PRODUCT
CATALOGUE

NT NOVATEK
ISO 9001 **ELECTRO**

CONTROL &
PROTECTION
DEVICES

RESEARCH DEVELOPMENT
AND MANUFACTURER
MICROCONTROLER BASED CONTROL
AND PROTECTION DEVICES

Certificate of Registration

This certificate has been awarded to

Novatek Electro India Pvt. Ltd.

C-30, Patparganj, Industrial Area, FIE, Delhi, 110092, India

in recognition of the organization's Quality Management System which complies with

ISO 9001:2015

The scope of activities covered by this certificate is defined below

Manufacture and Export of Microprocessor Based Relay, Timer and Data Logger

Certificate Number:	Date of Issue: (Original)	Date of Issue:
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On *behalf of the Schemes Manager*

QM016

Section 1

VOLTAGE MONITORING RELAY PH-102

Voltage monitoring relay PH-102 (hereinafter PH-102) is designed for the protection of industrial and consumer use single phase equipment with rated voltage of 220-240V and frequency 50 Hz. Main purpose of the device is to protect the equipment and electrically driven machinery and electronics from unallowable voltage surges/drops and fluctuations in the mains power circuits and automatically turning ON the equipment after the voltage recover and return to normal values with the user defined time delay. Total maximal power that could be connected to PH-102 is 6.5 kW (32 AC-1).

PH-102 contains built-in high frequency filter which additionally protects equipment also from impulse interruptions.

On the front panel there is a digital display indicating the acting value of input voltage during operation and when spinning the setting knobs it shows the precise parameter values adjusted by user. Additional LED indicator "Load" shows the ON/OFF state of the output relay (ON/OFF state for the connected equipment).

PH-102 complies with requirements: IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2.
No harmful substances in excess of the maximum permissible concentration is available.
To connect loading to output terminals ("O:L"; "O:N").
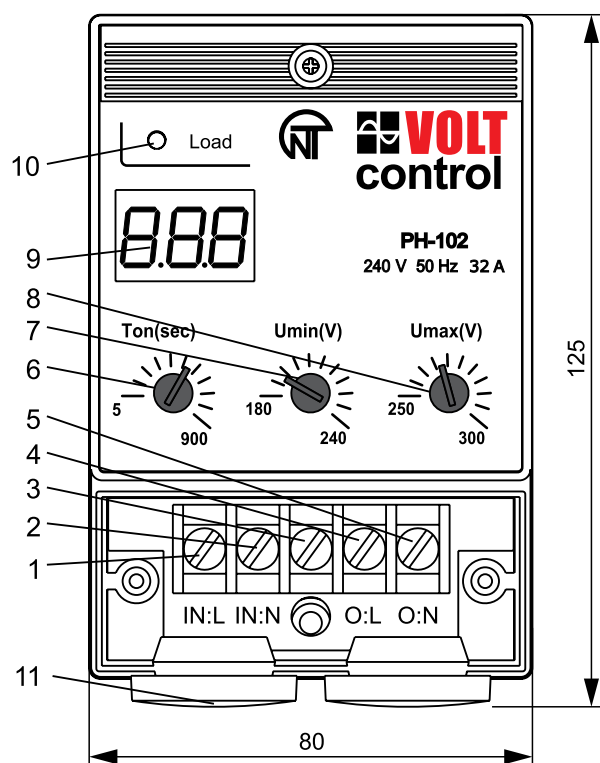
1 – Input connection terminal to connect phase wire (IN:L);
2 – Input connection terminal to connect neutral wire (IN:N);
3 – Common terminal for the ground connection (input/output);
4 – Output connection terminal to connect neutral wire (O:N);
5 – Output connection terminal to connect phase wire (O:L);
6 – Adjustment knob for the auto-reclosing time delay setting (Ton);
7 – Minimal voltage tripping threshold (Umin);
8 – Maximal voltage tripping threshold (Umax);
9 – Three digits seven segment LED indicator;
10– LED indicator for the ON/OFF state of the connected power load
11– Blank cover

Figure 1. Controls description and dimensions diagram (upper terminal cover lid is not shown)

Table 1. Technical Specifications

Rated voltage, V	240
Rated voltage frequency, Hz	47 – 65
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Adjustable settings ranges:	
- Minimal voltage tripping threshold (Umin), V	180 – 240
- Maximal voltage tripping threshold (Umax), V	250 – 300
- Auto-reclosing time delay, sec	5 –900
Device level protection	IP30
Fixed tripping time delay when input voltage exceeds the minimal tripping threshold (Umin), sec	7
Fixed tripping time delay when input voltage exceeds the maximal tripping threshold (Umax), sec	1
Fixed tripping time delay in case of voltage decrease more than 60V than the adjusted minimal voltage tripping threshold (Umin), sec	0.12
Fixed tripping time delay in case of voltage increase more than 30V than the adjusted maximal voltage tripping threshold (Umax), sec	0.12
Maximal commutation current (active power load), A (not less than) AC-1 type	32
Accuracy for tripping basing the voltage level measurement, V	< 3
Minimal operation voltage level at which PH-102 will keep working, V	120
Maximal operation voltage level at which PH-102 will keep working, V	400
Voltage hysteresis, V	4
Protection class against electric shock	II
Overvoltage category	II
Permissible contamination level	II
Nominal voltage of isolation, V	450
Rated impulse withstand voltage, kV	2.5
Guide section of connecting plugs, mm2	0.3-3.3
Maximum moment of an inhaling of screws of connection terminal, N*m	1.2
Operational temperature range, ^{o}C	from -30 to + 55
Total power consumption, mA	< 15
Commutation lifetime of the output contacts:	
- under 32A power load, times (not less than)	100 000
- under 5A power load, times (not less than)	1 000 000
Outer dimensions, mm	80 x 120 x 43
Net weight, kg	0.250
Wall mounting in vertical position in order to read the digits of the front panel indicator	

VOLTAGE MONITORING RELAY RN-101M "VOLT CONTROL"

The RN-101M voltage protection relay is designed to disconnect (turn OFF) industrial or domestic single-phase 220-240V/50Hz equipment with rated power up to 3.5 kW (16A) in case of inadmissible voltage surges, fluctuations, neutral break conditions with automatic turn ON function when the mains parameters return back to normal values after the fault.

The RN-101M combines and comprises several devices in one compact case:
• Surge protector (over and under voltage faults);
• Protection of the connected power load from high-frequency impulse voltage faults;
• Over-current protection from overload and short circuits;
• Protection from Neutral break condition;
• Multifunctional digital voltmeter and functional state indicator. The RN-101M "Volt Control" displays the input RMS voltage value, the output relay status (closed/open) and the status of the over-current protection circuit breaker.

The relay has several functional states which are as follows:
• normal state;
• voltage fault;
• current fault;
• auto-reset (AR) time delay countdown.

RN-101M "Volt Control" complies with requirements: IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2
No harmful substances in excess of the maximum permissible concentration is available.

1 – overcurrent protection circuit breaker switch button;
2 – three-digit seven-segment LED display;
3 – max voltage adjustment knob (Umax);
4 – min voltage adjustment knob (Umin);
5 – auto-reclosing time delay setting knob;
6 – input plug;
7 – output socket;
8 – power load state LED indicator.

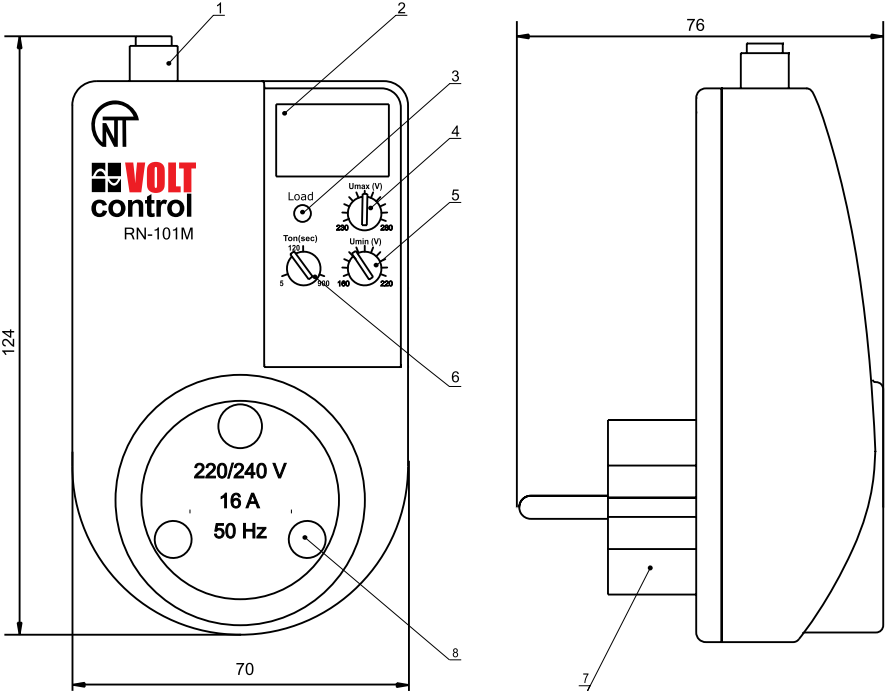*Fiqure 1.*
Front Panel and Overall Dimensions

Table 1. Technical Specifications

Rated voltage, V	220 – 240
Rated voltage frequency, Hz	47 – 65
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Adjustment ranges:	
– minimal voltage tripping range (Umin), V	160 – 220
– maximal voltage tripping range (Umax), V	230 – 280
– auto-reclosing time delay (Ton), sec	5 – 900
Fixed tripping time delay for overvoltage faults, sec	1
Fixed tripping time delay for undervoltage faults, sec	7
Fixed tripping time delay when voltage drops over 60V below the Umin setting ore if voltage drops below 140V, sec	0.12
Fixed tripping time delay in case of voltage increase more than 30V than the adjusted maximal voltage tripping threshold (Umax), sec	0.12
Maximal commutation current (active power load), A (no less than)	16
Tripping Voltage level accuracy, V	upto 3
Minimal operation voltage level at which RN-101M will keep working (effective value), V	120
Maximal operation voltage level at which RN-101M will keep working (effective value), V	400
Voltage hysteresis, V (no less than)	4
Total power consumption, mA	upto 15
Commutation life of the output contacts:	
– under 16A power load, times (no less than)	100 000
– under 5A power load, times (no less than)	1 000 000
Outer dimensions, (2 S-modules),	Fiqure 1
Weight, kg, no less than	0.170

SINGLE PHASE VOLTAGE PROTECTION RELAY
RN-111M

 Single phase (220-240V/50Hz) voltage protection relay RN-111M is designed to turn OFF home used consumer equipment or industrial power load in case of unallowable voltage fluctuations. And when the voltage parameters return back to normal values after fluctuation – it automatically turns ON the power load with the user adjusted time delay.

- If power load is less than 3.5 kW (16A) then RN-111M may operate with the power load directly using its own output terminals;
- If power load is more than 3.5 kW (16A) then it should be commutated using contactor of appropriate power rating. So RN-111M operates with the magnetic coil of the contactor and thus turn ON/OFF the power load when necessary. Kindly note that contactors of appropriate power rating should be chosen by User and not supplied along with RN-111M.

On the LED digital display RN-111M indicates the value of acting voltage level and the Open/Close (ON/OFF) state of the output contacts.
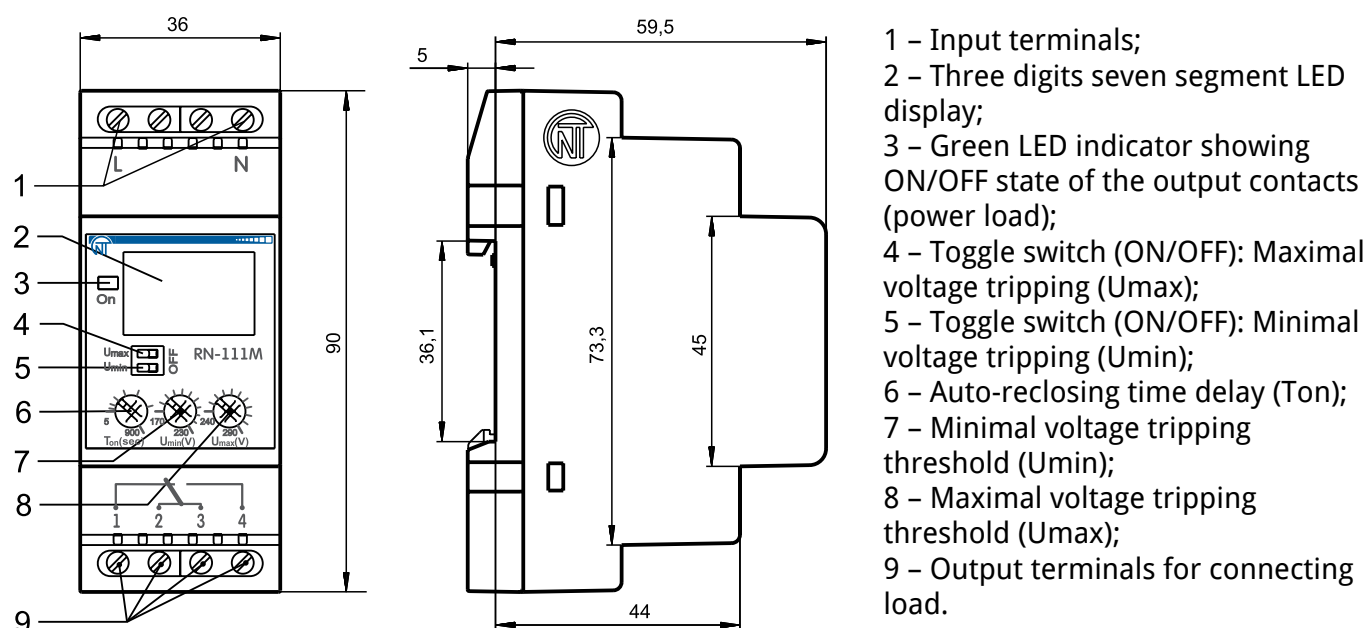

1 – Input terminals;
2 – Three digits seven segment LED display;
3 – Green LED indicator showing ON/OFF state of the output contacts (power load);
4 – Toggle switch (ON/OFF): Maximal voltage tripping (Umax);
5 – Toggle switch (ON/OFF): Minimal voltage tripping (Umin);
6 – Auto-reclosing time delay (Ton);
7 – Minimal voltage tripping threshold (Umin);
8 – Maximal voltage tripping threshold (Umax);
9 – Output terminals for connecting load.

Fiqure 1. Front panel controls description and dimensions diagram

Table 1. Technical Specifications

Rated voltage, V	220 – 240
Rated voltage frequency, Hz	47 – 65
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 50160
Adjustment ranges:	
– minimal voltage tripping range (Umin), V	160 – 230
– maximal voltage tripping range (Umax), V	240 – 280
– auto-reclosing time delay (Ton), sec	5 – 900
Fixed tripping time delay in case maximal voltage fault (Umax) detected, sec	1
Fixed tripping time delay in case minimal voltage fault (Umin) detected, sec	12
Fixed tripping time delay in case of voltage decrease more than 60V than the adjusted minimal voltage tripping threshold (Umin), sec	0.2
Fixed tripping time delay in case of voltage increase more than 30V than the adjusted maximal voltage tripping threshold (Umax), sec	0.12
Maximal commutation current (active power load), A	16
Tripping Voltage level accuracy, V	up to 3
Minimal operation voltage level at which RN-111M will keep working, V	100
Maximal operation voltage level at which RN-111M will keep working, V	420
Voltage hysteresis, V	4 - 5
Power consumption (when de-energization load), W	to 3.5
Commutation life of the output contacts:	
- under 16A power load, times (no less than)	100 000
- under 5A power load, times (no less than)	1 000 000
Outer dimensions, (2 S-modules),	Fiqure 1
Weight, kg, no less than	0.10
Casing material – self-extinguishing plastic	
The device preserves functionality in any position within the space	

Table 2. Parameters of the integrated relay output terminals

	Maximal current at ~ 250V AC	Maximal power when contacts are closed	Maximal commutation power	Maximal allowed AC/DC Voltage	Maximal current at 30V DC
Cos φ = 0.4 Cos φ = 1	5 A 16 A	5000 VA	4000 VA	380/150 V	5 A

RN-111M complies with requirements:
IEC 60947-1:2004; IEC 60947-6-2:1992; CISPR 11:2004; IEC 61000-4-2:2001.
No harmful substances in excess of the maximum permissible concentration is available.

The device can operate in four independent modes:
• Minimum voltage relay (when Umin switch is ON and Umax switch is OFF): the device switches to the ALARM state when the input voltage drops below the minimum voltage threshold Umin;
• Maximum voltage relay (when Umax switch is ON and Umin switch is OFF): the device switches to the ALARM state when the input voltage rises above the threshold for the maximum voltage Umax;
• Voltage relay (when Umin and Umax switches are ON): the device switches to the ALARM state when the input voltage drops below the minimum voltage threshold or when the input voltage rises above the maximum voltage threshold;
• Turn on time delay relay (when Umin and Umax switches are OFF).

SINGLE PHASE VOLTAGE MONITORING RELAY RN-113

Voltage monitoring relay RN-113 (hereinafter RN-113) is designed to turn OFF home used consumer equipment or industrial power load in case of unallowable voltage drops or fluctuations. And when the voltage parameters return back to normal values after the fault – it automatically turns ON the power load with the user adjusted time delay (auto-reclosing time).

- If power load is less than 7.0 kW (32A) then RN-113 may operate with the power load directly using its own output terminals;
- If power load is more than 7.0 kW (32A) then it should be commutated using contactor of appropriate power rating. So, RN-113 operates with the magnetic coil of the contactor and thus turn ON/OFF the power load when necessary. Kindly note that contactors of appropriate power rating should be chosen by User and not supplied along with RN-113.

RN-113 has four independent modes of operation:
1. Minimal/Maximal voltage protection relay;
2. Minimal voltage protection relay;
3. Maximal voltage protection relay;
4. Turn ON time delay relay.

Digital display of RN-113 indicates the value of acting voltage level and the remaining time to Open/Close (ON/ OFF) state of the output contacts. The position of the contacts is additionally shown using green color LED indicator.
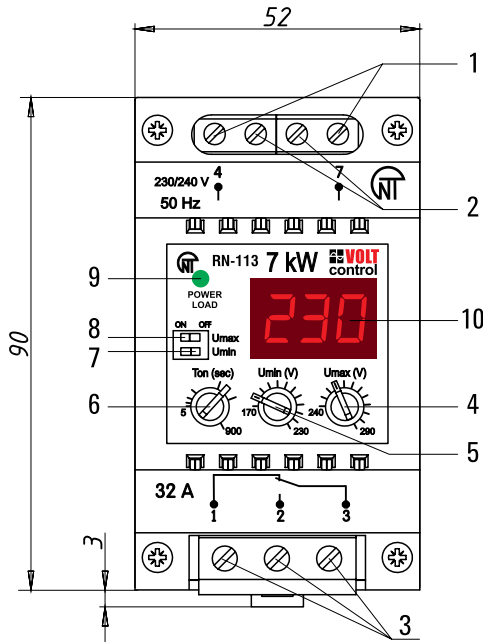
1 – input terminals;
2 – idle terminals;
3 – output terminals;
4 – Maximal voltage tripping threshold (Umax);
5 – Minimal voltage tripping threshold (Umin);
6 – Autoreclosing (AR) time delay (Ton);
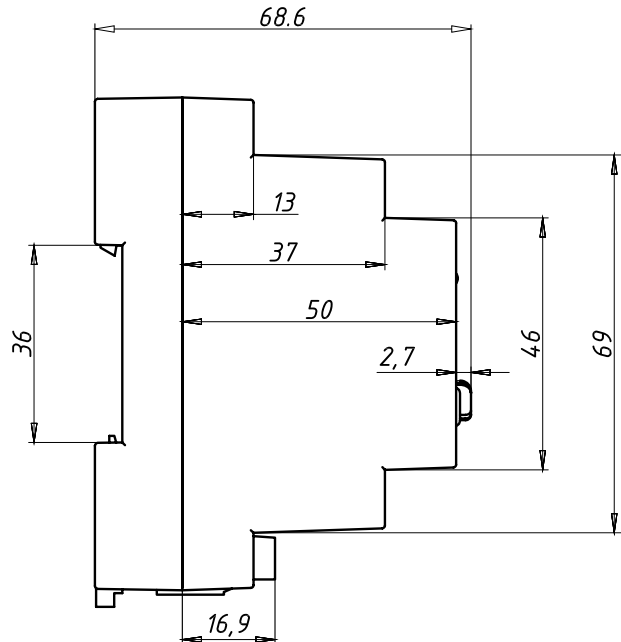
7 – toggle switch (ON/OFF): Minimal voltage tripping (Umin);
8 – toggle switch (ON/OFF): Maximal voltage tripping (Umax);
9 – ON/OFF state indicator showing the position of the output contacts (power load);
10 – Digital LED segment display.

Fiqure 1. Front panel controls and dimensions diagram

Table 1. Technical Specifications

Rated voltage, V	220 – 240
Rated voltage frequency, Hz	48 – 52
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 50160:2010
Adjustment ranges:	
– minimal voltage tripping range (Umin), V	170 – 230
– maximal voltage tripping range (Umax), V	240 – 290
– autoreclosing time delay (Ton), sec	5 –900
Fixed tripping time delay in case maximal voltage fault (Umax) detected, sec	1
Fixed tripping time delay in case minimal voltage fault (Umin) detected, sec	12
Fixed tripping time delay in case of voltage decrease more than 50V than the adjusted minimal voltage tripping threshold (Umin), sec	0.2
Fixed tripping time delay in case of voltage increase more than 30V than the adjusted maximal voltage tripping threshold (Umax), sec	0.12
Maximal commutation current (active power load), A	32
Tripping Voltage level accuracy, V	to 3
Minimal operation voltage level at which RN-113 will keep working, V	100
Maximal operation voltage level at which RN-113 will keep working, V	420
Protection class against electric shock	II
Permissible contamination level	II
Overvoltage category	III
Nominal voltage of isolation, V	450
Voltage hysteresis, V (no less than)	4-5
Rated impulse withstand voltage, kV	4
Moment of an inhaling of screws of input terminals plugs, N*m	0.4
Moment of an inhaling of screws of output terminals plugs, N*m	0.5
Guide section of connecting plugs of input terminals, mm2	0.3-3.3
Guide section of connecting plugs of output terminals, mm2	0.65-5
Operational temperature range, ºC	from -35 to + 55
Total power consumption, mA	15
Device level protection:	
– front panel	IP40
– plugs	IP20
Commutation life of the output contacts:	
– under 16A power load, times (no less than)	100 000
– under 5A power load, times (no less than)	1 000 000
Outer dimensions, (3 S-modules) L*B*D, mm	90 x 52.6 x 66.3
Weight, kg, no less than	0.150
Mounting to standard 35mm DIN rail	
Device allocation - control equipment and distribution	

Table 2. Specification of the Output contacts 1-2-3

|	Maximal current at ~ 250V AC	Maximal power when contacts are closed	Maximal commutation power	Maximal allowed AC/DC Voltage	Maximal current at 30V DC
Cos φ = 1.0	32 A	7200 VA	7200 VA	250/110 V	30 A

RN-113 complies with requirements:
IEC 60947-1:2004; IEC 60947-6-2:1992; CISPR 11:2004; IEC 61000-4-2:2001.
No harmful substances in excess of the maximum permissible concentration is available.

Fiqure 2. Connection diagram
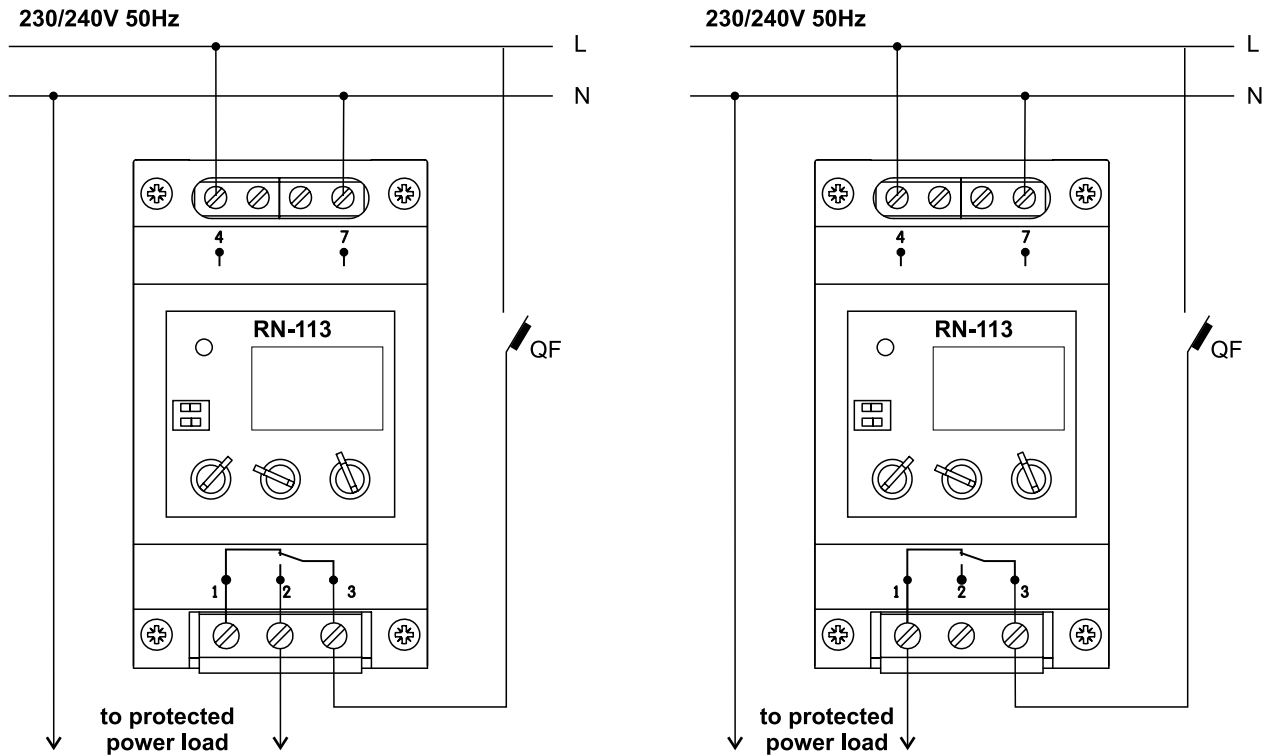
Variant A
If power is less than 32 A, then RN113 operates with the power load directly by output terminals

Variant B
If power is more than 32 A, then RN113 commutates the power load by operating the magnetic coil of the contactor.

L – Fuse
N – neutral wire
QF – Automatic circuit breakers 32A
Note – The status of output terminals is shown in case of a deenergized unit

User may select four independent operation modes:

- Minimal voltage protection relay
This mode is active when toggle switch Umin is set to the Left position and Umax is set to the right position.   RN-113 will turn OFF the power load if voltage level will get lower than the Minimal voltage threshold preset buy the user.
- Maximal voltage protection relay
This mode is active when toggle switch Umax is set to the Left position and Umin is set to the right position.   RN-113 will turn OFF the power load if voltage level will get higher than the Maximal voltage threshold preset buy the user.

- Minimal/Maximal voltage protection relay:
  This mode is active when both toggle switches (Umin, Umax) are set to the Left position. In case the voltage level will get lower/higher than the user adjusted allowable values – the power load will be turned OFF.
RN-113 will turn ON the power load with the user preset time delay (Ton) only after voltage parameters returned back to normal.
- Turn ON time delay relay
This mode is active when both toggle switches (Umin, Umax) are set to the Right position.

VOLTAGE RELAY RN-116
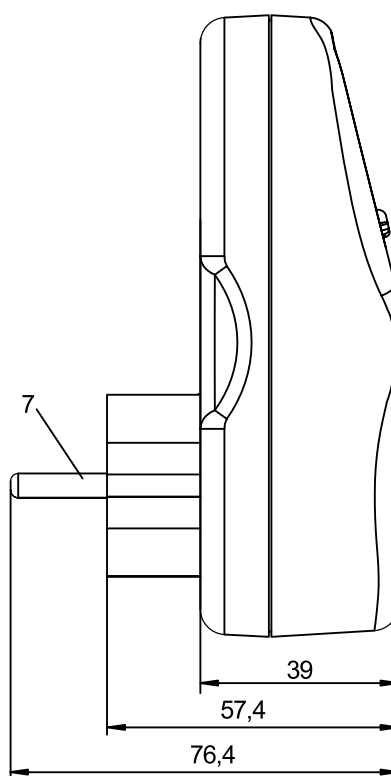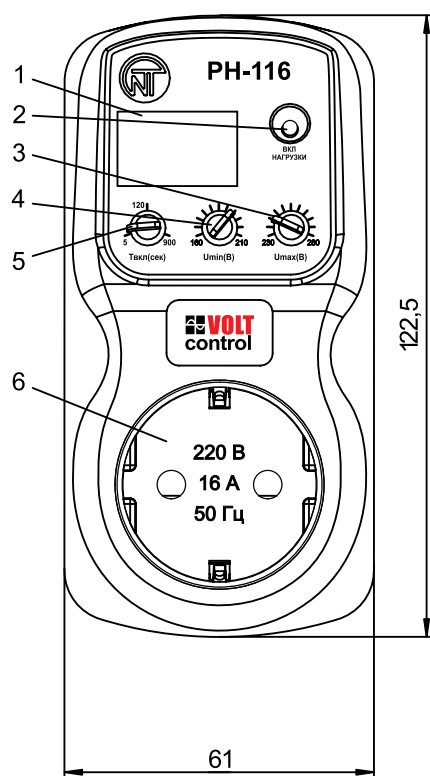
1 – tri-charged seven-segment indicator
2 – load switch indicator
3 – maximum voltage adjustment
4 – minimum voltage adjustment
5 – AR time adjustment
6 – output contacts
7 – input contacts

Fiqure 1.
Faceplate and overall dimensions

Table 1. Technical Specifications

Description	Value
Rated voltage, V	220 – 240
Rated voltage frequency, Hz	47 – 65
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2
Protection degree apparatus	IP30
Protection class against electric shock	I
Permissible contamination level	II
Overvoltage category	II
Adjustment ranges:	
- minimal voltage tripping range (Umin), V	160 – 220
- maximal voltage tripping range (Umax), V	230 – 280
- auto-reclosing time delay (Ton), sec	5 –900
Fixed tripping time delay in case maximal voltage fault (Umax) detected, sec	1
Fixed tripping time delay in case minimal voltage fault (Umin) detected, sec	7
Fixed tripping time delay in case of voltage decrease more than 60V than the adjusted minimal voltage tripping threshold (Umin) or at voltage reduction to less than 145 V, sec	0.12
Fixed tripping time delay in case of voltage increase more than 30V than the adjusted maximal voltage tripping threshold (Umax) or at voltage of over 285 V, sec	0.12
Fixed tripping time at pulsed voltage build-up to over 420 V at pulse duration of over 1.5 msec, sec, not more	0.02
Maximal commutation current (active power load), A (no less than)	16
U tripping threshold determination accuracy, V	up to 3
Minimal operation voltage level at which RN-116 will keep working (present value), V	120
Maximal operation voltage level at which RN-116 will keep working (present value), V	400
Rated voltage of insulation, V	450
Voltage hysteresis, V (no less than)	4
Operational temperature range, °C	from -20 to + 45
Storage temperature, °C	from -45 to + 60
Total power consumption, mA	up to 15
Commutation life of the output contacts:	
– under 16A power load, times (no less than)	100 000
– under 5A power load, times (no less than)	1 000 000
Outer dimensions, (2 S-modules),mm	Figure 1
Weight, kg, no less than	0.160
Mounting to standard 35mm DIN rail	

RN-116 "Volt Control" complies with requirements:
IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2.
No harmful substances in excess of the maximum permissible concentration is available.

The relay may be in one of the following conditions:
– normal operation;
– voltage faults;
– AR time delay.

SINGLE PHASE VOLTAGE MONITORING RELAY
RN-118 / RN-119

RN-118/RN-119 is designed to disconnect the household and industrial single-phase load in case of unacceptable voltage fluctuations in the mains, and then automatically turn on after res-toration of the mains parameters.

In case of load power of up to 2.3 kW (current is up to 10A) for RN-118 or load power of up to 3.6 kW (current is up to 16A) for RN-119, the disconnection is done directly by the device the output contacts of which are included in power supply load outage.

In case of higher power, the disconnection is done by the magnetic contactor of the appropriate power, the output contacts of the device are connected to the coil power supply for circuit disconnection (MC is not included in the delivery set).

RN-118/RN-119 detects the maximum and minimum voltage values from the moment the power supply voltage is applied to the device or since the last time the stored values were viewed. RN-118/RN-119 indicates the actual value of the input voltage and the state of the output relay contacts.
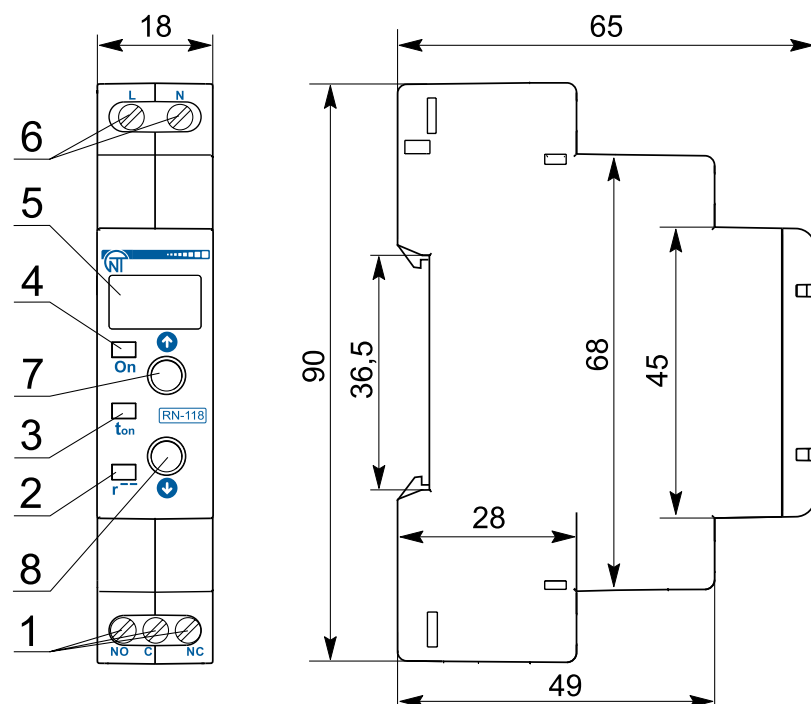
1 – output contacts for load connection;
2 – indicator for the mode of Overvoltage relay (⌐ - -);
3 – indicator for AR countdown (ton);
4 – indicator for power load on (On);
5 – display;
6 – input contacts for power supply connection;
7 – UP button;
8 – DOWN button.

Fiqure 1.
Controls, overall and mounting dimensions of RN-118/RN-119

Table 1. General Data

Description	Value
Device service	Switchgear and control-gear
Rated operating condition	Continuous
Installation (mounting) of the device	Standard 35 mm DIN-rail
Protection class rating of the front panel	IP40
Protection class rating of the terminal block	IP20
Electric shock protection class	II
Climatic design version	NC 3.1
Permissible contamination level	II
Overvoltage category	II
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Conductor cross-section for connecting to terminals, mm²	0.3 – 3.3
Tightening torque of the terminal screws of input contacts, N*m	0.4

Table 2. Basic Technical Specifications

Description	Value
AC single-phase operating supply voltage, V	230/240
Mains frequency, Hz	47 – 65
Harmonic composition (non-sinusoidality) of supply voltage	EN 50160
Control range for Umin, V	160 – 220
Control range for Umax, V	230 – 290
Control range for AR (ton), s	5 – 900
Fixed time of Umax response, s	0.5
Fixed time of response in case of voltage spike of more than 420 V when pulse duration reaching more than 1.5 ms, max., s	0.02
Fixed off-delay due to Umin, s	7
Fixed time of response when voltage reducing less than 145 V, s	0.15
Maximum switched current (with active load) of RN-118, A	10
Maximum switched current (with active load) of RN-119, A	16
Accuracy of determination of the voltage operation threshold, V	Up to 3
Minimum voltage when maintaining serviceability, V	100
Maximum switched current with active load, V	420
Hysteresis of overvoltage release, V	4 – 5
Power consumption (when load is not connected), max., W	2
Commutation life of output contacts:	
– under load of 16 A, min., time	100 thousand
– under load of 5 A, min., time	1 million
Overall dimensions (S-type module) – height * width * length, mm	90 x 65 x 18
Weight, max., kg	0.10
The device remains operational capability in any position in space	
Housing material - self-extinguishing plastic	

Table 3. Output Contacts Specifications

Operation mode	Max. current at U~250 V, A	Max. switching power, kVA	Max. continuous permissible AC / DC voltage, V	Max. current at Ucont=30 V, A
cos φ=1	10 (RN-118) 16 (RN-119)	2.3 (RN-118) 3.6 (RN-119)	250	5
cos φ=0.4	5	1.1		

The device meets the requirements of the following:

– EN 60947-1, Low-voltage switchgear and control-gear; Part 1; General rules;
– EN 60947-6-2, Low-voltage switchgear and control-gear; Part 6-2; Multiple function equipment; Control and protective switching devices;

– EN 55011, Electromagnetic compatibility; Industrial, scientific and medical RF equipment; Electromagnetic interference characteristics; Limits and methods of measurement;
– IEC 61000-4-2, Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test.

Connection of the device to the mains

Option 1

Option 2
(over voltage relay operation)
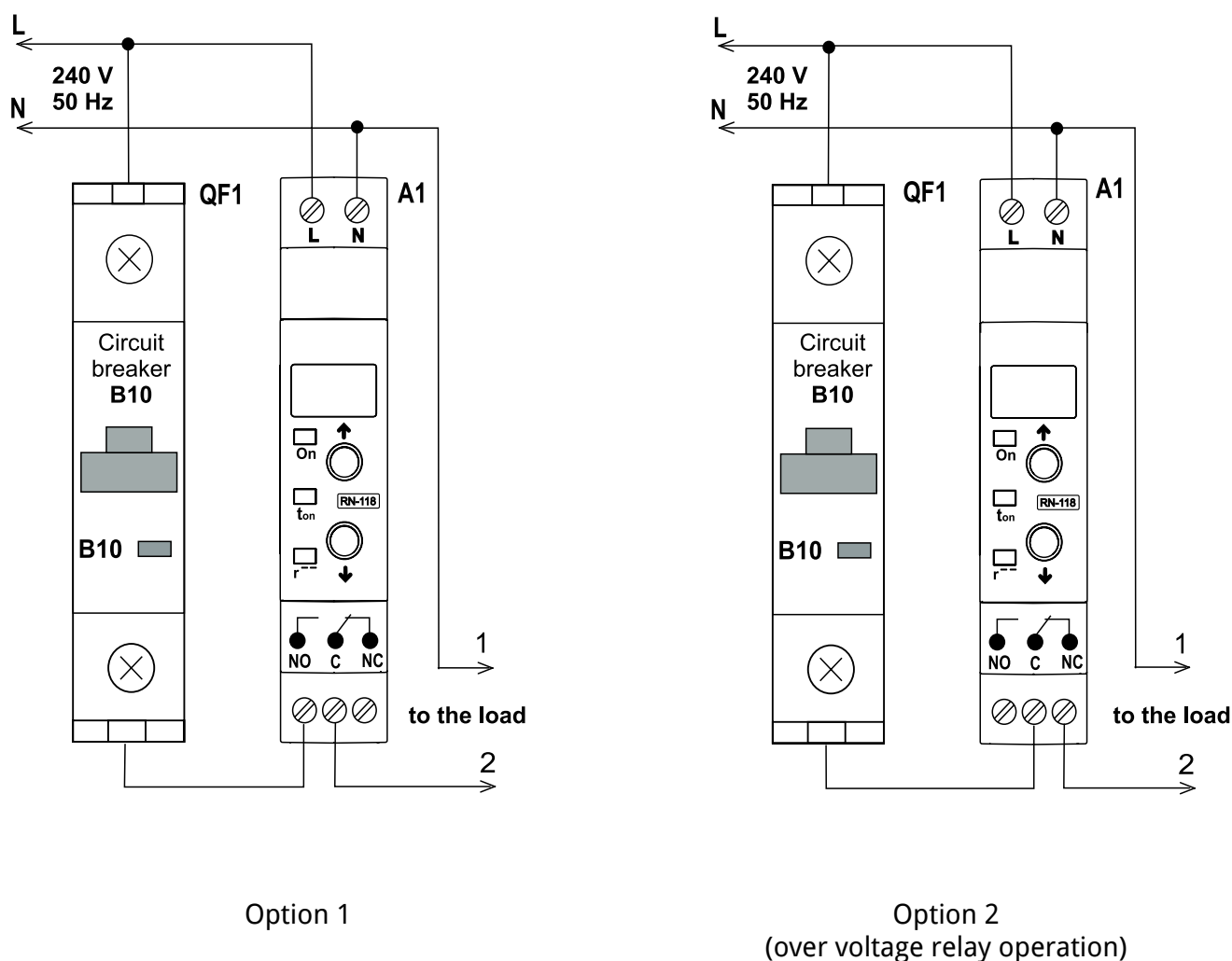
Figure 2. Connection diagram RN-118/RN-119
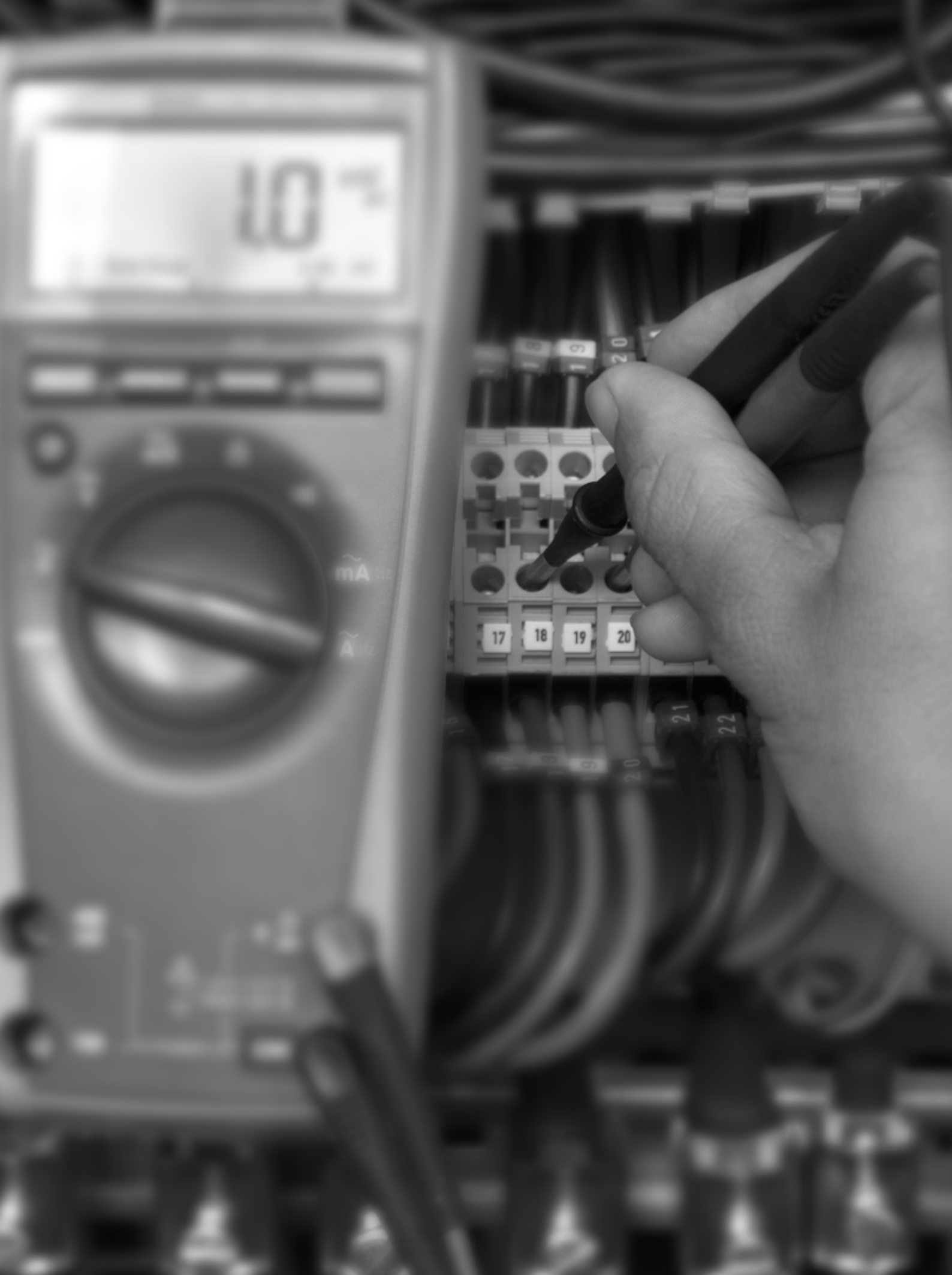
Section 2

THREE PHASE VOLTAGE SENSITIVE RELAYS

THREE PHASE VOLTAGE AND PHASE MONITORING RELAY

RNPP-301

RNPP-301 complies with requirements:
IEC 60947-1:2004, IDT; IEC 60947-6-2:1992, IDT; CISPR 11:2004, IDT; IEC 61000-4-2:2001, IDT
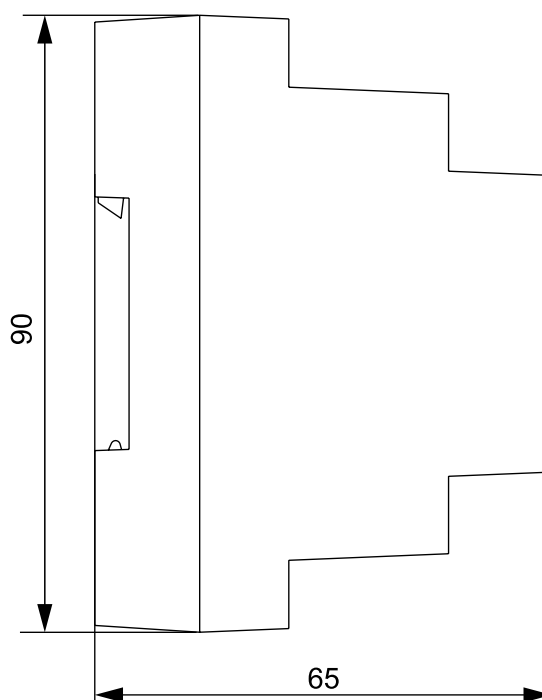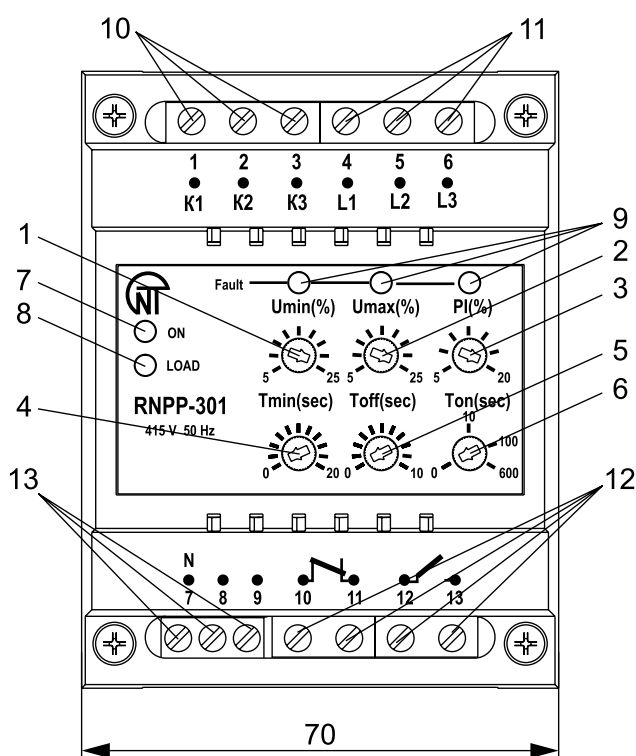
Fiqure 1.
Controls description and dimensions diagram

1. control for minimum voltage threshold, Umin (%);
2. control for maximum voltage threshold, Umax (%);
3. control for peak phase imbalance threshold, PI (%);
4. control of trip delay setting for Umin, Tmin (sec);
5. control of trip delay setting for the mains voltage faults, Toff (sec);
6. control for automatic reset delay setting, Ton (sec);
7. green LED signal that the mains voltage is present, ON;

8. green LED signal that load is energized, Load;
9. red LEDs signal for the mains voltage fault/ magnetic starter (MS) power contacts monitoring, Fault;
10. MS power contacts monitoring terminals;
11. input contacts;
12. output contacts;
13. terminals for the mode selection: line/phase voltage monitoring.

A RNPP-301 voltage control relay is designed for:

1. monitoring of the tolerable RMS phase/line voltage level (at the option of user) with independent setting adjustments for the minimum and maximum voltage thresholds;
2. monitoring of the correct phase sequence and phase "non-coincidence" (the phases are supposed to be coinciding when a load is energized not from two different phases but instead from one and the same phase);
3. monitoring of three phase lines for voltage presence and the mains voltage symmetry with adjustable phase imbalance or asymmetry setting;
4. monitoring of the magnetic contactor power contacts status at no-load and under load;
5. load (415V/50Hz) de-energization with user-set trip delay (Toff) through the opening the magnetic contactor coil power circuit (AC and DC electric circuit switching) when fault conditions occur;
6. mains voltage quality monitoring after the relay had tripped and did reset automatically with the user-set reset delay (Ton) upon the voltage parameters regeneration;
7. all fault conditions (full phase switching of the magnetic contactor power contacts is included) are displayed by special LEDs indicating the specific cause of the occurring voltage fault in the mains.

Table 1. Technical Specifications

Rated phase/line voltage, V	240/415
Mains frequency, Hz	45-55
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Adjustable range for Umin, % of nominal value	5-25
Adjustable range for Umax, % of nominal value	5-25
Adjustable range for phase imbalance, %	5-20
Adjustable range for Tmin, sec	0-20
Adjustable range for Toff, sec	0-10
Adjustable range for Ton, sec	0-600
Minimum trip delay when threshold settings are reached, sec	0.1
Reset/energization delay when the relay energizes, sec, not more than	0.2
Voltage hysteresis, V	5-6
Accuracy of trip threshold for voltage, V, not more than	3
Phase imbalance accuracy, %, not more than	1.5
Safe operating voltage, % of rated value	30-110
Power required (under load), VA, not more than	3.0
Maximum switched current of output contacts, A	5
Output contacts life:	
• under load 5A, no less than, operations	100 000
• under load 1A, no less than, operations	1 mln.
Protection degree of:	
• apparatus	IP40
• terminal block	IP20
Permissible contamination level	II
Overvoltage category	III
Nominal voltage of isolation, V	450
Rated impulse withstand voltage, kV	4
Cross-section area of connection terminals, mm²	0.5-2
Maximum torque of terminal fixing, N*m	0.4
Operating temperature range, °C	from -35 to +55
Weight, no more than, kg	0.200
Case dimensions 4 modules of S-type	
Mounting 35 mm DIN-rail	
Mounting position as desired	

The RNPP-301 relay (hereafter «the relay») is a digital microprocessor-based device that provides a high degree of reliability and accuracy. The relay doesn't require any auxiliary power supply because it is self-powered by the three-phase voltage to be monitored. This permits the relay to keep operation capability even when only one phase is present (in the three-phase systems with neutral). Two modes of the mains voltage monitoring can be selected at the user's option:

The phase voltage monitoring mode

To enable phase voltage monitoring mode, it's necessary to remove jumper in between terminals 8-9 and connect neutral wire to terminal 7. This mode of operation is recommended for the situations when for the machinery the neutral shift is very critical (within the range of user preset values) and when phase imbalance is a matter of a great concern.

The line voltage monitoring mode

To go into this mode of operation one needs to apply the jumper strap between terminals 8-9; in this case to connect the neutral is not necessary. This mode of operation is recommended when the neutral drift value and phase voltage imbalance is not important as well as for isolated neutral three-phase systems. The relay will trip when line voltage imbalance/asymmetry between phases occurs.

Table 2. The 10-11, 12-13 output contacts specification

	Max. current for ~ 250 VAC	Max. power	Max sustained safe voltage~	Max. current for U=30VDC
Cosφ = 0.4	3A			
Cosφ = 1.0	5A	1200VA	460V	3A

Controls

The relay has six independent controls for basic parameters. For user's convenience screwdriver slots of adjusting potentiometers are brought out to the relay front panel.

- Umin — trip threshold for the minimum allowable voltage, % of rated voltage;
- Umax — trip threshold for the maximum allowable voltage, % of rated voltage;
- PI — phase/line voltage imbalance threshold (according to selected monitoring mode), difference between RMS phase/line voltages, % of a lesser value;
- Tmin — trip delay for the minimum voltage that allows to ignore transient and/or starting voltage drops; it's recommended to set Tmin no less than 10 sec.
- Toff — trip delay covering all types of the mains voltage faults, under voltage excluded. It's recommended to set Toff no less than 1-1,5 sec to prevent the excessive relay tripping due to switching perturbations in the mains;
- Ton — automatic reset delay after the relay tripped and the mains voltage parameters have regenerated; this is also the energization time delay after the normal voltage was applied to the relay.
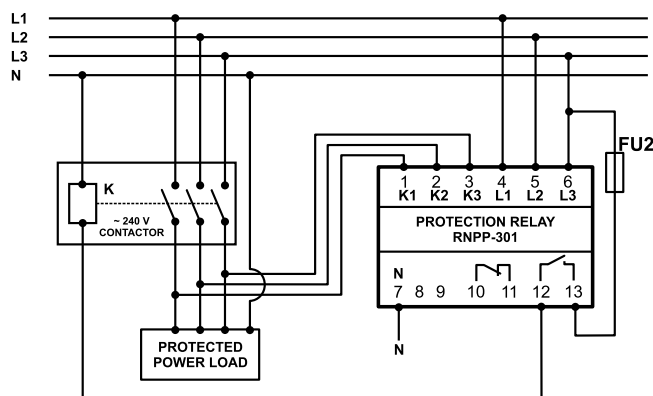
WIRING DIAGRAM

The relay should be connected in parallel to load according to the diagrams shown below.
The RNPP-301 wiring diagram with selectable mode of operation:

SCHEME A. LINE VOLTAGE (PHASE-TO-PHASE) MONITORING MODE
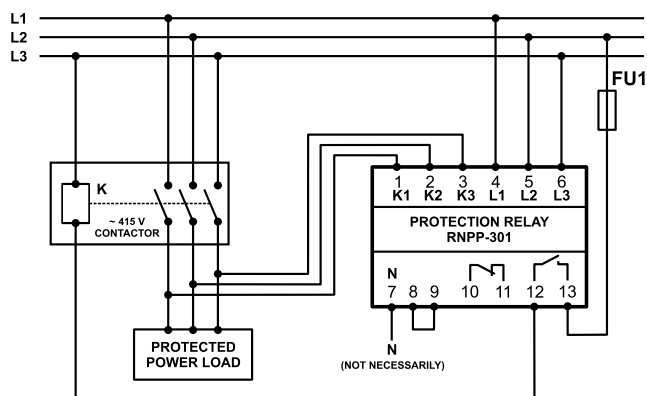
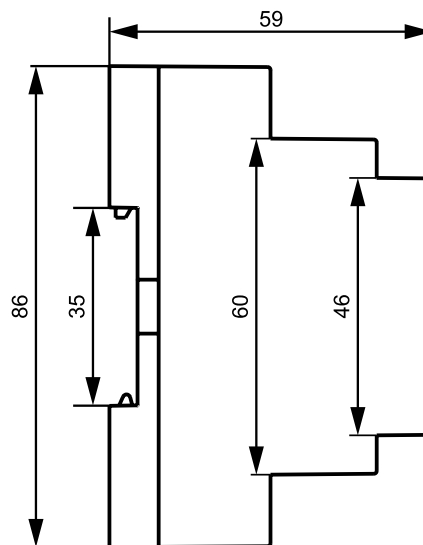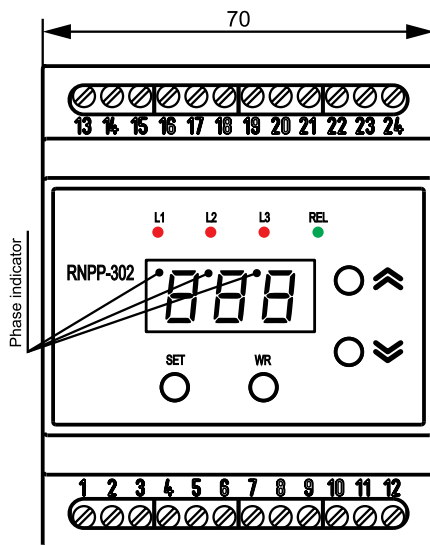*SCHEME B. PHASE VOLTAGE (LINE-TO GROUND) MONITORING MODE*

FU1, FU2 – fuse 6.3 A (circuit breaker)

MULTIFUNCTIONAL PROGRAMMABLE THREE PHASE VOLTAGE MONITORING RELAY

RNPP-302

RNPP-302 complies with requirements: IEC 60947-1:2004; IEC 60947-6-2:1992; CISPR 11:2004; IEC 61000-4-2:2001.

Red LED "L1" – lights up in case of the alarm on phase L1
Red LED "L2" – lights up in case of the alarm on phase L2
Red LED "L3" – lights up in case of the alarm on phase L3
Green LED "REL" – lights up when the output relay is closed
"SET" button – to set the parameter value
"WR" – to write and save the parameter
" and " Buttons - to scroll and adjust the parameters value in menu
Notes:
    button hereinafter in text – "UP",   button – "DOWN"

Figure 1. Front panel, controls and size dimensions of the RNPP-302

Universal Three phase voltage monitoring relay RNPP-302 (hereinafter RNPP-302) is designed for the permanent voltage monitoring, control and protection of the equipment with rated voltage parameters of 220/380V and 230/400V or 240/415V at rated frequency of 50Hz. RNPP-302 protects the power load from the following alarm situations and power faults:
• selectable phase voltage or line voltage monitoring modes,
• over and under voltage, voltage surges and fluctuations,

• phase loss (phase failure),
• phase collision (short between 2 or more phases),
• reverse phase sequence,
• phase imbalance/asymmetry in the AC power circuits
• control over the full phase switching of the contactor
• remote control input signal to operate with the power load as per requirement (emergency stop)

The RNPP-302 operates with the magnetic coil of the external contactor which in it's turn operates with the power load. The RNPP-302 constantly checks (before and after turning on) the condition of the power contacts of magnetic contactor and detects the stuck together and burned contacts. When the power parameters return back to normal after the interruption or when the reason of the tripping is eliminated the RNPP-302 performs automatic reclosing and thus restart the equipment. It does so following a time delay (0-600 sec), set previously by the user.

RNPP-302 relay may work in four independent modes:
1. phase loss monitoring mode without voltage level control (parameter tPr = 0);
2. minimum voltage monitoring mode (parameter tPr = 1);
3. maximum voltage monitoring mode (parameter tPr = 2);
4. symmetrical min/max voltage monitoring mode (parameter tPr = 3)

The LED display of the RNPP-302 indicates:
-    Acting value (true RMS) of the phase voltage or alternatively line voltage depending on mode of operation;
-    Voltage fault in mains power supply and the type of the interruption (fault indication);
-    State of output relay contacts (OPEN/CLOSE)

Digital input to turn ON/OFF the RNPP-302 remotely (emergency stop button);
Changeover relay output (NO+NC): 8A 250VAC at cos φ=1 for the operation by the magnetic contactor to commutate any desired power load;
Normally Open relay contact: 8A 250V at cos φ=1 for signalization/annunciation;
Measurement accuracy for tripping thresholds: not exceeding 3V;
Rated phase/line voltage: 220/380V, 230/400V or 240/415V selectable;
Rated power consumption: not exceeding 5W;
Protection degree of the enclosure case: IP40;
Protection degree of terminal block: IP20;
Operational temperature range from - 35 to +55 °C and exposed to not more than 90% of relative humidity
Weight not more than 0.3 kg
Mounting: fit the standard 35 mm DIN-rail
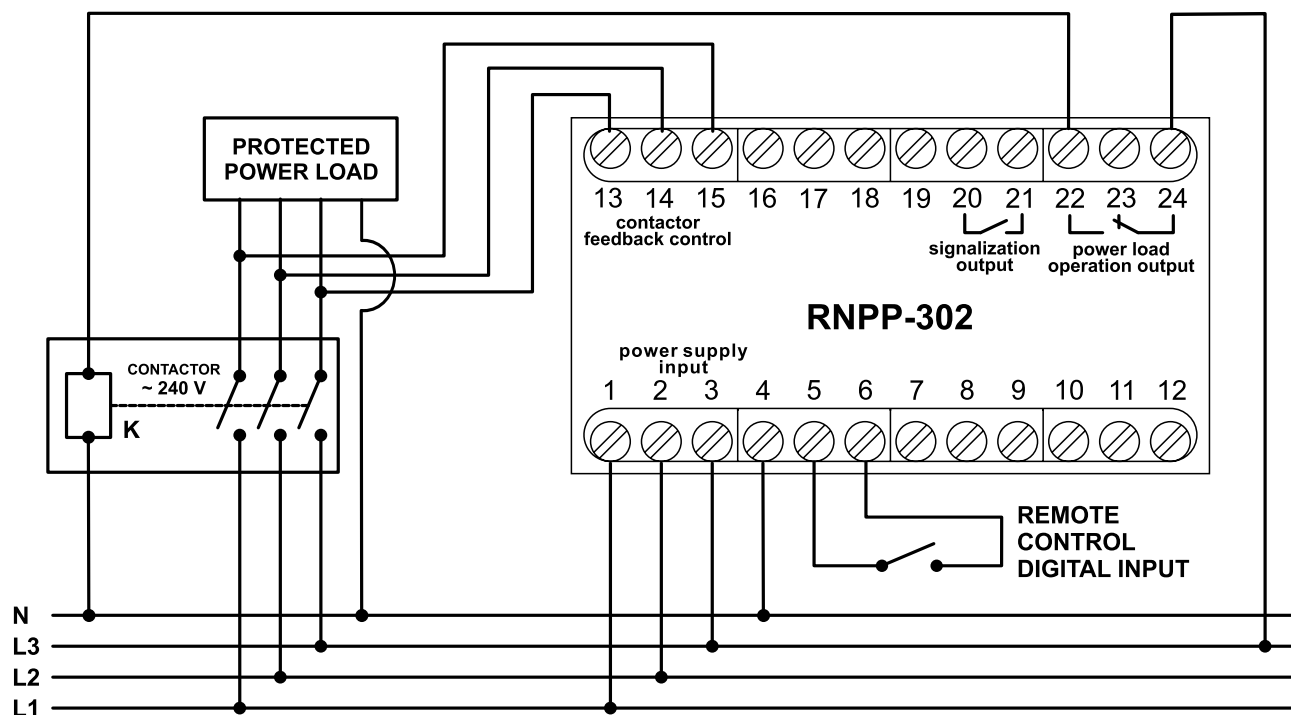Mounting position: arbitrary - as per requirement

Fiqure 2. Wiring diagram of the RNPP-302 to the 4 wires power circuits (with neutral phase present).

THREE PHASE VOLTAGE MONITORING RELAY RNPP-311.1

OVER & UNDER VOLTAGE,
PHASE IMBALANCE,
PHASE LOSS AND PHASE SEQUENCE MONITORING RELAY

• *EN 60947-6-2, Low-voltage switchgear and control gear; Part 6-2; Multiple function equipment; Control and protective switching devices;*
• *EN 55011, Electromagnetic compatibility; Industrial, scientific and medical RF equipment; Electromagnetic interference characteristics; Limits and methods of measurement;*
• *IEC 61000-4-2, Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test.*
Harmful substances in amounts exceeding maximum permissible concentrations are not available.
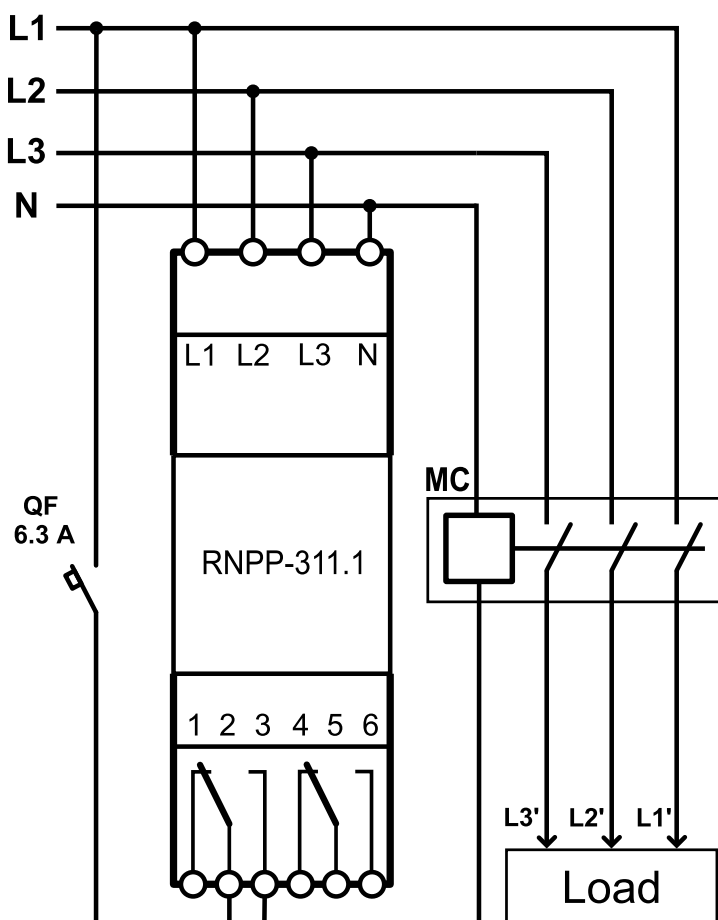
1 – Three green LINE LEDs indicating voltage presence in each phase;
2 – Red ALARM LED;
3 – Control of RNPP-311.1 setting threshold for maximum/minimum voltage (Unom±%);
4 – Terminals for power connection;
5 – Terminals for connecting the load.

Figure 1. Controls, overall and mounting dimensions of RNPP-311.1

Table 1. Technical Specifications

Description	Value
Rated phase / line supply voltage, V	230/400
Mains frequency, Hz	45 – 55
Harmonic composition (non-sinusoidality) of supply voltage	EN 50160
Control range of response for Umax/Umin, as a percentage of nominal	5 – 25
Fixed delay of response due to Umin, s	12
Fixed voltage of response due to phase imbalance, V	60
Fixed time of response due to Umax, s	1.5 (0.1– as option)
Fixed time of response in case of loss of one phase, s	1.5 (0.1– as option)
AR time after voltage parameters restoring*, s	5
Hysteresis of voltage, V	5-6
Accuracy of determination of the voltage operation threshold, max., V	3
The supply voltage when the operability is maintained, V	95 – 450
Power consumption (when load is not connected), max., W	3.0
Climatic design version	NC 3.1
Protection class rating of the front panel	IP40
Protection class rating of the terminal block	IP20
Commutation life under load of 5 A, min., time	100000
Permissible contamination level	II
Overvoltage category	III
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	4
Conductor cross-section for connecting to terminals, mm²	0.5 – 2
Tightening torque of the terminal screws, N*m	0.4
Overall dimensions (Fig. 1), H*B*L, mm	90.2*36*64.5
Weight, kg, maximum	0.100

Installation (mounting) of the device is on standard 35 mm DIN-rail
The device remains operational capability in any position in space
Housing material - self-extinguishing plastic
* - According to the order of the Buyer, the AR time can be changed to the following values – 0, 10, 60, 100, 150, 200, 250 seconds

Table 2. The 1-2-3, 4-5-6 Terminals Specifications

	Max. current at U~250 V, A	Max. switching power, kVA	Max. continuous permissible AC voltage at current of 2 A	Max. current at Ucont=30 V, A
Cosφ = 0.4	5	1.25	440V	1.5
Cosφ = 1.0	2	0.5	-	-

RNPP-311.1 constantly monitors the values of the voltages in the three-phase mains, comparing them with the values set by the user using regulator Unom±%.

The device will disconnect the load if the voltage value exceeds the limits set by the user.

RNPP-311.1 1 has one combined adjustable maximum / minimum voltage set point. For example: in the 10% position, the device will operate when the voltage is increased / decreased by 10% of the nominal value.

The device can be in the following states: normal operation; voltage failure; AR time delay.

Normal operation condition:
- the mains voltage is within the limits set by the user when setting the device;
- AR time has finished;
- the protected equipment is connected to the mains;

- ALARM indicator does not light up;
- LINE indicators are on.

Voltage alarm condition:
- the mains voltage has exceeded the limits set by the user when setting the device, for time longer than indicated in the technical specifications (see Table 1);
- the protected equipment is disconnected from the mains, ALARM indicator is on;
- **when the phase is broken, the corresponding LINE indicator does not light up.**

AR time delay condition:
The AR time countdown starts from the moment the power is applied or the failure occurs.

After completion of the AR time, the device will go to the Normal operation condition, if the mains voltage parameters are restored after the failure.
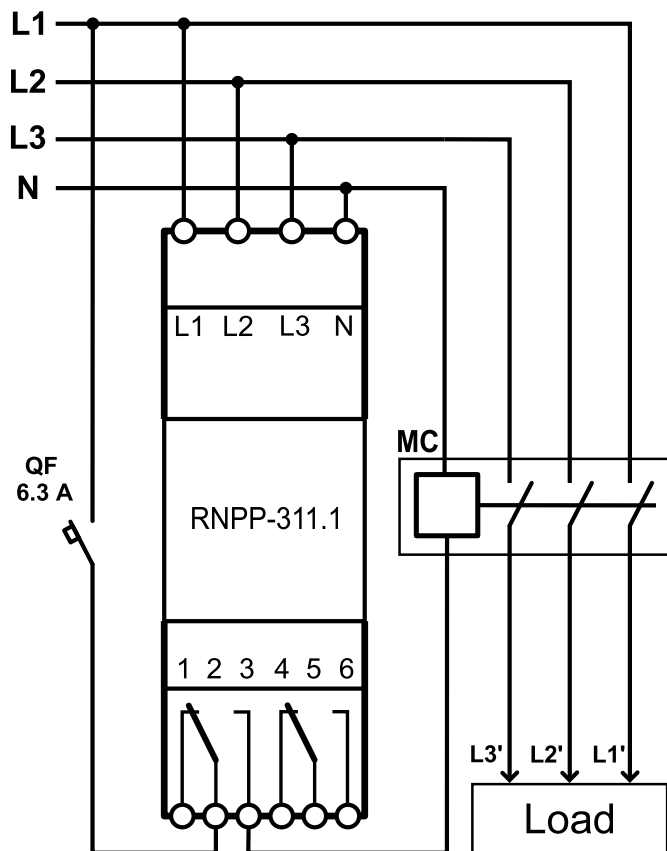
MC – magnetic contactor (the coil voltage is 230 V);

QF – automatic circuit breaker for current not exceeding 6.3 A

Figure 2. Connection Diagram of RNPP-311.1

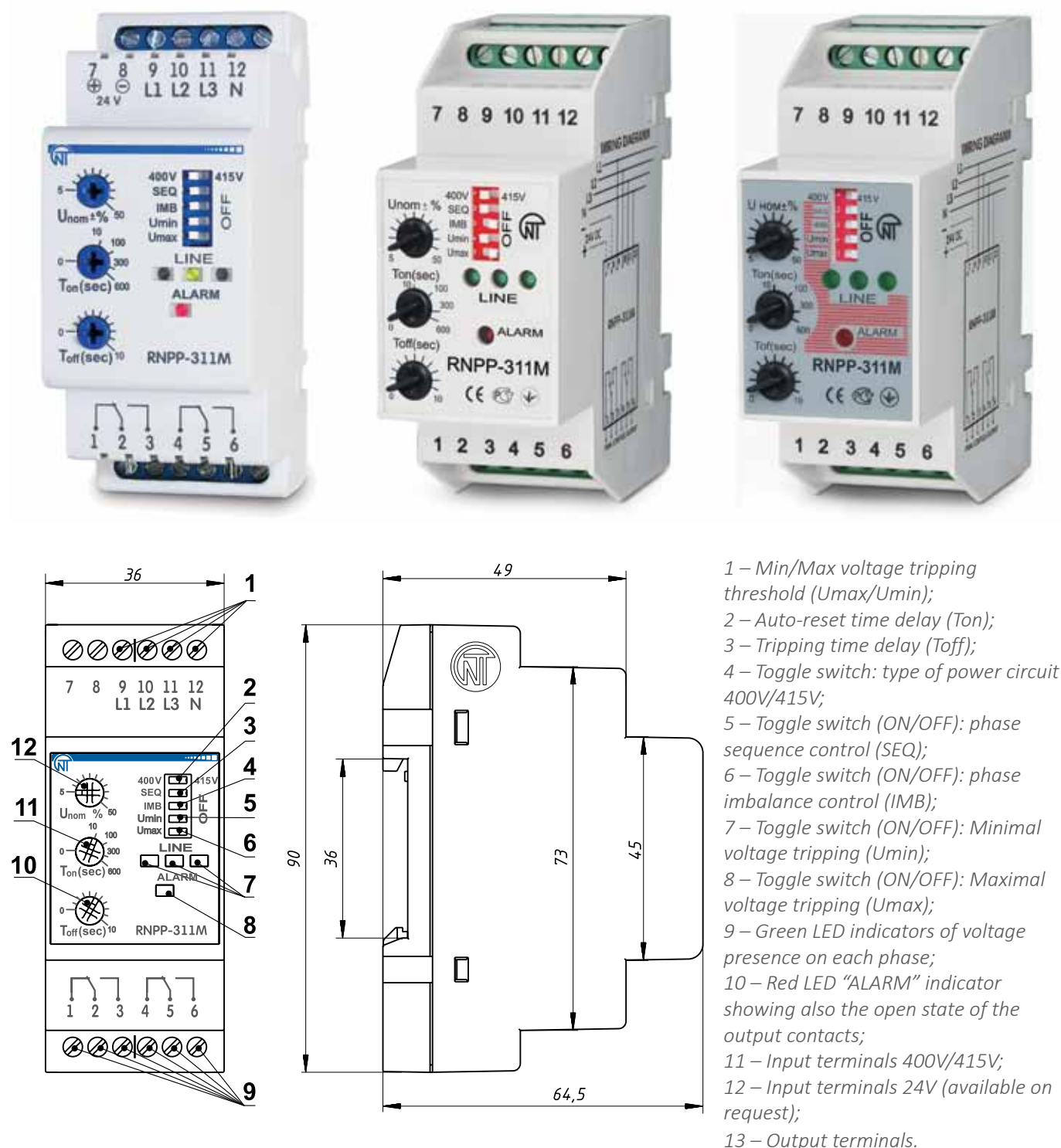# MULTIFUNCTIONAL THREE PHASE VOLTAGE MONITORING RELAY RNPP-311M

1 – Min/Max voltage tripping threshold (Umax/Umin);
2 – Auto-reset time delay (Ton);
3 – Tripping time delay (Toff);
4 – Toggle switch: type of power circuit 400V/415V;
5 – Toggle switch (ON/OFF): phase sequence control (SEQ);
6 – Toggle switch (ON/OFF): phase imbalance control (IMB);
7 – Toggle switch (ON/OFF): Minimal voltage tripping (Umin);
8 – Toggle switch (ON/OFF): Maximal voltage tripping (Umax);
9 – Green LED indicators of voltage presence on each phase;
10 – Red LED "ALARM" indicator showing also the open state of the output contacts;
11 – Input terminals 400V/415V;
12 – Input terminals 24V (available on request);
13 – Output terminals.

Fiqure 1. Control descriptions and dimensions diagram

Multifunctional voltage monitoring relay RNPP-311M (hereinafter RNPP-311M) performs the following functions:
• Permissible voltage level control;
• Control of correct phase sequence, phase loss and phase collision (shorting of 2 or more phases);
• Phase imbalance control (control of full phase power load and phase asymmetry);
• Turning the power load OFF by operating with output contacts in case of unallowable mains voltage parameters. User adjusted Tripping time delay is in the range 0-10 sec (Toff);
• Mains voltage monitoring after tripping and automatic turning ON the power load when the voltage parameters return back to normal conditions. Auto-reset time delay is adjusted by (Ton) user in the range 0-600 seconds;
• Alarm indication in case of voltage faults and indication of voltage presence on each phase.

It is possible to adjust the RNPP-311M to operate in following modes:

- complete voltage parameters monitoring;
- MIN/MAX voltage level monitoring;
- MIN voltage monitoring;
- MAX voltage monitoring;
- correct phase sequence monitoring and protection from phase collision;
- phase imbalance/asymmetry control and protection from phase loss.

Control of voltage presence on each phase is being performed at any position of 4-8 switches. On special request it is possible to arrange operative input voltage of 24V for the RNPP-311M (is recommended for using in the network lines with a high level of harmonic waves).

RNPP-311M complies with requirements IEC 60947-1:2004, IDT, IEC 60947-6-2: 1992, IDT, CISPR 11:2004, IDT, IEC 61000-4-2:2001, IDT.

Table 1. Technical Specifications

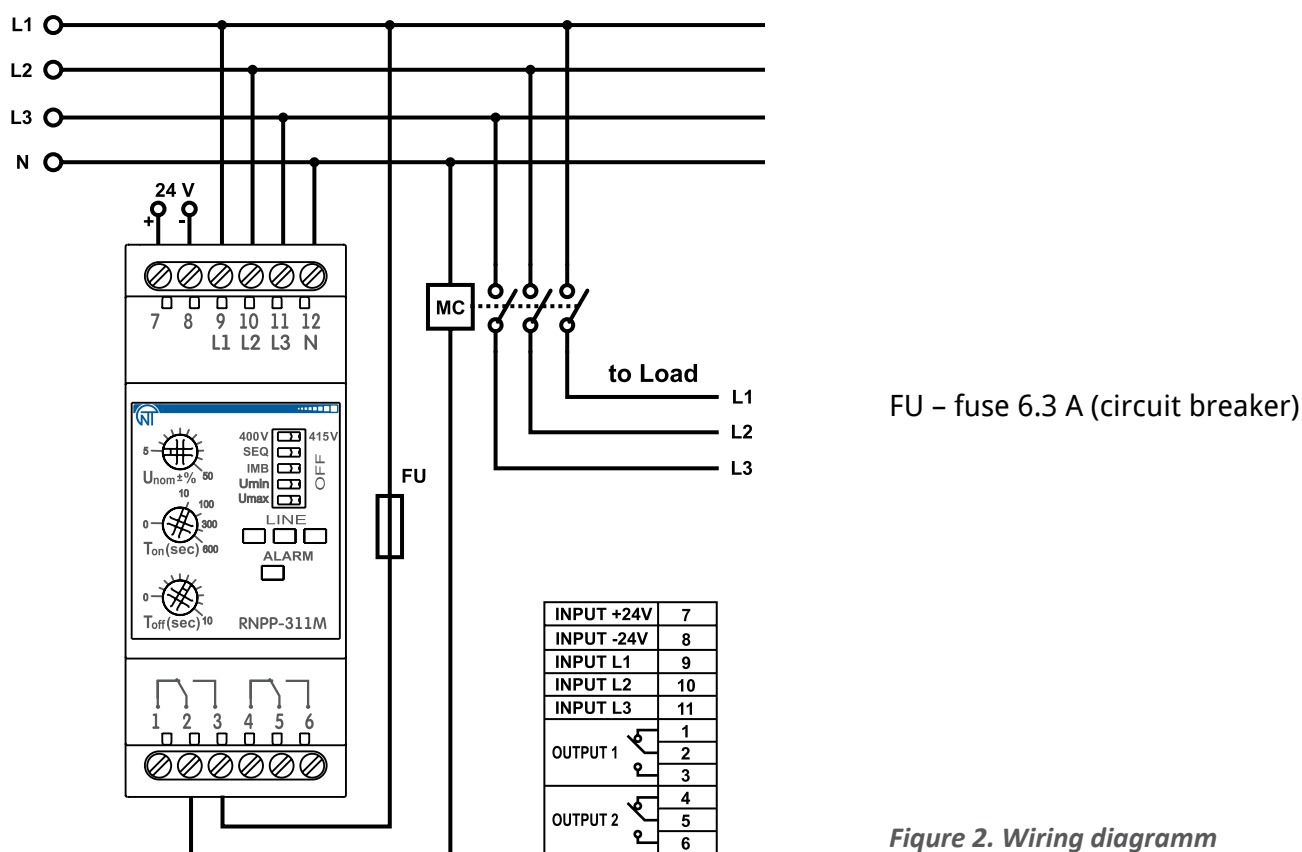| Description	Value
Rated line/phase voltage, V	400/230, 415/240
Rated frequency, Hz	45 – 65
Harmonical configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Adjustable range for Umax/Umin, % of nominal value Unom	5 – 50
Adjustable Tripping time delay (Toff), sec	0 – 10
Adjustable Auto-reset time delay (Ton), sec	0 – 600
Fixed time delay for tripping in case MIN voltage fault detected (time delay for Umin), sec	12*
Reaction time in case of phase loss, sec (not more)	0.2
Readiness time on energizing the RNPP-311M, sec (not more)	0.2**
Phase imbalance value, V	60
Voltage hysteresis, V	5 – 6
Phase imbalance hysteresis, V	5 – 6
Accuracy for voltage tripping threshold measurement, V (not more)	3
Accuracy for phase imbalance measurement, % (not more)	2
Protection class against electric shock	II
Permissible contamination level	II
Overvoltage category	II
Nominal voltage of isolation, V	450
Operational voltage range, % of rated voltage	from 50 to 150
Rated impulse withstand voltage, kV	2.5
Power consumption (under power load), VA (not more)	3.0
Maximal current that output contacts may commutate, A	5
Cross-section area of connection terminals, mm²	0.5 – 2
Maximum torque of terminal fixing, N*m	0.4
Commutation endurance for the output contacts:	
- under 5A power load, not less than	100000 times
- under 1A power load, not less than	1000000times
Protection degree:	
- for the device	IP40
- for the terminals	IP20
Operational temperature range, °C	from - 35 to +55
Storage temperature conditions, °C	from - 45 to +60
Weight, kg (not more)	0.200
Standard 35 mm DIN rail mounting	
Mounting position as per requirement (arbitrary)	

Table 2. Specification of the Output contacts (1-2-3 and 4-5-6)

	Max. current at U~250 V, A	Max. capacity, kVA	Maximal AC Voltage	Max. current at 30V DC, A
Cosφ = 0.4 Cosφ = 1.0	5 2	1.25 0.5	440V	1.5

RNPP-311M is a microprocessor-based device. It is self-powered by the power circuit to which it is connected – so that the controlled voltage is also a power supply source. Internal power supply scheme of RNPP-311M is designed such a way that it will keep working if the voltage is present at least at one of the phases (on condition that the neutral is connected).

Alternatively, RNPP-311M could be powered by 24 V (AC/DC) external power supply source.

On the upper and lower sides of the front panel there are input and output wiring terminals.

FU – fuse 6.3 A (circuit breaker)

INPUT +24V	7
INPUT -24V	8
INPUT L1	9
INPUT L2	10
INPUT L3	11
OUTPUT 1	1
	2
	3
OUTPUT 2	4
	5
	6

Fiqure 2. Wiring diagramm

VOLTAGE MONITORING, PHASE IMBALANCE AND SEQUENCE RELAY

RNPP-312

The device meets the requirements of the following:
EN 60947-1; EN 60947-6-; EN 55011; IEC 61000-4-2.

RNPP-312 is designed:
– for monitoring the permissible voltage level;
– for monitoring the correct alternation and absence of sticking of phases;
– for monitoring the full-phase and symmetry of the mains voltage (phase imbalance);
– to disconnect the load in case of phase failure (phase loss);
– for monitoring the quality of the mains voltage after switching off the load and automatically turning it on after restoration of voltage parameters within permissible user defined levels;
– to indicate the failure in the event of emergency situation and the presence of voltage in each phase.

The device provides the possibility of adjusting the parameters (voltage threshold, time of automatic re-closing and time delay of protection operation), selection of the voltage of the monitored mains (400 V or 415 V) and a set of protective functions through DIP switch.
After restoring the voltage parameters of the mains, the device enables the load again after the re-closing time.

Figure 1. Controls, overall and mounting dimensions of RNPP-312
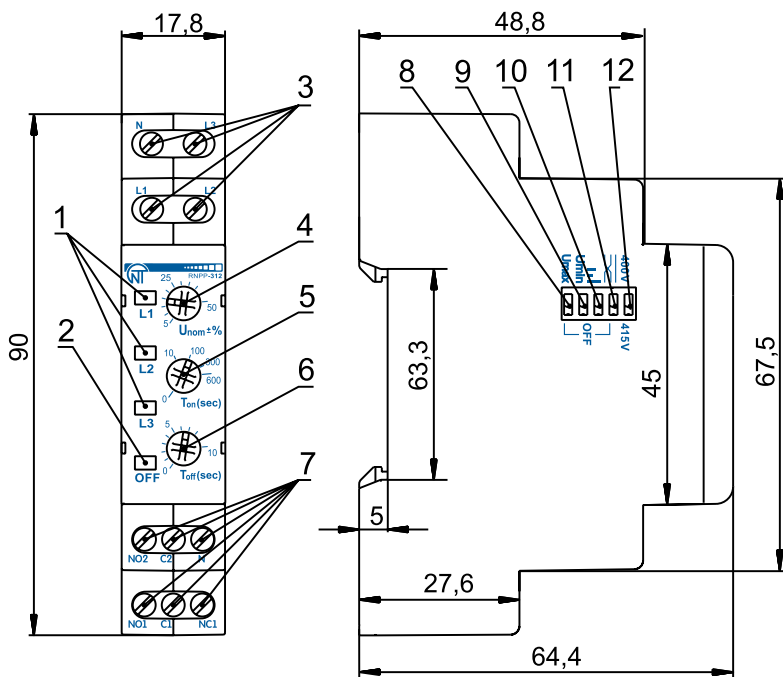
1 – Rated voltage indicators for each phase (L1, L2, L3);
2 – Failure indicator (OFF);
3 – Terminals for power supply connection of 400 V/415 V;
4 – Control of setting the threshold for maximum / minimum voltage ($U_{nom}\pm\%$);
5 – Control of setting the AR time (T_{on}(sec));
6 – Control of setting the protection operation time (T_{off}(sec));
7 – Terminals for load connection;
8 – Switch of protection operation at the maximum voltage (Umax) (in position "OFF" – the protection is disabled);
9 – Switch of protection operation at the minimum voltage (Umin) (in position "OFF" – the protection is disabled);
10 – Switch of protection operation at voltage imbalance (᠁) (in position "OFF» – the protection is disabled);
11 – Switch of protection operation at phase sequence (⇄) (in position "OFF" – the protection is disabled);
12 – Switch of rated voltage of controlled mains (400 V / 415 V).

Table 1. Technical Specifications

Description	Value
Rated line / phase supply voltage, V	400 / 230, 415 / 240
Mains frequency, Hz	45 – 65
Harmonic composition (unsinusoidality) of supply voltage	EN 50160
Control range of response threshold for Umax/Umin, as a percentage of rated voltage	5 – 50
Control range of protection operation time, s	0 – 10
Control range of AR time, s	0 – 600
Fixed delay of minimum voltage response, s	12*
Response time when one phase breaks, max., s	0.2
Readiness time when power supply voltage is supplied, max., s	0.2**
Phase imbalance determination value, V	30
Hysteresis of voltage, V	5 – 6
Hysteresis of phase imbalance, V	5 – 6
Accuracy of determination of the voltage operation threshold, max., V	3
Voltage when maintaining serviceability:	
- for one phase, V	95 – 450
- for three phases, V	95 – 450
Power consumption (when load is connected), max., W	1.2
Maximum switching current of output contacts, A	5
Commutation life of output contacts:	
- under load of 5 A (cos φ = 1.0), min., time	100 thousand
- under load of 1 A (cos φ = 1.0), min., time	1 million
Device service	Switchgear and control-gear
Rated operating condition	Continuous
Protection class rating of the front panel	IP40
Protection class rating of the terminal block	IP20
Electric shock protection class	II
Climatic design version	NC 3.1
Permissible contamination level	II
Overvoltage category	III
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	4.0
Conductor cross-section for connecting to terminals, mm²	0.5-1.5
Tightening torque of the terminal screws, N*m	0.4
Weight, max., kg	0.100
Overall dimensions (Fig. 1), H*B*L, mm	90*17.8*64.4
The device installation (mounting) is on standard 35 mm DIN-rail.	
The device remains operational capability in any position in space.	
Housing material - self-extinguishing plastic	

Notes:

* – When the input voltage drops below Umin, the fixed operation time of the device is 12 seconds, if the switches Umax and Umin are in the «ON» position. With any other combination of switches Umax and Umin, the device will operate after the delay time set by the User with Toff(sec) control. If during this time (12 seconds) the mains parameters change, for example, at the maximum voltage, the device will operate at the smallest of the periods - after the delay time specified by the User, or after the time remaining of 12 seconds.

** – When working in «Maximum Voltage Control» mode, the ready time is 0.3 seconds.
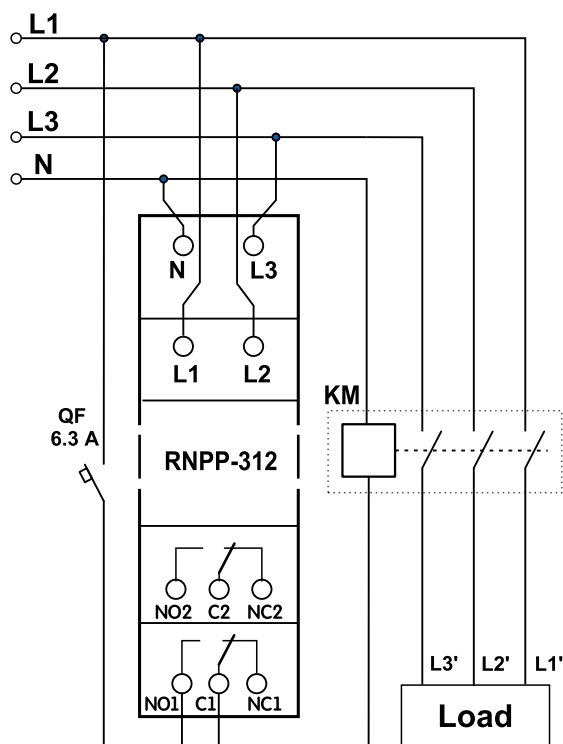
Notes: If the device is to be used in the «Maximum Voltage Control» mode (it.3.2.1.3), the MC coil power supply interruption must be connected to terminals C1-NC1 (C2-NC2) (inverse logic for enabling). Shift the switch Umax (it. 8, Fig. 1) to the position "ON", and switches, ⇄, ı.ıl Umin – to the position "OFF".

Figure 2. Connection Diagram of RNPP-312

Table 2. Status options for indicators L1, L2, L3 and OFF

Indicators L1, L2, L3	Status of indicators L1, L2, L3	Indicator OFF	Status of indicator OFF	Functional status of RNPP-312
	Constant lighting of each (all)		Absence of light	Value of voltage supplied to each phase is within the limits set by the user for the voltage operation
	Flashing of one (all)		Flashing (AR time ountdown)	Increase of voltage in one phase (phases)
	Absence of light of one (all)		Constant lighting	1) Lowering the voltage in one phase (phases) below the threshold; 2) Phase failure or under-voltage in one of the phases below 100 V;
	Alternate flashing of two indicators (first the middle and lower lights, then the middle and upper indicators light)		Constant lighting	Phase imbalance failure
	Alternate lighting (first upper, then middle, then lower indicators light)		Constant lighting	Failure due to incorrect phase sequence and the presence of phase sticking

Note: The failure is displayed in order of priority:
1 – Phase failure or voltage drop below 100 V (highest priority);
2 – Phase sequence;
3 – Minimum and maximum voltage;
4 – Phase imbalance.

Section 3

MULTIFUNCTIONAL TIME DELAY RELAYS

PROGRAMMABLE TIME DELAY RELAY
REV-114
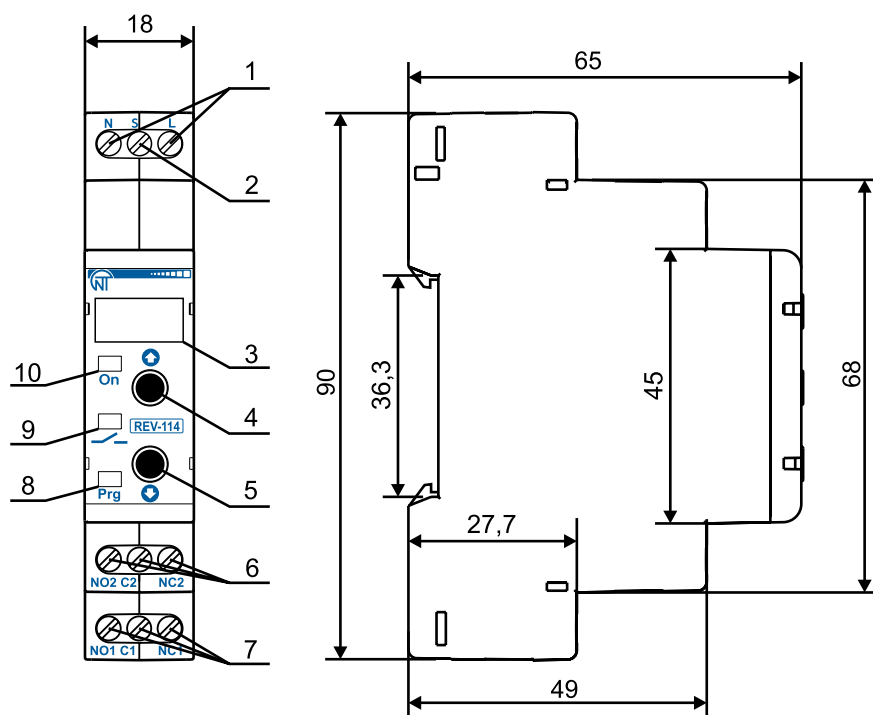
Figure 1. Controls, overall and mounting dimensions of REV–114

1 – input contacts ~230/240 V **N**, **L**;
2 – input control contact **S**;
3 – digital indicator display;
4 – button ⬆ (UP);
5 – button ⬇ (DOWN);
6, 7 – output contacts of load relay (**NO**, **C**, **NC**);
8 – LED indicator of setup mode prg;
9 – LED indicator of load relay ON ⌣–;
10 – LED indicator of power ON **On**.

F1 – Circuit breaker (fuse),
maximum current is 6 A
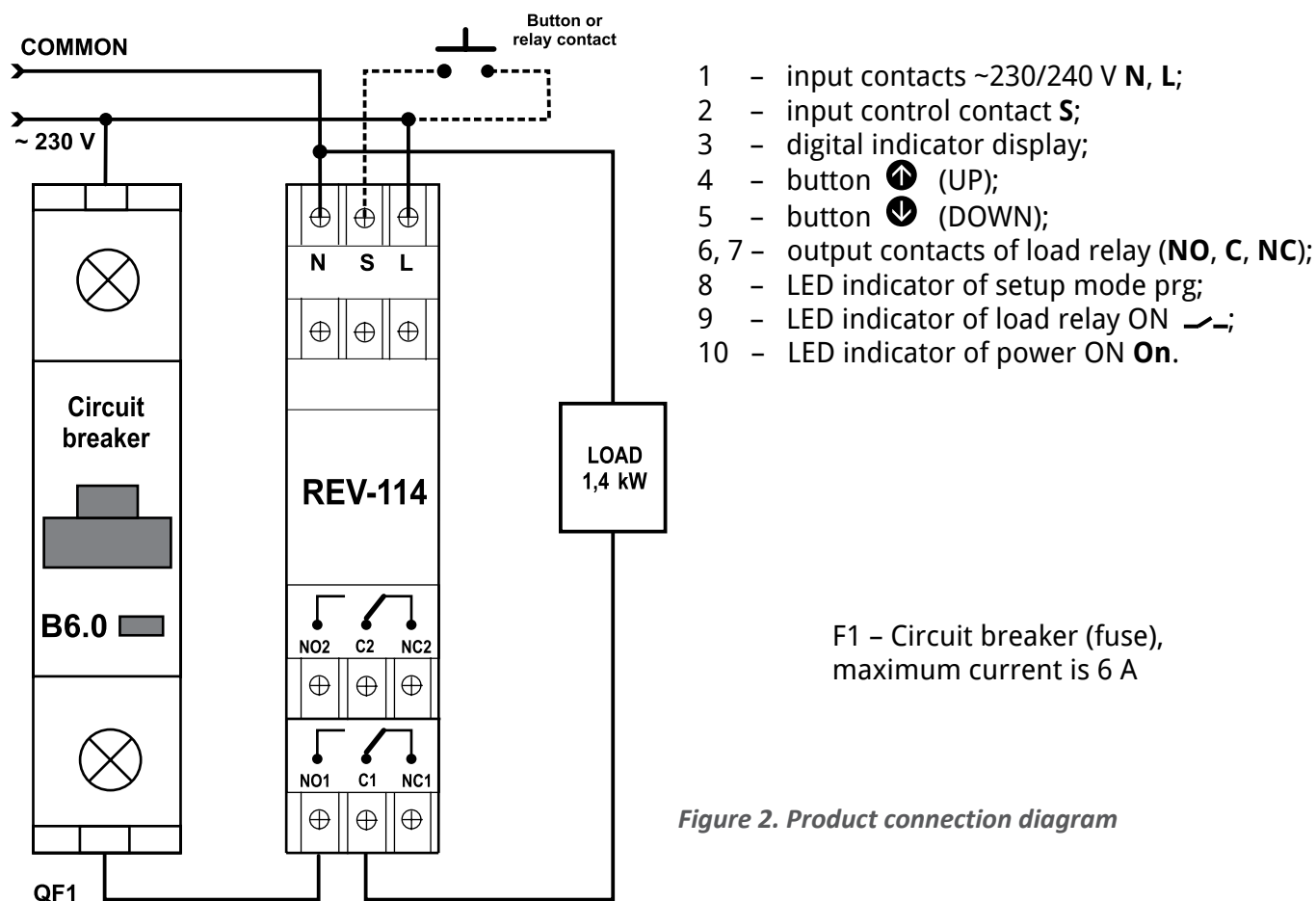
Figure 2. Product connection diagram

The product meets the requirements of the following:
IEC 60947-1 (Low-voltage switchgear; Part 1. General rules);
IEC 60947-6-2 (Low-voltage circuit breaker and controller; Part 6-2; multifunctional equipment;
Control and safety switching equipment);
CISPR 11 (Electromagnetic compatibility; Industrial, scientific and medical RF equipment; electromagnetic interference characteristics; standards and measuring procedure);
IEC 61000-4-2 (Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test).
Harmful substances in amounts exceeding maximum permissible concentrations are not available.

The time delay relay REV-114 is the microprocessor-based device intended to control the load with independent time delay. It provides the certain sequence of the load operation according to the mode specified by the user.

REV-114 is equipped with control buttons and a digital display designed for adjustment and visual check of timing.

Table 1. Technical Specifications

Description	Value
Operating supply voltage, V:	230 / 240
Frequency of supply mains, Hz	45 – 62
Voltage at which service capability is maintained, V	185 – 280
Permissible harmonic configuration (non-sinusoidality) of power supply voltage	EN 50160
Readiness time when energizing, s, no more than	0.4
Accuracy of time setting holding, %, no less than	0.5
Number of operation algorithms	17
Adjustment range of time	from 0.1 s to 10 days
Timing adjustment	Buttons on the front panel
Digit display of remaining time	available
Service of the product	Switchgear and control gear
Rated operating condition	Continuous
Type and quantity of contacts (switching)	2
Climatic design version	NC 3.1
Protection rating of case	IP40
Protection rating of terminal box	IP20
Commutation lifetime of output contacts if cos φ = 1:	
- under load of 6 A, time, no less than	100 000
- under load of 1 A, time, no less than	1 000 000
Power consumption (under load), W, no more than	0.5
Permissible contamination level	II
Overvoltage category	II
Electric shock protection class	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Wire cross-section for connection to terminals, mm²	0.5 – 2
Tightening torque of terminal screws, N*m	0.4
Weight, kg, not more	0.150
Overall dimensions, H x D x L, mm	90 x 18 x 65

Product installation (mounting) is on standard 35mm DIN rail
The product remains functional at any position in space
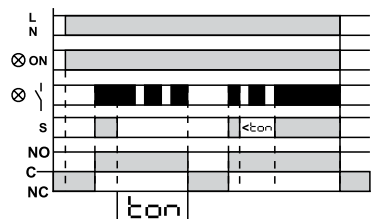Case material is self-extinguishing plastic

Table 2. Specifications of output contacts of the load relay

	Max. current at U~250 V, A	Max. switching power, kVA	Maximal AC Voltage, V	Max. current at 28V DC, A
Cosφ = 1	6	1.5	250	3

Table 3. Product operation modes

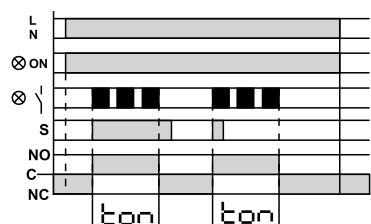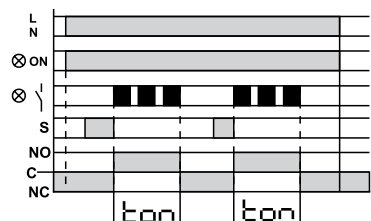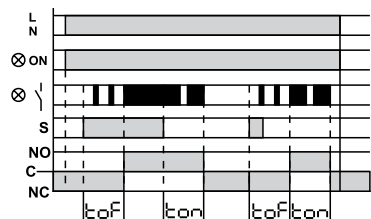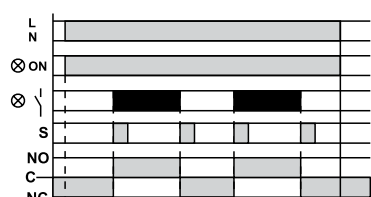| Mode number and name	Description
1. On-delay 	After energizing, the indicator **ON** (Fig.1 it.10) is on and the set delay time occurs ⌐ɒF. During the delay time the indicator ⌐ᴗ⌐ (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts **C** and **NO** are closed, the indicator ⌐ᴗ⌐ is on and the product goes into standby mode until power-off.
2. Time delay when energizing 	After energizing, the indicator **ON** (Fig.1 it.10) is on, contacts of the load relay **C** and **NO** are closed, the indicator ⌐ᴗ⌐ (Fig.1 it.9) is on and the set delay time occurs ⌐ɒn. During the delay time the indicator ⌐ᴗ⌐ periodically is off. At the end of the delay time the load relay contacts are open, the indicator ⌐ᴗ⌐ is off and the product goes into standby mode until power-off.
3. Periodic with on-delay 	After energizing, the indicator **ON** (Fig.1 it.10) is on and the set delay time occurs ⌐ɒF. During the delay time the indicator ⌐ᴗ⌐ (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts **C** and **NO** are closed for set time ⌐ɒn and the indicator ⌐ᴗ⌐ is on. During the delay time the indicator ⌐ᴗ⌐ periodically is off. At the end of the delay time the load relay contacts are open, and the product starts fulfillment of algorithm from the beginning.
4. Periodic with time delay when energizing 	After energizing, the indicator **ON** (Fig.1 it.10) is on, contacts of the load relay **C** and **NO** are closed, the indicator ⌐ᴗ⌐ (Fig.1 it.9) is on and the set delay time occurs ⌐ɒn. During the delay time the indicator ⌐ᴗ⌐ (Fig.1 it.9) periodically is off. At the end of the delay time the load relay contacts are open for set time ⌐ɒF and the indicator ⌐ᴗ⌐ is off. During the delay time the indicator ⌐ᴗ⌐ periodically flashes. At the end of the delay time the product starts fulfillment of algorithm from the beginning.
5. Pulse generator 	After energizing, the indicator **ON** (Fig.1 it.10) is on and the set delay time occurs ⌐ɒF. During the delay time the indicator ⌐ᴗ⌐ (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts **C** and **NO** are closed, and the set delay time occurs ⌐ɒn. During the delay time the indicator ⌐ᴗ⌐ (Fig.1 it.9) periodically is off. At the end of the delay time the load relay contacts **C** and **NO** are open, the indicator ⌐ᴗ⌐ is off and the product goes into standby mode until power-off.
6. On-delay with external start 	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ⌐ᴗ⌐ (Fig.1 it.9) is off. When control signal **S** occurs, there is the set time delay ⌐ɒF. During the delay time the indicator ⌐ᴗ⌐ (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts **C** and **NO** are closed, the indicator ⌐ᴗ⌐ is on and the product goes into standby mode. When there is no the control signal **S**, the load relay contacts **C** and **NO** are open, the indicator ⌐ᴗ⌐ is off and the product goes into standby mode.

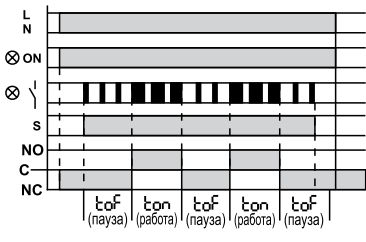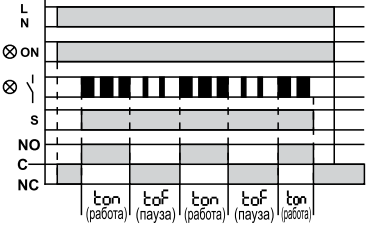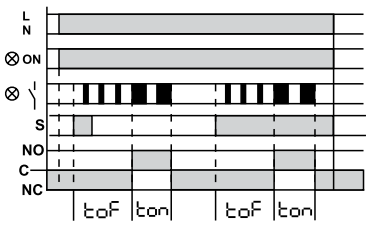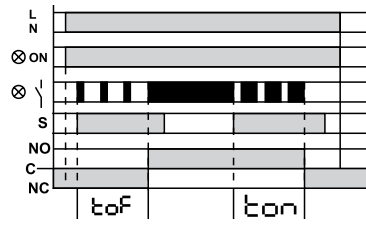| 7. Off delay with external start	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿‿ (Fig.1 it.9) is off. When control signal **S** occurs, the load relay contacts **C** and **NO** are closed, the indicator ‿‿ is on and the product goes into standby mode. When there is no the control signal **S**, there is the set time delay ton. During the delay time the indicator ‿‿ periodically is off. At the end of the delay time the load relay contacts **C** and **NO** are open, the indicator ‿‿ is off and the product goes into standby mode. In case of repeated occurrence of the control signal **S**, the algorithm fulfillment is repeated.
8. Pulse I with external start	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿‿ (Fig.1 it.9) is off. When control signal **S** occurs, the load relay contacts **C** and **NO** are closed, the indicator ‿‿ is on and there is the set time delay ton. During the delay time the indicator ‿‿ periodically is off. At the end of the delay time the load relay contacts are open, the indicator ‿‿ is off and the product goes into standby mode. In case of absence and repeated occurrence of the control signal **S**, the algorithm fulfillment is repeated.
9. Pulse II with external start	After energizing, the indicator **ON** (Fig.1it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿‿ (Fig.1 it.9) is off. When control signal **S** occurs, the product remains in standby mode. When there is no the control signal **S**, the load relay contacts **C** and **NO** are closed, the indicator ‿‿ is on and there is the set time delay ton. During the delay time the indicator ‿‿ periodically is off. At the end of the delay time the load relay contacts are open, the indicator ‿‿ is off and the product goes into standby mode. When control signal **S** occurs, the algorithm fulfillment is repeated.
10. Pitch of the load relay	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿‿ (Fig.1 it.9) is off. When control signal **S** occurs, the load relay contacts and the indicator ‿‿ change its state to the opposite, then the product goes into standby mode. When there is no the control signal **S**, the product continues to be in standby mode. In case of repeated occurrence of the control signal **S**, the algorithm fulfillment is repeated.
11. Pitch of the load relay	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿‿ (Fig.1 it.9) is off. When control signal **S** occurs, the load relay contacts and the indicator ‿‿ change its state to the opposite, then the product goes into standby mode. When there is no the control signal **S**, the product continues to be in standby mode. In case of repeated occurrence of the control signal **S**, the algorithm fulfillment is repeated.

12. Periodic with external start and on-delay	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿– (Fig.1 it.9) is off. When control signal **S** occurs, there is the set time delay toF. During the delay time the indicator ‿– (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts **C** and **NO** are closed for set time ton and the indicator ‿– is on. During the delay time the indicator ‿– periodically is off. At the end of the delay time the load relay contacts are open, and the product starts the algorithm fulfillment from the beginning. When there is no the control signal **S**, the algorithm fulfillment is stopped, the load relay contacts **C** and **NO** are open and the product goes into the standby mode.
13. Periodic with external start and time delay when energizing	After energizing, the indicator **ON** (Fig.1 it. 10) is on and the product goes into the standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿– (Fig.1 it.9) is off. When control signal **S**, the load relay contacts **C** and **NO** are closed for set time ton. During the delay time the indicator ‿– (Fig.1 it.9) periodically is off. At the end of the delay time the load relay contacts **C** and **NO** are open for set time toF and the indicator ‿– is off. During the delay time the indicator ‿– periodically flashes. At the end of the delay time the product starts the algorithm fulfillment from the beginning. When there is no the control signal **S**, the algorithm fulfillment is stopped, the load relay contacts **C** and **NO** are open and the product goes into the standby mode.
14. Pulse generator with external start	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into the standby mode, in this case the load relay contacts **C** and **NO** are open, and the indicator ‿– (Fig.1 it.9) is off. When control signal **S** occurs, there is the set time delay toF. During the delay time the indicator ‿– (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts C and NO are closed for the set time ton and the indicator ‿– is on. During the delay time the indicator ‿– periodically is off. At the end of the delay time the load relay contacts are open, and the product goes into the standby mode.
15. Start-stop	After energizing, the indicator **ON** (Fig.1 it.10) is on and the product goes into the standby mode, in this case the load relay contacts **C** and **NO** are open,and the indicator ‿– (Fig.1 it.9) is off. When control signal **S** occurs, there is the set time delay toF. During the delay time the indicator ‿– (Fig.1 it.9) periodically flashes. At the end of the delay time the load relay contacts **C** and **NO** are closed, the indicator ‿– is on. In case of repeated occurrence of the control signal **S**, there is the set time delay ton. During the delay time the indicator ‿– (Fig.1 it.9) periodically is off. At the end of the delay time the load relay contacts **C** and **NO** are open, the indicator ‿– is off and the product goes into the standby mode.
16. Always ON	After energizing, the indicator **ON** (Fig.1 it.10) is on, the load relay contacts **C** and **NO** are closed, the indicator ‿– is on and the product goes into the standby mode until power-off.
17. Always OFF	After energizing, the indicator **ON** (Fig.1 it.10) is on, the load relay contacts **C** and **NO** remain open, and the indicator ‿– is off. The product goes into the standby mode until power-off.

TIME DELAY RELAY REV-120

The product meets the requirements of the following:
- *Low-voltage switchgear; Part 1; General rules (IEC 60947-1);*
- *Low-voltage circuit breaker and controller; Part 6-2; multifunctional equipment; Control and safety switching equipment (IEC 60947-6-2);*
- *Electromagnetic compatibility; Industrial, scientific and medical RF equipment; electromagnetic interference characteristics; standards and measuring procedure (CISPR 11);*
- *Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test (IEC 61000-4-2).*

Harmful substances in amounts exceeding maximum permissible concentrations are not available.

The time delay relay REV-120 is the microprocessor-based device intended for on/off switching the load in user-defined time intervals.

REV-120 can be operated by ten operation modes:
- on-delay;
- time delay when energizing;
- periodic with on-delay;
- periodic with time delay when energizing;
- off-delay (when control contact opening);
- pulse I (when control contact closing);
- pulse II (when control contact opening);
- on/off delay (according to control contact);
- pitch of the load relay (during each control contact closing);
- pulse generator of 0.5 s.

1 – input contacts ~230/240 V L, N;
2 – input control contact S;
3 – regulator for setting the time interval ΔT;
4 – regulator for setting the time T;
5 – regulator for setting the operation mode W;
6, 7 – output contacts of load relay:
NO1 / NO2 – normally open contact (further NO);
NC1 / NC2 – normally closed contact (further NC);
C1 / C2 – switching contact (further C);
8 – LED indicator of load relay ON;
9 – LED indicator of power ON.
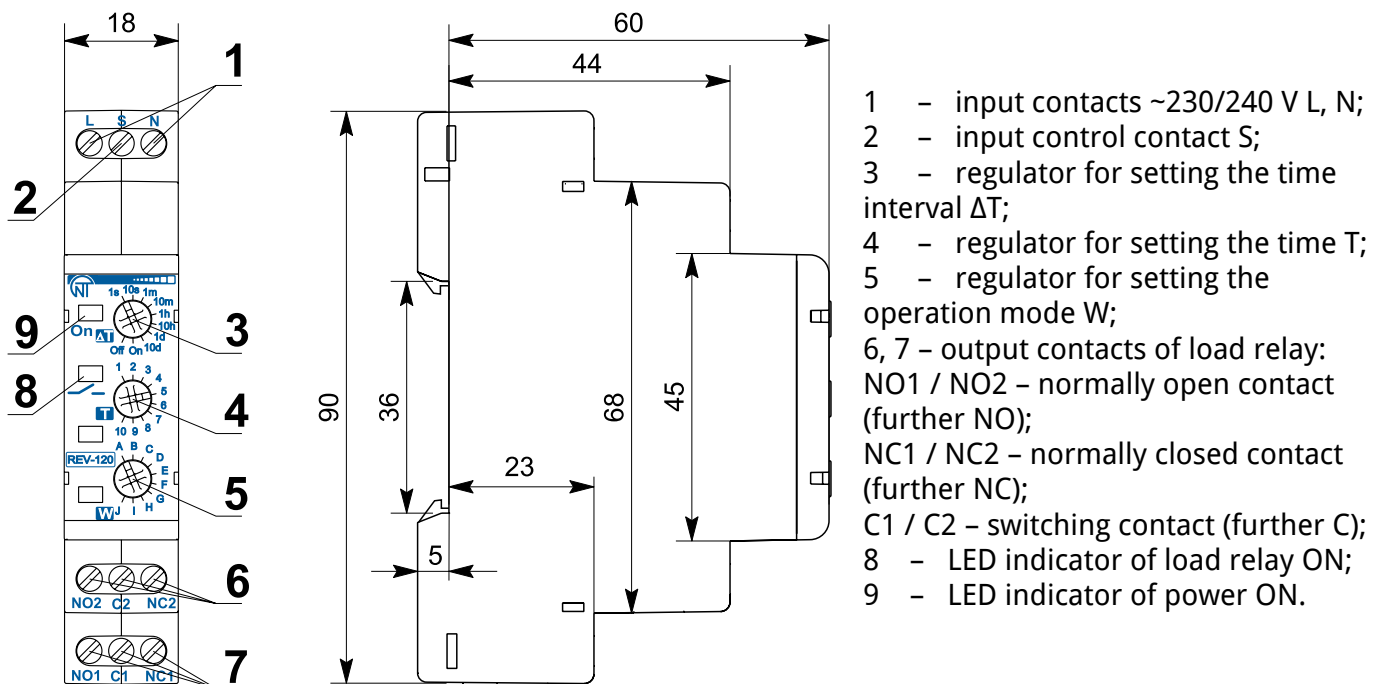
Figure 1. Controls, overall and mounting dimensions of REV–120

Table 1. Technical Specifications

Description	Value
Operating supply voltage, V	230/240 V
Frequency of supply mains, Hz	45 – 62
Voltage at which service capability is maintained, V	130-300
Permissible harmonic configuration (unsinusoidality) of power supply voltage	EN 50160
Readiness time when energizing, s, no more than	0.4
Accuracy of time delay, %, no less than	0.5
Accuracy of time setting (accuracy of scale), %, no less than	2.5
Number of operation modes	10
Adjustment range of time is divided into 10 subranges	0.1 ... 1 s
	1 ... 10 s
	6 s ... 1 min
	1 ... 10 min
	6 min ... 1 h
	1 ... 10 h
	0.1 ... 1 day
	1 ... 10 days
	Continuously ON
	Continuously OFF
Time delay adjustment	smooth
Service of the product	Switchgear and control gear
Rated operating condition	Continuous
Type and quantity of contacts (switching)	2
Climatic design version	CN 3.1
Protection rating of case	IP40
Protection rating of terminal box	IP20
Commutation lifetime of output contacts if cosφ = 1:	
- under load of 6 A, time, no less than	100,000
- under load of 1 A, time, no less than	1,000,000
Power consumption (under load), W, no more than	0.5
Permissible contamination level	II
Overvoltage category	II
Electric shock protection class	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Wire cross-section for connection to terminals, mm²	0.5-2
Tightening torque of terminal screws, N*m	0.4
Weight, kg, not more	0.150
Overall dimensions, H x D x L, mm	90 x 65 x 18
Product installation (mounting) is on standard 35mm DIN rail	
The product remains functional at any position in space	
Case material is self-extinguishing plastic	

Table 2. Specifications of output contacts of the load relay

	Max. current at U~250 V, A	Max. switching power, kVA	Maximal AC Voltage, V	Max. current at 28V DC, A
Cosφ = 1	6	1.5	250	3

Table 3 – Product operation modes

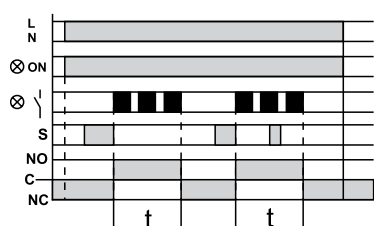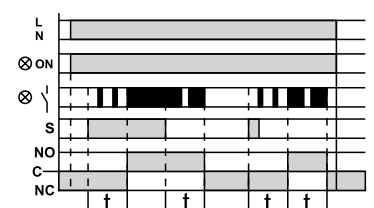| Mode number and name	Description
«A» On-delay	After energizing, the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay (Fig.1 it.8) periodically flashes. At the end of the delay time the load relay contacts **NO** and **C** are closed, the indicator **ON** of the load relay is on and the product goes into standby mode until power-off.
«B» Time delay when energizing	After energizing, the load relay contacts **NO** and **C** are closed, the indicator **ON** of the load relay (Fig.1 it.8) is on and the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay periodically is off. At the end of the delay time the load relay contacts are opened, the indicator **ON** of the load relay is off and the product goes into standby mode until power-off.
«C» Periodic with on-delay	After energizing, the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay (Fig.1 it.8) periodically flashes. At the end of the delay time the load relay contacts **NO** and **C** are closed for the set time t and the indicator **ON** of the load relay is on. During the delay time the indicator **ON** of the load relay periodically is off. At the end of the delay time the load relay contacts are opened, and the product starts fulfillment of algorithm from the beginning.
«D» Periodic with time delay when energizing	After energizing, the load relay contacts **NO** and **C** are closed, the indicator **ON** of the load relay (Fig.1 it.8) is on and the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay (Fig.1 it.8) periodically is off. At the end of the delay time the load relay contacts **NO** and **C** are open for the set time t and the indicator **ON** of the load relay is off. During the delay time the indicator **ON** of the load relay periodically flashes. At the end of the delay time the product starts fulfillment of algorithm from the beginning.
«E» Off-delay	After energizing, the product goes into standby mode, in this case the load relay contacts **NO** and **C** are open, and the indicator **ON** of the load relay (Fig.1 it.8) is off. When control contact **S** is closed with power supply terminal **L**, the load relay contacts are closed, the indicator **ON** of the load relay is on and the product goes into standby mode. When control contact **S** is open, the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay periodically is off. At the end of the delay time the load relay contacts are open, the indicator **ON** of the load relay is off and the product goes into standby mode. In case of repeated closing of the control contact **S**, the algorithm is repeated.
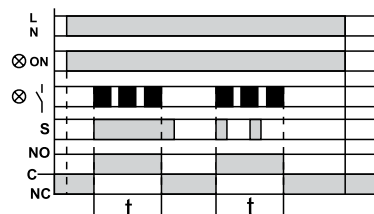
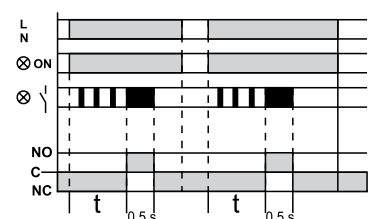|	
«F» Pulse 1	After energizing, the product goes into standby mode, in this case the load relay contacts **NO** and **C** are open, and the indicator **ON** of the load relay (Fig.1 it.8) is off.
	When control contact **S** is closed, the load relay contacts are closed, the indicator **ON** of the load relay is on and the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay periodically is off.
	At the end of the delay time the load relay contacts are open, the indicator **ON** of the load relay is off and the product goes into standby mode.
	In case of opening and repeated closing of the control contact **S**, the algorithm is repeated.
«G» Pulse 2	After energizing, the product goes into standby mode, in this case the load relay contacts **NO** and **C** are open, and the indicator **ON** of the load relay (Fig.1 it.8) is off.
	When control contact **S** is closed, the product continues being in standby mode.
	When control contact **S** is open, the load relay contacts are open, the indicator **ON** of the load relay is on and the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay periodically is off.
	At the end of the delay time the load relay contacts are open, the indicator **ON** of the load relay is off and the product goes into standby mode.
«H» On/off delay	In case of closing the control contact **S**, the algorithm is repeated.
	After energizing, the product goes into standby mode, in this case the load relay contacts **NO** and **C** are open, and the indicator **ON** of the load relay (Fig.1 it.8) is off.
	When control contact **S** is closed, the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay periodically flashes. At the end of the delay time the load relay contacts are closed, the indicator **ON** of the load relay is on and the product goes into standby mode.
	When control contact **S** is open, the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay periodically is off. At the end of the delay time the load relay contacts are open, the indicator **ON** of the load relay is off and the product goes into standby mode.
«I» Pitch of the load relay	In case of repeated closing of the control contact **S**, the algorithm is repeated. After energizing, the product goes into standby mode, in this case the load relay contacts **NO** and **C** are open, and the indicator **ON** of the load relay (Fig.1 it.8) is off.
	When control contact **S** is closed, the load relay contacts and the indicator **ON** of the load relay change its state to the opposite, and the product switches to standby mode.
	When control contact **S** is open, the product continues being in standby mode.
«J» Pulse generator of 0.5 s	In case of repeated closing of the control contact **S**, the algorithm is repeated. After energizing, the set delay time **t** (**T** regulator) occurs. During the delay time the indicator **ON** of the load relay (Fig.1 it.8) periodically flashes.
	At the end of the delay time the load relay contacts **NO** and **C** are closed for 0.5 s, the indicator **ON** of the load relay is on for 0.5 s and the product goes into standby mode until power-off.

Table 3 – Time intervals

ΔT knob position	Time interval	ΔT knob position	Time interval
1 s	from 0.1 to 1 s	10 h	from 1 to 10 h
10 s	from 1 to 10 s	1 d	from 0.1 to 1 day
1 m	from 6 s to 1 min	10 d	from 1 to 10 days
10 m	from 1 to 10 min	ON	Continuously ON
1 h	from 6 min to 1 h	OFF	Continuously OFF
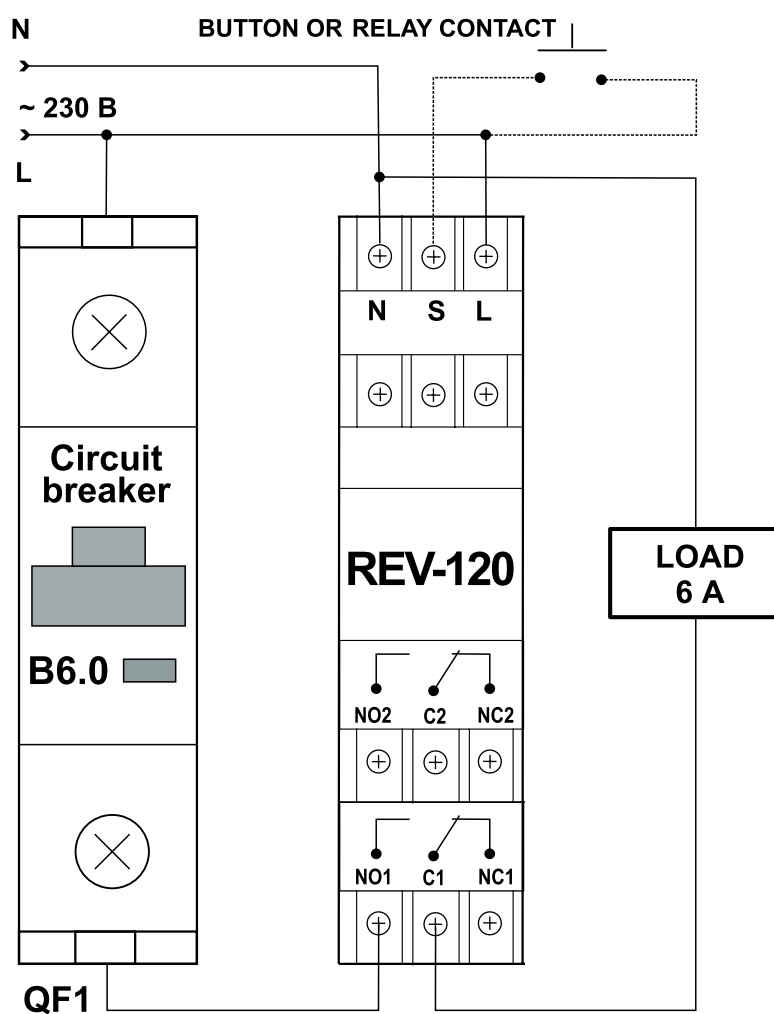
QF1 – Circuit breaker (fuse), maximum current is 6 A

Figure 2 – Product connection diagram

MULTIFUNCTIONAL TWO-CHANNEL TIME DELAY RELAY REV-201M

REV-201M is designed for the commutation of electrical circuits of 240V 50Hz AC as well as 24V DC electrical circuits with the adjustable time delay setting.

The relay has two channels and can be operated by one of seven operation algorithms that the user specifies:
• Turn ON time delay relay;
• Pulse relay 1;
• ntermittent (cyclic) relay 1;
• Operation relay *;
• Pulse relay 2;
• Intermittent (cyclic) relay 2;
• Off-delay relay.

* REV-201M could be used as the relay of pre-starting signalization for the machinery that require to announce that some mechanism or machinery will soon take a start to make people aware of this and get away from the risky zones. Widely used for steel plants, heavy machinery, cranes and construction mechanisms as well as mining companies for the technological stuff safety.
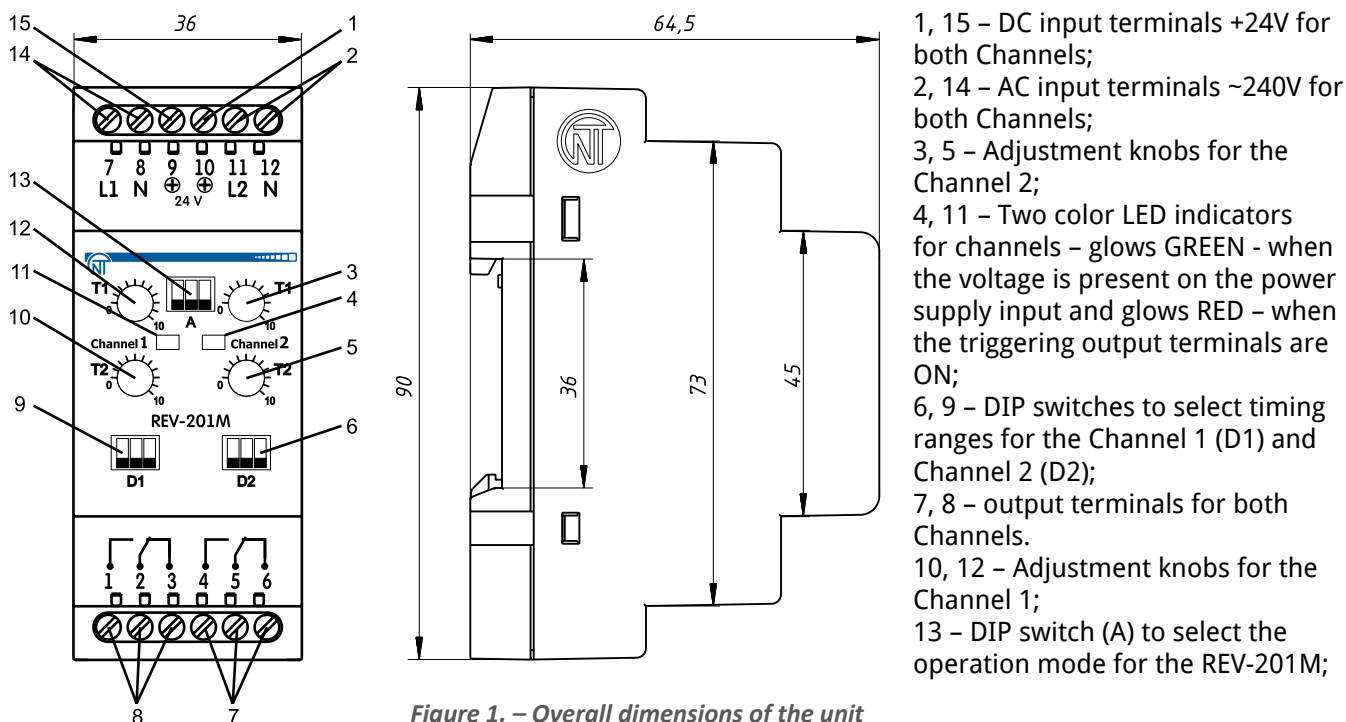
1, 15 – DC input terminals +24V for both Channels;
2, 14 – AC input terminals ~240V for both Channels;
3, 5 – Adjustment knobs for the Channel 2;
4, 11 – Two color LED indicators for channels – glows GREEN - when the voltage is present on the power supply input and glows RED – when the triggering output terminals are ON;
6, 9 – DIP switches to select timing ranges for the Channel 1 (D1) and Channel 2 (D2);
7, 8 – output terminals for both Channels.
10, 12 – Adjustment knobs for the Channel 1;
13 – DIP switch (A) to select the operation mode for the REV-201M;

Figure 1. – Overall dimensions of the unit

Time delay setting for each channel starts from the moment of the power supply given to the corresponding channel. REV-201M allows to provide 2 modes of operation:

Mode 1. Independent operation of channels. To each of two channels power supply is given independently and thus each channel starts the countdown from the moment the power supply is given. This is the mode when 2 independent time relays are functioning in one compact case housing (2-time delay relays in one case).
Mode 2. Parallel operation of the channels.

To each of two channels the power supply is applied simultaneously. Thus, the time countdown on each channel starts at the same time and comes one and the same input power supply. Triggering time corresponds to the user-adjusted settings for each of the channels. So the REV-201M in this mode operates like one time delay relay with 2 output contacts that have the same or different time settings.

Table 1. Technical Specifications

Description	Value	
Rated AC input power supply (terminals L, N), V	150 – 300	
Voltage Harmonicas Distortion Factor, not more than	12 %	
Rated DC input power supply (terminals +24, N), V	24 ±10%	
Rated power circuit frequency, Hz	50 – 60	
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)	
Initialization readiness time after the power supply application to the channel, sec, less then	0.25	
Timing accuracy, %, not less then	1.5	
Time setting accuracy (scale accuracy), %, not less then	4	
Number of operation algorithms	7	
The time setting range is divided in 8 subsections	**T1**	**T2**
	0-1 s	0-10 s
	0-10 s	0-100 s
	0-100 s	0-1 min
	0-1 min	0-10 min
	0-10 min	0-100 min
	0-100 min	0-1 hour
	0-1 hour	0-10 hours
	0-10 hours	0-20 hours
Time setting adjustment	Smooth	
Number of scale marks for the potentiometer knobs	10	
Type and quantity of the output commutation terminals	1 changeover	
Protection degree: - housing	IP40	
- contact terminals	IP20	
Commutation lifetime of the output terminals at cosφ=1:		
- under the load of 7A, times, not less then	100 000	
- under the load of 1A, times, not less then	1 000 000	
Rated power consumption (under the load), VA, not more then	1,0	
Allowable soil level	II	
Overvoltage category	II	
Nominal voltage of isolation, V	450	
Nominal impulse withstanding voltage, kV	2.5	
Cross section of wires of connection terminals, mm²	0.5-2	
Maximal tightening torque of terminals external screws, N*m	0.4	
Weight, kg, not more then	0.150	
Operation temperature range, °C	from - 30 to +55	
Storage temperature, °C	from - 45 to +60	
Arbitrary mounting position		
Standard 35 mm DIN rail mounting		

Table 2. Electrical characteristics for the Output terminals

|	Max. current at U~250 V, A	Maximal capacity, kVA	Maximal AC Voltage, V	Max. current at 28V DC, A
Cosφ = 1	5	1.25	250	3

Table 2.

№	Operation mode	A	Description
1	Turn ON time delay		After the power supply application REV-201M performs user preset time delay T1+T2 that will be followed by opening of the output contacts and REV-201M will switch to idle state.
2	Impulse 1		After power supply application comes time delay interval adjusted by the potentiometer knob T2, then the output contacts close for the time T1 and by the end of the T1 time interval output contacts open and REV-201M comes to idle state.
3	Intermittent 1		After energizing the power supply, the set time period T1 takes place, after the end of set time period the relay contacts get closed for the set time period T2. After the end of set time period T2 the relay contacts get open and the relay restarts the program from the beginning.
4	Control mode (pre-start signals)		After power supply application REV-201M output contacts close, then comes fixed time interval of 10 seconds and output contacts open. Then comes new fixed time interval of 30 seconds and output contacts close again for the time of 30 seconds. Then contacts open and REV-201M switch to idle state.
5	Impulse 2		After energizing the power supply, the relay contacts get closed for the set time period T1+T2, After the end of set time period the relay contacts get open and the relay switches over into the stand-by mode.
6	Intermittent 2		After energizing the power supply, the relay contacts get closed for the set time period T1. After the termination of this time interval T1 the relay contacts get open and starts the timing countdown of set time interval T2. After the termination of the T2 timing countdown REV-201M starts and the process keep on working in cycle mode in this way further.
7	Turn-off Delay		After voltage supplies to the second channel, the relay switches to the standby mode (contacts of the first (1, 2) and the second (4, 5) channels are open). When voltage supplies to the first channel, timing of T1 + T2 of the first channel is started. Upon completion of time-delay, the contacts (4, 5) of the second channel are closed and и the relay switches to the standby mode. In case of power failure in the first channel, timing of T1 + T2 of the second channel is started. Upon completion of time-delay, the contacts (4, 5) of the second channel are open and the relay switches to the standby mode.
8	Reserved		After energizing the power supply, the relay is in a stand-by mode. The LEDs (1,6 figure 1) blink in red-green colors, the relay contacts are in the standard open mode.

Table 3.

№	DIP switch position (D1, D2)	Time intervals adjusted by T1	Time intervals adjusted by T2
1		0 – 1 sec	0 – 10 sec
2		0 – 10 sec	0 – 100 sec
3		0 – 100 sec	0 – 1 min
4		0 – 1 min	0 – 10 min
5		0 – 10 min	0 – 100 min
6		0 – 100 min	0 – 1 hour
7		0 – 1 hour	0 – 10 hours
8		0 – 10 hours	0 – 20 hours

Connect REV-201M as shown on Figure 9 depending on the chosen operation mode
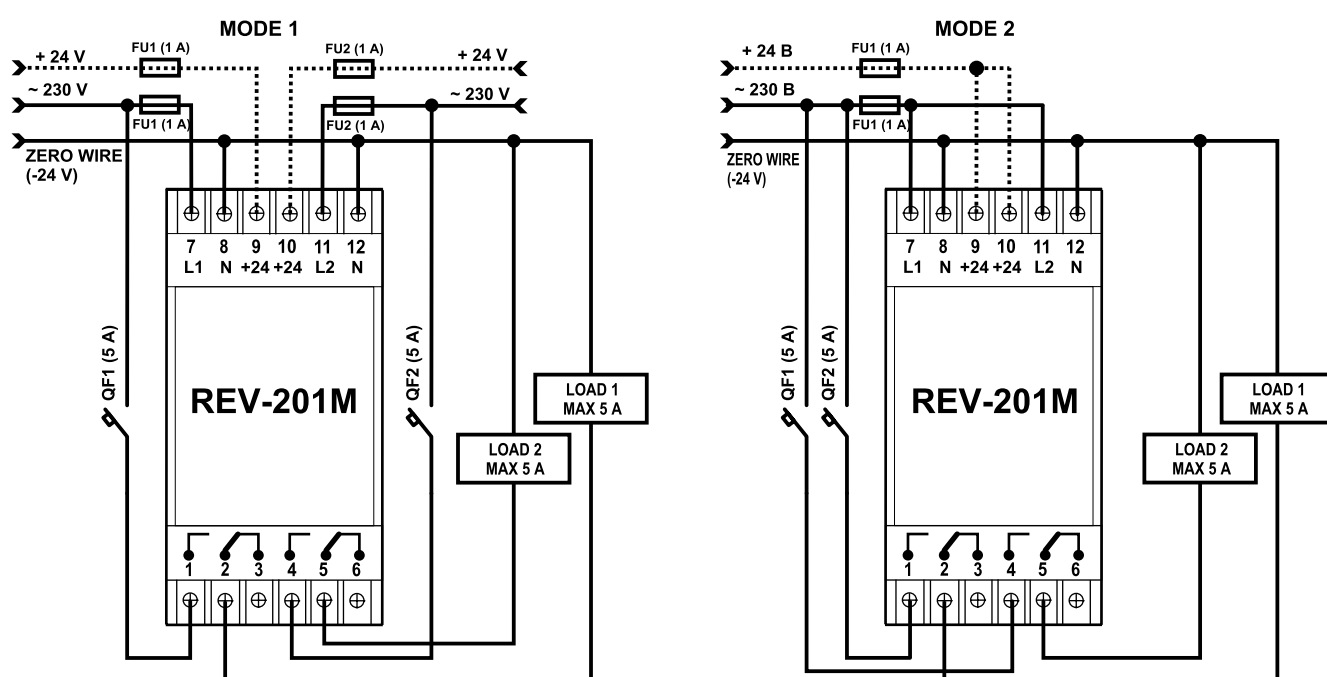
QA - automatic circuit breaker with the breaking current of 5 A not more.

Figure 2. – Wiring diagram depending on required operation mode

PROGRAMMABLE TIMERS WITH PHOTO SENSOR AND VOLTAGE MONITOR

MULTIFUNCTIONAL ASTRO TIMER WITH PHOTO SENSOR REV-302

REV-302 multifunctional timer is a microprocessor-based programmable device designed to energize/de-energize one or two loads within user-set time intervals based on time program, circuit voltage and external photo sensor luminance.

The REV-302 specific features:
- 2 switching contact groups of 10A rated current at 250V switching AC voltage.
- Power supply: 240V/50Hz AC or/and 8-30V DC.
- Time relay, voltage relay and photo relay combined or independent operation.
- Flexible contact switching control between the voltage relay, the photo relay and the time relay.
- 8 independent control programs and capability of swift transfer between them for each contact group.
- Capability to control both contact groups with a single program.
- 10-year calendar standalone power supply.
- Astronomical, daily, weekly, monthly, and yearly time program.
- Independent events settings for each program.
- Planned event clock accuracy of up to 1 second.
- Programmable holiday and day off list option.
- Specific timer listing execution for days off and holidays.
- Common internal memory for 5000 independent events distributed between all

programs for day/week/month/year mode depending on the mode selected.
- Option of program cyclic repeat within a specified time interval.
- Automatic summer/winter time conversion.
- Pulse time relay function (periodic, calendar independent contacts close/open).
- Function of plain contacts closure within a specified delay after energization.
- Contacts close/open based on minimum and maximum circuit voltage.
- Temporary delay for the after-energization relay start.
- Separate time delays for the voltage relay and the photo relay actions (for setting the re-closing time, etc.)
- External photo sensor input.
- LCD graphical display.
- Status indication for each contact group.
- PC connection USB input.
- Control via 5 keys on the front panel.
- Loading preset control programs via USB with use of supplemental PC software.
- Password protection option for the settings menu.
- General reset key on the front panel.

Table 1. – Output contacts specification

	Maximal current at ~ 250V AC, A	Maximum power, kVA	Maximal current at 24V DC, A
Cos φ = 0.4	4	1	16
Cos φ = 1	16	4	
Output contacts commutation lifetime:			
- mechanical life (times)			10^7
- electrical life 10A, 250V AC, times, no less than			100 thousand
- electrical life 10A, 24V DC, times, no less than			30 thousand
- electrical life 4A, 250V AC, (cos φ = 0,4), times, no less than			100 thousand

Table 1. Technical Specifications

| Description	Value
AC voltage (terminals 7-8), V	90 ÷ 420
DC voltage (terminals 7-8), V	100 ÷ 300
Rated DC voltage (terminals 9-10), V	8 ÷ 30
Supply circuit frequency range, Hz	50/60
Internal fuse	available
Max number of events	5000
Clock error, sec/day, sec, not more then	1
Clock standalone operation, when de-energized, years, no less than	10
Setting accuracy, sec	1
Voltage tripping threshold setting accuracy, V	1
Voltage measurement error, %, not more then	2
Illumination intensity measurement error up to 200 lx, %, not more then	10
Illumination intensity measurement error over 200 lx, %, not more then	20
Minimum time for the time relay contacts switching, sec	0.015
Minimum time for the voltage relay contacts switching, sec	0.035
Minimum time for the photo relay contacts switching, sec	0.1
Voltage lower tripping threshold setting range, Umin,V	90-416, but not more then Umax−dUmax
Voltage upper tripping threshold setting range, Umax,V	94-420, but no less than Umin+dUmin
Min voltage threshold hysteresis dUmin, V	3 ÷ 9
Max voltage threshold hysteresis dUmax, V	3 ÷ 9
Tripping delay for Umin	from 0 sec to 19 min 59 sec
De-energize tripping delay for Umax*	from 0 sec to 19 min 59 sec
Load re-energization delay	from 1 sec to 19 min 59 sec
Illumination level settings range, lux	0 ÷ 9999
Illumination level settings hysteresis, lux	0 ÷ 999
Action delay if illumination is lower than the threshold value	from 0 sec to 99 min 59 sec
Action delay if illumination is higher than the threshold value	from 0 sec to 99 min 59 sec
General delay after re-energization	from 0 sec to 99 min 59 sec
Load relay trip indication	available
Settings backup in case of circuit and standalone power supply failure	available
Data memory, years, no less than	10
Computer connection	USB
Photo sensor cable length, m	2
Distance between the device and the photo sensor, m, not more then	20
Event log	year / month / week / day
Allowable humidity without condensate, %	90
Protection degree:	IP20
Power consumption (under load), VA, not more then	3.0
Weight, kg, not more then	0.150
Dimensions, mm	90 x 52 x 66
Operating temperature range, °C	from -20 to +55
Storage temperature, °C	from -35 to +70
Quantity of output relays (channels)	2
Number and type of contacts per channel (changeover contacts)	1P
Mounting:	standard 35 mm DIN-rail
Mounting position:	Any

* For fastest opening it is recommended to leave the parameter at «00 min 00 sec» value.

REV-302 complies with requirements:
IEC 60947-1:2004, IDT; IEC 60947-6-2:1992, IDT; CISPR 11:2004, IDT; IEC 61000-4-2:2001, IDT
*No harmful substances in excess of the maximum permissible concentration is available.*
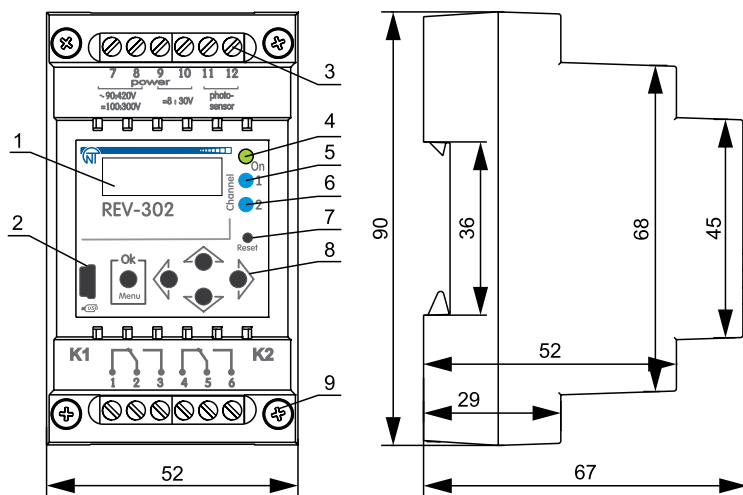
1 – liquid crystal display (LCD);
2 – USB jack for communication with PC;
3 – connection terminals;
4 – power indicator;
5 – channel 1 load relay energize indicator;
6 – channel 2 load relay energize indicator;
7 – reset key;
8 – menu navigation keys;
9 – mounting screws.

Figure 1. – Front panel view and dimension

Photo sensor

The photo sensor (figure 2) supplied in the REV-302 package consists of panel holder, photo receiver and twin cable to be connected to terminals 11-12. If necessary, the cable length can be extended to 20 m.
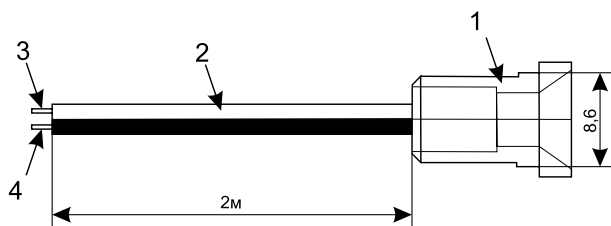
1 – photo sensor panel holder;
2 – twin cable, 0,25 sq. mm. section
3, 4 – the photo sensor contacts (connected to terminals 11-12);
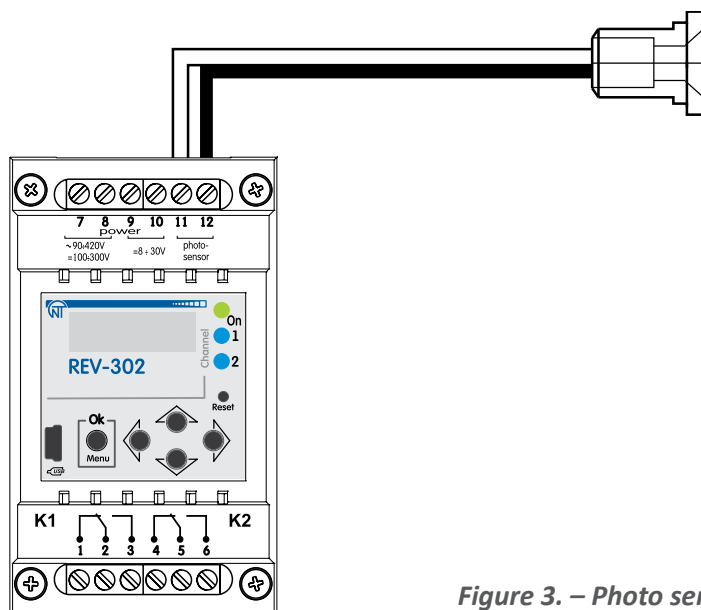
Figure 2. – Photo sensor diagram and exterior

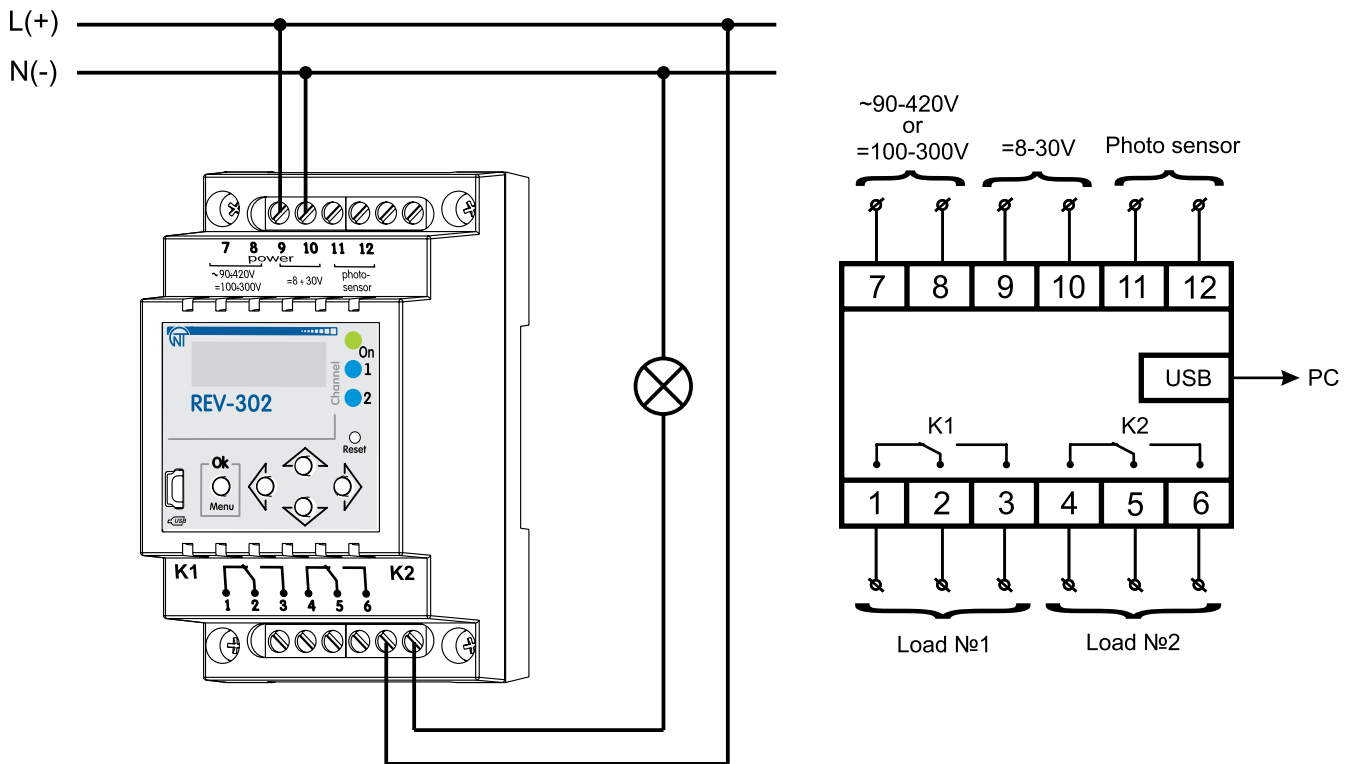*Figure 3. – Photo sensor connection to REV-302*

Figure 4. – The REV-302 wiring diagram

Current time, voltage and illumination display window.

After external power has been supplied, the LCD displays three different windows in 6 seconds iterations:
- the current time, measured circuit voltage and photo sensor illumination level display window;
- the basic settings and current status of K1 channel display window;
- the basic settings and current status of K2 channel display window.
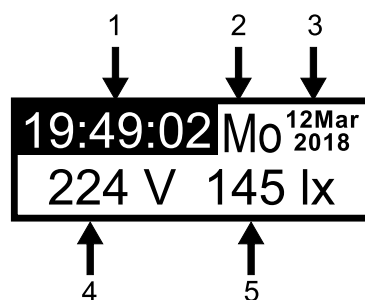
1 – current time;
2 – week day;
3 – date;
4 – K1 channel active modes;
5 – K2 channel active modes;
6 – time left till the next time relay timer activation
for K1 and K2 channels accordingly;
7 – voltage value on terminals 7-8;
8 – photo sensor illumination intensity.

Figure 5. – Current time, voltage and illumination display window view

PROGRAMMABLE MULTIFUNCTIONAL ASTRO TIMER REV – 303

Timer REV-303 is a microprocessor-based programmable device designed to control the loads in real time without permanent maintenance with minimum expenses and maximum electricity saving.

Timer REV-303 can be used to switch on the heating system, pumps, fans, school bells, street light (illumination), highlighting of buildings fronts (around territories, car parking and other objects).

Timer REV-303 can automatically define the time of sun rise and sun set on the basis of entered coordinates and current time which enables to control the illumination without using the external sensors.

Timer REV-303 features:
- Two programs of control with quick switching over between them;
- Four operational modes of timer (astronomical, weekly, daily and simple modes);
- Calendar with operational life for 6 years period without external power supply;
- Accuracy of planned events 1 second and 0.1 second in simple mode of timer;
- Total internal memory for 500 independent events, divided between the programs;
- Automatic shift for summer time (the last Sunday of march at 02:00 for +1 hour and back (the last Sunday of October at 03:00 for -1 hour);

- Light-emitting graphic OLED display;
- Indication of current state of relays contacts;
- Control of timer with 4 buttons, located on the front panel;
- Possibility to set an access pass code (password) for a setup menu;
- Power supply from the electric line 24 - 265 V 50/60 Hz or from a direct-current (DC) source of 8-24 V.

Timer REV-303 complies with requirements of:

Complex low voltage distribution devices. Part 1. General rules (IEC 60947-1:2004, IDT).

Low voltage switch and controller. Part 6-2. Multifunctional equipment.

Control and protection switch devices (IEC 60947-6-2:1992, IDT).

Electromagnetic compatibility. Radio frequency industrial, scientific equipment. Electromagnetic devices specification. Standards and methods of measuring (CISPR 11:2004, IDT).

Electromagnetic compatibility. Part 4-2 Testing and measuring methods. ESD resistance testing (IEC 61000-4-2:2001, IDT).
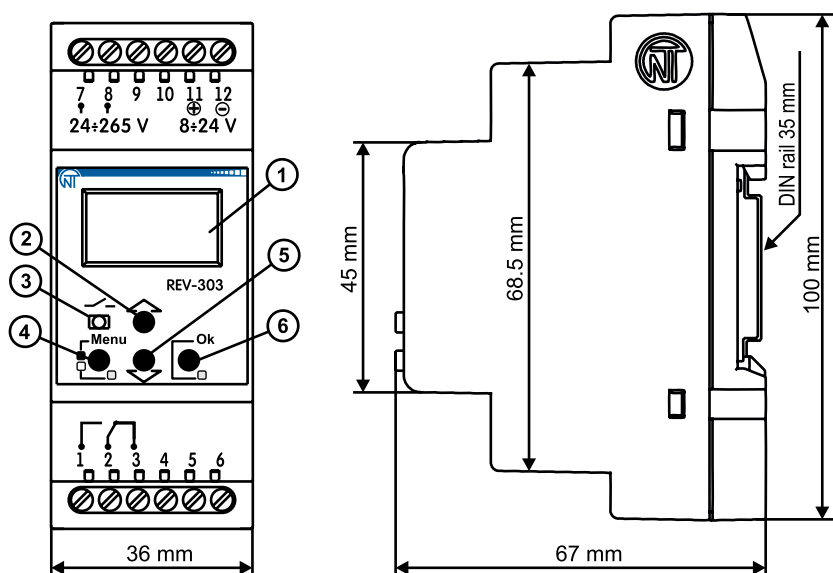
1 – Display;
2 – Button ▲ (up), is used for upward scrolling or increasing of parameter value;
3 – LED indicator of load relay state (lights on – when the load relay is on, lights off – when the load relay is off);
4 – Button Menu, is used to enter (escape) the menu of setup or reset of parameter;
5 – Button ▼ (down), is used for downward scrolling of the menu or decreasing of parameter value;
6 – Button **Ок**, is used for action confirming or saving of the changed parameter value.

Figure 1 – Timer visual appearance and overall

Table 1. Technical Specifications

Description	Value
External power supply (/), V	24 – 265
Power line frequency, Hz	45 – 65
Power consumption (from power line ~230 V), W, not more	1.5
Power supply from DC supply source ( ), V	8 – 24
Power consumption (from DC supply source +12 V), W, not more	0.6
Accuracy of planned events, sec	1 and 0.1*
Max. number of planned events	500
Work period of clock without power line supply (at temperature 25 ºC), years	6
Accuracy of clock, at temperature 25 ºC, not more, sec/day	1
Min. time of contacts commutation, sec	0.015
Indication of load relay state	yes
Parameters saving at power supply loss	yes
Data saving period, years, not less	10
Number and type of contacts, 16 A	1 toggle type
Weight, kg, not more	0.2
Intended use of device	Control and distribution devices
Standard operational mode	continuous
Device protection class (front panel / terminals plate)	IP40 / IP20
Electric shock protection class	II
Climatic type	NC3.1
Permissible contamination level	II
Overvoltage category	II
Nominal isolation voltage, V	450
Nominal withstand impulse voltage, kV	2.5
Cross section of terminals connection wires, mm²	0.2 – 2.5
Terminal screws, N*m	0.4
Installation on standard fixing DIN-rail 35 mm	
Position in space user-defined	

* Accuracy of planned events 0.1 sec. is available only for timer work simple mode;

Table 2. – Output contacts specification

	Maximal current at ~ 250V AC, A	Maximum power, kVA	Max. voltage at Udir = 24 N, A
Cos φ = 0.4	4	1	4
Cos φ = 1	16	4	
Commutation durability of contacts:			
- mechanical service durability, times			10 000 000
- electric durability 16 A 250 V AC, times, not less			100 000
- electric durability 4 A 24 V DC, times, not less			60 000
- electric durability 4 A 250 V AC (cosφ = 0.4), times, not less			100 000

Astronomical mode

As an event the user assigns the state of load relay (on or off) and a shift of time in reference to the sunrise and sunset (from -23:59 to +23:59).

Every day the timer calculates the real time of sunrise and sunset, sums this time with the time of event, and then the resulted time is referenced with the clock of real time and if the resulted time is more or equal to real time – the time will switch the load relay in state which is assigned by the event.

The above described algorithm is performed for each event planned by the user. In case when there are more than 1 event planned, only the event which corresponds to the real time clock will be activated, other events will not be performed.

At the latitudes where there is a polar day, the events concerning the sunset will not be performed and the time of the sunrise is taken as equal to 00:00.

At the latitudes where there is a polar night the events concerning the sunrise will not be performed, and the time of the sunset is taken as equal to 00:00.

In figure 2 there is resulted a case of Program P1 being set for the astronomic mode of work with four events for a street illumination during 4 hours at sunset and 4 hours at sunrise, the rest of the time the illumination is switched off.
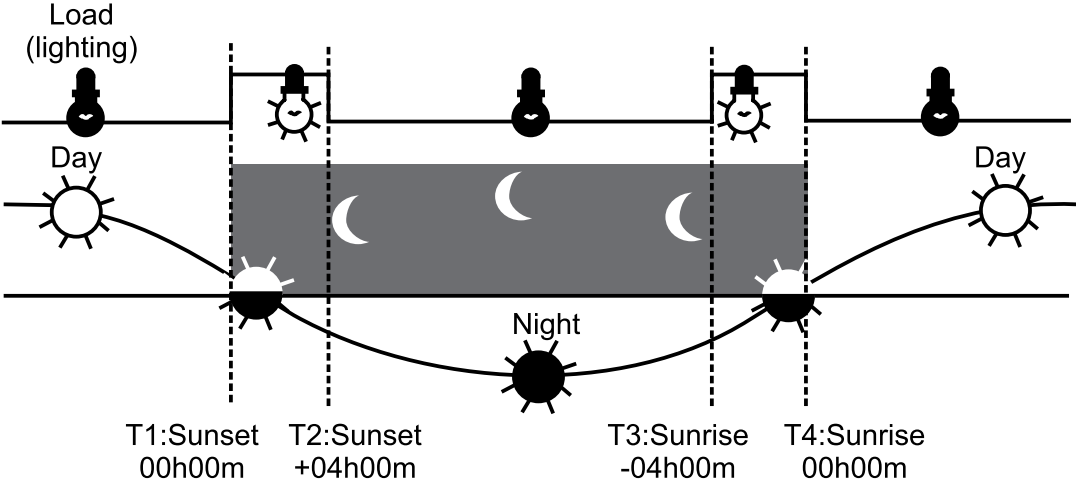

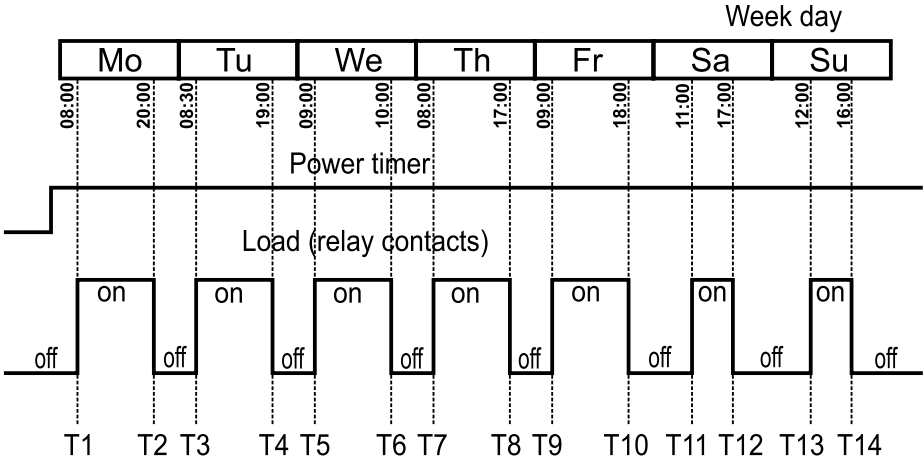*Figure 2 – Street illumination as an example of astronomic mode of work*

Figure 3 – On and Off of a loading relay as an example of the weekly mode of work
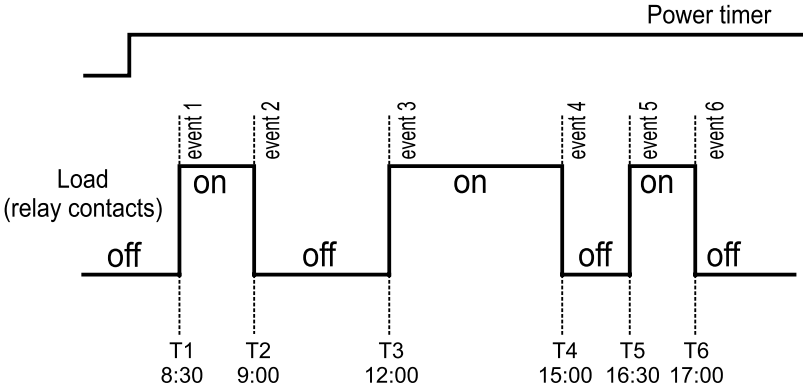

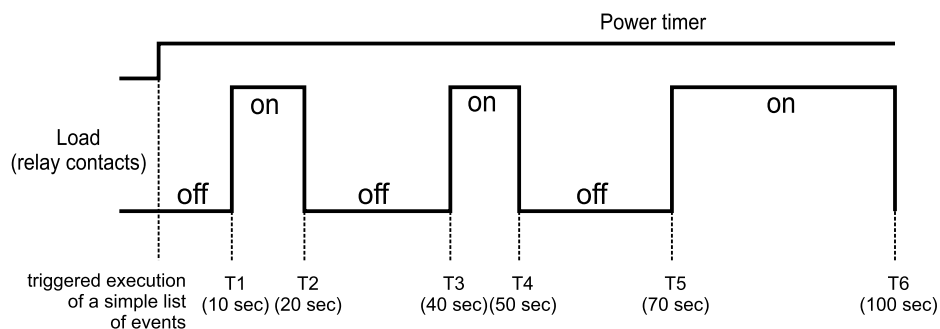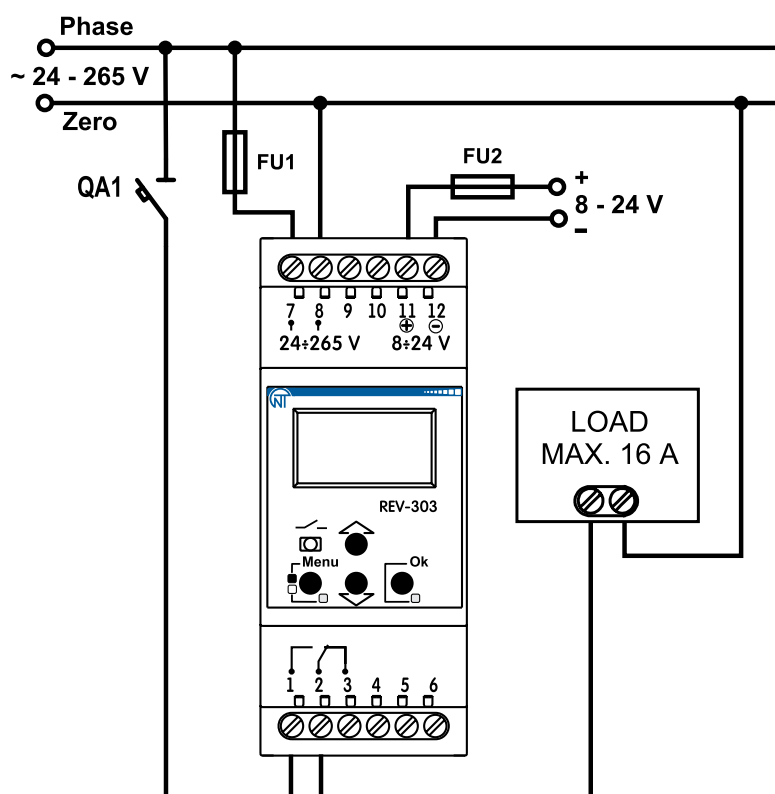*Figure 4 – Switching on of the load as an example of daily mode of work*

Power timer

Load
(relay contacts)

on — off — on — off — on — off

triggered execution
of a simple list
of events

| T1 (10 sec) | T2 (20 sec) | T3 (40 sec) | T4 (50 sec) | T5 (70 sec) | T6 (100 sec) |

Figure 5 – Switching on of the loading as an example of simple mode of work

Phase
~ 24 - 265 V
Zero

FU1   FU2

QA1

+ 8 - 24 V −

7 8 9 10 11 12
24÷265 V   8÷24 V

REV-303

Menu   Ok

1 2 3 4 5 6

LOAD
MAX. 16 A

QA1 - Automatic breaker (max. 16 A);
FU1, FU2 - Safety fuse (max. 1 A).

1,2 – N.O. contact;
2,3 – N.C. contact;
4,5,6 – are not used;
7 – power terminal ~ 24 ÷ 265 V (Phase);
8 – power terminal ~ 24 ÷ 265 V (Zero);
9,10 – are not used;
11 – power terminal plus 8 ÷ 24 V;
12 – power terminal minus 8 ÷ 24 V;

NOTE
1 – when relay is off the contacts 2,3 are closed and contacts 1,2 are open, when relay is on the contacts 2,3 are open and contacts 1,2 are closed;
2 – automatic breaker (QA1) should be taken concerning the least rated current of protected circuit or nominal load voltage but not more than 20 A (class B).

QA1 – Automatic breaker (max. 16 A);
FU1, FU2 – safety fuse (max. 1 A)
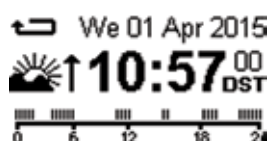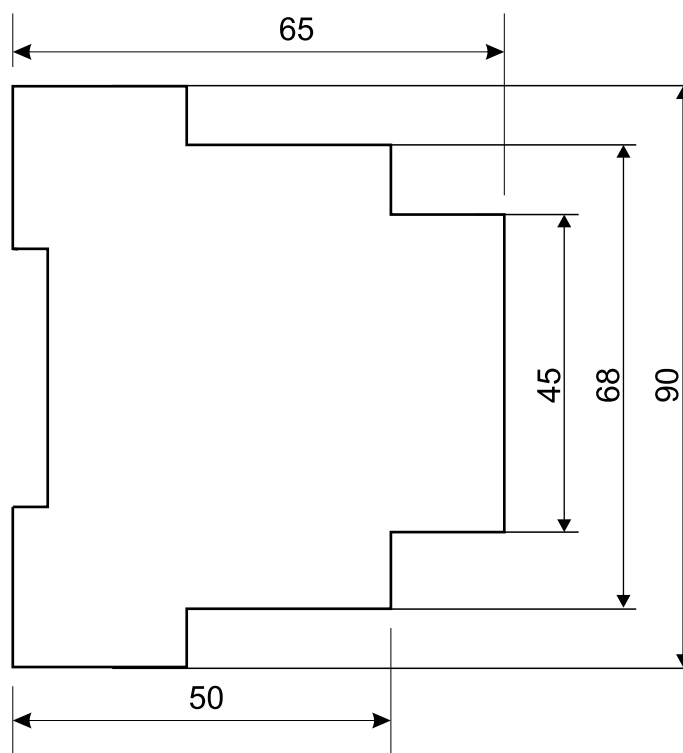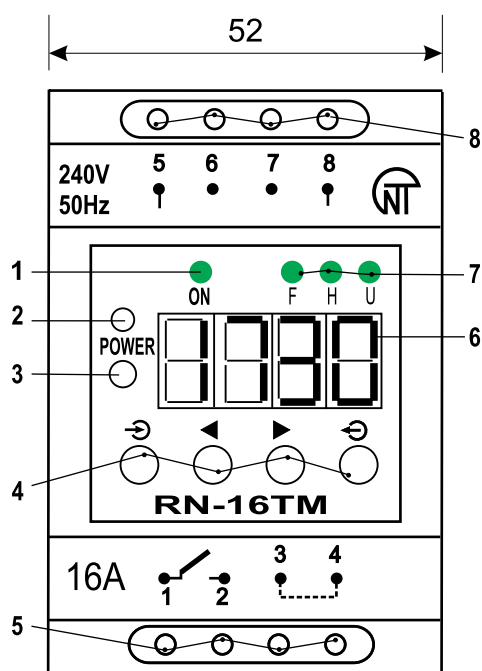
Figure 6 – REV-303 connection diagram

We 01 Apr 2015
10:57:00 DST
0   6   12   18   24

Figure 7 – Main timer display

MULTIFUNCTIONAL DAILY-WEEKLY TIMER RN-16TM

1 – green LED indicates the "ON" state of relay;
2 – green/red LED signal indicates the input voltage presence;
3 – light sensor (photodiode);
4 – menu control buttons:
  ⏻ – entry into menu, parameter input;
  ⏻ – save the parameter and menu exit;
◀ ▶ – scrolling buttons;
5, 8 – wiring terminals;
6 – seven-segment indicator (display);
7 – green LEDs to indicate the operation mode of the timer relay;
9 – strap of internal accumulator (set at the use of relay), during storage to take off a strap.

Figure 1. – Control descriptions and dimensions diagram

Table 1. Technical Specifications

Description	Value
Rated voltage, V	230
Lowest voltage level sufficient for the RN-16TM operation, V	140
Highest permissible voltage, V	320
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Tripping voltage thresholds, V:	
- Lower threshold	150 - 210
- Upper threshold	230 - 320
Adjustment accuracy for the voltage tripping thresholds, V	1
Illumination level adjustment range, Lx	0 - 175
Voltage measurement accuracy, V (doesn't exceed)	1
Voltage hysteresis (returning ratio), V	+ 5
Illumination level hysteresis (returning ratio), %	12
Adjustable reaction time delay to Max/Min voltage interruptions, sec	0– 9.9
Tripping time delay, sec	0– 9.9
Fixed reaction time to changes in illumination level, sec	12
Accuracy of the time clocks, seconds per day (not exceed)	3
Accuracy to adjust schedule time setting, min (not exceed)	1
Maximal number of events per day,	60
Include: - switching ON	30
- switching OFF	30
Events per week	60x7=420
Endurance to the voltage absence (retention of settings when supply voltage is absent), no less than	1 month
Protection degree: - relay	IP40
- terminal	IP20
Commutation life for the output contacts:	
- under load 16A, no less than, operations	100 000
- under load 5A, no less than, operations	1 000 000
Power consumption (under load), VA, not more than	3.0
Weight, not more than, kg	0.150
Outer dimensions	Figure 1
Operating temperature, °C	from -10 to +55
Storage temperature, °C	from -20 to +60

Table 2. – Output contacts haracteristics (terminals 1-2)

	Maximal current at ~ 250V AC, A	Max. power when contacts are closed, kVA	Max. switch. power, kVA	Max. long-term safe voltage AC/DC, V	Max. current under U=30V DC, A
Cos φ = 0.4	5	3	4	380/150	5
Cos φ = 1	16				

Multifunctional relay RN-16TM (hereinafter RN-16TM) performs the following functions:
- Programmable real time switch (daily-weekly timer)
- voltage relay
- Light-sensitive photo relay
- Voltage indicator
  The RN-16TM is designed for:
- Turning ON/OFF the power load (equipment) according to the time schedule preset by the user;
- Turn OFF home used or industrial single phase (230V / 50Hz) power load (equipment) in case the unallowable voltage fluctuations are detected. When the voltage returns back to normal parameters - the device will automatically turn ON the power load (equipment) with the user defined time delay;
- Turn ON/OFF the power load according to the curtain illumination level that the user may set.

Relay works in 3 basic operation modes (I-III) and 2 mixed modes (IV-V):

I.   H – daily-weekly timer;
II. U –voltage relay;
III. F – photo-relay;
IV. HU – daily-weekly timer with voltage control function;
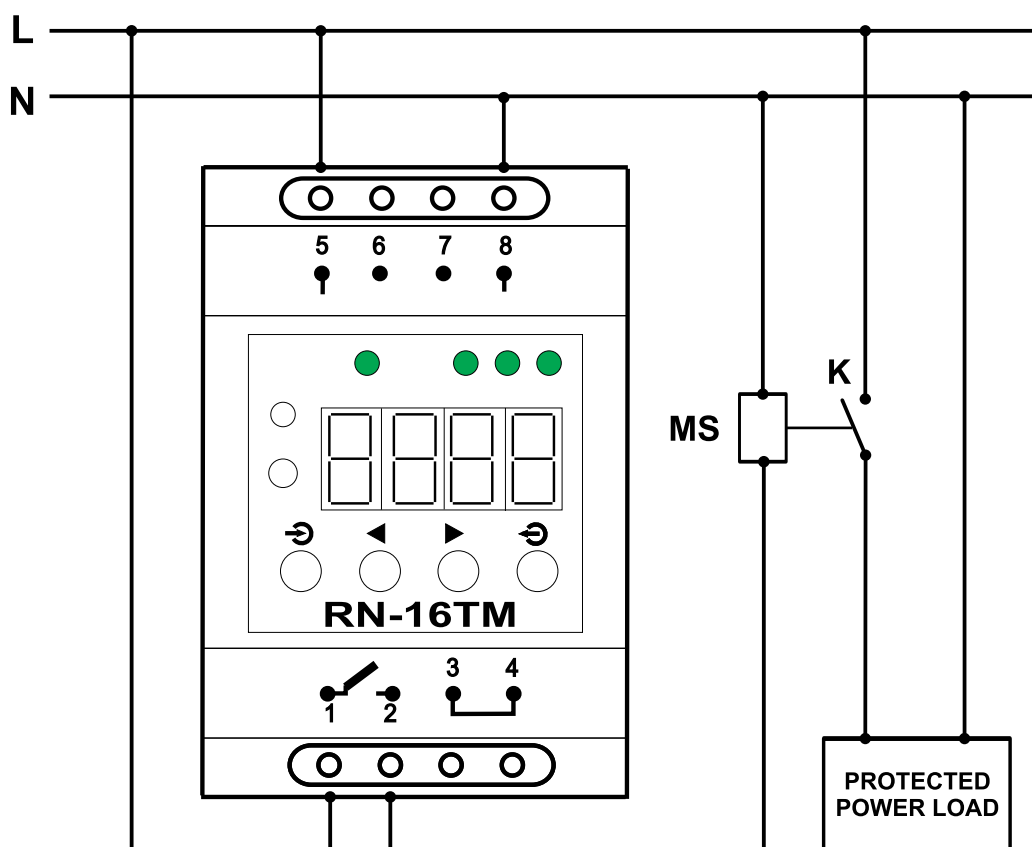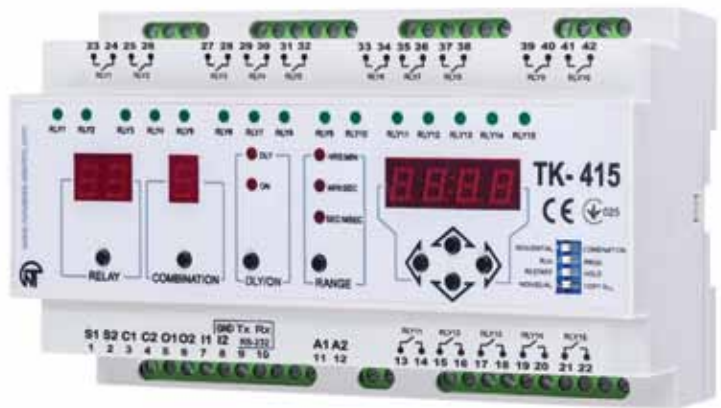V. FU – photo-relay with voltage control function

Figure 1. – Wiring diagramms

SEQUENTIAL AND COMBINATION TIMER TK-415

Sequential and Combination Timer TK-415 is a microprocessor based programmable unit. It is intended for switching in previously adjusted timepoints of 15 loadings in turn (the sequential mode) or in certain combinations (the combinational mode).

BASIC FUNCTIONS

- microprocessor controlled.
- simple change-over between sequential and combination timer.
- 7-segment LED indications.
- cascade connection of several devices for extended total number of channels.
- memorization of device mode after switching off and program operation restart from breakage.

- inputs for timer start and pause control.
- fast resetting.
- copy of settings.
- program can be executed only one time or/and cyclic operation possible.
- connect to PC via the RS-232 interface for easy & intricate programming.
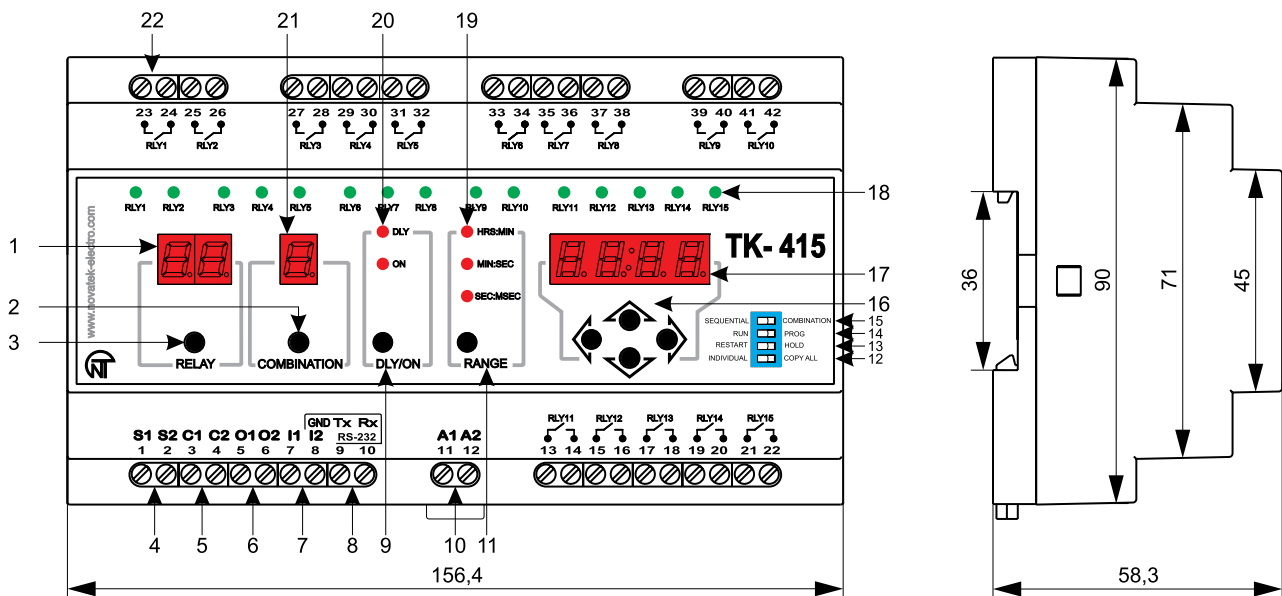

Figure 1. – External view and dimensions

1. Indicator for selected channel.

2. **COMBINATION** Button of selection of combination DLY/ON of active channel in case of timer operation in combination mode.

3. **RELAY** Button of selection of channel for programming or channel information displaying.

4. **S1/S2** Inputs of timer start for program execution. For start of program processing inputs S1 and S2 should be closed for 150 milliseconds. Switch RUN/PROG should be in position RUN.

5. **C1/C2** Inputs of looping execution of program. If inputs C1 and C2 are closed, the program is executed only one time. Otherwise, the program would be in cyclic mode.

6. **O1/O2** Outputs of cascade connections of devices. After completion of execution of program outputs O1 and O2 are closed for 200 milliseconds.

7. **I1/I2** Inputs of pause control. Zero potential between I1 and I2 suspends the program execution. After un-shorting between I1 and I2, the execution of program is continued from the suspension time.

8. **RS-232** COM port for copy options from personal computer. See novatek-electro.com for software.

9. **DLY/ON** Button of selection of time setting of open (DLY) or closed (ON) contacts of active channel output.

10. **A1/A2** Power inputs according to technical specifications.

11. **RANGE** Button for selection of range of time programming DLY/ON according to the Table 1

Table 1.

Designation	**Range**
HRS:MIN MIN:SEC SEC:MSEC	from 1 minute to 99 hours 59 minutes from 1 second to 99 minutes 59 seconds from 100 milliseconds to 999.9 seconds

Table 2. Technical Specifications

Description	**Value**
Supply voltage, V	from 85 to 270 AC/DC
Frequency range, Hz	47-63
Power consumption, VA	8
Time setting range	from 0.1s to 99 hr 59 min
Commutation accuracy	±0.1% + 20ms
Number of channels	15
Number of combinations per channel (ON/OFF)	8
Operating temperature range, °C	from -25 through +55
Storage temperature, °C	from -35 through +60
Humidity (non-condensing)	90% / 40°C
Insulation resistance	>100 MOhm / 500V DC
Dimensions, mm	85.8 x 156.2 x 56.8
Weight, kg	0.5
Indication of load relay	Yes
Protection level	IP20
Climatic resistance version	NF3.1
Permissible contamination level	||
Overvoltage category	||
Nominal voltage of isolation, V	450
Nominal impulse withstanding voltage, kV	2.5
Cross section of wires of connection terminals, mm²	0.5-2.5
Maximal tightening torque of terminals external screws, N*m	0.4
Data memory, years, minimum	10
Channel contacts type	normally open contact (NO)
Mounting position	any
Mounting: onto standard 35 mm DIN-rail	

Table 2. – Characteristics of output channels

	Maximal current at ~ 250V AC, A	Maximum capacity, kVA	Maximum current at U_{const}=24V, A
Cos φ = 0.4 Cos φ = 1	4 10	1 2,5	10

Commutation resource of output contacts:
  - mechanical resource
  - electric resource 10A 250V AC, times, minimum
  - electric resource 10A 24V DC, times, minimum
  - electric resource 4A 250V AC (cos φ = 0.4), times, minimum
			10^7
			100 000
			30 000
			100 000

Signal «Start»			Contact Closure S1 and S2 minimum at 150 milliseconds

CONNECTION

The Figure 2.1 represents the typical method of timer connection. Load is connected to output of channel RLY10 as an example.
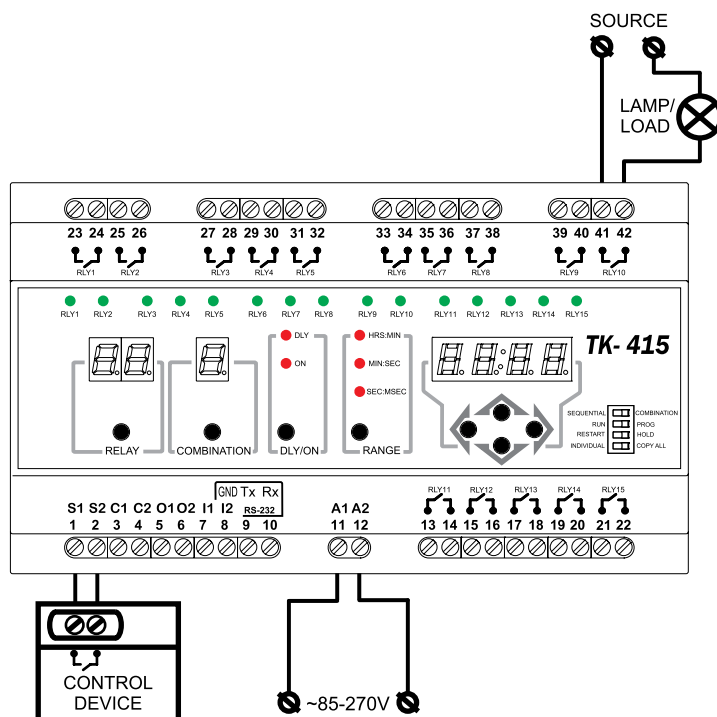

Figure 2.1 –
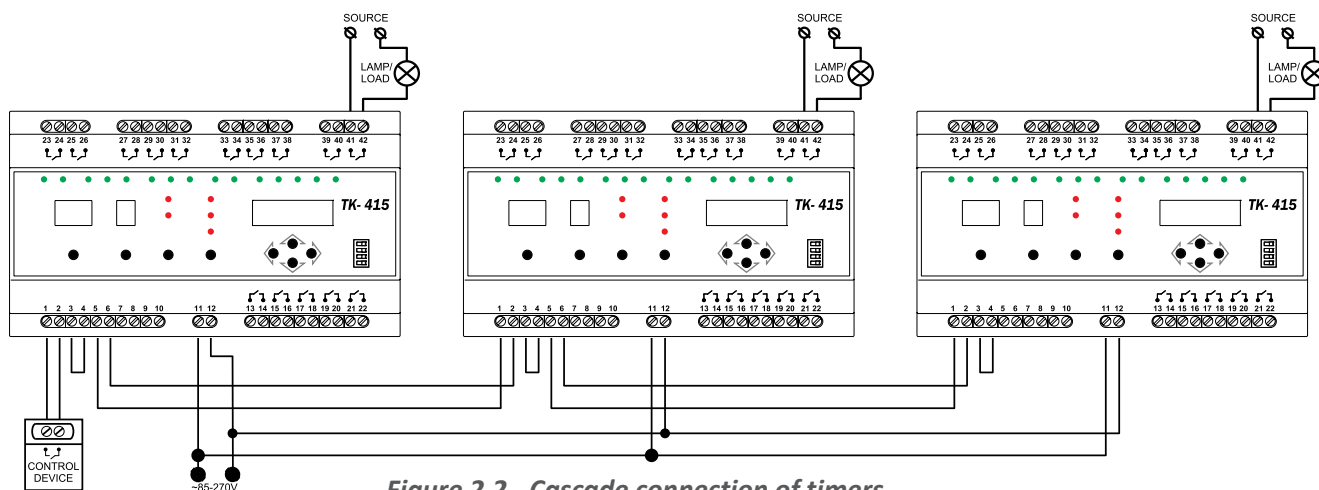*Typical method of timer connection*
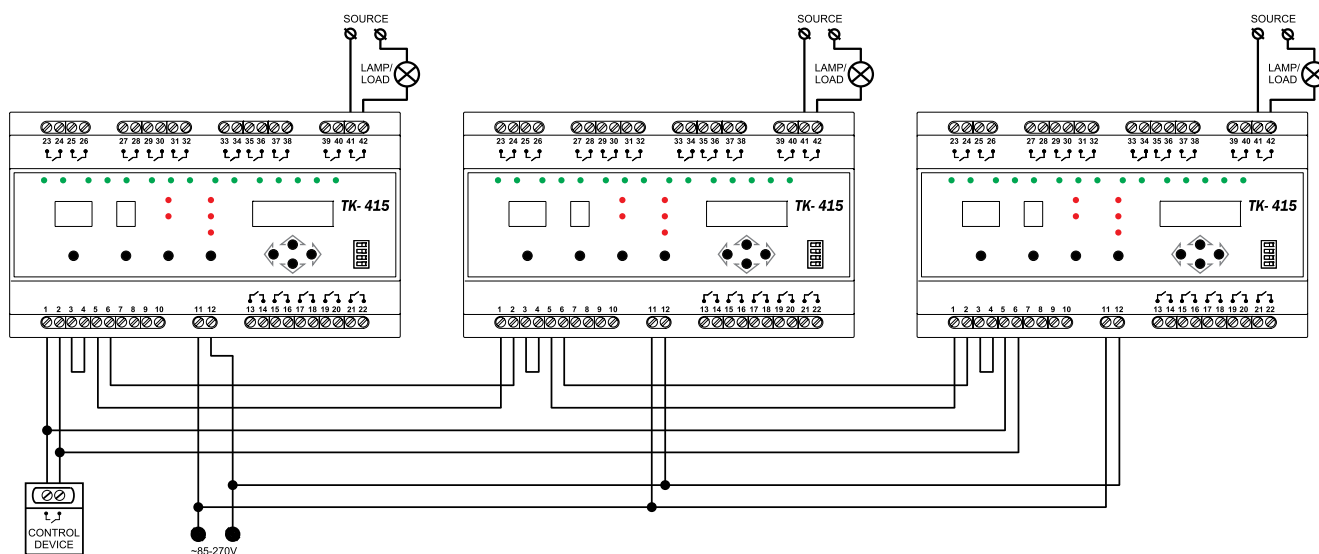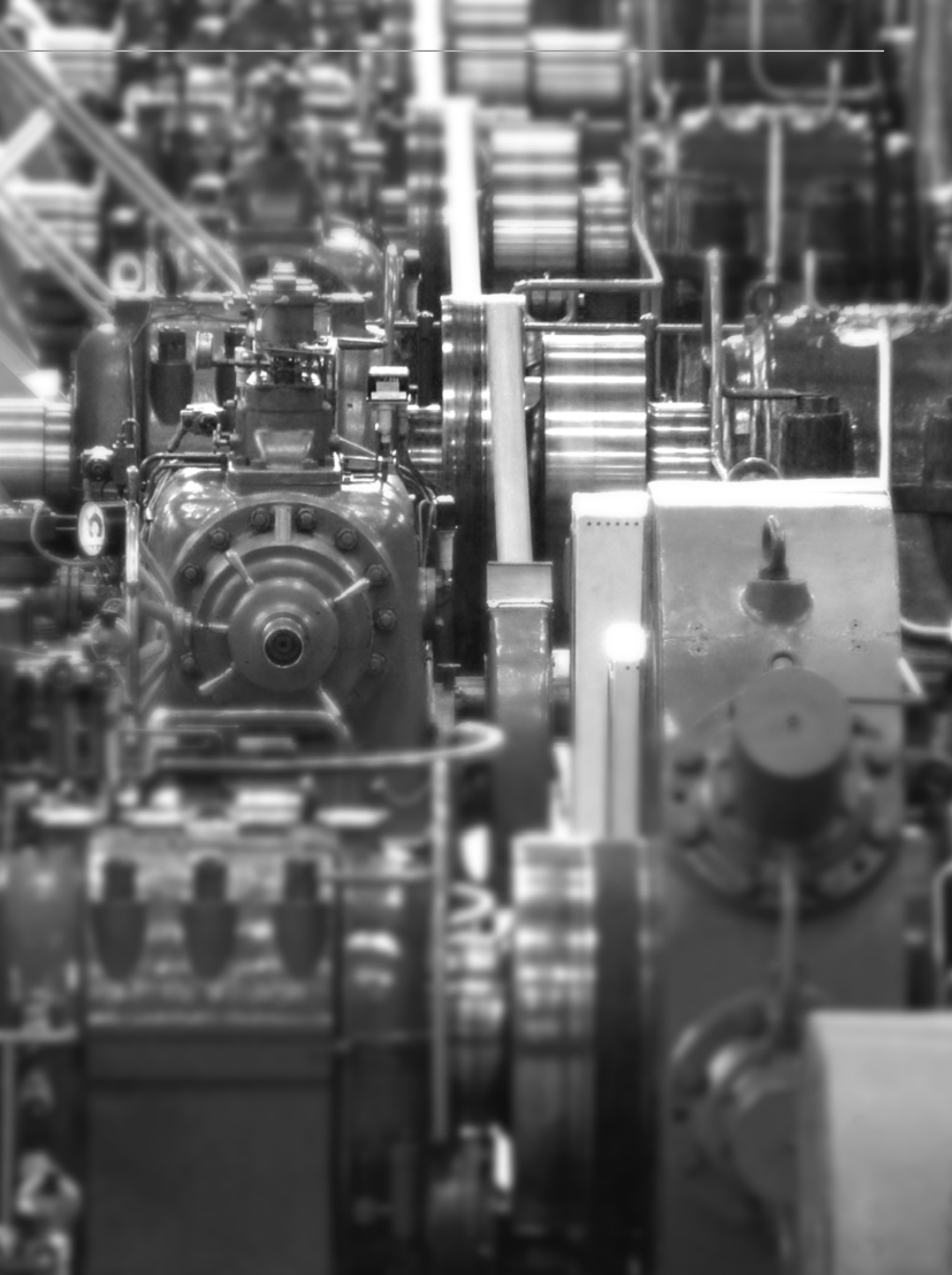

Figure 2.2 - Cascade connection of timers

Figure 2.3 - Cycle operation of timers in case of cascade connection

UNIVERSAL SINGLE-PHASE INDUCTION ELECTRIC MOTOR & PUMP PROTECTION UNIT WITH THE POSSIBILITY OF SOFT START UBZ-115

This operation manual is for the maintenance staff to familiarize with the unit, its operating principle, construction, operation and maintenance procedures of the Universal Single-Phase Induction Electric Motor Protection Unit – UBZ-115 (hereinafter referred to as "the unit", "UBZ-115" or "the UBZ-115 unit").

Terms and abbreviations:

- AR – Automatic reset;
- Motor – Single-phase induction electric motor;
- MCB – Miniature circuit breaker;
- Display – seven-segment three-digit LED indicator.

The Universal Single-Phase Induction Electric Motor Protection Unit UBZ-115 is a microprocessor unit.

UBZ-115 provides protection to single-phase induction electric motors with power up to 3 kW (25A).

The UBZ-115 unit is designed to provide permanent control of mains voltage parameters and current effective value, which is consumed by the 230-240 V/50Hz motor.

In the UBZ-115 provides an external input for remote start or stop the motor, and feature «soft start» the motor up to 5 seconds.

UBZ-115 provides protection in the following situations:

- when the mains voltage is of poor quality (over & under voltage);
- mechanical overloads of the motor (over current);
- when motor torque is lost («dry stroke»);
- delayed start or rotor jamming;
- thermal overload (thermal model of the motor).

For each separate type of fault, the unit allows to enable or disable an automatic reset (AR) of the motor.

Figure 1. – Control descriptions and dimensions diagram
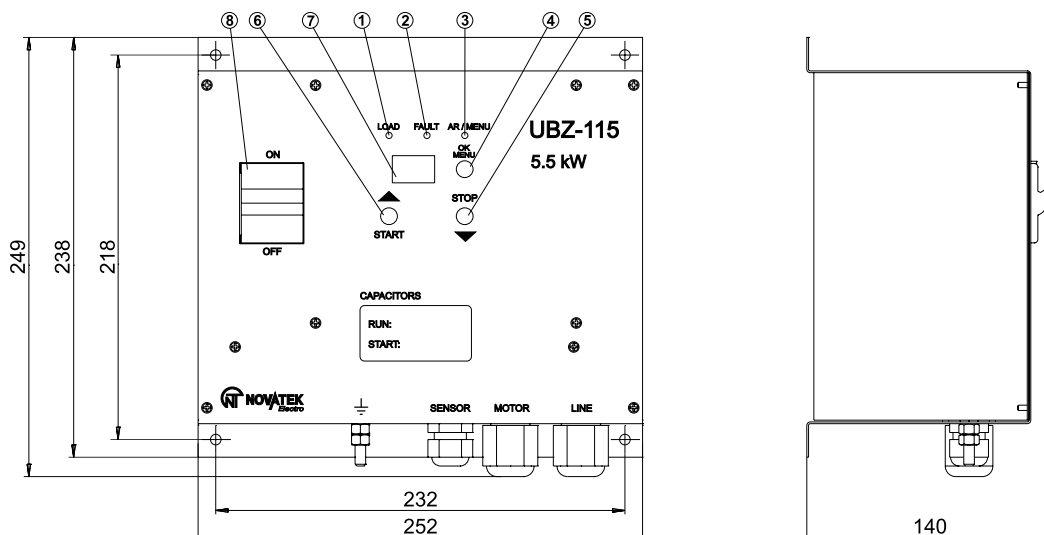
1 – motor power-on indicator (blinking when the motor is started, shines when the motor is working, flashes when the motor is stopped by external input);
2 – emergency indicator (shines, if there is a failure);
3 – AR count and MENU mode indicator (blinks, when AR count is taking place, flashes when the time AR is completed and the AR allowed, shines, when a user has entered the menu);
4 – programming mode and parameters input approval button;
5 – STOP button in the programming mode is down;
6 – START button in the programming mode is up;
7 – seven-segment three-digit LED indicator (display);
8 – miniature circuit breaker (MCB).

Table 1. Technical Specifications

Rated single phase supply voltage, V	~230
Minimum/maximum functional voltage, V	130 – 300
Protection against current overload (currents greater than 40A)	yes
MCB (Miniature Circuit Breaker), A	32 (class B)
Mains frequency, Hz	48 – 62
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Maximum load capacity, kW	5.5
Rated current, A	25
Maximum allowable start current, A	40
Trip threshold accuracy for current, ≤, % of rated current	3
Trip threshold accuracy for voltage, ≤, V	3
Hysteresis return on voltage, ≤, V	4
Data storage term, years, not less than	10
Current consumption (at 220 V), ≤, mA	200
Weight, ≤, kg	2.6
Overall dimensions, mm	252 x 188 x 125
Remote control (water level sensor) input	Clean contact
Motor control through	Relay 40A, 240V
	Triac 40A, 800V
Output connections starting capacitor	Triac 40A, 800V
Device allocation	Control equipment and distribution
Typical operation	Continued
Device level protection	IP30
Index protection of electrical shock	0I
Climatic modification	UHL3.1
Permissible degree of pollution	II
Overvoltage category	II
Nominal voltage of isolation, V	450
Rated impulse withstand voltage, kV	2.5
Selectable space position	Arbitrary

Table 2. – Characteristics of output channels

	Maximal current at ~ 240V AC, A	Maximum power, kVA	Max. voltage ~, V	Terminals material
Cos φ = 1	40	7,2	240	AgSnO
Commutation resource of output terminals: - electrical resource 40A 240V AC, times, not less than - mechanical resource, times, not less than		100 thousand 10 million		

Table 3. – Measured and computed parameters

NAME	MNEMONICS	RANGE	ACCURACY
Effective current, A	iA	0.1 ... 150	2%
Maximum effective current value, A	iAm	0.1 ... 150	3%
Mean value of effective current, A	iAG	0.1 ... 150	3%
maximum value of mean current, A	iGm	0.1 ... 150	3%
Overload current, A	iAo	0.1 ... 150	3%
Starting current, A	iS	0.1 ... 150	3%
Start time, sec	tS	0.1 ... 999	0.5%
Effective voltage, V	UA	100 ... 450	3V
Mains frequency, Hz	Frq	45 ... 65	1%
Heat balance of the motor, %	bE	0 ... 999	
Voltage and current angle cosine	CoS	0.00 ... 1.00	5%
Total power, kVA	PoF	0.00 ... 99.9	5%
Active power, kW	PoA	0.00 ... 99.9	5%
Reactive power, kVAr	Poq	0.00 ... 99.9	5%
AR time, sec	tAS	0 ... 999	1 sec
Operation time before heat shutdown, sec	tob	0 ... 999	1 sec
Latency time after heat shutdown, sec	tEb	0 ... 999	1 sec
*External input status	inP	ON ... OFF	
*Corresponds to the active state of the external input, depending on the setting of a parameter mCP.			

Types of protection:

UBZ-115 performs the following types of current protection:

- maximum current;
- minimum current ("dry run");
- maximum phase voltage;
- minimum phase voltage;
- delayed start and rotor lock-up;
- maximum mains frequency;
- minimum mains frequency;
- according to thermal overload;
- rotor jamming and rotor lock-up.

Soft start:

In UBZ-115, the soft start is applied on the basis of the method of phase adjusting.
Application of soft start allows:
- to decrease overload shocks by means of decreasing the starting currents;
- to decrease the probability of motor overheating;
- to prolong the motor service life;
- to eliminate jerking in the mechanical part of the drive at the moment of starting;
- to decrease the noise and vibration of the motor;
- to decrease the consumed power.
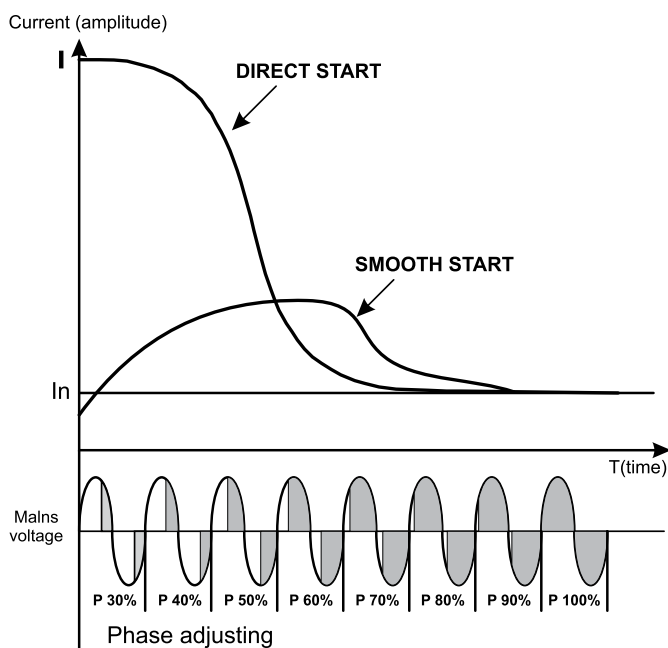
Where:
T – starting time (parameter $55t$);
I – current, consumed by the motor;
In – motor rated current (parameter ind);
P – power of the phase regulator.
The initial power is preset by the parameter $55P$.

Figure 3. – The principle of soft start function

1 – Mounting holes (4 pieces);
2 – Start capacitor;
3 – Run capacitor;
4 – Screw M3 (4 pieces);
5 – Connection terminals;
6 – Seals cable connection PG-24 (2 pieces);
7 – Seals cable connection PG-11 (1 pieces);
8 – Washer M3 (4 pieces);
9 – Spring washer M3 (4 pieces);
10 – Screw-nut M3 (4 pieces);
11 – Back cover is connected;
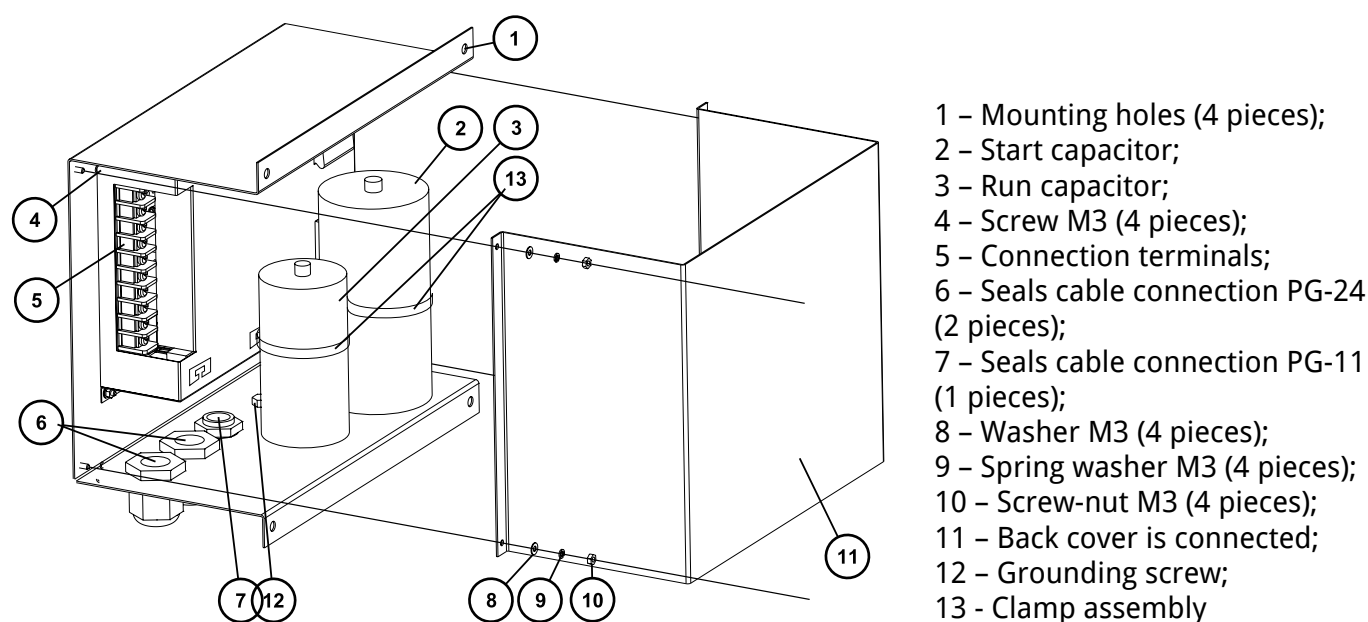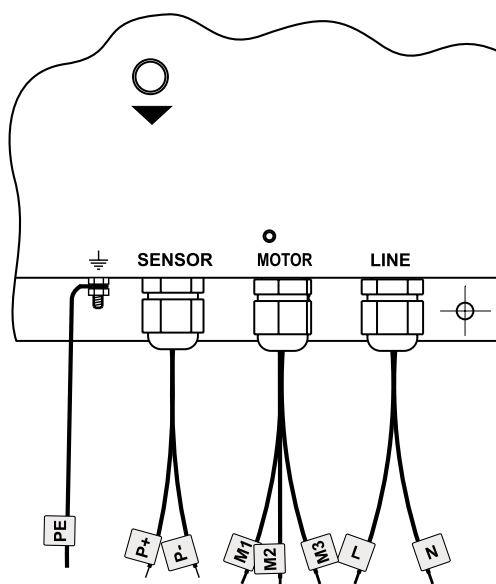12 – Grounding screw;
13 - Clamp assembly

Figure 4. – Scheme of mounting the device

Unit connection:

Depending upon the type of the used motor, connection is accomplished according to one of the following diagrams, shown in figure 5.

A – designation of connecting wires
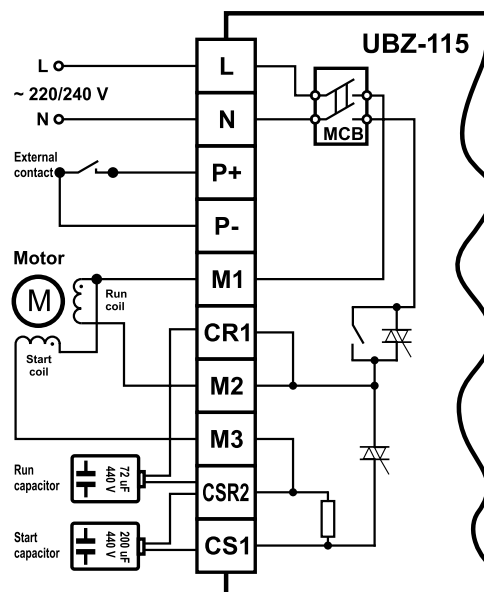
B – motor without any integrated capacitors

L – Phase ~230V;
N – Zero 230V;
M1 – common wire motor;
M2 – run wire motor;
M3 – start wire motor;
P+ – input external sensor "+";
P- – input external sensor "-";
PE – ground.

Figure 5 - Motor connection diagrams

C – motor with an integrated capacitor

Operation of UBZ-115 after motor start:

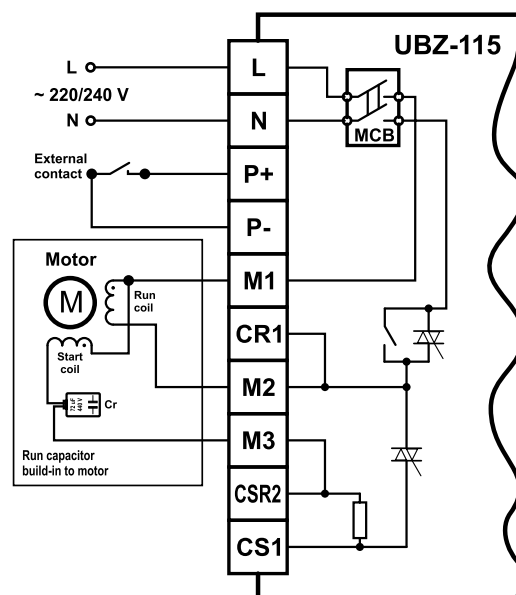UBZ-115 performs the voltage and current control. The motor shuts down on tripping of any of the protections, specified in table 3. The display shows the value of the current, consumed by the motor.

Table 3. – Measured and computed parameters

NAME	MNEMONICS	COMMENT
The presence of currents, when motor stopped, A	E. ı0	
Over current, sec	E.oF	Time lock device
Maximum phase current, A	E. ı̄	
Minimum phase current, A	E. ı̄	
Overvoltage, V	E.Uo	Voltage is greater than 310V
Maximum mains voltage, V	E.Uī	
Minimum mains voltage, V	E.Un	
Maximum mains frequency, Hz	E.Fī	
Minimum mains frequency, Hz	E.Fn	
Thermal overload, %	E.b2	
Delayed start, A	E.LL	
Rotor lock-up, A	E.Lb	

UBZ-115 and remote control by external input (water level sensor):

External input can be used as a signal to turn on and off the motor if the parameter "ā̄C.P" is set other than zero.
• If " ā̄C.P= 1" – closure of contacts will turn on the motor, and their breaking will turn it off.
• If " ā̄C.P= 2" – breaking of contacts will turn on the motor, and their closure will turn it off.

If it is allowed to turn on the motor (button "Start" is pushed (fig.2 pos.6) or the motor starts automatically after energy supply (parameter ā̄C.r = 0 or 1)) and there is an enabling signal on the external input, the motor will be turned on.
If it is allowed to turn on the motor and there is a forbidding signal on the external input, the motor will not be turned on, at this the LED "Load" (fig.2 pos.1) is flashing with interval 1.2 sec, indicating that when the enabling signal comes from the external input, the motor will be turned on.

UNIVERSAL SINGLE PHASE INDUCTION ELECTRIC MOTOR PROTECTION UNIT UBZ-118 (1.5 kW)

The Universal Single-Phase Induction Electric Motor Protection Unit UBZ-118 is a microprocessor-based unit.
UBZ-118 provides protection to single phase induction electric motors with power up to 2.6 kW (12A) working with a single capacitor.
The UBZ-118 unit is designed to provide permanent control of mains voltage parameters and current effective value, which is consumed by the 230V/50Hz motor.
In the UBZ-118 provides an input for water level sensor for remote start or stop the motor.
The setting of phase shifting capacitor directly into the device itself.
UBZ-118 provides protection in the following situations:

* when the mains voltage is of poor quality (over & under Voltage);
* mechanical overloads of the motor (over current);
* when motor torque is lost/ dry run (under current);

* delayed start or rotor lock-up;
* thermal overload (heat model of the motor).
* For each separate type of fault, the unit allows to enable or disable an automatic reset (AR) of the motor.

Indication and operating controls
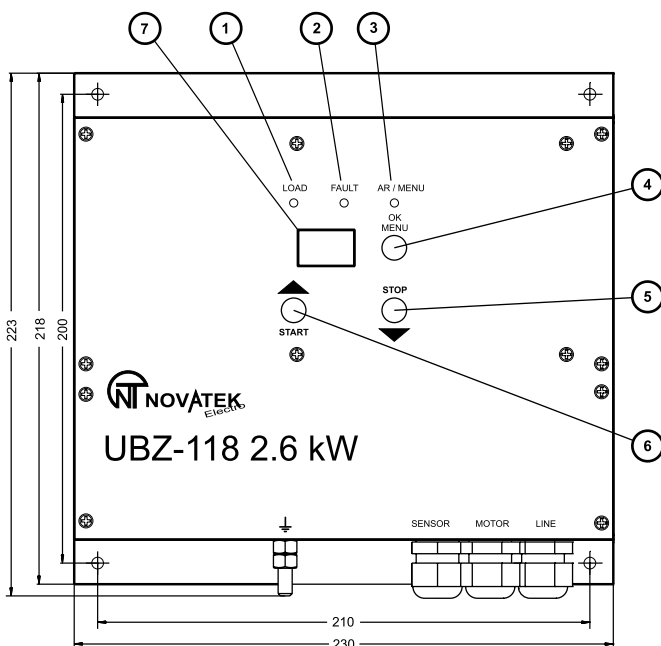
1 – motor power-on indicator (blinking when the motor is started, shines when the motor is working, flashes when the motor is stopped by external input);
2 – emergency indicator (shines, if there is a failure);
3 – AR count and MENU mode indicator (blinks, when AR count is taking place, flashes when the time AR is completed and the AR allowed, shines, when a user has entered the menu);
4 – programming mode and parameters input approval button;
5 – STOP button in the programming mode is down;
6 – START button in the programming mode is up;
7 – seven segment three-digit LED indicator (display)

Figure 1. - Overall unit dimensions

UBZ-118 performs the following types of current protection:

* maximum current;
* minimum current ("dry stroke");
* maximum phase voltage;
* minimum phase voltage;

* according to thermal overload (f(x)=I2.r.t);
* delayed start (rotor lock-up);
* maximum mains frequency;
* minimum mains frequency.

Table 1. Technical Specifications

Rated single phase supply voltage, V	~240
Minimum functional voltage, V	130 – 300
Acceptable short (2 hours) over voltage, V	420
Mains frequency, Hz	48 – 62
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Rated current, A	12
Maximum allowable start current, A	40
Trip threshold accuracy for current, ≤, % of rated current	3
Trip threshold accuracy for voltage, ≤, V	3
Hysteresis (recovery rate of voltage), V, not less	4
Data storage term, years, not less than	10
Current consumption (on voltage 230V), mA, not less	82
Weight, ≤, kg	1.4
Overall dimensions, mm	230 x 224 x 58
Remote control input	Clean contact
Port of motor control, Electronic relay	Relay 40A, 240V

Table 2. – Characteristics of output channels

	Maximal current at ~ 240V AC, A	Maximum power, kVA	Max. voltage ~, V	Terminals material
Cos φ = 1	40	7,2	240	AgSnO

Commutation resource of output terminals:	
- electrical resource 40A 240V AC, times, not less than	100 thousand
- mechanical resource, times, not less than	10 million

Device allocation	Control equipment and distribution
Typical operation	Continued
Device level protection	IP30
Index protection of electrical shock	01
Climatic modification	UHL3.1
Permissible degree of pollution	II
Overvoltage category	II
Nominal current of isolation, V	450
Rated impulse withstand voltage, kV	2.5
Rated over voltage, kV	2.5
Selectable space position	-----------

    While operating, UBZ-118 performs continuous measurement and control of mains voltage and the current consumed by the motor; on the basis of the received results the thermal model of the motor is determined. On parameters' exceeding the allowable limits, UBZ-118 shuts down the motor and starts it again (after AR time), provided that the parameters returned to their normal value and AR is enabled.

    UBZ-118 does not need any additional power supply – the control voltage is at the same time the supply voltage.

    UBZ-118 can operate in two modes – "manual" and "automatic".

Table 3. – Measured and computed parameters

NAME	MNEMONICS	RANGE	ACCURACY
Effective current, A	iA	0.1 ... 60	2%
Maximum effective current value, A	iA.m̄	0.1 ... 60	2%
Mean value of effective current, A	iA.G	0.1 ... 60	2%
Overload current, A	iA.o	0.1 ... 60	2%
Starting current, A	iS	0.1 ... 60	5%
Start time, sec	tS	0.1 ... 999	1%
Effective voltage, V	UA	100 ... 350	3V
Mains frequency, Hz	Fr9	45 ... 65	1%
Thermal balance of the motor, %	bE	0 ... 999	
AR time, sec	tAS	0 ... 999	1 sec
Operation time before thermal shutdown, sec	tob	0 ... 999	1 sec
Latency time after thermal shutdown, sec	tEb	0 ... 999	1 sec
*External input status	inP	ON ... OFF	

*Corresponds to the active state of the external input, depending on the setting of a parameter m̄CP.

UBZ-118 AND REMOTE CONTROL BY EXTERNAL INPUT

External input can be used as a signal to turn on and off the motor if the parameter "n̄C.P" is set other than zero.

- If "n̄C.P = 1" – closure of contacts will turn on the motor, and their breaking will turn it off.
- If "n̄C.P = 2" – breaking of contacts will turn on the motor, and their closure will turn it off.

If it is allowed to turn on the motor (button "Start" is pushed (fig.2 pos.6) or the motor starts automatically after energy supply (parameter n̄C.r = 0 or 1)) and there is an enabling signal on the external input, the motor will be turned on.

If it is allowed to turn on the motor and there is a forbidding signal on the external input, the motor will not be turned on, at this the LED "Load" (fig.2 pos.1) is flashing with interval 1.2 sec, indicating that when the enabling signal comes from the external input, the motor will be turned on.
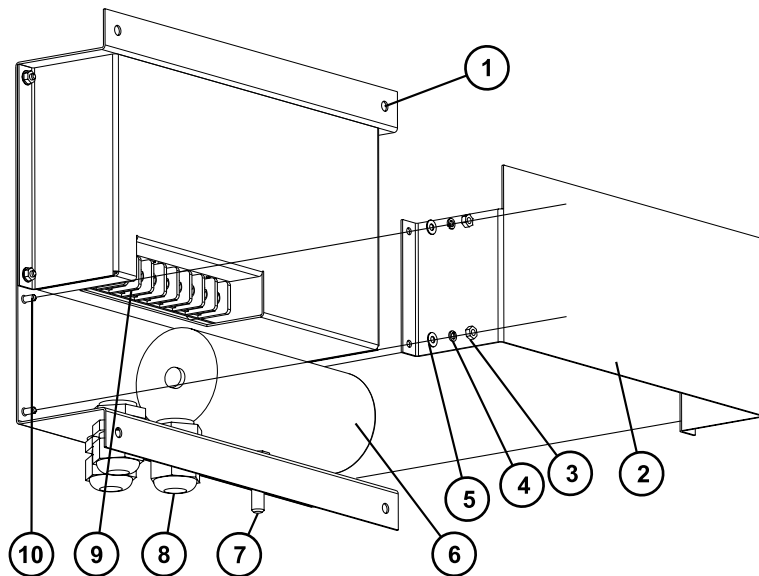
1 – Mounting holes (4 nos.);
2 – Back cover is connected;
3 – Screw-nut M3 (4 nos.);
4 – Spring washer M3 (4 nos.);
5 – Washer M3 (4 nos.);
6 – Phase shifting capacitor;
7 – Grounding screw;
8 – Seals cable connection PG-1 (3 nos.);
9 – Connection terminals;
10 – Screw M3 (4 nos.)

Figure 3. Scheme of mounting the device.
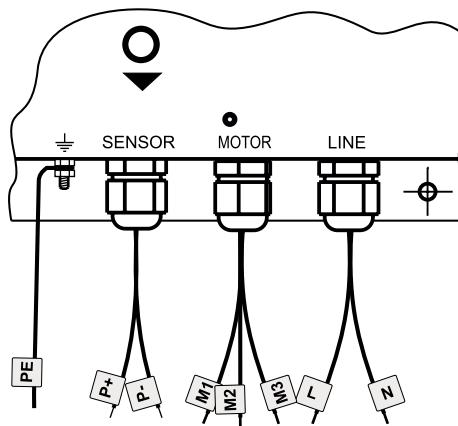
A – designation of connecting wires

L – Phase 240V;
N – Neutral 240V;
M1 – motor common wire;
M2 – operating winding;
M3 – phase shifting coil;
C1 – capacitor;
C2 – capacitor;
P+ – input of external sensor "+";
P- – input of external sensor "-".
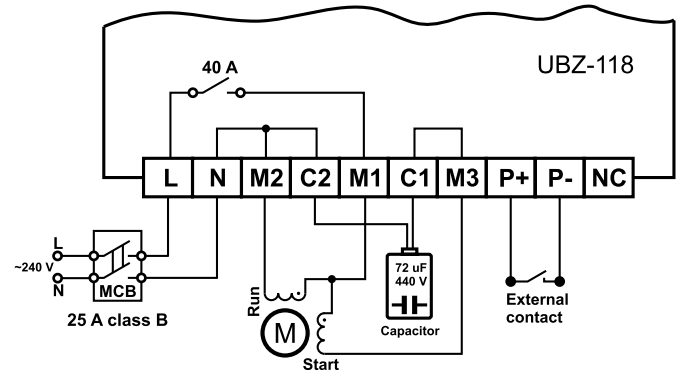
B – motor without any integrated capacitors, installation of a capacitor is made into the case UBZ-118.
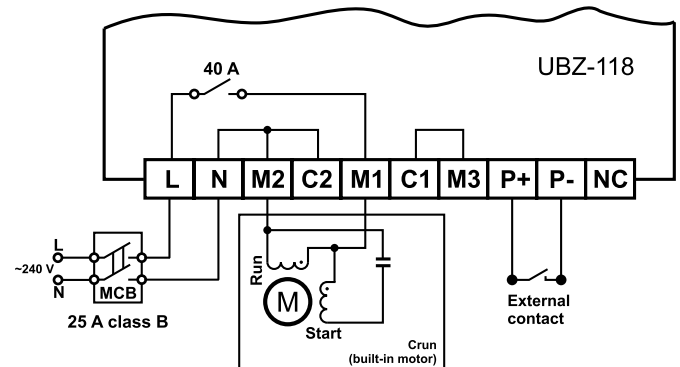
B – motor with an integrated capacitor

Figure 4- Motor connection diagrams

UNIVERSAL ASYCHRONOUS MOTOR PROTECTION RELAY UBZ-301 (5-50A)

UBZ-301 complies with requirements of IEC 60947-1, IEC 60947-6-2, CISPR 11, IEC 61000-4-2.
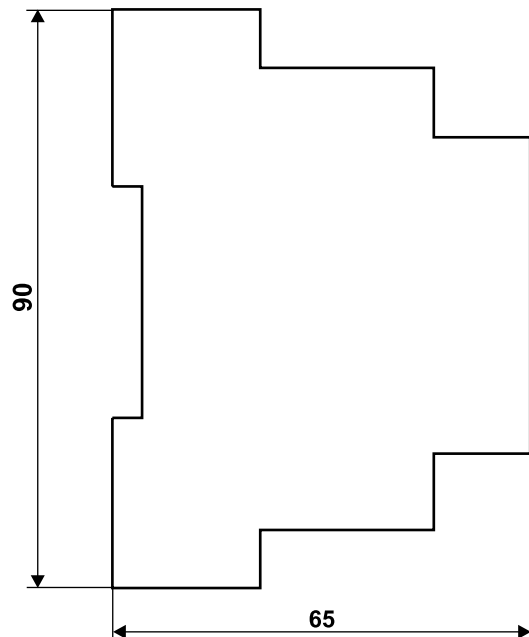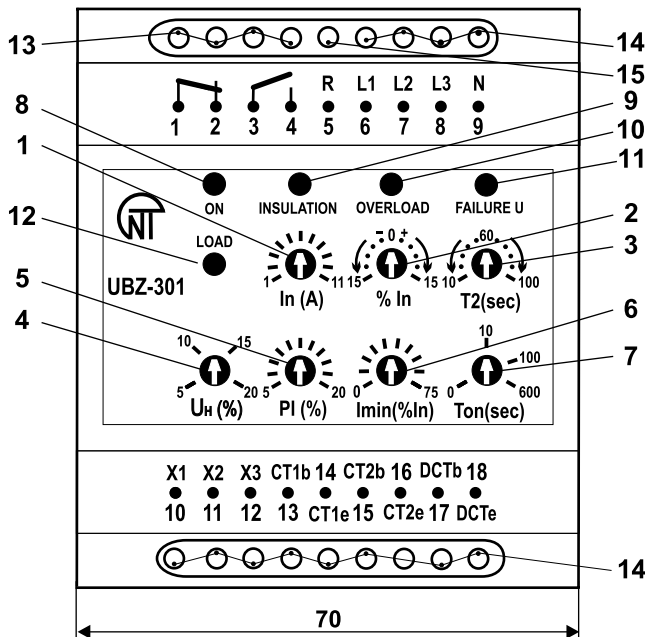
1. Control for nominal current setting, In(A);
2. Control for operating current setting, Iop (% In);
3. Control for T2 (double overload trip) delay setting;
4. Combined trip adjustment control for Umin/Umax;
5. Control for phase imbalance adjustment, PI;
6. Control for trip threshold for the minimum current, Imin (%In);
7. Control for automatic reset delay setting, Ton;
8. Green LED indicating for the mains voltage presence;
9,10,11. Red LEDs indicating faults for insulation, overload and U fault respectively;
12. Green LED indicating for load energization;
13. Output terminals;
14. Input terminals (10,11,12 are used for the connection with the BO-01 exchange unit);
15. Insulation monitoring terminal.

Figure 1. − Control descriptions and dimensions diagram

Table 1. Technical Specifications

Description	Value
Nominal line voltage, V	415
Mains frequency, Hz	45-55
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Nominal current range in UBZ-301 5-50, A	5-50
Operating current setting range, % of nominal	±15
Double overload delay adjustment range, sec	10-100
Voltage threshold adjustment range, % of nominal	±(5-20)
Phase imbalance adjustment range, %	5-20
Trip threshold adjustment range for the minimum current, % of nominal	0-75
Automatic reset delay adjustment range (Ton), sec	0-600
First energization load delay when Ton= 0, sec	2-3
Trip delay for current overload	According to current-time characteristic curve
Trip delay for voltage fault, sec	2
Trip delay for current fault (overload excluded), sec	2
Fixed trip point for leakage current, A	0.5
Insulation resistance threshold, kOhms	500±20
Voltage hysteresis, V	10/17
Heat hysteresis, % of stored-up heat after load de-energization	33
Trip threshold accuracy for current, % of nominal current, not more than	2-3
Trip threshold accuracy for voltage, V, not more than	3
Phase imbalance accuracy, %, not more than	1.5
Operating voltage range, % of nominal one	50-150
Power consumption (under load), VA, not more than	3.0
Maximum switched current of output contacts, A	5
Output contact life:	
- under 5A load , operations, no less than	100 000
- under 1A load , operations, no less than	1 000 000
Enclosure:	
- apparatus	IP40
- terminal block	IP20
Operating temperature range, °C	from -35 to +55
Overvoltage category	III
Nominal voltage of isolation, V	450
Nominal impulse withstanding voltage, kV	4
Cross section of wires of connection terminals, mm²	0.5-2
Maximal tightening torque of terminals external screws, N*m	0.4
Allowable soil level	II
Weight, kg, not more than	0.200
Case dimensions 4 modules of S-type	
Mounting standard 35 mm DIN-rail	
Mounting position arbitrary	

Table 2. – Output contacts haracteristics (terminals 1-2)

	Maximal current at ~ 250V AC, A	Max. power, kVA	Max sustained safe voltage ~, V	Max. current under U=30V DC, A
Cos φ = 0.4	5			
		2	460	5
Cos φ = 1	16			

The UBZ-301 (5-50A) universal induction motor protection unit is designed for the continuous monitoring of the mains voltage parameters and for RMS phase/line currents of 3-Phase AC 400V/50Hz electrical equipment monitoring, primarily, of induction motors whose power is from 2.5 kW up to 25 kW, isolated neutral system included.

<table>
<tr><td>The unit protects AC motors from the following conditions:</td><td>The UBZ-301 (5-50A) provides:</td></tr>
</table>

The unit protects AC motors from the following conditions:

1. when the mains voltage is of poor quality (unallowable voltage jumps, phase loss, incorrect phase sequence and phase «coincidence», phase/line voltage imbalance);
2. when mechanical overloads (symmetrical phase/line current overload) take place. The unit performs overload protection with a dependent time delay;
3. when phase/line current asymmetrical overloads induced by faults inside the motor occur. The unit performs protection from phase current imbalance and further disables an automatic reset;
4. when phase current asymmetry without overload occurs that is induced by the insulation fault inside the motor and/or the power cable;
5. when motor load is lost («dry stroke» for pumps). The unit provides the minimum start and/or operating current protection;
6. when insulation level to frame is abnormally low. The unit performs insulation level test before start and if the insulation is poor the start is disabled;
7. when stator winding ground-to-fault occurs during operation. The unit performs the ground leakage current protection.

The UBZ-301 (5-50A) provides:

1. a simple and accurate electromotor nominal current setting by nominal current standard scale;
2. the electromotor operating current setting that differs from standard values;
3. overload tripping with a dependent time delay (the current-time characteristic curve is plotted for a conventionally cold motor). The motor heat balance differential equation is being solved in the operation process. This approach enables to take account of the preceding electromotor status and to make a decision on heat overload presence with the maximum validity. This method also permits to allow for a motor start heating and to restrict (at the customer's option) amount of starts per unit time;
4. shift of current-time characteristic curve along the current-axis and along time-axis as well;
5. setting of trip thresholds for the minimum/the maximum voltage, line voltage & phase current imbalance, and also for automatic reset delay at the personal customer's discretion;
6. fault type indication, the mains voltage presence indication, current range indication the unit is adjusted to, and load energization indication;
7. the data exchange and transfer to the local computer network according to the RS-485 MODBUS record through the BO-01 exchange unit (BO-01 is supplied on order).

The unit is a microprocessor-based digital device that provides a high degree of reliability and accuracy. The unit doesn't need any auxiliary supply because it retrieves it's energy demand out of the measurement signal: it's self-powered by the voltage to be monitored. Simultaneous isolated independent monitoring for the mains voltage and phase currents permits to detect the type of occurring fault and to provide a different decision-making logic for each fault type. When the mains voltage faults occur the unit performs automatic load reset on return voltage parameters to normal operating conditions. If a fault is induced by abnormal condition inside the motor (phase current imbalance at the symmetrical mains voltage, leakage current presence etc.) restart is disabled.

The unit is stocked with three toroidal current transducers. Two of them are the phase/line current transducers (TT1, TT2), power phase cables are pulled through them. The third transducer is the differential current transducer (DCT) that has an enlarged diameter, because three power phase cables are pulled through it.

Nominal current setting. Nominal current is set by № 1 potentiometer. There are eleven positions of the potentiometer. Each position corresponds to the specific standard nominal current scale value (see below Table of Nominal Currents). Each position is characterized by the specific number of blinks that the green «ON» LED makes. To set the nominal current one needs to bring out potentiometer control arm to a corresponding position; when the unit is energized the number of blinks «ON» LED must correspond to the Table below. One needs to take into account that there are «dead bands» between the positions where «ON» LED glows without blinks and where the nominal current is indefinite.

Table 3. - Nominal current table

Potentiometer №1 devisions	Nom. current, A	Green LED «On» blink
1	5	1bl.- pause
2	6,3	2bl.- pause
3	8	3bl.- pause
4	10	4bl.- pause
5	12.5	5bl.- pause
6	16	6bl.- pause
7	20	7bl.- pause
8	25	8bl.- pause
9	32	9bl.- pause
10	40	10bl.- pause
11	50	11bl.- pause

In order to set operating value which is different from the nominal one that is specified in the nominal current table, **it's recommended** the № 1 potentiometer to set to the position corresponding to the nearest value from the nominal current scale, and by the № 2 potentiometer one can increase or decrease the necessary value in % from the set value.
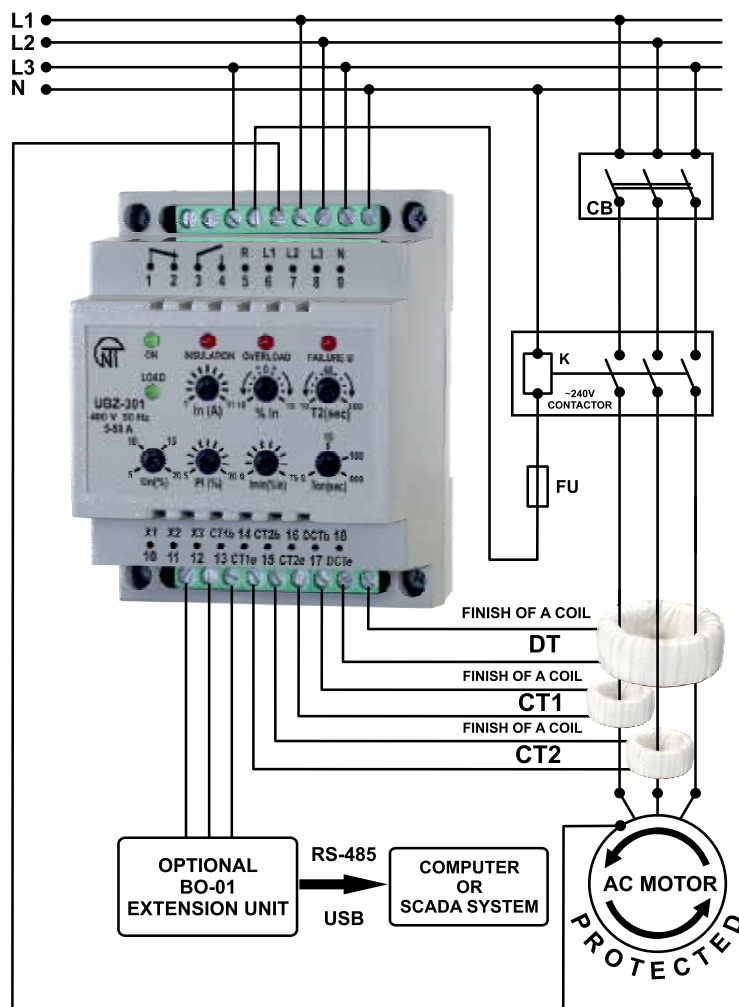
DT – differential current transducer (differential current transformer);
CT1,CT2 – current-transducers;
BO-01 – exchange and date transfer unit (on order)
FU – fuse 6,3 A
Figure 4. – The UBZ-301 wiring diagram

UBZ-301 (10-100A)

UBZ-301 complies with requirements IEC 60947-1, IEC 60947-6-2, CISPR 11, IEC 61000-4-2.

Table 1. - Nominal current table

Potentiometer №1 devisions	Nom. current, A	Green LED «On» blink
1	10	1bl.- pause
2	12,5	2bl.- pause
3	16	3bl.- pause
4	20	4bl.- pause
5	25	5bl.- pause
6	32	6bl.- pause
7	40	7bl.- pause
8	50	8bl.- pause
9	63	9bl.- pause
10	80	10bl.- pause
11	100	11bl.- pause

Table 2. Technical Specifications

Description	Value
Nominal line voltage, V	400
Mains frequency, Hz	45-55
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Nominal current range in UBZ-301 5-50, A	10-100
Operating current setting range, % of nominal	±15
Double overload delay adjustment range, sec	10-100
Voltage threshold adjustment range, % of nominal	±(5-20)
Phase imbalance adjustment range, %	5-20
Trip threshold adjustment range for the minimum current, % of nominal	0-75
Automatic reset delay adjustment range (Ton), sec	0-600
First energization load delay when Ton= 0, sec	2-3
Trip delay for current overload	According to current-time characteristic curve
Trip delay for voltage fault, sec	2
Trip delay for current fault (overload excluded), sec	2
Fixed trip point for leakage current, A	1.0
Insulation resistance threshold, kOhms	500±20
Voltage hysteresis, V	10/17
Heat hysteresis, % of stored-up heat after load de-energization	33
Trip threshold accuracy for current, % of nominal current, not more than	2-3
Trip threshold accuracy for voltage, V, not more than	3
Phase imbalance accuracy, %, not more than	1.5
Operating voltage range, % of nominal one	50-150
Power consumption (under load), VA, not more than	3.0
Maximum switched current of output contacts, A	5
Output contact life:	
- under 5A load , operations, no less than	100 000
- under 1A load , operations, no less than	1 000 000
Enclosure:	
- apparatus	IP40
- terminal block	IP20
Operating temperature range, °C	II
Overvoltage category	III
Nominal voltage of isolation, V	450
Nominal impulse withstanding voltage, kV	4
Cross section of wires of connection terminals, mm²	0,5-2
Maximal tightening torque of terminals external screws, N*m	0,4
Allowable soil level	from -35 to +55
Weight, kg, not more than	0.200
Case dimensions 4 modules of S-type	
Mounting standard 35 mm DIN-rail	
Mounting position arbitrary	

UBZ-301 (63-630A)

Table 1. - Nominal current table

Potentiometer №1 devisions	Nom. current, A	Green LED «On» blink
1	63	1bl.- pause
2	80	2bl.- pause
3	100	3bl.- pause
4	125	4bl.- pause
5	160	5bl.- pause
6	200	6bl.- pause
7	250	7bl.- pause
8	320	8bl.- pause
9	400	9bl.- pause
10	500	10bl.- pause
11	630	11bl.- pause

Table 2. Technical Specifications

Description	Value
Nominal line voltage, V	400
Mains frequency, Hz	45-55
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Nominal current range in UBZ-301 63-630, A	63-630
Operating current setting range, % of nominal	±15
Double overload delay adjustment range, sec	10-100
Voltage threshold adjustment range, % of nominal	±5-20
Phase imbalance adjustment range, %	5-20
Trip threshold adjustment range for the minimum current, % of nominal	0-75
Automatic reset delay adjustment range (Ton), sec	0-600
First energization load delay when Ton= 0, sec	2-3
Trip delay for current overload	According to current-time characteristic curve
Trip delay for voltage fault, sec	2
Trip delay for current fault (overload excluded), sec	2
Fixed trip point for leakage current, A	1.0
Insulation resistance threshold, kOhms	500±20
Voltage hysteresis, V	10/17
Heat hysteresis, % of stored-up heat after load de-energization	33
Trip threshold accuracy for current, % of nominal current, not more than	2-3
Trip threshold accuracy for voltage, V, not more than	3
Phase imbalance accuracy, %, not more than	1.5
Operating voltage range, % of nominal one	50-150
Power consumption (under load), VA, not more than	3.0
Maximum switched current of output contacts, A	5
Output contact life:	
- under 5A load , operations, no less than	100 000
- under 1A load , operations, no less than	1 000 000
Enclosure:	
- apparatus	IP40
- terminal block	IP20
Operating temperature range, °C	from -35 to +55
Storage temperature, °C	from -45 to +70
Weight, kg, not more than	0.200
Case dimensions 4 modules of S-type	
Mounting standard 35 mm DIN-rail	
Mounting position arbitrary	

UBZ-301 complies with requirements IEC 60947-1, IEC 60947-6-2, CISPR 11, IEC 61000-4-2.

ELECTRIC MOTORS UNIVERSAL PROTECTION DEVICE
UBZ-302
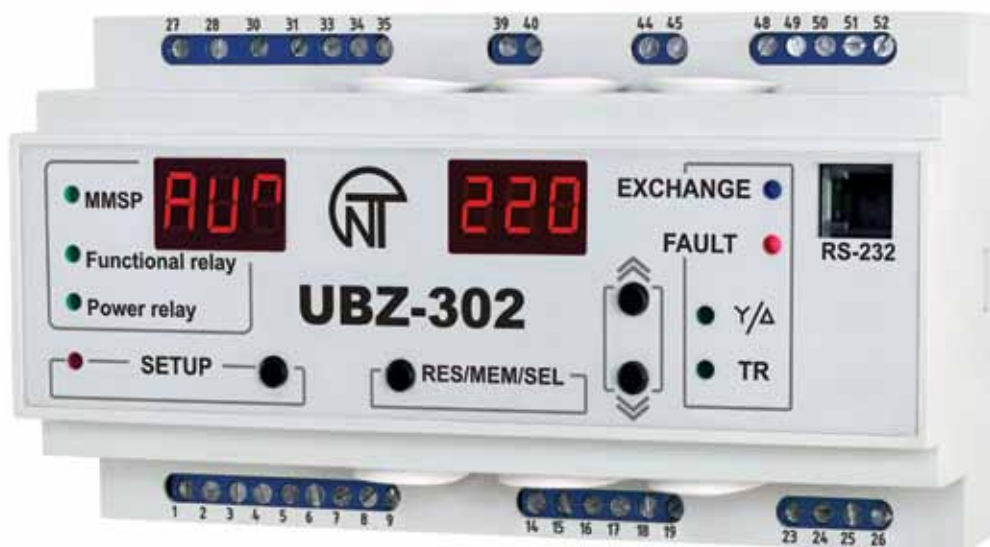
UBZ-302 complies with requirements: IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2
UBZ-302 conforms to the requirements: Hazardous substances in excess of maximum allowable concentration – absent.

UBZ-302 Electric Motor Universal Protection Device (UBZ) is designed for continuous monitoring of the circuit voltage parameters, the RMS values of phase/line currents of three-phase electric equipment, and the electric motor insulation resistance values.

UBZ is designed for protection of asynchronous induction motors ranging from 2.5 kW to 30 kW that use integrated current transformers, including in circuits with insulated neutral.

UBZ provides for electric motor protection in case of:

- poor quality supply voltage (unacceptable voltage surges, phase loss, incorrect phase sequence and phase coincidence, phase/line voltage imbalance);
- mechanical overloads (symmetrical phase/line current overload);
- exceeding the negative sequence current threshold;
- phase current imbalance without overload, induced by the insulation fault inside the motor and/or the lead cable (the current imbalance factor is compared to the voltage imbalance factor using negative sequence);

- loss of motor torque («dry stroke» for pumps) – protection based on the minimal starting and/or operating cur-rent;
- delayed motor start or rotor locking;
- abnormally low insulation level between the fixed coil and frame (testing before motor startup);
- ground fault of the stator coil during operation - protection against ground leakage current;
- motor thermal overload;
- coil overheating (measuring the coil temperature with integrated temperature sensors, or the body temperature with external temperature sensors).

- For each protection type, automatic reclosing (ARC) can be enabled or disabled.

The device provides for electric equipment protection by means of controlling a magnetic starter (contactor) coil.

The device detects the presence of load currents when the load relay is open (when the load relay is open and the functional relay is in the star-delta mode). In this case the Unit initiates the alarm of external Magnetic Starter (further in text as MS), which starts the engine, until the unit or the control of engine currents are switched off while the load relay is deactivated.

Communication

- control and parameter transfer via the RS-485 interface using the MODBUS protocol;
- control and parameter transfer via the RS-232 interface.
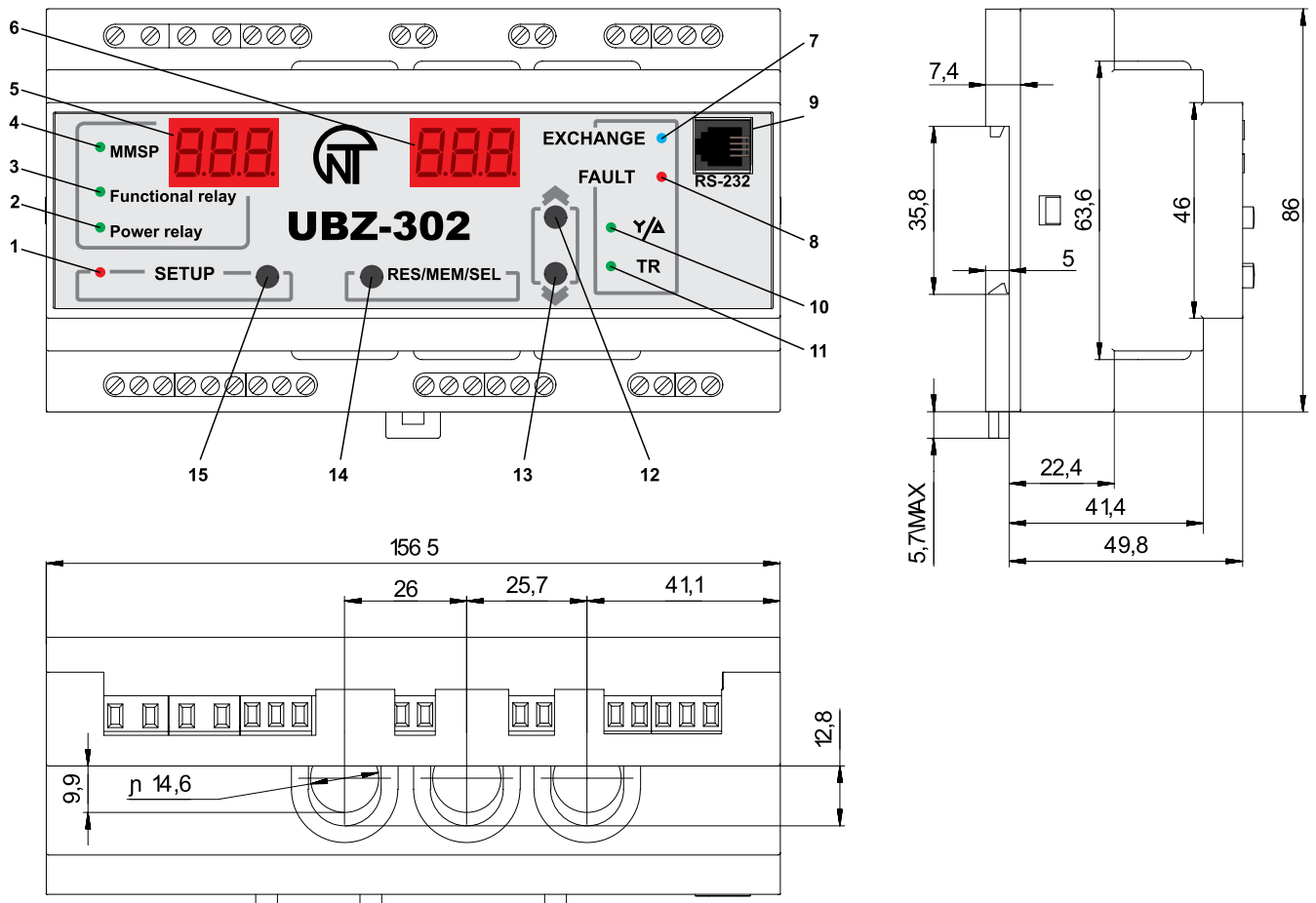
Table 1. – General Information

Item	Unit	Value
Purpose of device	-	Control and distribution equipment. Asynchronous motor protection control.
Assembly (mounting) type	-	Mounted on standard 35 mm DIN bar
Protection degree:		
- device	-	IP40
- terminal block	-	IP20
Climate zone category	-	N3.1 (moderate, indoors)
Operating temperature range	^{o}C	from - 35to +55
Storage temperature	^{o}C	from - 50to+60
Pollution degree	-	III
Overvoltage category	-	III
Diameter of adapters on terminals	mm2	0.5-2
Maximum torque of terminal screws	N*M	0.4

Table 2. Technical Specifications

Rated supply voltage: three-phase	400/415V
Mains frequency, Hz	48-62
Rated currents range (when using integrated current transformers), A	5-63
Voltage hysteresis, (phase/line), V	10/17
Thermal hysteresis, % of accumulated heat at shutdown	33
Current tripping threshold detection accuracy, % of rated current, ≤	2
Voltage tripping threshold detection accuracy, V, at least	3
Voltage based phase imbalance detection accuracy, V, at least	3
Minimum operational voltage:	
- single-phase voltage power supply, with connected neutral wire, V, at least	180
- three-phase power supply voltage, V, no more than	450

Main outputs
  - load relay –two groups of changeover contacts for motor starter control - 8A, 250V at cos φ=1;
  - functional relay – one group of changeover contacts - 16A, 250V at cos φ=1 (relay function assigned by the user)

Analog inputs
- two analog inputs for temperature sensors (type Pt100, Ni100,Ni120)
- analog input for sensor with 0-10 V output
- analog input for sensor with 4 mA (0mA) – 20 mA output
- three analog inputs for standard CT with 5A output (type T-0.66 or similar)
- input for differential current transformer (zero sequence transformer)

Temperature sensor resolution, ^{o}C	1
Power consumption (under load), VA, no more than	5.0
Weight, kg, no more than	0.5

Dimensions (figure 1.1) -nine S type modules
Mounting – on a standard 35 mm DIN bar
Mounting position – any

Table 3. – Characteristics of output terminals of integrated relays

Relay	Operation mode	Max. current at U~250V	N of trippingx 1000	Max. commutated power, VA	Max. additional alternating voltage, V	Max. current at Uconst=30V (N of tripping), A
functional relay	cos φ = 0.4	5 A				
	cos φ = 1.0	16 A	100	4,000	440/300	3
load relay	cos φ = 0.4	2 A	100	1,000	460	3 (50,000)
	cos φ = 1.0	8 A	100			

Figure 1. – UBZ-302 controls and dimensions

1 - SETUP - red LED, lit when UBZ in the parameter setting mode

2 - Power relay – green LED, lit when the load relay is closed

3 - Functional relay – green LED, lit when the functionalrelay is closed;

4 - MMSP – green LED – lit when the UBZ is working in the MMSP mode

5 - three-digit parameter mnemonic indicator:

- point in the lowest digit is lit when the UBZ is in the engineer setting mode;

- point in the middle digit is lit when the setting parameter value is protected with the engineer password;

- point in the highest digit is lit when the setting parameter is not included in the MMSP list.

6 - three-digit parameter value indicator

7 - EXCHANGE – blue LED – lit during data exchange with PC

8 - FAULT – red LED:

- when load relay is open, the LED is lit when UBZ is in a state of fault (blinking if ARC is allowed after fault);

- when load relay is closed, the LED blinks when the motor is in a state of overcurrent or temperature over-load, but the load relay opening time has not come yet

9 - outlet for connecting the UBZ to PC via RS-232

10 - 人/△ – green LED – lit when the UBZ functional relay is in the star-triangle mode (p.2.4.3)

11 - TR – green LED – lit when the UBZ functional relay is in the time relay mode

12 - ⌃ button UP–scroll through displayed parameters in parameter read mode, and scroll through the menu in parameter setting mode

13 - ⌄ button DOWN - scroll through indicated parameters in parameter read mode, and scroll through the menu in parameter setting mode

14 - RES/MEM/SEL –- write parameters in setting mode, switch between groups of displayed parameters in pa-rameter read mode, reset

15 - button SETUP –enter parameter setting mode

NOTE- 人/△ - referred to as (S/D, star-delta)

UBZ provides the following types of electric motor protection:
- overcurrent phase protection;
- ground fault protection (zero sequence current):
- negative sequence current protection
- excess value of current negative sequence ratio divided by voltage negative sequence ratio protection;
- thermal overload protection;
- undercurrent phase protection;
- delayed start (rotor blocking) protection;

- coil overheating protection;
- overvoltageline protection;
- undervoltageline protection;
- line voltage imbalance (voltage negative sequence) protection;
- phase sequence protection;
- motor insulation minimum resistance protection.
- control of external MS working order.

F1, F2, F3 – fuses

Figure 2.1–UBZ wiring chart
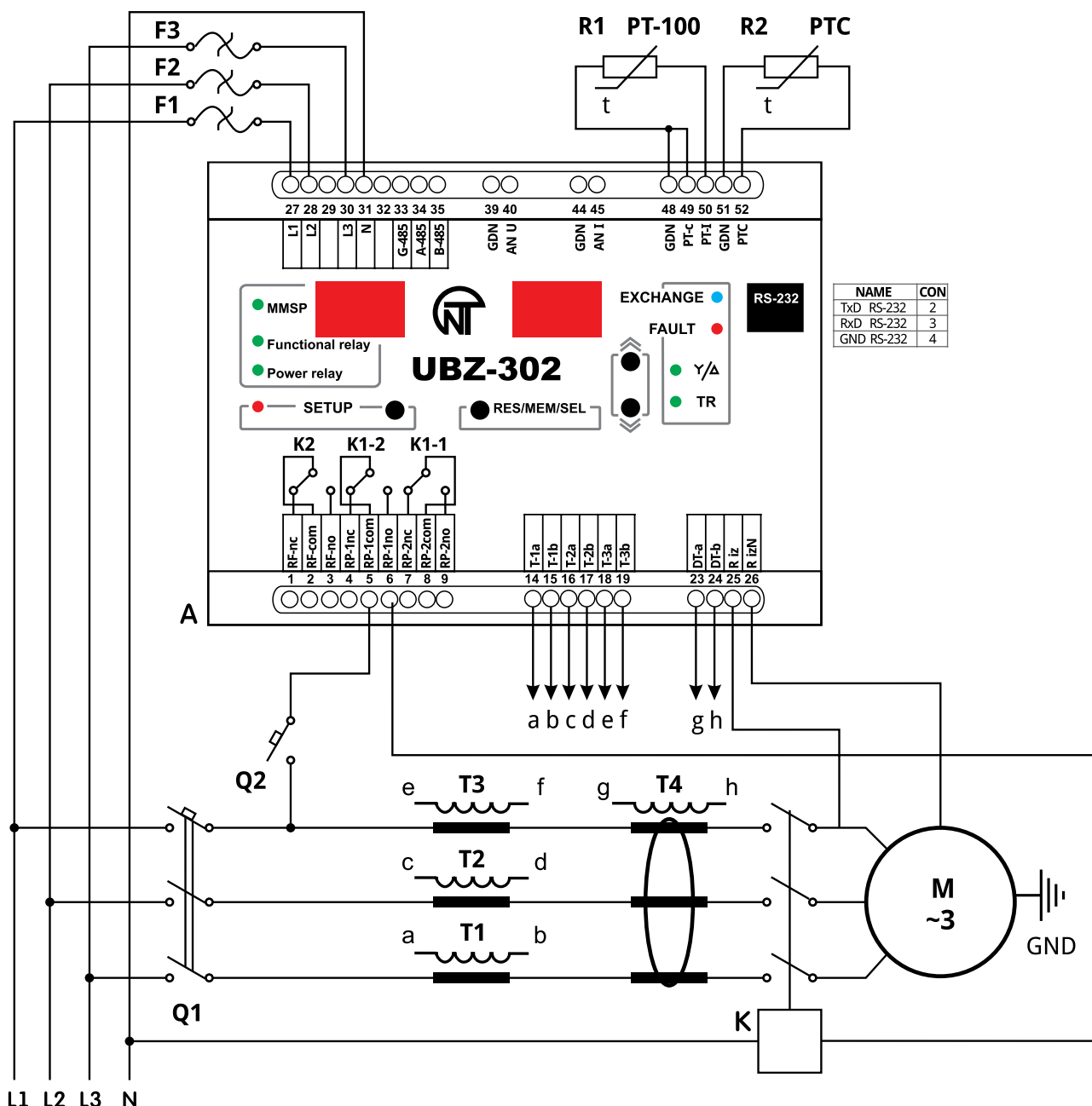
K1 –load relay
K2– functional relay
K – electromagnetic starter
M – induction motor

Q1, Q2 – Circuit breaker
R1, R2 - thermistor
T1-T3 – current transformers
T4 - differential transformer

Connect the UBZ-302 to motor operation in the star/delta switching mode according to the simplified scheme shown on Figure P1 below.

When working in the delta/star switching mode the motor could be controlled in a several ways:

- Turn OFF/ON of the motor by external circuit breaker (contactor) with simultaneous power supply OFF/ON to the input terminals of the UBZ-302;

- Operation with the motor from the front panel of the UBZ-302;

- Operation with the motor using interface RS-232/RS-485.

ATTENTION!!! *It is strictly prohibited to turn OFF the motor by external circuit breaker (contactor) without taking OFF the power supply from the input terminals of the UBZ-302. As a very exception it's possible to disconnect first the motor by external breaker (contactor) and then additionally turn the motor OFF from the front panel of the UBZ-302 or alternatively by giving the corresponding remote-control command by interface RS-232/RS-485 to avoid the direct start on Delta.*
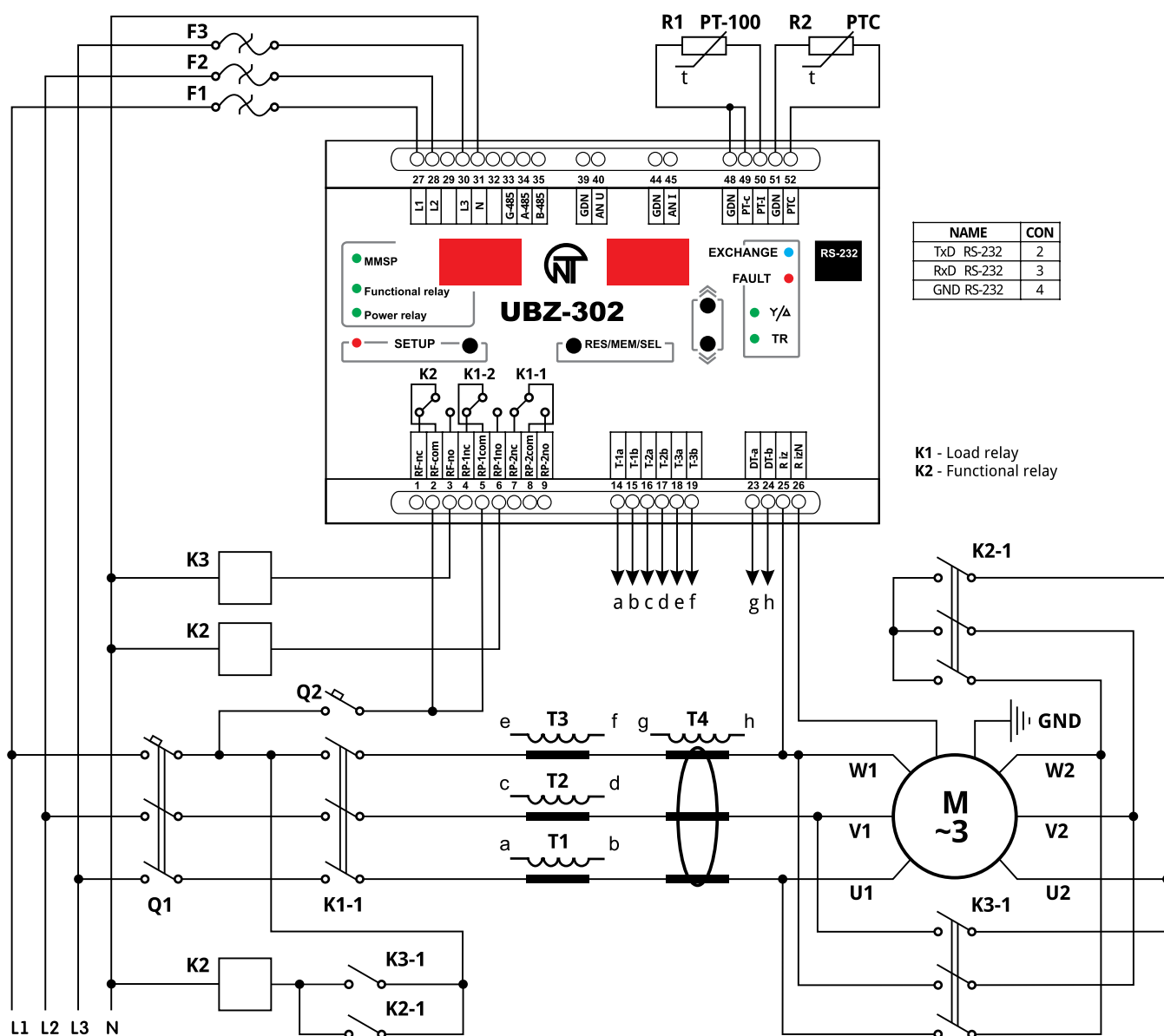

NAME	CON
TxD RS-232	2
RxD RS-232	3
GND RS-232	4

K1 - Load relay
K2 - Functional relay

Figure P1 - Wiring diagram for the UBZ-302 for star/delta mode of operation

NUMERICAL ASYNCHRONOUS LT MOTOR PROTECTION UNIT
UBZ-304

The product meets the requirements of:

UBZ complies with the requirements of the following international standards:
- IEC 60947-1, Low-voltage Switchgear and Control-gear; Part 1: General Rules;
- IEC 60947-6-2:1992, Low-voltage switchgear and control gear – Part 6-2: Multiple function equipment - Control and protective switching devices (or equipment)
- CISPR 11:2004, Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics – Limits and methods of measurement
- IEC 61000-4-2:2001, Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.

Note: The product characteristics comply with both international standards and corresponding national standards.

UBZ-304 is designed for protection of induction motors with power of 2.5 to 315 kW with use of external standard current transformers with 5A (secondary) output current.

UBZ can be operated in circuits both with insulated and dead grounded neutral.

The unit is Flush mounting type (96 x 96)

UBZ provides continuous monitoring of mains voltage parameters, **current** values of the phase (line) currents of three-phase electrical equipment for 415V, 50Hz, and checking the resistance values of motor insulation.

UBZ has in-built real time clock (RTC), Fault log and Bit register (binary) which helps in SCADA and DCS integration.

UBZ provides protection of electrical motors in case of:
- low-quality voltage and frequency parameters (unacceptable power surges, phase failure (phase loss), incorrect phase sequence, shorting of two or more phases and imbalance/asymmetry of phase/line voltages, the reduction in the network frequency lower than the set value and (or) increase of network frequency higher than the set value);
- mechanical overloads (symmetrical overload in phase/line currents);
- the threshold crossing of the negative-sequence current (phase current imbalance);
- unbalance of phase currents without overload associated with the insulation fault inside motor and/or the power cable (the comparison of current unbalance factor according to inverse sequence with voltage unbalance factor according to inverse sequence);
- the torque failure on the motor shaft («dry running» for pumps) – protection based on the minimum starting and/or operating current;
- motor delayed start or rotor blocking;
- extremely low isolation between the stator and the motor housing (pre-startup insulation resistance check);
- ground fault of the stator winding during operation – earth leakage current protection;
- motor thermal overload;
- overheated windings (temperature of windings is determined using the motor's built-in RTD type temperature sensors or the temperature of the housing when using the external temperature sensors).

For each type of protection, it is possible to have dis-allowing and permitting of automatic restarting with load.

UBZ provides for electric equipment protection by means of controlling the coil of the magnetic contactor.

UBZ detects motor currents when load relay is off (when the load relay is off and functional relay is in star-delta mode). In this case, UBZ indicates the fault of external contactor starting the motor until UBZ is turned off or control of motor currents is disabled when load relay is off.

For UBZ operation with PC the program of UBZ-304/305 Control Panel can be used.

UBZ-304/305 Control Panel program is designed to monitor the status and collect data of the UBZ-304 unit via RS-232 or RS-485 communication interfaces (MODBUS Protocol). The program allows for saving (loading) various UBZ settings, retrieving data and save them for further analysis. Data saved can be viewed in the graphs, comparing the parameters with each other.

Graphic interface of the control panel allows real-time viewing the current status of various UBZ parameters. The flexible adjustment of interface allows adapting to the needs of any user.
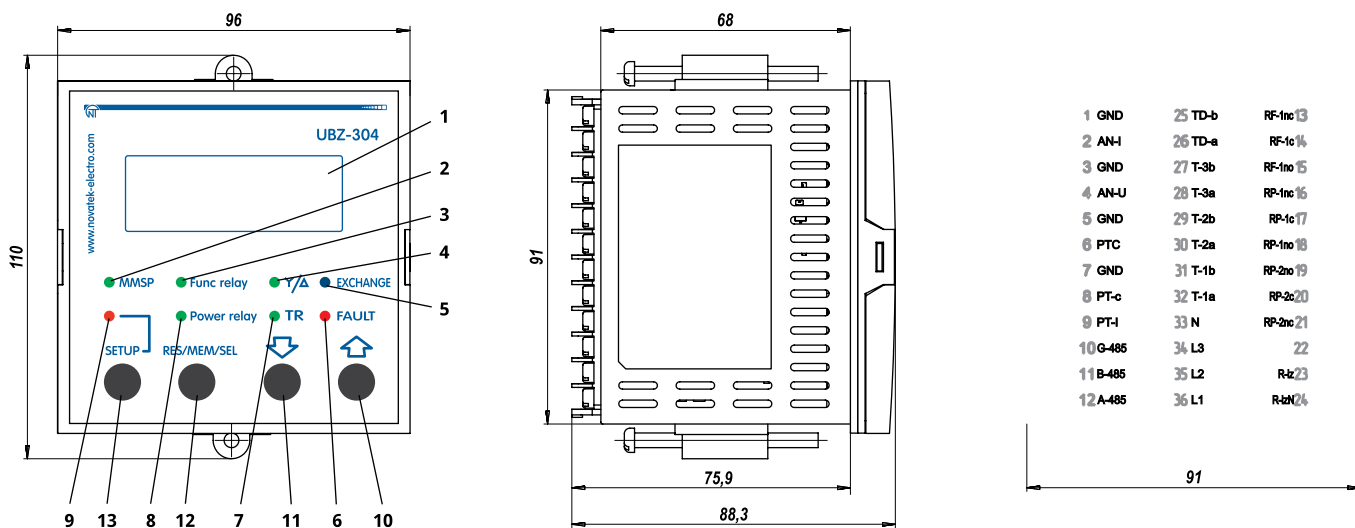
UBZ provides for electric motors control:
• using analog inputs «0-20 mA» and «0-10 V»;
• using remote control channels (RS-232 and RS-485 interfaces);
• by buttons on the front panel of UBZ.

Communication
UBZ provides:
• parameters control and transmission by RS-485 interface using MODBUS Protocol,
• parameters control and transmission by RS-232 interface.

1 – LCD
2 – Green LED MMSP is on when the relay is in MNS mode;
3 – Green LED Func relay is on when functional relay is on;
4 – Green LED ⅄/Δ is on when UBZ functional relay operates in start-delta mode (it.2.5.3);
5 – Blue LED EXCHANGE is on when data exchange with PC occurs;
6 – Red LED FAULT:
  • when load relay is off: it is on when UBZ is in fault conditions (it flashes if after fault ARS is expected);
  • when load relay is on: it flashes when the motor is in conditions of over-current or thermal overload but relay off time has not come yet;
7 – Green LED TR is on when UBZ functional relay operates in time-delay relay mode;

8 – Green LED Power relay:
  • it is on when load relay is on;
  • it flashes if UBZ is within hysteresis band when controlling using analog inputs;
9 – Red LED SETUP is on when UBZ is in the mode of parameters setting;
10 – Button (UP) is scrolling of displayed parameters in the parameter view mode and scrolling of the menu in the parameters setting mode;
11 – Button (DOWN) is scrolling of displayed parameters in the parameter view mode and scrolling of the menu in the parameters setting mode;
12 – Button RES/MEM/SEL is the parameters recording in the setting mode, switching over the group of displayed parameters in the view mode, reset;
13 – Button SETUP turns on the parameters setting mode.

Figure 1 – Controls and Overall Dimensions of UBZ

Table 1. – Basic Technical Specifications

Description	Value
Application of the unit	Switchgear and control-gear; induction motor protection control;
Design (installation) type	DIN rail 35 mm
Protection rating of front panel	IP64
Protection rating of housing	IP10
Climatic version	NC 3.1
Contamination level	II
Overvoltage category	II
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Electric shock protection class	II
Wire cross section for connection to terminals, mm2	0.5-2
Torque for terminal screws, N*m	0.4

Table 2. Technical Specifications

Operating supply voltage, three-phase	415 V, 50 Hz
Mains frequency, Hz	48-62
Rated current of CT, A	5
(Phase/line) voltage hysteresis, V	10/17
Heat hysteresis, in % of accumulated heat in case of shutdown	33
Determination accuracy of trip threshold for current, not more, in % of rated value	2
Determination accuracy of trip threshold for voltage, not more, V	3
Determination accuracy of out-of-phase voltage, not more, V	3
Voltage when maintaining serviceability:	
• phase voltage, when powered by one phase and zero wire is connected, not less, V	180
• line voltage, when powered by three phases, not more, V	450
Analog inputs:	
• input to connect temperature transmitter (types: Pt100, Ni100, Ni120), pc.;	1
• input to connect temperature transmitter of PTC-1000 type, pc.;	1
• three analog inputs for standard CT with 5A output (T-0.66 type or similar), pc.;	3
• input to connect differential current transformer (zero sequence transformer) pc.;	1
• input to measure current of 0-20 mA, pc.;	1
• input to measure voltage of 0–10 V, pc..	1
Main outputs:	
• load relay – two groups of changeover contacts to control the electric motor starter – 8 A, 250 V at cos φ=1;	
• functional relay – one group of changeover contacts - 16A, 250V at cos φ=1 (function of the relay is set by the user).	
Permit according to temperature of temperature transmitters, °C	1
Power consumption (under load), VA, not more	5.0
Weight, not more, kg	0.34
Overall dimensions (Fig.1), H*B*L, mm	110*96*88,3
Position in space	free
Housing material	self-extinguishing plastic

*Table 3. – Characteristics of built-in relay output contacts*

Relay	Operation mode	Max. current at U~250V, A	N of tripping x 1000	Max. switching power, VA	Max. continuous boosting AC / DC voltage, V	Max. current at Ucont=30V, A
functional relay	cos φ = 0.4	5	100	4	440/300	5
	cos φ = 1.0	16	100			
load relay	cos φ = 0.4	2	100	2	460	3
	cos φ = 1.0	8	100			

Table 4. – Special and Service Parameters

Measurement functions	Range		Remarks	Address
Heat balance of the motor	The number 1100000 corresponds to 100% of accumulated heat at which the motor is switched off when the thermal overload protection is enabled		Read-only parameter of RS-232, RS-485 interface	73,74
Index of the last fault in the fault logbook	It varies from 0 to 49, increasing by one after recording another fault in the fault logbook. When the quantity of faults will reach 50, the count of faults will begin again from scratch.		Read-only parameter	75

Protection Types. UBZ performs the following protection types for electric motors:

- over-current protection in phases;
- ground fault protection (zero-sequence current);
- phase current asymmetry (negative-sequence current);
- for exceeding negative-sequence current factor to negative-sequence voltage factor;
- thermal overload;
- undercurrent protection in phases (dry-run);
- delayed starting (rotor blocking);
- overheating of windings (RTD inputs);
- minimum line voltage;

- maximum line voltage;
- line voltage imbalance (negative sequence voltage protection);
- improper phase sequence;
- decreasing of mains frequency lower that setting;
- for increasing of mains frequency higher that setting;
- minimum insulation resistance of the motor winding;
- motor phase loss (protection is operated when the motor current is disabled in one (two) phase).
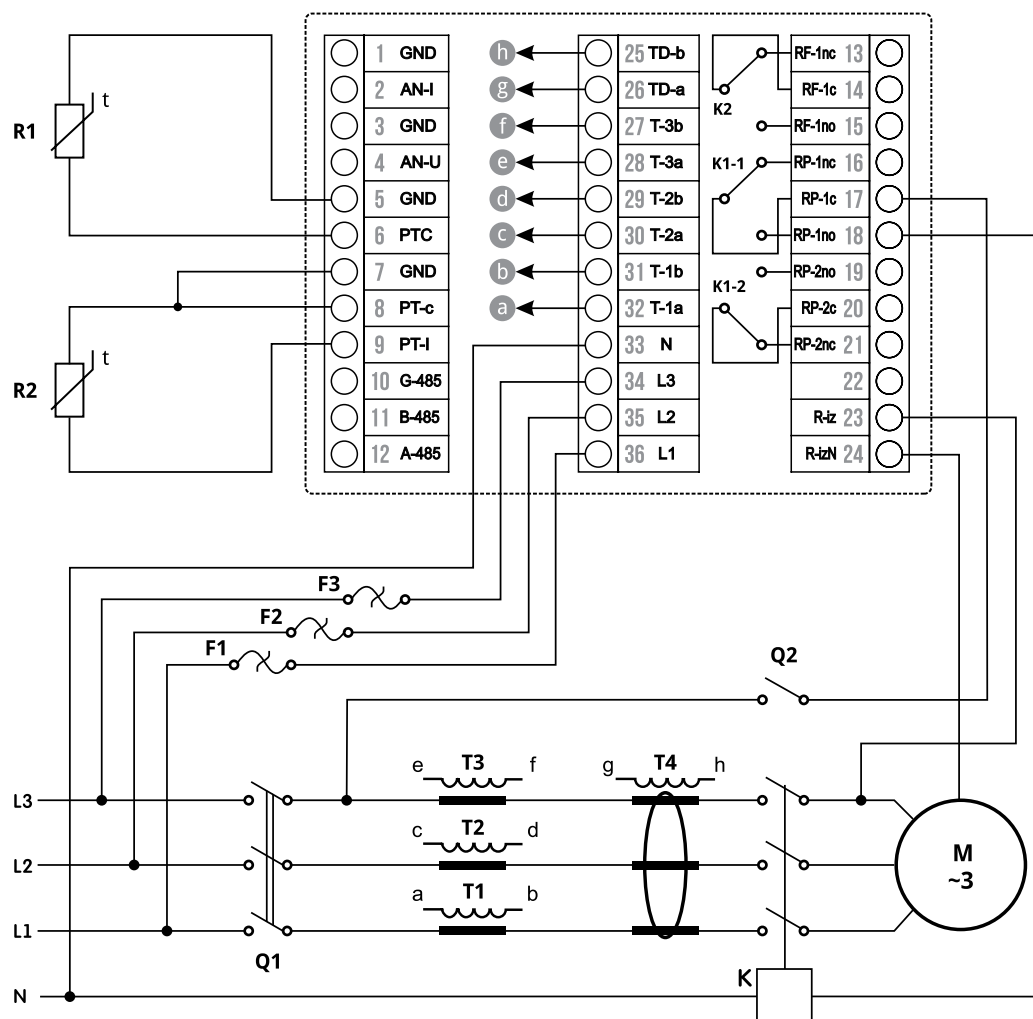
A – UBZ;
F1- F3 – Fusible element for 1 A (or its equivalent);
K – Magnetic starter (MS);
R1 – Temperature transmitter (for example: PTC1000, EKS111 made by DANFOSS);

R2 – Temperature transmitter (for example: PT100);
Q1, Q2 – automatic breaker;
T1-T3 – Current transformer (output 5 A);
T4 – Differential transformer.

Figure 2 – UBZ-304 Connection Diagram

UBZ OPERATION FOR MOTOR CONTROL WITH WINDING CHANGEOVER WHEN STAR-TO-DELTA STARTING

For operation of UBZ-304 for motor with windings changeover when star-to-delta starting to connect the unit according to figure 3
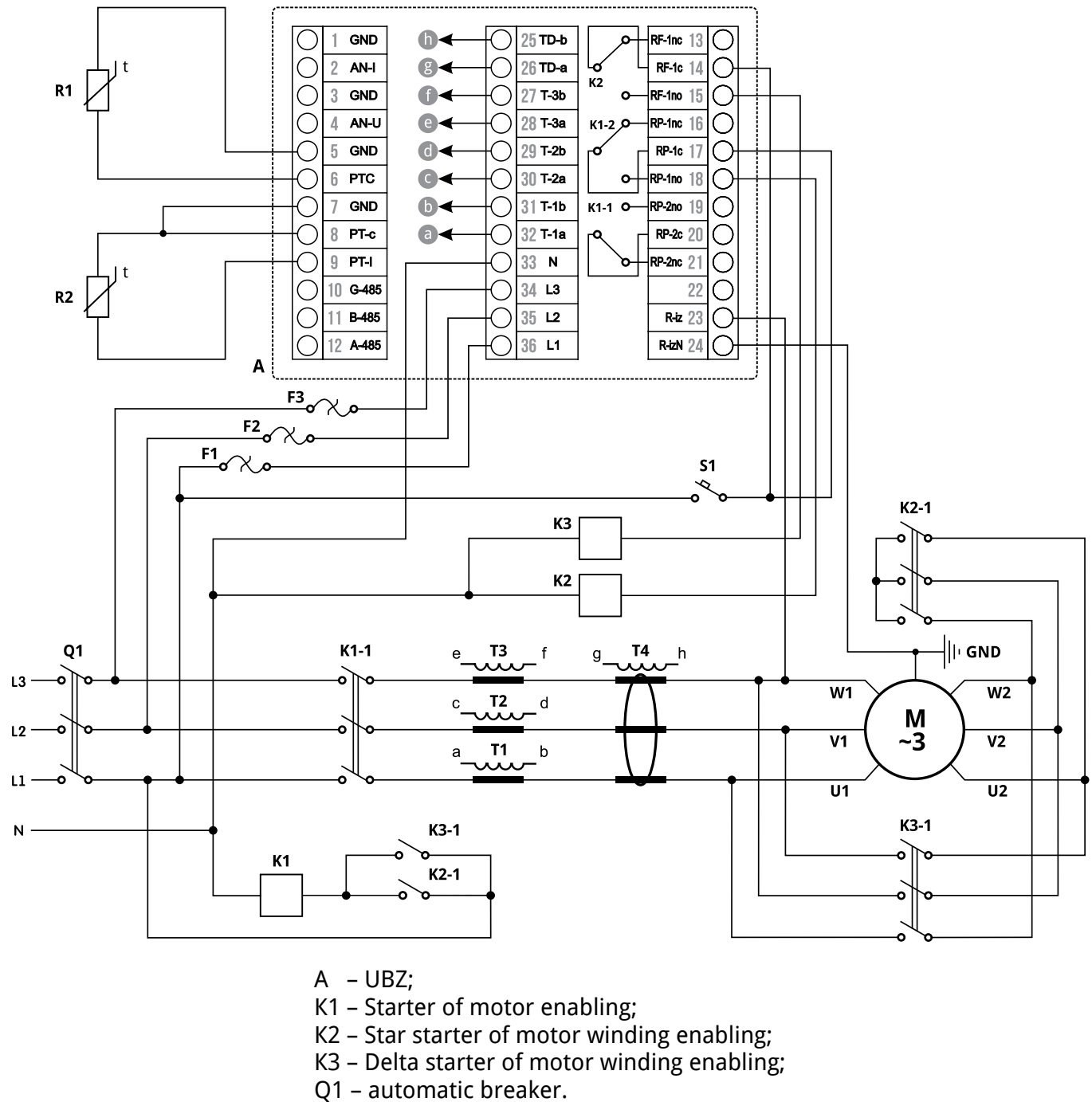

A – UBZ;
K1 – Starter of motor enabling;
K2 – Star starter of motor winding enabling;
K3 – Delta starter of motor winding enabling;
Q1 – automatic breaker.

Figure 3 – Diagram for UBZ enabling for the motor operation with star-delta switching over and the motor insulation control

When UBZ is in the star-delta mode it is allowed performing the motor control in the following ways:
–   the motor disabling/enabling using the external automatic starter (actuator) at the same time with the de-energizing/energizing the UBZ unit;
–   motor control on the front panel of UBZ;
–   motor control via RS-232/RS-485 interface.

UNIVERSAL MOTOR PROTECTION UNIT
UBZ-305
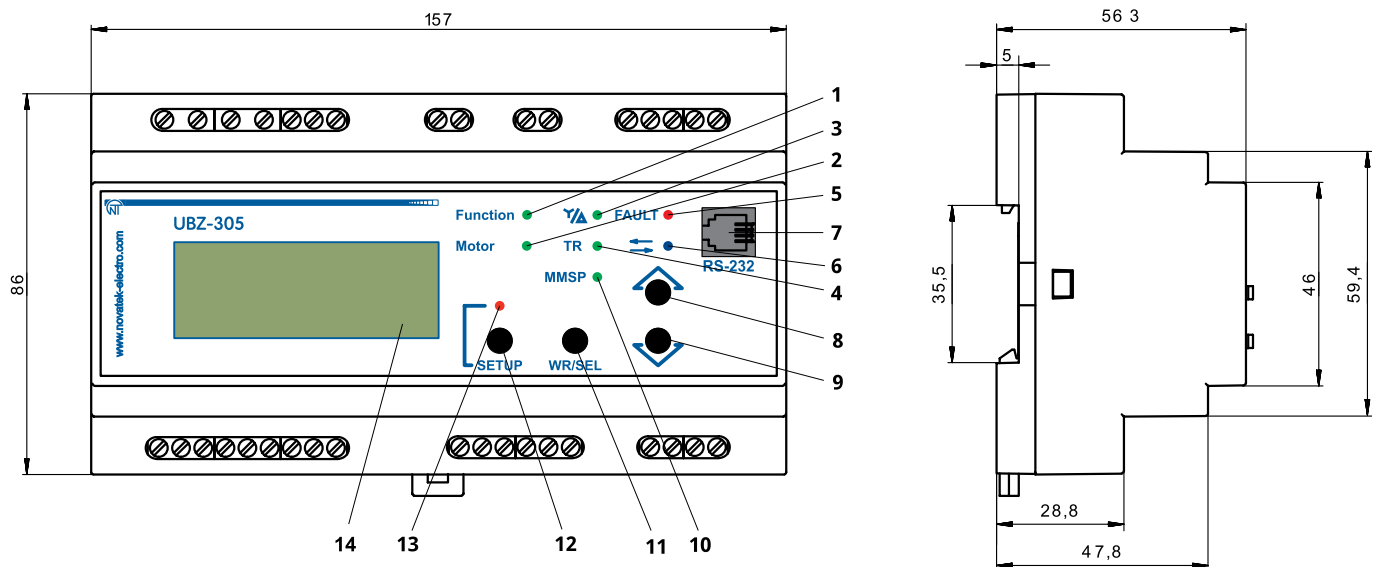
1 – Green LED **«Function»** is on when functional relay is on;

2 – Green LED **«Motor»**:
- is on when load relay is enabled;
- flashes if UBZ is within hysteresis band when controlling using analog inputs;

3 – Green LED **«⋏/△»** is on when UBZ functional relay operates in start-delta mode (it.2.5.3);

4 – Green LED **«TR»** is on when UBZ functional relay operates in time-delay relay mode;

5 – Red LED **«FAULT»**:
- when load relay is off: it is on when UBZ is in fault conditions (it flashes if after fault ARS is expected);
- when load relay is on: it flashes when the motor is in conditions of over-current or thermal overload but relay off time has not come yet;

6 – Blue LED **«⇆»** is on when data exchange with PC occurs;

7 – Connector for UBZ to a PC via RS-232;

8 – Button △(**UP**) is scrolling of displayed parameters in the parameter view mode and scrolling of the menu in the parameters setting mode;

9 – Button ▽(**DOWN**) is scrolling of displayed parameters in the parameter view mode and scrolling of the menu in the parameters setting mode;

10 – Green LED «**MMSP**» is on when the relay is in MNS mode;

11 – Button «**WR/SEL**» is the parameters recording in the setting mode, switching over the group of displayed parameters in the view mode, reset;

12 – Button «**SETUP**» turns on the parameters setting mode;

13 – Red LED «**SETUP**» is on when UBZ is in the mode of parameters setting;

14 – LCD.

Figure 1. – Overall Dimensions end controls of UBZ

UBZ is designed for protection of induction motors with power of 2.5 to 315 kW in case of using the external standard current transformers with 5A output current.

UBZ can be operated in networks both with insulated and dead grounded neutral.

The unit is of DIN rail design version.

UBZ provides continuous monitoring of mains voltage parameters, current values of the phase (line) currents of three-phase electrical equipment for 380V, 50Hz, and checking the resistance values of motor insulation.

UBZ provides protection of electrical motors in case of:
• low-quality network voltage (unacceptable power surges, phase failure, incorrect phase sequence and phase «coincidence», the imbalance of phase/line voltages, the reduction in the network frequency lower than the set one and (or) the increase of network frequency higher than the set value);
• mechanical overloads (symmetrical overload in phase/line currents);
• the threshold crossing of the negative-sequence current;
• unbalance of phase currents without overload associated with the insulation fault inside motor and/or the power cable (the comparison of current unbalance factor according to inverse sequence with voltage unbalance factor according to inverse sequence);
• the torque failure on the motor shaft («dry running» for pumps) – protection based on the minimum starting and/or operating current;
• motor delayed start or rotor blocking;
• extremely low isolation between the stator and the motor housing (pre-startup check);
• ground fault of the stator winding during operation – ground leakage current protection;
• motor thermal overload;
• overheated windings (temperature of windings is determined using the motor built-in temperature transmitters or the temperature of the housing when using the external temperature transmitters).
• For each type of protection, it is possible to have banning and permitting of automatic with load.

UBZ provides for electric equipment protection by means of controlling the coil of the magnetic contactor.

UBZ detects motor currents when load relay is off (when the load relay is off and functional relay is in star-delta mode). In this case, UBZ indicates the fault of external contactor starting the motor until UBZ is turned off or control of motor currents is disabled when load relay is off.

UBZ provides for electric motors control:
• using analog inputs «0-20 mA» and «0-10V»;
• using remote control channels (RS-232 and RS-485 interfaces);
• by buttons on the front panel of UBZ.

Communication
UBZ provides:
• parameters control and transmission by RS-485 interface using MODBUS Protocol,
• parameters control and transmission by RS-232 interface.
Note: Simultaneous use of RS-485 and RS-232 is not possible.

UBZ-304/305 Control Panel program is designed to monitor the status and collect data of the UBZ-305 unit via RS-232 or RS-485 communication interfaces (MODBUS Protocol). The program allows for saving (loading) various UBZ settings, retrieving data and save them for further analysis. Data saved can be viewed in the graphs, comparing the parameters with each other.

Graphic interface of the control panel allows real-time viewing the current status of various UBZ parameters. The flexible adjustment of interface allows adapting to the needs of any user.

Table 1 – General Data   *Basic Technical Specifications*

Description	Value
Application of the unit	Switchgear and control-gear; induction motor protection control;
Design (installation) type	DIN rail 35 mm
Protection level	IP20
Climatic version	UHL 3.1
Operating temperature range*, °C	from minus 20 to +55
Contamination level	II
Overvoltage category	II
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Electric shock protection class	II
Wire cross section for connection to terminals, mm2	0.5-2
Torque for terminal screws, N*m	0.4

*Note: It is allowed UBZ operation at temperatures from minus 35 to minus 20°C; in this case the readings on display can be not available.

Table 2 – Technical Specifications

Description	Value
Operating supply voltage, three-phase	380 V, 50 Hz
Mains frequency, Hz	48-62
Rated current of CT, A	5
(Phase/line) voltage hysteresis, V	10/17
Heat hysteresis, in % of accumulated heat in case of shutdown	33
Determination accuracy of trip threshold for current, not more, in % of rated value	2
Determination accuracy of trip threshold for voltage, not more, V	3
Determination accuracy of out-of-phase voltage, not more, V	3
Voltage when maintaining serviceability:	
- phase voltage, when powered by one phase and zero wire is connected, not less, V	180
- line voltage, when powered by three phases, not more, V	450
Analog inputs: • input to connect temperature transmitter (types: Pt100, Ni100, Ni120); • input to connect temperature transmitter of PTC-1000 type; • three analog inputs for standard CT with 5A output (T-0.66 type or similar); • input to connect differential current transformer (zero sequence transformer); • input to measure current of 0-20 mA; • input to measure voltage of 0–10 V.	
Main outputs: • load relay – two groups of changeover contacts to control the electric motor starter – 8 A, 250 V at cos φ=1; • functional relay – one group of changeover contacts - 16A, 250V at cos φ=1 (function of the relay is set by the user).	
Permit according to temperature of temperature transmitters, °C	1
Power consumption (under load), not more, VA	5.0
Weight, not more, kg	0.34
Overall dimensions (Fig.1.1), H*B*L, mm	91*157*58
Position in space	free
Housing material	self-extinguishing plastic

Table 3 – Characteristics of built-in relay output contacts

Relay	Max. current at U~250V, A	Number of actuations x1000	Max.switching power, VA	Max. continuous boosting AC / DC voltage, V	Max. current at Ucont=30V, A
Functional relay					
Cos φ = 0.4	5	100			
Cos φ = 1.0	16	100	4000	440/300	5
Load relay					
Cos φ = 0.4	2	100			
Cos φ = 1.0	8	100	2000	460	3

UBZ performs the following protection types for electric motors:

- over-current protection in phases;
- ground fault protection (for zero-sequence current);
- for negative-sequence current;
- for exceeding negative-sequence current factor to negative-sequence voltage factor;
- for thermal overload;
- undercurrent protection in phases;
- delayed starting (rotor blocking);
- overheating of windings;
- for minimum line voltage;
- for maximum line voltage;

- for line voltage imbalance (negative sequence voltage protection);
- for improper phase sequence;
- for decreasing of mains frequency lower that setting;
- for increasing of mains frequency higher that setting;
- for minimum insulation resistance of the motor winding;
- for the motor phase loss (protection is operated when the motor current is disabled in one (two) phase).
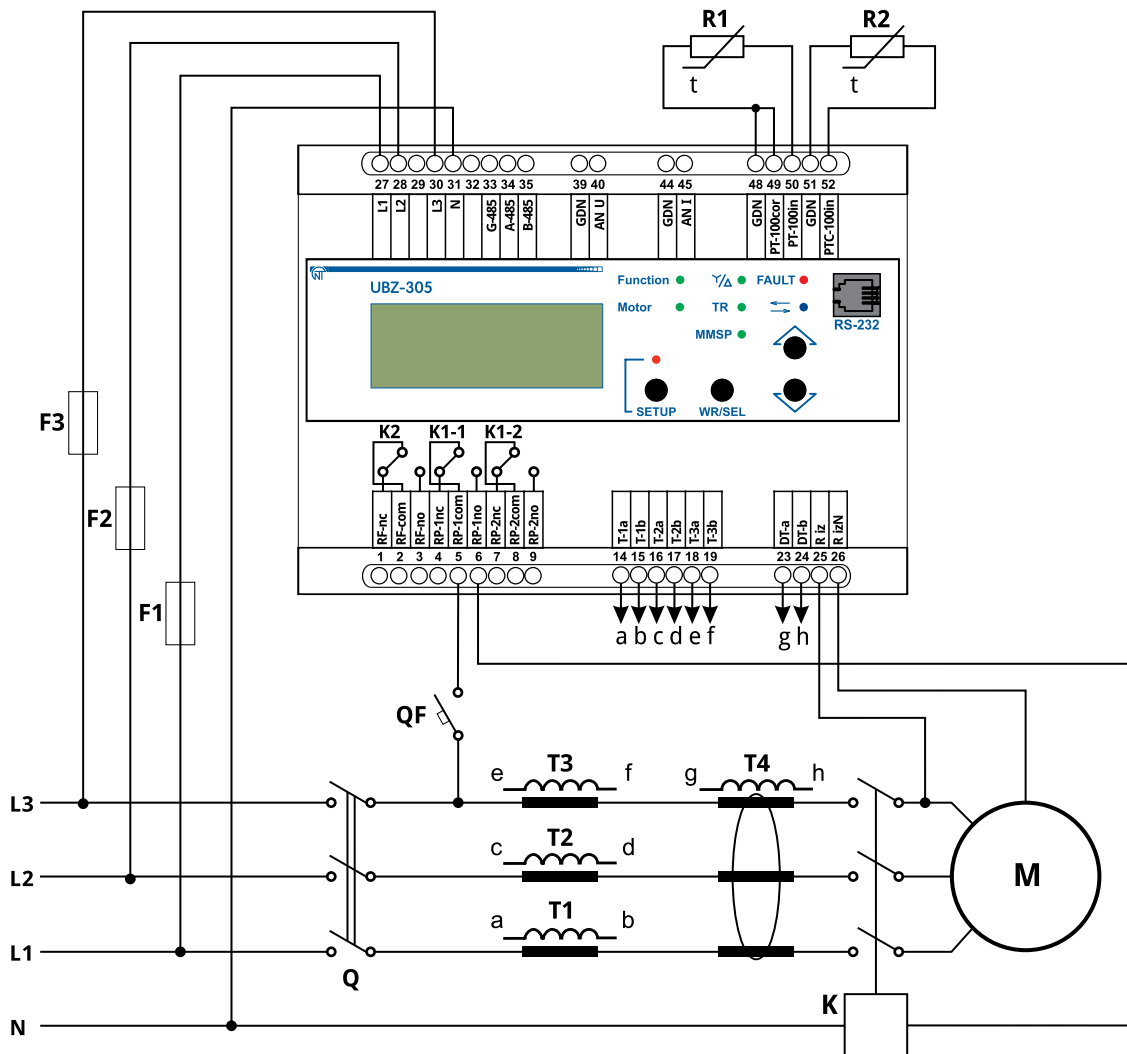

Figure 1. – UBZ Connection Diagram

F1- F3 – Fusible element for 1 A (or its equivalent);
K – Magnetic starter (MS);
R1–Temperature transmitter (for example: PT100);
R2– Temperature transmitter (for example: PTC1000, EKS111 made by DANFOSS);

Q – Circuit breaker;
QF– Circuit breaker at a maximum current of 6.3 A;
T1-T3 – Current transformer (output 5 A);
T4 – Differential transformer.
Fault description

Table 4. – Fault codes

Fault description	Fault mnemonics	Parameter value	Register address of parameter value	Fault code	Register address of faults for N bit
Maximum phase current	I max	Maximum phase current	300	0	901:0
Thermal overload	Thermal over		301	1	901:1
Ground fault (zero sequence current)	Iearth	Zero sequence current	302	2	901:2
Excess ratio of negative sequence current to negative sequence voltage	Coef I/U	Coefficient of negative sequence current *100	303	3	901:3
Negative sequence current	I2 rev	Negative sequence current	304	4	901:4
Minimum phase current	I min		305	5	901:5
Delayed start	LongStart	Current	306	6	901:6
Rotor blocking	Block Rot	Current	307	7	901:7
Upon reaching the temperature threshold of the first transmitter	Temp1	Temperature in degrees	308	8	901:8
Upon reaching the temperature threshold of the second transmitter	Temp2	Temperature in degrees	309	9	901:9
Phase sequence	PhaseSequen		310	10	901:10
External MS (the presence of currents when load relay is disabled)	Contactor	Current	311	11	901:11
At minimum line voltage	U min	Voltage	312	12	901:12
At maximum line voltage	U max	Voltage	313	13	901:13
At phase imbalance	Uimbal	Imbalance	314	14	901:14
Minimum insulation resistance of motor winding	Insul Res	Insulation resistance	315	15	901:15
Mains minimum frequency	F min	Frequency	316	16	902:0
Mains maximum frequency	F max	Frequency	317	17	902:1
Fault of remote control channel	RemoteCont			18	902:2
Motor emergency shutdown without possibility for restart	Stop nAR			19	902:3
Motor emergency shutdown with possibility to restart by simultaneously pressing the buttons UP and DOWN	Stop Motor			20	902:4
s.c. of temperature transmitter 1	ShortTempS1			21	902:5
Breakout of temperature transmitter 1	BreakTempS1			22	902:6
s.c. of temperature transmitter 2	ShortTempS2			23	902:7
Breakout of temperature transmitter 2	BreakTempS2			24	902:8
Loss of phase	Break Phase			25	902:9
EEPROM destruction	Error EEPROM			26	902:10
At analog input «0-20 mA»	Input I		327	27	902:11
At analog input «0-10 V»	Input U		328	28	902:12
Improper calibration	Error CALIB			29	902:13

Notes:
1 – Occurrence of fault as «EEPROM Error» – the destruction of EEPROM indicates that the data of the programmed parameters is damaged. To continue the operation, it is necessary to turn off UBZ and restore the factory settings (5.4.7 – second method).
2 – Occurrence of fault as «Error CALIB» – UBZ improper calibration means that the calibration coefficients of the measured data are damaged. The continued operation of UBZ is impossible. Re-calibration of the device is required to be done at the manufacturer factory.

UBZ OPERATION FOR MOTOR CONTROL WITH WINDING CHANGEOVER
WHEN STAR-TO-DELTA STARTING

When UBZ is in the star-delta mode it is allowed performing the motor control in the following ways:

– the motor disabling/enabling using the external automatic starter (actuator) at the same time with the de-energizing/energizing the UBZ unit;

– motor control on the front panel of UBZ;

– motor control via RS-232/RS-485 interface. It is strictly forbidden to shutdown the motor by external machine (the starter) without UBZ de-energizing. As an exception, it is allowed after the motor is switched off by external machine (the starter), additionally to turn off the motor on UBZ front panel or via RS-232/RS-485 interface to avoid the direct delta starting.
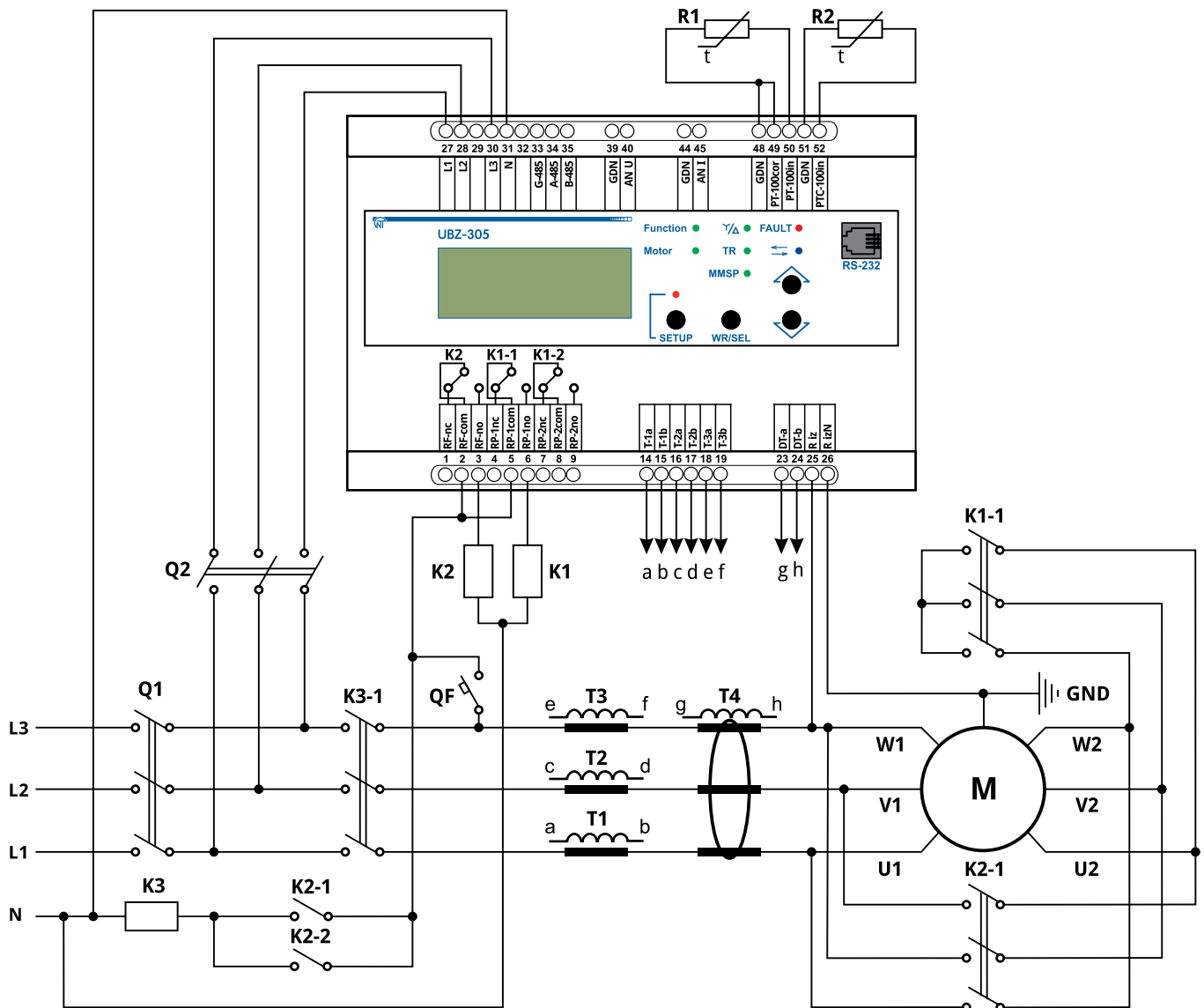
K1 – Star starter of motor winding enabling;
K2 – Delta starter of motor winding enabling;
K3 – Starter of motor enabling;
Q1, Q2, QF – Circuit breaker.

*Figure B. – Diagram for UBZ enabling for the motor operation
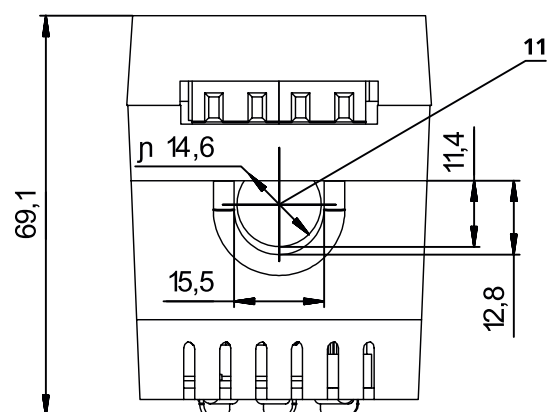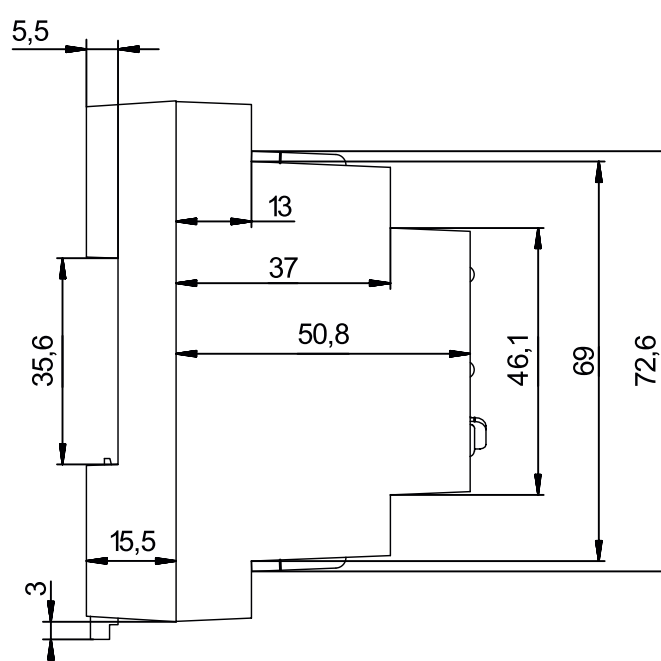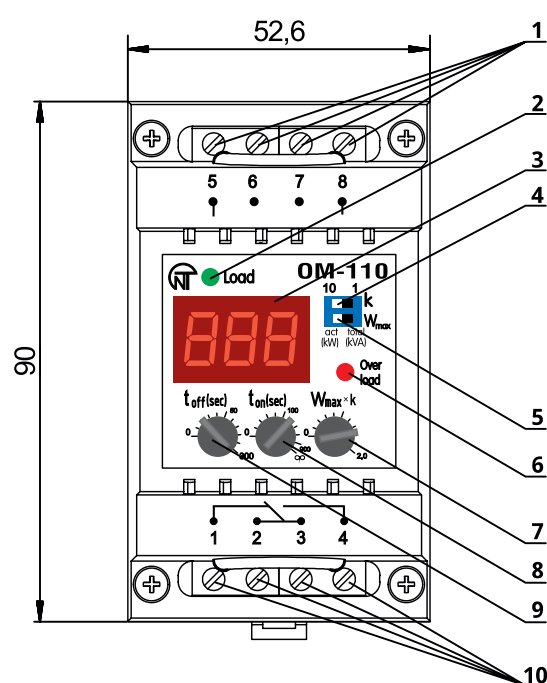with star-delta switching over and the motor insulation control*

Section 6

CURRENT RELAYS AND POWER LIMITERS

SINGLE PHASE POWER LIMITER

OM-110

1. Input terminals
2. LOAD LED indicator
3. Digital LED indicator for measured and controlled parameters
4. Multiply factor switch k (1/10) which sets the range for the knob "maximal power capacity" 0-20kW (kVA) or 0-1.75kW (kVA).
5. Mode selection switch – active power limiting// total power limiting
6. Overload LED indicator
7. Adjustment knob – Maximal power threshold – Wmax*k
8. Autoreclosing time delay (ton) – adjustment knob
9. Tripping time delay (toff) – adjustment knob
10. Output terminals ~250V AC, 8A (terminals of load control relay)
11. Hole of integrated current transformer

Figure 1 – Front panel and main knobs and controls.

Single phase power limiter OM-110 (hereinafter OM-110) is designed for the continuous control over active or total power capacity for the single-phase loads. Measured range is from 0 to 20 kVA.

The function of OM-110 is to cut off the power load in case of exceeding the preset threshold for maximal level of permitted power load consumed by the user (with user defined time delay) and automatic auto-reclosing with adjusted time delay or prohibited restart.

At load power up to 1.75 kVA, the power is connected directly through OM-110. If load power exceeds 1.75 kVA (but no more than 20 kVA), the power is connected through magnetic starter (MS) of the corresponding power (the magnetic starter is not included in the set).

User sets the threshold values for power, tripping time delay and auto-reclosing time delay using the knobs and DIP switches on the front panel of the OM-110.

Device can be applied as:
• Digital wattmeter (to measure active or total power capacity);
• Relay which limits the consumed power as per the user defined settings;
• Load priority relay.

OM-110 allows to control the level of power consumption and the state of the load with help of LED indicators located on the front panel. OM-110 doesn't require any additional power supply sources and is powered by the controlled circuit from the input terminals.

Table 1 - Technical Specifications

Purpose of device	Control and distribution
Rated power supply voltage, V	230/240
Typical operation	Continued
Rated voltage frequency, Hz	47– 53
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Measurement range of power, kW (kVA)	0– 20,0
Power measurement accuracy is not less than	2.5%
Adjustable range for setting maximal power	
a) k=1; Wmax, kW(kVA)	0– 1.075
Absolute deviation for power measurement not more than, kW (kVA)	±0,05
b) k=10; Wmax, kW(kVA)	0– 20
Absolute deviation for current measurement not more than, kW, kVA	±0,5
Adjustable time range for autoreclosing time delay - ton, sec	0– 900, ∞
Adjustable time range for tripping time delay – toff, sec	0– 300
Readiness time after turn ON, not more than, sec*	0,8
Maximal commutation current on the output terminals, A, not less	8
Minimum voltage when safe operating (effective value), V **	130
Maximal voltage when safe operating (effective value), V	300
Maximum permissible voltage, V,	400
Protection degree: - device	IP40
- terminal block	IP10
Index protection of electrical shock	II
Permissible degree of pollution	II
Overvoltage category	II
Nominal voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Power consumption (when load is disconnected), kW	to 3.5
Commutation lifetime for the output contacts:	
- under the load of 8A, not less than	100 000
- under the load of 1A, not less than	1 000 000
Torque for terminal screws, N*m	0.4
Weight, kg, not more than	0.200
Dimensions (3 way standard DIN module thickness for DIN rail mounting), mm	90 x 52,6 x 69,1
Positioning - free	
The wire cross section of connecting terminals is 0.5 - 2.0 mm2	
Mounting to standard 35 mm DIN-rail	

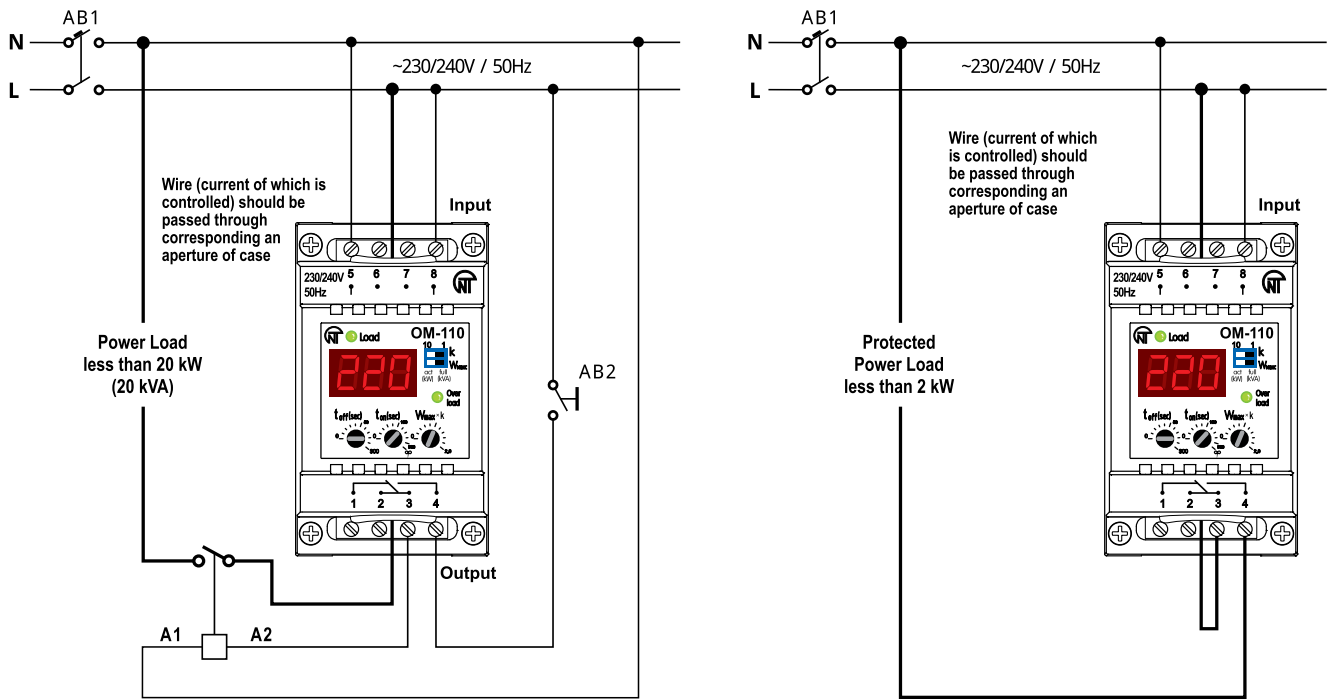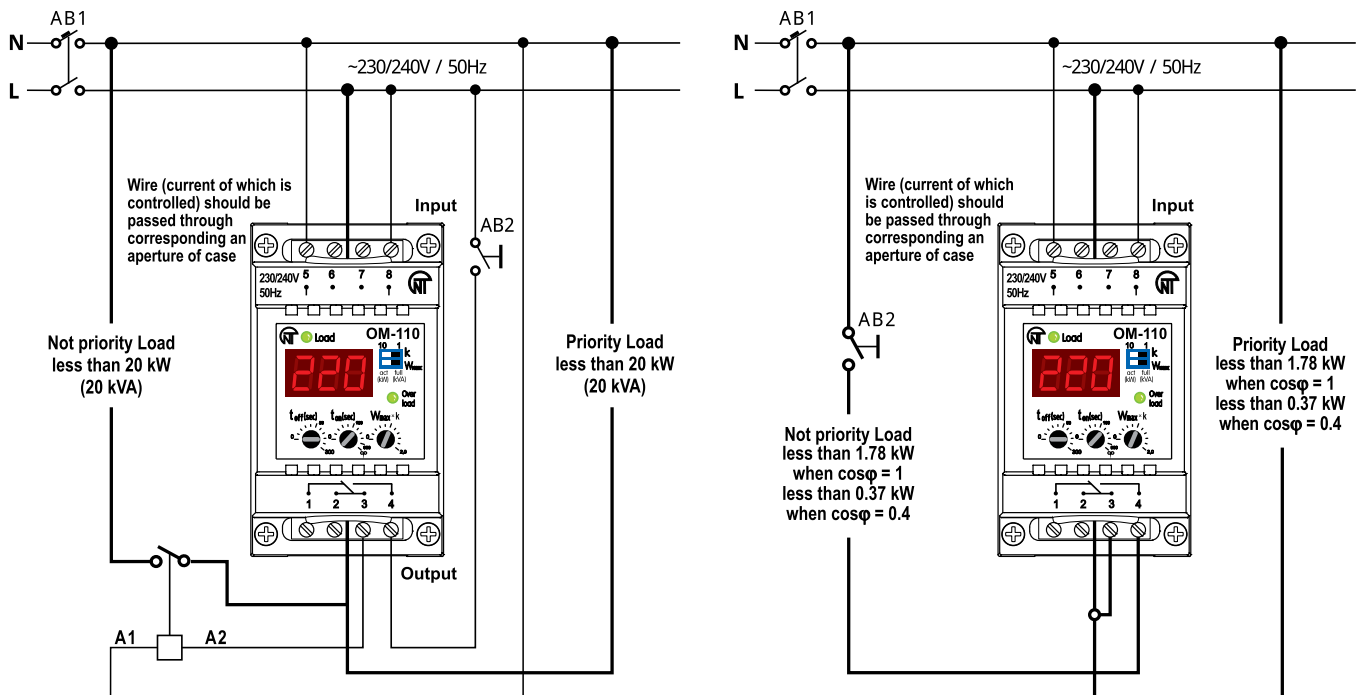*Figure 2. – Wiring diagram for OM-110*

*Figure 3. – Wiring diagram for OM-110 as the load priority relay*

Note – AB1 as the main circuit breaker should be installed for operating current not exceeding 8 A at load power up to 1.75 kW. When load power up to 20 kW, AB1 should be installed for current no more than 100 A. AB2 is circuit breaker for non-priority load, it protects both the load and OM-110 against short-circuit (SC).

POWER LIMITING RELAY WITH VOLTAGE AND CURRENT MONITORING OM-163

The device meets the requirements of the following:

•   IEC 60947-1, Low-voltage switchgear and control-gear; Part 1; General rules;

•   IEC 60947-6-2, Low-voltage switchgear and control-gear; Part 6-2; Multiple function equipment; Control and protective switching devices;

•   CISPR 11, Electromagnetic compatibility; Industrial, scientific and medical RF equipment; Electromagnetic interference characteristics; Limits and methods of measurements;

•   IEC 61000-4-2, Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test.

Harmful substances in amounts exceeding maximum permissible concentrations are not available.
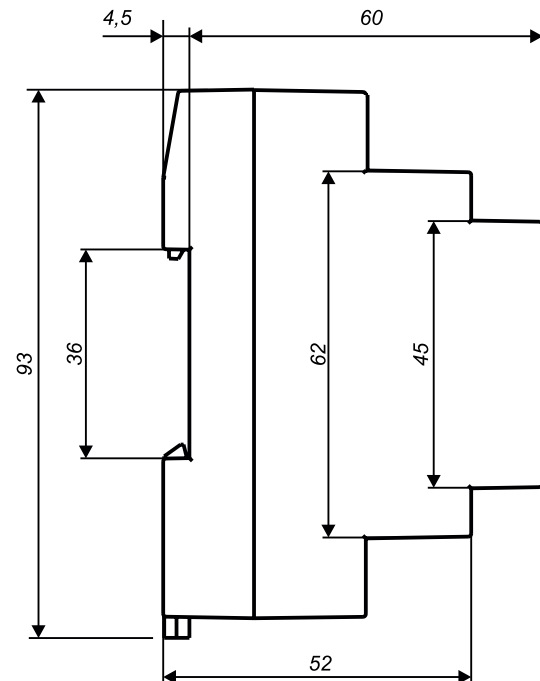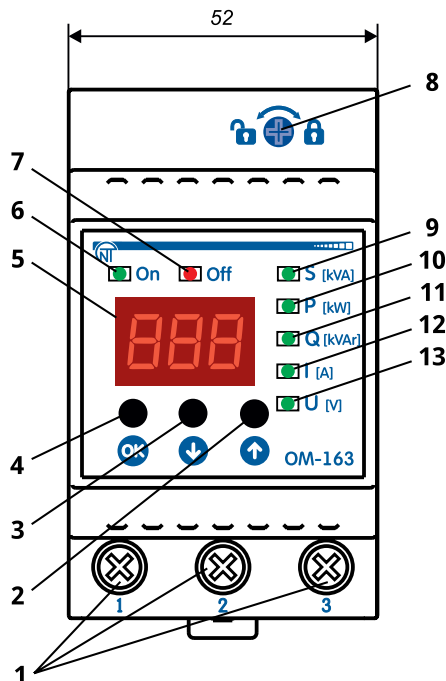
1 –   terminals for connecting the device;
2 –   button (UP) serves for navigation in the menu;
3 –   button (DOWN) serves for navigation in the menu;
4 –   button OK is used to enter the menu;
5 –   seven-segment three-digit display (hereinafter referred to as the display);
6 –   green LED On: it is on when the load relay is closed; it does not light up when the load relay is off; it flashes when the load off-delay time is counted;
7 –   red LED Off: it is on when the device is operated in the Fault condition; it flashes when the load off-delay time is counted;

8 –   switch for write protection;
9 –   green LED S [kVA] is on when the display shows the total power value;
10 – green LED P [kW] is on when the display shows the active power value;
11 – green LED Q [kVAr] is on when the display shows the reactive power value;
12 – green LED I [A] is on when the display shows the actual value of load current;
13 – green LED U [V] is on when the display shows the value of the mains voltage.

Figure 1. – Controls and overall dimensions of OM-163

OM-163 is designed to protect (disconnect) the equipment connected to it in the following cases:
- exceeding the threshold value of the controlled parameter;
- deviation of the mains voltage from the set values;
- excess of the temperature of the contact group (85 °C).

OM-163 opens contacts 1 - 3, if the controlled parameter exceeds the limits set by the user.

The user sets the maximum power, off-delay time and AR time using the buttons (it. 2, 3, 4, Fig. 1).

OM-163 can be used as:
- power consumption limiting relay;
- overcurrent relay;
- voltage monitoring relay;
- digital multi-meter (indication of total, active, reactive power, current consumption and mains voltage).

OM-163 is powered by the circuit that feeds the load.

OM-163 displays the value of the parameters and the status of the relay using indicators.

Table 1. – The ranges of measured and controlled parameters

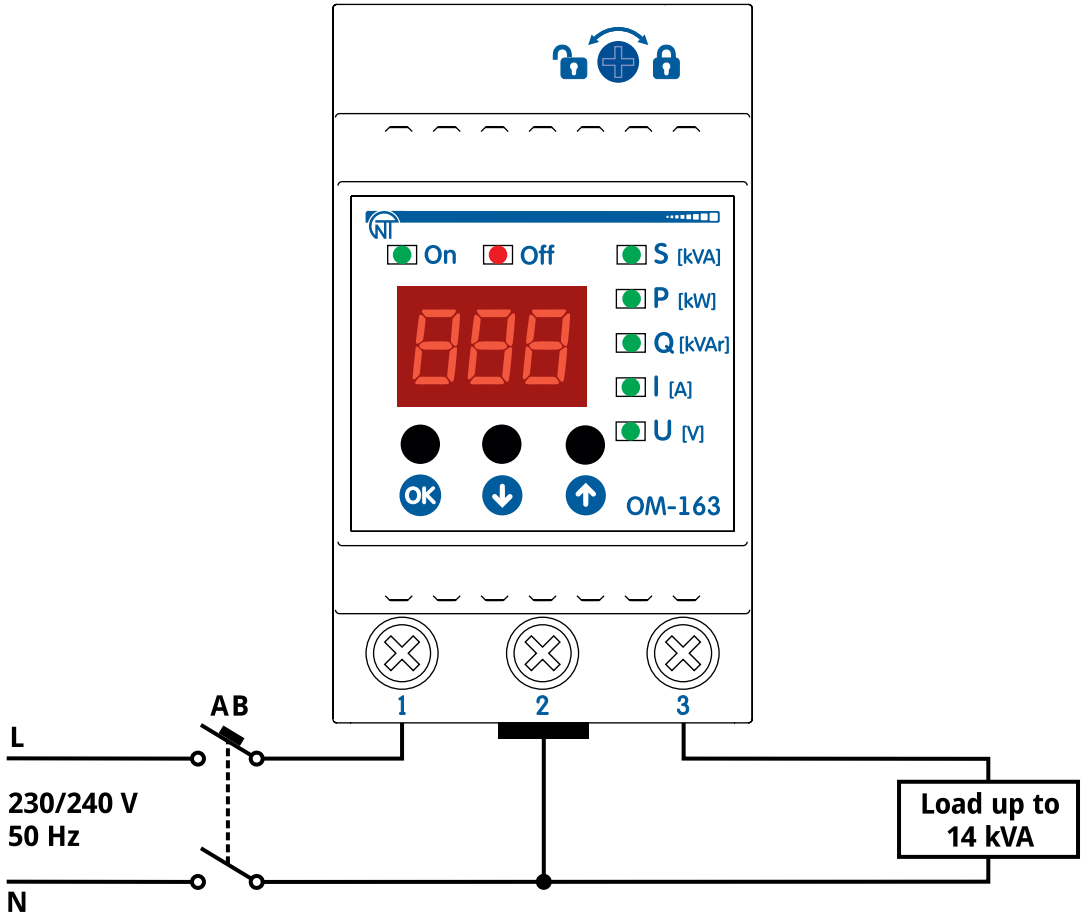| Description	Controlled range	Measured range
Total power, kVA	1 – 14	0 – 14
Active power, kW	1 – 14	0 – 14
Reactive power, kVAr	1 – 14	0 – 14
Load current, A	1 – 63	0.5 – 63
Input voltage, V	160 – 280	120 – 350

Figure 2. – Device connection diagram

Table 2. – The Basic Technical Specifications

Description	Value
AC single-phase operating supply voltage, V	230/240
Mains frequency, Hz	47 – 65
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Accuracy of total power measurement, min., %	5
Accuracy of active power measurement, min., %	5
Accuracy of reactive power measurement, min., %	5
Accuracy of current measurement, min., %	2.5
Accuracy of voltage measurement in the range of 120 – 350 V, min., %	2
On-delay, min	1 – 600
Off-delay, s	1 – 300
Voltage on-delay, s	1 – 900
Readiness time, max, s	0.8
Maximum switched current with active load, A	63
Power consumption when load is not connected, max., W	3
Maximum voltage when maintaining serviceability (effective value), V	450
Minimum voltage when maintaining serviceability (effective value), V	130
Fixed off-delay due to Umax, s	1
Fixed off-delay due to Umin, s	12
Fixed time of response in case of voltage spike of more than 450 V and pulse duration reaching more than 1.5 ms, max., s	0.05
Fixed time of response when voltage reducing more than 60 V of set point for Umin or when voltage reducing less than 145 V, s	0.12
Fixed time of response in case of voltage spike of more than 30 V of set point for Umax or in case of voltage spike of more than 285 V, s	0.12
Accuracy of determination of the voltage operation threshold, V	3
Hysteresis of voltage, V	5
Rated operating condition	Continuous
Protection class rating of the device	IP10
Electric shock protection class	II
Climatic design version	UHL 3.1
Permissible contamination level	II
Overvoltage category	II
Conductor cross-section for connecting to terminals, mm²	0.5 – 16.0
Tightening torque of the terminal screws, N*m	2±0.2
Weight, max., kg	0.2
Overall dimensions, HxBxL, mm	93x52x64.5
Installation is on standard 35 mm DIN-rail	
The device remains operational capability in any position in space	
Housing material - self-extinguishing plastic	

If the mains voltage is less than 120 V and more than 350 V, the voltage value measured by the device is not correct.

Table 3 – Relay Output Contacts Specifications

Description	Value
Max. current at voltage of ~220 V (cos φ = 1), A	63
Max. power when contacts are closed, kVA	14
Max. switching power (cos φ = 0.4), kVA	1.4
Max. permissible AC voltage, V	250
Service life:	
− mechanical, min., time;	500 thousand
− electrical, min., time;	10 thousand

DEMAND CONTROLLER WITH OVER CURRENT, EARTH FAULT AND VOLTAGE MONITORING

OM-310

OM-310 power limiter is designed for the following applications:
- load protection at poor parameters of the mains (over & under voltage, phase loss, imbalance, sequence);
- over current protection (mechanical overloads, SIT, VIT (LTI), EIT, UIT, RI selectable);
- earth leakage protection (earth fault detection through CB CT provided with device);
- complete load cutoff in case if watts input exceeds the main threshold within the user-set time period;
- partial load cutoff in case if watts input exceeds the additional threshold within the user-set time period;
- measurement and indication of 3-phase electric circuit (delta voltage and mesh voltage RMS values; positive phase, negative phase and zero phase sequence voltages; phase currents RMS values; input wattage of active power, reactive power, apparent/total power, power factor (cos φ);
- fault warning;
- remote load on and off via RS-232/RS-485 interface or an external emergency button/switch.

OM-310 provides for operation under loads ranging from 2.5 kW to 30 kW with use of integrated current transformers, and up to 350 kW with use of external current transformers, including when in circuits with insulated neutral.

OM-310 device provides the following types of load protection:
- when the mains voltage is of poor quality (impermissible voltage surges, phase loss, incorrect phase sequence and phase «coincidence», phase/line voltage imbalance);

- when maximum specified current in any load phase is exceeded;
- against "ground" leakage currents.
For each separate type of protection, the unit allows to enable or disable automatic load reset (further: AR)

OM-310 provides electric equipment protection by means of a magnetic starter (contactor) coil control.

Using OM-310 the user has possibility to choose functionality of additional relay and use it for following operations:
- signalization emergency situations
- contactor connection of additional loading
- as time relay
- signalization of reactive power excess
- signalization of active power excess

Communication
OM-310 provides for:
- control and parameters transfer via RS-485 interface according to MODBUS protocol;
- control and parameters transfer via RS-232 interface.

Interfacing of PC and OM-310 is possible via «OM-310 Control Panel" Software.

OM-310 Control Panel software is dedicated for monitoring status and retrieving data from OM-310 devices via standard communication interface (RS-232 or RS-485). The Software allows for saving (loading) various OM-310 settings, retrieving data and saving them for further research. The user can view saved data in a graph, while comparing parameters.
The CP graphic environment allows for real-time viewing the current status of various OM-310 parameters.
The flexible interface design allows tuning it to any user's preferences.

Table 1. – General Data   *Basic Technical Specifications*

Description	Value
Purpose of device	Control and distribution equipment.
Assembly (mounting) type	Assembly (mounting) type
Enclosure protection degree	IP10
Climate zone version	NC3.1
Pollution degree	III
Overvoltage category	III
Wires cross section of adapters on terminals, mm2	0.5-2
Torque of terminal screws, Nm	0.4
The maximum diameter of a wire when using internal current transformers, sq.mm	12

Table 2. – Technical Specifications

Description	Value
Rated supply voltage: AC Three-phase, V, 50Hz	380 - 415
Mains frequency, Hz	48-62
Rated load wattage range (during operation with use of integrated current transformers), kW	3-30
Tripping threshold accuracy for wattage, % of rated wattage, at most	5
Tripping threshold accuracy for current, % of rated current, at most	2
Tripping threshold accuracy for voltage, V, at most	3
Phase imbalance detection accuracy for voltage, V, at most	3
Minimum operational voltage:	
single-phase voltage power supply when one phase and neutral wires are connected, V, not less	180
three-phase power supply voltage, V, at most	450
Analog inputs	
remote switch connection input	
three analog inputs for connecting standard CT with 5A output (of T-0.66 type or similar)	
input for connecting differential current transformer (zero sequence transformer)	
Main outputs	
load relay – two groups of changeover contacts -8A 250V cos φ=1;	
characterizing relay – one group of changeover contacts -16A 250V at cos φ=1	
(the relay function is assigned by the user);	
Power consumption (under load), VA, at most	5.0
Weight, kg, at most	0.5
Case dimensions - nine S-type modules	
Mounting onto standard 35 mm DIN-rail (Mounting position any)	

Table 2. – Characterizing output terminals of relays

Relay	Max. current at U~250V, A	Number of actuations x1000	Max.switching power, VA	Max. continuous boosting AC / DC voltage, V	Max. current at Ucont=30V, A
Load relay Cos φ = 0.4 Cos φ = 1.0	2 8	200 100	500 2000	440/125	1.3
Characterizing relay Cos φ = 0.4 Cos φ = 1.0	5 16	400 50	1250 4000	440/125	3

OM-310 complies with requirements IEC 60947-1, IEC 60947-6-2, CISPR 11, IEC 61000-4-2.
No harmful substances in excess of the maximum permissible concentration is available.

Protection functions
OM-310 device provides the following types of load protection:

- maximum phase current;
- against line-to-earth fault (based on zero sequence current):
- for minimum line voltage;
- for maximum line voltage;

- for line voltages imbalance (negative sequence voltages);
- for phase sequence order;
- starter unit operability control.

EQUIPMENT FEATURES AND OPERATION

OM-310 is a microcontroller-based digital device that provides a high degree of reliability and accuracy. The device doesn't need any auxiliary supply: it's self-powered by the voltage to be monitored.

OM-310 device is equipped with three built-in CTs, through which power phase mains are passed/conducted.

OM-310 has five control modes:
- keyboard lock level;
- mode with minimal number of setting parameters (further on referred to as MMSP);
- user level;
- service engineer level;
- remote control.
- In all operation modes the following features are available:
- viewing measured and displayed parameters. Scrolling through parameters list is performed by DOWN and UP buttons;
- faults log view.
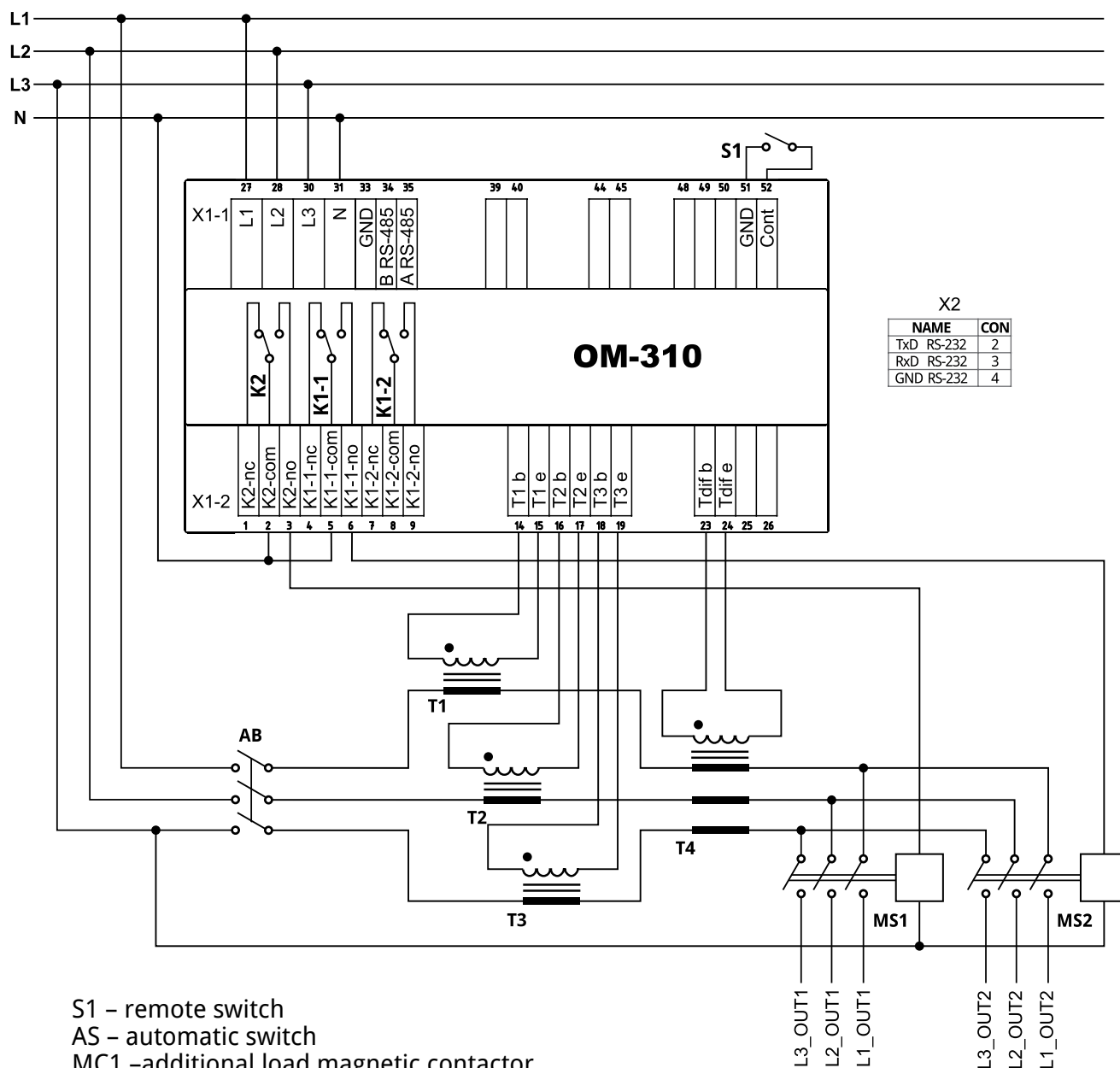
S1 – remote switch
AS – automatic switch
MC1 –additional load magnetic contactor
MC2 – main load magnetic contactor
K1 relay – load relay
K2 relay – characterizing relay
T1-T3 –external CTs
T4 – differential current transformer.

Figure 1. - OM-310 connection schematic with use of external CTs and at ⌐⌐5*= 2*
(characterizing relay operation in the mode of controlling additional load)

OVER CURRENT RELAY
RMT-101
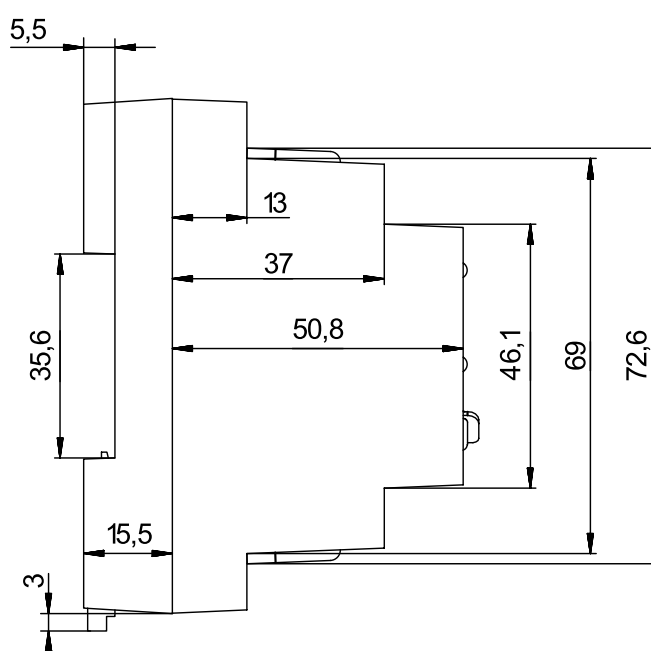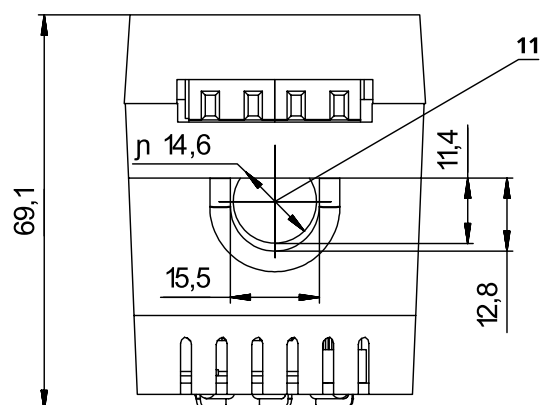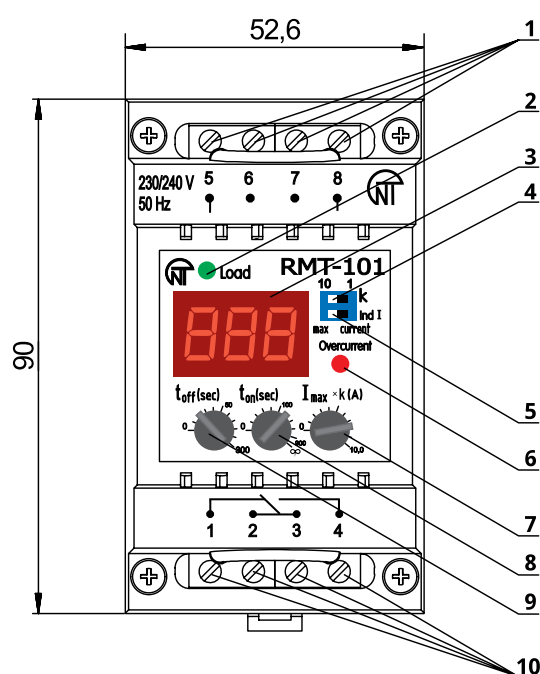
1. Power input of RMT-101
2. "Load" LED
3. Digital Indicator for measurable and controlled parameters
4. Range switch of 10/100A adjuster k –«10 /1» (overcurrent adjustment «Imax*k»)
5. Toggle for switch of indication modes ("current (now)"/ "max (current)"
6. "Overcurrent" LED indicator
7. Adjustment knob for overcurrent sitting – Imax*k
8. Adjustment knob for load reclosing delay setting – ton
9. Adjustment knob for power-cut delay setting – toff
10. Outputs of load-control relay
11. Socket of Built-in current transformer

Figure 1 - Front panel controls and dimensions diagram of RMT-101

RMT-101 designed to permanent control of active value current of single-phase load in 0 to 10A or in 0 to 100A ranges, and to turn OFF it in case of excess of user adjusted maximum allowed load current (with independent time lag) with preset cut-OFF time and subsequent automatic insertion with preset turn-ON time or with block of reclosing.

Current setting, reaction time of relay and auto-reclosing time are adjusted by user using potentiometers on the front panel of RMT-101.

RMT-101 can be used as:
- digital ammeter;
- limit relay input current;
- selection relay (to select of priority load).

In RMT-101 for current measuring it uses built-in current transformer. RMT-101 allows controlling current values and condition of load per LED indicators on the front panel.

No harmful substances in excess of the maximum permissible concentration is available.

RMT-101 complies with requirements of:
IEC 60947-1; IEC 60947-6-2; IEC 61000-4-2; CISPR 11:2004, IDT

Table 1. – General Data *Basic Technical Specifications*

Description	Value
Purpose of device	Control and distribution equipment.
Typical operation	Continued
Protection degree: - device	IP40
- terminal block	IP10
Index protection of electrical shock	II
Permissible degree of pollution	II
Overvoltage category	II
Nominal voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5

Table 2. – Technical Specifications

| Description	Value
Operation supply voltage, V	230/240
Power frequency , Hz	47 – 53
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 50160:2010
Current measurement range, A	0-100
Measurement inaccuracy, no worse than	1%
Adjustment range	
a) k=1; Imax, A	0 – 10
absolute measurement accuracy of current, A, no more than	±0,1
б) k=10; Imax, A	0-99.9
absolute measurement accuracy of current, A, no more than	±1
Adjustment range of ton, sec	0 – 900, ∞
Adjustment range of toff, sec	0 – 300
Readiness time, sec, no more than *	0.8
Commutation overcurrent of the output contacts, A, not less	8
Minimum voltage when safe operating (effective value), V **	130
Maximal voltage when safe operating (effective value), V	300
Maximum allowable start voltage, V, no more than	400
Torque for terminal screws, N*m	0.4
Commutation life of the output contacts:	
- under 8A power load, times, no less then	100 000
- under 1A power load, times, no less then	1 000 000
Weight , kg, no more than	0.200
Outer dimensions, 3 S-modules for 35mm DIN-rail	See fig.1
Mounting to standard 35 mm DIN-rail	
Positioning	Free
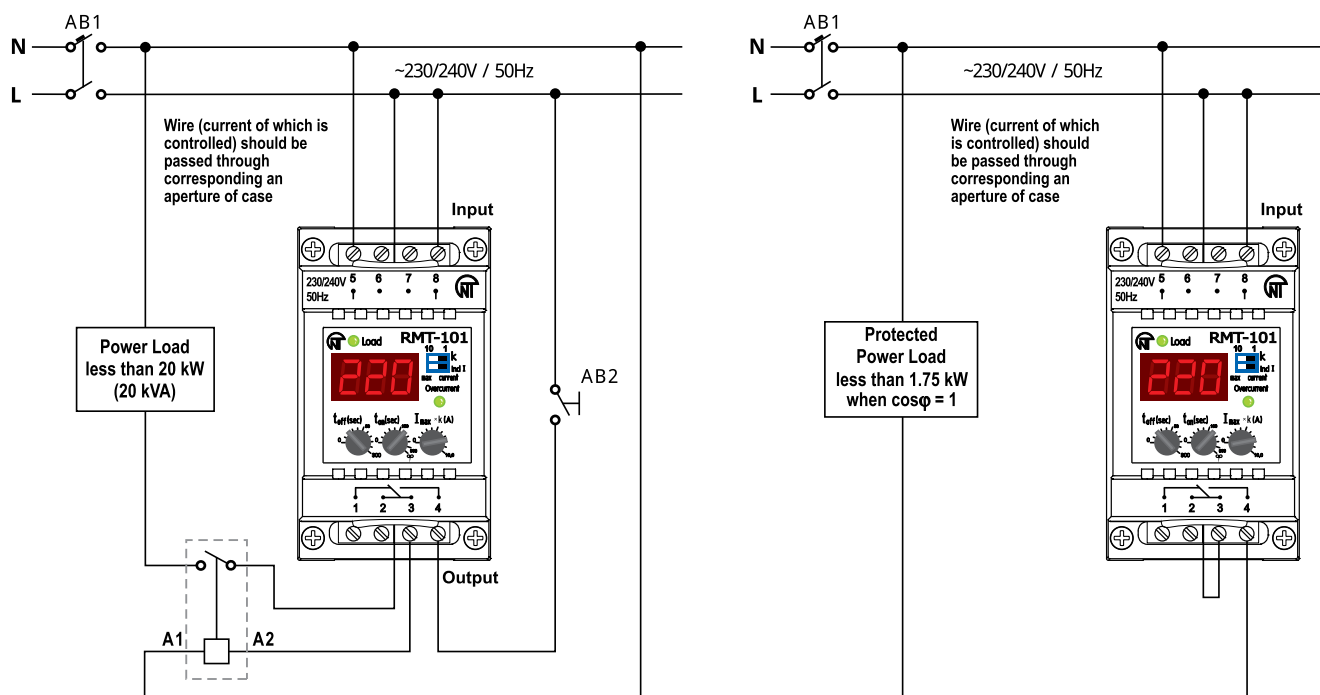
Figure 2 - Wiring diagram
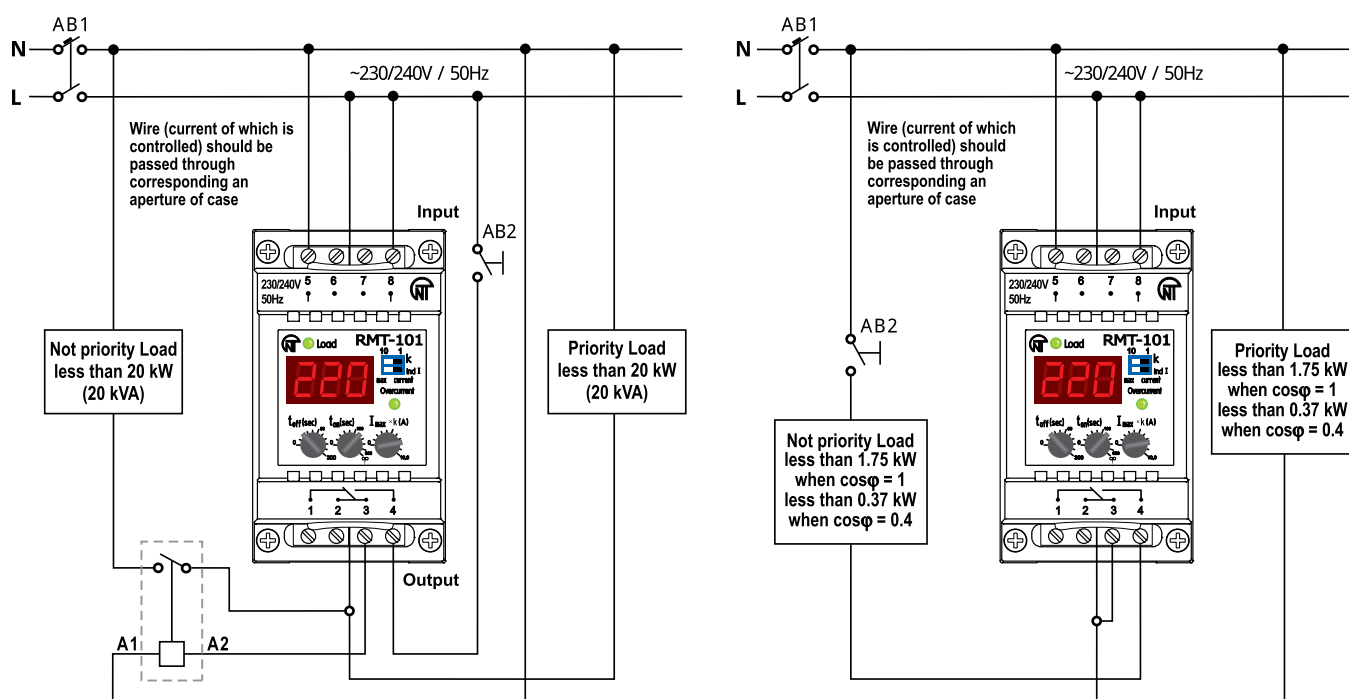
Note:

AB1 – Fusible element (or its equivalent) is not more 8A, when power of load less than 1,75 kW; When power of load less than 20 kW - fusible element isn't more 100 A.

AB2 – circuit breaker for non-priority loading it protects both loading and RMT-101 from the short circuit.

*Figure 3 - Wiring diagram RMT-101as a priority load selection relay*
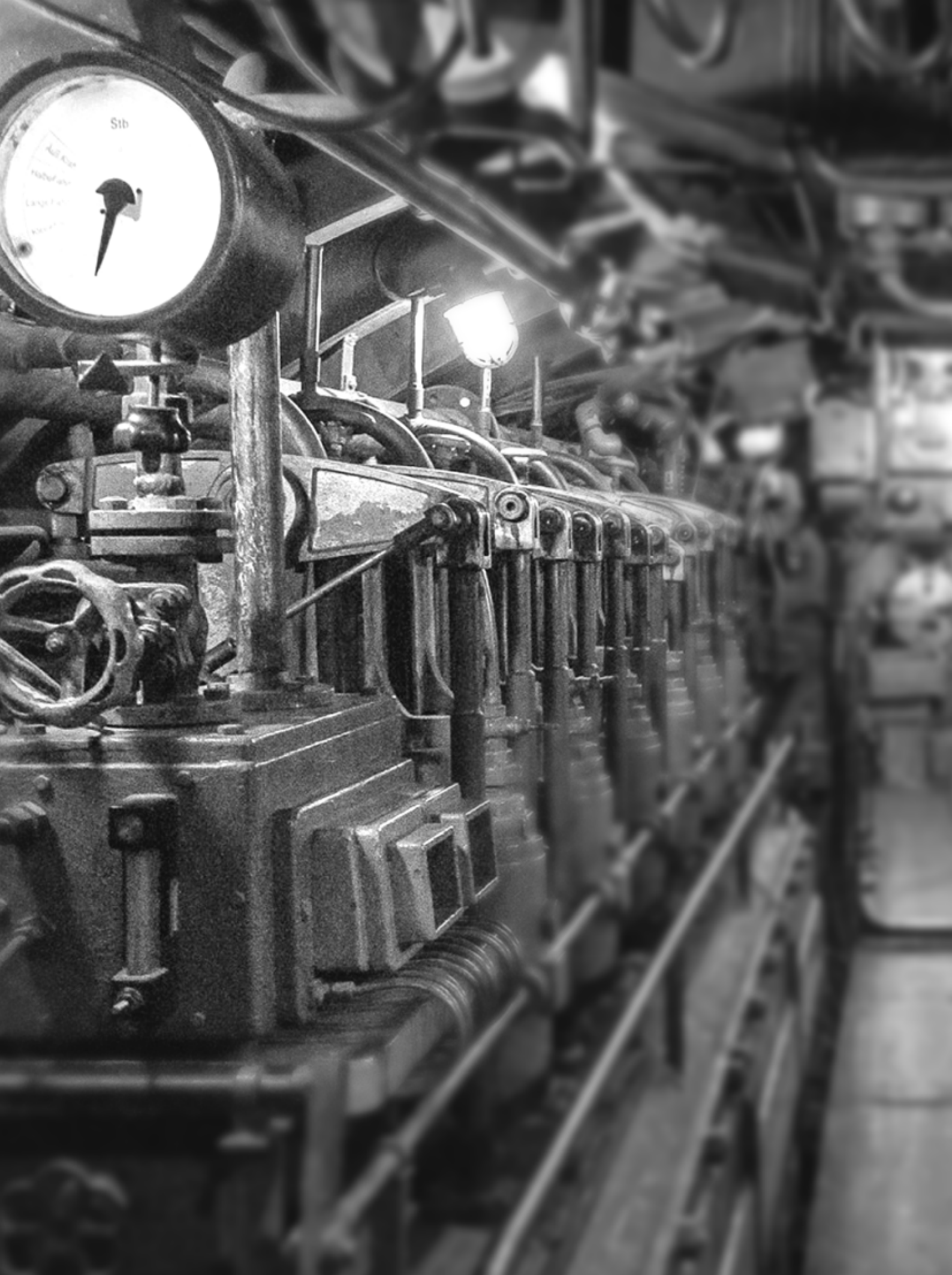
TEMPERATURE CONTROL MCK-301-61

The MCK-301-61 controller for temperature devices control is designed for:
indoor temperature monitoring;
climate devices control according to measurement data;
alarm signaling with a corresponding indication about user- specified maximum indoor temperature exceeding;
change of status between main and stand-by air conditioners after user-set time delay has expired;
switching to an operational air conditioner and signaling about a fault when one of the air conditioners is faulty;
all temperature devices are cut-out when there is a fire alarm signal;
the average indoor temperature indication;
indication of the climate device that is in operation at the moment.
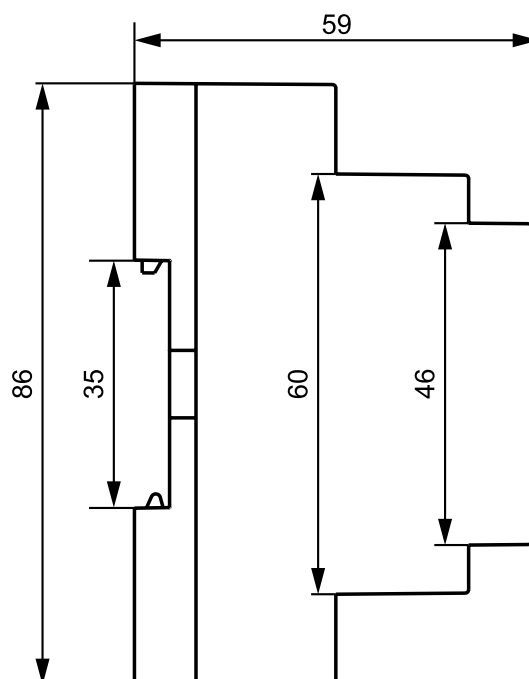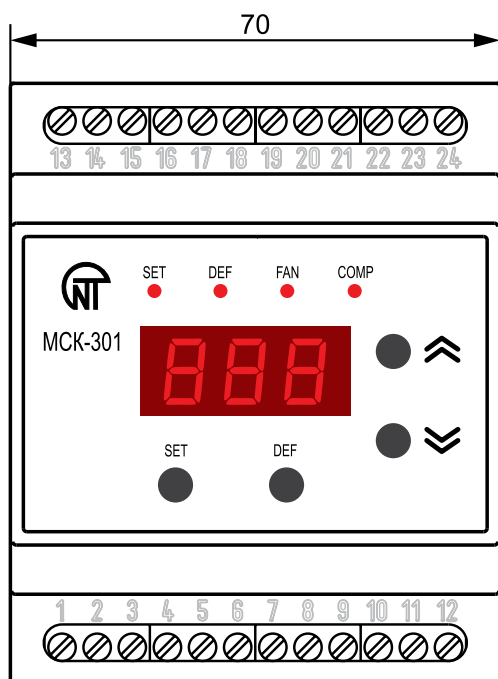
LED COMP glows when air conditioner №1 is ON;
LED FAN glows when air conditioner №2 is ON;
LED DEF glows when electric heater is ON;
Note - Button ⩘- UP in the text, button ⩗ - DOWN in the text.

Figure 1 - Front panel, indications and buttons diagram. Dimensions diagram.

Technical brief

Analog inputs: there are 2 inputs for PTC sensors with reinforced electric insulation for temperature monitoring;

A digital fire alarm input (the decision is made according to «closed/open» state, closed   state corresponds to the running order, open state corresponds to the fire alarm signaling);

Two digital inputs for air conditioner fault sensors (if closed the air conditioner is faulty);

Main outputs:

- two-way break-before-make   relay output for the 1st air conditioner control – 8A 250V at cos φ = 1;
- a normally open relay output for the 2nd air conditioner control – 8A 250V at cos φ = 1;
- a normally open relay output for the electric heater control -- 8A 250V at cos φ = 1;
- an opto-relay output to start the alarm signaling – 100 mA ~AC or =DC;

Temperature resolution – $0.1\,^{\circ}C$;

Nominal supply voltage: one-phase voltage is 240V/ 50Hz or three-phase voltage is 415V/ 50Hz;

Operating voltage at single-phase power supply: 160V – 330V;

Power consumption is no more than 5Wt;

Enclosure: IP40;

Terminal block enclosure: IP20;

Operating temperature: from –10 to +55 $^{\circ}C$;

Storage temperature: from –45 to +65 $^{\circ}C$;

Weight is no more than 0.3kg;

Mounted on the standard 35 mm DIN-rail;

Mounting position is arbitrary.

MCK-301-61 complies with requirements: IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2.
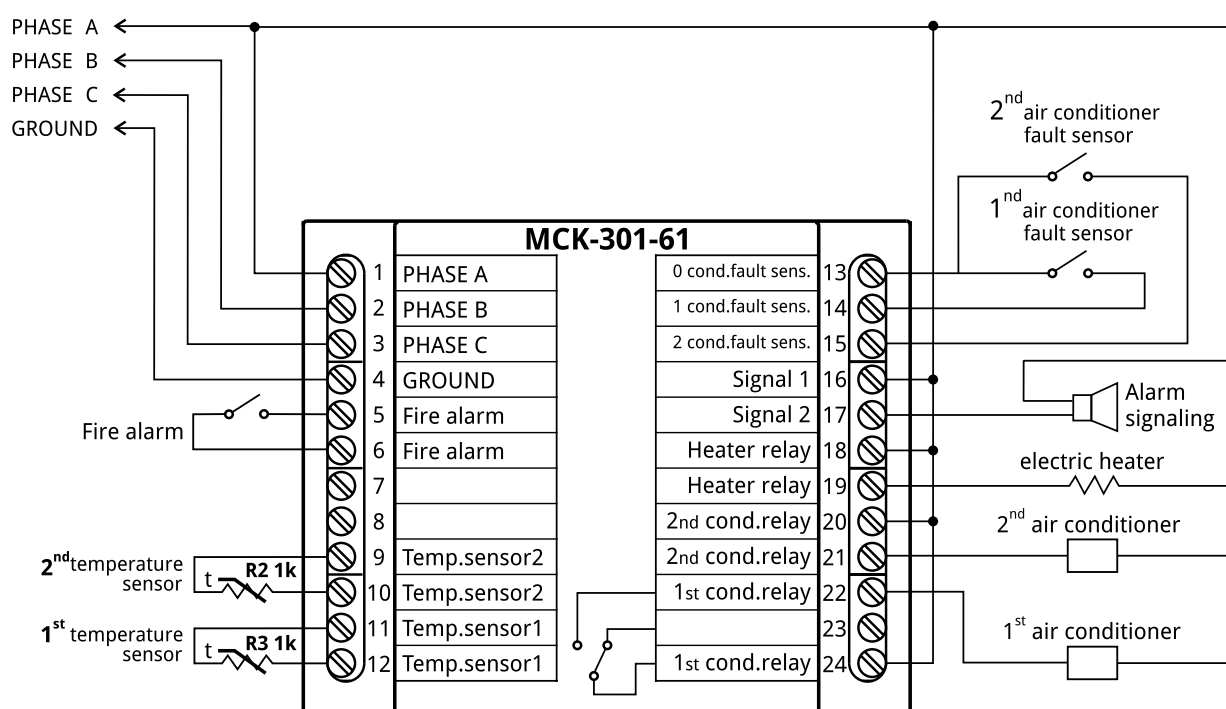

Figure 2 - The MCK-301-61 connections to the three-phase mains supply.

The MCK-301-61 modes of operation

The controller provides the modes of operation as follows:

- connected electric heater thermostat conditions;
- air conditioning zone control thermostat conditions;
- alarm conditions;
- testing conditions.

The MCK-301-86 is designed to control freezers, refrigerating counters, monoblocs and other refrigerating shop and industrial equipment.

The MCK-301-86 allows to monitor freezer and evaporator temperature and also, depending on a specified mode of operation, to monitor the second evaporator temperature or fan air stream temperature. The device permits to start automatic defrost at temperature difference between refrigerating chamber and fan air stream.

The MCK-301-86 can perform protective compressor cut-out if PTC or NTC-type temperature sensor of compressor is connected to the MCK-301-86.

The MCK-301-86 provides safety compressor and fan stop under abnormal supply line parameters (the unit performs monitoring of RMS phase voltage and line voltage, phase imbalance, correct phase sequence and power contacts state of external magnetic contactor before and after compressor cut-off) and also accomplishes a consequent automatic reset when voltage parameters regenerated after user-set time delay has expired.

MCK-301-86
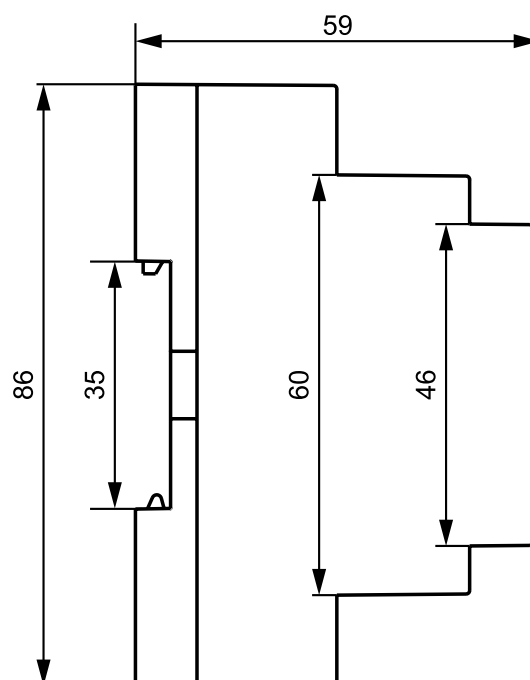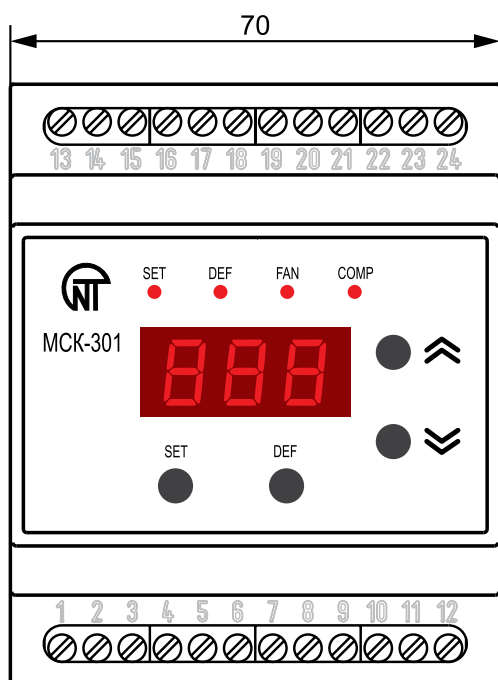
LED COMP glows when air conditioner №1 is ON;
LED FAN glows when air conditioner №2 is ON;
LED DEF glows when electric heater is ON;
Note - Button ⌃ - UP in the text, button ⌄ - DOWN in the text.

Figure 1. - MCK-301-86 front panel, indications and buttons diagram. Dimensions diagram.

Table 1. – The main technical specifications

Description	Value
Nominal supply voltage:	
one-phase voltage is	230V/50Hz
or three-phase voltage is	400V/50Hz;
Operating voltage:	from 160V to 330V;
Harmonical configuration (nonsinusoidality) of power supply voltage	EN 61000-3-2
Trip threshold accuracy for voltage, V, is no more than	3
Temperature resolution, °C;	0.1
Power consumption, W, is no more than	5
Enclosure	IP40
Terminal block enclosure	IP20
Climatic design version	NC3.1
Permissible contamination level	II
Overvoltage category	II
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Conductor cross-section for connecting to terminals, mm²	0.5 – 2.5
Tightening torque of the terminal screws, N*m	0.4
Weight, kg, is no more than	0.3
Mounted on the standard 35 mm DIN-rail	

Analog inputs: there are 3 inputs for NTC/PTC temperature sensors (temperature sensors of chamber)
A digital input can be used:
    - to connect a door alarm sensor;
    - to control defrost (the decision is made according to «closed/open» state);
    - as an input for external alarm signal.
Main outputs:
    -two-way break-before make relay output for the compressor control - 8A 250V at cos φ =1;
    -a normally open relay output for the evaporator fan control - 8A 250V at cos φ =1;
    -a normally open relay output for the electric heater control - 8A 250V at cos φ =1;
    -an opto-triac output to start an alarm signalling - 60 mA 50Hz
Mounting position is arbitrary.

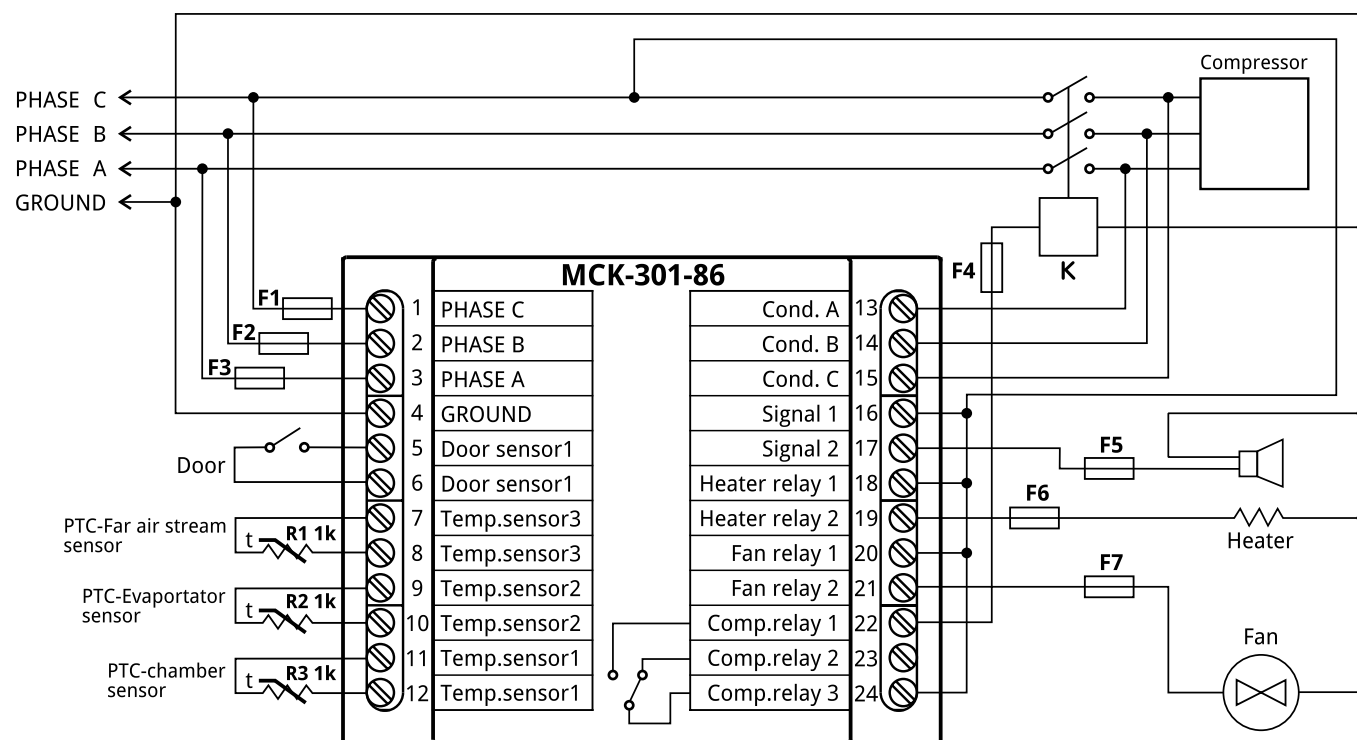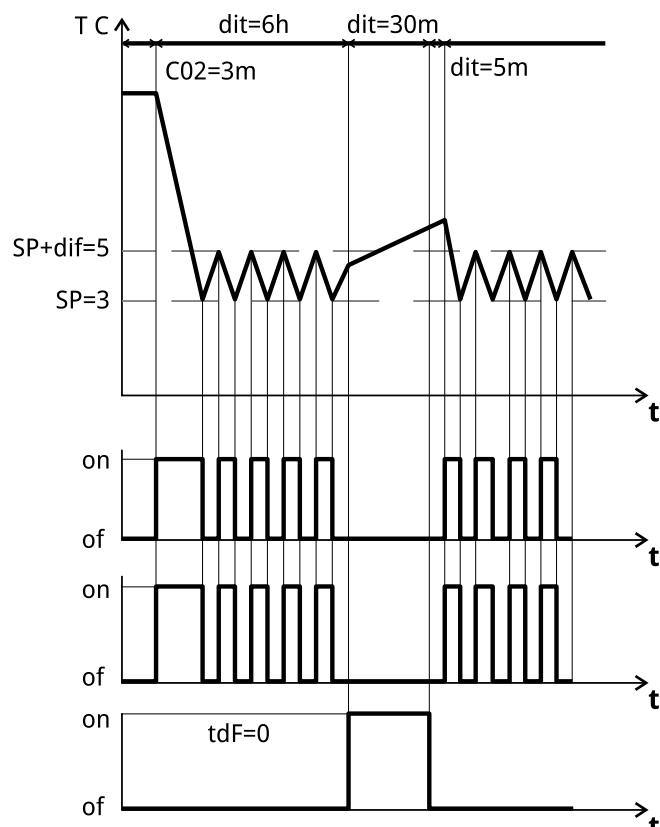*Figure 2 - The MCK-301-86 connections to the three-phase mains supply*

C02 –compressor start delay
dit – chamber temperature maintenance
dEt – defrost
ddt – drip- off

SP – setting (temperature set by user)
diF – differential

Compressor relay

Fan relay
Fans are **ON** and **OFF** together with the compressor (FCo=0)
Heater relay
Defrost by the electric heater (tdF=0)

Figure 3

The MCK-301 allows to specify defrost type, defrost stop type and between-defrost delay count method.

CCt parameter specifies the refrigeration time. *dAF* parameter specifies the start-of-defrost delay, i.e. the time before the start of the first defrost after the refrigeration time has expired.

Compressor relay

In the "Thermostat conditions" the unit performs the chamber temperature monitoring and detects when the temperature is outside the preset range (*LAL* and *HAL* parameters). This kind of monitoring is not performed in the refrigeration conditions and defrost conditions.

According to the preset additional temperature sensors (*d I0*, *o07*) connection parameters the unit performs sensors short-circuit & disconnection monitoring.

If an open door state time exceeds user-preset time *A07* parameter the situation considered to be a fault state.

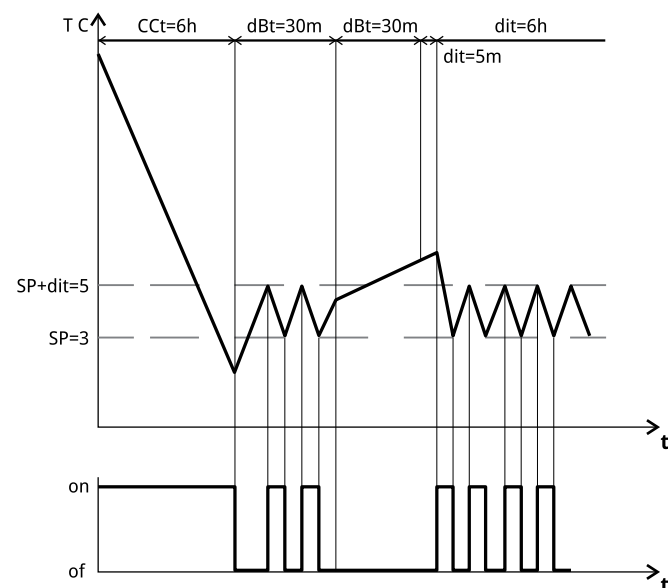To block premature trippings for temperature fault the *tA0*, *PA0* and *dAo* parameters are used.

The MCK-301-86 performs power supply voltage parameters monitoring in all modes of operation and when the power supply parameters deviate from the set range, the MCK-301-86 stops the compressor, the fan, the electric heater and cuts-in the alarm signal.

On return to normal operating conditions for power supply parameters the MCK-301-86 resets back to the conditions where voltage fault occurred after *U05* reset delay has expired, if only user-set power voltage regeneration time doesn't exceed *Utt* parameter. If yes, the MCK-301 begins to perform the program executing from the start-up. The MCK-301-86 will start the program from the start, and when from the power supply until the time of the accident voltage will be less than 200 seconds.

DIGITAL TEMPERATURE RELAY TR-100

TR-100 is designed for take measurement and control of temperature of device by 4 sensors which are may connected by two or three wire connection schemes. Temperatures will be indicated on digital display. It is possible to use alarm signals when some of parameters come out of user adjusted ranges.

TR-100 can be used for protection of:
• Motors and generators;
• Three-phase dry-type transformers with additional thermal sensors for core or environment.

TR-100 equipped for universal adapter and therefore it can use power supply from 24 to 260V (AC or DC) without reference to polarity.

In the capacity of thermal sensors, TR-100 is able to use next types of transducers:
• PT100 – Platinum transducer with rated resistance is 100 Ohms (0 °C);
• PT1000 – Platinum transducer with rated resistance is 1000 Ohms (0 °C);
• KTY83 – Silicon transducer with rated resistance is 1000 Ohms (25 °C);
• KTY84 – Silicon transducer with rated resistance is 1000 Ohms (100 °C);
• PTC (1, 3, 6 cascade) cold resistance of transducer is 20-250 Ohms.
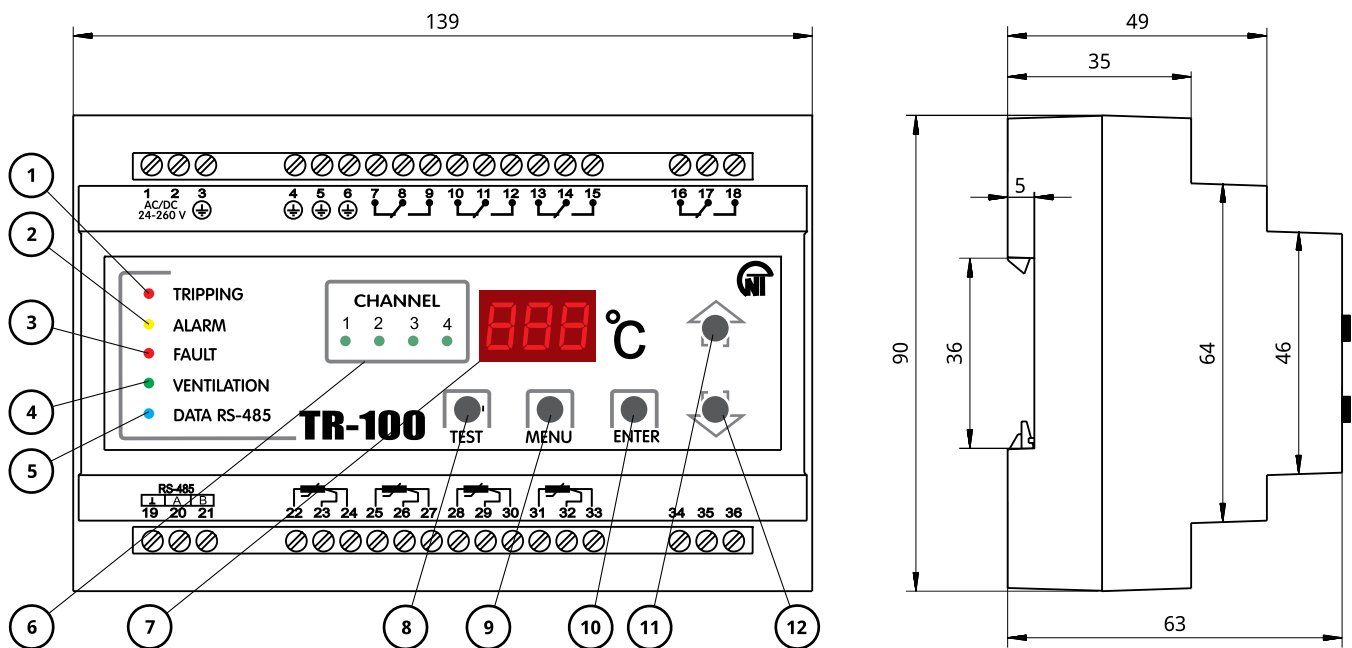
1 – Indication of tripping is ON;
2 – Indicator for ON state of alarm relay or for programmed mode is ON;
3 – Indicator for failure of device and switching on of bug relay;
4 – Indicator for turning on of ventilation relay;
5 – Indicator for switching on and actual connection with RS-485;

6 – Indicator for number of current display channel;
7 – Digital display;
8 – Test indication button; 9 – Button for entering in the view mode or programming mode;
10 – Use to confirm adjusted sittings and to exit from programming mode;
11 – Up button;
12 – Down button.

Figure 1. – Appearance and dimensions

Table 1. – The main technical specifications

Description	Value
Supply power, V	24 – 260 AC/DC
Recommended fuse for equipment protection, A	1-2
Thermal transducers	PT100, PT1000, KTY83, KTY84, PTC
Connectable transducers, pcs.	1 – 4*
Method of hardwire	2 / 3 wired
Wire length of sensor (depending on method of hardwire), m:	2 wired up to 5
	3 wired up to100
Amount of output relay, pcs.	4
Date-hold time, years, not less then	15
Temperature measurement error, °C	± 3
Temperature measurement range, °C	from - 40 to +240
Output relay test	Yes
Indication test	Yes
RS-485 MODBUS RTU	To order
Time measurement, sec.	≤ 2
Degree of protection: - body	IP30
- terminal block	IP20
Climatic execution	Y3.1
Power input (power load), VA, no more than	4,0
Weight, kg, no more then	0,180
Dimensions, mm	90 x 139 x 63
Operation temperature range, °C	from -40 to +55
Storage temperature, °C	from -50 to +60
Montage to standard 35mm mounting frame	
Free position in space	
* note – PTC transducers can be connected as serial connection (1, 3, 6 pc.)	

Table 2. – Characteristics of output channels

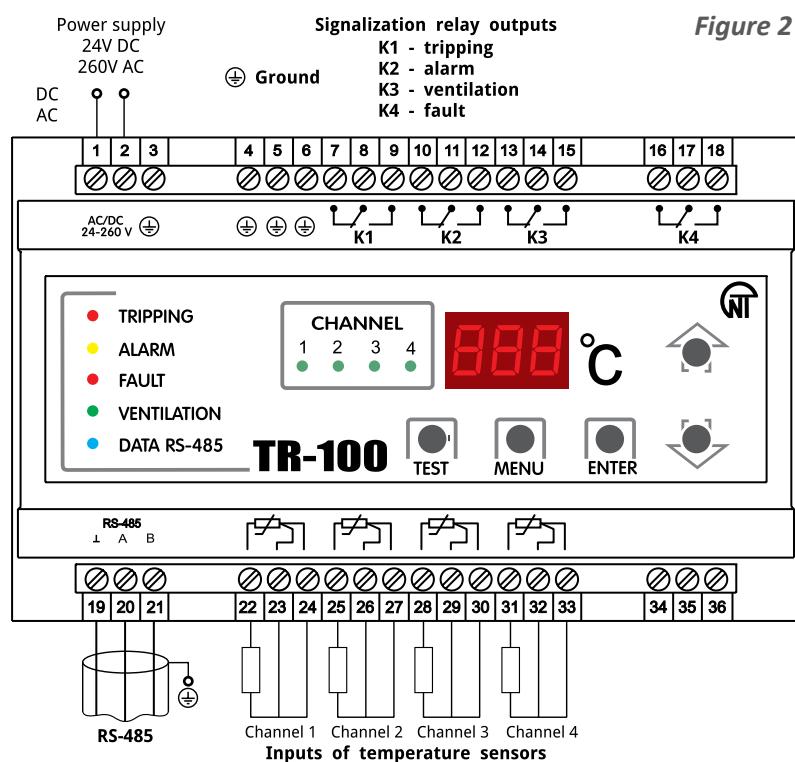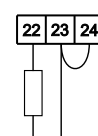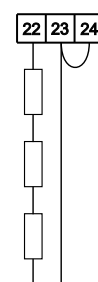|	Max. Current (U~250B), A	Maximum power, kVA	Max. voltage ~, V	Max. Current (U_{DC} =30B), A
Cos φ = 1	40	4	440	3
Commutation life of the output contacts: - under 10A 250V AC, times, not less than - under 10A 24V DC, times, not less than				10 million 10 million

Figure 2 – Electrical connections of TR-100

DIGITAL TEMPERATURE CONTROLLER FOR DRY TRANSFORMER PROTECTION TR-100M

The product meets the requirements of the following:
- *Low-voltage switchgear; Part 1; General rules (IEC 60947-1:2004, IDT);*
- *Low-voltage circuit breaker and controller; Part 6-2; multifunctional equipment; Control and safety switching equipment (IEC 60947-6-2:1992, IDT);*
- *Electromagnetic compatibility; Industrial, scientific and medical RF equipment; electromagnetic interference characteristics; standards and measuring procedure (CISPR 11:2004, IDT);*
- *Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test (IEC 61000-4-2:2001, IDT).*

TR-100M is the microprocessor-based device intended to measure and control temperature mode of dry-type transformer with four transducers connected by two or three-wire circuit, with subsequently displaying the temperature on the display and sending alarms when any parameters are outside preset limits.

The product can also be used for protection of motors and generators.

The product has the universal power supply of 24 to 265 V (AC or DC) and connection to network EIA/TIA-485 with MODBUS RTU / ASCII protocol.

The product can be applied with the following types of temperature transducers:

- PT100 – platinum transducer with rated resistance of 100 Ohm, at 0°C;
- PT1000 – platinum transducer with rated resistance of 1000 Ohm, at 0°C;
- PTC1000 (EKS111) – transducer with rated resistance of 990 Ohm, at 25°C;
- PTC (minika) – cold resistance of transducer of 20-250 Ohm.
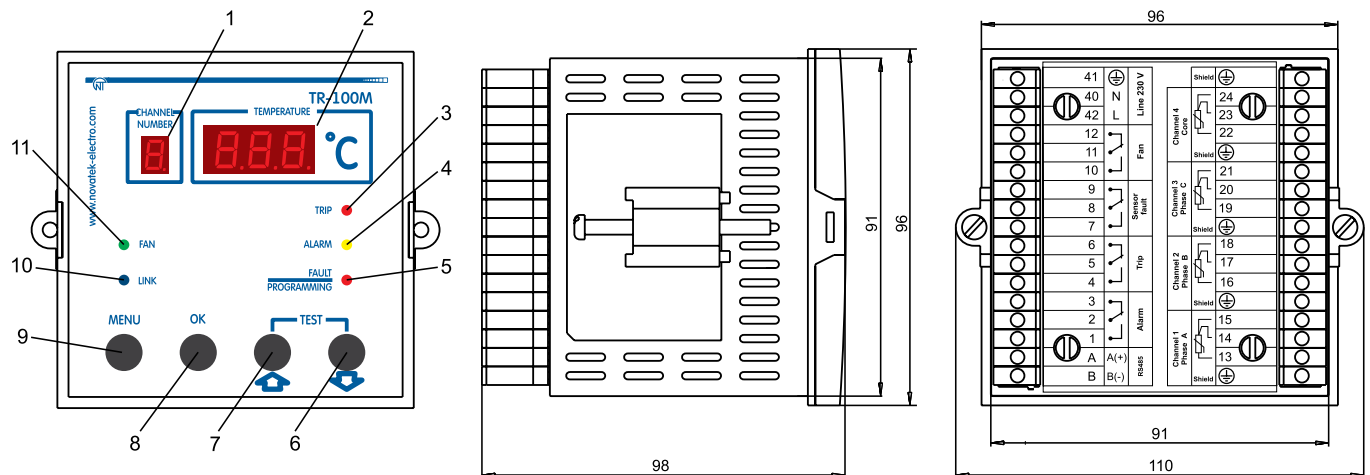
1 – Digital display for the number of operating display channel;
2 – Digital display for the temperature values;
3 – Indicator of **TRIP** relay enabling;
4 – Indicator of **ALARM** relay enabling;
5 – Indicator of TR-100M programming, **FAULT** and **PROGRAMMING** relay enabling;

6 – Button ⬇ (DOWN);
7 – Button ⬆ (UP);
8 – OK button (record and exit from parameters programming mode);
9 – MENU button (enter to review mode and parameters programming mode);
10 – Indicator of RS-485 communication activity;
11 – Indicator of cooling relay enabling.

Figure 1. – Overall and mounting dimensions of TR-100M

Table 1. – General Data   *Basic Technical Specifications*

| Description	Value
Operating supply voltage (⊢), V	230 / 240
Voltage at which service capability is maintained (⊢ /⊐), V	24 – 265
Frequency of supply mains, Hz	45 – 65
Consumed power (from mains of ~230 V), W, not more	6.0
Consumed power (from power supply unit +24 V), W, not more	2.2
Quantity of transducers connected, pc.	4
Types of transducers used to measure temperature	PT100, PT1000, PTC1000 (EKS111), PTC (minika)*
Transducers connection circuit	2 / 3-wire
Max. length of transducer wire depending on connection circuit, m	2-wire – to 5; 3-wire – to 100
Temperature measurement accuracy, °C	± 2

Table 2. – Technical Specifications

Description	Value
Measured temperature range, °C:	
PT100	minus 60 to +300
PT1000	minus 60 to +300
PTC1000 (EKS111)	minus 50 to +120
PTC (minika)	+60 to +180
Temperature digital filtering	Available
Quantity of output relays and contacts type, pc.	4 – switching
Commutation life of output contacts of the relay:	
– Electrical lifetime at 10A 250V AC (cos φ = 1.0), time, not less	100000
– Electrical lifetime at 10A 24V DC, time, not less	10000
– Mechanical lifetime, time, not less	10000000
Specification of output contacts of the relay:	
– Max. switching current at 250 V (cos φ = 1.0), A	10
– Max. switching current at 250 V (cos φ = 0.4), A	6
– Max. switching current at 30 V, A	3
– Max. switching power, VA	2500
Test of output relays	Available
Test of indication	Available
EIA/TIA-485 MODBUS RTU / ASCII	Available
Data storage time, year, not less	15
Product service	Control and distribution device
Rated operating condition	Continuous
Protection rating of front panel	IP64
Protection rating of housing	IP20
Electric shock protection class	II
Climatic version	NC 3.1
Permissible contamination level	II
Overvoltage category	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Wire cross-section for connection to terminals, mm²	0.5 – 2.5
Tightening torque of terminal screws, N*m	0.4
Weight, kg, not more	0.360
Overall dimensions (L x W x H), mm	110 x 98 x 96
Installation is designed on the front panel of the board (cabinet) or device	
The product remains functional at any position in space	
* – PTC (minika) transducers can be series-connected (by 1, 3, 6 pc.)	

The product has four channels for temperature measurement, and four output load relays.

The temperature transducers (sensors) of the first three channels measure the temperature of each transformer winding; and the fourth one measures temperature of the transformer yoke or ambient temperature.

In case of dangerous temperature rise of the transformer, the product first will enable alarm system and the cooling fans. If the temperature rise continues and the temperature exceeds the limit value, the product will perform emergency shutdown of the transformer.

In case of the temperature transducers (sensor) fault, TR-100M enables the alarm of the transducer (sensor) fault.
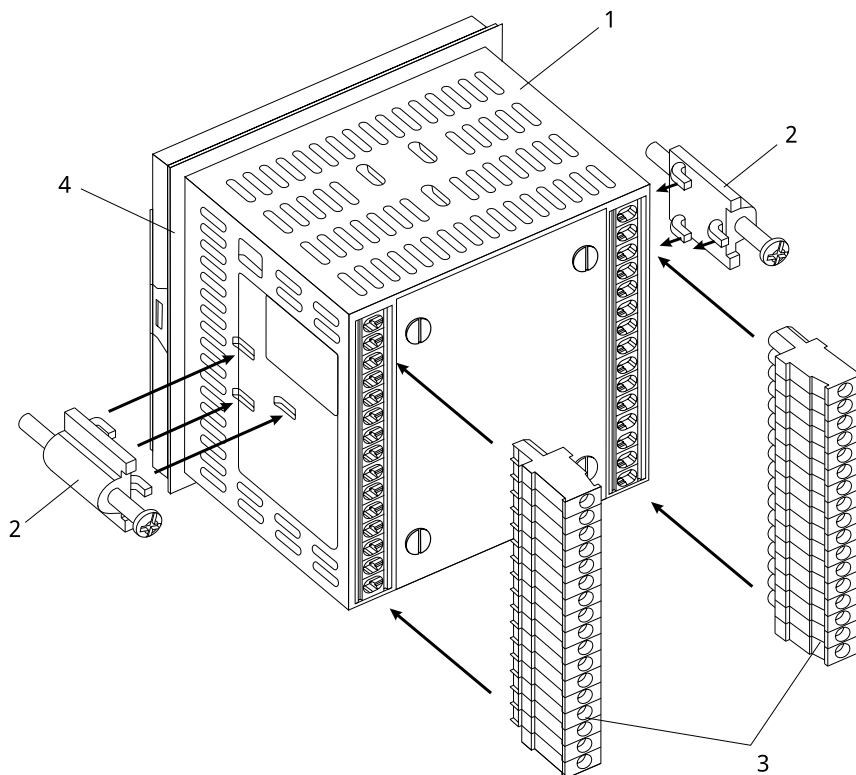
1 – TR-100M;
2 – Fasteners;
3 – Removable terminal blocks;
4 – Rubber seal.

Figure 2. – Product installation

2-wire transducer connection   *PTC (minika) transducer connection*
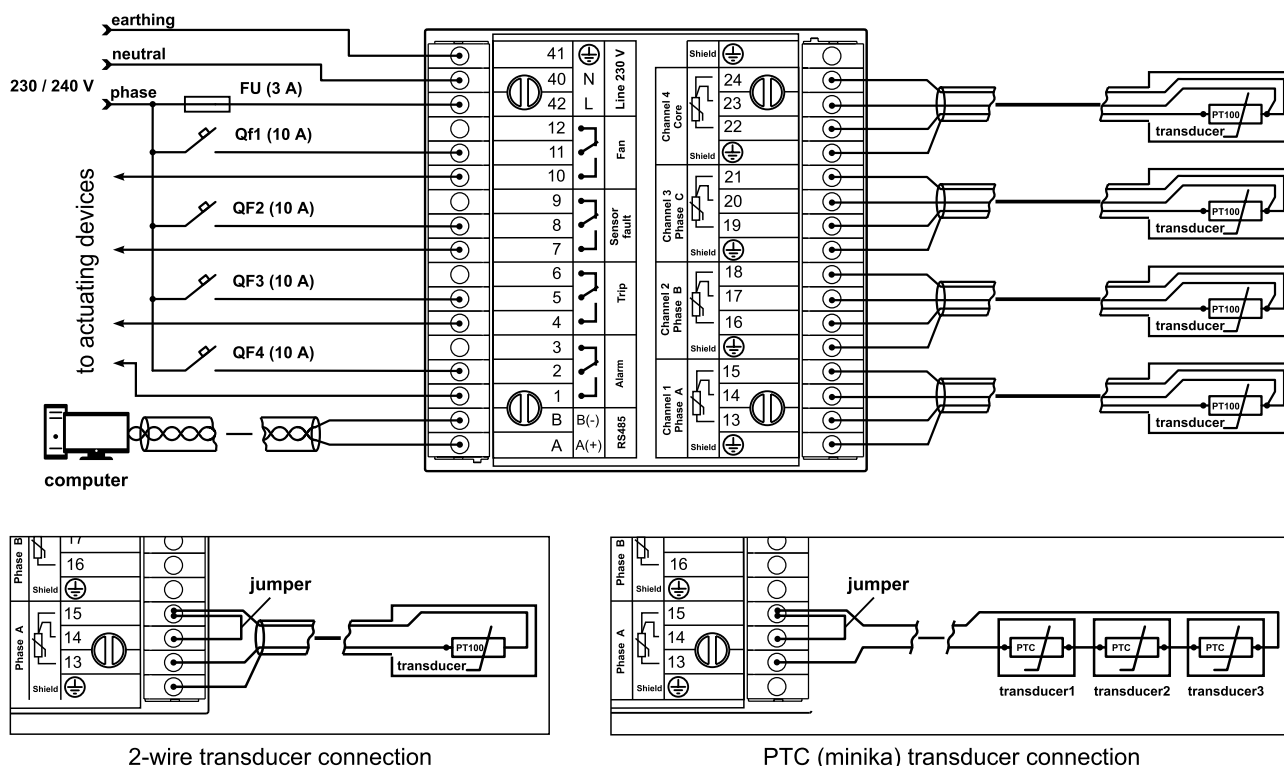
FU – Fuse (automatic/miniature circuit breaker) for current of 3A;
QF1 - QF4 – Automatic circuit breakers (fuses) for current of 10 A.

Figure 3. – TR-100M Connection Diagram

DIGITAL PID TEMPERATURE CONTROLLER WITH RS-485 COMMUNICATION
TR-101

TR-101 is designed for measuring and controlling a device temperature by means of four sensors connected according to a two or four-wire diagram, with subsequent temperature display.

The device can find various applications in industrial sector, in municipal utilities service, and agriculture.
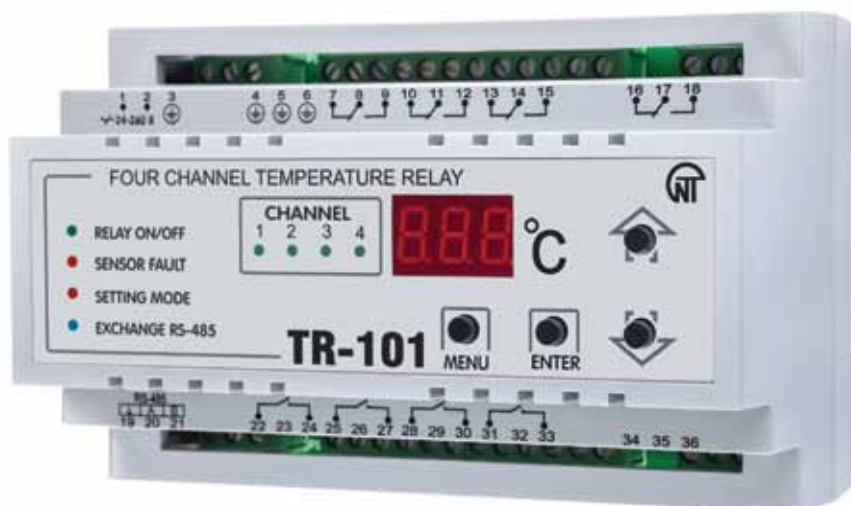
TR-101 complies with requirements of:
IEC 60947-1:2004, IDT; IEC 60947-6-2:1992, IDT; CISPR 11:2004, IDT; IEC 61000-4-2:2001, IDT
No harmful substances in excess of the maximum permissible concentration is available.

The device allows for performing the following functions:

- taking temperature measurement on 4 channels with use of standard sensors;
- controlling temperature according to proportional-integral-differential (PID) principle;
- temperature on-off regulation;
- displaying currently measured temperature value on the integral LED digital display;
- transferring the measured values of the sensors monitored via Modbus RTU standard protocol;
- defining a break or a short circuit on the connected sensors lines;
- measured temperature digital filtering and correction;
- programming by the front panel keys and via PC; settings backup when de-energized;
- settings protection from unauthorized change.

TR-101 has a flexible power supply and can use any voltage from 24 to 260 V (AC or DC), regardless of polarity.

Table 1. TR-100 can be used with the following types of temperature sensors

Sensor type	Rated resis-tance at 0 °C, R0, Ohm	Unique sensor curve (USC) notation			Temperature range
		national	international		
			W100 =1,3850	W100 =1,3910	
Platinum	50	50П	Pt50	Pt'50	-50...+200
	100	100П	Pt100	Pt'100	-50...+200
	500	500П	Pt500	Pt'500	-50...+200
	1000	1000П	Pt1000	Pt'1000	-50...+200
			W100 =1,4260	W100 =1,4280	
Copper	50	50M	Cu50	Cu'50	-50...+200
	100	100M	Cu100	Cu'100	-50...+200
			W100 = 1,6170		
Nickel	100	100H		Ni100	-50...+180
	120	120H		Ni120	-50...+180
	500	500H		Ni500	-50...+180
	1000	1000H		Ni1000	-50...+180
			W100 = 2,0805	W100 = 2,0805	
Other	990 by 25°C	807 by 0°C	PTC1000	EKS111	-50...+100

W100 – ratio rate of sensor resistance at 100°C to its resistance at 0°C (W100 = R100 / R0)
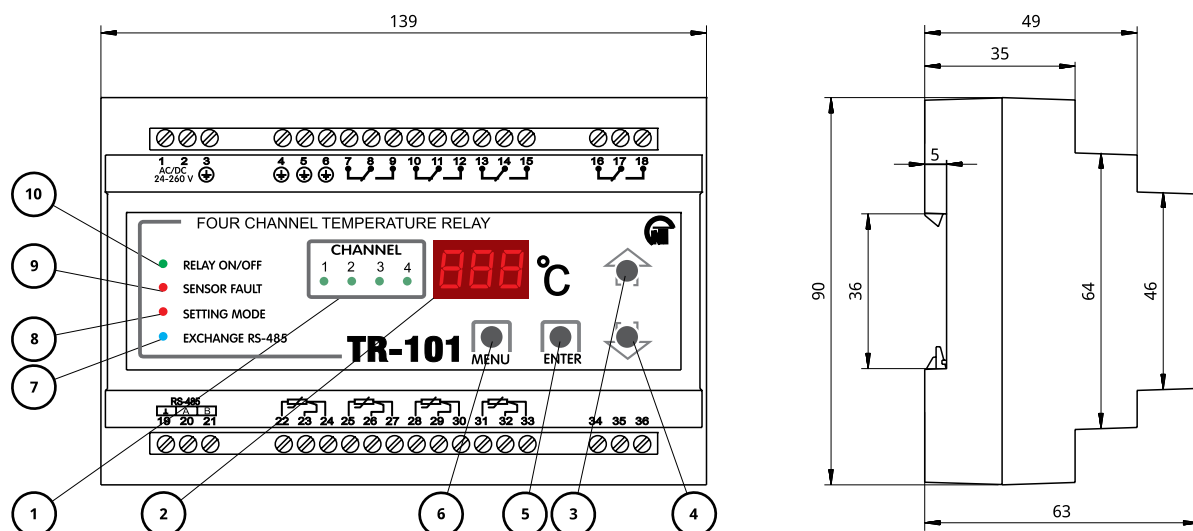
1– currently displayed channel number indicator;
2 – seven-digit numerical display;
3 – up key;
4 – down key;
5 – enter key, used in the device programming mode;
6 – view mode and device programming mode enter key;

7 – RS-485 connection and communication activity indicator;
8 – parameter programming mode indicator;
9 – sensors failure indicator;
10 – relay close (open) indicator

Figure 1. – TR-101 dimensions

Table 1. – Technical brief and operating conditions

Description	Value
Supply voltage, V	24 – 260 AC/DC
Recommended fuse, A	1
Type of temperature measurement sensors	Pt50, Pt100, Pt500,
Quantity of sensors connectable, pcs	Pt1000, Cu50, Cu100,
Sensors wiring schematic	Ni100, Ni120, Ni500,
Sensor wire length, depending on the wiring schematic, m	Ni1000, PTC1000
	1 – 4
Quantity of output relays, pcs	2 / 3 wires
Data memory, years, no less than	2- wire, up to 5
Temperature measurement error, °C	3- wire, up to 100
Measured temperature range, °C	4
Output relay testing	10
RS-485 MODBUS RTU	±2
PID regulation with keyword (relay)	from -50 to +200
Two-position regulator	available
Channel measurement time, sec, no more than	available
Protection degree: - enclosure	available
- terminal block	available
Power consumption (under load), no more than, VA	0,6
Weight, not more, kg	IP30
Dimensions, mm	IP20
Output contacts commutation lifetime:	4,0
- electrical life 10A, 250V AC, times, no less than	0,370
- electrical life 10A, 24V DC, times, no less than	90 x 139 x 63
Mounting onto standard 35 mm DIN-rail	100 thousand
Mounting position any	100 thousand

Table 2. – Characteristics of output channels

	Max. current at ~ 250 V AC, A	Maximum power, kVA	Max. voltage ~, V	Max. Current (U_{DC} =30B), A
Cos φ = 1	40	4	440	3

To provide for the input signal properties improvement the device employs digital filters that allow reducing the random interference effect on the temperature measurement.

The filters are set for each input independently.
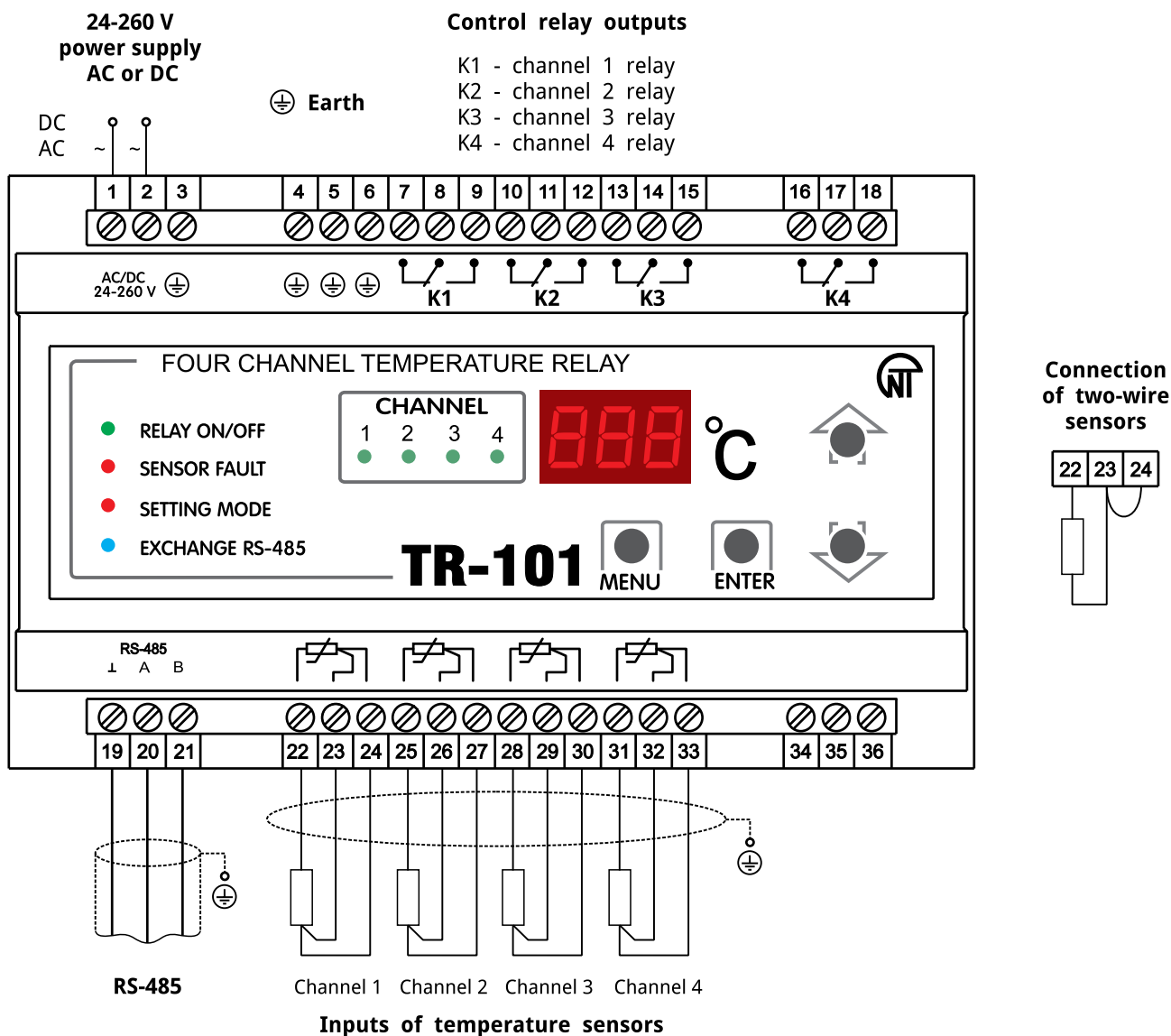

Figure 2 – TR–101 Connection Diagram

The communication interface is employed to connect the TR-101 device to RS-485 network. The device utilization within RS-485 network allows for the following functions.
• collecting data of measured temperatures within SCADA system;
• setting device parameters with use of configuration software;
• remote control of the channels output relays.

THERMOREGULATOR TP-12
(CONROL OF TEMPERATURE MAINTAINING DEVICS WITH VOLTAGE MINITORING)

Purpose of the product

TP-12 is used where it is necessary to maintain the air tempera-ture at a given level: in residential areas, greenhouses, vegetable storage facilities, incubators etc.

The product measures the air temperature via digital temperature sensor (hereinafter referred to as sen-sor) and operates the cooling and heating device. Depending on the wire length and sensor location in the lower or upper casing part, the device has several versions, given in the Table 1. The temperature is controlled in the place where the sensor is located.

Additionally TP-12 possesses functions of voltage relay, protecting the load inappropriate voltage levels.

Table 1. – Technical brief and operating conditions

Description	Value
AC single-phase nominal voltage, V	230/240
Network frequency, Hz	45 – 65
Temperature measurement error, °C	2
Harmonics (non-sinusoidal) of power voltage	EN 50160
Temperature control range (it isn't recommended to establish temperature higher than +60°C), °C	from -10 to +90
Hysteresis by temperature, °C	0.1 ...30
Actuation threshold control range:	
– by minimum voltage, V	120 – 210
– by maximum voltage, V	230 – 290
Fixed operating time by Umax, seconds	0.5
Fixed off-delay by Umin, seconds	7
Fixed operating time when voltage decrease lower than 120 V, seconds	0.12
Fixed operating time when pulse voltage increase more than 450 V while pulse duration more than 1 ms, seconds, not more than	0.02
Actuation threshold determination error by voltage, not more than, V	3
Return hysteresis by voltage, V	5
Minimum voltage, preserving functionality (RMS value), V	120
Maximum switching current when active load, A	16
Maximum voltage, preserving functionality (RMS value), V	320
Output contacts switching resource:	
– Under the load of 16 A, one time, not less than	100 thous.
– Under the load of 5 A, one time, not less than	1 mio.
Power consumption when non-connected load, W, not more than	1.3
Connected load power, kW, not more than	3.6
Weight, kg, not more than	0.16
Dimensions (fig.1), HxBxL, mm	122x61x76
The device preserves functionality in any position within the space	
Casing material – self-extinguishing plastic	

Table 2. – General Data   *Basic Technical Specifications*

Description	Value
Purpose of the device	Distribution and control equipment
Nominal operation mode	Continuous
Degree of device protection	IP30
Class of protection от against electric shock	I
Climatic version	CN3.1
Allowable degree of contamination	II
Overvoltage category	II
Insulation nominal voltage, V	450
Rated pulse withstand voltage, kV	2.5

DEVICE OPERATION DESCRIPTION
Device Factory Settings

Load operation mode	hot (Heat)
Temperature, supported by the device, when controlling the load	30°C
Hysteresis by temperature	3°C
Actuation threshold by maximum voltage	250 V
Actuation threshold by minimum voltage	190 V
Temperature calibration	0°C
Minimum load on/off time (protection from frequent actuations)	0 minutes*

* - the load of the device is on/off in 5 seconds

Normal Device Operation

Normal device operation – TP-12 maintains the set temperature by enabling (disabling) the load, thus the display shows the value of the temperature, measured by sensor.

When normal device operation the network voltage is in the set thresholds.

By using the heating device, in case factory settings fit, connect the load to the device and do not set anything, thus the heating device heats the premise up to 30°C and shuts down. After cool down up to 3°C (factory setting of hysteresis by temperature), that is up to 27°C, TP-12 enables the heating device once more and the cycle is repeated. If it is necessary to maintain the temperature lower than 30°C (i.e., 25°C), adjust the temperature to 25 °C. In this case the heating device heats the premise up to 25°C and shuts down. After cool down up to 3 °C (up to 22°C) the device enables the heating device once more and the cycle is repeated.

When using the cooling device, one should change the operating mode of the device to «Cooling» (how to change is described in section «Complete parameters setting»), set the temperature value, supported by TP-12. For instance, for maintaining within the premise 8 °C the cooling device cools the premise up to 8°C and shuts down, after increasing the temperature for 3 °C (factory setting of hysteresis by temperature), that is up to 11°C, the device enables the cooling device once more and the cycle is repeated.

«Fault» Status

If the network voltage value exceeds the set threshold, TP-12 enters «Voltage failure» status. From the moment of failure occurrence:
– the load turn off;
– the display periodically shows the "Erü" code;
–ON led is not lit.

After restoring voltage parameters, the "Erü" code stops to flash and the device returns to its normal operation.

Besides the voltage failure there also can be other failures, thus the display alternately shows the measured temperature values and failure code.

TP-12 Protection Against Overheat

TP-12 provides for «Device protection against overheat». If the temperature inside the device casing rises above 85 °C, the display shows the "ErP" code, ON led turns off and the load is disabled. To disable protection one should disconnect the device from power outlet, cool it down, than re-connect.

At frequent emergence on the display "ErP" code should contact the customer service or manufacturer.
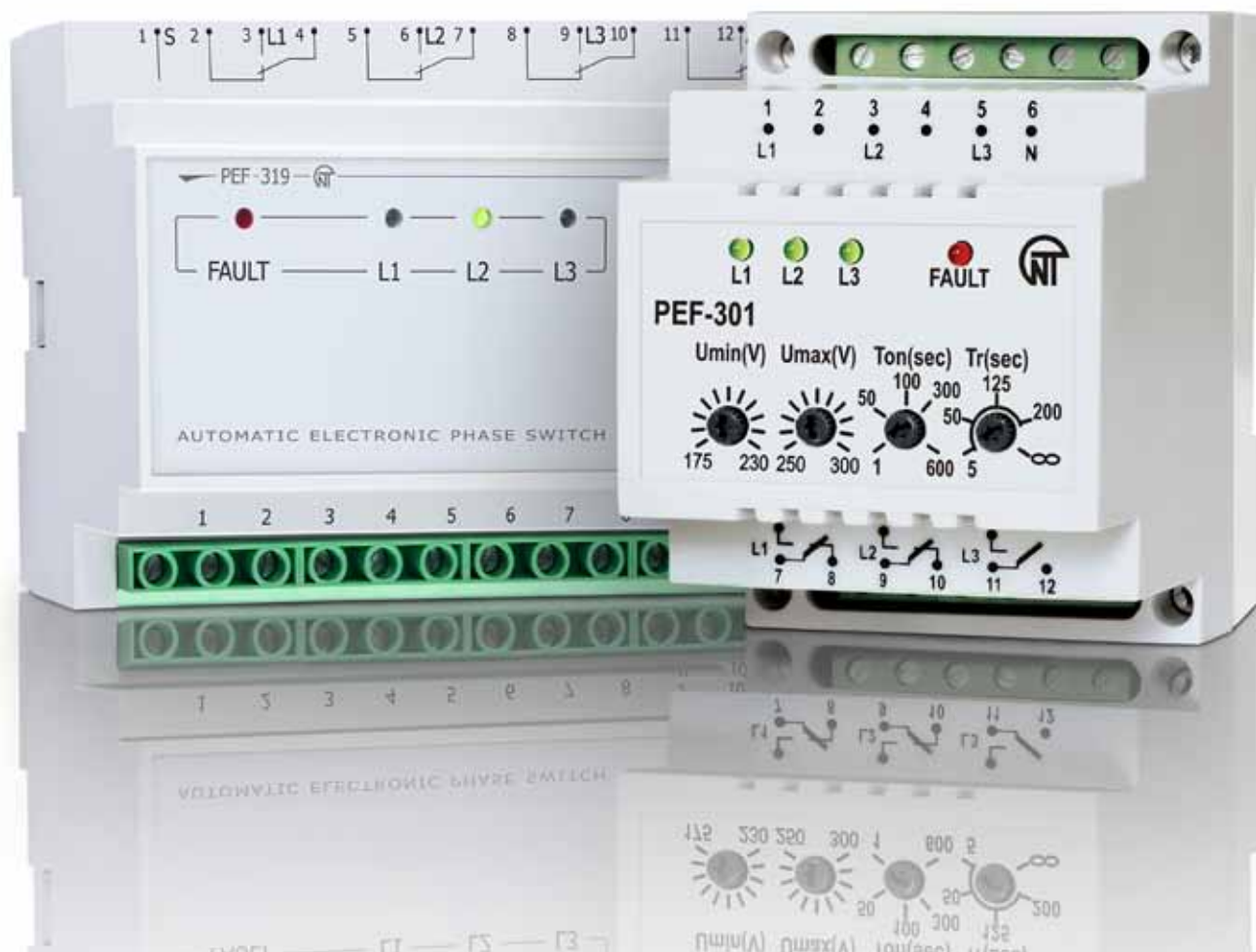
The device complies with the following requirements:
–IEC 60947-1; –IEC 60947-6-2;
–CISPR 11; – IEC 61000-4-2.

No harmful substances, exceeding the maximum allowable concentrations, available.

ELECTRONIC HEALTHY PHASE SELECTOR
**(UNIVERSAL AUTOMATIC ELECTRONIC PHASE SWITCH)**
PEF-301

The PEF-301 universal automatic electronic phase switch is designed to supply an industrial/ appliance single-phase 220-240V/50Hz load from three-phase four-wire mains in order to maintain uninterrupted power supply of essential single-phase loads and protect them against unallowable voltage variations in the mains. To this end a single-phase load is connected into the three-phase mains with the interposition of the PEF-301. According to voltage presence and voltage quality on phases the PEF-301 will automatically select the optimum phase and switch the single-phase load supply to this phase.

Any power load is energized with the interposition of the PEF-301:
- if power is less than 3.5 kW (16A), the load is energized from the PEF-301 directly;
- if power is more than 3.5 kW (16A), the PEF-301 controls magnetic contactor single phase coils of the corresponding power.

Reset delay to the priority phase, the maximum voltage threshold and the minimum voltage threshold are set by user.
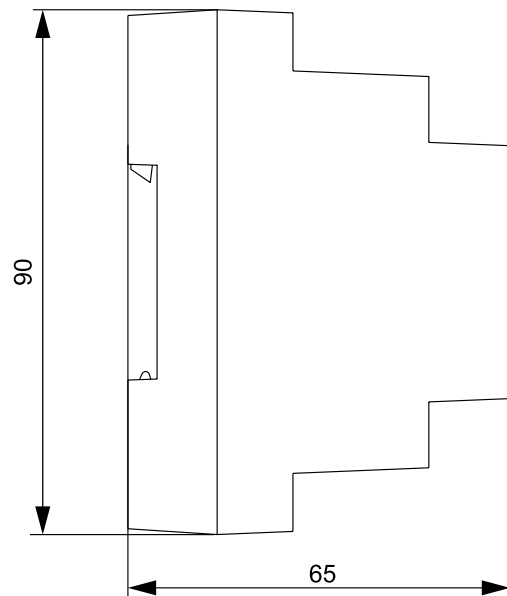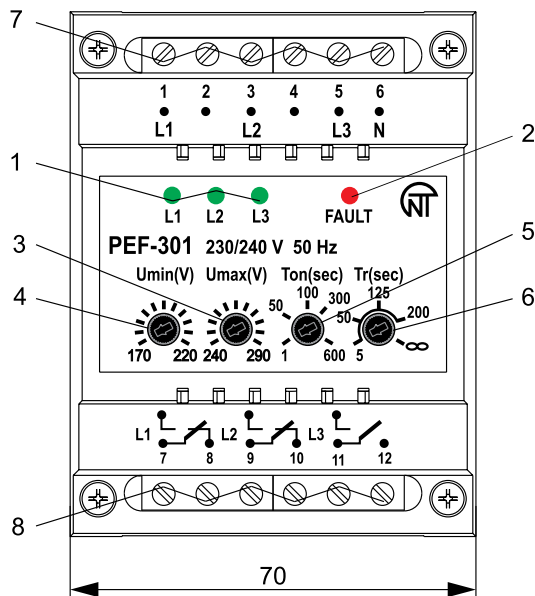
1. green LEDs indicating the phase the load is energized from
2. red LED indicating fault
3. control knob for Umax threshold setting, Umax
4. control knob for Umin threshold setting, Umin
5. control for autoreclosing time delay, Ton
6. control for time delay to return to the priority phase, Tr
7. connection terminals
8. connection terminals

Figure 1. – controls description and dimensions diagram

Table 1. – Technical brief and operating conditions

Description	Value
Nominal Phase Voltage, V	220 - 240
Mains frequency, Hz	45-55
Harmonic configuration (non-sinusoidality) of power supply voltage	EN 61000-3-2 (IEC 1000-3-2)
Trip threshold for Umin, V	160-220
Trip threshold for Umax, V	230-280
Adjustable reset delay, Ton, s	1-600
Return delay range to the priority phase, Tr, (5 — 200), s	present
Return delay range to the priority phase, Tr, (200 — ∞), s	absent
Fixed switch (de-energization) delay for Umin, s	12
Switch delay to reserve phases, s, not more than	0.2
Voltage hysteresis, V	5 - 7
Accuracy, V	±3
Maximum switched current of output contacts, A, no less than	16
Operating phase voltage, V	400
Transient withstand, V	450
Power consumption (under load), W, not more than	1.0
Protection class against electric shock	II
Permissible contamination level	II
Overvoltage category	II
Nominal impulse withstanding voltage, kV	4
Nominal voltage of isolation, V	450
Life of output contacts:	
• under load 16 A , operations, no less than	100 000
• under load 5 A , operations, not more than	1 mln.
Cross section of wires of connection terminals, mm²	0.5-2
Maximal tightening torque of terminals external screws, N*m	0.4
Operating temperature, °C	from -35 to +55
Weight, no more than, kg	0.200
Mounting 35 mm DIN-rail	
Mounting position arbitrary	

PEF-301 complies with requirements of:
IEC 60947-1:2004, IDT; IEC 60947-6-2:1992, IDT; CISPR 11:2004, IDT; IEC 61000-4-2:2001, IDT.
No harmful substances in excess of the maximum permissible concentration is available.

OPERATION

The PEF -301 is a digital microprocessor based device. User sets trip thresholds of the PEF-301, i. e. the minimum and the maximum voltage thresholds on reaching of which the device trips and de-energizes a load (switches the load to a reserve phase). The PEF-301 is connected to the three-phase four-wire mains through the 1(L1), 3(L2), 5(L3), 6(N) input terminals.

The phase L1 is the priority one, i. e. the load will always be energized from the L1 phase if voltage on this phase is present & within user-preset thresholds. The device performs monitoring of voltage presence & values on each phase and if the voltage value on the L1 goes outside the trip threshold range the PEF-301 effects the high speed (a switch delay is not more than 0.2 s) switching of the load to the phase where voltage value is within trip thresholds. If the voltages on both reserve phases are outside the preset trip voltage thresholds the load will be de-energized.

Switching is performed successively from L1 to L2, from L2 to L3 (the corresponding LED indicator glows).

SWITCHING TO THE PHASE WITH UNALLOWABLE PARAMETERS IS NOT PERFORMED.

After the load had been switched to reserve phases the monitoring of voltage presence & voltage value on the priority phase is going on and when the voltage parameters on this phase has regenerated, the load will be switched to the priority phase after user-preset reset delay Tr (5-200 s) has expired. If Tr is in «∞» position (the priority is excluded) the return to the priority phase is not performed.

If voltage drops below the minimum trip voltage threshold, the load will be switched (de-energized) after the fixed time delay for starting transient drops ignoring (12 sec) has expired.

If voltage exceeds the maximum trip voltage threshold the load will be switched (de-energized) at once.

If the load had been de-energized from all the three phases because of unallowable voltage level on each phase the PEF-301 goes on voltage monitoring on all phases. When voltage parameters regenerate at least on one phase the load will be energized after the reset delay Ton has expired.
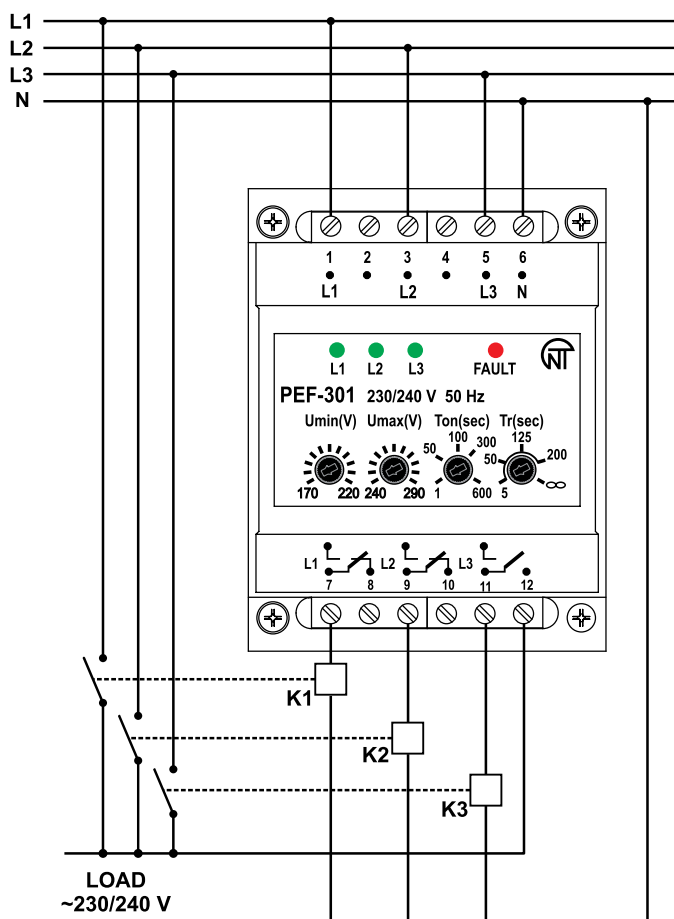
Wiring diagram №1

Connection when load is no more than 16A (apply jumper straps between the 8-9 and 10-11 terminals)
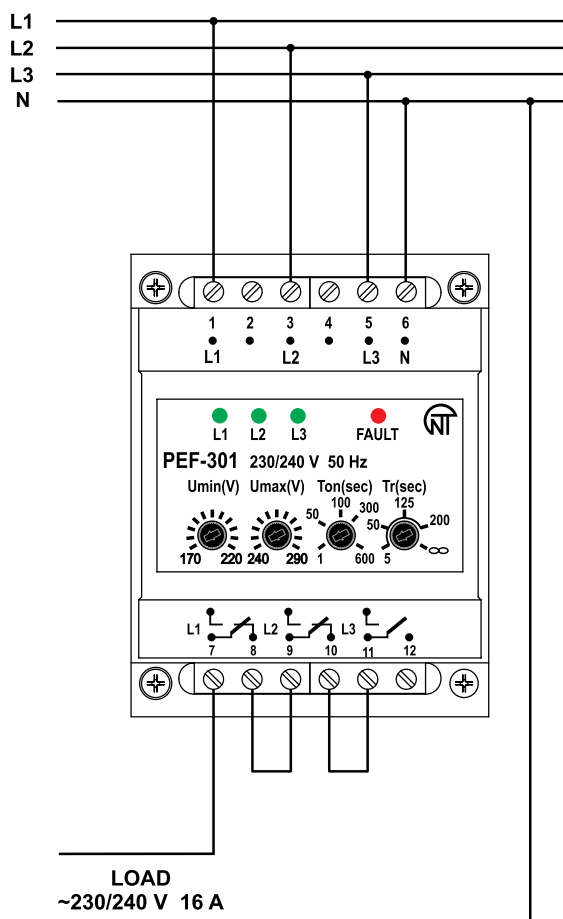
Wiring diagram №2

Magnetic starters-assisted connection under load more than 16A (remove jumper straps between the 8-9 and 10-11)

K1, K2 , K3 – magnetic starters

# UNIVERSAL AUTOMATIC ELECTRONIC PHASE SWITCH PEF-319

The PEF-319 universal automatic electronic phase switch is designed to supply an industrial and domestic single phase 230/240 V, 50 Hz load from three-phase four-wire mains 3x400+N in order to maintain uninterrupted power supply of essential single-phase loads and protect them against unallowable voltage variations in the mains. PEF-319 – with additional relay 16A, PEF-319-30 – with additional relay 30A.

According to the voltage presence and voltage quality on the phases, the PEF-319 will automatically select the optimum phase in limits range set by user and switch the single-phase load supply to this phase:
- If power is less than 6.6 kW (30 A), the load is energized directly from the PEF-319;
- If power is more than 6.6 kW (30 A), the PEF-319 controls the magnetic contactors (MC) single phase coils of the corresponding power (MS are not included in supply complete package).
  The maximum and minimum voltage limits are set by user.
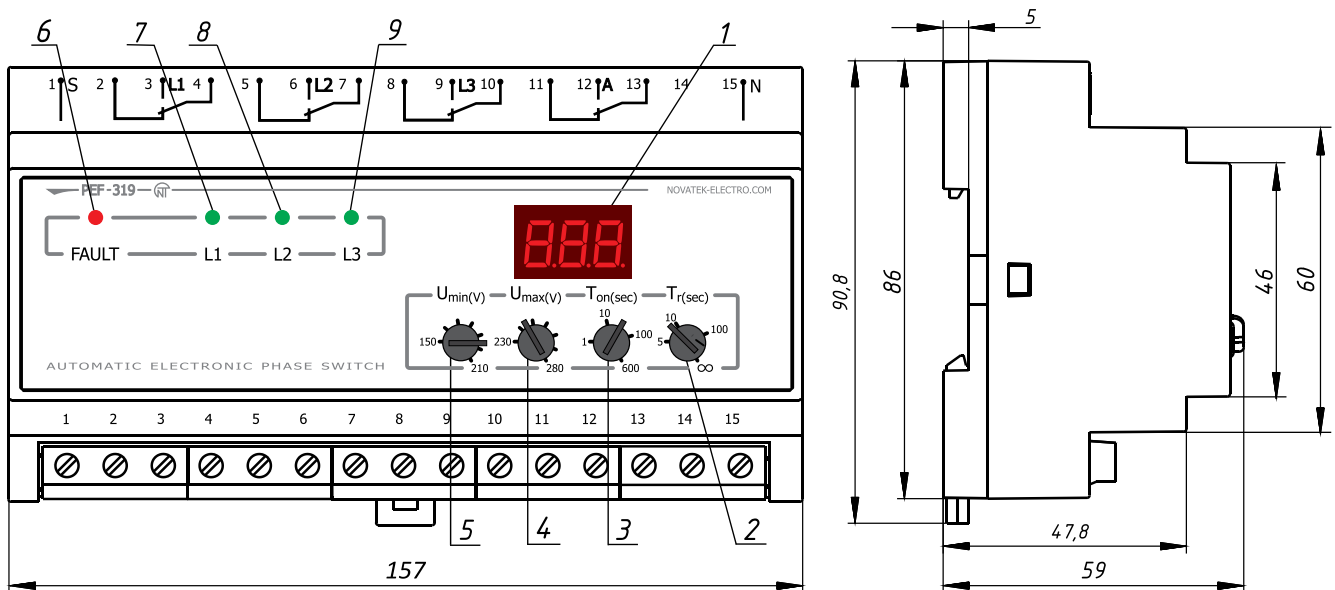
1– seven-segment display;
2 – knob for time delay setting of return to the priority phase, Tr;
3 – knob of time setting of automatic re-switching, Ton;
4 – knob for threshold trip setting on maximal voltage, Umax;

5 – knob for threshold trip setting on minimal voltage, Umin;
6 – LED indicator of alarm;
7 – LED indicator of phase L1;
8 – LED indicator of phase L2;
9 – LED indicator of phase L3.

Figure 1 – Controls and dimensions

Function of contact connection terminals:

1 – external contactor control;
2 – transit terminal of phase L1 relay;
3 – input of phase L1;
4 – output of phase L1 relay;
5 – транзитный контакт реле фазы L2;
6 – input of phase L2;
7 – output of phase L2 relay;
8 – transit terminal of phase L3 relay;
9 – input of phase L3;

10 – output of phase L3 relay;
11 – closed at switching off terminal of additional relay;
12 – closed at switching on terminal of additional relay;
13 – switching type terminal of additional relay;
14 – not connected;
15 – neutral of main (neutral wire).

Table 1. – General Data   *Basic Technical Specifications*

Description	Value
Device scope	Control and distribution device
Construction type (installation)	On standard DIN-rail, 35 mm
Protection degree of: - device	IP40
- terminals block	IP20
Climatic version	NC 3.1
Pollution rate	II
Electric shock protection class	II
Category of overload	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Cross-section of connection terminal wires, mm2	2-4
Screw torque of terminal clams, N*m	0.4

Table 2. – Technical Specifications

Description	Value
Nominal phase voltage, V	230/240
Operating capability voltage, on single phase, V	120
Mains frequency, Hz	45 - 65
Trip threshold for UMIN, V	150 - 210
Trip threshold for UMAX, V	230 - 280
Time delay range for return to the priority phase, sec	5 - 200
Note – If knob Tr is in position «∞» there is no return to the priority phase	
Time delay range of reclosing, Ton, sec	1 - 600
Fixed time delay of switching over (switching off) for UMIN, sec	12
Time of switching over to reserve phases, sec, not more than	0.2
Hysteresis (reset coefficient) on voltage, V	5 - 7
Accuracy of threshold trip, V	±3
Maximum switched current (active) of additional relay output contacts, A	
– PEF-319	16
– PEF-319-30	30
Device operating capability phase voltage, V	400
Short time allowable operating capability maximal phase voltage, V	450
Power consumption (under load), VA, not more than	10
Service life of output contacts:	
– Under load 30 A (active voltage), operations, not less than	100 000
– Under load 5 A, operations, not less than	1 000 000
Overall dimensions, mm	157 x 90.8 x 59
Weight, kg, not more than	0.38
Mounting – on standard DIN-rail 35 mm.	
Mounting position – user defined.	

PEF-319 meets the requirements of: IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2. Harmful substances in concentration more than allowed are absent.
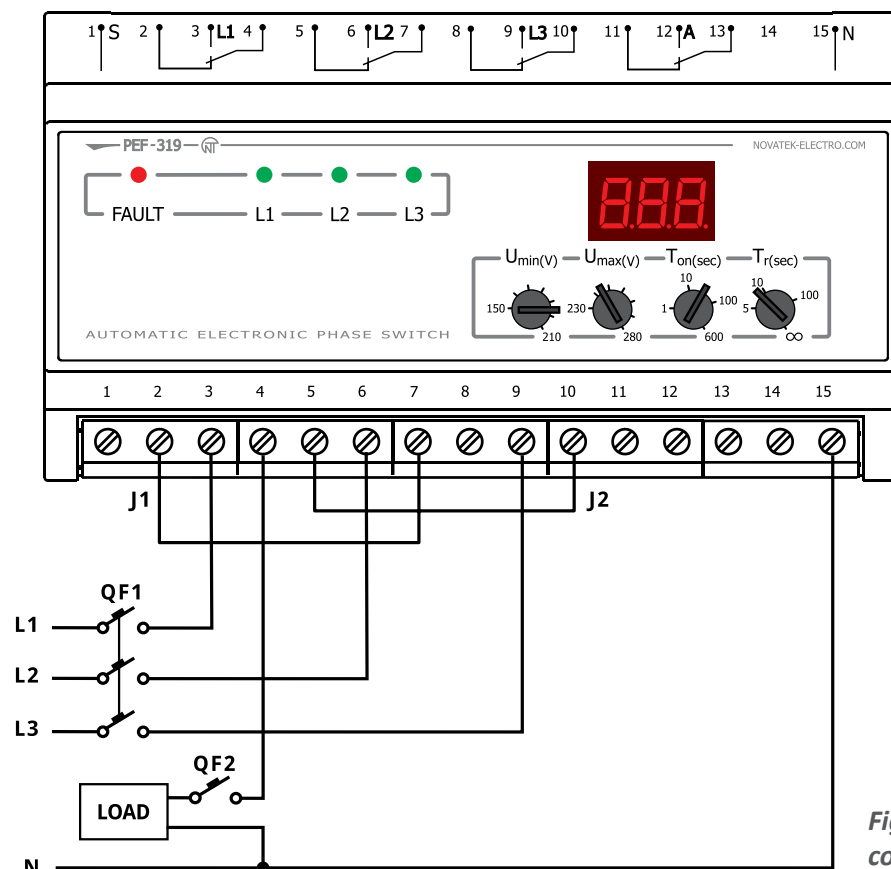
J1, J2 – Power link jumpers
QF1, QF2 – Automatic circuit breakers (with nominal not exceeding 30 A).

Figure 2. – The scheme of PEF-319 connection with load value less than 30 A

K1, K2, K3 – magnetic starters (MS)
QF1 – Automatic breaker (the breaker nominal is selected according to the power of the connected loading)
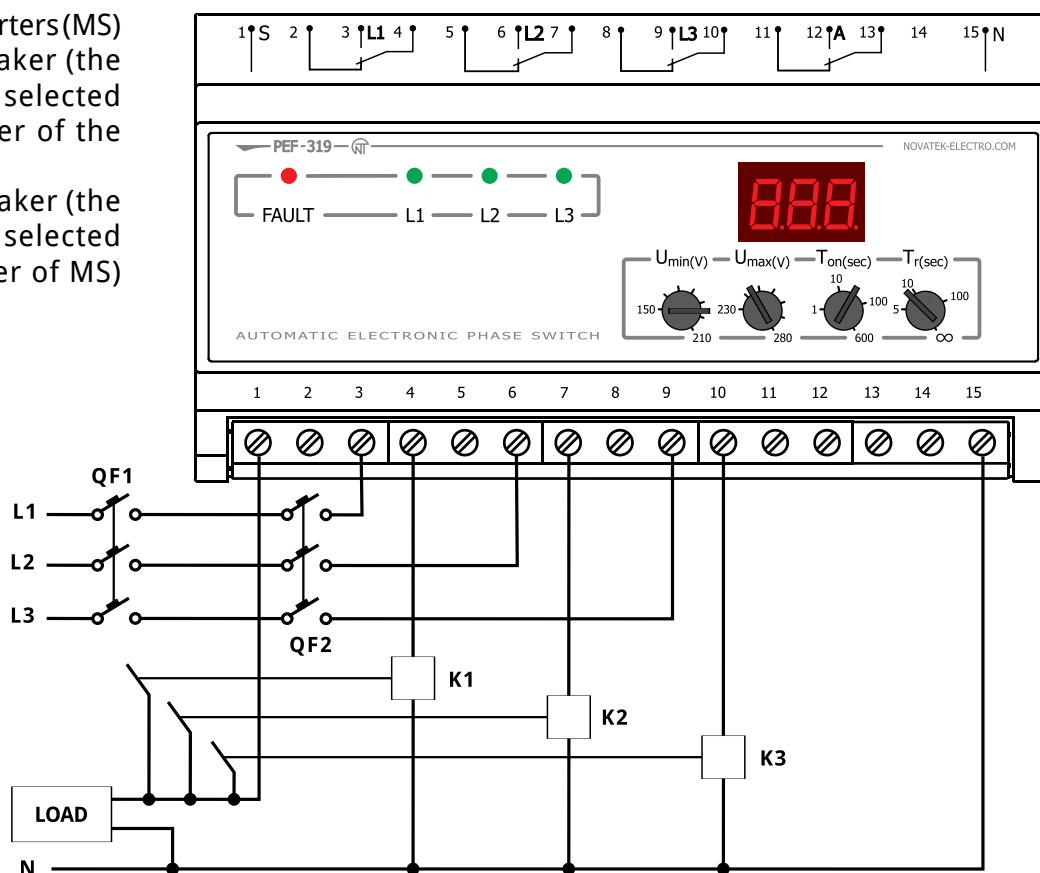QF2 – Automatic breaker (the breaker nominal is selected according to the power of MS)

Figure 3. – The scheme of PEF-319 connection with load value more than 30 A with use of magnetic contactors
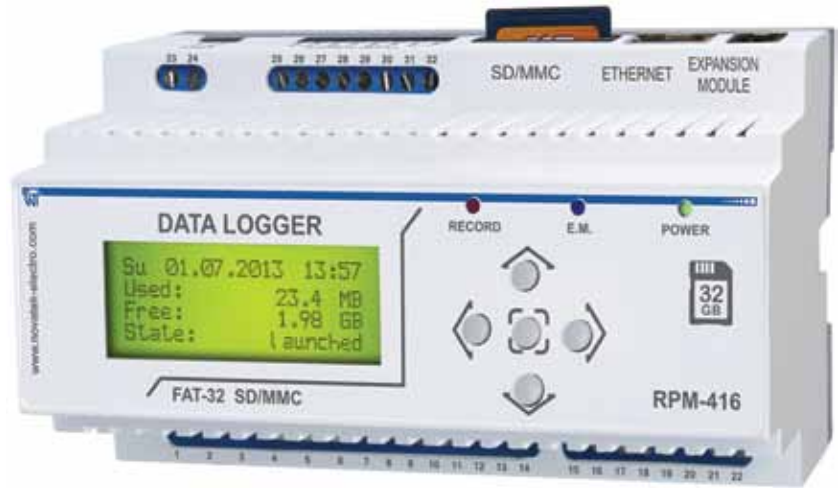
Section 9

RECORDER OF ELECTRIC PROCESS

POWER ANALYSER AND DATA LOGGER
RPM – 416

The product meets the requirements of the following: IEC 60947-1; IEC 60947-6-2; CISPR 11; IEC 61000-4-2. Harmful substances, in more than allowed concentration, are not available.

Data logger RPM-416 is a microcontroller based device intended for power quality analysis and electrical parameters measuring and monitoring on the data logger display as well as data archiving with a minimum sampling speed of 1 millisecond.

The data archiving is made on the removable memory card (SD/MMC) upto 32GB. RPM-416 has an inbuilt real time clock with power from a lithium-type battery.
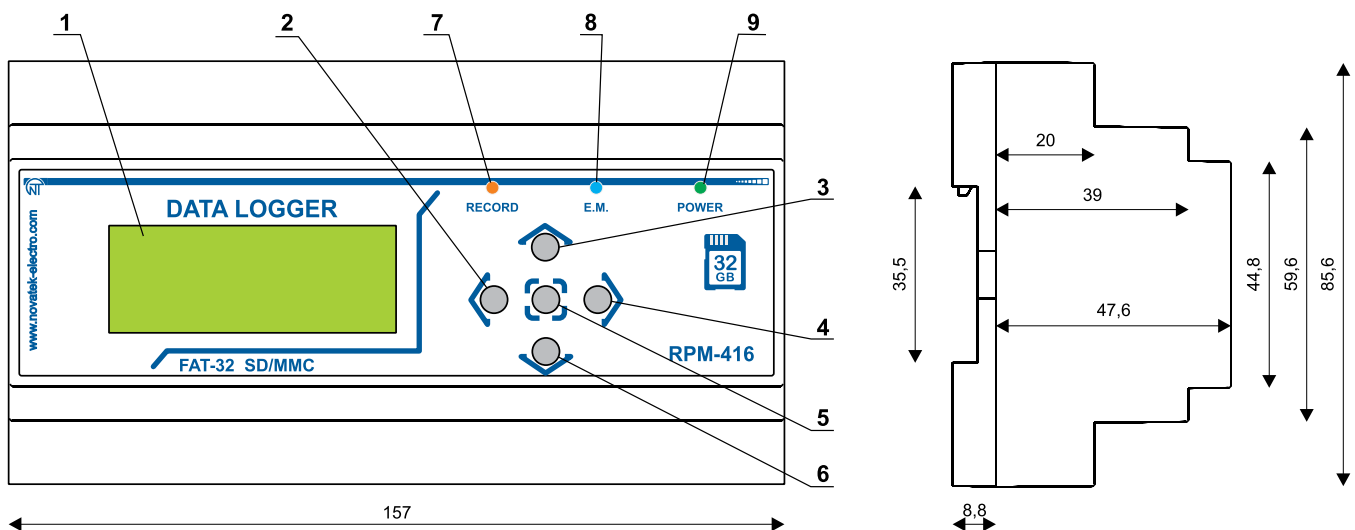
Controls

1 – Display (yellow-green indication);
2 – Button ◁ (left) is used for moving the indicator to the left;
3 – Button ⌃ (up) is used for moving the indicator upwards or for increasing parameter value;
4 – Button ▷ (right) is used for moving the indicator to the right;
5 – Button ⬤ (enter) is used for value entry approval or menu item choice;
6 – Button ⌄ (down) is used for moving the indicator downwards or for decreasing the parameter value;

7 – LED indicator RECORDING (light on – when the data recording on the memory card is initiated, light off – when the data recording on the memory card is finished, flare up – when the data recording on the memory card is paused, flickering – when there is at least one error in the data logger operation);
8 – LED indicator E.M. (E.M. light on – when at least one expansion module is connected, flickering – when there is data transmitting between expansion modules, light off – when the expansion modules are not connected);
9 – LED indicator POWER (light on – when the power is on, light off – when the power is off)

Figure 1. – Data logger design with overall and fixing dimensions and data logger controls

The main possibilities of the data logger:

- **Multi-channelling** – one data logger is sufficient for all working data receiving from the controlled device;
- **Versatility** – the additional modules can be connected to the data logger which makes it possible to expand the range of incoming signals (voltage, current, temperature, discrete inputs, etc.);
- **Galvanic separation** – incoming signals of high voltage and current are galvanic separated from other inputs which ensures easiness of data logger connection;
- **High fidelity** – self-control system and data saving algorithm protect against data loss in case of emergency situations (power supply failure);

- **Servicing convenience** – four-lined symbolic display with illuminating enables to adjust the data logger and monitor its work (the values of recorded incoming signals are shown on the display), the key-board is used for setting and control of the data logger.

Remote monitoring and configuration – if the data logger is installed in a hard-accessible place with Ethernet connection it can simultaneously with the data recording on the memory card make data transmitting to PC. It enables to make a remote monitoring of the object. The more detailed analysis can be made on the basis of the data stored on the memory card. Web-interface enables via PC browser to make a remote configuration of the data logger without installing any other additional programs. FTP provides remote access to the memory card to retrieve or delete files.

Table 1. – General Data   *Basic Technical Specifications*

Description	Value
Operating supply voltage (⊢), V	230 / 240
Voltage at which service capability is maintained (⊢ / ⌐), V	24 – 265
Power-line frequency, Hz	45 – 65
Power consumption (from line ~220 V), W, not more	6.0
Power consumption (from power source +24 V), W, not more	2.2
Period of data recording to the memory card, sec.	**0,001 – 3600**
External memory storage (memory card, optional)	SD / MMC
Maximal capacity of external memory card, GB	32
Supported file systems of external memory card, FAT	12, 16, 32
Minimal size of data file, KB	32
Maximal size of data file, MB	512
Size of one block of recorded data (20 parameters), byte	88
Error of clock run, at temperature 25 ºC, not more, sec / day	1
Connection to Ethernet or PC	10Base-T / 100Base-T
Modbus TCP	yes
Web-interface	yes
FTP	yes
The intent of the device	Digital indication devices
Nominal working mode	continuous
Protection class rating (case / terminal block)	IP40 / IP20
Protection class from electric shock	II
Climatic version	NC3.1 (average and cold zone, indoor)
Pollution level	II
Overvoltage category	II
Isolation nominal voltage, V	450
Nominal impulse withstand voltage, kV	2.5
Cross-section area of connection terminals, mm²	0.2 – 2.5
Terminal screw, N*m	0.4
Weight, kg, not more	0.5
Overall dimensions, mm	91 x 157 x 56.3
Assembling is designed on standard DIN-rack 35 mm	
Orientation, user-defined	

Table 2. – Inputs characteristics

Description	Value
Voltage input	3 channels
Voltage measuring range, V	3 – 450
Voltage measuring error (for a sine signal)	to 300 V ± 1 % exceed 300 V ± 1.5%
Voltage measuring type	RMS / Instant / Peak
Voltage frequency measuring range, Hz	25.00 – 70.00
Voltage frequency measuring error (for sine signal), Hz	± 0.05
THDr measuring range	0 – 100 %
THDr measuring error (if the signal level more than 14% of the range)	± 2 %
Current input	4 channels
Current measuring range, A	0.05 – 10.00
Current measuring error (for a sine signal)	± 1.0 %
Current measuring type	RMS / Instant / Peak
Current sensor type	CT with output 5 A
Supported rating values CT, A	5, 10, 15, 20, 30, 40, 50, 75, 100, 150, 200, 300, 400, 600, 800, 1000, 1500, 2000
Current frequency measuring range, Hz	25.00 – 70.00
Current frequency measuring error (for sine signal)	± 0.05 %
Overload capability 50 A (not often than once a minute), not more, sec	0.3
THDr measuring range	0 – 100 %
THDr measuring error (if the signal level more than 14% of the range)	± 2 %
***Working power input**	3 channels
Active power measuring range, W	30 – 200 000 000
Reactive power measuring rate, VAr	30 – 200 000 000
Gross power measuring range, VA	30 – 200 000 000
Power factor measuring range, cos φ	0.01 – 1.000
Power measuring error (for a sine signal)	± 2 %
Maximum value of active energy scaler, kW*h	999 999 999
Maximum value of reactive energy scaler, kVAr*h	999 999 999
Temperature input	2 channels
Temperature sensor type	PTC1000 / PT1000
Temperature measuring range for PTC1000, ºC	from -50.0 to +120.0
Temperature measuring range for PT1000, ºC	from -50.0 to +250.0
Temperature measuring error	± 1.5 °C
Voltage input 0 – 10 V (∪)	1 channel
Voltage measuring range, V	0.01 – 10.00
Voltage measuring error	± 1.0 %
Voltage sensor type	0 – 10 V / 2 – 10 V
Current input 0 – 20 mA (∪)	1 channel
Current measuring range, mA	0 – 20
Current measuring error	± 1.0 %
Current sensor type	0 – 20 mA / 4 – 20 mA
Digital input	4 channels
Measuring range	closed – opened
Digital signal sensor type	Dry contact
Pulse frequency measurement range, Pulse * min	1 – 29000
Maximum value of pulse scaler	999999999

Table 2. – The list of channels with corresponding names of measured values

Ch.	Number values					
	1	**2**	**3**	**4**	**5**	**6**
1	Voltage RMS, V	Frequency, Hz	THDr, %	Peak + voltage, V	Peak – voltage, V	Instantaneous voltage, V
2	Voltage RMS, V	Frequency, Hz	THDr, %	Peak + voltage, V	Peak – voltage, V	Instantaneous voltage, V
3	Voltage RMS, V	Frequency, Hz	THDr, %	Peak + voltage, V	Peak – voltage, V	Instantaneous voltage, V
4	Current RMS, A	Frequency, Hz	THDr, %	Peak + current, A	Peak – current, A	Instantaneous current, A
5	Current RMS, A	Frequency, Hz	THDr, %	Peak + current, A	Peak – current, A	Instantaneous current, A
6	Current RMS, A	Frequency, Hz	THDr, %	Peak + current, A	Peak – current, A	Instantaneous current, A
7	Current RMS, A	Frequency, Hz	THDr, %	Peak + current, A	Peak – current, A	Instantaneous current, A
8	Temperature, ℃	–	–	–	–	–
9	Temperature, ℃	–	–	–	–	–
10	Analog voltage, V	User's Value	–	–	–	–
11	Analog current, mA	User's Value	–	–	–	–
12	Digital input	Frequency, Pulse*min	Pulse Scaler	–	–	–
13	Digital Input	Frequency, Pulse*min	Pulse Scaler	–	–	–
14	Digital Input	Frequency, Pulse*min	Pulse Scaler	–	–	–
15	Digital input	Frequency, Pulse*min	Pulse Scaler	–	–	–
16	Active power, W	Reactive power, var	Full power, VA	Power factor, cos φ	Active Energy Scaler, kW*h	Reactive Energy Scaler, kVAr*h
17	Active power, W	Reactive power, var	Full power, VA	Power factor, cos φ	Active Energy Scaler, kW*h	Reactive Energy Scaler, kVAr*h
18	Active power, W	Reactive power, var	Full power, VA	Power factor, cos φ	Active Energy Scaler, kW*h	Reactive Energy Scaler, kVAr*h
19	Line voltage AB, V	Line voltage BC, V	Line voltage CA, V	Negative sequence voltage, V	Positive sequence voltage, V	Zero sequence voltage, V

Table 2. – Types of parameters and their names

Type	Name	Unit of measurement	Resolution
0	Unknown (parameter not use)	–	–
1	Voltage RMS	V	0.1
2	Voltage Instantaneous	V	0.1
3	Peak + voltage (positive half wave)	V	0.1
4	Peak – voltage (negative half wave)	V	0.1
5	Current RMS	A	0.01
6	Current Instantaneous	A	0.01
7	Peak + current (positive half wave)	A	0.01
8	Peak – current (negative half wave)	A	0.01
9	Frequency	Hz	0.01
10	THDr	%	1
11	Temperature	°C	0.1
12	Analog voltage 0-10 V	V	0.01
13	Analog current 0-20 mA	mA	0.01
14	Digital input (ON / OFF)	–	1
15	Full power	VA	0.1
16	Active power	W	0.1
17	Reactive power	Var	0.1
18	Power factor (cos φ)	---	0.001
19	Active Energy Scaler	kW*h	0.1
20	Reactive Energy Scaler	kVAr*h	0.1
21	User's Value	–	0.1
22	Pulse Frequency	Pulse*min	0.1
23	Pulse Scaler	–	1
24	Line voltage AB	V	0,1
25	Line voltage BC	V	0,1
26	Line voltage CA	V	0,1
27	Negative sequence voltage	V	0,1
28	Positive sequence voltage	V	0,1
29	Zero sequence voltage	V	0,1

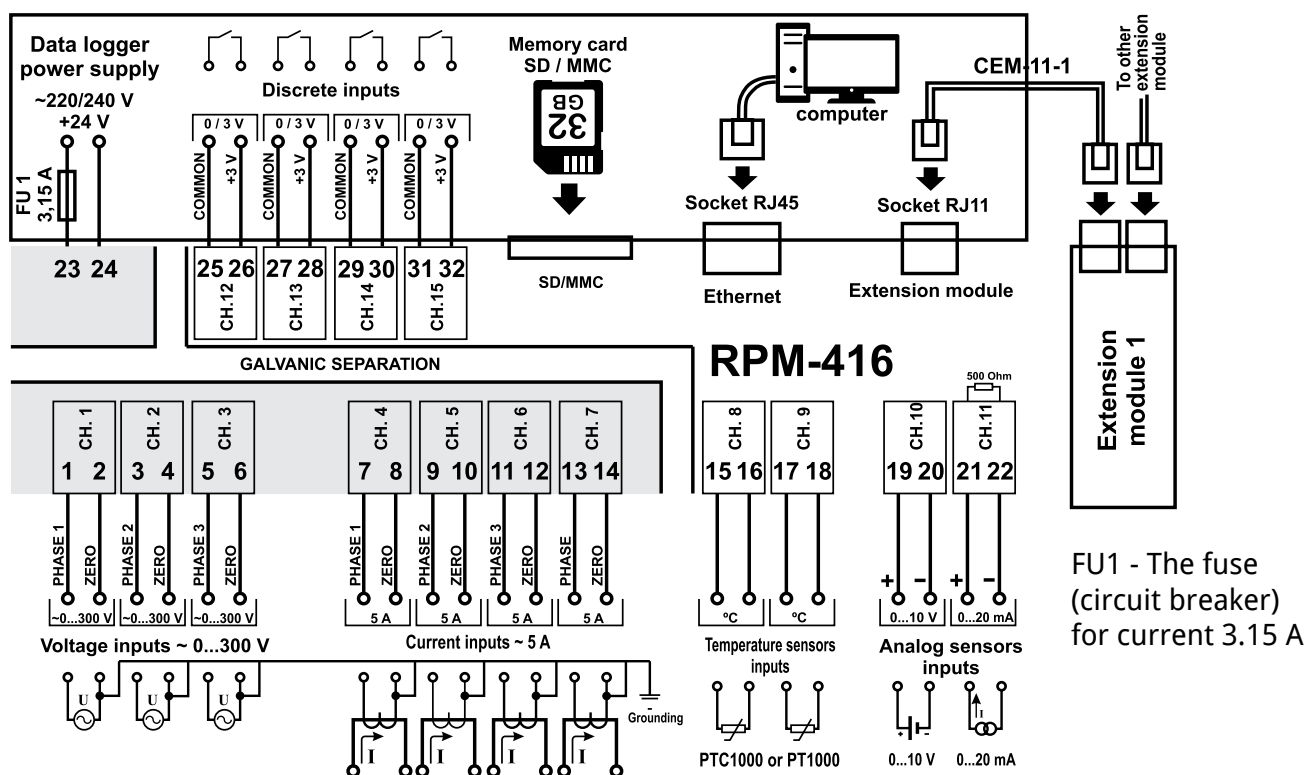*Figure 1. – Connection diagram of RPM-416*

INTERFACE CONTROLLER (RS-485 TO GSM/GPRS AND ETHERNET) EM-481

The device meets the requirements of the following:

- *EN 60947-1, Low-voltage switchgear and control-gear; Part 1; General rules;*
- *EN 60947-6-2, Low-voltage switchgear and control-gear; Part 6-2; Multiple function equipment; Control and protective switching devices (or equipment) (CPS);*
- *EN 55011, Industrial, scientific and medical RF equipment; Electromagnetic interference characteristics; Limits and methods of measurement;*
- *IEC 61000-4-2, Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test.*
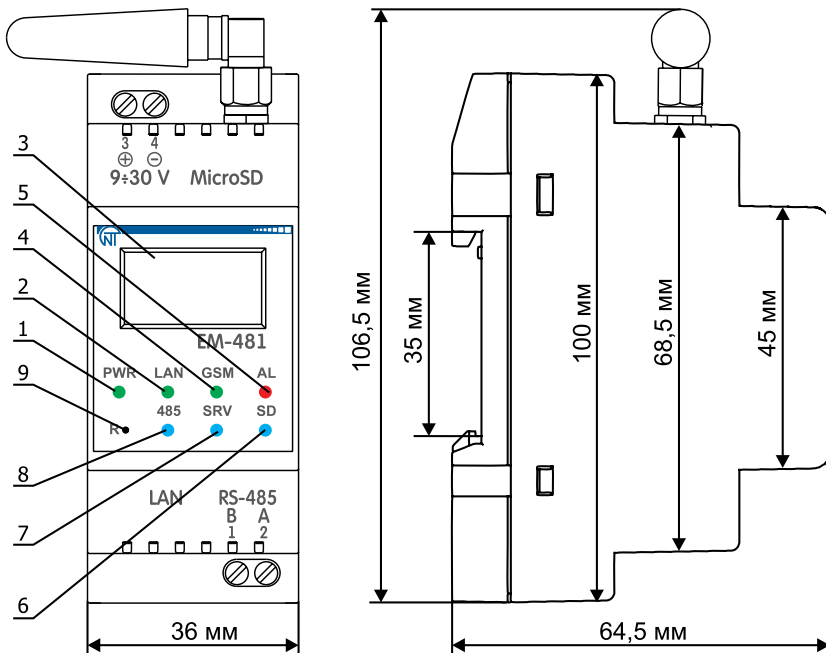
1 – "PWR" LED is on when there is supply voltage;
2 – "LAN" LED is on when connected to Ethernet network, it blinks while the data exchanging via the network;
3 – The display serves to display the state of the device, the connections, the load of the communication interfaces, and showing of warnings about detected faults;
4 – "GSM" LED is blinking every 3 sec. when there is connection via GSM network, it is blinking 3 times per second while data exchanging via GPRS;
5 – "AL" LED warns about the registration of the fault in the course by analysis of the received data;

6 – "SD" is on when there is a memory card in a special slot, it is blinking while the data exchanging to SD-card;
7 – "SRV" is on when there is a connection with a server for data collation, it is blinking while data exchanging with the server;
8 – "485" is on when waiting a respond from the device in Modbus network; it is blinking while data exchanging via Modbus network;
9 – "R" reset button (is located under the housing, designed to restart the device or by thin non-conducting current subject).

Figure 1. – Overall and mounting dimensions of EM-481

Device Purpose

EM-481 provides data collection from connected MODBUS devices, data transfer to the server, data access (via MODBUS TCP or SMS text messages), event tracking and response to events (sending SMS notifications, recording values to MODBUS devices).

EM-481 provides:

Flexible options of connection (via wire or wireless communication, automatic method selection of communicating with a server, automatic or manual selection of GSM provider and communication parameters, resetting of MAC-address and other Ethernet settings;

Protection of access (password for setting mode, filter of IP-address for setting or connection to Modbus network, connection only to the selected server with automatic login, password for control via SMS);

Different modes of data interchange via MODBUS network (RTU or ASCII, with checking of parity for even-odds or without checking, wide range of transmitting rate, adjustable delay); programming the collection of data, events, and action for events (see Appendix C);

Service functions (real time clock, firmware updating option).

Table 1. – Technical Specifications

| Description	Value
DC rated supply voltage, V	12
Data exchange interface via wired network	10Base-T/100Base-T
Supported Ethernet protocols	UDP, ARP, TCP
Data exchange interface via wireless network	GSM
Supported standards of wireless network	SMS, GPRS
Integrated servers	MODBUS TCP, HTTP
Maximum number of connections via Modbus TCP protocol	4
Data exchange interface via Modbus network	RS-485
Supported protocols of Modbus network MODBUS via RS-485	MODBUS RTU, MODBUS ASCII
Transmission speed in the MODBUS network via RS-485, bit/s	75 – 921600
Maximal output voltage of driver RS-485, V	3.3
Short circuit output voltage of driver RS-485 (maximum), mA	250
Resistance of in-built terminator, Ohm	70 – 1000 Ohm or disabled
The recommended number of connected devices in Modbus network:	
– when the input current of receivers on RS-485 bus is no more than 0.125 mA;	256 max.
– when the input current of receivers on RS-485 bus is no more than 1 mA;	32 max.
Readiness time when power is applied, no more than, s	15*
The supply voltage at which the operability is maintained	9 –30
Power consumption (under load), W, not more than	6
Device service	Switchgear and control-gear
Rated operating condition	Continuous
Protection class rating	IP20
Electric shock protection class	II
Climatic design version	UHL 3.1
Permissible contamination level	II
Overvoltage category	II
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	2.5
Conductor cross-section for connecting to terminals, mm²	0.5-3
Tightening torque of the terminal screws, N * m	0.4
Weight, kg, maximum	0.400
Overall dimensions (Fig. 1.1), H*B*L, mm	
– with installed GSM antenna	64.5*106.5*36
– without GSM antenna	64.5*100*36
Installation (mounting) of the device is on standard 35 mm DIN-rail	
The device remains operational capability in any position in space	
Housing material - self-extinguishing plastic	
Notes: * Connections in Ethernet networks/Internet can take more time.	

The device provides control for MODBUS devices in RS-485 network via Ethernet interfaces or GPRS, or via SMS. The device also allows reading data of devices by MODBUS. The processor supports connection to cloud-based data collection server via Ethernet network with a help of microchip of physical interface of Ethernet (or via GPRS with a help of in-built GSM-modem, if connection via Ethernet is not available).

In addition, the device can be connected to Ethernet via MODBUS TCP Protocol to exchange data with MODBUS devices, or with EM-481. The controller receives and processes SMS with a password and command read/write for Modbus devices.

When inserting a memory card the device reads the internal memory for operational logic - program for data collection and tracking of events. The program runs in the background mode.

The device stores the network settings, safety parameters, the logic of action, the collected data log in the built-in memory.
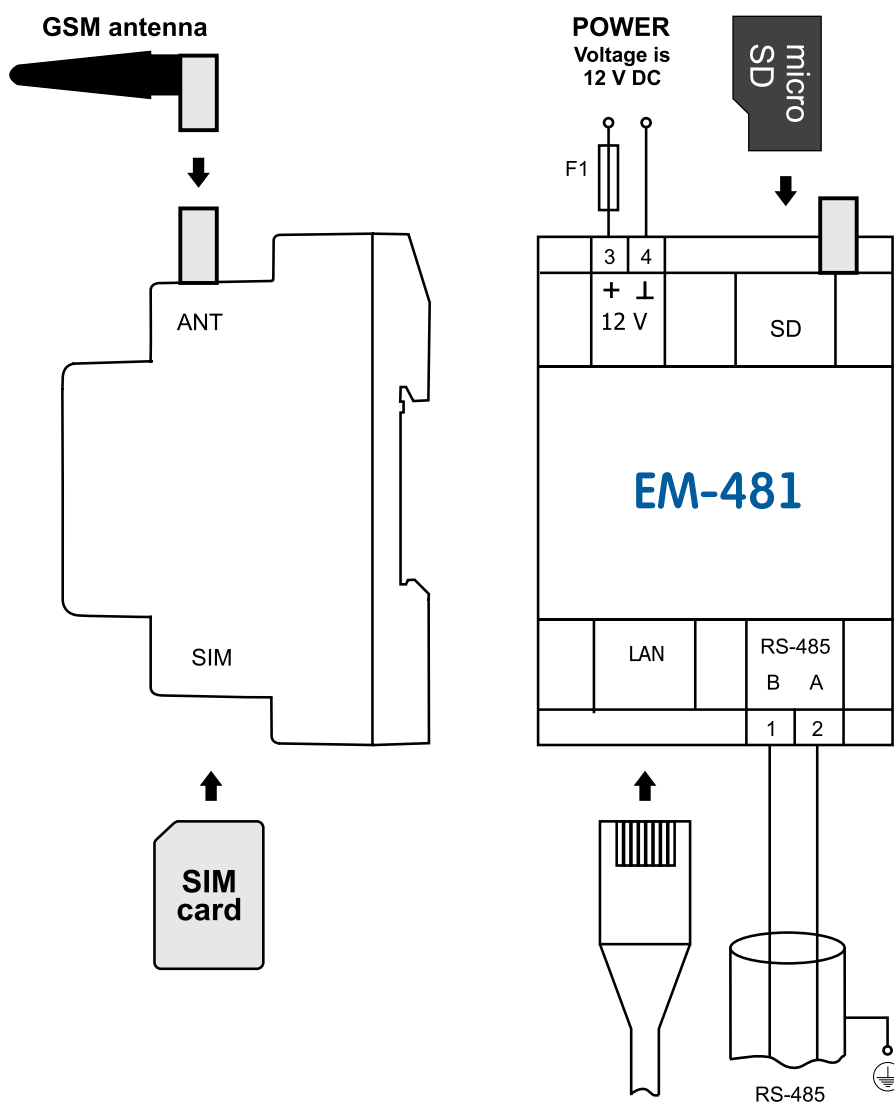
F1 – fuse (fuse element) for current of 2.5 A;
Contact "A" is designed for transmission of non-inverted signal;
Contact "B" is designed for transmission of inverted signal.

Figure 5.1 – Connection Diagram of the device

SMART RELAY WITH UNIVERSAL I/Os AND INTERFACE CONTROLLER
(RS-485 TO GSM/GPRS AND ETHERNET)
EM - 486

The product meets the requirements:

EM-486 meets the requirements of IEC 60950-1:2001

Data processing devices. Safety measures. Part 1. General requirements.

Low voltage complaint switchgears. Part 1. General rules (IEC 60947-1:2004, IDT).

Electromagnetic compatibility. Equipment is industrial, scientific and medical radio-frequency. Characteristics of electromagnetic interference. Limits and methods of measurement (CISPR 11:2004, IDT).

Low-voltage switchgear and control-gear. Part 6-1. Multiple function equipment. Transfer switching equipment (IEC 60947-6-1:2005, IDT);

Electromagnetic compatibility. Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment (EN 55013:1997, IDT)

Harmful substances in quantities exceeding the maximum permissible concentrations are not available.

EM-486 provides for data collection from connected devices (analog transducers and MODBUS devices), data transmission to the server, and access to data (via MODBUS TCP Protocol or via SMS text messages), tracking events and response to the events (control of the relay, recording the values in MODBUS devices).

Purpose

Interface controller RS-485 via mobile communication EM-486 provides access to readings of gauges and registers of Modbus connected via RS-485 interface MODBUS TCP with the help of text SMS messages, EM-486 has:

- Flexible options of connection (via wire or wireless communication, automatic method selection of communicating with a server, automatic or manual selection of GSM provider and communication parameters, resetting of MAC-address and other Ethernet settings);
- Protection of access (password for setting mode, filter of IP-address for setting or connection to
- Modbus network, connection only to the selected server with automatic login, password for control via SMS);
- Different modes of data interchange via RS-485 (RTU or ASCII, with checking of parity

for even-odds or without checking, wide range of transmitting rate, adjustable delay);
- programming the collection of data, events, and action for events (see Appendix B);
- Programmable outputs for reaction at events and alarms;
- Programmable inputs for analog sensors;
- Programmable impulse meters for every sensor;
- Power output for sensors;
- Reserve power supply input;
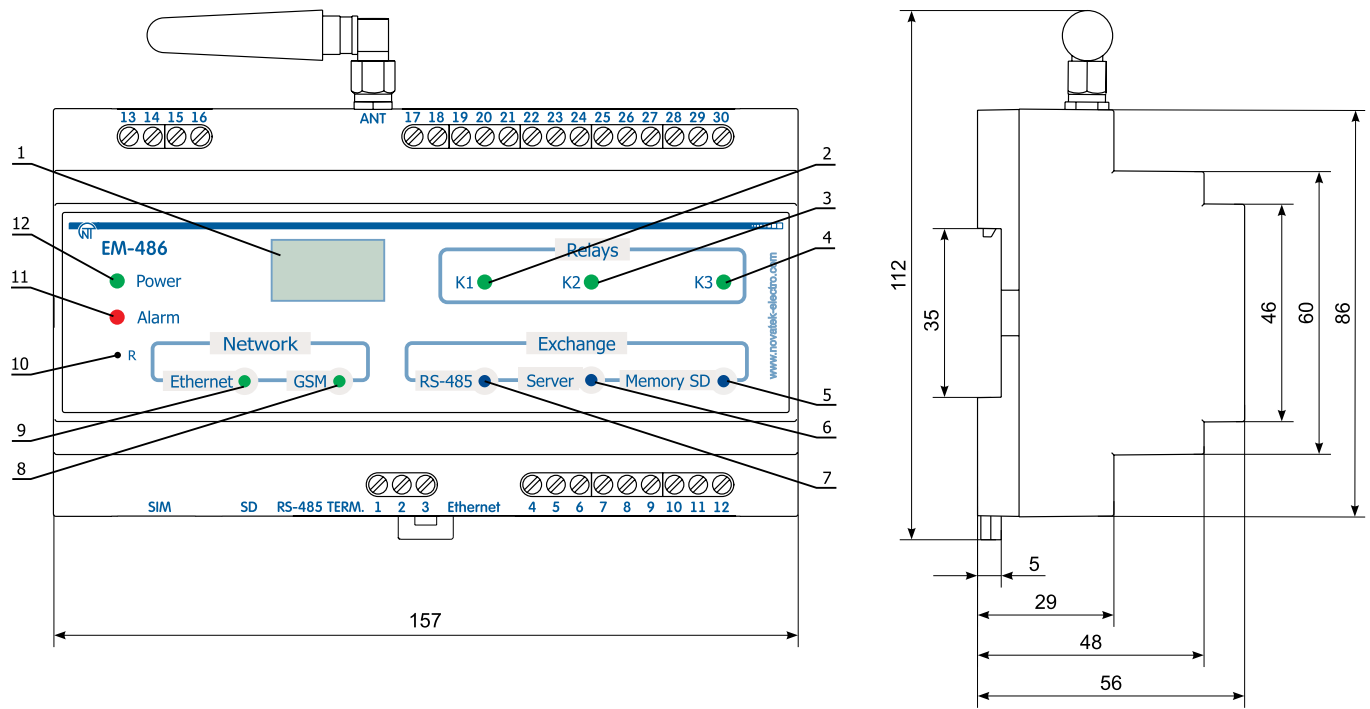- Service functions (real time clock, firmware updating option).

Figure 1 – Overall dimensions of the unit

1 – Graphic display OLED is designed for indicating the state of the unit, connections, communication interface loading and showing the alarm messages.

2 – Indicator **«K1»** is lit on when relay K1 is activated.

3 – Indicator **«K2»** is lit on when relay K2 is activated.

4 – Indicator **«K3»** is lit on when relay K3 is activated.

5 – Indicator **«Memory SD»** is lit on when there is a memory card in a special slot, is blinking while transmitting the data to the SD-card.

6 – Indicator **«Server»** is lit on when there is a connection with a server for data accumulating, is blinking while data exchange with a server.

7 – Indicator **«RS-485»** is lit on when waiting a respond from a device in Modbus network; is blinking while data exchange via Modbus net work.

8 – Indicator **«GSM»** is blinking every 3 sec. when there is a connection via GSM network, is blinking 3 times per second while data exchange via GPRS.

9 – Indicator **«Ethernet»** is lit on when there is a connection via Ethernet network; it is blinking while data exchange via network.

10 – Reset button **«R»** (is located under the casing and is available for pressing with a help of thin object such as a paper clip) is designed to restart the unit or make factory reset.

11 – Alarm indicator **«Alarm»** warns about an error registration by the analysis of received data.

12 - LED Indicator **«Power»** is lit on when power voltage present.

EM-486 provides control for MODBUS devices in RS-485 network via Ethernet interfaces or GPRS, or via the SMS. The unit also allows to read data from devices by MODBUS or from connected sensors.

The processor supports connection to the accumulating data cloud server via Ethernet network with a help of micro chip of physical interface of Ethernet (or via GPRS with a help of inbuilt GSM-modem, if connection via Ethernet is not available).

In addition, EM-486 can be connected to Ethernet via MODBUS TCP Protocol to exchange data with MODBUS devices, or with the product. The controller receives and processes SMS with a password and command read/write for Modbus devices.

When inserting a memory card the product reads the internal memory for operational logic – program for data collection and tracking of events. The program runs in the background mode.

Product stores in the internal memory the network settings, parameters of inputs and outputs, the logic of action, the collected data log.
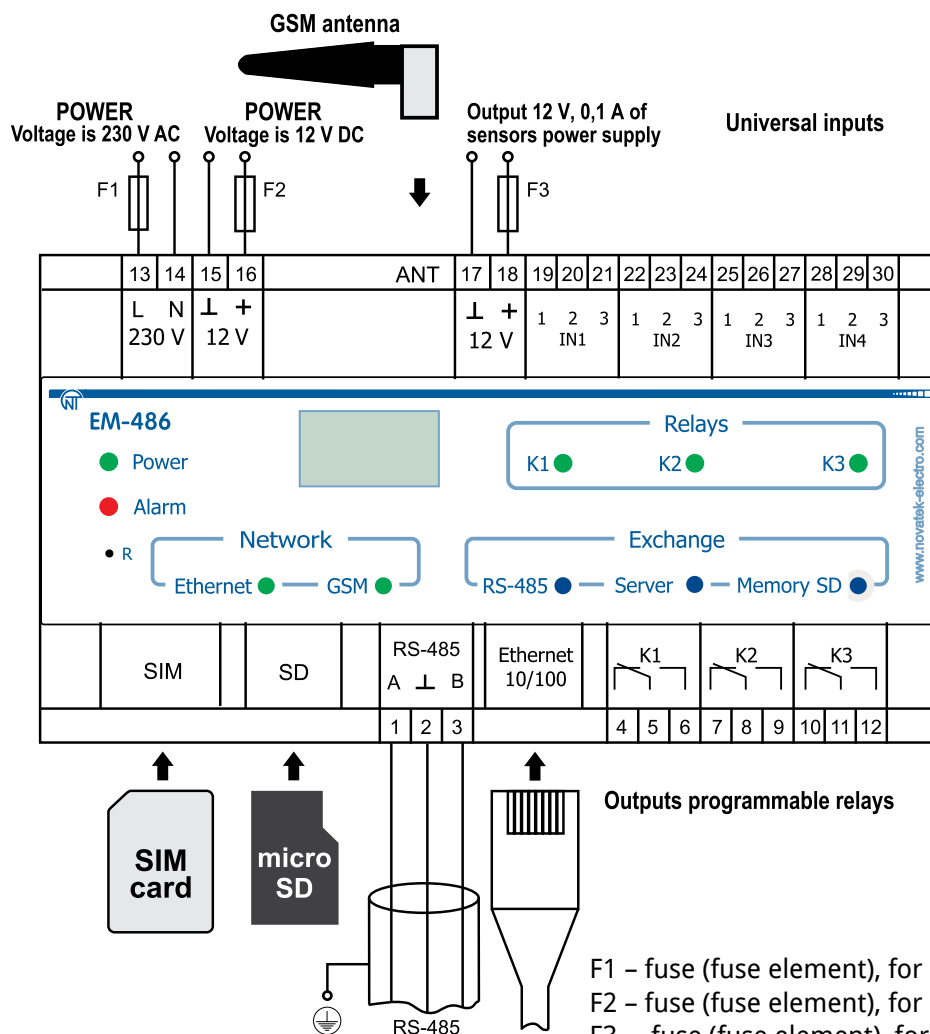
Table 1. – Main technical specifications of the unit

Operating supply voltage, VAC	230
Supply line frequency, Hz	45 – 65
Data Exchange Interface over the Ethernet network	10Base-T / 100Base-T
Supported Ethernet protocols	UDP, ARP, TCP
Data Exchange Interface over wireless network	GSM
Supported standards of wireless network	SMS, GPRS
Integrated servers	Modbus TCP, HTTP
Maximum number of connections over the Modbus TCP protocol	4
Data Exchange Interface over the Modbus network	RS-485
Supported protocols of Modbus network	Modbus RTU, Modbus ASCII
Maximal output voltage of driver RS-485, V	3.3
Short circuit output voltage of driver RS-485 (maximal), mA	250
Resistance of inbuilt terminator, Ohm	70–1 000 Ohm or deactivated
The recommended number of connected devices in Modbus network	
- at input voltage of receivers on bus RS-485 not more than 0,125 mA	Not more, 256
- at input voltage of receivers on bus RS-485 not more than 1 mA	Not more, 32
Readiness time at power switching on, sec, not more than	15*
Precision measurements of voltage, mV, not more than	40
Precision measurements of current, µA, not more than	200
Precision measurements of temperature, °C, not more than	2
Rated voltage direct current back supply , V	12
Voltage supply, at which operability is maintained:	
– alternative current, V	90 – 265
– direct current, V	127 – 375
Back supply voltage at which operability is maintained, V	9 – 16
Power consumption (under pressure), W, not more than	12
The maximum switched current of output pins, A	16
Universal inputs	4
Types of the connected gauges	Types of the connected gauges
– gauge with voltage output to 10 V	- gauge with voltage output to 10 V
– gauge with current output to 20 mA	- gauge with current output to 20 mA
– 'dry contact'	- 'dry contact'
– NTC temperature gauge	- NTC temperature gauge
The maximum voltage on the universal input, V	12
The maximum current through the universal input, mA	24
The voltage of sensors power output, V	12
The maximum current of sensors power output, A	0.1
Programmable relay outputs with switching contacts, pcs.	3
Commutation service life of output contacts:	
– electrical service life under load 16 A(cos φ = 1,0), times, not less	50 000
– mechanical service life, times, not less	10 000 000
Unit purpose	Communication equipment
Nominal operation condition	Continuous
The protection level	IP20
Climatic version	NC3.1
Permissible pollution density	II
Overvoltage category	II
Protection class against electrical shock	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Cross section of wires of connection terminals, mm²	0.5-3
Maximal tightening torque of terminals external screws, N*m	0.4
Weight, kg, not more than	0.750
Overall dimensions, H*B*L, mm: – with installed antenna	
– without antenna	157 x 112 x 56
Standard 35 mm DIN rail mounting	157 x 99 x 56
Operating position	
Housing material - self-extinguishing plastic	Arbitrary
Notes: * Connections on the Ethernet networks/Internet can take more time.	

Table 2 – Resistance of integrated terminator of bus RS-485

№	Resistance of terminator, Ohm	Position of switches «RS-485 Term.»	№	Resistance of terminator, Ohm	Position of switches «RS-485 Term.»
1	Terminator is deactivated	ON — switches 1 2 3 4 5 (all OFF)	13	132	ON — switches up: 3, 5
2	1 000	ON — switch up: 5	14	120*	ON — switches up: 1, 2
3	390	ON — switch up: 4	15	118	ON — switches up: 2, 3, 4
4	300	ON — switch up: 2	16	117	ON — switches up: 1, 4, 5
5	280	ON — switches up: 4, 5	17	107	ON — switches up: 1, 2, 5
6	230	ON — switches up: 2, 4	18	106	ON — switches up: 2, 3, 4, 5
7	200	ON — switch up: 1	19	99	ON — switches up: 1, 3, 4
8	195	ON — switches up: 3, 4	20	92	ON — switches up: 1, 2, 3
9	170	ON — switches up: 2, 3	21	90	ON — switches up: 2, 3
10	167	ON — switches up: 1, 5	22	84	ON — switches up: 1, 2, 3, 5
11	163	ON — switches up: 3, 4, 5	23	74	ON — switches up: 1, 2, 3, 4
12	145	ON — switches up: 4, 5	24	69	ON — switches 1 2 3 4 5 (all up)

* – is recommended for cable Cat. 3

GSM antenna

POWER
Voltage is 230 V AC

POWER
Voltage is 12 V DC

Output 12 V, 0,1 A of
sensors power supply

Universal inputs

13	14	15	16		ANT	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
L	N	⊥	+			⊥	+	1	2	3	1	2	3	1	2	3	1	2	3	
230 V		12 V				12 V		IN1			IN2			IN3			IN4			

EM-486

● Power

● Alarm

● R

Network
Ethernet ● — GSM ●

Relays
K1 ●   K2 ●   K3 ●

Exchange
RS-485 ● — Server ● — Memory SD ●

www.novatek-electro.com

| | SIM | | SD | | RS-485 A ⊥ B | Ethernet 10/100 | K1 | K2 | K3 | |
| | | | | | 1 | 2 | 3 | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |

SIM
card

micro
SD

RS-485

Outputs programmable relays

F1 – fuse (fuse element), for current of 0,25 A;
F2 – fuse (fuse element), for current of 2,5 A;
F3 – fuse (fuse element), for current of 0,25 A;
Contact "A" is designed for transferring
non-inverted signal,
Contact "B" is used for the inverted signal.

Figure 2 – The Unit connection diagram

Connection two-wire
temperature sensor

Connection of breaker

Connection of sensor
with output voltage up to 10 V

SENSOR
+V 0V

| 19 | 20 | 21 |
com T

EM-486

| 19 | 20 | 21 |
com no

EM-486

| 19 | 20 | 21 |
U com

EM-486

Connection of sensor with output current up to 20 mA

with external PSU (power supply unit)

with power supply from EM-486 output (12 V 0,1 A)

SENSOR
− +

SENSOR'S PSU
+V 0V

SENSOR
− +

| 19 | 20 | 21 |
Y com

EM-486

| 17 | 18 | 19 | 20 | 21 |
+12 ⊥ Y com

EM-486

Figure 3 – Sensors connection diagram

PROTOCOL CONVERTER
ET- 485

ET-485 is a microprocessor unit. The unit is designed to provide data exchange between the equipment, connected to Ethernet 10BASE-T and 100BASE-T network, and the equipment, supplied with RS-485 interface and forming Modbus network. The examples of network topology with application of ET-485 are shown in appendix C.

The unit fulfills the functions of a Modbus-server for switching the Modbus-clients to the Ethernet network. The unit provides functions of Modbus-server for connecting Modbus-clients within Ethernet network.

In the RS-485 master mode, the unit redirects Modbus-queries from the clients in Ethernet network to the devices in Modbus network and returns the answers from the devices to the clients. In the query redirection to remote server mode, the unit maintains the connection to Modbus TCP server in Ethernet network and in addition directs client queries to this server. In the RS-485 slave mode, the unit in addition accepts RS-485 queries from a Modbus-client within Modbus network.

ET-485 has:
- flexible addressing within the Ethernet network (overloading MAC-address, static and dynamic IP-address);
- different data transfer modes for Modbus network (RTU and ASCII with/without odd-even check, wide range of transmission speeds, selectable delay;

- adjustable redirection of queries;
- security access (IP address filtration and/or access password for condition reading, for setting the unit, for connection to Modbus network, and for recording/reading within Modbus network).
- possibility to update the embedded software.
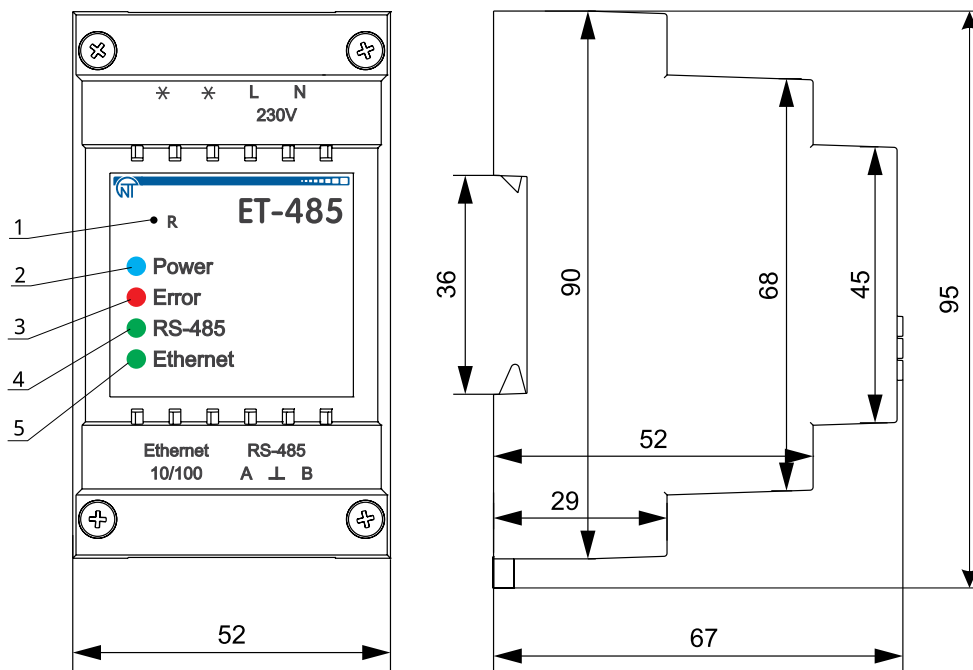
Figure 1. – Overall dimensions of the unit

ET-485 meets the following requirements:
IEC 60947-1:2004, IDT; IEC 60947-6-2:1992, IDT; CISPR 11:2004, IDT; IEC 61000-4-2:2001, IDT.

Table 1. – Main specifications of the unit

Description	Value
Operating supply voltage, VAC	230
Voltage to maintain normal operation, V	
- alternating current	100 – 265
- direct current	140 – 375
- voltage of DC backup power	7 – 24
Supply frequency, Hz	47 – 63
Data Exchange Interface over the Ethernet network	10BASE-T/100BASE-T (twisted pair)
Supported Ethernet protocols	ARP, IP, TCP, Modbus TCP, HTTP
Maximum number of connections over the Modbus TCP protocol	11
Integrated servers	Modbus-server, HTTP-server
Data Exchange Interface over the Modbus network	RS-485
Modbus network exchange modes	Driving (Master) / Driven (Slave)
Supported Modbus protocols	Modbus RTU, Modbus ASCII
RS-485 driver maximum output voltage, V	3.3
RS-485 output current of short circuit driver (limiting), mA	250
RS-485 receiver input current, mA, no more than	0.125
Integrated terminal resistance, Ohm	300
Recommend number of connected units within the Modbus network:	
- when receivers input current of RS-485 bus is doesn't more 0.125 mA	256, not more
- when receivers input current of RS-485 bus is doesn't more 1mA	32, not more
Indication	LEDs
Readiness time upon switching the unit to the mains, sec, not more than	1
Rower consumption, VA, not more than	1.2
Weight, kg, at most	0.200
Dimensions, mm	95 x 52 x 67
Unit purpose	Communication
Nominal operation condition	Continuous
Cross section of terminals connection wires, mm²	0.5 – 2.5
Terminal screws, N*m	0.4
Level of unit protection:	IP20
Protection class against electrical shock	II
Permissible pollution density	II
Overvoltage category	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Operating position	Arbitrary
Pollutants in the amount, which is not to exceed the maximum permissible concentration	None

Table 2. – Operating and storage conditions

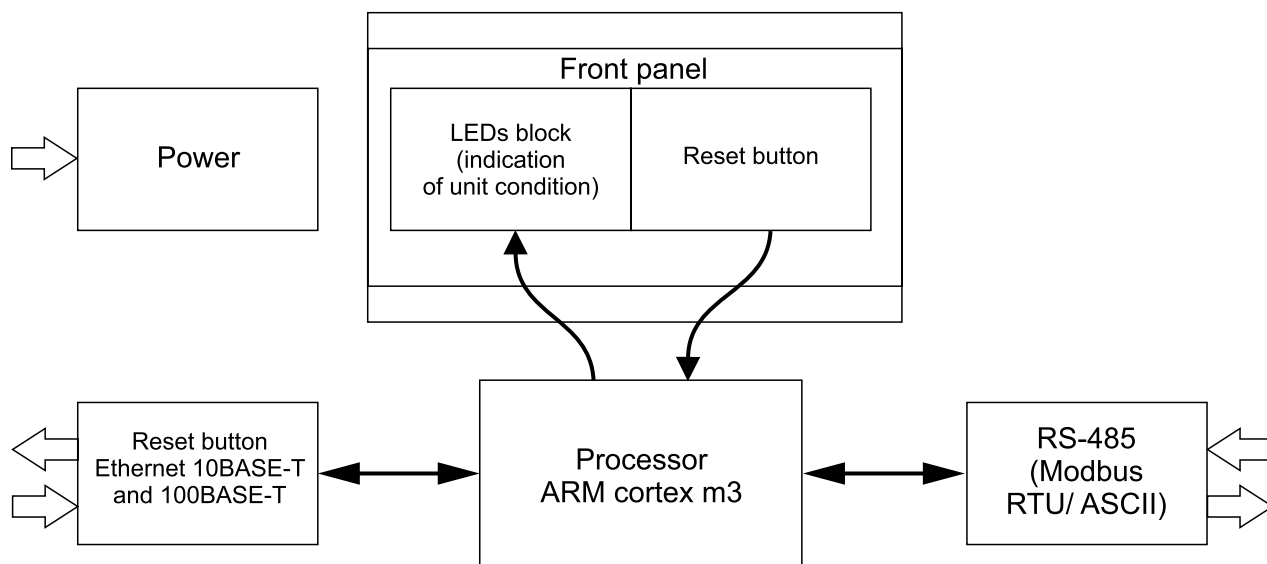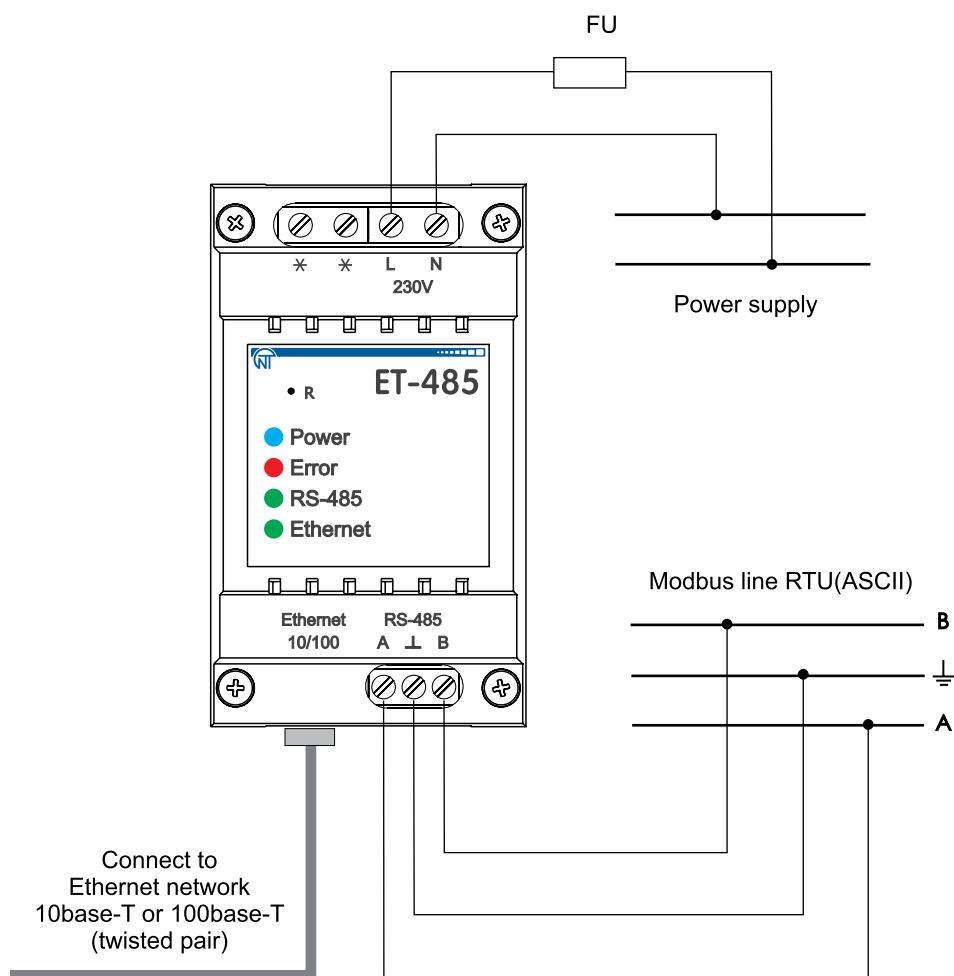|	
Operating temperature, °C	from minus 35 to +55
Storage temperature, °C	from minus 50 to +60
Atmospheric pressure, kPa	from 84 to 106.7
Relative air humidity (at 25°C) non-condensing, %	from 30 to 90

Figure 2. – Structural diagram of the unit

GB1 – DC backup power source of 7÷24 V; 1.2 W;
F1, F2 – fuses or their analogues of up to 1 A current

Figure 3. – Unit connection diagram

EXAMPLES OF NETWORKS TOPOLOGY (APPENDIX C)

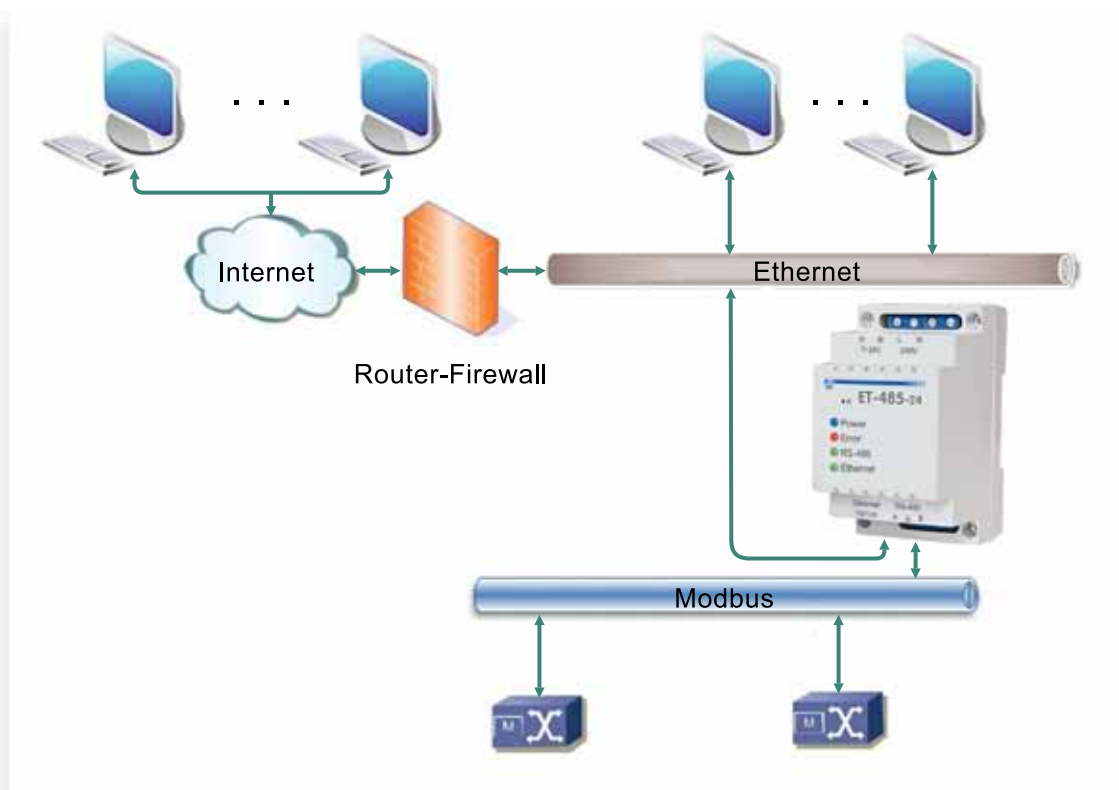**ACCESS TO RS-485 NETWORK FROM ETHERNET NETWORK**

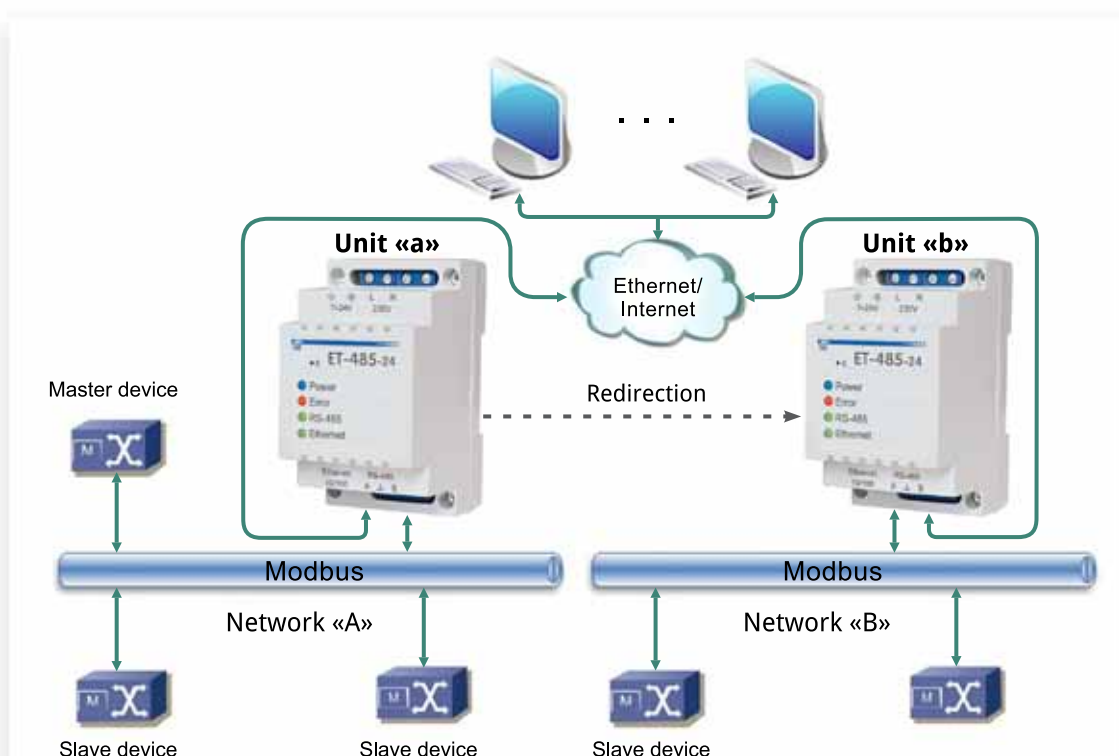*Figure C.1 – Access to RS-485 network (Modbus RTU/ASCII) via Ethernet (Modbus TCP) network*

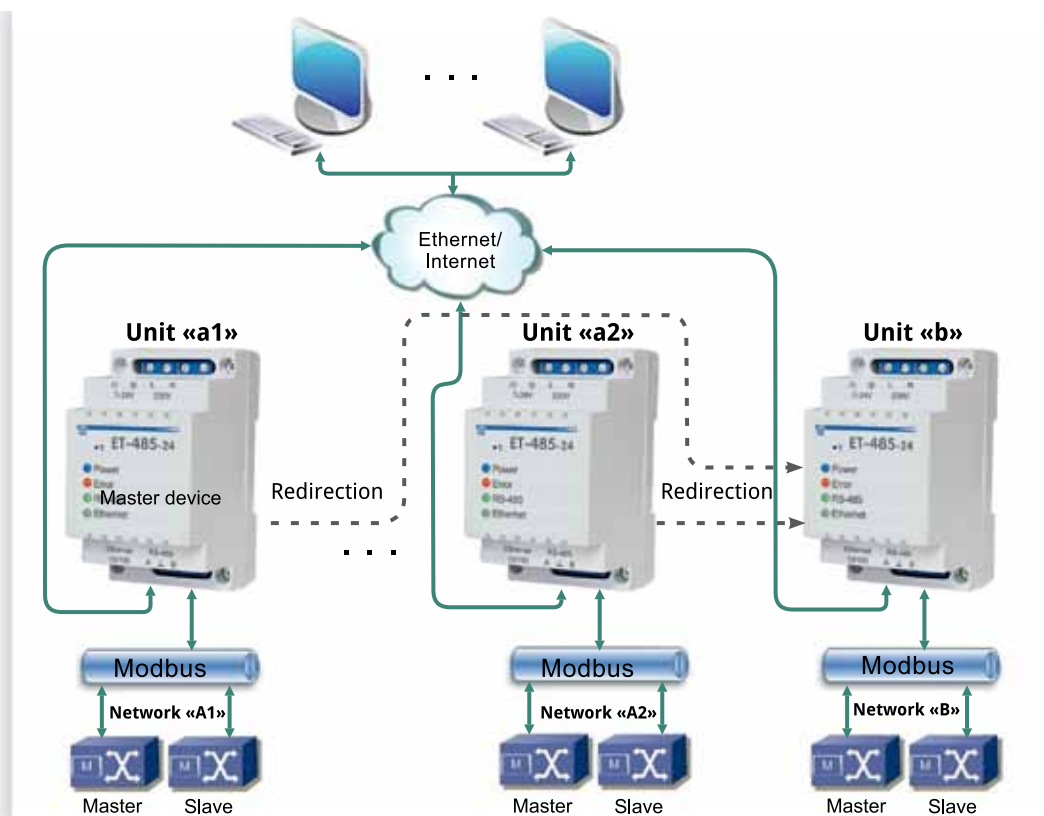*Figure C.2 – Extension of RS-485 network*
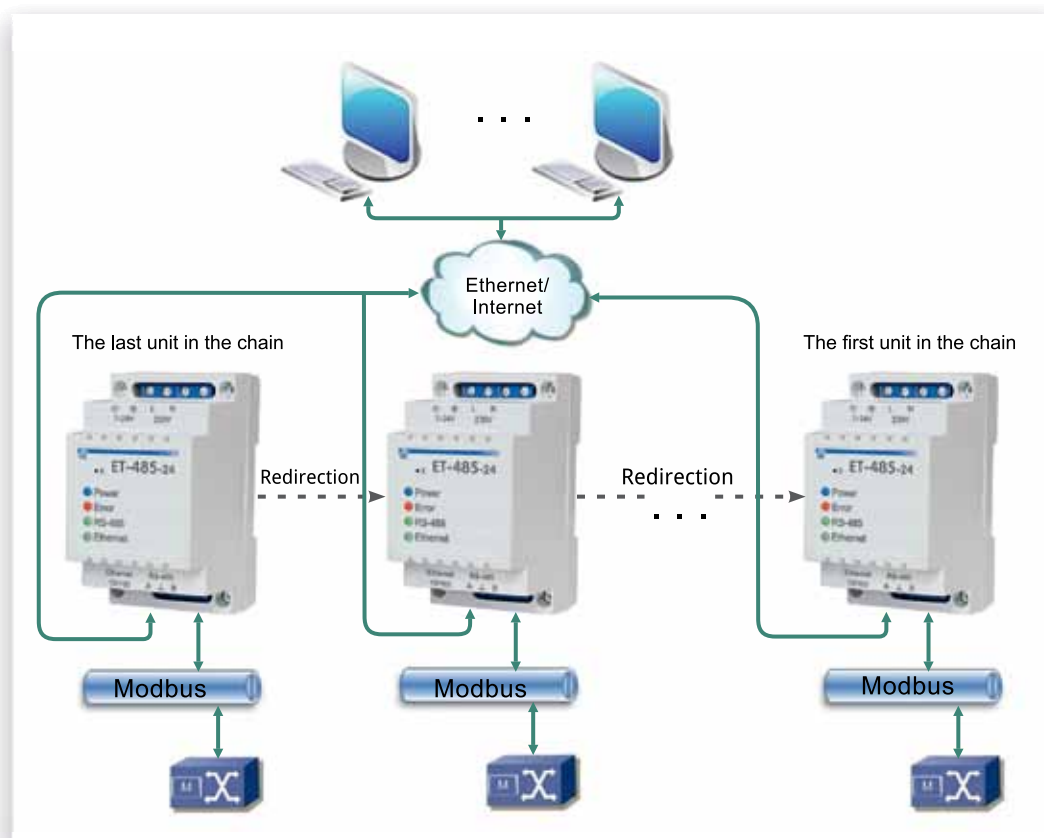
Figure C.3 – Connection of two independent Modbus networks to the third network

Figure C.4 – Consecutive readdressing

Input-Output Module OB-215

The device meets the requirements of the following:
- *DSTU EN 60947-1:2014, Low-voltage switchgear and controlgear; Part 1; General rules;*
- *DSTU EN 60947-6-2:2014, Low-voltage switchgear and controlgear; Part 6-2; Multiple function equipment; Control and protective switching devices;*
- *DSTU EN 55011:2014, Electromagnetic compatibility; Industrial, scien-tific and medical RF equipment; Electromagnetic interference characteris-tics; Limits and methods of measurement;*
- *DSTU IEC 61000-4-2:2008, Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test.*

OB-215 can be used as the following:
- remote DC voltage meter (0 – 10 V);
- remote DC meter (0 – 20 mA);
- remote temperature meter with the ability to connect sensors NTC (10 KV), PTC 1000, PT 1000 or digital temperature sensor D18B20;
- temperature regulator for cooling and heating plants;
- pulse counter with saving the result in memory;
- pulse relay with switching current up to 8 A;
- interface converter for RS-485 – UART (TTL).

OB-215 provides:
- equipment control using relay output with switching capacity up to 1.84 kVA;
- tracking the state (closed/open) of the contact at the dry contact input.

RS-485 interface provides control of the connected devices and reading of the sensors readings via the ModBus protocol.

Table 1. – Technical Specifications

Description	Value
Rated power supply voltage, V	12 – 24
The error of measuring DC voltage in the range of 0-10 V, min	1%
The error of measuring DC in the range of 0-20 mA, min	1%
Temperature measurement range (NTC 10 KV), °C	-25...+125
Temperature measurement range (PTC 1000), °C	-50...+120
Temperature measurement range (PT 1000), °C	-50...+250
Temperature measurement error, °C	±2
Max. pulse frequency in the "pulse counter" mode, Hz	200
Max. pulse frequency in the "logic input" mode, Hz	20
Readiness time, max, s	0.4
Max. switched current with active load, A	8
Consumed current, max, mA	100
Weight, max., kg	0.3
Overall dimensions, mm	18 x 90 x 64
Quantity and type of relay contact (switching contact)	1
Wire cross-section for connection, mm²	0.5 – 1.0
Tightening torque of screws, N*m	0.4
Installation is on standard 35 mm DIN-rail	
Protection rating of the device	IP20
Electric shock protection class	II
Climatic design version	UHL 3.1
Permissible contamination level	II
Overvoltage category	II
Position in space	arbitrary
Rated operating condition	continuous
Communication Interface	RS (EIA/TIA)-485
ModBus data exchange protocol	RTU / ASCII
Housing material is self-extinguishing plastic	

1 – indicator of data exchange via RS-485 interface (it is on when data is being exchanged);
2 – indicator of the status of the relay output (it is on with closed relay contacts);
3 – indicator   is on when there is supply voltage;
4 – terminals for connecting RS-485 communication;
5 – device power supply terminals;
6 – terminal for reloading (resetting) the device;
7 – terminals for connecting sensors;
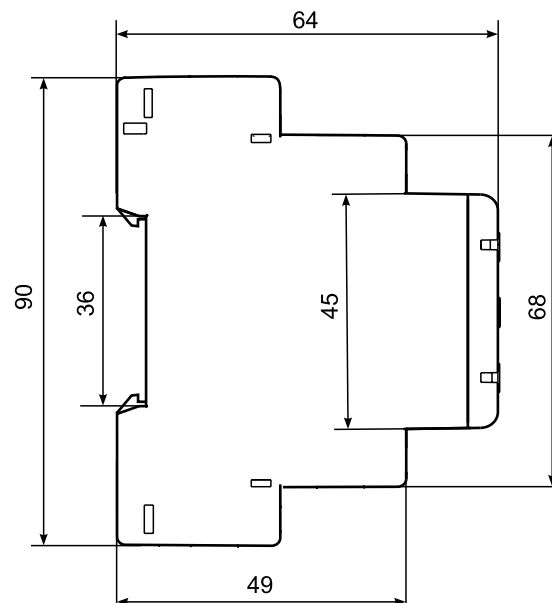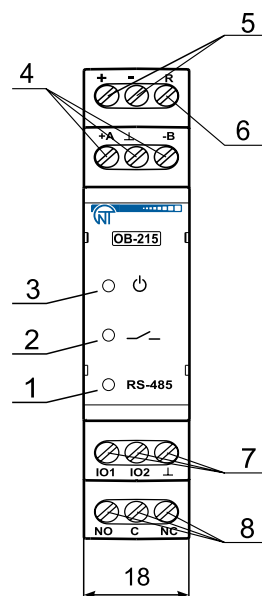8 – output terminals of relay contacts (8 A).

Table 2. – Output Contact Specifications

Operation mode	Max. current at U~250 V, A	Max. switching power at U~250 V, VA	Max. continuous permissible AC / DC voltage, V	Max. current at U_{cont}=30 V, A
Cos φ = 1	8	2000	250/30	0.6
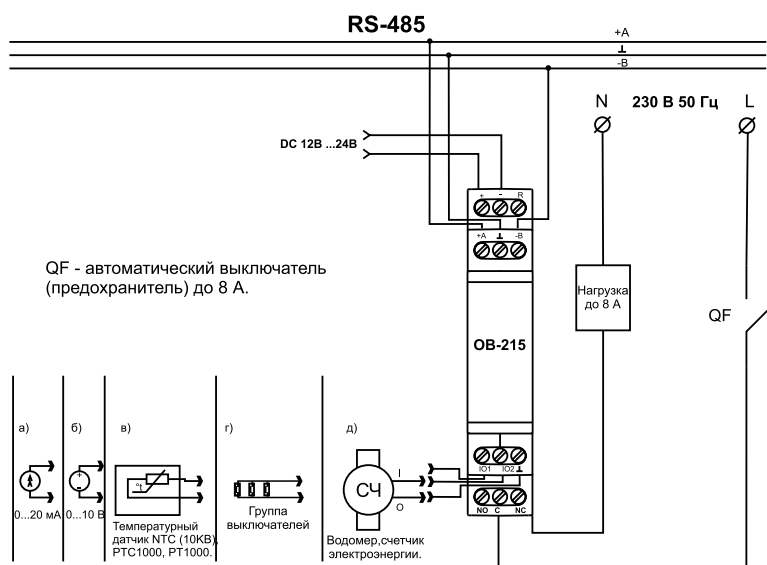
Figure 2. – Connection diagram in measurement mode
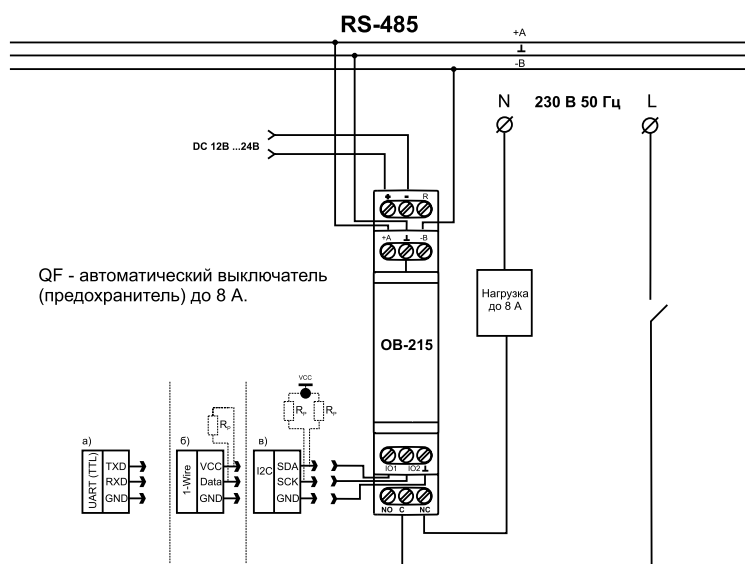
Figure 3. – Connection diagram in interface transformation mode

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NOVATEK ELECTRO INDIA PVT. LTD.
C-30, Patparganj Industrial Area, F.I.E.
Delhi - 110092, INDIA

novatek-electro.in