PRIZEWINNER AT THE INTERNATIONAL
SPECIALIZED EXHIBITION
“RUSSIAN ELECTRIC GRIDS 2014”

For more information
please refer to our website at
www.binom3.ru

For more information please refer
to integrated webserver at
www.binom3.com

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MULTIFUNCTIONAL REVENUE ENERGY METERS AND POWER QUALITY ANALYZERS **BINOM3**

Operational and practical publication

DEVELOPED
& MANUFACTURED
IN RUSSIA

- **BINOM334i**
- **BINOM335/336**
- **BINOM337/338/339**

DOCUMENT VERSION 0.8
от 22.09.2015

ALGORITHM
www.algspb.ru

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(CJSC «Algorithm»), 2015
St Petersburg

MEASURING TRANSDUCER

- ☐ ENERGY METER
- ☐ POWER QUALITY ANALYSER AND METER
- ☐ FEEDER BAY CONTROLLER
- ☐ FAULT (EMERGENCY EVENTS) RECORDER
- ☐ "BLACK BOX" OF ELECTRICAL PROCESSES
- ☐ AUTOMATIC PROCESS CONTROL OF ELECTRICAL BAY IN ONE DEVICE

BINOM$_3$ is a high-acuracy, high-speed three-phase measuring transducer for a comprehensive range of electrical quantities required for the efficient monitoring and operational control of parameters of the electrical connection system and various analytical tasks.

Rated current	1A, 5 A
Rated voltage (phase/line)	220 V/380 V, 57.7 V/100 V
Accuracy class	0,2S [1]
Range of measurements with retention of claimed accuracy	2Un, 2In
Synchronized measurement of instantaneous current and voltage values with a period of	31,25 μs
Positional accuracy of instantaneous measured values to UTC (Universal Coordinated Time)	1 μs
Period of measurement of RMS values (the measurement results can be transmitted with this period over the communication channels to the management centres)	**200 ms** **/10 periods** of the fundamental frequency of **50 Hz** **6400** instantaneous values of the parameter/
Data archiving on built-in MicroSD memory card or FTP store:	- change-based, - timer-based, - in case pf threshold violation, - according to a specified scenario (e.g. timer-based if a parameter value is present in the range of permissible values and change-based if the parameter value deviates beyond established limits)
Local and remote access to the built-in WEB-server	

[1] Lowest range value of the measurement parameters current range of 0,01 Iн

For more information please refer to integrated webserver at **www.binom3.com** | For more information please refer to our website at **www.binom3.ru**

BINOM$_3$

UNIQUE FUNCTION

THE MONITORING MODE SETTINGS IN THE POWER SYSTEM WITH ACTIVE-ADAPTIVE NETWORK

PARAMETERS OF THE THREE-PHASE CONNECTION, MEASURED AT THE TIME INTERVAL OF 10 PERIODS OF THE FUNDAMENTAL FREQUENCY (50 HZ~200MS)

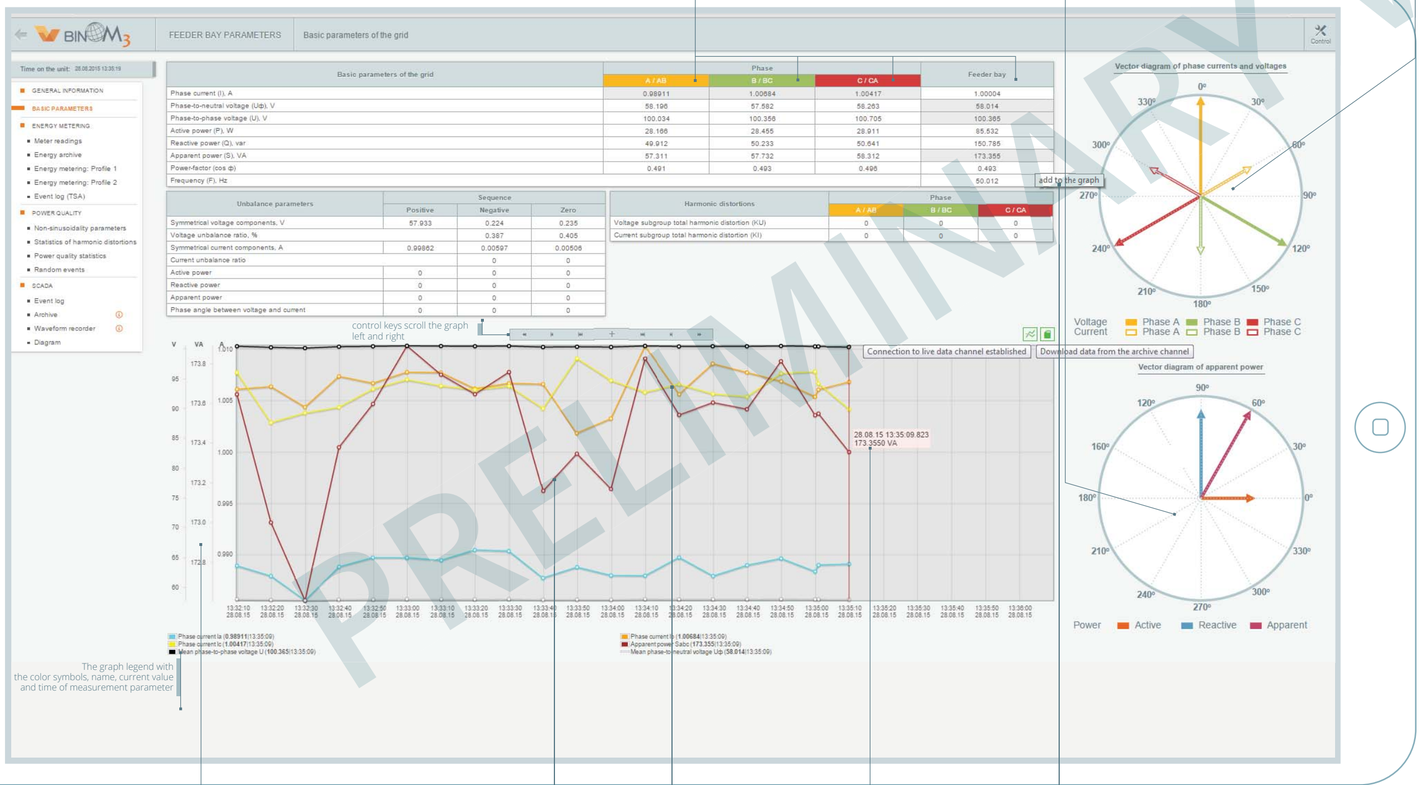
№	PARAMETER	RANGE OF MEASUREMENTS	LIMITS OF PERMISSIBLE FUNDAMENTAL ERROR	SWITCHING OF CIRCUIT
	FREQUENCY			
1	Frequency (f), Hz	42,5 - 57,5	± 0,01(Δ)	3 и 4
	VOLTAGE			
2	Phase-to-neutral voltage (U_A, U_B, U_C (RMS values)) and mean (U_{ABC}), V	(0,1 – 2) U_{rated}	± (0,2+0,04 · | U_{rated}/U-1 |) (δ)	4
3	Phase-to-phase voltage (U_{AB}, U_{BC}, U_{CA} (RMS values)) and mean (U_{A-B}), V	(0,1 – 2) $U_{rated\ p-p}$	± (0,2+0,04 · | $U_{rated\ p-p}$/U_{A-B} -1 |) (δ)	3 и 4
4	Positive sequence voltage U1 (RMS value) , V Negative sequence voltage U2 (RMS value), V Zero sequence voltage U0 (RMS value), V	(0,1 – 2) U_{rated}	± (0,2+0,04 · | U_{rated}/U-1 |) (δ) ± 0,2(γ) ± 0,2(γ)	3 и 4 4 4
5	Zero sequence voltage unbalance ratio (K_{U0}), %	0 – 20	±0,15 (Δ)	4
6	Negative sequence voltage unbalance ratio (K_{U2}), %	0 – 20	±0,15 (Δ)	3 и 4
7	Phase-to-neutral voltage of the 1st harmonic (RMS value) ($U_{A(1)}$, $U_{B(1)}$, $U_{C(1)}$(RMS values)), V	(0,1 – 2) U_{rated}	± (0,2+0,04 · | U_{rated}/U-1 |) (δ)	4
8	Phase-to-neutral voltage of the n-order harmonic (RMS value) ($U_{A(n)}$, $U_{B(n)}$, $U_{C(n)}$) (n = 2...50), V	от 0,0005U_{rated} to 0,5U_{rated}	± 0,05(γ) for $U_{A(n)}$<1%U_{rated} ±5%(δ) for $U_{A(n)}$≥ 1%U_{rated}	4
9	n-order phase-to-neutral voltage harmonic distortion ($K_{UA(n)}$, $K_{UB(n)}$, $K_{UC(n)}$), (n = 2...50), %	0,05 to 50	± 0,05(Δ) for $K_{U(n)}$<1% ±5%(δ) for $K_{U(n)}$≥ 1%	4
10	Phase-to-neutral voltage subgroup total harmonic distortion (K_{UA}, K_{UB}, K_{UC}) [16], %	0,1 –50	± 0,15(Δ) for K_U<3% ±5%(δ) for K_U≥ 3%	4
11	Phase-to-neutral voltage of the n-order interharmonic (RMS value) ($U_{A\,sg\,(n)}$, $U_{B\,sg\,(n)}$, $U_{C\,sg\,(n)}$), (n=0...49), V	от 0,0005U_{rated} to 0,5U_{rated}	± 0,05(γ) for $U_{sg_{A(n)}}$<1%U_{rated} ±5%(δ) for $U_{sg_{A(n)}}$≥ 1%U_{rated}	4
12	n-order phase-to-neutral voltage interharmonic distortion ($K_{UA\,sg\,(n)}$, $K_{UB\,sg\,(n)}$, $K_{UC\,sg\,(n)}$), (n=0...49), %	0,05 to 50	± 0,05(Δ) for $K_{U\,sg(n)}$<1% ±5%(δ) for $K_{U\,sg(n)}$≥ 1%	4
13	Phase-to-phase voltage of the 1st harmonic (RMS value) ($U_{AB(1)}$, $U_{BC(1)}$, $U_{CA(1)}$), V	(0,1 – 2)$U_{rated\ p-p}$	± (0,2+0,04· | $U_{rated\ p-p}$/U_{A-B} -1 |) (δ)	3 и 4
14	Phase-to-phase voltage of the n-order harmonic (RMS value) ($U_{AB(n)}$, $U_{BC(n)}$, $U_{CA(n)}$), (n = 2...50),V	от 0,0005U_{Rated} to 0,5U_{rated}	± 0,05(γ) for $U_{A-B(n)}$<1%$U_{rated\ p-p}$ ±5%(δ) for $U_{A-B(n)}$≥ 1%$U_{rated\ p-p}$	3
15	n-order phase-to-phase voltage harmonic distortion ($K_{UAB(n)}$, $K_{UBC(n)}$, $K_{UCA(n)}$), (n=2...50), %	0,05 to 50	± 0,05(Δ) for $K_{U(n)}$<1% ±5%(δ) for $K_{U(n)}$≥ 1%	3
16	Phase-to-phase voltage subgroup total harmonic distortion (K_{UAB}, K_{UBC}, K_{UCA}), %	0,1 –50	± 0,15(Δ) for K_U<3% ±5%(δ) for K_U≥ 3%	3
17	Phase-to-phase voltage of the n-order interharmonic (RMS value) ($U_{ABsg\,(n)}$, $U_{BCsg\,(n)}$, $U_{CAsg\,(n)}$), (n=0...49), V	от 0,0005 U_{rated} to 0,5 U_{rated}	± 0,05%(γ) for $U_{sg_{A-B(n)}}$<1%$U_{rated\ p-p}$ ±5%(δ) for $U_{sg_{A-B(n)}}$≥ 1%$U_{rated\ p-p}$	3
18	n-order phase-to-phase voltage interharmonic distortion ($K_{UABsg\,(n)}$, $K_{UBCsg\,(n)}$, $K_{UCAsg\,(n)}$), (n=0...49), %	0,05 to 50	± 0,05(Δ) for $K_{U\,sg(n)}$<1% ±5%(δ) for $K_{U\,sg(n)}$≥ 1%	3
19	Steady-state voltage deviation (δU y), %	- 20-+20	± 0,2 (Δ)	3 и 4
	CURRENT			
20	Phase current (RMS value) (I_A, I_B, I_C) and mean (I_{abc}), A	(0,01 – 2) I_{rated}	± (0,2+0,025· | I_{rated}/I-1 |) (δ)	3 и 4
21	Positive sequence current (RMS value) I1, A Negative sequence current (RMS value) I2, A Zero sequence current (RMS value) I0, A	(0,01 – 2) I_{rated}	± (0,2+0,025· | I_{rated}/I-1 |) (δ) ± 0,2(γ) ± 0,2(γ)	3 и 4 4 4
22	Zero sequence current unbalance ratio (K_{I0}), %	0-50	±0,3 (Δ) for 0,05I_{rated}≤ I ≤2I_{rated}	3 и 4
23	Negative sequence current unbalance ratio (K_{I2}), %	0-50	±0,3 (Δ) for 0,05I_{rated}≤ I ≤2I_{rated}	3 и 4
24	Phase current of the 1st harmonic (RMS value) ($I_{A(1)}$, $I_{B(1)}$, $I_{C(1)}$), A	(0,01 – 2) I_{rated}	± (0,2+0,025· | I_{rated}/I-1 |) (δ)	3 и 4
25	Phase current of the n-order interharmonic (RMS value) ($I_{A(n)}$, $I_{B(n)}$, $I_{C(n)}$), (n=2...50), A	от 0,0005I_{rated} to 0,5I_{rated}	±0,05% (γ) for $I_{sg_{A(n)}}$<1% I_{rated} ±5% (δ) for $I_{sg_{A(n)}}$≥ 1% I_{rated}	3 и 4
26	n-order phase current harmonic distortion ($K_{IA(n)}$, $K_{IB(n)}$, $K_{IC(n)}$), (n = 2...50), %	0,05 to 50	±0,05 (Δ) for $K_{I(n)}$ < 1% ±5% (δ) for $K_{I(n)}$ ≥ 1%	3 и 4
27	Phase current subgroup total harmonic distortion (K_{IA}, K_{IB} K_{IC}),%	0,1 – 60	±0,15(Δ) for K_I < 3% ±5 % (δ) for K_I ≥ 3%	3 и 4
28	Phase current of the n-order interharmonic (RMS value) ($I_{A\,sg\,(n)}$, $I_{B\,sg\,(n)}$, $I_{C\,sg\,(n)}$), (n = 0...49), A	от 0,0005I_{rated} to 0,5 I_{rated}	±0,05% (γ) for $I_{sg_{A(n)}}$ <1% I_{rated} ±5% (δ) for $I_{sg_{A(n)}}$ ≥1% I_{rated}	3 и 4
29	n-order phase current interharmonic distortion ($K_{IA\,sg\,(n)}$, $K_{IB\,sg\,(n)}$, $K_{IC\,sg\,(n)}$), (n = 0...49), %	0,05 to 50	±0,05 (Δ) for $K_{I\,sg(n)}$ < 1% ±5% (δ) for $K_{I\,sg(n)}$ ≥ 1%	3 и 4
	PHASE ANGLES			
30	Phase angle between voltages of the 1st harmonic ($\varphi_{UAB(1)}$, $\varphi_{UBC(1)}$, $\varphi_{UCA(1)}$),°	От -180° to +180°	± 0,2(Δ)	4
31	Phase angle between voltage and current of the 1st harmonic ($\varphi_{UA(1)}$, $\varphi_{UB(1)}$, $\varphi_{UC(1)}$),°	От -180° to +180°	± 0,5 (Δ) 0,1I_{rated} ≤ I ≤2I_{rated} ± 5 (Δ) 0,01I_{rated} ≤ I ≤ 0,1I_{rated}	4
32	Phase angle between voltage and current of the n-order harmonic ($\varphi_{UA(n)}$, $\varphi_{UB(n)}$, $\varphi_{UC(n)}$), (n = 2...50),°	От -180° to +180°	± 3 (Δ) 0,5I$_{rated}$ ≤ I ≤ 2I$_{rated}$ $K_{U(n)}$ ≥ 5%, $K_{I(n)}$≥ 5% ± 5 (Δ) 0,5I$_{rated}$ ≤ I ≤ 2I$_{rated}$ 1%≤$K_{U(n)}$ ≤5%, 1%≤$K_{I(n)}$ <5% ± 5 (Δ) 0,1I$_{rated}$ ≤ I ≤ 0,5I$_{rated}$ $K_{U(n)}$≥ 5%, $K_{I(n)}$≥ 5%	4
33	Phase angle between the positive-sequence voltage and current (φ_{U1I1}), zero-sequence voltage and current (φ_{U0I0}), negative-sequence voltage and current (φ_{U2I2})	От -180° to +180°	± 0,5 (Δ) ± 5 (Δ)	4
34	Power-factor ($\cos\varphi_A$, $\cos\varphi_B$, $\cos\varphi_C$) Power-factor mean value ($\cos\varphi_{abc}$)	±(0,25$_{ind}$–1–0,25$_{cap}$)	± 0,01(Δ)	4 3 и 4
35	Phase angle between currents of the 1st harmonic ($\varphi_{IA(1)}$, $\varphi_{IB(1)}$, $\varphi_{IC(1)}$),°	От -180° to +180°	± 0,5 (Δ)	3 и 4
	POWER			
36	Active power (P_A, P_B, P_C), W 3-phase active power (P), W	(0,008 – 4)P_{rated}	±(0,4+$\frac{0,025}{\lvert\cos\varphi\rvert}\cdot\lvert\frac{I_{rated}}{I}$-1 | +0,04·$\lvert\frac{U_{rated}}{U}$-1|) (δ)	4 3 и 4
37	Positive sequence active power (P1), negative sequence active power (P2), zero sequence active power (P0), W	(0,008 – 4) P_{rated}	±(0,4+$\frac{0,025}{\lvert\cos\varphi\rvert}\cdot\lvert\frac{I_{rated}}{I}$-1 | +0,04·$\lvert\frac{U_{rated}}{U}$-1|) (δ)	4
38	Active power of the 1st harmonic ($P_{A(1)}$, $P_{B(1)}$, $P_{C(1)}$), W 3-phase active power of the 1st harmonic ($P_{(1)}$), W	(0,008 – 4) P_{rated}	±(0,4+$\frac{0,025}{\lvert\cos\varphi\rvert}\cdot\lvert\frac{I_{rated}}{I}$-1 | +0,04·$\lvert\frac{U_{rated}}{U}$-1|) (δ)	4 3 и 4
39	Phase & 3-phase active power of the n-order harmonic ($P_{A(n)}$, $P_{B(n)}$, $P_{C(n)}$), ($P_{(n)}$) (n = 2...50), W	(0,001 – 0,15) P_{rated}	5%(δ)0,5≤ | cos φ | ≤1	4
40	Reactive power (Q_A, Q_B, Q_C), var 3-phase reactive power (Q), var	(0,008 – 4) Q_{rated}	±(0,5+$\frac{0,025}{\lvert\sin\varphi\rvert}\cdot\lvert\frac{I_{rated}}{I}$-1| +0,04·$\lvert\frac{U_{rated}}{U}$-1|) (δ)	4 3 и 4
41	Positive sequence reactive power (Q1), negative sequence reactive power (Q2), zero sequence reactive power (Q0), var	(0,008 – 4) Q_{rated}	±(0,5+$\frac{0,025}{\lvert\sin\varphi\rvert}\cdot\lvert\frac{I_{rated}}{I}$-1| +0,04·$\lvert\frac{U_{rated}}{U}$-1|) (δ)	4
42	Reactive power of the 1st harmonic ($Q_{A(1)}$, $Q_{B(1)}$, $Q_{C(1)}$) , var 3-phase reactive power of the 1st harmonic ($Q_{(1)}$), var	(0,008 – 4) Q_{rated}	±(0,5+$\frac{0,025}{\lvert\sin\varphi\rvert}\cdot\lvert\frac{I_{rated}}{I}$-1| +0,04·$\lvert\frac{U_{rated}}{U}$-1|) (δ)	4 3 и 4
43	Phase & 3 -phase reactive power of the n-order harmonic ($Q_{A(n)}$, $Q_{B(n)}$, $Q_{C(n)}$) (n = 2...50), var	(0,001 – 0,15) Q_{rated}	5%(δ) 0,5≤ | sin φ | ≤1	4
44	Apparent power (S_A, S_B, S_C) , VA 3-phase apparent power (S), VA	(0,008 – 4) S_{rated}	±(0,5+0,04·$\lvert\frac{I_{rated}}{I}$-1| +0,04·$\lvert\frac{U_{rated}}{U}$-1|)	4 3 и 4
45	Positive sequence apparent power (S1), negative sequence apparent power (S2), zero sequence apparent power (S0), VA	(0,008 – 4) S_{rated}	±(0,5+0,04·$\lvert\frac{I_{rated}}{I}$-1| +0,04·$\lvert\frac{U_{rated}}{U}$-1|)	4
46	Apparent power of the 1st harmonic ($S_{A(1)}$, $S_{B(1)}$, $S_{C(1)}$), VA 3-phase apparent power of the 1st harmonic ($S_{(1)}$), VA	(0,008 – 4) S_{rated}	±(0,5+0,04·$\lvert\frac{I_{rated}}{I}$-1| +0,04·$\lvert\frac{U_{rated}}{U}$-1|)	4 3 и 4
47	Phase & 3 -phase apparent power of the n-order harmonic S ($S_{A(n)}$, $S_{B(n)}$, $S_{C(n)}$), ($S_{(n)}$) (n = 2...50), VA	(0,001 – 0,15) S_{rated}	5%(δ)	4

Basic parameters of the grid

The measurements are made with allowance for the voltage and current transformer ratio factors:
– phase current, phase and phase-to--phase (line) voltage, frequency;
– phase and three-phase power (active, reactive, apparent);;
– symmetrical components of current, voltage, and power in positive, negative and zero sequence, unbalance factors, phase shift angles;

Vector diagram of apparent power: the total power vector is placed in the fourth quadrant:
– the active power consumption of the network,
– the issue of reactive power in the network

Vector diagram of phase currents and voltages: the lead vectors of the phase currents of the corresponding vectors of phase voltages
– active-capacitive load in the phases A, b and C



The graph legend with the color symbols, name, current value and time of measurement parameter

Individual axis values for each parameter type, a single time axis

The scaling of the axes by using the scroll

Autoscale the graph up to the size of the visible area when you add a parameter and if the parameter is outside the visible area

Graphs of parameter changes in time, simulraneous view of up to 8 parameters. Working with charts in on-line mode.

Date and time of measurement, the value on the graph

Adding a parameter to the graph or removing from the graph is done by clicking on the table cell with the value of the parameter

Type Approval Certificates of Measuring Instrument RU.C.34.001A № 57810, 18.02.2015
Type Approval Certificates of Measuring Instrument RU.C.34.001A № 58154, 23.03.2015

PRELIMINARY VERSION

- MEASURING TRANSDUCER
- **ENERGY METER**
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BINOM$_3$ – is a multi-tariff, multi-channel, dual profile meter for providing reliable commercial and technical metering of electrical energy.

Active power metering in accuracy class: **0,2S** according to **IEC 62053-22:2003**

Reactive power metering in accuracy class: **0,5** according to methods of **IEC 62053-23:2003**

Power metering in **4** quadrants, in **16** power metering channels.

In each of the **16** power metering channels there are 2 metering profiles:

Multi-tariff metering : in 4 tariff rates (in summary form and also outside tariff rates)

Power metering storage time: 10 years with power off

Event logging as required by “Market Council” Non-Profit Partnership

For use in three-phase three- and four-conductor a.c. power supply circuits and systems.

Recalibration period: 12 years

Local and remote access to the built-in WEB-server

For more information please refer to integrated webserver at **www.binom3.com** | For more information please refer to our website at **www.binom3.ru**

BINOM$_3$

TECHNOLOGY OF SMART METERING

UNIQUE FUNCTION

The limits of allowing fundamental energy measurement inaccuracy

Current value	Coefficient value cosφ/sinφ	%[1]
to measure active energy by GOST 31819.22-2012 (cos φ)		
0,01 $I_{nom} \le I < 0,05\ I_{nom}$	1,00	± 0,4
0,05 $I_{nom} \le I \le I_{max}$		± 0,2
0,02 $I_{nom} \le I < 0,10\ I_{nom}$	0,50 (with inductive load) 0,80 (capacitive load)	± 0,5
0,10 $I_{nom} \le I \le I_{max}$		± 0,3
0,10 $I_{nom} \le I \le I_{max}$	0,25 (with inductive load)	± 0,5
	0,50 (capacitive load)	
to measure reactive energy according to the specifications 4228-004-80508103-2011 (sin φ)		
0,02 $I_{nom} \le I < 0,05\ I_{nom}$	1,00	± 0,8
0,05 $I_{nom} \le I \le I_{max}$		± 0,5
0,05 $I_{nom} \le I < 0,1\ I_{nom}$	0,50	± 0,8
0,10 $I_{nom} \le I \le I_{max}$	0,50	± 0,5
0,10 $I_{nom} \le I \le I_{max}$	0,25	± 0,8

[1] The limits of allowing fundamental inaccuracy

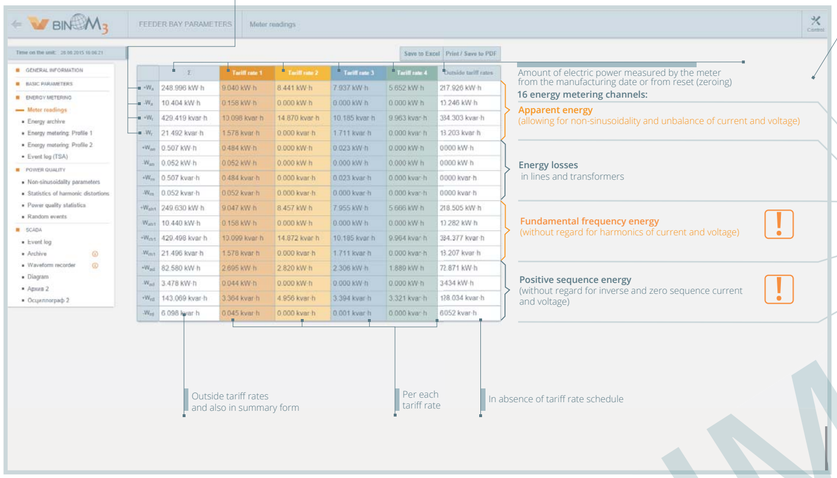
The meter is designed for large-scale installation in power networks, at generating plants with any installed power level, in power facilities of industrial enterprises, in power supply systems for enterprises in the petroleum industry, and in communal and residential property.

BINOM$_3$ establishes a new standard of smart meters. The counter is created for mass implementation in electrical networks, the generation of any of the installed capacity, energy and industrial businesses, residential consumers in the electricity supply systems of oil and gas industry.

BINOM$_3$ is the ideal choice for highly accurate, reliable, objective commercial (revenue) and technical accounting of electricity.

1. MULTI-TARIFF (OUT OF TIME) METERING

Active power import (received)
Active power export (supplied)
Reactive power import (received)
Reactive power export (supplied)



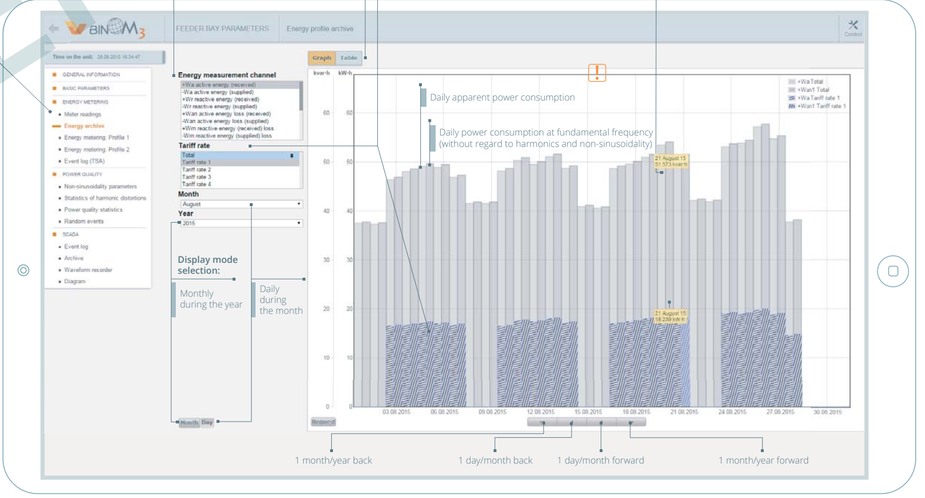
Metering data by accrued total in 4 tariff rates, in summary form and also outside tariff rates
Tariff rate schedule details:
- tariff rate switching at the border of half-hour intervals
- 8 day types (7 days of the week + a holiday)
- list of observed holidays moved to other calendar days
- any number of tariff seasons

Archive of energy measurements for 16 channels:
- Monthly energy consumption (generation) profile
- Daily energy consumption (generation) profile

The provision of data on the amount of apparent power, fundamental frequency and direct sequence power makes it possible to determine the energy distortion (energy losses) at Balance Sheet Attribution Demarcation points in the case of unbalance or non-linearity in the power supplier’s or consumer’s network.

2. ARCHIVE OF AMOUNT OF ENERGY MEASURED PER DAY/PER MONTH

Selection of several metering channels using SHIFT or CTRL keys
Display type selection:
- table
- graph
The values of selected tariff are applied to the cumulative value over the metering period
Metering period and electric power amount value over the metering period



3. ELECTRIC POWER METERING PROFILES

Load profile: the energy increment during the averaging interval
The duration of the averaging interval from a number sequence: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 min.

Profile 1 (revenue):
- standard metering interval **- 30 min**
- storage for **49** months (**30** min)

• Profile 2 (technical):
- standard metering interval **- 3 min**
- storage for **99** days (**3** min)

Event logging as required by “Market Council” Non-Profit Partnership:
- power sub system events:
  - meter restart
  - power off/on;
- real-time subsystem events:
  - time adjustments,
  - clock problem;
- data security subsystem events:
  - authorized web-server login,
  - unauthorized access attempt event (wrong password, cover tampering),
  - setting data modification;
- metering circuit events:
  - current/voltage drift
  - absence of voltage while the current is present.

Event (TSA) log capacity – **16 384** records.

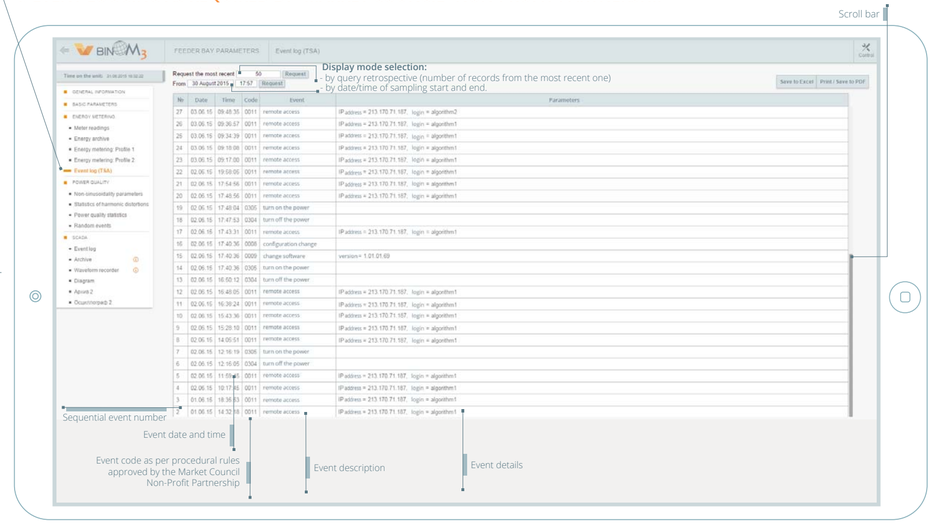
Metering data transfer according to protocols:
IEC 60870-5-101:2003
IEC 60870-5-104:2000
Frames with identifier type 140, 141

Documents transferred as **XML files** according to command from higher level hardware:
- Profile 1 (revenue) data: **80020** format,
- Data on status of measuring tool (ATC log): **80030** format (according to the requierements of Non-Commercial Partnership Administrator of the trade System of the Wholesale Power Market of the Unified Energy System (TSA) Russia),
- Profile 2 (technical), daily/monthly consumption profile, power by accrued total: format similar to **80020**.

Security from unauthorized access:
- **software-implemented:**
- numeric password assignment according to several privileged access levels,
- **hardware-implemented:**
- manufacturing facility verification officer’s seal application,
- seal application to the terminal panel cover,
- cover tampering sensor alarm (while meter is ON).

4. EVENT LOGGING AS REQUIRED BY “MARKET COUNCIL” NON-PROFIT PARTNERSHIP

Scroll bar



Type Approval Certificates of Measuring Instrument, RU.C.34.001A № 57810, 18.02.2015
Type Approval Certificates of Measuring Instrument, RU.C.34.001A № 58154, 23.03.2015

PRELIMINARY VERSION

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2. POWER QUALITY CONTROL AND STATISTICAL ANALYSIS

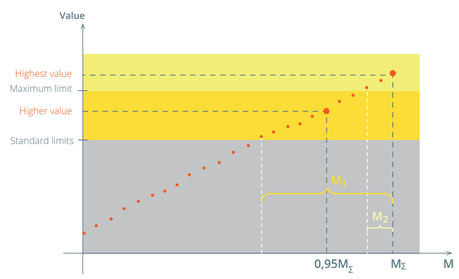
Statistical analysis of the **PQ parameters** is performed within the **monitoring period** that may last 1 week or 1 day. The duration of the **monitoring period** is user-defined through the configuration settings of the instrument.

Power frequency variations are measured at **10-second** intervals, compared with permissible values and assessed for conformance to the rated values during the monitoring period.

Voltage fluctuations are measured over 10 periods of frequency over the 10-minute interval, compared with permissible values and assessed for conformance to the rated values during the monitoring period.

For statistical analysis purposes, all values of each **PQ parameters** measured over the monitoring period are sequenced in the ascending order on the numeric axis (from lowest to highest) and then the statistical characteristics are determined that are compared to the rated values:

- highest value,
- higher value,
- relative time of measured data drift beyond standard limits T_1,
- relative time of of measured data drift beyond threshold limits (T_2 for both under- and -over deviation).



T_1 and T_2 are calculated by the formulas: $T_1 = \frac{M_1}{M_\Sigma} \cdot 100\%$ $T_2 = \frac{M_2}{M_\Sigma} \cdot 100\%$

where:
M_1 – number of readings drifted beyond standard limits,
M_2 – number of readings drifted beyond threshold limits,
M_Σ – total number of readings logged over 100% of the monitoring period.
$09{,}5M_\Sigma$ – number of readings logged over 95% of the monitoring period.

Measured PQ parameter statistical characteristics

Type of statistical characteristic	Input parameters for statistical analysis									
	$\delta U_{(-)y}$	$\delta U_{(+)y}$	$K_{U(n)y}$	K_{Uy}	$K2_{Uy}$	$K0_{Uy}$	P_{st}	P_{lt}	$\Delta f_{(-)}$10	$\Delta f_{(+)}$10
Highest value	$\delta U_{(-)}$	$\delta U_{(+)}$	$K_{U(n)(100\%)}$	$K_{U(100\%)}$	$K2_{U(100\%)}$	$K0_{U(100\%)}$	P_{st}	P_{lt}	$\Delta f_{(-)100\%}$	$\Delta f_{(+)(100\%)}$
Higher 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

Data labelling – tagging the readings and averaged PQ parameters logged over the periods when interruptions, voltage dips, and overvoltage took place.

Labeling is used to avoid multiple logging of the same single event for different indices (e.g., simultaneously logging a voltage dip as both voltage dip and frequency deviation).

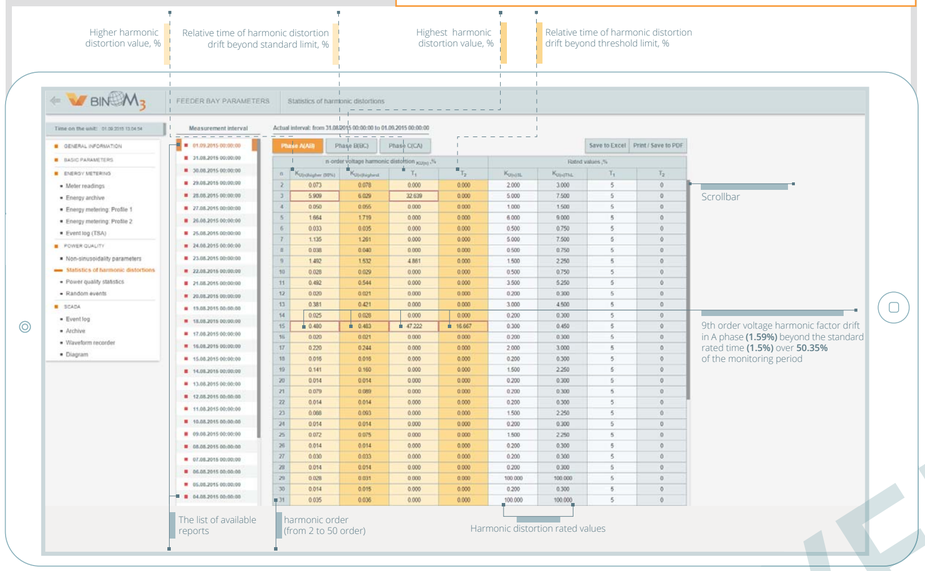
Readings acquired over tagged basic intervals (10 cycles) are excluded from the analysis for all subsequent time periods.

When calculating T_1 and T_2 values, tagged values are excluded from M_1, M_2 and M_Σ parameters.

Type Approval Certificates of Measuring Instrument RU.C.34.001A № 57810, 18.02.2015
Type Approval Certificates of Measuring Instrument RU.C.34.001A № 58154, 23.03.2015

VOLTAGE NON- SINUSOIDALITY $K_{U(n)} = \frac{U_{(n)}}{U_{(1)}} \cdot 100\%$

Voltage harmonics factor values should not exceed (a) the rated values established by the standards over **95%** of the monitoring period and (b) the rated values established by the standards multiplied by **1.5** over **100%** of the monitoring period.



Frequency deviation should not exceed:

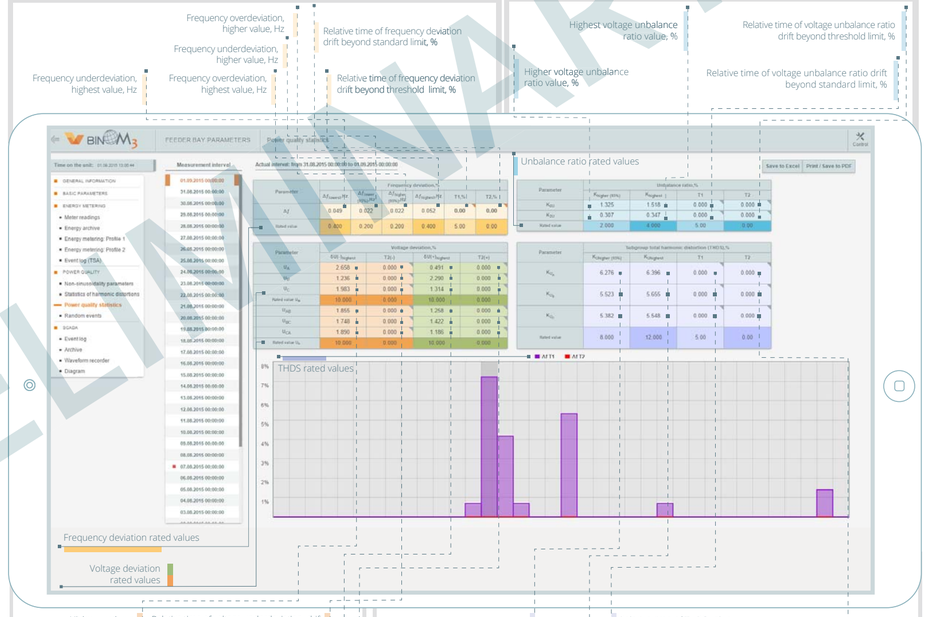
0,2 Hz over 95% of the monitoring period in one week
0,4 Hz over 100% of the monitoring period in one week

FREQUENCY DEVIATION $\Delta f_{10} = f_{10} - f_{HOM}$

Inverse/zero sequence voltage unbalance ratio should not exceed:

2 % over 95% of the monitoring period in one week
4 % over 100% of the monitoring period in one week

VOLTAGE UNBALANCE $K2_U = \frac{U2_{(1)}}{U1_{(1)}} \cdot 100\%$ $K0_U = \frac{U0_{(1)}}{U1_{(1)}} \cdot 100\%$



VOLTAGE OVER- AND UNDERDEVIATION

$\delta U_{(-)} = \frac{U - U_{HOM}}{U_{HOM}} \cdot 100\%$ при $U > U_{HOM}$ $\delta U_{(+)} = \frac{U_{HOM} - U}{U_{HOM}} \cdot 100\%$ при $U < U_{HOM}$

VOLTAGE NON-SINUSOIDALITY $K_U = \sqrt{\frac{\sum_{n=2}^{50} U_{(n)}^2}{U_{(1)}}}$

According to the standard, voltage under- and overdeviations at the electric power transmission point should not exceed:

10% over 100% of the monitoring period in one week
of standard (default) voltage value

According to the standard, THDS values are established for power networks of different voltage classes. For example, for 380 V grids the value of the THDS should not exceed:

8 % over 95% of the monitoring period in one week
12 % over 100% of the monitoring period in one week

PRELIMINARY VERSION

For more information please refer to integrated webserver at **www.binom3.com** | For more information please refer to our website at **www.binom3.ru**

BINOM3

UNIQUE FUNCTION

VALUABLE INFORMATION ABOUT THE QUALITY

BINOM3 is a certified universal device for monitoring and controlling power quality, with powerful resources for the statistical analysis of the results of measurements. It provides comprehensive information on the quality of the measured amount of power at the revenue metering point.

BINOM$_3$ can be used for the following tasks:

– **power quality control** for determining the conformity of power quality to established standards, to conditions of power supply contracts for the examination of power quality claims, and the performance of periodic and certification tests;

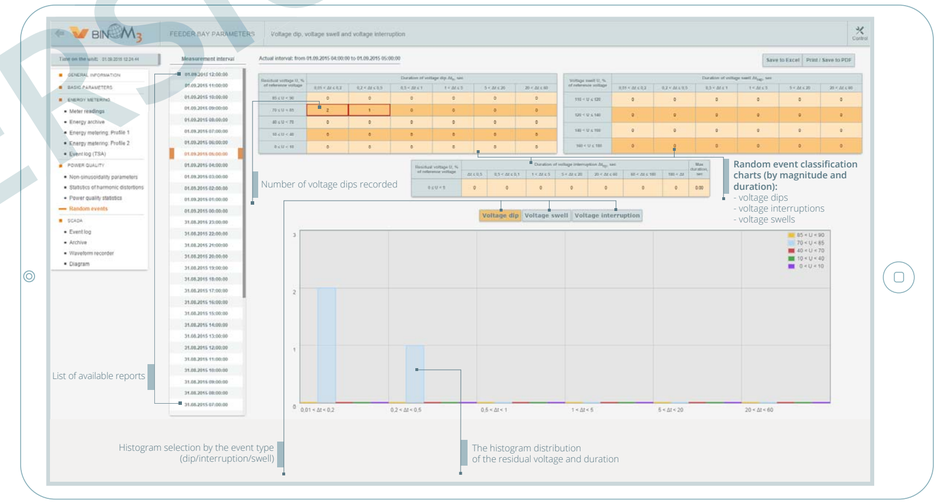
– **power quality monitoring** for diagnostic and research operations, calculation of power network conditions, development of actions to be taken for power quality management, tracing the cause of distortions, development of commercial sanctions, discounts and supplements for power tariffs.

At the point of the commercial (technical) metering, the device provides important information about the quality of the measured amount of electricity.

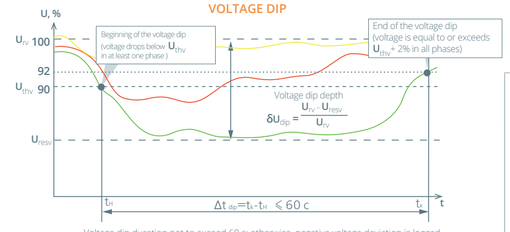
2.2. RANDOM EVENTS RECORDING

Random events shall mean sudden and significant changes in the voltage waveform resulting in a deviation of its parameters from the standard values.

For the purpose of detection and assessment of random events, RMS voltage values are calculated for the half cycle of the fundamental frequency (~ 10 ms).

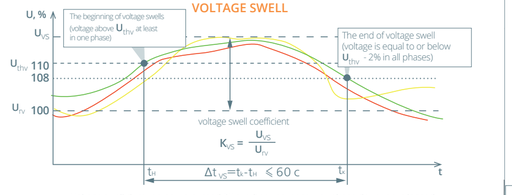


VOLTAGE DIP



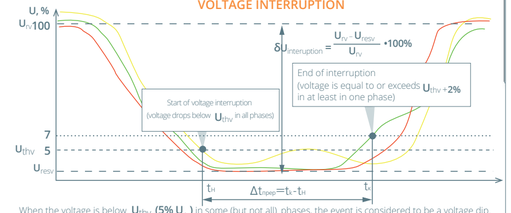
Voltage dip duration not to exceed 60 s; otherwise, negative voltage deviation is logged.

VOLTAGE SWELL



Voltage swell duration not to exceed 60 s; otherwise, negative voltage deviation is logged.

VOLTAGE INTERRUPTION



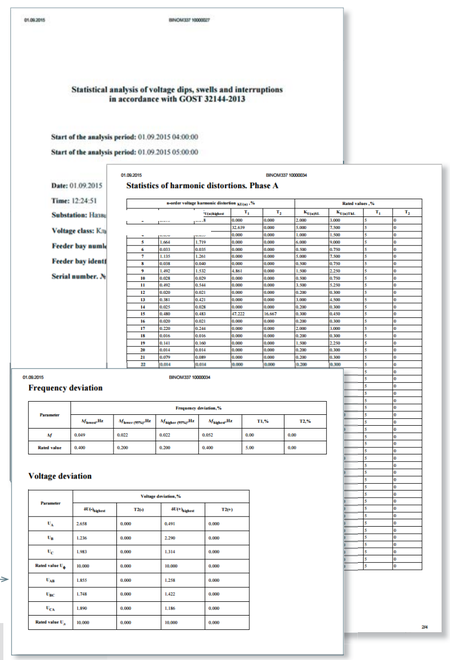
When the voltage is below U_{thv} (5% U_{hv}) in some (but not all) phases, the event is considered to be a voltage dip.

U_{hv} – reference voltage (standard or default value)
U_{thv} – threshold value at the beginning of the voltage dip, interruption or swell
U_{resv} – residual voltage U_{vS} – voltage swell value

фаза A
фаза B
фаза C

4. POWER TEST REPORT

Power Qulity Test Report created in the device **(GOST 33073-2014)**



- ☐ MEASURING TRANSDUSER
- ☐ ENERGY METER
- **POWER QUALITY METER AND ANALYSER**
- ☐ FEEDER BAY CONTROLLER
- ☐ FAULT (EMERGENCY EVENTS) RECORDER
- ☐ "BLACK BOX" OF ELECTRICAL PROCESSES
- ☐ AUTOMATIC PROCESS CONTROL OF ELECTRICAL BAY IN ONE DEVICE

BINOM3 is a certified universal instrument for monitoring and controlling power quality indicators, with powerful resources for the statistical analysis of the results of measurements. It provides comprehensive information on the quality of the measured amount of power at the commercial power metering point.

Methods of power quality measurement	**IEC 61000-4-30:2008**	(class A)
Methods of measuring harmonics (to the 50th order) and interharmonics (to the 49th order)	**IEC 61000-4-7:2009**	(class I)
Methods of measuring the flicker	**IEC 61000-4-15:2010**	
Adjustable metering intervals and evaluation of conformity of power quality parameters to standards	**EN 50160:2010***	* Voltage characteristics of electricity supplied by public distribution networks
Power test report	**GOST 33 073-2014**	!
Extended range of three-phase feeder-bay parameters	**GOST R 8.655-2009**	!
Local and remote access to the built-in WEB-server		!

For more information please refer to integrated webserver at **www.binom3.com** | For more information please refer to our website at **www.binom3.ru**

BINOM3

UNIQUE FUNCTION !

EVERYTHING ABOUT ELECTRIC ENERGY

'Power quality' shall mean the extent of conformance of the electric power characteristics at certain point of the power system with the unified power quality parameter.

$BINOM_3$ can be used for the following tasks:

– **Power quality monitoring** for diagnostic and research operations, calculation of power network conditions, development of actions to be taken for power quality management, tracing the cause of distortions, development of commercial sanctions, discounts and supplements for power tariffs.
– **Power quality control** for determining the conformity of power quality to established standards, to conditions of power supply contracts for the examination of power quality claims, and the performance of periodic and certification tests;

1. POWER QUALITY MONITORING

1.1. Measurement of power quality parameters

Calculations of PQ parameters and assessment of their conformity with the regulatory/controlled ones are performed according to the methods established by the national and international standards.

The list of regulated PQ parameters and non-regulated parameters of random events (dips, interruptions, and overvoltages) are listed in the table below.

PQIs are measured over the baseline time interval that is equal to 10 periods of the base frequency (~ 200 ms for 50 Hz).

In order to obtain PQI values over longer intervals, averaging (aggregation) of the readings obtained over the baseline intervals is performed. The average value is equal to the square root of the arithmetic mean of the squares of the input variables. In a typical configuration settings of the meter, the PQI averaging intervals are defined in accordance with the requirements of the standards. Averaging intervals can be modified by the user.

PQI EFFECTIVE MEASURING RANGE AND ERROR MARGINS ~200 ms

	№	Parameter	Symbol	Measurement range	Reference error margins: Δ– absolute; δ – relative, %; γ – reduced, %.	BASIC SETTINGS for statistical processing of power quality parameters: Measurement/ averaging interval	Standard limit	Threshold limit
VOLTAGE DEVIATION	1	Voltage overdeviation, %	$\delta U_{A(+)}$, $\delta U_{B(+)}$, $\delta U_{C(+)}$	0 – + 100	± 0,2 (Δ)	10 min	–	10%
	2	Voltage underdeviation, %	$\delta U_{A(-)}$, $\delta U_{B(-)}$, $\delta U_{C(-)}$	0 – + 90	± 0,2 (Δ)		–	10%
VOLTAGE UNBALANCE	3	Zero sequence voltage unbalance ratio, %	K_{0U}	0 – 20	± 0,15 (Δ)		2%	4%
	4	Negative sequence voltage unbalance ratio, %	K_{2U}	0 – 20	± 0,15 (Δ)		2%	4%
VOLTAGE NON-SINUSOIDALITY	5	n-order voltage harmonic distortion (n = 2...50), %	$K_{UA(n)}$, $K_{UB(n)}$, $K_{UC(n)}$, $K_{UAB(n)}$, $K_{UCA(n)}$	0,05 до 50	±0,05 (Δ) для $K_{U(n)} < 1\%$ ±5 (δ) для $K_{U(n)} \geq 1\%$	10 min	EN 50160: 2010	EN 50160: 2010
	6	n-order voltage interharmonic distortion (n = 2...50), %	$K_{UAisg(n)}$, $K_{UBisg(n)}$, $K_{UCisg(n)}$, $K_{UABisg(n)}$, $K_{UCAisg(n)}$	0,05 до 50	±0,05 (Δ) для $K_{disg(n)} < 1\%$ ±5 (δ) для $K_{disg(n)} \geq 1\%$		not standardized	
	7	Voltage subgroup total harmonic distortion, %	K_{UA}, K_{UB}, K_{UC}, K_{UAB}, K_{UBC}, K_{UCA}	0,1 –50	±0,15 (Δ) для $K_U < 3\%$ ±5 (δ) для $K_U \geq 3\%$		EN 50160: 2010	EN 50160: 2010
FLICKER	8	Short-term flicker, per unit value	P_{St}	0,2 – 10	±5 (δ)	10 min	–	1,38
	9	Long-term flicker, per unit value	P_{Lt}	0,2 – 10	±5 (δ)	2 hours	–	1
FREQUENCY DEVIATION	10	Frequency, Hz	f_{10}	42,5 – 57,5	± 0,01 (Δ)	10 s	not standardized	
	11	Frequency deviation, Hz	Δf_{10}	-7,5 – +7,5	± 0,01 (Δ)	10 вы	±0,2 Hz	±0,4 Hz
	12	Frequency overdeviation, %	Δf_{10} (+)	0 – +7,5	± 0,01 (Δ)		0,2 Hz	0,4 Hz
	13	Frequency underdeviation, %	Δf_{10} (-)	0 – +7,5	± 0,01 (Δ)		0,2 Hz	0,4 Hz
RANDOM EVENTS	14	Flags and voltage dip counter		–	–			
		Voltage dip duration, sec		0,01-60	± 0,01 (Δ)			
		Voltage dip depth, %		10 - 100	± 1,0 (Δ)			
	15	Flags and voltage interruption		–	–			
		Voltage interruption duration, sec		0,01-180	± 0,01 (Δ)			
		Voltage interruption depth, %		95-100	± 1,0 (Δ)			
	16	Flags and voltage swells		–	–			
		Voltage swell duration, sec		0,01-60	± 0,01 (Δ)			
		Voltage swell coefficient, (relative unit)		1,1-2	± 0,01 (Δ)			

Modern power systems are distinctive in their use of the power electronics components and equipment with a nonlinear current-voltage characteristics of the input circuits. Such electric loads are sources of higher current harmonics, thus creating a distortion of the voltage waveform.

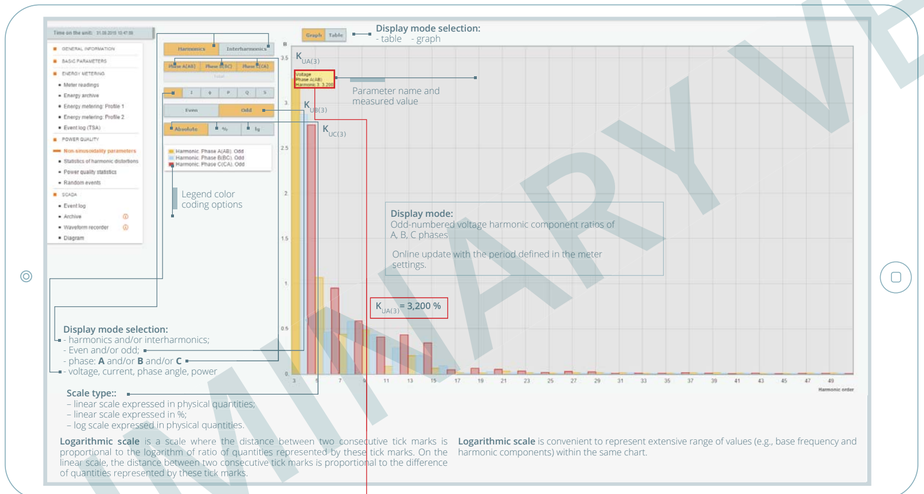
Current/voltage non-sinusoidality has a negative impact on the operation of electrical equipment as follows:
- It causes additional heating, premature failure, reduced service life;
- It increases the voltage/power losses and reduces transmission line capacity;
- It causes accidents due to rapid deterioration of insulation and false alarms of the automatic equipment.

The harmonic structure varies depending of the predominant consumer load types. On-line BINOM3 meter readings have been received from the meter installed at the input line of 0.4 kW power unit of the administrative and industrial building. The consumer load is comprised of lighting, computer equipment, and laboratory testing equipment.

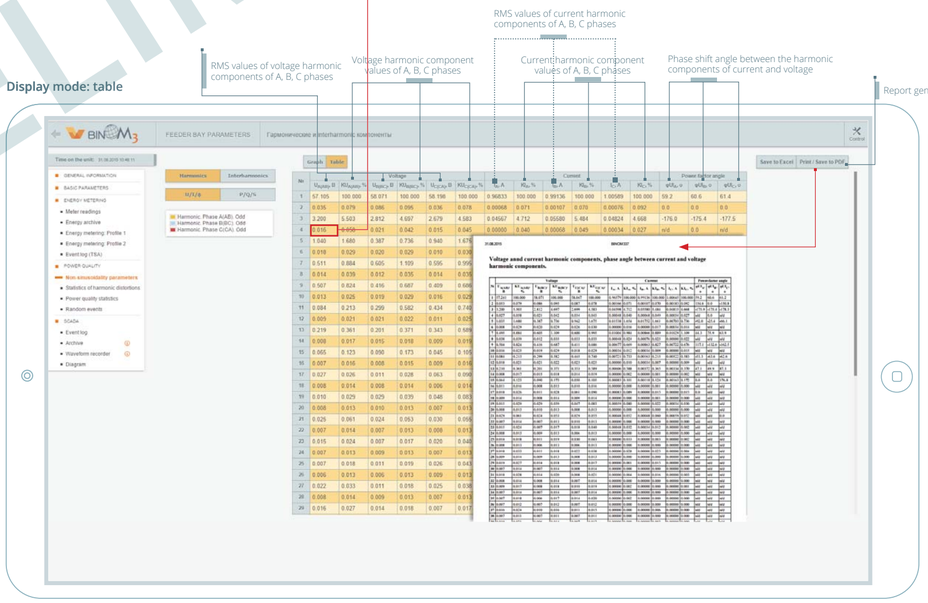
Presence of voltage harmonics of 3rd, 9th and 15th order has been identified. Presence of triplen harmonics can cause overheating and burn-out of neutral (zero) conductors. Broken neutral wire in the presence of asymmetry causes neutral shift, overvoltage, and loads failure, which in turn may lead to a major technological and economic damages.

Display mode: graph

On the page **«Non-sinusoidality parameters»** displays the RMS value of the harmonic and interharmonics components of currents, voltages, angles of phase shifts between the harmonic components of voltage and current, power harmonics.



Display mode: table



1.2. MEASUREMENT OF ADDITIONAL CHARACTERISTICS ELECTRICAL ENERGY

Power system objects are both sources and consumers of harmonics. The source of harmonics and the extent of distortion can be determined from the harmonics magnitude sign. **$BINOM_3$** continuously monitors **harmonics power level** at the installation point and provides **comprehensive statistical database** for the analysis of the causes and patterns of harmonics fluctuations. Once these causes and patterns are identified, it is possible to take measures to reduce the level of non-sinusoidality, to improve the mains voltage waveform, to reduce losses and to improve energy efficiency.

$BINOM_3$ calculates harmonics power over the baseline measurement interval and is capable of averaging the same over longer intervals depending on its configuration settings (e.g., 1 minute, 10 minutes, 30 minutes, etc.)

Shown below is a histogram of harmonics power consumed and generated by a non-linear consumer load. Negative values of the harmonics power determine the power fluctuations that cause additional losses (incomplete power metering) incurred by the power distribution company (or supplier). Such losses of electric power require increasing the power consumed from the electricity source by the amount of power attributed to these fluctuations.

For complete list of additional power characteristics measured by **$BINOM_3$**, see section **«MEASURING TRANSDUCER».**

Only the smart meter featuring separate measurement of apparent energy and fundamental frequency energy makes it possible to determine energy distortion !

incomplete energy metering, ~ energy **losses** ~ energy **distortion**

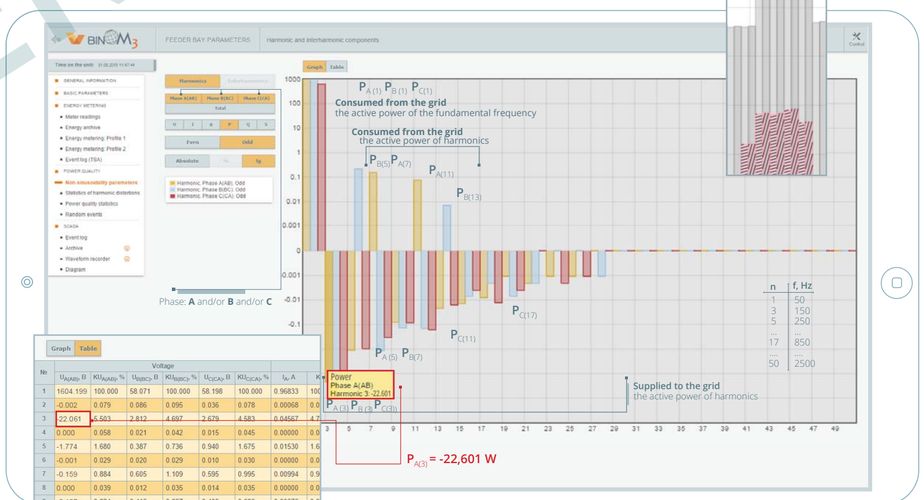
Active fundamental frequency energy consumed per day $W_{A(1)}$ **55, 665 kWh**

$W_{A(n)} = W_{A(1)} - W_{A(-)}$ **0, 667 kWh per day (1,2% of the fundamental frequency energy)**

Active apparent energy (accounted for harmonics) consumed $W_{A(-)}$ **54, 988 kWh**

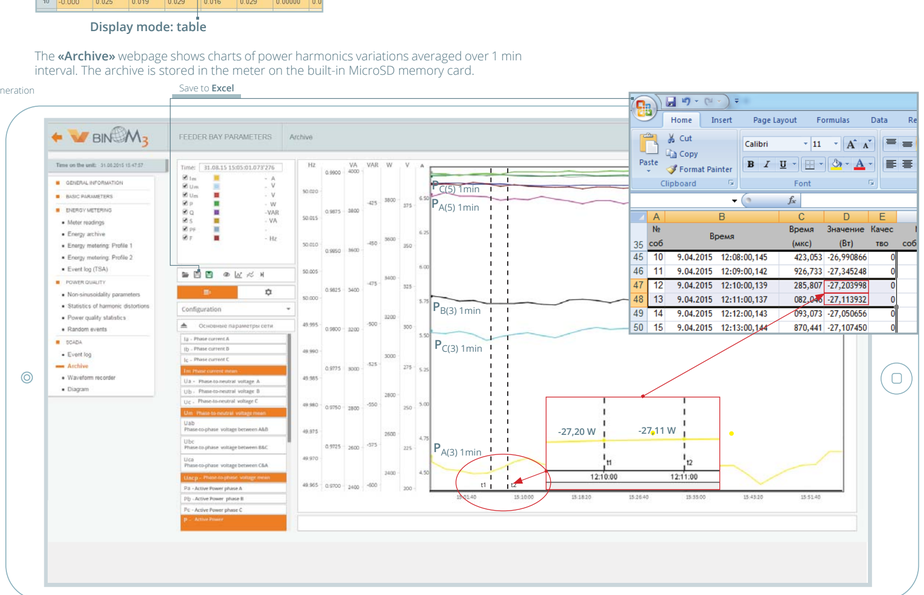
Excerpt from daily power profile archive

Display mode: graph



Display mode: table

The **«Archive»** webpage shows charts of power harmonics variations averaged over 1 min interval. The archive is stored in the meter on the built-in MicroSD memory card.



PRELIMINARY VERSION

- MEASURING TRANSDUSER
- ENERGY METER
- POWER QUALITY ANALYSER AND METER
- **FEEDER BAY CONTROLLER**
- FAULT (EMERGENCY EVENTS) RECORDER
- "BLACK BOX" OF ELECTRICAL PROCESSES
- AUTOMATIC PROCESS CONTROL OF ELECTRICAL BAY IN ONE DEVICE

BINOM$_3$ is a bay controller provided with:
– 16 digital inputs (DI, teleindication) for collecting and recording signals on the status of switchgear switching devices, relay protection and automatic safety systems, emergency control automatics (ECA), and engineering and auxiliary systems;
– external two-, three- and four-channel relay unit for local and remote control of equipment.

- DI sampling rate cycle: **100 µs**
- Discreteness of adjustment of debounce filter: **100 µs**
- Positional accuracy of teleindication readouts to single time: not more than **1 µs**
- Adjustable filter for number of switches of teleindication source per second
- Support for single-element and two-element[1)] teleindication
- Storage of **16,000,000 events** in a **1 GB** memory (built-in MicroSD memory card or FTP drive).
- Single-stage and two-stage telecommand conditions, teleswitching
- Remote control (teleswitching) hardware blocking
- Local and remote access to the built-in WEB-server

1) When using two-element information, the condition of the equipment is determined by the values of signals at two discrete inputs.

Бит 1	Бит 2	Values of teleindication	Teleindiation of description values
0	0	< 0 >	indeterminate or intermediate state
0	1	<1>	definition state ON
1	0	<2>	definition state OFF
1	1	<3>	the indeterminate state

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BINOM$_3$

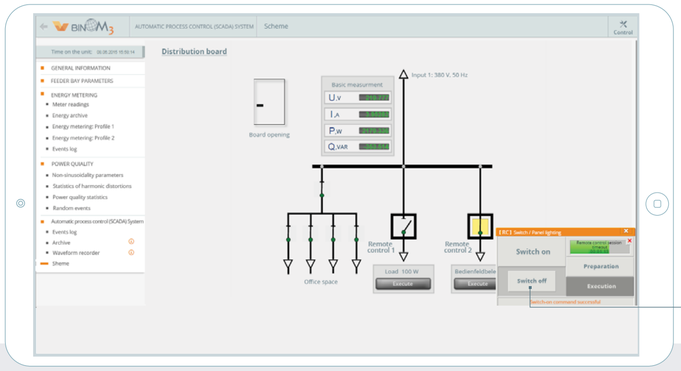
UNIQUE FUNCTION

FEEDER BAY CONTROLLER OF THE NEW GENERATION

Models of power quality analyzer and meter **BINOM$_3$** equipped with discrete inputs and relay outputs, represented as Feeder Bay Controller that allow you to pass to the practical creation of a «smart grid and power systems». The devices can be considered as a means of local and remote load control in violation of modes of consumption and distortion power quality, including automatic control equipment according to pre-set algorithms.

The built-in WEB pages in the device saves time and provides economic benefit to commissioning.

On the built-in Web-server of the device implements the diagram page of accession, reflecting the actual status of switching devices, emergency warning signals, measured values of parameters of the electric network.

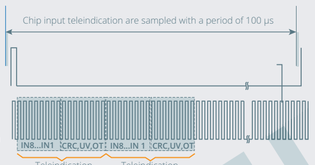


1. ФУНКЦИЯ ТЕЛЕСИГНАЛИЗАЦИИ

Actual element base, built into the architecture of the device, allowed us to obtain outstanding temporal characteristics in the processing of signals at the discrete inputs and accurate interpretation of their values.

Chip discrete signals input node signaling provide:
- reading of information from the 16 digital inputs of the CU and its transmission to the Central processor,
- formation of the cyclic code CRC to guarantee correct interpretation of the data,
- the formation of flags of reducing the supply voltage below the minimum desired value (UV) and flag overheating of the chip more than the maximum allowable temperature. (OT)

Provides galvanic isolation internal nodes of the counter when exposed to discrete inputs AC voltage of 3 kV for 1 min.



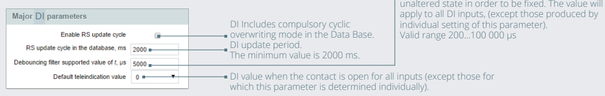
Reading data from the chip input teleindication is performed via serial interface with a clock frequency of 2.5 MHz, which allows to achieve a precision of binding to the same time + 0.4 microseconds.

Digital inputs characteristics

Parameter	Min.	Type	Max	Measurement unit
The low-level signal 1)	– 1,2	0	+ 10,4	В
The high signal 1)	+ 11,5	24	+ 30	В
The voltage between the outputs on the transducer in the open position	23	24	25	В
The resistance of a closed transducer	0	–	150	Ω
The resistance of a disconnected transducer	50	–	∞	kΩ
The current through closed transducer (current class 1 according to **IEC 870-3-89**)	1	2	5	mA
Class of protection against disturbances and overstrains protection according to **IEC 870-3-89**	–	2	–	

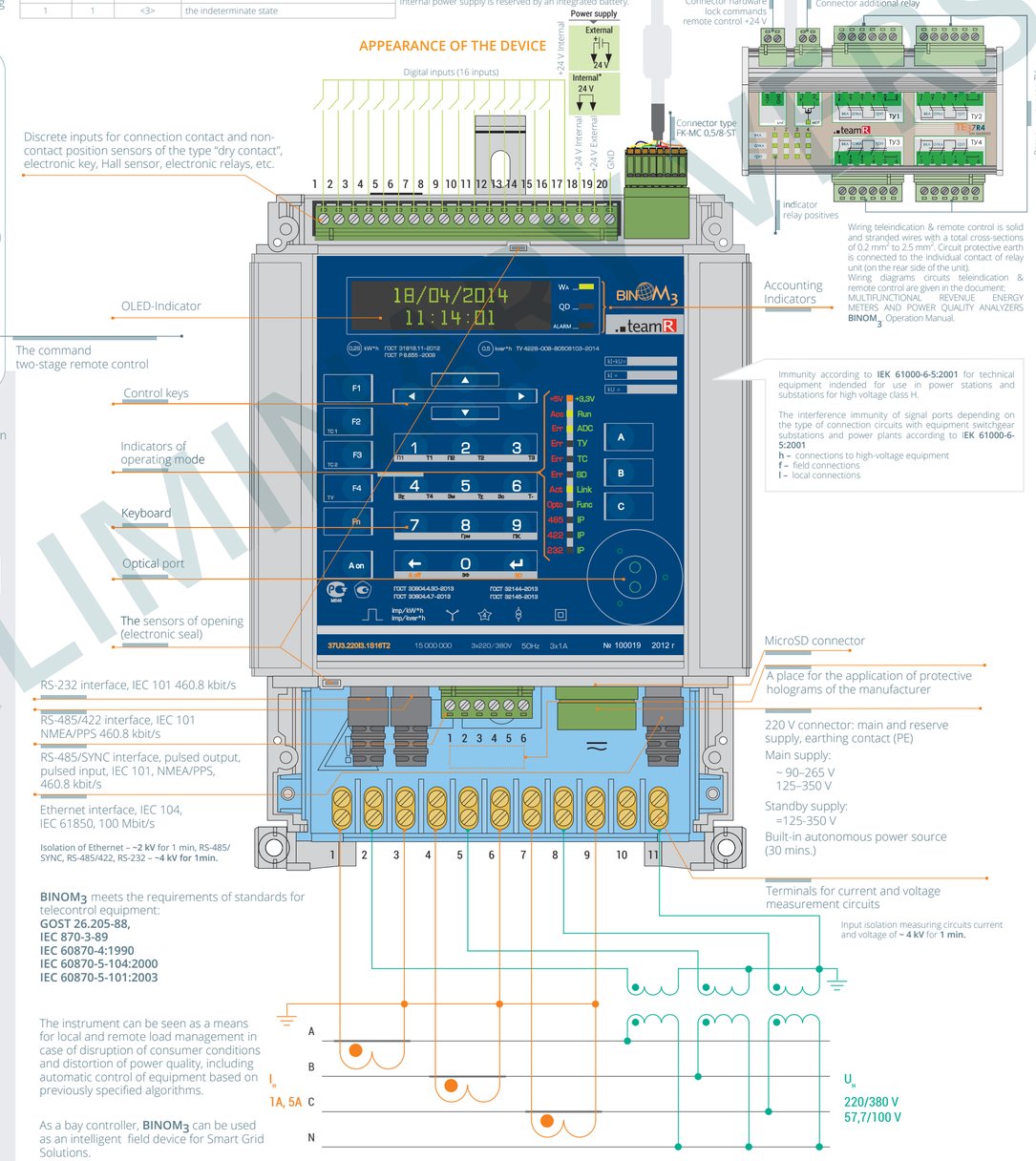
1) -the values of input levels set at the factory.

Function settings DI registration that is applicable for all digital inputs except sets with individual settings.



Discrete inputs Individual settings

APPEARANCE OF THE DEVICE



BINOM$_3$ meets the requirements of standards for telecontrol equipment:
GOST 26.205-88,
IEC 870-3-89
IEC 60870-4:1990
IEC 60870-5-104:2000
IEC 60870-5-101:2003

The instrument can be seen as a means for local and remote load management in case of disruption of consumer conditions and distortion of power quality, including automatic control of equipment based on previously specified algorithms.

As a bay controller, **BINOM$_3$** can be used as an intelligent field device for Smart Grid Solutions.

2. REMOTE CONTROL FUNCTIONS

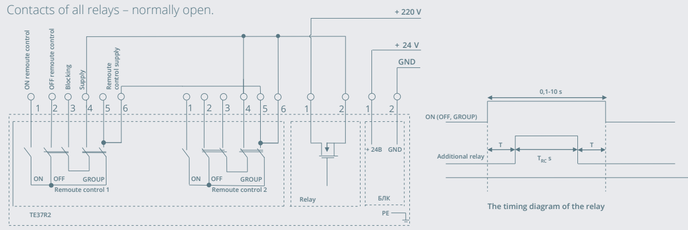
Blocks relays provide high voltage isolation and coordination of load controlled equipment with electronic counter circuits **BINOM$_3$**. Switching capacity up to **5A** in AC circuits **~ 220 V** and DC **=220 V** with inductive load.

In the node remoute control counter is implemented:
- periodic self-test of the remoute control circuits for the early detection of abnormal situations,
- protection against failures of the software
- protection from accidents power sources.

Blocks the relay depending on the version have 2, 3 or 4 channel remote control. At the same time only one channel of the remoute control can be located in the active state. Each channel of the remoute control contains three relays:
- on command **ON** (the wiring to the inclusion of actuators, switching devices),
- commands disable **OFF** (wiring disconnect the drives for this purpose the apparatus and lock automatic reclosing AR),
- select the channel – **GROUP**.

The unit includes an additional relay to control switching devices with large inductive loads. It can be electromagnetic (in block TE38Rx) or solid (in block TE37Rx).

Contacts of all relays – normally open.



CWiring diagram of the circuits of remoute control for switching the direct current circuit block TE37R2

The timing diagram of the relay

Additional relay closes on time **T (ms)** later and opened on time **T (ms)** earlier than the relay **ON, OFF, GROUP** (value **T** is set by parameterization).

Relay unit equipped with an input of a hardware lock relay control (**=24 V**)

Galvanic isolation outputs relay control electromagnetic relay and the input of the lock – ~ **4 kV for 1 min.,** with solid state relays – **~2.5 kV for 1 min.**

Electromagnetic relay – an Electromechanical device, which closes or open mechanical electrical contacts in the feed to the relay coil of an electric current whose value corresponds to the condition of the relay.

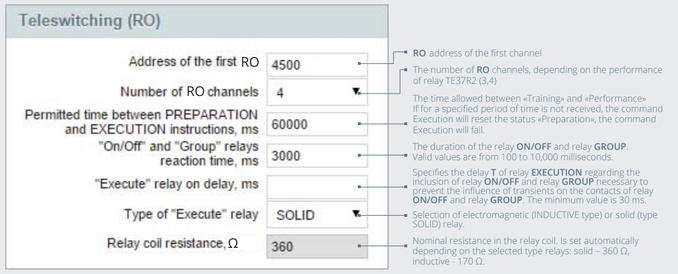
Solid state relay – actual semiconductor device containing a powerful power switches on the transistor structures.Solid state relay successfully used to replace the traditional electromagnetic relay, as they provide the most reliable non-invasive method of switching power circuits of the actuators. Solid state relay impact on chain driven by sudden changes in electrical parameters of output circuits (resistance, voltage, current)

Electrical and timing specifications digital outputs

Description	Min.	Type	Max.	Measurement unit
Switching voltage AC	0,5	–	250	V
Switched AC	0,05	–	5	A
Switching voltage DC	0,5	–	250	V
Switched constant current: - if the voltage is 24 V	0,05		8	A
- if the voltage is 220 V	0,05	–	0,1/ 5 1)	A
- if the voltage is 250 V	0,05		3 1)	A
Time relay circuit	0,1 2) 0,5 3)	1	10	s
Class of protection against interference and overload protection according to **IEC 870-3-89**	–	2	–	

1) – when using solid state relays in the relay box (TE37Rx),
2) – for solid state relays,
3) – for electromagnetic relays.

Teleswitching settings function



PRELIMINARY VERSION