# Ex BW

**Mounting**
**Connection**
**Application examples**
**Operation**
**Troubleshooting**




Thank you for buying this product.
Read this manual carefully to get the best perfomance from this unit.
Please keep this manual carefully.

11208577

en

Manual

## Safety advice

Please pay attention to the following safety advice in order to avoid danger and damage to people and property.

## Instructions

Attention must be paid to the valid local standards, regulations and directives!

## Target group

These instructions are exclusively addressed to authorised skilled personnel.

Only qualified electricians should carry out electrical works.

Initial installation must be effected by qualified personnel named by the manufacturer.

## Description of symbols

**WARNING!** Warnings are indicated with a warning triangle!



➔ **They contain information on how to avoid the danger described.**

Signal words describe the danger that may occur, when it is not avoided.

- **WARNING** means that injury, possibly life-threatening injury, can occur.
- **ATTENTION** means that damage to the appliance can occur.



**Note:**
Notes are indicated with an information symbol.

➔ Arrows indicate instruction steps that should be carried out.

## Information about the product

### Proper usage

The solar controller is designed for use in solar thermal systems and heating systems in compliance with the technical data specified in this manual.

Improper use excludes all liability claims.

### CE Declaration of conformity

The product complies with the relevant directives and is therefore labelled with the CE mark. The Declaration of Conformity is available upon request, please contact the manufacturer.



**Note:**
Strong electromagnetic fields can impair the function of the controller.

➔ Make sure the controller as well as the system are not exposed to strong electromagnetic fields.

## Disposal

- Dispose of the packaging in an environmentally sound manner.
- Dispose of old appliances in an environmentally sound manner. Upon request we will take back your old appliances bought from us and guarantee an environmentally sound disposal of the devices.

**Subject to technical change. Errors excepted.**



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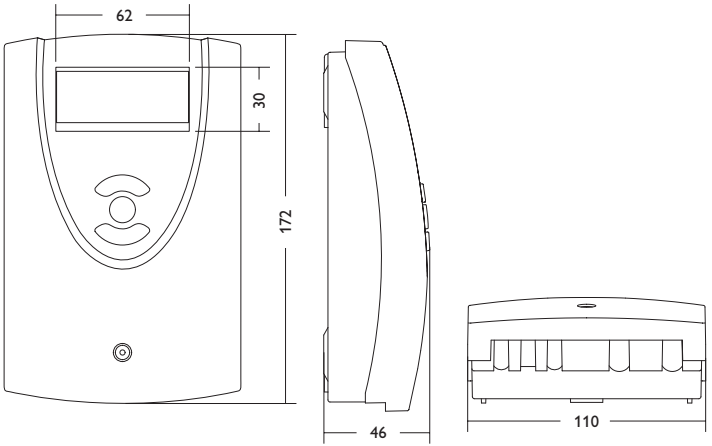
## Contents


**1 Installation ..... 5**
1.1 Mounting ..... 5
1.2 Electrical connection ..... 6
1.3 VFD Grundfos Direct Sensor™ ..... 7
1.4 PWM output ..... 7
1.5 Data communication / Bus ..... 7
1.6 Terminal allocation ..... 8
**2 Operation and function ..... 11**
2.1 Push buttons ..... 11
2.2 System-Monitoring-Display ..... 11
2.3 Flashing codes ..... 12
**3 Commissioning ..... 13**
**4 Channel overview ..... 15**
4.1 Display channels ..... 15
4.2 Adjustment channels ..... 17
**5 Troubleshooting ..... 27**
5.1 Various ..... 28
**6 Accessories ..... 30**

## Overview

- **System-Monitoring-Display**
- **Up to 4 Pt1000 temperature sensors**
- **Semiconductor relays for pump speed control**
- **1 input for a VFD Grundfos Direct Sensor™**
- **Heat quantity measurement**
- **VBus®**
- **Function control**
- **Control of the system by ServiceCenter software possible**
- **User-friendly operation**
- **Housing with outstanding design**
- **Extra-low power consumption**
- **HE pump control**
- **Drainback option**






**Technical data**

**Inputs:** 4 Pt1000 temperature sensors, 1 VFD Grundfos Direct Sensor™

**Outputs:** 1 semiconductor relays, 1 PWM output

**PWM frequency:** 512 Hz

**PWM voltage:** 10,5 V

**Switching capacity:** 1 (1) A 240 V~ (semiconductor relay)

**Total switching capacity:** 1 A 240 V~

**Power supply:** 100 … 240 V~ (50 … 60 Hz)

**Supply connection:** type Y attachment

**Power consumption:** < 1 W (standby)

**Mode of operation:** type 1.C.Y action

**Rated impulse voltage:** 2.5 kV

**Data interface:** VBus®

**VBus® current supply:** 35 mA

**Functions:** function control, operating hours counter, speed control, drainback option and heat quantity measurement

**Housing:** plastic, PC-ABS and PMMA

**Mounting:** wall mounting, mounting into patch panels is possible

**Indication / Display:**
System-Monitoring-Display for visualisation of systems, 16-segment and 7-segment display, 8 symbols for indication of system status

**Operation:** 3 push buttons at the front

**Ingress protection:** IP 20 / EN 60529

**Protection class:** I

**Ambient temperature:** 0 … 40 °C [32 … 104 °F]

**Pollution degree:** 2

**Dimensions:** 172 x 110 x 46 mm

# 1 Installation

## 1.1 Mounting

The unit must only be installed

- in a dry interior location
- in a non-hazardous location
- away from electromagnetic fields

The controller must additionally be supplied from a double-pole switch with contact gap of at least 3 mm. Route sensor cables and power supply cables separately.

➔ Unscrew the cross-head screw from the cover and remove it along with the cover from the housing

➔ Mark the upper fastening point on the wall and drill

➔ Fasten the enclosed wall plug and screw leaving the head protruding

➔ Hang the housing from the upper fastening point and mark the lower fastening point through the hole in the terminal box (centers 130 mm)

➔ Drill and insert the lower wall plug

➔ Fasten the housing to the wall with lower fastening screw and tighten

➔ Complete wiring connections in accordance with terminal allocations, see chap. 2.2 “Electrical connection”

➔ Place the cover back onto the housing

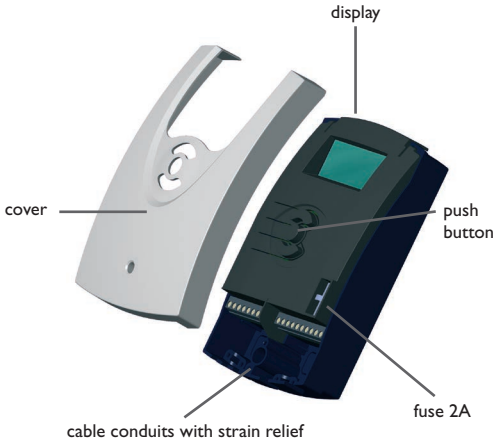
➔ Fasten the cover by means of the cross-head screw

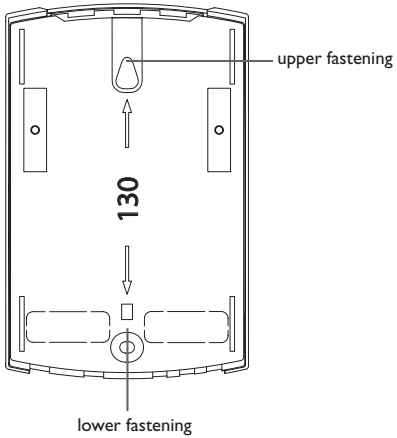
**WARNING!** **Electric shock!**



Opening the housing will expose live parts!

➔ **Switch off power supply and disconnect the device from power supply before opening the housing!**



## 1.2 Electrical connection

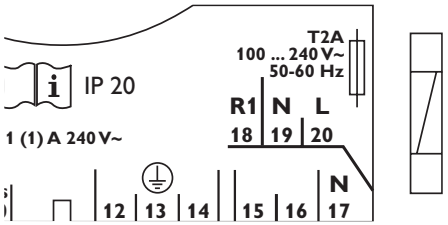
**WARNING!** **ESD damage!**

Electrostatic discharge can lead to damage to electronic components!

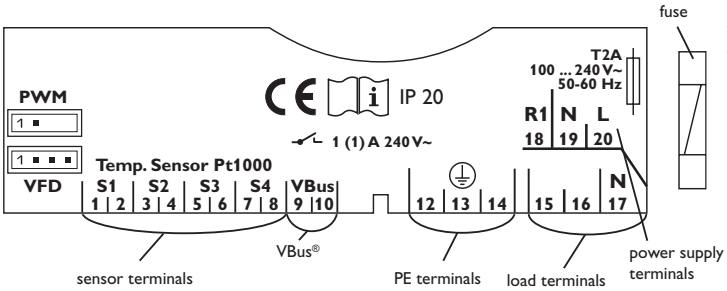
➔ **Take care to discharge properly before touching the inside of the device. To do so, touch a grounded surface such as a radiator or tap!**

**Note:**
The minimum pump speed must be set to 100% when auxiliary relays or valves are connected.

**Note:**
The mains connection must be carried out with the common ground of the building to which the pipework of the solar thermal system is connected.



PE and load terminals




Connecting the device to the mains supply must always be the last step of the installation!

The power supply to the controller must be carried out via an external power switch (last step!). The supply voltage must be 100 … 240 V~ (50 … 60 Hz). Flexible cables must be attached to the housing with the enclosed strain relief and the corresponding screws.

The controller is equipped with a semiconductor relay, to which a load such as a pump, a valve etc. can be connected:

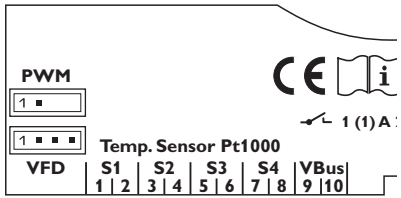
**Relay 1**
18 = conductor R1
17 = neutral conductor N
13 = protective conductor

The **mains supply** is to be carried out at the terminals:
19 = neutral conductor N
20 = conductor L
12 = protective conductor ⏚

The **temperature sensors** (S1 up to S4) are to be connected to the following terminals with either polarity:
1 / 2 = Sensor 1 (e.g. Sensor collector)
3 / 4 = Sensor 2 (e.g. Sensor store)
5 / 6 = Sensor 3 (e.g. Sensor store top)
7 / 8 = Sensor 4 (e.g. Sensor return)

All Pt1000 temperature sensors are equipped with a platinum measuring element in their tip. The electrical resistance of the measuring element changes in relation to the temperature (see table in chap. 5).

The difference between **FKP** and **FRP** type sensors only lies in the cable insulation material. The insulation material of FKP type sensor cables resists a higher temperature, so that FKP type sensors should be used as collector sensors. FRP type sensors are best used as reference sensors in stores or pipes.



Sensor terminals S1 … S4

## 1.3 VFD Grundfos Direct Sensor™

The controller is equipped with 1 input for a digital VFD Grundfos Direct Sensor™ for measuring the flow rate and the temperature. Connection is made at the VFD terminal (bottom left).

## 1.4 PWM output

The speed of a HE pump is adjusted through a PWM signal. In addition to connection to the relay, the pump must be connected to the PWM output of the controller.

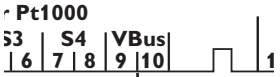
Power is supplied to the HE pump by switching the relay on or off.

The two left-hand pins of the connection marked "PWM" are the control output for a pump with PWM control input. The two right-hand pins are inactive.




1 = PWM output 1, control signal
2 = PWM output 1, GND

## 1.5 Data communication / Bus




VBus®
connection terminals

The controller is equipped with a **VBus®** for data transfer with and energy supply to external modules. The connection is carried out at the terminals marked "VBus" (either polarity). One or more VBus® modules can be connected via this data bus, such as

- GA3 Large Display, SD3 Smart Display
- DL3 Datalogger
- DL2 Datalogger
- VBus®/USB or VBus®/LAN interface adapter
- AM1 Alarm Module
- WMZ calorimeter module

By means of a Datalogger or an interface adapter, the controller can be connected to a PC or a computer network.

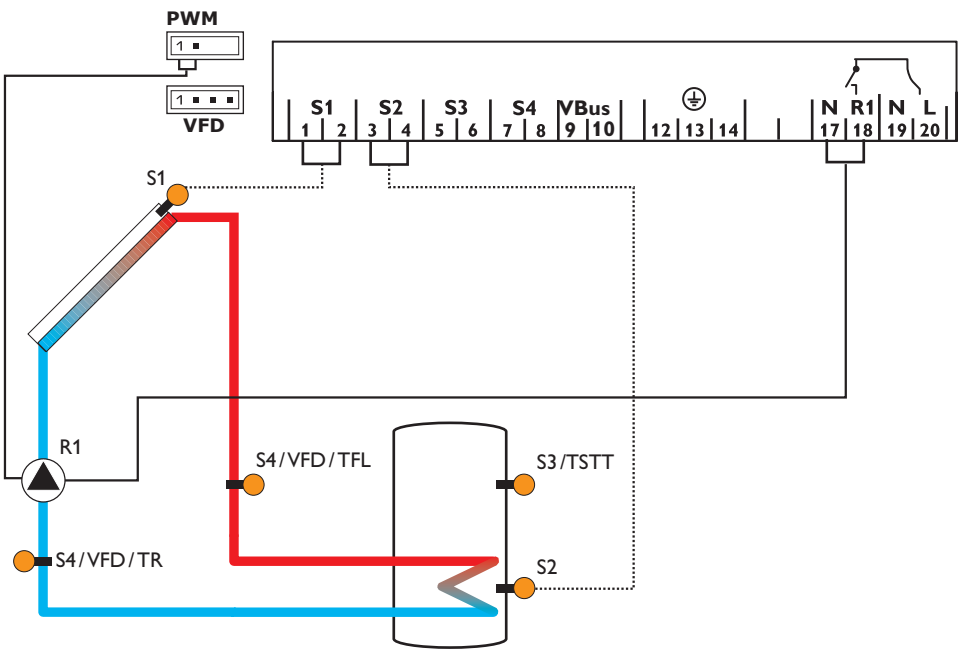
## 1.6 Terminal allocation

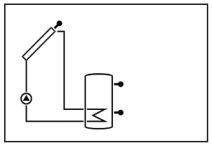
### System layout 1

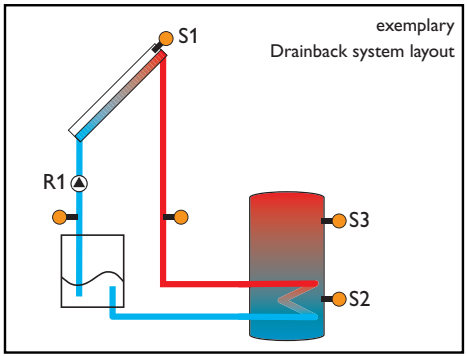
The controller calculates the temperature difference between collector sensor S1 and store sensor S2. If the difference is larger than or identical to the adjusted switch-on temperature difference (DTO), the solar pump will be operated by relay 1, and the store will be loaded until the switch-off temperature difference (DTF) or the maximum store temperature (SMX) is reached.

Sensors S3 and S4 can optionally be connected for measurement purposes. S3 can optionally be used as reference sensor for the store emergency shutdown option (OSEM).

If heat quantity measurement (OHQM) is activated, S4 and VFD are to be connected as flow and return sensors respectively.





| Display Channels | | | | |
|---|---|---|---|---|
| Channel | | Description | Terminal | Page |
| INIT | x* | ODB initialisation active | - | 15 |
| FLL | x* | ODB filling time active | - | 15 |
| STAB | x* | ODB stabilisation in progress | - | 15 |
| COL | x | Temperature collector | S1 | 15 |
| TST | x | Temperature store | S2 | 15 |
| S3 | x | Temperature sensor 3 | S3 | 15 |
| TSTT | x* | Temperatur store at the top | S3 | 15 |
| S4 | x | Temperature sensor 4 | S4 | 15 |
| TFL | x* | Temperature flow sensor | S1/S4/VFD | 15 |
| TR | x* | Temperature return sensor | S4/VFD | 15 |
| VFD | x* | Temperature Grundfos Direct Sensor™ | VFD | 15 |
| L/h | x* | Flow rate Grundfos Direct Sensor™ | VFD | 16 |
| n% | x | Pump speed R1 | R1 | 16 |
| hP | x | Operating hours R1 | R1 | 17 |
| kWh | x* | Heat quantity kWh | - | 16 |
| MWh | x* | Heat quantity MWh | - | 16 |
| TIME | x | Time | - | 16 |

| Adjustment Channels | | | | |
|---|---|---|---|---|
| Channel | | Description | Factory setting | Page |
| DTO | x | Switch-on temperature difference | 6.0 K [12.0 °Ra] | 17 |
| DTF | x | Switch-off temperature difference | 4.0 K [8.0 °Ra] | 17 |
| DTS | x | Nominal temperature difference | 10.0 K [20.0 °Ra] | 17 |
| PUM | x | Pump control type | PSOL | 18 |
| RIS | x | Rise control R1 | 2 K [4 °Ra] | 18 |
| nMX | x | Maximum pump speed | 100% | 18 |
| nMN | x | Minimum pump speed | 30% | 18 |
| SMX | x | Maximum store temperature | 60 °C [140 °F] | 19 |
| OSEM | x | Option store emergency shutdown | OFF | 19 |
| EM | x | Emergency temperature collector | 130 °C [270 °F] | 19 |
| | | Emergency temperature collector if ODB is activated: | 95 °C [200 °F] | 19 |
| OCC | x | Option collector cooling | OFF | 20 |
| CMX | x* | Maximum collector temperature | 110 °C [230 °F] | 20 |
| OSYC | x | Option system cooling | OFF | 20 |
| DTCO | x* | Cooling switch-on temperature difference | 20.0 K [40.0 °Ra] | 20 |
| DTCF | x* | Cooling switch-off temperature difference | 15.0 K [30.0 °Ra] | 20 |
| OSTC | x | Option store cooling | OFF | 20 |

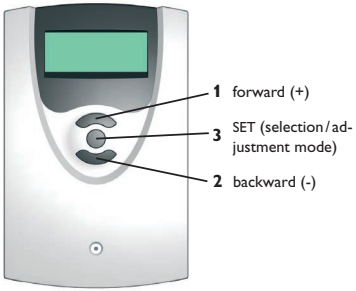
| Adjustment Channels | | | | |
|---|---|---|---|---|
| Channel | | Description | Factory setting | Page |
| OHOL | x* | Option holiday cooling | OFF | 20 |
| THOL | x* | Holiday cooling temperature | 40 °C [110 °F] | 22 |
| OCN | x | Option minimum limitation | OFF | 22 |
| CMN | x* | Minimum collector temperature | 10 °C [50 °F] | 22 |
| OCF | x | Option antifreeze | OFF | 22 |
| CFR | x* | Antifreeze temperature | 4.0 °C [40.0 °F] | 22 |
| GFD | x | Grundfos Direct Sensor™ | OFF | <?> |
| OHQM | x | Option heat quantity measurement | OFF | 24 |
| SEN | x* | VFD allocation | 2 | 24 |
| FMAX | x* | Maximum flow | 6.0 l/min | 24 |
| MEDT | x* | Antifreeze type | 1 | 24 |
| MED% | x* | Antifreeze concentration (only if MEDT = propylene or ethylene) | 45 % | 24 |
| ODB | x | Drainback option | OFF | 25 |
| tDTO | x* | ODB switch-on condition - time period | 60 s | 25 |
| tFLL | x* | ODB filling time | 5.0 min | 25 |
| tSTB | x* | ODB stabilisation time | 2.0 min | 25 |
| MAN | x | Manual operation R1 | Auto | 25 |
| LANG | x | Language | En | 25 |
| UNIT | x | Temperature unit | °C | 25 |
| RESE | x | Reset - back to factory settings | | 25 |
| ######### | | Version number | | |

**Legend:**

| Symbol | Specification |
|---|---|
| x | Channel is available |
| x* | Channel is available if the corresponding option is activated. |
| s | Channel is specifically available in this system layout |

## 2 Operation and function

### 2.1 Push buttons




The controller is operated via three push buttons below the display.

**Button 1** is used for scrolling forward through the indication menu or to increase the adjustment values. **Button 2** is used for scrolling backward and reducing values. **Button 3** is used for selecting channels and confirming adjustments.

During normal operation, only the display channels are shown.

➔ Scroll through the display channels by pressing buttons 1 and 2

**Accessing the adjustment channels:**

➔ Scroll down in the display menu and press button 1 for approx. two seconds after you have reached the last display item.

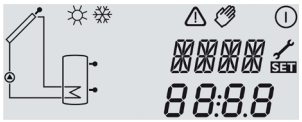
When an **adjustment value** is shown on the display, **SET** is indicated to the right of the channel name.

➔ Press button 3 in order to access the adjustment mode **SET** starts flashing.

➔ Adjust the value using buttons 1 and 2

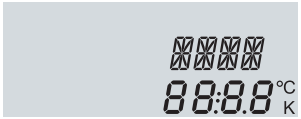
➔ Briefly press button 3, **SET** permanently appears,the adjusted value will be saved.

### 2.2 System-Monitoring-Display




System-Monitoring-Display

The System-Monitoring-Display consists of three blocks: **channel display**, **tool bar** and **system screen**.




channel display

The system monitoring display consists of three blocks: **channel display, tool bar** and **system screen**.

The **channel display** consists of two lines. The upper line is an alpha-numeric 16-segment display (text display) for displaying channel names and menu items. In the lower 7-segment display, the channel values and the adjustment parameters are displayed. Temperatures are either indicated in °C or °F, whereas temperature differences are indicated in K or °Ra respectively.




tool bar

The additional symbols of the **tool bar** indicate the current system status.

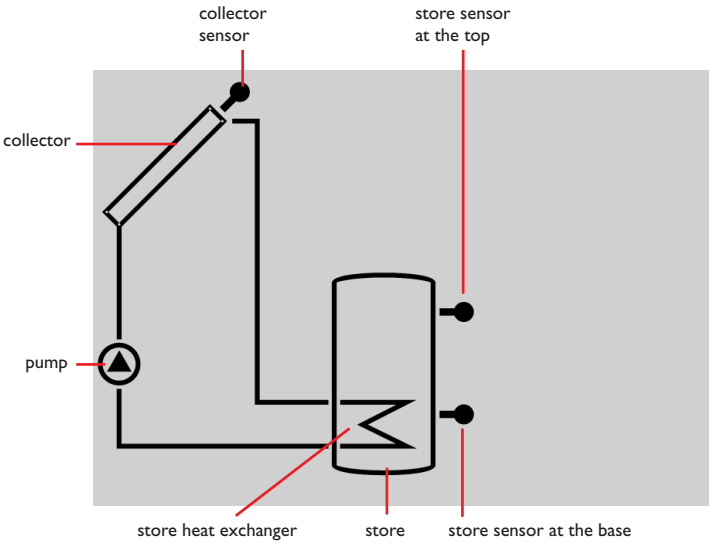
| Status | normal | blinkend |
|---|---|---|
| relay 1 active | ⏻ | |
| maximum store temperature exceeded | ☼ | |
| store emergency shutdown active | | ⚠ + ☼ |
| collector emergency shutdown active | | ⚠ |
| collector cooling active | ⏻ | ☼ |
| system cooling active | ⏻ | ☼ |
| store cooling active | ⏻ + ☼ | |
| holiday cooling function activated | ☼ | ⚠ |
| holiday cooling function active | ⏻ + ☼ | ⚠ |
| collector minimum limitation active | | ❄ |
| antifreeze function activated | ❄ | |
| antifreeze function active | ⏻ | ❄ |
| manual operation relay 1 ON | ✋ + ⏻ | ⚠ |
| manual operation relay 1 OFF | ✋ | ⚠ |
| sensor defective | 🔧 | ⚠ |

## System screen



System-Screen

The system screen (active system layout) shows the system selected on the controller. It consists of several system component symbols, which are – depending on the current status of the system – either flashing, permanently shown or hidden.




## 2.3 Flashing codes

### System screen flashing codes

- Pumps are flashing when the corresponding relay is switched on
- Sensor symbols are flashing if the corresponding sensor display channel is selected
- Sensors are flashing quickly in the case of a sensor fault
- Burner symbol is flashing if the afterheating is active



**Collectors**
with collector sensor



**Stores** 1 and 2
with heat exchanger

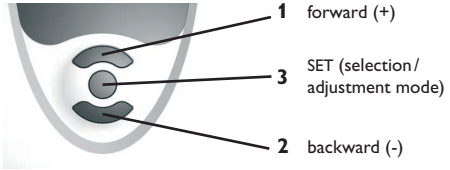


**Temperature sensor**



**Pump**

## 3 Commissioning




The three push buttons of the CS/2 controller

➔ Establish the power supply

The controller runs an initialisation phase.

When the controller is commissioned for the first time or after a reset, it will run a commissioning menu. The commissioning menu leads the user through the most important adjustment channels needed for operating the system.

**Operating the commissioning menu:**

➔ Enter the channel by pressing button 3

The **SET** symbol flashes.

➔ Adjust the value by pressing buttons 1 and 2

➔ Save the adjustment by pressing button 3 again

The **SET** symbol stops flashing.

➔ Press button 1 or 2 to switch to the next or previous channel

The commissioning menu consists of the following channels:




**LANG:**
Language selection
Selection: dE, En, Fr, ES, It
Factory setting: En

**1. Language**

➔ Adjust the desired menu language in this channel

- dE : German
- En : English
- Fr : French
- ES : Spanish
- It : Italian




**UNIT:**
Temperature unit selection
Selection: °C, °F
Factory setting: °C

**2. Unit**

➔ Adjust the unit in which temperatures and temperature differences shall be displayed




**SMX**
Maximum store temp.
Adjustment range: 4 … 95 °C [40 … 200 °F]
Arr 10: 4 … 90 °C [40 … 190 °F]
Factory setting: 60 °C [140 °F]

**3. Maximum store temperature**

➔ Adjust the desired maximum store temperature

**Note:**
The controller is also equipped with a non-adjustable emergency shut-down function, which will shut the system down if the store reaches 95 °C [200 °F].

en




**PUM**
Pump control type
Selection: OnOF, PULS, PSOL, PHEA
Factory setting: PSOL

**4. Pump control type**

➔ Adjust the pump control type.

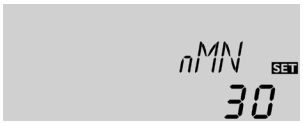
The following types can be selected:
Adjustment for standard pump without speed control
• OnOF (pump on / pump off)
Adjustment for standard pump with speed control
• PULS (pulse packet control via semiconductor relay)
Adjustment for high efficiency pump (HE pump)
• PSOL (PWM profile for a high-efficiency solar pump)
• PHEA (PWM profile for a high-efficiency heating pump)

In order to reduce the number of switching processes for high-efficiency pumps, the controller is equipped with a relay overrun function that automatically comes into effect when the speed control signal is not issued by the relay itself (PUM = PSOL or PHEA). The corresponding relay will then remain switched on for an hour after the switch-off conditions are fulfilled.

**WARNING!** **Electric shock!**

During the overrun time, the relay symbol disappears from the display and the pump is inactive, but the relay is still energised!

➔ **Switch off power supply and disconnect the device from power supply before working on the device or the cables connected!**




**nMN**
Minimum pump speed
Adjustment range: (10) 30 … 100 %
Factory setting: 30 %

**5. Minimum pump speed**

➔ Adjust a minimum speed for the pump

**Note:**
If loads which are not speed-controlled (e.g. valves) are used, the value must be set to 100 %.




**nMX**
Maximum pump speed
Adjustment range: (10) 30 … 100 %
Factory setting: 100 %

**6. Maximum pump speed**

➔ Adjust the maximum pump speed for the corresponding pumps.

**Note:**
When loads which are not speed-controlled (e. g. valves) are used, the value must be set to 100% or the pump control type must be set to OnOF in order to deactivate pump speed control.

**Confirmation enquiry**




**Completing the commissioning menu**

After the last channel of the commissioning menu has been adjusted and confirmed, the controller asks for confirmation of the adjustments.

➔ To confirm the adjustments made in the commissioning menu, press button 3

Now the controller is ready for operation with typical settings to suit the selected system layout.

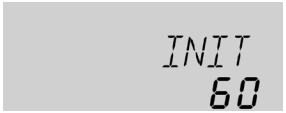
The settings made in the commissioning menu can be changed later on in the corresponding adjustment channels. Additional functions and options can of course be individually adjusted as well (see chap. 4.2).

# 4 Channel overview

## 4.1 Display channels

**Note:**
The displayed values and adjustment channels depend on which options and functions have been selected. Only values and adjustment channels available for the individual settings selected will appear in the menu.

**Indication of drainback time periods**
**Initialisation**




**INIT**
ODB initialisation active
Indicates the time adjusted in **tDTO**, running backwards.

**Filling time**




**FLL**
ODB filling time active
Indicates the time adjusted in **tFLL**, running backwards.

**Stabilisation**




**STAB**
Stabilisation
Indicates the time adjusted in **tSTB**, running backwards.

**Indication of collector temperature**




**COL**
Collector temperature
Display range: -40 … +260 °C [-40 … +500 °F]
Indicates the current collector temperature.

**Indication of store temperatures**

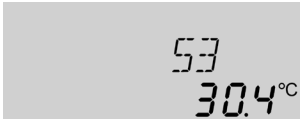



**TST, TSTT**
Store temperatures
Display range: -40 … +260 °C [-40 … +500 °F]
Indicates the current store temperature.

- TST : store temperature
- TSTT : store temperature top

(Arr = 2 only; replaces TSTT if, during thermal disinfection, the heating period DDIS is active)

**Indication of sensors 3, 4 and VFD**




**S3, S4, VFD**
Sensor temperatures
Display range: -40 … +260 °C [-40 … +500 °F]
VFD: 0 … 100 °C [32 … 212 °F]
Indicates the current temperature of the corresponding additional sensor (without control function).

- S3 : temperature at sensor 3
- S4 : temperature at sensor 4
- VFD : temperature at the Grundfos Direct Sensor™

**Note:**
S3 and S4 will only be indicated if the temperature sensors are connected. VFD will be indicated only if a Grundfos Direct Sensor™ has been connected and registered.

**Indication of other temperatures**

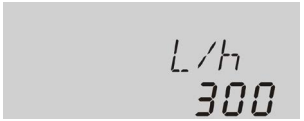



**TFL, TR**
Other measured temperatures
Display range: -40 … +260 °C [-40 … +500 °F]
Indicates the current temperature of the corresponding sensor.

- TFL : temperature flow
- TR : temperature return

**Note:**
TFL/TR will be indicated only if the heat quantity measurement option (OHQM) has been activated.

**Indication of flow rate**




**l/h**
Flow rate
Display range: depends on the sensor type
Indicates the current flow rate at the VFD flow rate sensor.
The display range depends on the sensor type selected.

**Indication of current pump speed**




**n %**
Current pump speed
Display range: 30 … 100 %
Indicates the current pump speed




**kWh / MWh**
Heat quantity in kWh / MWh
Display channel
Indicates the energy gained in heat quantity – only available if heat quantity measurement (OHQM) is activated.

Heat quantity measurement can be run in 2 different ways (see QV auf S. 57): with a fixed flow rate value or with a VFD Grundfos Direct Sensor™. It is shown in kWh in the channel **kWh** and in MWh in the channel **MWh**. The overall heat quantity results from the sum of both values.

The accumulated heat quantity can be set back to 0. As soon as one of the display channels of the heat quantity is selected, the **SET** symbol is permanently shown on the display.

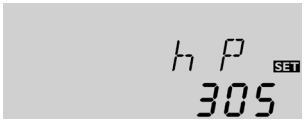
➔ Press button 3 for 2 s in order to access the RESET mode of the counter.

The display symbol **SET** will flash and the heat quantity value will be set to 0.

➔ Confirm the reset with button 3 in order to finish the reset.

In order to interrupt the RESET-process, do not press a button for about 5 s. The display returns to the display mode.

**Operating hours counter**




**h P**
Operating hours counter
Display channel
The operating hours counter accumulates the solar operating hours of the relay (**h P**). Full hours are displayed.

The accumulated operating hours can be set back to zero. As soon as one operating hours channel is selected, the symbol **SET** is displayed.

➔ In order to access the RESET-mode of the counter, press button 3 for approx. two seconds.

The display symbol **SET** will flash and the operating hours will be set to 0.

➔ Confirm the reset with button 3 in order to finish the reset.

In order to interrupt the RESET-process, do not press a button for about 5 s. The display returns to the display mode.

## 4.2 Adjustment channels

**ΔT control**




**DT O**
Switch-on temperature diff.
Adjustment range: 1.0 … 20.0 K [2.0 … 40.0 °Ra]
Factory setting: 6.0 K [12.0 °Ra]

The controller works as a standard differential controller. If the switch-on difference is reached, the pump is activated. When the temperature difference falls below the adjusted switch-off temperature difference, the respective relay switches off.

**Note:**
The switch-on temperature difference must be at least 0.5 K [1 °Ra] higher than the switch-off temperature difference.




**DT F**
Switch-off temperature diff.
Adjustment range: 0.5 … 19.5 K [1.0 … 39.0 °Ra]
Factory setting: 4.0 K [8.0 °Ra]

**Note:**
When the drainback option **ODB** is activated, the temperature differences **DT O**, **DT F** and **DT S** are set to a fixed adjustment:

DT O = 10 K [20 °Ra]
DT F = 4 K [8 °Ra]
DT S = 15 K [30 °Ra]

Previous adjustments made in these channels will be overridden and may have to be entered again if **ODB** is deactivated later on.

**Pump speed control**




**DT S**
Nominal temperature difference
Adjustment range: 1.5 … 30.0 K [3.0 … 60.0 °Ra]
Factory setting: 10.0 K [20.0 °Ra]




**RIS**
Rise
Adjustment range: 1 … 20 K [2 … 40 °Ra]
Factory setting: 2 K [4 °Ra]

**Note:**
For pump speed control, the operation mode of the relay must be set to Auto (adjustment channel **MAN**)

When the switch-on temperature difference is reached, the pump is activated at full speed for 10 seconds. Then, the speed is reduced to the minimum pump speed value (factory setting = 30 %).

If the temperature difference reaches the adjusted nominal temperature difference, the pump speed increases by one step (10 %). If the difference increases by the adjustable rise value, the pump speed increases by 10 % respectively until the maximum pump speed of 100 % is reached. The response of the controller can be adapted via the parameter "Rise".

**Note:**
The nominal temperature difference must be at least 0.5 K [1 °Ra] higher than the switch-on temperature difference.




**PUM**
Pump control type
Selection: OnOF, PULS, PSOL, PHEA
Factory setting: PSOL

With this parameter, the pump control type can be adjusted.

The following types can be selected:

Adjustment for standard pump without speed control

- OnOF (pump on / pump off)

Adjustment for standard pump with speed control

- PULS (pulse packet control via semiconductor relay)

Adjustment for high efficiency pump (HE pump)

- PSOL (PWM profile for a high-efficiency solar pump)
- PHEA (PWM profile for a high-efficiency heating pump)

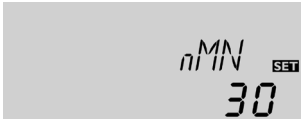
In order to reduce the number of switching processes for high-efficiency pumps, the controller is equipped with a relay overrun function that automatically comes into effect when the speed control signal is not issued by the relay itself (PUM = PSOL or PHEA). The corresponding relay will then remain switched on for an hour after the switch-off conditions are fulfilled.

**WARNING!** **Electric shock!**

During the overrun time, the relay symbol disappears from the display and the pump is inactive, but the relay is still energised!

➔ **Switch off power supply and disconnect the device from power supply before working on the device or the cables connected!**

**Minimum pump speed**




**nMN**
Minimum pump speed
Adjustment range: (10) 30 … 100 %
Factory setting: 30 %
A relative minimum pump speed can be allocated to the output R1 via the adjustment channel **nMN**.

**Note:**
When loads which are not speed-controlled (e.g. valves) are used, the value must be set to 100 % in order to deactivate pump speed control.




**nMX**
Maximum pump speed
Adjustment range: (10) 30 … 100 %
Factory setting: 100 %

A relative maximum pump speed can be allocated to the output R1 via the adjustment channel **nMX**.

**Note:**
When loads which are not speed-controlled (e. g. valves) are used, the value of the relay must be set to 100% or the pump control type must be set to OnOF in order to deactivate pump speed control.

**Maximum store temperature**




**SMX**
Maximum store temp.
Adjustment range: 4 … 95 °C [40 … 200 °F]
Arr 3: 4 … 90 °C [40 … 190 °F]
Factory setting: 60 °C [140 °F]

Once the adjusted maximum temperature is exceeded, the solar pump is switched off and further loading of the store is prevented to reduce scald risk or system damage. A fixed hysteresis of 2 K [4 °Ra] is set for the maximum store temperature.

When the temperature at the corresponding sensor exceeds the adjusted maximum store temperature, the ☼ symbol is shown on the display.

**Note:**
If the collector cooling or the system cooling function is activated, the adjusted store temperature may be overridden. In order to prevent system damage, the controller is also equipped with an integrated store emergency shutdown if the store reaches 95 °C [200 °F].

**Store emergency shutdown option**




**OSEM**
Store emergency shutdown option
Adjustment range: OFF / ON
Factory setting: OFF

This option is used for activating the integrated store emergency shutdown for an upper store sensor. If the temperature at the reference sensor exceeds 95 °C [200 °F], the store will be blocked and loading will be stopped until the temperature falls below 90 °C [190 °F]

**Note:**
Sensor S3 ist used as the reference sensor.

**Collector temperature limitation**

**Emergency shutdown of the collector**




**EM**

Collector temperature limitation
Adjustment range: 80 … 200 °C [170 … 390 °F]
Factory setting: 130 °C [270 °F]

If the adjusted collector emergency shutdown temperature (**EM**) is exceeded, the controller switches off the solar pump (R1) in order to protect the system against overheating (collector emergency shutdown). A hysteresis of 10 K [20 °Ra] is set for the collector temperature limitation. While the collector is in emergency shutdown, ⚠ (flashing) is shown on the display.

**Note:**
If the drainback option **ODB** is activated, the adjustment range of **EM** is changed to 80 … 120 °C [170 … 250 °F]. The factory setting in that case is 95 °C [200 °F].

**WARNING! Danger of injury and system damage through pressure surges!**

If water is used as a heat transfer medium in a pressure-less system, the water will start boiling at 100 °C [212 °F].

➔ **If a pressure-less drainback system is used with water as a heat transfer medium, do not adjust the collector temperature limitation EM to more than 95 °C [200 °F]!**

**Cooling functions**

In the following the three cooling functions – collector cooling, system cooling and store cooling – are described in detail. The following note is valid for all three cooling functions:

**Note:**
The cooling functions will not become active as long as solar loading is possible.

**Collector cooling function**




**OCC**

Option collector cooling
Adjustment range: OFF / ON
Factory setting: OFF




**CMX**

Maximum collector temp.
Adjustment range: 70 … 160 °C [150 … 320 °F]
Factory setting: 110 °C [230 °F]

When the collector cooling function is activated, the controller aims to keep the collector at an operational temperature.

When the adjusted maximum store temperature is reached, solar loading stops. If the collector temperature increases to the adjusted maximum collector temperature, the solar pump is activated until the collector temperature falls at least 5 K [10 °Ra] below the maximum collector temperature. The store temperature may increase (subordinate active maximum store temperature), but only up to 95 °C [200 °F] (emergency shutdown of the store).

If the collector cooling function is active, ⓘ and ☼ (flashing) is shown on the display.

**Note:**
This function will only be available if the system cooling function (**OSYC**) is deactivated.

**Note:**
In system layout 3, the parameter **CMX** is available without the **OCC** function. In system layout 3, **CMX** is used to set the activation temperature for the heat dump function. No other switch-on condition is needed in that case.

**System cooling function**




**OSYC**
Option system cooling
Adjustment range: OFF / ON
Factory setting: OFF




**DTCO**
Switch-on temperature diff.
Adjustment range: 1.0 … 30.0 K [2.0 … 60.0 °Ra]
Factory setting: 20.0 K [40.0 °Ra]

When the system cooling function is activated, the controller aims to keep the solar system operational for a longer time. The function overrides the maximum store temperature to provide thermal relief of the collector field and the heat transfer fluid on hot days.

If the store temperature is higher than the maximum store temperature (**SMX**) and the switch-on temperature difference **DTCO** is reached, the solar system remains activated. Solar loading is continued until either the store temperature reaches 95 °C [200 °F] (emergency shutdown of the store), the temperature difference falls below the adjusted value **DTCF** or the collector emergency shutdown temperature **EM** is reached.

If the system cooling function is active, ⏻ and ☼ (flashing) is shown on the display.




**DTCF**
Switch-off temperature diff.
Adjustment range: 0.5 … 29.5 K [1.0 … 59.0 °Ra]
Factory setting: 15.0 K [30.0 °Ra]

**Note:**
This function will only be available if the collector cooling function (**OCC**) is deactivated.

**Store cooling function**




**OSTC**
Store cooling option
Adjustment range: OFF / ON
Factory setting: OFF




**OHOL**
Holiday cooling option
Adjustment range: OFF / ON
Factory setting: OFF




**THOL**
Holiday cooling temperature
Adjustment range: 20 … 80 °C [70 … 175 °F]
Factory setting: 40 °C [110 °F]

When the store cooling function is activated, the controller aims to cool down the store during the night in order to prepare it for solar loading on the following day.

If the adjusted maximum store temperature (**SMX**) is exceeded and the collector temperature falls below the store temperature, the system will be reactivated in order to cool down the store. Cooling will continue until the store temperature has fallen below the adjusted maximum store temperature (**SMX**) again. A fixed hysteresis of 2 K [4 °Ra] is set for this function.

Reference threshold temperature differences for the store cooling function are **DTO** and **DTF**.

If no DHW consumption is expected for a longer period of time, the additional holiday cooling option **OHOL** can be activated in order to extend the store cooling function. The adjustable temperature **THOL** then replaces the maximum store temperature (**SMX**) as a switch-off temperature for the store cooling function.

When the holiday cooling function is activated, ☼ and ⚠ (flashing) are shown on the display.

While the holiday cooling function is active, ⏻, ☼ and ⚠ (flashing) are shown on the display.

**Collector minimum limitation option**




**OCN**
Collector minimum limitation
Adjustment range: OFF / ON
Factory setting: OFF




**CMN**
Collector minimum temp.
Adjustment range: 10.0 … 90.0 °C [50.0 … 190.0 °F]
Factory setting: 10.0 °C [50.0 °F]

If the collector minimum limitation option is activated, the pump (R1) is only switched on if the adjustable collector minimum temperature is exceeded. The minimum temperature prevents the pump from being switched on too often at low collector temperatures. A fixed hysteresis of 5 K [10 °Ra] is set for this function

If the collector minimum limitation is active, ❄ (flashing) is shown on the display.

**Note:**
If **OSTC** or **OCF** is active, the collector minimum function will be overridden. In that case, the collector temperature may fall below **CMN**.




**OCF**
Antifreeze function
Adjustment range: OFF / ON
Factory setting: OFF




**CFR**
Antifreeze temperature
Adjustment range: -40.0 … +10.0 °C [-40.0 … +50.0 °F]
Factory setting: 4.0 °C [40.0 °F]

The antifreeze function activates the loading circuit between the collector and the store when the temperature falls below the adjusted antifreeze temperature. This will protect the fluid against freezing or coagulating. If the adjusted antifreeze temperature is exceeded by 1 K [2 °Ra], the loading circuit will be deactivated.

When the antifreeze function is activated, ❄ is shown on the display. If the antifreeze function is active, ⓘ and ❄ (flashing) are shown on the display.

**Note:**
Since this function uses the limited heat quantity of the store, the antifreeze function should be used in regions with few days of temperatures around the freezing point.
The antifreeze function will be suppressed if the store temperature falls below 5 °C [40 °F] in order to protect the store from frost damage.

**Grundfos Direct Sensor™ registration**




**GFD:**
Grundfos Direct Sensor™ registration
Selection: OFF, 12, 40, 40F
Factory setting: OFF

Registration of a digital flow rate sensor which can be used for heat quantity measurement.

OFF : no Grundfos Direct Sensor™
12 : VFD 1-12 (water/glycol mixture)
40 : VFD 2-40
40F : VFD 2-40 Fast (water only)

**Heat quantity measurement**




**OHQM:**
Heat quantity measurement
Adjustment range: OFF/ON
Factory setting: OFF

If OHQM is activated, the heat quantity gained can be calculated and displayed.

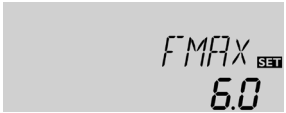
Heat quantity measurement can be run in 2 different ways (see below): with a fixed flow rate value or with a VFD Grundfos Direct Sensor™.

➔ Activate the heat quantity measurement option in the OHQM channel
➔ Select the flow rate detection type in the SEN channel

**Heat quantity measurement with a fixed flow rate value**

Heat quantity measurement is possible if a flowmeter is used. To enable heat quantity measurement, proceed as follows:

➔ Read the flow rate (l/min) from the flowmeter at maximum pump speed and adjust it in the **FMAX** channel
➔ Adjust the heat transfer fluid and the concentration of the antifreeze in the channels **MEDT** and **MED%**.




**FMAX:**
Flow rate in l/min
Adjustment range: 0.5 … 100.0
Factory setting: 6.0

**Note:**
The FMAX channel will be available only if the SEN channel has been set to OFF.

**Heat quantity measurement with a VFD Grundfos Direct Sensor™**

Heat quantity measurement with a VFD Grundfos Direct Sensor™ is possible in all system layouts.

In order to use a VFD Grundfos Direct Sensor™ for heat quantity measurement, proceed as follows:

➔ Register the VFD Grundfos Direct Sensor™ in the GFD channel.

➔ Adjust the position of the VFD Grundfos Direct Sensor™ in the SEN channel.

➔ Adjust the type and ratio of the heat transfer fluid in the channels MEDT and MED%.




**SEN:**
Digital flow rate sensor (only if SEN = 1 or 2)
Selection: OFF, 1, 2
Factory setting: 2

**Flow rate detection type:**

OFF : fixed flow rate value (flowmeter)

1 : Grundfos Direct Sensor™ in the flow pipe

2 : Grundfos Direct Sensor™ in the return pipe

**Sensor allocation for heat quantity measurement:**

| SEN | 1 | | 2 | | OFF | |
|---|---|---|---|---|---|---|
| | SFL | SRET | SFL | SRET | SFL | SRET |
| 1 | GFD | S4 | S4 | GFD | S1 | S4 |




**MEDT:**
Heat transfer fluid
Adjustment range: 0 … 3
Factory setting: 1

**Heat transfer fluid:**

0 : Water

1 : Propylene glycol

2 : Ethylene glycol

3 : Tyfocor® LS / G-LS




**MED%:**
Antifreeze ratio
in Vol-%
(MED% is hidden when MEDT 0 or 3 is used.)
Adjustment range: 20 … 70 %
Factory setting: 45 %

**Drainback option**

**Note:**
A drainback system layout requires additional components such as a holding tank. The drainback option should only be activated if all components required are properly installed.

A drainback system permits the heat transfer fluid to drain back into the holding tank when solar energy is not collected. The drainback option will initiate the filling of the system when solar loading begins.

If the drainback option **ODB** is activated, the pump will operate at 100 % speed for the adjusted filling time **tFLL** in order to fill the system with fluid from the holding tank. After **tFLL**, pump speed will go down to the adjusted minimum pump speed **nMn**. The switch-off conditions will then be ignored for the stabilisation time **tSTB** in order to avoid the system from shutting down prematurely.

If the function is activated, the menu items described in the following (**tDTO**, **tFLL** and **tSTB**) have to be adjusted:

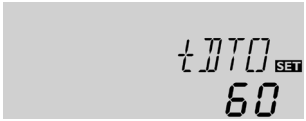



**ODB:**
Drainback option
Adjustment range: OFF / ON
Factory setting: OFF

**Note:**
When the drainback option **ODB** is activated, the cooling functions **OCC**, **OSYC** and **OSTC** as well as the antifreeze function **OCF** are not available.
If **OCC**, **OSYC**, **OSTC** or **OCF** have already been activated before, they will be deactivated again as soon as **ODB** is activated. They will remain deactivated, even if **ODB** is deactivated later on.

**Note:**
When the drainback option **ODB** is activated, the temperature differences **DTO**, **DTF** and **DTS** as well as the minimum speed values **nMN** are set to a fixed adjustment. Additionally, the adjustment range and the factory setting of the collector emergency shutdown temperature **EM** changes (see the corresponding channel descriptions for further information). Previous adjustments made in these channels will be overridden and have to be entered again if **ODB** is deactivated later on.

**Time period - switch-on conditions**




**tDTO:**
Time period - switch-on conditions
Adjustment range: 1 … 100 s
Factory setting: 60 s
The parameter **tDTO** is used for adjusting the time period during which the switch-on condition **DTO** must be permanentely fulfilled.

**Filling time**




**tFLL:**
Filling time
Adjustment range: 1.0 … 30.0 min
Factory setting: 5.0 min
The filling time can be adjusted using the parameter **tFLL**. During this period, the pump runs at 100 % speed.

**Stabilisation**




**tSTB:**
Stabilisation
Adjustment range: 1.0 … 15.0 min
Factory setting: 2.0 min
The parameter **tSTB** is used for adjusting the time period during which the switch-off condition **DTF** will be ignored after the filling time has ended.

**Operating mode**




**MAN**
Operating mode
Adjustment range: OFF, Auto, ON
Factory setting: Auto

For control and service work, the operating mode of the controller can be manually adjusted. For this purpose, select the adjustment value **MAN** in which the following adjustments can be made:

- **MAN**
  Operating mode
  OFF : relay off ⚠ (flashing) + 🔧
  Auto : relay in automatic operation
  ON : relay on ⚠ (flashing) + 🔧 + ⏻

**Note:**
Always adjust the operating mode back to "Auto" when the control and service work is completed. Normal operation is not possible in manual mode.

**Language**




**LANG:**
Language selection
Selection: dE, En, Fr, ES, It
Factory setting: En
The menu language can be adjusted in this channel.

- dE : German
- En : English
- Fr : French
- ES : Spanish
- It : Italian

**Unit**




**UNIT:**
Temperature unit selection
Selection: °C, °F
Factory setting: °C

In this adjustment channel, the display unit for temperatures and temperature differences can be chosen. The unit can be switched between °C / K and °F / °Ra during operation.

Temperatures and temperature differences in °F and °Ra are displayed without units. If the indication is set to °C, the units are displayed with the values.

**Reset**




**RESE**
Reset function
By using the reset function, all adjustments will be set back to the factory settings.

➔ To initiate a reset, press button 3

Any previous adjustments will be lost. Therefore, initiating the reset function is always followed by a security enquiry.

Only confirm the security enquiry if you are sure that you wish to reset all adjustments to the factory settings!

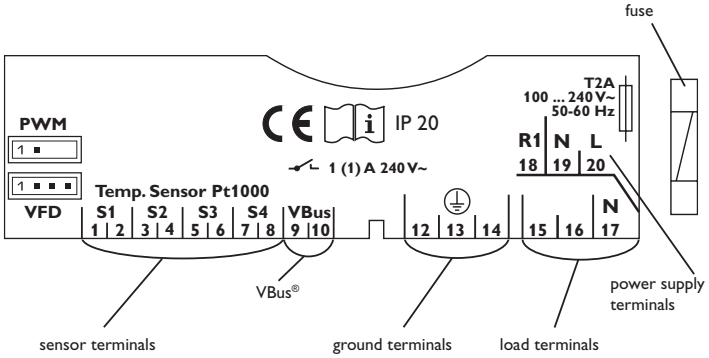



**Security enquiry:**

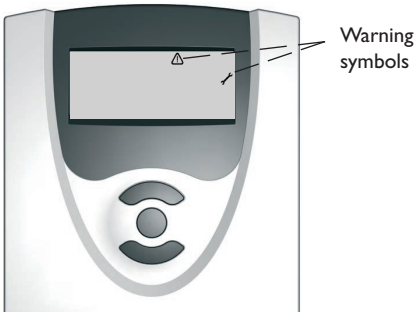
➔ To confirm the security enquiry, press button 3

**Note:**
Whenever a reset has been completed, the controller runs the commissioning menu again (see chap. 3).

## 5 Troubleshooting




In the case of an error, a message is shown on the display of the controller:




On the display the symbols and ⚠ appear.

Sensor defect. An error code instead of a temperature is displayed in the sensor display channel.

- 888.8 → Cable broken. Check cable.
- - 88.8 → Short circuit. Check cable.

Disconnected Pt1000 temperature sensors can be checked with an ohmmeter. In the following table, the resistance values with the corresponding temperatures are shown.

| °C | °F | Ω | °C | °F | Ω |
|---|---|---|---|---|---|
| -10 | 14 | 961 | 55 | 131 | 1213 |
| -5 | 23 | 980 | 60 | 140 | 1232 |
| 0 | 32 | 1000 | 65 | 149 | 1252 |
| 5 | 41 | 1019 | 70 | 158 | 1271 |
| 10 | 50 | 1039 | 75 | 167 | 1290 |
| 15 | 59 | 1058 | 80 | 176 | 1309 |
| 20 | 68 | 1078 | 85 | 185 | 1328 |
| 25 | 77 | 1097 | 90 | 194 | 1347 |
| 30 | 86 | 1117 | 95 | 203 | 1366 |
| 35 | 95 | 1136 | 100 | 212 | 1385 |
| 40 | 104 | 1155 | 105 | 221 | 1404 |
| 45 | 113 | 1175 | 110 | 230 | 1423 |
| 50 | 122 | 1194 | 115 | 239 | 1442 |

Resistance values of the Pt1000 sensors

Display off.

Check the power supply. Is it disconnected?

no: The fuse of the controller could be blown. It can be replaced after the front cover has been removed (spare fuse is enclosed in the accessory bag).

yes: Check the supply line and reconnect it.

## 5.1 Various

Pump is overheated, but no heat transfer from the collector to the store, flow and return have the same temperature; perhaps also air / gas bubbles in the lines.

Air in the system?

yes: Air in the system; increase the system pressure to at least static primary pressure plus 7. 25 psi (0.5 bar); if necessary continue to increase pressure; switch the pump off and on for a short time.

no: Is the collector circuit blocked at the dirt trap?

yes: Clean the dirt trap

Pump starts for a short moment, switches off, switches on again, etc.

Temperature difference at the controller too small?

yes: Change ΔTon and ΔToff correspondingly. Problem solved?

no: o.k.

no: Wrong position of collector sensors?

yes: Mount the collector sensor at solar flow (warmest collector output); use sensor well of the respective collector.

no: Plausibility control of the option tube collector special function

Pump starts up very late

Switch-on temperature difference ΔTon to large?

yes: Change ΔTon and ΔToff correspondingly.

no: Non-ideal position of the collector sensor (e.g. flatscrew sensor instead of sensor in sensor wells)?

yes: Activate tube collector function if necessary.

no: Minimum temperature limitation active

o.k.

The temperature difference between store and collector increases enormously during operation; the collector circuit cannot dissipate the heat.

Collector circuit pump defective?

yes: Check / replace it

no: Heat exchanger calcified?

yes: Decalcify it

no: Heat exchanger blocked?

yes: Clean it

no: Heat exchanger too small?

yes: Replace with correctly sized one.

## Store cools down at night

Collector circuit pump runs during the night?
- no
- yes → Check controller: Manual operation active? Tube collector function active? Store cooling or antifreeze function active?

Collector temperature is at night higher than the outdoor temperature
- no
- yes → Check the check valve in the flow and the return pipe with regard to the functional efficiency.

Sufficient store insulation?
- yes
- no → Increase insulation.

Insulation close enough to the store?
- yes
- no → Replace insulation or increase it.

Are the store connections insulated?
- yes
- no → Insulate the connections.

Warm water outflow upwards?
- no
- yes → Change connection and let the water flow horizontally or through a siphon (downwards); less store losses now ?
  - yes → o.k.
  - no

Does the warm water circulation run for a very long time?
- no
- yes → Use the circulation pump with timer and switch-off thermostat (energy efficient circulation).

Circulation pump and blocking valve should be switched off for one night; less store losses?
- yes → a
- no → Check whether the pumps of the afterheating circuit run at night; check whether the non-return valve is defective; problem solved ?
  - no → b

a

Control the non-return valve in warm water circulation - o.k.
- yes → The thermosiphoning in the circulation line is too strong; insert a stronger valve in the non-return valve or an electrical 2-port valve behind the circulation pump; the 2-port valve is open when the pump is activated, otherwise it is closed; connect pump and 2-port valve electrically in parallel; activate the circulation again
- no → Clean or replace it

b

Further pumps which are connected to the solar store must also be checked.

## The solar circuit pump does not work, although the collector is considerably warmer than the store.

Is the display working?
- yes
- no → There is no current; check fuses / replace them and check power supply.

Does the pump start up in manual operation?
- no
- yes → The adjusted temperature difference for starting the pump is to high; choose a value which makes more sense.

Is the pump current enabled by the controller?
- no
- yes → Is the pump stuck?
  - yes → Turn the pump shaft using a screwdriver; now passable?
    - no → Pump is defective - replace it
  - no → Controller might be defective - replace it or contact the distributor.

Are the controller fuses o.k. ?
- no → Replace fuses.
- yes

# 6 Accessories



**Sensors**

Our product range includes high-precision platinum temperature sensors, flatscrew sensors, outdoor temperature sensors, indoor temperature sensors, cylindrical clip-on sensors, also as complete sensors with immersion sleeve.

For more information, see our catalogue and price list.



**Overvoltage protection device**

In order to avoid overvoltage damage at collector sensors (e.g. caused by local lightning storms), we recommend the overvoltage protection SP10.



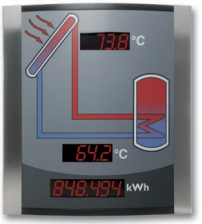
**VFD Grundfos Direct Sensors™**

The VFD Grundfos Direct Sensor™ is a digital sensor that measures both temperature and flow rate.



**Smart Display SD3**

The Smart Display is designed for simple connection to controllers with VBus®. It is used for visualizing data issued by the controller: collector temperature, storage temperature and energy yield of the solar thermal system. The use of high-efficient LEDs and filter glass assures a high optical brilliance and good readability even in poor visibility conditions and from a larger distance. An additional power supply is not required.




**Large Display GA3**

The Large Display GA3 is designed for simple connection to controllers via the VBus®. It is used for visualizing the data issued by the controller: collector and store temperature as well as heat quantity produced in the solar system.

The use of high-efficient LEDs and antireflective filter glass assures a high optical brilliance and good readability - even in poor lighting conditions and at a larger distance.



**DL3 Datalogger**

Be it solar thermal, heating or DHW heat exchange controllers – with the DL3 you can easily and conveniently log system data of up to 6 controllers.

Get a comprehensive overview of all controllers connected with the large full graphic display. Transfer data with an SD memory card or use the LAN interface to view and process data on your PC.



**DL2 Datalogger**

This additional module enables the acquisition and storage of large amounts of data (such as measuring and balance values of the solar system) over a long period of time. The DL2 can be configured and read-out with a standard internet browser via its integrated web interface. For transmission of the data stored in the internal memory of the DL2 to a PC, an SD card can be used.

The DL2 is appropriate for all controllers with VBus®. It can be connected directly to a PC or router for remote access and thus enables comfortable system monitoring for yield monitoring or for diagnostics of faults.



**VBus® / USB interface adapter**

The new VBus® / USB interface adapter is the interface between the controller and a personal computer. With its standard mini-USB port it enables a fast transmission of system data via the VBus® for processing, visualizing and archiving. A full version of the ServiceCenter software is included.



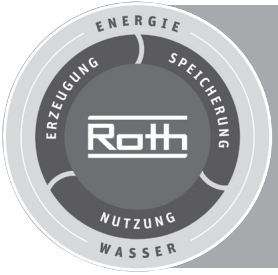
**VBus® / LAN interface adapter**

The VBus® / LAN interface adapter is designed for the direct connection of the controller to a PC network or router. It enables easy access to the controller via the local network of the owner. Thus, controller access and data charting can be effected from every workstation of the network. A full version of the ServiceCenter software is included.



**AM1 Alarm module**

The AM1 alarm module is designed to signal system failures. It is to be connected to the VBus® of the controller and issues an optical signal via a red LED if a failure has occurred. The AM1 also has a potential-free relay output, which can e. g. be connected to a building management system (BMS). Thus, a collective error message can be issued in the case of a system failure.

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