

# PS5000

## SERIES

### Flashlamp Drivers of PS5000 Series



**The PS5000 series units are efficient and reliable flashlamp drivers intended for pumping of solid-state pulsed lasers.**

#### EXCELLENT PULSE-TO-PULSE STABILITY

The charger is based on series resonant inverter topology which is most efficient way to charge capacitive loads. Innovative design of charger circuit allows to charge capacitor bank with excellent precision of 0.1%.

#### BUILT-IN SERIAL IGNITION CIRCUIT

The driver features a built-in serial ignition circuit. It greatly simplifies the design of laser head since external triggering circuit is not required anymore. The simmer module provides up to 900 V striking voltage. The flashlamp is ignited by 16 kV pulse of approximately 1  $\mu$ s duration applied to the flashlamp cathode. The ignition circuit reliably ignites flashlamps with up to 200 mm arc length. Optionally, the amplitude of the ignition pulse can be increased to 30 kV

for reliable ignition of flashlamps with up to 300 mm arc length and 12 mm bore diameter.

#### REMOTE CONTROL

Microprocessor based control allows seamless integration of the driver into sophisticated laser systems. The charge voltage, repetition rate, pulse duration can be controlled remotely through digital RS-232 and CAN interfaces. In addition, digital interfaces allow monitoring of status and error messages.

The discharge pulse can be triggered from external pulse generator facilitating synchronisation of several units.



#### FEATURES

- Excellent pulse-to-pulse stability
- Built-in serial ignition circuit
- Built-in simmer power supply
- Remote control
- Modular design
- Seamless integration

#### APPLICATIONS

- Laser pumping
- Pulsed lighting
- Capacitor bank charging

**BUILT-IN SIMMER POWER SUPPLY**

The simmer power supply keeps a low power discharge during the period of time between main discharge pulses. It improves pulse-to-pulse stability and the lifetime of the flashlamp. The simmer power supply is a constant current source producing 600 mA current at up to 300 V output voltage. Linear xenon flashlamps of 4–6 mm bore diameter and arc length of more than 200 mm are reliably simmered.

**MODULAR DESIGN**

The output parameters of power supply can be easily modified to meet customer needs, subject to active lasing material, average output power or pulse energy. Required pulse duration and energy for

any type of the flashlamp can be achieved by choosing appropriate values of Pulse forming network (PFN) components. The average output power of the driver can be scaled by paralleling the charger modules. Up to four modules with resulting 6.8 kJ/s peak charging rate can be fitted into single 19" body. More powerful configurations are available upon request.

Free technical assistance and calculations are available, helping to choose most efficient and cost-effective solution.

**SEAMLESS INTEGRATION**

The driver can be easily integrated with EKSPLA cooling units of PS1220, PS1245 series. Up to 6 units can be mounted into

up to 25U height 19" racks providing powerful yet compact laser pumping cabinets.



Flashlamp driver PS5050 and cooling unit PS1222CO mounted into a 9U rack

**PRINCIPLE OF OPERATION**

The block diagram of PS5000 series power supplies is shown in Fig. 1a.

As can be seen from voltage waveforms 1 (b), two periods of operation can be distinguished.

During the first period,  $t_{ch}$ , the capacitor  $C_{PFN}$  is charged to pre-set voltage  $U_{ch}$ . During the second period of time  $t_{dis}$  energy stored in capacitor is discharged trough flashlamp. At the end of discharge pulse the voltage on capacitors drops to  $U_{min}$  value.

**The charger module** charges the capacitor bank with constant current. The instant output power of the charger reaches the maximal value  $P_{peak}$  when the capacitor bank voltage is in proximity of  $U_{ch}$ . Peak output power of the charger depends on charger module design and is specified at 1.7 kJ/s for a single module. By paralleling charger modules, the peak charger output can be increased to 6.8 kJ/s and more.

**The discharge module** is based either on SCR producing a fixed pulsewidth pulse or IGBT switch producing variable pulsewidth output. Discharge time is constant,  $t_{dis} = 5$  ms, for fixed pulsewidth models and equals to the output pulse duration for variable pulsewidth models.

**The simmer module** is used to keep a low power discharge during the period of time between main discharge pulses.

**The control and protection module** provides protection against overvolt, overheat, short circuit and flashlamp damage as well as an interface for remote control.

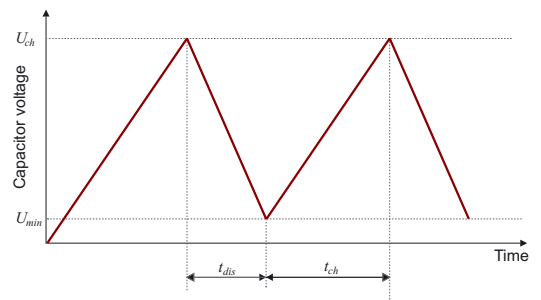
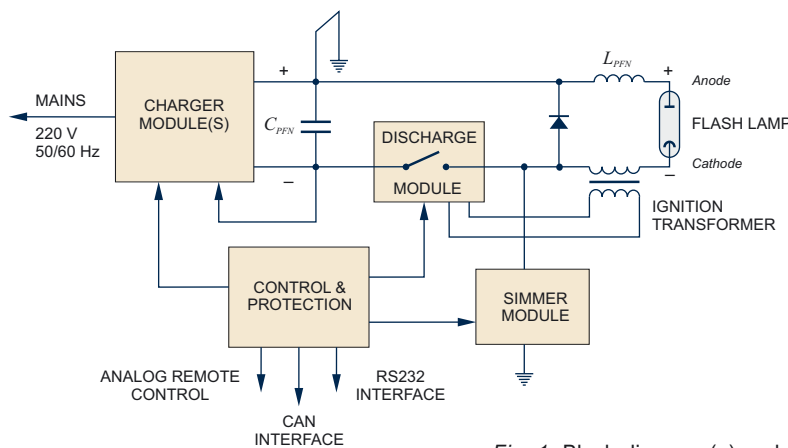


Fig. 1. Block diagram (a) and voltage waveform on capacitor  $C_{PFN}$  (b).

**FIXED PULSEWIDTH OUTPUT**

The pulse duration of fixed pulsewidth flashlamp drivers is determined by parameters of PFN. Consult our Application notes section for determination of values of PFN components subject to required pulse energy and duration and flashlamp type.

The discharge switch is based on SCR and all energy stored in capacitor bank is discharged trough the flashlamp.

The average power delivered to the flashlamp can be expressed as

$$P_{avg} = \frac{N \cdot P_{peak}}{2} (1 - f_{PRR} \cdot t_{dis}) \quad (1)$$

where N is number of charging modules,  $t_{dis}$  is discharge time equal to 5 ms,  $f_{PRR}$  – pulse repetition rate.

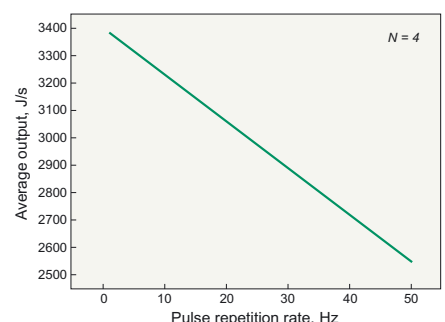


Fig. 2. Fixed pulsewidth driver average output power versus pulse repetition rate

## VARIABLE PULSEWIDTH OUTPUT

The pulse duration of variable pulse-width driver is controlled by electronic switch, based on IGBT transistor. The pulse shape is close to rectangular as can be seen from Fig. 3.

The average power delivered to the flashlamp can be expressed as

$$P_{avg} = N \cdot P_{peak} \cdot \left(1 - \frac{\Delta U}{2 \cdot U_{ch}}\right) \cdot (1 - t_{dis} \cdot f_{PRR})$$

There are few other factors limiting average power, though. Since the capacitor bank is only partially discharged during the pulse, to avoid damage of electronic components the voltage drop during discharge period of time should be less than 20%, i.e.  $\Delta U/U_{ch} < 0.2$ , which in turn places limitation for maximum pulse energy:

$$E_{pulse} < \left(1 - \left(1 - \frac{\Delta U}{U_{ch}}\right)^2\right) \cdot E_C$$

where  $E_C$  is energy stored in capacitor bank,  $E_{pulse}$  is pulse energy.

The maximum possible pulse energy is 480 J for  $C_{PFN} = 13.2$  mF version and 960 J for  $C_{PFN} = 26.4$  mF one.

On the other hand, the energy  $E_{pulse}$  delivered to the flashlamp depends on the

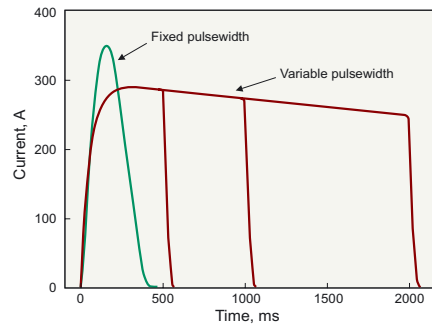


Fig. 3. Output pulse shape for fixed and variable pulsewidth drivers

pulse duration and flashlamp impedance parameter  $K_0$ :

$$K_0 = 1.28 \cdot \frac{l}{d} \cdot \left(\frac{p}{x}\right)^{0.2}$$

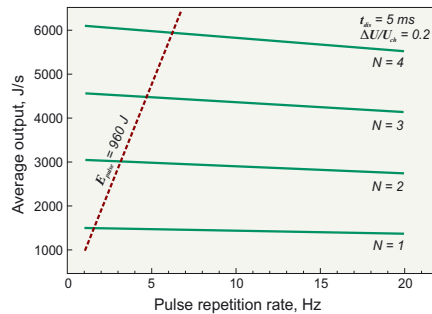


Fig. 4. Average power versus pulse repetition rate for variable pulsewidth drivers

where  $l$  is arc length,  $d$  is bore diameter,  $p$  is fill pressure in Torr, and  $x$  is a constant, 450 for xenon filled flashlamps and 800 for krypton filled flashlamps.

For given pulse duration and flashlamp impedance parameter, the energy delivered to the flashlamp can be found from Fig. 5.

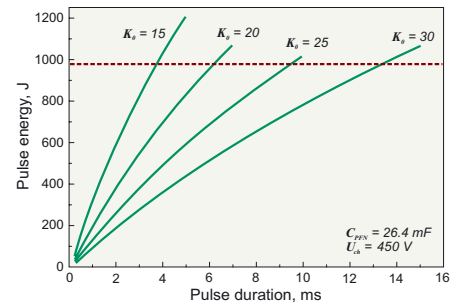
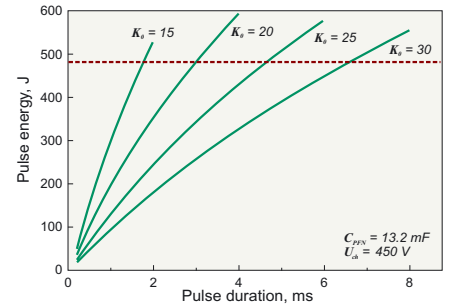
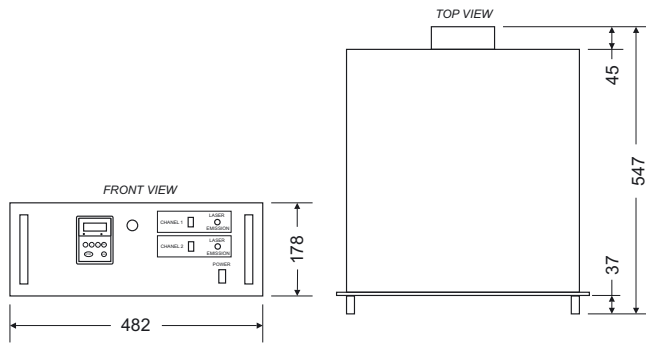


Fig. 5. Pulse energy versus pulse duration for variable pulsewidth drivers

## PHYSICAL DIMENSIONS



PS5021, PS5050, PS5053



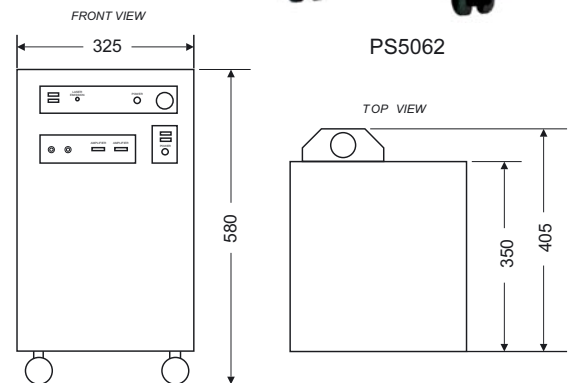
PS5050, PS5021



PS5053



PS5062



PS5062

## SPECIFICATIONS

MODEL	PS5021	PS5050	PS5053	PS5062
Number of independent outputs	1	1	2	1
Peak charge rate $P_{peak}$ , kJ/s	< 6.8 <sup>1)</sup>	< 6.8 <sup>1)</sup>	< 6.8 <sup>2)</sup>	< 3.4
Max average output power $P_{avg}$ @10 Hz PRR, kJ/s	> 5.8 <sup>1,4)</sup>	> 3.2 <sup>1,3)</sup>	> 3.2 <sup>2,3)</sup>	> 1.6
Standard charging voltage $U_{ch}$ , V	350, 450	1000, 1400, 1800 <sup>5)</sup>	1000, 1400, 1800 <sup>5)</sup>	1000 <sup>5)</sup>
Pulse duration	Variable	Fixed	Fixed	Fixed
Pulse repetition rate, Hz	< 250 <sup>6)</sup>	< 150	< 150	< 150
Pulse to pulse stability, %			0.1	
Load regulation, %			0.1	
Linearity, %			0.2	
Resolution, V			1	
Ignition pulse voltage, kV			16 <sup>7)</sup>	
Ignition pulse duration, ns			> 1000	
Simmer current, A			0.6	
Simmer voltage, V			< 300	
Striking voltage, V			< 900	
Protection features	Overvolt, overheat, flashlamp breakdown, interlock			
Error report	No simmer current, no charge, HV connectors			
Remote control	RS-232 / CAN	RS-232 / CAN	RS-232 / CAN	RS-232
Maximum $C_{PFN}$ value, $\mu$ F	< 26400 <sup>8)</sup>	< 240	< 200 <sup>2)</sup>	< 120
Integrated cooling unit	No	No	No	Yes <sup>10)</sup>
Mains	Single phase 230 V (-10%, +5%) or 3-phase 380 V (-10%, +5%) <sup>9)</sup>			
Power consumption, average, kW	< 7	< 4	< 4	< 2
Power consumption, peak, kW	< 10	< 6	< 6	< 3
Operating conditions	Ambient temperature from 0 to +40 °C Humidity from 10 to 90% non-condensing			

<sup>1)</sup> For parallel operation of four charging modules

<sup>6)</sup> Optional 1000 Hz PRR

Specifications are subject to changes without advance notice

<sup>2)</sup> Total for both channels

<sup>7)</sup> Optional 30 kV

<sup>3)</sup> See Fig. 2 for other pulse repetition rates

<sup>8)</sup> Standard options are 13200  $\mu$ F and 26400  $\mu$ F

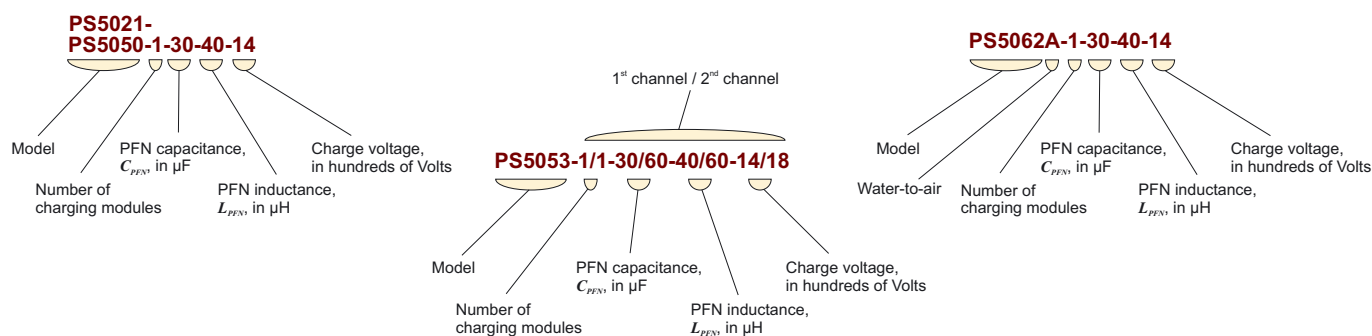
<sup>4)</sup> See Fig. 4 for other repetition rates

<sup>9)</sup> 3-phase 208 V mains are optional

<sup>5)</sup> Inquire for other voltages

<sup>10)</sup> Water-to-water or water-to-air

## ORDERING / PART NUMBER INFORMATION



Requests for custom made products are welcome !

**EKSPLA**  
An EKSPA Group Company

Lasers and Laser Systems Div.  
Savanoriu av. 231  
02300 Vilnius – 53  
L I T H U A N I A

Ph.: +370 5 2649629  
Fax: +370 5 2641809  
sales@ekspla.com  
www.ekspla.com

**ISO 9001**  
certified

EKSPLA distributor in United Kingdom:

**INGCRYS** Laser Systems Ltd.

Ingcrys Laser Systems Ltd  
14 Parris Road, Stokenchurch,  
High Wycombe, Bucks. UK  
Tel.: + 44 (0) 1494 482541  
Fax: + 44 (0) 1494 482873  
Email: sales@ingcrys.com  
www.ingcrys.com