Controller N480

TEMPERATURE CONTROLLER – OPERATION MANUAL – V2.6x

1. ASSEMBLY

The controller should be installed in a panel cut out as specified in item 2.1. First remove the mounting clamp and insert the controller into the panel cut out. Place the unit into the panel cut-out and slide the mounting clamp from the rear to a firm grip at the panel.

The internal circuitry can be fully removed from the housing without disconnecting any wiring. By using the thumb just press the tab in the lower part of the front panel, grab firmly the front panel and pull out the circuitry from the housing.

1.1. ELECTRICAL CONNECTIONS

Figure 1 shows the electrical terminals of the controller.

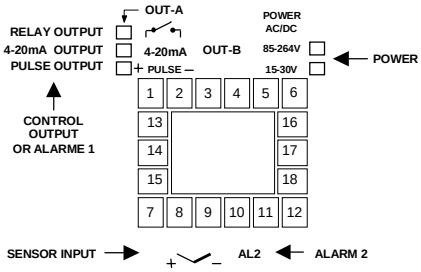


Figure 1 - Electrical connections

2. SPECIFICATIONS

2.1. GENERAL

- Dimensions: 48x48x106mm (1/16 DIN).
- Panel cut-out: 45,5x45,5mm
- Weight: 140g (1 relay), 160g (3 relays)
- Power: 85 to 264Vdc/ac, 50/60Hz, 3VA max. Optional: 15 to 30Vdc/ac
- Operation: 0 to 55°C, humidity 20 to 85%

2.2. CONTROL OUTPUT

- Relay output: SPST (U type) relay. Maximum current 3A/250Vac.
- Voltage pulse output: 5Vdc/20mA

Both outputs are available in the basic model and the desired main control output is user selected via keyboard (refer to " **cntr** " prompt). The remaining output can then be used as an alarm output.

In case of sensor break or failure an error **"Erro"** message is displayed and the control output is turned off.

2.3. ALARM OUTPUTS

- Alarm Output 1: SPST relay 3A/250Vac or 5Vdc/20mA pulse
- Alarm Output 2: SPST relay 3A/250Vca (optional)

2.4. POWER

Mains power is connected to terminals 5 and 6. Check the upper side of the housing for proper power indication.

2.5. TEMPERATURE SENSOR INPUT

- Pt100: 3-wire connection. Excitation current: 170µA
- Thermocouple input impedance: 10MΩ
- A/D converter resolution: 15000 steps
- Sampling rate: 10 measurements per second
- Accuracy: 0.2% of full scale for Pt100 and 0.25% of full scale ±1°C for T/C

Thermocouples are connected to terminals 8 and 9 with positive in terminal 8.

Pt100 sensors are connected to terminals 7, 8 and 9, as indicated in figure 1. For full compensation of cable resistance only cables with equal wire electrical resistance should be used.

Table 1 shows the sensor types accepted and their respective codes. via keyboard.

TYPE	CODE	RANGE
J	0	-50 to 760°C (-58 to 1400°F)
K	1	-90 to 1370°C (-130 to 2498°F)
S	2	0 to 1760°C (32 to 3200°F)
Pt100 (Resolution 0,1°C)	3	-199.9 to 530.0°C (-199.9 to 986.0°F)
Pt100 (Resolution 1°C)	4	-200 to 530°C (-328 to 986°F)
T	5	-100 to 400 °C (-148 to 752°F)
E	6	-30 to 720°C (-22 to 1328°F)
N	7	-90 to 1300°C (-130 to 2372°F)
R	8	0 to 1760°C (32 to 3200°F)

Table 1 - Sensor types, codes and ranges

3. CONFIGURATION AND OPERATION

Prior to first operation the controller should be fully configured. The user must set basic parameters as temperature type ("**tYPE**"), the desired control set point (" **SP** "), the alarms set points ("**SPA1**" and "**SPA2**"), etc.

3.1. PARAMETERS FLOW CHART

The programming parameters are organized in 4 different sets or levels:

- Operation level
- Alarms and tuning level
- Configuration level
- Calibration level

At power up the controller displays a prompt at the Operation Level and remains in this level while under normal operation.

The other levels are only accessed when a change of parameters is necessary (except for Set Point change). To reach these other parameters the user must keep the INDEX Key (⏎) pressed for about three seconds. After this time the controller will show the first parameter of the next level. By keeping the INDEX key pressed for another 3 seconds the next level will be accessed.

Release the ⏎ key when the desired level is reached. Press once the ⏎ to go to the next prompt in the same level.

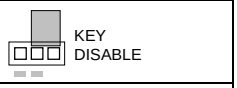
When a parameter is shown the display will alternate its name and value. The value can then be changed by pressing the ▼ or ▲ key.

After the last parameter in one level is reached the controller returns to operation level and the display will indicate the measured temperature.

The display will also go back to the measured temperature whenever the display is inactive for 20 seconds or more.

When a parameter value is changed via keyboard the controller will only accept the new value after the user presses the INDEX key to go to next prompt or if the keyboard is left inactive for 20 seconds.

For disabling the keyboard, move the internal strap to the position KEY DISABLE. All parameters will be protected, accept the **SP parameter**.

	
Figure 2 – Strap in normal operating position (enabled)	Figura 3 – Strap position for inhibiting the keyboard

3.2. OPERATION LEVEL

TEMPERATURE INDICATION END SP **S**et **P**oint	**TEMPERATURE** measured by the sensor. At power up, the upper display shows the process temperature value. It also shows the messages described in chapter 5 of this manual. The lower displays shows the set point value which is the temperature value desired for the process.
rAtE **rAtE**	**TEMPERATURE RATE OF RISE**: The user defines the rate of temperature rise from the starting temperature to the value set in " SP ". Rate is defined in **°C / minute**.
t SP **t**ime for soak	**TIME FOR SOAK**: Time in minutes which the temperature will remain at the selected " SP ". Refer to item 4.
run **run**	**RUN**: At this prompt the user sets the control output and alarms to active or to inactive. 0 - inactive outputs; 1 - active outputs;

3.3. TUNING AND ALARMS LEVEL

AtUn **A**uto **tun**e	**AUTO-TUNE**: Activates the auto-tuning of PID parameters. 0 - Auto-tune is off; 1 - Auto-tune is on;
Pb **P**roportional **b**and	**PROPORTIONAL BAND**: percentage of maximum input span. When set ot zero (**0**), control action is **ON/OFF**.
Ir **i**ntegral **r**ate	**INTEGRAL RATE**: Integral time constant in repetitions per minute (Reset). This constant is not used when controller is set to ON/OFF action (**Pb=0**).
dt **d**erivative **t**ime	**DERIVATIVE TIME**: Derivative time constant in seconds. This constant is not used when controller is set to ON/OFF action (**Pb=0**).
Ct **C**ycle **t**ime	**CYCLE TIME**: Pulse Width Modulation (PWM) period in seconds. This term is not used when controller is set to ON/OFF action (**Pb=0**).
HYSt **HYSt**erisis	**CONTROL HYSTERESIS**: Is the hysteresis for ON/OFF control (set in temperature units). This parameter is only used when the controller is in ON/OFF mode (**Pb=0**).
A 1SP **SP A**larm **1**	**SETPOINT for Alarm 1**: Triping point for alarm 1
A2SP **SP A**larm **2**	**SETPOINT for Alarm 2**: Triping point for alarm 2

3.4. CONFIGURATION LEVEL

tYPE **tYPE**	**INPUT TYPE**: Selects the input sensor type to be connected to the controller. ***This is the first parameter to be set.*** 0 - Thermocouple type **J**; 1 - Thermocouple type **K**; 2 - Thermocouple type **S**; 3 - **Pt100** with **0,1°** resolution; 4 - **Pt100** with **1°** resolution; 5 - Thermocouple type **T**; 6 - Thermocouple type **E**; 7 - Termopar tipo **N**; 8 - Termopar tipo **R;**
un It **unit**	**TEMPERATURE UNIT**: Selects display indication for degrees Celsius or Farenheit. 0 - degrees Celsius (**°C**); 1 - degrees Farenheit (**°F**);
ACt **ACt**ion	**CONTROL ACTION**: 0 - **reverse** action. Generally used for heating. 1 - **direct** action. Generally used for cooling.
Cntr **Cntr**ol	**CONTROL OUTPUT**: 0 - Sets control output to terminals OUT A. 1 - Sets control output to terminals OUT B. As control output is defined to terminals OUT A, alarm output is automatically set to OUT B. If control output is defined to OUT B alarm 1 will then be automatically set to OUT A.
SPLL **SP L**ow **L**imit	**SET POINT LOW LIMIT:** sets the lower range for SV
SPHL **SP H**igh **L**imit	**SET POINT HIGH LIMIT**: Sets the upper range for SV.
A 1Fu **A**larm **1 Fu**nction	**FUNCTION OF ALARM 1**: Refer to table 2 for function description and respective codes to set at this prompt.
A2Fu Alarm **2 Fu**nction	**FUNCTION OF ALARM 2**: Refer to table 2 for function description and respective codes to set at this prompt.
A 1HY A2HY **A**larm **HY**steresis	**ALARM 1 AND ALARM 2 HYSTERESIS**: Defines the differential range between the PV value at which the alarm is turned on and the value at which it is turned off (in engineering units).

3.5. CALIBRATION LEVEL

A T E N T I O N

These parameters are used to calibrate the temperature measurement and should only be dealt with by experienced and well equipped personnel.

InLC **In**put **L**ow **C**alibration	**SENSOR OFFSET CALIBRATION**. Sets the temperature sensor low calibration (offset). The display shows only the corrected temperature and not the offset added. A signal simulator should be used to inject a low value signal to properly adjust the offset.
InHC **In**put **H**igh **C**alibration	**INPUT HIGH CALIBRATION**. Sets the sensor input circuit gain or high calibration. A signal simulator should be used to inject a high value signal to properly adjust the offset.
CJ L **C**old **J**unction **L**ow **C**alibration	**COLD JUNCTION OFFSET CALIBRATION**: Sets the cold junction offset calibration. A good thermometer or a temperature simulator should be used to properly adjust this parameter.

4. RAMP TO SOAK FUNCTION CHARACTERISTICS

This function makes the process temperature rise gradually from the starting point (present PV) to the temperature value set in " SP " (Ramp). The user defines the rate of rise in degrees per minute at the "rAtE" prompt.

When SP is reached the temperature is leveled at this point for 1 to 9999 minutes as programmed at the " t SP " prompt. Setting **0** (zero) at " t SP " defines an infinite length soak profile.

To disable the ramp function Set **0.0** at the "rAtE" prompt. To disable the soak function set **1** at the " t SP " prompt (thus making a 1 minute soak) and the control output will go off in 1 minute. To restart control set 1 at the " run " prompt.

After a power failure the controller will resume ramp to soak execution at the equivalent previous ramp point. If the proces temperature is the same as the SP (no temperature drop) the controller will repeat the soak segment.

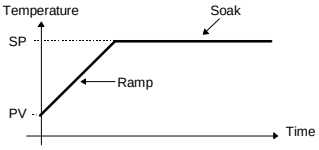


Figure 2 - Ramp to Soak Function

5. PROBLEMS WITH THE CONTROLLER

Connection and configuration errors state for most of the problems in using the controller. A final revision of parameters will save time and further losses.

Error messages are displayed to help the user to identify possible problems.

[_ _ _ _]: Process temperature is below the selected sensor range.

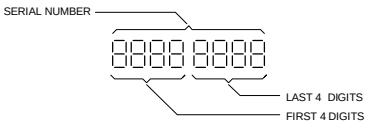
[- - - -]: Process temperature is above the selected sensor range

[Erro]: Controller or sensor error. Example:

- Broken thermocouple or Pt100.
- Pt100 badly connected, short-circuited or high cable resistance.

5.1. ELECTRONIC SERIAL NUMBER VISUALIZATION

To read the 8-digit serial number go to the Operation Level and press the ⏶ key for 3 seconds. The display will show the first 4 digits. Keep the ⏷ key pressed for 3 seconds and the display will show the last 4 digits.



When powering the unit the display will show the software version for a few seconds.

6. ALARM FUNCTIONS

Low and high alarms are used to signal minimum and maximum temperature values as programmed in the "SPA1" ande "SPA2" prompts.

Differential alarms are used to indicate deviations from the desired setpoint (**SP**) temperature. These deviations are programmed at the "SPA1" and "SPA2" prompts.

Error alarm shows sensor defects or not properly connected.

Alarm hysteresis is fixed and factory set as described below:

- Pt100: 1.1ºC
- Thermocouples: type J: 1.3ºC; types K and S: 2.3ºC

6.1. ALARM INITIAL BLOCKING

The initial blocking option inhibits the alarm from being recognized if an alarm condition is present when the controller is first energized. The alarm will actuate only after the occurrence of a non alarm condition followed by a new occurrence for the alarm.

Table 2 shows each alarm function operation with their respective code. Alarm 1 is used as an example.

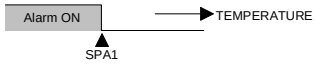
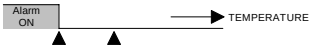
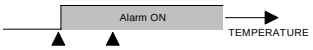
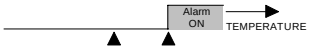
TYPE	CODE	ACTION
LOW	0	
HIGH	1	
LOW differential	2	SPA1 Negative 
		SPA1 Positive 
HIGH differential	3	SPA1 Negative 
		SPA1 Positive 
differential or deviation	4	SPA1 Negative 
		SPA1 Positive 
Input sensor error or heater break detection	5	Alarm is ON whenever: • Temperature is below/above selected range; • Termocouple or Pt100 is broken; • Pt100 is shorted; • Pt100 is badly connected or wire impedance is too high; • The heater resistence is broken
End of Program	6	Activated when the programmed soak time is run out. Refer to item 4 of this manual.
Alarm Functions With alarm inhibition at power-up	7	Low limit alarm disabled at power-up
	8	High limit alarm disabled at power-up
	9	Differential low limit alarm disabled at power-up
	10	Differential high limit alarm disabled at power-up
	11	Differential alarm disabled at power-up

Table 2 - Alarm functions and their identification codes

7. PID AUTO TUNE

During auto tune the temperature is controlled in ON/OFF mode at the programmed Set Point (SV). Depending on the process characteristics large oscillations above and below SV may occur and auto tuning may take several minutes to be concluded.

The recommended procedure is as follows:

- Program a new SP close to the desired final temperature other than the present measured temperature.
- Enable the auto tune at the "AtUn" prompt by selecting **1**.
- Set **1** at the "run" prompt.

During auto tune large oscillations will be induced around the setpoint. Make sure the process can accept these oscillations.

If auto tuning results are not satisfactory refer to table 3 for manual fine tuning procedure.

PARAMETER	RESPONSE	SOLUTION
Proportional Band	Slow Response	Decrease
	Large Oscillation	Increase
Integral Rate	Slow Response	Increase
	Large Oscillation	Decrease
Derivative	Slow Response or Instability	Decrease
Time	Large Oscillation	Increase

Table 3 - Suggestions for manual tuning of PID parameters