BINOM3 – MULTIFUNCTIONAL REVENUE ENERGY METER AND POWER QUALITY ANALYZER

Technical description

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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INTRODUCTION

The transition to an electric grid based on a new Smart Grid technology, which has become the objective of innovative advances in the Russian power distribution system, is intended to reduce power losses and save energy resources, while increasing the productivity, the quality of control, the operating efficiency, and the reliability of the power supply.

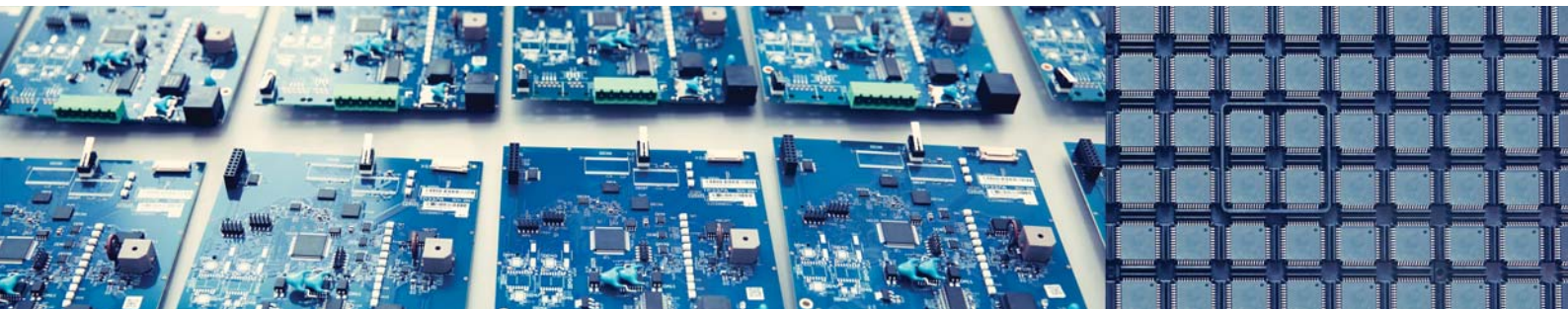
Success in achieving these objectives is largely dependent on the degree to which advanced technology can be introduced into the process of providing the staff of electric grid companies with information about the managed facilities. The new technology will make it possible to produce new equipment and enhance the quality of information provided to users, and to investigate the characteristics of the behaviour of monitored systems, find new methods of determining causation, and take rational, well-grounded decisions.

The development of microelectronics, which has substantially reduced the cost of electronic components (e.g. high-performance signal processors, high-capacity solid-state storage devices, high-capacity high-speed RAM microcircuits, multibit multi-channel ADCs), **has enabled data processing technology** (hard real-time multitasking operating systems, object-oriented libraries, protocol stacks) **which was previously available only in isolated computerized collection centres of automated process control and automated management control systems to be used in field installations comparable in cost to power meters, providing these installations with the same capacity as large-scale systems.**

The mastery of contemporary microprogramming and microelectronics technology, together with the experience of producing equipment and conventional automatic control (SCADA) systems for power resources, has made it possible **to develop unparalleled levels of multifunctionality and measurement accuracy in the new generation of field devices,** thus creating a truly **NEW INDUSTRIAL STANDARD OF FUNCTIONALITY:**

BINOM$_3$ MULTIFUNCTIONAL REVENUE ENERGY METER AND POWER QUALITY ANALYZER

Prizewinner at the international specialized exhibition RUSSIAN ELECTRIC GRIDS 2014



1. THREE-PHASE MEASURING TRANSDUCER

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 system and various analytical tasks.

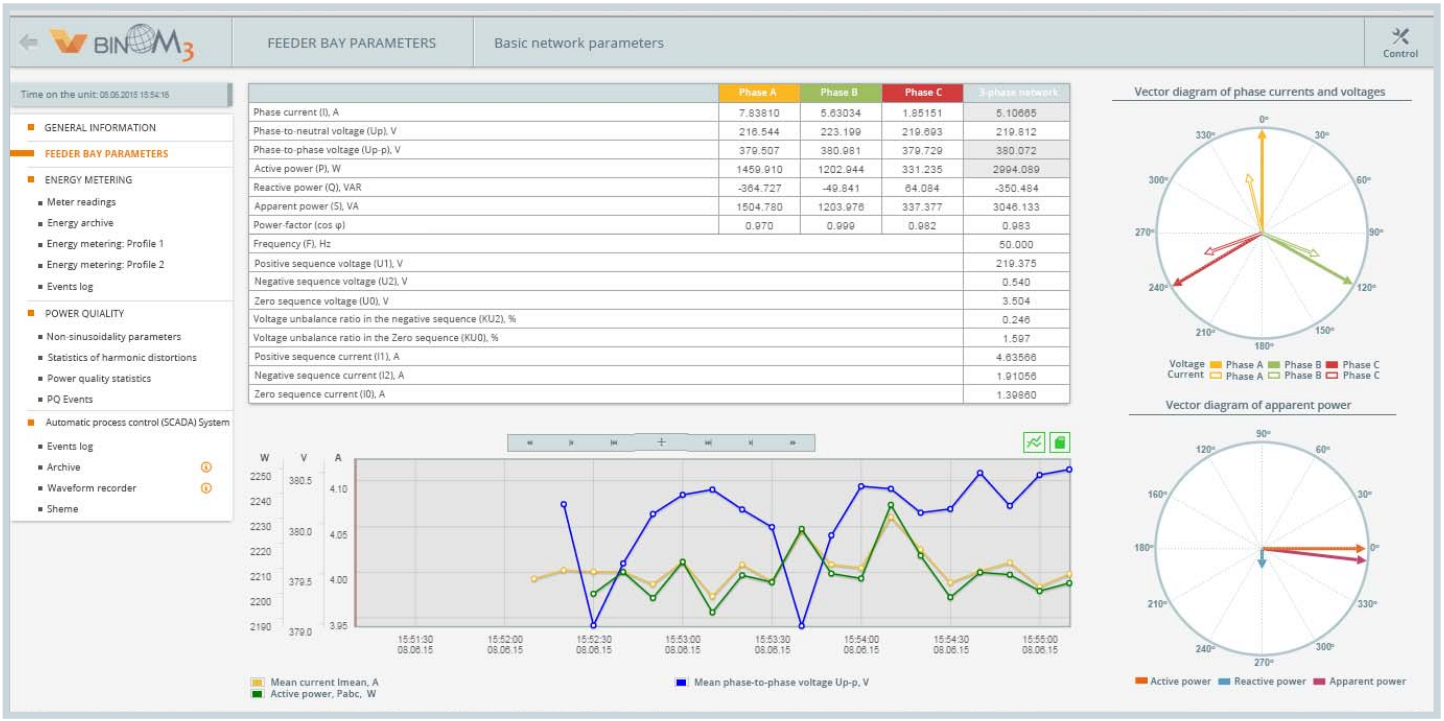
Rated current	**1 A, 5 A**
Rated voltage (phase-to-neutral/phase-to-phase)	**220 V / 380 V, 57,7 V/100 V**
Accuracy class	**0,2** Double metrological safety factor for accuracy of measurement
Range of measurements with retention of claimed accuracy	**2Un, 2In**
Synchronized measurement of instantaneous 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 of threshold violation (overshoot), - 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 the threshold values)

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

Extended range of three-phase connection parameters (more than 2300):

- phase current, phase and phase-to-phase (line) voltage, frequency;
- phase and three-phase power (active, reactive, apparent);
- phase angles between phase currents, phase voltages, phase voltage and phase current;
- power factors;
- symmetrical components of current, voltage, and power in positive, negative and zero sequence, unbalance factors, phase angles;
- harmonic components of current, voltage, power, phase angles between current and voltage (based on harmonic subgroups to the 50th order);
- interharmonic components of voltage and current (based on centred interharmonic subgroups to the 49th order).

The measurements are made with allowance for the voltage and current transformer ratio factors.



2. REVENUE METER

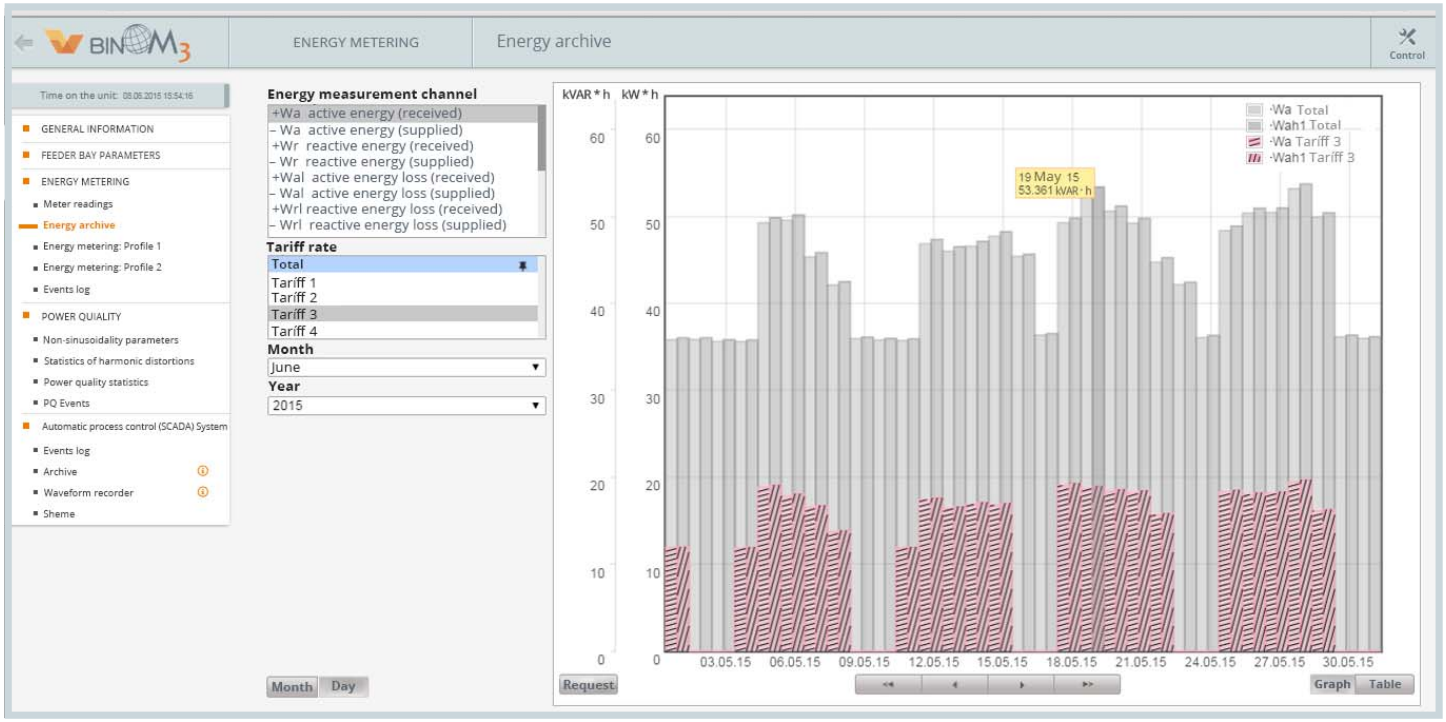
BINOM$_3$ is a multi-tariff, multi-channel, dual profile meter for providing reliable commercial and technical metering of electrical energy. The meter is designed for large-scale installation in power networks, at generating plants with any installed power level, in power facilities of industrial enterprises, in power supply systems for enterprises in the petroleum industry, and in communal and residential property.

Active energy metering in accuracy class:	**0,2S** according to **IEC 62053-22:2003** Lowest value of the current parameter measurement range: **0,01 I_N**
Reactive energy metering in accuracy class:	**0.5** according to methods of **IEC 62053-23:2003**
Energy metering	in **4 quadrants**, in **16 power metering channels**
In each of the **16 energy metering channels** there are **2 metering profiles:**	• **commercial (revenue),** storage for 49 months (30 min) • **technical,** storage for 99 days (3 min)
Metering per day/month,	storage for **9 years 10 months**
Multi-tariff (time-of-use) metering	in **4 tariff rates** (in summary form and also outside rate areas)
Energy metering storage time:	**10 years** with power off
Event logging as required by "Market Council" Non-Profit Partnership	✓
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.**
Mean life:	**30 years**
Recalibration interval:	**12 years**
Mean time between failures:	not less than **150,000 h**

Apparent energy	(allowing for non-sinusoidal and unbalance of current and voltage)
Energy losses	in lines and transformers
Fundamental frequency energy	(without allowance for harmonic components of current and voltage)
Positive sequence energy	(without allowance for negative and zero sequence current and voltage)

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

The provision of data on the amount of apparent energy, fundamental frequency and direct sequence energy 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.



Archive of amount of power measured per day/per month in **BINOM$_3$**

For detailed information, see our website at **www.binom3.ru**

3. POWER QUALITY METER AND ANALYZER

BINOM$_3$ 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.

Methods of power quality measurement — **IEC 61000-4-30:2008**

Methods of measuring harmonics (to the 50th order) and interharmonics (to the 49th order) — **IEC 61000-4-7:2009**

Methods of measuring the flicker — **IEC 61000-4-15:2010**

Statistical evaluation of conformity of power quality parameters to standard values — **EN 50160:2010***
/* Voltage characteristics of electricity supplied by public distribution networks /
Created in the device

Adjustable averaging intervals and evaluation of conformity of power quality parameters to standards

Power test report (ready-for-use statistic report)

Extended range of three-phase feeder bay parameters — More than 2300 parameters

Storage device for results of statistical processing of power quality parameters
– built-in **MicroSD** memory card
– **FTP store**

Measurement of power harmonics (to the 50th order) and interharmonics (to the 49th order) — referral to source of power quality distortion

Regulated power quality indicators:

- over- and underdeviation;
- frequency deviation;
- zero and negative sequence voltage unbalance ratios;
- harmonic and interharmonic voltage component factors;
- voltage subgroup total harmonic distortion (THDS);
- short-term and long-term flicker;

Random events:

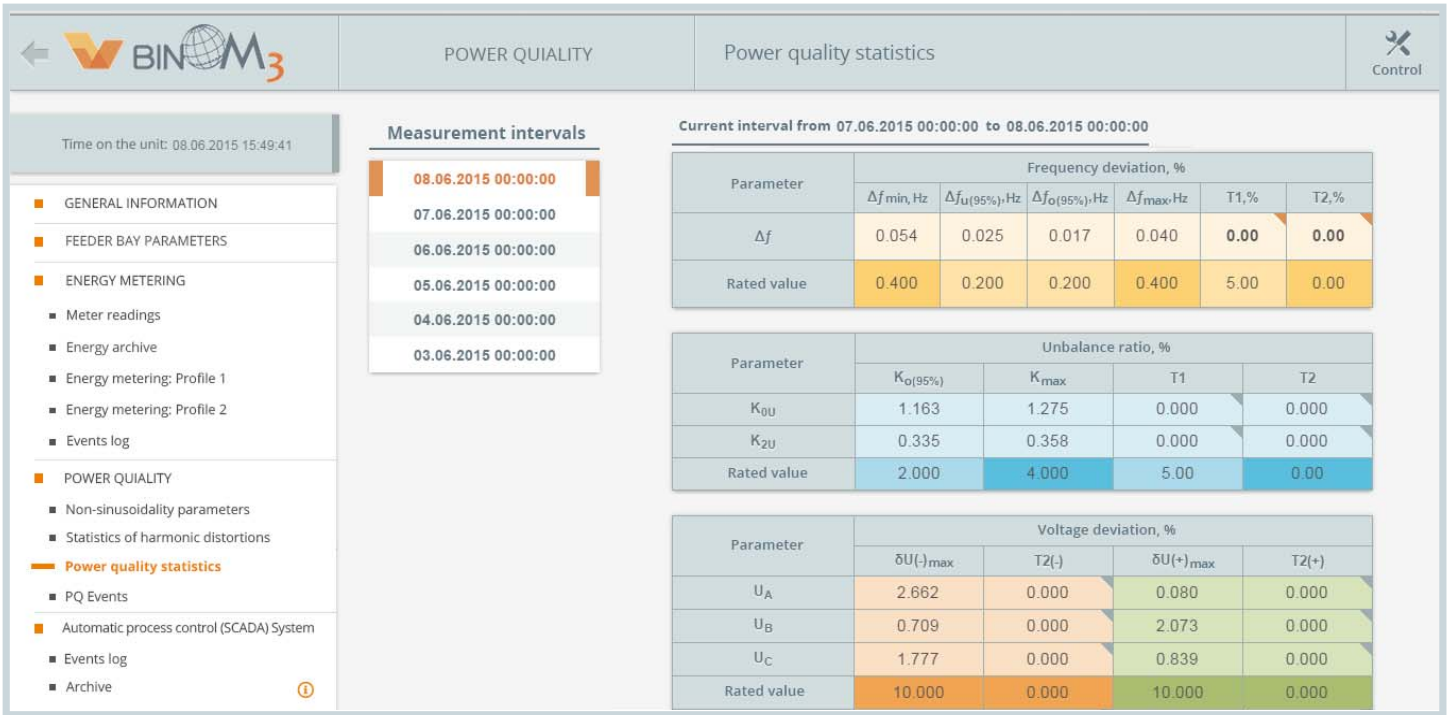
- voltage dip (duration and depth);
- voltage swell (duration and factor);
- voltage interruptions (duration and depth).

Unsatisfactory power quality causes additional losses of power, energy and voltage, premature wear and damage to equipment, false operation of automatic relay protection and automatic safety devices and Emergency Control Automatics (ECA) and disconnection of responsible consumers, burn-out of zero conductors in the cable from substations to consumer entry points, faulty disconnections, and incomplete power metering, thereby reducing the reliability of the power supply and creating the conditions for further damage to equipment and financial losses among power suppliers and consumers.

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.



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Results of the statistical analysis of power quality parameters in **BINOM$_3$**

4. FEEDER BAY CONTROLLER

BINOM$_3$ is a bay controller provided with:

– **16 discrete inputs** for collecting and recording signals on the status of switchgear switching devices, relay protection and automatic equipment and ECA systems, engineering and auxiliary systems;

– external **two-, three-** or **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 UTC:	**not more than 1 µs**
Adjustable filter for number of switches of remote signalling (teleindication) source per second	✓
Support for single-element and two-element teleindication	✓
Single-stage and two-stage teleswitching conditions	✓
Teleswitching	✓
Remote control (teleswitching) hardware blocking	✓
Switching capacity:	**up to 5A** in circuits **~ 220 V, = 220 V**
Solid-state and electromagnetic relays	✓

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

The device 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.

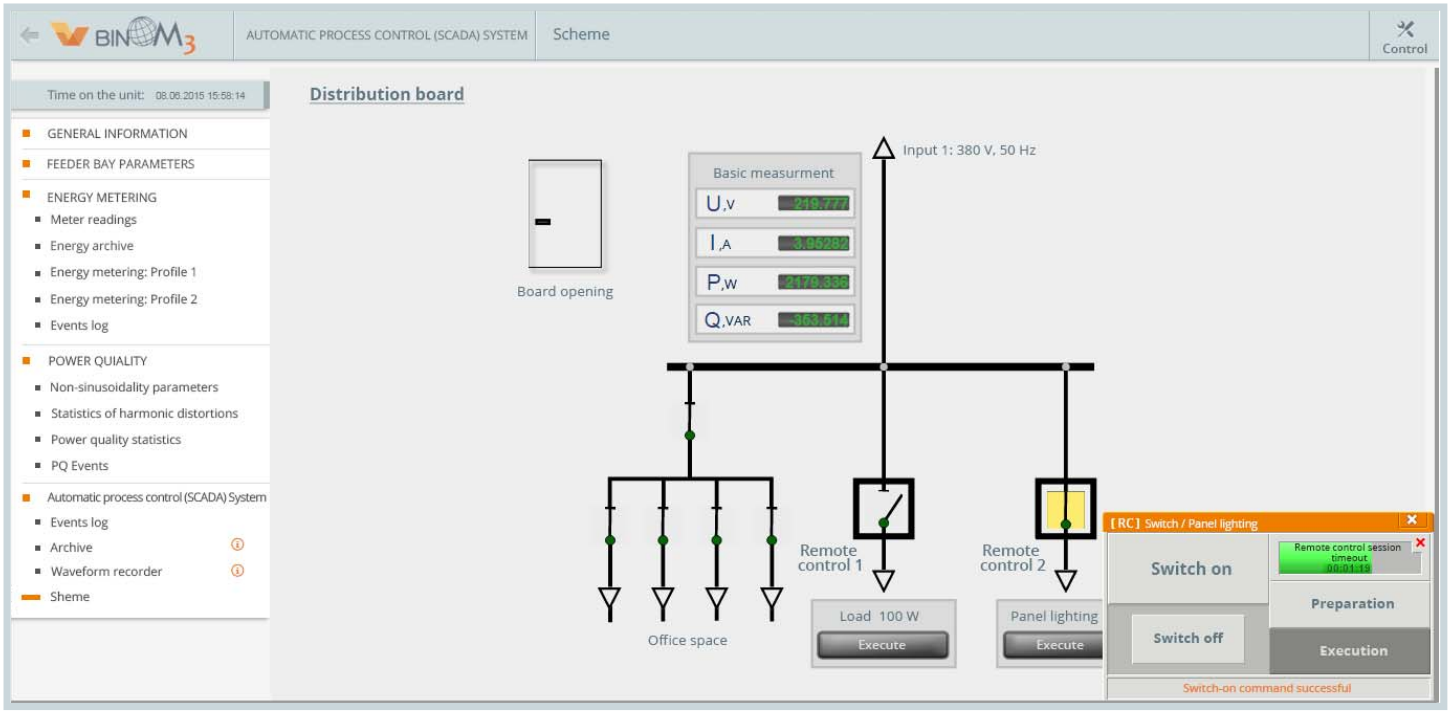


Diagram of 0.4 kV distribution panel in **BINOM$_3$**
(execution of command for connection of circuit-breaker)

5. FAULT (EMERGENCY EVENTS) RECORDER

BINOM$_3$ is a waveform (oscillographic) recorder of the parameters of normal conditions, transient processes and faults. It records a log of voltage and current distortions and changes in the discrete states of the monitored system, in real time, with high resolution and accuracy.

Synchronous recording of instantaneous current and voltage values	**in 6 ADC channels** (3 current channels, 3 voltage channels) and changes in digital inputs (DI) in **16 teleindication channels**
Sampling frequency	**32 kHz** **640 points** over the period of the fundamental frequency of **50 Hz**
Positional accuracy of readouts to UTC	**1 µs**
Waveform (oscillogram) storage device	– built-in **MicroSD** memory card, – **FTP-store**
Historical data:	**up to 60 seconds**
Waveform (oscillogram) duration:	**up to 120 seconds**
Trigger conditions:	- voltage dip or interruption; - change at a discrete input; - actuation of the trigger conditions creation algorithm. Current and voltage recording before, during and after a fault.
Storage of 41.5 minutes-long waveforms in a 1GB memory.	
Number of waveforms that can be stored	up to **1000**

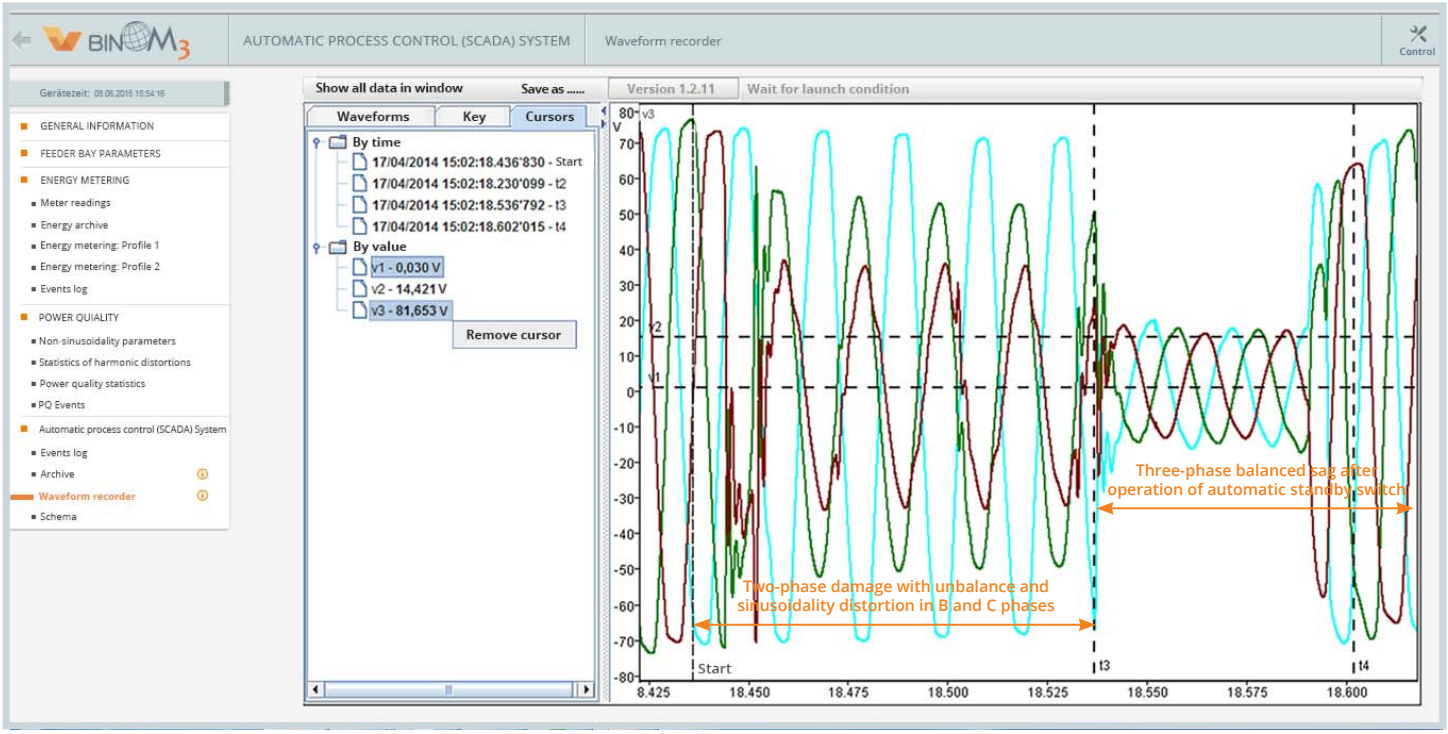
Used as a fault recorder, **BINOM$_3$** records voltage dips, swells and interruptions, the operation of switchgear, relay protection contacts and other ECA devices. These events, as well as failure to meet specifications for current (during overload, for example), frequency, and voltage are conditions for the automatic launch of the waveform recorder. The waveform recorder trigger conditions are configurable and can be designed to suit the special characteristics of the power network.

The waveform (oscillogram) of instantaneous current and voltage values can be combined with the graph of changes in teleindication at the discrete inputs, and with the graph of RMS and averaged values of measured quantities, thus revealing previously unknown characteristics of the behaviour of the monitored system.

By recording instantaneous current and voltage values during switchover and other transient processes caused by the starting of electric motors, the operation of automatic standby switches, voltage dips, swells and interruptions in supply lines, it is possible to speed up the process of troubleshooting.

The combination of the functions of recording discrete states of teleindication equipment and waveform recording, and the provision of high-accuracy synchronization from satellite navigation systems, makes it possible to carry out a detailed engineering analysis of faults and their circumstances where these faults have occurred in managed facilities and monitored systems which may be located in different geographical areas, providing comprehensive information for the subsequent development of recommendations for the use of electrical equipment.

Two-phase damage to the power supply system (recorded in BINOM$_3$)



Waveform (oscillogram) of phase voltages recorded during voltage dip in two-phase damage to a power supply system.

For detailed information, see our website at **www.binom3.ru**

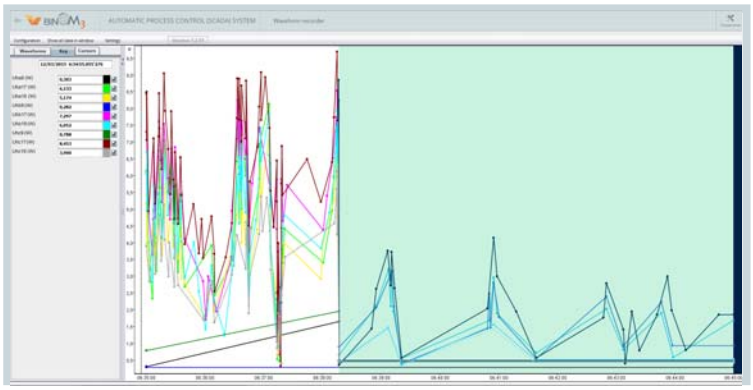
6. "BLACK BOX" OF ELECTRICAL PROCESSES

The **BINOM$_3$** "black box" of electrical processes is a single device for recording and storing the history of changes in the states of the monitored system, using integrated inspection and data analysis tools.

Data storage device (specified separately for each archive):	– built-in **MicroSD** memory card, – **FTP store**
1GB storage	for **16,000,000** discrete or analog events
Recording rate:	**up to 5,000 events/s** An event is a discrete or analog parameter value.
Peak recording rate:	up to **20,000 events/s**
Number of archives:	from **1** to **32**
Archiving depth:	from **2 minutes** to **10 years** Storage **of 16,000,000 events** in a **1 GB** memory.
Simultaneous display of	up to **50 graphs**

BINOM$_3$ records normal conditions and disturbances in the operation of the electrical part of a monitored system, and records a very large number of parameters of normal conditions and fault processes, using digital oscillographic recording and archiving of RMS and averaged values. The device stores large quantities of data arrays for examination and analysis by built-in viewing tools for working with graphs and oscillograms, as well as tables and forms.

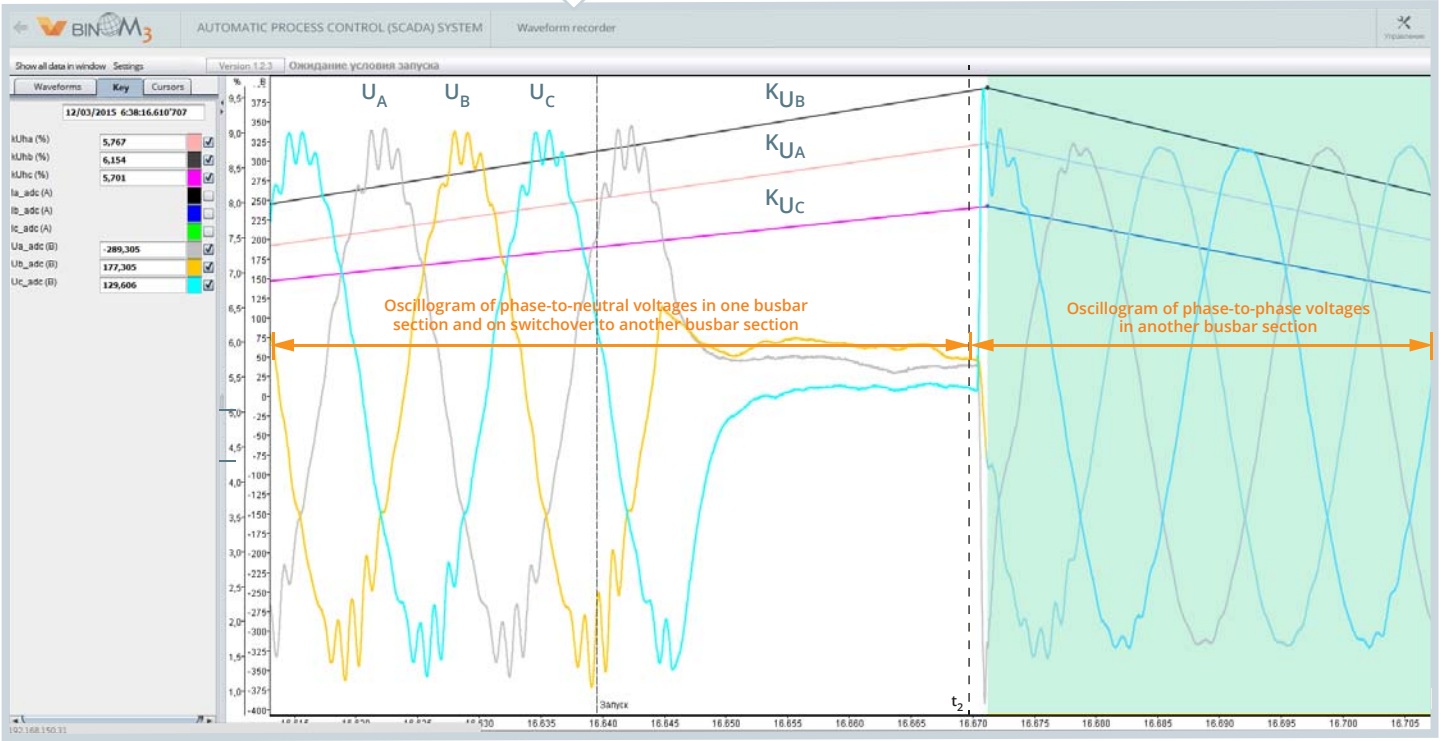
Incorrect operation (false alarm) of automatic safety protection equipment (recorded in BINOM$_3$)



Graph of changes in the voltage harmonics (RMS values) in 0.4 kV busbar sections with different level of non-sinusoidality.

It was found that the increase in the voltage harmonics in the monitored system by a factor of 1.4 over the standard values was due to the false alarm of the voltage control relay independently of the operating specifications, and the switch-over of electricity consumers to another section of the busbars.

Waveform (oscillogram) of phase voltages (instantaneous values), combined with the graph of voltage subgroup total harmonic distortion (RMS values).



7. AUTOMATIC PROCESS CONTROL OF FEEDER BAY IN ONE DEVICE

BINOM$_3$ is a Smart Grid field device with Automatic Process Control functionality.

– Multifunctionality:

- Revenue and technical energy metering
- Power quality monitoring, management and control
- Measurement of basic electrical quantities and supplementary power characteristics
- Recording of the parameters of normal conditions, transient processes and faults
- Synchronized waveform recording
- Collection of discrete signals (teleindication acquisition)
- Remote control of switching devices (teleswitching)

– Built-in **MicroSD memory card**, **4 GB** capacity (for storing archives, oscillograms, RMS and averaged values, and results of statistical processing of power quality parameters).

– Built-in display **viewing tools** for graphs, waveforms (oscillograms), tables, diagrams, forms and reports.

– Built-in **system for diagnosis** of functional units, software and computing resources.

– Built-in **system for limiting access rights**

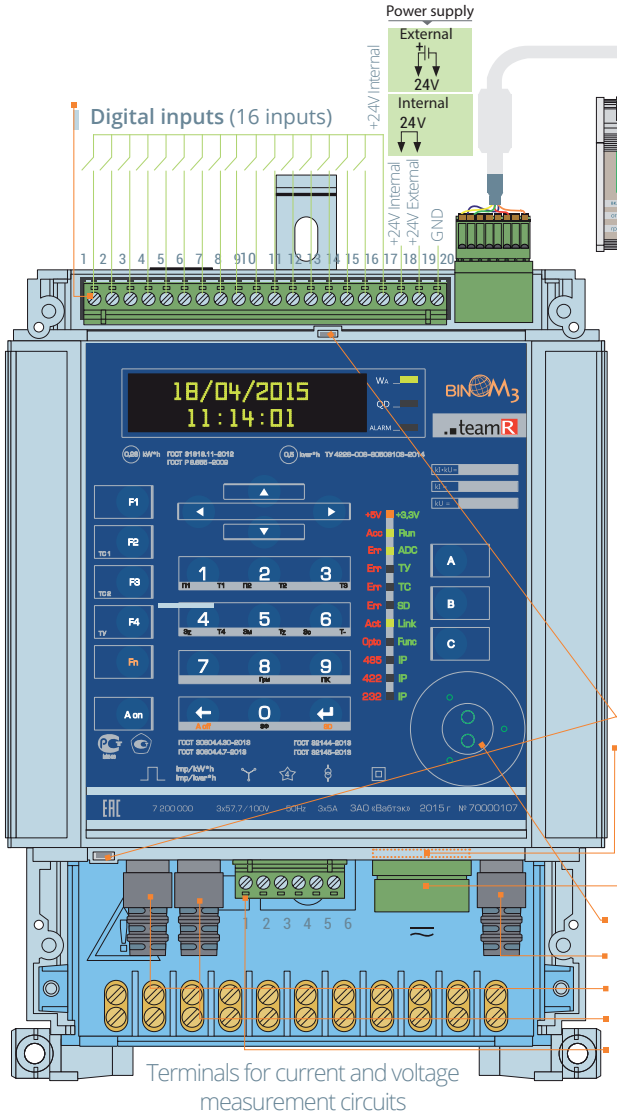
– Hard real-time multitasking operating system, **guaranteed event response time**, simultaneous execution of tasks **with equal priority**.

– Real-time transmission of results of measurements and calculations via Ethernet, 2x RS-485 and RS-232 channels simultaneously in data aquisition and transmission, power quality monitoring and control, automatic commercial power metering (technical power metering) and automatic process control and SCADA systems, independent configuration of data exchange volume, procedures and methods.

Table 6 - Voltage harmonic distortions to the 50th order (IEC 61000-4-7:2009)

n	Результат измерений, %												Нормативное значение	
	Phase A (AB)				Phase B (BC)				Phase C (CA)					
	$K_{U(n)}$ (95%)	$K_{U(n)}$ (100%)	T_1, %	T_2, %	$K_{U(n)}$ (95%)	$K_{U(n)}$ (100%)	T_1, %	T_2, %	$K_{U(n)}$ (95%)	$K_{U(n)}$ (100%)	T_1, %	T_2, %	$K_{U(n)}$ (95%)	$K_{U(n)}$ (100%)
2	0.093	0.096	0.000	0.000	0.096	0.096	0.000	0.000	0.094	0.095	0.000	0.000	2.000	3.000
3	5.576	5.745	28.571	0.000	4.765	4.966	0.000	0.000	4.828	5.068	1.786	0.000	5.000	7.500
4	0.048	0.049	0.000	0.000	0.044	0.050	0.000	0.000	0.047	0.065	0.000	0.000	1.000	1.500
5	1.669	1.699	0.000	0.000	1.058	1.069	0.000	0.000	1.417	1.453	0.000	0.000	6.000	9.000
6	0.030	0.038	0.000	0.000	0.040	0.051	0.000	0.000	0.036	0.066	0.000	0.000	0.500	0.750
7	1.064	1.072	0.000	0.000	1.548	1.587	0.000	0.000	1.246	1.348	0.000	0.000	5.000	7.500
8	0.042	0.044	0.000	0.000	0.043	0.052	0.000	0.000	0.043	0.066	0.000	0.000	0.500	0.750
9	1.435	1.457	0.000	0.000	1.256	1.291	0.000	0.000	1.204	1.228	0.000	0.000	1.500	2.250
10	0.030	0.038	0.000	0.000	0.034	0.046	0.000	0.000	0.029	0.059	0.000	0.000	0.500	0.750
11	0.534	0.584	0.000	0.000	0.701	0.771	0.000	0.000	0.699	0.753	0.000	0.000	3.500	5.250
12	0.027	0.036	0.000	0.000	0.026	0.039	0.000	0.000	0.028	0.057	0.000	0.000	0.200	0.300
13	0.592	0.681	0.000	0.000	0.422	0.510	0.000	0.000	0.554	0.664	0.000	0.000	3.000	4.500
14	0.030	0.031	0.000	0.000	0.027	0.035	0.000	0.000	0.023	0.052	0.000	0.000	0.200	0.300
15	0.441	0.449	33.929	0.000	0.280	0.288	0.000	0.000	0.363	0.369	19.643	0.000	0.300	0.450
16	0.025	0.028	0.000	0.000	0.022	0.034	0.000	0.000	0.018	0.050	0.000	0.000	0.200	0.300
17	0.192	0.211	0.000	0.000	0.255	0.273	0.000	0.000	0.260	0.281	0.000	0.000	2.000	3.000
18	0.017	0.026	0.000	0.000	0.016	0.033	0.000	0.000	0.017	0.047	0.000	0.000	0.200	0.300
19	0.130	0.154	0.000	0.000	0.175	0.193	0.000	0.000	0.321	0.325	0.000	0.000	1.500	2.250
20	0.016	0.024	0.000	0.000	0.015	0.031	0.000	0.000	0.021	0.044	0.000	0.000	0.200	0.300
21	0.161	0.165	0.000	0.000	0.069	0.079	0.000	0.000	0.054	0.068	0.000	0.000	0.200	0.300
22	0.014	0.023	0.000	0.000	0.017	0.030	0.000	0.000	0.016	0.042	0.000	0.000	0.200	0.300
23	0.090	0.096	0.000	0.000	0.131	0.134	0.000	0.000	0.139	0.144	0.000	0.000	1.500	2.250
24	0.014	0.022	0.000	0.000	0.015	0.028	0.000	0.000	0.017	0.039	0.000	0.000	0.200	0.300
25	0.052	0.054	0.000	0.000	0.063	0.064	0.000	0.000	0.097	0.103	0.000	0.000	1.500	2.250
26	0.014	0.022	0.000	0.000	0.013	0.026	0.000	0.000	0.014	0.036	0.000	0.000	0.200	0.300
27	0.043	0.046	0.000	0.000	0.032	0.036	0.000	0.000	0.045	0.047	0.000	0.000	0.200	0.300
28	0.014	0.021	0.000	0.000	0.014	0.025	0.000	0.000	0.014	0.034	0.000	0.000	0.200	0.300
29	0.048	0.053	0.000	0.000	0.038	0.040	0.000	0.000	0.040	0.041	0.000	0.000	100.000	100.000
30	0.014	0.020	0.000	0.000	0.014	0.024	0.000	0.000	0.015	0.031	0.000	0.000	0.200	0.300
31	0.028	0.029	0.000	0.000	0.028	0.028	0.000	0.000	0.023	0.030	0.000	0.000	100.000	100.000
32	0.014	0.019	0.000	0.000	0.014	0.021	0.000	0.000	0.014	0.028	0.000	0.000	0.200	0.300
33	0.021	0.022	0.000	0.000	0.021	0.022	0.000	0.000	0.021	0.027	0.000	0.000	0.200	0.300
34	0.014	0.018	0.000	0.000	0.014	0.021	0.000	0.000	0.015	0.026	0.000	0.000	0.200	0.300
35	0.022	0.023	0.000	0.000	0.019	0.020	0.000	0.000	0.020	0.025	0.000	0.000	100.000	100.000
36	0.012	0.015	0.000	0.000	0.012	0.017	0.000	0.000	0.012	0.021	0.000	0.000	0.200	0.300
37	0.021	0.022	0.000	0.000	0.020	0.022	0.000	0.000	0.028	0.031	0.000	0.000	100.000	100.000
38	0.012	0.015	0.000	0.000	0.011	0.016	0.000	0.000	0.012	0.019	0.000	0.000	0.200	0.300
39	0.022	0.024	0.000	0.000	0.022	0.023	0.000	0.000	0.022	0.025	0.000	0.000	0.200	0.300
40	0.012	0.013	0.000	0.000	0.011	0.015	0.000	0.000	0.012	0.016	0.000	0.000	0.200	0.300
41	0.018	0.019	0.000	0.000	0.020	0.021	0.000	0.000	0.018	0.018	0.000	0.000	100.000	100.000
42	0.012	0.013	0.000	0.000	0.012	0.014	0.000	0.000	0.012	0.015	0.000	0.000	100.000	100.000
43	0.019	0.019	0.000	0.000	0.013	0.014	0.000	0.000	0.021	0.022	0.000	0.000	100.000	100.000
44	0.011	0.012	0.000	0.000	0.011	0.012	0.000	0.000	0.011	0.013	0.000	0.000	100.000	100.000
45	0.019	0.020	0.000	0.000	0.019	0.020	0.000	0.000	0.018	0.020	0.000	0.000	100.000	100.000
46	0.011	0.011	0.000	0.000	0.011	0.011	0.000	0.000	0.011	0.011	0.000	0.000	100.000	100.000
47	0.014	0.015	0.000	0.000	0.014	0.015	0.000	0.000	0.014	0.015	0.000	0.000	100.000	100.000
48	0.011	0.011	0.000	0.000	0.010	0.011	0.000	0.000	0.010	0.010	0.000	0.000	100.000	100.000
49	0.015	0.015	0.000	0.000	0.013	0.014	0.000	0.000	0.015	0.016	0.000	0.000	100.000	100.000
50	0.011	0.011	0.000	0.000	0.011	0.011	0.000	0.000	0.011	0.011	0.000	0.000	100.000	100.000

BINOM$_3$ 37U3.220I3.1S16T4 Multifunctional Revenue Energy Meter and Power Quality Analyzer. Exterior view.



Electromagnetic compatibility:
Immunity according to **IEC 61000-6-5:2001** for technical equipment indended for use in power stations and substations for high voltage class H.

Connection type	Isolation for 1 min.	Immunity
Measurement circuits	~ 4 kV	h
Ethernet	~ 2 kV	f
RS-485/SYNC	~ 4 kV	f
RS-485/422	~ 4 kV	l
RS-232	~ 4 kV	l
Digital inputs (teleindication)	~ 3 kV	f
Relay outputs:		
electromagnetic relay solid-state relay	~ 4 kV ~ 2,5 kV	f f

h - connections to high-voltage equipment
f - field connections
l - local connections

Unlocking sensor (electronic seal)

MicroSD connector

220 V connector: main and standby supply, earthing contact (PE)

Main supply:
~ 90–265 V;
= 125–350 V

Standby supply:
=125-350 V

Built-in autonomous power source (30 mins.)

Optical port

Ethernet interface, **IEC 104 SNTP IEC 61850 100 Mb/s**

RS-232 interface, **IEC 101 460.8 kbit/s**

RS-485/422 interface, **IEC 101 NMEA/PPS 460.8 kb/s**

RS-485/SYNC interface, pulsed output, pulsed input, **IEC 101, NMEA/PPS, 460.8 kb/s**

For detailed information, see our website at **www.binom3.ru**

8. RANGE OF APPLICATIONS. FINANCIAL BENEFITS.

Range of applications of BINOM$_3$

POWER STATIONS, ANY INSTALLED POWER CAPACITY

POWER FACILITIES OF ENTERPRISES IN THE PETROLEUM INDUSTRY

POWER SUPPLY SYSTEMS FOR ELECTRIC TRANSPORT

6/0.4 - 1150 kV SUBSTATIONS

POWER FACILITIES OF INDUSTRIAL ENTERPRISES

COMMUNAL AND RESIDENTIAL POWER CONSUMERS

The meters are designed for autonomous operation in automated systems:

- SCADA systems
- Data aquisition and transmission systems
- Automated data and measurement systems for revenue and technical power metering
- Power quality monitoring and control systems
- Automated process control systems, Management information system

Using the **BINOM$_3$** universal device in feeder bays yields benefits not only in the technical sphere but also **in financial and operational terms:**

1. Significant **decrease in the unit cost** of a set of **measurement channels** (for teleindication, remote control (teleswitching), measurement and waveform recording) - by a factor of up to four, by reducing the range of connected measurement devices to a single model.
2. Reduced requiements to data acquisition and transmission devices, concentrators and computers in control centres, and lower capacity requirements for communication channels, due to the execution of many computing tasks within the device, the provision of local archiving resources and the possibility of access to measurement and monitoring results via communications channels.
3. Significant reduction, by a factor of up to 3 - 4, **in one-off costs of automation of power systems**, due not only to the reduced cost of measuring devices, but also the associated reduction in the cost of middle and higher level hardware, distribution panels and communication equipment, materials and labour (for design, installation, commissioning and testing) at all stages of automated systems development.
4. **Reduction in operating costs** due to the smaller range of hardware and the decreased demand on human and time resources (reduced number of call-outs for servicing, decreased expenditure on spares and accessories).
5. **Improved reliability of the power supply** because of the reduction in faults and the decrease in time spent tracing the causes of anomalous and fault conditions.
6. **Financial benefits** from implementation **of power quality assurance measures.**

For the power supplier

Identification of users or hardware distorting power quality (with non-sinusoidal and unbalanced loads).

implementation of actions and/or taking measures to improve power quality

Factors contributing to the financial outcome:

– longer service life of basic equipment (transmission lines, power transformers);
– reduced power losses in transportation over the network;
– elimination of incomplete power metering in distorting users;
– fewer number of emergency shutouts or unplanned outages and improved power supply reliability;
– lower costs for restoring power supplies;
– increased carrying capacity of power networks;
– elimination of possible technical and financial losses due to poor-quality power

For the power user

Identification of the facts of the supply of poor-quality power

implementation of actions and/or taking measures to improve power quality

Factors contributing to the financial outcome:

– longer service life of power users;
– reduced probability of unplanned outages and premature breakdown of equipment (due to breakage of zero conductor from technical process to user, for example) ;
– elimination of metering of power distortions received from supplier;
– elimination of possible technical and financial losses due to poor-quality power

7. Comprehensive database for theoretical investigations of the monitored system, to ensure that the multiplicity of details are not missed and previously unknown characteristics of its behaviour are visible.

The smart field device technology not only increases the amount and quality of information available to operators, but also changes their working methods. Access to the full range of digital data on electrical connections simplifies process control, enabling personnel to take more rational, well-grounded and effective decisions. Large-scale introduction of these devices at all levels of power networks and power systems as a whole will provide a universal improvement in the standards of operational and technical monitoring and control, while optimizing activity and increasing the financial efficiency of the power generation, transmission and distribution process.

For detailed information, see our website at **www.binom3.ru**

ALGORITHM
www.algspb.ru
Algoritm ZAO (CJCS «Algorithm»), 195265, St Petersburg, Grazhdanskiy pr. d. 111, lit. A,
tel. +7 (812) 448-5900, fax +7 (812) 596-6801, info@algspb.ru