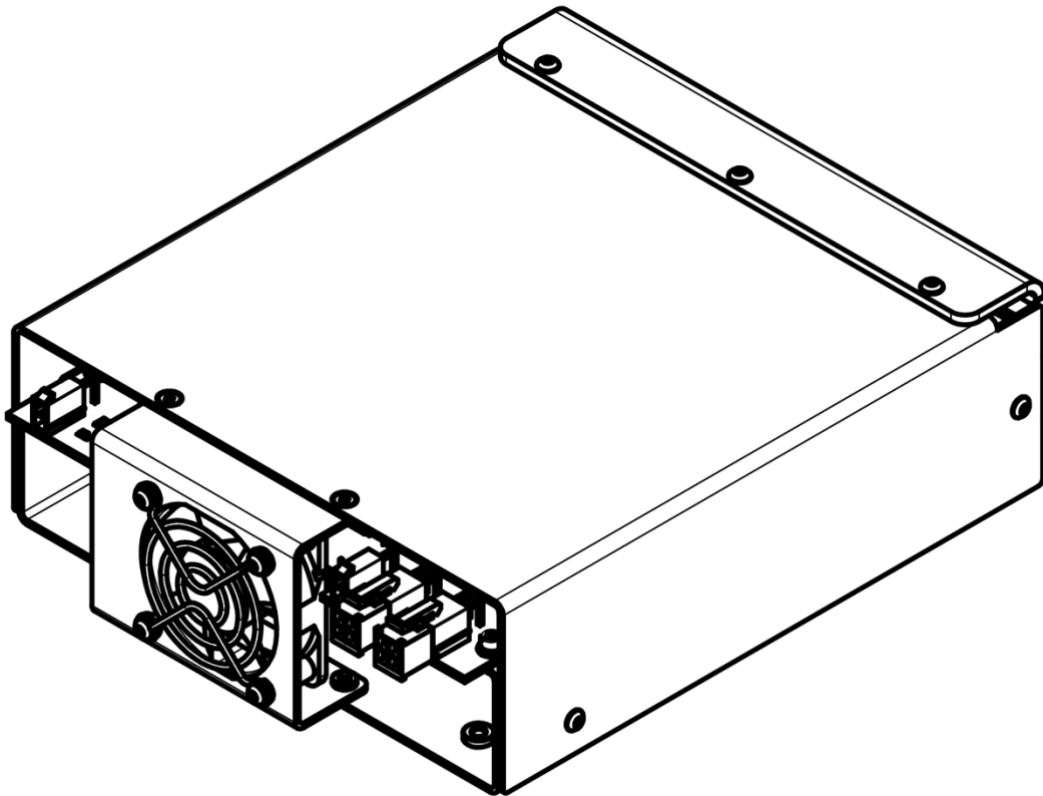


NBU-1508 thyristor-based discharge circuit

User manual



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

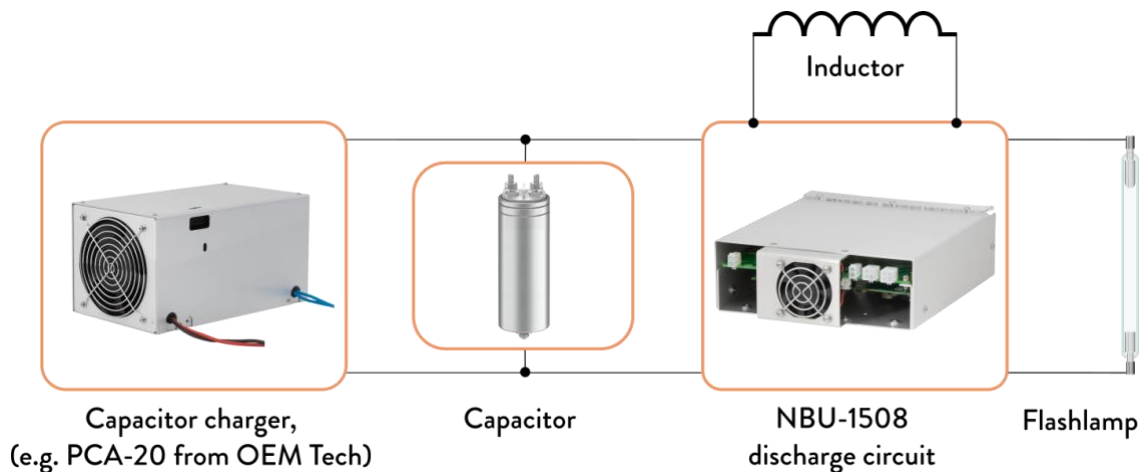
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Overview / Appearance

The NBU-1508 discharge circuit is designed for simplification of solid-state laser systems development. The module utilizes complete discharge of a relatively small capacitor bank (a typical value is 100uF), which, together with an external inductor, forms short (tens to hundreds of microseconds) bell-shaped pulses on a flashlamp. The NBU-1508 includes a thyristor, its driver, protective circuits, simmer and trigger circuits and controls. Typical applications are Q-switched Nd:YAG lasers or similar.

It's important to emphasize that the NBU-1508 is not a stand-alone solution. It requires a capacitor charging power supply, an external inductor and capacitor bank, as well as some minor parts and controls to operate properly.



By default the NBU-1508 includes capabilities both for serial and external triggering (See *Triggering* section for details). Simplified as well as more complicated modifications are available on request.

An important feature of the NBU-1508 is clear and visible separation between low voltage and high voltage parts. The 24V power input and all interface circuits (SIM and PWF) are separated from the high voltage circuits by 4mm creepage distances and solid insulation to 2500VAC test voltage (1 MOOP/MOPP).



Cooling

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

Contents of delivery

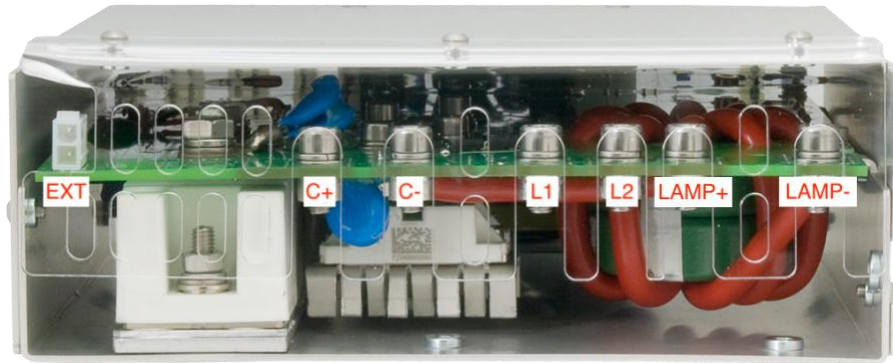
By default, the delivery package contains the NBU-1508 module only.

The following standardized set of cables can be purchased optionally:

- Flashlamp connection cable – 2pcs (150cm each)
- Capacitor connection cable – 2pcs (30cm each)
- Inductor connection cable – 2pcs (30cm each)
- External trigger transformer connection cable with mounted 1:70 trigger transformer – 1pc (150cm)
- 24VDC cable – 1pc (50cm)
- SIM cable – 1pc (50cm)
- PWF cable – 1pc (50cm)

A DR cable and a discharge resistor itself can not usually be supplied.
Customized delivery content is available on request.

Connections, signals, signal descriptions



INDUCTOR CONNECTION: Two M5 terminals

L1, L2 – to the inductor (polarity is not important)

FLASHLAMP CONNECTION: Two M5 terminals

LAMP+ – to the flashlamp anode

LAMP- – to the flashlamp cathode

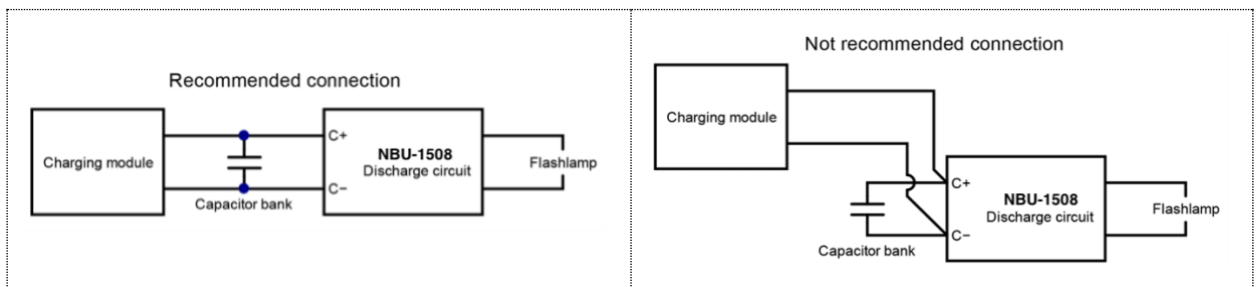
CAPACITOR BANK CONNECTION: Two M5 terminals

C+ – to the capacitor bank positive

C- – to the capacitor bank negative

CAPACITOR CHARGER CONNECTION CONSIDERATIONS

Note: we recommend connecting the capacitor charging power supply not to the C+/C- terminals, but directly to the capacitor bank.



EXT (TO THE TRIGGER TRANSFORMER): Molex 39-30-1020

By default, the NBU-1508 supports both serial and external methods of triggering. To use the NBU-1508 for external triggering, a trigger transformer should be connected to the EXT connector. If the EXT

connector is left unconnected, the NBU-1508 automatically recognizes this and applies pulses of serial triggering to the LAMP– flashlamp connection (see also *Triggering* section for details).



PIN (color)	DESIGNATION	DESCRIPTION
1 (-)	GND	Trigger transformer connection.
2 (-)	TRIGGER	Once a trigger transformer is connected, trigger pulses will be automatically applied to the EXT connector instead of LAMP– flashlamp connector. Trigger pulse parameters: <ul style="list-style-type: none"> • 350V by default, other on request • ~20mJ by default, other on request



DR (TO DISCHARGE RESISTORS): Molex 39-30-1020



PIN (color)	DESIGNATION	DESCRIPTION
1 (-)	C+	Discharge resistors connection
2 (-)	RELAY	<ul style="list-style-type: none"> • PIN1 is always under the same potential as C+ • PIN2 is commutated by embedded relay and follows Discharge signal of PWF connector Please do not exceed the peak and the average discharge current (500mA).

We suggest using the NBU-1508 with discharge resistors of your choice. The resistance and the power rating of discharge resistors must be selected accordingly to your application. Real operating voltages, your capacitor bank capacitance and the required quick discharge time are the most important parameters affecting the choice. You are welcome to contact us for assistance.

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



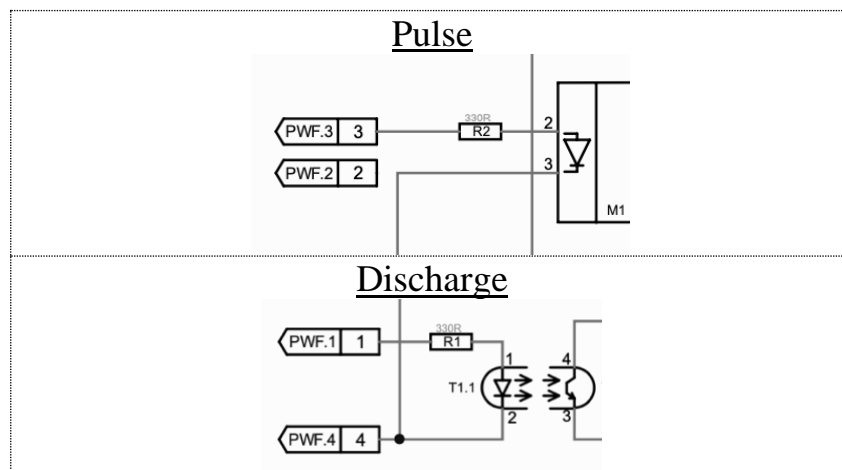
PIN (color)	DESIGNATION	DESCRIPTION
1 (-)	+24VDC	Supply power to the control circuits of NBU-1508 as well as to the integrated simmer supply module <ul style="list-style-type: none"> Voltage: 24VDC Current: 5A max (up to 10A peak)
2 (-)	+24VDC Return	Return of 24VDC power supply

PWF (PULSE CONTROL): Molex 39-30-1040



PIN (color)	DESIGNATION	DESCRIPTION
1 (-)	Discharge	When no voltage is applied to <i>PIN1</i> (or <i>PIN1</i> is unconnected), i.e. while <i>Discharge</i> is <i>ON</i> , the capacitor bank continuously discharges through discharge resistors connected to DR connector of the NBU-1508. 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>PIN1</i> (<i>Discharge</i> is <i>OFF</i>) module can be operated in the regular way.
2 (-)	Not Connected	–
3 (-)	Pulse	Rising edge of +5V TTL pulse applied to <i>PIN3</i> opens the thyristor. Pulse duration should be matched with the actual flash duration to ensure complete discharge of the capacitor bank.
4 (-)	Interface Return	Return of <i>Pulse</i> and <i>Discharge</i> signals

PWF CIRCUITS:

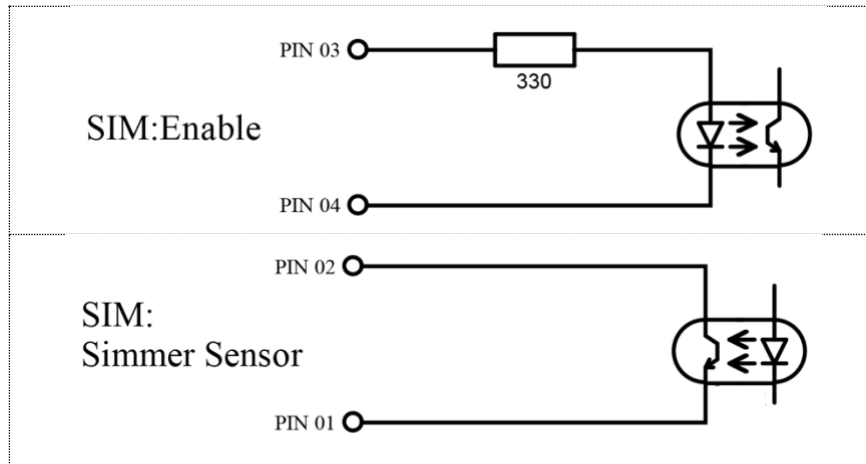


SIM (SIMMER SUPPLY CONTROL): Molex 39-30-1040



PIN (color)	DESIGNATION	DESCRIPTION
1 (-)	Sensor Return	Return of the <i>Simmer Sensor</i> signal
2 (-)	Simmer Sensor	<i>Simmer Sensor</i> circuit is closed while simmer current flows through flashlamp and is open while simmer current is absent
3 (-)	Enable	Once +5V voltage is applied to <i>PIN3</i> , the integrated simmer supply attempts to strike and maintain a low-current discharge (simmer) in the flashlamp. If flashlamp triggering is failed, the simmer supply module will try to trigger it again at a few Hertz repetition rate. After a successful triggering, the simmer supply can support up to 500mA flashlamp current (400mA is a preset by default). Simmer will be maintained until 0V is applied to <i>PIN3</i> .
4 (-)	Enable Return	Return <i>Simmer Enable</i> signal

SIM CIRCUITS:



LED:

There is the warning LED indicating that NBU-1508 circuits are under high voltage.

HV LED (**red**) – is ON when NBU-1508 circuits are under high voltage

GND: M4 THREAD

The module should be grounded using this thread.
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 the protective covers of the equipment must be securely fixed in place and all electrical connections must be properly attached
- The NBU-1508 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-1508, especially DR, L1/L2, 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 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

A typical start-up sequence of the NBU-1508 is given below:

1. Connect your capacitor charging power supply, +24V DC power supply, the inductor, the capacitor and the flashlamp to the NBU-1508 module
2. Set +5V voltage on *PIN1* of *PWF* connector 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 failure of discharge resistors used in the system.

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, capacitor is 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 the system
8. *Disable* the capacitor charging power supply prior to pulse

Note: this is important to disable the capacitor charging power supply. Otherwise, the output current of working capacitor charging power supply won't allow the thyristor to close after the flash.

9. Apply +5V TTL pulse to *PIN3* of *PWF* connector. The rising edge of TTL pulse will initiate the discharge through the flashlamp. The discharge will stop automatically once the energy stored in the capacitor bank is emitted. Pulse length of TTL signal should be a little longer than the actual discharge time, which depends on the L, C and flashlamp parameters
10. *Enable* the capacitor charging power supply after the pulse
11. Repeat #8-#10

To power down NBU-1508 and discharge capacitor bank:

1. *Turn off* or *Disable* your capacitor charging power supply (important!)
2. *Disable* simmer supply
3. Set 0V on *PIN1* of *PWF* 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

+24VDC INPUT:	
Voltage	+24V DC
Current consumption	5A max, up to 10A peak
PULSE PARAMETERS:	
Max. voltage	1500V (<i>other on request</i>)
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>)
Pulse width	Defined by L, C and flashlamp parameters
Max. rep. rate	50Hz (<i>up to 100Hz 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 serial triggering additional insulation (e.g. with silicone tubing) or spacing (e.g. with spiral bundle hose) of LAMP– wire is required
SIMMER PARAMETERS:	
Simmer current	400mA (<i>200-500mA 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 TRIGGERING:	
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)
SERIAL TRIGGERING:	
Pulse energy / trigger voltage	~160mJ / 10kV negative to LAMP– (<i>other on request</i>)
Trigger transformer	Integrated transformer
Cooling	Forced air cooling with built-in fan
Safety	1 MOOP/MOPP between high voltage and low voltage parts (4mm creepages / 2500VAC HiPot)
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. 217x177x64mm (see also the dimensional drawing below)
Weight	Approx. 2.0kg (w/o cables)

How to order? / Options

By default, there is the only standard part number, namely NBU-1508.

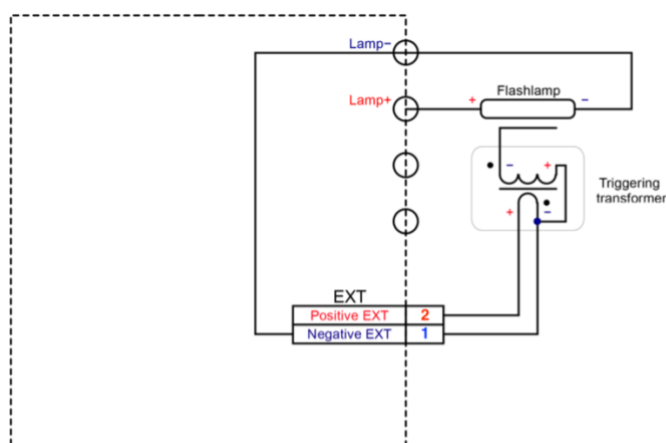
The following options are available on request:

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

Triggering (serial triggering, external triggering, triggering basics)

By default the NBU-1508 supports both serial and external methods of triggering.

To use the NBU-1508 for external triggering, a trigger transformer should be connected to the EXT connector.



Default parameters for 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, the NBU-1508 automatically recognizes this and applies serial triggering to the flashlamp.

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

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