

NANOSECOND PULSE GENERATOR

**NPG-20/3500
and
NPG-20/3500N**

USER MANUAL

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SAFETY MANUAL

Electrical safety

- NPG-20/3500 (NPG-20/3500N) 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 the generator or other electronic equipment in case of improper use.
- Do not turn on the generator without proper grounding. We recommend using a grounding cable connected to the terminal on the rear panel of the generator or a three-terminal power supply outlet with proper ground contact.
- It is strongly prohibited to switch on the generator without an output coaxial cable attached. There is a risk of electrical arcing on the open coaxial connector and damage to the 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 the generator to or from the system, ensure that the power supply ON/OFF switch is switched off and the 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 the generator is in high voltage OFF state only by HV ON/HV OFF switch.

Operation safety

- Please read this manual before installing and using 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 a short circuit, 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 Megaimpulse Ltd. Do not try to repair the generator by yourself.

PACKAGE CONTENT

Please check the package for the following items:

- ✓ NPG-20/3500 (positive polarity) or NPG-20/3500 (negative polarity) nanosecond pulse generator (hereinafter "generator")
- ✓ Power supply cable
- ✓ High voltage output coaxial cable
- ✓ User manual



Fig.1. General view of NPG-20/3500 nanosecond pulse generator.

DESCRIPTION

NPG-20/3500 (NPG-20/3500N) generates high voltage unipolar nanosecond range pulses. The pulse width is fixed, while the amplitude and repetition rate can be adjusted by the front panel knobs. The typical output pulse waveform is shown in Fig.2.

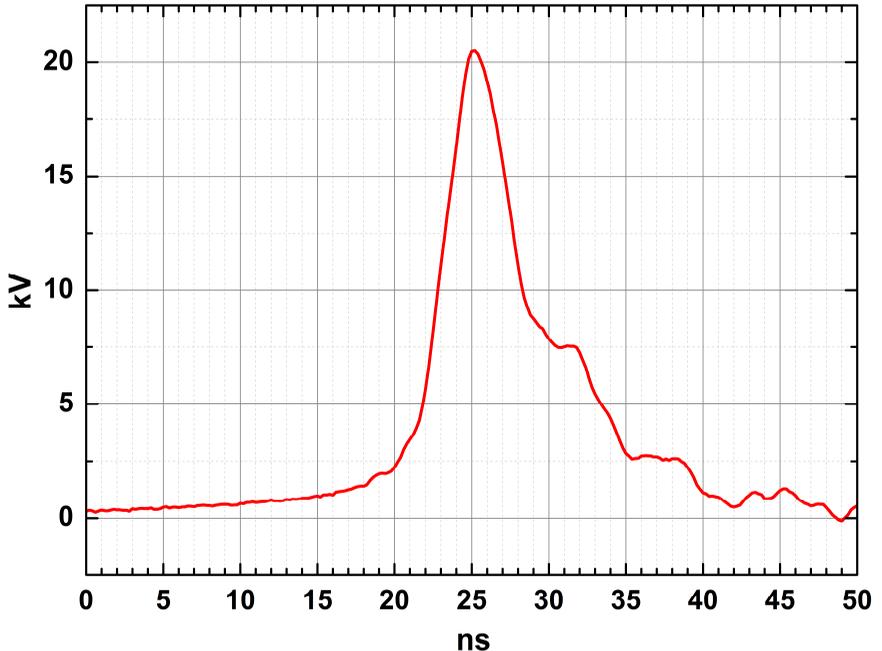


Fig.2. Typical output pulse waveform of NPG-20/3500 on matched 50 Ohm load. Amplitude knob is in max position.

The generator is designed for operation with 50 Ohm impedance load only, for example properly made antenna. In spite of the generator has protection from overheating and damage by the reflected pulses energy in case of unmatched load, RG213 or RG214 cables are not suitable for the long-time operation with high impedance load at high frequency.

- Please choose for the discharge applications 75 Ohm impedance models of nanosecond pulse generators, for example, NPG-18/100k or NPG-18/3500.

TECHNICAL SPECIFICATION

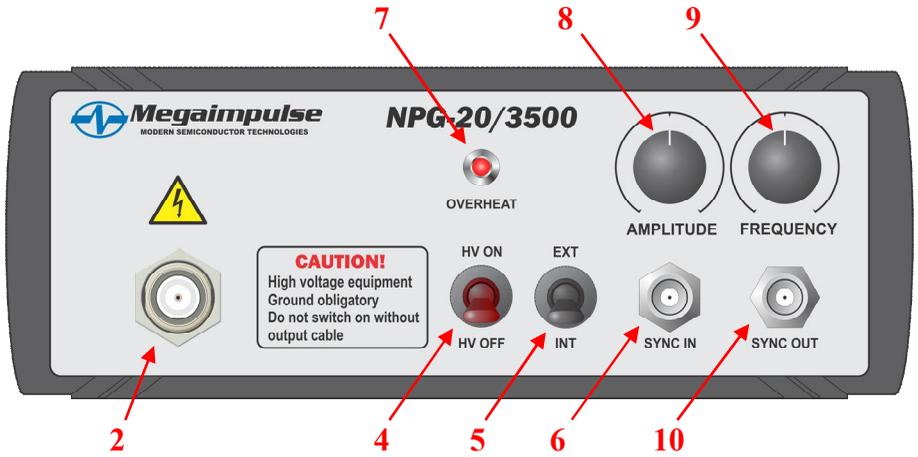
Output pulse amplitude (typical)	Regulated 10 kV ... 20 kV on matched 50 Ohm load
Output impedance / output cable	50 Ohm / RG213 or RG214
Pulse polarity	positive (NPG-20/3500) negative (NPG-20/3500N)
Pulse rise time (fast part of output pulse)	< 4 ns
Pulse width (FWHM)	10 ns
Min/max pulse energy	10 mJ / 40 mJ
Peak pulse power	up to 8 MW
Repetition rate	from 1 Hz up to 3.5 kHz
Single pulse mode	yes, in external triggering mode
Triggering	internal or external
External triggering	BNC input connector; +2.5V ... +15V amplitude, 50 µs ... 200 µs pulse width
Internal generator delay	1 µs
Jitter RMS (typical)	1 ns
Output pulse monitoring	BNC connector, 2.5V@50Ω/5V@1MΩ
Generator power supply	AC 110-230V / 50-60 Hz
Size	248 x 90 x 250 mm ³
Weight	4 kg

Ordering:

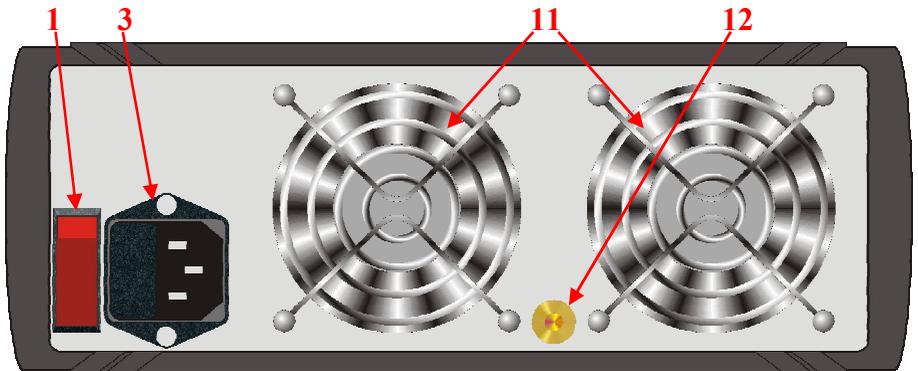
NPG-20/3500 – generator with positive output pulse polarity

NPG-20/3500N – generator with negative output pulse polarity

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 - BNC SYNC IN connector
- 7 - OVERHEAT LED
- 8 - AMPLITUDE regulation knob
- 9 - FREQUENCY regulation knob
- 10 - BNC SYNC OUT connector
- 11 - fans
- 12 - ground terminal

PUTTING THE GENERATOR INTO OPERATION

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

Step 1.

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

- NPG-20/3500 (NPG-20/3500N) generator;
- power supply cable;
- output 50 Ohm coaxial cable.

Step 2.

Set up the generator. Ground it obligatory by connecting ground cable to terminal on the rear panel (12) and/or use three-terminal power supply outlet with grounding contact.

Step 3.

Check the output coaxial female connector on the front panel of the generator (2) and co-pair male connector on the cable. Both connectors should be clean and dry, free from dust, dirt, and any obstacles. Clean the connectors with alcohol and/or cotton bud if necessary, put a drop of silicone oil onto the Teflon insulating parts. Attach the cable connector to the generator front panel connector (2). The tight and firm contact of the connectors is very important for the normal operation of the generator. Even a small air gap between the connectors may result in arcing, destroying 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 another 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 hand.

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 ozone or burnt smell from the cable connector, even a little, or any burnt traces. Please do not connect and disconnect the high voltage connectors many times to prevent the contacts from wearing.

Step 4.

Connect the other side of the coaxial cable directly to the load by soldering, or through an additional suitable HV HF connector. In case of using the wires between the coaxial cable and the load, please make them as short as possible.

- ➔ More than 5 cm additional wires between the load and coaxial cable result in excessive stray inductance in series with the load.
- ➔ The length of the output coaxial cable is about 3 meters. The shorter cable may result in permanent damage the generator in case of load breaks and operation on a short or open load.

Step 5.

Toggle HV ON/HV OFF switch (4) to HV OFF state.

Toggle EXT/INT switch (5) to INT state.

Place both "AMPLITUDE" (8) and "FREQUENCY" (9) knobs to the most counterclockwise position, which corresponds to minimum amplitude and frequency.

Connect power supply cable to the power outlet.

Switch on the generator by the power switch (1) on the rear panel. The internal fans (11) of the generator should start to rotate.

Step 6.

Switch on the high voltage by HV ON/HV OFF switch (4). The output high voltage pulses should be generated. The internal red lamp in HV ON/HV OFF switch (4) 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 (9). The output pulses amplitude increases proportionally to the rotation angle of AMPLITUDE regulation knob (8).

Step 7.

Always stop the operation of the generator by HV ON/HV OFF switch (4), after that you can switch off the generator by power switch (1). 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 (5) to INT position. No additional triggering generator is required for operation in this mode. The output pulses repetition rate can be adjusted by FREQUENCY regulation knob (9) on the front panel of the generator.

External triggering

External triggering mode is set by switching EXT/INT toggle switch (5) to EXT position. The external triggering pulse should be applied to BNC SYNC IN connector (6) by coaxial cable. Recommended triggering pulse width is 100 μs , the acceptable pulse width is from 50 μs to 200 μs . Triggering pulse amplitude should be from 2.5V to 15V, which allows triggering the generator by TTL, CMOS, or 3.3V LVTTTL/LVCMOS level signals. The delay between triggering pulse front and output pulse (internal generator delay) is about 1 μs , typical jitter (RMS) is about 1 ns. The internal red lamp in HV ON/HV OFF switch (4) lights on and indicates the generator triggering.

- The maximum allowable pulse repetition rate in this mode is limited by FREQUENCY regulation knob (9) on the front panel of the generator.

Therefore, internal generator frequency sets the upper limit for external triggering pulses frequency. Please rotate FREQUENCY regulation knob (9) to the most clockwise position to allow the maximum external triggering pulses frequency. The generator can operate also in single pulse mode.

Burst mode

The burst operation mode can be simply organized by using an external triggering pulse generator. Set EXT/INT toggle switch (5) to EXT position and apply external ENABLE pulse to BNC SYNC IN connector (6). The output pulse repetition rate is set by FREQUENCY regulation knob (9) on the front panel of the generator, and burst length is determined by the duration of ENABLE pulse. For example, 10 ms duration external ENABLE pulse applied to BNC SYNC IN connector (6), and 1 kHz set frequency result in 10 output pulses burst.

OVERHEAT MODE

NPG-20/3500 (NPG-20/3500N) generator has 50 Ohm impedance coaxial output connector and 50 Ohm impedance output cable. If the generator operates on an unmatched load with an impedance not exactly equal to 50 Ohm, then part of the pulse energy inevitably reflects from the load, returns back to the generator, and dissipates in it. The generator can withstand operation with unmatched load, but it may be overheated in case of long-time operation in such a regime.

OVERHEAT LED (7) lights on in this case and the generator stops the operation. Please turn off high voltage by HV ON/HV OFF switch (4) and allow fans to cool the generator for several minutes. OVERHEAT LED (7) lights off after the cooling and the generator is ready for operation again.

Unfortunately, the matching with the load usually is not exact. To estimate the portion of the energy reflected from the load please check the amplitude of the secondary and following pulses by an oscilloscope with a high voltage probe connected to the load. You should use 500 MHz or more bandwidth oscilloscope and >20 kV pulse voltage probe, for example, Tektronix TDS 3052C and Tektronix P6015A probe.

OVERHEAT LED (7) blinks for a short time when you switch on or switch off the generator by power switch (1) on the rear panel. This is normal and indicates that the generator control and protection system is in working condition.

OUTPUT PULSE MONITORING

The generator has BNC connector for the output SYNC OUT pulse (10). The SYNC OUT pulse amplitude is 2.5 V on 50 Ohm load and 5 V on high impedance load, the pulse width is about 1 μ s. The typical oscillograms of the external triggering pulse (Channel 1) and SYNC OUT pulse (Channel 2) are shown in Fig.3.

The high voltage few nanoseconds rise time output pulses are the source of strong interference. Therefore, one can see the noise on the oscillograms at the moment of the output pulse generation. The measured in Fig.3 delay between external triggering pulse and the output pulse is 1.03 μ s. The front of SYNC OUT pulse precedes the output high voltage pulse for about 0.8 μ s.

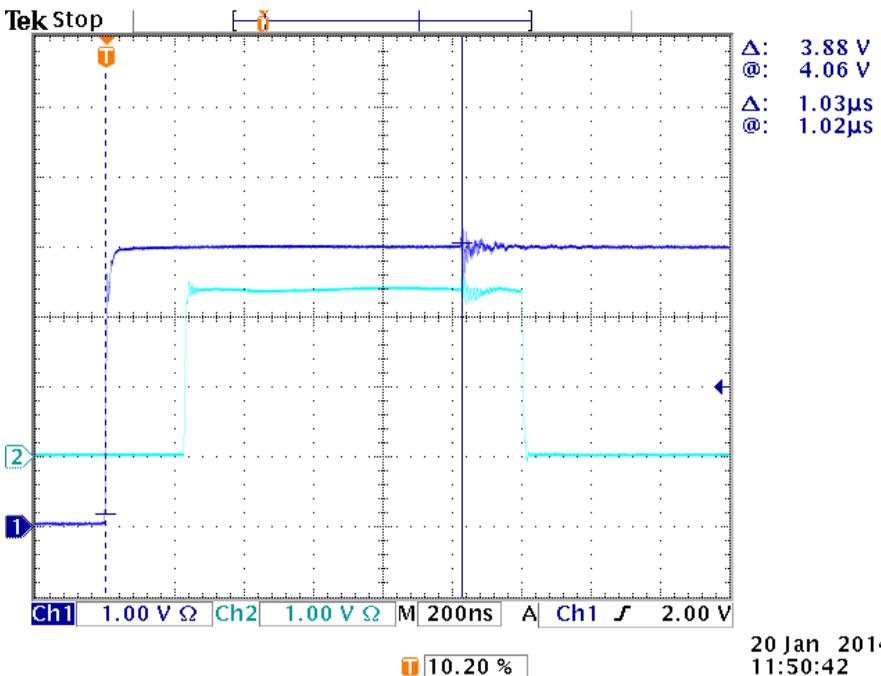


Fig.3. The measurement of internal generator delay. Typical oscillograms of the external triggering pulse (Channel 1) and SYNC OUT pulse (Channel 2) of the generator. The internal delay from the front of the triggering pulse to the high voltage output pulse is about 1 μ s.

FUSE REPLACEMENT

→ The type of the fuse is 4A/250V slow switching, cylindrical glass 5mm x 20mm.

The fuse holder is located in the three-terminal power supply connector. Please use a flat screwdriver or another suitable tool to remove the fuse holder (see Fig.4.).



Fig.4. Removing of the fuse holder by a flat screwdriver.

There are two fuses in the fuse holder including one spare (see Fig.5).



Fig.5. Two fuses in fuse holder including one spare (upper in the figure).

WARRANTY

Please see your sales agreement to determine the warranty period and warranty condition. The generator has warranty seals on the front and rear panels (see Fig.6.)

- Removing of the warranty seals terminates the warranty.



Fig.6. Warranty seals on the front and rear panels.