TRIO

Programmable Differential Thermostat for solar systems

Introduction

TRIO is differential thermostat, specialized device for controlling the heat exchange between the solar collector and the water heater. It not only ensures optimal system operation, but also monitors emergency situations, preventing potentially dangerous consequences for the system.

The device monitors the temperatures of the solar collector and water heater and when the conditions of the control algorithm are met, the thermal energy generated in the solar collector is transferred to the water heater through the circulation pump. The device offers flexibility of system management through adjustable parameters. This way it can be tuned specifically for the specifics of each installation.

In addition, the device offers regulation of the temperature of the water heater, controlling its heating from an additional heat source (electric heater) independently of the pump. The installation of a third probe in the upper part allows the monitoring of the actual temperature of the hot water.

Installation

TRIO is suitable for DIN rail mounting. It should only be installed in dry enclosed spaces and should not be located where it will be exposed to strong electromagnetic fields.

The device is powered by high voltage! Observe the safety regulations when working with high voltage!

It is mandatory to preserve all protections of the water heater when connecting an electric heater to the device!

Inputs and outputs

There are 3 sensors included in the set:

- T1 – Collector sensor Pt1000 (-40 ... 250°C)
- T2 – water heater sensor at the level of the coil NTC (-40 ... 125°C)
- T3 – water heater sensor at the highest point NTC (-40 ... 125°C)

The device has 2 independent relays with terminals for the normally open and normally closed contacts, which are connected to Live:

- R1 – circulation pump control (Max 1 kW / 5 A)
- R2 – electric heater control (Max 3 kW / 16 A)

Electrical connection

The thermostat must be powered through external mains switch (last work step of the installation process). The pump and water heater are connected to terminals 1 | 2 (relay **R1**) and 3 | 4 (relay **R2**).

The Pt1000 probe (**T1**) is connected to the collector terminal 10|11, (**T2**) and (**T3**) to 12|13 and 14|15 respectively. Connecting the sensor (**T3**) is optional and only necessary if the boiler thermostat function is used.

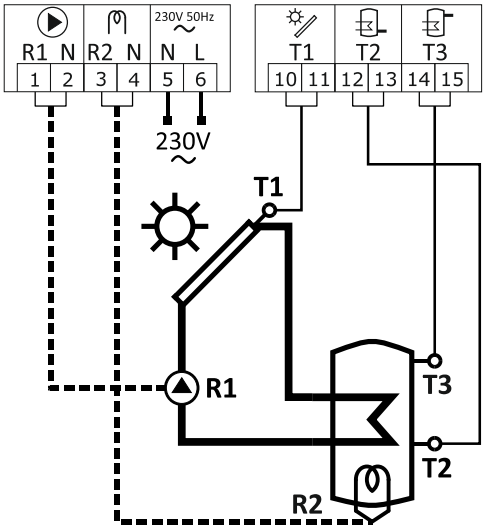

Fig. 1 Electrical connection

Operation

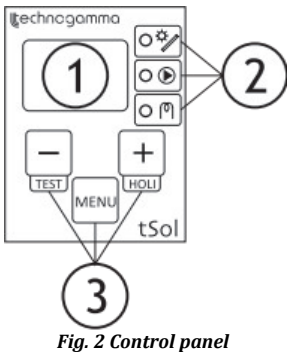

Fig. 2 Control panel

① Two digit seven-segment display

② Status LEDs:

- current temperature
- circulation pump
- electric heater

③ Buttons:

- increase (holiday mode)
- decrease (pump test)
- parameter adjust, exit

When the device is turned on, it is in the main operating mode. The display shows the temperatures of the sensors, changing every 3 seconds. When the LED is on, the temperature of the collector is displayed, when it is off, temperature of the water heater, and when it flashes – temperature of the sensor (T3). Using + and − you can select the temperature displayed. If you want to monitor a certain temperature constantly, press MENU to fix the currently displayed temperature.

If Er appears on the display, it means there is a problem with the thermal probe. Hi indicates a temperature value above 99°C, and Lo – below -9°C.

In the event of an emergency (see below), the temperature causing the emergency flashes on the display (for example, if the collector overheats, the collector temperature is displayed).

Temperatures

- ***TColl*** (T1) – collector temperature
- ***TBoil*** (T2) – water heater temperature at coil level
- ***TBoilHigh*** (T3) – water heater temperature at highest level

Parameter			Description	Limits			
				min	set	max	
P1	dt	***ΔT***	Temperature difference TColl – TBoil	2	**5**	40	°C
P2	Co	***TCollMin***	Minimal collector temeperature	20	**40**	80	°C
P3	bt	***TBoilSet***	Water heater set temperature	5	**50**	80	°C
P4	bd	***tBoilDelay***	Electrical heater turn on delay	0 (off)	**2**	99 (off)	min
P5	bP	***TBoilMax***	Water heater overheat temperature	50	**80**	90	°C
P6	CF	***TCollFreeze***	Collector freeze temperature	-9 (off)	**2**	10 (off)	°C
		TCollMax	Collector overheat temperature		**99**		°C
P7	HY	***HY***	Hysteresis	1	**2**	10	°C
P8	Hd	***VacΔT***	Holiday – temperature difference	2	**8**	40	°C
P9	Hb	***VacTBoilMin***	Holiday – minimal water heater temperature	20	**50**	70	°C

Setting parameters

All parameters have factory values, listed in the table. To change any of them, press and hold the button MENU for 3 seconds, at which point ☼ starts flashing slowly, and the display shows the number of the current parameter [P 1] . Use the buttons + HOLI and − TEST to select the desired parameter to edit. If no button is pressed for 3 seconds, the name of the current parameter appears (for example [P 1] → [dt]). The device returns to main mode if no button is pressed for 9 seconds.

To change or check the value of the selected parameter, press MENU. The display shows the current value and ☼ flashes rapidly. With the buttons + HOLI and − TEST you can increase or decrease the parameter accordingly. By pressing MENU or after 9 seconds of inactivity, the parameter is saved and you return to the select parameter menu.

Note: The ***TCollFreeze*** parameter has a value of [OF] (turned off) that is between the two limit values. With this setting, the collector anti-freeze protection function is disabled.

Differential thermostat control algorithm

The pump turns on when the temperature difference (***TColl*** - ***TBoil***) is greater than ***ΔT*** and the collector temperature is greater than ***TCollMin***. Otherwise, the pump is turned off because the heat exchange conditions are not met.

The hysteresis parameter ***HY*** is added/subtracted to each on and off condition. For example, with a set hysteresis of 2°C and ***Δ***T = 10°C, the pump will turn on at a temperature difference of 10 + 2 = 12°C, and it will turn off at 10 – 2 = 8°C.

Emergency cases

The circulation pump is shut off **Always** when the boiler temperature is higher than ***TBoilMax***.

The circulation pump is switched on under the following conditions:

- Collector overheat – ***TColl*** > ***TCollMax***
- Collector freeze – ***TColl*** < ***TCollFreeze*** и ***TBoil*** > 15°C

If the boiler and collector are overheated (***TBoil*** > ***TBoilMax*** и ***TColl*** > 110°C) then the pump is switched on for 2 seconds. in 2 minutes if ***TBoil*** < 95°C.

Pump test mode

When initially filling up the solar system or just to check that the circulation pump is working, use ***Pump test*** mode.

In order to enter into this mode, from main menu press and hold − TEST button for 4 seconds. The pump is turned on and the display shows alternating [Pt] and the number of minutes left in this mode. The remaining time can be adjusted usiing the buttons + HOLI and − TEST. The device automatically exits this mode once the time is up or the button MENU is pressed.

Circulation pump anti-block protection

If the pump has not been activated in 1 week hours, then the thermostat forcefully activates it for 30 sec, as a prevention of the pump's blocking. When this mode is active the display shows [Ab] .

Technical data

Power	230 V, 50 Hz, 1.5 VA
Operating ambient temperature	0 ... 40 °C
Protection	IP 40
Dimensions	36 x 90 x 58 mm
Mounting	DIN rail
Warranty	24 months
Pump relay output (R1)	1 kW / 5 A, 250 VAC
Heater relay output (R2)	3 kW / 16 A, 250 VAC
Temperature sensor Pt1000	-40 ... 250 °C
Temperature sensor NTC	-40 ... 125 °C

Water heater thermostat (heating the boiler from additional heat source)

TRIO allows the regulation of the temperature of the water heater, controlling an additional permanent heat source (for example, an electric heater). Thus you have a guaranteed minimum temperature in the boiler, determined by the parameter ***TBoilSet***. This function only works if a probe (T3) is connected, which measures the temperature in the upper part of the boiler.

By adjusting the ***tBoilDelay*** parameter, the operation of the heater can be linked to the operation of the pump. Thus, the additional heating can be switched on for a certain time after the pump has stopped. In this way, solar energy is utilized to the maximum.

Work principle

The heater is switched on when the boiler temperature is below the set ***TBoilHigh*** < ***TBoilSet***. Hysteresis is fixed at 1°C (only with connected sensor (T3)).

The ***tBoilDelay*** parameter sets the interval that is waited to turning on the heater after the pump is stopped. As long as the pump is on or the waiting time has not expired, the heater is turned off.

Note: The ***tBoilDelay*** parameter has a value of [OF] (turned off), which is between the two end values. With this setting, the heater works according to the thermostat set temperature ***TBoilSet*** or if there is no connected sensor (T3) the heater is constantly on.

Holiday mode

In case you will not be using the water heater for an extended period of time, Vacation mode prevents the water heater from overheating by dissipating the heat from the water heater through the collector to the atmosphere. Thus, during the day, the water heater is cooled enough to prevent the collector from overheating.

To activate this mode from the main menu, press and hold the button + HOLI for 4 seconds. The display shows [Ho] . By pressing + HOLI and − TEST you can change the displayed temperature on the display.

Return to normal operation mode by pressing MENU

Work principle

The pump is turned on when the temperature difference (***TBoil*** - ***TCol***) is higher than ***VacΔT*** and the water heater temperature is higher than ***VacTBoilMin***.

The hysteresis is fixed to 2°C.

In this mode the emergency cases are monitored and handled the same way as working in normal operation mode.

Limited warranty

The warranty is valid for 24 months from the sale date.

Warranty is void in case of:

- Incorrect installation
- Alteration of the product and/or attempts to repair or modify
- Visible damage of the housing and/or the inside of the device
- Damage caused by lightning storms
- Usage in inappropriate conditions (temperature and humidity)
- Broken warranty stickers

Warranty card

Sold (client/date):_____

_____

Invoice No (Receipt No):_____

Signature:_____

Technogamma LTD

4004 Plovdiv, Bulgaria
9N Kuklensko Shose str. fl. 3, office 6
Phone: +359 32 699-240

e-mail: info@technogamma.bg

www.technogamma.bg