INTIEL

Programmable Differential Thermostat
TD-3.3

User's Manual

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I. Application

Differential Thermostat DT-3.3 is used for a domestic hot water preparation, where the heating of the water tanks is provided in a combined way, by solar panels and electrical heating elements. It is designed to control the operation of one or two circulation pumps, installed in the water circuit between the solar panels and water tank serpentine, thus regulating the heat exchanging between them.

II. Functionality

DT-3.3 has an ability to control two main types of installations for a domestic hot water preparation by means of solar or heating systems depends on the selected program.

2.1 Systems equipped with one water tank (default program) – the differential thermostat follows the temperature of the solar panel (T1), the temperature of the lowest part of the water tank (T2) and the temperature of the upper part of the water tank (T3).

2.2 Systems equipped with two water tanks – the differential thermostats follows the solar panel temperature (T1), the temperature of the lowest part of water tank 1 (T2) and the temperature of lowest part of water tank 2 (T3). The heating of water tank 1 is with a higher priority than water tank 2

III. Operation

The Thermostat is equipped with three temperature sensors, mounted respectively at the water tank (tanks) and at the solar panels. During its operation the thermostat monitors the following parameters:

3.1. **dT, Δt** – adjusted and current (real) difference between the water tank and solar panel temperatures. dT can be adjusted in the range of 2 up to 20°C.
The default setting is 10°C

3.2. **Tzad (W)** – assigned temperature level of the water tank to which it can be heated from the solar panels. The temperature can be adjusted in the range between 30 and 80°C. *The default setting is 60°C.*

3.3. **Tzad1(W1)** –assigned temperature in the second water tank in systems with 2 water tanks or an assigned temperature at the upper part with systems with one water tank. *The default setting is 60°C.*

3.4. **Tbmax** – critical maximum allowed water tank temperature. It can be adjusted in the range between 80 and 100 °C. *The default setting is 90°C.*

3.5. **Tbmin** – minimum water tank temperature bellow which the solar panel defrosting is being stopped. It cannot be adjusted. *The default setting is 20°C.*

3.6. **Tcmin** – minimum temperature level of the solar panel. It can be adjusted in the range between 25 and 50 °C. *The default setting is 40°C.*

3.7. **Tcmax** – maximum allowed temperature of the solar panel. It can be adjusted in the range between 90 and 110°C. *The default setting is 110°C.*

3.8. **Tdef** – defrost temperature level of the solar panel. It can be fixed in the range between (-20) up to (+10)°C. *The default setting disables this function "- -".*

3.9. **Tvmax** – maximum allowed water tank temperature at which an emergency drainage of the water tank can be started by means of relay output 3. It can be adjusted in the range between 50 and 95°C. *The default setting is 95°C*

- When one of the temperatures is grater than +120°C on the digital display is being indicated "Hi".
- When one of the temperatures is lower than -20°C on the digital display is being indicated "Lo"

Differential Thermostat DT-3.3 operation depends on the temperature sensor states, as follows:

Installations equipped with one water tank

A) Normal operation

The circulation pump is being switched on and the water tank heating is being started if the temperature at the lowest part of the water tank is lower than **Tzad** and there is a positive difference **Δt** between the solar panel and lowest part or the water tank temperature, grater than the assigned one **dT (T1-T2> dT).** The circulation pump is being stopped (relay output 1) if during water tank heating **Δt** is being decreased, thus after **Δt** gets equalized with the assigned one **dT**

The heating of the water tank at the above mentioned conditions is going until the water tank temperature at its lowest part is getting the same with the assigned one **Tzad**. Afterwards the pump is being switched off and the heating is being stopped.

If under the above mentioned conditions the solar panel temperature is going down bellow **Tcmin**, then the circulation pump operation will be stopped by force, despite of conditions **Δt>dTи T2<Tzad** could be available.

In case the solar panel temperature falls bellow **Tdef**, the circulation pump is being switched on by force, never mind it has been switched off due to solar panel temperature decreasing bellow **Tcmin.** (only in case the defrost option is activated)

If during the previous mentioned operation mode the water tank temperature falls down bellow **Tbmin**, then the circulation pump is being switched off as the solar panel defrosting is being stopped.

If the water tank temperature at its upper part **T3** is lower than the assigned one **Tzad1**, then the electrical heating elements operation is being allowed until **Tzad1** is being reached. (relay output 2), but only in case there are no conditions for circulation pump operation.

B) Emergency operation

If during water tank heating, the solar panel temperature exceeds **Tcmax**, the circulation pump is being started by force in order to cool the solar panel. The previous mentioned will be fulfilled despite of the water tank temperature at its lowest part **T2** could exceeded **Tzad** (relay output 1).

If during the above mentioned emergency mode the water tank temperature at its lowest part reaches the critical maximum value **Tbmax**, then the circulation pump is being switched off never mind it could reflect to solar panel overheating. Thus the water tank temperature has a higher priority than the solar panel one.

When the water tank temperature at its upper part **T3** exceeds **Tvmax** a valve is being switched on in order to drain the hot water of the water tank (relay output 3).

Installations equipped with two water tanks

A) Normal operation

- The circulation pump 1 is being switched on and the heating of the water tank is being started by means of the solar panels if temperature **T2** in water tank 1 is lower than the assigned one **Tzad** and if there is a positive difference **Δt** between the solar panel and the water tank temperatures grater than the assigned **dT (T1-T2> dT),** The circulation pump is being stopped if during water tank heating **Δt** is being decreased, thus after **Δt** gets equalized with the assigned one **dT**.

The heating of the water tank at the above mentioned conditions is going until the water tank temperature is getting the same with the assigned one **Tzad**. Afterwards the pump is being switched off and the heating is being stopped (relay output 1).

- when water tank 1 reaches its assigned temperature, then the operation of circulation pump 1 is being stopped and the heating of the second water tank is being started as circulation pump 2 is being switched on. In this case circulation pump 2 will be started in case temperature **T3** in water tank 2 is lower than **Tzad1** and there is a positive difference **Δt** between solar panel and water tank, grater than the assigned one temperatures **dT (T1- T3>dT)** (relay output 1 and 2).
- the operation of circulation pump 2 is being stopped in case of reaching **Tzad1**, equalizing **Δt** with dT or with decreasing of **T2** concerning water tank 1 bellow **Tzad**. In the last case after circulation pump 2 is being switched off circulation pump 1 is being switched on for heating of water tank 1.
- If under the above mentioned conditions the solar panel temperature is going down bellow **Tcmin**, then both circulation pumps operation will be stopped by force, despite of conditions **Δt>dT** and **T2<Tzad**, **T3<Tzad1** co**uld be available. (relay output 1 and 2)**
- **in case the solar panel temperature falls bellow Tdef,** circulation pump 1 is being switched on by force, never mind it has been switched off due to solar panel temperature decreasing bellow **Tcmin**. (only in case the defrost option is activated)
- if during the previous mentioned operation mode water tank 1 temperature falls down bellow **Tbmin**, then the circulation pump is being switched off as the solar panel defrosting is being stopped.

B) Emergency operation

- if during water tanks heating, the solar panel temperature exceeds **Tcmax**, the circulation pumps are being started by force in order to cool the solar panel. The previous mentioned will be fulfilled despite of **temperatures T2** and **T3** of the water tanks could exceed **Tzad** and **Tzad1** (relay output 1 and 2).
- if during the above mentioned emergency mode the water tank temperatures reach the critical maximum value **Tbmax**, then the circulation pumps are being switched off never mind it could reflect to solar panel overheating. Thus the water tank temperature has a higher priority than the solar panel one.
- when temperature **T3** in water tank 2 exceeds **Tvmax** a valve is being switched on in order to drain the hot water of the water tank (relay output 3).

IV. Front panel indications

On the front panel are located the control elements and programming. These are two line LCD display, seven light indications and three buttons – button *up*, button *down* and button ”SET”.

The front panel vision is shown at Figure 1 bellow.

4.1 Light indication 1 – shows the operation of circulation pump 1

4.2 Light indication 2 - shows the operation of circulation pump 2 (in case two water tanks are installed) or heating of the water tank by means of electrical heating elements.

4.3 Light indication 3 – shows switched on valve for hot water draining.

4.4 Light indication 4 – shows emergency situation with the solar panel, for example a maximum solar panel temperature is being reached or a defrost protection is activated.

4.5 Light indication 5 – show an emergency situation, the temperature in water tank 1 has being reached the maximum allowed water tank temperature Tbmax.

4.6 Light indication 6 – show an emergency situation, the temperature in water tank 2 has being reached the maximum allowed water tank temperature Tbmax.

4.7. Light indication 7 – shows that the unit is in a “Vacation” regime.

After connection of the power supply the thermostat goes into an initial mode as it shows the solar panel and water tank/tanks temperatures.

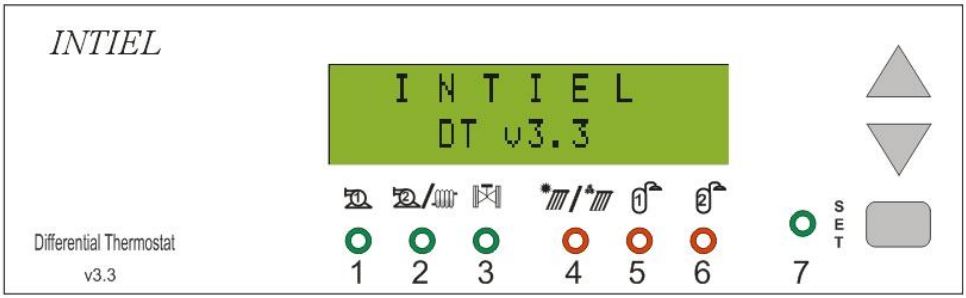


Figure 1

V.Programming

5.1 Entering the thermostat menu

By pressing and holding the *"SET"* button for more than 3 seconds. With the up and down to navigate forwards and backwards in the menu. Change the selected item by pressing of a button *SET* (**Figure 1).** A when the value is changed after pressing the button *SET* value start flashing, changing it is done by pressing up or down. Confirm the selected value - again with *SET*.

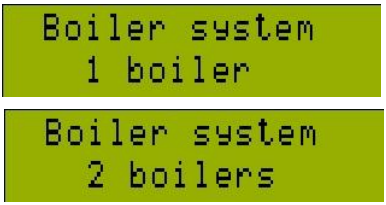
Vacation Regime - Mode is designed for cases where tanks is not used for a long time. When activated, the temperature of the water heater is set at 40 ° C and the inclusion of electric heaters is terminate. Pumps turns as necessary in order avoid overheating the water heater or the panel.

Save & Exit – Save Settings and exit from the menu.

Menu Password - Allows access to the menu to be restricted by password. When selecting ***enable***, the option is activated. You can change the password from the following setting - **Renew Password**. The default password (the one that the manufacturer supplies the controller) is **000**. After Menu Password is enable, to enter the menu you must enter the correct password. Press the *SET* button and the *up*, *down* select the appropriate number, press the *SET* button again to select the other two digits of the password. If the password is entered incorrectly three times, the controller returns to working condition.
If within 5 seconds not start entering the password, access the menu, but with limited rights, You can browse the selections and parameters, they can not be changed, except for the vacation regime.
In Menu Password - **disable**, menu access does not require a password.

If a period of 30 sec. no buttons are pressed, it should automatically exit the menu, as the changes are **not saved in memory. In this case they will be valid until it is stopped power.**

One of Two water tanks

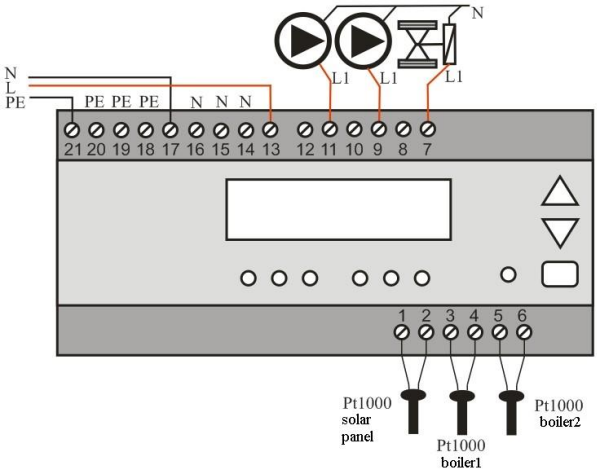


Anti-freezing protection

Figure 2

VI. Wiring

The wiring of the thermostat includes connection of the temperature sensors, power supply, controlled circulation pump, electrical heating elements and a valve according **Figure 3**. The temperature sensors are Pt-1000 non-polar ones. In case of necessity the connection cables of the sensors could be prolonged as the total resistance of both cores of the cable will be observed – an indication sensibility of **1°C/4Ω**. The recommended cable length which does not affect the measurement precision is up to 100m.

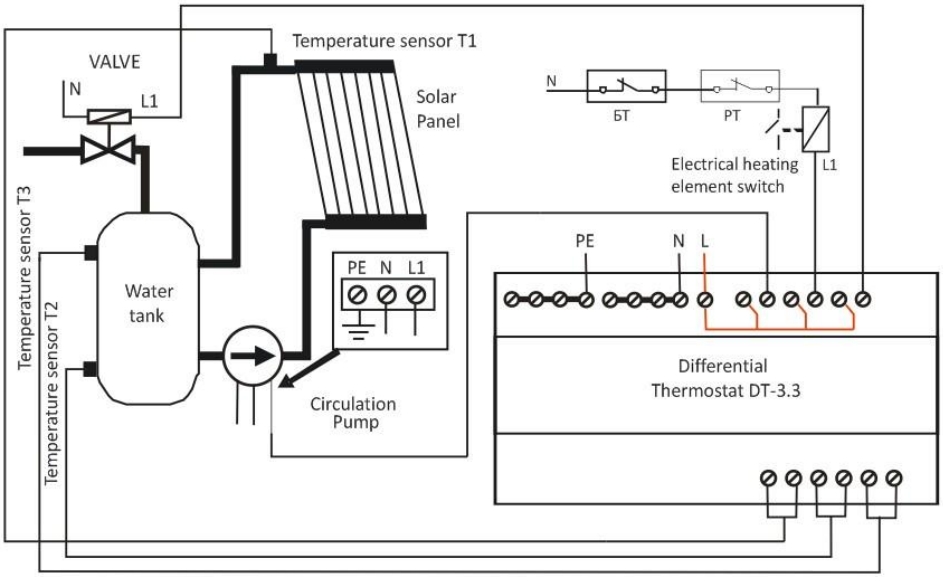


Terminals 1 and 2 are inputs for solar panel temperature sensor T1. Pt-1000 sensor is to be connected to those terminals. Terminals 3 and 4 are inputs for water tank 1 temperature sensor T2. Pt-1000 sensor is to be connected to those terminals. Terminals 5 and 6 are inputs for water tank1/water tank2 temperature sensors T3. Pt-1000 sensor is to be connected to those terminals.

To terminals 13, 17 and 21 are to be connected a phase, neutral and protection ground of the grid. To terminals 11, 9 and 7 are to be connected respectively circulation pump 1, circulation pump 2/electrical heating elements and a valve. A phase (L1) appears at terminals 12, 10 and 8, when it does not at terminals 13, 17 and 21, and an opposite.

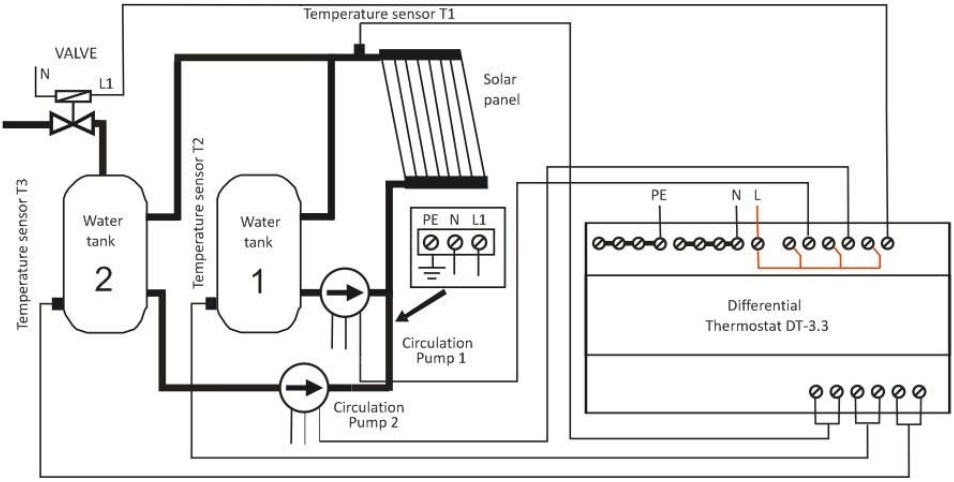
VII. Hydraulic connections

A) Systems equipped with one water tank. The water tank heating is provided by means of solar panel and electrical heating elements



БТ – blocking thermostat
PT – operation thermostat

B) Systems equipped with two water tanks. The water tank heating is provided by means of solar panels.



VIII. Technical data

Supply voltage:	230V / AC / 50-60Hz
Maximal rated current:	7A / 250V / AC / 50-60Hz
Outputs:	3 standard relays (changeover contacts)
Switch-on difference:	ΔT 2…20° C adjustable
Sensors:	3 temperature sensors Pt1000 (-50° до +200°C)
Sensor current:	2.6 mA
Range of temperature measuring:	from -20 up to +120°C
Digital display:	Two lines LCD
Measurement precision:	1°C
Humidity:	0-80%
Protection:	IP20

Parameters				
Indications	*Describtion*	*Temperature Range*	*Default settings*	*Clients' settingsa*
dT	Assigned temperature difference between the solar panel and the water tank	2 ÷ 20° C	10° C	
Tzad (W)	Assigned temperature until which the water tank can be heated by means of the solar panels	30 ÷ 80° C	60° C	
Tzad1 (W1)	Assigned temperature in second water tank with two water tanks systems and assigned temperature at the upper water tank part with systems with one water tank	30 ÷ 80° C	60° C	
Tbmax	Maximum allowed water tank temperature.	80 ÷ 100° C	90° C	
Tbmin	Minimum water tank temperature bellow which the solar panel antifreezing is being stopped.		20° C	
Tcmax	Maximum allowed solar panel temperature.	90 ÷ 110° C	110° C	
Tcmin	Minimum solar panel temperature.	25 ÷ 50° C	40° C	
Tdef	Solar panel temperature level at which the ant-freezing protection is being activated.	-20 ÷ 10°C	-20° C OFF	
Tvmax	Maximum water tank temperature at which the relay output 3 is being activated.	50 ÷ 95°C	95° C	

Warranty

The warranty period is 24 months following the purchase date of the unit or its installation by an authorized Engineering Company, but not exceeding 28 months after the production date. The warranty is extended to the malfunctions that occur during the warranty period and are result of the production reasons or defective used parts. The warranty does not relate to malfunctions corresponding to not-qualified installation, activities directed to the product body interference, not regular storage or transport.

The repairs during the warranty period can be done after correct filling of the manufacturer warranty card