**meerstetter engineering**
Member of Berndorf Group

TEC CONTROLLER TEC-1161-4A
Hardware Version 1.20

The TEC-1161 Series is a high-precision dual-channel thermoelectric controller designed for driving and monitoring Peltier elements with exceptional accuracy & stability. Featuring fully digital control, intelligent PID auto-tuning, and comprehensive communication interfaces, it offers a complete solution for demanding temperature-regulated applications.

HIGHLIGHTS

- **Output Stage**: ±4 A / ±10 A, ±21 V
- **Input Voltage**: DC 5 – 24 V
- Precision < 0.01 °C stability
- Digital PID control with auto-tuning
- Smooth temperature ramping and thermal stability indicator
- Stand-alone or remote-controlled via USB, RS485 (Half-Duplex), CANopen CiA 301
- PC software for configuration and data logging
- Supports Pt100, Pt1000, NTC or Voltage sensors (4-wire precision input)
- Available as screw-terminal or PCB-mount OEM module

RoHS compliant
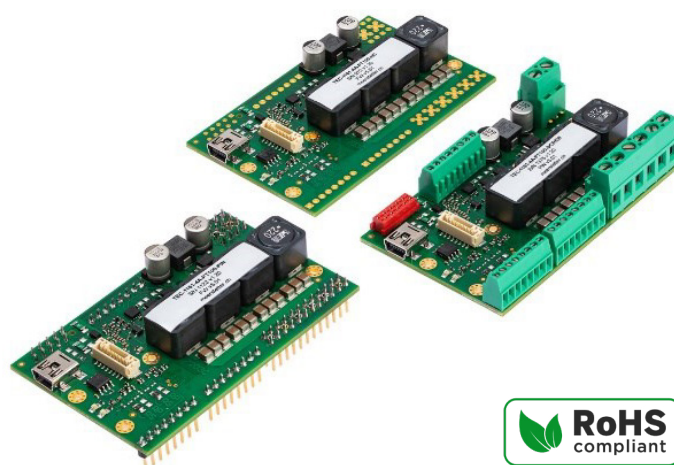
Trial Device & Technical Support

Trial devices and technical support are available for evaluation projects.
Please contact support@meerstetter.ch OR visit https://www.meerstetter.ch/customer-center/support

Meerstetter TEC Controller — Typical Application
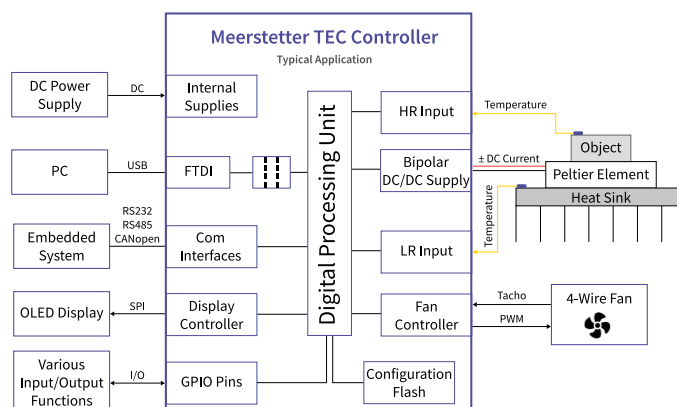
RELATED PRODUCTS

Model	Output	Channels	Description
TEC-1091	±4 A / ±21 V	1	Small, single channel
TEC-1162	±5 A / ±56 V	1	Medium-high, single channel
TEC-1161-4A	2 x (±4 A / ±21 V)	2	Small, dual channel
TEC-1161-10A	2 x (±10 A / ±21 V)	2	Medium, dual channel

See the full product overview in the Meerstetter's Product Compatibility section.

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1. Ratings

Absolute Maximum Ratings		Operating Ratings	
Parameter	Value	Parameter	Value
Supply voltage (DC)	25.5 V	Temperature	-40 – 90 °C
-	-	Humidity	5 – 95 %, non-condensing

1.2. Operating Characteristics
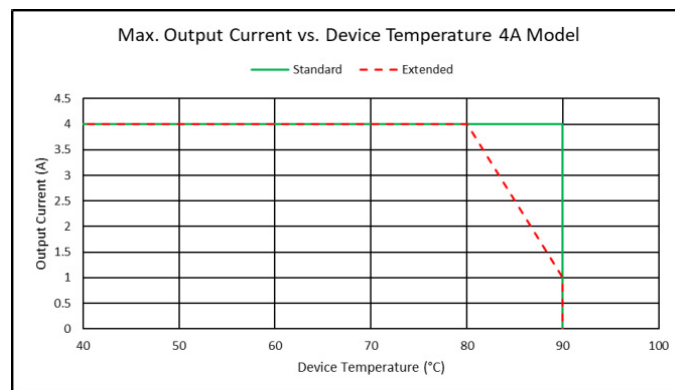
Figure 1: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed
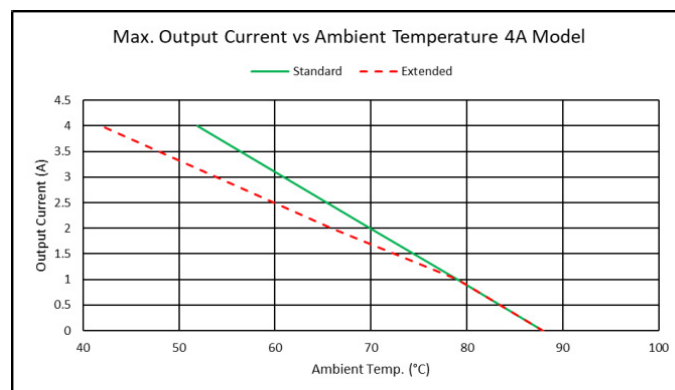
Figure 2: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

Standard or Extended Device Temperature Mode can be set as software setting.
The right Diagram shows the situation with an external 3.3Ω resistor (4A Model) or a 1.65Ω resistor (10A Model). No forced air flow was present.

1.3. Efficiency

Figure 3: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

The Efficiency measurements were done at 21V output voltage and a device temperature of 60°C. The ambient temperature was 23°C, no forced air flow was present.

1.4. Electrical Characteristics 4A Model

Unless otherwise noted: T_A = 25 °C, U_{IN} = 24 V, R_{load} = 3.3 Ω

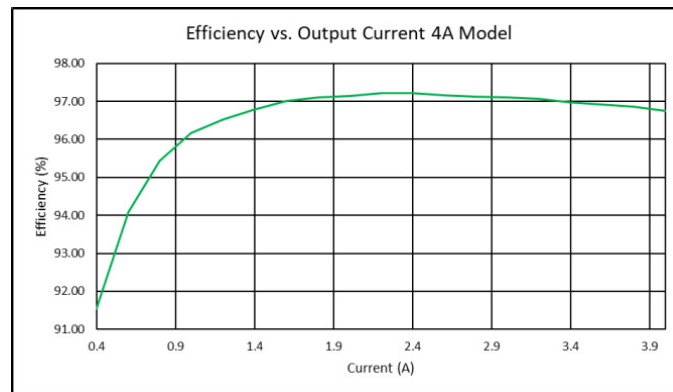| Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
DC Power Supply Input:						
U_{IN}	Supply voltage	Measured directly on power input terminals	4.9		24	V
U_{OUT} Ripple	Ripple tolerance	U_{IN} never below $U_{IN\,min}$ or above $U_{IN\,max}$			300	mV$_{PP}$
I_{IN}	Max input current	Hint: Software limitation			10	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			100	mV$_{PP}$
System Characteristics:						
$\eta_{50\%}$	Power efficiency	@ 50 % load (10.5 V, 4 A)		94		%
$\eta_{100\%}$	Power efficiency	@ 100 % load (21 V, 4 A)		96		%
Output Monitoring: (I_{OUT} Resolution is 1.46 mA; U_{OUT} Resolution is 6.1 mV)						
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.

1.5. Output Safety Characteristics

Unless otherwise noted: T_A = 25 °C, U_{IN} = 12 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			120		mA

2. TEMPERATURE CHARACTERISTICS

2.1. 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 $_{B25/100}$ 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	Corresponding temperature range	73 Ω (≈ 194.3 °C)		1 MΩ (≈ –55.5 °C)	Ω / °C

2.2. High Resolution Temp. Measurement Characteristics (Pt100 and Pt1000 Probes)

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

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{HR, RANGE}$	Range	Range is extendable upon request. Extended measurement range is -193°C … +787°C	-220		+200	°C
$R_{HR, PREC}$	Precision	(EN 60751 / IEC 751)		0.005		°C
$R_{HR, COEFF}$	Temp. Coefficient	Relative to device temperature			1.6m	°C/K
$R_{HR, NOISE}$	Value Noise	Reference measurement fluctuations while output stage operating @70% load		0.005		°C
$R_{HR, REP}$	Repeatability	Repeated measurements of reference resistors after up to 3 days		0.008		°C

2.3. High Resolution Temp. Measurement Characteristics (Volt. Measurement VIN1/2)

Sensors with linear Voltage/Temperature output
For detailed information on the VIN1/2 voltage measurement setup, please refer to the Application Note.

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

2.4. Low Resolution Temperature Measurement Characteristics (NTC only)

T_A = 25 °C, measurement configuration = 12 bit / 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	Corresponding temperature range	50 (≈ 214 °C)		49781 (≈ -8.1 °C)	Ω

3. INTERFACES AND CONNECTORS

3.1. General Purpose Digital I/O Characteristics (GPIO1 ... GPIO10)

Unless otherwise noted: T_A = 25 °C

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 8 mA	2.8		3.3	V
U_{OL}	Logic low output voltage	Input current 8 mA			0.4	V
Z_{OUT}	Output Impedance		110	120	150	Ω
I_{OUT}	Output Sink or Source Current			±8	±20	mA
ESD Protection: (Between Processor and Connector)						
V_{PP}	ESD discharge	IEC61000-4-2		18		kV
R_A	Series resistance		85	100	115	Ω

3.2. Auxiliary Connector X5 Power Supply Output Characteristics

Unless otherwise noted: T_A = 25 °C

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
Input Characteristics:						
U_{OUT}	Output voltage	Output current 50 mA	4.4	4.5	5	V
I_{OUT}	Output current		0	150	200	mA
U_{IMAX}	Maximum input voltage		-0.5		5.5	V

3.3. Pin Configuration Screw Connectors TOP View
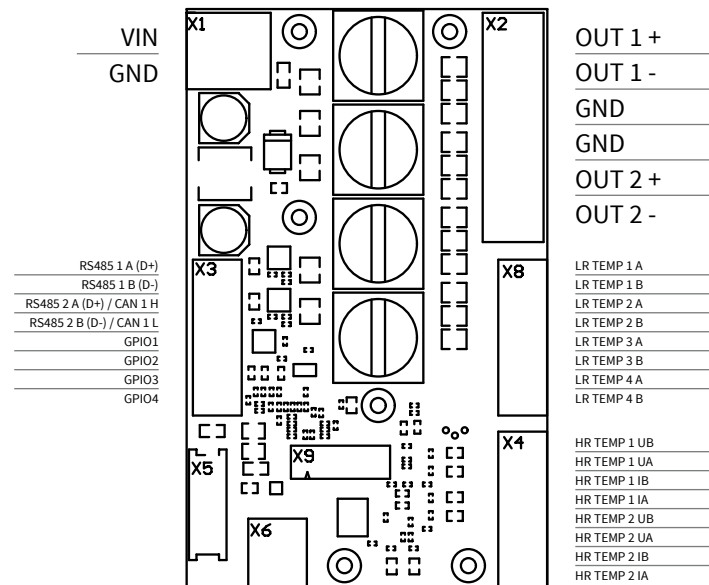

Figure 4: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

3.4. Matching Receptacles for the PIN Configuration

The following receptacles can be used for the TEC-1161 in the -PIN Configuration:
Manufacturer: MILL-MAX MANUFACTURING Part Number: 801-43-050-10-001000
The receptacles need to be broken up into the appropriate length.

3.5. Screw Connector Specifications X1 and X2

Parameter	Min	Typ	Max	Units
Wire Size (Mechanical Limit, current carrying capacity not considered)	0.05		2.5	mm^2
Torque		0.5	0.6	Nm
Stripping Length		6.5		mm

3.6. Screw Connector Specifications X3, X4 and X8

Parameter	Min	Typ	Max	Units
Wire Size (Mechanical Limit, current carrying capacity not considered)	0.05		0.5	mm^2
Torque		0.1		Nm
Stripping Length		5		mm

3.7. Temprature Sensor Connection X4 and X8
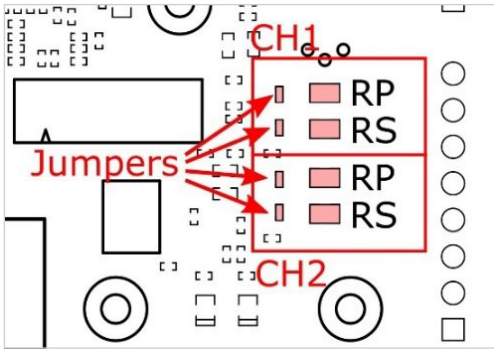

Figure 5: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

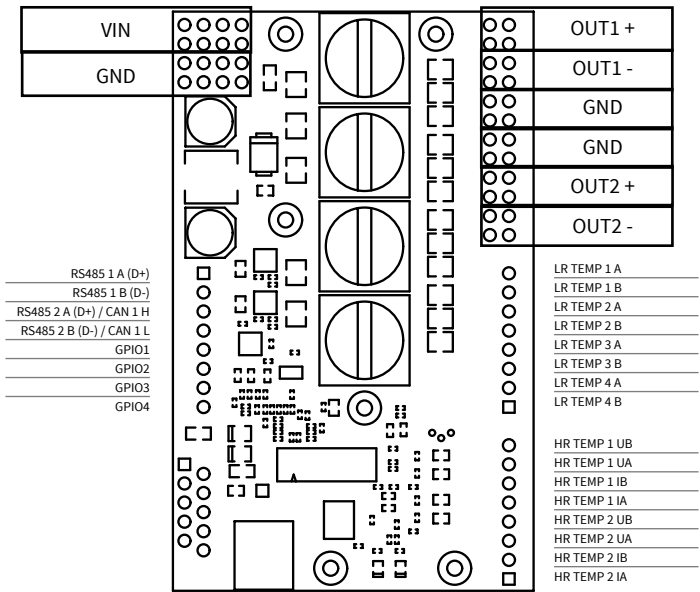## 3.8. Pin Configuration Pinheader Connectors TOP View

Figure 6: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

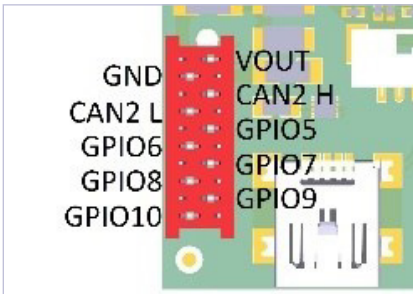## 3.9. Pin Configuration Auxiliary IO Connector X5

Mini-Module Plug

Figure 7: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

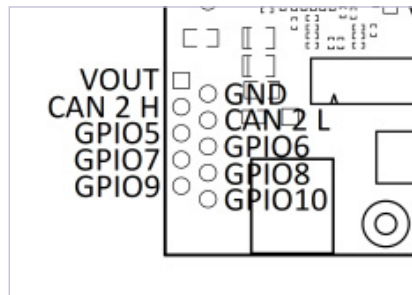| Parameter	Value
Plug used	Würth MINI MODULE
Part Number	690367181072
Matching Connector	Würth
Part Number	690157001072
Notes	CANopen only on CAN1

Pin-Header

Figure 8: Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed

3.10. Mini USB Connector X6

The Mini USB Connector X6 can be used to communicate with the TEC Controller using the meCom communications protocol or the software. It is electrically isolated.

3.11. Display Connector X9

The Connector X9 can be used to connect one of the OLED Displays available from Meerstetter (DPY-1113, DPY1114 or wDPY-1115).

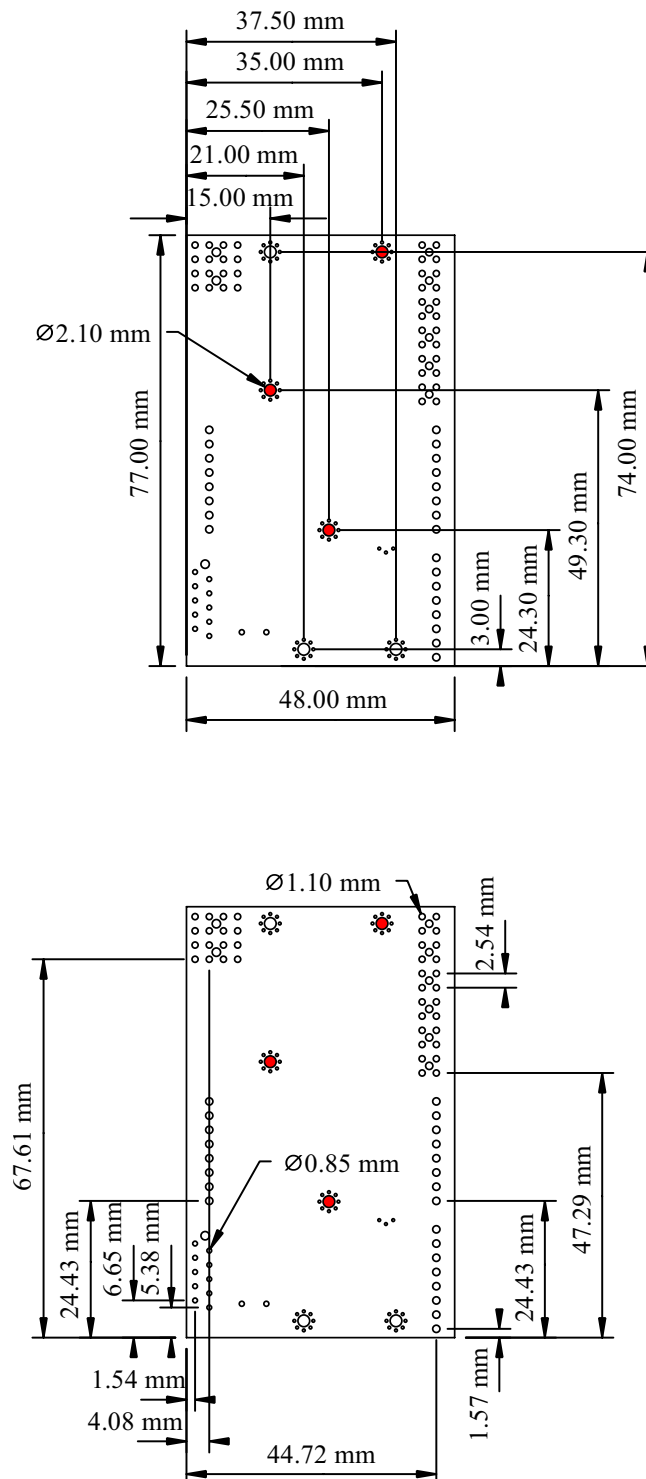## 3.12. Temperature Sensor Connection X4 and X8
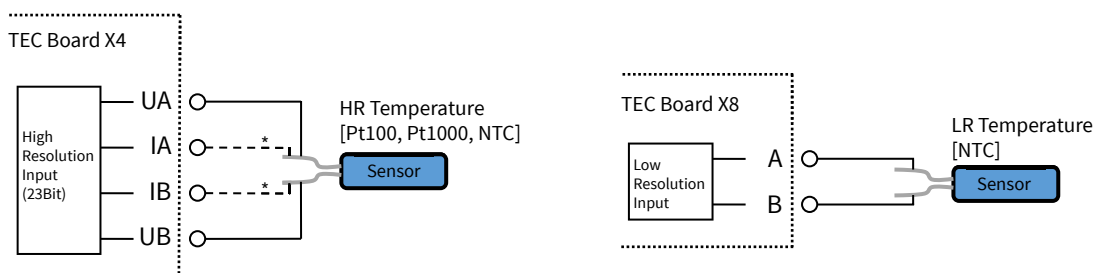
* In case of Pt100 or Pt1000, use 4 wires to connect the High Resolution Temperature Sensor

Further information can be found in the relevant article on our website.

4. MECHANICAL DATA

## 4.1. Dimensions

Top View

The holes marked in red are used to mount the aluminum baseplate for the 10A version and are therefore not available for mounting purposes in this version.
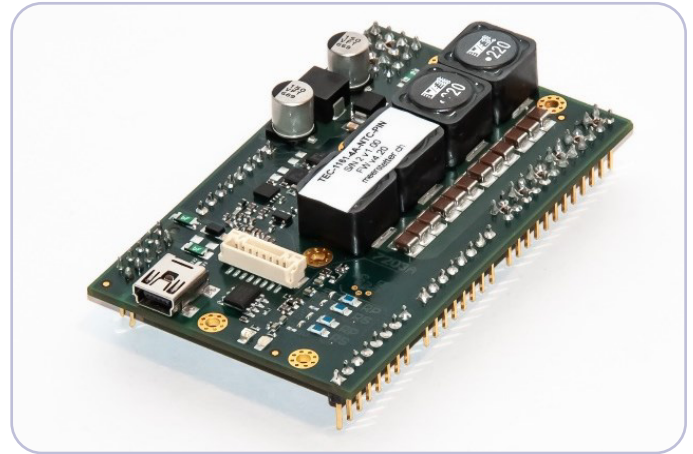
5. FUNCTIONAL DESCRIPTION

5.1. Operation Modes / Theory of Operation

The TEC-1161 is an OEM precision TEC Controller that is available with Screw Terminals or as a PCB mountable device. Its basic operation status is visually indicated by on-board green and red LEDs and their blinking pattern.
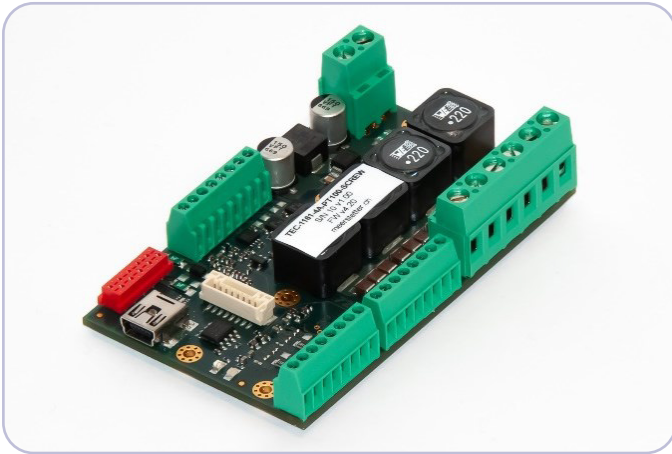
SCREW Screw terminal equipped Version

PIN PCB mountable Version

Status information can be polled at any time by the various communication interfaces. The TEC-1161 can also operate in a remotely 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-1161 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.

6. ORDERING AND CONFIGURATION

6.1. TEC-1161 Ordering Information & Configuration

Example Configuration:

TEC-1091 (NTC; PIN) FW6.20

Requirement	Variant Name	Description	Options / Single choice
Required	High Resolution Sensor Type	Defines compatibility with temperature sensor on HR input.	PT100 (4 Wire); PT1000 (4 Wire); NTC (2 Wire R_{max} of NTC); VIN1; VIN2;
Required	Terminal Configuration	Choose connector type.	NC; SCREW; PIN;
Optional	FW Version	Enter a compatible FW if you choose not to use the latest version (default). Check software change log for details.	FW vX.YY
Advanced	Customer Specific Modifications	Usually hardware modifications, available only on demand and quote.	Empty; or example: CS3
Advanced	Customer Specific Profile	Preset parameters/configuration, available only on demand and quote.	Default; or example: P15
-	Hardware Version	For reference, specifies the HW version (latest by default, subject to future change).	Example: HW v3.51

6.2. Ordering Confirmation Example

TEC-1091 (NTC; PIN; HW3.50) FW6.20
Profile: default

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7. ALL MEERSTETTER PRODUCTS

7.1. Meerstetter's Product Compatibility

The Laser Diode Drivers and TEC Controllers from Meerstetter 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 Laser Diode Drivers and TEC Controllers from Meerstetter Engineering:

Model	Output	Description
Laser Diode Drivers		
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 Controllers		
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

8. CHANGE HISTORY

Date of change	Version	Changed/Approved	HW-Version
14 October 2024	G	XF / ML	v1.20 / v1.21

Change / Reason

- 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
- Del: "Important note" regarding GPIO 9/10 and Low resolution temp. measurement 3/4 not being available removed as they are available as of firmware v6.00