

# High-Voltage High-Speed Switches

HVS Series

The HVS Series high-voltage, high-speed solid-state switches are designed for applications in Pockels cell drivers, nanosecond pulse generators, laser diode drivers, etc.

Recent developments in semiconductor technology combined with our cutting-edge proprietary design made it possible to achieve superior performance.

The HVS Series are used in our Pockels Cell Drivers and Laser Diode Drivers. As separate components, they are offered at very competitive prices. We offer two types of switches: The very high-speed models HVS-XXX-F with a voltage variable  $\pm 15\%$  of the specified value, as well as switches with wide-range variation of the applied voltage, models HVS-XXX-V.

The large selection of ON and OFF types is complemented by PUSH-PULL and single-pulse selection (PULSE PICKERS) models.

## Features

- Sub-nanosecond rise time\*
- More than 10 kV nanosecond pulses\*
- Up-to 300 kHz repetition rate\*
- Fixed or variable pulse duration
- Metal housing for strongly reduced EMI
- Unsurpassed electrical efficiency\*
- Very short delay to trigger down to 10 ns\*
- Very low jitter down to 100 ps\*
- In-House development and manufacturing
- Customized solution

*Note: \*For specific models*

## Applications

- Pockels Cell Drivers
- Nanosecond Pulse Generators
- Laser Diode Drivers
- Pulse Pickers
- Time-of-Flight (TOF) Measurements



LASERS, OPTICS, ELECTRONICS  
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### High-Voltage, High-Speed Driver: HVS ON Series 1/3 • Available Models

Parameters	HVS-ON-300-V-N	HVS-ON-1500-V-N-100k	HVS-ON-2500-V-N	HVS-ON-3000-F-N
HV OUT	-100 V to -250 V	-500 V to -1.5 kV	0 to -2.8 kV	-2.4 kV to -2.9 kV
HV IN	+250 V to +850 V	+500 V to +1.5 kV	0 to +3 kV	+700 V to +1 kV
Turn-On Rise Time, E <sup>1)</sup>	10 ns @ 80 pF	2.2 ns @ 5 pF	11 ns @ 6 pF	0.8 ns @ 3 pF
Turn-On Rise Time, O <sup>1)</sup>	7 ns @ 80 pF	1.8 ns @ 5 pF	10 ns @ 6 pF	0.7 ns @ 3 pF
Decay Time	10 ns @ 80 pF	350 ns @ 5 pF	40 μs @ 6 pF	7 μs @ 3 pF
Pulse Width	Fixed	Fixed	Fixed	Fixed
Pulse Width FWHM	15 ns @ 80 pF	600 ns @ 5 pF	16 μs @ 6 pF	3 μs @ 3 pF
Pulse Plateau	1 ns @ 80 pF	400 ns @ 5 pF	2 μs @ 6 pF	400 ns @ 3 pF
Repetition Rate, max	10 kHz	100 kHz	10 kHz	10 kHz
Jitter <sup>2)</sup>	300 ps	40 ps	80 ps	< 100 ps
Delay <sup>2)</sup>	130 ns	10 ns	30 ns	20 ns
Current, max	2 A	5 A	2 A	20 A
HV IN Current, max	1.5 mA	10 mA	1 mA	8 mA
HV Power, max	1.3 W	15 W	3 W	8 W
Dimensions	65 x 60 x 35 mm <sup>3</sup>	65 x 60 x 35 mm <sup>3</sup>	55 x 30 x 30 mm <sup>3</sup>	55 x 30 x 30 mm <sup>3</sup>
Comments	High capacity load. <sup>3)</sup>	Lower repetition rate on request.	<sup>3)</sup>	Lower repetition rate on request.

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

<sup>3)</sup> Auxiliary voltage +12 V is required.

### High-Voltage, High-Speed Driver: HVS ON Series 2/3 • Available Models

Parameters	HVS-ON-4000-V-N-100k	HVS-ON-4000-V-N	HVS-ON-4000-F-N	HVS-ON-4000-V-P
HV OUT	-1.5 kV to -3.5 kV	-1.8 kV to -4.3 kV	-3.4 kV to -4.3 kV	+1 kV to +4.5 kV
HV IN	+200 V to +500 V	+2 kV to +4.5 kV	+3.8 kV to +4.7 kV	+2 kV to +4.5 kV
Turn-On Rise Time, E <sup>1)</sup>	2.3 ns @ 1.5 pF 3.6 ns @ 10 pF	3 ns @ 6 pF	1.4 ns @ 6 pF	5.5 ns @ 6 pF
Turn-On Rise Time, O <sup>1)</sup>	2.0 ns @ 1.5 pF 3.2 ns @ 10 pF	2.2 ns @ 6 pF	1.1 ns @ 6 pF	4.4 ns @ 6 pF
Decay Time	250 ns @ 1.5 pF	20 μs @ 6 pF	15 μs @ 6 pF	100 ns @ 6 pF
Pulse Width	Fixed	Fixed	Fixed	Fixed
Pulse Width FWHM	200 ns @ 1.5 pF	15 μs @ 6 pF	3 μs @ 6 pF	180 ns @ 6 pF
Pulse Plateau	50 ns @ 1.5 pF	300 ns @ 6 pF	1 μs @ 6 pF	150 ns @ 6 pF
Repetition Rate, max	100 kHz	10 kHz	5 kHz	10 kHz
Jitter <sup>2)</sup>	< 100 ps	40 ps	80 ps	40 ps
Delay <sup>2)</sup>	30 ns	15 ns	20 ns	15 ns
Current, max	10 A	10 A	20 A	10 A
HV IN Current, max	61 mA	1.1 mA	1 mA	1.5 mA
HV Power, max	30.5 W	5 W	5 W	6.8 W
Dimensions	100 x 50 x 25	55 x 30 x 30	80 x 30 x 30	55 x 30 x 30
Comments	Lower repetition rate on request. <sup>3)</sup>		<sup>3)</sup>	

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

<sup>3)</sup> Auxiliary voltage +12 V is required.

High-Voltage, High-Speed Driver: HVS ON Series 3/3 · Available Models				
Parameters	HVS-ON-4500-F-N	HVS-ON-5000-V-N	HVS-ON-5000-F-P	HVS-ON-9000-V-N-HC
HV OUT	-3 kV to -4.5 kV	-1.4 kV to -4.8 kV	+3.8 kV to +4.8 kV	-4 kV @ 100 pF -9 kV @ 3 pF
HV IN	+700 V to +1 kV	+300 V to +1 kV	+3.8 kV to +4.8 kV	+200 V to +950 V
Turn-On Rise Time, E <sup>1)</sup>	1.2 ns @ 4 pF 1.6 ns @ 7 pF	2.3 ns @ 3 pF	1.9 ns @ 6 pF	9 ns @ 100 pF
Turn-On Rise Time, O <sup>1)</sup>	0.8 ns @ 4 pF 1.1 ns @ 7 pF	2 ns @ 3 pF	1.5 ns @ 6 pF	8 ns @ 100 pF
Decay Time	14 µs @ 4 pF	200 ns @ 3 pF	15 µs @ 6 pF	8 µs @ 100 pF
Pulse Width	Fixed	Fixed	Fixed	Fixed
Pulse Width FWHM	6 µs @ 4 pF	300 ns @ 3 pF	3 µs @ 6 pF	2 µs @ 100 pF
Pulse Plateau	1 µs @ 4 pF	50 ns @ 3 pF	1 µs @ 6 pF	100/200 ns @ 100/3 pF
Repetition Rate, max	10 kHz	1 kHz	5 kHz	100 Hz
Jitter <sup>2)</sup>	< 100 ps	< 100 ps	80 ps	40 ps
Delay <sup>2)</sup>	20 ns	30 ns	20 ns	15 ns
Current, max	20 A	10 A	20 A	70 A
HV IN Current, max	10 mA	2 mA	1 mA	5 mA
HV Power, max	10 W	2 W	5 W	5 W
Dimensions	100 x 30 x 30 mm <sup>3</sup>	100 x 50 x 25 mm <sup>3</sup>	80 x 30 x 30 mm <sup>3</sup>	110 x 80 x 45 mm <sup>3</sup>
Comments	Lower repetition rate on request.		<sup>3)</sup>	

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

<sup>3)</sup> Auxiliary voltage +12 V is required.

High-Voltage, High-Speed Driver, HVS OFF Series · Available Models			
Parameters	HVS-OFF-300-F-P-300k	HVS-OFF-4000-V-P(N)	HVS-OFF-4000-V-P
HV OUT	+300 V to +400 V	0 to +4.5 kV or 0 to -4.5 kV	+2 kV to +4.5 kV
HV IN	+350 V to +450 V	0 to +4.5 kV or 0 to -4.5 kV	+2 kV to +4.5 kV
Turn-Off Rise Time, E <sup>1)</sup>	4 ns @ 30 pF	6 ns @ 10 pF	3 ns @ 5 pF and 4 ns @ 10 pF
Turn-Off Rise Time, O <sup>1)</sup>	3 ns @ 30 pF	5 ns @ 10 pF	2 ns @ 5 pF and 3 ns @ 10 pF
Decay Time	2 µs @ 30 pF	5 µs @ 10 pF	20 µs @ 10 pF
Pulse Width	Fixed	Fixed	Fixed
Pulse Width FWHM	1.5 µs @ 30 pF	4 µs @ 10 pF	10 µs @ 10 pF
Pulse Plateau	700 ns @ 30 pF	2 µs @ 10 pF	2 µs @ 10 pF
Repetition Rate, max	300 kHz	10 kHz	10 kHz
Jitter <sup>2)</sup>	< 100 ps	80 ps	40 ps
Delay <sup>2)</sup>	< 2 ns	30 ns	12 ns
Current, max	3 A	10 A	10 A
HV IN Current, max	9 mA	1.1 mA	1.1 mA
HV Power, max	4.1 W	5 W	5 W
Dimensions	35 x 40 x 50 mm <sup>3</sup>	130 x 30 x 30 mm <sup>3</sup>	55 x 30 x 30 mm <sup>3</sup>
Comments	Very high repetition rate	Output galvanically isolated; Auxiliary voltage +5 V is required.	Fast turn-on rise time

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

<b>Half-Bridge (Push-Pull) Driver · Available Models</b>			
<b>Parameters</b>	<b>HVS-HB-1500-V-N</b>	<b>HVS-HB-2000-V-P</b>	<b>HVS-HB-5000-V-P</b>
HV OUT	-1 kV to -1.5 kV	1.2 kV to 2.0 kV	0 to +5 kV
HV IN	Integrated HV power supply	1.2 kV to 2.0 kV	0 to +5 kV
Turn-On Rise Time, E <sup>1)</sup>	11 ns @ 6 pF	30 ns @ 4 pF	4.6 ns @ 5 pF, 5 ns @ 10 pF
Turn-On Rise Time, O <sup>1)</sup>	10 ns @ 6 pF	25 ns @ 4 pF	2.7 ns @ 5 pF, 3 ns @ 10 pF
Turn-Off Rise Time, E <sup>1)</sup>	25 ns @ 6 pF	1.5 ns @ 4 pF	4.5 ns @ 5 pF, 5 ns @ 10 pF
Turn-Off Rise Time, O <sup>1)</sup>	24 ns @ 6 pF	1.1 ns @ 4 pF	2.7 ns @ 5 pF, 3.1 ns @ 10 pF
Pulse Width	Variable	Variable	Variable
Pulse Width FWHM	100 ns - 1 $\mu$ s	50 ns - 3 $\mu$ s	60 ns - 1 s
Repetition Rate, max	1 kHz	10 kHz	10 kHz
Jitter <sup>2)</sup>	< 100 ps	< 100 ps	300 ps
Delay <sup>2)</sup>	40 ns	10 ns	45 ns
Current, max	1 A	10 A	10 A
HV IN Current, max	Integrated HV power supply	2 mA	1.7 mA
HV Power, max	Integrated HV power supply	4 W	8.5 W
Dimensions	105 x 105 x 45 mm <sup>3</sup>	100 x 50 x 25 mm <sup>3</sup>	100 x 50 x 25 mm <sup>3</sup>
Comments	Supply +1 kV to +1,5 kV; Auxiliary voltage +12 V is required.	Auxiliary voltage +12 V is required	Auxiliary voltage +12 V is required.

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

<b>Pockels Cell Differential Driver · Available Models</b>		
<b>Parameters</b>	<b>HVS-DIF-10000-V-P</b>	<b>HVS-DIF-4000-V-P</b>
HV OUT	0 to +10 kV	+2.5 kV to +4.3 kV
HV IN	0 to +10 kV	+2.5 kV to +4.3 kV
Turn-On Rise Time, E <sup>1)</sup>	5.4 ns @ 7 pF	6 ns @ 10 pF
Turn-On Rise Time, O <sup>1)</sup>	4.5 ns @ 7 pF	5 ns @ 10 pF
Turn-Off Rise Time, E <sup>1)</sup>	10.5 ns @ 7 pF	8 ns @ 10 pF
Turn-Off Rise Time, O <sup>1)</sup>	9.5 ns @ 7 pF	7 ns @ 10 pF
Pulse Width	Variable	Variable
Pulse Width FWHM	8 ns - 1 $\mu$ s	15 ns - 1 $\mu$ s
Repetition Rate, max	1 kHz	1 kHz
Jitter <sup>2)</sup>	< 100 ps	< 100 ps
Delay <sup>2)</sup>	60 ns	40 ns
Current, max	30 A	10 A
HV IN Current, max	2 mA	1 mA
HV Power, max	20 W	4.5 W
Dimensions	110 x 80 x 45 mm <sup>3</sup>	120 x 65 x 40 mm <sup>3</sup>
Comments	Auxiliary voltage +400 V is required.	Auxiliary voltage +5 V is required.

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

### Pockels Cell Driver for PC with Two Crystals · Available Models

Parameters	HVS-20N-3000-F-N-UF	HVS-20N-3000-V-N
HV OUT	-2.8 kV to -3.2 kV	-1.8 kV to -4.3 kV
HV IN	+2.8 kV to +3.2 kV	+2 kV to +4.5 kV
Turn-On Rise Time, E <sup>1)</sup>	5 ns @ 3 pF	5 ns @ 3 pF
Turn-On Rise Time, O <sup>1)</sup>	3.6 ns @ 3 pF	3.6 ns @ 3 pF
Turn-Off Rise Time, E <sup>1)</sup>	1.0 ns @ 3 pF	3 ns @ 3 pF
Turn-Off Rise Time, O <sup>1)</sup>	0.8 ns @ 3 pF	2.2 ns @ 3 pF
Pulse Width	Variable	Variable
Pulse Width FWHM	10 ns - 200 µs	10 ns - 200 µs
Repetition Rate, max	1 kHz	10 kHz
Jitter <sup>2)</sup>	< 500 ps	< 500 ps
Delay <sup>2)</sup>	20 ns	20 ns
Current, max	10 A	10 A
HV IN Current, max	1.5 mA	2.2 mA
HV Power, max	4.8 W	10 W
Dimensions	55 x 60 x 30 mm <sup>3</sup>	55 x 60 x 30 mm <sup>3</sup>

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.

### High-Voltage Nanosecond Pulse Picker · Available Models

Parameters	HVS-PP-7000-V-P	HVS-PP-6500-V-N	HVS-PP-9000-V-N
HV OUT	+1.4 kV to +7.0 kV	-2.5 kV to -6.5 kV	-2.5 kV to -9.5 kV
HV IN	+100 V to +500 V	+200 V to +950 V	+200 V to +950 V
Turn-On Rise Time, E <sup>1)</sup>	8 ns @ 7 pF	6 ns @ 7 pF	8 ns @ 3.5 pF
Turn-On Rise Time, O <sup>1)</sup>	3 ns @ 7 pF	5 ns @ 7 pF	7 ns @ 3.5 pF
Turn-Off Rise Time, E <sup>1)</sup>	4 ns @ 7 pF	20 ns @ 7 pF and -2.5 kV 6 ns @ 7 pF and -6.5 kV	25 ns @ 3.5 pF and -2.5 kV 8 ns @ 3.5 pF and -9.5 kV
Turn-Off Rise Time, O <sup>1)</sup>	3 ns @ 7 pF	5 ns @ 7 pF and -6.5 kV	7 ns @ 3.5 pF and -9.5 kV
Pulse Width FWHM, E <sup>1)</sup> (fixed)	8 ns @ 7 pF	22 ns @ 7 pF and -2.5 kV 12 ns @ 7 pF and -6.5 kV	25 ns @ 3.5 pF and -2.5 kV 12 ns @ 3.5 pF and -9.5 kV
Pulse Width FWHM, O <sup>1)</sup>	7 ns @ 7 pF	8 ns @ 7 pF and -6.5 kV	8 ns @ 3.5 pF and -9.5 kV
Pulse Plateau	4 ns @ 7 pF	1 ns @ 7 pF	1 ns @ 3.5 pF
Repetition Rate, max	10 kHz	1 kHz	1 kHz
Jitter <sup>2)</sup>	< 400 ps	40 ps	40 ps
Delay <sup>2)</sup>	200 ns	30 ns	30 ns
Current, max	10 A	10 A	10 A
HV IN Current, max	40 mA	12 mA	14 mA
HV Power, max	20 W	12 W	14 W
Dimensions	98 x 64 x 36 mm <sup>3</sup>	110 x 80 x 45 mm <sup>3</sup>	110 x 80 x 45 mm <sup>3</sup>
Comments	Pulse form close to rectangular; Auxiliary voltage +15 V is required.	At lower voltages, the turn-off rise time and pulse width are longer. The jitter and the delay are higher. For strongly reduced EMI, an optical triggering unit is optionally available.	

Notes: <sup>1)</sup> The "E" designation stands for "Electrical" and "O" for "Optical".

<sup>2)</sup> Trigger input to pulse output.



High-Voltage Nanosecond Pulse Generator • Available Models				
Parameters	HVS-PG-1000-V-N	HVS-PG-1500-V-N	HVS-PG-200-F-N	HVS-PG-8000-F-DIF
HV OUT	0 to -1 kV	-500 V to -1.5 kV	-210 V	+4 kV and -4 kV
HV IN	0 to +1 kV	+1 kV to +3 kV	Integrated HV power supply	+500 V
Turn-On Rise Time	200 ns @ 50 Ohm	4.7 ns @ 50 Ohm	2 ns @ 50 Ohm	60 ns @ 6 pF
Turn-Off Rise Time	200 ns @ 50 Ohm	5 ns @ 50 Ohm	6 ns @ 50 Ohm	40 ns @ 6 pF
Pulse Width	Variable	Variable with coax. cable	Fixed	Fixed
Pulse Width FWHM	500 ns - 1 ms @ 50 Ohm	100 ns - 300 ns @ 50 Ohm	4.6 ns @ 50 Ohm	100 ns @ 6 pF
Pulse Plateau	100 ns - 600 ns @ 50 Ohm	100 ns - 300 ns @ 50 Ohm	1 ns @ 50 Ohm	5 ns @ 6 pF
Repetition Rate, max	20 Hz	100 Hz	1 kHz	10 kHz
Jitter <sup>1)</sup>	< 100 ps	40 ps	40 ps	< 200 ps
Delay <sup>1)</sup>	40 ns	20 ns	10 ns	70 ns
Current, max	20 A	40 A	5 A	5 A
HV IN Current, max	1 mA	1 mA	<sup>1)</sup>	4 mA
HV Power, max	1 W	3 W	<sup>1)</sup>	2 W
Dimensions	25 x 25 x 70 mm <sup>3</sup>	100 x 65 x 37 mm <sup>3</sup>	96 x 65 x 40 mm <sup>3</sup>	100 x 50 x 25 mm <sup>3</sup>
Comments	Auxiliary voltage +12 V is required.	Auxiliary voltage +12 V is required.	Auxiliary voltage +12 V is required.	Auxiliary voltage +12 V is required.

Notes: <sup>1)</sup> Trigger input to pulse output.



**WARNING!**  
High Voltage  
Electrical Hazard



**WARNING!**  
Dangerous to Pacemakers  
Radio Frequency Hazard

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