TEMPERATURE CONTROLLER

N322T

OPERATING MANUAL - V1.7x A

The N322T is a 2-output digital electronic controller for heating and cooling applications. It is available with NTC thermistor input sensor, Pt100, Pt1000 or J/K/T type thermocouple. Sensor offset correction is provided. The 2 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.

SPECIFICATIONS

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

- **NTC** Thermistor, 10 kΩ @ 25 °C; range: –50 to 120 °C (-58 to 248 °F); Accuracy: 0,6 °C (1,1 °F), with original sensor;
  Sensor interchangeability: 0,75 °C (1,35 °F). This error can be compensated by the **offset** parameter in the controller.
- **Pt100 (α**= 0,00385); Range: –50 to 300 °C (-58 to 572 °F);
  Accuracy: 0,7 °C (1.3 °F); IEC-751.
- **Pt1000** (**α**= 0,00385); Range: –200 to 530 °C (-328 to 986 °F); Accuracy: 0,7 °C (1.3° F);
- **J, K or T thermocouple (**IEC-584)**:**
  - **Type J:** Range: 0 to 600 ºC (32 to 1112 ºF); Accuracy: 3 ºC (5.4 ºF);
  - **Type K:** Range: -50 to 1000 ºC (-58 to 1832 ºF); Accuracy: 3 ºC (5.4 ºF);
  - **Type T:** Range: -50 to 400 ºC (-58 to 752 ºF); Accuracy: 3 ºC (5.4 ºF);

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 199.9º With NTC, Pt100 and Pt1000:.....0.1
elsewhere: 1

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

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

POWER SUPPLY: ..... 100~240 Vac/dc (± 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: 75 x 33 x 75 mm
.....Panel cut-out: 70 x 29 mm; Weight: 100 g

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 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.

ELECTRICAL WIRING

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

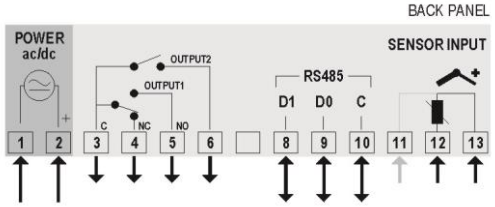

Figure 1 – N322T terminals

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.

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.

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 N322T 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. To go back to level 0, press P once more.
To access level 2 of paramenters, 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.

SP *Set Point*	Temperature adjustment for control. **SP** value is limited to the values programmed in **SPL** and **SPk** in the programming level.

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**.
kys	**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.
Act	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.
(nt	**Control** - Associates Setpoints and Outputs. **0** Setpoint is assigned to OUTPUT1 and Setpoint to OUTPUT2 (factory setting). **1** Setpoint is assigned to OUTPUT2 where as Setpoint is directed to OUTPUT1.
oft *Off time*	Defines the minimum ***off*** time for control OUTPUT. Once OUTPUT is turned off, it remains so for at least the time programmed in **oft**. 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 **oft** to zero. Value in seconds, 0 to 999 s.
ont *on time*	**On time** - Defines the minimum ***on*** time for control OUTPUT. Once turned on, OUTPUT remains so for at least the time programmed in **ont**. 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 **ont** to zero. Value in seconds, 0 to 999 s.

dly *Delay*	**Delay** - Delay time to start control. Upon power-on, control OUTPUT 1 is kept *off* until the time programmed in **dly** is elapsed. Its usage is intended to prevent multiple compressors to start simultaneouly after the turn-on of a system with several controllers. Value in seconds, 0 to 250 s.
t1b *T1 Base*	Time base for **t1**: **0** Seconds **1** Minutes **2** Hours
t2b *T2 Base*	Time base for **t2**: **0** Seconds **1** Minutes **2** Hours
t1 Time 1	Adjusts the interval between consecutive output relay pulses, from 0 to 999 units of **t1b**.
t2 Time 2	Timer output pulse duration, adjustable between 1 and 999 units of **t2b**.
fot *Force Timer*	**0** Timer period and duration **t1** and **t2** act regardless of the control output status. **1** Timer output is activated together with the control output. When the control output is turned off, the timer works as configured in **t1** and **t2**, **T2** first. For defrost applications, configure **Fot=0**. Not used for thermocouple inputs.
dfh *defrost hold*	Holds the temperature indication constant during the defrost time **plus** the time defined in **dFh.** Not valid for thermocouple inputs. **0** Display indicates actual temperature; **1** a **250** Time, in seconds, minutes or hours, following the defrost, in which the indication remains constant, showing the temperature measured just before the defrost cycle. When the defrost function is not used, configure **dFh=0.**
df(*defrost Compressor*	Output (OUTPUT1 - compressor) behavior during defrost: **0** OUTPUT1 é turned off during defrost; **1** OUTPUT1 remains ON during the defrost; **2** OUTPUT1 acts regardless of the defrost cycle (controls the output normally, according to the programmed setpoint). In refrigeration systems, OUTPUT1 is the normal compressor output. When defrost is not used, configure **df(=2**. Not valid for instruments with thermocouple input.
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.

WORKING WITH THE CONTROLLER

The controller cycles the control output as to maintain the system temperature at the value configure in the Setpoint parameter. The display **P1** sign is shown whenever the control output is activated.

The timer output is typically used for the system defrost. The **t1** and **t2** parameters define, respectively, the interval and duration of the defrost cycles.

Manual Defrost: the ⏱ key allows for the timer start or reset. Pressing this key for at least 1 second, the timer output is toggled.

The display **P2** sign lights when the timer output is on. The timer output is usually used for defrost in refrigeration systems. In different applications it can be used to periodically start other loads, such as a mixer, fan, etc.

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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.

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 987123465 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

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, 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.