Datasheet –
TEC Controller TEC-1090 (±16 A / ±30 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.

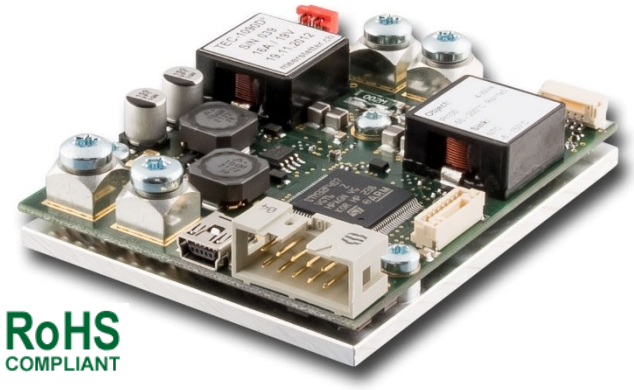
LDD-Family		
LDD-1321	0-1.5 A / 0-14 V	CW, Add on TEC Controller available
LDD-1301	0-20 A / 0.5-45 V	1 ms - CW
LDD-1303	0-20 A / 1-120 V	1 ms - CW
LDD-1137	0-75 A / 0-70 V	0.5 µs - CW, modulated, QCW and pulsed modes
LDD-1124-SV	0-1.5 A / 0-15 V	1 µs - CW, modulated, QCW and pulsed modes
LDD-1121-SV	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

Thermo Electric Cooling Temperature Controller TEC-1090

TEC Controller / Peltier Driver up to ±16 A / up to ±30 V

HW v1.90

OEM TEC Controller



The TEC-1090 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 high resolution, 1x low resolution) and intelligent PID control with auto tuning. The TEC-1090 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 and RS485. 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-1090. After power-up the unit will operate according to pre-configured values. (In stand-alone mode no control interface is needed.)

The TEC-1090 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.

Low resolution 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:

- Output Current: 0 to ±16 A, <1.5% Ripple
  (0 to ±10 A available as TEC-1089)

-HV (High Voltage) Version (stock item, recommended):

- DC Input Voltage: 12 – 36 V nominal
- Output Voltage / Channel: 0 to ±30 V (max. U_{IN} - 6 V)

Main Features:

- Temperature Sensor Types: Pt100, Pt1000, NTC, Voltage
- Temperature Precision / Stability: <0.01°C
- Temperature Control & Measurement Frequency: 1 Hz, 10 Hz, 80 Hz
- Performance-optimized PID for Thermal Power Control
- Configuration / Diagnosis over all communication interfaces with PC Software
- Dimensions (L x W x H): 75 mm x 60 mm x 18 mm
- Efficiency: 92 % (@ 50% Load)
- Cooling over Base Plate
- 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, 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)
- 2x RS485 (Half-Duplex)

General Purpose I/O Features:

- 4x Digital I/O Signals (3.3 V / 5 V)
- Configurable as Input to control TEC-1090 (Enable, Temperature Up / Down etc.)
- Configurable as Output to monitor TEC-1090 (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).

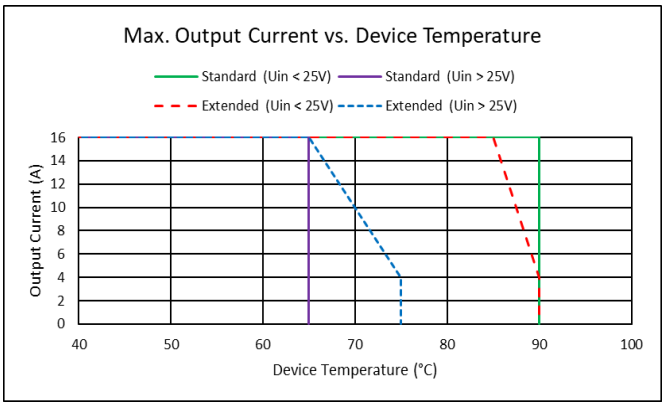
Document Number: 5165T (14 October 2024)

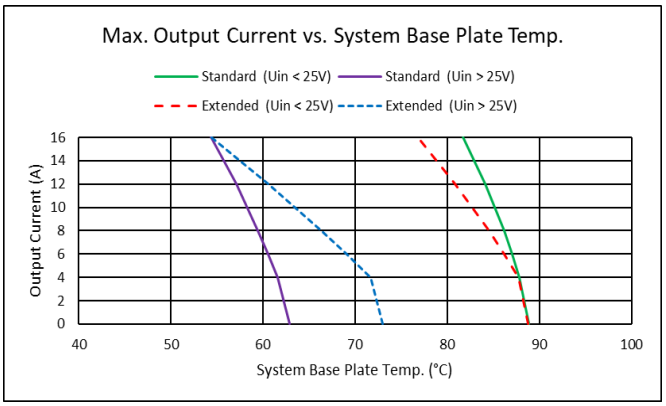
Absolute Maximum Ratings

Supply voltage (DC)	37 V (-HV)

Operating Characteristics for Firmware >= v4.00

Temperature	-40°C to 90°C
Humidity	5 – 95%, non-condensing



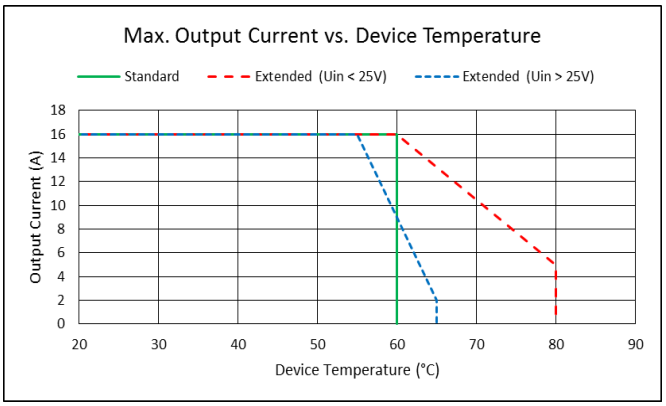


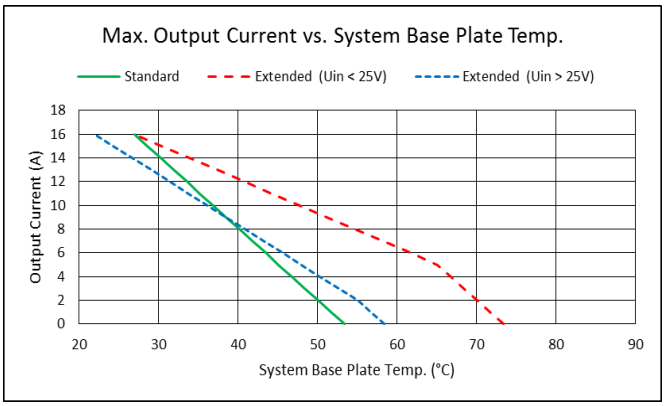
Additional information about the charts above:

- 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).
- The System Base Plate is assumed as the customers heatsink where the TEC Controller is mounted to.
  The right diagram shows the maximum temperature of the customers heatsink to not exceed the temperatures in the left diagram under the following conditions:
  - Between the TEC Controllers base plate and the customers heatsink this thermal pad:
    Bergquist: "GP1500R-0.010-02-0816" was used. We recommend employing this or a similar product.
  - The TEC Controller is pressed with 1.2kPa to the System Base Plate. It is recommended to use the mounting holes of the TEC Controller to press the TEC Controller to the System Base Plate.
  - The air ambient temperature was approximately 30°C colder than the System Base Plate.

Operating Characteristics for Firmware < v4.00

Temperature	-40 – 80°C
Humidity	5 – 95%, non-condensing





Test Condition:
TEC Controller pressed with 1.2kPa to an aluminum System Base Plate without any thermal conductivity material in between. Using a good thermal conductivity material is recommended for high output currents.
Standard or Extended Device Temperature Mode can be set as software setting.

Electrical Characteristics for HV (High Voltage) Version

Unless otherwise noted: T_A = 25°C, U_{IN} = 36 V, R_{load} = 2 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	11.5	36	36.5	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			16	A
Output (per Channel):						
I_{OUT}	Bipolar current				±16	A
U_{OUT}	Bipolar voltage	U_{IN} at least 6 V greater than U_{OUT} Measured directly on power output terminals			±30	V
I_{OUT}	Unipolar current [1]				16	A
U_{OUT}	Unipolar voltage [1]	U_{IN} at least 6 V greater than U_{OUT} Measured directly on power output terminals			30	V
U_{OUT} Ripple	Voltage ripple	R_{load} = 1.75 Ω @ 16 A		400		mV_{PP}
System Characteristics:						
$\eta_{50\%}$	Power efficiency	@ 50% load (15V, 16A)		92		%
$\eta_{100\%}$	Power efficiency	@ 100% load (30V, 16A)		96		%
Output Monitoring: (I_{OUT} Resolution is 12.2mA; U_{OUT} Resolution is 10.25mV)						
I_{OUT} Read	Precision	@ 15.5 A		1	5	%
U_{OUT} Read	Precision	@ 30.0 V		1	3	%
Input Reverse Polarity Protection: (GND input is connected through a Power MOSFET which is not active when reverse polarity is applied to the power supply terminals.)						
U_{IN} Pol.	Reverse polarity				-37	V

[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			1.6		A

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			1.6m	°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 Monitoring 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 Gain PGA = 1	Low-°T Configuration NTC56K	3360		55720	Ω
		Corresponding temperature range	51.8 to -10.1			°C
$R_{HR, RANGE}$	ADC Auto Gain PGA = 1 or 8	High-°T Configuration NTC18K	135		17910	Ω
		Corresponding temperature range	164.0 to 12.2			°C
		Mid-°T Configuration NTC39K	293		38805	Ω
		Corresponding temperature range	131.0 to -3.4			°C
		Very Low-°T Configuration NTC1M	293		1M	Ω
		Corresponding temperature range	131.0 to -55.5			°C

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

High Resolution Temperature Monitoring Characteristics (Voltage Measurement VIN1)

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		3.2	V

Low Resolution Temperature Measurement Characteristics (NTC only)

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

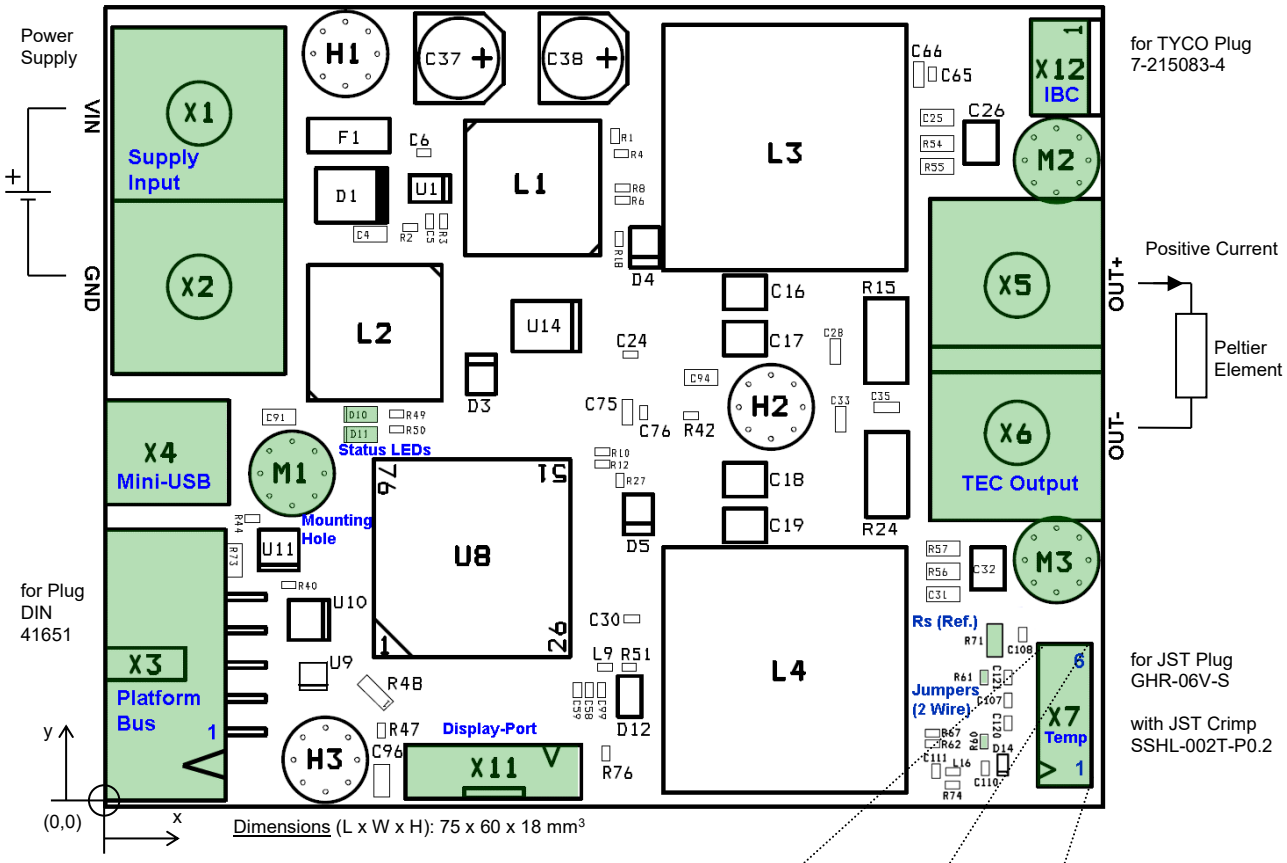
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{LR, RANGE}$	Range		180		44600	Ω
		Corresponding temperature range	150 to -6.0			°C

General Purpose Digital I/O Characteristics (GPIO1 … GPIO4)

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

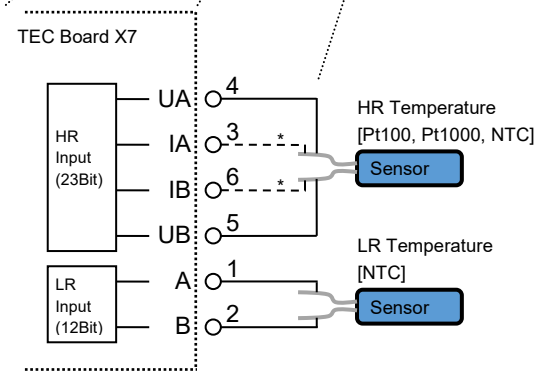
Package Outline and Pin Configuration



Mounting (3x 3.2mm Holes, 7.6 mm in Length):
M1: x = 14.0 mm, y = 25.0 mm
M2: x = 71.5 mm, y = 48.5 mm
M3: x = 71.5 mm, y = 18.5 mm

Power Terminals: M4-size Screws

Pin Descriptions Platform Bus X3:
1: VIN Output (fused with polyfuse 100mA)
2: GND (fused with polyfuse 100mA)
3: RS485_A1 (D+) [*R72 = Termination (120Ω), N.A.]
4: RS485_B1 (D-) *(*R72 not accessible from top)*
5: RS485_A2 (D+) [R73 = Termination (120Ω), N.A.]
6: RS485_B2 (D-)
7: GPIO1
8: GPIO2
9: GPIO3
10: GPIO4



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

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

Operation Modes and Communication Options

The TEC-1090 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 connection or by USB (see box below). The TEC-1090 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-1090 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-1090 Ordering Information, Hardware Configuration

Example Configuration: **TEC-1090-HV-PT100**

TEC Model:	**Voltage Version:**	**High Resolution Sensor Type:**
- TEC-1090	- HV (High Voltage)	- PT100 (4 Wire) - PT1000 (4 Wire) - NTC (2 Wire) - VIN1

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.

Thermocouple:
To use our TEC Controllers with thermocouples type K, you need a TCI-1181 in addition to the TEC Controller with a VIN1 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-1090 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	v1.90	• 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: 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 • 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