НАУЧНО-ПРОИЗВОДСТВЕННОЕ ПРЕДПРИЯТИЕ

Test generator of single voltage pulse IGM 05.1

CONTENTS

1. Product features

1.1 Test generator of single voltage pulse IGM 05.1 (hereinafter – the generator) is manufactured by "PRORYV" Research and development enterprise.

1.2 The test generator of single voltage pulse IGM 05.1 is designed to generate rated single voltage pulses (SVP), which are brought to external terminals of electronic chips to modulate electrical pulses at the outputs and contacts as a result of electromagnetic pulses (EMP) effect.

2. Technical specifications

• pulse output voltage at no-load, V	5 ÷ 500
• setting increment of the voltage pulse amplitude, V	1
maximum pulse current, A	10 minimum
• pulse direction	positive, negative
• output pulse form	biexponential
• voltage pulse time as of level 0.5 at 50 Ohm load, μs:	
	0.1 ± 10%
	1.0 ± 10%
	10.0 ± 10%
• leading edge pulse time as of 0.1 ÷ 0.9, when operating at 50 Ohm load, nsec:	
at 0.1 μs pulse time	10 max
at 1.0 μs pulse time	50 max
at 10.0 μs pulse time	500 max
• output resistance of the generator, Ohm	50 ± 20%
• generator pulse launch mode	single
• import power, W	50 max
• dimensions, mm	450 x 434 x 169
• mass, kg	10 max
• service life	10 years

3. Packing contents

The package includes:

- test generator IGM 05.1 — 1 unit
- mains cable — 1 unit
- blue switching cable — 1 unit
- red switching cable — 1 unit
- fuse 5A — 2 units
- technical passport — 1 unit

4. Feature and operation concept

4.1 The functional chart of the test generator IGM 05.1 is shown in **Figure 1.**

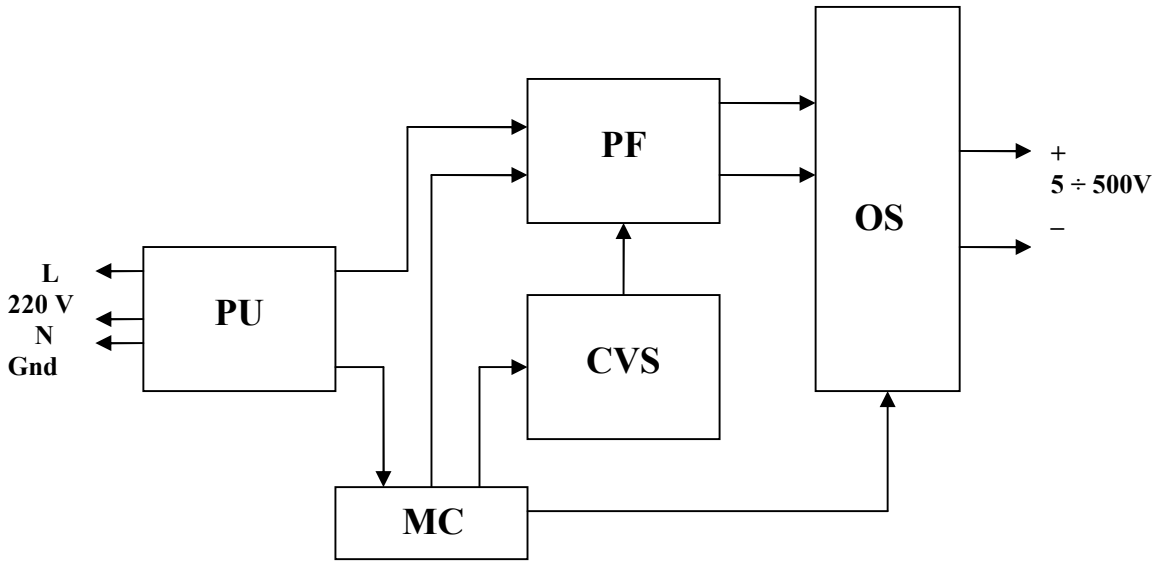

Fig. 1 The functional chart of the test generator IGM 05.1

1. Power Unit (PU).
2. Microprocessor Controller (MC).
3. Controlled Voltage Stabilizer (CVS).
4. Pulse Former (PF).
5. Output Switch (OS).

4.2 The power unit (PU) generates voltage supply for all generator units when it is powered by AC mains.

4.3 The microprocessor controller (MC) controls the operation of all generator units, changes the output voltage and generator pulse time.

4.4 The controlled voltage stabilizer (CVS) is a high-power DC amplifier. CVS generates a stable DC voltage.

4.5 The output switch (OS) generates time and polarity of the voltage pulses with the rated characteristics at the output of the test generator.

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.

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. 6.2. Check 5A fuse is 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.

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 "**Polarity (Полярность)**" line (ref. Figure 2). The "**START (ПУСК)**" LED becomes green, indicating the generator is ready to start. The cursor is moved over lines by "↓" and "↑" keys.

Figure 2

7.3. The output pulse polarity is set by "+" and "-" keyboard keys. The cursor has to be in "**Polarity (Полярность)**" line (ref. Figure 2). There are two values to be selected – "**positive (полож.)"** - positive polarity and **"negative (отриц.)" -** negative one.

7.4. The output pulse amplitude is set by "+" and "-" keyboard keys. The cursor has to be in "**Amplitude (Амплитуда)**" line (ref. Figure 3). The values ranging **from 5V to 500V can be selected, the setting increment for voltage pulse is 1V**. When holding "+" or "-" button for a long time, the setting increment for voltage pulse is **10V**.

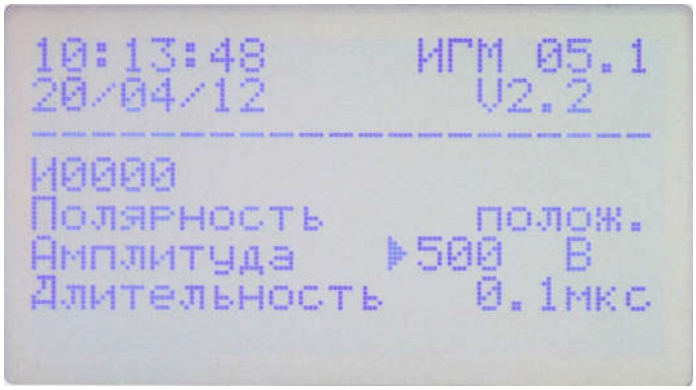

Figure 3

7.5. The output pulse time is set by "+" and "-" keyboard keys. The cursor has to be set in "**Time (Длительность)**" line. The values "**0.1µs (мкс)**, "**1µs (мкс)**", and "**10µs (мкс)**" can be selected (ref. Figure 4).

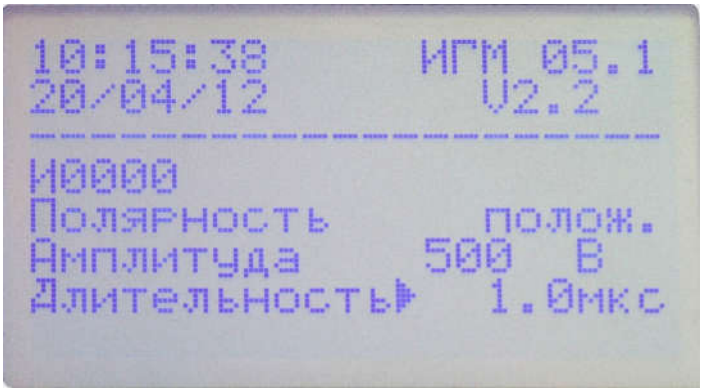

Figure 4

7.6. 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. A single pulse is brought to the output, "**START (ПУСК)**" LED shows red, and the "**I0000 (И0000)**" line reflects that the pulse counter goes up by one (the counter is reset either when the polarity changes or when the generator is turned off). A pulse of positive polarity with a 5 V amplitude and 80 µs time 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 1 second after "**START/STOP (ПУСК/СТОП)**" button is pushed. Green color of "**START (ПУСК)**" LED indicates that the generator is ready for a new start.

7.7. 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.

7.8. To install the internal clock of the generator in the clock setting mode when the generator is launched by "**POWER (СЕТЬ)**" button it is necessary to hold "↑" button. After that the generator is turned on in the clock setting mode (ref. Figure 5). To select the lines of hours, minutes, seconds, day, month and year setting use "↓" and "↑" buttons. Change the value in the selected line by using "+" and "-" buttons. To confirm the settings of the internal clock and turn to the operation mode of the generator, push "**START/STOP (ПУСК/СТОП)**" button. To cancel the setting, turn the generator off by "**POWER (СЕТЬ)**" switch.

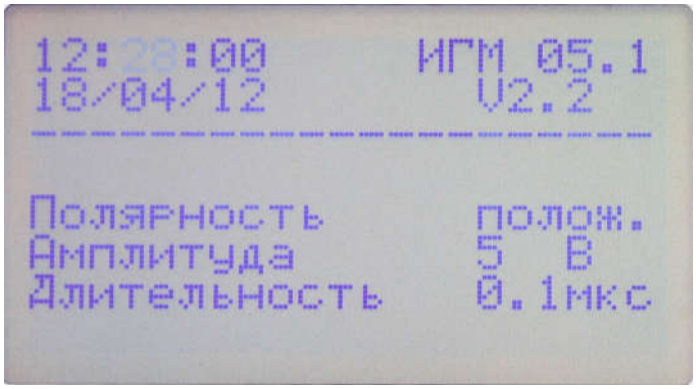

Figure 5

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
When "**POWER (СЕТЬ)**" switch is turned, LCD backlight does not work.	5A fuse is missing or blown-out.	Change 5A fuse in the rear-panel holder.
	The network cable is out of service.	Replace the network cable.

9.2. Otherwise, contact the manufacturer.

10. Equipment qualification procedure

10.1. The qualification of IGM 05.1 test generator is carried out according to the methodology set out below in accordance with 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 IGM 05.1 shall be carried out under normal climate
surrounding air temperature, *(293± 5)K;(20 ± 5) °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 rated accuracy characteristics of the test generator is shown in Table 2, 3.

Table 2

Set amplitude value (at no-load mode), kV	**5**	**50**	**500**	**Permissible fractional accuracy, %**
At no-load operation				
Pulse amplitude, V	5.0	50.0	500.0	± 10
When operating at 50 Ohm load				
Internal resistance, Ohm	50.0	50.0	50.0	± 20
Maximum pulse current, minimum, A	-	-	10	

Table 3

Set value of the time as of level 0.5, μs	**0.1**	**1.0**	**10.0**	**Permissible fractional accuracy, %**
When operating at 50 Ohm load				
Pulse-rise time as of 0.5, μs	0.1	1.0	10.0	± 10
Pulse-rise time as of 0.1-0.9 level, maximum, nsec	10	50	500	

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

Table 4

Measurement tools	**Technical specifications**	**Type**
Oscilloscope	Pass-band 400 Mmhz min	LeCroy WaveJet 354
Passive dividing circuit	Pass-band 500 Mmhz, 600 V	LeCroy PP006A
Resistor	50 Ohm	TVO-2
Instrument shunt	Pass-band 2 GHz minimum, resistance 2 Ohm	In compliance with GOST R 51317.4.2-2010

Note: The usage of other measurement tools which are compatible with the required accuracy is permissible. But the arbitration tools are the ones specified in the given list.
All the control and measuring equipment has to be accepted (calibrated) and have the qualification certificate.

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.
10.5.2. The pulse amplitude at no-load is measured at the output of the test generator by the oscilloscope connected via the pulse voltage divider. The oscilloscope is set in waiting mode with internal triggering. The base of the oscilloscope is set in position 20 ÷ 50 nsec/point. The deviation of measured values from the rated is calculated using a formula (10.1):

$$\Delta U = \frac{U_{амп} - U_{ном}}{U_{ном}} \times 100\%, \qquad (10.1)$$

where Uampl(амп) is the voltage pulse amplitude at no-load;
Urated(ном) is the voltage amplitude rated value.
The results of the measurements amd calculations are recorded in the protocol (ref. Passport, Table 5).

10.5.3. Turn the load of 50 O to the generator output and measure the amplitude of the pulses by means of the oscilloscope connected through the voltage divider. The oscilloscope is set in waiting mode with internal triggering. The base of the oscilloscope is set in position 20 ÷ 50 nsec/point. Measured values for all set values of the amplitude are recorded in a protocol (see Passport, Table 5).

10.5.4. Internal resistance for the all set values of time and amplitude is calculated using a formula (10.2):

$$R_i = (\frac{U_{амп}}{U_{нагр}} - 1) \times R_{нагр}, Ом \qquad (10.2),$$

where Uampl(амп) is the voltage pulse amplitude at no-load;
Uload(нагр) is the load pulse amplitude;
Rload(нагр) is the load resistance;
and is recorded in the protocol (ref. Passport, Table 5). The deviation from the rated values is calculated and recorded in the protocol.

10.5.5. The pulse-rise time as of 0.5 Umax is measured by the oscilloscope for all the set time and amplitude values. The results of the measurements are recorded in the protocol (ref. Passport, Table 5). The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.6. The pulse-rise time is measured by the oscilloscope at levels (0.1 ÷ 0.9) Umax with all the set time and amplitude values. The results of the measurements are recorded in the protocol (ref. Passport, Table 5). The deviation of measured values from the rated is calculated and recorded in the protocol.

10.5.7. Set 500 V pulse amplitude value. Measure the maximum pulse current by means of the shunt. The measured amplitude value is recorded in the protocol.

Table 5

		0.1 μs pulse time			1.0 μs pulse time			10.0 μs pulse time		
The voltage pulse amplitude at no-load,	rated	5.0	50.0	500	5.0	50.0	500	5.0	50.0	500
V ± 10 %	measured									
deviation, %	-									
Amplitude of the pulses at 50 O load, V	measured									
Internal resistance	rated	50	50	50	50	50	50	50	50	50
Ohm ± 20%	measured									
deviation, %	-									
Pulse-rise time at 50 Ohm load	rated	10	10	10	50	50	50	500	500	500
as of 0.1-0.9 level, maximum, nsec	measured									
deviation, %	-									
Pulse-rise time at 50 Ohm load	rated	0.1	0.1	0.1	1.0	1.0	1.0	10.0	10.0	10.0
as of level 0.5, μs ± 10%	measured									
deviation, %	-									
Maximum pulse current, minimum, A	rated	-	-	10.0	-	-	10.0	-	-	10.0
	measured									

11. Maintenance conditions

Climate conditions

The generator shall be operated under normal climate conditions

- surrounding air temperature ***(25 ± 10) ^{o} C;***
- relative air humidity ***45 - 80 %;***
- 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.

12. Shipment

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

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

The holds of ships and carbodies 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 device 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 IGM 05.1, manufacturing number , meets the technical requirements and is approved as ready for service.

Production date

Head of Inspection Department