

NANOSECOND PULSE GENERATOR

NPG-15/2000(N)

USER MANUAL

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PACKAGE CONTENT

Please check the package for the following items:

- ✓ NPG-15/2000(N) nanosecond pulse generator (hereinafter "generator")
- ✓ Power supply cable
- ✓ High voltage output coaxial cable
- ✓ Two optical cables
- ✓ User manual



Fig.1. General view of NPG-15/2000(N) nanosecond pulse generator.

SAFETY MANUAL

Electrical safety

- NPG-15/2000(N) generator is high voltage equipment. Please be very careful and operate by qualified personnel only.
- There is a risk of electric shock, strong electromagnetic interference, damage of generator or other electronic equipment in case of improper use.
- Do not switch on the generator without proper grounding. We recommend to use grounding cable connected to the terminal at the rear panel of the generator.
- It is strongly prohibited to switch on the generator without output coaxial cable. There is a risk of electrical arcing on the open coaxial connector and damage of output circuit of the generator. Please use our special high voltage coaxial connector and cable only. Standard UHF, N-type or 7/3-type connectors are not suitable.
- When adding or removing generator to or from the system, ensure that the power supply ON/OFF switch is switched off and power supply cable is unplugged before the output cable is connected or disconnected.
- Please connect or disconnect any equipment, toggle generator from internal to external triggering mode or vice versa while generator is in high voltage OFF state only by HV ON/HV OFF switch.

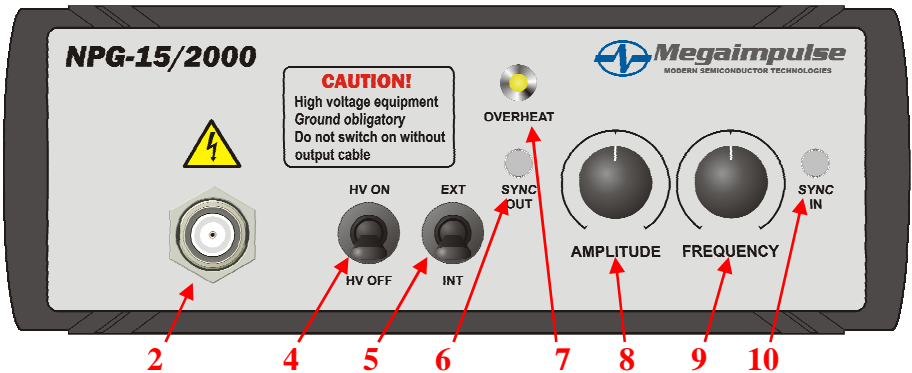
Operation safety

- Please read this manual before installing and using of the generator.
- Before using the product, make sure that all cables are applicable and not damaged. High voltage connectors should be clean and dry, free from dust, dirt and any obstacles.
- To avoid short circuits keep metal parts like clips, screws and staples away from the generator.
- The generator is designed to work in normal laboratory conditions. Avoid dust, humidity and temperature extremes. Do not place the generator in any place where it may become wet.
- Place the generator on a stable surface.
- If you encounter any technical problem with the generator, please contact with Megaimpulse Ltd. Do not try to repair the generator by yourself.

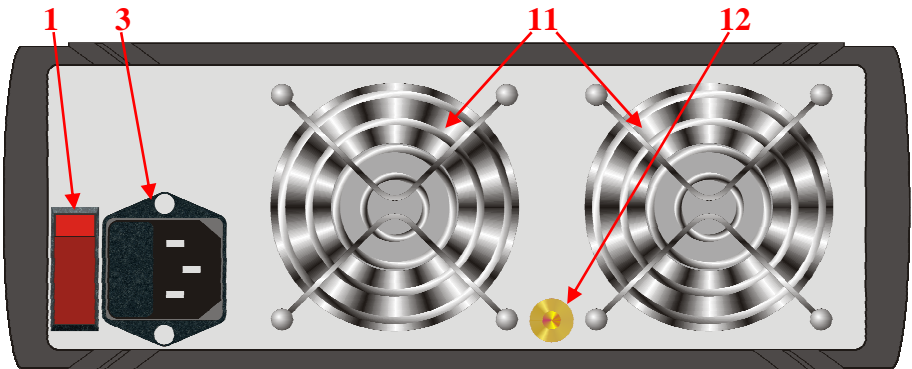
**TECHNICAL SPECIFICATION OF NPG-15/2000
NANOSECOND PULSE GENERATOR**

Output pulse voltage	Regulated 13 - 18kV at matched 75 Ohm load, up to 36kV at discharge reactor
Pulse polarity	positive (NPG-15/2000) negative (NPG-15/2000N)
Pulse rise time (0.1 – 0.9 U_{max})	4 ns
Max pulse energy	30 mJ
Peak pulse power	4.5 MW
Repetition rate	up to 3.2 kHz
Triggering	internal or external
External triggering	optical
Output pulse monitoring	optical
Generator power supply	AC 220-230V 50-60 Hz
Size	248 x 90 x 250 mm ³
Weight	4 kg

FRONT VIEW



REAR VIEW



- 1 - power supply ON/OFF switch
- 2 - output coaxial connector
- 3 - power supply connector and fuse holder
- 4 - HV ON/HV OFF - high voltage on/off switch
- 5 - EXT/INT - external/internal triggering switch
- 6 - optical SYNC OUT connector
- 7 - overheat LED
- 8 - AMPLITUDE regulation knob
- 9 - FREQUENCY regulation knob
- 10 - optical SYNC IN connector
- 11 - fans
- 12 - ground terminal

PUTTING THE GENERATOR INTO OPERATION

Please follow strictly the described steps. It helps to prevent damage of the generator, other equipment, and personnel injury.

Step 1.

Unpack the generator and check the presence into the package of the following items:

- NPG-15/2000(N) generator
- power supply cable
- output 75 Ohm coaxial cable
- two 3 meters length optical cables

Step 2.

Set up the generator. Ground it obligatory by connecting ground cable to terminal at the rear panel (12).

Step 3.

Check the output coaxial female connector at the front panel of the generator and co-pair male connector at the cable. Both connectors should be clean and dry, free from dust, dirt and any obstacles. Clean the connectors by alcohol and/or cotton bud if necessary.

Attach the cable connector to the generator front panel connector (2). The tight and firm contact of the connectors is very important for normal operation of the generator. Even small air gap between the connectors may result in arcing, destroying of the generator and the cable.

To obtain good and tight contact the following procedure is recommended:

1. Align both connectors.
2. Hold the generator by one hand to prevent moving and press the cable connector by other hand toward the generator connector.
3. Screw the cable connector nut by hand, usually one or two turns. Do not rotate the cable connector body.
4. Press the cable connector toward the generator connector again.
5. Once more screw the cable connector nut one or two turns.
6. Repeat steps 4 and 5 up to tight contact. Finally screw the cable connector nut firmly by hands.

It is recommended to check whether the tight contact obtained or not after the first test operation of the generator. Unscrew the cable connector; there should be no any ozone or burnt smell from the cable connector. Please do not connect and disconnect the high voltage connectors many times to prevent the wearing.

Step 4.

Connect the other side of coaxial cable to the load. The cone teflon insulator is used at the cable end to prevent the discharge between central cable wire and the cable braid (See Fig.2). You may use additional wires for connection: solder the high voltage signal wire to the central cable wire and screw/solder ground signal wire to the ground clamp. It is recommended to use as short additional wires as possible. More than 10 cm wires result in excessive stray inductance and significant reducing of the pulse voltage on the load.

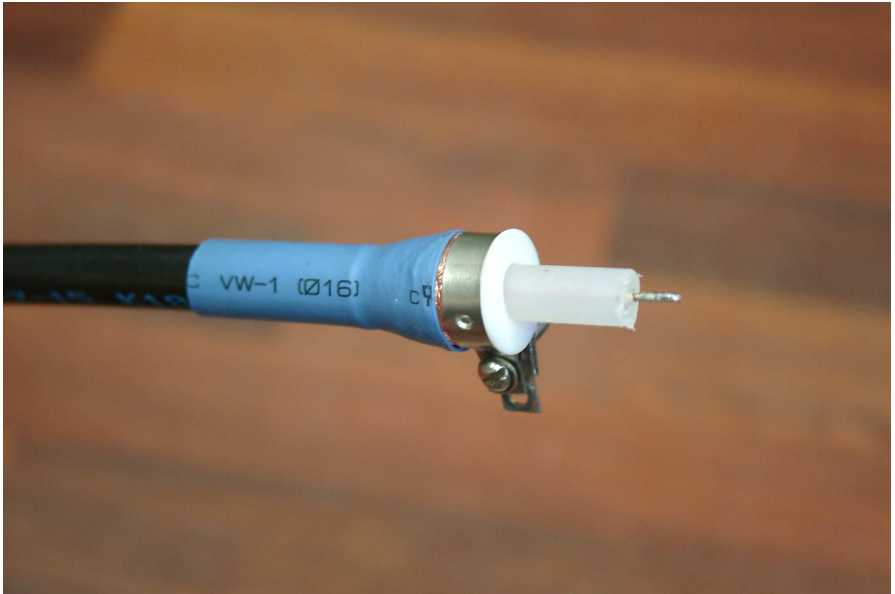


Fig.2. The cone teflon insulator at the cable end.

The length of coaxial cable is about 3 meters. Shorter cable may result in damage of the generator in case of operation on short or open load.

Step 4.

Toggle HV ON/HV OFF switch to HV OFF state.

Toggle EXT/INT switch to INT state.

Place both "amplitude" and "frequency" knobs to the most counterclockwise position, which corresponds to minimum amplitude and frequency.

Connect power supply cable to power outlet.

Switch on the generator by power switch at the rear panel. The internal fans of the generator should start to rotate.

Step 5.

Switch on the high voltage by HV ON/HV OFF switch. The output high voltage pulses should be generated. Increase the amplitude and frequency by corresponding knobs as necessary. The output pulses frequency in internal triggering mode is about proportional to the rotation angle of FREQUENCY regulation knob. The output pulses amplitude increases slightly while you rotate AMPLITUDE knob from the most counterclockwise position to the middle position and then increases faster while you rotate the knob to the most clockwise position.

Step 6.

Always stop the operation of the generator by HV ON/HV OFF switch, after that you can switch off the generator by power switch. Do not toggle EXT/INT switch while high voltage is on. After long time of operation at high output pulse amplitude and frequency please allow fans to rotate several minutes in idle mode for cooling.

OVERHEAT MODE

NPG-15/2000(N) generator has 75 Ohm impedance coaxial output connector. If the generator operates on unmatched load with impedance not equal to 75 Ohm then part of energy inevitably reflects from the load, returns back to generator, and dissipate in it. About all of generated energy returns back in case of operation on short or open load. Generator can withstand short or open load, but in case of long time operation in such regime it may be overheated.

"Overheat" LED lights on in this case and generator stop the operation. Please switch off high voltage by HV ON/HV OFF switch and allow fans to cool the generator for a several minutes. "Overheat" LED lights off after the cooling and generator is ready for operation again.

Unfortunately barrier and other discharge type loads have highly nonlinear nature and some reflection of energy inevitably occurs. If the generator overheats while it operates on discharge reactor you can try:

- change the parameters or operation regime of the reactor to increase the part of energy absorbed in it. To estimate the energy reflected from the load check the amplitude of the secondary and following pulses by oscilloscope with high voltage probe connected to the load. You should use 500 MHz or more bandwidth oscilloscope and 40 kV pulse voltage probe, for example Tektronix TDS 3052C and Tektronix P6015A probe;
- reduce pulse amplitude and/or frequency.

TRIGGERING OF THE GENERATOR

The generator can operate in three different triggering modes:

Internal triggering

Internal triggering mode is set by switching EXT/INT toggle switch in INT position. No any additional triggering generator is required for operation in this regime. Output pulse repetition rate can be adjusted by FREQUENCY regulation knob at the front panel of the generator.

External triggering

External triggering mode is set by switching EXT/INT toggle switch in EXT position. External pulse should be applied to optical SYNC IN connector for generator triggering. Recommended triggering pulse duration is one microsecond. The delay between triggering pulse front and output pulse (internal generator delay) is about 300 μ s. **The maximum allowable pulse repetition rate in this mode is limited by FREQUENCY regulation knob at the front panel of the**

generator, i.e. internal generator frequency sets the upper limit for external triggering pulses frequency.

Please rotate FREQUENCY regulation knob to the most clockwise position to allow the maximum external triggering pulses frequency.

The minimum repetition rate is 50 Hz. The lower frequency results in decreasing of output pulses amplitude.

Burst mode

Burst operation mode can be simply organized by using external pulse generator. Set EXT/INT toggle switch in EXT position and apply external ENABLE pulse to optical SYNC IN connector. Output pulse repetition rate is set by FREQUENCY regulation knob at the front panel of the generator and burst length is determined by duration of ENABLE pulse.

RECOMENDED OPTICAL TRANSMITTERS FOR EXTERNAL TRIGGERING AND OUTPUT PULSE MONITORING

NPG-15/2000(N) is equipped by optical connector for external triggering and output pulse monitoring. AVAGO HFBR-1522Z and HFBR-2522Z transmitters as well as AVAGO HFBR-4501, HFBR-4511 connectors and HFBR-RUS optical cable are used for optical signals transmitting.

The recommended external triggering pulse width is 1 μ s. Maximum frequency is 3.2 kHz and may be limited additionally by FREQUENCY regulation knob. The optical triggering pulse should be applied to SINC IN connector.

SYNC OUT signal may be used for synchronization and pulse monitoring. This signal precedes the output high voltage pulse for about 0.5 μ s and has 2 μ s width.

To use the optical connectors please remove the rubber protective caps by thin tweezers or other suitable tool, stick gently optical cable with HFBR-4501/HFBR-4511 connector into the hole up to click.

Replace the rubber caps back to the holes while you are not using optics to prevent transmitter lens from the dust.