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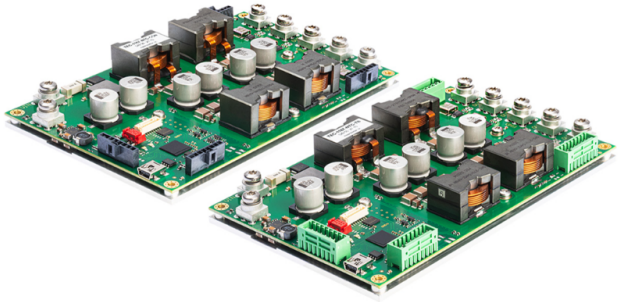
TEC-1167

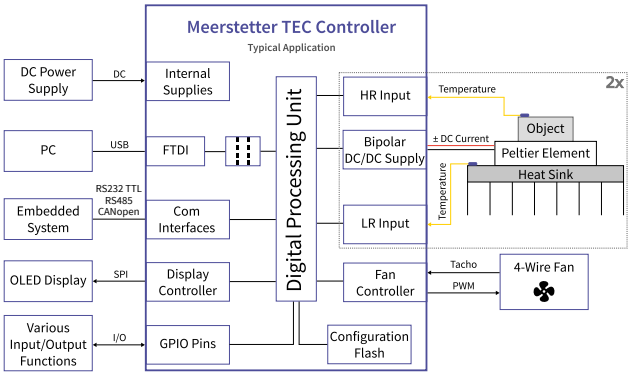
Hardware Version v1.30

The TEC-1167 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-controlled applications. Optional Advanced Features such as Cascade Temperature Control, Channel Splitting and Temperature Estimation are available through Software.

HIGHLIGHTS

- **Output per Channel:** variable up to ±25 A, ±56 V
- **Input Voltage:** 11.5 – 63 VDC
- Typical cooling capacity: 2×700 W (@COP=0.5)
- Temperature precision/stability: ≤ 0.01 °C
- Control Frequency: 1 Hz, 10 Hz, 90 Hz
- Dimensions: 160 × 100 × 28 mm
- Digital PID control with auto-tuning
- Smooth temperature ramping and thermal stability indicator
- Stand-alone or remote-controlled operation via USB (isolated), RS485, RS232 TTL or CANopen CiA 301
- GUI software for configuration and data logging
- Supports Pt100, Pt1000, NTC or Voltage sensors (4-wire precision input). The analog measurement circuit is factory calibrated
- GPIO features for monitoring and control (Enable, Error Indication, Fan Control, etc.)
- Two independent channels for individual or common loads
- Supports Peltier elements and resistive heaters
- Available as CON locking connector or terminal block OEM module





Trial Device & Technical Support

Trial devices and technical support are available for evaluation projects.
Please contact support@meerstetter.ch or visit our support center.

RELATED PRODUCTS

Model	Channels	Output per Channel	Description
TEC-1166	2	±5 A / ±56 V	lower power
TEC-1163	1	±25 A / ±56 V	single-channel version
TEC-1161-4A	2	±4 A / ±21 V	more compact, lower power
TEC-1161-10A	2	±10 A / ±21 V	more compact, lower power

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

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TABLE OF CONTENTS

1 SPECIFICATIONS

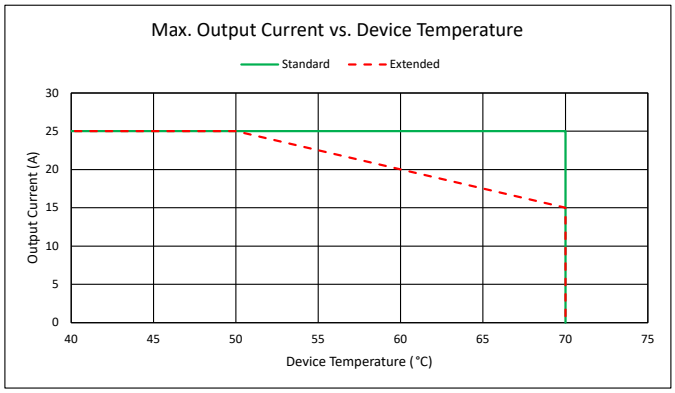
1.1 Absolute Maximum Ratings [1]

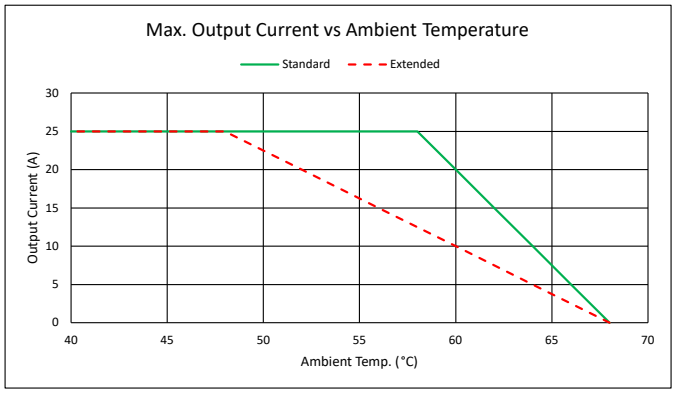
		Min	Max	Unit
Voltage	$U_{IN, DC}$		70	V
	$U_{IN, GPIO}$	-0.5	5.5	V

1 Operation at or beyond the absolute maximum ratings may result in permanent device damage. These limits are stress ratings only and functional operation of the device at these conditions is not guaranteed. Prolonged exposure to absolute maximum conditions can adversely affect long-term reliability and should be avoided during normal operation.

1.2 Operating Characteristics

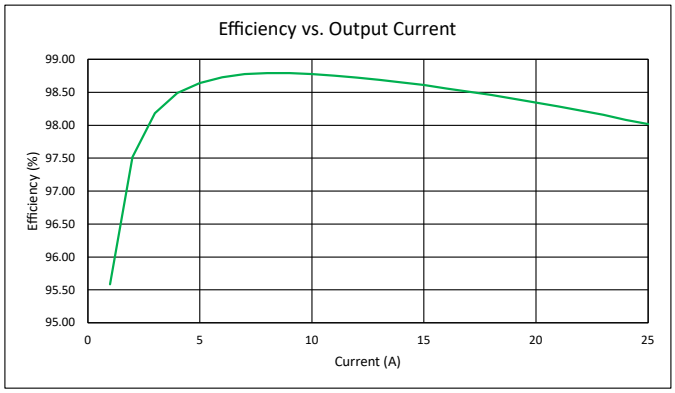
		Min	Max	Unit
Temperature	T_{OP}	-40	70	°C
Humidity	RH_{OP}, non-condensing	5	95	%

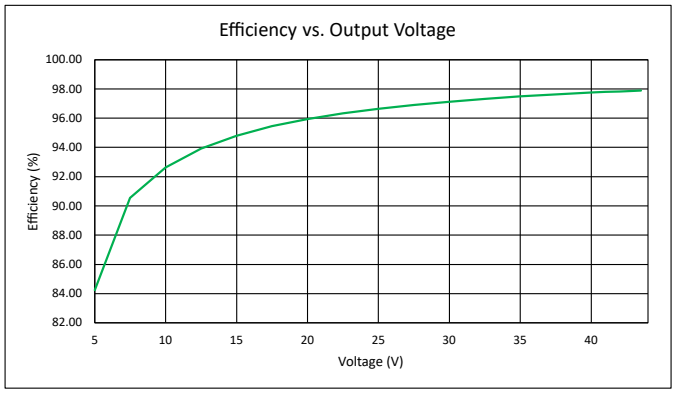




Note:
Standard or Extended Device Temperature Mode can be set as software setting.
No forced air flow was present.

1.3 Efficiency





Note:
The Efficiency measurements were done at 48 V input voltage, an output voltage of 44 V, an output current of 25 A and a base plate temperature of 60 °C unless otherwise noted. The ambient temperature was 23 °C, no forced air flow was present.

1.4 Electrical Characteristics

Unless otherwise noted: T_A = 25 °C, U_{IN} = 48 V

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
DC Power Supply Input:						
U_{IN}	Supply voltage	Measured directly on power input terminals	11.5		63	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			54	A
Output (per Channel):						
I_{OUT}	Bipolar current				±25	A
U_{OUT}	Bipolar voltage	U_{OUT} is maximum ~0.90 * U_{IN}			±56	V
I_{OUT}	Unipolar current [1]				25	A
U_{OUT}	Unipolar voltage [1]	U_{OUT} is maximum ~0.90 * U_{IN}			56	V
$U_{OUT\ Ripple}$	Voltage ripple	@ 25 A			120	mV_{PP}
System Characteristics:						
$\eta_{50\%}$	Power efficiency	@ 50 % load (28 V, 25 A)		96		%
$\eta_{100\%}$	Power efficiency	@ 100 % load (56 V, 25 A)		97		%
Output Monitoring: (I_{OUT} Resolution is 18.3 mA; U_{OUT} Resolution is 17.6 mV)						
$I_{OUT\ Read}$	Precision	@ 24 A		1	5	%
$U_{OUT\ Read}$	Precision	@ 30 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} = 48 V

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
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			2.5		A

2 TEMPERATURE CHARACTERISTICS

2.1 High Resolution Temperature Measurement Characteristics (Pt100 and Pt1000 Probes)

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

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
$T_{HR, RANGE}$	Range	Range is extendable upon request Extended measurement range is -193°C … +787°C	-220		200	°C
$T_{HR, PREC}$	Precision	(EN 60751 / IEC 751)		5		mK
$T_{HR, COEFF}$	Temp. Coefficient	Relative to device temperature			1.6	mK/K
$T_{HR, NOISE}$	Value Noise	Reference measurement fluctuations while output stage operating @70% load		5		mK
$T_{HR, REP}$	Repeatability	Repeated measurements of reference resistors after up to 3 days		8		mK

2.2 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	Unit
$R_{HR, RANGE}$ [1]	ADC Auto Gain PGA = 1 or 8 or 32		73 ≈ 194.3		1M ≈ -55.5	Ω °C

1 $R_{HR, RANGE}$ is the resistance range of the NTC sensor

2.3 High Resolution Temperature Measurement Characteristics (Voltage Measurement VIN1/VIN2)

Sensors with linear Voltage/Temperature output

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

2.4 Low Resolution Temperature Measurement Characteristics (NTC only)

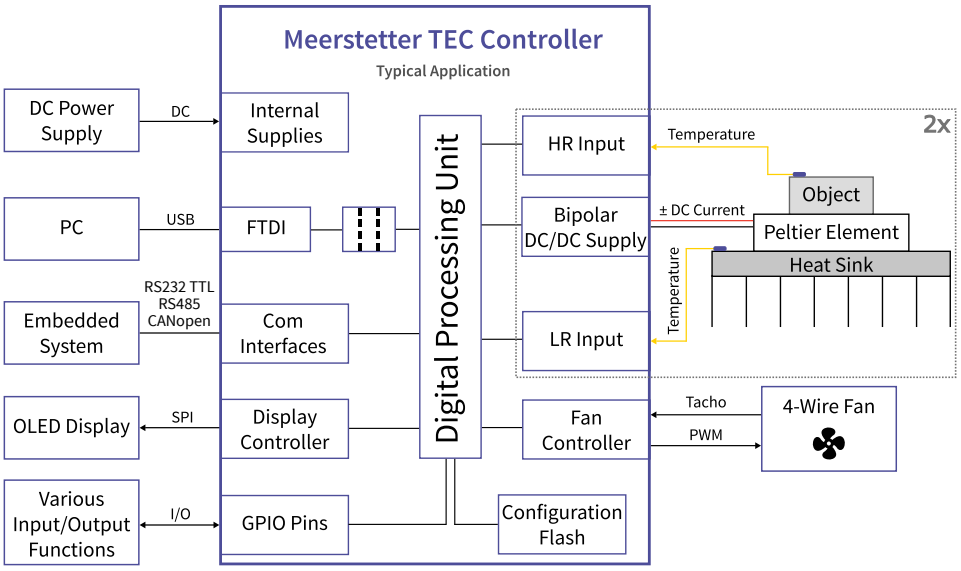
T_A = 25°C, measurement configuration = 12 bit / 2-wire / unshielded cable < 50 mm, °T probe = NTC $B_{25/100}$ 3988K R_{25} 10k

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
$R_{LR, RANGE}$	Range		83 ≈ -30.0		182413 ≈ 187.0	Ω °C

3 FUNCTIONAL DESCRIPTION

3.1 Typical Application

Following image gives an overview of a typical thermoelectric cooling (TEC) application using a Meerstetter Engineering TEC Controller to drive a thermoelectric heat pump, often also referred to as Peltier element.



A bipolar DC/DC converter supplies power the Peltier element in unipolar directions. This enables both heating and cooling of the object. A 23-bit high-resolution (HR) measurement input continuously measures the object temperature. Using the acquired temperature, the object temperature is controlled and held stable (deviation is typically 0.01 °C or less) by adjusting the heat pumping capacity.

Waste heat from the object is pumped to a heat sink and further radiated into the environment. A low-resolution (LR) input monitors the temperature of the heat sink to further optimize the control algorithm (not required but recommended). Optional fans enable controlling the sink temperature through forced air removal. The TEC Controller features two separate 4-Wire fan interfaces with integrated fan control.

Once configured, the device operates standalone by storing its configuration parameters in internal non-volatile flash storage. The configuration can be changed by using our configuration software or MeComAPI through the isolated USB port or RS-interfaces. Additionally, CANopen CiA 301 support provides options for advanced system integration.
Please ensure that the device supports your required communication interface and refer to the Remote Control Guide for more detailed information.

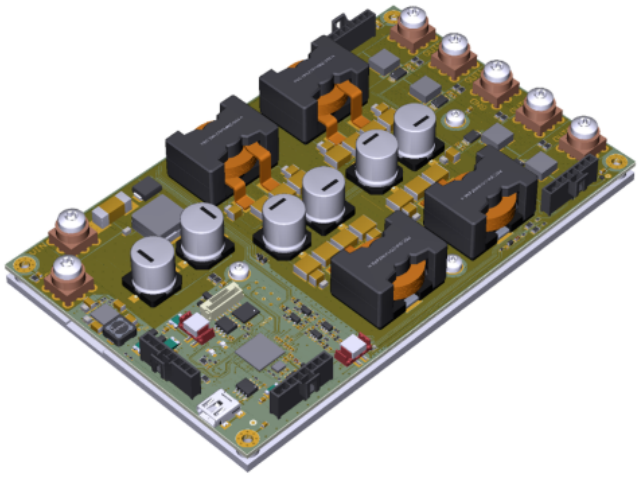
For easy on-site status information, an OLED display can be connected to show any parameter by freely setting it up through software.

The controller supports various GPIO functionalities for monitoring and controlling of the device. Features include Driver Enable, Error Indication, Fan Control & Pump Enable, Temperature Stable Indication, Temperature Increment/Decrement and more. Most functions can be freely assigned to any GPIO.

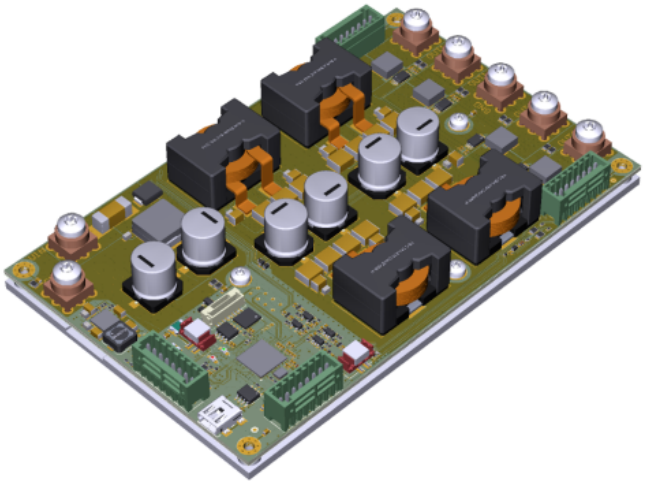
ℹ For more information on the operation of the device and the Peltier elements, as well as how to dimension them, please refer to the compendium on our website.

3.2 Operation Modes and Communication Options

The TEC-1167 is an OEM precision TEC Controller that is available with Terminal Blocks and with connectors. Its basic operation status is visually indicated by on-board green and red LEDs and their blinking pattern.



CON locking Connector equipped version. (Best suited for series production)



TB Terminal Block equipped version. (Best suited for prototyping, commissioning and small series. **Attention:** Counter parts for Terminal Blocks will not be shipped with the device!)

Status information can be polled at any time by industry standard connections RS485, RS232 TTL, CANopen or by USB. The TEC-1167 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-1167 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.

3.3 Hardware Configuration

High Resolution Sensor Type:
NTC: By default, we mount an NTC1M. If you require an older version (NTC18K, NTC39K or NTC56K), please write which one you need in the comment section of your order or contact us: contact@meerstetter.ch.

Terminal Configuration:
The Device is available with different types of connectors for X8, X9, X14 and X15:

- **NC** (no connector)
- **CON** (2.5 mm Con locking Connector)
- **TB** (2.5 mm Terminal Block)

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 X13 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-1167 are customizable upon request. Please contact Meerstetter Engineering with your enquiry.

4 INTERFACE AND CONNECTORS

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

Unless otherwise noted: T_A = 25 °C

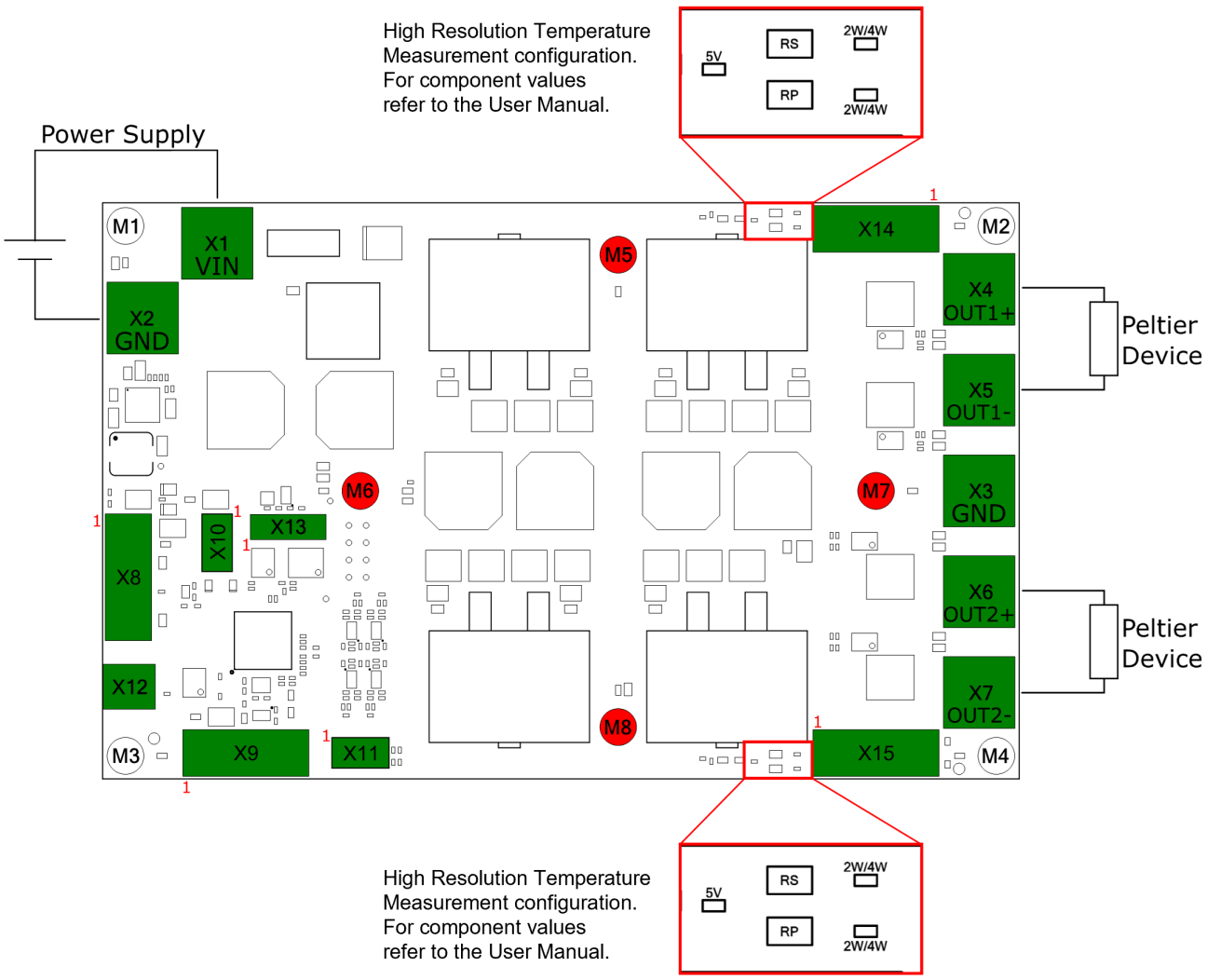
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
Input Characteristics:						
U_{IH}	Logic high input threshold		2.38			V
U_{IL}	Logic low input threshold				0.93	V
U_{IMAX}	Maximum input voltage	General Purpose Inputs are 5V-tolerant	-0.5		5.5	V
Output Characteristics: (Microprocessor)						
U_{OH}	Logic high output voltage	Output current 8 mA	2.8	3.3	3.4	V
U_{OL}	Logic low output voltage	Input current 8 mA			0.4	V
Z_{OUT}	Output Impedance			50		Ω
I_{OUT}	Output Sink or Source Current			±8	±20	mA
ESD Protection: (Between Processor and Connector)						
U_{PP}	ESD discharge	IEC61000-4-2		18		kV
R_A	Series resistance		85	100	115	Ω

4.2 Auxiliary Connector X8, X9, X10 Power Supply Output Characteristics

Unless otherwise noted: T_A = 25 °C

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
Output Characteristics:						
U_{OUT}	Output Voltage	Output Current 50 mA	4.4	4.5	5.0	V
I_{OUT}	Output Current	Sum of output currents of X8, X9 and X10	0	150	200	mA

4.3 PCB-Overview



4.4 Connector X1 – X7

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
	Matching screw			M4x6		
τ_{SCREW}	Tightening Torque			2.2		Nm

4.5 Connector X8, X9, X14, X15

4.5.1 TB (Terminal Block) Matching Receptacle

Matching Receptacle: Würth WR-TBL Series 382, P/N 691381000008.
Pin 1 is marked in red.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
A_{WIRE}	Wire Size	Mechanical Limit; current carrying capacity not considered	0.2		1.5	mm^2

4.5.2 CON Matching Receptacle

Matching Receptacle: Molex Nano-Fit. P/N 1053071208.
Pin 1 is marked in red.

4.5.3 Pinout X8, X9, X14, X15 for TB and CON version

Pinout Com Connector X8			
PIN 1	+5V	PIN 5	RS232 TTL TX
PIN 2	GND	PIN 6	RS232 TTL RX
PIN 3	RS485 1 A/D+	PIN 7	CAN1 H
PIN 4	RS485 1 B/D-	PIN 8	CAN1 L

Pinout GPIO Connector X9			
PIN 1	+5V	PIN 5	GPIO 3
PIN 2	GND	PIN 6	GPIO 4
PIN 3	GPIO 1	PIN 7	GPIO 5
PIN 4	GPIO 2	PIN 8	GPIO 6

Pinout Temp Measurement Connector X14			
PIN 1	HR Temp 1 IA	PIN 5	LR Temp 1 A
PIN 2	HR Temp 1 IB	PIN 6	LR Temp 1 B
PIN 3	HR Temp 1 UA	PIN 7	LR Temp 3 A
PIN 4	HR Temp 1 UB	PIN 8	LR Temp 3 B

Pinout Temp Measurement Connector X15			
PIN 1	HR Temp 2 IA	PIN 5	LR Temp 2 A
PIN 2	HR Temp 2 IB	PIN 6	LR Temp 2 B
PIN 3	HR Temp 2 UA	PIN 7	LR Temp 4 A
PIN 4	HR Temp 2 UB	PIN 8	LR Temp 4 B

4.6 Connector X10, X11

Matching Receptacle: Würth Mini Module, P/N 690157000472.
Pin 1 is marked in red.

Pinout Auxiliary Com Connector X10			
PIN 1	+5V	PIN 3	CAN2 H (CAN2 is not available)
PIN 2	GND	PIN 4	CAN2 L (CAN2 is not available)

Pinout Auxiliary GPIO Connector X11			
PIN 1	GPIO 7	PIN 3	GPIO 9
PIN 2	GPIO 8	PIN 4	GPIO 10

4.7 Connector Specifications X12

The Mini USB Connector X12 can be used to communicate with the TEC Controller using the MeCom communica-tions protocol or the software. It is electrically isolated.

4.8 Connector Specifications X13

The Connector X13 can be used to connect one of the OLED Displays available from Meerstetter (DPY-1113, DPY-1114 or DPY-1115).

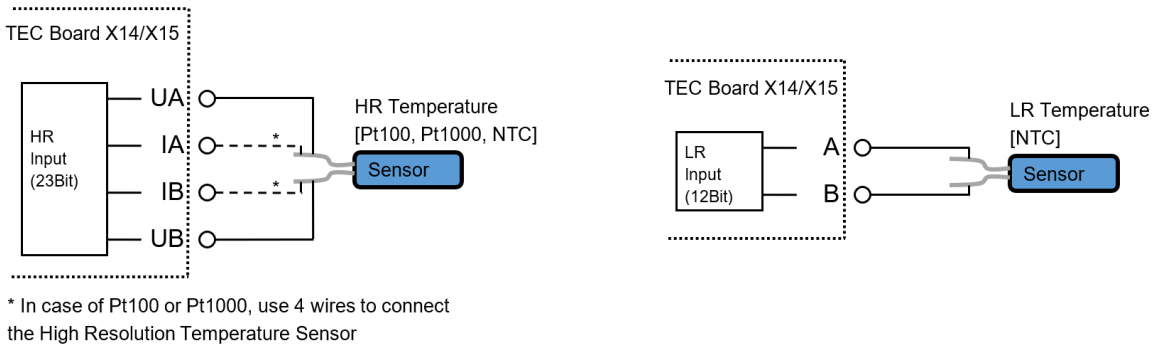
4.9 Temperature Measurement Configuration

The Jumpers “2W/4W” are used for the 2 Wire / 4 Wire configuration. For the values of RS and RP please refer to the TEC Controller User Manual.

4.10 Mounting Holes M1 – M8

All Mounting holes have a Diameter of 3.05 mm. Holes M5-M8 (Marked in red) are used to mount the aluminum base plate to the device and should not be removed.

4.11 Temperature Sensor Connection X14, X15

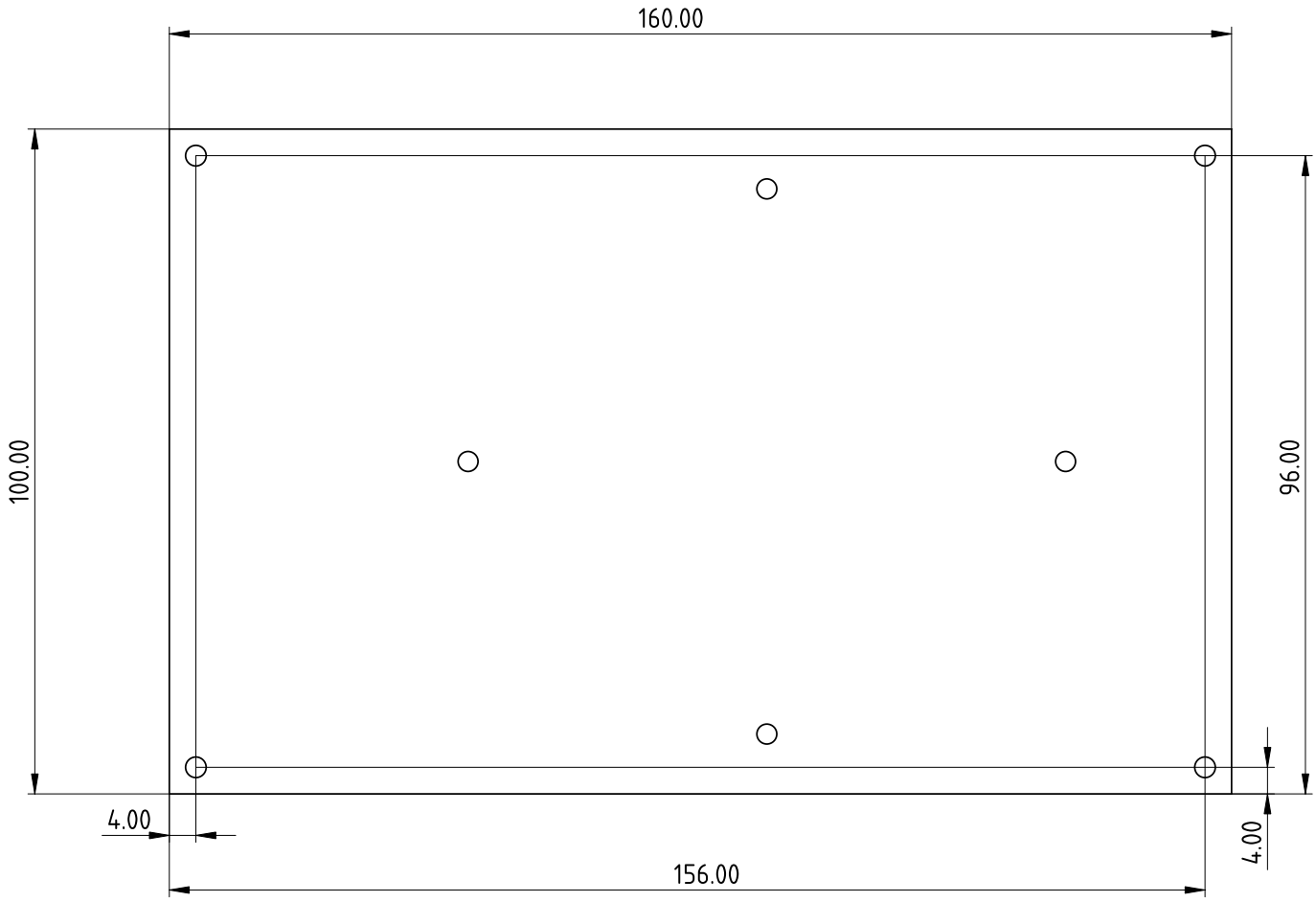


* In case of Pt100 or Pt1000, use 4 wires to connect the High Resolution Temperature Sensor

5 MECHANICAL DATA

5.1 Dimensions and Mounting Hole Positions

Top View, all measurements in mm.



6 ORDERING AND CONFIGURATION

6.1 TEC-1167 Ordering Information & Configuration

Example Configuration:
TEC-1167 (NTC, TB) FW6.31

Variant Name	Requirement	Description	Options / Single choice
High Resolution Sensor Type [1]	**Required**	**Select the temperature sensor type for the HR input.**	**PT100, PT1000, NTC, VIN1, VIN2**
Terminal Configuration [1]	**Required**	**Select connector type.**	**NC, CON, TB**
Firmware Version	Optional	Select a compatible firmware if you do not want the latest version (default). Check the relevant Software Release Notes for details.	Example: FW6.31
Customer Specific Modifications	Advanced	Usually hardware modifications, available only on demand and quote.	Empty, or example: CS3
Customer Specific Profile	Advanced	Preset parameters/configuration, available only on demand and quote.	Empty, or example: 15
Hardware Version	-	For reference, specifies the hardware version (latest by default, subject to future change).	Example: HW1.30

1 See also Chapter 3.3: Hardware Configuration

6.2 Ordering Confirmation Example

TEC-1167 (NTC, TB, HW1.30)
Firmware Version: FW6.31

String can additionally contain:
Profile: Default

7 ALL MEERSTETTER ENGINEERING PRODUCTS

7.1 Meerstetter Engineering'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	1 ms – CW
LDD-1124		0–1.5 A / 0–15 V	CW, modulated modes
LDD-1121		0–15 A / 0–15 V	1 µs – CW, modulated, QCW and pulsed modes
LDD-1125		0–30 A / 0–27 V	1 µs – CW, modulated, QCW and pulsed modes
TEC Controllers			
Single-Channel Models	TEC-1092	±1.2 A / ±9.6 V	Micro
	TEC-1091	±4 A / ±21 V	Small
	TEC-1089	±10 A / ±21 V	Medium
	TEC-1162	±5 A / ±56 V	Medium-high
	TEC-1090	±16 A / ±30 V	Large
	TEC-1163	±25 A / ±56 V	Extra-large
Dual-Channel Models	TEC-1161-4A	2 x (±4 A / ±21 V)	Small
	TEC-1161-10A	2 x (±10 A / ±21 V)	Medium
	TEC-1122	2 x (±10 A / ±21 V)	Medium
	TEC-1166	2 x (±5 A / ±56 V)	Medium-high
	TEC-1123	2 x (±16 A / ±30 V)	Large
	TEC-1167	2 x (±25 A / ±56 V)	Extra-large

8 CHANGE HISTORY

Date of change	Version	Changed / Approved	HW Version
July 6, 2023	A	HS / ML	v1.10
Change / Reason • Document created			
December 13, 2023	B	LS / MR	v1.20
Change / Reason • Add: Front Page			
October 18, 2024	C	XF / ML	v1.20
Change / Reason • 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: Specified that the RS485 Data Interface only sup-ports Half-Duplex communication • 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			
August 20, 2025	D	HS / ML	v1.30
Change / Reason • Add: HW v1.30			
April 20, 2026	E	NJ / HS/SR	v1.30
Change / Reason • Mod: Datasheet design • Del: Old Ordering codes • Add: Standardized product designations and ordering codes tables • Add: Typical Application Chapter • Fix: Change display connector to X13 • Add: Typ/Max output voltage (U_{OH}) for GPO pins			

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