This step by step guide will help you setting up a Meerstetter Engineering TEC controller for the first time.

Goal:

- Avoid difficulties and save time at first use
- Get familiar with the TEC Service Software

As an example application we set up a system to keep an object at a constant temperature. This means that the TEC controller will supply a Peltier element, to heat and cool depending on the measured temperature at the object.

Important: We assume that you set up a new TEC controller with default settings. If not please load the default settings in the service software from the CD or from the software package available on our website.
(CD: TEC_G01\Software\5134P TEC Default Config.ini)

During the setup we will perform the following steps:

1. Software Installation
2. Prepare the mechanical setup
3. Adjust settings for the TEC controller in the Meerstetter Engineering's service software
4. Test the cooling functionality of our setup
5. Adjust settings for temperature controlling
6. Auto tuning

Materials used for this example:

- TEC-1089-SV-NTC39K controller
- Peltier Element (CUI Inc. CP40236)
- Heat Sink
- PC with Microsoft Windows 8
- CD with Meerstetter Engineering's Service Software
- Cable with mini USB-B connector
- Temperature Sensor (NTC 10K, B value = 3988K)
- Power Supply (24 V, 6 A output)

This is a general TEC setup guide. So you can follow the steps even if you don't use exactly the same material and controller for the setup.

How to use this guide

Red boxes are actions to be performed by yourself

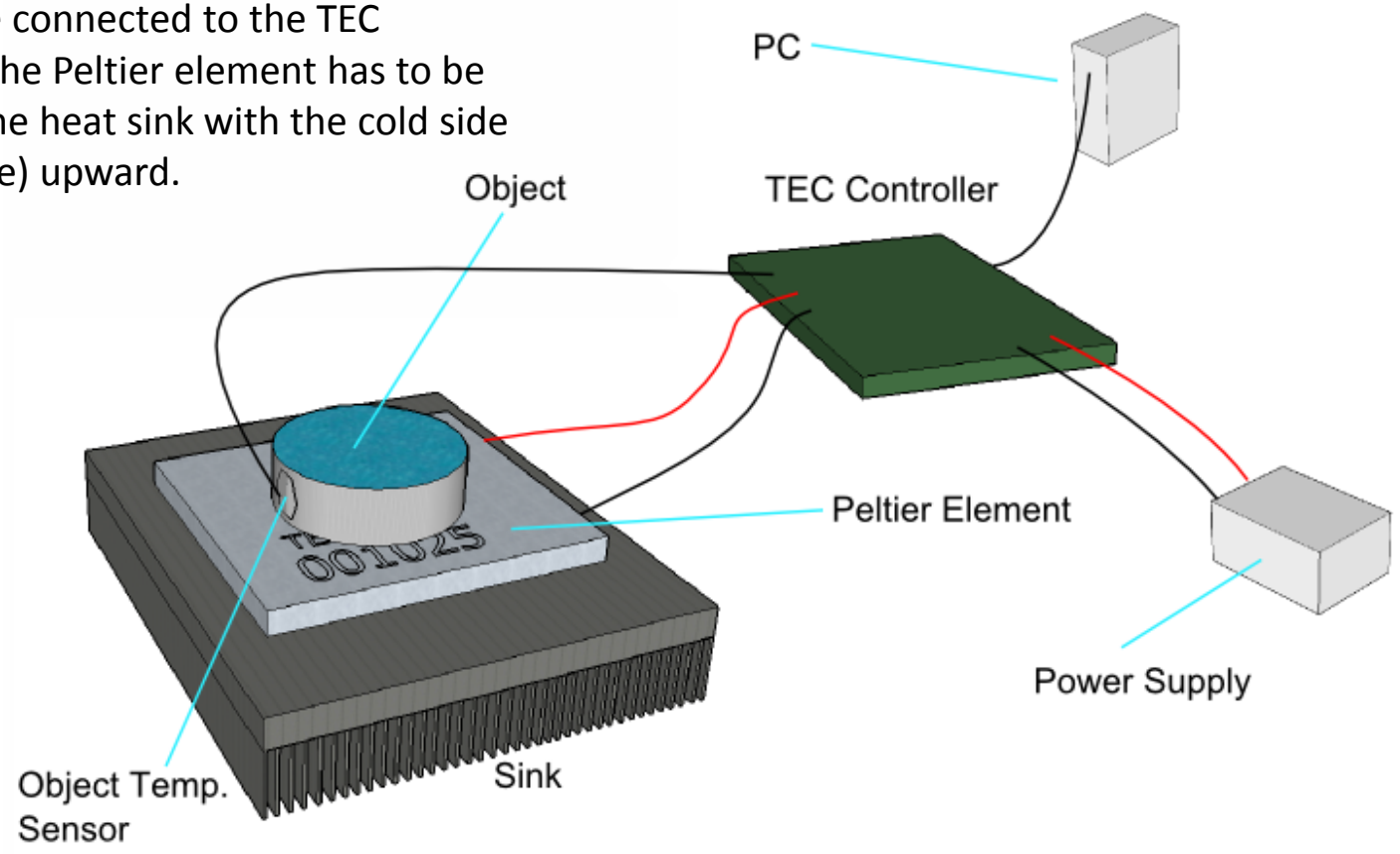
Yellow boxes show reactions from the soft- or hardware

Blue boxes provide additional information

Screenshots and photos will help you to better understand the actions you have to perform.

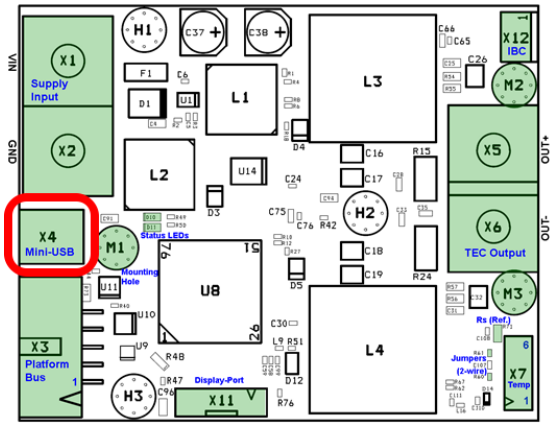
The TEC controller is configured by the service software on the PC.
The temperature sensor and the Peltier Element are connected to the TEC controller. The Peltier element has to be placed on the heat sink with the cold side (marked side) upward.

The connections are described later, step by step.



1. Connect TEC with PC

We will prepare the computer to be able to configure the TEC using the service software.



- Connect TEC on X4 to your PC using a mini USB-B cable

- Windows will prompt you to install a USB (serial interface) driver

- Follow the steps for the installation as shown by Windows

If Windows can not recognize a new device you can install the driver from our software CD (CD: Installation\FTDI Driver\CDM v2.10.00 WHQL Certified.exe)

2. Install Service Software

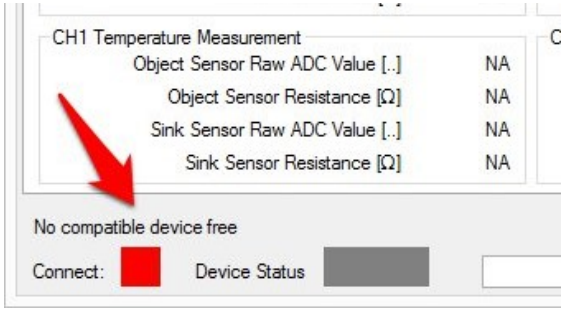
We need to install the service software from the software CD.

There are requirements for the service software:

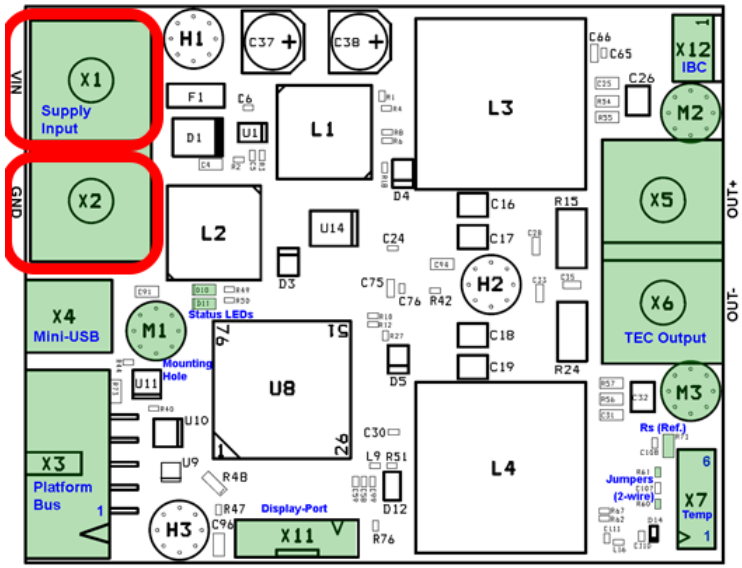
- Microsoft .net Framework 4.0 (CD: Installation\dotNetFx40_Full_x86_x64.exe)
- Microsoft Visual C++ 2010 Redistributable Package (x86)
  (CD: Installation\vcredist_x86.exe)

- Copy TEC service software to a folder on your PC. (CD: TEC_G01\Software\TEC Service v2.XX.exe)
- Execute TEC service software
- Get familiar with the 8 tabs of the TEC service software and their names on top

- TEC service software displays: «No compatible device free» because the TEC controller is not yet powered



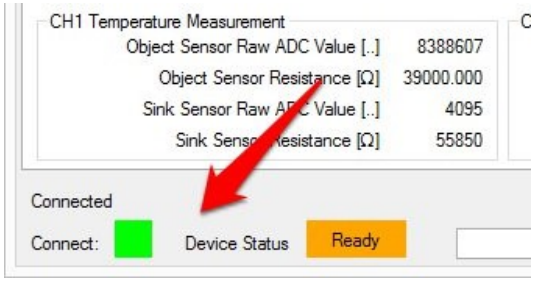
- Set the power supply to 24 V
- Connect TEC to the power supply at X1 (Vin) and X2 (GND)
- Switch on the power supply



- Green LED starts flashing continuously on the TEC Controller
- Service Software displays «Connected» and connect status indicator is green
- «Device Status» is amber and ready

Information about your TEC Controller is displayed on the top right corner of the first tab.

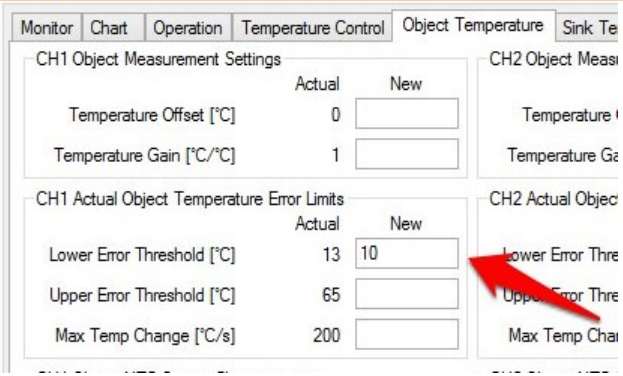
If an error occurs, the description is displayed in the monitoring tab.

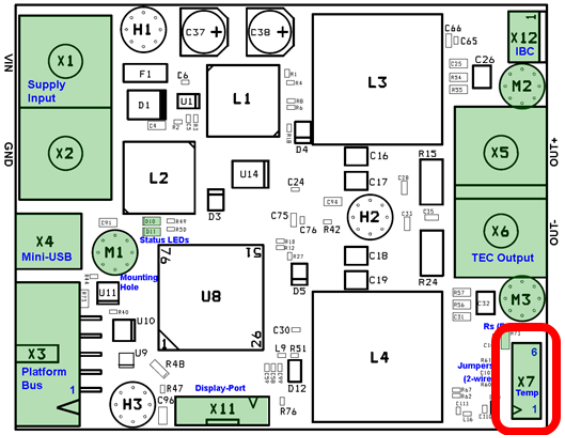


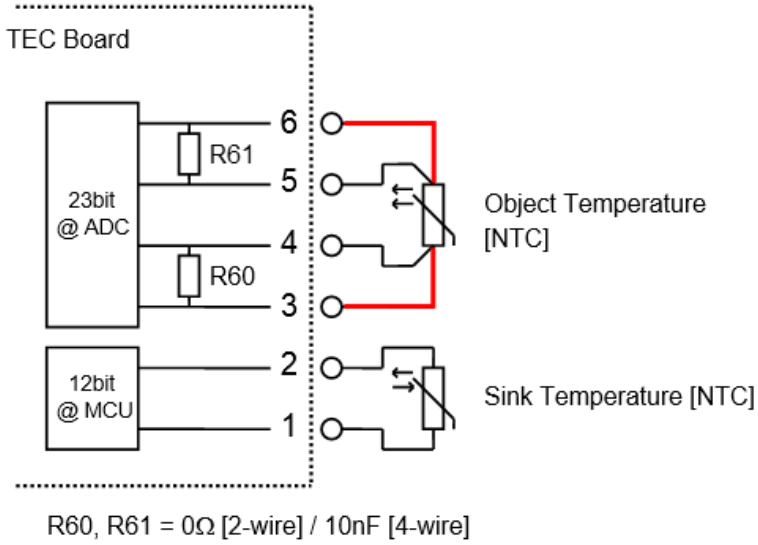
Tab 5 Object Temperature

In general you can set values by typing them to the corresponding field and click on «Write Config» to save them to the controller.

- Set «Lower Error Threshold» to 10 °C
- Connect your temperature sensor to the connector X7 on the TEC Controller
- Make sure temperature probes on cable and plug are assembled according to the following schematic showing X7. (Marked red)





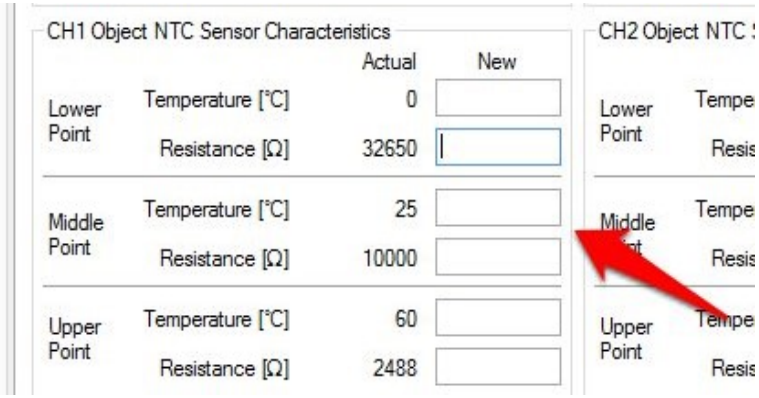


Tab 5 Object Temperature

We use a 10K NTC sensor with a B value of 3988K. The values for the sensor already correspond to the default settings. If you use another NTC sensor, you will have to set the values given by the datasheet of the sensor.

For Pt100/1000 sensors the TEC will use internally stored settings.

- Set «CH1 Object NTC Sensor Characteristics» if needed

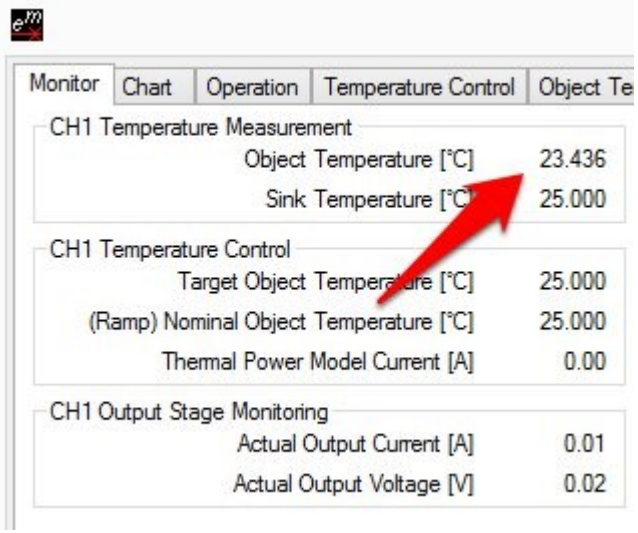


6. Check Functionality

Now the TEC controller is able to measure the temperature of the object.

Tab 1 Monitor

- Check if «Object Temperature» shows realistic values

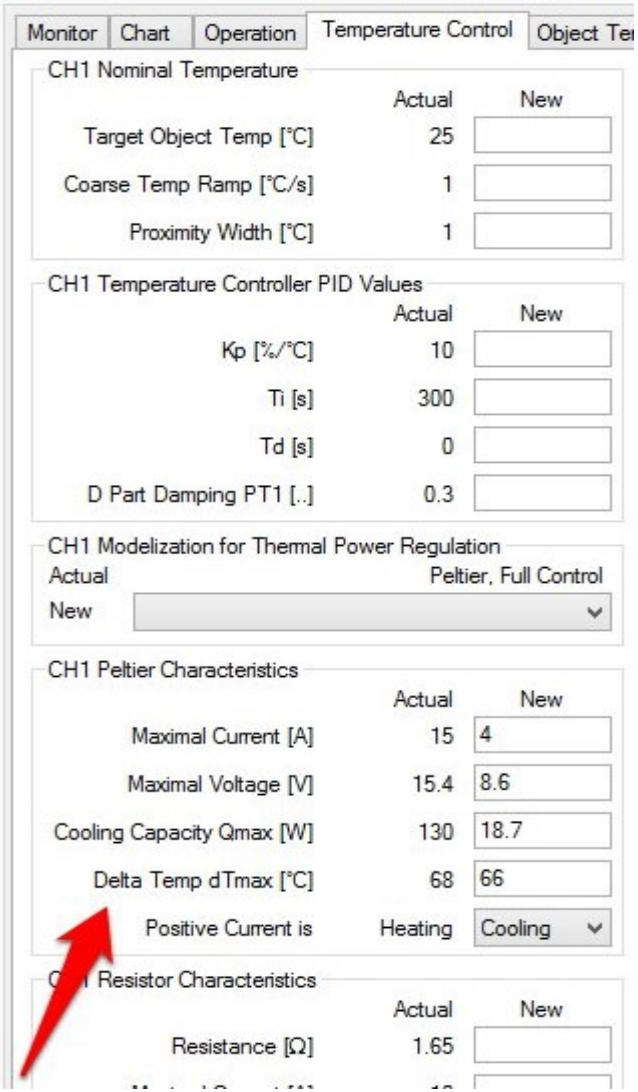


First we have to tell the TEC controller the characteristics of the Peltier element we are using.

Tab 4 Temperature Control

- Search the four parameters in the datasheet of your Peltier element: I_{max}, U_{max}, Q_{max}, dT_{max}
- «CH1 Peltier Characteristics»: Put the four parameters into the corresponding fields
- Choose the option «Cooling» in «Positive Current is»

Important: «CH1 Peltier Characteristics» are values given by the datasheet of the Peltier element. These values can not be used to limit the output. Limits are set in Tab 3 Operation.

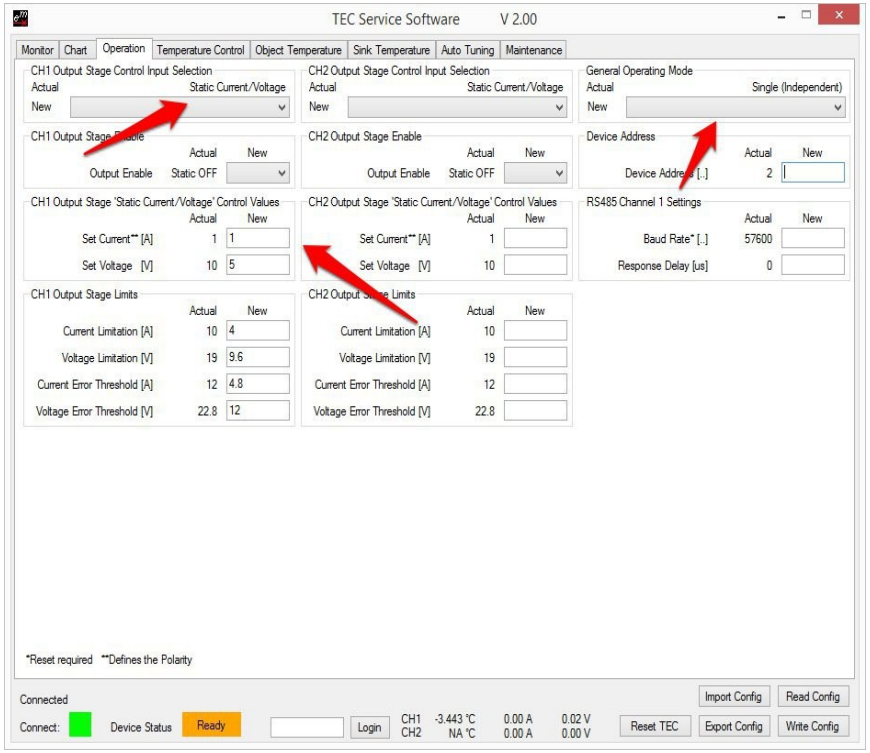


First we will operate the TEC controller in a static current mode to check the functionality in combination with the Peltier element. So the Peltier element is supplied by a constant current, temperature independent.

Tab 3 Operation

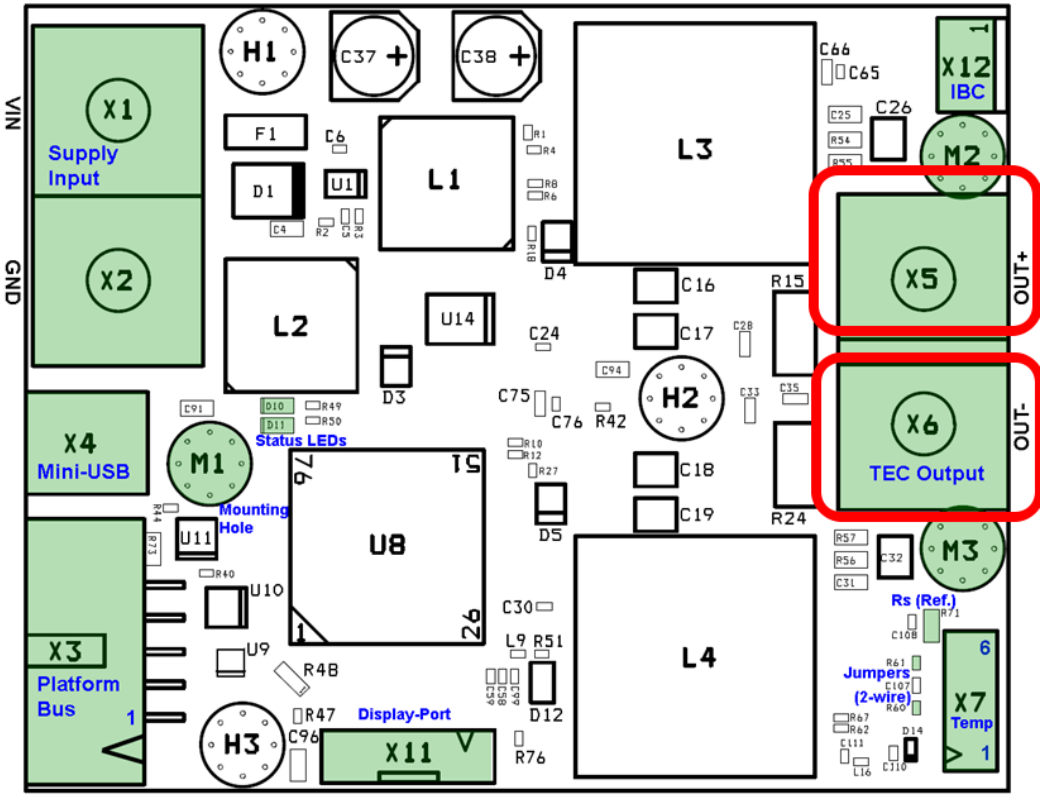
- «General Operating Mode» is by default set to «Single (Independent)»
- «CH1 Output Stage Control Input Selection» is by default set to «Static Current/Voltage»

- Set «CH1 Output Stage Control Values» for static operation:
  Set «Current [A]» to approx. 10% of I_{max} of the Peltier element. In our case we will use 1 A.

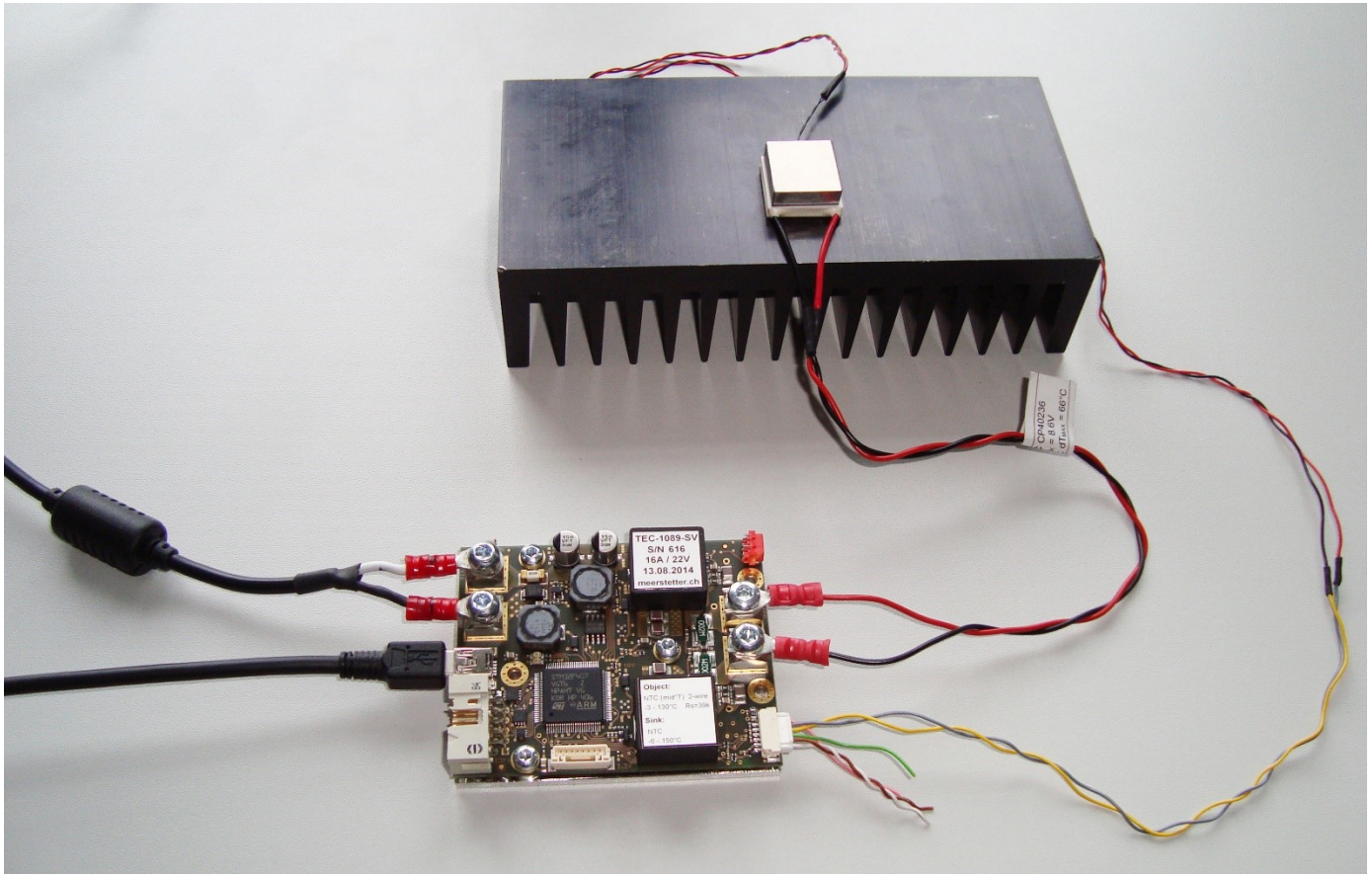


9. Connecting the Peltier Element

Connect the Peltier element to X5 (OUT+) and X6 (OUT-). Connect the red cable to OUT+ and the black cable to OUT-. The cold side of the Peltier element will be the one with the identification marking.



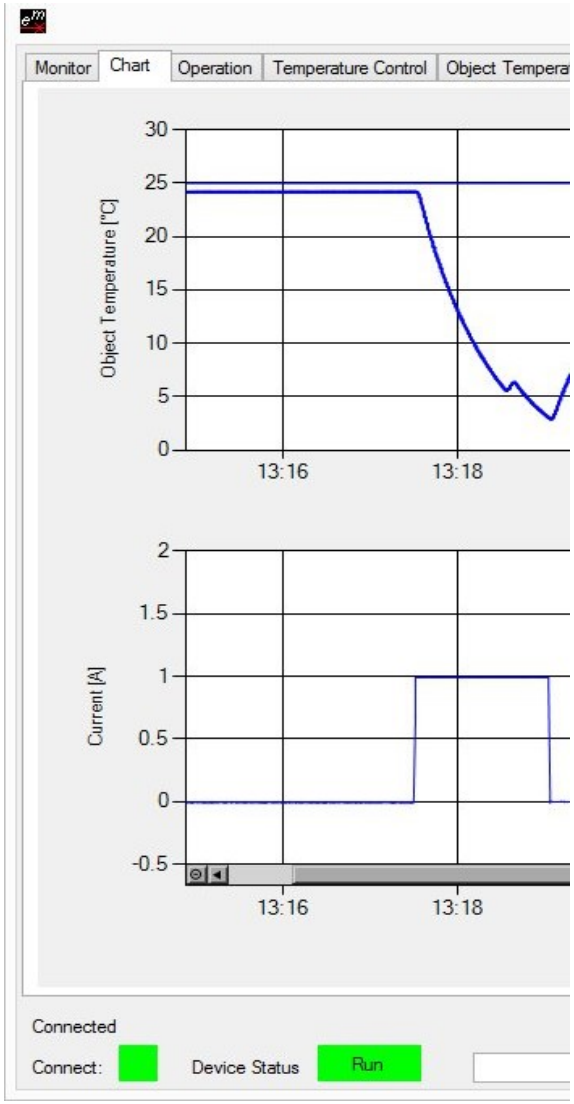
Since we have everything connected and prepared, our setup now looks like this.



- Tab 3 Operation: Set «CH1 Output Stage Enable» to «Static ON»

- «Device Status»: Run
- Tab 1 Monitoring: «Actual Output Current» shows 1 A
- Tab 2 Chart: Object temperature should sink. If not, the polarity of the Peltier element is wrong. Check your wiring.

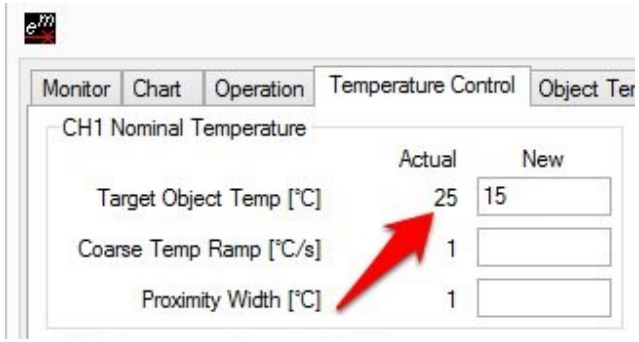
- Switch off output by setting «CH1 Output Stage Enable» to «Static OFF»



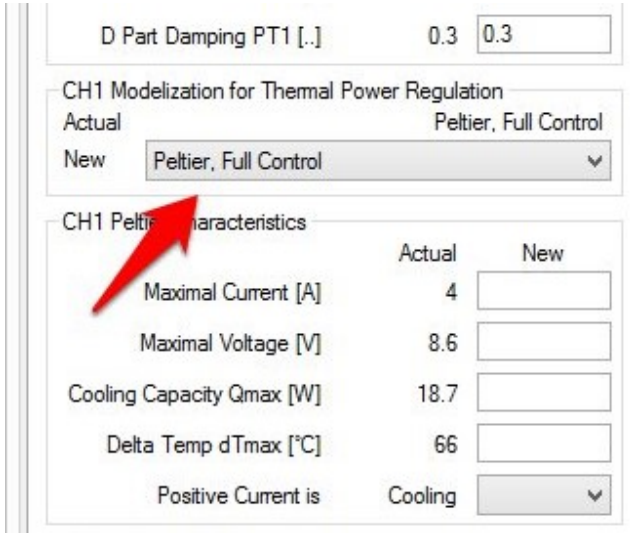
The TEC controller is working correctly. Now our goal is to keep an object at a constant temperature. First we set the control parameters. Then we have to limit the output of the TEC controller.

Tab 4 Temperature Control

- Set «Target Object Temperature» at «CH1 Nominal Temperature» to 15



In «CH1 Modelization for Thermal Power Regulation» the option «Peltier, Full Control» is chosen. This means that the controller can heat and cool the object using the Peltier element.



12. Operation Limits

Now we need to set the output limits for the operation of the Peltier element.

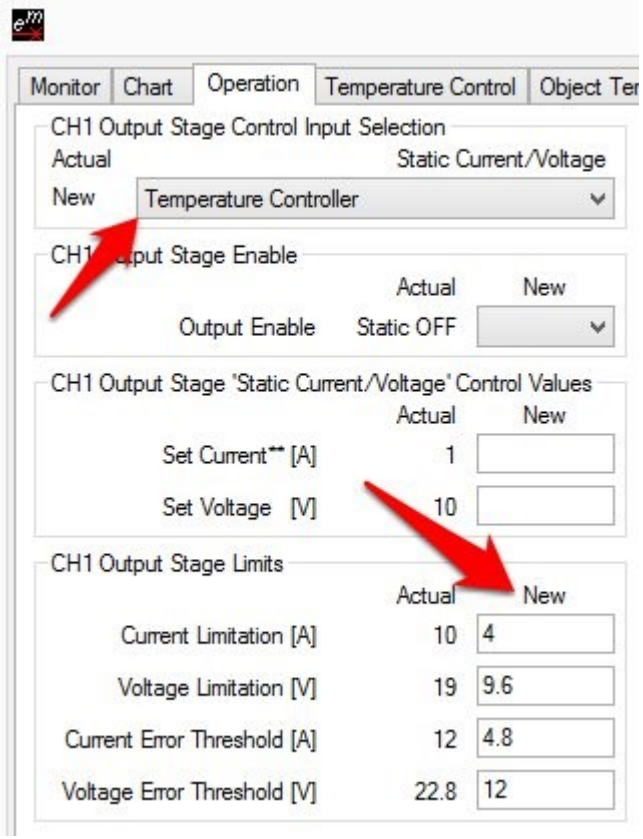
Tab 3 Operation

Limits are set depending on the application. However, usually the voltage limitation should be set approx. 1 V over U_{max} of the Peltier element.

- Set CH1 Limits & Error Thresholds:
  «Current Limitation [A]»: 4
  «Voltage Limitation [V]»: 9.6
  «Current Error Threshold [A]»: 4.8
  «Voltage Error Threshold [V]»: 12

Error Thresholds should be set approx. 20% over the corresponding limits.

- Set «CH1 Output Stage Control Input Selection» to «Temperature Controller»



Now we can check if the TEC controller reaches the desired temperature and monitor the stability of the set temperature.

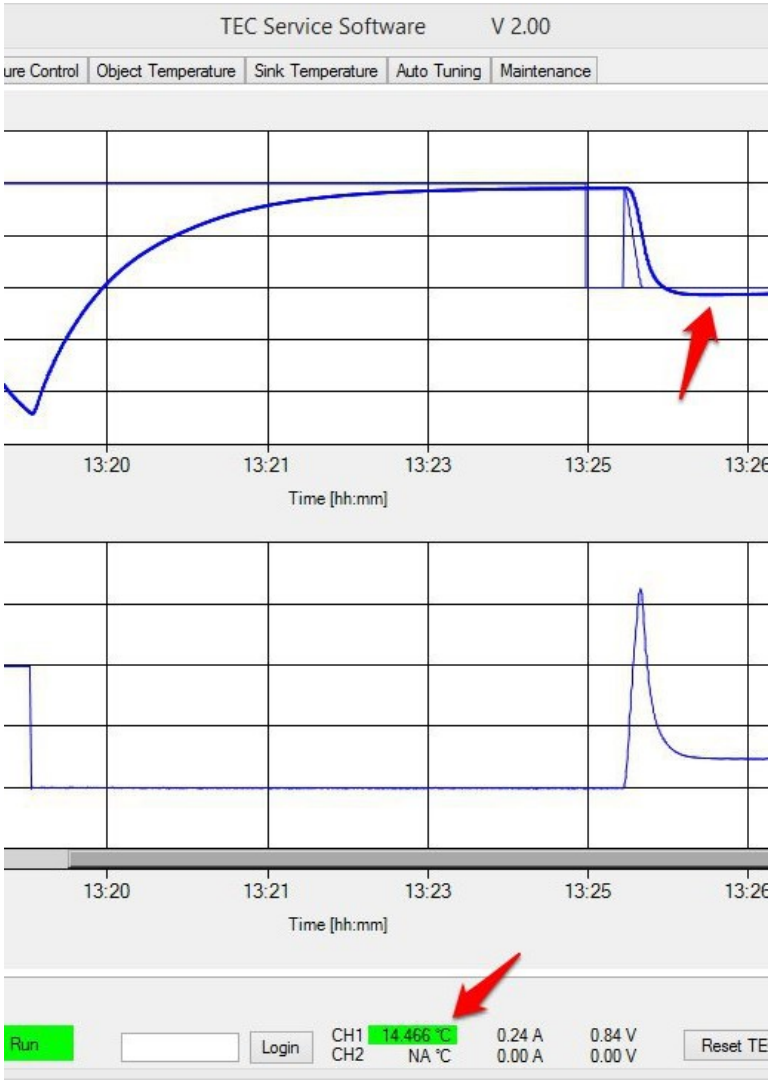
Tab 3 Operation

- Set «CH1 Output Stage Enable» to «Static ON»

Tab 2 Chart

- The temperature will converge to 15°C
- In the status bar at the bottom the «Object Temperature» is amber if it has not yet reached the target temperature
- If the «Object Temperature» equals the target temperature the indicator is green
- There can be a small difference between the desired target temperature and the measured object temperature

- Set «CH1 Output Stage Enable» to «Live OFF/ON» in Tab 3 Operation

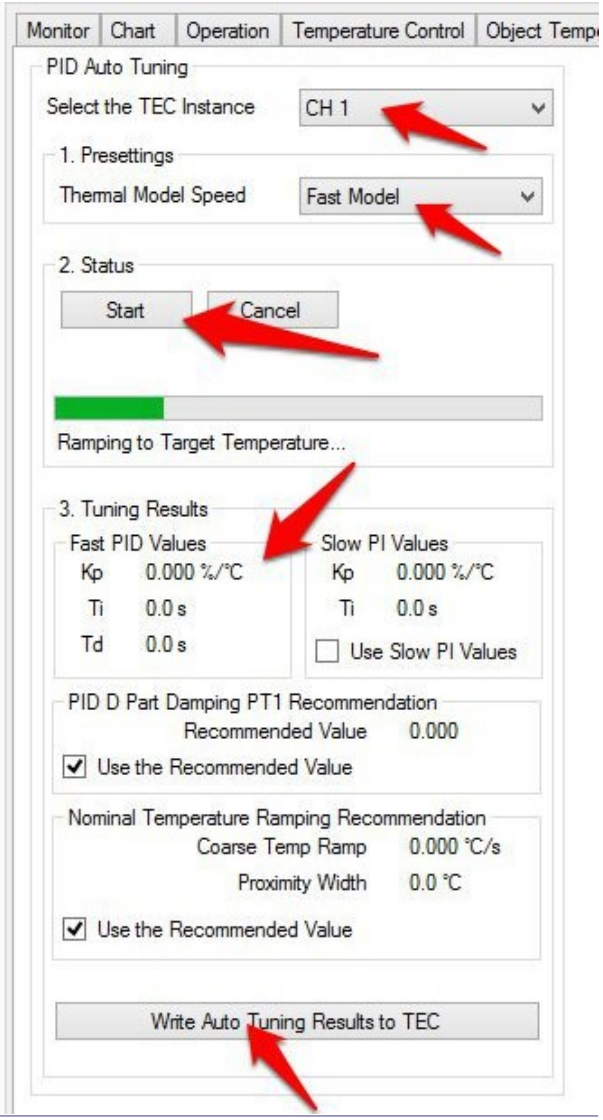


To be able to precisely control the object temperature we have to optimize the control system of the TEC controller. This can be done using the integrated PID Auto Tuning function.

Tab 7 Auto Tuning

- Click on the «Start» button

- The system tries to optimize the system and seeks optimum PID values



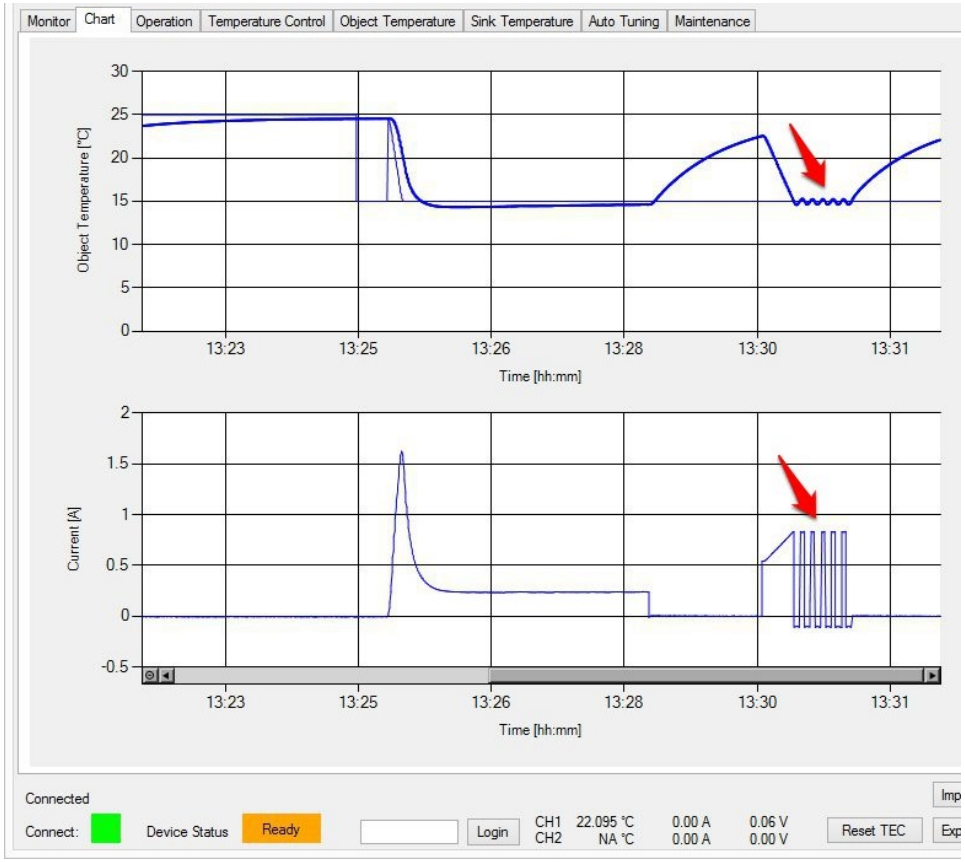
Tab 2 Chart

- In the chart you can see how the system is ramping to the target temperature

Tab 7 Auto Tuning

- If the tuning is successful, the found values can be saved by clicking on «Write Auto Tuning Results to TEC»
- If it was not successful, try the option «Slow Model» in «Thermal Model Speed»

The system will use the found PID parameters from now on to control the system if the tuning was successful.



16. Check the tuned System

Now we can check if the object temperature is closer to the desired temperature.

Tab 3 Operation

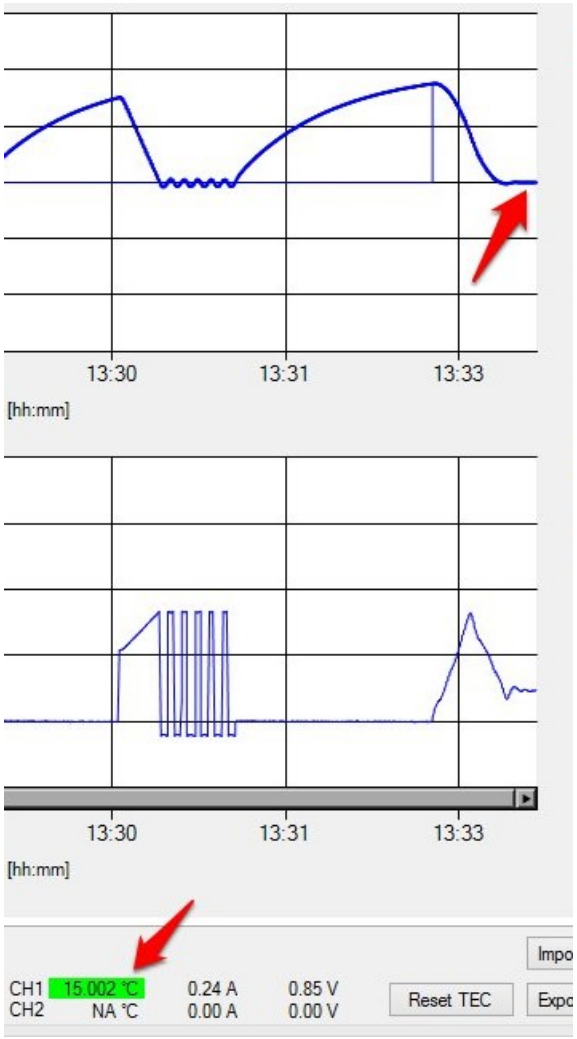
- Switch the output on by setting «CH1 Output Stage Enable» to «Static ON»

Tab 2 Chart

- After some time the controller holds the temperature at the target temperature with a high stability

Tab 3 Operation

- Switch off the output by setting «CH1 Output Stage Enable» to «Static OFF»



Congratulations! Your TEC controller is working and you should be able to set up a simple application with your TEC controller.

- If you need more information about how to design a thermoelectric application including calculations and choosing Peltier elements, please refer to our «TEC / Peltier Element Design Guide» on our website:
  http://meerstetter.ch/compendium/tec-peltier-element-design-guide
- If you need further or more detailed information about operating our TEC controllers, please refer to the TEC Family User Manual:
  http://meerstetter.ch/de/category/33-latest-user-manuals?download=4
- For a general overview of our TEC controllers please visit our products page:
  http://meerstetter.ch/products/tec-controllers