EKSMA OPTICS

HIGH VOLTAGE DRIVERS

DPB1-250-5.2-Al
DPB1-300-4.6-Al
DPB1-350-4.0-Al
DPB1-1000-3.0-Al

Technical Description
Rev. 2203

2022
Lithuania

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1.1. Warranty Statement

The Pockels cell drivers are protected by a one-year warranty covering labor and parts. The warranty enters into validity since the shipment date. Any evidence of improper use or unauthorized repair attempts voids the warranty.

1.2. Service Contact Information

For service/warranty requests, please contact:

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2.1. General Information

2.1.1. Models

Table 1. Models

Model	*Description*
DPB1-250-5.2-AI	250kHz repetition rate, 5.2kV output
DPB1-300-4.6-AI	300kHz repetition rate, 4.6kV output
DPB1-350-4.0-AI	350kHz repetition rate, 4.0kV output
DPB1-1000-3.0-AI	1000kHz repetition rate, 3.0kV output

2.1.2. Main Components

Table 2. Main components

Component	*Quantity*	*Notes*
High voltage (HV) driver **DPB1-*-*-***	1	-
DC power cable (l=1.5m)	1	-
BNC-SMB cables (l=1.5m)	2	-
HV power supply cable (l=1m)	1	-
Pair of cables for HV output to the Pockels cell (<10 cm)	2	-
Technical description	1	-

2.2. Technical Specifications

Table 3. Technical specifications

Parameter	***Value(s)***			
	DPB1-250-5.2-AI	***DPB1-300-4.6-AI***	***DPB1-350-4.0-AI***	***DPB1-1000-3.0-AI***
Maximum working (HV supply) voltage, *kV*	±2.6	±2.3	±2.0	±1.5
Maximum output voltage (HV), *kV*	5.2	4.6	4.0	3.0
Maximum HV consumption (6 pF load), *W*	<100	<100	<100	<120
Output polarity	Bipolar			
Maximum capacity load at maximum repetition rate and HV supply, *pF*[1]	10			
HV pulse rise/fall time, *ns* (6pF load)	<8.5/8.5	<8/8	<7.5/7.5	<7.5/7.5
HV pulse duration, *ns*	100…5000			
Maximum HV repetition rate, *kHz*	250	300	350	1000
HV pulse delay, typical, *ns*	30			
External triggering inputs	1 or 2			
External triggering pulse amplitude @50Ω load, *V*	3.5…5			
External triggering pulse rise time, *ns*	<10			
External triggering pulse duration 2-input control mode, *ns*	>20			
External triggering pulse delay between IN1 and IN2 for 2 input control mode or IN1 pulse duration in 1- input control mode, *ns*	100…5000			
Low voltage DC requirements	+24V ±1V			
	120mA	140mA	150mA	300mA
DC Connector	Molex Micro-Fit 3.0			
Maximal operating temperature of base plate, *°C*	35			
Water connector	“Festo” for OD=6mm tube			
Dimensions, *mm*	158 x 49 x 81			
Weight, *g*	1180			

[1] Voltage or repetition rate derating is necessary if capacitance of your Pockels cell is higher. Contact Eksma Optics for details.

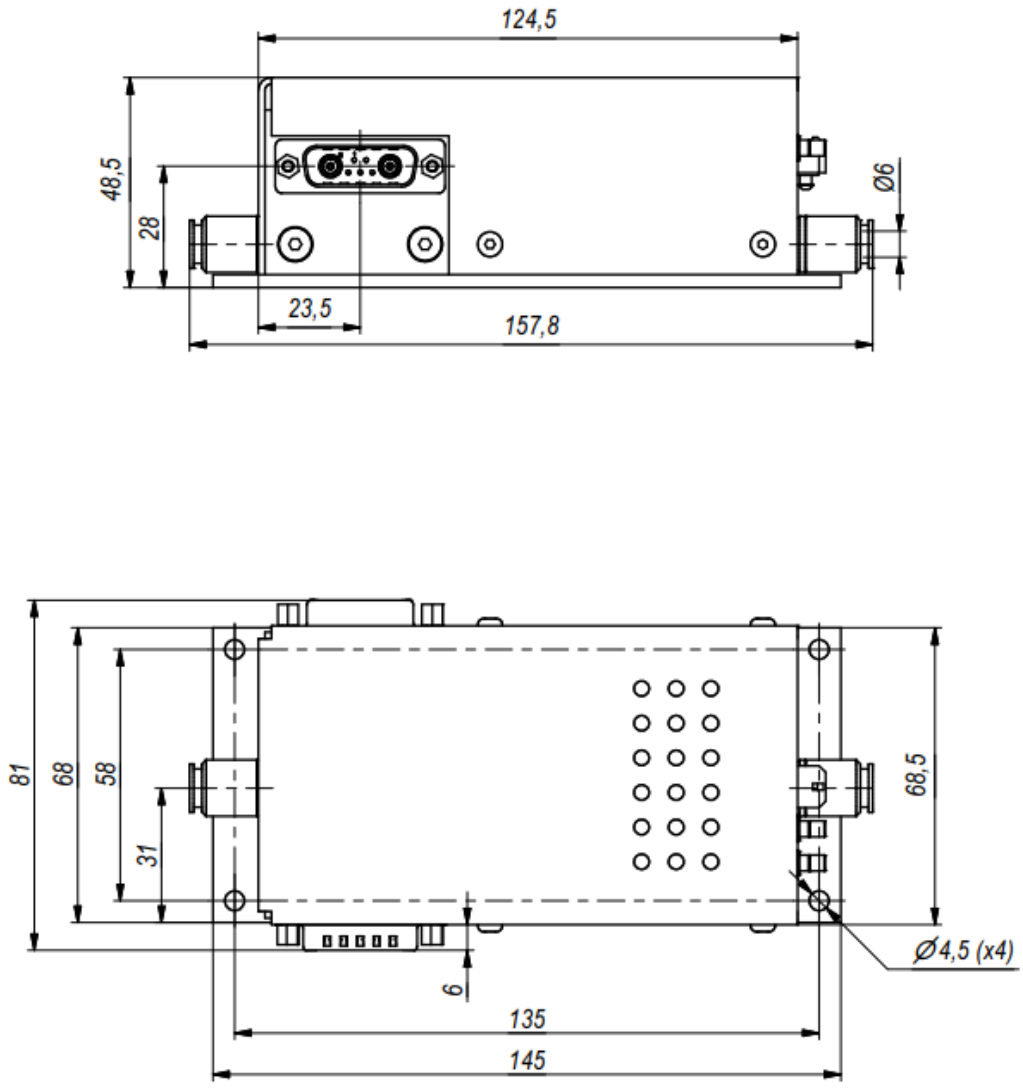


Figure 1. Outline drawing and dimensions of the driver

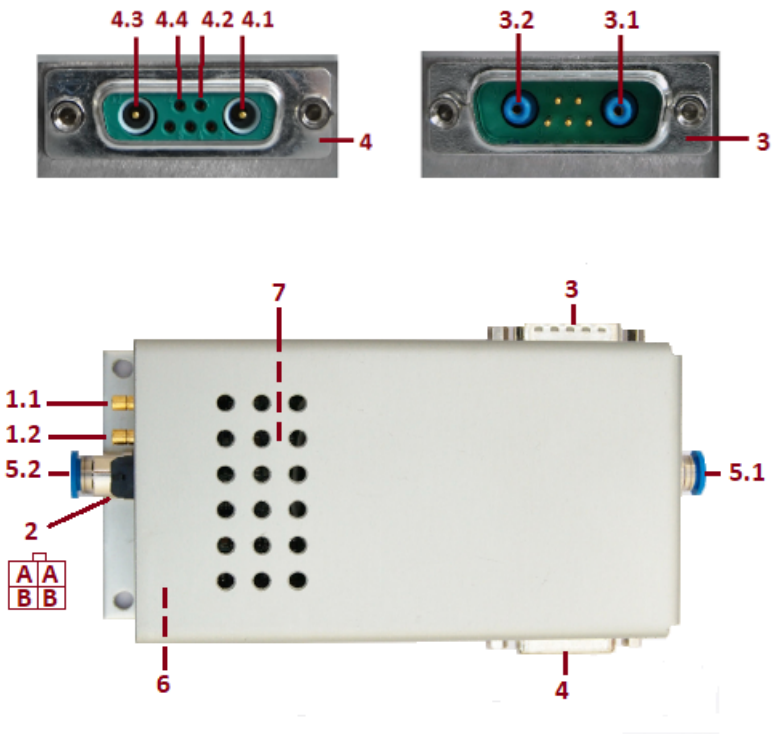


Figure 2. View of the driver

Table 4. Ports seen on top view of the driver

#	*Port*
1.1	**X1**(SYNC IN1) for HV opening, or SYNC IN in 1-input control mode
1.2	**X2** (SYNC IN2) for HV closing
2	Connector Molex 4 (Microfit series) - interface for +DC (24 VDC) supply ("**A**" is +DC; "**B**" is GND)
3	HV pulse output connector
3.1	HV pulse output pin **+OUT**
3.2	HV pulse output pin **-OUT**
4	HV input connector
4.1	+HV input pin from HV supply
4.2	GND input from HV supply
4.3	-HV input pin from HV supply
5.1	Cooling water input connector
5.2	Cooling water output connector
6	Cooper base plate
7	Jumper for toggle of SYNC IN mode between one-and-two pulses control

Chapter 4 SAFETY

Equipment is designed to be safe under normal environmental conditions according to 1.4.1. 61010-1@IEC:2010 (Safety requirements for electrical equipment, control and laboratory use):

1. indoor use;
2. altitude up to 2000 m;
3. temperature 5˚C to 35˚C;
4. maximum relative humidity 80% for temperatures up to 31˚C decreasing linearly to 50% relative humidity at 35˚C;
5. POLLUTION degree 1: no POLLUTION or only dry, non-conductive POLLUTTION occurs.

Warning:
The safety of the system incorporating driver and HV power supply is the responsibility of the assembler of the system.

Operating the driver is allowed to persons acquainted with the operation manual and having permission to deal with voltages over 1000 V.

Do not remove unit covers while power cable is connected to the mains (if applicable).

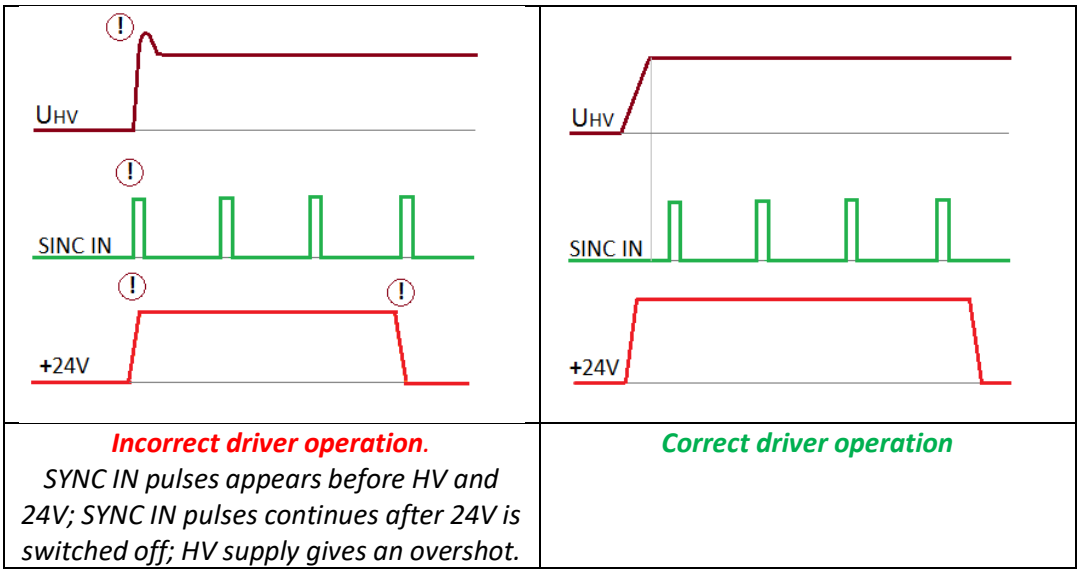
Do not touch any parts of the system when high voltage is applied, as it may cause injury or death.

Do not operate the unit until it is **grounded** and the load is connected.

Do not use the unit if any defects have been detected.

Please read these important notes before using the product!

1. External triggering pulses to inputs **X1** (SYNC IN1) and **X2** (SYNC IN2) may be applied only if high voltage and DC power are provided and turned on. When turning off the driver, first turn off synchronization pulses, then turn off the power. Otherwise the driver can be damaged.



Incorrect driver operation. *SYNC IN pulses appears before HV and 24V; SYNC IN pulses continues after 24V is switched off; HV supply gives an overshot.*	***Correct driver operation***

Figure 3. Driver operation chart

2. The output pulse is provided between **+OUT** and **-OUT,** meanwhile both the outputs are hot. The voltage on the Pockels cell is equal to the sum of positive and negative voltages of the HV driver (i.e. amplitude between positive and negative DPD output signals). Do not connect an oscilloscope or any other device to the OUT pins. The wire contact with the Pockels cell must be proper in order to avoid a discharge, which may damage the driver. Do not power the driver without a capacitive load (4…10 pF) as this may damage the driver.

3. The pulse shape (including fronts) can be measured indirectly. On your oscilloscope, select 1 V sensitivity and the 1 MΩ input. Use isolated 1:10 oscilloscope probe for measurement. Move the probe *slowly* and *carefully* toward the hot output wire. When the probe is ~10 mm away from the hot output wire, the pulse shape should appear in the oscilloscope (amplitude should be several volts). Do not place the probe too close to the hot output wire – a discharge may start and damage the driver. This measurement method is not suitable for measuring >500 ns pulses.

4. Do not attempt to measure the parameters of any part of the driver's electronics using an oscilloscope, especially when the driver is running in pulsed mode. Attempts to measure parameters of certain parts of the driver's circuitry may lead to damage.

6.1. Set jumper #7 to required operation mode

This step describes the commutation jumper marked "**#7**"in **Figure 2**/**Table 4**.

The DPB driver may be controlled by one or two SYNC IN signals (see **Figure 4**), depending on the jumper position:

- Jumper position **1**: 1-input control mode
  SYNC IN1 rising edge turns HV to Pockels cell on, falling edge turns the voltage off.
- Jumper position **2**: 2-input control mode
  SYNC IN1 rising edge turns voltage on, SYNC IN2 rising edge turns the voltage off.

Either of the two jumper positions must be selected when operating the driver. Do not leave the driver with no position set on the jumper.

Cables from generator must be of equal length for control by two synchronization pulses.

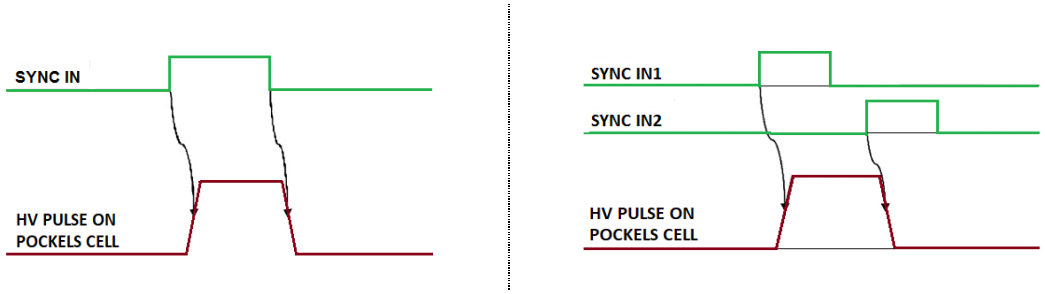


Figure 4. Control timing for 1-input (left) and 2-input (right) controlled driver

There are several requirements for the wires leading from outputs **+OUT** and **-OUT** to the Pockels cell.

The wires must be about 0.24 mm^2 CSA. Both wires must be as short as possible and equal length. The length of each wire must be not exceeding 100 mm. Each of wires must be at least 5 mm away from any conductive materials (including the operator's fingers and instruments) – this is done to avoid any additional capacitive load. Otherwise, driver characteristics may degrade and/or the driver may get damaged.

6.2. Connect wires to the Pockels cell

The wires leading from outputs **OUT1** and **OUT2** to the Pockels cell must be about 0.24 mm^2 CSA. Both the wires must be as short as possible and equal length. The length of each wire must be not exceeding 100 mm. They should be located at least 5 mm away from any conductive material (including the operator's fingers and instruments) – this is done to avoid any additional capacitive load. Otherwise, driver characteristics may degrade and/or the driver may get damaged.

6.3. Ground the Pockels cell driver together with the generator and HV supply

The driver output of several kilovolts (kV) with very fast edges is a powerful source of electromagnetic interference (EMI). Please ensure proper wiring and grounding to avoid problems caused by interference.

The best solution to minimize EMI is mounting the driver and the HV power supply on the metal body of the laser. Use mounting holes of the driver and HV supply to ground them together with laser body. Ensure that these connections are firmly tighten and has god electrical connection. This is enough in most of cases.

If the EMI level is still very high, attempt mounting ferrites on all power and control wires leading to the driver and power supply (except wires to the Pockels cell).

Please note that the aluminum case of the driver is not designed to provide effective EMI shielding. Essentially, correct wiring gives the best result.

6.4. Supply voltage to the driver from the DC power supply

For a safe start of the driver, the DC power supply must provide at least 0.6 A peak current when turning on. Although most of DC power supplies are capable of providing this, it is recommended to double-check your supply as an insufficient peak current may damage the driver.

6.5. Supply voltage from the HV supply

Connect the HV power supply and set required voltage.

If the HV power supply is manufactured by a third party, before supplying voltage, ensure there is no overvoltage while turning it on.

6.6. Provide synchronization pulses from the generator

It is necessary to measure the generator output voltage with a 50Ω load before applying synchronization signals to the driver. The amplitude must be in range 3.5…5 V, rise/fall time ≤ 10 ns. Make sure that the duration of SYNC IN1 pulse is longer than 100 ns in single-pulse driving, or delay between SYNC IN1 and SYNC IN2 is greater than 100 ns in two-pulse driving. A shorter duration or delay of the synchronization pulses may damage the driver.

After the generator output voltage is measured, remove the 50Ω load and provide synchronization pulses to the driver.

Figure 5 presents the trigger input circuit.

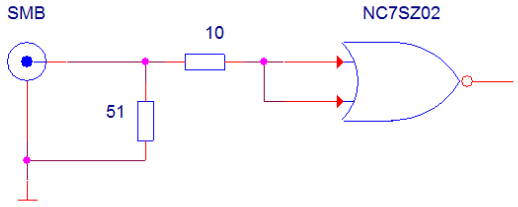
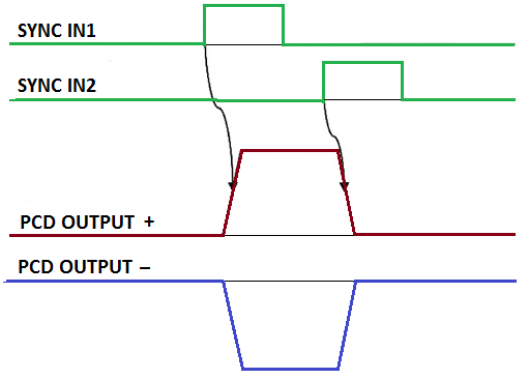


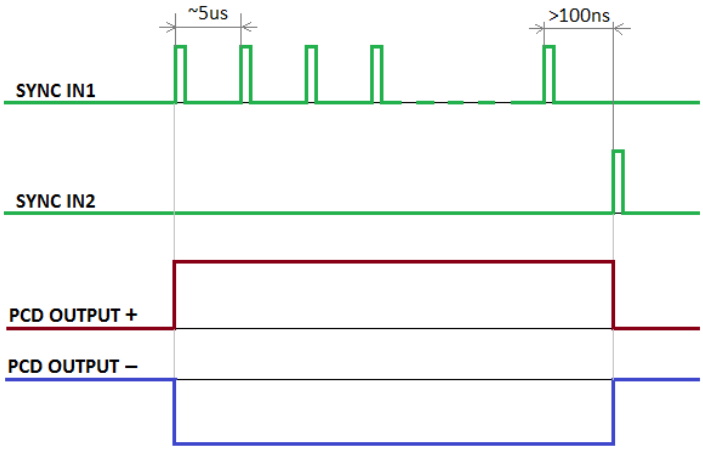
Figure 5. Input circuit of driver

6.7. Pulse regeneration

HV pulse duration of the driver is limited 5000 ns for normal operation. The limitation is based on pulse flat top decay with time constant 33 MOhm resistance multiplied by capacitance of Pockels cell. Pulse duration can be extended as long as needed using pulse regeneration, principle is explained in **Figure 6.** It is applicable operating two-pulses triggering mode only.



Normal timing chart



Timing chart with a regeneration

Figure 6. Control timing charts