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We Measure, We Control, We Record

TEMPERATURE CONTROLLER
N323
OPERATING MANUAL – V1.8x M

N323 is a temperature controller for heating or cooling with input for the following types of temperature sensors: **NTC** thermistors, **Pt100** or thermocouples type **J**, **K** or **T**. They allow you to correct sensor errors (Offset). Each type of sensor has a specific temperature measurement range that must be observed. It has three independent outputs that can operate in temperature control or operate with alarm.

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

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:

- NTC Thermistor: 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
- 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 1832 °F), Accuracy: 3 °C (5.4 °F)
- Thermocouple type **T**: Range: -50 to 400 °C (-58 to 752 °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-NO

OUTPUT3: ..... Relay: 3 A / 250 Vac, SPST-NO

POWER SUPPLY: Voltage: ..... 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.

Housing: Polycarbonate UL94 V-2; Protection: Box: IP42, front panel: IP65

RS485 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

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

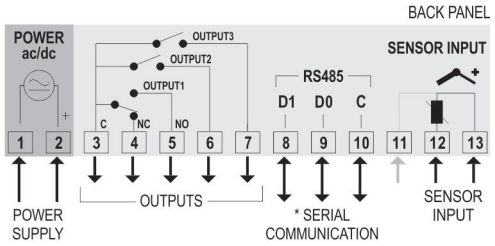


Figure 1 – Connections shown on controller label

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

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 resistance (same cross section).

INSTALLATION RECOMMENDATIONS

- The temperature sensor conductors should run through the system layout separately from the control output and power supply conductors. If possible, in grounded conduits.
- The power supply to the controller should preferably come from a network suitable for instrumentation or from a different phase from that used by the control output.
- It is recommended to use RC FILTERS (47R and 100 nF, series) in contactor coils, solenoids etc.

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	FUNCTION
0	Temperature Measurement
1	Setpoint Adjustment
2	Configuration
3	Calibration

Table 1 – Parameter levels

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 is shown. By pressing **P** again, the **SP2** parameter will be shown. By pressing **P** again, the **SP2**" parameter will be shown. To go back to level 0, press **P** once more.

To access level 2, 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 change 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

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.

Use ▲ and ▼ keys to set the desired value.

SP 1 **SP2** **SP3** *Setpoint*	Setpoint adjustment. Temperature value for the operation of outputs 1, 2 and 3. These values are limited to the values programmed in **SPL** and **SPH** in the Operation Mode cycle.

LEVEL 2 – OPERATION MODE LEVEL

This shows the sequence of the other parameters that must be set. The parameters are shown alternately with their values.

tYP *Type*	Type of temperature sensor to be used. This parameter is only available for the model for thermocouple sensors, where you can choose between J, K and T thermocouples. **0** Thermocouple **J** **1** Thermocouple **K** **2** Thermocouple **T**
Unt *Unit*	Temperature unit. It allows you to choose the display unit of the measured temperature. **0** Temperature in Celsius degrees. **1** Temperature in Fahrenheit degrees.
OFS *Offset*	Value to correct the temperature indication. Allows you to make small adjustments to the temperature indication, seeking to correct measurement errors that appear, for example, when replacing the NTC temperature sensor.
SPL *SP Low Limit*	Setpoint lower limit. Must be defined with a value **lower** than **SPH**.
SPH *SP High Limit*	Setpoint upper limit. Must be defined with a value **higher** than **SPL**.
AC 1 *Action 1*	Control action for OUTPUT 1: **0** Reverse action control. Suitable for **heating**. Turns on control output when temperature is below SP. **1** Direct action control. Suitable for **cooling**. Turns on control output when temperature is above SP.
AC2 *Action 2* **AC3** *Action 3*	Control action or alarm for outputs 2 and 3: **0** Control. Reverse action for heating. **1** Control. Direct action for cooling. **2** Minimum temperature alarm. **3** Maximum temperature alarm. **4** Alarm within range. **5** Alarm out-of-range. **6** Minimum temperature alarm with initial blocking. **7** Maximum temperature alarm with initial blocking.

	8 Alarm within range with initial block. **9** Alarm out-of-range with initial block. The OPERATION section details these functions.
Cnt *Control*	Switching between Setpoints and outputs: **0** SP1 acts on the OUTPUT 1 relay and SP2 acts on the OUTPUT 2 relay. Factory setting. **1** SP1 acts on the OUTPUT 2 relay and SP2 acts on the OUTPUT 1 relay.
HY1 **HY2** **HY3** *Hysteresis*	Control hysteresis. Parameter that applies to both control and alarm. Differential between the switch-on and switch-off point of the relay output configured as a control output. In degrees.
dL1 **dL2** **dL3** *Delay*	Delay time for both control start and alarm. After the controller is turned on, the output (1, 2 or 3) will only be turned on when the time programmed in this parameter elapses. Used in large cooling systems to prevent simultaneous activations of compressors in the return of a power failure. Value in seconds (from 0 to 250 seconds).
OF1 **OF2** **OF3** *Off time*	Sets the minimum OFF time for output 1 and, when in Control Mode (Reverse Action and Direct Action), for outputs 2 and 3. Once the control output is turned OFF, it will stay in this status at minimum during the time programmed in this parameter. Typically used to increase compressor life in cooling systems. Program zero for heating applications. Not valid for thermocouples. Value in seconds (from 0 to 999 seconds).
On1 **On2** **On3** *on time*	Sets the minimum ON time for output 1 and, when in Control Mode (Reverse Action and Direct Action), for outputs 2 and 3. Once the control output is turned ON, it will stay in this status at minimum during the time programmed in this parameter. Typically used to increase compressor life in cooling systems. Program zero for heating applications. Not valid for thermocouples. Value in seconds (from 0 to 999 seconds).
2t1 **2t2** *Timer T1*	Time interval **T1** for alarm timing. Sets timed alarm operation as shown in **Table 4**. Adjustable between 0 and 1999 seconds. Parameter available when outputs 2 and 3 are configured as alarms.
3t1 **3t2** *Timer T2*	Time interval **T2** for alarm timing. Sets timed alarm operation as shown in **Table 4**. Adjustable between 0 and 1999 seconds. Parameter available when outputs 2 and 3 are configured as alarms.
Adr *Address*	The controller that has the built-in RS485 serial communication interface features the **Adr** parameter in its Operation Mode level. In this parameter, you define a **communication address** for each network element. The address set must be between 1 and 247.

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.

In case it is accessed by accident, do not press the ▲ and ▼ keys. 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.
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.
Sn1	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

The multi-output controller has 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 or signaling alarms.

In the multi-stage control application, the setpoints of outputs 1, 2, and 3 are programmed to act at different temperatures. This forms a progressive sequence of compressor activation, increasing the refrigeration capacity as the temperature rises and reducing it when the temperature approaches that programmed for **SP1**.

The use of the compressor delay (**dL1**, **dL2** and **dL3**) ensures that when a power failure returns or when the system starts the compressors will be started one by one according to the programmed timing, reducing the energy demand.

Another typical application for the use of the controller with multiple outputs has to do with the automatic switching of the hot/cold cycle, where one output is programmed with reverse action and commands the heating, and another is programmed with direct action and commands the cooling.

ALARM FUNCTIONS

There are **eight alarm functions**, which can be set for outputs 2 and 3 by programming parameters **AC2** and **AC3** with the following values:

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**. The following figures 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.

P2 and P3 light up whenever the alarm condition occurs, regardless of the status of the output relays. During the delay, the respective indicator remains blinking.

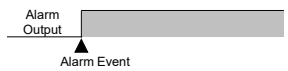
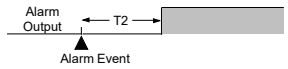
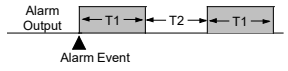
ADVANCED FUNCTION	T1	T2	ACTION
Normal Operation	0	0	
Delayed	0	1 to 1999 s	
Pulse	1 to 1999 s	0	
Oscillator	1 to 1999 s	1 to 1999 s	

Table 2 – 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 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 equipment leaves the factory with password **111**.

MASTER PASSWORD

The master password allows you 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]

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. At **PAS** screen, enter the master password value.
2. Go to **PAC** parameter and enter the 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 temperature measurement. Whenever they are displayed, the control output relay is immediately turned off.

	• The temperature has exceeded the **upper** limit of the sensor range. • **Pt100** or **T/C** sensor broken. Shorted **NTC** sensor.
	• The temperature has exceeded the **lower** limit of the sensor range. • Shorted **Pt100** or **T/C** sensor. Broken **NTC** sensor.

Table 3 – Error messages

WARRANTY

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