

IMPULSE

SRPA “IMPULSE”

**ELECTROTECHNICAL
PRODUCTS**

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1. ABOUT THE ENTERPRISE

SRPA “Impulse” is a designer, manufacturer, and supplier of highly reliable instrumentation and control systems (I&C systems), a leader of the I&C market for nuclear power engineering and railways of Ukraine. I&C systems meet both Ukrainian and international quality and safety standards.



The company was established in 1956 as the basic enterprise for development of instrumentation and control systems for automation of technological processes. For more than sixty-year-long history of work, the enterprise has developed and commissioned tens of thousands of instrumentation and control systems for nuclear and thermal power engineering, railway transport, oil and gas, chemical, aerospace industries, metallurgy, mechanical engineering, geophysics, defence, etc.



The staff of SRPA “Impulse” – a team of professionals with experience and operating skills in the area of instrumentation and control systems for critical facilities. This experience includes all stages of automation system life cycle – from inspection of a facility and design to author’s support and technical support of operation.

Main products of SRPA “Impulse” are automation hardware, software, and I&C systems assuring execution of control and safety functions for critical facilities. All stages

of product life cycle have been implemented: development, manufacturing, testing package, commissioning, and support of operation.

Equipment manufactured by SRPA “Impulse” operates successfully at NPPs of Ukraine, Armenia, Bulgaria, Slovakia and railways of Ukraine, Bulgaria, Lithuania and Estonia.

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State Nuclear Regulatory Inspectorate of Ukraine



State Scientific and Technical Centre for Nuclear and Radiation Safety



National Scientific Centre "Institute of Metrology"



Institute for Nuclear Research of National Academy of Sciences of Ukraine



PJSC "Kyiv Research and Design Institute "Energoproekt"



OJSC "Kharkiv Research and Design Institute "Energoproekt"



PJSC «TURBOATOM»



Framatome GmbH, Germany



VUJE, a.s., Slovakia



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JSC "Ukrzaliznytsia"



ДП НАЦИОНАЛНА КОМПАНИЯ
ЖЕЛЕЗОПЪТНА ИНФРАСТРУКТУРА

National Railway Infrastructure Company, Bulgaria

LTG LIETUVOS GELEŽINKELIAI JSC «Lithuanian Railways», Lithuania



JSC «Latvian Railways», Latvia



EESTI RAUDTEE

JSC «Estonian Railways», Estonia



«Gigastroy», Bulgaria



SVI S.P.A., Italy

FRAUSCHER Frauscher Sensortechnik GmbH, Austria



TTC MARCONI, Czech Republic



2. AUTOMATICS DEVICES FOR DIGITAL SUBSTATIONS

Assure automation of digital substations with observance of the requirements of the international standard IEC 61850: operation of relay protection and automatics systems, automation of electric power transmission and distribution, registration of emergency events.

The automatics devices allow arranging control software and hardware systems for digital substations (PTK TsP) in accordance with the required parameters and with compatibility with different types of station equipment.

Main functions of PTK TsP:

- Acquisition, registration, calculation, and archiving of parameters, events, and emergency situations;
- Operational-dispatching control (remote and local);
- Relay protection and emergency automatics;
- Technological and protective prompt interlocking;
- Preventive and emergency alarm;
- Data exchange via a “station bus” in accordance with IEC 61850;
- Diagnostics of equipment state.

Composition:

- Automated workstations of operating personnel, service of relay protection and automatics devices, and an I&C service based on industrial workstations of PS51XX series;
- Microprocessor-based ImPR1 terminals of relay protection and automatics;
- Upper level’s servers (databases, SCADA) based on PS51XX;
- Telemechanics servers based on PS51XX;
- Arc protection devices;
- Current and voltage sensors (for traction networks 0.4÷3.3 kV);
- Ethernet network switchboards;
- Synchronometer.

Information acquisition from a whole substation, data archiving, and control of switching devices in a real-time mode are carried out using an SCADA-system, which is included into the base case of all PTKs TsP. The SCADA-system allows visualizing signals and events occurring at a substation and provides detailed information on alarm signals or events in graphic representation.

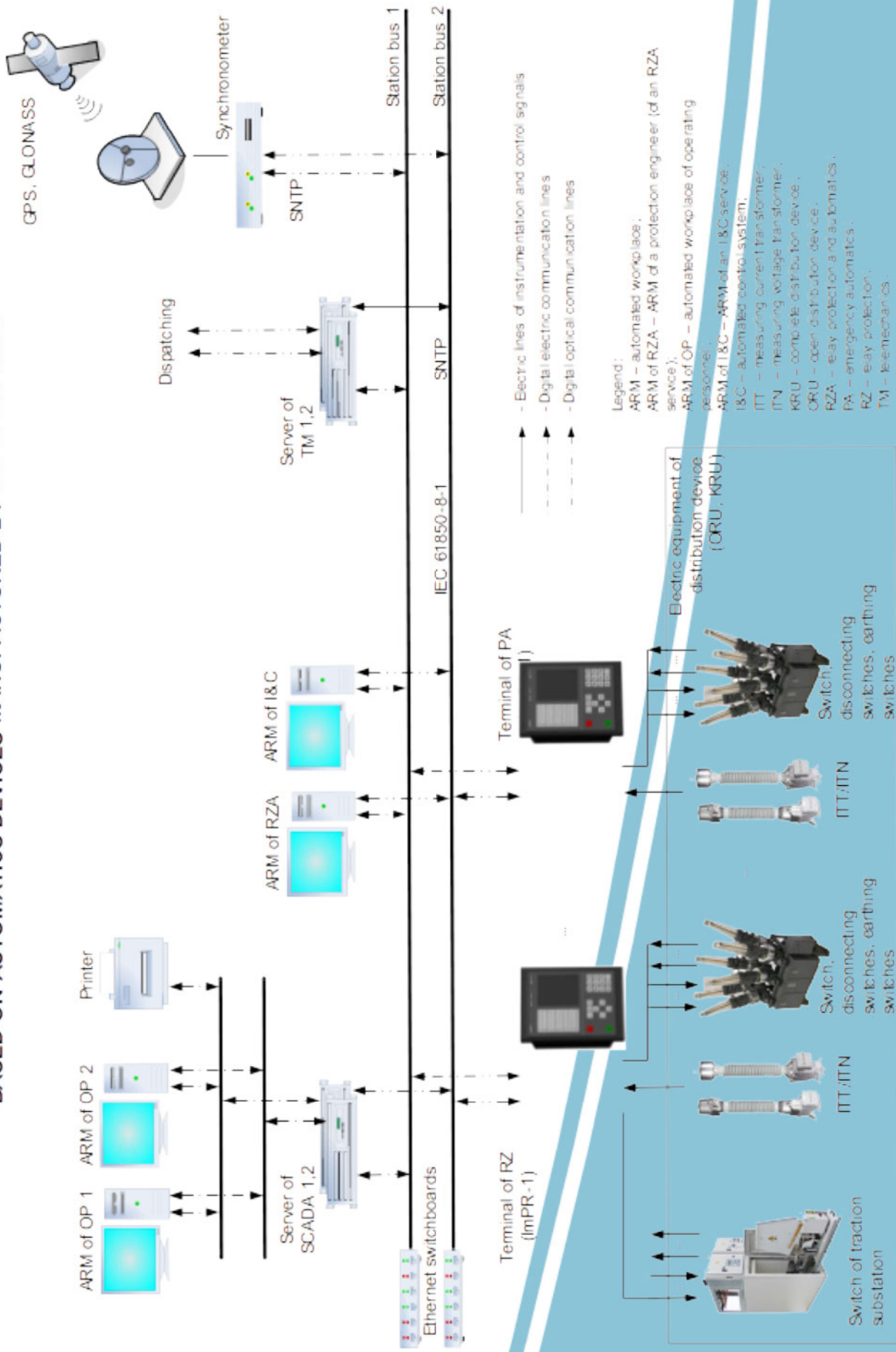
Safety of the PTK TsP software is assured with the following factors:

- All peripheral ports are closed (there is no threat of “accidental” contamination);
- Absence of sporadic exchanges (only determined flows);
- Connections with external systems are implemented via autonomous gateways with a function of an inter-network screen;
- Use of coding in accordance with IEC TS 62351;
- User authentication.

Advantages of PTK TsP:

- Easy integration of all automatics and telemechanics systems into a unified digital space allows controlling substation online;
- High electromagnetic interference resistance;
- Cabling and capital expenditure reduction during installation;
- Compliance of the PTK TsP equipment with the modern requirements for electromagnetic compatibility, external exposure factors, and mechanical impacts;
- Unification of substation configuration mechanisms and information protocols for data exchange;
- Functional compatibility of devices;
- Real-time visualization of process data;
- Assurance of substation information safety;
- Forming of a unified diagnostics system with the possibility of remote functional diagnostics and evaluation of equipment state;
- Reduction of expenditure for substation maintenance due to creation of recommendations for equipment maintenance;
- Possibility of transfer to unattended substations.

POSSIBLE VARIANTS OF I&C STRUCTURAL SCHEME FOR POWER FACILITY BASED ON AUTOMATICS DEVICES MANUFACTURED BY SRPA "IMPULSE"



2.1 ImPR1 MICROPROCESSOR-BASED RELAY PROTECTION AND AUTOMATICS DEVICES

Microprocessor-based ImPR1 device is designated for relay protection, automation, and control of systems generating, transmitting, and distributing electric power.

ImPR1 is notable for wide nomenclature and quantity of analog and discrete inputs, output relays, digital communication channels, and has three variants of design arrangement. The hardware based on one platform and modular structure of the ImPR1 device allow changing its configuration easily and choosing an optimal variant as to functionality, price, and overall dimensions for each specific application. The SPTA set is minimum due to possibility of module replacement.

ImPR1 meets the requirements of the IEC 61850 standard, which allows guaranteed transmission and data exchange with devices and systems meeting the requirements of this standard.



**ImPR1
Front panel**



**ImPR1
Back panel**

- DIDOM

- DOM discrete signal shaping (output) modules that have 16 channels to output discrete signals;
- PSM power supply modules, with nominal voltage 110 V or 220 V DC and AC (one or two inputs for power supply are possible);
- An indication and control panel: built-in or remote.

Composition of ImPR1:

- A CPUM central processor module:
 - processor capacity – 32;
 - processor frequency, not less than – 1 GHz;
- up to 4 RS-485, Ethernet (TX and/or FX) digital communication channels;
- An AIM analog signal input module that has 8 channels to input signals ITN and ITT, with possible configuration:
 - 4U + 4I or 5U + 3I or 2U + 6I or 8I;
- AIDOM analog signal input and discrete signal output modules that have 8 channels to input signals 0-20 mA and 8 channels to output discrete signals;
- DIM discrete signal input modules that have 16 channels to input potential signals =110 V, =220 V, and ~220 V; discrete signals =110 V, =220 V, and ~220 V and 8 channels to output discrete signals;

ImPR1 relay protection functions:

- Creating free logic of protections;
- Current protections – up to 14 types;
- Voltage protections – up to 2 types;
- Logical protections – up to 3 types;
- Remote protections – up to 4 types;
- Differential protections – up to 4 types;
- Frequency protections – 2 types;
- Arc protection – 2 types.

ImPR1 automatics functions:

- Creating free logic of automatics;
- Control of devices – from 1 to 20 pcs.;
- Underfrequency load shedding – 2 types;
- Automatic backup introduction – 2 types;
- Automatic restarting – 2 types;
- Switch failure backup – 2 types.

ImPR1 monitoring, recording, and warning functions:

- Monitoring operating circuits – 2 types;
- Monitoring measuring circuits – 3 types;
- Monitoring synchronism – 3 types;
- Centralized signal acquisition – 3 types;
- Detecting fault location;
- Operability monitoring and calculating lifetime for a high-voltage circuit breaker;
- Light and acoustic alarms;
- Recording events in normal and emergency modes;
- Oscillography of emergency processes.

ImPR1 service functions:

- Event log viewing;
- Emergency oscillogram viewing;
- Indicating current values;
- Setting setpoints;
- Synchronization of a calendar and an astronomical time clock from the GLONASS, NAVSTAR GPS system or a universal time network of a protection object;
- Protection logic adjusting and configuring;
- Receiving signals from external devices and the I&C system;
- Data exchanging with the I&C system by means of redundant digital communication channels (RS-485, Ethernet (TX and/or FX));
- Preventing unauthorized change of the device's configuration by means of the password system;
- Three-colour light indication;
- Self-diagnostics.

Safety class and category: 3B or 4.

Applicable for nuclear power plants, railway and general industrial use.



Possible applications of ImPR1

- protection and automatics of a feeder;
- protection and automatics of a feeder with differential protection;
- protection and automatics of a transformer;
- protection and automatics of a line and a bypass switch;
- protection and automatics of busbars.

ImPR1 software (SW):

- application software of ImPR1 is configured by user depending on the composition and characteristics of a specific object of protection and automation;
- SW tool is designated to be used at an engineering station (PC) or a notebook computer to configure application SW, as well as to service the devices when being operated by a customer – adjustment of protection logic, network exchanges, hardware configuration, setting of setpoints, viewing of events, monitoring of state of ImPR1;
- service SW is designated to view and analyze oscillograms of emergency situations.

Functions available for applications of ImPR1

- Maximum current protection;
- Maximum current protection with start by voltage;
- Directional maximum current protection;
- Current cutoff;
- Logical protection of busbars;
- Protection against “ground” short circuits;
- Directional protection against “ground” short circuits;
- Protection against loss of phases of a power feeder;
- I2 directional negative sequence current protection;
- Protection by overload, current of upper harmonics;
- Protection of minimum current;
- Protection of asymmetric modes;
- Protections of motor start;
- Current directional protection of zero sequence;
- Protection of arc short circuits of a cell and a section;
- Protection against infeed or reverse power;
- Single-phase remote protection;
- Two-phase remote protection;
- Protection by minimum voltage;
- Protection by voltage increase;
- Differential protection of a motor;
- Differential protection of a transformer;
- Differential protection of busbars;
- Phase differential protection of a line;
- Function of a switch failure backup device;
- Function of switch failure backup device towards “ITSELF”;
- Automatic restarting;
- Frequency automatic restarting;
- Automatic backup introduction;
- Automatic frequency load-shedding;
- Control of a power switch;
- Control of a load-break switch;
- Monitoring of disabling circuits;

- Monitoring of enabling circuits;
- Evaluation of commutation life of a switch;
- Switch state monitoring;
- Monitoring of current circuits;
- Monitoring of voltage circuits;
- Monitoring of synchronism;
- Control of transformer voltage regulating devices;
- Technological protections:
 - gas protection;
 - by oil level;
 - overheating, overload;
- Differentially phase protection of a line;
- Fault localization;
- Voltage measurement;
- Current measurement;
- Switching of setpoints' groups;
- Oscillography;
- Event recording;
- Self-diagnostics.

Technical characteristics of the CPUM central processor module

Parameter	Unit of meas.	Value
Embedded memory capacity, not less than: - random-access memory - nonvolatile memory (flash memory)	Gb	1 4
1PPS signal receipt communication channel from a universal time network (SEV)	pc.	1
Quantity of RS-485, Ethernet (TX and/or FX) digital communication channels	pc.	up to 4
Protocols of communication by RS-485		ModBus/RTU, IEC 60870-5-103
Protocols of communication by Ethernet (TX or FX)		ModBus TCP, IEC 61850-8-1, IEC 61850-9-2LE
Protocols of synchronization by Ethernet (TX or FX)		SNTP (RFC 4330), NTP (RFC 5905), PTPv2 (IEEE Std 1588TM)
Connector type for RS-485 and Ethernet TX communication channels		RJ-45
Connector type for Ethernet FX communication channels		MTRJ or LC
Rate of data transmission by RS-485	Kbit/s	up to 62.5
Rate of data transmission by Ethernet (TX or FX)	Mbit/s	up to 100
Distance of data transmission by RS-485	m	up to 1200
Distance of data transmission: - by Ethernet TX - by Ethernet FX	m	up to 100 up to 1 500
Light indicators of modes of operation (g/r)	pc.	2

Technical characteristics of the AIM analog signal input module

Parameter	Unit of meas.	Value
Quantity of current and voltage input channels: - 4U + 4I; - 5U + 3I; - 2U + 6I; - 8I	pc.	8
Operating range of alternating current frequency	Hz	45÷55
Limits of basic absolute error of frequency measurement, not more than	Hz	±0.01
Nominal monitored current I_{nom}	A	1.0 or 5.0
Current measurement range of I_{nom} , not less than	%	from 0 to 4000
Nominal zero-sequence current $3I_0$	A	0.2; 1.0 or 5
Current measurement range of $3I_0$, not less than	%	from 0 to 4000
Continuous current, not less than	A	$4 \times I_{nom}$
Surge current for not more than 1 s, not less than	A	$100 \times I_{nom}$

Dynamic stability for 10 ms, not less than	A	250, 250, 1250
Nominal monitored voltage U_{nom}	V	100
Voltage measurement range of U_{nom} , not less than	%	from 0 to 200
Nominal input voltage $3U_0$	V	100
Voltage measurement range of $3U_0$, not less than	%	from 0 to 200
Voltage stability, not less than - long-term - during 10 s	V	300 400
Limits of basic relative error of current measurement, not more than - for the range from 10 to 1000 % of I_{nom} - for the range from 10 to 1000 % of $3I_0$ - for the range from 1000 to 4000 % of I_{nom} and $3I_0$	%	± 2.5 ± 2.5 ± 5.0
Limits of basic relative error of voltage measurement (at temperature 25 ± 5 °C), not more than	%	± 2.5
Limits of additional error of current and voltage measurement at ambient air temperature deviation by each 10 °C of temperature 25 ± 5 °C, not more than	%	± 0.5 of basic error
Additional error of current and voltage measurement with input signal frequency change in the range 45÷55 Hz	%	0 (adjustment by frequency is stipulated)
Galvanic isolation		channel-by-channel

Technical characteristics of the AIDOM analog signal input and discrete signal output module

Parameter	Unit of meas.	Value
Quantity of analog input channels	pc.	6
Measurement range	mA	from 0 to 5; from 0 to 20
Power supply of an input circuit of a module channel signal		from an external source
Limits of permissible reduced error of conversion by each measuring channel with long-term working conditions of operation, not more than	%	± 0.1
Quantity of discrete output channels	pc.	8
Signal type		relay, normally open "dry contact"
Switched DC voltage	V	from 19 to 264
Maximum long-term DC voltage	V	264

Switching capacity of contacts of output channels in direct current circuits, operating upon switching-on (closing), with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s), not less than: - flowing during 0.03 s - flowing during 0.2 s - flowing during 0.3 s - flowing during 1.0 s	A	40 30 15 10
Current long flowing through closed contacts, not less than	A	5
Switching capacity of contacts of output channels in direct current circuits, operating upon switching-off (opening), with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s), not less than: - with voltage 48 V - with voltage 110 V - with voltage 220 V - with voltage 250 V	A	1.00 0.40 0.25 0.20
Electrical wear resistance for loaded contacts, not less than	cycles	10 000
Mechanical wear resistance, not less than	cycles	100 000
Actuation time of each output channel, not more than	ms	10
Galvanic isolation		channel-by-channel

Technical characteristics of the DIM discrete signal input module

Parameter	Unit of meas.	Value
Quantity of discrete input channels	pc.	16
Discrete signal type		potential
Nominal voltage (depending on a version): - of direct current - of alternating current	V	110 or 220 220 (50±1 Hz)
Operation threshold of a discrete input at 110 V of nominal DC voltage	V	from 66 to 71 from 75 to 82
Operation threshold of a discrete input at 220 V of nominal DC voltage	V	from 135 to 143 from 154 to 165
Operation threshold of a discrete input at 220 V of nominal AC voltage	V	from 154 to 165
Drop-away of a discrete input at 110 V of nominal DC voltage	V	from 57 to 62 from 66 to 71
Drop-away of a discrete input at 220 V of nominal DC voltage	V	from 122 to 130 from 141 to 149
Drop-away of a discrete input at 220 V of nominal AC voltage	V	from 141 to 149
Maximum long-term voltage of a discrete input: - with 110 V of nominal DC voltage - with 220 V of nominal DC or AC voltage	B	154 300
Rejection current width, T	ms	0 or from 4 to 10
Galvanic isolation		channel-by-channel

Technical characteristics of the DOM discrete signal output module

Parameter	Unit of meas.	Value
Quantity of discrete output channels	pc.	16
Signal type		relay, normally open "dry contact"
Switched DC or AC voltage	V	from 19 to 300
Switching capacity of contacts of output channels in direct current circuits, operating upon switching-on (closing), with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s), not more than: - flowing during 0.1 s - flowing during 0.3 s - flowing during 1.0 s	A	30 15 10
Direct current long flowing through closed contacts, not less than	A	5
Switching capacity of contacts of output channels in direct current circuits, operating upon switching-off (opening), with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s, $R=7.8 \Omega$, $L \leq 1$ H), not more than: - with voltage 48 V - with voltage 110 V - with voltage 220 V - with voltage 250 V	A	0.40 0.30 0.20 0.20
Switching capacity of contacts of output channels in alternating current circuits, operating upon opening and closing, with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s, $R=7.8 \Omega$, $L \leq 1$ H), not more than: - with voltage ≈ 48 V - with voltage ≈ 110 V - with voltage ≈ 220 V - with voltage ≈ 250 V	A	10 10 5 5
Actuation time of each output channel, not more than	ms	10
Galvanic isolation		channel-by-channel

Technical characteristics of the DIDOM discrete signal input-output module

Parameter	Unit of meas.	Value
Quantity of discrete input channels	pc.	8
Discrete signal type		potential
Nominal voltage (depending on a version): - of direct current - of alternating current	V	110 or 220 220 (50 \pm 1 Hz)
Operation threshold of a discrete input at 110 V of nominal DC voltage	V	from 66 to 71 from 75 to 82
Operation threshold of a discrete input at 220 V of nominal DC voltage	V	from 135 to 143 from 154 to 165

Operation threshold of a discrete input at 220 V of nominal AC voltage	V	from 154 to 165
Drop-away of a discrete input at 110 V of nominal DC voltage	V	from 57 to 62 from 66 to 71
Drop-away of a discrete input at 220 V of nominal DC voltage	V	from 122 to 130 from 141 to 149
Drop-away of a discrete input at 220 V of nominal AC voltage	V	from 141 to 149
Maximum long-term voltage of a discrete input: - with 110 V of nominal DC voltage - with 220 V of nominal DC or AC voltage	V	154 300
Rejection current pulse duration	ms	0 or from 4 to 10
Quantity of discrete output channels of type: - relay, normally open "dry contact" - transistor switch, normally open "dry contact"	pc.	8 or 4 0 or 4
Switched DC or AC voltage	V	from 19 to 300
Switching capacity of contacts of output channels in direct current circuits, operating upon switching-on (closing), with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s), not more than: - flowing during 0.1 s - flowing during 0.3 s - flowing during 1.0 s	A	30 15 10
Direct current, long flowing: - through closed relay contacts, not less than - through enabled transistor switch, not less than	A	5 3
Switching capacity of transistor switches in direct current circuits, operating upon switching-off (opening), with active or inductive load with time constant not more than 0.04 s with voltage from 48 to 250 V ($L/R \leq 0.04$ s, $R=7.8 \Omega$, $L \leq 1$ H), not less than	A	30
Switching capacity of relay contacts in direct current circuits, operating upon switching-off (opening), with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s, $R=7.8 \Omega$, $L \leq 1$ H), not more than: - with voltage 48 V - with voltage 110 V - with voltage 220 V - with voltage 250 V	A	0.40 0.30 0.20 0.20
Switching capacity of relay contacts in alternating current circuits, operating upon opening and closing, with active or inductive load with time constant not more than 0.04 s ($L/R \leq 0.04$ s, $R=7.8 \Omega$, $L \leq 1$ H), not more than: - with voltage ≈ 48 V - with voltage ≈ 110 V - with voltage ≈ 220 V - with voltage ≈ 250 V	A	10 10 5 5
Actuation time: - of a relay, not more than - of a transistor switch, not more than	ms	10 0.2
Galvanic isolation		channel-by-channel

Technical characteristics of the PSM power supply module

Parameter	Unit of meas.	Value
Nominal input supply voltage: - of direct current - of alternating current	V	110 or 220 220 (50±1 Hz)
Rate of input supply voltage: - with 110 V DC voltage - with 220 V DC and AC voltage	V	from 65 to 134 from 130 to 264
Quantity of primary power supply feeders		1 or 2
No-load current, not more than	mA	40 (with 110 V) 20 (with 220 V)
Maximum current consumption on all inputs, not more than	A	0.8 (with 110 V) 0.4 (with 220 V)

Structural and functional peculiarities of ImPR1

Parameter	Unit of meas.	Value
Own actuation time of ImPR1, not more than (without taking into account time lag)	ms	10
Possible quantity of analog signal input channels from measuring current and voltage transformers	pc.	from 0 to 32
Possible quantity of discrete signal input channels	pc.	from 0 to 176
Possible quantity of discrete signal shaping and output channels	pc.	from 0 to 176
Insulation resistance: - at normal climatic conditions - at upper temperature value - at upper humidity value	MOhm	≥ 100 ≥ 20 ≥ 2
Electrical insulation of input or output independent circuits withstands (during 1 min without damages) effective value of testing voltage: - with frequency 50 Hz - of DC voltage	V	2000 2800
Electrical insulation of digital interface circuits withstands (during 1 min without damages) effective value of testing voltage with frequency 50 Hz and of DC voltage	V	500
Electrical insulation of input power supply circuits withstands (without damages) five positive and five negative pulses of testing voltage of the following parameters: - amplitude - duration of rising edge - duration of halfdroop of falling edge - duration of pulse spacing	kV μs μs s	from 5.0 ±10% 1.2 ±0.36 50 ±10 1.0

Electrical insulation of digital interface circuits withstands (without damages) five positive and five negative pulses of testing voltage of the following parameters: - amplitude - duration of rising edge - duration of halfdroop of falling edge - duration of pulse spacing	kV μs μs s	from 1.0 ±10% 1.2 ±0.36 50 ±10 1.0
Quantity of nodes of communication channels: - of the CPUM central processor module - of the indication and control panel	pc.	4 1 (service)
Design structure of indication and control panel		built-in or remote
Daigonal of the graphic display of HMIU, not less than		5.7"
Quantity of input and control keys of indication and control panel	pc.	21
Quantity of freely-programmable functional keys of indication and control panel	pc.	9
Interface language		English Russian Ukrainian
Possible dimension types of the modular structure of the case, with height 6U		19" ¾ 19" ½ 19"
Quantity of service three-colour light indicators on PIU depending on the dimension type of the case: - 19" - ¾ 19" - ½ 19"	pc.	48 32 16
Quantity of modes of freely-programmable three-colour light indicators, not less than		4
Possible quantity of installed input and output modules (without taking into account the CPUM central processor module and the PSM power supply module) into the dimension type of the case: - 19" - ¾ 19" - ½ 19"	pc.	до 11 до 7 до 4
Overall dimensions of ImPR1 depending on the dimension type of the case (W×H×D), not more than: - 19" - ¾ 19" - ½ 19"	mm	439×311×293 334×311×293 229×311×293
IP protection degree according to GOST 14254, not less than: - of the case, except external connectors and clamps - on clamps of current circuits - of the indication and control panel from the front side		IP40 IP20 IP54

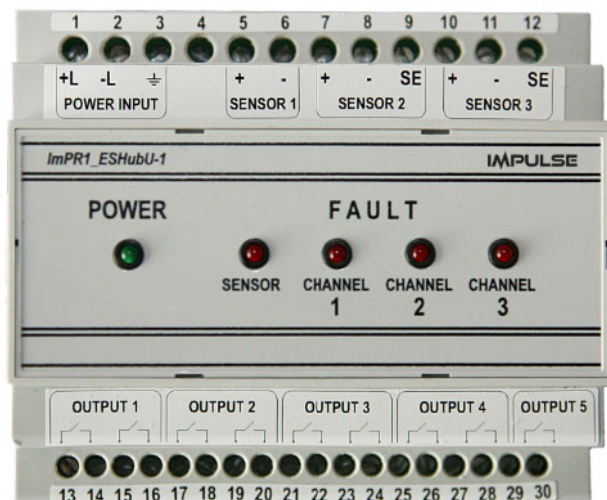
Seismic resistance according to SOU NAEK 100:2016	cat.	I
Electromagnetic compatibility according to SOU NAEK 029:2012	group	IV
Average lifetime, not less than	years	30
Ambient air temperature	°C	-40 +60

2.2 ARC PROTECTION DEVICE

An **ImPR1_ESHubU-1 switching unit** with **ImPR1_ESensU-1** optical sensors is designated to detect a short circuit arc in distribution devices in a short period of time and to transmit information on a monitored section into relay protection and automatics devices (electromechanical, semiconductor, and microprocessor-based).

ImPR1_ESHubU-1 switches a control electrical signal if a specified elimination level is exceeded with the specified illumination increase rate in a zone where an optical sensor is installed.

ImPR1_ESHubU-1 can be supplied both independently and within the composition of ImPR1 microprocessor-based relay protection and automatics devices.



**ImPR1_ESHubU-1
switching unit**



**Optical sensor
ImPR1_ESensU-1**

ImPR1_ESHubU-1 has three inputs with the possibility to connect up to three optical sensors (sensor 1..3), three outputs to display the state of each sensor (output 1..3), one generalized output (output 4), and a discrete output of the unit operability state (output 5). The outputs (output 1..4) have two normally open discrete outputs of “dry contact” type each. All discrete outputs of ImPR1_ESHubU-1 are galvanically independent.

When ImPR1_ESHubU-1 with one or two optical sensors is used, a jumper is installed onto unused inputs, the jumper simulates monitoring of a circuit of an absent sensor.

The following is located on the front panel of ImPR1_ESHubU-1: a “POWER” indicator for unit power supply availability, actuation indicators for each optical sensor – “CHANNEL 1”, “CHANNEL 2”, “CHANNEL 3”, and a generalized “SENSOR” indicator for optical sensor faultiness, which lights together with an indicator for a faulty or incorrectly connected optical sensor.

The main users of ImPR1_ESHubU-1 are enterprises operating power electrical installations.

Version: “NPP” and for general industrial use.

Technical characteristics of a switching unit with optical sensors

Parameter	Unit of meas.	Value
Input supply voltage range: - of alternating current with nominal value 230 V - of direct current with nominal value 220 V	V	from 130 to 264 from 88 to 308
Permissible load current of output contacts: - for alternating current with voltage 230 V - for direct current with voltage 220 V - for direct current with voltage 48 V	A	5 0.25 2
Power consumption of a switching unit, not more than: - from alternating current - from direct current	V·A W	10 8
Response time, not more than	ms	7 ±10%
Quantity of optical sensors connected	pcs.	from 1 to 3
Optical sensor type		phototransistor
Operation threshold with illumination increase rate not less than 500 lx/ms makes	lx	2 500 ±500
Monitoring of switching unit power supply availability		available
Monitoring of switching unit state		available
Monitoring of optical sensor state		available
IP degree of protection of a switching unit according to GOST 14254, not less than		IP20
IP degree of protection of an optical sensor according to GOST 14254, not less than		IP50
Manner of fastening of a switching unit		DIN rail
Manner of fastening of an optical sensor		nut, bracket
Limiting ambient air temperature	°C	from -40 to +60
Average life, not less than	years	20
Overall dimensions of a switching unit (W×H×D), not more than	mm	107×92×80
Overall dimensions of an optical sensor (W×D), not more than	mm	44×60
Diameter of a mounting hole for an optical sensor	mm	22
Weight of a switching unit, not more than	kg	0.4
Weight of a sensor with cables with different length: - a cable 2 000 mm long - a cable 3 000 mm long - a cable 4 000 mm long - a cable 5 000 mm long	kg	0.4 0.6 0.8 1.0

2.3 CURRENT AND VOLTAGE SENSOR

The **PSensU-1 current and voltage sensor** is designated to measure and monitor current up to 6 kA and voltage up to 6.5 kV and to transmit data via fiber-optical channels into a protection device.

PSensU-1 assures possibility of programming of the main microcontroller via a physical interface – 100Base-FX if remote update of a microprogram is required.

PSensU-1 has an additional diagnostic input of primary voltage.

Basic functions of PSensU-1:

- measurement of current and voltage in current supply lines;
- conversion of analog signals into digital ones;
- transmission of converted signals via redundant channels;
- possibility to measure voltage in two points of one connection.

Version: for general industrial use.



PSensU-1
current and voltage sensor

Technical characteristics of PSensU-1

Parameter	Unit of meas.	Value
Operating range of current measurement	kA	up to 6
Extreme range of current measurement		up to 10 rated values of a shunt
Rated value of a measuring shunt	mV	60, 75, 100, 150
Range of an analog signal of a current measurement channel	mV	from 0 to 800
Maximum permissible basic reduced error from a measuring shunt, not more than	%	± 1
Bandwidth of a current measurement channel	kHz	from 0 to 100
Operating range of voltage measurement	kV	up to 6.5
Maximum permissible basic reduced error of voltage measurement, not more than	%	± 0.5
Bandwidth of a voltage measurement channel	kHz	from 0 to 100
Settling time for mode of operation, not more than	s	1
Range of operating supply voltage from alternating- or direct-current mains	V	110÷240

Data transmission channel		Fiber-optical FastEthernet (IEEE Std 802.3u)
Protocols of communication by 100Base-FX		IEC 61850-8-1, IEC 61850-9-2LE, IEC 61869-9
Data transmission rate	Mbit/s	100
Data transmission distance	m	1 500
Connector type for Ethernet FX communication channels		MTRJ or LC
Galvanic isolation of a power supply source of a high-voltage board		wireless
Electric strength of insulation of galvanically isolated circuits of a sensor at alternating current 50 Hz/1 min	V	15 000
Electric strength of insulation of galvanically isolated circuits of a sensor at impulse voltage 1.2/50 μ s	V	30 000
Limiting ambient air temperature	$^{\circ}$ C	from -40 to +60
Average life, not less than	years	10
Overall dimensions (W×H×D), not more than	mm	250×380×70
Weight, not more than	kg	3

Family of PSensU-1

Model	Peculiarities
PSensU-1	Accuracy of resistors in a voltage divider is ± 0.1 %. There is no redundancy of an output interface.
PSensU-1/1	Accuracy of resistors in a voltage divider is ± 0.1 %. Two redundant digital outputs.
PSensU-1/2	Accuracy of resistors in a voltage divider is ± 1 %. There is no redundancy of an output interface.
PSensU-1/3	Accuracy of resistors in a voltage divider is ± 1 %. Two redundant digital outputs.

2.4. PS51XX INDUSTRIAL WORKSTATIONS

PS51XX project-arranged industrial computers – serial products used in automatics systems of power and other critical facilities.

PS51XX are used as workplaces for operators, servers with different functionality, gateways, etc. They operate under control of software developed at SRPA “Impulse”.

Composition of PS51XX:

- Processor modules (based on compact computers) with different versions:
 - Intel Atom/Core i5/i7 processors;
 - random-access memory – DDR3;
 - read-only memory – SSD;
 - Ethernet controllers – not less than two 100/1000Base-TX;
 - video interfaces – HDMI, Display Port, DVI, VGA (up to three independent video outputs);
 - USB 3.0 and USB 2.0 ports, COM-ports, audio output;
- Power supply equipment:
 - uninterruptible power supply devices with the possibility of installation onto a board or into a 19" form factor;
 - network filters;
 - an emergency backup actuation device;
- Display devices:
 - a video wall;
 - wide-screen monitors;
 - operator consoles;
- Network equipment:
 - switchboards (with the possibility of installation onto a din rail or into a 19" form factor);
 - “copper”-“optics” media converters;
 - SHDSL-modems;
 - Ethernet/SHDSL network protection filters;
 - fiber-optical crosses;
- Operator equipment:
 - keyboards for tabletop installation or to be installed in a 19" rack;
 - a “mouse” manipulator;
 - audio speakers;
- form factors:
 - a desk;
 - a pedestal and an angle pedestal;
 - a cabinet-pedestal.



Basic characteristics:

- Built based on fanless compact computers and highly reliable industry-oriented component parts;
- Highly resistant to:
 - electromagnetic impacts;
 - changes of power network parameters;
 - environmental impacts;
 - mechanical impacts;
 - corrosion;
 - dust;
- Designated for continuous operation (24×7);
- Possibility of multi-use in automation systems.



3. POWER SUPPLY DISTRIBUTION SYSTEMS

3.1 ShchV-1 INPUT PANEL

The **ShchV-1 panel** is designated to input, protect against impulse lightning overvoltages, and record electric power consumption of three feeders of three-phase voltage depending on the package.



Basic functions of ShchV -1:

- remote switching-off;
- manual selective switching-off;
- protecting input and output circuits against overloads and short circuits;
- recording electric power consumption on each feeder;
- shaping discrete signals of modes of operation;
- monitoring and diagnosing panel's components;
- indicating (light).

Version: for general industrial use.

Technical characteristics of ShchV -1

Parameter	Value
Rated input and output three-phase AC voltage (50±1) Hz	230 / 400 Vac
Allowed deviation from the rated AC input voltage value	-10 %, +5 %

Guaranteed DC voltage for power supply of control circuits	24 Vdc
Allowed deviation from the rated DC input voltage value	from 22 to 30 Vdc
Allowed load current of input guaranteed DC voltage, not more than	2 A
The maximum value of phase current of output three-phase voltage, not more than - for versions ShchV-1 and ShchV-1/1 - for versions ShchV-1/2 and ShchV-1/3 - for versions ShchV-1/4 and ShchV-1/5	120 A 80 A 63 A
Allowed quantity of electric power meters	up to 3
Mean time between failures, not less than	50 000 h
Operating temperature range	from +1 to +50 °C
Protection degree	IP 21
Dimensions WxHxD	1010x1945x430 mm
Weight, not more than	280 kg

Family of ShchV -1

Model	Load current	Availability of an electric power meter of a "3" feeder
ShchV-1 469114.069	120 A	available
ShchV-1/1 469114.069-01	120 A	not available
ShchV-1/2 469114.069-02	80 A	available
ShchV-1/3 469114.069-03	80 A	not available
ShchV-1/4 469114.069-04	63 A	available
ShchV-1/5 469114.069-05	63 A	not available

3.2 ShR-1 DISTRIBUTION CABINET

The **ShR-1 cabinet** is designated for connection of 21 users (with rated power 880 V·A each) to a power network by means of automatic switches from two independent feeders.

ShR-1 is divided into two sections, each of which has 3 three-phase inputs with 7 single-phase outgoing lines and a “BLOCKING” panel. ShR-1 can be used both in mounted and floor versions in indoor areas.



Basic functions of ShR -1:

- inputting from two independent feeders;
- blocking outgoing lines;
- indicating (light).

Version: for general industrial use.

Technical characteristics of ShR-1

Parameter	Value
Rated input three-phase AC voltage (50±2) Hz	220 / 380 Vac
Allowed deviation from the rated voltage value	–15 %, +10 %
Phase voltage waveform distortion factor, not more than	10 %
Rated current on each phase of a three-phase automatic switch	28 A
Mean time between failures, not less than	300 000 h
Operating temperature range	from +5 to +40 °C
Protection degree	IP 21
Dimensions WxHxD	800x1400x330 mm
Weight, not more than	95 kg

3.3 ShchOAB-1 PANEL TO SWITCH OFF ACCUMULATOR BATTERIES

The **ShchOAB-1 panel** is designated for inputting and emergency switching-off of a bus of direct voltage of accumulator batteries (ABs) from a power supply system.



Basic functions of ShchOAB -1:

- remotely switching off ABs;
- shaping discrete signals of modes of operation;
- connecting an external sensor of temperature of ABs;
- protecting input and output circuits against overloads and short circuits;
- monitoring and diagnosing panel's components;
- inputting-outputting circuits monitoring voltage on ABs;
- indicating (light).

Version: for general industrial use.

Technical characteristics of ShchOAB-1

Parameter	Value
Rated input and output power direct voltage during operation from ABs	24÷240 Vdc
Allowed deviation from the rated DC input voltage value: - during operation from ABs 240 Vdc - during operation from ABs 24 Vdc	-30 V, +110 V -2 V, +6 V
Allowed voltage ripple, not more than	6 %
The maximum value of phase current, not more than - for versions ShchOAB-1 - for versions ShchOAB-1/1 - for versions ShchOAB-1/2	250 A 200 A 160 A
Guaranteed DC voltage for power supply of control circuits	24 Vdc
Allowed deviation from the rated DC input voltage value	-2 V, +6 V

Allowed load current of input guaranteed DC voltage, not more than	2 A
Mean time between failures, not less than	50 000 h
Operating temperature range	from -5 to +50 °C
Protection degree	IP 21
Dimensions WxHxD	600x676x250 mm
Weight, not more than	42 kg

Family of ShchOAB-1

Model	Position of a switch $I_R(\times I_n)$	Load current
ShchOAB-1 469114.068	1,00	250 A
ShchOAB-1/1 469114.068-01	0,80	200 A
ShchOAB-1/2 469114.068-02	0,63	160 A

3.4 MODULAR INDUSTRIAL-CLASS UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

Designated for uninterruptible power supply of devices of electric interlocking, manufacturing lines, telecommunication equipment, private houses, television and radio companies, video servers, offices, etc.



**Single-phase
uninterruptible power
supply system**



**Three-phase
uninterruptible power
supply system**



**Cabinet for
accumulator
batteries**

Basic peculiarities:

- True On-line double conversion technology assuring high rates of reliability and efficiency;
- automatic and manual Bypass;
- wide range of input voltage: from minus 50 % to plus 25 % of a rated value;
- high stability of output voltage with the low level of distortions;
- protection against atmospheric and switching overvoltages;
- high scalability – single-phase uninterruptible power supply systems with power from 1.5 to 6 kVA and three-phase systems with power from 4.5 to 18 kVA are composed based on one power module;
- an intelligent parallel-operation system with redundancy according to a scheme N+1;
- possibility to set output voltage;
- display of main parameters and modes of operation on a built-in display;
- availability of a high-capacity charger;
- regulated charging rate of accumulator batteries;
- operation with any type of load: active, capacity, inductive;
- ease of maintenance.



**Frame with
power modules**



Charger



Control module

Technical characteristics of a modular power supply system

Parameter	Value	
Type of an uninterruptible power supply system	Single-phase	Three-phase
Quantity of phases (input/output)	1 / 1	3 / 3
Power of uninterruptible power supply systems	1.5 kVA / 1.2 kW; 3.0 kVA / 2.4 kW; 4.5 kVA / 3.6 kW; 6.0 kVA / 4.8 kW	4.5 kVA / 3.6 kW; 9.0 kVA / 7.2 kW; 13.5 kVA / 10.8 kW; 18.0 kVA / 14.4 kW
Power of one power module	1.5 kVA / 1.2 kW	1.5 kVA / 1.2 kW
Quantity of modules installed in an uninterruptible power supply system	from 1 to 4	from 3 to 12
Battery type	built-in / external	built-in / external
Input characteristics:		
Rated voltage	~220 V	~380 V (3 phases+N+earthing)
Voltage range	from ~150 to ~275 V (with 100 % load)	from ~260 to ~478 V (with 100 % load)
Power coefficient	0.98	
Output characteristics:		
Rated voltage	~220 V / ~230 V / ~240 V	~380 V / ~400 V / ~415 V (3 phases+N+earthing)
Voltage stability	≤±1 %	≤±1 % (balanced load); ≤±2 % (nonbalanced load)
Voltage distortion coefficient	< 2 % (linear load); < 6 % (nonlinear load)	< 1.5 % (linear load); < 4 % (nonlinear load)
Overload capacity	150 % / 60 s	150 % / 60 s
Characteristics of a battery and a charger:		
Battery voltage	24 V / 48 V / 110 V	
Maximum power of a charger	800 W / 1000 W / 2200 W	
Charge time up to 90% of rated capacity of accumulator batteries	≈ 0.3 h	

System characteristics:		
Coefficient of efficiency from mains / a battery	96 % / 94 %	
Degree of protection	IP 20	
Interfaces	RS-485, Ethernet (optics)	
“Dry contact”	6 pcs.	
Display	3.6" TFT graphic	
Permissible temperature of operation	from -25 to +50	
Compliance with standards:		
Electromagnetic compatibility	Meets the requirements of DSTU 4151, EN 50121-4, EN 50121-5	
Physical data:		
Power module	Dimension	132.5 x 108 x 500 mm
	Weight	5.1 kg
Frame to install power modules	Dimension	132.5 x 484 x 645 mm
	Weight	29.3 kg
Control module	Dimension	44x 484 x 291 mm
	Weight	3.1 kg
Charger	Dimension	88 x 484 x 645 mm
	Weight	11.3 kg
Rack	Dimension	1240 x 600 x 816 mm
	Weight	138.8 kg

3.5 UBP-14 UNINTERRUPTIBLE POWER SUPPLY DEVICE

The **UBP-14 device** is designated to convert input voltage and to provide devices and units with power of alternating voltage 220 V and direct voltage 27 V. “Hot” swapping of units (possibility to replace faulty replacement units without loss of operability) is assured in UBP-14.

Design: a device for panel mounting into a 19" rack.



Basic functions of UBP-14:

- automatically switching on UBP when input voltage is switched on;
- protecting against short circuit on the output;
- softly transferring to operation from an accumulator battery;
- softly returning to operation from input voltage;
- signaling (audio) in case of overload, transfer to an accumulator battery and a fault of UBP;
- indicating (light) operation of UBP units, charging of an accumulator battery, availability of input and output voltages.

Version: “NPP” and for general industrial use.

Technical characteristics of UBP-14

Parameter	Value
Rated input voltage: - of alternating current (50±2) Hz - of direct current - of direct current (for versions UBP-14/1, 14/2)	220 Vac 220 Vdc 24 Vdc
Allowed deviation from the rated voltage value	±20 %
Waveform distortion factor (at alternating current), not more than	10 %
Allowed voltage ripple (double amplitude) (with direct current), not more than	6 %
Allowed surge of input voltage from the rated value with the duration 2 s and the recurrence interval not more than 10 s	+25 %

Allowed interruption of input voltage with the duration 60 ms and the recurrence interval not less than 1 s	minus 100 %
Allowed depression of input voltage with the duration 2 s and the recurrence interval not more than 10 s	minus 30 %
Coefficient of efficiency, not less than	0.85
Coefficient of power at the input, not less than	0.96
Maximum current impulse at the input at the moment of its switching on with duration on the level 0.5 not more than 20 ms, not more than	50 A
Interface port	RS-232
Rated output voltage: - of alternating current (50±0.5) Hz - of direct current	220±10 Vac 27±0.8 Vdc
Maximum value of load current: - of alternating current "220 Vac" - of direct current "27 Vdc"	0.9 A 22.5 A
Maximum value of output power: - of alternating current "220 Vac" - of direct current "27 Vdc"	200 W 600 W
Operation threshold for protection against current overloads at the output: - of alternating current "220 Vac" - of direct current "27 Vdc"	from 1.0 to 1.4 A from 23 to 27 A
Allowed value of output voltage during operation from an accumulator battery (for version UBP-14)	from 28 to 18 Vdc
Time of UBP operation from a built-in accumulator battery (2 batteries with capacity 8 A·h each) (for version UBP-14), not less than	4 min
Mean time between failures, not less than	150 000 h
Operating temperature range	from +1 to +60 °C
Dimensions WxHxD	482.6x132.6x479 mm
Weight, not more than - for version UBP-14 (with an accumulator battery) - for version UBP-14/1 - for version UBP-14/2	19 kg 16 kg 10 kg

Family of UBP-14

Model	Input voltage	Output voltage	Internal accumulator battery
UBP-14 435141.009	220 Vac ±20 % 220 Vdc ±20 %	220±10 Vac 27±0.8 Vdc	+
UBP-14/1 435141.009-01	220 Vac ±20 % 220 Vdc ±20 % 24 Vdc (21.6÷29 V)	220±10 Vac 27±0.8 Vdc	-
UBP-14/2 435141.009-02	24 Vdc (21.6÷29 V)	220±10 Vac 27 Vdc (20.6÷29 V)	-

3.6 BPt-157 POWER SUPPLY UNIT

The **BPt-157 unit** is designated for power supply of circuits of “Sapphir”-type devices and conversion of alternating voltage 220 V, 50 Hz into direct voltage 36 V (six isolated from each other outputs).

BPt-157 has three versions and is structurally compatible with a 22-BP 36 unit used for power supply of “Sapphir”-type devices.

The unit's outputs are protected against short circuits from load and are isolated from each other. Current in the short-circuit mode doesn't exceed 0.1 A.



Basic functions of BPt-157:

- powering transducers with direct voltage 36 V;
- converting voltage;
- indicating (light).

Version: “NPP” and for general industrial use.

Technical characteristics of BPt-157

Parameter	Value
Rated input AC voltage (50±2) Hz	220 Vac
Allowed deviation from the rated input voltage value	-15 %, +10 %
Waveform distortion factor, not more than	10 %
Allowed interruption of input voltage with the duration up to 400 ms and the recurrence interval not more than 10 s	minus 100 %
Allowed depression of input voltage with the duration 2 s and the recurrence interval not more than 10 s	minus 30 %
Allowed surge of input voltage from the rated value with the duration 2 s and the recurrence interval not more than 10 s	+25 %
Output DC voltage (six isolated outputs)	36 Vdc
Allowed deviation of output voltage	±0.18 Vdc
Maximum value of load current	0.035 A
Power consumption, not more than	25 V·A
Mean time between failures, not less than	300 000 h
Operating temperature range	from +5 to +60 °C
Dimensions WxHxD: - BPt-157, BPt-157/1 - BPt-157/2	80x180x305 mm 80x180x340 mm
Weight, not more than	4.2 kg

Family of BPt-157

Model	Features of construction	Remark
BPt-157 436711.001	with a "NETWORK" switch	-
BPt-157/1 436711.001-01	without a "NETWORK" switch	-
BPt-157/2 436711.001-02	without a "NETWORK" switch and with a BSd aligner	to replace obsolete power supply units earlier produced for "Sapphir"-type devices

3.7 AVR-1 EMERGENCY BACKUP ACTUATION DEVICE

The **AVR-1 device** is designated for connection of two power supply inputs and for automatic backup actuation for load transfer from the main power supply feeder to a backup one in case of a failure of the main feeder, and vice versa.

AVR-1 can be used at the enterprises, where increased reliability is required. AVR-1 assures mechanical interlock and electrical protection eliminating possibility of simultaneous connection of the “Feeder 1” and “Feeder 2” inputs to its output.

Design: a remote device for wall or panel mounting.



Basic functions of AVR-1:

- switching on and switching off each input feeder;
- protecting against short circuit on the output;
- light warning on availability of input and output voltages.

Version: “NPP” and for general industrial use.

Technical characteristics of AVR-1

Parameter	Value
Rated input single-phase AC voltage (50±2) Hz	220 Vac
Allowed deviation from the rated voltage value	–15 %, +10 %
Load connection, not more than	10 A
Starting current, not more than	50 A
Time for switching from a feeder to a feeder, not more than	200 ms
Allowed interruption of input voltage with the duration up to 0.02 s and the recurrence interval not more than 10 s	from 242 V to zero
Allowed depression of input voltage with the duration 2 s and the recurrence interval not more than 10 s	from 220 V to zero
Allowed surge of input voltage from the rated value with the duration 2 s and the recurrence interval not more than 10 s	+25 %
Mean time between failures, not less than	300 000 h
Operating temperature range	from +5 to +70 °C
Dimensions WxHxD	126x148x175 mm
Weight, not more than	1.5 kg

3.8 AVR-2 EMERGENCY BACKUP ACTUATION DEVICE

The **AVR-2 device** is designated for connection of two power supply inputs and for automatic backup actuation for load transfer from the main power supply feeder to a backup one in case of a failure of the main feeder, and vice versa.

AVR-2 can be used at the enterprises, where increased reliability is required. AVR-2 assures mechanical interlock and electrical protection eliminating possibility of simultaneous connection of the “Feeder 1” and “Feeder 2” inputs to its output.

Design: a device for panel mounting into a 19" rack.



Basic functions of AVR-2:

- switching on and switching off each input feeder;
- protecting against short circuit on the output;
- light warning on availability of input and output voltages;
- shapes the “MONITOR.” of the “dry contact” type.

Version: “NPP” and for general industrial use.

Technical characteristics of AVR-2

Parameter	Value
Rated input voltage: - of alternating current (50±2) Hz - of direct current	220 Vac 220 Vdc
Allowed deviation from the rated voltage value	±20 %
Waveform distortion factor (at alternating current), not more than	10 %
Allowed voltage ripple (double amplitude) (at direct current), not more than	6 %
Load connection, not more than	8 A
Time for switching from a feeder to a feeder, not more than	140 ms
Voltage of priority on the “Feeder 1” input to shape output voltage, not less than	150 V
Mean time between failures, not less than	300 000 h
Operating temperature range	от +5 до +60 °C
Dimensions WxHxD	142x128x191 mm
Weight, not more than	3.0 kg

4. LOCAL AUTOMATICS

4.1 RShch-1 PANEL ELECTRONIC MULTI-CHANNEL REGISTRATOR

The **RShch-1 registrator** is designated to measure, monitor, and record parameters of technological processes.

Basic functions of RShch-1:

- receiving signals of thermoelectric transducers, resistive temperature transducers, voltage sensors, current sensors, and resistance sensors;
- converting, processing, logging, and archiving values of signals;
- linearizing characteristics of thermoelectric transducers and resistive temperature transducers;
- extracting a square root of a value of a current input signal;
- receiving and shaping discrete signals;
- delivering measurement results and diagnostic information to a built-in TFT-display as digital values, diagrams, and histograms;
- monitoring correspondence of an output DC signal;
- monitoring opening of a circuit delivering a current signal;
- monitoring sensor connection.

Types of sensors connected:

- direct voltage;
- current;
- resistance.

Safety class and category: 2A.

Version: “NPP” and for general industrial use.

Technical characteristics of RShch-1

Parameter	Value
Quantity of universal analog galvanically isolated monitoring and logging channels	up to 16 (multiple of 4)
Quantity of discrete inputs	8
Quantity of discrete (relay) outputs	8 or 16
Quantity of DC output channels	8, 16, or 24
Quantity of monitored setpoints on each analog signal	up to 4
Type of connected thermal electric transducers	TKhK (L), TKhA (K), TPP (S), TPR (B), TVR (A-1), TVR (A-2), TVR (A-3), TMK (M), TKhKd



Type of connected resistive temperature transducers	50P, 100P, 50M, 100M, GR21 P, GR23 M
Compensation of free ends of thermal electric transducers with the possibility to be switched off in the menu	from 5 to 60 °C
TFT display, dimensions	6.4" or 10.4"
Type of information representation	digital values, diagrams, and histograms
Time interval for outputting each next point to a screen	0.2, 0.5, 1, 2, 5, 10, 30, 60 s
Archive data storage volume at the logging interval 1 s, for time not less than	10 days and nights
Menu control	button
Data exchange through interfaces	RS-232 / RS-485
Archive data copying to an external memory (an access password is set)	USB 2.0
Limits of maximum permissible basic reduced error of conversion, depending on a conversion range	$\pm 0.1\%$ or $\pm 0.25\%$
Pool time of all channels, not more than	200 ms
Parameters of discrete inputs: - voltage, not more than - current, not more than	30 V 5 mA
Parameters of discrete relay outputs: - AC switching voltage, max - DC switching voltage, max - switching current, not more than - switched power, max	250 Vac 30 Vdc 3 A 50 W
Parameters of analog DC outputs	from 4 to 20 mA
Power supply from a single-phase AC network	from 187 to 242 Vac
Power consumption, not more than	50 V·A
Range of operating temperatures	from +5 to +60 °C
Protection degree: - front panel - case	IP 54 IP 20
Dimensions WxHxD: - with the display size 6.4" - with the display size 10.4"	190x205x370 mm 240x320x400 mm
Weight, not more than: - with the display size 6.4" - with the display size 10.4"	8 kg 10 kg

Family of RShch-1

Model	Quantity of inputs/outputs			
	Analog input	Discrete input	Discrete output	Current output
RShch -1 421411.001	16	8	16	–
RShch -1/*41 421411.001-01 (09)	16		8	–
RShch -1/*32 421411.001-02 (10)	12		16	–
RShch -1/*31 421411.001-03 (11)	12		8	–
RShch -1/*22 421411.001-04 (12)	8		16	–
RShch -1/*21 421411.001-05 (13)	8		8	–
RShch -1/*12 421411.001-06 (14)	4		16	–
RShch -1/*11 421411.001-07 (15)	4		8	–
RShch -1/*00 421411.001-08	16		16	–
RShch -1/*32-1T 421411.001-16 (28)	12		16	8
RShch -1/*31-1T 421411.001-17 (29)	12		8	8
RShch -1/*22-1T 421411.001-18 (30)	8		16	8
RShch -1/*22-2T 421411.001-19 (31)	8		16	16
RShch -1/*21-1T 421411.001-20 (32)	8		8	8
RShch -1/*21-2T 421411.001-21 (33)	8		8	16
RShch -1/*12-1T 421411.001-22 (34)	4		16	8
RShch -1/*12-2T 421411.001-23 (35)	4		16	16
RShch -1/*12-3T 421411.001-24 (36)	4		16	24
RShch -1/*11-1T 421411.001-25 (37)	4		8	8
RShch -1/*11-2T 421411.001-26 (38)	4		8	16
RShch -1/*11-3T 421411.001-27 (39)	4	8	24	
<i>Remark – * “1” is specified in the version designation (after a slant) if a device is ordered with the display size 10.4”</i>				
<i>Remark – (...) a value is specified in the version designation (instead of a number after a “dash”) a device is ordered with the display size 10.4”</i>				

RShch-1 assures operation with sensors and input signals in the ranges in accordance with Tables 1, 2, and 3.

Table 1

Designation of a thermal electric transducer	Temperature measurement ranges, °C	Input signal change range, mV
TKhK (L)	from -70 to 800	from -4.107 to 66.442
TKhA (K)	from -150 to 1300	from -4.913 to 52.41
TPP (S)	from 0 to 1600	from 0 to 16.777
TPR (B)	from 300 to 1800	from 0.431 to 13.591
TVR (A-1)	from 0 to 1800	from 0 to 26.999
TVR (A-2)	from 0 to 1800	from 0 to 27.231
TVR (A-3)	from 0 to 1800	from 0 to 26.772
TMK (M)	from -170 to 100	from -5.572 to 4.725
TKhKd	from -50 to 50	from -4.19 to 4.25

Table 2

Nominal static characteristic of a resistive temperature transducer	Temperature measurement range, °C	Temperature transducer resistance change range, Ω
50P, W=1.3850	from -70 to 500	from 36.165 to 140.49
50P, W=1.3910	from -70 to 500	from 35.95 to 141.945
100P, W=1.3850	from -70 to 500	from 72.33 to 280.98
100P, W=1.3910	from -70 to 500	from 71.9 to 283.89
50M, W=1.4260	from -50 to 180	from 39.345 to 88.355
50M, W=1.4280	from -50 to 180	from 39.225 to 88.5
100M, W=1.4260	from -50 to 180	from 78.69 to 176.71
100M, W=1.4280	from -50 to 180	from 78.45 to 177
GR21 P	from -50 to 650	from 36.80 to 153.30
GR23 M	from -50 to 180	from 41.71 to 93.64

Table 3

Type of a sensor connected	Input signal change ranges
Sensors with output signals of direct voltage	from -100 to +100 mV
Resistance sensors	from 0 to 250 Ω
Sensors with output signals of direct current	from 0 to 5 mA
	from 4 to 20 mA

4.2 IA-3 SMOOTH START-UP DEVICE

The **IA-3 device** is designated for direct or reverse start-up of three-phase asynchronous alternating current electric motors of actuators of control, stop, and other valves with capacity from 3 to 15 kW. The following is stipulated in IA-3: protection of electric motors against short-circuit currents, overloads, and phase loss, generation of an emergency signal in case of an emergency, as well as monitoring of 24 V power supply to control circuits.

IA-3 can be used at power plants and other facilities, where improved reliability and environmental resistance are required.

Design: a remote device for wall or panel mounting.



Basic functions of IA-3:

- receiving control signals;
- soft start and gradual braking of electric motors;
- outputting supply voltage +24 V or pulsating one 24 V to arrange control signals through contacts of “dry contact” type or “thyristor keys”;
- switching off electric motors in case two control signals are available simultaneously;
- electrodynamically braking electric motors.

Variants of control:

- from local regulators;
- from instrumentation and control systems;
- from a console of a process operator (manually).

Modes of operation:

- continuous;
- short-term;
- recursive short-term with frequency up to 630 switching on/hour.

Possibility of regulation by means of local regulators:

- of braking time of electric motors after removal of a control signal;
- of smooth start-up and smooth braking of electric motors.

Indication:

- readiness and correctness of phase connection;
- modes of operation.

Type of connectors to connect facility cables:

- plug one on a case;
- clip one inside a case through sealed lead-ins.

Safety class and category: 3B.

Version: “NPP” and for general industrial use.

Technical characteristics of IA-3

Parameter	Value
Capacity of controlled electric motors	from 3 to 15 kW
Rated load current on each of three AC voltage commutation circuits	30 A
Time of start-up smoothness, braking smoothness, braking time at opening and closing is regulated within the limits	from 0 to 0.25 s
Protection actuation time from the moment at least one of phases disappears: - with a switched off electric motor, not less than - with a switched on electric motor, not more than	(0.6±0.06) s 10 s
Time for control signal shaping from the moment a command arrives	50 ms
Operability of a device at smooth and ramp change of power supply voltage from a rated value and a network drop for a time not more than 20 ms	-15 %, +10 %
Control commands to open and to close correspond to the input voltage level	+24 V
Output direct or pulsating (with duty ratio 2 with period 20 ms) voltage of a source	(+24 ±4.8) V
Current of external load of a source, not more than	100 mA
Setting range of overload protection current	from 13.5 to 66 A
Peak current overload, not more than	500 A
Range of operating temperatures	from +5 to +75 °C
Input three-phase current with voltage	220 / 380 V
Own power consumption, not more than	20 W
Protection degree	IP 54
Dimensions WxHxD	320x350x170 mm
Weight, not more than	14 kg

4.3 IA-4 SMOOTH START-UP DEVICE

The **IA-4 device** is designated for direct or reverse start-up of three-phase asynchronous alternating current electric motors of actuators of control, stop, and other valves with capacity from 0.06 to 3.5 kW, protection of electric motors against short circuits, overloads, and phase loss, generation of an emergency signal in case of an emergency.

It is permitted to use IA-4 to control three-phase synchronous electric motors of the following types:

- DSR-63/60 power consumption 250 W;
- DSR-160/136 power consumption 1150 W;
- 2DSTR 135-1.8-136D01 power consumption 220 W;
- 2DSTR 135-4.5-136D01 power consumption 360 W;
- DSTR 190-11-60D02 power consumption 150 W;
- DSTR 230-19-136D02 power consumption 600 W.

For the above listed synchronous electric motors there is no thermal protection as to current consumption, due to its small increase for locked electric motors.

IA-4 can be used at power plants and other facilities, where improved reliability and environmental resistance are required.

Design: a remote device for wall or panel mounting.



Basic functions of IA-4:

- receiving control signals;
- soft start and gradual braking of electric motors;
- outputting supply voltage +24 V or pulsating one 24 V to arrange control signals through contacts of “dry contact” type or semistors;
- switching off electric motors in case two control signals are available simultaneously;
- electrodynamically braking electric motors;
- accident logging.

Variants of control:

- from local regulators;
- from instrumentation and control systems;
- from a console of a process operator (manually).

Modes of operation:

- continuous;
- short-term;
- recursive short-term with frequency up to 630 switching on/hour.

Possibility of regulation by means of local regulators:

- of braking time of electric motors after removal of a control signal;
- of smooth start-up and smooth braking of electric motors;
- setting response of IA-4 and output circuits in case of an emergency.

Indication:

- readiness and correctness of phase connection;
- modes of operation;
- values of parameters;
- emergency situations.

Type of connectors to connect facility cables:

- plug one on a case;
- clip one inside a case through sealed lead-ins.

Safety class and category: 3B.

Version: “NPP” and for general industrial use.

Technical characteristics of IA-4

Parameter	Value
Capacity of controlled electric motors	from 0.06 to 3.5 kW
Rated load current on each of three AC voltage commutation circuits: - for versions IA-4/1 and IA-4/3 - for versions IA-4/2 and IA-4/4 - for version IA-4/5	up to 1.2 A up to 3.5 A up to 8 A
Time of start-up smoothness, braking smoothness, braking time at opening and closing is regulated within the limits	from 0 to 0.25 s
Protection actuation time from the moment at least one of phases disappears: - with a switched off electric motor, not more than - with a switched on electric motor, not more than	2 s 10 s
Time for control signal shaping from the moment a command arrives	50 ms
Operability of a device at smooth and ramp change of power supply voltage from a rated value and a network drop for a time not more than 20 ms	-15 %, +10 %
Control commands to open and to close correspond to the input voltage level	+24 V
Output direct or pulsating (with duty ratio 2 with period 20 ms) voltage of a source	(+24 ±6) V
Current of external load of a source, not more than	100 mA
Setting range of overload protection current: - for versions IA-4/1 and IA-4/3 - for versions IA-4/2 and IA-4/4 - for version IA-4/5	from 0.3 to 3.5 A from 0.7 to 8 A from 0.1 to 1.2 A

Peak current overload, for time up to 20 ms	10-multiple of a setpoint
Range of operating temperatures	from +5 to +50 °C
Input three-phase current with voltage	220 / 380 V
Own power consumption, not more than	14 W
Protection degree	IP 54
Dimensions WxHxD	155x185x147 mm
Weight, not more than	6 kg

Family of IA-4

Model	Maximum capacity of electric motors	Range of setpoints	Type of connectors
IA-4/1 421413.007	1.5 kW	from 0.3 to 3.5 A	clip one inside a case through sealed lead-ins
IA-4/2 421413.007-01	3.5 kW	from 0.7 to 8 A	
IA-4/3 421413.007-02	1.5 kW	from 0.3 to 3.5 A	plug one on a case
IA-4/4 421413.007-03	3.5 kW	from 0.7 to 8 A	
IA-4/5 421413.007-04	0.4 kW	from 0.1 to 1.2 A	

4.4 BKTU-1 LEAK CURRENT MONITORING UNIT

The **BKTU-1 unit** is designated for monitoring of current state of a leak current in the range from 0 to 300 mA in 12 monitored circuits by means of PT-3 or PT-4 current transducers by comparison of a current value with the preset threshold and monitoring of connection integrity of each of current transducers in AC and DC power supply networks.

BKTU-1 is a multi-channel device and assures possibility of network address inputting to identify a device in a network.

Design: a unit for mounting onto a DIN rail.



Basic functions of BKTU-1:

- acquiring data from PT-3 and PT-4 current transducers;
- monitoring leak current values;
- outputting information on each channel;
- exchanging information with a BKSI-2 insulation resistance monitoring unit;
- independently adjusting on each channel;
- operating in radial and network topology of RS-485 interface;
- testing self-check of functions;
- indicating (light).

Version: “NPP” and for general industrial use.

Technical characteristics of BKTU-1

Parameter	Value
Supply voltage: - of alternating current (50±1) Hz - of direct current (for version BKTU-1/1)	220 Vac 24 Vdc
Range of measurements of differential current in alternating and direct current networks	from 0 to 300 mA
Display format on a liquid-crystal display	alphanumeric and graphic
Control and adjustment of parameters	button
Interface port (galvanically isolated double-wire bidirectional)	2 x RS-485
Possibility of connection of PT-3 and PT-4 current transducers	up to 12
Mean time between failures, not less than	130 000 h
Operating temperature range	from +5 to +60 °C
Dimensions WxHxD	107x90x65 mm
Weight, not more than	0.35 kg

4.5 PT-4 CURRENT TRANSDUCERS

The **PT-4 transducers** are designated to operate with the BKTU-1 leak current monitoring unit, to convert input direct and alternating differential current, the value of which is within the limits from minus 300 to plus 300 mA, into voltage, which is in the range from minus 3 to plus 3 V.

PT-4 can be used in current supply lines with load current up to 30 A, alternating voltage up to 250 V, direct voltage up to 350 V.

Design: a unit for mounting onto a DIN rail.

Basic functions of PT-4:

- singling out differential current in electrical power lines;
- converting differential current;
- outputting converted direct voltage.

Version: “NPP” and for general industrial use.



Technical characteristics of PT-4

Parameter	Value
Power supply from a direct current source	24 Vdc
Allowed deviation of supply voltage	from +20 to +30 V
Range of converted differential current	from –300 to +300 mA
Output voltage	from –3 to +3 V
Allowed deviation of output voltage, not more than	±0.05 V
Own power consumption, not more than	0.5 W
Mean time between failures, not less than	130 000 h
Operating temperature range	from +5 to +60 °C
Dimensions WxHxD	26x76x112 mm
Weight, not more than	0.3 kg

4.6 BKSI-2 INSULATION RESISTANCE MONITORING UNIT

The **BKSI-2 unit** is designated for automatic monitoring and online indication of electrical insulation resistance in electrical networks:

- a network of alternating current with a floating neutral;
- a network of alternating current with a floating neutral containing galvanic coupled rectifiers;
- a network of direct current with floating poles.

Use of BKSI-2 is regulated with Electrical Installation Regulations (PUE). BKSI-2 can operate in conjunction with the BKTU-1 leak current monitoring units, assuring exact localization of insulation damage. BKSI-2 has two galvanically isolated double-wire bidirectional RS-485 interfaces and can assure data acquiring from 384 monitored circuits.

BKSI-2 assures possibility to input a network address to identify a device in a network. Design: a unit for mounting onto a DIN rail.



Basic functions of BKSI-2:

- acquiring data from BKTU;
- monitoring a value of electrical insulation resistance;
- indicating electrical insulation resistance;
- independently setting resistance thresholds;
- independently adjusting on each control input;
- outputting and receiving signals;
- testing self-check of functions;
- powering an external contact;
- indicating (light).

Version: “NPP” and for general industrial use.

Technical characteristics of BKSI-2

Parameter	Value
Voltage of a monitored network of alternating or direct current	up to 650 V
Supply voltage:	
- of alternating current (50±1) Hz	220 Vac
- of direct current	220 Vdc
- of direct current (for version BKSI-2/1)	24 Vdc
Parameters of a measuring circuit	
Measuring voltage	from 49 to 51 V
Maximum measuring current	from 170 to 180 µA
Output resistance of a measuring circuit	285 kΩ
Range of insulation resistance measurement	from 1 to 10 000 kΩ
Allowed measurement error, not more than	10 %
Leak capacity of a measuring circuit	500 µF
Measurement time with leak capacity in a measuring	20 s

circuit 1.0 μ F	
Signaling parameters	
Quantity of adjusted resistance thresholds	2
Setting limits for a value of resistance thresholds	from 1 to 10 000 k Ω
Hysteresis of resistance thresholds, of a threshold value	10 %
Signaling relay parameters	
Switched voltage, not more than - of alternating current - of direct current	250 V 220 V
Switched current: - of alternating current - of direct current	from 0.001 to 5 A from 0.001 to 0.25 A
Switched power: - of alternating current - of direct current	60 V·A 60 W
Parameters of external control inputs	
Supply voltage of an external contact	from 3 to 3.5 V
Internal resistance of an external contact	from 0 to 3.5 k Ω
Time of response to activation of an external contact	100 ms
Other parameters	
Display format on a liquid-crystal display	alphanumeric and graphic
Control and adjustment of parameters	button
Interface port (galvanically isolated double-wire bidirectional)	2 x RS-485
Support of the leak current monitoring units (BKTU) to exchange information	up to 32
Quantity of monitored circuits	up to 384
Own power consumption, not more than	10 V·A
Mean time between failures, not less than	130 000 h
Operating temperature range	from +5 to +60 $^{\circ}$ C
Dimensions WxHxD	107x90x65 mm
Weight, not more than	0.5 kg

4.7 BKSI-3 INSULATION RESISTANCE MONITORING UNIT

The **BKSI-3 unit** is designated for automatic monitoring and online indication of electrical insulation resistance in electrical networks:

- a network of alternating current with a floating neutral;
- a network of alternating current with a floating neutral containing galvanic coupled rectifiers;
- a network of direct current with floating poles.

Use of BKSI-3 is regulated with Electrical Installation Regulations (PUE).

BKSI-3 is a one-channel device.

Design: a unit for mounting onto a DIN rail.



Basic functions of BKSI-3:

- acquiring data from a sensor;
- indicating electrical insulation resistance;
- independently setting resistance thresholds;
- receiving a control signal from an external contact;
- testing self-check of functions;
- powering an external contact;
- indicating (light).

Version: “NPP” and for general industrial use.

Technical characteristics of BKSI-3

Parameter	Value
Voltage of a monitored network of alternating or direct current	up to 350 V
Supply voltage of direct current	24 Vdc
Parameters of a measuring circuit	
Measuring voltage	from 9 to 12 V
Maximum measuring current	from 90 to 110 μ A
Output resistance of a measuring circuit	88 k Ω
Range of insulation resistance measurement	from 1 to 1 000 k Ω
Allowed measurement error, not more than	10 %
Measurement time with leak capacity in a measuring circuit 1.0 μ F	20 s
Leak capacity of a measuring circuit	20 μ F
Signaling parameters	
Quantity of resistance thresholds	2
Setting limits for a value of resistance thresholds	from 1 to 1 000 k Ω
Hysteresis of resistance thresholds, of a threshold value	10 %

Signaling relay parameters	
Switched voltage, not more than - of alternating current - of direct current	250 V 220 V
Switched current: - of alternating current - of direct current	from 0.001 to 5 A from 0.001 to 0.25 A
Switched power: - of alternating current - of direct current	60 V·A 60 W
Parameters of external control inputs	
Supply voltage of an external contact	12 V
Internal resistance of an external contact	from 0 to 3.5 kΩ
Time of response to activation of an external contact	100 ms
Other parameters	
Display format on a liquid-crystal display	alphanumeric and graphic
Control and adjustment of parameters	button
Own power consumption, not more than	5 V·A
Mean time between failures, not less than	130 000 h
Operating temperature range	from +5 to +60 °C
Dimensions WxHxD	35x90x65 mm
Weight, not more than	0.5 kg

4.8 PrS-2 SIGNAL TRANSDUCER

The **PrS-2 transducer** is designated to convert a signal from a primary or normalizing transducer into a unified output electrical signal of direct current or voltage and a digital signal. PrS-2 can be used for continuous, twenty-four-hour operation.

PrS-2 can be used for power supply of primary measuring transducers of "Sapphir-22" type or analogs, as well as when replacing an EP 4700 AS measuring transducer, an EP 4701 AS measuring transducer, an EP 4710 AS rooting unit. Design: a device for panel mounting.



Basic functions of PrS-2:

- receiving and shaping signals;
- converting and processing signal values;
- linearizing characteristics;
- extracting a square root;
- monitoring sensor connection;
- powering transducers with direct voltage 24 V;
- adjusting to a selected sensor type;
- indication on a display:
 - ranges of input and output signals;
 - value of temperature of free ends and an output analog signal;
 - emergency;
 - indication of the first and the second setpoint (for PrS-2/1).

Types of sensors connected:

- direct voltage;
- current;
- resistance.

Version: "NPP" and for general industrial use.

Technical characteristics of PrS-2

Parameter	Value
Rated input voltage: - of alternating current (50±2) Hz - of direct current (from a backup source)	220 Vac 24 Vdc
Allowed deviation from the rated input voltage value	from 187 to 242 Vac from 20.4 to 28.2 Vdc
Type of connected thermal electric transducers	TKhK (L), TKhA (K), TPP (S), TPR (B), TVR (A-1), TVR (A-2), TVR (A-3), TMK (M), TKhKd
Type of connected resistive temperature transducers	50P, 100P, 50M, 100M, GR21 P, GR23 M
Output direct current voltage for power supply of primary measuring transducers	24 Vdc
Maximum switching voltage	250 V
Switching current, not more than	0.2 A

Limits of maximum permissible basic reduced error of conversion	±0.1 % or ±0.25 %
Outputting signals through a digital channel	RS-485
Mean time between failures, not less than	200 000 h
Operating temperature range	from minus 10 to +60 °C
Dimensions WxHxD - for version PrS-2 - for version PrS-2/1	85x190x320 mm 85x190x360 mm
Weight, not more than - for version PrS-2 - for version PrS-2/1	3.5 kg 4.0 kg

Family of PrS-2

Model	Functional differences	Type of a liquid-crystal display
PrS -2 421415.002	Availability of two discrete inputs of control of an output analog signal.	Alphanumeric
PrS -2/1 421415.007	Availability of two discrete outputs of “dry contact” type of warning on the fact that an input analog signal goes out of the first or second setpoints.	Graphic

PrS-2 assures operation with sensors and input signals in the ranges in accordance with Tables 1, 2, and 3.

Table 1

Designation of a thermal electric transducer	Temperature measurement ranges, °C	Input signal change range, mV
TKhK (L) *	from –70 to 800	from –4.107 to 66.442
TKhA (K) *	from –70 to 1300	from –2.587 to 52.41
TPP (S) *	from 0 to 1600	from 0 to 16.777
TPR (B) *	from 300 to 1800	from 0.431 to 13.591
TVR (A-1) *	from 0 to 1800	from 0 to 26.999
TVR (A-2) *	from 0 to 1800	from 0 to 27.231
TVR (A-3) *	from 0 to 1800	from 0 to 26.772
TMK (M) *	from –170 to 100	from –5.572 to 4.725
TKhKd	from –50 to 50	from –4.19 to 4.25
<i>Remark – * “l” is specified in the designation if the transducers with the included linearization function are ordered.</i>		

Table 2

Nominal static	Temperature measurement	Temperature transducer
----------------	-------------------------	------------------------

characteristic of a resistive temperature transducer	range, °C	resistance change range, Ω
50P, W=1.3850 (X * 1I **)	from -70 to 500	from 36.165 to 140.49
50P, W=1.3910 (X * 2I **)	from -70 to 500	from 35.95 to 141.945
100P, W=1.3850 (X * 1I **)	from -70 to 500	from 72.33 to 280.98
100P, W=1.3910 (X * 2I **)	from -70 to 500	from 71.9 to 283.89
50M, W=1.4260 (X * 1I **)	from -50 to 180	from 39.345 to 88.355
50M, W=1.4280 (X * 2I **)	from -50 to 180	from 39.225 to 88.5
100M, W=1.4260 (X * 1I **)	from -50 to 180	from 78.69 to 176.71
100M, W=1.4280 (X * 2I **)	from -50 to 180	from 78.45 to 177
GR21 P (X * I **)	from -50 to 650	from 36.80 to 153.30
GR23 M (X * I **)	from -50 to 180	from 41.71 to 93.64
<p><i>Remark – * instead of X “3” is specified in case of work with a resistive temperature transducer according to the three-wire scheme; instead of X “4” is specified in case of work with a resistive temperature transducer according to the four-wire scheme.</i></p>		
<p><i>Remark – ** “I” is specified in the designation if the transducers with the included linearization function are ordered.</i></p>		

Table 3

Type of a sensor connected	Designation	Input signal change ranges
Sensors with output signals of direct voltage	U	from -100 to 100 mV
Resistance sensors	R	from 0 to 250 Ω
Sensors with output signals of direct current	I 5 (n * SQ ** H ***)	from 0 to 5 mA
	I 20 (n * SQ ** H ***)	from 4 to 20 mA
<p><i>Remark – * “n” is specified in the designation in case of work with the included dead space at the initial section;</i></p>		
<p><i>Remark – ** “SQ” is specified in the designation in case of work with the included square-rooting function.</i></p>		
<p><i>Remark – *** “H” is specified in the designation in case of work with the dependency between an input and output signal in accordance with the table inputted by a user.</i></p>		

4.9 NAS-5 ANALOG SIGNAL NORMALIZER

The **NAS-5 normalizer** is designated to convert an input analog signal (of direct voltage, the value of which is within the limits from 0 to 36 V or from 0 to 100 mV, depending on the mode selected) into an output direct current directly proportional to it with the value, which is in the range from 4 to 20 mA.

NAS-5 has a design to be mounted onto a DIN rail and assures galvanic isolation of NAS's nodes from a 24 V power supply source.



Basic functions of NAS-5:

- receiving a signal;
- converting a signal;
- outputting a converted signal;
- possibility to select the input signal range.

Version: "NPP" and for general industrial use.

Technical characteristics of NAS-5

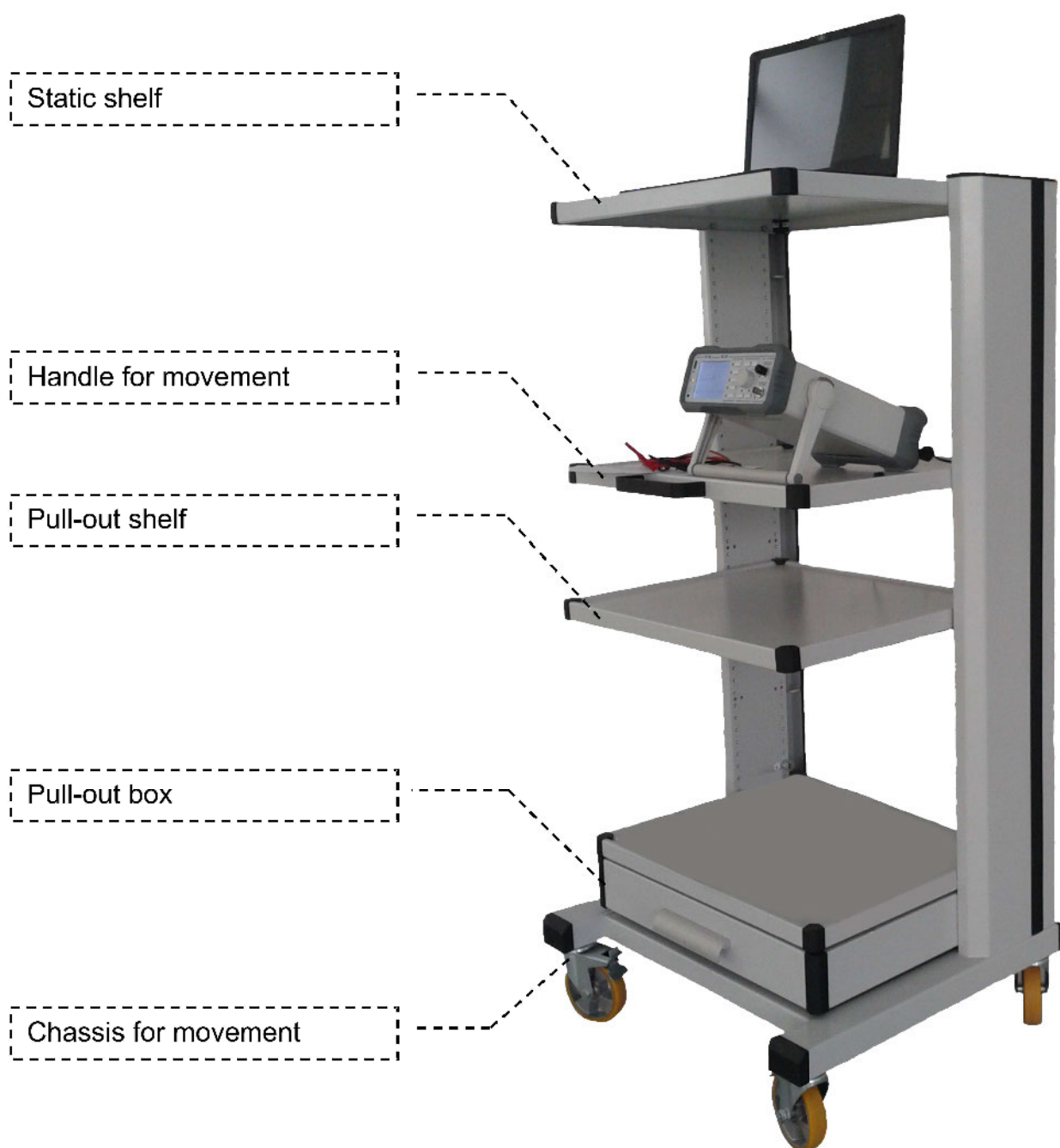
Parameter	Value
Rated direct supply voltage	24 Vdc
Allowed deviation from the rated voltage value	-4 V, +6 V
Input signal range	from 0 to 36 V from 0 to 100 mV
Output signal	from 4 to 20 mA
Reduced conversion error, not more than	±1 %
Output signal pulsation, not more than	±0.5 %
Output signal setting time, not more than	50 ms
Maximum load resistance value, not more than	500 Ω
Mean time between failures, not less than	500 000 h
Operating temperature range	from minus 5 to +45 °C
Dimensions WxHxD	26x76x112 mm
Weight, not more than	0.5 kg

5. INSTRUMENT MOBILE RACK (CART)

The rack has a project-arranged structure and is designated for steady placement of measuring devices and other accessories with the possibility of their movement.

Basic peculiarities:

- robust construction of sheet steel;
- resistance of power coating to external impact;
- boxes are equipped with guides with a "PUSH" system assuring smooth and noiseless complete opening and closing with a slight push;
- shelves are equipped with telescopic guides with finishers;
- a unit of sockets with a power cable located on a backside;
- compact dimensions allowing going through a lift door (chassis dimension is not more than 714x670 mm, rack height is 1432 mm);
- load capacity of shelves is up to 23 kg;
- load capacity of boxes is up to 25 and 30 kg.



6. MANUFACTURING CAPABILITY

The factory of PJSC “SRPA “Impulse” is equipped with modern equipment allowing serial manufacturing and monitoring of items of industrial electronics, electrotechnics, project-arranged cabinets, panels, and structures.

The production facilities meet the requirements of Ukraine and international standards as to manufacturing, testing, and warehousing. The production rooms equipped with required equipment are protected against negative impact of dust, vibrations, and other influencing factors. Constant temperature is year-round maintained in them due to a heating system, ventilation and conditioning systems.

The quality control system at the enterprise is certified to meet the requirements of the Ukrainian standards [DSTU ISO 9001](#), [DSTU ISO 14001](#), [DSTU OHSAS 18001](#) and the [international standards ISO 9001](#), [ISO 14001](#), [BS OHSAS 18001](#), [BS EN ISO 27001](#).

Development of manufacturing technological processes, interaction of services when manufacturing products are determined with the package of standards, guides, instructions of the enterprise, as well as requirements specifications, design documentation, product quality and reliability assurance programs.

Purchased raw materials, materials, semi-finished products, componentry, and structural elements used during manufacturing undergo obligatory incoming inspection.



Details, assembly units, units of elements, devices, sets, hardware complexes, independent sets of spare parts, tools, and accessories during the manufacturing process undergo operational technical inspection in accordance with the enterprise's standards.

Before handover-acceptance testing, all items (units of elements, devices, sets, hardware complexes) undergo technological run under the utmost permissible operation conditions.

After manufacturing, finished products are inspected by the quality control department, undergo special technical acceptance (to supply products to NPPs) and certification testing. Products having a certificate of correspondence are packed and transmitted to the enterprise's warehouse, where they are stored till shipping to a user, a customer.

Production automated lines, machines and installations with computer numerical control are constantly renewed.

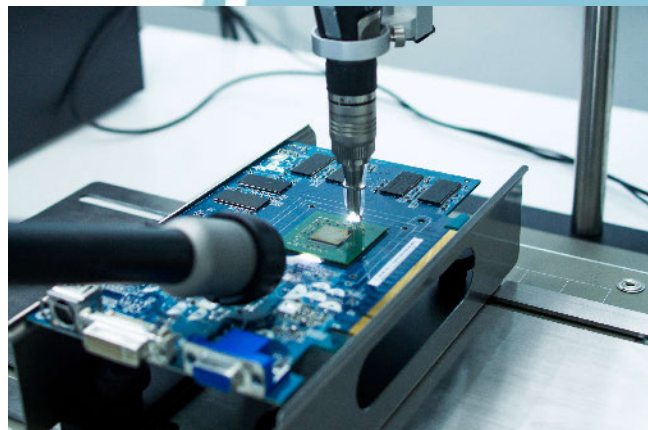


The following is done at the enterprise's production facilities:

- mechanical treatment:
 - material cutting using a Byjet Pro 3015 hydroabrasive cutting machine, an EVERISING BS-250 SSV contour band machine, a guillotine shearing press;
 - punching and bending using an Amada turret punch press, hydraulic presses, an Amada bending press, crank presses;
 - turning using Goodway GS-260, Nexturn 26E turning machining centres with CNC;
 - milling using all-purpose Takang and Doosan milling machines and milling centres with CNC;
 - grinding, polishing, bead-blasting treatment;
 - coordinating using coordinate boring machines;
 - welding for rough and stainless steels using a Fronius TT4000 job semiautomatic welder, spot and condenser welding;
 - washing machine to clean metal details;



- polymeric detail manufacturing by means of pressure die casting and moulding;
- application of electrochemical (zink, nickel, chrome, tin-bismuth) and paint-and-lacquer (powder painting) coatings to metals;
- application of polyurethane seals;
- application of marking symbols (thermal transfer, UV-print, engraving, burning-in decalcomania, punch marking);
- изготовление блоков элементов на основе печатных плат и другие работы по сборке радиоэлектронной аппаратуры:
 - installation of active and passive components to printed circuit boards using a Samsung automatic surface mounting line;





- quality of assembly of printed circuit assemblies is monitored using an HV5000TLC automatic optical checking system (NEXSCIEN). Quality of microchip installation in BGA cases is monitored using a Flexia BGA videomicroscope (Optilia);
- installation of pin components to printed circuit boards using modern digital soldering stations by PEACE, ERSA;
- washing of printed circuit boards on a semiautomatic modular line in ultrasonic and jet installations;
- installation and assembly of cabinets, panels, racks, cabinet bases, tables, etc.;
- production of harnesses, cables, jumpers using standard lugs, connectors by Wago, Harting, etc.



Then the following processes are done at the enterprise:

- testing for resistance to external exposure factors, electromagnetic compatibility, and safety at the independent testing laboratory certified to meet ISO 17025 at the National Ukrainian Certification Agency, the laboratory is situated at the territory of the enterprise;
- equipment installation supervision, participation in adjustment, in testing, and in commissioning;
- continuous technical support for operational services and author's support during the whole life-cycle of equipment produced;
- warranty and post-warranty repair.

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