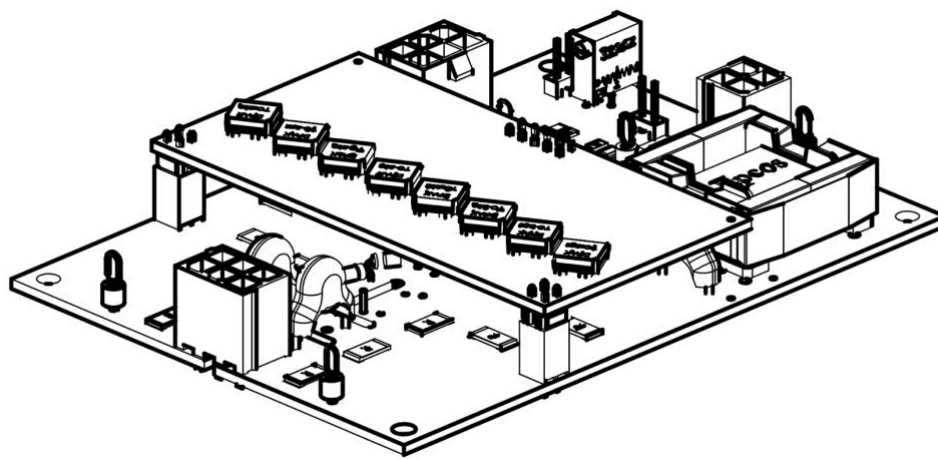


QBD series Pockels cell driver

User manual



Warning! This equipment produces high voltages that can be very dangerous.
Please read user manual before starting operations.

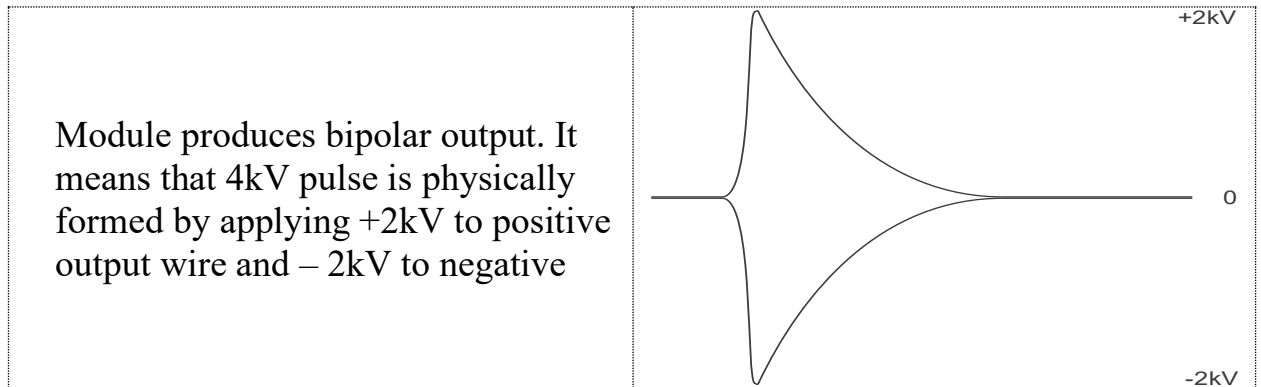
Important note: please measure the output with symmetrical (differential) high voltage probe only. Measurement made with inappropriate equipment is a common cause of driver's failure.



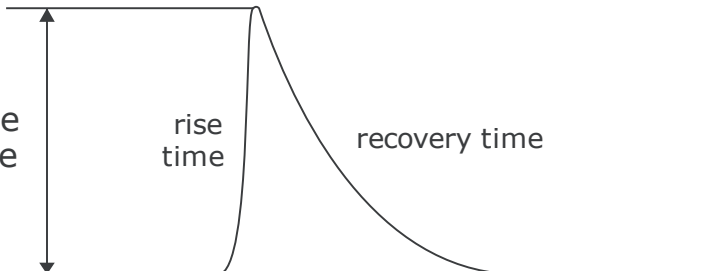
Overview

QBD series Pockels cell drivers produce high voltage pulses with high repetition rates, fast risetimes (falltimes) and adjustable voltage amplitude. Drivers are available in two modifications: QBD-DN for pull-down scheme and QBD-UP for push-up scheme. Two control types are available: manual and automatic

Pulse parameters



Attention! Further description of HV output will be given in terms of voltage differences. Please keep it in mind!

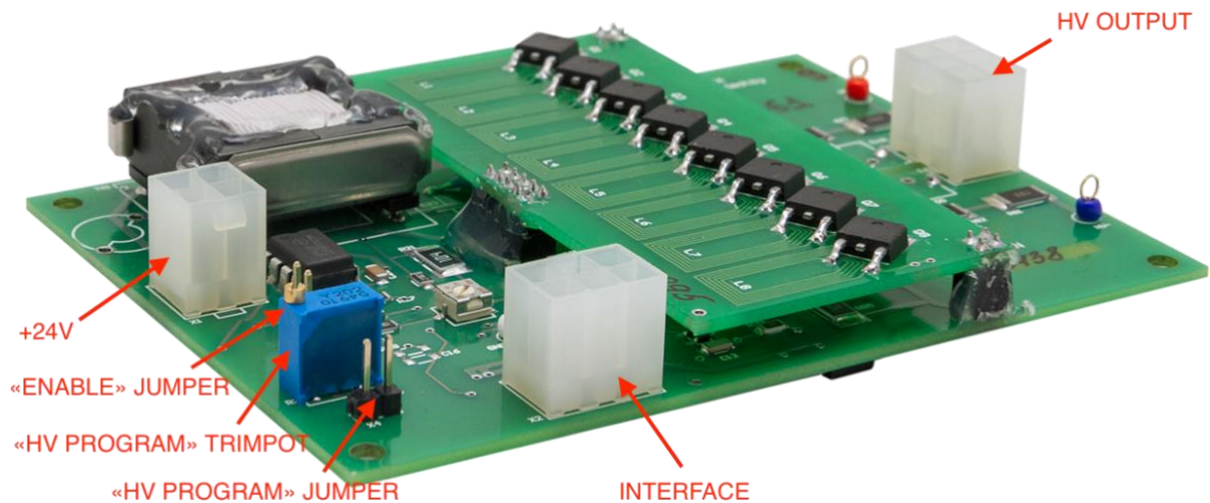
Typical pulse shape (QBD-DN modification)	
Typical pulse shape (QBD-UP modification)	
Risetime/Falltime	<20 ns ^{1, 2}
Recovery time ²	5-10 us (depends on load capacitance)
HV pulse amplitude	from HVmin to HVmax ³
Repetition rates	from single shot to ~100 kHz ²

¹ at 10-90% level

² depends on HV pulse amplitude and load capacitance

³ HVmin and HVmax values see in part number table

Connections, signals, signal descriptions



There are three connectors at Pockels cell driver board. Hereafter is description of corresponded female connectors (supplied with the board)

“ENABLE” JUMPER:

Use “*ENABLE*” *JUMPER* instead of “*ENABLE*” *PIN3* of *INTERFACE*. Don’t use “*ENABLE*” *JUMPER* and “*ENABLE*” *PIN* at the same time.

“HV PROGRAM” JUMPER AND “HV PROGRAM” TRIMPOT:

Use “*HV PROGRAM*” *JUMPER* instead of “*HV PROGRAM*” *PIN6* of *INTERFACE*. If jumper is on it sets output voltage according to “*HV PROGRAM*” *TRIMPOT* state.

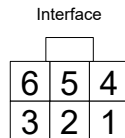
Don’t use “*HV PROGRAM*” *JUMPER* and “*HV PROGRAM*” *PIN* at the same time.

+24V (Molex 39-30-1040):



PIN (color)	DESIGNATION	DESCRIPTION
1, 2 (red)	+24V	INPUT positive 24VDC for turn on the Pockels cell driver Regulation: 22-28V, typical
3, 4 (black)	RETURN	Return from power supply producing +24VDC

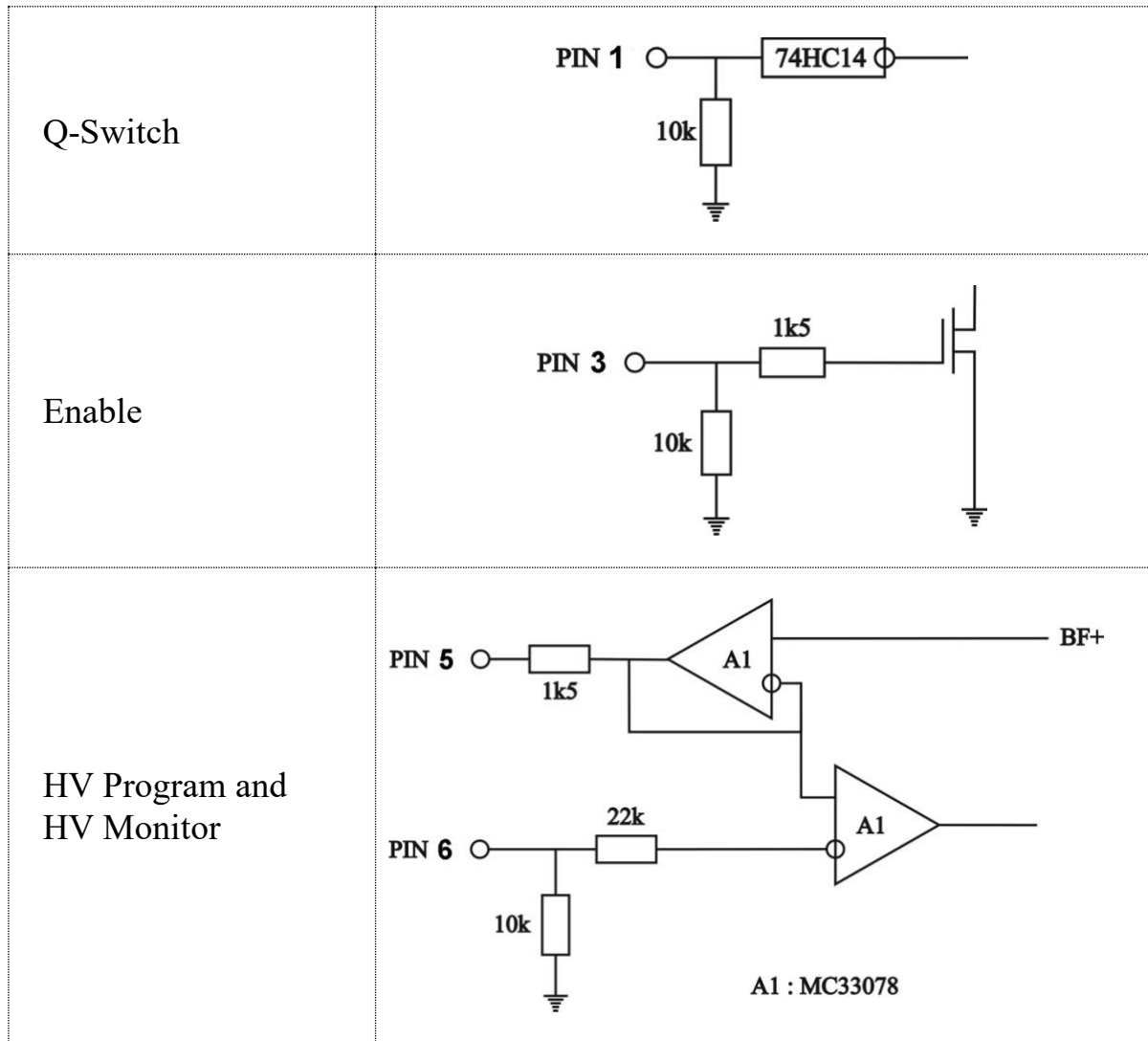
INTERFACE (Molex 39-30-1060):



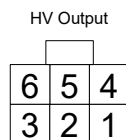
PIN (color)	DESIGNATION	DESCRIPTION
1 (orange)	Q-switch	Step from “0” or ”1” on PIN1 forms Q-Switched pulse on Pockels Cell
2, 4 (black)	Interface Return	PIN2 and PIN4 are connected to the circuit ground of all internal circuits
3 (blue)	Enable	The high voltage output is enabled by PIN3 (“1” – enable, “0” – disable)
5 (purple)	HV Monitor	The voltage at PIN5 is a monitor signal proportional to the measured value of high voltage output HVmax corresponds to 10V at PIN5, HVmin corresponds to approx. 4V at PIN5
6 (yellow)	HV Program	Positive DC voltage applied to PIN6 sets up high voltage value HV HVmax corresponds to 10V at PIN6, HVmin corresponds to approx. 4V at PIN6

“0” means logical 0 low level (0V), “1” means logical 1 high level (5V)

INTERFACE CIRCUITS



HV OUTPUT (Molex 39-30-1060):



QBD-series, UP-modification			QBD-series, DN-modification		
PIN (color)	DESIGNATION	DESCRIPTION	PIN (color)	DESIGNATION	DESCRIPTION
1 (blue)	Negative	HV Negative	1 (red)	Positive	HV Positive
2-5	N/C		2-5	N/C	
6 (red)	Positive	HV Positive	6 (blue)	Negative	HV Negative

Safety

Warning! This equipment produces high voltages that can be very dangerous. Don't be careless around this equipment.

- To provide safety the QBD-series Pockels cell driver module is designed to be powered with supply voltage +24VDC, which must be galvanically separated from mains.
- It is the user's responsibility to ensure that personnel are prevented from accidentally contacting the QBD-series Pockels cell driver module, especially the high voltage connector and cable. **Casual contact could be fatal.** Output cables must have good isolation for output voltage and low capacitance.
- After shut down, do not touch the load until it has been discharged. Use an appropriate measurement device to check for complete discharge.
- Disconnect the QBD-series Pockels cell driver module from DC power supply before changing electrical or mechanical connections.

Operations (Manual control)

1. Connect +24VDC power supply, pulse generator and Pockels cell
2. Set up "*HV PROGRAM*" JUMPER
3. Turn on +24VDC power supply
4. Set up "*ENABLE*" JUMPER
5. Use "*HV PROGRAM*" TRIMPOT to set up required output voltage
6. Send driving pulses from pulse generator to *PINI* of *INTERFACE*
7. To power down the driver, turn off +24VDC power supply or remove "*ENABLE*" JUMPER

Operations (Automatic control)

1. Connect +24V, *INTERFACE* and *HV OUTPUT* connectors to the board.
2. Remove "*HV PROGRAM*" JUMPER, remove "*ENABLE*" JUMPER
3. *DISABLE* the high voltage output
4. Apply the correct nominal *DC INPUT* power to the module
5. Set up the required output voltage by applying a DC voltage to the *HV PROGRAM PIN6* of *INTERFACE*
6. *ENABLE* the high voltage output
7. Send driving pulses to *PINI* of *INTERFACE*
8. To power down the driver, remove *DC INPUT* power or *DISABLE* high voltage output

Specification

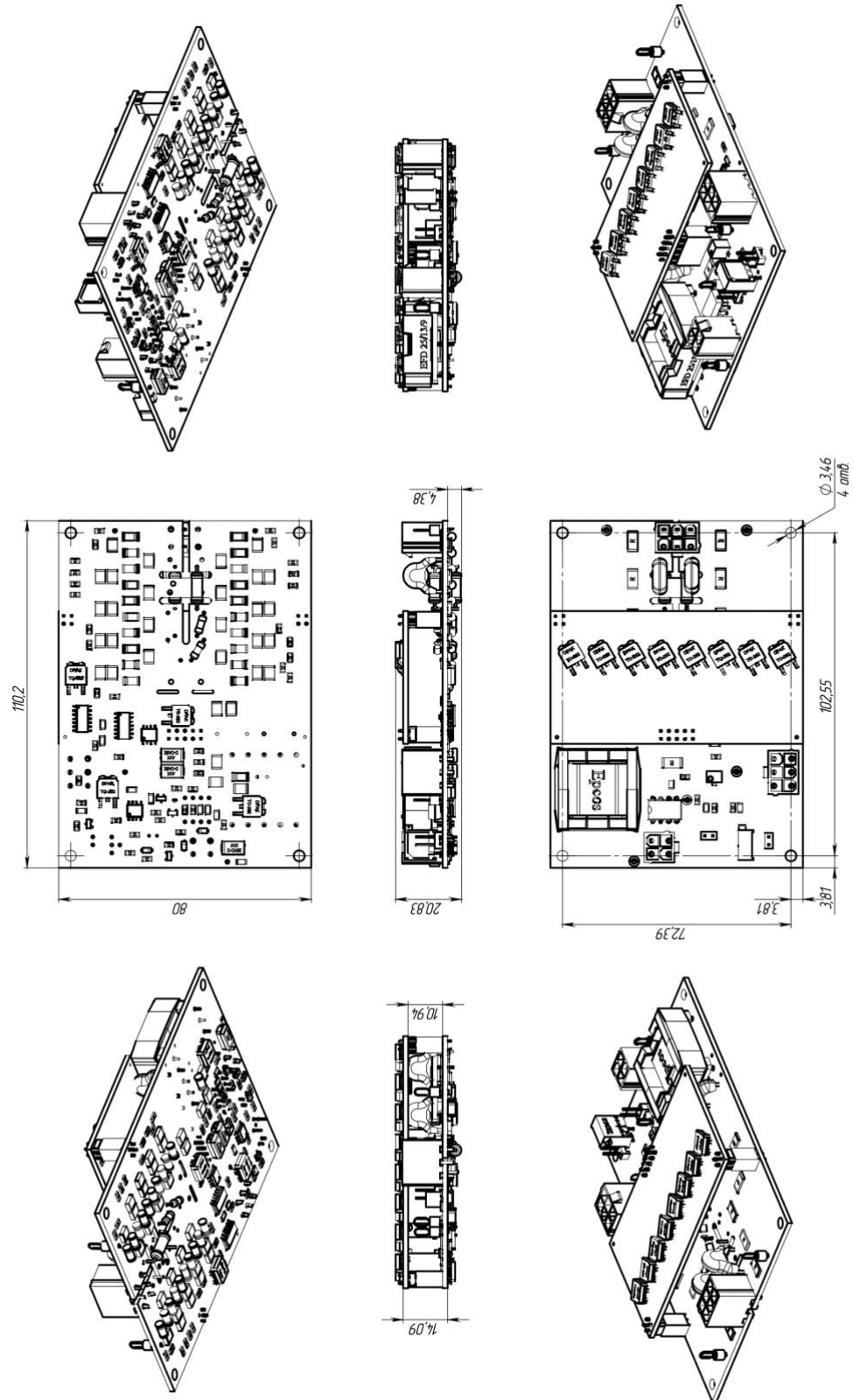
ELECTRICAL SPECIFICATION

Input:	+24V DC; 0,8A max
Output:	
Working mode	Pulses up in UP-modifications Pulses down in DN- modifications 
HV high level	adjustable in HV_{MIN} – HV_{MAX} range (see also <i>How to order?</i> section)
HV low level	fixed, 0V
Rise time (UP-modifications)	<20ns (depends on load)
Fall time (DN-modifications)	<20ns (depends on load)
Jitter	±1ns in LJ-modification ±10ns in low-cost version
Delay time	<100ns in LJ-modification <1µs in low-cost version
Recovery time	depends on load (5-10µs typ.)
HV pulse amplitude	see Part number table
Max. repetition rate	see <i>Performance</i> section
Cooling:	forced air cooling at high repetition rates
Protections:	from overheating (approx. 72 °C)
Environment:	
Operation Temperature	+10...+40°C (wider temperature range is available on request)
Storage Temperature	-20...+60°C
Humidity	0...90%, non-condensing

MECHANICAL SPECIFICATION

Size (LxWxH)	110x80x25 mm (see also the dimensional drawing below)
Weight	0,1 kg

Dimensional drawing



How to order?

QBD-XXYY-UP-[ZZ] or QBD-XXYY-DN-[ZZ], where:

- XX codes the maximum output voltage (HV_{MAX} , user selectable up to 6000V),
- YY codes the minimum output voltage (HV_{MIN} , 40% of V_{MAX}),
- UP codes push-up version of the product (pulses up),
- DN codes pull-down version of the product (pulses down),
- [ZZ] codes options:

LJ – low jitter option. In LJ version of the driver jitter is as low as $\pm 1\text{ns}$, delay time is shorter than 100ns. Without LJ option specified a low-cost version of the driver (with $\pm 10\text{ns}$ jitter and $< 1\mu\text{s}$ delay) will be supplied instead.

Examples (the most popular modifications):

Part number	HV_{MAX}	HV_{MIN}
QBD-6024-DN QBD-6024-UP QBD-6024-DN-LJ QBD-6024-UP-LJ	6000	2400
QBD-5020-DN QBD-5020-UP QBD-5020-DN-LJ QBD-5020-UP-LJ	5000	2000
QBD-4016-DN QBD-4016-UP QBD-4016-DN-LJ QBD-4016-UP-LJ	4000	1600
QBD-3012-DN QBD-3012-UP QBD-3012-DN-LJ QBD-3012-UP-LJ	3000	1200
QBD-2008-DN QBD-2008-UP QBD-2008-DN-LJ QBD-2008-UP-LJ	2000	800
QBD-1004-DN QBD-1004-UP QBD-1004-DN-LJ QBD-1004-UP-LJ	1000	400

Other modifications are available on request.

Performance

The table below contains the maximum repetition rate in dependence on output voltage and cooling conditions. Other setup parameters – total load capacitance 11pF, ambient temperature 25 °C:

Output voltage, kV	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0
Repetition rate, kHz (conductive cooling)	>40	>25	>18	>13	>10	>8	>6	>5
Repetition rate, kHz (<i>appropriate</i> forced-air cooling)	>115	>80	>60	>45	>35	>30	>25	>15

In the burst mode (= short time operation) the performance increases approximately twice and can greatly exceed 100kHz value at low operating voltage and low load capacitance.

Higher load capacitance and higher ambient temperature decreases the performance.

Typical output

Product: QBD-6024-UP

Load: 11pF HV capacitor + HV Probe (approx. 13pF)

Regime: 6kV pulses

