

## Guidance - Supplement to the manual of instructions

# Microprocessor Temperature Controller MP-988 Profibus

Bussystem: Profibus DP-V0  
Transmission: max. 1.5 MBit/s  
Address: 1...253  
Physical values: Temperature [°C], Flow [l/min]



Controller version 708 / E / C

10/2014  
Version: 05

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## General information

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In case of inconsistencies in the English translation, the German version shall prevail.

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### NOTE



**This guidance provides specific information to the temperature controller.  
Observe the General Safety Information in the manual of instructions to the  
TOOL-TEMP machine!**

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## 1. Overview MP-988 Profibus



|    |  |                        |                         |
|----|--|------------------------|-------------------------|
| 1  | Display of set value   | 2                      | Display of actual value |
| 3  | <b>Flow control</b><br>Display of the current flow in litres/min, English or American gallons/min.   |                        |                         |
| 4  | <b>Up arrow</b>  | Raise of set value     |                         |
| 5  | <b>Down arrow</b>  | Reduction of set value |                         |
| 6  | <b>Program button</b>  |                        |                         |
| 7  | <b>Flow control</b><br>Flow control active      LED green<br>Alarm flow control      LED red   |                        |                         |
| 8  | <b>LED Cooling</b><br>Lights up when the cooling relay is activated  |                        |                         |
| 9  | <b>LED Heating</b><br>Lights up when the heating relay is activated  |                        |                         |
| 10 | <b>LED Sensor failure</b><br>Lights up when the sensor is intermitted or the wrong type of sensor is used  |                        |                         |
| 11 | <b>LED Temperature deviation control</b><br>Lights up when the difference between set and actual temperature is too high   |                        |                         |
| 12 | <b>LED Maximum temperature</b><br>Lights up when the maximum temperature has been reached  |                        |                         |
| 13 | <b>LED External temperature control</b><br>Lights up when the set value is applied from extern   |                        |                         |
| 14 | T1 = Sensor 1 - Actual value (at this value is controlled)<br>T2 = Sensor 2 - Temperature to mould (relevant for performance measurement)<br>T3 = Sensor 3 - Temperature from mould (relevant for performance measurement) |                        |                         |
| 15 | LED Receiving  | 16                     | LED Send                |



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Type **MP-988** Serie No.

110 - 240V AC  Fe-Ko J 2

0 - 10V  $\cong$  0 - 400°C  Pt-100 2L 3

5

4 

|    |    |    |
|----|----|----|
| 88 | 89 | 90 |
|----|----|----|

  
 flow sensor  
 PE

6 

|    |    |    |    |
|----|----|----|----|
| 27 | 28 | 29 | 30 |
|----|----|----|----|

  
 10V OUT IN2 IN3

7 

|    |    |    |
|----|----|----|
| 14 | 15 | 16 |
|----|----|----|

  
 R5 flow

8 Input Output 9

|    |    |    |
|----|----|----|
| 31 | 32 | 33 |
|----|----|----|

4-20mA 0-10V U OUT 0-10V

10 

|   |   |   |   |   |   |    |    |    |    |
|---|---|---|---|---|---|----|----|----|----|
| 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|----|----|----|----|

  
 R1 R2 R3 R4  
 0-1 limit cooling heating

11 

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
|---|---|---|

  
 N Ph mains

|           |  |  |
|-----------|--|--|
| <b>1</b>  | <b>Possible supply voltages</b>  | (factory adjusted)   |
| <b>2</b>  | <b>Possible temperature sensor</b>   | (factory adjusted)   |
| <b>3</b>  | <b>Version of the controller</b>   |  |
| <b>4</b>  | 88+89 <b>Flow control – encoder signal</b><br>90            PE   | (factory occupied)<br>(factory occupied)   |
| <b>5</b>  | <b>Temperature sensor connection</b><br>21+22      Temperature sensor 1 – note +/-<br>23+24      Temperature sensor 2 – note +/-<br>25+26      Temperature sensor 3 – note +/- | (factory occupied)   |
| <b>6</b>  | 27+28      Collective alarm 10V Output   | (reserved 29,30)   |
| <b>7</b>  | 14+15      Output flow control normally open<br>14+16      Output flow control normally close  |  |
| <b>8</b>  | 31+32      Analog input 4 - 20mA<br>32+33      Analog input 0 - 10 V   |  |
| <b>9</b>  | 41+42      Analog output 0 - 10V   |  |
| <b>10</b> | 4+5+6      Input unit ON/OFF<br>7+8+9      Temperature monitoring, deviation alarm<br>10+11      Cooling (command)<br>12+13      Heating(command)                              | (factory occupied)<br>(factory occupied)<br>(factory occupied)<br>(factory occupied) |
| <b>11</b> | <b>Power supply</b><br>1            PE<br>2            Neutral<br>3            230V AC   | (factory occupied)<br>(factory occupied)<br>(factory occupied)                       |
| <b>12</b> | <b>D-Sub plug 9-poles (2x)</b><br>Looped Profibus interfaces   |  |

## 1.1. Connection – Wiring guidelines

It doesn't matter whether the upper or the lower SUB-D plug is used as input or as output.

With TOOL-TEMP delivered cables (1 x 10m and 1 x 1m) a maximum of 6 units can be connected together. To connect more units, Profibus cables (violet) are to be used.

The following points must be ensured when the interfaces are wired:

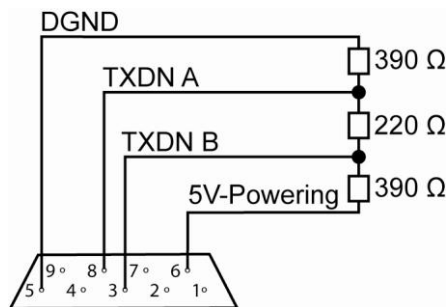
- Only use shield interface cable.
- Suppressed as good as possible the power consumption respectively power switch.

The following rules should be observed when Profibus units are wired:

- Use termination resistors on all open ends and before the first unit.



The resistors have to be wired as in the picture below (termination resistors are not included in the scope of delivery):



- Avoid stubs

Use both Profibus plugs (input/output) of the MP-988 to guarantee a good signal quality. Thereby, it doesn't matter which plug is used as input (side to master) or output (side to final unit). If a plug is used as input and output, connect the second still free plug of the MP-988 with a termination resistor. It is important to note that each termination resistor pulls power from the bus. Too many resistors result in connection losses.

- Grounding

For long lines, it is important that the controller, the connector of the Profibus cable and the opposite side (master or next controller) are properly grounded. In extreme cases it could be necessary that the ground terminal of the controller is connected with a separate grounding cable that is run close to the Profibus cable.

### NOTE



MP-988 Profibus contains only the Profibus interface.

Controller programming can only be done at unplugged interface cable!

#### Special units with set value setting by the set value transmitter

The value transmitter has priority over the Profibus. Set value setting via Profibus needs an adjustment of the value transmitter to the minimum or a clamp separation.



## 1.2. Interfaces – pin assignment

This interface is based on the Profibus–Standard. The connection is based on the standard DP-V0. A master needs a so called unit-master file (.gsd), to describe the unit which is connected to the Feldbus. The download of this file is available on the TOOL-TEMP Website.

### Data description

| <b>Inputs (Master → MP-988)</b> |                    |            |                 |           |
|---------------------------------|--------------------|------------|-----------------|-----------|
| Address                         | Description        | Data typ   | Unit / Display  | Remark    |
| 0                               | Modus              | Integer 16 | Numerical value | See below |
| 2                               | Temperatursollwert | Integer 16 | 1/10 °C         |           |

| <b>Outputs (MP-988 → Master)</b> |                           |                     |                 |           |
|----------------------------------|---------------------------|---------------------|-----------------|-----------|
| Address                          | Description               | Data typ            | Unit / Display  | Remark    |
| 0                                | Status                    | Integer 16          | Numerical value | See below |
| 2                                | Actual temperature        | Integer 16          | 1/10 °C         |           |
| 4                                | Flow control actual value | Integer 16          | 1/10 l/min      |           |
| 6                                | Set value                 | Integer 16          | %               |           |
| 8                                | Alarm                     | Unsigned Integer 16 | Bit - Code      | See below |

### Status

| Value | Description  |
|-------|--|
| 0     | Controlling <i>Normal operating mode</i>                     |
| 1     | Leakstopper <i>not supported</i>                             |
| 2     | Vacuum (a) <i>not supported</i>                              |
| 3     | Cooling (k) <i>Special application</i>                       |
| 4     | Controlling off (pump still runs) <i>Special application</i> |
| 5     | Controlling and pump off <i>Special application</i>          |

### Modus

| Value | Description   |
|-------|---|
| 0     | Unit starts – Normal operating mode – Controlling   |
| 1     | Leakstopper ( <b>not supported by the temperature control unit</b> )  |
| 2     | Controlling off (pump still runs)   |
| 3     | Unit off: cooling down to the pump overrun temperature, switch off ( <b>Possible adjustment by programme step P631</b> )            |
| 4     | Unit off: Cooling down to the pump overrun temperature, vacuum, switch off ( <b>not supported by the temperature control unit</b> ) |
| 5     | Unit off: Cooling down to the safety limit, switch off ( <b>Possible adjustment by programme step P630</b> )                        |
| 6     | Cooling down to the safety limit, vacuum, switch off ( <b>not supported by the temperature control unit</b> )                       |

### Alarms

#### Higherbyte

| 7. Bit  | 6. Bit  | 5. Bit  | 4. Bit  | 3. Bit  | 2. Bit  | 1. Bit  | 0. Bit  |
|---------|---------|---------|---------|---------|---------|---------|---------|
| Reserve | Reserve | Reserve | Reserve | Reserve | Reserve | Reserve | Reserve |

#### Lowerbyte

| 7. Bit  | 6. Bit  | 5. Bit  | 4. Bit  | 3. Bit              | 2. Bit                                    | 1. Bit             | 0. Bit                   |
|---------|---------|---------|---------|---------------------|---|--------------------|--------------------------|
| Reserve | Reserve | Reserve | Reserve | Maximum temperature | Collective alarm pump and unit switch off | Flow control alarm | Faulty temperature probe |

**GSD-Data for TOOL-TEMP MP988 Profibus Controller – from Version 700 E / B (from June 2009)**-----  
Connection as DP-Slave

last Revision: 19.06.09

```

#Profibus_DP
GSD_Revision          = 1    19.05.2005
Vendor_Name           = "Tool Temp AG"
Model_Name            = "TT MP988"
Revision              = "V1.2"
Ident_Number          = 0x0ABC
Protocol_Ident        = 0    Profibus DP
Station_Type          = 0    DP-Slave
FMS_supp              = 0
Hardware_Release      = "Revision B"
Software_Release      = "102"
9.6_supp              = 1
19.2_supp             = 1
93.75_supp            = 1
187.5_supp           = 1
500_supp              = 1
1.5M_supp             = 1
3M_supp               = 0
6M_supp               = 0
12M_supp              = 0
MaxTcdr_9.6           = 60
MaxTcdr_19.2          = 60
MaxTcdr_93.75         = 60
MaxTcdr_187.5         = 60
MaxTcdr_500           = 100
MaxTcdr_1.5M          = 150
MaxTcdr_3M            = 250
MaxTcdr_6M            = 450
MaxTcdr_12M           = 800
Redundancy            = 0
Repeater_Ctrl_Sig     = 2    TTL
24V_Pins              = 0
Implementation_Type   = "Asic"
Bitmap_Device         = "TT_A1"
Freeze_Mode_supp      = 0
Sync_Mode_supp        = 0
Auto_Baud_supp        = 0
Set_Slave_Add_supp    = 0
Min_Slave_Intervall   = 10
Modular_Station       = 1
Max_Module            = 1
Max_Input_Len         = 244
Max_Output_Len        = 244
Max_Data_Len          = 432
Modul_Offset          = 0
Fail_Safe             = 0
Slave_Family          = 5    Controller
Max_Diag_Data_Len     = 10
Module="MP988 - IO"

0xE0,\               IN: Modus (INT16)
0xE0,\               IN: Target (INT16, 1/10 Deg. Celsius)
0xD0,\               OUT: Status (INT16, 1/10 Deg. Celsius)
0xD0,\               OUT: Cur_Temp (INT16, 1/10 Deg. Celsius)
0xD0,\               OUT: Cur_Flow (INT16, 1/10 l/min)
0xD0,\               OUT: Cur_Out (INT16, %)
0xD0,\               OUT: Cur_Alarm(INT16)

EndModule
End of GSD

```

## 2. Overview programs of the controller

Once the „US-programs“ are set, the corresponding parameters are adjusted automatically on US-Gallons per minute and degree Fahrenheit.

| Temperature control units without flow control |         |                                   |   |
|--|---------|-----------------------------------|---|
| Programme                                      |         | New models                        | Old models  |
| T 41   | US T 41 | TT-180, TT-181                    | TT-155, TT-156, TT-157 E, TT-162 E, TT-162H   |
| T 42   | US T 42 | TT-170 L, TT-100 K-E, TT-100 KB-E | TT-162 E/PHE, TT-162 H/PHE, TT-162 E/A, TT-162 H/A, TT-154 E, TT-113 K, TT-103 K FeKo |
| T 43   | US T 43 |                                   | TT-130, TT-131, TT-132, TT-133, TT-134, TT-139  |
| T 44   | US T 44 |                                   | TT-220, TT-230, TT-240, TT-245  |
| T 45   | US T 45 |                                   | TT-260, TT-270, TT-280, TT-280/2  |
| T 46   | US T 46 |                                   | TT-360, TT-370, TT-380, TT-380/2, TT-380 / 48 kW                                      |
| T 47   | US T 47 |                                   | TT-300, TT-301, TT-302, TT-303, TT-304, TT-305, TT-500, TT-700                        |

| Temperature control units with flow control |         |  |            |
|---|---------|--|------------|
| Programme                                   |         | New models   | Old models |
| T 72  | US T 72 | TT-DW160 9kW   |            |
| T 73  | US T 73 | TT-1358  |            |
| T 74  | US T 74 | TT-1398  | TT-148     |
| T 75  | US T 75 | TT-108 E / 6 - 18 kW / Pt-100  |            |
| T 76  | US T 76 | TT-108 K / 18 - 45 kW / Pt-100   |            |
| T 77  | US T 77 | TT-1000  |            |
| T 78  | US T 78 | TT-137 B/BP, TT-138 B/BP   |            |
| T 79  | US T 79 | TT-188, TT-168 E special unit<br>1,5 – 35 l/min  |            |
| T 80  | US T 80 | TT-188, TT-168 E, TT-168 H   |            |
| T 81  | US T 81 | TT-168 E/A, TT-168 H/A,<br>TT-168 E/PHE, TT-168 H/PHE,<br>TT-168 E/A/PHE, TT-168 H/A/PHE |            |
| T 82  | US T 82 | TT-118 K, TT-1038 K, TT-108 K FeKo   |            |
| T 83  | US T 83 | TT-1548 E  |            |
| T 84  | US T 84 | TT-137 N-B, TT-138 N-B,<br>TT-142 N-B, TT-142 B/BP                                       | TT-143     |
| T 85  | US T 85 | TT-288, TT-288/2   |            |
| T 86  | US T 86 | TT-1368  |            |
| T 87  | US T 87 | TT-388, TT-388/2, TT-390, TT-390/2   |            |



|             |                |                          |                                  |
|-------------|----------------|--------------------------|----------------------------------|
| <b>T 88</b> | <b>US T 88</b> | TT-388 / 48 kW, TT-608 Z | TT-380 / 48 kW with flow control |
| <b>T 89</b> | <b>US T 89</b> | TT-508 X, TT-510 X       | TT-500 with flow control         |
| <b>T 90</b> | <b>US T 90</b> | TT-708 Y                 | TT-700 with flow control         |
| <b>T 91</b> | <b>US T 91</b> | TT-248                   |                                  |
| <b>T 92</b> | <b>US T 92</b> | TT-407 Z, TT-409 Z       | TT-408                           |
| <b>T 93</b> | <b>US T 93</b> | TT-410 X                 |                                  |
| <b>T 94</b> | <b>US T 94</b> | TT-30/160                |                                  |

| <b>Heating- and cooling units</b> |                |                     |                   |
|-----------------------------------|----------------|---------------------|-------------------|
| <b>Programme</b>                  |                | <b>New models</b>   | <b>Old models</b> |
| <b>W 09</b>                       | <b>US W 09</b> | TT-13'502 10 - 90°C |                   |
| <b>W 10</b>                       | <b>US W 10</b> | TT-13'502 10 - 40°C |                   |

| <b>Water chillers without flow control</b> |                |  |   |
|--|----------------|--|---|
| <b>Programme</b>                           |                | <b>New models</b>  | <b>Old models</b>   |
| <b>W 11</b>                                | <b>US W 11</b> | TT-29'000, TT-54'000, TT-54'000 WK, TT-54'000 OT, TT-108'000, TT-108'000 WK, TT-108'000 OT, TT-216'000, TT-216'000 WK, TT-216'000 OT, TT-14'000 E/LC | TT-4'500, TT-5'000, TT-9'500, TT-11'000, TT-11'000 WK, TT-12'000, TT-12'000 WK, TT-14'000, TT-14'000 WK, TT-20'000, TT-23'000, TT-23'000 WK, TT-25'000, TT-28'000, TT-28'000 WK, TT-29'000 WK, TT-40'000, TT-41'000, TT-57'000, TT-57'000 WK, TT-70'000, TT-80'000, TT-80'000 WK, TT-95'000, TT-95'000 WK, TT-110'000, TT-110'000 WK, TT-160'000, TT-160'000 WK |
| <b>W 12</b>                                | <b>US W 12</b> | TT-5'000 H, TT-14'000 H, TT-28'000 H, TT-5'000 E/LC  | TT-4'500 H, TT-9'500 H, TT-11'000 H, TT-12'000 H, TT-14'000 H, TT-20'000 H, TT-23'000 H, TT-25'000 H  |

| <b>Water chillers with flow control</b> |                |  |                   |
|---|----------------|--|-------------------|
| <b>Programme</b>                        |                | <b>New models</b>  | <b>Old models</b> |
| <b>W 13</b>                             | <b>US W 13</b> | TT-5'500 E, TT-14'500 H, TT-14'500 H/WK  |                   |
| <b>W 14</b>                             | <b>US W 14</b> | TT-28'500, TT-28'500 WK, TT-28'500 OT, TT-29'500 WK, TT-54'500, TT-54'500 WK, TT-54'500 OT, TT-58'500 WK |                   |

| <b>For all units with a special programming</b> |  |                     |                   |
|---|--|---------------------|-------------------|
| <b>Programme</b>                                |  | <b>New models</b>   | <b>Old models</b> |
| <b>T 100</b>                                    |  | Special programming |                   |

### 3. Selection of the controller programme

By starting the controller, the selected programme (T80) is shown.  
 For an optimised controller operation each temperature control unit or water chiller requires a different programming of the parameters.



Start the unit, on the display follows...

Controller programme T72



Press button twice



With the arrow buttons choose the required programme (see overview controller programmes)



Press button once to save



### 4. Settings

By starting the controller, the selected programme is shown.  
 After this the display shows the controller version (708) / controller hardware (E) / interface hardware (C), the interface (RS485), the communication protocol (Profibus) and the address of the unit (1).  
 If no interface is set, "OFF/OFF" is displayed.



### 5. Navigation in the controller

#### Enter into the controller and navigate to the different parameter:

- To enter into the program of the controller, the programme button has to be pressed until the menu appears.
- In the main menu, choose the submenu „3. Parameter” and press the program button again.
- To move from parameter to parameter, press the two arrow buttons (confirm again with the programme button).



#### Setting the parameter value:

With the two arrow buttons the value of the parameters can be adjusted.



#### Save the parameter setting:

- To save the parameter settings and get back to the main menu, press the flow button.
- To get back to the control function, choose the submenu “1. Controller” in the main menu.



**For all units with special programming T100:**

If a parameter will be changed the controller shows T100. Controllers with a special programming have a written the parameters on a label on the controller and in the manual of the model.

**CAUTION**

**Programming the controller only when the interface cable is unplugged.**

## 6. Parameter – Overview

### 6.1. General

|             | Function                      | Factory adjusted  | User | Agent | TOOL-TEMP | Description  |
|-------------|-------------------------------|---|------|-------|-----------|--|
| <b>P100</b> | Language                      | 0: English<br><b>1: German</b><br>2: French<br>3: Italian<br>4: Spanish                               |      |       |           | Here the desired language can be selected.   |
| <b>P101</b> | Temperature unit              | <b>1: °C</b><br>2: °F   |      |       |           | Temperature-unit for the indication of actual/set value as well as temperature relevant parameters. (Internally the temperature is always stored in °C)                      |
| <b>P102</b> | Flow unit                     | 0: Flow OFF<br>1: Impulse (Hz)<br><b>2: Litre/min</b><br>3: US gallons/min<br>4: Imperial gallons/min |      |       |           | Indication of flow unit<br>1 US Gallone = 3.785 litres<br>1 Imperial Gallone = 4.546 litres  |
| <b>P110</b> | Setting range FROM            | <b>Setting depends on each unit model</b><br>(-50.0...399.0°C)<br>(-58.0...750.2°F)                   |      |       |           | This parameter limits the lowest temperature which can be set.   |
| <b>P120</b> | Setting range TO              | <b>Setting depends on each unit model</b><br>(-49.9...400.0°C)<br>(-57.8...752.0°F)                   |      |       |           | This parameter limits the highest temperature which can be set.  |
| <b>P150</b> | Power measurement-coefficient | 0.0 switched off<br>0.6 oil<br><b>1.0 water</b><br>(0.0...10.0)                                       |      |       |           | Power calculation:<br>$P=k * (T_{x2}-T_{x3}) * Q$<br>P: Performance in kcal/h<br>k: Coefficient of performance<br>T <sub>x</sub> : Sensor temperature<br>Q: Flow rate in l/h |
| <b>P151</b> | Power measurement unit        | <b>0: switched off</b><br>1: W<br>2: kW<br>3: kcal/h  |      |       |           | Unit of the power measurement  |
| <b>P160</b> | Indication contrast           | <b>62</b><br>(45...80)  |      |       |           | Setting of the display contrast  |
| <b>P170</b> | Control parameter             | <b>0.5</b><br>(0.0...5.0)   |      |       |           | Factory parameter  |

## 6.2. Inputs

|             | Function                      | Factory adjusted   | User | Agent | TOOL-TEMP | Description  |
|-------------|-------------------------------|--|------|-------|-----------|--|
| <b>P200</b> | Temperature sensor            | <b>Setting depends on each unit model</b><br>FeKo Type J<br>NiCr Type K<br>Pt 100 2-wire |      |       |           | Selection of temperature sensor, applies for all 3 temperature inputs  |
| <b>P201</b> | Temperaturabgleich bei Pt 100 | <b>0.7°C / 33.3°F</b><br>(0.0...130.0°C)<br>(0.0...234.0°F)                              |      |       |           | The resistance of the line can be compensated for Pt 100 on very long sensor cables. A comparative measurement is necessary for this purpose. Example:<br>measured temperature: 100°C,<br>temperature displayed: 108°C.<br>-> 8°C set (difference) |
| <b>P210</b> | Analogue input                | <b>Voltage 0-10 V</b><br>Current 0-20mA<br>Current 4-20mA                                |      |       |           | Analog input of signal threshold.<br>0-10 V (threshold <0.1V)<br>0-20 mA (threshold <0.5mA)<br>4-20 mA (threshold <0.1mA)  |
| <b>P212</b> | Temperature of 0V at AIN      | <b>0°C / 32°F</b><br>(-50.0...399.9°C)<br>(-58.0...751.8°F)                              |      |       |           | Lower scaling point of the voltage analog input<br>0V corresponds 0°C  |
| <b>P213</b> | Temperature of 10V at AIN     | <b>400.0°C / 752.0°F</b><br>(-49.9...400.0°C)<br>(-57.8...752.0°F)                       |      |       |           | Upper scaling point of the voltage analog input<br>10V corresponds 400°C   |
| <b>P214</b> | Temperature of 0/4mA at AIN   | <b>0°C / 32°F</b><br>(-50.0...399.9°C)<br>(-58.0...751.8°F)                              |      |       |           | Lower scaling point of the voltage analog input<br>4mA corresponds 0°C   |
| <b>P215</b> | Temperature of 20mA at AIN    | <b>400.0°C / 752.0°F</b><br>(-49.9...400.0°C)<br>(-57.8...752.0°F)                       |      |       |           | Upper scaling point of the voltage analog input<br>20mA corresponds 400°C  |

### 6.3. Controller

|             | Function   | Factory adjusted  | User | Agent | TOOL-TEMP | Description  |
|-------------|--|---|------|-------|-----------|--|
| <b>P301</b> | Sensor-Nr.<br>Actual value of sensor                                   | <b>Setting depends on each unit model</b><br>(1...3)                            |      |       |           | Indicates which sensor input is used for the controlling.  |
| <b>P302</b> | Relation between cooling- and heating capacity                         | <b>0</b><br>(1...50)  |      |       |           | Adjustment of cooling capacity<br>0: 2-point cooling (standard)<br>1: Cooling capacity = Heating capacity<br>50: Cooling capacity > Heating capacity               |
| <b>P310</b> | P-band heating, control parameter                                      | <b>Setting depends on each unit model</b><br>(1.0...100.0°C)<br>(1.8...180.0°F) |      |       |           | Within the proportional band is controlled PID-algorithm.  |
| <b>P320</b> | Amplification factor I-proportion (K <sub>I</sub> ), control parameter | <b>Setting depends on each unit model</b><br>(0...100%)                         |      |       |           | Integration constant of the PID-control<br>Controls the sensitivity/reactivity of the controller   |
| <b>P330</b> | Differential portion heating and cooling, control parameter            | <b>Setting depends on each unit model</b><br>(0...100%)                         |      |       |           | Differential proportion of the PID-control<br>Controls the maximum regular rate of the controller  |
| <b>P340</b> | Integration speed-limitingband, control parameter                      | <b>Setting depends on each unit model</b><br>(0.0...5.0°C)<br>(0.0...9.0°F)     |      |       |           | Prevents an overshoot of the temperature   |
| <b>P350</b> | Delta-W – cooling  | <b>Setting depends on each unit model</b><br>(-9.9...9.9°C)<br>(-17.8...17.8°F) |      |       |           | Starting point of cooling<br>If the setpoint exceeded this value the cooling system starts   |
| <b>P351</b> | Hysteresis cooling   | <b>Setting depends on each unit model</b><br>(0.2...25.0°C)<br>(0.4...45.0°F)   |      |       |           | Difference between activation and deactivation point of cooling.<br>Temperature control units and Water Chillers adjust according to the controller setting table. |
| <b>P360</b> | Cycle time, control parameter  | <b>15s</b><br>(6...255s)  |      |       |           | Controller time base of PM-output<br>Duration of the analysis of the control system to the readjustment of the correcting condition                                |
| <b>P361</b> | Minimal switching time heating, control parameter                      | <b>2s</b><br>(1...9s)   |      |       |           | Minimal switching time for heating relay.  |
| <b>P362</b> | Minimal switching time cooling, control parameter                      | <b>1s</b><br>(0.5...9s)   |      |       |           | Minimal switching time for cooling relay.  |



#### 6.4. Flow control

|             | Function                           | Factory adjusted  |         | User | Agent | TOOL-TEMP | Description  |
|-------------|------------------------------------|---|---------|------|-------|-----------|--|
| <b>P400</b> | Flow measurement function          | 0: Off<br><b>1: Automatic</b><br>2: Manual  |         |      |       |           | If the automatic flow measurement is activated, the measured flow is stored as a reference after an initial period of 15 s (after start of the unit) and monitoring is enabled. The green LED lights up. |
| <b>P401</b> | Flow measurement calibrating table | 0 = Manual<br>1 = Small units 1<br>2 = Medium units<br>3 = Large units<br>4 = Reserved<br>5 = Small units 2<br>6 = Reserved |         |      |       |           | Selection of the calibration table for flow measurement  |
| <b>P410</b> | Alarmschwelle Durchfluss           | <b>8.0 l /min</b><br>(0.1...999.9 l/min)  |         |      |       |           | (P400) set to manual<br>Alarm is triggered when the set value is exceeded.   |
| <b>P420</b> | lower alarm threshold (P431)       | <b>30%</b>  |         |      |       |           | Applies only to automatic mode (P400 = 1) and calculates the alarm point   |
| <b>P421</b> | top alarm threshold (P431)         | <b>10%</b>  |         |      |       |           | Applies only to automatic mode (P400 = 1) and calculates the alarm point   |
| <b>P431</b> | Flow measurement Measuring point 1 | x Hz  | y l/min |      |       |           | Relevant calibration table for flow measurement by P401  |
| <b>P432</b> | Flow measurement Measuring point 2 | x Hz  | y l/min |      |       |           | Relevant calibration table for flow measurement by P401  |
| <b>P433</b> | Flow measurement Measuring point 3 | x Hz  | y l/min |      |       |           | Relevant calibration table for flow measurement by P401  |
| <b>P434</b> | Flow measurement Measuring point 4 | x Hz  | y l/min |      |       |           | Relevant calibration table for flow measurement by P401  |
| <b>P435</b> | Flow measurement Measuring point 5 | x Hz  | y l/min |      |       |           | Relevant calibration table for flow measurement by P401  |

## 6.5. Outputs

|             | Function                 | Factory adjusted  | User | Agent | TOOL-TEMP | Description  |
|-------------|--------------------------|---|------|-------|-----------|--|
| <b>P510</b> | Output function          | <b>0: P511,P512</b><br>1: 10V=100%<br>2: 5V=0%<br>3: Flow   |      |       |           | Voltage-analog output<br>0 : Actual value P511...P512 -> 0...10V<br>1 : Size 0...100% -> 0...10V<br>2 : Size -100...0...100% -> 0..5...10V<br>3 : Flow 0...P435 -> 0...10V |
| <b>P511</b> | Temperature at 0 V AOUT  | <b>0.0°C / 32.0°F</b><br>(-50.0...399.9°C)<br>(-58.0...751.8°F)   |      |       |           | Lower scaling point of the voltage analog output<br>0V corresponds 0°C   |
| <b>P512</b> | Temperature at 10 V AOUT | <b>400.0°C / 752°F</b><br>(-49.9...400.0°C)<br>(-57.8...752.0°F)  |      |       |           | Upper scaling point of the voltage analog output<br>10V corresponds 400°C  |
| <b>P520</b> | Relay 1 function         | 1: Maximal temperature<br>2: Limit value 1<br>3: Limit value 2<br>(not integrated)<br>4: Limit 1 or Limit 2<br>5: Difference to mould /<br>from mould<br>6: Drain<br><b>7: Unit on/off</b><br>8: Flow measurement alarm |      |       |           | The relay 1 can be programmed, that is switches on with different signals.<br>Standard: Unit on/off  |
| <b>P530</b> | Relay 2 function         | 1: Maximal temperature<br>2: Limit value 1<br>3: Limit value 2<br>(not integrated)<br><b>4: Limit 1 or Limit 2</b><br>5: Difference to mould /<br>from mould<br>6: Drain<br>7: Unit on/off<br>8: Flow measurement alarm |      |       |           | The relay 2 can be programmed, that is switches on with different signals.<br>Standard: Limit 1 or Limit 2   |
| <b>P560</b> | Relay 5 function         | 1: Maximal temperature<br>2: Limit value 1<br>3: Limit value 2<br>(not integrated)<br>4: Limit 1 or Limit 2<br>5: Difference to mould /<br>from mould<br>6: Drain<br>7: Unit on/off<br><b>8: Flow measurement alarm</b> |      |       |           | The relay 5 can be programmed, that is switches on with different signals.<br>Standard: Flow measurement alarm   |

The relay 3 (cooling) and relay 4 (heating) cannot be programmed.

## 6.6. Limit values

|             | Function   | Factory adjusted   | User | Agent | TOOL-TEMP | Description  |
|-------------|--|--|------|-------|-----------|--|
| <b>P600</b> | Maximal temperature  | <b>Setting depends on each unit model</b><br>(0.0...400.0°C)<br>(32.0...752.0°F) |      |       |           | If the maximum temperature is exceeded, heating and cooling are inactive and the maximum value LED on the controller lights.   |
| <b>P602</b> | Safety thermostat T2   | <b>0°C / 0°F</b><br>(0...50.0°C)<br>(0...90.0°F)                                 |      |       |           | 0 = T2 inactive<br>see below for detailed explanation  |
| <b>P610</b> | Starting interlock   | <b>1: On</b><br>0: Off   |      |       |           | The activation of the temperature deviation occurs after initial power and first reaching the target temperature.  |
| <b>P611</b> | Temperature deviation control (deviation between the desired and actual temperature) | <b>5.0°C / 9.0°F</b><br>(0...20.0°C)<br>(0...36.0°F)                             |      |       |           | The temperature deviation control determines the maximum deviation from the nominal value, which is still tolerated. If the actual temperature outside the set value window, the alarm sounds and the limit LED lights. If the restart interlock (P610) is activated, the temperature deviation control is active only when it reaches the set temperature. The starting lockout starts when the set point is changed. |
| <b>P630</b> | Safety temperature   | <b>50.0°C / 122.0°C</b><br>(-50.0...400.0°C)<br>(-58.0...752.0°F)                |      |       |           | Operation with interface: When the corresponding command is received through the interface, this temperature will be attained.   |
| <b>P631</b> | Trail temperature  | <b>70.0°C / 158.0°F</b><br>(-50.0...400.0°C)<br>(-58.0...752.0°F)                |      |       |           | Operation with interface: When the corresponding command is received through the interface, this temperature will be attained.   |
| <b>P640</b> | Drain time   | <b>30s</b><br>(5...120s)   |      |       |           | Time of draining after reaching the target temperature.  |

**Maximum temperature P600 (Tmax):** As soon as the evaluated temperature of the temperature sensor (T1) is higher as the parametrising value, the cooling and heating relay are obligatory open. The normal control operation starts if the temperature is again below this temperature.

### Safety thermostat P602:

The set value in this parameter 602 defines the maximum allowable temperature limit of the additional measurement point (temperature sensor 2) to the set value. The setting of this parameter is 0...50.0°C (resp. 0...90°F). The temperature sensor 2 must be connected to the desired control point for this function.

Example 1: T1 measures the temperature of the product in a double-walled vessel, T2 measures the temperature in the unit, P602 is set to 3°C -> T2 is more than 3°C above the set temperature and interrupts the heating command.

Example 2: T1 measures the temperature in the unit, T2 measures the temperature outside the unit on a mould, P602 is set to 3°C-> T2 is more than 3°C above the set temperature and interrupts the heating command.

If this safety thermostat is active the error message "safety thermostat" is shown on the display.

## 6.7. Ramp controller

Temperature curves can be traversed in function time with this controller. The curves can be programmed with 10 points and 8 curves can be stored.

The flow control and temperature deviation control are inactive in this control method.

### Enter into the controller for adjusting the ramp control:

- To enter into the program of the controller, the program button has to be pressed until the menu appears.
- In the main menu, choose the submenu „2. Ramp controller” and press the program button again.
- Navigate between the menu with the arrow buttons

**Start:** Start the ramp control (start with the selected curve)

With the flow button the controller is interrupted and switches back to the ramp controller menu

**Curve:** Select the ramp control curve 1...8

Navigate with the arrow keys to the desired curve

Confirm with the flow button and use the arrow buttons to switch back and "start" the ramp controller

**Change:** Edit the selected curve

Use the arrow buttons to select the curve points 1...10 and edit them. Set-curve can be determined by: **setpoint, gradient** or **time** (can only be changed when gradient =0)

Selected with the program button

Edit value with arrow keys

Confirm with the flow button and use the arrow buttons to switch back and „start" the ramp controller

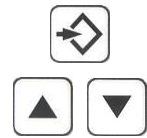


**Parameters:** Selection ramp control mode

Using the modes „Cycle“ or „Timehold“ with the arrow buttons:

**Cycle:** Cyclic passing through the curve; repetitive (Cycle: On)  
If the curve only runs through once (Cycle: Off) the follow temperature regulates at P631.

**Timehold:** If the temperature must be maintained the timehold is relevant. The temperature holding time would be counted after the setpoint value is reached. The parameter P791 defines the allowable timeout for reached the setpoint. The light-dark change of the display visualized the “non-compliance”.



The desired modes „On“ / „Off“ can be selected with the program button

Pressing the flow button to switch back to the ramp control menu

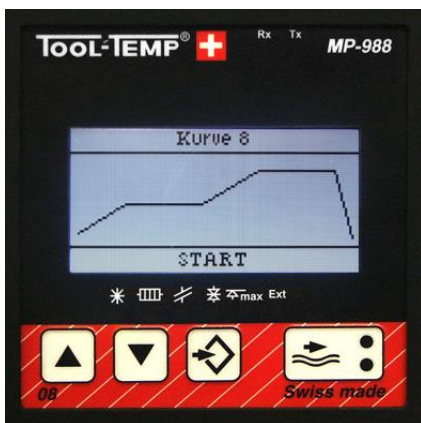


**Leaving the ramp controller:**

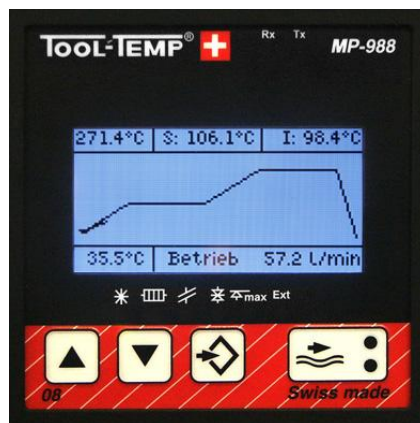
- To save the parameter settings and get back to the main menu, press the flow button.
- To get back to the control function, choose the submenu “1. Controller” in the main menu.



**Examples ramp controller**



Curve 8 is set and can be started by the program button.



The actual value are „plotted“. The temperature limit (35.5°C; line below the curve), the operating mode and the actual flow displayed in the bottom line. The top line shows the temperature limit (271.4; line above the curve), the setpoint and actual value.

The following parameters are applied only for the ramp control.

|             | Function   | Factory adjusted  | User | Agent | TOOL-TEMP | Description  |
|-------------|--|---|------|-------|-----------|--|
| <b>P722</b> | Relation heating- and cooling capacity                               | <b>Setting depends on each unit model</b><br>(0...50)                           |      |       |           | 0: PID heating control,<br>2 points cooling<br>1...50 PID heating/cooling control  |
| <b>P723</b> | P-Band heating, control parameter                                    | <b>Setting depends on each unit model</b><br>(1.0...100.0°C)<br>(1.8...180°C)   |      |       |           | Within the proportional band is controlled PID-algorithm.  |
| <b>P724</b> | Amplification factor I-quantity (K <sub>I</sub> ), control parameter | <b>Setting depends on each unit model</b><br>(1...100%)                         |      |       |           | Integration constant of the PID-control<br>Controls the sensitivity/reactivity of the controller   |
| <b>P725</b> | Differential percentage heating and cooling, control parameter       | <b>Setting depends on each unit model</b><br>(0...100%)                         |      |       |           | Differential proportion of the PID-control<br>Controls the maximum regular rate of the controller  |
| <b>P726</b> | Integration limit band, control parameter                            | <b>Setting depends on each unit model</b><br>(0.0...5.0°C)<br>(0.0...9.0°F)     |      |       |           | Prevents an overshoot of the temperature   |
| <b>P727</b> | Delta-W – cooling  | <b>Setting depends on each unit model</b><br>(-9.9...9.9°C)<br>(-17.8...17.8°F) |      |       |           | Starting point of cooling<br>If the setpoint exceeded this value the cooling system starts   |
| <b>P728</b> | Hysteresis cooling   | <b>Setting depends on each unit model</b><br>(0.2...25.0°C)<br>(0.4...45.0°F)   |      |       |           | Difference between activation and deactivation point of cooling.<br>Temperature control units and Water Chillers adjust according to the controller setting table. |
| <b>P730</b> | Cycle time, control parameter  | <b>15s</b><br>(6...255s)  |      |       |           | Controller time base of PM-output<br>Duration of the analysis of the control system to the readjustment of the correcting condition                                |
| <b>P731</b> | Minimum switching time heating, control parameter                    | <b>2s</b><br>(1...9s)   |      |       |           | Minimum switching time for heating relay. If P722 is 0, then also relevant for cooling relay.  |
| <b>P732</b> | Minimum switching time cooling, control parameter                    | <b>1s</b><br>(0.2...9s)   |      |       |           | Minimum switching time for cooling relay. Only active if P722 greater than 0.  |
| <b>P791</b> | Maximal delay of reaching the set value                              | <b>10 min</b><br>(1...120 min)  |      |       |           | If the set value is not reached within the adjusted time period, there is a break-off.   |



## 6.8. Communication

|             | Function                              | Factory adjusted  | User | Agent | TOOL-TEMP | Description  |
|-------------|---------------------------------------|---|------|-------|-----------|--|
|             |                                       |   |      |       |           |  |
| <b>P800</b> | Physical interface                    | 0: Switched off<br>1: RS232<br><b>2: RS485</b><br>3: Current Loop<br>4: CAN   |      |       |           | The physical interface is defined here.  |
| <b>P801</b> | ComProtocol<br>Communication-protocol | 0:<br>1:<br>2:<br>3:<br>4:<br>5:<br>6:<br>7:<br>8:<br>9:<br>10:<br>11:<br>12:<br>13:<br>14:<br>15:<br>16:<br>17:<br>18:<br>19:<br><b>20: Profibus</b> |      |       |           | The interface protocol is defined here.<br>By switching the unit off and on, the parameter will be set back to 20. |
| <b>P802</b> | ComAdress<br>Address of the unit      | <b>1</b><br>(1...253)   |      |       |           | For multiple units, each number has to be incremented.   |
| <b>P830</b> | Reserve - Bit<br>Standard interface   | <b>1</b><br>(0...3)   |      |       |           | Transmission speed of the CAN, respectively the Profibus interface   |
| <b>P840</b> | CAN - Baudrate                        | Nr. CAN<br>0: 125 kBit/s<br><b>1: 250 kBit/s</b><br>2: 500 kBit/s<br>3: 615 kBit/s<br>4: 625 kBit/s<br>5: 750 kBit/s<br>6: 1000 kBit/s                |      |       |           | Transmission rate of CAN-interface.  |

## 7. Communication – Overview interfaces

At the controller MP-988 the following parameters are adjusted:

- P-800 2 (RS-485 / Profibus)
- P-801 19 (Profibus TT)
- P-802 Address of the unit – has to correspond to the screen of the injection moulding machine (1-253)
- P-840 The baudrate does not have to be adjusted. It will be automatically recognised. Baudrate until 1.5 Mbits/s are permitted.

### 8. Connection diagram Profibus – communication connection

Use only Profibus cables! It is possible to connect up to 12 units in series.

