

**THREE-PHASE VOLTAGE
MEASURING TRANSDUCER
E4855**

Operation manual

49501860.3.019 PЭ

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ATTENTION! TRANSDUCER HAS A SAFETY SYMBOL SHOWING THAT SPECIFIC WARNING OR CAUTION INFORMATION IS GIVEN IN A MANUAL, TO DEFINE CHARACTER OF POTENTIAL DANGER AND PRECAUTIONS

This operation manual contains information for using Three-phase voltage measuring transducer E4855 (further – the transducer) and information on packing, transportation and storage.
Read this manual before operation.

1 Description and operation

1.1 General information

The transducer is intended for linear conversion of line-to-line or line-to-neutral voltages in four-wire and three-wire electrical networks of a three-phase current by frequency of 50 Hz into three unified output signals of a DC. The transducer can be applied in dispatch control systems of installations of electric power industry and various industries.

The transducer corresponds to engineering factors TY 4227-009-49501860-02.

The transducer is produced of following modifications:

- A – output current range from 0 to 5 mA;
- B – output current range from 4 to 20 mA;
- C – output current range from 0 to 20 mA.

The transducer is fulfilled without a galvanic coupling between input and an output circuit.

The transducer is mounted on the rails TH-35 ГОСТ Р МЭК 60715-2003 or immediately on the panel.

Transducer power supply is carried out from a network alternating current network by voltage 220 V by frequency of 50 Hz.

The transducer is a product of the third order in accordance with ГОСТ 12997.

The transducer is a product of the ordinary version by immunity from environmental attack.

Guard level: IP00 (ГОСТ 14254-96, МЭК 529-89).

Climatic category: УХЛ3 (ГОСТ 15150-69).

Environmental conditions - Group C4 (ГОСТ 12997-84):

- Ambient air temperature - 30 to 50 °C;
- Relative humidity at 35 °C..... up to 95 %;

Atmospheric pressure – Group P1 (ГОСТ 12997-84): 84 – 106 kPa (630 – 800 mm Hg);

Vibration and Shock: Group N2 (ГОСТ 12997-84):

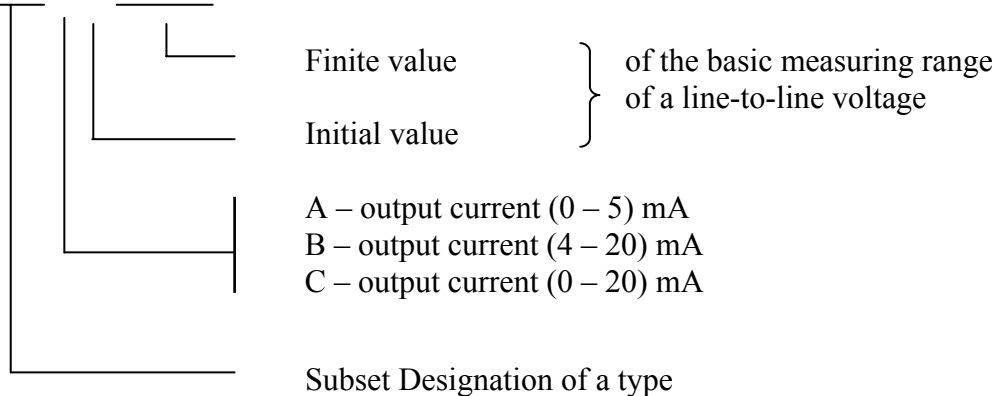
Reference conditions relative to each of the influence quantities are given in table 1.

Table 1 – Reference conditions of the influence quantities and tolerances or testing purposes

Influence quantity	Reference conditions (reference range)	Tolerances permitted for testing purposes applicable to a single reference value
Ambient Air Temperature	20 °C	± 5 °C
Relative Humidity	30 ... 80 %	
Atmospheric pressure	84 ... 106 kPa (630 ... 800 m Hg)	
Auxiliary A.C. supply	220 V	± 4,4 V
Frequency of the Auxiliary supply	50 Hz	± 0,5 Hz
Waveform of the Auxiliary supply	Sinusoidal	Distortion factor shall not exceed 5%
Location	Soever	
Magnetic field of external origin	Earth's magnetic field	
Frequency of the input quantity	50 Hz	± 1 Hz
Waveform of the input quantity	Sinusoidal	Distortion factor shall not exceed 5%
Load resistance E4855A E4855B, E4855C	2500 Ω 250 Ω	±500 Ω ±50 Ω

Instance of the denotation of the transducer:

Transducer E4855A-0-125·√3 TY 4227-009-49501860-02



1.2 Technical data

1.2.1 Transducer provides linear conversion of True RMS values of line-to-line or line-to-neutral voltages of a three-phase three-wire system into three direct current output signals according to table 2.

1.2.2 Limits of a permissible intrinsic error are $\pm 0,5$ % of a fiducial value. Upper value of input signal range is taken as a fiducial value.

1.2.3 Setup time of performance is no more than 10 minutes after turning on of the transducer.

1.2.4 Variations from influencing magnitudes correspond to table 3.

1.2.5 The transducer satisfies to requirements 1.2.2:

- on expiring a setup time of performance;
- at auxiliary supply voltage fluctuating from 187 up to 242 V;
- at grounding one of output contacts;
- under effecting sine-wave vibrations in a frequency band from 10 up to 55 Hz with displacement amplitude 0,35 mm.

1.2.6 Output current ripple amplitude is no more than 0,2 %.

1.2.7 Setting time of output signal is no more than 0,5 s.

1.2.8 The transducer withstands 120 % overload by an input voltage during 2 hours.

Output current, when overloading, is no more:

- for modification A 5,5 mA;
- for modifications B and C 21 mA.

1.2.9 Transducer withstands against short-term overloads by an input voltage according to ГОСТ 23855-81.

1.2.10 Transducer withstands a durable break of a load circuit without failures.

An output voltage at a break of a load circuit is no more than 25 V.

1.2.11 Consumption current for each measuring circuit is no more than 1 mA.

1.2.12 Power supply consumption is no more than 6 V·A.

1.2.13 Isolation of all circuits with external terminals concerning the case, between input circuits and the supply circuit, between input and output circuits withstands a testing voltage of practically sine-wave shape by frequency from 45 to 65 Hz according to table 4 during 1 min.

Isolation between output circuits and the supply circuit withstands a testing voltage of practically sine-wave shape by frequency from 45 to 65 Hz during 1 min:

- 2,5 kV RMS - in application reference conditions;
- 1,5 kV RMS - to 95 % R.H. at 35 °C.

1.2.14 Isolation between different outputs withstands a testing voltage of practically sine-wave shape by frequency from 45 to 65 Hz during 1 min:

- 0,5 kV RMS - in application reference conditions;
- 0,3 kV RMS - to 95 % R.H. at 35 °C.

Table 2

Identification	Type's modification	Range of Voltage, V		Output DC range, mA	Load resistance range, Ω
		Line-to-neutral, U_A, U_B, U_C	Line-to-line, U_{AB}, U_{BC}, U_{CA}		
49501860.3.019	E4855A	0 – 125 (75 – 125)	0 - 125· $\sqrt{3}$ (75· $\sqrt{3}$ - 125· $\sqrt{3}$)	0 - 5	0 – <u>2000</u> - 3000
-01		0 – 250 (150 – 250)	0 - 250· $\sqrt{3}$ (150· $\sqrt{3}$ - 250· $\sqrt{3}$)		
-02		0 – 400 (240 – 400)	0 - 400· $\sqrt{3}$ (240· $\sqrt{3}$ - 400· $\sqrt{3}$)		
-03	E4855B	0 – 125 (75 – 125)	0 - 125· $\sqrt{3}$ (75· $\sqrt{3}$ - 125· $\sqrt{3}$)	4 – 20	0 – <u>200</u> – <u>300</u> - 500
-04		0 – 250 (150 – 250)	0 - 250· $\sqrt{3}$ (150· $\sqrt{3}$ - 250· $\sqrt{3}$)		
-05		0 – 400 (240 – 400)	0 - 400· $\sqrt{3}$ (240· $\sqrt{3}$ - 400· $\sqrt{3}$)		
-06	E4855C	0 – 125 (75 – 125)	0 - 125· $\sqrt{3}$ (75· $\sqrt{3}$ - 125· $\sqrt{3}$)	0 – 20	0 – <u>200</u> – <u>300</u> - 500
-07		0 – 250 (150 – 250)	0 - 250· $\sqrt{3}$ (150· $\sqrt{3}$ - 250· $\sqrt{3}$)		
-08		0 – 400 (240 – 400)	0 - 400· $\sqrt{3}$ (240· $\sqrt{3}$ - 400· $\sqrt{3}$)		
-18	E4855A	0 – 125 / $\sqrt{3}$ (75 / $\sqrt{3}$ – 125 / $\sqrt{3}$)	0 – 125 (75 – 125)	0 – 5	0 – <u>2000</u> - 3000
-19	E4855B	0 – 125 / $\sqrt{3}$ (75 / $\sqrt{3}$ – 125 / $\sqrt{3}$)	0 – 125 (75 – 125)	4 – 20	0 – <u>200</u> – <u>300</u> – 500
-20	E4855C	0 – 125 / $\sqrt{3}$ (75 / $\sqrt{3}$ – 125 / $\sqrt{3}$)	0 – 125 (75 – 125)	0 – 20	0 – <u>200</u> – <u>300</u> – 500
Remarks 1 Line-to-line measurement mode is installed by a crosspiece between contacts 6 and 7. 2 Additional measuring range in brackets is installed by a crosspiece between contacts 7 and 8. 3 Normal value area of load resistance range is underlined.					

Table 3

Name of influencing magnitude	Value of influencing magnitude	Variation of the fiducial value, %	
Ambient temperature	From a minus 30 to 50 °C	± 0,4 for everyone 10 °C	
Relative Humidity	95 % at temperature 20 °C	± 0,5	
	95% at temperature 35 °C	± 0,9	
Frequency of an input signal	45 to 65 Hz	± 0,25	
External magnetic field of frequency 45 ... 65 Hz by strength	to 400 A/m	± 0,5	
Load resistance, Modification A	From 0 to 2000 Ω	± 0,25	
	Modifications B and C	From 0 to 200; above 300 to 500 Ω incl.	± 0,25
			± 0,25

Table 4

Finite value of the measuring range, V (line-to-line voltage)	Testing voltage, kV RMS	
	Test conditions	
	Reference condition	95 % Relative Humidity at 35 °C
125; 125·√3; 250·√3	2,5	1,5
400·√3	3,5	2,0

1.2.15 Electrical insulation resistance of circuits specified in 1.2.13, 1.2.14 is not less:

- 40 MΩ - in reference conditions;
- 10 MΩ - to 80 % R.H. at 50 °C;
- 2 MΩ - to 95% R.H. at 35°C.

1.2.16 Overall dimensions: 120x80x77 mm.

1.2.17 Weight: 0,6 kg.

1.3 Construction

General Form of the transducer is presented in Annex A.

Transducer has the following parts:

- Case;
- Cover;
- Input card;
- Three output cards;
- Supply transformer;
- Latch.

The contacts installed on a cover ensure the mount of the input card and also the electric contact of printed conductors of an input card to bringing wires.

The electrical connection of output cards with an input card is made by means of contacts.

The cover is mounted to the case through four self-rifled screws, which can be sealed up.

The latch ensures mounting the transducer to the rail or panel depending on variant of installation.

1.4 Functional description

The transducer is the device with digital machining of signals. Transducer Block Diagram is presented in Figure 1.

The input part consists of input stages BK1 – BK3 at which measured signals arrive, analog-to-digital converter (ADC) and computational part (microcontroller).

The cascades BK1 – BK3 are scaling amplifiers and have immediate galvanic coupling with measuring circuits. Input cascades will convert input voltage signals into proportional output voltages that are transmitted to inputs of four-channel ADC.

The discrete sampling of input signals and the converting to 10-discharge parallel binary code are yielded in ADC.

Parallel binary code is acting on input ports of a microcontroller.

The microcontroller receives the data simultaneously through tree channels about instantaneous value of the input signal with sampling rate 3200 Hz. The microcontroller's operation mode is installed by the crosspiece "U_{L-L} / U_{L-N}".

When the "U_{L-N}" mode is using (the crosspiece is absent), the transducer calculate three RMS values of line-to-neutral voltages. When the "U_{L-L}" mode is using (the crosspiece is established), the transducer calculate three RMS values of line-to-line voltages.

The choice of the additional measuring range (truncated scale) is installed by the crosspiece «ДЮП» (additional).

When the crosspiece «ДЮП» is missed, the transducer is being under basic mode (full scale).

Evaluation values (U₁, U₂, U₃) as serial binary code arrive at microcontroller's output ports and transits through optocouplers to output channels of the transducer.

Transducer output channels are identical; each of them includes following parts: an optocoupler (for galvanic isolation support), a digital-to-analog converter (DAC); a matching output cascade (BCK).

DAC is carried out by a principle of sigma-delta transformation. DAC is implemented on a microcontroller and includes the following parts: an adder, an integrator, a comparator.

The input code N_{DAC} arrives at the adder, where some value (N_H or N_L, depending on a condition of the comparator) is subtracted from its value. The result of a subtraction N_c moves to an integrator input. The comparator compares output value of the integrator (N_и) to threshold value and changes the condition, depending on result of comparison. The comparator drives the CMOS-structure of microcontroller's output port thus, that it connects an output bus to a power bus (U_{cc}), or to a common wire.

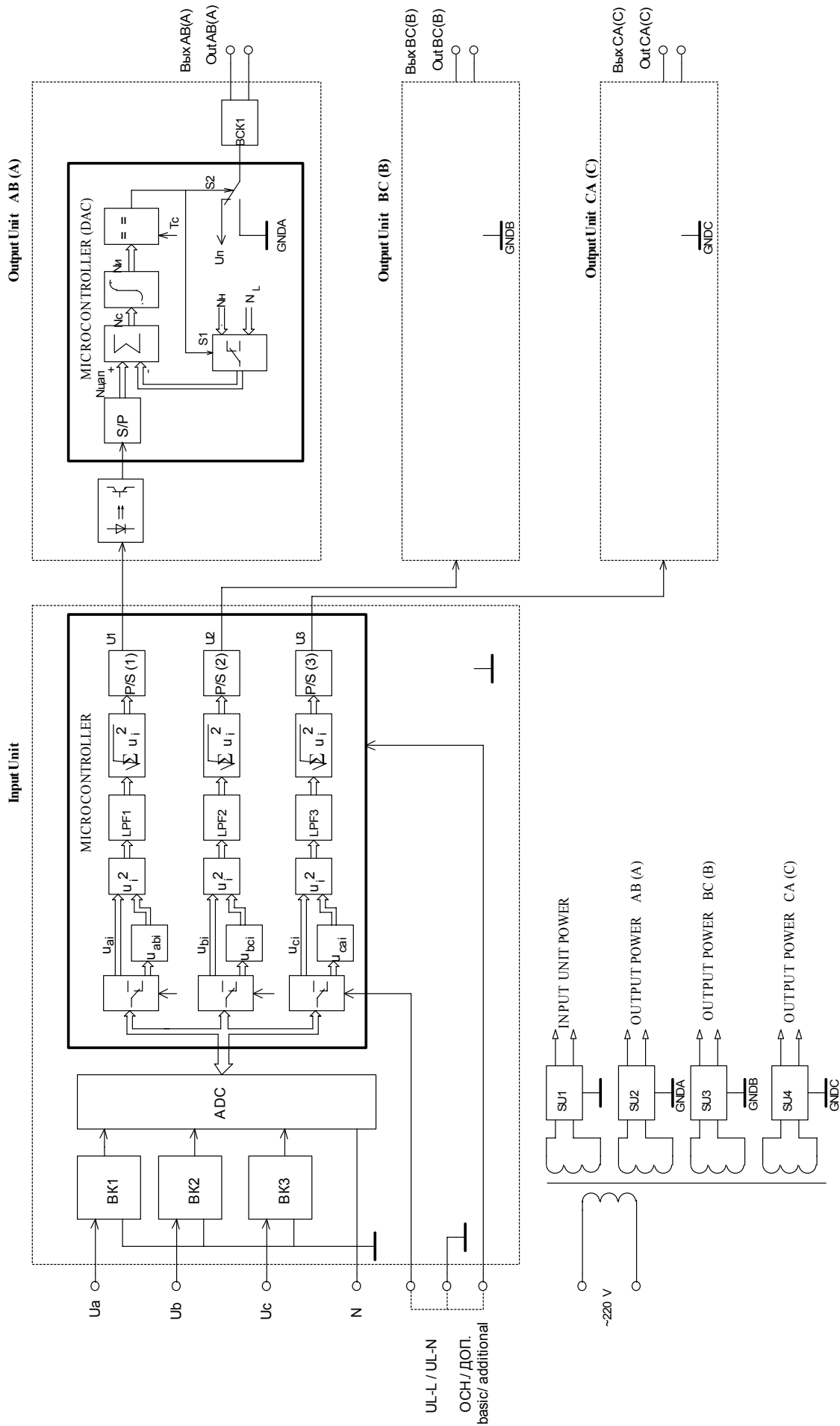


Figure 1. Transducer Block Diagram

The DAC works in discrete instants with sampling interval T_d and represents the system with negative feedback which supports averaged for anyone major time interval ($T_a \gg T_d$) value on the integrator output equal to response level of the comparator.

Thus voltage average for an interval T_a on the DAC output is defined by formula:

$$U_{DAC} = U_{CC} \cdot \left(1 - \frac{N_{DAC} - N_L}{N_H - N_L}\right), \quad (1)$$

Voltage U_{dac} is proportional to an input code N_{DAC} and depends on it linearly.

DAC output voltage arrives at matching output cascade with the low-pass filter, where it is flattened and will be translated to transducer's output current.

Coefficients N_H and N_L are erected so that the value of an output current of the transducer is equaled:

- initial value of a range if $N_{DAC} = 0$;
- finite value of a range if $N_{DAC} = 2^{12} - 2$.

Meanings of coefficients N_H and N_L are recorded in non-volatile memory of the microcontroller.


Precision circuits are applied to a stabilization of supply voltage of the microcontrollers of an input and output parts.

Transducer customization is carried on by electronic way through a technological connector.

1.5 Marking and sealing

1.5.1 The following information is marked on a cover of the transducer:

- Symbolic representation of the transducer;
- Manufacturer trade mark;
- Measuring range of the line-to-line voltage (basic and additional);
- Nature of the measurand and number of circuits;
- Frequency range of the input signal;
- Range of values of the output current;
- Range of values of the output load with marked reference range;
- Overvoltage category;
- Designation of intrinsic error;

- Symbol  ;

- Designation of numbers, polarity and assignment of contacts;
- Serial number and two last digits of Issue Year.

1.5.2 Sealing of the transducer is yielded with a bitumen mastic №1 (according to ГОСТ 18680-73) applies on one of four located on a cover screws.

1.6 Packing

1.6.1 The Transducer is delivered in transport container.

1.6.2 In transport container there is:

- Operation manual (1 copy on everyone 50 transducers or on separate delivering);
- Packing leaf.

1.6.3 The transducer is packaged into individual packing.

The passport is inserted inside the individual packing.

2 Uses to assignment

2.1 Operational constraints

2.1.1 Transducer is not intended for operation in the conditions of explosive and hostile environment.

2.1.2 The transducer should not be exposed to direct heating up to temperature more than 50 °C. Indoors there should not be sharp fluctuation of temperature. Near to a transducer setting point there should not be sources of strong electromagnetic fields.

2.2 Preparation for use

2.2.1 1 When you received the transducer from a warehouse, check the integrity of packing. Unpack it. Pull out the transducer. Make external survey. Make sure that any visible mechanical injuries are missing. Check completeness presence according to table 5.

Table 5

Name and nomenclature	Quantity
Transducer	1
Three-phase voltage measuring transducer E4855. Operation manual	1 *
Three-phase voltage measuring transducer E4855. Passport	1
Individual package	1
Latch	1 **
* It is applied on quantity 50 transducers or to the separate delivery	
** Set on the case	

2.2.2 Check the information on a cover of the transducer on correspondence to demanded parameters.

2.3 Use

2.3.1 All operations on mounting and maintenance to make with observance of the acting rules providing safety service and maintenance of electrical installations.

2.3.2 ATTENTION! THE AUTOMATIC SWITCH OR THE SWITCH PLACED IN IMMEDIATE PROXIMITY FROM THE TRANSDUCER SHOULD BE INCLUDED IN INSTALLATION OF BUILDING WIRING. THE SWITCH SHOULD BE IDENTIFIED AS THE DISCONNECTING DEVICE FOR THE TRANSDUCER.



2.3.3 Installation of the transducer on plant

2.3.3.1 When mounting the transducer *on the rail*:

- place a latch according to figure B.1 to link the protuberances of a case to edge of the rail;
- push a case up to its fixing.

The mounting of the transducer on the rail is supposed at mount the rail on a horizontal or vertical plane.

When the rail is mounted on the vertical plane, its distortion from a horizontal position should not be more than 15°.

2.3.3.2 When mounting the transducer *on the panel*:

- fix a latch on the panel with the help of two screws according to figure B.2;
- pull the transducer over a latch against the stop.

Use two screws with a diameter 4 mm to fasten a latch on the panel. Screws should not overhang a mounting plane of the latch.

When mounting the transducer on a latch it is necessary to provide on object a place not less than 15 mm for initial fixing of the transducer.

2.3.4 Fix exterior conductive wires on terminals according to the diagram of transducer connections, which is located in the Annex C.

2.3.5 Install the crosspiece between contacts 7 and 8 for use in an additional measuring range (truncated scale mode).

When the crosspiece «ДЮП» is missed, the transducer is being under basic mode (full scale mode).

2.3.6 Install the crosspiece between contacts 6 and 7 for use in the «U_{L-L}» mode (measuring of line-to-line voltages).

When the crosspiece «U_{L-L} / U_{L-N}» is missed, the transducer is being under «U_{L-N}» mode (measuring of line-to-neutral voltages).

2.3.7 Verify the correspondence of output parameters of a radiant of a signal to data-ins of the transducer. Verify quality of wiring.

2.3.8 Turn on supply voltage 220 V on the transducer.

2.3.9 Turn on input signals on the transducer.

2.4 Operation in extreme conditions

2.4.1 In case of origination of emergency conditions, you should turn out the transducer immediately.



The switch or automatic switch should be used for cutting off.

3 Maintenance and repair

3.1 Common directions

3.1.1 The operational supervision of operation of transducers should be manufactured by persons, which have the responsibility for this equipment.

The transducer should not be opened during operation.

3.1.2 The manufacturer eliminates all defects originating during operation.

3.2 Safety

3.2.1 Operations on maintenance should be fulfilled by qualified personnel.

3.2.2 The Transducer correspond to ГОСТ Р 52319-2005 (МЭК 61010-1:2001).

Insulation class is primary. Pollution degree is 2. Overvoltage category III.

3.2.3 IT IS FORBIDDEN: TO CHANGE EXTERNAL CONNECTIONS, WHEN INPUT SIGNALS AND SUPPLY VOLTAGE ARE AVAILABLE IN THE TRANSDUCER.



3.3 Order of maintenance

3.3.1 It is recommended quarterly to carry out routine inspection in field. For this purpose:

- to turn input signals and supply voltage off;
- to delete from the case a dust;
- to test a condition of the case; to be convinced of absence of mechanical failures; to test a condition of mounting;
- to turn on a supply voltage and input signals on the transducer after the termination of survey.

3.3.2 If the transducer is mounted on the rail you can carry demounting by release of a latch by a screwdriver inserted into a recess in the bottom of the case.

3.4 Metrology monitoring

3.4.1 To confirm real values of the metrology characteristics and fitness of the transducer to application, they can be exposed to calibration according to the document 49501860.3.019 МП «Преобразователи измерительные напряжения трехфазного тока Е3855, Е4855. Методика поверки» («Three-phase voltage measuring transducers E3855, E4855. Calibration procedure»), which was matched with ВНИИМС (Russian Research Institute for Metrological Service).

The transducer should be calibrated on a 2-year interval determined by the requirements of this document.

4 Storage

4.1 Before introduction in operation the transducers should be stored in storehouses according to ГOCT 12997-84.

4.2 Storage conditions for transducers in transport container:

- Ambient Air Temperature 5 to 40 °C;
- Relative Humidity at 25 °C up to 80 %.

4.3 Storage conditions for transducers in individual packing:

- Ambient Air Temperature 10 to 35 °C;
- Relative Humidity at 25 °C up to 80 %.

4.4 The contents of a dust, steams of acids and alkalis, aggressive gases and other harmful admixtures calling corrosion should not exceed the contents of the corrosion-active agents for the atmosphere of a type 1 (ГOCT 15150-69).

5 Transportation

5.1 The transducers in transport container can be transported in the closed vehicles of any type. When air transporting, the transducers should be disposed in heated hermetic bays.

5.2 Values of climatic and mechanical effects on the transducer at transportation should be in limits:

- Ambient Air Temperature - 50 to 55 °C;
- Relative Humidity at 35 °C up to 95 %;
- Atmospheric pressure, kPa (mm Hg) 84-106 (630-800).
- Impacts with peak shock acceleration..... 98 m/sec².

**Annex A
(informative)**

General form of the transducer

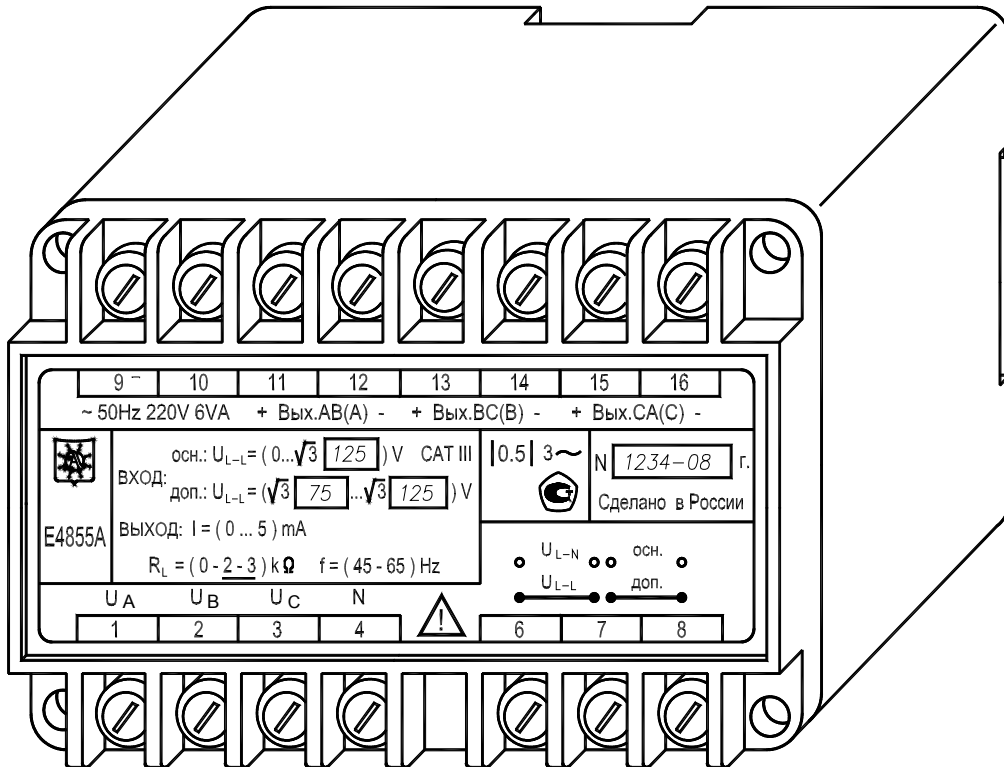


Figure A.1

Annex B (informative)

Variants of transducer mounting

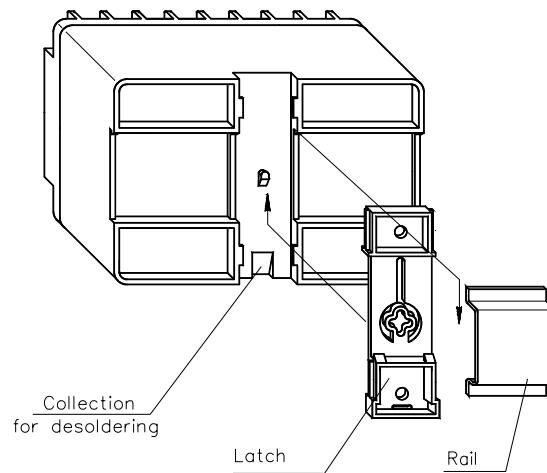


Figure B.1 Mounting of the Rail

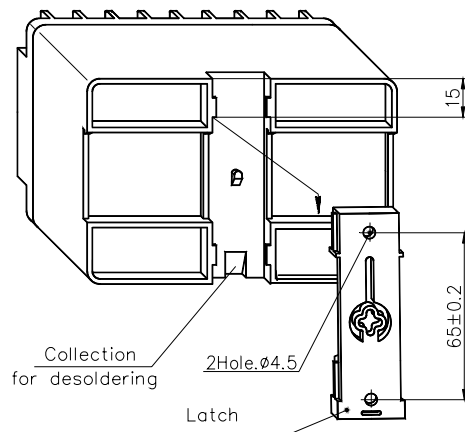


Figure B.2 Mounting of the Panel

Annex C (informative)

Diagrams of transducers connection

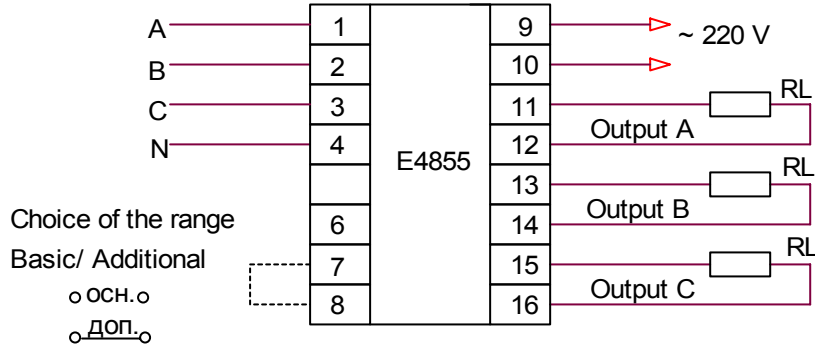


Figure C.1 Four-wire circuit. Line-to-neutral measuring mode

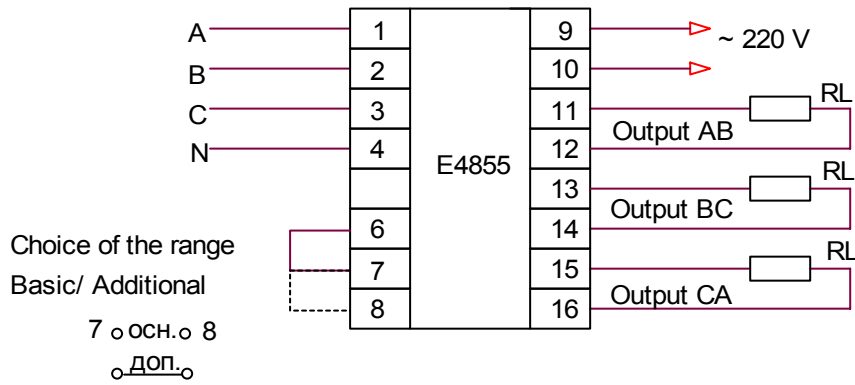


Figure C.2 Four-wire circuits. Line-to-line measuring mode

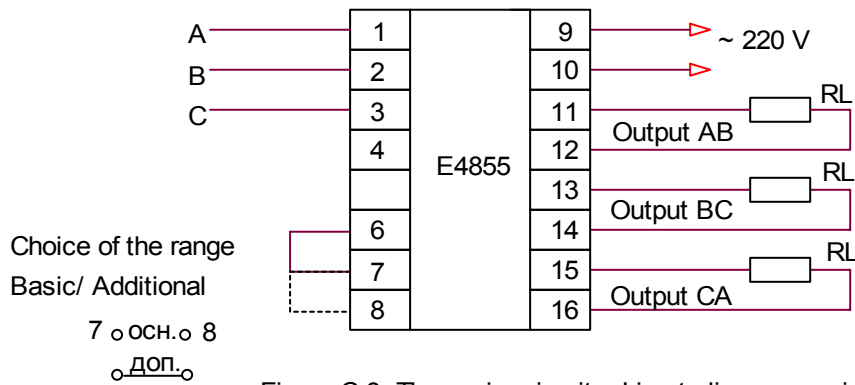


Figure C.3 Three-wire circuits. Line-to-line measuring mode