



## N321, N322, N323

### TEMPERATURE CONTROLLERS – USER GUIDE – V1.8x

#### 1. SAFETY ALERTS

The symbols below are used in the device and throughout this manual to draw the user's attention to valuable information related to device safety and use.

<b>CAUTION:</b> Read the manual fully before installing and operating the device.	<b>CAUTION OR HAZARD:</b> Risk of electric shock.

All safety recommendations appearing in this manual must be followed to ensure personal safety and prevent damage to the instrument or system. If the instrument is used in a manner other than that specified in this manual, the device's safety protections may not be effective.

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#### 3. INTRODUCTION

**N321, N322, and N323** are temperature controllers for heating and cooling. They are distinguished by the number of outputs available:

- **N321:** It has 1 output channel: **OUT1**.
- **N322:** It has 2 output channels: **OUT1** and **OUT2**.
- **N323:** It has 3 output channels: **OUT1, OUT2, and OUT3**.

The models are subdivided by the type of temperature sensor supported:

- **NTC:** Model accepting only the NTC sensor.
- **Pt100:** Model accepting only the Pt100 sensor.
- **J/K/T:** Model accepting only J, K and T sensors.

The features of each controller are in accordance with the purchase order and are shown on the label attached to the body of the controller itself.

Example of the label of an **N323** model:

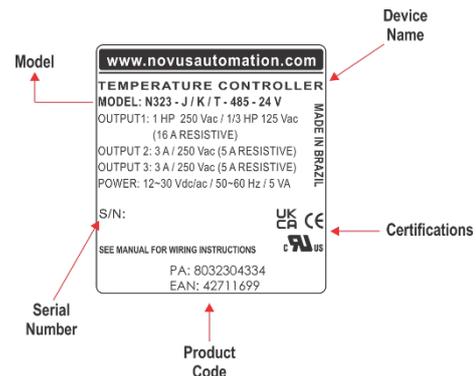


Figure 1 – Identification label

These models may have differences in power supply and the availability of an RS485 communication channel.

#### 4. SPECIFICATIONS

**Sensor Input:** The choice of sensor is made at the time of purchase and shown on the controller identification label. There are three options:

**NTC Input:**

Type:..... NTC Thermistor, R25 = 10 kΩ, 1%, β25/85 = 3435 K 1 %  
 Measurement range: .....-50 to 120 °C / -58 to 248 °F  
 Measurement accuracy:..... ± 1 °C @ 25 °C

**Pt100 Input:**

Type:..... Pt100, α = 385  
 Measurement range: .....-50 to 300 °C / -58 to 572 °F  
 Measurement accuracy:..... 0.2 % F.S. ± 2 °C @ 25 °C

**J/K/T Input:**

Measurement range **J**: ..... 0 to 600 °C / 32 to 999 °F  
 Measurement range **K**: .....-50 to 999 °C / 32 to 999 °F  
 Measurement range **T**: .....-50 to 400 °C / 32 to 752 °F

Measurement accuracy:.....0.2 % F.S. ± 2 °C @ 25 °C

**Notes:**

1. All input types are factory calibrated.
2. The thermocouples follow the NBR 12771/99 standard.
3. The Pt100 follow the NBR 13773/97 standard.
4. The operating range of the NTC sensor cable, which may come with the controller, is limited to -30 to +105 °C. Its typical length is 3 meters. It can be extended up to 100 meters. It is composed of two wires of 0.5 mm<sup>2</sup> section.

**Measurement resolution:** ..... 0.1° in the range -19.9 to 199.9°  
 ..... 1° in the rest of the range

**OUT1:** ..... SPDT relay  
 ..... 1 HP 250 Vac / 1/3 HP 125 Vac (16 A Res.)

**OUT2:** ..... Relay: 3 A / 250 Vac, SPST-NO

**OUT3:** ..... Relay: 3 A / 250 Vac, SPST-NO

**Power supply:**

- Voltage: ..... 100 to 240 Vac/dc (± 10 %)
- Frequency: ..... 50–60 Hz
- Consumption: ..... 5 VA
- Optionally: ..... 24 V (12~30 Vdc/ac)

**Dimensions:**

- Width x height x depth:.....75 x 33 x 75 mm
- Panel cut-out: .....70 x 29 mm
- Weight: ..... 100 g

**Operation conditions:**

- Operation temperature: ..... 0 to 40 °C
- Storage temperature: ..... -20 to 60 °C
- Relative humidity: ..... 20 to 85 % RH

**Connections for wires up to 4.0 mm<sup>2</sup>.**

**Housing: Polycarbonate UL94 V-2.**

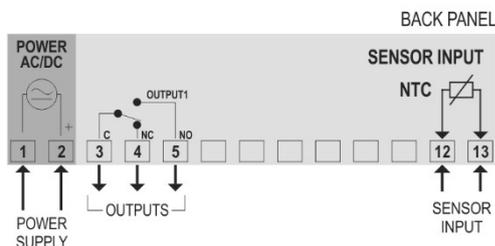
**Protection degree: Enclosure IP42, front IP65.**

	<p><b>RS485 interface (optional) with Modbus protocol. Not electrically isolated from the input circuit. Electrically isolated from the power supply circuit.</b></p>
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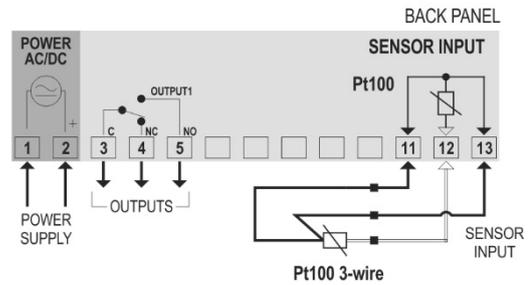
## 5. ELECTRICAL CONNECTIONS

### 5.1 N321 MODEL

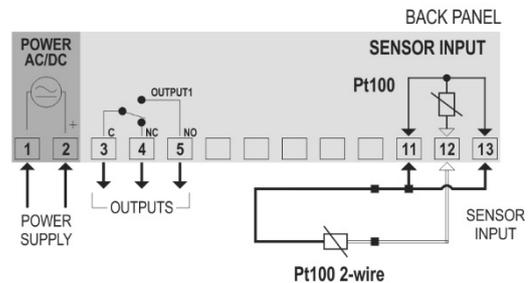
The figures below show the connection terminals for the **N321** sensor, power supply, and output:



**Figure 2 – Connections (NTC)**



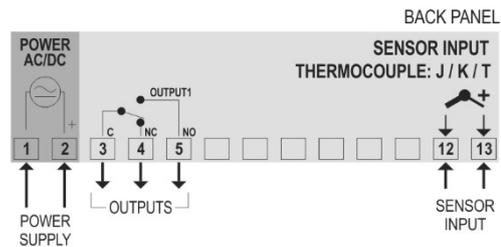
**Figure 3 – Connections (Pt100 3-wire)**



**Figure 4 – Connections (Pt100 2-wire)**

For Pt100, you must use a 3-wire Pt100 sensor, as shown in **Figure 3**. To use a 2-wire Pt100, use the connections shown in **Figure 4**. In it, terminals 11 and 13 of the controller are interconnected.

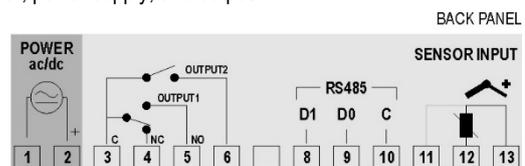
To compensate the Pt100 sensor cables properly, the conductors must all have the same electrical resistance (cross-section).



**Figure 5 – Connections (Thermocouple)**

### 5.2 N322 MODEL

The figures below show the connection terminals for the **N322** sensor, power supply, and output:



**Figure 6 – Connections**

\* The serial communication feature is not always available in **N322**.

Pt100 3-wire. For 2-wire connection, terminals 11 and 13 must be interconnected. For proper cable resistance compensation, the conductors must all have the same electrical resistance (cross-section).

5.3 N323 MODEL

The figures below show the connection terminals for the N323 sensor, power supply, and output:

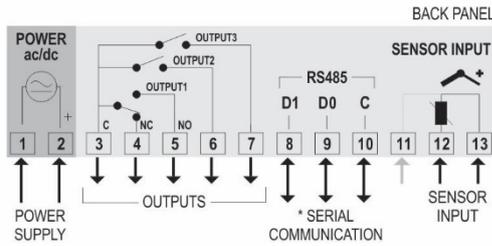


Figure 7 – Connections

\* The serial communication feature is not always available in N323.

Pt100 3-wire. For 2-wire connection, terminals 11 and 13 must be interconnected. For proper cable resistance compensation, the conductors must all have the same electrical resistance (cross-section).

5.4 INSTALLATION RECOMMENDATIONS

- Input signal conductors should run through the plant separate from output and supply conductors. If possible, in grounded conduits.
- The power supply for the electronic instruments must come from a network dedicated to the instrumentation.
- It is recommended to use RC FILTERS (noise suppressor) in contactor coils, solenoids, etc.
- In control applications, it is essential to consider what can happen when any part of the system fails. The controller internal devices do not guarantee full protection.

6. OPERATION

Before use, the controller must be configured. To configure it, you must set values for the parameters that determine how the equipment operates.

These configuration parameters are organized in groups or Levels, called Parameter Levels.

LEVEL	RELATED FUNCTIONS
0	Temperature measurement
1	Setpoint adjustment
2	Operation mode
3	Calibration

Table 1 – Parameter levels

When you turn on the controller, the display shows the version of the equipment for 1 second. This information is important for eventual consultations with the manufacturer. Then, the controller starts presenting the temperature value measured by the sensor. This is level 0 or the Temperature Measurement level.

To access level 1, press **P** for 1 second until **SP 1** parameter appears. To return to the temperature measurement level, press **P** again.

To access level 2, press **P** for 2 seconds until **unt** parameter appears. Release the **P** key to remain at this level. To access the other parameters of this level, press **P** again. After the last parameter, the controller returns to the temperature measurement level.

To change the parameter values, press the **▲** and **▼** keys until you get the desired values.

- Notes:**
- 1 The controller saves the programming when you move from one parameter to another. Only then will it be considered valid.
  - 2 If the keys are not used for a time longer than 20 seconds, the controller returns to the measuring level, finishing and saving the configuration done so far.

6.1 LEVEL 1 – SETPOINT ADJUSTMENT LEVEL

At this level, only the Setpoint parameter (SP) is displayed. It defines the desired temperature value for the system. The current value of SP is shown alternately with the parameter.

To program the desired value, use **▲** and **▼** keys.

<b>SP 1</b>	Setpoint values for the action of outputs 1, 2 and 3.
<b>SP 2</b>	These values are limited to the values programmed in <b>SPL</b> and <b>SPH</b> in the Operation Mode cycle.
<b>SP 3</b>	The available parameters are according to the model.
<i>Setpoint</i>	

6.2 LEVEL 2 – OPERATION MODE LEVEL

Displays the sequence of the remaining parameters to be set. The parameters are shown alternately with their values.

The number of outputs depends on the controller model.

<b>unt</b> <i>Unit</i>	Temperature unit. It allows you to choose the display unit of the measured temperature. <b>0</b> Temperature in Celsius degrees. <b>1</b> Temperature in Fahrenheit degrees.
<b>LYP</b> <i>Type</i>	Type of temperature sensor to be used. This parameter is only available in models for THERMOCOUPLE sensors, where you can choose between the <b>J</b> , <b>K</b> , and <b>T</b> thermocouples. <b>0</b> Thermocouple J <b>1</b> Thermocouple K <b>2</b> Thermocouple T
<b>oF5</b> <i>Offset</i>	Correction value for temperature indication. Allows you to make small adjustments to the temperature indication to correct measurement errors that appear, for example, when replacing the NTC temperature sensor.
<b>SPL</b> <i>SP Low Limit</i>	Setpoint lower limit. Must be defined with a value <b>lower</b> than <b>SPH</b> .
<b>SPH</b> <i>SP High Limit</i>	Setpoint upper limit. Must be defined with a value <b>higher</b> than <b>SPL</b> .
<b>AC 1</b> <i>Action 1</i>	Output 1 action type: <b>0</b> Control with <b>Reverse Action</b> . Suitable for <b>heating</b> . Turns on the control output when the temperature is below SP. <b>1</b> Control with <b>Direct Action</b> . Suitable for <b>cooling</b> . Turns on the control output when the temperature is above SP.
<b>AC 2</b> <i>Action 2</i> <b>AC 3</b> <i>Action 3</i>	Output 2 and 3 action type: <b>0</b> Control. Reverse action for heating. <b>1</b> Control. Direct action for cooling. <b>2</b> Minimum temperature alarm. <b>3</b> Maximum temperature alarm. <b>4</b> Within-range alarm. <b>5</b> Out-of-range alarm. <b>6</b> Minimum temperature alarm with initial blocking. <b>7</b> Maximum temperature alarm with initial blocking. <b>8</b> Within-range alarm with initial blocking. <b>9</b> Out-of-range alarm with initial blocking. Parameters available only for <b>N322</b> and <b>N323</b> models.

<p><b>Cnt</b> Control</p>	<p>Inversion between Setpoints and Outputs:</p> <p><b>0</b> SP1 acts on OUTPUT 1 relay and SP2 acts on OUTPUT 2 relay. Factory setting.</p> <p><b>1</b> SP1 acts on OUTPUT 2 relay and SP2 acts on OUTPUT 1 relay.</p> <p>Parameter available only for the <b>N322</b> and <b>N323</b> models.</p>
<p><b>HY 1</b> <b>HY 2</b> <b>HY 3</b> Hysteresis</p>	<p>Control hysteresis. Parameter that applies to both control and alarm.</p> <p>Differential between the on and off point of the relay output configured as a control output. In degrees.</p>
<p><b>dL 1</b> <b>dL 2</b> <b>dL 3</b> Delay</p>	<p>Delay time for both control start and alarm.</p> <p>After the controller is turned on, the output (1, 2, or 3) will only be turned on after the time programmed in this parameter has elapsed.</p> <p>Used in large refrigeration systems to prevent the simultaneous activation of compressors when returning of a power failure.</p> <p>Value in seconds (from 0 to 250 seconds).</p> <p>Parameters available only for <b>N322</b> and <b>N323</b> models.</p>
<p><b>oF 1</b> <b>oF 2</b> <b>oF 3</b> Off time</p>	<p><b>N321 Model:</b> Sets minimum off time for the output.</p> <p><b>N322 and N323 Model:</b> Sets minimum off time for output 1 and, when in Control Mode (Reverse Action and Direct Action), for outputs 2 and 3.</p> <p>In either model, when <b>turned off</b>, the output will stay in this condition for at least the time programmed in this parameter.</p> <p>Typically used to increase the lifespan of the compressor in a refrigeration system. For heating applications, program zero.</p> <p>Not valid for thermocouples.</p> <p>Value in seconds (0 to 999 seconds).</p>
<p><b>on 1</b> <b>on 2</b> <b>on 3</b> on time</p>	<p><b>N321 Model:</b> Sets minimum on time for the output.</p> <p><b>N322 and N323 Model:</b> Sets minimum on time for output 1 and, when in Control Mode (Reverse Action and Direct Action), for outputs 2 and 3.</p> <p>In either model, when <b>turned on</b>, the output will stay in this condition for at least the time programmed in this parameter.</p> <p>Typically used to increase the lifespan of the compressor in a refrigeration system. For heating applications, program zero.</p> <p>Not valid for thermocouples.</p> <p>Value in seconds (0 to 999 seconds).</p>
<p><b>Tt 1</b> <b>Tt 2</b> Timer T1</p>	<p>Time interval <b>T1</b> for alarm timing.</p> <p>Defines the timed action of alarms, as shown in <b>Table 2</b>.</p> <p>Adjustable between 0 and 1999 seconds.</p> <p>Parameter available when outputs 2 and 3 are configured as alarms.</p> <p>Parameters available only for the <b>N323</b> model.</p>

<p><b>Tt 1</b> <b>Tt 2</b> Timer T2</p>	<p>Time interval <b>T2</b> for alarm timing.</p> <p>Defines the timed action of alarms, as shown in <b>Table 2</b>.</p> <p>Adjustable between 0 and 1999 seconds.</p> <p>Parameter available when outputs 2 and 3 are configured as alarms.</p> <p>Parameters available only for the <b>N323</b> model.</p>
<p><b>Adr</b> Address</p>	<p>The controller with an RS485 serial communication interface features the <b>Adr</b> parameter at the Operation Mode level.</p> <p>In this parameter, you define a <b>communication address</b> for each network element. The address set must be between 1 and 247.</p>

**6.3 LEVEL 3 – CALIBRATION LEVEL**

The controller leaves the factory already calibrated. When a recalibration is necessary, it must be performed by a specialized professional. To access this level, press the **P** key for more than 3 seconds.

If you access it by accident, do not press the **▲** and **▼** keys. Using the **P** key, simply step through all the parameters, until the controller returns to the measurement screen.

<p><b>PAS</b></p>	<p>Password. Parameter to enter a password that will allow you to change the other parameters.</p>
<p><b>CAL</b></p>	<p>Calibration low. Allows to set the Offset of the measurement range. Adjusts the lower value of the sensor measurement range.</p>
<p><b>CAH</b></p>	<p>Calibration high. Allows to calibrate the measure scale gain. Adjusts the upper value of the sensor measurement range.</p>
<p><b>CJL</b></p>	<p>Cold Junction calibration. Allows to calibrate the Cold Junction Offset.</p> <p>Only available for thermocouples.</p>
<p><b>FAC</b></p>	<p>Factory calibration. Allows to return to the controller original calibration.</p> <p>When changing from <b>0</b> to <b>1</b>, the original calibration will be restored, and the changes made during the calibration will be discarded.</p>
<p><b>PrL</b></p>	<p>Protection. Allows to define the parameter levels to be protected.</p>
<p><b>PAC</b></p>	<p>Password change. Allows to change the current password. You can set the password to a number between 1 and 999.</p>
<p><b>Sn2</b></p>	<p>Serial number 2. Displays the first two digits of the electronic serial number of the controller.</p>
<p><b>Sn 1</b></p>	<p>Serial number 1. Displays the middle three digits of electronic serial number of the controller.</p>
<p><b>Sn0</b></p>	<p>Serial number 0. Displays the last three digits of the electronic serial number of the controller.</p>

## 7. OPERATION

### 7.1 N321 MODEL: OPERATION

The controller with a single output triggers this control output to bring the process temperature to the value set in parameter **SP1 (Setpoint 1)**.

On the **N323** front panel, the P1 flag will light when the control output is turned on.



Figure 8 – Front panel

### 7.2 N322 AND N323 MODELS: OPERATION

Controller models with multiple outputs have typical applications in alarm control and multi-stage power control.

In the alarmed control application, output 1 is used as the temperature control output, while outputs 2 and 3 are programmed to act as protection alarms or signaling.

In the multi-stage control application, the Setpoints of outputs 1, 2, and 3 are programmed to act at different temperatures. This allows you to trigger the compressors in a progressive sequence, increasing the refrigeration capacity as the temperature rises and reducing it when the temperature approaches the temperature programmed for **SP 1**.

By using the compressor delay (**dL 1**, **dL 2**, and **dL 3**), you ensure that, when returning from a power failure or when starting the system, the compressors will start according to the programmed timing. This allows you to reduce the energy demand.

Another typical application for the use of a multi-output controller concerns the **automatic changeover of the hot/cold cycle**, where one output will be programmed with Reverse Action and will command heating, and another will be programmed with Direct Action and will command cooling.

### 7.3 N322 AND N323 MODELS: ALARM FUNCTIONS

The **N322** and **N323** models have 8 alarm functions for outputs 2 and 3. **AL2** and **AL3** parameters can be programmed with the following values:

- 2 Minimum temperature alarm:** The output turns on when the measured temperature is below the value programmed in the corresponding Setpoint (**SP2** or **SP3**).
- 3 Maximum temperature alarm:** The output turns on when the measured temperature is above the value programmed in the corresponding Setpoint (**SP2** or **SP3**).
- 4 Within range temperature alarm:** The output turns on when the measured temperature is **within** the temperature range defined by:

$$(SP\ 1 - SP2) \text{ and } (SP\ 1 + SP2) \text{ or } (SP\ 1 - SP3) \text{ and } (SP\ 1 + SP3)$$

- 5 Out-of-range temperature alarm:** The output turns on when the measured temperature is **outside** the temperature range defined by:

$$(SP\ 1 - SP2) \text{ and } (SP\ 1 + SP2) \text{ or } (SP\ 1 - SP3) \text{ and } (SP\ 1 + SP3)$$

Functions **6**, **7**, **8**, and **9** are identical to the functions mentioned in this section, but they have the Initial Alarm Blocking feature, which blocks the alarm (does not allow it to activate) when the controller initiates control already in an alarm condition.

The alarm will be unblocked after the equipment goes through a non-alarm condition.

Although they have the same operation and alarm functions, the **N322** and **N323** models have a different number of outputs (2 outputs for the former; 3 outputs for the latter), which should be considered while reading the above explanation. Therefore, the **N322** model will not show the **dL 3** and **SP 3** parameters, for example. Other differences may exist.

### 7.4 N323 MODEL: ALARM TIMER

The **N323** model allows you to program a timer for alarms. You can set 3 conditions: **1)** delay on alarm triggering, **2)** pulse when triggering, or **3)** triggering as sequential pulses.

Timing is only available for outputs 2 and 3 and can be programmed using the following parameters: **2t 1**, **3t 1**, **2t 2**, and **3t 2**. The figures in **Table 2** represent these functions.

**T1** and **T2** can range from **0 to 1999 seconds**, and their combinations determine the timing mode. For the alarms to have normal operation, without timings, program 0 (zero).

**P2** and **P3** flags light up whenever an alarm condition occurs, regardless of the status of the output relays. During the delay, the respective signal flag remains blinking.

ALARM OUTPUT FUNCTION	T1	T2	ACTION
Normal Operation	0	0	
Delay	0	1 a 1999 s	
Pulse	1 a 1999 s	0	
Oscillator	1 a 1999 s	1 a 1999 s	

Table 2 – Timer functions for alarms 1 and 2

## 8. CONFIGURATION PROTECTION

The purpose of the configuration protection system is to prevent undue changes to the parameters and, consequently, to its operating mode. This system is composed of parameters that define the protection degree to be adopted: Total or partial.

Parameters that define the level of protection:

**PR5** Parameter to enter a password to allow changes to the other parameters.

**PrL** Parameter to define the levels of parameters to be protected.

1. Only the **Calibration** level is protected (factory setting option).
2. The **Calibration** and **Configuration** levels are protected.
3. All levels are protected: **Calibration**, **Configuration**, and **SP**.

**PRC** Parameter to change the current password. You can set the password to a number between 1 and 999.

### 8.1 CONFIGURATION PROTECTION OPERATION

The **PRS** parameter appears at the beginning of the protected level. If you enter the password correctly, you can change the parameters of the protected levels. If you do not enter the password correctly or simply pass by this parameter, the parameters of the protected levels can only be viewed and not changed.

**Important notes:**

1. When you enter an incorrect password **five** consecutive times, the equipment will prevent new attempts for 10 minutes. If you do not remember the current password, you can enter a **master password**, which only allows you to set a new password.
2. The equipment leaves the factory with password **111**.

## 9. MASTER PASSWORD

The master password, which allows you to set a new password for the controller, uses the serial number of the equipment. It is composed as follows:

$$[ 1 ] + [ \text{largest number of SN2} ] + [ \text{largest number of SN1} ] + [ \text{largest number of SN0} ]$$

The master password for an equipment with serial number 97123465 is: **1936**

Example:  $1 + \text{Sn}2 = 97; \text{Sn}1 = 123; \text{Sn}0 = 465 = 1 + 9 + 3 + 6$

### 9.1 HOW TO USE YOUR MASTER PASSWORD

1. In the **PRS** parameter, enter the master password.
2. In the **PRC** parameter, enter any new non-zero (0) password.
3. Use the new password.

## 10. ERROR INDICATION

On the display, the controller shows messages that correspond to problems related to temperature measurement. Whenever they are displayed, the control output relay will be turned off immediately.

	<ul style="list-style-type: none"> <li>• The temperature has exceeded the <b>upper</b> limit of the sensor range.</li> <li>• <b>Pt100</b> or <b>T/C</b> sensor broken. <b>NTC</b> sensor short-circuited.</li> </ul>
	<ul style="list-style-type: none"> <li>• The temperature has exceeded the <b>lower</b> limit of the sensor range.</li> <li>• <b>Pt100</b> or <b>T/C</b> sensor short-circuited. Broken <b>NTC</b> sensor.</li> </ul>

Table 3 – Error indications

## 11. SERIAL COMMUNICATION

The controller can optionally be supplied with an RS485 serial communication interface, asynchronous, for communication with a supervisor software.

### 11.1 FEATURES

- Signals compatible with RS485 standard.
- 2-wire connection between 1 master and up to 31 slave controllers in bus topology. When using multi-output converters, you can reach up to 247 nodes.
- Maximum connection distance: 1000 meters.
- Rate: 9600 bps
- Data bits: 8
- Parity: None
- Stop bits: 1

The RS485 signals are:

D1	D	D +	B	Bidirectional data line.
D0	$\overline{D}$	D -	A	Inverted bidirectional data line.
C			Optional connection that improves communication performance.	
GND				

Table 4 – RS485

### 11.2 PARAMETER CONFIGURATION

To use serial communication, you must set the following parameter:

**Raddr**: Controller communication address.

### 11.3 COMMUNICATION PROTOCOL

The equipment supports the slave MODBUS RTU protocol, available in most supervision software on the market.

The Modbus commands available are the following:

03 – Read Holding Register

06 – Preset Single Register

Command 03 (Read Holding Register) reads up to 4 consecutive registers.

### 11.4 REGISTER TABLE

The following are the most used registers. For complete information, refer to the **Register Table for Serial Communication**, available for download in the product page.

ADDRESS	PARAMETER	REGISTER DESCRIPTION
0000	SP active	Read: Setpoint da OUTPUT1. Write: Setpoint da OUTPUT1. Range: From <b>SPLL</b> to the value set in <b>SPHL</b> .
0001	PV	Read: Measured temperature variable. Write: Not allowed. Range: Equals the range of the sensor used by the equipment.

Table 5 – Register table

## 12. WARRANTY

Warranty conditions are available on our website [www.novusautomation.com/warranty](http://www.novusautomation.com/warranty).