AutoPID *plus*

PID TYPE DIGITAL TEMPERATURE CONTROLLER

Ver.02



E251415

AUTOPID2-10T-11757

1. DESCRIPTION

The **AutoPID** *plus* is a digital controller for heating and cooling processes. It uses a PID (proportional, integral, and derivative) type controller, which enables to control the temperature with minimal fluctuation. Product complies with UL Inc. (United States and Canada).

2. APPLICATION

- Freezing and heating chambers
- Refrigeration plants
- Set of compressors etc.

3. TECHNICAL SPECIFICATIONS

- **Power Supply:** 90 to 264Vac (50/60 Hz)
- **Controlled Temperature:** -50 to 100°C (with resolution of 0.1°C)
- **Indication Accuracy:** 0.1°C between -10 and 100°C
  and 1°C for the rest of the scale
- **Controlling Accuracy:** 0.1°C for the whole scale
- **Proportional Outputs:** Voltage output: 0~10Vdc 5mA
  PWM: Adjustable period 5mA
- **Alarm Output:** 5(3)A 250Vac 1/8HP
- **Dimensions:** 71 x 28 x 71mm
- **Operation temperature:** 0 to 50°C
- **Operation humidity:** 10 to 90% RH (without condensation)

4. CONFIGURATION

4.1 - Setpoint adjustment

Press SET for 2 seconds until it displays SEt and then release the key. The operation temperature you set is displayed. Use ▼ and ▲ keys to change this value and press SET to configure the new value when ready.

4.2 - Accessing the function menu

Press ▼ and ▲ keys simultaneously for 2 seconds until it displays Fun and then release the keys. When F01 is displayed, press SET (shortly) and enter the code (123) by using the ▼ and ▲ keys. Press SET to confirm. You can use ▼ and ▲ keys to access other functions. Use the same procedure to adjust other functions.
To exit the menu and return to the normal operation, hold the SET key pressed for a while to display ---.

4.3 - Advanced functions

Fun	Description	Min	Max	Default	Unit
F01	Access code (123)	-99	999	0	-
F02	Static gain	0.0	99.9	1.0	-
F03	Integral time	0	999	12	x 10 sec.
F04	Derivative time	0	999	3	x 10 sec.
F05	Anti-windup time	0	999	4	x 10 sec.
F06	Setpoint gain in the proportional control	0.0	1.0	1.0	-
F07	Control type (0 = cooling, 1 = heating)	0	1	0	-
F08	Output amplitude for autotuning	10	100	40	%
F09	Temperature hysteresis for autotuning	0.1	20.0	5.0	°C
F10	Steady temperature validation time	1	999	6	x 10 sec.
F11	Autotuning starting method	0	3	0	-
F12	Max. amount of time for stabilizing the temperature before autotuning activation	1	999	999	min.
F13	Low temperature alarm	-50.0	100.0	-50.0	°C
F14	Hysteresis for resetting the low temperature alarm	1.0	10.0	1.0	°C
F15	High temperature alarm	-50.0	100.0	100.0	°C
F16	Hysteresis for resetting the high temperature alarm	1.0	10.0	1.0	°C
F17	ON-OFF cycle time for alarm output	0	210	0	sec.
F18	PWM output period	1	999	1	x 10 ms.
F19	Output value in the manual mode	0	100	0	%
F20	Output value when error occurs	0	100	50	%
F21	Minimum setpoint allowed to the final user	-50.0	100.0	-50.0	°C
F22	Maximum setpoint allowed to the final user	-50.0	100.0	100.0	°C
F23	Indication offset	-5.0	5.0	0.0	°C
F24	RS-485 network address	1	247	1	-

4.4 - Function description

F01 Access code (123)
The access code is needed when you want to change the configuration settings. If you just want to view the parameters you don't need to input the access code.

F02 Static gain (K)
This gain actuates in the system error (proportional control) and is related to stabilization time and control circuit speed. The static gain can be calculated automatically by the autotuning.

F03 Integral time (Ti)
The integrative control is responsible for canceling an error when the system is in a steady condition and is also responsible for the system stabilization time. This parameter can be calculated automatically by the autotuning.

F04 Derivative time (Td)
This is responsible for stabilizing the system in the setpoint and canceling the overshoot. It can be calculated automatically by autotuning, just as the other parameters.

F05 Proportional output anti-saturation system time (Tt)
This is responsible for preventing the proportional control output from becoming saturated due to integral control action (windup). The value recommended for this function is:

$$\sqrt{(Ti * Td)}$$

The value for this parameter is calculated automatically at the end of autotuning by using Ti and Td parameters according to the formula above.

F06 Setpoint influence in the static gain
This is the setpoint gain when calculating the system error. It is used to reduce the effect of an eventual noise from the temperature sensor. When you reduce this parameter value, you increase the immunity to noise.

F07 Control type
Indicates the process type that the controller will operate.
- 0 Cooling
- 1 Heating

F08 Output amplitude for autotuning
Initial amplitude of the signal to be applied in the proportional output during the autotuning stage.
This value is recalculated automatically by the controller during the autotuning and it must be chosen so that the system can distinguish the temperature oscillation around the setpoint and the hysteresis.

F09 Temperature hysteresis for autotuning
This hysteresis is used together with the setpoint to control the temperature oscillation in the autotuning.

F10 Steady temperature validation time
This is the time used by the controller to make sure that system temperature is steady and stabilized.

F11 Autotuning starting type
This function defines the mode in which the autotuning must be started.
- 0 Only manual start;
- 1 Performs autotuning when automatic control is activated;
- 2 Performs autotuning if the temperature does not stabilize inside the period of time configured in F12;
- 3 Performs autotuning when automatic control is activated or if the temperature does not stabilize inside the period of time configured in F12.

F12 Max. time for system stabilization
Maximum time for temperature stabilization before executing autotuning (if configured).

F13 Low temperature alarm
Temperature for activating the low temperature alarm.

F14 Hysteresis for resetting the low temperature alarm
Hysteresis for resetting the low temperature alarm.

F15 High temperature alarm
Temperature for activating the high temperature alarm.

F16 Hysteresis for resetting the high temperature alarm
Hysteresis for resetting the high temperature alarm.

F17 ON-OFF cycle time for alarm output
Cycle time in which the alarm output is turned ON and OFF. If the alarm output is intended to remain always ON, this parameter must be set to "0".

F18 PWM output period
Total time the PWM output remains in the ON and OFF state. The time for each state depends on the proportional output value.

F19 Output value in the manual mode
PWM and proportional output value when the controller is in the manual mode.

F20 Output value when a sensor error occurs
PWM and proportional output value when an error occurs in the temperature readings.

F21 Minimum setpoint allowed to the final user
Lower limit to avoid that extremely low temperatures be configured by mistake.

F22 Maximum setpoint allowed to the final user
Upper limit to avoid that extremely high temperatures be configured by mistake.

F23 Indication offset
Allows to compensate an eventual variation of temperature readings caused by sensor replacement.

F24 RS485 network controller address
Device address in the network for communication with Sitrad® software application.
Warning: it is not allowed to have more than one device with the same address in a network.

5. AUTOTUNING

The **AutoPID** *plus* uses the Critical Period method to calculate automatically its PID parameters. This method consists in making the system temperature oscillate around the setpoint so that the necessary data can be collected to adjust the controller. The user must input two parameters for the method to work properly: Temperature Hysteresis (F09) and Output Amplitude (F08). Both parameters must be chosen to permit a recognizable oscillation around the setpoint. The autotuning operation time will vary for each response from the system. Systems with a bigger cooling/heating capacity will have quicker responses and the autotuning function will finish the data collection quicker.
The method for starting the autotuning can be configured in the function F11 and may operate in the following modes:

Manual activation: The autotuning can be activated either through the controller keyboard or through the Sitrad® software.
When activating the automatic control: The autotuning will be executed every time the controller enters the automatic control mode (PID).
Temperature not steady: The autotuning will be executed every time the temperature does not stabilize inside the time period programmed in the function F12.
When activating the automatic control and the temperature is not steady: The autotuning will be executed every time the controller enters in the autotuning mode and when the temperature does not stabilize inside the time period programmed in the function F12.

If an error occurs during the system data collection, the controller will interrupt the autotuning and emit an alarm with the message AL1. Then it returns to the operation mode set before the autotuning activation.

6. EASY ACCESS FUNCTIONS

6.1 - Proportional output value indication

Press the SET key shortly for displaying the current proportional output value. The percentage value will be displayed followed by the indication ---.

6.2 - Minimum/Maximum temperature indication

Press ▲ shortly to display the minimum/maximum temperature. When pressing the key, the message will be displayed indicating the sensor temperature followed by the indication ---. If you hold the ▲ key pressed, the values are restarted and the message rST is displayed.

6.3 - Controller operation mode selection

Hold the ▲ key pressed for 4 seconds to choose the controller operation mode. After pressing the key, the MOd message will be displayed followed by the current operation mode. Use the ▼ and ▲ keys to choose one of the following options:
OFF Controller OFF
MAn Controller in the manual mode
Aut Controller in the automatic mode

Use the SET key to confirm the selection and wait the message --- indicating that the setting is finished.

6.4 - Canceling the active alarms

Press the ▼ key shortly to cancel the indication of current active alarms. After pressing the key, the ALn OFF message is displayed and all the current active alarms will be deactivated.

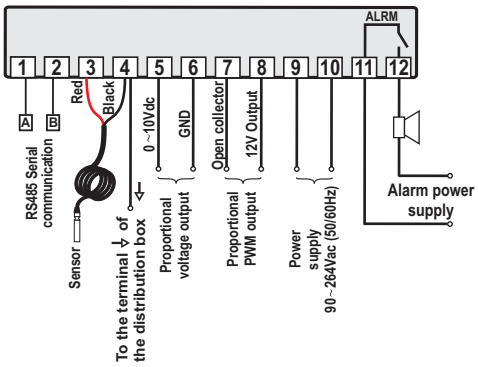
6.5 - Autotuning manual activation/deactivation

You can activate or deactivate the PID parameter autotuning by holding the ▼ key pressed for 2 seconds. The tUn message will be displayed followed by the On message (for activating) or OFF (for deactivating). When manually activating the autotuning, its starting conditions described in item 5 will not be tested.

7 - DISPLAY MESSAGES

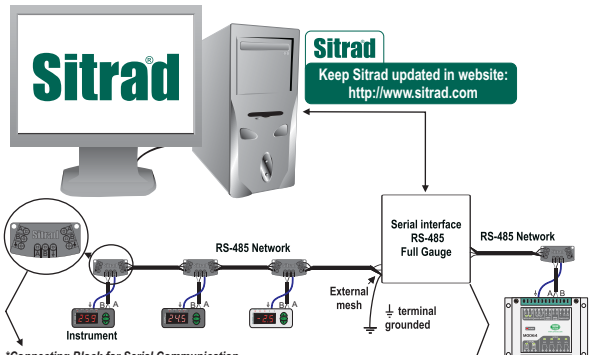
AL0 Low temperature alarm
AH1 High temperature alarm
AL1 Autotuning error
Er1 Indicates the autotuning was not completed after 12 hours.
Er2 Indicates an error occurred in the parameter calculation during the autotuning.
Er3 Indicates an error occurred in the temperature reading during the automatic control.
Err Temperature sensor disconnected or out of range
PPP Invalid parameters configuration
The outputs are turned off automatically in this situation
Please check which parameters have invalid data configured and correct them to return to normal operation

8. CONNECTION



For a current higher than the specified value, use a power relay for activating the alarm.

Integrating Controllers, RS-485 Serial Interface and Computer

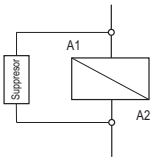


**Connecting Block for Serial Communication*
Used to connect more than one instrument to the Interface. The wire's connections must be made in agreement with the following rules: terminal **A** of the instrument connects to the terminal **A** of the connecting block, that must be connected with the terminal **A** of the Interface. Repeat the action for terminals **B** and ⏚ , being ⏚ the cable shield.
the terminal ⏚ of connecting block must be connected to the respective terminals ⏚ of each instrument.
***Sold Separately**

RS-485 Serial Interface
Device used to establish the connection Full Gauge Controls' instruments with the Sitrad®.

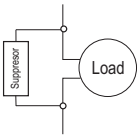
IMPORTANT
According to the chapters from the IEC60364 standard:
1: Install protectors against over voltage on power supply
2: Sensor cables and computer signals can be together, however not at the same place where power supply and load wires pass for
3: Install suppresor of transient in parallel to loads to increase the usefull life of the relays

Wiring diagram of suppresors in contactors



A1 e A2 are the contactor coils.

Wiring diagram of suppresor for direct drive



For direct activation the maximum specified current should be taken into consideration.

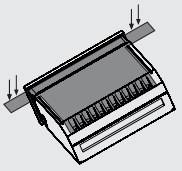
ENVIRONMENTAL INFORMATION
Package:
The packages material are 100% recyclable. Just dispose it through specialized recyclers.

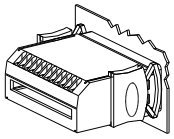
Products:
The electro components of Full Gauge controllers can be recycled or reused if it is disassembled for specialized companies.

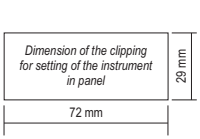
Disposal:
Do not burn or throw in domestic garbage the controllers which have reached the end-of-life. Observe the respectively law in your region concerning the environmental responsible manner of dispose its devices. In case of any doubts, contact Full Gauge controls for assistance.

PROTECTIVE VINYL:
This adhesive vinyl (included inside the packing) protects the instruments against water drippings, as in commercial refrigerators, for example. Do the application after finishing the electrical connections.

Remove the protective paper and apply the vinyl on the entire superior part of the device, folding the flaps as indicated by the arrows.







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