PicoLAS
FOCUSSING POWER TO THE POINT

LASER COMPONENTS

User Manual

Rev. 09.01 valid from June 2009

LDP-C 200-20

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Rev. 09.02 valid from June 2009

LDP-C 200-20

Driver for High Power Laser Diodes

- Output current: 10 .. 200 A
- Output current between pulses: 0 A
- Compliance Voltage: 2 .. 20 V
- Coverage of both cw and qcw range
- Several protective features
- Adjustable current rise time
- Max. Output Power: 4000 W

*Technical Data:**

Output current	10 .. 200 A
Max. compliance voltage	20 V
Typ. pulse rise time (@100 A)	0.8 .. 5 µs **
Typ. pulse trigger delay	2 .. 6 µs **
Min. pulse duration (@100 A)	< 5 µs **
Max. pulse duration	cw
Max. repetition rate (@100 A)	> 100 kHz **
Current ripple	< 2,5 A, > 20 kHz
Current overshoot	< 5 %
Current settling time (full-scale)	< 100 ms **
Pulse trigger input	5 V TTL into 500 Ω PLB-20
Current setting input	0 .. 2 V external (100 A/V) Internal poti PLB-20
Current monitor	100 A/V
Voltage monitor	0.1 V/V
Supply voltage	+ 24 V DC
Dimensions in mm	145 x 107 x 90
Operating temperature	0 to + 55 °C
Weight	1582 g

* Specifications measured with a fast recovery diode instead of a laser diode.
Technical data is subject to change without further notice.
** See User Manual for Details.

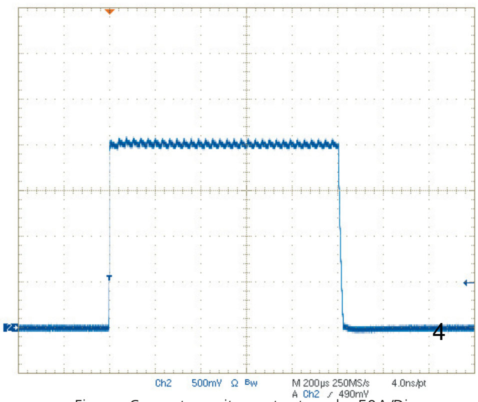

Figure: Current monitor output, scale: 50A/Div

Product Description:

The LDP-C 200-20 OEM is a compact high-power current supply to drive almost any kind of Laser Diode.
The pulsing capability ranges from single pulses over hundred kilohertz repetition frequency up to continuous operation. Pulses are generated by shorting the output, thus the current between two pulses equals zero.
Several analog Inputs and monitor outputs provide an easy way to control the LPD-C. In combination with the PLB-21, the LDP-C 200-20 is capable of generating pulses on its own. No external Pulse generator is required and all parameters can be comfortably adjusted.
The innovative current regulation concept of the LDP-C 200-20 produces, compared to the commonly used linear regulation concept, considerably less losses.

Designed to shield your laser diode from damage, the LDP-C 200-20 features a number of powerful protective safeguards:

- Innovative current regulation concept actively prevents laser diode from overshoots and over-current
- Protection against transients through regulated current rise time
- Over-temperature shutdown
- Enable/Disable input
- Shunt MOSFETs short the output clamps in case of an error
- Protection of the laser diode against reverse currents

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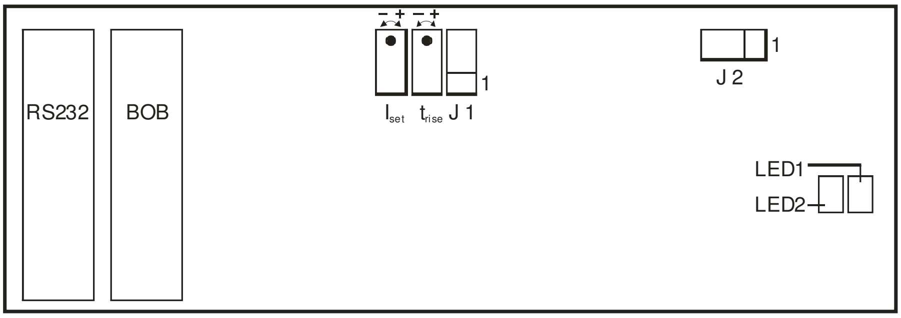
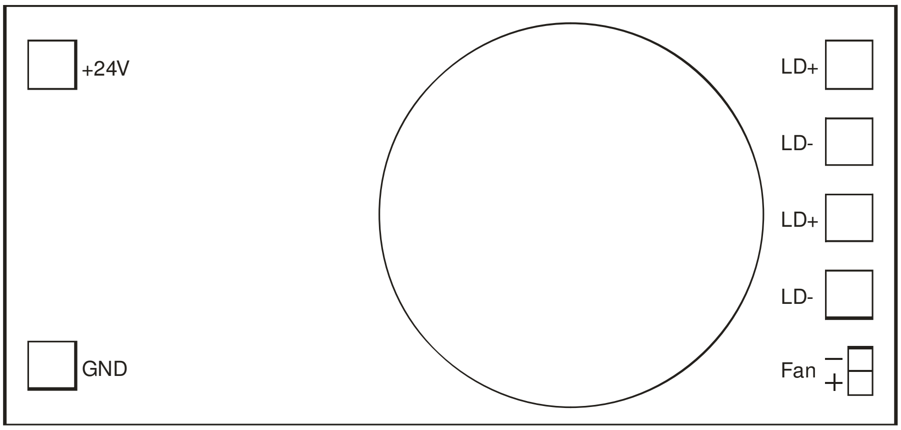
Description of Connections and Jumpers

The following drawing shows all connections, potis and jumpers which are available to the user. The upper drawing shows the controller, the lower shows the power board.



controller board



power board

RS232	RS232 connector. See page 10 for detailed information.
BOB	Break-out-board connector. See page 10 for detailed information.
Iset	Poti for current setpoint (only active when PLB-20 disabled and J1 in position 1-2).
Trise	Poti for current rise time adjustment.
J1	Selects current setpoint input (only active when PLB-20 disabled): 1-2: internal poti; 2-3: external input (BOB connector)
J2	PLB-20 communication: 1-2: enable 2-3: disable
LED1	Green status LED. See page 12 for detailed information.
LED2	Red status LED. See page 12 for detailed information.
+24V	Supply voltage
GND	Supply ground
LD+	Positive laser diode output (anode).
LD-	Negative laser diode output (cathode). Do not connect to ground!
Fan+	Positive temperature regulated fan output (12 V / 0.4 A)
Fan-	Negative fan output. Do not connect to ground!

How to get started

Step #	What to do	Note
1	Unpack your Device	
2	Apply a dummy load at the output (e.g. a Fast-Recovery-Diode)	Dummy load must be a valid equivalent to a laser diode (e.g. concerning parasitic capacitance)
3	Turn the output-current setpoint poti to the lowest value (turn Poti fully counterclockwise)	
4	Connect a Pulse source to the triggering Input	e.g. 100 µs, 5 V TTL, 100 Hz.
5	Connect your Scope to the diode current monitor output I_{Diode}.	Select high impedance termination, trigger on positive rising edge, 500 mV/div.
6	Apply the supply voltage (24 V DC).	Make sure that the supply voltage can deliver enough energy to be stable during the pulses.
7	Set enable pin "high"	To protect your Laser-Diode the Driver will stay disabled, if the enable Pin is "high" during power-up.
8	Adjust the pulse current value to the desired value.	Turn poti clockwise and observe the current on the oscilloscope.
9	Disconnect the supply, remove the dummy load at the output and assemble the Laser Diode (Polarity!)	To protect your Laser-Diode the Driver will keep disabled, if the enable Pin is "high" during power-up.

Dos and Don'ts (LDP-C 200-20)

Never ground any lead of the output. This will immediately destroy the driver!

Never use any grounded probes at the output. This will immediately destroy the driver and the probe!

Never make a short at the output. This will not do any harm to the laser driver but will yield in an incorrect current measurement.

Always use all four terminals at the driver's output. This will reduce the stray impedance of the connection and yields better performance of the internal current monitor. Using only two terminals will result in excessive heat production at the terminal itself and may damage driver and cable.

Keep connection between power supply and the driver as well as the connection between driver and laser diode as short as possible.

Mount the driver on an appropriate heat sink.

Attach a fan to the temperature regulated fan output. The fan should cool the heat sink and the driver itself.

Product Specification

Output current	10 ... 200 A*
Current between Pulses	0 A
Parasitic voltage between poles measured across the terminals	< 150 mV
Simmer-current	Not availiable
Current droop during Pulse	< 1%
Current Ripple during Pulse	Typ 2,6 A (50…200A, @10V)
Max. compliance voltage	20 V *
typ. Pulse rise time	< 1 µs ... 5 µs adjustable
typ. Pulse trigger delay	typ. 2 µs
min. Pulse duration	typ. 5 µs
max. Pulse duration	cw
Current settling time (full-scale)	< 100 ms
Pulse trigger input	5 V TTL into 500 Ω
Current setting input	Internal (Poti) 0 .. 2 V external (100 A / V) PLB-20
Current monitor	100 A / V
Voltage monitor	0.1 V / V
Supply voltage	+ 18 … 26 V DC
Fan output voltage	12 V
Fan output current	400 mA
RS232	Yes
Compatible to PLB-20	Yes
Dimensions in mm	145 x 107 x 90
Operating temperature	0 to + 55 ° C

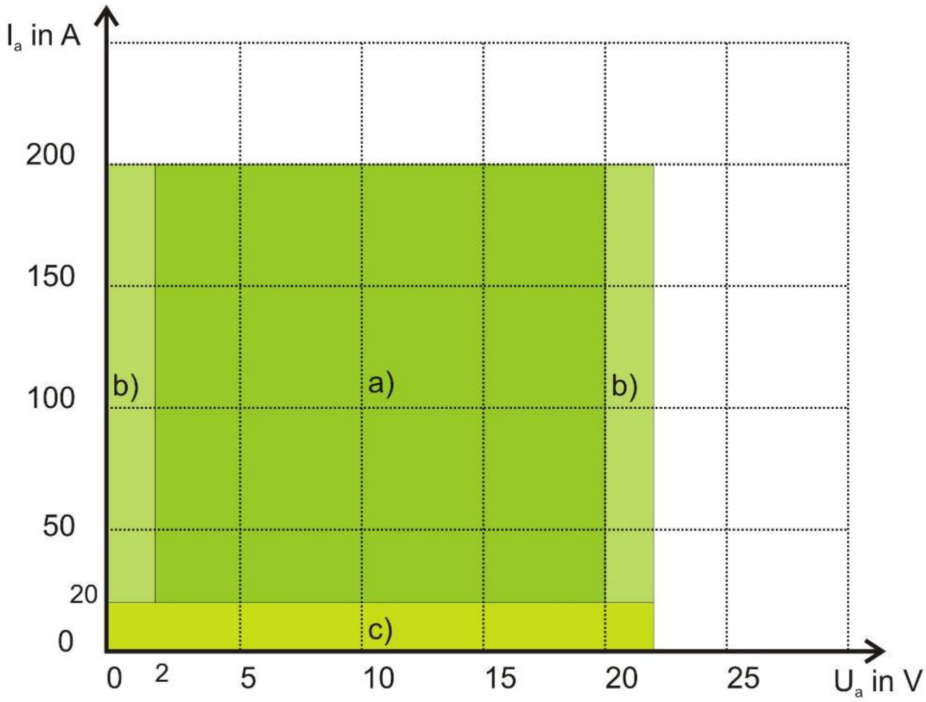
* See page 8 for information about the useful operating range.

Operating Range

The following diagram shows the operating range regarding pulse-current and -voltage of the LDP-C 200-20. The best performance is achieved with currents above 40 A and compliance voltage between 2 V and 20 V (area a)).

Compliance voltages in the range from 4 V to 20 V will result in the best performance. Compliance voltages below 4 V yield in longer tail currents, above 20 V result in a current droop at the beginning of the pulse. Both will not do any harm to the driver. A compliance voltage below 1 V is not recommended and may do harm to the laser diode.

An output current below 40 A results in a relative high current ripple (c)). This won't do any harm to the driver but is for some applications not acceptable. For currents below 40A we recommend e.g. the LDP-C 40-05.

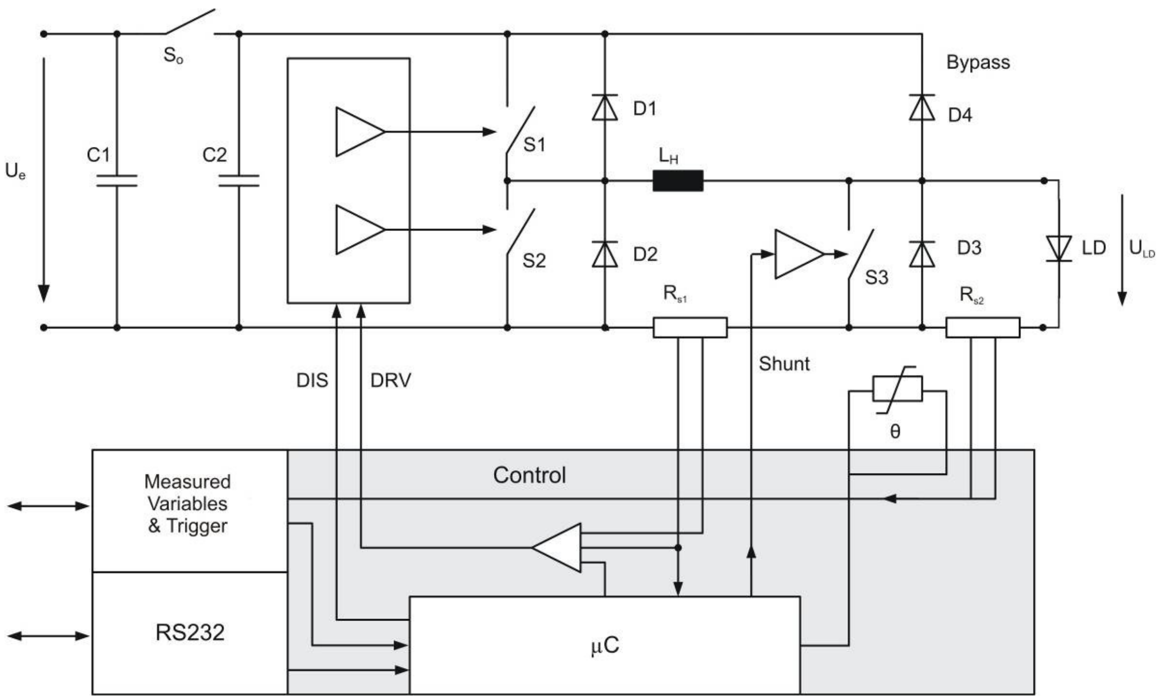


Legend:

a) Area of best performance.
b) Compliance-voltages below 4 V and above 20 V will cause a longer tailing of the current or a current droop at the beginning of the pulse.
c) Currents below 40 A result in relative high current ripple.

Functional Description

The LDP-C 200-20 operates by the following principle: A buck converter (S_1, S_2, D_1, D_2, L_H) generates a current in its inductor L_H. This current is shorted to ground through the shunt MOSFET S_3. During a pulse, S_3 is open and the current flows through the laser diode L_D. The inductor current through L_H is measured with R_{S1}, this allows the control circuit to regulate the current to a constant value under all circumstances. The laser diode current is measured with R_{S2}. Blocking capacitors decouple the driver from the power supply. C_2 filters the high frequency ripple of the buck converter, C_1 provides the pulse energy.
Inductor current, laser diode current and compliance voltage are preprocessed and then lead to an external connector. A trigger input for generating pulses as well as an enable-input is available. An RS232 interface allows communication with a PLB-20 or a PC. The integrated microcontroller is capable of generating pulses with a configurable repetition rate and duration on its own, but also allows throughput of the external trigger input.
Several security features protect the laser diode and driver from damage. The microcontroller supervises driver temperature, inductor current, input and output voltage and disconnects the driver from the power supply in case of an error by opening the security switch S_0. D_3 protects the laser diode from reverse currents; bypass diode D_4 protects the driver in case of a load failure.



Element	Function
S_0	Security Switch
C_2, S_1, S_2, D_1, D_2	Buck Converter
S_3	Shunt Mosfets Short Output
D_3, D_4	LD-Protection
R_{S1}	Current sensor for Regulation (Control)
R_{S2}	LD-current monitor
θ	Temperature-sensor
µC	RS232-communication Temperature-supervision Current-control

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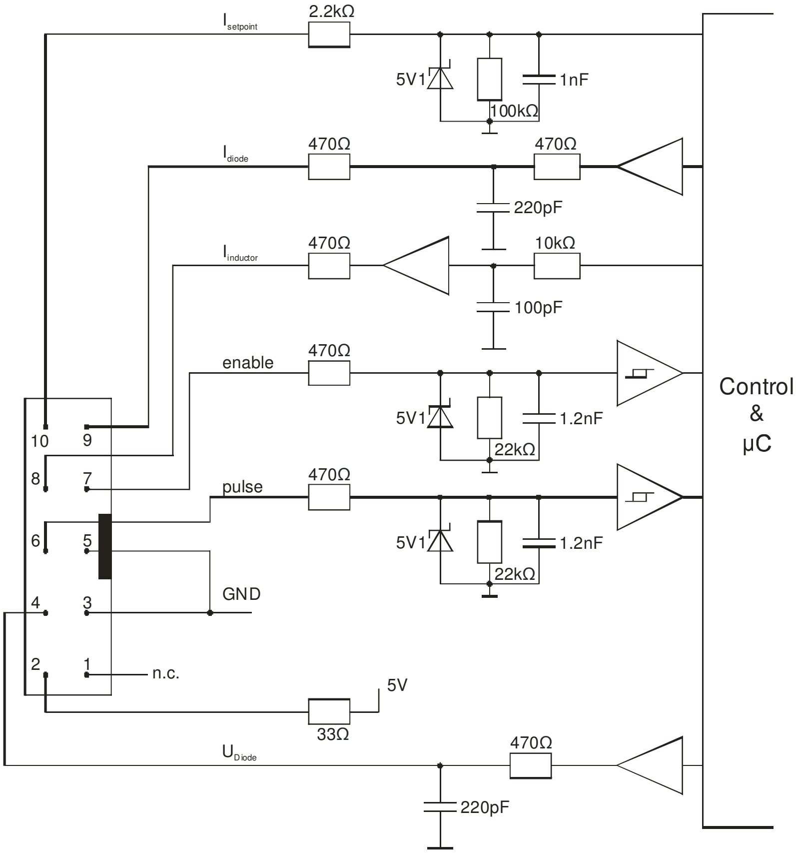
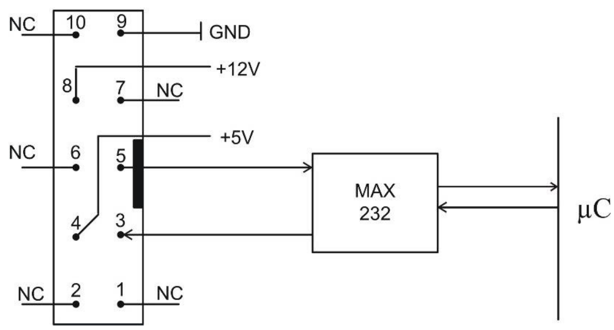
Interface Specification

The following figure shows the input and output stages of the external analog connector. The monitoring outputs are filtered and buffered to improve signal quality.
Digital inputs (enable and pulse-trigger) are filtered to reduce spikes and then evaluated by Schmitt-triggers to ensure proper evaluation. The external current setpoint input is filtered and then sampled by the microcontroller. All inputs are protected by clamping diodes against over voltage. An auxiliary high impedance 5 V supply voltage is provided to power e.g. the LDP-C BOB.

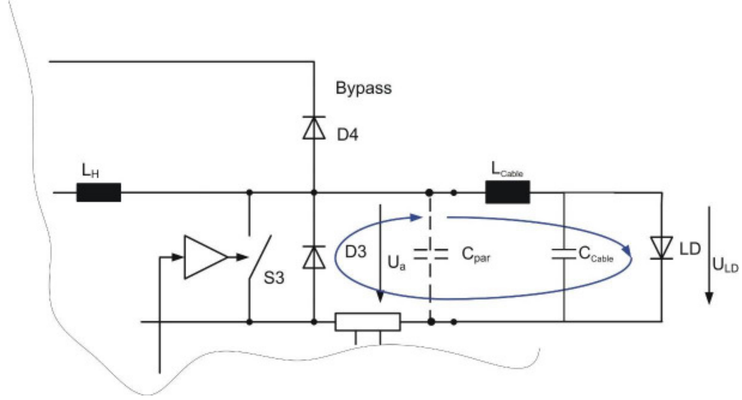


The RS232 interface is mainly designed to communicate with the PLB-20. Thus it contains two additional supply voltages to power the PLB-20.



Current Rise Time Adjustment

The LDP-C 200-20 provides current rise time adjustment of the positive edge of a pulse. When the shunt switch S3 closes, the inductor current through L_H commutates from S3 to the output. There it has to magnetize the parasitic inductance L_{cable} of the cabling between pulser and laser diode. During this process, the current through the laser diodes rises. The time during which the laser diode current rises depends on the voltage difference between the output of the pulser and the laser diode compliance voltage, the current through L_H and the parasitic inductance itself. Obviously higher parasitic inductance result in slower current rise and thus higher rise time. Equally a higher current results in a higher rise time. With a higher compliance voltage, the voltage difference between pulser output and laser diode decreases and though the rise time increases.
With the poti t_{rise} on the controller board, the user can influence the voltage rise of the output voltage of the pulser and thus the rise time of the laser diode current. However, as the rise time depends mainly on the cabling as well as on the chosen current and compliance voltage of the load, no absolute relation for the current rise time can be given.



Effect of Laser Diode Connection on the Pulse Shape

Parasitic elements in pulser and connection line to the laser diode have an important influence on pulse shape and rise time. The parasitic output capacitance of the pulse C_{par}, the cabling inductance L_{cable} and the parasitic capacitance of the diode C_{diode} form a resonant circuit. Applying a step function (which is done at the beginning of a pulse) on a resonant circuit results in oscillations and current overshoot. As these oscillations are inacceptable for most laser applications, the parasitic capacitances and inductances have to be minimized.
Laser diodes usually have a very low parasitic capacitance in the order of some 10 pF. Together with a short and low inductive connection between laser diode and driver no oscillations or overshoot should occur. In addition, the adjustable current rise time helps to avoid overshoot and oscillations. A very short rise time and thus a very high current rise results in a strong excitation of the resonant circuit. With a longer rise time and softer current rise the resonant circuit is considerably less excited and though oscillations and overshoot will not appear.
As already mentioned above, L_{cable} influences the current rise time at the beginning of the pulse. Because L_{cable} has to be magnetized up to the inductor current which flows through L_H, a higher L_{cable} yields in a longer rise time. At the end of a pulse S3 closes and shorts the output. Then L_{cable} has to be demagnetized. At this time, only a very low voltage is available at the output. The time required to demagnetize L_{cable} depends only on its value. Higher L_{cable} results in a longer current fall time.

Test Load

A common method to test the driver is to connect a regular silicon rectifier diode to the driver output. Here has to be paid attention to the junction capacitance of the diode. Only fast recovery diodes (or similar) have a low parasitic capacitance as laser diodes have. To achieve reasonable test results, the parasitic elements of the test diode and the connection must be very similar to a laser diode approach. Regular silicon rectifier diodes have a junction capacitance of several microfarads and are not a suitable test load! The use of these diodes will yield in incorrect current measurement at the pulse edges!

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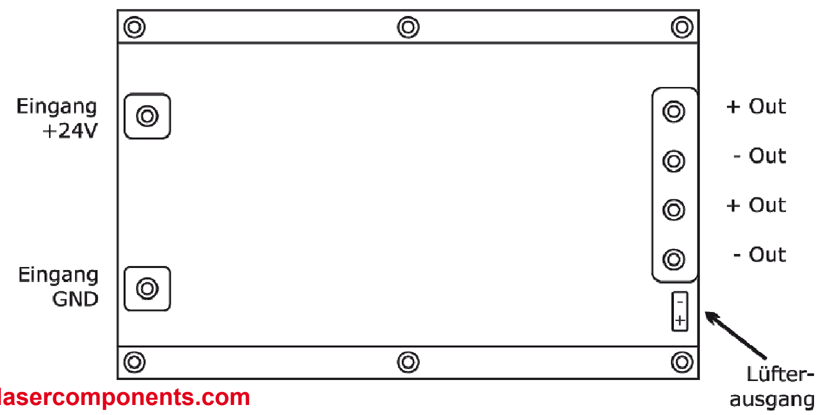
LED Status Indications

Nr.	Green LED	Red LED	Description	Solution (if applicable)
01	Cont. On	Off	Ready for operation, a pulse at the Trigger input will be followed by the reaction at the output	
02	Flashes 2x	Off	System power up Running self-test If device is not continuously on after a few seconds, the power supply might be too low or too high.	Check power supply
03	Flashes 3x	off	Enable not connected	
10	Cont. On	Cont. On	Temperature above chosen Maximum	Let device cool down
11	Cont. On	flashes 1x	Device is cooling after switching off because of over-temperature	Let device cool down
12	Cont. On	flashes 2x	Temperature approaching switch-off-temperature	Potentially: additional cooling with a fan
13	Don´t care	flashes 3x	Internal Fault, DAC not addressable	Repair needed
14	Don´t care	flashes 4x	Internal Fault, Temperature-sensor failed	Repair needed
15	flashes 2x	flashes 5x	Minimum Voltage Fault Power supply is below 18 V	Adjust power supply
16	flashes 2x	flashes 6x	Overvoltage Fault Power supply exceeds 27 V	Adjust power supply

Absolute Maximum Ratings

- Supply voltage range (Vcc): +18 (UVLO) to +27 V (OVLO)
- Input current: 200 A
- Laser diode output current: 210 A
- Laser diode output voltage: Vcc – 2 V
- Pulse repetition rate: 200 kHz
- BOB-connector input and output voltages: 0 V to 5 V
- BOB-connector output currents: 1 mA
- Auxiliary 5 V supply voltage output current: 30 mA
- RS232-connector: +/- 30 V
- Fan output current: 500 mA (fused)
- Operating temperature: 0-55 °C

Mechanical Dimensions



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