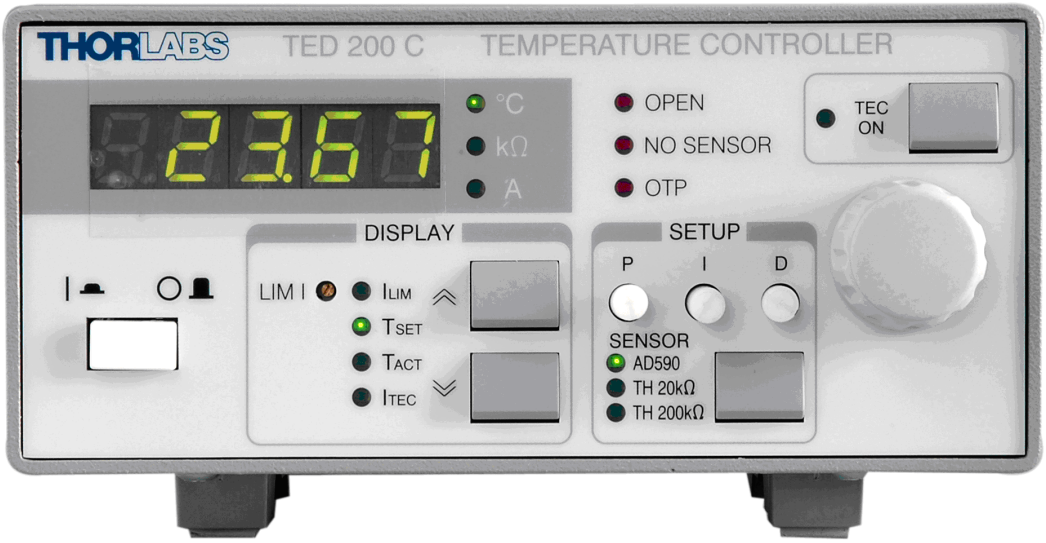
THORLABS

Thermoelectric Temperature Controller

TED200C
Operation Manual



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Contents

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and improve 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 GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

Attention

Paragraphs preceeded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

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

Please read these advices carefully!

1 General Information

The Thorlabs TED200C Thermoelectric Temperature Controller is a precise temperature controller for laser diodes and detectors.

The TED200C is excellently suited for:

- **wavelength stabilization of laser diodes**
- **noise reduction of detectors**
- **laser diode's wavelength tuning by regulating the temperature**
- **modulation of wavelength by tuning the temperature**

The TED200C is easy to operate via the operating elements on the front panel. Operating parameters are shown on a 5-digit LED display. UP-DOWN keys allow to select the parameter to be displayed.

The P, I and D shares of the temperature control loop can be set independent of each other.

The TED200C operates with different temperature sensors - NTC thermistors and IC temperature sensors are supported. With a thermistor, the temperature is displayed in kW, with a temperature sensor IC - in °C.

The output for the TEC current can be switched on or off via front panel key.

The temperature sensor and the TEC element are connected to a 15-pin D-SUB jack at the rear of the unit.

At the TE OUTPUT jack a control signal is available to drive an external LED to indicate TEC ON mode when the TEC current is activated.

The set value of the temperature can be changed with a knob at the front panel or via an analog input at the rear panel.

For monitoring purposes, an DC voltage proportional to the actual temperature is available at the rear panel (CTL OUT).

The TED200C controller is cooled by an internal fan, which protects the unit against overheating in case of high environmental temperatures. With free air circulation a safe operation of the unit is guaranteed up to 40 °C ambient temperature.

Note

In order to prevent damages to the laser diode, it is recommended to mount the laser into a suitable Thorlabs laser diode mount (e.g., LM14S2, LDM21 or TCLDM9) and connect it to the TED200C using the supplied Thorlabs CAB420-15 cable. This ensures the utmost protection of the laser diode from damage by wrong connection.

In case of overheating, the output is switched off automatically in order to avoid damages. The LED "OTP" (Overtemperature Protection) indicates the overtemperature. After a temperature drop for about 10°C the LED "OTP" extinguishes and the output current can be switched on again by pressing the key "ON".

If an error occurs (OTP or OPEN) the corresponding LED lights up and a short warning beep is heard.

The installed mains filter and the careful shielding of the transformer provide a low ripple at the output.

1.1 Protection of the TEC element

- **Limit of the TEC current in all operating modes**

  Protection against thermal destruction.

- **Protection of the sensor**

  Protection against use of incorrect temperature sensors; protection against interrupted connection of the temperature sensor.

- **Contact protection of the TEC element (open circuit)**

  Protection against cable damage, bad contact or TEC element with too high resistance.

- **Control LED for TEC current on**

  Protection against accidental turning off the cooling.

- **Overtemperature protection**

  Protection against malfunction caused by internal overheating of the controller.

- **Line failure protection**

  The TEC current is switched off immediately if a power failure or line interruption occurs. In this case, same as after turning on the controller, the TEC current remains switched off and can be switched on manually only.

1.2 Safety

Attention

The safety of any system incorporating the equipment is the responsibility of the assembler of the system.

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

The TED200C must not be operated in explosion endangered environments!

Do not obstruct the air ventilation slots in the housing!

Do not remove covers!

Do not open the cabinet.There are no parts serviceable by the operator inside!

This precision device is only serviceable if properly packed into the complete original packaging including the plastic foam sleeves. If necessary, ask for replacement packaging.

Refer servicing to qualified personnel!

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

Attention

Prior to applying power to the TED200C, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth ground contact of the socket outlet! Improper grounding can cause electric shock resulting in damage to your health or even death!

Ensure that the line voltage setting of the fuse holder at the rear panel agrees with your local supply and that the corresponding fuses are inserted. If not, please change the line voltage setting (see section Line voltage setting) and the mains fuses (see section Replacing the mains fuses).

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

All modules must only be operated with duly shielded connection cables.

Attention

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the respective accompanying documentation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- **Reorient or relocate the receiving antenna.**
- **Increase the separation between the equipment and receiver.**
- **Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.**
- **Consult the dealer or an experienced radio/T.V. technician for help.**

Users that change or modify the product described in this manual in a way not expressly approved by Thorlabs (party responsible for compliance) could void the user's authority to operate the equipment.

Thorlabs GmbH is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs GmbH. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

Attention

Mobile telephones, cellular phones or other radio transmitters must not 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 IEC61326-1.

This product has been tested and found complying with the limits according to IEC 61326-1 for using connection cables shorter than or equal to 3 meters (9.8 feet).

Warning

Laser modules can deliver up to several 100mW of even invisible laser radiation! When operated incorrectly, this can cause severe damage to your eyes and health! Be ensure to pay strict attention to the safety recommendations of the appropriate laser safety class, as stated for the used light source.

Vous pouvez trouver les traductions françaises des paragraphes ayant trait à la sécurité d'utilisation de ce produit sur le lien suivant:

https://www.thorlabs.com/_sd.cfm?fileName=15986-D03.pdf&partNumber=TED200C

En outre, vous pouvez soit scanner le QR code, soit vous référer à la section "Documents" sur la page web du produit.

1.3 Ordering Codes and Accessories

Ordering code	Short description
TED200C	thermoelectric Temperature Controller, TEC current 0 ... 2 A, working with thermistors and IC temperature sensors (AD590, AD592, LM135 and LM335) as temperature sensor, 5-digit LED-display
Shielded cable:	
CAB420-15	Cable to connect the temperature controller TED200C to a Thorlabs Laser Diode Mount.

Note

The cable should not be manipulated as it serves multiple devices and therefore does not have the standard pin assignment as described for TED200C.

Laser diode mounts for different laser diode packages:

TCLDM9	Temperature controlled laser diode mount for 3- and 4-pin TO18-packages (9 mm CD, 5.6 mm CD)
LDM21	Miniature sized temperature controlled laser diode mount for 3- and 4-pin TO18-packages (9 mm CD, 5.6 mm CD)
LM14S2	laser diode mount for laser modules in a 14-pin butterfly-package (programmable pinning)

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

2 Getting Started

2.1 Parts List

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 TED200C controller mechanically and electrically.

Verify that you have received the following items within the package:

1. 1 TED200C controller
2. 1 power cord, connector according to ordering country
3. 1 operation manual
4. 1 connection cable CAB420-15

2.2 Preparation

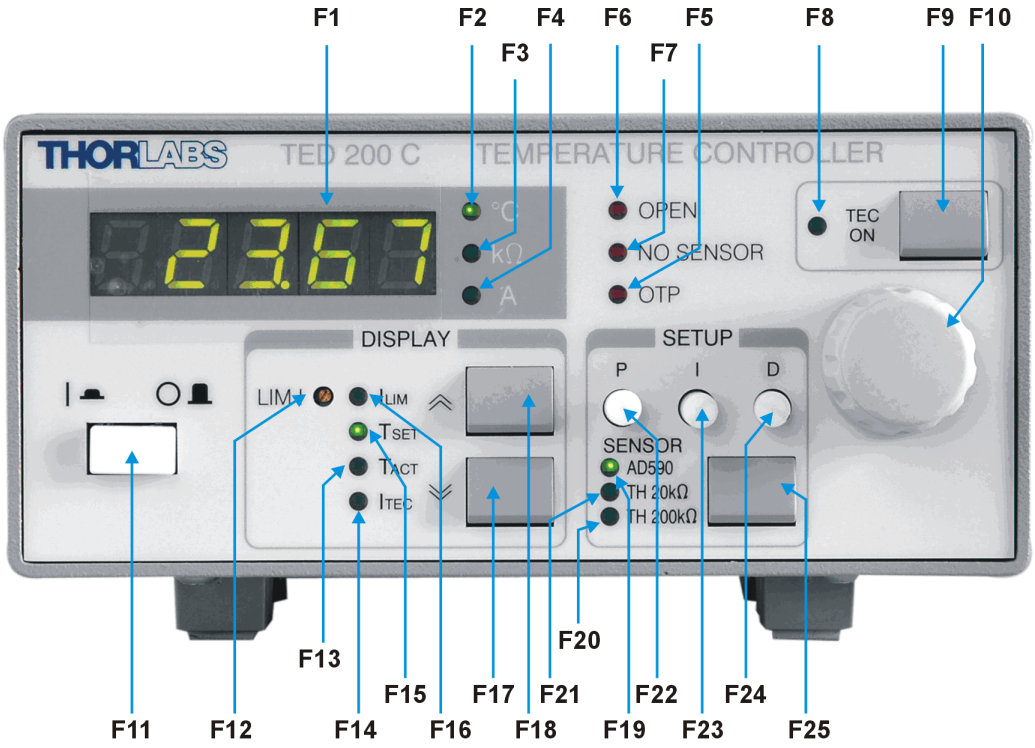
Prior to operate a TED200C controller, check if the set line voltage matches with your local power supply and if the appropriate fuses are inserted. (See sections Line Voltage Setting and Replacing the Mains Fuses)

Connect the unit to the power line using the supplied cable. Turn the unit on by pressing the line switch (F11).

If required, the chassis ground can be connected to ground potential via the connector jack R4.

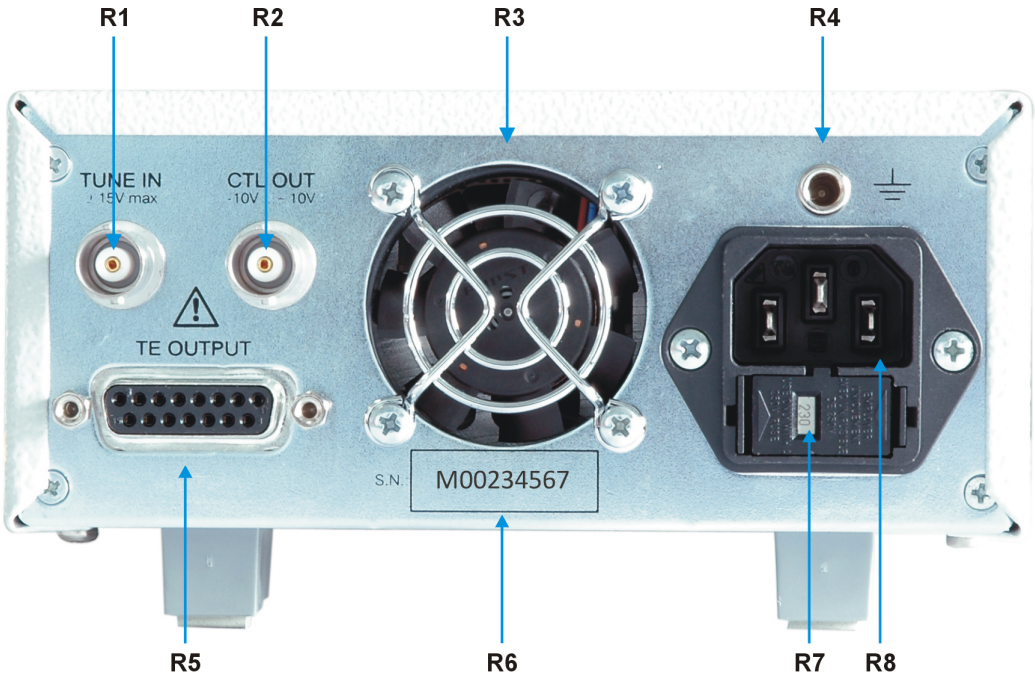
2.3 Operating elements

Front Panel



F1	-	5-digit LED display
F2	LED "°C"	Temperature display in C
F3	LED "kΩ"	Resistance display in k
F4	LED "A"	Current display in A
F5	LED "OTP"	Over temperature protection is active
F6	LED "OPEN"	TEC element is not connected or too high resistance
F7	LED "NO SENSOR"	Temperature sensor is wrong or not connected
F8	LED "TEC ON"	TEC output is switched on
F9	Key "TEC ON"	On / Off switch for the TEC output
F10	-	Knob for adjusting the set temperature / resistance
F11	-	Line switch (ON / OFF)
F12	LIM I	Potentiometer for setting the TEC current limit
F13	LED "T_{ACT}"	Display shows the actual temperature / resistance
F14	LED "I_{TEC}"	Display shows the TEC current
F15	LED "T_{SET}"	Display shows the set temperature / resistance
F16	LED "I_{LIM}"	Display shows the current limit
F17	Key “DOWN”	Select the parameter to be displayed
F18	Key “UP”	Select the parameter to be displayed
F19	LED "AD590"	Selected sensor is AD 590, AD 592, LM 135 or LM 335
F20	LED "TH 200kΩ"	Selected sensor is thermistor in the 200 kΩ range
F21	LED " TH 20kΩ"	Selected sensor is thermistor in the 20 kΩ range
F22	P	Potentiometer for setting P- (gain) share of control loop
F23	I	Potentiometer for setting I- (integral) share of control loop
F24	D	Potentiometer for setting D- (derivative) share of control loop
F25	Key “SENSOR”	Select sensor / disable I-share (press for more than 1 sec.)

Rear Panel



R1 Analog temperature control input "TUNE IN", -10 ... +10 V
R2 Analog temperature control output "CTL OUT", -10 … +10 V
R3 Fan
R4 4 mm banana jack for chassis ground
R5 15-pin D-SUB jack for the TEC element and the temperature sensor "TE OUTPUT"
R6 Serial number of the unit
R7 Indicator / switch for line voltage (included in fuse holder)
R8 Mains connector and fuse holder

2.4 First Operation

Attention

Prior to switch on your TED200C controller, please make sure that the line voltage setting corresponds to your mains voltage! Mismatching may lead to damage of the controller!

Turn the unit on by pressing the line switch F11.

After switching on the unit, the LED display F1 and a LED, indicating the selected measurement value (F13 ... F16), light up, otherwise please check the line voltage and the mains fuses.

By using F17 and F18 keys, the displayed measurement value can be selected.

A TED200C controller is immediately ready to use after turning on. The rated accuracy is reached, however, after a warming-up time of approx. 10 minutes.

3 Operating Instruction

3.1 External Connections

Prior to switch on the TED200C controller, all required external connections must be made properly. Please read the following sections carefully.

3.1.1 TEC Output

The Thorlabs TED200C controller can drive all thermoelectric coolers up to a current of 2 A. The voltage drop across the TEC must not exceed the TED200C compliance voltage (6V)

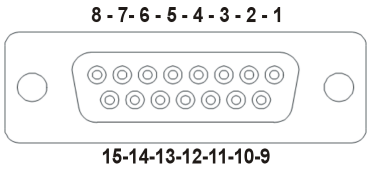
If a Thorlabs laser mount is used, just connect the 15-pin D-SUB jack "TE OUTPUT" (R5) of the TED200C controller to the 9-pin plug "TEC DRIVER" of the Laser Diode Mount using the supplied shielded cable CAB420-15.

Note

The cable should not be manipulated as it serves multiple devices and therefore does not have the standard pin assignment as described for TED200C.

If a Thorlabs laser mount TCLDM9 or LDM21 is used, in addition the polarity of laser diode and photodiode must be set using the two slide switches at the laser mount. Please refer to the individual operation manual of the laser diode mount.

If other laser diode fixtures are used, connect the TE cooler and the temperature sensor using shielded cables to "TE OUTPUT" (R5) according to the pin assignment as shown below:



Pin #	Connection
	TEC element, status indication:
5	TEC (+)
6	TEC (+)
7	TEC (+)
13	TEC (-)
14	TEC (-))
15	TEC (-)
1	Status LED (+) for TEC ON/OFF indication
	Temperature sensor:
4	Thermistor (+)
3	Thermistor (-), ground
10	Transducer AD 590/592 (-), LM135/335 (+)
11	Transducer AD 590/592 (+), LM135/335 (+)
2	N.C.
9	N.C.
12	N.C.
8	AGND LM135/335 (-), Status LED (-)

3.1.2 Connecting the TEC element

Connect the thermoelectric cooler between pin 5, 6, 7 (TEC anode) and pin 13, 14, 15 (TEC cathode) of the 15-pin D-SUB jack.

Attention

A mispoled TEC element may lead to thermal runaway and destruction of the connected components.

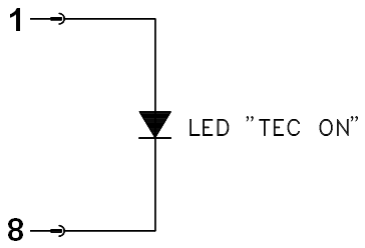
Check the TEC polarity

- Turn on the Temperature Controller TED200C
- Connect the temperature sensor to the jack "TE OUTPUT" (R5) (refer to "Connecting a temperature sensor").
- Select the appropriate sensor type with the key (F25).
- Select a suitable current limit "I_{LIM}" for the TEC element (refer to "Setting the TEC current limit ").
- Switch the display to "T_{SET}" and set the desired set temperature using the tuning knob.
- By pressing the key "ON" switch on the TED200C output current. The LED "ON" (F8) lights up.
- Switch the LED display to "T_{ACT}".

If the TEC module is connected with correct polarity, the difference between the set temperature "T_{SET}" and the actual temperature "T_{ACT}" will decrease. If the control loop parameters are set well (see section Adjusting Temperature Control Loop), the actual temperature approximates the set temperature within a short time.

If the TEC module is connected with wrong polarity, the difference between set temperature and actual temperature will increase continuously. Switch off the TEC current by pressing key "ON" (F9) and change the TEC module wiring at the D-SUB plug connected to the jack "TE OUTPUT" (R5).

3.1.3 Control LED for TEC ON mode



If a LED is connected between pin 1 and pin 8 as shown to the left, this LED lights up when the TEC current output is switched on.

3.1.4 Connecting a temperature sensor

The TED200C is compatible with a number of temperature sensor types:

- NTC (standard thermistor)
- AD590/AD592
- LM135/LM335

The temperature sensor is selected at the front (key SENSOR - F25). The LED F19 to F21 indicate the selected sensor.

Temperature Ranges

- NTC (thermistor): 2 measurement ranges - 0 to 20kΩ and 0 to 200kΩ
- AD590/AD592/LM135/LM335): the measurement range -45°C to +145°C.
- The actual temperature control range depends on the sensor ratings and the individual thermal setup.

If no temperature sensor is connected or if the temperature sensor does not correspond to the selected sensor type, the LED “OPEN” (F6) lights up and the display (F1) indicates overflow when "TACT" measurement value is selected.

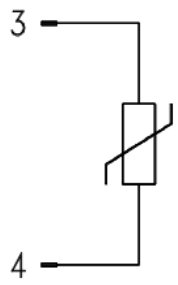
The temperature sensor is connected to the 15-pin D-SUB jack "TE OUTPUT" (R5) at the rear of the TED200C depending on the used sensor type.

Note

If LM135/LM335 is used as temperature sensor, select "AD590" (key F25). The LED "AD590" (F19) lights up.

Thermistor

A thermistor is a resistor with a **N**egative **T**emperature **C**haracteristic, that's why it is also known as NTC. It's resistance decreases exponentially with the temperature.



A thermistor must be connected between pin 3 and pin 4 of the 15-pin D-SUB jack (R5). The polarity is not relevant, so far the thermistor is floating. If one pin of the thermistor is grounded (for example in a laser module), this pin has to be connected to pin3.

If the TED200C is operated with a thermistor temperature sensor, the "TSET" and "TACT" temperature is displayed as resistance in kΩ.

The NTC measurement current is 100µA in 20kΩ range and 10µA in 200kΩ range.

To describe the dependency of resistance vs. temperature, several algorithms are known. A simplified method, giving good results within a range relatively close to the reference temperature, is the exponential formula:

$$R(T) = R_0 * e^{B_{val}(\frac{1}{T}-\frac{1}{T_0})} \Leftrightarrow T(R) = \frac{B_{val} * T_0}{T_0 * \ln(\frac{R}{R_0}) + B_{val}}$$

with: R_0: Thermistor nominal resistance at temperature T_0

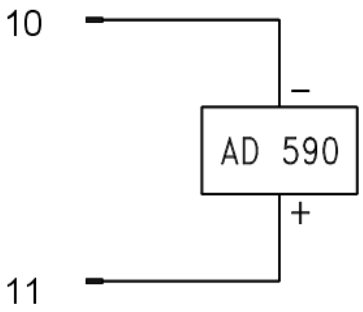
T_0: Nominal temperature (usually 298.15 K = 25°C)

B_{val} Energy constant

For R_0 and B_{val} please refer to the data sheet of the thermistor; T and T_0 are given in K (Kelvin)

If using a thermistor, the resistance for a given temperature $T_{SET} \neq T_0$ must be calculated first. If the thermistor characteristic R(T) is given in the data sheet, the thermistor resistance can be read directly. Then select "TSET" (key F18 or F19) to display the resistance set value. Adjust the value using the tuning knob (F10).

AD 590/AD 592 Temperature sensor



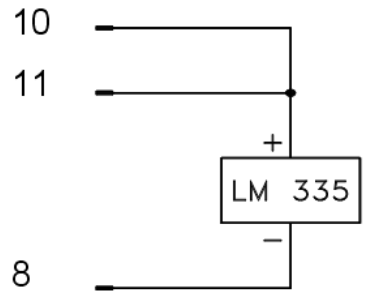
AD590/592 are IC transducer type temperature sensors that produce an output current linearly proportional to the absolute temperature.

These devices act as current source, delivering 1µA/K within a wide supply voltage range. They are calibrated to 298.2µA output current at 298.2K (25°C).

An AD590/592 is connected between pin 10 (-) and pin 11 (+) of the 15-pin D-SUB jack "TE OUTPUT" (R5)

The accuracy of the displayed temperature depends on the tolerance of the used transducer.

LM135/LM335 Temperature sensor



The LMx35 Temperature Transducer Sensors operate as a zener diode (inverse current direction) with a breakdown voltage linearly proportional to absolute temperature at +10 mV/K. They operate over a current range of 400 µA to 5 mA.

A LM135/LM335 is connected to pin 10 (+), pin 11 (also +) and pin 8 (AGND) of the 15-pin D-SUB jack "TE OUTPUT" (R5) at the rear of the unit.

The accuracy of the displayed temperature depends on the tolerance of the used transducer.

3.1.5 Analog Temperature Tuning Input

The set temperature "TSET" can be tuned by applying a voltage to the input "TUNE IN" (R1) at the rear panel of the TED200C. The temperature set value is proportional to the sum of the signal at input "TUNE IN" (R1) and of the value set with the adjustment knob (F10).

The tuning range for the analog control input "TUNE IN" depends on the connected sensor:

Sensor	Control Range	TUNE IN voltage range	Conversion Coefficient
TH 20 K	0 ... 20 kΩ	0 ... 10 V	2 kΩ/V
TH 200 K	0 ... 200 kΩ	0 ... 10 V	20 kΩ/V
AD590/592; LM135/335	-45 °C...+145 °C	- 2.25 V...+7.25 V	20 °C/V

Note

Only slow variations of the temperature set value (<< 1 Hz) are possible via the analog control input "TUNE IN".

The actual temperature "TACT"can be observed at the temperature monitor output "CTL OUT" (R2).

3.1.6 Analog Temperature Output

The analog output "CTL OUT" (R2) delivers a DC voltage, proportional to the actual temperature "TACT". The output voltage range depends on the used temperature sensor:

Sensor	Control Range	TUNE IN voltage range	Conversion Coefficient
TH 20 K	0 ... 20 kΩ	0 ... 10 V	2 kΩ/V
TH 200 K	0 ... 200 kΩ	0 ... 10 V	20 kΩ/V
AD590/592; LM135/335	-45 °C...+145 °C	- 2.25 V...+7.25 V	20 °C/V

To the analog output "CTL OUT" any measurement equipment can be connected directly. Devices connected to these outputs should have an input resistance of ≥ 10 kΩ.

This monitor output is convenient to use for temperature monitoring e.g. during adjustment of PID loop parameters.

3.2 Operation

- Connect the jack "TE OUTPUT" (R5) at the rear panel of the TED200C to the input "TEC DRIVER" of the Thorlabs Laser Diode Mount using the supplied cable CAB420-15. If a different laser diode fixtures is used, the output jack “TE OUTPUT” (R5) must be connected according to the TEC Output pin assignment, see also "Connecting a temperature sensor”.
- Switch on the Temperature Controller TED200C.
- Select a suitable current limit "I_{LIM}" for the TEC element
- Select the used temperature sensor with key (F25).

Note

The TEC output can be switched on only if a temperature sensor is connected "TE OUTPUT" (R5) and the sensor type is selected correctly. If the connected temperature sensor does not correspond to the selected sensor type, the LED "OPEN" (F6) lights up. In this case check the connection and the type of the temperature sensor.

- Select "TSET" to display the set temperature (keys F17 or F18)
- Set the desired temperature "TSET" using the tuning knob (F10).
- If a thermistor is used, the instead of temperature (°C) the resistance is set (kW). If an AD590/AD592 or LM135/LM335 is used as temperature sensor, the set temperature is entered in °C.
- Switch on the TEC current output by pressing key "ON" (F9). The LED "ON" (F8) lights up.

Note

The TEC output cannot be switched on as long as the LED "OPEN" (F6) lights up. In such case check the connection of the temperature sensor and the selected sensor type.

During operation between the displayed values for "TSET", "TACT", "ILIM" or "ITEC" can be switched at any time by pressing (F17) or (F18).

3.2.1 Setting the TEC current limit

The Temperature Controller TED200C delivers a maximum TEC current of 2 A. Prior to switch on the TEC output, an appropriate TEC current limit "ILIM" should be set using the potentiometer "LIM I" in order to avoid damage of the TEC element.

A limitation of the maximum TEC current can be helpful to optimize the settling time in case of a low thermal load (laser with low output power, set temperature close to environmental temperature etc.)

Select the display parameter "ILIM" with the key (F17) or (F18).

Use a screwdriver to set the desired TEC current limit "ILIM" with the 12-turn potentiometer "LIM I" (F12).

Note

The current limit can be displayed at any time by selecting the parameter "ILIM".

3.2.2 Adjusting Temperature Control Loop

Temperature controllers are used to manage the temperature of thermo-electrically heated/cooled components in experimental setups, independent of external influences. To adapt a controller to different thermal loads, and to optimize the controller's response characteristics, the controlling parameters of the system's feedback loop must be optimized. All Thorlabs' temperature controllers provide a PID control loop whose shares (P, I and D share) must be matched with the thermal load of the device under test. For an optimum adaptation, these parameters have to be adjusted separately and independent of each other. This section describes how to optimize the PID parameters in order to get optimum performance from the TED200C temperature controller.

- The P share (proportional, gain) can be adjusted with potentiometer "P" (F22).
- The I share (integral, offset control) can be adjusted with potentiometer "I" (F23).
- The D share (derivative, rate control) can be adjusted with potentiometer "D" (F24).

Preparation

1. Select "TACT" to display the actual temperature or thermistor resistance (keys F17 or F18).
2. Turn the three potentiometers "P" (F22), "I" (F23) and "D" (F24) completely counter-clockwise.
3. Switch off the I share to ease the setting of P and D shares: Press key (F25) for at least one second to switch off the I share. The sensor LED (F19/F20/F21) is flashing to indicate the "I share off" state.
4. Set the temperature "TSET" to a value around room temperature and switch on the TEC current output (switch "ON" F9).

Adjust P share

Repeatedly increase and decrease the set temperature for about ± (1...2)°C around room temperature using the tuning knob (F10) or by applying a suitable slow, square-wave signal to the analog control input "TUNE IN" (R1) at the rear panel. Watch the settling behavior of the actual temperature "TACT".

Note

The settling behavior can be observed at the "CTL OUT" output (R2).

Increase the P-share gradually by turning potentiometer (F22) clockwise.

Higher values will increase the settling speed. Too high values will increase the amplitude and number of overshoots or will even make the system instable (continuous oscillation).

The P share is set correctly if the actual temperature remains stable near the set temperature after only 2 … 3 overshoots.

Adjust D share

Change set temperature again repeatedly for ± (1...2)°C around room temperature while observing the settling behavior of the actual temperature.

Increase the D share gradually by turning potentiometer (F23) clockwise.

Higher values will decrease the amplitude and number of overshoots. Too high values will increase again the amplitude and number of overshoots or will even make the system instable.

The D share is set correctly if the actual temperature remains stable at a value near the set temperature after a minimum of overshoots.

Adjust I Share

Turn on the I share, if it was if disabled, by pressing key (F25) for at least one second. The sensor LED (F19/F20/F21) stops flashing if the I-share is enabled.

Change set temperature again repeatedly for ± (1...2)°C around room temperature while observing the settling behavior of the actual temperature.

Increase the I share gradually by turning potentiometer (F24) clockwise.

Higher values will accelerate the settling to the set temperature. Too high values will increase the amplitude and number of overshoots. The I share is set correctly when the actual temperature reaches the set temperature in short time with at most one overshoot.

3.2.3 Over-Temperature Protection

The TED200C controllers come with an internal over-temperature protection. If the internal heat sink is overheated, the output of the controller is disabled automatically. The LED "OTP" (F5) lights up and a short beep is heard. The TEC current is switched off immediately. Pressing the key "TEC ON" (F9) has no effect in this case.

After the internal heat sink's temperature decreased for about 10°C, the LED "OTP" (F6) extinguishes and the laser current output can be switched on again.

3.2.4 Disabling the Beeper

If audible signals are unwanted, the beeper can be disabled in this way:

- Press and hold the key “UP” (F18).
- Press the key “Down” (F17). Now the beeper state is displayed:
  - “Sd.ON” - Sound ON
  - “Sd.OFF” - Sound OFF

To change the beeper state, hold the key “UP” pressed and toggle the beeper state by pressing "DOWN" key.

4 Maintenance and Service

Protect the TED200C from adverse weather conditions. The TED200C is not water resistant.

Attention

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

The unit does not need a regular maintenance by the user. If necessary the unit and the display can be cleaned with a cloth dampened with water. A mild 75% Isopropyl Alcohol solution can be used for more efficient cleaning.

TED200C Controllers do not contain any modules and/or components that could be repaired by the user himself. If a malfunction occurs, please contact Thorlabs for return instructions.

Do not remove covers!

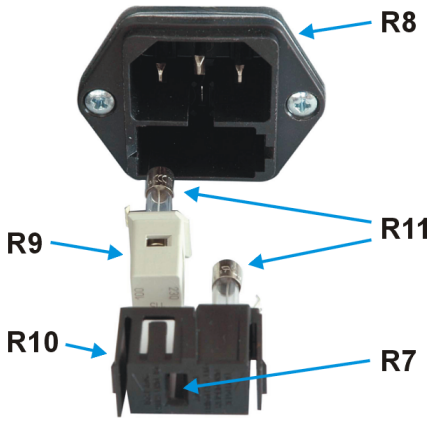
To guarantee the specifications given in section Technical Data over a long period it is recommended to have the unit factory calibrated every two years.

4.1 Line Voltage Setting

The TED200C operates at fixed line voltages of

100 V +15% / -10% (90 V … 115 V)
115 V +15% / -10% (104 V … 132 V)
230 V +15% / -10% (207 V … 264 V)
line frequency 50 … 60 Hz.

The line voltage setting can be changed from the rear without opening the unit.



1. Turn off the controller and disconnect the mains cable.

2. The fuse holder (R10) is located below the 3-pole power connector of the mains jack (R8). Release the fuse holder by pressing its plastic retainers with the aid of a small screwdriver. The retainers are located on the right and left side of the holder and must be pressed towards the center.

3. Unplug the white line voltage switch/indicator (R9, containing the left fuse) from the fuse holder (R10), rotate it until the appropriate voltage marking (100V, 115V, or 230V) is on target for the cutout (R7) of the fuse holder, and plug it back into the fuse holder. Press in the fuse holder until locked on both sides. The appropriate line voltage marking must be visible in the cutout (R7) of the fuse holder.

Attention

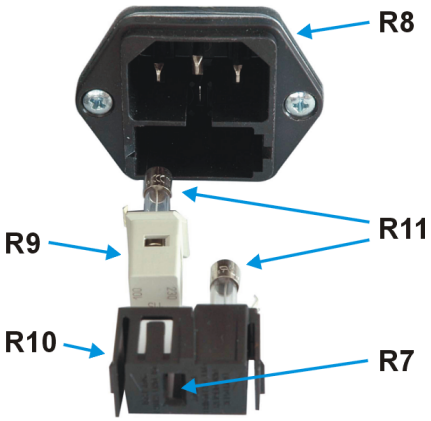
If you have changed to or from 230 V, also change the mains fuses to the correct value given in section Replacing Mains Fuses.

4.2 Replacing Mains Fuses

The two power input fuses are externally accessible. If they blew due to line distortions, incorrect line voltage or other causes, they can be replaced from the rear without opening the unit.

Attention

To avoid risk of fire only the appropriate fuses for the corresponding line voltage must be used



1. Turn off the TED200C and disconnect the mains cable.
2. The fuse holder (R10) is located below the 3-pole power connector of the mains jack (R8). Release the fuse holder by pressing its plastic retainers with the aid of a small screwdriver. The retainers are located on the right and left side of the holder and must be pressed towards the center.
3. Replace the defective fuses (R11) and press in the fuse holder until locked on both sides. Take care to maintain the correct rotation of the white line voltage indicator / switch (R9) which contains the left fuse and is plugged into the fuse holder. The appropriate line voltage marking must be visible in the cutout (R7) of the fuse holder.

Fuse types

100 V	500 mA, time-lag, 250V	T0.5A250V
115 V	500 mA, time-lag, 250V	T0.5A250V
230 V	250 mA, time-lag, 250V	T0.25A250V

All fuses must meet IEC specification 60127-2/III, time characteristic: time-lag (T), 250V AC, size 5 x 20 mm.

4.3 Troubleshooting

In case that your TED200C Controller shows malfunction please check the following items:

- ❑ Unit does not work at all (no display at the front):
  - o TED200C connected properly to the mains?
    - Check the power cord and the line voltage setting
  - o TED200C turned on?
    - Turn on your TED200C Controller (button "LINE" F11).
  - o Check the fuses at the rear panel.
    - If blown, replace the fuses with the correct type.
- ❑ The display works but you don't get the desired operation temperature
  - o Is the hardware current limit I_{LIM} set to 0?
    - Adjust the hardware limit "LIM I" (F12) on the front panel to an appropriate value.
  - o Is the TEC connected properly to the TEC output?
    - Check all cables.
    - Check the correct polarity
  - o Is the temperature sensor connected properly and is the sensor type selected correctly?
    - Check the corresponding connections and polarities of the temperature sensor.
    - Select the corresponding temperature sensor by pressing key F25.
    - Adjust the right set value for T_{SET}
- ❑ After pressing "TEC ON" the unit beeps and the error LED "OPEN" lights up
  - o Is the TEC connected properly to the TEC output?
    - Check all cables.
- ❑ The operation temperature is oscillating
  - o Are the control loop parameters of the PID control loop adjusted correctly ?
    - Set the P share, D share and I share appropriate to the thermal load
- ❑ The unit switches on, but display shows error message (e.g., "Err06")
  - o This indicates a malfunction of the TED200C. In such case, the controller needs to be returned to Thorlabs for maintenance. Please contact Thorlabs with the information of the error code number and the serial number of your TED200C in order to receive the RMA (Return Material Authorization) instructions accordingly.

If you don't find the error source by means of the trouble shooting list please contact Thorlabs for advise and/or return instructions

5 Appendix

5.1 Technical Data

TEC Current Output		
Control Range	0 to ±2 A	
Compliance Voltage	>6 V	
Maximum Output Power	12 W	
Measurement Resolution	1 mA	
Measurement Accuracy	±10 mA	
Noise and Ripple (typ.)	<1 mA	
TEC Current Limit		
Setting Range	0 to >2 A	
Resolution	1 mA	
Accuracy	± 20 mA	
Thermistor Sensors [2])		
Control Range	10 Ω to 20 kΩ	100 Ω to 200 kΩ
Resolution	1 Ω	10Ω
Accuracy	±10 Ω	±100 Ω
Temperature Stability 24 hours [3])	<0.5 Ω	<5 Ω
IC Sensors (Transducers)		
Supported Sensors	**AD590, AD592, LM135, LM335**	
Control Range with AD590, LM135	-45 °C to +145 °C	
Control Range with AD592	-25 °C to +105 °C	
Control Range with LM335	-40 °C to +100 °C	
Resolution	0.01 °C	
Accuracy	±0.1 °C	
Temperature Stability 24 hours	<0.002 °C	
Temperature Control Input		
Input Resistance	10 kΩ	
Control Voltage	-10 V to +10 V	
Transmission Coefficient Thermistor	2 kΩ/V ± 5 %	20 kΩ/V ± 5 %
Transmission Coefficient IC-Sensors	20 °C/V ± 5%	
Temperature Monitor Output		
Load Resistance	>10 kΩ	
Transmission Coefficient Thermistor	500 mV/kΩ ± 5 %	50 mV/kΩ ± 5 %

Transmission Coefficient IC-Sensors	50 mV/°C ± 5 %

General Data	
Safety Features	TEC Current Limit Short Circuit when TEC off Missing Sensor Protection Open Circuit Detection Over Temperature Protection
Display	LED, 5 Digits
Connector for Sensor, TE Cooler, TEC On Signal:	15-pin D-Sub Jack
Connectors for Control Input / Output	BNC
Chassis Ground Connector	4mm Banana Jack
Line Voltage	100 V 115 V +15% / –10% 230 V
Line Frequency	50 to 60 Hz
Mains Supply Overvoltage	Category II (Cat II)
Maximum Power Consumption	60 VA
Operating Temperature Range [1])	0 °C to +40 °C
Storage Temperature Range	-40 °C to +70 °C
Relative Humidity	Max. 80% 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
Dimensions (W x H x D) w/o Operating Elements with Operating Elements	 146 x 66 x 290 mm³ 146 x 77 x 320 mm³
Weight	<3.1 kg

[1]) non-condensing

[2]) Temperature Control Values for thermistors are given in Ω since the controlled parameter is the resistance, not the temperature

[3]) Due to the nonlinear conversion from Ω to °C the stability in °C depends on the operating conditions and the characteristics of the thermistor. E.g. for a typical thermistor at a set point of 10kΩ (25°C), a 0.5Ω stability translates into about 1mK temperature stability. At a set point of 5kΩ (38°C), the stability is about 2mK.

All technical data are valid at 23 ± 5°C and 45 ± 15% rel. humidity (non condensing)

5.2 Declaration of Conformity

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs GmbH

Of: Hans-Boeckler-Str. 6, 85221 Dachau/München, Deutschland

in accordance with the following Directive(s):

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***TED200C***

Equipment: ***Benchtop Laser Diode Temperature Controller***

is in conformity with the applicable requirements of the following documents:

EN 61010-1	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.	2010
EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed:  *On:* 26 June 2015

Name: Dorothee Jennrich

Position: General Manager

EDC - TED200C -2015-06-26

CE 15

This product was tested for and complies with the following standards:

- CAN/CSA-C22.2 No. 61010-1-04
- ANSI/UL 61010-1-2004

5.3 Warranty

Thorlabs warrants material and production of the TED200C 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. 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/or 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 fault free and uninterrupted operation of the unit, of the software 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 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.

5.4 Exclusion of Reliability and Copyright

Thorlabs has taken every possible care in preparing this document. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this document is regularly updated and adapted to reflect the current status of the hardware and/or software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.

Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.

Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.

Please note that the content of this document is neither part of any previous or existing agreement, promise, representation or legal relationship, nor an alteration or amendment thereof. All obligations of *Thorlabs* result from the respective contract of sale, which also includes the complete and exclusively applicable warranty regulations. These contractual warranty regulations are neither extended nor limited by the information contained in this document. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the document, please contact your local *Thorlabs* dealer or system installer.

5.5 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 below)
- 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.).

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.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment 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.

Crossed out "Wheelie Bin" symbol

5.6 Thorlabs Worldwide Contacts

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