Megaimpulse
MODERN SEMICONDUCTOR TECHNOLOGIES

# SUBNANOSECOND

# PULSE GENERATOR MODULE

# PPM0621

## USER MANUAL

v.1.0

## Megaimpulse Ltd. contact information

Address: 28 Polytechnicheskaya str., St. Petersburg, 194021 Russia
www: http://www.megaimpulse.com
e-mail: mp@power.ioffe.rssi.ru
phone/fax: +7-812-297-3145

**CONTENTS**

# SAFETY MANUAL

## Electrical safety

- The PPM0621 pulse generator module is a high-voltage equipment. Please be careful and only operate it by qualified personnel.
- There is a risk of electric shock, strong electromagnetic interference, and damage to the generator or other electronic equipment in case of improper use.
- It is strongly prohibited to switch the generator on without an output coaxial cable. We recommend to use a coaxial cable at least 50 centimeters long between the generator and the load to prevent permanent damage to the generator in case of a load breakdown. There is a risk of electrical arcing at the open HV connector and damage to the output circuit of the generator.
- When adding or removing the generator to or from a system, ensure that the power supply is disconnected (in OFF state). Apply power supply only after connecting the input and output coaxial cables.
- Provide sufficient free space and allow free airflow around the generator for good cooling, especially during 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 short circuits, 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 leave it in a wet place.
- 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:

- ✓ PPM0621 subnanosecond pulse generator module (hereinafter "generator")
- ✓ Dual voltage AC/DC switching power supply:
  input - AC 85V..264V, 47Hz..63Hz
  outputs - DC +24V, 3.2A and DC +160V, 1.6A;
- ✓ Semirigid coaxial cable assembly for the output pulses feeding to the load:
  N connector/SM141 cable/open cable or
  N connector/SM141 cable/N connector;
- ✓ Coaxial cable assembly for the input triggering pulses feeding:
  SMA connector/RG316 cable/SMA connector;
- ✓ User manual (printed or electronic version).


Fig.1. General view of PPM0621 subnanosecond pulse generator module.

## DESCRIPTION OF THE OPERATION

PPM0621 generates nanosecond unipolar 6 kV pulses with subnanosecond rise time and up to 100 kHz repetition rate. It is designed as a compact pulse generator module (head), with an external power supply, and has only external triggering. The typical output pulse waveform is shown in Fig.2.

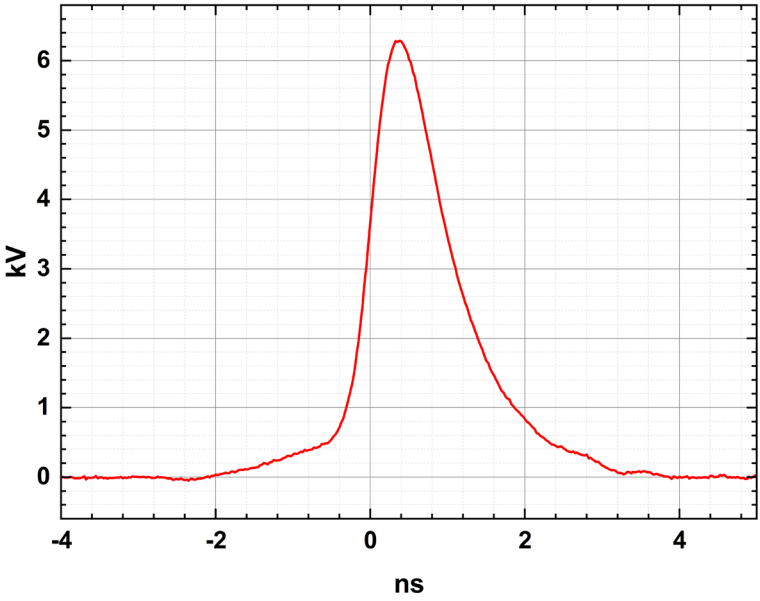



Fig.2. The PPM0621 typical output pulse waveform on matched 50 Ohm load.

The generator is designed to operate only with a 50-Ohm matched load, i.e., a 50 Ohm resistive load or a matched impedance antenna connected via a 50 Ohms impedance coaxial cable. Operating with an unmatched load will inevitably cause a portion of the pulse energy to be reflected back to the generator, potentially causing overheating.

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

PPM0621 has overheating protection. If the temperature exceeds ~ 55 ºC, then 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 during long-term operation at high frequencies, especially for mismatched loads.**

The generator is triggered by the leading edge of an external triggering pulse. There is no internal triggering. The triggering pulse amplitude should be within +3.5V … +5V @ 50 Ohm. Low triggering pulse amplitude leads to unstable triggering and increases the output pulse jitter. The recommended triggering pulse width is 100 ns, the acceptable range is 10 ns ... 1000 ns. The pulse rise time should be as short as possible, preferably not more than 1 ns. Longer rise time increases the output pulse jitter. Orange LED "SYNC IN" lights on in case of successful triggering.

The package includes an external AC/DC converter which provides two fixed power supply voltages: DC +24V (low voltage) and DC +160V (high voltage).

The generator has internal over-frequency protection. If the frequency of triggering pulses exceeds a maximum value, the generator blocks triggering and red LED “OVERLOAD” lights on. The same occurs if the triggering pulse width is more than 1 μs. Please reduce the frequency of triggering pulses or the triggering pulse width.

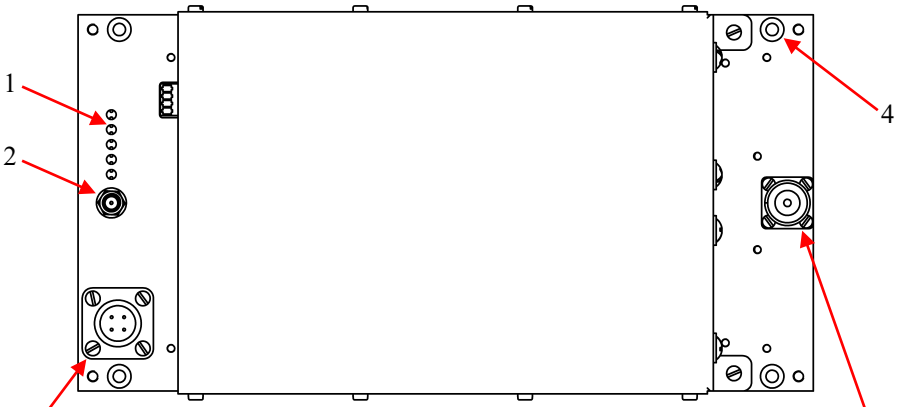
The temperature of the generator is stabilized by the cooling system. Initially, if the temperature is low, the fans are stopped. During operation, the speed of rotation of the fans depends on heating, providing temperature stabilization, which improves stability of output pulse waveform and reduces temperature drift.

## TECHNICAL SPECIFICATION

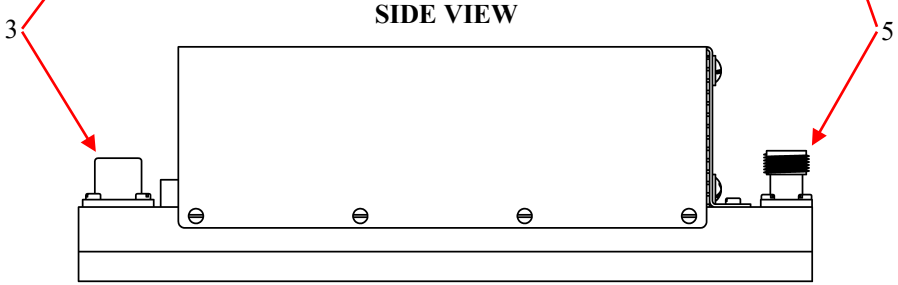
| | |
|---|---|
| Output pulse amplitude | **≥ 6 kV** |
| Pulse polarity | **positive** |
| Output connector and load impedance | **50 Ohm** |
| Pulse rise time (20%-90% levels) | **500 ps** |
| Pulse rise time (10%-90% levels)[1)] | **< 700 ps** |
| Pulse width (FWHM) | **1.1 ns** |
| Max repetition rate | **100 kHz** |
| Jitter (RMS) | **< 20 ps** |
| Jitter (peak-to-peak) | **< 100 ps** |
| Triggering | **external only** |
| Input triggering pulse connector | **SMA** |
| Triggering pulse | **+3.5V … +5V on 50 Ohm;<br>10 ns ... 1000 ns pulse width;<br>1 ns rise/fall time for min jitter** |
| Power supply | **+24V, 3.2A;+160V, 1.6A** |
| Size | **250 x 130 x 80 mm$^3$** |
| Operation temperature | **0 °C.. +50°C** |

[1)] Measurement of the pulse rise time at 10%-90% levels includes the prepulse, which is the slow rising part of the pulse before the main pulse up to about 10% of its amplitude. This parameter is only given for reference.

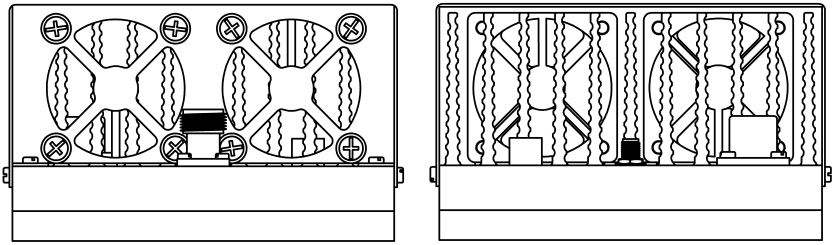
**TOP VIEW**




**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) – successful triggering 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 4.2 mm dia, 222x118mm footprint
5 – Output HV N-type connector

## PUTTING INTO OPERATION

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

### Step 1.

Unpack the generator and check for the presence of the following items in the package:

- PPM0621 pulse generator;
- Dual-voltage AC/DC switching power supply converter with a power supply cable;
- Semirigid coaxial cable assembly with N-type connector(s) for the output HV pulses feeding;
- Coaxial cable assembly SMA/RG316_cable/SMA for the input triggering pulses feeding.

### Step 2.

Connect the output of the generator to the load using a semirigid coaxial cable assembly with N-type connector(s).
Connect the triggering pulse generator using SMA/RG316_cable/SMA coaxial cable assembly.

### Step 3.

Connect the AC/DC switching power supply converter to the generator.

### Step 4.

Set the following triggering pulse parameters: waveform - pulse, load - 50 Ohm, frequency - 1 kHz, low level 0 V, high level +5 V (i.e. +5V amplitude with +2.5 V bias), pulse width - 100 ns, rise time - as short as possible (1 ns recommended). Turn on the power supply. Both the green LED “+24V DC” and “+HV DC” should light on. Apply the triggering pulses, orange LED “SYNC IN” should light on.
High voltage output pulses should be generated. Please check them. Set the external triggering pulse frequency as required, but not exceeding the maximum allowable repetition rate.

➔ **Please pay attention that most standard GHz range coaxial attenuators are not suitable for direct measurement of output pulses due to their extremely high peak power. Even 100 W and more power attenuators will break immediately. We recommend using the 142 series from Barth Electronics for frequencies below 5 kHz as the first attenuator connected to the generator output, or using a special high-voltage directional coupler.**

The generator is designed for long-term operation at maximum repetition rate. However, it can overheat in the case of operating with an unmatched load and at high ambient temperatures. Please ensure free airflow around the generator to ensure good cooling. The temperature of the generator should not exceed 55°C. If overheating occurs, reduce the repetition rate or improve airflow.

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

## TRIGGERING

The recommended triggering pulse waveform is shown in Fig. 3. The nominal triggering pulse amplitude is +5V at 50 Ohm, and the pulse duration should be between 10 ns and 1,000 ns. The rise time should be 1 ns or less. A longer rise time may increase the output pulse jitter.

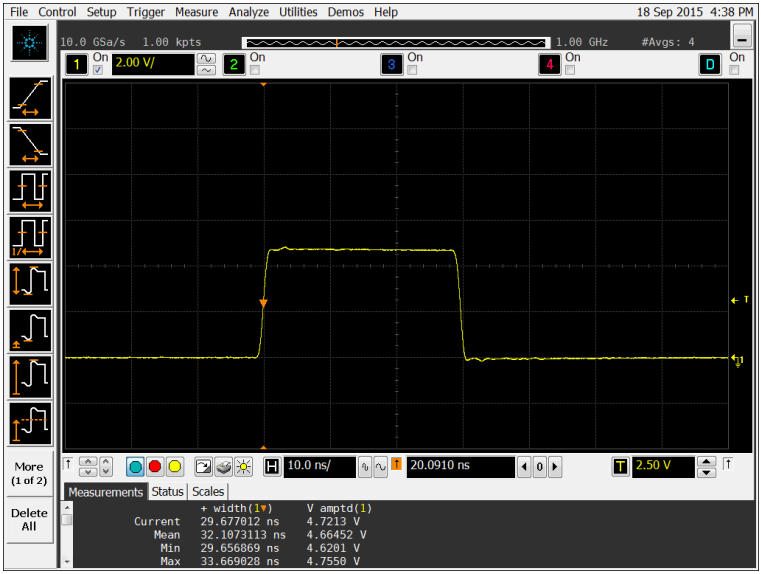



Fig. 3. The recommended triggering pulse waveform.

## 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.**