НАУЧНО-ПРОИЗВОДСТВЕННОЕ ПРЕДПРИЯТИЕ

Surge generator up to 4kVas per IEC/EN 61000-4-4

IGN 4.1m

CONTENTS

1. Product features

1.1 Test generator of nanosecond noise pulse (hereinafter – test generator IGN 4.1m) is manufactured by "PRORYV" Research and development enterprise.

1.2 Test generator IGM 4.1m is designed to jam normalized nanosecond impulsive noise packet in the power and signal circuits when making tests of the technical equipment (hereinafter – TE), which may be exposed in accordance with GOST 30804.4.4-2013 (IEC 61000-4-4:2012).

2. Technical specifications

Set amplitude value (at no-load mode), kV	**0.25**	**0.5**	**1**	**2**	**4**	**Permissible fractional accuracy, %**
Operating at 1000 Ohm load						
Pulse amplitude, kV	0.24	0.48	0.95	1.9	3.8	± 20
Pulse-rise time as of 0.1-0.9 level, nsec	5.0					± 30
Pulse-rise time as of 0.5, nsec	35 ÷ 150					
Operating at 50 Ohm load						
Pulse amplitude, kV	0.125	0.25	0.5	1.0	2.0	± 10
Pulse-rise time as of 0.1-0.9 level, nsec	5.0					± 30
Pulse-rise time as of 0.5, nsec	50.0					± 30
Pulse packet rise time at 5 kHz frequency, msec	15.0					± 20
Pulse packet rise time at 100 kHz frequency, msec	0.75					± 20
Pulse packet repetition period, msec	300.0					± 20
Pulse packet repetition frequency, kHz	5.0					± 20
	100					± 20
Maximum current value drawn by a tested TE from mains 220 V; 50 Hz						10 A
Pulse direction						positive and negative
Operation to line voltage phase						asynchronous
Import power						20 W max
Dimensions: test generator IGN 4.1m						450 x 434 x 169 mm
Dimensions: capacitive coupling clamp EK4						1050 x 140 x 170 mm
Device mass: test generator IGN 4.1m						12 kg max
capacitive coupling clamp CCC4						8 kg max
Service life						10 years

3. Packing contents

The package includes:

- test generator IGN 4.1m 1 unit
- mains cable 1 unit
- capacitive coupling clamp EK4 1 unit
- coaxial cable 1 unit
- fuse 15 A 2 unit
- fuse 1A 2 unit
- Technical passport 1 unit

4. Feature and operation concept

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

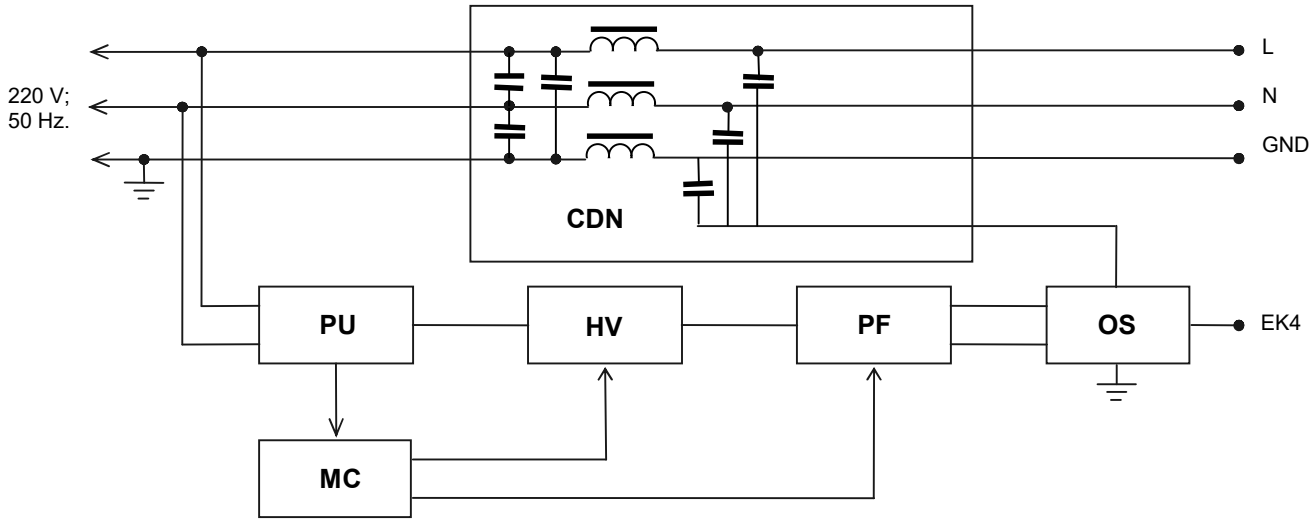

Fig. 1 The functional chart of the test generator IGN 4.1m

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

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 0.25 to 4 kV, which is required for charging the pulse former storage capacitors.
4.4. The microprocessor controller (MC) generates start pulses (for the pulse former), and controls the operation of the high voltage transducer and the output switcher, a keyboard, and a LCD display.
4.5. The pulse former (PF) is designed to generate pulses of an appropriate form and amplitude.
4.6. The coupling-decoupling networks (CDN) is designed to bring pulse noise packets into power circuits 'phase', 'neutral', and 'ground' in common mode.
4.7. The output switcher (OS) ensures the output pulses polarity change and the connection of the PF either to the CDN or to the output of the capacitive coupling clamp EK4.

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 generator.

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

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

5.4. A protective ground connection is required.

5.5. Do not touch the power cables of the tested equipment and the capacitive coupling clamp when a test effect is generated.

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:	**0.25 kV ←**
Frequency:	**5 kHz**
Output:	**CDN+**
Mode:	**continuous**

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. The tested equipment (with drawn current of 10 A maximum) is recommended to be connected to "**OUTPUT (ВЫХОД)**" outlet when the generator power is off.

7.2. After connecting of the TE to the generator, turn on "**POWER (СЕТЬ)**" of the generator and the power of the TE.

7.3. After the generator is turned on, text and an arrow cursor appear in the top line of the screen (see Figure 2).

7.4. 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: **0.25 kV**, **0.5 kV**, **1.0 kV**, **2.0 kV** and **4.0 kV**.

7.5. The cursor is moved over lines by "↓" and "↑" keys.

7.6. The output pulse frequency is set by "+" and "**-**" keys. The cursor has to be set in "**Frequency: (Частота:)**" line. The following values can be selected: **5 kHz** and **100 kHz**.

7.7. The bringing model of test pulses, as well as their polarity is selected by moving the cursor to "**Output: (Выход)**:" line by "+" and "**-**" buttons. The signs "**CDN+ (УСР+)**", "**CDN- (УСР-)**", "**ЕК4+(ЕК4+)**", "ЕК4**-(ЕК4-)**" appear sequentially, which specify the connection scheme and the polarity (CDN is connection to the coupling-decoupling networks, EK4 - to the outlet for the connection of capacitive coupling clamp and external CDN).

7.8. When setting the cursor to "**Mode: (Режим)**:" line by using "**+**" and "**-**" keys, select one of the following mode of bringing pulse packets: constant ("**const (непр)**), when pulse packets are brought continuously over 1 minute, and periodic ('**periodic (прер)**"), which is recommended for tests in accordance with GOST 30804.4.4-2013 (IEC 61000-4-4:2006), when pulse packets are brought over 6 periods of 10 sec each with 10 sec pauses. In this case the total length of the test is 2 minutes.

7.9. The capacitive coupling clamp is connected to "**ЕК4**" output by means of the included coaxial cable.

7.10. The start and stop functions of test pulses packets generation are performed by pushing "**START/STOP (ПУСК/СТОП)**" button. When the pulse packet generates LED near the button shows red. When the generation is being performed, there is count-down in the bottom line of the screen.

7.11. After the work is completed, the power of a 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 generator 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 generator 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 1.

Table 1

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 message "**MISCONNECTION (НЕПРАВИЛЬНОЕ ПОДКЛЮЧЕНИЕ!**".	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.

9.2. Otherwise, contact the manufacturer.

10. Equipment qualification procedure

10.1. The qualification of the test generator of nanosecond noise pulse IGN 4.1m is based on the qualification procedure written below in accordance with GOST R 8.568, GOST 30804.4.4-2013 (IEC 61000-4-4:2012), and the technical passport.

The qualification frequency of the test generator during its operation and storage process is to be 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 qualification procedure of the IGN 4.1m shall be carried out under normal climate

surrounding air temperature, *(293± 5)K;(20 ± 5) ^{o}C;*
relative air humidity, (*60±15)%;*
atmospheric pressure (84.0-106.0) kPa (630-800) mm Hg;

AC supply voltage, (*220 ± 10) B:*
mains frequency; (*50 ± 0,5) Hz.*

10.3. The list of standardized accuracy characteristics of the test generator is shown in Table 2.

Table 2

Set amplitude value (at no-load mode), kV	**0.25**	**0.5**	**1**	**2**	**4**	**Permissible fractional accuracy, %**
Operating at 1000 Ohm load						
Pulse amplitude, kV	0.24	0.48	0.95	1.9	3.8	± 20
Pulse-rise time as of 0.1-0.9 level, nsec	5.0					± 30
Pulse-rise time as of 0.5, nsec	35 ÷ 150					
Operating at 50 Ohm load						
Pulse amplitude, kV	0.125	0.25	0.5	1.0	2.0	± 10
Pulse-rise time as of 0.1-0.9 level, nsec	5.0					± 30
Pulse-rise time as of 0.5, nsec	50.0					± 30
Pulse packet rise time at 5 kHz frequency, msec	15.0					± 20
Pulse packet rise time at 100 kHz frequency, msec	0.75					± 20
Pulse packet repetition period, msec	300.0					± 20
Pulse packet repetition frequency, kHz	5.0					± 20
	100					± 20

10.4. The recommended measurement tools for testing the generator are shown in Table 3.

Table 3

Measurement tools	**Technical specifications**	**Type**
Oscilloscope	Pass-band 400 Mhz min	LeCroy WaveJet 354
Pulse voltage divider	Ratio 1:40 Input resistance 1 kOhm Input capacity 6pF max Maximum voltage 5 kV min Pass-band 400 Mhz min	IDN 5.1
Attenuator	Input resistance 50 kOhm Attenuation 26 dB Maximum voltage 3 kV min Pass-band 400 Mhz min	IAN 3.1
Attenuator	Input resistance 50 kOhm Attenuation 20 dB	D2-32

10.5. Generator qualification and measurement of main metrological characteristics

10.5.1. The pre-starting procedure of the test generator shall be conducted in accordance with item 6 of the present passport. Set the output mode "**ЕК4+**" (see item 7.7).

10.5.2. The pulse amplitude at 1000 Ohm load operation is measured at "**ЕК4**" output of the test generator by the oscilloscope connected via the pulse voltage divider with the output resistance 1000 Ohm. The oscilloscope is set in waiting mode with internal triggering. The base of the oscilloscope is set in position 5 ÷ 10 nsec/point. Measured values for the four set values of the amplitude are recorded in a protocol.

The deviation of measured values from the rated is calculated using a formula (1):

$$\Delta U = \frac{U_{амп} - U_{ном}}{U_{ном}} \times 100\%, \qquad (1)$$

where: ΔU is the deviation of the measured values from the rated ones;

Uampl(амп) is the voltage pulse amplitude, V;

Urated(ном) is the voltage amplitude rated value, V.

The results of the calculation are recorded in the protocol.

10.5.3. Voltage pulse-rise time for the all set values of the amplitude is measured by the oscilloscope when the value of the oscilloscope base is 1 nsec/point as of levels (0.1 ÷ 0.9)Umax at 1000 Ohm load. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.4. Pulse-rise time for the all set values of the amplitude is measured by the oscilloscope when the value of the oscilloscope base is 10 nsec/point at level of 0,5 Urated at 1000 Ohm load. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.5. The pulse amplitude at 50 Ohm load operation is measured at "**ЕК4**" output of the test generator by the oscilloscope connected via the pulse voltage divider with the output resistance 50 Ohm. The base of the oscilloscope is set in position 5 ÷ 10 nsec/point. Measured values for the four set values of the amplitude are recorded in a protocol.

10.5.6. Voltage pulse-rise time for the all set values of the amplitude is measured by the oscilloscope when the value of the oscilloscope base is 1 nsec/point as of levels (0.1 ÷ 0.9)Urated at 50 Ohm load. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.7. Pulse-rise time for the all set values of the amplitude is measured by the oscilloscope when the value of the oscilloscope base is 10 nsec/point at level of 0,5 Urated at 50 Ohm load. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.8. Packet pulse-rise time for the all values of the amplitude and the frequency of pulse repetitions is measured by the oscilloscope. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.9. The period of packet pulse-rise time for the all values of the amplitude and the frequency of pulse repetitions is measured by the oscilloscope when the value of the oscilloscope base is 50 μs/point. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.10. The pulse frequency for the all values of the amplitude is measured by the oscilloscope. The results of the measurements are recorded in the protocol. The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.11. Choose the mode of the output of "**ЕК4-**". Repeat the actions according to item 5.2-5.10 for the negative polarity of the output pulses. The results are recorded in Table 4.

Table 4

The results of the measurements for the output voltage **positive** polarity.

Set amplitude value (at no-load mode), kV		**0.25**	**0.5**	**1**	**2**	**4**
Operating at 1000 Ohm load						
Pulse amplitude, kV ± 20%	rated	0.24	0.48	0.95	1.9	3.8
	measured					
deviation, %	-					
Voltage pulse-rise time as of 0.1-0.9, nsec ± 30%	rated	5.0				
	measured					
deviation, %	-					
Pulse-rise time as of 0.5, nsec	rated	35-150				
	measured					
Operating at 50 Ohm load						
Pulse amplitude, kV ± 10 %	rated	0.125	0.25	0.5	1.0	2.0
	measured					
deviation, %	-					
Pulse rise-time as of 0.1-0.9, nsec ± 30%	rated	5.0				
	measured					
deviation, %	-					
Pulse-rise time as of 0.5, nsec ± 30%	rated	50.0				
	measured					
deviation, %	-					
Pulse packet rise time at 5 kHz frequency, ms ± 20%	rated	15.0				
	measured					
deviation, %	-					
Pulse packet rise time at 100 kHz frequency, msec ± 20%	rated	0.75				
	measured					
deviation, %	-					
Pulse packet repetition period, ms ± 20%	rated	300.0				
	measured					
deviation, %	-					
Pulse packet repetition frequency, kHz ± 20%	rated	5.0				
	measured					
deviation, %	-					
Pulse packet repetition frequency, kHz ± 20%	rated	100.0				
	measured					
deviation, %	-					

Table 5

The results of the measurements for the output voltage**negative** polarity.

Set amplitude value (at no-load mode), kV		**0.25**	**0.5**	**1**	**2**	**4**
Operating at 1000 Ohm load						
Pulse amplitude, kV ± 20%	rated	0.24	0.48	0.95	1.9	3.8
	measured					
deviation, %	-					
Voltage pulse-rise time as of 0.1-0.9, nsec ± 30%	rated	5.0				
	measured					
deviation, %	-					
Pulse-rise time as of 0.5, nsec	rated	35-150				
	measured					
Operating at 50 Ohm load						
Pulse amplitude, kV ± 10 %	rated	0.125	0.25	0.5	1.0	2.0
	measured					
deviation, %	-					
Pulse rise-time as of 0.1-0.9, nsec ± 30%	rated	5.0				
	measured					
deviation, %	-					
Pulse-rise time as of 0.5, nsec ± 30%	rated	50.0				
	measured					
deviation, %	-					
Pulse packet rise time at 5 kHz frequency, ms ± 20%	rated	15.0				
	measured					
deviation, %	-					
Pulse packet rise time at 100 kHz frequency, msec ± 20%	rated	0.75				
	measured					
deviation, %	-					
Pulse packet repetition period, ms ± 20%	rated	300.0				
	measured					
deviation, %	-					
Pulse packet repetition frequency, kHz ± 20%	rated	5.0				
	measured					
deviation, %	-					
Pulse packet repetition frequency, kHz ± 20%	rated	100.0				
	measured					
deviation, %	-					

11. Maintenance conditions

Climate conditions

The generator shall be operated under normal climate conditions:
surrounding air temperature, *(293± 5)K;(25 ± 5) ^{o}C;*
relative air humidity, (*60±15)%;*
atmospheric pressure (84.0-106.7) kPa (630-800) mm Hg;

General requirements of 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 tested 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.

14. Certificate of acceptance.

Test generator IGN 4.1m, manufacturing number , meets the technical requirements and is approved as ready for service.

Production date .