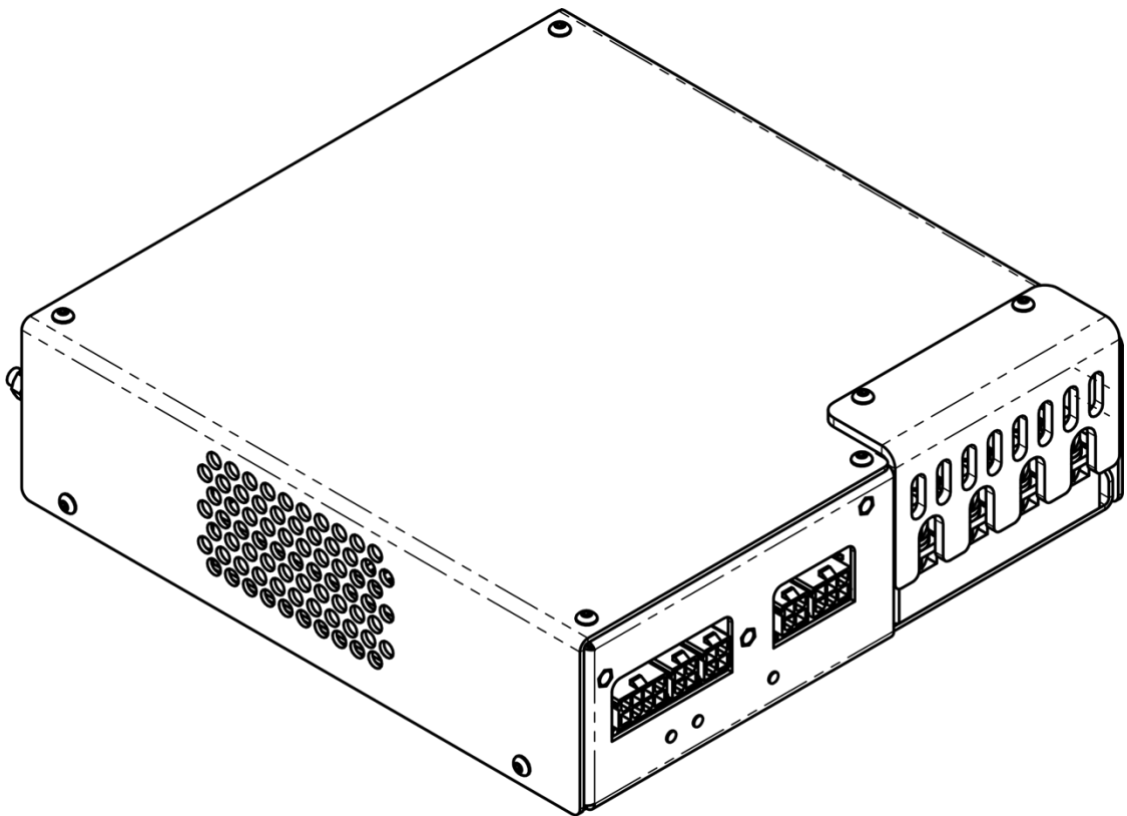


# NBU-1012 discharge circuit

## User manual

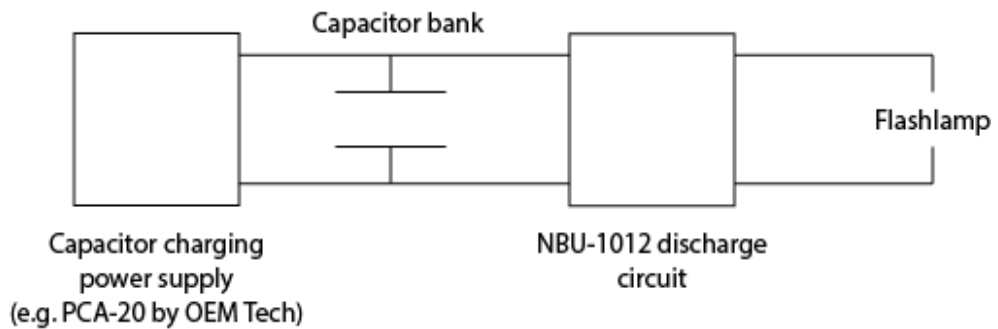


## Overview / Applications

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NBU-1012 discharge circuit is designed for simplification of solid-state laser systems development. Module forms flashlamp pulses of 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.

Let us emphasize, NBU-1012 isn't a stand-alone solution. For proper operation it requires capacitor charging power supply and capacitor bank as well as some minor parts and controls.



By default NBU-1012 includes capabilities both for serial and external triggering (See *Triggering* section for details). Simplified as well as more complicated modifications are available on request.

## Cooling

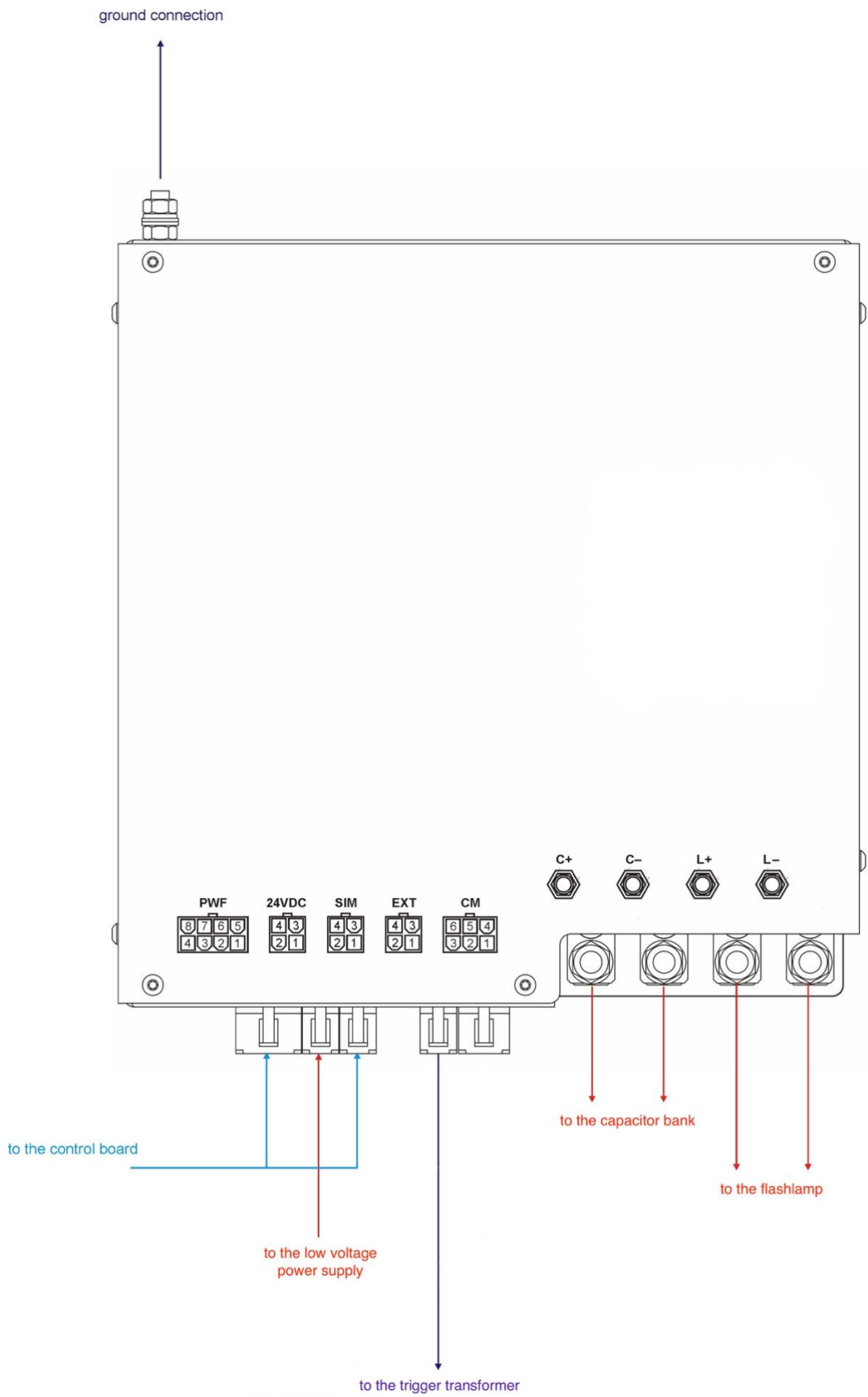
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Module is cooled with built-in fan.  
No external cooling is required.

## Appearance

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## Connections, signals, signal descriptions

### CAPACITOR BANK CONNECTIONS: M6 studs

- C+ – to the capacitor bank positive
- C– – to the capacitor bank negative

### FLASHLAMP CONNECTIONS: M6 studs

- L+ – to the flashlamp positive (i.e. to the flashlamp anode)
- L– – to the flashlamp negative (i.e. to the flashlamp cathode)

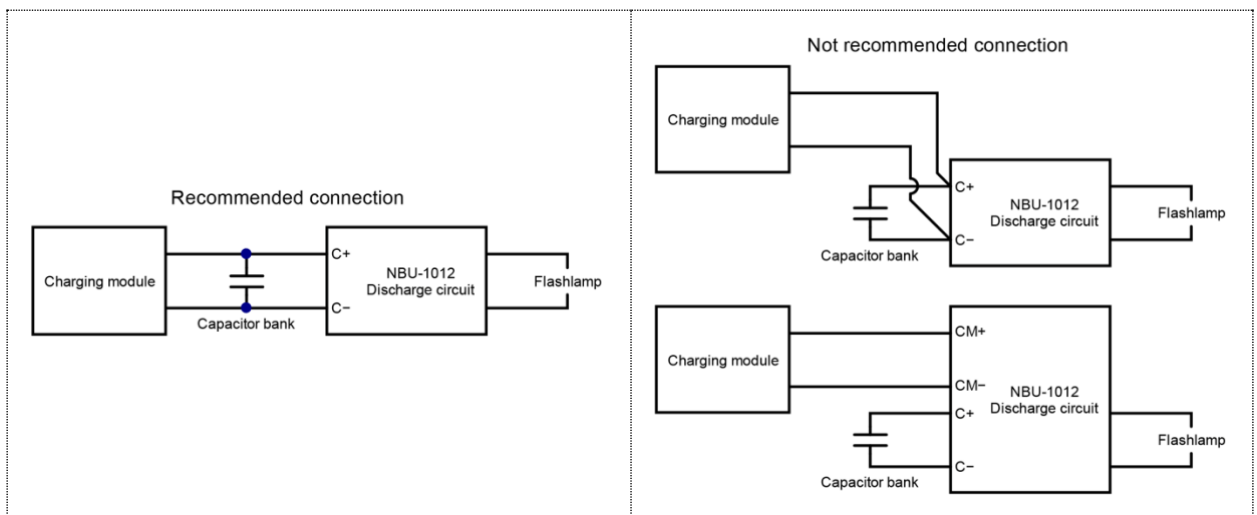
### CM (TO BE LEFT UNCONNECTED): Molex 39-30-1060

CM is an alternative connection point of the capacitor charging power supply (see pictures below). We do not recommend to use this connector in new developments. At now the connector is left only for the compatibility purposes and might be discontinued in next revisions of NBU-1012.

6	5	4
3	2	1

PIN (color)	DESIGNATION	DESCRIPTION
1, 2, 3 (red)	CM Positive	To the capacitor charging power supply positive
4, 5, 6 (black)	CM Negative	To the capacitor charging power supply negative

**Note:** we recommend to connect capacitor charging power supply neither to the CM connector nor to C+/C– terminals, but straight to the capacitor bank.



## 24VDC (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 NBU-1012 as well as to the integrated simmer supply module Voltage: 24V DC Current: 5A max (up to 10A peak)
3, 4 (black)	+24V DC Return	Return of 24V DC power supply

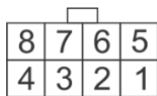
## EXT (TO THE TRIGGER TRANSFORMER): Molex 39-30-1040

By default NBU-1012 supports both serial and external methods of triggering. To use NBU-1012 for external triggering, a trigger transformer should be connected to the EXT connector. If EXT connector is left unconnected, NBU-1012 automatically recognizes this and applies serial triggering to the flashlamp (see also *Triggering* section for details).



PIN (color)	DESIGNATION	DESCRIPTION
1, 2	N/A	-
3 (red)	Positive EXT	Positive of the trigger transformer primary winding
4 (black)	Negative EXT	Negative of the trigger transformer primary winding

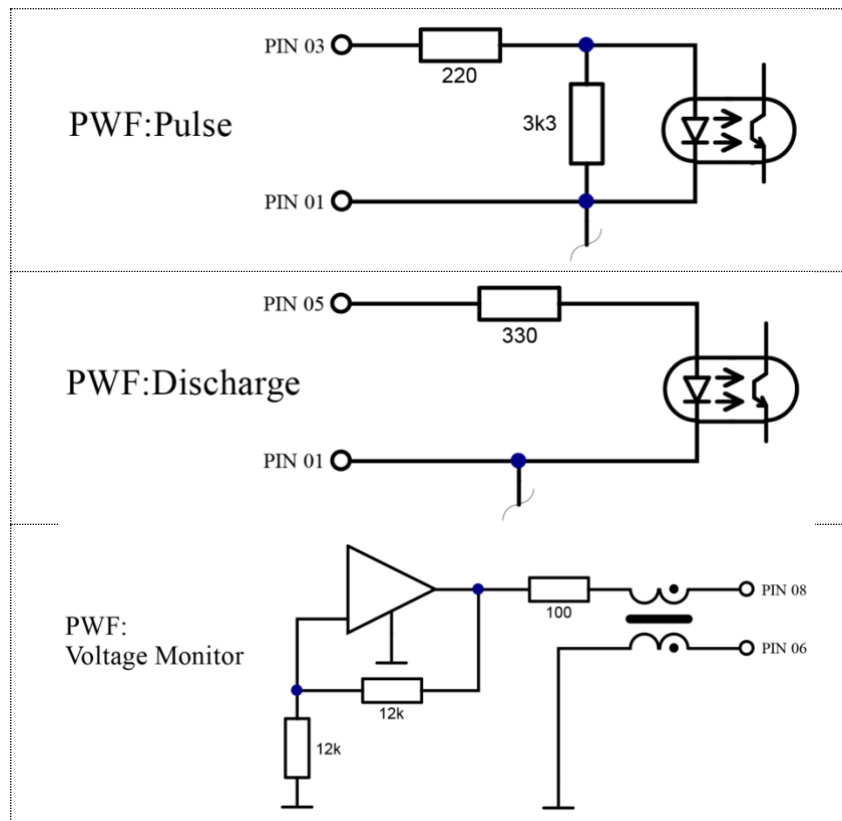
## PWF (PULSE CONTROL): Molex 39-30-1080



PIN (color)	DESIGNATION	DESCRIPTION
1 (black)	Interface Return	Return <i>Pulse</i> and <i>Discharge</i> signals
2, 4, 7	Not Connected	-
3 (orange)	Pulse	Duration of +5V TTL pulse at <i>PIN3</i> completely defines IGBT-key open state time and, as consequence, flashlamp pulse duration
5 (green)	Discharge	While 0V voltage is applied to <i>PIN5</i> (or <i>PIN5</i> is unconnected), i.e. while <i>Discharge</i> is <i>ON</i> , capacitor battery is continuously discharging on internal 4kOhm 200W resistors. Be careful, while <i>Discharge</i> is <i>ON</i> the capacitor charging is prohibited and capacitor charging power supply must be disabled.

		While +5V voltage is applied to <i>PIN5 (Discharge is OFF)</i> module can be operated in the regular way.
<b>6 (blue)</b>	<b>Monitor Return</b>	Return of the <i>Voltage Monitor</i> signal
<b>8 (red)</b>	<b>Voltage Monitor</b>	Voltage measured at <i>PIN8</i> is a monitor signal proportional to the voltage on the capacitor bank 0V at <i>PIN8</i> corresponds to 0V on capacitor bank; 10V at <i>PIN8</i> corresponds to maximum voltage value (1000V by default) on capacitor bank

### PWF CIRCUITS:



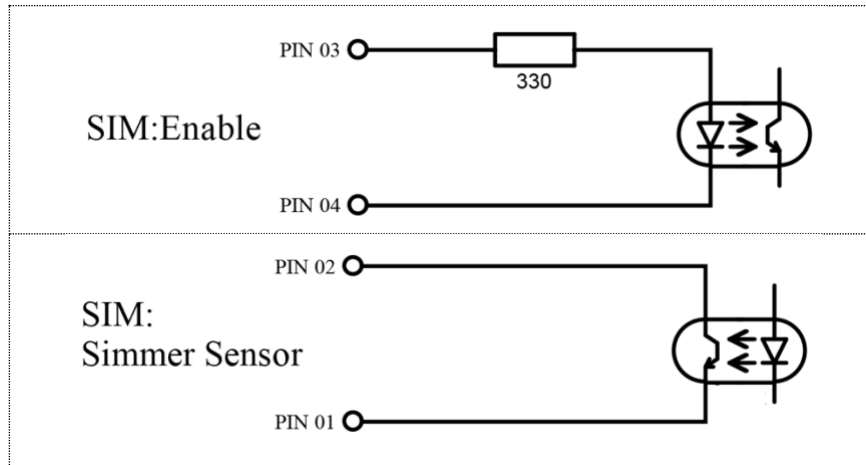
### SIM (SIMMER SUPPLY CONTROL): Molex 39-30-1040



<b>PIN (color)</b>	<b>DESIGNATION</b>	<b>DESCRIPTION</b>
<b>1 (violet)</b>	<b>Sensor Return</b>	Return of the <i>Simmer Sensor</i> signal
<b>2 (yellow)</b>	<b>Simmer Sensor</b>	<i>Simmer Sensor</i> circuit is closed while simmer current flows through flashlamp and is open while simmer current is absent
<b>3 (red)</b>	<b>Enable</b>	Once +5V voltage is applied to <i>PIN3</i> integrated simmer supply tries to strike and maintain low-current discharge (simmer) in the flashlamp.

		If flashlamp triggering is failed simmer supply module tries to trigger it again with a few Hertz repetition rate. After successful triggering the simmer supply can support up to 800mA flashlamp current (500mA is a preset by default). Simmer will be maintained until 0V is applied to <i>PIN3</i> .
<b>4 (black)</b>	<b>Enable Return</b>	Return <i>Simmer Enable</i> signal

### SIM CIRCUITS:



### LEDS:

There are three LEDs located on NBU-1012 front panel and indicating its internal states.



Discharge LED – is ON while the *Discharge* is ON

Overheat LED – is ON while critical components of NBU-1012 (IGBT switch and discharge resistors) are overheated

Warning LED – reserved for the future use (non-functional at the moment)

## Safety

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**Warning!** This equipment produces high voltages that can be very dangerous. Don't be careless around this equipment.

- During operation all the protective covers of the equipment must be securely in place and all electrical connections must be properly attached
- NBU-1012 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 NBU-1012, especially CM Positive/Negative, C+/C-, L+/L- 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 the DC power source before making or changing electrical or mechanical connections.
- **Don't remove protective covers!** There are no user serviceable parts inside this equipment.



## Operations

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1. Connect capacitor charging power supply, +24V DC power supply, capacitor battery and flashlamp to NBU-1012 module
2. Set +5V voltage on *PIN5* of *PWF* to switch off capacitor bank discharging

**Warning!** By default capacitor discharging is on.

Be careful and always switch off capacitor discharging before turning on your capacitor charging module.

Otherwise it may lead to capacitor charging module failure caused with open-circuit operations

3. *Disable* simmer supply (*PIN3* of *SIM*)
4. Apply +24V DC power to the module
5. *Enable* your capacitor charging power supply (charging module). As soon as charging module starts operation, capacitors are charged
6. *Enable* simmer supply (set +5V on *PIN3* of *SIM*)
7. Wait a few seconds for *Simmer Sensor*. If it fails shut down your system
8. *Disable* your capacitor charging power supply before pulse

Note that PCP-series and PCA-series power supplies by OEM Tech are well-protected and it isn't obligatory to disable them. We recommend you do not disable PCP (PCA) at high on-off time ratio

9. Set +5V TTL pulse on *PIN3* of *PWF*. This pulse duration defines IGBT-key open state time and flashlamp pulse width.
10. *Enable* your power supply after pulse
11. Repeat #8-#10

To power down NBU-1012 and discharge capacitor battery

1. *Turn off* or *Disable* your capacitor charging power supply (important!)
2. *Disable* simmer supply
3. Set 0V on *PIN5* of *PWF* to switch on capacitor bank discharging. Wait for complete discharge of capacitors.

**Warning!** If the capacitor bank capacitance is enormously high, this might lead to the overheating of the discharging resistors. However, they are protected with OverTemp protection.

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

## Specifications

### ELECTRICAL

<b>+24VDC:</b>	
Voltage regulations	+24 V DC
Maximum power consumption	5A max, up to 10A peak
<b>PULSE PARAMETERS:</b>	
Max. voltage	1000 V ( <i>other on request</i> )
Max. discharge current (depends on flashlamp impedance K0)	1000 A for pulse width < 1 ms 500 A for pulse width > 1 ms ( <i>other on request</i> )
Max. average power	2000 W ( <i>other on request</i> )
Min. pulse width, max. pulse width	Accordingly to <i>PWF:Pulse</i> signal
Max. rep. rate	100 Hz ( <i>up to 200Hz on request</i> )
<b>RECOMMENDED WIRES:</b>	
For capacitor bank connections	FLEXI-2V or similar (>1000V rated voltage, >4mm <sup>2</sup> cross-section), short length (30cm recommended)
For flashlamp connections	For external triggering – FLEXI-2V or similar (>1000V rated voltage, >4mm <sup>2</sup> cross-section) For serial triggering additional insulation (e.g. with silicone tubing) or spacing (e.g. with spiral bundle hose) of L– wire is required
<b>SIMMER PARAMETERS</b>	
Simmer current	500 mA ( <i>100-800 mA on request</i> )
Max output voltage	300 V
Max output power	100 W
Open circuit voltage	1500 V
<b>FLASHLAMP TRIGGERING PARAMETERS</b>	
Trigger pulse width	~1 us
Restrike rate	A few Hertz (automatically adjusted)
<b>EXTERNAL:</b>	
Pulse energy / trigger voltage	~20mJ / 350V positive to the EXT connector ( <i>other on request</i> )
Trigger transformer	External transformer (purchased separately) Recommended p/n ZS1324-24V LUL1(H) by

	Excelitas Technologies (Digikey p/n ZS1324-24VLUL1(H)-ND)
<b>SERIAL:</b>	
Pulse energy / trigger voltage	~160mJ / 10kV negative to L– ( <i>other on request</i> )
Trigger transformer	Integrated transformer
<b>Cooling</b>	Forced air cooling with built-in fan
<b>Protections</b>	
From overheating of internal components	
<b>Environment:</b>	
Operation temperature	0 ... +40 °C
Storage temperature	-20 ... +60 °C
Humidity	90%, non-condensing

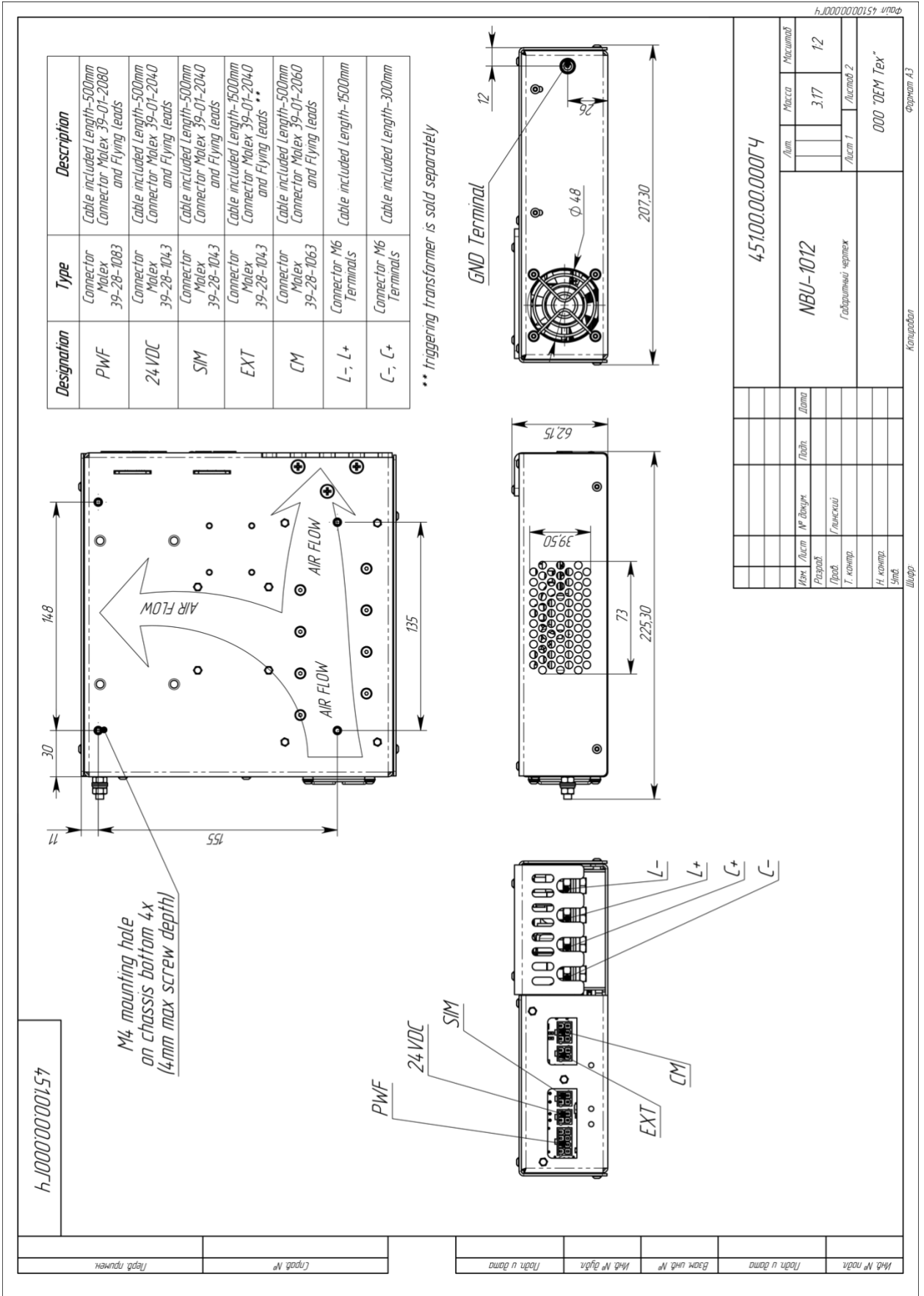
### MECHANICAL

<b>Size (LxWxH)</b>	See dimensional drawing below
<b>Weight</b>	Approx. 2.0 kg (w/o cables)

### CABLE SET SUPPLIED WITH NBU-1012

<b>Cables</b>	See dimensional drawing below
<b>Trigger transformer for external triggering</b>	Sold separately

# DIMENSIONAL DRAWING



## How to order? / Options

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By default there is the only standard part number, namely NBU-1012.

On request the next options are available:

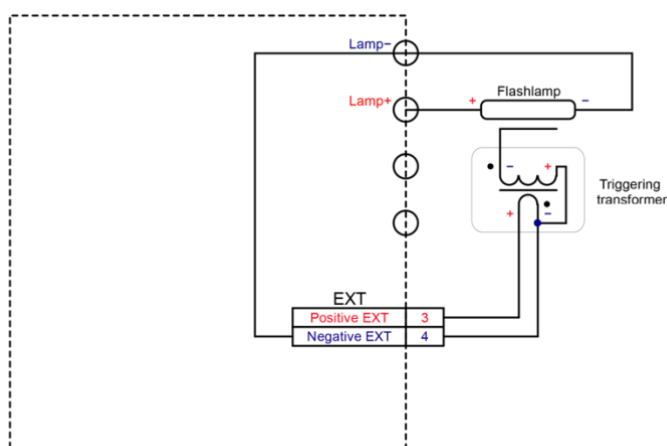
- Integrated current sensor
- High power / current / voltage IGBT with extended parameters
- Low power / current / voltage IGBT with reduced cost
- Digital RS-232 / RS-485 interface
- Modified cables
- Modified simmer and / or trigger parameters

## Triggering. Serial triggering, external triggering, triggering basics

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By default NBU-1012 supports both serial and external methods of triggering.

To use NBU-1012 for external triggering, a trigger transformer should be connected to the EXT connector.



Default parameters of external triggering are (other on request):

- 350V voltage (applied to EXT connector)
- ~20mJ energy
- Recommended transformer (sold separately) – 1:70 e.g. *ZS1324-24V LUL1(H)* by Excelitas Technologies (Digikey p/n *ZS1324-24VLUL1(H)-ND*)

If EXT connector is left unconnected, NBU-1012 automatically recognizes this and applies serial triggering to the flashlamp.

Default parameters of serial triggering are (other on request):

- 10kV voltage (applied to L-)
- ~160mJ energy

# NBU-1012 block diagram

