# AP-430/AP-432

Phase Sequence
Phase Failure
Phase Asymmetry Monitor

## ORDERING CODE

| TYPE | MODEL | VOLTAGE | POWER SUPPLY | RELAY CONTACTS |
|---|---|---|---|---|
| AP | 430 | 230V | A | D |

SEE PAGE ?? 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 lines supervision in rural areas.
- Protection against reverse phase sequence on forward and reverse operating machines.
- Protection against phase reversal on 3 phase motors.
- Detection of phase angle errors.
- Detection of unbalanced supply voltage.
- Detection of loss of neutral (AP-432 only).

## Features

- Failsafe feature.
- DIN rail mount.
- Detection of phase asymmetry.
- Adjustable Negative Phase Sequence (NPS) sensitivity.
- Insensitive to regenerated EMF.
- High stability under harmonic distortion.
- Insensitive to balance supply voltage variations.
- Fast response to reversed phase sequence.
- AP-432 available with neutral.
- Power ON and Relay On LEDs.
- 10A SPDT or 5A DPDT relay output.

## Description of Operation

The **AP-430** and **AP-432** 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.

**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 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 (AP-432 only).

The relay will energise again when proper power supply conditions are established. Imbalance sensitivity, ie 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 AP-230.*

**Negative Phase Sequence (NPS) Voltage:** The negative phase sequence voltage component is a measure of the imbalance of the three phase supply. Any imbalance due to unequal voltage amplitude of the three phases or 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 33.3% NPS voltage, a 100% NPS voltage would result from a balanced system with reversed phase sequence.
For installations where significant regeneration EMF may occur, a sensitivity of 5% - 7% is recommended.

**Calculation of NPS Voltage in terms of Amplitude for 3 phase voltage A, B and C:**

$$\%\ \text{NPS} = \frac{33\sqrt{A^2 + B^2 + C^2 - AB - AC - BC}}{\text{Nominal Voltage}}$$

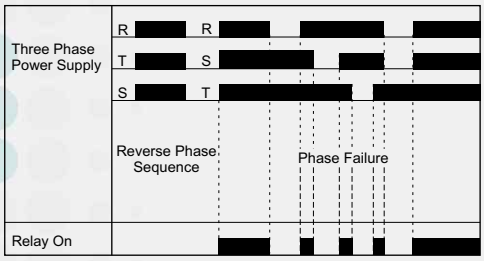
**Example: measured voltage, 220V, 200V, 180V in a 220V system:**

$$\%\ \text{NPS} = \frac{33\sqrt{220^2 + 200^2 + 180^2 - (220)(200) - (220)(180) - (200)(180)}}{220}$$

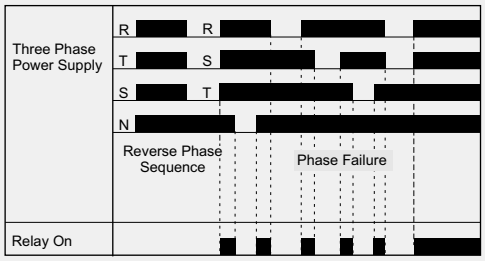
$$= 5.2\%$$

## Operational Diagrams

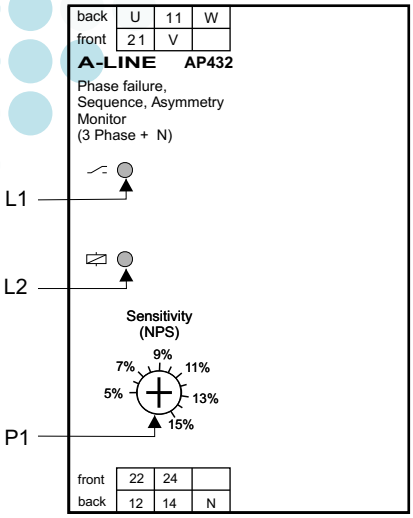
**AP-430**




**AP-432**




## Description of Controls




L1: The yellow **"Relay ON"** LED marked illuminates when the relay is energised i.e. the power is balanced and in the correct sequence, and switches off when the unit registers a fault condition.

L2: The green **"Power ON"** LED marked illuminates when power is supplied to the unit.

P1: The **Sensitivity** to Three Phase voltage imbalance is adjusted on P1. The scale is calibrated in percentage NPS voltage. For general applications a settings of between 5% and 7% is recommended.

## Wiring and Connection

**Power Supply**

| | |
|---|---|
| Phase R | U |
| Phase S | V |
| Phase T | W |
| Neutral N (AP-432 only) | N |

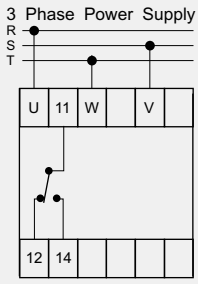
**Relay Contacts - SPDT**

| | |
|---|---|
| Normally Open | 11 + 14 |
| Normally Closed | 11 + 12 |

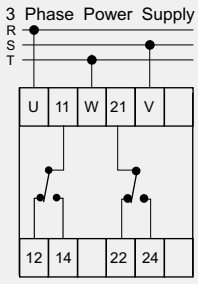
**Relay Contacts - DPDT**

| | | |
|---|---|---|
| CONTACT 1 | Normally Open | 11 + 14 |
| | Normally Closed | 11 + 12 |
| CONTACT 2 | Normally Open | 21 + 24 |
| | Normally Closed | 21 + 22 |

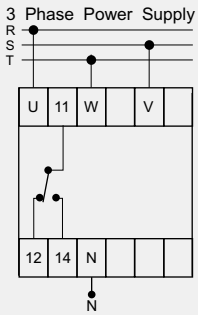
**AP-430 SPDT**



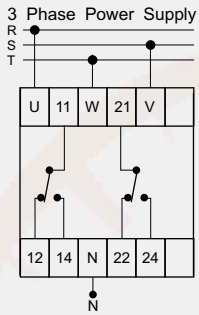

**AP-430 SPDT**




**AP-432 SPDT**




**AP-432 DPDT**




## Technical Specifications

**Power Supply**

| Type | Voltage | Tolerance | Consumption |
|---|---|---|---|
| AC Transformer (2kV galvanic isolation) | 110, 115, 190, 200, 380, 400-415, 525, 550V | ±20% | 2VA (approx.) |

**Relay**

| | |
|---|---|
| Relay Options (250V) | 10A SPDT or 5A DPDT |

**Voltage Sensing**

| | |
|---|---|
| Repetitive Accuracy | 1% |
| Hystersis | 2% fixed (relative to supply voltage) |
| Response Delay | 1 second (approx.) |

**Housing**

| | | |
|---|---|---|
| Voltage | 250V and below | Above 250V |
| Housing Width | 22.5mm | 45mm |