

## TEMPERATURE CONTROLLER

# N323R

OPERATING MANUAL V1.7x



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The N323R is a Refrigeration controller designed to control the temperature of refrigeration cases and coldrooms, embedding several specialized functions for best system performance. The N323R can read two temperature probes (controller and defrost probes) and has three relay outputs for controlling the compressor, the defrost and the fan.

The controller can be ordered with optional features such as to comply with the application's requirements. The label on the instrument housing shows the complete instrument configuration.

## SPECIFICATIONS

**PROBE INPUT:** ..... 2 Thermistor NTC  
..... Type 10 k $\Omega$  @ 25 °C  
..... Range: -50 to 120 °C (-58 to 248 °F)  
..... Accuracy: 0,6 °C

Two 3-meter probe cable are bundled with the instrument. The cable can be extended up to 200 m. Sensor interchangeability: 0,75 °C. This error can be compensated by the **offset** parameter in the controller.

**Measurement Resolution:** ..... 0,1 °C from -19,9° to 199,9°  
..... 1 °C elsewhere

**OUTPUT1:** ..... Relay SPDT; 1 HP 250 Vac / 1/3 HP 125 Vac (16 A Resistive)  
..... Optionally: Pulse, 5 Vdc, 25 mA max.

**OUTPUT2:** ..... Relay SPST-NA, 3 A / 250 Vac (General use) ; 5A / 250Vac (Resistive)

**OUTPUT3:** ..... SPST-NA, 3 A / 250 Vac (General use) ; 5A / 250Vac (Resistive)

**POWER SUPPLY:** ..... 100 to 240 Vca/dc  $\pm$ 10 %  
Optionally: ..... 12 to 30 Vdc  
Mains frequency: ..... 50~60 Hz  
Power consumption: ..... 5 VA

**Dimensions:** Width x Height x Depth: ..... 75 x 33 x75 mm  
Weight: ..... 100 g  
Panel cut-out: ..... 70 x 29 mm

**ENVIRONMENT:** ..... Operating temperature: 0 to 40 °C (32 to 122 °F)  
..... Storage temperature: -20 to 60 °C (-4 to 140 °F)  
..... Relative humidity: 20 to 85 % non-condensing

**CASE:** ..... Polycarbonate UL94 V-2; Protection: Front panel: IP65, Box: IP42  
..... Suitable wiring: Up to 4,0 mm<sup>2</sup>

**DIGITAL COMMUNICATION:** ..... RS-485, RTU MODBUS protocol (optional)  
..... **Serial interface not isolated from input circuitry.**  
..... **Serial interface isolated from input circuitry, except in 24 V powered model.**

## INSTALLATION

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 inductor.
- Use protection devices like circuit breakers and fuses.

## ELECTRICAL WIRING

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

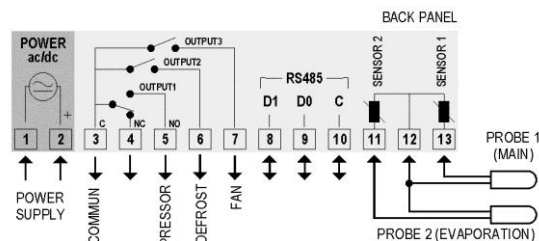


Figure 1 – N323R terminals

## 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 N323R 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**” message shows up. Pressing **[P]** again to go back to level 0.

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 that 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:**
- 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.
  - If no keyboard activity is detected for over 20 seconds, the controller saves the current parameter value and returns to the measurement level.
  - While in the temperature measurement level, a momentary pressing on the **[↓]** key will show the Probe 2 temperature (evaporator temperature)

### 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.

<b>SP</b> Set Point	Case of coldroom temperate adjustment. <b>SP</b> value is limited to the values programmed in <b>SPL</b> and <b>SPk</b> in the programming level (Parameter configuration, level 2).
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### 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.

<b>Unt</b> Unit	<b>Temperature Unit.</b> Selects display indication for degrees Celsius or Fahrenheit 0 Temperature Celsius. (factory default) 1 Temperature in degrees Fahrenheit.
<b>Of1</b> Offset Probe 1	<b>Probe 1 Offset</b> - Offset value to be added to the sensor 1 measured temperature such as to perform fine adjustments to the value showed on the display (after sensor replacement, for instance, if required). Range: $\pm$ 0.1 to 10.0 degrees.
<b>Of2</b> Offset sensor 2	<b>Probe 2 Offset</b> - Offset value to be added to the sensor 2 measured temperature to perform fine adjustments to the value showed on the display (after sensor replacement, for instance, if required). Range: $\pm$ 0.1 to 10.0 degrees.
<b>Spl</b> SP Low Limit	<b>SP Low Limit</b> - Lower range for <b>SP</b> . <b>SPL</b> must be programmed with a lower value than <b>spK</b> .
<b>spK</b> SP High Limit	<b>SP High Limit</b> - Upper range for <b>SP</b> . <b>SPx</b> must be greater than <b>spl</b> .
<b>Kys</b> Hysteresis	<b>OUTPUT 1 Hysteresis:</b> 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.
<b>(nt</b> Control	Defines the output position for the refrigeration relay. 0 Refrigeration at OUTPUT1 / Defrost at OUTPUT2. (factory default) 1 Refrigeration at OUTPUT2 / Defrost at OUTPUT1.
<b>Dly</b> Delay	Delay time to start control. Upon power-on, control OUTPUT 1 is kept off until the time programmed in <b>dly</b> 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.
<b>Ont</b> on time	<b>On time</b> - Defines the minimum <b>on</b> time for refrigeration output. Once turned on, OUTPUT 1 remains so for at least the time programmed in <b>ont</b> . This parameter is intended for refrigeration systems where increased compressor life is desired. Value in seconds, 0 to 999 s.
<b>OfT</b> Off time	<b>Off time</b> - Defines the minimum <b>off</b> time for control OUTPUT 1. Once OUTPUT 1 is turned off, it remains so for at least the time programmed in <b>oft</b> . This parameter is intended for refrigeration systems where longer compressor life is desired. Value in seconds, 0 to 999 s.
<b>df1</b> Defrost Interval	<b>Interval time between defrost cycles.</b> Adjustable from 0 to 999s. During this time, the defrost output remains <b>off</b> . <b>df1= 0</b> disables this function (no defrost cycles)
<b>Dft</b> Defrost time	<b>Defrost duration.</b> Interval time during which the defrost output remains <b>on</b> .

	Value in minutes, 1 to 999.
<b>df(</b> <i>defrost Compressor</i>	<b>Compressor output behavior during the defrost cycle:</b> <b>0</b> Always off; <b>1</b> Always on ; <b>2</b> Compressor output works normally, turning on and off to maintain the temperature.
<b>Dfs</b>	<b>Temperature for finalizing the defrost cycle</b> – evaporator temperature value as measured by sensor 2 which terminates the defrost cycle, regardless of the time configured in <b>Dft</b> . Range: -50 to +120 degrees (-58 to 248°F). NOTE: the defrost cycle will not initiate if the evaporator temperature is the value defined in this parameter.
<b>ddt</b>	<b>Drain down time</b> – This parameter sets the time interval for keeping the outputs off to allow optimum drying of the evaporator. Value in minutes, 0 to 999.
<b>frs</b>	<b>Evaporator temperature for liberating the fan</b> – after defrost and water draining, the refrigeration is turned on. To keep warm air from circulating in the system, demanding more energy to lower the temperature, the N323R can be configured to maintain the fan output <b>off</b> until the temperature cools below the value defined in <b>frs</b> . Range: : -50 to 120 °C (-58 to 248°F)
<b>fdl</b>	<b>Fan maximum delay after draining</b> – to assure product integrity, the fan output will be unconditionally turned on after the time programmed in <b>fdl</b> , regardless of the fact that the evaporator temperature may not have reached the temperature value defined in <b>frs</b> Value in minutes, 0 to 999.
<b>foc</b>	<b>Fan behavior during refrigeration .</b> <b>0</b> Fan is active only when the compressor is on.. <b>1</b> Fan is active during the complete refrigeration cycle, even when the compressor is turned off.
<b>fod</b>	<b>Fan behavior during defrost.</b> <b>0</b> Fan is <b>off</b> during the defrost cycle. <b>1</b> Fan is <b>active</b> during the defrost cycle.
<b>fss</b>	<b>Fan deactivation due to evaporator heating</b> – evaporator temperature that turns the Fan off when the evaporator heats up (above temperature defined in <b>fss</b> ), improving system efficiency and protecting the compressor. The fan is allowed to turn on again when the temperature drops 2 degrees below the value defined in this parameter.
<b>Coe</b>	<b>Compressor function during a probe failure:</b> This parameter fixes the compressor operating mode in the event of the main probe failure. <b>0</b> Compressor is <b>deactivated</b> when probe 1 is in error. <b>1</b> Compressor <b>is activated</b> when probe 1 is in error
<b>Dfh</b> <i>defrost hold</i>	<b>Defrost hold time (temperature indication hold):</b> This is the time interval following the end of the defrost cycle for the controller to display actual control temperature. During the defrost cycle and the time defined by <b>dfh</b> , the display will be showing the last measured temperature prior to the start of the defrost cycle. <b>0</b> : function disabled (shows actual temperature during the defrost cycle); <b>1 to 250</b> : Time interval (sec., min. or hours) after the end of defrost for the display to show the actual control temperature.

#### 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.**

<b>Pas</b>	<b>Password</b> - Enter the correct password to unlock write operations for the parameters in the following levels.
<b>[I1]</b>	<b>Calibration low input 1</b> – Zero value of the input 1. It adjusts the lower measurement range of Probe 1.
<b>[k1]</b>	<b>Calibration High input 1</b> – Gain calibration. It adjusts the full scale measurement range of the Probe 1.
<b>[I2]</b>	<b>Calibration low input 2</b> – Zero value of the input 2. It adjusts the lower measurement range of of Probe 2.
<b>[k2]</b>	<b>Calibration High input 2</b> – Gain calibration. It adjusts the full scale measurement range of the Probe 2.
<b>FA(</b>	<b>Factory Calibration</b> – Restores factory calibration parameters. The value <b>1</b> restores the calibration parameters to the factory values.
<b>Prt</b>	<b>Protection</b> – Defines the levels of parameters that will be password protected. See "Configuration Protection Usage" for details.
<b>Pa(</b>	<b>Password Change</b> - Allows changing the current password to a new one. Values from 1 to 999.
<b>Sn2</b>	<b>Serial number</b> - First part of the instrument serial number.
<b>sn1</b>	<b>Serial number</b> - Second part of the instrument serial number.
<b>sn0</b>	<b>Serial number</b> - Third part of the instrument serial number.

## CONTROLLER OPERATION

The controller turns on and off the compressor output such as to maintain the temperature at the selected *Setpoint*. The front panel display shows the symbol ❄ whenever the compressor is active.

#### Defrost

Function to eliminate the ice accumulated on the evaporator, for improving system efficiency. The duration and interval of the defrost cycles are user configurable. However, it may be unconditionally terminated depending on the evaporator temperature as measured by Probe 2 (refer to the **dfs** parameter)

The defrost can be achieved by: 1) compressor deactivation; 2) electrical heater or 3) heat pump inversion.

In the first case, the refrigeration is turned off and the defrost happens naturally. In the second case the defrost output drives an electrical resistance to generate heat and so melt the ice. In this mode, the compressor output is also deactivated. In the third case, heat pump inversion, the compressor is kept active and the defrost output commands the valve that inverts the heat cycle.

During defrost, the case of coldroom temperature may be forced to reflect the last temperature measured prior to entering the defrost cycle (refer to the **dfh** parameter).

The **df1** and **dft** parameters define, respectively, the time interval between defrosts and the duration of the defrost cycle. The controller display shows the symbol ❄ to indicate that a defrost cycle is in progress.

**Manual defrost:** The **[▲]** key allows that a defrost cycle be initiated or terminated immediately. Pressing this key for 3 seconds will toggle the current defrost status.

**Definition of the evaporator temperature that terminates the defrost. (dfs parameter)**

- Wait for ice building on the evaporator;

- Start a defrost cycle manually;
- Visually monitor the evaporator until there is no more ice on it.
- Check the Probe 2 temperature (momentary press on the **[▲]** key). This is the correct temperature setting for the **dfs** parameter.

## 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 must 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

The **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 987123 465 is: **1 9 3 6**  
as follows: **1 + sn2= 987; 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 **PA(** 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

Probe 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.

## PRODUCT IDENTIFICATION

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

MODEL: **N323R - A - B - C**, where:

- A:** Input Sensor: **NTC**
- B:** Digital communication: **blank** or **485** (RS485, Modbus protocol)
- C:** Voltage rating: **blank** (100-240 Vac/dc) or **24V** (10-30 Vac/dc);