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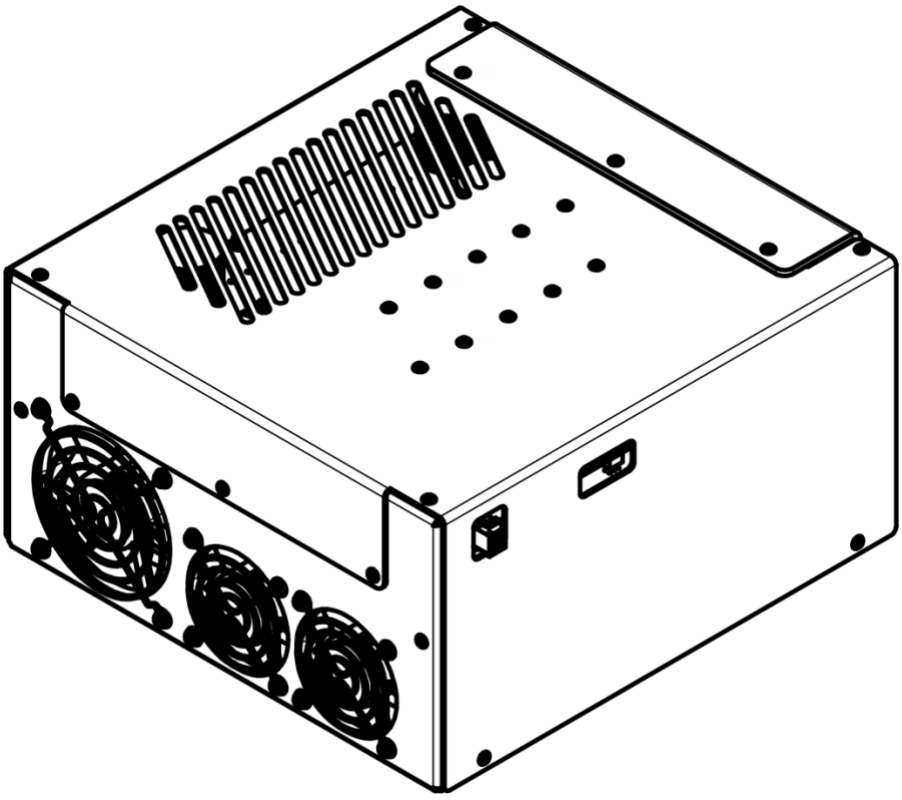
NBD-0505-PWM
dual channel discharge circuit with PWM

User manual



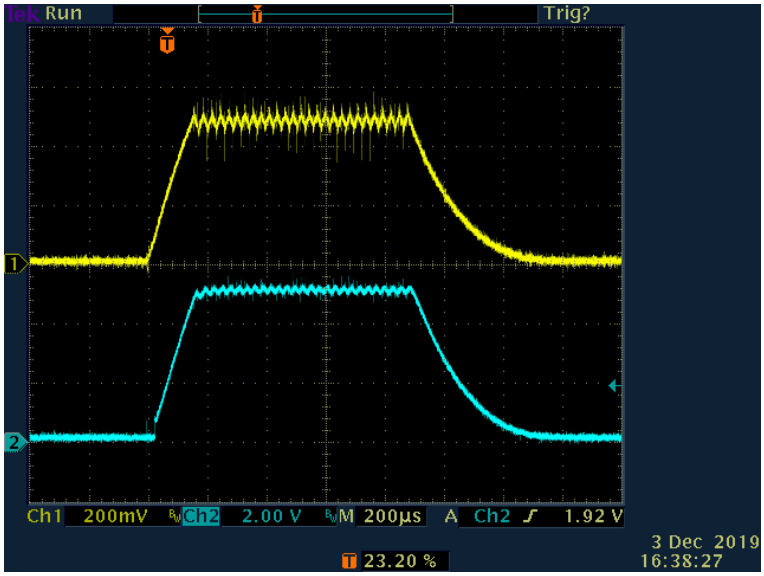
Warning! This equipment may be dangerous.
Please read the entire user manual carefully before using the product.

Table of content

Overview / Applications

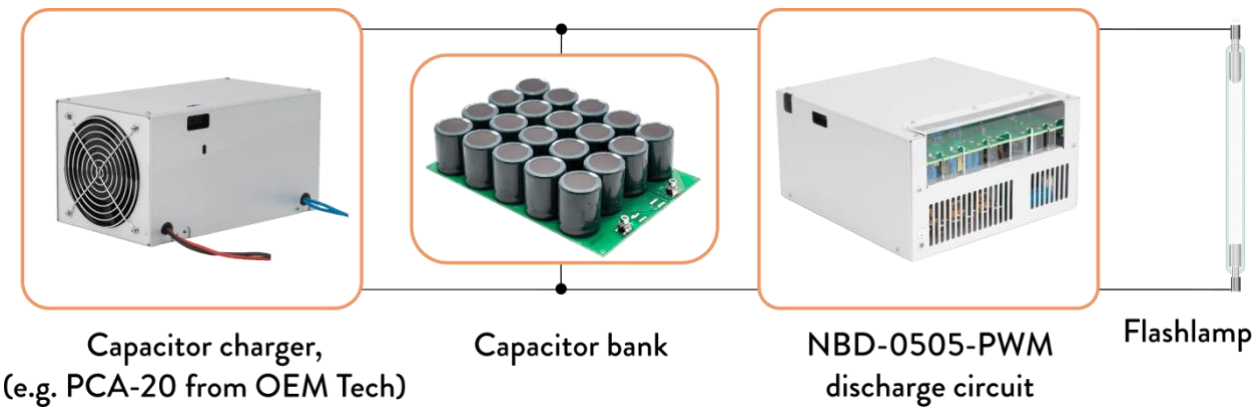
The NBD-0505-PWM discharge circuit is designed to simplify the development of IPL and/or solid-state laser systems. The module forms flashlamp pulses of rectangular or quasi-rectangular shape using the energy stored in an external capacitors bank. The module includes an IGBT, its driver, protective circuits, 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)

It's important to emphasise that the NBD-0505-PWM discharge circuit is not a stand-alone solution. It requires a capacitor charging power supply and a capacitor bank, as well as some minor parts and controls to operate properly.



The 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

Appearance

Cooling

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

Inductance coil

The PWM mode is realized with an integrated inductor of 80uH inductance. No external inductance coil is required.

Contents of delivery

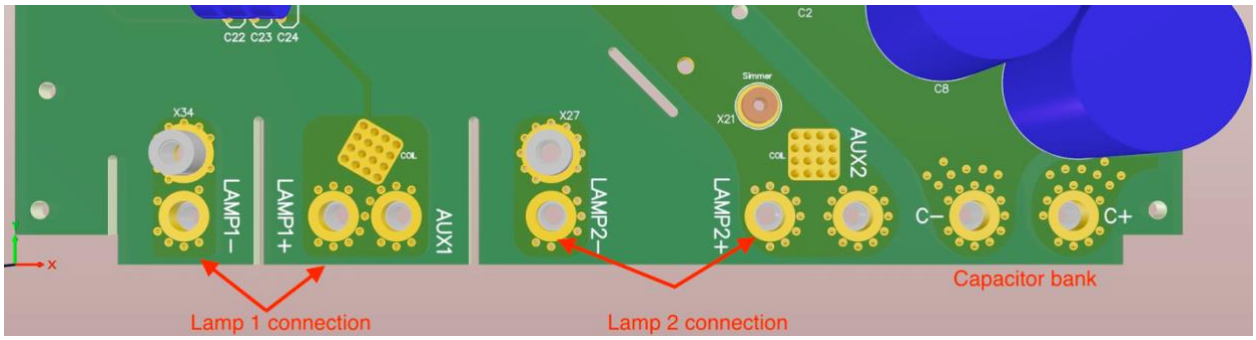
By default, the delivery package contains the NBD-0505-PWM module only.

The following standardized set of cables can be purchased optionally:

- Flashlamp connection cable – 4pcs (150cm each)
- Capacitor connection cable – 2pcs (30cm each)
- 24VDC cable – 1pc (50cm)
- INTERFACE cable – 1pc (50cm)

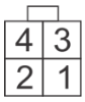
A customized delivery content is available on request.

Connections, signals, signal descriptions



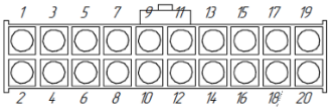
DESIGNATION	TYPE	DESCRIPTION / LAYOUT
24V DC	Molex MiniFit 2x2 Male	Low voltage power supply connection
INTERFACE	Molex C-Grid III 2x10 Male	Interfaces and controls
LAMP 1 +	M5 thread	Channel 1 (PWM) – Handpiece 1 connections (flashlamp anode "+", cathode "-")
LAMP 1 –	M5 thread	
LAMP 2 +	M5 thread	Channel 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 following 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* when no voltage is applied to *PIN10*. In this state the capacitor bank continuously discharges through internal 5kOhm 250W resistors. Be careful, while *Discharge* is *ON* the capacitor charging is prohibited and the capacitor charging power supply must be disabled. Once +5V DC voltage is applied to *PIN10* (*Discharge* is *OFF*) the module can be operated in the regular way.
11 (white/blue mark)	**Simmer Sensor**	Indicates whether or not simmer discharge is established: • *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 the NBD-0505-PWM is to be run in current stabilization mode, the Current Program should be set to the desired value **and** the Voltage Program should either be set higher than the maximum expected voltage in Channel 1 (e.g. set to 5V) or pulled to ground (0V) • if Handpiece 2 (Free-discharge) is selected, Current Program should be set higher than the 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 showing instantaneous 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 the NBD-0505-PWM is to be run in voltage stabilization mode, the Voltage Program should be set to the desired value **and** the Current Program should either be set higher than the maximum expected current in Channel 1 (e.g. set to 5V) or pulled to ground (0V) • if Handpiece 2 (Free-discharge) is selected, Current Program should be set higher than the maximum expected current in Channel 2 (e.g. 8V) **and** Voltage Program should be set to 0V
18 (yellow)	**Voltage Monitor**	Real-time signal showing instantaneous 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 outputs

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 power circuits.

Module must be protectively grounded using the 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 fixed in place and all electrical connections must be properly attached
- The NBD-0505-PWM discharge circuit is designed to be installed inside a properly grounded metal enclosure. 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 (example)

Let's assume we want to operate *Channel 1, PWM, current stabilization, 200A*. In this case the operating instructions are as follows:

1. Disconnect the entire setup from the mains
2. Connect to the NBD-0505-PWM:
   - low voltage power supply
   - capacitor bank
   - flashlamp (to Channel 1)
   - your control device (to INTERFACE connector)

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

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

To power down NBD-0505-PWM and discharge capacitor bank:

1. *Turn off* or *Disable* your capacitor charging power supply (important!)
2. *Disable* simmer supply
3. Set 0V on *Pin 10* of *INTERFACE* connector to switch on capacitor bank discharging. Wait for the complete discharge of capacitors.

Warning! If the capacitor bank capacitance is enormously high, this might lead to the overheating of the discharge resistors used in the system.

4. Remove *+24V DC* power from the module.

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. discharge current (depends on flashlamp impedance K0)	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)	Approx. 275x260x145mm (see also the dimensional drawing below)
Weight	Approx. 9.0 kg (w/o cables)

How to order? / Options

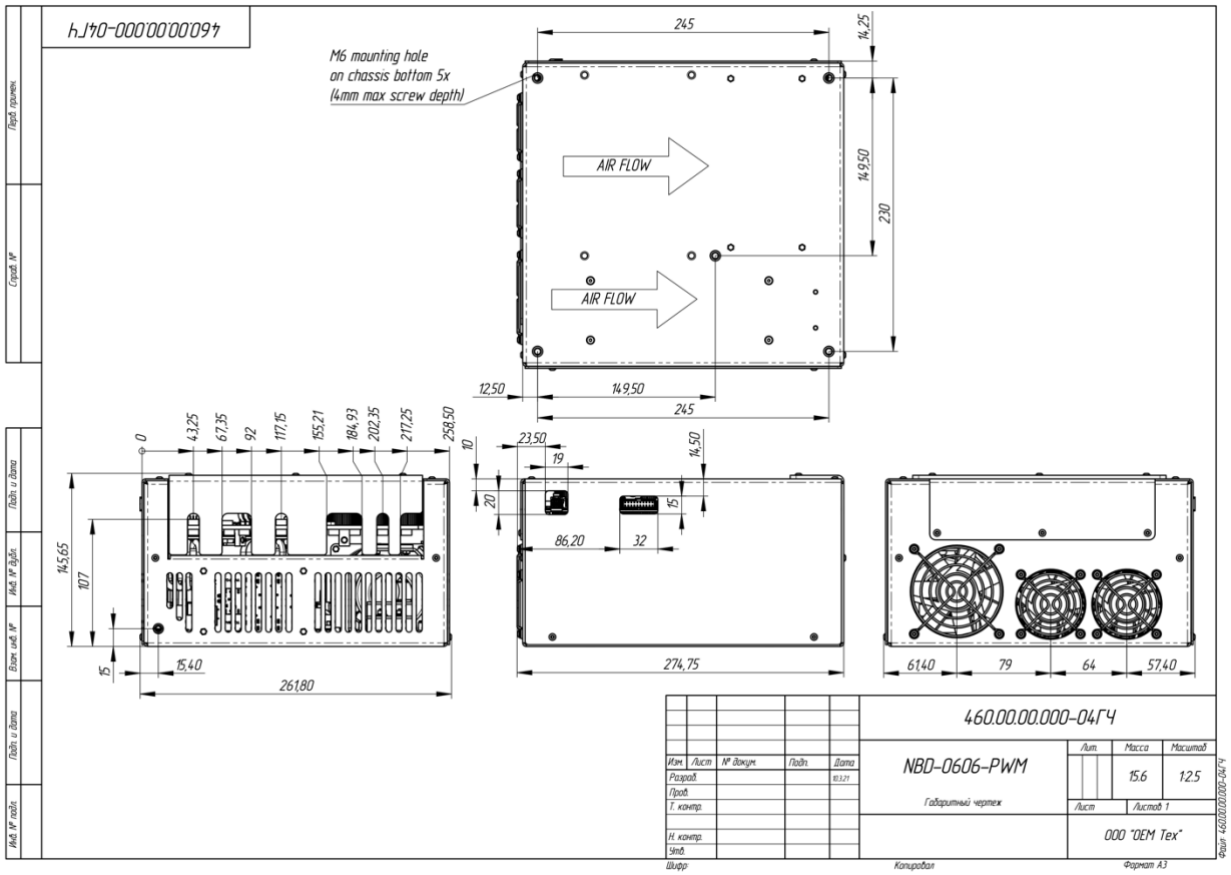
By default, there is the only standard part number, namely NBD-0505-PWM.

The following options are available on request:

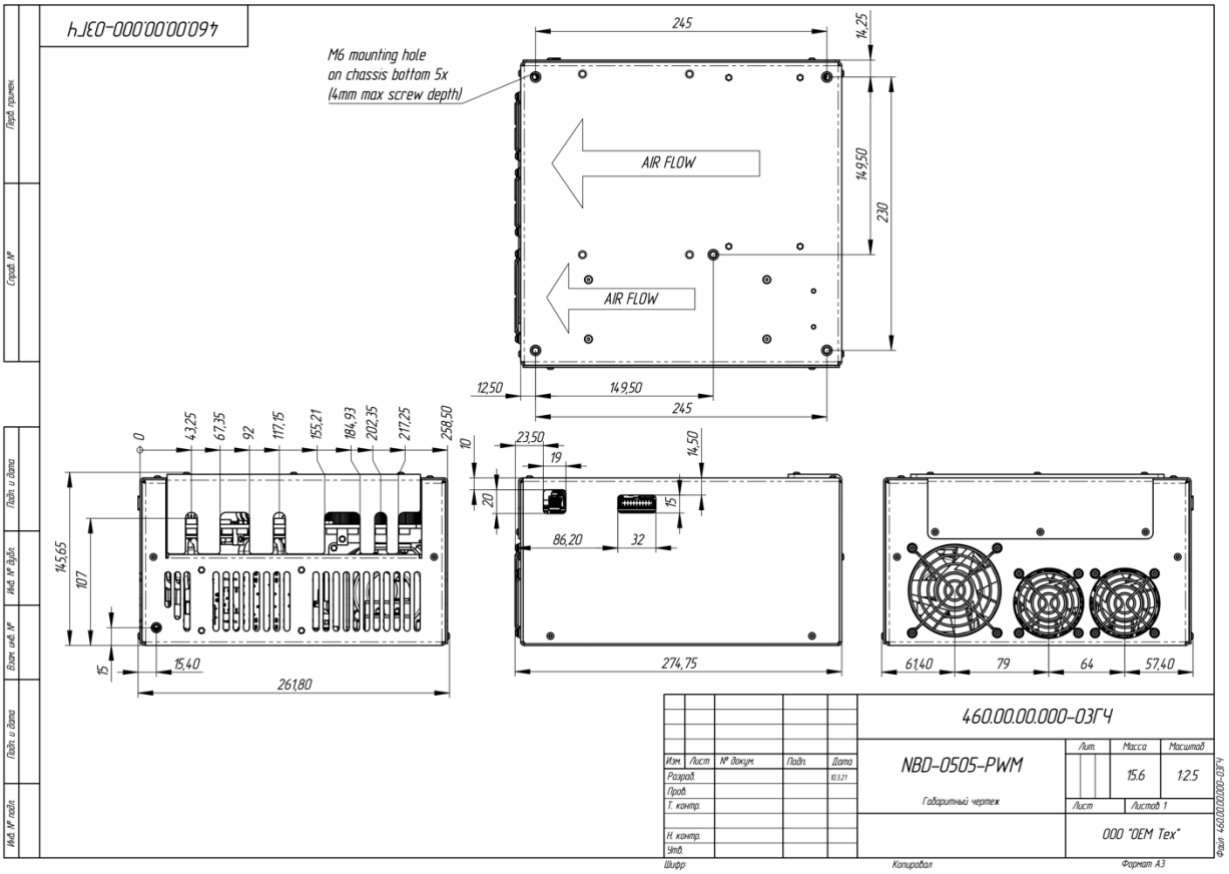
- Air flow direction
- Realization of PWM and free-discharge as switched operating regimes in the only output
- Extended parameters – higher power / current / voltage at higher cost
- Reduced parameters – lower power / current / voltage at lower cost
- Digital RS-232 / RS-485 interface
- Modified cables
- Modified simmer and / or trigger parameters

Dimensional drawing

STANDARD VERSION



REVERSED AIR FLOW VERSION



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