NOVUS
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TEMPERATURE CONTROLLER
N323
OPERATING MANUAL - V1.8x K

The N323 is a 3-output digital electronic controller for heating and cooling applications. It is available with **NTC** thermistor input sensor, **Pt100**, **Pt1000** or **J** / **K** / **T** type thermocouple. Sensor offset correction is provided. The 3 independent outputs can be used as control or alarm.

The features of a particular model 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 (1.35 °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 meters 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 °F); 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 1000 °C (-58 to 248 °F); Accuracy: 3 °C (5.4 °F);
- Thermocouple type **T**; Range: -50 to 400 °C (-58 to 248 °F); Accuracy: 3 °C (5.4 °F);

Thermocouples according to IEC-584 standards.

Measurement resolution: ..... 0.1° from -19.9 to 199.9°
..... 1° 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 SPDT; 1 HP 250 Vac / 1/3 HP 125 Vac (16 A Res.)

OUTPUT2: ..... Relay: 3 A / 250 Vac, SPST-NA

OUTPUT3: ..... Relay: 3 A / 250 Vac, SPST-NA

POWER SUPPLY:
Tension: ..... 100~240 Vac/dc (± 10 %)
Optionally ..... 24 V (12~30 Vdc/ac)
Mains frequency: ..... 50~60 Hz
Power consumption: ..... 5 VA

DIMENSIONS:
Width x Height x Depth: ..... 75 x 33 x 75 mm
Panel cut-out: ..... 70 x 29 mm
Weight: ..... 100 g

ENVIRONMENTAL CONDITIONS:
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 % RH

Suitable wiring: Up to 4.0 mm².

Case: Polycarbonate UL94 V-2; Protection: box: IP42, front panel: IP65

RS-485 digital communication; RTU MODBUS protocol (optional)

Serial interface not isolated from input circuitry.

Serial interface isolated from input circuitry, except in 24 V powered model.

ELECTRICAL WIRING

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

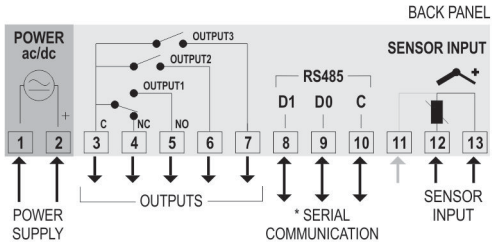

Fig. 1 – N323 terminals

* The serial communication feature is not always present in the controller.

Pt100 with 3 conductors: Terminals 11, 12 and 13 must have the same wire resistance for proper cable length compensation. For 2 wire Pt100, short circuit terminals 11 and 13.

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.

OPERATION

The controller requires the internal parameters to be configured according to the intended use for the instrument.

The parameters are organized in groups or levels:

Level	Function
0	Temperature Measurement
1	Setpoint Adjustment
2	Configuration
3	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. Pressing P again, the "**SP2**" parameter is presented. To go back to level 0, press P once more.

To access level 2 of parameters, press P for 2 seconds until the "**Unit**" 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) parameters are available, alternating the names with their respective values. Adjust the desired temperature for each setpoint clicking on the ▲ and ▼ keys.

SP 1 SP2 SP3	SetPoint 1, 2 and 3. Temperature adjustment for control OUTPUT. **SP** value is limited to the values programmed in **SPL** and **SPH** in the programming level (Parameter configuration, level 2).

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.

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**
Unt	**Temperature Unit** - Selects display indication for degrees Celsius or Fahrenheit. 0 Temperature in degrees Celsius 1 Temperature in degrees Fahrenheit
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 HY2 HY3	**OUTPUT Hysteresis**: defines the differential range between the temperature value at which the OUTPUT is turned on and the value at which it is turned off. In degrees.
AC 1	Control action for OUTPUT 1 : 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 OUTPUT 2 and OUTPUT3 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
AC3	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.

CnE	**Control** – Inversion between Setpoints and Outputs. 0 SP1 is assigned to OUTPUT 1 and SP2 to OUTPUT 2 (factory setting). 1 SP1 is assigned to OUTPUT 2 where as SP2 is directed to OUTPUT 1.
dL 1 dL2 dL3	**Delay 1, 2 and 3** - Delay time to start control. Upon power-on, control OUTPUT 1 is kept *off* until the time programmed in **dL 1** is elapsed. Its usage is intended to prevent multiple compressors to start simultaneously after the turn-on of a system with several controllers. Value in seconds, 0 to 250 s.
OF 1 OF2 OF3	**Off time 1, 2 and 3** - Defines the minimum ***off*** time for control OUTPUT. Once OUTPUT 1 is turned off, it remains so for at least the time programmed in **OF 1**. For thermocouple inputs this parameter is not available. This parameter is intended for refrigeration systems where longer compressor life is desired. For heating systems, program **OF 1** to zero. Value in seconds, 0 to 999 s.
On 1 On2 On3	**On time 1, 2 and 3** - Defines the minimum ***on*** time for control OUTPUT 1. Once turned on, OUTPUT 1 remains so for at least the time programmed in **On 1**. For thermocouple inputs this parameter is not available. This parameter is intended for refrigeration systems where increased compressor life is desired. For heating systems, program **On 1** to zero. Value in seconds, 0 to 999 s.
2t 1 3t 1 *Timer T1*	Time interval **T1** for alarm temporization. Defines the temporization mode and interval, as shown in **Table 4.** Adjustable from 0 to 1999 seconds. Available only when outputs 2 or 3 are configured as alarms.
2t2 3t2 *Timer T2*	Time interval **T2** for alarm temporization. Defines the temporization mode and interval, as shown in **Table 4**. Adjustable from 0 to 1999 seconds. Available only when outputs 2 or 3 are configured as alarms.
Adr	**Address** - Controllers with the optional RS485 Modbus RTU communication interface have the **Adr** parameter at the Configuration level. Set a unique Modbus address for each equipment connected to the network. Address range is from 1 to 247.

Level 3 – 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 3 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.
CJC	**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.
Sn 1	**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 OUTPUT 1 to be the control output and OUTPUT 2 to be the alarm.

In a multiple stage application, **SP 1**, **SP2** and **SP3** 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 (**dL 1**, **dL2** and **dL3**) 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).

Alarm Functions

There are eight distinct alarm functions implemented in OUTPUT 2 and 3, selected by the parameter **AC2** and **AC3**, described below:

2 - Low temperature alarm – OUTPUT is turned on when the measured temperature falls **below** the respective set point value.

3 - High temperature alarm – OUTPUT is turned on when the measured temperature exceeds the respective set point value.

4 - Inside range alarm – OUTPUT 2 is turned on when the measured temperature is within the range defined by:

(**SP 1 – SP2**) and (**SP 1 + SP2**) or (**SP 1 – SP3**) and (**SP 1 + SP3**)

5 - Outside range alarm: OUTPUT 2 is turned on when the temperature falls outside the range defined by:

(**SP 1 – SP2**) and (**SP 1 + SP2**) or (**SP 1 – SP3**) and (**SP 1 + SP3**)

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.

Alarm Timer

Alarms can be configured for timed operation. Three operation modes can be programmed: alarm delay, alarm timed pulse or alarm oscillator. Alarm temporization is available only for outputs 2 and 3 and is configured through parameters: "**2t 1**", "**3t 1**", "**2t2**" and "**3t2**".

Table 4 shows these advanced functions. Times T1 and T2 can be programmed from 0 to 1999 seconds. Programming 0 (zero) in the timer parameters T1 and T2 disables the timer function.

The output status led P2 and P3 in the controller panel, signals when the control output is on.

Advanced Function	T1	T2	ACTION
Normal Operation	0	0	
Delayed	0	1 to 1999 s	
Pulse	1 to 1999 s	0	
Oscillator	1 to 1999 s	1 to 1999 s	

Table 4 – Timer Alarm Functions 1 and 2

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 **SP**.

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 97123 465 is: **1 9 3 6**
as follows: **1 + Sn2**= 97; **Sn 1**= 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- Use this new password.

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**, **Pt1000** or **T/C**. Short circuited NTC sensor.
– – –	• Measured temperature is below **minimum** measurement range of the sensor. • Short circuited **Pt100**, **Pt1000** or **T/C**. Broken **NTC**.

WARRANTY

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