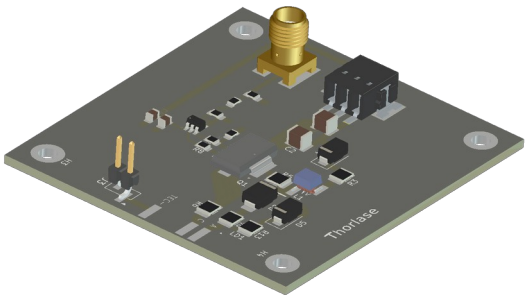
Laser diode driver for short pulses

Features

- Produce short (ns) pulses from high power laser diodes
- Pulse energy limited by design for safe overdriving
- Fast edge generated onboard
- Compact half brick formfactor

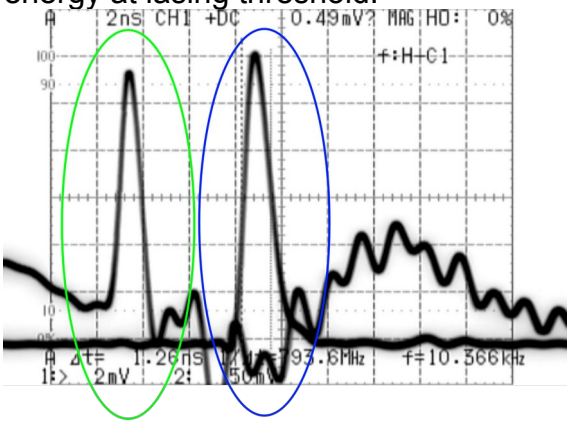
Applications

- Seed driver
- LiDAR
- SOA gating
- Strobe photography
- R & D



Description

The IDLPD is an answer to the challenge of driving pulses in Reactance dominated loads. Low power DFB laser diode modules for direct modulation use a series resistor (10 to 50 ohms). Drivers for such modules see a load which is Resistor dominated. This approach is workable for low currents up to 100mA, where the power dissipation ($P=RI^2$) can be managed. In high power laser modules the forward current is on the order of 1 Amper and a matching resistor approach is not viable. The IDLPD uses a technique to dose a current pulse to the laser diode, with very high voltage compliance [M.O.Berendt et al.]. There are several ways of generating short laser pulses, mode locking, Q-switching and for the laser diodes gain switching. These are technique that depend on the physics of the laser cavity. For laser diodes gain switching is used to generate pulses with width in the 100ps range. These pulses are limited in pulse energy since they extract the stored energy at lasing threshold.

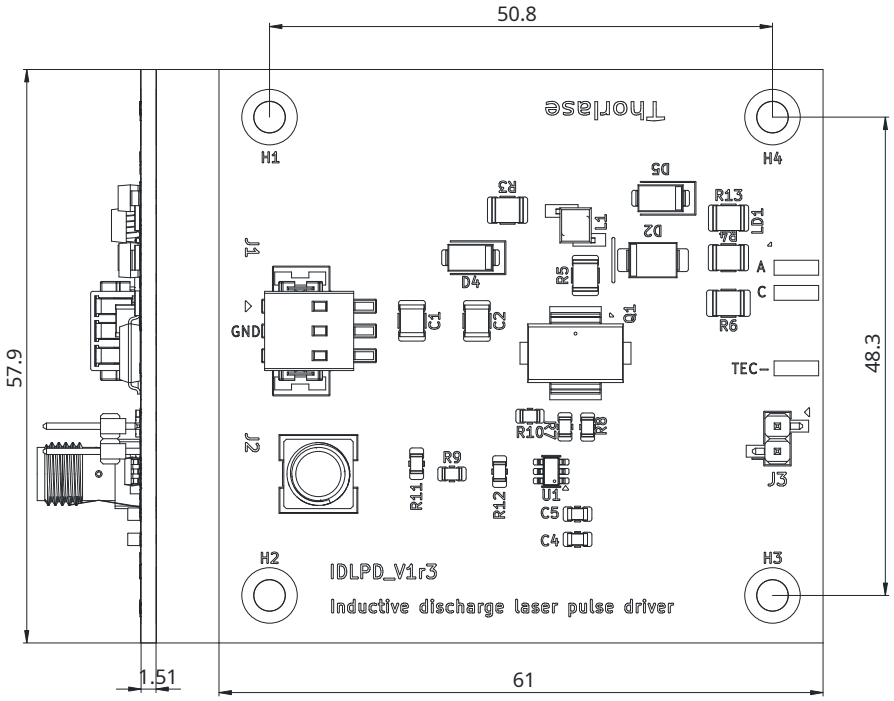


Rogowski coil signal di/dt

Optical pulse

The IDLPD pulse the laser current and drive the laser diode rapidly passed laser threshold. The figure show oscilloscope trace of an optical pulse (980nm 750mW pump, Biased PD detector) and the pulse current detected with a Rogowski coil. The optical signal follows the current pulse. SLD's, SOA's, DFB and FP laser can all be pulsed with the Inductive Discharge Laser Pulse Driver.

Drawing (mm)


50.8
57.9
48.3
1.51
61
H1
H4
H2
H3
Thorlase
J1
J2
J3
GND
TEC-
A
C
D4
D5
D2
R3
R13
R5
R6
R8
R9
R10
R11
R12
C1
C2
C4
C5
U1
Q1
L1
LD1
IDLPD_V1r3
Inductive discharge laser pulse driver

Absolute Maximum Ratings

VDC……..60V
VCC……..14V
Total current consumption……1.5A
Maximum Operating Temperature……..+50°C
Storage Temperature……..-5°C to +50°C

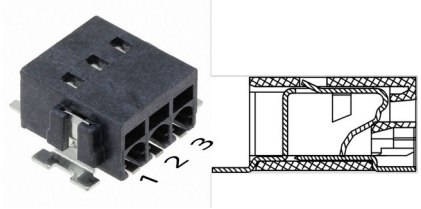
Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply for LD step-up branch	VDC	3.3	5	60	V	
Gate driver supply	VCC	4	5	14	V	
VDC and VCC total current	I_{con}	0.05	0.3	2.5	A	max incl. charging gated always on
Logic High Input Voltage	V_{IH}		2.0		V	
Logic Low Input Voltage	V_{IL}		0.8		V	
Charge time	t_{ch}			30	ns	to saturation
Off delay	t_{od}	2	10	20	ns	
Pulse delay	t_{pd}			25	ns	
Pulse width	t_w	1		4	ns	

Connector pinning

J1 Wire (20-24 AWG) to Board Terminal Block NQ0300000000G

pin	Name	Description	Normal Operation
1	VDC	Supply for LD step-up branch	+5V to +12V
2	GND	Common system GND	0V
3	VCC	Gate driver supply	+5V



Wire range:

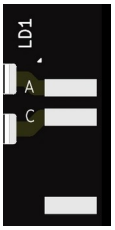
- Solid wire (AWG): 20–26
- Tin Dipped Stranded wire (AWG): 20–26
- Wire strip length: 6mm

J2 SMA Connector Receptacle, Female Socket 50 Ohms

pin	Name	Description	Normal Operation
1	In	Trigger input, Logic High Input Voltage 2V in 50 ohm	Max +5V
2	GND	Common system GND	0V

LD1 100 mil (2.54mm) pitch solder pads

pin	Name	Description
1	A (10)	Laser diode anode
2	C (11)	Laser diode cathode
3	TEC- (14)	Landing pad for TEC-



Application Information

Electrical wiring

Typical electrical wiring of the IDLPD is shown in the figure. The laser diode is soldered to the provided pads on the IDLPD. The pads will accept 14 pin and 10 pin Butterfly laser modules or most TO can lasers. Power is supplied on J1. VDC and VCC can be connected to the same +5V PSU, for general use. The negative net has to be common GND, wired to the PSU. The triggering of the pulses from the IDLPD comes from a pulse pattern generator (PPG).

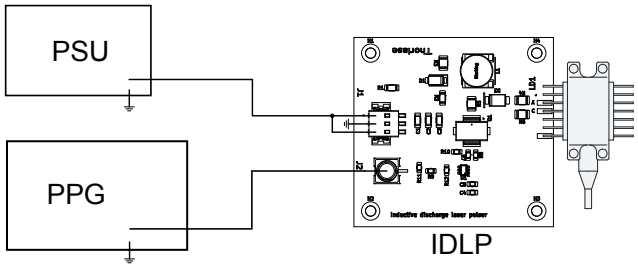
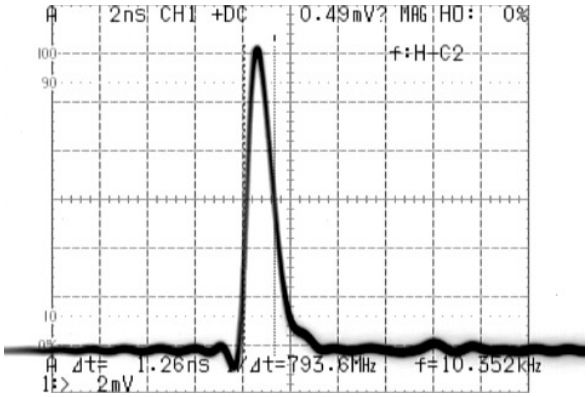


Figure 1. Typical electrical wiring

The LD module should be soldered to the anode and cathode pads on the IDLPD to ensure a low impedance connection.

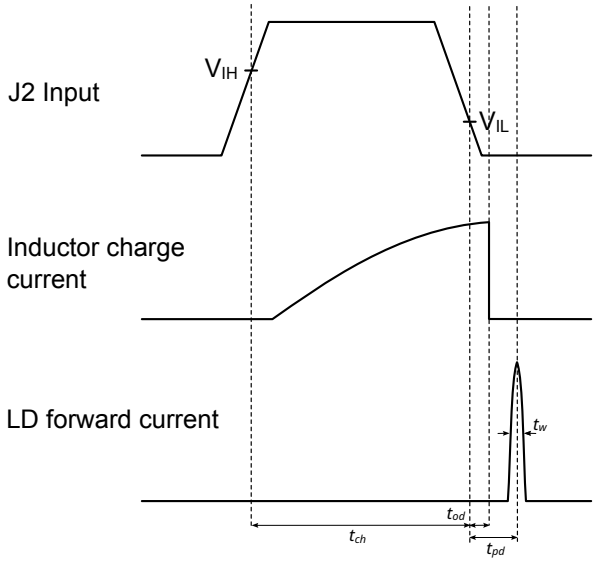
Example pulse shape

The oscilloscope screenshot shot the pulse obtained with a 980nm 750mW 14-pin butterfly pump module. The pulse is significantly shorter than the shortest pulse expected from the ~100 MHz modulation bandwidth. The peak level can be tuned via VDC or the trigger input to J2.



Timing Diagram

The trigger input to J2 commands the charge and discharge operation. The rising edge logic crossing of V_{IH} starts the charging and the pulse is triggered by the falling edge when V_{IL} is crossed. The current through the LD is the due to the release of energy stored in the inductor. The J2 input high time is normally set larger than the max charge time for maximum pulse energy. Reducing the high-time allow controlled reduction of the pulse energy. A high-time longer will drive nonproductive current and should be avoided. The pulse energy is clamped by the maximum energy stored in the inductor. No gating timing will produce excessive current through the LD.



Timing diagram.

Mounting considerations

The IDLPD connect to the laser diode via the anode and cathode terminal. It is recommended to solder the laser diode modules pins directly to the IDLPD board. Connecting with wires introduce parasitic impedance which will distort the pulses. Mounting suggestion is show in the figure for TO-can and 14 or 10 pin Butterfly modules. The IDLPD generate some heat during operation and heat dissipation can be insured with directly mounted heatsink or heat-spread base plate, mounting both the IDLPD, Butterfly module and TEC controller.

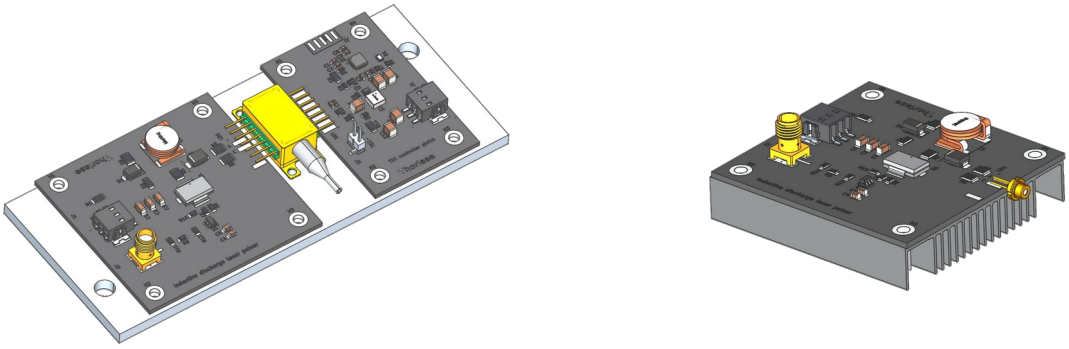


Figure 3. Mounting suggestion.

List of accessories

This is a list of accessories that are not included in the kit but are often used together with the kit.

Description	Supplier	Mfr. Part No.
SMA to BNC male cable	SparkFun Electronics	27480
	Amphenol	RF 095-850-249M100
Half Brick Platefin Heatsink, 61x58x12mm	Radian	HS1576EB
Baseplate	Thorlase	BLDDTEC
TEC-controller-qbrick	Thorlase	TECCQB

References

[M.O.Berendt et al.] Inductive discharge pulse driver in time gated laser ranging (Conference Presentation):
Laser Radar Technology and Applications XXV, Martin Ole Berendt, Hugo Barbosa, Job Tomé, Miguel Melo, April 2020 DOI:10.1117/12.2558840.

Document control

Version	Apply to	Data
Datasheet_Inductive_Discharge_Laser_Pulse_Driver	inductive_discharge_laser_pulse_driver_V1r3	20261021