meerstetter engineering
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Datasheet –
TEC Controller TEC-1091 (±4 A / ±21 V)

Support / First Steps

Meerstetter Engineering provides technical support for all products and helps you to integrate a product into your solution. Most of your questions should be solved by reading the provided user manuals of the corresponding product or the FAQ (frequently asked questions).
For further help or if you have any other questions, please do not hesitate to contact us. We are happy to help you. You can contact us by email support@meerstetter.ch.

Meerstetter's Product Family Compatibility

The Meerstetter LDD- and TEC-Families have been developed to work along with each other. They share the same platform bus, communication protocol and hardware architecture. See the following table for an overview of the LDD- and TEC-Families.

LDD-Family		
LDD-1321	0-1.5 A / 0-14 V	CW, Add on TEC Controller available
LDD-1301	0-20 A / 0.5-45 V	1 ms - CW
LDD-1303	0-20 A / 1-120 V	1 ms - CW
LDD-1137	0-75 A / 0-70 V	0.5 µs - CW, modulated, QCW and pulsed modes
LDD-1124-SV	0-1.5 A / 0-15 V	1 µs - CW, modulated, QCW and pulsed modes
LDD-1121-SV	0-15 A / 0-15 V	1 µs - CW, modulated, QCW and pulsed modes
LDD-1125-HV	0-30 A / 0-27 V	1 µs - CW, modulated, QCW and pulsed modes
TEC-Family		
TEC-1092	±1.2 A / ±9.6 V	Micro, single channel
TEC-1091	±4 A / ±21 V	Small, single channel
TEC-1089-SV	±10 A / ±21 V	Medium, single channel
TEC-1162	±5 A / ±56 V	Medium-high, single channel
TEC-1090-HV	±16 A / ±30 V	Large, single channel
TEC-1163	±25 A / ±56 V	Extra-large, single channel
TEC-1161-4A	2 x (±4 A / ±21 V)	Small, dual channel
TEC-1161-10A	2 x (±10 A / ±21 V)	Medium, dual channel
TEC-1122-SV	2 x (±10 A / ±21 V)	Medium, dual channel
TEC-1166	2 x (±5 A / ±56 V)	Medium-high, dual channel
TEC-1123-HV	2 x (±16 A / ±30 V)	Large, dual channel
TEC-1167	2 x (±25 A / ±56 V)	Extra-large, dual channel

Thermoelectric Cooling Temperature Controller TEC-1091

TEC Controller / Peltier Driver up to ±4 A / up to ±21 V

HW v3.40 / v3.50

Small OEM TEC Controller

RoHS COMPLIANT

The TEC-1091 is a specialized TEC Controller / power supply able to precision-drive a single Peltier element.

It features a true bipolar DC current source for cooling / heating, two temperature monitoring inputs (1x main, 1x auxiliary) and intelligent PID control with auto tuning. The TEC-1091 is fully digitally controlled, its hard- and firmware offer numerous communication and safety options.

The included PC-Software allows configuration, control, monitoring, and live diagnosis of the TEC Controller via USB, RS485 and RS232 TTL. All parameters can be saved to non-volatile memory.

For the most straightforward applications, only a power supply, Peltier elements and two temperature sensors need to be connected to the TEC-1091. After power-up the unit will operate according to pre-configured values. (In stand-alone mode no control interface is needed.)

The TEC-1091 can handle either Pt100, Pt1000, NTC or Voltage temperature probes. For highest precision and stability applications a Pt100 / 4-wire input configuration is recommended. Analog measurement circuit is factory calibrated.

Auxiliary temperature input allows the connection of an NTC probe that is located on the heat sink of the Peltier element. This additional data is used to compensate for parasitic thermal conduction of Peltier element. Also, it allows the control of an external heat sink cooling fan.

The heating and cooling power is optimized by proprietary thermal management routines based on power balance models (for Peltier elements and resistive heaters).

Further functionality includes: Smooth temperature ramping, thermal stability indication and auto gain (NTC probes). The PC-Software allows data logging and configuration import/export.

Many features (hardware, software) of this OEM product are customizable upon request.

Features

Output Stage:

- DC Input Voltage: 5 – 24 V
- Output Voltage: 0 to ±21 V (max. ~ 0.9 · U_{IN})
- Output Current: 0 to ±4 A, <1 % Ripple
  (TEC Modules with higher Output Power available)

Main Features:

- Temperature Sensor Types: Pt100, Pt1000, NTC, Voltage
- Temperature Precision / Stability: <0.01 °C
- Temperature Control & Measurement Frequency: 1 Hz, 10 Hz, 90 Hz
- Performance-optimized PID for Thermal Power Control
- Configuration / Diagnosis over all communication interfaces with PC Software
- Dimensions (L x W x H): 65 mm x 38 mm x 14 mm
- Efficiency: 96 % (@ 90 % Load)
- Cooling not required (natural convection)
- Low Resolution Heat Sink NTC Temp. Sensor Input
- Measurement Inputs freely assignable to any Output Channel
- Bipolar output channel can be split into unipolar channels

Operation Modes:

- Stand-Alone without Live Control Interface
- Remote-Controlled over USB, RS485, RS232 TTL, CANopen CiA 301, I/O
- Script-Controlled over Lookup Table Read-Out

Driver Modes:

- DC Power Supply: Set Current or Voltage
- Temperature Control: PID Settings, Auto Tuning, optional Cool/Heat-Only or Resistor modes

Data Interfaces:

- USB 2.0 1kV isolated (FTDI Chip)
- 1x RS485 (Half-Duplex)
- 1x RS232 TTL
- CANopen CiA 301

General Purpose I/O Features:

- 6x Digital I/O Signals (3.3 V / 5 V)
- Configurable as Input to control TEC-1091 (Enable, Temperature Up / Down etc.)
- Configurable as Output to monitor TEC-1091 (Error Indication, Temperature Stable Indication etc.)

Optional Components:

- Various displays available up to 4x20 Chars (e.g., DPY-1113)

Further Information:

- Please contact us for additional information or consult the current TEC Controller User Manual (Document 5216).

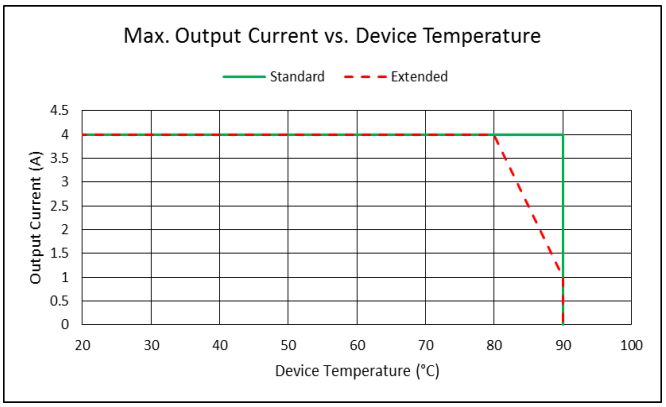
Document Number: 5175T (14 October 2024)

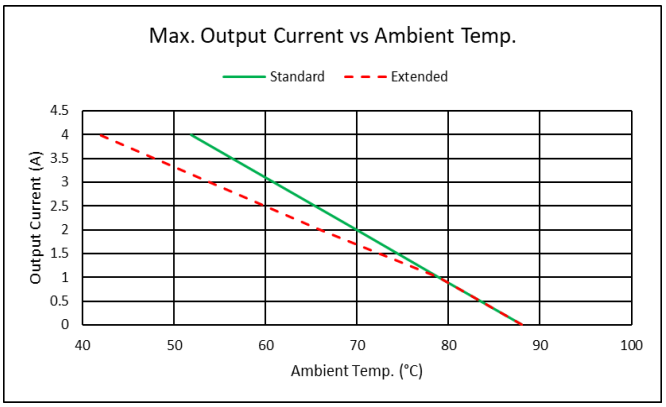
Absolute Maximum Ratings

Supply voltage (DC)	27 V

Operating Characteristics for all firmware versions

Temperature	-40 – 90 °C

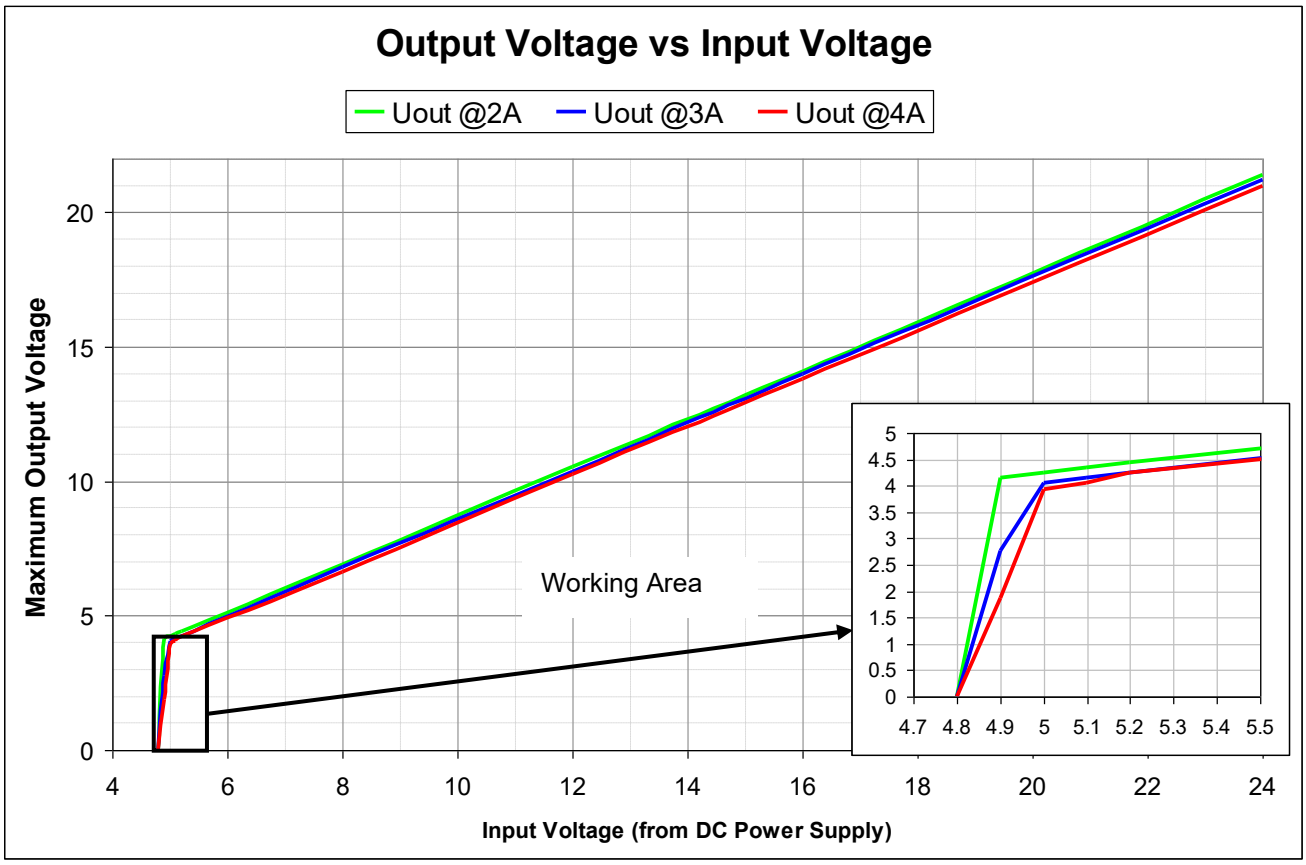




Standard or Extended Device Temperature Mode can be set as software setting. Using forced air cooling, it is possible to enhance the ambient temperature performance.

Additional information about the charts above:

- Standard or Extended device temperature mode can be set as a software setting.
  - In standard mode, the device throws an error and switches off if the maximal device temperature is reached.
  - In extended mode, the device first reduces the maximum output current before it throws an error and switches off.
- The Device Temperature is the temperature which is being measured by the TEC Controller itself on its own PCB. This is the temperature which is relevant for the overtemperature behavior (left chart).



Electrical Characteristics

Unless otherwise noted: T_A = 25 °C, U_{IN} = 24 V, R_{load} = 3.75 Ω, FW >= v4.00

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
DC Power Supply Input:						
U_{IN}	Supply voltage	Measured directly on power input terminals	4.9		24	V
U_{IN} Ripple	Ripple tolerance	U_{IN} never below $U_{IN\ min}$ or above $U_{IN\ max}$			300	mV_{PP}
I_{IN}	Max input current	Hint: Software limitation			3.8	A
Output (per Channel):						
I_{OUT}	Bipolar current				±4	A
U_{OUT}	Bipolar voltage	U_{OUT} is maximum ~0.9 * U_{IN}			±21	V
I_{OUT}	Unipolar current [1]				4	A
U_{OUT}	Unipolar voltage [1]	U_{OUT} is maximum ~0.9 * U_{IN}			21	V
U_{OUT} Ripple	Voltage ripple	@ 4 A		80		mV_{PP}
I_{OUT} Drift	Output current temperature drift			0.1		mA/°C
System Characteristics:						
$\eta_{50\%}$	Power efficiency	@ 50 % load (10.5V, 4A)		94		%
$\eta_{100\%}$	Power efficiency	@ 100 % load (21V, 4A)		96		%
Output Monitoring: (I_{OUT} Resolution is 1.46mA; U_{OUT} Resolution is 6.1mV)						
I_{OUT} Read	Precision	@ 3.8 A		1	5	%
U_{OUT} Read	Precision	@ 15.0 V		1	3	%

[1] In unipolar mode, the total output power is doubled in comparison to the bipolar mode, but the controller input current is limited to I_{IN}, which limits the total available output power. The controller limits the output current for each channel dynamically if the max input current limit is reached.

Output Safety Characteristics

Unless otherwise noted: T_A = 25 °C, U_{IN} = 24 V

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
Output Stage Protection Delays:						
t_{OFF}	Short circuit	Full load condition		10	30	µs
t_{OFF}	Power system limits	Current and voltage limits			200	µs
Output Stage Current Supervision: (If the OUT+ and OUT- currents differ too much, an error is generated)						
I_{OUT_DIFF}	Error threshold			400		mA

High Resolution Temperature Measurement Characteristics (Pt100 and Pt1000 Probes)

Measurement configuration = 23bit / 4-wire / unshielded cable <50mm

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$T_{HR,\ RANGE}$	Range	Range is extendable upon request Default measurement range is -220 °C … +200 °C Extended measurement range is -193 °C … +787 °C	-100		+200	°C
$T_{HR,\ PREC}$	Precision	(EN 60751 / IEC 751)		0.005	0.01	°C
$T_{HR,\ COEFF}$	Temp. Coefficient	Relative to device temperature			1.6 m	°C/K
$T_{HR,\ NOISE}$	Value Noise	Reference measurement fluctuations while output stage operating @ 70 % load		0.003		°C
$T_{HR,\ REP}$	Repeatability	Repeated measurements of reference resistors after up to 3 days		0.005		°C

High Resolution Temperature Measurement Characteristics (NTC Probes)

NTC thermistor resistive input characteristics translate into temperature ranges valid for only one type of NTC probe. Below example is given in the case of an NTC $B_{25/100}$ 3988K R_{25} 10k temperature sensor.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{HR, RANGE}$	ADC Auto Gain PGA = 1 or 8 or 32	Low-°T Configuration R_s = 56 kΩ	105		55742	Ω
		Corresponding temperature range	176 to -10.1			°C
		Very Low-°T Configuration NTC	73		1M	Ω
		Corresponding temperature range	194.3 to -55.5			°C

$R_{HR, RANGE}$ is the resistance range of the NTC sensor

High Resolution Temperature Monitoring Characteristrics (Voltage Measurement VIN1 / VIN2)

Sensors with linear Voltage/Temperature output.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$V_{SENS, DIFF}$	Range	Differential input voltage Temperature range depends on sensor used	-2.039		2.039	V
$V_{HRUx, ABS}$	Range	Absolute input voltage	-0.1		5.1	V

Low Resolution Temperature Measurement Characteristics (NTC only)

T_A = 25 °C, measurement configuration = 12bit / 2-wire / unshielded cable <50 mm, °T probe = NTC $B_{25/100}$ 3988K R_{25} 10k

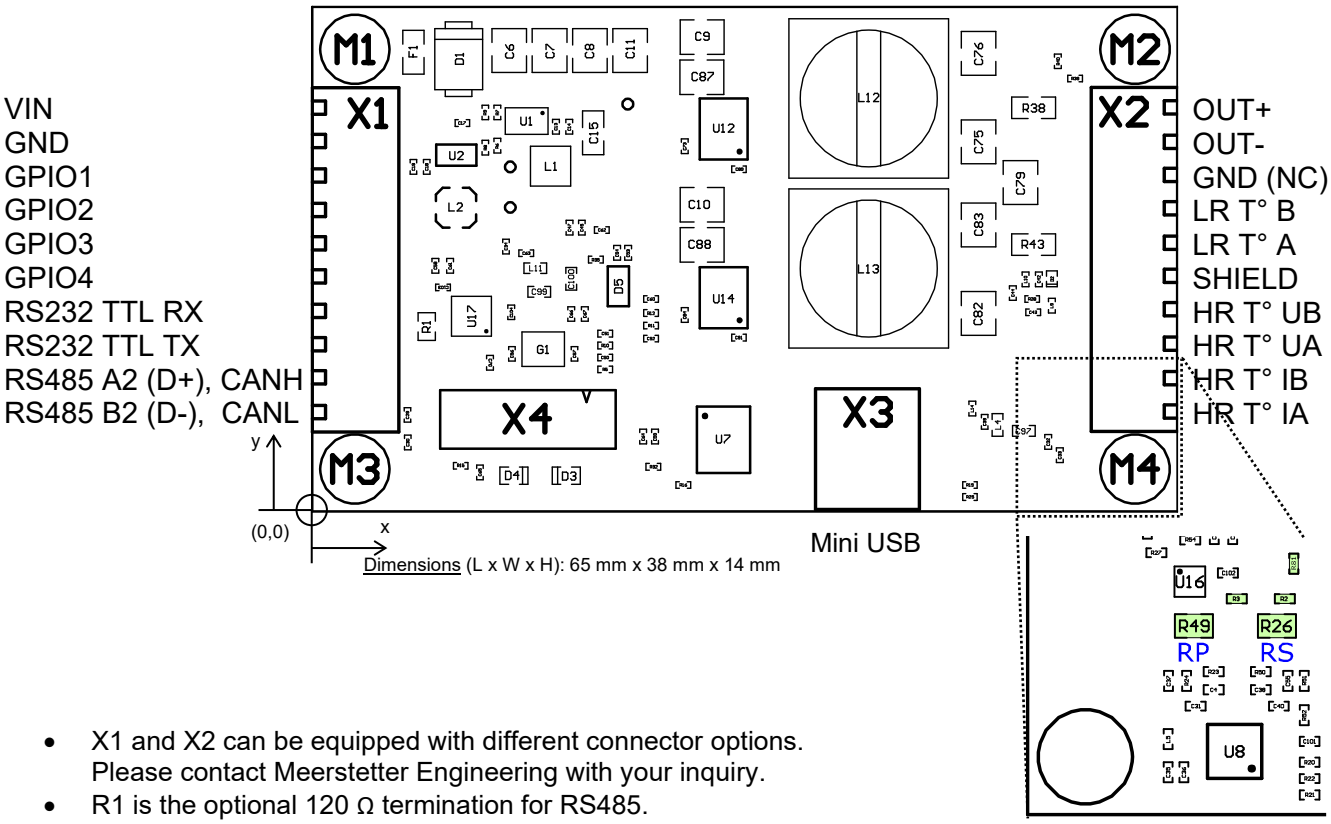
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{LR, RANGE}$	Range		50		49781	Ω
		Corresponding temperature range	214 to -8.1			°C

RS232 TTL and General Purpose Digital I/O Characteristics (GPIO1 … GPIO4, RX, TX)

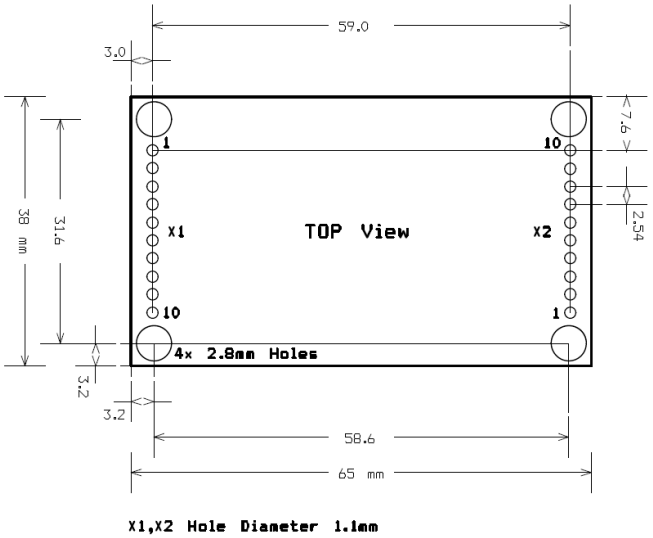
Unless otherwise noted: T_A = 25 °C, U_{IN} = 24 V

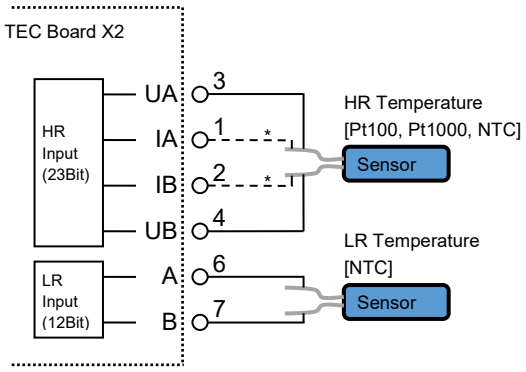
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
Input Characteristics:						
U_{IH}	Logic high input threshold		2.38			V
U_{IL}	Logic low input threshold				0.93	V
U_{IMAX}	Maximum input voltage		-0.5		5.5	V
Output Characteristics: (Microprocessor)						
U_{OH}	Logic high output voltage	Output current 8mA	2.8			V
U_{OL}	Logic low output voltage	Input current 8mA			0.4	V
ESD Protection: (Between Processor and Connector)						
V_{PP}	ESD discharge	IEC61000−4−2			100	kV
R_A	Series resistance		170	200	230	Ω

Package Outline and Pin Configuration



- X1 and X2 can be equipped with different connector options. Please contact Meerstetter Engineering with your inquiry.
- R1 is the optional 120 Ω termination for RS485.
- For direct PCB mounting: If the TEC Controller is powered by a sensitive power supply net, it is recommended decouple the TEC Controller Supply by some filter components. Please contact us for further information.
- For direct PCB mounting: Do not place any component under the TEC Controller.
- RP, RS and the two Jumpers R2 and R3 define the High Resolution Sensor Type
- R81 is for VIN2, which connects IA directly to the 5 V supply.





Peltier element, temperature probes, power supply and connectors not included.

Operation Modes and Communication Options

The TEC-1091 is an OEM precision TEC Controller that is primarily designed to operate as a stand-alone device. Once configured and in operation, its basic status is visually indicated by on-board green and red LEDs and their blinking pattern. More detailed status information can be polled at any time by industry standard RS485 / RS232 TTL connection or by USB (see box below). The TEC-1091 can also operate in a remote-controlled manner, with parameters adjusted on the fly. Scripting capability by sequential lookup table read-out is supported.

Configured as a DC power-supply, the TEC-1091 can handle current and voltage settings. In the remote-control case, temperature data may be passed on to be processed by the host.

Configurable parameters further include: sensor linearization (Pt100 / Pt1000) and Steinhart-Hart modeling (NTC), temperature acquisition hardware calibration, Peltier element modeling, PID controller auto tuning, nominal temperature ramping, current, voltage and temperature limits, error thresholds, etc. Please refer to the TEC Controller User Manual (Document 5216) for further information.

TEC-1091 Ordering Information, Hardware Configuration

Example Configuration: **TEC-1091-PT100-SCREW**

TEC Model:	**High Resolution Sensor Type:**	**Terminal Configuration:**
- TEC-1091	- PT100 (4 Wire) - PT1000 (4 Wire) - NTC (2 Wire) - VIN1 - VIN2	- SCREW (2.54mm Screw Terminal) - PIN (2.54mm Pin Header) - NC (no connector) - (Special connector on request)

High Resolution Sensor Type:
NTC: By default, we mount an NTC1M. If you require an older version (NTC56K), please write which one you need in the comment section of your order or contact us: contact@meerstetter.ch.

Thermocouple:
To use our TEC Controllers with thermocouples type K, you need a TCI-1181 in addition to the TEC Controller with a VIN1 or VIN2 High Resolution Sensor Type configuration.

Display Unit:
It is possible to connect a small or big OLED 2x16 / 4x20 character display directly to the X11 connector of the device. Please visit the DPY-111x product pages on our website for further information.

Customization:
Many hardware and software features of the TEC-1091 are customizable upon request. Please contact Meerstetter Engineering with your enquiry.

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Change History

Date of change	Version	Changed/ Approved	HW-Version	Change / Reason
14 October 2024	T	XF / ML	v3.40 / v3.50	• Add: Change History • Add: New Main Feature: Measurement Inputs are freely assignable to any Output Channel • Add: New Main Feature: Bipolar output channels can be split into unipolar channels • Add: "Unipolar current per channel" and "Unipolar voltage per channel" specifications in "Electrical Characteristics" section • Add: Max Input Current (I_{IN}) specification in Electrical Characteristics section • Mod: Measurement Frequency is now possible up to 90 Hz instead of 80 Hz • Mod: The RS232 pins can now be used as GPIO pins, which makes it possible to use 6 GPIO pins in total • Mod: Changed naming of "Main"/"Object" measurement input to "High Resolution" measurement input • Mod: Changed naming of "Auxiliary"/"Sink" measurement input to "Low Resolution" measurement input • Mod: Specified that the RS485 Data Interface only supports Half-Duplex communication • Fix: "NTC1M" is the default NTC configuration and not "NTC56K" • Del: RS422 communication is not supported • Del: "Bipolar output current" and "Bipolar output voltage" removed from "Absolute Maximum Ratings" section • Del: "TEC Service Software" and "Temperature Control (Autotuned PID)" sections removed