## Advanced OEM Laser Diode Driver with Laser Power Control [LPC optional]

## Features

| | |
|---|---|
| DC Input Voltage: | 12-24 V |
| Output Current: | 0-30 A, <2‰ Ripple<br>Parallel operation on request |
| Output Voltage: | 0-15 V |
| CW / Modulated Current: | |
| - CW Current Control | Configurable PID |
| - Temperature Coefficient | Typ: 20 ppm/K |
| - CW Current Resolution | 0.6 mA |
| - CW Current Modulation | 3 kHz (0.2 A/µs @ 10-30 A) |
| Pulsed Current: | |
| - Pulse Generation | CW Chopping |
| - Pulse Rise Time | 135 ns ($L_{Load}$ ~ 10 nH) |
| - Pulse Frequency | up to 40 kHz |
| - Pulse Duty Cycle | 0 to 100% |
| Laser Power Control (LPC): | [LPC option] |
| - CW Light Control | Configurable PID |
| - Start up Phase | Fully Parameterizable |
| - LPC Meas. $PD_{Current}$ | up to 5 mA |
| Error Handling | Ultra-Fast Switch-off (<8 µs) for optimal LD protection |
| Configuration / Diagnosis: | on PC (via USB / RS485) |
| Dimensions (L x W x H): | 120 mm x 90 mm x 18 mm |
| Efficiency: | >94% (@ >50% Load) |
| Cooling: | over Base Plate |

## Control Modes and Interfaces

| | |
|---|---|
| Control Modes: | |
| - Data (USB or RS485) | Full Control |
| - Internal Generators | Modulation, Pulse, LPC |
| - Hardware Lines | Nominal Current, Pulse |
| Interfaces: | 1x NTC for LD Temp.<br>1x Isolated USB 2.0<br>2x RS485 / RS422<br>1x Analogue Input<br>- Nominal Current |
| Digital I/O, 3.3 V / 5 V: | - Pulse Input<br>- Pulse Output (Trigger)<br>- Interlock (Enable)<br>- 5x Reserve I/O |

## General Description

The LDD-1125 is an innovative laser diode driver that contains a specialized current source able to precision-drive laser diodes in continuous / modulated and pulsed or mixed operation. Equipped with optional laser power measurement circuitry (photodiode input), the LDD-1125-LPC can also be operated as a Laser Power Controller.

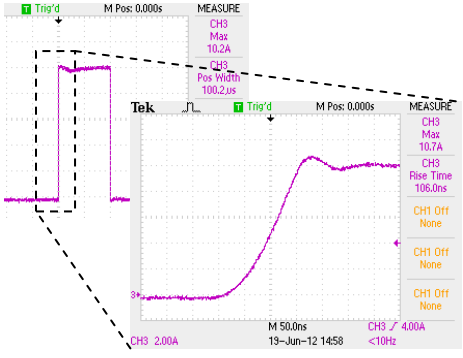
Core element of the LDD's internal current source is the generation of highly precise 333 ps timing PWM steps that results in high resolution and very low ripple current.
The output is short-circuit safe and can be modulated and chopped for up to 40 kHz pulsed-mode operation. Driving low inductive loads, ultra short fall and rise times are achievable.

For ultimate laser diode protection the supervision of critical system values is directly implemented in hardware. This results in very fast switch-off times (<8 µs) in case of limit value violation. The LDD-1125 also monitors laser diode temperature (NTC thermistor input).
The LDD-1125 is fully digitally controlled; its firmware is upgradeable to offer various communication options and to meet specific customer requirements.
Current, laser power [LPC option] and temperature measurement hardware can be calibrated.

For basic applications or device evaluation, only a power supply and a laser diode need to be connected to the LDD-1125. The device can operate stand-alone in current control mode, internal generators (on board) allow for parametric definition of flexible output waveforms.
The included PC-Software (USB / RS485) facilitates configuration, control, monitoring and live diagnosis of the LDD. Current and laser power [LPC option] charting is also available from within the software.
All device settings are saved in non-volatile memory and can be backed up and restored.

For remote / OEM applications, the LDD-1125 may be fully controlled by a system bus that features RS485 communication, pulse, interlock and 6 reserve lines.

The LDD-1125 is part of the LDD-Family of Meerstetter laser diode drivers, which are designed to operate alongside devices of the TEC-Family of Peltier controllers. Both families of drivers share the same system bus protocol, design concept and technology.



| Absolute Maximum Ratings | |
|---|---|
| Supply voltage (DC) | 27 V |
| Supply current (DC) | 25 A |
| Output current | 35 A |
| Output voltage | $V_{IN}$ |

| Operating Ratings | |
|---|---|
| System base plate | < 50°C |
| Operation temperature | 0 – 60°C |
| Storage | -30 – 70°C |
| Humidity | 5 – 95%, non-condensing |

## Electrical Characteristics

Unless otherwise noted: $T_A$ = 25°C, $V_{IN}$ = 24 V, $V_{LD}$ = 10 V

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **DC Power Supply Input:** | | | | | | |
| $V_{IN}$ | Supply voltage | | 11.5 | 24 | 26.5 | V |
| $V_{IN\_TRANS}$ | Overvoltage tolerance | Transients | | 28.2 | | V |
| $V_{IN\_RIPPLE}$ | Ripple tolerance | | | | 300 | $mV_{PP}$ |
| **System Characteristics:** | | | | | | |
| $\eta_{50\%}$ | Power efficiency | @ 50% load | | 95 | | % |
| $\eta_{90\%}$ | Power efficiency | @ 90% load | | 93 | | % |

## Output Characteristics

Unless otherwise noted: $T_A$ = 25°C, $V_{IN}$ = 24 V, $V_{LD}$ = 10 V

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Output CW:** | | | | | | |
| $I_{OUT}$ | Current range | | 0 | | 30 | A |
| $T_{coefficient}$ | Temp. coefficient | $T_A$ = 25°C - 50°C | | 20 | 35 | ppm/K |
| $I_{OUT\_RES}$ | Current resolution | | | 0.6 | | mA |
| $I_{OUT\_RIPPLE}$ | Current ripple | $I_{out}$ > 2A | | 10 | 50 | mA |
| $V_{OUT\_MAX}$ | Diode voltage | | 0 | | 15 | V |
| $V_{OUT\_LIMIT}$ | Output voltage | | | $V_{IN}$ - 8 | | V |
| $P_{OUT}$ | Output power | $V_{LD}$ = 15 V | | | 450 | W |
| $f_{CW}$ | Current change | For $L_{Load}$ <100 nH, higher $f_{CW}$ are possible | | 3 | | kHz |
| $I_{OUT\_SLOPE}$ | Current slope limit | $I_{out}$ > 10A | | 0.2 | | A/us |
| **Output Pulse:** | | | | | | |
| $t_{rise}$ | Current rise time | $L_{Load}$ ~ 10 nH / $V_{LD}$ = 2.5 V | | 135 | | ns |
| $t_{fall}$ | Current fall time | $L_{Load}$ ~ 10 nH / $V_{LD}$ = 2.5 V | | 1200* | | ns |
| $t_{delay}$ | Delay pulse/current | $L_{Load}$ ~ 10 nH / $V_{LD}$ = 2.5 V | | 800 | | ns |
| $t_{pH\_min}$ | Minimal Pulse High | $L_{Load}$ ~ 10 nH / $V_{LD}$ = 2.5 V | | 1 | | us |
| $t_{pL\_min}$ | Minimal Pulse Low | $L_{Load}$ ~ 10 nH / $V_{LD}$ = 2.5 V | | 3 | | us |

* Given by the discharge energy.

## Safety Characteristics

Unless otherwise noted: $T_A$ = 25°C, $V_{IN}$ = 24 V, $V_{LD}$ = 10 V

| Symbol | Parameter | Comments | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **I/O Ports:** | | | | | | |
| $t_{OFF\_CURRENT}$ | Overcurrent | | | 6 | 8 | µs |
| $t_{OFF\_OPVAL}$ | Operating Values | Voltages, currents | | 100 | | µs |
| $t_{OFF\_SFAIL}$ | System failure | System status | | 100 | | ms |

## Laser Diode Temperature Measurement

Unless otherwise noted: $T_A$ = 25°C, $V_{IN}$ = 24 V, NTC = $B_{25/100}$ 3988K $R_{25}$ 10k

| Symbol | Parameter | Comments | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Temperature Measurement** | | | | | | |
| $R_{NTC}$ | NTC Resistance | | | 10 | | kΩ |
| $T_{RANGE}$ | Temperature Range | | -6 | | 150 | °C |
| $T_{PRECISION}$ | Temp. Precision | Not calibrated | | | 1.5 | °C |

## General Purpose Digital I/O Characteristics on X3 (RES1 … RES8)

Unless otherwise noted: $T_A$ = 25°C, $V_{IN}$ = 24 V

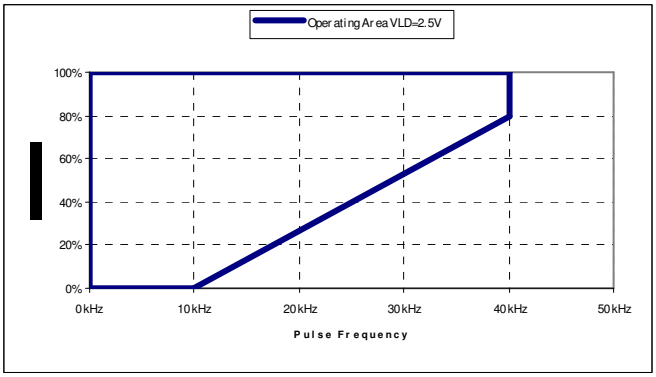
| Symbol | Parameter | Comments | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Input Characteristics:** | | | | | | |
| $V_{IH}$ | Logic high input threshold | | 2.35 | | | V |
| $V_{IL}$ | Logic low input threshold | | | | 0.9 | V |
| $V_{IMAX}$ | Maximum input voltage | | -0.3 | | 5.5 | V |
| $V_{AN}$ | Input voltage range | Analog input | 0 | | 3 | V |
| | | | | | | |
| **Output Characteristics: (RES1 … RES4)** | | | | | | |
| $V_{OH}$ | Logic high output voltage | | 2.9 | 3.3 | | V |
| $V_{OL}$ | Logic low output voltage | | | 0 | 0.4 | V |
| $R_S$ | Series Resistor | | 170 | 200 | 230 | Ω |
| | | | | | | |
| **Output Characteristics: (RES5 … RES8)** | | | | | | |
| $V_{OH}$ | Logic high output voltage | | 2.9 | 3.3 | | V |
| $V_{OL}$ | Logic low output voltage | | | 0 | 0.4 | V |
| $R_S$ | Series Resistor | | 1160 | 1200 | 1240 | Ω |
| | | | | | | |
| **ESD Protection:** | | | | | | |
| $V_{PP}$ | ESD discharge | IEC61000–4–2 | | | 100 | kV |

## Light Measurement Characteristics [Devices with LPC Option only]

Unless otherwise noted: $T_A$ = 25°C, $V_{IN}$ = 24 V, $V_{BIAS}$ = -3.3 V

| Symbol | Parameter | Comments | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Photodiode Input Characteristics:** | | | | | | |
| $I_{PD}$ | Photodiode current | | | | 5 | mA |
| $f_{ADC\_LPC}$ | Sampling frequency | @ 16bit | | 0.5 | | MSPS |

## Operating Area (Pulse Mode)




**Test Conditions:**

$T_A$ = 25°C, $V_{IN}$ = 24 V, $I_{LD}$ = 20 A

$V_{LD}$ = 2.36 V@20A, $R_{LD\_Diff}$ = 68 mΩ, $L_{LD}$ = 10 nH

Laser diode directly mounted to the screw terminals.

The maximum achievable pulse frequency depends on the connected load's characteristics. The reason for the performance derating for high frequencies and low duty-cycles (bottom-right part of the operating area) are the internal control topology and available FPGA hardware resource.

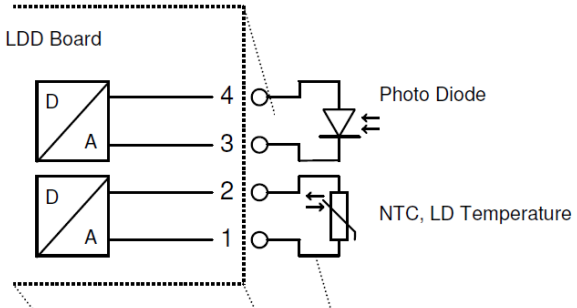
## Package Outline and Pin Configuration

Mounting (M3-size Bores, 7.5mm in Length):
M1: x = 4.0 mm, y = 86.0 mm
M2: x = 98.0 mm, y = 86.0 mm
M3: x = 4.0 mm, y = 4.0 mm
M4: x = 98.0 mm, y = 4.0 mm

Power Terminals: M4-size Screws

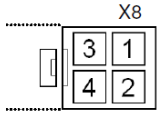
Pin Descriptions Platform Bus X3:
1: GND
2: RES1
3: RES2
4: RES3 (Analog Input)
5: RES4
6: RES5 (PULSE Trigger Output)
7: RES6
8: RES7 (PULSE Trigger Input)
9: RES8 (ENABLE)
10: GND
11: RS485_A1 [120Ω Termination, DIP-Switch J1, 1]
12: RS485_B1
13: RS485_A2 [120ΩTermination, DIP-Switch J1, 2]
14: RS485_B2

for TYCO Plug 14-POL
8-215083-4




for TYCO 4-POL
Plug Housing
794617-4

with AWG 20-24
Crimp Contacts
794610-1




*4-POL Connector, Back View (Cable Insertion Voids)*




Dimensions (L x W x H): 120 x 90 x 18 mm$^3$

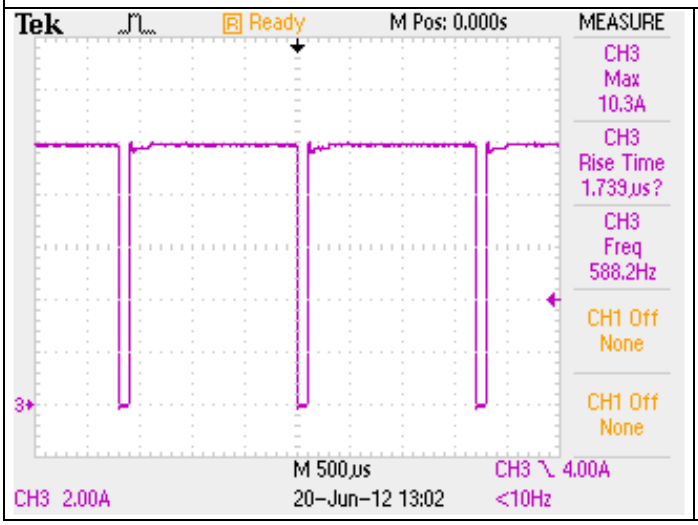
*Laser diode, temperature probes, power supply and connectors not included.*

## Current-Controlled Operation-Modes and Communication Option

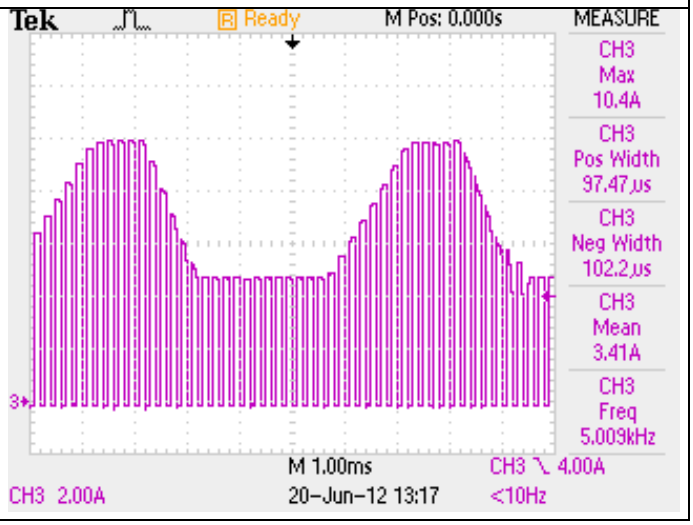
The LDD-1125 is an OEM high performance current source that is primarily designed to operate as a fast pulsed laser diode driver but that can also be used in CW mode. It is configured over an industry-standard RS485 or a USB connection, either GUI-driven using the included LDD Service Software, or by 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-1125 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.

## Typical Current Waveforms

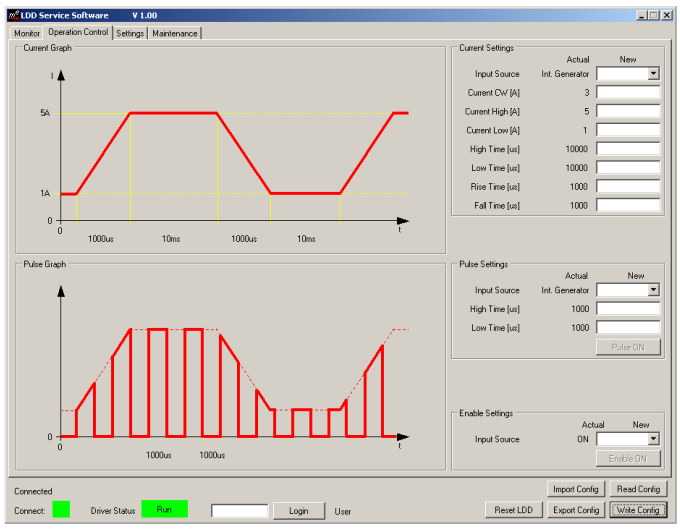



High duty-cycle chopping, unmodulated CW.




High repetition rate chopping, modulated CW.

## LDD Service Software




CW Current Modulation and Chopping by Internal Generators.

The included LDD Service Software is a powerful tool that allows monitoring and full configuration of the LDD-1125 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 set up [see. illustration on the left]
- 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)

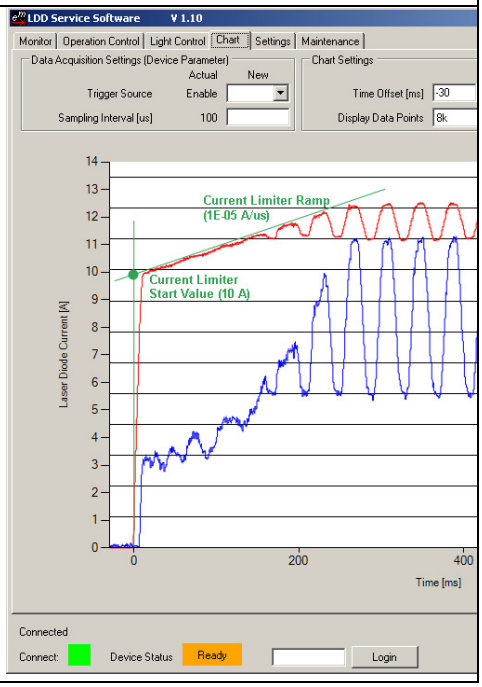
Please refer to the laser diode driver user manual for more information on features and system requirements.

## Light-Controlled Operation-Mode [Devices with LPC Option only]

The LDD-1125-LPC is a laser power controller that is based on the LDD-1125, with additional light measurement circuitry (photodiode input). A user-defined 'Light System Scale' factor links the generated photocurrent to the absolute light power. The light PID controller's output is fed to the current controllers input. The nominal light power value may be CW, modulated CW (using internal generation) or remotely controlled. A configurable soft-start feature is available, as well.

## Typical LPC Waveforms


Laser Power Control (blue) and Diode Current (red).




LPC Soft-Start Limitation (green)

## LDD-1125 Ordering Information

| Part number* | LPC Option | | Bias Voltage* ($V_{BIAS}$) | | Max. Photodiode Current* | |
|---|---|---|---|---|---|---|
| | -Suffix | Signification | -Suffix | Options | -Suffix | Signification |
| LDD-1125 | [NA]<br>-LPC | without LPC<br>with LPC | -xxx | 0 V<br>-3.3 V<br>-10 V | -yyy | 0.5mA<br>1mA<br>2mA<br>5mA |

**The suffixes Bias Voltage (for photoconductive mode) and Max. Photodiode Current (for optimal amplification) are only required if the LPC option is chosen*

Example Configuration 1: LDD-1125
The above ordering information refers to an LDD-1125 0-30 A laser diode driver with current control

Example Configuration 2: LDD-1125-LPC-3.3V-2mA
The above ordering information refers to an LDD-1125 with added Laser Power Control, -3.3 V bias voltage and a maximum photodiode current below 2 mA.

Further customization can include digital lines for control, and diagnosis and communication protocol. Please contact Meerstetter Engineering GmbH with your inquiry.

Meerstetter Engineering GmbH
Schulhausgasse 12
3113 Rubigen, Switzerland

Phone: +41 31 712 01 01
Email: contact@meerstetter.ch
Website: www.meerstetter.ch