HEAT TRACE™
SETTING THE STANDARDS   LEADING THE WAY

POWERMATCH MICRO + (PMM+)
USER MANUAL

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1.   Controller & Component Parts

The **POWERMATCH MICRO+** (**PPM+**) electronic controller is designed for temperature measurement and control of electric heat tracing circuits. The controller provides a facility for temperature measurement by means of one or, optionally, two measurement sensors. The output control optimises the temperature maintenance process. The controller is straightforward, easy to operate and maintain.

The component parts of the controller are :
•   2-channel input signal measuring unit.
•   The control unit device.
•   Power supply unit.
•   2 output relays. (1 x load and 1 x alarm).
•   Indication and control elements unit.

2.   Connection Methods

The **PMM+** may be connected to provide temperature control methods Type I or II (requiring only the Pt100 ambient sensor) or Type II (requiring both the Pt100 ambient and line sensors).

The **PMM+** may be connected for circuit switching by means of:
a)   integral 16 amp, 230 volt relay (see Fig 2).
b)   external suitably rated contactor (see Fig 3).
c)   external thyristor, or solid state relay drive (see Fig 4).

3.   Temperature Control Methods - Process Temperature Accuracy

POWERMATCH MICRO+ can be set up to operate in a number of ways.

IEC electric trace heating standards define 3 levels of process temperature accuracy:-

Type I
A Type I process is one for which the temperature should be maintained above a minimum point e.g. freeze protection of water lines. Ambient sensing control is usual.
Type II
A Type II process is one for which the temperature should be maintained within a moderate band e.g. temperature maintenance of fuel oil lines.
Type III
A Type III process is one for which the temperature should be controlled within a narrow band e.g. maintenance of temperature sensitive materials, such as chocolate.

POWERMATCH MICRO+ can be set up to provide Types I, II, or III control methods.

Type I

Type I control is achieved by means of the PT100 ambient sensor only. Large blocks of power may be controlled by means of a single device. Energy savings compared with a traditional on/off air thermostat will typically be 80-90%.

Type II

Type II process control may also be achieved by means of the PT100 ambient sensor only. Heating cables should be applied to the pipework such that heating loads approximate heat losses when the ambient temperature is at the minimum design level.

Type III

A Type III process control may be achieved by means of both the PT100 ambient and line sensors. The line sensor should be located on a heated line having no flow. This may need to be a 'dummy' pipe (dead-leg). Heating cables should be applied to the pipework such that heating loads closely match heat losses (this means that heating cables may need to be spiralled).

One **POWERMATCH MICRO+** will be required for each different line temperature required. Fewer controllers will be required compared with the use of traditional line controls.

4.   Controller Specification

Temperature control range	From -60ºC to +500ºC * *see note below*
Temperature measurement accuracy	0.5%
Temperature indication accuracy	0.1ºC
Measurement channels	Two channels: - Air temperature measurement - Surface / Process temperature (Optional)
Ouitput Relays	Two relays: - Control channel .... 16A, 220VAC - Alarm channel 16A, 220VAC
Analogue outputs (2)	0 - 10 V
Temperature sensor types * *see note below*	Pt100 sensors
Control unit operating temperature	5ºC to 40ºC
Enclosure protection level	IP20
Supply voltage	220VAC +10%, -15%, 50-60Hz
Control unit panel mounting	DIN rail, 4 modules
Overall dimensions	68 wide x 85 high x 57 deep (mm)
Weight	272 grammes without sensor

* *Note: Sensors are purchased seperately.*
        Temperatures in excess of 180ºC require MI sensors – contact Heat Trace Limited

5.   Input circuit

The controller can simultaneously process two measurement channels. Each channel performs temperature measurement by means of a resistive temperature transducer (sensor).
The temperature sensors are type Pt100. Two wire sensors are provided. Where the sensor is located more than 50 metres from the controller, a 3 wire sensor is required, wired as shown in wiring diagram (Fig 1.) The resistance of the sensor extension wires must be <u>100 Ohms</u> maximum.

6.   Output circuit

The controlling unit comprises an output circuit of one control relay channel and one alarm relay channel. Both relays have a load capacity 16 A, 230 VAC, 50 Hz. Both control and alarm relays have normally open contacts. For larger heating loads, switching should be via a suitably rated external contactor, solid state relay, or thyristor drive.

7.   Connection of the Controller

The controller is intended for installation in an electrical panel. Mounting is by DIN rail, size: 4 modules. Connection terminals are shown in Figure 1.
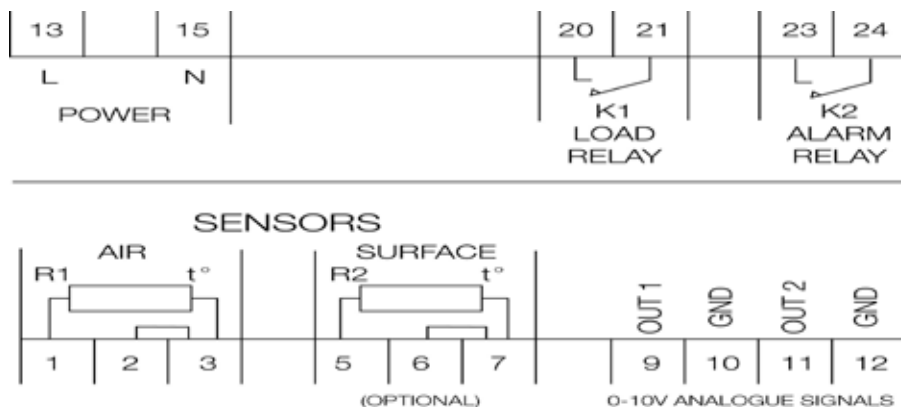

Fig 1

Designation of the controller connection terminals:

- The temperature detectors Rt1, and optionally, Rt2, are connected using two-wire sensors to terminals 1 & 3 and 5 & 7 respectively. The resistance of the sensor connection wires must be no more than 100 Ohm.
- Note - air sensor terminals 2 & 3 and surface sensor terminals 6 & 7 are linked
- Power supply voltage is applied to terminals 13 and 15
- Terminal contacts of control relay K1 and alarm relay K2 are 20–21 and 23–24 respectively
- Analogue output signals in the voltage range 0…10 V are available at terminals 9-10 and 11-12
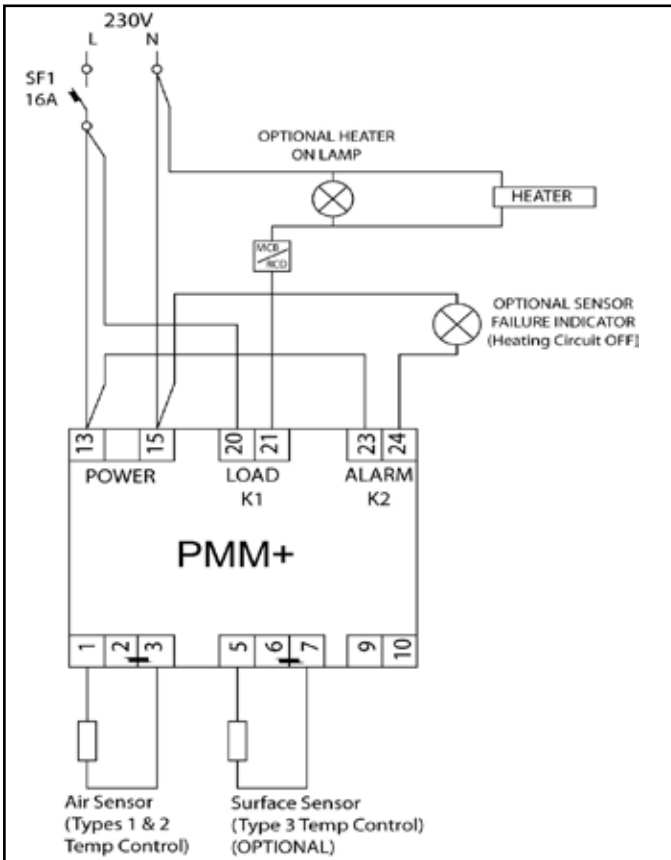
Connection Wiring Diagrams

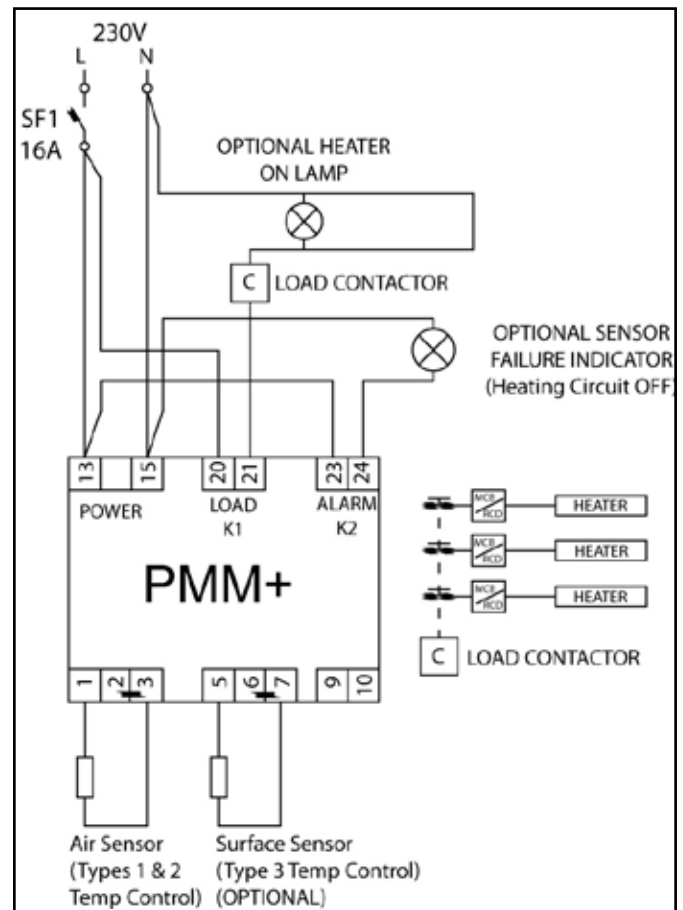Fig 2   Wiring Diagram using Integral 16 amp, 230 volt Relay

Fig 4   Wiring Diagram using external thyristor drive

Fig 3   Wiring Diagram suitably rated external contactor / solid state relay

8.   Operating Principles

Two algorithms are provided in the controller for heating process control. Choice of the actual algorithm is defined by presence/absence of the process (surface) temperature sensor.

Designations and clarifications:

$T_{air\ min}$ – the design minimum air temperature.
$T_{surface\ min}$ – the design minimum process (surface) temperature.
$T_{surface\ max}$ – the design maximum process (surface) temperature.
$T_{surface\ mid}$ – the medium value calculated from the design minimum and maximum process
                   (surface) temperature.

Algorithm No. 1. Using Ambient Air Temperature Sensor Only (See Fig 5)

The process (surface) temperature sensor is not used (disconnected). The controller measures only the air temperature and calculates the percent of the total power required for heating based on the preset temperature parameters: $T_{air\ min}$; $T_{surface\ min}$ and $T_{surface\ max}$. When the current air temperature is lower than $T_{air\ min}$, the calculated heating power is 100%. When the current air temperature is higher than the medium temperature (i.e. the required process temperature ($T_{surface\ mid}$) calculated from the preset temperatures ($T_{surface\ min}$ and $T_{surface\ max}$) the calculated heating power is 0 %. When the current air temperature is between $T_{surface\ min}$ and $T_{surface\ mid}$ the heating power is calculated in proportion to the temperature based on 100% for $T_{air\ min}$ and 0% for $T_{surface\ mid}$.
For example, when the current air temperature is exactly in the middle between $T_{air\ min}$ and $T_{surface\ mid}$, the calculated heating output is 50%.
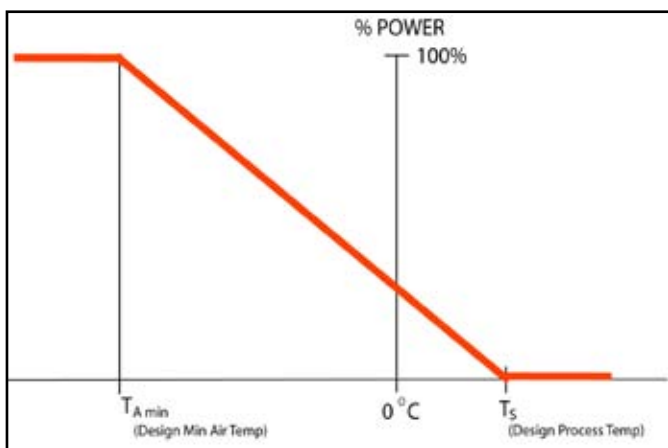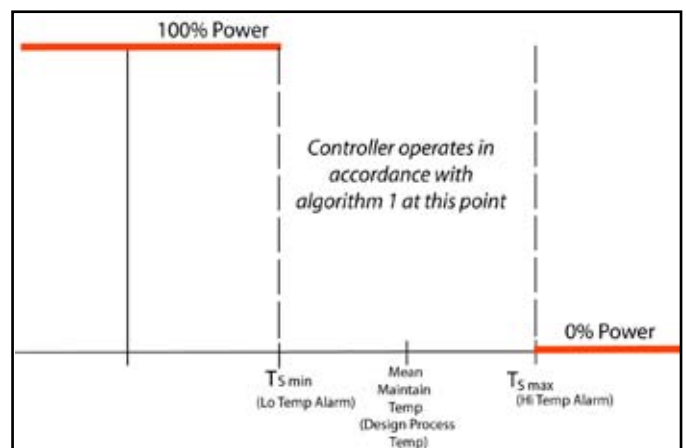

Fig 5 Algorithm 1

Fig 6 Algorithm 2

Algorithm No. 2. Using Ambient air AND Process Temperature Sensors. (See Fig 6)

The process (surface) temperature sensor is used (connected). The controller operates in accordance with the Algorithm No. 1 but with some additions. If the current process (surface) temperature is less than the preset minimum surface temperature $T_{surface\ min}$, the calculated heating power is 100%, irrespective of the air temperature. If the current surface temperature is higher than the preset maximum surface temperature $T_{surface\ max}$, the calculated heating power is 0% irrespective of the air temperature. When the surface temperature is between $T_{surface\ min}$ and $T_{surface\ max}$, the

controller works according to the Algorithm No. 1.

Analogue Outputs

Two analogue outputs are provided in the controller with outputs in the range 0…10 V.
The output voltage level of both outputs is proportional to the calculated current heating power (as a percentage of the maximum power). One analogue output can be used when smooth heating control is to be provided by means of an external thyristor power controller. The second analogue output may, for example, provide an indication of the heater power by means of a pointer-type instrument calibrated for 0 to 10 V indication. Heating power (in percent) is applied according to the time during which the heating is in the ON condition, relative to the total cycle period corresponding to 100% heating power. This total cycle period is chosen by the user and set by means of the controller's menu within the range of 30 to 60 minutes.

9. Control and Indication Elements

The LED indicator is used for information I/O, 84x48 pixels resolution, comprising 6 strings, each 14 symbols long.
Information is entered into the controller by means of 4 control buttons:
1.   «Up» / «+».
2.   «Down» / «−».
3.   «Right».
4.   «Reset» (Return to main menu).

During operation the controller displays the main screen. The control buttons are used to navigate through the controller's other screens.

Main Screen Display

The main screen displays the current temperature of the two channels, the preset temperature control values and the current calculated heating power in percent (see Figure 7).

```
Actual Temps
Ta: -10°C    Air
Ts:  15°C    Surface/process
 Power: 100%
Ta input: -35°C  Design min
Ts input: Design surface/proc
```
Figure 7

Setting of Control parameters.

P⌐   ⌐bmenu will be displayed (Figure 8):
```
Set surface
temperature
```
Figure 8

From this sub-menu you can go to a display window designed for setting the process temperature parameters of the heating surface.

Setting of the process alarm levels.

Press the «**Right**» button. The following window will appear (Figure 9):

Lo - temp alarm
set point

Ts min: 10°C

Figure 9

Setting of minimum temperature of the heating surface $T_{surface\ min}$.
Using «**Up**» / «**+**» «**Down**» / «**-**» buttons, set the required temperature value.

Press the «**Right**» button. The following window will appear (Figure 10):

Hi - temp alarm
set point

Ts max: 10°C

Figure 10

Setting of maximum temperature of the heating surface $T_{surface\ max}$.
Using «**Up**» / «**+**» «**Down**» / «**-**» buttons, set the required temperature value.

Press the «**Right**» button. The display window will appear (Figure 7). To jump to the next sub-menu for setting of the further operating parameters press the "**Up**" button.
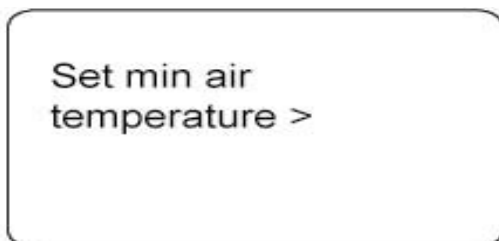The following window will appear (Figure 11):

Set min air
temperature >

Figure 11

From this submenu you can go to an display window designed for setting the minimum ambient air temperature, below which 100% power must be applied by the heating system.

Press the «**Right**» button. The following window will appear (Figure 12):

Set min design
air temp

Ta min: -35°C

Figure 12

Setting of minimum temperature of the air $T_{air\ min}$.
Using «**Up**» / «**+**» «**Down**» / «**-**» buttons, set the required temperature value.

Press the «**Right**» button. The display window will appear (Figure 11). To jump to the next sub-menu for setting of the further operating parameters press the "**Up**" button. The following window will appear (Figure 13):
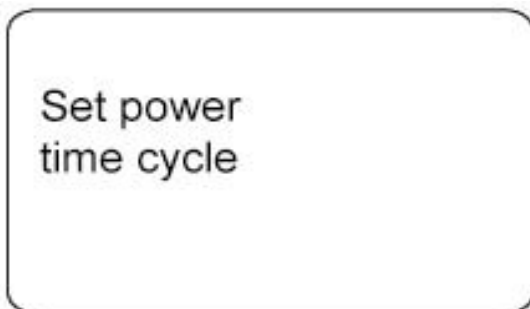
Set power
time cycle

Figure 13

Press the «**Right**» button. The next display window will appear (Figure 14):

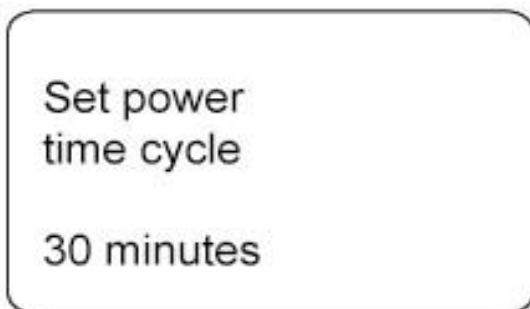Set power
time cycle

30 minutes

Figure 14

Setting of the cycle period corresponding to 100% heater power output.
Using «**Up**» / «**+**» «**Down**» / «**-**» buttons, set the required cycle period value.
The possible range is from 30 to 60 minutes.

Press the «**Right**» button. The display window will appear (Figure 13). To jump to the next sub-menu press the «**Up**» button. The display window will appear (Figure 15):
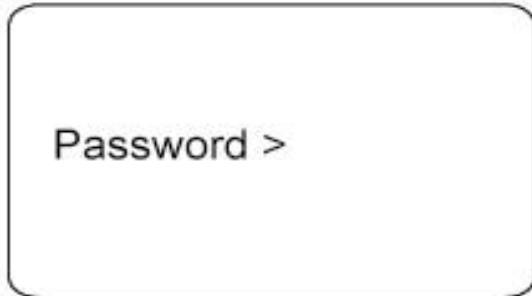
Password >

Figure 15

Press the «**Right**» button. The display window will appear (Figure 16):
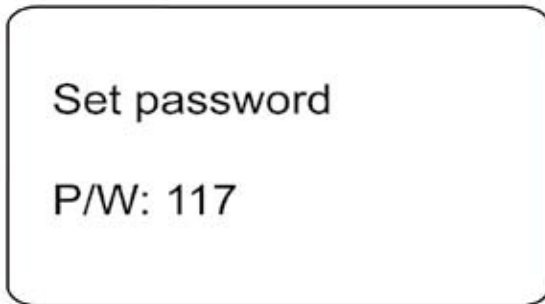
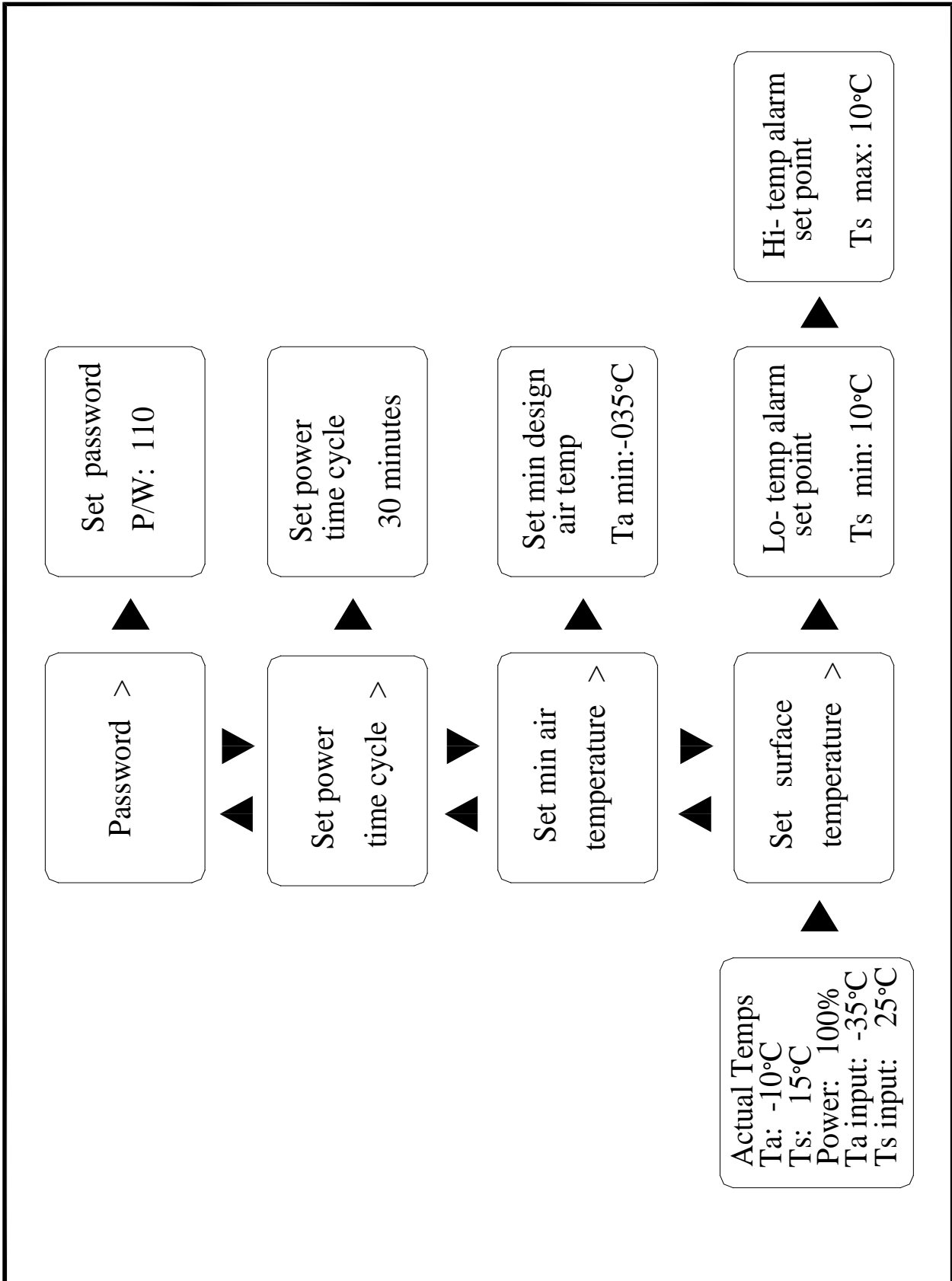Set password

P/W: 117

Figure 16

The entering of a password enables the temperature parameters to be changed.
To set the password:-.

Using «**Up**» / «+» «**Down**» / «-» buttons, set the required password. Then you can opriate sub-menu for change/setting of the temperature parameters.

To return to the main indication screen of the controller, press the "Reset" button (Return to the main menu).

Figure 16.
The controller's indication/ display diagram (the menu structure).

Password >

Set password
P/W: 110

Set power
time cycle >

Set power
time cycle
30 minutes

Set min air
temperature >

Set min design
air temp
Ta min:-035°C

Set surface
temperature >

Lo- temp alarm
set point
Ts min: 10°C

Hi- temp alarm
set point
Ts max: 10°C

Actual Temps
Ta: -10°C
Ts: 15°C
Power: 100%
Ta input: -35°C
Ts input: 25°C

10. Maintenance Operation

• Maintenance of the controller should be carried out annually. Electrical contacts must be verified, and dust/ contamination removed from the terminals of the controller.
• Verification (calibration) of the controller should be carried out by simulation of the system sensors and process requirements etc. every 2 years.
• During installation and maintenance of the controller, the device must be disconnected from the supply network.
• Connection, adjustment, servicing of the controller must be performed by competent personnel.

11. Marking of the Controller

• Front label with the name and the trade mark of Heat Trace Limited.
• All terminals labeled with terminal number and designation.
• Serial number label to the side of the enclosure.
• Basic operation conditions and supply voltage label fitted to the side of the controller.

12. Storage Conditions

• Storage temperature range: from 20°C to +60°C.
• Relative air humidity (at temperature +35°C): not less than 80%.
• The air in the storage room shall not contain dust, vapours of acids and alkalis, or corrosive gases.

13. Transportation Conditions

• The controller must be packaged when transported.
• Transportation temperature range -20°C to +60°C.
• Relative air humidity (at temperature +35°C) not more than 90%.
• The controller must not be transported in open conditions.

13. Junction Boxes for Sensors

There are two sensors available for use with the PMM+ Controller, an Ambient (Air) temperature sensor and (optionally) a Surface / Process temperature sensor. Sensors are the Pt100 type and should be ordered seperately from the Control unit. The standard Pt100 sensors are suitable for temperatures up to180°C.   Where surface temperature sensors are required to operate at temperatures higher than 180°C a special mineral insulated Pt100 sensor should be specified at the time of ordering. Two wire sensors are provided as standard. Where the sensor is remotely located more than 50 metres from the controller, a three wire sensor is required. The resistance of the sensor wires should be 100 Ohms maximum.

Junction boxes and ancillary equipment may be sourced locally, if required. However, it is the responsibility of the installation contractor to ensure that all equipment and components meet the necessary local and international standards and carry the correct approvals and certification to suit the area in which they are installed.

Fig 17 Ambient Sensor shown in JB9000 Junction Box

Fig 18 Surface Sensor with DJB9000 (EX) Junction Box and DESTU (Optional).

(For the surface temp sensor, the complete unit of sensor, DESTU & DJB9000 carries Ex'e' type of protection for hazardous area use.)

Fig 19 Image showing how surface sensor is protected on pipe by DESTU

Typical Sensor Configurations

INSTALLATION NOTES

PMM+ Controller Serial No: ....

Date Purchased: ....

Date Installed: ....

Date commissioned: ....

Installation Details & Comments