

NANOSECOND PULSE GENERATOR

NPG-10/100k (NPG-10/100kN)

USER MANUAL

v. 1.1

© 2022 Megaimpulse Ltd.

Copyright © 2022 MEGAIMPULSE Ltd. All Rights Reserved.

MEGAIMPULSE LTD. PROVIDES THIS MANUAL "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MEGAIMPULSE LTD., ITS DIRECTORS, OFFICERS, EMPLOYEES OR AGENTS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING DAMAGES FOR LOSS OF PROFITS, LOSS OF BUSINESS, LOSS OF USE OR DATA, INTERRUPTION OF BUSINESS AND THE LIKE), EVEN IF MEGAIMPULSE LTD. HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES ARISING FROM ANY DEFECT OR ERROR IN THIS MANUAL OR PRODUCT.

SPECIFICATIONS AND INFORMATION CONTAINED IN THIS MANUAL ARE FURNISHED FOR INFORMATION ONLY, AND ARE SUBJECT TO CHANGE AT ANY TIME WITHOUT NOTICE, AND SHOULD NOT BE CONSTRUED AS A COMMITMENT BY MEGAIMPULSE LTD. MEGAIMPULSE LTD. ASSUMES NO RESPONSIBILITY OR LIABILITY FOR ANY ERRORS OR INACCURACIES THAT MAY APPEAR IN THIS MANUAL, INCLUDING THE PRODUCTS AND SOFTWARE DESCRIBED IN IT.

Products and corporate names appearing in this manual may or may not be registered trademarks or copyrights of their respective companies, and are used only for identification or explanation and to the owners' benefit, without intent to infringe.

Megaimpulse Ltd. contact information

Mail address: 26 Polytechnicheskaya str., St. Petersburg, 194021 Russia
www: <http://www.megaimpulse.com>
e-mail: mp@power.ioffe.rssi.ru
fax: +7-812-297-3145

CONTENTS

Package content	2
General view of NPG-10/100k nanosecond pulse generator	2
Safety manual	3
Technical specification	4
Front and rear panels view	5
Operation description	6
Front panel in detail	7
Putting the generator into operation	9
Triggering of the generator	11
Output SYNC pulse	17
Overheat mode	18
Fuse replacement	19
Warranty	20
Appendix A.	
List of preset repetition rates and number of pulses within a burst	21

PACKAGE CONTENT

Please check the package for the following items:

- ✓ NPG-10/100k (NPG-10/100kN) nanosecond pulse generator (hereinafter "generator")
- ✓ Power supply cable
- ✓ High voltage output coaxial cable
- ✓ User manual



Fig.1. General view of NPG-10/100k (NPG-10/100kN) nanosecond pulse generator.

SAFETY MANUAL

Electrical safety

- NPG-10/100k (NPG-10/100kN) pulse 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 to the generator or other electronic equipment in case of improper use.
- Do not switch on the generator without proper grounding. The grounding cable should be connected to the terminal on the rear panel of the generator or a three-terminal power supply outlet with ground contact should be used.
- It is strongly prohibited to switch on the generator without an output coaxial cable. The electrical arcing on the open coaxial connector will damage the generator. Please use our special high voltage coaxial connector and cable only. Standard N-, HN- or 7/3-types connectors are not suitable. High voltage connectors should be clean and dry, free from dust, dirt and, any obstacles. The mating Teflon parts are lubricated by silicone grease.
- When adding or removing the generator to or from the system, ensure that the power supply ON/OFF switch is turned off and/or power supply cable is unplugged before the output cable is connected or disconnected.
- Please connect or disconnect any equipment, toggle the generator from internal to external triggering mode or vice versa while the generator is in high voltage OFF state only by HV ON/OFF switch.

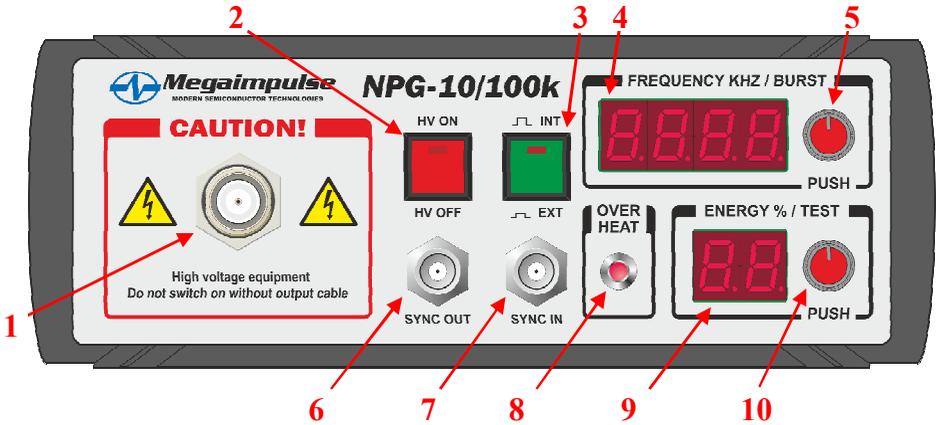
Operation safety

- Please read this manual before installing and using the generator.
- Before using the product, make sure that all cables are applicable and not damaged.
- To avoid a short circuit, please 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.

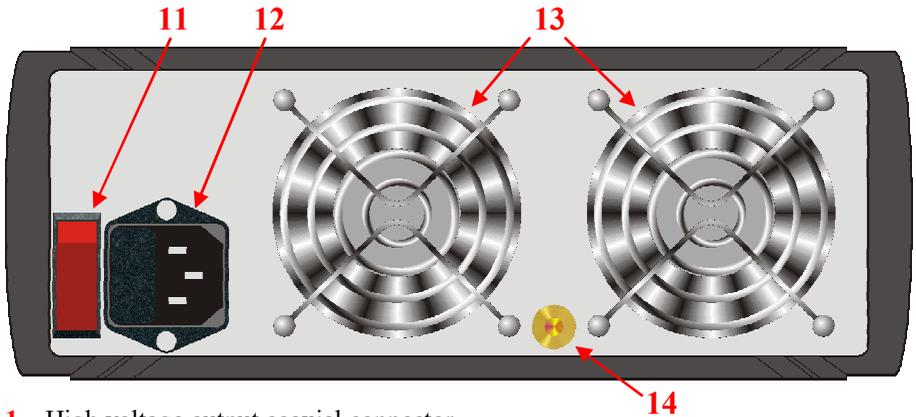
**TECHNICAL SPECIFICATION OF NPG-10/100k (NPG-10/100kN)
NANOSECOND PULSE GENERATOR**

Output pulse amplitude (typical)	smooth regulated within 7.0 kV ... 11.0 kV (50 steps) on matched 75 Ohm load; up to 22kV on open cable and discharge reactor
Output impedance	75 Ohm
Output connector	special HV coaxial type connector
Output cable	coaxial cable with 75 Ohm impedance, outer diameter 9.6 mm
Pulse polarity	positive (NPG-10/100k) negative (NPG-10/100kN)
Pulse rise time	< 4 ns (fast part of output pulse)
Pulse width (FWHM)	7 ns
Pulse energy	regulated within 4 mJ ... 8 mJ (50 steps)
Peak pulse power	up to 1.6 MW
Operation modes	continuous, burst, single pulse modes; internal and external triggering
Continuous mode repetition rates	up to 30 kHz @ 4mJ up to 20 kHz @ 6mJ up to 15 kHz @ 8mJ
Burst mode repetition rates; number of pulses in burst	up to 100 kHz; up to 30k@4mJ, 20k@6mJ, 15k@8mJ within a burst or each one second interval
External triggering (SYNC IN)	BNC connector, +2.4V ... +5V amplitude
Internal generator delay	~ 1 μ s
Jitter RMS (typical)	5 ns
SYNC OUT	BNC connector, TTL level
Power supply	AC 110-230V, 50-60 Hz
Size	248 x 90 x 250 mm ³
Weight (with cables)	6 kg

FRONT VIEW



REAR VIEW



- 1 – High voltage output coaxial connector
- 2 – High voltage ON/OFF push button with ON state LED indicator
- 3 – Internal/external triggering push button with LED indicator
- 4 – Frequency and number of pulses in burst 4-digit display
- 5 – Frequency and number of pulses in burst regulation knob with push button
- 6 – BNC type SYNC OUT connector
- 7 – BNC type SYNC IN connector
- 8 – Overheat LED indicator
- 9 – Output pulse energy 2-digit display
- 10 – Output pulse energy regulation knob with push button
- 11 – Power supply ON/OFF switch
- 12 – Power supply connector and fuse holder
- 13 – Fans
- 14 – Ground terminal

OPERATION DESCRIPTION

NPG-10/100k generator is a powerful and smart device. In spite of its compact size and small number of control elements it implements a lot of operation regimes and high output power according to the user demands. Please read this manual carefully to be familiar with the basic operation principles.

- The generator has open and short load protection as well as overheating protection. However, it is strongly prohibited to switch on the generator without output cable or use less than 3 meters length output cable.

The generator can operate in a single pulse, continuous and burst operation modes, as well as internal or external triggering. The generator's control system provides quartz stabilized triggering pulses in continuous and burst operation modes and prevents improper triggering in case of external triggering mode. The complete list of the preset frequencies and the preset number of pulses in a burst are shown in Appendix A.

- In all operation modes, the minimum pulse-to-pulse interval is limited to 9.9 μ s, which corresponds to 101 kHz repetition rate; the maximum number of pulses within any one-second interval is limited to 10000. Therefore, the maximum operation frequency in continuous mode is 10 kHz. Higher repetition rates are available in burst mode only.

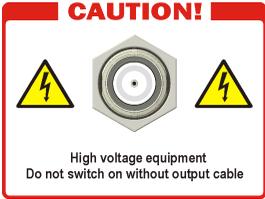
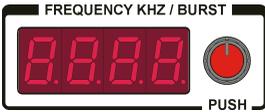
The following operation parameters can be set by the front panel controls:

- FREQUENCY from 1 Hz to 101 kHz, the default value is 100 Hz;
- NUMBER OF PULSES in the burst (within one-second interval) from 1 to 10000, the default value is 1000;
- Output PULSE ENERGY from 50% to 99%, the default value is 75%.

If the currently set repetition rate in Hz is lower than or equal to the set number of pulses (within one-second interval) then the generator operates in continuous mode, otherwise, it switches into burst mode automatically. The period of bursts is fixed to one second. So, FREQUENCY parameter sets the time interval between pulses, while NUMBER OF PULSES sets the burst length or number of pulses followed by a pause up to the end of the one-second interval.

- The FREQUENCY and NUMBER OF PULSES parameters work as the limits for the external triggering pulses. Therefore, FREQUENCY sets the maximum allowable external pulses frequency (minimum interval between pulses) and NUMBER OF PULSES sets the maximum burst length or the maximum number of pulses within each one-second interval. By the way, the generator's control system prevents overloading and damage to the generator in case of improper external triggering.

FRONT PANEL IN DETAIL

 <p>CAUTION!</p> <p>High voltage equipment Do not switch on without output cable</p>	<p>Special type coaxial connector suitable for HV nanosecond pulses feeding. Please attach the output HV cable firmly before turn-on the generator. It is very important to keep HV connectors clean to prevent unwanted arcing and glow discharge inside the mating pair. If necessary, please clean the connectors with cotton bud and alcohol, and then apply a drop of pure silicone grease before mating the connectors. Grease fills air gaps and eliminates possible discharge inside.</p>
 <p>HV ON HV OFF</p>	<p>Non-latching push button, which toggles HV system ON and OFF. Red LED on the button lights on when HV system is activated and ready for triggering by internal or external triggering pulse. HV sets to OFF state when the generator is powered on, and automatically switches to OFF state in case of overheating or TRIGGERING TEST mode activation.</p>
 <p>INT EXT</p>	<p>Latching push button, which toggles internal or external triggering modes. LED lights off if the button is pushed and no external triggering pulses are applied. LED blinks with 1 Hz frequency in case of successful external triggering. Internal triggering mode is activated in the pushing back state. Red LED on the button lights on and indicates immediate triggering when HV system is activated by HV ON/OFF button.</p>
 <p>FREQUENCY KHZ / BURST PUSH</p>	<p>Four-digit LED display and control knob with push-button, which set FREQUENCY and NUMBER OF PULSES parameters. The FREQUENCY is indicated in kHz with a decimal dot. For example, 1 Hz is indicated as 0.001; 100 kHz is indicated as 100.0. Please push the control knob until it clicks and hold it for one second to switch into NUMBER OF PULSES mode. LED display would blink and indicate NUMBER OF PULSES. For example, 1 pulse is indicated as 0001, 10000 pulses are indicated in thousands as 010.0. Please push the control knob and hold for one second again to switch back into FREQUENCY mode. The complete lists of preset frequencies and the number of pulses are shown in Appendix A.</p>

	<p>Two-digit LED display and control knob with push-button, which set PULSE ENERGY parameter. The energy can be adjusted from 50% to 99% with 1% step. LED display lights on constantly in idle or continuous operation modes. It blinks in burst mode, the duration of LED light on and off states corresponds to the duty cycle. Please push the control knob until it clicks and hold it for one second to switch into triggering TEST mode. HV ON/OFF push button is blocked in this mode. LED display shows 00, which means zero output power. Triggering sequence from the internal or external source goes to SYNC OUT connector. This mode allows to test the triggering and see the exact triggering sequence without applying HV pulses to the load. Please push the control knob and hold for one second again to switch back into PULSE ENERGY mode.</p>
	<p>If the internal temperature exceeds a safe level, then OVERHEAT LED lights on, and the generator stops the operation. It may occur in case of high ambient temperature / insufficient cooling or after long-time operation at high amplitude and high repetition rate. HV ON/OFF button is blocked while the generator is overheated. Please stay the generator in idle mode, and allow cooling by the fans for several minutes. The generator will return to normal operation automatically when the temperature decreases; press HV ON again to continue the operation.</p>
 <p>SYNC IN</p>	<p>BNC input connector for external triggering pulses. The amplitude should be +2.4V ... +5V, the nominal pulse width is 1 μs. External synchronization mode is activated by pressing INT/EXT green push button.</p>
 <p>SYNC OUT</p>	<p>BNC output connector for SYNC OUT pulses. The front edge of SYNC OUT pulse precedes HV output pulse by \sim1 μs. SYNC OUT pulse duration is 400 ns, the amplitude is 3V@50Ω.</p>

PUTTING THE GENERATOR INTO OPERATION

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

Step 1.

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

- NPG-10/100k (NPG-10/100kN) generator,
- power supply cable,
- output 75 Ohm coaxial cable.

Step 2.

Set up the generator. Ground it obligatory by connecting ground cable to terminal on the rear panel (14) 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 and co-pair male connector on the cable. Both connectors should be clean, free from dust, dirt, and obstacles. Clean the connectors with alcohol and/or cotton bud if necessary. After cleaning, please apply a drop of pure silicone grease before mating the connectors. Grease fills the air gap between co-pair connectors and eliminates possible glow discharge inside.

Attach the cable connector to the generator front panel connector (1). The tight and firm contact of the connectors is important for the safe operation of the generator. Even a small air gap between the connectors may result in a glow discharge, arcing, and damage to the generator and the cable.

The following procedure is recommended for obtaining good and tight contact:

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. Again, 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 with both hands.

After the first testing of the generator, it is highly recommended to check whether the tight contact of the connectors is obtained. Unscrew the cable connector. It should be no ozone or burnt smell from the connectors or burnt traces.

Do not disconnect and connect the high voltage connectors many times to prevent them from wearing and contamination. Silicone grease is already applied to both connectors at the factory. It remains between the mating connectors for a very long time and prevents discharge inside.

Step 4.

Connect another side of the coaxial cable to the load. The Teflon cone insulator is installed on the cable end to prevent the barrier discharge between the central wire and the cable braid across the cable solid polyethylene insulator (See Fig.2). You may use additional wires for connection to the load. Solder the high voltage load contact to the central cable wire and screw/solder ground load contact to the ground cable clamp. Please keep the length of the wires between the coaxial cable and the load as short as possible.

- More than 10 cm additional wires between the load and the coaxial cable result in excessive stray inductance and significantly decrease the pulse amplitude on the load.



Fig.2. Teflon cone insulator on the cable end.

- ➔ The length of the output coaxial cable is 3 meters. Using the shorter coaxial cable may result in damage to the generator.

Step 5.

Connect power supply cable to the wall power outlet.

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

Step 6.

Push back INT/EXT push button (if it is pressed) in INT position. Red LED on the button should light on indicating the internal triggering mode.

Set the required frequency, the number of pulses, and the energy by the knobs. It is clever to start the experiments with low operation parameters, which helps to prevent possible damage to the equipment in case of any error or improper using.

Press HV ON/OFF push button. Red LED on the button would light on, and output HV pulses would go to the output and load. Increase the amplitude and frequency by corresponding knobs as necessary.

Step 7.

Always stop the operation of the generator by HV ON/OFF switch. After that, you can switch off the generator by the power switch. After a long time of operation at high 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 internal and external triggering operation modes.

Internal triggering

The internal triggering mode is set when the INT/EXT button is pushed back. Red LED on the button continuously lights on, indicating the internal triggering mode. The external triggering pulse generator is not required, and continuous or burst operation mode can be implemented. Output pulses repetition rate can be adjusted by FREQUENCY regulation knob within 1 Hz ... 101 kHz. Press this knob and hold it for one second for entering into NUMBER-OF-PULSES adjusting regime. The four-digit indicator would start to flash. Set the required number of pulses in a burst. Press and hold the knob for one second again to return back to

FREQUENCY adjusting regime. The generator operates in burst mode if the set number of pulses is less than the set frequency, otherwise, it is in continuous mode. The complete lists of preset frequencies and number of pulses in the burst are presented in Appendix A.

External triggering

External triggering mode is set by pressing INT/EXT latching push button. Red LED on the button lights off, indicating the external triggering mode. The generator is triggered by the rising edge of the external triggering pulse applied to BNC type SYNC IN connector. Please use a coaxial cable and triggering generator with 50 Ohm impedances. Recommended triggering pulse amplitude and width are +5 V and 1 μ s. Red LED on INT/EXT button blinks with 1 Hz frequency in case of successful triggering. The delay between the triggering pulse front and the output pulse (internal generator delay) is about 1 μ s. Typical jitter (RMS) is 1 ns.

- The maximum allowable pulse repetition rate and the number of pulses within the burst are limited by internally set FREQUENCY and NUMBER OF PULSES parameters. Please set the required values by FREQUENCY knob.

The generator can operate in burst enable mode also. Long triggering pulse generates a burst of pulses with repetition rate set by FREQUENCY parameter. The external triggering pulse fed to SYNC IN connector works as enable signal in this case. HV pulses are generated continuously until the level of the triggering pulse becomes low.

The single pulse operation is available in the case of external triggering mode only.

Fig.3 – Fig.10 show the various bursts of the pulses formed in the external triggering mode.

Triggering test mode

Push and hold for one second the PULSE ENERGY knob to switch into TRIGGERING TEST mode. HV ON/OFF push button is blocked in this mode, and HV output pulses are not generated. LED display shows **00**, which means zero output power. Triggering sequence from internal and/or external source goes to SYNC OUT connector and can be registered by the external oscilloscope. This mode is useful to check the triggering sequence, especially in complicated operation regimes. Push and hold for one second the PULSE ENERGY knob one more time for returning back to the normal operation mode.

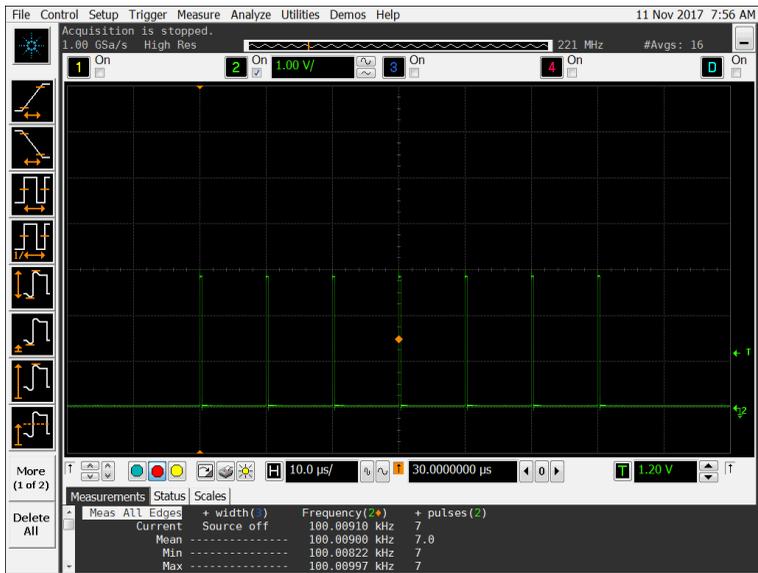


Fig.3. Internal triggering, burst mode. FREQUENCY sets 100 kHz repetition rate, NUMBER OF PULSES sets 7 pulses burst length. CH2 (green line) shows the output pulses on SYNC OUT connector.

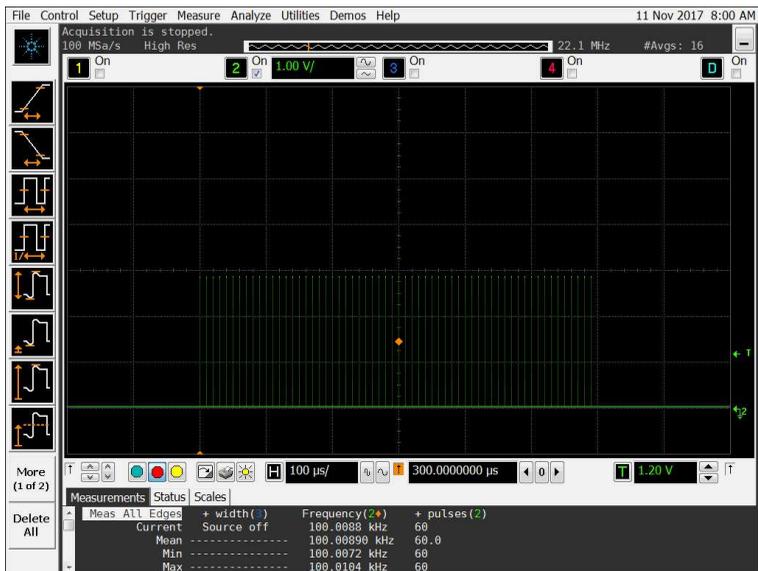


Fig.4. Internal triggering, burst mode. FREQUENCY sets 100 kHz repetition rate, NUMBER OF PULSES sets 60 pulses burst length. CH2 (green line) shows the output pulses on SYNC OUT connector.



Fig.5. External triggering mode. The external triggering pulses define the repetition rate. CH2 (green line) shows SYNC OUT pulses. CH3 (blue line) shows the triggering pulses fed to SYNC IN connector.



Fig.6. External triggering, burst mode. External triggering pulses (CH3, blue line) set 60 kHz repetition rate and 2 pulses in a burst. CH2 (green line) shows SYNC OUT pulses.

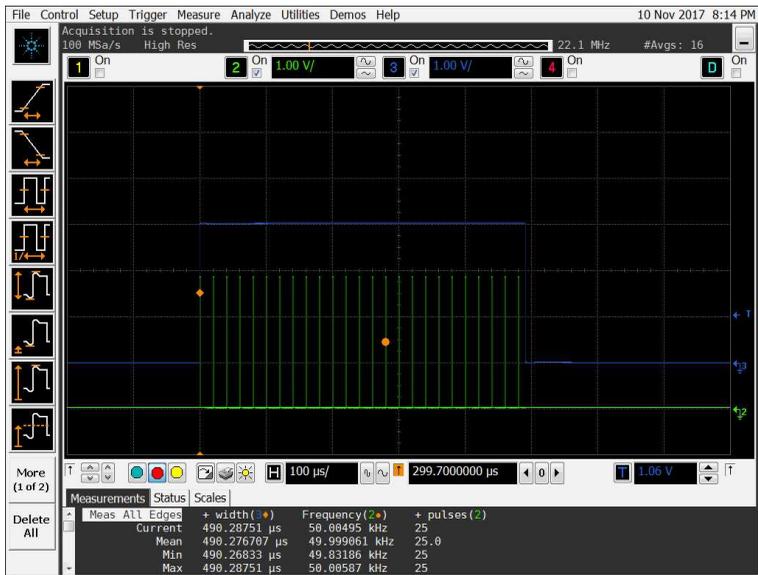


Fig.7. External triggering, burst enable mode. FREQUENCY parameter sets 50 kHz repetition rate within a burst, SYNC IN triggering pulse duration (CH3, blue line) defines the burst length of 25 pulses.

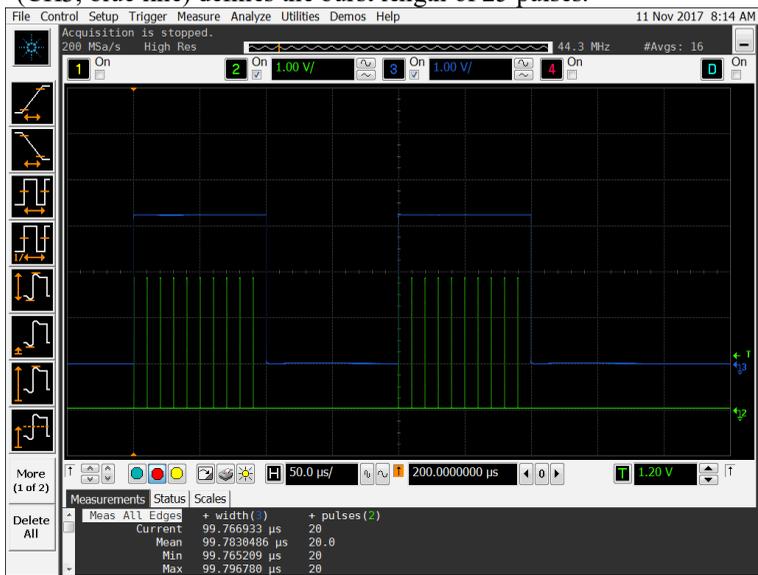


Fig.8. External triggering, burst enable mode. Two SYNC IN pulses (CH3, blue line) define two bursts of 10 pulses each. FREQUENCY parameter sets 100 kHz frequency within the bursts.

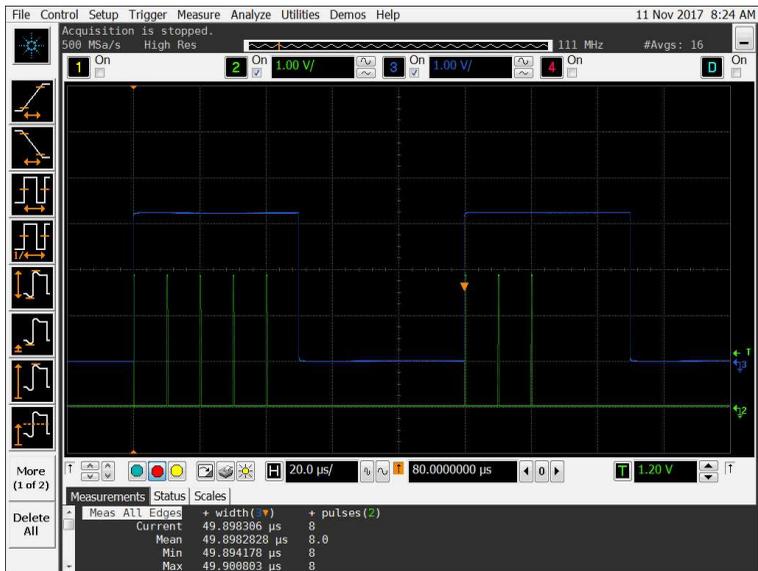


Fig.9. External triggering, burst enable mode. The NUMBER OF PULSES parameter is set to 8, limits the total number of pulses, and reduces the length of the second burst to 3 in spite of a longer external triggering pulse.

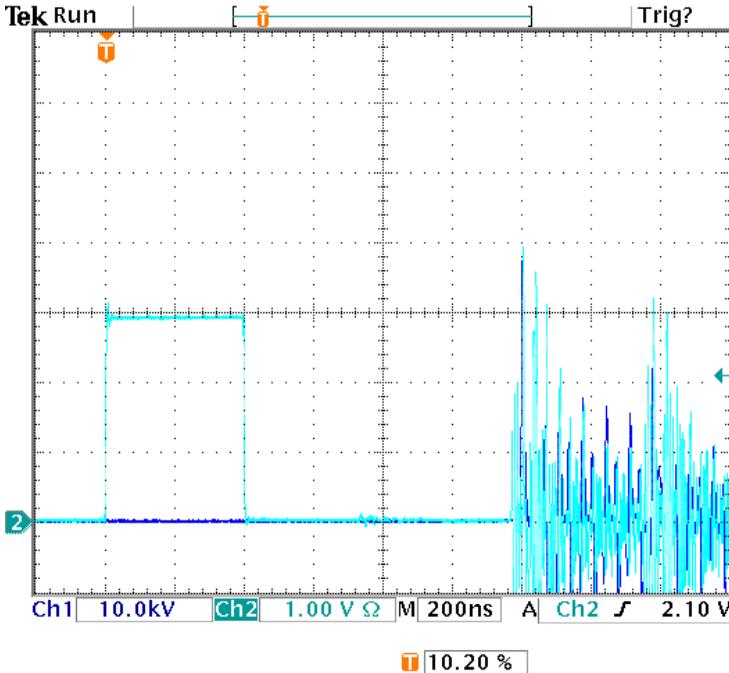


Fig.10. External triggering, burst enable mode. The pairs of SYNC IN pulses (CH3, blue line) set the pair bursts of output pulses (CH2, green line).

SYNC OUT PULSE

NPG-10/100k (NPG-10/100kN) generator has BNC type output connector for SYNC OUT pulses. The SYNC OUT pulse amplitude is 3 V on 50 Ohm load and 5 V on high impedance load. The pulse width is 400 ns.

The oscillogram of SYNC OUT pulse (Channel 2, cyan line) is shown in Fig.11. Channel 1 is the output HV pulse, which is a source of strong interference. Therefore, one can see the noise on the oscillogram at the moment of the output pulse generation. The delay between the rising edge of the triggering pulse and the output pulse is about 1 μ s.



7 Nov 2017
18:03:30

Fig.11. Oscillogram of SYNC OUT pulse (Channel 2, cyan line). The pulse amplitude is 3 V on 50 Ohm load and 5 V on high impedance load. The pulse width is 400 ns. The delay between the rising edge of the triggering pulse and the high voltage output pulse is about 1 μ s.

OVERHEAT MODE

NPG-10/100k (NPG-10/100kN) pulse generator has overheating protection system. The long-time operation with high amplitude and high repetition rate and/or at high ambient temperature may lead to the overheating of the generator. OVERHEAT LED lights on in this case, and the generator stops the operation. HV ON/OFF push button is turned off automatically and disabled. Please stay the generator in idle mode for several minutes, and allow the fans to cool it. OVERHEAT LED would light off when the temperature decreases and returns within the safe range. The generator is ready for the operation again.

FUSE REPLACEMENT

→ The type of fuse is 6A/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.12.).



Fig.12. Removing the fuse holder with a flat screwdriver.

There are two fuses in the fuse holder, including one spare (see Fig.13).



Fig.13. Two fuses in the fuse holder, including one spare (upper in the figure).

WARRANTY

Please see your sales agreement to determine the warranty period and condition. The generator has warranty seals on the front and rear panels (see Fig.14.).

- Removing the warranty seals terminates the warranty.



Fig.14. Warranty seals on the front and rear panels.

Appendix A.

List of preset repetition rates.

Frequency	4 digits display	Frequency	4 digits display
1 Hz	0.001	2.5 kHz	002.5
2 Hz	0.002	3 kHz	003.0
3 Hz	0.003	3.5 kHz	003.5
4 Hz	0.004	4 kHz	004.0
5 Hz	0.005	4.5 kHz	004.5
6 Hz	0.006	5 kHz	005.0
7 Hz	0.007	5.5 kHz	005.5
8 Hz	0.008	6 kHz	006.0
9 Hz	0.009	6.5 kHz	006.5
10 Hz	0.010	7 kHz	007.0
20 Hz	0.020	7.5 kHz	007.5
30 Hz	0.030	8 kHz	008.0
40 Hz	0.040	8.5 kHz	008.5
50 Hz	0.050	9 kHz	009.0
60 Hz	0.060	9.5 kHz	009.5
70 Hz	0.070	10 kHz	010.0
80 Hz	0.080	15 kHz **)	015.0
90 Hz	0.090	20 kHz **)	020.0
100 Hz *)	0.100	25 kHz	025.0
200 Hz	0.200	30 kHz **)	030.0
300 Hz	0.300	35 kHz	035.0
400 Hz	0.400	40 kHz	040.0
500 Hz	0.500	45 kHz	045.0
600 Hz	0.600	50 kHz	050.0
700 Hz	0.700	60 kHz	060.0
800 Hz	0.800	70 kHz	070.0
900 Hz	0.900	80 kHz	080.0
1 kHz	001.0	90 kHz	090.0
1.5 kHz	001.5	100 kHz	100.0
2 kHz	002.0	101 kHz ***)	101.0

*) the default value is 100 Hz, which is set after powering the generator

**) more than 15 kHz @ 8mJ, 20 kHz @ 6 mJ, and 30 kHz @ 4 mJ are available in the burst mode only

***) please set 101 kHz internal frequency if you want to operate in external triggering mode with up to 100 kHz repetition rate

List of the preset number of pulses within a burst. 4-digit display blinks with 1 Hz frequency while indicates the set number of pulses value.

Number of pulses	4 digits display	Number of pulses	4 digits display
1	0001	600	0600
2	0002	700	0700
3	0003	800	0800
4	0004	900	0900
5	0005	1000 *)	001.0
6	0006	1500	001.5
7	0007	2000	002.0
8	0008	2500	002.5
9	0009	3000	003.0
10	0010	3500	003.5
20	0020	4000	004.0
30	0030	5000	005.0
40	0040	5000	005.0
50	0050	6000	006.0
60	0060	7000	007.0
70	0070	8000	008.0
80	0080	9000	009.0
90	0090	10000	010.0
100	0100	15000	015.0
200	0200	20000	020.0
300	0300	25000	025.0
400	0400	30000	030.0
500	0500		

*) the default value is 1000 pulses, which is set after powering the generator