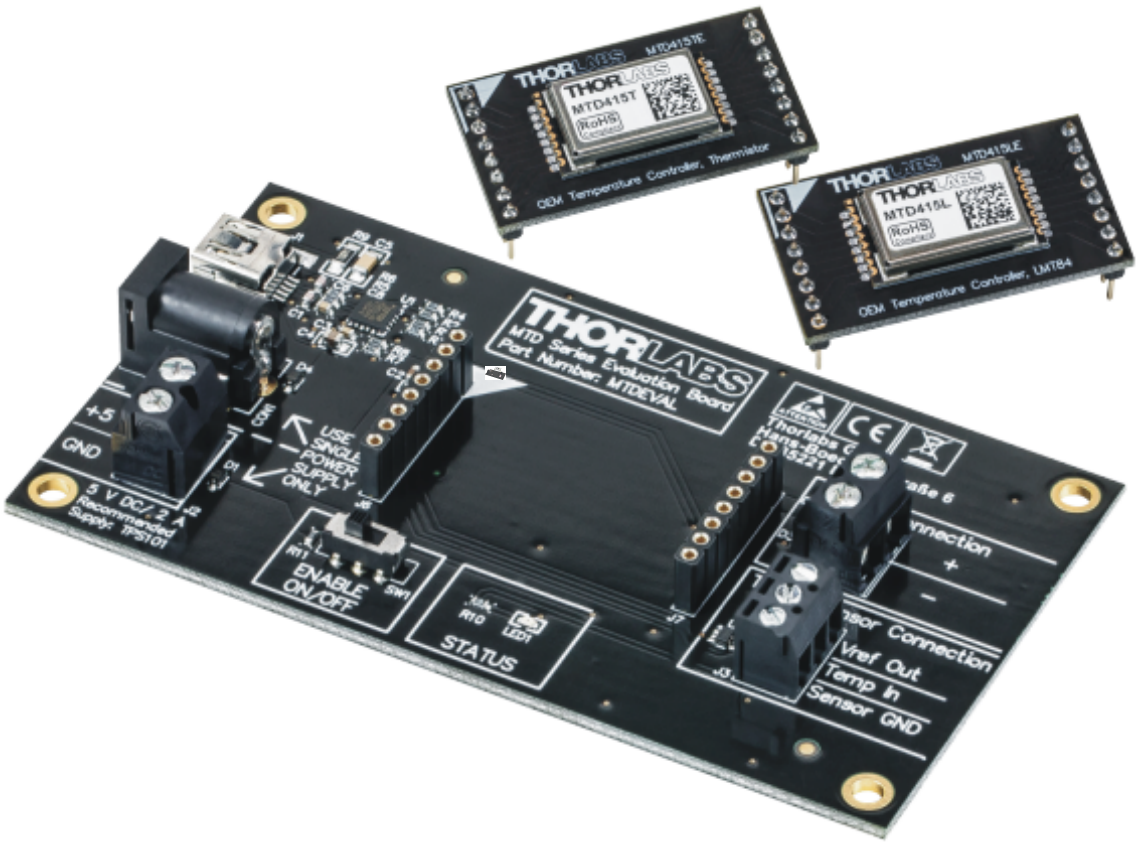
THORLABS

Miniature TEC Driver Evaluation Board

MTDEVAL User 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 MTDEVAL is designed for evaluation of a module of the MTD415 Miniature Laser Driver Series. It has a socket to accommodate a daughterboard with mounted MTD415 TEC controller. There are available two types of TEC controllers (see section Ordering Codes and Accessories) that need to be ordered separately.

Screw terminals allow to connect the TEC and the temperature sensor.

The MTD415x TEC controllers need to be programmed for a number of parameters via a UART interface. To ease evaluation, the MTDEVAL incorporates an UART-to-USB adapter that allows to use a standard USB2.0 connection to the control PC. Thorlabs GmbH offers an easy-to-use software that interfaces the MTDEVAL to the GUI. Using this software, the MTD415x TEC controller settings can be evaluated and adapted to the particular thermal load.

The MTDEVAL is powered by a Thorlabs TPS101 wall-plug adapter (recommended). Alternatively, any stabilized 5 V / min. 1.6 A DC power supply can be used.

Note

Do not use both DC power supply inputs simultaneously! This will damage the MTDEVAL!

The links to the MTD415 Series Data Sheets can be found in section Documentation Reference.

1.1 Safety

Attention

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

Prior to apply power to the MTDEVAL, make sure that the switch SW1 (ENABLE ON/OFF) (see section Operating Elements) **is switched off.**

The MTDEVAL must not be operated in explosion endangered environments!

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

Follow the common recommendations for handling of ESD sensitive devices when installing a MTD415xE Miniature TEC Driver daughterboard.

1.2 Ordering Codes and Accessories

Ordering Code	Description
MTDEVAL	Evaluation Board for MTD415 Miniature TEC Driver Series

Optional Accessories

- MTD415LE TEC Controller, on daughterboard, LMT84 temperature sensor
- MTD415TE TEC Controller, on daughterboard, thermistor temperature sensor
- USB-AB-72 USB A to Mini B Cable, length 72" (1.83 m)
- TPS101 Power Supply Unit 5 V, 2.0 A

Note

The TEC controllers and the temperature sensors are not included with the MTDEVAL. They need to be ordered separately!

1.3 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 MTDEVAL mechanically and electrically.

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

1. MTDEVAL Evaluation Board

1.4 Requirements

These are the requirements for the PC intended to be used for remote operation of the MTDEVAL.

Hardware Requirements

CPU:	1 GHz or higher
RAM:	512 MB
Graphic resolution	min. 1024 x 768
Hard disc	min. 1 GB of available disk space (32 bit) min. 2 GB of available disk space (64 bit)
Interface	free USB2.0 port, USB cable according the USB 2.0 specification

Software Requirements

The MTDEVAL software is compatible with the following operating systems:

- Windows® 7 (32-bit, 64-bit)
- Windows® 8.1 (32-bit, 64-bit)
- Windows® 10 (32-bit, 64-bit)

For operation of the MTDEVAL, the Microsoft .NET Framework V 4.5.1 or later is required. This software (V 4.6.1) is included with the MTDEVAL installation package.

2 Getting Started Quickly

For proper operation of the MTDEVAL, please observe the order of the following steps:

1. Install the software to your computer.
2. Install the daughterboard (MTD415LE or MTD415TE) to the MTDEVAL.
3. Connect the TEC and the temperature sensor.
4. Make sure that switch SW1 (**ENABLE ON/OFF**) is set to **OFF** (right position).
5. Connect the power supply.
6. Establish the USB connection to the PC.

3 Operating Principle

The MTDEVAL - in combination with MTD software - is a comfortable developer tool that allows to adjust the MTD415x parameters to the operation environment, such as target temperature, allowed temperature deviation, etc.

The MTD software offers an intuitive GUI that allows to optimize the operating parameters and save the result to a file and / or to the MTD415x Miniature TEC Driver module. The MTDEVAL connects the MTD415x module (UART interface) with the PC by an USB2.0 interface.

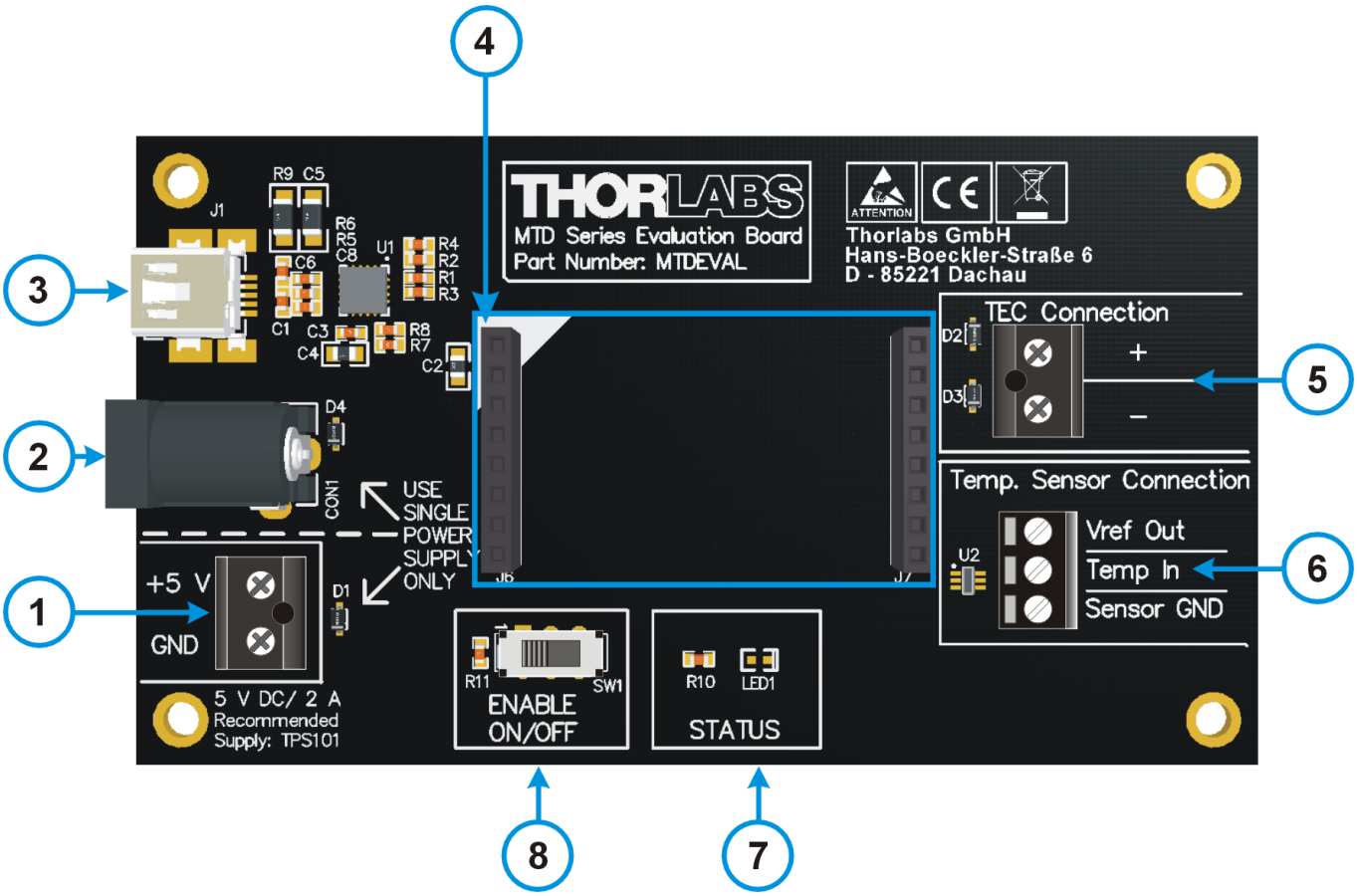
It is important to understand the memory structure of the MTD415x module. It comprises of a volatile and a non-volatile (flash) memory.

The flash memory keeps the information independently of the power supply. It has a limited number of write-erase cycles. For the reason of lifetime extension, the actual parameters are not saved automatically to the flash, but to a temporary volatile memory instead. A special command allows to transfer then the entire content of temporary memory to the flash. The parameters in the volatile memory are used for operation only during the actual session. With power-down, this memory is cleared.

When power-up the MTDEVAL, the data from the flash memory are read out to the volatile memory.

The MTD software sends parameters only to the volatile memory. At any time, the actual configuration can be transferred to the non-volatile flash memory or can be saved to an XML file on the PC.

4 Operating Elements



1	Screw terminal for external DC power supply 5 V DC ± 5 %, recommended 2 A
2	Jack for connecting the TPS101 power supply (5 V DC / 2.0 A)
Attention! **Do NOT use both power supplies at once!** Use either the screw terminal **OR** the TPS101! Otherwise, the MTDEVAL will be damaged!	
3	USB terminal for external PC control. No power supply here!
4	**J6** and **J7** - Sockets for adapter PCB. The white triangle marks pin 1 of the adapter
5	Screw terminal for TEC connection.
6	Screw terminal for temperature sensor connection. See section Preparation.
7	Status LED
8	**SW1 ENABLE** - switch TEC ON / OFF

Power Supply Connection

The MTDEVAL consumes up to 1.6 A, depending on the TEC current. For this reason, it cannot be powered via the USB connection.

There are two alternative ways to power the MTDEVAL:

1. Thorlabs GmbH recommends to use the power supply TPS101. Connect it to the MTDEVAL using the jack 2 in above figure.
2. Any external DC power supply that delivers (5 ± 0.25) V DC and at least 1.6 A (recommended: 2 A) can be connected to the terminal 1. Take care for correct poling.

Do **NOT** use both power supplies at the same time - this will damage the MTDEVAL!

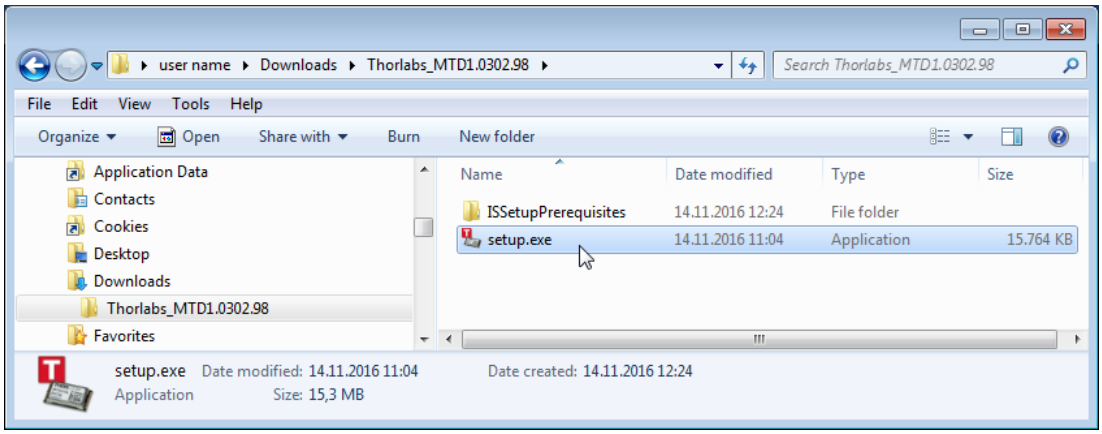
5 Installing Software

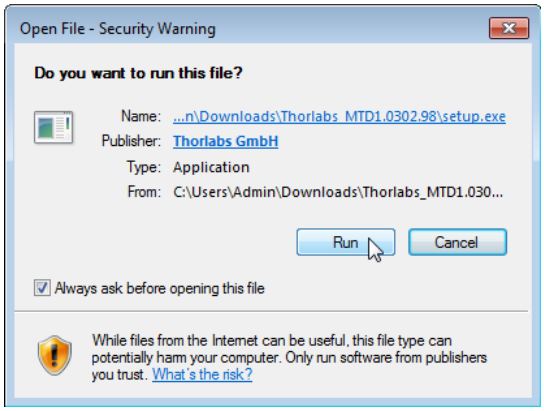
The MTDEVAL control software can be downloaded from our web site https://www.thorlabs.com/software_pages/ViewSoftwarePage.cfm?Code=MTDEVAL.

Note

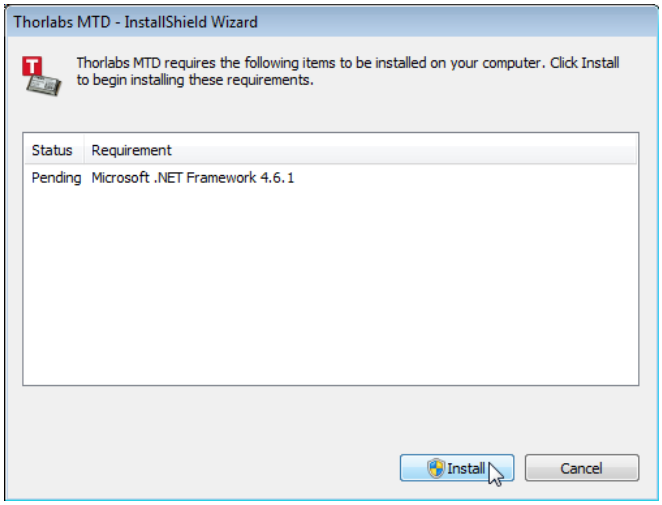
It is strongly recommended to exit all applications on the PC prior to starting the software installation!

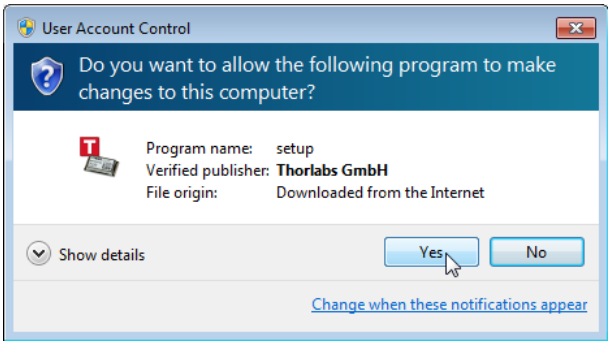
Unzip the downloaded package and execute the setup.exe that can be found in unzipped folder:

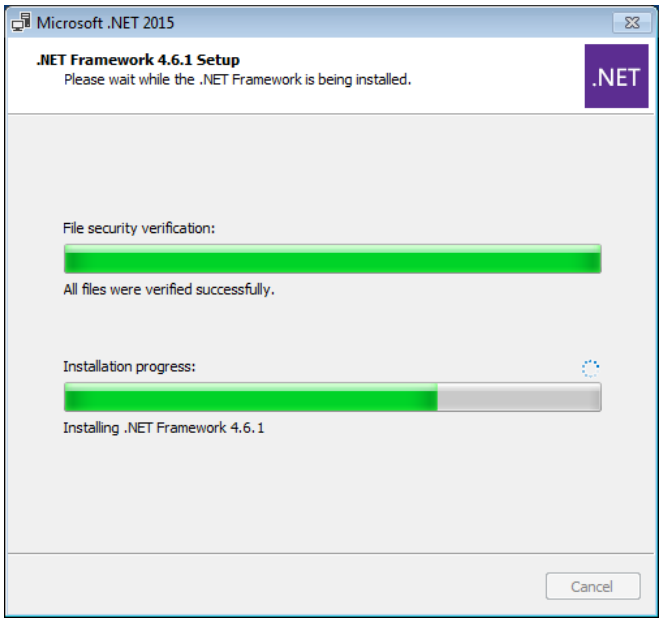


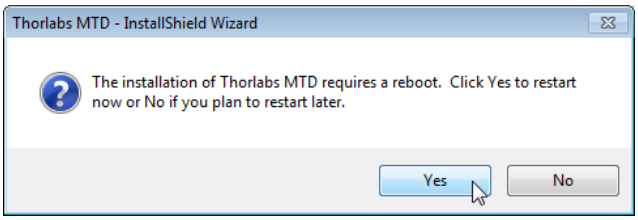


If no .NET Framework is installed or a version older than V 4.5.1 is detected on the computer, you will be prompted for installation:

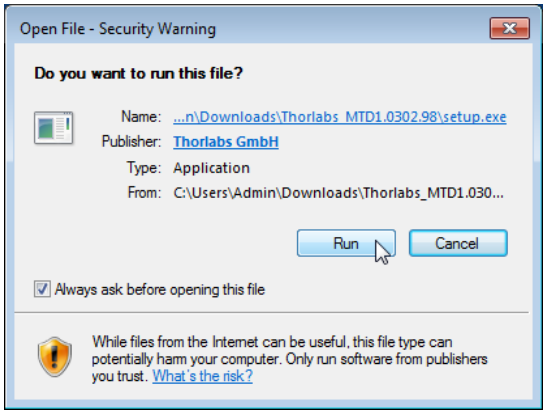


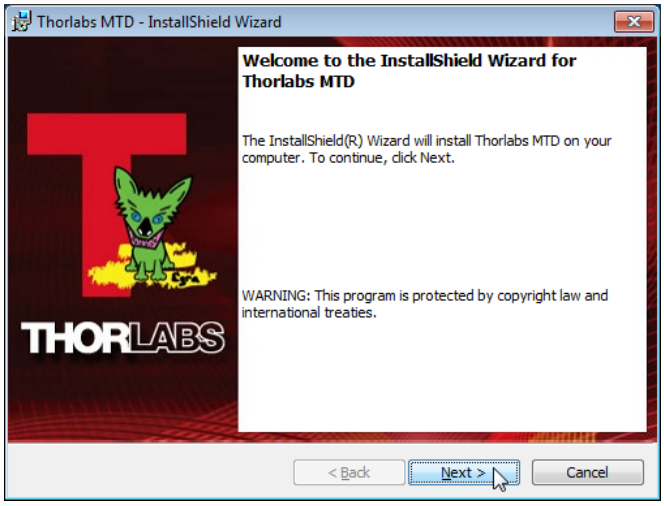






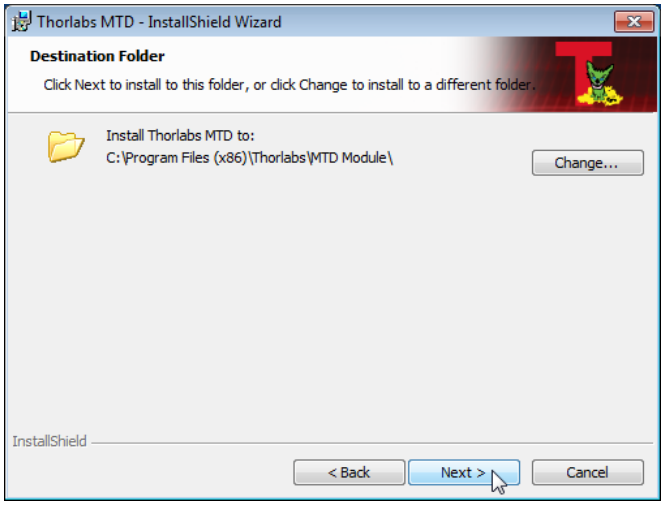
If you are prompted to reboot the computer, please do so.
Note The reboot is required to ensure a proper operation of the MTDEVAL!
After rebooting, the installer automatically resumes installation:



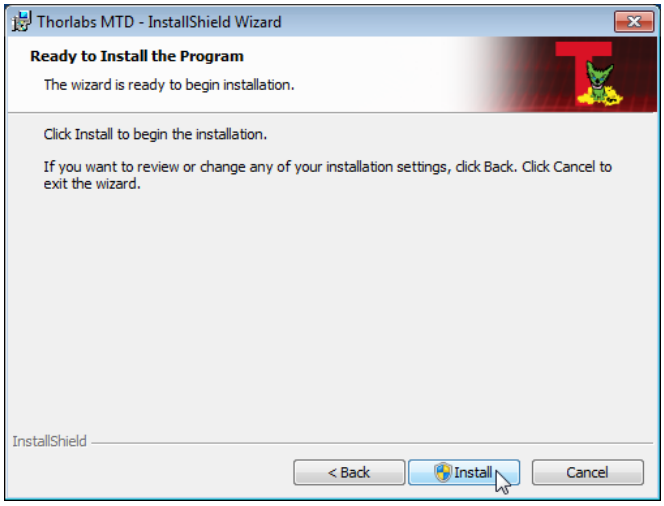


Click '**Next >**' to continue.

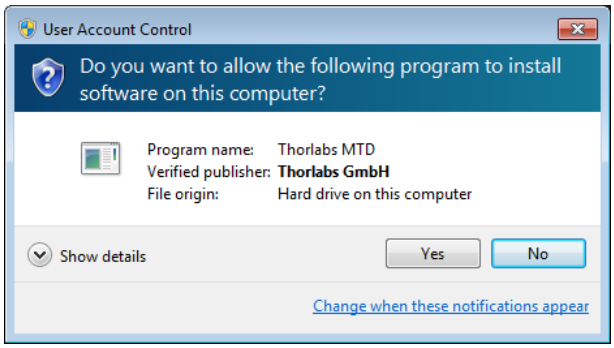
Click '**I accept**...' if you do so, then '**Next >**' to continue.



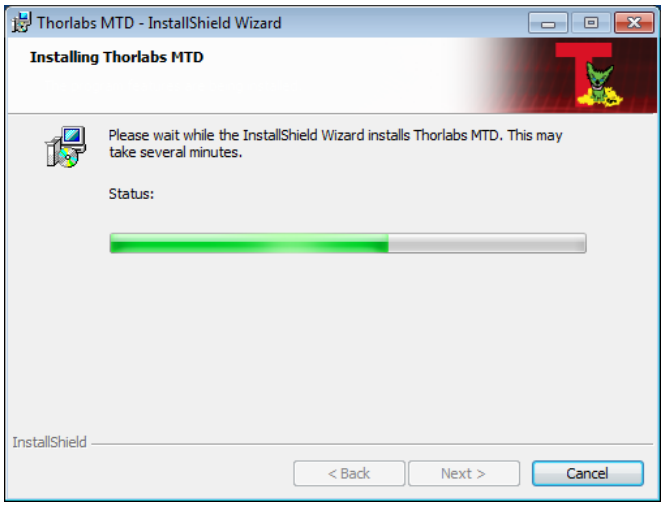
Click '**Next >**' to continue.

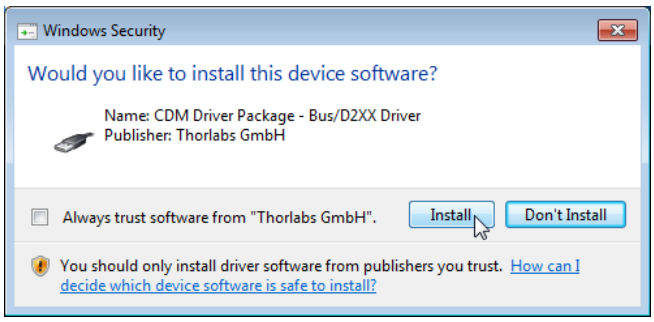


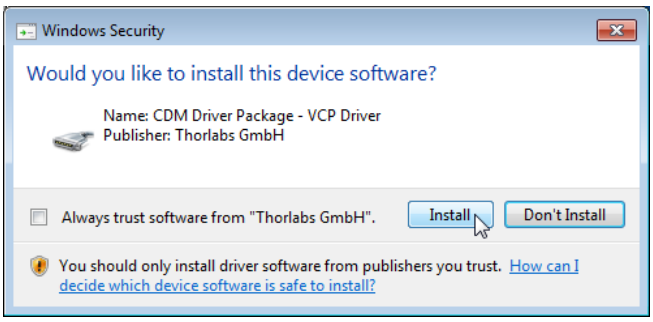
Click '**Install**' to continue.



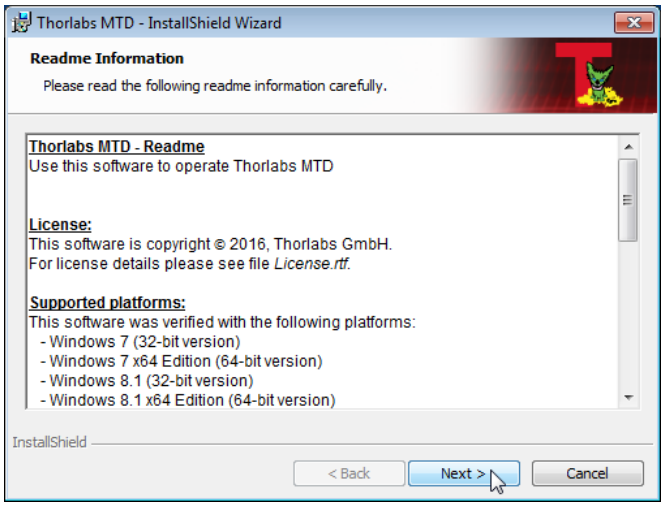
Click '**Yes**' to install the MTD software.



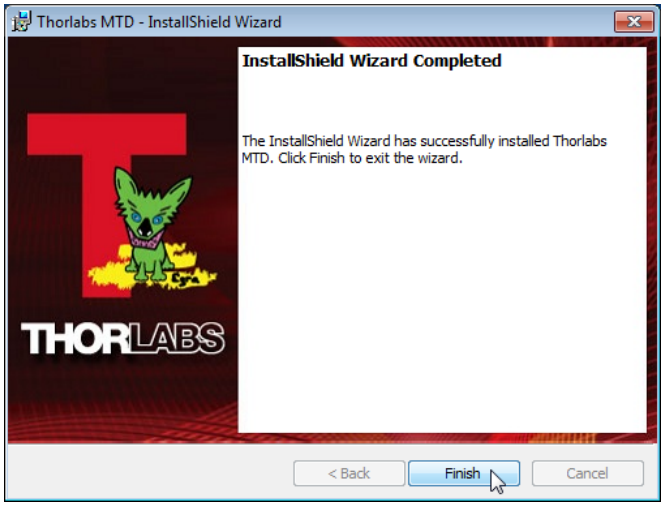




Click '**Install**' to continue.



Click '**Install**' to continue.



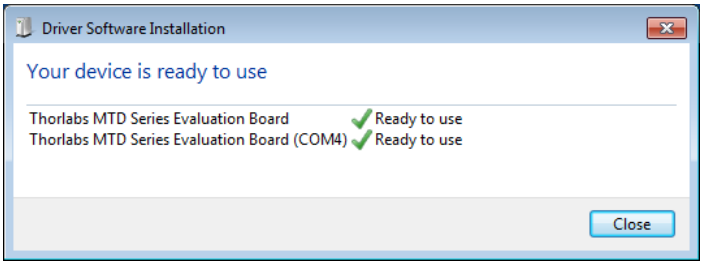
Click '**Finish**' to complete the installation.

6 Preparation

Note

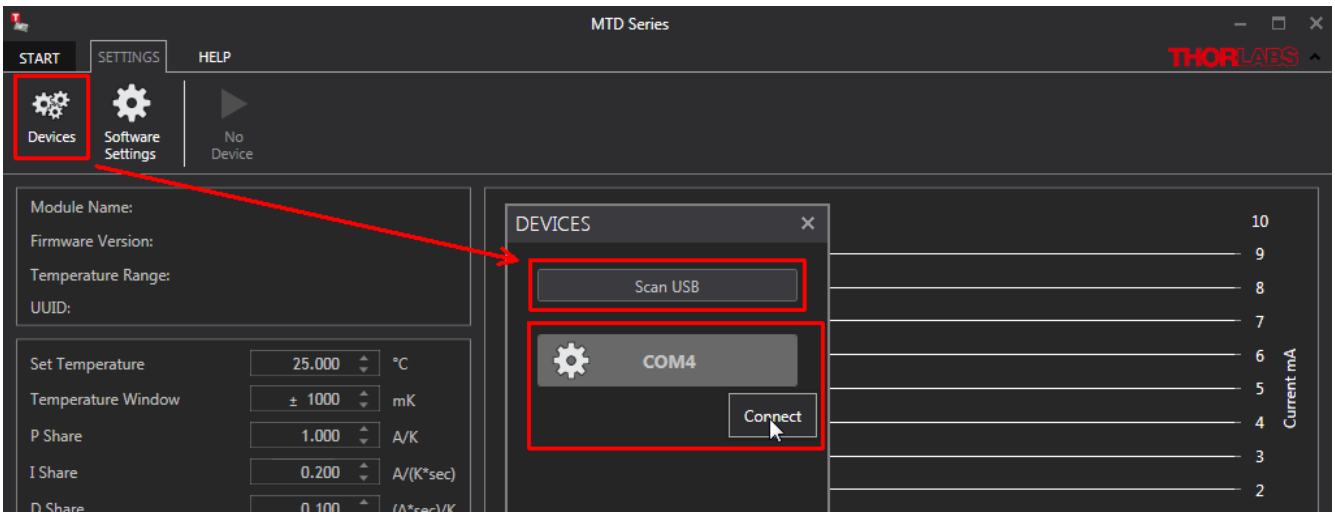
Do not connect the MTDEVAL to a PC prior to installing the software! This may lead to wrong installation of the driver software.

1. Install the daughterboard (MTD415LE or MTD415TE) to the MTDEVAL.
2. Connect the TEC and the temperature sensor.
3. Make sure that switch SW1 (ENABLE ON/OFF) is set to OFF (right position).
4. Connect the power supply.
5. Establish the USB connection to the PC
6. The hardware is recognized and the driver software is being installed:



Click the desktop icon to start the GUI:

The GUI starts:



Click "Devices" in the toolbar, then in the pop-up window "**Scan USB**". The found virtual COM-Port is shown; click to it to connect the MTDEVAL. Then close the **Devices** window.

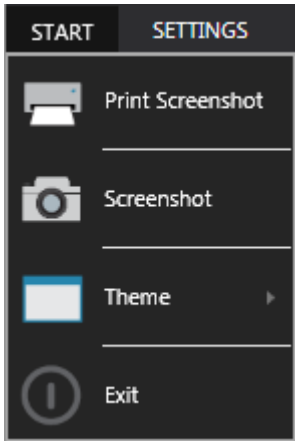
7 GUI Overview

After connection of the MTDEVAL, the device information and actual settings are read out from the MTD415x non-volatile memory (flash). The GUI will be filled in with these data. Additionally, the actual status is read out and displayed.

1. Menu bar
2. Tool bar
3. Device information
4. MTD415x Program parameters
5. Functional buttons
6. Graphic chart with selectable parameters vs. time
7. Actual read-out values
8. Status bar
9. Displayed error message

7.1 Menu Bar

Menu Start



This menu has four entries:

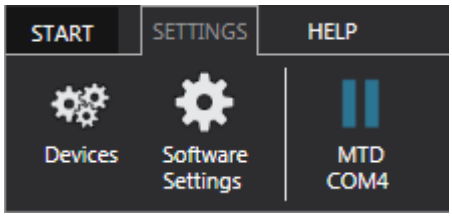
Print Screenshot opens a dialog window with a screenshot of the software in order to print it to a system printer.

Screenshot opens a dialog to save a screenshot as *.jpg to a selectable file folder.

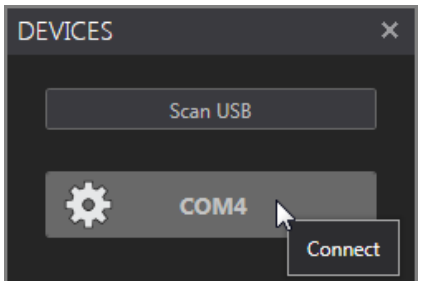
Theme allows to change between **Dark** and **Light** software display.

Exit disconnects the MTDEVAL and closes the application.

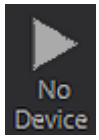
Menu Settings



Sub menu **Devices**



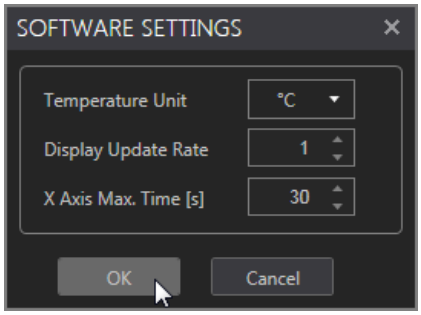
The software needs to be manually connected to the MTDEVAL. After starting, the ribbon shows the connect state:



Click to **Scan USB**. The USB port is scanned for a connected to a virtual serial port MTDEVAL and displays the findings. Click to the button that comes up, in order to connect the MTDEVAL.

After successful connection, the icon changes. Close the **Devices** window.

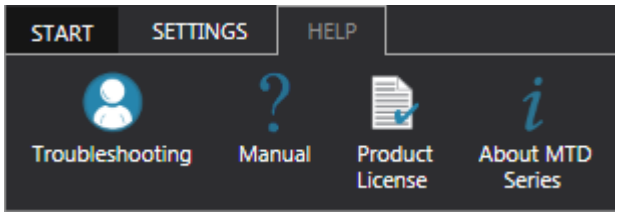
Sub menu **Software Settings**



- Select the Temperature unit to °C or °F.
- Select the Display Update Rate. The number indicates the number of Cycle Times between two subsequent display updates.
- Select the maximum time duration that shall be displayed in the chart (1 to 360 s)

Click **OK** to apply changes, or **Cancel** to discard.

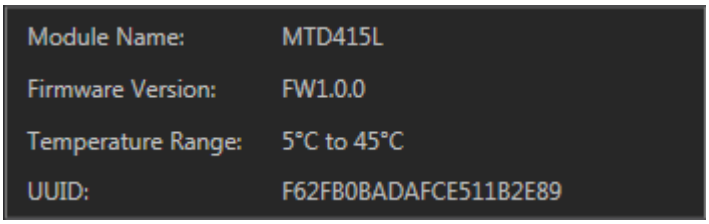
Sub menu **Help**



This menu has four entries:

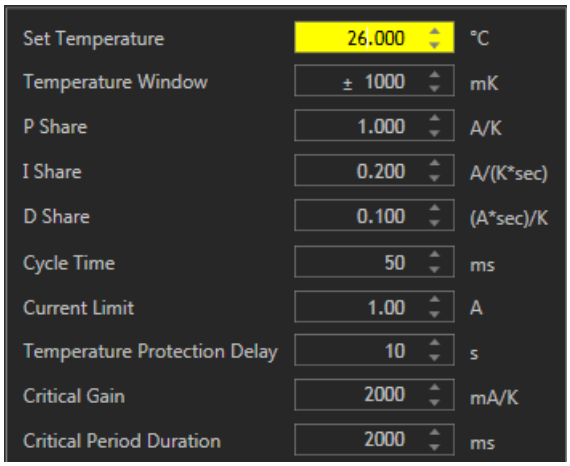
- **Troubleshooting...** opens a dialog window with several actions that can be undertaken:
  Contact Technical Support: shows the Thorlabs GmbH website with contact information.
  Save Logfile opens a dialog to save the log. It might be helpful to attach the log file when contacting Thorlabs GmbH Technical Support.
  System Info opens the System Information panel of the operating system.
- **Manual** opens this User Manual (PDF file).
- **Product License** opens the End User Agreement (RTF file).
- **About MTD Series** shows the **About** dialog:

7.2 Device Information



This panel displays individual information about the connected MTD415x module. The UUID is a unique number that identifies the hardware. When contacting Thorlabs GmbH for technical support, it is recommended to state the UUID.

7.3 Program Parameters

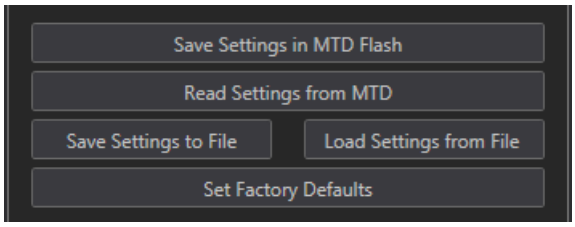


Here, the parameters can be set to program the MTD415x module.

Note

After entering a value, either by typing in the numerical value or by using the arrow buttons, the parameter is highlighted this way indicating that it must written to the MTD415x module. Press the Enter key. If multiple parameters were changed, by pressing the Enter key all parameters are sent to the MTD415X module.

7.4 Functional Buttons



Save Settings in MTD Flash This button writes all current settings of the MTD module RAM into the non-volatile flash memory. Use this function if you want to store your settings permanently to the MTD module.

Read Settings from MTD This button reads all current settings of the MTD volatile memory and displays them in the Program Parameters pane.

Save Settings to File Save actual GUI settings and the device information to a XML file on the PC.

Note

This function saves the information displayed in the GUI to a file, not the parameters stored in the MTD415x module!

Load Settings from File Load settings from a XML on the PC.

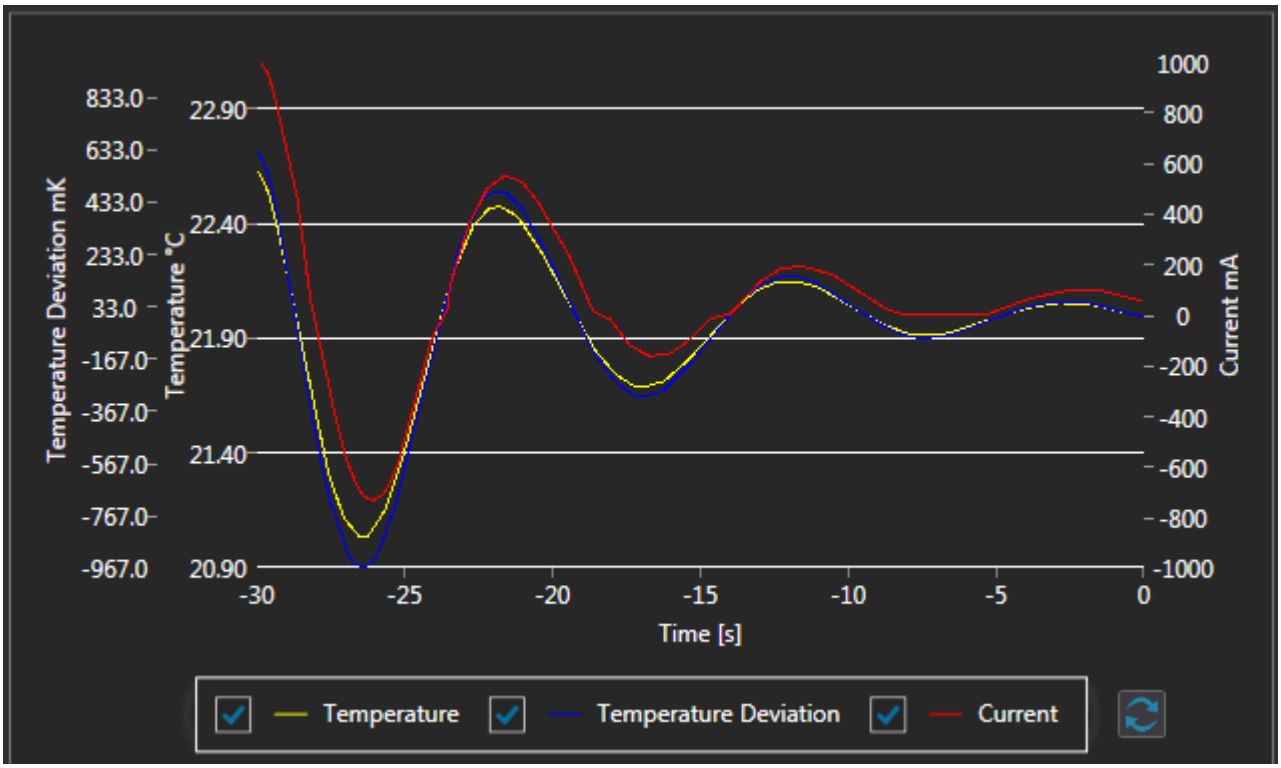
Set Factory Defaults Writes the factory default values (see table below) to the MTD415x module.

Parameter	Factory Default
Set Temperature	25.000 °C
Temperature Window	1000 mK
P Share	1.000 A/K
I Share	0.200 A/(K*sec)
D Share	0.100 (A*sec)/K
Cycle Time	50 ms
Current Limit	1.00 A
Temperature Protection Delay	10 s

Note

When setting the MTDEVAL to factory defaults, the Critical Gain and Critical Period Duration are not changed, as these are parameters that shall be defined during the oscillation test.

7.5 Graphic chart



In the graphic chart, up to three curves can be displayed:

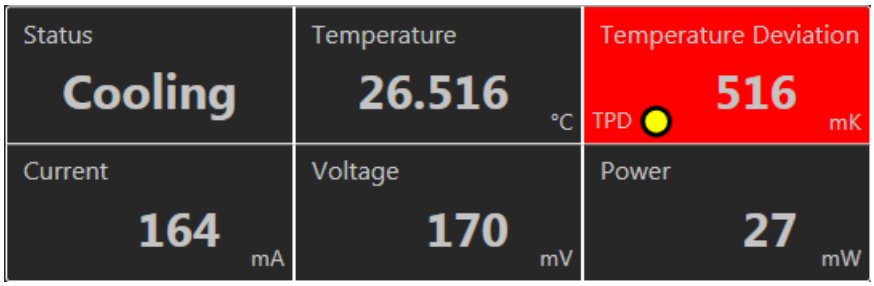
- Actual temperature in °C or °F. The unit can be selected in Software Settings.
- Temperature deviation in mK
- TEC current

The most recent value is displayed to the left. Each of these curves can be disabled by unchecking the appropriate box below the chart.

The time base can be set between 1 and 360 s. Please note, that the longer the time base the more data need to be accumulated. This may lead to a slow-down of the software.

To clear the chart, click the button.

7.6 Read-Out Values



Status Indicates the TEC status - cooling, heating, or disabled (if the enable switch is set to OFF)

Temperature Actual temperature

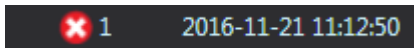
Temperature Deviation Deviation of the actual temperature from the set value.

Note

If the temperature deviation exceeds the value that is set as **Temperature Window**, this box turns into red and the TPD (Temperature Delay Protection) indicator turns yellow, the status LED is OFF. After the actual temperature remains within the temperature window at least for the TPD time interval (to be set in Program Parameters pane), this box turns to normal view:

The lower row indicates the TEC current, the voltage across the TEC and the TEC input power.

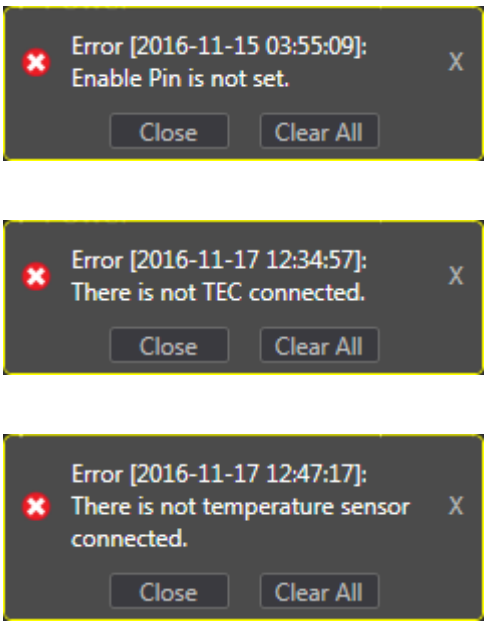
7.7 Status Bar



In the status bar normally only the current date and time are displayed. If an Error appears, a notification comes up, showing the number of actual error message.

7.8 Error Messages

If an error appears, it will be displayed in the GUI as a pop-up message that contains the error description and the time stamp, for example:



Additionally, in the status bar a notification is displayed: 1

Click **Close** to remove the error message from the GUI. Click **Clear All** to reset the MTD415x internal error register.

Note

Closing an error message does not clear the MTD415x error register, it just makes the message disappear from the GUI foreground. In this case, the status bar notification remains.

Only **Clear All** will reset the error register and delete the notification. Clearing the error register is mandatory to resume normal operation. Alternatively, switch **SW1** off and on again.

Example

The TEC connection was interrupted. The TEC current is switched off, and the appropriate error message is displayed.

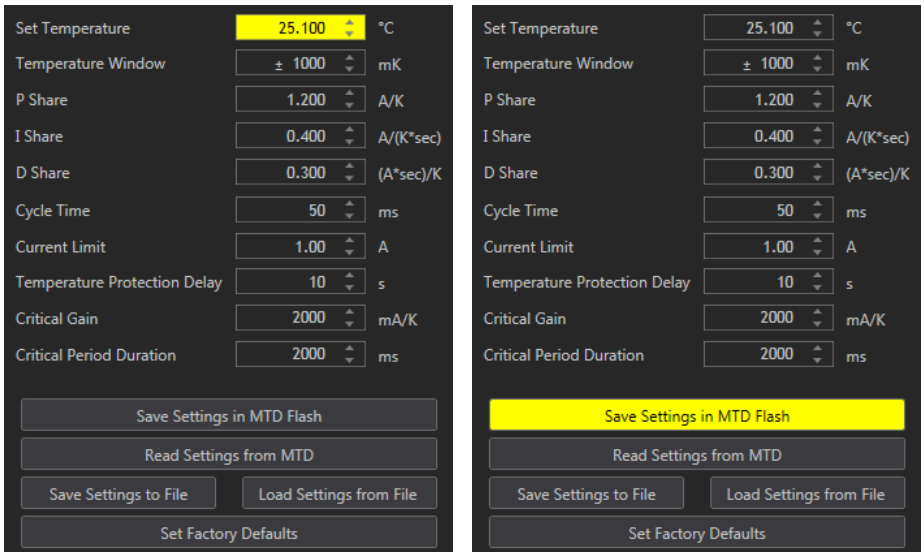
Reconnect the TEC. The MTD415x will resume operation only after clicking to **Clear All** or by switching OFF and ON again the enable switch (8).

8 Operating a MTD415xE Module

8.1 Common Rules

Please remember the memory structure of the MTD415x modules:

- The volatile memory.
  Parameters in this memory are used temporarily for operation for the current power-on session. If the module is powered down, these parameters are lost and upon a new power-on, the data from the flash (non-volatile memory) are read out and applied.
- The flash memory.
  Parameters stored to the flash are permanent. As the flash memory has a limited number of erase-write cycles, there is a separate command to transfer manually the data from the volatile memory into the flash.



When a parameter was changed, it will be highlighted. Press the **Enter** key to apply changes to the MTD415x. The parameter is sent to the volatile memory and applies now. This function can be used to change multiple parameters at once - just click to one of the highlighted parameters an press **Enter**.

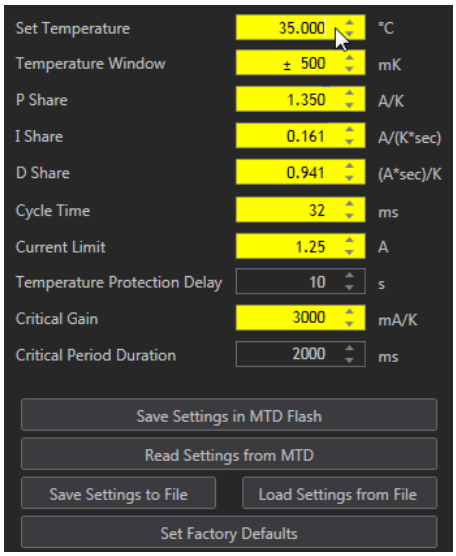
Additionally, the button **Save Settings in MTD Flash** is highlighted. This indicates that parameters are in use that have not been saved to the flash yet.

Further, if one or more parameters are modified, you can press the **Save Settings in MTD Flash** button - this will write all parameters in the list to the flash **and** to the volatile memory as well.

Save Settings to File reads the displayed information (device information and parameters) ***from the GUI*** and saves them to a file. In other words, this function does not read the actual parameters from the MTDEVAL!

Load Settings from File loads the information from the selected file to the GUI. In this case, the GUI content is compared to the content of the volatile memory of the MTD415x module and differing parameters are highlighted. In order to apply them, you can press **Enter** (parameters are written to the volatile memory only) or click the **Save Settings in MTD Flash** button (parameters are written to the volatile memory **and** to the flash).

Example



You have loaded settings from a file.
You will see the differing from the previous settings highlighted. Now you have the choice:

1. You can press the **Save Settings in MTD Flash** button to transfer the new data to the volatile memory **and** to the flash. This way, all changed parameters become active and will be saved permanently.

2. Click to one of the highlighted parameters and press the **Enter** key. This way, all changed parameters become active, but they are not stored to the flash.

8.2 Oscillation Test

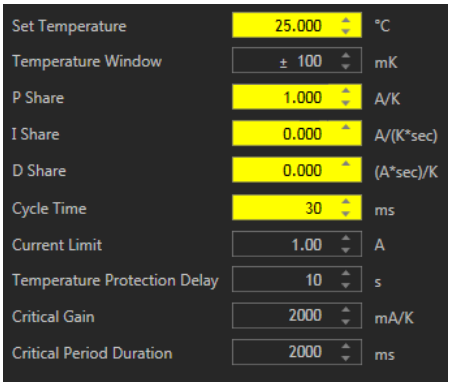
The MTD415x modules incorporate a digital PID controller. The P, I and D shares can be programmed manually or calculated automatically by the firmware by entering the results of a loop oscillation test. Below an example procedure is explained in detail.

The oscillation test is an convenient method to optimize the PID loop parameters.

Pre-conditions:

- TEC current limit is set to 1 A
- All connections are made properly
- For convenient observation
  - Set the Temperature Window to ±100 mK;
  - Set the temperature chart X Axis maximum time to 60 s and display only the actual temperature.

1. Initial settings of the PID loop:

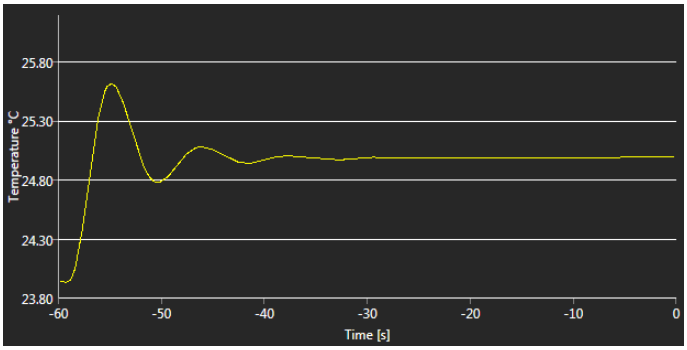


Set temperature	25°C
P share	1000 mA/K
I share	0
D share	0
Cycle time	30 ms

Press the **Enter** key to write the parameters to the MTD module.

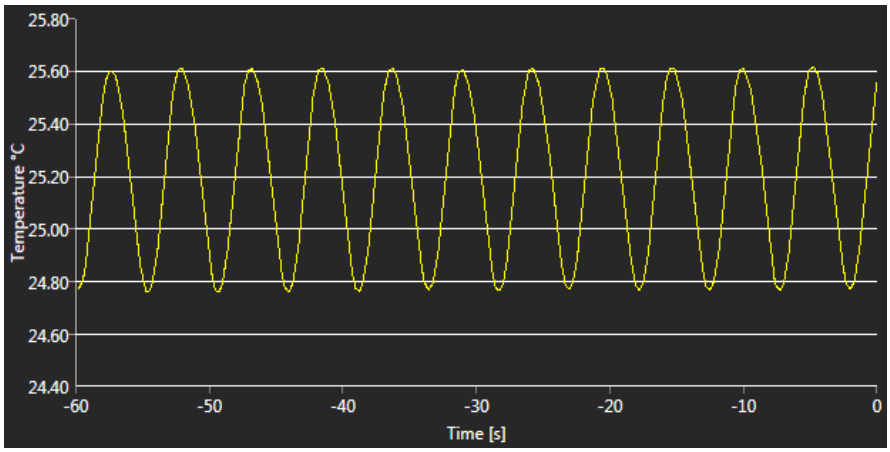
2. Enable the TEC. The actual temperature approximates the set value.
3. Now, find the critical P share (critical gain) value at which the system starts to oscillate for a minimum of 20 cycles without amplitude drop as a reaction to a changed set temperature.
4. The procedure is simple. With I and D share set to 0, the P share is set first to a sufficient high value in order to ensure that the loop oscillates. Decrease the P share until the loop shows damped oscillations. Then approximate the value of the P share until the critical value is found - this is the minimum P share at which the loop oscillates permanently. Each time the P share is changed, the set temperature needs to be changed for a small amount in order the trigger the loop. Below an example experiment is described in detail:

- After enabling the TEC with initial setting, the temperature is settling:



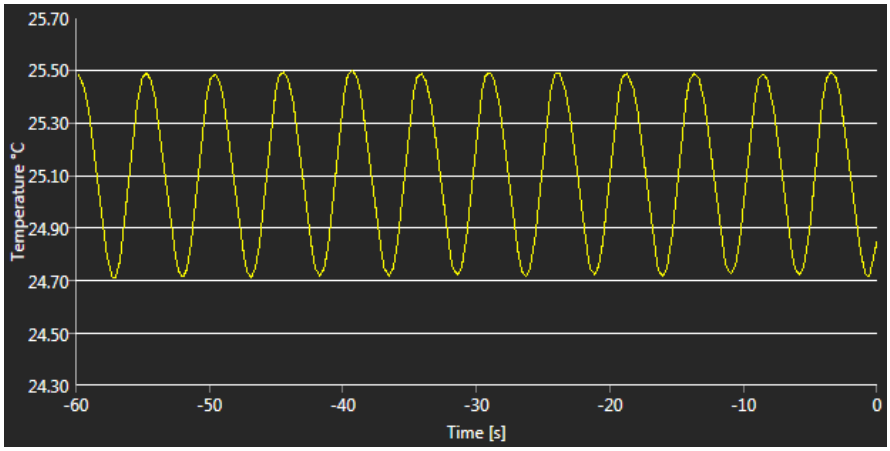
P=1000; T=25.0°C

- Set P to 10,000 mA/K; increase the set temperature for 0.1 K to 25.1 °C - the loop shows strong oscillations:



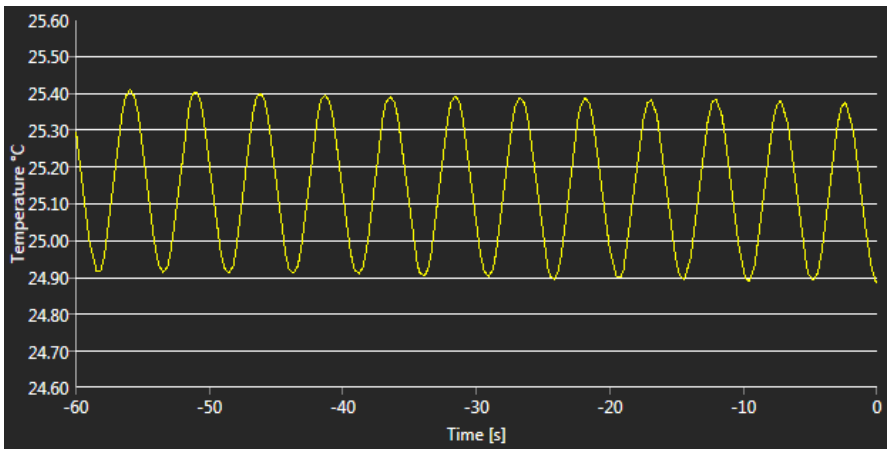
P=10000; T=25.1 °C

- Lower P to 5000 mA/K; decrease the set temperature to 25.0 °C - the loop still oscillates:



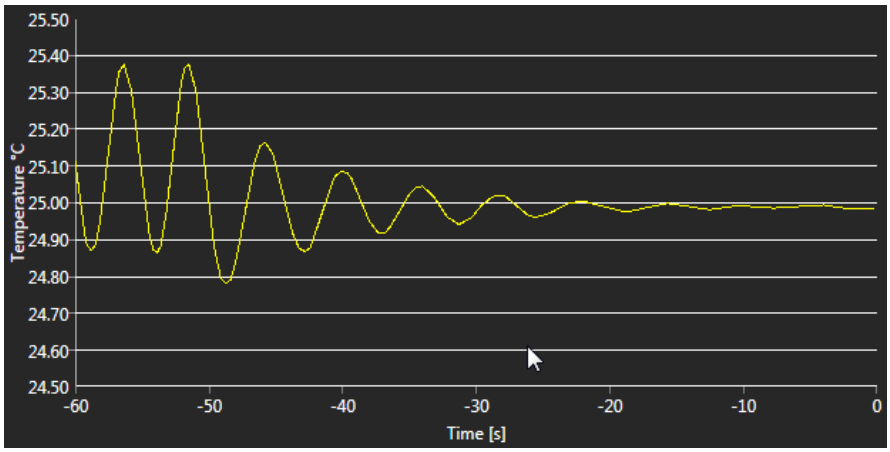
P=5000; T=25.0 °C

- Lower P to 3000 mA/K; increase the set temperature to 25.1 °C - the loop still oscillates:



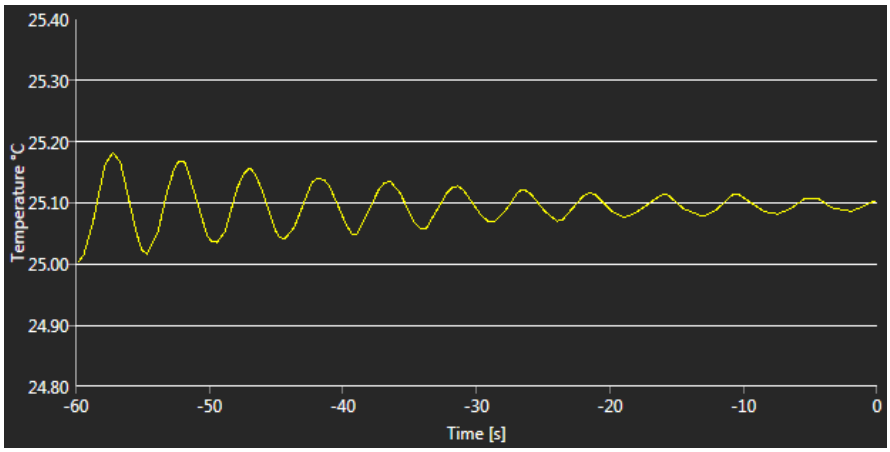
P=3000; T=25.1 °C

- Lower P to 2000 mA/K; decrease the set temperature to 25.0 °C - the loop shows damped oscillations:



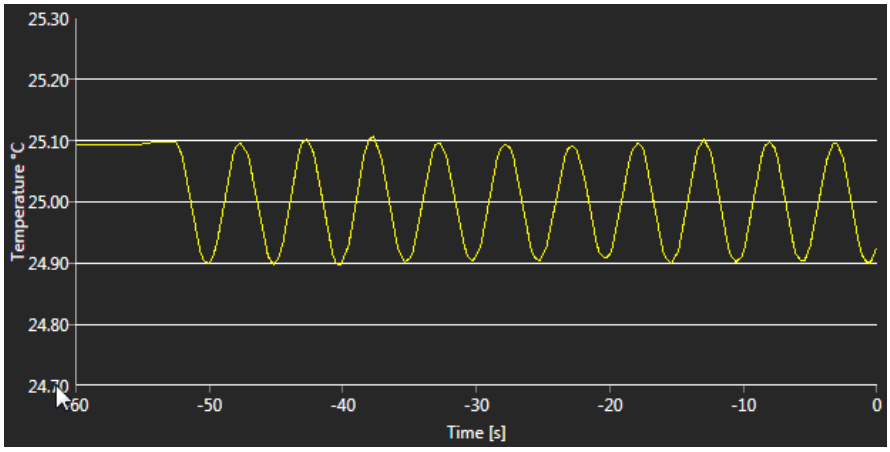
P=2000; T=25.0 °C

- Increase P to 2600 mA/K; increase the set temperature to 25.1 °C - the loop oscillations are still damped:



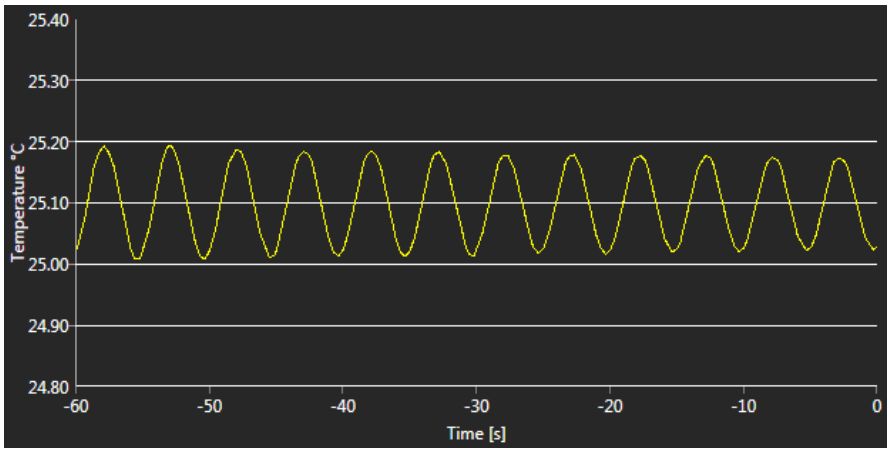
P=2600; T=25.1 °C

- Increase P to 2800 mA/K; decrease the set temperature to 25.0 °C - the loop oscillates again:



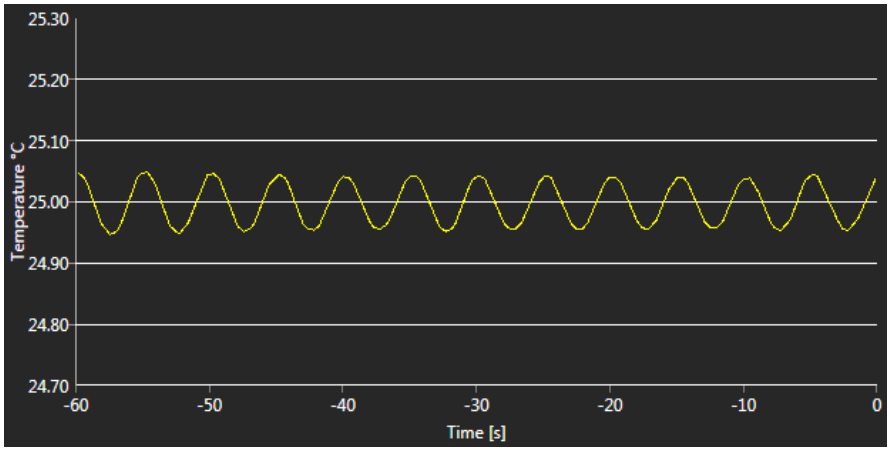
P=2800; T=25.0 °C

- Lower P to 2700 mA/K; increase the set temperature to 25.1 °C - the loop still oscillates:



P=2700; T=25.1 °C

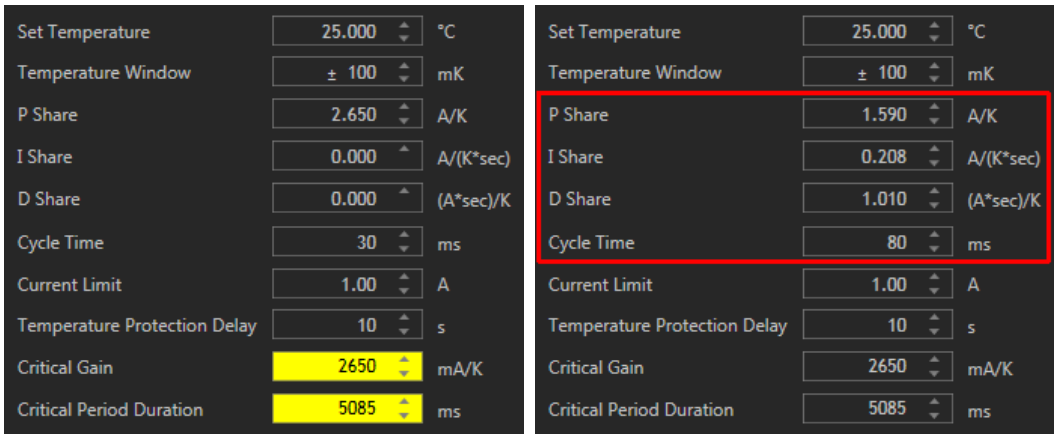
- Lower P to 2650 mA/K; decrease the set temperature to 25.0 °C - the loop is still oscillating:



P=2650; T=25.0 °C

- At P = 2600 mA/K the loop was no more oscillating, at P = 2650 mA/K the oscillations came back.

5. The found P share value of 2650 mA/K is the **Critical Gain**. From above diagram, the **Critical Period** can be found: Over 60 s you can count approximately 11.8 periods. In other words, the duration of 1 period is ~ 5.085 s.
6. Enter these values in the GUI. Pressing the Enter key triggers the calculation of the PID shares and the cycle time by the firmware and immediately displays the calculated loop parameters:



7. Usually, at this point the PID optimization for the settling behavior is finished. If required, the PID values and the cycle time can be manually fine tuned in order to optimize the loop response to changes of the thermal load.
8. As a final step, save the settings to the non-volatile memory:

Notes

- The cycling time is the time base of the internal digital control loop and is calculated automatically by entering the critical gain and the critical oscillation period.
- If manually changing the cycling time, the firmware calculates the I and the D share anew.
- The optimized PID parameters are valid for a steady state, that depends on the set temperature as well as on the ambient conditions (ambient temperature, temperature of the thermally controlled object). Any changes of the operating and/or environmental conditions may require a re-adjustment of the PID parameters.

9 Appendix

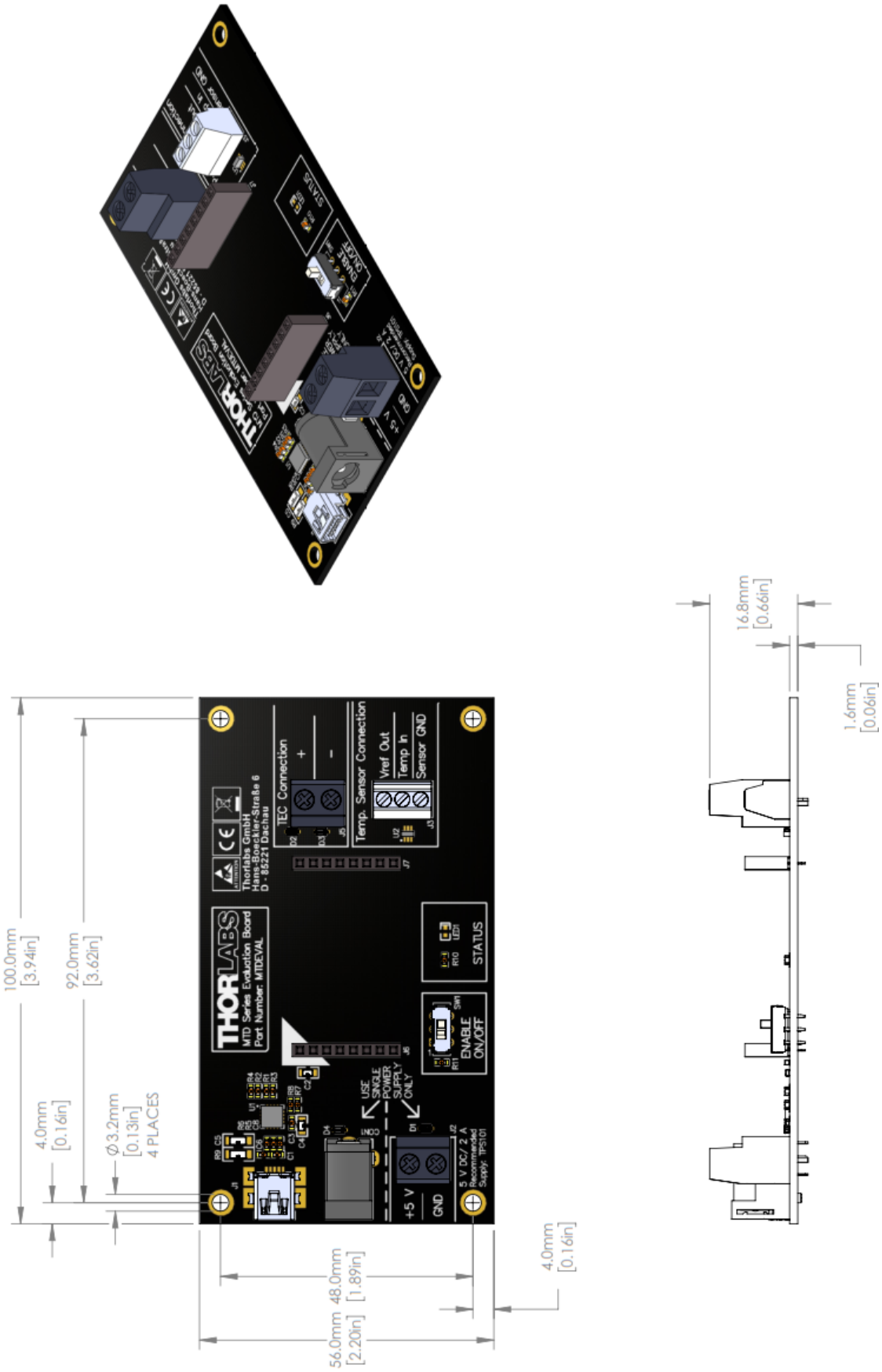
9.1 Technical Data

Supply Voltage	5 V DC ±5 %
Maximum Current Consumption	1.6 A DC
USB Connection	USB Mini B
Operating Temperature Range [1])	0 - 40 °C
Storage Temperature Range	-40 to 70 °C
Dimensions (W x H x D)	100.0 mm × 56.0 mm × 16.8 mm
Weight	0.04 kg

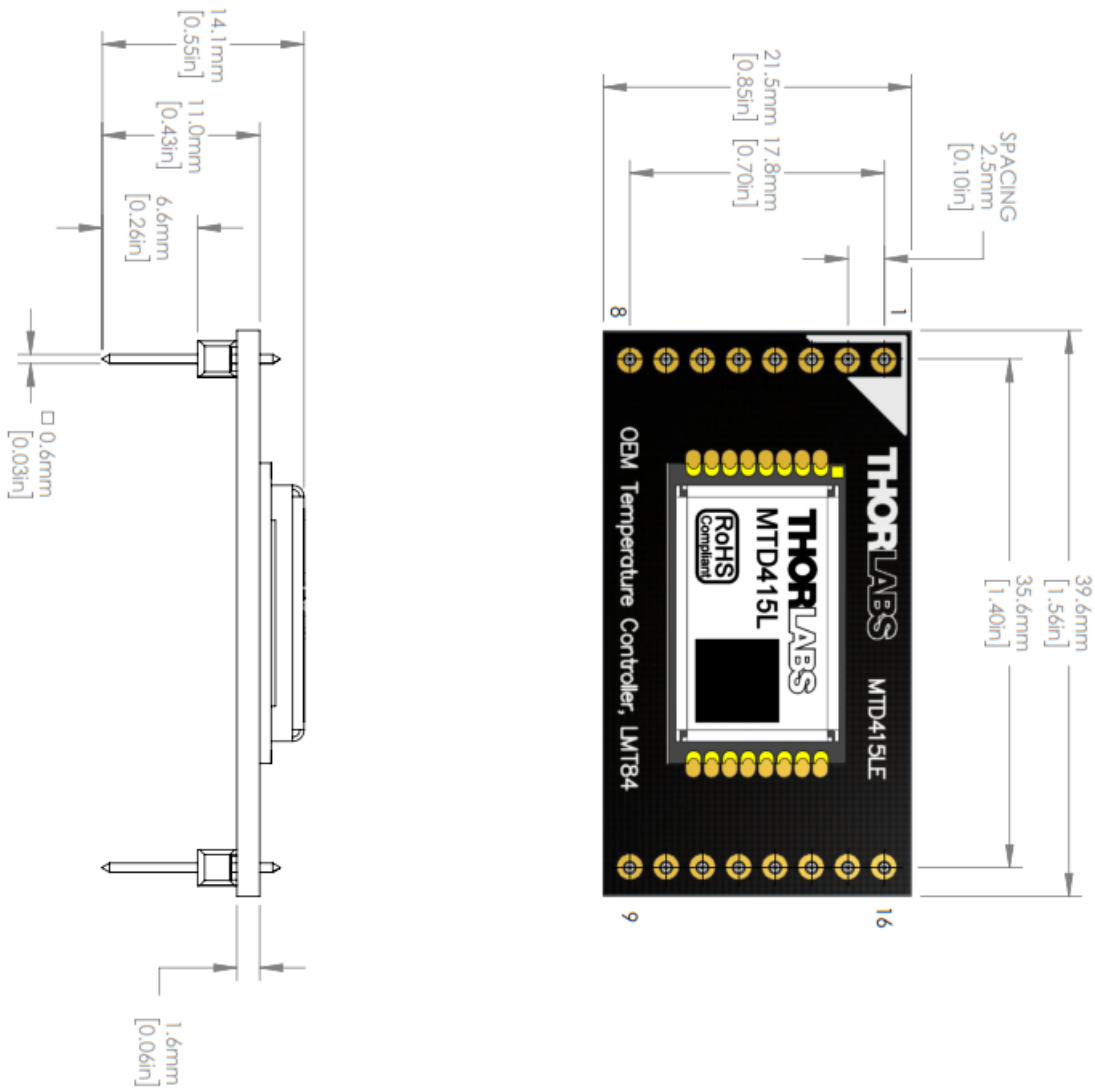
[1]) non-condensing

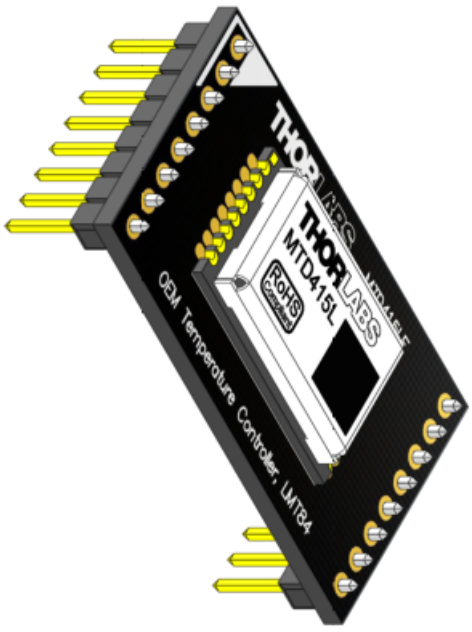
All technical data are valid at 23 ± 5°C and 45 ± 15% rel. humidity (non condensing)

9.2 Dimensions



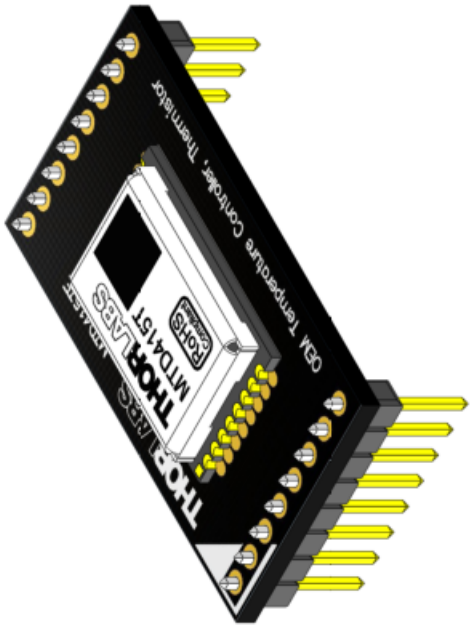
Dimensions MLDEVAL Board



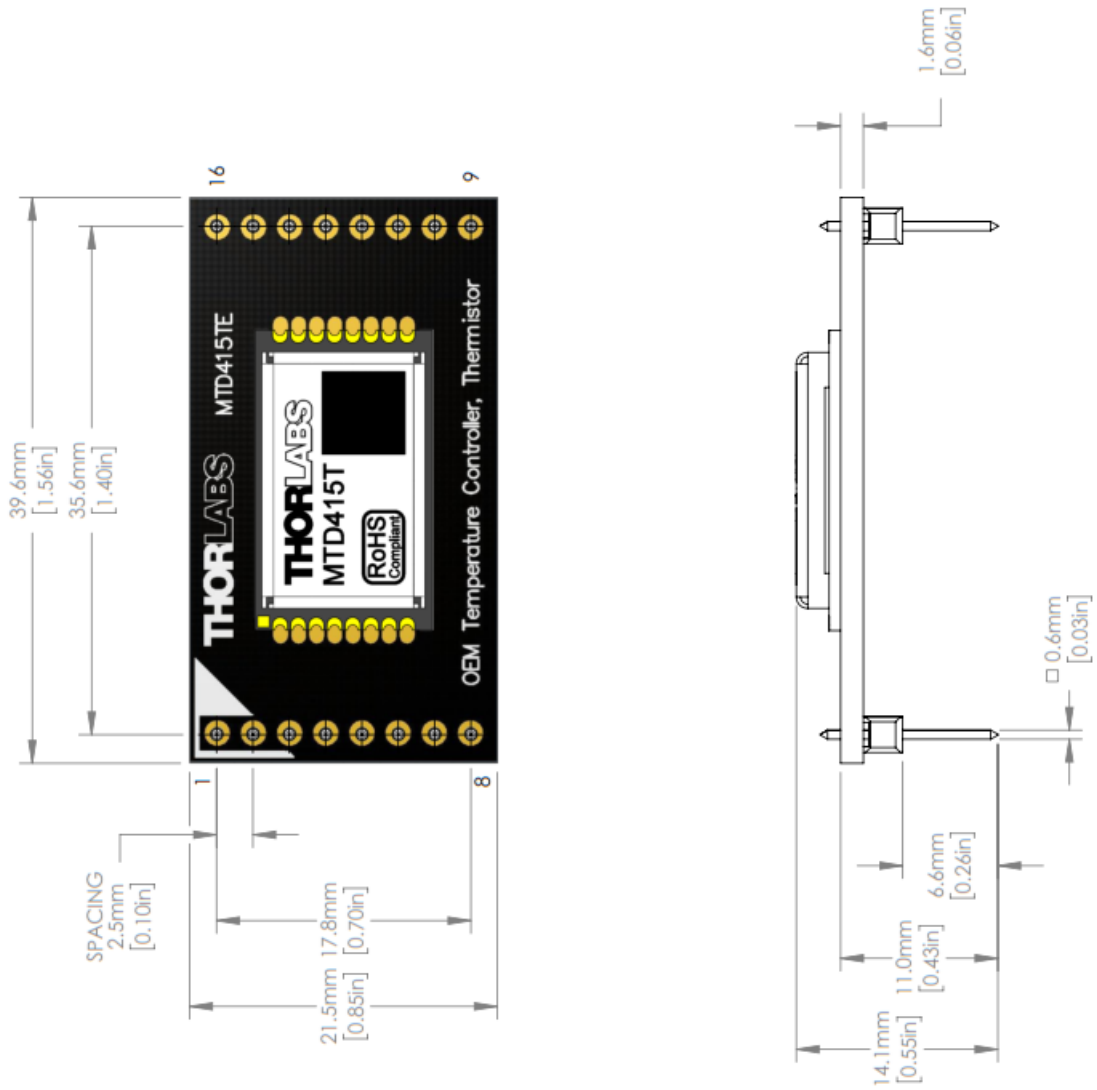


Pin	Name	Description
1	VDD	Supply Voltage Input
2	GND	Supply Voltage Ground
3	GND	Supply Voltage Ground
4	DNC	Do Not Connect
5	DNC	Do Not Connect
6	VREF	Reference Output Voltage for LMT84 Temperature Sensor
7	TEMP	LMT84 Temperature Sensor Input
8	GNDS	Temperature Sensor Ground
9	GND	Supply Voltage Ground
10	ENABLE	Enable Signal Input (Low-Active)
11	STATUS	Status Signal Output (Can be Left Floating)
12	TX	Digital Interface Transmit Signal
13	RX	Digital Interface Receive Signal
14	GND	Supply Voltage Ground
15	TEC-	TEC Element Negative Connection
16	TEC+	TEC Element Positive Connection

Dimensions MTD415LE Module (MTD415L on daughter board)



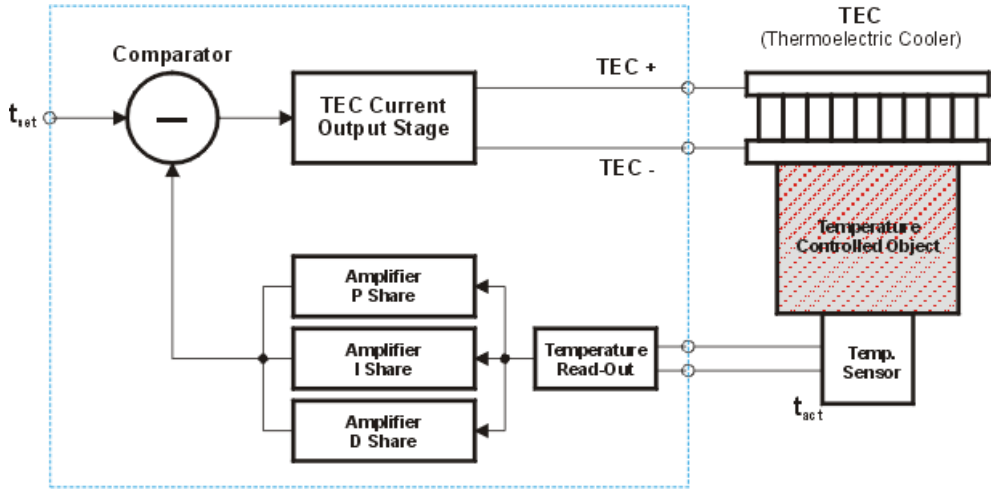
Pin	Name	Description
1	VDD	Supply Voltage Input
2	GND	Supply Voltage Ground
3	GND	Supply Voltage Ground
4	DNC	Do Not Connect
5	DNC	Do Not Connect
6	VREF	Reference Output Voltage for Thermistor Temperature Sensor
7	TEMP	Thermistor Temperature Sensor Input
8	GNDS	Temperature Sensor Ground
9	GND	Supply Voltage Ground
10	ENABLE	Enable Signal Input (Low-Active)
11	STATUS	Status Signal Output (Can be Left Floating)
12	TX	Digital Interface Transmit Signal
13	RX	Digital Interface Receive Signal
14	GND	Supply Voltage Ground
15	TEC-	TEC Element Negative Connection
16	TEC+	TEC Element Positive Connection



Dimensions MTD415TE Module (MTD415T on daughter board)

9.3 Tutorial

9.3.1 Operating Principle of a Temperature Controller



In general, a temperature controller (within the blue frame) is a closed loop system. A temperature sensor measures the temperature of the controlled object (e.g., a laser diode). This **actual temperature** signal is amplified and compared with the **temperature set value**. The differential signal out of the **comparator** controls then the current of the **thermoelectric cooler** in order to maintain the temperature of the object constant. Ideally, the temperature settling is carried out in the shortest times, with minimum settling error and without temperature overshoots.

A thermoelectric coolers is a Peltier element that produces a temperature gradient depending on the current direction trough the TEC. For this reason, the TEC current must be bidirectional.
In order to adapt the control loop to different thermal loads, and to optimize the temperature controller's response characteristics, a PID amplifier is used.

The general requirements to a temperature control loop are:

- fastest settling time after power on or changing the set temperature
- minimum residual temperature error
- settling without temperature overshoots
- fastest response to changes of the thermal load

PID amplifiers can fulfill these requirements. Temperature control loops are comparatively slow; control oscillations appear with a frequency in the range of several Hz or parts of Hz. The PID adjustment allows to optimize the dynamic behavior.

The **P share** is the proportional share, or the gain of the amplifier, that defines the settling time. The higher the P share, the faster the settling and the less residual temperature error. The downside is that high P shares lead to oscillations.

The **I share** is the integrating share of the amplification, or the gain at low frequencies. It allows to minimize the residual temperature error.

Optimal settings of the P and I shares result in a fast approach to the set temperature, without oscillations and with a minimum residual temperature error. However, such a loop is not able to quickly react to sudden changes of the thermal load, for example, if a thermally stabilized laser diode is set to a higher or lower output power that changes the laser's heat dissipation. The **D share** (differential share, or the gain at high frequencies) allows the system to quickly react to temperature changes, without generating oscillation of the temperature around the set point.

9.4 References

Data Sheets of the MTD415 Series

Click to appropriate link to download the data sheet:

MTD415L Miniature TEC Driver; LMT84 (or similar) Temperature Sensor

MTD415T Miniature TEC Driver; Thermistor Temperature Sensor

Software Download Link

https://www.thorlabs.com/software_pages/ViewSoftwarePage.cfm?Code=MTDEVAL

9.5 Warranty

Thorlabs GmbH warrants material and production of the MTDEVAL for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs GmbH 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 GmbH. The customer will carry the shipping costs to Thorlabs GmbH, in case of warranty repairs Thorlabs GmbH 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 GmbH warrants the hard- and/or software determined by Thorlabs GmbH for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs GmbH 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 GmbH 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 GmbH does explicitly not warrant the usability or the economical use for certain cases of application.

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

9.6 Copyright and Exclusion of Reliability

Thorlabs GmbH 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.

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9.7 Thorlabs 'End of Life' Policy

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs GmbH 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 GmbH 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 GmbH 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

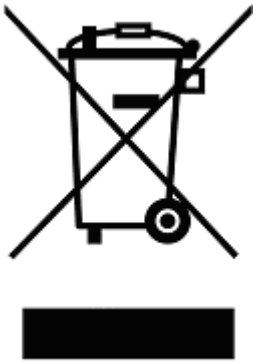
If you do not return an “end of life” unit to Thorlabs GmbH, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

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

9.8 List of Acronyms

CPU	Central Processing Unit
DC	Direct Current
ESD	Electrostatic Discharge
GUI	Graphic User Interface
Hz	Hertz
MB	Megabyte
MTD	Miniature TEC Driver
PC	Personal Computer
PCB	Printed Circuit Board
PDF	Portable Document File
PID	Proportional - Integral - Differential (shares)
RAM	Random Access Memory
RTF	Rich-Text Format File
TEC	Thermo-Electric Cooler
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
UUID	Universal Unique Identifier

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