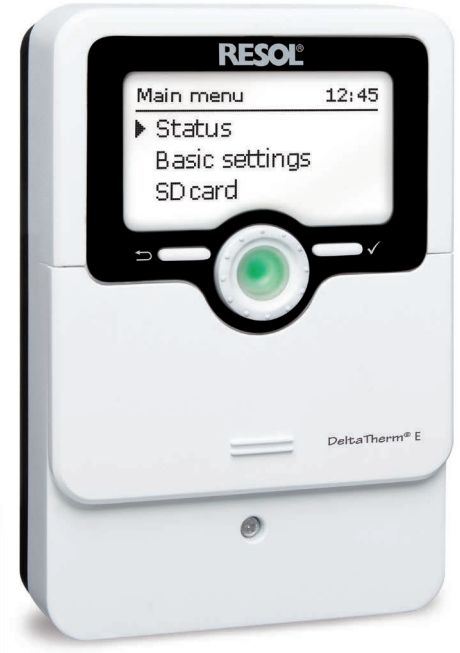
DeltaTherm® E

Beginning with firmware version 2.01

Control unit

Manual for the
specialised craftsman

Installation
Operation
Functions and options
Troubleshooting



11213873

Thank you for buying this RESOL product.
Please read this manual carefully to get the best performance from this unit. Please keep this manual safe.

en
Manual
www.resol.com

Safety advice

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

Danger of electric shock:

- When carrying out works, the device must first of all be disconnected from the mains.
- It must be possible to disconnect the device from the mains at any time.
- Do not use the device if it is visibly damaged!

Instructions

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

Information about the products

Proper usage

The controller is designed for use in the FlowSol® E electrothermal station for using excess PV current for heating a store in compliance with the technical data specified in this manual.

Improper use excludes all liability claims.

EU 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 device.

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

Subject to technical change. Errors excepted.

Target group

These instructions are exclusively addressed to authorised skilled personnel.

Only qualified electricians are allowed to carry out electrical works.

Initial commissioning must be effected by authorised skilled personnel.

Authorised skilled personnel are persons who have theoretical knowledge and experience with the installation, commissioning, operation, maintenance, etc. of electric/electronic devices and who have knowledge of relevant standards and directives.

Description of symbols

Warnings are indicated with a warning symbol!

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

WARNING **means that injury, possibly life-threatening injury, can occur.**

➔ It is indicated how to avoid the danger described.

ATTENTION **means that damage to the appliance can occur.**

➔ It is indicated how to avoid the danger described.

Note

Notes are indicated with an information symbol.

➔ Arrows indicate instruction steps that should be carried out.

Disposal

- Dispose of the packaging in an environmentally sound manner.
- At the end of its working life, the product must not be disposed of as urban waste. Old appliances must be disposed of by an authorised body 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.

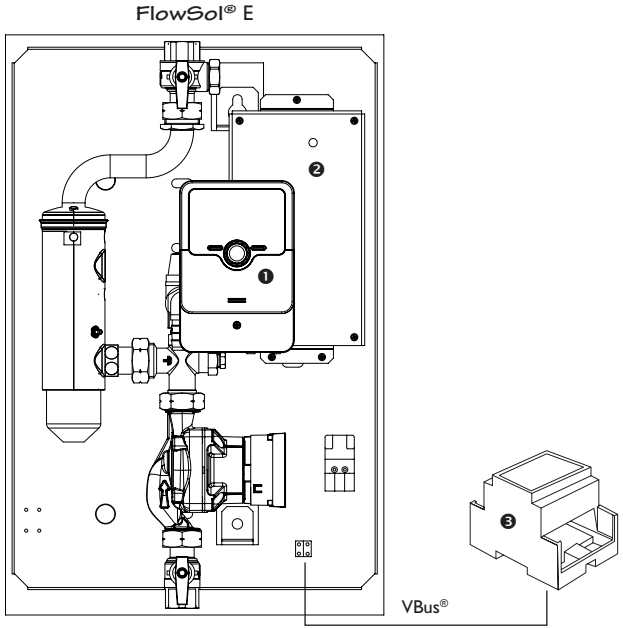
Overview

The DeltaTherm® E is integrated in the FlowSol® E and is designed for using excess PV current for heating a store. An electric heater with 3 power stages (electric immersion heaters) heats the water in the store. Thus, excess energy will be stored in the form of thermal energy and made available when required.

- **Increase in self-consumption of the PV system**
- **Environmental protection and reduction of heating costs**
- **Store excess PV current as regenerative thermal energy**
- **Optimisation of solar current feed-in**
- **Can be fitted to all central heating and hot water systems**
- **One solar system for current and heat**

Scope of delivery DeltaTherm® E

❶ Controller (DeltaTherm® E)
❷ Power unit (DeltaTherm® E power)
❸ Sensor module (DeltaTherm® E sensor) and current sensors



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1 Technical data

Controller

Inputs: 4 Pt1000 temperature sensors, 2 digital switching inputs
Outputs: 3 semiconductor relays, 1 potential-free extra-low voltage relay, 1 PWM output
PWM frequency: 512 Hz
PWM voltage: 10.8 V
Switching capacity:
1 (1) A 240 V~ (semiconductor relay)
1 (1) A 30 V⎓ (potential-free relay)
Total switching capacity: 3 A 240 V~
Power supply: 100–240 V~ (50–60 Hz)
Supply connection: type X attachment
Standby: < 1 W
Mode of operation: type 1.B.C.Y action
Rated impulse voltage: 2.5 kV
Data interface: VBus®, MicroSD card slot
VBus® current supply: 60 mA
Functions: controlling a hydraulic group and electric heater for using excess PV current for heating a store, internal backup heating, external backup heating, S0 Excess, S0 Heating, Smart Remote, external load, inverter
Housing: plastic, PC-ABS and PMMA
Mounting: integrated in the station
Indication / Display: full graphic display, control LED (Lightwheel®) and background illumination
Operation: 2 buttons and 1 adjustment dial (Lightwheel®)
Ingress protection: IP 20 / EN 60529
Protection class: I
Ambient temperature: 0 … 40 °C
Degree of pollution: 2
Dimensions: 110 x 166 x 47 mm

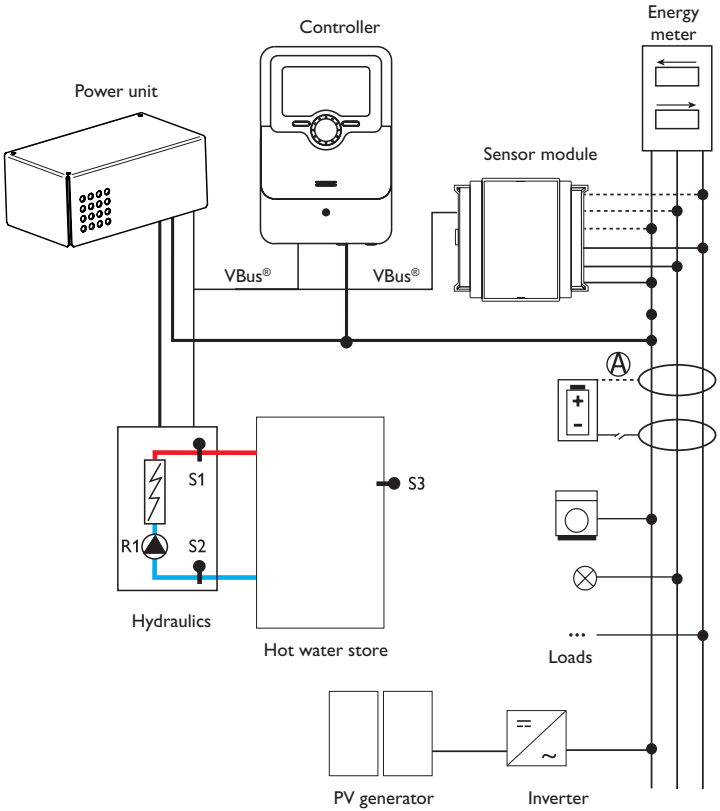
Sensor module

Inputs: 3 current inputs for CT, 3 voltage inputs
Outputs: 2 digital S0 impulse outputs
Power supply: 100–240 V~ (50–60 Hz)
Supply connection: type Y attachment
Standby: < 1 W
Rated impulse voltage: 1.0 kV
Data interface: VBus®
Functions: energy measuring unit
Housing: plastic, PC (UL 94 V-0)
Mounting: DIN rail in the domestic distribution board
Indication / Display: 2 operating control LEDs
Ingress protection: IP 20 / EN 60529
Protection class: II
Ambient temperature: 0 … 40 °C
Degree of pollution: 2
Dimensions: 71 x 90 x 58 mm

Power unit

Inputs: 1 PWM input, 1 0-10 V input
Outputs: 3 semiconductor relays
Total switching capacity: 16A 250 V~
Power supply: 220–240 V~ (50–60 Hz)
Supply connection: type X attachment
Standby: < 1 W
Mode of operation: type 1.C.Y action
Rated impulse voltage: 2.5 kV
Data interface: VBus®
Functions: controlling an electric heater for using excess PV current for heating a store
Housing: metal
Mounting: integrated in the station
Ingress protection: IP 10 / EN 60529
Protection class: I
Ambient temperature: 0 … 40 °C
Degree of pollution: 2
Dimensions: 225 x 130 x 95 mm

2 System overview



Sensors		
S1	Flow temperature	1 / GND
S2	Return temperature	2 / GND
S3	Store temperature (optional)	3 / GND
S4	Free / switching input	4 / GND
S5	Free / switching input	5 / GND

Relay		
R1	Loading pump	R1 / N / PE
R2	External backup heating external load 2 (optional)	R2 / N / PE
R3	External load (optional)	R3 / N / PE
R4	Power limitation Inverter	8 / 10

The control unit consists of the controller, the power unit and the sensor module.

The sensor module measures the current flow directly at the energy meter. If the power is high enough, the PV current can be used for electrically heating the water in the store. By means of the power unit the controller controls the 3 power stages in the electrothermal station for store heating.

In order to compensate for thermal losses, an internally calculated switch-on power has to be exceeded. An additional supply reserve will prevent using power from the mains because of system-dependent tolerances (see **Status / Controller** on page 18).

The pump speed is adapted so that the target temperature at S1 is reached for store loading in layers. If the maximum store temperature (S2) is reached, loading stops.

Optionally, different optional functions can be activated, see page 21.

Common operation with a battery is possible, but correct functioning cannot be guaranteed in all cases. PV current is used with the following priorities:

1. Direct consumption
2. Battery loading
3. Loading of a hot water store
4. Current feed-in

For this purpose, the sensor modules and the battery have to be arranged as shown in the illustration. The current sensor Ⓐ of the battery must not measure the current consumption of the controller and the loads controlled by the controller.

The **SR off** function allows remote access to the controller, e.g in order to switch it off when the battery is in use. If the switching input S5 is closed, all loads are switched off independently from the excess measured.

3 Installation

3.1 Mounting

WARNING! Electric shock!

Upon opening the housing, live parts are exposed!

➔ **Always disconnect the device from power supply before opening the housing!**

Note

Strong electromagnetic fields can impair the function of the device.

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

The devices must only be located in dry and dust-free interior rooms.
If the controller is not equipped with a mains connection cable and a plug, the device must additionally be supplied from a double pole switch with contact gap of at least 3 mm.

Please pay attention to separate routing of sensor cables and mains cables.

Step-by-step installation:

ATTENTION! Damage through overheating!

Commissioning the power stages in a system electrically connected, but not hydraulically filled can lead to damage caused by overheating!

➔ **Make sure the hydraulic system is filled and ready for operation.**

➔ Make sure the hydraulic system is filled and ready for operation.

The controller and the power unit are integrated in the electrothermal station.

➔ Mount the sensor module on a DIN rail in the domestic distribution board as close as possible to the energy meter. Make sure that no load is installed between the sensor module and the energy meter.

➔ Connect the current sensors and the conductors of the sensor module in phase directly at the energy meter (see page 7).

➔ Connect the sensor module with the controller by means of the VBus® (see page 7 and page 9).

➔ Establish the power supply of the controller (see page 9).

➔ Run the commissioning menu (see page 16).

➔ Carry out the desired adjustment in the controller menu (see page 19).

3.2 Electrical connection

WARNING! Electric shock!

Upon opening the housing, live parts are exposed!

➔ **Always disconnect the device from power supply before opening the housing!**

ATTENTION! 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!**

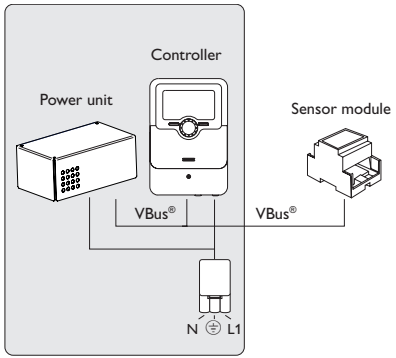
Note

The connection to the power supply must always be the last step of the installation!

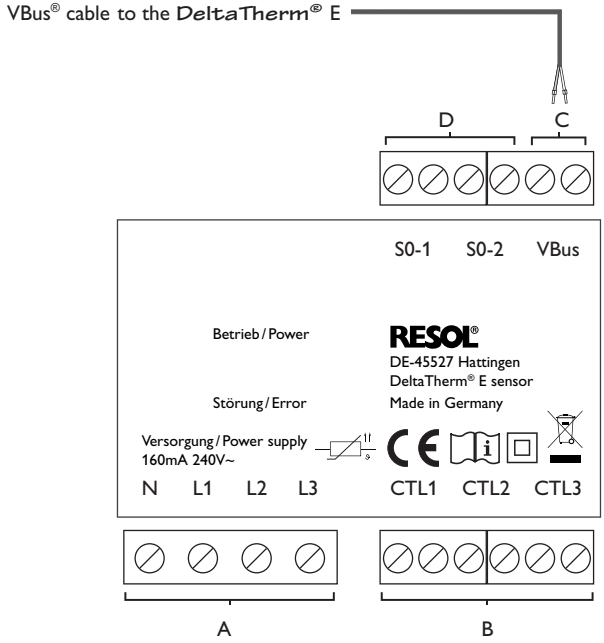
Do not use the devices if they are visibly damaged!

The power unit is supplied with power via a mains cable. The power supply of the device must be 100 … 240 V~ (50 … 60 Hz). The cross section of the cable must be 2.5 mm².

The controller is supplied with power via the power unit.



Sensor module



C

Data communication VBus®

The connection is to be carried out at the terminals marked **VBus** (either polarity).

The bus cable can be extended with a two-wire cable (bell wire). The cable carries low voltage and must not run together in a cable conduit with cables carrying a higher voltage than 50 V (please pay attention to the valid local regulations). The cross section must be at least 0.5 mm² and the cable can be extended up to 50 m in the case of a single connection.

D

Digital S0 impulse outputs

S0-1: Heating

S0-2: Excess

The S0 outputs can be used for transferring the heat energy of the FlowSol® E to external energy management systems and for feeding the excess into the public grid.

A

Power supply:

Neutral conductor	N
Conductor 1	L1
Conductor 2	L2
Conductor 3	L3

B

Current sensors:

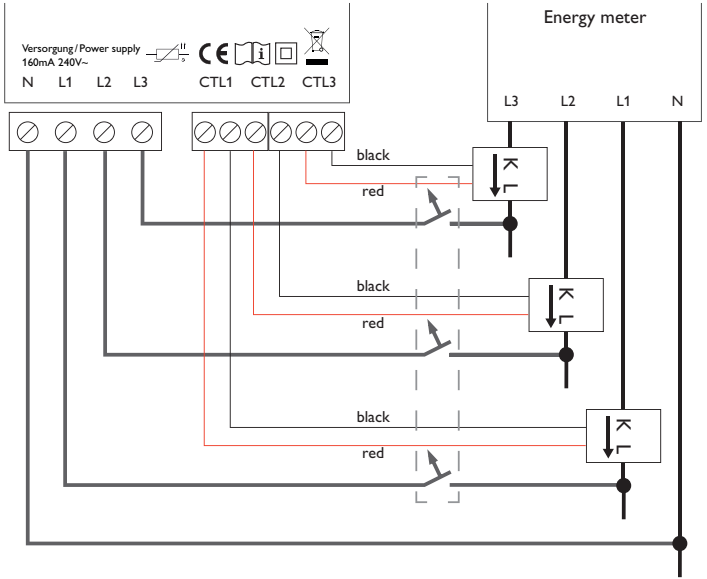
Current sensor	CTL1
Current sensor	CTL2
Current sensor	CTL3

Three-phase connection

➔ Connect the current sensors and the conductors of the sensor module in phase directly at the energy meter. The arrow indicated on the current sensors must point in the direction of the loads.

➔ Make sure that no load is installed between the energy meter and the current sensors.

The sensor module adds up the power values of all 3 phases. All 3 phases have to be connected to the sensor module.



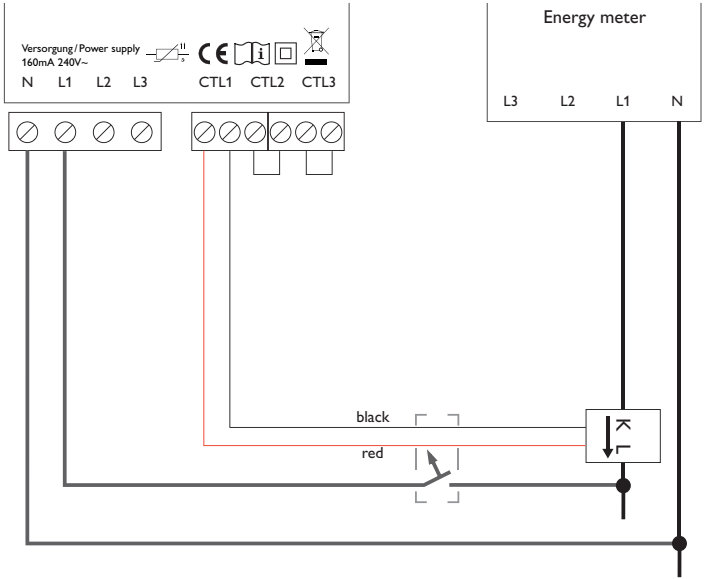
Note
The 3 phases have to be protected by means of a three-phase 16 A circuit-breaker (not included with the device).

Single-phase connection

➔ Connect the current sensor and the conductor L1 of the sensor module directly at the energy meter. The arrow indicated on the current sensor must point in the direction of the loads.

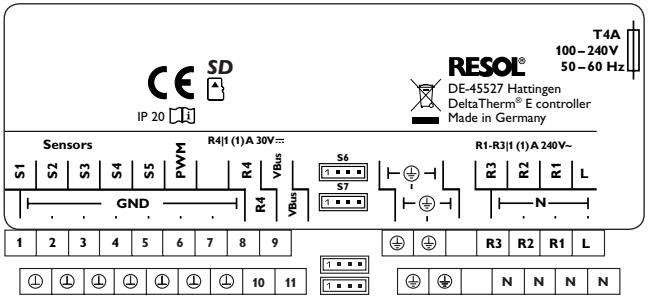
➔ Make sure that no load is installed between the energy meter and the current sensor.

➔ Short circuit the connections of CTL2 as well as those of CTL3. The other current sensors are not used.



Note
The phase has to be protected by means of a single-phase 16 A circuit-breaker (not included with the device).

Controller



The power supply via the power unit is at the terminals:

Neutral conductor	N
Conductor	L
Protective earth conductor	⏚

The controller is equipped with 4 relays in total. The loading pump is connected to R1.

- Relays 1 … 3 are semiconductor relays, designed for pump speed control:
  Conductor R1 … R3
  Neutral conductor N
  Protective earth conductor ⏚
- Relay 4 is a potential-free extra-low voltage relay.

Mains and sensor cables are already connected to the device.

Further **temperature sensors** can be connected to the terminals S3 and S4 (either polarity).

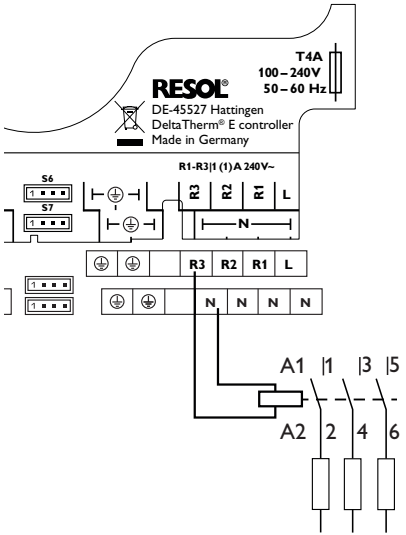
S4 and S5 can be used as digital switching inputs with either polarity.

S6 and S7 are impulse inputs (no function).

The terminal marked **PWM** is the control output for a high-efficiency pump.

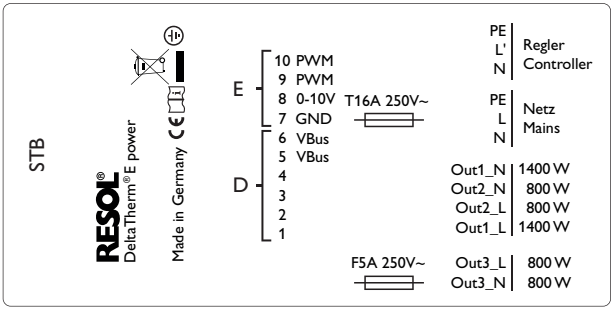
The controller is equipped with the **VBus®** for data communication. The connection is to be carried out at the terminals marked **VBus** (either polarity). The power unit and the sensor module are connected via this data bus.

Note
For more details about the commissioning procedure see page 16.



Note
The optional function **External load** switches relay 3 (see page 25). The optional function **External load 2** switches relay 2. As an external load usually has a high power consumption, it must be controlled by means of an auxiliary relay.

Power unit



Note:
It must be possible to disconnect the device from the mains at any time.
➔ Install the mains plug so that it is accessible at any time.
➔ If this is not possible, install a switch that can be accessed.

A
Power supply of the controller:
Neutral conductor N
Conductor L'
Protective earth conductor ⏚

B
Mains connection of the electric heater:
Neutral conductor N
Conductor L
Protective earth conductor ⏚

C
Connection of the electric heater:
Neutral conductor 1400 W Out1_N
Conductor 1400 W Out1_L
Neutral conductor 800 W Out2_N
Conductor 800 W Out2_L
Neutral conductor 800 W modulating Out3_N
Conductor 800 W modulating Out3_L

D
Internal supply / data communication:
Terminal 1 cooling element sensor
Terminal 2 cooling element sensor
Terminal 3 fan
Terminal 4 fan
Terminal 5 VBus®
Terminal 6 VBus®

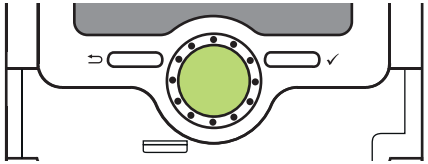
E
External interfaces
Terminal 7 GND
Terminal 8 0-10 V input
Terminal 9 PWM input
Terminal 10 PWM input

3.3 MicroSD slot of the controller

The controller is equipped with a MicroSD card slot.

With a MicroSD card, the following functions can be carried out:

- Store measurement and balance values onto the MicroSD card. After the transfer to a computer, the values can be opened and visualised, e.g. in a spreadsheet.
- Prepare adjustments and parameterisations on a computer and transfer them via the MicroSD card.
- Store adjustments and parameterisations on the MicroSD card and, if necessary, retrieve them from there.
- Download firmware updates from the Internet and install them on the controller via MicroSD card.



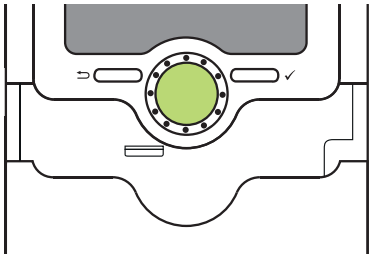
MicroSD card slot

A MicroSD card is not included, but can be purchased from the manufacturer.

Note
For more information about using a MicroSD card, see page 26.

4 Operation and function of the controller

4.1 Buttons and adjustment dial



The controller is operated via 2 buttons and 1 adjustment dial (Lightwheel®) below the display:

Left button (⮌) - escape button for changing into the previous menu
Right button (✓) - confirming / selecting
Lightwheel® - scrolling upwards / scrolling downwards, increasing adjustment values / reducing adjustment values

4.1.1 Control lamp

The controller is equipped with a multicolour LED in the centre of the Lightwheel®, indicating the following states:

Colour	Permanently shown	Flashing
Green	Everything OK	Manual mode: at least one relay in manual operation
Red		Sensor line break, sensor short circuit
Red / Green		VBus® defective / no communication with the sensor module or power unit respectively
Yellow		SD card full, maximum flow temperature exceeded

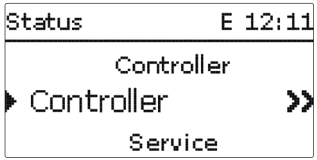
4.1.2 Selecting menu points and adjusting values

During normal operation of the controller, the display shows the status menu.

If no button is pressed for 1 min, the display illumination switches off. After 3 more minutes, the controller switches to the status menu.

In order to get from the status menu into the main menu, press the left button (⮌)!

Press any key to reactivate the display illumination. In order to scroll through the menu items, turn the Lightwheel®.

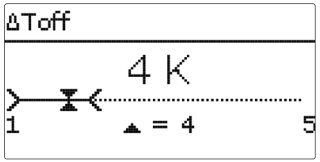


If the symbol ❯❯ is shown behind a menu item, pressing the right button (✓) will open a new submenu.

Values and options can be changed in different ways:

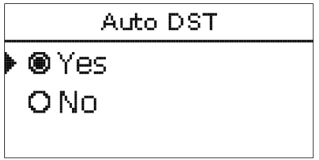
Numeric values can be adjusted by means of a slide bar. The minimum value is indicated to the left, the maximum value to the right. The large number above the slide bar indicates the current adjustment. By turning the Lightwheel®, the upper slide bar can be moved to the left or to the right.

Only after the adjustment has been confirmed by pressing the right button (✓) will the number below the slide bar indicate the new value. The new value will be saved if it is confirmed by pressing the right button (✓) again.



When 2 values are locked against each other, they will display a reduced adjustment range depending on the adjustment of the respective other value.

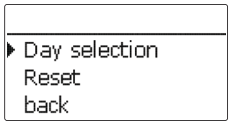
In this case, the active area of the slide bar is shortened, the inactive area is indicated as a dotted line. The indication of the minimum and maximum values will adapt to the reduction.



If only one item of several can be selected, they will be indicated with "radio buttons". When one item has been selected, the radio button in front of it is filled.

Adjusting the timer

When the **Timer** option is activated, a timer is indicated in which time frames for the function can be adjusted.



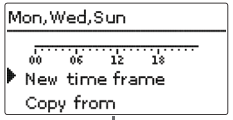
In the **Day selection** channel, the days of the week are available individually and as frequently selected combinations.
If more than one day or combination is selected, they will be merged into one combination for the following steps.

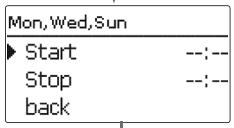
The last menu item after the list of days is **Continue**. If Continue is selected, the timer menu opens, in which the time frames can be adjusted.

Adding a time frame:

In order to add a time frame, proceed as follows:

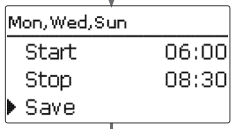
➔ Select **New time frame**.

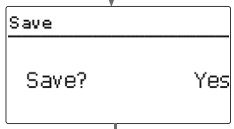




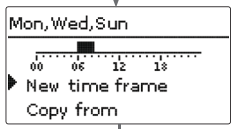
➔ Adjust **Start** and **Stop** for the desired time frame.
The time frames can be adjusted in steps of 5 min.

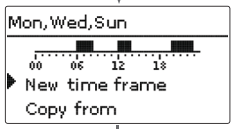
➔ In order to save the time frame, select **Save** and confirm the security enquiry with **Yes**.



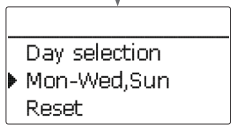


➔ In order to add another time frame, repeat the previous steps.
6 time frames can be adjusted per day or combination.





➔ Press the left button (⮌) in order to get back to the day selection.



Copying a time frame:

In order to copy time frames already adjusted into another day / another combination, proceed as follows:

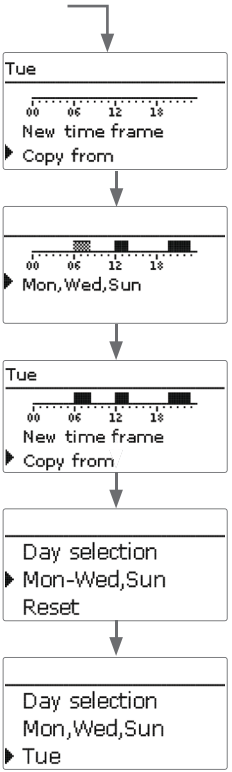
➔ Choose the day / the combination into which the time frames are to be copied and select **Copy from**.

A selection of days and / or combinations with time frames will appear.

➔ Select the day or combination from which the time frames are to be copied.

All time frames adjusted for the selected day or combination will be copied.

If the time frames copied are not changed, the day or combination will be added to the combination from which the time frames have been copied.



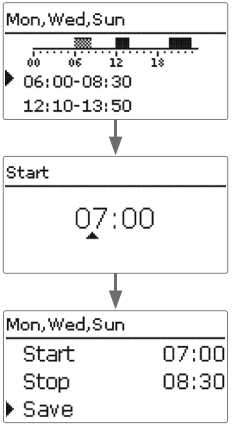
Changing a time frame:

In order to change a time frame, proceed as follows:

➔ Select the time frame to be changed.

➔ Make the desired change.

➔ In order to save the time frame, select **Save** and confirm the security enquiry with **Yes**.

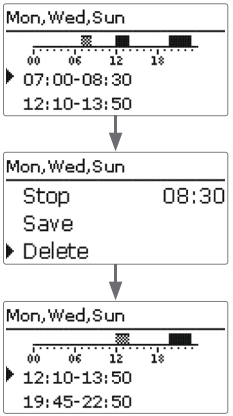


Removing a time frame:

In order to delete a time frame, proceed as follows:

➔ Select the time frame that is to be deleted.

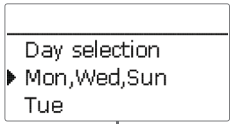
➔ Select **Delete** and confirm the security enquiry with **Yes**.

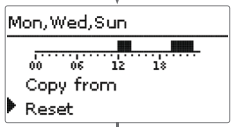


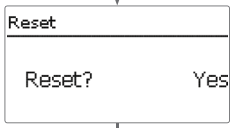
Resetting the timer:

In order to reset time frames adjusted for a certain day or combination, proceed as follows

➔ Select the desired day or combination.

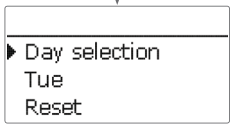






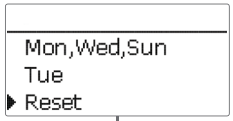
➔ Select **Reset** and confirm the security enquiry with **Yes**.

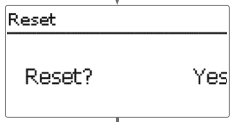
The selected day or combination will disappear from the list, all its time frames will be deleted.



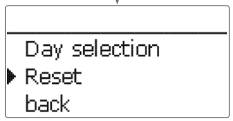
In order to reset the whole timer, proceed as follows:

➔ Select **Reset** and confirm the security enquiry with **Yes**.





All adjustments made for the timer are deleted.



4.2 Menu structure

- **Main menu**
  - Status
  - Controller
  - Measuring unit
  - Optional functions
  - Basic settings
  - SD card
  - Manual mode
  - User code
- **Controller**
  - Target temperature
  - Minimum temperature
  - Hysteresis
  - ΔTon
  - ΔToff
  - …
- **Optional functions**
  - Internal backup heating
  - External backup heating
  - S0 Excess
  - S0 Heating
  - Smart Remote
  - External load
  - External load 2
  - Inverter
- **Basic settings**
  - Language
  - Auto DST
  - Date
  - Time
  - Target temperature
  - Factory setting
  - …

The menu items and adjustment values selectable are variable depending on adjustments already made. The figure only shows an exemplary excerpt of the complete menu in order to visualise the menu structure.

4.3 Commissioning

When the hydraulic system is filled and ready for operation, connect the power unit to the mains.

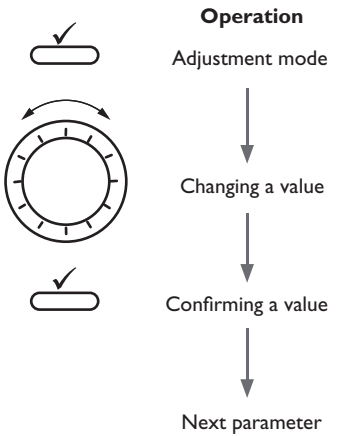
The controller has to be connected to the power unit (pre-connected) and to the sensor module by means of the VBus®.

The controller runs an initialisation phase in which the Lightwheel® glows red.

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

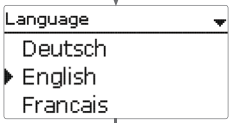
Commissioning menu

The commissioning menu consists of the channels described in the following. In order to make an adjustment, adjust the desired value with the Lightwheel® and confirm with the right button (✓). The next channel will appear in the display.



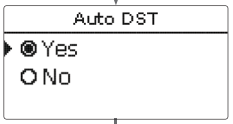
1. Language:

➔ Adjust the desired menu language.



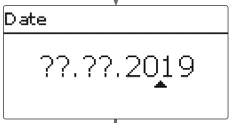
2. Daylight savings time adjustment:

➔ Activate or deactivate the automatic daylight savings time adjustment.



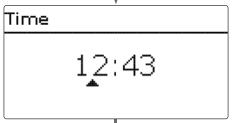
3. Date:

➔ Adjust the date. First of all adjust the year, then the month and then the day.



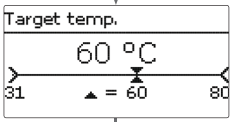
4. Time:

➔ Adjust the clock time. First of all adjust the hours, then the minutes.



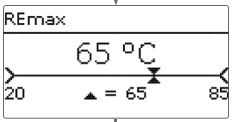
5. Target temperature:

➔ Adjust the desired target temperature.



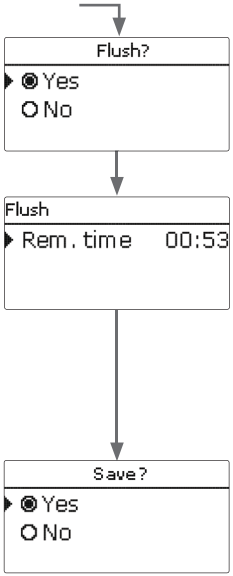
6. Maximum return temperature (maximum store temperature):

➔ Adjust the desired maximum return temperature.



7. Flush?

➔ Activate the flushing option, if necessary.



The flushing option is used for venting the heating element.

If the flushing option is activated, the loading pump switches on at 100 % for 1 min. The remaining flushing time is indicated as a countdown.

The flushing process can be stopped by means of the escape button (⮌) at any time.

8. Completing the commissioning menu:

Lastly a security enquiry will appear. If the security enquiry is confirmed, the adjustments will be saved.

➔ In order to confirm the security enquiry, press the right button (✓).

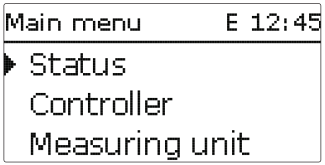
➔ In order to get back to the adjustment channels of the commissioning menu, press the left button (⮌). If the security enquiry has been confirmed, the controller is ready for operation.

Note

The adjustments carried out during commissioning can be changed anytime in the corresponding adjustment channel. Additional functions and options can also be activated and adjusted.

Set the code to the customer code before handing over the controller to the customer (see page 28).

4.4 Main menu



In this menu, different menu areas can be selected.

The following menus are available:

- Status
- Controller
- Measuring unit
- Optional functions
- Basic settings
- SD card
- Manual mode
- User code

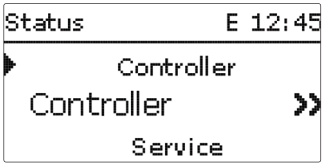
➔ Select the menu area by turning the Lightwheel®.

➔ Press the right button (✓) in order to enter the selected menu area.

If no button is pressed for 1 min, the display illumination switches off. After 3 more minutes, the controller switches to the status menu.

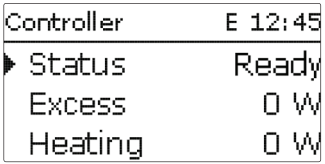
➔ In order to get from the status menu into the main menu, press the left button (⮌)!

4.5 Status



In the status menu of the controller, controller status messages as well as measurement / balance values and messages can be found.

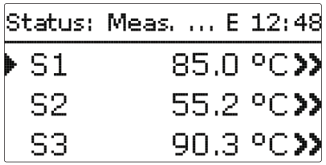
4.5.1 Controller



In the **Status / Controller** menu, all current controller values (power values, temperatures, etc.) are indicated.

Display	Description
Status	Functional state
Blocking	Countdown of the blocking time (maximum shutdown)
Inv. limit	Power limitation of the inverter active/inactive
Excess	Excess power (Reserve / P_{PV} > 3000 W)
Heating	Heating power
Load ext.	Power of the external loads
Flow	Temperature flow (S1)
Return	Temperature return (S2) (store base)
Store	Temperature store top (S3) (optional)
Sensor 4	Temperature sensor 4
Loading pump	Loading pump speed

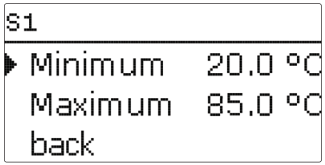
4.5.2 Measured / Balance values



In the **Status / Meas./Balance v.** menu, all current measurement values as well as a range of balance values are displayed.

Display	Description
S1 … S4	Temperature S1 … S4
S4, S5	Switching state S4, S5
R1 … R4	Operating state relays 1… 4
PWM	Operating state PWM output
Excess Wh / kWh / MWh	Excess energy in Wh / kWh / MWh
Heating Wh / kWh / MWh	Heat energy produced in Wh / kWh / MWh
Heating h	Operating hours of the electric heater
Backup heating h	Operating hours of the internal backup heating

When a line with a measurement value is selected, another submenu will open.



If, for example, **S1** is selected, a submenu indicating the minimum and maximum values will open.

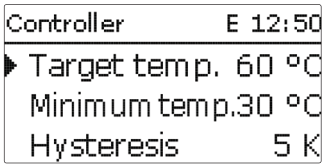
4.5.3 Messages

In the **Status / Messages** menu, error and warning messages are indicated.
During normal operation, the message **Everything OK** is indicated.
A message consists of a short text about the fault condition.

Display	Description
!VBus Sensor unit	VBus® communication disturbed
!VBus Power unit	VBus® communication disturbed
!Sensor error S1 … S3	Sensor defective

In case of an error, the control LED starts flashing red and a message is indicated in the status display. In case of a sensor error, the system switches off, and a message appears on the display.
If the VBus® communication is disturbed, the operating control LED flashes red/green.
After the error has been removed and acknowledged, the error message disappears.

4.6 Controller



In this menu, all adjustments for the hydraulic part of the FlowSol® E can be made. The target temperature and the maximum return temperature have already been adjusted during commissioning.

Adjustment channel	Description	Adjustment range / selection	Factory setting
Targ. temp.	Target temperature	30 … 70 °C	60 °C
Minimum temp.	Minimum temperature	20 … 50 °C	30 °C
Hysteresis	Hysteresis minimum temperature	1 … 10 K	5 K
ΔTon	Switch-on temperature difference	2 … 20 K	6 K
ΔToff	Switch-off temperature difference	1 … 19 K	4 K
REmax	Maximum return temperature	20 … 70 °C	65 °C
Min speed	Minimum speed	5 … 100 %	24 %
Max speed	Maximum speed	5 … 100 %	100 %
Reserve	Reserve which is not used for heating	0 … 9000 W	100 W

If the temperature difference between the flow sensor S1 and the return sensor S2 reaches or exceeds the switch-on temperature difference, the pump switches on. For this purpose, the adjusted value for the minimum temperature has to be exceeded at S1. The switch-on hysteresis is adjustable.
The controller aims to keep the flow temperature at the adjusted target temperature. For this purpose, the controller adjusts the pump speed. The minimum and the maximum pump speed can be adjusted by means of the parameters **Min speed** and **Max speed**.
If the temperature at the flow sensor reaches 85 °C, the heating switches off. In order to avoid this emergency shutdown, the pump speed increases up to 100 % (in steps) as soon as the target temperature is exceeded. The electric heating remains switched on during this process.
If the temperature at the return sensor reaches the adjusted maximum return temperature (maximum store temperature), the pump and the electric heating switch off. The maximum return temperature serves as the maximum store temperature.

The controller changes to the **Max. temp.** status (maximum shutdown).
The maximum shutdown is used for shutting down the PV heating in order to prevent overheating of the store.

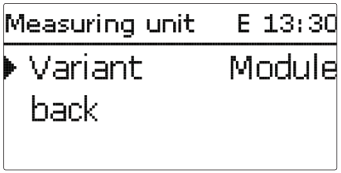
If the temperature at the return sensor reaches the adjusted return maximum temperature, loading is blocked for 15 min. The blocking time is indicated in the status menu (countdown). The controller is ready again, if the temperature falls below the maximum return value by 2 K after the blocking time has elapsed.

The **Reserve** is an adjustable excess power which is fed into the grid and not used for heating. The reserve can be used, e. g. in large PV systems, in order to start the heating at a later point in time. This reduces power peaks at noon.

As long as the heating power is > 0 W, the power supply over R1 remains switched on, even if the speed signal is 0 %. This guarantees a fast start-up of the pump.

Note
The target temperature is blocked against the minimum temperature by 1 K.

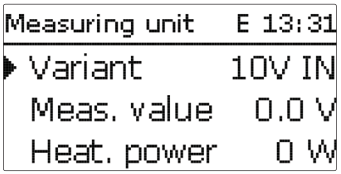
4.7 Measuring unit



In this menu, the source for the immersion heater power control can be defined. The following options are available:

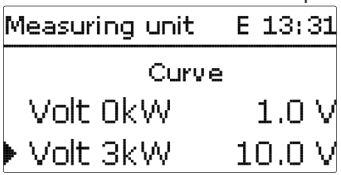
- Sensor module (**Module**)
- External 0-10 V power control (**10V IN**)

Adjustment channel / Indication	Description	Adjustment range / Indication range / Selection	Factory setting
Variant	Power control source	Module, 10V IN	Module
Measured value	Signal indication	0.0 … 10.0V	-
Heat. pow.	Heat energy indication	1 … 3000W	-
Volt 0kW	Lower voltage	0.0 … 9.0 V	1.0 V
Volt 3kW	Upper voltage	1.0 … 10.0 V	10.0 V



10V IN

With the **10V IN** variant, the power control takes place via an external 0-10 V signal. The signal is issued at the terminals 7 and 8 of the power unit.

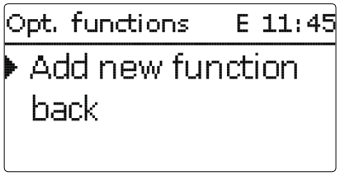


The parameters **Volt 0kW** and **Volt 3kW** can be used for adjusting the power control curve.

Note
Since there is no communication with the sensor module in this variant, no excess is measured and balanced.

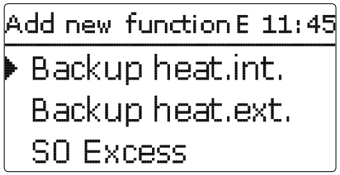
Optional functions which require the sensor module are not available or are deleted.

4.8 Optional functions



In this menu, optional functions can be selected and adjusted for the arrangement.

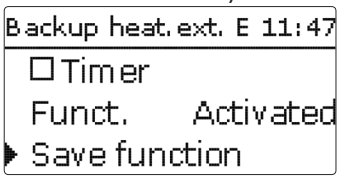
By selecting **Add new function**, different pre-programmed functions can be selected.



When a function is selected, a submenu will open in which all adjustments required can be made.

When a function has been adjusted and saved, it will appear in the **Opt. functions** menu above the menu item **Add new function**.

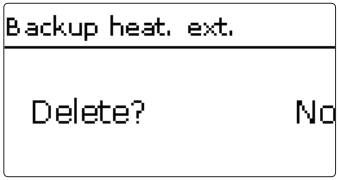
This allows an easy overview of functions already activated.



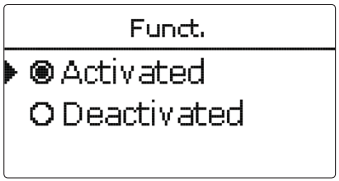
At the end of each optional function submenu, the menu items **Funct.** and **Save function** are available.

In order to save a function, select **Save function** and confirm the security enquiry by selecting **Yes**. In functions already saved, the menu item **Delete function** will appear instead.

In order to delete a function already saved, select **Delete function** and confirm the security enquiry by selecting **Yes**.

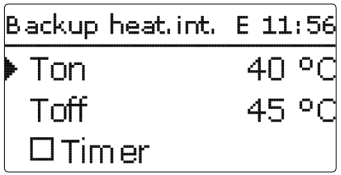


If the menu item **Delete function** is confirmed by pressing the right button (✓), a security enquiry appears. The Lightwheel® can be used for changing between **Yes** and **No**. If **Yes** has been selected and confirmed by pressing the right button (✓), the function is deleted and available under **Add new function** again.



With the menu item **Funct.**, an optional function already saved can be temporarily deactivated or re-activated respectively. In this case, all adjustments remain stored, the allocated relays remain occupied and cannot be allocated to another function.

Internal backup heating



Opt. functions /Add new function / Backup heat.int.

Adjustment channel	Description	Adjustment range / selection	Factory setting
Ton	Switch-on temperature	20 … 74 °C	40 °C
Toff	Switch-off temperature	21 … 75 °C	45 °C
Timer	Timer option	Yes, No	No
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

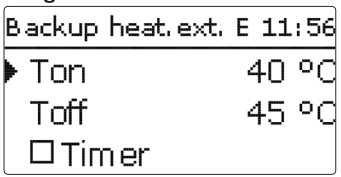
The **Backup heat.int.** function is used for operating the electrothermal station for backup heating with current from the mains. For this purpose, the power stages of the power unit and the pump (R1) switch on. The switch-on and switch-off temperatures **Ton** and **Toff** are used as reference parameters.

If the temperature falls below the adjusted threshold **Ton**, the power stages and the relay switch on. They switch off if the temperature exceeds the threshold **Toff**.

S3 is used as the reference sensor (non adjustable).

Note:
For information on timer adjustment see page 13.

External backup heating



Opt. functions /Add new function / Backup heat.ext.

Adjustment channel	Description	Adjustment range / selection	Factory setting
Ton	Switch-on temperature	20 … 84 °C	40 °C
Toff	Switch-off temperature	21 … 85 °C	45 °C
Timer	Timer option	Yes, No	No
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

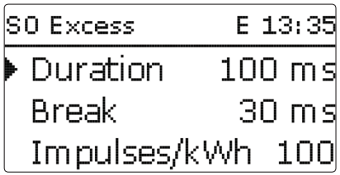
The **Backup heat.ext.** function is used for operating the electrothermal station for backup heating by means of an external heat source (e.g. heat pump, solid fuel boiler). The switch-on and switch-off temperatures **Ton** and **Toff** are used as reference parameters.

If the temperature falls below the adjusted threshold **Ton**, R2 is energised at 100 %. It switches off if the temperature exceeds the threshold **Toff**.

S3 is used as the reference sensor (non adjustable).

Note:
For information on timer adjustment see page 13.

S0 Excess



Opt. functions /Add new function / S0 Excess

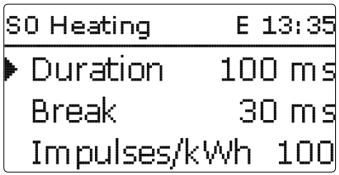
Adjustment channel	Description	Adjustment range / selection	Factory setting
Duration	Impulse duration	30 … 120 ms	100 ms
Break	Impulse break	30 … 120 ms	30 ms
Impulses/kWh	Impulse rate	1 … 1000	100
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

The **S0 Excess** function is used for activating the digital impulse output **S0-2** of the sensor module in order to issue the balanced excess energy in the form of impulses.

The impulse duration, break and rate can be adjusted.

Note:
This function is only available, if the variant **Module** has been selected in the **Measuring unit** menu.

S0 Heating



Opt. functions /Add new function / S0 Heating

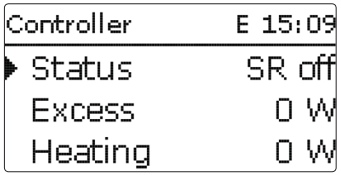
Adjustment channel	Description	Adjustment range / selection	Factory setting
Duration	Impulse duration	30 … 120 ms	100 ms
Break	Impulse break	30 … 120 ms	30 ms
Impulses/kWh	Impulse rate	1 … 1000	100
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

The **S0 Heating** function is used for activating the digital impulse output **S0-1** of the sensor module, in order to issue the balanced heat energy in the form of impulses.

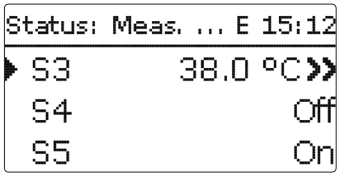
The impulse duration, break and rate can be adjusted.

Note:
This function is only available, if the variant **Module** has been selected in the **Measuring unit** menu.

Smart Remote



The **Smart Remote** function is used for remote access to the controller via a 4-state signal.



The sensor inputs S4 and S5 of the controller are used as switching inputs. The switching states are **On** (contact closed) and **Off** (contact open).

Mode	S4	S5
Off	Off	On
Normal operation	Off	Off
Normal operation + external load	On	Off
On (3 kW)	On	On

In the mode **normal operation + ext. load**, the additional load is switched on independently of the excess measured.

Opt. functions / Add new function / Smart Remote

Adjustment channel	Description	Adjustment range / selection	Factory setting
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

Inverter

This function is used for operating the inverter at reduced power, if the excess exceeds a threshold. The operation is specified by a switching signal.

Opt. functions / Add new function / Inverter

Adjustment channel	Description	Adjustment range / selection	Factory setting
Power	Nominal power of the inverter	0.0 … 99.9 kW	0.0 kW
Limitation	Threshold limit	0 … 100 %	0 %
Monitoring	Monitoring period	1 … 60 min	10 min
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

The parameter **Power** can be used for adjusting the nominal power of the inverter. The threshold is calculated from the adjustable **limitation** in relation to the power of the inverter.

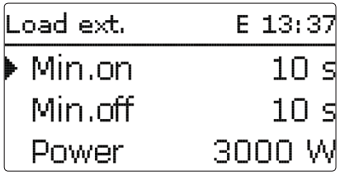
Threshold = power x threshold limit

If the average threshold value is continuously exceeded during the adjustable monitoring time, the signal is switched via the potential-free relay R4. If the value falls below the average value during the monitoring time, R4 switches off.

Note:
This function is only available, if the variant **Module** has been selected in the **Measuring unit** menu.

The control unit reduces the feed-in power of the PV system into the public grid. If the store is fully loaded (REmax), the full inverter power is available for grid feed-in. With this function this power can be limited.

External load



This function is used for switching an additional external load (e.g. immersion heater, heat pump), if enough power for its operation is available.

Opt. functions /Add new function / Load ext.

Adjustment channel	Description	Adjustment range / selection	Factory setting
Min.on	Minimum switch-on time	10 … 1800 s	10 s
Min.off	Minimum switch-off time	10 … 1800 s	10 s
Power	Power external load	0 … 9999 W	3000 W
Tolerance	Power tolerance	0 … 100 %	2 %
Monitoring	Monitoring period	10 … 600 s	30 s
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

In normal operation, the control unit operates in modulating mode. If the power consumption of the control unit (at maximum power + excess) exceeds the power consumption of the external load, the external load switches on. The parameter **Power** can be used for adjusting the power consumption of the load. An adjustable tolerance can additionally be added.

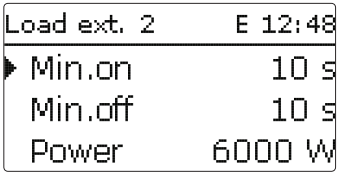
Switch-on condition of the external load in normal operation:
Power of control unit + excess > power + power x tolerance

The switch-on condition has to be fulfilled for the adjusted monitoring period. The external load is switched on for the adjustable minimum switch-on time. After switching off, the external load remains switched off for the adjustable minimum switch-off time. The external load switches off, if the excess falls below 0 during the monitoring period.

The external load is switched via relay 3 by means of an auxiliary relay, see page 9.

Note:
This function is only available, if the variant **Module** has been selected in the **Measuring unit** menu.

External load 2



If the external load function has been activated, it is offered a second time (Load ext. 2). This function works like **External load** and is used for switching higher power values. **External load 2** has priority over the control unit and the external load.

Opt. functions /Add new function / Load ext. 2

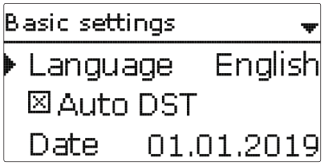
Adjustment channel	Description	Adjustment range / selection	Factory setting
Min.on	Minimum switch-on time	10 … 1800 s	10 s
Min.off	Minimum switch-off time	10 … 1800 s	10 s
Power	Power external load	0 … 9999 W	6000 W
Tolerance	Power tolerance	0 … 100 %	2 %
Monitoring	Monitoring period	10 … 600 s	30 s
Funct.	Activation / Deactivation	Activated, Deactivated	Activated
Save function / Delete function	Save / Delete function	-	-

Switch-on condition of the external load 2 in normal operation:
Power of control unit + power of external load + excess > power + power x tolerance

The external load 2 is switched via relay 2 by means of an auxiliary relay, see page 9.

Note:
This function is only available, if the variant **Module** has been selected in the **Measuring unit** menu and if the external backup heating is not activated.

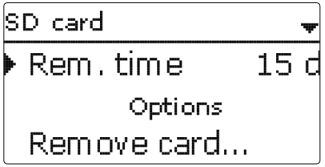
4.9 Basic settings



In the **Basic settings** menu, all basic parameters for the controller can be adjusted. Normally, these settings have been made during commissioning. They can be subsequently changed in this menu.

Adjustment channel	Description	Adjustment range / selection	Factory setting
Language	Selection of the menu language	Deutsch, English, Français, Español, Italiano, Nederlands	Deutsch
Auto DST	Daylight savings time selection	Yes, No	Yes
Date	Adjustment of the date	01.01.2001 … 31.12.2099	01.01.2019
Time	Adjustment of the current time	00:00 … 23:59	-
Targ. temp.	Target temperature control	30 … 80 °C	60 °C
Factory setting	back to factory setting	Yes, No	No

4.10 MicroSD card



Adjustment channel	Description	Adjustment range / selection	Factory setting
Rem. time	Remaining logging time	-	-
Options			
Remove card...	Safely remove card	-	-
Save adjustments	Save adjustments	-	-
Load adjustments	Load adjustments	-	-
Logging int.	Interval for data logging	00:01 … 20:00 (mm:ss)	01:00
Logging type	Logging type	Cyclic, Linear	Linear

The controller is equipped with a MicroSD card slot for MicroSD memory cards.
With a MicroSD card, the following functions can be carried out:

- Logging measurement and balance values. After the transfer to a computer, the values can be opened and visualised, e.g. in a spreadsheet.
- Store adjustments and parameterisations on the MicroSD card and, if necessary, retrieve them from there.
- Running firmware updates on the controller.

Firmware updates

When a MicroSD card with a firmware update is inserted, the enquiry **Update?** is indicated on the display.

➔ In order to run an update, select **Yes** and confirm with the right button (✓).

The update will run automatically. The indication **Please wait...** and a progress bar will appear on the display. When the update has been completed, the controller will automatically reboot and run a short initialisation phase.

Note:
Only remove the card when the initialisation phase has been completed and the main menu is indicated on the controller display!

➔ To skip the update, select **No**.

The controller starts normal operation.

Note:
The controller will only recognise a firmware update file if it is stored in a folder named **ETHERM** on the first level of the MicroSD card.
➔ Create a folder named **ETHERM** on the SD card and extract the downloaded ZIP file into this folder.

Starting the logging

➔ Insert the MicroSD card into the slot.

➔ Adjust the desired logging type and interval.

Logging will start immediately.

Completing the logging process

➔ Select the menu item **Remove card...**

➔ After **Remove card** is displayed, remove the card from the slot.

When **Linear** is adjusted in the Logging type adjustment channel, data logging will stop if the capacity limit is reached. The message **Card full** will be displayed.
If **Cyclic** is adjusted, the oldest data logged onto the SD card will be overwritten as soon as the capacity limit is reached.

Note:
Because of the increasing size of the data packets, the remaining logging time does not decrease linearly. The data packet size can increase, e.g. with the increasing operating hours value.

Storing controller adjustments

➔ To store the controller adjustments on the MicroSD card, select the menu item **Save adjustments**.

While the adjustments are being stored, first **Please wait...**, then **Done** will be indicated on the display. The controller adjustments are stored as a .SET file on the MicroSD card.

Loading controller adjustments

➔ To load controller adjustments from a MicroSD card, select the menu item **Load adjustments**.

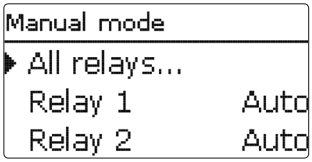
The File selection window will appear.

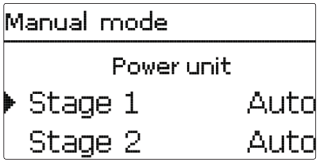
➔ Select the desired .SET file.

While the adjustments are being loaded, first **Please wait...**, then **Done** will be indicated on the display.

Note:
To safely remove the MicroSD card, always select the menu item **Remove card...** before removing the card.

4.11 Manual mode



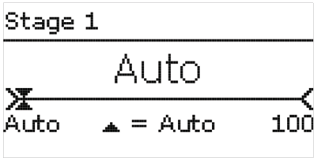


Adjustment channel	Description	Adjustment range / selection	Factory setting
Relay 1 … 4	Operating mode selection	Auto, Min, Max, Off, On	Auto
All relays...	Operating mode of all relays	Auto, Off	Auto
Stage 1	Manual mode selection for stage 1 (power unit), modulating	Auto, 0 … 100 % (in steps of 10 %)	Auto
Stage 2, 3	Manual mode selection for stages 2, 3 (power unit)	Auto, 0 %, 100 %	Auto

In the **Manual mode** menu, the operating mode of the pump relays and stages respectively can be adjusted.

In the menu item **All relays...**, all relays at once can be switched off (Off) or set to automatic mode (Auto):
Off = Relay is switched off (manual mode)
Auto = Relay is in automatic mode

The operating mode can be selected for each individual relay, too. The following options are available:
On = Relay active at 100 % (manual mode)
Off = Relay is switched off (manual mode)
Min = Relay active at minimum speed (manual mode)
Max = Relay active at maximum speed (manual mode)
Auto = Relay is in automatic mode



ATTENTION! **Damage through overheating!**

The manual mode > 0 % of the power stages in a system electrically connected, but not hydraulically filled can lead to damage caused by overheating!

➔ **Make sure the hydraulic system is filled and ready for operation.**

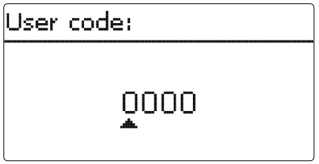
An operating mode can be selected for each stage of the power unit (electric immersion heaters). The following options are available:

Auto = Stage is in automatic mode
0 % = Stage is switched off
100 % = Stage is switched on at 100 %

The power of the modulating stage 1 can be set to the manual mode in steps of 10 %.

Note:
After service and maintenance work, the relay mode must be set back to **Auto**. In manual mode the control logic is overridden.

4.12 User code



The access to some adjustment values can be restricted via a user code (customer).

1. Installer **0262** (Factory setting)
All menus and adjustment values are shown and all values can be altered.

If the installer user code is active, an **E** is displayed next to the clock time.

2. Customer **0000**
The installer level is not shown, adjustment values can be changed partly.

For safety reasons, the user code should generally be set to the customer code before the controller is handed to the customer!

➔ In order to restrict the access, enter 0000 in the **User code** menu item.

5 Troubleshooting

If a malfunction occurs, a message will appear on the display of the controller.

WARNING! **Electric shock!**

Upon opening the housing, live parts are exposed!

➔ **Always disconnect the device from power supply before opening the housing!**

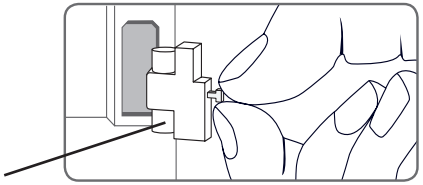
The Lightwheel® flashes red.

Sensor fault. An error code instead of a temperature is shown on the sensor display channel.

Short circuit or line break.

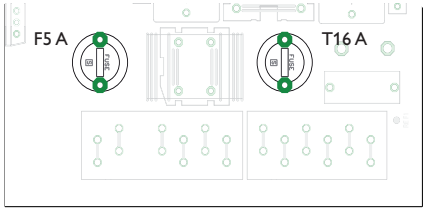
Disconnected temperature sensors can be checked with an ohmmeter. Please check if the resistance values correspond with the table.

°C	Ω Pt1000	°C	Ω Pt1000
-10	961	55	1213
-5	980	60	1232
0	1000	65	1252
5	1019	70	1271
10	1039	75	1290
15	1058	80	1309
20	1078	85	1328
25	1097	90	1347
30	1117	95	1366
35	1136	100	1385
40	1155	105	1404
45	1175	110	1423
50	1194	115	1442



Fuse

The controller is protected by a fuse. The fuse holder (which also holds the spare fuse) becomes accessible when the cover is removed. To replace the fuse, pull the fuse holder from the base.



Power unit

The power unit is protected by a fuse (16 A). The fuse holder becomes accessible when the cover is removed. To replace the fuse, unfasten the fuse holder using a screw driver and pull it from the base.

The modulating power stage is protected by a fuse (5 A) in the power unit. The fuse holder becomes accessible when the cover is removed. To replace the fuse, unfasten the fuse holder using a screw driver and pull it from the base.

The thermal cut-out is located on the upper part of the power unit. In order to unlock the thermal cut-out, remove the protective cap and push the button of the thermal cut-out.

The display is permanently off.

Press the right button (✓) Display illuminated?

- yes → Controller has been in standby, everything OK
- no → Check the power supply of the controller. Is it disconnected?
  - yes → The 16 A fuse of the power unit is blown. The fuse holder (which holds the spare fuse) becomes accessible when the cover is removed. The fuse can then be replaced.
  - no → The fuse of the controller is blown. The fuse holder (which holds the spare fuse) becomes accessible when the cover is removed. The fuse can then be replaced.

Status display **Excess** fluctuates quickly between positive and negative values.

The 5 A fuse of the power unit is blown. The fuse holder (which holds the spare fuse) becomes accessible when the cover is removed. The fuse can then be replaced.

Does the status display indicate an irregular value?

- yes → o.k.
- no → The power unit is defective - replace it.

The Lightwheel® flashes red / green.

Is the message **!VBus Sensor unit** indicated in the **Status / Messages** menu?

- yes → The **error** LED of the sensor module is flashing red?
  - yes → Check the VBus® line from the controller to the sensor module / establish the connection.
  - no → The **operating** LED of the sensor module is flashing red?
    - yes → o.k.
    - no → Check / establish power supply of the sensor module.
- no → Is the message **!VBus Power unit** indicated in the **Status / Messages** menu?
  - yes → LED of the power unit glows red?
    - yes → Check the VBus® line from the controller to the power unit / establish the connection.
    - no → LED of the power unit glows green?
      - no → Unlock the thermal cut-out of the power unit and check the hydraulics:
        - Air inside the electric heating?
        - Sufficient operating pressure?
        - Sufficient flow rate?

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Important note

The texts and drawings in this manual are correct to the best of our knowledge. As faults can never be excluded, please note:

Your own calculations and plans, under consideration of the current standards and directions should only be basis for your projects. We do not offer a guarantee for the completeness of the drawings and texts of this manual - they only represent some examples. They can only be used at your own risk. No liability is assumed for incorrect, incomplete or false information and / or the resulting damages.

Note

The design and the specifications can be changed without notice.

The illustrations may differ from the original product.