

# Temperature Controls

## Single Loop PID-Controllers

### Type PDI 42

CARLO GAVAZZI



- Dual display 4-dgt indication
- Multi-range  $\mu$ P-based PID controller
- Temperature measurements in  $^{\circ}\text{C}$  or  $^{\circ}\text{F}$
- All software functions selectable by key-pad
- PID and ON/OFF selectable controls
- Autotuning, direct and reverse PID control
- Up to two relay/SSR or analogue signal (20mA or 10V) outputs
- One independent alarm setpoint (on request)
- Heater break alarm
- Degree of protection: IP 54
- Front size: 48 x 48mm

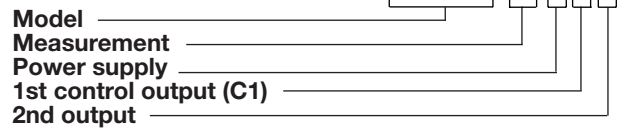
## Product Description

Dual 4-dgt multi-range  $\mu$ P-based controller for temperature measurements in  $^{\circ}\text{C}$  or  $^{\circ}\text{F}$  and for process signals. Input from thermoresistance or thermocouple. Any parameter is fully programmable by an user-friendly key-pad.

The PDI42 includes autotuning, direct and reverse PID control. The housing is easy to mount and ensures a degree of protection of IP 54.

## Ordering Key

**PDI42 T HRX**



## Type Selection

Measurements	Power supply	1st Control output (C1)	2nd Output (*)
<b>T:</b> TC inputs: J, K, R, S, T RTD inputs: Pt100 <b>C:</b> 0/4 to 20 mADC <b>V:</b> 0/1 to 5 VDC <b>W:</b> 0/2 to 10 VDC	<b>L:</b> 24 VAC, -10% +10%, 50/60 Hz, 24 VDC -10% +10% <sup>1)</sup> with galvanic insulation <b>H:</b> 90 to 240 VAC, 50/60 Hz with galvanic insulation	<b>R:</b> Relay <b>O:</b> SSR (24 VDC) <b>C:</b> 0/4 to 20 mADC <b>V:</b> 0/2 to 10 VDC	<b>Control Output (C2) (cooling)</b> <b>XX:</b> None <b>R1:</b> Relay <b>O1:</b> SSR (24 VDC) <b>C1:</b> 0/4 to 20 mADC <b>V1:</b> 0/2 to 10 VDC  <b>Temperature alarm output</b> <b>R2:</b> Relay <b>O2:</b> SSR (24 VDC)  <b>Heater break alarm output (∅)</b> <b>R3:</b> Relay <b>O3:</b> SSR (24 VDC)

(\*) When the second output is requested together with the first one, the outputs have to be of the same type.

(∅) The heater break output is not available if the first control output (C1) is a 0/4 to 20 mADC or a 0/2 to 10 VDC output

## Input Specifications

<b>Accuracy</b> RTD (Pt100, IEC) (@ 25 $^{\circ}\text{C}$ $\pm$ 5 $^{\circ}\text{C}$ , R.H. $\leq$ 60%) $\pm$ 0.25% f.s., $\pm$ 1 dgt TC (J, K, R, S, T) (@ 25 $^{\circ}\text{C}$ $\pm$ 5 $^{\circ}\text{C}$ , R.H. $\leq$ 60%) $\pm$ 0.25% f.s., $\pm$ 1 dgt Process Signals (20mA, 5V, 10V) (@ 25 $^{\circ}\text{C}$ $\pm$ 5 $^{\circ}\text{C}$ , R.H. $\leq$ 60%) $\pm$ 0.25% f.s., $\pm$ 1 dgt	<b>Sampling rate</b> 1 time/second
<b>Temperature drift</b> RTD $\pm$ 10 ppm/ $^{\circ}\text{C}$ TC $\pm$ 10 ppm/ $^{\circ}\text{C}$ Process signals $\pm$ 10 ppm/ $^{\circ}\text{C}$	<b>Display</b> 7-segment LED, h 7 mm
	<b>Max. and min. indication</b> RTD/TC Depending on range and type of the temperature probe Max. 9999 Min. -999
	Process signals



## Input Specifications (cont.)

<b>Compensation</b> RTD	For 3-wire connections, line resistance up to 10 Ω Cold junction, within the temperature range from 0 to +55°C	Probe: TC-R	0°C/32°F/273K to +1760°C/+3200°F/2033K -50°C/-58°F/223K to +1760°C/+3200°F/2033K -200°C/-328°F/73K to +400°C/+752°F/673K
TC		Probe: TC-S	
		Probe: TC-T	
<b>Input RTD ranges</b> Probe: Pt100	-200/-328°F/73K to +850°C/+1562°F/1123K, -99.9°C/°F/73K to +850.0°C/+999.9°F/K	<b>Display process signal ranges</b>	-999 to 9999 Input impedances: 20 mA ≥51 Ω; 5 V ≤100 kΩ; 10 V ≤210 kΩ
<b>Input TC ranges</b> Probe: TC-J	-200°C/-328°F/73K to +870°C/+1598°F/1143K	<b>Key-pad</b>	3 Keys: "S" to enter into the programming procedure; "LEFT/UP" for parameter selection and for value programming
Probe: TC-K	-200°C/-328°F/73K to +1370°C/+2498°F/1643K		

## Output Specifications

<b>Output combinations</b>	<ul style="list-style-type: none"> <li>- only one control output (C1) type: ON/OFF, PID;</li> <li>- one control output (C1) with additional alarm output: up, down alarm;</li> <li>- two independent PID/ (heating/cooling) control outputs;</li> </ul>	Insulation	Analogue: 0/4 to 20 mADC (load: max.600 Ω) 0/2 to 10 VDC (load: min. 50k Ω) able to drive a SSR or other kind of loads, if the control is a PID type, the analogue signal according to the PID working details is generated from 0 to 100% of the power being controlled. If the control is an ON/OFF type, the analogue signal is 0% for OFF output and 100% for ON output Relay output: 1350 V <sub>rms</sub> from output to measuring input, AC/DC power supply input. SSR output: no insulation from output to measuring input, 1350 V <sub>rms</sub> from output to AC/DC power supply input. Analogue output: no insulation from output to measuring input, 1350 V <sub>rms</sub> from output to AC/DC power supply input.
<b>Control outputs</b> Control types	1 (standard), 2 (on request) PID, PID double action, ON/OFF		
Setpoint adjustment	0 to 100% of the input range.	Alarm outputs	Up to 2 (on request) 2 alarms only with common output and 2 separated front LED's (A1+HB). No alarm outputs are available if the instrument is enabled as double action PID control.
Limits of setpoint adjustment	Programmable minimum and maximum values		
Basic PID control parameters	Programmable proportional band within the whole input range (1 to 9999); Programmable manual reset (-99.9 to 100.0%); Programmable integral time (0 to 9999 s); Programmable derivative time (0 to 9999 s); Double (C1+C2) programmable cycle time (1 to 255 s)	Alarm functions	Absolute up alarm, absolute down alarm, absolute window alarm, relative up alarm, relative down alarm, relative window alarm, down
Double action PID control	Basic PID control parameters + programmable 1st control output and 2nd control output power ratio (0 to 999.9)		
ON/OFF control parameters	Programmable symmetric hysteresis within the whole input range		
Output Working	Direct (cooling) or/and reverse (heating)		
Type of output	Relay: 6A-AC1, 2.25A-AC3, 250 VAC, 100.000 cycles SSR: 24 VDC/max. 20 mA		



## Output Specifications (cont.)

Setpoint adjustment	<p>alarm with disabling at power on, furthermore any listed alarm may be selected also with latch function.</p> <p>0 to 100% of the input range</p> <p>Programmable minimum and maximum values</p> <p>Programmable within the whole measuring range</p> <p>Normally energized, de-energized</p> <p>The alarm will be activated in case of broken heating element (it will be available only with the 2nd output). This control function works only if the 1st control output (C1) is a digital one (relay or SSR). The setpoint can be adjusted within the</p>	Type of output	<p>whole measuring range (25 A or 100 A). The alarm type is only down alarm and the hysteresis is fixed to 2% of the alarm setpoint. The output status can be selected either energized or de-energized.</p> <p>Relay: 6A-AC1, 2,25A-AC3, 250 VAC, 100.000 cycles</p> <p>SSR: 24 VDC/max. 12 mA</p> <p>Relay output: 1350 V<sub>rms</sub> from output to measuring input, AC/DC power supply input.</p> <p>SSR output: no insulation from output to measuring input.</p> <p>1350 V<sub>rms</sub> from output to AC/DC power supply input</p>	
Limits of setpoint adjustment				Insulation
Hysteresis				
Output status				
Heater break alarm				

## Software Functions

<p><b>Password</b></p> <hr/> <p><b>Scaling factor</b></p> <hr/> <p><b>Digital Filter</b></p> <hr/> <p><b>Autotuning</b></p>	<p>Numeric code of max. 4 digits: 2 protection levels of the programming data.</p> <p>1st level: no protection (all the control and alarm setpoints)</p> <p>2nd level: total protection (all the remaining programming parameters + on request the alarm setpoints)</p> <p>programming of the lower limit of the displayed scale (only mA/V input) connected to 0 mA/V or 4 mA/1 V/2 V, programming of the higher limit of the displayed scale (only mA/V input) connected to 20 mA/5 V/10 V.</p> <p>Offset programming value: from -999 to 9999, engineering unit selection (°C/°F/K/process signal)</p> <p>Programmable filtering constant (0 to 20 s)</p> <p>Automatic calculation of all the basic PID parameters according to the kind of process being controlled and referred to the programmed setpoint. Same as previous features but with the setpoint at 70% of lower value.</p> <p>Manual programming of all the parameters</p>	<p><b>Diagnostics</b></p> <hr/> <p>Burn-out</p> <p>TC</p> <p>RTD</p>	<p>The diagnostics will be activated:</p> <ul style="list-style-type: none"> <li>- when the variable being measured is under the input zero scale;</li> <li>- when the variable being measured is over the input full scale;</li> <li>- when the autotuning has been interrupted by an abnormal condition;</li> <li>- when the autotuning has not been completed within 4 hours;</li> <li>- when the instrument has been switched off during the programming procedure.</li> <li>- The display flashes when the diagnostics is activated and can also be connected to the activation of an alarm output</li> </ul> <p>Opening of the probe connection, ---- indication</p> <p>Opening of the probe connection, ---- indication</p>
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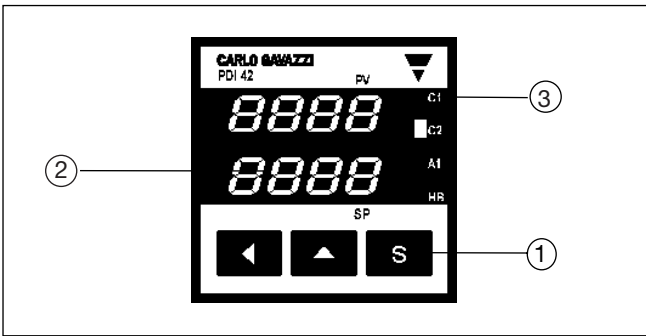
## Supply Specifications

<b>AC supply</b>	24 VAC±10%, 90 to 240 VAC 50/60 Hz
Insulation	1350 V <sub>rms</sub> from power supply input to: measuring input, relay output
<b>DC supply</b>	24 VDC±10%, 500 V <sub>rms</sub> from power supply input to: measuring input, relay output
Insulation	
<b>Power consumption</b>	7 VA
<b>Operating temperature</b>	From 0° to +55°C (R.H. < 90% non-condensing)
<b>Storage temperature</b>	From -10° to +60°C (R.H. < 90% non-condensing)
<b>Insulation reference voltage</b>	300 V <sub>rms</sub> to earth
<b>Dielectric strength</b>	3750 V <sub>rms</sub> for 1 minute

## General Specifications

<b>Noise rejection</b>	
NMRR	40 dB, from 40 to 60 Hz
CMRR	100 dB, from 40 to 60 Hz
<b>EMC</b>	EN 50 081-1, EN 50 082-1
<b>Safety standards</b>	EN 60730-1
<b>Connector</b>	Fast-on 6,3mm
<b>Housing</b>	
Dimensions	48 x 48 x 107 mm
Material	ABS, self-extinguishing: UL 94 V-0
<b>Degree of protection</b>	IP 54 with gasket
<b>Weight</b>	Approx. 290 g
<b>Approvals</b>	CE

## Front Panel Description



### 1. Key-pad

Set-up and programming procedures are easily controlled by the 3 pushbuttons.

“S”

- Key to enter the programming procedure (instrument configuration) and data confirmation

“◀”

- Left key for selecting the digit (from right to left) where the number has to be modified by means of the up key.

“▲”

- Up key for increasing the value from 0 to 9 of the previous selected digit.

### 2. Display

4-digit (maximum read-out 9999).

Dual alphanumeric indication by means of 7-segment display for:

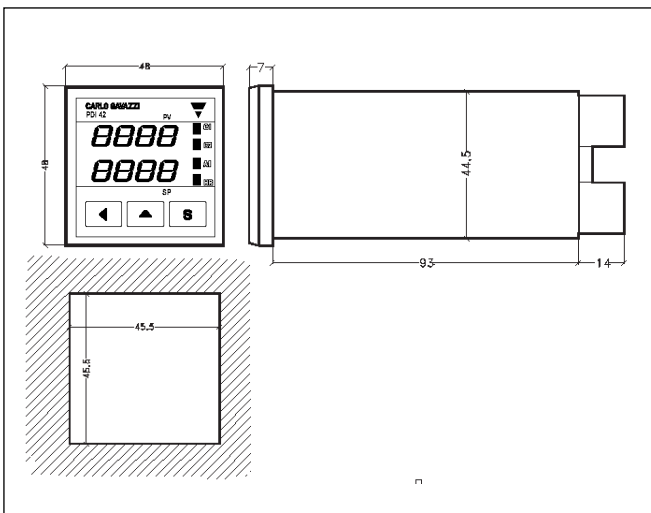
- (Red) Displaying of the measured value (process variable), programming menus, diagnostics and the current being measured (only with HBA).
- (Green) Displaying of the setpoints.

### 3. LEDs

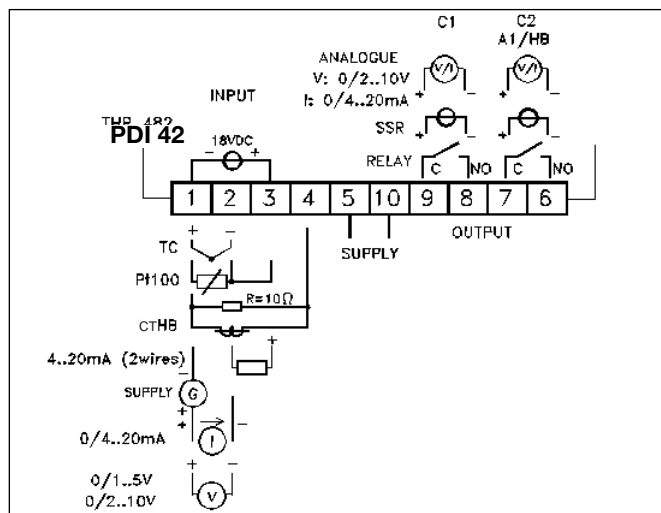
4 red LEDs for the indication of:

- control output (C1)
- control output (C2)
- alarm output (A1)
- heater break alarm output (HB)

## Dimensions



## Terminal Board



# Control Output Operating Mode

ON/OFF control (Heating)

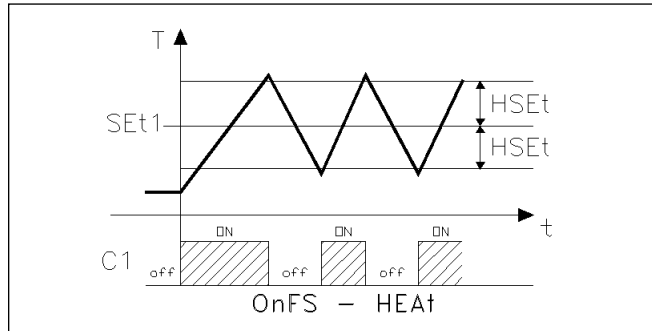


Fig. 1

Symmetric hysteresis

ON/OFF control (Cooling)

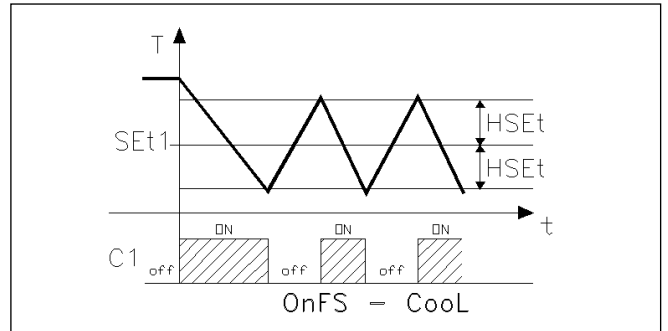


Fig. 2

Symmetric hysteresis

PID control

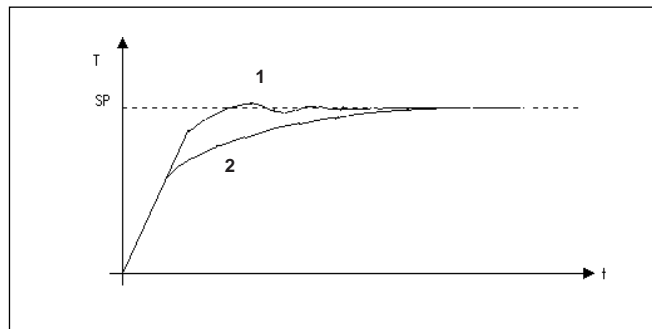
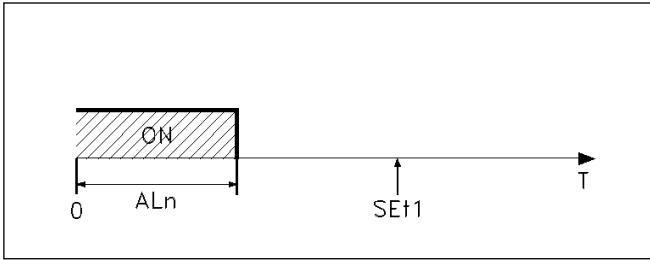


Fig. 3

Different behaviours of the process according to the different programming of the basic parameters.

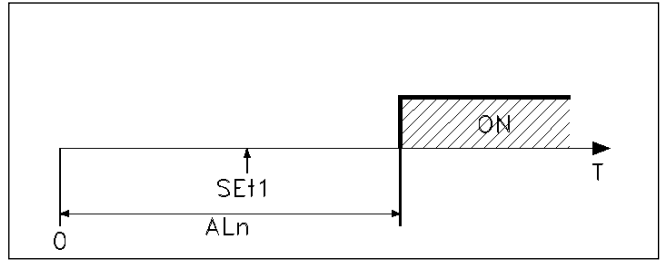
# Alarm Output Operating Mode

**Absolute down alarm**



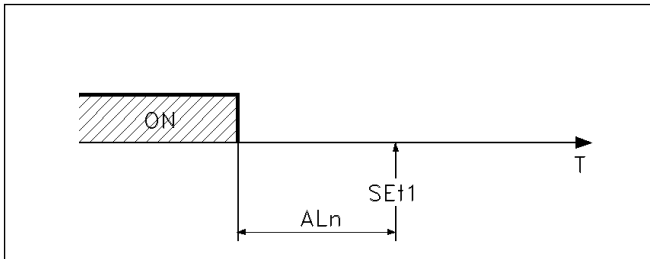
**Fig. 4**

**Absolute up alarm**



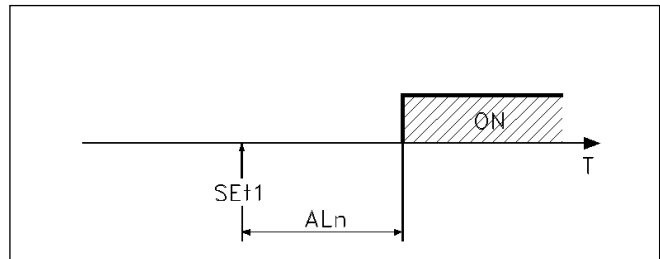
**Fig. 5**

**Relative down alarm**



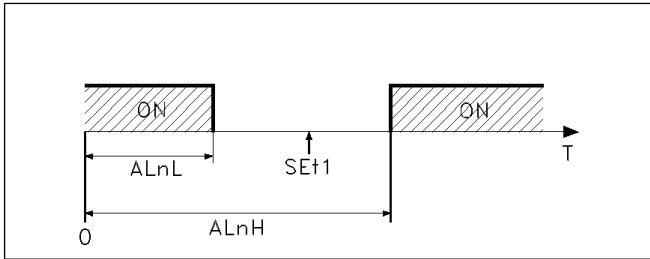
**Fig. 6**

**Relative up alarm**



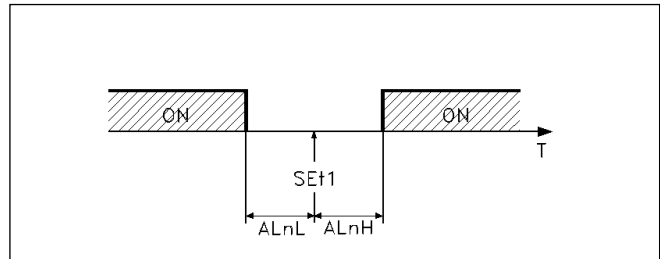
**Fig. 7**

**Absolute window alarm**



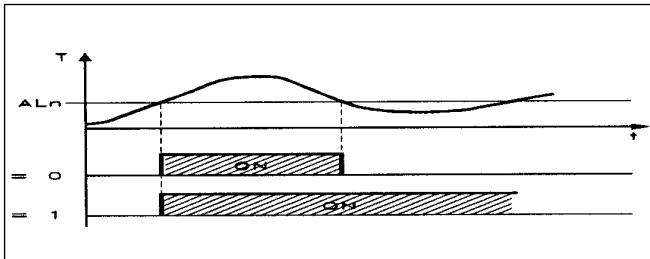
**Fig. 8**

**Relative window alarm**



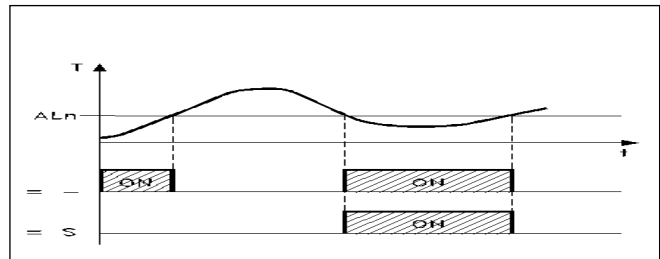
**Fig. 9**

**Up alarm with latch capability**



**Fig. 10**

**Down alarm with disabling at power-on**



**Fig. 11**

SEt1 = Control Setpoint 1 (C1)  
 ALn = Alarm setpoint  
 ALnL = Lower alarm setpoint  
 ALnH = Higher alarm setpoint

## Alarm Output Operating Mode (cont.)

### Working mode of hysteresis - Up alarm

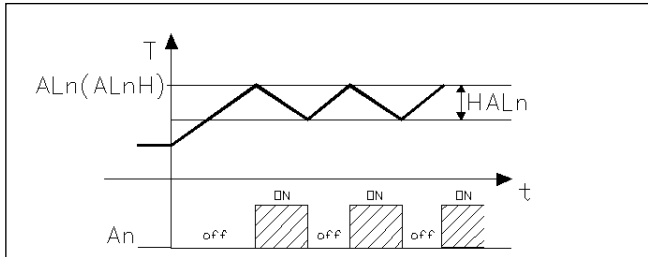


Fig. 12

### Down alarm

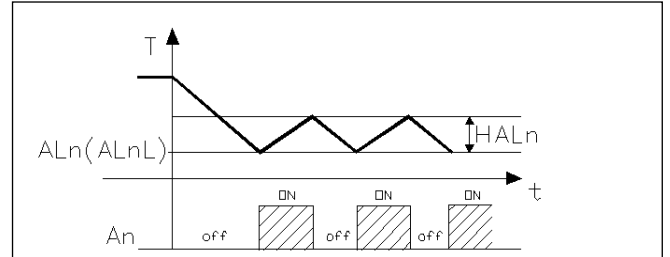


Fig. 13

### Loop break alarm

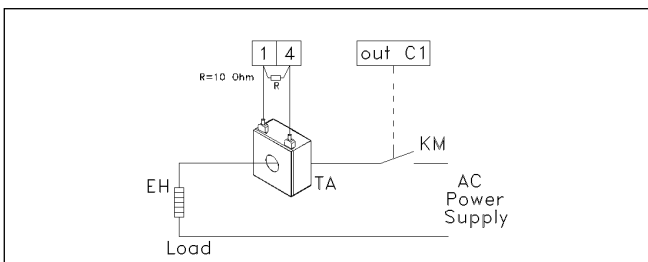


Fig. 14

**ALn** = Alarm setpoint  
**ALnL** = Lower alarm setpoint  
**ALnH** = Higher alarm setpoint  
**HALn** = Hysteresis