

<div>TEMPERATURE CONTROLLER</div> <div>N323</div> <div>OPERATING MANUAL - V1.8x A</div>	
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SAFETY SUMMARY

The symbols below are used on the equipment and throughout this document to draw the user's attention to important operational and safety information.

CAUTION or WARNING: Read complete instructions prior to installation and operation of the unit.	CAUTION or WARNING: Electrical Shock Hazard

All safety related instructions that appear in the manual must be observed to ensure personal safety and to prevent damage to either the instrument or the system. *If the instrument is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.*

SPECIFICATIONS

INPUT SENSOR: The input sensor type can be chosen from the options below (specified when placing the order):

- **NTC Thermistor**, 10 k Ω @ 25 °C; range: -50 to 120 °C (-58 to 248 °F); Accuracy: 1,0 °C (1,1 °F), with original sensor;
Sensor interchangeability: 1 °C (1.35 °F). This error can be compensated by the **offset** parameter in the controller.
- **Pt100 (α = 385)**; Range: -50 to 300 °C (-58 to 572 °F); Accuracy: 0,7 °C (1.3 °F); IEC-751.
- **J, K or T thermocouple** (IEC-584):
 - **Type J**: Range: 0 to 600 °C (32 to 1112 °F); Accuracy: 3 °C (5.4 °F);
 - **Type K**: Range: -50 to 1000 °C (-58 to 1832 °F); Accuracy: 3 °C (5.4 °F);
 - **Type T**: Range: -50 to 400 °C (-58 to 752 °F); Accuracy: 3 °C (5.4 °F);

Note: In the controller with NTC input, a 3 m-sensor cable is bundled with the instrument. The cable can be extended up to 200 m.

WARM-UP:..... 15 minutes

MEASUREMENT RESOLUTION:

from -19.9 to 199.9° With NTC, Pt100: 0.1
elsewhere:..... 1

OUTPUT1:..... Relay SPDT; 1 HP 250 Vac / 1/3 HP 125 Vac (16 A Resistive)

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

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

POWER SUPPLY: 100-240 Vac (\pm 10 %) or 24 Vdc/ac (12-30 Vdc/ac)
..... 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

ENVIRONMENTAL CONDITIONS:..... 5 to 50 °C
Maximum RH: 80 % up to 31 %, decreasing linearly to 50 % at 40 °C. Installation category II.
Pollution degree 2. Altitude < 2000 m.

CASE:..... Polycarbonate UL94 V-2; Protection: Front panel: IP65, Box: IP42
..... Suitable wiring: Up to 4,0 mm²

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.

The N323 is a 3-output digital electronic controller for heating and cooling applications. It is available with **NTC** thermistor input sensor, **Pt100** 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 (input sensor type, sensor range, mains supply, etc) are identified by the label placed on the controller body.

ELECTRICAL WIRING

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.
- The use of protection devices.

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

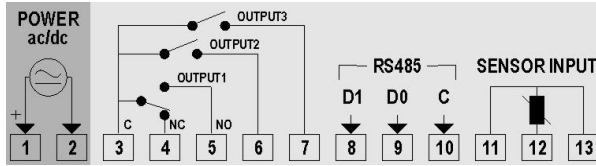


Figure 1 – N323 terminals

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.

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	Calibration

Upon power-up, the N323 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 “**SP1**” 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 “**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 (**SP1** and **SP2**) parameters are available, alternating the names with their respective values. Adjust the desired temperature for each setpoint clicking on the **▲** and **▼** keys.

SP1	SetPoint 1, 2 and 3. Temperature adjustment for control OUTPUT. SP value is limited to the values programmed in SPL and SPk in the programming level (Parameter configuration, level 2).
Sp2	
Sp3	

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 SP1 and SP2 . SPL must be programmed with a lower value than spK .
spK	SP High Limit - Upper range for SP1 and SP2 . SPx must be greater than spl .
Ac1	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 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.
Ac3	The section Working with the Controller describes how these functions work.
(nt	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.
ky1	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.
ky2	

Ky3 Hysteresis	
dl1 DI2 DI3	Delay 1, 2 and 3 - Delay time to start control. Upon power-on, control OUTPUT 1 is kept <i>off</i> until the time programmed in dl1 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.
of1 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 of1 . 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 of1 to zero. Value in seconds, 0 to 999 s.
On1 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 on1 . 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 on1 to zero. Value in seconds, 0 to 999 s.
2t1 3t1 <i>Timer T1</i>	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 <i>Timer T2</i>	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.
Add	Address - Controllers with the optional RS485 Modbus RTU communication interface have the Add 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 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.
[Al	Calibration low - Offset value of the input. It adjusts the lower measurement range of the sensor.
[Ak	Calibration High - Gain calibration. It adjusts the upper measurement range of the sensor.
[JL	Cold Junction Offset calibration - This parameter is available only for thermocouple.
FA(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.
Pa(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.
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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, **SP1**, **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 (**dL1**, **dI2** 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:
(SP1 – SP2) and **(SP1 + SP2)** or **(SP1 – SP3)** and **(SP1 + SP3)**
- 5- Outside range alarm: OUTPUT 2 is turned on when the temperature falls outside the range defined by:
(SP1 – SP2) and **(SP1 + SP2)** or **(SP1 – SP3)** and **(SP1 + 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: "**2t1**", "**3t1**", "**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.


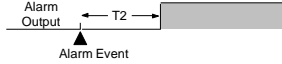

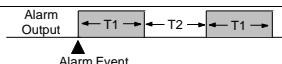
Advanced Function	T1	T2	ACTION
Normal Operation	0	0	
Delayed	0	1 to 1999 s	
Pulse	1 to 1999 s	0	
Oscillator	1 to 1999 s	1 to 1999 s	

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 setpoints.
- PA(** 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**.

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.

PRODUCT IDENTIFICATION

The label attached to the controller case identifies the model and the optional present in the product, as described below:

MODEL: **N323 - A - B - C**, where:

- A:** Input Sensor: **NTC** or **Pt100** or **J/K/T** (Thermocouples)
- B:** Digital communication: **blank** or **485** (RS485, Modbus protocol)
- C:** Voltage rating: **blank** (100-240 Vac/dc) or **24V** (24 Vac/dc);



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