

Drivers for Pockels Cells

PCD-UHR SERIES OEM CAVITY DUMPER DRIVERS



Fig. 1. OEM version of PCD-UHR series Pockels cell driver



Fig. 2. Encased version of PCD-UHR series Pockels cell driver

FEATURES

- ▶ Fast HV rise/fall time <math>< 4-8 \text{ ns}</math>
- ▶ HV pulse amplitude up to 3.6 kV
- ▶ Pulse repetition rate up to 3.5 MHz
- ▶ Output pulse jitter <math>< 50 \text{ ps}</math> if trigger pulse rise time <math>< 0.5 \text{ ns}</math>

PCD-UHR series Pockels cell drivers are designed for wide range of applications and operating modes. Repetition rate can be up to 500 kHz for standard range of drivers, up to 1 MHz enhanced and up to 3.5 MHz high rate. Standard range of possible pulse durations is from 100 ns to 5 μs . It can be extended to infinity using pulse regeneration technique.

Next pages of the catalog presents tables of different versions of the drivers built as variations of voltage, repetition rate and rise/fall time. That three main parameters are mutually dependent. Higher voltage means longer rise/fall time, and higher repetition rate is limited by voltage. However, all the drivers can work at 1 MHz and even higher repetition rate in burst mode not exceeding specified average HV power. Connection diagram can be PUSH-PULL configuration using stand-alone driver, as well as FULL BRIDGE using two drivers for one Pockels cell. FULL BRIDGE configuration gives such advantages as repetition rate doubling to reach up to 7 MHz rate, pulse duration shortening down to zero or voltage doubling on pockels cell. Contact EKSPLA for more information and suggestions for Pockels cell driving solutions you need.

Most of PCD-UHR series units are available in two versions: „open frame“ which is ideal for OEM manufacturers incorporating drivers in their own systems and encased in aluminum housings. Encasing of Pockels cell driver in aluminum housing solves two problems: shields both humans and electronics from high voltage impact from operating Pockels cell driver, and protects driver itself from potentially harmful external contact – ensuring safe operation and driver longevity. The housed option is especially handy for researchers and custom product manufacturers who use these drivers during their own systems build-up.

PCD-UHRs modification has possibility to shorten output pulse duration down to 15 ns. Following they can be used for single pulse selection in pulse picker applications for high repetition rate lasers.

PCD-UHR series drivers has two modifications by control inputs. PCD-UHR1 drivers are controlled by one triggering pulse while rising edge turns on high voltage to Pockels cell and falling edge turns off – see Fig. 4. for reference. PCD-UHR2 drivers are controlled by two triggering pulses that are applied to separate inputs of the driver, see Fig. 3.



Fig. 3. Control timing charts for two-pulses controlled drivers

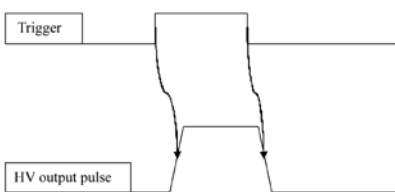


Fig. 4. Control timing charts for single pulse controlled drivers

PULSE REGENERATION TECHNIQUE

Gives possibility to operate push-pull drivers very long output pulse, and full bridge drivers get very low repetition rate. Pulse regeneration does not work with bipolar and short-pulse drivers.

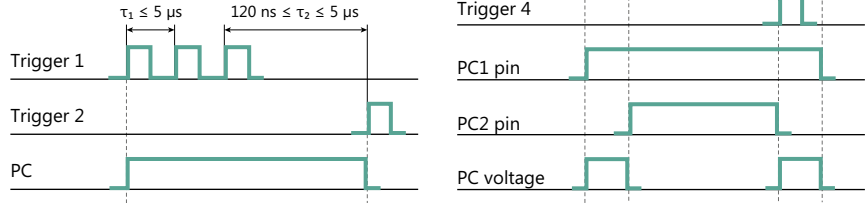


Fig 5. Principle and requirements for long output pulse forming – control way using pulse regeneration. Left diagram is related to PCD-UHR series, right for 2PCD-UHR series (Full-Bridge) drivers.

SELECTION CHART

Below chart presents summary of full line of PCD-UHR series drivers. This chart helps to choose optimal driver for your application. Horizontal axis

means repetition rate, vertical voltage. Lower voltage and lower repetition rate means lower price.

PCH-UHR SERIES DRIVERS' SELECTION CHART

kHz	50	250	300	350	400	500	600	1000	2000	kV
PCD-UHR1-					400-1.5					1.5
PCD-UHR2-					400-1.5					1.5
PCD-UHRS-									2000-1.6-C	1.6
2PCD-UHR1-							600-1.8	1000-1.8		1.8
2PCD-UHR2-								1000-1.8-C		1.8
PCD-UHR1-								1000-2.4-C		2.4
PCD-UHR2-		250-2.5					600-2.5			2.5
		250-2.5-C					600-2.5-C			2.5
		250-2.5								2.5
		250-2.5-C								2.5
						500-2.6				2.6
						500-2.6-C				2.6
								1000-2.9-C		2.9
Regural drivers	50-3.6	250-3.6								3.6
	50-3.6	250-3.6-C								3.6
Biolar drivers		250-3.6								3.6
		250-3.6-C								3.6
Short-pulse drivers				350-4-C						4.0
			300-4.6-C							4.6
Full-bridge drivers		250-5.2-C								5.2

GENERAL SPECIFICATIONS TABLE FOR PCD-UHR SERIES DRIVERS ¹⁾

Driver model	PCD-UHR series	PCD-UHRS series
Maximal HV rated voltage (for testing only)	See next tables for specific drivers	
Maximal HV operating voltage	<90 % from rated voltage	
HV pulse rise time	< 4–8 ns (Fig. 7)	
HV pulse fall time	< 4–8 ns (Fig. 8)	
HV pulse duration for single driver	100–5000 ns	15–5000 ns
Max HV pulse duration for full-bridge configuration	0–5000 ns	N/A
Maximal HV pulse repetition rate	3.5 MHz	600 kHz
External triggering pulse duration requirement	>100 ns	>10 ns
External triggering pulse amplitude requirement	3.5–5 V (50 Ω load)	
External triggering pulse rise & fall time	< 20 ns	< 5 ns
Maximal length of leads to Pockels cell	10 cm	
Control diagram options:		
– single triggering pulse control	Fig. 4	
– two trigger pulses control	Fig. 3	
HV pulse delay, typical	45 ns	30 ns
External powering requirements:	depends on modification	
– high voltage supply		
– low voltage DC supply	24 ⁺¹ ₋₁₀ V, <150 mA 12±0.5 V, <150 mA on request	24±1 V, <150 mA

¹⁾ Specifications are given for Pockels cell with capacity <6 pF. Not all combinations of parameters can be possible at the same time. Specifications are subject to changes without advance notice.

Driver needs to be mounted on the heatsink (excluding water cooled versions). Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation.

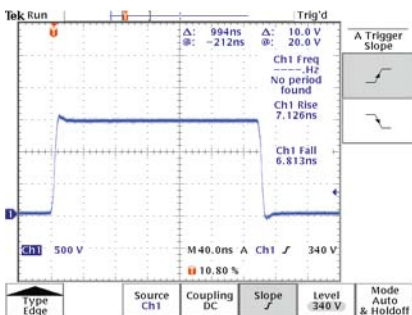


Fig. 6. Typical output pulse shape

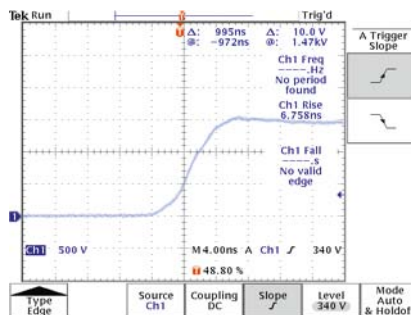


Fig. 7. Typical rising front of output pulse in detail

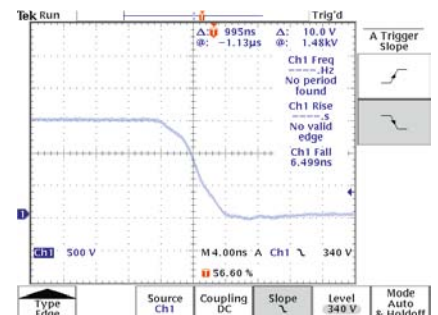
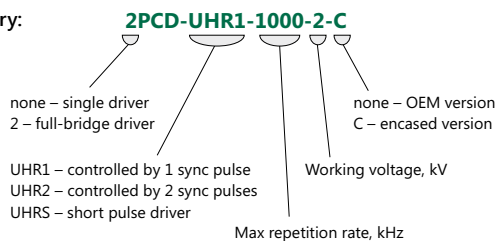


Fig. 8. Typical falling front of output pulse in detail

Ordering / Part number information

Please indicate following points by inquiry:

- Voltage
- Repetition rate
- Pulse duration (range)
- Capacitance of Pockels cell
- 24 V / 12 V option
- OEM / encased



OEM VERSION

CONFIGURATION EXAMPLES OF OEM VERSION OF PCD-UHR SERIES DRIVERS

P/N of driver	PCD-UHR1-50-3.6 PCD-UHR2-50-3.6	PCD-UHR1-400-1.5 PCD-UHR2-400-1.5	PCD-UHR1-250-3.6 PCD-UHR2-250-3.6	PCD-UHR1-250-2.5 PCD-UHR2-250-2.5	PCD-UHR1-500-2.6 PCD-UHR2-500-2.6	PCD-UHR1-1000-1.8 PCD-UHR2-1000-1.8
Maximal HV rated voltage	3.8 kV	1.6 kV	3.7 kV	2.6 kV	2.7 kV	2 kV
Maximal HV operating voltage	3.6 kV	1.5 kV	3.6 kV	2.5 kV	2.6 kV	1.8 kV
Maximal HV repetition rate	50 kHz	400 kHz	250 kHz	250 kHz	500 kHz	1000 kHz
Pulse duration *	100–5000 ns					
HV pulse rise time, typical	<7 ns	<5.5 ns	<7 ns	<6 ns	<6.5 ns	<6 ns
HV pulse fall time, typical	<7 ns	<5.5 ns	<7 ns	<6 ns	<6.5 ns	<6 ns
Output polarity	positive					
HV power consumption	<20 W	<20 W	<75 W	<40 W	<90 W	<80 W
12V/24V power consumption	1 W	5.5 W	4 W	4.5 W	6 W	9 W
Dimensions	see Fig. 10, 11			see Fig. 13, 14		
Cooling	conductive			conductive or water		

Driver needs to be mounted on the heatsink (excluding water cooled versions).
Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation.
Please specify working voltage and required tuning range by ordering.
HV output voltage to Pockels cell is equal to HV power supply voltage.

* Pulse duration of PCD-UHR2 series drivers can be extended using pulse regeneration.



Fig. 9. OEM version of PCD-UHR series driver with conductive pad. Suitable for repetition rate up to 50 kHz

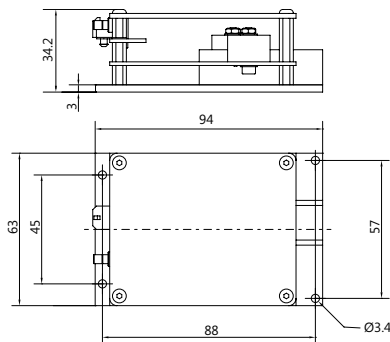


Fig. 10. Outline drawing of PCD-UHR1 series drivers with conductive pad

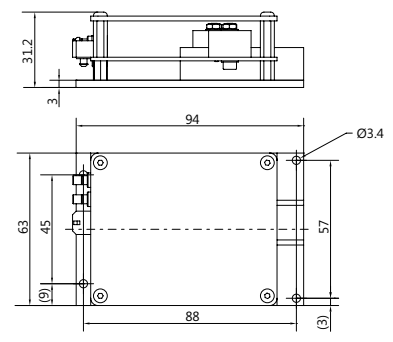


Fig. 11. Outline drawing of PCD-UHR2 series drivers with conductive pad



Fig. 12. OEM version of PCD-UHR series driver with general purpose pad

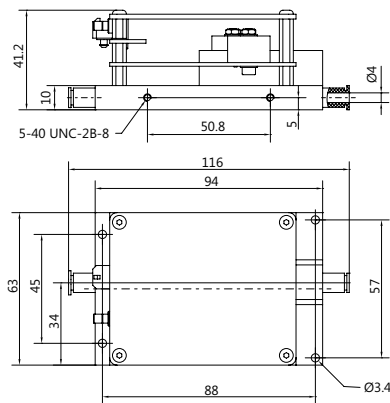


Fig. 13. Outline drawing of PCD-UHR1 series driver with general purpose pad

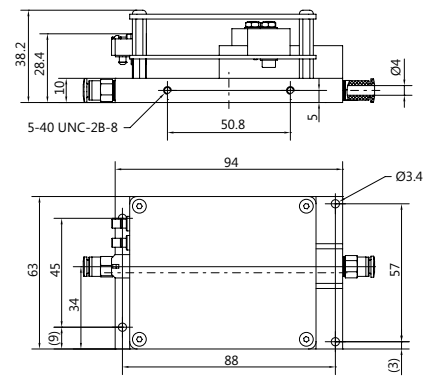


Fig. 14. Outline drawing of PCD-UHR2 series driver with general purpose pad

ENCASED VERSION

CONFIGURATION EXAMPLES OF ENCASED VERSION OF PCD-UHR SERIES DRIVERS

P/N of driver	PCD-UHR1-250-3.6-C PCD-UHR2-250-3.6-C	PCD-UHR1-250-2.5-C PCD-UHR2-250-2.5-C	PCD-UHR1-500-2.6-C PCD-UHR2-500-2.6-C	PCD-UHR1-1000-1.8-C PCD-UHR2-1000-1.8-C
Maximal HV rated voltage	3.7 kV	2.6 kV	2.7 kV	2 kV
Maximal HV operating voltage	3.6 kV	2.5 kV	2.6 kV	1.8 kV
Maximal HV repetition rate	250 kHz	250 kHz	500 kHz	1000 kHz
Pulse duration *	100–5000 ns			
HV pulse rise time, typical	<7 ns	<6 ns	<6.5 ns	<6 ns
HV pulse fall time, typical	<7 ns	<6 ns	<6.5 ns	<6 ns
Output polarity	positive			
HV power consumption	<75 W	<40 W	<90 W	<80 W
12V/24V power consumption	4 W	4.5 W	6 W	9 W
Dimensions	see Fig. 16			
Cooling	water			

Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation.

HV output voltage to Pockels cell is equal to HV power supply voltage.

Please specify working voltage and required tuning range by ordering.

* Pulse duration of PCD-UHR2 series drivers can be extended using pulse regeneration.



Fig. 15. Encased version of driver
PCD-UHR models PCD-UHRx-200-xx, PCD-UHRx-250-xx,
PCD-UHRx-500-xx, PCD-UHRx-1000-1.8

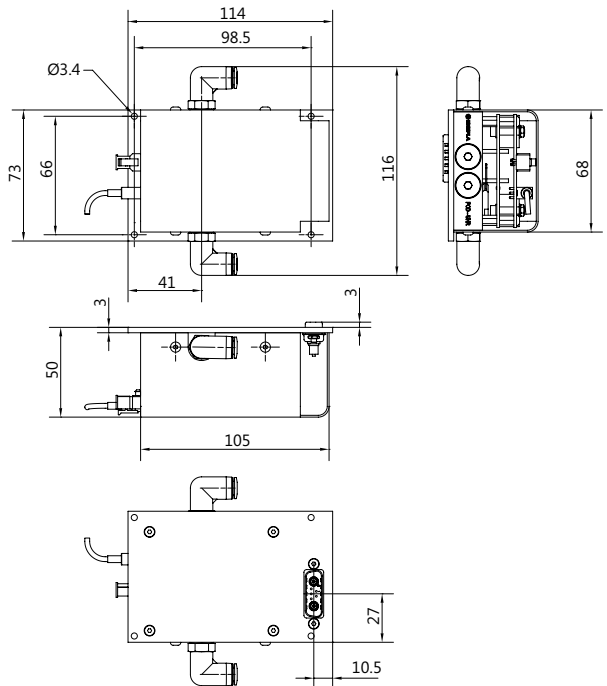


Fig. 16. Outline drawing of encased version of driver
PCD-UHR models PCD-UHRx-200-xx, PCD-UHRx-250-xx,
PCD-UHRx-500-xx, PCD-UHRx-1000-1.8

SPECIFIC FEATURES OF PCD-UHRS DRIVERS

- Short circuit protection at driver output
- Driver pad overheat sensor stops operation when overheated
- Overheat optocoupled output signal – open circuit means error state
- Switchable single pulse and two pulses control operation modes
- LED for error indication (green for overheat and red for short circuit)

OEM SHORT-PULSE VERSION

CONFIGURATION EXAMPLES OF OEM VERSION OF PCD-UHRS SERIES SHORT-PULSE DRIVERS

P/N of driver	PCD-UHRS-50-3.6	PCD-UHRS-400-1.5	PCD-UHRS-250-3.6	PCD-UHRS-250-2.5	PCD-UHRS-600-2.5	PCD-UHRS-600-1.8
Maximal HV rated voltage	3.8 kV	1.6 kV	3.7 kV	2.6 kV	2.6 kV	2 kV
Max/min HV operating voltage	3.6 kV / 1.8 kV	1.5 kV / 0.75 kV	3.6 kV / 1.8 kV	2.5 kV / 1.25 kV	2.5 kV / 1.25 kV	1.8 kV / 0.9 kV
Maximal HV repetition rate	50 kHz	400 kHz	250 kHz	250 kHz	600 kHz	600 kHz
Pulse duration	15–5000 ns	15–620 ns	15–1250 ns	15–1000 ns	15-400 ns	15-400 ns
HV pulse rise time, typical	<7 ns	<5.5 ns	<7 ns	<6 ns	<6.5 ns	<6 ns
HV pulse fall time, typical	<7 ns	<5.5 ns	<7 ns	<6 ns	<6.5 ns	<6 ns
Output polarity	positive					
HV power consumption	<20 W	<20 W	<75 W	<40 W	<100 W	<35 W
12 V / 24 V power consumption	1 W	5.5 W	4 W	4.5 W	7 W	7 W
Dimensions	see Fig. 18			see Fig. 19		
Cooling	conductive			conductive or water		

Driver needs to be mounted on the heatsink (excluding water cooled versions).
 Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation.
 Please specify working voltage and required tuning range by ordering.
 HV output voltage to Pockels cell is equal to HV power supply voltage.



Fig. 17. OEM version of PCD-UHRS series driver with general purpose pad

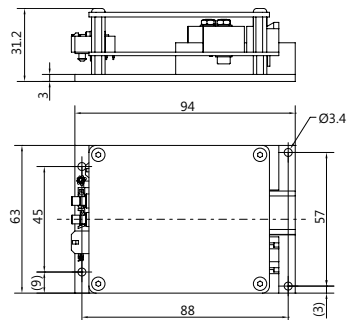


Fig. 18. Outline drawing of PCD-UHRS series driver with conductive pad

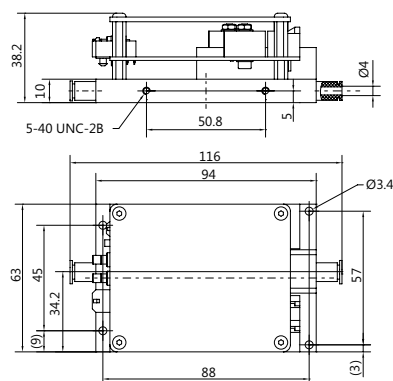


Fig. 19. Outline drawing of PCD-UHRS series driver with general purpose pad

ENCASED SHORT-PULSE VERSION

CONFIGURATION EXAMPLES OF ENCASED VERSION OF PCD-UHRS SERIES SHORT-PULSE DRIVERS

P/N of driver	PCD-UHRS-250-3.6-C	PCD-UHRS-250-2.5-C	PCD-UHRS-600-2.5-C
Maximal HV rated voltage	3.7 kV	2.6 kV	2.6 kV
Max/min HV operating voltage	3.6 kV / 1.8 kV	2.5 kV / 1.25 kV	2.5 kV / 1.25 kV
Maximal HV repetition rate	250 kHz	250 kHz	600 kHz
Pulse duration	15–1250 ns	15–1000 ns	15–400 ns
HV pulse rise time, typical	<7 ns	<6 ns	<6.5 ns
HV pulse fall time, typical	<7 ns	<6 ns	<6.5 ns
Output polarity	positive		
HV power consumption	<75 W	<40 W	<100 W
12V/24V power consumption	4 W	4.5 W	7 W
Dimensions	see Fig. 21		
Cooling	water		

Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation.
Please specify working voltage and required tuning range by ordering.
HV output voltage to Pockels cell is equal to HV power supply voltage.



Fig. 20. Encased version of driver PCD-UHRS

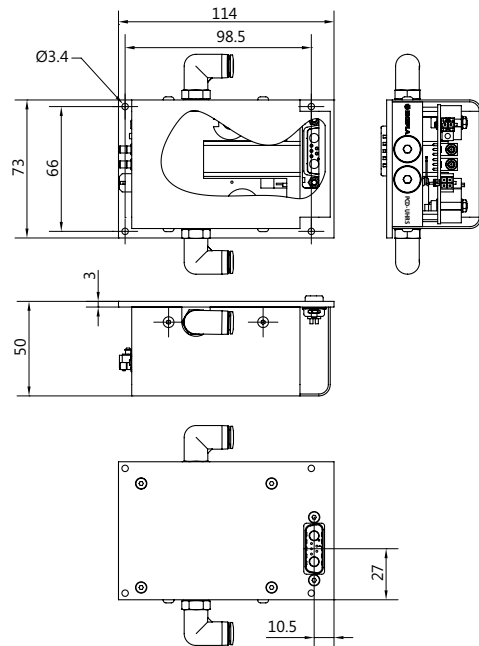


Fig. 21. Outline drawing of encased version of driver PCD-UHRS

ENCASED VERSION (bipolar drivers)

CONFIGURATION EXAMPLES OF ENCASED VERSION OF PCD-UHR SERIES BIPOLAR DRIVERS

P/N of driver	PCD-UHR1-1000-2.9-C PCD-UHR2-1000-2.9-C	PCD-UHR1-350-4-C PCD-UHR2-350-4-C	PCD-UHR1-300-4.6-C PCD-UHR2-300-4.6-C	PCD-UHR1-250-5.2-C PCD-UHR2-250-5.2-C
Maximal HV rated voltage	3.0 kV	4.2 kV	4.8 kV	5.3 kV
Maximal HV operating voltage	2.9 kV	4.0 kV	4.6 kV	5.2 kV
Maximal HV repetition rate	1000 kHz	350 kHz	300 kHz	250 kHz
Pulse duration *	100–5000 ns			
HV pulse rise time, typical	<7.5 ns	<7.5 ns	<8.0 ns	<8.5 ns
HV pulse fall time, typical	<7.5 ns	<7.5 ns	<8.0 ns	<8.5 ns
Output polarity	bipolar			
HV power consumption **	<120 W	<100 W	<100 W	<100 W
12 V / 24 V power consumption	9 W			
Dimensions	see Fig. 23			
Cooling	water			

Driver needs to be mounted on the heatsink (excluding water cooled versions).
 Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation.
 HV output voltage to Pockels cell is equal to HV power supply voltage i.e. sum of positive and negative HV values.
 Please specify working voltage and required tuning range by ordering.

* Pulse duration of PCD-UHR2 series drivers can be extended using pulse regeneration.
 ** Bipolar HV power supply HV2×60Wm is specifically designed for these drivers.



Fig. 22. Encased version of bipolar PCD-UHR series drivers

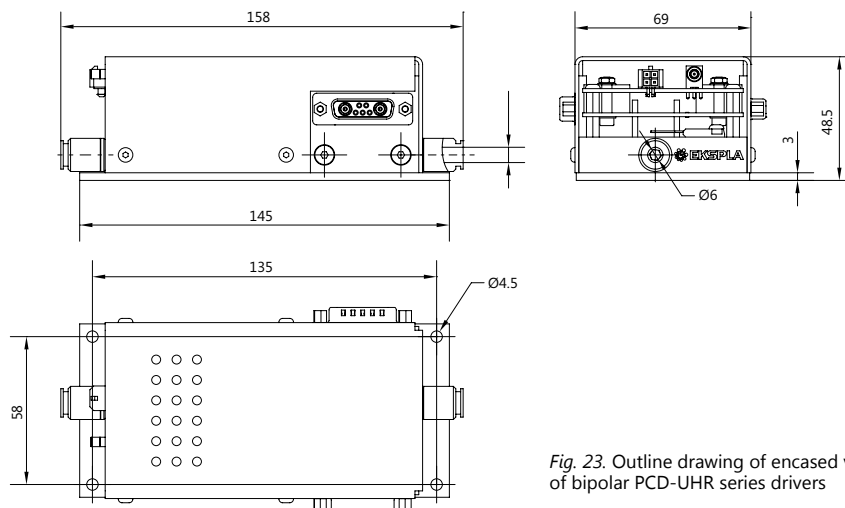


Fig. 23. Outline drawing of encased version of bipolar PCD-UHR series drivers

FULL-BRIDGE VERSION

CONFIGURATION EXAMPLES OF FULL-BRIDGE CONFIGURATION DRIVERS

P/N of FULL-BRIDGE driver	2PCD-UHR1-1000-2.4-C 2PCD-UHR2-1000-2.4-C	2PCD-UHR1-2000-1.6-C 2PCD-UHR2-2000-1.6-C
Base driver	PCD-UHR1-500-2.5 PCD-UHR2-500-2.5	PCD-UHR1-1000-1.8 PCD-UHR2-1000-1.8
Maximal HV operating voltage	2.4 kV	1.6 kV
Maximal HV repetition rate with frequency doubling *	1000 kHz	2000 kHz
HV pulse duration range for OUT1	100–5000 ns	
HV pulse duration range for OUT2	100–5000 ns	
HV pulse duration range to Pockel's cell	0–5000 ns	
HV pulse rise time	<6.5 ns	<6 ns
HV pulse fall time	<6.5 ns	<6 ns
Maximal capacitance of Pockel's cell	<6 pF	
HV power consumption	<160 W **	
Case	see Fig. 27	
Cooling	water	

Heat sink temperature needs to be lower than 35 °C (95 °F) in all regimes of operation. HV output voltage pulse to Pockels cell appears as difference of pulses OUT1 and OUT2 and is lower as HV power supply voltage. Contact Ekspla for technical details based on your request.

* Full-Bridge drivers are generally designed for operation at high repetition rate. However, low repetition rate pulsing can be achieved using pulse regeneration technique.

** Two HV power supplies HV80Wm are suggested.

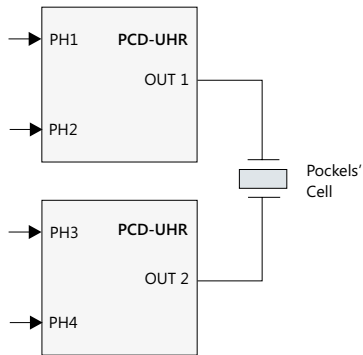


Fig. 24. Diagram of Pockels cell full-bridge connection to driver



Fig. 25. External view of full-bridge driver

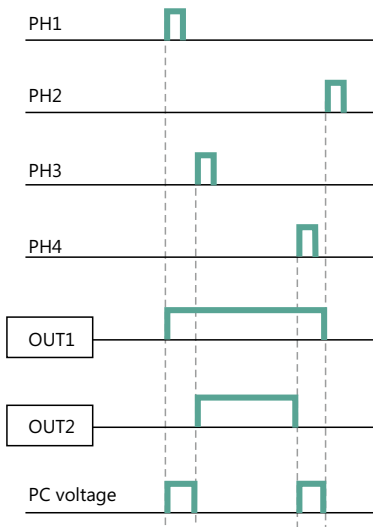


Fig. 26. Principle of 4-phase control of FULL-BRIDGE driver configuration

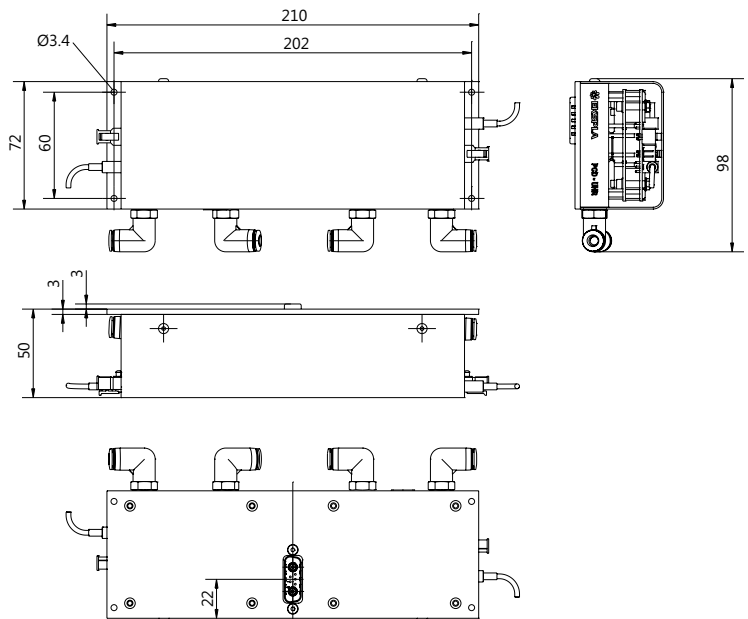


Fig. 27. Outline drawing of case for full-bridge drivers