

**FREQUENCY-TO-CURRENT CONVERTER  
E858**

**Operation manual**

**49501860.3.006 PЭ**

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**WARNING! CONVERTER HAS A SAFETY SYMBOL SHOWING THAT SPECIFIC WARNING OR CAUTION INFORMATION IS GIVEN IN MANUAL, TO AVOID PERSONAL INJURY OR EQUIPMENT DAMAGE.**

This operation manual contains information for using and operating Frequency-to-current Converter E858 (further - Converter) and information on calibration procedure, packing, transportation and storage.

Read this manual before operation.

## 1 Description and operation

### 1.1 General Information

Converter is manufactured in accordance with engineering factors TY 4227-010-49501860-2004. Converter is intended for linear converting frequency input signals to industry standard signals of:

- from 0 up to 5 mA for E858A;
- from 4 up to 20 mA for E858B;
- from 0 up to 20 mA for E858C.

Average value of the output signal carries an information.

Converter can be applied to frequency monitoring of electrical systems, in the equipment of technical diagnostics, for an integrated automation of plants of power engineering.

Converter can work in six frequency ranges of measurement. The input frequency range is sampled by means of exterior jumpers or in a condition of remote control.

Converter is SSI product of the third order according to ГOCT 12997-84.

Depending on a rated voltage the Converter can be produced of two variants:

- Index 1 – with rated voltage 100 V;
- Index 2 – with rated voltage 220 V.

Power supply is from measuring circuit.

Converter is single-channel hardware product without galvanic link between input and output circuit.

Converter can be mounted on the rail TH-35 in accordance with ГOCT P MЭK 60715-2003 or immediately on the panel.

Guard level IP00 (ГOCT 14254-96, MЭK 529-89).

Climatic category – YXJ3.1 (ГOCT15150-69).

Operating Environment: Group C4 (ГOCT 12997-84):

- Ambient Air Temperature ..... - 40 to 60 °C;
- Relative Humidity at 35 °C ..... up to 95 %;
- Atmosphere pressure, kPa (mm Hg) ..... 84-106 (630-800).

Stability to influence of sine wave vibrations: Group N2 (ГOCT 12997-84).

Standard conditions for use correspond to Table 1.

Table 1

Name of influencing magnitude	Standard value	Admitted deviation from standard value
Ambient Air Temperature	20°C	± 5°C
Relative Humidity	30 to 80 %	
Atmosphere pressure	84 to 106 kPa (630 to 800 mm Hg)	
Orientation	Any	
External magnetic field	Magnetic field of the Earth	
Input Voltage E858A1, E858B1, E858C1 E858A2, E858B2, E858C2	100 V 220 V	± 2,0 V ± 4,4 V
Input signal waveform	Sinusoidal	Percent of harmonic distortion < 5%

Example of a designation of the converter:

Converter E 8 5 8 A 1 TY 4227-010-49501860-2004

Designation of a type

Designation of variant:

1 – rated voltage 100 V

2 – rated voltage 220 V

## 1.2 Characteristics

1.2.1 Converter ensures conversion of an input signal frequency to direct current output signal according to Table 2.

Table 2

Type's modification	Rated voltage, V	Frequency range, Hz	Output DC range, mA	Load resistance range, $\Omega$
E858A1	100	49-51	0 – 5	0 – 3000
E858A2	220	48-52	0 – 5	
E858B1	100	45-55	4 – 20	0 – 500
E858B2	220	59-61	4 – 20	
E858C1	100	58-62	0 – 20	0 – 500
E858C2	220	55-65	0 – 20	

1.2.2 The input frequency range is sampled by installation of exterior jumpers or in a condition of remote control.

Conditions of range select inputs correspond to Table 3.

Table 3

Frequency range, Hz	Conditions of range select inputs		
	Input 5	Input 6	Input 8
49 - 51	0	1	1
48 - 52	1	0	1
45 – 55*	1	1	1
59 - 61	0	1	0
58 - 62	1	0	0
55 - 65	1	1	0

\* Basic range  
**Note** - “1” – free input, or the voltage of a high logic level concerning contact 7 is sent on it;  
“0” – the input is connected to input 7, or the voltage of a low logic level concerning contact 7 is sent on it

1.2.3 The electrical parameters of range select inputs correspond to Table 4.

Table 4

Name of parameter	Value		Note
	min	max	
Voltage on the input at break contacts ( $U_b$ )	4,8 V	5,2 V	concerning contact 7
Input Low Voltage	-0,3 V	0,8 V	concerning contact 7
Input High Voltage	2,4 V	$U_b + 0,3$ V	concerning contact 7
Input Low Current (implying)	–	0,4 mA	when Input Low Voltage is 0,4 V

The additional information on use of converter in a condition of remote control is given in an Annex A.

1.2.4 Limits of the intrinsic error are  $\pm 0,02\%$  of the fiducial value.

Upper value of input frequency range is taken as a fiducial value.

1.2.5 Set-up time of performance is 15 min.

1.2.6 Variations from influencing magnitudes given in Table 5.

Table 5

Name of influencing magnitude	Value of influencing magnitude	Variation, % of the fiducial value
Ambient Air Temperature	- 40 to 60 °C	±0,02 on 10 °C of temperature variation
Relative Humidity	to 95% at 20 °C to 95% at 35 °C	± 0,02 ± 0,04
External magnetic field of frequency 45-65 Hz by strength	to 400 A/m	± 0,04
Input Voltage		
E858A1, E858B1, E858C1	85 – 115 V	± 0,01
E858A2, E858B2, E858C2	187 – 253 V	± 0,01

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

1.2.8 Transient time of output signal at remote switching of a range is 0,5 s.

1.2.9 The converters satisfy the requirements 1.2.4:

- when expiring a set-up time of performance;
- for load resistance range according to table 2;
- when grounding one of the output contacts;
- when effecting the sine-wave vibrations in a frequency band from 10 up to 55 Hz with displacement amplitude 0,35 mm.

1.2.10 Ripple amplitude of output current is no more than 0,2 %.

1.2.11 Converters withstand 120% overload by an input voltage for 2 hours.

Output current, when overloading, is no more:

- for E858A..... 5,5 mA;
- for E858B and E858C..... 21 mA.

1.2.12 Converters withstand 150% short-term overloads by an input voltage (9 overloads with duration 0,5 s, with interval 15 s).

1.2.13 Converters withstand a long-lived break of a load circuit without any failures. An output voltage when breaking a load circuit, is no more than 25 V.

1.2.14 Isolation of electric circuits concerning the case and between input and output circuits; input and range select inputs withstands a testing voltage of practically sine-wave shape by frequency from 45 up to 65 Hz for 1 min:

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

1.2.15 Electrical insulation resistance of circuits pointed in 1.2.12 not less:

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

1.2.16 Input Power Consumption, no more 2 V·A.

1.2.17 Overall dimensions ..... 70x80x77 mm.

1.2.18 Weight..... 0,5 kg.

### 1.3 Construction

1.3.1 General Form of the converter is presented in Annex B.

1.3.2 Converter has the following parts:

- Case;
- Cover;
- Supply transformer;
- Component board;
- Latch.

The contacts established on a cover ensure strengthening a component board and reliable contact of conductors of a plated circuit to bringing wires.

The cover is mounted to a case through four screws, which can be sealed up.

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

### 1.4 Functional description

1.4.1 The converter is a device with digital processing of a signal.

The operation of the converter is based on measuring an input voltage period with further converting into result, which is proportional to frequency.

Converter Block Diagram is shown in Figure 1.

The converter consists of a power supply; a measuring part; an output matching stage.

The measuring part of the converter is carried out on a microcontroller.

1.4.2 The converter works as follows.

The input signal of measured frequency arrives at a primary winding of the supply transformer. The  $U_1$  voltage, pulsing with measured frequency, is transmitted from one rectifier bridge arm of a power supply to analog comparator input of a microcontroller ( $U_{SIGN}$ ) through the clipper. The comparator's output signal drives the counter. The clock pulses with frequency  $f_c$ , shaped by a master clock of a microcontroller, arrive at a clock input of the counter.

The counter counts number of pulses ( $n_i$ ), which are coming for a time interval  $t_i$  between edges of a comparator's output signal  $U_{comp}$  (see Figure 2).

Each value  $n_i$  is added to the previous value  $n_{i-1}$ , number  $N_i$  of clock pulses, acting for a input signal period  $T_i$ , is gained as its result:

$$N_i = T_i \cdot f_c, \quad (1)$$

$$N_i = n_i + n_{i-1}. \quad (2)$$

The instantaneous frequency  $f_i$  is calculated from the metered value  $N_i$ :

$$f_i = f_c / N_i \quad (3)$$

As the clock rate of microcontrollers can vary from a copy to a copy, the following value  $f_c$  is used when calculating.

$$f_c = f_{cr} + \Delta f_c, \quad (4)$$

where:  $f_{cr}$  - rated value of a clock rates, equal to 8.000 MHz;

$\Delta f_c$  - deflection of the clock rate actual value from the rated value.

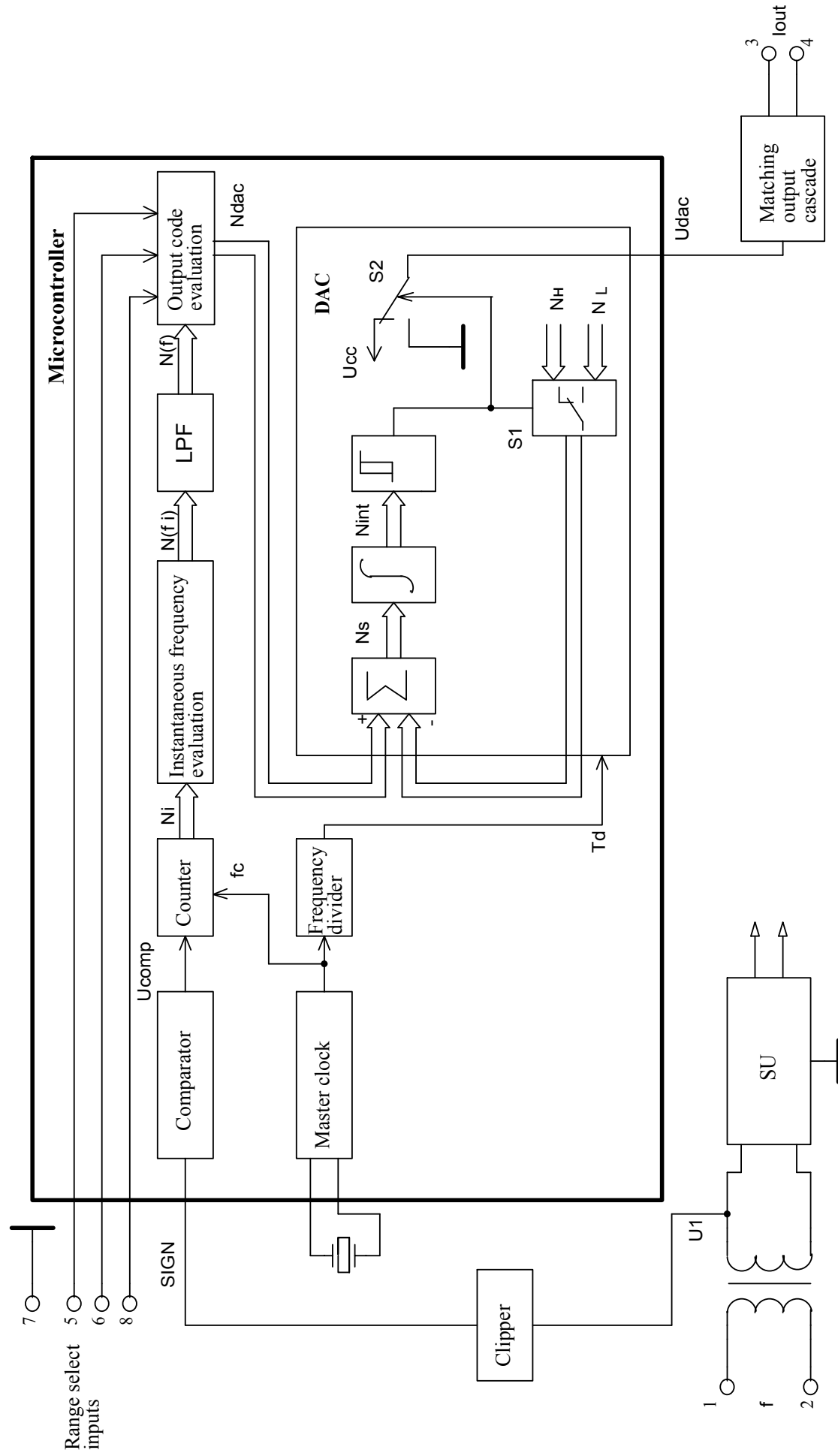


Figure 1. Block diagram



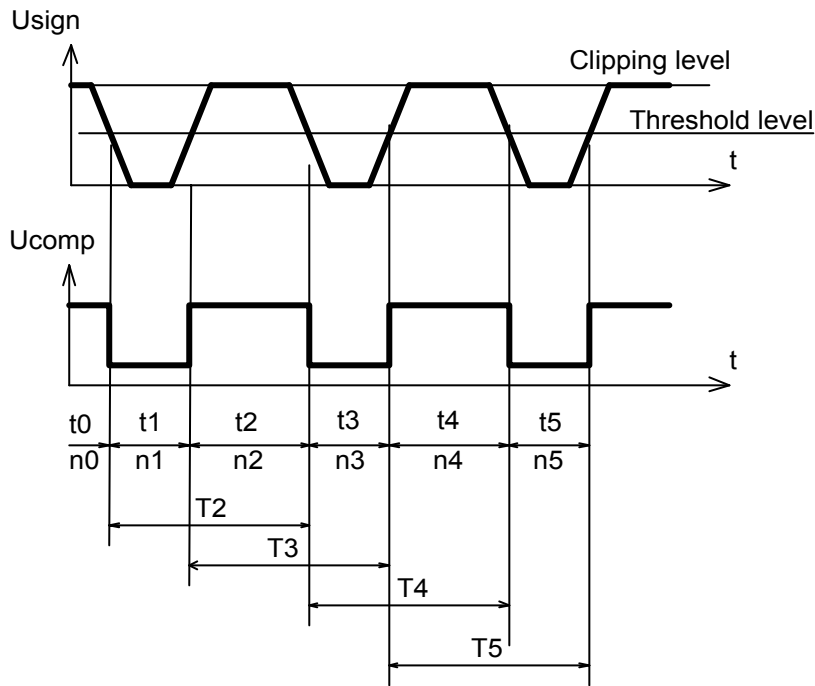


Figure 2

When adjusting a converter, the value  $\Delta f_c$  is metered and then registered in microcontroller's nonvolatile memory.

The digital value  $N(f_i)$ , corresponding to instantaneous frequency  $f_i$ , arrives at an on-board digital filter LPF. Its output value  $N(f)$  is corresponded to averaged measured frequency.

The time constant of a digital filter LPF has been selected so to ensure, jointly with the analog filter of a matching output stage, summary transient time of an output signal of the converter about 0.45 s.

The value  $N(f)$  is normalized according to a selected frequency range; the  $N_{DAC}$  value, obtained as its result, is sent to digital-to-analog converter (DAC).

The normalization is executed according to the expression:

$$N_{DAC} = (N(f) - N_1) \cdot N_2, \quad (5)$$

The coefficients  $N_1$ ,  $N_2$  depending on a selected frequency range of the converter are stored in a microcontroller's ROM; the values of coefficients obey:

$$\begin{aligned} N_{DAC}(f \leq f_b) &= 0, \\ N_{DAC}(f \geq f_e) &= N_{max}, \\ N_{DAC}(f_b \leq f \leq f_e) &= N_{max} \cdot (f - f_b) / (f_e - f_b), \end{aligned}$$

here  $f_b$  – beginning of a selected frequency range;

$f_e$  – end of a selected frequency range.

$N_{max}$  – maximal input value a DAC, equal  $2^{14} - 1$ .

The DAC is carried out under the classical circuit of a sigma - delta modulator; it consists of an adder, an integrator and 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 subtraction  $N_s$  is transferred to an

integrator input. The comparator compares an output value of the integrator  $N_{\text{int}}$  to threshold level  $N_{\text{th}}$  and changes the condition, depending on a result of comparison. The comparator drives the CMOS-structure of the microcontroller's output port thus, that it connects an output bus to a power bus ( $U_{\text{cc}}$ ), or to a common wire.

DAC works in discrete instants with sampling interval  $T_d$  about  $32 \mu\text{s}$  and represents the system with negative feedback, which supports averaged for anyone major time interval ( $T_{\text{int}} \gg T_d$ ) value on the integrator output equal to response level of the comparator.

$$N_{\text{int avr}} = \frac{1}{T_{\text{int}}} \int_t^{t+T_{\text{int}}} N_{\text{int}} dT_d = N_{\text{th}}. \quad (6)$$

Let's receive, that  $K_{\text{avr}}$  is an average for a period  $T_{\text{int}}$  pulses filling factor on the output of the comparator:

$$K_{\text{avr}} = 1/Q_{\text{avr}}, \quad (7)$$

where  $Q_{\text{avr}}$  is an average on-off time ratio of pulses on the comparator output.

It is possible to show, that following condition is satisfied on an interval  $T_{\text{int}}$ :

$$K_{\text{avr}} = 1 - \frac{N_{\text{DAC}} - N_L}{N_H - N_L}. \quad (8)$$

The average voltage for an interval  $T_{\text{int}}$  on a DAC output is featured by expression:

$$U_{\text{DAC}} = U_{\text{cc}} \cdot \left( 1 - \frac{N_{\text{DAC}} - N_L}{N_H - N_L} \right), \quad (9)$$

The mean of voltage is proportional to an input code  $N_{\text{DAC}}$  and depends on it linearly.

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

The expression for an output current has an aspect:

$$I_{\text{out}} = I_{\text{out b}} + (I_{\text{out e}} - I_{\text{out b}}) \cdot (f - f_b)/(f_e - f_b), \quad (10)$$

where  $I_{\text{out b}}$  - beginning of the converter's output DC range,

$I_{\text{out e}}$  - end of the converter's output DC range.

The coefficients  $N_H$  and  $N_L$  are erected so that the output current value of the converter is equaled:

- initial value of a range if  $N_{\text{DAC}} = 0$ ;

- finite value of a range if  $N_{\text{DAC}} = 2^{14} - 1$ .


The coefficients  $N_H$ ,  $N_L$  are stored in a microcontroller's ROM when adjusting the converter.

Adjusting the converter is carried on by an electronic mode through a technological connector.

The precision circuits are used to stabilize a supply voltage of the microcontroller.

## 1.5 Marking and sealing

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

- The name and type designation;
- Trade mark of the manufacturer;
- Ranges of measurement of frequency of an input signal;
- Rated voltage;
- Overvoltage category;
- Output signals range;
- Load resistance range;
- Module of intrinsic error;
- Symbol  ;
- Designation of numbers, polarity and designations of contacts;
- Serial number and two last digits of Issue Year;
- Sign of the type assertion;
- Inscription “Made in Russia”.

1.5.2 Sealing of the converter 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 converters are delivered in transport container.

1.6.2 In transport container there is:

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

1.6.3 The converter is packaged into individual packing.

The passport is inserted inside the individual packing.

## 2 Use to assignment

### 2.1 Operational constraints

2.1.1 The converters are not intended for operation in requirements explosion-hazard and hostile environment.

2.1.2 The converters must not be effected by direct heat up to temperature more 60°C. The converters should be placed on the premises without sharp temperature fluctuation and off the sources of strong electromagnetic field.

### 2.2 Preparation for use

2.2.1 Check integrity of packing after deriving the converter. Unpack it. Take out the converter, make exterior survey, get sure that any apparent mechanical damages are missing. Check completeness of delivering according to table 4.

Table 4

Name and nomenclature	Quantity
Converter	1
Frequency-to-current Converter E858. Passport	1
Frequency-to-current Converter E858. Operation manual	1*
Individual package	1
Latch	1**
* On a batch in quantity 50 pieces, delivered at the one address	
** Set on the body	

2.2.2 Check the correspondence of information on a converter's cover to required parameters.

### 2.3 Use

2.3.1 All the wiring and service operation should be make with observance of live rules of safe service.

2.3.2 Arranging the converter on a plant should be made according to Annex C.

#### 2.3.3 Installation of the converter on a plant

2.3.3.1 When mounting the converter *on the rail*:

- place a latch according to Figure C.1 to link the protuberances of a case to edge of the rail;
- push a body down to its fixing.

The mounting of the converter 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 converter *on the panel*:

- fix a latch on the panel with the help of two screws according to Figure C.2;
- pull the converter 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 converter on a latch it is necessary to provide on object a place not less than 15 mm for initial fixing of the converter.

2.3.4 Fix exterior conductive wires on terminals according to the diagram of converter connection, which is located in an Annex D.

2.3.5 Establish exterior jumpers for a select of a demanded frequency conversion range of according to table 3. At absence of exterior jumpers the basic range (45-55) Hz will be installed.

2.3.6 Verify the correspondence of output parameters of a signal source to data-ins of the converter. Verify quality of wiring.

2.3.7 Turn on an input signal to the converter.

## 2.4 Operation in extreme conditions

2.4.1 Turn off the converter immediately in case of originating an emergency conditions of operation.



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

### 3 Verification procedure

The present section erects methods and equipments of verification of the converter.  
The interval between calibrations should be 2 years

#### 3.1 Operations and Verification Test Equipment

3.1.1 The executable procedures and Verification test Equipment is listed in table 7.

Table 7

Name of procedure	Item number of a procedure	Verification Test Equipment
Exterior survey	3.3.1	–
Insulation resistance Test	3.3.2	Megohmmeter <b>M4101/3</b> Range of measured resistances from 0 to 100 MΩ Measuring voltage 500 V
Test of an intrinsic error	3.3.3	Precision LF oscillator <b>Г3-110</b> Frequency range from 0.01 Hz to 2 MHz by a discretization 0.01 Hz. Accuracy $3 \cdot 10^{-7} f$ Hz Output voltage to 2 V  Universal amplifier <b>У7-5</b> (with transformer 1:19) Frequency range from 0 to 2 MHz Amplification factor 1; 2; 5; 10 Rated output power 10 W  Universal digital voltmeter <b>B7-34A</b> Ranges of direct voltage 1V; 10 V Accuracy class 0.006/0.002  Resistance standard <b>MC3007</b> Rated value 100 Ω. Accuracy class 0.002  Resistance box <b>P33</b> Rated resistance range from 0.1 to 99999.9 Ω. Accuracy class 0.2  Voltmeter <b>Э545</b> Ranges of AC voltage 150V; 300V. Accuracy class 0.5
Registration of verification result	3.4	–

3.1.2 In all cases, if any test equipment is replaced with a different model, its accuracy shall be not worse than the accuracy requirement.

3.1.3 Verification Test Equipment shall be operable and certified.

### 3.2 Verification condition and preparation for it

3.2.1 Standard conditions during verification correspond to Table 1.

3.2.2 The converter must be standing in normal climatic requirements at least 2 hours before the verification.

3.2.3 Used equipment are prepared according to the requirements of their operation documentation.

### 3.3 Verification

#### 3.3.1 Exterior survey

3.3.1.1 Correspondence of the converter to the following requirements must be determined by exterior survey procedure:

- absence of mechanical failures of the case, cover, the latch and terminals set on the cover;
- presence of precise marking;
- presence of a seal and certificate of calibration (at fulfillment of the periodic calibration).

#### 3.3.2 Insulation resistance Test

3.3.2.1 At insulation resistance Test, the test voltage ( $500 \pm 50$ ) V is applied between joint together by groups of contacts 1 - 2 (input circuit) and 3 - 4 - 5 - 6 - 7 - 8 (output circuit and control circuits).

The megohmmeter's reading is considered on expiry of 1 min after a test of voltage or when this reading will be established practically.

3.3.2.2 Result of the test is satisfactory if the value of an insulation resistance makes not less than 40 MΩ.

#### 3.3.3 Test of an intrinsic error

3.3.3.1 Intrinsic error is defined by a method of matching of an output signal metered with use of a standard means with an output signal design value, when input signal is exhibiting precise on a standard means.

3.3.3.2 The intrinsic error ( $\gamma$ , in percents) expressed in the reduced shape is defined by formula

$$\gamma = \frac{I_{\text{out.r}} - I_{\text{out}}}{I_N} \cdot 100, \quad (11)$$

where  $I_{\text{out.r}}$  is real value of the output current in mA;

$I_{\text{out}}$  is design value of the output current in mA.

$I_N$  is fiducial value of the output current in mA.

Output current design values are expressed on the check-up points with the formula (10).

Finite value of input frequency range  $f_e$  is taken as a fiducial value of the converter.

As to a fiducial value of the output current  $I_N$ , it is determine according to formula

$$I_N = f_e \frac{I_{\text{out.e}} - I_{\text{out.b}}}{f_e - f_b}, \quad (12)$$

where  $I_{out\ b}$  is beginning of the converter's output DC range,

$I_{out\ e}$  is end of the converter's output DC range;

$f_b$  – beginning of a selected frequency range;

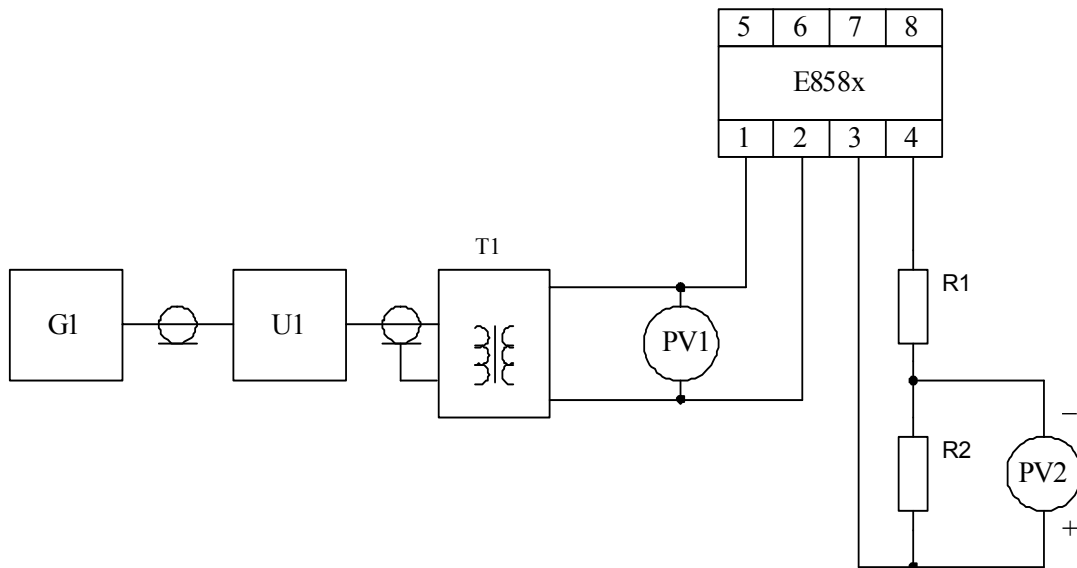
$f_e$  – end of a selected frequency range.

3.3.3.3 Intrinsic error is defined in all ranges of measurement.

3.3.3.4 It is admitted: to carry out verification of an intrinsic error only for a measurement range in which the converter is used, if there is a decision of the head of a department of calibration or director of firm.

3.3.3.5 The following operations should be execute before measurements:

- a working place for test of the intrinsic error is made according to a figure 3;
- exterior jumpers for a select of a demanded frequency conversion range are established of according to table 3;
- a load resistance is made equal  $2500 \pm 500 \Omega$  for the converter E858A1 (E858A2); or  $250 \pm 50 \Omega$  for the converter E858B1 (E858B2, E858C1, E858C2).



G1 – Precision LF oscillator Г3-110

U1 – Universal amplifier Y7-5

T1 - Transformer ( $w_2/w_1 = 19$ )

PV1 - Voltmeter Э545

PV2 – Universal digital voltmeter B7-34A

R1 – Resistance box P33

R2 –Resistance standard MC3007

Figure 3. Working place for Test of the intrinsic error



3.3.3.6 The following operations should be executed at test of the intrinsic error:

- Input signal with frequency equal to average value of the measurement range is given to the converter (50 Hz or 60 Hz);
- The converter is held during a set-up time of performance equal to 15 min;
- The frequency values of an input signal are exposed by turns according to table 8;
- Direct voltage on standard resistance R2 is metered by a standard voltmeter PV2;
- Real values of an output current ( $I_{out,r}$  in mA) are defined in all frequency ranges of measurement according to formula

$$I_{out,r} = \frac{U_{out,r}}{R}, \quad (13)$$

where  $U_{out,r}$  is the reading of standard voltmeter PV2, mV;

R is the value of standard resistance R2,  $\Omega$ ;

Table 8

Frequency range, Hz	Frequency, Hz	Design value of the output current, mA, for the converter		
		E858A	E858B	E858C
45 - 55	45,00	0,000	4,000	0,00
	45,01	0,005	4,016	0,02
	47,50	1,250	8,000	5,00
	50,00	2,500	12,000	10,00
	52,50	3,750	16,000	15,00
	54,99	4,995	19,984	19,98
	55,00*	5,000	20,00	20,00
49 - 51	49,00	0,000	4,000	0,00
	49,50	1,250	8,000	5,00
	50,00	2,500	12,000	10,00
	50,50	3,750	16,000	15,00
	51,00*	5,000	20,000	20,00
48 - 52	48,00	0,000	4,000	0,00
	49,00	1,250	8,000	5,00
	50,00	2,500	12,000	10,00
	51,00	3,750	16,000	15,00
	52,00*	5,000	20,000	20,00
59 - 61	59,00	0,000	4,000	0,00
	59,50	1,250	8,000	5,00
	60,00	2,500	12,000	10,00
	60,50	3,750	16,000	15,00
	61,00*	5,000	20,000	20,00
58 - 62	58,00	0,000	4,000	0,00
	59,00	1,250	8,000	5,00
	60,00	2,500	12,000	10,00
	61,00	3,750	16,000	15,00
	62,00*	5,000	20,000	20,00
55 - 65	55,00	0,000	4,000	0,00
	57,50	1,250	8,000	5,00
	60,00	2,500	12,000	10,00
	62,50	3,750	16,000	15,00
	65,00*	5,000	20,000	20,00
* Fiducial value				

- The intrinsic error ( $\gamma$ , in percents) is defined on the check-up points in accordance with formula (11).

If the intrinsic error of the converter not exceeds of control tolerance, equal 0,8 limits to a supposed intrinsic error, the converter is suitable.

Limits of the supposed intrinsic error are  $\pm 0.02\%$ .

3.3.3.7 The value of a ratio between an Test Equipments Accuracy and intrinsic error of the gauged converter should not exceed 1/3.

The greatest adoption probability of the unsuitable converter as suitable is equal 0,05.

The greatest supposed value of a ratio of a converter's intrinsic error to a limit of the supposed intrinsic error is equal 1,2, when the unsuitable converter receives as suitable.

### 3.4 Registration of verification result

3.4.1 The results of verification are put down into the protocol in accordance with Annex E.

3.4.2 If the converter is recognized suitable for use by results of verification, the gauge brand must be plotted on it (on its passport) or the certificate of calibration must be granted according to rules IIP 50.2.006-94

3.4.3 If the converter is recognized unsuitable for use by results of verification, the notification on unfitness must be written according to rules IIP 50.2.006-94. In case periodic verification, the gauge brand at its presence must be suppressed, the previous certificate of calibration must be nullified

## 4 Maintenance and repair

### 4.1 Common indicating

4.1.1 The operational supervision for converters operation should be carried by persons, which have the responsibility for this equipment.

4.1.2 The converter should not be opened during operation.

4.1.3 The manufacturer eliminates all defects originating during operation.

### 4.2 Safety

4.2.1 The qualified personnel should execute operations of maintenance.

4.2.2 The converters correspond to ГОСТ P 52319-2005 (IEC 61010-1:2001).

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



4.2.3 IT IS FORBIDDEN: TO CHANGE EXTERIOR CONNECTIONS, WHEN INPUT SIGNAL IS APPLIED TO THE CONVERTER.

### 4.3 Order of maintenance

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

- to turn input signal off;

- to delete from a case a dust;

- to test a condition of a case; to be convinced of absence of mechanical failures; to test a condition of the mounting;

- to turn on input signals on the converter after the termination of survey.

4.3.2 If the converter 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.

## 4.4 Metrology monitoring

4.4.1 To confirm real values of the metrology characteristics and fitness of the converter to application, it can be exposed to verification (calibration) according to section 3 of the present manual, which was matched with ВНИИМС (All-Russian Research Institute).

4.4.2 Recalibration interval is 2year.

## 5 Storage

5.1 Before introduction in operation the converters should be stored in storehouses according to ГОСТ 12997-84.

5.2 Storage conditions for converters in transport container:

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

5.3 Storage conditions for converters in individual packing:

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

5.4 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 (ГОСТ 15150-69).

## 6 Transportation

6.1 The converters in transport container can be transported in the closed vehicles of any kind. When air transporting, the converters should be disposed in heated hermetic bays.

6.2 Values of climatic and mechanical effects on the converter at transportation should be in limits:

- Ambient Air Temperature ..... - 50 to 60 °C;
- Relative Humidity at 35 °C ..... up to 95 %;
- Atmosphere pressure, kPa (mm Hg) ..... 84-106 (630-800).
- Impacts with peak shock acceleration ..... 98 m/sec<sup>2</sup>.

## Annex A

### Use of the converter in a condition of remote control

The range select inputs have galvanic link with output circuits of the converter.

Fragment of an electric circuit concerning to an input 8 is shown in Figure A.1. The range select inputs 5 and 6 are carried out similarly.

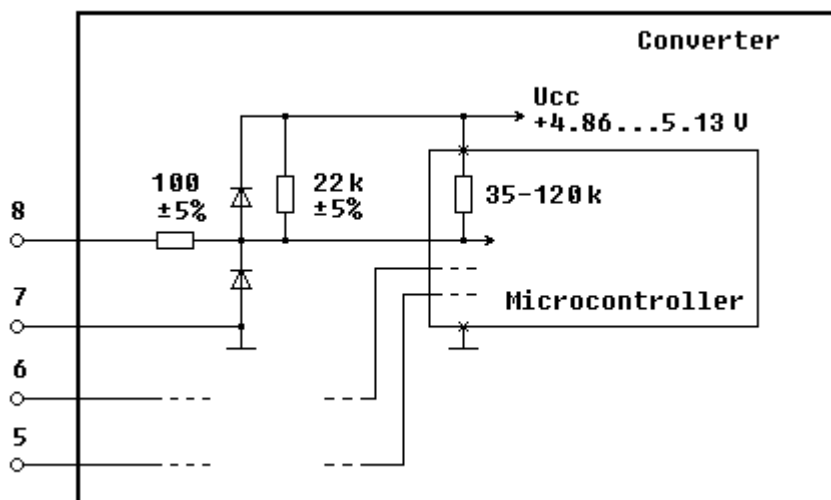


Figure A.1 The scheme of the input circuit of a range select

It is visible from Figure A.1, that the contact 7 is connected to an incircuit return wire. The voltage between an range select inputs and converter's output can achieve 25 V.

That influence of circuits of remote control to an converter's output signal to eliminate, the signals on range select inputs are necessary to give through devices ensuring a galvanic isolation, for example, relay or optocouplers. The example of use of optocouplers for remote control by the converter is shown in Figure A.2.

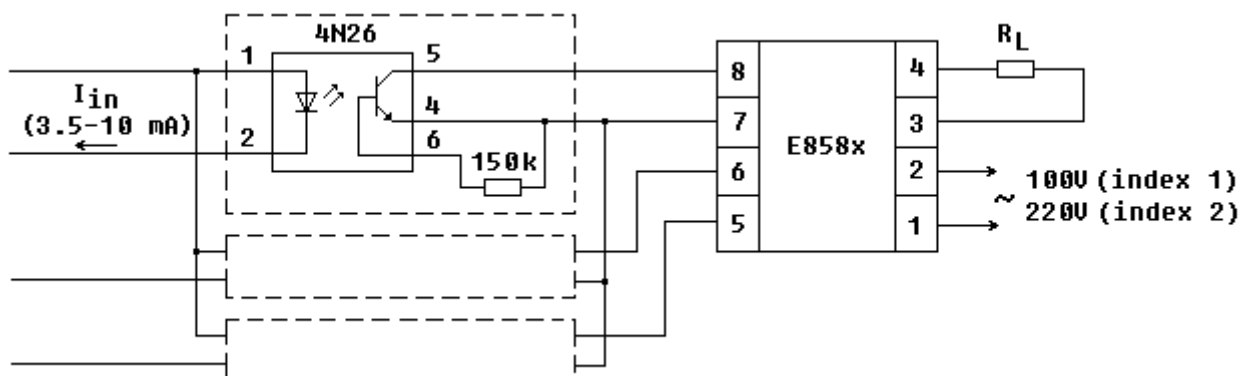


Figure A.2 Use of optocouplers for remote control by the converter

## Annex B

### General Form of the converter

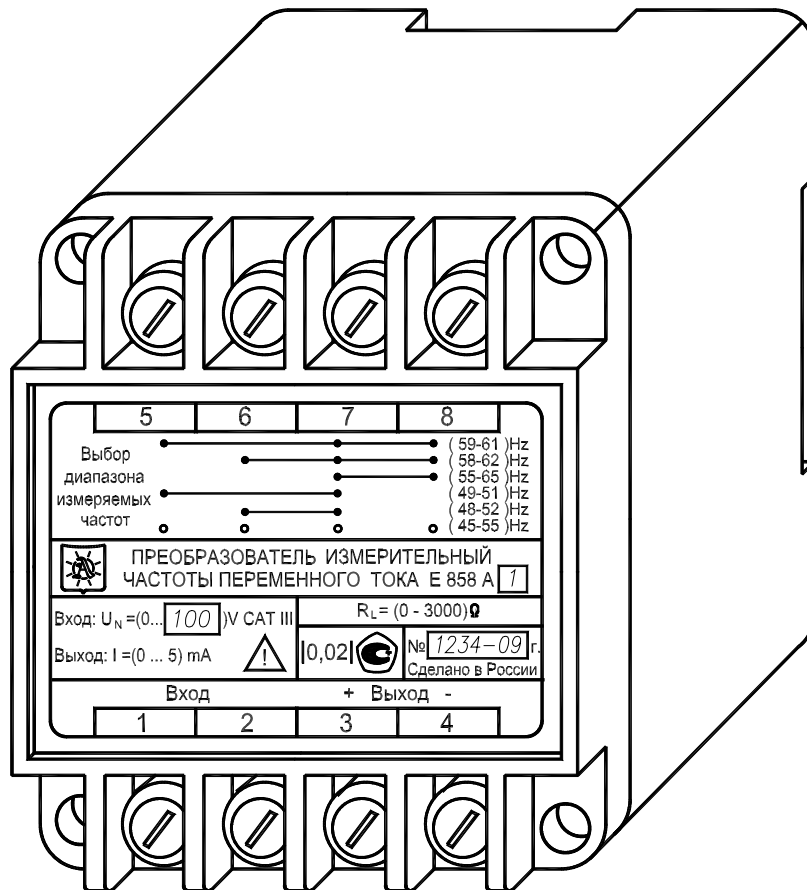


Figure B.1

## Annex C

### Variants of converter mounting

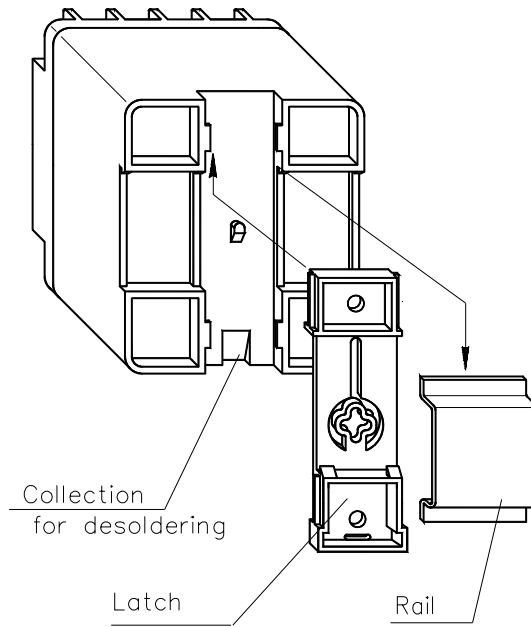


Figure C.1 Mounting on the Rail

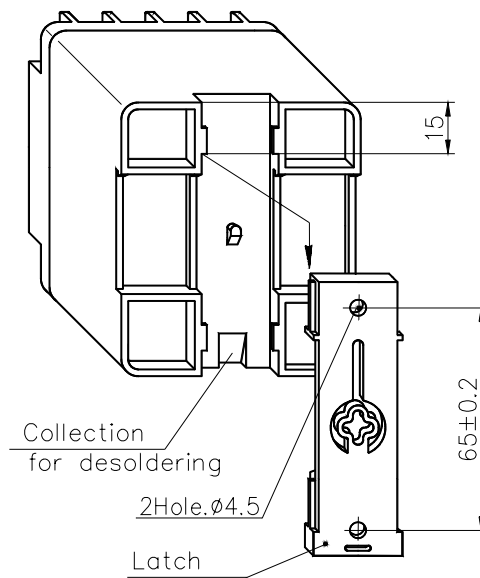
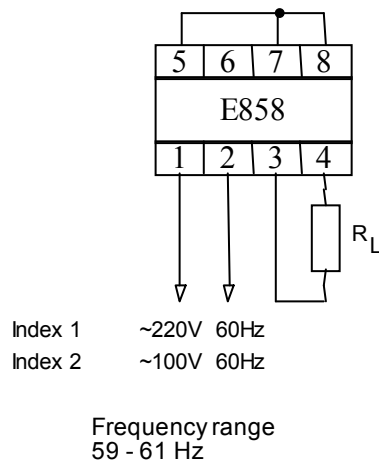
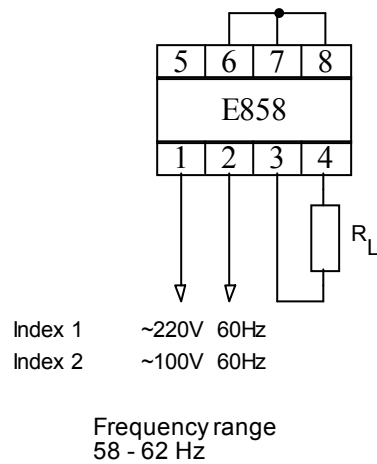
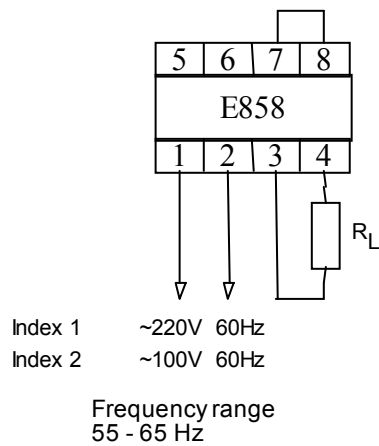
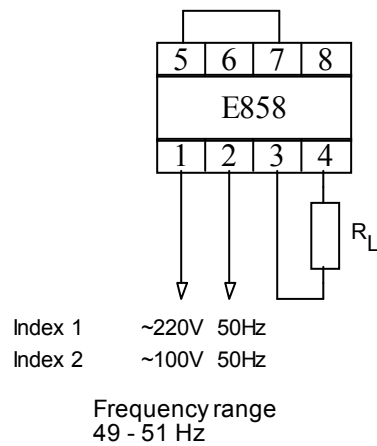
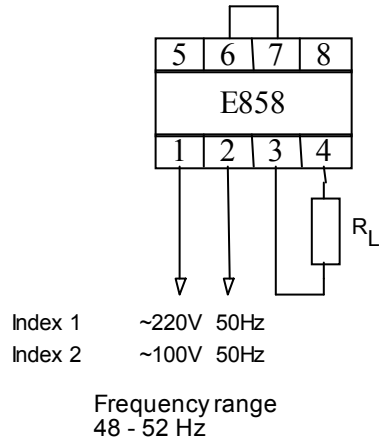
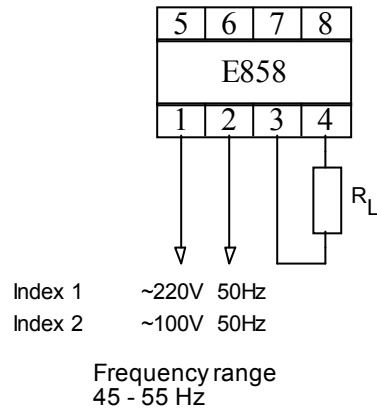


Figure C.2 Mounting on the Panel

## Annex D

### Diagrams of converters connection

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# Annex E

## The shape of the protocol of calibration of the converter

### Protocol of calibration

Converter \_\_\_\_\_, Inhering \_\_\_\_\_  
Type № Serial number The name of firm

is checked by \_\_\_\_\_  
The name of firm making calibration Year, month, date

#### Calibration condition

Ambient Air Temperature \_\_\_\_\_ °C  
Relative Humidity \_\_\_\_\_ %  
Atmosphere pressure \_\_\_\_\_ kPa  
Input Voltage \_\_\_\_\_ V  
Load resistance \_\_\_\_\_ Ω

**Used Test Equipment** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

#### 1 Exterior survey

Result: \_\_\_\_\_

#### 2 Insulation resistance Test

Result: \_\_\_\_\_

#### 3 Test of an intrinsic error

Result: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Common conclusion** \_\_\_\_\_

Certificate of calibration (number) is granted, or the reason of unsuitability

The chief of a gauge service

\_\_\_\_\_  
Personal signature Interpretation of the signature

Performer

\_\_\_\_\_  
Personal signature Interpretation of the signature

Seal

\_\_\_\_\_  
Year, month, date