TEMPERATURE CONTROLLER
N322P I D

OPERATING MANUAL - V1.7x E

We Measure, We Control, We Record

Man 5001262

The N322PID is a 2-output digital electronic controller with PID control algorithm, intended for heating and cooling applications. The input sensors available are NTC thermistor, Pt100, or J/K/T type thermocouples. Sensor offset correction is provided. The 2 independent outputs can be used as control or alarm.

The features of a particular model (input sensor type, sensor range, mains supply, etc) are identified by the label placed on the controller body.

SPECIFICATIONS

INPUT SENSOR: The sensor is chosen by the user at the time of purchase and is presented on the upper side of the equipment box. The options are:

- Thermistor NTC, 10 kΩ @ 25 °C; Range: –50 to 120 °C (–58 to 248 °F); Accuracy: 0.6 °C (1.1 °F);
  Maximum error in the interchangeability of original NTC sensors: 0.75 °C (33.35 °F). This error can be eliminated through the **offset** parameter of the equipment.

> **Note:** For the NTC thermistor option, the sensor comes with the equipment. Its operating range is limited to –30 to +105 °C (–222 to +221 °F). It has cable of 3 m in length, 2 x 0.5 mm², and can be extended up to 200 meters.

- Pt100; Range: –50 to 300 °C (–58 to 572 °F); α= 0,00385; 3 wires;
  Accuracy: 0.7 °C (1.3 °F); according to IEC-751 standards;
- Pt1000; Range: –200 to 530 °C (–328 to 986 ºF); α= 0,00385; 3 wires;
  Accuracy: 0.7 °C (1.3 °F);
- Thermocouple type **J**; Range: 0 to 600 °C (32 to 1112 °F); Accuracy: 3 °C (5.4 °F);
- Thermocouple type **K**; Range –50 to 120 °C (–58 to 248 °F); Accuracy: 3 °C (5.4 °F);
- Thermocouple type **T**; Range: –50 to 120 °C (–58 to 248 °F); Accuracy: 3 °C (5.4 °F);
  Thermocouples according to IEC-584 standards.

WARM-UP: 15 minutes

MEASUREMENT RESOLUTION:

0.1 °C: from –19.9 to 199.9 °C (-3.8 to 391.8 °F) With NTC and Pt100

1°C: elsewhere

Note: The equipment keeps its precision all over the range, despite the lack of display resolution in a part of the range does not allow its visualization.

OUTPUT1: Relay: 16 A / 250 Vac, SPDT

OUTPUT2: Relay: 3A / 250 Vac, SPST

Note: In the standard configuration (1 SPDT + 1 SPST) both relays share a common terminal (no electrical isolation between the both relays – Figure 1). Optionally, it can be supplied with 2 SPST relays, isolated from each other.

POWER SUPPLY: 100~240 Vac (± 10 %)
Mains frequency: 50~60 Hz. Power consumption: 5 VA

Caution: check the power supply specification before energizing the controller.

DIMENSIONS: Width x Height x Depth: 74 x 32 x 75 mm
Panel cut-out: 70 x 29 mm; Weight: 100 g

ENVIRONMENT: Operating temperature: 0 to 40 °C (32 to 104 °F)
Storage temperature: -20 to 60 °C (-4 to 140 °F)
Relative humidity: 20 to 85 % no condensing

CASE: Polycarbonate UL94 V-2; Protection: Front panel: IP65, Box: IP42
Suitable wiring: Up to 4.0 mm²

Serial interface isolated from input circuitry.

ELECTRICAL WIRING

Fig. 1 below shows the controller connections to sensor, mains and outputs.

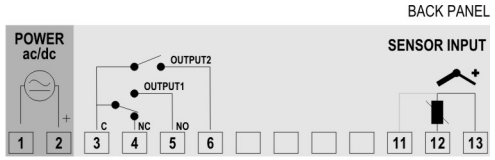

Fig. 1 – N322PID terminals

It is important to follow the recommendations below:

- Signal wires should be installed in grounded conduits and away from power or contactor wires.
- The instrument should have its own power supply wires that should not be shared with electrical motors, coils, contactors, etc.
- Installing RC filters (47 R and 100 nF, series combination) is strongly recommended at contactor coils or any other inductors.
- System failure should always be taken into account when designing a control panel to avoid irreversible damage to equipment or people.

OPERATION

The controller requires the internal parameters to be configured according to the intended use for the instrument. The parameters are organized in 4 groups or levels:

Level	Function
0	Temperature measurement
1	Setpoint Adjustment
2	Configuration
3	PID control parameters
4	Calibration

Upon power-up, the controller display shows for 1 second its firmware version. This information is useful when consulting the factory.

Then, the temperature measured by the sensor is shown on the display. This is the parameter level **0** (temperature measurement level).

To access level **1**, press [P] for 1 second until the "**SP 1**" message shows up. Pressing [P] again, the "**SP2**" parameter is presented. To go back to level 0, press [P] once more.

To access level 2 of paramenters, press [P] for 2 seconds until the "**Unt**" message is shown. Release the [P] key to remain in this level. Each new pressing on the [P] key will advance to the next parameter in the level. At the end of the level, the controller returns to the first level (**0**). Use the [▲] and [▼] keys to alter a parameter value.

Notes: 1 A parameter configuration is saved when the [P] key is pressed to advance to the next parameter in the cycle. The configuration is stored in a non-volatile memory, retaining its value when the controller is de-energized.

2 If no keyboard activity is detected for over 20 seconds, the controller saves the current parameter value and returns to the measurement level.

Level 1 – Setpoint Adjustment

In this level only the Setpoint (**SP 1** and **SP2**) parameters are available, alternating the names with their respective values. Adjust the desired temperature for each setpoint clicking on the [▲] and [▼] keys.

SP 1 *Set Point 1*	Temperature adjustment for control OUTPUT1. **SP 1** value is limited to the values programmed in **SPL** and **SPH** in the programming level (Parameter configuration, level 2).
SP2 *Set Point 2*	Temperature adjustment for control OUTPUT1. **SP2** value is limited to the values programmed in **SPL** and **SPH**

Level 2 – Configuration - Parameters configuration Level

Contains the configuration parameters to be defined by the user, according to the system's requirements. Use [▲] and [▼] keys to set the value. The display alternates the parameter name and respective value.

Unt	**Temperature Unit** - Selects display indication for degrees Celsius or Fahrenheit. **0** – Temperature in degrees Celsius **1** – Temperature in degrees Fahrenheit
tYP	**Input Type** - Selects the input sensor type to be connected to the controller. Available only for thermocouple models, allowing selection of types J, K and T. **0** - Thermocouple type **J** **1** - Thermocouple type **K** **2** - Thermocouple type **T**
oFS	**Sensor Offset** - Offset value to be added to the measured temperature to compensate sensor error.
SPL	**SP Low Limit** - Lower range for **SP 1** and **SP2**. **SPL** must be programmed with a lower value than **SPH**.
SPH	**SP High Limit** - Upper range for **SP 1** and **SP2**. **SPH** must be greater than **SPL**.
HY 1	**OUTPUT1 Hysteresis**: defines the differential range between the temperature value at which the OUTPUT1 is turned on and the value at which it is turned off. In degrees.
HY2	**OUTPUT2 Hysteresis**: defines the differential range between the temperature value at which the OUTPUT2 is turned on and the value at which it is turned off. In degrees.
Ac 1	Control action for OUTPUT1 : **0** Reverse: For heating applications. Outputs turn on when temperature is lower than SP. **1** Direct: For cooling applications. Output turns on when temperature is above SP.
Ac2	Action 2 - Control OUTPUT2 action or Alarm functions: **0** Reverse control action (heating). **1** Direct control action (cooling). **2** Low (minimum) temperature alarm. **3** High (maximum) temperature alarm. **4** Alarm for temperature inside the range **5** Alarm for temperature outside the range. **6** Low temperature alarm with initial blocking. **7** High temperature alarm with initial blocking. **8** Inside range alarm with initial blocking. **9** Outside range alarm with initial blocking. The section **Working with the Controller** describes how these functions work.
Cnt	**Control** - Associates Setpoints and Outputs. **0** Setpoint 1 is assigned to OUTPUT1 and Setpoint 2 to OUTPUT2 (factory setting). **1** Setpoint 1 is assigned to OUTPUT2 where as Setpoint 2 is directed to OUTPUT1.

Level 3 – PID control parameters

This level contains the parameters of PID control to be defined by the user, according to the system's requirements. The display alternates the parameter name and respective value.

AtN	Auto-Tune: Activates the auto-tuning of PID parameters. 0 Auto-tune is **off**; 1 Auto-tune is **on**;
Pb	Proportional Band: Percentage of the maximum input span. Select zero for ON/OFF control.
Ir	Integral Time: Integral time constant in repetitions per minute (Reset). This parameter is not used when controller is set to ON/OFF action (**Pb=0**).
dt	Derivate Time: Derivative time constant in seconds. This constant is not used when controller is set to ON/OFF action (**Pb=0**).
ct	Cycle Time: Pulse Width Modulation (PWM) period in seconds. This term is not used when controller is set to ON/OFF action (**Pb=0**).

Level 4 – Calibration level

The controller is factory calibrated. The following parameters should be accessed only by experienced personnel. To enter this cycle, the P key must be kept pressed for 4 seconds.

Don't press the ▲ and ▼ keys if you are not sure of the calibration procedures. Just press the P key a few times until the temperature measurement level is reached again.

PAS	**Password** - Enter the correct password to unlock write operations for the parameters in the following levels.
CAL	**Calibration low** - Offset value of the input. It adjusts the lower measurement range of the sensor.
CAH	**Calibration High** - Gain calibration. It adjusts the upper measurement range of the sensor.
CJL	**Cold Junction Offset calibration** - This parameter is available only for thermocouple.
FAC	**Factory Calibration** - Restores factory calibration parameters. Change from **0** to **1** to restore the calibration parameters with factory values.
Prt	**Protection** - Defines the levels of parameters that will be password protected. See "Configuration Protection" for details.
PAC	**Password Change** - Allows changing the current password to a new one. Values from 1 to 999 are allowed.
Sn2	**Serial number** - First part of the controller electronic serial number.
Sn1	**Serial number** - Second part of the controller electronic serial number.
Sn0	**Serial number** - Third part of the controller electronic serial number.

WORKING WITH THE CONTROLLER

Multiple output controllers are suited for controlling multiple stage systems.
Other applications require OUTPUT1 to be the control output and OUTPUT2 to be the alarm.
There are eight distinct alarm functions implemented in OUTPUT2, selected by the parameter **Ac2**, described below:

2 - Low temperature alarm – OUTPUT2 is turned on when the measured temperature falls **below** the **SP2** value.

3 - High temperature alarm – OUTPUT2 is turned on when the measured temperature exceeds the value programmed in **SP2**.

4 - Inside range alarm – OUTPUT2 is turned on when the measured temperature is within the range defined by:

(**SP1 – SP2**) and (**SP1 + SP2**)

5 - Outside range alarm: OUTPUT2 is turned on when the temperature falls outside the range defined by:

(**SP1 – SP2**) and (**SP1 + SP2**)

Functions **6**, **7**, **8** e **9** are identical to the above ones except that they incorporate the Initial Blocking feature, which inhibits the output if an alarm condition is present at start-up. The alarm will be unblocked after the process reaches a non-alarm condition for the first time.

In a multiple stage application, **SP1** and **SP2** are configured to operate at different temperatures, creating a progressive sequence for turning on the outputs (compressors) in response to a system demand. The output delays for turning on the compressors (**dL1** and **dL2**) cause the compressors to be turned on one by one, minimizing energy demand.

Another usage for multiple output controllers is in systems that require automatic selection between cool and heat action. In these applications, one output is configured as reverse action (heating) and the other as direct action (refrigeration). The output status led P1 and P2 in the controller panel, signals when the control output in on.

CONFIGURATION PROTECTION

A protection system to avoid unwanted changes to the controller parameters is implemented. The level of protection can be selected from partial to full. The following parameters are part of the protection system:

PAS When this parameter is presented, the correct password should be entered to allow changes of parameters in the following levels.

Prt Defines the level of parameters that will be password protected:

1 - Only calibration level is protected (factory configuration);

2 - Calibration and Configuration levels are protected;

3 - All levels are protected - calibration, Configuration and setpoints.

PAC Parameter for definition of a new password. Since it is located in the calibration level, can only be changed by a user that knows the current password. Valid passwords are in the range 1 to 999.

CONFIGURATION PROTECTION USAGE

PAS parameter is displayed before entering a protected level. If the correct password is entered, parameters in all following levels can be changed. If wrong or no password is entered, parameters in the following levels will be read only.

Important notes:

1- After five consecutive attempts to enter a wrong password, new tentative will be blocked for the next 10 minutes. If the current valid password is unknown, the master password can be used only to define a new password for the controller.

2 - The password for a brand new device is **111**.

MASTER PASSWORD

The master password allows user to define a new password for the controller, even if the current password is unknown. The master password is based in the serial number of the controller, and calculated as following:

[1] + [higher digit of SN2] + [higher digit of SN1] + [higher digit of SN0]

for example the master password for the device with serial number 97123465 is: **1 9 3 6** as follows: **1 + Sn2**= 97; **Sn1**= 123; **Sn0**= 465 = 1 + 9 + 3 + 6

How to use the master password:

1- Enter the master password value at **PAS** prompt.

2- Go to **PAC** parameter and enter the new password, which must not be zero (**0**).

3- Now you can use this new password to access all controller parameters with modify rights.

ERROR MESSAGES

Sensor measurement errors force the controller outputs to be turned off. The cause for these errors may have origin in a bad connection, sensor defect (cable or element) or system temperature outside the sensor working range. The display signs related to measurement errors are shown below:

– – –	Measured temperature exceeded maximum allowed range for the sensor. Broken **Pt100** or **T/C**. Short circuited **NTC** sensor.
– – –	Measured temperature is below minimum measurement range of the sensor. Short circuited **Pt100** or **T/C.** Broken **NTC**.

WARRANTY

Warranty conditions are available on our web site www.novusautomation.com/warranty.