

NANOSECOND PULSE GENERATOR

NPG-30/500

USER MANUAL

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PACKAGE CONTENT

Please check the package for the following items:

- ✓ NPG-30/500 nanosecond pulse generator (hereinafter "generator")
- ✓ Power supply cable
- ✓ High voltage output coaxial cable
- ✓ User manual
- ✓ Bottle with silicon oil

Optional items:

- ✓ Coaxial cable(s) with BNC connectors for generator external triggering and synchronization
- ✓ Optical cable(s) for generator external triggering and synchronization
- ✓ BNC-to-optics transmitter
- ✓ Optics-to-BNC receiver with USB power supply adapter



Fig.1. General view of NPG-30/500 nanosecond pulse generator.

SAFETY MANUAL

Electrical safety

- NPG-30/500 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 or three terminal power supply outlet with ground contact.
- It is strongly prohibited to switch on the generator without output coaxial cable. Please apply obligatory high pure silicon oil on the Teflon insulator part of the cable connector before mating of the connectors. 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.
- 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-30/500
NANOSECOND PULSE GENERATOR**

Output pulse amplitude (typical)	Regulated 18 .. 30kV at matched 75 Ohm load, up to 60kV at discharge reactor
Pulse polarity	positive
Pulse rise time (fast part of output pulse)	< 5ns
Max pulse energy	120 mJ
Peak pulse power	up to 12 MW
Repetition rate	up to 500 Hz
Single pulse mode	Yes, in external triggering mode
Triggering	internal or external
External triggering	BNC connector, +2.5 .. +15V amplitude; Optical connector, AVAGO all plastic fiber (APF) 1mm
Internal generator delay	1.5 μ s
Jitter RMS (typical)	1 ns
Output pulse monitoring	BNC connector, 2.5V@50 Ω /5V@1M Ω ; Optical connector, AVAGO all plastic fiber (APF) 1mm
Generator power supply	AC 220-230V 50-60 Hz
Size	357 x 305 x 144 mm ³
Weight	7 kg

FRONT PANEL CONTROLS AND CONNECTORS

- 1 - Output coaxial high voltage connector
- 2 - HV ON/HV OFF - high voltage on/off switch
- 3 - EXT/INT - external/internal triggering switch
- 4 - BNC SYNC IN connector
- 5 - Optical SYNC IN connector
- 6 - BNC SYNC OUT connector
- 7 - Optical SYNC OUT connector
- 8 - OVERHEAT LED
- 9 - AMPLITUDE regulation knob
- 10 - FREQUENCY regulation knob

REAR PANEL CONTROLS AND CONNECTORS

- 1 - Power supply ON/OFF switch
- 2 - Power supply connector and fuse holder
- 3 - Fans
- 4 - 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-30/500 generator
- power supply cable
- output high voltage 75 Ohm coaxial cable
- bottle with silicon oil

Step 2.

Set up the generator. Ground it obligatory by connecting ground cable to terminal at the rear panel or use three terminal power supply outlet with grounding contact.

Step 3.

Check the output coaxial connector at the front panel of the generator and co-pair 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.

Apply a drop of silicon oil onto the teflon insulator of the cable connector.

It should be completely wet by oil, but excessive oil is not needed. Please see Fig.2.



Fig.2. High voltage output cable connector of NPG-30/500.

The oil fills the air gap between pair of connectors and prevents unwanted discharge inside the connector in case of long time generator operation with the open cable and high energy reflection back to generator.

Attach the cable connector to the generator front panel connector. 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 or any burnt traces. Please do not connect and disconnect the high voltage connectors many times to prevent the contacts wearing.

Please apply a drop of oil each time when you disconnect and connect the output connector again as well as check the connectors and add oil if required once per week.

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.3). 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 additional wires between the load and coaxial cable result in excessive stray inductance and significant reducing of the pulse voltage on the load.
- The length of output coaxial cable is about 10 meters. Shorter cable may result in damage of the generator in case of operation on short or open load.



Fig.3. The cone teflon insulator at the cable end.

Step 5.

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 on the rear panel. The internal fans of the generator should start to rotate.

Step 6.

Switch on the high voltage by HV ON/HV OFF switch. The output high voltage pulses should be generated. The internal red lamp in HV ON/HV OFF switch lights on and indicates the triggering of the generator. 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 proportionally to the rotation angle of AMPLITUDE regulation knob.

Step 7.

Always stop the operation of the generator by HV ON/HV OFF switch, after that you can switch off the generator by power switch. After long time of operation at high output pulse amplitude and frequency please allow fans to rotate several minutes in idle mode for cooling.

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 triggering pulse should be applied to BNC SYNC IN connector or to optical SYNC IN connector. Recommended triggering pulse duration is from 100 ns to 100 μ s, recommended pulse amplitude at BNC input is from 2.5V to 15V which allows to trigger the generator by TTL, CMOS or 3.3V LVTTTL/LVCMOS level pulse. The delay between triggering pulse front and output pulse (internal generator delay) is about 1.5 μ s, typical jitter RMS is about 1 ns. The internal red lamp in HV ON/HV OFF switch lights on and indicates the generator triggering.

- The maximum allowable pulse repetition rate in this mode is limited by FREQUENCY regulation knob at the front panel of the generator.

Therefore 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 generator can operate also in single pulse mode.

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 any 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.

OVERHEAT MODE

NPG-30/500 generator is equipped by coaxial 75 Ohm impedance output cable. 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 stops 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 the 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 high voltage 1000:1 probe, for example Tektronix TDS 3052C and Tektronix P6015A probe;
- reduce pulse amplitude and/or frequency.

OVERHEAT LED blinks for a short time when you switch on or switch off the generator by power switch on the rear panel. This is normal and indicates that the generator control and protection system is in working condition.

OUTPUT PULSE MONITORING

NPG-30/500 generator has BNC and optical output connectors for output pulse monitoring. The pulse amplitude at BNC output is 2.5 V at 50 Ohm load and 5 V at high impedance load, the pulse width is about 1 μ s.

The typical oscillograms of external triggering pulse (Channel 1) and SYNC OUT pulse (Channel 2) are shown in Fig.4. The high voltage few nanoseconds rise time output pulse is a source of strong interference. Therefore one can see the noise on the oscillograms at the moment of output pulse generation.

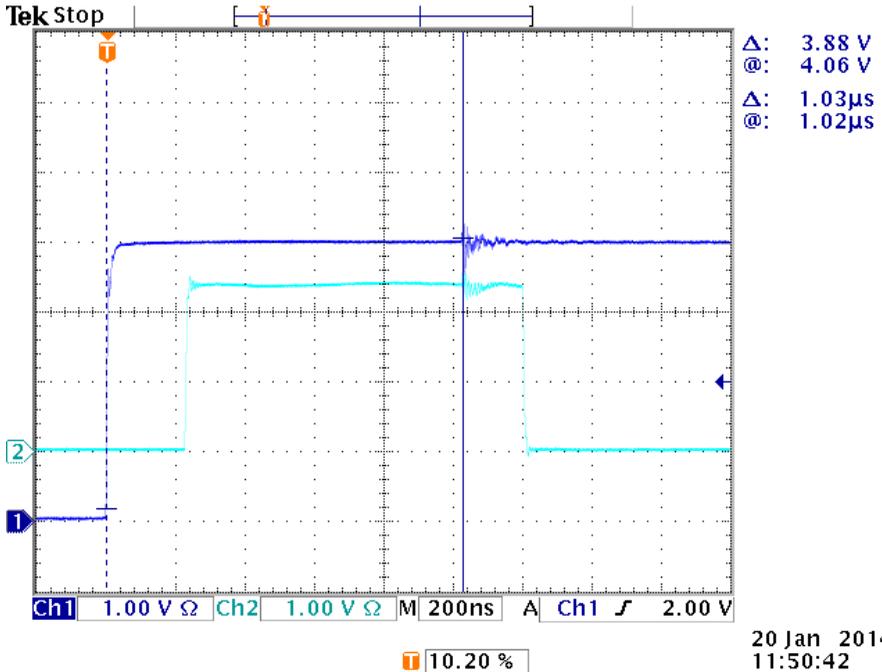


Fig.4. Typical oscillograms of external triggering pulse (Channel 1) and SYNC OUT pulse (Channel 2) of the generator.

FUSE REPLACEMENT

- ➔ Type of the fuse is 4A/250V standard (not fast) cut off time, cylindrical glass 5mm X 20mm

The fuse holder is located in three terminal power supply connector. Please use flat screwdriver or other suitable tool to remove the fuse holder.

WARRANTY

Please see your sales agreement to determine the warranty period and warranty condition. The generator has warranty seals at the side panels.

- ➔ Removing of the warranty seals terminates the warranty.