

**N321R** is an electronic controller for refrigeration and has features to facilitate the defrost process. It has input for temperature sensors type **Pt100**, **Pt1000** or **NTC** thermistor and can correct indication errors (Offset). Each type of sensor has a specific temperature measurement range. The controller has a relay-type control output with Common, NO and NC contacts.

The characteristics of each controller are identified on the body of the device and according to the purchase order.

## SPECIFICATIONS

**SENSOR INPUT:** The sensor is chosen at the time of purchase and displayed on the top side of the thermometer case. 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 is included in the equipment. Its operating range is limited to **-30 to +105 °C** (-222 to +221 °F). It has a 3 m long, 2 x 0.5 mm² cable, which 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).

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

**POWER SUPPLY:** Voltage .....100 to 240 Vac/dc (± 10 %)

Optionally:.....12 to 30 Vdc

Mains frequency:.....50-60 Hz

Power consumption:.....5 VA

**Dimensions:** Width x Height x Depth:.....75 x 33 x 75 mm

Weight: .....100 g

Panel cut-out:.....70 x 29 mm

**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 % RH

**Housing:** Polycarbonate UL94 V-2

**Protection:** Housing IP42, Frontal panel IP65

**Suitable wiring:** Up to 4.0 mm².

**Serial interface not isolated from input circuit.**

**Serial interface isolated from power supply circuit, except for the model with 24 V supply.**

## ELECTRICAL WIRING

The figure below indicates the connection terminals for the sensor, power and controller output and a connection example.

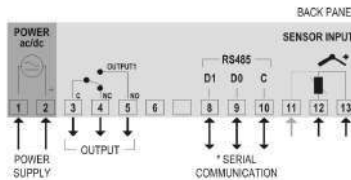


Fig. 01 - Connections shown on controller label

\* The serial communication interface is optional.

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

## INSTALLATION RECOMMENDATIONS

- Input signal conductors must run through the plant separately from the supply and output conductors. If possible, in grounded conduits.
- All electronic instruments must be powered by a clean mains supply, proper for instrumentation.
- It is recommended to use RC FILTERS (47 Ω and 100 nF, series combination) at contactor coils, solenoids, etc.

## OPERATION

Before use, you must configure the controller. 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 | FUNCTION                                 |
|-------|------------------------------------------|
| 0     | Temperature Measurement                  |
| 1     | Setpoint Adjustment / Voltage indication |
| 2     | Parameters Configuration                 |
| 3     | Calibration                              |

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]** key for 1 second until the **SP** message shows up. Press **[P]** key to go back to level 0.

To access level 2, press **[P]** key for 2 seconds until the **Unit** message shows up. Release the **[P]** key to remain in this level. Press **[P]** key to 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:**
- The programming is saved by the controller when it switches from one parameter to another, and only then is it considered valid. Even in the event of a power outage, the programming is saved in **permanent** memory.
  - If the keys are not used for longer than 20 seconds, the controller returns to the measuring level, finishing and saving the programming done so far.

## Level 1 – Setpoint Adjustment

This level displays the Setpoint (SP) parameter only. It sets the desired temperature value for the system. The current SP value is shown alternately. To program the desired value, use the **[▲]** and **[▼]** keys.

|                       |                                                                                                                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>U</b><br>Voltage   | Screen indicating the measured electrical voltage. If the voltage is below 150 V, it should indicate 0. When it exceeds 254 V, it should saturate and indicate 255 V.<br>Function available only for N321R-NTC-LVD model. |
| <b>SP</b><br>Setpoint | Adjustment of the control temperature or working temperature. This adjustment is limited to the values programmed in <b>SPL</b> and <b>SPH</b> (see below).                                                               |

## Level 2 – Configuration Level

Displays the sequence of parameters that must be set by the user. The parameters are shown alternately with their values. To program the desired value, use the **[▲]** and **[▼]** keys.

|                                     |                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Unit</b><br>Unit                 | Temperature unit. It allows you to choose the display unit for the measured temperature.<br><b>0</b> Temperature in Celsius degrees<br><b>1</b> Temperature in Fahrenheit degrees                                                                                                                                               |
| <b>oF5</b><br>Offset                | Adjustment for temperature indication. Allows you to make small adjustments to the temperature display, seeking to correct measurement errors that appear, for example, when replacing the NTC temperature sensor.                                                                                                              |
| <b>SPL</b><br>SP Low Limit          | Setpoint lower limit. Minimum value that can be used to program the Setpoint. Must be programmed with a lower value than the one programmed in <b>SPH</b> .                                                                                                                                                                     |
| <b>SPH</b><br>SP High Limit         | Setpoint upper limit. Maximum value that can be used to program the Setpoint. Must be programmed with a higher value than the one programmed in <b>SPH</b> .                                                                                                                                                                    |
| <b>HYS</b><br>Hysteresis            | Control hysteresis. Differential between the point of turning the control output relay on and off. In degrees.                                                                                                                                                                                                                  |
| <b>oFt</b><br>Off time              | Defines the minimum off time for control output. Once the control output is turned off, it remains so for at least the time programmed in this parameter. Typically used to increase the life of the compressor in a refrigeration system. For heating applications, program zero.<br>Value in seconds (0 to 999 seconds).      |
| <b>ont</b><br>on time               | Defines the minimum on time for control output. Once the control output is turned on, it remains so for at least the time programmed in this parameter. Typically used to increase the life of the compressor in a refrigeration system. For heating applications, program zero.<br>Value in seconds (0 to 999 seconds).        |
| <b>dLY</b><br>Delay                 | Delay time for control start. After the controller is switched on, the control output will only be switched on when the time programmed in this parameter has elapsed.<br>Used in large refrigeration systems to prevent simultaneous compressor starts on return from a power failure.<br>Value in seconds (0 to 250 seconds). |
| <b>d b</b><br>Defrost Interval Base | Time base for <b>dF</b> .<br><b>0</b> Seconds<br><b>1</b> Minutes<br><b>2</b> Hours                                                                                                                                                                                                                                             |
| <b>dtb</b><br>Defrost Time Base     | Time base for <b>dFt</b> .<br><b>0</b> Seconds<br><b>1</b> Minutes<br><b>2</b> Hours                                                                                                                                                                                                                                            |

|                                              |                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>dF i</b><br><i>Defrost interval</i>       | Interval between defrost cycles. Adjustable between 0 and 999 seconds/minutes/hours, depending on the specified time base.                                                                                                                                                                                    |
| <b>dFt</b><br><i>Defrost time</i>            | Defrost duration. Adjustable between 0 and 999 seconds/minutes/hours, depending on the specified time base.                                                                                                                                                                                                   |
| <b>dFh</b><br><i>Defrost hold</i>            | Hold the temperature indication throughout the defrost interval or the time defined by this parameter.<br><b>0</b> Allows to update the defrost indication.<br><b>1 to 250</b> Time (seconds/minutes/hours) besides the defrost time the indication will remain held.                                         |
| <b>CPE</b><br><i>Compressor Protect</i>      | Enables compressor protection by monitoring the electrical voltage if the mains voltage is not between the Setpoints <b>CPL</b> and <b>CPH</b> .<br><b>0</b> Disables compressor protection.<br><b>1</b> Enable compressor protection.<br>Function available only for N321R-NTC-LVD model.                    |
| <b>CPT</b><br><i>Compressor Protect Time</i> | Determines a delay in compressor shutdown during the activation of compressor protection by voltage monitoring. Adjustable time interval between 5 and 30 seconds.<br>Function available only for N321R-NTC-LVD model.                                                                                        |
| <b>CPL</b><br><i>CP Low Limit</i>            | Voltage lower limit used by the compressor protection. Voltage minimum value at which the compressor can operate.<br>Parameter adjustable between 150 to 254 Vac must be obligatorily 5 Vac lower than the value set at the higher limit ( <b>CPH</b> ).<br>Function available only for N321R-NTC-LVD model.  |
| <b>CPH</b><br><i>CP High Limit</i>           | Voltage higher limit used by the compressor protection. Voltage maximum value at which the compressor can operate.<br>Parameter adjustable between 150 to 254 Vac must be obligatorily 5 Vac higher than the value set at the lower limit ( <b>CPL</b> ).<br>Function available only for N321R-NTC-LVD model. |
| <b>Add</b><br><i>Address</i>                 | Controllers with the optional RS485 Modbus RTU communication interface have the <b>Add</b> parameter at the Configuration level. Set a unique <b>communication address</b> for each equipment connected to the network. You must set an address between 1 and 247.                                            |

Level 3 – Calibration Level

The controller is factory calibrated. Recalibration should only be done by qualified personnel.  
Press the **P** key for **3 seconds** to access this level. This level also contains the parameters for protection configuration.

If you access it by accident, go through all the parameters without changing them, until the controller returns to the measurement level.

|            |                                                                                                                                                                                          |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PRS</b> | <b>Password.</b> Parameter to enter a password to allow changes to the other parameters.                                                                                                 |
| <b>CAL</b> | <b>Calibration Low.</b> Calibration of the measuring range offset. Adjustment of the lower value of the sensor measuring range.                                                          |
| <b>CAH</b> | <b>Calibration High</b> - Gain calibration. Adjustment of the upper value of the sensor measuring range.                                                                                 |
| <b>UoL</b> | <b>Voltage Calibration.</b> Offset adjustment for calibrating the voltage indication. Adjustable between -20 to 20 °C (-4 to 68 °F).<br>Function available only for N321R-NTC-LVD model. |
| <b>Frq</b> | <b>Frequency.</b> Line frequency. Line frequency setting for the supply voltage supervisor.<br><b>0</b> 60 Hz<br><b>1</b> 50 Hz<br>Function available only for N321R-NTC-LVD model.      |
| <b>CJL</b> | <b>Cold Junction Calibration.</b> Function available only for thermocouples.                                                                                                             |
| <b>FAC</b> | <b>Factory Calibration.</b> Restores factory calibration parameters. When                                                                                                                |

|            |                                                                                                                                           |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------|
|            | changed from <b>0</b> to <b>1</b> , the original calibration is retrieved and changes to the calibration will be ignored.                 |
| <b>Prb</b> | <b>Protection.</b> Defines the levels of parameters to be protected.                                                                      |
| <b>PRC</b> | <b>Password Change.</b> Parameter that allows you to change the current password. You can set the password to a number between 1 and 999. |
| <b>Sn2</b> | <b>Serial number.</b> First part of the controller electronic serial number.                                                              |
| <b>Sn1</b> | <b>Serial number.</b> Second part of the controller electronic serial number.                                                             |
| <b>Sn0</b> | <b>Serial number.</b> Third part of the controller electronic serial number.                                                              |

WORKING WITH THE CONTROLLER

The controller turns on the control output to maintain the system temperature at the selected Setpoint. The front panel display shows the symbol  whenever the compressor is active.

The defrost process of this controller is executed by stopping the compressor. This procedure is done every time interval defined by the user. The control output remains off by time also defined by the user. During the defrost procedure, the temperature indication can be held by adjusting the parameter **dFH**.

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 you to start or stop the defrost immediately. By pressing this key for 1 second, the controller is forced into defrost. If it is in defrost, it will be forced to end it.

CONFIGURATION PROTECTION

The configuration protection system prevents undue changes to the controller parameters and, consequently, to its operating mode. This system is composed of parameters that define the degree of protection adopted (whether total or only partial).

Parameters that define protection:

- PRS:** Parameter to enter a **password** to allow changes in the other parameters.
- Prb:** Parameter to define the level of parameters that will be protected:
  - 1 - Only **Calibration** level is protected (Default configuration).
  - 2 - **Calibration** and **Configuration** levels are protected.
  - 3 - All levels are protected: **Calibration**, **Configuration** and **SP**.
- PRC** Parameter to change the current password. Valid passwords are in the range 0 to 999.

Configuration protection usage

The **PRS** 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 5 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 equipment leaves the factory with password 111.

MASTER PASSWORD

The master password, which allows you to define a new password for the controller, 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 a device with serial number 97123 465 is: **1936**

As follows: 1 + **Sn2**= 97; **Sn1**= 123; **Sn0**= 465 = 1 9 3 6

How to use the master password:

- 1 - In the **PRS** parameter, enter the master password.
- 2 - In the **PRC** parameter, enter a new password, which must not be zero (**0**).
- 3 - Use this new password.

ERROR MESSAGES

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

|                                                                                     |                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"><li>Measured temperature exceeded <b>maximum</b> measurement range of the sensor.</li><li>Broken <b>Pt100</b> or <b>Pt1000</b>. Short-circuited NTC sensor.</li></ul> |
|  | <ul style="list-style-type: none"><li>Measured temperature exceeded <b>minimum</b> measurement range of the sensor.</li><li>Short circuited <b>Pt100</b> or <b>Pt1000</b>. Broken NTC.</li></ul>        |

COMPRESSOR PROTECTION (N321R-NTC-LVD)

The controller constantly monitors the voltage of power network and shuts the compressor if this tension is not within limits. These limits are defined in parameters **CPL** and **CPH**