EKSMA OPTICS

HIGH VOLTAGE DRIVERS

2DPB2-300-3.4

2DPB2-500-3.4-AI

2DPB2-1000-2.5-AI

2DPB2-2000-1.8-AI

2DPB2-2000-1.5-AI

Technical Description
Rev.2311

2023

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*
2DPB2-300-3.4	300kHz repetition rate, 3.4kV output, conductive cooling, open PCB design
2DPB2-500-3.4-Al	500kHz repetition rate, 3.4kV output, conductive or water cooling, encased
2DPB2-1000-2.5-Al	1000kHz repetition rate, 2.5kV output, conductive or water cooling, encased
2DPB2-2000-1.8-Al	2000kHz repetition rate, 1.8kV output, conductive or water cooling, encased
2DPB2-2000-1.5-Al	2000kHz repetition rate, 1.5kV output, conductive or water cooling, encased

2.1.2. Main Components

Table 2. Main components

Component	*Quantity*	*Notes*
High voltage (HV) driver **2DPB2-*-*-***	1	-
DC power cable (l=1.5m)	1	-
BNC-SMB cable (l=1.5m)	2	-
HV power supply cable (l=1m)	1	Soldered to driver
Pin connector for HV wires to Pockels cell	2	-
Technical description	1	-

2.2. Technical Specifications

Table 3. Technical specifications

Parameter	***Value(s)***				
	2DPB2-300-3.4	***2DPB2-500-3.4-AI***	***2DPB2-1000-2.5-***	***2DPB2-2000-1.8-***	***2DPB2-2000-1.5-AI***
Maximum working (HV supply) voltage, *kV*	3.6		2.6	2.0	1.75
Maximum output voltage (HV), *kV*	3.4		2.5	1.8	1.5
Maximum HV consumption (DPB load = 6 pF), *W*	<110	<200	<170	<210	<215
Output polarity	Positive				
Maximum capacity load at maximum repetition rate and HV supply, *pF*[1]	6				
HV pulse rise/fall time, *ns* (HV load=6pF)	<7	<7	<7	<7	<6
Output HV pulse duration with frequency doubling at maximal repetition rate, *ns*	0…1566	0…900	0…400	0…150	
Output HV pulse duration without frequency doubling at maximal repetition rate, *ns*	0…3233	0…1900	0…900	0…400	
External triggering pulse duration at maximal repetition	100…5000	100…3900	100…1900	100…900	
Maximum repetition rate using frequency doubling, *kHz*	300	500	1000	2000	
Maximum repetition rate appearing on each of HV outputs, *kHz*	150	250	500	1000	
Maximal triggering frequency, k*Hz*	150	250	500	1000	
HV pulse delay, *ns*	~30				
External triggering inputs	2				
External triggering pulse amplitude @50Ω load, *V*	3.5…5				
External triggering pulse rise/fall time, *ns*	<10				
Low voltage DC requirements	+24V ±1V				
	200mA	250mA	350mA	450mA	
DC Connectors	Molex Micro-Fit 3.0				
Maximal operating temperature of base plate, *°C*	35				
Water connector	N/A	“Festo” for OD=6mm tube			
Dimensions, *mm*	148x74x 33	148(172) x 74(77) x 51			
Weight, *g*	490	1600			

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

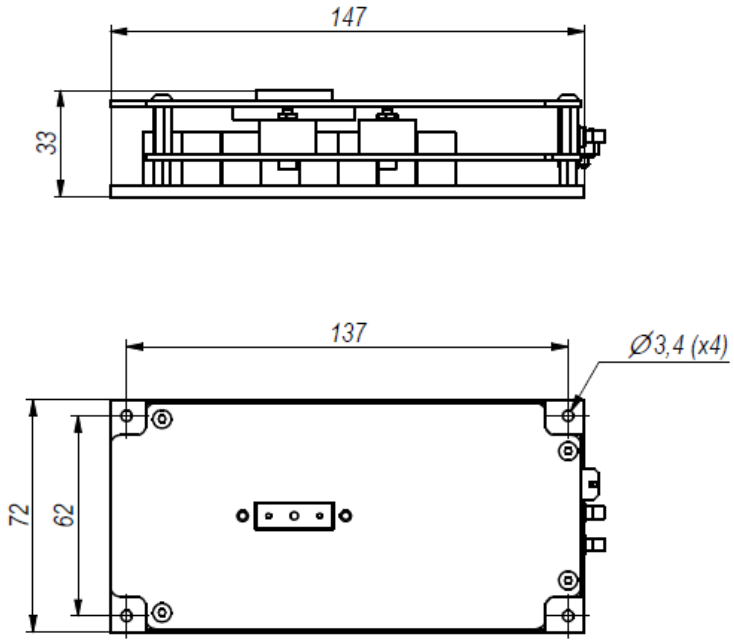


Figure 1. Outline drawing and dimensions of the driver **2DPB2-300-3.4**

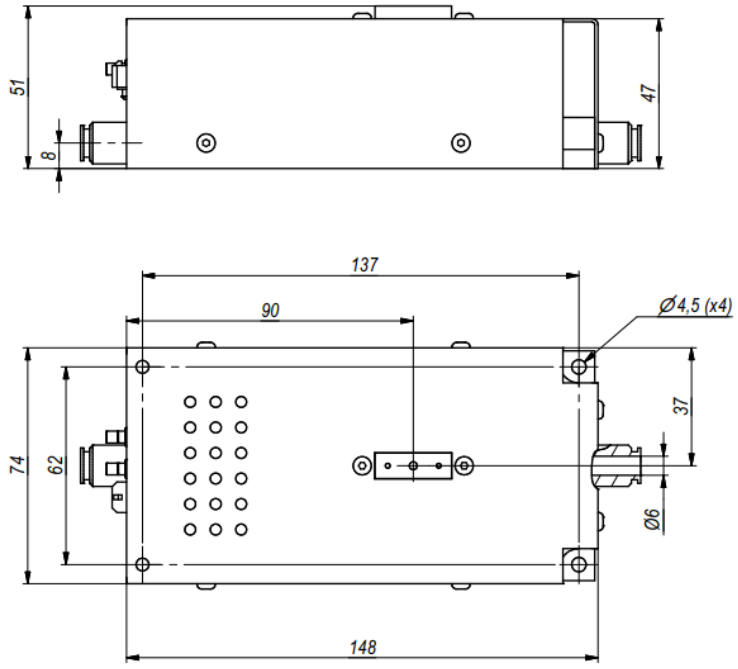


Figure 2. Outline drawing and dimensions of the drivers **-AI**

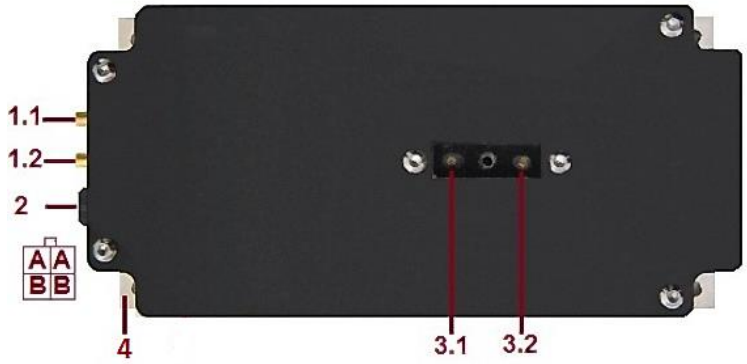


Figure 3. Top view of the driver **2DPB2-300-3.4**

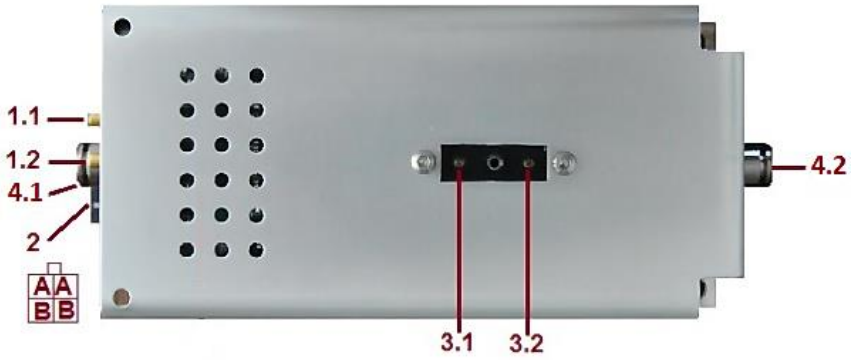


Figure 4. Top view of the drivers **-AI**

Table 4. Ports seen in top view of the driver

#	***Port***
1.1	**X1** (SYNC IN1), SMB type connector
1.2	**X2** (SYNC IN2), SMB type connector
2	Connector Molex 4 (Microfit series) - interface for +DC (24 VDC) supply ("**A**" is +DC; "**B**" is GND)
3.1	HV pulse output pin **+OUT1**
3.2	HV pulse output pin **+OUT2**
4	Conductive cooled pad
4.1	Cooling water input connector
4.2	Cooling water output connector

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).

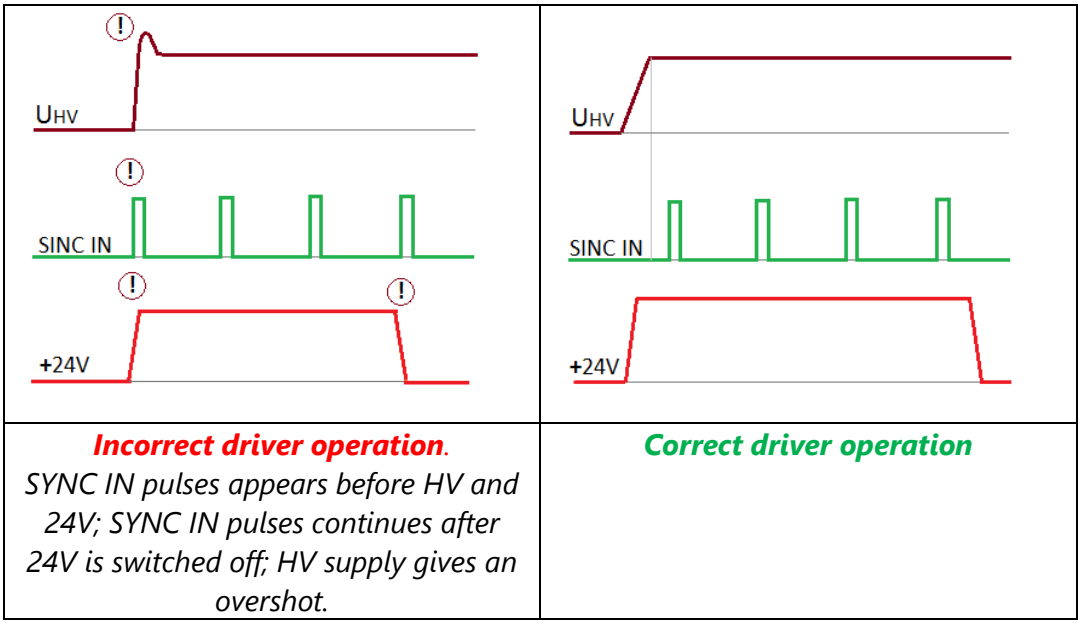
Do not touch any parts of the system when high voltage is applied, as it may cause injury or death.

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 may 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 5. Driver operation chart

2. The output pulse is provided between **OUT1** and **OUT2** pins. Voltage on the Pockels cell is equal to difference of voltages between these two outputs. Do not connect an oscilloscope or any other device to the OUT pins. The wire connection with the Pockels cell must be proper in order to avoid a discharge, which may damage the driver. Do not connect 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. Note that you can see voltage this way shape of each individual output OUT1 or OUT2, but not working voltage of the Pockels cell.

4. Do not attempt to measure the parameters of any parts 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. Connect wires to the Pockels cell

Use the included pin connectors on the driver's side to solder to the wires. The wires leading from the **OUT1** and **OUT2** outputs to the Pockels cell should have a cross-section of approximately 0.24 mm2. Both wires should be as short as possible and the same length. The length of each wire should not exceed 100 mm. They should be located at least 5mm away from any conductive material (including the operator's fingers and tools) to avoid additional capacitive loading. Otherwise, the driver's performance may deteriorate and/or the driver may be damaged.

6.2. 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 to mount the driver and the HV power supply on the metal body of the laser. The driver base plate must have very good electrical contact with the ground wire of the HV power supply, such as the four mounting holes on the edges of the board. 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 provides best results.

6.3. 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 capability when turning on. Although most 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.

6.4. Supply voltage from the HV supply

Set output voltage from HV supply.

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

6.5. 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. Make sure that the duration of SYNC IN pulses is longer than 100 ns.

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

Figure 6 presents the trigger input circuit.

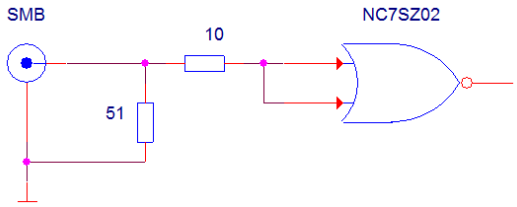


Figure 6 . Input circuit of driver

6.6. Operation

1. Operation with frequency doubling. Output pulses to Pockels cell appear double frequency as any of trigger input. **Figure 7** presents the principle. SYNC1 and SYNC2 are triggering inputs. Corresponding outputs OUT1 and OUT2 of the driver repeats the time scale of SYNC inputs and presents amplitude in kV. Resulting HV pulse on Pockels cell appears as difference of these two outputs. Pulse duration to Pockels cell is tuned by shifting SYNC input's edges toward directions marked by arrows t simultaneously. The width of pulse SYNC1 must to be about 0.5 period or longer. The pulse duration can be tuned down to 0 unlike as in regular Pockels cell drivers.

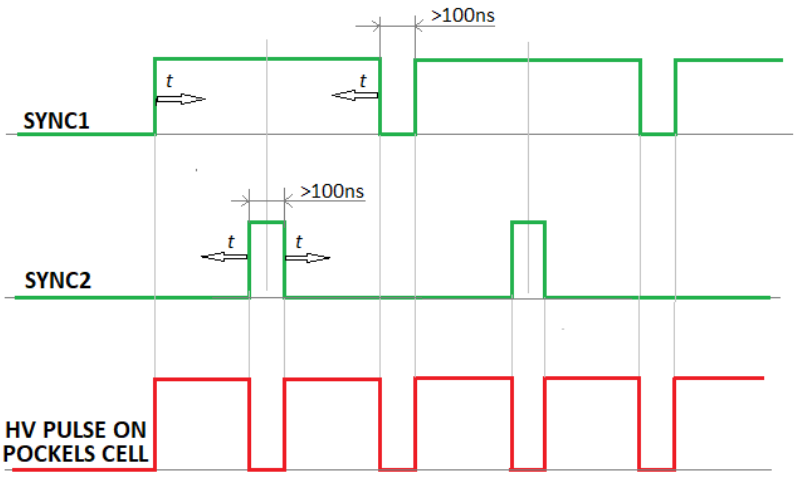


Figure 7. Control **2DPB2** drivers with frequency doubling

2. Operation with frequency doubling and alternating voltage polarity on Pockels cell. SYNC2 pulses train is like SYNC2 but delayed in time. Output pulse duration is equal to time shift in between these two SYNC pulse trains. The pulse duration can be tuned down to 0 unlike as in regular Pockels cell drivers. Note that voltage amplitude on Pockels cell can be lower than HV supply by 20%...30% depending on Pockels cell capacitance.

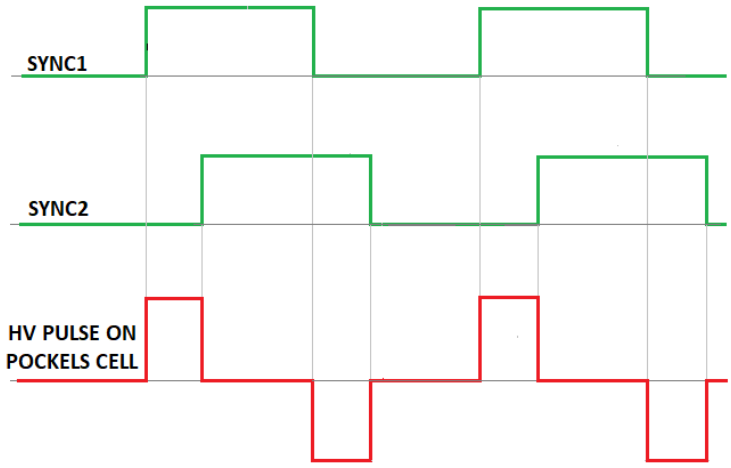


Figure 8. Control **2DPB2** drivers with frequency doubling and polarity alternating

3. Operation with no frequency doubling and pulse duration tuning possibility from maximal down to zero. Pulse duration to Pockels cell is tuned by shifting SYNC input's edges toward directions marked by arrows.

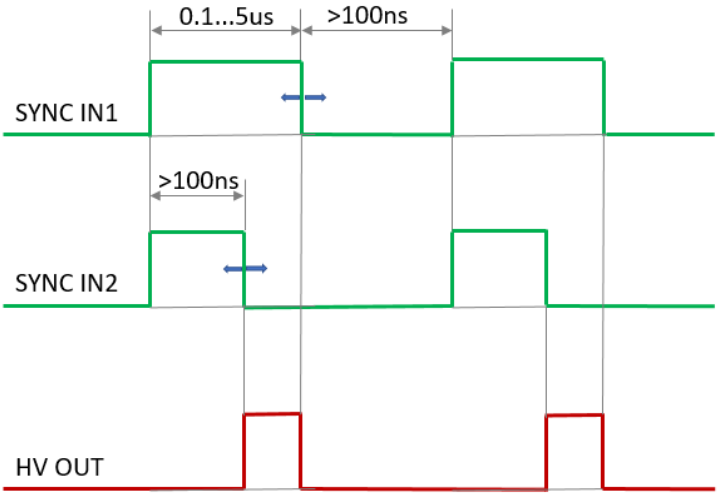


Figure 9. Control **2DPB2** drivers by tuning output pulse duration