Instructions for installation and operation

System controller for thermal solar systems Suntana2

Contents

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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 features 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 service water or a buffer storage tank.

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

Before starting operation read section 5 ("installation and operation") and make sure that all preparing steps have been done before.

Only begin with the installation when you have understood this instruction and proceed in the described 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.

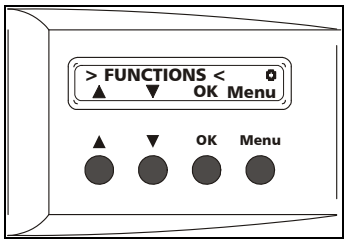
NOTE:

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 clarifiy the potential selections and give an overview of the menu-driven system controller.



On delivery the controller is equipped with preset standard configurations (see page 23) 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.

illustration 1: Control panel and 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 (menu "*MAN.OPERATION*") 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 factory setting*" (paragraph 2.4 and 5). In these operating instructions menus that are only accessible after fetching the main menu are called submenus (e. g. parameters, 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.

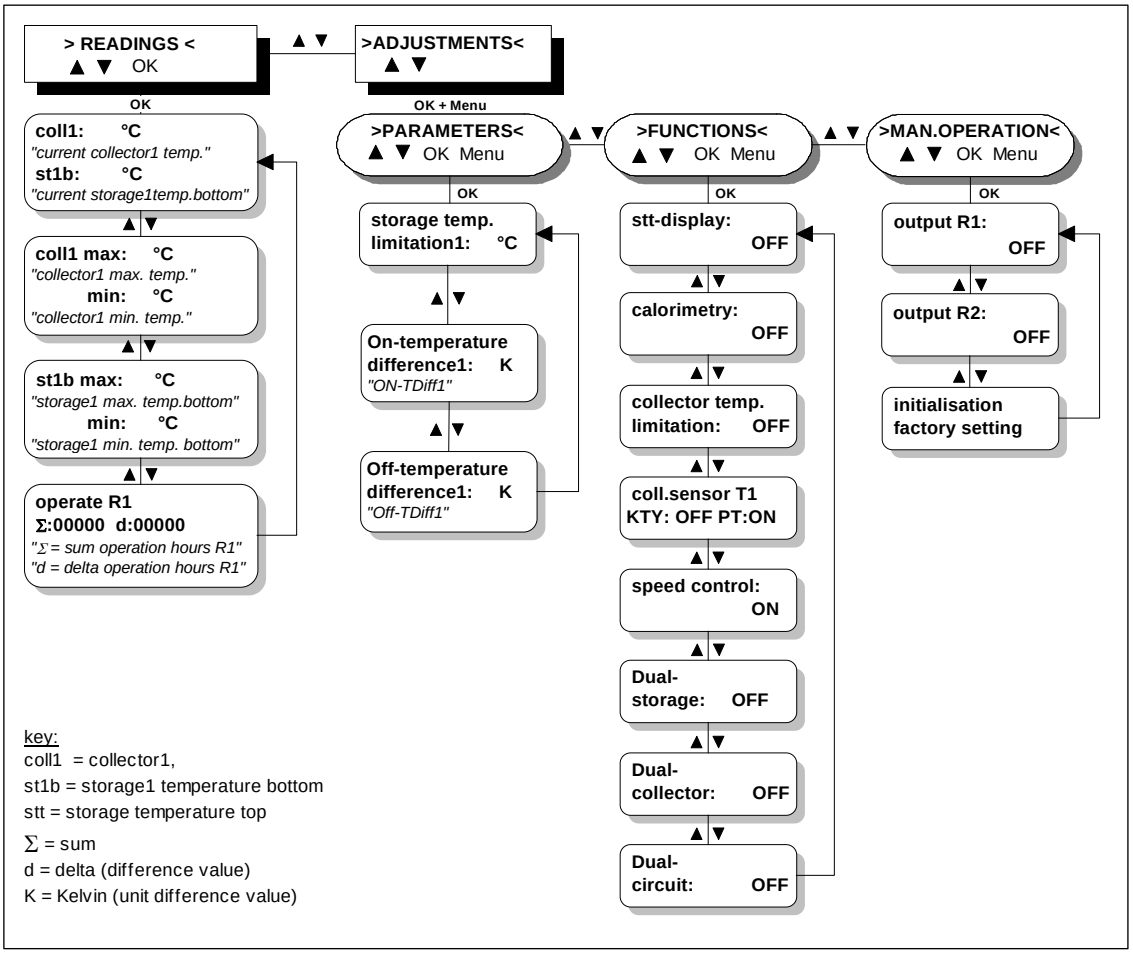
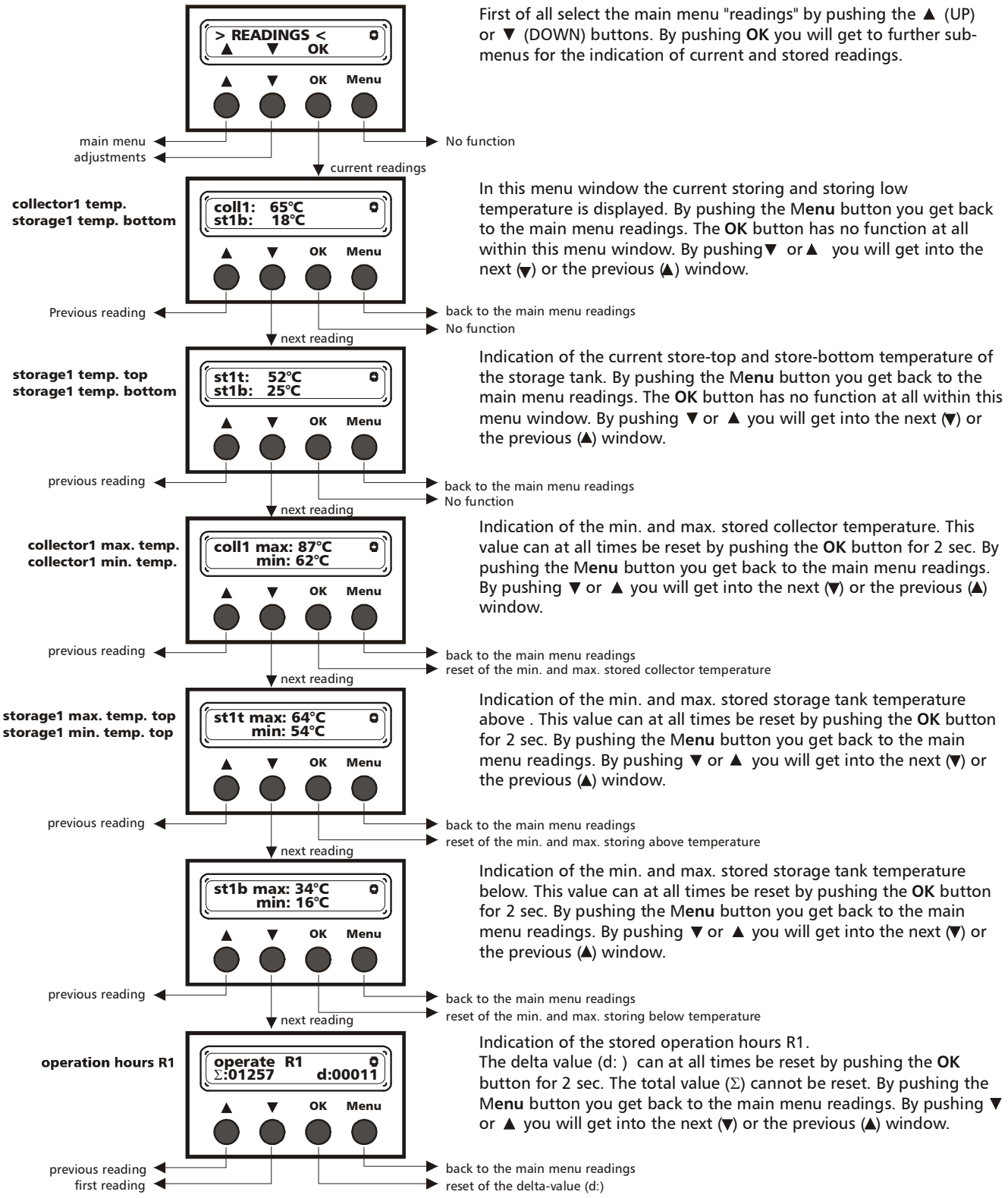


illustration 2: Diagram of different menu

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*".



First of all select the main menu "readings" by pushing the ▲ (UP) or ▼ (DOWN) buttons. By pushing **OK** you will get to further sub-menus for the indication of current and stored readings.

In this menu window the current storing and storing low temperature is displayed. By pushing the M**enu** button you get back to the main menu readings. The **OK** button has no function at all within this menu window. By pushing▼ or▲ you will get into the next (▼) or the previous (▲) window.

Indication of the current store-top and store-bottom temperature of the storage tank. By pushing the M**enu** button you get back to the main menu readings. The **OK** button has no function at all within this menu window. By pushing ▼ or ▲ you will get into the next (▼) or the previous (▲) window.

Indication of the min. and max. stored collector temperature. This value can at all times be reset by pushing the **OK** button for 2 sec. By pushing the M**enu** button you get back to the main menu readings. By pushing ▼ or ▲ you will get into the next (▼) or the previous (▲) window.

Indication of the min. and max. stored storage tank temperature above . This value can at all times be reset by pushing the **OK** button for 2 sec. By pushing the M**enu** button you get back to the main menu readings. By pushing ▼ or ▲ you will get into the next (▼) or the previous (▲) window.

Indication of the min. and max. stored storage tank temperature below. This value can at all times be reset by pushing the **OK** button for 2 sec. By pushing the M**enu** button you get back to the main menu readings. By pushing ▼ or ▲ you will get into the next (▼) or the previous (▲) window.

Indication of the stored operation hours R1.
The delta value (d:) can at all times be reset by pushing the **OK** button for 2 sec. The total value (Σ) cannot be reset. By pushing the M**enu** button you get back to the main menu readings. By pushing ▼ or ▲ you will get into the next (▼) or the previous (▲) window.

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 $\sum$= 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 configurated 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 and/or output R2

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 factory setting*"
2. press OK for 2 sec

Warning:

Measured values and parameters are only displayed on the controller's display if the corresponding function has been specifically selected in the "FUNCTIONS" menu.

Functions that cannot be selected at the same time (e.g. Display Storage tank top temperature and calorimetry) are interdependently locked by means of a software function. In the event that a function cannot be activated, another function must be deactivated first.

Menu illustrations in the Annex of this document provide an overview of possible additional parameters that can be set and/or measured values that can be displayed following selection of a supplementary controller function.

Note: All the functions are listed and described in detail in Section 3 of this Operating Manual. To exclude the possibility of incorrect operation you should gain a thorough understanding of the context and usage of the function in question before modifying it.

3 System controller for thermal solar energy systems with monitoring functions

3.1 Tasks of the system controller in the solar energy system

The controller is a microprocessor-controlled temperature difference controller for monitoring and controlling thermal solar energy systems. The controller controls the functions of a solar energy system with up to two collector units oriented in different directions and a maximum of two storage tanks.

The microprocessor processes all the important measured values, calculates the control function and controls the final control element of the system. As well as controlling the solar energy system, the controller is also responsible for important system monitoring and safety functions.

The controller is equipped with 5 analog inputs for measuring temperature, one digital pulse input for acquiring the heat quantity and two outputs for controlling pumps and/or valves.

The controller can be used in conjunction with various system designs. The controller's standard system components include, depending on the system layout, a speed-regulated solar energy circuit pump, a 3-way valve (or instead a second, non-speed-regulated solar energy circuit pump), one or two collector sensors, storage tank bottom sensors used as maximum storage temp. limiters, and storage tank top sensors used as additional visual temp. displays.

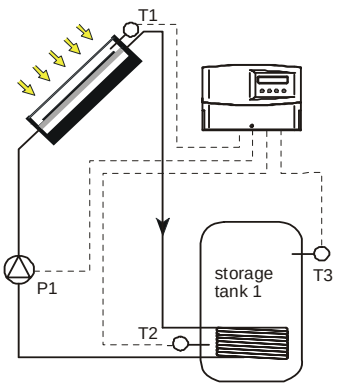
The controller also makes it possible to acquire the amount of heat fed into the storage tank (see section 3.3.3). This is achieved using an additional volumetric flow sensor and the temperatures in the solar forward and backward flow. The volumetric flow sensor is a conventional water meter with a pulse output. The important factor is that the volumetric flow sensor can withstand the increased stresses associated with the temperature in the solar circuit. You should therefore use warm or hot-water meters from authorised specialist dealers rather than cold-water meters.

3.2 Control functions

Overview of functions

- **Function for switching temperature difference control on and off**
- **Speed control of the solar energy circuit pump**
- **Storage temperature limitation**
- **Collector temperature limitation**
- **Priority function for dual-storage tank systems**
- **Standard single-circuit control (with optional calorimetry)**
- **Dual-storage control system with pump and 3-way valve (with optional calorimetry)**
- **Dual-storage control system with two pumps (with optional calorimetry)**
- **East/west collector orientation with pump and 3-way valve (with optional calorimetry)**
- **East / west collector orientation with two pumps (with optional calorimetry)**
- **Two self-contained solar energy circuits**

3.2.1 Function for switching the temperature difference control on and off (Appendix 10, Fig. A)



The solar energy circuit pump is switched on by a temperature difference function. As soon as the collector temperature exceeds the temperature at the storage tank bottom sensor by a specified difference (which can be defined in the Parameters menu as "On-temperature difference"), the circulating pump (P1) in the solar energy circuit is switched on.

To prevent the solar energy circuit pump from switching on and off constantly it is only switched off automatically once the temperature has fallen below a defined temperature difference (this can be set in the Parameters menu as "Off-temperature difference").

In systems with two storage tanks or two collector panels, the temperature differences ("On-temperature difference1, On-temperature difference2, Off-temperature difference1, Off-temperature difference2") can be set separately for each storage tank circuit and collector circuit. The appended digit indicates the corresponding storage tank or collector circuit.

Example:

The parameters are set by default to 8 Kelvin for switch-on temperature difference and 4 Kelvin for switch-off temperature difference. A temperature of 20 °C is measured at the measurement point at storage tank bottom. This means in this case that the solar energy circuit pump is switched on when the collector reaches 28 °C, and is switched off when the collector temperature falls below 24 °C.

Important: The factory defaults for the switch-on temperature difference (8 Kelvin) and switch-off temperature difference (4 Kelvin) are standard settings that have proved to be appropriate over long years of practical experience. These values therefore only need to be changed in exceptional circumstances (e.g. unusually long pipe paths). The switch-on and switch-off temperature difference are mutually interlocked. The difference between these two settings cannot exceed the value of 2 Kelvin. As a result incorrect settings are avoided.

3.2.2 Speed control of the solar energy circuit pump (Appendix 10, Fig. B)

The controller is equipped with an electronic relay for controlling the speed of a circulating pump (P1) in the solar energy circuit. By controlling the speed of the pump the system attempts to maintain a constant temperature difference between collector and storage tank. If solar energy circuit pumps with adjustable speeds are used, the fastest speed (generally setting 3) should be selected. This setting is selected using the rotary switch on the pump itself. In operation the necessary output adjustment is automatically realised by the speed controlling of the controller.

The regulating action of speed control is equivalent to a PI controller (proportional-integral controller). The P-action has the effect of quickly stabilising the control operation while the I-action serves to achieve the specified set value reliably. This controller has an extremely robust design due to the way in which the control values are precisely matched, and the user therefore has absolutely no need to make any fine adjustments.

Nevertheless, it is still possible to switch off speed control via "speed control" in the Functions menu. The controller then operates like a conventional temperature difference controller and makes sure that the connected circulating pump is continuously feeding a constant volumetric flow (as long as the controller's switch-on conditions are satisfied).

In systems with two storage tanks or two collectors, electronic speed control is performed exclusively on pump P1 (controller output R1). If a pump P2 (controller output R2) is connected to the controller, it will not be speed-controlled and therefore feeds a constant volumetric flow.

3.2.3 Storage temperature limitation (Appendix 10, Fig. C)

To prevent the service water storage tank from overheating, the solar energy circuit pump (P1) is switched off once the maximum permissible temperature is reached. The storage tank temperature limit can be adjusted ("storage temp. limitation" in the Parameters menu) in a range from 20 - 95 °C and responds, depending on the system layout selected, to temperature sensors T2, T3 or T4 in the lower area of the storage tank. Once the set temperature is reached, the solar energy circuit pump switches off and does not switch back on again until the temperature in the storage tank drops to a temperature of 4 Kelvin below the storage tank temperature limit. In systems with two storage tanks a separate storage temperature limit value can be set for each storage tank ("storage temperature limitation1, storage temperature limitation2"). When the first storage tank reaches the maximum temperature set, the system switches over to the second storage tank, and this one is loaded until it reaches its switch-off temperature. When the solar energy circuit pump is switched off extreme levels of solar radiation can even result in the solar fluid of the collector vaporising and thus reaching temperatures of above 130 °C. The solar energy circuit pump therefore cannot be switched on automatically despite falling storage tank temperatures as there may be vapour in the collector circuit. In this case, the solar energy circuit pump is not switched back on automatically until the collector temperature has dropped to less than 100 °C and the temperature of the storage tank bottom has at the same time fallen by at least 4 Kelvin below the storage temperature limit set.

3.2.4 Collector temperature limitation (Appendix 10, Fig. D)

When there is a high level of solar radiation and no hot water is taken out of the storage tank for a considerable length of time, the temperatures in the solar circuit rise automatically. An attempt is now made through "collector temp. limitation" in the Function menu to prevent the heat carrier medium in the collector panel from vaporising. Therefore the system losses in the collector circuit are deliberately increased by reducing the pump speed. As a result the heat carrier medium in the collector is heated more intensely and the collector is inevitably operated less efficiently.

⚠ **Caution: This function has absolutely no effect on the storage tank temperature limit set as described in Section 3.2.3. The storage tank temperature limit function continues to take precedence, and when the set maximum temperature is reached it switches off the solar energy circuit pump.**

Since the storage tank temperature limit reacts to the "storage tank bottom" temperature sensor, the upper area of the storage tank can warm up to a temperature greater than the set maximum storage tank temperature. In systems that include a service water storage tank it is therefore recommended as a matter of principle that a service water mixer unit should be installed as protection against scalding.

Functionality: If the temperature at the storage tank bottom sensor (T2, T3 or T4 depending on the system layout) reaches a value of 7 Kelvin below the storage tank temperature limit set (see Section 3.2.3), the solar energy circuit pump is switched off automatically. Since the solar energy circuit now does not release any heat via the service water storage tank, the collector temperature is inevitable increased. Once the adjustable temperature designated collector temperature limit (Parameters menu "collector temp. limitation") measured at the collector temperature sensor (T1 or T3 depending on the system layout) has been exceeded, the solar energy circuit pump is switched on again and operated at an appropriate speed. The solar energy circuit pump is operating until the temperature at the collector sensor (T1 or T3) has dropped by 10 Kelvin relative to the collector temperature limit set (Parameters menu). If the temperature in the collector rises again, the procedure described above is repeated by the controller again. This continues until such time as either the storage temperature limit takes effect or the temperature in the collector has

risen to 130 °C. If the temperatures in the collector circuit exceed 130 °C, vaporisation of the heat carrier medium must be reckoned with. For this reason the controller safely switches off the solar energy circuit pump.

The controller returns to normal operation - i.e. without executing the collector temperature limit control function – as soon as collector temperature has cooled down to below 100 °C and the temperature in the lower area of the storage tank (T2, T3 or T4) has at the same time dropped to a level at least 10 Kelvin below the storage tank temperature limit set.

In case of systems with two storage tanks (see Sections 3.2.7 and 3.2.8), this function is applied to the most recently loaded storage tank. If there are two collector panels (see Sections 3.2.9 and 3.2.10), this function is applied to the active panel / panels. If there are two separate circuits (see Section 3.2.11), one common collector temp. limit setting is used and applied to storage tank temp. limit1 or storage tank temp. limit2 setting respectively.

3.2.5 Storage priority no. (Appendix 10, Fig. E)

In solar energy systems with two storage tanks, this function is used to prioritise the loading of one of the storage tanks. The "priority storage no.:" window in the Functions menu offers three settings, which can be selected by pressing the OK button (hold down for 2 seconds). **"priority storage no.: 1" means that storage tank1 is prioritised for loading.** If "priority storage no.: 2" has been selected, storage 2 is prioritised for loading. "priority storage no.: 0" must be selected if neither of the storage tank is to be prioritised for loading. This means that the first storage tank to reach its switch-on temperature difference will be loaded.

If one of the two storage tanks is selected as the priority storage tank, then this storage tank will be loaded by preference whenever possible. Whilst loading the low-priority storage tank, the controller also constantly checks for the possibility of loading the priority storage tank (illustration 3).

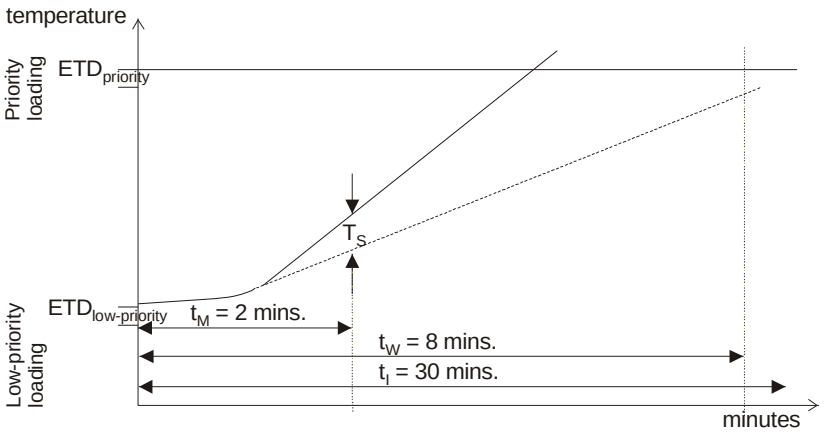
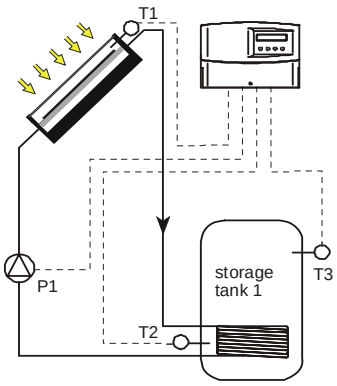


illustration 3: Check for the possibility of loading the priority storage tank

Legend
$ETD_{low\text{-}priority}$: Switch-on temperature difference of low-priority storage tank
$ETD_{priority}$: Switch-on temperature difference of priority storage tank
T_S: Temperature increase
t_M: Measuring time (fixed value 2 minutes)
t_W: Waiting time (fixed value 8 minutes)
t_I: Interval time (adjustable from 10 to 60 minutes)

Functionality:
Initially, the storage tank whose switch-on criteria (see Section 3.2.1) has been satisfied is loaded. If this turns out to be the low-priority storage tank, its solar energy circuit pump is switched off automatically after an adjustable period of time t_I (Parameters menu "Interval time: mins."). The pump is switched off initially for a measuring period t_M of 2 minutes. During this period the change in collector temp. at sensor T1 is acquired. The controller detects whether the temp. rise T_S at sensor T1 is sufficient to enable it to switch over to the priority storage tank. For this purpose, the increase in temp. T_S which is required to enable switching over from low-priority to priority storage tank is calculated by the controller's microprocessor. If the temperature at collector sensor T1 rises during the measuring period t_M by at least 25% of the set switch-on temperature difference (ETD) of the priority storage tank, the pump remains switched off until the switch-on criteria for the priority storage tank are satisfied. If this fails to take place within 8 minutes, or if the required temperature increase T_S was not achieved earlier during the measuring period t_M, then the system continues with the previous operating mode. Once the adjustable interval time t_I has elapsed, measurement begins anew.

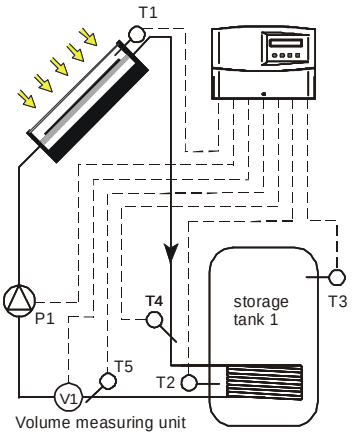
3.2.6 Single-circuit control in the standard system



This system layout ("single-circuit control") corresponds to the controller's basic factory setting when it is delivered. All the additional functions for systems with two storage tanks or two collectors are switched off. As soon as the collector temperature exceeds the temperature at the storage tank1 bottom sensor (T2) by a specified difference (which can be defined in the Parameters menu as "On-temperature difference1"), the circulating pump in the solar energy circuit is switched on. This pump remains in operation until the set storage tank maximum temperature1 (which can be set in the Parameters menu as "storage temp. limitation1") is reached, or the temperature falls below the set switch-off temperature difference1 (which can be set in the Parameters menu as "Off-temperature difference1").

Temperature sensor T3 is only used as an additional checking and monitoring point of measurement, and is not taken into account by the controller. If the temperature T3 is to be displayed in the menu "READINGS" , then the option "stt- display: ON" must be selected in the Functions menu.

3.2.6.1 Single-circuit control in the standard version, and calorimetry (App. 10, Fig. G)

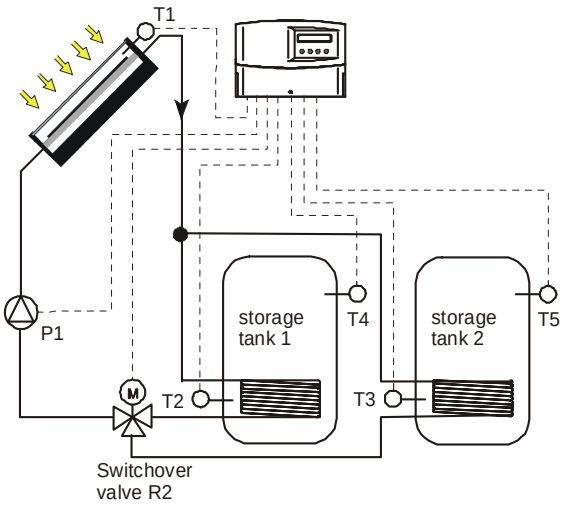


The function "calorimetry" can be added at any time to the previous system layout (3.2.6). To enable the quantity of heat fed into the storage tank by the solar energy system to be acquired, the function "calorimetry: ON" must be selected in the controller's Functions menu. A volume measuring unit with a pulse output (V1) and temperature sensors in both the solar feed flow(T4) and return flow (T5) also need to be installed. The configuration of these additional components is illustrated in the adjoining hydraulics diagram.

In order to calculate the heat quantity precisely, the pulse rate of the volume measuring unit used (WMZ litre/pulse) and the mixing ratio ("WMZ Glykol % by vol.") of the heat carrier medium (water/Glykol) must be set in the Parameters menu. The functionality of calorimetry is described in detail in Section 3.3.3.

3.2.7 Dual-storage control system with pump and 3-way valve (Appendix 10, Fig. I)

(Menu selection: "Dual-storage", "pump-valve")



To select the illustrated system layout of a dual-storage control system with a pump and a 3-way switchover valve on the controller, the following settings must be chosen in the Functions submenu.
"Dual-storage: ON" and **"pump-valve: ON"**.

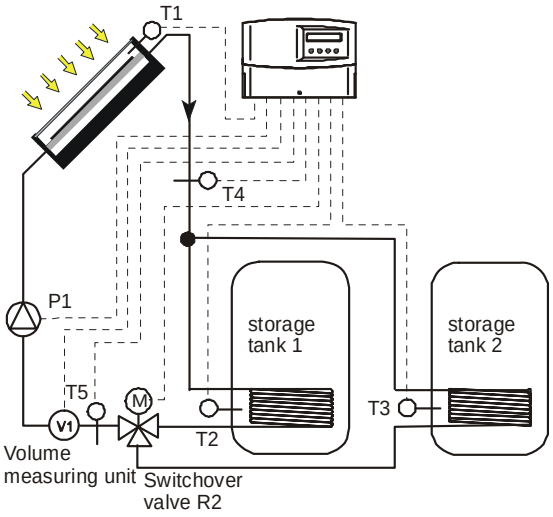
In the event that the menu items cannot be selected, a different system layout has already been activated. This must therefore be switched off first. The controller now constantly acquires the temperature differences between the collector sensor T1 and the two storage tank sensors T2 and T3. If one of the two switch-on temperature differences specified in the Parameters menu is reached, the solar energy circuit pump is switched on and the 3-way valve moved to the appropriate position (storage1 or storage2). A check is now performed to ascertain whether load priority (Section 3.2.5) has been assigned to one of the two storage tanks in the controller's Functions menu. If this is the case, and if the storage tank that is currently in line for loading is already the priority storage tank, then it is loaded until its switch-off criteria are satisfied (storage temperature limit reached, or falls below switch-off temp. difference). Then, as long as the switch-on criteria for the low-priority storage are satisfied, the 3-way valve is switched over to the low-priority storage. While the low-priority storage is being loaded, the switch-on criteria of the priority storage continue to be checked in order that it can be loaded again if necessary. If the low-priority storage is to be loaded first following switch-on, a specific method is used to constantly monitor the possibility of loading the priority storage tank (Section 3.3.3). In the event that no storage tank priority has been selected in the Functions menu (setting 0), the first storage tank whose switch-on criteria are satisfied is the first to be loaded.

Temperature sensors T4 and T5 are used as additional checking and monitoring points of measurement, and are not taken into account by the controller. If the temperatures of the two sensors are to be displayed in the Measured values menu, then "**Display Stt: ON**" must be selected in the Functions menu. If "stt-display" cannot be selected, the function "calorimetry" has already been activated. You should therefore first switch calorimetry off to enable "stt-display" to be selected.

Note: The body of the 3-way valve must be installed in such a way that storage 1 is loaded when there is no voltage applied to the valve. Care must also be taken to ensure that the temperature sensors are arranged in accordance with the diagram provided.

3.2.7.1 Dual-storage control system with pump, 3-way valve and calorimetry

(Menu selection: "Dual-storage", "pump-valve", "calorimetry")

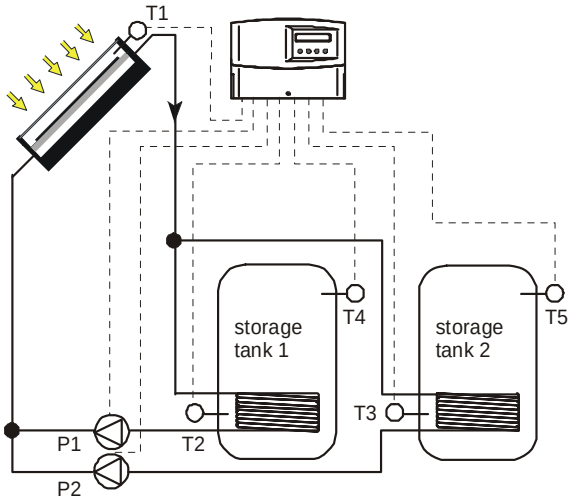


The function "Calorimetry" can be added at any time to the previous system layout (3.2.7). To enable the quantity of heat fed into the storage tank by the solar energy system to be acquired, the function "Calorimetry: ON" must be selected in the controller's Functions menu. A volume measuring unit with a pulse output (V1) and temperature sensors in both the solar feed flow (T4) and return flow (T5) also need to be installed. The configuration of these additional components is illustrated in the adjoining hydraulics diagram.

In order to calculate the heat quantity precisely, the pulse rate of the volume measuring unit used (WMZ litres/pulse) and the mixing ratio ("WMZ glycol % by vol.") of the heat carrier medium (water+glycol) must be set in the Parameters menu. The functionality of calorimetry is described in detail in Section 3.3.3.

3.2.8 Dual-storage control system with two pumps (Appendix 10, Fig. I)

(Menu selection: "Dual-storage", "pump-pump")



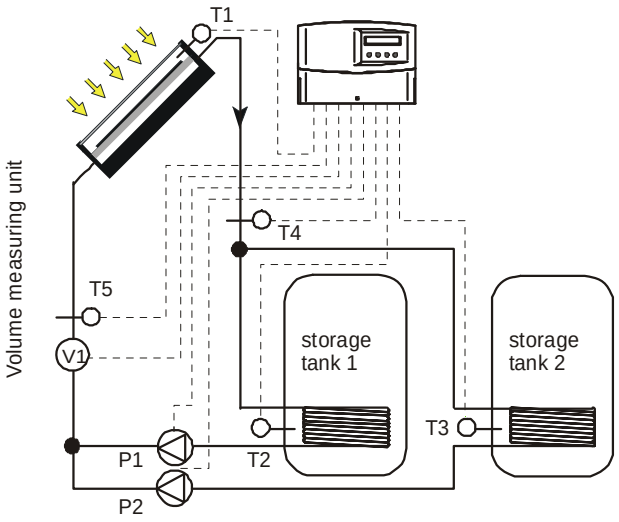
In order to select the dual-storage control system with two pumps on the controller as illustrated, the following settings must be chosen in the Functions submenu:
"**Dual-storage:** ON" and "pump-pump: ON".

In the event that the menu items cannot be selected, a different system layout has already been activated. This must therefore be switched off first. The controller now constantly acquires the temperature differences between the collector sensor T1 and the two storage tank sensors T2 and T3. If one of the two switch-on temperature differences specified in the Parameters menu is reached, the corresponding solar energy circuit pump will be switched on. The sequence of events is as follows: Storage tank1 is loaded by solar energy circuit pump P1 when the temperature difference between T1 and T2 has reached the specified switch-on temperature difference1 (Parameters menu). In the same way, for storage tank2 solar energy circuit pump P2 is switched on when switch-on temperature difference2 between temperature sensors T1 and T3 is reached. If one of the solar energy circuit pumps is in operation a check is performed to ascertain whether load priority (Section 3.2.5) has been assigned to one of the two storage tanks in the controller's Parameters menu. If this is the case, and if the storage tank that is currently being loaded is already the priority storage tank, then it is loaded until its switch-off criteria are satisfied (storage tank temperature limit reached, or falls below switch-off temperature difference). Then, as long as the switch-on criteria for the low-priority storage tank are satisfied, the pump for loading the low-priority storage tank is switched on. While the low-priority storage tank is being loaded, the switch-on criteria of the priority storage tank continue to be checked in order that it can be loaded again if necessary.

If the low-priority storage tank is to be loaded first following switch-on, a specific method is used to constantly monitor the possibility of loading the priority storage tank (Section 3.3.3). In case of no storage tank priority has been selected in the Functions menu (setting 0), the first storage tank whose switch-on criteria are satisfied is the first to be loaded. Temperature sensors T4 and T5 are used as additional checking and monitoring points of measurement, and are not taken into account by the controller. If the temperatures of the two sensors are to be displayed in the Measured values menu, then "**stt-display: ON**" must be selected in the Functions menu.

3.2.8.1 Dual-storage control system with two pumps and calorimetry

(Menu selection: "Dual-storage", "pump-pump", "calorimetry")

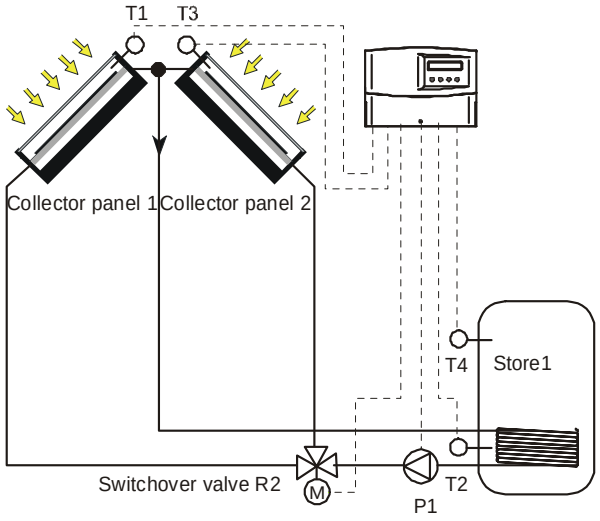


The function "calorimetry" can be added at any time to the previous system layout (3.2.8). To enable the quantity of heat fed into the storage tank by the solar energy system to be acquired, the function "calorimetry: ON" must be selected in the controller's Functions menu. A volume measuring unit with a pulse output (V1) and temperature sensors in both the solar feed flow (T4) and return flow (T5) also need to be installed.
The configuration of these additional components is illustrated in the adjoining hydraulics diagram.

In order to calculate the heat quantity precisely, the pulse rate of the volume measuring unit used (WMZ litres/pulse) and the mixing ratio ("WMZ glycol % by vol.") of the heat carrier medium (water+glycol) must be set in the Parameters menu. The functionality of calorimetry is described in detail in Section 3.3.3.

3.2.9 East / west collector orientation with pump and 3-way switchover valve (Appendix 10, Fig. J)

(Menu selection: "Dual-collector", "pump-valve")



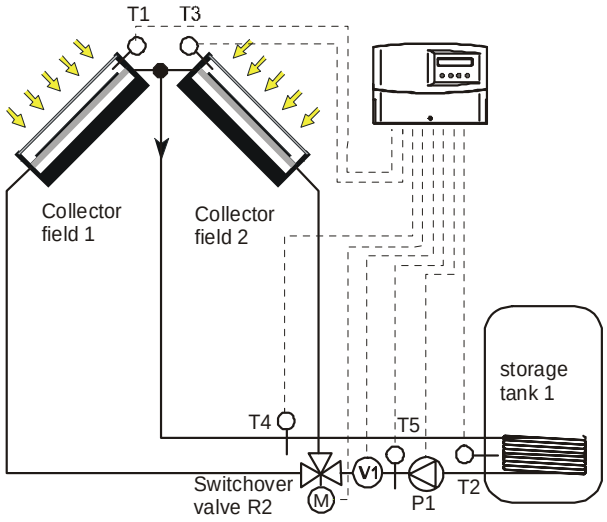
To select the illustrated system layout for a solar energy system with two collector panels oriented in different directions and storage tank loading using a pump and a 3-way valve on the controller, the following settings must be chosen in the Functions submenu:
"Dual-collector: ON" and "pump-valve: ON".

In the event that the menu items cannot be selected, a different system layout has already been activated. This must therefore be switched off first. The controller now continuously acquires the temperature differences between T2 (storage tank bottom) and T1 (collector panel 1) or T3 (collector panel 2), comparing them with switch-on temperature differences 1 and 2 as set in the Parameters menu. If one of the two switch-on criteria is satisfied, the solar energy circuit pump is switched on and the 3-way valve switched to the position which results in flow passing through the corresponding collector panel. During loading of the storage tank, continuous checking is performed for the possibility of switching over to the other collector panel. The switch-over criterion is for the temperature at the passive collector panel to be greater than the temperature at the active panel by an adjustable value (Parameters menu: "Switching hysteresis, collectors"). Irrespective of which collector panel is active, the storage tank continues to be loaded until either the storage tank temperature limit is reached or the temperature difference falls below the switch-off temperature difference. In this case both the solar energy circuit pump and the switchover valve are switched off (no voltage applied to the outputs). Temperature sensor T4 is used as an additional checking and monitoring point of measurement, and is not taken into account by the controller. If the temperature of the sensor is to be displayed in the Measured values menu, then "**stt-display: ON**" must be selected in the Functions menu.

Note: The body of the 3-way valve must be installed in such a way that flow passes through collector panel 1 when there is no voltage applied to the valve. Care must also be taken to ensure that the temperature sensors are arranged in accordance with the layout described above.

3.2.9.1 East / west collector orientation with pump and 3-way switchover valve and calorimetry

(Menu selection: "Dual-collector", "pump-valve", "calorimetry")

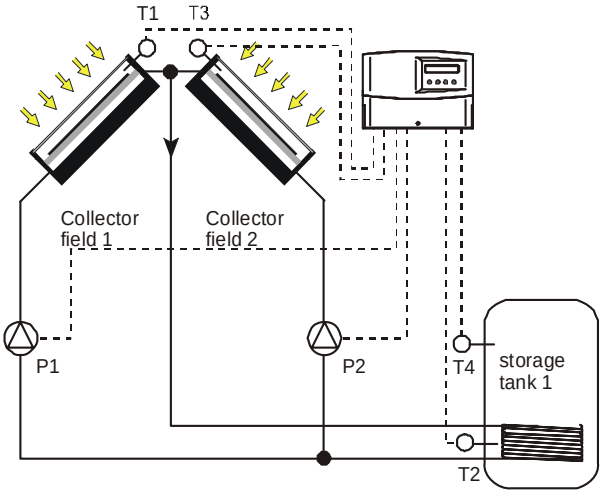


The function "calorimetry" can be added at any time to the previous system layout (3.2.9). To enable the quantity of heat fed into the storage tank by the solar energy system to be acquired, the function "**calorimetry: ON**" must be selected in the controller's Functions menu. A volume measuring unit with a pulse output (V1) and temperature sensors in both the solar feed flow(T4) and return flow (T5) also need to be installed. The configuration of these additional components is illustrated in the adjoining hydraulics diagram.

In order to calculate the heat quantity precisely, the pulse rate of the volume measuring unit used (WMZ litres/pulse) and the mixing ratio ("WMZ glycol % by vol.") of the heat carrier medium (water+glycol) must be set in the Parameters menu. The functionality of calorimetry is described in detail in Section 3.3.3.

3.2.10 East / west collector orientation with 2 pumps (Appendix 10, Fig. J)

(Menu selection: "Dual-collector", "pump-pump")



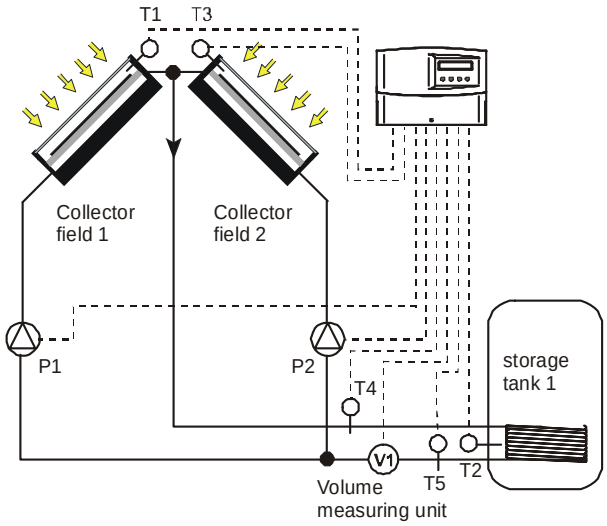
To select the illustrated system layout for a solar energy system with two collector panels oriented in different directions and storage tank loading using two solar energy circuit pumps on the controller, the following settings must be chosen in the Functions submenu: **"Dual-collector: ON" and "pump-pump:** ON".

In the event that the menu items cannot be selected, a different system layout has already been activated. This must therefore be switched off first. The controller now continuously acquires the temperature differences between T2 (storage tank bottom) and T1 (collector panel 1) or T3 (collector panel 2). Depending on which collector panel's switch-on temperature difference is reached first, either solar energy circuit pump 1 is switched on for collector panel 1 or solar energy circuit pump 2 for collector panel 2. During loading of the storage tank, checks continue to be performed to determine whether the switch-on temperature difference for the second collector panel has also been reached. In this event the second solar energy circuit pump is switched on as well. **In this system both pumps can be used at the same time. therefore the switch-over criterion (Parameter menu: "Switching hysteresis, collectors") is not taken into account by the controller**. If the temperature difference falls below switch-off temperature difference1 or switch-off temperature difference2, then the corresponding pump is switched off. When the storage tank temperature reaches the set maximum, both solar energy circuit pumps are switched off. Temperature sensor T4 is used as an additional checking and monitoring point of measurement, and is not taken into account by the controller. If the temperature of sensor T4 is to be displayed in the Measured values menu, then "**stt-display: ON**" must be selected in the Functions menu.

Note: For proper functioning of the control system it is essential that the hydraulic pipes are set up in accordance with the system layout specified above. This means pump P1 (controller output R1) along with the associated collector sensor T1 have to form collector panel 1, and pump P2 (controller output R2) along with collector sensor T3 have to form collector panel 2. It is essential to ensure that the temperature sensors are arranged in accordance with the above layout.

3.2.10.1 East / west collector orientation with 2 pumps and calorimetry

(Menu selection: "Dual-collector", "pump-pump", "calorimetry")

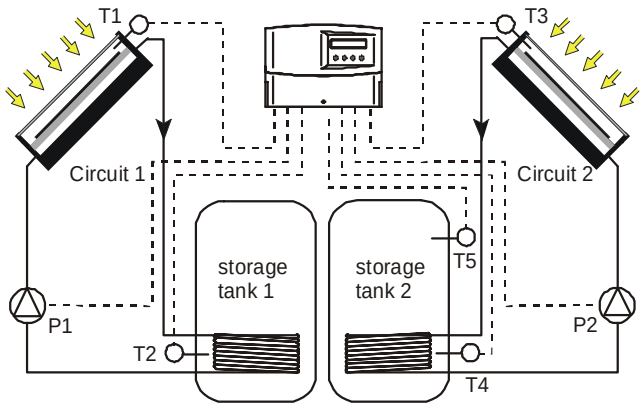


The function "calorimetry" can be added at any time to the previous system layout (3.2.10). To enable the quantity of heat fed into the storage tank by the solar energy system to be acquired, the function "**calorimetry: ON**" must be selected in the controller's Functions menu. A volume measuring unit with a pulse output (V1) and temperature sensors in both the solar feed flow (T4) and return flow (T5) also need to be installed. The configuration of these additional components is illustrated in the adjoining hydraulics diagram.

In order to calculate the heat quantity precisely, the pulse rate of the volume measuring unit used (WMZ litres/pulse) and the mixing ratio ("WMZ glycol % by vol.") of the heat carrier medium concerned (water+glycol) must be set in the Parameters menu. The functionality of calorimetry is described in detail in Section 3.3.3.

3.2.11 Two self-contained solar energy system circuits (Appendix 10, Fig. K)

(Menu selection: "Dual circuit")



In order to select the solar energy system with two independent solar energy circuits on the controller as illustrated, the following setting must be chosen in the Functions submenu: "**Dual-circuit:** ON".

In the event that the menu item cannot be selected, a different system layout has already been activated. This must therefore be switched off first. Once the setting has been selected the controller offers the following functions:

Circuit 1:

The solar energy circuit pump P1 is switched on by a temperature difference function. As soon as the collector temperature T1 exceeds the temperature at the storage tank1 bottom sensor by a specific temperature difference, the circulating pump (P1) in solar energy circuit1 is switched on. The pump continues to operate until the set maximum storage tank temperature1 is reached, or until the temperature falls below the associated switch-off temperature difference1.

Circuit 2:

Solar energy circuit 2 is controlled in the same way as solar energy circuit 1.
In solar energy circuit 2: T3 = collector temperature, T4 = temperature at storage tank2 bottom , P2 = solar energy circuit pump. The following settings can be adjusted in the Parameters menu: switch-on temperature difference2, switch-off temperature difference2 and maximum storage tank temperature2.

Temperature sensor T5 is used as an additional checking and monitoring point of measurement, and is not taken into account by the controller.

Note: For proper functioning of the control system it is essential that the hydraulic pipes are set up in accordance with the system layout specified above. That means pump P1, storage tank1 and the temperature sensors T1 and T2 have to form solar energy system circuit 1. Solar energy system circuit 2 consists of pump P2, storage tank2 and the temperature sensors T3 and T4.

3.2.12 Manual operation of the switch outputs (Appendix 10, Figs. L and M)

For maintenance and repair operations the two switch outputs R1 and R2 can be switched on and off manually. First, the relevant output must be selected in the "MAN.OPERATION" submenu. In order to activate a different switch state the OK button must be pressed and held down for 2 seconds. This setting remains active until the menu button is used to exit the Manual Operation submenu.

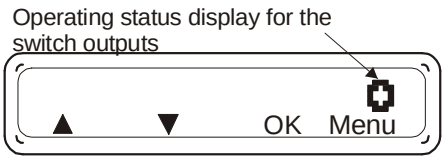
Caution: The controller does not change back to automatic operating mode or take into account the current system parameters and measured values until the Manual Operation submenu has been exited.
This menu must therefore be exited once the maintenance or repair operations have been completed.

3.3 Monitoring and control functions

Overview of functions

- **Display operating status of switch outputs**
- **Display temperature of storage tank top sensor**
- **Calorimetry**
- **Acquisition of operating hours**
- **Storage of minimum and maximum measured temperature values**
- **Temperature sensor detection (PT1000 or KTY81-210)**
- **Temperature sensor monitoring and fault diagnosis**

3.3.1 Display operating status of the switch outputs



The active status of the switch outputs is indicated in the controller's LCD display my means of an alternating display of the symbol ✪ and the numbers 1 or 2. The display can be seen in all the menus. If output R1 is switched on, the symbol ✪ and the number **1** change in a 0.5 second cycle. If both outputs (R1 and R2) are active, first **1** and then **2** are displayed following the symbol ✪.
If the symbol does not alternate neither of the outputs is active.

3.3.2 Display temperature of storage tank top sensor (Appendix 10, Fig. F)

Depending on the system layout, temperature sensors T3, T4 and T5 are available for temperature display. The sensors are used as an additional checking and monitoring point of measurement, and are not taken into account by the controller. If the sensor temperature is to be displayed in the Measured Values menu, then "**stt-display: ON**" must be selected in the "Functions" menu. If "stt-display" cannot be selected, the function "calorimetry" is activated. You should therefore first switch off "Calorimetry" to enable "stt-display" to be selected. If the function "calorimetry" is switched on with the "stt-display" active, the controller will deactivate "stt-display" and switches over automatically to "calorimetry".

3.3.3 Calorimetry (Appendix 10, Fig. G)

Using a volume measuring device with a pulse output (V1) and the temperature difference between solar feed flow and solar return flow(sensors T4 and T5), the solar energy fed into the service water storage tank is acquired and constantly added up. The accumulated heat quantity is displayed on the controller's LCD display The user also has the possibility to acquire the heat quantity over any period of time, and to reset this value. It can be reset by pressing the OK button (and holding it down for 2 seconds).

A temperature-dependent correction of density and heat capacity is performed in the microprocessor controller's arithmetic unit.. Varying mix ratios of antifreezer and water can be specified through the Operation menu.

Note: Within the calorimetry function, the controller's microcontroller takes into account the physical characteristics of the frequently-used solar fluid propylene glycol (trade name: Tyfocor L). The mix ratio along with physical characteristics such as density capacity and heat capacity are included in the calculation. The use of a different solar fluid can lead to variances in the calculation. The heat quantity in pure drinking water can be acquired as well. For this purpose you should set the mix ratio (Parameters menu: "WMZ Glycol % by vol.") to zero.

Installation hints: When installing the temperature sensors T4 (solar feed flow) and T5 (solar return flow), they must be positioned correctly (see system layouts). The volume measuring unit should always be installed in the solar return flow of the solar energy circuit due to the temperature-related stress. We recommend that there should be a straight tube section of at least 300 mm leading into the volume measuring unit.

3.3.4 Acquisition of operating hours

The operating hours of the solar energy circuit pumps and switchover valve are acquired all the time they are in operation, and constantly added up. The operating hours are displayed in the Measured Values menu at "operate R1" and "operate R2". The user also has the possibility to acquire the operating hours over any period of time, and to reset this value. It can be reset by pressing the OK button (and holding it down for 2 seconds).

3.3.5 Display of minimum and maximum values

For the purpose of monitoring the system, the minimum and maximum values for collector temperature, storage tank bottom temperature and storage tank top temperature (if selected in the Function menu) are acquired and stored. These values can be reset at any time by pressing the OK button (and holding it down for 2 seconds).

3.3.6 Detection of sensor type (Appendix 10, Fig. H)

To avoid mistakes due to installation of wrong types of temperature sensors, the control system automatically detects whether a factory-supplied standard temperature sensor of type PT1000 or type KTY81-210 has been installed, and takes it into account when controlling and operating the system. As a general rule both of these sensor types may be used, and both are recognised automatically by the controller.

Note: This function does not apply to the collector sensors since the resistance values of PT1000 and KTY sensors overlap to a certain extent, thus a correct automatic identification couldn't be guaranteed.

Initially PT1000 sensors are supposed to be used as collector sensors. But the sensor type can be changed manually to KTY81-210 in the Functions submenu. If a KTY sensor is used you must select the menu item "coll. sensor T1" and press the OK button (hold for 2 seconds) until the display "KTY: ON" appears on the LCD display. The functions "Dual-collector" and "Dual-circuit" provide the facility to select the type of the second collector sensor (T3) in menu item "coll. sensor T3" as described above.

3.3.7 Sensor monitoring and fault diagnosis

The controller continuously checks the connected sensors for failure, damage or short circuits. 10 seconds after a fault is detected an error message identifying temperature sensor and failure (e.g. short circuit T1) is shown on the LCD display. The error must be fixed and acknowledged subsequently by one of the four buttons before the controller returns automatically to normal operating mode. In the event that the fault has not been fixed, a fault message will appear again within 10 seconds of the acknowledgement being given. If the function "stt-display: ON" has been selected in the Functions menu, the corresponding sensors are also included in the sensor diagnosis.

Note: After a fault has occurred, any pump / valve directly affected by the sensor defect is switched off automatically. The only exception to this rule is "Manual operation", in which no system parameters or measured values are taken into account for maintenance and repair purposes.

4 Configuration

The controller is shipped from the manufacturer with settings for the "Single-circuit control system" layout described in section 3.2.6. If a different system layout is required, this can be selected using the Function menu. Basic settings for each system layout are programmed by the manufacturer, these can be used unaltered for most applications. If parameters are altered incorrectly, they can be reset to the factory settings using the "initialisation factory setting" function (Appendix 10, Fig. N) in the Manual Operation menu. To do this press the OK button and hold it down for 2 seconds. Please note in this connection that any parameters changed to custom settings and selected functions must be modified subsequently again to match the system concerned.

⚠ **If you do not have the courage to configurate the controller yourself please contact your authorised 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 V AC (±15%) at a frequency of 50 Hz [or optional 115 V (±15 %), 60 Hz]. Using this controller for other V and Hz values is not allowed. Please note as well that the admissible nominal currents must not be exceeded.

If there is an earthed conductor planed or prescribed for pump or switchover valve it MUST be connected. There are corresponding connection clamps. Please make sure that the earthing contact is led to the controller on the power supply side as well.

Wires that are not permanently connected with the building have to be equipped with a strain 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 its type of protection (see section 8) is sufficient. The maximum and. minimum permissible ambient temperature at the place of installation must never be exceeded respectively. 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!

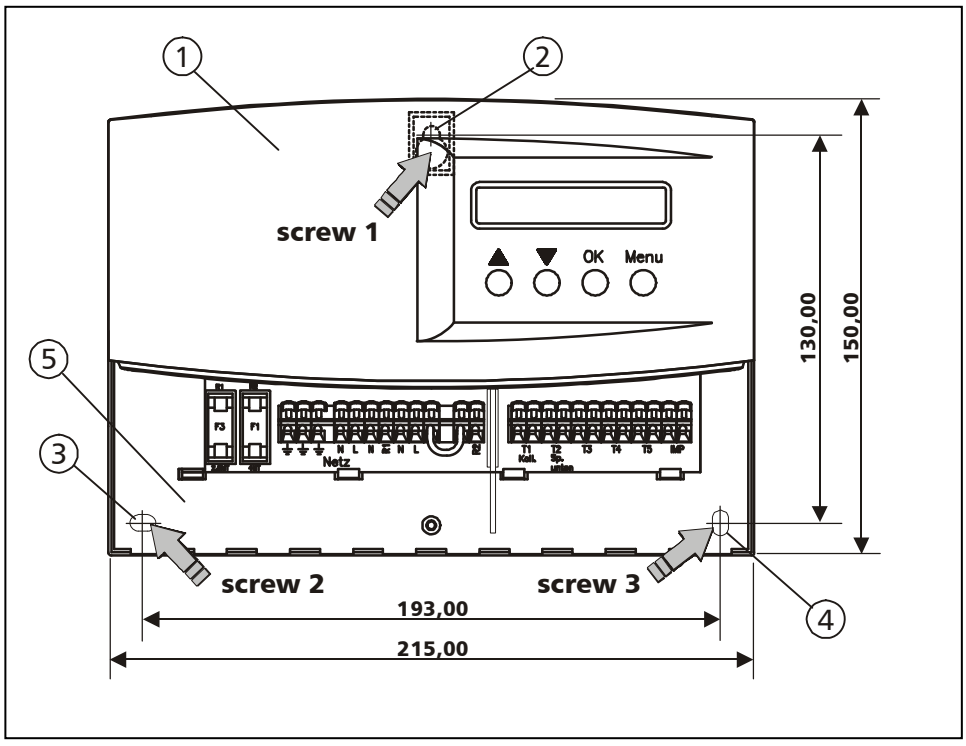


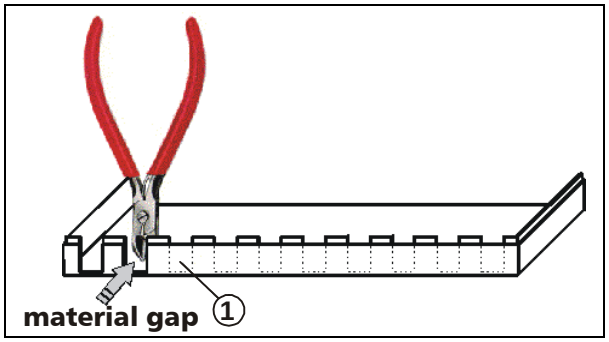
illustration 4: installation

5.2 Installation

Installation on walls

The upper controller cover (Illustration 4, 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 4, 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.

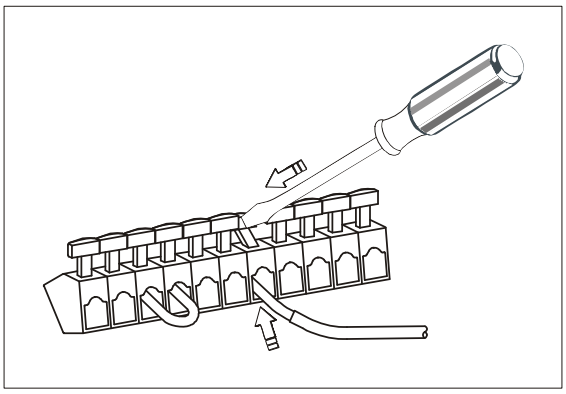
5.3 Connecting the controller



First of all wire feed-throughs for the power supply connection and the connecting wires of the sensors and the pumps / valve have to be cut into the casing box. For this purpose there are material tapering (Illustration 5, Pos. ①) to be cut out. Each wire input needs two vertical cuts into the side of the plastic case. For the cutting you can use a 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 5: 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 controller from the power supply. Stick to all valid regulations for working on a 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 type of protection is not violated.**



Connect power supply and pump / valve connecting wires to the prescribed clamps (Illustration 7, Pos ① to ⑫). Each clamp can only be furnished with one connecting wire (up to 2.5 mm^2). For fine-strand wires please use end sleeves. Outside the controller the wires must be strain-relieved.
Storage and collector sensor are to be connected to the prescribed clamps (Illustration 7, Pos ⑬ to ㉒). 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).

illustration 6: connection clamp

⚠ **If the pumps or the switchover valves are planed or prescribed for being connected to an earthed conductor this MUST also be connected. For this purpose there are clamps. Please make sure that the earthing contact is led to the controller on the power supply side as well.**

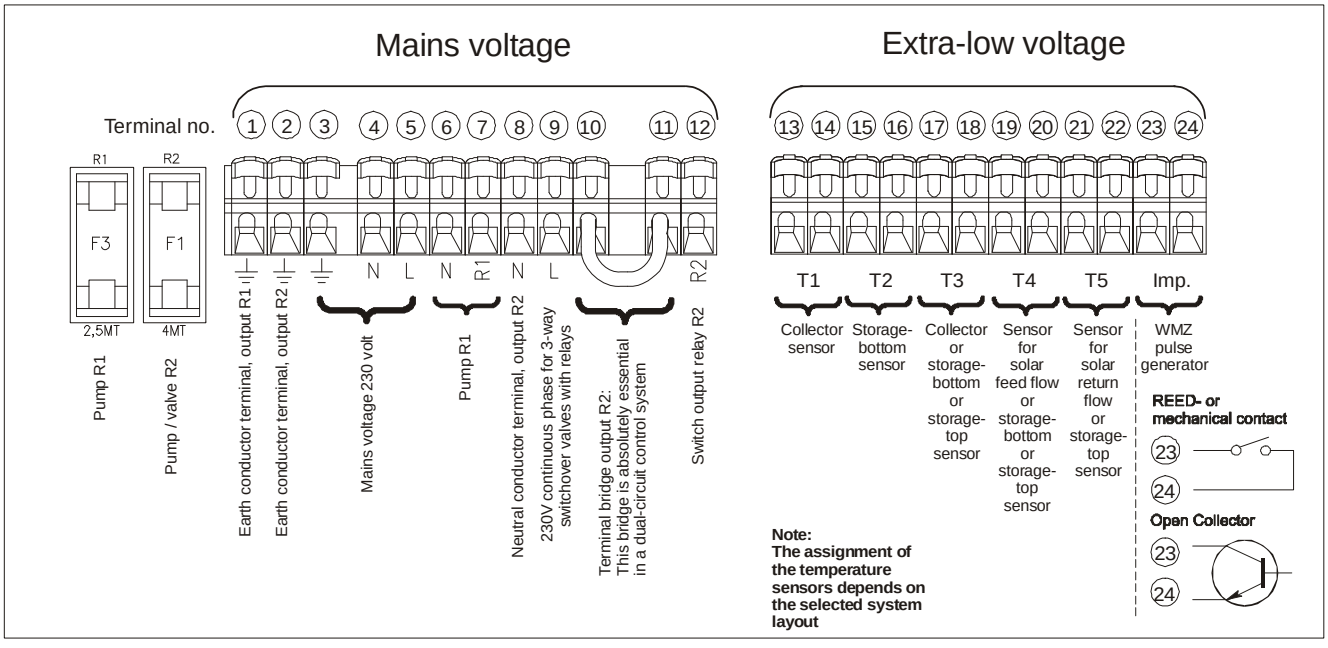


illustration 7: controller clamps

Connections:

Mains voltage 230 V / 50Hz [or optional 115 V (±15 %), 60 Hz]**:**
⑤ = Phase conductor L
④ = Neutral conductor N
③ = Earth conductor PE

Pump output R1:
⑦ = Pump relay R1 (switched phase for pump)
⑥ = Neutral conductor N
① = Earth conductor PE

Output R2:
⑫ = Relay R2 (pump or valve)
⑧ = Neutral conductor N
② = Earth conductor PE
⑩ + ⑪ = Terminal bridge R2: The terminal bridge is used to provide 230 V [115 V] to the switching output R2. Without this bridge ⑪ + ⑫ could be used as floating output.
⑨ = 230 V [115 V] continuous phase for 3-way switchover valves with relays

Temperature sensors (according to system layout) :
⑬ + ⑭ = Collector temperature sensor
⑮ + ⑯ = Storage tank bottom temperature sensor
⑰ + ⑱ = Collector or storage tank bottom or storage tank top temperature sensor
⑲ + ⑳ = Calorimetry (solar feed flow) or storage tank bottom or storage tank top temperature sensor
㉑ + ㉒ = Calorimetry (solar return flow) or storage tank top temperature sensor

Note: The assignment of the temperature sensors depends on the selected system layout.

Connecting the temperature sensors, polarity is irrelevant.

Type PT1000 temperature sensors are precision platinum temperature sensors equipped with a 1.5 m-long silicone cable that is resistant to weathering and temperature. The temperature sensors and silicone cables are temperature-resistant up to +180 °C. This is the preferred type to use for collector temperature acquisition and, due to its high degree of precision and linearity, also for calorimetry.

Temperature sensors of type KTY81-210 are standard temperature sensors equipped with a 2.0 m-long PVC cable. Temperature sensors and PVC cables are temperature-resistant to 105 °C and are therefore used preferentially for acquiring the storage tank temperatures.

Factory-supplied temperature sensors have a diameter of 6 mm.

All sensor leads carry extra-low voltage and must be routed separately from leads carrying 230 V [115 V] or 400 V (minimum distance 100 mm) in order to avoid the possibility of inductive interference. If there is a likelihood of external inductive interference, e.g. from power cables, contact wires, transformer stations, radios and televisions, CB radio stations, microwave appliances etc., then shielded lines should be used for carrying the measurement signals.

The sensor cables can be extended up to approx. 100 m in length. When extending the cable you should use cable with a cross-section of 1.5 mm^2 up to 100 m and 0.75 mm^2 up to 50 m.

Pulse generator:

㉓ + ㉔ = Pulse input for volumetric flow meter (used for acquiring the heat quantity)

If pulse generators with a "reed switch" are used, any polarity is permissible in the connection. If an "open collector" circuit is being used, the polarity must be paid attention to (see Fig. 7).

Once the terminal area (Fig. 4, item ⑤) has been closed with terminal box cover and the associated housing screw, mains power can be switched on. After mains power has been switched on, the first program menu, Measured Values, should appear in the controller's LCD display.

The Manual Operation submenu (Section 3.2.12) allows a manual check to ascertain whether the connected pumps can be switched ON or OFF. Once the commissioning process or any maintenance operations that may be necessary have been completed, this service function should be exited and control switched to the Measured Values main menu.

6 Faults and troubleshooting

⚠ **Caution! Disconnect the controller from the mains before opening the housing.**

The controller has been designed to provide many years of continuous service. Faults may, of course, occur nonetheless. However, the cause of the fault can very often be found not in the controller but in the peripheral system components. The following descriptions of a number of common faults should help the installation engineer and the user to locate the cause of the problem in order to get the system running again as quickly as possible and avoid any unnecessary costs. It is of course impossible to list all the possible causes of faults, but you should find that the list includes the most common causes covering the majority of faults associated with the controller. Only return the controller to the factory if you have first made sure that the fault that has occurred is none of those described.

The basic factory settings can be reinstated at any time using the menu function "Initialise factory settings" (see Chapter 4 "Configuration").

Solar energy circuit pump not running although the collector temp. is above the storage tank temperature

Secondary condition:	Possible cause:
LCD display off	No power supply, possibly defective fuse or supply line
"Manual Operation" submenu selected	Solar energy circuit pump switched manually to OFF
Storage tank temperature is close to or above the set maximum storage tank temperature	Storage tank temperature limitation has switched off the pump
Fault displayed	Sensor lead or sensor defective or disconnected. **NOTE: Depending on the system layout selected, in the event of a fault in sensors T1, T2, T3 or T4, outputs R1 and R2 are switched off.**
Operating status display of the pump is shown as active but it does not run	Possibly defective fuse of the output

Collector sensor indicates a false temperature value

Secondary condition:	Possible cause:
The collector sensor T1, T3 indicates an incorrect value or even "short circuit "	An incorrect temperature sensor has been selected for collector temperature acquisition in the "Functions" submenu (KTY or PT1000)

Calorimetry acquires zero or incorrect heat quantity although the solar energy pump is operating

Possible cause:

- Temperature sensor T4 (feed flow temperature) or temperature sensor T5 (return flow temperature) or external volumetric flow sensor (pulse controller input) have either not been connected or have been connected incorrectly.
- "Calorimetry" function has not been selected.
- The feed flow and return flow temperature sensors are the wrong way round.
- The pulse value of the volumetric flow sensor has been entered incorrectly.
- The mix ratio of water and solar fluid has been specified incorrectly.
- Instead of Tyfocor L, another medium with different properties has been used as solar fluid.
- Volume measuring device has been installed in the wrong flow direction.
- If the volume measuring device has a filter, that may have become blocked.
- There could be air in the solar energy circuit.

Error message in the controller's LCD display:

Short circuits and interruptions in the individual temperature sensors are only reported if the sensors concerned are actually in use on the basis of the selected functions.

The controller automatically detects the faults described next and reports them on the display device after 10 secs. Depending on the system layout selected, when a fault occurs with sensors T1, T2, T3 or T4 outputs R1 and R2 are switched off for safety reasons. If the fault is repaired the controller automatically returns to normal operation. However, the fault message remains on the display device until it is acknowledged by pressing any button. If, despite the fault message, a fault is not repaired but the message is nonetheless acknowledged, then the fault message is displayed again after 10 seconds. If several faults occur at the same time, the lowest-ranking fault is always displayed (e.g. first T1, then T2 etc.).

Message displayed	Meaning
Short circuit T1	Short circuit in sensor lead T1 for acquiring collector temperature (or wrong sensor type chosen)
Interruption T1	Interruption in sensor lead T1 for acquiring collector temperature
Short circuit T2	Short circuit in sensor lead T2 for acquiring "storage tank bottom" temperature
Interruption T2	Interruption in sensor lead T2 for acquiring "storage tank bottom" temperature
Short circuit T3	Short circuit in sensor lead T3 for acquiring collector temperature or "storage tank top" or "storage tank bottom" temperature
Interruption T3	Interruption in sensor lead T3 for acquiring collector temperature or "storage tank top" or "storage tank bottom" temperature
Short circuit T4	Short circuit in sensor lead T4 for acquiring the temperature in "solar feed flow" or "storage tank bottom" or "storage tank top"
Interruption T4	Interruption in sensor lead T4 for acquiring the temperature in " solar feed flow " or "storage tank bottom" or "storage tank top"
Short circuit T5	Short circuit in sensor lead T5 for acquiring the temperature in " solar return flow " or "storage tank top"
Interruption T5	Interruption in sensor lead T5 for acquiring the temperature in " solar return flow " or "storage tank top"

Temperature sensor troubleshooting

Temperatures are captured by devices known as resistance sensors. The types concerned are the PT1000 and/or KTY81-210. The resistance value depends on the temperature. An ohmmeter can be used to check whether or not a sensor is defective. This is carried out by disconnecting the temperature sensor concerned from the controller and then measuring the resistance value. The two tables below list the typical resistance values with the associated temperatures. It should be noted that slight variations are permissible.

Resistance values in temperature 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 Guarentee

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 and/or KTY 81-210
1 x pulse determination	pulse counter (1…99 litre/pulse)
• 2 outputs	
R1	Triac for speed control, max. switch. capacity 200 W at 230 V [or 100 W / 115 V]
R2 as 230 V [115 V] switch output	relay, max. switching capacity 800 W at 230 V [or 400 W at 115 V]
• Both outputs are protected against overloading and short circuits.	
• Setting ranges	
On-temperature difference1	4...17 K
On-temperature difference2	4...17 K
Off-temperature difference1	2...15 K
Off-temperature difference2	2...15 K
• Display	LCD display, 2 lines, 16 characters each menu-driven with plain text display
• Type of protection	IP 20 / DIN 40050
• Permissible ambient temperature	0°C to +45 °C
• Installation	Wall mounting
• Weight	490 g
• Casing	recyclable 3-piece plastic case
• Dimensions LxWxH (mm)	150 x 215 x 43 mm
• Temperature sensor: PT1000	1,5 m Silicone cable, measuring range up to 180 °C

9 Preset standard configurations

In the submenu "*MAN.OPERATION*" you can configurate a "*initialisation factory setting*." (preset configuration by the manufacturer). This means that individual configuration of paramenter values and function are deleted from the controller memory and subsequently the preset configurations are valid again.

After a power failure there is no need to enter parameter values or function configurations again since these values are stored in the EEPROM of the controller.

On delivery the following parameters and functions are configurated. 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 an 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.

Device name and Commissioning date:

Types of sensor used (place a cross or tick in the corresponding boxes if making a complaint):

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

Parameter settings (please specify if making a complaint):

parameter	Factory setting	configuration range	preset values (customer specification)
On-temperature difference1 (On-TDiff1)	8 K	(„Off-TDiff1“+2)...17 K	
On-temperature difference2 (On-TDiff2)	8 K	(„Off-TDiff2“+2)...17 K	
Off-temperature difference1 (Off-TDiff1)	4 K	2 K...(„On-TDiff1“-2) K	
Off-temperature difference2 (Off-TDiff2)	4 K	2 K...(„On-TDiff2“-2) K	
storage temp. limitation1 (STL1)	60 °C	20...95 °C	
storage temp. limitation2 (STL2)	60 °C	20...95 °C	
storage temp. limitation hysteresis	3 K	Fixed value	-
switch hyster. collectors	8 K	2...17 K	
collector temp. limitation	110 °C	80...120 °C	
collector temp. limitation hysteresis	10 K	Fixed value	-
Prevention of repeat switch-on	130 °C	Fixed value	-
Prevention of repeat switch-on, hysteresis	30 K	Fixed value	-
calorimetry [litre/pulse]	1	0...99	
calorimetry Glycol Vol. % (= mix ratio)	40 %	0...99 %	
interval time	30 min	10...60 min	

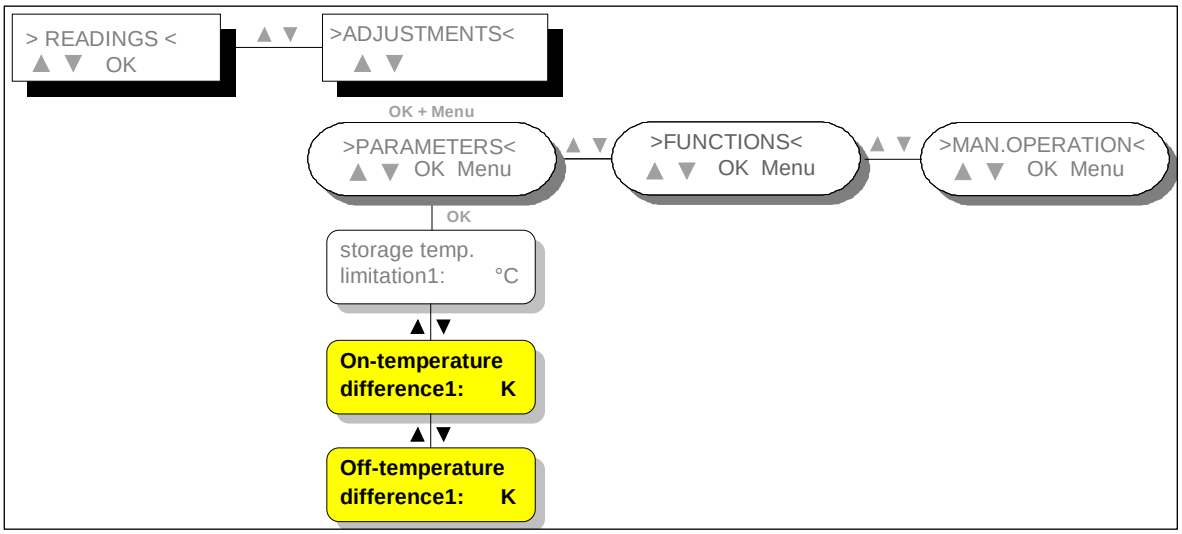
Function settings (please specify if making a complaint):

Functions	Factory presetting	Actual value (customer setting)
stt-display:	OFF	
calorimetry:	OFF	
collector temp. limitation:	OFF	
coll. sensor T1 KTY: ___ PT: ___	KTY: OFF PT: ON	KTY: ___ PT: ___
coll. sensor T3 KTY: ___ PT: ___	KTY: OFF PT: ON	KTY: ___ PT: ___
speed control:	ON	
Dual-storage:	OFF	
pump-pump: ___ pump-valve: ___	pump-pump: OFF pump-valve: ON	pump-pump: ___ pump-valve: ___
priority storage no.:	1	priority storage no.: _
Dual-circuit:	OFF	
Dual-collector:	OFF	

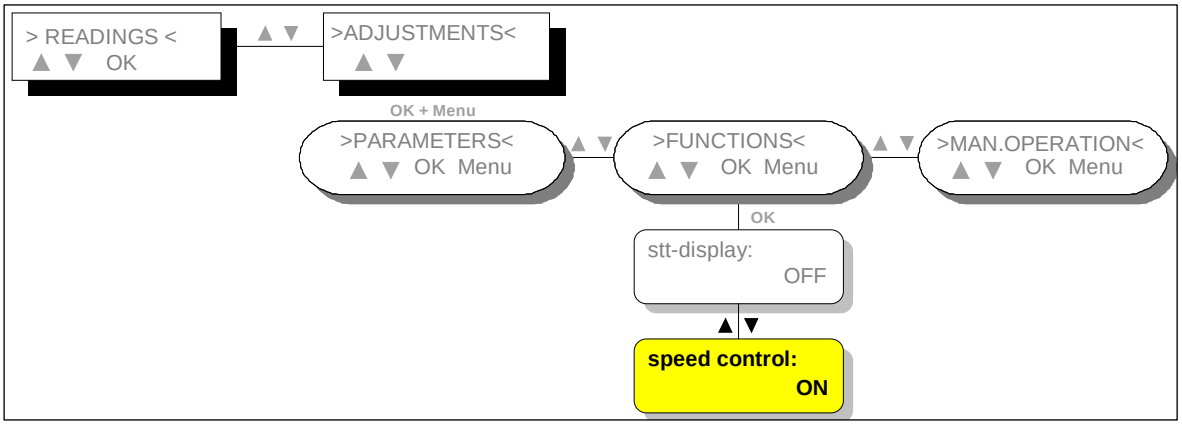
10 Appendix

Diagrams on menu control

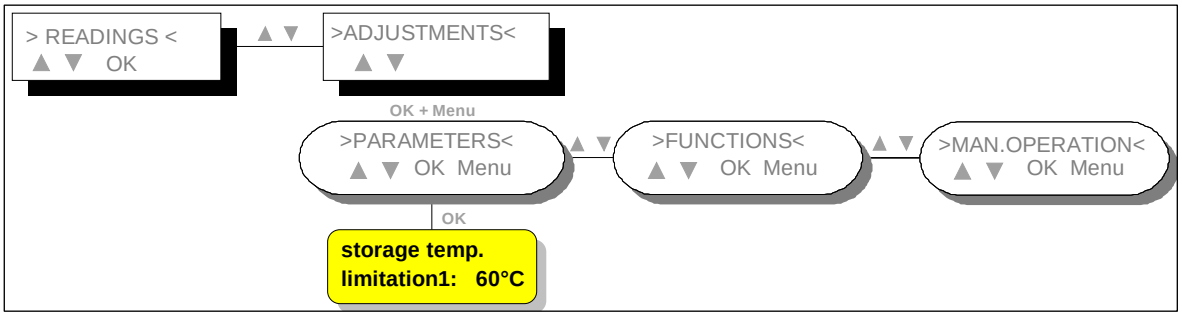
Picture A **Setting the switch-on and switch-off parameters**



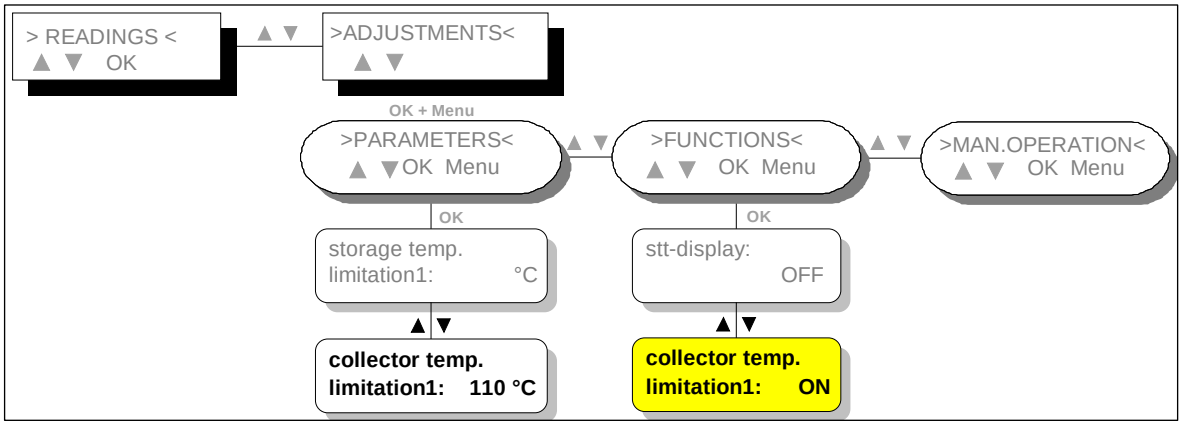
Picture B **Speed control**



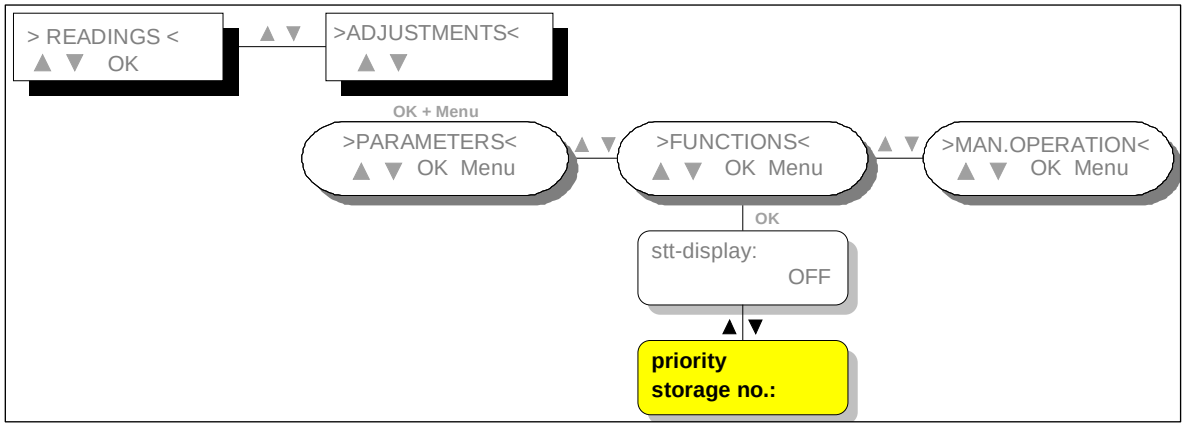
Picture C **Storage temperature limitation**



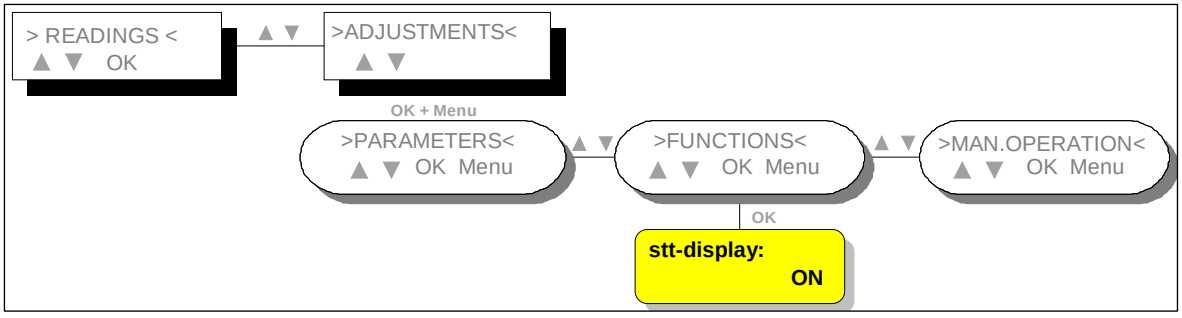
Picture D collector temperature limitation



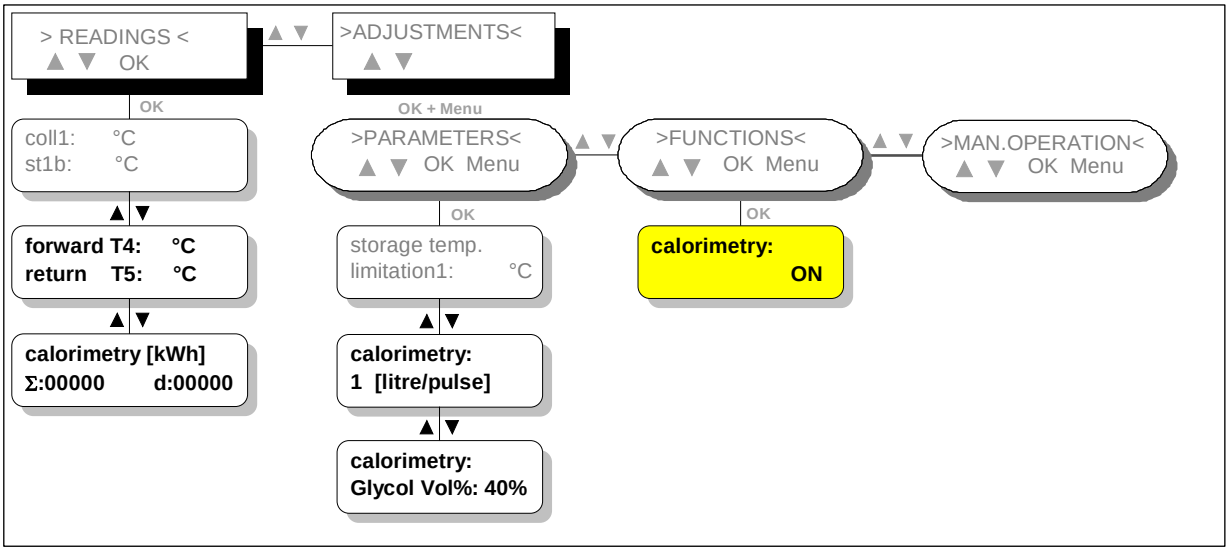
Picture E priority storage function



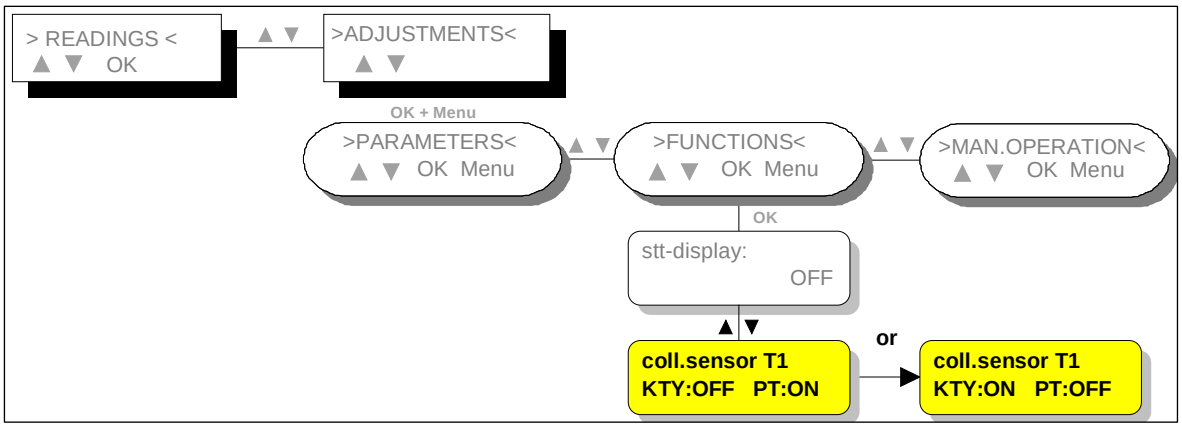
Picture F Storage temperature top display



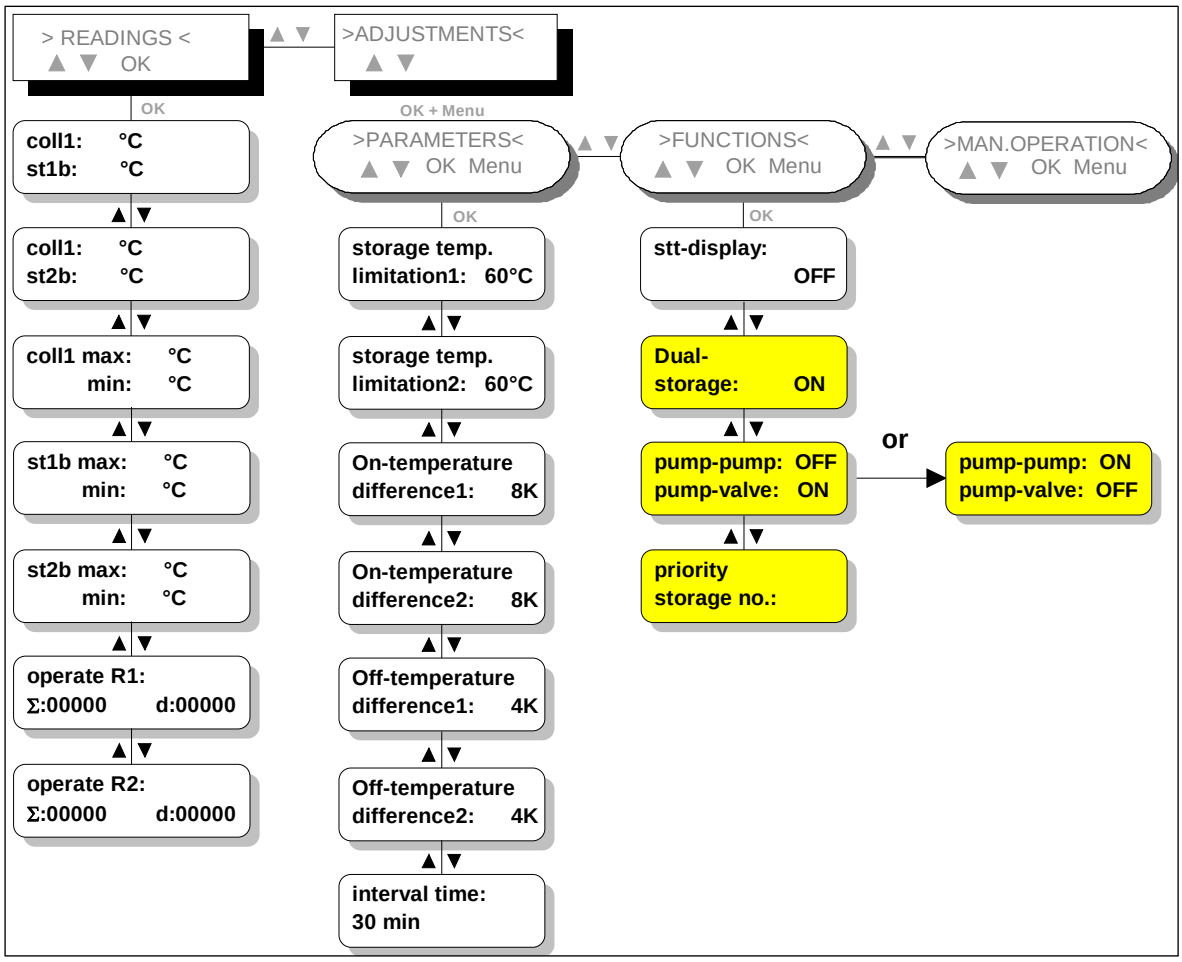
Picture G **calorimetry**



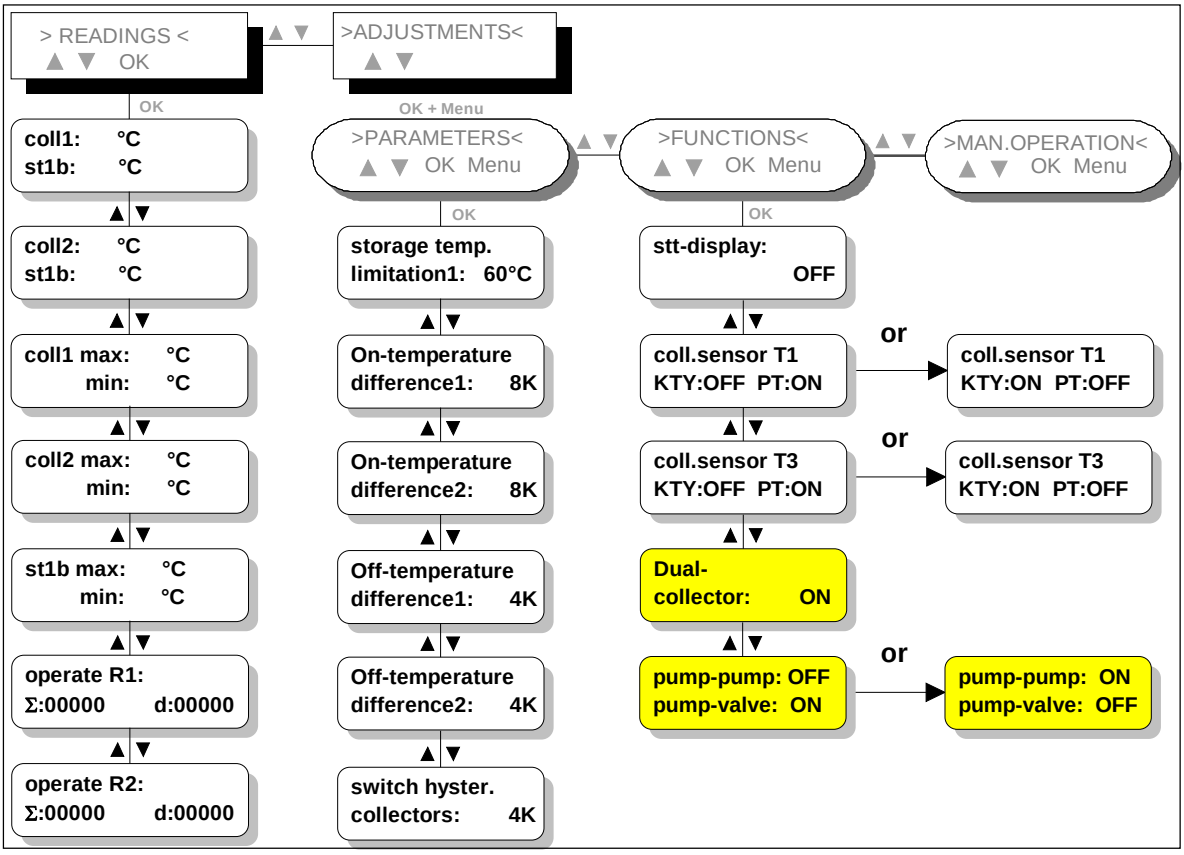
Picture H **selection of collector sensor type**



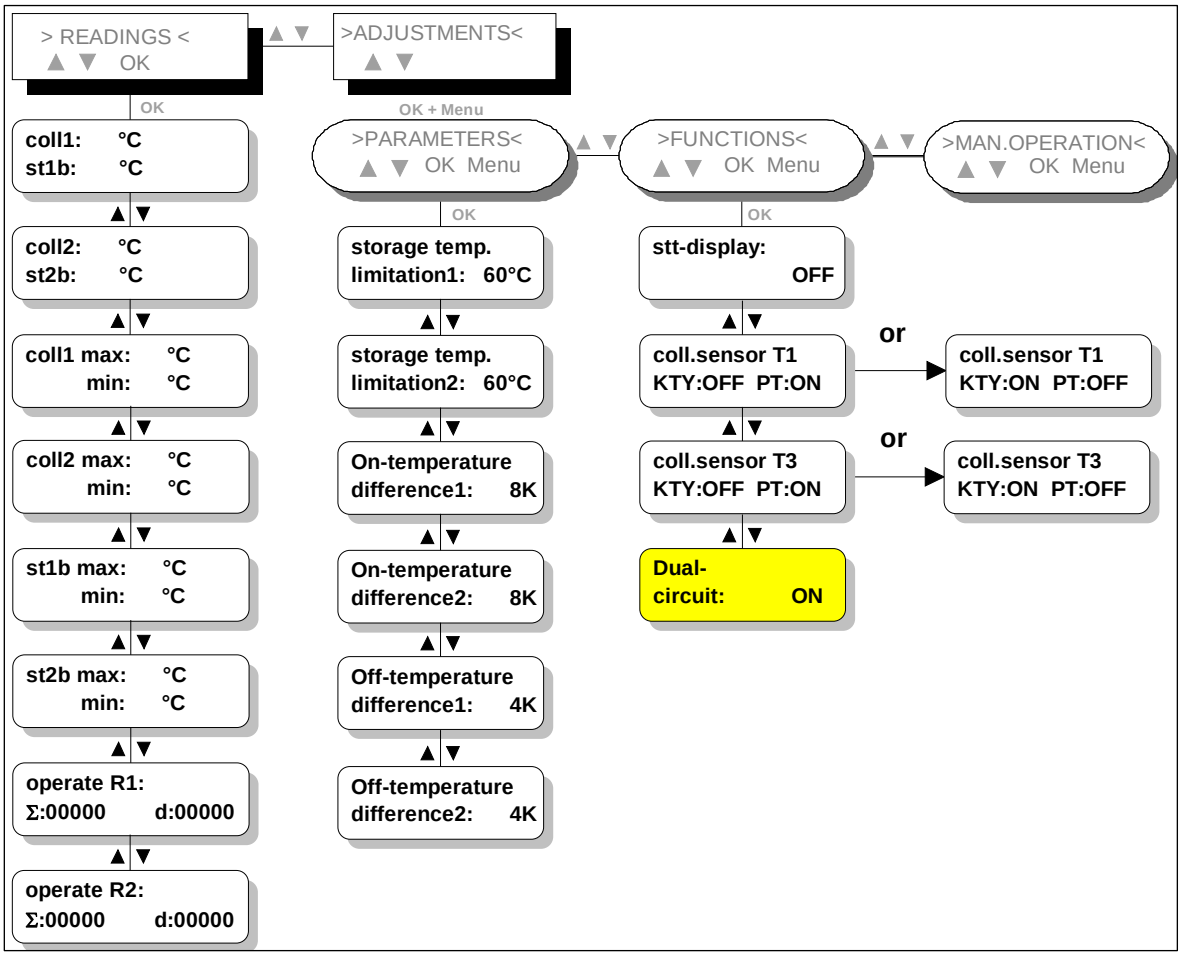
Picture I selection of dual-storage tank function with pump and 3-way valve or dual-storage tank function with two pumps



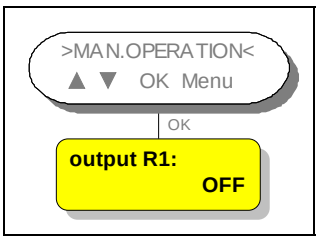
Picture J selection of east/west collector orientation with pump and 3-way valve or selection of east/west collector orientation with two pumps



Picture K **Selection of two separate solar systems**

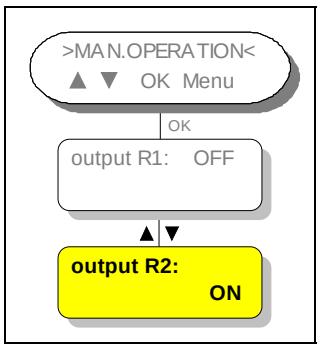


Picture L



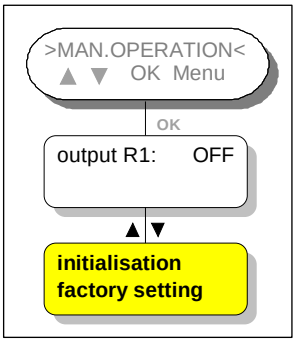
manual operation output R1

Picture M



manual operation output R2

Picture N



initialisation factory setting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