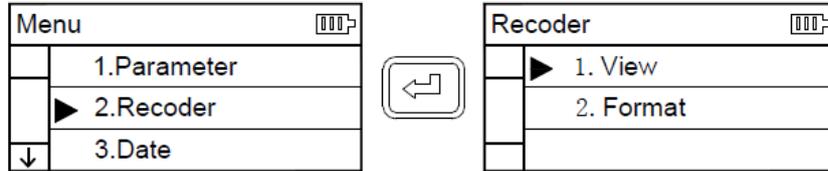
5.2.1 Saving of measured data

To save the measured data, simply press the “Save/print” button  in the main screen after a measurement.

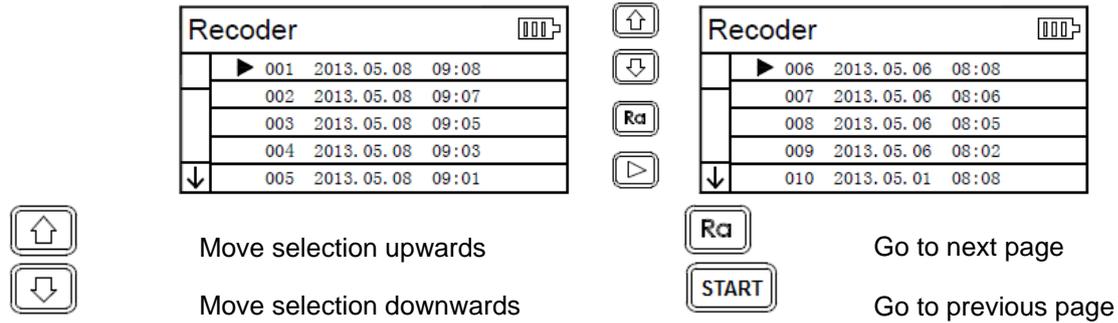


5.2.3 View saved data

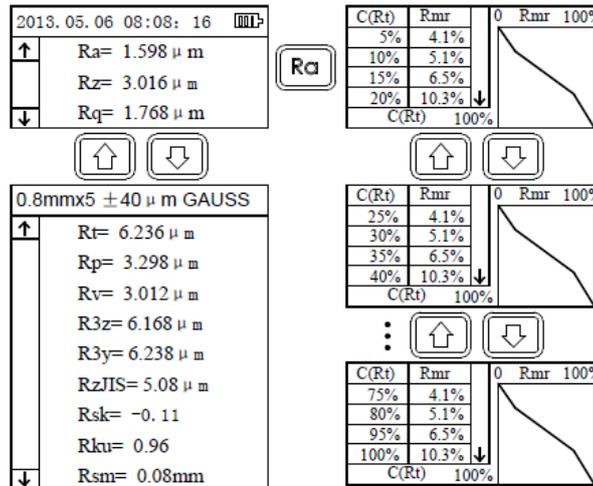
To view the saved data, press the “Enter/menu” button on the main screen to open the menu. Then use the arrow buttons and to select option “2. Recorder” and press the “Enter/menu” button again to confirm.



Next, select option “1. View” and confirm by pressing the “Enter/menu” button . Now you get to the memory screen. Here you can see a list of all stored data.



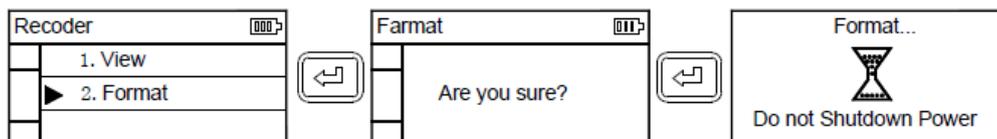
Choose a data record and press the “Enter/menu” button to open it.



If a printer is connected to the device, you can print out the selected record by pressing the “Save/print” button .

Clear the memory

To clear the memory, select Option “2. Format” and press the “Enter/menu” button . A confirmation message appears on the display. Press the “Enter/menu” button to confirm and to clear the memory or press the „Escape/cancel” button to cancel.



5.3 Settings

Press the “Enter/menu” button  to open the menu.

5.3.1 Measurement settings

Use the arrow buttons  and  to select option “1. Parameter” and press the “Enter/menu” button  to confirm. Now you get to the measurement settings.

Menu			
	▶	1.Parameter	
		2.Recoder	
		3.Date	

Parameter		Content
↑ ▶ λ c	0.8mm	0.25mm; 0.8mm; 2.5mm
	Nx λ c	5
	RANGE	±40 μm
	FILTER	GAUSS
	DISPLAY	Ra
	UNIT	μm
	LANGUAGE	ENG

To change a parameter, select it and press the “Enter/menu” button  to change the displayed option.

5.3.2 Date and time settings

Use the arrow buttons  and  to select option “3. Date” and press the “Enter/menu” button  to confirm. Now you get to the date and time setting.

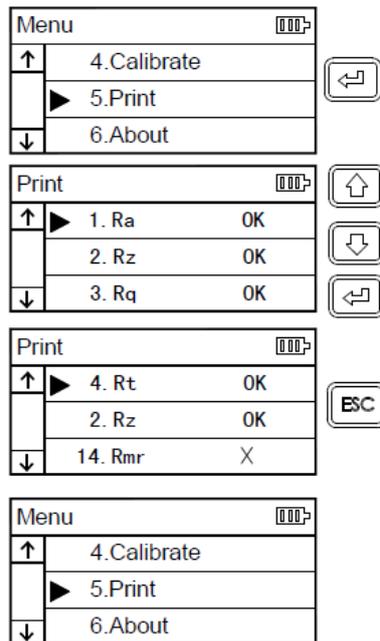
Menu	
	1.Parameter
	2.Recoder
▶	3.Date

Date	
	2013. 05. 08
	09:01:18
	Up: + Down:-
◀	:Change
ESC	:Back

Press the “Enter/menu” button  to adjust the setting. The selected parameter starts to flash. Now you can use the arrow buttons  and  to adjust the selected parameter. Press the “Enter/menu” button  to move to the next parameter. After you adjusted all desired parameters, you can press the “Escape/cancel” button  to return to the main screen.

5.3.3 Print settings

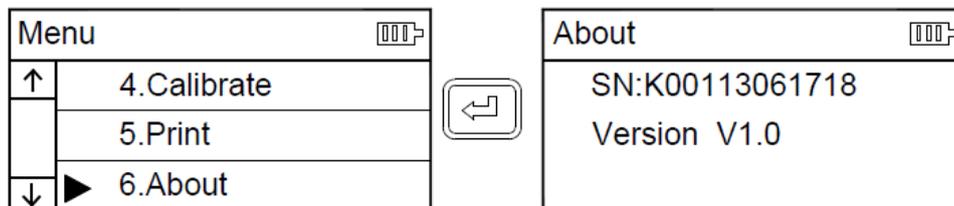
Use the arrow buttons and to select option “4. Print” and press the “Enter/menu” button to confirm. Now you get to the print settings.



Here you can select, which parameters shall be printed out. To do so, select the particular parameters by using the arrow buttons and and press the „Enter/menu“ button afterwards. “OK” means that the selected parameter appears on the printout. “X” means that the parameter does not appear on the printout.

5.3.4 Device information

Use the arrow buttons and to select option “6. About” and press the “Enter/menu” button to confirm. Now you see the device information.



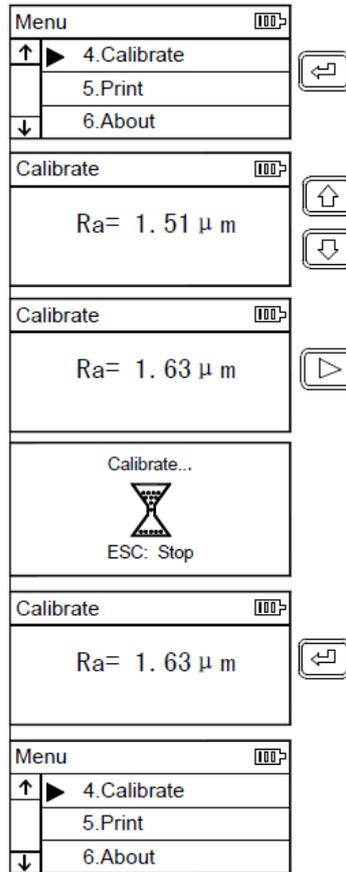
You can see the serial number of the device as well as the firmware version.

5.4 Calibration

We recommend calibrating the device before each use, especially if it has not been used in a long time. To do so, use the provided calibration standard.

Take a measurement on the calibration standard (see chapter 5.1). If the reading deviates from the properties of the calibration standard by more than the accuracy of the device ($\pm 10\%$), you can adjust the reading manually and calibrate the device.

To do so, press the “Enter/menu” button  to open the menu. Then use the arrow buttons  and  to select option “4. Calibrate” and press the “Enter/menu” button  to confirm.



Use the arrow buttons  and  to adjust the Ra value on the screen to the properties of the calibration standard. Once you are done, press the “Enter/menu” button  to confirm.

Note: The calibration standard has its Ra value engraved on the top side.

6 Troubleshooting

Error / error message	Possible cause	Possible fixing
Motor error	Motor is stuck	Restart device
Out of range	1. Surface properties exceed the measuring range of the device. 2. Stylus is out of position.	Increase the Measuring distance Adjust stylus position before the measurement.
No test data	Measurement cannot be started.	Restart device
Deviation of the reading is bigger than the accuracy	Device has not been calibrated / has not been calibrated properly	Calibrate device

7 Additional Information

7.1 Filter information

Filtered profile: The unfiltered primary profile is filtered. The roughness profile (filtered profile) is separated from the waviness profile.

D-P (direct profile): Adopt centreline from least square algorithm.

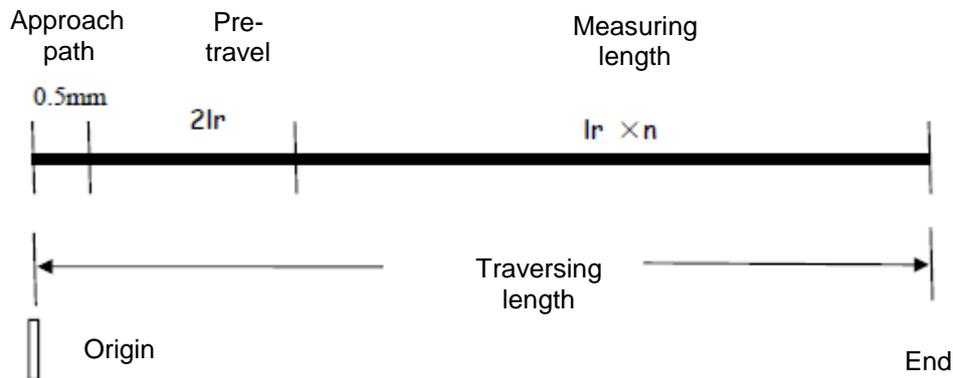
RC filter: analogue 2 RC filter with phase difference

PC-RC filter: RC filter with phase correction

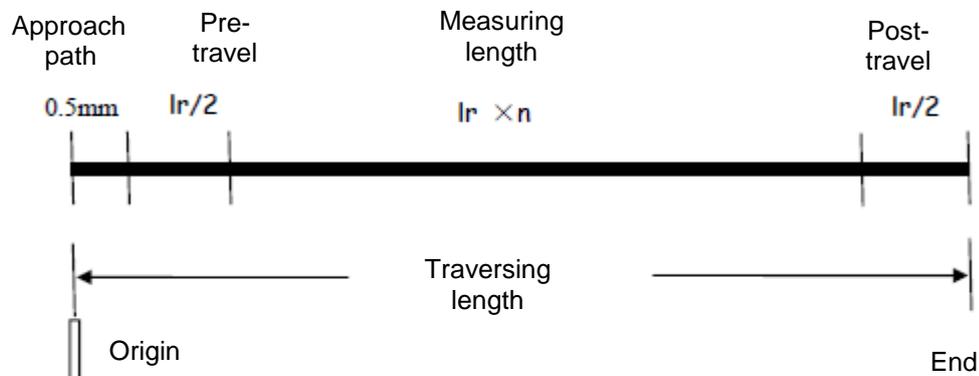
Gauss filter: ISO 11562

7.1.1 Traversing length

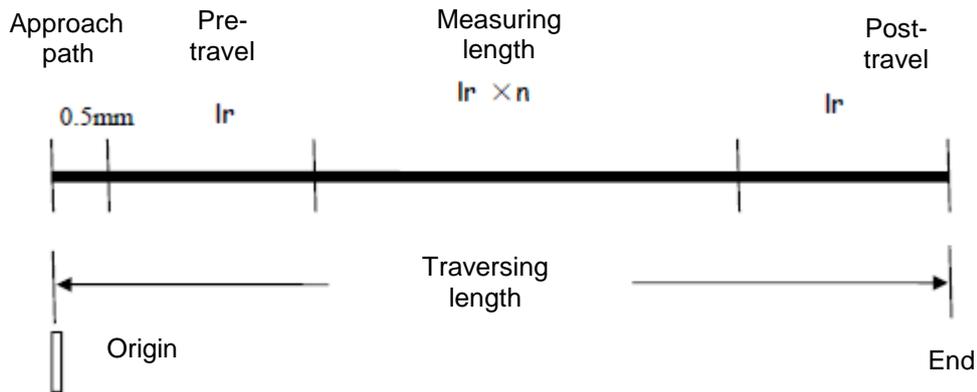
RC filter



Gauss filter



PC-RC filter

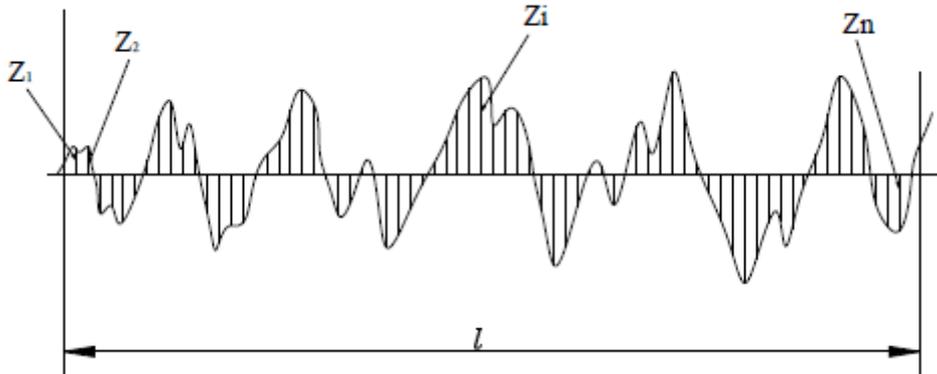


7.2 Measuring parameters

7.2.1 Arithmetical mean deviation of the roughness profile Ra

Ra is the arithmetic mean of the absolute values of profile deviation from the centreline within the measuring length.

$$R_a = \frac{1}{l} \int_0^l |Z(x)| dx$$



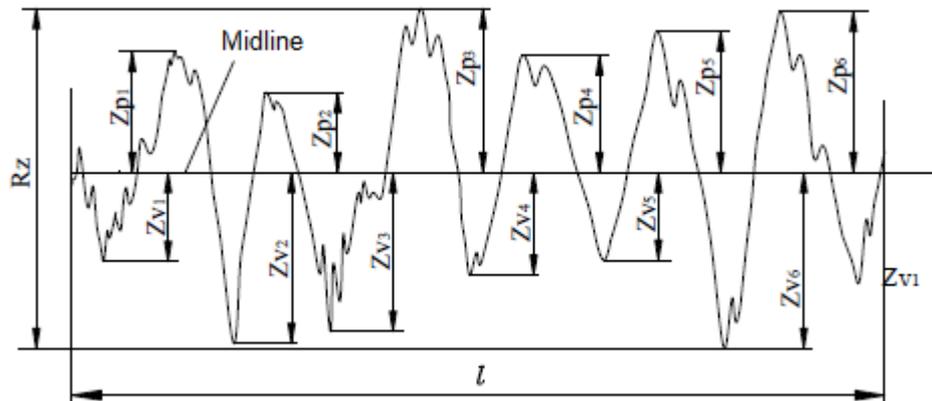
7.2.2 Root mean square roughness Rq

Rq is the square root of the sum of the squares of the individual heights and depths from the centreline.

$$R_q = \sqrt{\frac{1}{2} \int_0^l Z^2(x) dx}$$

7.2.3 Mean Roughness depth R_z

R_z is the sum of the height Z_p of the highest profile peak from the centreline and depth Z_v of the deepest profile valley from the centreline within the measuring length.



7.2.4 Total peak-to-valley height R_t

R_t is the sum of the height of the highest peak Z_p and the depth of the deepest valley Z_v over the measuring length.

7.2.5 Choosing the sampling length

R_a (μm)	R_z (μm)	Einzelmessstrecke $l_r = \lambda c$ (mm)
> 5 ... 10	< 20 ... 40	2.5
> 2.5 ... 5	> 10 ... 20	
> 1.25 ... 2.5	> 6.3 ... 10	0.8
> 0.63 ... 1.25	> 3.2 ... 6.3	
> 0.32 ... 0.63	> 1.6 ... 3.2	
> 0.25 ... 0.32	> 1.25 ... 1.6	0.25
> 0.20 ... 0.25	> 1.0 ... 1.25	
> 0.16 ... 0.20	> 0.8 ... 1.0	
> 0.125 ... 0.16	> 0.63 ... 0.8	
> 0.1 ... 0.125	> 0.5 ... 0.63	
> 0.08 ... 0.1	> 0.4 ... 0.5	
> 0.063 ... 0.08	> 0.32 ... 0.4	
> 0.05 ... 0.063	> 0.25 ... 0.32	
> 0.04 ... 0.05	> 0.2 ... 0.25	
> 0.032 ... 0.04	> 0.16 ... 0.2	
> 0.025 ... 0.032	> 0.125 ... 0.16	
> 0.02 ... 0.025	> 0.1 ... 0.125	

8 Disposal

For the disposal of batteries, the 2006/66/EC directive of the European Parliament applies. Due to the contained pollutants, batteries must not be disposed of as household waste. They must be given to collection points designed for that purpose.

In order to comply with the EU directive 2012/19/EU we take our devices back. We either re-use them or give them to a recycling company which disposes of the devices in line with law.

If you have any questions, please contact PCE Instruments.



9 Contact

If you have any questions about our range of products or measuring instruments please contact PCE Instruments.

9.1 PCE Instruments UK

By post:

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