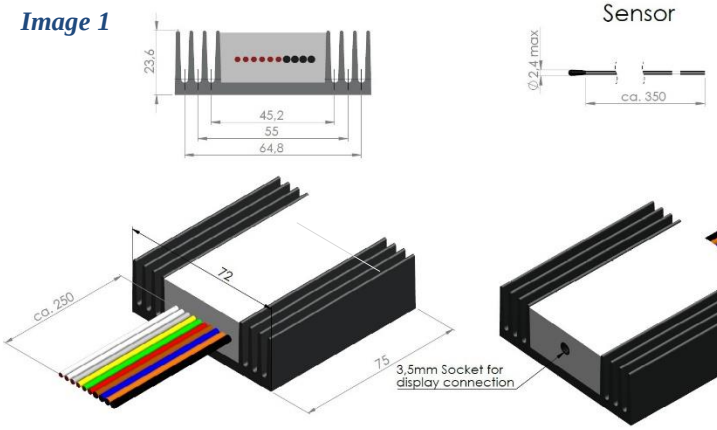
Manual: QC-PC-CO-CH1

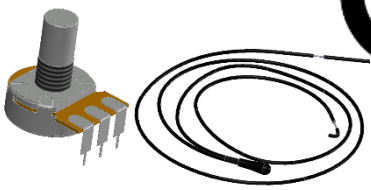
Temperature controller for automatic heating and cooling

Image 1



Deliverables:

1 Peltier controller QC-PC-CO-CH1
1 Temperature sensor: NTC 10KΩ ($\beta_{25/85}$=3977K)
1 Potentiometer: 10KΩ
1 Manual



Technical specifications:

-Voltage supply: 12 24VDC/<45mA
-Peltier supply 3…48VDC
-Maximum output current 20A
- Display connection: 3,5mm stereo
-Temperature range: -40°C bis +100°C
-Sensitivity: 0,1 K
-Accuracy ± 1 K
-P- Control characteristics
-Separate control parameters for heating range and cooling range
-Maximum setpoint limitation adjustable -Minimum setpoint limitation adjustable
-Maximum output power adjustable -Minimum output power adjustable
-Sensor defect detection (Wire broken: NP) and (Short cut: PSC)

Attention: All settings are made with the QC-PC-D-CH1 display. The display is not required for operation. The display is not included in the scope of delivery.

1 Intended use of the controller QC-PC-CO-CH1

The controller QC-PC-CO-CH1 is a temperature controller. This controller is used to control Peltier elements. The Peltier controller is a further development of the Quick-Ohm compact controllers QC-PC-C01H-100 und QC-PC-C01C. The controller controls the Peltier element bidirectionally. This ensures that both heating and cooling is possible. The target temperature can be set in the range from -40°C to 100°C. The control parameters for the cooling mode and the heating mode can be set separately. The parameter settings are made with the help of the display QC-PC-D-CH1. The display is not included in the scope of delivery and must be ordered separately if required. In addition to programming, the display is also used to show the setpoint and actual value as well as the control status. The controller can be operated without the display. A prerequisite for this is a thermal structure, that is shown in ***Image 2***. The controller is operated with low voltage and must never be connected to the mains voltage. Electrical wiring must be carried out in order to set up a functioning control system. This requires basic electrical knowledge. Only work on the wiring when the supply is switched off. Bear in mind that the controller and controlled components can be destroyed if they are used improperly. In spite of the low input voltage, high currents occur, which lead to considerable heating of incorrectly executed contact files and thin cables. These faulty connections can cause fires. Therefore, please read these operating instructions carefully. If you are not specialized, you should definitely be instructed by a qualified electrician. If you notice any warming within the wiring at any point in time, the circuit must be de-energized immediately. Regulators and Peltier elements will work for a long time, only if you adhere to the following instructions.

Quick-Ohm Küpper & Co. GmbH
Cronenfelder Straße 75
D-42349 Wuppertal

2 The thermal design

The Peltier element is able to transfer thermal energy from one side to the other. As a result, the temperature decreases where the energy is extracted and increases where this energy is transferred. In order to make this "heat pump" usable, a structure as shown in ***Image 2*** must be set up.

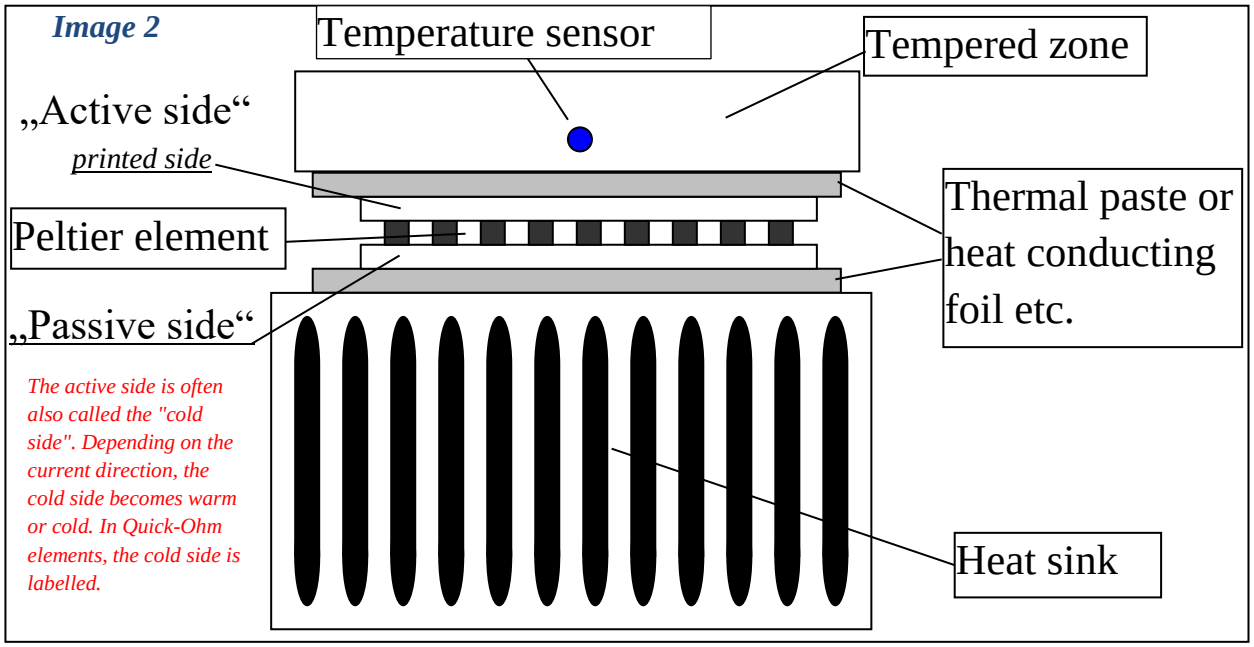
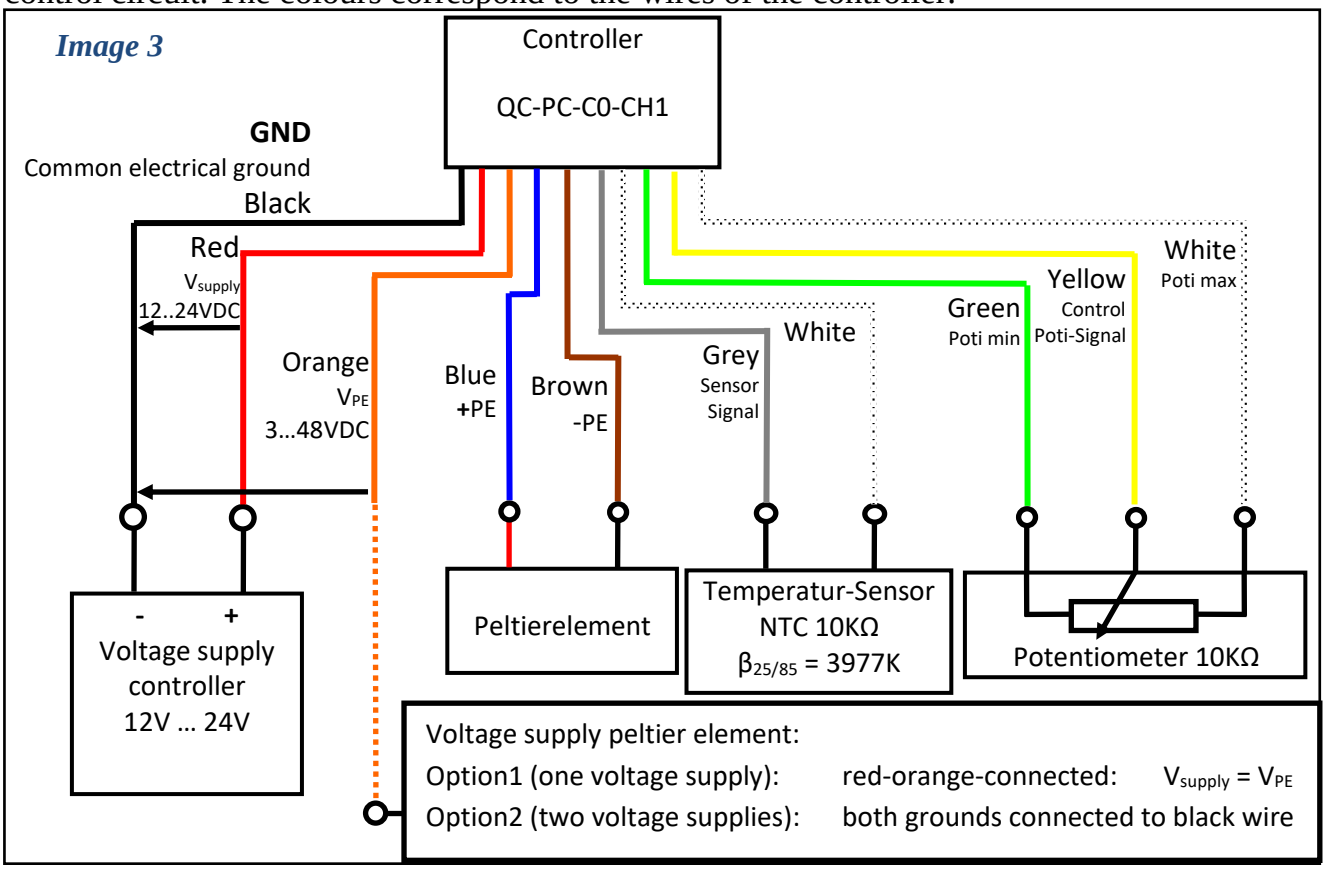


Image 2 shows the basic structure of the peltier temperature control. The active side is the zone that is to be brought to a desired temperature with a peltier element. The "cold side" of the peltier element is attached here. If current is now passed through the element, a heat flow occurs, which in turn causes a temperature difference between the two sides of the peltier element. The size of this temperature difference is in turn influenced by other factors, such as heat flow and temperature. If the connected heat capacity of one side dominates, then the temperature difference mentioned primarily controls the temperature of the other side. This is exactly what a correctly dimensioned heat sink achieves. The heat sink keeps the passive side temperature close the cooling medium. Only then the temperature difference changes the temperature of the peltier side where it is required. Without a heat sink, the zone to be tempered dominates. A controlled current will then only change the temperature of the open passive side. The design of this heat sink and the proper contact between the individual components are primarily what determine the performance of your set-up. Please always focus your attention on this basic design, only then your results can be successful. To deepen your knowledge, please visit the section ***Library*** in Thermal Management on our homepage. Here you will find tips and information in an easy-to-understand and well-illustrated form.

3. The electrical wiring

The controller requires a supply voltage V_{supply} ***(Image 3)*** of 12VDC to 24VDC. It is to be connected via the red wire. The voltage U_{PE} for the Peltier element may deviate from this and must be connected to the orange wire. U_{PE} may be in the range of 3VDC to 48VDC. The common electrical ground is to be brought together on the black wire for this purpose. If the U_{max} (data sheet) of the Peltier element is in the range of the controller supply voltage 12VDC to 24VDC, a second source can be omitted. In this case, the red and orange lines must be connected together. Please note that no current or voltage limits can be set in the controller. This means that the controller passes on the full voltage U_{PE} to the Peltier element. Therefore, make sure that the supply voltage U_{PE} is not higher than the maximum permissible voltage U_{max} (data sheet). Also, select the load so that the maximum permissible current of 20 amperes is not exceeded. ***Image 3*** shows the wiring of the individual components of the control circuit. The colours correspond to the wires of the controller.



The target temperature can be set in two ways. In the Fixed mode, the target temperature is set on the display. In the External mode, the position of the potentiometer determines the target temperature. In the delivery state, >*External*< is set here.
For all other parameter descriptions, please refer to the *Manual* for the display.

4. Parameter-Settings

To set the control parameters, the display QC-PC-D-CH1 must be connected. You can access the adjustable values via an easy-to-understand menu. During operation, the setpoint, actual value and control status can be read on the display. A detailed description can be found in the Manual for the display. When all settings have been made and the control status does not need to be watched, the display can be removed. The controller also works without the display.

Important:

The voltage supply U_{PE} must not exceed the value of the maximum permissible voltage U_{max} of the Peltier element. You can find out this value for each Quick-Ohm Peltier element from its data sheet.

Dimensioning of the heat sink: The peltier element can only work purposefully if its passive side is given a properly dimensioned heat sink. The quality of a heat sink is indicated by its thermal resistance R_{th}. This value describes how much the temperature of the cooling surface changes during operation compared to the temperature of the cooling medium.
In cooling mode, the heat sink must deliver the supplied electrical power ($I_{operating}$ x $V_{operating}$) and the dissipated thermal power ($Q_{operating}$) to the cooling medium. If the Peltier element is used for heating, the maximum possible cooling capacity that the heat sink must withstand is Q_{max}. The heat sink temperature should not change by more than 10 Kelvin compared to its cooling medium for effective temperature control. The result is that the most powerful cooling mode causes the greatest load on the heat sink. This condition defines the "*critical*" operating point. The heat sink must be designed for this operating point:

$$R_{th} \leq 10K/(I_{operating} \text{ x } V_{operating} + Q_{operating})$$

Here is: $I_{operating}$ the "*critical*" operating current through the peltier element, $V_{operating}$ the "critical" operating voltage and $Q_{operating}$ the "critical" heat output dissipated on the cold side of the Peltier element.

The display QC-PC-D-CH1 must be connected for the parameter settings. The display is not included in the deliverables.