



Temperature regulator with permission

Application Note

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CONTENTS

1.Introduction.....	3
2.Thermostat with resolution.....	4
2.1.Block circuit and initial conditions.....	4
2.2.Inputs and outputs setup.....	5
2.3.Setup of "Automation".....	5
2.4.Creation of macros HeaterOFF and HeaterON.....	6
2.5.Change on speed on the thermostat.....	6
3.Additional functions: enable by time of day.....	7
4.Additional functions: disable by Alarm input.....	8

Document versions

Version	Date	Brief description of the changes introduced
1.00	09.06.2022	Initial version of the document

Legend:



The text contains additional and useful information that explains specific situations and features.



The text contains information of essential importance which you must get to know well!

1. Introduction

Automatic switching on/off of a load according to the value of a sensor is a classic task in automation systems.

On this principle, thermostats, automatic filling of tanks, ventilation of premises, control of pumps in solar systems and many others are realized.

NetControl series controllers have a built-in module "Automation", which is sufficient for solving such tasks. Combined with its network connectivity, this gives an even more complete level of remote control and monitoring.

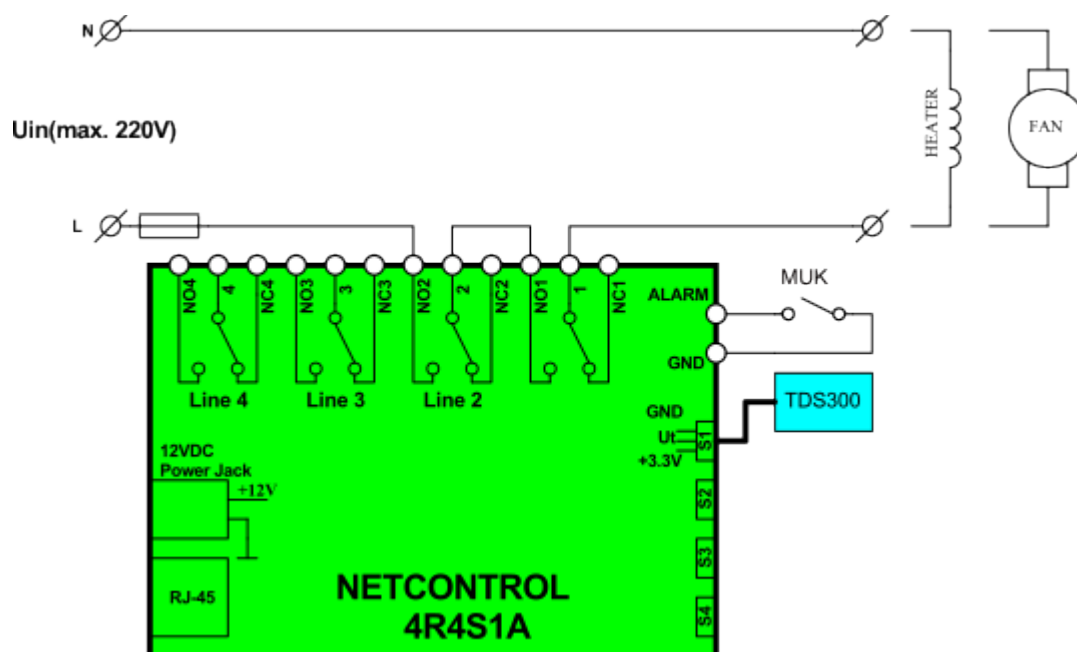
In this document we will illustrate the implementation of a classic heating thermostat with a function to activate/deactivate its operation.

With small changes in the macros or the connection of the load to the relay outputs, the action can easily be reversed and become a cooling thermostat.

2. Thermostat with resolution

2.1. Block circuit and initial conditions

The following image shows the schematic diagram of the thermostat. We use a [NetControl 4R4S1A](#) controller and [TDS300](#) temperature sensor. The load can be a heater, fan or other device, depending on the task to be solved.



In our case we set ourselves the exemplary task of maintaining room temperature: we turn on the heater when the temperature drops below 21°C and turn it off when the temperature is above 23°C.

We use Line 1 relay output to control the load, and Line 2 output for resolution: if the Line 2 relay is on, only then the load is powered by the thermostat algorithm (since the thermostat algorithm cannot be turned off with one easy action, so the Line 2 button acts as an enable/disable switch).

2.2. Inputs and outputs setup

In the menu "IO Settings" we must have the following settings (these are the factory settings, only change names of the outputs, for greater convenience): Line 1 = Heater, Line 2 = Enable

Digital I/O Channels						
Visible	Name	Mode	Invert	Initial State	Impulse[s]	Filter[ms]
<input checked="" type="checkbox"/>	Heater	Manual Output	<input type="checkbox"/>	OFF		25
<input checked="" type="checkbox"/>	Enable	Manual Output	<input type="checkbox"/>	OFF		25

Note: Filter values are rounded to 20ms and apply only to automation events!

Analog Inputs			
Visible	Name	Mode	MA Filter Points
<input checked="" type="checkbox"/>	Temperature	Temperature TDS300	32
<input checked="" type="checkbox"/>	Humidity	Humidity HDS300	32
<input checked="" type="checkbox"/>	Alarm	Contact switch(Alarm)	32

Miscellaneous parameters

Analog inputs scan interval: 20ms* [1..100]

2.3. Setup of "Automation"

Automation" menu and select the "HYST" operating mode (hysteresis). We set the lower and upper temperature threshold according to our assignment.

We must also select macros for "On Event" (when the temperature is $>23^{\circ}\text{C}$) and for "On Restore" (when the temperature drops below 21°C). Since we have not set up the macros at this stage, you will not see the HeaterOFF/HeaterON names, but select Macros 1 (9) (after defining them in the next step, their names will appear here).

Event Group No.1	
Value compare mode	HYST (<LOW=Restore >HIGH=Event) <input type="text"/>
Thresholds LOW	<input type="text" value="21"/>
HIGH	<input type="text" value="23"/>
Main Sensor	Temperature [°C] <input type="text"/>
Diff. Sensor (=main-diff)	Not used <input type="text"/>
On Event	HeaterOFF <input type="text"/>
On Restore	HeaterON <input type="text"/>



Have in mind that entered values for the temperature will be automatically rounded to the closest step of ADC.

2.4. Creation of macros HeaterOFF and HeaterON

In the previous step we chose macros 1 and 9 to be responsible for load management and now we set them in the "Macros" menu:

The image shows two macro configuration panels. The top panel is for '1. HeaterOFF' and the bottom panel is for '9. HeaterON'. Both panels have a 'Start' and 'Stop' button. Below the title, there are three checkboxes: 'Visible', 'Restart', and 'Auto Start'. The 'IO Action/Value' dropdown is set to 'EXIT'. The 'Heater' dropdown is set to 'OFF' for the top panel and 'ON' for the bottom panel.

With this the setting of the thermostat is ready and when the temperature changes you will see the changing state of Line 1/Heater. If the Line 2/Enable output is switched on - power will also be supplied to the load!

2.5. Change on speed on the thermostat

The presence of hysteresis in the on and off temperature setting ensures stable operation of the algorithm. But sometimes it is necessary to further limit the speed of an automatic algorithm.

In *NetControl* you can influence the speed by using the setting for "MA filter points" and "Analog inputs scan interval" in the "IO Settings" menu (see picture in 2.2).

"MovingAverage" filter at each input averages the set number of recent measurements and the result is used to check for inequalities in Automation. If the temperature value in our example changes by one bit of the ADC, it will be necessary to enter at least 50% of the new value before the arithmetic mean is rounded to the new one.

Factory "MA Filter Points" = 32, and input scanning: every 20 ms. So we have $32 * 20 = 640$ ms time to average the data in the filter. Practically (with some inaccuracy and conditionality) the reaction delay time with a stable change in the input value is 50% or 320 ms. With fluctuating values of the input value, the time will be longer.

At maximum values of the parameters ($256 * 2000$ ms) we have averaging from 512s back.

3. Additional functions: enable by time of day

Let's expand the functionality of our thermostat by adding a function to enable it only at certain times of the day, for example: the thermostat only works in the interval from 07:00 to 17:00 on weekdays (space heating)

For this purpose we will use the block "Timers" (real-time clock events). We remind you that a properly configured SNTP server is required for this service to work.

Will use the already defined Line 2/Enable output, setting two new macros 17 and 18 to turn it on and off:

Add the two new timers in "Timers" menu:

If you still want to keep the manual function Enable/Disable, which can globally stop the thermostat (without making adjustments each time), you can connect the normally open contact of Line 3 in series with the circuit Line 2 → Line 1 Then, through the state of Line 3, we will be able to deactivate the thermostat completely.

4. Additional functions: disable by Alarm input

In hotels and other intelligent heating systems, the heat/cooling source is switched off when opening a door in a room.

We can easily add such a feature to our **NetControl** thermostat using the Alarm input and connect a magnetic sensor (MUK) to the door / window.

Again, we will use the available Line 2/Enable as a signal to stop the power supply to the thermostat.

We add an Automation block to intercept the change in the state of Alarm (there is one defined by default) and set it to run macros 2 (Enable) and 10 (Disable):

Event Group No.8

Value compare mode HYST (<LOW=Restore|>HIGH=Event) ▾

Thresholds LOW 426 HIGH 614

Main Sensor Alarm [0..1023] ▾

Diff. Sensor (=main-diff) Not used ▾

On Event Disable ▾

On Restore Enable

2. Disable Start Stop

Visible Restart Auto Start

IO Action/Value ▾ Enable ▾ OFF ▾

EXIT ▾

10. Enable Start Stop

Visible Restart Auto Start

IO Action/Value ▾ Enable ▾ ON ▾

EXIT ▾

When the door is opened, the sensor interrupts the circuit and the Alarm input becomes high (> 614, typically over 1020) - the macro " 2. Disable" is started, Line 2/Enable is switched off and the power supply to the heater is interrupted.

When sensor is closed, a low level occurs (ie <426, typically around 10) - the macro "10. Enable" is started and the heating restored.