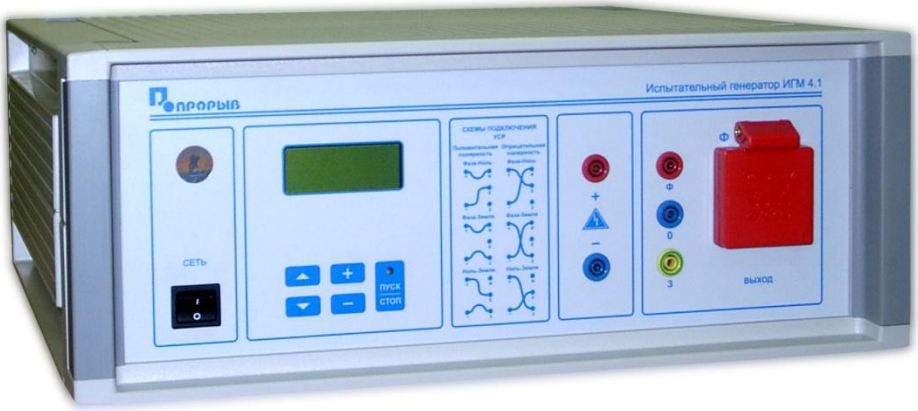
НАУЧНО-ПРОИЗВОДСТВЕННОЕ ПРЕДПРИЯТИЕ



Surge generator up to 4kVas per

IEC/EN 61000-4-5

IGM 4.1

CONTENTS

1. Product features.

1.1. Surge generator of microsecond noise pulse (hereinafter – test generator IGM 4.1) is manufactured by "PRORYV" Research and development enterprise.

1.2 . Test generator IGM 4.1 is designed to jam normalized microsecond impulsive noise of high-energy in the power circuits, and to transfer data when making tests of the technical equipment (hereinafter – TE), which may be exposed by MIN in accordance with GOST R 51317.4.5-99, GOST IEC 61000-4-5-2014, GOST R 50009-2000, IEC 61000-4-5-95.

1.3 . Test generator IGM 4.1 is packed with an integrated **single phase** coupling-decoupling networks (CDN), 220V/10A.

"PRORYV" Research and development enterprise manufactures and provides the Customer with other types of CDN for making tests in accordance with GOST R 51317.4.5-99 via special arrangement.

2. Technical specifications.

• Output Maximum current	10 A
• voltage pulse amplitude at no-load (U_{max})	(0.5; 1; 2; 4) kV ± 10%
• voltage pulse rise time	1 μs ±30%
• duration of voltage pulses	50 μs ± 20%
• pulse direction	positive and negative
• phase pulse shift to AC power voltage	0-330° at a pitch of 30 °
• current short-circuit pulse amplitude (I_{max})	(0.25; 0,5; 1; 2) kA ± 10%
• current pulse rise time	6.4 μs ± 20%
• duration of current pulses	16 μs ± 20%
• current pulse backswing amplitude	0.3 x I max
• effective internal resistance	2 Ohm ± 25 %
• pulse interval	1 min
• triggering mode	single / 1 min interval
• import power	30 W max
• dimensions	450 x 434 x 169 mm
• device mass	15 kg max
• service life	10 years

3. Packing contents.

The package includes:

• test generator IGM 4.1	1 unit
• mains cable	1 unit
• blue switching cable	1 unit
• red switching cable	1 unit
• 15A fuse	2 unit
• 1A fuse	2 unit
• Technical passport	1 unit

4. Feature and operation concept.

4.1 The functional chart of the test generator IGM 4.1 is shown in **Figure 1.**

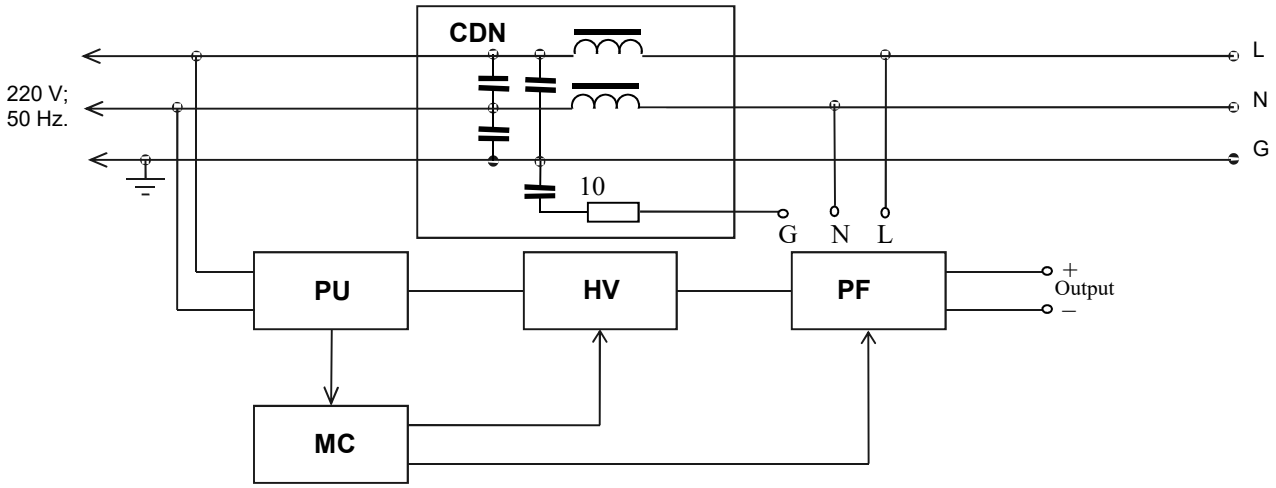


Fig. 1 The functional chart of the test generator IGM 4.1

1. Power Unit (PU)
2. Microprocessor Controller (MC)
3. High Voltage Transducer (HVT)
4. Pulse Former (PF)
5. Coupling-Decoupling Networks (CDN)

4.2. The power unit (PU) generates + 5V, + 15V, -15V and + 300V, which are required for appropriate functioning of the microprocessor controller and the high voltage transducer.

4.3. The high voltage transducer (HVT) generates voltage ranging from 0.5 to 4 kV, which is required for charging the pulse former storage capacitor.

4.4. The microprocessor controller (MC) generates start pulses (for the pulse former), which are synchronized with the circuit voltage phase, and controls the operation of the high voltage transducer, a keyboard, and a LCD display.

4.5. The pulse former (PF) is designed to generate voltage and current pulses of an appropriate wave form and amplitude.

4.6. The coupling-decoupling networks (CDN) are designed to bring pulse noises into power circuits according to 'phase-to-neutral', 'phase-to-ground', and 'neutral-to-ground' connections.

5. Safety precautions.

5.1. Only persons who have read and understood "The rules of technical operation of electric installations of consumers", have an approved group-based electrical safe work practices (not less than level 3), have been instructed on safety measures for work with electronic test equipment, and have examined technical specification and the manual, are permitted to use the test oscillator.

5.2. The repair of the oscillator shall be done only by the manufacturer's representatives.

5.3. ***Do not cut on the test generator into mains when the upper cap is removed.***

5.4. A protective ground connection is required.

5.5. Do not touch switching cables and power cable of the tested equipment when test pulses are brought.

6. Preliminary starting procedure.

6.1. After transfers in winter or high humidity conditions, the product should be kept under normal conditions 2 hours minimum before using.

6.2. Check 1A and 15A fuses are inserted in the rear panel holders.

6.3. Connect the protective ground to the connecting device ⏚ on the rear panel by a wire sections of 1.5 mm ^{2} min.

6.4 Connect the power cable to the socket on the rear panel and to the power outlet 220 V ; 50 Hz. Turn on the test generator by "**POWER (СЕТЬ)**" switch. The message shown in Figure 2 should be displayed. If the message "**MISCONNECTION! (НЕПРАВИЛЬНОЕ ПОДКЛЮЧЕНИЕ!)**" is displayed, turn off the generator and upturn the plug. If the same message is shown when you turn it on again, check the existence and integrity of the power ground.

Amplitude:	**0.5kV ←**
Phase:	**0°**
Power:	**Off**
00:00:00	**N=1**

Figure 2

6.5. The phase and neutral of the output receptacle correspond to "L **(Ф)**" and "**N (0)**" signs on the front panel.

7. Working sequence.

7.1. It is recommended that the tests be carried out 10-15 minutes after the generator is turned on.

7.2. After the generator is turned on by "**POWER (СЕТЬ)**" switch, text and an arrow cursor appear in the top line (see Figure 2). The "**START (ПУСК)**" LED becomes green, indicating the generator is ready to start. The cursor is moved over lines by "↓" and "↑" keys.
7.3. The output pulse amplitude at no-load is set by "+" and "-" keys. The cursor has to be set in "**Aplitude: (Ампл:)**" line. The following values can be selected: **0.5 kV**, **1.0 kV**, **2.0 kV** and **4.0 kV**.

7.4. The phase displacement of test pulses in relation to supply voltage is selected by moving the cursor to "**Phase (Фаза)**:" line by "+" and "-" buttons. The following values can be selected: 0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°.
0°, 90°, 180° and 270° are the main values for testing a TE, powered by single-phase network. The remaining values are required for testing of three-phase equipments when the generator IGM 4.1 is used together with CDN 25.3 device.

7.5. When setting the cursor to "**Power (Сеть)**:" line by using "+" and "-" keys, electric line voltage 220V in "**OUTPUT (ВЫХОД)**" socket of the generator can be turned on and off. This makes it possible to connect tested TE without turning off the power of the test generator.

7.6. The pattern of bringing pulses and their polarity is selected by corresponding connection of "+" and "**-**" receptacles to "L **(Ф)**", "**N (0)**" and "**GND (3)**" sockets (see Table 1). With regard to the above mentioned, the generator total output resistance in "Phase-to-neutral" scheme is 2 Ohm ± 25%, and in "Phase-to-ground" and "Neutral-to-ground" schemes is 12 Ohm ± 20%.
Do not transfer switching cables if there is a network voltage on the generator "**OUTPUT (ВЫХОД)**" ***outlet***.

Table 1.

Scheme of bringing test pulses	**Polarity**	**" + " receptacle**	**" - " receptacle**
Phase-to-neutral	+	L	N
	-	N	L
Phase-to-ground	+	L	GND
	-	GND	L
Neutral-to-ground	+	N	GND
	-	GND	N

7.7. Green color of "**START (ПУСК)**" LED indicates that the generator is ready to start. The generator is started by pushing "**START/STOP (ПУСК/СТОП)**" button. The high voltage transducer is turned on and "**START (ПУСК)**" LED shows red. After the required voltage is set (the time of charging depends on the set output pulses amplitude and does not exceed 10-15 seconds for 4 kV amplitude), the launch is started. A pulse of the specified amplitude is formed at the generator output. A pulse of positive polarity with a 5-10 V amplitude and length of 1.5-2.5 μs is formed at "**TRIGGERING (СИНХРОНИЗАЦИЯ)**" output during the launch. When the launch is made "**START (ПУСК)**" LED is turned off and then shows green in a minute after "**START/STOP (ПУСК/СТОП)**" button is pushed. Green color of "**START (ПУСК)**" LED indicates that the generator is ready for a new start.

7.8. When moving the cursor to the bottom line by using "+" and "**-**" buttons, the number of brought pulses with chosen parameters from 1 to 10 can be set. After "**START/STOP (ПУСК/СТОП)**" button is pushed, the generator generates pulses with a period of 60 sec. By pushing "**START/STOP (ПУСК/СТОП)**" button, an operation cycle is terminated. The generator blocks other buttons during an operation cycle.

7.9. After the work is completed, the power of the technical equipment shall be switched off, the test generator is powered off and the technical equipment is disconnected from the generator "**OUTPUT (ВЫХОД)**" socket.

8. Maintenance.

8.1. The maintenance of the test oscillator after the end of the warranty period shall be performed by the manufacturer under a particular contract.

8.2. The manufacturer shall provide warranty service for the oscillator over 24 months after work acceptance is made in accordance with the contract.

8.3. The warranty obligations shall not apply to equipment with clear mechanical or other damage caused by malfunctioning, mistreatment or accidents.

8.4. The warranty period is terminated if the repair is to be completed by the Customer or any third party.

8.5. Biennially at a minimum, the test generator shall be checked in accordance with periodical qualification procedure.

9. Problems and solutions.

9.1. Possible problems and solutions of fixing them are indicated in Table 2.

Table 2.

Kind of malfunction	Probable cause	Solutions
1. When "**POWER (СЕТЬ)**" switch is turned, LCD backlight does not work.	1A fuse is missing or blown-out.	Change 1A fuse in the rear-panel holder.
2. The "**MISCONNECTION! (НЕПРАВИЛЬНОЕ ПОДКЛЮЧЕНИЕ!)**" message is shown on the display.	Phase and zero wires of the supply outlet and generator are mismatched.	Upturn the plug in the outlet.
	Protective ground does not connected or damaged	Connect the ground connector to ground bus of a room.
	15A fuse is missing or blown-out.	Change 15A fuse in the rear-panel holder.
3. Misrepresentation of information on the display.	Electromagnetic disturbance.	Turn off the generator and in 5-6 seconds to turn it back on.

9.2. Otherwise, contact the manufacturer.

10. Equipment qualification procedure.

10.1. The qualification of test equipment shall be carried out in accordance with GOST R 8.568-97, GOST R 51317.4.5-99, technical passport of the test generator of microsecond noise pulse.
The qualification frequency of the test generator of microsecond noise pulse.
The qualification frequency of IGM 4.1 during its operation and storage process is defined by an enterprise using the equipment in accordance with the conditions and intensity of its operation. It is recommended to conduct it biennially.
10.2. The list of standardized accuracy characteristics of the test generator.

10.2.1. The list of normalized output pulse parameters is shown in Table 3.

Table 3.

Amplitude, kV	**0.5**	**1**	**2**	**4**
The voltage pulse amplitude at no-load, kV ± 10%	0.5	1.0	2.0	4.0
Voltage pulse-rise time as of 0.1-0.9 μs ± 30%	1.0			
Voltage pulse-rise time as of 0.5 μs ± 20%	50.0			
Current pulse amplitude at short-circuit, kA ± 10%	0.25	0.5	1.0	2.0
Current pulse-rise time as of 0.1-0.9 μs ± 20%	6.4			
Current pulse-rise time as of 0.5 μs ± 20%	16.0			
Current pulse backswing amplitude, A, max	75.0	150.0	300.0	600.0
Effective internal resistance, O ± 25%	2.0			

10.3. The recommended measurement tools for testing the generator are shown in Table 4.

Table 4.

Measurement tools	Technical specifications	Type
Universal oscilloscope	Pass-band 10 Mhz min	TDS 2022
Pulse voltage divider	Dividing ratio 1:200 ± 1% Input resistance 10 kOhm ± 1% Maximum voltage 5kV min Pass-band 5 Mhz min	IDM 5.1
Instrument shunt	Impedance of 0 ÷ 0,1 Mhz frequency 0,01 Ohm ± 4%	IShM 3.1

10.4. Generator qualification and measurement of main metrological characteristics

10.4.1. The pre-starting procedure of the test generator shall be conducted in accordance with item 6 of the present passport. It is recommended that the tests be carried out 10-15 minutes after the generator is turned on. The oscilloscope using to measure parameters shall be grounded. The point of ground wire connection shall be determined in accordance with a minimum of noise on the output pulse oscillogram. It is recommendable to connect it near the input connector of the vertical deflection amplifier.

10.4.2. The voltage pulse amplitude at no-load is measured at the output of the test generator by the oscilloscope connected via the pulse voltage divider to of "+" and "-" receptacles. The oscilloscope is set in waiting mode with external triggering. The external trigger is connected to "**TRIGGERING (СИНХРОНИЗАЦИЯ)**" output of the test generator located on the back panel. The sync pulse parameters are specified in item 7.7. The base of the oscilloscope is set in position 5 ÷ 10 μs/point. Measured values for the four set values of the amplitude are recorded in a protocol (see Passport, Table 5).
The deviation of measured values from the rated is calculated using a formula (10.1):

$$\Delta U = \frac{Uамп - Uном}{Uном} \times 100\%. \quad (10.1)$$

(where Uамп is Uamp, Uном is Urated)

The results of the measurements are recorded in the protocol (see Passport, table 5).
10.4.3. Voltage pulse-rise time for the four set values of the amplitude is measured by the oscilloscope when the value of the oscilloscope base is 0.2 μs/point as of levels (0.1 ÷ 0.9)U_{max}. The results of the measurements are recorded in the protocol (see Passport, table 5). The deviation of measured values from the rated is calculated and recorded in the protocol.

10.4.4. Voltage pulse-rise time for the four set values of the amplitude is measured by the oscilloscope when the value of the oscilloscope base is 10 μs/point as of level 0.5U_{max}. The results of the measurements are recorded in the protocol (see Passport, table 5).
The deviation of measured values from the rated is calculated and recorded in the protocol.

10.4.5. The amplitude of current pulses is measured with the aid of the oscilloscope by the current transducer connected to the output of the test generator. The base of the oscilloscope is set in position 5 μs/point. The amplitude of current pulses is calculated using a formula:

$$Iмакс = \frac{Uизм}{Rш} \quad (10.2),$$

(where Iмакс is Imax, Uизм is Umst, Rш is Rshunt)

where I_{max} is the amplitude of the current pulse; U_{mst} is the amplitude of the measured voltage pulse; R_{shunt} is the resistance of the current transducer.

The results of the measurements for the four set values of the amplitude are recorded in the protocol (see Passport, Table 5). The deviation of measured values from the rated is calculated and recorded in the protocol.

10.4.6. Current pulse-rise time is measured for the four set values of the amplitude when the oscilloscope base value is 1 μs/point as of levels (0.1 ÷ 0.9)I_{max}. The results of the measurements are recorded in the protocol (see Passport, table 5).
The deviation of measured values from the rated is calculated and recorded in the protocol.

10.4.7. Current pulse-rise time is measured for the four set values of the amplitude when the oscilloscope base value is 2 μs/point.

10.4.8. Backswing amplitude pulse-rise time is measured for the four set values of the amplitude when the oscilloscope base value is 5 μs/point. The measured values shall not exceed the values specified in Table 3 of the Passport.

10.4.9. Effective internal resistance for the four set values of the amplitude is calculated using a formula:

$$Ri = \frac{Umaкс}{Imaкс} \qquad (10.3),$$

(where Uмакс is Umax, Iмакс is Iмакс)

and is recorded in the protocol (see Passport, table 5). The deviation from the rated values is calculated and recorded in the protocol.

10.4.10. The phase displacement of voltage pulses to AC network is controlled at the "OUTPUT (ВЫХОД)" of the integrated CDU. The oscilloscope is connected through the voltage divider between the phase and ground contact element of "OUTPUT (ВЫХОД)" outlet. "+" and "-" receptacles of the generator shall be connected by switching cables to "L (Ф)" and "GND (3)" sockets correspondingly.
Mode of the generator IGM 4.1: Amplitude – 0.5 kV / Power - off. The position of the oscilloscope base switcher is 5 μs/point.
Positive pulse in "0°" shall occur when the circuit voltage is at the transition point of zero from negative to positive half-wave.
Positive pulse in "90°" shall occur at the maximum of the positive half-wave of the circuit voltage.
Positive pulse in "180°" shall occur when the circuit voltage is at the transition point of zero from positive to negative half-wave.
Positive pulse in "270°" shall occur at the minimum of the negative half-wave of the circuit voltage.

Table 5.

Set value of the amplitude	**-**	**0.5 kV**	**1 kV**	**2 kV**	**4 kV**
Voltage pulse amplitude at no-load, kV	rated	0.5	1.0	2.0	4.0
	measured				
deviation, %	-				
Pulse rise time voltage as of level 0.1-0.9, μs	rated	1.0			
	measured				
deviation, %	-				
Duration of voltage pulses as of level 0.5, μs	rated	50.0			
	measured				
Deviation, %	-				
Current pulse amplitude short circuit, kA	rated	0.25	0.5	1.0	2.0
	measured				
deviation, %	-				
Pulse rise time voltage as of level 0.1-0.9, μs	rated	6.4			
	measured				
Deviation, %	-				
Duration of current pulses as of level 0.5, μs	rated	16.0			
	measured				
Deviation, %	-				
Pulse backswing amplitude current pulse, A, max	rated	75.0	150.0	300.0	600.0
	measured				
Effective internal Resistance, Ohm	rated	2.0			
	measured				
Deviation, %	-				

11. Maintenance conditions

Climate conditions

The generator shall be operated under normal climate conditions**:**

- surrounding air temperature ***(20 ± 10) ^{o} C;***
- relative air humidity ***(60 ± 15)%;***
- atmospheric pressure ***84.0 – 106.0 kPa (630-800 mm Hg).***

General requirements for electric power.

The generator is powered by a single-phase AC network with a frequency of 50 Hz, nominal voltage of 220 V ± 10%. The sections of the wires should correspond to the maximum loads of the test equipment. The workplaces shall have euro sockets with the connected grounding pins. The sockets and protective ground connected devices shall be located in close proximity to the generator. The connection of the protective ground to the "ground" connecting device located on the rear panel of the generator require a flexible wire having sections of 1.5 mm .
Do not use dividing transformers to power the generator.

12. Shipment

The packed generator is transported by all kinds of transport, provided that it is protected against precipitation.

When the generator is transported by an air plane, it shall be placed in a heated sealed compartment.

The holds of ships and car bodies used for shipment shall not have cement, coal, chemicals, etc.

The shipment of the generator shall be carried out at air temperature ranging from -25 °C to + 55 ° C, relative air humidity up to 95% at +55°C temperature

13. Storage precautions

The generator shall be stored in heated space under the following conditions:
air temperature from 283 to 308 K (from 10 to 35 °C) ;
relative air humidity 80% at 298 K (25 ºC) air temperature ;
there shall be no dust, acid vapor, grease alkali and corroding gases in the storage space ;
do not store unpacked generators on the top of one another.
The storage of the packed generator is acceptable.