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LDD-1321

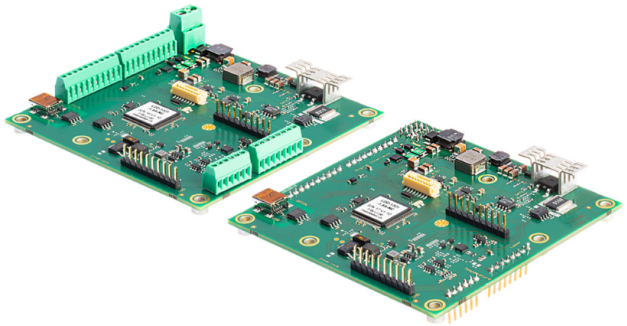
Hardware Version v1.30

The LDD-1321 is a current driver designed to precision-drive low-current laser diodes or other loads in continuous wave applications. Featuring fully digital current and optional light power control, various safety features and comprehensive communication interfaces, it offers a complete solution for low current continuous wave control.

Attaching a PWR-1191 expansion board enables the TEC Controller features of the device, turning it into a full-fledged Laser and TEC Controller (LTC).

HIGHLIGHTS

- **Input Voltage:** 12 – 24 VDC
- **Laser Diode Driver:**
  - Nominal Output Voltage: 0 – 14 V
  - Nominal Output Current: 0 – 1.5 A
  - Target application: low current CW
- **TEC controller:** (optional feature)
  - Bipolar Output: variable up to ±4 A, ±20 V
  - Supports Peltier elements and resistive heaters
  - Autotuning
  - Used to control the laser's temperature
- Dimensions: 90 × 90 × 20–27 mm
- Digital PID-controlled current source with internal signal generator and LUT
- Safety features: Interlock input and overvoltage/ -current/ -temperature protection
- Easy configuration via provided GUI software
- Stand-alone or remote-controlled operation via USB (isolated), RS485, RS232 TTL or CANopen CiA 301
- GPIO features for monitoring and control (Enable, Error Indication, Fan Control, etc.)
- Available as screw-terminal or PCB-mount OEM module
- Optional LPC feature allows for precise controlling of Light Power through Photodiode feedback



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	Type	Output Range	Description
PWR-1191	Accessory	±4 A / ±20 V	Enables TEC Controller functionality on LDD-1321
LDD-1124	LDD	0–1.5 A / 0–15 V	CW
LDD-1301	LDD	0–20 A / 0.5–53 V	1 ms – CW
LDD-1121	LDD	0–15 A / 0–15 V	CW, modulated, QCW and pulsed modes

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

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TABLE OF CONTENTS

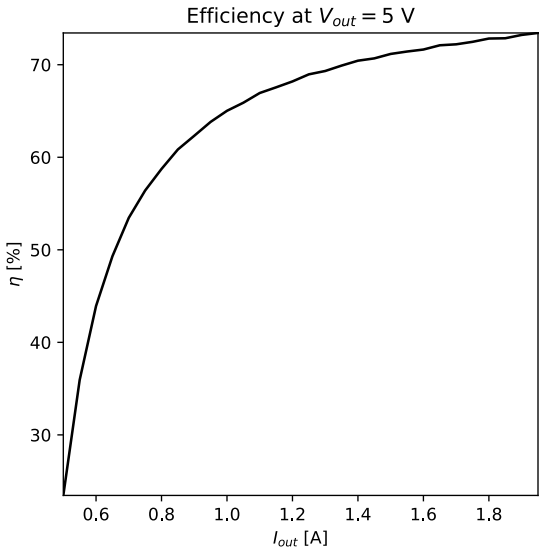
1 SPECIFICATIONS

1.1 Absolute Maximum Ratings [1]

		Min	Max	Unit
Voltage	$U_{IN, DC}$		27	V
Current	I_{IN} (On Board Fuse)		7	A
Temperature	T_{OP}	–40	90	°C
Humidity	RH_{OP}, non-condensing	5	95	%

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 Thermal Information



		Min	Max	Unit
Temperature	T_{OP} [1]	0	70	°C

1 Operating board temperature range; Upper limit enforced by overtemperature protection

1.3 Power Input Characteristics

Unless otherwise noted: T_A = 25 °C.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
U_{in}	Supply voltage	Nominal	11.5		25.5	V
$U_{in\ ripple}$	Tolerated ripple voltage	U_{in} always in range specified above		300		mV_{PP}

1.4 LDD Output Characteristics

Unless otherwise noted: T_A = 25 °C.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
Static:						
$I_{out\ max}$	Maximum nominal output current	Operating area limitations apply separately.		1.5		A
$I_{out\ leak}$	Leakage output current [1]	U_{LDA} > 1 V, $R_{load} \cong 0\ \Omega$		0.84 × U_{LDA}		mA
$I_{out\ min}$	Zero-setpoint output current [2]	V_{LDA} = 6 V, $R_{load} \cong 0\ \Omega$		4		mA
		V_{LDA} = 15 V, $R_{load} \cong 0\ \Omega$		5		
ΔI_{out}	Set current resolution			0.1		mA
U_{LDA}	Anode voltage limit		U_{in} – 1		20	V
$U_{out\ max}$	Maximum output voltage (on load)	Corresponding anode voltage must be reachable		14		V
$\alpha_{T\ drive}$	Output current temperature coefficient/drift [3]	I_{out} = 0.5 A, T_0 = 15 °C, T_1 = 40 °C		±125		ppm/K
$\alpha_{T\ meas}$	Output current measurement temperature coefficient/drift [3]	I_{out} = 0.5 A, T_0 = 15 °C, T_1 = 40 °C		±80		ppm/K
Dynamic:						
f_{BW}	Analog bandwidth	1.5 A on 1 Ω resistor, 50% sine amplitude. This specification is relevant to changing load characteristics. Applies independently of the refresh rate.		190		kHz
t_{rise}	Analog rise time	1.5 A on 1 Ω resistor. This specification is relevant to step changes in the load and applies independently of the modulation rise time. Pulsing not supported at time of publication.		6		µs
f_s	Setpoint refresh rate	Applies to internally generated current ramping. Current modulation not supported at time of publication.		1562.5		Hz

1 Applies with current output disabled but anode supply enabled (use case: current modulation down to zero). Disabling the anode power supply turns off this current (use case: static on or off use of the current source).

2 Due to calibration. Can be reduced to the specification above by applying a user calibration offset (reduces current accuracy).

3 Relative to device temperature.

1.5 Safety Characteristics

Unless otherwise noted: T_A = 25 °C, U_{in} = 24 V, I_{out} = 1.5 A, U_{LDA} = 15 V

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
Current shut-off time: (current < TBD)						
$t_{off\ overcurrent}$	Overcurrent (against set threshold)			632		µs
$t_{off\ overcurrent}$	Fast overcurrent (fixed threshold)			5.2		µs
$t_{off\ PIDover}$	PID upper saturation	defined through firmware			100	µs
$t_{off\ interlock}$	Interlock signal low			< 1		µs
$t_{off\ error}$	Generic software-initiated error	defined through firmware			100	ms

1.6 External Temperature Measurement (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
$R_{LR\ range}$	Measurement range		295 ≈ 130		106400 ≈ –21	Ω °C

2 FUNCTIONAL DESCRIPTION

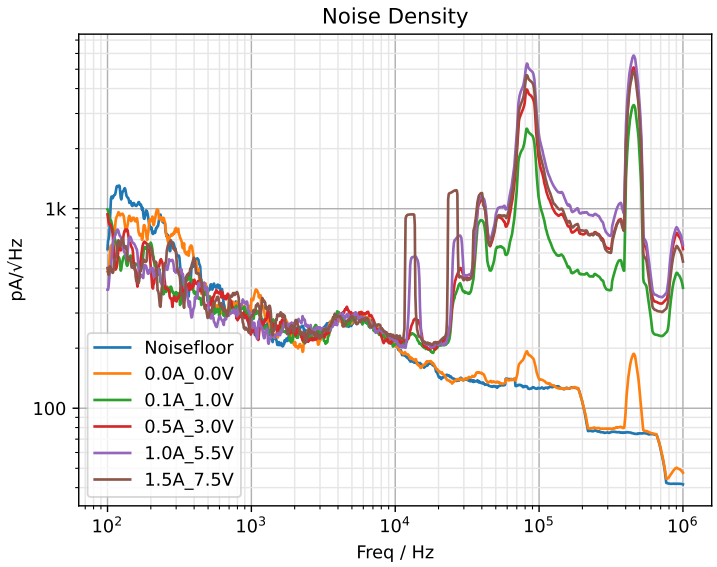
2.1 Current Controlled Operation-Modes and Communication Option

The LDD-1321 is an OEM high performance current source that is primarily designed to operate as a CW laser diode driver at low currents with low current noise. It is configured over an industry-standard RS485 or a USB connection, either GUI-driven using the included Configuration Software, or by direct parameter control using the predefined communication protocol. Basic system status is visually indicated by on-board LEDs, more detailed status information can be polled at any time. The LDD-1321 can operate in a stand-alone configuration as well as in a remotely-controlled manner, with parameters adjusted on the fly. The laser diode driver is current-PID-controlled.

Configuration parameters further include: control source selection, maximum current limits, nominal current ramping, PID controller settings, NTC temperature sensor modeling coefficients, measurement circuitry calibration, error thresholds, communication watchdog, etc. Please refer to the user manual for further information.

2.2 Typical Current Noise Density

Measurement Configuration: T_A = 25 °C, U_{IN} = 24 V, R_{Load} = 5 Ω.



2.3 Configuration Software

The included LDD-1321 Configuration Software is a powerful GUI (FW version ≥ v1.40) tool that allows monitoring and full configuration of the LDD-1321 via a standard USB or an RS485 connection from a PC running Windows.

This tool is ideal for laboratory setups, product evaluation diagnosis, debugging and commissioning:

- internal generators setup for CW and waveforms such as sine, triangle, square or custom LUT
- configuration import and export
- data charting with trigger functionality
- error codes and built-in descriptions
- hardware configuration (e.g. calibration)
- maintenance (e.g. firmware upgrades)

Please refer to the user manual for more information on features and system requirements.

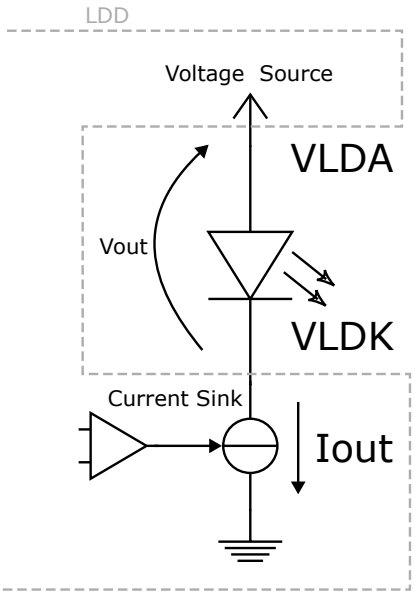
2.4 Light-Power-Controlled Operation Mode [only with photodiode input and LPC feature]

The LDD-1321 can be used as a light power controller with this optional feature. A user-defined light system scale factor links the generated photocurrent to the absolute light power. The light PID controller's CW output is fed to the current

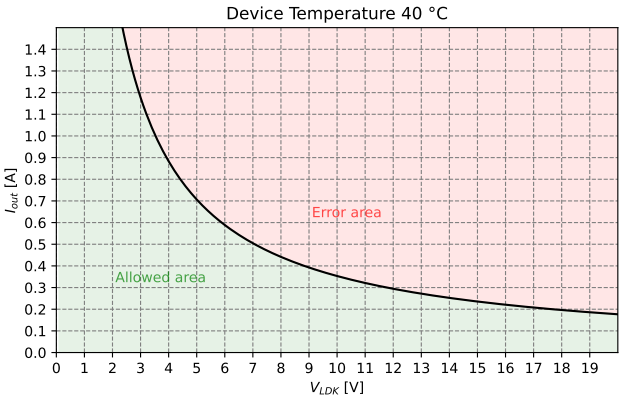
controller's input.

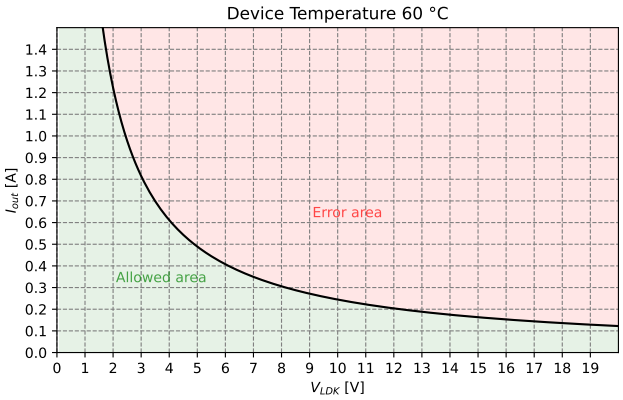
2.5 Operating area

This device features a linear-mode laser diode driver, which uses a transistor (pictured as a current source) to control the current in the laser. This topology requires to consider the power dissipated on the current sink, as the portion of the voltage that does not fall on the load will fall on it. To enable simple and safe use, this device automatically shuts down if the safe operating area of the current sink is not respected. The shutdown limit is shown in the charts below, at a typical device temperature and at the limit device temperature (worst-case). The voltage of the voltage source, V_{LDA} (laser diode anode voltage), is automatically set by the device based on the laser characteristics and maximum current set by the user.



Note: these points are not all thermally stable without additional cooling. See User Manual for details on how to use this curve to see if your load is compatible with the LDD-1321.

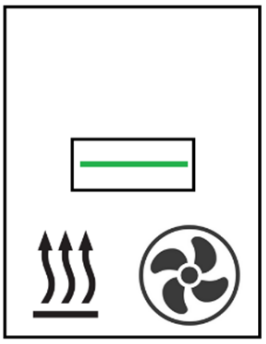




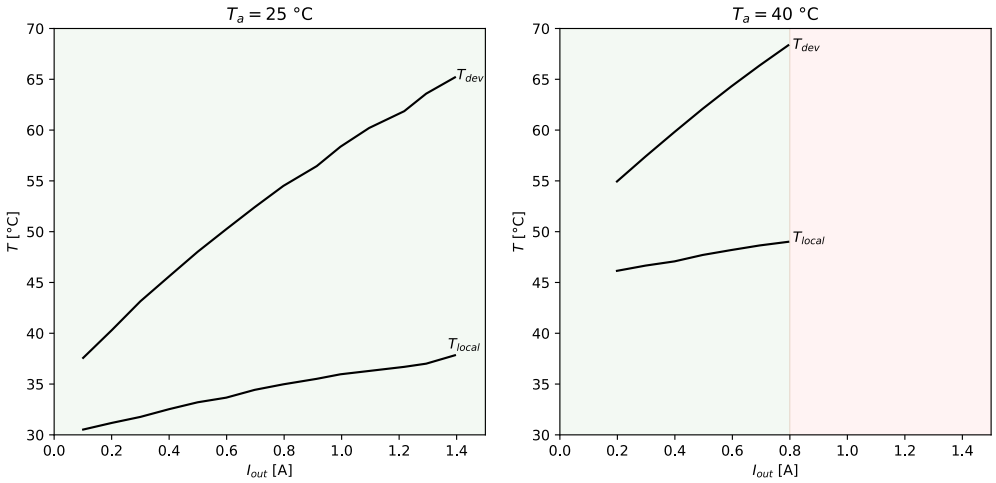
2.6 Cooling the device

Depending on your setup, additional cooling might be needed to avoid an overtemperature error during operation of the LDD.

This note shows a possible application scenario. The LDD-1321 was placed in a closed aluminum case with one perforation, which was then placed inside a ventilated climatic chamber. The device was driving a constant voltage load of 5 V with the following settings: forward voltage 5 V, differential resistance 0 Ω, maximum current 1.5 A. The power supply voltage chosen was 12 V.



Three temperatures were measured. T_a is the ambient temperature inside the chamber, T_{local} is the air temperature inside the case, and T_{dev} is the PCB temperature of the device. In the operating area marked in red, the heatsinking (or lack thereof) of this setup becomes insufficient for continuous use over several minutes.



3 INTERFACE 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	Unit
Input Characteristics:						
U_{IH}	Logic high input threshold		2			V
U_{IL}	Logic low input threshold				1	V
$U_{I\ MAX}$	Maximum input voltage		–0.3		5.5	V
Output Characteristics:						
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:						
U_{PP}	ESD discharge	IEC61000-4-2		18		kV

3.2 Analog Input Characteristics

Unless otherwise noted: T_A = 25 °C. Voltages referenced to AGND.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
Input Characteristics:						
UI_+	AIN+ voltage		–1		11	V
UI_-	AIN– voltage		–1		11	V
U_{IN}	Nominal differential input voltage range		0		10	V

3.3 Interlock Input Characteristics

Unless otherwise noted: T_A = 25 °C. The interlock can be deactivated by using the dipswitch S1.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
Input Characteristics:						
U_{IACT}	Interlock active input voltage range	Voltage range which is detected as active input	3		30	V
U_{IORM}	Maximum working insulation voltage				120	V

3.4 Photodiode Input Characteristics (optional)

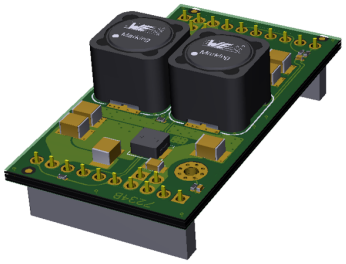
Unless otherwise noted: T_A = 25 °C.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
Input Characteristics:						
I_{in}	Photodiode current measurement nominal limits	-PD0.5	0		0.5	mA
		-PD1	0		1	
		-PD2	0		2	
		-PD4	0		4	

3.5 TEC Controller (PWR-1191 expansion board required)

HW v1.20

This board features a bidirectional current driver, which enables the TEC Controller functionality of the LDD-1321.



		Min	Max	Unit
Temperature	T_{OP} [1]	0	90	°C

1 Operating temperature range; Upper limit enforced by overtemperature protection

3.5.1 Electrical characteristics

Unless otherwise noted: 25 °C, U_{in} = 24 V, R_{load} = 3.75 Ω.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Unit
I_{out}	Bipolar output current swing				±4	A
U_{out}	Bipolar output voltage swing	U_{out} maximum ~ 0.85 · U_{in}		±20		V
η	Power efficiency			90		%
Output Monitoring: (IOUT Resolution is 1.46 mA; UOUT Resolution is 6.1 mV)						
I_{OUT} Read	Precision	@ 3.8 A		1	5	%
U_{OUT} Read	Precision	@ 15.0 V		1	3	%

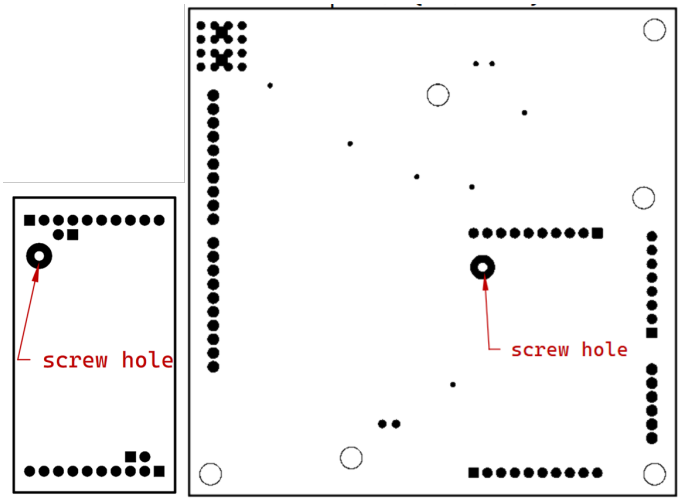
3.5.2 Attaching the device to the LDD-1321

This step is necessary if you buy the PWR-1191 separately from the LDD-1321.

> ⚠ *Always perform this operation with the LDD-1321 disconnected from the power supply.*

The board must be inserted with the correct orientation. The screw holes shown in the picture provide a reference and can optionally be used to secure the two boards together (not required for static applications).

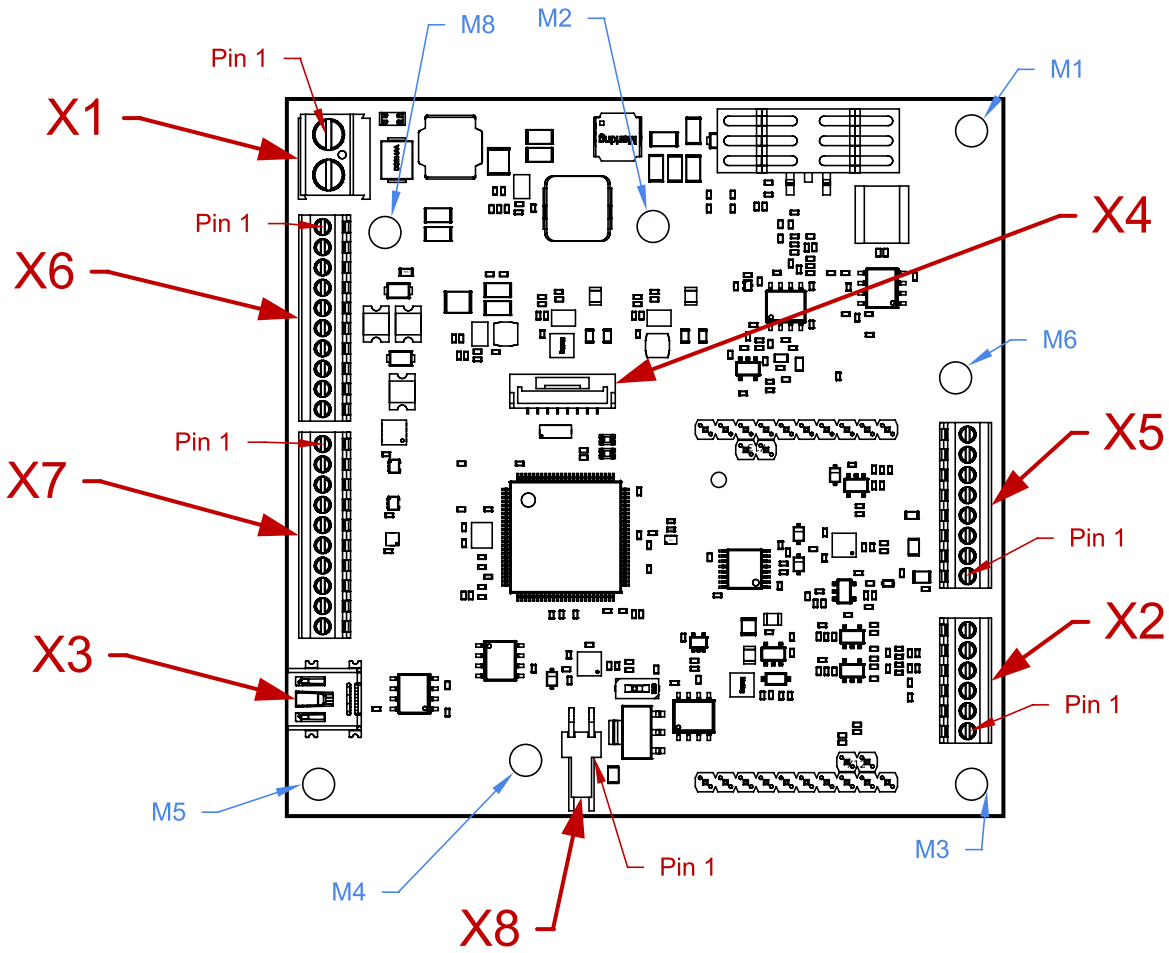
> ⚠ *An incorrect orientation of the PWR-1191 can damage the devices upon turning on the power. Damage due to incorrect assembly is not covered by warranty. In case of doubt, please refer to support before proceeding.*



3.6 Connector Overview

- SCREW: X1, X6, X7, X5, X2 are populated with screw headers and X8 is populated with a connector. See connector details below.
- PIN: X1, X6, X7, X5, X2 and X8 are populated with 2.54 mm pin headers on the bottom side of the board.
- NC: X1, X6, X7, X5, X2 and X8 are not populated.

Customized configurations available on request.



SCREW version pictured for reference, top view. Connector locations analogous in other versions.

3.7 Connector Specifications

3.7.1 X1

No connector (NC) or PIN: 2.54 mm pitch pads/pins. For each of the two pins, a 2x8 Pinheader is used.
SCREW terminal: see table

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
A_{WIRE}	Wire Size	Mechanical Limit; current carrying capacity not considered	0.05 30		2.5 12	mm^2 AWG
τ_{SCREW}	Tightening Torque			0.5		Nm
L_{STRIP}	Stripping Length			6.5		mm

3.7.2 X2, X5 – X7

No connector (NC) or PIN: 2.54 mm pitch pads/pins.
SCREW terminal: see table

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
A_{WIRE}	Wire Size	Mechanical Limit; current carrying capacity not considered	0.05 30		1 16	mm^2 AWG
τ_{SCREW}	Tightening Torque			0.1		Nm
L_{STRIP}	Stripping Length			5		mm

3.8 Connector Pin Description

3.8.1 X1

Pin	Name	Description
1	VIN	Power Input +
2	GND	Power Input –

3.8.2 X2

Pin	Name	Description
1	TEC–	TEC negative output, only available with PWR-1191 expansion board.
2	TEC+	TEC positive output, only available with PWR-1191 expansion board.
3	T2B	Resistive temperature sensor input 2 terminal B. Internally connected to GND.
4	T2A	Resistive temperature sensor input 2 terminal A. Must be independent from GND (floating).
5	T1B	Resistive temperature sensor input 1 terminal B. Internally connected to GND.
6	T1A	Resistive temperature sensor input 1 terminal A. Must be independent from GND (floating).

3.8.3 X3

Mini USB type B. ID pin not connected.

3.8.4 X4

Reserved. Do not connect.

3.8.5 X5

Pin	Name	Description
1	SYNC OUT	Reserved. Do not connect.
2	AIN–	Differential analog input, negative terminal.
3	AIN+	Differential analog input, positive terminal.
4	AGND	Ground connection for ancillary analog circuits.
5	PDC	Photodiode cathode terminal. Must be independent from GND (floating).
6	PDA	Photodiode anode terminal. Internally connected to GND.
7	LDC	Laser diode cathode terminal. Must be independent from GND (floating).
8	LDA	Laser diode anode terminal. Must be independent from GND (floating).

3.8.6 X6

Pin	Name	Description
1	5V	5V supply for ancillary circuits
2	GND	GND connection for ancillary circuits
3	3.3V	3.3V supply for ancillary circuits
4	RS485 1 A/D+	RS485 communication interface.
5	RS485 1 B/D–	
6	RS232 TTL RX	RS232 TTL communication interface.
7	RS232 TTL TX	
8	GND	GND connection for communication interfaces. Internally shorted to pin 2.
9	CAN1 H	CAN communication interface. Firmware feature available from FW v1.10.
10	CAN1 L	

3.8.7 X7

Pin	Name	Description
1	GPIO1	Configurable digital input/output pins.
2	GPIO2	
3	GPIO3	
4	GPIO4	
5	GPIO5	
6	GPIO6	
7	GPIO7	
8	GPIO8	
9	GPIO9	
10	GPIO10	

3.8.8 X8

Populated with connector in -SCREW version of the device, compatible mating part: Molex 0022013027 with pre-crimped leads 0797580015.
No connector or pin: 2.54 mm pitch pads/pins.

Pin	Name	Description
1	Interlock+	Interlock positive input
2	Interlock-	Interlock negative input

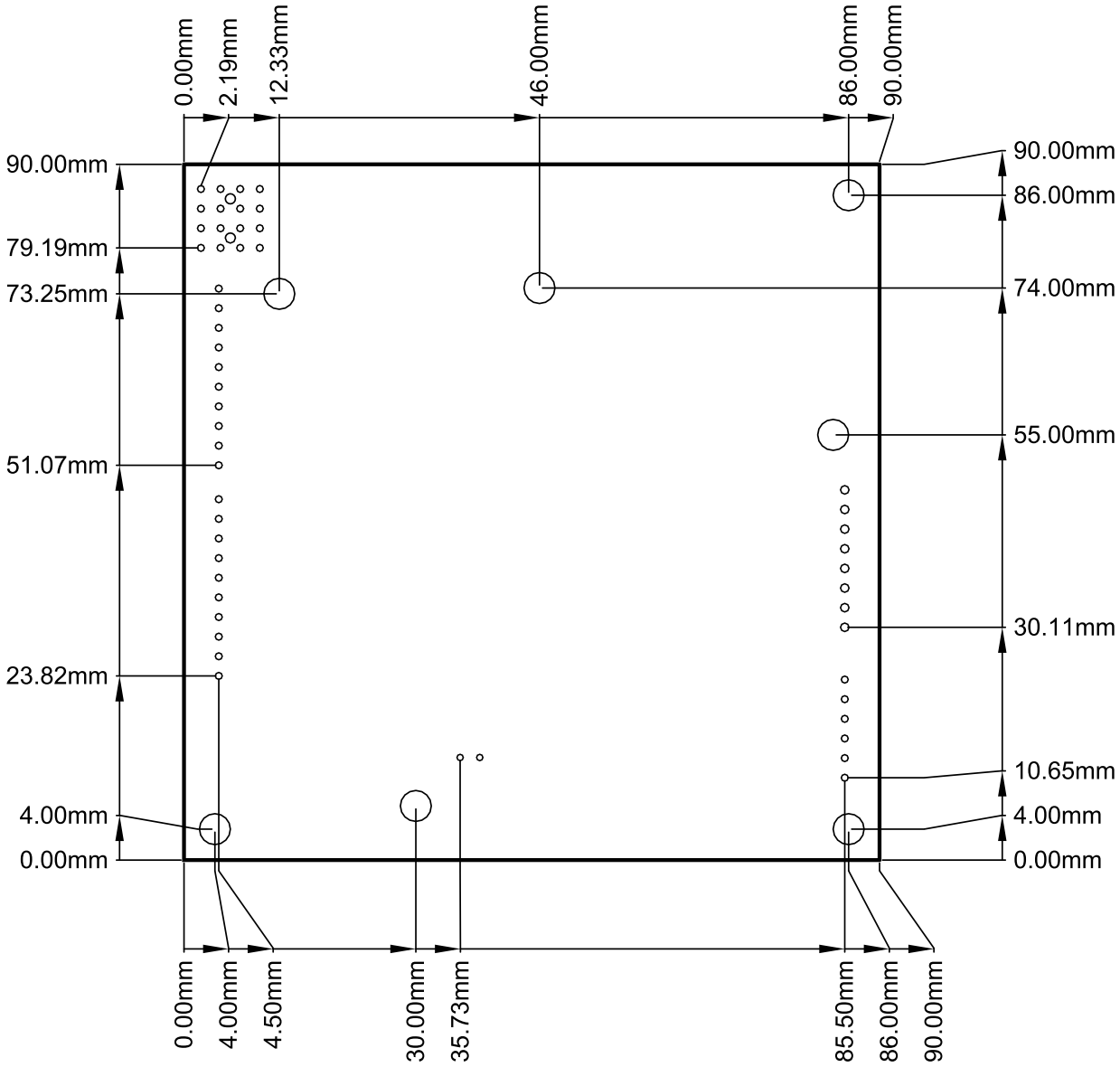
If the connector is not used, the interlock can be deactivated via the DIP switch.

3.9 Mounting Holes M1 – M6 & M8

Internal capacitive connection to GND.
M1 and M4: 1 MΩ connection to GND.

4 MECHANICAL DATA

4.1 Dimensions



All dimensions nominal.
Connector pads: 2.54 mm pitch, compatible with 2.54mm pin headers.
Mounting holes nominal diameter: 3.05 mm (compatible with M3 screws).
3.17 mm spacer on the bottom side.

3D models of the device are available on our website or on request.

5 ORDERING AND CONFIGURATION

5.1 LDD-1321 Ordering Information & Configuration

Example Configuration:
LDD-1321 (SCREW, PD4) FW1.40

Variant Name	Requirement	Description	Options / Single choice
Connector Type [1]	**Required**	**Select connector type.**	**NC, PIN, SCREW**
Photodiode Input Type	**Required**	**Select the maximum measurable photodiode current in mA. Default: PD4, 4mA. Laser power control feature sold separately.**	**PD4, PD2, PD1, PD0.5**
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: FW1.40
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 3.6: Connector Overview

The PWR-1191 module is sold as a separate item.
Laser diode, temperature probes, power supply and mating connectors not included.

5.2 Ordering Confirmation Example

LDD-1321 (SCREW, PD4, HW1.30)
Firmware Version: FW1.40

String can additionally contain:
Profile: Default

6 ALL MEERSTETTER ENGINEERING PRODUCTS

6.1 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

7 CHANGE HISTORY

Date of change	Version	Changed / Approved	HW Version
April 20, 2026	E	NJ/SR / RS	v1.30
Change / Reason • Add: Change History • Mod: PD4 is now the default option (LPC function sold separately as license) • Mod: Replace ordering strings with new system • Mod: Datasheet design Add: Typical current noise density graph			

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