

SP-430/SP-431

Phase Sequence, Phase Failure
Phase Asymmetry Detector

SLIMLINE

MONITORING RELAYS



ORDERING CODE

TYPE	MODEL	VOLTAGE	POWER SUPPLY	RELAY CONTACTS
SP	430	230V	AC	SP

SEE PAGE 32 FOR ORDERING OPTIONS

Application Examples

- Detection of phase failure and phase reversal on voltage transformers of HT switchgear.
- Protection of 3 phase motors against single phasing.
- Overhead line supervision in rural areas.
- Protection against reverse phase sequence on forward and reverse operating machines.
- Protection against phase reversal on 3 phase compressor motors.
- Protection against phase reversal on 3 phase fan motors.
- Detection of phase angle errors.
- Detection of unbalanced supply voltage.
- Detection of loss of neutral.

Features

- Failsafe feature.
- Detection of phase asymmetry.
- Adjustable sensitivity.
- Insensitive to regenerated EMF.
- High stability under harmonic distortion.
- Insensitive to balanced supply voltage variations.
- Fast response to reversed phase sequence.
- SP-431 available with neutral.

Description of Operation

The **SP-430** and **SP-431** monitors the negative phase sequence (NPS) voltage component on a three phase power supply, thus providing reliable detection of phase imbalance, phase failure or reversed phase sequence. Power supply to the unit is tapped off the voltage sensing inputs for the SP-430 and between phase and neutral for the SP-431.

Fault Detection: When power is applied, the relay energises after approximately one second, provided all three phases are balanced and in the correct sequence. The relay will de-energise when any one of the following faults occur:

- Reversal of phase sequence.
- Excessive imbalance between phases.
- Excessive phase angle error.
- Failure of one or more phases ("single phasing").
- Loss of neutral.

The relay will energise again when proper power supply conditions are established. Imbalance sensitivity, i.e. percentage NPS voltage tolerance is adjustable between 5% and 15%.

Note: The unit will not react to a balanced under-voltage or over-voltage condition on all three phases. For over-voltage and under-voltage protection refer to SP-230.

Negative Phase Sequence (NPS) Voltage: The negative phase sequence voltage component is a measure of the imbalance of a three phase supply. Any imbalance due to unequal voltage amplitude of the three phases or a phase angle error between phases, results in the generation of NPS voltage. A completely balanced system with positive phase sequence, generates 0% NPS voltage. Complete loss of one phase results in 50% NPS voltage, a 100% NPS voltage would result from a balanced system with reversed phase sequence. For installations where significant regenerated EMF may occur, a sensitivity of 5% - 7% is recommended.

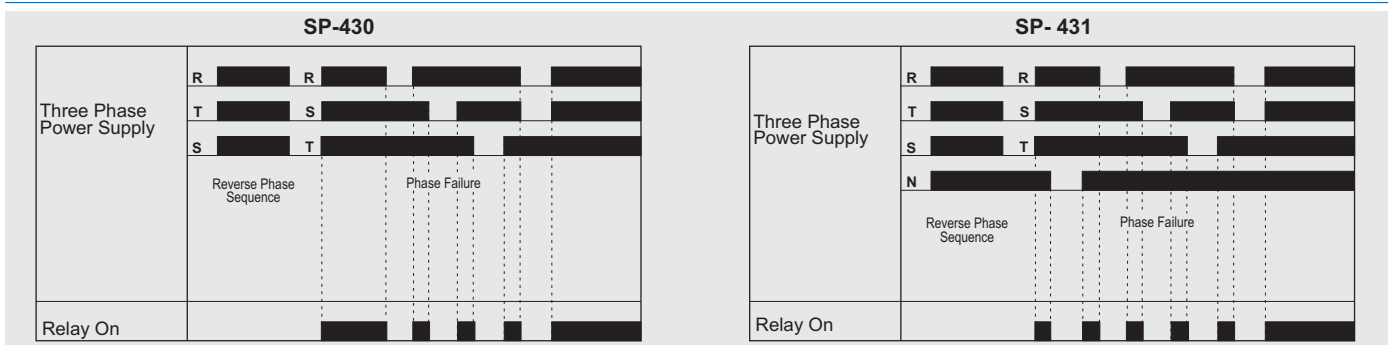
Calculation of NPS Voltage (approximate):

$$\% \text{ NPS Voltage} = \frac{V_{\text{high}} - 1/4 V_{\text{middle}} - 3/4 V_{\text{low}}}{V_{\text{average}}} \times 71$$

E.g.: Measured voltages, 400V, 380V, 360V

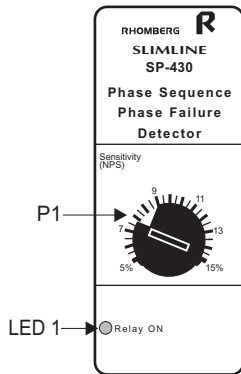
$$\% \text{ NPS} = \frac{71}{1/3(400+380+360)} (400 - 1/4 \times 380 - 3/4 \times 360) = 6,5\%$$

Operational Diagrams





Description of Controls



P1: The **Sensitivity** to 3-phase voltage imbalanced is adjusted on P1. The scale is calibrated in percentage NPS voltage. For general applications, a setting of between 5% and 7% is recommended.

LED 1: The green LED marked "**Relay ON**" illuminates when the relay is energised, i.e. The power supply is balanced and in the correct sequence.

Wiring and Connection

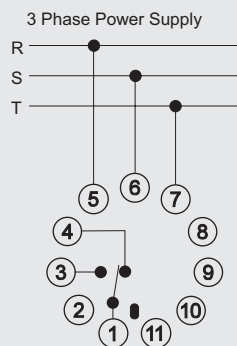
Power Supply

The three phases R, S and T are to be connected to pins 5, 6 and 7 respectively (and neutral to pin 10 on SP-431). The correct sequence is to be observed.

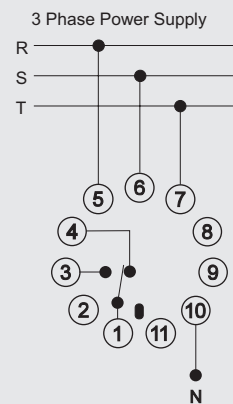
Relay Contacts

Normally Open	1 + 3
Normally Closed	1 + 4

SP- 430



SP- 431



Technical Specifications

POWER SUPPLY

Supply voltage phase-to-phase: 110, 230, 400, 415, 525V AC $\pm 20\%$
Power consumption: 3VA (approx.)
6VA for 415, 525V AC (approx.)

VOLTAGE SENSING:

Repetitive accuracy: 1%
Hysteresis: 2% fixed (relative to supply voltage).
Response delay: 1 second (approx.)