Equipment for power engineering

LPW305

Telemetric devices for measuring of electrical power quality, capacity and quantity parameters

User manual

ДЛИЖ.411722.0001 РЭ

L-CARD

http://en.lcard.ru
en@lcard.ru

DAQ SYSTEMS DESIGN, MANUFACTURING & DISTRIBUTION

First appl.

Ref. No.

Signature and date

Dupl. inv. No.

Repl. inv. No.

Signature and date

Orig. inv. No.

Contents

Rev.	Sheet	Document No.	Signature	Date	ДЛИЖ.411722.0001 РЭ		
Developed by		Gapeyeva		31.03.16	Telemetric devices for measuring of electrical power quality, capacity and quantity LPW-305 User Manual	Letter	Sheet 2 / Total number of sheets 121
Checked by		Kliuyev		31.03.16			
QC		Trofimova		31.03.16			
Approved by		Butkevich		31.03.16		L-Card LLC	

This User Manual describes the design, principle of operation, characteristics and instructions for correct and safe operation of telemetric devices for measuring of electrical power quality, capacity and quantity parameters LPW-305 (hereinafter, LPW-305). LPW-305 modifications are listed in Section 1.

DO NOT PROCEED TO WORK WITHOUT HAVING LOOKED THROUGH THIS USER MANUAL!

Use the e-tree of the table of contents (for example, in Acrobat Reader) for easy navigation when reading this manual in the electronic form.

1 APPLICATION AND COMPOSITION

1.1 LPW-305 is designed for measurement and analysis of characteristics of voltage, amperage, power, energy and power quality indicators (hereinafter, PQI) in accordance with GOST 30804.4.30-2013, Class A in single-phase and three-phase alternating current networks with a frequency of 50 Hz with the capability to generate and transmit information and control electrical signals.

The main area of application is power companies, electric grid organizations, industrial enterprises, testing laboratories, metrological services and other organizations in various industries.

1.2 LPW-305 modifications are shown in Figure 1, design and functional features as well as the range of measured PQI for each modification are presented in Tables 1, 2.

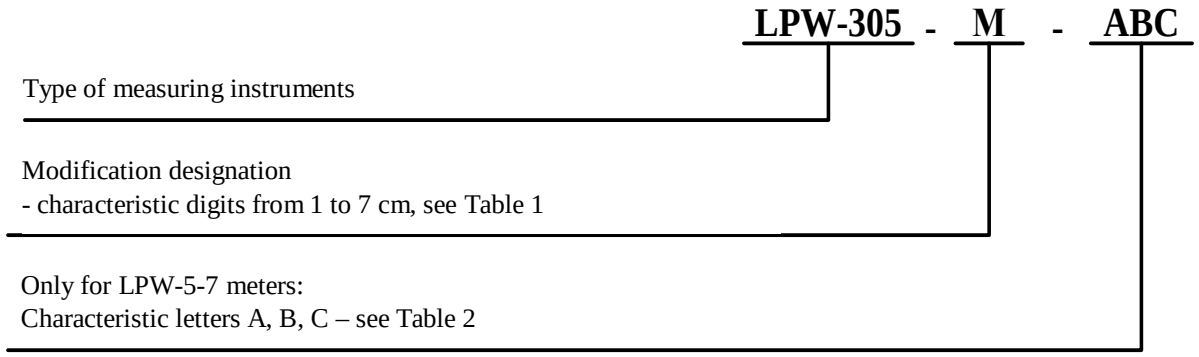


Figure 1 – Designation of LPW-305 modifications

Table 1 – Design features of LPW-305 modifications

Design feature	Characteristic digit in designation of a LPW-305 modification as shown in Figure 1						
	"1"	"2"	"3"	"4"	"5"	"6"	"7"
Method of mounting for operation	On DIN-rail						Portable version
Min. 2 GB Micro SD memory	–	–	–	+	+	+	+
Opto-relay pulse output	–*	+**	+	–	+	+	–
Electromechanical relay	+	+	+	+	+	+	–
Resistive load of RS-485 communication interface line	–	+	–	–	+	–	–
Discrete opto-isolated input	–	–	+	–	–	+	–

* "–" means absence of a design feature.
** "+" means presence of a design feature

Table 2 – Functional features of LPW-305-7 modification

Characteristic letter in designation of LPW-305-7 modification as shown in Figure 1	Functional feature of LPW-305-7	
	if characteristic letter is present in the designation	if characteristic letter is absent in the designation
A	3 voltage measuring inputs and 3 current measuring inputs connected to the line with current clamps	3 voltage measuring inputs. No current measuring inputs
B	The lower operating temperature limit is minus 40 °C	The lower operating temperature limit is minus 25 °C
C	Built-in GPS module	No built-in GPS module

The specifics of use of LPW-305 modifications indicated in Table 1 is as follows:

– the pulse output of opto-relay (LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6) can be used by the user to arrange additional signaling at his own discretion or during LPW-305 verification (measurement of accumulated energy);
– the resistive load of RS-485 communication interface line built into the design of LPW-305-2 and LPW-305-5 modifications is designed for convenient connection of a terminal load in RS-485 line, if necessary;
– the discrete opto-isolated input (LPW-305-3, LPW-305-6) is designed to ensure quick response of several LPW-305 used in an alternating current network to critical events occurring in this network (see paragraph 3.1.7);
– the Micro SD memory with a storage capacity of at least 2 GB (LPW-305-4-LPW-305-7) is designed for long-term storage of the electronic report (in case that LPW-305 is operating without connection to a computer for months).

1.3 Normal operating conditions:

– ambient temperature (20 ± 5) ˚C;
– relative humidity from 30 to 80 %;
– atmospheric pressure from 80 to 106.7 kPa;
– AC voltage (220.0±2.2) V;
– frequency (50.00±0.15) Hz;
– DC voltage from 12 to 24 V for LPW-305-7 modification;
– phase sequence – L1 - L2 - L3;
– voltage unbalance - all phases are connected;
– the shape of the voltage and current curve is sinusoidal, distortion factor is less than 2%;
– no permanent magnetic induction of external origin;

– magnetic induction of external origin at a frequency of 50 Hz is not more than 0.05 mT;
– radio-frequency electromagnetic fields from 30 kHz to 2 GHz are less than 1 V/m;
– conductive interference induced by radio-frequency fields from 15 kHz to 80 MHz is less than 1 V.

1.4 Operating conditions are in accordance with GOST 22261-94, Group 4:

– the upper value of relative humidity is 90% at a temperature of 30 °C.

In this case:

– the lower value of operating ambient temperature for all modifications except LPW-305-7 with characteristic letter "B" in the designation is minus 25 °C; for LPW-305-7 with characteristic letter "B" in the designation it is minus 40 °C;
– the upper value of operating ambient temperature is plus 60 °C.

1.5 In terms of tolerance to physical impact, LPW-305 conforms to GOST 22261-94, Group 4.

1.6 The scope of supply of LPW-305 is given in Table 3.

Table 3

Item	Designation	Quantity
Telemetric device for measuring of electrical power quality, capacity and quantity parameters LPW-305	ДЛИЖ.411722.0001	1
Telemetric device for measuring of electrical power quality, capacity and quantity parameters LPW-305. Data sheet	ДЛИЖ.411722.0001 ПС	1
Power supply unit LPW-305-7*	ДЛИЖ.565126.0013	1
CD-ROM disc with data**: – verification methodology – user manual – software	 ДЛИЖ.411722.0001 МП ДЛИЖ.411722.0001 РЭ —	1
Package	—	1

* For LPW-305-7 modification only.

** supplied at a customer's request under a separate order

2 SPECIFICATIONS

2.1 LPW-305 make measurements at three measuring voltage inputs.

Voltage measuring inputs of LPW-305 ensure measurements at rated values of phase/phase-to-phase voltage U_r of 230.9 V/400 V ("400 V" operating mode) or 57.7 V/100 V ("100 V" operating mode).

2.2 DIN-rail mounted LPW-305 modifications make measurements at three current measuring inputs.

The current measuring inputs connected in series with the measuring circuit of LPW-305 ensure measurements at a rated input current I_r of 5 A ("5 A" operating mode) or 1 A ("1 A" operating mode).

Maximum input current value I_{max}:

– 10 A for "5 A" operating mode;

– 2 A for "1 A" operating mode.

In the portable version of LPW-305, the current measuring inputs are either missing or there is a connector for connecting three measuring clamps with a voltage in the range from 0 to 5 V to the meter. See Table 2.

In the portable version of LPW-305, a GPS module can be installed; the operating temperature range is extended (from minus 40 to plus 60 ºC), see Table 2.

2.3 A controlled AC voltage source can be connected to the measuring inputs of LPW-305 as follows:

for voltage measuring inputs, directly or through external devices (voltage measuring transformers (hereinafter, VT), voltage dividers), with obligatory accounting for influence of characteristics of the voltage measuring inputs of LPW-305 on characteristics of the external devices connected;

for current measuring inputs (DIN-rail mounted LPW-305 modifications), through external current transformers (hereinafter, CT).

Note: for current measuring inputs, it is allowed to directly connect a controlled AC voltage source in series with the circuit, provided that there is no constant current component in that circuit. However, as a rule, electric networks in which PQI are measured do not meet this condition.

LPW-305 has an option for entering correction factors to measurement results to take into account the transmission (transformation) factors used for measurements of external devices (transformers). The procedure for correction factors entering for DIN-rail mounted LPW-305 modifications is described in sub-paragraph7.3.24.15, 7.3.24.16. Correction factors for LPW-305-7 are entered in a window of LPWStudio II program described in paragraph7.2.1.

2.4 LPW-305 provide for measurement of PQI, voltage, current, electric power and electric energy parameters specified in Table 4.

Table 4 – List of measured PQI

PQI		Possibility of PQI measurement in the modification	
		LPW-305-1, LPW-305-2, LPW-305-3, LPW-305-4, LPW-305-5, LPW-305-6	LPW-305-7
1	Root mean square value of phase voltage	+*	+
2	Root mean square value of phase-to-phase voltage	+	+
3	Root mean square value of phase voltage at fundamental frequency	+	+
4	Steady-state deviation of root mean square voltage value	+	+
5	Frequency	+	+
6	Frequency deviation	+	+
7	Voltage total harmonic distortion	+	+
8	*n*-th harmonic voltage component factor (*n* is harmonic order)	+	+
9	Negative sequence voltage unbalance factor	+	+
10	Zero sequence voltage unbalance factor	+	+
11	Voltage fall depth	+	+
12	Voltage fall duration	+	+
13	Temporary overvoltage factor	+	+
14	Temporary overvoltage duration	+	+
15	Short-term flicker indicator	+	+
16	Long-term flicker indicator	+	+
17	Phase shift angle between phase voltages at fundamental frequency (first harmonic)	+	+
18	Phase shift angle between *n*-th harmonic component of phase voltages (*n* is harmonic order)	+	+
19	Root mean square value of phase current	+	–**
20	Root mean square value of phase current at fundamental frequency	+	–
21	Current total harmonic distortion	+	–

Continuation of Table 4

PQI	Possibility of PQI measurement in the modification	
	LPW-305-1, LPW-305-2, LPW-305-3, LPW-305-4, LPW-305-5, LPW-305-6	LPW-305-7
22 *n*-th harmonic current component factor (*n* is harmonic order)	+	–
23 Phase shift angle between voltage and current at fundamental frequency (first harmonic) of one phase	+	–
24 Phase shift angle between *n*-th harmonic components of voltage and current of one phase (*n* is harmonic order)	+	–
25 Active single-phase power	+	–
26 Reactive single-phase power	+	–
27 Total single-phase power	+	–
28 Active phase energy	+	–
29 Reactive phase energy of first harmonic	+	–

* "+" means that there is a possibility to measure the indicator.
** "–" means that there is no possibility to measure the indicator

2.5 Measurement ranges and standardized metrological characteristics of LPW-305 are given in Tables 5 – 11.

Table 5 – Metrological characteristics of LPW-305 standardized under normal operating conditions indicated in Table 11

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible basic measurement error
1 Root mean square value of phase voltage, V: – for "400 V" operating mode – for "100 V" operating mode	U_p	 From 5 to 462 From 5 to 116	Reduced (to rated value of phase voltage U_r), ±0.1 %
2 Root mean square value of phase-to-phase voltage, V: – for "400 V" operating mode – for "100 V" operating mode	U_{pp}	 From 8.7 to 800 From 8.7 to 200	Reduced (to rated value of phase-to-phase voltage U_r), ±0.1 %

Continuation of Table 5

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible basic measurement error
3 Root mean square value of phase voltage at fundamental frequency, V: – for "400 V" operating mode – for "100 V" operating mode	$U_{(1)}$	 From 5 to 347 From 5 to 87	Reduced (to rated value of phase voltage U_r), ±0.1 %
4 Steady-state deviation of root mean square voltage value, %	δUy	From minus 20 to plus 20	Absolute, ±0.2 %
5 Negative sequence voltage unbalance factor, %	K_{2U}	From 0.4 to 20	Absolute, ±0.2 %
6 Zero sequence voltage unbalance factor, %	K_{0U}	From 0.4 to 20	Absolute, ±0.2 %
7 Root mean square value of phase current, A: – for "5 A" operating mode – for "1 A" operating mode	I	 From 0.005 to 10 From 0.001 to 2	Reduced (to rated value of phase current I), ±0.1 %
8 Root mean square value of phase current at fundamental frequency, A: – for "5 A" operating mode – for "1 A" operating mode	$I_{(1)}$	 From 0.005 to 7.5 From 0.001 to 1.5	Reduced (to rated value of phase current I), ±0.1 %
9 Active single-phase power in the frequency band from 30 to 4000 Hz, W: – "400 V" and "1 A" modes – "100 V" and "1 A" modes – "100 V" and "5 A" modes – "400 V" and "5 A" modes	$P_{(f)1}$	 From 2.3 to 346 From 0.6 to 87 From 2.9 to 433 From 11.5 to 1732	Relative, according to Table 6

Signature and date | Dupl. inv. No. | Repl. inv. No. | Signature and date | Orig. inv. No.

Continuation of Table 5

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible basic measurement error
10 Reactive single-phase power in the frequency band from 40 to 2875 Hz, VAr – "400 V" and "1 A" modes – "100 V" and "1 A" modes – "100 V" and "5 A" modes – "400 V" and "5 A" modes	$Q_{(f)1}$	From 12 to 346 From 3 to 87 From 14 to 433 From 58 to 1732	Relative, ±[0.5×(0.9+0.02/*m*)] % for *m* from 0.01 to 0.2, where $m=(I_{(1)}\times U_{(1)}\times/sin\varphi_{IU}/) / (I_r\times U_r)$, ±0.5 % for *m* from 0.2 to 1.2
11 Total single-phase power in the frequency band from 30 to 4000 Hz, V·A: – "400 V" and "1 A" modes – "100 V" and "1 A" modes – "100 V" and "5 A" modes – "400 V" and "5 A" modes	S	From 12 to 346 From 3 to 87 From 14 to 433 From 58 to 1732	Relative, ±0.5 % at current from 0.01 to 1.5 A in the "1 A" mode and at current from 0.05 to 7.5 A in the "5 A" mode
12 Active phase energy, W·h	W_A	—	Relative, GOST 31819.22-2012, accuracy class 0.2S (see Table 6)
13 Reactive phase energy of first harmonic, VAr·h	W_P	—	Relative, ±[0.5×(0.9+0.02/*m*)] % for *m* from 0.01 to 0.2, where $m=(I_{(1)}\times U_{(1)}\times /sin\varphi_{IU}/)/ (I_r\times U_r)$, ±0.5 % for *m* from 0.2 to 1.2

Table 6 – Limits of permissible main relative error of measurement of active single-phase power and active phase energy

Operating mode	Root mean square value of phase current *I*, A	Power factor *cosφ*	Limits of permissible main relative error of measurement of active single-phase power and active phase energy, %
"100 V" and "5 A"; "400 V" and "5 A"	From 0.05 to 0.25 (exclusively)	1	±0.4
	From 0.25 to 7.5		±0.2
	From 0.1 to 0.5 (exclusively)	From 0.5 to 0.9	±0.5
	From 0.5 to 7.5		±0.3
"100 V" and "1 A"; "400 V" and "1 A"	From 0.01 to 0.05 (exclusively)	1	±0.4
	From 0.05 to 1.5		±0.2
	From 0.02 to 0.1 (exclusively)	From 0.5 to 0.9	±0.5
	From 0.1 to 1.5		±0.3

Table 7 – Metrological characteristics of LPW-305 standardized under working operating conditions indicated in Table 11

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible measurement error
1 Frequency, Hz	*f*	From 42.5 to 57.5	Absolute, ±0.01 Hz
2 Frequency deviation, Hz	*Δf*	From minus 5 to plus 5	Absolute, ±0.01 Hz
3 Voltage total harmonic distortion, %	K_U	From 1 to 30	Relative, ±10 %
4 *n*-th harmonic voltage component factor (*n* is harmonic order), %	$K_{U(n)}$		Absolute, ±0.05 % for $K_{U(n)} < 1.0$ %.
– for $2 \le n \le 10$		From 0.1 to 30	
– for $10 < n \le 20$		From 0.1 to 20	Relative, ±5 % for $K_{U(n)} \ge 1.0$ %
– for $20 < n \le 30$		From 0.1 to 10	
– for $30 < n \le 50$		From 0.1 to 5	

Signature and date | Dupl. inv. No. | Repl. inv. No. | Signature and date | Orig. inv. No.

Continuation of Table 7

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible measurement error
5 Voltage fall depth, %	δU_f	From 10 to 100	Absolute, ±1.0 %
6 Voltage fall duration, s	Δt_f	From 0.04 to 60	Absolute, ±0.02 s
7 Temporary overvoltage factor	$K_{ov\ U}$	From 1.1 to 1.5	Relative ±2 %
8 Temporary overvoltage duration, s	$\Delta t_{ov\ U}$	From 0.04 to 60	Absolute, ±0.02 s
9 Short-term flicker indicator	P_{St}	From 0.2 to 10	Relative ±5.0 %
10 Long-term flicker indicator	P_{Lt}	From 0.2 to 10	Relative ±5.0 %
11 Current total harmonic distortion at current from 0.05 to 7.5 A for "5 A" operating mode, from 0.01 to 1.5 A for "1 A" operating mode	K_I	From 0.3 to 60	Absolute, ±0.15 % for $K_I < 3.0$. Relative ±5 % for $K_I \geq 3.0$
12 n-th harmonic current component factor (n is harmonic order) from 0.05 to 7.5 A for "5 A" operating mode, from 0.01 to 1.5 A for "1 A" operating mode, %:	$K_{I(n)}$		Absolute, ±0.15 % for $K_{I(n)} < 3.0$.
– for $2 \leq n \leq 10$		From 0.3 to 30	Relative ±5 % for $K_{I(n)} \geq 3.0$
– for $10 < n \leq 20$		From 0.3 to 20	
– for $20 < n \leq 30$		From 0.3 to 10	
– for $30 < n \leq 50$		From 0.3 to 5	

Signature and date | Dupl. inv. No. | Repl. inv. No. | Signature and date | Orig. inv. No.

Continuation of Table 7

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible measurement error
13 Phase shift angle between phase voltages at fundamental frequency (first harmonic) at voltage from 184.7 to 277.1 V for "400 V" operating mode, from 46.2 to 69.2 V for "100 V" operating mode, °	φ_U	From minus 180 to plus 180	Absolute, ±0.2°
14 Phase shift angle between *n*-th harmonic component of phase voltages (*n* is harmonic order), °	$\varphi_{U(n)}$	From minus 180 to plus 180	Absolute, ±1° for $K_{U(n)}$ over 5 %, ±5° for $K_{U(n)}$ over 1 to 5 %, ±10° for $K_{U(n)}$ from 0.2 to 1 %
15 Phase shift angle between voltage and current at fundamental frequency (first harmonic) of one phase, °	φ_{UI}	From minus 180 to plus 180	Absolute, ±0.5° at current from 0.05 to 6 A for "5 A" operating mode, from 0.1 to 1.2 A for "1 A" operating mode, ±5° at current below 0.5 A for "5 A" operating mode and below 0.1 A for "1 A" operating mode
16 Phase shift angle between *n*-th harmonic components of voltage and current of one phase (*n* is harmonic order), °	$\varphi_{UI(n)}$	From minus 180 to plus 180	Absolute, according to Table 8

Table 8 – Limits of permissible absolute error of measurement of phase shift angle between *n*-th harmonic components of voltage and current of one phase

Operating mode	Root mean square value of phase current, A	*n*-th harmonic voltage component factor $K_{U(n)}$, %	*N*-th harmonic current component factor $K_{I(n)}$, %	Limits of permissible absolute error of measurement of phase shift angle between *n*-th harmonic components of voltage and current of one phase, °
"5 A"	From 0.5 to 2.5	Over 5	Over 5	±5
	Over 2.5 to 6	From 1 to 5	From 1 to 5	
"1 A"	From 0.1 to 0.5	Over 5	Over 5	±5
	Over 0.5 to 1.2	From 1 to 5	From 1 to 5	±5
		Over 5	Over 5	±3

Table 9 – Standardized metrological characteristics in case of change of ambient temperature

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible additional measurement error caused by deviation of ambient air temperature within the operating temperature range by every 10 °C
1 Root mean square value of phase voltage, V: – for "400 V" operating mode – for "100 V" operating mode	U_p	 From 5 to 462 From 5 to 116	Reduced (to rated value of phase voltage U_r), ±0.05 %
2 Root mean square value of phase-to-phase voltage, V: – for "400 V" operating mode – for "100 V" operating mode	U_{pp}	 From 8.7 to 800 From 8.7 to 200	Reduced (to rated value of phase voltage U_r), ±0.05 %
3 Root mean square value of phase voltage at fundamental frequency, V: – for "400 V" operating mode – for "100 V" operating mode	$U_{(1)}$	 From 5 to 347 From 5 to 87	Reduced (to rated value of phase voltage U_r), ±0.05 %

Continuation of Table 9

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible additional measurement error caused by deviation of ambient air temperature within the operating temperature range by every 10 ºC
4 Steady-state deviation of root mean square voltage value, %	δU_y	From minus 20 to plus 20	Absolute, ±0.1 %
5 Negative sequence voltage unbalance factor, %	K_{2U}	From 0.4 to 20	
6 Zero sequence voltage unbalance factor, %	K_{0U}	From 0.4 to 20	
7 Root mean square value of phase current, A: – for "5 A" operating mode – for "1 A" operating mode	I	 From 0.005 to 10 From 0.001 to 2	Reduced (to rated value of phase current I), ±0.05 %
8 Root mean square value of phase current at fundamental frequency, A: – for "5 A" operating mode – for "1 A" operating mode	$I_{(1)}$	 From 0.005 to 7.5 From 0.001 to 1.5	
9 Active single-phase power in the frequency band from 30 to 4000 Hz, W: – "400 V" and "1 A" modes – "100 V" and "1 A" modes – "100 V" and "5 A" modes – "400 V" and "5 A" modes	$P_{(f)1}$	 From 2.3 to 346 From 0.6 to 87 From 2.9 to 433 From 11.5 to 1732	Relative, according to Table 10

Continuation of Table 9

Indicator (parameter)	Letter designation according to GOST R 8.655-2009	Indicator (parameter) measurement range	Type and limits of permissible additional measurement error caused by deviation of ambient air temperature within the operating temperature range by every 10 ºC
10 Reactive single-phase power in the frequency band from 40 to 2875 Hz, VAr: – "400 V" and "1 A" modes – "100 V" and "1 A" modes – "100 V" and "5 A" modes – "400 V" and "5 A" modes	$Q_{(f)1}$	From 12 to 346 From 3 to 87 From 14 to 433 From 58 to 1732	Relative, ±[0.25×(0.9+0.02/*m*)] % for *m* from 0.01 to 0.2, where $m=(I_{(1)}\times U_{(1)}\times/sin\varphi_{IU}/)/(I_r\times U_r)$, ±0.25 % for *m* from 0.2 to 1.2
11 Total single-phase power in the frequency band from 30 to 4000 Hz, V·A: – "400 V" and "1 A" modes – "100 V" and "1 A" modes – "100 V" and "5 A" modes – "400 V" and "5 A" modes	*S*	From 12 to 346 From 3 to 87 From 14 to 433 From 58 to 1732	Relative, ±0.25 % at current from 0.01 to 1.5 A in the "1 A" mode and at current from 0.05 to 7.5 A in the "5 A" mode
12 Active phase energy, W·h	W_A	—	Relative, according to Table 10
13 Reactive phase energy of first harmonic, VAr·h	W_P	—	Relative, ±[0.25×(0.9+0.02/*m*)] % for *m* from 0.01 to 0.2, where $m=(I_{(1)}\times U_{(1)}\times sin\varphi_{IU})/(I_r\times U_r)$; ±0.25 % for *m* over 0.2 to 1.2

Table 10 – Limits of permissible additional relative error of measurement of single-phase active power and active phase energy caused by deviation of ambient air temperature

Operating mode	Root mean square value of phase current *I*, A	Power factor *cosφ*	Limits of permissible additional relative error of measurement of single-phase active power and energy caused by deviation of ambient air temperature within the operating temperature range by every 10 ºC, %
"100 V" and "5 A"; '400 V" and "5 A"	From 0.05 to 0.25 (exclusively)	1	±0.2
	From 0.25 to 7.5		±0.1
	From 0.1 to 0.5 (exclusively)	From 0.5 to 0.9	±0.25
	From 0.5 to 7.5		±0.15
"100 V" and "1 A"; '400 V" and "1 A"	From 0.01 to 0.05 (exclusively)	1	±0.2
	From 0.05 to 1.5		±0.1
	From 0.02 to 0.1 (exclusively)	From 0.5 to 0.9	±0.25
	From 0.1 to 1.5		±0.15

Table 11 – Key specifications of LPW-305

Specification	Value	
	LPW-305-1, LPW-305-2, LPW-305-3, LPW-305-4, LPW-305-5, LPW-305-6	LPW-305-7
Normal operating conditions in accordance with GOST 22261-94: – temperature, ºC – humidity at a temperature of 25 ºC, not more than, %	20 ± 5 80	

Continuation of Table 11

Specification	Value	
	LPW-305-1, LPW-305-2, LPW-305-3, LPW-305-4, LPW-305-5, LPW-305-6	LPW-305-7
Working operating conditions:		
– temperature, °C	From minus 25 to plus 60	From minus 25 to plus 60, except for modifications with letter "B" in the designation From minus 40 to plus 60 for modifications with letter "B" in the designation
– humidity at a temperature of 30 °C, not more than, %	90	90
Power supply voltage, V:		
– DC	From 120 to 600 (rated value is 311), positive or negative polarity	From 12 to 24
– AC, 50 Hz frequency	From 85 to 600 (rated value is 220)	—

2.6 Limits of the permissible basic absolute error of rate of the built-in LPW-305 clock (all modifications except for LPW-305-7 with the characteristic letter "C" in the designation) are ±1 s for 24 hours.

2.7 Limits of the permissible additional absolute error of rate of the built-in LPW-305 clock (all modifications except for LPW-305-7 with the characteristic letter "C" in the designation) caused by deviation of ambient air temperature within the operating temperature range by every 10 ºC are±0.5 s for 24 hours.

2.8 Limits of the permissible basic absolute error of current time of the built-in clock of LPW-305-7 modification with the characteristic letter "C" in the designation are ±0,005 s.

2.9 Limits of the permissible additional absolute error of current time of the built-in clock of LPW-305-7 modification with the characteristic letter "C" in the designation caused by deviation of ambient air temperature within the operating temperature range by every 10 ºC are ±0.0025 s.

2.10 The time of operating mode setting is not more than 10 minutes.

2.11 Input resistance of LPW-305 is not more than:

– (3.00 ± 0.15) MOhm for each voltage measuring input respective to the neutral input;
– (6.0 ± 0.3) MOhm between any two voltage measuring inputs.

2.12 Electrical capacitance of each voltage measuring input at a frequency of 100 Hz is not more than 100 pF.

2.13 Electromechanical relay characteristics (DIN-mounted LPW-305 modifications)

2.13.1 Maximum permissible voltage at open contacts:

– 30 V when connected to DC circuit;
– 250 V when connected to 50 Hz AC circuit;

2.13.2 Maximum permissible value of current flowing through closed relay contacts:

– 3 A when connected to DC circuit;
– 3 A (root mean square value) when connected to 50 Hz AC circuit;

2.14 Discrete input characteristics (LPW-305-3, LPW-305-6 modifications)

2.14.1 The discrete input has two states:

– "Closed" in case of connection of an external circuit with an impedance of no more than 0.2 kOhm;
– "Open" in case of connection of an external circuit with an impedance of not less than 50 kOhm.

2.15 Pulse output characteristics (LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications):

– voltage at the output contacts in the "Open" state is not more than 24 V;
– current in the output circuit in the "Closed" state is not more than 30 mA;
– resistance of the output circuit in the "Open" state is not more than 1 MOhm;
– resistance of the output circuit in the "Closed" state is not more than 50 MOhm;

2.16 Data receiving and transmitting

– via RS-232, RS-485, Ethernet interfaces for DIN-rail mounted LPW-305 modifications;
– via Ethernet interface for LPW-305-7.

Rate of exchange via RS-232, RS-485 interfaces: 1,200; 2,400; 4,800; 9,600; 14,400; 19,200; 38,400; 57,600; 115,200 b/s.

Ethernet interface characteristics: 10/100BASE-TX standard, Auto-MDIX supported, full-duplex, rate of exchange 10; 100 Mb/s.

2.17 Input resistance of LPW-305 (LPW-305-2, LPW-305-5 modifications) for RS-485 interface load input is (120 ± 5) Ohm.

2.18 Technical characteristics of LPW-305 are kept within the standard specifications (Tables 5 – 11) at the voltage indicated in Table 11.

2.19 Power consumption of LPW-305:

– not more than 20 V·A (20 W) for DIN-rail mounted LPW-305 modifications;
– not more than 5 W for LPW-305-7.

The power consumed by each phase voltage measurement circuit relative to the neutral is not more than 0.05 V·A.

2.20 The rating of protection against penetration of water and foreign objects is IP52 according to GOST 14254-96.

2.21 Overall dimensions:

– not more than 170 × 155 × 82 mm for DIN-rail mounted LPW-305 modifications;
– not more than 100×65×205 mm for LPW-305-7.

2.22 Weight:

– not more than (0.9 ± 0.2) kg for DIN-rail mounted LPW-305 modifications;
– not more than (0.7 ± 0.2) kg for LPW-305-7.

2.23 Mean time to failure is not less than 60,000 h.

2.24 Average recovery time is not more than 8 h.

2.25 Service life is not less than 10 years.

2.26 No creep: LPW-305 (DIN-rail mounted LPW-305 modifications) does not measure electrical power at no current in the circuit current and at a voltage of 1.15 of the nominal value specified in paragraph2.1.

2.27 Starter current (sensitivity)

2.27.1 LPW-305 (DIN-rail mounted LPW-305 modifications) starts and continues to measure electrical power:

- at a current value of $0.001 \cdot I_r$ (paragraph 2.1) and a power factor of 1.0, for active power measurements;
- at a current value of $0.002 \cdot I_r$ (paragraph 2.1) and a value of sinφ factor of 1.0 (inductive or capacitive load), for reactive power measurements.

2.28 DIN-rail mounted LPW-305 modifications are equipped with a real time clock and a calendar. Time setting allows the user to set the hours, minutes and seconds, date setting allows the user to set the day, month and year.

The real-time clock is powered by a built-in battery that ensures continuous operation for at least two years.

2.29 Each voltage measuring input of LPW-305 can withstand a 50 Hz AC overvoltage with a root mean square value of 1,600 V for 1 hour.

2.30 Each current measuring input of LPW-305 (DIN-rail mounted LPW-305 modifications) can withstand a 20 A input overcurrent for 1 hour.

2.31 In DIN-rail mounted LPW-305 modifications, system log data and measurement results in non-volatile memory are kept in case of power failure for at least 15 days.

2.32 LPW-305 provides for unlimited continuous operation.

2.33 Electrical strength and isolation resistance of LPW-305

2.33.1 Electrical strength and isolation resistance of DIN-rail mounted LPW-305 modifications

2.33.1.1 Internal protection circuit of DIN-rail mounted LPW-305 (modifications according to Table 1) which is connected between the Ethernet interface contacts on one side and the contacts of the protective earth terminals on the other side withstands 1A DC effect in both directions for 1 minute.

2.33.1.2 Isolation between combined contacts of terminals of voltage and current measuring inputs, electromechanical relay circuit, network power supply circuit, pulse output (for LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications), discrete input (for LPW-305-3, LPW-305-6 modifications) and RS-485, RS-232 interfaces on one side and combined contacts of protective earth terminals on the other side withstands 3.3 kV DC voltage effect for 1 minute without breakdown.

2.33.1.3 Isolation between combined contacts of terminals of voltage and current measuring inputs, electromechanical relay circuit, network power supply circuit on one side and combined contacts of terminals of pulse output (for LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications), discrete input (for LPW-305-3, LPW-305-6 modifications) and RS-485, RS-232 interfaces on the other side withstands 5.5 kV DC voltage effect for 1 minute without breakdown.

2.33.1.4 Resistance of isolation between the circuits indicated in sub-paragraphs2.33.1.2 2.33.1.3 is not more than:

- 20 MOhm for normal operating conditions;
- 5 MOhm at 60 °C and a relative air humidity of up to 80 %;
- 2 MOhm at (20±5) °C and a relative air humidity of 93 %.

2.33.2 Electrical strength and isolation resistance of LPW-305-7

2.33.2.1 Internal protection circuit of LPW-305-7 which is connected between the Ethernet interface contacts on one side and the contact of the protective earth terminal on the other side shall withstand 1A DC effect in both directions for 1 minute.

2.33.2.2 Isolation between the combined contacts of terminals of the voltage measurement inputs, the contacts of the connector for connection of outputs of three measuring current clamps to LPW-305-7 on one side and the protective grounding terminal on the other side shall withstand 2 kV DC voltage effect for 1 minute without a breakdown.

2.33.2.3 Resistance of isolation between the circuits indicated in sub-paragraph 2.33.2.2 is not more than:

- 20 MOhm for normal operating conditions;
- 5 MOhm at 60 °C and a relative air humidity of up to 80 %;
- 2 MOhm at (20±5) °C and a relative air humidity of 93 %.

2.34 Electromagnetic compatibility

2.34.1 In terms of resistance to electromagnetic interference, LPW-305 conforms to GOST R 51317.6.5-2006 for power plants and medium voltage substations.

2.34.2 Electromagnetic emission of LPW-305 during its operation meets the requirements of GOST 30804.6.3-2013.

3 LPW-305 DESIGN AND OPERATING PRINCIPLES

3.1 General information

3.1.1 LPW-305 are multi-functional measuring instruments for electric power industry which are produced in various modifications, see paragraph1.2.

LPW-305 can be used not only in the off-line mode (in the mode of information accumulation with subsequent withdrawal of this information, for example, by means of a laptop computer), but also as a telemetry device connected to a computer. Data are received and transmitted between LPW-305 and a computer via one of the interfaces (RS-232, RS-485, Ethernet) indicated in paragraph2.16.

Note. RS-232 is a "short-range" interface (from several meters to tens of meters), RS-485 is a "medium-range" interface (tens to hundreds meters), Ethernet is a "long-range" interface (in case of integration into a global network, the communication range is almost unlimited).

In a portable version of LPW-305-7, a GPS-module can be installed at a customer's request (LPW-305-7 with the characteristic letter "C" in the designation (see paragraph 1.2). There is a connector for connection of a GPS antenna on the case of such LPW-305-7.

Portable LPW-305-7 modification with characteristic letter "B" in the designation (see paragraph 1.2) is designed for performing PQI measurements at a temperature below minus 25 °C (down to minus 40 °C).

3.1.2 LPW-305 are used for measuring phase voltages U_{ph1}, U_{ph2}, U_{ph3} relative to neutral circuit *N*.

DIN-rail mounted LPW-305 modifications ure also used for measuring phase currents I_{ph1}, I_{ph2}, I_{ph3}. In the portable version of LPW-305-7, the current measuring inputs are either missing (if characteristic letter "A" is absent in the designation), or there is a connector for connecting outputs of three current measuring clamps to LPW-305-7 with a voltage at their outputs in the range from 0 to 5 V (if characteristic letter "A" is present in the designation), for example, LPW-305-7-A). The type of current clamps can be selected in the window of LPWStudio II program.

All other physical values indicated in Table 4, apart from the values of phase voltages and currents, are the results of indirect measurements, i.e. LPW-305 calculates them based on the measured values of phase voltages and currents.

3.1.3 Indicators, keys and electronic menu of DIN-rail mounted LPW-305 described in section 7 allow for making initial settings during the installation of these LPW-305 modifications and, if necessary, for monitoring any LPW-305 readings visually. However, this indication system and menu are rather auxiliary as it is more convenient for the user to use a computer for taking and analyzing the readings of all LPW-305 modifications.

3.1.4 Power supply to DIN-rail mounted LPW-305

3.1.4.1 If power is supplied to DIN-rail mounted LPW-305 from 50 Hz AC network, then the device shall only be connected only to 50 Hz AC network with a rated voltage of 220 V, despite the fact that LPW-305 has a wide voltage range (see Table 11) and is a highly reliable event recorder even in emergency situations of long-term overvoltage or a voltage drop in the line used to power it.

3.1.4.2 If measurements are to be made with measuring inputs of LPW-305 directly connected to the voltage circuit, i.e. without the use of voltage transformers (VT), LPW-305 can be powered from one of the phase voltages U_{ph1}, U_{ph2}, U_{ph3} of the AC network (paragraph6.5.2, Table 136.5.2).

3.1.4.3 LPW-305 can be powered by DC voltage of positive or negative polarity from 250 to 320 V (see Table 11). In this case, all metrological and technical specifications of LPW-305 are ensured in full.

3.1.5 LPW-305-7 power supply

3.1.5.1 LPW-305-7 is powered by 12 to 24 V, up to 5 W DC voltage. The power supply source is connected to the terminals of the terminal block on the side panel of LPW-305-7 in accordance with the polarity indicated on it. If the power supply source poles are connected to LPW-305-7 incorrectly, this error will trigger the automatic protection of LPW-305-7.

For user convenience, there is a possibility to connect a backup (second) voltage source to LPW-305-7. In LPW-305-7, one of the two connected sources is selected automatically.

At a customer's request, LPW-305-7 power supply can be included in the LPW-305-7 supply package for its powering from 50 Hz AC network (220 ± 22) V.

3.1.6 Data are received and transmitted during LPW-305 operation via one of the interfaces described in paragraph 2.16.

The type of active interface is selected in the window of LPWStudio II program (see paragraph7.2.1). For DIN-rail mounted LPW-305 modification, own nested menu system of LPW-305 can also be used in accordance with sub-paragraphs7.3.24.6 – 7.3.24.12.

If RS-485 and RS-232 interfaces are simultaneously connected by the user to DIN-rail mounted LPW-305, data will only be received and transmitted via RS-232 interface. Simultaneous connection of Ethernet and RS-232 or Ethernet and RS-485 interfaces by the user is possible, but in this case the interface selected in the window of LPWStudio II program or in the menu of LPW-305 (see paragraph 7.3.24.6) will be the active interface, and the inactive interface will not be logically engaged and will be electrically passive.

3.1.7 If several DIN-rail mounted LPW-305 are used in AC network, the pulse opto-isolated input of one LPW-305 can be connected to the discrete opto-isolated input of another LPW-305 to ensure quick response of several LPW-305 to critical events in this network. In this case, the signaling will be performed based on the "master-slave" principle according to the diagrams shown in Figures B.18 – B.20 of Appendix B.

3.1.8 The output of the executive circuit of the electromechanical relay of DIN-rail mounted LPW-305 ("Relay 1", "Relay 2" outputs on the front panel) is used to control the external overvoltage protective device. The tripping logic of the electromechanical relay can be either single (for one LPW-305) or group, according to paragraph 3.1.7.

3.2 LPW-305 design

3.2.1 Design of DIN-rail mounted LPW-305

3.2.1.1 DIN-rail mounted LPW-305 is enclosed in an isolated polycarbonate case. On the front of it, a display panel and control buttons are located. On the rear, there is a bracket for DIN-rail mounting. In the lower part of the case of LPW-305, there is a terminal block with threaded terminals (21 pins), intended for connection to voltage measuring circuits, supply, grounding and control circuits. The terminals of the terminal block can only be accessed with the protective cover removed, which is sealed after the necessary user connections are made. In the upper part of the case of LPW-305, there are three through-holes of current measuring inputs, designed to pass the wires of current measuring circuits through them. On the bottom surface of the case of LPW-305 there is a RJ-45 on the side of the terminal block for connection to the Ethernet interface.

3.2.1.2 LPW-305 case consists of the front and back covers. Inside the case, boards of the interface module and the controller module are fixed. The interface module board is attached to the inside of the back case cover and the controller module board is attached to the front case cover. Both boards are connected to each other with a flat cable located on one side, which allows for disconnecting the front and back covers of the case during dismantling to open the structure as a book.

3.2.1.3 On the front panel of LPW-305 (on the front case cover), there are indicators for displaying measurement results and auxiliary information (indication of the displayed value, etc.) of the following types:

- three four-place 7-segment digital indicators with a decimal point to the right of each place;
- one two-place 14-segment -alphanumeric indicator with a decimal point to the right of each place.

The glowing color of the indicators for displaying measurement results and auxiliary information is green. The glowing brightness is adjusted with the use of LPW-305 menu in accordance with paragraph 7.3.23.3. The indicator control is of impulse type.

3.2.1.4 The "Rx" and "Tx" LEDs on the front panel of LPW-305 serve to indicate the process of information exchange via RS-232, RS-485 interfaces: the "Rx" indicator glows during information receiving and the "Tx" indicator glows during information transmission. For active RS-232 or RS-485 interface, the "Rx" LED glows in the receiving mode, the "Tx" LED glows in the data transfer state.

The "1000 imp/kWh" LED on the front panel of LPW-305 is an optical test output.

3.2.1.5 On the front panel, there are four keys for setting up and control of LPW-305: "▼", "►", SELECT, RESET. Their designation and use are described in sub-section 7.3.

3.2.1.6 View of DIN-rail mounted LPW-305 is shown in Figure A.1 of Appendix A.

3.2.2 LPW-305-7 design

3.2.2.1 LPW-305-7 are enclosed in a case made of ABS UL94-HB plastic and have no indication and control panel. On one of the side panels of the case there are voltage measuring inputs - four sockets for connection of three phase voltages and electrical network neutral, a protective grounding socket, indicators "POW" ("РАБ") (meter power supply) and "PHASE" ("ФАЗ) (correct connection of phase voltages). On the opposite side panel there is a screw terminal connector for connecting main and backup power supplies, RJ-45 connectors for connecting to the Ethernet interface, and there also can be a connector for connecting to a GPS system antenna and a connector for connecting up to three current clamps.

The view of LPW-305-7 is shown in Figure A.2 of Appendix A.

3.3 Electrical block diagrams of LPW-305 modifications

3.3.1 Electrical block diagram of DIN-rail mounted LPW-305

3.3.1.1 The electrical block diagram of DIN-rail mounted LPW-305 is shown in Figure 2. Functional differences of DIN-rail mounted LPW-305 modifications are described in paragraph 1.2.

The interface module shown in the electrical block diagram includes:

– pulse power supply unit;
– three-phase voltage divider;
– relay;
– RS-232/RS-485 interface transceiver unit with galvanic isolation;
– I/O submodule with galvanic isolation (in LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications only)

The controller module shown in the electrical block diagram includes:

- ARM controller;
- six-channel sigma-delta ADC;
- frequency measuring channel;
- Flash memory;
- galvanic isolation unit;
- Ethernet interface protective unit;
- CT current shunt unit;
- MicroSD memory card (only for LPW-305-4, LPW-305-5, LPW-305-6 modifications);
- built-in real-time clock;
- battery for power supply to the built-in clock and MicroSD memory card;
- LPW-305 internal temperature sensor;
- keyboard;
- LEDs;
- alphanumeric and numeric indicators.

3.3.1.2 ADC has six parallel signal conversion channels: three channels for conversion of voltage from the outputs of a three-phase voltage divider and three channels for conversion of current from CT current shunts.

3.3.1.3 A specific feature of DIN-rail mounted LPW-305 is the arrangement of current measuring inputs which are implemented as through holes of toroidal CTs located inside LPW-305 case. Such an arrangement of current measuring inputs ensures electromagnetic coupling with negligibly small energy losses between the current in the wire passed through the hole and the current flowing in the CT winding. Provided that the recommendations for section of the connected current wires (paragraph 6.5.3.2) are observed, power consumed by LPW-305 through the circuits of the current measuring inputs will be negligible, and the inductance value of each current measuring input will be negligible compared to the inductance of the incoming wires.

3.3.1.4 The frequency measuring channel includes a generator of frequency signal from the output of a three-phase voltage divider, a bandpass filter, a comparator, and an ARM controller timer used to measure the signal period. Frequency measurement results are used in the mathematical method of signal processing applied in LPW-305.

3.3.1.5 Non-volatile 2 MB flash-memory provides storage of system log data, measurement results and PQI calculations, system log replenishment, and storage of these data when the power is off. Writing to the memory is cyclic.

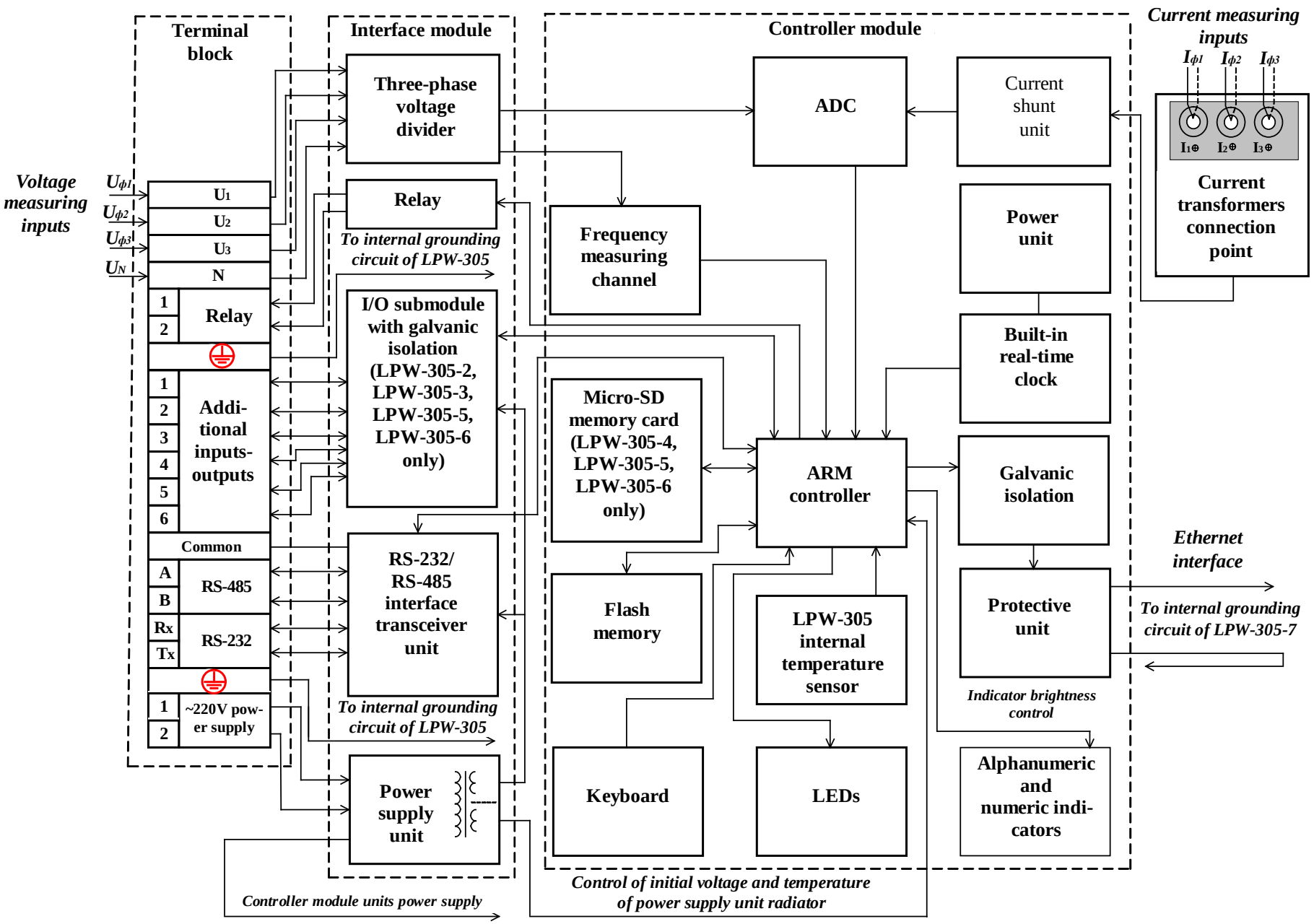


Figure 2 – Electrical block diagram of DIN-rail mounted LPW-305

3.3.1.6 ADC has six parallel signal conversion channels: three channels for conversion of voltage from the outputs of a three-phase voltage divider and three channels for conversion of current from CT current shunts.

3.3.1.7 A specific feature of DIN-rail mounted LPW-305 is the arrangement of current measuring inputs which are implemented as through holes of toroidal CTs located inside LPW-305 case. Such an arrangement of current measuring inputs ensures electromagnetic coupling with negligibly small energy losses between the current in the wire passed through the hole and the current flowing in the CT winding. Provided that the recommendations for section of the connected current wires (paragraph 6.5.3.2) are observed, power consumed by LPW-305 through the circuits of the current measuring inputs will be negligible, and the inductance value of each current measuring input will be negligible compared to the inductance of the incoming wires.

3.3.1.8 The frequency measuring channel includes a generator of frequency signal from the output of a three-phase voltage divider, a bandpass filter, a comparator, and an ARM controller timer used to measure the signal period. Frequency measurement results are used in the mathematical method of signal processing applied in LPW-305.

3.3.1.9 Non-volatile 2 MB flash-memory provides storage of system log data, measurement results and PQI calculations, system log replenishment, and storage of these data when the power is off. Writing to the memory is cyclic.

3.3.1.10 Non-volatile MicroSD memory (in LPW-305-4, LPW-305-5, LPW-305-6 modifications only) with a capacity of not less than 2 GB is designed for a significant extension of the time of storage of system log data, measurement results and PQI calculations. Writing to the memory is cyclic.

3.3.1.11 The built-in real time clock is used for time referencing of measurement results. Remote clock synchronization via LPW-305 interfaces is technically possible.

3.3.1.12 A lithium battery (CR2032 type) serves to support the operation of the built-in real-time clock in the event of a power failure of LPW-305.

3.3.1.13 The power supply unit provides three-way galvanic isolation among:

1) network power supply circuits;

2) low-voltage interface circuits RS-485, RS-232, additional inputs-outputs (LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications only);

3) power supply circuits of controller module units galvanically coupled with the neutral N input.

3.3.1.14 The power supply unit has an own thermal sensor to control the heating of the internal heat sink in the mode of supply voltage overload. Temperature sensor readings are monitored by the ARM controller.

3.3.1.15 The temperature sensor inside LPW-305 housing (see Figure 2) provides additional evaluation data on the temperature conditions of LPW-305 operation. This information is transferred to the ARM-controller and can be used in telemetry. The sensor is not an official means of temperature measuring, and its typical (reference) absolute error is ± 5 °C.

3.3.2 Electrical block diagram of LPW-305-7

3.3.2.1 The electrical block diagram of LPW-305-7 is shown in Figure 3. On PCB of LPW-305-7, the following components are mounted:

- DC-DC converter with galvanic isolation;
- four-channel voltage divider;
- ARM controller;
- sigma-delta ADC;
- frequency measuring channel;
- Flash memory;
- galvanic isolation unit;
- Ethernet interface protective unit;
- MicroSD memory card;
- built-in real-time clock;
- battery for power supply to the built-in clock and MicroSD memory card;
- LPW-305 internal temperature sensor;
- LEDs;
- a connector for current clamps connection (in LPW-305-7 modification with characteristic letter "A" in the designation);
- a GPS module (in LPW-305-7 modification with characteristic letter "C" in the designation).

3.3.2.2 The sigma delta ADC has seven parallel signal conversion channels: four channels for conversion of voltage from the outputs of a four-channel voltage divider and three channels for conversion of current from current clamps outputs.

3.3.2.3 For more information about the frequency measuring channel, see paragraph 3.3.1.8.

3.3.2.4 For non-volatile Flash-memory, see paragraph 3.3.1.5.

3.3.2.5 For non-volatile MicroSD memory, see paragraph 3.3.1.10.

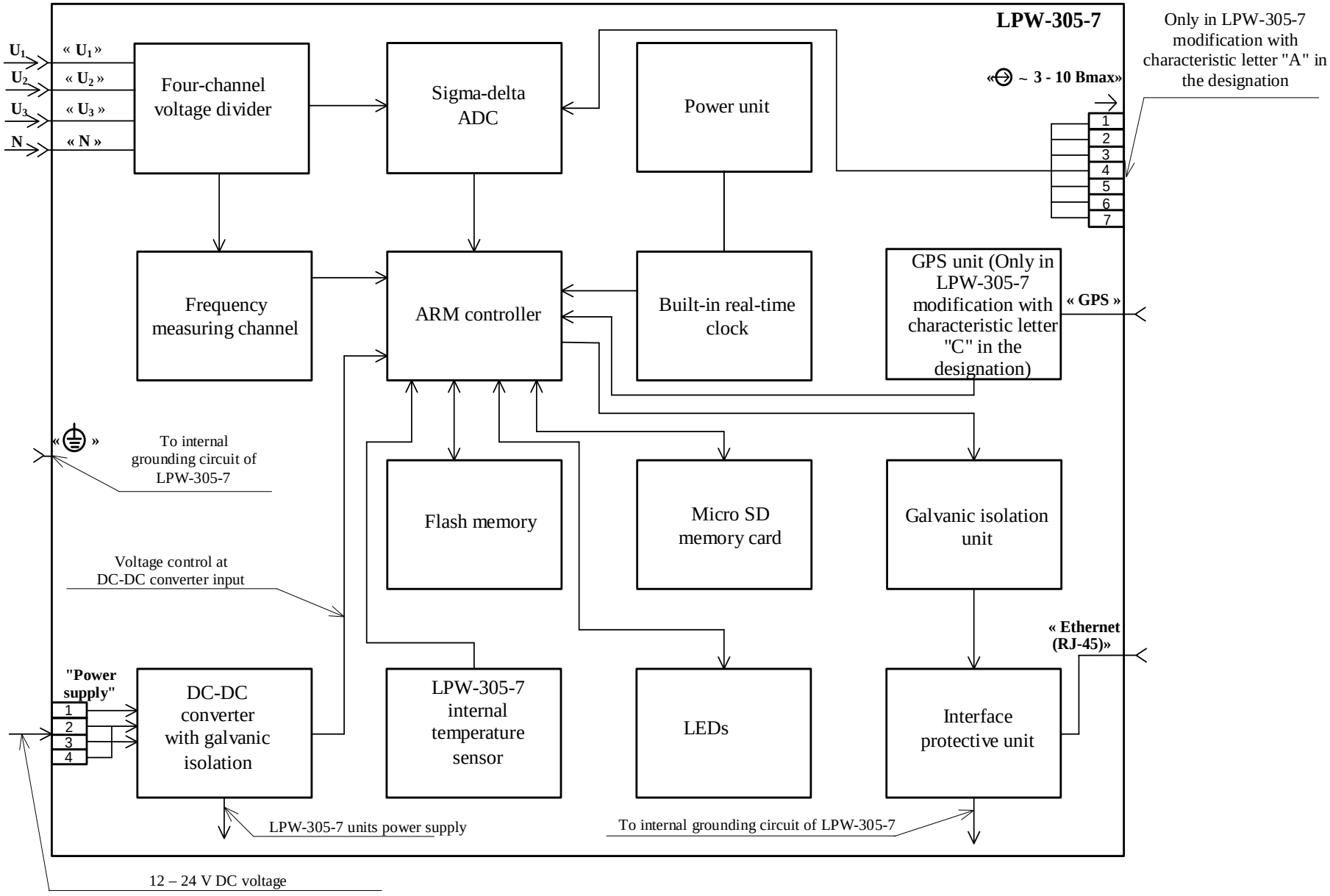


Figure 3 – Electrical block diagram of LPW-305-7

3.3.2.6 For buil-in real-time clock, see paragraph 3.3.1.11.

3.3.2.7 A lithium battery serves to support the operation of the built-in real-time clock in the event of a power failure

3.3.2.8 DC-DC converter provides three-way galvanic isolation among:

1) external power supply circuits of LPW-305-7 (DC-DC converter input);

3.3.2.9 For more information about LPW-305-7 internal temperature sensor, see paragraph 3.3.1.15.

2) power supply circuits of PCB units galvanically coupled with the neutral N input;

3) voltage control circuits at DC-DC converter input.

3.3.2.10 The connector for connecting current clamps with an AC output voltage of 3 to 10 V with a frequency of 50 Hz is provided only in LPW-305-7 modification with characteristic letter "A" in the designation.

3.3.2.11 On the PCB of LPW-305-7 modification with characteristic letter "C" in the designation a GPS module is installed to which a remote GPS antenna is connected.

3.4 Description of LPW-305 operation.

3.4.1 Description of DIN-rail mounted LPW-305 operation

3.4.1.1 The ARM controller processes digital codes coming from the ADC and frequency measuring channel and calculates measured values of voltage, current, PQI, electric power and electric energy. Then the ARM controller writes the processed measurement results to the Flash memory. For LPW-305-4, LPW-305-5, LPW-305-6 modifications, measurement results can also be written to the MicroSD memory card. The background task of the ARM controller is also servicing one of the three interfaces, which is currently active (paragraph 7.3.24.6), indicators, LEDs, checking states of the keys, collecting readings from temperature sensors and operating the real-time clock.

3.4.1.2 In the event that the power supply unit heat sink is overheated (which can occur in overvoltage situations in the power circuit, possibly in combination with a high ambient temperature factor), the ARM controller switches LPW-305 over to a low power consumption mode by turning off the indicators while all other functions of LPW- 305 continue to be performed. The external manifestation of the low power consumption mode is the complete absence of indicators glowing and constant glowing of the "Rx" LED. LPW-305 will be returned to the normal operating mode automatically as the power unit heat sink cools down due to the reduced power consumption or due to the disappearance of the above factors which have caused LPW-305 transition to the low power consumption mode. Thus, the low power consumption mode is the "survival mode" of LPW-305 in emergency situations, and continuous operation of LPW-305 in this mode is inadmissible.

3.4.1.3 In the event of a complete power failure, LPW-305 will store the current status in the Flash memory or on the MicroSD memory card (LPW-305-4, LPW-305-5, LPW-305-6 modifications).

3.4.2 Description of LPW-305-7 operation.

3.4.2.1 The ARM controller LPW-305-7 processes digital codes coming from the ADC and frequency measuring channel and calculates voltage parameters and voltage-dependent PQIs for LPW-305-7 modification with characteristic letter "A" in the designation (for example, LPW-305-A), current values, current-dependent PQIs, electric power and electric energy parameters are also calculated if current clamps are connected to the connector . «⊖ ~ 3 - 10 Bmax»

Then the ARM controller writes the processed measurement results to the Flash memory. Measurement results can also be written to the MicroSD memory card. The background task of the ARM controller is also servicing the Ethernet interface, LEDs, collecting readings from temperature sensors and operating the real-time clock.

3.4.2.2 In the event of a complete power failure, LPW-305-7 will store the current status in the Flash memory or on the MicroSD memory card.

4 MARKING AND SEALING

4.1 Each LPW-305 device is marked with indication of:

- product name and modification;
- manufacturer's name;
- factory number and year of manufacture;
- type of measuring instruments approval mark according to PR 50.2.107;
- unified mark of product circulation in the market of the Customs Union Member States subject to the Resolution of the Customs Union Commission No. 711 dated July 15, 2011;
- maximum voltage at the measuring inputs;
- rated supply voltage value;
- maximum power consumed from the power source;
- rated frequency of the power supply network (for DIN-rail mounted LPW-305, modifications according to Table 1);
- maximum current (for DIN-rail mounted LPW-305, modifications according to Table 1);

4.2 Near the terminals of the terminal block, connectors, indicators and LEDs, there are inscriptions and symbols indicating their designation.

4.3 Sealing of DIN-rail mounted LPW-305

4.3.1 Manufacturer's QCD seals the screw heads on the back cover of LPW-305 case.

4.3.2 LPW-305 case is sealed by the power supervisory control service with sealing wire, the holes for which are in the upper left and right parts of LPW-305 case, as shown in Figure 3.

4.3.3 The protective cover closing the terminal block is sealed by the power supervisory control service after making all the necessary connections with sealing wire, the holes for which are in the lower left and right parts of LPW-305 case (see Figure 3). The method of fixing the seal and the position of the sealing wire should prevent it from getting into the contact area of the terminal block.

4.3.4 Current inputs wires are sealed by the power supervisory control service with a special sealing tape at LPW-305 installation slot (see Figure 3).

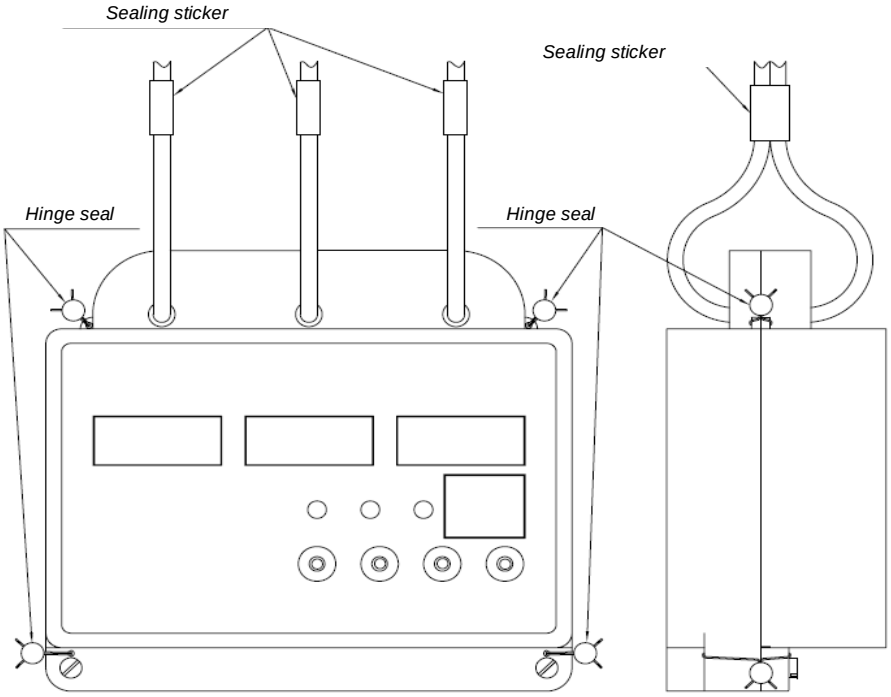


Figure 3 – Sealing of DIN-rail mounted LPW-305

4.4 Sealing of LPW-305-7

4.4.1 LPW-305-7 is sealed using two special sealing labels with the inscription "DO NOT OPEN". Labels location is shown in Figure 4.

Figure 4 – Sealing of LPW-305-7

5 SAFETY MEASURES

5.1 In terms of protection against electric shock, LPW-305 corresponds to class I according to GOST 12.2.007.0-75.

5.2 For general safety requirements, LPW-305 complies with GOST 12.2.091-2012.

5.3 LPW-305 must be safely grounded.

DIN-rail mounted LPW-305 is grounded by means of two terminals of the terminal block marked " ⏚ ", according to Table 13.

For LPW-305-7 grounding, a socket is used on the side panel marked " ⏚ ".

5.4 Connection, replacement and repair of LPW-305 must be carried out with the power network disconnected and measuring and control circuits de-energized.

Connection to Ethernet, RS-485, RS-232 interface lines during LPW-305 operation is only allowed if LPW-305 is grounded. In addition, for DIN-rail mounted LPW-305, the connection performed should not assume any installation actions with the terminal block, which is only possible if the RS-232 or RS-485 interface wires have been pre-connected to the terminal block with LPW-305 de-energized.

5.5 LPW-305 may only be operated by persons who have valid certificates confirming their right to work on electrical installations with an electric safety qualification group of not lower than III.

6 PRE-STARTING PROCEDURES

6.1 Check after opening the package

6.1.1 After opening the package, LPW-305 completeness shall be checked for conformity to the packing list.

6.2 Requirements to the slot of installation of LPW-305

6.2.1 LPW-305 shall be installed in slots that are protected from direct water ingress and exclude the contact with chemically aggressive environments.

6.2.2 It is recommended to install LPW-305 away from heat sources to minimize the effect of additional temperature error on the measurement results. If LPW-305 is operated at a high ambient temperature, it is recommended to reduce the brightness of the indicator of DIN-rail mounted LPW-305 to the minimum required value (paragraph 7.3.23.3).

6.2.3 Bright sunlight does not affect the technical specifications of LPW-305. However, when direct sunlight hits the front panel of the DIN-rail mounted LPW-305, it may be difficult to take the readings from its indicators visually.

6.3 Observance of safety requirements

6.3.1 Connections shall be made with strict observance of the safety rules set forth in section 5.

6.4 Connection of open (aerial) interface lines to LPW-305

6.4.1 In case of connection of open (aerial) RS-485 and Ethernet interface lines passing outside buildings to LPW-305, additional lightning protection devices with surge arresters must be used.

6.5 Installation and connection of DIN-rail mounted LPW-305

6.5.1 Diagrams of LPW-305 connection to external circuits are presented in Appendix B.

In order to ensure trouble-free operation, the following components must be installed (see the diagrams presented in Appendix B):

- in current measuring circuits - contactors for reliable closing of secondary CT circuits before dismantling of LPW-305;
- in voltage measuring circuits - single-pole circuit breakers of class B or C for 1 A or 2 A current;
- in the power supply circuit - a two-pole circuit-breaker of class B or C for 4 A or 5 A current.

6.5.2 Perform the following sequence of operations:

1) install LPW-305 on a DIN-rail on a vertical surface using the attachment on the back cover

of LPW-305 case. The operating position of LPW-305 is vertical;

ATTENTION: to remove LPW-305 from the DIN-rail, it shall be pulled up and tilted so that the top of LPW-305 be closer to the user than the bottom;

2) fasten LPW-305 to the DIN-rail having ensured that there is free space for wire connections from above and from below;

3) unscrew the self-tapping screws of the protective cover of the terminal block of LPW-305 to obtain access to the terminals of the terminal block;

4) prepare the wires for connecting the terminals of LPW-305 terminal block to the circuits of the voltage measuring inputs, power supply inputs, RS-232, RS-485 interfaces and external devices in accordance with the recommendations given in Table 12. Chip the wires for a recommended length of 8 mm;

Table 12

Designation of terminal block output	Recommended wire section, mm^2
" ⏚ "	From 2.5 to 4
"220 V, 50 Hz, 20 V·A 1», «220 V, 50 Hz, 20 V·A 2»	2.5
"U_1", "U_2", "U_3", "N"	From 1 to 2.5
"Relay 1", "Relay 2"	
"RS-485 A", "RS-485 B"	From 0.2 to 0.5
"RS-232 A", "RS-232 B", "COM"	
"Additional inputs-outputs 1"	
"Additional inputs-outputs 2"	
"Additional inputs-outputs 3"	
"Additional inputs-outputs 5"	
"Additional inputs-outputs 6"	

5) fully open the connected terminals of the terminal block by turning the screws of these terminals counter-clockwise with a screwdriver;

6) connect the terminals of LPW-305 terminal block to the external circuits in strict accordance with Table 13. Insert the bare ends of the connected wires into the corresponding terminals of the terminal block and fasten the wires by turning the terminal screws of the terminal block clockwise;

Table 13

Designation of terminal block output	Electrical circuit application	Additional instructions on connecting terminal block output
"U_1"	Phase *L1* voltage measuring input	If the voltage measuring input is not engaged in the measurement diagram, it shall be connected to the same circuit to which the "N" neutral input connected for the selected measurement diagram.
"U_2"	Phase *L2* voltage measuring input	If the voltage measuring input is not engaged in the measurement diagram, it shall be connected to the same circuit to which the "N" neutral input connected for the selected measurement diagram.
"U_3"	Phase *L3* voltage measuring input	If the voltage measuring input is not engaged in the measurement diagram, it shall be connected to the same circuit to which the "N" neutral input connected for the selected measurement diagram.
"N"	Neutral connection input	If connection to the neutral is not provided for by the measurement diagram, the output shall be grounded.
"Relay 1"	Contacts 1 and 2 of the executive circuit of the electromechanical relay	See Figure B.12 of Appendix B
"Relay 2"		
" ⏚ "	Protective grounding contacts (two)	Both outputs shall be grounded at the same point on the grounding bus
"Additional inputs-outputs 1"	Pulse output * of the executive circuit of the optical relay with the possibility of connecting into a DC or AC circuit for LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications	For LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications, the outputs shall be connected as shown in Figures B.13 – B.15 of Appendix B. **The outputs shall not be connected** for LPW-305-1, LPW-305-4 modifications
"Additional inputs-outputs 2"		
"Additional inputs-outputs 3"		

Continuation of Table 13

Designation of terminal block output	Electrical circuit application	Additional instructions on connecting terminal block output
"Additional inputs-outputs 4"	The output is not used in LPW-305-1, LPW-305-4 modifications	**Do not connect the output!**
	In LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6 modifications, this output is connected to the grounding circuit inside LPW-305 for protection purpose	**Do not connect the output!**
"Additional inputs-outputs 5"	The output is not used in LPW-305-1, LPW-305-4 modifications	**Do not connect the output!**
	Load of line "A" of RS-485 interface for LPW-305-2, LPW-305-5 modifications	Connect as shown in Figure B.8 of Appendix B
	Discrete input (positive potential) for LPW-305-3, LPW-305-6 modifications	Connect only to a contact isolated from other circuits or to an electronic circuit equivalent to the isolated contact as shown in Figures B.16, B.17 of Appendix B
"Additional inputs-outputs 6"	The output is not used in LPW-305-1, LPW-305-4 modifications	**Do not connect the output!**
	Load of line "B" of RS-485 interface for LPW-305-2, LPW-305-5 modifications	Connect as shown in Figure B.9 of Appendix B
	Discrete input (negative potential) for LPW-305-3, LPW-305-6 modifications	Connect only to a contact isolated from other circuits or to an electronic circuit equivalent to the isolated contact as shown in Figures B.16, B.17 of Appendix B
"COM"	Common wire for circuits of RS-232, RS-485 interfaces	Connect as shown in Figures B.8 to B.11of Appendix B If a RS-485 design version with a drain wire is used, the "COM" output is connected to the drain wire that must be grounded through 100 Ohm resistors (typically) from both ends of the wire.

Continuation of Table 13

Designation of terminal block output	Electrical circuit application	Additional instructions on connecting terminal block output
"RS-485 A"	Line "A" of RS-485 interface	Connect as shown in Figures B.8 to B.10 of Appendix B
"RS-485 B"	Line "B" of RS-485 interface	
"RS-232 Rx"	RS-232 interface input	Connect as shown in Figure B.11 of Appendix B
"RS-232 Tx"	RS-232 interface output	
'220 V, 50 Hz, 20 V·A 1"	LPW-305 power supply	Any order of the neutral phase connection in the power circuit is allowed. In case of direct connection of LPW-305 measuring inputs to the network (i.e., without the use of voltage transformers), LPW-305 can be powered from one of the phase voltages U_{ph1}, U_{ph2}, U_{ph3} of the AC network, as shown in Figures B.2 and B.7 of Annex B for a three-phase 380 V network and single-phase 220 V network, respectively.
'220 V, 50 Hz, 20 V·A 2"		

* The pulse output of one LPW-305 (LPW-305-2, LPW-305-3, LPW-305-5, LPW-305-6) can be connected to the discrete input of another LPW-305 (LPW-305-3, LPW-305-6) to arrange signaling based on the "master-slave" principle as shown in Figures B.18 – B.20 of Appendix B

7) secure the protective cover of LPW-305 terminal block, blocking access to its terminals.

ATTENTION: since the protective cover of the terminal block is sealed on both sides by the supervisory services, all necessary connections (including RS-232, RS-485 interfaces) to the terminals of the terminal block must be performed in advance, because it will not be possible to change the connections with sealed protective cover;

8) connect the current measuring inputs of LPW-305 to external circuits in full compliance with the instructions given in paragraph6.5.3;

9) connect, if necessary, LPW-305 to Ethernet interface circuits in accordance with paragraph6.5.4;

10) supply power to LPW-305;

For a few seconds after powering on, LPW-305 self-diagnostics will be running;

after successful completion of the self-diagnostics, the "OK" indication will be displayed on the indicator, and presence of an interface connection with type external devices will be indicated

by"Rx", "Tx" LEDs blinking.

6.5.3 The procedure for connection of current measuring inputs of LPW-305 to external circuits

6.5.3.1 Diagrams of possible connections of current measuring inputs of LPW-305 to external circuits are shown in Figures B.1 – B.7 of Appendix B.

ATTENTION: to avoid a fire, current wires from an external CT should be connected only with closed secondary current circuit from the external CT (see paragraph6.5.1).

6.5.3.2 Make sure that the connected wires have a current wire cross-section of 4 mm^2 and an outer diameter with insulation of not more than 5.2 mm.

In addition, the wires should have increased flexibility (the recommended brand is PV-3 with a cross section of 4 mm^2).

Provided that the recommendations as to the section of current wires are fulfilled, LPW-305 operates correctly in case of an overload of the current measuring inputs with an input current of 20 A for 1 hour (see paragraph 2.30).

6.5.3.3 Pass each current wire connected from the external transformer once in the hole of the corresponding current measuring input at the top of LPW-305 case. The designations of the current measuring inputs and instructions on observing the current direction are given in Table 14. The wire entering the current input hole on the front side of LPW-305 panel must correspond to the current direction "from the generator".

For circuits in which there are unused current measuring inputs, the corresponding holes in the top of LPW-305 case should be left empty.

Table 14

Designation of current measuring input	Input application	Additional instructions on input connection
"$I_1 \oplus$"	Phase *L1* current measuring input	Sign ⊕ means that the current wire corresponding to the current direction "from the generator" must enter the current input hole on the side of the front panel of LPW-305. It is prohibited to pass the current wire through the hole for more than once
"$I_2 \oplus$"	Phase *L2* current measuring input	
"$I_3 \oplus$"	Phase *L3* current measuring input	

6.5.4 Procedure for connection to Ethernet interface circuits

6.5.4.1 For correct operation of the Ethernet interface with the LPW-305, it is necessary that a connected remote device (switch, router, computer) has galvanic isolation of the used Ethernet interface line from the grounding circuit.

6.5.4.2 LPW-305 is connected to the Ethernet interface circuits via a RJ-45 connector located on the bottom of LPW-305 case on the terminal board side, in accordance with Table 15. If a

screened Ethernet cable is used, it is recommended to connect the screen to not more than one grounding point.

Table 15

Contact	Circuit	Circuit application
1	"Tx+"	Information transmission line
2	"Tx–"	Information transmission line
3	"Rx+"	Information receiving line
4	"Reserved"	Not used
5	"Reserved"	Not used
6	"Rx-"	Information receiving line
7	"Reserved"	Not used
8	"Reserved"	Not used

Since LPW-305 supports Auto-MDIX technology (which means that it automatically identifies the type of cable connected and "adapts" for operating with it), it is possible to make connections to the Ethernet interface circuits not only with a straight cable with the pin layout described in Table 15, but also with a cross cable, the pin assignment of which is indicated in Table 16.

Table 16

Contact	Circuit	Circuit application
1	"Rx+"	Information receiving line
2	"Rx-"	Information receiving line
3	"Tx+"	Information transmission line
4	"Reserved"	Not used
5	"Reserved"	Not used
6	"Tx–"	Information transmission line
7	"Reserved"	Not used
8	"Reserved"	Not used

6.6 Installation and connection of LPW-305-7

6.6.1 The diagrams of LPW-305-7 connection to external voltage circuits are similar to the connections shown in Figures B.1 - B.7 of Appendix B. In order to ensure trouble-free operation of the voltage and neutral measuring circuits, single-pole circuit breakers of class B or C must be installed for current 1 A or 2 A, as shown in the diagrams.

6.6.2 Perform the following sequence of operations:

1) position LPW-305-7 with account for recommendations given in sub-paragraphs6.2.1, 6.2.2;

2) ground LPW-305-7, using the protective grounding terminal "⏚";

3) connect LPW-305-7 to external voltage circuits in accordance with the sockets marking on the case of LPW-305-7;

4) connect the outputs of current clamps of LPW-305-7 (only for the modification with characteristic letter "A" in the designation) to the connector «⊖ ~ **3 - 10 Bmax**» ;

5) connect a remote GPS antenna (only for the modification with characteristic letter "C" in the designation) to the "GPS" connector on the case of LPW-305-7;

6) connect LPW-305-7, if necessary, to a computer via the Ethernet interface in accordance with paragraph6.5.4, using the "Ethernet (RJ45)" connector on the case of LPW-305-7;

7) connect the voltage supply to LPW-305-7 in accordance with the designations of the "Power" terminal block on LPW-305-7 case, using an external DC voltage source from 12 to 24 V, or LPW-305-7 power supply unit from its delivery package for power supply from a 220 V 50 Hz AC network;

8) supply voltage to LPW-305-7 and make sure that the self-diagnostics process has launched.

7 OPERATING PROCEDURE

7.1 Completion of LPW-305 self-diagnostics

7.1.1 Make sure that the self-diagnostics of LPW-305 is successfully completed:

1) for DIN-rail mounted LPW-305 – after the completion of the operation 10) according to paragraph6.5.2, the LED indicator on the front panel shall display "OK", and the "Rx" and "Tx" LEDs should blink indicating the interface communication with external devices;

2) for LPW-305-7 – during the performance of the operation 8)according to paragraph6.6.2, the "POW" and "PHASE" LEDs shall light up after LPW-305-7 is turned on and go out for 1 second and light up again upon the completion of the self-diagnostics process (LPW-305-7 switches over to the operating mode).

When LPW-305-7 with characteristic letter "C" in the designation switches over to the operating mode, the mode of external synchronization is set automatically: the current time of the built-in clock is set according to the signals from the communication satellites received by the connected remote GPS antenna. If the remote GPS antenna is not connected, then in "LPWStudio II" program window the user can disable the external synchronization mode and check the operation of the built-in clock of this LPW-305 modification.

7.2 LPW-305 operation in conjunction with a computer and in computer networks

7.2.1 To enable LPW-305 operation in conjunction with external devices (a computer or computer network), "LPWStudio II" program is used which is supplied in the form of a distribution kit with LPW-305 (paragraph 1.6) or can be downloaded from the manufacturer's website www.lcard.ru.

7.2.2 For data exchange between LPW-305 and external devices, one of the interfaces specified in paragraph 2.16and an open communication protocol MODBUS are used. MODBUS TCP protocol is used with the Ethernet interface, and MODBUS RTU protocol is used with RS-232 or RS-485 interfaces.

7.3 Control of DIN-rail mounted LPW-305 operation using of its keyboard

7.3.1 LPW-305 operation can be controlled using its LPW-305 keyboard with four keys ("▼", "►", "SELECT", "RESET") located on the front panel and the nested menu system available in LPW-305.

The nested menu system has a top-level menu (hereinafter, the main menu) with nine items and nine sub-menus, one for each item of the main menu.

Main menu items are numbered from 0 to 9.

On the front panel of LPW-305, an item of the main menu is displayed in the format from "00." to "09." as follows:

Key "►" is used for navigating through main menu items.

Each item (from "00." to "09.") of the main menu is at the same time the title of the respective nested menu.

Key "▼" is used for switching from the main menu to the corresponding nested menu. This key is also used for navigating through nested menu items. A nested menu item is indicated by the state of the "MODE" indicator. To return to the title of the current nested menu, press the "RESET" key.

7.3.2 Table 17 describes the states of the indicators located on the front panel for each of the selected items of the main and nested menus.

Table 17

Main menu item	Cascading menu item		Operation performed by LPW-305	State of "L1", "L2", "L3" indicators during operation performance
	Sequential number	State of "MODE" indicator		
"00."	0	Indicator is off	Indication of "00" title of the cascading menu	p.7.3.1
	1	"U"	Indication of root mean square value of phase voltage	p.7.3.3
	2	"∠U"	Indication of phase shift angle between phase voltages at fundamental frequency (first harmonic) relative to phase L1	p.7.3.4
	3	"I"	Indication of root mean square value of phase current	p.7.3.5
	4	"∠I"	Indication of phase shift angle between voltage and current at fundamental frequency (first harmonic) of one phase	p.7.3.6
	5	"F"	Indication of AC network frequency	p.7.3.7
	6	"P"	Indication of value of active single-phase power in 30 – 4000 Hz frequency band	p.7.3.8
	7	"Q"	Indication of value of reactive single-phase power in 40 – 2875 Hz frequency band	p.7.3.9
	8	"S"	Indication of value of total single-phase power in 30 – 4000 Hz frequency band	p.7.3.10
	9	"PS"	Indication of aggregate value (for three phases) of active, reactive, and total power	p.7.3.11
	10	"U0"	Indication of zero sequence unbalance factor value	p.7.3.12
	11	"U2"	Indication of negative sequence unbalance factor value	p.7.3.13
	12	"Fl"	Indication of short-term flicker indicator value by phases	p.7.3.14
	13	"KF"	Indication of K factor value by phases	p.7.3.15

Continuation of Table 17

Main menu item	Cascading menu item		Operation performed by LPW-305	State of "L1", "L2", "L3" indicators during operation performance
	Sequential number	State of "MODE" indicator		
"01."	0	Indicator is off	Indication of "01" title of the cascading menu	p.7.3.1
	1	"AP"	Indication of value of the accumulated three-phase or phase active energy in the forward direction	p.7.3.16.1
	2 –4	"AP"	Indication of value of the accumulated phase active energy in the forward direction	p.7.3.16.6
	5	"AN"	Indication of value of the accumulated three-phase active energy in the reverse direction	p.7.3.16.2
	6 – 8	"AN"	Indication of value of the accumulated phase active energy in the reverse direction	p.7.3.16.7
	9	"RP"	Indication of value of the accumulated three-phase reactive energy in the forward direction	p.7.3.16.3
	10 – 12	"RP"	Indication of value of the accumulated phase reactive energy in the forward direction	p.7.3.16.8
	13	"RN"	Indication of value of the accumulated three-phase reactive energy in the reverse direction	p.7.3.16.4
	14 – 16	"RN"	Indication of value of the accumulated phase reactive energy in the reverse direction	p.7.3.16.9
	17	"EF"	Indication of value of the accumulated three-phase total energy	p.7.3.16.5
	18 – 20	"EF"	Indication of value of the accumulated phase total energy	p.7.3.16.10
"02."	0	Indicator is off	Indication of "02" title of the cascading menu	p.7.3.1
	2 – 50	"HU"	Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L1	p.7.3.17
"03."	0	Indicator is off	Indication of "03" title of the cascading menu	p.7.3.1
	2 – 50	"HU"	Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L2	p.7.3.18

Continuation of Table 17

Main menu item	Cascading menu item		Operation performed by LPW-305	State of "L1", "L2", "L3" indicators during operation performance
	Sequential number	State of "MODE" indicator		
"04."	0	Indicator is off	Indication of "04" title of the cascading menu	p.7.3.1
	2 – 50	"HU"	Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L3	p.7.3.19
"05."	0	Indicator is off	Indication of "05" title of the cascading menu	p.7.3.1
	2 – 50	"HI"	Indication of value of the *n*-th harmonic current component factor (*n* is harmonic order from 2 to 50) for phase L1	p.7.3.20
"06."	0	Indicator is off	Indication of "06" title of the cascading menu	p.7.3.1
	2 – 50	"HI"	Indication of value of the *n*-th harmonic current component factor (*n* is harmonic order from 2 to 50) for phase L2	p.7.3.21
"07."	0	Indicator is off	Indication of "07" title of the cascading menu	p.7.3.1
	2 – 50	"HI"	Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L3	p.7.3.22
"08."	—	Indicator is off	Indication of "08" title of the cascading menu	p.7.3.1
	—	"Sr"	Indication of the software version	p.7.3.23.1
	—	"Hr"	Indication of the hardware version	p.7.3.23.2
	—	"Br"	Display brightness regulation	p.7.3.23.3
	—	"M0"	Indication and selection of main menu item to be performed first at LPW-305 powering on	p.7.3.23.4
	—	"M1"	Indication and selection of cascading menu item to be performed first at LPW-305 powering on	p.7.3.23.5
	—	"SI"	Indication and selection of dimensions of displayed current values	p.7.3.23.6
	—	"SU"	Indication and selection of dimensions of displayed voltage values	p.7.3.23.7
	—	"SP"	Indication and selection of dimensions of displayed power values	p.7.3.23.8
	—	"SE"	Indication and selection of dimensions of displayed energy values	p.7.3.23.9

Continuation of Table 17

Main menu item	Cascading menu item		Operation performed by LPW-305	State of "L1", "L2", "L3" indicators during operation performance
	Sequential number	State of "MODE" indicator		
"09."	—	Indicator is off	Indication of "09" title of the cascading menu	p.7.3.1
	—	"IB"	Indication and selection of operating mode by current measuring inputs	p.7.3.24.1
	—	"UB"	Indication and selection of operating mode by voltage measuring inputs	p.7.3.24.2
	—	"T"	Time indication and setting	p.7.3.24.3
	—	"D"	Date indication and setting	p.7.3.24.4
	—	"Ct"	Indication and selection of diagram for LPW-305 connection to an AC network	p.7.3.24.5
	—	"IF"	Indication and selection of active interface	p.7.3.24.6
	—	"Bd"	Indication and change of rate of exchange via RS-232, RS-485 interfaces	p.7.3.24.7
	—	"Pr"	Serial interface parity check	p.7.3.24.8
	—	"MA"	Indication and change of MODBUS-RTU address	p.7.3.24.9
	—	"IP"	Indication and change of IP--address of LPW-305 in Ethernet network	p.7.3.24.10
	—	"NM"	Indication and change of subnet mask	p.7.3.24.11
	—	"GW"	Indication and change of gateway address	p.7.3.24.12
	—	"Sw"	Indication and change of voltage overvoltage threshold	p.7.3.24.13
	—	"DP"	Indication and change of voltage fall threshold	p.7.3.24.14
	—	"KU"	Indication and change of correction factor for voltage measurement results	p.7.3.24.15
	—	"KI"	Indication and change of correction factor for current measurement results	p.7.3.24.16
	—	"UN"	Indication and change of network rated voltage	p.7.3.24.17

Application of LPW-305 keys is described in Table 18.

Table 18

Key designation	Key application
"▶"	Navigating through main menu items Changing values when entering numeric values; switching between values. If the key is pressed sequentially, it cycles through the possible values, increasing the digital value in the direct order with the given step. If the key is pressed and held, it scrolls automatically through the values, automatically changing the digital value in the direct order with the given step.
"▼"	Navigating through nested menu items (without getting to the title of the nested menu). Changing values when entering numeric values. If the key is pressed sequentially, it cycles through the possible values, increasing the digital value in the reverse order with the given step. If the key is pressed and held, it scrolls automatically through the values, automatically changing the digital value in the reverse order with the given step.
"SELECT"	Switching over to the data editing mode; confirmation of input; changing the dimension of the displayed values
"RESET"	Exit from the data entry mode without saving changes

7.3.3 Indication of the root mean square value of phase voltage U_{ph} (item "00." of the main menu, item "U" of the nested menu)

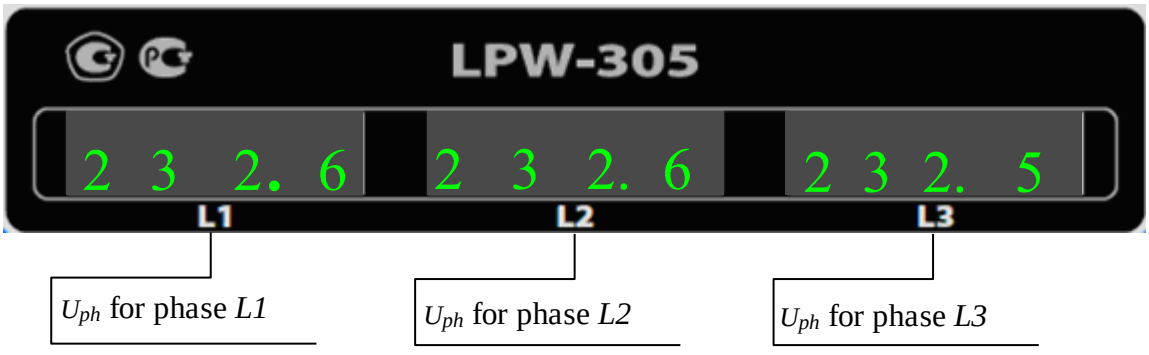
States of the indicators during indication of the root mean square value of phase voltage U_{ph} are the following:

when voltage is indicated in mV

when voltage is indicated in V

when voltage is indicated in kV

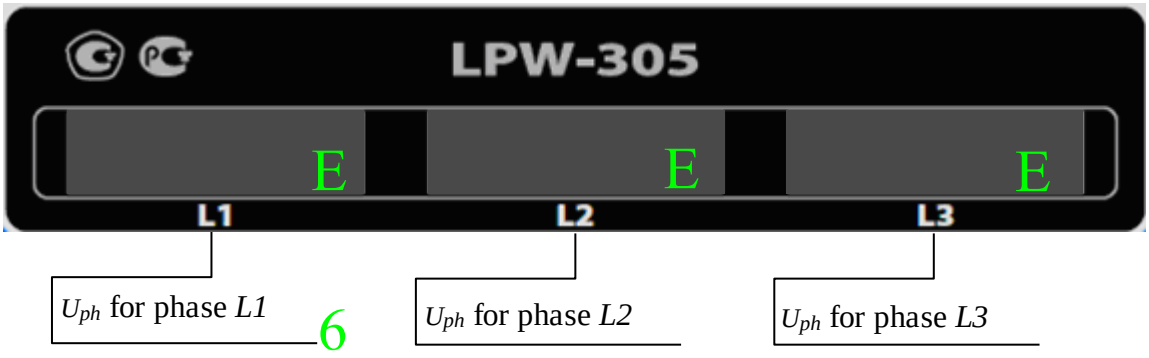
when voltage is indicated in MV



The dimension of the indicated value U_{ph} can be changed by pressing the "SELECT" key.

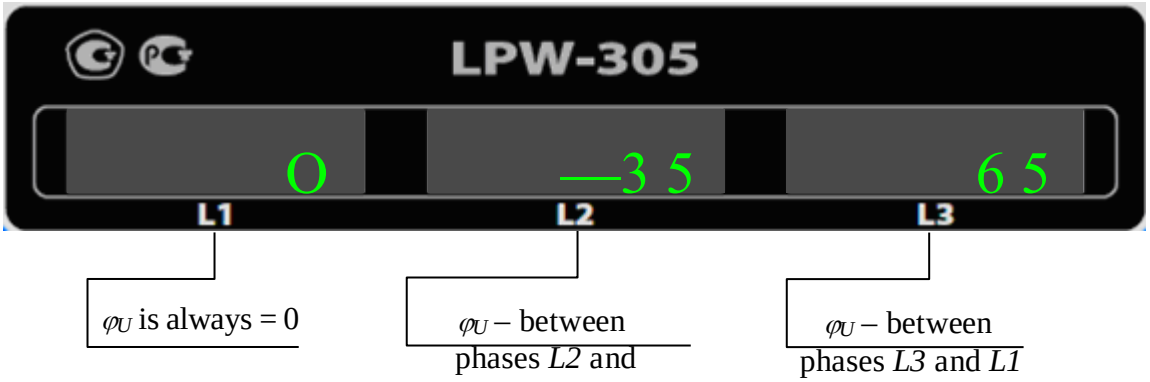
The dimension of the value U_{ph} can also be changed during the selection of item "08." of the main menu and item "SU" of the nested menu (paragraph7.3.23.7).

If such a dimension is chosen that four digits of the indicator are not sufficient to display U_{ph}, then the indicator status is as follows:



7.3.4 Indication of the value of the phase shift angle φ_U between the phase voltages of the fundamental frequency (first harmonic) relative to phase L1 (item "00." of the main menu, the item "∠U" of the sub-menu)

States of the indicators when the value of the phase shift angle φ_U between the phase voltages of the fundamental frequency (first harmonic) is indicated relative to the phase L1 are as follows:



Values φ_U are displayed in degrees.

7.3.5 Indication of the root mean square value of phase current *I* (item "00." of the main menu, item "I" of the nested menu)

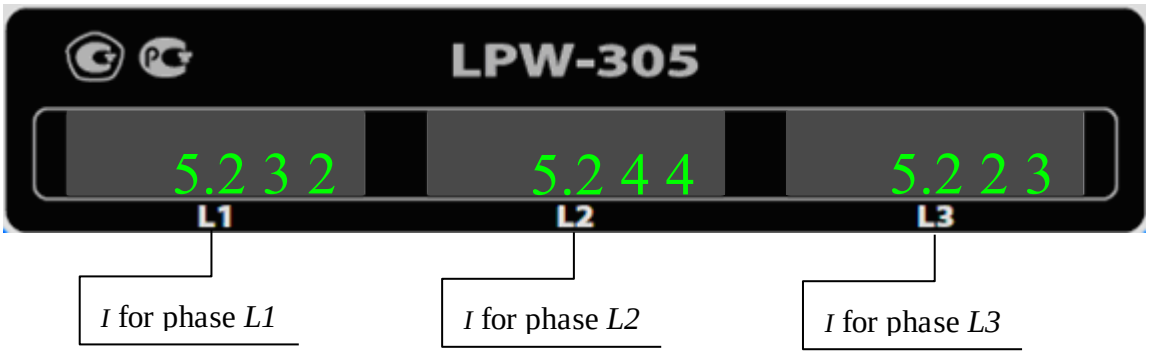
States of the indicators during indication of the root mean square value of phase current *I* are the following:

when current is indicated in mA

when current is indicated in A

when current is indicated in kA

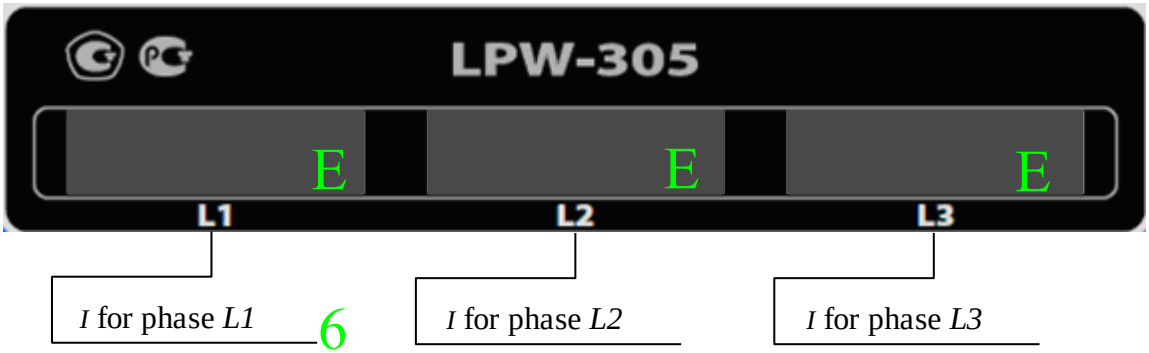
when current is indicated in MA



The dimension of the indicated value *I* can be changed by pressing the "SELECT" key.

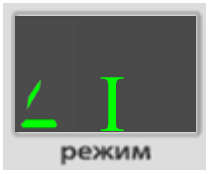
The dimension of the value *I* can also be changed during the selection of item "08." of the main menu and item "SI" of the nested menu (paragraph 7.3.23.6).

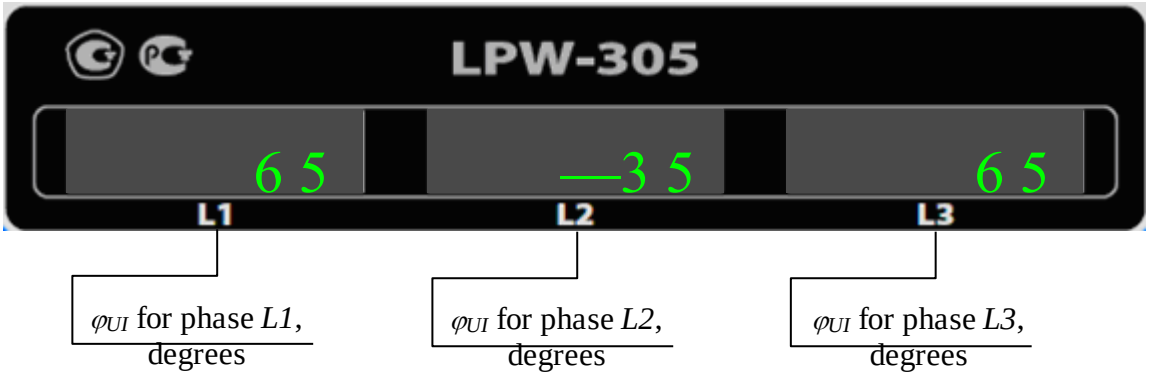
If such a dimension is chosen that four digits of the indicator are not sufficient to display *I*, then the indicator status is as follows:



7.3.6 Indication of the value of the phase shift angle φ_{UI} between the phase voltages and current of the fundamental frequency (first harmonic) of one phase (item "00." of the main menu, item "∠I" of the nested menu)

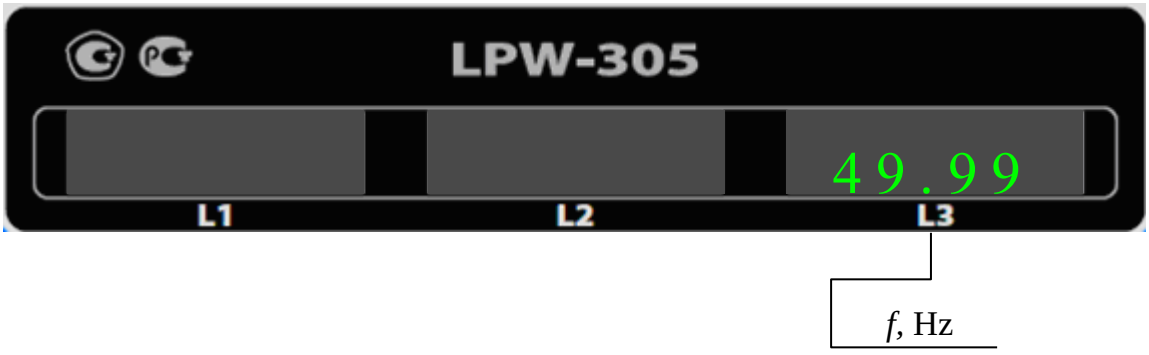
States of the indicators when the value of the phase shift angle φ_{UI} between the phase voltages and current of the fundamental frequency (first harmonic) of one phase is indicated are as follows:





7.3.7 Indication of AC network frequency *f* (item "00." of the main menu, item "F" of the nested menu)

States of the indicators when the value of AC network frequency *f* is indicated are as follows:



7.3.8 Indication of the value of active single-phase power $P_{(f)1}$ in the frequency band of 30 - 4000 Hz (item "00" of the main menu, item "P" of the nested menu)

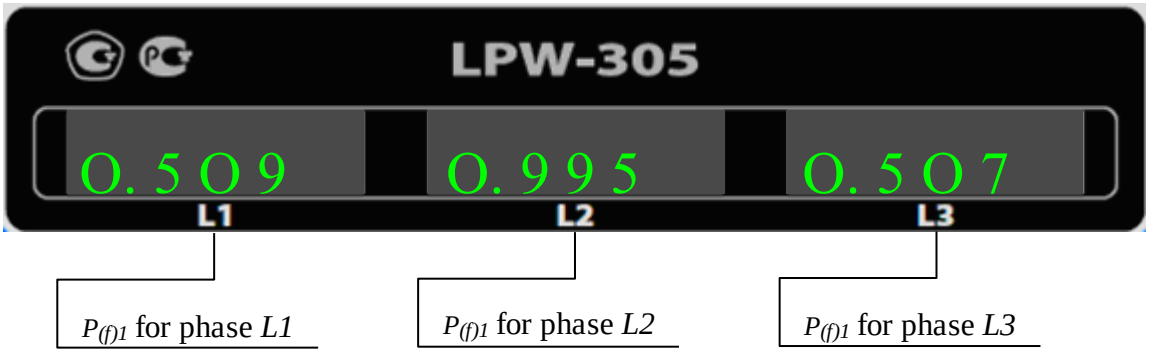
States of the indicators when the value of active single-phase power $P_{(f)1}$ in the frequency band of 30 - 4000 Hz is indicated are as follows:

when $P_{(f)1}$ is indicated in mW

when $P_{(f)1}$ is indicated in W

when $P_{(f)1}$ is indicated in kW

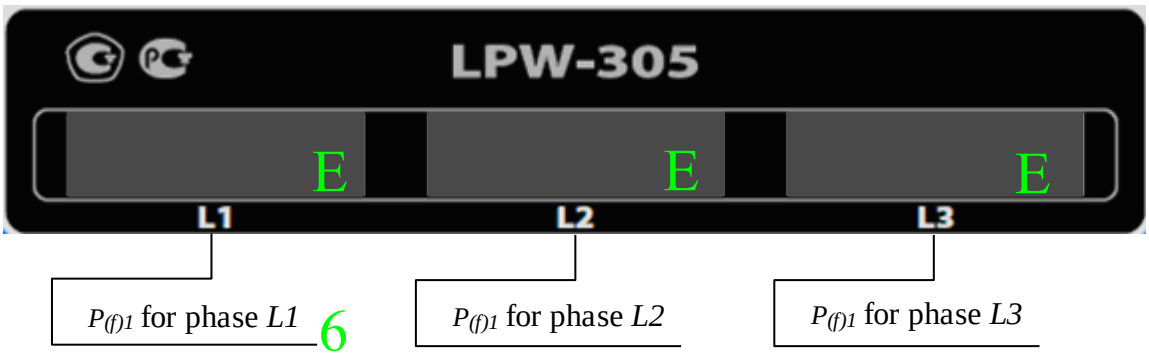
when $P_{(f)1}$ is indicated in MW



The dimension of the indicated value $P_{(f)1}$ can be changed by pressing the "SELECT" key.

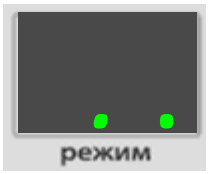
The dimension of the value $P_{(f)1}$ can also be changed during the selection of item "08." of the main menu and item "SP" of the nested menu (paragraph 7.3.23.8).

If such a dimension is chosen that four digits of the indicator are not sufficient to display $P_{(f)1}$, then the indicator status is as follows:

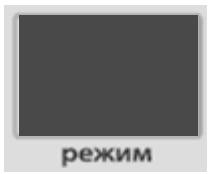


7.3.9 Indication of the value of reactive single-phase power $Q_{(f)1}$ in the frequency band of 40 – 2875 Hz (item "00" of the main menu, item "Q" of the nested menu)

States of the indicators when the value of reactive single-phase power $Q_{(f)1}$ in the frequency band of 40 – 2875 Hz is indicated are as follows:



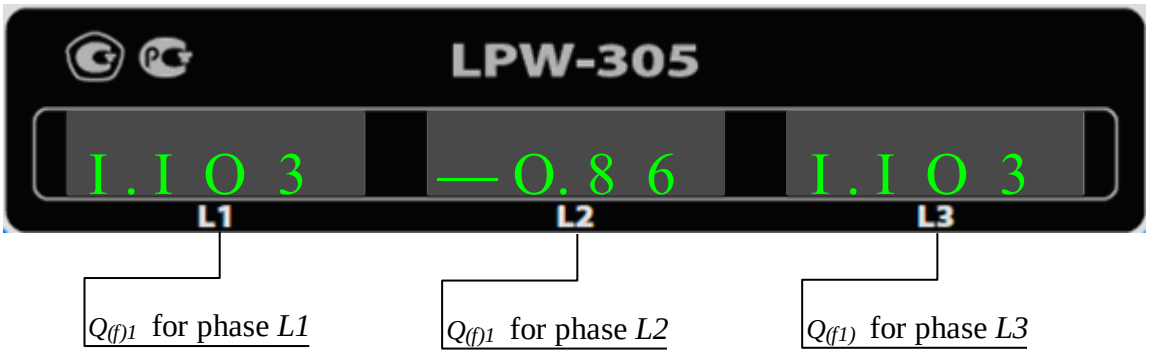
when $Q_{(f)1}$ is indicated in mVAr



when $Q_{(f)1}$ is indicated in VAr

when $Q_{(f)1}$ is indicated in kVAr

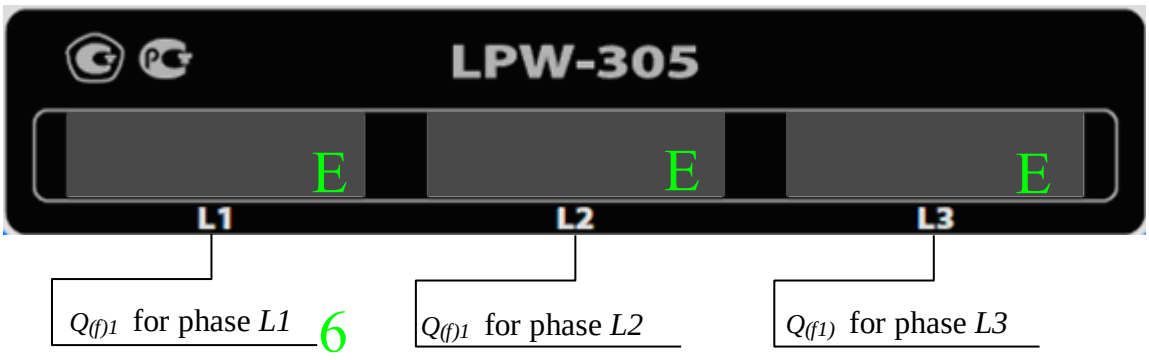
when $Q_{(f)1}$ in MVAr



The dimension of the indicated value $Q_{(f)1}$ can be changed by pressing the "SELECT" key.

The dimension of the value $Q_{(f)1}$ can also be changed during the selection of item "08." of the main menu and item "SP" of the nested menu (paragraph 7.3.23.8).

If such a dimension is chosen that four digits of the indicator are not sufficient to display $Q_{(f)1}$, then the indicator status is as follows:



7.3.10 Indication of the value of active single-phase power *S* in the frequency band of 30 - 4000 Hz (item "00" of the main menu, item "S" of the nested menu)

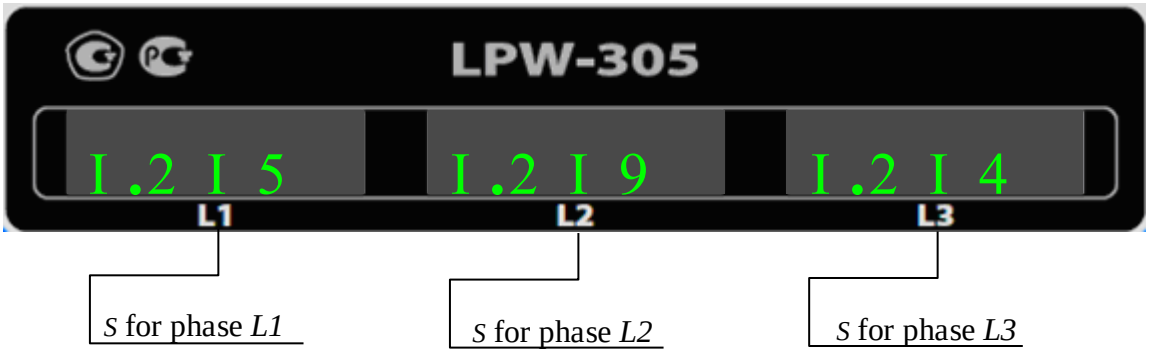
States of the indicators when the value of total single-phase power *S* in the frequency band of 30 - 4000 Hz is indicated are as follows:

when *S* is indicated in mVA-

when *S* is indicated in VA-

when *S* is indicated in kVA-

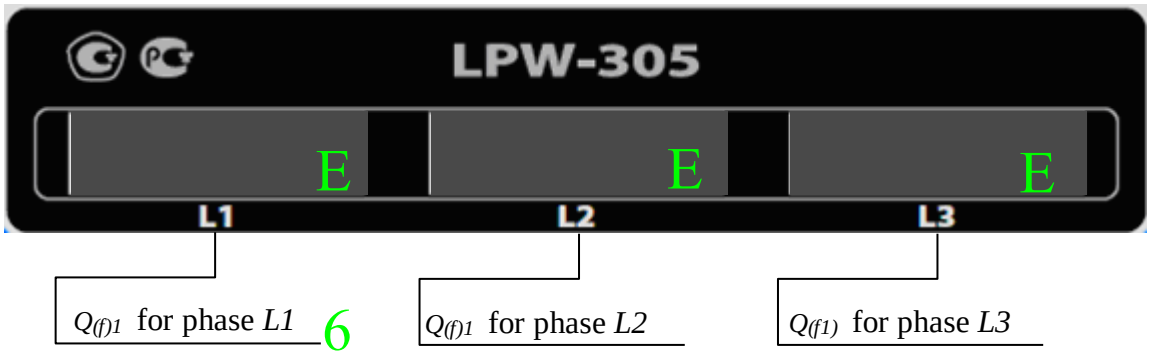
when *S* is indicated in MVA-



The dimension of the indicated value *S* can be changed by pressing the "SELECT" key.

The dimension of the value *S* can also be changed during the selection of item "08." of the main menu and item "SP" of the nested menu (paragraph 7.3.23.8).

If such a dimension is chosen that four digits of the indicator are not sufficient to display *S*, then the indicator status is as follows:



7.3.11 Indication of aggregate value (for three phases) of active, reactive, and total power (item "00." of the main menu, item "PS" of the nested menu)

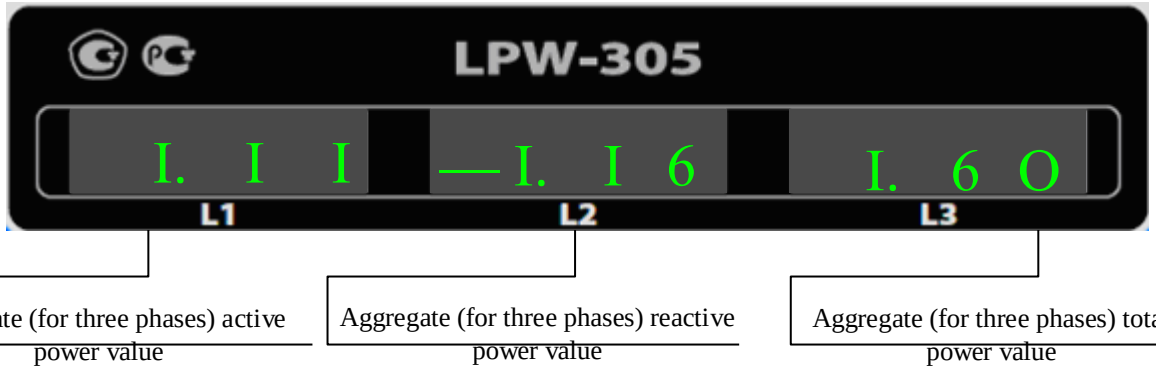
States of the indicators when aggregate value (for three phases) of active, reactive, and total power is indicated are as follows:

in case of indication in mVA-

in case of indication in VA-

in case of indication in kVA-

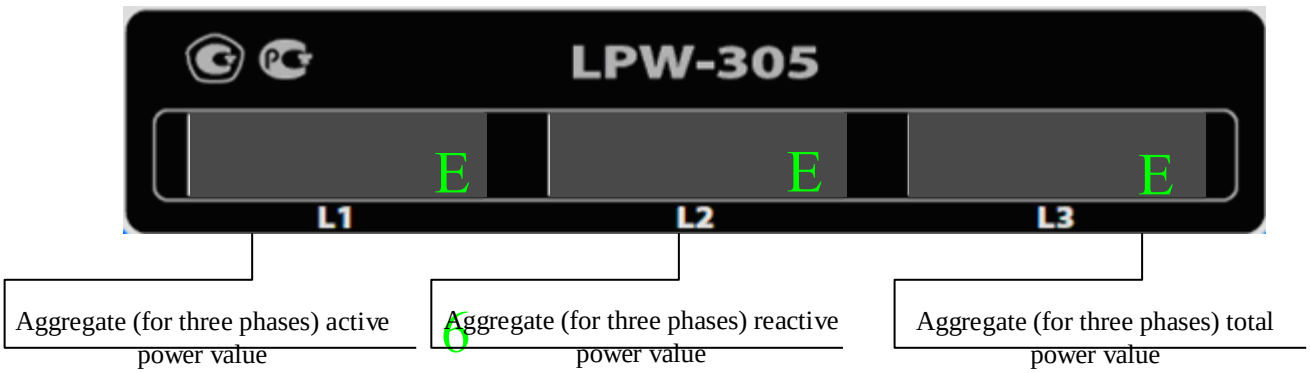
in case of indication in MVA-



The dimension of the indicated total power value can be changed by pressing the "SELECT" key.

The dimension of the total power value can also be changed during the selection of item "08." of the main menu and item "SP" of the nested menu (paragraph 7.3.23.8).

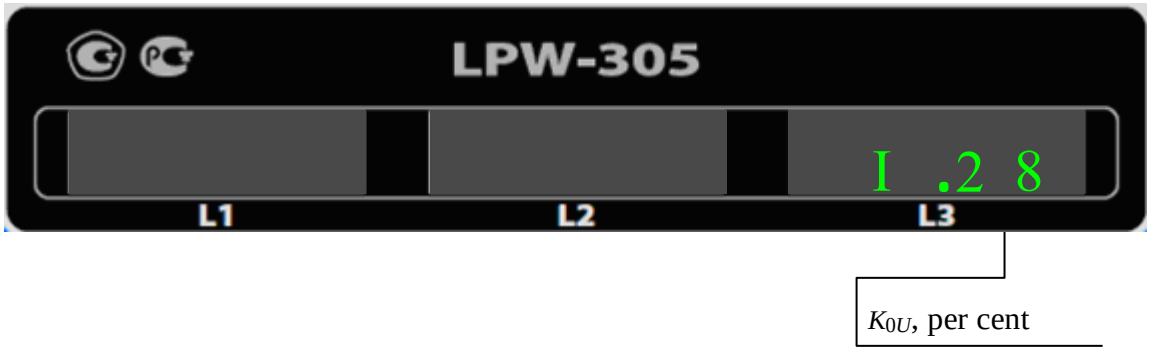
If such a dimension is chosen that four digits of the indicator are not sufficient to display the value, then the indicator status is as follows:



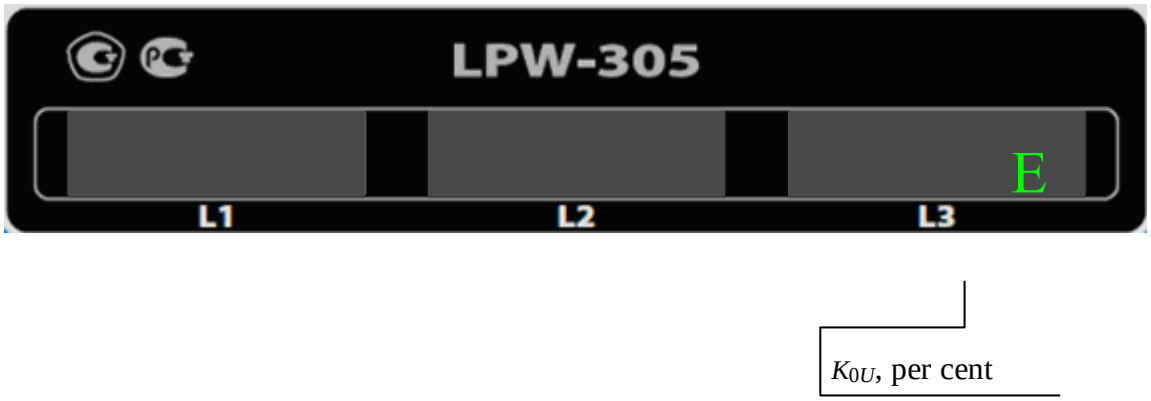
Signature and date | Dupl. inv. No. | Repl. inv. No. | Signature and date | Orig. inv. No.

7.3.12 Indication of zero sequence unbalance factor value K_{0U} (item "00." of the main menu and item "U0" of the nested menu)

States of the indicators during indication of zero sequence unbalance factor value K_{0U} are the following:

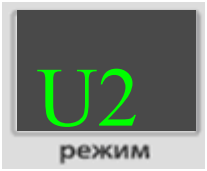


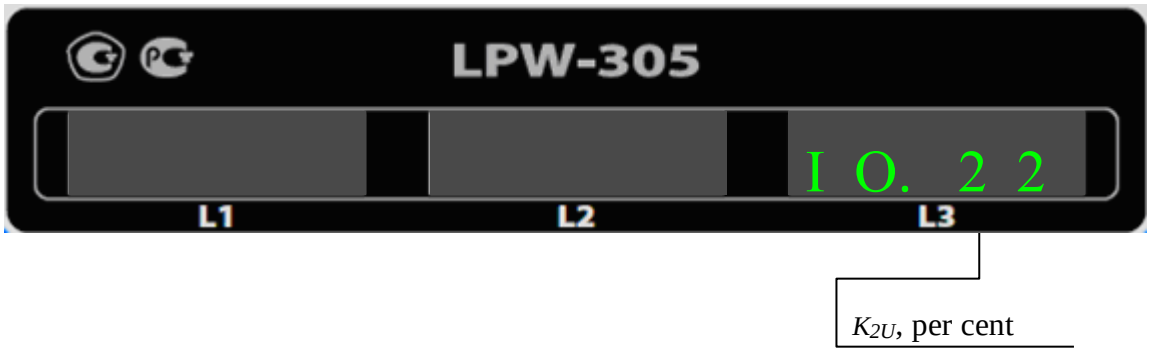
If the indicated value of zero sequence unbalance factor K_{0U} falls out the measurement range indicated in paragraph2.5, then the indicator state is the following:



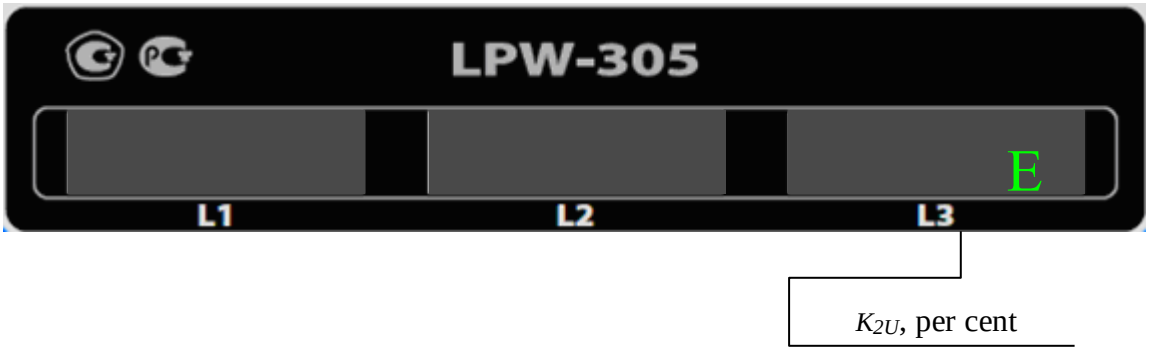
7.3.13 Indication of negative sequence unbalance factor value K_{2U} (item "00." of the main menu and item "U2" of the nested menu)

States of the indicators during indication of negative sequence unbalance factor value K_{2U} are the following:



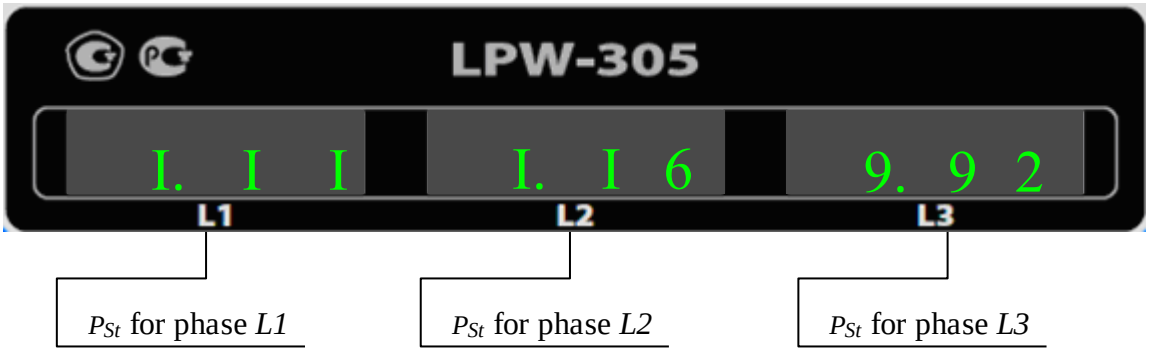


If the indicated value of negative sequence unbalance factor K_{2U} falls out the measurement range indicated in paragraph 2.5, then the indicator state is the following:



7.3.14 Indication of short-term flicker indicator value P_{St} by phases (item "00." of the main menu and item "FI" of the nested menu)

States of the indicators during Indication of short-term flicker indicator value P_{St} by phases are the following:

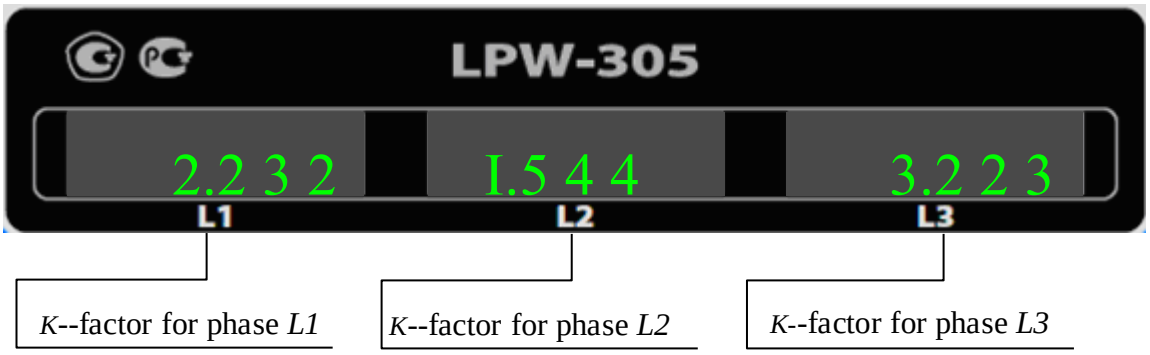


If the indicated value of short-term flicker indicator value P_{St} falls out the measurement range indicated in paragraph 2.5, then the indicator state is the following:

7.3.15 Indication of K-factor value by phases (item "00." of the main menu and item "KF" of the nested menu)

Note: the definition of K-factor is presented in Appendix B.

States of the indicators during Indication of K-factor value by phases are the following:



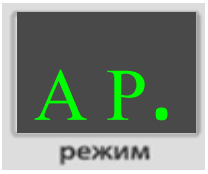
7.3.16 Indication of accumulated energy values (item "01." of the main menu)

7.3.16.1 States of the indicators during indication of value of the accumulated three-phase active energy in the forward direction (item "01." of the main menu, item "AP" of the nested menu) are as follows:

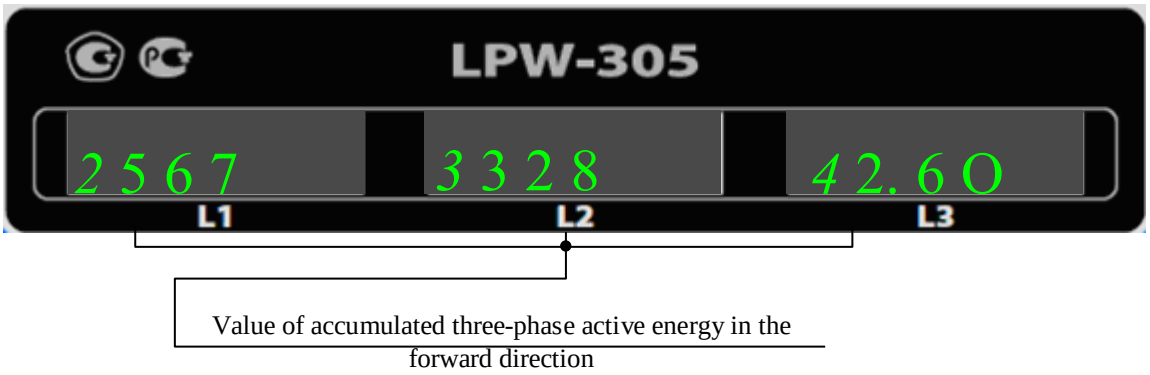
in case of indication in mW*h

in case of indication in W*h

in case of indication in kW*h



in case of indication in MW*h



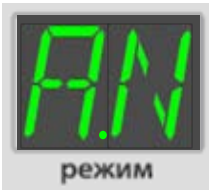
The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

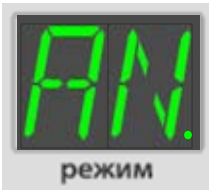
7.3.16.2 States of the indicators during indication of value of the accumulated three-phase active energy in the reverse direction (item "01." of the main menu, item "AN" of the nested menu) are as follows:

in case of indication in mW*h

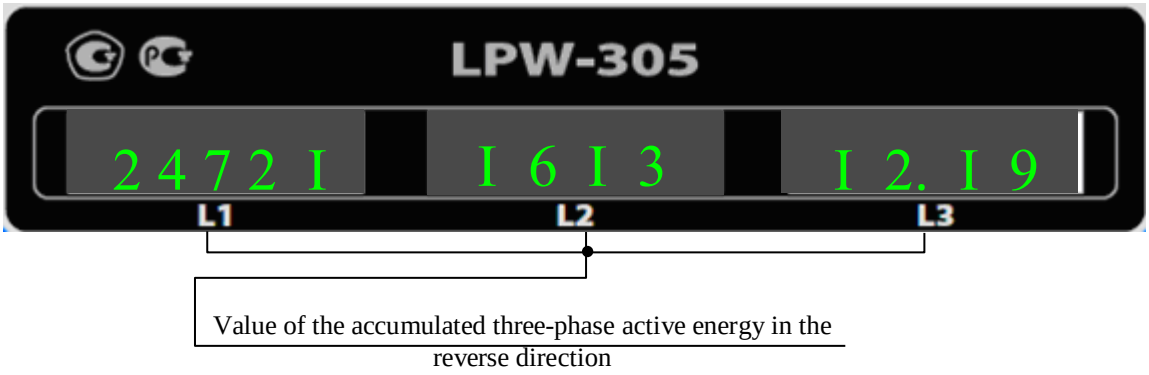
in case of indication in W*h



in case of indication in kW*h



in case of indication in MW*h



The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

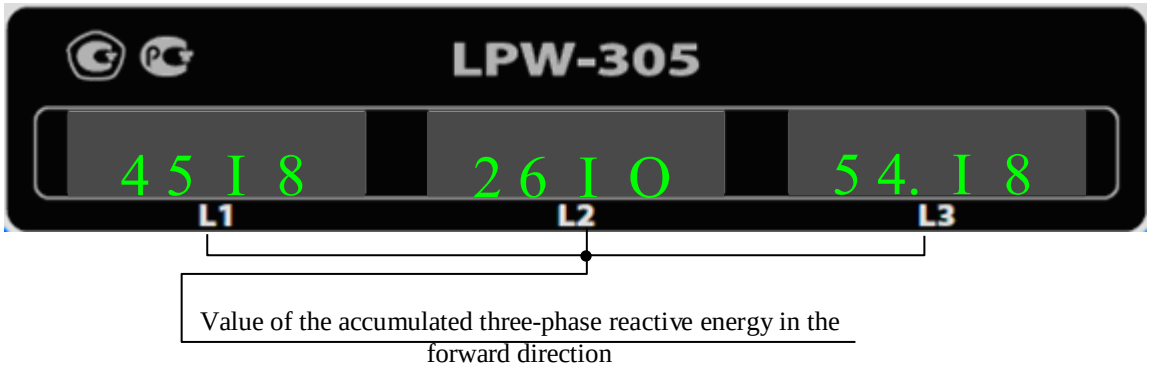
7.3.16.3 States of the indicators during indication of value of the accumulated three-phase reactive energy in the forward direction (item "01." of the main menu, item "RP" of the nested menu) are as follows:

in case of indication in mVAr*h

in case of indication in VAr*h

in case of indication in kVAr*h

in case of indication in MVAr*h



The dimension of the indicated value can be changed by pressing the "SELECT" key.

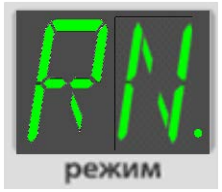
The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.16.4 States of the indicators during indication of value of the accumulated three-phase reactive energy in the reverse direction (item "01." of the main menu, item "RN" of the nested menu) are as follows:

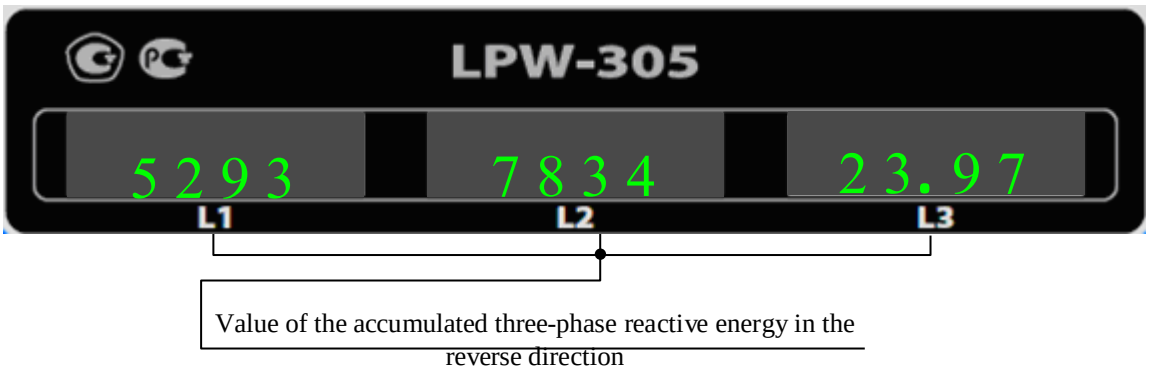
in case of indication in mVAr*h

in case of indication in VAr*h

in case of indication in kVAr*h



in case of indication in MVAr*h



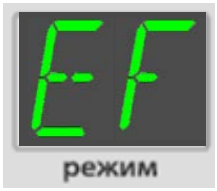
The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main

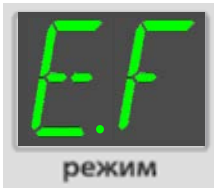
menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.16.5 States of the indicators during indication of value of the accumulated three-phase total energy (item "01." of the main menu, item "EF" of the nested menu) are as follows:

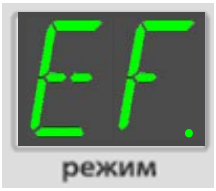
in case of indication in mVA*h



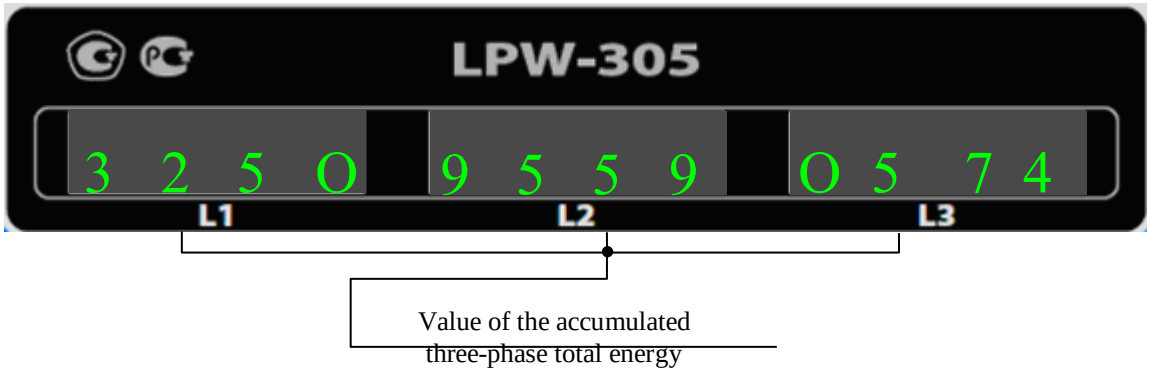
in case of indication in VA*h



in case of indication in kVA*h



in case of indication in MVA*h



For displaying, the three indicators are combined into one, thus forming a single indicator for 12 positions.

The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

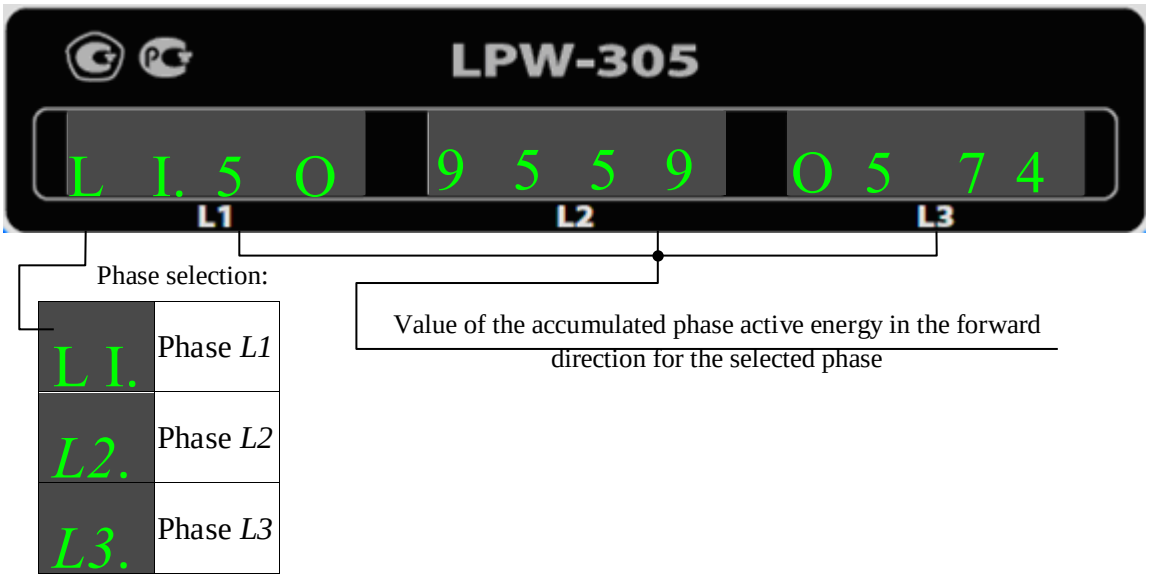
7.3.16.6 States of the indicators during indication of value of the accumulated phase active energy in the forward direction (item "01." of the main menu, item "AP" of the nested menu) are as follows:

in case of indication in mW*h

in case of indication in W*h

in case of indication in kW*h

in case of indication in MW*h

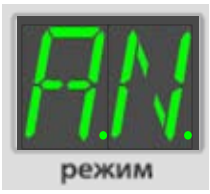


For displaying, the three indicators are combined into one, thus forming a single indicator for 12 positions.

The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.16.7 States of the indicators during indication of value of the accumulated phase active energy in the reverse direction (item "01." of the main menu, item "AN" of the nested menu) are as follows:

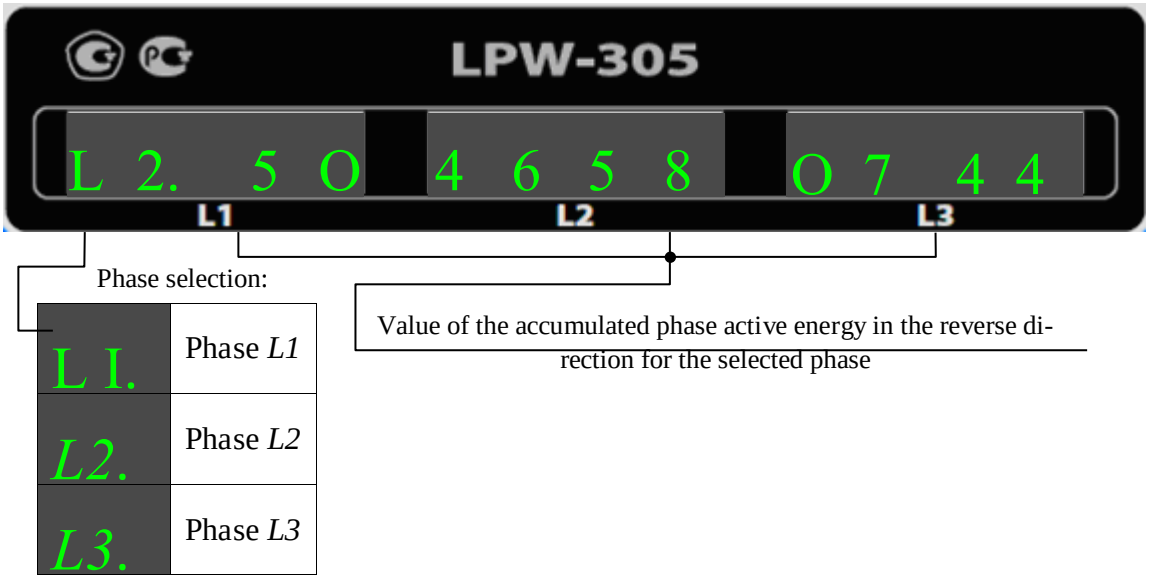


in case of indication in mW*h

in case of indication in W*h

in case of indication in kW*h

in case of indication in MW*h



For displaying, the three indicators are combined into one, thus forming a single indicator for 12 positions.

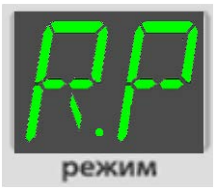
The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.16.8 States of the indicators during indication of value of the accumulated phase reactive energy in the forward direction (item "01." of the main menu, item "RP" of the nested menu) are as follows:

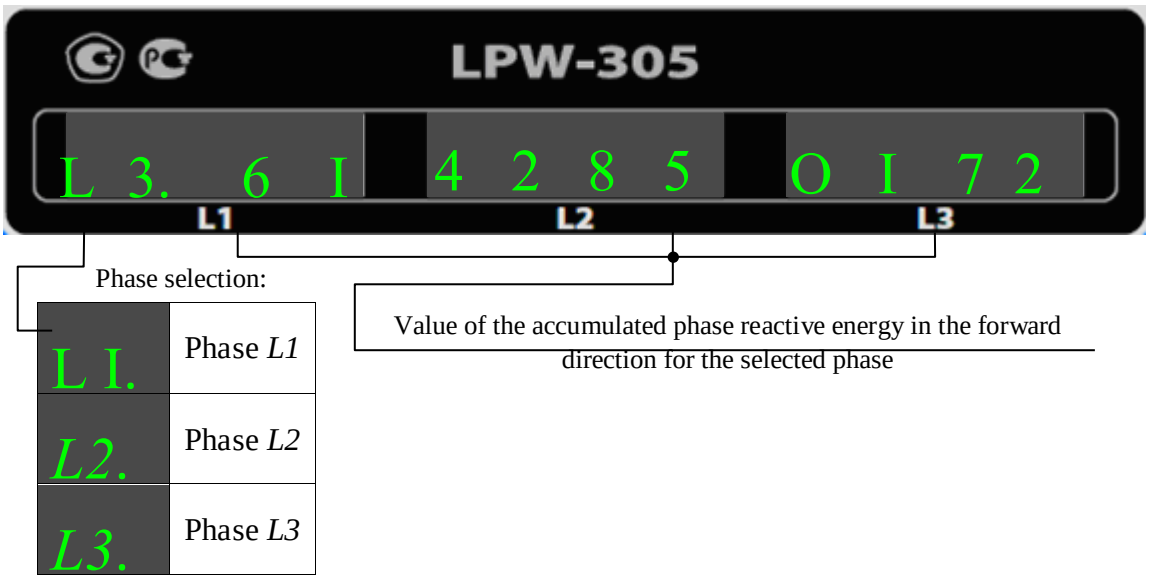
in case of indication in mVAr*h-

in case of indication in VAr*h-



in case of indication in kVAr*h-

in case of indication in MVAr*h-

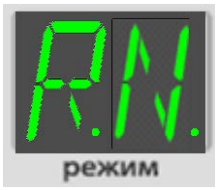


For displaying, the three indicators are combined into one, thus forming a single indicator for 12 positions.

The dimension of the indicated value can be changed by pressing the "SELECT" key.

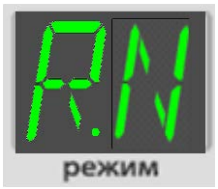
The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.16.9 States of the indicators during indication of value of the accumulated phase reactive energy in the reverse direction (item "01." of the main menu, item "RN" of the nested menu) are as follows:

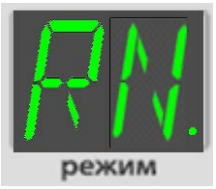


in case of indication in mVAr*h-

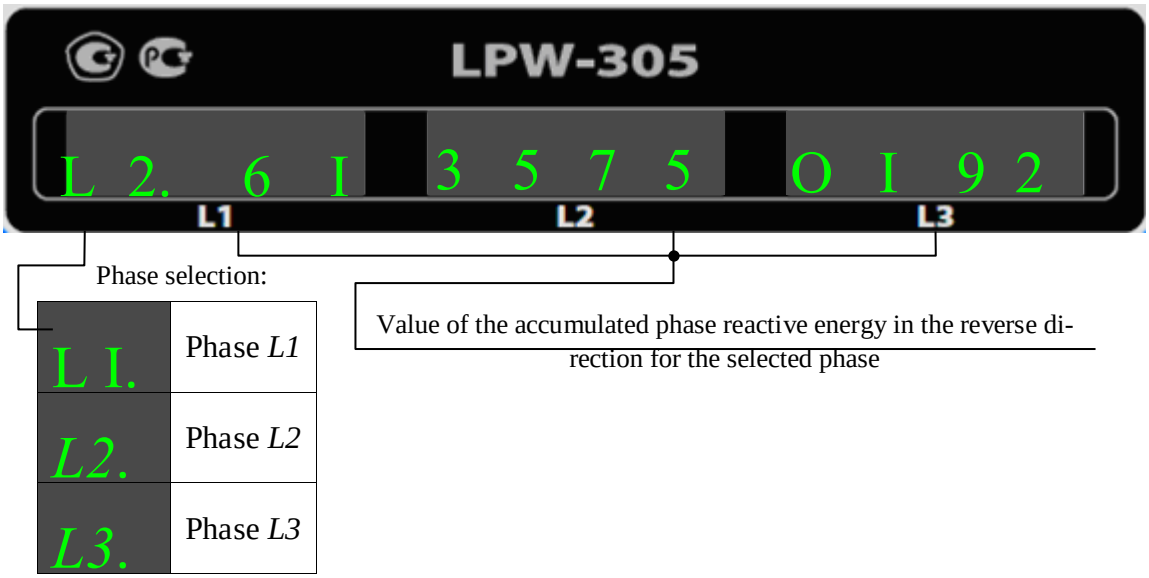
in case of indication in VAr*h-



in case of indication in kVAr*h-



in case of indication in MVAr*h-



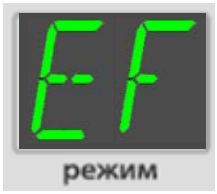
For displaying, the three indicators are combined into one, thus forming a single indicator for 12 positions.

The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.16.10 States of the indicators during indication of value of the accumulated phase total energy (item "01." of the main menu, item "EF" of the nested menu) are as follows:

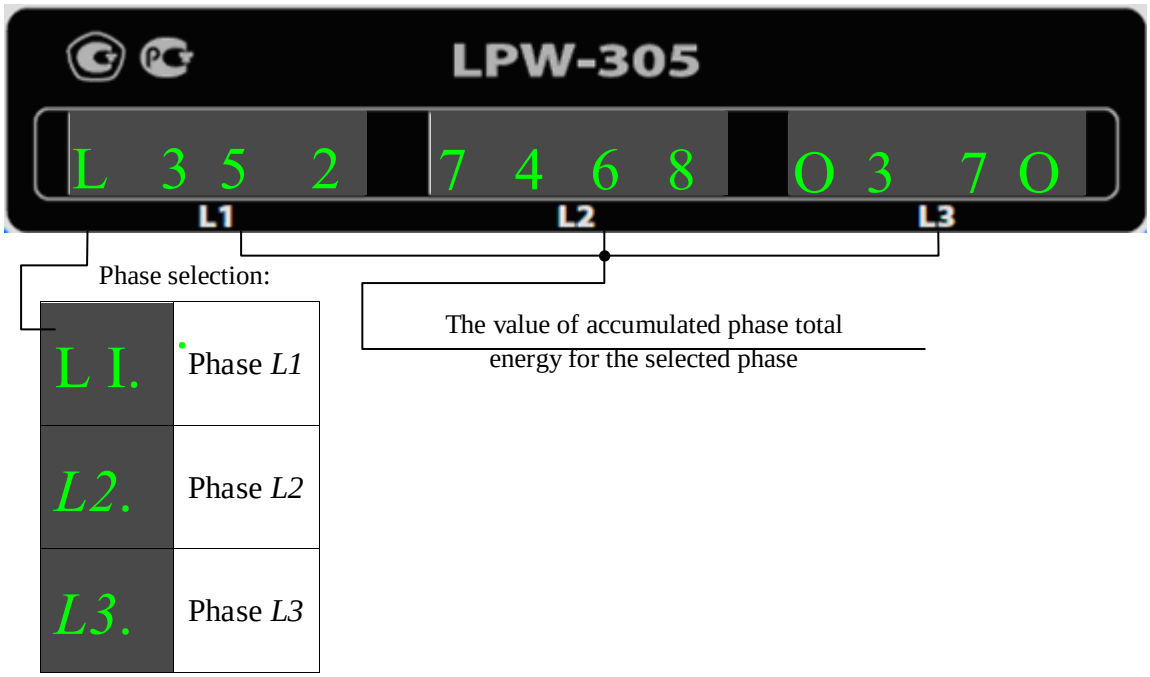
in case of indication in mVA*h--



in case of indication in VA*h-
-

in case of indication in kVA*h-
-

in case of indication in MVA*h-
-



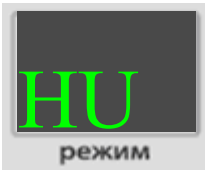
For displaying, the three indicators are combined into one, thus forming a single indicator for 12 positions.

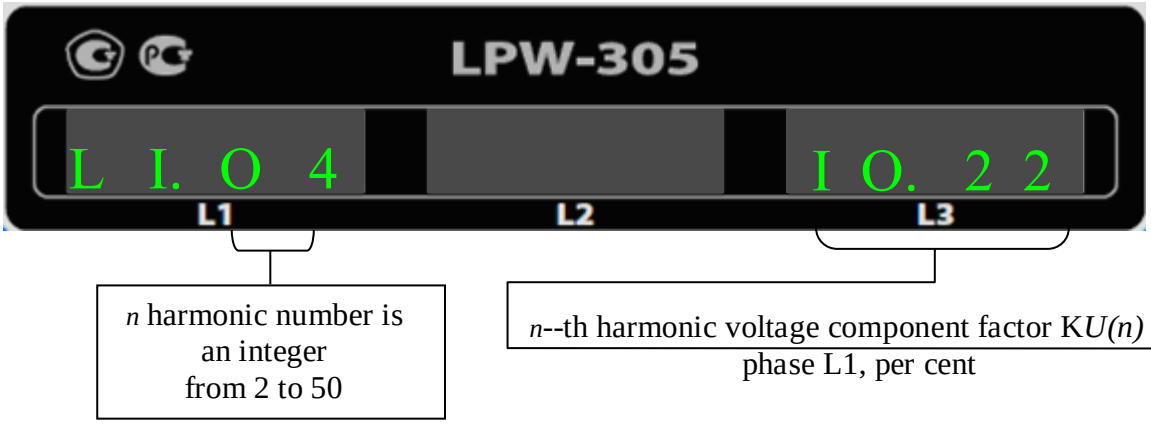
The dimension of the indicated value can be changed by pressing the "SELECT" key.

The dimension of the value can also be changed during the selection of item "08." of the main menu and item "SE" of the nested menu (paragraph 7.3.23.9).

7.3.17 Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L1 (item "02." of the main menu and item "HU" of the nested menu)

States of the indicators during the indication of value of the *n*-th harmonic voltage component factor $K_{U(n)}$ for phase L1 are the following:



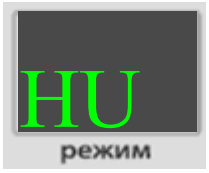


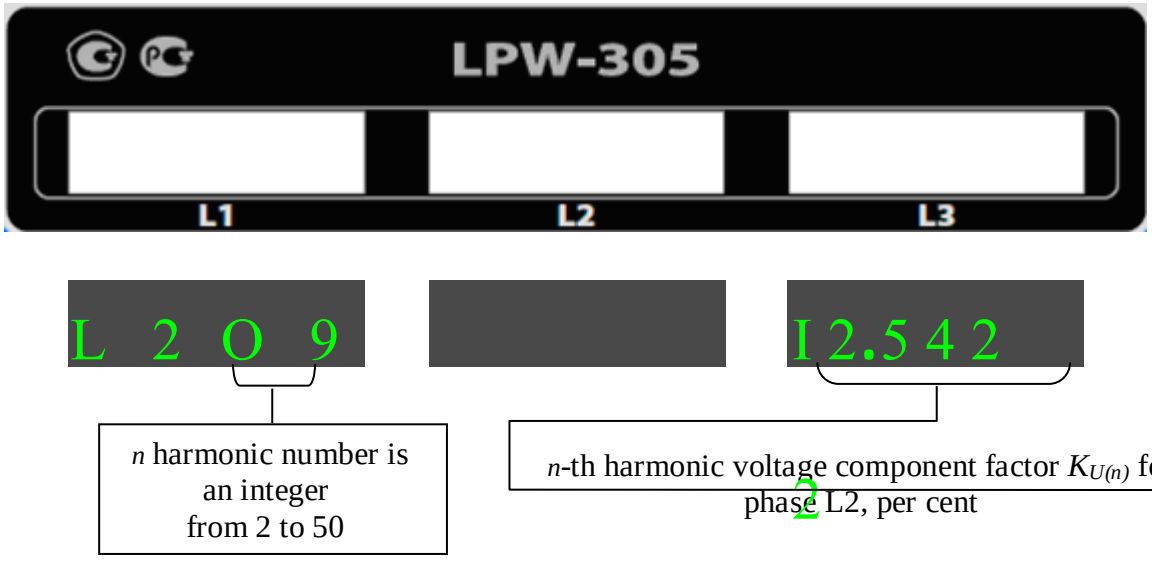
The third and fourth positions of the leftmost indicator are used to display the harmonic number, the harmonic component for which is displayed on the rightmost indicator.

Consecutive switching between the harmonics numbers is performed with the use of key "▼".

7.3.18 Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L2 (item "03." of the main menu and item "HU" of the nested menu)

States of the indicators during the indication of value of the *n*-th harmonic voltage component factor $K_{U(n)}$ for phase L2 are the following:



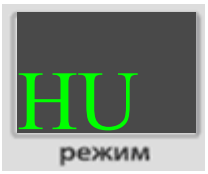


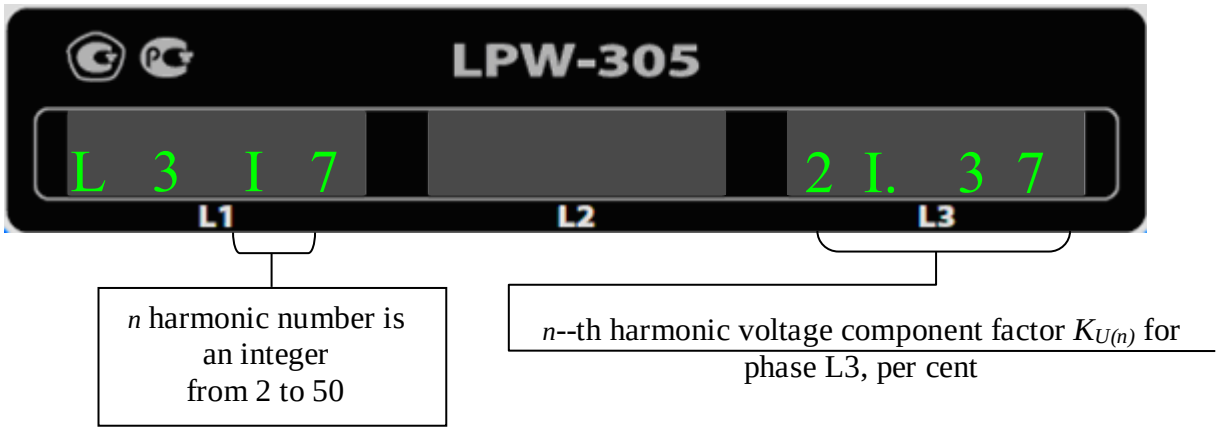
The third and fourth positions of the leftmost indicator are used to display the harmonic number, the harmonic component for which is displayed on the rightmost indicator.

Consecutive switching between the harmonics numbers is performed with the use of key "▼".

7.3.19 Indication of value of the *n*-th harmonic voltage component factor (*n* is harmonic order from 2 to 50) for phase L3 (item "04." of the main menu and item "HU" of the nested menu)

States of the indicators during the indication of value of the *n*-th harmonic voltage component factor $K_{U(n)}$ for phase L3 are the following:



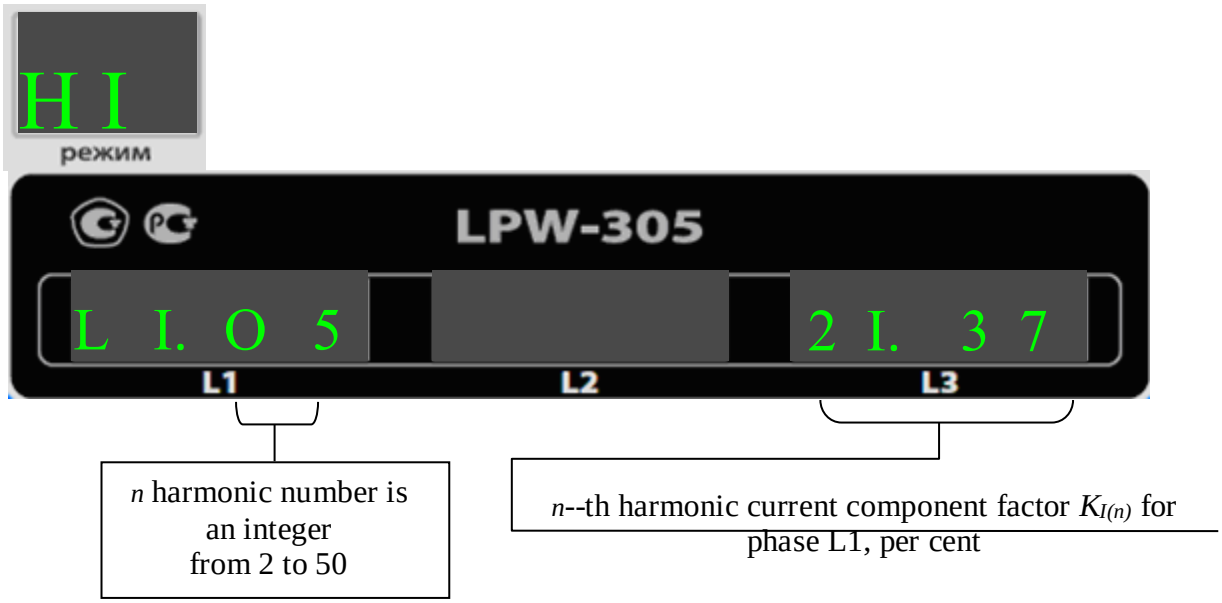


The third and fourth positions of the leftmost indicator are used to display the harmonic number, the harmonic component for which is displayed on the rightmost indicator.

Consecutive switching between the harmonics numbers is performed with the use of key "▼".

7.3.20 Indication of value of the *n*-th harmonic current component factor (*n* is harmonic order from 2 to 50) for phase L1 (item "05." of the main menu and item "HI" of the nested menu)

States of the indicators during the indication of value of the *n*-th harmonic current component factor $K_{I(n)}$ for phase L1 are the following:

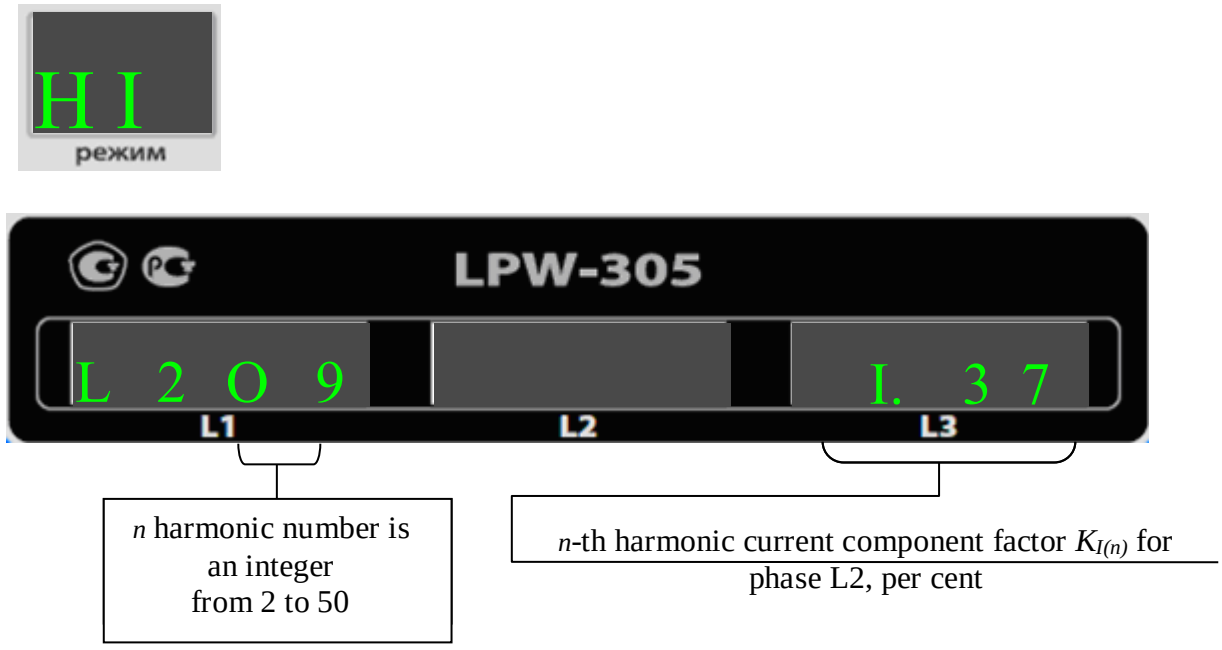


The third and fourth positions of the leftmost indicator are used to display the harmonic number, the harmonic component for which is displayed on the rightmost indicator.

Consecutive switching between the harmonics numbers is performed with the use of key "▼".

7.3.21 Indication of value of the *n*-th harmonic current component factor (*n* is harmonic order from 2 to 50) for phase L2 (item "06." of the main menu and item "HI" of the nested menu)

States of the indicators during the indication of value of the *n*-th harmonic current component factor $K_{I(n)}$ for phase L2 are the following:

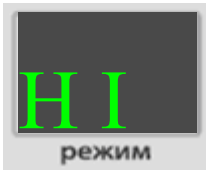


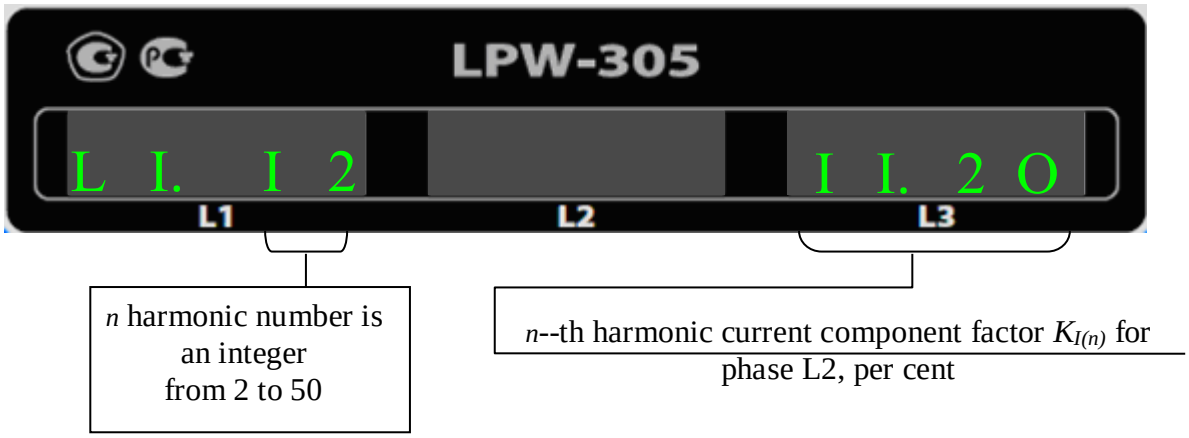
The third and fourth positions of the leftmost indicator are used to display the harmonic number, the harmonic component for which is displayed on the rightmost indicator.

Consecutive switching between the harmonics numbers is performed with the use of key "▼".

7.3.22 Indication of value of the *n*-th harmonic current component factor (*n* is harmonic order from 2 to 50) for phase L3 (item "07." of the main menu and item "HI" of the nested menu)

States of the indicators during the indication of value of the *n*-th harmonic current component factor $K_{I(n)}$ for phase L3 are the following:





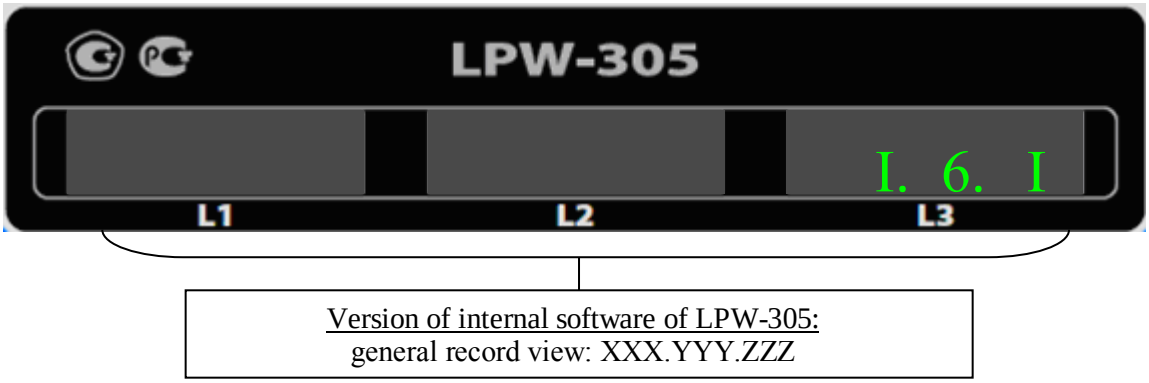
The third and fourth positions of the leftmost indicator are used to display the harmonic number, the harmonic component for which is displayed on the rightmost indicator.

Consecutive switching between the harmonics numbers is performed with the use of key "▼".

7.3.23 Menu settings available for reading and changing without entering a password (item "08." of the main menu)

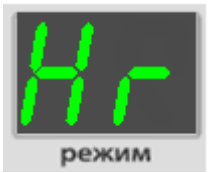
7.3.23.1 Indication of the software version (item "08." of the main menu, item "Sr" of the nested menu)

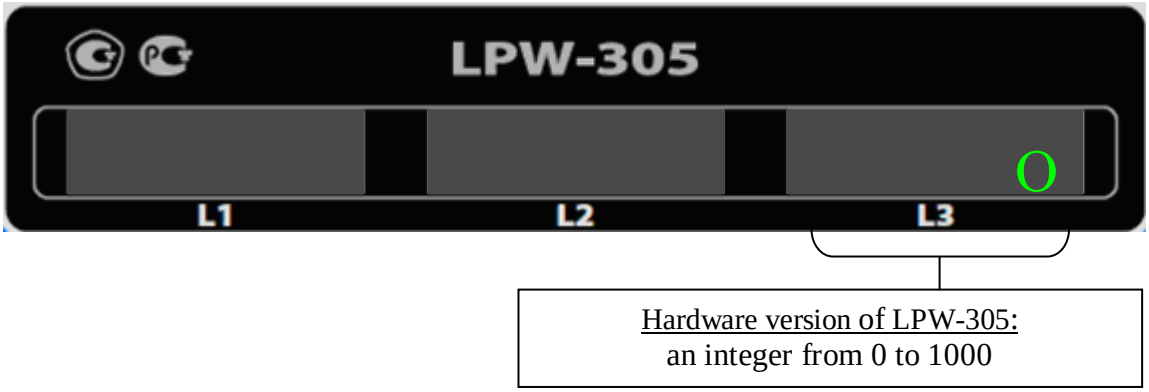
States of the indicators when the software version is displayed are as follows:



7.3.23.2 Indication of the hardware version (item "08." of the main menu, item "Hr" of the nested menu)

States of the indicators when the hardware version is displayed are as follows:

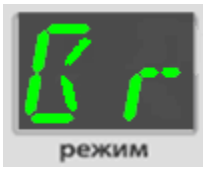


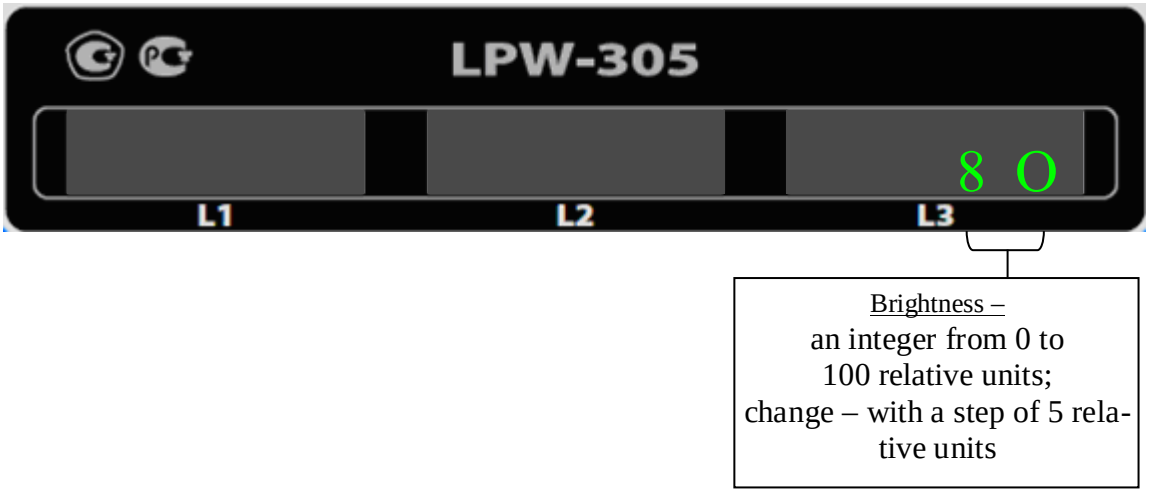


Signature and date | Dupl. inv. No. | Repl. inv. No. | Signature and date | Orig. inv. No.

7.3.23.3 Display brightness regulation (item "08." of the main menu, item "Br" of the nested menu)

States of the indicators when the display brightness is regulated are as follows:





The set value determines the brightness of all indicators ("MODE" indicator and three indicators "*L1*", "*L2*", "*L3*").

To adjust the display brightness:

1) switch over to the editing mode by pressing the "SELECT" key;

2) select a new value for the indicators brightness, using the "▼" key (brightness decrease) or the "►" key (brightness increase);

3) confirm the selection and save the settings by pressing the "SELECT" key;

4) if you need to cancel the input, press the "RESET" key.

7.3.23.4 Indication and selection of the main menu item to be performed first when LPW-305 is turned on (item "08." of the main menu, item "M0" of the nested menu)

States of the indicators during the indication and selection of the main menu item to be performed first when LPW-305 is turned on are the following:

0	Item "00." of the main menu
2	Item "01." of the main menu
3	Item "03." of the main menu
4	Item "04." of the main menu
5	Item "05." of the main menu
6	Item "06." of the main menu
7	Item "07." of the main menu

The main menu item to be performed first when LPW-305 is turned on is selected as follows:

1) switch over to the editing mode by pressing the "SELECT" key;

2) select the main menu item to be performed first when LPW-305 is turned on by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

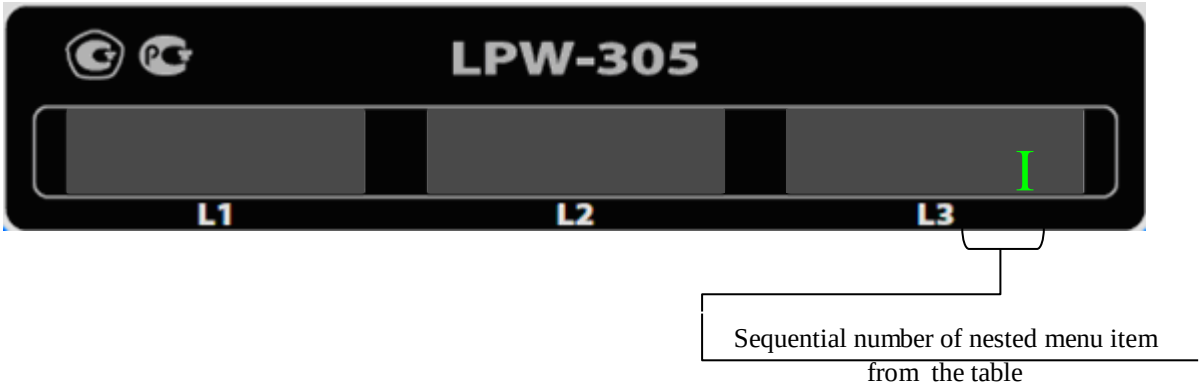
3) confirm the selection and save the settings by pressing the "SELECT" key;

4) if you need to cancel the input, press the "RESET" key.

7.3.23.5 Indication and selection of the nested menu item to be performed first when LPW-305 is turned on (item "08." of the main menu, item "M1" of the nested menu)

This setting determines which item of the nested menu will be displayed on the indicators when the LPW-305 is turned on. It is interconnected with the setting that defines the main menu item when the LPW-305 is turned on.

States of the indicators during the indication and selection of the nested menu item to be performed first when LPW-305 is turned on are the following:



The nested menu item to be performed first when LPW-305 is turned on is selected as follows:

1) determine which main menu item is performed first when the LPW-305 is turned on and set it following the instructions given in paragraph 7.3.23.4;

2) determine the required sequential number of the nested menu item for Table 17;

3) set item "08." of the main menu and item "M1" of the nested menu;

4) switch over to the editing mode by pressing the "SELECT" key;

5) select the main menu item to be performed first when LPW-305 is turned on determined in operation 2) by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

6) confirm the selection and save the settings by pressing the "SELECT" key;

7) if you need to cancel the input, press the "RESET" key.

7.3.23.6 Indication and selection of dimensions of displayed current values (item "08." of the main menu and item "SI" of the nested menu)

States of the indicators during the indication and selection of dimensions of displayed current values are the following:

-3	Measurement results are displayed in mA
I	Measurement results are displayed in A
3	Measurement results are displayed in kA
6	Measurement results are displayed in MA

The dimension of displayed current values is selected as follows:

1) set item "08." of the main menu and item "SI" of the nested menu;

2) switch over to the editing mode by pressing the "SELECT" key;

3) select the required dimension by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

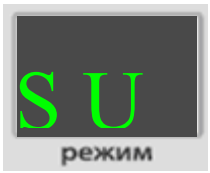
4) confirm the selection and save the settings by pressing the "SELECT" key;

5) if you need to cancel the input, press the "RESET" key.

The dimension of the value *I* can also be changed during the selection of item "00." of the main menu and item "I" of the nested menu (paragraph 7.3.5).

7.3.23.7 Indication and selection of dimensions of displayed voltage values (item "08." of the main menu and item "SU" of the nested menu)

States of the indicators during the indication and selection of dimensions of displayed voltage values are the following:



-3	Measurement results are displayed in mV
I	Measurement results are displayed in V
3	Measurement results are displayed in kV
6	Measurement results are displayed in MV

The dimension of displayed voltage values is selected as follows:

1) set item "08." of the main menu and item "SU" of the nested menu;

2) switch over to the editing mode by pressing the "SELECT" key;

3) select the required dimension by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

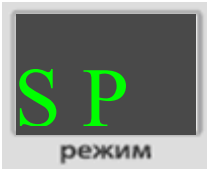
4) confirm the selection and save the settings by pressing the "SELECT" key;

5) if you need to cancel the input, press the "RESET" key.

The dimension of the value *U* can also be changed during the selection of item "00." of the main menu and item "U" of the nested menu (paragraph 7.3.3).

7.3.23.8 Indication and selection of dimensions of displayed power values (item "08." of the main menu and item "SP" of the nested menu)

States of the indicators during the indication and selection of dimensions of displayed power values are the following:



-3	Measurement results are displayed in mW, mVAr and mVA-
I	Measurement results are displayed in W, VAr and VA-
3	Measurement results are displayed in kW, kVAr and kVA-
6	Measurement results are displayed in MW, MVAr and MVA-

The dimension of displayed power values is selected as follows:

1) set item "08." of the main menu and item "SP" of the nested menu;

2) switch over to the editing mode by pressing the "SELECT" key;

3) select the required dimension by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

4) confirm the selection and save the settings by pressing the "SELECT" key;

5) if you need to cancel the input, press the "RESET" key.

The dimension of the displayed power values can also be changed during the selection of item "00." of the main menu and items "P", "Q", "S", "PS" of the nested menu (subparagraphs 7.3.8 – 7.3.11, respectively).

7.3.23.9 Indication and selection of dimensions of displayed energy values (item "08." of the main menu and item "SE" of the nested menu)

States of the indicators during the indication and selection of dimensions of displayed energy values are the following:

-3	Measurement results are displayed in -mW*h, -mVAr*h and -mVA*h
I	Measurement results are displayed in -W*h, -VAr*h and -VA*h
3	Measurement results are displayed in -kW*h, -kVAr*h and -kVA*h
6	Measurement results are displayed in -MW*h, -MVAr*h and -MVA*h

The dimension of displayed energy values is selected as follows:

1) set item "08." of the main menu and item "SE" of the nested menu;

2) switch over to the editing mode by pressing the "SELECT" key;

3) select the required dimension by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

4) confirm the selection and save the settings by pressing the "SELECT" key;

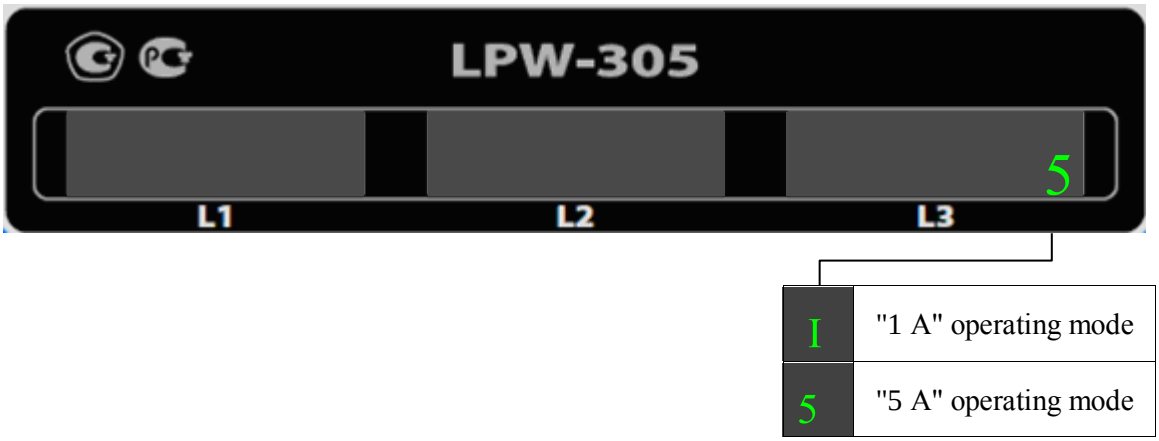
5) if you need to cancel the input, press the "RESET" key.

The dimension of the displayed energy values can also be changed during the selection of item "00." of the main menu and items "AP", "AN", "RP", "RN", "EF" of the nested menu (subparagraphs 7.3.16.1 – 7.3.16.10, respectively).

7.3.24 Menu settings available for reading and changing only upon entering a password (item "09." of the main menu)

7.3.24.1 Indication and selection of the operating mode for the current measuring inputs (item "09." of the main menu, item "IB" of the nested menu)

States of the indicators during the indication and selection of dimensions of the operating mode for the current measuring inputs are the following:



ATTENTION: the operating mode selected for the current measuring inputs is applied immediately after pressing the "SELECT" key during performance of the operation 4), therefore, be careful to avoid overloading the LPW-305 at the current measuring inputs.

The operating mode for the current measuring inputs is selected as follows:

1) set item "09." of the main menu and item "IB" of the nested menu;

2) switch over to the editing mode by pressing the "SELECT" key;

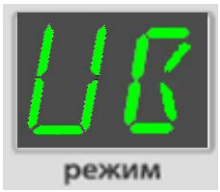
3) select the required operating mode for the current measuring inputs by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

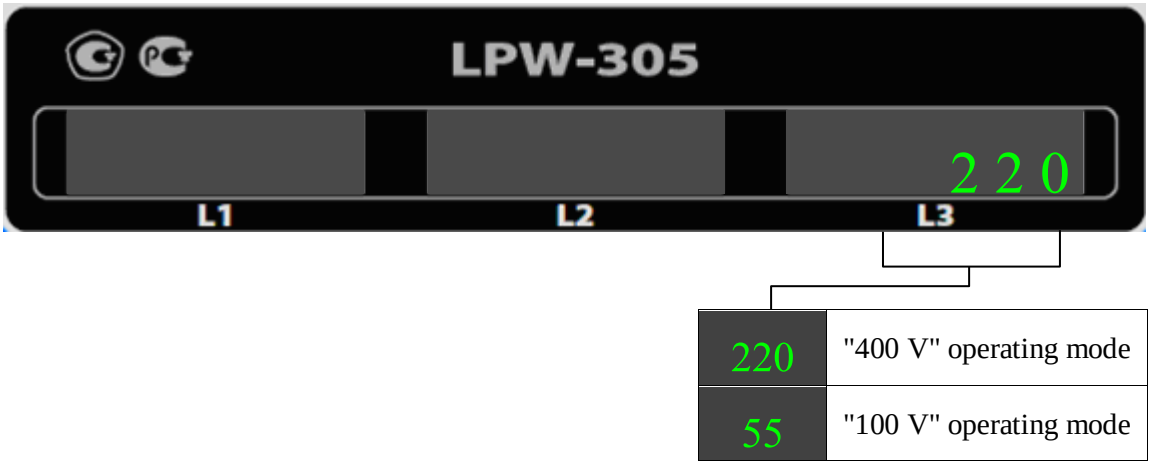
4) confirm the selection and save the settings by pressing the "SELECT" key;

5) if you need to cancel the input, press the "RESET" key.

7.3.24.2 Indication and selection of the operating mode for the voltage measuring inputs (item "09." of the main menu, item "UB" of the nested menu)

States of the indicators during the indication and selection of dimensions of the operating mode for the voltage measuring inputs are the following:





220	"400 V" operating mode
55	"100 V" operating mode

The operating mode for the voltage measuring inputs is selected as follows:

1) set item "09." of the main menu and item "IB" of the nested menu;

2) switch over to the editing mode by pressing the "SELECT" key;

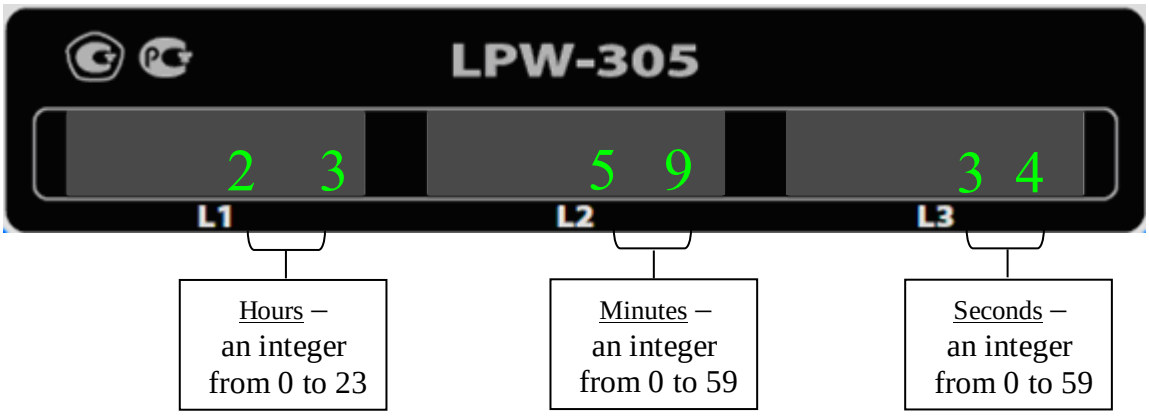
3) select the required operating mode for the voltage measuring inputs by switching between possible values with successively pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order);

4) confirm the selection and save the settings by pressing the "SELECT" key;

5) if you need to cancel the input, press the "RESET" key.

7.3.24.3 Indication and setting of time (item "09." of the main menu, item "T" of the nested menu)

States of the indicators when the time is displayed and set are as follows:



The time is set as follows:

1) set item "09." of the main menu and item "T" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

4) set seconds by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) make sure that you can start editing: the indication on the "L2" indicator should blink;

6) set minutes by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

7) make sure that you can start editing: the indication on the "L3" indicator should blink;

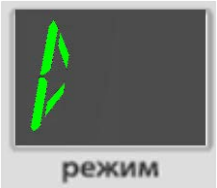
8) set hours by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

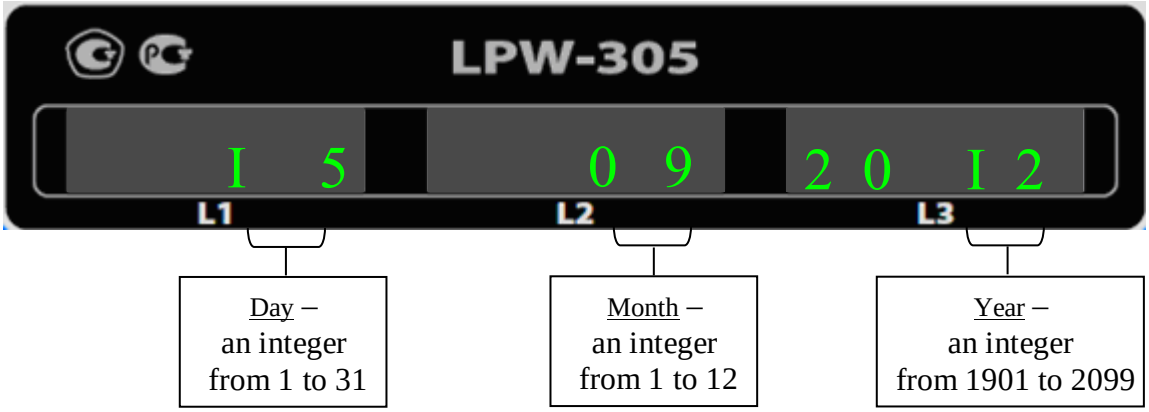
9) confirm the selection and save the settings by pressing the "SELECT" key;

10) if you need to cancel the input, press the "RESET" key.

7.3.24.4 Indication and setting of date (item "09." of the main menu, item "D" of the nested menu)

States of the indicators when the date is displayed and set are as follows:





The date is set as follows:

1) set item "09." of the main menu and item "D" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

4) set the year by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) make sure that you can start editing: the indication on the "L2" indicator should blink;

6) set the month by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

7) make sure that you can start editing: the indication on the "L3" indicator should blink;

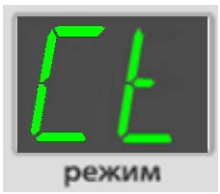
8) set the day by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

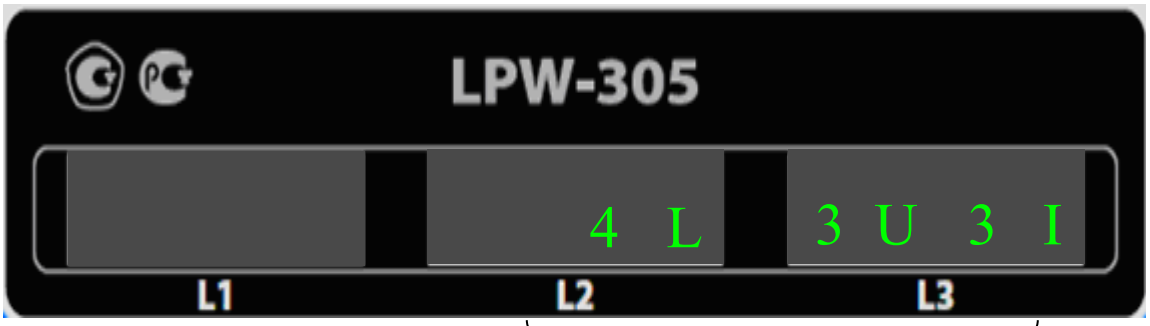
9) confirm the selection and save the settings by pressing the "SELECT" key;

10) if you need to cancel the input, press the "RESET" key.

7.3.24.5 Indication and selection of diagram for LPW-305 connection to an AC network (item "09." of the main menu, item "Ct" of the nested menu)

States of the indicators during the indication and selection of diagram for LPW-305 connection to an AC network are the following:





4L3U3I	Four-wire "star" connection with three CTs and three VTs)	Figure B.1 of Appendix B
4L3I	Four-wire connection with three CTs	Figure B.2 of Appendix B
4L2U3I	Four-wire "star" connection with three CTs and two VTs	Figure B.3 of Appendix B
3L2I	Three-wire connection with two CTs	Figure B.4 of Appendix B
3L2U3I	Three-wire V-connection with three CTs and two VTs	Figure B.5 of Appendix B
3L2U2I	Three-wire V-connection with two CTs and two VTs	Figure B.6 of Appendix B
2L	Connection to a single-phase circuit	Figure B.7 of Appendix B
4L3UI3I	Four-wire "star" connection with three CTs and three VTs) with indication of PQIs for phase-to-phase voltage values	

Figure B.1

The diagram for LPW-305 connection to an AC network is selected as follows:

1) set item "09." of the main menu and item "Ct" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indications on the "L2" and "L3" indicators should blink;

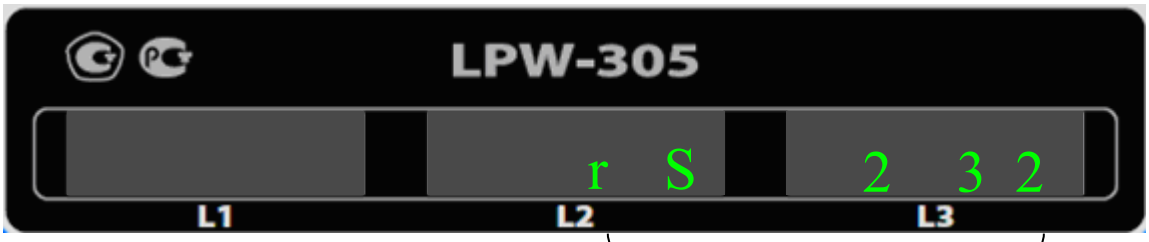
4) set the required diagram by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.6 Indication and setting of the active interface (item "09." of the main menu, item "IF" of the nested menu)

States of the indicators during the indication and selection of diagram for LPW-305 connection to an AC network are the following:



rS 2 3 2	RS-232 interface
rS 4 8 5	RS-485 interface
E h	Ethernet interface

The active interface is selected as follows:

1) set item "09." of the main menu and item "IF" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

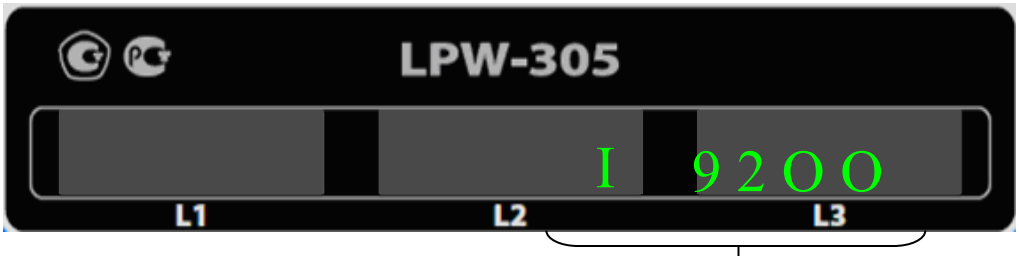
4) set the required active interface by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.7 Indication and change of rate of exchange via RS-232, RS-485 interfaces (item "09." of the main menu, item "Bd" of the nested menu)

States of the indicators during the indication and change of rate of exchange via RS-232, RS-485 interfaces are the following:



1200	Rate of exchange of 1200 bit/s
2400	Rate of exchange of 2400 bit/s
4800	Rate of exchange of 4800 bit/s
9600	Rate of exchange of 9600 bit/s
14400	Rate of exchange of 14400 bit/s
19200	Rate of exchange of 19200 bit/s
38400	Rate of exchange of 38400 bit/s
57600	Rate of exchange of 57600 bit/s
115200	Rate of exchange of 115200 bit/s

The rate of exchange via RS-232, RS-485 interfaces is changed as follows:

1) set item "09." of the main menu and item "Bd" of the nested menu;

2) press the "SELECT" key;

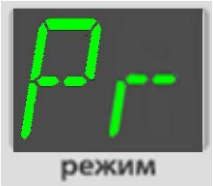
3) make sure that you can start editing: the indication on the "L3" indicator should blink;

4) set the exchange rate by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.8 Serial interface parity check (item "09." of the main menu, item "Pr" of the nested menu)



E	Parity check
O	Odd parity check
–	Check is off

The parity check is set as follows:

1) set item "09." of the main menu and item "Pr" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

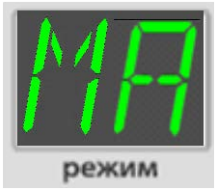
4) set the exchange rate by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

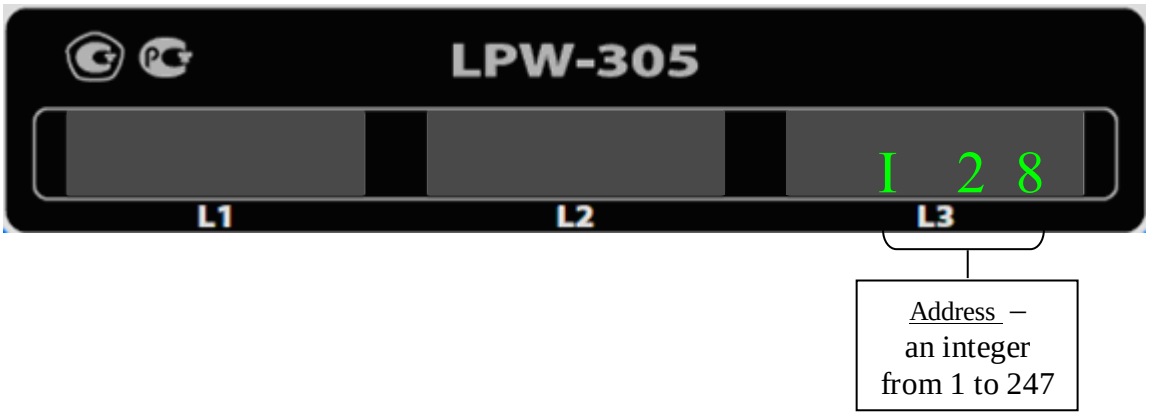
5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.9 Indication and setting of MODBUS-RTU address (item "09." of the main menu, item "MA" of the nested menu)

States of the indicators during the indication and setting of MODBUS-RTU address are as follows:





Indication and setting of MODBUS-RTU address are performed as follows:

1) set item "09." of the main menu and item "MA" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

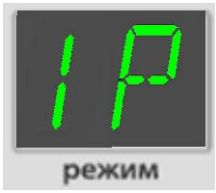
4) set the exchange rate by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.10 Indication and change of LPW-305 IP-address in the Ethernet network (item "09." of the main menu, item "IP" of the nested menu)

States of the indicators during the indication and change of LPW-305 IP-address in the Ethernet network are the following:



IP-address consists of four groups of digits. Each group is an integer from 0 to 255 with a point at the end.

LPW-305 IP-address in the Ethernet network is changed as follows:

1) set item "09." of the main menu and item "IP" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L1" indicator should blink;

4) set the required value for the first group by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

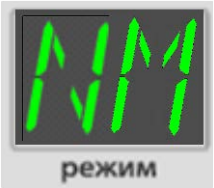
5) set the values for the second, third, fourth groups in the same way as for the first group;

6) confirm the selection and save the settings by pressing the "SELECT" key;

7) if you need to cancel the input, press the "RESET" key.

7.3.24.11 Indication and change of the subnet mask (item "09." of the main menu, item "NM" of the nested menu)

States of the indicators during the indication and change of the subnet mask are as follows:



The subnet mask consists of four groups of digits. Each group is an integer from 0 to 255 with a point at the end.

The subnet mask is changed as follows:

1) set item "09." of the main menu and item "NM" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L1" indicator should blink;

4) set the required value for the first group by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) set the values for the second, third, fourth groups in the same way as for the first group;

6) confirm the selection and save the settings by pressing the "SELECT" key;

7) if you need to cancel the input, press the "RESET" key.

7.3.24.12 Indication and change of gateway address (item "09." of the main menu, item "GW" of the nested menu)

States of the indicators during the indication and change of gateway address are as follows:

Gateway address consists of four groups of digits. Each group is an integer from 0 to 255 with a point at the end.

Gateway address is changed as follows:

1) set item "09." of the main menu and item "GW" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L1" indicator should blink;

4) set the required value for the first group by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

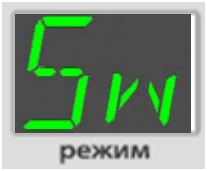
5) set the values for the second, third, fourth groups in the same way as for the first group;

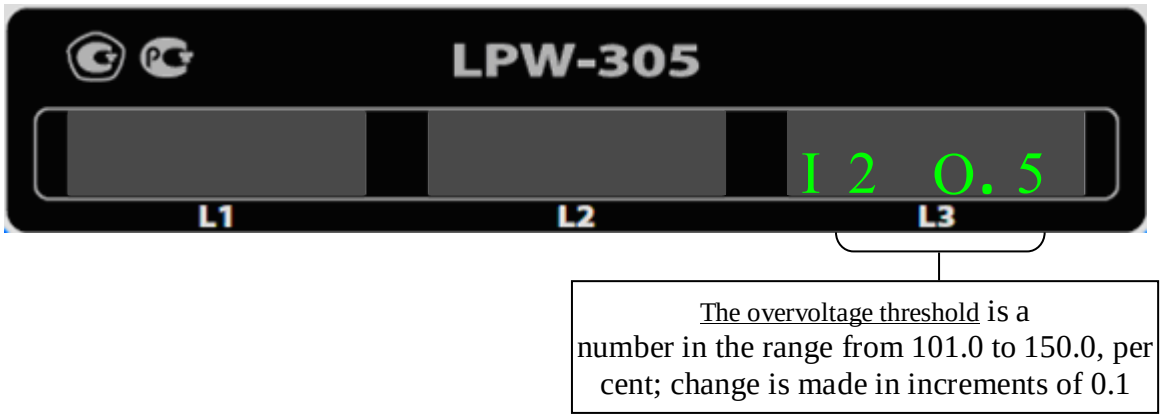
6) confirm the selection and save the settings by pressing the "SELECT" key;

7) if you need to cancel the input, press the "RESET" key.

7.3.24.13 Indication and change of overvoltage threshold (item "09." of the main menu, item "Sw" of the nested menu)

States of the indicators during the indication and change of overvoltage threshold are as follows:





The overvoltage threshold is set as a percentage of the rated value of phase voltage (paragraph 2.1).

The overvoltage threshold is changed as follows:

1) set item "09." of the main menu and item "Sw" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

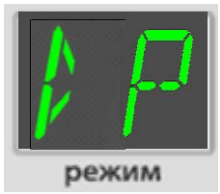
4) set the required overvoltage threshold by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.14 Indication and change of voltage fall threshold (item "09." of the main menu, item "DP" of the nested menu)

States of the indicators during the indication and change of voltage fall threshold are as follows:



Voltage fall threshold is
a number in the range from 10.0 to 99.0, per cent,
change is made in increments of 0.1

The voltage fall threshold is changed as follows:

1) set item "09." of the main menu and item "DP" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

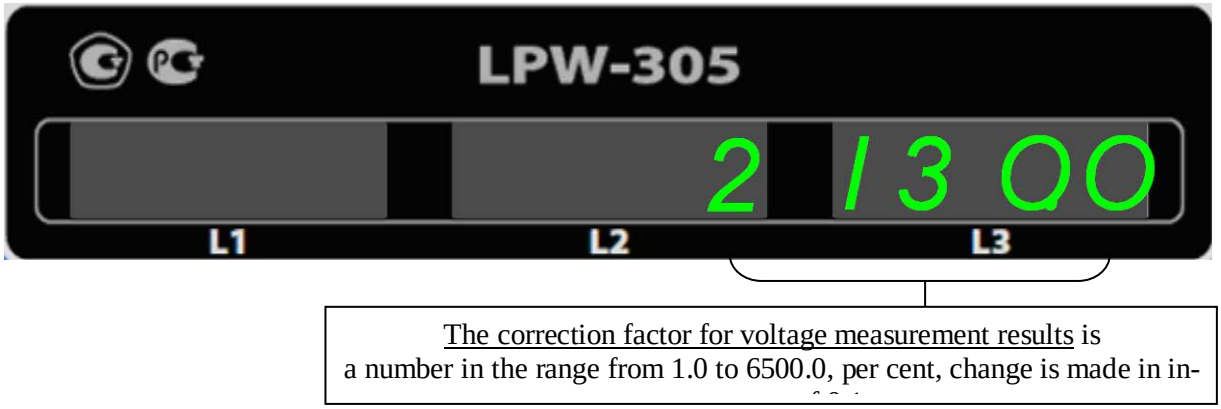
4) set the required voltage fall threshold by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.15 Indication and change of correction factor for voltage measurement results (item "09." of the main menu, item "KU" of the nested menu)

States of the indicators during the indication and change of correction factor for voltage measurement results are as follows:



The correction factor for voltage measurement results is a number in the range from 1.0 to 6500.0, per cent, change is made in in-

The correction factor for voltage measurement results is changed as follows:

1) set item "09." of the main menu and item "KU" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

4) set the required value of correction factor for voltage measurement results by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

if you need to cancel the input, press the "RESET" key.

7.3.24.16 Indication and change of correction factor for current measurement results (item "09." of the main menu, item "KI" of the nested menu)

States of the indicators during the indication and change of correction factor for current measurement results are as follows:

The correction factor for current measurement results is an integer in the range from 1 to 50000; change is made in increments of 0.1

The correction factor for voltage measurement results is changed as follows:

1) set item "09." of the main menu and item "KI" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

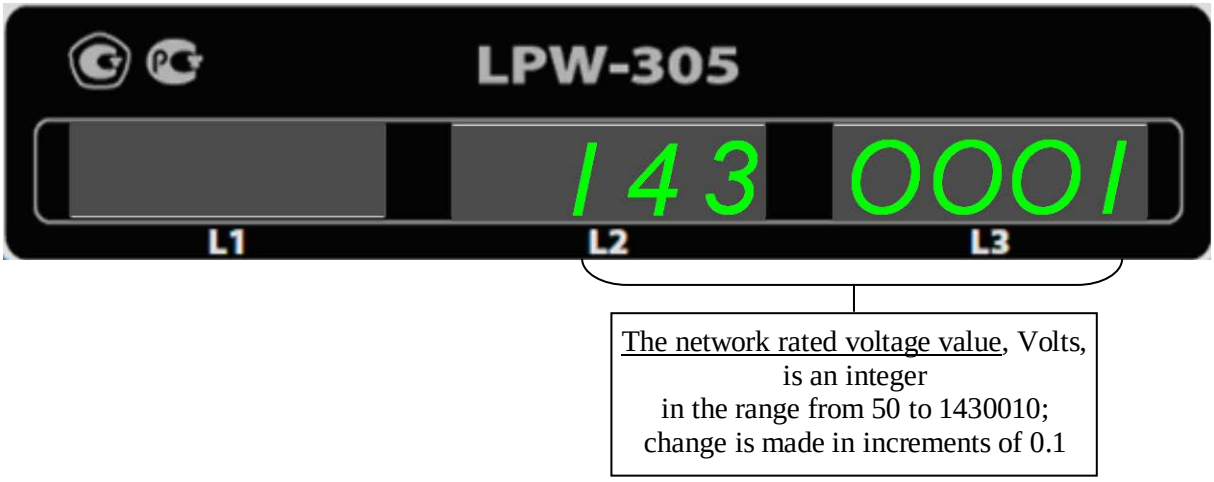
4) set the required value of correction factor for voltage measurement results by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.3.24.17 Indication and change of network rated voltage (item "09." of the main menu, item "UN" of the nested menu)

States of the indicators during the indication and change of correction factor for current measurement results are as follows:



The network rated voltage value is changed as follows:

1) set item "09." of the main menu and item "UN" of the nested menu;

2) press the "SELECT" key;

3) make sure that you can start editing: the indication on the "L3" indicator should blink;

4) set the required network rated voltage value by pressing the "►" key (direct values sorting order) or "▼" (reverse values sorting order) and press the "SELECT" key;

5) confirm the selection and save the settings by pressing the "SELECT" key;

6) if you need to cancel the input, press the "RESET" key.

7.4 Troubleshooting

7.4.1 The list of possible malfunctions of DIN-rail mounted LPW-305 modifications and recommendations for their elimination are summarized in Table 19.

Table 19

Malfunction description	Possible cause of malfunction	Recommendations for elimination
Indicators do not glow	LPW-305 is de-energized	Check the voltage in the power supply circuit "220 V, 50 Hz, 20 V·A 1", "220 V, 50 Hz, 20 V·A 2" with a voltmeter.
	LPW-305 has switched over to the low power consumption mode (see paragraph 3.4.1.2). The sign of switching to this mode is glowing of only one "Rx" LED on the front panel of LPW-305	Switching to the low power consumption mode can be caused by a long-term overvoltage in LPW-305 power circuit, high ambient temperature, or a combination of these factors. In the low power consumption mode, when the indicators are off, all other regular functions of LPW-305 are performed normally. LPW-305 will be returned to the normal operating mode automatically as the power unit heat sink cools down
No communication with the computer via the Ethernet interface	No physical connection of LPW-305 to the computer	Check the connection of the "Ethernet" connector. Use the "ping" command of the host computer to check the physical connection
	IP address and subnet masks are set incorrectly in LPW-305	Set the IP address and subnet masks in LPW-305 correctly, using LPW-305 menu
	The type of Ethernet interface is not specified in LPW-305 menu	Specify the type of Ethernet interface in LPW-305 menu
No connection to the computer via RS-232 or RS-485 interface	The required interface is not connected	Check the connection of the required interface
	Device address is specified incorrectly	Specify the device address correctly using LPW-305 menu
	The type of the required interface is not specified	Specify the type of the required interface in LPW-305 menu
	Transmission rate and stop bits are not specified	Specify the transmission rate and stop bits using LPW-305 menu

7.4.2 The list of possible malfunctions of LPW-305-7 and recommendations for their elimination are summarized in Table 20.

Table 20

Malfunction description	Possible cause of malfunction	Recommendations for elimination
Indicators do not glow	LPW-305-7 is de-energized	Check 220 V, 50 Hz AC voltage at the input of the power supply unit of LPW-305-7, using a voltmeter.
		Check 12 V DC voltage at the output of the power supply unit of LPW-305-7, using a voltmeter.
No communication with the computer via the Ethernet interface	No physical connection of LPW-305 to the computer	Check the connection of the "Ethernet" connector. Use the "ping" command of the host computer to check the physical connection
	IP address and subnet masks are set incorrectly in LPW-305	Set the IP address and subnet masks in LPW-305 correctly, using LPW-305 menu
	The type of Ethernet interface is not specified in LPW-305 menu	Specify the type of Ethernet interface in LPW-305 menu

8 TECHNICAL MAINTENANCE AND VERIFICATION

8.1 **ATTENTION:** observe the safety measures described in section 5 when performing technical maintenance.

8.2 Technical maintenance of LPW-305 is carried out before its verification and includes:

1) conducting a technical inspection;

2) performing self-diagnostics;

3) cleaning the keys and indicators from dust and dirt;

4) cleaning the contacts of terminal connectors in case of appearance of oxide films on them;

5) checking the fastening of the terminal connectors;

6) replacing the battery of LPW-305.

8.3 LPW-305 shall be verified in accordance with the regulatory document - verification procedure ДЛИЖ.411722.0001 МП "Telemetric devices for measuring electrical power quality, capacity and quantity parameters LPW-305", approved by LLC "ICRM".

The verification shall be conducted every three years.

9 TRANSPORTATION AND STORAGE

9.1 LPW-305 shall be transported by closed vehicles of any type at a relative humidity of not more than 95% at a temperature of 25 °C; ambient temperature from minus 25 to plus 60 °C for all modifications except for LPW-305-7 with characteristic letter "B" in the designation; ambient temperature from minus 40 to plus 60 °C for LPW-305-7 modification with characteristic letter "B" in the designation.

During loading and- unloading operations, LPW-305 shall not be subjected to sudden impacts and atmospheric precipitation.

The transportation shall be carried out in accordance with the rules for the carriage of goods being in force for particular means of transport.

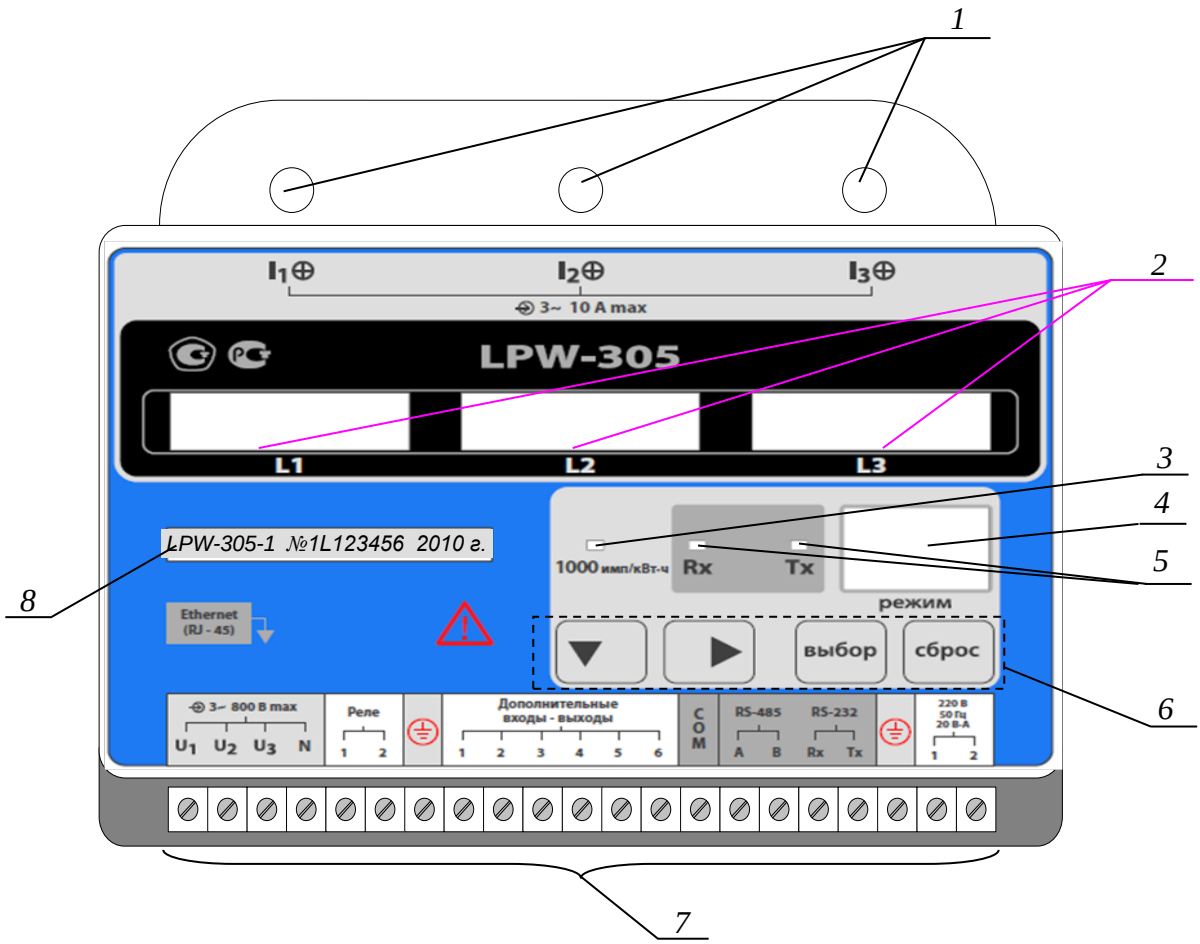
9.2 LPW-305 shall be stored at a temperature of 0 to plus 40 °C and a relative humidity of not more than 80% at a temperature of 35 °C.

In the storage rooms, the content of dust, acid and alkali vapors, corrosive gases and other harmful impurities causing corrosion shall not exceed the content of corrosive agents for the atmosphere of type I prescribed by GOST 15150-69.

APPENDIX A

(compulsory)

VIEW OF LPW-305



1 – through-holes for connection of current measuring inputs of LPW-305 to external circuits;

2 – LED indicators for displaying measurement results and service information;

3 – optical test output;

4 – LED indicator for displaying additional information;

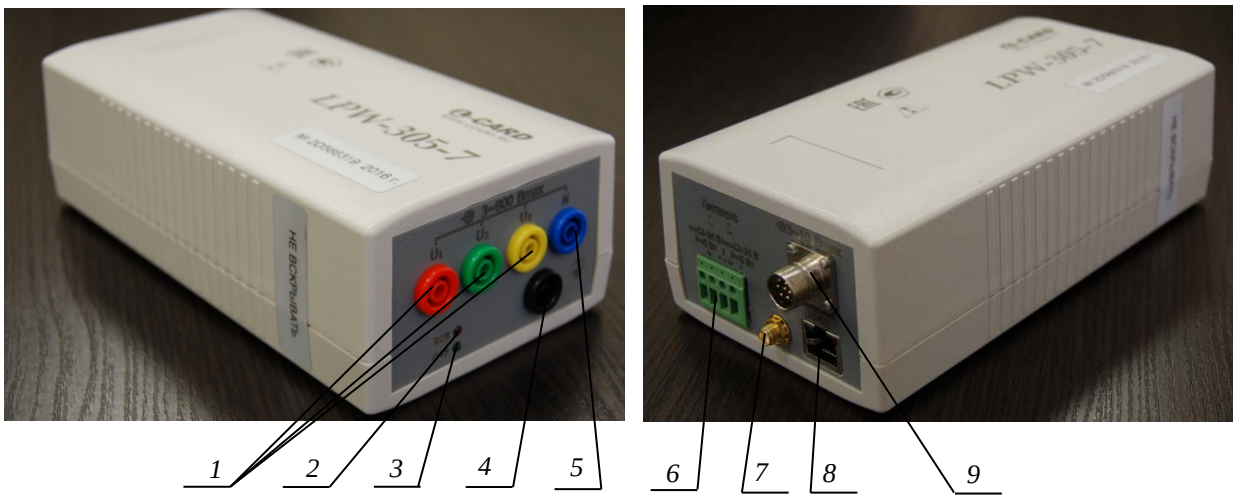
5 – LED indicators indicating active exchange via S-232, RS-485 interfaces ("Rx" indicates information receiving and "Tx" indicates information transmission);

6 – keyboard;

7 – screw terminals for connection of voltage measuring inputs, power circuit, interfaces, grounding and control circuits;

8 – place of marking with designation of the modification, factory number and year of manufacture

Figure A.1 – View of DIN-rail mounted LPW-305



1 – connectors for connection of measured phase voltages;
2 – "POW" ("РАБ") LED indicator (power supply connection);
3 – "PHASE" ("ФАЗ") LED indicator (correct connection of phase voltages);
4 – protective grounding connector;
5 – connector for three-phase network neutral connection;
6 – screw terminal connectors for supply voltage connection;
7 – "GPS" connector for connecting a remote GPS antenna;
8 – connector for connecting the Ethernet interface;
9 – connector for connecting current clamps (LPW-305-7 with characteristic letter A in the designation) and outputting the current time signal from LPW-305-7

Figure A.2 – View of LPW-305-7 modification

APPENDIX B

(compulsory)

DIAGRAMS OF LPW-305 CONNECTION TO EXTERNAL CIRCUITS

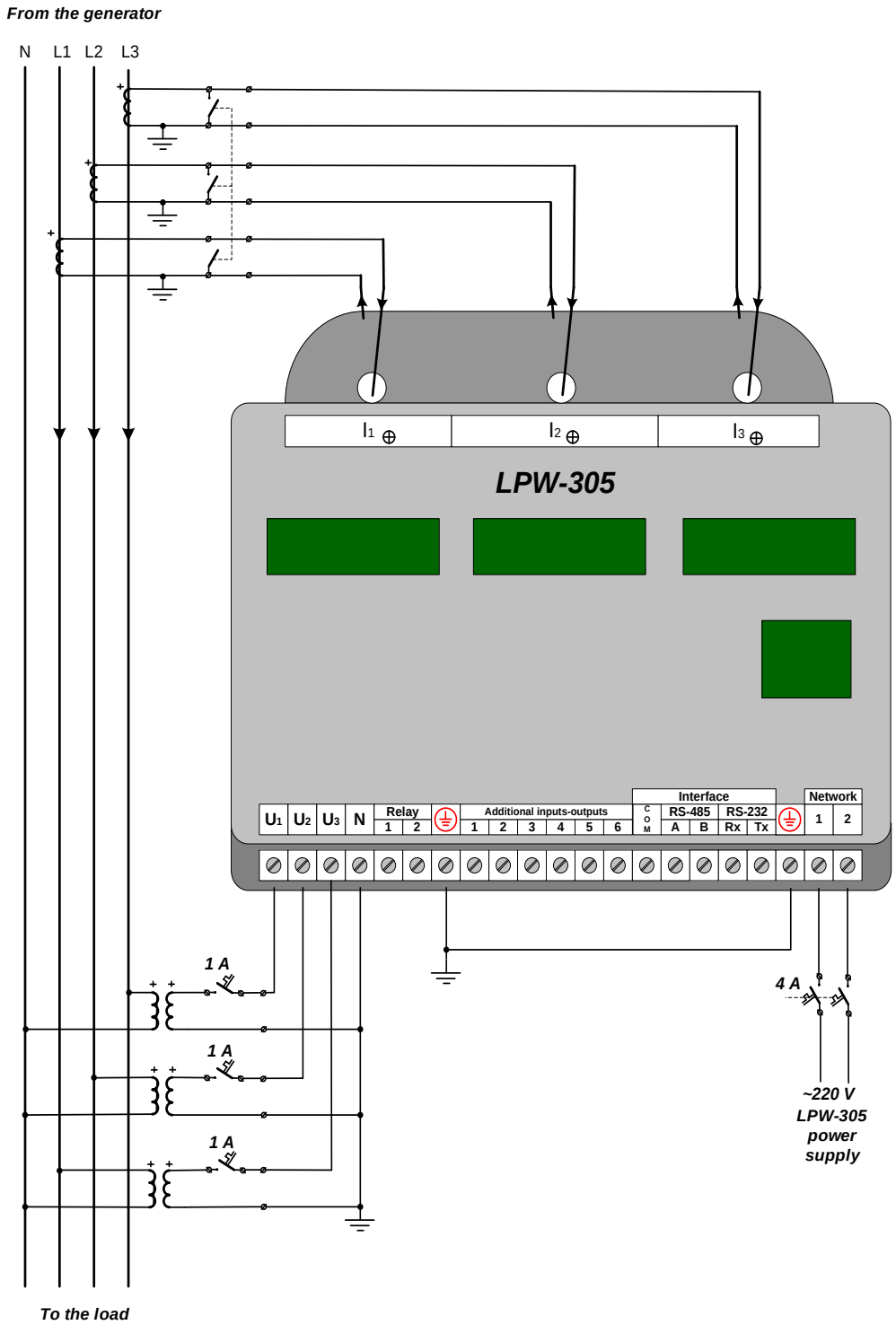


Figure B.1 – Diagram of four-wire "star" connection with three CTs and three VTs, for DIN-rail mounted LPW-305

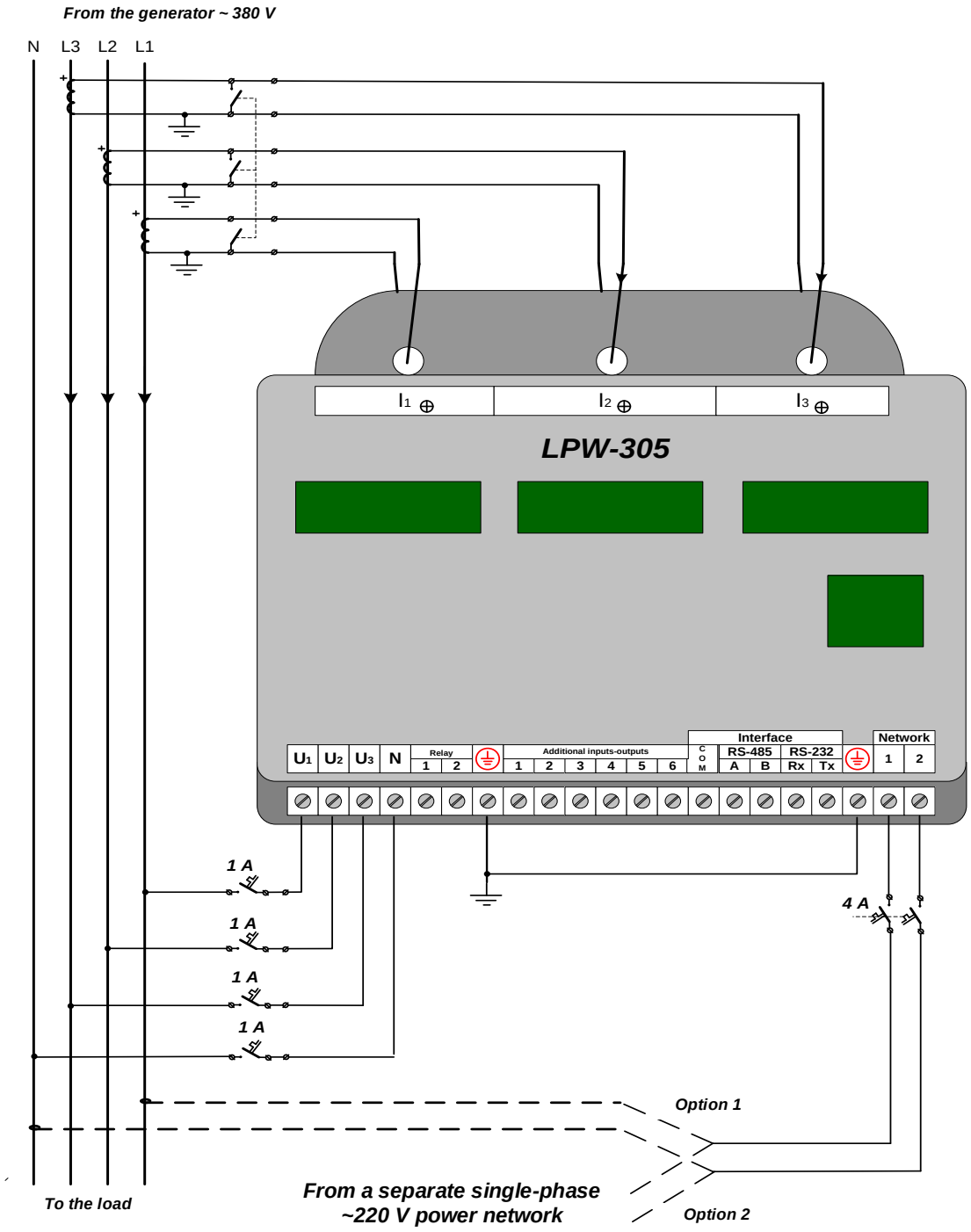


Figure B.2 – Diagram of four-wire connection with three CTs and two power supply options: either from a separate network or from one of voltage measuring circuit phases for DIN-rail mounted LPW-305

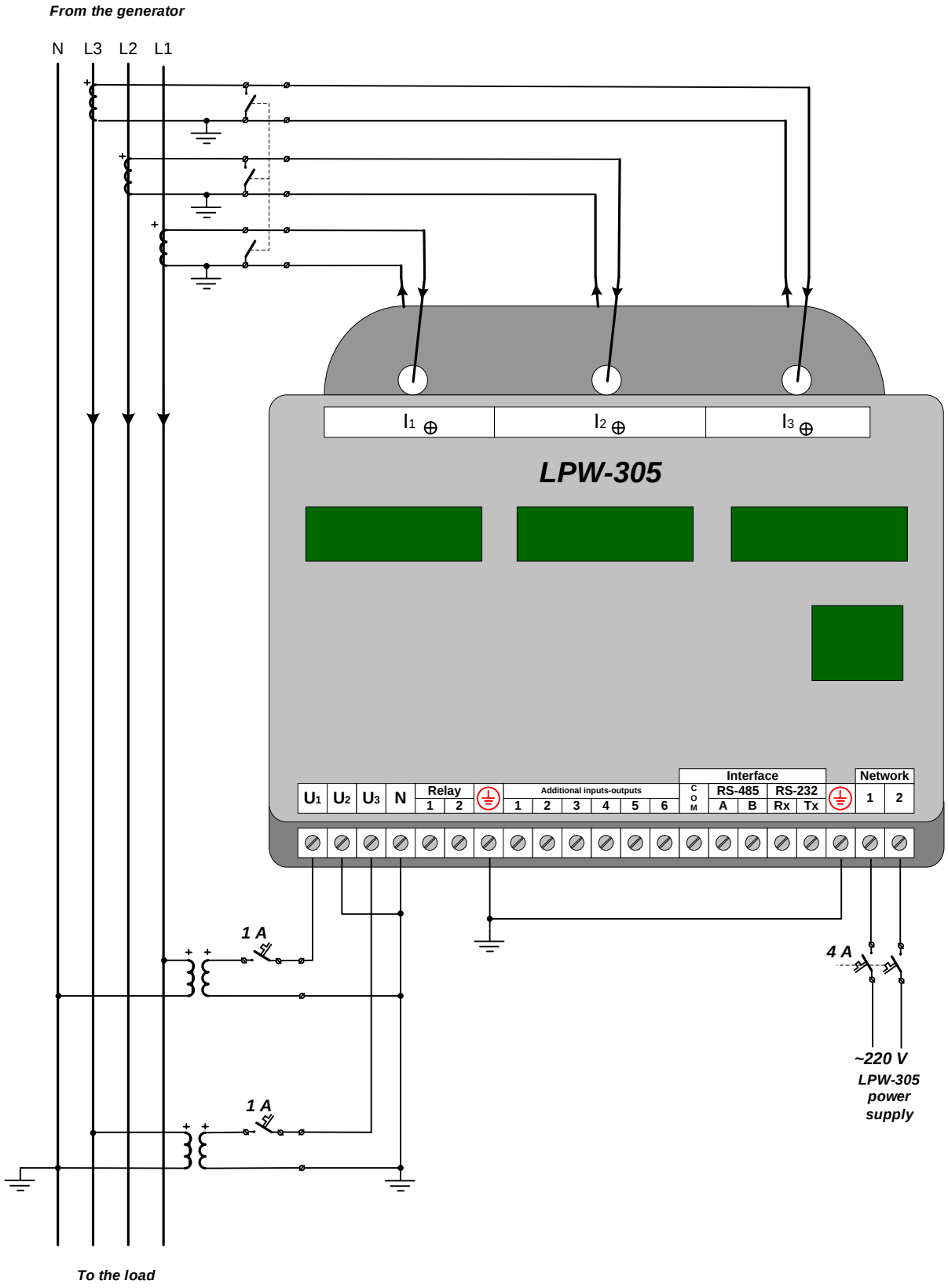


Figure B.3 – Diagram of four-wire "star" connection with three CTs and two VTs, for DIN-rail mounted LPW-305

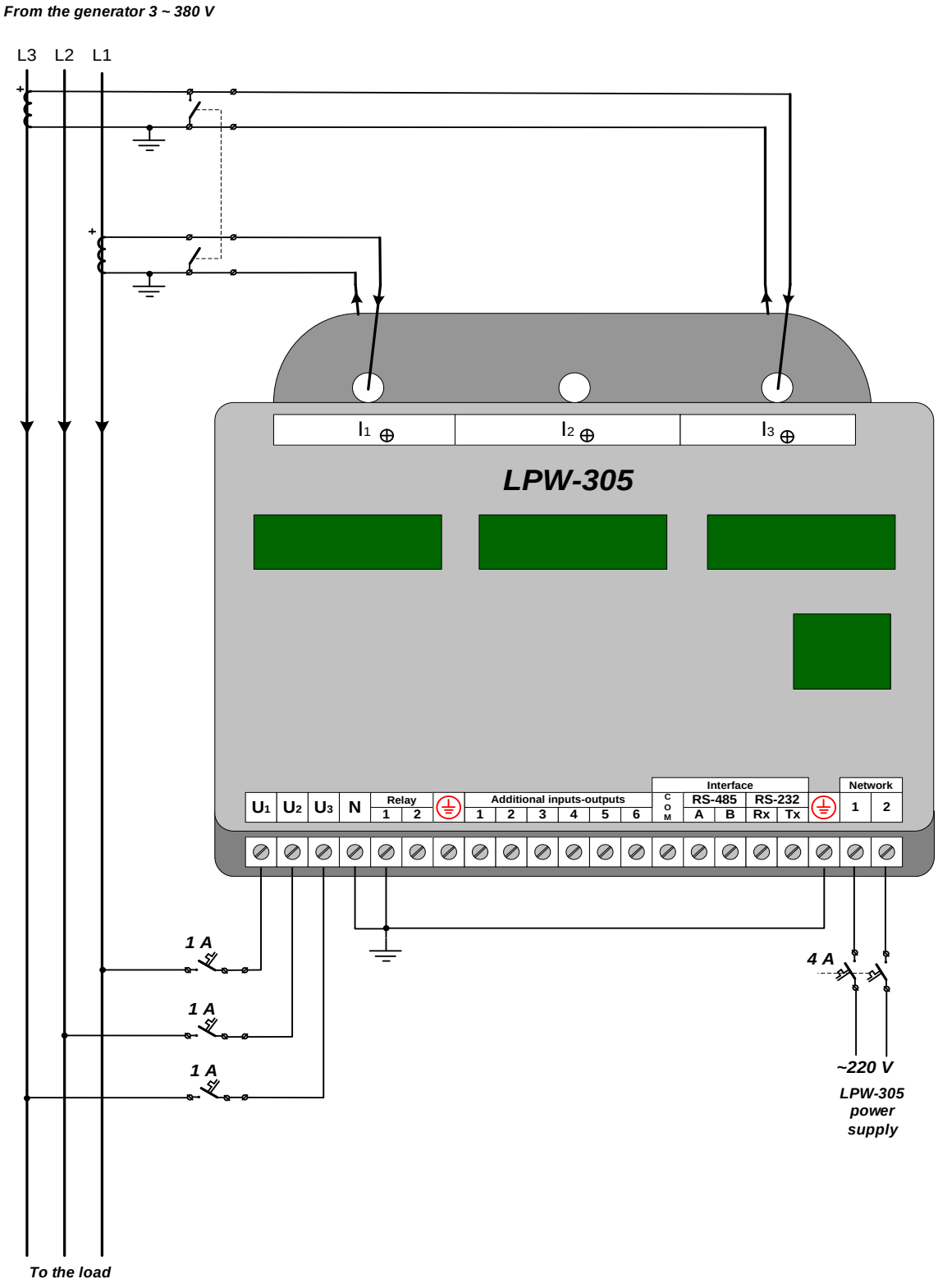


Figure B.4 – Diagram of three-wire connection with two CTs,
for DIN-rail mounted LPW-305

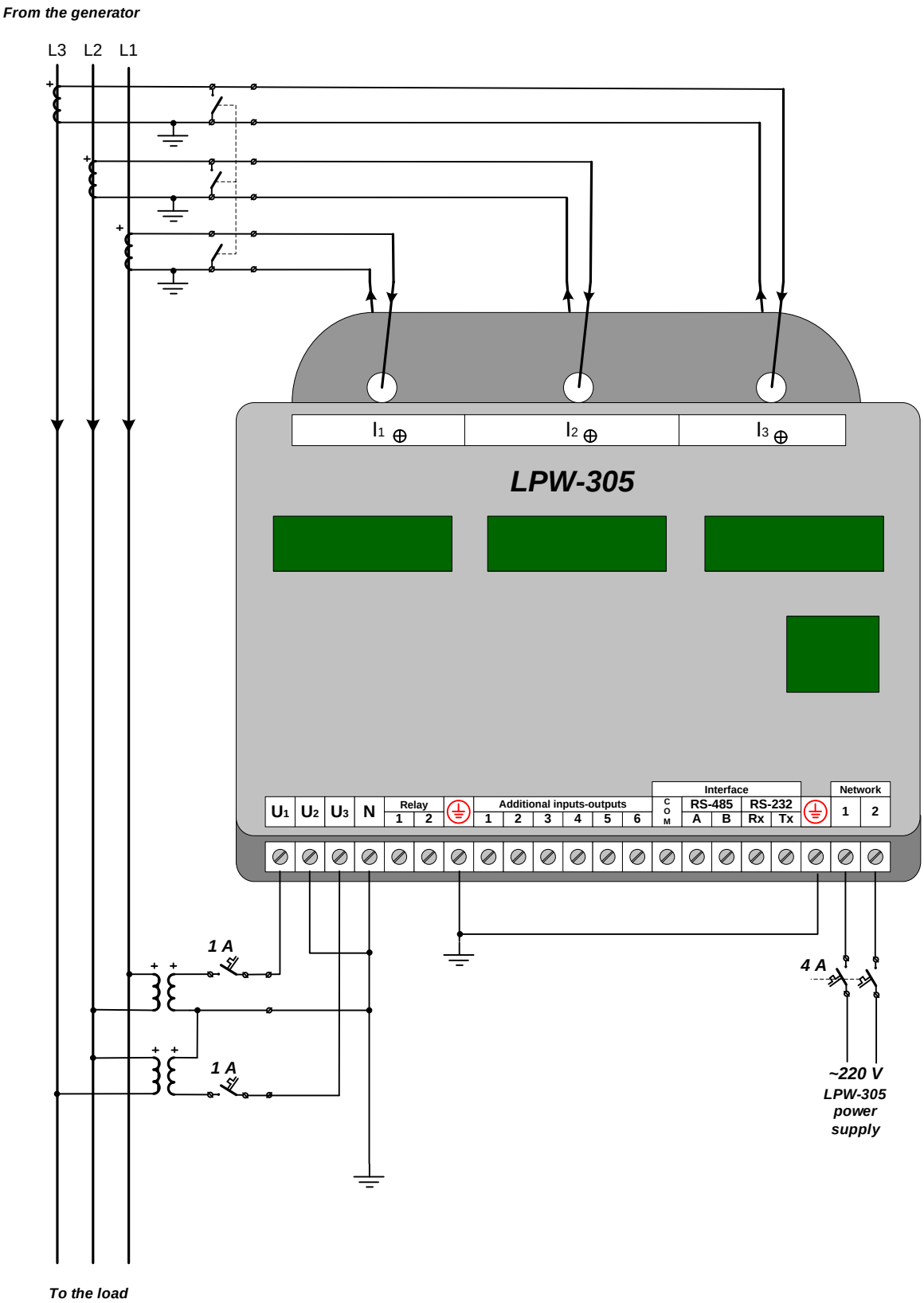


Figure B.5 – Diagram of three-wire V-connection
with three CTs and two VTs, for DIN-rail mounted LPW-305

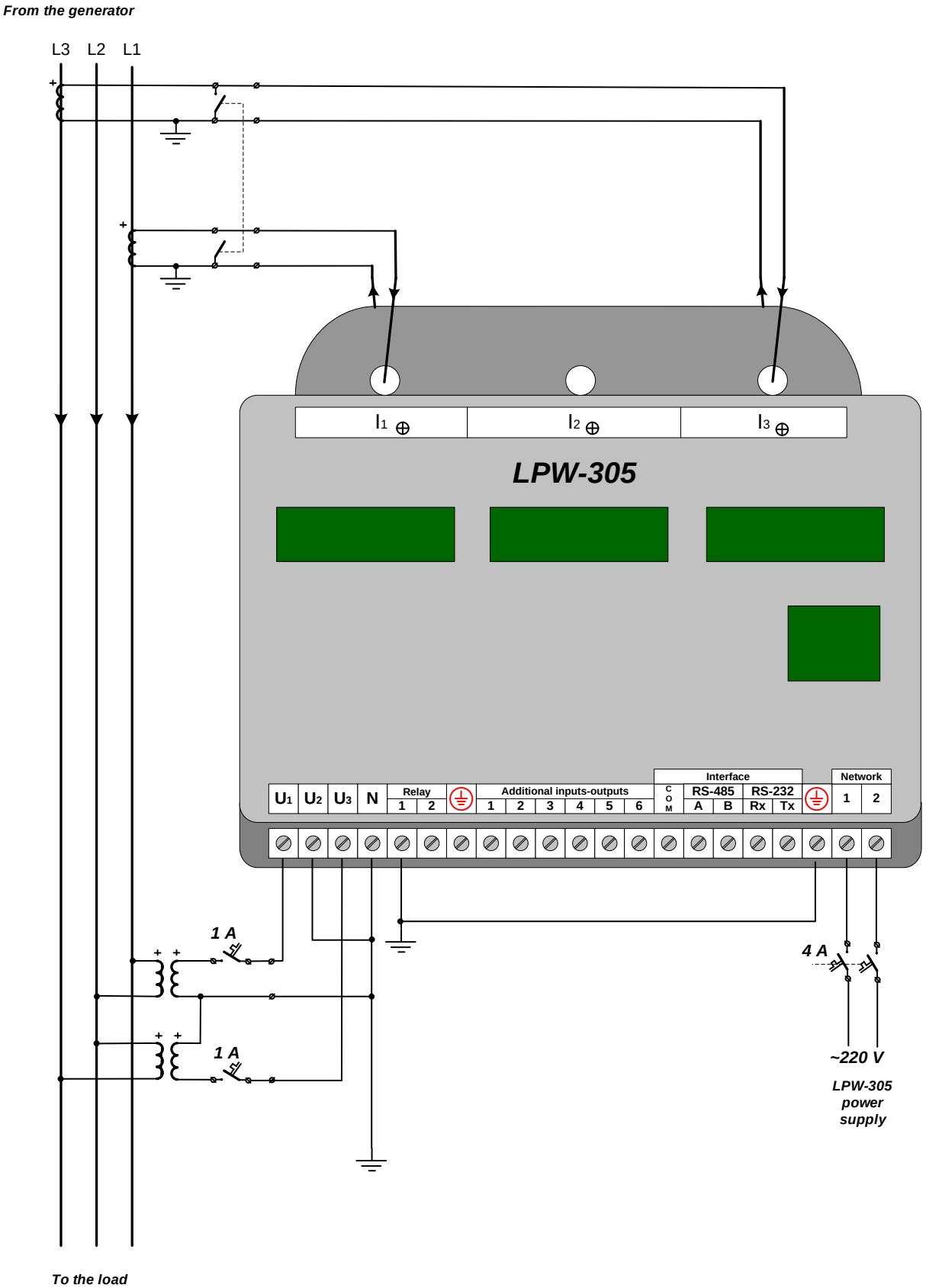


Figure B.6 – Diagram of three-wire V-connection with two CTs and two VTs, for DIN-rail mounted LPW-305

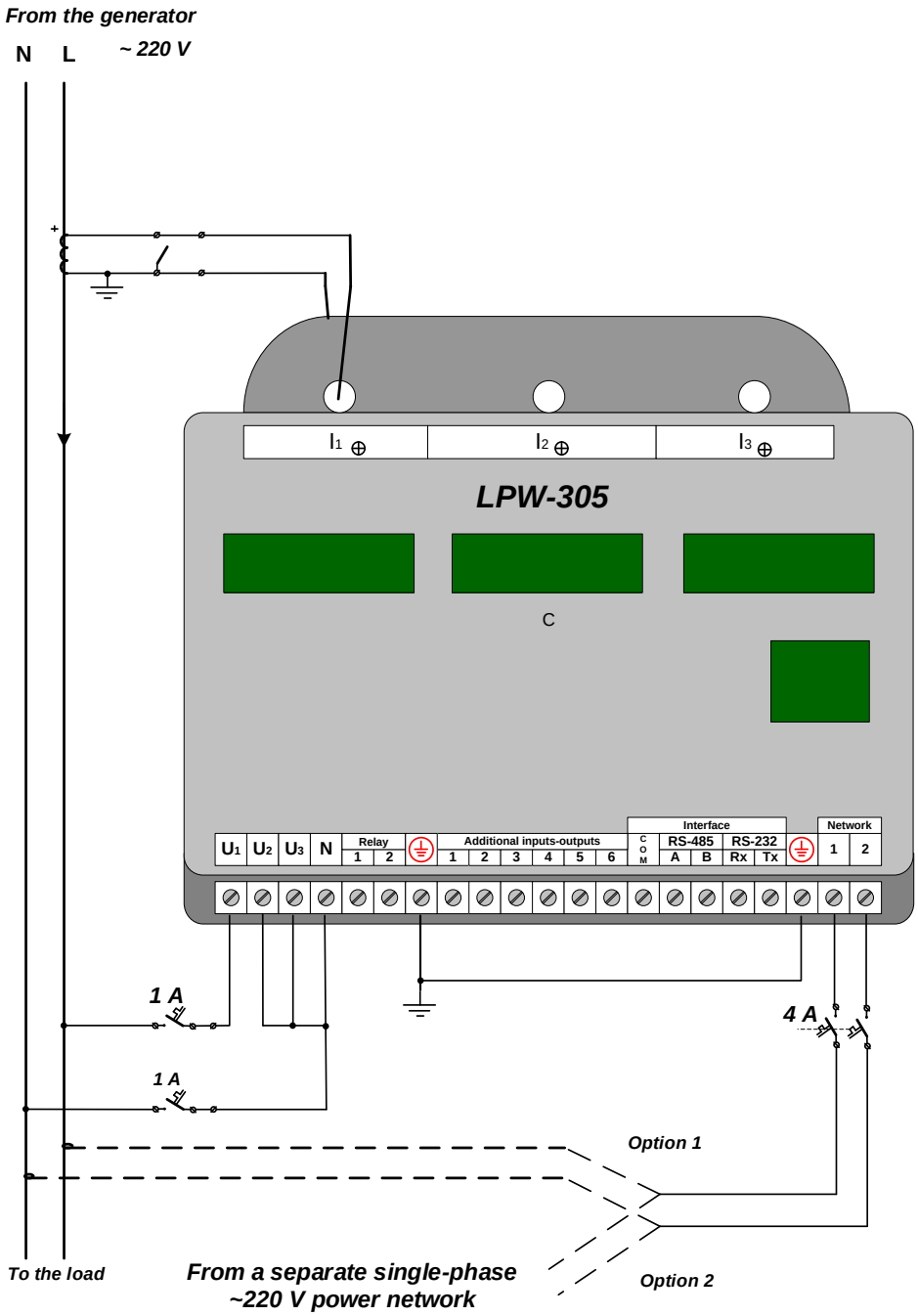


Figure B.7 – Diagram of connection to a single-phase network with two power supply options: either from a separate network or from a measuring circuit, for DIN-rail mounted LPW-305

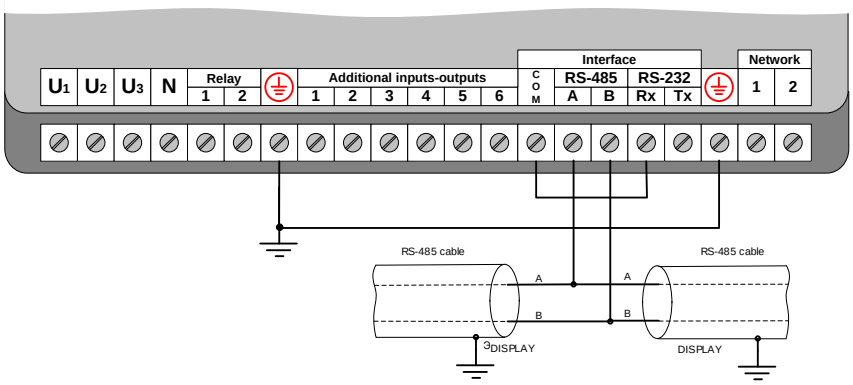


Figure B.8 – Connection of DIN-rail mounted LPW-305 to RS-485 interface as a transmission device

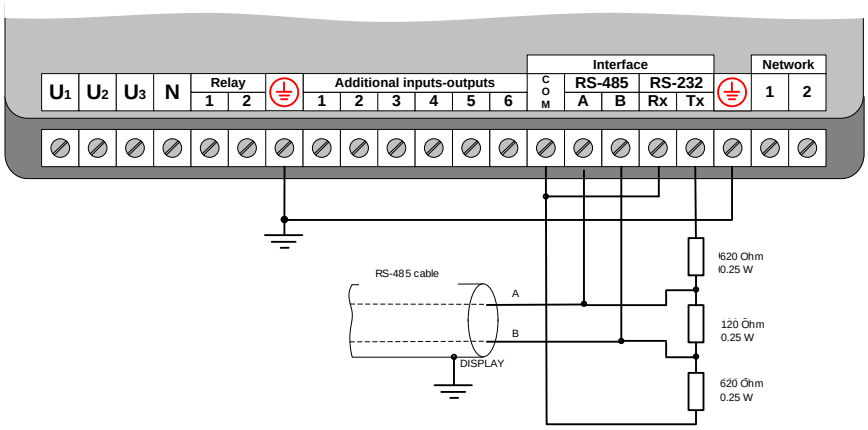


Figure B.9 – Connection of DIN-rail mounted LPW-305 to RS-485 interface as a termination device

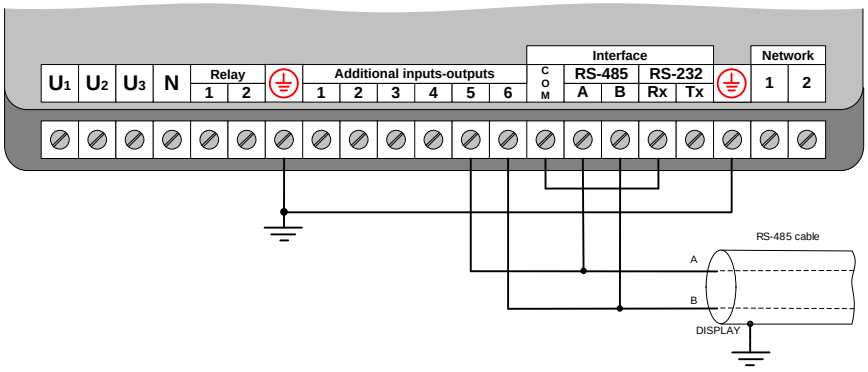


Figure B.10 – Connection of LPW-305-2 and LPW-305-5 modifications to the RS-485 interface line as a device with 120 Ohm line load

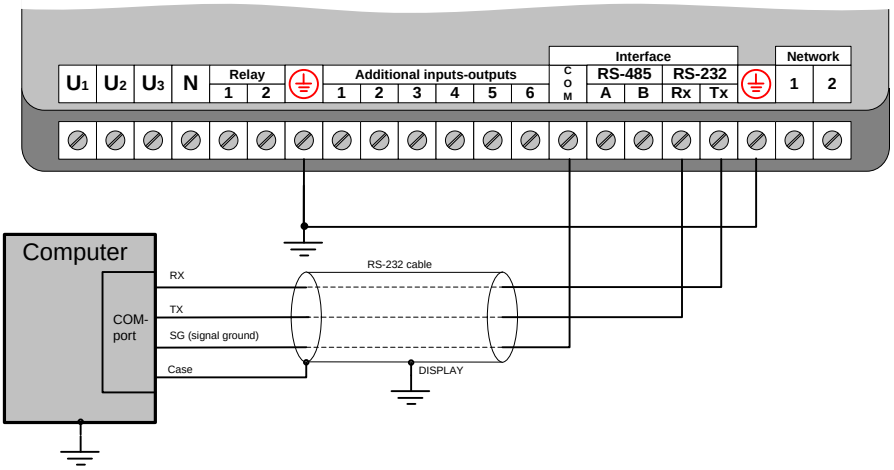


Figure B.11 – Connection of LPW-305 for DIN-rail mounted LPW-305 to the RS-232 interface

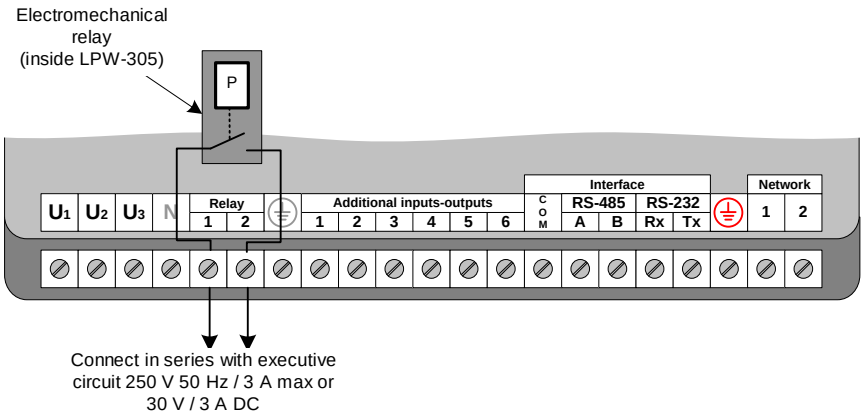


Figure B.12 – Connection to the contacts of electromechanical relay for DIN-rail mounted LPW-305

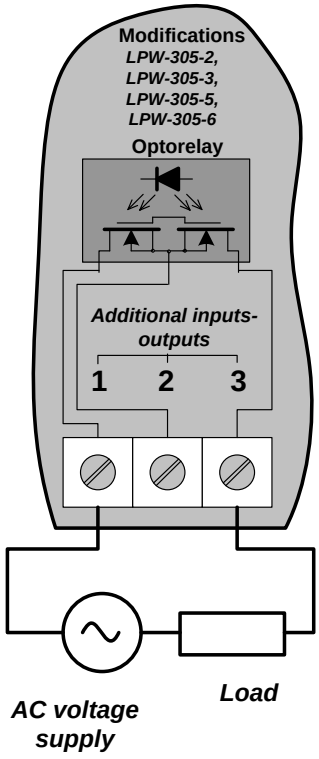


Figure B.13 – Connection of the pulse output of opto-relay of DIN-rail mounted LPW-305 to an AC circuit

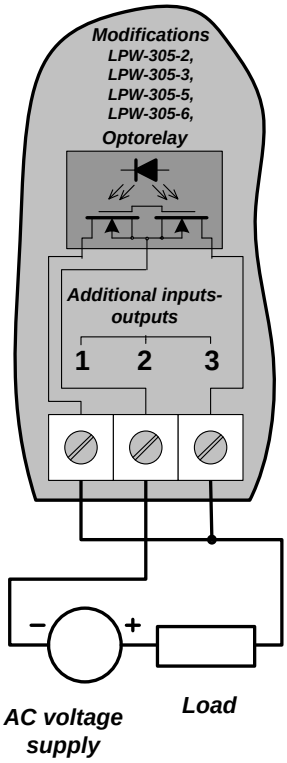


Figure B.14 – Connection of the pulse output of opto-relay of DIN-rail mounted LPW-305 to a DC circuit

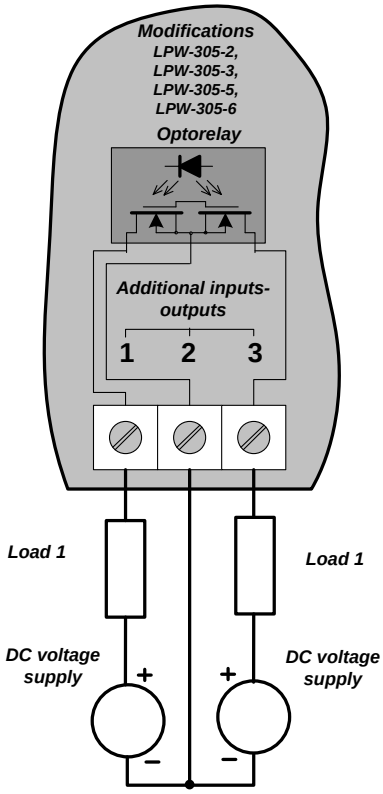


Figure B.15 – Connection of the pulse output of opto-relay of DIN-rail mounted
LPW-305 to two DC circuits

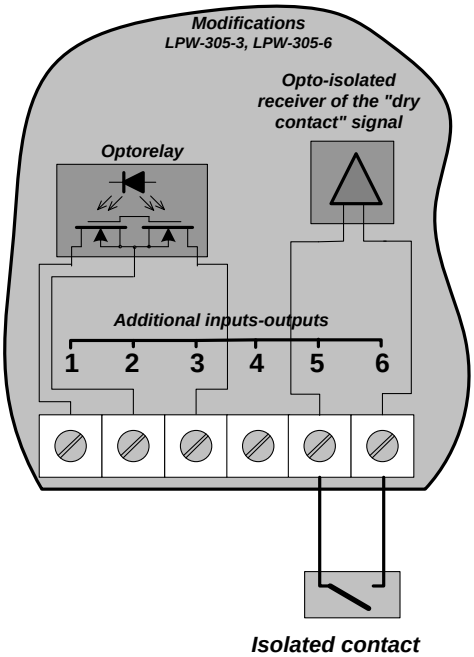


Figure B.16 – Connection
of the mechanical contact
to the discrete input of DIN-rail mounted
LPW-305

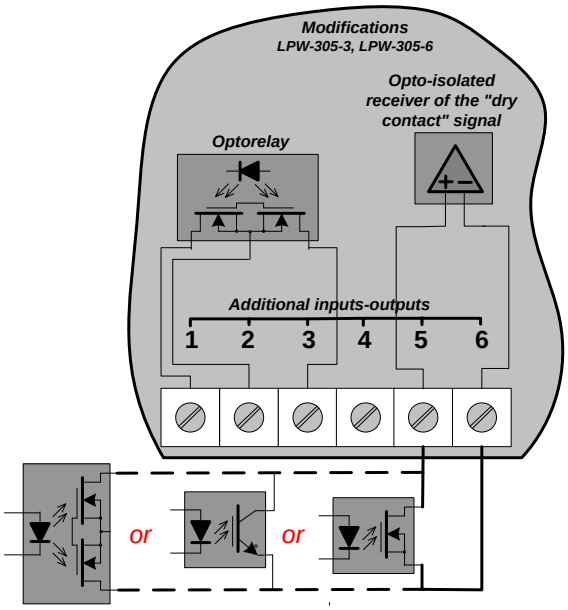


Figure B.17 – Options for connection of "electronic contacts" to the discrete input of DIN-rail mounted LPW-305

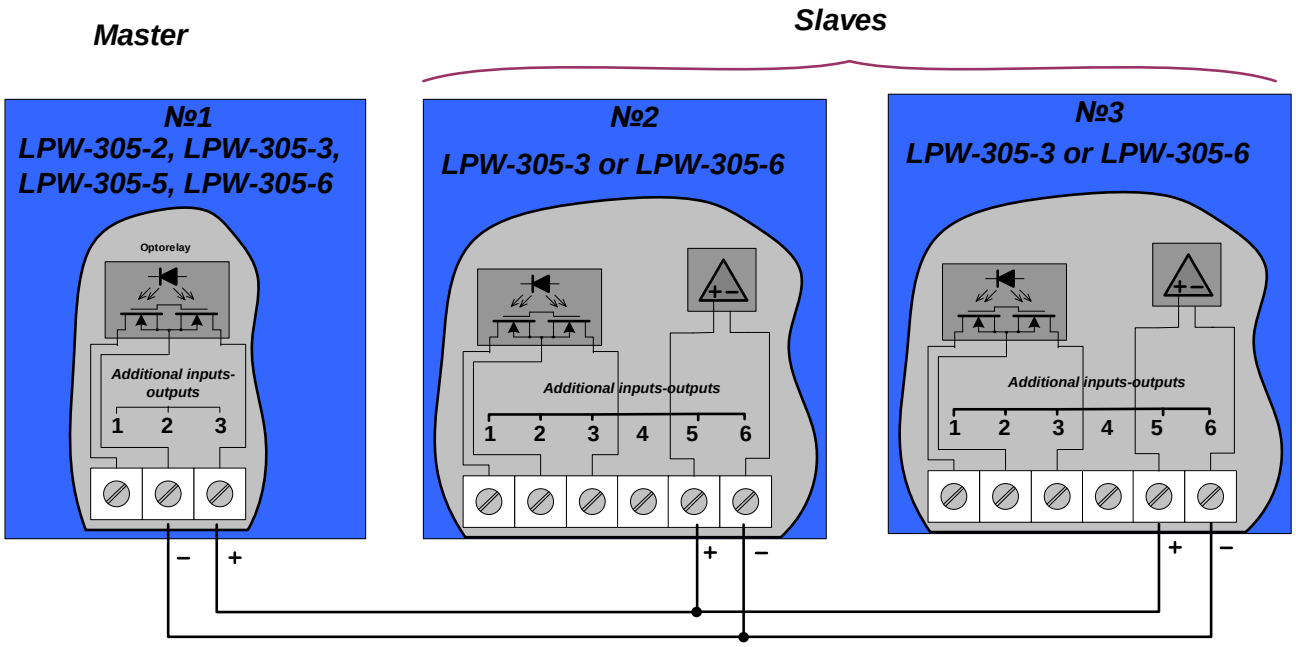


Figure B.18 – Signaling based on the "master-slave" principle- for DIN-rail mounted LPW-305

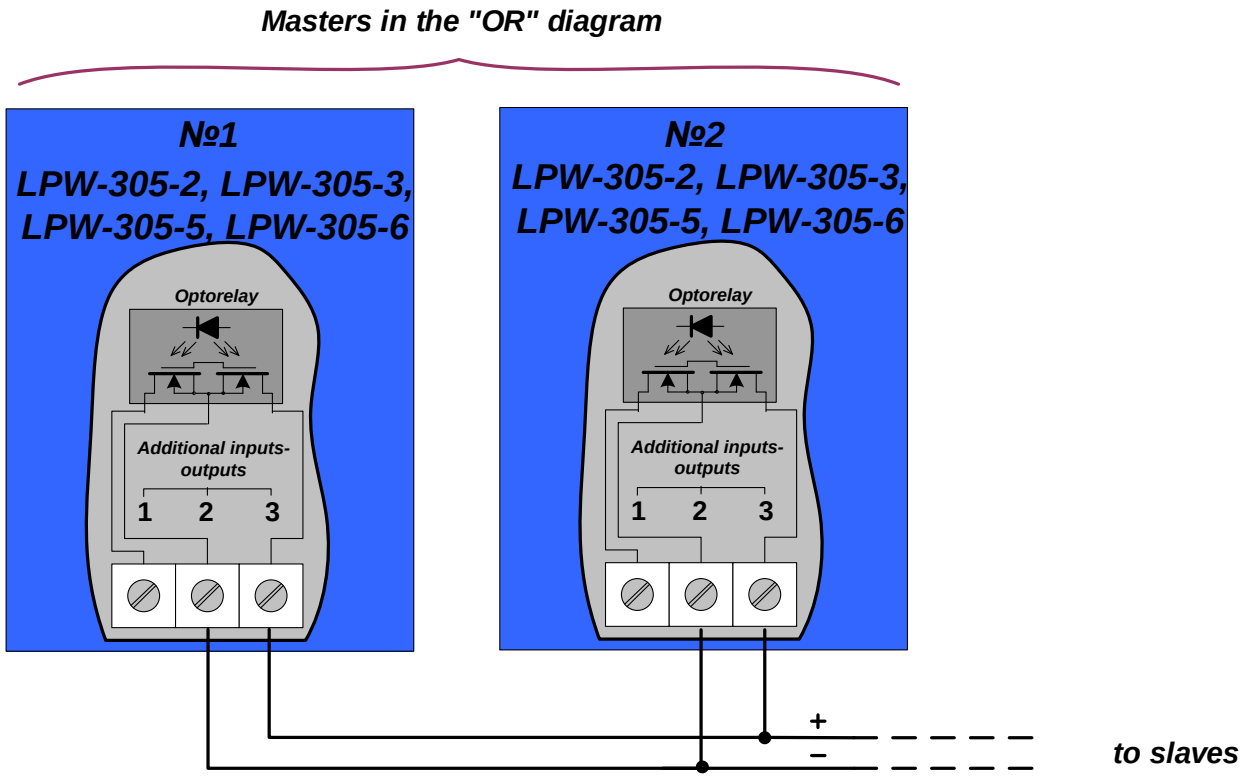


Figure B.19 – Connection of master LPW-305 mounted on DIN-rail in a signaling circuit based on the "logic OR" principle

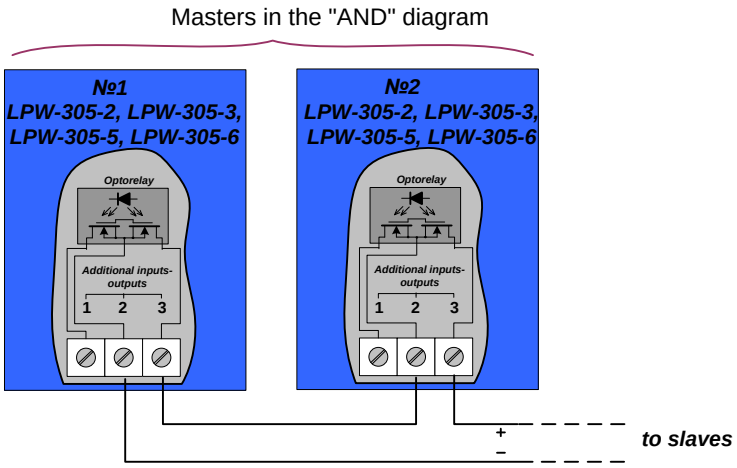


Figure B.20 – Connection of master LPW-305 mounted on DIN-rail in a signaling circuit based on the "logic AND" principle

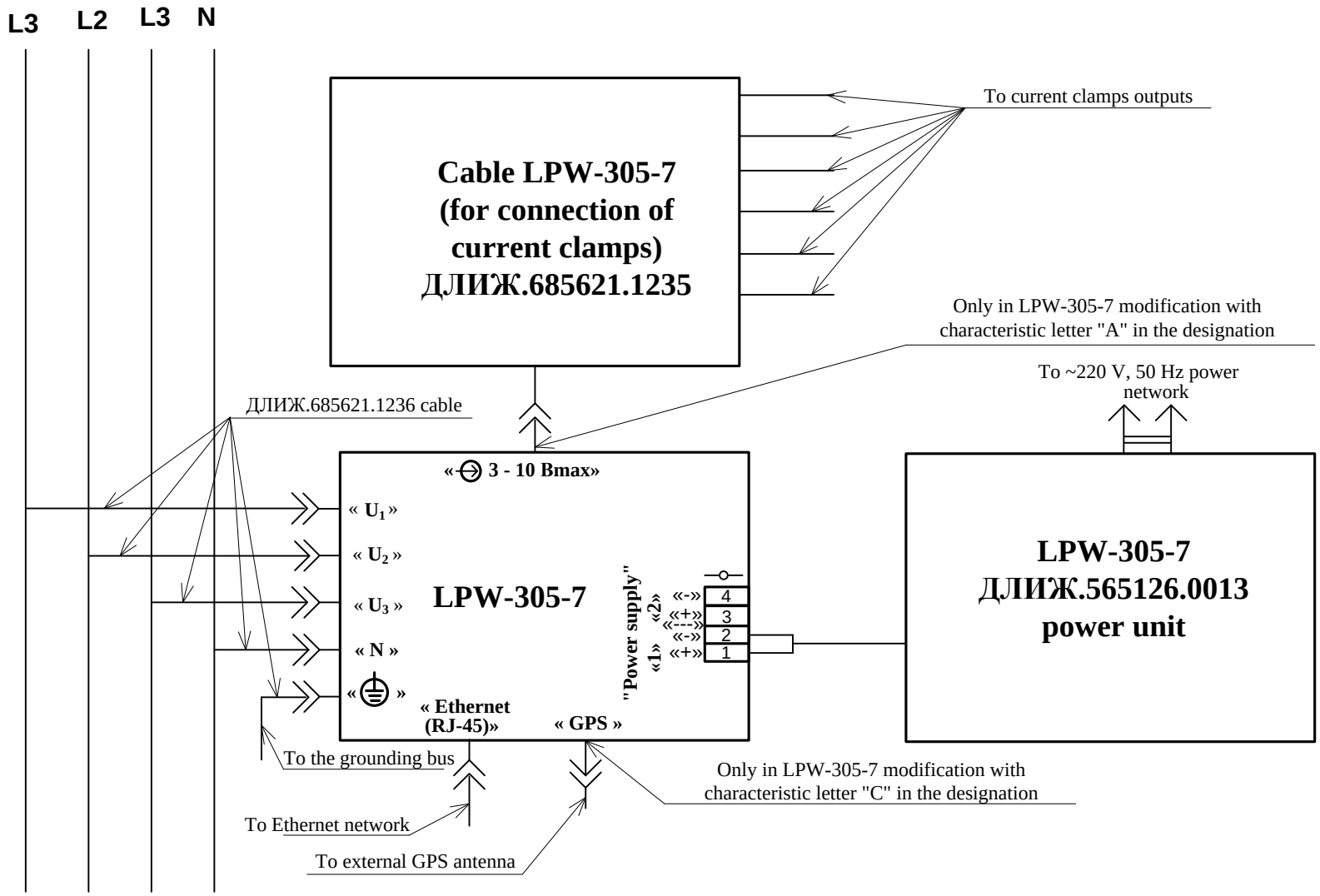


Figure B.21- Electrical block diagram of four-wire LPW-305-7 connection

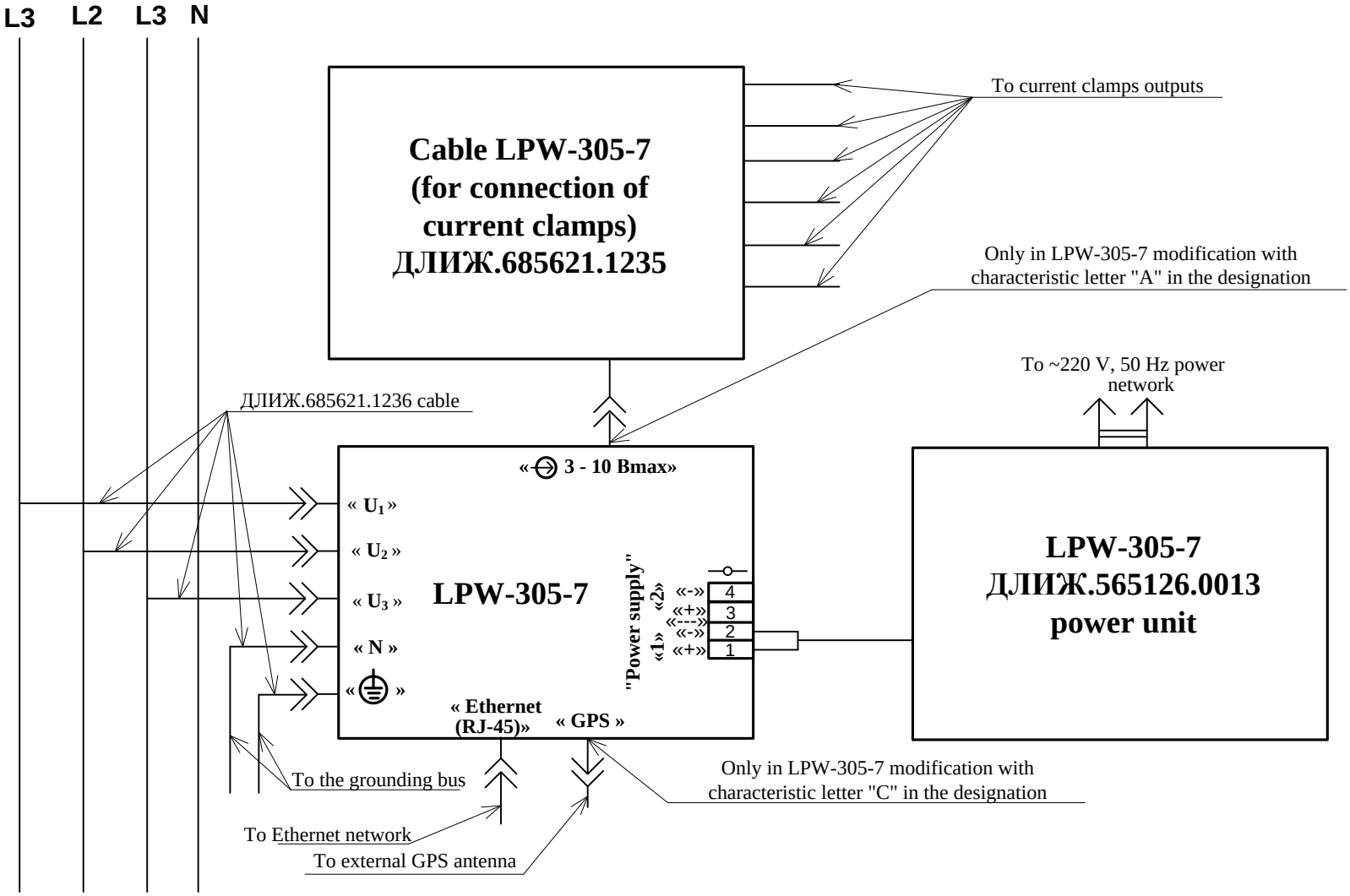


Figure B.22- Electrical block diagram of four-wire LPW-305-7 connection

APPENDIX C
(reference).

DETERMINATION OF K-FACTOR

Value of the K-factor K_f is calculated according to the formula:

$$K_f = \sum_{i=1n} [(I_i)^2 \times i^2], \quad \text{(C.1)}$$

where n is the number of considered harmonic current components, n=25;

i – is the current number of the harmonic component from 1 to n;

I_i – root mean square value of the i--th harmonic current component in relative units.

The sum of squares of root mean square values of harmonic current components in relative units is equal to one:

$$\sum_{i=1}^{n} [(I_i)^2] = 1. \quad \text{(C.2)}$$

REVISION HISTORY

Rev.	Numbers of sheets (pages)				Total number of sheets (pages) in the document	Document No.	Ref. No. of accompanying document	Signature	Date
	Amend.	Repl.	New	Cancelled					

Signature and date | Dupl. inv. No. | Repl. inv. No. | Signature and date | Orig. inv. No.