



## Instructions for installation and operation


### System controller for thermal solar systems Suntana

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## 1 Security instructions and restriction of liability

### 1.1 Sign for security instructions

 Security instructions for personal safety are marked with this sign and are printed in bold letters.

Instructions that refer to the functioning safety of the system are also printed in bold letters.

### 1.2 General safety instructions

For your own safety please note the following for installation:

 Please see that fire safety cable systems and similar things are not impaired!

The controller must not be installed and used in moist areas (e. g. bathrooms) or in rooms in which flammable gas mixtures (by gas bottles, paint, solvents etc.) are likely to occur!

Do not store any of the above and similar things in rooms where the solar controller is installed!

The controller must not be installed on a conductive base!

Use well-isolated tools only!

Do not use technical equipment that is defective or broken!

The construction safety measures can deteriorate if the controller is used in a way other than the one determined by the manufacturer.

The preset signs and marks must not be changed, removed or made illegible.

All operations must be conducted in accordance with the national electricity regulations and local rules!

For installation in foreign countries please see your corresponding institutions for information on regulations and safety measures.

Keep children away from electronics!

### 1.3 Regarding these instructions

These operating instructions describe the functioning and installation of a controller for thermal solar systems for feeding solar heat into a water or buffer store.

For the installation of the other components such as the solar collectors, pump group and the storage basins please follow the corresponding installation instructions of the manufacturer.

Before starting operation read the paragraph "installation and operation" no. 5 and make sure that all measurements have been prepared before.

Only begin with the installation when you have understood this instruction and proceed in sequence!

These instructions must be handed out to all persons that work with this system.

These instructions are part of the system controller and must be handed over in case the controller is sold.

### 1.4 Exclusion of liability

The manufacturer cannot monitor compliance with this manual as well as the conditions and methods during the installation, operation, usage and maintenance of the inverter. Improper installation of the system may result in damage to property and, as a result, in bodily injury.

Therefore, we assume no responsibility and liability for loss, damage or costs which result or are in any way related to incorrect installation, improper operation and incorrect use and maintenance.

Similarly, we assume no responsibility for patent right or other right infringements of third parties caused by usage of this inverter.

The manufacturer reserves the right to make changes to the product, technical data or assembly and operating instructions without prior notice.

As soon as it becomes evident that safe operation is no longer possible (e.g. if there is visible damage), a qualified personnel remove the device from the grid and the photovoltaic generator immediately.

#### NOTE:

Opening the device – connecting case excluded – as well as other use than determined by the manufacturer leads to a loss of warranty.

## 2 Operating the system controller

By using a thermal solar system you have – with this controller – the possibility to design your own personal solar system. This is guaranteed by various possibilities to adjust parameters and functions.

How to change and watch readings, parameters and functions as follows. Illustrations (menu) show and clarify the potential selections and give an overview of the menu-driven system controller.

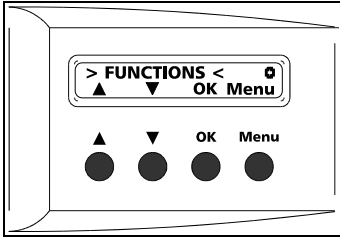


Illustration 1: Control panel and LCD display

On delivery the controller is equipped with preset standard configurations (see page 18) that only guarantee immediate use of the controller after proper installation. Set points and functions are adjusted by using the 4 control buttons (illustration 1). System parameters, readings, operating status of the solar circulation pump can be monitored via a two line LCD display.

### 2.1 Standard menu with display "preset configurations"

Here we differ between main menu "READINGS" (paragraph 2.3) and "ADJUSTMENTS" (paragraph 2.4) and sub menus. Usually you will find yourself in the main menu "READINGS". All current and stored readings can be fetched. The second main menu "ADJUSTMENTS" is only for changing parameters and functions. Moreover, the connected circulation pumps can be used manually for operation start or maintenance. If you are forced (due to wrong configurations) to reset all parameters and functions to the original preset configuration you can do so in the menu "initialisation preset configuration" (paragraph 2.4 and 5). In these operating instructions menus that are only accessible after fetching the main menu are called submenus (e. g. parameter, functions, manual operation).

**Basically the following is valid:**

Selecting a menu window is done via buttons ▲ (UP) or ▼ (DOWN). By using the OK button you can fetch a corresponding sub-menu (see second line LCD display - buttons in operation). By pressing MENU you get back into a higher menu.

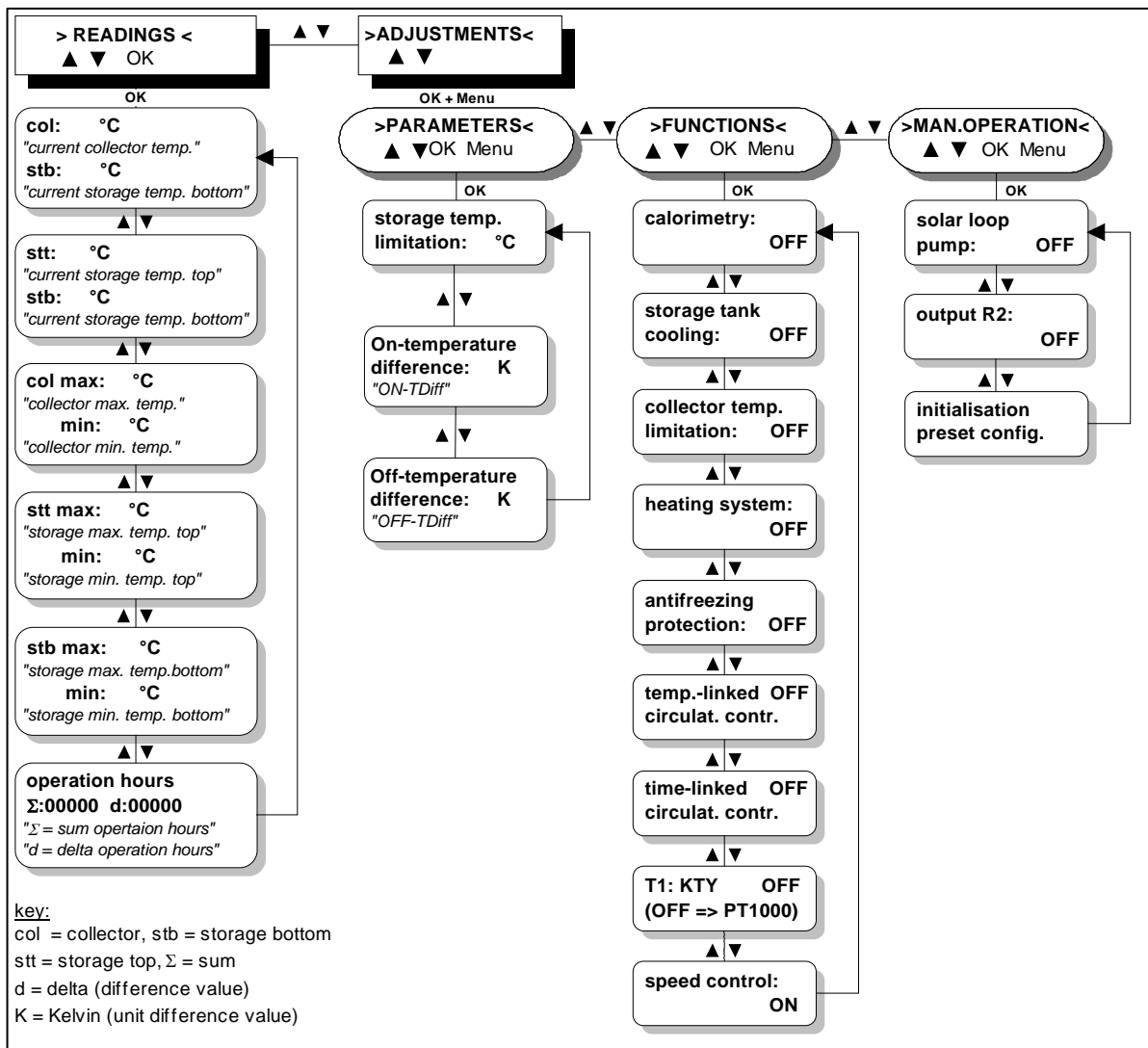
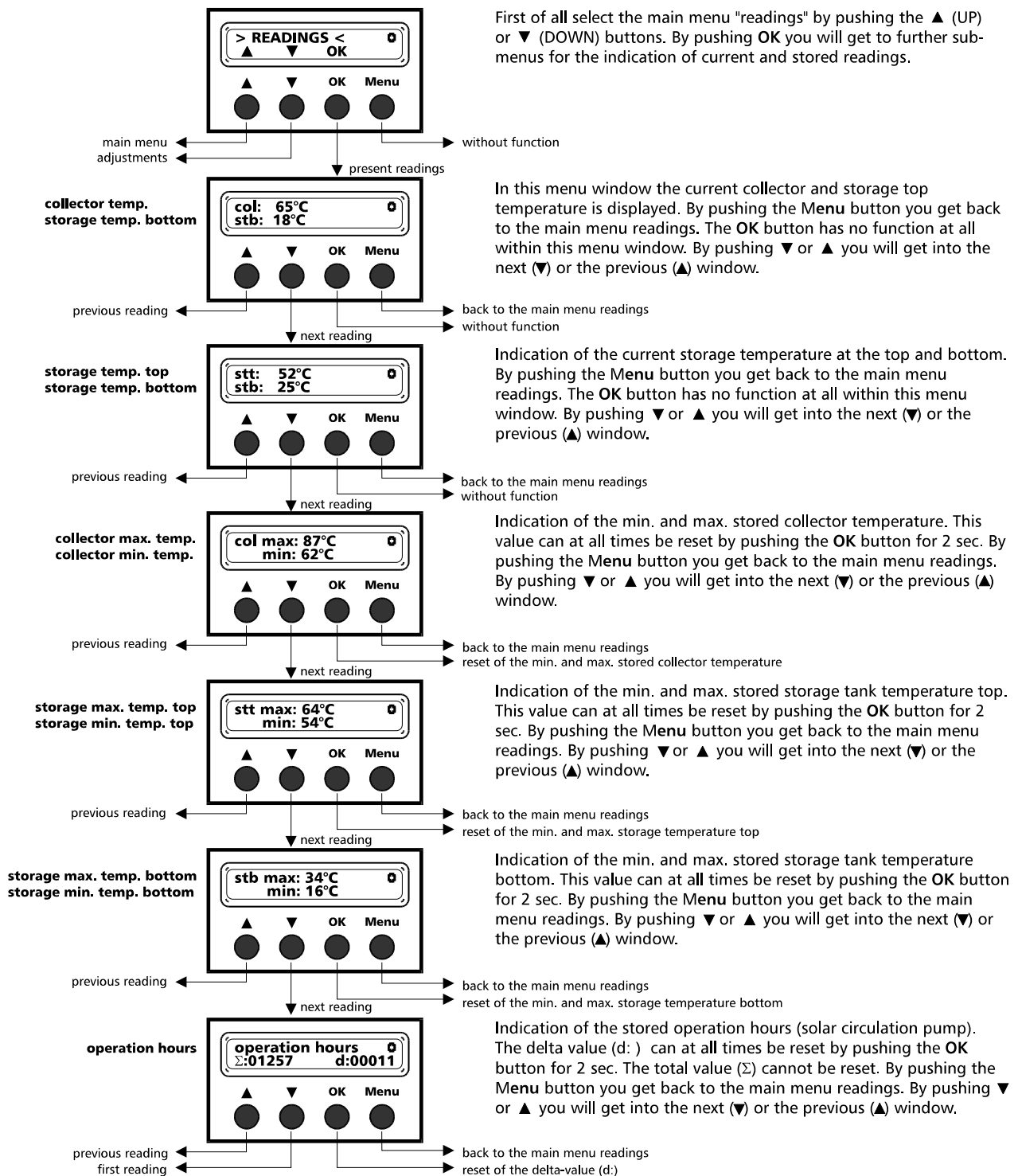


illustration 2: Diagram of different menu

## 2.2 Example – illustration on menu-driven operation

With this example you can see how to fetch current and stored readings within the main menu "READINGS".



## 2.3 Menu "READINGS"

By pushing the OK button within the menu "READINGS" you can fetch the various temperatures of the sensors installed. Moreover, the controller stores minimum and maximum temperature values of the collector, storage tank top and storage tank bottom. These values can be reset just as the solar circulation pump's operating hours over a certain period of time or the measured heat quantity (using the function calorimetry). Please note that only the delta values at the second job will be deleted. (d hours; greek delta = difference). The total value (greek  $\Sigma$  = total value) cannot be lost and will be summed up over the complete lifetime of the controller. Resetting the difference value „d“ can be achieved by pushing the OK button for 2 sec.

## 2.4 Menu "ADJUSTMENTS"

The submenu of the configured values are protected against unauthorized or unintentional use. If you intend to change them, press OK and MENU for 2 sec **at the same time**. Submenus like parameters, functions or manual operation can be selected via the OK button. By pushing the MENU button you get back to a higher menu.

### Changing the "PARAMETERS" values:

1. select parameter with button ▲ ▼
2. press OK for 2 sec
3. change the value with button ▲ ▼
4. leave parameter menu by pressing OK for 2 sec

### Changing the "FUNCTIONS" configuration:

1. select function with button ▲ ▼
2. press OK for 2 sec

### "MANUAL OPERATION" manual switch of output R1

1. select output R1 or R2 with button ▲ ▼
2. press OK for 2 sec

### Initialization of all parameters and functions to the preset manufactured status:

1. select menu "initialisation preset configuration"
2. press OK for 2 sec

### **Attention!**

**Readings and parameters will only be displayed when the corresponding function has actually been selected within the menu "FUNCTIONS".**

Example: Selecting the function calorimetry

It is only now that the temperatures T4, T5 and the measured calorimetry appears in the menu READINGS. Moreover, within the menu Parameter you may change the volume flow dispenser's pulse valency configuration and the proportion of mixture of the heat transfer medium.

In the appendix you will find diagrams that give an overview on potential additional configuration parameters and/or reading indications after selecting an additional controller function.

### **Note:**

**All functions are listed in detail in paragraph 3 of these operating instructions. In order to exclude operation faults you should be sure to have understood the connection and the usage of the corresponding function BEFORE changing it.**

## 3 System controller for thermal solar systems with monitoring functions

### 3.1 Overall function of the system controller in the solar system

The controller is a temperature difference controller driven by microprocessors and is used for monitoring and controlling thermal solar systems and, if wanted, an accessory heating system or circulation pump.

The microprocessor takes all important readings, calculates the control function and controls the servo components of the system. Beside controlling the system the controller also undertakes important monitoring and safety functions.

The controller has 5 analog inputs for measuring the temperature, a digital impuls input point and 2 outputs for triggering circulation pumps. For this purpose we have integrated a timer with 3 possible times.

The controller can be used in connection with various system concepts. A collector temp. sensor (T1), a storage temp. sensor (T2) in the bottom storage area for the limitation of the max. stored temperature and a storage sensor in the top storage area (T3) for additional temperature indication or for triggering a heat system pump, are standard system components. For triggering a circulation pump you can - in addition to the adjustable time intervals - also utilize the temperature sensor (paragraph 3.2.7).

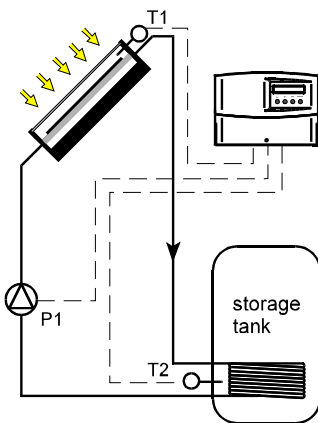
Apart from this the controller allows for registering the calorimetry fed into the service water storage basin by an additional volume flow dispenser and the temperatures in the solar forward and backward movement. The volume flow dispenser is a traditional water meter with pulse output point. It is important that the volume flow dispenser resists the higher temperatures within the solar circuit. This is the reason why you should not use cold water but warm or hot water meters sold by authorized dealers.

## 3.2 Regulation function

### Function overview

- "ON" and "OFF function" of the temp. difference regulation (menu "**On-temperature difference**" = ON-Tdiff; menu "**Off-temperature difference**" = OFF-TDiff)
- menu "**speed control**" of the solar circulation pump
- "**storage tank temperature limitation**" (menu "*storage temp. limitation*")
- "**collector temperature limitation**" (menu "*collector temp. limitation*")
- Thermostat functions (due to software lock only one function to be selected)
  - menu "**storage tank cooling**"
  - temperature and time-linked "**heating system**" (menu "*heating system*")
  - temperature and time-linked "**circulation control**" (menu "*temp.-linked circulat. contr.*", menu "*time-linked circulat. contr.*")
- menu "**antifreezing protection**"
- "**Manual operation**" of the switch outputs (menu "*MAN.OPERATION*" )

### 3.2.1 "On-temperature difference" and "Off-temperature difference" function of the temperature difference regulation (Appendix 10, illustration A)



The solar circulation pump P1 is switched on by a temp. difference function. As soon as the collector temp T1 is a certain temperature difference (to be adjusted within the menu parameter "On-temperature difference" higher than the sensor's "storage tank bottom" T2 temp. the circulation pump will be switched on.

In order to avoid a permanent ON and OFF of the solar circulation pump it only switches off automatically after falling below an adjusted temperature difference (to be configured within the menu parameter "Off-temperature difference").

#### Example:

The parameter value of the switch-on temperature difference is 8 Celvin, the parameter value of the switch-off temp. is 4 Celvin. On the point of measurement at the bottom of the storage tank (T2) 20°C are registered, i. e. in this case the solar circulation pump will be switched on at a collector temp. of 28°C and will be switched off at a collector temp of 24°C.

#### IMPORTANT:

The preset values of the switch-on (8 Celvin) and switch-off (4 Celvin) temperature difference have been proven standard configuration for years. Changing these values is thus only necessary in exceptionate situations, e. g. long pipeline distances. Switch-on and switch-off temperature differences are interlocked. Both values can be adjusted to a maximum of 2 Celvin against each other so that misconfiguration are avoided.

### 3.2.2 "speed control" of the solar circulation pump (Appendix 10, Illustration B)

The controller has an electronic relay for the regulation of a circulation pump's speed (P1) within the solar circuit. By regulation this speed the temperature difference between collector and storage tank is to be kept on a constant level. When using solar circulation pumps with changeable cycle speed stages the highest stage (in most cases stage 3) should be adjusted. This adjustment is done directly by moving the pump speed switch. The speed regulation automatically adjusts the necessary performance.

The regulating performance of the speed control corresponds to a "PI" controller (proportional integral controller). The "P" part serves for a fast stabilisation of the regulation process and "I" part serves for a fast achievement of the preset set point. This controller is – due to its precise adjustment – extraordinarily rugged and it is not necessary for the user to conduct any detailed configuration.

Nevertheless, you have the possibility to switch off the speed control within the menu functions "speed control". Then the controller works just as a traditional temp. difference controller and takes care that the circulation pump delivers a constant volume flow (if the switch-on conditions are fulfilled).

### 3.2.3 Storage tank temperature limitation ("*storage temp. limitation*") (Appendix 10, illustration C)

In order to avoid overheated service water the solar circulation pump P1 will be switched off when reaching a maximum temp. This temperature can be adjusted within a range of 20 to 95°C (within the menu parameter "storage temp. limitation") and reacts on the temperature sensor T2 at the bottom of the service water tank. When the adjusted temp. is reached the pump switches off automatically and only switches on again when the configured storing temp. limitation is below the fixed preset hysteresis of 4 Celvin. Due to extremely high solar irradiation and the switched-off solar pump the solar liquid in the collector may also evaporate and thus reach temperatures of over 130°C. So regardless of reduced storing temperatures the solar circulation pump cannot be switched on automatically since there might be vapour within the collector circuit. In this case the pump only switches on automatically after the collector has cooled down to less than 127°C and - at the same time - the temp. T2 has decreased by a minimum of 4 Celvin below the preset storing temp. limitation.

### 3.2.4 Collector temperature limitation ("*collector temp. limitation*") (Appendix 10, Illustration B)

If no warm water is taken out from the tank regardless of high solar irradiation over a longer period of time the temperatures in the solar circuit automatically rise. The collector's cooling function is now "trying" to avoid the heat transfer medium to evaporate into the collector surrounding. The losses within the collector circuit are deliberately increased by warming up the heat transfer medium through a reduction of the pump speed. Logically the collector is operated with a lower degree of effectiveness.

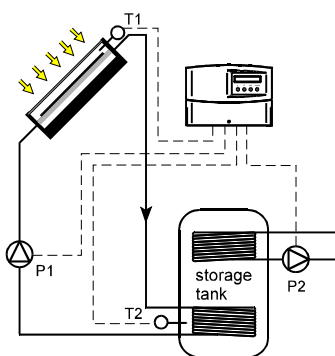
**Attention:** This function has no influence on the preset storing temp. as described in paragraph 3.2.3. The function storage temp. limitation still has priority and switches off the solar circulation pump when reaching the preset max. temp.

#### Functioning:

If the temp. on the sensor storage low T2 reaches below 7 Celvin of the preset storage temp. limitation (paragraph 3.2.3) the solar circulation pump is automatically switched off. As there is no heat transfer of the solar circuit via the service water tank the collector temp. inevitably rises. After exceeding the preset temperature with the description collector temp. limitation (menu parameter), to be measured at the collector temp. sensor T1, the solar circulation pump is again switched on and is operated with an adjusted rpm value. When the temp. at the sensor T1 has fallen 10 Celvin against the preset value of the collector temp. limitation (menu parameter) the solar circulation pump is switched off again. If the collector temp. is now rising this procedure is repeated by the regulation again and again until the storing temp. limitation materializes or the temp. in the collector has risen to 130°C. With temperatures higher than 130° in the collector it is most likely that the heat transfer medium evaporates. This is the reason why the regulation secures a switch-off of the solar circulation pump.

Without carrying out the described controller function of the collector temp. limitation, regular operation is again possible after cooling down the collector temp. to less than 127°C and – at the same time – lowering the temp. T2 by a value that is at least 10 Celvin below the preset storing temp.

### 3.2.5 Thermostat function storage cooling ("*storage tank cooling*") (Appendix 10, illustration E)



The thermostat function storage tank cooling allows for cooling down the service warm water tank at high solar irradiation. Excess energy can be released via the heating tank or another warm water storage basin.

If the temperature on T2 rises by a value that is below 3 Celvin of the preset storing temp. limitation the relay is connected to output R2 (max. performance 800 W) and a circulation pump P2. After falling below a fixed temperature difference of 3 Celvin the pump switches off, the solar circuit pump P1 remains in operation and only switches off when reaching the adjustable storing temp. limitation.

If you cannot select the desired thermostat function another one is already activated. For safety reasons the thermostat functions storage tank cooling, heating system and circulation have been interlocked on software basis. So please switch off one thermostat function first and then switch on another one.

#### Note:

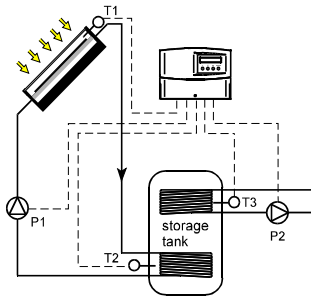
Please note that a circulation pump at R2 can either be triggered with 230 Volt [optional 115 V] (preset terminal board must be installed) or indirectly via a tank control and the power-free output R2 (preset terminal must be removed!).

#### Also note:

The controller offers the thermostat function storage tank cooling. Please follow the relevant electronic norms for the proper use of the system.



### 3.2.6 Thermostat function heating system ("*heating system*") (Appendix 10, illustration F)



The thermostat function heating system allows for warming up a warm water service tank by a heating tank. If an adjustable temp. (menu parameter: "*heating system ON*") on sensor T3 falls below 3 adjustable time windows (menu parameter: "*indexing time 1: ...*") the circulation pump P2 at output R2 is activated. The circulation pump remains in operation as long as an adjustable switch-off temp. is reached (menu parameter: "*heating system OFF*") or as long as the time window in question is exceeded.

Preset configurations are "*heating system ON: 45°C*" and "*heating system OFF: 52°C*". For safety reasons ON and OFF values are interlocked. Both values can be adjusted against each other up to a maximum difference of 3 Celvin .

The indexing times of the integrated automatic time switch are preset to "indexing time 1: 06.00 to 09.00 h", "indexing time 2: 12:00 to 14:00 h" and "indexing time 3: 18:00 to 21:00 h". Winter and summer daylight saving time are not preset configurations and must be adjusted manually, if needed.

Indexing times can be changed as follows:

Select indexing time by pushing the buttons ▲ ▼. Press one of them for 2 sec and change the time by pressing ▲ ▼. Finally press OK for 2 sec to store this configuration.

If you cannot select the desired thermostat function another one is already activated.

For safety reasons the thermostat functions storage cooling, heat coasting and circulation have been interlocked on software basis. So please switch off one thermostat function first and then switch on another one.

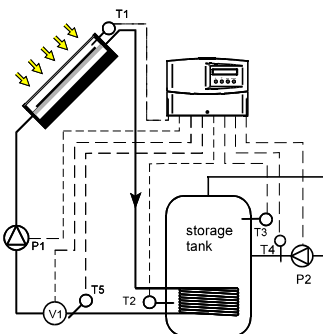
#### Note:

Please note that a circulation pump can be triggered with either 230 V [optional 115 V] (e. g. old heating tanks) directly (preset terminal board must be installed) or indirectly via a separate tank control (e. g. gas condensing boiler) or the power-free output R2 (preset terminal board must be removed, or else tank control may be destroyed).

#### Note:

The controller offers the thermostat function storage cooling. Please follow the relevant VDE norms for the proper use of the system.

### 3.2.7 Thermostat functions circulation control



The controller offers the possibility to trigger a circulation pump via output R2. This pump can be triggered temperature-linked by an additional temperature sensor at T4 or time-linked by certain time windows. Both functions may be combined at any time. The combination of the following circulation functions allows for reducing circulation to a minimum. This saves energy for operating the pump, reduces circulation losses in the pipelines and improves warmth bedding in the service water tank. Circulation losses in detached houses may easily amount to 10 to 30 % of the energy that is need for warm water supply.

If you cannot select the desired thermostat function another one is already activated. For safety reasons the thermostat functions storage cooling, heat coasting and circulation have been interlocked on software basis. So please switch off one thermostat function first and then switch on another one.

#### A) temperature-linked circulation control ("*temp.-linked circulat. contr.*") (Appendix 10, illustration G):

This function needs an additional temperature sensor T4 at the return of the circulation pipeline. After falling below the adjustable value (menu parameter: "*circulation ON*") the circulation pump switches on and remains in operation until the switch-off value - also adjustable - (menu parameter: "*circulation OFF*") is reached. In order to avoid wrong measurements due to heat transfer of the pipeline you should provide for a minimum of 1.50m to the storage basin when you install the sensor.

**Note:** If you intend to use a calorimeter in addition to this function (paragraph 3.3.2) you can only use it "with restrictions". As in this case the sensor T4 is used as circulation sensor the controller automatically registers the heat quantity from temperatures T1 and T4 and the external volume flow measuring device's discharge.

#### B) Time-linked circulation control ("*time-linked circulat. contr.*") (Appendix 10, illustration H)

Without an additional temp. sensor a circulation pump may be operated via three different time windows. During the adjusted time window the pump will be in operation for the corresponding period of time. First of all you have to chose a time within the menu parameter. By selecting one of the indexing times 1 to 3 certain circulation cycles may be selected manually.

Indexing times can be changed as follows:

Select indexing time by pushing the buttons ▲ ▼. Press one of them for 2 sec and change the time by pressing ▲ ▼. Finally press OK for 2 sec to store this configuration.

### C) temperature-linked circulation control and time-linked circulation control

The combination of the above functions provides for optimally triggering a circulation pump with an extremely reduced running time.

Here the circulation pump is only switched on during a given time window and a parallel temperature undershot. It immediately switches off when a certain temperature is reached.

#### 3.2.8 "antifreezing protection" (Appendix 10, illustration I)

The heat transfer medium is usually a mixture of water and a special non-toxic anti-freezing compound. Depending on the mixture relations of the solar liquid with water anti-freezing temperatures of a minimum of  $-20^{\circ}\text{C}$  are realized.

In southern European countries and in countries where the solar circuit is empty in cold periods (vacation and weekend houses, camping facilities) water can also be used as heat transfer medium. In order to achieve a secured anti-freezing protection the collector can be kept "on temp." through the warm storing water. If the anti-freezing temp. is below  $+4^{\circ}\text{C}$  on the sensor T1 the pump P1 switches on. The switch-off hysteresis is preset by the manufacturer and the pump switches off when reaching a T1 temp. of  $+7^{\circ}\text{C}$ .

#### Note:

Please only use this function when you are sure that water has been used as heat transfer medium and so there is the danger of the solar circuit to freeze.

This function enables the operation of a solar system without anti-freezing compound only for particular applications. Technical equipment for security and measurements against freezing should be installed if necessary.

#### 3.2.9 Manual operation of the switch outputs ("solar loop pump" or "output R2") (Appendix 10, illustrations L and M)

For maintenance and repair works the switch outputs R1 (solar loop pump) and R2 can be used manually. After selecting output R1 or R2 within the submenu "MAN.OPERATION" press OK for 2 sec to achieve another switch status. This status remains until the submenu manual operation is left by pushing the menu button.

#### Attention:

Only after leaving the submenu manual operation does the controller switch over to automatic operation and considers current system parameters and configured readings.

So it is inevitable to quit this menu after maintenance and repair works.

### 3.3 Monitoring and control function


#### Function overview

- ♦ operating status solar circulation pump
- ♦ calorimetry
- ♦ operating hours solar circulation pump
- ♦ minimum and maximum temperature storage
- ♦ automatic temp. sensor recognition (PT 1000 or KTY81-210)
- ♦ temp. sensor control and diagnosis of errors
- ♦ excess temp. indication in the case of an all-too high temp. difference

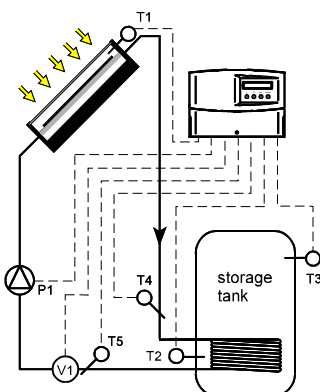
#### 3.3.1 Operating status solar circulation pump

Operating status display for the switch outputs



The LCD display indicates the operating status of the solar circulation pump by showing the sign . The symbol is visible in all menus and only refers to the solar circulation pump. During pump operation the indication symbol changes.

#### 3.3.2 Calorimetry (Appendix 10, illustration J)



The solar energy fed into the service water tank is registered and permanently summed up by a volume measuring unit with pulse output V1 and the temp. difference between solar forward and backward movement (sensors T4 and T5). In addition the user has the possibility to register the heat quantity over any period of time and to reset this value again by pressing OK for 2 sec.

A temperature-linked density and heat capacity are corrected within the microprocessor controller's counter. The cumulated heat quantity is indicated on the LCD display. Various proportion of mixes of anti-freezing compounds and water can be configured via operating menu.

If the thermostat function "temperature-linked circulation control" is selected (paragraph 3.2.7) there is an automatic restriction in measuring the heat quantity by temp. sensors T1 and T5. This is due to the fact that otherwise the temp. sensor

T4 of the solar forward movement is used for circulation control. The function of the calorimetry remains the same, however, slight deviations have to be taken into consideration.

**Note:**

Within the function calorimetry the microcontroller takes into consideration the physical characteristics of the solar liquids TYFOCOR L (propylenglykol) that are frequently used. It registers the proportion of mixture as well as the physical characteristics such as density and heat capacity. At any times it is possible to measure the heat quantity of pure drinking water. For this reason please zeroize the proportion of mixture (menu parameter: "calorimetry: Glykol Vo/%).

### 3.3.3 Operating hours of the solar pump

During the whole lifetime the operating hours of the solar pump are registered and summed up in sequence. In addition the user has the possibility to register operating hours over a certain period of time and to reset this value, which is done by pushing OK for 2 sec.

### 3.3.4 Minimum and Maximum value indication

For control purposes the minimum and maximum value of the collector (sensor T1), storing low (sensor T2) and storing high (sensor T3) are registered and stored. These values can at any time be reset by pushing OK for 2 sec. If T3 is not used, a min. and max. value of  $-55^{\circ}\text{C}$  is stored and indicated.

### 3.3.5 "Self-recognition" of sensor type for registering storing and circulation temp. and calorimetry (Appendix 10, illustration K)

In order to avoid confusion when installing the storage, heat quantity or circulation sensors the regulation automatically recognises if a preset (from the side of the manufacturer) standard temp. sensor type PT1000 or type KTY81-210 has been installed and takes this into account for the regulation and controlling of the system. Generally both sensor types can be used and are automatically recognized by the controller.

**Note:** This function is not valid for the collector sensor since the PT1000 and KTY value of resistance partly overlap and so a faultless self-recognition would not be guaranteed. A PT1000 is planned as a collector sensor but you can change to a KTY sensor within the submenu functions (T1:KTY). When you use this type of sensor you have to push OK for 2 sec until the LCD display indicates "T1:KTY ON".

### 3.3.6 Sensor control

The controller permanently checks if the sensors are working properly (no failure, breakdown or short circuit). If there is an error after having installed the temp. sensor you can see it 10 sec. afterwards in the LCD display, e. g. "short circuit T1". Only after eliminating the error and subsequent acknowledgement by switching one of the four control buttons does the controller set back to standard operation. If the error has not been eliminated 10 sec after pushing the control buttons another error indication appears in the LCD display.

**Note:**

In the case of error those devices and functions that are directly affected by the sensor defect are switched off automatically. The only exception is the manual operation where no system parameters and readings for maintenance and repair works are taken into account.

## 4 Configuration

On delivery the controller is configured in that way that it can be used for most applications without changing the standard configuration. If parameters have been changed by accident they can be reset by using the function "initialisation preset config." (Appendix 10, illustration N) within the menu manual operation. For this purpose press OK for 2 sec. Please note that afterwards individually adjusted parameters and selected functions have to be adapted to the system again.



If you do not have the courage to configure the controller yourself please see your authorized dealer. We do not take over liability for any damages occurring as a consequence of misadjustment.

## 5 Installation and operation

### Safety instructions

The controller has been built for the use at 230 Volt AC at a frequency of 50 Hz [or optional 115 V ( $\pm 15\%$ ), 60 Hz]. Using this controller for other V and Hz values is not allowed. Please also note that the admissible nominal currents must not be exceeded.

If there is a grounded conductor planed or laid down for pump or reversing valve it **MUST** also be connected. There are corresponding supply terminals. Please make sure that the earthing contact is led to the controller also on the power supply side.

Wires that are not permanently connected with the building have to be equipped with a pull relief outside the controller.

The controller is only for the prescribed applications. No liability is taken over for other utilization.

All operations on an open controller are only to be conducted cleared from the power supply. All safety regulations for working on the power supply are valid. Connecting and/or all operations that require opening the controller are only to be conducted by specialists.

The controller is protected against overload and short circuit.

### 5.1 Location of installation

The controller is designed for installation on vertical walls. It must not be installed in areas where you can find flammable liquids or gases. It is only allowed to install the controller in areas in which the protective system (paragraph 8. Technical data) is sufficient. The max. permissible ambient temperature at the place of installation must never be exceeded or fallen below. Moreover, the controller must not be used in moist rooms (bathrooms) or in rooms in which flammable gas mixtures (by gas bottles, paint, solvents etc.) are likely to occur!

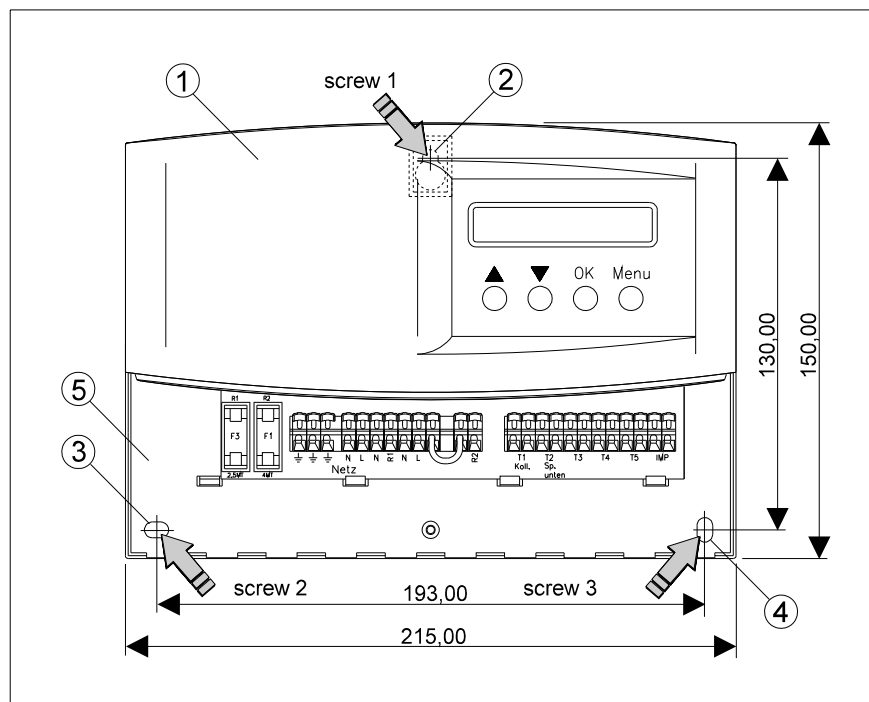


illustration 3: Installation

### 5.2 Installation

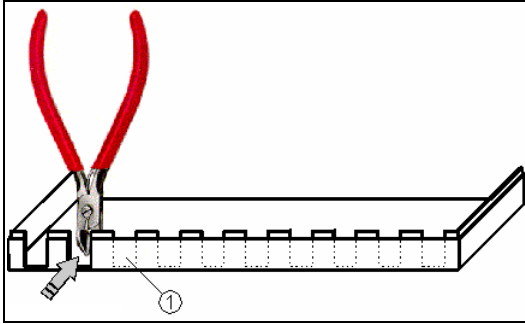
#### Installation on walls

The upper controller cover (Illustration 3, Pos. ①) protects the electronic system and must not be taken off.

First of all, fix screw 1 into the wall. The controller will be hung up on this screw afterwards (Illustration 3, Pos. ②). You can use the controller as a stencil for the marking of the other 2 mounting holes. (Attention: Do not use the controller as a stencil for drilling!)

After tightening the controller to the wall, you can start with the wiring.

### 5.3 Connecting the controller



First of all leave open the wire inputs for the power supply connection and the connecting wires of the sensors and the pump in the casing box. For this purpose there are material draws to be cut out (Illustration 4, Pos. ①). Each wire input needs two vertical cuts into the wall of the plastic case. For the cutting you can use cable stripping knife or an electronic side cutter. The cutting depth should be 2 mm min. from the plastic case ground. Afterwards the plastic clip can be taken out by moving it back and forth.

illustration 4: material gap for wire entrance

**⚠** The connecting activities as described here are only possible when the terminal box cover plate of the controller is open. For this purpose clear the power supply net. Stick to all valid regulations for working on a cleared power supply net. Only connect to the power supply net when controller case is closed. Moreover, the user has to take care of the fact that the IP protection is not damaged.

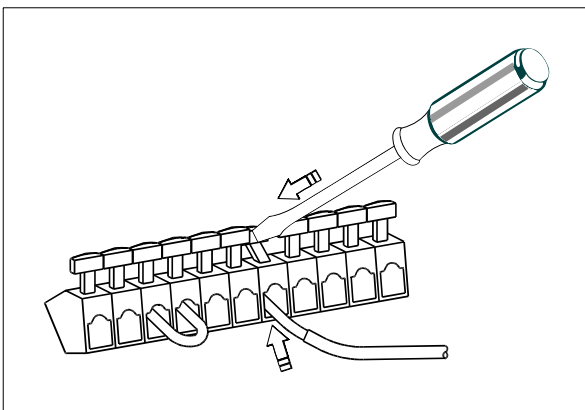


illustration 5: Connection clamp

Connect net and pump connecting wires to the prescribed draws (Illustration 6, Pos ① to ⑫). Each draw can only be furnished with one connecting wire (up to 2.5 mm<sup>2</sup>). For fine-strand wires please use end sleeves for strands. Outside the controller the wires must be strain-relieved.

Storing and collector sensor are to be connected to the prescribed draws (illustration 6, Pos ⑬ to ⑳). In this context the polarity does not play a role. Outside the controller the wires must be strain-relieved.

**Attention:** Only use original sensors specified for this controller (sensors KTY81-210 or PT1000).

**⚠** If the pumps or the reversing valves are planned or prescribed for being connected to a grounded conductor this **MUST** also be connected. For this purpose there are draws. Please make sure that the earthing contact is led to the controller also on the power supply side.

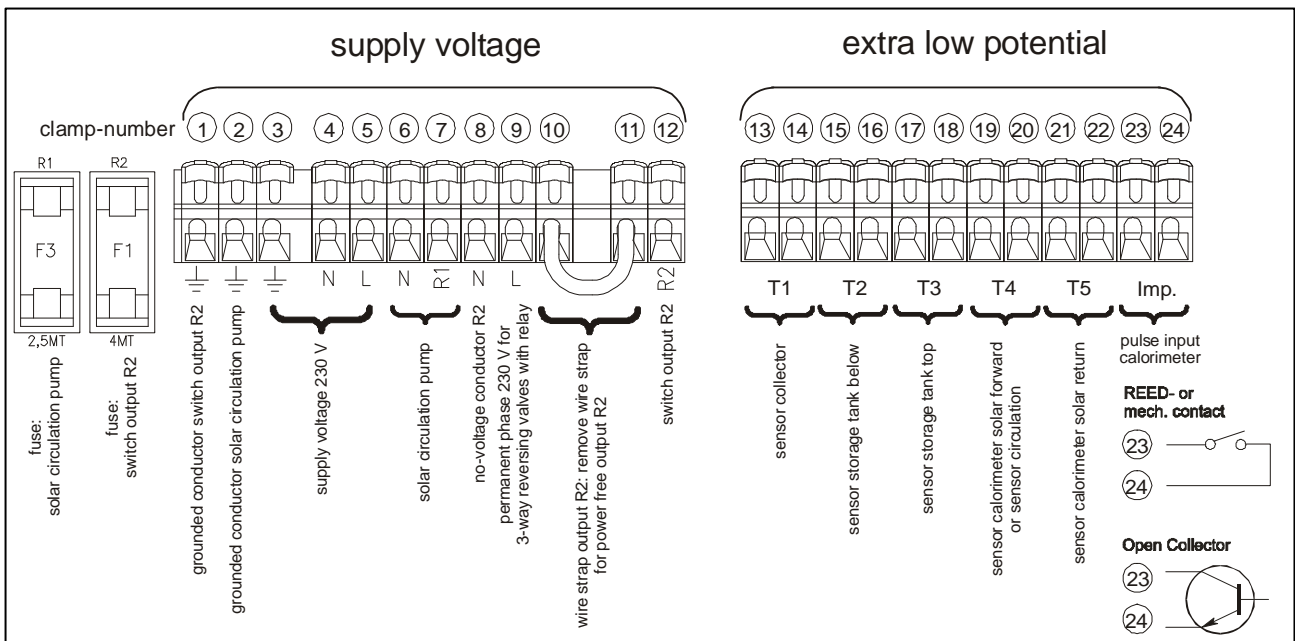


illustration 6: controller clamps

#### Connections:

**Supply voltage 230V/50Hz** [or optional 115V/60Hz]:

- ⑤ = Conductor L
- ④ = no-voltage conductor N
- ③ = grounded conductor PE

**Output R1 solar circulation pump**

- ⑦ = relay solar circulation pump R1
- ⑥ = no-voltage conductor N
- ② = grounded conductor PE

**Output R2 solar circulation pump**

- ⑫ = relay R2
- ⑧ = no-voltage conductor N
- ① = grounded conductor Pe
- ⑩ + ⑪ = terminal boards for power-free R2 (e. g. when heat coasting pump controls for gas condensing boilers)

(⑨ = permanent phase 230 V [optional 115 V] for 3-way reversing valves with relay, not to be used in this device!)

**Temperature sensor:**

- ⑬ + ⑭ = temp. sensor collector
- ⑮ + ⑯ = temp. sensor storing low
- ⑰ + ⑱ = temp. sensor storing high
- ⑲ + ⑳ = temp. sensor calorimetry (solar forward movement) or temp. sensor circulation
- ㉑ + ㉒ = temp. sensor calorimetry (solar backward movement)

The temp. sensors do not need to be polarized.

**PT1000:** Standard temperature sensors for this controller are PT1000. This sensor type is a high precision platinum temperature sensor that guarantees a temp. measuring range of up to +180°C (silicon cable – black).

**KT81-210:** Alternatively you can also use temp. sensors with the type KT81-210. For the registration of the storing temp. a sensor with a PVC cable of 2.0 m (grey) and a measuring range of up to +105°C is prescribed. There are higher demands on the collector sensor and so a silicon cable (red-brown) – resistant against all kinds of weather and temperatures – of 1.5 m and a measuring range of up to +150°C is used.

**Please see paragraph 3.3.5 when using KTY81-210 sensors.**

Temperature sensors delivered by the manufacturer have a 6 mm diameter.

All sensor conductors have extra-low voltage and have to be laid (minimum distance 100 mm) from 230 V [optional 115 V] and 400 V conductors to exclude inductive influence. If there are inductive influences from outside (e. g. high-voltage currents, TV and radio sets, microwaves etc.) conductors that carry reading signals have to be screened. The sensor cable can be extended to approx. 100 m. For this purpose please use a profile section of the extension cable of 1.5 mm<sup>2</sup> to 100 m and 0.75 mm<sup>2</sup> to 50 m.

**Impulse dispenser**

- ㉓ + ㉔ = pulse input point for volume flow dispenser for calorimetry

If impulse dispensers with "Reed-switch" are used any kind of connecting polarization can be used. If and "open collector" is used please pay attention the right polarization (illustration 6).

After the clamping area (illustration 3, Pos. ⑤) has been shut with the terminal box cover plate and the corresponding screw you can switch on power. Afterwards the first program menu Messwerte (readings) should appear in the LCD display.

Within the submenu manual operation (paragraph 3.2.9) you can check manually if the connected pumps can be switch ON and/or OFF. After having put into operation and/or maintenance you should quit this function and switch over to the main menu Messwerte (readings).

## 6 Malfunction and sources of error



**Attention! Please switch of the device from power supply before opening the case!**

The controller is designed for many years of constant use. Nevertheless, there may be faults. It is very often, however, that the causes for these faults and errors do not occur by the controller itself, but in the peripheral system components. The following description should be used as a helpful guidance to find the sources of malfunctions and to put the device into operation as soon as possible so that unnecessary costs can be avoided. Certainly not all errors are listed below. You will find the most common errors and faults covering the biggest part of all those possible. Send in the controller only when you are sure that none of the below-described errors has occurred.

The preset standard can be reset at any time within the menu "initialisation preset configuration" (see chapter 4 "configuration").

**Solar circulation pump does not work although collector temp. is above storing temp.**

"side" condition

LCD display gone out

potential source of error

no power supply, maybe safety fuse  
or current feed defective

Submenu "MAN.OPERATION"

manual switch-off of solar circulation (manual operation) selected  
pump

Storing temp. T2 near or above storing temp.

limitation has switched off the configured max. storing  
temp.pump

Indication of an error

(e. g. short circuit T1 and/or T2, or cut off  
interruption T1 and/or T2)

sensor conductor or sensor defective

(Note: only output R1 (solar circuit pump)

switches off in the case of T1 or T2

sensor defect. Output R2 remains unaffected)

Collector sensor shows wrong temperature"side" condition

Collector sensor T1 shows

a value of 180°C or a negative value temp.

potential source of error

In the submenu "FUNCTIONS" a wrong

sensor has been selected

Calorimeter registrates no or wrong heat quantity despite of solar pump in operationPotential source of error:

- temp. sensor T4 (forward movement temp. registration) or temp. sensor T5 (backward movement temp. registration) or external volume flow dispenser (controller input point Imp.) have not or incorrectly been connected.
- function calorimetry has not been selected
- forward and backward movement temp. sensors have been exchanged
- wrong input of wrong impulse valency of volume flow dispenser
- wrong configuration of proportion of mixture water /solar liquids
- volume indicator shows no discharge
  - volume indicator installed in the wrong direction
  - obstruction of the volume indicator filter that might have been installed
  - air within the solar circuit
- Usage of another solar liquid than Tyfocor L

Indication of error in the LCD display

Short circuits and interruptions of each single temp. sensor are only indicated when the corresponding sensors are really in use on the basis of the selected function.

The controller automatically recognizes the below-described errors and indicates them after 10 sec on its LCD display. Only after confirming by pressing a button does the controller start working regularly again. If a malfunction is not eliminated despite indication and confirmed the LCD display indicates again error. When there are several errors the one with the "lowest impact" (e. g. first T1, then T2 etc.) is indicated.

**Note:** If the controller recognizes an error the output of the controller switches off due to safety reasons.

Display indicates the following	Significance
Short circuit T1	short circuit of sensor conductor T1 for the registration of the collector temperature
Interruption T1	Cut-off of sensor conductor T1 for the registration of the collector temperature
Short circuit T2	short circuit of sensor conductor T2 for the registration of the „storage tank temp. bottom“
Interruption T2	Cut-off of sensor conductor T2 for the registration of the „storage tank temp. bottom“
Short circuit T3	short circuit of sensor conductor T3 for the registration of the „storage tank temp. top“
Interruption T3	Cut-off of sensor conductor T3 for the registration of the „storage tank temp. top“
stt: No °C	temp. sensor T3 not existing (T3 is normally only needed for the indication of storing high temp. and so exclusively necessary within the function heating system)

Display indicates the following	Significance
---------------------------------	--------------

Short circuit T4	short circuit of sensor conductor T4 for "calorimetry-forward" temp. registration or short circuit of T4 for circulation temp. registration
Interruption T4	Cut-off of T4 for "calorimetry-forward" temp. registration or short circuit of T4 for circulation temp. registration
Short circuit T5	short circuit T5 for "calorimetry backward" temp. registration
Interruption T5	Cut-off of T5 for "calorimetry-backward" temp. registration
EEPROM error	The controller's EEPROM cannot be read or described. What to do: cut off voltage supply of the controller and switch on again. If the errors persists please contact your authorized dealer.

#### Source of error temp. sensor

The temperature is registered done by so-called resistance sensors type PT1000 and/or KTY81-210. Depending on the temperature the resistance value also changes. With the help of a ohmmeter you can check if the sensor is defective. For this purpose disconnect the corresponding temp. sensor from the controller and measure the resistance. In the below list you find the typical values of resistance in connection with temperature. Please note there might be slight deviations.

#### Resistance values of the temp. sensors

##### **PT1000**

temperature [°C]	0	10	20	30	40	50	60	70	80	90	100	110	120
resistance [Ω]	1000	1039	1078	1117	1155	1194	1232	1271	1309	1347	1385	1423	1461

##### **KTY81-210**

temperature [°C]	0	10	20	30	40	50	60	70	80	90	100	110	120
resistance [Ω]	1630	1772	1922	2080	2245	2417	2597	2785	2980	3182	3392	3607	3817

## **7 Legal Guarantee**

In accordance with German statutory regulations, there is a 2-year legal guarantee on this product for the customer.

The seller will remove all manufacturing and material faults that occur in the product during the legal guarantee period and affect the correct functioning of the product. Natural wear and tear does not constitute a malfunction. Legal guarantee does not apply if the fault can be attributed to third parties, unprofessional installation or commissioning, incorrect or negligent handling, improper transport, excessive loading, use of improper equipment, faulty construction work, unsuitable construction location or improper operation or use. Legal guarantee claims shall only be accepted if notification of the fault is provided immediately after it is discovered. Legal guarantee claims are to be directed to the seller.

**The seller must be informed before legal guarantee claims are processed. For processing a legal guarantee claim an exact fault description and the invoice / delivery note must be provided.**

The seller can choose to fulfil the legal guarantee either by repair or replacement. If the product can neither be repaired nor replaced, or if this does not occur within a suitable period in spite of the specification of an extension period in writing by the customer, the reduction in value caused by the fault shall be replaced, or, if this is not sufficient taking the interests of the end customer into consideration, the contract is cancelled.

Any further claims against the seller based on this legal guarantee obligation, in particular claims for damages due to lost profit, loss-of-use or indirect damages are excluded, unless liability is obligatory by German law.



## 8 Technical Data

• Nominal voltage	230 Volt (± 15 %), 50 Hz [optional 115 Volt (± 15 %), 60 Hz]
• Max. self consumption	≤ 1,0 W
• 6 inputs	
5 x temperature determination	PT1000 or KTY81-210
1 x pulse determination	pulse counter 1 ... 99 liter/pulse
• 2 outputs	
R1	Triac for speed control, max. switch. capacity 200 W at 230 V [or 100W at 115V]
R2 as switch output 230 V [115 V]	relay, max. switching capacity 800 W at 230 V [or 400W at 115 V]
or R2 voltage-free	remove wire strap (drive, e.g. gas burners)
• All outputs are protected against overload and short circuit	
• Adjustment ranges	
Turn-on temperature difference	4...17 K
Turn-off temperature difference	2...15 K
• Automatic timer	24 hours, 3 response times freely programmable
• Display	LCD display, 2 lines with 16 char each, menu-driven clear text display
• Protection	IP 20 / DIN 40050
• Permissible ambient temperature	0 °C ... +45 °C
• Installation	wall installation
• Weight	490 g
• Casing	Recycleable 3-part plastic casing
• Dimensions l x w x h (mm)	150 x 215 x 43 mm
<b>Temperature sensors</b>	
• storage tank <sup>(*)</sup> : PT1000	1,5 m silicon cable (colour black), measuring range up to 180° C
• collector <sup>(**)</sup> : PT1000	1,5 m silicon cable (colour black), measuring range up to 180° C

<sup>(\*)</sup> alternative: KTY81-210 with 2,0 m PVC-cable (colour grey), measuring range up to 105 °C

<sup>(\*\*)</sup> alternative: KTY81-210 with 1,5 m silicon-cable (colour red-brown), measuring range up to 150 °C

## 9 Preset standard configurations

In the submenu "MAN.OPERATION" you can configure a "initialisation preset config." (preset configuration by the manufacturer). This means that individual configuration of parameter values and function are deleted from the controller memory and that subsequently the preset configurations are valid.

After a power failure there is no need to put in parameter values or function configurations since these values are stored in the EEPROM of the controller. If the automatic time switch is used within the thermostat function heat coasting or circulation please adjust the time. For this purpose the menu window TIME automatically appears after a potential power failure.

On delivery the following parameters and functions are configured. Any changes done to the parameter values or functions should be noted in the following chart in order to be able to find and eliminate the source of error in the case of failure or a erroneous misadjustment. Furthermore, we would ask you to enclose a sketch of your hydraulic system together with the complete chart in the case of any reclamation you pass on to your dealer or manufacturer.

Name of device:

Date of putting the device into operation:

Used sensor types (please cross out in the case of reclamation):

sensor type:	T1	T2	T3	T4	T5
PT1000					
KTY81-210					

Parameter configuration (please indicate in the case of reclamation):

Menu indication	parameter	preset configuration	configuration range	preset values (customer specification)
On-temperature difference	On-temperature difference (On-TDiff)	8 K	(„Off-TDiff“+2)...17 K	
Off-temperature difference	Off-temperature difference (Off-TDiff)	4 K	2 K...(„On-TDiff“-2) K	
storage temp. limitation	storage temperature limitation (STL)	60 °C	20...95 °C	
-	storing temp. limitation hysteresis	4 K	constant	-
collector temp. limitation	collector temperature limitation	110 °C	80...120 °C	
-	collector temp. limitation hysteresis	10 K	constant	-
-	storage tank cooling	3 K below STL	constant	-
-	storage tank cooling hysteresis	3 K	constant	-
-	restore prevention	130 °C	constant	-
-	restore prevention hysteresis	4 K	constant	-
heating system ON	heating system ON temperature (HSONT)	45 °C	20 °C...HSOFT-3K	
heating system OFF	heating system OFF temperature (HSOFT)	52 °C	HSONT+3K...95 °C	
circulation ON	circulation switch-ON temperature (CSONT)	35 °C	20 °C...CSOFT-3K	
circulation OFF	circulation switch-OFF temperature (CSOFT)	40 °C	CSONT+3K...95 °C	
indexing time 1: indexing time 2: indexing time 3:	Indexing times for circulation or heating: indexing time 1: indexing time 2: indexing time 3:	06:00...09:00 h 12:00...14:00 h 18:00...21:00 h	0...24 h 0...24 h 0...24 h	
-	antifreezing protection switch-on temp.	4 °C	constant	-
-	antifreezing protection switch-off hysteresis	2 K	constant	-
calorimetry: ... [liter/puls]	calorimetry: programming quantity liter/puls of volume meter	1 l/puls	0...99 l/puls	
calorimetry: Glykol Vol. %: ... %	calorimetry: mixture of glykol-water by programming glykol in %	40 %	0...99	

-	excess temp. switch-off	(T1-T2) > 80 K	constant	-
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Function configurations (please indicate in the case of complaint):

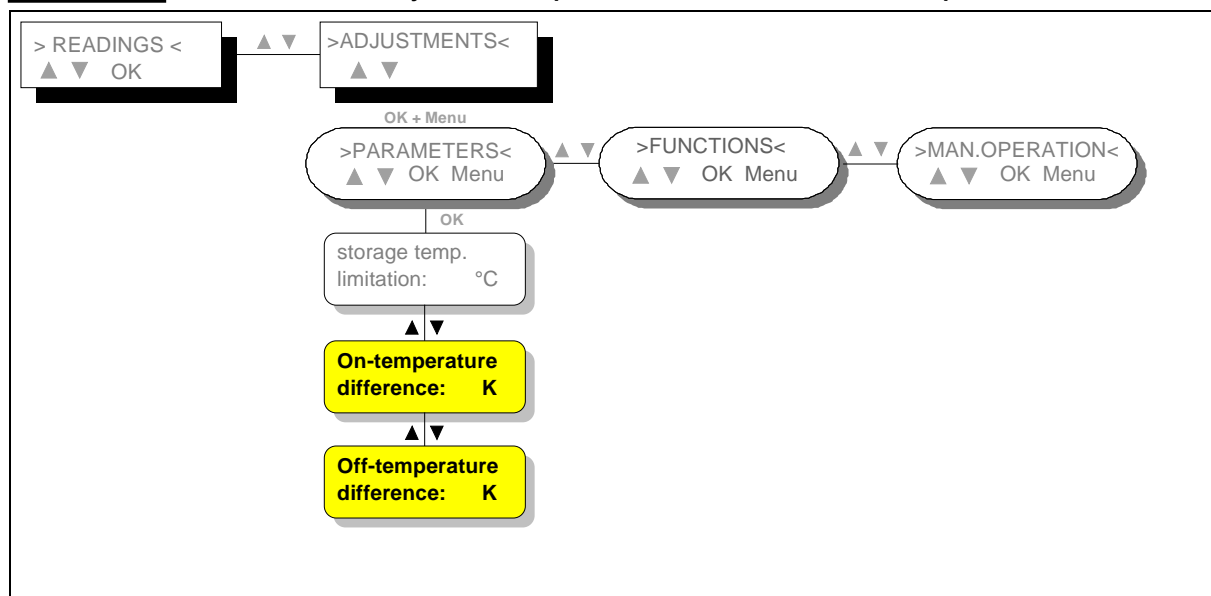
Menu indication	functions	preset configuration	preset values (customer specification)
calorimetry	calorimetry	OFF	
storage tank cooling	storage tank cooling	OFF	
collector temp. limitation	collector temperature limitation	OFF	
heating system	heating system	OFF	
antifreezing protection	antifreezing protection	OFF	
temp.-linked circulat. contr.	temperature linked circulation control	OFF	
time-linked circulat. contr.	time linked circulation control	OFF	
T1: KTY	T1: KTY (OFF => PT1000)	OFF	
speed control	speed control	ON	

## 10 Appendix

### Diagrams on menu control

#### illustration A

How to adjust "On-temperature difference" and "Off-temperature difference"



#### illustration B

cycle "speed control" of solar loop pump

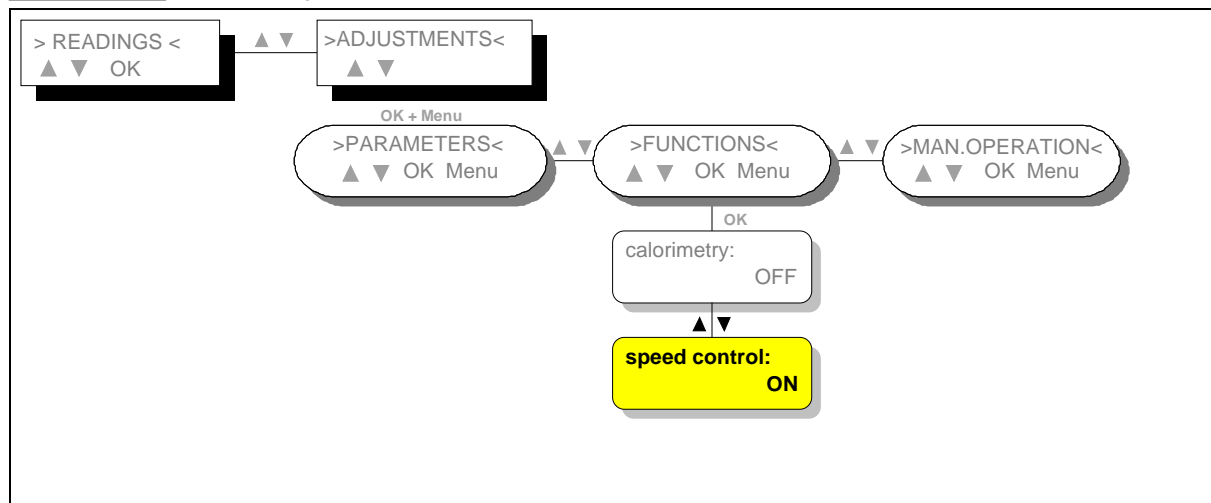


illustration C

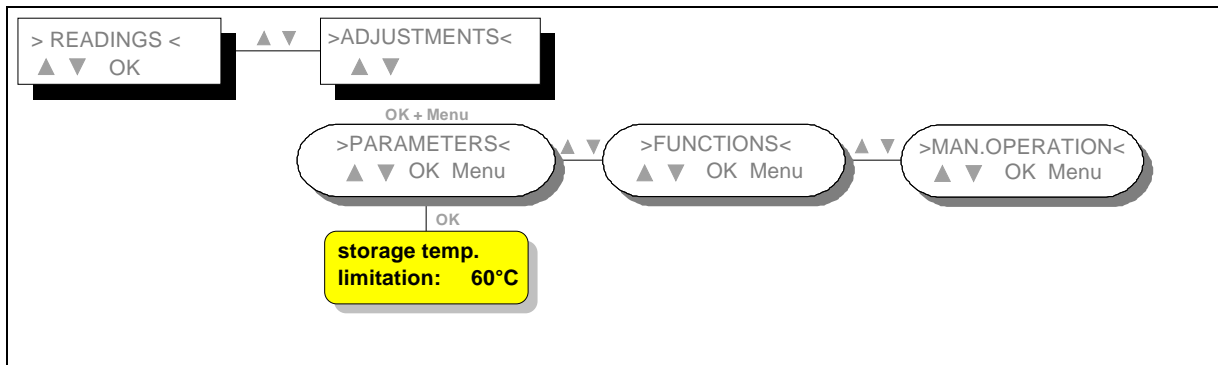
**"storage temperature limitation"**

illustration D

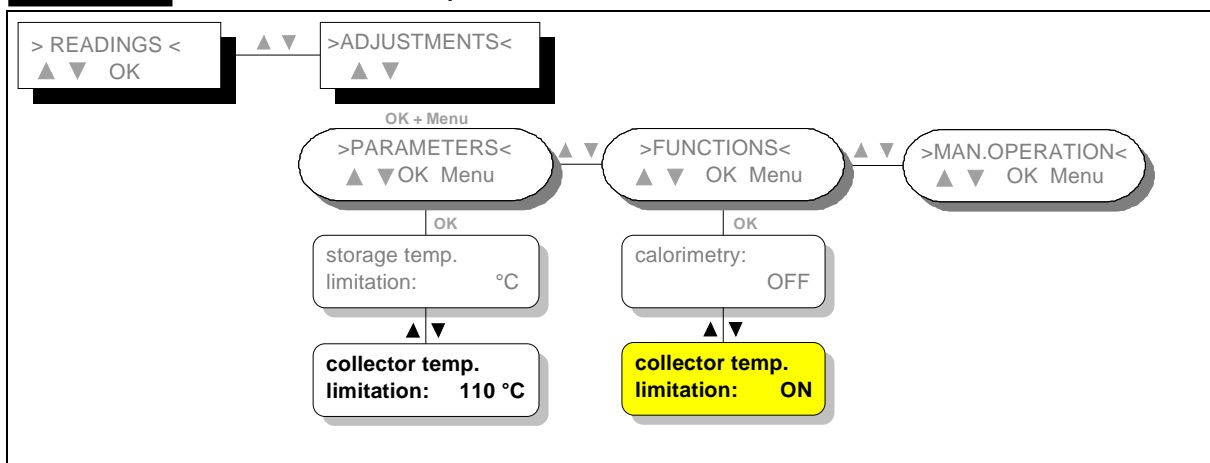
**"collector temperature limitation"**

illustration E

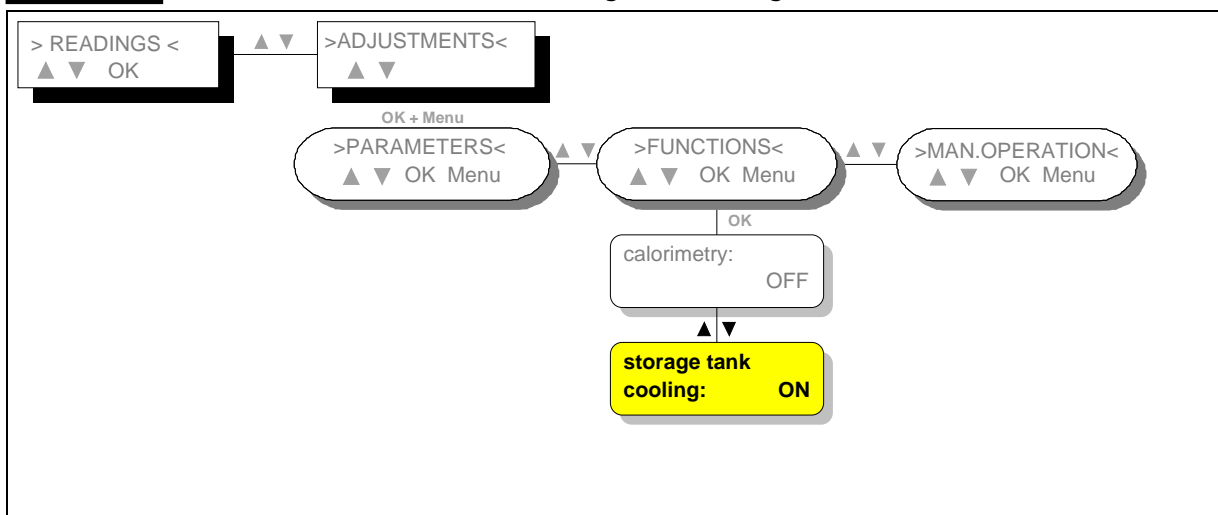
**Thermostat function: "storage tank cooling"**

illustration F

Thermostat function: "heating system"

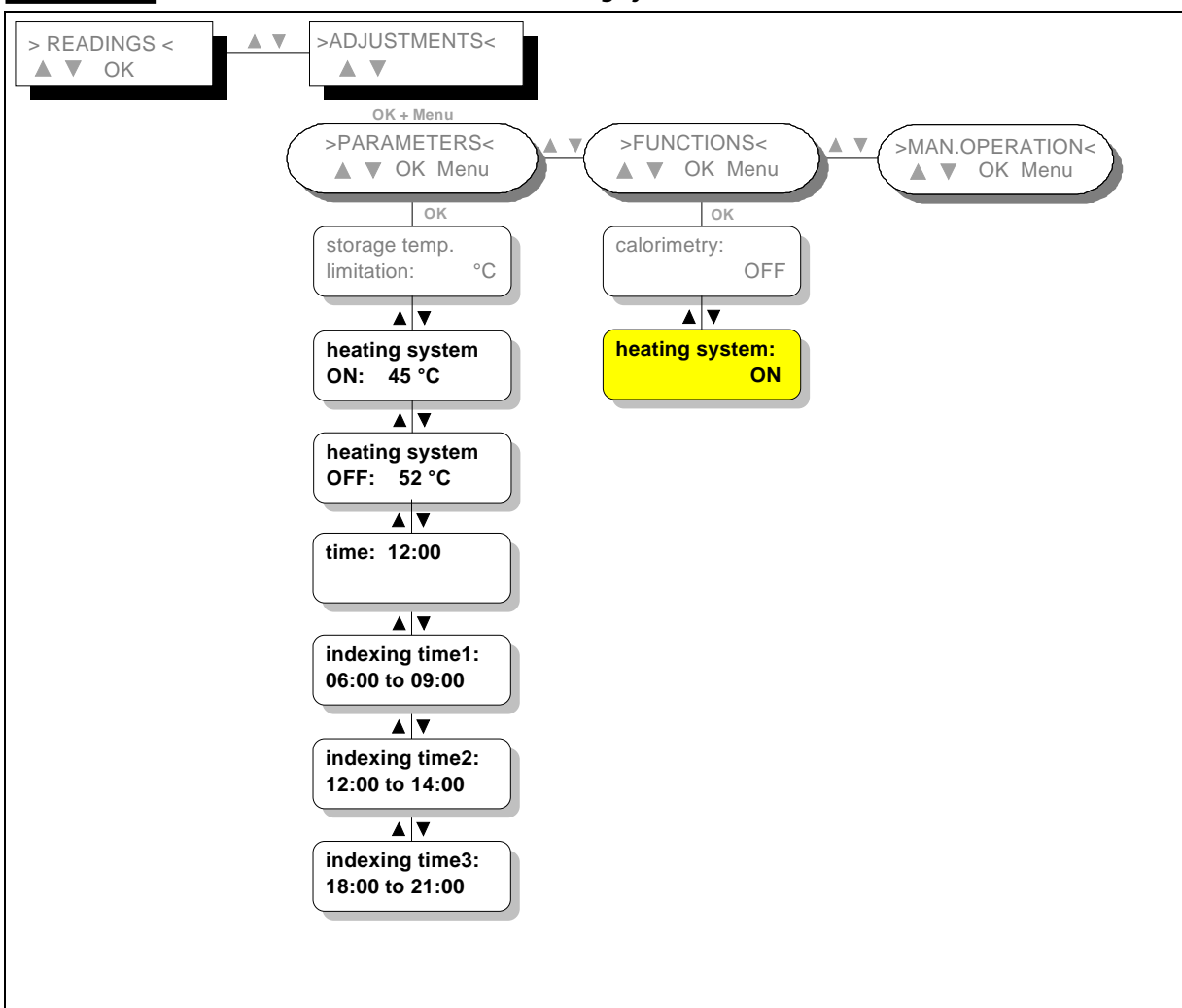


illustration G

Thermostat functions: circulation control  
 1) "temperature-linked circulation control"

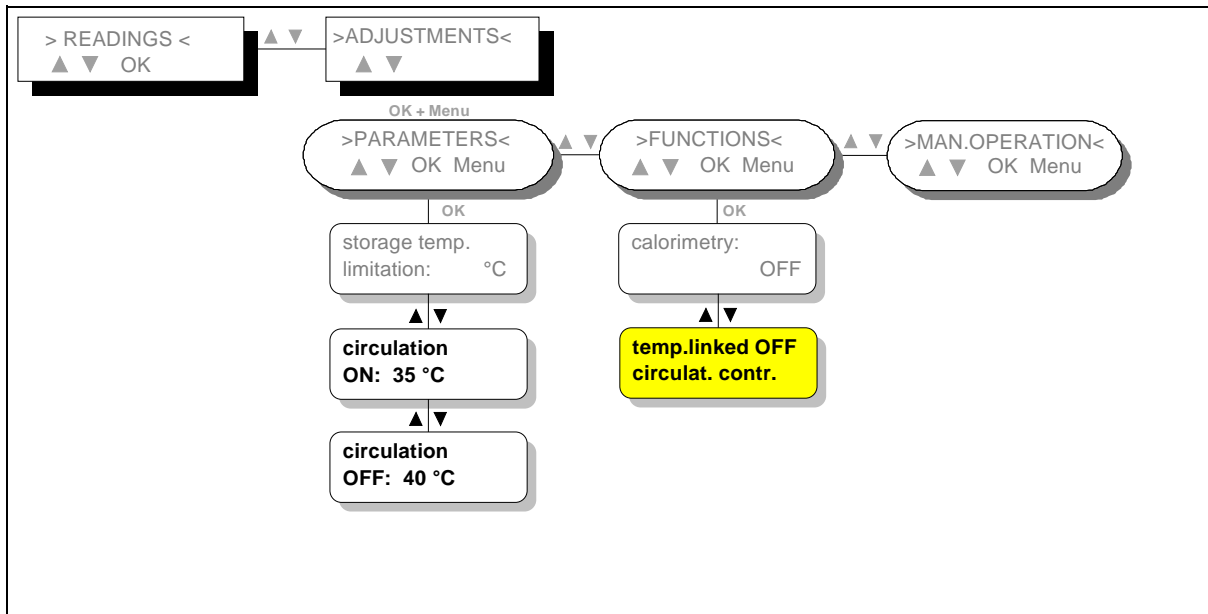


illustration H

## 2) "Time-linked circulation control"

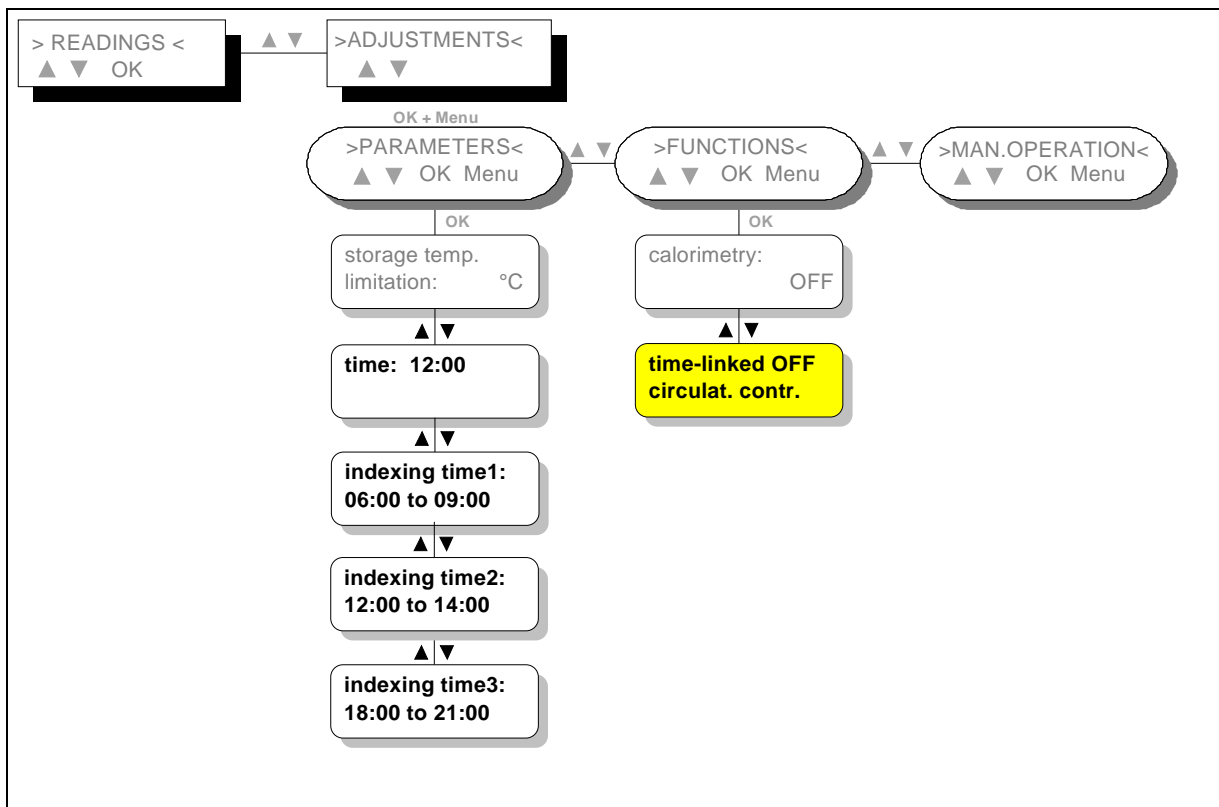


illustration I

## "antifreezing protection"

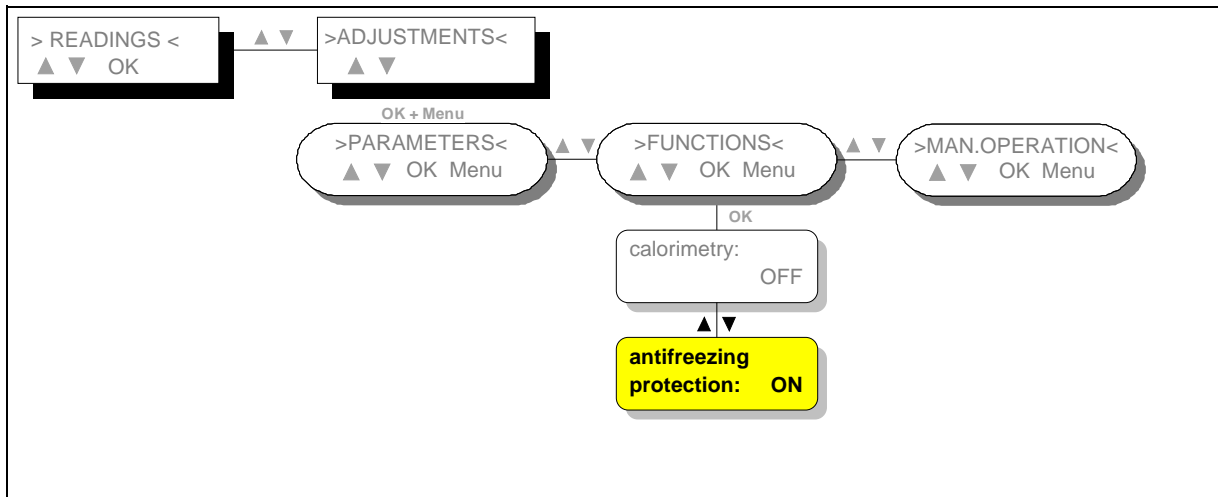


illustration J

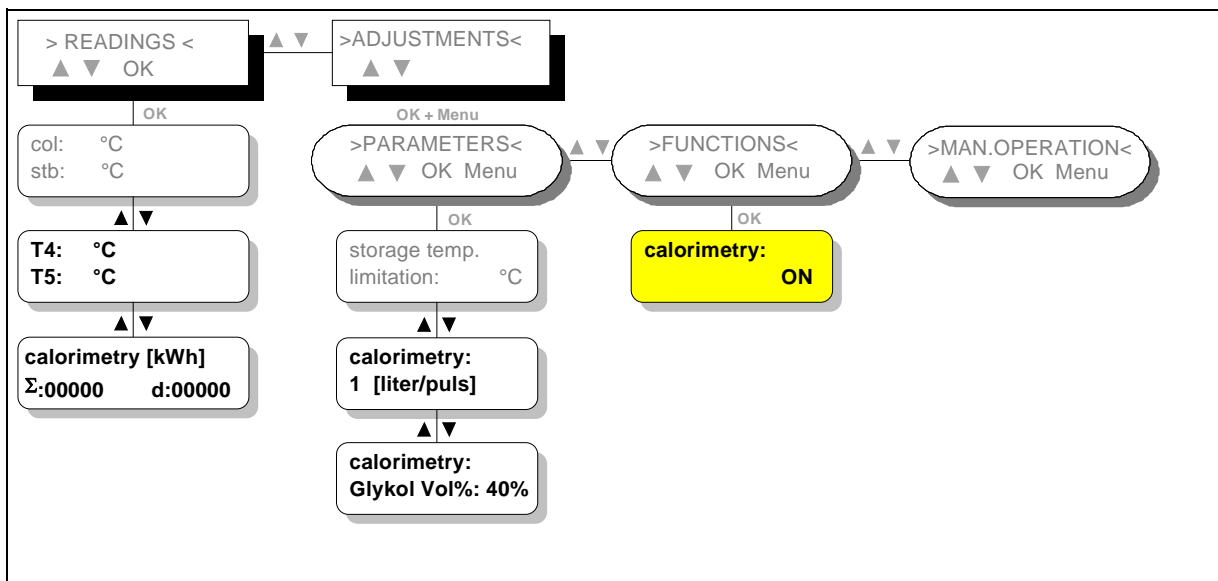
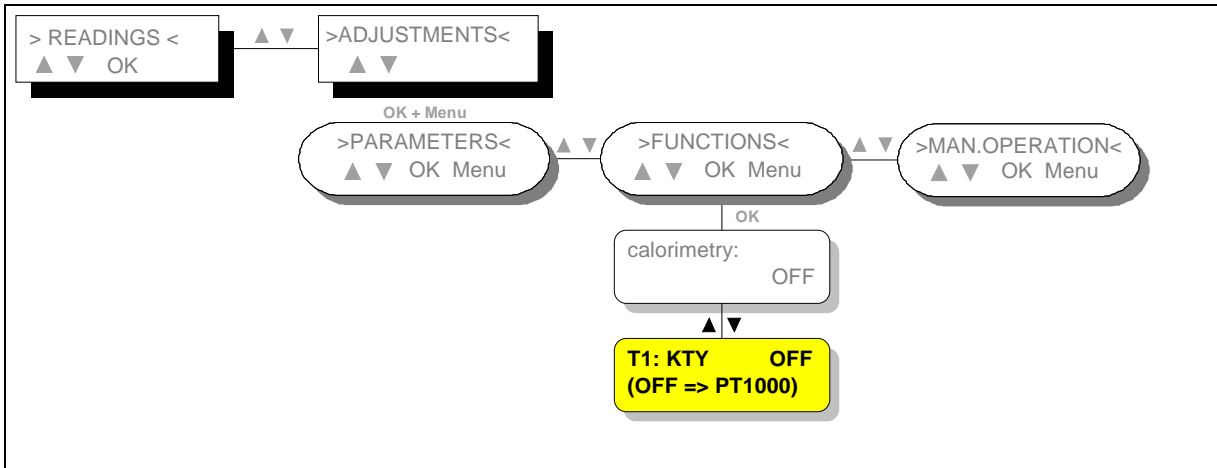
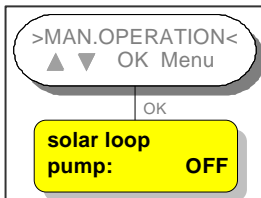
**"calorimetry"**

illustration K

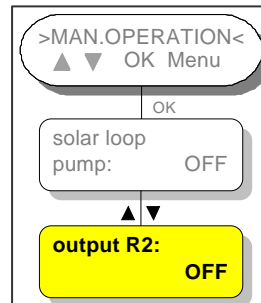
**selection of collector sensor type "T1: KTY"**



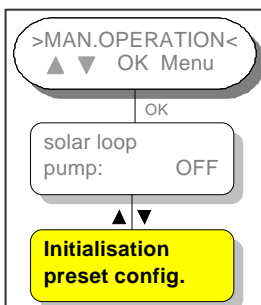
**illustration L** manual operation output R1  
"solar loop pump"



**illustration M** manual operation "output R2"



**illustration N** "initialisation preset configuration"







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