Kokyo
株式会社 光響
Email : info@symphotony.com
Web : https://www.symphotony.com/

rev 3.15 / 2021 06 29

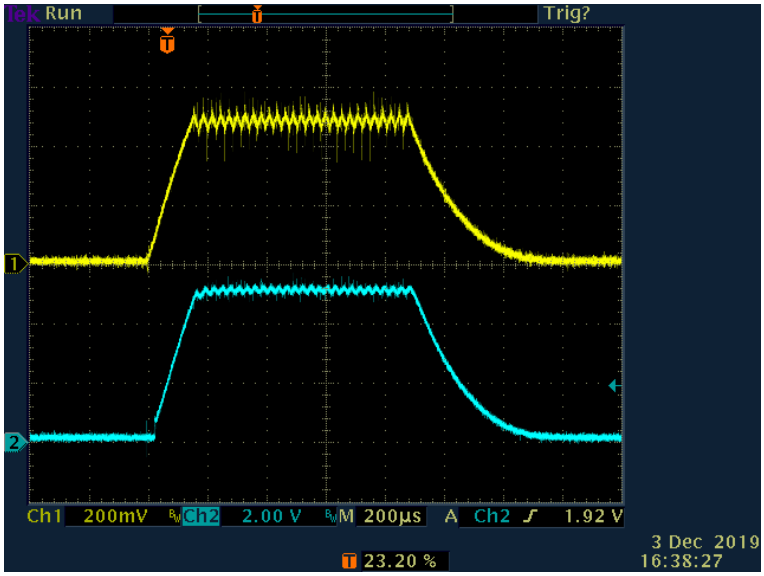
NBD-0505-PWM
dual channel discharge circuit with PWM

User manual

Overview / Applications

NBD-0505-PWM discharge circuit is designed for simplification of IPL and/or solid-state laser systems development. Module forms flashlamp pulses of rectangular or quasi-rectangular shape using the energy stored in external capacitors bank. Module includes IGBT, its driver, protective circuits, simmer and trigger circuits, discharge resistors and controls.

The unique feature is advanced current control (PWM), which makes true rectangular pulses possible (see picture below for a typical waveform).



current stabilization mode, 500A current
yellow curve – output measured with an external Hall effect current sensor,
blue curve – Current monitor (Pin 16 of Interface)

Let us emphasize, NBD-0505-PWM is not a stand-alone solution. For proper operation it requires capacitor charging power supply and capacitor bank as well as some minor parts and controls.

NBD-0505-PWM possesses the next major features:

- Two outputs – one output (Output #1) is for PWM operations, the other output (Output #2) is for free-discharge operations; outputs cannot be used simultaneously, but sequentially only
- Output #1 (PWM) – up to 2000W, up to 500V, up to 500A, true rectangular pulse width from 0.3ms to 100ms, current stabilization and voltage stabilization regimes
- Output #2 (Free discharge) – up to 2000W, up to 800V, up to 800A, quazi-rectangular pulse width from 50us to 10ms
- Powerful simmer board, which is able to drive two flashlamps connected in series
- Serial triggering in both channels (external triggering is available on request)
- Integrated capacitor bank – ~1mF @ 800V

Cooling

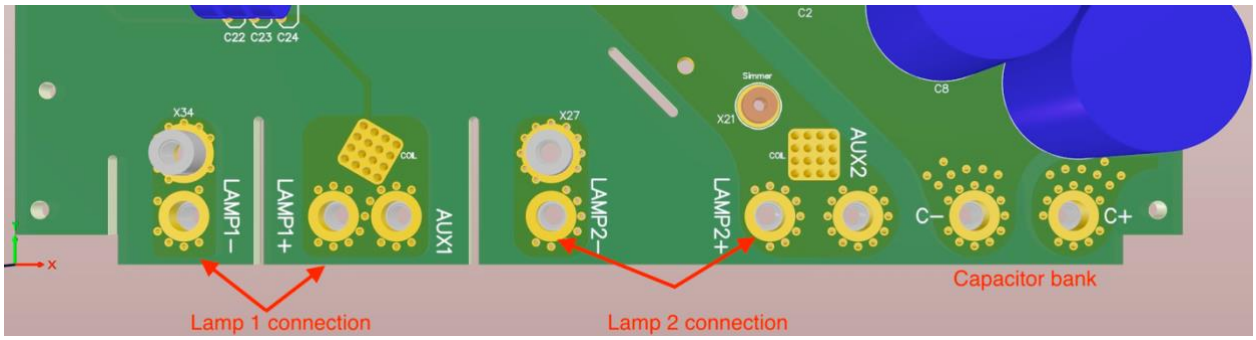
Module is cooled with built-in fans.
No external cooling is required.

Inductance coil

PWM mode is realized with integrated inductance coil of 80uH inductivity.
No external inductance coil is required.

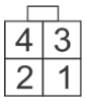
Appearance

Connections, signals, signal descriptions



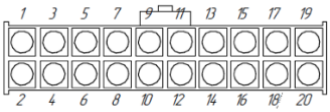
DESIGNATION	TYPE	DESCRIPTION / LAYOUT
24V DC	Molex MiniFit 2x2 Male	Low voltage power supply connection
INTERFACE	Molex C-Grid III 2x10 Male	Interfaces and controls
LAMP 1 +	M5 thread	Channel 1 (PWM) – Handpiece 1 connections (flashlamp anode "+", cathode "-")
LAMP 1 –	M5 thread	
LAMP 2 +	M5 thread	Channel 2 (Free-discharge) – Handpiece 2 connections (flashlamp anode "+", cathode "-")
LAMP 2 –	M5 thread	
C +	M5 thread	Capacitor bank connections (polarity is important)
C –	M5 thread	
GROUND	M5 thread	Protective grounding of NBD-0505-PWM

24V DC (TO 24V DC POWER SUPPLY): Molex 39-30-1040



PIN (color)	DESIGNATION	DESCRIPTION
1, 2 (red)	**+24V DC**	Supply power to the control circuits of NBD-0505-PWM as well as to the integrated simmer supply module • Voltage: 24V DC • Current: up to 10A peak
3, 4 (black)	**+24V DC Return**	Return of 24V DC power supply

INTERFACE: Molex 90142-0020



PIN (color)	DESIGNATION	DESCRIPTION
1-8	**Not Connected**	–
9 (white/red mark)	**Fault**	Module rises Fault if one of the next conditions is met: • IGBT overheating • Discharge resistors overheating • Incorrect channel selection (both channels are enabled at the same time) • Incorrect current/voltage setup: - Current Program >5V in PWM regime - Current Program >10V in Free discharge regime - Voltage Program >5V in PWM regime - Voltage Program >0V in Free discharge regime Some of the Faults block Pulse signal (IGBT overheating, Incorrect channel selection), but some do not (Discharge resistors overheating, Incorrect current/voltage setup).

10 (red)	**Discharge**	*Discharge* is *ON* while 0V are applied to *PIN10*. In this state capacitor bank is continuously discharging on internal 5kOhm 250W resistors. Be careful, while *Discharge* is *ON* the capacitor charging is prohibited and capacitor charging power supply must be disabled. Once +5V DC voltage is applied to *PIN10* (*Discharge* is *OFF*) module can be operated in the regular way.
11 (white/blue mark)	**Simmer Sensor**	Indicates whether simmer discharge is established or not: • *Simmer Sensor* circuit is closed – simmer established (in either channel) • *Simmer Sensor* circuit is open – no simmer
12, 20 (black)	**Interface GND**	Return of all Interface signals (Fault, Pulse, Current monitor, Current program, Voltage monitor, Voltage program etc)
13 (green)	**Enable 1 (PWM)**	Switches on and off simmer discharge in Channel 1 (PWM channel) • 5V – simmer on • 0V – simmer off
14 (blue)	**Enable 2 (free discharge)**	Switches on and off simmer discharge in Channel 2 (free-discharge channel) • 5V – simmer on • 0V – simmer off
15 (violet)	**Current Program**	• 0-5V to set 0-500A in Channel 1 • if Handpiece 1 (PWM) is selected and NBD-0505-PWM to be run in current stabilization mode, Current Program should be set to the desired value **and** Voltage Program should be either set higher than maximum expected voltage in Channel 1 (e.g. set to 5V) or pulled to the ground (0V) • if Handpiece 2 (Free-discharge) is selected, Current Program should be set higher than maximum expected current in Channel 2 (e.g. 8V) **and** Voltage Program should be set to 0V
16 (blue/white)	**Current Monitor**	Real time signal depicting instant current at NBD-0505-PWM outputs Calibration is 1V->100A
17 (orange)	**Voltage Program**	• 0-5V to set 0-500V in Channel 1 • if Handpiece 1 (PWM) is selected and NBD-0505-PWM to be run in voltage stabilization mode, Voltage Program should be set to the desired value **and** Current Program should be either set higher than maximum expected current in Channel 1 (e.g. set to 5V) or pulled to the ground (0V) • if Handpiece 2 (Free-discharge) is selected, Current Program should be set higher than maximum expected current in Channel 2 (e.g. 8V) **and** Voltage Program should be set to 0V
18 (yellow)	**Voltage Monitor**	Real time signal depicting instant voltage at NBD-0505-PWM outputs Calibration is 1V->100V

19 (transparent)	**Pulse**	Duration of 5V TTL pulse applied to this pin completely defines flashlamp pulse duration at NBD-0505-PWM output

GROUNDING AND MOUNTING

Grounding policy

By default, C–, LAMP 1–, LAMP 2– and 24V DC Return are galvanically interconnected to each other, although still disconnected from the module's chassis ground.

Interface circuits are completely insulated from the power circuits.

Module must be protectively grounded using provided Grounding thread

Safety

Warning! This equipment produces high voltages that can be very dangerous. Be careful around the device.

- During operation all the protective covers of the equipment must be securely in place and all electrical connections must be properly attached
- NBD-0505-PWM discharge circuit is designed to be installed inside a properly grounded metal. It is the user's responsibility to ensure that personnel are prevented from accidentally contacting the NBD-0505-PWM, C+/C–, LAMP+/LAMP– connectors and cables. **Casual contact could be fatal!**
- After shutdown, do not handle the capacitance load until it has been discharged. Use an appropriate meter to check for complete discharge.
- Disconnect the module from all power sources before making or changing electrical or mechanical connections.
- **Don't remove protective covers!** There are no user serviceable parts inside this equipment.

Operations (an example of)

1. Let's assume we want to operate Channel 1, PWM, current stabilization, 200A
2. Disconnect the entire setup from the mains
3. Connect to NBD-0505-PWM:
   a/ low voltage power supply
   b/ capacitor bank
   c/ flashlamp (to Channel 1)
   d/ your control device (to INTERFACE connector)

> There are some requirements for connective cable from NBD-0505-PWM to the capacitor bank. It should be as short as possible and its inductance should be as small as possible.

4. Connect your capacitor charger to the capacitor bank
5. Assure protective grounding of all units
6. Apply power to the setup
7. Turn off the discharge resistors (apply 5V to Pin 10 of INTERFACE)
8. Enable your capacitor charger and charge the capacitor bank to the desired voltage (estimated from desired operating current, flashlamp impedance K0, desired pulse duration and energy and capacitor bank capacitance)
9. Trigger flashlamp in Channel 1 with *Enable 1* signal (Pin 13 of INTERFACE)
10. Set Voltage Program e.g. to 0V to avoid voltage stabilization
11. Set Current Program to 2V (200A current set point)
12. Apply Pulse signal of the desired duration (10ms for example) to Pin 19 of INTERFACE
13. Observe flash visually or using Voltage Monitor and Current Monitor of INTERFACE

Specifications

ELECTRICAL

+24V DC:	
Voltage regulations	+24V DC
Maximum power consumption	up to 10A
Integrated capacitor bank	~1mF / 800V
Integrated inductance coil	80uH
Output 1 (PWM) - PULSE PARAMETERS:	
Max. voltage	500V *
Max. current	500A *
Max. average power	2000W *
Max. RMS current	50A *
Pulse width	0.3ms to 100ms
Output 2 (Free discharge) - PULSE PARAMETERS:	
Max. voltage	800V *
Max. current	800A *
Max. average power	2000W *
Max. RMS current	50A *
Pulse width	50us to 10ms
RECOMMENDED WIRES:	
For capacitor bank and inductance coil connections	FLEXI-2V or similar (>1000V rated voltage, >4mm^2 cross-section), short length (30cm recommended)
For flashlamp connections	Due to serial triggering, additional insulation (e.g. with silicone tubing) or spacing (e.g. with spiral bundle hose) of LAMP– wires is required
SIMMER PARAMETERS:	
Simmer current	500mA (*other on request*)
Max output voltage	300V
Max output power	100W
Open circuit voltage	1500V
FLASHLAMP TRIGGERING PARAMETERS:	
Trigger type	Serial triggering
Pulse energy / trigger voltage	~160mJ / 10kV negative to LAMP– (*other on request)*

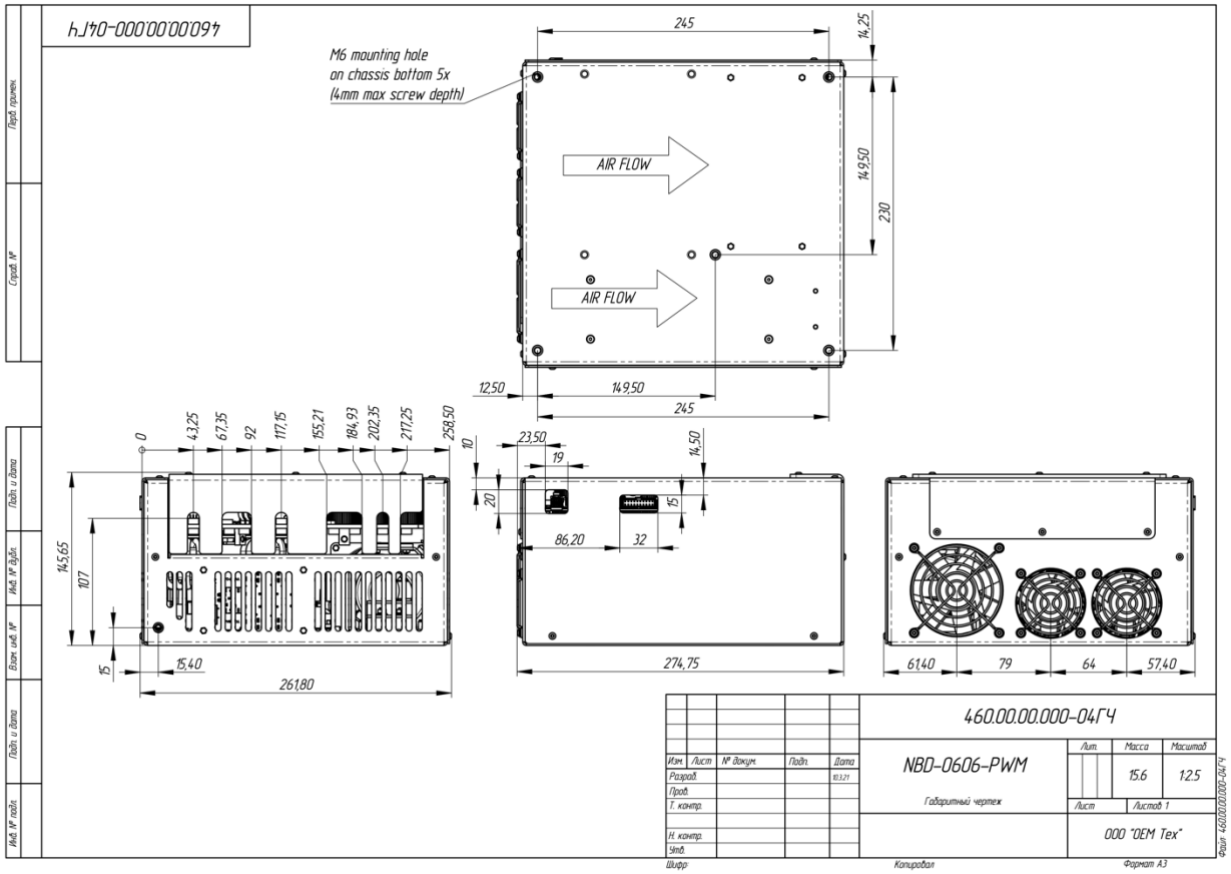
Trigger pulse width	~1us
Restrike rate	A few Hertz (automatically adjusted)
Trigger transformer	Integrated transformer
Cooling	Forced air cooling with built-in fans
Protections	From overheating of internal components
Environment:	
Operation temperature	0 … +40 °C
Storage temperature	-20 … +60 °C
Humidity	90%, non-condensing

* higher on request

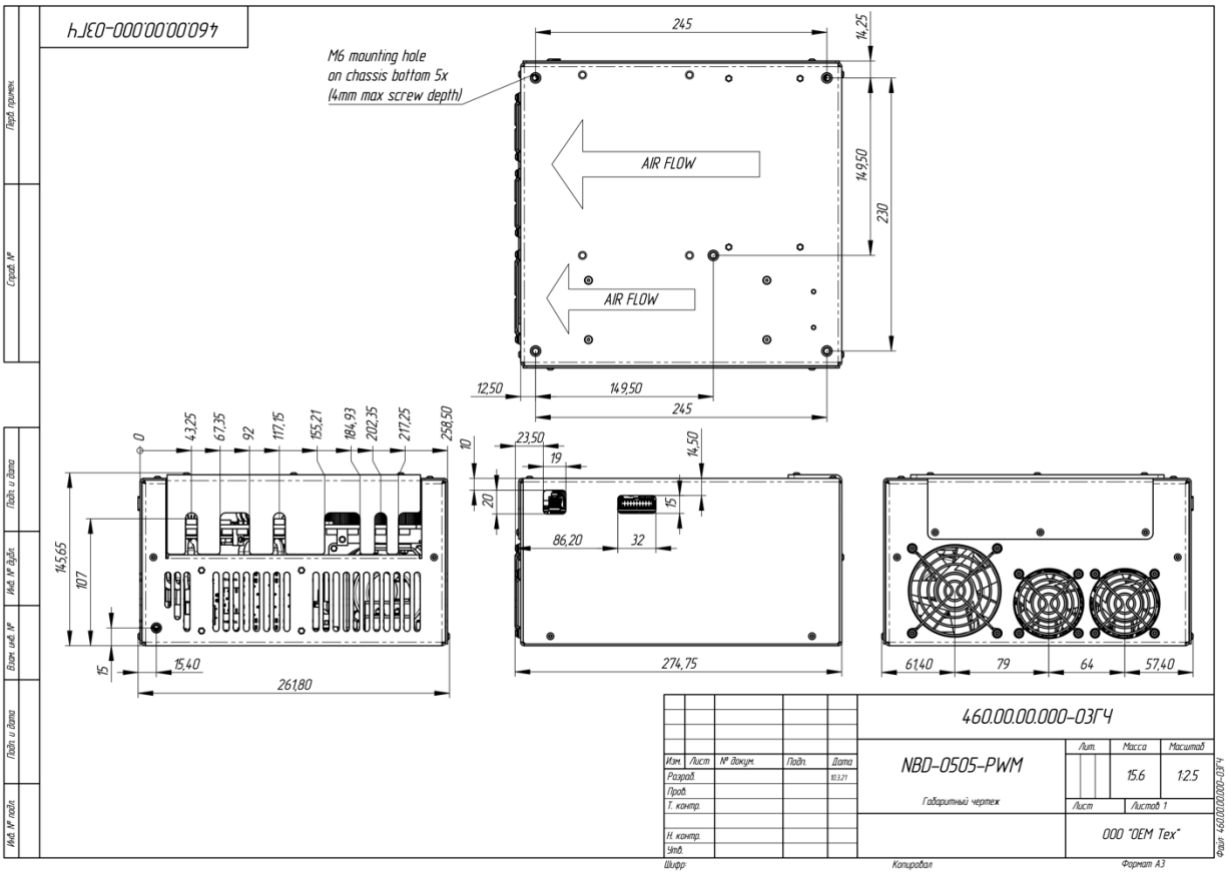
MECHANICAL

Size (LxWxH)	See dimensional drawing below
Weight	Approx. 9.0 kg (w/o cables)

DIMENSIONAL DRAWING (STANDARD AIR FLOW DIRECTION)



DIMENSIONAL DRAWING (REVERSED AIR FLOW DIRECTION)



Non-optimal air flow direction in this option might result in reduced maximum average power.