EKSMA OPTICS

HIGH VOLTAGE DRIVERS

DPB-10-4.2

DPB-10-4.2-Al

DPB-5-5.5

DPB-5-5.5-Al

Technical Description
Rev. 2201

2022
Lithuania

CONTENTS

LIST OF FIGURES

LIST OF TABLES

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*
DPB-10-4.2	10kHz repetition rate, 4.2kV output, open PCB
DPB-10-4.2-AI	10kHz repetition rate, 4.2kV output, with case and HV supply
DPB-5-5.5	5kHz repetition rate, 5.5kV output, open PCB
DPB-5-5.5-AI	5kHz repetition rate, 5.5kV output, with case and HV supply

2.1.2. Main Components

Table 2. Main components

Component	*Quantity*	*Notes*
High voltage (HV) driver **DPB-*-*-***	1	-
DC power cable (l=1.5m)	1	-
BNC-SMB cables (l=1.5m)	2	-
HV power supply cable (l=1m)	1	Not supplied if **DPB-*-*-*** driver and HV power supply are ordered and screwed together.
Pair of cables for HV output to the Pockels cell (<10 cm)	1	-
Technical description	1	-

2.2. Technical Specifications

Table 3. Technical specifications

Parameter	***Value(s)***	
	DPB-10-4.2(-AI)	***DPB-5-5.5(-AI)***
Maximum output pulse amplitude (HV), *kV*	4.2 at 2.2 kV HV supply	5.5 at 2.8 kV HV supply
Minimum output pulse amplitude (HV), *kV*[1]	±1.4	
Maximum HV consumption (DPB load = 6 pF), *W*	5	
Polarity output	Bipolar	
External triggering input	1 or 2 pulses	
Maximum capacity load at maximal repetition rate and HV supply voltage, *pF*[2]	12 6 for **– AI** models	
HV pulse rise/fall time, *ns* (HV load=6pF)	<6/6	<7/7
HV pulse duration, *ns*	30…3000	
Maximum HV repetition rate, *kHz*	10	5
HV pulse delay, *ns*	~30	
External triggering pulse amplitude @50Ω load, *V*	2…6	
External triggering pulse rise time, *ns*	<10	
External triggering pulse duration for 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*	30…3000	
Low voltage DC requirements	15…25 V, 150 mA or 12 V, 200 mA	
DC Connectors	Molex Micro-Fit 3.0	
Dimensions, *mm*	See figure(s) in CHAPTER 3 DEVICE LAYOUT 140×60×29 (without HV supply) 151×71×52 (with HV supply) 192×81×75 (**-AI**)	
Weight, *g*	70 (without HV supply) 200 (with HV supply) 480 (**-AI**)	

[1] Minimal voltage limit can be switched off, see CHAPTER 5 Specifications .

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

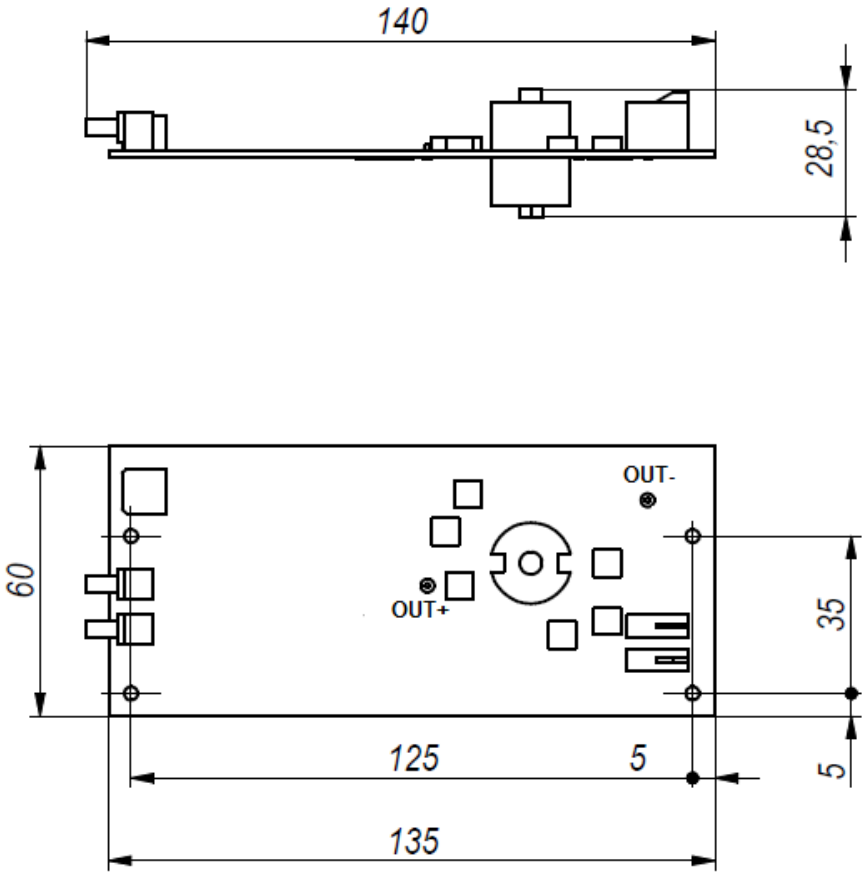


Figure 1. Outline drawing and dimensions of the driver without HV supply

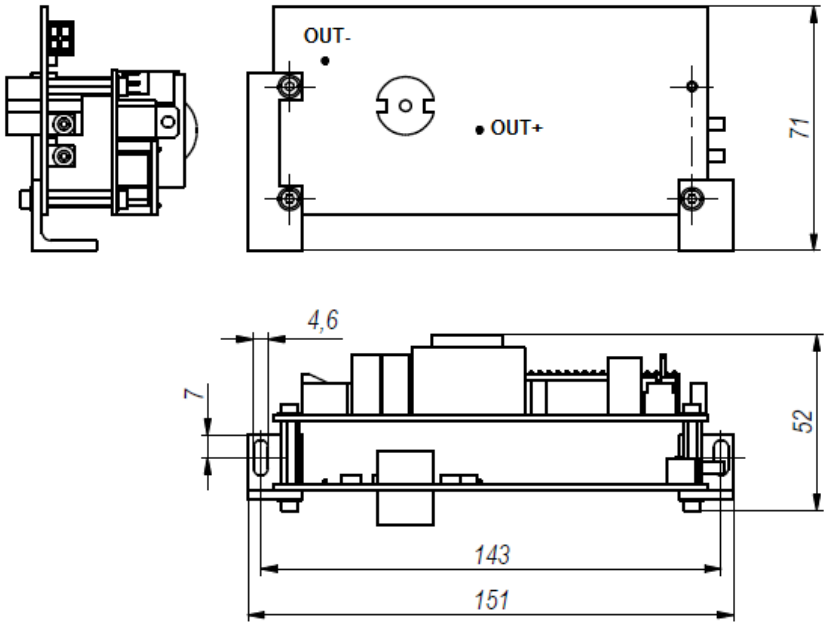


Figure 2. Outline drawing and dimensions of the driver with HV supply without case

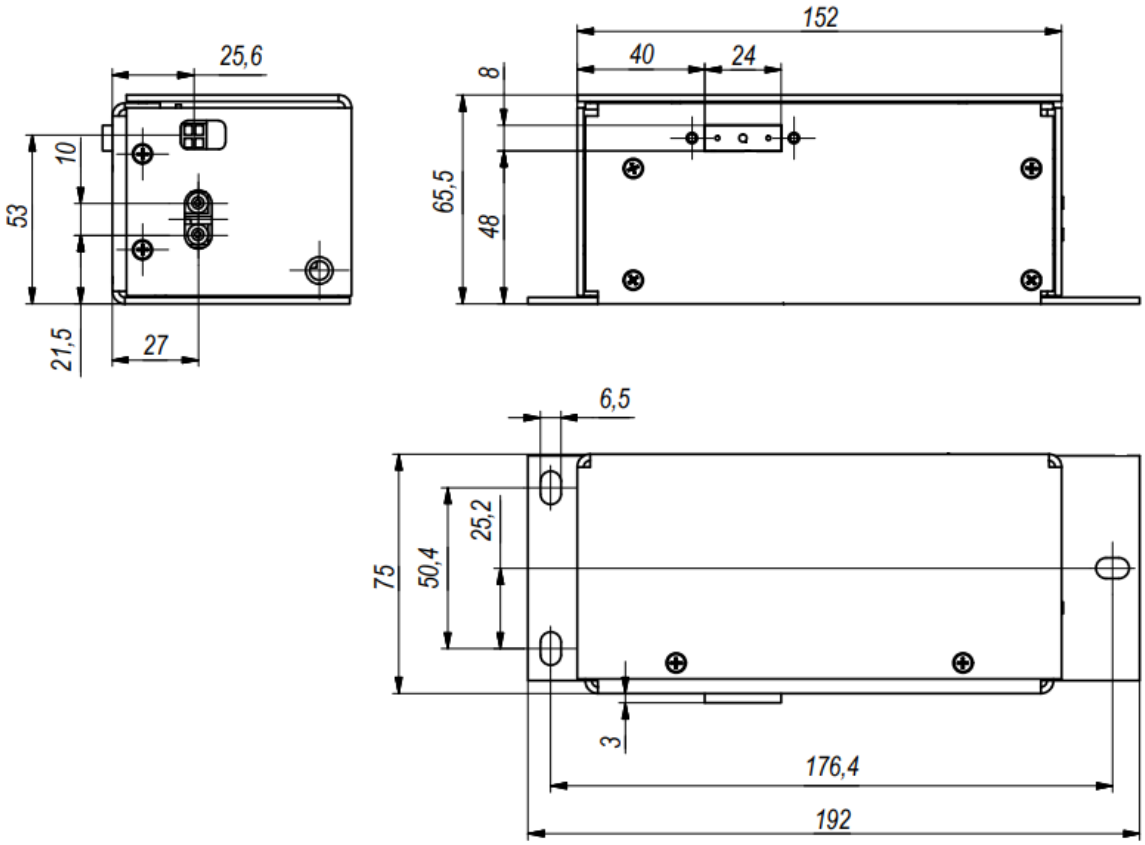


Figure 3. Outline drawing and dimensions of the driver with case and HV supply (**-AI**)

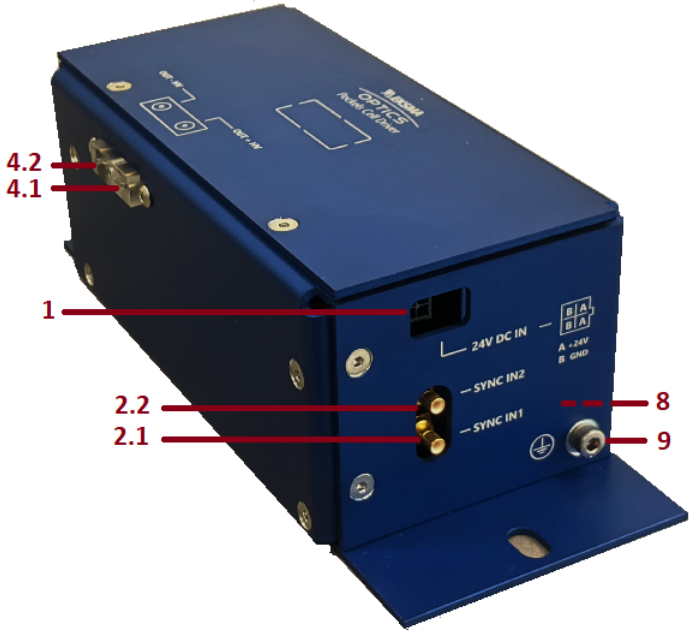


Figure 4. View of the encased driver with HV supply (**-AI**)

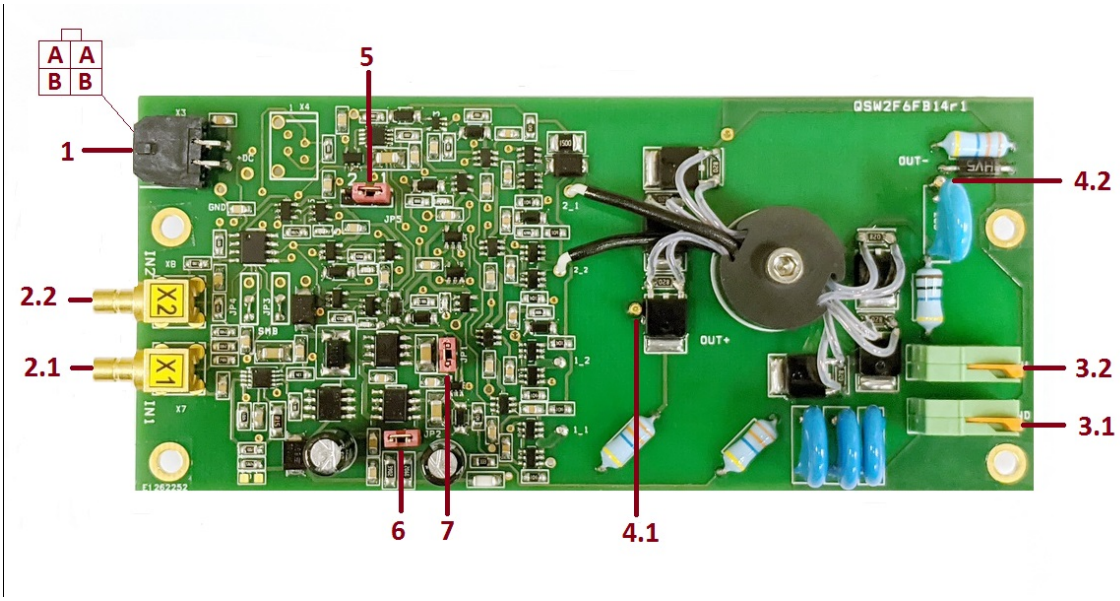


Figure 5. View of the driver without case

Table 4. Ports seen in top view of the driver

#	*Port*
1	Connector Molex 4 (Microfit series) - interface for +DC (24 VDC) supply ("**A**" is +DC; "**B**" is GND)
2.1	**X1**(SYNC IN1) for HV opening, or SYNC IN in 1-input control mode
2.2	**X2** (SYNC IN2) for HV closing
3.1	Connector for GND input from HV supply
3.2	Connector for +HV input from HV supply
4.1	HV pulse output pin **+OUT**
4.2	HV pulse output pin **-OUT**
5	Jumper to toggle SYNC IN mode between one-and-two pulses control
6	Jumper for commutation of DC voltage mode (with jumper- +12V; without jumper- +15…25V)
7	Protection jumper
8	HV power supply tuning port (only for **–AI** drivers)
9	Grounding screw (only for **–AI** drivers)

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 5ºC to 35˚C;
4. maximum relative humidity 80% for temperatures up to 31ºC decreasing linearly to 50% relative humidity at 35ºC;
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.

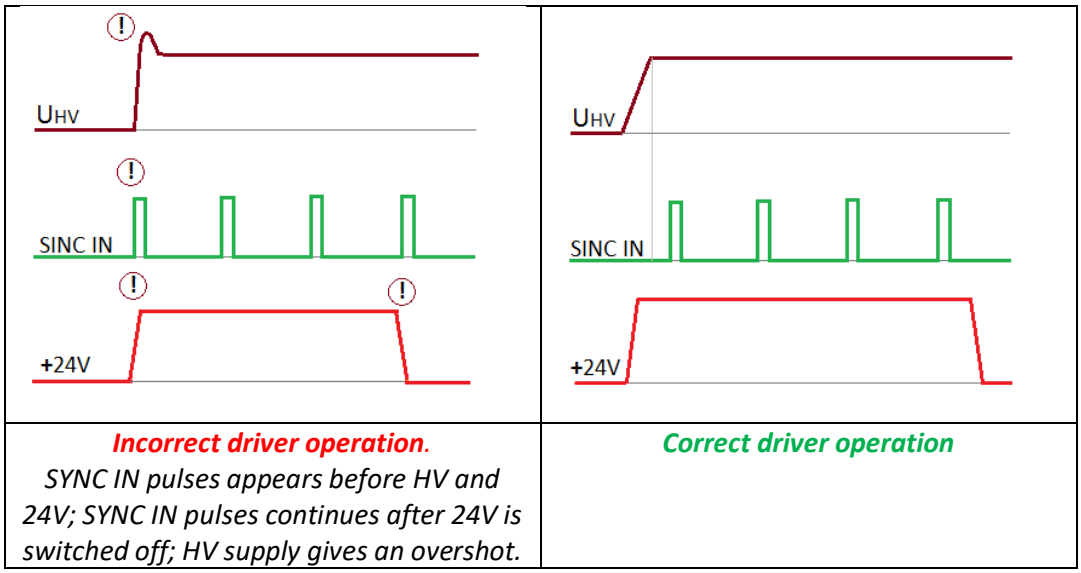
Do not use the unit if any defects have been detected.

Please read these important notes before using the product!

1. Different voltages may be supplied to the driver depending on the jumper **#6** in **Figure 5**:

- Without jumper: +15…25V
- With jumper: +12V±0.5V

2. 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 6. Driver operation chart

The DPB driver has protection against damage due above wrong SYNC IN timing. However, this protection blocks output if HV supply is set below $0.5U_{max}$. If you still need to operate below this limit, the protection can be switched off by shortening pins of jumper **#7 Figure 5**). This case HV supply voltage and following amplitude of output pulses can be reduced down to 0 V. You should be absolutely sure that correct operation conditions as per **Figure 6** are fulfilled.

3. The output pulse is provided between **OUT+** and **OUT-** connectors. Do not connect an oscilloscope or any other device to the OUT connector. The wire contact 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.

4. 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.

5. 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. Set jumper #5 to required operation mode

This step describes the commutation jumper marked "**#5**"in **Figure 5** / **Table 4**

The DPB series driver may be controlled by one or two SYNC IN signals (see **Figure 7**), 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.

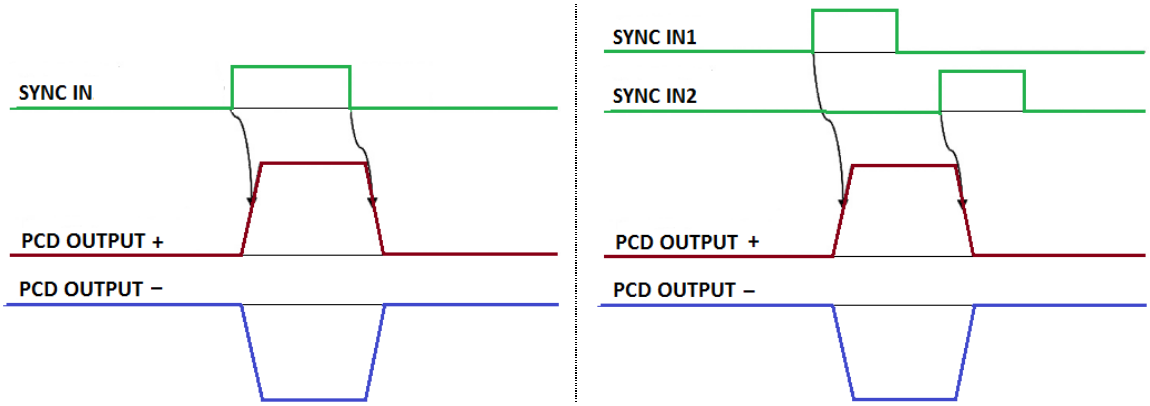


Figure 7. Control timing for 1-input (left) and 2-input (right) controlled driver

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 to mount the driver and the HV power supply on the metal body of the laser. The driver base plate must have very good contact with the ground wire of the HV power supply, such as the four mounting holes on the edges of the board. This is enough in

most cases, provided the driver is firmly attached to the metal laser body and the HV power supply is attached to the same body via all available mounting holes.

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.

6.4. 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 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

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.

If driver is fixed together with HV power supply, connect CAN cable to HV tuning port **#8** in **Figure 4** or set HV voltage by potentiometer.

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 DPB driver. The signal voltage must be at 2…6 V level. Make sure that the duration of SYNC IN1 pulse is longer than 30 ns in single-pulse driving, or delay between SYNC IN1 and SYNC IN2 is greater than 30 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.

Note that the output pulse duration and delay depend of the control pulse signal level and HV pulse rise/fall time (edges of HV pulse); the duration may vary in the order of several nanoseconds (in positive and negative directions). It is not recommended to use control signals with edges longer than 10 ns. **Figure 8** presents the input circuit. Below 30 ns, driver output voltage starts decreasing. Output pulses shorter than 30 ns can damage the driver.

> *Note:*
> *After +DC voltage is applied, the first synchronization pulse is skipped.*

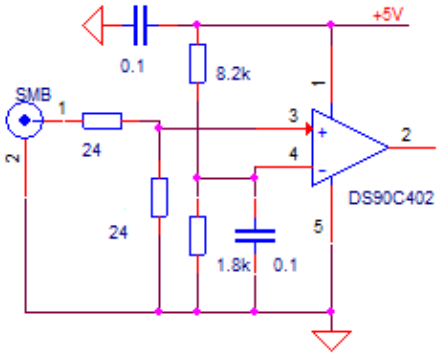


Figure 8. Input circuit of driver