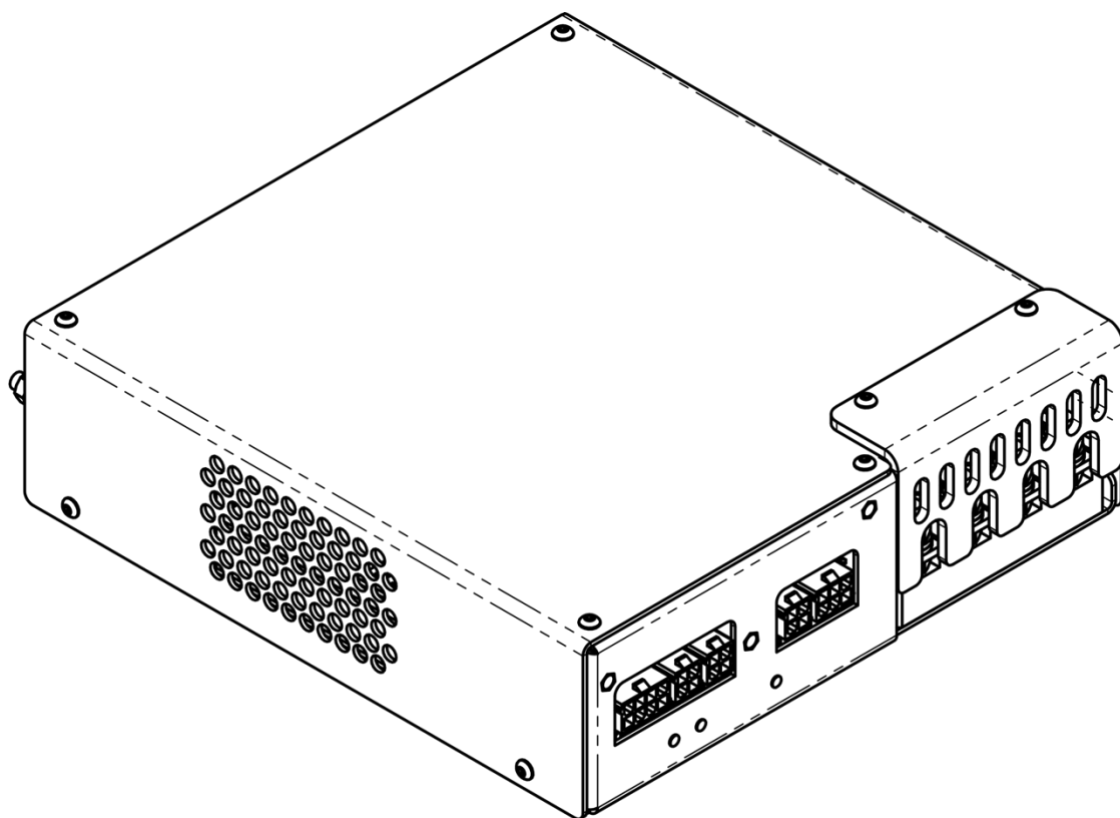


NBU-1012 discharge circuit

User manual



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

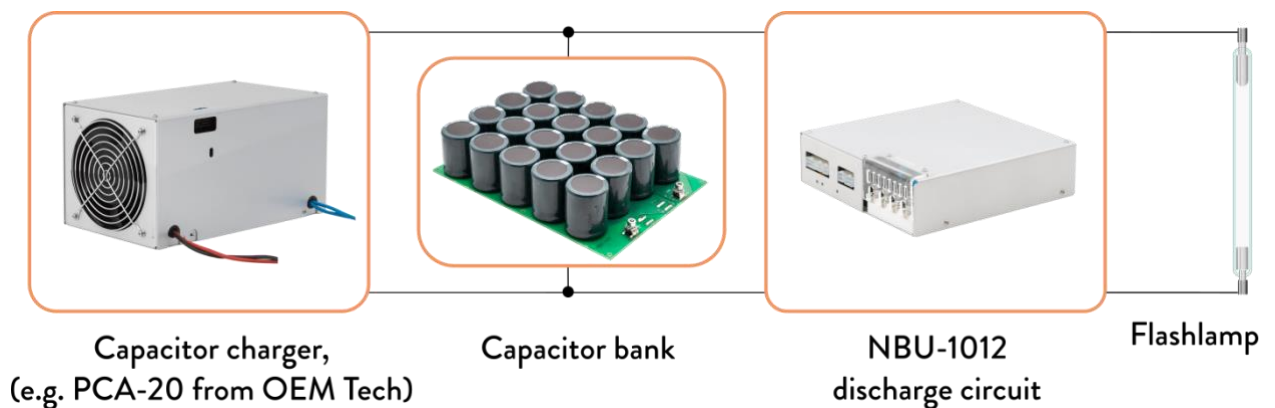
Table of contents

Table of contents	2
Overview / Applications.....	3
Appearance	3
Cooling	4
Contents of delivery	4
Connections, signals, signal descriptions	5
Safety	10
Operations.....	11
Specifications	12
Dimensional drawing.....	14
How to order?	15
Comparison with NBU-1112.....	16
Triggering (series triggering, external triggering, triggering basics)	17
NBU-1012 block diagram	18

Overview / Applications

The NBU-1012 discharge circuit is designed to simplify the development of solid-state laser systems. The module forms quasi-rectangular pulses on a flashlamp using energy stored in an external capacitors bank and supplies simmer current during the intervals between pulses. The module includes an IGBT with its driver, protective circuits, simmer and trigger circuits, fast discharge resistors and control electronics.

It's important to emphasize that the NBU-1012 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.



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

Appearance



Cooling

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

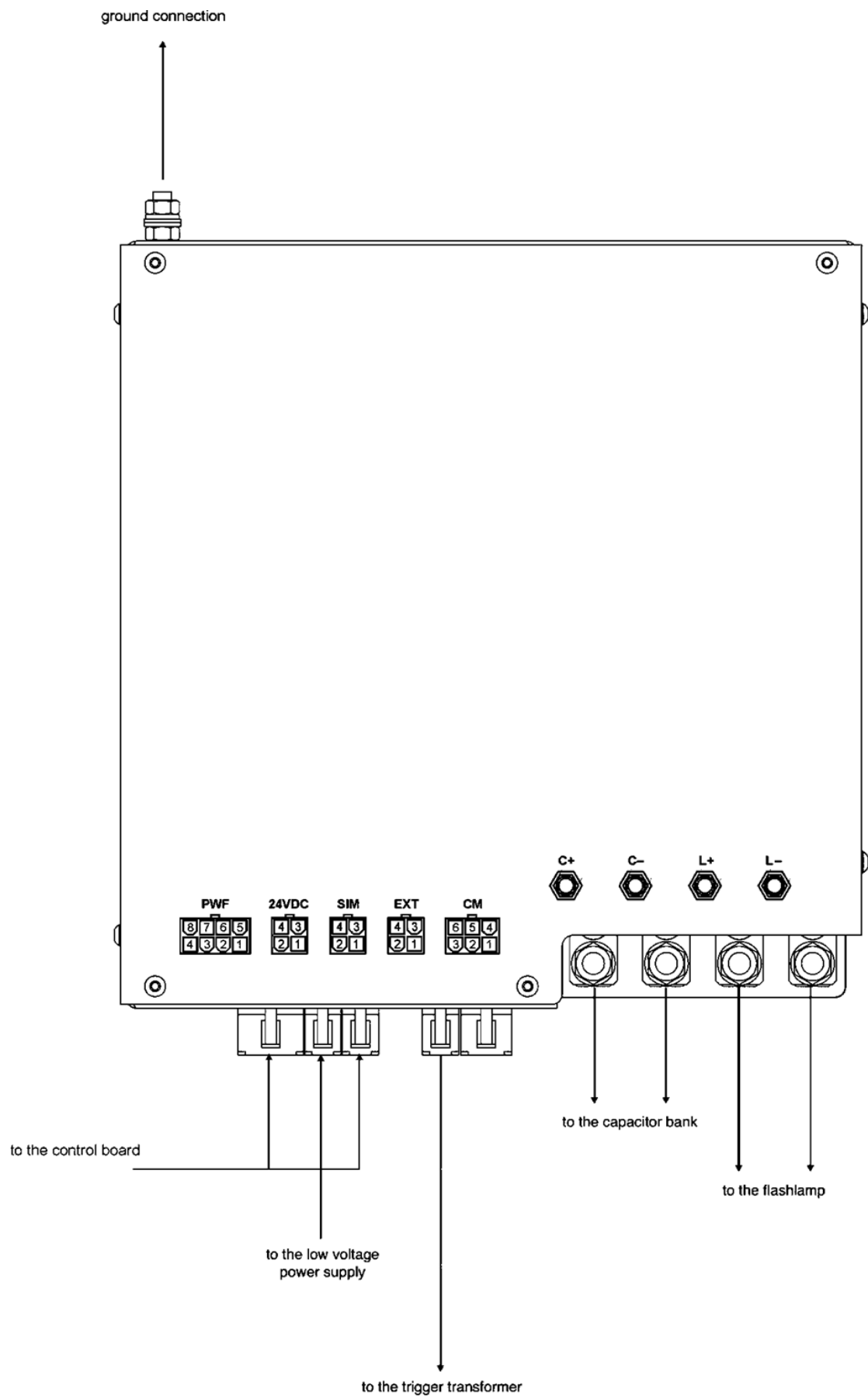
Contents of delivery

By default, the delivery package contains the following parts:

- NBU-1012 discharge circuit – 1pc
- Flashlamp connection cable – 2pcs (150cm each)
- Capacitor connection cable – 2pcs (30cm each)
- External trigger transformer connection cable (without trigger transformer) – 1pc (150cm)
- 24VDC cable – 1pc (50cm)
- SIM cable – 1pc (50cm)
- PWF cable – 1pc (50cm)

A CM cable and a trigger transformer cannot usually be supplied.
Customized delivery content is available on request.

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 anode

L– – to the flashlamp cathode

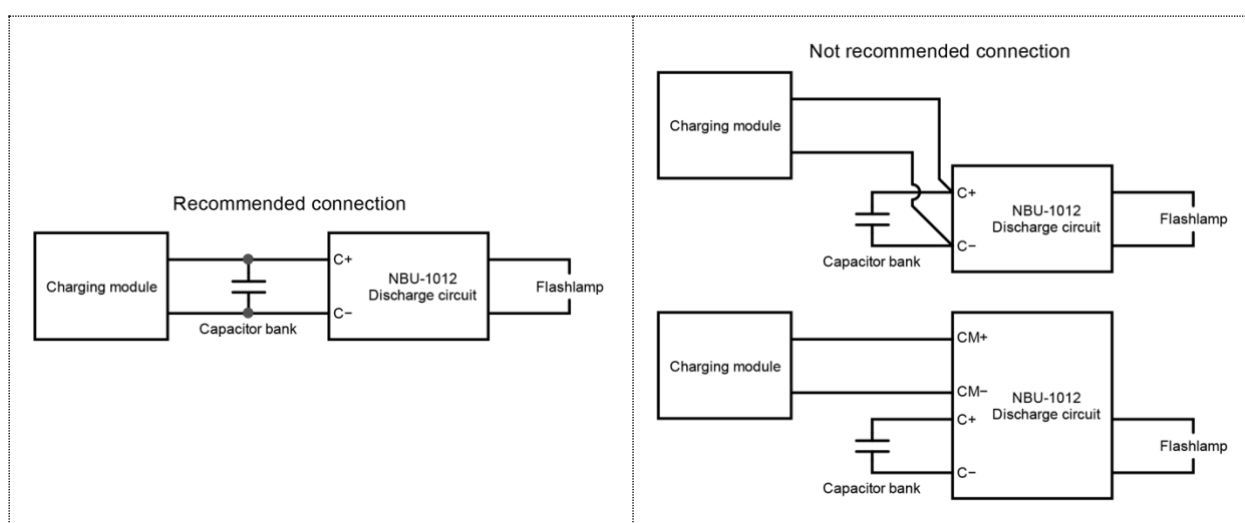
CM (TO BE LEFT UNCONNECTED): Molex 39-30-1060

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 the 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 the capacitor charging power supply neither to the CM connector nor to C+/C– terminals, but directly to the capacitor bank.



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

4	3
2	1

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

4	3
2	1

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

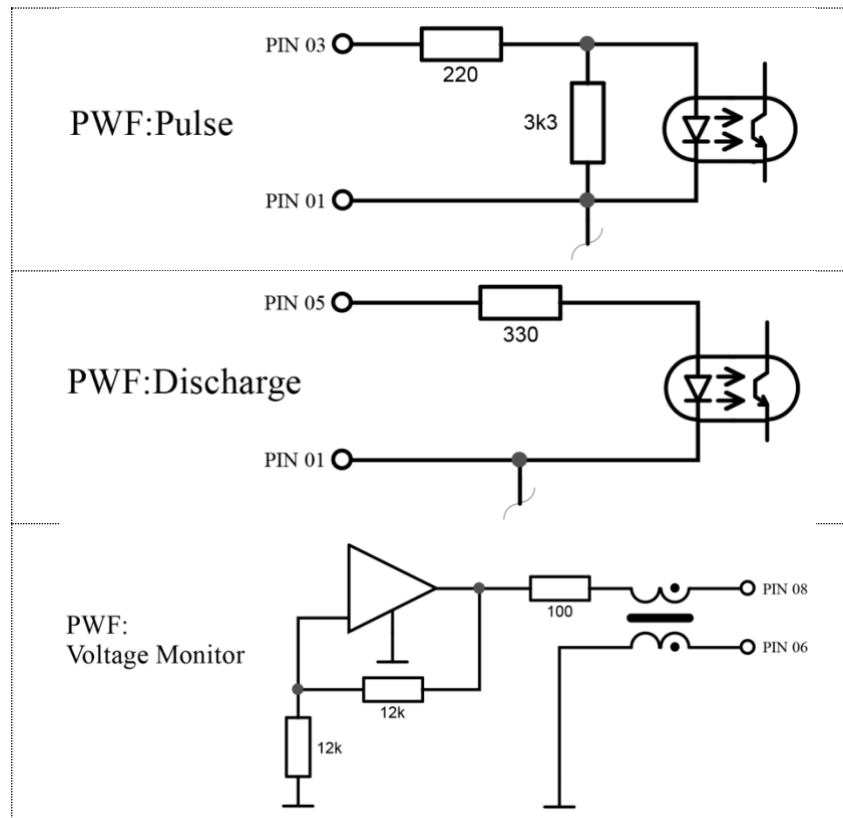
PWF (PULSE CONTROL): Molex 39-30-1080

8	7	6	5
4	3	2	1

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 a consequence, the flashlamp pulse duration
5 (green)	Discharge	When no voltage is applied to <i>PIN5</i> (or <i>PIN5</i> is unconnected), i.e. while <i>Discharge</i> is <i>ON</i> , the capacitor bank continuously discharges through 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</i> (<i>Discharge</i> is <i>OFF</i>) module can be operated in the regular way.
6 (blue)	Monitor Return	Return of the <i>Voltage Monitor</i> signal
8 (red)	Voltage Monitor	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 the capacitor bank; 10V at <i>PIN8</i> corresponds to maximum voltage value (1000V by default) on the capacitor bank

PWF CIRCUITS:



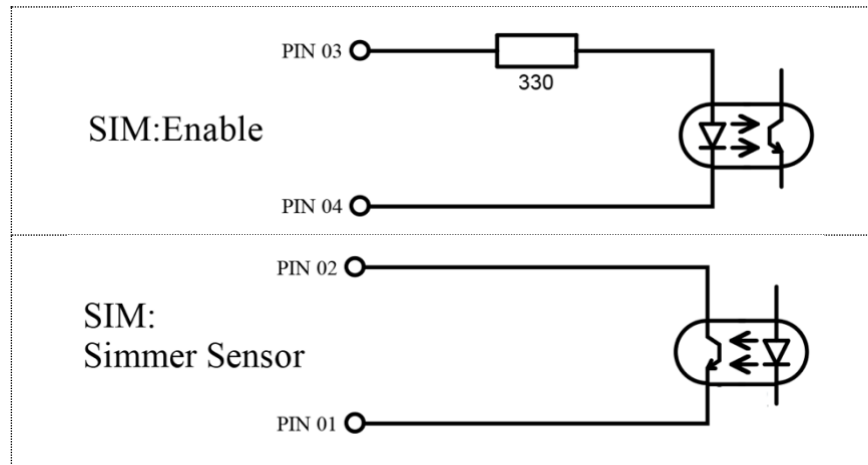
SIM (SIMMER SUPPLY CONTROL): Molex 39-30-1040



PIN (color)	DESIGNATION	DESCRIPTION
1 (violet)	Sensor Return	Return of the <i>Simmer Sensor</i> signal.
2 (yellow)	Simmer Sensor	The <i>Simmer Sensor</i> circuit is closed while simmer current flows through the flashlamp and is open while simmer current is absent.
3 (red)	Enable	Once a +5V voltage is applied to <i>PIN3</i> , the integrated simmer supply will attempt to strike and maintain a low-current discharge (simmer) in the flashlamp. If the flashlamp triggering fails, the simmer supply module will attempt to trigger it again at a few Hertz repetition rate. After a 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> .
4 (black)	Enable Return	Return of the <i>Simmer Enable</i> signal.

SIM CIRCUITS:



LEDS:

There are three LEDs on the front panel of NBU-1012 that indicate its internal status.



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

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

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

GND: M5 STUD

The module should be grounded using this stud.

Grounding should be carried out before the module is powered up.

Safety

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

- During operation, all protective covers of the equipment must be securely fixed in place, and all electrical connections must be properly secured.
- The NBU-1012 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 NBU-1012, especially CM Positive/Negative, C+/C–, L+/L– connectors and cables. **Accidental contact could be fatal!**
- After shutdown, do not handle the capacitive load until it has been fully discharged. Use an appropriate meter to verify complete discharge.
- Disconnect the module from the DC power source before making or changing any electrical or mechanical connections.
- **Don't remove protective covers!** There are no user-serviceable parts inside this equipment.

Operations

A typical start-up sequence for the NBU-1012 is given below:

1. Connect your capacitor charging power supply, the +24V DC power supply, the capacitor bank and your flashlamp to the NBU-1012 module
2. Set +5V voltage on the *PWF PIN1* to switch off the capacitor bank discharging

Warning! By default, the capacitor discharge is switched 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* connector)
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* connector)
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* connector. 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 the NBU-1012 and discharge the capacitor bank:

1. *Switch off* or *Disable* your capacitor charging power supply (important!)
2. *Disable* simmer supply
3. Set 0V on *PIN5* of *PWF* connector to switch on capacitor bank discharging. Wait for the complete discharge of the 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 the +24V DC power from the module.

Specifications

ELECTRICAL

+24VDC:	
Voltage regulations	+24V DC
Maximum power consumption	5A max., up to 10A peak
PULSE PARAMETERS:	
Max. voltage	Several modifications up to 1300V (see also <i><u>How to order?</u></i> section)
Max. discharge current (depends on flashlamp impedance K0)	1000A for pulse width < 1ms 500A for pulse width > 1ms (<i>other on request</i>)
Max. average power	2000W (<i>other on request</i>)
Min. pulse width, max. pulse width	Accordingly to <i>PWF:Pulse</i> signal
Max. rep. rate	100Hz (<i>up to 200Hz on request</i>)
RECOMMENDED WIRES:	
For capacitor bank connections	FLEXI-2V or similar (>1000V rated voltage, >4mm ² cross-section), short length (30cm recommended)
For flashlamp connections	For external triggering – FLEXI-2V or similar (>1000V rated voltage, >4mm ² cross-section) For series triggering additional insulation (e.g. with silicone tubing) or spacing (e.g. with spiral bundle hose) of L– wire is required
SIMMER PARAMETERS:	
Simmer current	500mA (<i>100-800mA on request</i>)
Max. output voltage	300V
Max. output power	100W
Open circuit voltage	1500V
FLASHLAMP TRIGGERING PARAMETERS:	
Trigger pulse width	~1us
Restrike rate	A few Hertz (automatically adjusted)
EXTERNAL:	
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 <i>ZS1324-24V LUL1(H)</i> by Excelitas Technologies (Digikey p/n <i>ZS1324-24VLUL1(H)-ND</i>)
SERIES:	
Pulse energy / trigger voltage	~160mJ / 10kV negative to L– (<i>other on request</i>)
Trigger transformer	Integrated transformer
Cooling	Forced air cooling with built-in fan
Protections	From overheating of internal components
ENVIRONMENT:	
Operation temperature	0 ... +40 °C
Storage temperature	-20 ... +60 °C
Humidity	<90%, non-condensing

MECHANICAL

Size (LxWxH)	Approx. 225x207x62mm (see also the dimensional drawing below)
Weight	Approx. 2.0kg (w/o cables)

Dimensional drawing

[illegible]

How to order?

By default, we offer a few standardized versions of NBU-1012:

P/N (version)	Description	Comments
NBU-1012 or NBU-1012-10	Standard version: - 1200V IGBT - 1000V maximum voltage - 1000A maximum current - Standard simmer board	Fits well for most of the customers
NBU-1012-13	High-voltage version: - 1700V IGBT - 1300V maximum voltage - 1000A maximum current - High-power simmer board	More expensive than standard version Recommended for driving two flashlamps connected in series Also known under its older name NBU-1012-MAX
NBU-1012-08	Optimized version: - 1200V IGBT - 800V maximum voltage - 1000A maximum current - Standard simmer board	Significantly cheaper than standard version Perfectly suits for Holmium lasers
NBU-1012-05	Low-cost version: - 600V IGBT - 500V maximum voltage - 1000A maximum current - Standard simmer board	The cheapest option Good for IPL and low-voltage laser systems

Besides, the following options are available on request:

- Modified simmer and / or trigger parameters
- Modified cables and connectors
- Customized discharge resistor assemblies
- Higher current (up to 1500A in short pulses)
- Higher operating voltage
- Higher operating power
- Digital RS-232 / RS-485 interface
- Integrated current sensor

Comparison with NBU-1112

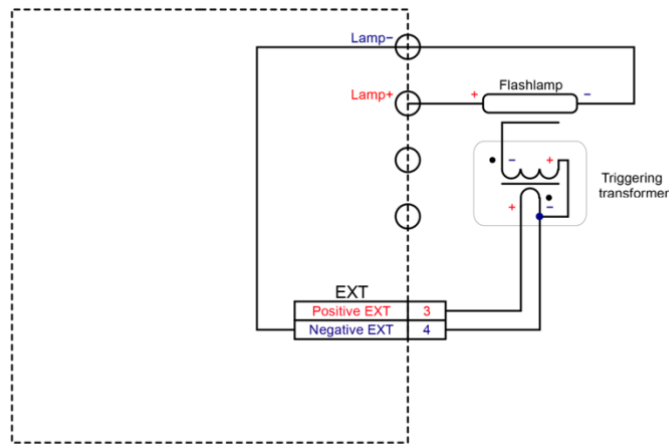
The [NBU-1112](#) and the NBU-1012 are very similar products, but there are some differences between them. The comparison is given in the table below:

Parameter	NBU-1112	NBU-1012
General comparison	[+] Newer, more technological product	[–] Older, less technological product
End of life	[=] No	[=] No
Performance	[=] Identical	[=] Identical
Price	[+] Slightly cheaper	[–] Slightly more expensive
Regulations	[+] Clear separation between high-voltage and low-voltage parts	[–] More complex internal design, the separation between high-voltage and low-voltage parts is not so obvious
Discharge resistors	[=] External, easily customizable	[=] Fixed, embedded
Dimensions (NBU only, without discharge resistors)	[+] Slightly smaller	[–] Slightly larger
Total dimensions (NBU + discharge resistors)	[–] Slightly larger	[+] Slightly smaller

Triggering (series triggering, external triggering, triggering basics)

By default, the NBU-1012 supports both series and external methods of triggering.

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



Default parameters for external triggering are (others on request):

- 350V voltage (applied to the 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 the EXT connector is left unconnected, the NBU-1012 automatically recognizes this and applies series triggering to the flashlamp.

Default parameters for series triggering are (others on request):

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

NBU-1012 block diagram

