

N322S

DIFFERENTIAL TEMPERATURE CONTROLLER

USER GUIDE – V2.0



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.

CAUTION: Read the manual fully before installing and operating the device.	CAUTION OR HAZARD: 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 safety protections may not be effective.

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3. PRESENTATION

N322S is a versatile differential temperature controller designed for applications that require control based on the temperature difference between two points. Typical applications include solar water heating systems, air destratification in HVAC installations, and grain drying processes. The controller continuously monitors two temperatures through its included NTC sensors and activates a control output whenever the programmed temperature differential is reached. This enables efficient energy management, optimized process performance, and reduced operating costs.

4. SPECIFICATIONS

SENSOR INPUT:

- Thermistor NTC: 10 k Ω @ 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 (33.35 °F). This error can be eliminated through the **offset** parameter of the equipment.

Note: The sensor comes with the equipment. Its operating range is limited to **-30 to 105 °C** (-22 to 221 °F). It has cable of 3 m in length, 2 x 0.5 mm², and can be extended up to 200 meters.

Measurement Resolution: 0.1° from -19.9 to 119.9°
..... 1° elsewhere

Note: The equipment keeps its accuracy all over the range, despite the lack of display resolution in a part of the range does not allow its visualization.

Circulation Output (OUTPUT1):Relay SPDT
..... 1 HP 250 Vac / 1/3 HP 125 Vac (16 A Resistive)

Backup Output (OUTPUT2): Relay: 3A / 250 Vac, SPST

POWER SUPPLY: 100 to 240 Vac/dc $\pm$ 10 %

Optionally:24 V (12–30 Vdc) (*)

Mains Frequency:50–60 Hz

Power Consumption:5 VA

(*) **Note:** Models with a 24 V power supply do not have electrical isolation between the power supply, input, and RS485 communication circuits.

In direct current (Vdc) supply networks, you must observe the polarity of the connection.

DIMENSION: Width x Height x Depth:75 x 34 x 75 mm
Panel:70 x 29 mm
Weight:100 g

ENVIRONMENT:

Operating:0 to 40 °C (32 to 104 °F)

Storage temperature:-20 a 60 °C (-4 to 140 °F)

Relative humidity:20 to 85 % RH

Housing in polycarbonate UL94-2.

Protection: Housing: IP42; Front panel: IP65.

Suitable wiring: Up to 4.0 mm².

RS485 interface with MODBUS protocol (optional).

Serial interface not isolated from the input circuit.
Interface isolated from the power supply circuit, except for the model with 24 V power supply.
Certifications: CE, UL.

5. ELECTRICAL CONNECTIONS

The following figure indicates the connection, power supply, and output terminals of the controller:

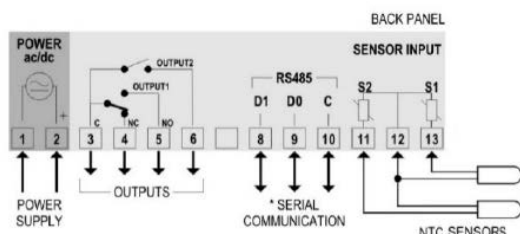


Figure 1

OUTPUT1 is the Control Output.

OUTPUT2 is the Backup Output.

* Serial communication feature is not always present in the controller.

5.1 INSTALLATION RECOMMENDATIONS

- The temperature sensor wires should run through the system plant **separately** from the control output and power supply wires. If possible, in grounded conduits.
- The controller power supply 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 (47 μ and 100 nF, series) in contactor coils, solenoids, etc.

6. OPERATION

Before use, the controller must be configured. That is, you must set values for the parameters that determine how the equipment operates.

The configuration parameters are organized in groups or Levels, called parameter levels.

LEVEL	FUNCTION
0	Measurement
1	Setpoint Adjustment
2	Programming Parameters
3	Calibration

Table 1

When you turn on the controller, the display shows for 1 second its firmware version. This information is useful when consulting the manufacturer. The controller then starts displaying the temperature value measured by the sensor. This is level 0 or the Measurement level.

To access level 1, press **P** for **2 seconds** until the **dOn** parameter appears. To move forward, press **P** once more.

To access level 2, press **P** for **4 seconds** until the **Unit** parameter appears. Release **P** to remain on this level. Press **P** again to access the other parameters of this level. After reaching the last parameter, the controller will return to the first level (0).

Use the **▲** and **▼** keys to alter a parameter value.

Notes:

- The configuration will be saved by the controller upon advancing to the next parameter in a level. Even in the event of a power outage, the configuration will be saved in permanent memory.

- If the keys are not used for more than 20 seconds, the controller returns to the measuring level, ending and saving the configuration made so far.

6.1 LEVEL 1 – SETPOINT ADJUSTMENT LEVEL

This level displays the Setpoint parameters. They define the differential temperatures values for the control.

Use the **▲** and **▼** keys for setting suitable values.

dOn	Differential setpoint for turning on Output1. When the temperature difference between S1 and S2 is above the value configured in dOn , Output1 will be turned on. Adjustable from dOF to 20 °C (68 °F).
dOF	Differential setpoint for turning off Output1. When the temperature difference between S1 and S2 is below the value configured in dOF , Output1 will be turned off. Adjustable between 1 °C (33.8 °F) and dOn .
SP1	Backup activation setpoint. It determines the minimum desired temperature (measured by sensor 2). When this value is reached, the backup output is triggered. Adjustable between SPL and SPH .

6.2 LEVEL 2 – PROGRAMMING LEVEL

This level displays the remaining parameters. The parameters and their values are shown alternately.

Use the **▲** and **▼** keys for setting suitable values.

Unit Unit	Temperature Unit. Selects display indication for degrees Celsius or Fahrenheit. 0 Temperature in Celsius. 1 Temperature in Fahrenheit
ind Indication	Temperature value showed on the display 0 Temperature of the sensor 1 (S1). 1 Temperature of the sensor 2 (S2). 2 Temperature difference between the sensors (S1–S2). 3 Alternates the indication of (S1), (S2) and (S1–S2) at every 3s.
ICE Ice	Setpoint of the minimum critical temperature in the sensor 1 (anti-freezing for water heating applications). When the temperature in the sensor 1 is lower than the value here configured, the output 1 is turned on. This prevents, for example, the water from freezing in the pipe system in a solar heating application. Adjustable between SPL and SPH .
HE1 High Temperature 1	Setpoint of the maximum critical temperature in the sensor 1. When the temperature in the sensor 1 exceeds this value, the control output stops operating. This prevents, for example, the overheated water from circulating and damaging the pipe system. Adjustable between SPL and SPH .
HE2 High Temperature 2	Setpoint of the maximum critical temperature in the sensor 2. Function that prevents the activation of the control output when the temperature in the sensor 2 (S2) is already high enough. Adjustable between SPL and SPH .

RC 1 <i>Action 1</i>	Determines the action type of the Backup Output: 0 Reverse action control. Proper for heating. Turns on the backup output when temperature is below SP1. 1 Direct action control. Proper for cooling. Turns on the backup output when temperature is higher than SP1.
HYS <i>Hysteresis</i>	Hysteresis for the minimum critical temperature setpoint in the sensor 1 (ICE). In Celsius degrees. Adjustable between 0.1 and 50 °C (32.18 and 122 °F).
HY 1 <i>Hysteresis 1</i>	Hysteresis for the maximum critical temperature setpoint in the sensor 1 (HE 1). In Celsius degrees. Adjustable between 0.1 and 50 °C (32.18 and 122 °F).
HY2 <i>Hysteresis 2</i>	Hysteresis for the maximum critical temperature setpoint in the sensor 2 (HE2). In Celsius degrees. Adjustable between 0.1 and 50 °C (32.18 and 122 °F).
b 19 <i>Booster</i>	Hysteresis for the Backup Output operation (SP 1). Adjustable between 0.1 and 50.0 °C (32.18 and 122 °F).
dLY <i>Delay</i>	Delay for control start. After the controller is turned on, the control output will only be turned on after the time programmed in this parameter has elapsed. Value in seconds (from 0 to 250 seconds).
OF 1 <i>Offset Sensor 1</i>	Correction value for the temperature measured by Sensor 1. It allows performing small adjustments in the room temperature, seeking to correct measurement errors that appear, for example, when replacing temperature sensors. Adjustable from -10 to 10 °C (14 to 50 °F).
OF2 <i>Offset Sensor 2</i>	Correction value of the temperature measured by Sensor 2. It allows performing small adjustments in the evaporator temperature, seeking to correct measurement errors that appear, for example, when replacing temperature sensors. Adjustable from -10 to 10 °C (14 to 50 °F).
SPL <i>SP Low Limit</i>	Setpoint lower limit. Defines the minimum value for the setpoint adjustment. In degrees. Adjustable between -50 and 120 °C (-58 and 248 °F).
SPH <i>SP High Limit</i>	Setpoint upper limit. Defines the maximum value for the setpoint adjustment. Must be defined to a value higher than SPL . In degrees. Adjustable between -50 and 120 °C (-58 and 248 °F).
Rd- <i>Address</i>	Controllers with the RS485 serial communication interface shows the Rd- parameter. In this parameter, it is possible to define a communication address for each network element. The set address must be between 1 and 247.

6.3 LEVEL 3 – CALIBRATION LEVEL

The controller leaves the factory perfectly calibrated. When recalibration is necessary, it must be performed by a specialized professional.

Press the **P** key for **4 seconds** to access this level. This level also contains the parameters for configuration protection.

If you have entered this level by accident, go through all the parameters without making any changes until the controller returns to the measurement level.

PAS <i>Password</i>	In this parameter you must enter a password. This allows you to change the other parameters.
CL 1 <i>Calibration Low Input 1</i>	Calibration of the input measurement range offset 1. Adjustment of the lower value of the sensor measurement range.
CH 1 <i>Calibration High Input 1</i>	Gain calibration of the input measurement range 1. Adjustment of the upper value of the sensor measurement range.
CL2 <i>Calibration Low Input 2</i>	Calibration of the input measurement range offset 2. Adjustment of the lower value of the sensor measurement range.
CH2 <i>Calibration High Input 2</i>	Gain calibration of the input measurement range 2. Adjustment of the upper value of the sensor measurement range.
FAC <i>Factory Calibration</i>	Allows to return to the controller's original calibration. Change from 0 to 1 to restore the calibration parameters with factory values.
PrE <i>Protection</i>	Allows you to define the parameter levels to be protected.
PAC <i>Password Change</i>	Allows you to change the current password. You can set a number between 1 and 999 as the password.
Sn2 <i>Serial number 2</i>	Displays the first two digits of the electronic serial number of the controller.
Sn 1 <i>Serial number 1</i>	Displays the middle three digits of the controller's electronic serial number.
Sn0 <i>Serial number 0</i>	Displays the last three digits of the controller's electronic serial number.

7. OPERATION

When the temperature difference between the sensor 1 (S1) and the sensor 2 (S2) is above the value configured in **dLn**, the control output is activated, turning on a pump or fan to circulate the water or air. As the pump or fan operates, the water or air temperature gradually reduces the difference between S1 and S2.

Once the temperature difference falls below a predefined minimum threshold (**dBF**), the pump or fan is switched off, stopping the circulation of water or air.

On the controller's front panel, the **P1** LED lights up when the control output is turned on. The **P2** LED lights up when the backup output is turned on.



Figure 2

T1 T2	S1 – S2 (Differential Temperature)

Table 2

7.1 BACKUP OUTPUT

- In solar applications the output 2 can be used to call for electricity to heat the reservoir. For example on a cloudy day when solar energy is insufficient.
- In air destratification it can be used to call for additional heat from a boiler if the temperature at ground level is too low.
- In grain drying the output 2 can be used to inhibit the system if the external temperature is too low to avoid drawing in moisture.

8. CONFIGURATION PROTECTION

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

Parameters that define the protection:

- PR5** Parameter for defining the parameter levels to be protected.
- PR1** Parameter for defining the parameter levels to be 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**.
- PRC** Parameter for changing the current password. You can set the password to a number between 0 and 1999.

8.1 HOW CONFIGURATION PROTECTION WORKS

The **PR5** parameter appears at the beginning of the protected level. By entering the correct password, you can change the parameters of the protected levels.

If you do not enter the correct password or if you just pass this parameter, the parameters of the protected levels can only be viewed and not changed.

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 factory default password is **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:

$$[1] + [\text{higher digit of SN2}] + [\text{higher digit of SN1}] + [\text{higher digit of SN0}]$$

The master password for the device with serial number 97123465 is: **1936**

As follows: $5n2 = 97$; $5n1 = 123$; $5n0 = 465 = 1 + 9 + 3 + 6$

9.1 HOW TO USE THE MASTER PASSWORD

1. In the **PR5** parameter, enter the master password.
2. In the **PRC** parameter, enter the new password, which must not be zero (0).
3. Use the new password.

10. 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 will be turned off.

If it is configured to show the differential temperature, the value shown will be zero.

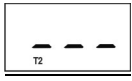
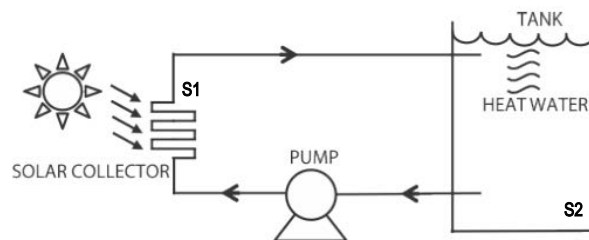
	The measured temperature has exceeded the upper limit of the sensor's measurement range. The NTC sensor is short-circuited. Ind = 0 or 1
	The measured temperature has exceeded the lower limit of the sensor's measurement range. The NTC sensor is broken. Ind = 0 or 1
	If the temperature at S1 or S2 exceeds the Ind = 2 measurement limit, the differential value displayed is 0 .

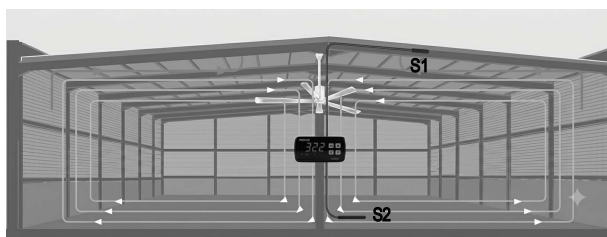
Table 3

11. APPLICATIONS

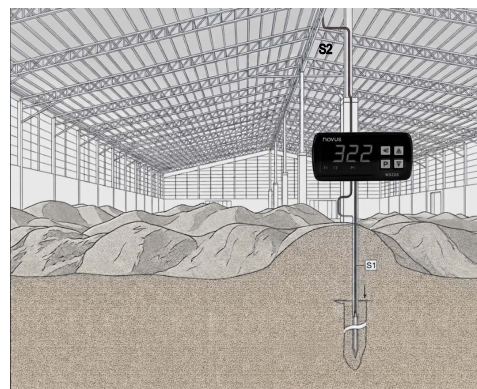
Solar Water Heating



Air Destratification



Grain Drying



12. WARRANTY

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