

Product Document

Operating the pulsed laser diode SPL PLxx

Application Note



Valid for:
SPL PLxx

Abstract

The SPL PLxx type pulsed laser diode has a plastic package. The pulsed laser diode is operated by directly applying the forward current pulses to the anode and cathode pins. The cathode pin is the short one. To generate short (up to 100 ns) and high-amp (up to 75 A) current pulses a suited laser diode driver is necessary.



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A. Electrical operation: laser diode drivers

The important criterion concerning the driver electronics is the combination of amplitude, width and repetition frequency (or rep rate) of the current pulses.

In principal two different types of suited laser diode driver are offered:

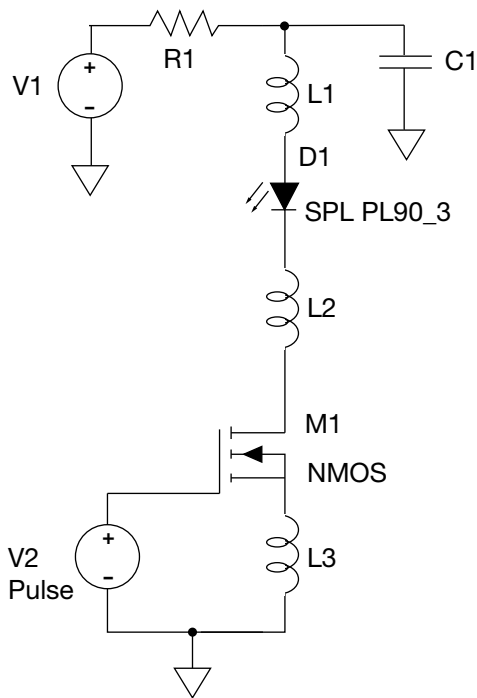
- Cost-effective driver boards for OEM application
- Housed tabletop devices

With these boards very short pulses with high currents and high rep rates can be achieved:

- Pulse widths from 4 ns to 100 ns
- Peak currents up to 120 A
- Repetition rates up to 50 kHz

The pulsed laser driver consists of a capacitor with capacitance C and a switch which discharges the charge of the capacitors to the laser. The charging of the capacitor is performed between two laser pulses. A MOSFET, an avalanche transistor [1] or a GaN FET can be used as a switch. Figure 1 shows a simplified schematic of a pulser circuit using an n-channel MOSFET as a low-side switch.

Figure 1: Schematic pulse laser driver circuit with a capacitor C1 for storing the electrical energy and a MOSFET as a switch]



A simple approximation for the value of the storage capacitance C is:

$$C \times U = I_p \times t_p \quad (1)$$

Increasing the value of C increases both the width of the current pulse t_p and the peak amplitude of the current I_p . By increasing the operating voltage U the amplitude of the current pulse increases (and in practice, at the same time the width of the current pulse decreases slightly, because the on state resistance of the transistor decreases) [2], [3]. Please note that it is very important to minimize the inductance of the circuit. Therefore, low loss RF capacitors (ceramic chip capacitors) have to be used. Current carrying conductors have to keep to the bare minimum. Also the leads of the laser diode have to be cut as short as possible.

To separate the laser diode from the circuit board a transmission line has be used to minimize the inductance. Note that each inch of length adds approximately 20 nH of inductance. This means that a di/dt of 20 A/10 ns generates a transient Ldi/dt voltage of 40 V per inch of wire length. The real effect will be a significant increase in rise time. Please note that the operating voltage is in the range of some tens or hundreds volts.

Enhancement Mode GaN (eGAN) FETs are offered e.g. by the company EPC Corp. <https://epc-co.com/epc/>.

B. Suppliers of pulsed laser drivers boards and accessories

There are several suppliers of pulsed laser drivers with different combinations of current pulse amplitude, width and repetition rate.

EO-Devices Inc. [4]

The product line of OEM pulsed laser diode driver boards is called ETX [5]. These driver boards have fixed pulse widths determined by the capacitors. The peak current is adjustable by the operating high voltage. As switch a MOSFET is used. Maximum current pulse amplitudes and pulse widths vary from 35 to 75 A and from 5 to 30 ns, respectively. The 75 A board is equipped with an on-board DC-DC-converter to supply the high voltage directly on the board.

Also available from EO-Devices are DC-converters to convert low DC voltage (12 V) into high DC voltage, adjustable by a trim potentiometer.

EO-Devices also offers optical receivers, laser ranging subsystems and time-of-flight chronometers for OEM applications.

Directed Energy Inc. [6]

The product line of OEM pulsed laser diode driver boards is called PCO-7110 [7] and uses MOSFETs as power switch. These driver boards have fixed pulse widths determined by the capacitors. The peak current is adjustable by the operating high voltage. Maximum current pulse amplitudes and pulse widths vary from 40 to 120 A and from 4 to 65 ns, respectively. Figure 2 shows the detector signal of a SPL PL90_3 driven by the PCO-7110 model 100-7. The optical peak power is 70 W at 250 V operating voltage of driver board (see Figure 3).

Figure 2: PIN photo diode signal of SPL PL90_3 driven by the board PCO-7110 model 100-7 from Directed Energy Inc. Peak power is 70 W, pulse width is 15 ns (FWHM) and rise/ fall times are 6 and 12 ns respectively.

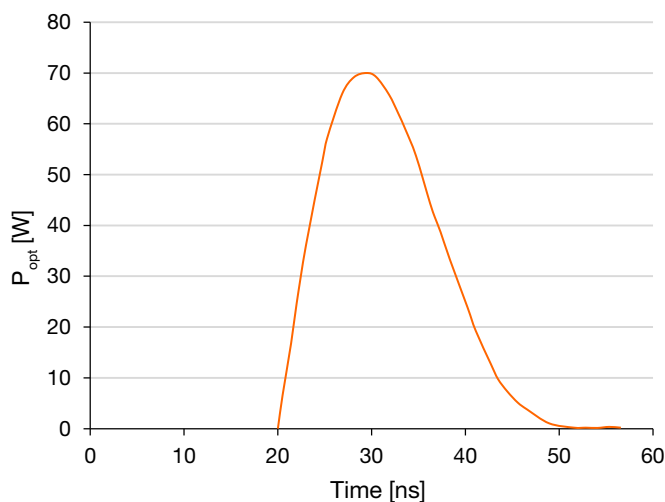
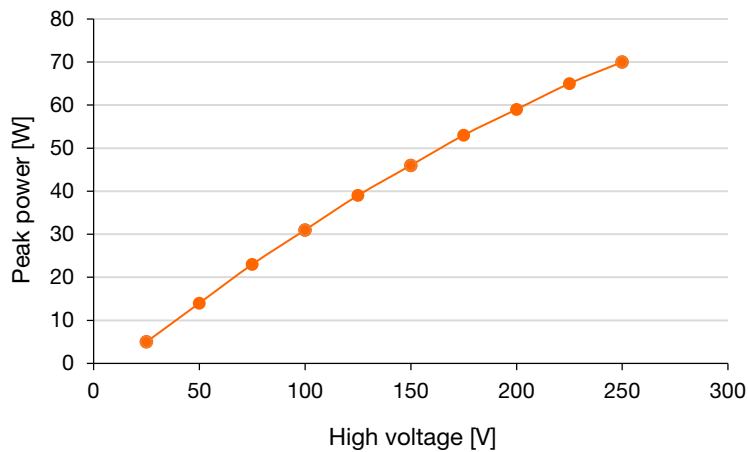


Figure 3: Peak power vs. pulser voltage for SPL PL90_3 with pulser PCO-7110 model 110-7 from Directed Energy Inc.

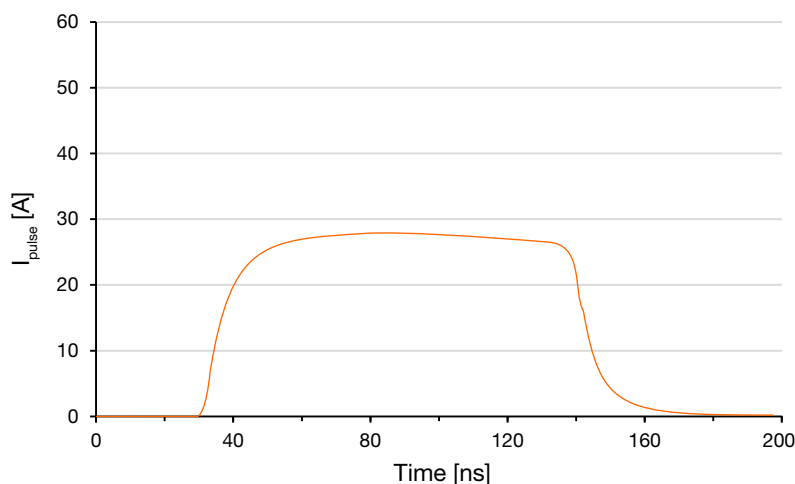


Also available is a driver board called PCO-7120 [8] with variable pulse width from 12 ns to 1 μ s and variable peak current from 5 to 50 A. Maximum rep rate varies with pulse width and amplitude. The absolute maximum is 1 MHz at moderate pulse width and amplitude.

Dr. Heller Elektronik KG [9]

Dr. Heller Elektronik offers an OEM driver board with variable peak current (0 to 50 A), pulse width (25 to 100 ns) and repetition rate (up to 10 kHz). Because the principal of operation is based on charging a delay line the driver delivers roughly rectangular shaped pulses (see Figure 4). This driver board is custom made for OSRAM Opto Semiconductors for testing the laser diodes in the lab and production line.

Figure 4: PIN photo diode signal of SPL PL 90_3 driven by a 30 A high and 100 ns wide current pulse using a pulser from Dr. Heller Elektronik.



Another type of driver board the HS-LD25.0 operates at fixed pulse width of 4 ns and peak currents from 4 to 25 A.

Avtech Electrosystems Ltd. [10]

Avtech Electrosystems Ltd. is a supplier of housed tabletop laser diode drivers with front panel, display, interfaces etc. The parameters like pulse current, width and repetition rate are adjustable by front panel knobs or via IEEE or RS232 interface. There are two types of laser diode driver series operating in pulsed voltage or pulsed constant current mode. The type of choice depends on the operating conditions of the laser diode. Please see the Avtech website to select the suited laser driver out of the large product range. As an example the model AVO-5A-C (20 to 200 ns, max. 5 kHz, max. 40 A) should be mentioned here.

Current Probes [11]

For measuring high-amp current pulses so called current probes can be used. These inductive probes transform the current pulses into voltage pulses which can be displayed on an oscilloscope. A supplier of suited current probes is for example Tektronix [11].

C. References

- [1] Diodes Inc., <https://www.diodes.com/products/discrete/bipolar-transistors/special-function-transistors>
- [2] A. Kilpelä, J. Kostamovaara, A laser pulser for a TOF laser radar, Review of Scientific Instruments Vol 68(6) pp. 2253 – 2258, June 1997.
- [3] A. Kilpelä, Pulsed time-of-flight laser range finder techniques for fast, high precision measurement applications, University of Oulu, Finland, 2004, <http://herkules.oulu.fi/isbn9514272625/isbn9514272625.pdf>
- [4] EO Devices Inc.; <http://www.eodevices.com>
- [5] Application note of EO-Devices ETX pulsed laser driver series: http://www.eodevices.com/pdf/an_1.pdf
- [6] Directed Energy Inc. now IXYS Colorado <https://directedenergy.com/>
- [7] Application note of Directed Energy PCO-7120 pulsed laser driver series: http://ixapps.ixys.com/datasheet/pco-7120_manual.pdf
- [8] Application note of Directed Energy PCO-7110 pulsed laser driver series: http://ixapps.ixys.com/datasheet/pco-7110_manual.pdf
- [9] Dr. Heller Elektronik KG, Germany, <http://www.dr-heller-elektronik.de/>
- [10] Avtech Electrosystems Ltd.; <http://www.avtechpulse.com>
- [11] Current Probes; <http://www.tek.com/current-probe>



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