

## 3-PHASE SEQUENCE CONTROL & PHASE MONITORING RELAY

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

### FEATURES

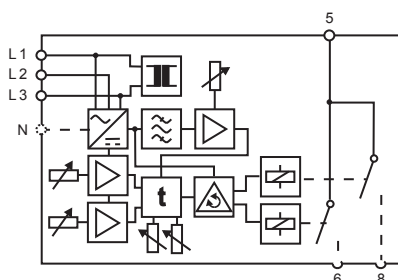
- Active contact function for both phase sequences with two relays
- Detects phase sequence, phase failure, phase regeneration and phase loss in three-phase mains
- High sensitivity for the protection of installations, control gear, motors and power transformers
- Time delay - on and off - individually 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 Sequence Relay 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.

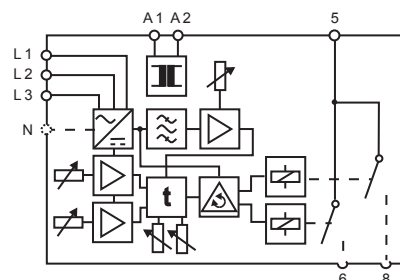
### Operation:

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	Type B110: 100, 110 and 115	
Selectable by DIP switch	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
True time delay	PAHI & PAMI > 6 sec. at total supply loss
<b>ELECTRICAL</b>	
Temp. dependence	Typical: ± 0.02 % / °C
Supply dependence	Typical: ± 0.01 % / ΔU

**OUTPUT**

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

**SUPPLY**

AC supply range	AC voltage from L1 & L3
with transformer	110 V (From 80 to 138 V)
Standard voltage	230 V (From 176 to 288 V)
	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

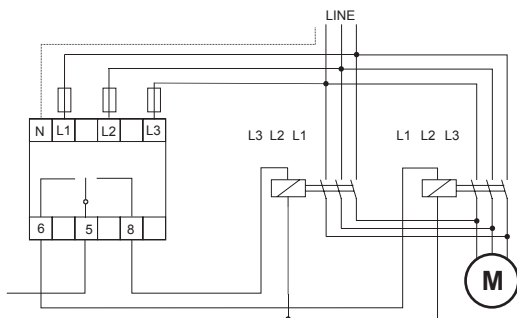
**GENERAL**

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	International Standards	
EMC directive 89/336:	RoHS	
	Emission and Immunity	EN50283:2000 EN61000-3-2 EN61000-3-3
Low voltage directive 73/23:	Electrical Relays	EN60255

**APPLICATION DIAGRAM**



**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  
110  
220, 230 and 240  
230  
380, 400 and 415  
400  
440, 460 and 480  
460

**ADJUSTMENT**

Trimpot and dipswitch adj.

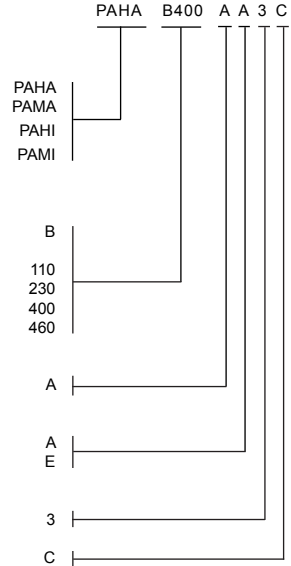
**HOUSING**

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 115V  
110  
220, 230 and 240V  
230  
380, 400 and 415V  
400  
440, 460 and 480V  
460  
(other voltages on request)  
10.0 to 99.9 V  
1  
100. to 999. V  
2

**SUPPLY**

AC with transformer  
AC/DC with switch mode supply

**SUPPLY VOLTAGE**

From 19.2 to 28.8 V  
From 38.4 to 57.6 V  
From 80 to 138 V  
From 176 to 288 V  
From 304 to 498 V  
From 352 to 576 V  
(other voltages on request)

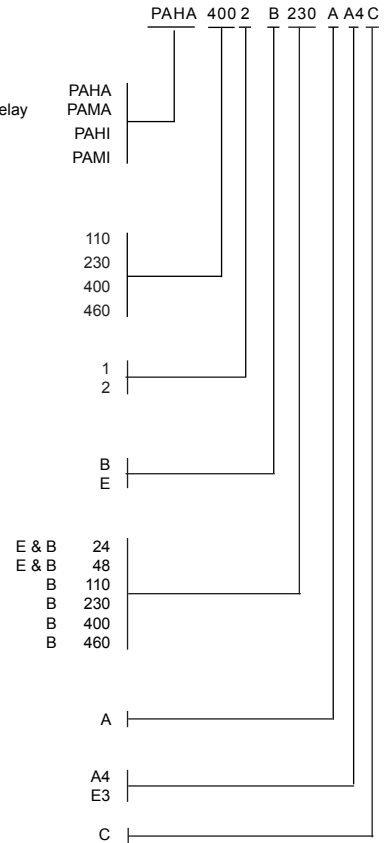
**ADJUSTMENT**

Trimpot and dipswitch adj.

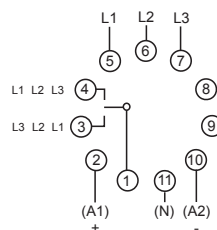
**HOUSING**

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

**CODE END**



**SOCKET MOUNTING\***



\*CE up to 230V phase to phase voltage