Advanced metering infrastructure (AMI) for industrial applications

Multifunctional solution for managing power supply infrastructure of an industrial enterprise. It improves the efficiency of enterprise, the reliability and safety of its power grid.

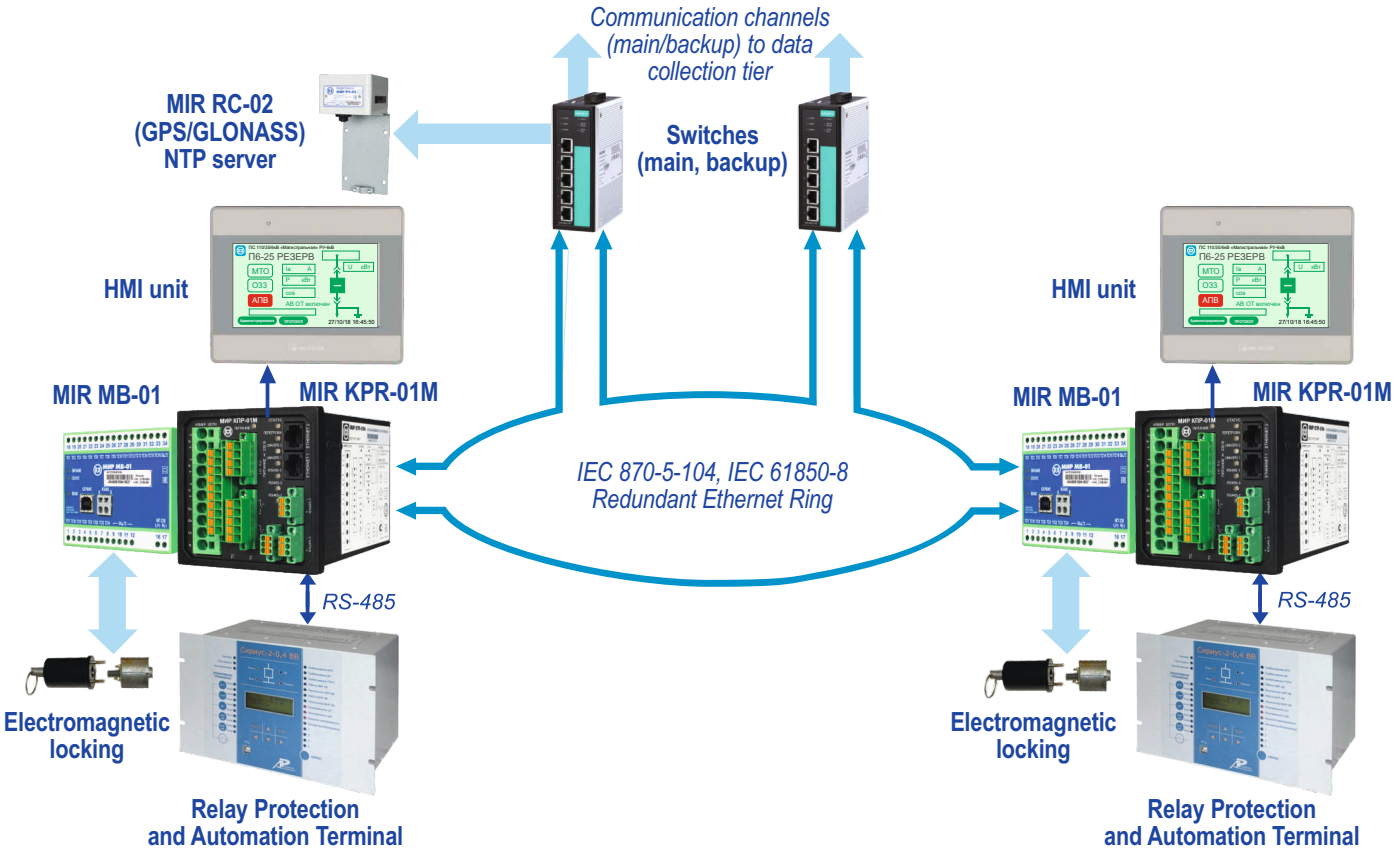
Functions

– Monitoring technological parameters and switching devices state;
– remote control of power facilities equipment;
– registration of emergency events;
– prompt blocking;
– monitoring of relay protection devices;
– power quality monitoring and management.

The system includes

– Multifunctional bay controller MIR KPR-01M;
– Measurement transducer MIR KPR-01MA;
– I/O extension unit MIR MV-01;
– Time Server MIR RC-02.

Sample AMI configuration



Main features of this solution:

– MIR KPR-01M – multifunctional bay controller, measuring transducer, prefault recording device, electric power quality monitoring device, telecontrol module in a single unit;
– Interchangeability – each KPR-01M unit can act as a substation controller;
– Ethernet ring for further reliability.

Integration

AMI allows usage of third-party intelligent devices including power meters as data source.

Supported communication protocols with the data collection tier:

– IEC 60870-5-101;
– IEC 60870-5-104;
– IEC 61850-8-1 (MMS, GOOSE).

Supported data exchange protocols with external intelligent devices:

– ModBus RTU/ASCII/TCP;
– IEC 60870-5-101;
– IEC 60870-5-103;
– IEC 60870-5-104;
– IEC 61850-8-1 (MMS, GOOSE);
– DLMS/COSEM;
– Proprietary protocols of smart devices manufacturers.

Certified by Russian Register

2008

2013

Multifunctional bay controller MIR KPR-01M

Purpose

Multifunctional bay controller MIR KPR-01M is used as part of industrial AMI

The device has optional functions of measurement transducer, faults recorder, energy quality monitor.

Functions

– data collection from protection relays, field devices and intellectual devices;
– prompt blocking;
– support of IEC 61850-8 (MMS/GOOSE); IEC 870-5-101/104, ModBus RTU/TCP protocols and proprietary manufacturers protocols;
– ability of expansion with I/O modules and display units.
– instrumentation parameters monitoring and recording;
– electric energy metering with load profiles storing;
– oscillograms recording with prefault history recording;
– recording discrete signals on the state of the equipment;
– issuing control commands.

Specifications:

– rated phase voltage 57.7-230 V;
– rated (maximum) current 1-5 (10) A or 5 (150) A;
– 8 discrete channels with a rated voltage of 24V;
– 2 discrete outputs;
– powered by 24V or 230V.

Interfaces:

– one CAN interface;
– one RS232;
– up to 4 RS-485 interfaces;
– 2 Ethernet 100BASE-TX interfaces with ring topology support and with hardware Bypass function;
– interface external indicator (LCD or LED) (24V).

Discrete input channels characteristics

Parameter name	Value
Number of channels	8 for voltage of 24 V or 230 V
The minimum duration of the signal at the discrete channel input	1 ms
Contact debouncing time	1 ms – 60 s, discreetness 1 ms
Insulation strength	4 kV
Channel interrogate rated current	5 mA
The external circuit resistance, at which the "closed" state is fixed	150 Ohm and less
The external circuit resistance, at which the "open" state is fixed	50 kOhm and more

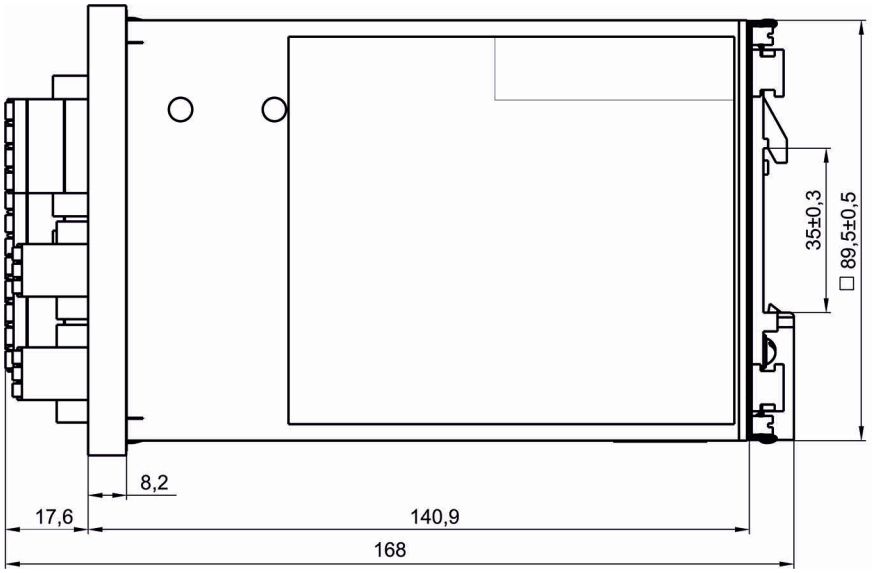
Discrete output channels characteristics

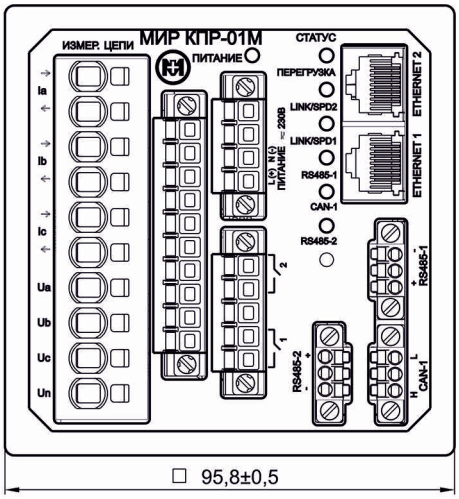
Parameter name	Value
Number of channels	2
Channels switching capacity when switching AC	5 A, 230 V, load class AC1 1.3 A, 230 V, load class AC15
Channels switching capacity when switching DC	0.3 A, 230 V, load class DC1, DC13 5 A, 24 V, load class DC1, DC13
Switching relay lifetime	not less than 30,000 cycles
Insulation strength between channels	2 kV
Group of discrete output channels insulation strength	4 kV
Control pulse duration	10 ms – 60 s, discreteness 10 ms, or continuously

Power supply characteristics

Parameter name	Value
Power supply rated voltage	24 V DC 230 V AC
Power consumption	not more than 16 VA at rated voltage of 230 V not more than 6 W at rated voltage of 12 V

Dimensions





MIR KPR-01M numbering system

Code symbols	Code symbols decryption
МИР KPR-01M-**5(10)**-230-R2E-8TC24-2TU-IP230-**KQ**	**Rated (maximum) current, accuracy class when measuring active/reactive energy**
	5(10) – 1-5 (10) A[1], accuracy class 0,2S/0,5
	5(150) – 5(150) A, accuracy class 0.5S/1
МИР KPR-01M-5(10)-230-R2E-8TC24-2TU-IP230-KQ	**Rated voltage**
	230 – 57.7-230 V[1]
MIR KPR-01M-5(10)-230-**R2E-**8TS24-2TU-IP230-**KQ**	**Availability and number of interfaces**
	R – one RS-485 interface
	2R – two RS-485 interfaces
	3R – three RS-485 interfaces
	4R – four RS-485 interfaces
	2E – two Ethernet TX interfaces
	S – one RS-232 interface
	C – one CAN interface
	I – one external display power interface
MIR KPR-01M-5(10)-230-R2E-**8TS24-**2TU-IP230-**KQ**	**Availability and rated voltage of discrete input channels**
	no symbols - no discrete channels
	8TS24 – 8 discrete channels with rated voltage of 24 V
MIR KPR-01M-5(10)-230-R2E-8TS24-**2TU-**IP230-**KQ**	**Availability and number of discrete output channels**
	no symbols - no channels
	2TU – 2 discrete output channels
MIR KPR-01M-5(10)-230-R2E-8TS24-2TU-**IP230-KQ**	**Power supply circuit voltage**
	IP24 – power supply from 24 V circuit
	IP230 – power supply from 230 V circuit
MIR KPR-01M-5(10)-230-R2E-8TS24-2TU-IP230-**KQ**	**Functions availability:**
	K – oscillography
	Q – electric power quality measurement

1) The values of the rated current and voltage are selected by software when configuring

Measurement transducer MIR KPR-01MA

Purpose

The MIR KPR-01MA devices are designed to measure and analyze the parameters of the electrical network, determine and control the equipment state, record processes, including oscillography, determine the power quality and energy metering.

Functions

– measurement of power grid instrumentation parameters (U, I, P, Q, S, cos φ);
– determination of the state of electrical equipment, built-in discrete input channels;
– electrical equipment control, built-in discrete output channels;
– throwing events when discrete or analog parameters changed;
– recording of emergency and transient processes in the network, including oscillography with prefault history recording;
– power qualty parameters measurement;
– multi-tariff metering of electricity with storing load profiles;
– ability of expansion with I/O modules and display modules.

Features

– All-in-one device – current, voltage, and power transducer, electric energy meter, fault recorder, bay controller, electric power quality metering device.
– Powered from measuring terminals and from the backup power supply terminals with automatic backup without loss of information.
– Ethernet ring topology support with hardware Bypass function when power supply is lost.
– The smallest dimensions in its class.

Main metrological characteristics

Modification	Rated current, I_{rated}, A	Rated phase voltage U_{rated}, V	Maximum voltage value, $U_{max.}$ V	Maximum current value during measurement		Accuracy class when measuring energy, %	
				RMS of current, $I_{max.}$, A	energy, $I_{max.en.}$, A	active	reactive
KPR-01M-A, I_{max10}, $U_{rated57}$	1	57	130	10	10	0.5S	1
KPR-01M-A I_{max10}, $U_{rated230}$	1	230	300	10	10	0.5S	1
KPR-01M-A, I_{max50}, $U_{rated57}$	5	57	130	50	10	0.5S	1
KPR-01M-A, I_{max50}, $U_{rated230}$	5	230	300	50	10	0.5S	1

Discrete input channels characteristics

Parameter name	Value
General characteristics	
Number of channels	8 discrete input for voltage of 24 V or 230 V
The minimum duration of the signal at the channel input	1 ms
Contact debouncing time	1 ms – 60 s, discreetness 1 ms
Group of discrete output channels insulation strength	4 kV
230V channels characteristics	
Channel power source category	wet contact
Channel rated voltage	230 V DC
Channel actuation minimum voltage	158 – 170 V
Channel reswitching maximum voltage	132 – 154 V
Channel rated impedance	200 kOhm
24V channels characteristics	
Channel rated impedance	Dry contact, internal power supply 24V DC
Channel interrogate rated current	5 mA
The external circuit resistance, at which the «closed» state is fixed	5 mA
The external circuit resistance, at which the «open» state is fixed	50 kOhm and more

Discrete output channels characteristics

Parameter name	Value
Number of channels	2
channels switching capacity when switching AC	6 A, 230 V, load class AC1 1.3 A, 230 V, load class AC15
channels switching capacity when switching DC	0.12 A, 230 V, load class DC1, DC13 6 A, 30 V, load class DC1, DC13
Switching relay lifetime	not less than 30,000 cycles
Insulation strength between channels	2 kV
Group of discrete output channels insulation strength	4 kV
Control pulse duration	10 ms – 60 s, discreteness 10 ms, or continuously

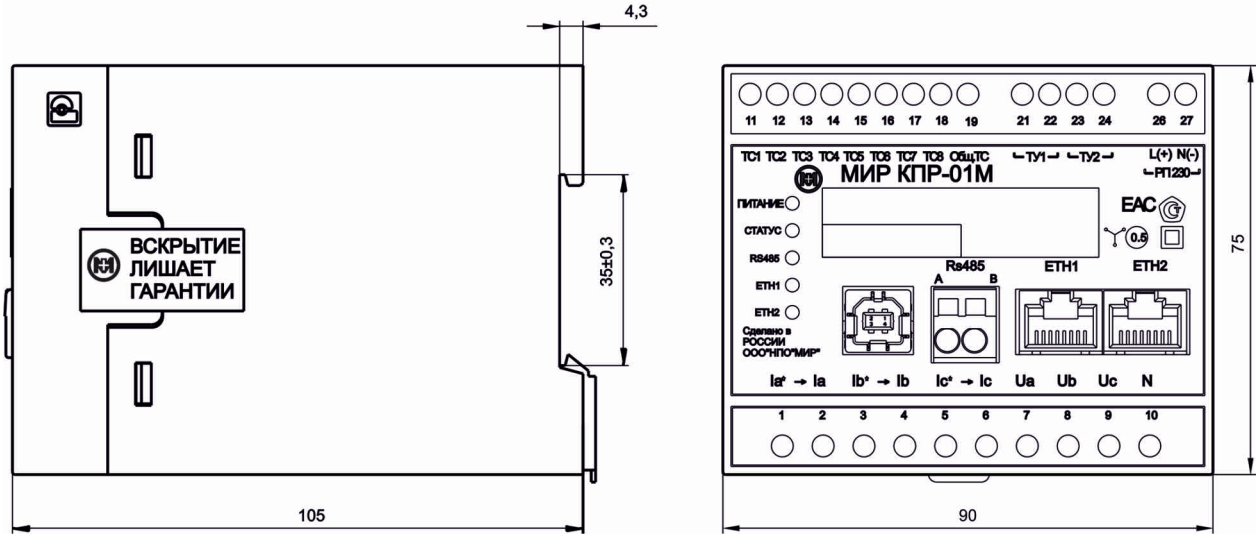
Power supply characteristics

Parameter name	Value
Rated supply voltage from measuring terminals	three-phase 57,7 V, for $U_{rated57}$ three-phase 230 V, for $U_{rated230}$
Rated supply voltage from the backup power terminals	24 V DC 230 V DC or AC
Active/total power consumption over measuring voltage terminals	not more than 2 W/5 VA for $U_{rated230}$ not more than 2 W/3 VA for $U_{rated57}$ for each phase at rated voltage
Total power consumption over measuring current terminals	not more than 0.1 VA for rated current of 5 A
Power consumption over the backup power supply terminals	not more than 5 W at rated voltage not more than 6W / 10 VA at rated voltage
Start-up current	not more than 1.5 A for the 24 V backup power supply circuit not more than 0,7 A for other circuits
Resistance to voltage interruptions	up to 0.1 s for the 24 V backup power supply circuit up to 0.5 s for other circuits

Interfaces and communication protocols:

– up to 3 RS-485 interfaces;
– up to 2 Ethernet TX interfaces with the ability to work in ring topologies and with support for hardware Bypass function;
– RF interface, operating in the 868 MHz frequency band with support for a self-organizing Mesh network;
– MODBUS RTU/TCP and IEC 60870-5-101/104 exchange protocols.

Dimensions



MIR KPR-01M-A numbering system

Code symbols	Options and deciphering the symbols
MIR KPR-01M-A-5(50)-57IP-R2E-8TS24-2TU-RP24-KQ	**Device type**
MIR KPR-01M**-A-**5(50)-57IP-R2E-8TS24-2TU-RP24-KQ	**Structural design**
	A – housing with dimensions of 90*75*105 mm
MIR KPR-01M-A**-5(50)-**57IP-R2E-8TS24-2TU-RP24-KQ	**Rated (maximum) current, accuracy class when measuring active/reactive energy**
	5(50) – 5(50) A, accuracy class 0.5S/1
MIR KPR-01M-A-5(50)**-57**IP-R2E-8TS24-2TU-RP24-KQ	**Rated phase voltage**
	57 – 57.7 V
	230 – 230 V
MIR KPR-01M-A-5(50)-57**IP-**R2E-8TS24-2TU-RP24-KQ	**Availability of power supply from measuring terminals**
	IP – power supply from measuring terminals
MIR KPR-01M-A-5(50)-57IP-**R**2E-8TS24-2TU-RP24-KQ	**Availability and number RS485 of interfaces**
	no symbols – no RS485 interfaces
	R – one RS485 interface
	2R – two RS485 interfaces
	3R – three RS485 interfaces
MIR KPR-01M-A-5(50)-57IP-R**2E**-8TS24-2TU-RP24-KQ	**Availability and number of Ethernet TX interfaces**
	no symbols – no Ethernet TX interfaces
	2E – two Ethernet TX interfaces
	2EB – two Ethernet TX interface with the Bypass technology
MIR KPR-01M-A-5(50)-57IP-R2E-**8TS**24-2TU-RP24-KQ	**Availability and number of discrete input channels**
	no symbols – no channels
	8TS – 8 discrete input channels
MIR KPR-01M-A-5(50)-57IP-R2E-8TS**24**-2TU-RP24-KQ	**Discrete input channels rated voltage**
	24 – 24 V
	230 – 230 V
MIR KPR-01M-A-5(50)-57IP-R2E-8TS24**-2TU-**RP24-KQ	**Availability and number of discrete output channels**
	no symbols – no channels
	2TU – 2 discrete output channels
MIR KPR-01M-A-5(50)-57IP-R2E-8TS24-2TU**-RP24-**KQ	**Availability and voltage of backup power supply terminal**
	no symbols – power supply only from measuring terminal
	Rp24 – power supply from 24 V terminal
	Rp230 – power supply from 230 V terminal
MIR KPR-01M-A-5(10)-57IP-R2E-8TS24-2TU-RP24**-KQ**	**Availability of program functions**
	K – oscillography
	Q – power quality measurement

Record Example – MIR KPR-01M-A-5 (50) -57-R2E-8TS24-2TU-RP24-KQ, multifunctional measuring device MIR KPR-01M in design A (90*75*105 mm), rated (maximum) current 5 (50) A, rated voltage 57.7 V, power supply from measuring terminals, one RS485 interface, 2 EthernetTX interfaces, 8 discrete input channels 24 V, 2 discrete input channels, 24 V backup power supply with oscillographic functions

MIR MV-01 I/O extension unit

Purpose

The MIR MV-01 I/O extension unit is designed for collecting and processing discrete signals and issuing discrete control commands as part of automation systems in the power and other industries.

Functions

Identification of the electrical equipment state:

– built-in discrete input channels;
– indication of the discrete input channels state;
– events throwing based upon the discrete inputs state.

Controlling electric equipment:

– built-in discrete output channels;
– monitoring the availability of discrete output operational voltage.

Specifications

– module power supply voltage 24V or 230V;
– 8, 16 or 24 discrete input channels;
– discrete input channels dry contact type with built-in power supply 24V DC;
– discrete input channels wet contact type 230V DC;
– discrete input channels wet contact type 230V AC;
– discrete output channels for AC and DC switching;
– 4 or 14 discrete output channels.

Discrete input channels characteristics

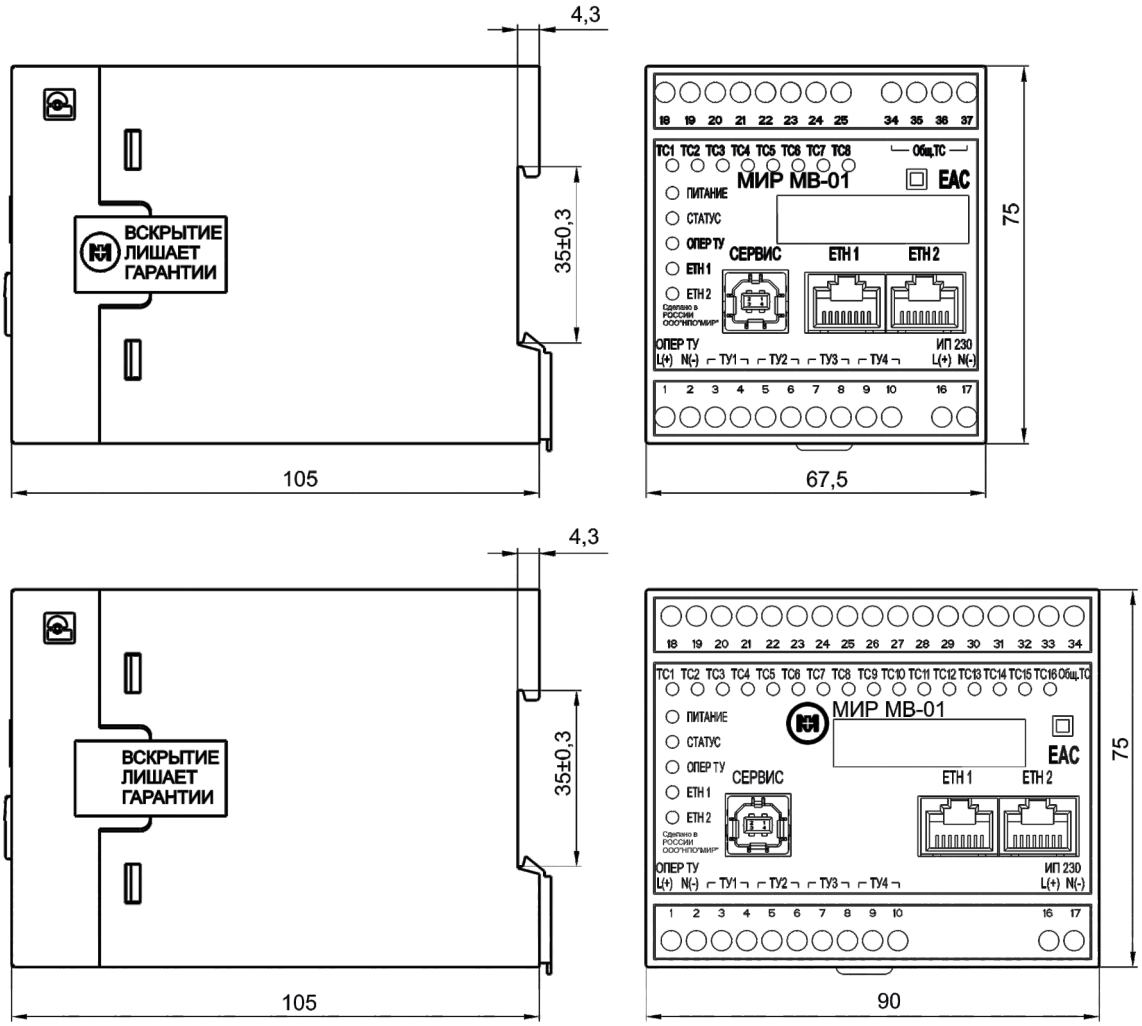
Parameter name	Value
Maximum switching current of discrete output DC channels when switching AC	8 A, 230 V, load class AC1[1)] 3 A, 230 V, load class AC15[1)]
Maximum switching current of discrete output DC channels when switching DC	1 A, 230 V, load class DC1, DC13[1)] 4 A, 110 V, load class DC1, DC13[1)] 8 A, 30 V, load class DC1, Dc13[1)]
Maximum switching current of discrete output AC channels when switching AC	6 A, 230 V, load class AC1[1)] 1.3 A, 230 V, load class AC15[1)]
Maximum switching current of discrete output AC channels when switching DC	0.12 A, 230 V, load class DC1, DC13[1)] 0.2 A, 110 V, load class DC1, DC13[1)] 6 A, 30 V, load class DC1, DC13[1)]

[1)] Load classes according to IEC 60947-1-2014, for a load of class DC13, it is necessary to connect a diode in parallel in order to ensure switching capacity

Interfaces and protocols

– RS-485 interface;
– two Ethernet TX interfaces with the ability to work in ring topologies;
– USB service interface type B;
– MODBUS RTU/TCP exchange protocol;
– IEC 60870-5-101/104 exchange protocol.

Dimensions



Numbering systems

Code symbols	Options and deciphering the symbols
MIR MV-01-R-8TS230-4TUDC-IP230	**Device type**
MIR MV-01-**R-**8TS230-4TUDC-IP230	**Availability and number of interfaces** R – one RS-485 interface E – one Ethernet TX interface 2E – two Ethernet TX interfaces
MIR MV-01-R-**8TS**230-4TUDC-IP230	**Availability and number of discrete input channels** no symbols – no discrete input channels 8TS – 8 discrete input channels 16TS – 16 discrete input channels 24TS – 24 discrete input channels
MIR MV-01-R-8TS**230**-4TUDC-IP230	**Discrete input channels rated voltage** 24 – 24 V 230 – 230 V
MIR MV-01-R-8TS230-**4TUDC**-IP230	**Availability and number of discrete output channels** no symbols – no discrete output channels 4TUDC – 4 discrete output channels, switching DC load 14TUAC – 14 discrete output channels, switching AC load
MIR MV-01-R-8TS230-4TUDC-**IP230**	**Power supply voltage** IP24 – 24 V IP230 – 230 V

Record example: The I/O module MIR MV-01-R-8TS230-4TUDC-IP230 T The I/O module with 1 RS 485 channel has 8 discrete inputs for 230 V and 4 discrete outputs for switching the DC power load. Module power supply – 230 V.

Time server MIR RC-02

Purpose

Time server is a time synchronization device and is designed to receive signals from GLONASS and GPS, satellite navigation systems, to generate and transmit frequency and time signals in different sequences and codes (1PPS (1 Hz), NMEA, SNTP), synchronized with the UTC universal coordinated time scale.

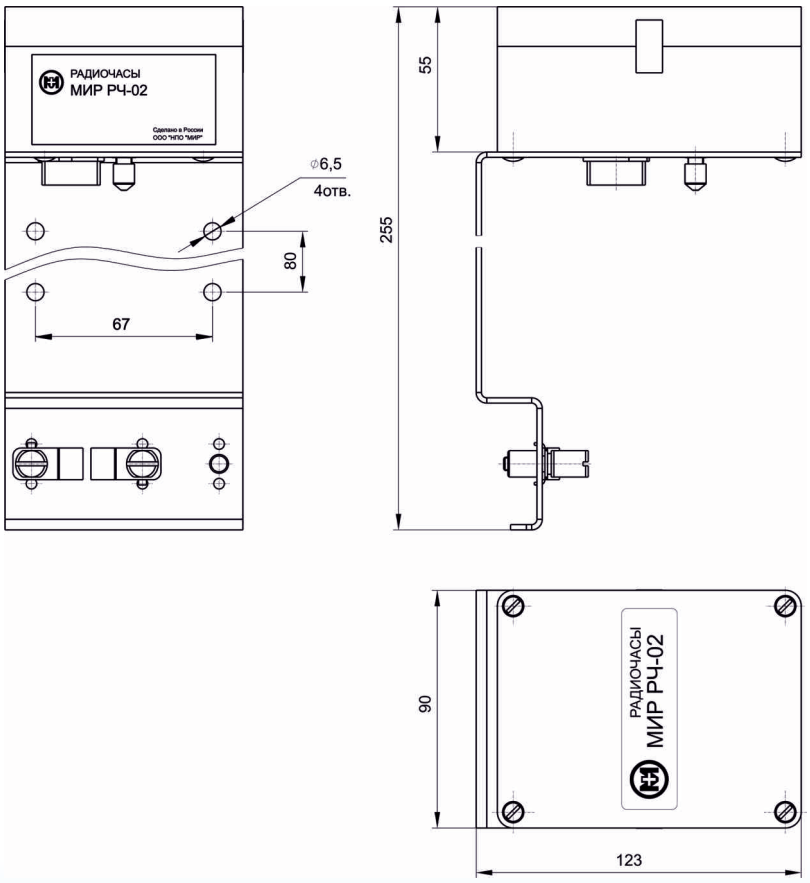
The time server can be powered either from an external power source with a nominal voltage of 24 V, or using Power Over Ethernet (POE) technology.

The device has 2 Ethernet ports with PoE power supply or RS-485 port and 1 PPS ou

Specifications

Parameter name	Value
Time synchronization accuracy over PPS output, μs	± 0.2, ± 1 depending on modification
Time synchronization accuracy over RS-485 (NMEA) output, μs	± 35
Weight, kg	0.9
Dimensions (LxWxH), mm	90 x 125 x 255
Recalibration interval, years	16

Dimensions



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