IMPULSE

SRPA "IMPULSE"

ImPR1 MICROPROCESSOR-BASED RELAY PROTECTION AND AUTOMATICS DEVICES

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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

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;
- DIDOM discrete signal input-output modules that have 8 channels to input potential signals =110 V, =220 V, and ~220 V and 8 channels to output discrete signals;
- 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.

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 Inom	A	1.0 or 5.0
Current measurement range of Inom, 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×Inom
Surge current for not more than 1 s, not less than	A	100×Inom

Dynamic stability for 10 ms, not less than	A	250, 250, 1250
Nominal monitored voltage Unom	V	100
Voltage measurement range of Unom, 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 Inom - for the range from 10 to 1000 % of $3I_0$ - for the range from 1000 to 4000 % of Inom and $3I_0$	%	 ±2.5 ±2.5 ±5.0
Limits of basic relative error of voltage measurement (at temperature 25±5 ºC), not more than	%	±2.5
Limits of additional error of current and voltage measurement at ambient air temperature deviation by each 10 ºC of temperature 25±5 ºC, 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 ≤ 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 ≤ 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 ≤ 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 ≤ 0.04 s, R=7.8 Ω, L≤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 ≤ 0.04 s, R=7.8 Ω, L≤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±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 ≤ 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 ≤ 0.04 s, R=7.8 Ω, L≤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 ≤ 0.04 s, R=7.8 Ω, L≤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 ≤ 0.04 s, R=7.8 Ω, L≤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	ºC	–40 +60

A full technological cycle of equipment production, its implementation at facilities, and subsequent support of operation are assured at PJSC “SRPA “Impulse”.

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