ENERGO-SOYUZ LLC

E 856ЭС DC MEASURING TRANSDUCERS

AND

E 857ЭС DC VOLTAGE TRANSDUCERS

OPERATION MANUAL

СКЮИ.411600.001РЭ

1 SCOPE OF APPLICATION

1.1 This present Operation Manual is designed to familiarize you with principles of operation, structure, installation and maintenance of the E 856ЭC DC measuring transducers and E 857ЭC DC voltage measuring transducers.

1.2 Measuring transducers (hereinafter referred to as MT) are designed to linear conversion of an input signal into a DC or DC voltage unified electric signal, and/or conversion of an input signal into a digital code and transferring the conversion results to a computer (hereinafter referred to as PC) and/or an external displaying device (hereinafter referred to as PU).

The MT can be used for complex automation of electric power facilities in various industries.

1.3 E 856ЭC MT are designed for direct connection or connection from external shunts with a rated output voltage of 75 mV.

MT with external shunts are designed to be included in a circuit with an operating voltage not more than 1000 V, -Ц modification - not more than 500 V.

E 857ЭC MT are designed for direct connection.

1.4 According to a number of converted electrical quantities, both single-channel and dual-channel (except for -Ц modification) MT can be manufactured, depending on the customer's needs.

Only one-channel MT can be manufactured with the upper limit of the measurement range of 1000 V.

Single-channel MT can have one, two or three outputs with the same signal parameters for each output.

1.5. MT power supply is carried out in one of the following options:

a) from an AC power supply, 198 to 242 V (220 V* rated voltage) and 50 Hz frequency;

b) from an AC power supply, 85 to 264 V (220 V* rated voltage) and 50 Hz frequency or 120 to 300 V DC voltage;

c) from a DC power supply, 18 to 36 V (24 V rated voltage).

* - rated voltage for deliveries to Russia is 230.

1.6 The MT have IP 20 shell protection degree as specified in ГОСТ 14254-2015.

1.7 The MT are designed for operation at an ambient air temperature of minus 30 ºC to plus 60 ºC and relative humidity (95 ± 3) % at 35 ºC.

1.8 The MT are resistant to radio interference and classified to stationary equipment operated in industrial premises, outside residential buildings.

2 FEATURES

2.1 The main features of MT E 856ЭC and E 857ЭC are specified in Table 1.

Table 1

Type, modification	Converted input signal measurement range	Output signal			Load resistance variation range, kΩ	Input signal ripple, %
		Measurement range	Nominal value	Settling time, ms		
E 856/1ЭC	0-75 mV	0-5 mA	5 mA	500	0-3.0	Up to 15
E 856/21ЭC				5		
E 856/2ЭC	0-75 mV	0-5	5 V	500	1-100.0	
E 856/22ЭC				5		
E 856/3ЭC	±75 mV	±5 mA	5 mA	500	0-3.0	
E 856/23ЭC				5		
E 856/4ЭC	±75 mV	±5	5 V	500	1-100.0	
E 856/24ЭC				5		
E 856/5ЭC	0-75 mV	0-5 mA	5 mA	500	0-3.0	Up to 100
E 856/6ЭC		4-20 or 0-20 mA	20 mA	500	0-0.5	
E 856/7ЭC	0-75 mV	4-20 or 0-20 mA	20 mA	500	0-0.5	Up to 15
E 856/27ЭC				5		
E 856/8ЭC	±75 mV	4-12-20 or 0-10-20 mA		500		
E 856/28ЭC				5		
E 856/9ЭC	0-5 mA	4-20 or 0-20 mA		500		
E 856/29ЭC				5		
E 856/10ЭC	4-20 mA	0-5 mA	5 mA	500	0-3.0	
E 856/30ЭC				5		
E 856/11ЭC	0-20 mA	0-5 mA		500		
E 856/31ЭC				5		
E 856/12ЭC	4-20 mA	0-20 mA	20 mA	500	0-0.5	
E 856/32ЭC				5		
E 856/13ЭC	0-20 mA	4-20 or 0-20 mA		500		
E 856/33ЭC				5		
E 856/14ЭC	±5 mA	4-12-20 or 0-10-20 mA		500		
E 856/34ЭC				5		
E 856/15ЭC	0-5 mA	0-5 mA	5 mA	500	0-3.0	
E 856/35ЭC				5		
E 856/16ЭC	±5 mA	±5 mA		500		
E 856/36ЭC				5		
E 857/1ЭC	0-1; 0-3 0-5; 0-10; 0-30; 0-60; 0-100; 0-150; 0-250; 0-500; 0-1000 V	0-5 mA	5 mA	500	0-3.0	
E 857/11ЭC				5		
E 857/2ЭC		0-5 or 0-10 V	5 V (0-5 V) or 10 V (0-10 V)	500	1-100.0 (5 V) 2-100.0 (10 V)	
E 857/12ЭC				5		
E 857/3ЭC		4-20 or 0-20 mA	20 mA	500	0-0.5	
E 857/13ЭC				5		

Table 1 (continued)

Type, modification	Converted input signal measurement range	Output signal			Load resistance variation range, kΩ	Input signal ripple, %
		Measurement range	Nominal value	Settling time, ms		
E 857/4ЭС	±1; ±3; ±5; ±10; ±30; ±60; ±100; ±150; ±250; ±500; ±1000 V	±5 mA	5 mA	500	0-3.0	Up to 15
E 857/14ЭС				5		
E 857/5ЭС		0-2.5-5.0 mA		500		
E 857/15ЭС				5		
E 857/6ЭС		4-12-20 or 0-10-20 mA	20 mA	500	0-0.5	
E 857/16ЭС				5		
E 857/7ЭС		±5 ±10 V	5 V (±5 V) 10 V (±10 V)	500	1-100.0 (5 V) 2-100.0 (10 V)	
E 857/17ЭС				5		

The main features of E 856ЭС-Ц measuring transducer and E 857ЭС-Ц measuring transducer are shown in Table 2 and Table 3.

Table 2

Type, modification	Output 1 (RS-485 port)	Output 2 (port PU)	Output 3 (analog output)
E 856/1ЭС-Ц, E857/1-Ц	Yes	Yes	No
E 856/2ЭС-Ц, E857/2-Ц	Yes	No	
E 856/3ЭС-Ц, E857/3-Ц	No	Yes	
E 856/4ЭС-Ц, E857/4-Ц	Yes	Yes	Yes
E 856/5ЭС-Ц, E857/5-Ц	Yes	No	
E 856/6ЭС-Ц, E857/6-Ц	No	Yes	

Table 3

Measuring transducer type	Input signal measurement range	Signal measurement ranges for output 3	Rated signal for output 3	Load resistance measurement range for output 3, kOhm
E 856ЭС-Ц	0-75 mV; 0-5 mA; 4-20 mA; 0-20 mA	0-5 mA	5 mA	0-3.0
		4-20 mA	20 mA	0-0.5
		0-20 mA	20 mA	0-0.5
		0-5 V	5 V	1.0-100.0
		0-10 V	10 V	2.0-100.0
	0-2.5-5 mA; ±5 mA; 4-12-20 mA; ±5 mA; 0-10-20 mA; ±75 mV	±5 mA; 0-2.5-5 mA	5 mA	0-3.0
		4-12-20 mA	20 mA	0-0.5
		0-10-20 mA	20 mA	0-0.5
		±5 V; 0-2.5-5 V	5 V	1.0-100.0
		0-5-10 V; ±10 V	10 V	2.0-100.0

Table 3 (continued)

E 857ЭС-Ц	0-1 V; 0-5 V; 0-10 V; 0-60 V; 0-100 V; 0-150 V; 0-250 V; 0-400 V; 0-500 V	0-5 mA	5 mA	0-3.0
		4-20 mA	20 mA	0-0.5
		0-20 mA	20 mA	0-0.5
		0-5 V	5 V	1.0-100.0
		0-10 V	10 V	2.0-100.0
	±1 V; ±5 V; ±10 V; ±60 V; ±100 V; ±150 V; ±250 V; ±400 V; ±500 V	±5 mA; 0-2.5-5 mA	5 mA	0-3.0
		4-12-20 mA	20 mA	0-0.5
		0-10-20 mA	20 mA	0-0.5
		±5 V; 0-2.5-5 V	5 V	1.0-100.0
		0-5-10 V; ±10 V	10 V	2.0-100.0

2.2 Insulation electrical resistance between different circuits is not less than the values that are specified in Table 4.

Table 4

Circuits tested	Normal conditions of use	At the maximal temperature for working conditions	At the maximal relative humidity for working conditions
Network, input (inputs) - output (outputs), housing	100 MΩ	20 MΩ	5 MΩ
Input (inputs), output (outputs) - housing			
All outputs between themselves			

2.3 Depending on the circuit rated voltage, the measuring transducer electrical circuit isolation relative to the housing and between themselves withstands test voltage of almost sinusoidal shape with a frequency of 45 to 65 Hz for 1 min, the value of which is given in Tables 5 and 6.

Table 5

Circuits tested	Test voltage, kV, for MT (except for modifications -Ц) with nominal input signal				
	1, 3, 5, 10, 30, 60 V	100, 150 V	250 V	500 V 5, 20 mA	1000 V 75 mV
Housing - all inputs	2,70		3,00	3,70	5,40
Housing - power	3,00				
Housing - all outputs	0,86				
Inputs between each other	1,35	1,50	2,21	3,31	-
Input – outputs			1,50	2,21	3,31
Input – power	1,50	2,21	2,21		
outputs – power	1,50				
Inputs between each other	0,86				
Note. Presence of circuits shall be in accordance with a modification of the MT					

Table 6

Circuits tested	Test voltage, kV, for MT modification -Ц with nominal input signal		
	5, 20 mA; 1, 3, 5, 10, 30, 60, 100, 150 V	250 V	400, 500 V 75 mV
Housing - power	3,00		
Housing - all inputs	2,70	3,00	3,70
Housing - all outputs	0,84		
Power - all inputs	3,00		3,70
Power - all outputs	3,00		
Input – outputs 1, 2, 3	1,50		2,21
Output 1 – outputs 2, 3	0,84		
Output 2 – outputs 3			
Analog outputs between themselves	0,84		
Note. Presence of circuits shall be in accordance with a modification of the MT			

2.4 Limits of the MT permissible basic reduced error are ± 0.5% of the normalizing value.

If a MT has an analog output, limits of the permissible basic reduced error shall be ± 0.5% of the normalizing value in the whole range of variation of the load resistance.

2.5 Limits of MT permissible additional errors caused by deviation of influencing factors from the normal values specified in Table 7 shall be not more than:

a) 0.8 of the limit of the MT permissible basic error, when the ambient temperature varies from normal to any temperature within the operating conditions of use for every 10 ºC;

b) 1.8 of the limit of the MT permissible basic error, when operating in high humidity conditions up to (95 ± 3) % at 35 ºC;

c) limit of the MT permissible basic error under influence of external uniform alternating magnetic field with a magnetic induction of 0.5 mT at the most unfavourable direction and phase of the magnetic field;

d) 0.5 of the MT permissible basic error limit when the supply voltage is changing.

2.5.1 The output signal ripple frequency is not more than 75 mV for MT with output signal setting time 500 ms, for MT with rated values 5 mA, 5 V, 10 V, and not more than 50 mV for MT with a rated value 20 mA.

The output signal ripple frequency is not more than 200 mV for MT with output signal setting time 5 ms, for MT with rated values 5 mA, 5 V, 10 V, and not more than 140 mV for MT with a rated value 20 mA.

Table 7

Influencing factor	Normal value
Ambient air temperature, °C	20 ± 5
Ambient air relative humidity, %	30-80
Supply voltage, V:	220±4.4 (230±4.6); 24±0.48
Power frequency, Hz	50 ± 0.5
E 856ЭС measuring transducer supply wire resistance, Ω	0.035 max.
External magnetic field	Earth's magnetic field
Input signal ripple, %, for E 856/5ЭС, E 856/6ЭС for other modifications of MT	 Up to 100 Up to 15
Input signal ripple frequency, Hz, for E 856/5ЭС, E 856/6ЭС and -Ц-modification with RMS function	100±1
Load resistance, kΩ, for a MT with the upper measurement range of the output signal: - 5 mA; - 20 mA; - 5 V, 10 V	 2.5±0.5 0.4±0.1 95.0±5.0

2.6 MT shall withstand a two-hour overload with an input signal equal to 120% of the final value of the measurement range, without being damaged.

2.7 MT shall withstand a short-term overload as specified in Table 8.

The output signal for all overloads shall not be more than 30 V at the maximum load.

Table 8

MT type	Current ratio	Input signal, mV	Voltage ratio	Number of overloads	Duration of one overload, s	Interval between two overloads, s
E 856ЭС	2	150	-	10	10	10
	7	525	-	2	15	60
	10	750	-	5	3	2.5
	20	1500	-	2	0.5	0.5
E 857ЭС	-	-	1.5	9	0.5	15

2.8 The MT output signal setting time at a jump-like change of the input signal from the initial value to any value within the measurement range is no more than 0.5 s or 5 ms for high-speed MT.

2.9 The power consumed by the MT for each channel is no more than:

1) From the input signal circuit:

- 0.05 W for E 856ЭС measuring transducer;
- 0.02 W for measuring transducers with 1, 5, 10 V input signal upper measurement limits;
- 0.10 W for measuring transducers with 60 V input signal upper measurement limit;
- 0.15 W for measuring transducers with 100 V input signal upper measurement limit;
- 0.20 W for measuring transducers with 150 V input signal upper measurement limit;
- 0.35 W for measuring transducers with 250 V input signal upper measurement limit;
- 0.70 W for measuring transducers with 500 V input signal upper measurement limit;
- 1.00 W for measuring transducers with 1000 V input signal upper measurement limit;

2) From the AC power supply circuit:

- 5.00 V·A for all single-channel measuring transducers (except for -Ц modifications, which have Output 2);
- 6.00 V·A for all dual-channel MT;
- 10.00 V·A for -Ц modifications of MT, which have Output 2.

3) From the DC power supply circuit:

- 5.00 W for all single-channel MT (except for -Ц modifications, which have Output 2);
- 6.00 W for all dual-channel MT;
- 10.00 W for all -Ц modifications of MT, which have Output 2.

2.10 The maximal overall dimensions of the MT is 125x110x132 mm. The maximal overall dimensions of the PU is 130x60x30 mm. The cord shall provide connection of the MT to the PU at a distance of up to 3 m. Annex A includes overall dimensions and mounting dimensions.

2.11 Weight of the MT shall not be more than 1.5 kg. Weight of the PU with the cord shall not be more than 0.4 kg.

2.12 Average service life shall not be less than 12 years.

2.13 The measuring transducer in a transport container shall be held without damage:

a) Effect of sinusoidal vibration in the frequency range 10 to 55 Hz with an amplitude displacement of 0.35 mm, in the direction indicated on the container with the "Up" handling sign according to ГОСТ 14192-96;

b) Temperature effect: minus 50 ºС to plus 60 ºС;

c) Exposure to relative humidity (95 ± 3) % at a temperature of 35 ºС.

3 MEASURING TRANSDUCER STRUCTURE AND OPERATION

3.1 According to the conversion method, Е 856ЭС and Е 857ЭС MT are classified to pulse-width modulation and demodulation transducer that provide galvanic separation of input and output circuits.

3.2 Terminal block clamps provide connection of copper or aluminium wires of a cross-section of 0.5 to 7.0 mm^2.

4 MARKING AND SEALING

4.1 The following shall be specified on a plate attached to a measuring transducer:

- Type and/or modification of the measuring transducer;
- Accuracy Class;
- Input signal measuring range and unit of measurement;
- Variation range, unit of measure and type of current of the output signal (В-1 symbol according to ГОСТ 30012.1-2002);
- Variation range and unit of measurement of load resistance;
- Input signal variation range and unit of measurement;
- Designation of the test voltage of the measuring circuit insulation with respect to the housing;
- Manufacture year and serial number according to the manufacturer's numbering system;
- Connection diagram and/or pin functions; Clamp polarity designation;
- Single mark of circulation of products on the market of the Member States of the Customs Union;
- Sign of the State Register of the Republic of Belarus;

- Manufacturer's name and/or trademark;
- Inscription with a symbol of the power supply type (B-2 symbol according to ГОСТ 30012.1-2002), rated values and units of measure for frequency, supply voltage and power consumed from the supply mains;
- Symbol of equipment protected by double or reinforced insulation (014 symbol according to ГОСТ 25874-83);
- IP20 enclosure protection;
- F-33 symbol according to ГОСТ 30012.1-2002 “Warning!”;
- Inscription "Made in Belarus".

4.2 MT have an QC Department brand and a verification brand on the housing at the points of attachment of the cover, and a sticker-brand on the surface of the measuring transducer.

5 ACCOMMODATION AND INSTALLATION

5.1 Electrical equipment of the building where a MT is installed shall include a protective device. When supplying:

From AC power supply with rated voltage 220 V and frequency 50 Hz, external fuse with operating current I_{nom}=32 mA and response time threshold values t_{min}=200 ms and t_{max}=10 s;

From a DC power supply with rated voltage 24 V, external fuse with operating current I_{nom}=250 mA and response time threshold values t_{min}=200 ms and t_{max}=10 s;

From a universal power supply, an external fuse with operating current I_{nom}=2 A and response time threshold values t_{min}=200 ms and t_{max}=10 s.

The protective device shall be located near the measuring transducer and be easily accessible to an operator. and marked as a measuring transducer power switch device.

5.2 Before commissioning of the MT, it shall be verified as specified in the МП.ВТ.043-2002 calibration procedure.

Intercheck interval shall be no more than 12 months when it is used in the legal metrology.

Recommended intercheck interval shall be no more than 48 months when it is used not in the legal metrology.

5.3 Marking of the attachment site shall be made in accordance with the mounting dimensions that are specified in Annex A.

5.4 Before installing the MT in the facility, the following shall be performed:

- Pull out and remove the terminal block that covers terminals for connecting to external circuits;
- Install the MT in a workplace and fasten it with two screws, putting a flat and spring washers under each screw.

5.5 External connections shall be made in accordance with the Wiring Diagram (Annex A).

5.6. Installation and operation shall be carried out in compliance with current regulations to ensure safe maintenance and operation of electrical installations.

5.7 The following actions shall be performed when installation is completed, before switching on the MT in the measuring circuit:

a) Check that parameters of the measured circuit match the MT input parameters;

b) Install the terminal block cover.

5.8 The following sequence of actions shall be performed when turning on the MT:

- Connect the load to the MT;
- Connect the power supply;
- Connect to the input source.

5.9. The technician who mounts a system is responsible for safety of any system in which a MT is included.

6 SAFETY MEASURES

6.1 Technicians that are allowed to work with MT shall be informed on both ТКП 181-2009 “Regulations for Operation of Consumer Electrical Installations” approved by the State Energy Supervision, and safety rules when working with installations up to 1000 V.

6.2 The following is not allowed:

a) Operating a MT in conditions and modes different from those specified in Sections 1-2 of this present Operation Manual;

b) Removing of the terminal block cover without prior instruction on electrical safety and obtaining written permission for routine maintenance;

c) Operating a MT with the terminal block cover removed, protecting against accidental contact with terminals for connection to dangerous voltage circuits;

d) Making external connections without disconnecting the input signal and power;

e) Operating a MT at breaks in the wires of external connection.

6.3 Hazard factor is supply voltage 220 V and input voltage up to 1000 V.

Protection measure against the hazard factor is checking insulation resistance.

In case of emergency conditions and operating modes, the MT shall be immediately disconnected.

6.4 Fire protection in the premises where inverters are operated shall be achieved by the following:

a) Using of automatic fire alarm systems;

b) Using of fire extinguishing agents;

c) Arrangement of timely notification and evacuation of people.

7 MAINTENANCE

Operational supervision of the MT operation shall be carried out by the persons assigned to the equipment.

7.1 Routine preventive inspection

Routine preventive inspection (PPO) shall be carried out in the time period provided for by the relevant consumer instructions.

Routine preventive inspection sequence:

- Disconnect all the MT voltages and currents;
- Make an external examination of the MT, remove dirt and moisture from the housing with a dry cloth;
- Remove the terminal block covers, make sure that there are no mechanical damages, check tightness of the clamps and fastening;
- Put the terminal block covers in place;
- Supply voltage and input signal.

8 TRANSPORTATION

8.1. During loading, unloading and handling it is necessary to act taking into account the requirements stipulated by handling signs "Top" and "Fragile. Handle with care" as specified

in ГОСТ 14192-96, which are applied on a shipping container.

8.2 Transportation of the MT can be carried out by rail and road.

8.3 If special conditions of transportation are required, they shall be specified in a supply agreement.

8.4 When transporting a MT by rail, use low-tonnage types of covered cars or universal containers according to ГОСТ 18477-79.

9 STORAGE RULES

9.1 The MT shall be stored in warehouses on racks in the manufacturer's packages at an ambient air temperature of 5 °C to 40 °C and a relative humidity of not more than 80%. No dust, gases and vapours that causes corrosion are allowed in storage rooms.

9.2 Storage facilities shall be equipped with automatic fire alarm systems and fire extinguishing equipment.

10 MANUFACTURER'S WARRANTY

10.1 The manufacturer guarantees conformity of the MT to provisions of ТУ РБ 300521831.001-2002 technical specifications, subject to conditions of operation, transportation and storage.

10.2 MT warranty service life is 48 months after the commissioning date.

10.3 MT warranty shelf life is 12 months after the manufacturing date.

11 MANUFACTURER ADDRESS

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210601 Vitebsk, st. S. Pankovoy 3, Energo-Soyuz LLC
Tel/fax (10375212) 67-72-77, 67-72-30; e-mail: energo@vitebsk.by
Sales department Tel/fax (10375212) 67-75-76, 67-75-80, 67-75-98, 67-75-78
e-mail: energo-soyz2@yandex.ru, energo1@ens.by

ANNEX A

OVERALL DIMENSIONS AND MOUNTING DIMENSIONS, WIRING DIAGRAMS

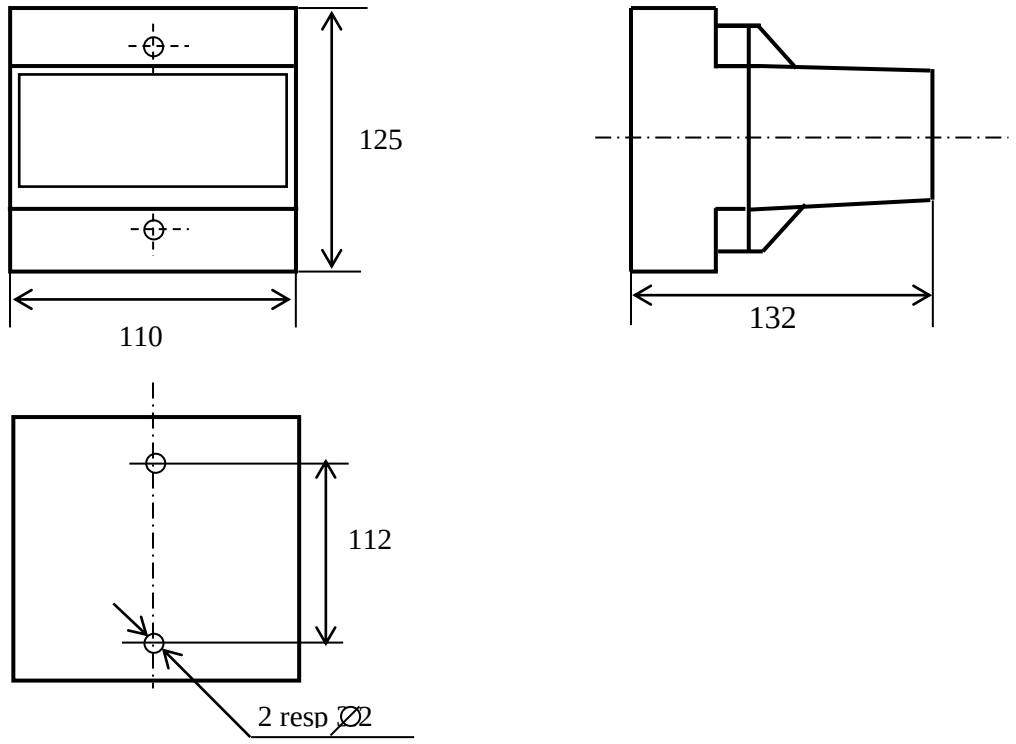


Figure A.1 - Overall dimensions and mounting dimensions

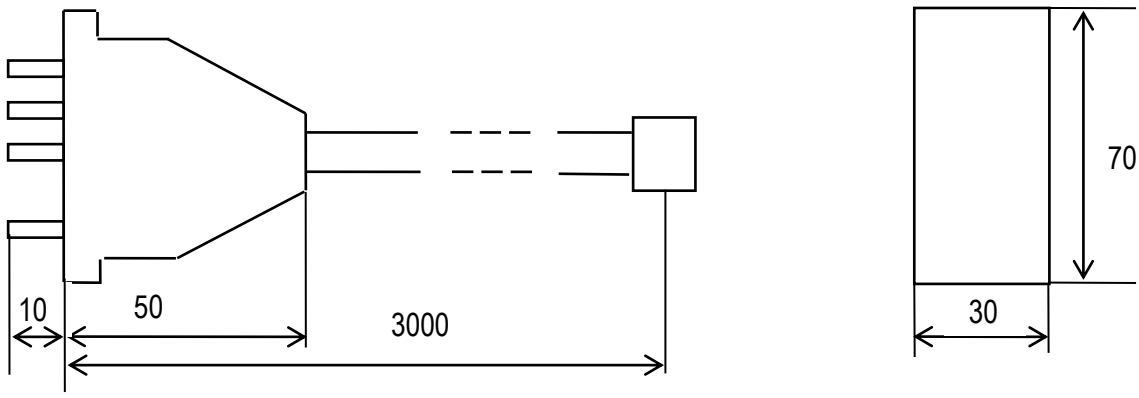


Figure A.2 - Cord dimensions

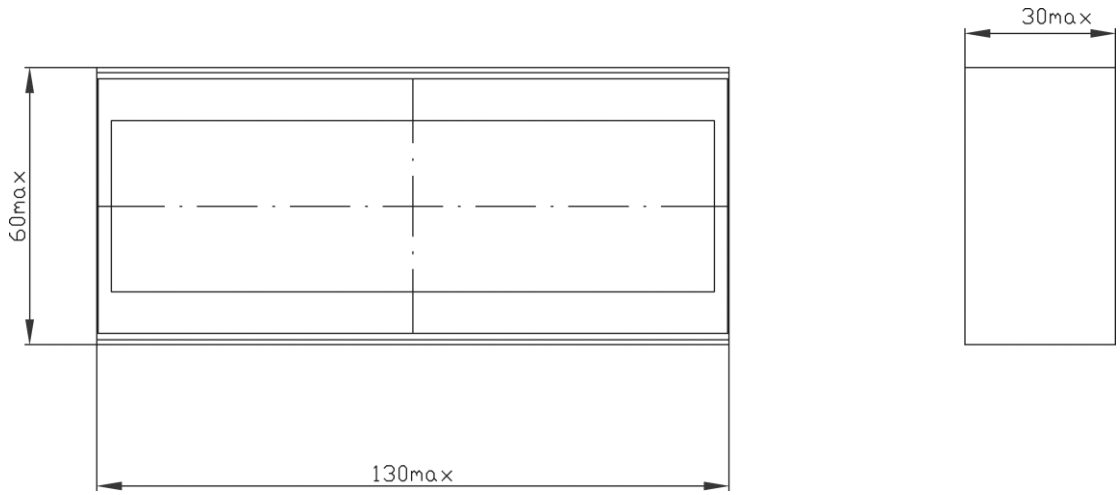


Figure A.3 - ПУ-25 display device overall dimensions

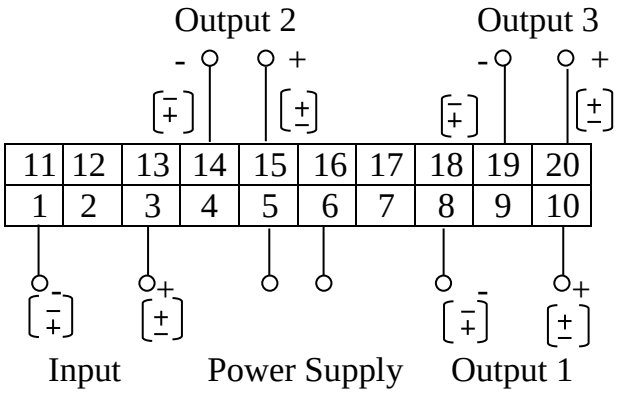


Figure A.3 - Single-channel measuring transducer electrical wiring diagram

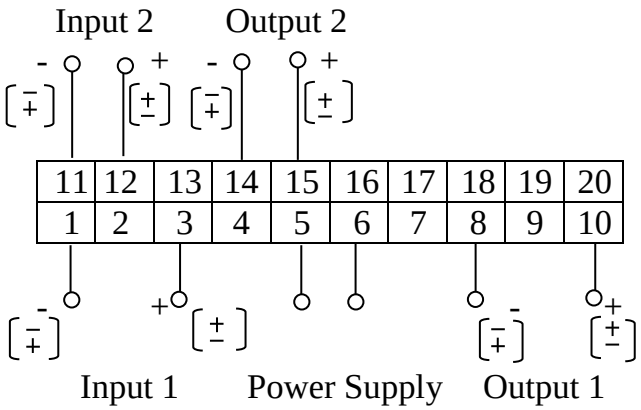
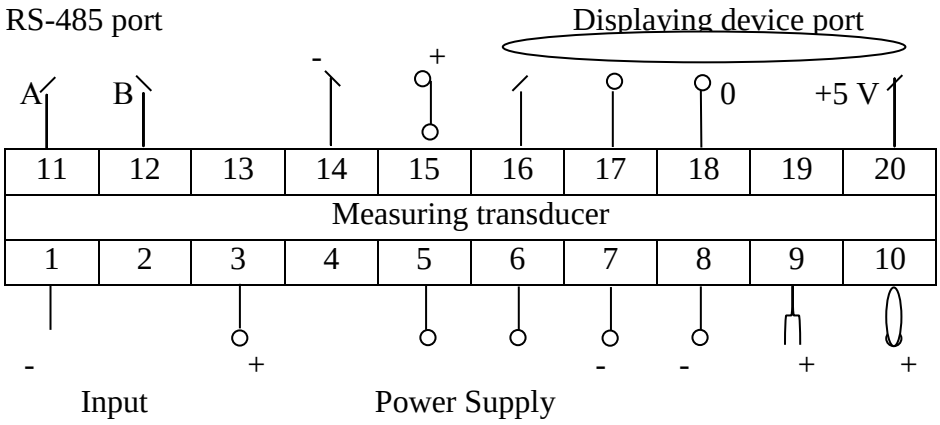


Figure A.4 - Two-channel measuring transducer electrical wiring diagram



Note - The first analog output - pins 8, 10;
The second analog output - pins 14, 15;
The third analog output - pins 7, 9;

Figure A.5 - Single-channel MT (-Ц modification) electrical connection diagram

ANNEX B

(for reference)

Description of the Communication Protocol

MODBUS communication protocol (RTU mode) is implemented in the product.

Sending format is 8 bits, no parity.

Default exchange rate is 9600 bauds.

Network number of the device can be set by a customer within 1 to 255. If the number is not specified when ordering, it is set to 255.

MODBUS functions supported by this device:
Function 1 - relay status reading;
Function 3 - setup register reading (4x - bank);
Function 4 - input register reading (3x - bank);
Function 6 - setting of a single setup register (4x - bank).

This protocol is implemented in a series of MT with built-in relays. However, it is necessary to take into account the fact that there are no built-in relays in MT E 856ЭС-Ц and E 857ЭС-Ц, therefore all references to their use for this product are not relevant.

Function 1 is designed to determine a state of the relays built into the device. Function 1 request format:

SLAVE	01	START	LENGTH	CRC

wherein

SLAVE address of the device requested (1 byte);
01 function code (1 byte);
START beginning address of the data requested (2 bytes, high-order byte and then low-order byte);
LENGTH amount of data requested (2 bytes, high-order byte and then low-order byte);
CRC Cyclical Redundancy Check.

The device will respond only if START = 0000h, and LENGTH = 0002h. If START and/or LENGTH are different from the above, the device generates an **exception** - “Wrong data address” (see exceptions).

Function 1 response format:

SLAVE	01	01	DATA	CRC

wherein

SLAVE address of the device responded (1 byte);
01 function code (1 byte);
01 amount of bytes of data transmitted (1 byte);
DATA relay status byte, where: 0 bit is the K1 relay status; bit 1 - K2 relay status; the remaining bits are always “0”;
CRC Cyclical Redundancy Check.

If a bit is set in the DATA field, then the corresponding relay is on.

Function 3 is designed to determine settings for this device. Function 3 request format:

SLAVE	03	START	LENGTH	CRC

wherein

SLAVE address of the device requested (1 byte);
03 function code (1 byte);
START beginning address of the data requested (2 bytes, high-order byte and then low-order byte);
LENGTH amount of data requested (2 bytes, high-order byte and then low-order byte);
CRC Cyclical Redundancy Check.

The device will respond only if START is in the range 0000h to 000Ch, and LENGTH is 0001h to 000Ch. The following shall be considered: START + LENGTH shall not be more than 000Ch. If START and/or LENGTH are outside the specified ranges, the device generates an **exception** - "Wrong data address".

Function 3 response format:

SLAVE	03	BYTES	DATA…	CRC

wherein:

SLAVE address of the device responded (1 byte);
03 function code (1 byte);
BYTES amount of bytes of data transmitted (1 byte);
DATA ... the actual data intended for exchange;
CRC Cyclical Redundancy Check.

Feature of this command is that double-byte data (WORD) is requested. The Table A.1 shows all the possible requested data with their addresses and lengths.

Table A.1

Data name	Data start address, words	Length of the data, words
Brightness code, comma position on the indicator	0000h	0001h
Rated input value	0001h	0002h
Exception threshold	0003h	0002h
Drop-off threshold	0005h	0002h
Measurement time	0007h	0002h
Relay delay time	0009h	0002h

The "brightness code" and "comma position on the indicator" are two functionally different bytes combined into one WORD to reduce length of the data requested. The high-order byte in a word is the brightness code, the low-order byte is the comma position on the indicator. Brightness code is a number 0 to 31, with 0 indicating absence of the indicator light, 31 is the maximum brightness. The device uses the following values: 11 - gradation 0; 15 - gradation 1; 21 - gradation 2; 31 - gradation 3. Comma position on the indicator byte determines a decimal place of the indicator where the decimal point is displayed. It can take values 0 to 3, and for a value of 0, a comma is displayed in the second digit from the left; 3 - comma is in the fifth the most extreme digit.

The "Rated value of the input signal" is a value that a device shows when a signal is supplied to its input that corresponds to the rated value of the input signal when directly turned on or a rated value of the primary current (voltage) of the measuring transformer when switched on via the measuring transformer. It can take values 00001 to 19999. Decimal point position is taken from the field Comma Position on the Indicator and has a similar interpretation.

A byte transmitted first corresponds to the high order.

The parameter is represented by four bytes that have the following structure:

First byte		Second byte		Third byte		Fourth byte	
0/1	X	0	X	0	X	0	X

wherein: X takes values 0 to 9.

The "Exception (Drop-off) threshold" is a threshold for triggering setpoints, which is expressed as a percentage of the rated value of the input signal. The parameter is represented as a binary-decimal unpacked code. The byte transmitted first corresponds to the high order. The decimal point position is always in the third digit. Possible values are within a range of "000.0" to "255.0" and can only be integers with plus or minus signs. Sign attribute in the decimal place. The plus sign is 0, the minus sign is 1.

The "Measurement Time" is a time in seconds that has elapsed from the moment the input signal changes until receipt of a new measurement result on the reading device with a normalized error. The parameter is represented as a binary-decimal unpacked code. The byte transmitted first corresponds to the high order. The decimal point position is always in the second digit. The parameter can take the following values: 01.00, 02.00, 03.00, 04.00.

The "Relay Trip Delay Time" is a time during which the relay trigger condition is rechecked. Data format is the same as the Measurement Time parameter. It can take values within the range of 00.5 to 10.00 and set with a resolution of 0.1 s.

Function 4 is designed to determine a type of a device requested and obtain a code corresponding to the input signal. **Function 4** request format:

SLAVE	04	START	LENGTH	CRC

wherein

SLAVE address of the device requested (1 byte);

04 function code (1 byte);

START beginning address of the data requested (2 bytes, high-order byte and then low-order byte);

LENGTH amount of data requested (2 bytes, high-order byte and then low-order byte);

CRC Cyclical Redundancy Check.

The device will respond only if START is in the range 0000h to 0001h, and LENGTH is 0001h to 0002h. The following shall be considered: START + LENGTH shall not be more than 0002h. If START and/or LENGTH are outside the specified ranges, the device generates an **exception** - "Wrong data address".

Function 4 response format:

SLAVE	04	BYTES	DATA…	CRC

wherein

SLAVE address of the device responded (1 byte);

04 function code (1 byte);

BYTES amount of bytes of data transmitted (1 byte);

DATA ... the actual data intended for exchange;

CRC Cyclical Redundancy Check.

Feature of this command is that WORDS are requested. The Table A.2 shows all the possible requested data with their addresses and lengths.

Table A.2

Data name	Data start address, words	Length of the data, words
Code of the device that is involved in the exchange	0000h	0001h
Code corresponding to the input signal	0001h	0001h

Code of the device participating in the exchange is a WORD in which distinctive features of the selected device are encoded. Table A.3 includes a description of the device code individual bits. If the corresponding bit is set, then assignment of this bit to the device is fair.

Table A.3

Bit number	Application
15	RMS current or voltage transducer
14	AC frequency transducer
13	Active power transducer
12	Reactive power transducer
11	Relay installed in the device
10	DC or voltage transducer
9	Analog output available
8	There is device support the PU
7	0 is OK, is fault.
1 – 6	Reserves
0	Always 0

Code corresponding to the input signal is a numerical value of this WORD, which is proportional to the magnitude of the signal applied to the device input. It can take values within the range minus 7600 to plus 7600. 5000 corresponds to the nominal value of the input signal. The data is presented lake int16.

Function 6 is intended for remote programming of device operation modes. **Function 6** request format:

SLAVE	06	START	DATA	CRC

wherein

SLAVE address of the device requested (1 byte);

06 function code (1 byte);

START is address of the register involved in exchange (2 bytes, the most significant and the least significant);

DATA is data written to the register (2 bytes, the most significant and the least significant);

CRC Cyclical Redundancy Check.

The device will respond only if START is within a range of 00h to 17h. Feature of this command is that the most significant and the least significant bytes of the START field shall match. Actually, the address is transmitted in the least significant byte, and the most significant byte just copies it (for reducing a random entry probability). If START is outside the specified range, the device generates an **exception** - “Wrong data address”.

Function 6 response format:

SLAVE	06	START	DATA	CRC

wherein

SLAVE address of the device requested (1 byte);

START is address of the register involved in exchange (2 bytes, the most significant and the least significant);

DATA is data written to the register (2 bytes, the most significant and the least significant);

CRC Cyclical Redundancy Check.

Another feature of this command is that BYTES are written, not WORDS. In this case, the upper part of DATA field includes a sign of saving of all possible data in the device non-volatile memory. If the high byte of the DATA field includes 0xFF byte, then its low byte is placed in the device memory at the address specified by the START field. If the high and low bytes of the DATA field match, then all the registers are recorded in the Flash memory of the device, after which the device is automatically restarted with new values. If you need to write 0xFF data byte and do not yet need to save it to the Flash memory, then the high byte of the DATA field shall be equal to 0xFE. Table A.4 below includes all possible registers with their addresses.

Table A.4.

Register address in the device	Register assignment	Register length, byte
0000h	Brightness code	1
0101h	Position of the comma on the screen	1
0202h…0505h	The current (voltage) value displayed on the PU corresponds to the rated value of the input signal	4
0606h…0909h	Exception threshold	4
0A0Ah…0D0Dh	Dropoff threshold	4
0E0Eh…1111h	Measurement time	4
1212h…1515h	Relay delay time	4
1616h	Exchange rate code	1
1717h	Network number	1

Purpose of the first seven registers is the same as in function 3. The last two allow you to determine an exchange speed and a network number when working in the network.

Possible network number values are 1 to 255.

When manufacturing, the speed is set at 9600. Network number is 255.

Exceptions

If an incorrect command comes or an error is detected in the CRC field during operation, the device does not respond.

If a command received with incorrect data or an incorrect address during operation, the device responds in a special way.

Exception response format:

SLAVE	0x80|CMD	02	CRC

wherein

SLAVE address of the device requested (1 byte);

0x80 | CMD function code that detected an error with the high bit set;

02 error code "Invalid address or data";

CRC Cyclical Redundancy Check.

Change Log

No. of change	Numbers of sheets (pages)				Sheets, total (pages) in the doc.	Docu-ment No	Your applied document Ref. No. and date	Signa-ture	Date
	changed	substituted	new	cancelled					

						Sheet
6	Dep	УИМЯ.016-2020		31.08.20	СКЮИ.411600.001РЭ	11
Rev.	Sheet	Doc. No.	Sign.	Date		

Reg. No. Orig	Signature and Date	Repl. Reg. No.	Reg. Orig.	Signature and Date