1. INTRODUCTION

1.1. The PID microprocessor controller TPM10 (below termed as "device") is designed for:
· temperature measurement with a L or K-type thermocouple;
· reading, digitizing and displaying current temperature on the 4-digit LED indicator;
· controlling the process value in terms of classic PID principles;
· producing "Alarm" at an output 2 relay.
1.2. The functional parameters are configurable and stored in embedded nonvolatile flash memory.

2. DEVICE TYPES CLASSIFICATION

2.1. OWEN company offers a few versions of TPM10 depending on power input, mounting case, sensor type and PID output. Numbering codes are shown in Fig.1.

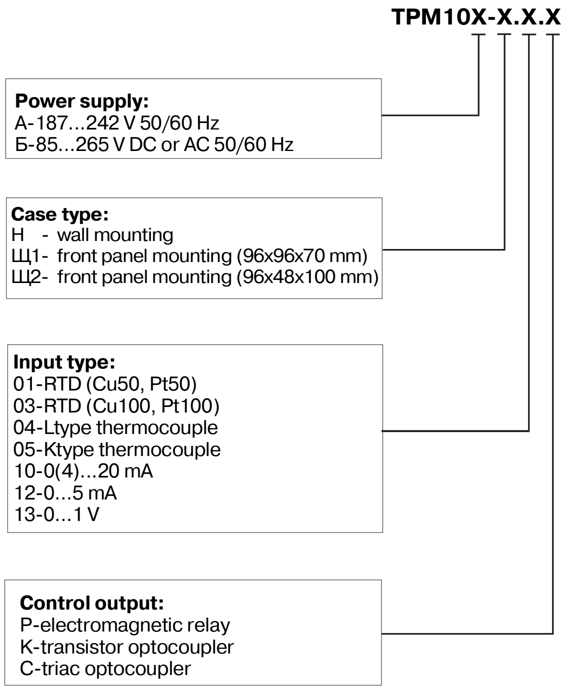


Fig. 1

2.2. When ordering the device you should specify an appropriate device code.
Example: TPM10A-Щ2.04.C means for controlling unit made for front panel mounting and processing L or K-type thermocouple with a triac optocoupler output.

3. SPECIFICATIONS

Input and measuring features.

Sensor	Range	Resolving
L-type thermocouple	-80…750°C	0.1°C
K-type thermocouple	-80…1300°C	1°C
Sensor reading time	1.5 sec	
Accuracy (regardless sensor error)	±0,5%	

Note:
Accuracy = linearity error + cold junction compensating error + offset drift error.

Power features

Power supply voltage	220V AC 50/60 Hz
Power supply voltage tolerance	-15…10%
Power consumption	less than 6 VA

Maximum load ratings

PID control output (triac)	50 mA @ 600V AC continuous 1A @ max 5 ms pulse width in a pulse mode (50/60 Hz)
"Alarm" relay load current	8 A @ 250 V AC 50/60 Hz cos ϕ>0.4

Environmental features

Operating temperature range	+5…+50°C
Air pressure	86…107 kPa
Humidity	30…80 RH (non-condensing)

Housing

Dimensions	96x48x100 mm
Protection	IP20
Weight	0,8 kg

4. ACCESSORIES

TPM10 device	1 pc
Mounting set: retains screws	2 pc
Manual	1 pc

5. HOUSING AND CONTROLS

The device is housed in screen mounting plastic case. See drawings in Appendix 1.

Front panel shown in Fig 2 incorporates a 4-digit LED indicators, eight LED's lightning during operation and programming, three keys for setup and adjustment functional parameters. The terminal block is located at the rear end of the case.

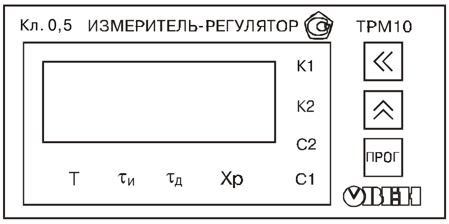


Fig. 2

6. GENERAL DESCRIPTION

6.1. INPUT.

6.1.1. Input Connections.

Thermocouple input connections are shown in Fig. 3. For thermocouple connections the correct type of extension lead wire or compensating cable must be used for the entire distance between the controller and the thermocouple, ensuring that the correct polarity is observed throughout. Joints in the cable should be avoided if possible. There is an embedded CJC (cold junction compensation) circuit in the device. The semiconductor diode located at the rear edge of the PCB is used as a cold junction temperature gauge. You must check and set a proper thermocouple type if needed (see Fig 3).

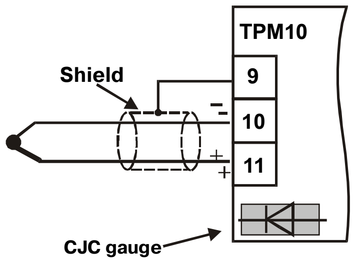


Fig. 3

6.1.2. Digital Filtering.

You can set the number of input samples to calculate an average one as a processing value. The digital filter allows ignoring false sensor readings occurring in disturbing conditions. As the parameter value happens to be 0 or 1 the digital filter is off.

6.1.3. Drift Compensation.

You can change the value of this parameter if processing temperature adjustment is necessary. Only qualified personnel should perform modifying the drift compensation parameter when measuring verification is failed.

6.2 OUTPUT CONNECTIONS.

Optocoupler triac PID control output incorporating a Zero-crossing circuit has a weak load capacity so it can be used as a driver for powerful triacs, alternistors or back-to-back SCRs . See typical connections in Fig.4.

7. SAFETY RULES

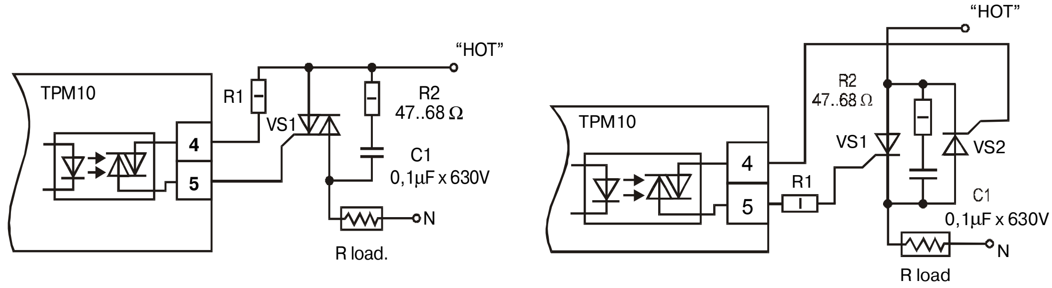


Fig. 4

7.1. Please, learn this Manual before starting up the device.

7.2. Dangerous voltages capable of causing death are present in this device. Before installation or beginning any troubleshooting procedures all the equipment must be switched off and isolated. Units suspected of being faulty must be disconnected and removed to a properly equipped workshop for testing and repair. Component replacement and internal adjustment must be made by qualified maintenance personnel only.

7.3. To minimize the possibility of fire or shock hazards do not expose this device to rain or excessive moisture. The ambient temperature should not exceed the maximum ratings specified in Section 3.

8. INSTALLATION

8.1. Cut the window in screen-shield panel according drawings in Appendix 1. Insert the device from the front into this cut-out. Tighten the retainer screws at both sides evenly.

8.2. The leads for power and sensor wiring must be stripped and tinned carefully. The lead cross-section should not exceed 1.0 mm^2.

8.3. Electric noise in industrial environment can affects the operation of microprocessor based controls adversely. For this reason it's strongly recommended to use grounded shield for sensor connection wires (as steel pipe grounded). That shield has to be attaches to point 9 at the device terminal but isolated of your equipment power and ground lines.

8.4. Connections for outputs and inputs are performed according a diagram shown at Appendix 2.

9. OPERATION MODES

9.1. The device works at three modes: CONTROL, PROGRAMMING and AUTO-TUNE. Selecting modes and modifying are performed by means front keys.

9.2. OPERATION

9.2.1. OPERATION is a primary mode. Device puts it on this mode after power is on immediately. In the OPERATION mode the device performs

· reading sensor, measuring and displaying processing values.

· providing control output as PWM signal

· comparing measured value with setpoints and provides "Alarm" output if it occurs.

Properly tuned PID controller enables a process to reach a setpoint in the shortest time with the minimum overshoot during power-up load disturbance. When PID output is ON the «K1» LED lightens.

9.2.2. PID control operation is determined with a few configurable parameters.

<u>1. PID constants:</u>

Xp-proportional band

τd-deriviative time

τi-integral time

<u>2. Cycle time and PID drive</u>

Cycle time is related to the speed of process response. The smaller the cycle time is selected the better control can be achieved. If a long cycle time is selected for a fast process an unstable result may occur. It is recommended to use control output to drive the powerful thyristors or SSRs. In this case set PID Drive into 1 that is not to limit a pulse width minimum value. If you drive magnetic contactor or electromagnetic relay the cycle time should be as large as possible (Cycle time value=4 is recommended minimum) in order to not reduce relay life. The PID Drive in that case must be set into 0 to limit a pulse width as short as 200 ms.

3. PID output action

For heating process set this parameter to 0 that is to increase the output power as the process value decreases. For cooling process set this parameter to 1 that is to increase the output power as the process value increases

4. Power limit for PID control

This parameter limits maximum percentage power during warm-up and within proportional band. It is used only for those processes that heating or cooling with full speed is dangerous or not satisfactory with results. For normal applications this parameter is 100.

5. Dead band

When process value is within a dead band proportional action of PID turns off as if temperature is equal to a setpoint.

9.2.3. Alarm output action

The alarm output performs an ON-OFF control basically. It is determined with two setpoints C1 and C2. The following diagram (Fig. 5) describes an alarm functioning. The Alarm output is activated in the four ways: Direct ("heating"), Reverse ("cooling"), P- and U-types. An appropriate parameter defines conditions when "Alarm" occurs. The «K2» LED lightens when «Alarm» output is on.

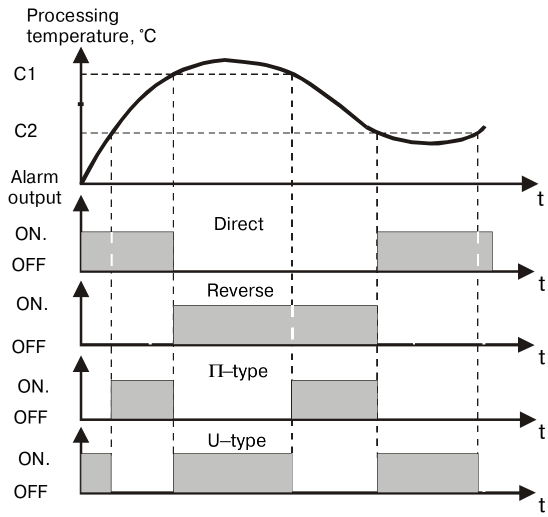


Fig. 5

9.3. PROGRAMMING

In this mode you can modify all the setpoints and parameter value and store new ones in embedded non-volatile flash memory.

The chart of parameters (Fig.6) shows a typical programming sequence. To enter level 1 of the PROGRAMMING mode where you can monitor and modify PID constants, control and Alarm setpoints press ПРОГ key during operation mode. To change value of a parameter press and release key to select the desired digit. Then press and release key to change the value of the selected digit. To select next parameter to modify press ПРОГ key.

You may enter the programming level 2 only access codes throughout:

· group 1 - 0107

· group 2 - 0108.

Among the group 1 parameters one can reach a security parameter to set the lock for PID constants and setpoints to be changed. If the LOCK is set you can monitor these parameters but not modify them.

9.4. TUNING

PID constants can be defined in AUTOTUNE mode or manually. An AUTOTUNE mode should be activated during initial setup while starting up the entire system the first time.

To start auto-tuning enter level 1 programming (press ПРОГ key) and then hold ПРОГ key for 6 s approximately until hyphens display on indicator. Set an 8206 access code and press ПРОГ key again. The device turns on a control output with ti, td and Xp LED's lighting. When auto-tune is finished τi, τd and Xp LED's start blinking. Then scroll the level 1 parameters by pressing ПРОГ key for reviewing and storing new value of PID constants.

The PID parameters determined by AUTOTUNE procedure are just rough values however in most

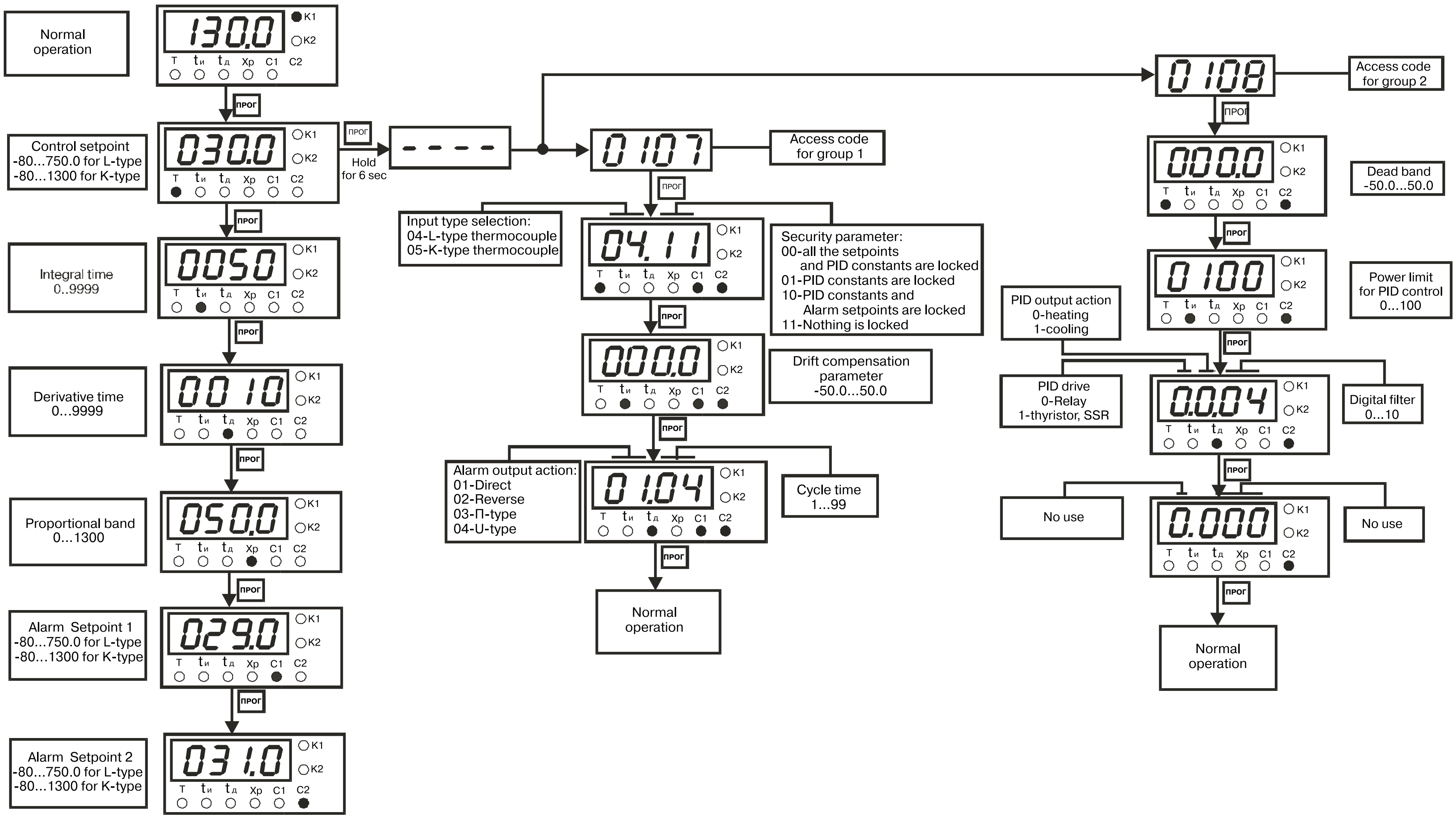

Normal operation
130.0
Control setpoint
-80...750.0 for L-type
-80...1300 for K-type
030.0
ПРОГ
Hold for 6 sec
- - - -
Integral time
0..9999
0050
Derivative time
0...9999
0010
Proportional band
0...1300
050.0
Alarm Setpoint 1
-80...750.0 for L-type
-80...1300 for K-type
029.0
Alarm Setpoint 2
-80...750.0 for L-type
-80...1300 for K-type
031.0
0107
Access code for group 1
Input type selection:
04-L-type thermocouple
05-K-type thermocouple
04.11
Security parameter:
00-all the setpoints and PID constants are locked
01-PID constants are locked
10-PID constants and Alarm setpoints are locked
11-Nothing is locked
000.0
Drift compensation parameter
-50.0...50.0
Alarm output action:
01-Direct
02-Reverse
03-П-type
04-U-type
01.04
Cycle time
1...99
Normal operation
0108
Access code for group 2
000.0
Dead band
-50.0...50.0
0100
Power limit for PID control
0...100
PID output action
0-heating
1-cooling
PID drive
0-Relay
1-thyristor, SSR
0.004
Digital filter
0...10
No use
0.000
No use
Normal operation
K1 K2
T tи tд Xp C1 C2

Fig. 6

cases they are suitable. If the control results by using above values are unsatisfactory, the following rules may be used to further adjust the PID constants:

Adjustment sequence	Symptom	Solution
Proportional band (Xp)	Slow response	Decrease Xp
	High overshooting or oscillations	Increase Xp
Integral time (τi)	High overshooting	Decrease τi
	Instability	Increase τi
Derivative time (τd)	Instability or oscillations	Decrease τd
	Slow response to disturbances	Increase τd

Effects of PID adjustment on process response is shown in Fig.7

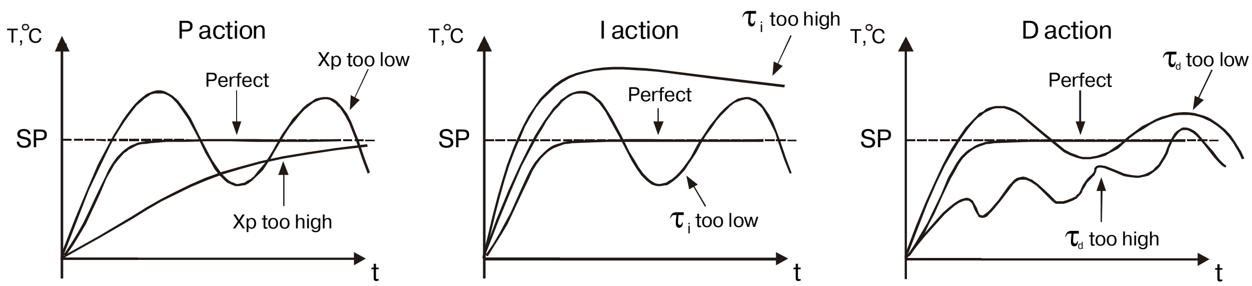


Fig. 7

10. STARTING UP AND OPERATION PROCEDURES

10.1. Power up the device (220 V 50/60 Hz).

10.2. In the upper indicator current temperature value displays. Is you see hyphens rather than measured value check out the input sensor efficiency and if it breaks down remove it.

10.3. REVIEW all the setpoints and parameters values and override them (see 8 chapter) if this required.

10.4. Return to OPERATION mode and begin to work.

11. MAINTENANCE

You should perform visual inspection of the device input and power connections every 6 months. Remove from terminals dirt and dust if it occurs.

12. STORAGE

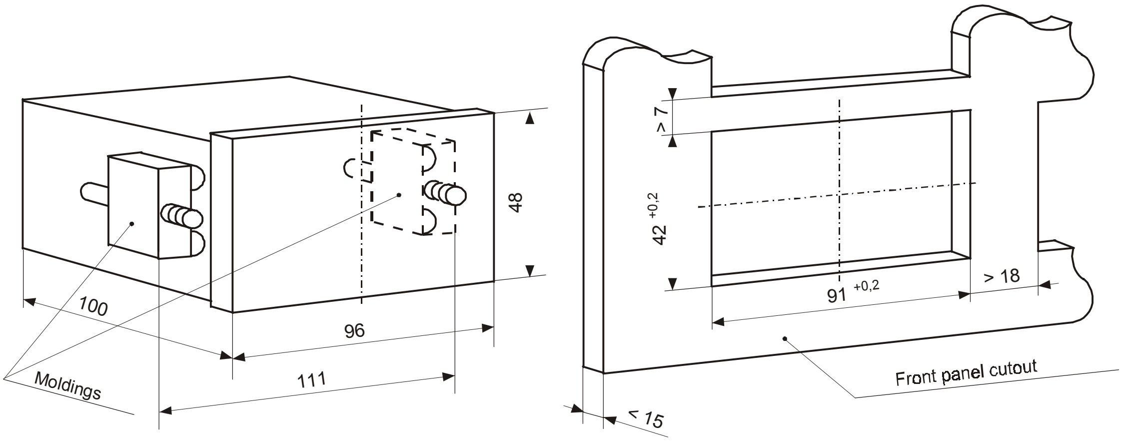
Store the device in dry warm place at ambient temperature 0…60°C and air humidity less than 95%.

13. WARRANTY

The device is warranted against defective materials for a period of 24 months from the date of delivery to the original purchaser.

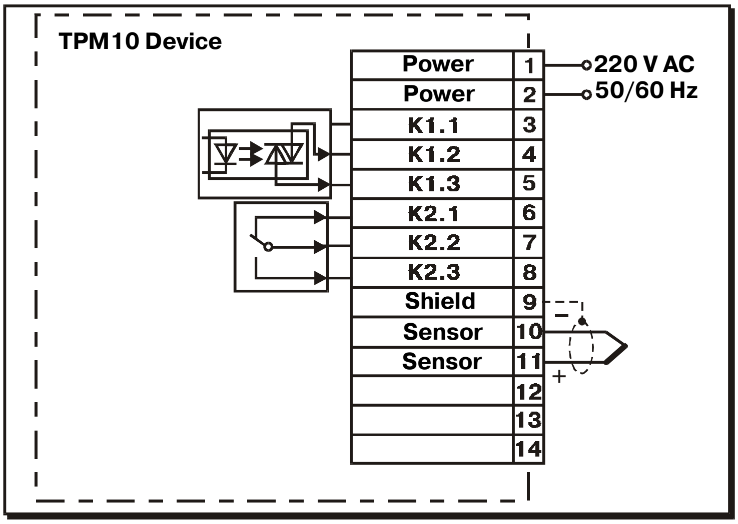
OWEN company assumes no liability for damages consequent to the use of this product. OWEN reserves the right to change or free repair at any time.

Appendix 1



Case and mounting dimension

Appendix 2



TPM10 connection giagram

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Microprocessor PID temperature controller

TPM10

Operation Manual