DNPT

PWR-CTRL-XS
Technical Datasheet
v1.0

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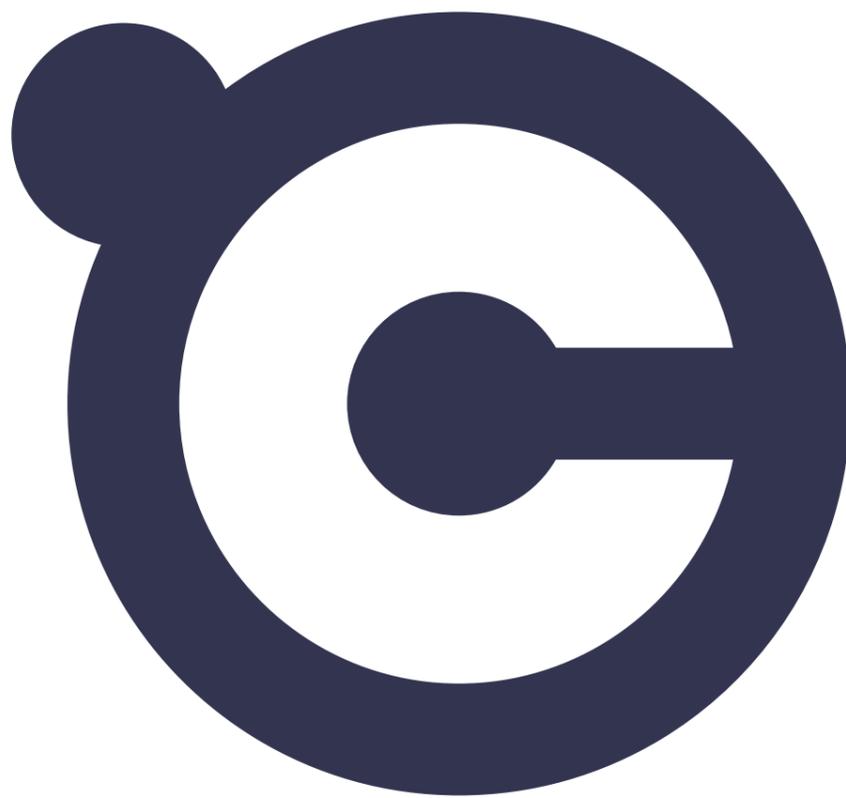
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Version	Description	Date	Approved by
1.0.0	Initial release	18.07.2025	Sascha Wilhelm
1.0.1	Formal corrections	31.07.2025	Sascha Wilhelm

Contents

PWR-CTRL-XS
Overview
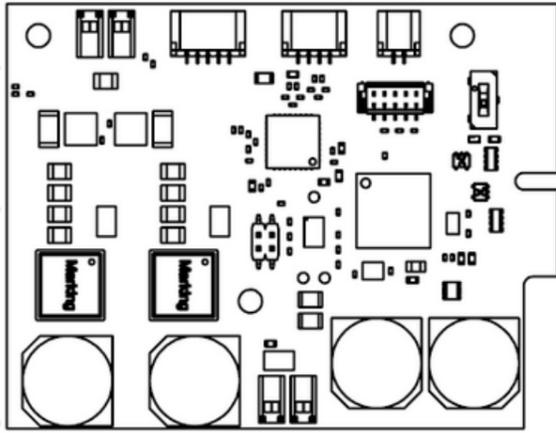
The **PWR-CTRL-XS** is a specialized and miniaturized, precise OEM-Peltier-Controller.

With dimensions of **40x52x14.4 mm**, it is the most compact, full-featured Peltier controller in its class.

Easy integration:

Thanks to the **PCIe Mini Card-Edge** connector, the PWR-CTRL-XS can be easily integrated into applications. With additional pogo pin connectors, the controller can be integrated into a system without having to plug additional connectors onto the controller.

The use of the PCIe Mini card edge connector allows the full functionality of the controller to be utilized.

If the card edge connector is not used (e.g., due to limited space), a Peltier system can be connected directly to the on-board connectors, and communication can be etablished via UART.

Peltier driver stage:

It has a bipolar output stage for heating and cooling functions. Thanks to the bipolar driver stage, developed for Peltier technology, precise control and ultra-fast temperature changes are possible with maximum component service life.

Various autotuning modes allow the control to be automatically adapted to the application.

Embedded Cycle Control:

The embedded cycle control functionality allows the configuration of up to 5 main cycles, each with 20 steps and adjustable repetitions. The cycles can also be linked together.
Cycle control can be created using different strategies. When configured as "timed," the set cycle times are primarily taken into account. In "precise mode," the settled temperature is primarily relevant.

Peripheral driver stage:

The controller has four integrated driver stages for peripheral devices belonging to the Peltier system, such as fans and pumps.

Depending on the configuration, the driver stages switch the supply voltage directly to the peripherals. The four outputs can be controlled and limited via PWM. Each output has its own tacho input.

If the driver stages are configured as fans, different control modes can be set.

GPIO:

The controller has 9 GPIOs for predefined functions. GPIOs 1-7 are freely configurable. If no peripheral devices are connected to peripheral stages 3 and 4, GPIOs 8 and 9 can be configured freely, too.

Temperature inputs:

The controller has two high-resolution temperature inputs.

These can be connected to and configured with 2-, 3-, or 4-wire Pt100 or Pt1000 sensors.

These sensors are typically used as temperature input for the Peltier stage and enable highly accurate control.

Additionally, four low-resolution NTC inputs are implemented.

These can be used as control inputs for the peripheral fans or the Peltier stage and as indicators for events.

However, they can also be used as simple monitors with warning and error thresholds.

HMI:

A 2.83-inch display can be connected to the controller for stand-alone functionality.

The display is divided into 4 quadrants. Each quadrant can be configured with its own values and plain text.

A basic keyboard can be configured via the GPIOs to adjust the setpoint temperature and to start and stop the control. Furthermore, function keys can be configured to initiate autotuning or to start the cycling functionality.

Communication interfaces:

The **COMM-Serial** option cards can be used to implement serial communication via RS232 or RS485/422 or USB, depending on requirements.

Each COMM-Serial also provide an micro SD card slot for data logging.

The PWR-CTRL-XS can be expanded and linked to the separately orderable **COMM-PRO** via LVDS interface.

It supports communication via **REST API** and has an **embedded web server** for visualisation and control of up to 16 PWR-CTRL assemblies.

Technical Data

General:

Type	Value
Supply Voltage	12-36 V-DC
Dimensions (LxWxH)	40 x 53 x 24.4 mm
Communication on Board	UART, LVDS (to COMM-PRO), I²C (for sensors and extensions)
Communication with accessories	**COMM-SERIAL:** RS232 | RS485 full duplex/ half duplex, RS422 | USB Note: Every COMM-SERIAL is equipped with micro SD card slot for logging functions **COMM-PRO:** Embedded webserver, REST API

Peltier-Driver:

Type	Value
Output Voltage	$\pm$ (V_{in} - 0.6 V); Limited @ $\pm$ 24 V; negative Voltage is cooling
Output Current	$\pm$ 6.25 A, negative Current is cooling
Efficiency	> 95 % at 80 % Load
Precision and stability	better 0.01 K - depending on the peltier-system

Peripheral-Driver:

Type	Value
General	1x on Board 3x via PCIe Mini
Output Voltage	V_{in} - 0.3 V; with additional CVTR-DC/DC Step-Down Driver-Board: 12 V or 24 V selectable
Output Current	1 A/Stage
PWM-Output	Adjustable frequency: 1 kHz or 25 kHz
Tacho-Input	Adjustable limits and thresholds per stage

Temperature-Inputs:

Type	Value
General	**High Resolution Selectable per Input: Pt100/ Pt1000 2-, 3-, 4-Wire** 1x on Board | 1x via PCIe Mini **Low Resolution Selectable per Input: NTC (NTC10k recommended)** 1x on Board | 3x via PCIe Mini
Resolution	**High Resolution (24 Bit):** Displayed: 0.001 ℃ | Internally: 0.0001 ℃ **Low Resolution (16 Bit):** Displayed: 0.001 ℃ | Internally: 0.001 ℃
Precision	**High Resolution:** 0.001 ℃ **Low Resolution:** 0.1 ℃

Absolut Maximum Ratings

Parameter	Conditions	MIN	TYP	MAX	VALUE
Supply					
Input Voltage		5	-	39.6	V-DC
Standby Current	V_{in} = 24 V	100	250	350	mA
Input Current	V_{in} = 24 V; 100% Output Power	-	7.65	7.85	A
Peltier-Stage					
Output Voltage	± (Vin - 0.6 V)	-24.1	-	24.1	V
Output Current	100 % Load	-6.4	± 6.25	6.4	A
Voltage Ripple	24 V; 6.25 A			50	mV_{PP}
Peripheral-Stage (per Stage)					
Output Voltage	V_{in} = 24 V	23.4	23.7	-	V
Output Current	V_{in} = 24 V; 100% Output Power	-	-	1	A
GPIO (per GPIO)					
Input Current		-	2	200	nA
HIGH-Level Input		2.31	-	3.3	V
LOW-Level Input		-0.3	-	0.99	V
Output Current		-	-	8	mA
HIGH-Level Output		1.32	-	3.3	V
LOW-Level Output		-	-	0.4	V

Dimensions
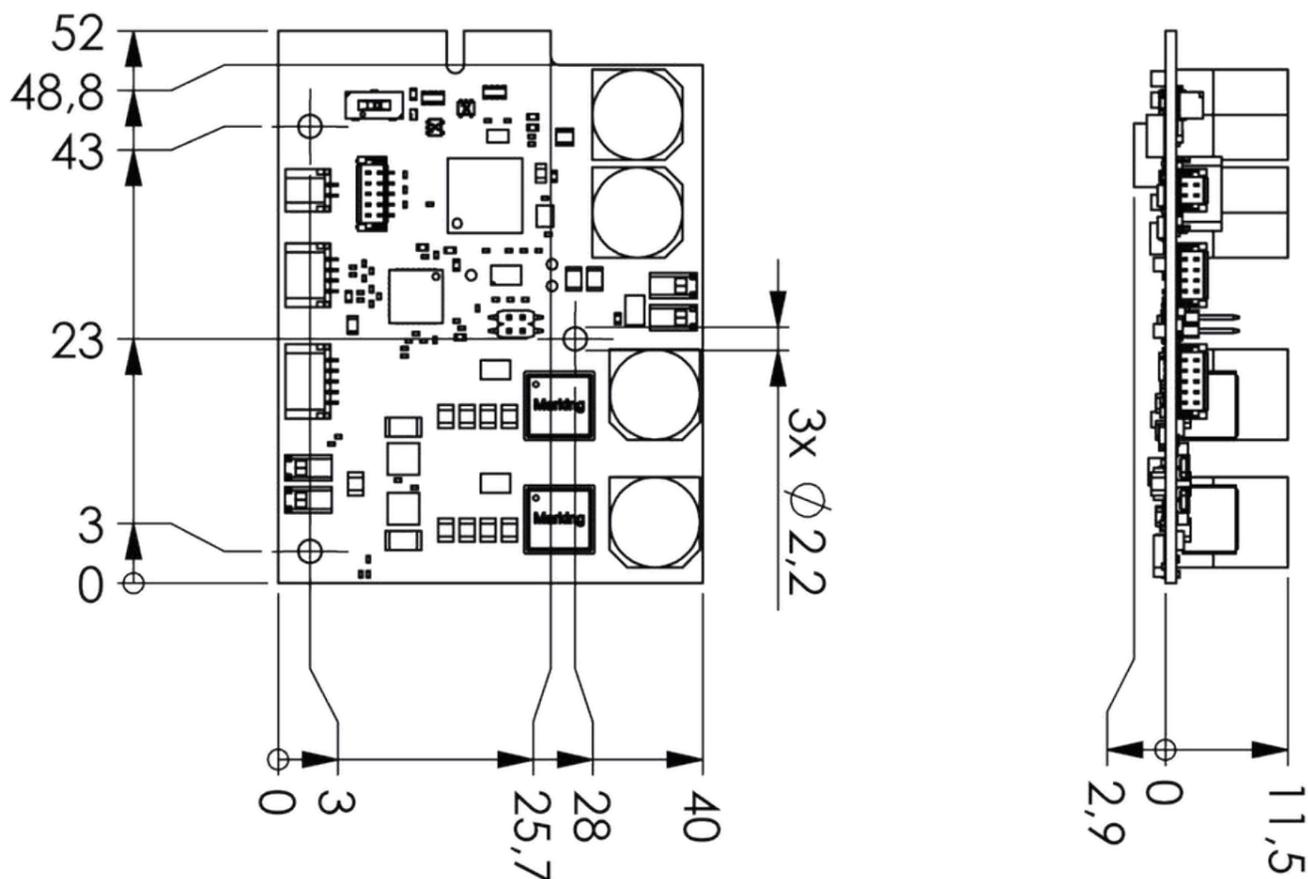
Connectors
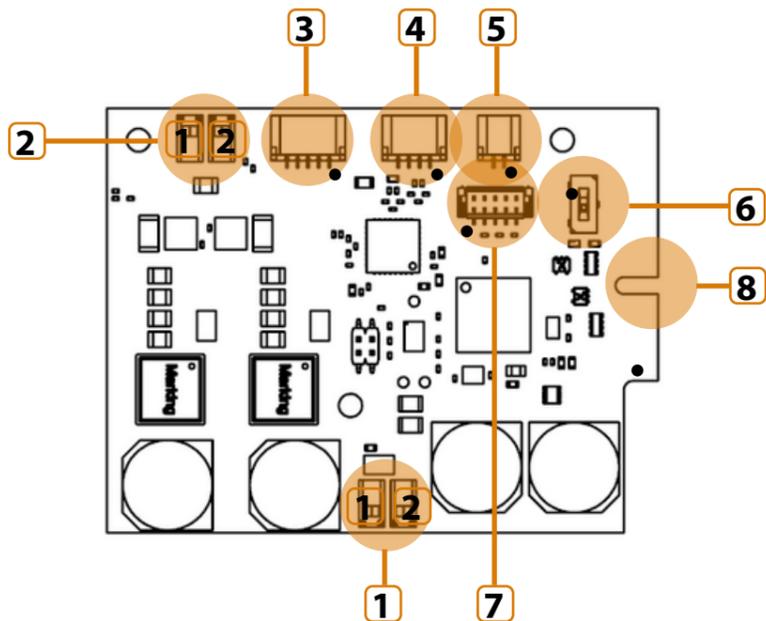
1 Power-Input; 2 Peltier-Output:
Mating Part: AVX Kyocera 70 9141 001 018 1 1 6

PIN	Value	Description
1.1	V_{in}	Supply Voltage
1.2	GND_{in}	GND from Power Supply
2.1	V_A	Peltier-Output A
2.2	V_B	Peltier-Output B

3 Peripheral L1:
Mating Part: Würth Elektronik 665005113322

PIN	Value	Description
1	V_{SYS}	Output Voltage/ System-Voltage
2	VL1-	Switched GND Peripheral L1
3	T_{L1}	Tacho Input Peripheral L1
4	PWM_{L1}	PWM Output Peripheral L1
5	GND	System Ground

4 HR-Temperature 1:
Mating Part: Würth Elektronik 665004113322

PIN	Value	Description
1	HR_{1+}	Pt100/ Pt1000_1 +
2	HR_{I1+}	Pt100/ Pt1000_1 +
3	HR_{1-}	Pt100/ Pt1000_1 -
4	HR_{I1-}	Pt100/ Pt1000_1 -

5 LR-Temperature:
Mating Part: Würth Elektronik 665002113322

PIN	Value	Description
1	LR_{1+}	LR_1 +
2	LR_{1-}	LR_1 -

6 : LVDS Termination resistance

Switch	Value	Description
OFF	-	no termination resistance
ON	•	termination resistance activated

7 UART:
Mating Part: Würth Elektronik 665005113322

PIN	Value	Description
1	3V3	3.3 V
2	RTS	Request to send Pin
3	TxD	Transmit Data Pin
4	RxD	Receive Data Pin
5	GND	System Ground

8 PCIe Mini Connector:
Mating Part: TE Connectivity 1775838-2 Minimum High 5.6H

Value	Description	PIN
V_{SYS_5V}	5V Output	1/3
V_{SYS}	Output System Voltage	2/4/6/8
GND	System Ground	7/9/14/16/43/44
V_{L2}	Switched GND Peripheral L2	10/12
T_{L2}	Tacho Input Peripheral L2	18
PWM_{L2}	PWM Output Peripheral L2	20
T_{L3}	Tacho Input Peripheral L3	22
PWM_{L3}	PWM Output Peripheral L3	24
T_{L4}	Tacho Input Peripheral L4	26
PWM_{L4}	PWM Output Peripheral L4	28
$GPIO_1$	GPIO1	27
$GPIO_2$	GPIO2	25
$GPIO_3$	GPIO3	23
$GPIO_4$	GPIO4	21
$GPIO_5$	GPIO5	19
$GPIO_6$	GPIO6	17
$GPIO_7$	GPIO7	15
$GPIO_8$	GPIO8	13
$GPIO_9$	GPIO9	11
HR_{2+}	Pt100/ Pt1000_2 +	46
HR_{I2+}	Pt100/ Pt1000_2 +	48
HR_{2-}	Pt100/ Pt1000_2 -	50
HR_{I2-}	Pt100/ Pt1000_2 -	52
LR_{2+}	LR_2 +	45
LR_{3+}	LR_3 +	47
LR_{4+}	LR_4 +	49
$LR_{common-}$	LR common -	51
PWM_{DISP_BL}	PWM Output Display Backlight	29
$DISP_{CX}$	SPI CX for Display	31
SD_{CS}	SPI Chipselect for SD-Card	33
$DISP_{CS}$	SPI Chipselect for Display	35
$MISO_{common}$	SPI common MISO	37
$MOSI_{common}$	SPI common MOSI	49
SCK_{common}	SPI common SCK	41
$LVDS_A$	LVDS A	30
$LVDS_B$	LVDS B	32
RTS	UART Request to send Pin	34
TxD	UART Transmit Data Pin	36
RxD	UART Receive Data Pin	38
SDA_{I2C}	I²C SDA (GPIO-Voltage-Level)	40
SCL_{I2C}	I²C SCL (GPIO-Voltage-Level)	42
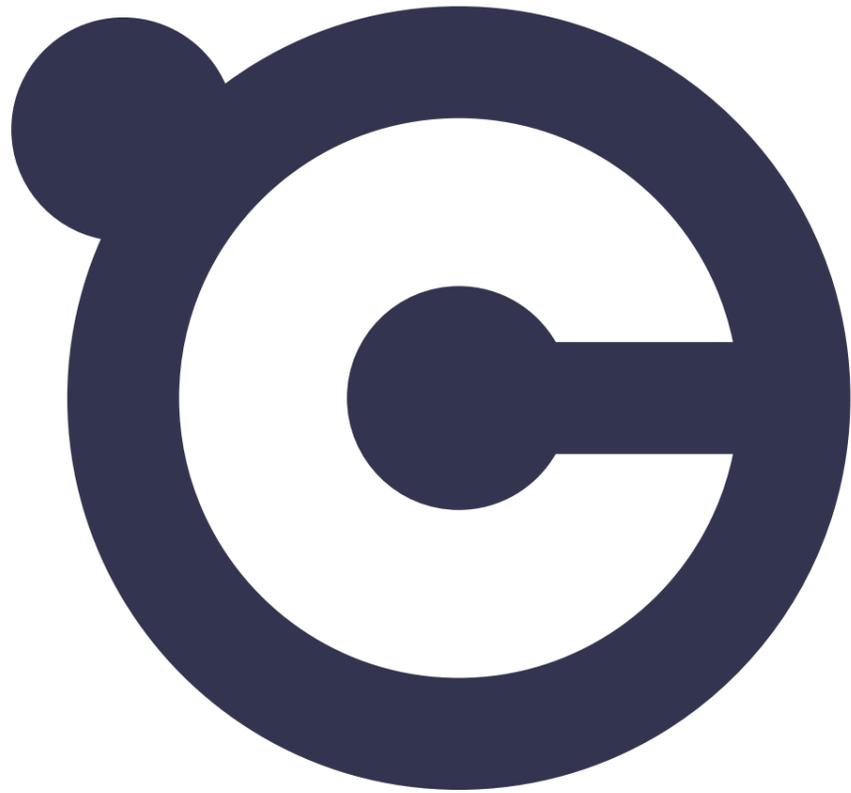
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