
Operation Manual
Thorlabs Instrumentation
Photo Current Amplifier

PDA200



2006

Version: 2.31
Date: 02.08.2006

Contents	Page
1 General description of the PDA200	1
1.1 At a Glance	1
1.2 Safety	2
1.3 Ordering codes and accessories	4
2 Getting Started	5
2.1 Unpacking	5
2.2 Preparation	5
2.3 Operating elements at the front and back of the unit	6
3 Operating the PDA200	9
3.1 Connecting a photodiode	9
3.2 Offset adjustment	9
3.3 Calibration of the power display	10
3.4 Setting a bias voltage	11
3.5 Analog control output	12
4 Maintenance and Repair	13
4.1 Maintenance	13
4.2 Line voltage setting	14
4.3 Exchanging the mains fuse	15
4.4 Internal Fuse Replacement	16
4.5 Troubleshooting	18
5 Appendix	19
5.1 Certifications and compliances	19
5.2 Warranty	20
5.3 Technical data	21
5.4 Thorlabs “End of Life” policy (WEEE)	22
5.4.1 Waste treatment on your own responsibility	22
5.4.2 Ecological background	23
5.5 List of acronyms	24
5.6 List of figures	24
5.7 Addresses	25

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to come up to your expectations and develop our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

Thorlabs

This part of the instruction manual contains every specific information on the photo current amplifier PDA200. A general description is followed by explanations on how to operate the unit.

Attention

This manual contains “WARNINGS” and “ATTENTION” label in this form, to indicate dangers for persons or possible damage of equipment.

Please read these advises carefully!

NOTE

This manual also contains “NOTES” and “HINTS” written in this form.

1 General description of the PDA200

1.1 At a Glance

The PDA200 by [Thorlabs](#) is a precise, small photodiode amplifier to operate with all kinds of photodiodes. After calibration the PDA200 can be used as precise optical power meter.

The photodiode amplifier PDA200 by [Thorlabs](#) is excellently suited for:

- **simple operation of photodiodes (transimpedance amplifier)**
- **sensitive pico-Ampère meter**
- **low noise amplification of photodiode current**
- **simple optical power meter**

The PDA200 is easy to use due to the clearly arranged front panel. The operating parameters are shown on an illuminated 4½-digit LCD display. Either PD-current, optical power or bias voltage can be displayed. The displayed parameter is chosen by up / down toggle switches and indicated by LEDs. The units of the measurement for current and power ranges are indicated by LEDs. The unit for bias voltage is V.

With a 20-turn potentiometer the offset of the input amplifier and of the photodiode can be adjusted.

With a sliding switch on the rear side of the PDA200 a bias voltage range of +0..+10 V (for polarity anode grounded) or -0..-10 V (for polarity cathode grounded) can be applied to the photodiode. The voltage is set with a 20-turn Potentiometer.

With a 20-turn potentiometer the displayed power values can be calibrated for a known power level.

A voltage proportional to the photodiode current is provided at an analog control output.

The installed mains filter and the transformer shielding provide a low ripple at the analog control output.

If requested [Thorlabs](#) offers calibrated photodiodes as accessories.

1.2 Safety

Attention

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

Before applying power to your PDA200, please check that the voltage range set in the PDA200 (see letterplate on the back) agrees with your local supply.

Also make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth contact of the socket outlet!

Improper grounding can cause electric shock with damages to your health or even death!

Only with written consent from Thorlabs may changes to single components be carried out or components not supplied by Thorlabs be used.

This precision device is only dispatchable if duly packed into the complete original packaging including the plastic form parts. If necessary, ask for a replacement package.

Attention

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to EN 50 082-1.

The unit must not be operated in explosion endangered environments!

This equipment has been tested and found to comply with the limits for a Class A device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.3 Ordering codes and accessories

<u>Ordering-code</u>	<u>Short description</u>
-----------------------------	---------------------------------

PDA200	Photodiode amplifier/optical power meter
---------------	--

Thorlabs offers a variety of photodiodes for different wavelengths and power regions, which can be used with the PDA200.

Please visit our homepage <http://www.thorlabs.com> for further information.

2 Getting Started

2.1 Unpacking

Inspect the shipping container for damage.

If the shipping container seems to be damaged, keep it until you have inspected the contents and you have inspected the PDA200 mechanically and electrically.

Verify that you have received the following items:

1. 1 PDA200
2. 1 power cord, connector according to ordering country
3. 1 operation manual

2.2 Preparation

Prior to starting operation with a Photodiode Amplifier PDA200, check if the line voltage specified on the letterplate agrees with your local supply and if the appropriate fuse is inserted. (To change the line voltage see 4.2, on page 14)

Connect the unit to the line with the provided mains cable. Turn the unit on by means of the line switch (P9).

Via the connector jack of the chassis ground (R2) the external optical build-up can be connected to ground potential, if required.

2.3 Operating elements at the front and back of the unit

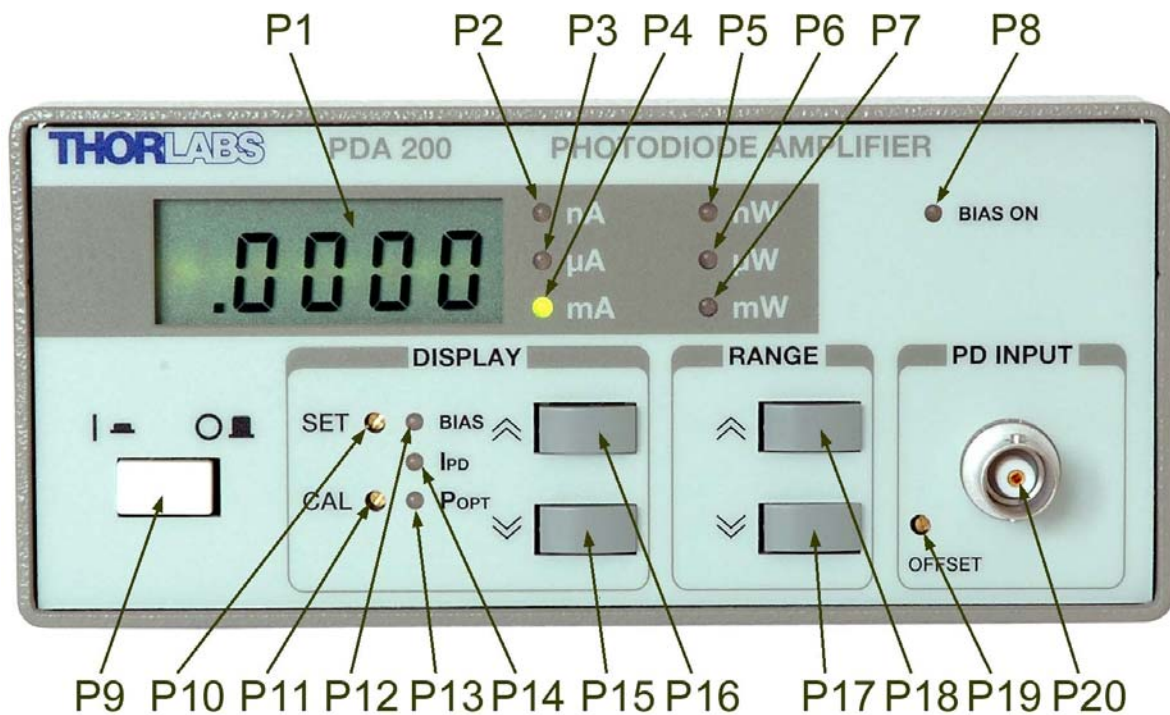


Figure 1 Operating elements at the PDA200 front panel

- P1 4½-digit LCD display
- P2/P3/P4 Current display in nA / μA / mA
- P5/P6/P7 Power display in nW / μW / mW
- P8 LED indicating "BIAS ON"
- P9 Line switch
- P10 Setting the bias voltage
- P11 Calibrating the power display "P_{OPT}"
- P12 Bias voltage display in V
- P13 Power display
- P14 Current display
- P15 Choosing the displayed parameter
- P16 Choosing the displayed parameter
- P17 Decreasing the input sensitivity
- P18 Increasing the input sensitivity
- P19 Potentiometer "OFFSET" for offset adjustment
- P20 Photodiode input

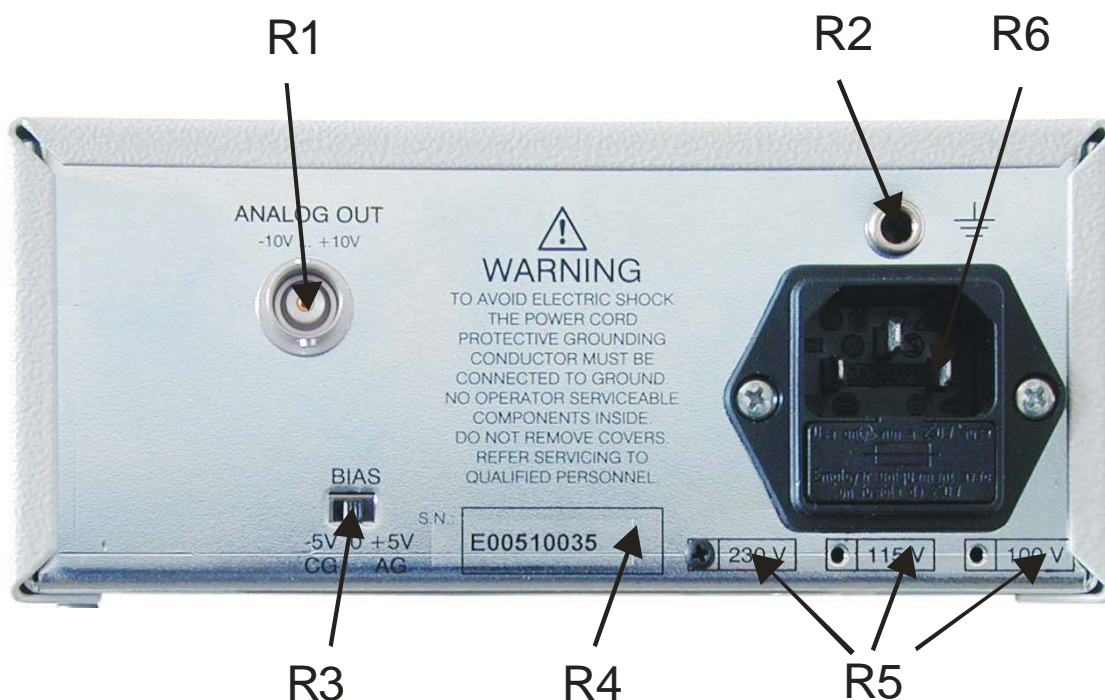


Figure 2 Operating elements at the PDA200 back panel

- R1** Analog control output "ANALOG OUT" to monitor the photodiode current
- R2** 4 mm banana jack "protective ground"
- R3** Selector switch for the photodiode bias voltage (>0V/0V/<0V)
- R4** Serial number of the unit
- R5** Line voltage labels with indicator screw for the set range
- R6** Mains jack and fuse holder

3 Operating the PDA200

3.1 Connecting a photodiode

Photodiodes with both polarities can be used with the PDA200. If a photodiode with anode connected to ground is used, the display (P1) shows a negative sign.

Attention

If the polarity of the photodiode is not known, first set the bias switch (R3) to zero to avoid damage to the diode!

Select the 20 mA current range with the range keys (P17 and P18).

Select display I_{PD} with keys "display down" (P15) and "display up" (P16).

Connect the photodiode to the input jack "PD INPUT" (P20).

Select an adequate current range with the range keys (P17 and P18) to show the actual photodiode current with the finest possible resolution on the LCD display.

3.2 Offset adjustment

With the potentiometer "OFFSET" (P19) the offset of the input amplifier and if desired the dark current of the photodiode may be adjusted to 0 reading on the display.

- Switch on the PDA200.
- Warm up the unit for about 10 min.
- Do not connect a photodiode to the input jack "PD INPUT" (P20), if only the offset of the input amplifier shall be adjusted.
- Select the 20 μ A current range with the range keys (P17 and P18).
- Select display I_{PD} with the display selection keys (P15 and P16).
- Use a screwdriver to set with potentiometer "OFFSET" (P19) the displayed value of the photodiode current I_{PD} to zero.

It is not necessary to repeat the offset correction if you change the current range.

If the offset of the PDA200 input amplifier shall be adjusted together with the dark current of your photodiode, then connect the photodiode to the input jack "PD INPUT". Make sure that no light reaches the photodiode. Use a screwdriver to set the displayed value of I_{PD} to zero with potentiometer "OFFSET" (P19).

NOTE

If the offset of the PDA200 is adjusted together with the dark current of the photodiode, the offset setting depends on the current range.

3.3 Calibration of the power display

The display can be calibrated to show the optical power of the connected photodiode, if the sensitivity of the photodiode is in the 0.05 A/W to 2 A/W range (standard, other ranges on request).

- Connect the photodiode and turn on the unit.
- Expose the photodiode to a known optical power. Take care that no additional light falls on the photo diode.
- Select display I_{PD} with the display selection keys (P15 and P16).
- Select an adequate current range with the range keys (P17 and P18) to show the actual photodiode current with the best possible resolution on the LCD display.
- Select display P_{OPT} with the display selection keys (P15 and P16).
- Use a screwdriver to adjust the displayed value of the optical power P_{OPT} to the known power level with potentiometer "CAL" (P19).

This calibration is valid for all current ranges of the PDA200.

3.4 Setting a bias voltage

The PDA200 provides the possibility of applying a reverse voltage of up to ± 10 V (bias) to the photodiode (photoconductive mode).

- Set the bias switch to 0V
- Connect the photodiode and turn on the PDA200
- Expose the photodiode to light.
- Select an adequate current range with the range keys (P17 and P18).

If the displayed value is positive (polarity cathode grounded), set the bias switch (R6) to " - CG". The applied bias voltage is negative.

If the displayed value is negative (polarity anode grounded), set the bias switch (R6) to " + AG". The applied bias voltage is positive.

Select Display "Bias" with the display selection keys (P15 and P16).

Use a screwdriver to set the desired value for the bias voltage with potentiometer "SET" (P10).

Attention

If the polarity of the bias does not match to the photodiode polarity, the bias voltage may damage the photodiode.

If the bias voltage exceeds the reverse voltage rating of the photodiode, the bias voltage may damage the photodiode.

3.5 Analog control output

There is an analog output "ANALOG OUT" (R1) at the rear panel of the PDA200 at which a DC voltage proportional to the photodiode current I_{PD} is available for monitoring purposes.

The output voltage is

0 ... +10 V for a display reading of 0 ... 19999 (photodiode cathode grounded)

or

0 ... -10V for a display reading of 0 ... -19999 (photodiode anode grounded).

The maximum bandwidth of the analog output "ANALOG OUT" (R1) depends on the current range (see page 21).

The outer connection of "ANALOG OUT" (R1) is grounded. Thus an oscilloscope or PC based ADConverter or other recording devices can be connected directly.

Take care to avoid ground loops.

Devices connected to these outputs should have an input impedance of at least 1 k Ω .

4 Maintenance and Repair

4.1 Maintenance

Protect the unit from adverse weather conditions. The PDA200 is not water resistant.

Do not store or leave the PDA200 where the LCD display will be exposed to direct sunlight for long periods of time.

Attention

To avoid damage to the PDA200, do not expose it to spray, liquids or solvents!

The photo diode amplifier PDA200 does not need regular maintenance by the user.

The unit can be cleaned with a cloth dampened with water.

You can use a mild 75% Isopropyl Alcohol solution for more efficient cleaning.

It does not contain any modules that could be repaired by the user himself. If any malfunction occurs, the whole unit has to be sent back to [Thorlabs](#).

If highest precision of measurements is vital to you, you should have recalibrated the PDA200 by [Thorlabs](#) about every two years.

4.2 Line voltage setting

The photodiode amplifier PDA200 operates at line voltages of 100 V / 115 V / 230 V (-10%, +15 %) (selectable). Prior to starting operation, check if the line voltage specified on the back of the unit agrees with your local supply.

If not, the internal voltage setting must be changed:

The Line voltage setting should be changed only by qualified service personnel. Only qualified service personnel should perform service procedures.

Disconnect Power. To avoid electrical shock, first switch off the PDA200 power, and then disconnect the power cord from the mains power.

With the PDA200 turned over, remove the two screws that secure the cover to the chassis.

Remove the cover by sliding it out of the unit. With the unit set upright, you will find the range switch near the front of the unit, next to the transformer (see Figure 5)

Using a flat-blade screwdriver, turn the switch to the desired range by aligning the triangle with the appropriate voltage (100V, 115V, or 230V +15%, -10% each). Ensure that the switch has clicked into one of the three positions and is not between positions.

On the back of the instrument, remove the indicator screw from the old location and install it in the location corresponding to the new range setting.

Attention

If you have changed to or from 230 V, also change the mains fuse to the correct value given in section 4.2 of this manual.!

Reattach the cover with the two screws.

4.3 Exchanging the mains fuse

If the mains fuse has opened due to line distortion, incorrect line voltage or other causes, it can be easily replaced from the rear without opening the unit.

👉 Attention 👈

To avoid risk of fire, only the fuse designated for the corresponding line voltage must be used.

Line voltage	Fuse	Fuse type
100 V	250 mA, Slow, 250V	T0.25A250V
115 V	250 mA, Slow, 250V	T0.25A250V
230 V	160 mA, Slow, 250V	T0.16A250V

All fuses are to be IEC 60127-2/III

Turn off the PDA200 and disconnect the mains cable. Open the cover of the fuse holder (R6) at the rear with a screwdriver.

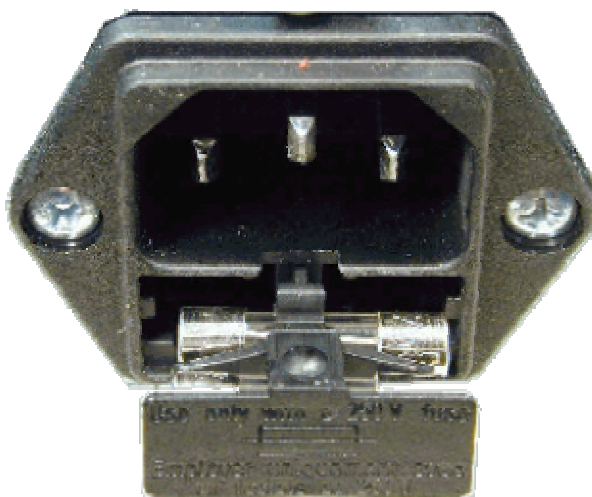


Figure 3 Changing the mains fuse

Remove the fuse drawer and replace the defective fuse (one spare fuse is contained in the fuse holder). Insert the new fuse and close the cover of the fuse holder.

4.4 Internal Fuse Replacement

Internal fuses must be changed only by qualified service personnel.

👉 Attention 👈

**Dangerous or even lethal voltages inside the unit!
Any service procedure must only be done by specially trained
service personal!**

Open the unit like described in section 4.2.

You will find an adhesive label on wall besides the transformer depicting type and location of the internal fuses.

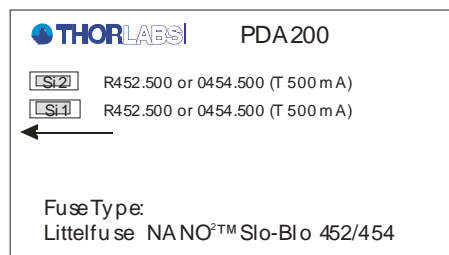


Figure 4 Label 'Internal fuses'

Use only fuses of the type 'Littelfuse NANO²™ Slo-Blo Fuse 452/454 Series'.

Replace the defective fuse and close the unit again (see section 4.2).

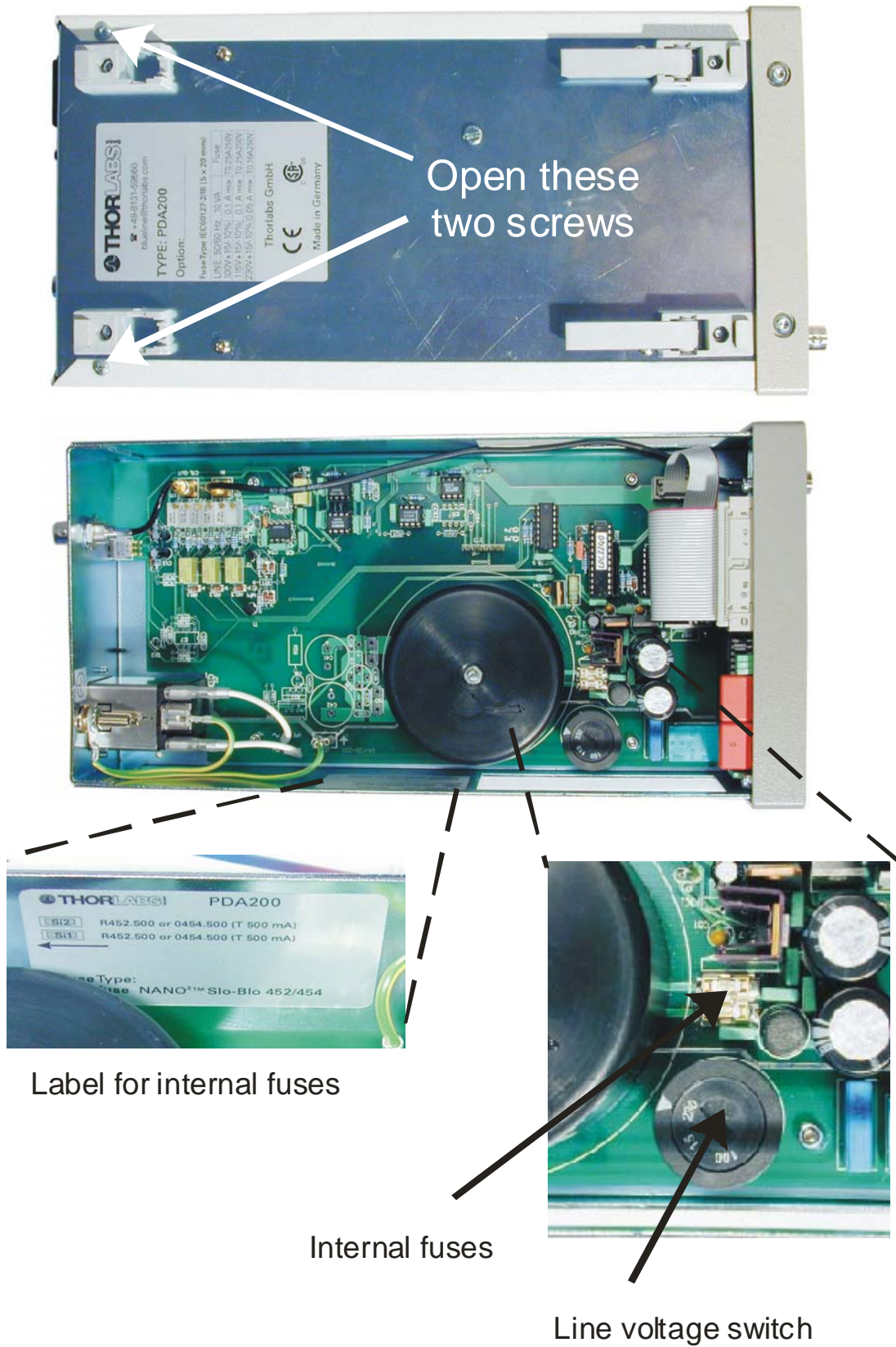


Figure 5 Setting the line voltage

4.5 Troubleshooting

In case that your PDA200 shows malfunction please check the following items:

- ◆ Unit does not work at all (no display on the mainframe):
 - PDA200 connected properly to the mains?
 - Check the mains cable and the line voltage setting!
 - Check the mains fuse (please refer to section 4.3) and replace if necessary.

- ◆ The unit only works partially
 - Check the internal fuses (see 4.4)

- ◆ You don't measure the correct photo current or optical power
 - Are all offset errors eliminated?
 - See 3.2 for adjustment
 - Is the photo diode calibrated?
 - See 3.3, Calibration of the power display.
 - Do you have calibrated the dark current of the photodiode in one measurement range and are now working in another measurement range?
 - Repeat the dark current calibration for the measurement range you are using. This calibration is range dependant! (See 3.2)

- ◆ Your measurement results are unstable
 - Check your system setup for possible ground loops which may introduce line interferences (50/60 Hz) into your setup.

If you don't find the error source by means of the trouble shooting list please first connect the [Thorlabs -Hotline \(blueline@thorlabs.com\)](mailto:blueline@thorlabs.com) before sending the PDA200 for checkup and repair to [Thorlabs-Germany](#).

(refer to section 5.7, on page 25)

5 Appendix

5.1 Certifications and compliances

Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A Radiated and Conducted Emissions ^{1,2} and Immunity. ^{1,3}
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance criterion C)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance criterion B)
	IEC 61000-4-4	Electrical Fast Transient / Burst Immunity (Performance criterion C)
	IEC 61000-4-5	Power Line Surge Immunity (Performance criterion C)
	IEC 61000-4-6	Conducted RF Immunity (Performance criterion B)
	IEC 61000-4-11	Voltage Dips and Interruptions Immunity (Performance criterion C)
	EN 61000-3-2	AC Power Line Harmonic Emissions
Australia / New Zealand Declaration of Conformity - EMC	Complies with the Radiocommunications Act and demonstrated per EMC Emission standard ^{1,2} :	
	AS/NZS 2064	Industrial, Scientific, and Medical Equipment: 1992
FCC EMC Compliance	Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B ^{1,2} .	

¹ Compliance demonstrated using high-quality shielded interface cables.

² Emissions, which exceed the levels required by these standards, may occur when this equipment is connected to a test object.

³ Minimum Immunity Test requirement.

5.2 Warranty

Thorlabs warrants material and production of the PDA200 for a period of 24 months starting with the date of shipment. During this warranty period *Thorlabs* will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to *Thorlabs (Germany)* or to a place determined by *Thorlabs*. The customer will carry the shipping costs to *Thorlabs*, in case of warranty repairs *Thorlabs* will carry the shipping costs back to the customer.

If no warranty repair is applicable the customer also has to carry the costs for back shipment.

In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs warrants the hard- and software determined by *Thorlabs* for this unit to operate fault-free provided that they are handled according to our requirements. However, *Thorlabs* does not warrant a faulty free and uninterrupted operation of the unit, of the soft- or firmware for special applications nor this instruction manual to be error free. *Thorlabs* is not liable for consequential damages.

Restriction of warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient conditions stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. *Thorlabs* does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs reserves the right to change this instruction manual or the technical data of the described unit at any time.

5.3 Technical data

General data

Line voltage	100 V / 115 V / 230 V (-10%, +15 %) (selectable)
Line frequency	50 ... 60 Hz
Operating temperature	0 ... +40°C
Storage temperature	-40°C ... +70°C
Maximum power consumption	10 VA
Supply mains over-voltage	Category II (Cat II)
Relative Humidity	Max. 90% up to 31°C, decreasing to 50% at 40 °C
Pollution Degree (indoor use only)	2
Operation altitude	< 2000 m
Warm-up time for rated accuracy	10 min
Weight	< 3 kg
Dimensions W x H x D	147 x 72 x 318 mm ³
Photodiode current range	200 nA ... 20 mA
Resolution	10 pA ... 1 µA
Photodiode polarity	cathode grounded (CG) and anode grounded (AG)
BIAS voltage	0..-10 V (CG) / 0 V / 0..+10 V (AG)
Photodiode sensitivity for calibrated power display	0.05 ... 2 A/W
Temperature coefficient	≤ 50 ppm/K
Input impedance	~0 Ω, (virt. Ground)

Current range	Resolution	Accuracy	Bandwidth
20 mA	1 µA	± 0.05 % f.s.	1500 kHz
2 mA	100 nA	± 0.05 % f.s.	200 kHz
200 µA	10 nA	± 0.05 % f.s.	70 kHz
20 µA	1 nA	± 0.05 % f.s.	10 kHz
2 µA	100 pA	± 0.05 % f.s.	1 kHz
200 nA	10 pA	± 0.1 % f.s.	100 Hz

Control output

Minimum allowed load resistance	1 kΩ
Noise (rms)	0.02 % f.s.
Output voltage 0 ... full scale	0 ... +10 V (CG), 0 ... -10 V (AG)

Connectors

Photodiode input	BNC
Control output	BNC

5.4 Thorlabs “End of Life” policy (WEEE)

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see Figure 6)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

5.4.1 Waste treatment on your own responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

5.4.2 Ecological background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.



Figure 6 Crossed out "wheelie bin" symbol

5.5 List of acronyms

The following acronyms or abbreviations are used in this manual:

ADC	<u>A</u> nalog to <u>D</u> igital <u>C</u> onverter
AG	<u>A</u> node <u>G</u> round
CG	<u>C</u> athode <u>G</u> round
DC	<u>D</u> irect <u>C</u> urrent
LD	<u>L</u> aser <u>D</u> iode
PD	<u>P</u> hoto <u>D</u> iode
PDA	<u>P</u> hoto <u>D</u> iode <u>A</u> mplifier
FCC	<u>F</u> ederal <u>C</u> ommunication <u>C</u> ommission
EMC	<u>E</u> lectro <u>M</u> agnetic <u>C</u> ompatibility

5.6 List of figures

Figure 1	Operating elements at the PDA200 front panel	6
Figure 2	Operating elements at the PDA200 back panel	7
Figure 3	Changing the mains fuse	15
Figure 4	Label 'Internal fuses'	16
Figure 5	Setting the line voltage	17
Figure 6	Crossed out "wheelie bin" symbol	23

5.7 Addresses

Thorlabs GmbH

Gauss-Strasse 11
D-85757 Karlsfeld
Fed. Rep. of Germany
Tel.: +49 (0)81 31 / 5956-0
Fax: +49 (0)81 31 / 5956 99
Email: europa@thorlabs.com
Internet: <http://www.thorlabs.com>

USA

Thorlabs, Inc.
435 Route 206 North
Newton, NJ 07860
USA

Sales and Support

Phone: 1-973-579-7227
Fax: 1-973-300-3600
Email: sales@thorlabs.com
Email: techsupport@thorlabs.com
Web: www.thorlabs.com

Japan

Thorlabs, Inc.
6th Floor, Fujimizaka Building
5-17-1, Ohtsuka
Bunkyo-ku, Tokyo 112-0012
Japan

Sales and Support

Phone: +81-3-5977-8401
Fax: +81-3-5977-8402
Email: sales@thorlabs.jp
Web: www.thorlabs.jp

Please call our hotlines, send an Email to ask for your nearest distributor or just visit our homepage

<http://www.thorlabs.com>