

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



Features

DC Input Voltage:	12-24 V
Output Current:	0-15 A, <1‰ Ripple
Output Voltage:	0-15 V
CW / Modulated Current:	
- CW Current Control	Configurable PID
- Temperature Coefficient	Typ: 15 ppm/K
- CW Current Resolution	0.3 mA
- CW Current Modulation	3 kHz (0.1 A/μs @ 5-15 A)
Pulsed Current:	
- Pulse Generation	CW Chopping
- Pulse Rise Time	110 ns (L _{Load} ~ 15 nH)
- Pulse Frequency	up to 80 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 10 mA
Error Handling	Ultra-Fast Switch-off 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:	>92% (@ >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.
	1x Isolated USB 2.0
	1x RS485 / RS422
	1x Analogue Input
	- Nominal Current
	2x Digital I/O, 3.3 V / 5 V
	- Pulse
	- Interlock (Enable)
	6x Reserve I/O

General Description

The LDD-1121 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-1121-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 80 kHz pulsed-mode operation. Driving low inductive loads, ultrashort 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-1121 also monitors laser diode temperature (NTC thermistor input).

The LDD-1121 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.

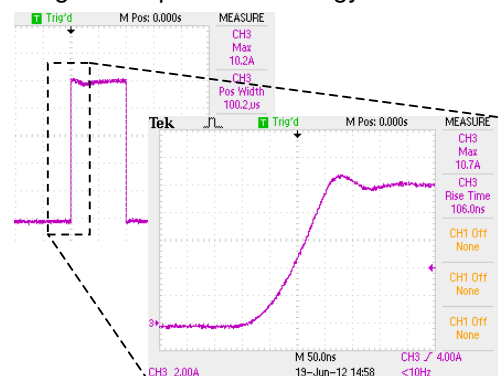
For basic applications or device evaluation, only a power supply and a laser diode need to be connected to the LDD-1121. The device can operate stand-alone in current control mode, internal generators (on board) allow for parametric definition of flexible output waveforms.

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-1121 may be fully controlled by a system bus that features RS485 communication, pulse, interlock and 6 reserve lines.

The LDD-1121 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)	12 A
Output current	18.5 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: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$, $V_{LD} = 10\text{ V}$

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		92		%
$\eta_{90\%}$	Power efficiency	@ 90% load		95		%

Output Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Output CW:						
I_{OUT}	Current range		0		15	A
$T_{\text{coefficient}}$	Temp. coefficient	$T_A = 25\text{ °C} - 50\text{ °C}$		15	35	ppm/K
$I_{OUT\ RES}$	Current resolution			0.3		mA
$I_{OUT\ RIPPLE}$	Current ripple	$I_{out} > 1\text{ A}$		3	20	mA
$V_{OUT\ MAX}$	Diode voltage		0		15	V
$V_{OUT\ LIMIT}$	Output voltage			$V_{IN} - 8$		V
P_{OUT}	Output power	$V_{LD} = 15\text{ V}$			225	W
f_{CW}	Current change	For $L_{Load} < 100\text{ nH}$, higher f_{CW} are possible		3		kHz
$I_{OUT\ SLOPE}$	Current slope limit	$I_{out} > 5\text{ A}$		0.1		A/us
Output Pulse:						
t_{rise}	Current rise time	$L_{Load} \sim 15\text{ nH} / V_{LD} = 8.5\text{ V}$		110		ns
t_{fall}	Current fall time	$L_{Load} \sim 15\text{ nH} / V_{LD} = 8.5\text{ V}$		110		ns
t_{delay}	Delay pulse/current	$L_{Load} \sim 15\text{ nH} / V_{LD} = 8.5\text{ V}$		800		ns
$t_{pH\ min}$	Minimal Pulse High	$L_{Load} \sim 15\text{ nH} / V_{LD} = 8.5\text{ V}$		0.5		us
$t_{pL\ min}$	Minimal Pulse Low	$L_{Load} \sim 15\text{ nH} / V_{LD} = 8.5\text{ V}$		1		us

Safety Characteristics

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

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: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$, NTC = B_{25/100} 3988K R₂₅ 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

Input Characteristics

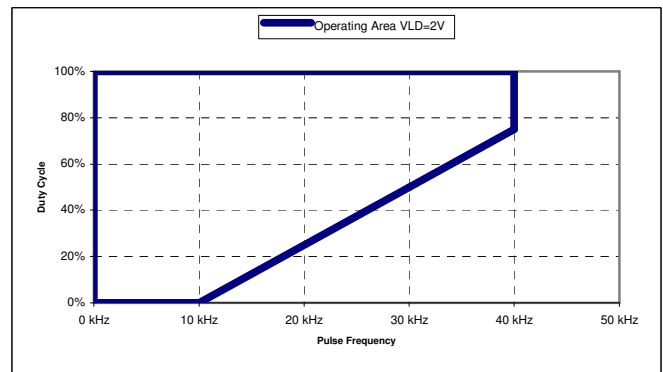
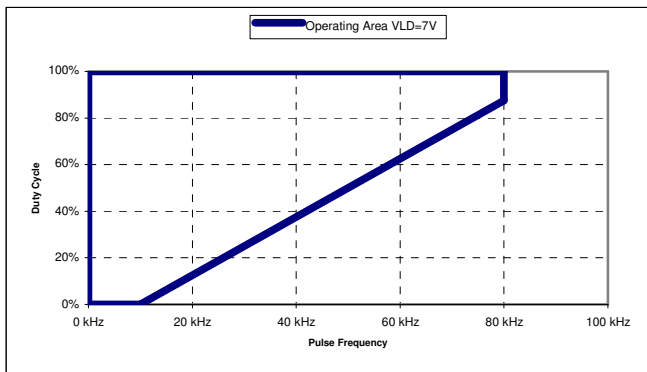
Symbol	Parameter	Comments	Min	Typ	Max	Units
I/O Ports						
V_{IL}	Input low threshold	Digital inputs			0.7	V
V_{IH}	Input high threshold	Digital inputs	2.3			V
V_{MAX}	Max. input Voltage	Digital inputs	-0.3		5.4	V
V_{AN}	Input voltage range	Analog input	0		3	V
ESD Protection: (Between Processor and Connector)						
V_{ESD}	ESD discharge	IEC61000-4-2			100	kV
R_A	Series resistance		170	200	230	Ω

Light Measurement Characteristics [Devices with LPC Option only]

Unless otherwise noted: $T_A = 25^\circ\text{C}$, $V_{IN} = 24\text{ V}$, $V_{BIAS} = -3.3\text{ V}$

Symbol	Parameter	Comments	Min	Typ	Max	Units
Photodiode Input Characteristics:						
I_{PD}	Photodiode current				10	mA
f_{ADC_LPC}	Sampling frequency	@ 16bit		0.5		MSPS

Operating Area (Pulse Mode)



Test Conditions:

$T_A = 25^\circ\text{C}$, $V_{IN} = 24\text{ V}$, $I_{LD} = 10\text{ A}$
 $V_{LD} = 7.36\text{ V}@10\text{A}$, $R_{LD_Diff} = 350\text{ m}\Omega$, $L_{LD} = 18\text{ nH}$
 Laser diode directly mounted to the screw terminals.

Test Conditions:

$T_A = 25^\circ\text{C}$, $V_{IN} = 24\text{ V}$, $I_{LD} = 10\text{ A}$
 $V_{LD} = 2.26\text{ V}@10\text{A}$, $R_{LD_Diff} = 100\text{ m}\Omega$, $L_{LD} = 15\text{ nH}$
 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):

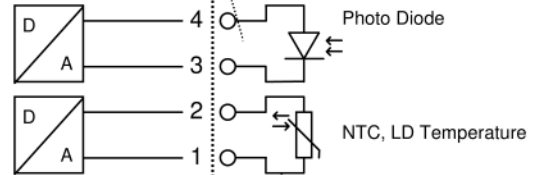
- M1: x = 4.0 mm, y = 86.0 mm
- M2: x = 98.0 mm, y = 86.0 mm
- M3: x = 4.0 mm, y = 4.0 mm
- M4: x = 98.0 mm, y = 4.0 mm

Power Terminals: M4-size Screws

Pin Descriptions Platform Bus X3:

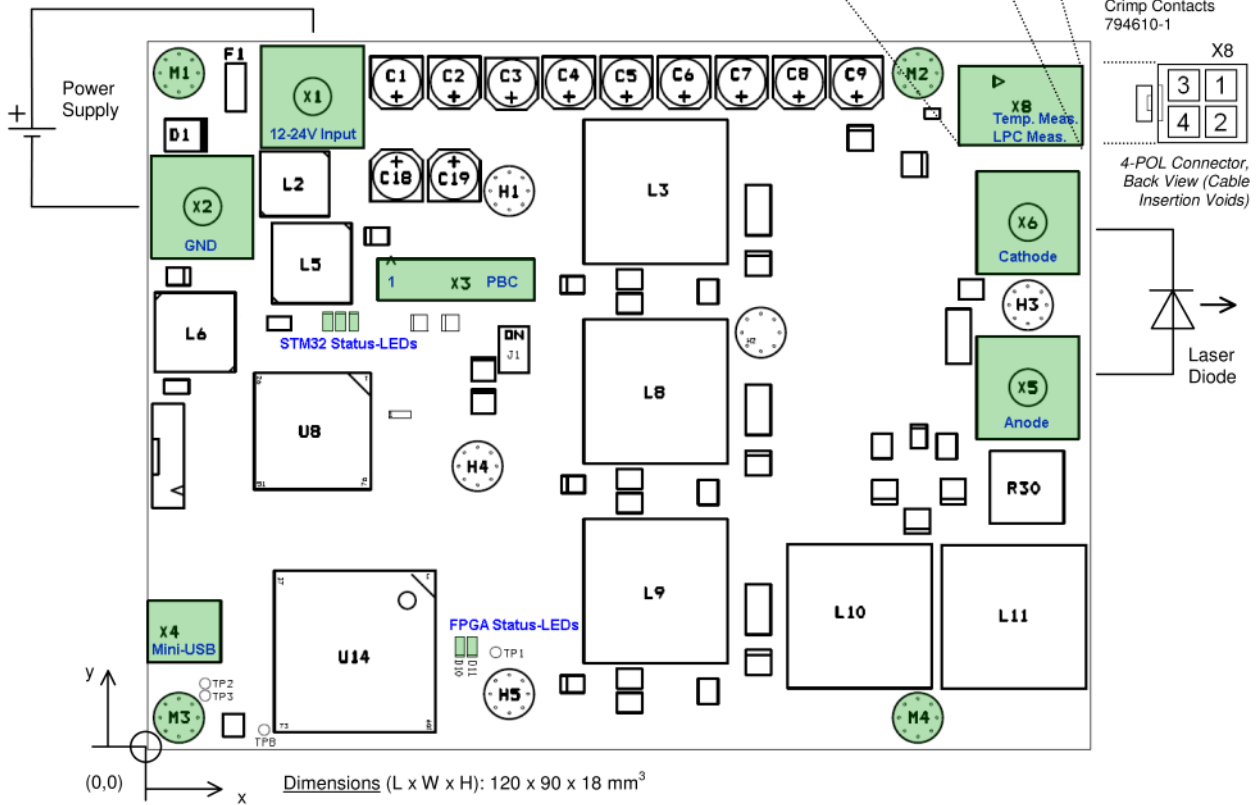
- 1: GND
 - 2: RES1
 - 3: RES2
 - 4: RES3 (Analog)
 - 5: RES4
 - 6: RES5
 - 7: RES6
 - 8: PULSE
 - 9: ENABLE
 - 10: GND
 - 11: RS485_A1 [120Ω Termination, DIP-Switch J1, 1]
 - 12: RS485_B1
 - 13: RS485_A2 [120Ω Termination, DIP-Switch J1, 2]
 - 14: RS485_B2
- for TYCO Plug 14-POL
8-215083-4

LDD Board



for TYCO 4-POL
Plug Housing
794617-4

with AWG 20-24
Crimp Contacts
794610-1



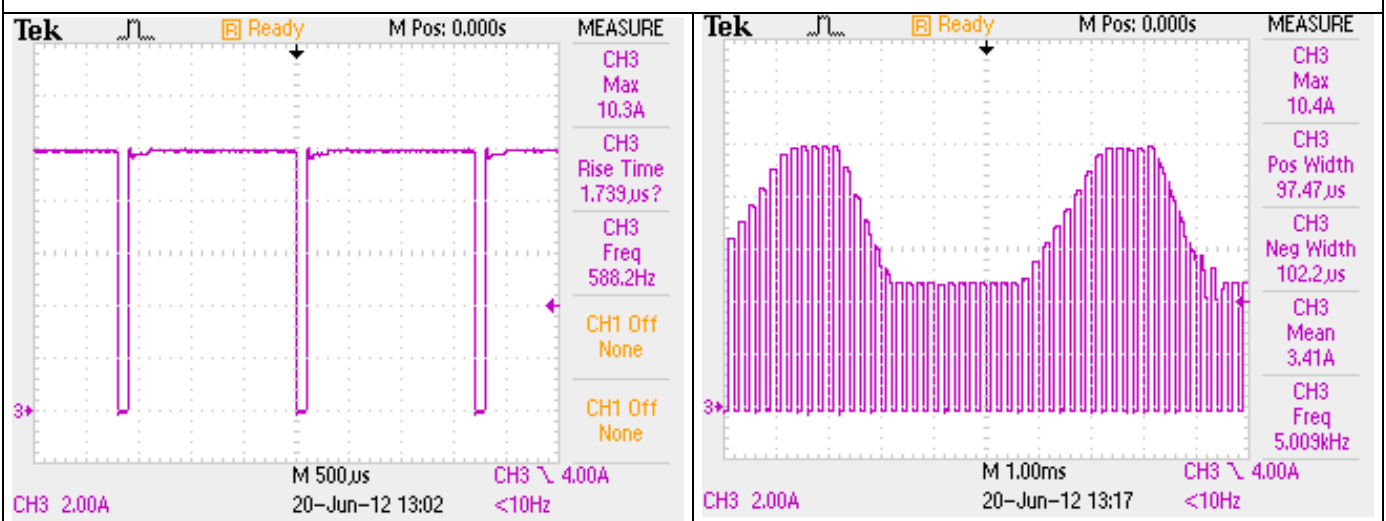
Laser diode, temperature probes, power supply and connectors not included.

Current-Controlled Operation-Modes and Communication Option

The LDD-1121 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-1121 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.

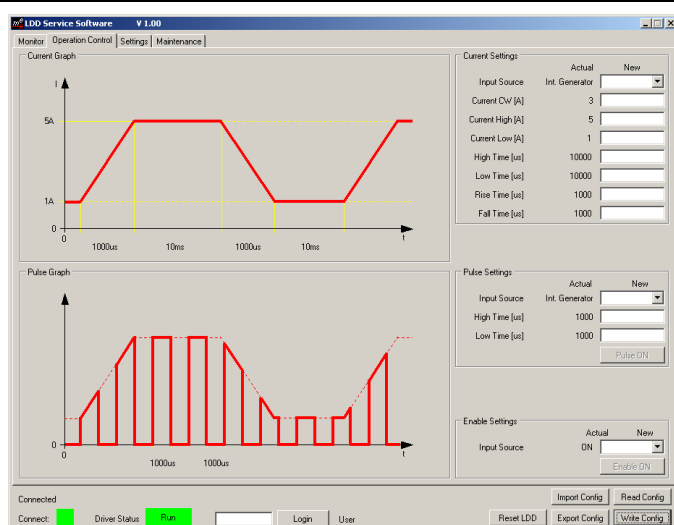
Typical Current Waveforms



High duty-cycle chopping, unmodulated CW.

High repetition rate chopping, modulated CW.

LDD Service Software



The included LDD Service Software is a powerful tool that allows monitoring and full configuration of the LDD-1121 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)

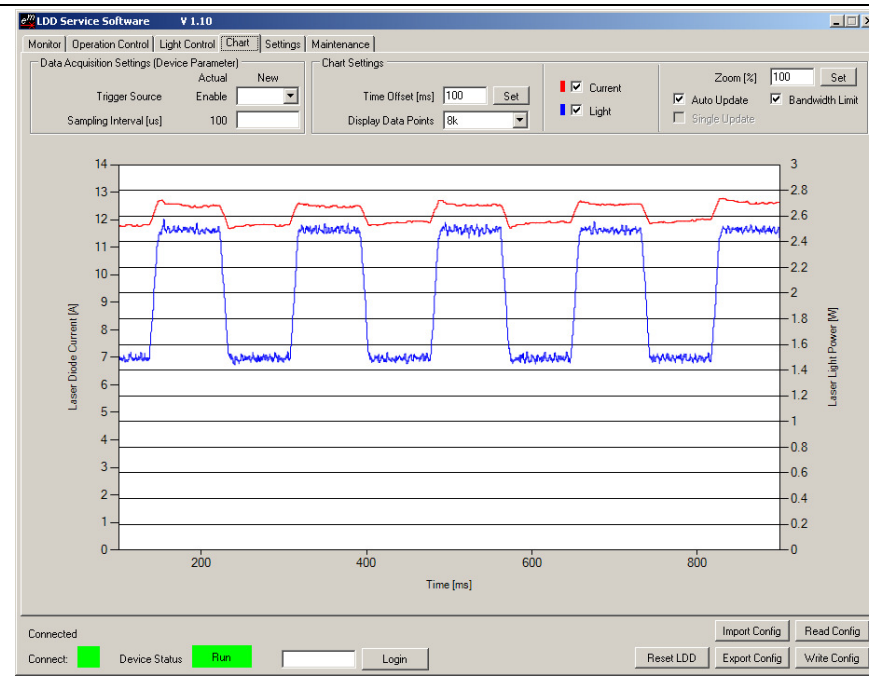
Please refer to the laser diode driver user manual for more information on features and system requirements.

CW Current Modulation and Chopping by Internal Generators.

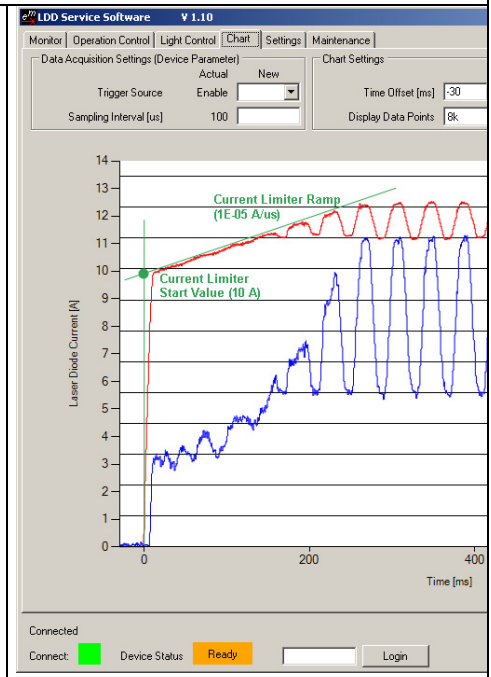
Light-Controlled Operation-Mode [Devices with LPC Option only]

The LDD-1121-LPC is a laser power controller that is based on the LDD-1121, 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-1121 Ordering Information						
Part number*	LPC Option		Bias Voltage* (V _{BIAS})		Max. Photodiode Current*	
	-Suffix	Signification	-Suffix	Options	-Suffix	Signification
LDD-1121	[NA] -LPC	without LPC with LPC	-xxx	0 V -3.3 V -10 V	-yyy	0.5mA 1mA 2mA 5mA 10mA

**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-1121
The above ordering information refers to an LDD-1121 0-15 A laser diode driver with current control

Example Configuration 2: LDD-1121-LPC-3.3V-2mA
The above ordering information refers to an LDD-1121 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.

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