

# VOLTAGE, PHASE IMBALANCE AND SEQUENCE RELAY RNPP-312



## OPERATING MANUAL

Quality Management System of the products designing and production complies with the requirements of ISO 9001:2015

Dear Customer,

NOVATEK-ELECTRO Ltd. Company thanks you for purchasing our products. You will be able to use properly the device after carefully studying the Operating Manual. Store the Operating Manual throughout the service life of the device.

### SERVICE

- 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 improper mains voltage;
  - for monitoring the quality of the mains voltage after switching off the load and automatically turning it on after restoring the voltage parameters;
  - to indicate the failure in the event of emergency situation and the presence of voltage in each phase.
  - for monitoring of the broken zero.

The device provides the possibility of adjusting the parameters (voltage threshold, time of automatic reclosing 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.

After restoring the voltage parameters of the mains, the device enables again the load after the reclosing time.

The RNPP-312 uses pulsed power supply unit, which allows using devices in circuits with significant distortion of the supply voltage.

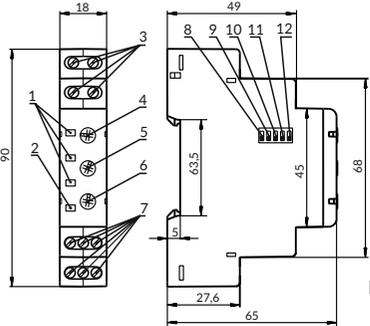


Figure 1

- 1 - Voltage indicators for each phase (L1, L2, L3);
- 2 - Failure indicator (OFF);
- 3 - Terminals for power supply connection of 400V/415V;
- 4 - Control of setting the threshold for maximum / minimum voltage (U<sub>nom</sub>±%);
- 5 - Control of setting the AR time (T<sub>on</sub>(sec));
- 6 - Control of setting the protection operation time (T<sub>off</sub>(sec));
- 7 - Terminals for load connection;
- 8 - Switch of protection operation at the maximum voltage (U<sub>max</sub>) (in position "OFF" – the protection is disabled);
- 9 - Switch of protection operation at the minimum voltage (U<sub>min</sub>) (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).

### TECHNICAL SPECIFICATIONS

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 U <sub>max</sub> / U <sub>min</sub> , 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	60
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 controlgear
Rated operating condition	Continuous
Climatic design version	NF 3.1
Protection class rating of the front panel	IP40
Protection class rating of the terminal block	IP20
Permissible contamination level	II
Overvoltage category	III
Electric shock protection class	II
Rated voltage of insulation, V	450
Rated impulse withstand voltage, kV	4,0
Conductor cross-section for connecting to terminals, mm <sup>2</sup>	0,5 - 1,5
Tightening torque of the terminal screws, N*m	0,4
Weight, max., kg	0,100
Overall dimensions, H*B*L, mm	90x18x65
The device meets the requirements of the following: EN 60947-1; EN 60947-6-2; EN 55011; EN 61000-4-2	
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	
Harmful substances in amounts exceeding maximum permissible concentrations are not available	

- Notes:**
- \* - If the switches U<sub>max</sub> are in the "ON" position the fixed operation, time of the device is 12 seconds.
  - \*\* - When working in "Maximum Voltage Control" mode, the ready, time is 0.3 seconds.

### TERMS AND ABBREVIATIONS

- AR** is automatic reclosing;
- C** - (Common) is common relay contact.
- LINE** - voltage indicators on each phase L1, L2, L3;
- KM** is magnetic starter;
- NO** - (Normal Open) is normally open relay contact;
- NC** - (Normal Closed) is normally closed relay contact;
- The term "Normal voltage" means that the voltage value does not exceed the threshold limit values set by the User.

### OPERATION CONDITIONS

The device is intended for operation in the following conditions:

- Ambient temperature: from minus 35 to +55 °C;
- Atmospheric pressure: from 84 to 106.7 kPa;
- Relative humidity (at temperature of +25 °C): 30 ... 80 %.

*If the temperature of the device after transportation or storage differs from the ambient temperature at which it is supposed to be operated, then before connecting to the mains keep the device under the operating conditions within two hours (because of condensation may be on the device elements).*

**ATTENTION!** The device is not intended for operation in the following conditions:

- Significant vibration and shocks;
- High humidity;
- Aggressive environment with content in the air of acids, alkalis, etc., as well as severe contaminations (grease, oil, dust, etc.).

### DEVICE CONNECTION

**WARNING!** THE DEVICE TERMINALS AND INTERNAL COMPONENTS ARE UNDER POTENTIALLY LETHAL VOLTAGE.

*The device is not intended for the load commutation in case of short circuit. So the power supply load circuit should have installed automatic circuit breaker for current no more than 6.3 A class B.*

*To improve the device performance, it is recommended to install the fuse (fuse-link) in the power supply circuit of RNPP-312 (L1, L2, L3) for current 1 A.*

*All connections must be performed when the device is deenergized.*

*It is not allowed to leave exposed portions of wire protruding beyond the terminal block.*

*To ensure the reliability of electrical connections the flexible (stranded) wires with insulation for voltage of at least 450 V should be used, the ends of which it is necessary to be striped of insulation for 5±0.5 mm and tightened with bootlaces.*

*It is recommended to use the wire with cross-section of at least 1 mm<sup>2</sup>. Wires fastening should exclude mechanical*

damage, twisting and abrasion of the wire insulation.

For a reliable contact, tighten the terminal screws with the force 0.4 N\*m.

When reducing the tightening torque, the junction point is heated, the terminal block may be melted and wire can burn. If you increase the tightening torque, it is possible to have thread failure of the terminal block screws or the compression of the connected wire.

1) Enable the necessary protections using protection switches (it. 8 - 11, Fig. 1).

2) Set the type of mains used with switch of rated voltage of 400V / 415V (it. 12, Fig. 1).

3) Connect the device according to the diagram shown in Fig. 2.

4) Using the U<sub>nom</sub>±% control (it. 4, Fig. 1), set the required operation threshold for the maximum and minimum voltage as a percentage of the rated supply voltage of the mains.

*When setting the lower threshold for U<sub>min</sub>, the release voltage of the MS must be taken into account.*

5) Using the T<sub>off</sub>(sec) control (it. 6, Fig. 1), set the protection operation time at the maximum voltage and phase imbalance.

6) Using T<sub>on</sub>(sec) control (it. 5, Fig. 1) set the reclosing time AR.

T<sub>on</sub>(sec) is the time of automatic reclosing after the device operation and restoration of the mains voltage parameters; on-time is after the rated voltage supply to the device.

It is recommended to set the reclosing time AR for air conditioners, refrigerators and other compressor equipment at least 180 - 240 seconds.

**ATTENTION!** In order not to break or turn the control, please do not use excessive force when performing the setting operations.

7) Feed the supply voltage to the terminals of the device.

**Notes:**

1. If the device is to be used in the "Maximum Voltage Control" mode (The Device Use), the KM coil power supply interruption must be connected to terminals C1-NC1 (C2-NC2) (inverse logic for enabling). Shift the switch U<sub>max</sub> (it. 8, Fig. 1) to the "ON" position, and switches ( ) , ( ) , U<sub>min</sub> - to the "OFF" position.

2. If on the first start up RNPP-312 doesn't allow to turn ON the power load and indicates wrong phase sequence alarm but the user is absolutely sure that the phase sequence is correct - then it is necessary to exchange the wires connected to terminals L1 and L2.

### THE DEVICE USE

RNPP-312 can be operated in the following modes:

1) "Minimum / maximum voltage control"  
In "Minimum / maximum voltage control" mode, when the voltage value of the mains is exceeded for the thresholds set by the User, the protected equipment will be disconnected from the mains.

2) "Minimum voltage control"  
In "Minimum voltage control" mode, when the mains voltage drops below the threshold set by the User, the protected equipment is disconnected from the mains.

3) "Maximum voltage control"  
In "Maximum voltage control" mode, when the mains voltage rises above the threshold set by the User, the protected equipment is disconnected from the mains.

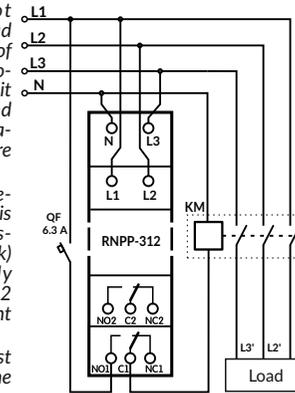


Figure 2

4) "Phases presence control"

In "Phases presence control" mode, if one phase is broken, the protected equipment is disconnected from the mains.

5) "Control of incorrect phase sequence and presence of phase sticking"

In "Control of incorrect phase sequence and presence of phase sticking" mode, if the connection is incorrect or if one of the phases is sticking, the protected equipment disconnects from the mains.

6) "Phase imbalance control"

In "Phase imbalance control" mode, in case of the difference of tension between phases more than 60 V, the protected equipment disconnects from the mains.

7) "Broken zero control"

In "Broken zero control" the protected equipment disconnects from the mains and the OFF and LINE indicators goes out.

NOTES:

1) The control of the phase presence and broken zero are kept in any operating mode.

2) In all operation modes, the device is operated when the phase is broken or the voltage drops below 100 V in one or more phases for the fixed time of 0.2 s, except for the "Maximum voltagecontrol" mode.

The LEDs status in all modes of operation (alarms) is shown in Table «The options for the status of indicators L1, L2, L3 and OFF»

The options for the status of 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 countdown)	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 100V (highest priority);
- 2 - Phase sequence;
- 3 - Minimum and maximum voltage;
- 4 - Phase imbalance.

The device at the output has two groups of independent output changeover contacts (NO1-C1-NC1, NO2-C2-NC2). If there is no voltage to the device, the contacts C1-NC1 (C2-NC2) are closed, and the contacts NO1-C1 (NO2-C2) are open.

When the RNPP-312 is operated, the load is disconnected by interrupting the power supply of the KM coil through NO1-C1 (NO2-C2) contacts, except for the "Maximum Voltage Control" mode in which the device is operated with an inverse switching logic.

After the power is supplied to the terminals of the device, the indicators L1, L2, L3 turn on. The device goes into the AR delay time mode (set by the Ton(sec) control), while the OFF indicator flashes. After the reclosing time has finished, the OFF indicator turns off and the device connects the protected equipment to the mains.

In the event of the failure, the reclosing time AR begins immediately after the device disconnects the protected equipment.

If the device is used in the "Maximum voltage control" mode, at normal voltage in the mains, the device contacts C1-NC1 (C2-NC2) are closed, and the contacts NO1-C1 (NO2-C2) are open. This is done to ensure that the device in the "Maximum voltage control" mode has never operated for reducing the voltage. In this mode, when the device is turned on for the first time, the reclosing time value (Ton(sec)) is not taken into account.

ATTENTION! This mode is not recommended for use with loads of such types: motors, compressor, three-phase transformers, etc.

EXAMPLES OF RNPP-312 USING

RNPP-312 in "Minimum voltage control" mode

In this mode:

- Switch Umin is in ON position (the device operation for Umin is allowed);
- Switches ul, Umax are in OFF position (the operation for these failures is not allowed).

If the voltage drops below Umin, the device will operate after the Toff (sec) time set by the User, the red OFF indicator will light up, the corresponding LINE indicator (-s) will off. If the voltage drops below 100 V, the device will be operated after 0.2 seconds.

RNPP-312 in "Minimum / maximum voltage control" and "Phases presence control" modes

Switches Umin и Umax are in ON position. RNPP-312 will operate if the voltage rises above the set threshold after the time Toff (sec), and when it decreases - with the fixed delay of 12 seconds (setting the starting voltage slumps), the red OFF indicator will light up. If the phase breaks, the device will operate after 0.2 seconds.

RNPP-312 in "Maximum voltage control" mode

- Switch Umax is ON position (the device operation for Umax is allowed);
- Switches ue, ul, Umin are in OFF position, the indicator OFF does not light.

When the voltage rises more than Umax, the device will operate after (Ton(sec) + 0.4) seconds, the red indicator OFF will light up.

On delay time

The protected equipment will be connected after the AR time countdown set by the User with the help of Ton(sec) control.

In all modes of operation, the switching on / off of protection due to the phase sequence disturbance is carried out by the switch ue, and the switching on / off due to the phase imbalance protection - by the switch ul. If the phase is broken or the voltage drops below 100 V in one or more phases, the device will operate (turn off), the corresponding phase indicator will turn off.

If switches Umin, Umax, ue, ul are in ON position and the voltage drop is less than Umin, the device will operate with the fixed delay of 12 seconds (setting the starting voltage slumps).

SAFETY PRECAUTIONS

During maintenance it is necessary to disable the device and connected devices from the mains.

It is strictly forbidden to open and repair the device without any professional help.

It is strictly forbidden to operate the device with mechanical damages of the housing.

It is not allowed water penetration on terminals and internal elements of the device.

During operation and maintenance, the regulatory document requirements must be met, namely:

- Regulations for Operation of Consumer Electrical Installations;
- Safety Rules for Operation of Consumer Electrical Installations;
- Occupational Safety in Operation of Electrical Installations.

MAINTENANCE

Maintenance of the device must be performed by the skilled professionals.

Recommended frequency of maintenance is every six months.

Maintenance Procedure:

- 1) Check the connection reliability of the wires, if necessary, clamp with the force 0.4 N\*m;
- 2) Visually check the integrity of the housing, in case of detection of cracks and damages take the device out of service and send for repair;
- 3) If necessary, wipe the front panel and the housing of the device with cloth.

Do not use abrasives and solvents for cleaning.

SERVICE LIFE AND MANUFACTURER WARRANTY

The lifetime of the device is 10 years. Upon expiration of the service life, contact the manufacturer.

Shelf life is 3 years.

Warranty period of the device operation is 5 years from the date of sale.

During the warranty period of operation (in the case of failure of the device) the manufacturer is responsible for free repair of the device.

Attention! If the device has been operated with the violation of the requirements of this user manual, the user will lose the right to warranty maintenance.

Warranty service is performed at the place of purchase or by the manufacturer of the device. Post-warranty service of the device is performed by the manufacturer at current rates.

Before sending for repair, the device should be packed in the original or other packing excluding mechanical damage.

TRANSPORTATION AND STORAGE

The device in the original package is permitted to be transported and stored at the temperature from minus 45 to +60 °C and relative humidity of no more than 80%.

ACCEPTANCE CERTIFICATE

RNPP-312 has been manufactured and accepted in accordance with the requirements of valid technical documentation and classified as fit for operation.

Head of QCD \_\_\_\_\_

Date of manufacture \_\_\_\_\_

Seal \_\_\_\_\_

CLAIMS DATA

You are kindly requested, in case of the device return and transfer it to the warranty (post-warranty) service please indicate detailed reason for the return in the field of the claims data.

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The Company is grateful to you for the information about the quality of the device and suggestions for its operation.

For all questions, please contact the manufacturer:

NOVATEK-ELECTRO Ltd,  
59, Admiral Lazarev Str.,  
Odessa, 65007, Ukraine.  
Tel.: (+38048)738-00-28;  
Tel./fax: (+3820482)34-36-73.  
www.novatek-electro.com

Date of sale \_\_\_\_\_