

Fast constant current laser diode driver with coaxial modulation input

Features

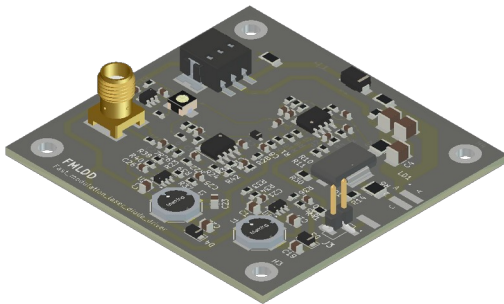
- High peak current
- Fast settling
- Low overshoot

Applications

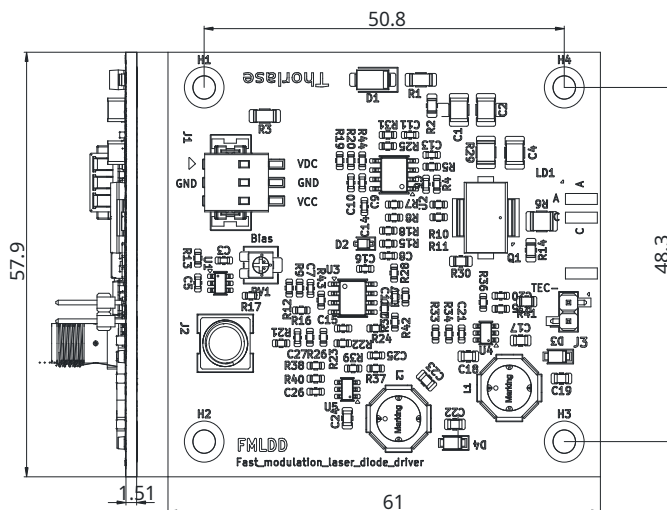
- Seed driver
- Sensing
- R & D

Description

The FMLDD is a constant current laser diode driver. It allows shaped short pulses or any other analog waveform. The driver uses transient feed-forward plus current feedback to combine fast rise time with long term stability. This concept was first demonstrated in the digital domain [M.O.Berendt et al.]. The FMLDD driver uses all analog high speed control to bring this concept to the ns timescale.



Drawing (mm)



Absolute Maximum Ratings

VDC.....	60V
VCC.....	16V
I_{total}	2A
Maximum Operating Temperature.....	+50°C
Storage Temperature.....	-5°C to +50°C

Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply for LD	VDC	3	12	60	V	
Supply for DC-DC converters	VCC	4	12	16	V	
Modulation input, 50 ohm	V_{IN}	0	1	1.5	V	
Conversion Gain	$I_{\text{LD}} / V_{\text{IN}}$		1.0		A/V	
Bias current	I_{bias}	0	20	200	mA	Set by trimmer
Current rise time	t_r		4		ns	10% to 90%
Current fall time	t_f		6		ns	90% to 10%
Settling time, top	t_{s_top}		22.5		ns	to 2%
Settling time, bottom	t_{s_bottom}		32		ns	to 2%
Overshoot			7		%	

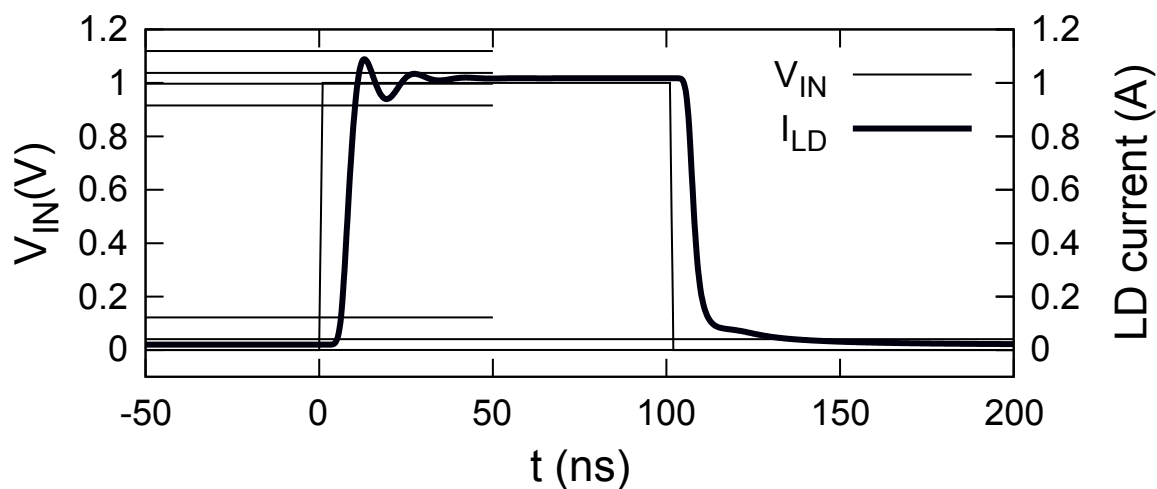


Figure. Transient dynamics.

Connector pinning

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

pin	Name	Description	Normal Operation
1	VDC	Supply for LD	+12V
2	GND	Common system GND	0V
3	VCC	Supply for DC-DC converters	+12V

J2 SMA Connector Receptacle, Female Socket 50 Ohms

pin	Name	Description	Normal Operation
1	V _{IN}	Trigger input, 50 ohm termination	Max +2.5V
2	GND	Common system GND	0V

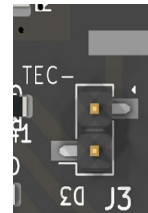
LD1 100 mil (2.54mm) pitch solder pads

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



J3 CONN HEADER SMD 2POS 2.54MM

pin	Name	Description
1	TEC - ▼	Butterfly pin 14 (10)
2	Not connected	



Application Information

Electrical wiring

Power is supplied to the FMLDD on the J1 Wire J1 Wire to Board Terminal Block Terminal Block. There are separate inputs for LD (VDC) and for the control (VCC). This allow VDC at a higher voltage for special laser applications. In most case one +12V PSU channel can be used for both VDC and VCC. The negative net is common GND. The FMLDD converts the waveform applied to J2 into laser current. Connector J2 is a the 50 ohm terminated SMA connector that is connected to the arbitrary waveform generator (AWG) or other signal source.

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

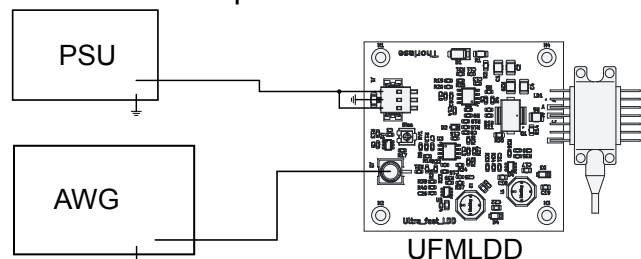
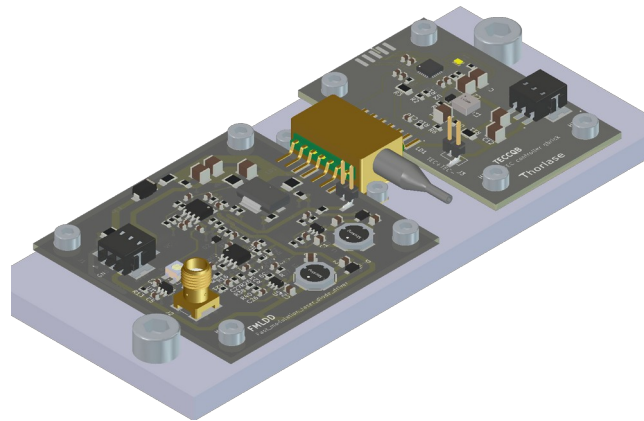


Figure. Electrical wiring.

Mounting considerations

Mounting suggestion is show in the figure for 14 or 10 pin Butterfly modules. The FMLDD generate some heat during operation. Heat

dissipation can be insured with directly mounted heatsink or heat-spread base plate, mounting both the FMLDD, Butterfly module and TEC controller.



FMLDD mounting on baseplate, together with TEC-controller-qbrick and Butterfly laser diode modules.

Bias adjustment

A fast ramp of the laser current (I_{LD}) from 0 mA will cause a gain switching peak in the optical output power (P_{op}) when the laser threshold current is reached.

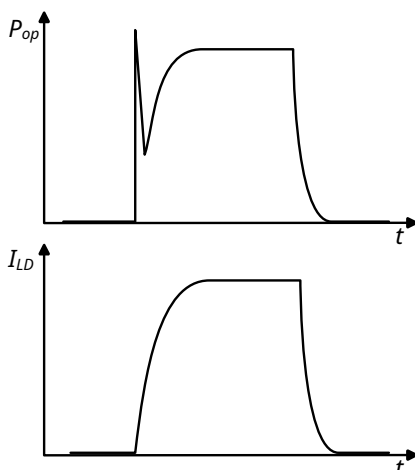


Figure. Gain switching

Applying a bias current before the fast ramp can prevent the gain switching peak. In the FMLDD bias current can be set in two ways. A constant bias current can be set with the trimmer RV1 on the board.

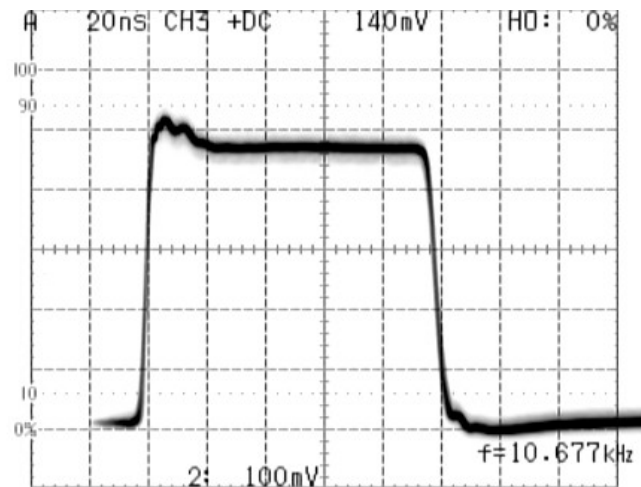


Figure. Trimmer RV1.

Since FMLDD is a precise voltage to current driver the bias can alternatively be included in the control waveform. A bias point just below the laser threshold is sufficient to avoid gain switching. Should the emitted ASE is a problem in the application, then include the bias as a slow ramp just some tens of ns before a fast ramp.

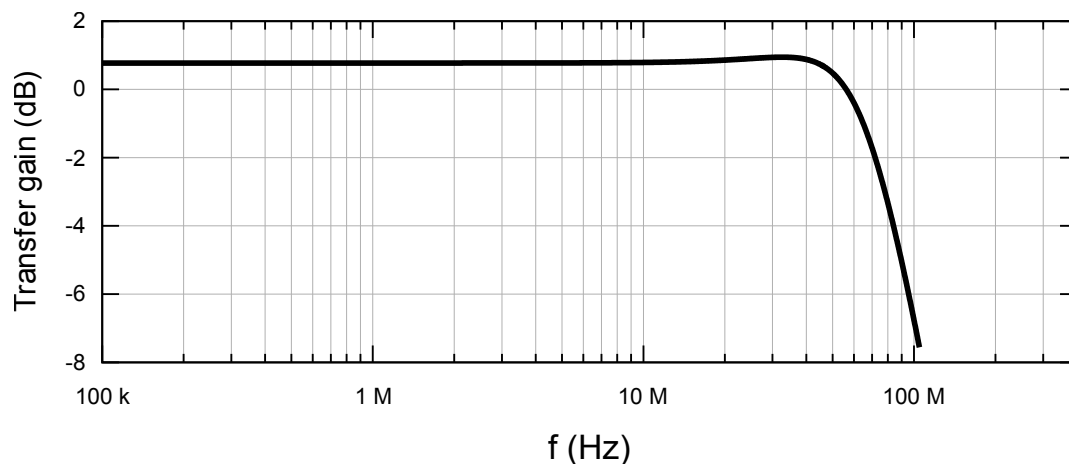
Example waveform

The oscilloscope screenshot shows the current waveform driving a short between A and C terminals. The current is measured as the voltage drop in a 0.47 ohm sensing resistor. The modulation input on J2 SMA Connector is a 0V to 1V, 100ns wide square wave. The rise time is 4.2ns and fall time is 4.8ns,



Frequency response

The frequency response of the FMLDD driver is analyzed through simulation. A sinusoidal input between 0V to 1V is applied to the 50 ohm input. The resulting current transfer gain driving a short is plotted in the graph. The 3 dB modulation BW is from DC to 80MHz.



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
HOOK-UP STRND 22AWG RED	CNC Tech	3132-22-1-0500-004-1-TS
HOOK-UP STRAND 22AWG BLACK	CNC Tech	1569-22-1-0500-001-1-TS
Half Brick Platefin Heatsink, 61 X 58 X 12mm	Radian	HS1576EB
Baseplate	Thorlase	BLDDTEC
TEC-controller-qbrick	Thorlase	TECCQB
Spacers 2mm, 3.2 ID	RAF Electronic Hardware	M0501-3-AL
Socket head screw M3 x 6 mm		
Socket head screw M2.5 x 4 mm		

Document control

Version	Apply to	Data
Datasheet_Fast_Modulation_Laser_Diode_Driver_r3	Fast_Modulation_Laser_Diode_Driver_r3	20261023

References

[\[M.O.Berendt et al.\]](#) Martin Berendt, Hugo Barbosa, Job Tomé, et al. "Fast settling PWM laser diode driver (Conference Presentation)", Proc. SPIE 11410, Laser Radar Technology and Applications XXV, 114100D (27 Apr 2020)