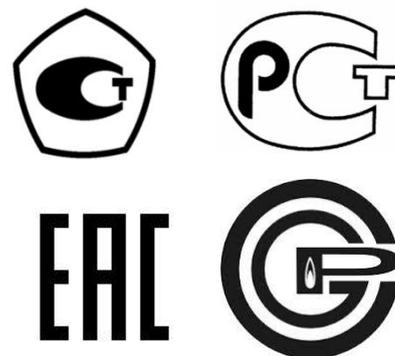


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**MULTIFUNCTIONAL METERS - ELECTRIC ENERGY QUALITY
CHARACTERISTICS MEASUREMENT DEVICES
BINOM3 SERIES**

**OPERATION MANUAL
TLAS.411152.002-01 RE**

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This Operation Manual (OM) is intended for studying the arrangement and operation principles of BINOM3 series multifunctional meters - electric energy quality characteristics multifunctional measurement devices; it contains information and rules needed for their correct operation.

Full name: BINOM3 series multifunctional meter - electric energy quality characteristics multifunctional measurement device.

Brief name: BINOM3 series meter, BINOM3 meter.

BINOM3 series meters are intended for fulfilling the following functions:

- measuring current and voltage per phase;
- calculating symmetric current and voltage components;
- calculating active, reactive and total connected power, inter alia per phase;
- network frequency measurement;
- measuring progressive total active energy as per GOST 31819.22-2012 (class 0.2S) and reactive energy for accuracy class 0.5 (GOST 31819.22-2012 guidelines) both in direct and reverse direction in total and by two independent accounting intervals, as well as by four tariff in view of non-working days and holidays (total energy, positive sequence and basic frequency);
- energy losses recording (by measuring current and voltage squares and subsequent calculation of losses) in both directions by four tariffs and two independent recording intervals;
- measuring, calculating and analyzing electric energy quality characteristics as per GOST R 8.655-2009. GOST 30804.4.30-2013 (class A), GOST 30804.4.7-2013 (class I), GOST R 51317.4.15-2012 and quality norms as per GOST 32144-2013. GOST 33073-2014:
 - established voltage deviation value;
 - negative and positive voltage deviations;
 - voltage asymmetry ratios by negative sequence;
 - voltage asymmetry ratios by zero sequence;
 - frequency and frequency deviation;
 - voltage depression length;
 - voltage depression depth;
 - temporary overvoltage length;
 - overvoltage ratio;
 - voltage interruption length;
 - harmonical components of current, voltage, power, phase shift angles (based on harmonic subgroups up to the 50th order of magnitude);
 - interharmonical components of current, voltage, power (based on centered interharmonic subgroups up to the 49th order of magnitude);
 - current and voltage waveform distortion factors;
 - short-term and long-term flicker indicators.
- oscillographic recorder of normal mode parameters, transient processes and electric energy quality defect;
- archiving;
- remote indication data collection;
- remote control;

- storage, aggregation and transmission of all data via communication channels to higher hierarchical levels of automated informative electric power accounting systems and/or energy resources dispatching;

- WEB parameterization and WEB access to current and archived events.

BINOM3 series meters as electrical parameters measuring instruments meet the requirements of GOST 22261-94.

BINOM3 series meters as instruments measuring electrical energy quality characteristics meet the requirements of GOST 8.655-2009.

BINOM3 meters as remote control devices meet the requirements of GOST 26.205-88. GOST 26.013-81. GOST R IEC 870-3-93. GOST R IEC 870-4-93. GOST IEC 60870-4-2011. GOST R IEC 60870-5-104-2004. GOST R IEC 60870-5-101-2006.

The functional capabilities, design principles, hardware and software composition and structure of BINOM3 series meters meet the regulations prepared by OJSC Rosseti and the Concept of Automated Informative Electric Power Accounting Systems Design, and their principal technical parameters to the active Standard Technical Requirements for Electric Energy and Power Control and Metering for Power Systems Automated Informative Electric Power Accounting Systems.

The operational safety and degree of electric shock hazard protection of BINOM3 series meters correspond to Class II of equipment as per GOST 12.2.091-2012

The service personnel operating BINOM3 series meters must be familiarized with this Operation Manual, General Rules of Electrical Installations operation and have the appropriate Electrical Level for carrying out work with voltage up to 1000 V.

The Operation Manual shall apply to all version of BINOM3 series multifunctional meters measuring electric energy quality characteristics.

BINOM3 series meters were registered in the State Register of Measuring Instruments under number 60113-15. Type approval certificate No. 58154 dated 23.03.15.

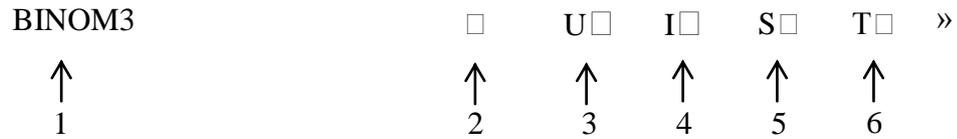
BINOM3 series meters have a registered Declaration of Conformity to the Requirements of Customs Union Technical Regulations - CU TR 004/2011 "Safety of Low-Voltage Equipment" and CU TR 020/2011 "Electromagnetic Compatibility of Technical Equipment". Declaration of Conformity No. RU Д-РУ.АУ40.В.05945 dated 03.04.15.

BINOM3 series meters were certified by the Certification Body for Instrumentation Product of the FSUE "D.I. Mendeleev All-Russian Scientific Research Institute of Metrology" and have a Certificate of Conformity in the GOST R system No. POCC RU. ME48.H02789 dated 02.12.14.

BINOM3 series meters were certified in a voluntary certification system - VCS GAZPROMCERT of PJSC Gazprom. Certificate of conformity No. FO00.RU.1348.H00266 dated 12.04.16.

An example of conventional designation of a meter in technical documentation:

Multifunctional meter - electric energy quality characteristics multifunctional measurement device



where:

- 1 - is the name;
- 2 - version type as per Table 2;
- 3 - nominal voltage (phase-to-earth):
 - 2.57 - for 57.7/100 meters;
 - 3.220 - for 220/380 meters;
- 4 - nominal current:
 - 3.5 – 5 A;
 - 3.1 – 1 A;
- 5 – remote indication option - S16 (16 TC);
- 6 - remote control option:
 - T2 (2 TU);
 - T3 (3 TU);
 - T4 (4 TU).

An example of ordering designation:

Multifunctional meter - electric energy quality characteristics measurement device BINOM335U3.57I3.1
 - three-element BINOM3 series meter, BINOM335 version for 1 A nominal current and 57.735 phase-to-earth voltage.

1 DESCRIPTION AND OPERATION OF BINOM3 SERIES METERS

1.1 Purpose of the Meters

BINOM3 series meter is a three-phase, transformer one.

BINOM3 series meters are intended for standalone operation and for operation as parts of automated systems:

- automated informative electric power accounting and technical record-keeping systems,
- electric energy quality monitoring and control systems;
- data collection and transmission systems;
- automatic dispatching, technological monitoring and control systems;
- automated process control systems, etc.

Depending on hardware version, meters ensure connection and data gathering from 5 A and 1 A current transformers and 57.7 V, 100 V, 220 V, 380 V. Direct voltage connection is allowed.

Meter operation environment:

- ambient air temperature from minus 40° to +60°C;
- relative air humidity up to 95 % at plus 25 °C temperature.
- atmospheric pressure from 70 to 106.7 kPa (from 537 to 795 mm Hg).

Normal meter operation conditions are tabulated in Table 1.

Table 1 – Normal Operation Conditions

Influencing Quantity	Normal Value	Permissible Deviation
Ambient temperature	20 °C	± 5 °C
Power voltage - AC, frequency - DC	220 V, 50 Hz; 220 V	± 1.0 %; ± 0.3 % ± 1.0 %
Measured voltage	Nominal value	± 1.0 %
Measured network frequency	Nominal frequency 50 Hz	± 0.3 %
Succession of phases in measured network	L1-L2-L3	-
Measured network voltage unsymmetry	All phases connected	-
Measured network AC voltage and current waveform	Sinusoidal	Distortion factor less than 2%
Constant heterogeneous magnetic induction	0	-

Table 1 (Continued)

Influencing Quantity	Normal Value	Permissible Deviation
Heterogeneous constant magnetic induction at normal frequency	0	Induction value that creates a change in error not exceeding $\pm 0.1\%$ but in any case must not be less than 0.05 mT.
Radio-frequency electromagnetic fields, from 30 kHz to 2 GHz	0	Less than 1 V/m
Functioning of auxiliary parts	Non-functioning of auxiliary parts	-
Conductive interference induced by radio-frequency fields	0	Less than 1 V

Versions of meters with various nominal input signal values are presented in Table 2.

Table 2 (Continued)

№	Functions Full Name ¹⁾	Nominal Input Signal Values		Functions				Interfaces					Ambient Temperature Range	Power Supply		
		Current (I _{nom}), A	Voltage (U _{nom}), V	Archiving	Oscillography	TS	TU	485/sync (r)	485/sync (422) (l)	232 (l)	Eth	Opto		micro SD	Primary: ≈220V /≠220V Backup: = 220V	Built-in Battery
6	BINOM338U3.57I3.5S16T2(3.4)	3·5	3·57.7 ²⁾ /100													
	BINOM338U3.57I3.1S16T2(3.4)	3·1	3·57.7 ²⁾ /100													
	BINOM338U3.220I3.5S16T2(3.4)	3·5	3·220/380 ²⁾	+	+	16	+	+			+	+	+	-40 +45	+	+
	BINOM338U3.220I3.1S16T2(3.4)	3·1	3·220/380 ²⁾													
7	BINOM338sU3.57I3.5S16	3·5	3·57.7 ²⁾ /100													
	BINOM338sU3.57I3.1S16	3·1	3·57.7 ²⁾ /100													
	BINOM338sU3.220I3.5S16	3·5	3·220/380 ²⁾	+	+	16		+			+	+	+	-40 +45	+	+
	BINOM338sU3.220I3.1S16	3·1	3·220/380 ²⁾													
8	BINOM339iU3.57I3.5	3·5	3·57.7 ²⁾ /100													
	BINOM339iU3.57I3.1	3·1	3·57.7 ²⁾ /100													
	BINOM339iU3.220I3.5	3·5	3·220/380 ²⁾	+	+			+	+	+	+	+	+	-40 +45	+	+
	BINOM339iU3.220I3.1	3·1	3·220/380 ²⁾													
9	BINOM339U3.57I3.5	3·5	3·57.7 ²⁾ /100													
	BINOM339U3.57I3.1	3·1	3·57.7 ²⁾ /100													
	BINOM339U3.220I3.5	3·5	3·220/380 ²⁾	+	+			+			+	+	+	-40 +45	+	+
	BINOM339U3.220I3.1	3·1	3·220/380 ²⁾													

¹⁾ - meter versions are set in boldface;
²⁾ – precise input signal values U_{nom} (V) – 57.735 и 381.051.

Connection pattern for all meter versions: four-wire or three-wire voltage line, three or two current lines (see Fig. 15a-15e for connection diagrams)
 Software for all meter versions: 80508103.00052-01.

1.2 Technical Characteristics of BINOM3 Series Meters

1.2.1 Characteristics of Electric Power Network parameters and Quality Characteristics Measurements

Acceptable basic error limits meet the requirements of GOST 31818.11-2012. GOST 31819.22-2012. GOST 30804.4.30-2013. GOST R 8.655-2009. They are reflected:

- in Table 3: parameters of electricity metering, current, voltage, power and frequency measurements;
- in Table 4: electric energy quality characteristics related to long-term measurements of voltage characteristics;
- in Table 4.1: electric energy quality characteristics related to accidental events;
- in Table 5: information about measurement methods and the electric energy quality characteristics statistic analysis parameters set in the instrument configuration settings.

Claimed measurement errors at minimum parameter values are achievable only when information is transmitted via exchange interfaces in the "floating decimal point" format.

Averaging parameter during electric mains parameters measurement is equal to 10 electric mains periods (~ 0.2 s).

The averaged parameter value is equal to square root from the sum of input value squares. Averaging for any parameter presented in Table 3 may be set in the meter configuration settings; additional averaging parameters may be entered as well.

Harmonic subgroups are used for calculation of current and voltage harmonic components, total coefficients of harmonic components (Table 3. Table 4).

Interharmonic centered subgroups were used for the calculation of interharmonic current and voltage component coefficients (Table 3. Table 4).

Accidental event parameters are measured on the basis of root-mean-square voltage measurements updated for every elementary frequency semiperiod (in 50 Hz frequency electrical power supply systems).

During voltage dips, overvoltage's, voltage interruptions the results of electric energy quality parameters measurements related to voltage deviation, flicker dose, total coefficient of harmonic voltage components, n order of magnitude coefficient of harmonic voltage components, voltage asymmetry ratio in inverted sequence, voltage asymmetry ratio in zero sequence, frequency deviation are marked. Averaged electric energy quality parameters including marked values are also marked. Marked data are not taken into account when in the process of assessment of electric energy conformity to quality norms.

Table 3 - Electric Energy Metering Parameters and Network Parameters

Parameters		Designations	Maximum Permissible Basic Error Δ – Absolute; δ – Relative, %; γ – Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
Electric Energy Metering Parameters						3-wire	4-wire
Active energy	Import/export total, W·h	+Wat, -Wat	$\pm 0.2 (\delta)^{1)}$	2	-	+	+
	Import/export by 4 tariffs, W·h	+Wa1. -Wa1. +Wa2. -Wa2. +Wa3. -Wa3. +Wa4. -Wa4		8		+	+
	Non-tariff import/export, W·h	+Wa0. -Wa0		2		+	+
	Import/export Profile 1 (technical), W·h	+WaP1. -WaP1		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
	Import/export Profile 2 (commercial), W·h	+WaP2. -WaP2		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
Reactive Energy	Import/export total, VAR·h	+Wrt, -Wrt	$\pm 0.5 (\delta)^{1)}$	2	-	+	+
	Import/export by 4 tariffs, VAR·h	+Wr1. -Wr1. +Wr2. -Wr2. +Wr3. -Wr3. +Wr4. -Wr4		8		+	+
	Non-tariff import/export, VAR·h	+Wr0. -Wr0		2		+	+
	Import/export Profile 1 (technical), VAR·h	+WrP1. -WrP1		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
	Import/export Profile 2 (commercial), VAR·h	+WrP2. -WrP2		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
Active energy loss	Import/export total, W·h	+Walt, -Walt	$\pm 0.6 (\delta)$	2	-	+	+
	Import/export by 4 tariffs, W·h	+Wal1. -Wal1. +Wal2. -Wal2. +Wal3. -Wal3. +Wal4. -Wal4		8		+	+
	Non-tariff import/export, W·h	+Wal0. -Wal0		2		+	+
	Import/export Profile 1 (technical), W·h	+WalP1. -WalP1		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
	Import/export Profile 2 (commercial), W·h	+WalP1. -WalP1		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
Reactive energy loss	Import/export total, VAR·h	+Wrlt, -Wrlt	$\pm 0.6 (\delta)$	2	-	+	+
	Import/export by 4 tariffs, VAR·h	+Wrl1. -Wrl1. +Wrl2. -Wrl2. +Wrl3. -Wrl3. +Wrl4. -Wrl4		8		+	+
	Non-tariff import/export, VAR·h	+Wrl0. -Wrl0		2		+	+
	Import/export Profile 1 (technical), VAR·h	+WrlP1. -WrlP1		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
	Import/export Profile 2 (commercial), VAR·h	+WrlP2. -WrlP2		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
Energy metering violation flags	Phase current failure	PhIAoff, PhIBoff, PhICoff	-	3	-	+	+
	Phase voltage failure	PhUAoff, PhUBoff, PhUCoff	-	3		-	+
	Phase power failure	PhPAoff, PhPBoff, PhPCoff, PhPoff	-	4		-	+
	Current available, voltage failure	PhIwoUA, PhIwoUB, PhIwoUC	-	3		+	+
	Phases misconnection	PhTAMP, PhLRP, PhLBP, PhPHV	-	4		+	+

Table 3 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
Electric Energy Metering Parameters						3-wire	4-wire
Basic Frequency Active Energy	Import/export total, W·h	+Wat ₁₍₁₎ , -Wat ₁₍₁₎	$\pm 0.2 (\delta)^1$	2	-	+	+
	Import/export by 4 tariffs, W·h	+Wa1 ₁₍₁₎ , -Wa1 ₁₍₁₎ , +Wa2 ₁₍₁₎ , -Wa2 ₁₍₁₎ , +Wa3 ₁₍₁₎ , -Wa3 ₁₍₁₎ , +Wa4 ₁₍₁₎ , -Wa4 ₁₍₁₎		8		+	+
	Non-tariff import/export, W·h	+Wao ₁₍₁₎ , -Wao ₁₍₁₎		2		+	+
	Import/export Profile 1 (technical), W·h	+WaP1 ₁₍₁₎ , -WaP1 ₁₍₁₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
	Import/export Profile 2 (commercial), W·h	+WaP1 ₂₍₁₎ , -WaP1 ₁₍₁₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
Basic Frequency Reactive Energy	Import/export total, VAR·h	+Wrt ₁₍₁₎ , -Wrt ₁₍₁₎	$\pm 0.5 (\delta)^1$	2	-	+	+
	Import/export by 4 tariffs, VAR·h	+Wr1 ₁₍₁₎ , -Wr1 ₁₍₁₎ , +Wr2 ₁₍₁₎ , -Wr2 ₁₍₁₎ , +Wr3 ₁₍₁₎ , -Wr3 ₁₍₁₎ , +Wr4 ₁₍₁₎ , -Wr4 ₁₍₁₎		8		+	+
	Non-tariff import/export, VAR·h	+Wro ₁₍₁₎ , -Wro ₁₍₁₎		2		+	+
	Import/export Profile 1 (technical), VAR·h	+WrP1 ₁₍₁₎ , -WrP1 ₁₍₁₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
	Import/export Profile 2 (commercial), VAR·h	+WrP1 ₂₍₁₎ , -WrP1 ₁₍₁₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	+	+
Direct sequence active energy	Import/export total, W·h	+Wat ₁₍₁₎ , -Wat ₁₍₁₎	$\pm 0.2 (\delta)^1$	2	-	-	+
	Import/export by 4 tariffs, W·h	+Wa1 ₁₍₁₎ , -Wa1 ₁₍₁₎ , +Wa2 ₁₍₁₎ , - Wa2 ₁₍₁₎ , +Wa3 ₁₍₁₎ , -Wa3 ₁₍₁₎ , +Wa4 ₁₍₁₎ , -Wa4 ₁₍₁₎		8		-	+
	Non-tariff import/export, W·h	+Wao ₁₍₁₎ , -Wao ₁₍₁₎		2		-	+
	Import/export Profile 1 (technical), W·h	+WaP2 ₁₍₁₎ , -WaP2 ₁₍₁₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	-	+
	Import/export Profile 2 (commercial), W·h	+WaP2 ₂₍₁₎ , -WaP2 ₁₍₂₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	-	+
Direct sequence reactive energy	Import/export total, VAR·h	+Wrt ₁₍₁₎ , -Wrt ₁₍₁₎	$\pm 0.5 (\delta)^1$	2	-	-	+
	Import/export by 4 tariffs, VAR·h	+Wr1 ₁₍₁₎ , -Wr1 ₁₍₁₎ , +Wr2 ₁₍₁₎ , -Wr2 ₁₍₁₎ , +Wr3 ₁₍₁₎ , -Wr3 ₁₍₁₎ , +Wr4 ₁₍₁₎ , -Wr4 ₁₍₁₎		8		-	+
	Non-tariff import/export, VAR·h	+Wro ₁₍₁₎ , -Wro ₁₍₁₎		2		-	+
	Import/export Profile 1 (technical), VAR·h	+WrP2 ₁₍₁₎ , -WrP2 ₁₍₁₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	-	+
	Import/export Profile 2 (commercial), VAR·h	+WrP2 ₂₍₁₎ , -WrP2 ₁₍₂₎		2	1.2.3.4.5.6.10.12. 15.20.30.60 min	-	+

Table 3 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
Network Parameters as per GOST 31818.11-2012 and GOST R 8.655-2009						3-wire	4-wire
Frequency	Frequency, Hz	f	$\pm 0.01 (\Delta)$	1	10 basic frequency periods (~200 ms)	+	+
Voltage parameters	Root mean square ¹⁾ and average ²⁾ phase voltage values, V	$U_A, U_B, U_C, U_{ph_{av}}$	$\pm 0.1 (\gamma)$	4		-	+
	Root mean square ¹⁾ and average ²⁾ interphase voltage values, V	$U_{AB}, U_{BC}, U_{CA}, U_{iph_{av}}$	$\pm 0.1 (\gamma)$	4		+	+
	Root mean square positive and negative sequence voltage value ⁴⁾ , V	U1, U2	$\pm 0.1 (\gamma)$	2		+ ¹⁷⁾	+
	Zero sequence root mean square value ⁴⁾ , V	U0		1		-	+
	Voltage asymmetry ratios by zero sequence, %	K_{0U}	$\pm 0.15 (\Delta)$	1		-	+
	Voltage asymmetry ratios by negative sequence, %	K_{2U}	$\pm 0.15 (\Delta)$	1		+ ¹⁷⁾	+
	Root mean square basic frequency phase voltage value, V	$U_{A(1)}, U_{B(1)}, U_{C(1)}$	$\pm 0.1 (\gamma)$	3		-	+
	Root mean square value of n order of magnitude phase voltage harmonic component (n = 2...50), V	$U_{A(n)}, U_{B(n)}, U_{C(n)}$	$\pm 0.05 (\gamma)$ for $U_{(n)} < 1\% U_{nom}$ $\pm 5\% (\delta)$ для $U_{(n)} \geq 1\% U_{nom}$	147		-	+
	Coefficient of n order of magnitude phase voltage harmonic component (n = 2...50), %	$K_{UA(n)}, K_{UB(n)}, K_{UC(n)}$	$\pm 0.05 (\Delta)$ for $K_{U(n)} < 1\%$ $\pm 5\% (\delta)$ for $K_{U(n)} \geq 1\%$	147		-	+
Total coefficient of phase voltage harmonic components ¹¹⁾ , %	K_{UA}, K_{UB}, K_{UC}	$\pm 0.05 (\Delta)$ for $K_U < 1\%$ $\pm 5\% (\delta)$ for $K_U \geq 1\%$	3	-	+		

Table 3 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
						3-wire	4-wire
Voltage parameters	Root mean square value of n order of magnitude phase voltage interharmonic component (n = 0...49), V	$U_{Aisg(n)}$, $U_{Bisg(n)}$, $U_{Cisg(n)}$	± 0.05 (γ) for $U_{isg(n)} < 1\% U_{nom}$ $\pm 5\%$ (δ) for $U_{isg(n)} \geq 1\% U_{nom}$	147	10 basic frequency periods (~200 ms)	-	+
	Coefficient of n order of magnitude phase voltage interharmonic component (n = 0...49), %	$K_{UAisg(n)}$, $K_{UBisg(n)}$, $K_{UCisg(n)}$	± 0.05 (Δ) for $K_{Uisg(n)} < 1\%$ $\pm 5\%$ (δ) for $K_{Uisg(n)} \geq 1\%$	147		-	+
	Root mean square basic frequency interphase voltage value, V	$U_{AB(1)}$, $U_{BC(1)}$, $U_{CA(1)}$	± 0.1 (γ)	1		+	+
	Root mean square value of n order of magnitude interphase voltage harmonic component (n = 2...50), V	$U_{AB(n)}$, $U_{BC(n)}$, $U_{CA(n)}$	± 0.05 (γ) for $U_{(n)} < 1\% U_{nomiph}$ $\pm 5\%$ (δ) для $U_{(n)} \geq 1\% U_{nomiph}$	147		+	-
	Coefficient of n order of magnitude interphase voltage harmonic component (n = 2...50), %	$K_{UAB(n)}$, $K_{UBC(n)}$, $K_{UCA(n)}$	± 0.05 (Δ) for $K_{U(n)} < 1\%$ $\pm 5\%$ (δ) for $K_{U(n)} \geq 1\%$	147		+	-
	Total coefficient of interphase voltage harmonic components, %	K_{UAB} , K_{UBC} , K_{UCA}	± 0.05 (Δ) for $K_U < 1\%$ $\pm 5\%$ (δ) for $K_U \geq 1\%$	3		+	-
	Coefficient of n order of magnitude interphase voltage interharmonic component (n = 0...49), %	$U_{ABisg(n)}$, $U_{BCisg(n)}$, $U_{CAisg(n)}$	± 0.05 (γ) for $U_{isg(n)} < 1\% U_{nomiph}$ $\pm 5\%$ (δ) for $U_{isg(n)} \geq 1\% U_{nomiph}$	147		+	-
	Coefficient of n order of magnitude interphase voltage interharmonic component (n = 0...49), %	$K_{UABisg(n)}$, K_{UB-} $Cisg(n)$, $K_{UCAisg(n)}$	± 0.05 (Δ) for $K_{Uisg(n)} < 1\%$ $\pm 5\%$ (δ) for $K_{Uisg(n)} \geq 1\%$	147		+	-
	Negative phase voltage deviation, %	$\delta U_{A(-)}$, $\delta U_{B(-)}$, $\delta U_{C(-)}$	± 0.1 (Δ)	3		-	+
	Positive phase voltage deviation, %	$\delta U_{A(+)}$, $\delta U_{B(+)}$, $\delta U_{C(+)}$	± 0.1 (Δ)	3		-	+
	Negative interphase voltage deviation, %	$\delta U_{AB(-)}$, $\delta U_{BC(-)}$, $\delta U_{CA(-)}$	± 0.1 (Δ)	3		+	+
	Positive interphase voltage deviation, %	$\delta U_{AB(+)}$, $\delta U_{BC(+)}$, $\delta U_{CA(+)}$	± 0.1 (Δ)	3		+	+
	Established voltage deviation value, %	δU_{est}	± 0.2 (Δ)	1		+	+

Table 3 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
						3-wire	4-wire
Current Parameters	Root mean square (I_A, I_B, I_C) and average (I_{av}) ²⁾ phase current values, A	I_A, I_B, I_C, I_{av}	$\pm 0.1 (\gamma)$	4	10 basic frequency periods (~200 ms)	+	+
	Root mean square positive, negative and zero sequence current values ⁴⁾ , A	I1. I2. I0	$\pm 0.1 (\gamma)$	3		+	+
	Current unbalance factor by zero sequence,%	K_{0I}	$\pm 0.3(\Delta)$ $0.05 \cdot I_{nom} \leq I \leq 2 \cdot I_{nom}$	1		+	+
	Current unbalance factor by negative sequence,%	K_{2I}	$\pm 0.3(\Delta)$ $0.05 \cdot I_{nom} \leq I \leq 2 \cdot I_{nom}$	1		+	+
	Root mean square basic frequency phase current value, A	$I_{A(1)}, I_{B(1)}, I_{C(1)}$	$\pm 0.1 (\gamma)$	3		+	+
	Coefficient of n order of magnitude phase current harmonic component ($n = 2...50$), A	$I_{A(n)}, I_{B(n)}, I_{C(n)}$	$\pm 0.15 (\gamma)$ for $I_{(n)} < 3\% I_{nom}$ $\pm 5\% (\delta)$ for $I_{(n)} \geq 3\% I_{nom}$	147		+	+
	Coefficient of n order of magnitude phase current harmonic component ($n = 2...50$), %	$K_{IA(n)}, K_{IB(n)}, K_{IC(n)}$	$\pm 0.15 (\Delta)$ for $K_{I(n)} < 3\%$ $\pm 5\% (\delta)$ for $K_{I(n)} \geq 3\%$	147		+	+
	Total coefficient of interphase current harmonic components, %	K_{IA}, K_{IB}, K_{IC}	$\pm 0.15 (\Delta)$ for $K_I < 3\%$ $\pm 5\% (\delta)$ for $K_I \geq 3\%$	3		+	+
	Root mean square value of n order of magnitude phase current interharmonic component ($n = 0...49$), A	$I_{Aisg(n)}, I_{Bisg(n)}, I_{Cisg(n)}$	$\pm 0.15 (\gamma)$ for $I_{isg(n)} < 3\% I_{nom}$ $\pm 5\% (\delta)$ for $I_{isg(n)} \geq 3\% I_{nom}$	147		+	+
	Coefficient of n order of magnitude phase current interharmonic component ($n = 0...49$), %	$K_{IAisg(n)}, K_{IBisg(n)}, K_{ICisg(n)}$	$\pm 0.15 (\Delta)$ for $K_{Iisg(n)} < 3\%$ $\pm 5\% (\delta)$ for $K_{Iisg(n)} \geq 3\%$	147		+	+

Table 3 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
						3-wire	4-wire
Phase shift angle parameters	Phase shift angle between basic frequency phase voltages, °	$\Phi_{UAB(1)}, \Phi_{UBC(1)}, \Phi_{UCA(1)}$	$\pm 0.2 (\Delta)^6$	3	10 basic frequency periods (~200 ms)	-	+
	Phase shift angle between basic frequency phase voltage and current, °	$\Phi_{UIA(1)}, \Phi_{UIB(1)}, \Phi_{UIC(1)}$	$\pm 0.5 (\Delta) 0.1I_{nom} \leq I \leq 2I_{nom}$ $\pm 5 (\Delta) 0.1I_{nom} \leq I \leq 0.1I_{nom}$	3		-	+
	Phase shift angle between phase voltage and n order of magnitude harmonic component current (n = 2...50), °	$\Phi_{UIA(n)}, \Phi_{UIB(n)}, \Phi_{UIC(n)}$	$\pm 3 (\Delta) 0.5I_{nom} \leq I \leq 2I_{nom}, K_{I(n)} \geq 5\%, K_{U(n)} \geq 5\%$ $\pm 5 (\Delta) 0.5I_{nom} \leq I \leq 2I_{nom}, 1\% \leq K_{I(n)} < 5\%, 0\% \leq K_{U(n)} < 5\%$ $\pm 5 (\Delta) 0.1I_{nom} \leq I \leq 0.5I_{nom}, K_{I(n)} \geq 5\%, K_{U(n)} \geq 5\%$	147		-	+
	Phase shift angle between positive, zero and negative sequence voltage and current, °	$\Phi_{U111}, \Phi_{U010}, \Phi_{U212}$	$\pm 0.5 (\Delta)^8$ $\pm 5 (\Delta)^9$	3		-	+
	Phase and average power coefficient ⁷⁾	$\cos\phi_A, \cos\phi_B, \cos\phi_C$	$\pm 0.01 (\Delta)$	3		-	+
	Average power coefficient ⁷⁾	$\cos\phi_{av}$	$\pm 0.01 (\Delta)$	1		+	+
	Phase shift angle between basic frequency phase currents, °	$\Phi_{IAB(1)}, \Phi_{IBC(1)}, \Phi_{ICA(1)}$	$\pm 0.5 (\Delta)^{10}$	3		+	+

Table 3 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement Interval	Connection Diagrams	
						3-wire	4-wire
Power parameters	Active phase power, W	P _A , P _B , P _C	$\pm(0,2 + \frac{0,025}{ \cos \varphi } \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HOM}}{U} - 1 \right)$ (δ)	3	10 basic frequency periods (~200 ms)	-	+
	Active three-phase power, W	P		1		+	+
	Active positive, negative and zero sequence power, W	P1. P2. P0	$\pm(0,2 + 0,025/ \cos \varphi \cdot I_{1HOM}/I - 1 + 0,04 \cdot U_{1HOM}/U - 1)$ (δ)	3		-	+
	Active basic frequency phase power, W	P _{A(1)} , P _{B(1)} , P _{C(1)}	$\pm(0,2 + 0,025/ \cos \varphi \cdot I_{1HOM}/I - 1 + 0,04 \cdot U_{1HOM}/U - 1)$ (δ)	3		-	+
	Active basic frequency three-phase power, W	P ₍₁₎		1		+	+
	Active phase and three-phase power of n order of magnitude harmonic component (n = 2...50),	P _{A(n)} , P _{B(n)} , P _{C(n)} , P _(n)	5% (δ) 0.5 ≤ cos φ ≤ 1	196		-	+
	Reactive phase power, VAR	Q _A , Q _B , Q _C	$\pm \left(0,5 + \frac{0,025}{ \sin \varphi } \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HOM}}{U} - 1 \right \right)$ (δ)	3		-	+
	Reactive three-phase power, VAR	Q		1		+	+
	Reactive positive, negative and zero sequence power, VAR	Q1. Q2. Q0	$\pm \left(0,5 + \frac{0,025}{ \sin \varphi } \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HOM}}{U} - 1 \right \right)$ (δ)	3		-	+
	Reactive basic frequency phase power, VAR	Q _{A(1)} , Q _{B(1)} , Q _{C(1)}	$\pm \left(0,5 + \frac{0,025}{ \sin \varphi } \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HOM}}{U} - 1 \right \right)$ (δ)	3		-	+
	Reactive basic frequency three-phase power, VAR	Q ₍₁₎		1		+	+
	Reactive phase and three-phase power of n order of magnitude harmonic component (n = 2...50), VAR	Q _{A(n)} , Q _{B(n)} , Q _{C(n)} , Q _(n)	5% (δ) 0.5 ≤ sin φ ≤ 1	196		-	+
	Full phase power, VA	S _A , S _B , S _C	$\pm \left(0,5 + 0,04 \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HC}}{U} - 1 \right \right)$ (δ)	3		-	+
	Full three-phase power, VA	S		1		+	+
	Full positive, negative and zero sequence power, VA	S1. S2. S0	$\pm \left(0,5 + 0,04 \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HC}}{U} - 1 \right \right)$ (δ)	3		-	+
	Full basic frequency phase power, VA	S _{A(1)} , S _{B(1)} , S _{C(1)}	$\pm \left(0,5 + 0,04 \cdot \left \frac{I_{HOM}}{I} - 1 \right + 0,04 \cdot \left \frac{U_{HC}}{U} - 1 \right \right)$ (δ)	3		-	+
	Full basic frequency three-phase power, VA	S ₍₁₎		1		+	+
Full phase and three-phase power of n order of magnitude harmonic component (n = 2...50), VA	S _{A(n)} , S _{B(n)} , S _{C(n)} , S _(n)	5% (δ)	196	-	+		

Table 3 (Continued)

- 1) Root mean square value with regard for basic frequency value, harmonics and interharmonics;
- 2) Average voltages and currents are calculated as an arithmetical mean of root mean square values by the following formulas: $I_{av} = 1/3 \cdot (I_A + I_B + I_C)$, $U_{MPhav} = 1/3 \cdot (U_A + U_B + U_C)$, $U_{L_{av}} = 1/3 \cdot (U_{AB} + U_{BC} + U_{CA})$;
- 3) $U_{nom\ iph} = \sqrt{3} U_{nom}$;
- 4) Calculation of symmetric components for the basic frequency;
- 5) Measurement range for input voltages is specified;
- 6) Voltage range $(0.8 - 2) U_{nom}$;
- 7) Current range $(0.02 - 2) I_{nom}$, voltage range $(0.8 - 2) U_{nom}$;
- 8) current range $(0.1 - 2) I_{nom}$;
- 9) current range $(0.01 - 0.1) I_{nom}$;
- 10) current range $(0.01 - 2) I_{nom}$;
- 11) Other definition - waveform distortion factor.

Table 4 - Maximum Permissible Basic Error of Measurement of Electric Energy Quality Characteristics Related to Long-Term Voltage Characteristics Measurements

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement/Averaging Time Interval	Connection Diagrams	
						3-wire	4-wire
Voltage deviation	Positive phase voltage deviation, %	$\delta U_{Ay (+)}, \delta U_{By (+)}, \delta U_{Cy (+)}$	$\pm 0.1 (\Delta)$	3	10 min	-	+
	Positive interphase voltage deviation, %	$\delta U_{ABy (+)}, \delta U_{BCy (+)}, \delta U_{CAy (+)}$	$\pm 0.1 (\Delta)$	3		+	-
	Negative phase voltage deviation, %	$\delta U_{Ay (-)}, \delta U_{By (-)}, \delta U_{Cy (-)}$	$\pm 0.1 (\Delta)$	3		-	+
	Negative interphase voltage deviation, %	$\delta U_{ABy (-)}, \delta U_{BCy (-)}, \delta U_{CAy (-)}$	$\pm 0.1 (\Delta)$	3		+	-
	Established voltage deviation value, %	δU_{est}	$\pm 0.2 (\Delta)$	1		+ ²⁾	+
Voltage Un-symmetry	Positive and negative sequence voltage values, V	$U_{1y} U_{2y}$	$\pm 0.1 (\gamma)$	2		+ ²⁾	+
	Positive, negative and zero sequence voltage values, V	U_{0y}		1		-	+
	Voltage asymmetry ratios by zero sequence, %	K_{0Uy}	$\pm 0.15 (\Delta)$	1		-	+
	Voltage asymmetry ratios by negative sequence, %	K_{2Uy}	$\pm 0.15 (\Delta)$	1		+ ²⁾	+
Voltage unisoidality	Coefficient of n order of magnitude phase voltage harmonic component (n = 2...50), %	$K_{UAy(n)}, K_{UBy(n)}, K_{UCy(n)}$	$\pm 0.05 (\Delta)$ for $K_U(n) < 1\%$ $\pm 5\% (\delta)$ for $K_U(n) \geq 1\%$	147		-	+
	Coefficient of n order of magnitude interphase voltage harmonic component (n = 2...50), %	$K_{UABy(n)}, K_{UBCy(n)}, K_{UCAy(n)}$	$\pm 0.05 (\Delta)$ for $K_U(n) < 1\%$ $\pm 5\% (\delta)$ for $K_U(n) \geq 1\%$	147	+	-	
	Coefficient of n order of magnitude phase voltage interharmonic component (n = 0...49), %	$K_{UAisg y(n)}, K_{UBisg y(n)}, K_{UCisg y(n)}$	$\pm 0.05 (\Delta)$ for $K_{Uisg(n)} < 1\%$ $\pm 5\% (\delta)$ for $K_{Uisg(n)} \geq 1\%$	147	-	+	
	Coefficient of n order of magnitude interphase voltage interharmonic component (n = 0...49), %	$K_{UABisg y(n)}, K_{UBCisg y(n)}, K_{UCAisg y(n)}$	$\pm 0.05 (\Delta)$ for $K_{Uisg(n)} < 1\%$ $\pm 5\% (\delta)$ for $K_{Uisg(n)} \geq 1\%$	147	+	-	

Table 4 (Continued)

Parameters		Designations	Maximum Permissible Basic Error Δ - Absolute; δ - Relative, %; γ - Reduced, %.	Qty	Measurement/Averaging Time Interval	Connection Diagrams	
						3-wire	4-wire
Voltage unisoidality	Total coefficient of phase voltage harmonic component, %	$K_{UAy}, K_{UBy}, K_{UCy}$	$\pm 0.05(\Delta)$ for $K_U < 1\%$ $\pm 5\% (\delta)$ for $K_U \geq 1\%$	3	10 min	-	+
	Total coefficient of interphase voltage harmonic component, %	$K_{UABy}, K_{UBCy}, K_{UCAy}$		3		+	-
Flicker ³⁾	Short-term flicker dose, relative units	P_{St}	$\pm 5\% (\delta)$	1		2 hours	+ ²⁾
	Long-term flicker dose, relative units	P_{Lt}	$\pm 5\% (\delta)$	1	+ ²⁾		+
Frequency	Frequency, Hz	f_{10}	$\pm 0.01 (\Delta)$	1	10 sec	+	+
	Frequency deviation, Hz	Δf_{10}	$\pm 0.01 (\Delta)$	1		+	+
	Positive and negative frequency deviation, Hz	$\Delta f_{10 (+)}, \Delta f_{10 (-)}$	$\pm 0.01 (\Delta)$	2		+	+

¹⁾ – Time interval length is a settable value, measurement time interval values (for frequency, frequency deviation, short-term flicker dose) and averaging (for other electric energy quality parameters) are shown as per GOST 32144-2013;
²⁾ – analysis is performed on the basis of interphase voltages;
³⁾ – short-term and long-term flicker dose calculation functions are implemented only in the following meter versions: BINOM335. BINOM339.

Table 4.1 - Maximum Permissible Basic Error of Measurement of Electric Energy Quality Parameters Related to Accidental Events

Parameters	Designations	Maximum Permissible Basic Absolute Error	Qty	Connection Diagrams		
				3-wire	4-wire	
Voltage dips	Flags and meter	$F_{dip}, F(\Delta t > 60)_{dip}, N_{dip}$	-	3	+	+
	Duration, s	Δt_{dip}	$\pm T$, where $T=1/f$	1	+	+
	Depth, %	δU_{dip}	$\pm 0.2 (\Delta)$	1	+ ¹⁾	+
Voltage interruptions	Flags and meter	$F_{inter}, F(\Delta t > 180)_{inter}, N_{inter}$	-	3	+	+
	Duration, s	Δt_{inter}	$\pm T$, where $T=1/f$	1	+	+
	Depth, %	δU_{inter}	$\pm 0.2 (\Delta)$	1	+ ¹⁾	+
Temporary over-voltages	Flags and meter	$F_{over}, F(\Delta t > 60)_{over}, N_{over}$	-	3	+	+
	Duration, s	Δt_{over}	$\pm T$, where $T=1/f$	1	+	+
	Temporary overvoltage coefficient, relative units	C_{over}	$\pm 0.002 (\Delta)$	1	+ ¹⁾	+

¹⁾ interphase voltage is adopted as reference voltage.

Table 5 – Information about Measurement Methods and the Electric Energy Quality Characteristics Statistic Analysis Parameters Set in BINOM3 Configuration Settings

Parameters		Designations	Averaging Interval ¹	Measurement Methods and Quality Norms Standard Section		Normally Permissible Value ²⁾	Maximum Permissible Value ³⁾	Measurement or Accuracy Class, SI
				GOST 30804.4.30-2013	GOST 32144-2013			
Long-Term Voltage Changes in Voltage Characteristic								
Frequency deviation	Positive frequency deviation, Hz	$\Delta f_{I0(+)\text{stat}}$	10 s (measurement interval)	5.1	4.2.1	0.2 Hz	0.4 Hz	A
	Negative frequency deviation, Hz	$\Delta f_{I0(-)\text{stat}}$	10 s (measurement interval)	5.1	4.2.1	0.2 Hz	0.4 Hz	A
Voltage deviation	Positive phase voltage deviations, %	$\delta U_{A(+)\text{stat}}, \delta U_{B(+)\text{stat}}, \delta U_{C(+)\text{stat}}$	10 min	5.2. 5.12	4.2.2	-	10%	A
	Positive interphase voltage deviations, %	$\delta U_{AB(+)\text{stat}}, \delta U_{BC(+)\text{stat}}, \delta U_{CA(+)\text{stat}}$	10 min	5.2. 5.12	4.2.2	-	10%	A
	Negative phase voltage deviations, %	$\delta U_{A(-)\text{stat}}, \delta U_{B(-)\text{stat}}, \delta U_{C(-)\text{stat}}$	10 min	5.2. 5.12	4.2.2	-	10%	A
	Negative interphase voltage deviations, %	$\delta U_{AB(-)\text{stat}}, \delta U_{BC(-)\text{stat}}, \delta U_{CA(-)\text{stat}}$	10 min	5.2. 5.12	4.2.2	-	10%	A
Voltage unisoidality	Total coefficient of phase/interphase voltage harmonic components, %	$K_{UA\text{stat}}, K_{UB\text{stat}}, K_{UC\text{stat}}$	10 min	5.8 (GOST 30804.4.7-2013 Cl. 3.2)	4.2.4.1	GOST 32144-2013. Table 5	GOST 32144-2013. Table 5	A, I
	Coefficient of n order of magnitude interphase voltage harmonic component (n = 2...50), %	$K_{UA(n)\text{stat}}, K_{UB(n)\text{stat}}, K_{UC(n)\text{stat}}$	10 min	5.8 (GOST 30804.4.7-2013 Cl. 3.2)	4.2.4.1	GOST 32144-2013. Tables 1÷4	GOST 32144-2013. Tables 1÷4	A, I
	Coefficient of n order of magnitude interphase voltage harmonic component (n = 0...49), %	$K_{UA\text{isg}(n)\text{stat}}, K_{UB\text{isg}(n)\text{stat}}, K_{UC\text{isg}(n)\text{stat}}$	10 min	5.9 (GOST 30804.4.7-2013 App. A)	-	-	-	I
Flicker ⁴⁾	Short-term flicker dose, relative units	$P_{St\text{stat}}$	10 min (measurement interval)	5.3 (GOST R 51317.4.15 Cl. 5.7.2)	4.2.3	-	1.38	A
	Long-term flicker dose, relative units	$P_{Lt\text{stat}}$	2 hours	5.3 (GOST R 51317.4.15 Cl. 5.7.3)	4.2.3	-	1	A
Voltage Unsymmetry	Voltage unsymmetry ratios by negative and zero sequences, %	$K_{2U\text{stat}}, K_{0U\text{stat}}$	10 min	5.7	4.2.5	2%	4%	A

Table 5 (Continued)

Parameters	Designations	Averaging Interval ¹⁾	Measurement Methods and Quality Norms Standard Section		Normally Permissible Value ²⁾	Maximum Permissible Value ³⁾	Measurement or Accuracy Class, SI
			GOST 30804.4.30-2013	GOST 32144-2013			
Accidental Events							
Voltage dip depth and duration	DIP(85:90%)stat, DIP(70:85%)stat, DIP(40:70%)stat, DIP(10:40%)stat, DIP(0:10%)stat	Mean root square voltage value measured over a basic frequency semiperiod	5.4	4.3.2	-	-	A
Overvoltage maximum value/coefficient and duration	SWELL(110:120%)stat, SWELL(120:140%)stat, SWELL(140:160%)stat, SWELL(160:180%)stat		5.4	4.3.2	-	-	A
Voltage interruption length;	INTR(0:5%)stat		5.5	4.3.1	-	-	A
¹⁾ averaging intervals are set and may be changed in the instrument configuration settings; ²⁾ normally permissible values are set and may be changed in the instrument configuration settings; ³⁾ maximum permissible values are set and may be changed in the instrument configuration settings; ⁴⁾ short-term and long-term flicker dose calculation functions are implemented only in the following meter versions: BINOM335. BINOM339.							

1.2.1.1 Active current, voltage, frequency and energy quality parameters values metering lag does not exceed 100 s after power voltage input.

1.2.1.2 The maximum permissible values of additional error of network parameters measurement on ambient temperature change from normal to any temperature in the working temperature range do not exceed ° of the basic error cited in Table 3 per each 10 °C.

1.2.1.3 The maximum permissible additional error of current, voltage and frequency measurements caused by changes in influencing quantities in relation to normal conditions do not exceed the limits cited in Table 6.

Table 6 - Maximum Additional Error of Network Parameters Measurement

Influencing Quantity	Error Variation Limit, %			
	Current	Voltage	Fre- quency	Network Quality In- dicators
Mains frequency within the range from 42.5 to 57.5 Hz	° basic error	° basic error	-	-
Curve form: basic frequency current harmonics within the range from 85 Hz to 2875 Hz	° basic error	-	-	-
Curve form: basic frequency voltage harmonics within the range from 42.5 Hz to 57.5 Hz	° basic error	-	-	-
Measured voltage within the range (0.1 – 0.8) U_{nom}	0.2	-	0.2	-
Heterogeneous magnetic induction 0.5 mT	° basic error	-	-	-
Constant heterogeneous magnetic induction	° basic error	-	-	-

1.2.1.3 The maximum permissible additional error of power measurements caused by changes in influencing quantities in relation to normal conditions do not exceed the limits cited in Table 7.

Table 7 - Maximum Additional Error of Power Measurement

Influencing Quantity	Current Value (Symmetric Load)	Coeffi- cient	Maximum additional measurement error			
			Power, %			Cosφ (Δ)
			S_{ph}, S_{abc}	P_{ph}, P_{abc} c	Q_{ph}, Q_{abc}	
Curve form: The fifth harmonic current is equal to 40% of load current. The fifth harmonic voltage is equal to 10% of basic frequency voltage	$0.5 I_{max}$ U_{nom}	$\cos \varphi = 1$	± 0.4	± 0.4	-	0.005
Heterogeneous magnetic induction 0.5 mT	I_{nom} U_{nom}	$\cos \varphi = 1$	± 0.5	± 0.5	-	0.01
		$\sin \varphi = 1$	± 1	-	± 1	
Constant heterogeneous magnetic induction MMF value is equal to 1000 A·coils (GOST 31819.22)	I_{nom} U_{nom}	$\cos \varphi = 1$	± 1	± 1	-	0.01
		$\sin \varphi = 1$		-	± 1	

Table 7 (Continued)

Influencing Quantity	Current Value (Symmetric Load)	Coefficient	Maximum additional measurement error			
			Power, %			Cosφ (Δ)
			S _{ph} , S _{abc}	P _{ph} , P _{ab} c	Q _{ph} , Q _{abc}	
Measured voltage within the range (0.1 – 0.8) U _{nom}	-		0.2	0.2	0.2	0.005
Unsymmetrical load phase by phase (for connected power)	-	-	δ _{S_n} ¹⁾	δ _{P_n} ¹⁾	δ _{Q_n} ¹⁾	
Single-phase load (with voltage symmetry)	0.05·I _{nom} ≤ I ≤ 2·I _{nom}	cos φ = 1	± 0.1 ²⁾	± 0.1 ²⁾	-	0.005
	0.1·I _{nom} ≤ I ≤ 2·I _{nom}	cos φ ≥ 0.5				0.005
	0.05·I _{nom} ≤ I ≤ 2·I _{nom}	sin φ = 1	± 0.8 ²⁾	-	± 0.8 ²⁾	
	0.1·I _{nom} ≤ I ≤ 2·I _{nom}	sin φ ≥ 0.5				
Mains frequency within the range from 42.5 to 57.5 Hz	0.05·I _{nom} ≤ I ≤ 2·I _{nom}	cos φ = 1	δ ³⁾	δ ³⁾	-	0.005
	0.1·I _{nom} ≤ I ≤ 2·I _{nom}	cos φ ≥ 0.5				0.005
	0.05·I _{nom} ≤ I ≤ 2·I _{nom}	sin φ = 1	± 0.8	-	± 0.8	

1) - $\delta_{S_n} = \pm \frac{\sum_{\phi=a,b,c} \delta S_{\phi} \cdot S_{\phi}}{S_n}$, $\delta_{P_n} = \pm \frac{\sum_{\phi=a,b,c} \delta P_{\phi} \cdot P_{\phi}}{P_n}$, $\delta_{Q_n} = \pm \frac{\sum_{\phi=a,b,c} \delta Q_{\phi} \cdot Q_{\phi}}{Q_n}$;
 2) - For connected power P_n, Q_n and S_n;
 3) - 1/2 basic error.

1.2.2 Metrological Characteristics of Electric Energy Measurements

Active electric energy measurements accuracy conforms to GOST 31818.11-2012 and GOST 31819.22-2012 for class 0.2S. Reactive electric measurements accuracy conforms to class 0.5 as per TU 4228-008-80508103-2014 specifications, measurement methods as per GOST 31819.23-2012. The maximum basic error of energy measurement is presented in Table 8.

Table 8 - Maximum Permissible Basic Error of Measurement Expressed as a Percentage (for Multiphase Meters with Symmetrical Loads)

Current Value	cosφ/sinφ Coefficient Value	Maximum Permissible Basic Error, %
For Active Energy Measurement as per GOST 31819.22-2012 (cosφ)		
0.01 I _{nom} ≤ I < 0.05 I _{nom}	1.00	± 0.40
0.05 I _{nom} ≤ I ≤ I _{max}		± 0.20
0.02 I _{nom} ≤ I < 0.10 I _{nom}	0.50 (under inductive load)	± 0.50
	0.80 (under capacity load)	
0.10 I _{nom} ≤ I ≤ I _{max}	0.50 (under inductive load)	± 0.30
	0.80 (under capacity load)	
0.10 I _{nom} ≤ I ≤ I _{max}	0.25 (under inductive load)	± 0.50
	0.5 (under capacity load)	

Table 8 (Continued)

For Reactive Energy Measurement as per GOST 31819.23-2012 (sinφ)		
$0.02 I_{nom} \leq I < 0.05 I_{nom}$	1.00	± 0.8
$0.05 I_{nom} \leq I \leq I_{max}$		± 0.5
$0.01 I_{nom} \leq I < 0.05 I_{nom}$	0.50	± 0.8
$0.10 I_{nom} \leq I \leq I_{max}$	0.50	± 0.5
$0.10 I_{nom} \leq I \leq I_{max}$	0.25	± 0.8

1.2.2.1 The maximum permissible basic error of energy measurement under single-phase load (multiphase voltages applied to voltage circuits being symmetrical) correspond to the values indicated in Table 9.

The difference between error value under single-phase meter load and under symmetrical multiphase load, nominal current I_{nom} :

- for active energy and power factor (cosφ) equal to 1 does not exceed 0.4%.
- for reactive energy and coefficient (cosφ) equal to 1 does not exceed 0.8 %.

Table 9 – The Maximum Error Expressed as a Percentage (for Multiphase Meters with a Single-Phase Load, Multiphase Voltage Applied to Voltage Circuits Being Symmetrical)

Current Value	cosφ/sinφ Coefficient Value	Maximum Permissible Basic Error, %
For Active Energy Measurement as per GOST 31819.22-2012 (cosφ)		
$0.05 I_{nom} \leq I \leq I_{max}$	1.0	± 0.30
$0.10 I_{nom} \leq I < I_{max}$	0.5 (under inductive load)	± 0.40
For Reactive Energy Measurement as per GOST 31819.23-2012 (sinφ)		
$0.05 I_{nom} \leq I < I_{nom}$	1.0	± 0.8
$0.10 I_{nom} \leq I \leq I_{max}$	0.5 (under inductive and capacity load)	± 0.8

1.2.1.3 The maximum permissible additional energy measurement error caused by changes in influencing quantities in relation to normal conditions are presented in Tables 10 and 11.

Table 10 - The Maximum Active Energy Error Caused by Influencing Quantities

Influencing Quantity	Current Value (Symmetrical Load)	Power factor, cos φ	Additional Error Limits, %
For Active Energy Measurement as per GOST 31819.22-2012 (cos φ)			
Ambient air temperature measurement ¹⁾	$0.05 I_{nom} \leq I \leq I_{max}$	1	Average Temperature Coefficient, %K 0.01 0.02
	$0.1 I_{nom} \leq I \leq I_{max}$	0.5 (under inductive load)	
Voltage variation within the limits $\pm 10\%$ ^{2), 3)}	$0.5 I_{nom} \leq I \leq I_{max}$	1.0	0.10
	$0.1 I_{nom} \leq I \leq I_{max}$	0.5 (under inductive load)	0.20
Frequency variation within the limits $\pm 2\%$ ³⁾	$0.05 I_{nom} \leq I \leq I_{max}$	1.0	0.10
	$0.1 I_{nom} \leq I \leq I_{max}$	0.5 (under inductive load)	0.10
Self-heating	I_{max}	1.0	0.10
		0.5 (under inductive load)	0.10
Reverse sequential order of phases	$0.10 I_{nom}$	1	0.05
Voltage Unsymmetry ⁴⁾	I_{nom}		0.50
Harmonics in current and voltage circuits ⁵⁾	$0.50 I_{max}$		0.40
Subharmonics in AC circuit ⁷⁾	$0.50 I_{nom}$ ⁶⁾		0.60
Constant heterogeneous magnetic induction ⁵⁾	I_{nom}		2.0
Heterogeneous magnetic induction 0.5 mT ⁷⁾	I_{nom}		0.50
Radio-frequency electromagnetic fields			1.00
Functioning of auxiliary parts ⁸⁾	$0.01 I_{nom}$		0.05

Table 10 (Continued)

Influencing Quantity	Current Value (Symmetrical Load)	Power factor $\cos \varphi$	Additional Error Limits, %
Conductive interference induced by radio-frequency fields	I_{nom}	1	1.00
Electrical fast transient burst			
Resistance to oscillatory damped interference			
<p>¹⁾ - Average temperature coefficient must be determined for the whole working range. The working temperature range must be divided into subranges amounting to 20 K each. After that, the average temperature coefficient must be determined by performing measurements for those subranges: 10 K above and 10 K below the subrange middle. The temperature must under no circumstances fall outside the above working range during the test.</p> <p>²⁾ - For voltage ranges from minus 20 to minus 10% and from plus 10 to plus 15%, additional error limits may triple those shown in the table. With voltage less than $0.8 U_{nom}$, energy measurement error may vary within the limits from plus 10 to minus 100%.</p> <p>³⁾ - It is advisable to carry out tests under I_{nom}.</p> <p>⁴⁾ - Multiphase meters with three measuring elements must measure energy and register readings within the range of limit error variation values presented in the table if the following is interrupted: - one or two phases in a three-phase, four-wire network; - one of three phases in a three-phase, three-wire network. This relates only to phase interruptions and does not relate, e.g., to such cases as transformer fuses blowing.</p> <p>⁵⁾ - Test conditions are presented in Cl.Cl. 8.2.1-8.2.3. GOST 31819.22-2012.</p> <p>⁶⁾ - Voltage curve waveform distortion factor must not exceed 1%.</p> <p>⁷⁾ - 0.5 mT heterogeneous magnetic induction created by a current whose frequency is equal to the frequency of the voltage fed to the meter and with the most unfavorable phase and direction must not bring about additional meter error exceeding the values specified in the table. Magnetic induction may be created by putting the meter inside of a coil 1 m in diameter on the average with a rectangular cross section, a small radial thickness as compared to the diameter and having 400 ampere-windings.</p> <p>⁸⁾ - The auxiliary part inside the meter casing shall be energized discretely. It is desirable to mark the auxiliary park connection in order to ensure its correct connection. In case these connections are implemented with the help of plugs and sockets, they must be protected against possible incorrect connection of the meter. However, upon availability of such markings or connections preventing incorrect meter connection additional error must not exceed the one specified in the table if the meter is tested with the connections creating the most adverse conditions.</p>			

Table 11 - Quantities Influencing Reactive Energy Measurement

Influencing Quantity	Current Value (Symmetrical Load)	Coefficient $\sin\phi$	Additional Error Limits, %
For Reactive Energy Measurement as per GOST 31819.23-2012 ($\sin\phi$)			
Ambient air temperature measurement ¹⁾	$0.05 I_{nom} \leq I \leq I_{max}$	1.0	Average temperature coefficient, %K 0.03 0.04
	$0.10 I_{nom} \leq I \leq I_{max}$	0.5	
Voltage variation $\pm 10\%$ ^{2), 3)}	$0.02 I_{nom} \leq I \leq I_{max}$	1.0	0.4
	$0.05 I_{nom} \leq I \leq I_{max}$	0.5	0.5
Frequency variation $\pm 2\%$ ³⁾	$0.02 I_{nom} \leq I \leq I_{max}$	1.0	0.8
	$0.05 I_{nom} \leq I \leq I_{max}$	0.5	0.8
DC component in the current network ⁴⁾	-	1	-
Constant heterogeneous magnetic induction ⁵⁾	I_{nom}		1.0
Heterogeneous magnetic induction 0.5 mT ⁶⁾	I_{nom}		1.0
Radio-frequency electromagnetic fields	I_{nom}		1.0
Functioning of auxiliary parts ⁷⁾	$0.05 I_{nom}$		0.3
Conductive interference induced by radio-frequency fields	I_{nom}	1	1.0
Electrical fast transient burst			2.0
Resistance to oscillatory damped interference			1.0
¹⁾ - For voltage ranges from minus 20 to minus 10% and from plus 10 to plus 15%, additional error limits may triple those shown in the table. With voltage less than $0.8 U_{nom}$, energy measurement error may vary within the range from plus 10 to minus 100%. ²⁾ - It is advisable to carry out tests under I_{nom} . ³⁾ - This test does not apply to transformer-operated meters. ⁴⁾ - Test conditions are presented in Cl. 8.2.2. GOST 31819.23-2012.			

Table 11 (Continued)

<p>⁵⁾ - 0.5 mT heterogeneous magnetic induction created by a current whose frequency is equal to the frequency of the voltage fed to the meter and with the most unfavorable phase and direction must not bring about additional meter error exceeding the values specified in the table.</p> <p>During tests, the meter must be placed in the center of a round coil 1 meter in diameter on the average, having a rectangular cross-section, a small radial thickness as compared to the diameter and 400 ampere-windings magnetomotive force.</p> <p>⁶⁾ - The auxiliary part of the meter placed inside its casing shall be energized periodically. It is desirable to have the meter and the auxiliary part connection interface marked in order to ensure its correct connection. In case connections are implemented with the help of electric connectors (plugs) they must be protected from possible meter misconnection. However, upon availability of such markings or connections preventing meter misconnection additional error must not exceed the one specified in the table if the meter is tested with the connections creating the most adverse conditions.</p> <p>⁷⁾ - Average temperature coefficient must be determined for the whole working range. The working temperature range must be divided into subranges amounting to 20 K each. After that, the average temperature coefficient must be determined by performing measurements for those subranges: 10 K above and 10 K below the subrange middle. The temperature must under no circumstances fall outside the above working range during the test.</p>
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1.2.2.3 The meter shall function normally (meter energy) not later than 5 s after nominal voltage has been applied to its terminals.

1.2.2.4 Initial start of the meter, absence of creep, starting current, operating mode setting meet the requirements of GOST 31819.22-2012.

1.2.2.4.1 The meter shall switch on and continue recording readings when current is equal to or more than $0.001 I_{nom}$ (sensitivity threshold) and power factor equal to 1.

1.2.2.4.2 The meter shall not meter energy after voltage equal to $1.15U_{nom}$ has been applied and when there is no current in the circuit being measured. Test output of a meter switched on under such conditions shall not create more than one impulse.

1.2.2.5 Impulse outputs of a BINOM3 meter have two states differing in output circuit impedance. In the "closed" state, impulse output resistance is not more than 200 Ω , in the "open" state, not less than 50 k Ω .

1.2.2.5.1 The maximum permissible current the circuit of one BINOM3 meter impulse output can withstand in the "closed" state is 5 to 30 mA.

1.2.2.5.2 The maximum permissible voltage on the terminals of one BINOM3 meter impulse output is 24 V.

1.2.2.6 The meter constant in operating mode (relationship between the quantity of impulses formed at the impulse output and the display reading) conforms to Table 12; it is marked on the keypad module.

Impulse outputs operation mode is set from the display.

There are the following impulse outputs operation modes:

- off;
- test output - impulse frequency is proportional to the measured power;
 - active power;
 - reactive power;
 - active loss power;
 - reactive loss power;
 - active basic frequency power;
 - reactive basic frequency power;
 - active positive sequence power;
 - reactive negative sequence power;
- test output - impulse frequency is proportional to the measured energy;
 - Active energy;
 - reactive energy;
 - active loss energy;
 - reactive loss energy;
 - active basic frequency energy;
 - reactive basic frequency energy;
 - active positive sequence energy;
 - reactive negative sequence energy;
- test - 1500 Hz signal is formed.

Table 12 - Impulse Output Parameters in Test Mode

BINOM3 Meter Ver- sion	Constant, imp./kWh, imp./kVArh	Normalized frequency, Hz/W, Hz/VAr	Frequency at no- minal power, kHz
U3.57I3.1	36000000	10	1.73205
U3.220I3.1	9000000	2.5	1.650
U3.57I3.5	7200000	2	1.73205
U3.220I3.5	1800000	0.5	1.650

As the meter is switched on, the test output is automatically activated in the active energy measurement mode.

1.2.3. Technical Parameters

1.2.3.1 The meter operating mode setting (preheating) time is not more than 20 min.

1.2.3.2 The meter operates in a continuous mode. The duration of continuous operation is unlimited.

1.2.3.3 The meter withstands input metering circuits overload with the parameters specified in Table 13. BINOM3 series meter performance restoration time after current or voltage overload not exceeding $2 I_{nom}$ or, respectively, $2 U_{nom}$ is not more than 120 s.

Table 13 - Overload Resistance

Overload Ratio		Number of Overload	Duration of Each Overload, s	Interval between Overloads, s
Current	20	2	0.5	0.5
	10	2	1	0.5
	2	-	long-term	-
Voltage	2	-	long-term	-

Error variation after overload at nominal current, voltage and power factor (sinφ coefficient) equal to one does not exceed:

- 0.1% for currents and voltage;
- 0.2% active power;
- 0.3% for reactive power;
- 0.05% for active power;
- 0.3 % for reactive power.

1.2.3.4 The meter is resistant to voltage dips and short-term interruptions.

BINOM3 meter performance restoration time after the impact of an aperiodical process having 0.1 time constant and amplitude equal to the current or voltage nominal value does not exceed 120 s.

1.2.4 Communication Channels and Interfaces

BINOM3 meter has the following data independent interfaces:

- **RS-485. RS-485/422** for data transmission from the meter over a physical communication line. The maximum data transmission speed is 460.8 kbit/s, the maximum distance is 600 m. It is also used for meter synchronization from standard time signal receivers (DF01. GPS).

- **Ethernet 10/100Base-T** for data transmission via Ethernet. In the process of remote parameterization, this interface can also be used for connecting to the BINOM3 web server built in the meter. Data transmission speed 100 Mbit/s. Ethernet interface terminals are electrically insulated from all meter input/output signals.

Screened Ethernet cable must be used at power plants and substations, the screen earthing point is to be determined by the design.

- **RS-232** for data transmission via a physical communication lines, private voice-frequency channels or a radio channel with the help of an external modem, as well as via GSM network with the help of a GSM modem. The maximum data transmission speed is 460.8 kbit/s, the maximum distance is 12 m.

- **optical interface** for contactless meter connection and data exchange with external data processing devices with the help of an adapter (TX06A communication module). Data transmission speed - 115200 bit/s.

1.2.4.1 Data Exchange with Devices via RS-485 Interface

Data exchange with devices via RS-485 interface may be carried out as per GOST R IEC 60870-5-101-2006 protocol, whereupon the BINOM3 meter carries out a SLAVE function. The main function is data transmission from the meter.

RS-485 interface has a built-in polarization from a +3.3 V internal source via a 20 kΩ resistor.

1.2.4.2 The parameters of RS-485 interface circuits must conform to the requirements specified in Table 14.

Table 14 - RS-485 Interface Circuit Parameters

Name	Value			Meas. Unit
	Min.	Type	Max.	
Differential output signal levels at 200 Ω load	2	–	–	V
Operational range of differential input signal levels	0.5	–	12	V
Number of receivers connected to the same trunk line	–	–	20	–
Test voltage of galvanic isolation between channel terminals and module power supply terminals (active commercial frequency value)	–	4000	–	V

1.2.5 Data Processing

1.2.5.1 Energy Metering Data

The meter stores the following kinds of energy metering data:

- energy increment data for every energy meter for two independent time intervals from 1. 2. 3. 4. 5. 6. 10. 12. 15. 20. 30. 60 series (hereinafter, load profiles). Storage depth of the first profile conventionally called a commercial one is 32.768 snapshot, for the second profile (technical) - 21.845 snapshots.
- energy meter readings as off the beginning of a natural day by four tariff and totally: 3.574 days

The meter has sixteen electric energy meters:

- consumed active energy;
- produced active energy;
- reactive energy under inductive load;
- reactive energy under capacitive load;
- consumed active energy loss;
- produced active energy loss;
- reactive energy loss under inductive load;
- reactive energy loss under capacitive load;
- consumed basic frequency active energy;
- produced basic frequency active energy;
- reactive basic frequency energy under inductive load;
- reactive basic frequency energy under capacitive load;
- consumed positive sequence active energy;
- produced positive sequence active energy;
- reactive positive sequence energy under inductive load;
- reactive positive sequence energy under capacitive load.

1.2.5.2 Meter Logs

The meter keeps two logs. One log records the events provided by the requirements of NP Market Council (JSC TSA) - "TSA Log", the other log records all events generated by the meter - "Events Log". A code is assigned to every type of event. The events provided by the requirements of NP Market Council have codes meeting the requirements of the NP Market Council.

The event log records the following classes of events:

- power supply subsystem events:
 - BINOM3 meter restart;
 - meter cutoff;
- real time subsystem events:
 - time correction;
 - synchronization;
 - real time clock fault;
- data protection subsystem events:
 - unauthorized access attempt (incorrect password entry, covers tampering);
 - parameterization data change;
- energy metering events and excess of user-set range of the following parameters:
 - first sequence current (the average for 10 network periods - ~ 0.2 s);
 - first sequence voltages (the average for 10 network periods);
 - active power (sums of phase power modules) (the average for 10 network periods);
 - excesses of active energy consumption during the commercial metering interval;
 - electric energy metering interruption;
 - overload of any input;
 - voltage loss;
- change in electric energy quality parameters:
 - voltage deviation value and date/time;
 - voltage dip duration, depth and date/time;
 - overvoltage duration and date/time;
 - voltage asymmetry ratio by negative sequence;
 - voltage asymmetry ratio by zero sequence;
 - frequency deviation

Logs data are stored in the BINOM3 meter non-volatile memory. The volume of the "Events Log" is 65535 entries, the volume of the "TSA Log" is 16384 entries.

The logs may be read with the help of BINOM3 Web server.

Frame formats for logs data transmission via communication channels, event formats and codes, event distribution in logs are described in the document "BINOM3 Series Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1».

1.2.6 Data Protection

1.2.6.1 Data Security

The following data security measures are provided in the BINOM3 meter:

- mechanical sealing of the terminal cover;
- electronic cover tampering sensors operating when the meter is on;
- software protection with the help of digital passwords making it possible to distribute rights between several access levels (including separate time correction, interfaces setting, parameters change);
- reading permit;
- writing/configuration change permit.

Data reading password allows to read data via a Web interface.

Data change password allows to change the meter configuration and the automated informative electric power accounting system settings.

The following measures are provided for data protection against unauthorized access via digital data exchange interfaces:

- mechanical closing of connectors with a sealable terminal cover;
- built-in Web server software access level settable during user parameterization;

Passwords changes, incorrect password access attempts are recorded in event logs.

1.2.6.2 Data Protection Against Change

The following measures are provided in the BINOM3 series meter for data protection against change:

- it is impossible (there are no commands) to change measured parameters and energy metering parameters, including those of the main increment total meters;
- blocking the meter current time in case of synchronization period violation (frequent synchronizations are rejected) and in case of excess of established time correction value with recording of the event in the event logs. During a single synchronization cycle, time is corrected during parameterization;
- meter operation is blocked when the clock operates incorrectly or in case of current time loss, whereupon clock fault is recorded in event logs;
- the event of authorized meter parameterization change is recorded in log events, including energy metering parameters;
- it is impossible to make changes to the log events.

1.2.7 Remote Control Functions Characteristics

BINOM3 meters as remote control devices meet the requirements of GOST 26.205-88. GOST 26.013-81. GOST R IEC 870-3-93. GOST IEC 60870-4-2011. GOST R IEC 60870-5-104-2004. GOST R IEC 60870-5-101-2006.

According to GOST R IEC 870-4-93 classification, a BINOM3 meter complies with the following classes:

- reliability: R3;
- data transmission validity: I2 and I3 for control commands acquisition;
- readiness: A3;
- repairability: RT1 ($T_p \leq 2$ h) (by replacing the meter or the TE3xRx relay block);
- timing resolution: SP4 (≤ 1 ms);
- remote signaling priority resolution: TR4 (≤ 1 ms).

In case there is no data exchange via communication channels, the most recent events are saved in the event queue.

1.2.7.1 Remote Signaling (RS) Acquisition Parameters

Rs inputs are discrete inputs for connection of two-position contact and contactless position sensors: dry contact sensors, electronic keys, Hall sensors, electronic relays, etc. The characteristics of BINOM3 meter discrete inputs are presented in Table 15.

Table 15 - Discrete Input Characteristics

Parameter	Min.	Type	Max.	Meas. Unit
Low level signal ¹⁾	- 1.2	0	+ 10.4	V
High level signal ¹⁾	+ 11.5	24	+ 30	V
Open sensor terminals voltage	23	24	25	V
Closed sensor resistance	0	-	150	Ω
Open sensor resistance	50	-	∞	k Ω
Closed sensor current (current class 1 as per GOST R IEC 870-3-93)	1	2	5	mA
Sensors scanning period	-	-	100	μ s
Interference and overload protection class as per GOST R IEC 870-3	-	2	-	

¹⁾ - The table presents input signal level values set by the manufacturer.

An isolated +24 V power source is provided in the BINOM3 meter for powering passive RS meters. Its parameters are presented in Table 16.

Table 16 - Built-in RS Sensors Power Source Characteristics

Characteristic Name	Value	Class
Nominal DC voltage U_{nom} , V: - minimum; - maximum	24 23.5 24.5	DCx as per GOST R 51179-98 E ⁻ , E ⁺ , EF classes with a 1 Ω shunting resistor as per GOST R
Output current, mA - minimum; - maximum	0 80	
Voltage ripple factor (from the nominal voltage), %	≤ 5	VR3 class GOST R 51179-98
Instability, %	1	

1.2.7.2 Remote control Parameters Characteristics

Remote control outputs are passive binary output signals (in GOST R IEC 870-3-93 terms) intended for control circuits connection and discrete adjustment of objects. Remote control output are arranged binominally and implemented as a separate TE37Rx or TE38Rx relay block.

Each remote control channel contains three relays:

- ON activation command (connection of switching device drives enabling circuits),
- OFF trip command (connection of switching device drives disabling circuits and automatic recloser actuation blocking),
- choice of channel - main cross group.

The block also includes an additional relay intended for protection of relay contacts in the process of controlling switching devices with a large inductive load (EIS): electromagnetic in a TE38Rx relay block, solid-state in a TE37Rx block. The contacts of all relays are normally open.

Functionally the BINOM3 meter subassembly implementing remote control functions has the following parameters:

- diagnostics including a check of relay coil resistance;
- software bugs and breakdowns protection and protection from various types of power source breakdowns.

Self-diagnostics is carried out cyclically every 10 s (a settable parameter) and in the process of the "Remote control Preparation" command fulfilment.

Only one remote control channel at a time may be in an activated state.

Electrical and time remote control parameters with regard for characteristics of relay block remote control outputs are presented in Table 17.

Table 17 – Requirements for Discrete Output Characteristics

Characteristic	Min.	Type	Max.	Meas. Unit
Switched AC voltage	0.5	–	250	V
Switched AC current	0.05	–	5	A
Switched DC voltage	0.5	–	250	V
Switched DC current				
- at 24 V voltage	0.05		8	A
- at 220 V voltage	0.05	-	0.1/ 5 ¹⁾	
- at 250 V voltage	0.05		3 ¹⁾	
Relay closing time	0.25 ²⁾ 0.5 ³⁾	1	10	s
Interference and overload protection class as per GOST R IEC 870-3-93	–	2	–	
¹⁾ – When a solid-state relay is used in the relay block (TE37Rx). ²⁾ – for a solid-state relay. ³⁾ – for an electromagnetic relay.				

1.2.8. Electric Power Supply

All versions of BINOM3 meters are powered from the following sources:

- from AC mains;
- from DC control current mains;
- from an external backup DC power source intended for power supply in case of the main power source failure;
- from an internal backup power supply intended, among other things, for a clean task termination and the meter shutdown in case of the main power source failure.

1.2.8.1 Parameters of Main and Backup Electric Power Supply from DC Control Current Mains

The parameters of main and backup power supply from a DC power source are presented in Table 18.

Table 18 - Parameters of Electric Power Supply from DC Control Current Mains

Name	Value	Meas. Unit	Note
Nominal voltage	220	V	
Expanded working voltage range	from 125 to 350	V	DCx class, GOST R 51179
Voltage ripple factor (from the nominal voltage)	≤ 5	%	VR3 class, GOST R 51179
Earth for DC power source	Any class		GOST R 51179

Steady-state average meter consumption current ($I_{av=}$) from DC mains at 220 V voltage - 0.04 A (reference).

1.2.8.2 Parameters of Electric Power Supply from AC Mains

The parameters of electric power supply from AC mains are presented in Table 19.

Table 19 - Parameters of Electric Power Supply from AC Mains

Name	Value	Meas. Unit	Note
Nominal voltage	220	V	
Expanded working voltage range	90 to 265	V	ACx class, GOST R 51179
Nominal frequency	50	Hz	
Expanded working frequency range	47 to 63	Hz	
Unsinusoidality, maximum	10	%	H2 class, GOST R 51179

ATTENTION!

**SIMULTANEOUS CONNECTION TO DC AND AC MAINS IS NOT SUPPORTED.
POWER MAINS (\approx /= 220 V) MUST HAVE AN EARTH WIRE.**

Recommendations on the matters of power circuits connection are presented in Cl. 2.7.4.

1.2.8.3 Parameters of Internal Backup Power Supply

Internal power source must ensure:

- at least 30 min continuous operation time;

- at least 24 h loading time;
- the number of load/unload cycles with retention of declared continuous operation time is not more than 500 (ensured by battery characteristics).

1.2.9 Power Consumption

Power consumed by the meter:

- over AC power supply circuits - not more than 9 W (20 VA), peak load not more than 12 W.
- over Dc power supply circuits - not more than 9 W, peak load not more than 12 W.

The power consumed by the meter over each input circuit at nominal current and voltage values is presented in Table 20.

Table 20 - Power Consumed by the Meter via Input Circuit

Input Circuit	Nominal value	Consumed Input Circuit Power	Deviation (Reference)	Nature of Load (for Reference)
Current	5 A	0.05 VA	not more	Inductive, less than 10 μH
Current	1 A	0.01 VA	not more	Inductive, less than 100 μH
Voltage	57.7 V	0.02 W	± 5 %	Active
Voltage	220 V	0.1 W		

1.2.10 Heat and Fire Resistance

BINOM3 series meters are resistant against heating and fire in compliance with the requirements of GOST 31818.11-2012. The clamping plate, flap lid, clamps, body and keypad ensure fire propagation safety and comply to GOST 12.1.004-91, GOST 27483-87. GOST 27924-88.

1.2.11 Environmental Stability

The meters have 3K5 class of ambient air temperature and humidity resistance in operation as per GOST 31818.11-2012 with range expansion towards low temperatures (established operational temperatures range from minus 40 to plus 45 °C, relative humidity up to 95% at plus 35 °C temperature).

Table 21 - 3K5 Climatic Impact Class Characteristic

Relative Humidity	Relative Humidity Value, %
Average annual	Less than 75
30-days, distributed naturally throughout a year	95
Rarely (occasionally) taking place at other days	85

Mechanic impacts on the parameters not specified in GOST 31818.11-2012 comply to group 4. GOST 22261-94. group M7. GOST 30631-99.

The meters are resistant to atmospheric pressure from 70 to 106.7 kPa (from 537 to 800 mm Hg). BINOM3 meters have IP51 ingress protection as per GOST 14254-96.

1.2.12 Electromagnetic Compatibility

As regards electromagnetic compatibility, BINOM3 series meters meet the requirements of GOST 31818.11-2012. GOST P 51317.6.5-2006 and STO 56947007-29.240.044. Federal Grid Company JSC.

BINOM3 meters interference emission meets the requirements of GOST 31818.11-2012 and GOST 30805.22-2013 for A class equipment.

Under GOST 5 51317.6.5. test strictness grade is established for the technical facilities intended for use at power plants and high voltage substations (H).

GOST R 51317.6.5 requirements for field-type connection (f) signal ports were applied to RS-485. SYNC and Ethernet ports.

Requirements for field type connection (f) signal ports were applied to RS-232 and RS-485/422 interface ports subject to the use of a screened cable with a earthed screen or, should using a cable be impossible, the use of EM337 external protection block (TLAS.426475.001).

The full list of requirements is presented in Table 22.

Table 22 - BINOM3 Series Meters Electromagnetic Compatibility Requirements

№	Type of Tests	Test Parameters	Degree of Strictness	Regulatory Document
1	Evanescent oscillatory magnetic field resistance	100 A/m	5	GOST R 50652
Enclosure port				
2	Commercial frequency magnetic field resistance	long-term: 100 A/m short-term: 1000 A/m	5 5	GOST R 50648
3	Radiated radio-frequency electromagnetic fields resistance.	test field intensity: 10 V/m with energized circuits, 30 V/m with energized circuits,	3 4	GOST 30804.4.3
4	Impulse magnetic field resistance.	1000 A/m	5	GOST R 50649
5	Static electric discharge resistance.	contact discharge ± 8 kV, air discharge ± 15 kV	4	GOST 30804.4.3
Signal Ports (RS-485. Ethernet, RS-485/422. RS-232. SYNC, TS, TU²), Measuring Ports)				
6	Resistance to oscillatory damped interference	<i>Field (RS-485. SYNC, Ethernet¹, TC, TV²)</i> single-time 2 kV [P-Z], 1 kV [P-P] cyclic 1 kV [P-Z], 0.5 kV [P-P] <i>RS-485/422¹, RS-232¹)</i> single-time 2 kV, cyclic 1 kV <i>metering circuits from TT and TN</i> single-time 4 kV [P-Z], 2 kV [P-P] cyclic 2.5 kV [P-Z], 1 kV [P-P]	3 2 3.2 4 3	GOST R 51317.4.12

Table 22 (Continued)

№	Type of Tests	Test Parameters	Degree of Strictness	Regulatory Document
7	High-energy microsecond impulse interference resistance	<i>Field (RS-485, SYNC, RS, RC²⁾)</i> 2 kV [P-Z], 1 kV [P-P] <i>metering circuits from TT and TN</i> 4 kV [P-Z], 4 kV [P-P]	3 2 4 4	GOST R 51317.4.5
		<i>Ethernet¹⁾, RS-485/422¹⁾, RS-232¹⁾</i> 2 kV	3	
8	Nanosecond impulse interference resistance	<i>RS-485, SYNC, Ethernet, TS, TU²</i> <i>RS-485/422¹⁾, RS-232¹⁾</i> 4 kV <i>metering circuits from TT and TN</i> 4 kV	4 4	GOST 30804.4.4
9	Conductive interference resistance within 150 kHz to 80 MHz frequency band	10 V	3	GOST R 51317.4.6
DC Power Supply Ports				
10	Resistance to - voltage dips - voltage interruptions	30 % (1 s); 60 % (0.1 s) 100 % (0.5 s)		GOST R 51317.6.5
11	DC voltage ripple resistance	ripple not exceeding 10%.	3	GOST R 51317.4.17. GOST R 51317.6.5
12	Conductive interference resistance within 0 to 150 kHz frequency band	30 V (long-term); 100 V (1 s)	4	GOST R 51317.4.16. GOST R 51317.6.5
13	High-energy microsecond impulse interference resistance	2 kV [P-Z] 1 kV [P-P]	3 2	GOST R 51317.4.5
14	Nanosecond impulse interference resistance	4 kV	4	GOST 30804.4.4
15	Conductive interference resistance within 150 kHz to 80 MHz frequency band	10 V	3	GOST R 51317.4.6 GOST R 51317.6.5
16	Resistance to oscillatory damped interference	single-time 2 kV [P-P], 4 kV [P-Z] cyclic 2.5 kV [P-Z], 1 kV [P-P]	4 3	GOST R 51317.4.12 GOST R 51317.6.5
AC Power Supply Ports				
17	Voltage dips resistance	3 class electromagnetic situation 0% U _T (0.5 period), 0% U _T (1 period), 40% U _T (10 periods), 70% U _T (25 periods), 80% U _T (250 periods)	-	GOST 30804.4.11
18	Voltage interruptions resistance	3 class electromagnetic situation 0% U _T (250 periods)	-	
19	Dynamic power voltage variations resistance	3 class electromagnetic situation 70% U _T test voltage level; voltage drop - sharp; reduced voltage exposure time - 1 period; voltage increase time - 25 periods	3	
20	Resistance to harmonics and interharmonic in AC mains voltage	3 class electromagnetic situation up to 12 %	-	GOST 30804.4.13
21	Voltage interruptions resistance	± 20 %	3	GOST R 51317.4.14

22	AC mains power supply frequency change resistance	$\pm 15\%$ nominal frequency	4	GOST R 51317.4.28
23	Conductive interference resistance within 150 kHz to 80 MHz frequency band	10 V	3	GOST R 51317.4.6
24	Oscillatory damped interference resistance	single-time 4 kV [P-Z], 2 kV [P-P] cyclic 2.5 kV [P-Z], 1 kV [P-P]	4 3	GOST R 51317.4.12
25	Nanosecond impulse interference resistance	4 kV	4	GOST 30804.4.4
26	High-energy microsecond impulse interference resistance	4 kV [P-Z] 4 kV [P-P]	4 3	GOST R 51317.4.5
Interference Emission				
27	Equipment radio interference. Interference emission.	As per GOST for A class equipment		GOST 30805.22 GOST R 51318.11
¹⁾ – when using a screened cable or an external protection block. ²⁾ – understood as TU1 ° TUx output of TE3xRx relay block (depending on the version).				

ATTENTION!

THIS PRODUCT BELONGS TO A CLASS EQUIPMENT. WHEN USED IN HOUSEHOLD SETTING, THIS EQUIPMENT MAY INTERFERE WITH FUNCTIONING OF OTHER TECHNICAL FACILITIES AS A RESULT OF INDUSTRIAL RADIO INTERFERENCE CREATED BY IT. IN THIS CASE, USER MAY BE REQUIRED TO TAKE ADEQUATE MEASURES.

1.2.13 Reliability

The meter mean time between failures (T_0) under normal conditions is at least 150.000 h.

Average service time ($T_{av.ser.t}$) is thirty years.

The meter mean time to repair (T_r) performed by replacement from SPTA, including configuring, does not exceed 2 h.

1.3 BINOM3 Series Meters Arrangement and Scope of Delivery

BINOM3 series meters arrangement corresponds to TLAS.411152.002 set of design documentation. The meter includes:

- TP337A processor module TLAS.426469.014;
- TU337A measuring module TLAS.426444.027 in the respective version;
- RS/RC TS337A TLAS.426444.029 for meters with RS and/or RC functions;
- MS337A TLAS.426458.025 keypad module;
- software for all meter versions: 80508103.00052-01.

The meter scope of delivery is presented in Table 23.

Table 23 - Scope of Delivery

Name	Document Designation	Quantity
BINOM3 series multifunctional meter - electric energy quality characteristics multifunctional measurement device.	TU 4228-008-80508103-2014	1 pc.
Box	TLAS.735321.005	1 pc.
Screws BM5x20.36.019	GOST 1491-80	3 pc.
microSD card		1 pc.
TE3xRx relay block	TLAS.426458.026	1 pc.
Documentation		
Datasheet	TLAS.411152.002-01 PS	1 pc.
Operation Manual ¹⁾	TLAS.411152.002-01 RE	1 pc.
Verification procedure ²⁾	TLAS.411152.002 PM	1 pc.
BINOM3 Web server. Operator's manual	80508103.00053-01 34 01	1 pc.
¹⁾ - Depending on the number of RCs and type of relays for meter versions with the remote control option. ²⁾ – When a batch of meters is delivered, 1 copy of Operation Manual per 10 meters is included in the scope of delivery. ³⁾ – Sent upon request of organizations carrying out meters verification.		

The BINOM3 series meters scope of delivery may include additional accessories supplied on separate orders: TX06A communication module, a cabinet, a microclimate system, a charge battery with a fastening, charge battery microclimate system, RS-232/RS-485 transducer, a measuring terminal strip.

1.4 Meter Structure and Functioning

The structural diagram of a BINOM3 series meter as exemplified by a BINOM337 meter (including connector pins assignment) is presented in Figure 1.

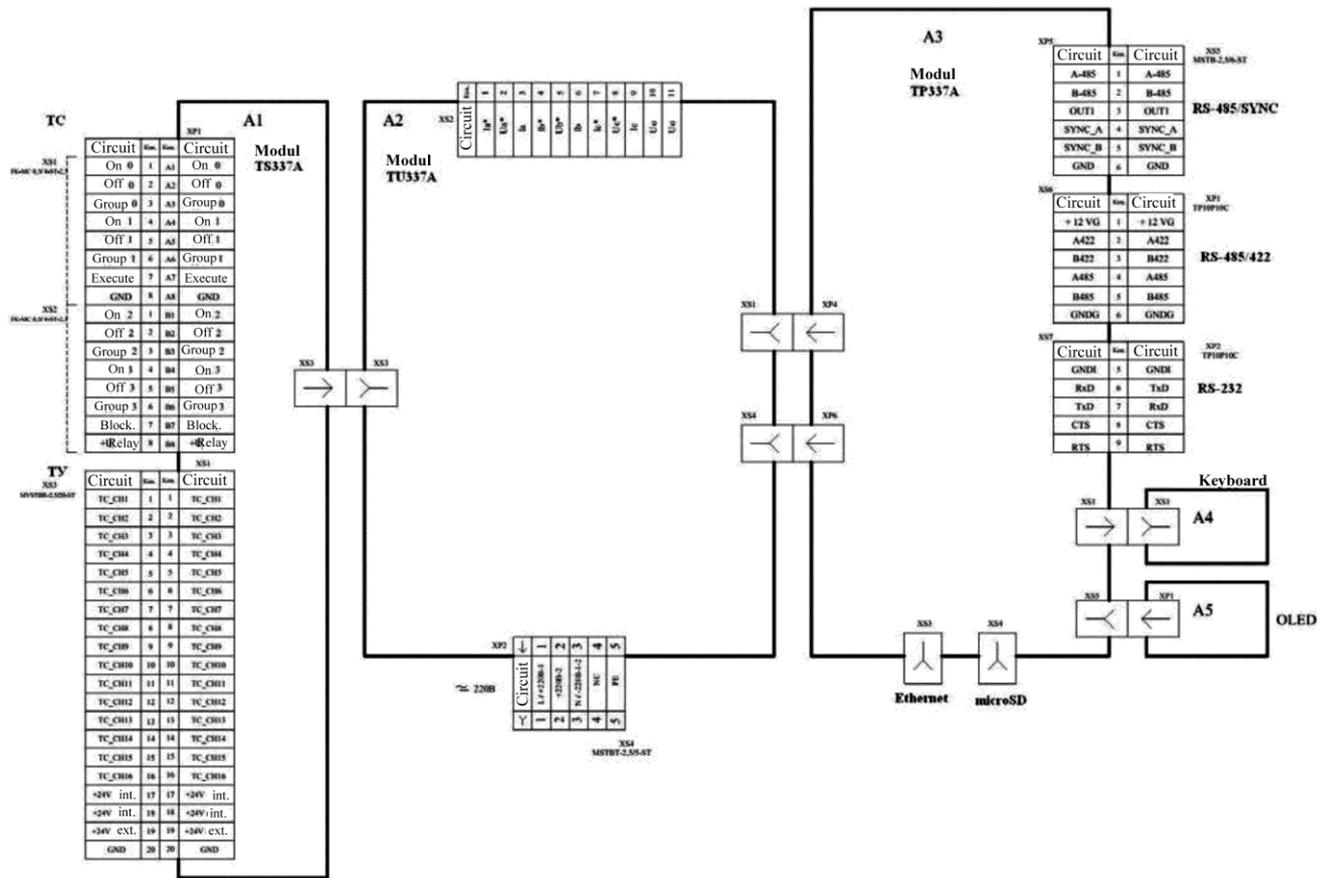


Figure 1 - Meter Diagram as Exemplified by BINOM337 Meter

The meter operation principle is based on measuring instantaneous values of current and voltage input signals by a six-channel analog-digital converter (ADC).

1.4.1 Measurements and Calculation in BINOM3 Series Meters

The meter is a digital device operating under the control of a built-in microcontroller. The meter measuring section is based on the principle of digital processing of input analog signals and measures 10 network periods average values of phase voltage, current, active and full power for each phase, as well as network frequency.

Signals from TU337A module current transformer and voltage dividers are fed to the respective ADC inputs; the ADC measures instantaneous values in parallel six channels, transforms them into a digital codes and transmits to the DSP processors via a serial link.

Calculations are performed on the ground of instantaneous voltage (U_k) and current (I_k) value selections.

1.4.1.1 Network Frequency Calculation

Commercial network frequency f is determined by the moments of instantaneous voltage values zero crossing.

Frequency determining channel is chosen by the maximum active voltage value in the working range.

1.4.1.2 Calculations of Active Current and Voltage Values

Root mean square values of currents and phase voltages are calculated by the following formulas:

$$I_A = \sqrt{\sum_{n=1}^{50} (|DFT(\{I_a\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{I_a\})_k|^2)} \quad , \quad (1)$$

$$I_B = \sqrt{\sum_{n=1}^{50} (|DFT(\{I_b\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{I_b\})_k|^2)} \quad , \quad (2)$$

$$I_C = \sqrt{\sum_{n=1}^{50} (|DFT(\{I_c\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{I_c\})_k|^2)} \quad . \quad (3)$$

$$U_A = \sqrt{\sum_{n=1}^{50} (|DFT(\{U_A\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{U_A\})_k|^2)} \quad , \quad (4)$$

$$U_B = \sqrt{\sum_{n=1}^{50} (|DFT(\{U_B\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{U_B\})_k|^2)} \quad , \quad (5)$$

$$U_C = \sqrt{\sum_{n=1}^{50} (|DFT(\{U_C\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{U_C\})_k|^2)} \quad . \quad (6)$$

where index n indicates a harmonic number, k, an interharmonic number.

Root mean square values of basic frequency currents and phase voltages are calculated by the following formulas:

$$I_{A(1)} = |DFT(\{I_A\})_1|, \quad I_{B(1)} = |DFT(\{I_B\})_1|, \quad I_{C(1)} = |DFT(\{I_C\})_1| \quad (7, 8, 9)$$

$$U_{A(1)} = |DFT(\{U_A\})_1|, \quad U_{B(1)} = |DFT(\{U_B\})_1|, \quad U_{C(1)} = |DFT(\{U_C\})_1| \quad (10, 11, 12)$$

Root mean square values of linear (interphase) voltages are calculated by the following formulas:

$$U_{AB} = \sqrt{\sum_{n=1}^{50} (|DFT(\{U_{AB}\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{U_{AB}\})_k|^2)} \quad , \quad (13)$$

$$U_{BC} = \sqrt{\sum_{n=1}^{50} (|DFT(\{U_{BC}\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{U_{BC}\})_k|^2)} \quad , \quad (14)$$

$$U_{CA} = \sqrt{\sum_{n=1}^{50} (|DFT(\{U_{CA}\})_n|^2) + \sum_{k=0}^{49} (|DFT(\{U_{CA}\})_k|^2)} \quad , \quad (15)$$

where

$$U_{AB} = U_A - U_B, \quad U_{BC} = U_B - U_C, \quad U_{CA} = U_C - U_A \quad (16, 17, 18)$$

Root mean square values of linear (interphase) basic frequency voltages are calculated by the following formulas:

$$U_{AB(1)} = |DFT(\{U_{AB}\})_1|, \quad U_{BC(1)} = |DFT(\{U_{BC}\})_1|, \quad U_{CA(1)} = |DFT(\{U_{CA}\})_1| \quad (19, 20, 21)$$

1.4.1.3 Calculations of Root Mean Square Current and Voltage Values

Calculations are performed by a BINOM334i meters microcontroller by formulas 22 - 24.

$$I_{cp} = \frac{1}{3} \cdot (I_A + I_B + I_C), \quad (22)$$

$$U\phi_{cp} = \frac{1}{3} \cdot (U_A + U_B + U_C), \quad (23)$$

$$U\lambda_{cp} = \frac{1}{3} \cdot (U_{AB} + U_{BC} + U_{CA}), \quad (24)$$

where I_A, I_B, I_C ; U_A, U_B, U_C ; U_{AB}, U_{BC}, U_{CA} are root mean square values of currents, phase and linear (inter-phase) voltages calculated by formulas (1-3), (4-6), (13-15) respectively.

1.4.1.4 Calculation of Currents and Voltages Symmetric Components

First harmonic vectors of phase currents $I_{A(1)}, I_{B(1)}, I_{C(1)}$ and voltages $\dot{U}_{A(1)}, \dot{U}_{B(1)}, \dot{U}_{C(1)}$ discrete Fourier transformation (DFT) are calculated. Active values of current and voltage symmetric components are calculated by the formulas:

$$I_1 = \frac{1}{3} \cdot |I_{A(1)} + I_{B(1)} \cdot e^{i \cdot 120^\circ} + I_{C(1)} \cdot e^{i \cdot 240^\circ}|, \quad (25)$$

$$I_2 = \frac{1}{3} \cdot |I_{C(1)} + I_{C(1)} \cdot e^{i \cdot 240^\circ} + I_{C(1)} \cdot e^{i \cdot 120^\circ}|, \quad (26)$$

$$I_0 = \frac{1}{3} \cdot |I_{A(1)} + I_{B(1)} + I_{C(1)}|, \quad (27)$$

$$U_1 = \frac{1}{3} \cdot |\dot{U}_{A(1)} + \dot{U}_{B(1)} \cdot e^{i \cdot 120^\circ} + \dot{U}_{C(1)} \cdot e^{i \cdot 240^\circ}|, \quad (28)$$

$$U_2 = \frac{1}{3} \cdot |\dot{U}_{A(1)} + \dot{U}_{B(1)} \cdot e^{i \cdot 240^\circ} + \dot{U}_{C(1)} \cdot e^{i \cdot 120^\circ}|, \quad (29)$$

$$U_0 = \frac{1}{3} \cdot |\dot{U}_{A(1)} + \dot{U}_{B(1)} + \dot{U}_{C(1)}|, \quad (30)$$

where i is an imaginary unit.

1.4.1.5 Phase Shift Angles Calculation

Phase shift angle between basic frequency phase voltages is calculated with the help of discrete Fourier transformation first harmonic vectors:

$$\varphi_{U_{AB}(1)} = \arg(\dot{U}_{A(1)}) - \arg(\dot{U}_{B(1)}), \quad (31)$$

$$\varphi_{U_{BC}(1)} = \arg(\dot{U}_{B(1)}) - \arg(\dot{U}_{C(1)}), \quad (32)$$

$$\varphi_{U_{CA}(1)} = \arg(\dot{U}_{C(1)}) - \arg(\dot{U}_{A(1)}). \quad (33)$$

Phase shift angle between basic frequency phase currents is calculated with the help of discrete Fourier transformation first harmonic vectors:

$$\varphi_{I_{AB}(1)} = \arg(\dot{I}_{A(1)}) - \arg(\dot{I}_{B(1)}), \quad (34)$$

$$\varphi_{I_{BC}(1)} = \arg(\dot{I}_{B(1)}) - \arg(\dot{I}_{C(1)}), \quad (35)$$

$$\varphi_{ICA(1)} = \arg(\mathbf{I}_{C(1)}) - \arg(\mathbf{I}_{A(1)}). \quad (36)$$

Phase shift angle of the nth phase current harmonic component and the nth phase voltage harmonic component is calculated with the help of discrete Fourier transformation nth harmonic vectors:

$$\varphi_{UIA(n)} = \arg(\mathbf{U}_{A(n)}) - \arg(\mathbf{I}_{A(n)}), \quad (37)$$

$$\varphi_{UIB(n)} = \arg(\mathbf{U}_{B(n)}) - \arg(\mathbf{I}_{B(n)}), \quad (38)$$

$$\varphi_{UIC(n)} = \arg(\mathbf{U}_{C(n)}) - \arg(\mathbf{I}_{C(n)}). \quad (39)$$

Phase shift angle between symmetric components of voltage and current of same name is calculated with the help of symmetric component vectors:

$$\varphi_{U1I1} = \arg(\mathbf{U1}) - \arg(\mathbf{I1}), \quad (40)$$

$$\varphi_{U2I2} = \arg(\mathbf{U2}) - \arg(\mathbf{I2}), \quad (41)$$

$$\varphi_{U0I0} = \arg(\mathbf{U0}) - \arg(\mathbf{I0}). \quad (42)$$

1.4.1.6 Power and Energy Calculations

Single-phase active $P_{X(n)}$ and reactive $Q_{X(n)}$ harmonics powers are calculated:

$$P_{X(n)} = U_{X(n)} \cdot I_{X(n)} \cdot \cos \varphi_n, \quad (43)$$

$$Q_{X(n)} = U_{X(n)} \cdot I_{X(n)} \cdot \sin \varphi_n \quad (44)$$

where φ_n is difference between n-harmonic component current and voltage phases.

Single-phase active P and reactive Q powers are, respectively, equal to:

$$P_X = \sum_{n=1}^{50} P_{X(n)}, \quad (45)$$

$$Q_X = \sum_{n=1}^{50} Q_{X(n)}. \quad (46)$$

Full single-phase S_X power and single-phase power factor PF_X are calculated by the following formulas:

$$S_X = \sqrt{P_X^2 + Q_X^2}, \quad (47)$$

$$\cos \varphi_X = \frac{P_X}{\sqrt{P_X^2 + Q_X^2}}, \quad (48)$$

where n is harmonic number (1-50);

X – hereinafter corresponds to phases A, B, C.

Three-phase power S is calculated by the formula:

$$P = P_A + P_B + P_C, \quad (49)$$

$$Q = Q_A + Q_B + Q_C, \quad (50)$$

$$S = S_A + S_B + S_C, \quad (51)$$

where $P_A, P_B, P_C, Q_A, Q_B, Q_C$ и S_A, S_B, S_C are calculated by formulas (45 -47).

Three-phase power factor $\cos \varphi$ is calculated by the following formula:

$$\cos \varphi = \frac{P}{S}. \tag{52}$$

Threshold power S_{thr} at which the meter starts metering energy is not more than $S_{thr} \leq 25 \cdot 10^{-4} \cdot 0.2 \cdot S_{nom}$, where $S_{nom} = 3 \cdot I_{nom} \cdot U_{nom}$ (kV·A).

Positive, negative and zero sequence active $P1, P2, P0$, reactive $Q1, Q2, Q0$ and full powers $S1, S2, S0$ are calculated by the following formulas

$$P1 = U1 \cdot I1 \cdot \cos \varphi_{U1I1(1)}, \tag{53}$$

$$Q1 = U1 \cdot I1 \cdot \sin \varphi_{U1I1(1)}, \tag{54}$$

$$S1 = \sqrt{P1^2 + Q1^2}, \tag{55}$$

$$P2 = U2 \cdot I2 \cdot \cos \varphi_{U2I2(1)}, \tag{56}$$

$$Q2 = U2 \cdot I2 \cdot \sin \varphi_{U2I2(1)}, \tag{57}$$

$$S2 = \sqrt{P2^2 + Q2^2}, \tag{58}$$

$$P0 = U0 \cdot I0 \cdot \cos \varphi_{U0I0(1)}, \tag{59}$$

$$Q0 = U0 \cdot I0 \cdot \sin \varphi_{U0I0(1)}, \tag{60}$$

$$S0 = \sqrt{P0^2 + Q0^2}. \tag{61}$$

Active energy and reactive energy are calculated by active and reactive power values determined for 10 network periods (~0.2 s). In the process of energy measurements, quadrant number is determined by power signs. The diagram of active and reactive energy distribution by quadrants is presented in Figure 2. (the diagram corresponds to GOST 31819.23-2012).

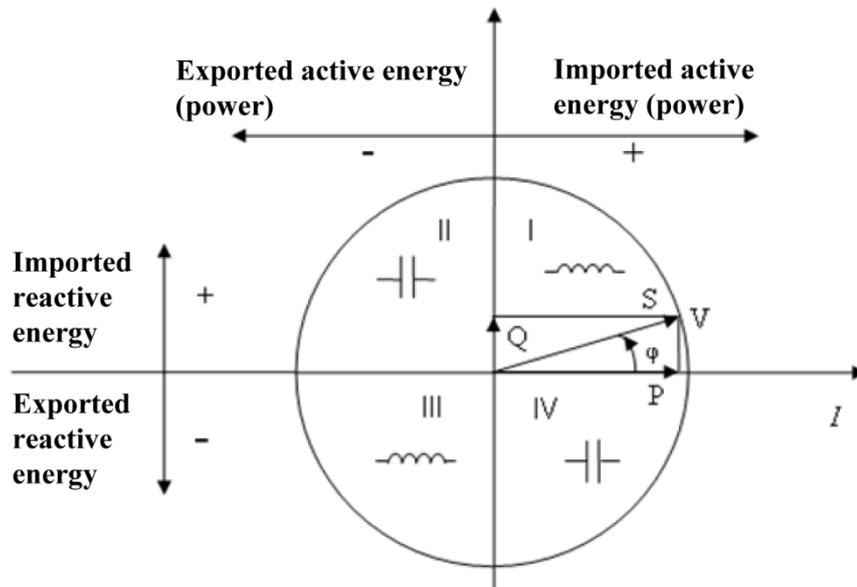


Figure 2 - Diagram of Active and Reactive Energy Distribution by Quadrants

1.4.1.7 Loss Metering

BINOM334i meters can meter line and transformer electric energy losses (load losses and semi-constant losses). There are two losses metering methods.

The algorithm of active losses calculation ($+ W_{la}$, $- W_{la}$) is presented in Figure 3. The algorithm of totaling and determining direction in the process of losses metering is presented in Figure 4. Reactive losses ($+ W_{lr}$, $- W_{lr}$) are calculated in a similar manner.

When currents (power) are below the meter sensitivity threshold, total power (P_n) measured by the meter will be equal to zero and the transformer no-load losses will be classified as positive metering direction.

Losses metering coefficient values are preliminarily calculated according to transformer and line equivalent circuits and with the utilization of transformer nameplate data and line parameters (specific resistance, length, laying conditions).

The sum of any phase active loss factors must be within the range from 0.1% to 25%.

The sum of any phase reactive loss factors must be within the range from 0.1% to 25% in absolute magnitude.

In case complete metering of losses (active and reactive line and transformer losses metering) is not carried out, the respective coefficients must be equal to zero.

E.g., it is necessary to meter only line losses - all transformer loss factors must be equal to zero.

Losses metering activation and the data needed for losses metering are entered into the meter in the respective page of the BINOM334i Web server built in the meter.

Loss factors shall be established separately for each phase, their values shall be entered in percentage form.

The following factors must be set for metering load losses (proportional to current square):

- KP_{line} - active line losses metering
- KQ_{line} - reactive line losses metering
- $KP_{transformer}$ - active transformer copper losses metering;
- $KQ_{transformer}$ - reactive transformer copper losses metering;

The following factors must be set for metering semi-constant losses (transformer iron losses proportional to square of voltage):

- $KPU_{transformer}$ - active transformer iron losses metering;
- $KQU_{transformer}$ - reactive transformer iron losses metering;

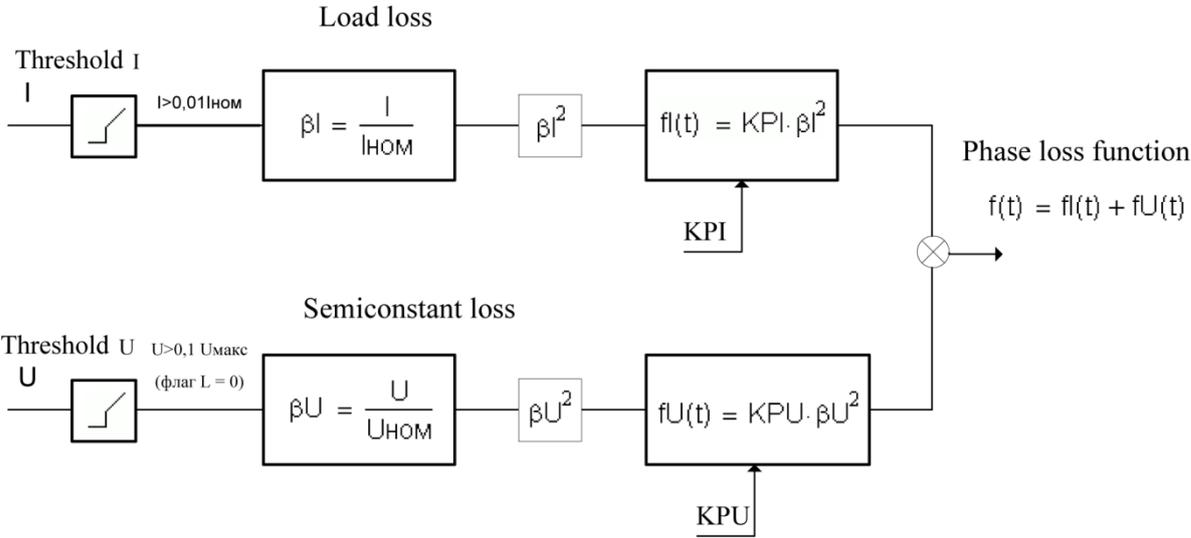


Figure 3 - Active Energy Losses. Phase Losses Calculation Algorithm

The following designations are used in the active energy phase losses calculation algorithm:

- I – active (root mean square) phase current value;
- I_{nom.} – meter nominal current value (1 A or 5 A);
- U - active (root mean square) value of:
 - phase voltage (four-wire connection diagram);
 - interphase voltage (three-wire connection diagram);
- U_{nom.} – meter nominal voltage value:
 - 57.735 V or 220 B (four-wire connection diagram);
 - 100 V (√3·57.735 B) or 381.051 B (√3·220 V) (three-wire connection diagram)
- KPI - load loss factor, KPI = KP_{line} + KP_{transformer};
- KPU - semi-constant loss factor, KPU = KPU_{transformer}.

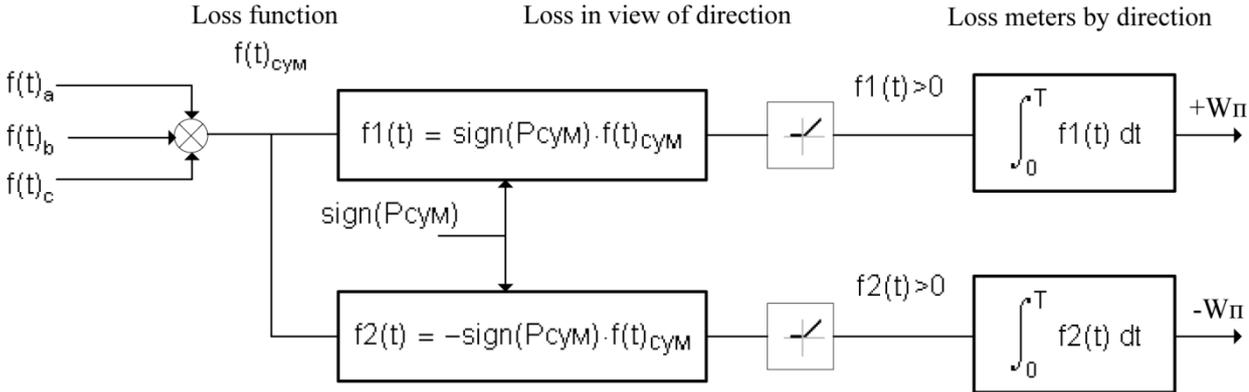


Figure 4 - Algorithm of Totaling and Determining Direction in the Process of Loss Metering

The following designation are used in the algorithm of totaling and determining direction in the process of loss metering:

- $f(t)$ phase loss functions;
- sign (P_{total}) - total metered power sign; + 1. - 1;
- + W1, - W1 - loss energy values for two directions.

1.4.2 Quality Indicator Calculations

Electric energy quality calculations and assessment of electric energy quality indicators conformity to standard values are carried out according to the guidelines of GOST 30804.4.30-2013. RD 153034.0-15.501-00. GOST 30804.4.7-2013. GOST P 51317.4.15-2012. GOST 32144-2013. GOST 33073-2014.

1.4.2.1 Measurement Results Processing during Energy Quality Indicators Calculation

Energy quality indicators measurement is carried out on the basis of current and voltage instantaneous values selection and root mean square values calculation. 10 base currency period were adopted as the base time interval in the process of energy quality indicators measurement, except accidental event parameters. For detection and assessment of accidental events, root mean square voltage values are calculated over a basic frequency semiperiod.

For obtaining electric energy quality indicator values during long time intervals, measurement results obtained during basic time intervals are *averaged (united)*. An averaged value is equal to square root of the arithmetic mean of input value squares. Electric energy quality indicators averaging intervals were set in the meter standard configuration settings as per Table 5. Averaging intervals may be changed by the user.

Statistical processing of electric energy quality indicators measurement results is carried out during the monitoring period equal to one (1) week as per GOST 32144-2013; this period may be changed by the user in the meter configuration settings. For statistical processing, all values of each electric energy quality indicator measured during the monitoring period are arranged by in ascending order on the number axis (from the smallest to the largest) and statistical characteristics are determined and compared with standard values:

- the largest value (the limit below which 100% of measured values are located),
- the upper value (the limit below which 95 % of measured values are located),
- relative time of normally permissible values range excess T_1 .
- relative time of measurement results' maximum permissible values range excess T_2 .

T_1 and T_2 are calculated by the following formulas:

$$T_1 = \frac{M_1}{M_\Sigma} \cdot 100\% \quad T_2 = \frac{M_2}{M_\Sigma} \cdot 100\% \quad (62, 63)$$

where M_1 is the number of measurement results exceeding the range of normally permissible
 M_2 is the number of measurement results exceeding the range of permissible limit values,
 M_Σ is the total number of measurement results obtained during the monitoring period.

Table 24 - Structure of Electric Energy Quality Indicator Characteristics

Type of stat. characteristics	Input Parameters for Statistical Processing									
	$\delta U_{(-)y}$	$\delta U_{(+)y}$	$K_{U(n)y}$	K_{Uy}	$K2_{Uy}$	$K0_{Uy}$	P_{st}	P_{lt}	$\Delta f_{(-)10}$	$\Delta f_{(+)10}$
The largest value	$\delta U_{(-)}$	$\delta U_{(+)}$	$K_{U(n)(100\%)}$	$K_{U(100\%)}$	$K2_{U(100\%)}$	$K0_{U(100\%)}$	P_{st}	P_{lt}	$\Delta f_{(-)(100\%)}$	$\Delta f_{(+)100\%)}$
The upper value	-	-	$K_{U(n)(95\%)}$	$K_{U(95\%)}$	$K2_{U(95\%)}$	$K0_{U(95\%)}$	-	-	$\Delta f_{(-)(95\%)}$	$\Delta f_{(+)95\%)}$
T_1	-	-	T_1	T_1	T_1	T_1	-	-	T_1	T_1
T_2	T_2	T_2	T_2	T_2	T_2	T_2	T_2	T_2	T_2	T_2

In the process of electric energy quality indicators, data (measurement results and averaged electric energy quality indicators over the time intervals during which voltage interruptions or dips and overvoltages occurred) are *marked* (designated). Marking is used in order to avoid recording the same event more than once for different indicators (i.e., recording a voltage dip as a voltage dip and a frequency deviation at the same time). Measurement results obtained over marked basic time intervals (10 periods) are excluded from calculations in all subsequent time intervals. While calculating T_1 и T_2 , marked values were excluded from parameters M_1 , M_2 и M_Σ .

The results of electric energy tests are recorded in a Electric Energy Test Report executed on the form recommended by GOST 33073-2014.

4.1.2.2 Frequency Deviation Calculation

Frequency deviation Δf_{10} is calculated over a 10 s measurement interval by the formula:

$$\Delta f_{10} = f_{10} - f_{nom}, \tag{64}$$

where f_{nom} is the nominal frequency value equal to 50 Hz.

f_{10} is frequency value over a 10 s interval:

$$f_{10} = \frac{\sum_{i=1}^N f_i}{N}, \tag{65}$$

where f_i is the frequency value measured over the i th basic time interval by zero crossing moments of instantaneous basic frequency voltage values;

i is the sequence number of the basic time interval within the averaging interval;

N is the number of basic time intervals in the averaging interval.

Negative frequency deviation $\Delta f_{(-)10}$ over a 10 s interval:

$$\Delta f_{(-)10} = f_{nom} - f_{under} \tag{66}$$

f_{under} is defined using the following rule:

$$\text{if } f_{10} > f_{nom}, \text{ TO } f_{under} = f_{nom}$$

$$\text{if } f_{10} \leq f_{nom}, \text{ TO } f_{under} = f_{10}$$

Positive frequency deviation $\Delta f_{(+)\mathbf{10}}$ over a 10 s interval:

$$\Delta f_{(+)\mathbf{10}} = f_{over} - f_{nom} \quad (67)$$

f_{over} is defined using the following rule:

$$\text{if } f_{\mathbf{10}} < f_{nom}, \text{ TO } f_{over} = f_{nom}$$

$$\text{if } f_{\mathbf{10}} \geq f_{nom}, \text{ TO } f_{over} = f_{\mathbf{10}}$$

4.1.2.3 Positive and Negative Voltage Deviation Calculation

Positive and negative voltage deviations are calculated on the basis of root mean square voltage values measured over basic time intervals during an averaging interval set in the meter configuration settings.

Negative voltage deviation over an averaging interval $\delta U_{(-)y}$:

$$\delta U_{(-)y} = \frac{U_{nom} - \sqrt{\frac{\sum_{i=1}^N U_{under,i}^2}{N}}}{U_{nom}} \cdot 100\% \quad , \quad (68)$$

where $\delta U_{(-)y}$ is negative deviation of phase $\delta U_{A(-)y}$, $\delta U_{B(-)y}$, $\delta U_{C(-)y}$ and line voltage $\delta U_{AB(-)y}$, $\delta U_{BC(-)y}$, $\delta U_{CA(-)y}$ over an averaging interval;

U_{nom} is voltage equal to standard nominal or approved value (set in the meter configuration settings);

$U_{under,i}$ is defined using the following rule:

$$\text{if } U_i > U_{nom}, \text{ TO } U_{under,i} = U_{nom}, \quad (69)$$

$$\text{if } U_i \leq U_{nom}, \text{ TO } U_{under,i} = U_i, \quad (70)$$

U_i is root mean square value of the respective voltage measured over the i th basic time interval (U_{Ai} , U_{Bi} , U_{Ci} , U_{ABi} , U_{BCi} , U_{CAi}) according to (); root mean square voltage value includes harmonics and interharmonics;

N is the number of basic time intervals in the averaging interval.

Positive voltage deviation over an averaging interval $\delta U_{(+)y}$:

$$\delta U_{(+)y} = \frac{\sqrt{\frac{\sum_{i=1}^N U_{over,i}^2}{N}} - U_{nom}}{U_{nom}} \cdot 100\% \quad (71)$$

where $\delta U_{(+)y}$ is positive deviation of phase $\delta U_{A(+)y}$, $\delta U_{B(+)y}$, $\delta U_{C(+)y}$ and line voltage $\delta U_{AB(+)y}$, $\delta U_{BC(+)y}$, $\delta U_{CA(+)y}$ over an averaging interval;

$U_{over,i}$ is defined using the following rule:

$$\text{if } U_i < U_{nom}, \text{ TO } U_{over,i} = U_{nom}, \quad (72)$$

$$\text{if } U_i \geq U_{nom}, \text{ TO } U_{over,i} = U_i, \quad (73)$$

U_i is root mean square value of the respective voltage measured over the i th basic time interval (U_{Ai} , U_{Bi} , U_{Ci} , U_{ABi} , U_{BCi} , U_{CAi}) according to (); root mean square voltage value includes harmonics and interharmonics;

N is the number of basic time intervals in the averaging interval.

4.1.2.4 Steady-State Voltage Deviation Calculation

Steady-state voltage deviation over an averaging interval δU_y is calculating by the following formula:

$$\delta U_y = \frac{U_{1y}}{U_{nom}} \cdot 100\% \quad (74)$$

where U_{1y} is root mean square value of positive sequence basic frequency voltage over an averaging interval:

$$U_{1y} = \sqrt{\frac{\sum_{i=1}^N U_{1i}^2}{N}} \quad (75)$$

where U_{1i} is root mean square value of positive sequence basic frequency voltage measured over the i th basic time interval.

N is the number of basic time intervals in the averaging interval.

GOST 32144-2013 does not stipulate the need for calculating steady-state voltage deviation. Statistical analysis of conformity to norms is not performed.

4.1.2.5 Calculation of Harmonic and Interharmonic Current and Voltage Components and their Coefficients.

Calculation of harmonic and interharmonic current and voltage components is implemented on the basis of discrete Fourier transformation. Output components of discrete Fourier transformation at frequencies taken in 5 Hz increments are grouped (Figure 5) and root mean square values of harmonic and interharmonic current and voltage subgroups are calculated over basic time intervals.

Harmonic subgroups over the i th basic time interval are calculated by the following formula:

$$Y_{sg(n)i} = \sqrt{\sum_{k=-1}^{k=1} Y_{Ci,(10 \cdot n)+k}^2} \quad (76)$$

Interharmonic centered subgroups over the i th basic time interval are calculated by the following formula:

$$Y_{isg(n)i} = \sqrt{\sum_{k=2}^{k-2} Y_{Ci,(10 \cdot n)+k}^2} \quad (77)$$

where $Y_{sg(n)i}$ is root mean square value of a harmonic subgroup linked to the n order of magnitude harmonic (root mean square value of the n order of magnitude harmonic component) over the i th ba-

sic time interval: square root from the sum of squares of root mean square harmonic component values and two spectral components immediately adjacent to it; calculated for phase current $I_{A(n)}$, $I_{B(n)}$, $I_{C(n)}$, phase voltage $U_{A(n)}$, $U_{B(n)}$, $U_{C(n)}$, interphase voltage $U_{AB(n)}$, $U_{BC(n)}$, $U_{CA(n)}$;

$Y_{isg(n)i}$ is root mean square value of a centered interharmonic subgroup situated above the n order of magnitude harmonic (root mean square value of the n order of magnitude harmonic component) over the i th basic time interval; calculated for phase current $I_{isgA(n)}$, $I_{isgB(n)}$, $I_{isgC(n)}$, phase voltage $U_{isgA(n)}$, $U_{isgB(n)}$, $U_{isgC(n)}$, interphase voltage $U_{isgAB(n)}$, $U_{isgBC(n)}$, $U_{isgCA(n)}$;

$Y_{Ci,(10 \cdot n)+k}$ is root mean square value of $(10 \cdot n) + k$ order of magnitude spectral component over the i th basic time interval;

n is the sequence number of the harmonic component (for harmonic parameters $n = 1 \dots 50$. for interharmonic parameters $n = 0 \dots 49$);

k is the sequence number of the spectral component in the subgroup;

K is the number of power supply system basic frequency corresponding to the length of measurement time interval;

10 is the number of basic frequency periods over the i th basic time interval (10 periods).

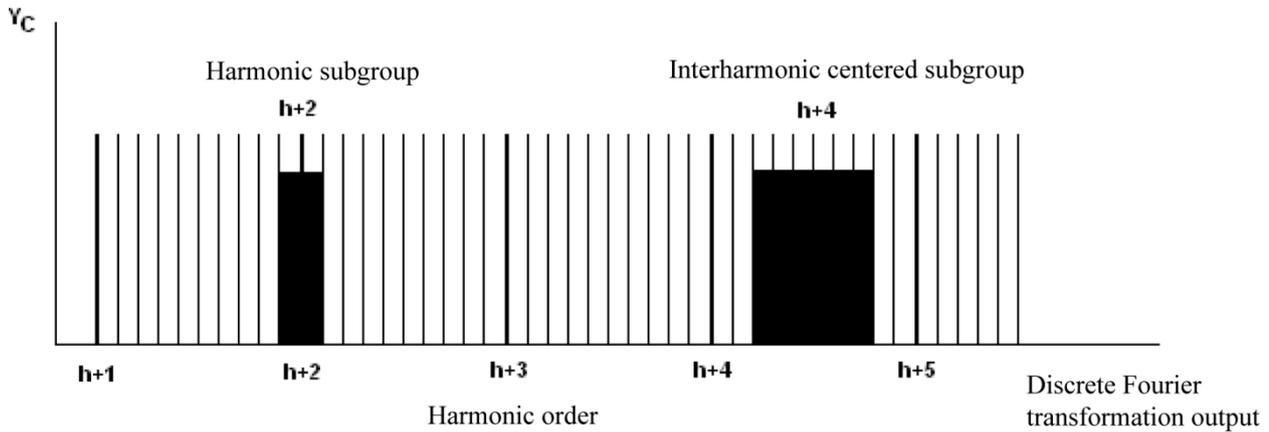


Figure 5 - Diagram of Harmonic Subgroups and Interharmonic Centered Subgroups Formation

n order of magnitude harmonic component coefficient and total harmonic component coefficient (total harmonic distortion) over the i th basic time interval (not present in the meter factory configuration)

$$K_{Y_{sg(n)i}} = \frac{Y_{sg(n)i}}{Y_{sg(1)i}} \cdot 100\% \quad , \quad K_{Y_{sg i}} = \sqrt{\sum_{n=2}^{50} \left(\frac{Y_{sg(n)i}}{Y_{sg(1)i}} \right)^2} \cdot 100\% \quad (78, 79)$$

where $Y_{sg(1)i}$ is root mean square of the basic frequency (first order of magnitude) harmonic component over the i th basic time interval; the root mean square value of the harmonic subgroup linked to the basic frequency component is used.

n order of magnitude harmonic component coefficient and total harmonic component coefficient (total harmonic distortion) over the averaging interval:

$$K_{Y_{sg}(n)y} = \sqrt{\frac{\sum_{i=1}^N K_{Y_{sg}(n)i}^2}{N}}, \quad K_{Y_{sg}y} = \sqrt{\frac{\sum_{i=1}^N K_{Y_{sg}i}^2}{N}} \quad (80, 81)$$

where N is the number of basic time intervals in the averaging interval.

n order of magnitude interharmonic component coefficient over the i th basic time interval (not present in the meter factory configuration):

$$K_{Y_{isg}(n)i} = \frac{Y_{isg}(n)i}{Y_{sg}(1)i} \cdot 100\% \quad (82)$$

n order of magnitude interharmonic component coefficient over the averaging interval:

$$K_{Y_{isg}(n)y} = \sqrt{\frac{\sum_{i=1}^N K_{Y_{isg}(n)i}^2}{N}} \quad (83)$$

N is the number of basic time intervals in the averaging interval.

The calculation of harmonic and interharmonic current and voltage components parameters in standard meter configuration settings is implemented in the scope of Table 22.

Table 25 - Parameters of Current and Voltage Harmonic and Interharmonic Components

Parameter	$Y_{sg}(n)i$	$Y_{isg}(n)i$	$K_{Y_{sg}(n)y}$	$K_{Y_{isg}(n)y}$	$K_{Y_{sg}i}$	$K_{Y_{sg}y}$
I_A	$I_{A(n)}$	$I_{isgA(n)}$	$K_{IA(n)y}$	$K_{IisgA(n)y}$	K_{IA}	K_{IAy}
I_B	$I_{B(n)}$	$I_{isgB(n)}$	$K_{IB(n)y}$	$K_{IisgB(n)y}$	K_{IB}	K_{IBy}
I_C	$I_{C(n)}$	$I_{isgC(n)}$	$K_{IC(n)y}$	$K_{IisgC(n)y}$	K_{IC}	K_{ICy}
U_A	$U_{A(n)}$	$U_{isgA(n)}$	$K_{UA(n)y}$	$K_{UisgA(n)y}$	K_{UA}	K_{UAY}
U_B	$U_{B(n)}$	$U_{isgB(n)}$	$K_{UB(n)y}$	$K_{UisgB(n)y}$	K_{UB}	K_{UBy}
U_C	$U_{C(n)}$	$U_{isgC(n)}$	$K_{UC(n)y}$	$K_{UisgC(n)y}$	K_{UC}	K_{UCy}
U_{AB}	$U_{AB(n)}$	$U_{isgAB(n)}$	$K_{UAB(n)y}$	$K_{UisgAB(n)y}$	K_{UAB}	K_{UABy}
U_{BC}	$U_{BC(n)}$	$U_{isgBC(n)}$	$K_{UBC(n)y}$	$K_{UisgBC(n)y}$	K_{UBC}	K_{UBCy}
U_{CA}	$U_{CA(n)}$	$U_{isgCA(n)}$	$K_{UCA(n)y}$	$K_{UisgCA(n)y}$	K_{UCA}	K_{UCAy}

4.1.2.6 Short-Term and Long-Term Flicker Dose Calculation

Short-term flicker indicator P_{st} is calculated according to the GOST R 51317.4.15-2012 over a 10 min. time interval

Long-term flicker indicator P_{lt} is calculated by the following formula:

$$P_{lt} = \sqrt[3]{\frac{\sum_{i=1}^N P_{sti}^3}{N}} \quad (84)$$

where P_{sti} is short-term flicker indicator over the i th measurement interval (10 min).

N is the number of subsequent short-term flicker indicator measurement intervals ($N=12$ over a 2 h averaging interval).

1.4.2.7 Voltage Dips and Interruptions

Root mean square voltage value over a basic frequency semiperiod U_{rms} is measured for all meter phases.

The starting moment of a dip $t_{s\ dip}$ is recorded by U_{rms} reduction below $0.9 \cdot U_{nom}$ level. The final moment of a dip $t_{f\ dip}$ is recorded by U_{rms} restoration to $0.9 \cdot U_{nom} + 2\%U_{nom}$. The dip length and depth δU_{dip} is calculated:

$$\Delta t_{пров} = t_{к\ пр} - t_{н\ пр}, \quad (85)$$

$$\delta U_{пров} = \frac{U_{ном} - U_{с\кв\ min}}{U_{ном}} \cdot 100\%, \quad (86)$$

where $U_{rms\ min}$ is the minimum root mean square value U_{rms} measured over the interval limited by $t_{s\ dip}$ and $t_{f\ dip}$.

Dips detected since the meter activation moment are counted. Voltage dips are recorded in the event log.

In case U_{rms} voltage reduction duration is less than 60 s, the voltage is considered as a steady-state one. When voltage is restored to its normally permissible value, an additional event is formed in the log, recording restoration time without changing the dip number.

In a similar manner, when U_{rms} drops below $0.05 \cdot U_{nom}$, a voltage interruption is recorded.

1.4.2.8 Overvoltages

U_{rms} values are used for determining the duration of overvoltages. The starting moment of an overvoltage $t_{s\ ov}$ is recorded by U_{rms} excess of $1.1 \cdot U_{nom}$ level. The final moment of an overvoltage $t_{f\ ov}$ is recorded by U_{rms} drop to $1.1 \cdot U_{nom} - 2\%U_{nom}$.

$$\Delta t_{пер} = t_{к\ пер} - t_{н\ пер}. \quad (87)$$

An overvoltage is recorded in the event log. Detected overvoltages are counted since the moment of the meter activation.

In case U_{rms} voltage rise duration is more than 60 s, the voltage is considered as a steady-state one. When voltage is restored to its normally permissible value, an additional event is formed in the log, recording restoration time without changing the overvoltage number.

Overvoltage coefficient K_{ov} is calculated by the formula:

$$K_{пер} = \frac{U_{с\кв\ max}}{U_{ном}}, \quad (88)$$

where $U_{rms\ max}$ is the maximum root mean square value U_{rms} measured over the interval limited by $t_{s\ ov}$ and $t_{f\ ov}$.

1.4.3 Data Transmission over Communication Channels

The meter supports data exchange over the following communication channels:

- Ethernet;
- RS-485 interface;
- RS-485 interface;
- RS-232 interface;
- Optical communication interface.

When data are transmitted over Ethernet and PPP, TCP/IP protocol with a transport level interface is used as a transport protocol (between the user and TCP) as per GOST R IEC 60870-5-104-2004.

Data transmission over the radio channel is effected with the help of an external modem connected to the meter via RS-232 interface.

When data are transmitted over RS-485 and RS-232 interfaces, protocol is used as per GOST R IEC 60870-5-101-2006.

Energy metering data transmission frame formats are described in the documents "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1». Some energy metering data (current values) included into the database may be transmitted over communication channels in the same manner as the measured grid parameters as described in the document "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1».

Log data transmission frame formats are described in the document "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1».

In order to make it possible for the meter to interact with data collection devices operating as per GOST R IEC 60870-5-101-2006 and GOST R IEC 60870-5-104-2004. the document "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1" presents telemechanic system compatibility protocols.

Data exchange between the meters and a computer via an optical communication interface is ensured by a TX06A communication module (TLAS.426419.005) serving as an optical port - USB adapter. From the computer side, TX06A is equipped with a USB connector. When it is connected, a virtual COM port is created in the system and it becomes possible to scan, program and configure meters. The TX06A module casing has a built-in magnet that fastens it to the meter and orients it unequivocally in relation to the transceiving LEDs. Structurally, the optical port conforms to GOST IEC 61107-2011. Data exchange speed via optical interface is up to 115200 bod, computer USB port power supply - not more than 30 mA, cable length not more than 1.8 m.

1.4.3.1 BINOM3 Series Meters Database

Parameter values included into the meter database (DB) and specified in output channels in the process of parameterization may be transmitted over communication channels in standard formats (requests). The base contains current changes, as well as service data about the state of modules, meter subassemblies, its operation modes and the quality of information exchange via communication channels. The meter database description can be found in the document "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1».

Parameter values presentation and scaling in the process of their transmission via communication channel and initial parameterization are described in the document "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1». Additional information about forming the list of parameters sent via BINOM3 meter interfaces are set forth in the Chapter "BINOM3 Series Meters Web Server Operator Manual".

1.4.3.2 Time Count and BINOM3 Meter Synchronization

The maximum basic absolute error of BINOM3 meter internal clock rate without synchronization under primary or backup power supply (the meter is on) does not exceed ± 0.5 s per day. The maximum absolute error of the internal clock rate without synchronization and without power supply does not exceed ± 1.5 s per day. The duration of the clock operation depends on the built-in clock power source.

BINOM3 meter is synchronized:

- from TM3com control center telemechanic devices over data exchange channels in compliance with exchange protocols as per GOST R IEC 60870-5-101 or GOST R IEC 60870-5-104 supplemented by exact synchronization user frame. Subject to the transmission of supplementary exact synchronization user frame and using the impulse synchronization signal, the permissible absolute time error signal upon receipt of the timing mark does not exceed 5 μ s;
- from GLONASS/GPS global positioning systems signal receivers over data exchange channels in compliance with NMEA 0183 exchange protocol and a separate PPS impulse synchronization signal. Subject to receipt of the timing mark, the permissible absolute time setting error does not exceed 5 μ s;
- from automated informative electric power metering systems and/or electric power resources dispatching systems (telemetric devices) over data exchange channel in compliance with exchange protocols as per GOST R IEC 60870-5-101 or GOST R IEC 60870-5-104. Subject to receipt of the timing mark, the permissible absolute time setting error does not exceed 5 μ s.

1.4.4 Controlling the Type of Information Displayed on the Screen

The parameter that is to be displayed on the screen is chosen from a menu with the help of keypad buttons. The menu has a tree-like structure. Its appearance is shown in Figure 7. The external appearance of the keypad is shown in Figure 6.



Figure 5 - External Appearance of the Keypad

1.4.4.1 Meter Liquid Crystal Display Operation Mode

The meter liquid crystal display (hereinafter, the LCD) operates in the following data display modes:

- Startup screen mode;
- Background displaying mode;
- Menu displaying mode;
- Parameters displaying mode.

1.4.4.1.1 After power supply voltage is applied to the meter, the meter LCD displays a startup screen including the meter software name, the software designer name and the loaded software version number. Upon expiry of ~ 60 s, the meter switches to a background display mode.

1.4.4.1.2 Background Displaying Mode

The meter changes to this mode after power supply is switched on upon expiry of startup screen displaying. The meter switches back to this mode from the menu displaying mode after pushing the ← button. In the background displaying mode, the LCD cyclically displays a set of parameters set at the respective page of the Web server built in the meter.

Navigation in Background Displaying Mode.

- ▶ - contrast enhancement,
- ▶ - contrast decay,
- ▲, ▼ – switch over to the menu displaying mode.

1.4.4.1.3 Menu displaying mode;

The meter switches to this mode from the background displaying mode after pushing the ▲, ▼ button or from the parameters displaying mode after pushing the button ←.

Menu Items List:

- Current Phase A Parameters
- Current Phase B Parameters
- Current Phase C Parameters
- Current Connection Parameters
- Quality Indicators
- A/B/C Phases Harmonic Components
- Meter Readings
- Discrete Inputs *
- Remote Control *
- Load Commercial Profile
- Load Technical Profile
- Energy since Reset
- Monthly Energy
- Daily Energy

- Impulse Output
- Power Supply System State
- Meter Off
- System Parameters
- Temporal Characteristics Monitoring

* - for versions with RS and RC options.

Navigations in Menu Displaying Mode.

▼ – proceed to the next menu item,

▲ – proceed to the previous menu item,

Enter – switch to the selected menu item parameters displaying mode.

1.4.4.1.4 Parameters displaying mode.

The meter switches to the selected parameters group displaying mode from the menu displaying mode after pushing the **Enter** button.

Standard navigation in this mode, unless specified otherwise:

▼ – proceed to displaying the next parameter

▲ – proceed to displaying the previous parameter

Esc – exit to the menu displaying mode.

1.4.4.1.4.1 Displaying Current A/B/C Phase Parameters

The following set of parameters is displayed on the LCD:

- Active phase power
- Reactive phase power
- Full phase power
- Phase power factor
- Phase current
- Phase voltage
- Interphase voltage
- Basic frequency interphase voltage
- Angle between basic frequency phase voltages
- Angle between basic frequency phase currents
- Active basic frequency power;
- Reactive basic frequency power;
- Full basic frequency power;

Navigation (supplementary to standard):

▶ – proceed to displaying the same next phase parameter

▶ – proceed to displaying the same previous phase parameter

1.4.4.1.4.2 Displaying Current A/B/C Phase Connection Parameters

The following set of parameters is displayed on the LCD:

- Active connection power
- Reactive connection power
- Full connection power
- Connection power factor
- Frequency
- Average phase current
- Average phase voltage
- Average interphase voltage
- Positive sequence voltage
- Negative sequence voltage
- Zero sequence voltage
- Positive sequence current
- Negative sequence current
- Zero sequence current
- Current unbalance factor by negative sequence
- Current unbalance factor by zero sequence
- Phase shift angle between positive sequence voltage and current
- Phase shift angle between negative sequence voltage and current
- Phase shift angle between zero sequence voltage and current
- Basic frequency positive sequence active power
- Basic frequency negative sequence active power
- Basic frequency zero sequence active power
- Basic frequency positive sequence reactive power
- Basic frequency negative sequence reactive power
- Basic frequency zero sequence reactive power
- Basic frequency positive sequence full power
- Basic frequency negative sequence full power
- Basic frequency zero sequence full power

1.4.4.1.4.3 Quality Indicators Displaying

The following set of parameters is displayed on the LCD:

- Frequency
- Frequency deviation
- Positive sequence voltage
- Steady-state voltage deviation
- Root mean square negative sequence voltage value
- Voltage unbalance factor by negative sequence
- Root mean square zero sequence voltage value

- Voltage unbalance factor by zero sequence
- Total coefficient of A phase voltage harmonic component
- Total coefficient of B phase voltage harmonic component
- Total coefficient of C phase voltage harmonic component
- Total coefficient of A phase current harmonic component
- Total coefficient of B phase current harmonic component
- Total coefficient of C phase current harmonic component
- Voltage dips meter
- Voltage depression length
- Voltage depression depth
- Voltage interruptions meter
- Voltage interruption length
- Voltage interruption depth
- Temporary overvoltages meter
- Temporary overvoltage length
- Temporary overvoltage factor

1.4.4.1.4.4 Displaying Current and Voltage Harmonic components

When switched to the harmonic components displaying mode, the meter displays the parameter groups menu section. Navigation in this section:

- ▼, ▲ – phase selection (A/B/C)
- ▶, ◀ – parameter group selection:
 - A(B,C) voltage harmonics
 - A(B,C) voltage interharmonic
 - A(B,C) voltage harmonic factors
 - A(B,C) voltage interharmonic factors
 - A(B,C) current harmonics
 - A(B,C) current interharmonic
 - A(B,C) current harmonic factors
 - A(B,C) current interharmonic factors

Enter – proceed to the selected parameter group displaying section

In the selected parameter group displaying section, the LCD displays the values of parameters from this group from the 1st harmonic to the 50th, from the 0th interharmonic to the 49th. Navigation in this section:

- ▼, ▲ – harmonic selection
- ▶, ◀ - proceed to displaying the same phase parameter from another group
- Enter** – proceed to the parameter group selection menu

1.4.4.1.4.5 Meter Readings Display

The energy recorded by the meter is displayed on the LCD in total and by tariffs:

- Consumed active energy
- Restored active energy
- Inductive reactive energy
- Capacitive reactive energy
- Consumed active energy loss ;
- Restored active energy loss
- Inductive reactive energy loss
- Capacitive reactive energy loss
- Consumed basic frequency active energy;
- Restored basic frequency active energy;
- Inductive basic frequency reactive energy
- Capacitive basic frequency reactive energy
- Consumed positive sequence active energy;
- Restored positive sequence active energy;
- Inductive positive sequence reactive energy
- Capacitive sequence reactive energy

Navigation in this section:

- ▼, ▲ – energy meter selection
- ▶, ◀ - tariff selection: total, tariff 1. tariff 2. tariff 3. tariff 4. non-tariff

1.4.4.1.4.6 Commercial/Technical Load Profile Displaying

Navigation in this mode:

- ▶ – proceed to the next electric energy metering channel
- ▶ – proceed to the previous electric energy metering channel
- ▼ – proceed to the next profile point in time
- ▼ – proceed to the previous profile point in time

1.4.4.1.4.7 Energy Archive Data Displaying

When switched into the archive data displaying mode, the meter enters the data type selection section. Navigation in this section:

- ▼, ▲ – data type selection: since reset, for a month, for a day
- ▶, ◀ - tariff selection: total, tariff 1. tariff 2. tariff 3. tariff 4. non-tariff

Enter – proceed to the data displaying section

Navigation in the data displaying section:

- ▶ – proceed to the next electric energy metering channel
- ▶ – proceed to the previous electric energy metering channel

▼ – proceed to the next profile point in time: for data for a month - to the next month, for data for a day and since reset - to the next day

▼ – proceed to the previous profile point in time: for data for a month - to the previous month, for data for a day and since reset - to the previous day

Enter – proceed to the data displaying section

1.4.4.1.4.8 Discrete Input Values Displaying

Navigation in this section:

►, ◀ – RS group selection: RS1÷RS8. RS9÷RS16

1.4.4.1.4.9 Remote Control

Navigation in this section:

▼, ▲ – RC selection: RC1÷RC4

▼, ▲ – RC command selection: "Off", "On"

Enter – remote control command launch

1.4.4.1.4.10 Impulse Input Control

The meter impulse input can operate in one of the following modes:

- Wa – the number of impulses is proportional to active energy
- Wr – the number of impulses is proportional to reactive energy
- Wa(loss) – number of impulses is proportional to active energy loss
- Wr(loss) – number of impulses is proportional to reactive energy loss
- Wa bas. fr. - the number of impulses is proportional to basic frequency active energy
- Wr bas. fr. - the number of impulses is proportional to basic frequency reactive energy
- Wa pos. seq. - the number of impulses is proportional to positive sequence active energy
- Wa neg. seq. - the number of impulses is proportional to negative sequence active energy
- P - impulse repetition rate is proportional to active power
- Q - impulse repetition rate is proportional to reactive power
- P (loss) – impulse repetition rate is proportional to active power loss
- Q (loss) – impulse repetition rate is proportional to reactive power loss
- P bas. fr.- impulse repetition rate is proportional to active basic frequency power
- Q bas. fr.- impulse repetition rate is proportional to reactive basic frequency power
- P pos. seq.- impulse repetition rate is proportional to active positive sequence power
- P pos. seq.- impulse repetition rate is proportional to reactive positive sequence power
- 1500 Hz - test mode, a 1500 Hz signal is formed
- Off

Navigation in this mode:

▼, ▲ – mode selection

Enter - mode selection confirmation

1.4.4.1.4.11 System Parameters Displaying

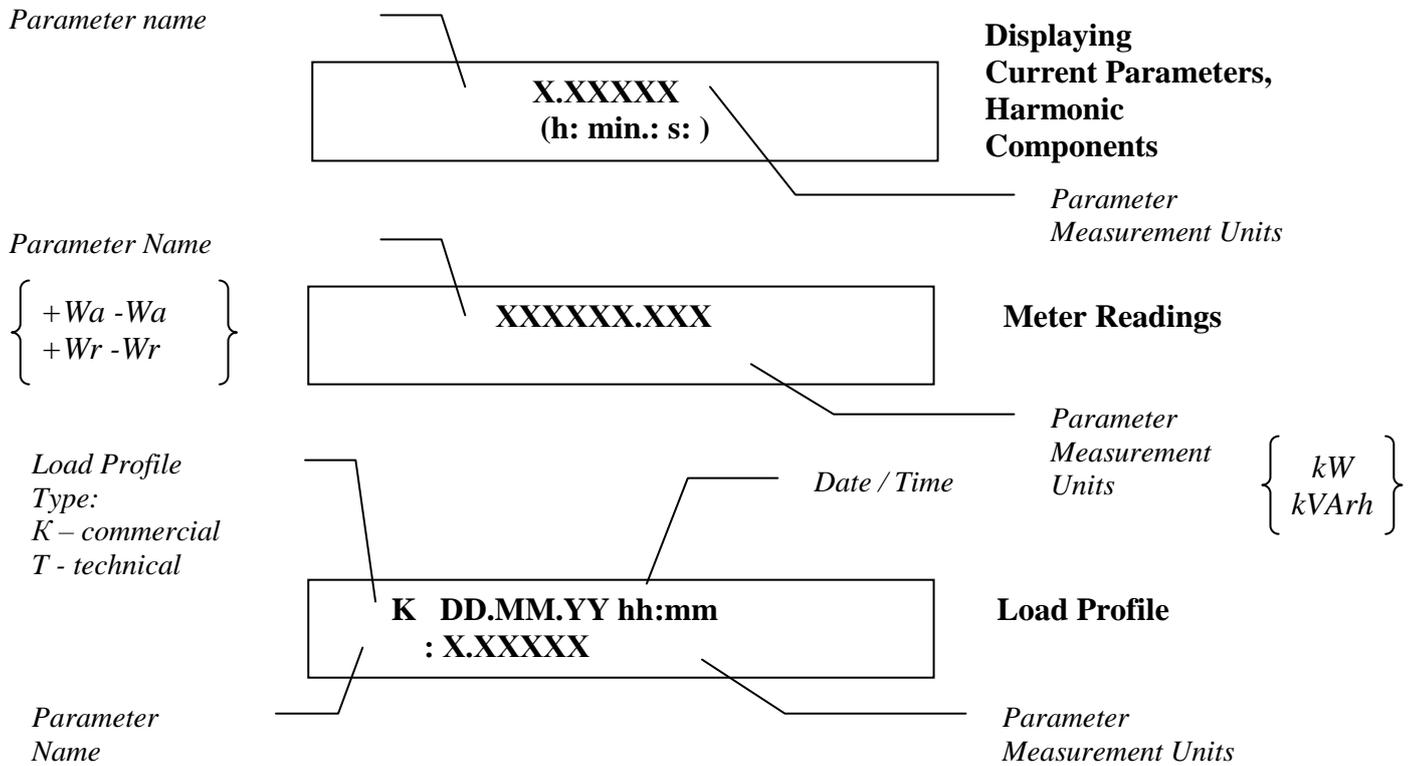
The following parameters are displayed:

- Software version, CRC (software checksum);
- Number of restarts
- Current date and time
- Temperature
- Network

1.4.4.1.4.12 Temporal Characteristics Monitoring

Used during the meter RSI in order to implement the guideline for determining current time metering errors and to receive the timing mark.

Data Displaying Examples:



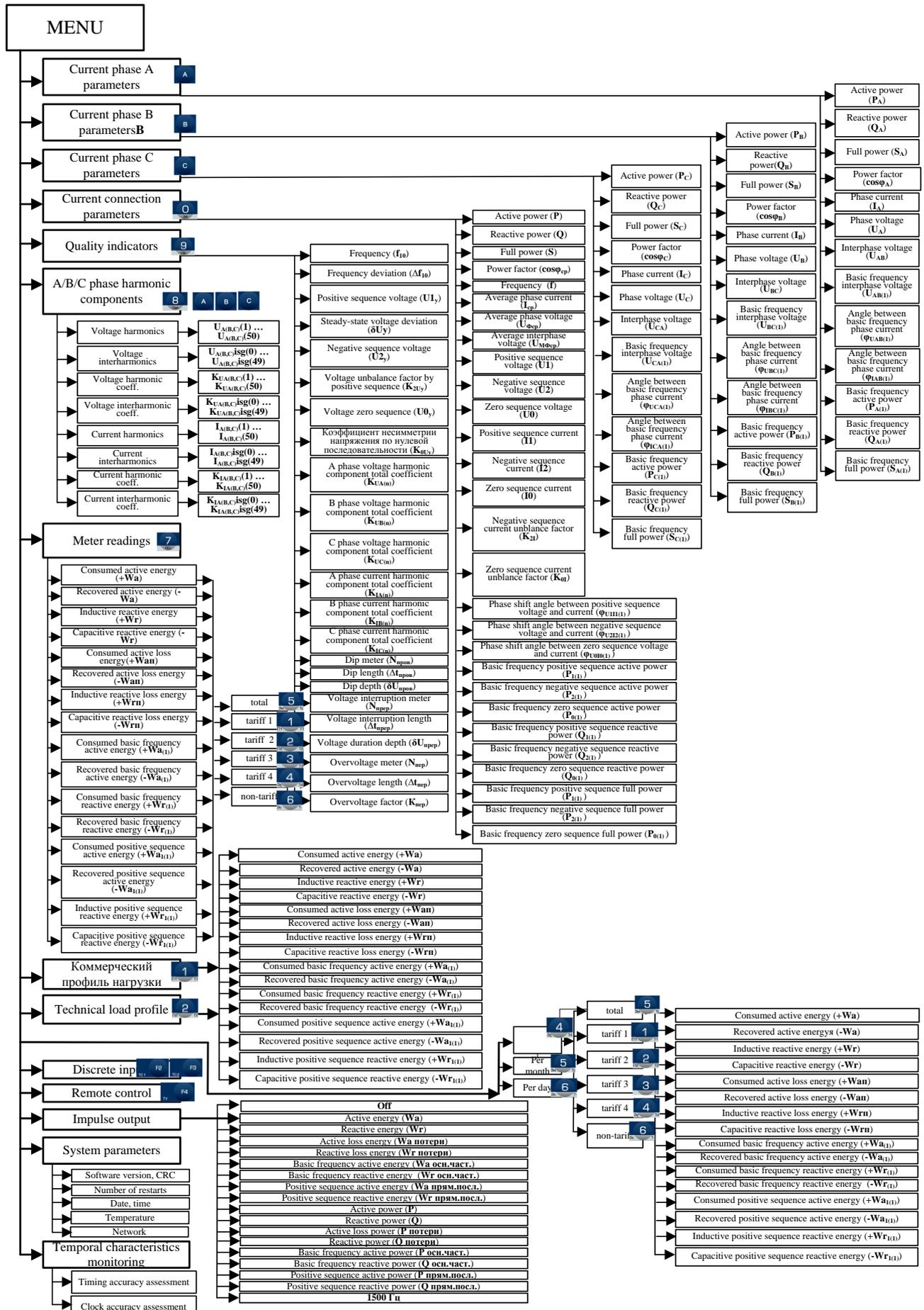


Figure 7 - LCD Data Displaying Menu

1.4.5 Structure

The meter has a completed structure meeting the requirements of GOST 31818.11-2012 and the manufacturer's drawings. Its internal structure is built on a modular principle. The modules are placed in a plastic casing made of high-impact polycarbonate and ensuring a convenient and safe operation under impact of external factors. The meter casing consists of a base, a shell (panel) and three covers. The casing has IP51 protection rating as per GOST 14254-96. The casing, compression terminal (board) and the terminal cover meet the requirements of GOST 31818.11-2012. The external appearance of the meter is presented in Figures 8. 9.1 and 9.2.

The first cover is hinged, transparent, swinging, with a latch. Its opening provides access to the controls, LED indicators, LCD display, the optical port and the marking.

The second (bottom) cover (the terminal cover) is removable; it is fastened to the base by two screws. There is the compression terminal for metering circuits connection and interface terminals (RS-485/SYNC, RS-232. RS-485/422. Ethernet) located under it. Located on the internal side of the terminal cover (Figure 9.2) is the plate explaining the contact marking of the compression terminal, power connector and the connectors used for connecting external devices.

The third cover (the remote signal cover) is also removable; it is fastened to the base by two screws. Located under it are connectors for remote signaling (RS) and remote control (RC) circuits connection (TE37Rx (TE38Rx) external relay block) (Figure 9.1).

The terminal cover may be sealed by the operator and the inspection authority. It is impossible to get access to the compression terminal without breaking the seal. When the meter is on, upon terminal covers removal the event time and type are recorded in the electronic logs.

Terminal covers prevent access to the meter fastening screw, making it impossible to remove the meter without breaking the seals. The meter fastening screws also may be sealed.

The shell (panel) is fastened to the base with four screws that are sealed by the manufacturer's QC and the verification officer. These seals cannot be broken when the meter is fastened properly to a panel.

The meter casing has 3 holes for fastening it to a metal panel with BM5 screws. Two of those holes are located under the removable cover, making it impossible to remove the meter without breaking the seals.

The external appearance of the meter from the fastening panel side is shown in Figure 10. The meter design provides for its installation in cabinet front panel openings.

Fastening screws and mating connectors are delivered with the meter.

Metering circuits are connected with the help of compression devices installed on the clamp plate (terminal strip). Terminals have 20 mm deep holes 5.0 mm in diameter that ensure connection of single-conductor or multiconductor (terminated) wires 1.5 to 5.0 mm² cross-section that are fastened with two M4 screws. Distance between terminals in the terminal strip is 10.5 ± 0.2 mm, the number of terminals is eleven.

The earth terminal (PE) separate from the terminal strip is located in a Socket MSTBT – 2.5/5-ST-5.0 type connector near the terminal strip. It ensures connection of a wire with a section up to 2.5 mm² hole depth 8.3 mm, the wire is fastened with a single M3 screw.

The dimensions of the opening for circuit output covered by the terminal cover is 95mm*27 mm.
The dimensions of the opening for circuit output covered by the top cover is 105mm*20 mm.

The maximum meter weight is 2 kg.



Figure 8 - External Appearance of the Meter



Figure 9.1 - Meter Terminals. Top View.

- ① - XS1 remote signaling input terminals;
- ② – XS1 (RC1, RC2) relay block connector connecting terminal;
- ③ – XS2 (RC3, RC4) relay block connector connecting terminal;
- ④ - tampering sensor (electronic seal);
- ⑤ - place for the verification officer's seal imprint.



Figure 9.2 - Meter Terminals. Bottom View.

- ① – XS7 RS-232 interface connector;
- ② – Xt7 RS-485/422 interface connector;
- ③ - XP5 RS-485/SYNC connector - RS-485 interface, impulse output, impulse input;
- ④ - place for application of the manufacturer's QC protective hologram; 
- ⑤ – MicroSD socket;
- ⑥ – XS3 Ethernet connector;
- ⑦ – XP2 220 V connector - primary and backup power supply, earth (PE) terminal;
- ⑧ - XS2 compression plate (terminal strip) - metering circuits connection
- ⑨ - tampering sensor (electronic seal);

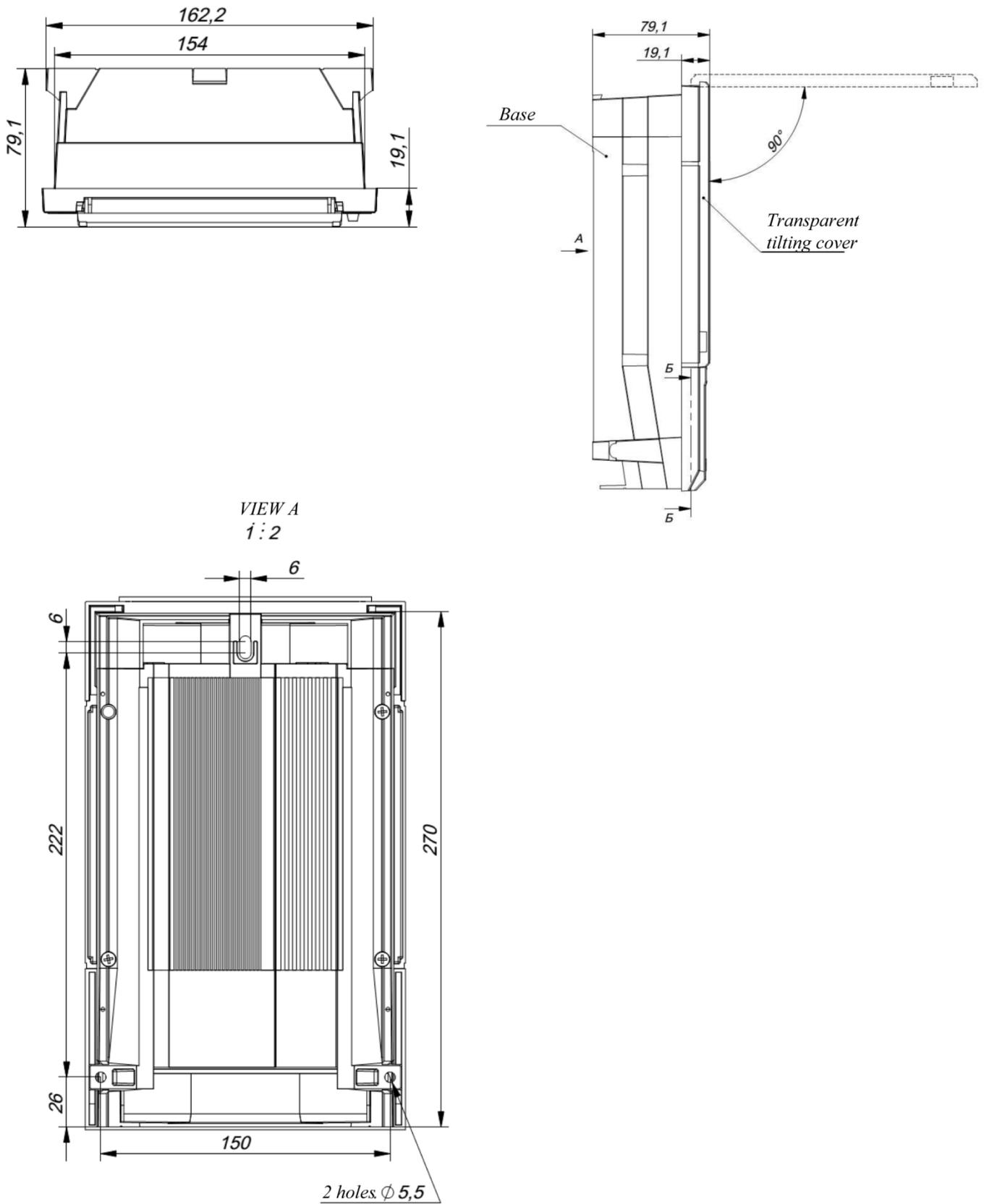


Figure 10 - Meter Dimensions and View from the Fastening Side

1.4.6 Marking and Sealing

The meter casing marking has been implemented in compliance with GOST 31818.11-2012. GOST IEC 62053-52-2012. It includes the following information:

- the manufacturer's trade mark and/or name (put on the number plate at the bottom of the panel);
- name;
- nominal secondary current of a transformer to which the meter can be connected, 5 A (1 A);
- nominal voltage: 57.7/100 V, 220/380 V, 100 V, 380 V;
- mains frequency 50 Hz;
- the number of phases and the number of wires of the circuit for which the m4 is intended presented as a graphic icon (as per GOST IEC 62053-52-2012);
- accuracy class including standard designation (as per GOST 8.401-80);
- insulation test voltage (as per GOST 23217-78); 
- sign  for meters in class II insulating casing;
- conventional designation of the measured energy;
- GOST 31818.11-2012 standard designation
- images of the SI type Approval Sign and Conformity Sign;
- serial number and year of manufacture.

The terminal strip bears the dangerous voltage sign , the terminal numbers and the meter power connectors marking.

An information plate is glued to the inside of the terminal cover, bearing the marking of the meter terminals covered by the cover and the metering circuits connection diagrams.

As per PR 50.2.007-2001. the verification mark is imprinted on the right-hand screw connecting the meter base and shell, the manufacturer's QC hologram is pasted on the panel to terminal strip connection; it blocks access to the SD card.

As the meter is put in operation, an Electric Inspection Service representative seals one of the terminal cover screw. It is permitted to seal the terminal covers, for which special holes are provided.

The meter packaging is marked as per GOST 14192-96. Its marking contains handling signs, the principal, supplementary and information inscriptions.

Handling signs contain the following load handling instructions:

- "Fragile. Handle with Care";
- "Keep Dry",
- "Top".

The principal inscriptions contain:

- the consignee's name;
- the destination point name;
- the number of cargo items in the batch and the item running number in the batch.

Supplementary inscriptions contain:

- the consignor's name;
- the departure point name;

- inscriptions made by shipping organizations.

Information inscriptions contain:

- cargo item gross and net weight in kilograms;
- cargo item dimensions in centimeters

1.4.7 Packing

The meter and the items delivered with it are packed as per the requirements of GOST 23170-78 and TLAS.411152.002 SB.

The accompanying documents delivered with the meter are put into a polyethylene film cover welded in a way ensuring tightness of welds and put into the box with the meter. The box is put into a case.

The case is marked with the case number and the total number of cases in the delivered batch. A packing slip is filled for the package case; it is put into the case.

The case is sealed as per GOST 18680-73 and marked as per GOST 14192-96.

1.5 Description and Operation of the Meter Components

The meter is a set of modules placed into a common shell (casing). The meter structural diagram is presented in Figure 1.

The principal element of the meter is TP337A processor module that receives transformed signals from TU337A metering module, measures actual current, voltage, active and reactive power, frequency, quality control and electric power metering values.

1.5.1 TP337A Processor Module

TP337A module TLAS.426469.014 is intended for operation as a part of the meter, namely the central processor module and actual current and voltage values discretizer. TP337A module also ensures data exchange with top level devices.

Functionally, the module consists of the following principal parts:

- CPU;
- a signal processor;
- a HOST controller;
- memory;
- real time clock;
- interfaces.

1.5.2 TU337A Metering Module

TU335A analog input module TLAS.426444.027 is intended for discretizing actual current and voltage values.

TU337A includes the following parts:

- metering current transformers;
- precision voltage dividers;
- an analog to digital converter (ADC);
- a reference voltage source;
- a power source.

Current and voltage metering circuits are connected to the TU337A module inputs. The module matches input currents and voltages with the ADC inputs with the help of isolating metering transformers and norming circuits.

Special materials and hardware components used in the TU337A module parts have stable characteristics and low intrinsic loss. They ensure high precision of signals conversion with required error over an expanded operating range.

Depending on the meter version, TU337A has TU337A, TU337A1, TU337A2 and TU337A3 versions that differ in input circuit element ratings.

1.5.3 TS337A Discrete Signals Input/output Module

TS337A RS and RC module TLAS.426444.029 is included in meters having remote signaling and remote control functions. It is intended for converting 16 discrete input signals into a digital code and transmitting it to the processor module, as well as converting digital code into output discrete signals (up to 4 depending on the connected relay block).

1.5.4 MS337A Keypad Module

MS337A keypad module TLAS.426458.025 is intended for displaying modes, state, parameter values and controlling the meter.

MS337A module is made of polyester film; it has a multilayer structure.

The top layer or the visible part of the module with alphanumeric designations, transparent windows and pushbuttons is the decorative face plate (instrument panel). The image of keys and special symbols is printed on the inner side of the face film; this protects it from abrasion. The outer side is covered with antireflective coating.

Twenty-five buttons of the keypad module have a special shape ensuring tactile effect.

The keypad elementary diagram (wiring) is implemented on the second layer of the MS337A module by conductive ink printing. A conductive ribbon cable is connected to this layer; with its help the MS337A keypad module is connected to the TP337A processor module.

When keypad buttons are pressed the necessary wiring lines are closed with the help of conductive pads located under the buttons on the inner side of the face panel.

A layer of glue is applied to the MS337A module reverse side in order to fasten it to the meter casing.

The external appearance of the BINOM3 series meter face panel is shown in Figure 11.



Figure 11 - BINOM3 Series Meter Face Panel

- | | |
|--------------------------|--|
| 1 – OLED indicator; | 4 – power indicator; |
| 2 – control buttons; | 5 – meter operation indicators (Table 26); |
| 3 – metering indicators; | 6 – optical port; |

1.5.4.1 Built-In Single Indication

The meter is provided with single indication on the face panel:

- 1) Metering indicators:
 - W_A indicator:
 - blinks green at the frequency proportional to the active connected power modulus but not less than 0.05 Hz. At nominal power, blinking frequency is equal to 0.5 Hz;
 - blinks red at the frequency proportional to the active connected power modulus when the maximum allowable power value is exceeded;
 - shines yellow at zero active connected power;
 - QD (quality deterioration) indicator:
 - blinks red at 2 Hz frequency for 5 seconds when an overvoltage is detected;

- blinks yellow at 2 Hz frequency for 5 seconds when a voltage dip is detected;
 - shines red when positive sequence voltage exceeds the maximum permissible limit;
 - blinks red at 4 Hz frequency when zero sequence unbalance factor exceeds the maximum permissible limit;
 - blinks red at 8 Hz frequency when negative sequence unbalance factor exceeds the maximum permissible limit;
 - shines yellow when positive sequence voltage exceeds the warning limit;
 - blinks yellow at 4 Hz frequency when zero sequence unbalance factor exceeds the warning limit;
 - blinks yellow at 8 Hz frequency when negative sequence unbalance factor exceeds the warning limit;
 - **ALARM indicator:**
 - blinks red at 2 Hz frequency when active phase powers have different signs or when at least one phase has zero active power value;
 - shines yellow at negative phase sequence;
 - shines red when phase voltages are connected incorrectly.
- 2) Power indicators:
- Green +3.3V indicator - shining indicates presence of 3.3 V voltages at TP337A electronic module.
- 3) The purposes and colors of the meter operation indicators are presented in Table 26.

Table 26 - Purposes and Colors of the Meter Operation Indicators

Indicator Name	Indicator Color			
	Green	Yellow	Red	
			Shines	Blinks
+3.3V / +5V	+3.3V		+5V	
Run / Acc	blinks in proportion to the CPU load	operates with an error (e.g., processor initialization errors)	battery powered operation	
ADC / Err	blinks when the ADC operates, containers are processed	blinks when the ADC operates, containers are lost	ADC error	
TU / Err	Operation	Closing relay	error	
TS / Err	Operation		error	
SD / Err	During SD reading	During SD recording	During SD access	in case of SD error/absence
Link / Act	Ethernet transmission indicator		Ethernet line availability	
Func / Opto			optical port exchange	
IP / 485	when TCP/IP packets are transmitted via RS-485 interface		RS-485 transmission indicator	
IP / 422	when TCP/IP packets are transmitted via RS-422 interface		RS-422 transmission indicator	
IP / 232	when TCP/IP packets are transmitted via RS-232 interface		RS-232 transmission indicator	

1.5.4.2 Optical Port

The optical port is located on the meter face panel. The optical port provides access to the data stored in the meter, meter programming and its accuracy check during metrological tests. Besides, the optical port may be used for reading data from each meter and entering that data into the operator's PC.

Optical elements (sending/receiving infrared rays) installed in the TP337A module and controlled by output signals fed from the microcontroller are used as the transmitter and the receiver.

1.5.5 TX06A Communication Module

Data exchange between the meters and a computer via an optical communication interface is ensured by a TX06A communication module (TLAS.426419.005) serving as an optical port - USB adapter. From the computer side, TX06A is equipped with a USB connector. When it is connected, a virtual COM port is created in the system and it becomes possible to scan, program and configure meters. The TX06A module casing has a built-in magnet that fastens it to the meter and orients it unequivocally in relation to the transceiving LEDs. Structurally, the optical port conforms to GOST IEC 61107-2011. Data exchange speed via optical interface is up to 115200 bod, computer USB port power supply - not more than 30 mA, cable length not more than 1.8 m.

1.5.6 TE37Rx (TE38Rx) Relay Blocks

TE37Rx (TE38Rx) relay blocks TLAS.426458.026 are intended for ensuring high-voltage isolation and matching the controlled device impedance with the BINOM3 meter electronic circuits. The structural diagram of a single TE37Rx (TE38Rx) element (relay channel) is presented in Figures 19 - 21.

Technical Characteristics of TE37Rx (TE38Rx) relay blocks are presented in Table 27.

Table 27 - Technical Characteristics of Relay Blocks

Name	Technical Characteristics					
	Number of RC Channels	Number of Electromagnetic Relays	Number of Solid-State Relays	Number of LEDs	Nominal Relay Operation Voltage	Relay Coil Resistance
TE37R2	2	6	1	7	12 V.	170 Ω ± 10 %
TE37R3	3	9	1	10		
TE37R4	4	12	1	13		
TE38R2	2	7	-	7		
TE38R3	3	10	-	10		
TE38R4	4	13	-	13		

TE37Rx (TE38Rx) relay blocks are connected with the XP1 connector of the BINOM3 meter. Cable connector type from the BINOM3 meter side - FK-MC 0.5/8-ST. Cable length - 1000 mm. A separate PE contact is provided for earthing.

TE37Rx (TE38Rx) relay blocks are installed on a DIN rack (Figure 12).

Dimensions of the relay blocks: 62*124*67 mm (h*w*d*) (Figure 13).

Relay block weight does not exceed 0.7 kg.

In the process of the meter operation, the resistance of TE37Rx (TE38Rx) relay block coils is periodically checked.

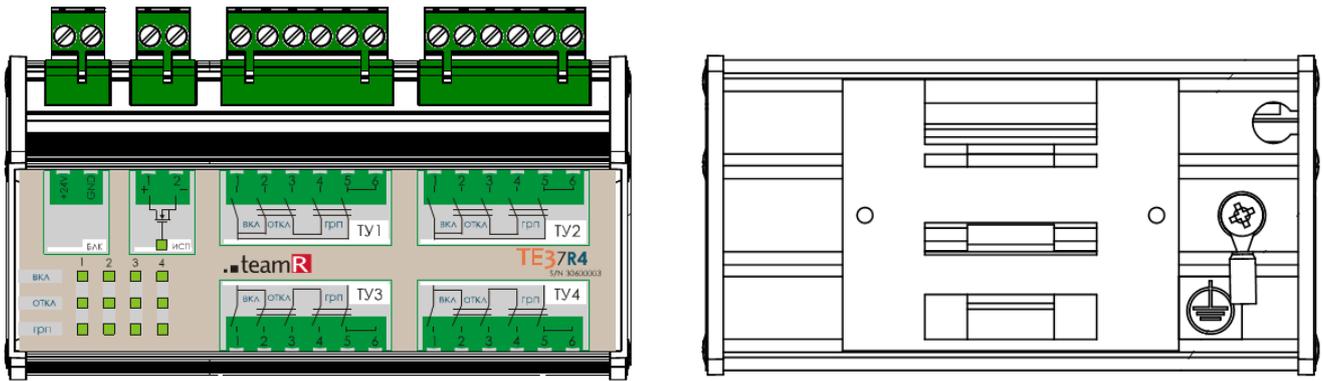


Figure 12 - External Appearance of a Relay Block as Exemplified by TE37R4

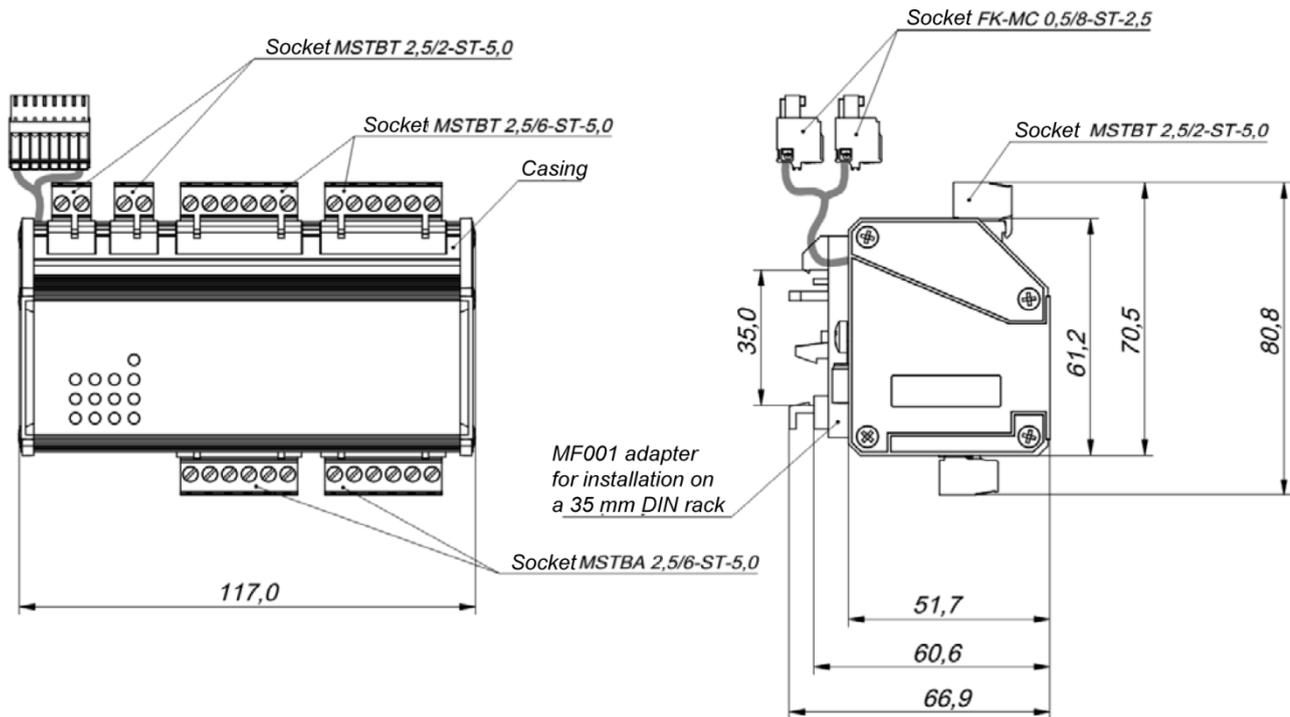


Figure 13 - Relay Block Dimensions

1.6 Functional Flavor Description

1.6.1 Archiving Function

BINOM3 series meters ensure storage of measurement results over time intervals and electric energy quality statistical characteristics as per GOST R 32144-2013, as well as a freely programmable set of parameters (current measurements, diagnostic information).

Data are archived on a built-in microSD card or an external storage, as well as by transmitting data to the TM3com control point telemechanic device over communication channels with subsequent data archiving from the TM3com control point telemechanic device to an external storage.

The meter ensures security of the collected energy metering data, the electric energy quality analysis results and the configuring data upon complete deenergization for account of non-volatile memory storage. Data storage time without power supply: at least 10 years.

1.6.2 Built-In Information Presentation Facilities

BINOM3 series meters have a built-in WEB server allowing to view the measurements and calculations results in the form of diagrams, tables, graphs. WEB server is called from a computer with an installed browser (e.g., Google Chrome), the meter automatically formats and displays the requested WEB pages into which real time data are integrated.

The Web server can form document, such as Power Consumption Reports and Electric Energy Test Report drawn up according to recommendations of GOST 33073-2014. The documents are formed directly on the browser page; they are downloadable in the form of Excel compatible *.xml files.

1.6.3 Oscillography Function

Depending on their version (Table 2), BINOM3 series meters carry out the oscillography function, i.e. they register instantaneous current and voltage values in the form of oscillograms (in view of RD 34.35.310-97), the registration of root mean square and averaged values of analog parameters and discrete signals in the form of graphs.

Data are registered on a MicroSD memory card. Registration modes are settable. The registration start moment is defined by a settable set of external signals (analog and discrete) and internal meter parameters.

Instantaneous current and voltage values are oscillographed at 32 kHz frequency (31.25 μ s) with assignment of a time mark in the h:min:s.ms' μ s format.

Prehistory oscillography (data recording before the oscillograph start condition operation) is provided. Prehistory length is adjustable within the interval from 0 to 25 s and set in the meter configuration settings. The total length of a single oscillogram is up to 120 s. The number of subsequently recorded oscillograms following one another with overlap of the end of the previous oscillogram and the prehistory of the previous one is 4 oscillograms. The number of stored oscillogram is specified during parameterization (by default, 30).

Oscillograms and graphs are viewed on the meter built-in Web server. A registration record analysis, processing and decoding includes recording registration date and time (astronomical time) for all recorded parameters, parameter values at any moment of time, scaling of any parameter along the axis of ordinates and the whole oscillogram along the time axis.

It is possible to download oscillogram files through the built-in WEB server or over communication channels in the GOST R IEC 60870-5-101/104 in COMTRADE or MS Excel format.

2 USING ON PURPOSE

2.1 Safety Precautions

Electric shock hazard protection method of BINOM3 series meters conforms to GOST 22261-94. GOST 12.2.091-2012. class II equipment, contamination level I, installation (overvoltage) category III.

As you make the meter ready for operation, as well as during its operation, it is necessary to abide by the active Regulations for Operation of Consumer Electrical Installations and Safety Rules for Operation of Consumer Electrical Installations /

Only persons who were briefed in safety rules and have at least electrical safety qualification level III for electrical installations up to 1000 V are allowed to perform the meter installation work.

The meter must be earthed; for that purpose, it is equipped with PE earthing terminal in its power supply connector.

All interface connections and circuits that may be affected by a lightning must be lightning protected.

2.2 Operation Conditions

BINOM3 series meters are designed for continuous operations under the conditions meeting GOST 31818.11-2012 at temperatures within the range from minus 40 to plus 45 °C. The rest of operation conditions characteristics are presented in 1.2.11.

2.3 BINOM3 Series Meters Preparation for Use

2.3.1 Depreservation

After transportation and storage at subzero temperatures, the meter must be kept under normal conditions for 3 h. before depreservation.

Open the package. Check the contents of delivery, the availability of a certificate and operation documentation.

Perform external inspection.

During external inspection, establish whether the meter meets the following requirements:

- markings must be distinct and easily readable;
- the casing must not have any mechanical damage;
- the clamps must have all screws and the screws thread must be serviceable;
- presence of a verification mark imprint on the irremovable part of the casing and/or in the meter certificate.

2.4 Insulation Check

2.4.1 Insulation Resistance Check

Insulation resistance and dielectric strength must be checked before the first meter activation and each time it is put into operation, as well as necessary.

Insulation resistance is checked with the help of a megohmmeter with 500 V measuring voltage. Its measuring leads must be connected between:

- 1) The power connector PE contact and each of the circuits enumerated below:
 - mains power supply (XP2:1. 3);
 - impulse output (XP5:3);
 - impulse input (XP5:4.5);
 - RS-485 (XP5:1. 2);
 - RS-485/422 (XS6);
 - RS-232 (XS7);
 - Ethernet (XS3);
 - TE37Rx (TE38Rx) relay module terminals (TU1:1. 2. 3. 4. 5. 6), (TU2:1. 2. 3. 4. 5. 6), (TU3:1. 2. 3. 4. 5. 6), (TU4:1. 2. 3. 4. 5. 6);
 - remote signals contacts XS1.

2) Measuring circuit contact pairs (between *Ia* and *Ib*, between *Ib* and *Ic*, between *Ic* and *Ia*, between *Ia*, *Ib*, *Ic* connected together and compression plate terminals 10 and 11.

Measurements shall be performed after a steady-state reading is achieved but not earlier than after 5 s. Insulation resistance must be at least:

- 20 MΩ under normal conditions (Table 1);
- 5 MΩ under 45 °C temperature and 80% relative humidity;
- 2 MΩ under 30 °C temperature and 95 % relative humidity;

2.4.2 Insulation Dielectric Breakdown Test

2.4.2.1 Insulation Dielectric Breakdown Test by Commercial Frequency Voltage

Insulation dielectric breakdown test voltage during manufacture of meters intended for various insulated circuits shall meet the values specified in Table 28.

Table 28 - Insulation Dielectric Strength Parameters

Insulated Circuit	Test Voltage, 1 min, kV (RMS)
Between all power supply circuits (primary and backup), current and voltage input metering circuits connected together and the PE terminal (XP2:5)	4.0
Between impulse (test) output (XP5:3) and input (XP5:4.5) circuits and PE terminal (XP2:5)	4.0
Between communication channel adapter input and output circuits RS-485 (XP5:1.2), RS-232 (XS7), RS-485/422 (XS6) and PE terminal (XP2:5)	4.0
Between input and output Ethernet communication channel circuits (XS3) and PE terminal (XP2:5)	2.0
Between remote signaling circuits (XP1) and PE terminal (XP2:5)	3.0
Between TY1-TY4 relay block outputs, «Исп» ¹⁾ , «Блк» input and the relay block PE terminal	4.0
«Исп» relay block output ²⁾ and PE relay block terminal	2.5
¹⁾ – when an electromagnetic relay is used in the TE38Rx block. ²⁾ – when a solid-state relay is used in the TE38Rx block.	

Test shall be performed on a disconnected BINOM3 meter with the help of a breakdown tester (e.g, GPI-735-A type).

When testing circuit insulation dielectric strength as related to the casing, one terminal of the breakdown tester shall be connected to all metering circuit short-circuited together and the other, to metal foil tightly pressed to the BINOM3 meter surface and connected to the PE power supply connector terminal so that the distance between it and the tested circuit terminals would be at least 20 mm.

Test voltage shall be increased from 0.1 to 3.0 kV 50 Hz for (5-10) s steplessly or in increments not exceeding 200 V. Insulation shall be exposed to test voltage for one minute; after that, voltage shall be decreased to zero steplessly or in increments.

There must be no insulation breakdown or surface flashover during the test. The occurrence of a corona discharge or noise shall not be considered as symptoms of unsatisfactory test results.

Test result shall be considered as positive in case no insulation breakdown or flashover occurred.

2.4.2.2 Impulse Voltage Test of Insulation Dielectric Strength

Insulation shall withstand 6 kV impulse voltage as per GOST 31818.11-2012 requirements for line-to-earth voltage equal to 300 V between:

- each current circuit and all other meter circuits connected with PE power supply connector terminal;
- all voltage circuits including common terminal (10.11 of the compression plate) and all other meter circuits connected with PE power supply connector terminal.

During the test, free meter outputs including interface ones, must be connected with the PE terminal.

2.5 BINOM3 Meter Installation

BINOM3 meter must be installed in heated premises.

The following requirements must be met upon BINOM3 meter installations on site:

- 1) the installation place must be chosen in view of the input and output circuit connecting cables minimum length;
- 2) the temperatures of ambient air and the surface on which the meter is installed must not exceed the specified performance limits.
- 3) the location of BINOM3 meter must ensure quick access to its controls, functional devices and installation elements;
- 4) it is not advisable to place the BINOM3 meter in direct sunlight coverage are because this reduces indicators light contrast and the meter is additionally heated;
- 5) BINOM3 meter should be installed only in explosion safe rooms at least 10 m distance from highly flammable substances and at least 1 m distance from combustible materials. Meters must be installed on walls or surfaces not subject to vibration, recommended height from the floor 1.4 to 1.7 m. The meters are not sensitive to angles of deflection from the vertical.

All BINOM3 meter external circuits shall be connected in compliance with the requirements of «Rules for the Operation of Electrical Installations» Clauses 1.5.1.7 and 3.4 by single-core insulated copper or aluminum wires having 0.5 to 4 mm² section depending on the kind of circuit.

It is allowed to use terminated multicore cables having the same section area. Metering circuits terminal length must be from 15 to 20 mm.

The following requirements must be met during installation of input and output circuits:

- 1) Metering circuits must be wired in compliance with « Rules for the Operation of Electrical Installations» Clauses 1.5.19 and 3.4.4 by at least 2.5 mm² section copper wires or 4 mm² section aluminum wires. The internal meter circuits connected to the neutral line (common metering wire) between compression plate terminals 10 and 11 (Figure 1. SX2) are designed for maximum current 10 A, one minute (damage threshold).
- 2) Mains power supply circuits must be wired by 1.0 to 2.5 mm² copper wires.
- 3) The mains power supply circuit must be equipped with an automatic circuit breaker designed for $(10 - 15) I_{av}$ operation current (where I_{av} is the average current consumed by the meter from the mains).
- 4) For avoidance of the meter breakdown, connection to DC or AC voltage exceeding the specified one is not allowed.
- 5) Long-term exposure of the meter insulated circuits to DC and AC voltage exceeding 24 V is not allowed.
- 6) Screws must be tightened with the following torque:
 - M2.5 – 0.4-0.5 Nm;
 - M3 – 0.5-0.6 Nm;
 - M4 – 1.2-1.5 Nm;

ATTENTION!

IT IS NOT ALLOWED TO PERFORM INSTALLATION OF ACTIVATED BINOM3 METER TO LIVE CONNECTED CIRCUITS UNDER DANGEROUS VOLTAGE!

2.6 Meter Installation

The meter shall be installed directly on a smooth surface (a wall, a panel, etc.).

Installation shall be performed in accordance with the following procedure:

- 1) remove covers from the meter (Figures 8 and);
- 2) depending on the chosen fastening method, mark out the installation place in compliance with

Figure 14.

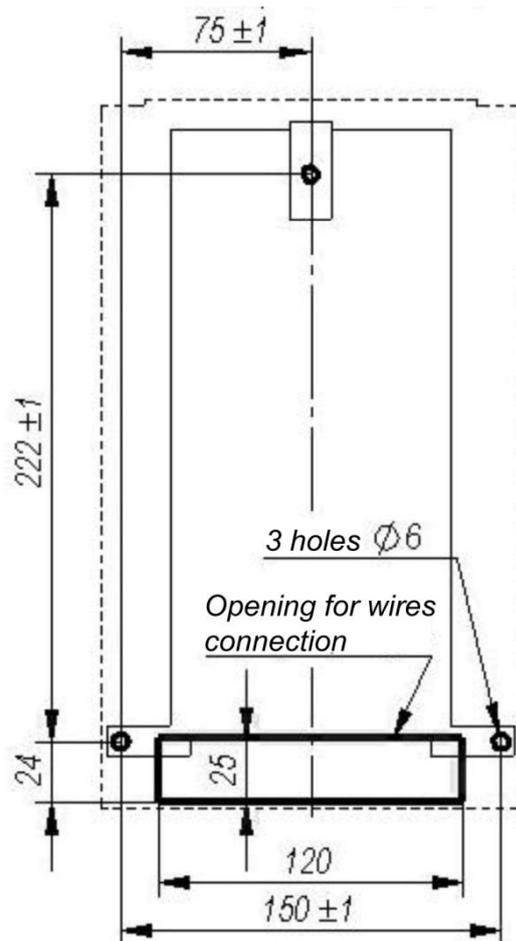


Figure 14 - Marking Out the Meter Installation Place

- 3) install a screw into the top hole (Figure 14);
- 4) install the meter on the screw and fasten it by screws through slots in the bottom part of its casing and the bottom holes (Figure 14);
- 5) connect external circuits and power circuits to the meter connectors;
- 6) install the covers on their designated places;
- 7) apply power to the meter;
- 8) check the correctness of the meter circuits connection;
- 9) seal the meter covers (as necessary).

2.7 Connection of External Circuits

2.7.1 Metering Circuits connection

The meters connection diagram is presented in Figures 15a - 15i.

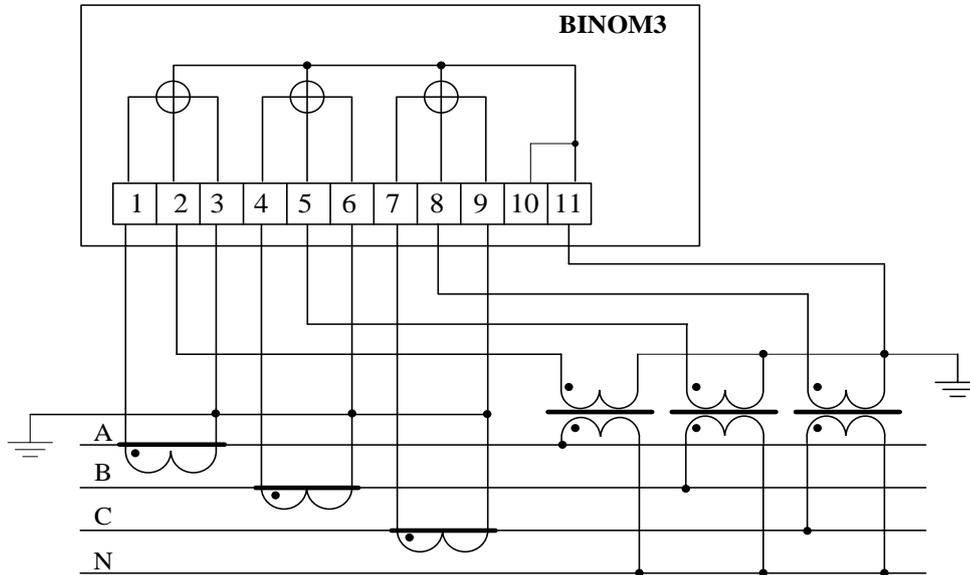


Figure 15a - BINOM3 Meter Connection Diagram to a Three-Phase, Four-Wire Network via Voltage Measuring Transformers and Three Current Transformers.

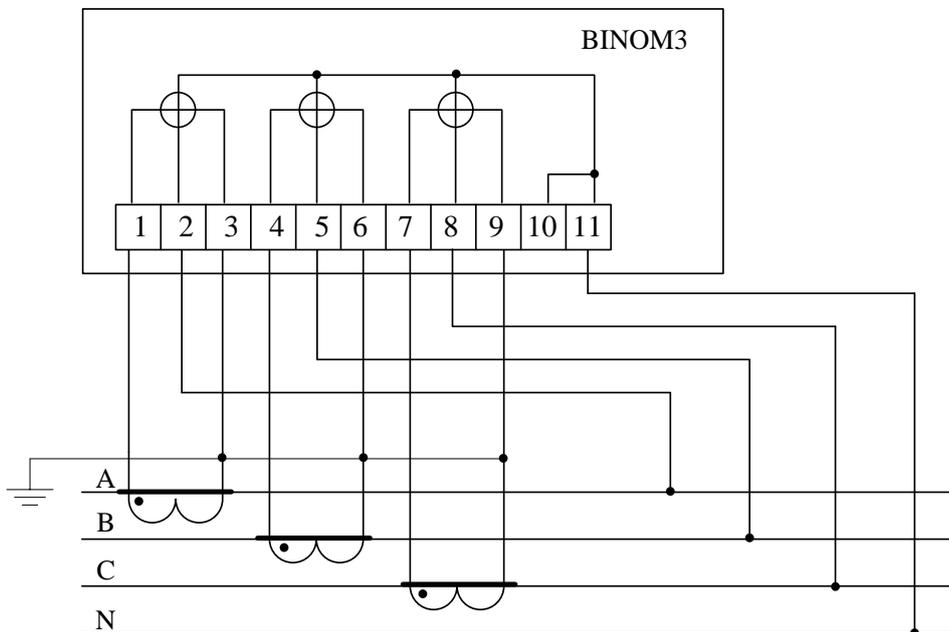


Figure 15b - BINOM3 Meter Connection Diagram to a Three-Phase, Four-Wire Network (Direct Connection to Voltage Circuits and via Three Current Measuring Transformers)

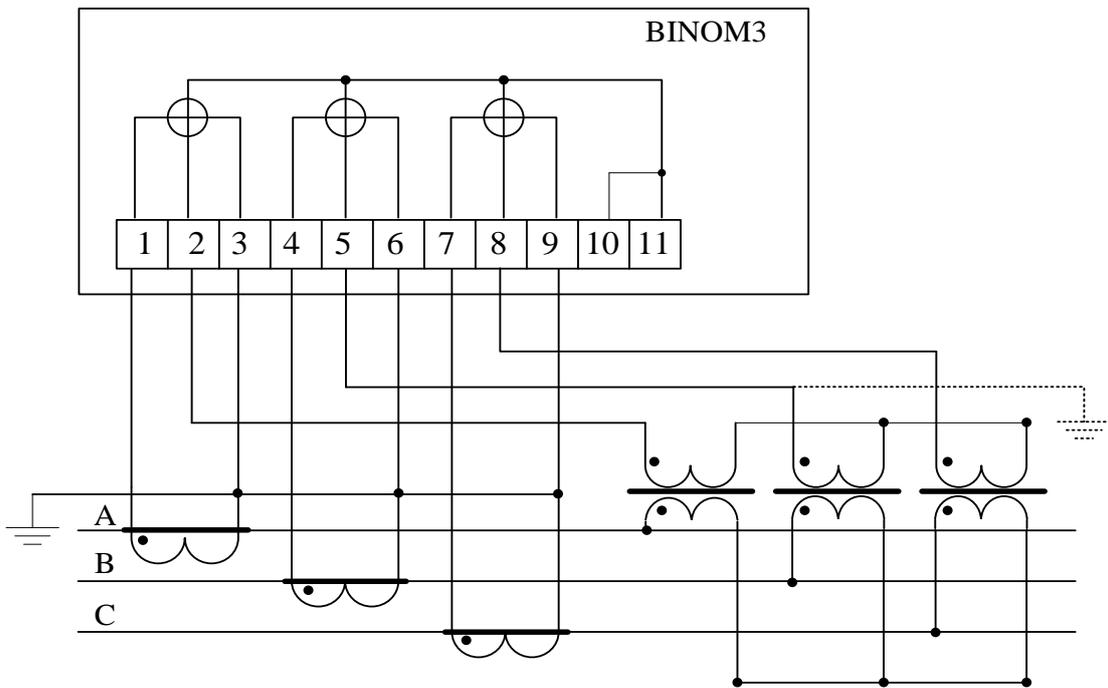


Figure 15c - BINOM3 Meter Connection Diagram to a Three-Phase, Three-Wire Network via Voltage Measuring Transformers and Three Current Transformers.

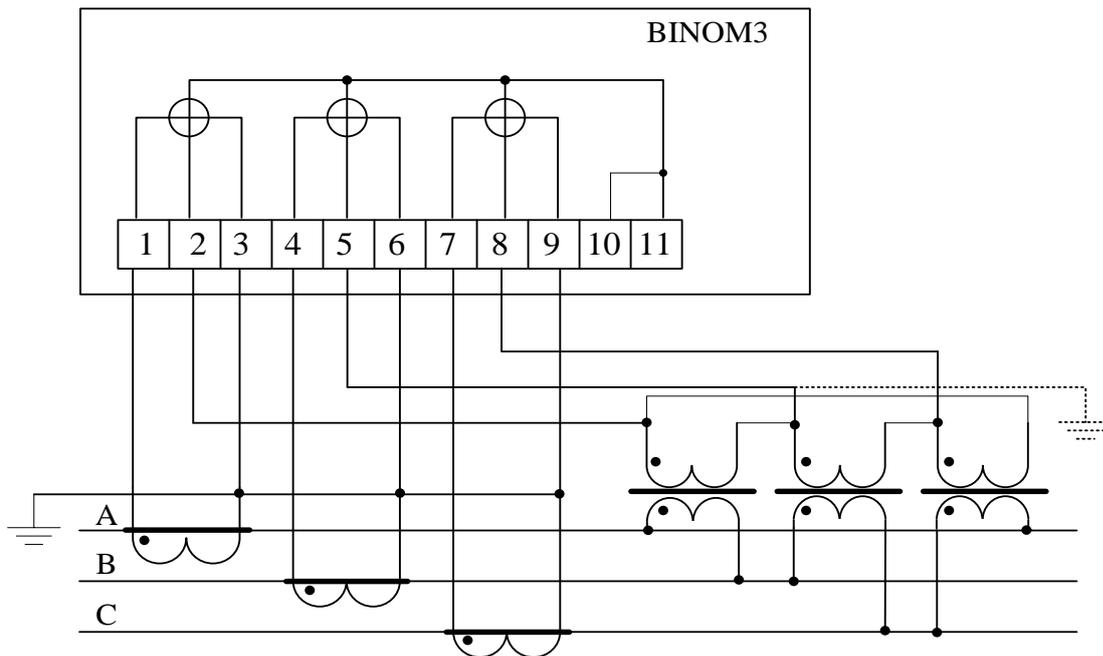


Figure 15d - BINOM3 Meter Connection Diagram to a Three-Phase, Three-Wire Network via Voltage Measuring Transformers Connected in a Delta and Three Current Transformers

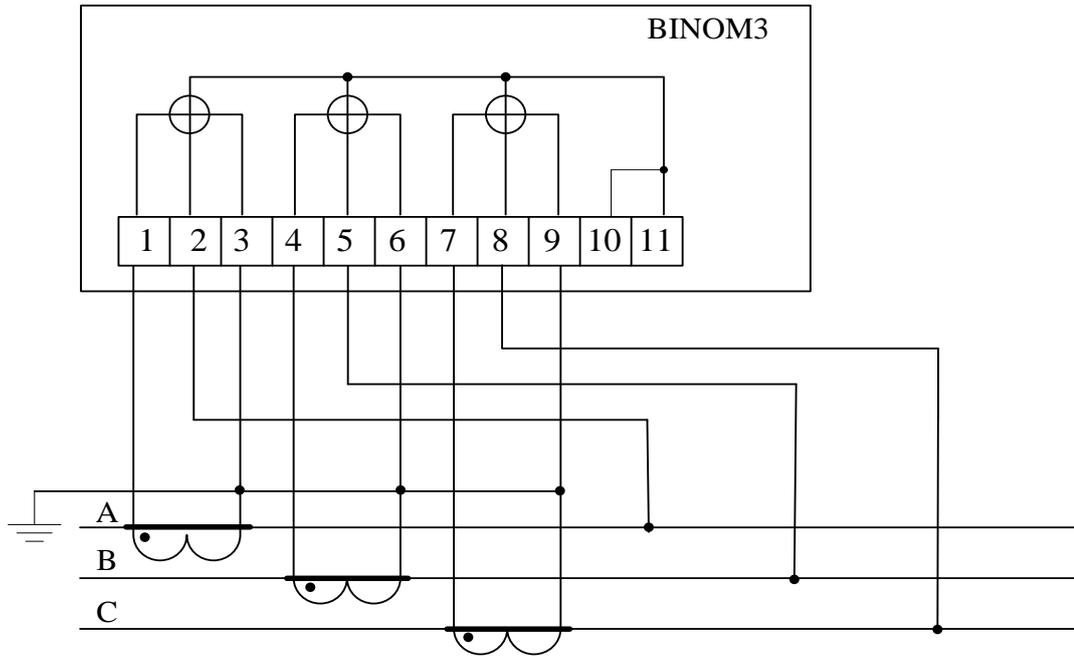


Figure 15e - BINOM3 Meter Connection Diagram to a Three-Phase, Three-Wire Network (Direct Connection to Voltage Circuits and via Three Current Measuring Transformers)

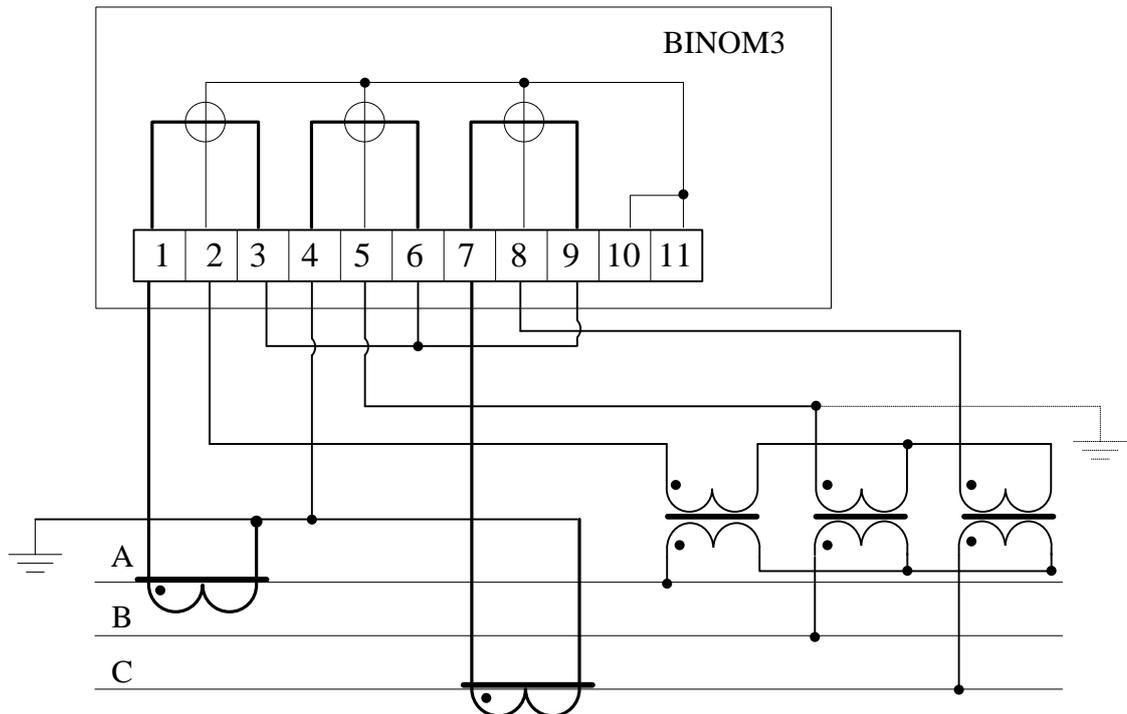


Figure 15f - BINOM3 Meter Connection Diagram to a Three-Phase, Three-Wire Network via Voltage Measuring Transformers and Two Current Transformers.

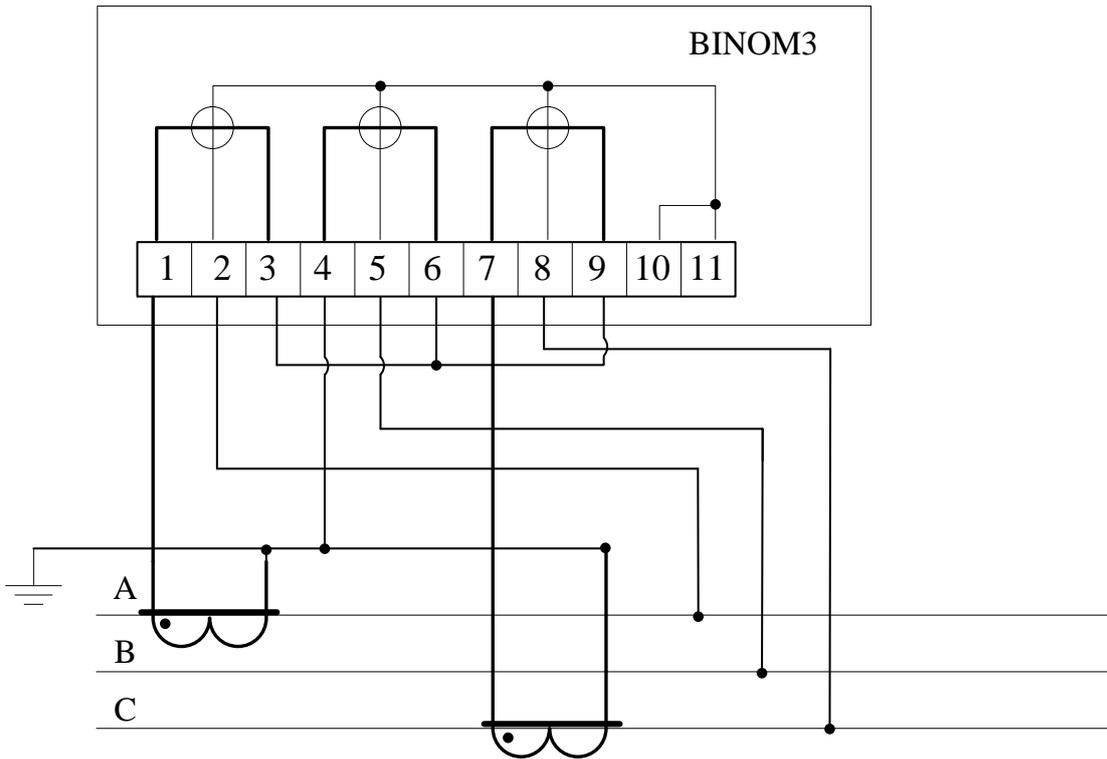


Figure 15g - BINOM3 Meter Connection Diagram to a Three-Phase, Three-Wire Network (Direct Connection to Voltage Circuits and via Three Current Measuring Transformers)

When connecting a BINOM3 meter according to the diagrams in Figures 15f - 15g:

- B phase current is calculated with the deduction zero sequence current;
- positive, negative and zero sequence basic frequency currents (symmetrical components) are not used;
- B phase active and reactive powers are calculated with the deduction of zero sequence current from the phase current;
- electric energy is metered with regard for the items cited above.

2.7.2 RS-485 Interface Circuits Connection

Data collection device is connected to a BINOM3 meter via RS-485 highway interface as per Figure 16a. Circuit "A" is connected to terminal 1. circuit "B", to terminal 2.

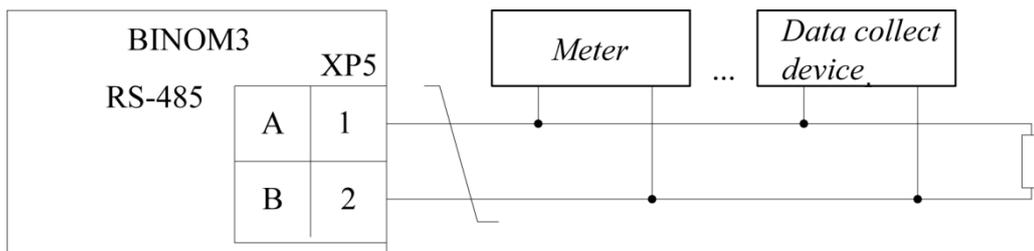


Figure 16a - Meters Connection to RS-485 Highway Interface Circuits

In case the meter has a RS-485/422 interface, a data collection device may be connected to the BINOM3 meter as shown in Figure 16b.

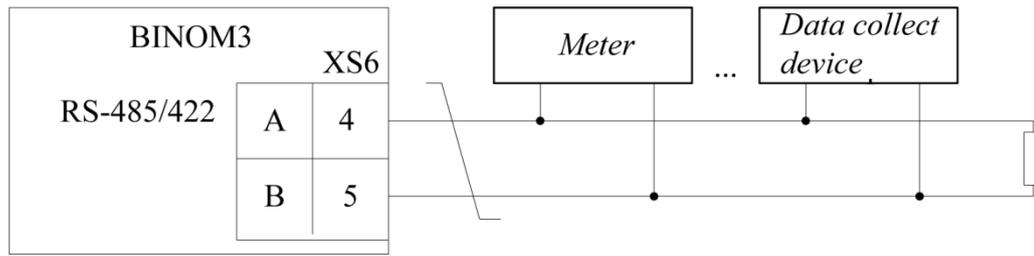


Figure 16b - Meters Connection to RS-485/422 Interface

The maximum number of meters connected to a single interface is 20. The communication line must be implemented as a twisted pair with 120 Ω characteristic impedance. Maximum line length - 600 m. 120 Ω termination resistors must be installed on the line ends. Maximum data transmission speed: 460.8 kbit/sec.

The RS-485 (XS5) mating connector is delivered with the BINOM3 meter.

2.7.3 Impulse Output Connection Instruction

The test output output stage is implemented by an optrons with an open-collector output transistor. To ensure its functioning, apply 4 to 24 V power voltage according to the diagrams presented in Figure 17.

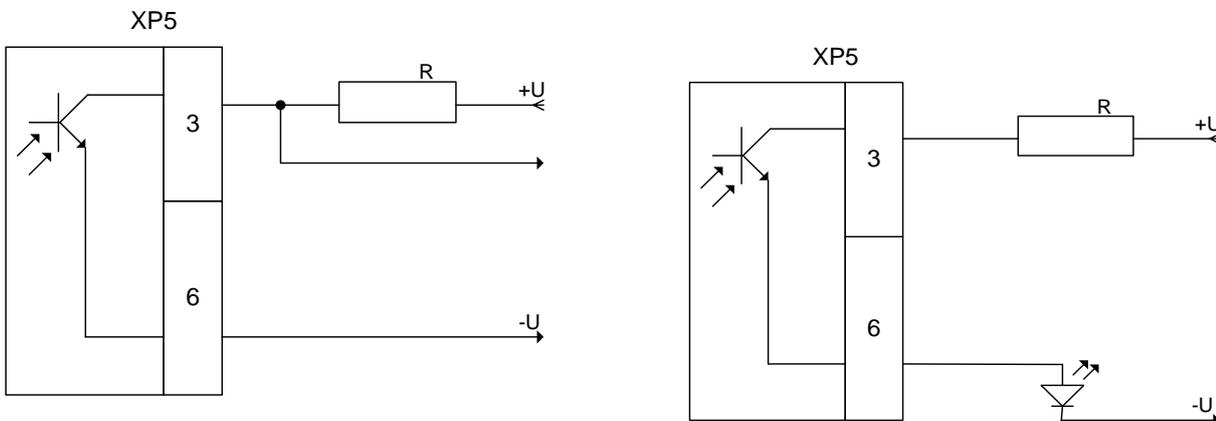


Figure 17 - Test Outputs Connection Diagrams

The ohmage of R resistance in the test output load circuit is determined by formula (89).

$$R = \frac{(U - 1,0 \cdot B)}{I}, \Omega \tag{89}$$

where U is test output power voltage, V,
 I is test output circuits current rate, A.

Nominal test output power voltage $(10 \pm 2)V$, the maximum permissible one: 24V.

Nominal current rate is equal to $(10 \pm 1)mA$, the maximum permissible one, not more than 30m.

The test output has protection circuits protecting against:

- incorrect power connection;
- overvoltage (more than 60 V).

2.7.4 Power Circuits Connection

Primary mains power supply circuits (both AC and DC) are connected to the BINOM3 meter with a single-core or multicore wire having 1.0 to 2.5 mm² cross section (with regard for a possibly installed terminal) to XP2 220 V connector (cable, mating connector). One of the mains wires shall be connected to the "L" contact (XP2:1), the other, to the "N" contact (XP2:3). In case DC voltage is connected, connection polarity is irrelevant.

Backup mains power circuits are connected with a 1.0 to 2.5 mm² single-core or multicore wire to the XP2 220V connector. One of the mains wires shall be connected to the "+220B-2" contact (XP2:2), the other, to the "N/-220B" contact (XP2:3).

The earthing circuit is connected to terminal 5 "PE" of XP "220 V" connector as per Clauses 1.7.121-1.7.135. «Rules for the Operation of Electrical Installations», Edition 7.

Mains power supply lines and their installation must meet the requirements of Section 6 GOST 12.2.091-2012.

A BINOM3 meter belongs to permanently connected multiphase equipment for which under Section 6. GOST 12.2.091-2012 a switch or an automatic circuit breaker not being a part of the meter must be used as a part of the meter.

2.7.4.1 Coordination with Automatic Circuit Breakers, Fuses and Protective Tripping Devices

The BINOM3 meter mains power network is protected with built-in slow-acting fuses having nominal operation current 5 A. After built-in fuses operation, the meter is to be repaired.

An external automatic circuit breaker and/or fuses must ensure the meter power circuit tripping at short circuit current ratings not exceeding 5 A. To ensure selective operation of the automatic circuit breaker, use the data presented in Table 29.

Table 29 - Power Mains Consumed Starting Current Values

Time after Start, t	Consumed Current, A	
	≈ 220 V	= 220 V
50 μs ≤ t	20	20
50 μs ≤ t < 1.5 ms	10	5
1.5 ≤ t < 30 ms	3	2
30 ≤ t < 500 ms	0.5	0.3 (impulse)
500 μs ≤ t < 2 s	0.15 (impulse)	0.03
2c ≤ t	0.06	0.03

The nominal operating current value of an automatic circuit breaker with a C type protective characteristic made as per GOST R 50345-99 is 2 A per one BINOM3 meter.

Additional requirements for the circuit breakers are presented in Section 6. GOST 12.2.091-2012.

When using protective tripping devices, take into account possible 0.5 mA current leak to the PE terminal of the "220 V" power supply connector.

2.7.5 Remote Signaling Circuits Connection

Remote signaling (RS) sensor circuits are connected to the respective terminals of the "TC" connector (Figure 1). The "TC" has 20 input terminals: "TC1" – "TC16", two internal power source terminals "+24V ВНУТР.", one internal power source terminal "+24V ВНЕШ." and "GND".

Remote signaling circuits connection diagram is presented in Figure 18. The following connections are presented in Figure 18:

- terminal 1 - a "dry contact" type sensor;
- terminal 2 - a "dry contact" type sensor with an external power source;
- terminal 3 - RS 24 V, 2 mA. When using semiconductor and other polarized RS sensor instead of "dry contact" sensors, take into account their polarity when connecting them to the RS channel terminals.

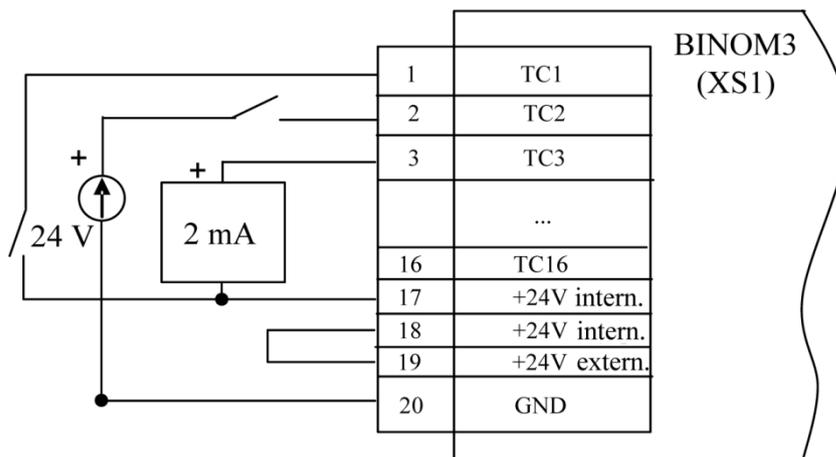


Figure 18 - RS Circuits Connection

Note: TS337A board (terminal 19) is powered either from an internal power source by installing a jumper between contacts 17 and 19 or 18 and 19 or from an external source (Figure 18b).

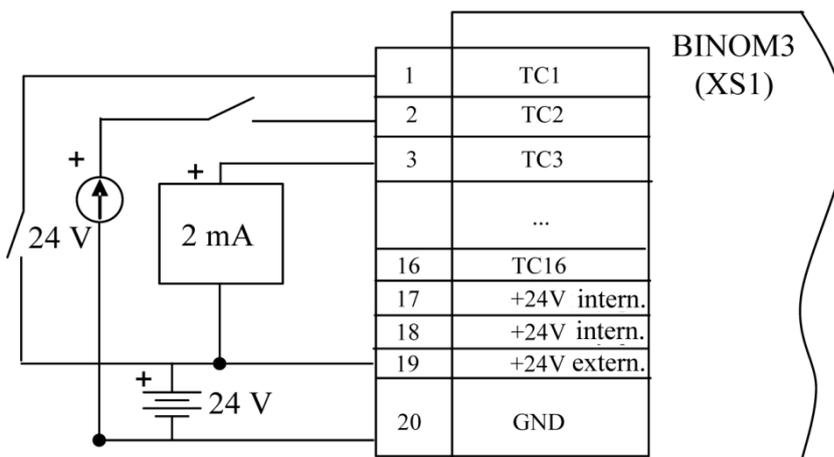


Figure 18b - RS Circuits Connection Using an External Power Source

The connector terminals used allow connection of single-core and terminated multicore wires having 0.2 mm² to 2.5 mm². total cross-section.

When connecting a two-component remote signaling system, the position of circuit switching devices ("two-bit RS") must be put in an "Off" - "On" sequence within a single pair of RS inputs (odd - even, e.g., 1-2. as per Table 30).

Table 30 - Two-Bit RS Circuits Connection

Switched Object State	Off	On
Odd RS (low)	Closed	Open
Even RS (high)	Open	Closed

2.7.6 Remote Control Circuit Connection

Remote control (RC) circuits are connected to the respective terminals of TE3xRx relay block connectors. The closing contacts of ON and OFF channels have a single common-wire circuit terminated to two terminals and the contact intended for blocking automatic reclosing are insulated from them and other device circuits. The enabling circuits of contactors, magnetic starters and other switching equipment drives are connected to the ON terminals, the disabling circuits, to the OFF terminals, and automatic reclosing blocking circuits, to the ARB terminals. The cross sections of the wires used for connecting controlled devices must correspond to the control current ratings. The connector terminals used allow connection of single-core and terminated multicore wires having 0.2 mm² to 2.5 mm². total cross-section.

Protective earth circuit is connected to a separate relay block PE terminal (on the block reverse side) by an at least 2.5 mm² section wire.

Figure 19 shows an RC circuits connection diagram with a separate automatic reclosing blocking circuit, Figure 20 - an RC connection diagram with an integrated automatic reclosing blocking circuit, Figure 21 - an RC connecting diagram with independent RC enabling and disabling circuits.

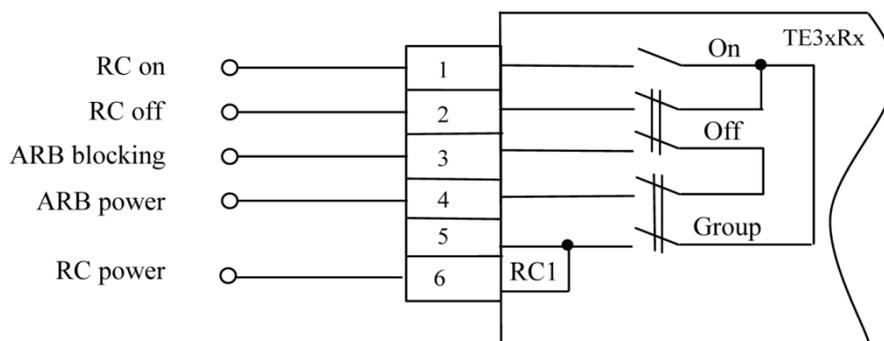


Figure 19 – RC Circuits Connection with an Independent Automatic Reclosing Blocking Contact

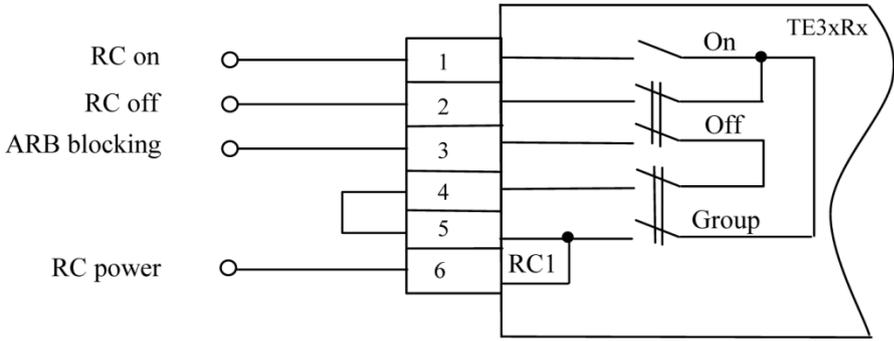


Figure 20 – RC Circuits Connection with an Integrated Automatic Reclosing Blocking Contact

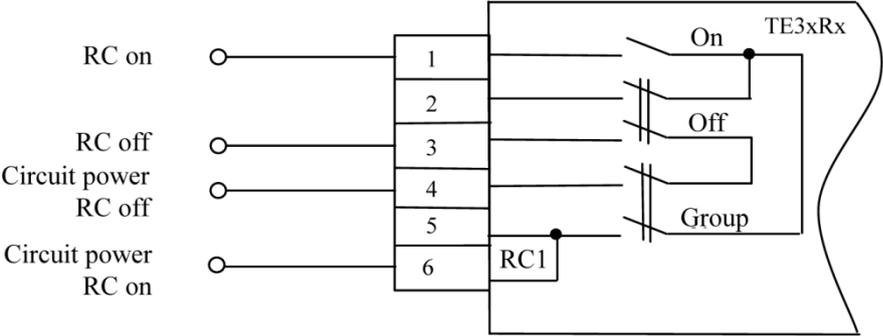


Figure 21 - RC Circuits Connection with Independent Enabling and Disabling Contacts

RC circuits connection diagram for DC circuits switching is presented in Figure 22. In case the power handled by TE38Rx block relays is insufficient, it is recommended to use a TE37Rx block with a repeater relay (REP relay in Figure 22) with contact groups designed for the required load.

The additional REP relay being a part of TE3xRx block is enabled T1 ms later and disabled T2 ms earlier than ON, OFF, ARB relays. (T1 and T2 values are set in the process of parameterization).

The time diagram of a TE3xRx block relays is presented in Figure 23.

The time of ON, OFF, ARB relays contacts closing is set within the range from 0.5 s to 10 s.

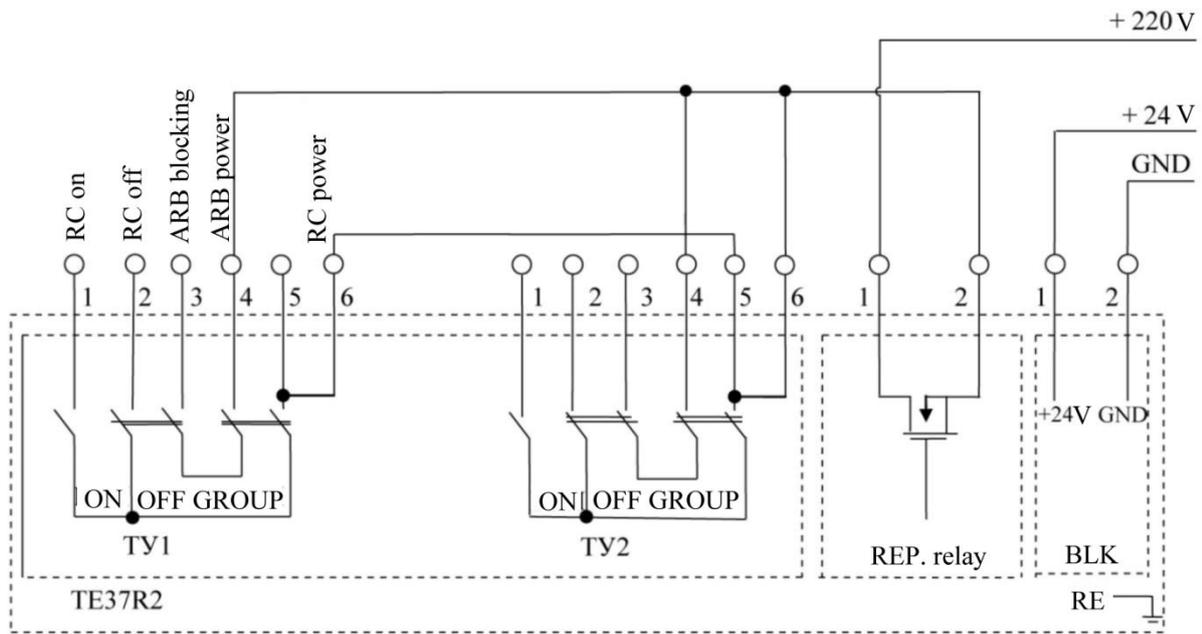


Figure 22 - RC Circuits Connection Diagram for DC Circuits Switching as Exemplified by TE37R2 Block

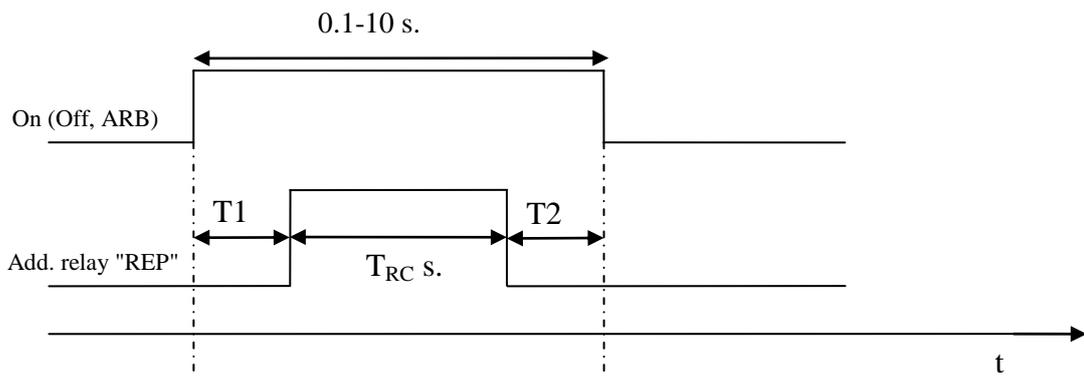


Figure 23 - Relay Operation Time Diagram

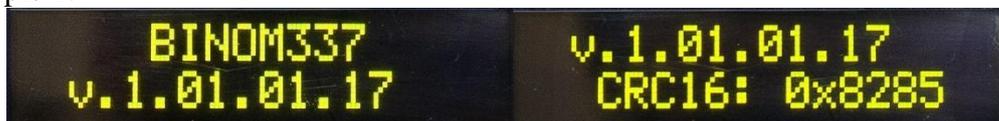
2.8 Checking the Correctness of Meter Connection and Functioning

2.8.1 Checking Power Voltage Availability

Switch on the mains voltage. As power voltage as applied, "+5V" and "+3.3V" indicators are lit on the meter face panel. The shining of the above indicators and the blinking of the "RUN/ERR" mean that the meter is ready for operation.

A startup screen specifying the meter software name, version number and checksum is lit on the meter display with a ~ 5 s delay. In about 2 s it is replaced by current time indicators (and cyclic displaying of parameters if such an operation mode has been set). Check the meter running time readings for conformity to the actual time. The appearance of the startup screen on the meter display is presented in Example 1.

Example 1:



2.8.2 Switching Metering Circuits on

Switch on metering circuits. Check the meter serviceability by switching indication modes by buttons located on the meter front panel as specified in Subclause 1.1.4.6.

Make sure that currents, voltages and metered energy values are displayed on the indicator.

2.8.3 Checking Correctness of the Meter Connection

For checking correctness of the meter connection, it is necessary to apply the respective currents and voltages to the respective circuits.

When the meter is correctly connected and active power values exceed the threshold ones, "ABAP" ("FAULT") indicator must not be lit.

In case signs of active phase powers do not correspond to the expected sign, change the direction of the respective phase current.

Configure the meter as described in Cl. 2.9. if necessary.

Install the compression connector protective cover, fix it with two screws and seal it.

Make an entry to the meter datasheet recording the dates of its installation and putting into operation.

2.8.3.1 Filling in Information on the Meter Plate

For convenience of operation, the meter plate (keypad) is equipped with a plate for noting the actual operation conditions data: transformation ratios $K_T =$, $K_H =$, $K_T \times K_H =$.

2.9 BINOM3 Meter Configuring

BINOM3 meters are configured with the help of the BINOM3 Web server built in the meter that allows users to enter and edit the BINOM3 meter parameters and read data.

The factory configuration is presented in the document "BINOM3 Multifunctional Electric Energy Quality Meters". Interaction Protocols. TLAS.411152.002 D1».

2.10 Procedure of the Meter Removal from Operation

When removing the meter from the operation, perform the following actions:

- before disconnecting the meter, make sure that all necessary data stored in the meter memory have been read with the help of the control computer software;
- deenergize the power, metering and communication circuits;
- if you use a meter with a backup power supply option, switch off the meter by a command from the keypad;
- remove terminals and remote signals covers;
- disconnect the meter from power, metering and communication circuits;
- remove three fastening screws (Figures 8. 9) and remove the meter;
- put the meter in the packing box;
- make an entry to the meter datasheet recording the dates of the meter removal and putting out of operation.

3 TECHNICAL MAINTENANCE

The meters must undergo technical maintenance as per GOST 18322-78. Established maintenance procedure includes scheduled status checks, as well as unscheduled check in order to find out consequences of facility accidents. Technical maintenance is performed by the operator organization.

The scope, procedure and frequency of scheduled checks must conform to the active power equipment operation instructions adopted at the operator organization. In the process of scheduled checks, the meter status is inspected, its surface is cleaned from dust and dirt.

Unscheduled maintenance is performed in case of faults. It includes determining and correction of occurred faults by the personal authorized to perform such works.

The relay block connected to the meter does not require operator actions during operation. In case it is necessary to perform the relay block technical maintenance, disconnect interface and power circuits from it and make sure there is no static electricity.

Recommended meter maintenance frequency and checkup methods are presented in Table 31.

Table 31 - Recommended Meter Checkup Frequency and Methods

Work Name	Checkup Method	Checkup Frequency	
		during Operation	during Storage
Checking availability of seals	Visually	Scheduled	1 year
Removing dust from the meter casing and face panel	3.1.1	Scheduled	1 year
Performance, functionality check	3.1.3	Scheduled	-
Clock rate check	Visually, by display readings	Scheduled	-
Checking the condition of connectors, connection reliability of the meter metering, power and interface circuits	3.1.2	Scheduled	-
Checking the condition of fastenings		Scheduled	-
Backup power supply check	3.2	1 year	1 year
Clock battery serviceability check	3.3	1 year	1 year
Meter verification	Reference meter. Verification procedure	Verification interval	-

After finishing maintenance, make an entry in the meter datasheet.

3.1 Scheduled Technical Maintenance

3.1.1 Dust is removed from the meter surface by clean and soft wiping rags.

3.1.2 For checking the reliability of power and interface meter circuits, it is necessary to:

- remove seals from covers, remove fastening screws and covers;
- remove dust from the compression plate (terminal strip) power, signal and interface connectors with the help of a brush;
- tighten the screws fastening metering, power, signal and interface circuit wires;
- reinstall the covers, fasten them with screws and seal.

Frequency of scheduled technical maintenance during operation - 3 years.

ATTENTION!

BEFORE STARTING WORK, DEENERGIZE THE METER AND RELAY BLOCK CONTACTS!

3.1.3 Functional check is performing at the meter operation site: power circuits are loaded with real loads - the meter must meter electric energy, the indicator must display actual current, voltage, power values. The date and time display on the meter LCD must correspond to the current value in view of the clock error, possibly without regard for daylight saving time and time belt.

3.2 Checking Backup Power Supply from an Internal Battery

The purpose of checking backup power supply is also training and recharging the internal battery during the meter warehouse storage.

Backup power supply is checked as follows:

- 1) Switch the meter on. Check whether the battery charger is on.
- 2) If the charger is on, wait till the battery is fully charged.
- 3) After the charger trip, switch off the meter primary power supply and record time.
- 4) Record the time of automatic meter trip (for the built-in battery, from 30 min. to 1 hour) and switch on the meter primary power supply. Wait till the battery is fully charged (for a built-in battery ~24 h, at ambient temperature less than 30 °C).
- 5) Backup power supply is considered as serviceable if the meter and charger autonomous operation time corresponds to the time specified in the documentation.

3.3 Clock Battery Check

3.3.1 Checking Clock Battery Serviceability During Operation

For checking the clock battery serviceability, switch on the meter unless it was already on.

The date and time displayed on the meter LCD must correspond to the current value in view of the clock error.

If the date, time and clock deviation change do not correspond to the required value, the meter must be removed and sent to the manufacturer plant for repairs. Make an entry to the meter datasheet recording the dates of the meter removal and putting out of operation.

3.3.2 Checking Clock Battery Serviceability During Storage

To ensure meter serviceability during storage, the procedure of clock battery recharging must be performed at least annually. For that purpose, switch the meter on for a period of time not exceeding 1 hour. After that, make sure that the date and time displayed on the meter LCD correspond to the current value.

4 CURRENT REPAIR

4.1 General Guidelines

The meter cannot be repaired by the operator organization. Routine repairs are performed by the manufacturer or legal and natural persons licensed to perform repair of the meter.

After repair, the meter is to be verified.

4.2 Troubleshooting

Possible meter faults and the methods of their correction are presented in Table 32. Information in Event Logs allows to determine the meter fault and its possible cause. Should it be impossible to correct the above faults as described, it is necessary to apply to the repair service or to the manufacturer.

Table 32 - Troubleshooting

Fault	Cause	Method of Correction
"+3.3V" and "+5V" indicators are not lit.	No power voltage	Connect power voltage to the meter
	Faulty meter power source	Dismantle the meter and send it to the manufacturer for repair
No image on display, the display is lit	The indicator contrast has not been adjusted	Adjust contrast
	Faulty TP337A module	Dismantle the meter and send it to the manufacturer for repair
Faulty interface RS-485	A wire has been disconnected from the connector	Check connection circuit
	No contact in the connector	Check communication cable
	Noncompliance of the receipt/transmission parameters to the required values	Check meter parameterization
	Faulty TP337A module	Dismantle the meter and send it to the manufacturer for repair

Table 32 (Continued)

Fault	Cause	Method of Correction
Incorrect date/time indication on the meter	Real-time clock unit battery empty	If the meter was not operated less than a year: - charge the clock unit battery by leaving the meter on for 24 hours; - check the clock operation after loading the battery
	Faulty real-time clock unit	Dismantle the meter and send it to the manufacturer for repair
ALARM indicator is lit	No voltage and/or current in one of the phase cables. Significant unsymmetry of connected phases operation. No active energy metering	Check conformity of the meter readings and status registers to the connection operation mode (as per Cl. 2.8.3 hereof)
	Incorrect meter connection	Check the meter connection (as per 2.8.3 hereof)
	Faulty meter input circuit	Dismantle the meter and send it to the manufacturer for repair

5 CALIBRATION

5.1 The meter is subject to State metrological control and supervision.

5.2 The meter shall be verified only by the State Metrological Service or accredited metrological services of legal persons.

5.3. Calibration shall be performed in compliance with the document "BINOM3 Multifunctional Electric Energy Quality Meters". Calibration procedure TLAS.411152.002 PM.

Interval between verifications – 12 years.

Note: for meters exported out of the Russian Federation interval between calibrations shall conform to the importer country's regulatory documents.

6 STORAGE

Limiting storage conditions at ambient air temperature from minus 50 to plus 50°C and relative air humidity not exceeding 95% at temperature plus 30°C in compliance with group 3 as per GOST 15150-69.

Warranty shelf life: 60 months since the moment of the meter manufacture

Shelf life is valid subject to the user's compliance with the requirements of existing operation documentation.

The content of dust, acid and alkali fumes, aggressive gases and other corrosive impurities at the places where BINOM3 meters are stored must not exceed corrosive agents content for type 1 atmosphere as per GOST 15150-69.

7 TRANSPORTATION

The meters may be transported in covered railroad waggons, by motor transport with protection against rain and snow, by water transport and in pressurized heated airplane compartment. Transportation must be performed in compliance with the rules of carriage valid for each type of transport.

In respect of climatic and mechanical impact under limiting transportation conditions, the meters meet the requirements of group 4. GOST 22261-94:

- temperature: from minus 50 °C to plus 55 °C;
- relative air humidity: 95 % at 35° C temperature;
- atmospheric pressure: from 70 to 106.7 kPa (from 537 to 795 mm Hg).
- transport jolting - 80-120 jolts per minute with maximum acceleration 30 m/s^2 and 1 h impact duration.

Shipping type - small consignments, less-than-truckload.

Packed meters in vehicles must be fixed in order to ensure a stable position, exclude shifting and jolts. During load handling work and transportation, the requirements of consumer package marks must be complied with.

After transporting the meters under subzero temperatures, they must be unpacked only after storage for at least 12 h under $(20 \pm 5) \text{ °C}$ temperature.

8 DISPOSITION

The meter modules are to be disposed of according to the rules adopted at the operator organization.

9 REALIZATION

BINOM3 meters, including relay blocks, are realized under delivery contracts.

10 GUARANTEES

10.1 The Manufacturer guarantees conformity of the BINOM3 meter that passed the Manufacturer's QC tests and sealed by the verification seal to the requirements of TU 4228-008-80508103-2014 specifications for 30 years subject to compliance to operation, storage and transportation conditions.

This guarantee does not apply to any hardware and software that were not manufactured by the Manufacturer even if they were packed and sold together with the Manufacturer's products.

10.2 Guaranteed shelf life: 6 months since the moment of the BINOM3 meter manufacture. Upon expiry of the guaranteed shelf life, the guaranteed operation period starts irrespective of whether the BINOM3 meter has been put into operation or not.

10.3 Guaranteed service life: 36 months since the date of putting the BINOM3 meter into operation but not more than 42 months since the date of the BINOM3 meter manufacture.

10.4 During the guarantee period, the Manufacturer undertakes to rectify the BINOM3 meter defects by repairing it provided the defect occurred through the Manufacturer's fault.

10.5 The guarantee period does not apply to:

- batteries;
- connection cables, data storage devices (memory cards);
- package and documentation delivered with the product;
- embedded software and the need for software reinstallation and setting, unless such a need is caused by a BINOM3 meter fault that arose through the Manufacturer's fault.

10.6 The manufacturer is not liable for its guarantee obligations for the BINOM3 meter damages that were detected during the guarantee period if such defects arose in the following cases:

- BINOM3 meter damage that occurred because of noncompliance to the transportation rules and storage conditions;
- breaking the Manufacturer's seals; the BINOM3 meter bears traces of tampering or attempts of self-made repairs or traces of serial numbers and seals alterations;
- unauthorized changes to the BINOM3 meter design have been detected;
- cosmetic damage of the BINOM3 meter, including but not limited to scratches, dents and broken parts;
- if the BINOM3 meter was operated not for its designated purposes or under conditions for which it was not intended;

- BINOM3 meter damage have been detected that were caused by incorrect connection to a power source or connection to power sources that do not meet technical requirements;
- if it was detected that the BINOM3 meter was broken down because of operation rules violations or lack of BINOM3 meter technical maintenance;
- if the BINOM3 meter broke down because of incorrect actions during software update performed by persons not being the Manufacturer's authorized representatives;
- if the BINOM3 meter broke down because of force majeure circumstances (such as a fire, flood, earthquake, etc.);
- if the BINOM3 meter broke down because of mechanical, thermal, chemical and other types of impacts if their parameters exceed their maximum operational characteristics;
- in case the BINOM3 meter was repaired by unauthorized persons.

10.7 Embedded Software

The BINOM3 meter embedded software is provided "as is" at the moment of the BINOM3 meter delivery.

The Manufacturer may provide access to the embedded software updates and configuration files at its own option and/or at the Customer's request and for the Customer's account. In any case, embedded software update must be performed by the persons being the Manufacturer's authorized representatives.

No one except the Manufacturer is entitled to copy and provide to other persons the opportunity to copy, decompile, reverse engineer, attempt to decode the software structure, to alter the embedded software or create derivative works on its basis.

10.8 BINOM3 meters are accepted for repairs (including guarantee service) only subject to availability of the meter datasheet and a filled-in Certificate of Equipment Handover for Repair (the above document is publicly accessible on the Manufacturer's website www.binom3.ru).

10.9 BINOM3 meter Repair Deadline:

- is 30 workdays for guarantee service;
- may amount up to 45 workdays for non-guarantee cases and up to 60 workdays in case of intermittent or periodical defects.

10.10 The guarantee period is prolonged for the period of guarantee period.

If the guarantee period expires earlier than a month after the meter repair, an additional guarantee is established for it for 30 days' time since the moment of repair expiry.

10.11 The guarantee for replaced accessories expires together with the guarantee for the BINOM3 meter.

10.12 The Manufacturer disclaims responsibility for possible damage directly or indirectly inflicted by the BINOM3 meter to persons, domestic animals and property in case it occurred as a result of non-compliance with operation rules and conditions, deliberate or reckless acts of third persons.

10.13 The Manufacturer does not bear responsibility for the consumer' expenses for periodical checkup and possible expenses for extraordinary checkup connected with the energy service companies' requirements for verification frequency being less than 12 months on newly installed three-phase meters (Rules for the Operation of Electrical Installations, v. 6. 1.5.13).

The guarantee repair is performed at the Manufacturer (CJSC Vabtec) by the address:

111. Block A, Grazhdansky Prospect, Saint Petersburg, 195265. Russia

Telephone: (812) 531-13-68. fax: (812) 596-58-01.

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