

## 3-PHASE SEQUENCE CONTROL & PHASE MONITORING RELAY

3 wire: PAHA & PAHI  
4 wire: PAMA & PAMI

### FEATURES

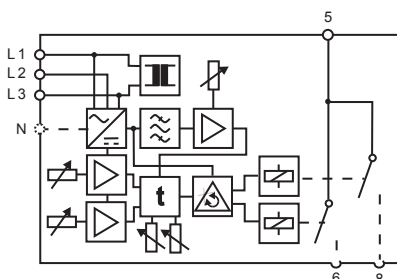
- **Active contact function for both phase sequences with two relays**
- **Detects phase sequence, phase failure, phase regeneration and phase loss in three-phase mains**
- **High sensitivity for the protection of installations, control gear, motors and power transformers**
- **Time delay - on and off - individually adjustable. PAHI and PAMI includes a true time delay independent of the power supply**
- **Insensitive to harmonics and spikes as the detection system includes a narrow band pass filter**
- **Adjustable set points with individual adjustments for unbalanced and balanced under and over voltage settings**
- **Function setting with DIP-switch**
- **12 standard mains voltages covered by just 4 units**
- **LED indication of the state of input, relay and timing function**

### PROGRAMMABLE FEATURES

VOLTAGE SETTING				ACTUATOR ■	FUNCTION	SET
TYPE	TYPE	TYPE	TYPE			
110 V	230 V	400 V	460 V		■ ASYM ■ ASYM & SYM LOW ■ ASYM & SYM HIGH ■ ASYM & SYM HIGH, LOW	A B C D
100 V	220 V	380 V	440 V			
110 V	230 V	400 V	460 V			
115 V	240 V	415 V	480 V			

### CONNECTION DIAGRAM

35mm Rail mounting



With correct Voltage  
Phase Relay  
Sequense Contact  
L1-L2-L3 : 5-6 on  
L3-L2-L1 : 5-8 on

### Description:

The PAHA & PAHI are 3 wire relays for sequence control and phase monitoring. The PAHI includes a true time delay. The PAMA & PAMI are 4 wire relays for sequence control and phase and neutral monitoring. The PAMI includes a true time delay.

The phase sequence and phase and neutral monitoring relays are designed for applications where the sequence of a three-phase system needs to be controlled. In addition to the sequence control the relays monitors the three-phase system for phase unbalance, and according to the selected setting, they can further monitor balanced under or over voltage, as well as both under and over voltage. The relays work in "fail-safe" mode and the 35mm modules need no external power supply. If an external stable power supply is available, the 45mm modules offer separate terminals for the internal power.

Unbalance, due to phase angle and phase voltage deviation, is very accurately measured by measuring the inverse phase system relatively to the main system. The method is independent of the actual balanced voltage and perfect for the protection of three-phase motors, generators and transformers. The measuring system is insensitive to higher harmonics and secures the relays from false triggering due to "noisy" power lines. As the measuring system includes the phase angles in the measurement, it provides full protection against regenerated phases. Balanced voltage is measured by adding the three individual rectified phase voltages.

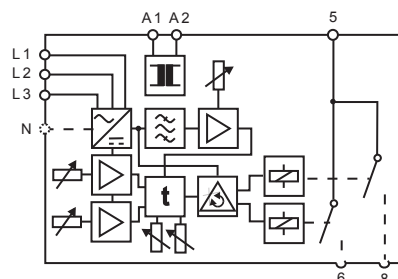
### Operation:

Under normal phase conditions the green input LED is on and one of the sequence sensitive relays will be energized, indicated by a yellow LED. The yellow LED, next to the description, shows the sequence of the three-phase system. If there is a phase deviation beyond one of the set levels, the failure will be detected, and the red input LED will go on. During the set delay period the yellow timing LED for off delay will be on. At the end of the timing period the relay will drop out and only the red input LED will stay on. If the common phase voltage drops below -40%, the relay will drop out, even if the under voltage detection is disabled. If the phase or the separate supply voltage is lost, the relay and all LED's will de-energize with out delay for PAHA and PAMA. The PAHI and PAMI will be able to hold the relays for more than 6 sec.

### Application:

To prevent motors from rotating in the wrong direction and being switched on to a faulty supply. Motor protection by controlling the direction of rotation and on-off switching depending on supply conditions. E.g. pumps, compressors, ventilators and refrigerators. Automatic control of phase sequence and monitoring of phase and neutral voltages in mobile equipment like refrigerated containers, control and distribution panels and machines used on building sites and on service jobs.

45mm Rail Mounting



## SPECIFICATIONS

### MEASURING CIRCUIT

Phase to phase voltage Selectable by DIP switch	Type B110: 100, 110 and 115 Type B230: 220, 230 and 240 Type B400: 380, 400 and 415 Type B460: 440, 460 and 480
Input resistance	300 kΩ      100 < U <sub>N</sub> < 200 V 500 kΩ      200 < U <sub>N</sub> < 480 V
Frequency range	45 to 66 Hz
Unbalance sensitivity *	Adj. 5 to 25 %
Balanced under voltage	Approx. - 40 %      A - Function Adj. 0 to - 20 %      B - & D - Function
Balanced over voltage	Adj. 0 to + 20 %      C - & D - Function
Differential	
Unbalance	2 % of U <sub>N</sub>
Balanced	2 % of U <sub>N</sub>

\* Unbalance is defined and tested by varying one phase against neutral keeping the two other phases on nominal value against neutral.  
The 4-wire units PAMA & PAMI are further tested for the same sensitivity by varying neutral, keeping the three phase to phase voltages on nominal values.

### PERFORMANCE PARAMETERS

<b>TIMING</b>	
Response time	100 to 500 msec. depending on fault Approx. 100 msec. with drop out
Time range during run	Separate On and Off delay 0 - 10 sec. adjustable PAHI & PAMI > 6 sec. at total supply loss
True time delay	
<b>ELECTRICAL</b>	
Temp. dependence	Typical: ± 0.02 % / °C
Supply dependence	Typical: ± 0.01 % / ΔU

### OUTPUT

Relay, 2 NO (moving contact connected)	
Contact rating	6 A, 250 VAC, 1500 W
Mechanical life	30 Million operations

### SUPPLY

AC voltage from L1 & L3	
AC supply range with transformer	110 V (From 80 to 138 V) 230 V (From 176 to 288 V)
Standard voltage	400 V (From 304 to 498 V) 460 V (From 352 to 576 V)
AC/DC voltage from A1 & A2	24 to 480V can be specified
AC frequency range	45 to 440 Hz
Power consumption	4 VA, 2 W

### GENERAL

Temperature range	- 25 °C to + 55 °C ambient
Humidity	Up to 90 % RH non-condensing
Dielectric test voltage	Coil to relay contacts      4000 VAC
Weight	0.22 kg



Directive 2002/95/EC of

27 January 2003

EMC directive 89/336:

Low voltage directive 73/23:

International Standards

RoHS

Emission and

Immunity

Electrical Relays

EN50283:2000

EN61000-3-2

EN61000-3-3

EN60255

## ORDERING INFORMATION

### EXAMPLE: 35mm Housing Internal supply connection

#### TYPE

3 Phase sequence & voltage relay  
3 Phase + N sequence & voltage relay  
PAHA + True time delay  
PAMA + True time delay

#### INPUT

Standard voltages  
Transformer internal connected to L1-L3

100, 110 and 115 VAC  
220, 230 and 240 VAC  
380, 400 and 415 VAC  
440, 460 and 480 VAC

#### ADJUSTMENT

Trimpot and dipswitch adj.

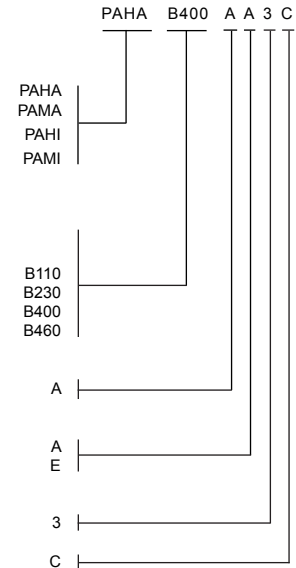
#### HOUSING

Rail mounting  
Socket 11-pin

#### SIZE

35 mm.

#### CODE END



### EXAMPLE: 45mm w/socket External supply connections

#### TYPE

3-Phase sequence & voltage relay  
3-Phase + N sequence & voltage relay  
PAHA + True time delay  
PAMA + True time delay

#### INPUT

standard voltages  
100, 110 and 115VAC  
220, 230 and 240VAC  
380, 400 and 415VAC  
440, 460 and 480VAC  
(Other voltages on request)

10.0 to 99.9 V  
100. to 999. V

#### SUPPLY

AC with transformer  
AC/DC with switch mode supply

#### SUPPLY VOLTAGE

18-360VDC and 20-240VAC  
From 19.2 to 28.8 VAC  
From 38.4 to 57.6 VAC  
From 80 to 138 VAC  
From 176 to 288 VAC  
From 304 to 498 VAC  
From 352 to 576 VAC  
(Other voltages on request)

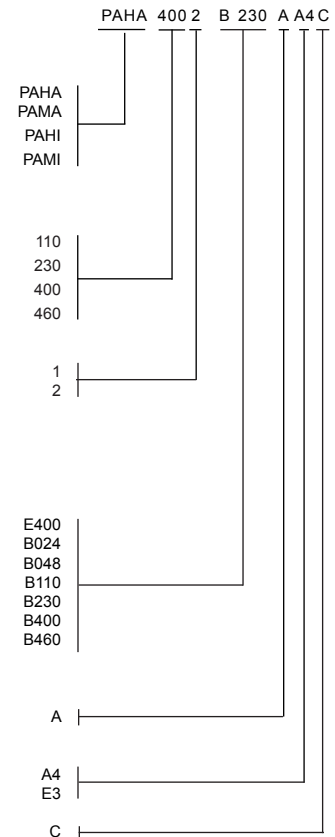
#### ADJUSTMENT

Trimpot and dipswitch adj.

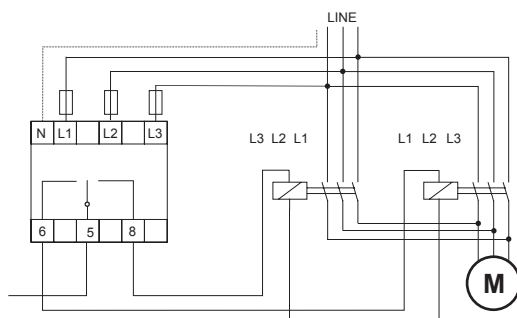
#### HOUSING

Rail mounting 45mm wide  
Socket 11-pin 35mm wide

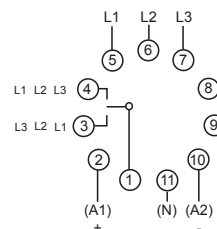
#### CODE END



## APPLICATION DIAGRAM



## SOCKET MOUNTING\*



\*CE up to 230V phase to phase voltage