НАУЧНО-ПРОИЗВОДСТВЕННОЕ ПРЕДПРИЯТИЕ

Industrial-frequency current test generator IGP 1.1

CONTENTS

1. Product features.

1.1. Industrial-frequency current test generator (hereinafter – test generator IGP 1.1) is manufactured by "PRORYV" Research and development enterprise.

1.2 . Test generator IGP 1.1 is designed to generate rated pulsed magnet field of industrial frequency (with spark inductor IK 1.1), and short harmonic interference current in protective and signal earthing circuits, when making tests of the technical equipment (hereinafter – TE), which may be exposed by noise in accordance with GOST R 50648-94, GOST 32137-2013, IEC 1000-4-8-93, GOST 30804.6.-1-2013 item 8, GOST 30804.6.2-2013 item 8.

2. Technical specifications.

Mode in accordance with GOST К 50648-94 and IEC 1000-4-8-93 (with spark inductor IK 1.1):

- Density of field in continuous mode — 1, 3, 10, 30, 40, 100 A/m
- Density of field in short-time mode — 300, 400, 600, 1000 A/m
- Output current harmonic distortion factor — 8% max
- Current marking interval in short-time mode — 1.0, 1.5, 2.0, 2.5, 3.0 sec
- Current marking repetition interval in short-time mode — 60 sec

In a mode as indicated in GOST 32137-2013 items 4.2.1.13 and 5.2.13:

- Short-circuit output current — 50, 100, 150, 200 A ± 20%
- Effective internal resistance — 15 mOhm ± 50%
- Current marking intervals length — 1.0, 1.5, 2.0, 2.5, 3.0 sec ± 10%
- Current marking repetition interval — 60 sec
- Import power — 2 kW max
- Dimensions — 620×520×300 mm
- Device mass — 50 max
- service life — 10 years

Spark inductor IK 1.1 parameters:

- Number of turns — 3
- Coil coefficient (ratio between the density of field in the coil center to its current) — $2.65 m^{-1} \pm 1\%$
- Operation volume — 0.6×0.6×0.5m

3. Packing contents.

- test generator IGP 1.1 — 1 unit
- mains cable — 1 unit
- 1A fuse — 2 units
- 15A fuse — 2 units
- spark inductor IK 1.1 with a set of mounting elements — 1 unit
- 4.0 m cable for connecting to the spark inductor IK 1.1 — 2 units
- 2.5 m cable for connecting to the earthing network — 2 units
- technical passport — 1 unit

4. Feature and operation concept.

4.1 The functional chart of the test generator IGP 1.1 is shown in **Figure 1**.

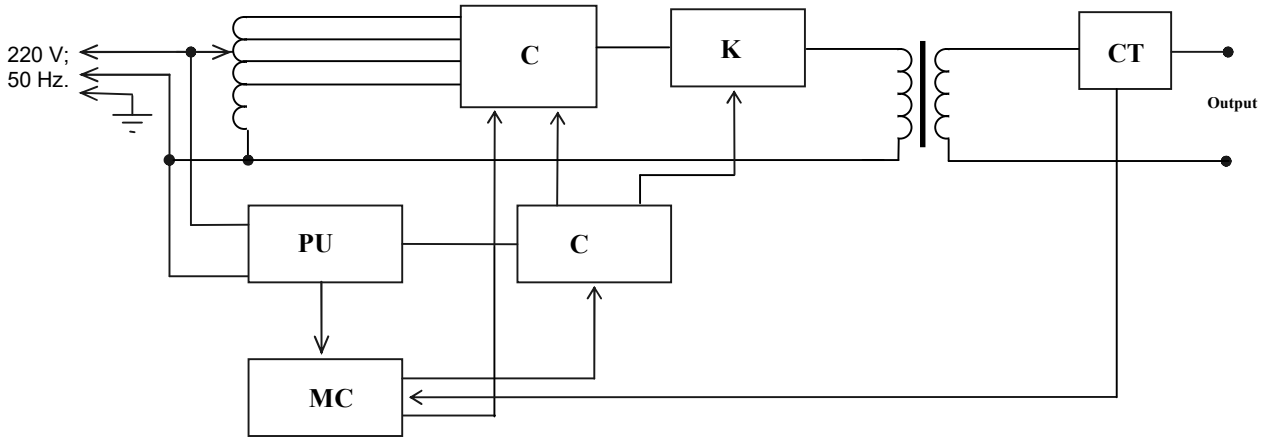

Fig. 1 The functional chart of the test generator IGP 1.1

1. Power Unit (PU)
2. Microprocessor Controller (MC)
3. Control Means (CM)
4. Central Control Unit (CCU)
5. Key (K)
6. Current transducer (CT)

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

4.3. The microprocessor controller (MC) manages the operation of the generator, keyboard input, readout, the synchronization with the supply network frequency, output voltage and current measurement, and generates signals for the control means.

4.4. The control means (CM) produces control signals for the key (K) and the central control unit (CCU), and generates sync pulses when network voltage crosses the zero for MC.

4.5. The central control unit (CCU) switches the winding ends of the autotransformer in relation to generator operation mode and sets internal resistance that is necessary for the required output current value.

4.6. The current transducer (CT) generates voltage which is in proportion to the output current value for the analog-digital converter incorporated in the MC.

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. When the output cables are connected to the generator, spark inductor and tested TE, the test generator shall be disconnected from the power network.

6. Preliminary starting procedure.

6.1. Remove the shipping cover. 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 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. Depending on the type of testing, connect the intertwined cables of the spark inductor IK 1.1 or cables intended for connecting to the ground circuit of the TE, to the output connectors.

6.5 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.

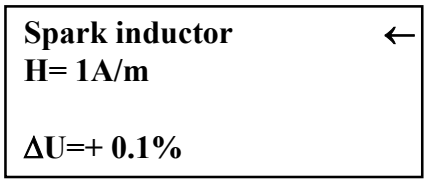

Figure 2

7. Working sequence.

7.1. After the generator is turned on by "**POWER (СЕТЬ)**" switch, text and an arrow cursor appear in the top line (ref. Figure 2). The cursor is moved by "↓" and "↑" keys.

7.2. By means of "+" and "-" buttons turn on the necessary generator mode (**Spark inductor (Инд. катушка)** or **Ground circuit (Цепь заземления)**) by placing the cursor to the appropriate line. The cursor has to be set in the top line. When "**Ground circuit (Цепь заземления)**" mode is turned on, a text as shown in Figure 3 appears on the display.

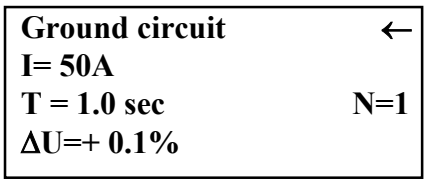

Figure 3

7.3. The output pulse amplitude at load with spark inductor is set by "+" and "-" keys. The cursor shall be located in "**H=___A/m**" position. The values **1, 3, 10, 30**, **40, 100, 300, 400, 600** and **1000A/m** can be chosen. The generator switches to a short-term operation mode, which allows setting the number and the test exposure time, when setting the values to **300, 400, 600**, and **1000 A/m**.

The output pulse amplitude at bringing noise to the ground circuits is set by "+" and "-" buttons. The cursor shall be located in "**I=___A**" position. The following values can be selected: **50**, 1**00, 150** and **200A**.

7.4. The number of test exposure is set at the cursor position "**N = _**" ranging from **1** to **10**, and the time ranging from **1** to **3sec** – at the cursor position "**T= __sec**".

7.5. The bottom line of the display reflects voltage deviation on the primary winding of the output transformer from the rated value caused by the voltage deviation of the power network. Before starting the generator, set the minimum voltage deviation value using the "**RATED VOLTAGE (НОМИНАЛЬНОЕ НАПРЯЖЕНИЕ)**" slider on the front panel of the generator.

7.6. The generator is started by pushing "**START/STOP (ПУСК/СТОП)**" button. When the output current is generated, the "**START (ПУСК)**" LED shows red. The output current is generated over 60 sec in the long-term operation mode. The "**START (ПУСК)**" LED shows red in the short-term mode when the output current is brought, and shows green during the pause.

7.7. The generator operation can be interrupted by second clicking the "**START/STOP (ПУСК/СТОП)**" button. The generator does not react on commands from other buttons during an operation cycle.

7.8. The output current value is measured and displayed in the bottom line of the display, and when working with the spark inductor, a value for the density of field, taking into account the IK 1.1 coil coefficient equaling 2.65, is shown. The value of the density of field should be checked when there is no TE in the spark inductor work area.

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 "**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.
3. Displayed value of the current or density of field is significantly different from the set one. *	Poor contacts in power connectors or in places where test ground circuits are connected.	Make good contacts in the output circuits.
	The voltage deviation from the rated value is too high.	Set minimum deviation using the "**RATED VOLTAGE (НОМИНАЛЬНОЕ НАПРЯЖЕНИЕ)**" slider

***** The displayed value of density of field can be significantly different when a tested TE is set in the coil operation area. The current in the ground circuit may be much less than the set one if the grounding has the bad quality.

9.2. Otherwise, contact the manufacturer.

10. Equipment qualification procedure.

10.1. The test generator shall be qualified according to the methodology described below.
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 list of standardized accuracy characteristics of the test generator.

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

Table 2.

Parameters at load with the spark inductor IK 1.1 in compliance with GOST R 50648-94											**Permissible fractional accuracy, %**
Density of field, A/m	1	3	10	30	40	100	300	400	600	1000	
Output current, A *	0.377	1.13	3.77	11.3	15.1	37.7	113	151	226	377	± 20
Output current harmonics coefficient, max, %	8	8	8	8	8	8	8	8	8	8	
Parameters in the mode as indicated in GOST 32137-2013 items 4.2.1.13											
Short-circuit output current, A			50		100		150		200		± 20
Marking intervals time, sec			1 – 3		1 – 3		1 – 3		1 - 3		± 10
Effective internal resistance, mO			15		15		15		15		± 50

***Note:** intensity of magnetic field in the center of the inductor equals $H = K * I$, where I is the inductor current value, K is the inductor coefficient, for the spark inductor IK 1.1 it equals K=2.65 m-1.

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

Table 3.

Measurement tools	**Technical specifications**	**Type**
Universal oscilloscope	Pass-band 10 Mmhz min	TDS 2022
Multimeter	Measurement limit (0.1 - 300) V at frequency of 50 Hz	LR 34401A
Current transformer	Maximum primary current 600 A Secondary current 5A, Class 0.2 Turns ration 120 Auxiliary resistor 0.3 O	UTT-5M
Distortion meter	Frequency range 20 Hz-100.0 kHz Kg (0.1 - 30) %	SK6-13

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.

10.4.2. The current at the test generator output when working with the spark inductor is measured by the AC voltmeter, connected to the current transformer that is crossed by one of the cables linking the generator with IK 1.1 inductor. The value of output current is calculated using a formula (10.1).

$$I_{вых} = \frac{U_{изм} \times K_{тр}}{R} \quad (10.1),$$

where $U_{msr(изм)}$ - measured voltage; C_{tr}- current transformer transformation ratio; R - resistance of the auxiliary resistor, connected to current transformer output.
The results of the measurements for all set values are recorded in the protocol (ref. Passport, Table 4).
The deviation of measured values from the rated ones is calculated using a formula (10.2):

$$\Delta I = \frac{I_{изм} - I_{ном}}{I_{ном}} \times 100\%. \quad (10.2)$$

where ΔI - deviation of the measured values
$I_{msr(изм)}$ - measured output current;
$I_{rated(ном)}$ - rated output current;
The results of the measurements are recorded in the protocol (ref. Passport, table 4).

10.4.3. Output current harmonic coefficient is measured at the current transformer output by the distortion meter. The results of the measurements are recorded in the protocol.
Output current harmonic coefficient is almost equal to power network voltage harmonic coefficient.

10.4.4. The current at the output of the test generator when working in the mode as indicated in GOST R 50746-95 item 5.9 is measured in the same way as item 10.4.2, but one of the cables goes through the current transformer. The cable is intended for testing the ground circuits and these cables are connected by the ends to each other. The results of the measurements are recorded in the protocol (ref. Passport, table 5).
The deviation of measured values from the rated ones is calculated and recorded in the protocol.

10.4.5. To calculate the effective internal resistance, the voltage at no-load the output of the generator is measured in the mode of ground circuits testing. Use the AC voltmeter connected to the generator output. The values of effective internal resistance for all four set values of the output current is calculated using a formula (10.3):

$$R_{эфф} = \frac{U_{nl}}{I_{вых}} \quad (10.3),$$

where $U_{nl(xx)}$ - voltage at no-load; $I_{output(вых)}$ - output current in short-circuit mode;
and is recorded in the protocol (ref. Passport, table 5). The deviation from the rated values is calculated and recorded in the protocol.

10.4.6. The length of the current bringing in the mode as per GOST R 50746-95 item 5.9 is measured by the oscilloscope connected to the current transformer output. The results of the measurements are recorded in the protocol (ref. Passport, table 6).
The deviation of measured values from the rated ones is calculated and recorded in the protocol.

Table 4.

Parameters at load with the spark inductor IK 1.1 as indicated in GOST R 50648-94										
Density of field, A/m	**1**	**3**	**10**	**30**	**40**	**100**	**300**	**400**	**600**	**1000**
Output current, A										
Deviation, %										

Table 5.

Parameters in the mode as indicated in GOST 32137-2013 items 4.2.1.13				
Set current value, A	**50**	**100**	**150**	**200**
Short-circuit output current, A				
Deviation, %				
Effective internal resistance, mO				
Deviation, %				

Table 6.

Set current bringing length, sec	**1**	**1.5**	**2**	**2.5**	**3**
Measured length, sec					
Deviation, %					

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 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 minimum.
Do not use dividing transformers to power the generator.

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 device 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 devices on the top of one another.
The storage of the packed device is acceptable.

14. Certificate of acceptance.

Test generator IGP 1.1, manufacturing number , meets the technical requirements and is approved as ready for service.

Production date

Head of Inspection Department Mazurovsky A. R.