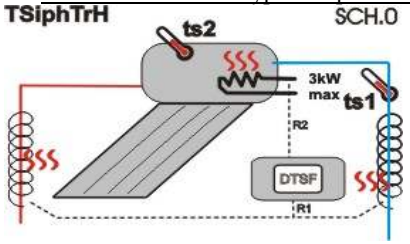
„DTSF3+" Temperature Controller For Solar Thermal And Heating Application With 8 Schemes

BRIEF DESCRIPTION

The unit is a programmable digital temperatute controller for solar thermal and heating plants. It manages the interaction between the solar collector, hot water tank, storage tank, boiler, pumps, valves and electric heater. The unit helps to improve thermal comfort by combining high efficiency with autonomy of the system. The joint functional work of differential temperature, built-in clock and a flexible treshold temperatures further helps to increase energy savings. It has 8 pre-programmed functional diagrams which cover vast range of prooved by practice application. The application of the device extends from thermo-syphonic solar water heaters to more complex solar systems with a combination of hot water tank and storage tank, boiler and heating. It also can control one HF pump with PWM input.

Functional diagrams, schemes, sensors and outputs arrangement:

1 **Scheme 0** – Thermosyphonic panel with integrated tank and trace heating

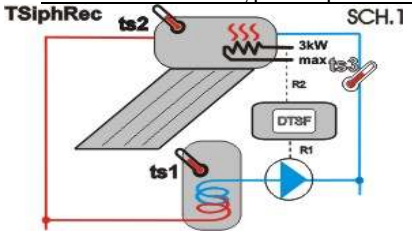


Sensors **Schm=0; "TSyphTrH"**
- TS1 – trace temperature
- TS2 – solar tank temperature
- **TS3 – not used;**
- Level sensor - Terminals 3 and 4

Outputs
- R1 – trace heater
- R2 – electric heater of solar operated tank
- R3 – refill valve (N.C.)

Level sensor: Controls electric valve for proper boiler fill up while monitoring the water level with submerged electrode.

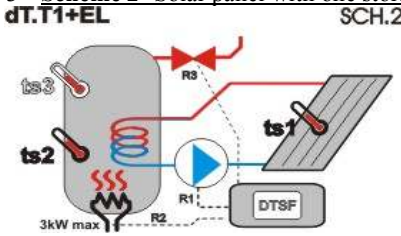
2 **Scheme 1-** Thermosyphonic panel with integrated tank and recirculation;



Sensors **Schm=1; "TSyphReC"**
- TS1 – temperature of suplimentary tank/recirculation point
- TS2 – solar tank temperature
- TS3 – trace temperature

Outputs
- R1 – recirculation pump
- R2 – electric heater of solar operated tank
- R3 – * valve – not used

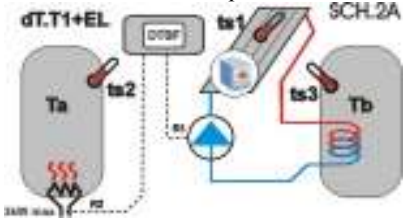
3 **Scheme** 2- Solar panel with one storage tank and electric heater (standard)



Sensors **Schm=2; „dT.EL+T1"**
- TS1 – temperature of solar panel
- TS2 – tank temperature at bottom (at coil position)
- TS3 – tank temperature at top (for heater control)

Outputs
- R1 – solar pump
- R2 – electric heater of tank
- R3 – emergency draining valve

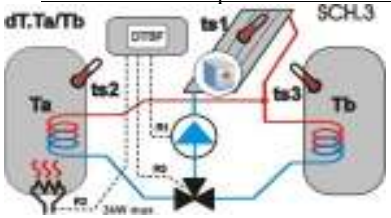
4 **Scheme** 2a - Solar panel with two storage tanks – Ta-with electric heater, Tb-with solar heating,



Sensors **Schm=2; „dT.EL+T1"**
- TS1 – temperature of solar panel
- TS2 – temperature of electric heater operated tank
- TS3 – temperature of solar operated tank

Outputs
- R1 – solar pump
- R2 – electric heater of tank
- R3 – emergency draining valve

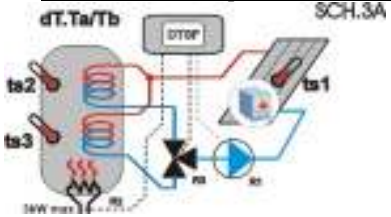
5 **Scheme** 3 - Solar panel with two storage tanks – main and suplimentary with priority



Sensors **Schm=3;"dTETa/Tb"**
- TS1 – temperature of solar panel
- TS2 – temperature of tank („A") - main
- TS3 – temperature of tank („B") -suplimentary

Outputs
- R1 – solar pump
- R2 – electric heater of tank („A")
- R3 – 3-way valve main/suplimentary tank

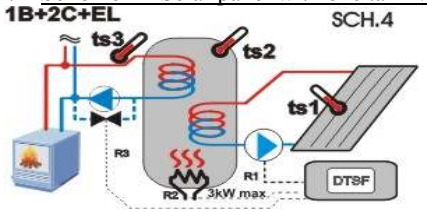
6 **Scheme** 3a - Solar panel with one tank with two solar coils and electric heater



Sensors **Schm=3;"dTETa/Tb"**
- TS1 – temperature of solar panel
- TS2 – temperature of tank – top („A")
- TS3 – temperature of tank – bottom („B")

Outputs
- R1 – solar pump
- R2 – electric heater of tank
- R3 – 3-way valve top/bottom

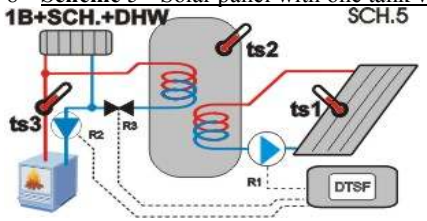
7 **Scheme** 4 - Solar panel with one tank with two coils, electric heater and suplimentary heater



Sensors **Schm=4; "1B+2C+EL"**
- TS1 – temperature of solar panel
- TS2 – tank temperature
- TS3 – suplimentary heating source temperature

Outputs
- R1 – solar pump
- R2 – electric heater of tank
- R3 – DHW suplimentary heating valve/pump

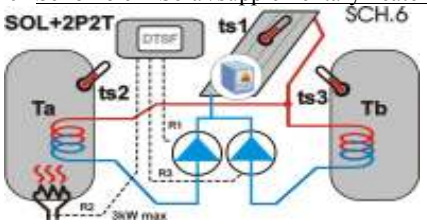
8 **Scheme** 5 - Solar panel with one tank with two coils, suplimentary heater and heating pump



Sensors **Schm=5; "SolDhwCh"**
- TS1 – temperature of solar panel
- TS2 – tank temperature
- TS3 – suplimentary heating source temperature

Outputs
- R1 – solar pump
- R2 – circulation pump for domestic heating
- R3 – DHW suplimentary heating valve/pump

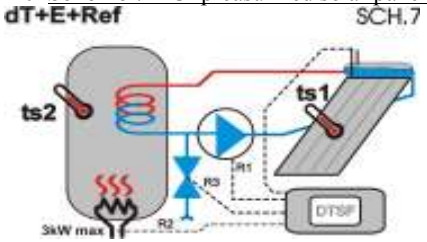
9 **Scheme** 6 – Solar/supplementary heater with two tanks and two pumps, no priority



Sensors **Schm=6; "SOL+2P2T"**
- TS1 – temperature of heat source
- TS2 – temperature of tank – "A"
- TS3 – temperature of tank – "B"

Outputs
- R1 – pump for tank "A"
- R2 – electric heater of tank "A"
- R3 – pump for tank "B"

10 **Scheme** 7 – Unpreasurized solar panel (open to air system) with el. heater and refill function



Sensors **Schm=7; "dT.EL.T1+R"**
- TS1 – temperature of solar panel
- TS2 – temperature of solar tank
- TS3 – not used
- Level sensor - Terminals 3 and 4; reads level of liquid

Outputs
- R1 – solar pump
- R2 – electric heater of tank
- R3 – refill valve (N.C.)

Level sensor: Controls electric valve for proper solar panel fill up while monitoring the water level with submerged electrode.

TABLE OF AVAILABLE PARAMETERS:

	Name	Range	↻	Parameter description	Shceme participation:							
					0	1	2	3	4	5	6	7
1	Clock	h:m:s		Clock	*	*	*	*	*		*	*
2	ON	24h/15min		Beginning of time zone (El. Heater)	*	*	*	*	*		*	*
3	Off	24h/15min		End of time zone (El. Heater)	*	*	*	*	*		*	*
4	GoodTnk	min÷max		Comfort t°C in main tank	*	*	*	*	*	*	*	*
5	dT1-Sol	3÷35°C	*	Temperature difference – solar/ tank		*	*	*	*	*	*	*
5a	dT1-hst	2 or 5°C	*	Hysteresis of dT1-Sol		*	*	*	*	*	*	*
6	dT2-Kot	3÷15°C	*	Temperature difference supplementary heater / tank					*	*		*
6a	dT2-hst	2 or 5°C	*	Hysteresis of dT2-Kot					*	*		*
7	MinTank	5÷75°C	*	Minimal tank t°C maintained by El. heater	*	*	*	*	*		*	*
8	CH Pump	5÷75°C	*	Suplimentary source t°C to start CH pump						*		
9	MaxTank	10÷95°C	*	Maximal t°C in tank	*	*	*	*	*	*	*	*
10	Min Sol	5÷80°C	*	Temperature in solar source to enable solar pump			*	*	*	*	*	*
10a	Min Sol -hst	2 or 5°C	*	Hysteresis of Min Sol			*	*	*	*	*	*
11	DefrSol	-40÷10°C	*	Defrost t°C of solar (to starts solar pump)			*	*	*	*	*	*
12	MinKot	5÷90°C	*	Minimal t°C of supplementary heating to enable DHW valve/pump				*	*	*		
13	TankA/B	5÷90°C	*	Tank switching t°C Main/Storage or (coil 1 / 2)				*				
14	PumpSec	2÷128sec	*	Pump operation hold time			*	*	*	*	*	*
15	Act Sol	0÷240min	*	Delay of electric heater activation			*	*	*		*	*
16	AutCool	Y / N	*	Automatic cooling of tank to „GoodTnk" t°c			*	*	*	*	*	*
17	Passwrd			Password for majour parameter access	*	*	*	*	*	*	*	*
18	Schm	0 ÷ 5	*	Application select scheme	0	1	2	3	4	5	6	7
19	Lt./Min	0.0÷5.0	*	Expected flow of solar pump (for statistics purpouse)			*	*	*	*	*	*
20	dTLoss	0÷10°C	*	Expected t°C losses of trace (for statistics purpouse)			*	*	*	*	*	*
21	Pump%Lo	25÷100%	*	Minimal opperation speed of HF pump		*	*	*	*	*	*	*
22	Pump°cdT	0÷25°C	*	Sets upper t°C margine obove dT1-Sol for HF pump to operate at 100% (speed vs t°c distributuion)		*	*	*	*	*	*	*
23	SolOvrh	N	*	Solar panel overheating counter- can be cleared		*	*	*	*	*	*	*
24	TnkOvrh	N	*	Tank overheating counter - can be cleared	*	*	*	*	*	*	*	*
25	AutoVac	Y / N	*	Automatic activation of "Vacancy" mode	*	*	*	*	*	*	*	*
26	LimTnkA	Y / N		Limiting of Main tank t°C to "GoodTnk", excess energy is transferred to storage tank				*				

MEANS FOR PREVENTION AND PROTECTION:

	Type	Action
1	Anti frost of Solar	Forced circulation of solar pump
2	Overheat of solar	Forced circulation of solar pump
3	Thermal shock of solar	"Slow" solar pump activation
4	Thermal shock of pipeline	"Slow" solar pump activation
5	Anti frost of pipeline	Trace heating/ Forced circulation of solar pump
6	Tank overheat	"Vacancy" mode
		Operation with "maximal thermal losses"
		Auto cooling to "TBGood"
		*Heat transfer to supplementary heating system
		*Activation of emergency drainig valve
7	Pumps blockage	Forced activation on certain period of inactivity
8	Current time lost (time not being set after power failure with longer duration)	Blinking display

* Available only for certain operational schemes

OTHERS:

„**Vacancy**" mode - forced cooling of tank (during night time) to have full heat storage for next day.	
Selectable hysteresis 2 or 5 ºC	Fault notification - entire screen blinking
Displays sensor failure message: „no" – no sensor; "sc" – sensor short circuited	
Displays state of R1, R2 and R3	Manual activation/test of pumps
Important parameter change is password protected	
Automatical switching to "Vacancy" mode if unit is left unattended and possible tank overheating is sensed	
PWM output for HF pump speed control ; PWM – 1kHz	

TECHNICAL DATA

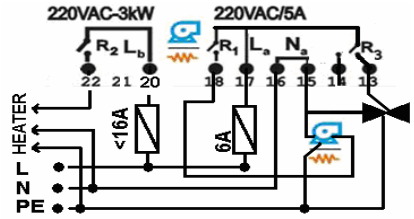
Power supply: 230V±10% /50Hz. ≤ 2VA
Enviroment: -5T45, RH80%
Storage and transportation-20/+60 ° C
Sensors: durability 200 ºC
Measurment and display: -40ºC÷150 ºC;
Accuracy ±1ºC in range (-5ºC ÷ +100 ºC);
±4ºC not in range
Real time clock authonomy up to 2h

Instalation on DIN rail 35mm; to be incorporated
Overall dimentions 68x85x58 mm.
Protection casing IP20
Outputs:
-Relay R1(SPST)- 230V - 5A or 180W/AC3 (motor)
-Relay R2(SPDT)- 230V -16A or 1500W/AC3 (motor)
-Relay R3(SPDT)- 230V - 5A or 180W/AC3 (motor)

MAIN CHARACTERISTICS:

1. Supplies directly power for electrical heater (up to3kW) and two circulation pumps / trace heater or directional valve.
2. Reads three temperatures.
3. Build in conductivity sensor - terminals 3 and 4 – (TS3 not used) for water level monitor and filling
4. Fully programmable by 29 parameters
5. Fast and direct selection of heater operation mode by separate button among „Auto" /On./ Off./Vacancy
6. Build in real time clock with programmable time zone for additional electric heater activation.
7. Relay outputs 3 (separate) for:
   - R1 n.o. SPST, supplies phase for pump/trace heating (HFпомпа)
   - R2 n.o./n.c SPDT, voltage free contact for electric heater
   - R3 n.o./n.c SPDT, supplies phase for pump/direction valves
8. Backup power supply for real time clock
9. Alphanumeric LCD display 8x2 rows.
10. Navigation – 3 push buttons. One button for elecric heater activation
11. Statistics (solar energy accumulated, alarm events)
12. Diagnostic information for sensor failure.
13. A set of functional means for independatnt action at critical events.

WIRING DIAGRAM



Attention!
Power supply should be applied via fuses:
- **La – Circuit Breaker max 6A for trm. 17**
- **Lb - Circuit Breaker max 20A for trm. 20**
- **If UPS is used, tem. 17/16 should be supplied by UPS while trm.20 and heater "N" should be connected before UPS (directly to mains).**

Attention!: Junction for heater's neutral "N" should be made on external terminal block (not provided)!
All conections to PE should be made to external terminal block (not provided)**!**

- Power supply 230V AC – (internal and R1) – #17 (Live "La"); #16 („N");
- R1: Pump/trace heating – #18 (switches Live); #15 („N"); – 5A max.
- R2: Electric heater – #20 (separate Live "Lb"); #22 output – 16A max.
- R3: Pump2/Valve(Open/Close) – (switches Live) #13 (n.o); #14 (n.c.) – 5A max.

Terminals 3 and 4 – level sensor input (measures conductivity of water)
Terminals 1 and 2 – PWM output for HF pumps

Instalation and commusioning

Attention!
Danger of electric shock!
All activities involving installation and commissioning should be done while electric power is off

This device is dedicated to be incorporated in apartment electrical box with size of 4 or more poles or a cabinet and can be attached on 35mm DIN rail.

Attention!
Keep all protections and comutation devices required by tank manufacturer to operate the electric heater (circuit breakers, temperature regulator, safety temperature switch)!
DTSF3+ is not safety device as by means of *EN60730-1-Annex H*

USAGE

Front pannel
Description
- LCD display, alphanumeric type with two rows and back light [5]
- 3x push buttons: [1] for Down **„Dn↓”,** [2] for Up **„Up↑”**, to select „**Set**” [3]
- Push button for selection of operation mode (of heater): [4] „-^v^v-”
- Indicaton of alarm event – blinking of backlight (if a sensor is defective or current time is lost).

Usage of buttons:

- buttons [1]**„Dn-↓”**/ [2] **„Up- ↑”**: navigates among list of parameter screens previous/next; increase / decrease selected value wih 1;
- button [3] „**Set**” toggles buttons [1] and [2] usage, to select parameters or change value of selected parameter
- button [4] „-^v^v-” – selects the operational mode of the unit (heater) AUTO/ ON/ OFF/ VACANCY

Available windows and usage

Window #1 - Main window
Displays temperature reading of sensors and operational mode of outputs.

```
S:XX°cAUT
B:YY°cA:ZZ
```

- **Row 1**: temperature reading of solar sensor ”**XX**” / % of HF pump (if password is set), Operational mode of the unit (electric heater): AUTO/OFF/ON/VAC.
Each one second the mode and state of the R2 output’s state is displayed alternatively  if R2 is switched on (activated) and  if R2 is switched off (not active).

Modes:
- “AUTO” – auto mode, El. heater operates according to preset temperature setpoint and selected time zones.
- “OFF” – El. heater is de-activated, automatically switches on as frost protection of tank if temperature is <10ºC
- “ON” – El. heater is automatically activated/de-activated to continiouslly keep TBGOOD temperature in tank, it is de-activated if temperature is >TBGOOD.
- “VAK” - vacancy mode of the system, the El. Heater is shut off (can be activated for defrost of tank). Cools down the tank by tranfering back the available heat energy from tank to solar (if possible).

Mode of R1: if active – (solar pump), the symbol „S” blinks

Row 2: reading ”**YY**” - temperature of main tank, reading “ZZ” – temperature of storage tank/boiler
Mode of R2: if active – (valve/pump), the symbol „A” blinks
- If selected scheme of unit is #0 - „**TSyphTrH** ” on Row2 currnet time as HH:MM:SS is displayed while during defrost “**DeIce**” is displayed.
- If level sensor is “open” or terminals 9 & 10 are open, also displays „**Fill-up**”
- If selected scheme of unit is #1 -„**TSyphReC**” on Row2 currnet time as HH:MM:SS is displayed while if re-circulation is activated - displays „**ReCirc.**”.
- If selected scheme of unit is #7 -„**dT.EL.T1+R**” after ZZ :  -level is reached  - low level

***** If there is no sensor „**no**” is displayed, if sensor is shor circuit or resistance is <600Ohm “**sc**” is displayed.

Manual activation of outputs:

R1 – solar pump	**R3 – valve/pump**
Press and hold [2]**„Up- ↑”** button.	
Press and hold [1] **„Dn-↓”** button	Press and hold [3] **„Set”** button

***** As long as the buttons are keeped pressed, the output is activated.

Parameter Visualization:

```
ParamXX 1
 15°C   3
```

- row 1 - name of the selected parameter "ParamXX" and screen number (of tenths-"1 .. 2")
- row 2 - value of the selected parameter and screen number (of small numbers "3")

Change of parameters:

```
ParamXX 1
[15°C   ]
```

Navigate to the required parameter "**ParamXX**" using the buttons [1] **„Dn-↓”**and [2]**„Up- ↑”**
Press the [3] "Set" button and the selected value is displayed in square brackets “**[**“ „**]**”.
Adjust the value using the buttons [1] **„Dn-↓”**и [2]**„Up- ↑”**
Confirm with the button [3] “**Set**”

* To correct the basic parameters, it is necessary first to enter a correct password in the "Password" field!

LEVEL CONTROL– applicable in schmemes 0 and 7, for systems with valve for automatic filling up of fluid:

Connect terminal no.3 tank’s body, terminal no.4 connect to the electrode. The electrode must be electrically insulated from tanks body and needs to be partially submerged in the water.
If the reguired level of the fluid is reached (the conductivity between tank’s boady and electrode is enough - the electrode is partially submerged) the filling is stopped (R3=Off)
If the level is decreased (there is no water between the electrode and tank body - no conductivity is senced) the filling process is activated (R3=ON), if scheme 0 is used, the text “Fill-up” is displayed**,** if scheme 7 is used, the icons  and  are blinking alternatively.

Забележка: 1. If the level sensor function is used, the sensor TS3 can not be used and have to be left free.
2. If the level sensor is not necessary, place bridge connection on **TS3**

Connection to HF pumps:

Connect pump’s power supply to terminals no.18 and no.15. Connect pump speed input to terminals no.1 and no.2. Initially the pump is activated on 100% for 10 sec. and this time the preset speed by parameter Pump%Lo and the remaining temperature related conditions are followed.

LOGICS OF OPERATION

Scheme 0:

Output	General Condition	Additional condition	Device’s Mode
R1	TS1< 8’C		All modes
R2	TS2< MinTank		Auto
R2	TS2< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2< GoodTnk		On
R2	TS2< 5’C		Off/Vakc
R3	Level sensor	TS2<70’C	All modes

Scheme 1:

R1	TS2>TS1+dTSol	TS1<Max Tank	All modes
R1	TS3<5’C	TS2>10’C	All modes
R2	TS2< MinTank		Auto
R2	TS2< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2< GoodTnk		On
R2	TS2< 5’C		Off/Vakc
R3	TS2> MaxTank		All modes

Scheme 2:

R1	TS1>TS2+dTSol	TS2<Max Tank; TS3<Max Tank; TS1> MinSol	All modes
R1	TS1< DefrSol	TS2>10’C	All modes
R2	TS2/TS3< MinTank	R1 was not activated longer than ActSolar value	Auto
R2	TS2/TS3< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2/TS3< GoodTnk		On
R2	TS2/TS3< 5’C		Off/Vakc
R3	TS2> MaxTank		All modes

Scheme 2a:

R1	TS1>TS3+dTSol	TS3<Max Tank; TS2<Max Tank; TS1> MinSol	All modes
R1	TS1< DefrSol	TS3>10’C	All modes
R2	TS2< MinTank	R1 was not activated longer than ActSolar value	Auto
R2	TS2< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2< GoodTnk		On
R2	TS2< 5’C		Off/Vakc
R3	TS2> MaxTank		All modes

Scheme 3; 3a:

R1	TS1>TS2+dTSol	TS2< TankA/B; TS1> MinSol	All modes
R1	TS1< DefrSol	TS2>10’C	All modes
R1	TS1>TS3+dTSol	TS2> TankA/B; TS1> MinSol; TS3< Max Tank	All modes
R2	TS2< MinTank	R1 was not activated longer than ActSolar value	Auto
R2	TS2< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2< GoodTnk		On
R2	TS2< 5’C		Off/Vakc
R3	TS2> TankA/B	TS2> TankA/B; TS3> TankA/B; TS3<TS2 TS2 < GoodTnk & LimTnkB=ON	All modes

Scheme 4:

R1	TS1>TS2+dTSol	TS2< Max Tank; TS1> MinSol	All modes
R1	TS1< DefrSol	TS2>10’C	All modes
R2	TS2< MinTank	R1 was not activated longer than ActSolar value	Auto
R2	TS2< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2< GoodTnk		On
R2	TS2< 5’C		Off/Vakc
R3	TS3> TS2+dTKot	TS3> MinKot; TS2< GoodTnk	All modes
R3	TS2> Max Tank	TS3<90’C	All modes

Scheme 5:

R1	TS1>TS2+dTSol	TS2< Max Tank; TS1> MinSol	All modes
R1	TS1< DefrSol	TS2>10’C	All modes
R2	TS3> CH Pump		All modes
R2	TS2> Max Tank	TS3<90’C	All modes
R3	TS3> TS2+dTKot	TS3> MinKot; TS2< GoodTnk	All modes
R3	TS2> Max Tank	TS3<90’C	All modes

Scheme 6:

R1	TS1>TS2+dTSol	TS2< Max Tank; TS1> MinSol	All modes
R1	TS1< DefrSol	TS2>10’C	All modes
R2	TS2 или TS3 < MinTank	R1 was not activated longer than ActSolar value	Auto
R2	TS2&TS3< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2&TS3< GoodTnk		On
R2	TS2&TS3< 5’C		Off/Vakc
R3	TS3> TS2+dTKot	TS2> Max Tank; TS1>MinSol	All modes
R3	TS1< DefrSol	TS3>10’C	All modes

Scheme 7:

R1	TS1>TS3+dTSol	TS2<Max Tank; TS1> MinSol	All modes
R1	TS1< DefrSol	TS2>10’C	All modes
R2	TS2< MinTank	R1 was not activated longer than ActSolar value	Auto
R2	TS2< GoodTnk	During preset time interval (time zone)	Auto
R2	TS2< GoodTnk		On
R2	TS2< 5’C		Off/Vakc
R3	Level sensor	TS2<70’C	All modes

WARRANTY THERMS AND CONDITIONS:

The warranty period of the product is 24 months from the day of sale or installation by the installer but no more than 30 months from the date of manufacture. The warranty covers defects attributable to the manufacturer (manufacturing defects or defective materials). They are not subject to warranty defects in the product or damage to other equipment as a result of improper or unskilled installation, improper workflow selection and / or adjustment, unauthorized change of the product, natural disasters, non-standard power supply, improper storage or transportation.

Warranty card

Please completely fill this card for valid guarantee

Manufacturer: Proxel Engineering Ltd **Type: Temperature controller DTSF 3+**

Plovdiv, Bulgaria, office@proxel-bg.com

Serial number: **Data of manufacture:**

....

Seller/Installer:.....

Address: .....

Date of (sale) Instalation: .....

Installer/ seller :.....

(name and signature)

Instalation is made by ☐ **Installer** ☐ **Client**

(please mark the true one)

CE

2004/108/EC
2006/95/EC