

**SUBNANOSECOND
PULSE GENERATOR MODULE
PPM0411**

USER MANUAL

v.1.0

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SAFETY MANUAL

Electrical safety

- PPM0411 pulse generator module 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 the generator, or other electronic equipment in case of improper use.
- It is strongly prohibited to switch on the generator without an output coaxial cable. We recommend using at least 50 centimeters length coaxial cable connected between the generator and the load (antenna or first attenuator) to prevent permanent damage to the generator. There is a risk of electrical arcing on the open HV coaxial connector and damage to the output circuit of the generator.
- When adding or removing the generator to or from the system, ensure that the power supply is unplugged (in OFF state). Please apply the power supply only after connecting output and input coaxial cables.
- Please provide sufficient free space and allow free airflow around the generator for good cooling in case of long-time operation at a high repetition rate.

Operation safety

- Please read this manual before installing and using the generator.
- Before using the product, make sure that all the 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 for operation 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:

- ✓ PPM0411 subnanosecond pulse generator module (hereinafter "generator")
- ✓ Dual voltage AC-DC power converter:
AC 85V...264V, 47Hz...63Hz / DC +24V, 3.2A; DC +160V, 1.6A;
- ✓ Semirigid coaxial cable assembly with N-type connector(s) for the output pulses feeding and connection to the load;
- ✓ Coaxial cable assembly SMA connector / RG316 cable / SMA connector for the input triggering signal feeding;
- ✓ User manual (printed or electronic version).



Fig.1. General view of PPM0411 subnanosecond pulse generator module.

DESCRIPTION OF THE GENERATOR OPERATION

PPM0411 generates nanosecond range unipolar high voltage pulses with up to 4kV amplitude and 150kHz max repetition rate. It is made as a compact pulse generator module (head) with an external triggering and an external AC-DC power supply. The typical output pulse waveform is shown in Fig.2.

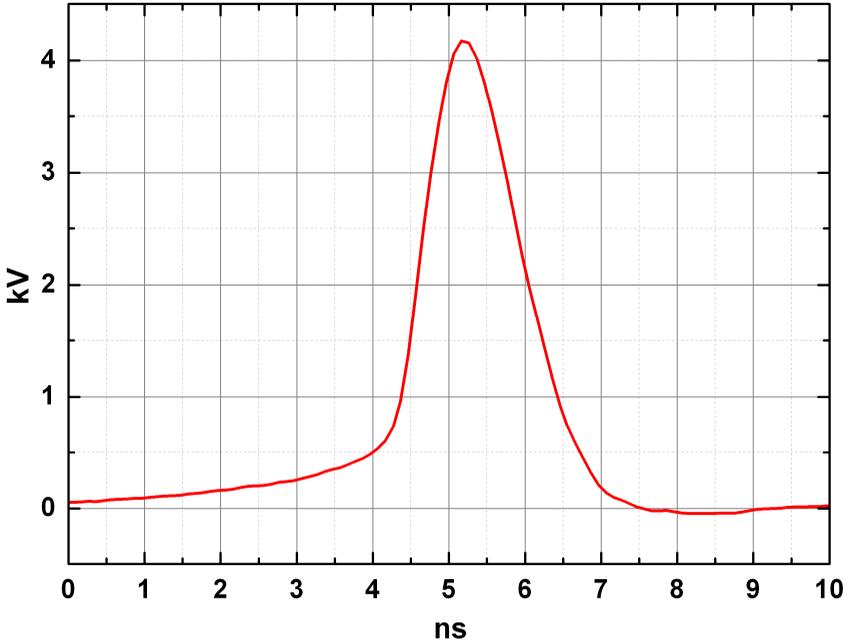


Fig.2. PPM0411 typical output pulse waveform on 50 Ohm matched load.

The generator is designed for the operation with 50 Ohm matched load only, i.e. 50 Ohm resistive load or matched impedance antenna connected by 50 Ohm impedance coaxial cable. Operation with non-matched load inevitably results in reflection part of the energy back to the generator and it's possible overheating.

- ➔ **It is strongly prohibited to turn on the generator without the load (with an open connector). We recommend using 50 centimeters length coaxial cable between the generator and the load (antenna or first attenuator) to prevent damage to the generator in the case of load breakdown or disconnection.**

PPM0411 has overheating protection. If the temperature exceeds 55 °C, then the red LED "OVERHEAT" lights on and the triggering is blocked. Please cool down the generator and reduce the repetition rate if required.

- ➔ **Please provide free airflow around the generator in the case of long-time operation at high frequency, especially in the case of non-matched load.**

The standard package includes an external AC-DC converter which provides two fixed power supply voltages: DC +24V (low voltage) and DC +160V (high voltage). The output pulse amplitude is proportional to the level of high voltage DC supply. It is fixed in the case of using a standard AC-DC converter but can be smoothly adjusted using a laboratory DC voltage power supply, please see Fig.3. Do not exceed DC +168V level for high voltage supply. There is a risk of damage to the generator. The low voltage should always be DC +24V.

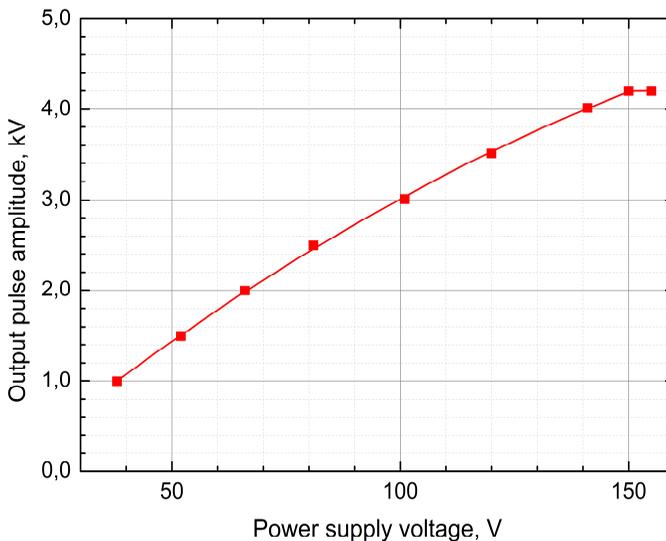


Fig.3. PPM0411 output pulse amplitude VS high voltage power supply.

The optional four wires DC power supply cable may be supplied together with the pulse generator.

- ➔ **The ground wires of the optional power supply cable are marked by black color. Low voltage and high voltage supply wires are marked by labels 24 and 160 correspondingly.**

The contact pins of the power supply connector are the following:

Pin 1 – GND (ground return DC +24V)

Pin 2 – DC +24V low voltage supply

Pin 3 – GND (ground return DC +160V)

Pin 4 – DC +160V high voltage supply

The generator is triggered by the leading edge of the external triggering pulse. There is no internal triggering mode. Acceptable triggering pulse amplitude is +3.5V ... +5V at 50 Ohm; low triggering pulse amplitude leads to unstable triggering and increases the output pulse jitter. The recommended triggering pulse width is 100ns, the range within 10 ns ... 1000 ns are acceptable. Triggering pulse rise time should be no more than 1 ns. A longer rise time may result in increasing the output pulse jitter. Orange LED "SYNC IN" lights on in case of successful triggering.

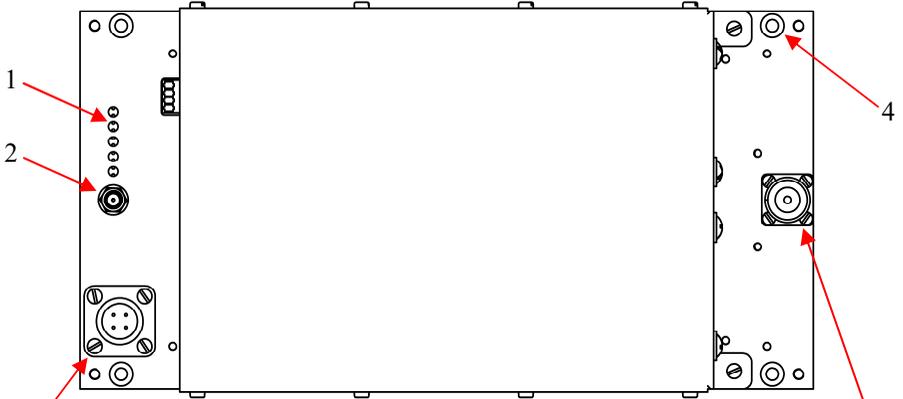
The generator has internal over-frequency protection. If the frequency of the triggering pulses is more than 150 kHz, then the generator blocks the triggering and red LED "OVERLOAD" lights on. The same occurs in the case of a very long triggering pulse. Please reduce the frequency of the triggering pulses and/or triggering pulse width.

Two fans are used for the cooling of the generator. If the temperature is low, then the fans do not rotate. The rotation speed of the fans increases with increasing the temperature. Therefore, the cooling system stabilizes the temperature of the generator; this improves the stability of the output pulse waveform, and reduces temperature drift.

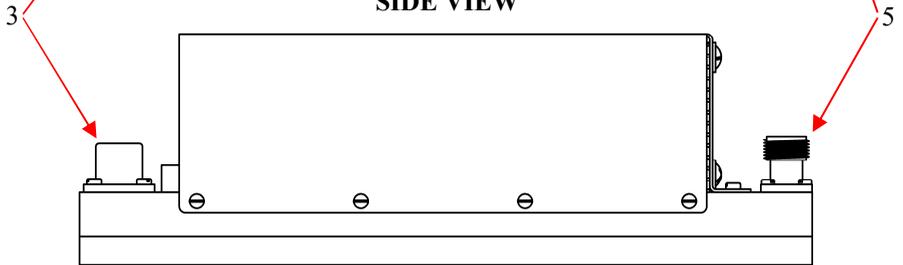
**TECHNICAL SPECIFICATION
OF PPM0411 SUBNANOSECOND PULSE GENERATOR MODULE**

Output pulse amplitude	4 kV
Pulse polarity and waveform	Positive, bell-like
Output connector and impedance	N-type, 50 Ohm impedance
Pulse rise time (fast part)	< 600 ps
Pulse width (FWHM)	1.7 ns
Max repetition rate	150 kHz
Jitter (RMS)	< 20 ps
Jitter (peak-to-peak)	< 100 ps
Internal delay (from leading edge of the triggering pulse to output pulse)	~ 130 ns
Triggering	External only
Input triggering pulse connector	SMA
Triggering pulse parameters	+5V amplitude on 50 Ohm, 10 ns ... 1000 ns width, 1ns rise time
Power supply (standard AC-DC converter)	+24V, 3.2A; +160V, 1.6A
Size	250 x 130 x 80 mm ³
Operation temperature	0 °C.. +50°C

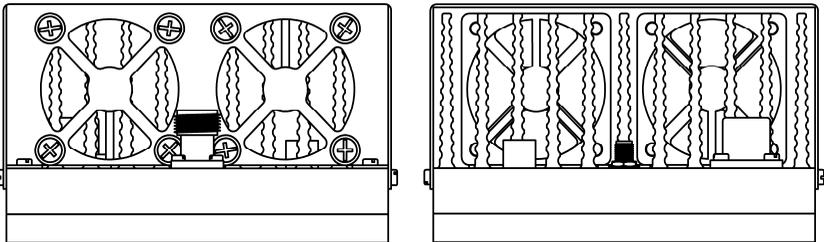
TOP VIEW



SIDE VIEW



LEFT AND RIGHT VIEW



- 1 – control LED (from top to bottom)
 - +24V DC (green) – low voltage +24V DC power supply is applied
 - +HV DC (green) – high voltage +160V DC power supply is applied
 - SYNC IN (orange) – triggering of the generator
 - OVERHEAT (red) – too high temperature
 - OVERLOAD (red) – too high repetition rate
- 2 – Input triggering SMA connector
- 3 – Power supply connector
- 4 – 4x mounting holes 4mm dia, 222x118mm footprint
- 5 – Output HV N-type connector

PUTTING THE GENERATOR INTO OPERATION

- ➔ **Please follow strictly the following steps. It helps to prevent damage to the generator and other equipment.**

Step 1.

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

- PPM0411 pulse generator;
- Dual voltage AC-DC converter with supply cables;
- Semirigid coaxial cable assembly with N-type connector(s) for the output pulses feeding;
- Coaxial cable assembly SMA/RG316_cable/SMA for the input triggering pulses feeding.

Remove the protective and packaging materials from the generator and power supply converter.

Step 2.

In case of using alternative laboratory DC power supply:

Please set the external power supplies according to the recommended low voltage and high voltage levels before connecting to the generator.

Step 3.

Connect the output semirigid coaxial cable assembly and the load to the generator. Connect the triggering pulse generator by input coaxial cable assembly. Connect standard AC/DC converter or alternative laboratory DC power supply by using optional four wires DC power supply cable. The ground wires of the cable are marked by black color. Low voltage and high voltage supply wires are marked by the labels.

- ➔ **Improper connection of DC power supply will damage the generator.**

Step 4.

Switch on the power supply. Both greens LED “+24V DC” and “+HV DC” should light on. Set the external triggering pulses frequency to 1 kHz, amplitude to +5V, pulse width 100 ns. Apply triggering pulses, orange LED “SYNC IN” should light on.

High voltage output pulses should be generated. Please check them. Set the external triggering pulses frequency as required, but below or equal to the maximum repetition rate.

- **Please pay attention that most of the standard GHz range coaxial attenuators are not suitable for direct registration of output pulses because of extremely high peak power. Even 100W and more power attenuators will be broken inevitably. We recommend using of 142 series Barth Electronics attenuator (for the frequencies below 5 kHz) as the first attenuator connected just to the generator output or use a high voltage directional coupler.**

The generator is designed for long-time operation at a max repetition rate, but it can be overheated in case of unmatched load and high ambient temperature. Please provide free airflow around the generator for good cooling. The temperature of the generator should be below 55 °C. Reduce the repetition rate and/or improve the airflow in case of overheating.

If the frequency of the triggering pulses is too high, then the red LED “OVERLOAD” lights on and the generator stops the operation. Please reduce the frequency of the triggering pulses, LED “OVERLOAD” lights off and the generator continues the operation automatically.

TRIGGERING OF THE GENERATOR

The recommended triggering pulse waveform is shown in Fig. 4. Nominal triggering pulse amplitude is +5V on 50 Ohm, pulse duration should be within 10 ns ... 1000 ns, rise time should be 1 ns or less. A longer rise time may result in increasing the output pulse jitter.

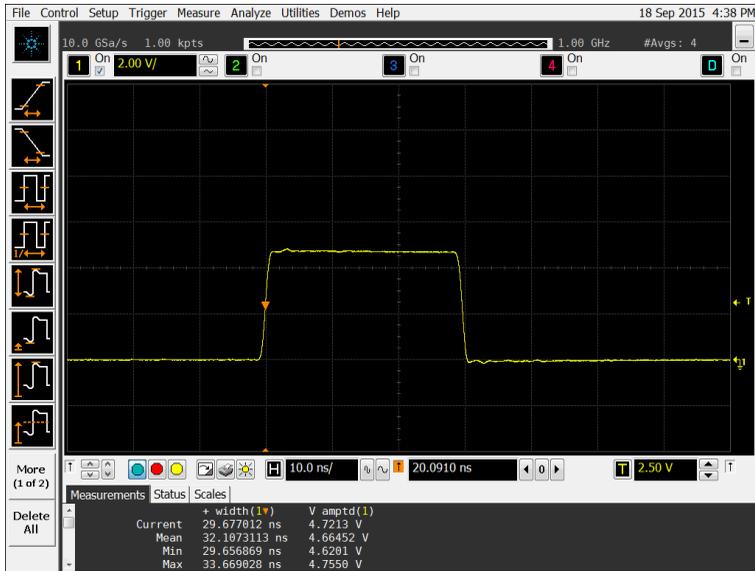


Fig. 4. Recommended triggering pulse waveform.

WARRANTY

Please see your sales agreement to determine the warranty period and warranty terms. The generator has warranty seals.

- ➔ **Removing the warranty seals terminates the warranty.**