UVR 1611

Version A3.25-5 EN

Freely programmable universal controller

Operation
Programming
Installation instructions

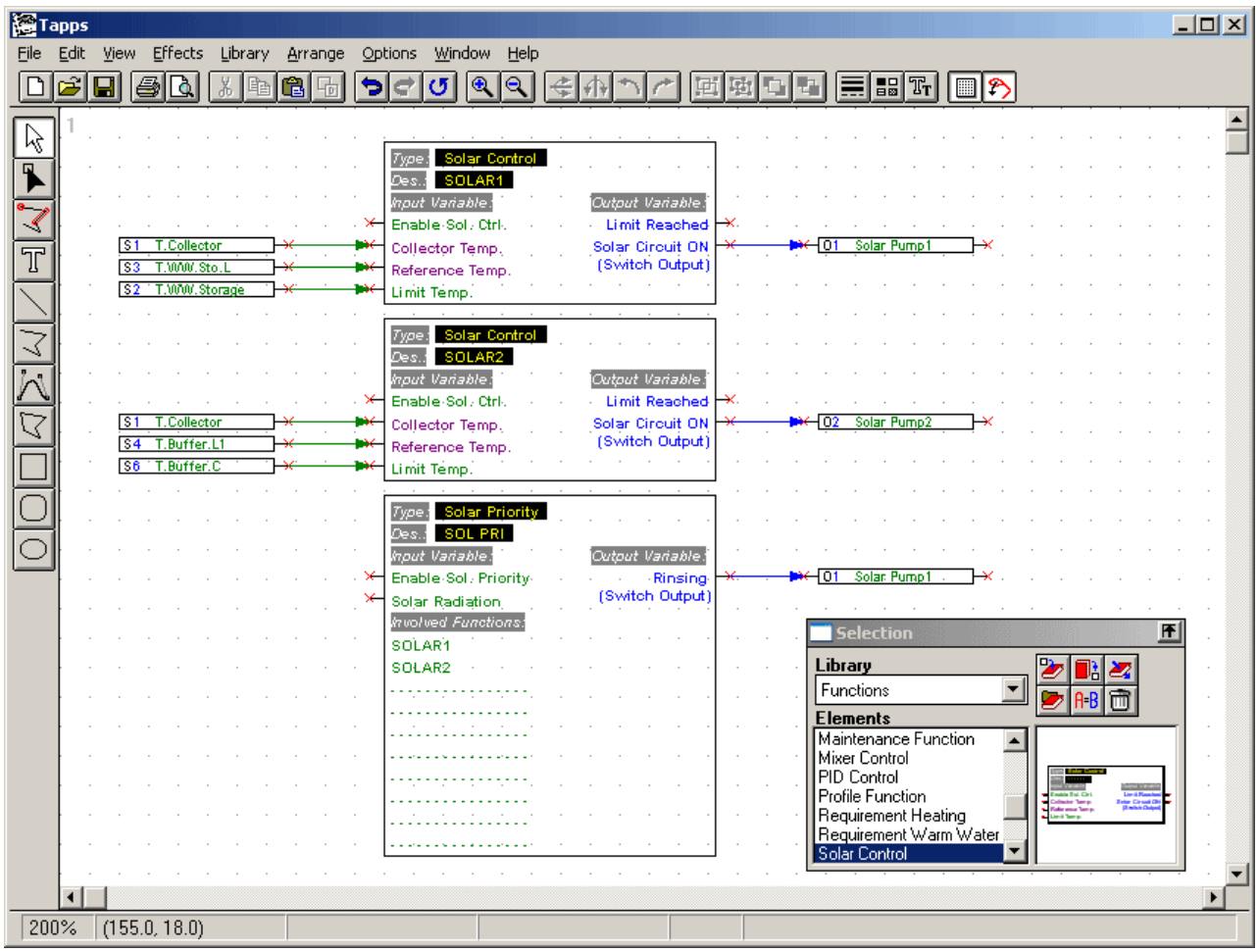
EN

TECHNISCHE ALTERNATIVE

NOTICE

This manual was written in order to provide the specialist with both an overview of the various control possibilities of the unit and its corresponding basic standards. It serves especially as a programming tool while operating the unit. Even using the **TAPPS** – system (the „**T**echnische **A**lternative **P**lanning and **P**rogramming **S**ystem") which you can find on our homepage **www.ta.co.at,** it is sometimes to know the programming mechanisms of the unit in order to be able to make local changes remotely.
In principle however, **TAPPS** is still recommended. This enables the specialist to design (= program) and parameterize the entire functionality in a graphical flow chart. In order to load the data into the control unit, the **Bootloader** is absolutely necessary.

Example with TAPPS:



The present manual describes exclusively the direct programming of the control unit and does not refer to TAPPS.

Contents:

Safety requirements:

All installation and wiring work on the controller must only be carried out in a zero-volts state.

The opening, connection and commissioning of the device may only be carried out by competent personnel. In so doing, all local security requirements must be adhered to.

The device corresponds to the latest state of the art and fulfills all necessary safety conditions. It may only be used or deployed in accordance with the technical data and the safety conditions and rules listed below. When using the device, the legal and safety regulations apposite to the particular use are also to be observed.

- ► The device must only be installed in a dry interior room.
- ► It must be possible to isolate the controller from the mains using an all-pole isolating device (plug/socket or double pole isolator).
- ► Before starting installation or wiring work, the controller must be completely isolated from the mains voltage and protected against being switched back on. Never interchange the safety extra-low voltage connections (sensor connections) with the 230V connections. Destructive and life-threatening voltages at the device and the connected sensors may occur.
- ► Solar thermal systems can become very hot. Consequently there is a risk of burns. Take care when fitting temperature sensors!
- ► For safety reasons, the system should only be left in manual mode when testing. In this operating mode, no maximum temperatures or sensor functions are monitored.
- ► Safe operation is no longer possible if the controller or connected equipment exhibits visual damage, no longer functions or has been stored for a lengthy period of time under unsuitable conditions. If this is the case, place the controller and equipment out of service and secure against unintentional use.

Maintenance

The system does not require maintenance if handled and used properly. Use a cloth moistened with soft alcohol (such as spirit) to clean. Harsh solvents such as chlorethenes or tri-gases are not admissible.
As the components relevant to accuracy are not subjected to loads if used properly, long-term deviation is very low. The unit thus cannot be adjusted. Hence, no calibration is possible.
The design characteristics of the unit must not be changed during repairs. Spare parts must correspond to the original parts and be used as intended.

Function mode

This unit is a very compact control system that has many applications for solar warm water and heating systems and for pumps and valves used in such systems.
The 16 sensor signals pass through overvoltage protection, a low-pass filter, and the multiplexer before they reach the processor's A/D transformer. An adjustable reference is used to calculate the value of the measurement signal. In addition, the computer periodically checks all of the operator's controls, describes the display, and handles the CAN bus.
Once the temperatures have been calculated and links set, the power driver switches the respective outputs. To prevent a loss of data, the device has nonvolatile memory (EEPROM) and a super capacitor (for around three days) for reserve power.

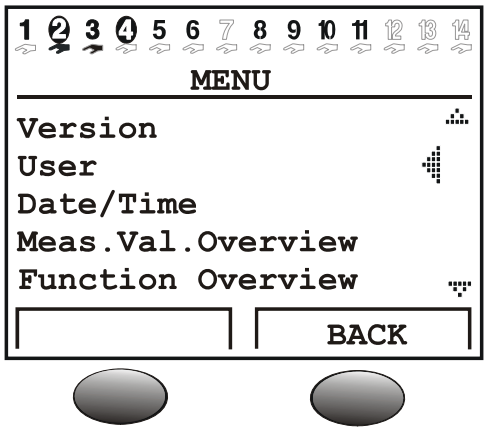
Planning basics

To ensure efficient programming, the following order has to be observed:

1	The basic condition of writing the desired controller functions and its parameterizing is an **accurate hydraulic diagram**!
2	This diagram **must** show **what** should be regulated and **how**.
3	The **sensor positions** are to be defined according to the desired controller functions and drawn into the diagram.
4	The next step consists in providing all sensors and "consumers" with the desired **input or output numbers**. As all the sensor inputs and outputs have different characteristics, it is not possible to provide consecutive numbers. Therefore, the input and output assignment must be made according to the following description: **Inputs:** All 16 inputs are suitable for standard sensors of the types KTY (2 kΩ) and PT1000 or for digital inputs. In addition, the following inputs have special functions: **S8:** Current loop (4 – 20 mA) or control voltage (0 - 10V=) **S15, S16:** Pulse input, such as for volume flow encoder Signal voltages of **more than** 5 V at the inputs S1 to S7 and S9 to S16 or **more than** 10 V at S8 are **not allowed**. **Outputs (supply voltage side):** **A1:** Speed-adjustable output **(!!!!!!!!!! max. 0.7A !!!!!!!!!!)** with integrated interference filter. It can also be used to regulate the phase-controlled ventilators. **A2, 6, 7:** Speed-adjustable outputs for pumps (max. 1A) , no phase controlled modulator possible **A3:** Relay output (closer) for undefined consumers **A4:** Relay output with opener and closer for undefined consumers, preferably for valves without retracting spring. A4 combined with A3 is also suitable for mixer motors. **A5:** Relay output – **potential-free** with opener and closer for burner requirement with the legally prescribed distance to the supply voltage. **A8, A9:** Relay outputs (closer) for undefined consumers, preferably together with mixer engines, as only one commonly used neutral conductor clamp is available for both outputs **A10, A11:** Relay outputs (A10 with closer, A11 with opener and closer) for undefined consumers, preferably together with mixer engines, as only one commonly used neutral conductor clamp is available for both outputs **Outputs (protective low voltage side):** **Hirel 1, 2:** Control lines for a relay module for two other relay outputs **A12** and **A13**, which can be installed as module in "Slot 1". **DL (14):** DL-Bus as bus link for diverse sensors and/or data recording using Bootloader to a PC. This connection is not only able to be used through the parameterization but also to activate an additional relay. **0-10 V / PWM (A15, A16)**: Control output with a standardized voltage level of 0 to 10 V e.g. for boiler modulation. Switchable to PWM (level approx. 10 V, cycle duration 0.5 ms). Referred to as analogue output in the user software.
5	Now the calling of the functions and its parameterizing is effected.

Basic standards

The basic operation



The display

The display consists of four information fields

The top line constantly provides information about the actual output states.

	Blank field instead of number 5 = output five has not yet been parameterized
5	Output five is active, runs in automatic mode and is temporarily **switched off**
⑤	Output five is active, runs in automatic mode and is temporarily **switched on**
5	Output five is active, runs in **manual mode** and is temporarily switched off
⑤	Output five is active, runs in **manual mode** and is switched on at the moment

The second line is the headline for the following menu and/or parameter lines.

The middle display area is the operative range. Within this range the programming, parameterizing and indicating takes place.

The lowest line exclusively serves to mark the two keys below in order to be able to assign different functions to it.

The keys

The control unit has two keys below the display. They are constantly assigned with the required functions via the display.

x10 – The changeable value changes for 10 steps each per increment of the scroll wheel.

SCROLLING – This function allows the direct “switch" from one menu level to the same level of the next menu by means of the scroll wheel

MENU – To switch from the opening image (after starting-up) to the menu

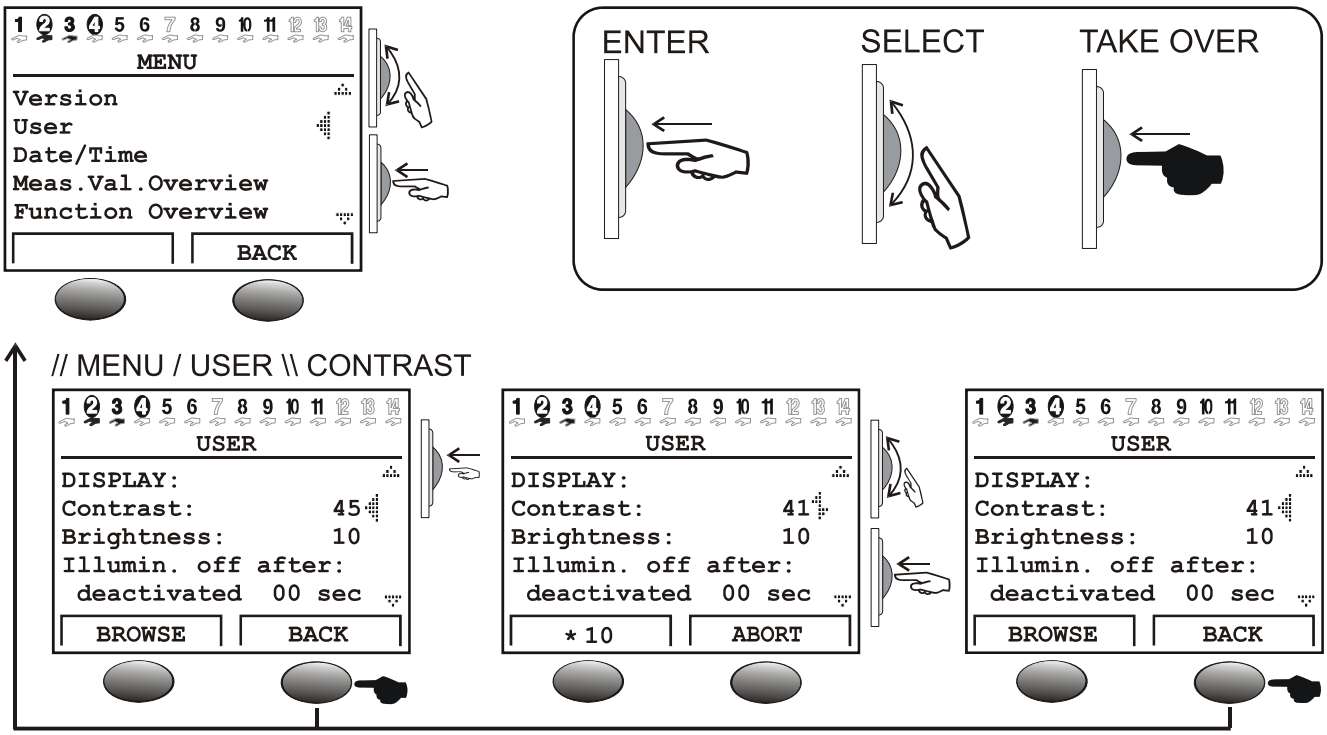
SERVICE – To switch from the function overview (the most important menu for the user) into all other menus

BACK – The PC switches immediately into the next-higher menu level

CANCEL - The current entry or change of a value is stopped

The scroll-wheel

By means of the scroll-wheel, the selected menu can be gone through by the right pointer in the display. Small upward or downward showing arrows symbolize the possibility of further menu lines above or below the visible display range.
If a parameter is to be changed, the pointer must be put in the desired position. Press the wheel to change the background lighting of the scroll wheel frame to orange to indicate programming. Now the value can be adjusted using the wheel (possibly also with "* 10"). You may cancel at any time by pressing CANCEL. Press the wheel again to turn the screen light green and take over the parameter.



Terms used

- **Operating system** = The software (operating system) of the control unit (e.g.: version A3.25EN) with indicator of the user language
- **Bootloader** = Accessory equipment for data transfer between control unit and PC
- **Boot sector** = Protected storage area in the processor containing a basic menu for “auto-programming" of the chip (e.g.: B2.00)
- **CAN-Bus** = Data bus for data exchange within the unit family
- **Function data** = Customized programming and parameterizing
- **Function module** / **Function** / **Module** = Available functions (e.g.: solar thermal control), which constitute the control characteristics.
- **Infrared interface** – CAN bus on infrared basis (below the two keys) allowing a slack connection to the Bootloader
- **Measuring data** = Measured values, output states, results of computation such as kW and others

The user interface

After starting up, the display indicates this menu.

```
   TECHN. ALTERNATIVE
----------------------
Homepage: www.ta.co.at
----------------------
          UVR1611
Operat.Syst: Ax.xxEN
```

Operating system: Version number of the software. The latest software (higher number) is available for download under http://www.ta.co.at. It can be transferred to the control unit by means of accessory equipment – the Bootloader.

The key ***MENU*** offers an entrance to the unit menu:

```
       MENUE
--------------------
Version
User
Date/Time
Meas.Val.Overview
Function Overview
Inputs
Outputs
Functions
Messages
Network
Data Administration
```

and by scrolling downwards:

Version – shows only the same indication as after the starting up - i.e. the operating system of the unit.

User – This menu permits the adjustment of the control level, the indication contrast and the background lighting as well as the entrance into a so-called "User interface editor", which allows the creation of an own menu surface.

Date / Time – To set the date and time. It is also possible to switch between normal time and summer time.

Measured Values Overview – To display all measured values and network inputs in a table.

Function Overview – All important information and parameters (e.g.: ambient temperature) of the determined function modules are written by the programmer (specialist) in an editor ("User interface editor") and displayed here clearly. The computer switches automatically to this overview after a few minutes, since it is the most important control panel for the user.

Inputs - This menu offers an exact overview of all input values. Furthermore, parameters for all inputs are set here. For details, see chapter "Parameterizing the inputs".

Outputs - For the complete parameterizing and manual operation of all outputs. For details, see chapter "Parameterizing the outputs".

Functions - This is the menu where all function modules of use are listed. Also, the control tasks and all corresponding parameters are specified here.

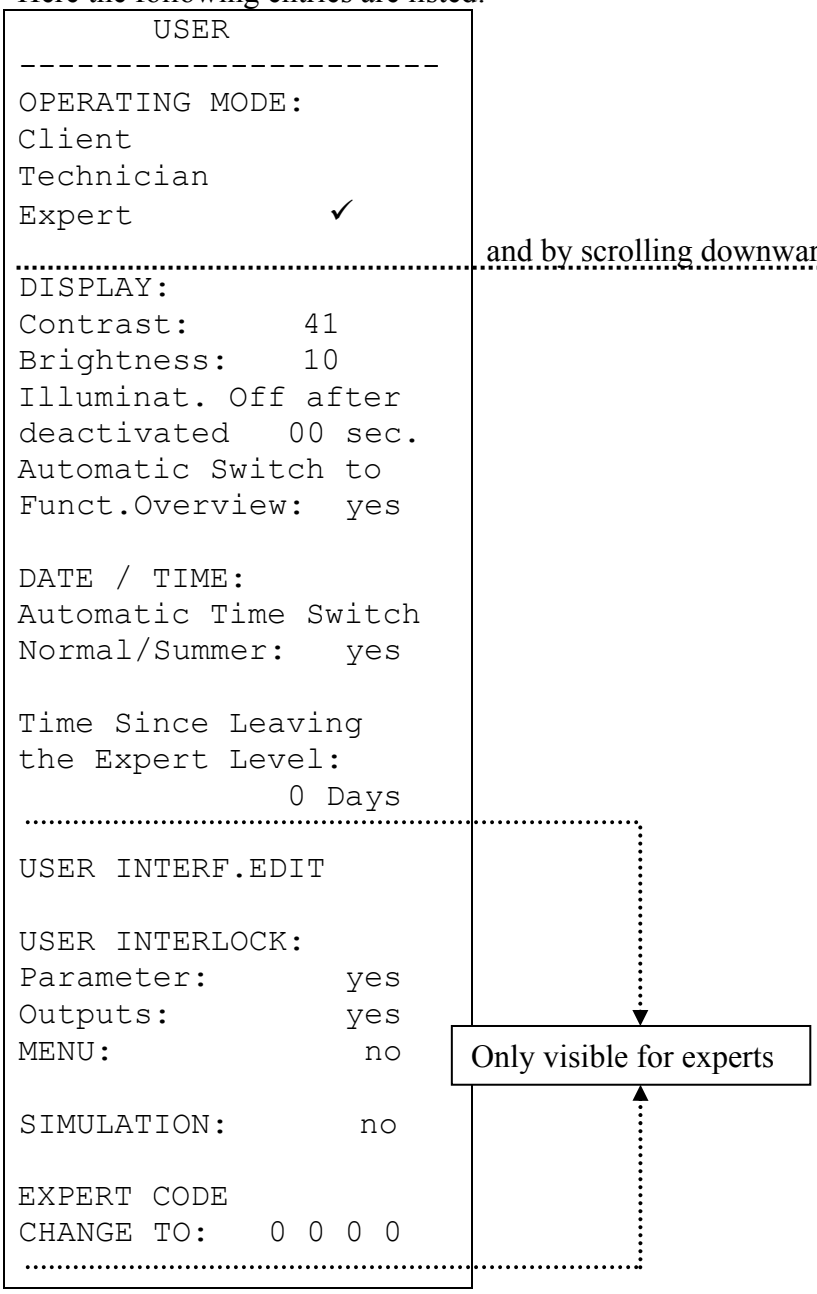
Messages – Events determined by the programmer via this menu can trigger status and error messages as well as an alarm tone.

Network – In this menu, all settings (node number, network in- and outputs, …) concerning the integration of the control unit in a CAN open bus network are defined.

Data Administration – This menu contains for the specialist all commands for the data administration and protection as well as for an update of the operating system.

MENU User

Here the following entries are listed:



Client - All indication possibilities, but only the most important settings are permitted.

Technician – In addition, all the settings are permitted. Access only possible via a key number. This number can be detected by solving a "little riddle" hidden in the manual.

Expert – In addition, the programming of all functions is possible. The necessary key number is only passed on to trained personnel by email or by telephone.

***DISPLAY:* Contrast** – Adaptation of the display contrast to the lighting conditions.

***DISPLAY:* Brightness** – The display has a background lighting, which is integrated in the circuit so that it does not need additional energy. The attenuation of the 12V relays to the 5V computer tension in many devices is transformed into heat, but in case of the UVR1611 also into light! Thus disconnecting does not save energy. The intensity of the background lighting is variable and can be switched off after an adjustable time, while no control element is used.

***DISPLAY:* Automatic Switching to Overview of Functions** – In the user surface the most important information for the user is listed in a overview of functions. This command can be used to activate an automatic switch when no control element has been used for several minutes.

***DATE / TIME:* Automatic Switch Normal / Summer time** - This command allows the automatic switching between summer and normal time.

Time Since Leaving the Expert Level: - A negligent passing on of the expert key number often leads to changing of important parameters and linkages by unauthorized persons. This function allows you to check.

USER INTERFACE EDITOR: Press the scroll-wheel to open an editor menu to program the dialogue (the overview of functions) between control unit and user (only for “expert”).

***USER INTERLOCK:* Parameter** – If set to yes, the user is not allowed to change any of the parameters (exception: function overview, all parameters in the user menu and outputs (MANUAL / AUTO)).

***USER INTERLOCK:* Outputs** – If set to yes, if set to yes, the output conditions can also no longer be changed by the user.

***USER INTERLOCK:* MENU –** if set to yes, user and technician now only have access to the function overview and the user menu (switching using the left key). After logging in as an expert, it is possible, to go to the main menu from the function overview by pressing the "SERVICE" key.

SIMULATION: option to activate the simulation mode (in expert mode only):

- no average determination of the outside temperature in heating circuit control
- inputs defined as PT1000 sensors are measured as KTY
- no RAS/RASPT evaluation

The simulation mode is ended automatically when closing the expert level.

CHANGE EXPERT KEY NUMBER TO: - Change the ex-works key number. Without knowledge of this number no read-out of the program (function data) is possible later on.
Under normal conditions, the control unit automatically returns to the user mode two hours after the last key actuation. Since this is unwanted in devices used for programming or test purposes, the key number 0 0 0 0 blocks the resetting.
WARNING: The loss of the selected key number can only be cancelled by resetting to the factory setting – under complete loss of the function data.

MENU Date / Time

Here the following entries are listed:

```
      DATE / TIME
----------------------
        Thursday
      16. 12. 2010

 Normal time: 00 : 00
```

All values can be selected and changed accordingly by means of the scroll-wheel (pressing the wheel - frame = orange – change value, possibly with the help of the key "*10" – pressing the wheel). The date and time function has a power reverse of approximately three days in case of a blackout. The indication of the "normal time" corresponds to the winter time. The switch to the summer time is possible manually or automatically (see user menu).

MENU Measured values overview

In this menu, all entries of the measured values are listed in a table:

```
   MEAS.VAL.OVERVIEW
----------------------
 1:  60.3 °C  27.6 °C
 3:  49.2 °C  88.4 °C
 5:  29.0 °C  47.5 °C
     …
     …
     …
NETWORK INP.:
 1:OFF         ON
17: 25.4 °C    10.6°C
```

In other words, the temperature at sensor 1 is 60.3°C; the one at sensor 2 is 27.6°C, etc.

If there is a network connection to other devices, the analogue values and digital conditions of the defined network inputs are subsequently displayed too.

In the example, network input 1 (=digital input 1) is in the "OFF" state, network input 2 is in the "ON" state, network input 17 (= analogue input 1) is equal to 25.4°C and network input 18 is equal to 10.6°C.

MENU Function overview

All of the function modules offer a wide range of information, measurement values, and parameters that can be viewed via the menu "Functions." To give users a quick overview of the main settings, experts can use the "user interface editor" to display all of the information that users need to see from all the menus. This information later appears in the menu "Function overview." Only the most important information and parameters should be entered in the menu "Function overview," and otherwise the overview would simply be too long. In other words, this menu is by far the most important interface to users.

The following display is an example of the system with one heater circulation, one heat counter and a chimney sweep function:

```
HEAT.CIR.1      F: 5
OPERAT.:  TIME/AUTO

T.Room LOWER:  15 °C
T.Room NORMAL: 20 °C
TIME PROG.:
----------------------
CH.SWEEP         F: 9
FUNCTION START
Status:           OFF
Tot.Runtime:   0 Min
----------------------
HQC              F:13
POWER:        6.81 kW
HEAT QUANT.:
            544.7 kWh
```

The controller automatically switches from any menu to the function overview when it is switched on or if no operator's control is used for a few minutes, provided that the automatic option has been activated in the user menu (recommended).

Code for Technicians:

In order to enable all of the setting parameters, open the function "User" in the device's basic menu and then select "Technician". Enter the product of 2^6 as the code!

The user interface editor

To keep the dialogue between users and the controller as simple as possible, an overview menu is automatically provided to present the most essential information that users need to know from the wide array of information available. The *FUNCTION OVERVIEW* serves that purpose in this device.
Experts can use the "user interface editor" at any time to create this overview. **The dialogue is complicated in accordance with the scope of information as to cover; the PC user interface TAPPS simplifies it.** We recommend that you use it in any case to provide an easy-to-follow overview of the most important information that users need.
The command can be found under the entry "USER INTERF. EDIT" in the menu *USER*. Once the menu is open, the cursor will be to the left of the display. Press the scroll wheel to open it and then select from the following commands:

S... A source can be entered in the following dialogue for the entry. The first entry from a "source" always begins with this command. The next source command closes the previous one and opens a new one.
A... If the value in the following entry can be changed, users may also make these changes. User area A
B… --- " --- User area B
C… --- " --- User area C
T... If the value in the following entry can be changed, only technicians, but not users may make these changes.
E... If the value in the following entry can be changed, experts may make these changes. Only experts and technicians can see this entry, which is hidden for users.
>... Enter lines. About your current position (line), information is to be entered. The number of lines must be entered.
<... Delete lines. Information in and below your current line is to be deleted. The number of lines must be entered.
-... Empty line that only appears in the editor; and entry can be made here at any point.

User areas A, B, and C are only important if you are using the CAN monitor. For the unit itself, it does not matter whether the entry is made with A, B, or C.

Assumption: A house with three apartments (three heating circuits in one control unit), each of which has its own CAN monitor:
Each of the three parties should only be able to access its own heating circuit; therefore, the first heating circuit is programmed for user area A in the function overview, while the second one is programmed for B and the third one for C. Experts can set the user level (such as A) on the CAN monitor. This ensures that user A only sees that heating circuit on the CAN monitor.

Programming example:

The example in the function overview we will start with is the date, the time (both of which users can change), and the collector temperature. Enter the command ***S*** (source). Now, the display shows:

```
S        User
```

User is a special feature as it does not have anything to do with commands or entries and is the only source information that does not produce a heading. It only serves as an indication of the date and time (summertime, wintertime). Enter ***A*** in the next line after you have entered the source of the information. Now the user can change the value. The current date will immediately be displayed.

```
S    User
A    Fr.  24.04.2009
```

When ***A*** is entered in the next line, the date appears again. It can be set to summertime or wintertime, depending on the date. Now, the current time appears in the function overview next term (such as summertime). Now, the display shows:

```
S    User
A    Fr.  24.04.2009
A    Summertime:
```

Use the command ***S*** to enter the collector temperature, but instead of *User* enter *Input*, and this information is in the input menu:

```
S    User
A    Fr.  24.04.2009
A    Summertime:
S    Input
```

Every time the command ***S*** is entered, the function overview displays a new bar across the width of the display indicating the new function along with a heading (in this example: *input*). ***T*** is in entered in the next line to set the collector temperature. It does not matter whether ***A***, ***E*** or ***T*** is selected for information that cannot be changed, such as collector temperature. In case of doubt (can it really not be changed?), select ***T***.

```
S        User
A        Fr. 24.04.2009
A        Summertime:
S        Input
T        1: T.Collector
```

Date
Time
Bar and heading `INPUTS`
The information (temperature) is always displayed for this purpose.

The function overview should now look as follows:

```
Fr.  24. 04. 2009
Summertime: 13:08
--------------------
INPUTS
1:  T.Collector
         86.7 °C
```

Tips and tricks

- The commands Delete < and Insert > acquire the inputs of the number of lines.
- The overview is all the more useful for users if the information is provided in a proper sequence. Begin with the functions for maintenance and control of the heater.
- Each source command ***S*** inserts a separation bar in the function overview and the name of the "source" and is used whenever information is to be added for an additional function. In other words, ***S*** is always at the beginning of any function.
- If no new source command is set, the only selection in the subsequent lines concerns information for the previously inserted function.
- Select a device input output to display the respective values automatically (temperature, automatic / manual) in the function overview as headings.
- When entering outputs assigned to mixtures, proceed in descending order (such as makes or 8.9 before 8).
- Entries of INPUT or OUTPUT VARIABLES are admissible and do help users reach this menu directly in the function overview, but do not provide users with any truly valuable information. In other words, they can be confusing and should not be used. In addition,
- With any function is called (via ***S***), the heading of the selected function that allows the user a direct entrance into the function is always automatically entered in the overview. Users can thus reach all the areas of the selected function from the overview.
- All of the entries concerned are automatically deleted when the expert deletes this function in the menu *Functions* or turns it into a different function.
- A set monitoring function of the system from the “messages” module is always entered at the start of the function overview, but only if it is actually active.
- To make sure that the function overview truly provides an overview, you should only enter the most important information.
- Only a few parameters (mainly from the heating circuit control function) should be set by the user. We thus recommend that you use command ***A*** (user may change value) sparingly.
- Parameters that can be changed (nominal values) cannot be changed in the function overview (nor in the functions themselves) if these nominal values are transferred from another function via INPUT VARIABLE.
- Users only see "one level up" -- in other words, the information stored with the commands ***A*** (***B***, ***C***) and ***T***. Only experts see the information marked with E (expert), but experts are also not able to change this information.

The parameterizing of the inputs

The menu "*Inputs*“ primarily serves as overview over the measured values of the inputs and/or sensors. Furthermore, it allows the expert the parameterizing of all used inputs if employed the following procedure:
The line “*Inputs*” has already been selected and then pressed the scroll-wheel. Hereby the indication example is as follows:

```
1: T.Collector
    78.3 °C   PAR?
2: T.Warm Water1
    45.8 °C   PAR?
3: T.Warm Water2
    61.2 °C   PAR?
4:  -----
   unused     PAR?
```

The temperature of the collector is currently 78.3°C etc.

Input 4 has to be set before

In the above indication example the sensor inputs 1 to 3 were already defined by the expert, while the input 4 is not yet fixed. In order to assign e.g. the tank sensor *buffer, bottom* to the input 4 the arrow has to be induced to the corresponding entrance into the parameterizing level PAR by means of the scroll-wheel. By pressing the wheel the entrance is effected and the indication "TYPE unused” appears.
First, it has to be determined which basic characteristic (TYPE) the sensor owns. Possible selections:

- *Unused* = The input is not used
- *ANALOG* = Temperature, ambient temp., radiation sensors and others
- *DIGITAL* = Direct ON/OFF control input (possible at each input!) from another function or connection of a **potential-free** switch contact between sensor connection and sensor earth (no voltage)
- *PULSE* = Volume flow encoder, wind sensor (only for the inputs 15.16)

After having selected the type (according to example *ANALOG*; as it represents the analog measured variable "Temperature") all available parameter lines are faded in.
Indication example:

```
TYPE:     ANALOG
MEAS VAR: Temperat.

DESIGNATION
GROUP: General
DES:      -------

SENSOR:       Pt 1000
SENSOR CHECK:     no
SENSOR CORR.:  0.0 K

MEAN VAL:     1.0 Sec
```

A temperature sensor has the measured variable *Temperat.* which is already faded in. A radiation sensor would need the measured value *Solar Rad.*.

Menu Inputs

In the next step the name (designator) *Buffer, bottom* is to be assigned to the input 4. To do so, superset "designator groups" were specified such as *General, Producer, Consumer, Pipe, Climate* and others. *General* is a group which had to be taken over from old operating systems (< A1.21). Many names out of it are represented also in the other groups. *T.Buffer.L* is put down in the group *Consumer*.
When selecting the "designator", the computer suggests different texts with sequential index up to 9 by scrolling forward. T.Buffer.C2). Instead of the "0" the index is faded out (e.g.: T.Buffer.C). In order to proceed quickly from one designator to the next, the key (x10) must be pressed at the same time. According to our example we select *T.Buffer.L.*

Indication example:

```
TYPE:     ANALOG
MEAS VAR: Temperat.

DESIGNATION
GROUP: Consumer
DES:  T.Buffer.L

SENSOR:        Pt 1000
SENSOR CHECK:       no
SENSOR CORR:    0.0 K

MEAN VAL:      1.0 Sec
```

Under "SENSOR" the sensor type has to be specified. Possible selections are: *RAS* (KTY) or RASPT (Pt1000) for the ambient temperature sensor, *Pt 1000* for the standard temperature sensor and *KTY 10*.

If a short circuit and/or interruption occur, an active "SENSOR CHECK" issues **automatically** en error message in the **function overview**.
If "SENSORCHECK" is active, the **Sensor status** is also available: OFF for a correctly working sensor and ON for a defective sensor (short circuit or circuit interruption). As the **sensor status** can also be set as source of an input variable (see menu function modules), it is thereby possible to react accordingly if e.g. the external sensor fails. The sensor status can optionally be selected for individual sensors or for all sensors together ("sensor status 17").

If there is a "SENSOR CORR" such as 0.5K and a measured temperature of 60.0°C, 60.5°C is indicated. This corrected value is then used also internally for all calculations.

"MEAN VAL" means the temporal averaging of the measured values. Calculating a mean of 0.3 seconds leads to an extremely rapid reaction of the display and the unit. However, this can be expected to cause fluctuations of the value. A large mean slows everything down and is only recommended for the sensors for the heat counter. For simple measurements, around 1 – 3- sec. should be selected, for the provision of hygienic warm water with the ultra-speed sensor 0.3 – 0.5 sec.

Special abilities of the inputs

The inputs also permit as measured analogue variable *Voltage* including the necessary scaling. By this the determination of the value range is to be effected with a separate indication for the limit of the minimum and maximum input signal.
For program reasons, the same configuration options are available with all inputs for the *voltage* measurement value.
The following points must therefore be taken into account:

- **Inputs 1-7** and **9-16** can process a maximum ***voltage*** of **5 volts**
- The heat quantity counter function cannot establish the *flow rate* for **inputs 15** and **16** from a voltage signal.
- **Input 8** also allows ***current*** and ***resistance*** as measurement.
- The process values of *voltage*, *current* and *resistance* are processed as dimensionless values (without decimal point).

Example:

```
TYPE:       ANALOG
MEAS VAR:   Voltage
PROC VAR:   Voltage

DESIGNATION
GROUP: General
DES: Level

SCALING:
 0.00V    :     0
10.00V    :   100
MEAN VAL:     1.0 Sec
```

Specification of the value range using scaling

The calculated voltage rate is averaged over 1 sec.

In addition, the **inputs 15 and 16** are able to detect faster pulses (pulse duration min. of 50 ms, pause of min. 50 ms). Thereby they are suitable as inputs for volume flow encoders.
The parameterizing of a pulse input leads to the following indication:

```
TYPE:       IMPULS
MEAS VAR:   Flow Rate

DESIGNATION
GROUP: General
DES: Solar Flow R

QUOTIENT:   0.5 l/Pls
MEAN VAL:     1.0 Sec
```

Per each 0.5 litres a pulse is received

The calculated flow rate is averaged over 1 sec

When selecting the measured variable *Flow Rate*, also the "QUOTIENT" is to be entered. It describes which flow rate creates a pulse. Some of the function modules such as the heat quantity counter have the ability to directly handle these pulses. The control unit calculates at the same time the effective flow rate as number by putting together the received pulses, the quotient and the calculation of a mean. This number is available as information also internally. All functions linked with pulse input decide independently on which pulses or flow rate they want to receive as numerical value.

Menu Inputs

With "TYPE" *Pulse* and "MEAS VAR" *Pulse* there is also available a "PRESCALER" at the **inputs 15 and 16**. It indicates how many pulses have to arise at the input, so that a pulse is passed on to the functions. Thus it is possible to realize a slow pulse counter in conjunction with a counter module. (see function modules)
That leads to the following indication:

```
TYPE:       IMPULS
MEAS VAR: Pulse

DESIGNATION
GROUP: General
DES: Solar Flow R

PRESCAL.:    10
```

Only each tenth pulse is passed on.

With "TYPE" *pulse* and "MEAS VAR" *wind speed* a "QUOTIENT" must also be stated for **inputs 15 and 16**. Here the frequency per one km/h must also be set.
Example: A wind sensor issues one pulse (=1Hz) per second at a wind speed of 20 km/h (= 1Hz). Therefore, the frequency at one km/h is equal to 0.05Hz.

Connection of an electronic sensor (VFS2-40, RPS0-6)

Power supply:
The sensor can be supplied via both analogue outputs (output 15 or output 16). A small drop in voltage is caused by the internal circuitry of the analogue outputs. In order to keep to the 5V supply as closely as possible, the analogue output is to be set to the following voltage values, dependent on the number of sensors (scaling):

With one sensor: 5.10 V two sensors: 5.20 V three sensors: 5.20 V four sensors: 5.30 V
Example:

```
SCALING:
      0 : 5,10 V
```

Evaluation:
The sensor signals (volume flow, pressure, temperature) can be recorded via any control inputs. **Exception**: the volume flow signal is not to be put into inputs 15 or 16 as these connections possess a special internal circuitry for encoders.

The **measured variable** must be set to **voltage** at the appropriate input; the **process variable** to **temperature**, **volume flow** or **pressure**. In addition scaling according to sensor data is possible.

Connection of electronic sensors in version DL:

Electronic sensors for temperature, pressure, humidity, differential pressure, etc. are also available in the **DL** version. In this case, the supply and signal transmission takes place via the **DL bus**.

Due to the relatively high power requirement, the **"bus load"** must be considered:
The controller UVR 1611 has the maximum bus load, 100%. For example, the electronic sensor FTS4-50**DL** has a bus load of 36%, therefore up to a max. 2 FTS4-50**DL** can be connected to the DL bus. The bus loads of the electronic sensors are listed in the technical data of the respective sensors.
The advantage of this signal transfer lies in the fact that sensor inputs are not necessary, but rather the information (signals) are transferred as a network variable as with the CAN bus (see: MENU network/input variables).

The parameterizing of the outputs

The menu *"Outputs"* primarily serves for the switching between the automatic and manual mode of the outputs. As in the status line of the outputs (top symbol line on the display) it is not possible to share information concerning the speed stages (if active), this indication was put down in the output menu. The parameterizing of all used outputs is effected by employing the following procedure:
The line "*Outputs*" has already been selected and then pressed the scroll-wheel. Hereby the indication example is as follows:

```
1: Solar Pump1
   HAND/ON     PAR?
2: Heat C Pump1
   AUTO/OFF    PAR?
   RPM stage:   0
3: Mix Heat C1
       AUTO    PAR?
   op.:  OFF
4: cl.:  OFF
5:    -----
      -----    PAR?
```

Pump solar 1 is switched on in **manual mode.**

Heating circuit pump 1 is switched off in **automatic mode.**

Output A4 together with A3 is configured as a mixer output.
Input 5 has to be set before.

and so on

Hence, the output 1 as solar pump, the output 2 as heating circuit pump and the outputs 3 and 4 as mixer (open/closed) were already determined.
According to the example the outputs 1 and 4 are set to the automatic mode and indicate the current operating state (OFF). If the pointer is placed behind that position, the switching to manual mode on/off is possible (pressing the wheel / selecting the state / pressing the wheel). The current status of the output is immediately shown up in the status line of the outputs. As the speed control function at output 1 is active, the current speed stage is also faded in. This only can be changed in manual mode for experimental purposes.
As seen at the output 5, neither the "Designator" nor the status of the output appears before the parameterizing (similar to the parameterizing of the inputs). Thus, the corresponding symbol would also be missing in the top display line of the output status.
If e.g. the solar pump is to be assigned to the (not yet determined) output 1, the arrow must be induced to the corresponding entrance of the parameterizing level *PAR?* by means of the scroll-wheel. Pressing the wheel causes the entering and the following indication appears:

```
TYPE: unused
```

First, it has to be determined which basic characteristic (TYPE) the output should own. Possible selections:

- *SWITCH OUTP* = Output only can effect switches (no speed control)
- *RPM OUTPUT* = Output is prepared for the speed control

At the outputs 3, 8, 10 and 12 the suggestion MIXER appears instead of the type *RPM OUTPUT*, while each first output means "Mixer open" and the next-following (4, 9, 11 and 13) "Mixer closed". In other words, if output 4 is defined as relay and if output 3 is parameterized afterwards as mixer, output 4 automatically becomes the second mixer output!

Menu Outputs

After selecting the type (such as *RPM OUTPUT*, since a solar pump shall run speed-controlled at output 1 later on) all available parameter lines are faded in.

```
OUTPUT STATUS:
TYPE: RPM OUTPUT

DESIGNATION
GROUP: General
DES:      -------

MODE:  Wave Packet
DELAY:          0 Sec
AFTER-RUN:      0 Sec
```

(This line is suppressed in *SWITCH OUTP*)
Rise-delay time
After-running time

In the next step the name (designator) *Solar Pump 1* is to be assigned to the output 1. As in the parameterizing of the sensors superset "designator groups" and a sequential index until 9 (e.g. *Solar Pump 4*) were specified. Most suggestions like *Solar Pump 1* are to be found in *General*. In order to proceed quickly from one designator to the next, the key (x10) must be pressed at the same time.
The waveform can be selected via the parameter "MODE" of the speed control. While usual commercial pumps are controlled by wave packets (fast switching on/off of the motor), ventilated motors need a phase control (such as a light dimmer).
“DELAY” permits the setting of an adjustable rise-delay time.
Via “AFTER-RUN” the cutoff-delay time of the output can be determined.

If after the entrance the TYPE MIXER has been selected, the following indication appears:

```
OUTPUT STATUS:
TYPE: MIXER

DESIGNATION
GROUP: General
DES:      -------

RUN TIME:  2.5 Min
```

With “RUN TIME” the total running time of the mixer motor has to be fixed.
Where there are stability problems in the mixer control circuit, the mixer running time can be increased or reduced to lengthen or shorted the pulses or pauses. This has no influence on the remaining running time, as this is always loaded with 20 minutes upon a direction change or enable.

WARNING:

The factory setting of the total running time of the motor is 0 seconds! Thus the mixer is not controlled. Unfortunately it is not possible for reasons due to the programming technique to preset another value in the factory setting. Therefore this parameter must be entered while setting the mixer output.

The submenu option “**OUTPUT STATUS**“ represents a special characteristic. Here a list of all functions and messages (including status) controlling the output is put down. By this it is easier to understand at the system, why a pump is being controlled right now or not. In addition, it is possible to enter the corresponding functions out of the output status in order to check the function status there (see function modules).
If an output is controlled by multiple functions, the output switches ON, if at least one function is active (OR – function)!

The outputs (manual and automatic) are controlled only 30 sec. after the starting up of the control unit.

Particularities of output 14

Output 14 basically serves as a data link (DL-Bus9 but can also be used as a switch output for switching an external relay and can be configured accordingly (*unused / SWITCH OUTP / DATA LINE*).

Output 14 as data link:

Output 14 serves as data link for recording of measured values ("DATA LOGGING") using Bootloader BL-NET or D-LOGG and/or as bus link for various sensors.

If the controller receives data via the network the possibility exists to send a second data packet with the data from the network inputs via DL. In this case the data logger recognizes the second data packet as virtual second UVR1611 controller. However this option can only be used if the data logger's second DL input is unused.

Any cable with a cross section of 0.75 mm² can be used for the data link (e.g. twin-strand) having a max. length of 30 m. For longer cables, we recommend the use of shielded cable. Where the processing of two control inputs by the data converter are concerned separate screened cables must be used. Equally the DL must never be put through the same cable with the CAN.

```
OUTPUT STATUS:
TYPE:  DATA LINE

DESIGNATION
GROUP: General
DES: Data Line

NETW.IP.=>DL.: no
```

Output 14 as data line / DL-bus

For a "yes" input: Use network inputs as second data packet

Output 14 as switch output:

When required, output 14 together with an external 12 V / 20 mA relay (laid to ground) can be used as an additional switch output. The relay must be fitted with a suitable free-wheeling diode.
Recording of the measured values with the data logger and capturing sensors via the DL bus link are not possible in this mode.
With device type UVR1611E (special type for control cabinet fitting) output 14 is able to be used **simultaneously** as a switch output and a DL link (DL bus). That is why for this type of device in the setting "`UVR1611E: yes`" the data link can be activated in addition to the switch output. This option may only be activated for type UVR1611E and results in a malfunctioning of the output with other types of devices.

```
OUTPUT STATUS:
TYPE:  SWITCH OUTP

DESIGNATION
GROUP: General
DES: Load Pump

DELAY:      0 Sec
AFTER-RUN:  0 Sec

UVR1611E: no
NETW.IP.=>DL.: no
```

Output 14 as switch output

This option may only be activated with type UVR1611E.

Particularities of outputs 15, 16

Output 15, 16 = analog outputs. These outputs provide a voltage between 0 and 10V for performance control of modern burners (burner modulation). They can be controlled by a PID function module, but also by other functions with an analog value. The "scaling" offers the possibility of adapting the arithmetic value to the control range of the downstream device. If several functions act simultaneously on one analog output, the higher value is output.
By activating the analog output via a **digital command** (ON), a **dominating** output voltage between 0.00 and 10.00 V can be specified.
Output of the calculated value takes place either as a voltage (0-10 V) or as a PWM signal. In PWM (pulse width modulation), a square wave signal is created with a voltage level of about 10 V and a frequency of 2 kHz with a variable duty cycle (0 - 100%).

Examples for different scaling:

Correcting variable for PID function: Mode 0-10 V, correcting variable 0 should correspond to 0 V, correcting variable 100 should correspond to 10 V:

```
Output status:
MODE:  0 - 10 V

SCALING:
      0  :  0.00 V
    100  : 10.00 V

Outp.Voltage Digital
Command:   10.00 V
```

The correcting value is imported without a decimal point

Temperature value, e.g. of an analog function: Mode PWM, the temperature 0°C should correspond to 0 %, 100°C should correspond to 100 %:

```
Output status:
MODE:  PWM

SCALING:
      0  :  0.0 %
   1000  : 100.0 %

Outp.Voltage Digital
Command:   10.00 V
```

The temperature value is imported in 1/10°C **without** a decimal point

Burner performance, e.g. from the functions hot water requirement or maintenance: Mode 0-10V, a burner performance of 0% should correspond to 0 V, 100% should correspond to 10 V:

```
Output status:
MODE:  0 - 10 V

SCALING:
      0  :  0.00 V
    100  : 10.00 V

Outp.Voltage Digital
Command:   10.00 V
```

The percentage value is imported without a decimal point

Anti-Skid Control

Circulating pumps, which do not run for longer periods (such as: heating circuit pump during the summer), often have starting problems as a result of inner corrosion. This problem can be easily avoided by activating the pump periodically for 30 seconds.
The menu *SKID CONTROL* added after the output 16 permits to indicate the time and the outputs which are to receive this anti-skid control.

```
Mo Tu We Th Fr Sa Su
at:16.30

OUTPUT:
 1 2 3 4 5 6 7 8
 9 10 11 12 13 14
15(=analog=)   16
```

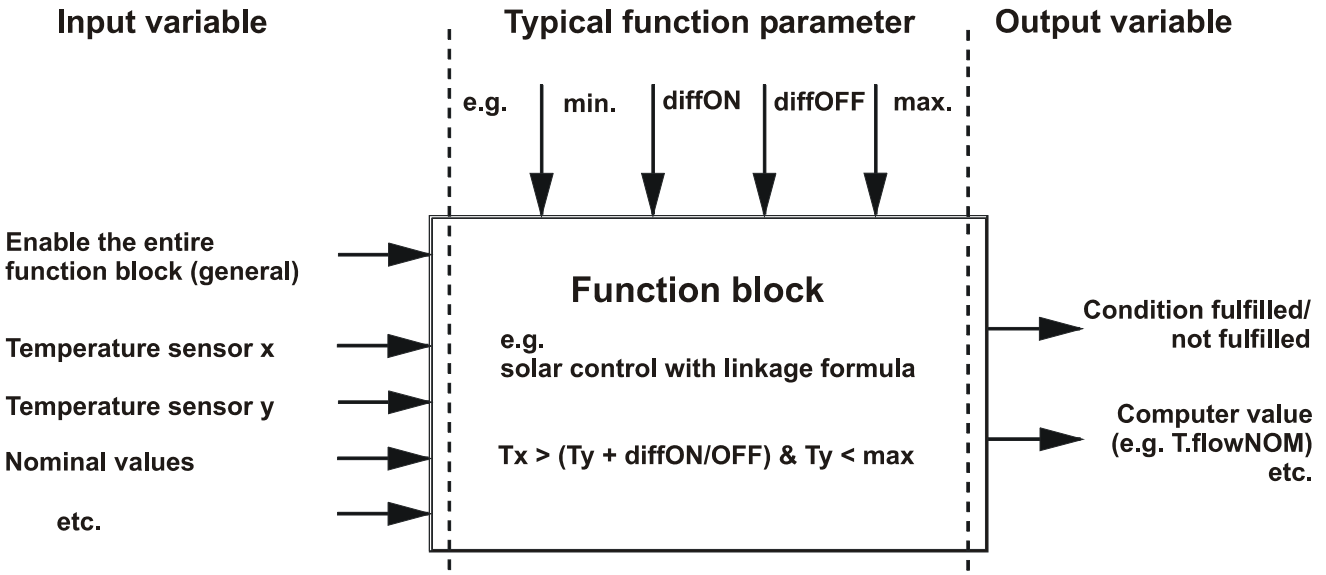
In the example the pumps 3,4,6,9 and 10 are activated for 30 seconds on Tuesday and Friday at 16,30 if the output has not been active since the controller start or the last call of the anti-skid control. However, the computer does not connect all outputs at the same time, but begins with output 3, switches after 30 seconds to output 4 and so on. In order to save energy a switching time is selected when neither the industry nor the typical households are using the mains supply with maximum consumption. In addition, it will be sufficient to set one day per week.

MENU Functions

The basic standards of the function menu

In the menu “Functions“ all linkages concerning the control are to be set and parameterized (therein the control engineering of the entire solar and heating installation is described!). To this end, the unit has a set of function modules which can be registered successively and also several times in the list “Functions”.

Schematic diagram of a function module:



By means of the input variables of the function module the module receives all data necessary for the internal decision. Most of it will be temperature data. In addition, each module has the input variable “Enable” which means a general permission for processing the task.
Within the function module the decisions and the nominal values are calculated by means of the data and settings and made available as output variable.
Thus, a function module only can fulfill tasks when connected with the other parts of the system (inputs, outputs, other modules) by its input and output variables.

The following example shows how to set a new function.
Indication example from the menu Functions:

```
5: LOAD PUMP
   LD PUMP 1   PAR?
6: NEW FUNCTION
   -----       PAR? ◄
```

The function module already has been assigned to function 5 “Load pump”.
A new module can be entered.

Employing the following procedure a new function module can be added: Induce the pointer to *PAR?* and press the scroll-wheel. The following text appears in the display:

```
TYPE: HEAT.CIRC.CONT
DES:     -----

Scope of TIME PROG:
Number Prog.:      1
```

At present the computer suggests the module *HEAT.CIRC.CONT* as a new function with all its options. Assuming that the module *SOLAR CONTROL* is to be added, press the wheel once again under “TYPE” in order to switch to the selection of a function module. Now, the desired module can be selected by means of the scroll-wheel. By pressing the wheel once again the new module *SOLAR CONTROL* is called.
Indication example:

```
TYPE:  SOLAR CONTROL
DES:     -----

ADD ?               no
```

In the line DES.: a text for the module can be selected (by the usual operation – press / select text / press). Assuming that a solar circuit already exists as function number 1 with the designation ”SOLAR 1” “SOLAR 2” will be selected.
In addition, the question "ADD ? *no*” is to be answered with *yes*. The computer has now taken over the module *SOLAR CONTROL* in the list under the number 6 and immediately shows the menu of this function which is now the module solar control *SOLAR 2*.
Hereby the indication example is as follows:

```
DES:    SOLAR2
FUNCTION STATUS:
INPUT VARIABLE:
OUTPUT VARIABLE:

COLLECTOR TEMP.:
T.Coll.ACT:  -----
T.Coll.MAX:    130 °C
        .....
```

and so on

Input variables

Serve as link to sensors and also to eventually prepared output variables from other function modules or definable parameters. The collector and the tank sensor are the typical input variable of the module *SOLAR CONTROL*. Another typical input variable for the module *REQ.HEATING* is the calculated nominal temperature of the flow (T.flow.NOM) of the module *HEAT.CIRC.CONT*.
Sometimes also simple parameters can be defined as input variable, when it is reasonable to apply the computation results of a function module (= its output variable) as thermostat threshold in the new block. Like the threshold min of the module *LOAD PUMP* which is not a function parameter but an input variable.
In principle each function module has the input variable "Enable …" which represents a general permission of the entire function. This enables a simple interlock and/or enable of the entire module by another one.
Indication example:

```
DES:   HEAT.CIR.2
FUNCTION STATUS:
INPUT VARIABLE:        ◄
OUTPUT VARIABLE:

OPERAT.: TIME/AUTO
```

other text lines by scrolling

Induce the pointer to "INPUT VARIABLE" and press the wheel (in the following designated as "Enter"). Hereby the indication example is as follows:

```
HEAT.CIR.2

ENABLE HEAT.CIRC.:
Source:   User
Status:   ON
```

The line "ENABLE HEAT. CIRC.:" represents the general permission of the entire function module. The user has effected the enable (ON) as "(signal) source".

Instead of *User* another source of enable can be selected, such as:

- *Input* In the example this only makes sense if in the following an input is selected which has been set to ***DIGITAL*** (as control inlet) in the parameterizing of the inputs.
- *Output* In some cases the outputs of the control unit are controlled by multiple modules (such as a common solar pump). Via *Output* it is also possible to use a common output as enable control.
- *NW Status* The enable is effected according to the **status of the network** (See chapter Network/Timeouts). The network status can optionally be selected for individual inputs or for all network inputs together ("network status 33").
- *Sens.malf* The enable is effected according to the **status of the sensors**. A correctly working sensor has status OFF and a defective (circuit interruption or short circuit) ON. Thus, for example, failure of the external sensor can be correspondingly reacted to (e.g. for the function "messages"). The sensor status can optionally be selected for individual sensors or for all sensors together ("sensor status 17").
- *Message* The enable of the function module depends on the status of a *message*.
- *Network* Responsible for the enable of the function *HEAT.CIR.2* is a function module of another control unit from the CAN-network (**digital** network input variable).

Evers other function which already has been specified can switch the function HEAT.CIR.2.

If another function module (also from the network) has been selected as a source, its first output variable (or network input variable) in the following. **An analogue value** (temperature, computation result) **is not suitable for the enable control**. An enable control only can be a switch, thus a digital value such as the output status of an already registered function module. If a module has several output variables it is possible to choose between these variables.
If the enable is to be made via a digital input, output or another module, it is also possible to select the enable via ***normal*** and/or ***inverse*** of the registered control line. Thus, a module also can be enabled by the switch-off status of another one.
Indication example of the input variable "ENABLE PUMP": of the function module *HEAT.CIRC.* The heating circuit pump only should run, when the tank load is not active at the moment (tank priority) via the function module *LOAD PUMP*.

`ENABLE PUMP:`	
`Source:  LD PUMP1`	Enable via the module with that specification
`1 : Stat.Load Pump`	via the output status of the module
`MODE:  invers`	via the inverse output status of the module
`Status: ON`	heating circuit pump is currently enabled

Hence, the enable of the heating circuit pump is controlled by the function module *LOAD PUMP* with the specification *LD PUMP 1*. Since the mode is ***inverse***, the enable is made always when the load pump is not running. This also happens at the moment, since the status of the enable indicates *ON* (enabled).

By scrolling the next input variables of the module *HEAT.CIR.2* appear right after the enables.

```
ROOM TEMPERATURE:
Source:   Input
12 : T.Room2

FLOW TEMPERATURE:
Source:   Input
11 : T.Heat.Cir.P2
    .......
```

etc.

Hence, the module *HEAT.CIR.2* needs further input information such as room temperature, flow temperature etc.
Just as the input variable "ENABLE" also an unit input of an unit from the CAN-network can be set as source for the temperatures via *network*. By this it is possible to transfer the information of the ambient temperature to multiple control units.

Output variables

They represent the result of a function module. They can be used directly for the switching of hardware output or serve as input variable for another module. If this output variable is to be used directly for the switching of a pump, the respective assignment can be made in the relative menu “OUTPUT VARIABLE” of the module. The output variable is always available as input variable for the other modules **with or without** assignment to a real output.
The previous example, the module solar control unit, normally creates an output out of a difference function together with a thermostat function (such as: difference already reached, tank temperature limit not yet reached => output variable (= *ON*). This information can now be assigned to a hardware output under ”output variable”.
Indication example (we are already in the menu of the function 6 = SOLAR 1):

```
DES:   SOLAR 1
FUNCTION STATUS:
INPUT VARIABLE:
OUTPUT VARIABLE:     ◄

COLLECTOR TEMP.:
```

Other text lines by scrolling

After entering the menu “OUTPUT VARIABLE” the following menu appears:

```
SOLAR 1

SOLAR CIR.:
Status:   OFF
OUTPUT:
 1 2 3 4 5 6 7 8
 9 10 11 12 13 14
 15 (=analog=) 16
```

The output variable actually shows the status *OFF*, i.e. either the nominal temperature difference has yet not been reached or the tank limit has been exceeded. Now, the variable is to be assigned to the real (hardware) output 1.
To do this, induce the pointer to 1 and make the assignment by the usual operation - / press / darken the 1 / press.
Now, the display shows:

```
SOLAR 1

SOLAR CIR.:
Status:   OFF
OUTPUT:
 1◄2 3 4 5 6 7 8
 9 10 11 12 13 14
 15 (=analog=) 16
```

Above the visible range

Below the visible range

Hence, the function *SOLAR 1* influences the real output 1.

A common pump with valves is often used in solar thermal systems with multiple consumers. Therefore, we assume the following:

Double circuit solar thermal system with common pump and three-way valve
Output 1 = Common pump
Output 3 = Three-way valve

In this example both the output 1 and the output 3 have to be activated in *SOLAR 2* (1 and 3 darkened). Output 1 has already been correctly assigned in the function *SOLAR 1* according to the above example. Now, the display shows:

```
SOLAR2

SOLAR CIR.:
Status:   OFF
OUTPUT:
 1 2 3◄4 5 6 7 8
9 10 11 12 13 14
15 (=analog=) 16
```

Above the visible range

Below the visible range

Hence, *SOLAR 1* with output 1 (only with pump) would switch the first solar circuit and *SOLAR 2* with output 1 and 3 (pump and valve) the second one.
No matter if all these assignments were made or not, the variable is available for other function modules.
The output variable (switch status pump on/off) from *SOLAR 2* and possibly also from *SOLAR 1* in the example can be assigned as input variable to the module *PID-CONTROL* (speed control). By this the starting of the speed control for the common solar pump can be switched via the input variable "ENABLE".

The following output variables are available in the heating control unit function:

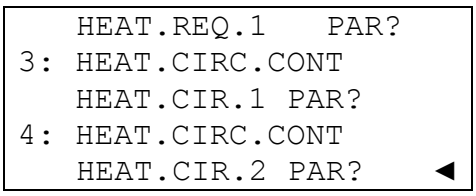
- Flow nominal temperature – To further use in the burner requirement
- Effective room temperature – As nominal value for the speed control when instead of the mixer the room temperature is only controlled by the module *PID-CONTROL* via the circulating pump.
- Heating circuit pump – Switches the respective hardware output
- Mixer on/off - Assignment to the two hardware outputs *Mixer OPEN / CLOSED*
- Maintenance mode - ON If the maintenance function requires the operation of the heating circuit
- Frost protection mode - ON If the heating circuit runs in frost protection mode

Function parameter

Function parameters are set values which provide the user with the possibility to adapt the ready (i.e. with all preset function modules) control unit to the characteristics of his system.
In the module *SOLAR CONTROL* these are parameters such as switch-on/off difference, maximum limit to the possible sensors (tank, top and bottom etc.). In the module *HEAT.CIRC.CONT* these would be parameters such as heating characteristic, desired room temperature in the heating and lowering mode and others.
In addition, the function parameters of the time windows in some of the modules allow a time-controlled enable and blockage of the module or of parts of the module. There are maximum 5 time programs with each 3 time windows available per function module. Each time program can be assigned separately to undefined days.
As the function parameters are an essential integrated part of a function module, they are explained extensively in the description of the various function modules.

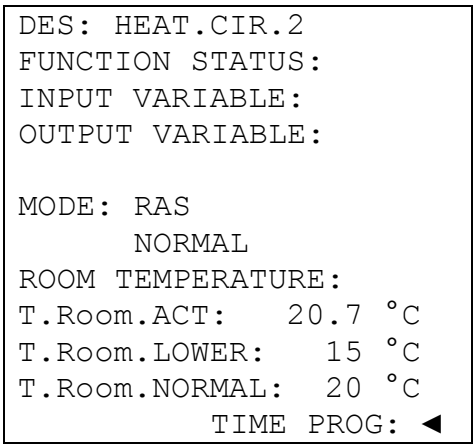
Time programs

They are set up in the same way in almost each function module and thus can be described here in a general way.
Now, we make another assumption: The module *HEAT.CIRC.CONT* has already been defined twice as the function (F3 = HEAT.CIRC.1, F4 = HEAT.CIRC.2) with two time programs. We will now define separate time programs for "HEAT.CIRC.2" on weekdays and the weekend.
In the menu "*FUNCTIONS*" where we are, scroll to the display:



Remaining text from function 2

And after entering into "HEAT.CIR.2":



Other text lines by scrolling

After entering the menu “TIME PROG:” all time programs are listed sequentially with their time windows.

Indication example:

```
Mo Tu We Th Fr Sa Su
05.00 - 07.00  h
12.00 - 22.00  h
00.00 - 00.00  h
```

Time window not used

If the first time program applies to the period from Monday to Friday, these five symbols are darkened after each other in the usual fashion (select, press, darken, press). Indication example:

```
Mo Tu We Th Fr Sa Su
06.00 - 07.30  h
12.00 - 21.00  h
00.00 - 00.00  h
```

The first time program provides for two heating periods on workdays (Mo-Fr) from 6 a.m. to 07:30 a.m. and then again from 12 noon to 9 p.m.

It is suggested that only one time program be used when the first settings are made for a function module. This can be changed for up to five time programs before the module's entry is injured in the function list by using "add function?" Each module has five entries at the end of the menu (scroll down) to change a number of time windows and programs for a function module already entered.

```
DELETE FUNCTION
CHANGE FUNCTION
INSERT FUNCTION
```

Use “CHANGE FUNCTION” to open the following menu for the example above:

```
TYPE: HEAT.CIRC.CONT
DES:    HEAT.CIR.2

Scope of TIME PROG:
Number Prog.:     1
Number Window:    3
Nominal Value?   no
```

Here, the number of time programs desired and the number of windows per program can be set again.

The question "with nominal value? *no*" means that the same nominal value for the module is to be used for all time programs (such as desired room temperature during heating periods). The question "with nominal value? *yes*" allows you to assign a separate nominal value to any time window of a time program in the module concerned. In the example used about of *HEAT.CIRC.CONT*, it is possible to set a room temperature for each heating period.

As soon as the assignment has been made (such as two programs with three time windows each), the change has to be acknowledged; to do so, scroll to the end of the menu and confirm CHANGE? by pressing *yes*.

Functions that have already been entered can be deleted at any time. It is recommended that a function be deleted if function data are available from a similar project and the changes that have to be made are minor. To do so, you will find the command "DELETE FUNCTION" at the end of the menu in each function module.
The command "INSERT FUNCTION" allows you to insert a function module before the one currently selected. This function allows you to add a function module before or after another one in the overview at any time.

Function status

Function modules have a multitude of parameters that influence the output variables accordingly. It is thus not that easy to tell why an output is blocked or cleared any given time. For example, *HEAT.CIRC.CONT* has some 10 function parameters, such as enable, mood, switch-off conditions, that determine whether the heating circuit pump is enabled. The entry "FUNCTION STATUS" at the beginning of every basic menu provides a quick overview of the status.
This submenu lists all of the effective functional elements, with a ✓ to the right indicating that is activated. Each functional element that does not have a check at the end of the line blocks the output variables at that moment.

Indication example:

```
ENABLE HEAT.CIR.2    ✓
ENABLE PUMP          ✓
ENABLE MIXER         ✓

HEAT.CIRC.PUMP:
Status:   OFF
MIXER:
Status:   off
Rest of Run    0.0 Sec

FROST PROT.MODE      ✓

LIMIT T.FlowNOM :
T.Pre.: NOM < MAX    ✓
T.Pre.: NOM > MIN    ✓

SWITCH-OFF COND.:
T.Room: ACT < NOM
T.Pre.: NOM > MIN    ✓
```

The remaining running time of the mixer is reloaded after a direction change or granted enable and always equals 20 minutes independent of the set mixer running time.

In this example, the heating circuit pump is currently blocked (status = OFF) because the specified room temperature has been exceeded (Switching condition *T.Room: ACT < NOM* is not fulfilled).
In addition to the main functional elements, this submenu also always indicates all of the output variables along with their current output status.

MENU Messages

This module allows messages (error, malfunction, and others) to be triggered by specified events **that last longer than 10 seconds**. Any messages issued are automatically entered in the function overview. In addition, output variables provide switching signals as long as the message is current. A total of eight message lines can be set up, each of which should be understood as an independent module.
As no message lines are preset ex works, "unused PAR?" is displayed on all eight lines when the menu is opened. Open the parameter level to assign variables and set parameters as with all functions. Each message line consists of the following variables:

Input variables:	**Output variables:**
Enable message **Activate message** = Triggering event Delete message = Input to delete the Message	Status message Output (Normal On) = Single output signal during the message Output (Dominant On) = Overwrites the assignment with an "on" signal Output (Dominant Off) = Overwrites the assignment with an "off" signal Output (Unlock Malfunction) = Creates a pulse three seconds long when resetting

Special features:

- Each message line has a deletion input that can be assigned to an acknowledgment key via a digital input or that allows for automatic reset with another function. The message can only be deleted by using the scroll wheel with *User/*OFF. *User*/ON causes the automatic deletion of the message, as soon as the cause of the message clears.
- An acoustic warning signal can be activated.
- Outputs assigned under the output variables Output dominant… are set for the output status of the message line regardless of any assignments from other modules or from a current manual mode.
- A separate output variable that generates a pulse lasting three seconds when the message is deleted is available in order to reset external devices (only possible if the message type is "malfunction").
- The line "DELETE MESSAGE" only appears if the event is no longer current. If deleted, the entire message will automatically be removed from the function overview.

In the example below, a compare function as boiler thermostat shall issue the message "excess temperature" to set off an acoustic warning signal when excess temperature is in the boiler (=event), switch on dominantly the heating circuit pump and the tank load pump and switch off the burner requirement:

INPUT VARIABLE:	
OUTPUT VARIABLE:	
TYPE OF MESSAGE:	What is the heading of the message?
WARNING	A warning is issued
MESSAGE GROUP:	What group was the name of the message selected from?
Default	General or user-defined (only with TAPPS)
MESSAGE CAUSE:	What event caused the message to be issued?
Excess Temp	Excess temperature triggered the message
WARNING TONE yes	As soon as this event occurs, a warning tone is issued

In addition, appears as the message type "MALFUNCT":

Unlock Malfunction?	Pass on the scroll wheel to set off a pulse that last three seconds in the output variable "Unlock Malfunction"

The respective pump outputs are darkened to show that they are assigned in the output variables under the heading "output (dominant ON)." This ensures that the pumps are always reliably switched on when the event occurs. At the same time, assigning this output for the burner requirement via "output (dominant OFF)" ensures that the burner is switched off in all cases.
In general: If outputs are triggered by means of "dominant" commands (even for other modules that have such options), all control signals from simple assignments are overwritten -- **including manual mode**. If two different dominant signals come into an output at the same time (ON and OFF), the signal "dominant OFF" has priority.
If the event sets off the message as described above, the function overview will begin with:

WARNING TONE OFF:	

WARNING	
Excess Temp.	
since:	
29,01. at 15:18	
DELETE MESSAGE:	Is not displayed if the event is still current
----------	

As soon as the cursor is on "WARNING TONE OFF," press the scroll wheel to switch off the acoustic warning signal and delete this line from the display.

Only for the message "MALFUNCTION": The additional line "Unlock Malfunction?" sets off a pulse that lasts for three seconds with the scroll wheel in the output variable "Unlock Malfunction" regardless of whether the event to trigger this reaction is still current at this point or not. If this event no longer occurs after the pulse, the entire message is deleted at the same time.

MENU Network

This menu contains all of the information and settings needed to set up a CANopen network.

In this menu, the following entries are listed:

```
Node No.:         1
ENABLE:        ON
Autooperat.:    yes
Status:     operat

OUTPUT VARIABLE:
DIGITAL:
ANALOG:
Transm.Conditions:

INPUT VARIABLE:
DIGITAL:
ANALOG:
Timeouts:

DATA LOGGING

NETWORK NODES:
```

The device has network address 1
Participation in bus communication admissible
Device communicates with other bus participants without master and is active

- **Node No**. - Each device in the network must be allocated its own address (node number 1-62)
- **Enable** - Without network release (OFF / ON), the device cannot send or receive messages; it would thus not be able to take part in communication.
- **Autooperat**. - If the network only consists of devices from the UVR1611- family (UVR1611, CAN monitor, BL-NET, etc.), **autooperat**. must be set to *yes* (normal case). If there is a master or network manager in the network**, autooperat**. must be set to *no*.
- **Status** – Autooperat. is set to *yes*, the status automatically switches from *init* → *preop(erational)* → *operat(ional)* after the controller is started according to a preset procedure. Only then is communication possible. If there is a bus master, it will switch the nodes to *operational*.

Output variable

A total of 16 digital and 16 analogue network outputs can be programmed. All of the input and output statuses, output variables for the functions, network status, sensor status, and the status of messages can be used.

```
DIG. NETW. OUTPUT
-----------------
OUTPUT  1:
Source: HEAT CIR.1
 2: Pump Status
Status:  ON
Target:        CAN
```

Example: The digital network output 1 has been allocated the status of heating circuit pump 1, the current pump status is "ON"

With input Target "DL" it is possible, to switch specific sensors on or off via the DL bus. More precise instructions are contained in the data sheets for these sensors.

Parameterizing of the analog output variables takes place in the same way.

Transmission conditions:
This menu determines the conditions for the transmission of output variables.

```
DIGITAL OUTP.:  1..16
On Change         yes
Blocked:       10 Sec
Interval:       5 Min

ANALOG OUTP.:    1..4
On Change        > 30
Blocked:       10 Sec
Interval:       5 Min
        …
        …
```

The transmission conditions are divided into five groups:

- digital network outputs 1-16
- analog network outputs 1-4, 5-8, 9-12, and 13-16

On Change yes/no: Transmission of a digital message if status is changed.

On Change > 30: If the last analog value transmitted has been changed by more than 3.0 K, the data are transmitted again (= 30 because numbers are transmitted without a comma).

Blocked 10 sec: If the value is changed within 10 seconds of the last transmission by more than 30 (3,0K), the value is not transmitted anew for another 10 seconds.

Interval 5 min.: The value is transmitted every five minutes even if it has not changed by more than 30 (3.0K) since the last transmission.

Input variable

A total of 16 digital and 16 analog network inputs can be programmed. They are indicated by the transmission node number and the number of the network output variable of the transmission node.

```
INPUT 1:
NW.Node:          2
Anal.NW.Outp.:    1
Source:         CAN
Value:          234
```

Assumption: The analog network output 1 on CAN-node 2 is assigned to outdoor temperature. Transmission thus does not include the unit or a label. Therefore, the reception node only receives the number 234. Only when linked with a function, such as input variable outdoor temperature in the function module HEATING CIRCUIT is the correct value displayed: 23.4°C.
When the controller is started, the entire analog network input variables are set to 0 and all of the digital ones to OFF.

Another example: input of the volume flow from the electronic volume flow encoder FTS4-50DL via the **data link (DL-Bus)**. Sensor address = 1.

```
INPUT 2:
NW.Node:          1
Anal.NW.Outp.:    1
Source:          DL
Value:          357
```

sensor address
index of the volume flow (see data sheet of respective sensor)

Parameterizing of the digital input variables takes place in the same way.

Timeouts

Timeouts are monitoring functions that can cause reactions in the control strategy, if bus messages are missing (such as a result of a device failure). The timeouts are divided into 8 groups of network inputs:

- Digital network inputs 1-4, 5-8, 9-12 and 13-16
- Analog network outputs 1-4, 5-8, 9-12, and 13-16

```
DIGITAL INPUT:    1...4
Timeout:         60 Min
```

As long as the information is being read from the CAN bus, the **network status** is OFF. If the value has not been updated since the set timeout, the network status changes from OFF to ON. You can then program the system to react to the failure of a network node or a lack of information. The network status can optionally be selected for individual inputs or for all network inputs together ("network status 33").

Network and network status are also available as sources for input variables in all function modules and messages.

Data logging

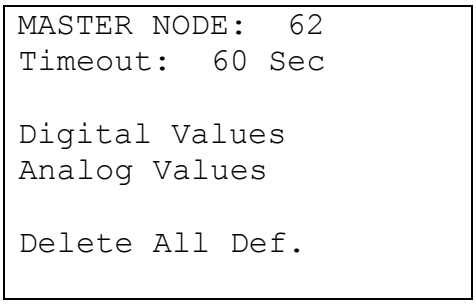
There are 2 data logging possibilities:

Via the data link (DL-bus):
When data logging via the DL-bus, there is a constant data flow from the controller to the Bootloader BL-NET or data converter D-LOGG. The values or states of all inputs, switch outputs and the values of up to two heat quantity counters are specified as a data record. For more information see chapter **Outputs/Special Features of Output 14**.

Via the CAN-bus:
CAN data logging is only possible with the Bootloader BL-NET. In contrast to data recording via the DL-bus, the data to be logged via the CAN-bus are freely selectable. Likewise, there is no constant data output. Upon querying of a BL-NET the controller stores the actual values in a logging buffer and locks this to prevent it from being overwritten (requests received from a second BL-NET) until the data are read out and the logging buffer has been released again. In the menu **Network/Data Logging** the parameters for data logging are defined via a CAN bus connection.

The necessary settings of the Bootloader for data logging via CAN bus are comprehensively described in the manual of the Bootloader BL-NET.

Menu overview:



WARNING! Settings are immediately deleted without prior security prompt!

Master Node – The controller is allocated one BL-NET as the logging master. The logging command of this master has absolute priority; this means that the logging buffer is **always** updated upon the command of the master (even if it is blocked by another BL-NET) except for when, at this point in time, data is being output (sent) to another Bootloader.

Timeout – The duration of the logging buffer data block has a time limit. Once this time span has expired, the buffer is again released by the controller.

Digital and Analogue Values - Each controller can output a maximum of 26 digital and 32 analogue values using 2 data records that are defined in the menu "**Network/Data Logging**" of the UVR 1611. Each data record comprises 16 analogue and 13 digital values as well as 2 heat quantity counters:

	Digital	**Analogue**	**Heat quantity counter**
Data record 1	**1 – 13**	**1 – 16**	**1 – 2**
Data record 2	**14 – 26**	**17 – 32**	**3 – 4**

If, for example, a digital value is to be stored in data record 2, then it must be defined as digital value 14 or higher.

Speed stages of the outputs:

If the speed stages of an output are also to be captured, the digital value must have the same number as the corresponding output, e.g., output 6 must have been allocated digital value 6. If the output is allocated to another digital value, then status output still occurs (ON/OFF), but no speed stage output.

Heat quantity counter:

The output variables of the heat quantity counter function are **automatically bound into data records** according to the sequence in the function list (heat quantity counters 1 and 2 in data record 1, heat quantity counters 3 and 4 in data record 2). The values of the heat quantity counter function cannot be defined as analog values.

```
 DATA LOGGING
-----------------
DIGITAL VALUE 1:
Source:  Output
 1 : Solar Pump1
Status:       ON

DIGITAL VALUE 2:
Source:   Output
2 : Solar Pump2
Status:       OFF
```

Digital values – in this sub-menu the total 26 digital parameters of the two data records are defined:
Data record 1: digital values 1 - 13
Data record 2: digital values 14 - 26

```
 DATA LOGGING
-----------------
ANALOG VALUE 1:
Source:   Input
 1 : T.Collektor
Status:    105.6 °C

ANALOG VALUE 2:
Source: HEAT CIR.1
 1 : PR.Nom.Temp
Status:     58.2 °C
```

Analog values – in this sub-menu the total 32 analog parameters of the two data records are defined:
Data record 1: analog values 1 - 16
Data record 2: analog values 17 - 32

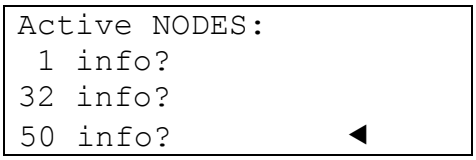
Functions of type "Heat quantity counter" cannot be selected as a source. Their parameters are automatically bound into the two data records.

Delete All Def. – is only displayed at expert level. All settings (definitions) in data logging can be deleted by pressing the scroll wheel once. All logging values are in this respect set to *Source: User <unused>*.

CAUTION! Settings are immediately deleted without prior security prompt.

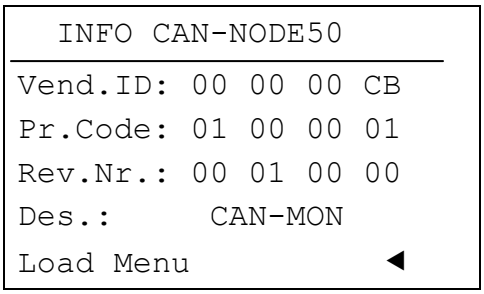
Important instruction re CAN data logging: One controller must be assigned node number 1 in the CAN network, so that the time stamp of this controller can be accepted from the Bootloader (version > 2.00). This controller must be at least version E3.18.

Network nodes



All network nodes in the network, with which the controller is linked, are listed here. This means that I/O modules and bus converters can be set from the controller. For CAN monitors, the room temperature (and room humidity for respective version) is displayed.
Setting CAN monitors and accessing other controllers is not possible.

Example CAN monitor, node 50:



- selected node number

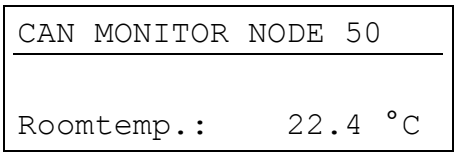
Vend.ID: Manufacturer identification number (CB for Technische Alternative GmbH)

Pr.Code: Product code of the selected node (here for a CAN monitor)

Rev.Nr.: Revision number

Des.: Node product description

These data are fixed values specified by Technische Alternative GmbH and cannot be changed.



Load menu page: This is used to access the menu level of the selected network node. The controller now serves as a display for this device.

MENU Data administration

In this menu the commands concerning the administration and protection of the function data as well as the update of the operating system are listed.

Current Funct. Data: TA FACTORY SETTINGS Status: original	Name of the current function data (TAPPS) if function data have already been changed: modified
Save Settings as Factory Settings Load Factory Setting	
Create Backup Copy Load Backup Copy	(Only appears if a backup copy exists!)
Delete Functions Execute Totalreset	
DATA <=> BOOTLOADER: Upload Data: CONTR. => BOOTLD. Download Data: BOOTLD. => CONTR.	
OPER.SYSTEM<=BOOTLD.: Download Oper.System : BOOTLD. => CONTR.	

Internal Data administration

Current function data:

TA FACTORY SETTING – The function data with this specification have been transferred to the control unit by means of the Bootloader. **The TA factory setting can be loaded by simultaneously pressing the two input keys and scroll wheel when starting up the controller.**

Status: original – Since transmission, nothing has been changed in the function data.

Save Settings as Factory Setting – The function data of two heating circuits including solar and load pump system are put down in the unit as factory setting. If proprietary programming has been tested, it uses this command to replace the original setting as a factory setting.

Load Factory Settings - Call via the following commands in a security query *YES* / *NO*. **WARNING:** By this, the own function data will be deleted and replaced by the factory setting (ex works or an own one previously created). Nevertheless, a previously created backup copy (see following commands) is maintained.

Menu Data administration

Create Backup Copy – The function data can be saved in a backup copy. By this, it is possible to change the program or the parameters without losing the existing function data. If a backup copy has been created, than appears as a further menu option:

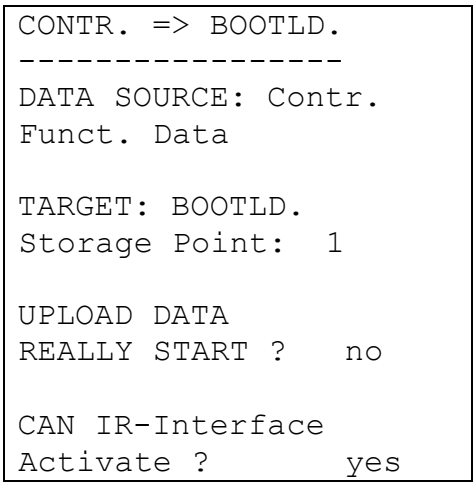
Load Backup Copy – The backup copy is backloaded instead of the current function data and thus overwrites all previous settings and programs – except the factory setting.

Delete Functions – In order to start a new programming all function modules from the function list are deleted.

Execute Totalreset – This calling causes a complete loss of all entries (function data) except the data record of the factory setting and the backup copy. Besides the function modules it also clears the parameterizing of all in- and outputs.

Data exchange with the PC and/or Bootloader

DATA <=> BOOTLOADER:
Upload DATA – All function data are transferred via the CAN- Bus or the infrared interface to the Bootloader for the data protection in the PC. Choosing this command leads to the following indication:



Transfer of function data or backup copy

One of 7 storage locations of the Bootloader is assigned.

Starting the upload by *yes*
and pressing the start key of the Bootloader

Transfer is possible via cable as well as via IR

Notice: Depending on its operating system (update via internet is possible) and starting from boot sector version B1.01 the control unit has up to seven storage locations for function data.

***DATA <=> BOOTLOADER:* Download DATA** – By means of the Bootloader (accessory equipment) the protected function data in the PC are transmitted into the control unit via the CAN Bus or the infra-red interface and thus the current programming is overwritten. The call contains similar commands as the upload; however it is possible to choose between several "data targets".

```
BOOTLD. => CONTR.
-----------------
DATA SOURCE: BOOTLD.
Storage Point:   1

TARGET: Contr.
Funct. Data
Overwrite ?      yes
Factory Settings
Overwrite ?       no

!!! CAUTION !!!
ALL COUNTER STATES
ARE LOST!

DOWNLOAD DATA
REALLY START ?   no

CAN IR-Interface
Activate ?       yes
```

Data are coming from storage location 1 of the Bootloader (from 7 possible storage points)

The function data are loaded into the main store

The function data are not loaded into the factory settings

Starting the download by *yes* and pressing the start key of the Bootloader

Transfer is possible via cable as well as via IR

***OPER. SYSTEM <= BOOTLD.:* Download Operating System:** By its flash technology the unit offers the possibility to replace the own operating system (unit software) by a more current version (purchase from the download area of the address http://www.ta.co.at) by means of the Bootloader.
The application of a new operating system is only advisable, if it contains new **necessary** functions. An update of an operating system always represents a risk (comparable with the flashing of the PC Bios) and requires an examination of all function data as compatibility problems due to new function parts are to be expected!

Since the update of the operating system takes its time, it is advisable to carry out an update of the operating system ONLY via the cable wiring! After a missed update via IR the updating is permitted only via the cable wiring.

```
BOOTLD. => CONTR.
-----------------
DOWNL.OPERAT.SYSTEM
REALLY START ?   no

WARNING: Use
Cable Wiring

CAN IR-Interface
Activate?        yes
```

Start the download by pressing *yes* and pressing the start key of the Bootloader

Transfer via IR is possible but is not recommended

The description of the function modules

The following modules are available at present:

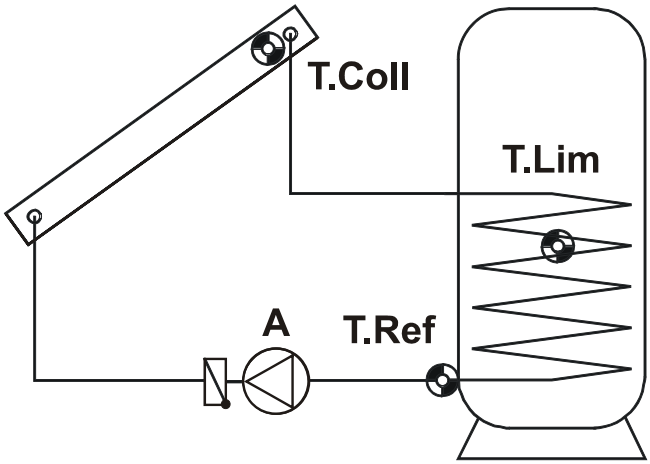
Solar thermal control	Differential controller including various auxiliary functions
Solar priority	Priority assignment between multiple solar differential controllers
Start function	Start help for solar thermal systems
Cooling function	Cooling of an overheated solar tank during the night
Heating circuit controller	A mixer controller including heating circuit pump
Mixer regulation	Stabilizing the temperature variations by means of a mixer
Comparison	Comparison of two temperatures with one another (= thermostat
Feed pump	Differential and thermostat control of a feed pump
Requirement heater	Burner requirement by the buffer tank
Requirement WW	Requirement WW
Boiler cascade	Controls the burner requirement of max. three boilers
Circulation	Time and temperature control of a circulation pump
PID Control	Pump speed control
Analog function	Searches for the lowest / highest temperature or the average
Profile function	Creates time-related (temperature) values (such as: for age-hardening of Floor pavement)
Logic function	AND-, OR-, holding function (Flip-Flop)
Time switch	Freely usable time switch clock
Timer	Freely usable time interval function
Synchronization	Creates date-related switching signals
Heat quantity counter	Energy evaluation
Counter	Freely usable interval or operating hours counter
Maintenance function	As a chimney sweep assistance and for exhaust measurement
Function check	Freely usable monitoring of sensors and differences
Menu Messages	System monitoring and output of error messages (The messages module is listed directly in the basic menu due to its properties.)

A maximum of 44 modules can be entered in the functions list.
When using memory-intensive functions (e.g. heating circuit controller), this number can be reduced.

Input variables which are absolutely necessary are highlighted in **bold** in the following function module description. The other input variables are optional.

Solar control

Basic diagram:



Input variables:	Output variables:
Enable Solar Circuit **Collector Temperature** = T.Coll **Reference Temperature** = T.Ref Limit Temperature = T.Lim	Status Solar Circuit Indication of the output A of the basic diagram Status MAX Limit Reached = tank limit has been reached

Simple description of the function:
Release of the solar pump A, if the temperature in the collector T.Coll is greater by a difference than the reference temperature T.Ref, which is the (outlet) temperature of the tank. In addition, T.Ref must not have reached its upper limit yet.

Special features:

- The system comes to a standstill when the collector exceeds the temperature of 140°C to prevent damage from steam. This means that the heat medium is no longer circulated, so that T.Coll has a set upper limit (T.Coll.MAX) including hysteresis.
- The differential temperature does not have a hysteresis that can be adjusted and is divided into a switch on and a switch of differential.
- If the tanks have bare-tube heat exchangers, the reference temperature sensor should be screwed into the heat exchanger outlet using a t-shaped connector and an immersion sleeve (see the section on installing sensors in the instruction manual). If the surface of the collector is too large, the return flow temperature will increase too quickly, causing the limiter at T.ref to switch of the system to quickly. However, T.ref also cools down quickly in the standstill medium in the cold section of the tank. The pump will then start operating again, etc. To prevent this "cycling" and to prevent the tank from overheating if good layered tanks are used, an additional optional upper limit has been defined in the module "solar control" for T.Lim.
- The output variable “MAX Limit Reached:” shows that the upper limit has been reached (status: OFF/ON).
- If no additional limit sensor T.lim is used, it suffices to indicate *User* as the "source:" in the input variables.

Solar control

Entire menu view:

DES: SOLAR1	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
COLLECTOR TEMP.:	
T.Coll.ACT: 74.3 °C	Current collector temperature
T.Coll.MAX: 130 °C	Pump is blocked when T.Coll.MAX has been reached
Hysteresis: 10 K	Release at T.Coll.MAX minus hysteresis
REFERENCE TEMP:	
T.Ref.ACT: 65.7 °C	Current tank temperature (bottom/return)
T.Ref.MAX: 70 °C	Tank limit
Hysteresis: 3.0 K	Release at Tref.MAX minus hysteresis
DIFFERENCE COLL-REF:	
DIFF.ON: 7.0 K	Switch-on differential T.Coll – T.Ref
DIFF.OFF: 4.0 K	Switch-off differential T.Coll – T.Ref
LIMIT TEMPERATURE:	
T.Lim.ACT: 54.0 °C	Current temperature of the limit sensor
T.Lim.MAX: 70 °C	Blocked by sensor
Hysteresis: 3.0 K	Release at T.Lim.MAX minus hysteresis

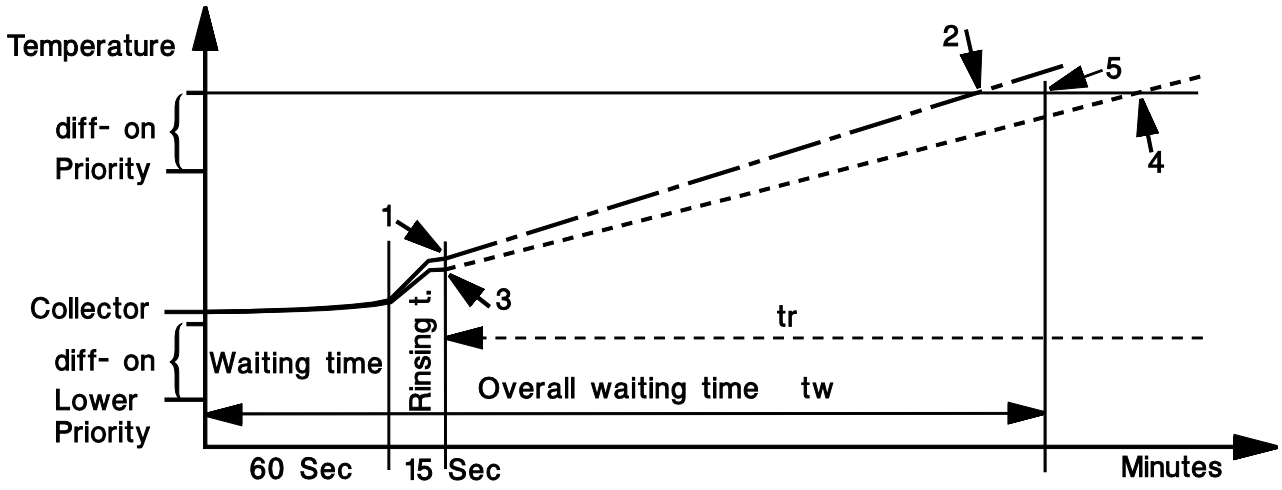
Because the module is used for all kinds of consumers, the labels "reference temperature" and "limit temperature" have been specified as generally applicable.
When using the third sensor as a limiter, the upper limit of reference sensor "T.Ref.MAX" should be set high enough so that it does not affect operation.
The output variable “MAX Limit Reached:” has the status "ON" if the reference sensor's **or** the limit sensor's upper limit has been reached.

Solar priority

In solar heating systems used to charge more than one consumer (such as a tank, a buffer, and a basin), priorities must be set for the various circuits. There are basically two sets of rules used for a system of priority and lower priority assignment.

- Absolute priority: Only when a tank that has priority has reached its upper limit for temperature does the system switch to the next lower priority.
- Relative priority: The charge begins with the colder tank (because the collector will reach the differential here first), even if this tank does not have priority.

While the consumer that does not have priority is being charged, the device monitors the collector temperature. If the collector temperature once again reaches the switch-on differential for the consumer currently being charged while the pump is running, the priority timer is activated. If a radiation sensor is used, it must exceed at threshold value in lieu of the switch-on differential.



The priority timer switches the pump off for waiting time 1 (60 sec). After rinsing (1, 3), the computer then calculates the increasing collector temperature. It recognizes whether the set overall waiting time tw will suffice to heat up the collector to the priority temperature (5). If not, the system waits for priority temperature to be reached before switching (case 2). If the computer determines that the increase will not suffice within the dwell time tw (case 4), it interrupts the procedure and disables the priority timer until run-time tr has expired.

If run-time = 0, the lower priority is allowed once the maximum threshold of the current priority has been reached. In other words, the system is switched to absolute priority assignment mode.

Solar priority

Input variables:	Output variables:
Enable Solar Priority Solar Radiation = Radiation sensor **Functions Involved** = Entry of all solar functions in the function list	Status Rinsing Process Indication of the output for the rinsing

Special features:

- In this function blocks, the "functions involved" are not individual values, but rather entire function module input variables.
- The program automatically looks for all of the values needed in the function modules involved and also automatically blocks the modules involved that are lower in the hierarchy.

Entire menu view:
(Assumption: Six solar functions are entered in the function list)

DES: SOL PRI	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
SOLAR1 1	SOLAR 1 is the highest priority
SOLAR2 2	SOLAR 2 is the second priority
SOLAR3 3	SOLAR 3 is the last priority
SOLAR4 1	SOLAR 4 is the highest priority
SOLAR5 2	SOLAR 5 is the second priority
SOLAR6 3	SOLAR 6 is the last priority
RANKING TIMER:	
From Pri Stage 2	SOLAR 1 is loaded as "absolute" without time element
Radiation: 488 W/m²	Current irradiation (does not apply without radiation sensor)
Threshold: 200 W/m²	Activation threshold for timer (does not apply without radiation sensor)
Run Time: 20 Min	Run-time for the consumer of lower priority until timer starts
Waiting: 5 Min	The collector must reach the temperature of the priority tank within five minutes; otherwise, the tank of lower priority will be charged

As this example makes clear, it is also possible to assign the same priority. Generally, this approach is only useful if the system has multiple collector fields. The priorities in the example correspond to the system with two collector fields charging three consumers (such as Solar 1 = collector 1 for tank 1 and Solar 2 = collector 1 for tank 2, etc.).
SOLAR 1 and SOLAR 4 are admissible first as the lower priority time element is only active starting at priority level 2 until the consumer has reached its maximum temperature (absolute). Only then does the priority treatment shift to the other solar functions via the priority timer (relative).
In standard solar heating systems, this priority timer technology has proven useful again and again. Therefore, there is almost always no need for a radiation sensor.

Start function

Simple description of the function:
Sometimes, the collector sensor is not immersed in the heated heat medium quickly enough. In other words, the system goes into operation too late. There may not always be enough gravity force if the collector fields are completely horizontal, if the connections between the absorber strips meander, and especially if **vacuum tubes** are used with forced circulation.
This module puts the solar pump into operation in preset intervals, thus transporting the content of the collector to the sensor. To reduce energy losses, this interval operation is only launched within a certain time window and only if the solar radiation reaches a certain level (determined using **GBS** radiation sensor - special accessory) **or** with constant monitoring of the collector temperature. Without a radiation sensor, the computer first attempts to determine the current weather conditions by constantly measuring the collector temperature. By this, it finds the right time for a brief rinsing interval so that the temperature for normal operation can be maintained. Each collector field must have its own start function.

Input variables:	**Output variables:**
Enable Start Function Solar Radiation = Radiation sensor Reference Temperature = Input of the collector sensor **Functions Involved** = Entry of all solar functions for the collector field in the function list	Status Rinsing Process Indication of the output for the rinsing

Entire menu view:

DES: SOL START	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
Activation Time:	
07:00 - 20:00 h	Time window for permission of start function
Run Time: 15 Sec	Rinsing time
Interval: 20 Min	Maximum delay between rinses
Activ.Grad.: 20	or radiation threshold - see description below
Start Tests: 13	Sum of attempted starts today
Unsuccessful: 11	Number of unsuccessful starts
Since Last Run: 6	Number of attempts since the system last operated correctly

If a radiation sensor is used, instead of "Activ. grad." the computer displays the desired radiation threshold above which the start function is to be active. Almost always, you can do without this sensor altogether. Then, a mean value is calculated from the collector temperature, with special attention paid to the lowest temperatures reached. The start function is enabled when the collector temperature is warmer than the mean value by the difference of the activation gradient. A lower activation gradient therefore leads to an earlier start attempt, a higher gradient to later attempts.
If you need more than ten tries to start the system, the activation gradient must be increased and must be reduced, if the number of attempts is below four.
If the activation gradient is set to zero, then only the activation or interval time applies without consideration of the temperature curve at the collector sensor.

Cooling function

Simple description of the function:
Solar heating systems with partial solar heating produce more warm water in the summer than can be used. This function can be used at night to remove some of the excess energy from the lower section of the tank back into the collector when a critical temperature has been reached in the buffer tank by regulating the speed of circulation. During the day, the system will then not have to be brought to a standstill as often due to excess temperature.

Input variable:	Output variable:
Enable Cooling Function **Reference Temperature** = Measuring point that sets off the function Maximum Temperature Reference = Temperature that sets off the function	Correcting Variable = Speed stage RPM output Indication of the RPM control-output Status switching output, Indication of the switching output

Special features:
- Generally, the maximum value for the thermostat threshold can be set. This value is defined as an input variable to make it easy to link it. You only need to enter "source" *User* as the setting value. The user can see it as a common function parameter when it appears in the menu of the function.
- In addition to the output indicated with a set speed, the function module also provides a switchable output. This output can be used to block other functions during the cooling phase.
- The maximum nominal value does not have a hysteresis that can be set, but rather a switch-on and a switch-off differential.

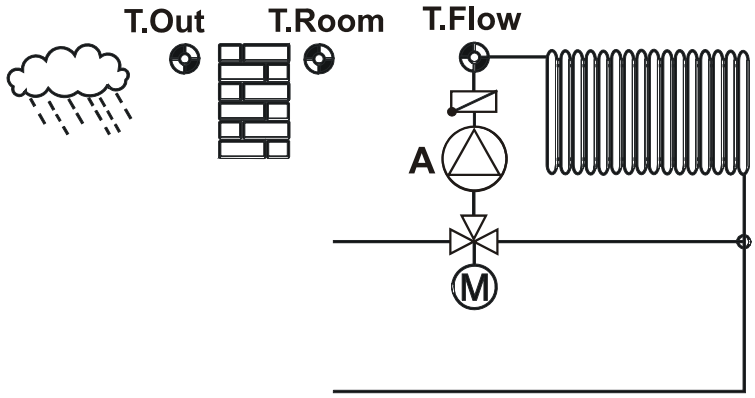
Entire menu view:

DES: COOL FUNC	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
TIME WINDOW:	
00:00 - 06:00 h	Time window for active cooling
REFERENCE TEMP.:	
T.Ref.ACT: 65.7 °C	Current tank temperature (bottom/return)
T.Ref.MAX: 90 °C	Tank limit
DIFF.ON: 5.0 K	Cooling active between 12 midnight and 6 a.m. above 95°C
DIFF.OFF: 0.0 K	The cooling function is switched off once the temperature drops below 90°C
CORRECT.VAR.: 15	The pump runs at speed stage 15

Tests have shown that cooling is also sufficient at the lowest speed stages. We therefore recommend that you use a speed stage just above circulation standstill. For instance, at the stage 5 the pump only consumes 10% as much energy.

Heating circuit controller

Basic diagram:



Input variable:	Output variable:
Enable Heating Circuit Controller	Nominal Temp. of the Flow = Temperature of the pre-run calculated by the control unit T.FlowNOM
Enable Pump	
Enable Mixer	Effect Nominal Temperature for Room = Valid indoor temperature according to time program T.Room.EFF
Room Temperature = T.Room	
Flow Temperature = T.Flow	Status of the heating circuit pump, indication of the output
Outdoor Temperature = T.Out	Status of the mixer, indication of the output
External Switch = Switching to frost protection mode (status: ON) / Operation according to the setting of the unit (status: OFF)	Status of the maintenance mode
	Status of the frost protection mode

Simple description of the function:
Mixer controller based on outdoor and indoor temperature with consideration of the heating and lowering temperature specified in the switching times. The heating pump can be enabled in various parameters.

Special features:

- The input variable "EXTERNAL SWITCH" can be used to switch a remote switch between frost protection mode and normal operation according to the device settings. Furthermore, the external setting of an operating mode is possible via a dimensionless number (64 to 67).
- In addition to the pump and the mixer, this function also provides a calculated flow temperature (T.FlowNOM) and the status of maintenance and frost protection modes, e.g. for messages.
- Another output variable is the effective room temperature (T.RoomEFF), which is influenced by the timer and other functions. A heating control unit **without a mixer** can thus be set up with a downstream speed control module.
- Under "OPERATION," special functions such as PARTY and VACATION, etc. are callable.
- A delay time which can be selected and is based on the outdoor temperature also affects the switching between lowering and heating modes.
- Four criteria can be selected to switch off the pump.
- If, when the function is first called, or using "CHANGE FUNCTION" yes is specified to the time program "with nominal value?", then each time window receives its own adjustable room temperature, which replaces the value "T.room.NORMAL".
- If a room sensor is indicated in the input variables but the sensor is short-circuited, the heating circuit controller will operate as though no room sensor were indicated in the parameters.
- The mixer runtime is reloaded when the mixer output is in manual mode, is triggered by a message (dominant ON or OFF), or a trigger switches from OPEN to CLOSED. If mixer enable is OFF the mixer remains stationary in the last position.

Heating circuit controller

Basic menu view:

DES: HEAT.CIR.1	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
OPERAT.: RAS NORMAL	The heater is controlled by a room sensor RAS and is currently running in heating mode (*NORMAL*)
ROOM TEMPERATURE:	
T.RoomACT: 20.7 °C	Current room temperature
T.RoomLOWER: 16 °C	Desired room temperature doing lowering time
T.RoomNORMAL: 20 °C	Desired room temperature doing heating time
TIME PROG:	Submenu for heating times (see **Time programs**)
Rate time: 30 Min	The heating time begins 30 min earlier if the outdoor temperature is below -10°C
T.RoomEFF: 20°C	Current desired room temp. = 20°C (current heating operation)
FLOW TEMPERATURE:	
T.FlowACT 58.4 °C	Current flow temperature
T.FlowNOM: 58.2 °C	Calculated flow temperature
HEAT CURVE:	Submenu for the calculation of the flow temperature
OUTDOOR TEMPERATURE:	
T.Out.ACT: 3.6 °C	Current outdoor temperature
AVG. TIME:	Settings for calculation of outdoor temperature for the calculation of flow temperature and to switch off the pump
SWITCH-OFF COND.:	Submenu to switch off the pump and conditions for mixer
FROST PROTECTION:	Submenu where the outdoor temperature is indicated to keep the room at a certain minimum temperature

OPERATION

TIME/AUTO may also be found under "OPERAT.:" if "unused" has been entered as an input variable for the room sensor. Furthermore, you can also switch to the following heating functions here regardless of whether a room sensor is being used:

- ♦ STANDBY — Switches the control to standby (frost protection remains activated)
- ♦ LOWERED — The controller is switched to manual mode - lowered
- ♦ NORMAL — The controller is switched to manual mode - heating (normal)
- ♦ HOLIDAY — The controller takes the heating times for Saturday starting today and the times of Sunday for the last day indicated
- ♦ LEAVE — Up to date xx, 00:00 hours, the controller will only work in lowering mode
- ♦ PARTY — The heating mode remains in operation until the indicated time xx

For the modes of operation *HOLIDAY, LEAVE* and *PARTY,* the controller switches back to automatic mode after the time indicated has expired.

Further possible displays under "OPERATION":

FROST PROT — The frost protection function is activated. The activation conditions are described in the section "Frost protection".

EXT/STANDBY — The input variable " External Switch " is a digital "ON" signal.

MAINTENANCE — The maintenance function is active (see function "Maintenance"). The flow temperature is controlled to match the setting T.FlowMAX set in the menu HEAT CURVE. The function module remains active for three minutes after maintenance mode has been switched off.

MALFUNCTION — If the line to the external sensor (measuring value > 100°C) is interrupted, the heating circuit is switched off. In the worst-case scenario, the system may be damaged by frost. To prevent such damage, the heating circuit is operated according to a set outdoor temperature of 0°C if the outdoor temperatures are clearly too high, and *MALFUNCTION* is displayed under "OPERAT.:".

Status of the heating circuit pump and the mixer
relative to the operation mode and releases:

Operation mode	Enable heating circuit	Enable pump	Enable mixer	Status: pump	Status: mixer
X	OFF	x	x	OFF	OFF
Maintenance	x	x	x	ON	AUTO[1]
Standby, external standby	x	x	x	OFF	OFF
Frost protection, malfunction	ON	x	ON	ON	AUTO
			OFF	ON	OFF
Time / Auto, normal, lowered party, vacation, holiday	ON	OFF	OFF	OFF	OFF
		ON	OFF	AUTO	OFF
		OFF	ON	OFF	OFF[2]
		ON	ON	AUTO	AUTO
RAS	ON	as with Standby, Time/Auto, Normal, Lowered,			

x… Status and operation mode do not matter

[1]… In this case, AUTO means that the settings for T.FlowMAX are used in the menu HEAT CURVE.

[2]… OFF does not apply if in "SWITCH-OFF COND." the setting "controlled" is set under "if heat.circ. OFF => MIXER:"

EXTERNAL SWITCH

The “EXTERNAL SWITCH” input variable also accepts analogue values on external operating mode switching:

Value (dimensionless):	**Operating mode:**
64	Stand-by/anti-freeze
65	Time/automatic
66	Normal
67	Lowering
127	Switch back to internal operation

These analogue values can originate from another function or also come from the GSM module from the Bootloader as a network input. Values **64 - 67** are dominant, i.e. it is not possible to set any other controller operating mode, as long as the value "external switch" exists.

NB: If nevertheless at attempt is made to set another operating mode, then the controller display jumps back from the operating mode specified from the "External switch" and remains in the original operating mode. However, the controller "notices" this change and adopts this operating mode after resetting using the value 127 at the "External switch". If during this time an operating mode **other** than "**RAS**" is selected, then this operating mode cannot be changed on the **RAS**, rather only on the controller, on the CAN monitor or via the browser. As soon as the value at the "External switch" is 127, manual alteration of the operating mode is possible at any time.

TIME PROGRAM

Parameterizing of the time program is described in the chapter "Menu functions".

The room temperature T.RoomNORMAL or the set nominal value apply in the time window. T.RoomLOWER applies outside the time window. The switchover causes a corresponding parallel shift of the heating curve and therefore a change to the flow nominal temperature, T.FlowNOM.

"CHANGE FUNCTION" is used to change the number of required time programs and the number of windows per program and to specify the use of a special nominal value per time window:

```
Scope of TIME PROG:
Number Prog.:    3
Number Window:   3
Nominal Value ? nein
```

Maximum 5 time programs can be set

Maximum 3 time windows per time program can be set

The input "*no”* means that the same nominal value T.RoomNORMAL is used for all time windows.

The input "*yes*" makes it possible to allocate a special nominal value instead of T.RoomNORMAL.

RATE TIME:

Depending on the outdoor temperature, fixed heating times can cause the system to switch on or off too quickly. The rate time can shift the switch point relative to the outdoor temperature. This entry refers to an outdoor temperature of -10°C and is 0 at plus 20°C. For example, if the rate time is 30 minutes and the outdoor temperature is 0°C, the system will switch on 20 minutes earlier under normal operation.

HEAT CURVE:

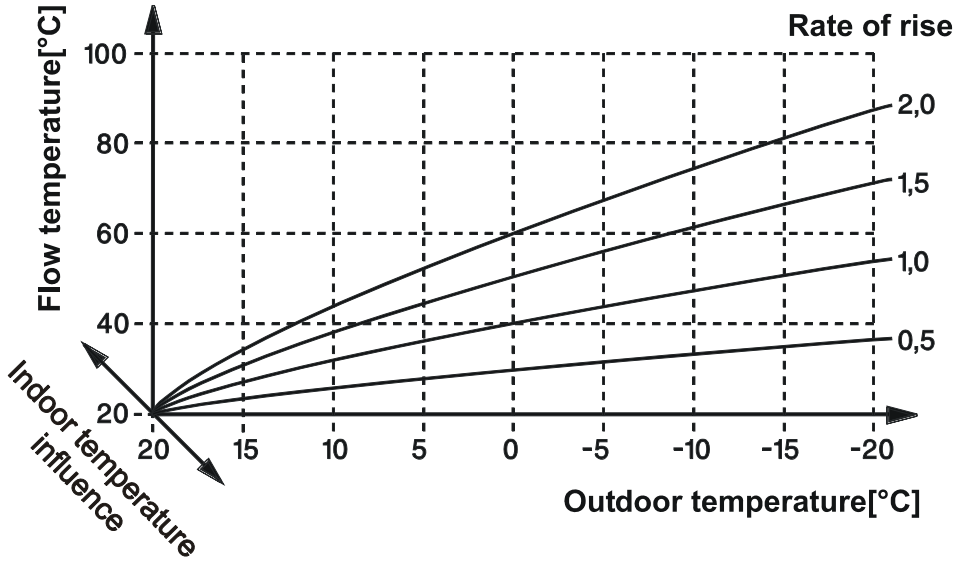
The feed-line temperature is usually calculated from the outdoor temperature and the heating curve. The heating curve is calculated based on a room nominal temperature of +20°C and is subject to an appropriate parallel offset for other room nominal temperatures. An exception is the fixed value control. The feed-line is set in lowering mode to the listed temperature of +10°C and in heating mode to that of -20°C.

The module allows you to set parameters for the heating curve in two ways:

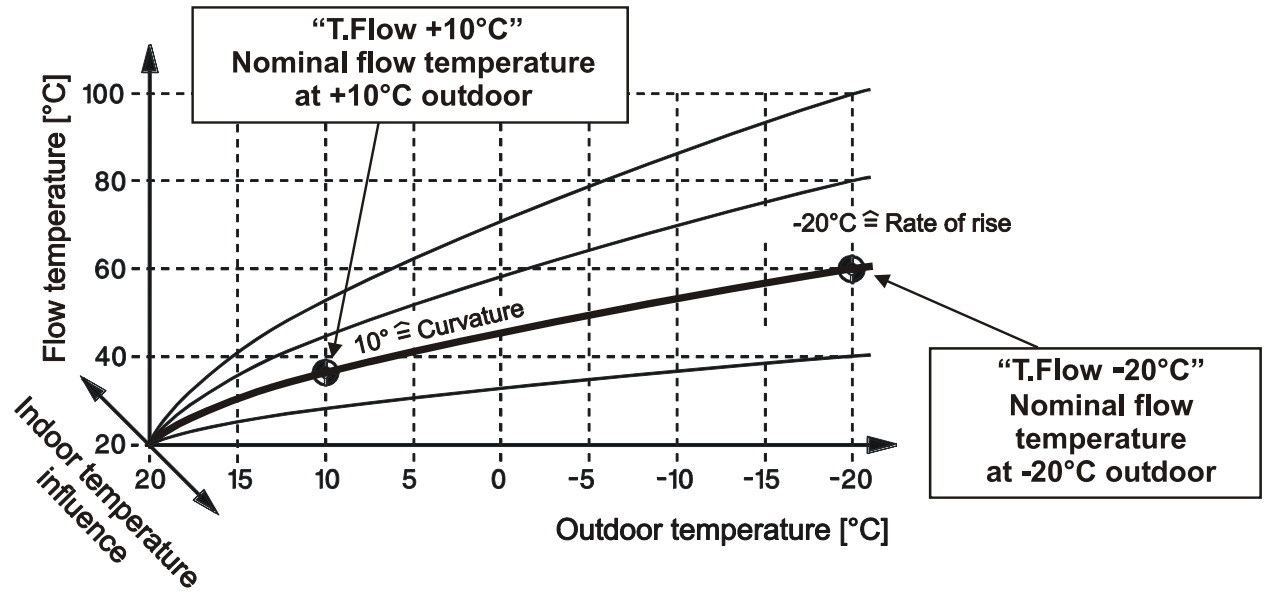
- With reference to the rate of rise as is common in many heating control units.
- As a product of the relation between the outdoor temperature (at +10°C and -20°C) and the flow temperature. Here, another reference point is set at plus 20°C outdoor temperature = plus 20° flow temperature.

In both of these methods, the influence of the outdoor temperature on the flow temperature is not linear. Via "*Rate of rise*" the curvature is set according to the standards. Via "*Temperature*" a "curvature of the heating characteristic" is created with the desired feed-line temperature at 10°C in order to take into account the different heat emissions of various heating systems.

Heat Curve "Rate of rise"



Heat Curve "Temperature"



Heating circuit controller

The following entries are found in this submenu:

HEAT.CIR.1 MODE: CONTROL : Out.Temp. ***or*** Fixed Val	Control based on outdoor temperature and heating curve The flow is set in lowering mode to the indicated temperature at +10°C and in heating mode to the one at -20°C.
HEAT CURVE: Temp. ***or*** Slope	Heating curve via temperature points +10°C and -20°C Heating curve via input of the rate of rise (0.05-2.50)
Room Infl.: 0 %	The room temperature is taken into consideration for the calculation of the flow at xx%, setting range 0 – 90% The room influence is also active in fixed value mode.
Increasing on Start: 0 %	The previous lowering time leads to an excess increase of the flow temperature (maximum up to T.FlowMAX) which reduces over time. Setting range 0 – 20% *) for detailed explanation see below
T.Flow+10°C: 35 °C T.Flow-20°C: 60 °C ***or:*** Slope 0.60	Desired flow temp. at +10°C outdoor temp. (heating curve) Desired flow temp. at -20°C outdoor temp. (heating curve) Specification of the slope (for selection Heat Curve: Slope)
T.FlowMAX: 65 °C T.FlowMIN: 20 °C	The flow must not exceed this value The flow must not drop below this value

***) Switch-on excess ("Increasing on Start")**
The precise formula for the switch-on excess is:
T.flowNOM/SOE = T.flowNOM + T.flowNOM* (Switch-on excess / 100) * (Counter/ 30)
The counter is increased by 1 every 20 minutes with the heating circuit set to lowered, with the heating circuit in normal mode, it is lowered by 1 every minute.
The **maximum** counter value is 255. Therefore it is reached after 85 hours lowering time (= 255/3 hours or approx. 3.5 days). The **maximum** run-down time after this is 4.25 hours (= 255 minutes).
The set excess is effective for a lowering time of 10 hours (= 30 x 20 minutes).
Example: T.flowNOM=40°C, Switch-on excess = 10%, Lowering time 8 hours
The excess temperature starts at +3.2 K (above the set value) and falls uniformly to zero within 24 minutes.
Protection of heat-sensitive systems parts:
Heat-sensitive systems parts (e.g. plastic ducts) must be equipped with additional protecting devices (e.g. thermal temperature limit for floor heating) which prevent overheating in the event of failure of the controller or of another system component.

AVERAGE of outdoor temperature:
Sometimes, fluctuations in outdoor temperature may even not be desirable in calculation of flow temperature or when determining the disconnection of the heating pump. Therefore, a separate calculation of the mean is available for the outdoor temperature to calculate the heating curve and the disconnection of the pump. The following entries are found in this submenu:

HEAT CIR.1 For Flow Control: AVG-Time: 10 min T.OutAVGcon: 13.6 °C For Switch-Off: AVG-Time: 30 min T.OutAVGoff: 13.8 °C	The average outdoor temperature is calculated for 10 minutes for the flow The current outdoor temperature average is 13.6°C The average outdoor temperature is calculated for 30 minutes for switching off The current outdoor temperature average is 13.8°C

SWITCH-OFF CONDITIONS and mixer behaviour:
The controller allows the following switch-off conditions for the heating circuit pump:

if Room Temp. ACT > NOM ? no Hysteresis: 1.0 K	when the desired room temperature has been reached
If Flow Temp. NOM < MIN ? yes Hysteresis: 2.0 K	when the flow temperature falls below the lower limit T.FlowMIN
If Outdoor Temp. AVGoff>MAX ? no T.Out.MAX: 20 °C Hysteresis: 2.0 K	when the average outdoor temperature T.Out.MAX exceeds a set value in the heating or lowering mode
If Lowering Operat. and Outdoor Temp. ACT > MIN ? no T.Out.MIN: 5 °C Hysteresis: 2.0 K	when the outdoor temperature T.Out exceeds a set value in the lowering mode
If Flow Temp. ACT > MAX ? no	when the flow temperature is larger than T.FlowMAX (settings in the heat curve) plus a fixed hysteresis of 3K, reactivation if T.FlowACT. < T.FlowMAX
If Heating Circ. OFF MIXER: close	**Mixer behaviour:** In addition, in this menu you can determine how the mixer is to respond once the pump has been switched off (*close, open, unchanged, (continue to) control*). If mixer enable is "OFF" the mixer remains stationary in the last position it took up (Status Mixer: OFF).

The hystereses of the switch-off conditions generally have an increasing effect.

As both the outdoor temperature and the room temperature are taken into consideration when the flow set temperature is calculated (provided a sensor is used), the best method is to switch off under the limit T.FlowMIN.

FROST PROTECTION:
This function is only active in the standby mode or when the input variable "EXTERNAL SWITCH" is active, and even then only if the module has been partially blocked by the input variable ENABLE PUMP or a switch-off condition would block the heating circuit pump**. However, if the function is blocked via Enable heating circuit, there is no frost protection mode.**
If frost protection is activated, the flow nominal temperature is maintained at least at T.FlowMIN (setting in the sub-menu heating curve), until the temperature, which triggered the frost protection function, increases by 2 K above the frost protection limit. This submenu has the following entries:

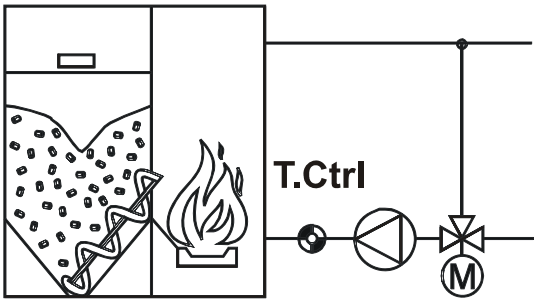
```
Activation if
T.OutAVGcon  <    5°C
T.Room.FROST:     5°C
```

Frost protection function is active below +5°C (outdoor) and keeps the room at a temperature of 5°C

Heating circuit condition	**Frostschutzfunktion**
Operating mode STANDBY Set to RAS/RASPT	without activated frost protection function: T.flowNOM set to +5°C, mode display: STANDBY Activation of the frost protection function: If T.Out.ACT < T.out.AVGcon, then T.flowNOM ≥ T.flowMIN (mode display: FROST PROT)
Operating mode STANDBY Controller setting	without activated frost protection function: T.flowNOM set to +5°C, mode display: STANDBY Activation of the frost protection function: If T.Out.ACT < T.out.AVGcon **or** (if RAS available) TroomACT < T.Room.FROST, then T.flowNOM ≥ T.flowMIN (mode display: FROST PROT)
Switching via digital "ON" at the "external switch" to EXT/STANDBY	without activated frost protection function: T.flowNOM set to +5°C, mode display: EXT/STANDBY Activation of the frost protection function: If T.Out.ACT < T.out.AVGcon **or** (if RAS available) TroomACT < T.room.FROST, then T.flowNOM ≥ T.flowMIN (mode display: FROST PROT)
Switching via analog 64 at "external switch" to STANDBY	without activated frost protection function: T.flowNOM set to +5°C, mode display: STANDBY Activation of the frost protection function: If T.Out.ACT < T.out.AVGcon **or** (if RAS available) TroomACT < T.room.FROST, then T.flowNOM ≥ T.flowMIN (mode display: FROST PROT)
Enable pump off	without activated frost protection function: T.flowNOM according to the setting heat curve, Mode display: selected operating mode Activation of the frost protection function: If RAS available: If T.roomACT < T.room.FROST the pump is switched on, **independent of the outside temperature**, then T.flowNOM ≥ T.flowMIN (mode display: FROST PROT)
Switching off of the pump via a switch-off condition	without activated frost protection function: T.flowNOM set to +5°C, mode display: STANDBY Activation of the frost protection function: If RAS available: If T.roomACT < T.Room.FROST the pump is switched on, **independent of the outside temperature**, then T.flowNOM ≥ T.flowMIN (mode display: FROST PROT)

Mixer control

Basic diagram:



Input variables:	Output variables:
Enable Mixer **Control Temperature** = Indication of a sensor Nominal Value = Control to this value (+diff)	Control Temperature = T.CtrlEFF, nominal temperature calculated by the controller from the control temperature and the differential Status Mixer = M, indication of the outputs

Simple description of the function:
This function allows a mixer to be constantly controlled for a nominal value.

Special features:

- Generally, the nominal value will be an adjustable one. This value has been defined as an input variable to make it easy to link it. It will then appear in the menu for the function that the user can see as a common function parameter if *User* is indicated as the "source."
- Another differential can also be used to set the nominal value.
- In addition to the mixer output, the function also sets the overall nominal value as the effective control temperature (T.CtrlEFF) for the output variable.
- As the module can only be switched via its enable, the mixer setting is preset to "enable OFF."
- In addition to *normal*, the mixer mode can also be set to *invers* (such as a cooling function for wall heaters, etc.). Under *invers*, the mixer opens as the temperature increases.
- The mixer running time (20 minutes) is reloaded, if the mixer output is in manual mode, triggered by a message (dominant ON or OFF), or the triggering direction changes from OPEN to CLOSED or vice versa or the enable is switched from OFF to ON.

Entire menu view:

`DES: MIX CTRL`	
`INPUT VARIABLE:`	
`OUTPUT VARIABLE:`	
`MODE:  normal`	The mixer closes as the temperature increases
`CONTR. TEMPERATURE:`	
`T.CtrlACT:  30.4 °C`	Current control temperature
`T.CtrlNOM:  30 °C`	Preset control temperature
`Difference:  0.0 K`	Additional control differential for the nominal value
`If ENABLE = Off`	Mixer behaviour with enable = off:
`MIXER: unchanged`	*close, open, unchanged*

Comparison

(Thermostat/differential function)

Simple description of the function:
Two (temperature) values, Va and Vb + differential, are compared to produce the two output variables Va > Vb and Va < Vb.

Input variables:	Output variables:
Enable comparison **Comparative Value a** = First comparison value Comparative Value b = Second comparison value	Status Va > Vb + diff = Value a is greater than value b Status Va < Vb + diff = Value a is lower as value b, indication of the output

Special features:

- Only one sensor input / one output variable for another function is admissible for the value a. Value b can also be a flexible (temperature) value. If so, *User* has to be indicated as the "*source*." The user can see the value b as a common function parameter when it appears in the menu of the function.
- Generally this function applies to a thermostat. Use the "function parameter" to make comparisons of any figures. Possible selections: temperature, dimension-free, volume flow, output, heat quantity, number of pulses, time, solar radiation, relative humidity, wind speed and pressure.
- The comparison difference consists in the differential between the switch-on and switch-off.
- Both Va > Vb and Va < Vb can be used as output variables. When comparing a temperature sensor with a threshold value (value b is entered as "user" under the input variables), this basically functions as a mechanical thermostat with mutual contact (Va > Vb = make contact and Va < Vb = break contact).
- If sensors have been assigned to both values, the result is a simple differential function.
- If enable is set to "OFF", then both output variables are set to "OFF".

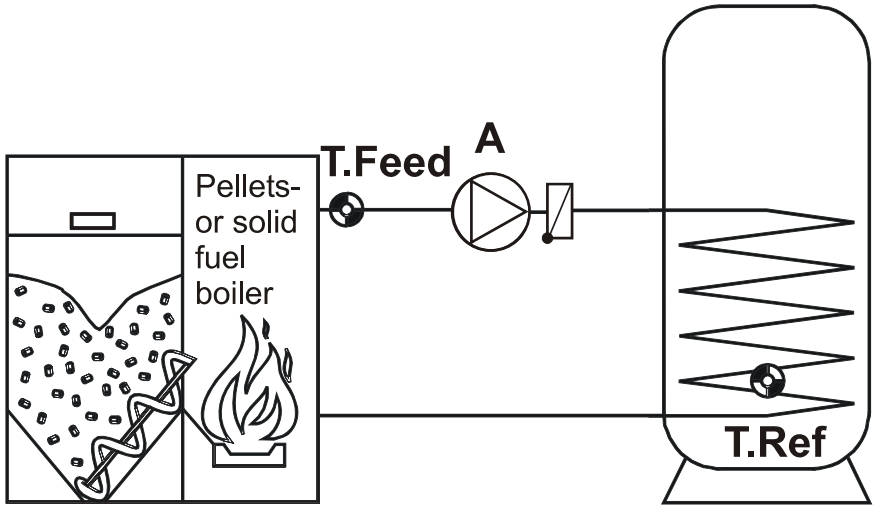
Entire menu view:

DES: COMP.1 FUNCTION STATUS: INPUT VARIABLE: OUTPUT VARIABLE:	
FNCT.VAR: Temperat.	Comparison of two temperatures
VALUEa: 39.1 °C VALUEb: 44.3 °C	
DIFF.ON: 5.0 K	Switch on if value a exceeds 49.3°C (44.3 + 5.0)
DIFF.OFF: 2.0 K	Switch on if value a falls below 46.3°C (44.3 + 2.0)

WARNING: The output status of the second output variable is the inverse of the first output variable Va > Vb + diff. The designation Va < Vb + diff for the second output variable is thus inaccurate. This representation was selected because the display cannot indicate the inverse symbol.
If to sensors are compared, the connection of the warmer sensor (generator) to Va is recommended. If the link between values a and b are adversely linked in the input variables, switching will then be based on a negative differential.

Load pump

Basic diagram:



Input variables:	Output variables:
Enable Load Pump **Feeder Temperature** = T.Feed **Reference Temperature** = T.Ref Minimum Temp. Feeder = Min. threshold at T.Feed Maximum Ref. Temp. = Max. threshold at T.Ref	Status of the load pump = A Indication of the output A

Simple description of the function:
Release of load pump A if the temperature on the tank (feed temperature T.Feed) is higher than the minimum temperature and one differential higher than the reference temperature T.Ref. In addition, T.Ref must not have reached its upper limit yet.

Special features:

- In most applications, the minimum threshold for T.Feed and the maximum threshold for T.Ref can be set. These two thresholds are defined as input variables to make it easy to link them.
  The example used is a link with the burner requirement for warm water preparation. The function *WW requirement* provides the nominal temperature for the tank as an output variable. The nominal temperature can therefore be used simultaneously as the maximum temperature for the load pump function.
- If the two input variables can be set, all you need to enter is *User* as the "source." The user can see it as a common function parameter when it appears in the menu of the function.
- Neither thermostat threshold has hysteresis, but rather a switch-on/off differential to the adjustable threshold value.
- Example: Minimum threshold = 60°C
  DIFF. ON = 5.0 K
  DIFF.OFF = 1.0 K
  In other words, if the temperature T.Feed exceeds 65°C (= 60°C + 5°K), the output is activated, whereas it is switched off if the temperature drops below 61°C (= 60°C + 1°k).

Load pump

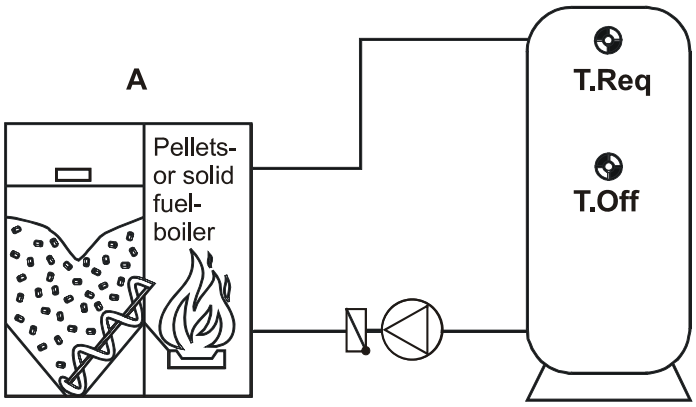
Entire menu view:

DES: LD PUMP 1	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
FEEDER TEMPERATURE:	
T.Feed.ACT: 74.3 °C	Current temperature of the "energy provider"
T.Feed.MIN: 60 °C	Basic switch-on threshold at sensor T.Feed
DIFF.ON: 5.0 K	Switch-on differential to T.Feed.MIN (here, 65°C)
DIFF.OFF: 0.0 K	Switch-off differential to T.Feed.MIN (here, 60°C)
REFERENCE TEMP.:	
T.Ref.ACT: 65.7 °C	Current tank temperature
T.Ref.MAX: 90 °C	Tank limit
DIFF.ON: 1.0 K	Switch-on differential to T.Ref.MAX (here, 91°C)
DIFF.OFF: 5.0 K	Switch-off differential to T.Ref.MAX (here, 95°C)
DIFFERENCE FEED-REF:	
DIFF.ON: 6.0 K	Switch-on differential FEED - REF
DIFF.OFF: 3.0 K	Switch-off differential FEED - REF

While the minimal feeder temperature has to have constantly DIFF.ON > DIFF.OFF, DIFF.ON must always be < DIFF.OFF for the maximal reference temperature.

Heating requirement

Basic diagram:



Input variables:	Output variables:
Enable Heating Requirement **Requirement Temperature** = T.Req Shut-off Temperature = T.Off Nom. Value Requirement = Min. threshold at T.Req Nom. Value Shut-off = Max. threshold at T.Off	Status Requirement Indication of the output A (= Enable burner)

Simple description of the function:
Release of burner A if temperature in the buffer tank at the top (requirement temperature T.Req) falls below the "nominal value requirement" (corresponds to a minimum threshold) and switch-off if the temperature in the bottom of the tank (shut-off temperature T.Off) exceeds the "nominal value shut-off" (corresponds to a maximum threshold).

Special features:

- Generally, the values for requirements and switch-off as thermostat threshold can be set. Here, both thresholds are defined as input variables. If the values can be set, you only have to enter *User* as the "source" in order to have it here for the user as a function parameter in the menu of the function. The system is switched on / off via separate threshold values and sensors, so that the two thresholds do not have any hysteresis. Instead, both thresholds have a differential to the value that can be cumulated.
  Switch-on threshold = Nominal value requirement +DIFF.ON at sensor T.Req
  Switch-off threshold = Nominal value shut-off +DIFF.OFF at sensor T.Off
- The method of burner requirement via a sensor and switch-off via another one is called "holding circuit" If a switch function has separate switch on/off thresholds **for just one sensor**, the input variable "SHUT-OFF TEMPERATURE" has to be set to *User / unused*. If the boiler sensor is entered instead of the tank sensor, the result is a sliding boiler operation. The "REQ. TEMPERATURE" then has a differential for switch on/**off** in addition to the threshold value.
  Switch-on threshold = Nominal requirement + DIFF.ON
  Switch-off threshold = Nominal requirement + DIFF.OFF
- A minimum temperature can be set via "**base temperature**" T.Reg.MIN.
  Switch-on threshold = T.Req.MIN +DIFF.ON at sensor T.Req
  Switch-off threshold = T.Req.MIN +DIFF.OFF at sensor T.Off
  The base temperature is only effective, if the nominal value requirement > 5°C. A value > 30°C is only useful if the function is used for sliding boiler operation. In this case, the switch off and on thresholds relate to the sensor T.Req.

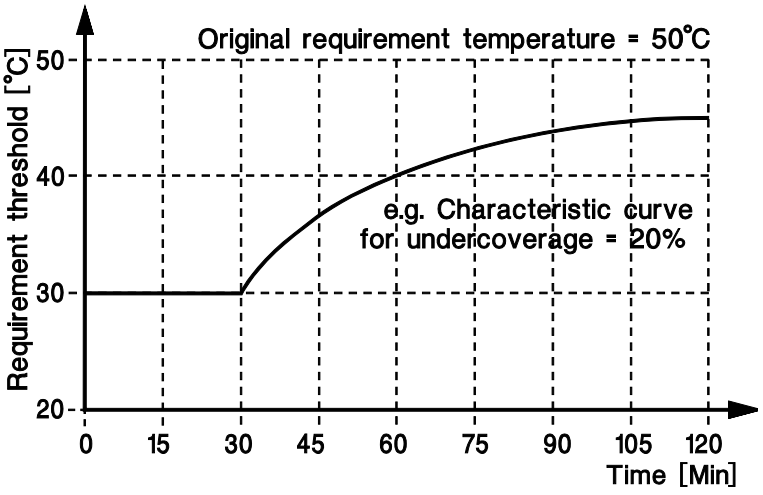
Heating requirement

Eco operation:
Eco operation is related by "undercoverage" to a particular time span. The undercoverage stage always applies for 60 minutes. For a requirement temperature of 50°C undercoverage of 20% has the following effect: requirement after 30 minutes below 30°C or below 40°C (= 20%) after an hour or below 45°C after 2 hours. The threshold value remains the same below 30 minutes.

Formula: dT * dt = Undercoverage * nominal value requirement temperature = constant

Example: Requirement temp. = 50°C
Undercoverage = 20%

=> 20% of 50°C = 10K
dt= 30min => dT= 20K
dt= 60min => dT= 10K
dt= 120min => dT= 5K
dt= 240 min => dT= 2.5K
dt= 480 min => dT= 1.25K
dt= 1440 min => dT= 0.42K



In other words, there is a requirement if the requirement temperature (current temperature) is 20°K below the nominal value for 30 minutes or 0.42K below the nominal value for 1440 minutes (= one day).
If the value falls below the double undercoverage * nominal value requirement temperature (corresponds to the value at 30 minutes), the characteristic curve is limited. If the difference between the nominal value requirement and the current value of the requirement temperature is greater than the double undercoverage * nominal value requirement temperature, the burner is started immediately (such as when the heating circuit switches from lowering to normal mode or when a switch-off condition is no longer fulfilled and the heating circuits go into operation again).

In practice, neither the requirement temperature nor the nominal value are constant. The difference between the two values over time will normally become greater, thus making the product of dt*dT greater, which is added to the register of sums and compared to the characteristic curve. This does not happen if the heating circuits switch, such as from normal mode into lowering mode, or if the heating circuit pump shuts down due to a shut-off condition, etc. However, in such cases the energy is saved that the burner would have consumed if immediately required as soon as the nominal value has been underrun. In certain intervals, the program adds up the difference between the nominal value of the requirement and the current value of the requirement temperature. If this sum is greater than the product of undercoverage * nominal value requirement temperature for one hour with consideration of the immediate switch-on of the burner when the double undercoverage is underrun, the burner is started.

Entire menu view:

DES: HEAT.REQ.	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
REQ. TEMPERATURE:	
T.Req.ACT: 64.3 °C	Current temperature of the sensor T.Req
T.Req.NOM: 60 °C	(Switch-on) threshold value at sensor T.Req
DIFF.ON: 1.0 K	Switch-on difference to T.Req (here, 61°C)
SHUT-OFF TEMP.:	
T.Off.ACT: 44.3 °C	Current temperature of the sensor T.Off
T.Off.NOM: 60 °C	(Switch-off) threshold value at sensor T.Off
DIFF.OFF: 9.0 K	Switch-off difference to T.Off (here, 69°C)
Base Temperature:	Burner requirement, if T.req falls below this value (only effec-
T.Req.MIN: 20 °C	tive, if T.req.NOM > +5°C)
Minimum Runtime	
Burner: 90 Sec	
ECO OPERAT.:	
Undercover: 0 %	No eco operation

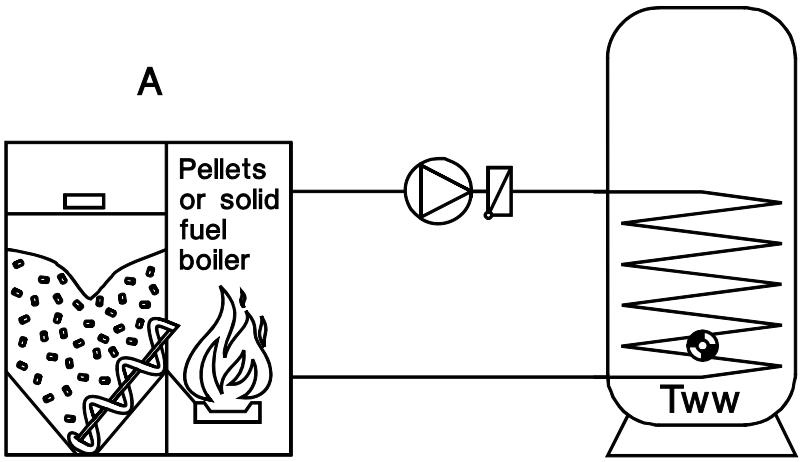
Most common example: Burner requirement if the buffer tank is colder than the calculated heating circuit flow with the input variables:

- ENABLE / User / ON = The function is enabled
- REQ. TEMPERATURE: = Source: / input / sensor buffer upper
- SHUT-OFF TEMP.: = Source: / User / unused = only one sensor is being used
- NOM.VALUE REQ.: = Source: / HEATING CIRCUIT / T.FlowNOM = is thermostat value

The calculated flow temperature of the function *heating circuit 1* is given as the nominal value (as the thermostat threshold). The controller compares this value to the "requirement" temperature *buffer top* along with the switch-on/off differential. Thus, the burner is required when the tank is colder than the calculated nominal flow temperature + DIFF.ON and is switched off if the tank is hotter than the nominal flow temperature + DIFF.OFF.
If the boiler sensor is entered instead of the tank sensor, the result is a sliding boiler operation, for which a socket temperature can also be set.

Warm water requirement

Basic diagram:



Input variables:	Output variables:
Enable Warm Water Requirement **Warm Water Temperature** = T.ww Nominal Temperature = Desired warm water temperature External Switch = Switching between "normal operation" according to the time program (Status: OFF) and Requirement only of Tww.min (Status: ON)	Effective Nominal Temperature = Time-related WW nominal value T.WW.EFF Nominal Temperature = Desired tank temperature T.WW.NOM Status Requirement, indication of the output A Burner Performance = Assignment only makes sense to analog output A15 or A16

Simple description of the function:
Release of burner A if temperature in the tank (warm water temperature T.ww) falls below the nominal temperature set via the time window.

Special features:

- The nominal temperature is also defined as an input variable in this function block. If it is only to be used as a simple set value, you need only enter *User* as the "source." Now, it will appear as a common function parameter in the function menu.
- The nominal temperature indicates the "desired temperature" within definable time windows. In order to ensure a minimum tank temperature even outside the time windows, T.WW.MIN (minimum hot water temperature) can be used to generate a burner requirement outside these specified times.
- The effective nominal temperature T.WW.EFF currently set by the time window is available as an output variable. If the tank exceeds this temperature, 5°C is output. The burner can then be required via another module (such as burner requirement heating) by comparing T.WW.EFF with the buffer temperature.
- The *nominal value* as another output variable is the temperature that the user determines. Therefore, the setting of the desired tank temperature can be transferred to other function modules.
- The input variables "EXTERNAL SWITCH" can be used via a remote wage to switch between normal operation in accordance with the time program and a requirement based only on T.WW.MIN (for instance vacation).

- Neither thermostat threshold has hysteresis, but rather a common switch-on/off differential to the adjustable threshold value.
  Example: T.WW.NOM = 50°C
  DIFF. ON = 1.0 K
  DIFF.OFF = 8.0 K
  In other words, if the temperature falls below T.WW 51°C (= 50°C + 1°K), the output is activated, while it is switched off if the temperature exceeds 58°C (= 50°C + 8°k).
- The function block provides the burner output as an output variable. It can be assigned to a speed output or to the analog output. For instance, the burner performance can be controlled (assuming you have the appropriate burner technology) via hardware output 15 or 16 (analog output 0 - 10V). This is recommended when the burner's performance compared to the heat exchanger's performance sets off the excess temperature protection in the boiler.
- It is also possible to charge the tank outside the programmed time window to the set temperature once by pressing the key.

Entire menu view:

DES: WW-REQ	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
SINGLE LOADING:	Charge the tank outside of the main time by pressing the key
START	
WARM WATER TEMP.:	
T.WW.ACT: 54.3°C	Current temperature of the warm water tank
T.WW.NOM: 50 °C	Nominal temperature of the warm water tank
TIME PROG.:	Opens the Time menu (see **Time programs**)
T.WW.MIN: 40 °C	Minimum temperature of the warm water tank
DIFF.ON: 0.0 K	Switch-on differential to T.WW.NOM and T.WW.MIN
DIFF.OFF: 4.0 K	Switch-off differential to T.WW.NOM and T.WW.MIN
Burner Perf.: 100 %	Specification for burner performance

Code for Technicians:

In order to enable all of the setting parameters, open the function "User" in the device's basic menu and then select "Technician". Enter the product of 2^6 as the code!

Boiler cascade

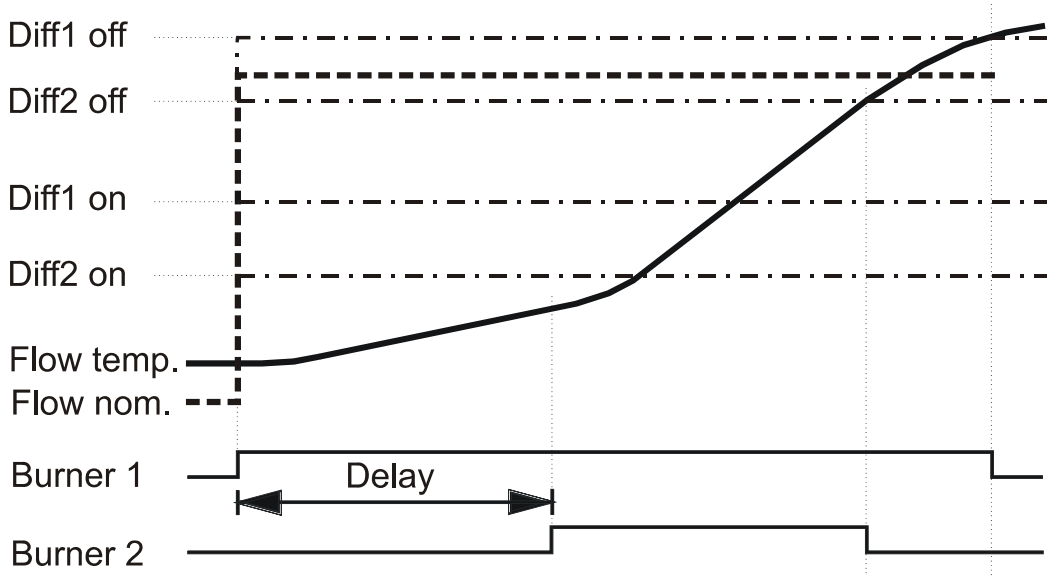
Simple description of the function:
The coordination of up to three burner requirements based on runtime and delay time by comparing the current demand temperature with a common flow temperature.
The indication of the functions involved (requirement modules) automatically gives the module permission to control the burner via its internal signals "burner requirement" and "nominal temperature." The highest nominal temperature is compared to the common flow temperature and issues a burner requirement if need be. After the set delay time, the next burner stage is enabled if the conditions have been fulfilled, etc.

Input variables:	**Output variables:**
Enable (starting with first) Boiler Stage	Flow Nominal Value = Highest demand temperature
Enable Second, Third Boiler Stage	Status Burner Requirement for boiler A, B, C Indication of the outputs
Flow Temperature = Common flow	Operating Hours Boiler (A, B, C)
Functions Involved = Indication of the requirement modules involved	Status of Boiler (1, 2, 3) = Status of burners required

Special features:
- Few input variables as the module automatically communicates with them internally by means of the indication of the functions involved.
- Recording of the burner runtimes. You can therefore automatically switch which boiler is dominant by putting a limit on runtime.
- In addition to the necessary burner requirements, the highest demand temperature (flow nominal value) and the switched stages are available as output variables.

Warning:
Sometimes it makes sense to link one of the output variables directly to the control output to create a 0 to 10 V or PWM signal. Linking this function is only allowed using control output A15, not with output A16.

The following runtime chart assumes that two boilers are to be controlled:



If there is requirement (flow nominal temperature T.FlowNOM suddenly increases) and the flow temperature is less than the switch on temperature of the controlling boiler (=T.FlowNOM + DIFF 1 ON), the first requirement is generated. If the flow temperature remains under the switch-on temperature for the second boiler (T.FlowNOM + DIFF2 ON), a second requirement is generated. The boilers are switched off in the same sequence as the flow temperatures exceed the switch-off temperatures (T.FlowNOM + DIFF OFF).

The nominal flow temperature **T.FlowNOM** is linked with the following values of the involved functions and is determined from the highest of these temperatures:

1. From the function module **Heating requirement**:
   Switch off temperature T.Off.NOM+ DIFF.OFF,
   or request temperature T.Req.NOM+ DIFF.OFF, if no self-provided sensor is used for switching off,
   or base temperature T.Req.MIN + DIFF.OFF.
   The requirement itself is generated, when the temperature falls below the requirement temperature T.Req.NOM + DIFF.ON or below the base temperature T.Req.MIN + DIFF.ON. An approximate burner minimum running time is not considered.
2. From the function module **Warm water requirement**:
   Hot water nominal temperature T.WW.NOM + DIFF.OFF
   or minimum temperature T.WW.MIN + DIFF.OFF (outside the time window)
   The requirement itself is generated when the temperature falls below the hot water nominal temperature T.WW.NOM + DIFF.ON or the minimum temperature T.WW.MIN + DIFF.ON.

If no requirement arises out of the involved functions or the release is set to "OFF", then T.FlowNOM is +5°C.

Overall menu view (for two boilers as shown in the chart):

DES: BOIL.CASC	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
SERVICE MENU:	
T.FlowACT: 34.6 °C	Current flow temperature
T.FlowNOM: 55 °C	Desired nominal flow temperature from the requirement
BOILER 1:	
DIFF.ON: -8.0 K	Switch-on difference to T.FlowNOM (here, 47°C)
DIFF.OFF: 2.0 K	Switch-off difference to T.FlowNOM (here, 57°C)
Delay Time: 0 sec	Switch-on delay for the first boiler (usually zero)
BOILER 2:	
DIFF.ON: -13 K	Switch-on difference to T.FlowNOM (here, 42°C)
DIFF.OFF: -1.5 K	Switch-off difference to T.FlowNOM (here, 53.5°C)
Delay Time: 15 min	Switch-on delay for the second boiler 15 minutes

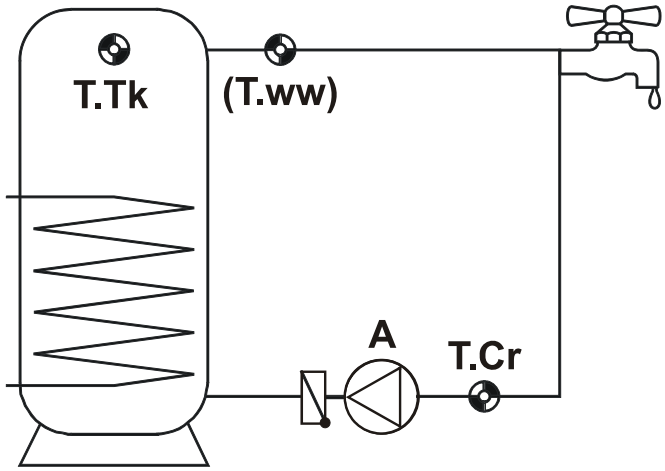
Boiler cascade

The variables in the service menu (according to example):

BOIL.CASC	
Boiler Series:	
Boiler A: 1	Boiler A is top priority (= dominant boiler)
Boiler B: 2	Boiler B is second priority
Boiler A:	
Automatic Boiler Exchange: yes	Exchange dominant boiler if A - B = 200 hours
Operating Time 284 Hrs	Total boiler runtime A = 284 hours
RESET COUNTER: no	“yes” to reset the counter
Boiler B:	
Automatic Boiler Exchange: yes	Exchange dominant boiler if B - A = 200 hours
Operating Time 91 Hrs	Total boiler runtime B = 91 hours
RESET COUNTER: no	“yes” to reset the counter
Differing Operating Hours for Exchange: 200 Hrs	Once a difference of 200 operating hours between A and B is reached, the control boiler is changed over, provided an automatic boiler changeover is required (setting: yes).

Circulation

Basic diagram:



Input variables:	Output variables:
Enable Circulation pump **Circ. Return Temperature** = T.Cr Warm Water Temperature = T.ww Nominal Return Temperature = maximum temperature allowed at T.Cr Tank Temperature = T.Tk tank sensor for mixing protection	Effective Circulation Return Temperature T.CR.EFF (takes into account also the mixing protection) Status Circulation, indication of the output

Simple description of the function:
Release of circulation pump A via time window as long as return sensor T.Cr has not reached its upper limit (nominal temperature). In a simple application, the warm water sensor does not have a function and is thus not used.

Special features:

- Mixture protection 1: Below a minimum tank temperature (T.Tk.MIN), the circulation function is blocked so that the layered remaining energy in the tank is not lost through pump operation.
- Mixture protection 2: To prevent a mixture above this threshold, the temperature difference is used between the tank temperature and the return temperature (MIXT.DIFF.). If the tank temperature minus "MIXT.DIFF." is less than the set return temperature T.CR.NOM, this value is considered the limit temperature. Mixture protection is deactivated without a tank sensor ("source" user).
- If hygienic warm water is to be provided instead of a warm water tank, the pulse mode can be used as an alternative control method using a warm water sensor T.ww. This approach requires a properly dimensioned plate heat exchanger including an ultrafast temperature sensor (MSV+SS = special accessory) at the warm water outlet. Tww also controls the water heating and circulation.
  If a faucet is opened, the temperature at T.ww changes. If the temperature rises or falls by a set value within 1 second at T.WW, the controller switches on the circulation pump. The pump is then switched off either after a set runtime or once the preset nominal value on T.Cr has been exceeded. This ensures that warm water is available quickly at the faucet even when it is closed.
- In the **time/pulse** mode, the time mode is active within the time window; the pulse operation, outside.

Circulation

Entire menu view:

DES: CIRCU	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
OPERAT.: Time	Switching to "Pulse" or "Time/Pulse" mode (see special features)
CIRCU. RETURN:	
T.CR.ACT: 34.7 °C	Current temperature of the return
T.CR.NOM: 50 °C	Nominal (maximum) temperature of the return
TIME PROG:	Open the switch time menu
DIFF.ON: 0.0 K	Switch-on difference to T.CR.NOM (here, 50°C)
DIFF.OFF: 5.0 K	Switch-off difference to T.CR.NOM (here, 55°C)
WARM WATER TEMP.:	
T.WW.ACT: 53.2 °C	Current warm water temperature

Other menu lines appear when a sensor has been indicated for the tank temperature:

MIXTURE PROTECT.:	
T.Tk.ACT: 58.2 °C	Current temperature of the tank
T.Tk.MIN: 30 °C	No circulation is allowed below this tank temperature (Hysteresis = 3K)
MIXT.DIFF.: 8.0 K	If the tank temperature minus MIXT.DIFF. falls below T.CR.NOM, the new value is “T.CR.NOM” (= Effective circulation return temperature)

For the option *Pulse* in lieu of *Time* the following menu options are displayed in place of the time program:

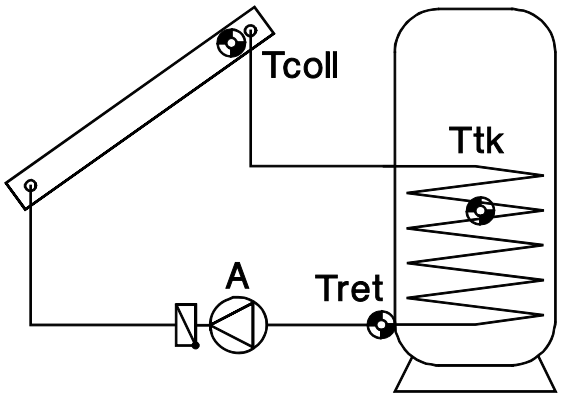
Ddiff_on: 2.0 K	Temperature change of 2K / seconds starts the pump
Run Time: 90 Sec	Maximum runtime per interval
Pause Time: 10 Min	Minimum interval time (= minimum time between two pump runs)

If the operating mode *Time/Pulse* is selected rather than *Time*, then within the time window, time mode is active, while outside it pulse mode is active.

In combination with hygienic service water preparation, the pulse mode runs very reliably with an ultrafast Sensor (special accessory). If standard sensors are used, the temperature change is recognized much more slowly. If there are problems, a flow switch for the circulation function can also be used instead of temperature measurement.
The suddenly increasing digital signal of the flow switch at the function input "Warm water temperature T.WW" causes immediate switching on of the circulation pump.

PID control (speed control)

The PID control can be used to change the delivered quantity – i.e. the volume flow – of usual commercial circulating pumps. That allows the system to maintain temperatures (differences). It can be used not only for the speed control but also for the control of the burner performance and others.
The following simple solar diagram illustrates the possibilities of this process:



Absolute value control = Stabilizing a sensor

Tcoll can be stabilized very well at one temperature (such as 60°C) via the speed control. If solar radiation decreases, **Tcoll** becomes cooler. The control unit reduces the speed and hence the flow rate. That leads to a long dwell time for the heat transfer medium in the collector, which in turn increases **Tcoll**.
As an alternative, a constant return (**Tret**.) can make sense in various systems (such as tank load). That requires an inverse control characteristic. If **Tret** increases, the heat exchanger adds too little energy to the tank. Thus the flow rate is reduced. Greater dwell time in the exchanger cools the heat transfer medium more, thus reducing **Tret**.
Stabilizing **Ttk** would not make sense because the varying flow rate would not affect **Ttk** directly and thus not lead to a functioning regulating circuit.

Difference control = Keeping the temperature between two sensors stable.

Keeping the temperature difference constant between, for example, **Tcoll** and **Tret** leads to a "sliding" operation of the collector. If **Tcoll** drops as a result of reduced irradiation, the difference between **Tcoll** and **Tret** also falls. The control unit reduces the speed leading to a greater dwell time of the medium in the collector and hence to a greater difference **Tcoll** – **Tret**.

Event control = If a set temperature event occurs, the speed control starts, thus keeping a sensor constant.

If, for instance, **Ttk** reaches 60°C (activation threshold), the collector is to be kept stable at a certain temperature. The respective sensor is stabilized just as in the absolute value control.

Note: If the absolute value control (stabilization of a sensor) and the differential control (stabilizing the difference between the two sensors) are both active at the same time, the slower speed of the two methods "wins". The event control "overwrites" the speed results from other regulation methods. This means that a defined event can block the absolute value or differential control.

PID control

Waveform
Two waveforms are available for motor control (in the menu “Outputs”).

Wave packet - only for circulating pumps with standard motor dimensions. Here, individual half-waves are blended in to the pump motor. The pump is run via pulses; the “smooth running” of the motor is only due to the moment of inertia.
Benefit: Great dynamics of 1:10 well suited for usual commercial pumps without internal electronics and a motor length of around 8 cm.
Drawback: Linearity depends on the pressure loss; there is some noise, not suitable for pumps with evidently deviating motor diameters and / or length from 8 cm.

Phase angle - for pumps and ventilation motors. The pump is switched to the mains within each half-wave at a certain point (phase).
Benefit: Suitable for almost all types of motors
Drawback: Low dynamics of 01:03 for pumps. A filter has to be inserted upstream from the unit with at least 1.8mH and 68nF to fulfill the CE standards for interference suppression (except A1 which on the other hand is able to carry a current of only up to 0.7A)

Speed control via a phase angle control is serially not possible at outputs 2, 6 and 7.

Stability problems
The **p**roportional part of the PID controller represents the reinforcement of the deviation between the nominal and the actual value. The speed is changed in increments every **X***0.1 K of deviation from the nominal value. A large number makes the system more stable and leads to a greater deviation from the regulation.
The **i**ntegral part of the PID controller periodically adjusts the speed relative to the deviation remaining from the proportional part. For **1** K of deviation from the nominal value, the speed is changed one increment every **X** seconds. A larger number makes the system stable, but the adjustment to the nominal value is slower.
The **d**ifferential part of the PID controller leads to a short-term overreaction the faster a deviation occurs between the nominal and the actual value in order to provide the fastest compensation possible. If the nominal value deviates at a speed of **X***0.1 K per second, the speed is changed by one increment. Large numbers provide a more stable system, but it then takes longer to reach the desired value.
In some cases an adjustment of the PID values is necessary. The pump should be running in automatic mode if the system is ready for operation and has the appropriate temperatures. With I and D are set to zero, the proportional part P is reduced from 10 each 30 seconds until the system is instable and the pump speed changes its rhythm. It can be read in the menu above the PID parts. The proportion at which instability begins is noted as P_{crit}, with the duration of the oscillation (= time between the two highest speeds) noted as t_{crit}. The correct parameters can be determined with the following formulae.

$$P = 1{,}6 \times P_{crit} \qquad I = \frac{t_{crit} \times P}{20} \qquad D = \frac{P \times 8}{t_{crit}}$$

A typical result of hygienic service water preparation with an ultrafast sensor is PRO= 8, INT=9, and DIF=3. For reasons not entirely understood, the settings PRO=3, INT=1, and DIF=4 have proved to be effective. Probably, the control unit is so instable here that it oscillates very quickly, appearing balanced due to the systems and the fluids inertia.

Pump standstill
The wave packet method (standard) allows the volume flow to be changed by a factor of 10 in 30 increments. If the flow rate is too low, return flaps may cause a standstill as well as a low output of the pump at low speeds of the control unit. This may even be desirable, which is why the lower limit of 0 is admissible. A reasonable speed limit is found in a simple test. Select manual mode in the menu "Outputs" and set a speed. The rotor can be observed with its hood removed. Now, the revolutions are reduced until the rotor comes to a standstill. Three stages above this limit will provide safe pump operation. The indication of the lower speed stage occurs in the respective function *Speed control*.

All functions have a variety of input variables:

Input variables:	**Output variables:**
Enable PID- Control	Correcting Variable = Calculated speed stage
Absolute Value Control of the Temperature = Sensor which should be kept stable at the nominal temperature. Absolute Value Control of the Nominal Value = Desired control temperature	Indication of the RPM control output
Temperature + ***Difference Control*** = Base sensor (the warmer sensor, e.g. collector) of the difference control Temperature - Difference Control = Reference sensor (the colder sensor, e.g. tank) of the difference control	
Activation Temperature of the ***Event Control*** = Sensor where an event is expected. Activation Threshold = Temperature event at the above sensor Control Temperature of the Event Control = Sensor which is kept stable after the occurrence of an event. Nominal Value = Desired nominal regulation temperature for the event control	

Simple description of the function:
With the indication of temperature sensors the volume flow in the hydraulic system is controlled via the variability of the pump speed to keep the respective sensor constant at a nominal temperature.

Special features:
- The current speed is available as output variable also for other functions for further use. In addition, it also can be switched to an analog output instead of the pump outputs.
- It is possible to set all control processes separately to *normal* control operation (speed increases along with the temperature), to *invers* operation (speed decreases as temperatures increases) or to *OFF* (control process is not active).
- If the absolute value control (stabilization of a sensor) and the differential control (stabilizing the difference between the two sensors) are both active at the same time, the "slower speed wins out".
- If 2 PID controllers act simultaneously on an output, then the faster speed "wins".

PID control

- Event control "overwrites" the results of speed control from other control processes. Hence, a set event can block the absolute value control or differential control. Example: Keeping the collector temperature at 60°C with the absolute value control is blocked when the tank has already reached 50°C at the top = the fast provision of warm water is complete and is now to be continued with full volume flow (and hence a lower temperature but slightly better efficiency). To do so, a value that automatically requires full speed has to be entered as the new nominal temperature in the event control (e.g. coll = 10°C).

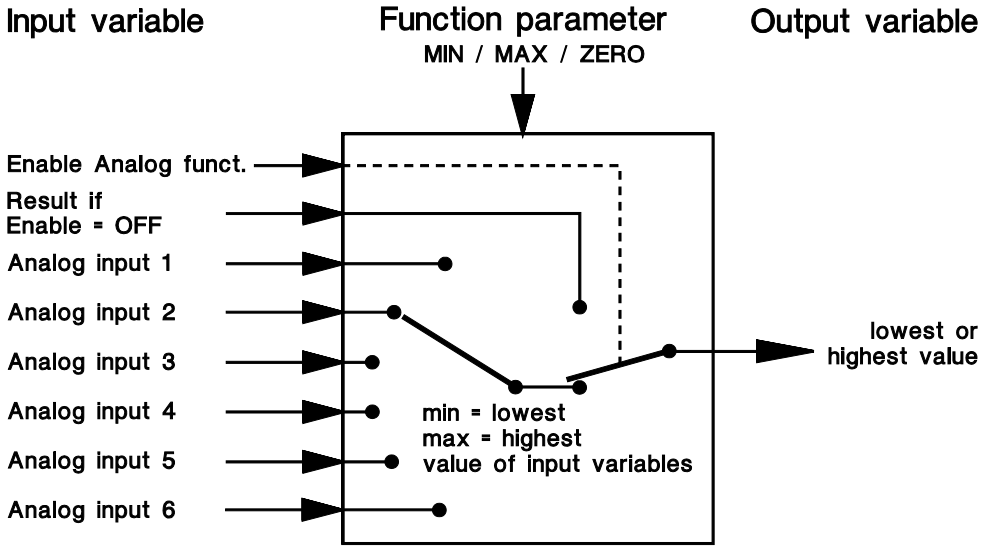
Entire menu view:

DES: PID CONT.1	
FUNCTION STATUS:	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
ABSOL.VALUE CONTROL:	
MODE: normal	Speed increases as temperature increases
T.Abs.ACT: 50.3 °C	The sensor is currently measuring 50.3°C
T.Abs.NOM: 50 °C	The sensor is kept at 50°C
DIFFERENCE CONTROL:	
MODE: normal	The speed increases with the difference T.Diff+ to T.Diff-
T.Diff+.ACT: 50.3 °C	The sensor at the source is currently measuring 50.3°C
T.Diff-.ACT: 42.7 °C	The reference sensor is currently measuring 42.7°C
NOM.DIFF 8.0 K	The desired difference (T.Diff+ to T.Diff-) should be 8 K
EVENT CONTROL:	
MODE: off	No event control is allowed. If *normal*, then:
COND.: ACT < THRES	Condition
T.Ev.ACT: 48.1 °C	The sensor that activates the function is measuring 48.1°C
T.Ev.THRES: 60 °C	Event control should launch at 60°C on (act-) sensor (fixed activation threshold, no hysteresis)
T.Ctrl.ACT 50.3 °C	The sensor control starting with the event is displaying 50.3°C
T.Ctrl.NOM 90 °C	Starting with this event, the sensor is controlled to 90°C
CORRECT.VAR.:	
Maximal: 30	Highest admissible speed stage is the stage 30 (full run)
Minimal: 8	Lowest admissible speed stage is stage 8 (0 also admissible)
Current: 14	Stage 14 is currently output
CONTROL PARAMETER:	
P: 10 I: 0 D: 0	PID shares for stable operation

The control parameters P=8, I=5, and D=2 generally ensure stable operation. If the speed periodically changes (generally for 20-30 seconds), I and D should be set to zero for simple systems. Drawback: A low, constant temperature is incorrectly controlled for, and the system is a bit slower.
If a speed control is used in service water systems, the PID settings must be determined in a test (see "stability problems") to ensure optimal performance.

Analog function

Basic diagram:



Input variables:	Output variables:
Enable Analog Function Result if (Enable = Off) Analog Input Variables 1 - 6	Result Indication of the RPM control output

Simple description of the function:
According to the basic diagram it looks for the highest (lowest) value of the analog inputs. Besides the heating circuit and load pump module this modules represents an extremely versatile and important link to the burner requirement. In addition, it offers also simple calculating operations.

Special features:

- When an entry is made in the function list, the number of analog inputs can also be entered. Thus, not all six inputs have to be assigned.
- The function produces the following result as an output variable via a control command from the inputs:
  - ***MIN***: Output of the minimum value of the input variables.
  - ***MAX***: Output of the maximum value of the input variables.
  - ***MEAN VALUE***: The output variable is the **mathematical** mean (average) of all input variables. In this way, the average of multiple measurement values can be calculated.
  - ***FILTER***: The output variable is the **temporal** mean of the first input variable. All other inputs are ignored. The average time can also be set.
  - ***SUM***: The output variable is created based on the following formula from the sum of input variables E(1-6): sum = E1 - E2 + E3 - E4 + E5 - E6. For example: if the input variable E2 is set to *User* and zero is entered in the parameters for E2, E1 + E3 are simply added.
  - ***ZERO***: Output of the number zero as an output variable.
- If the module is blocked (enable = off), a value is output that either the user determines via "RESULT (ENABLE: = Off)" or that is created from an own input variable. It is therefore possible to switch between analog values via the enable.
- The specification of *User* and analog input creates an adjustable numeric value in the menu of the function.
- In the input variables, an offset that is added to the value of the variables can also be set.
- Digital conditions can also be processed at the inputs: if the condition is OFF, 0 is used to calculate the value; if the condition is ON, the set value “Offset” of the respective input variables is used for the calculation.

Analog function

Example of use:
The greatest temperature that the system currently demands is calculated from the three functions "heating circuit 1." "heating circuit 2" (output variable = flow nominal value), and requirement warm water (output variable = effective tank temperature) so that the burner requirement is later correctly compared to the buffer tank temperature. In addition, the customer also wishes to have a constant buffer standby temperature. When this function was called, the number of input variables was already set at four. The following parameters are now set in the submenu *INPUT VARIABLES*:

INPUT VARIABLE 1: Source: HEAT.CIR.1 1: PR.Nom.Temp Offset: 0.0 K	Input variable 1 is the flow nominal temperature of the function HEAT.CIR. 1
INPUT VARIABLE 2: Source: HEAT.CIR.2 1: PR.Nom.Temp Offset: 0.0 K	Input variable 2 is the flow nominal temperature of the function HEAT.CIR. 2
INPUT VARIABLE 3: Source: WW REQ 1: Eff.NOM.Temp Offset: 0.0 K	Input variable 3 is the effective temperature of the function WW-REQ
INPUT VARIABLE 4: Source: User	The user sets the socket temperature in the menu

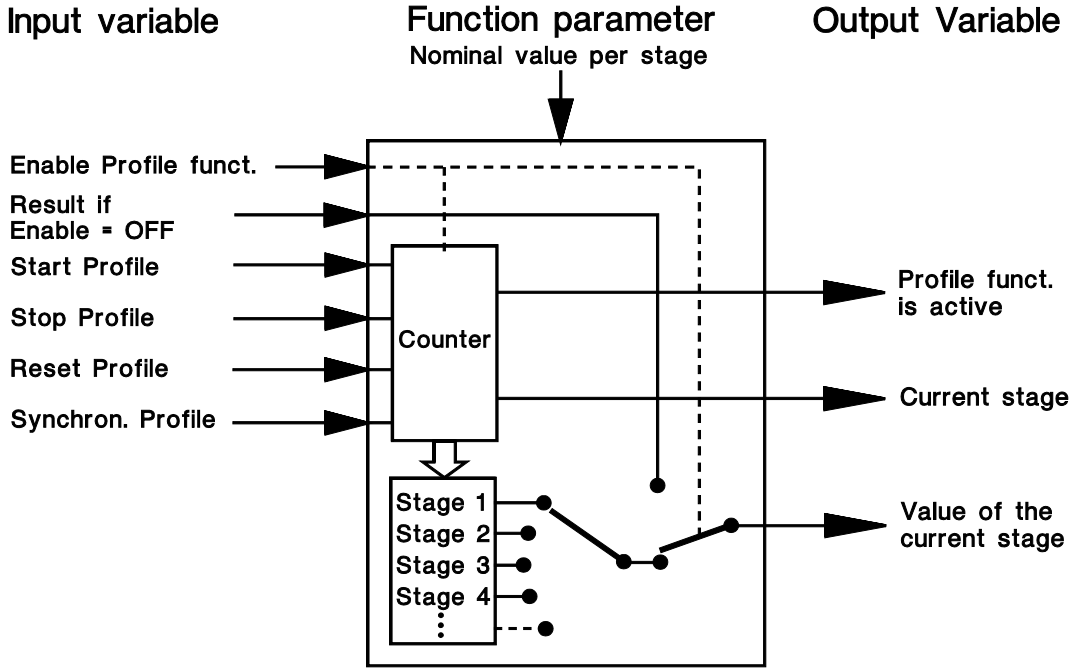
Entire menu view:

DES: MAX(An) INPUT VARIABLE: OUTPUT VARIABLE:	
FNCT.VAR: Temperat.	All inputs are temperatures
FUNCTION: MAX	Output of the highest temperature of the inputs
VAR. 1: 53.6 °C	Flow temperature of the function HEAT.CIRC.1
VAR. 2: 66.4 °C	Flow nominal temperature of the function HEAT.CIRC.2
VAR. 3: 5.0 °C	Effective temperature of the function WW-REQ
VAR. 4: 40.0 °C	Socket temperature set by the user
If ENABLE = Off 0 °C	If the analog mode has not been released, the module outputs 0°C
RESULT: 66,4 °C	Result of the analog function

The function therefore provides 66 .4°C as the greater value for the output variable. As an input variable, this temperature now allows a comparison with the temperature at the top of the buffer tank in the function *burner requirement heating*. If the buffer is colder than 66 .4°C (+ diff), the burner is required.

Profile function

Basic diagram:



Input variables:	**Output variables:**
Enable Profile Nominal Value if (Enable = Off) Start Profile = Starting the time controlled process Stop Profile = Stopping the time controlled process Reset Profile = Reset to stage 0 (profile disabled) Sync. Profile = More forward by 1 step (from step 1)	Status Profile Active = Output ON when nominal value is not OFF Indication of the output Nominal Value = Value of the current stage Current Stage

Simple description of the function:
This function generates a time-controlled output of **up to 64 values**. In each step, the system switches from one value to the next in a set table and outputs the value as a "nominal value." In this way, a profile can be set up, e.g. a temperature profile that is suitable for a floor screed drying out program.

Special features:

- The input variables Start, Stop, Reset or Sync. Profile must be digital commands (ON/OFF) (e.g. digital input, switching output or another function, etc.)
- Each of the input variables can be manually operated directly from the function by entering *User*. However, the command "STOP PROFILE" behaves differently than a linked input variable in manual mode. In the link, the counter is only stopped as long as the stop signal is active, thereafter the counter continues running. In the manual mode, "STOP PROFILE" also generates a reset. The counter then starts from the beginning again when restarted.
- The table entry zero means that the profile is not active during this step.
- A cyclical process is possible: the first value is called again after the last one.
- If the module is blocked (enable = off), a value is output that is either determined via " If ENABLE = Off " or that another module creates as an input variable. It is therefore possible to use the enable to switch between the profile and an external analog value.

Profile function

- The table entry OFF means: During this step, the profile is not active. A value is output, that can either be specified via “NOMINAL VALUE (ENABLE: = off)” or which originates from another module as the input variable.
- The following functional variables can be set as the nominal value: temperature, dimensionless, power, heat quantity MWh, heat quantity kWh, number of pulses, time and solar radiation

Although the profile stage is registered every 6 hours in the internal storage, it gets lost while loading new function data (load factory settings, load backup copy, data transfer from Bootloader).
If an internal cycle > 23.5 hours is set (such as heat drying of a pavement floor), profile stage 1 is saved in the internal memory immediately after the profile function starts. This ensures that the heat drying program continues to run when the controller is reconnected after a blackout just after the heat drying of the floor pavement has been launched.

Example:
A temperature profile for heat drying of floor pavement is to be created. It is assumed that all input variables are set to *User* so that the function can be manually changed at any time.

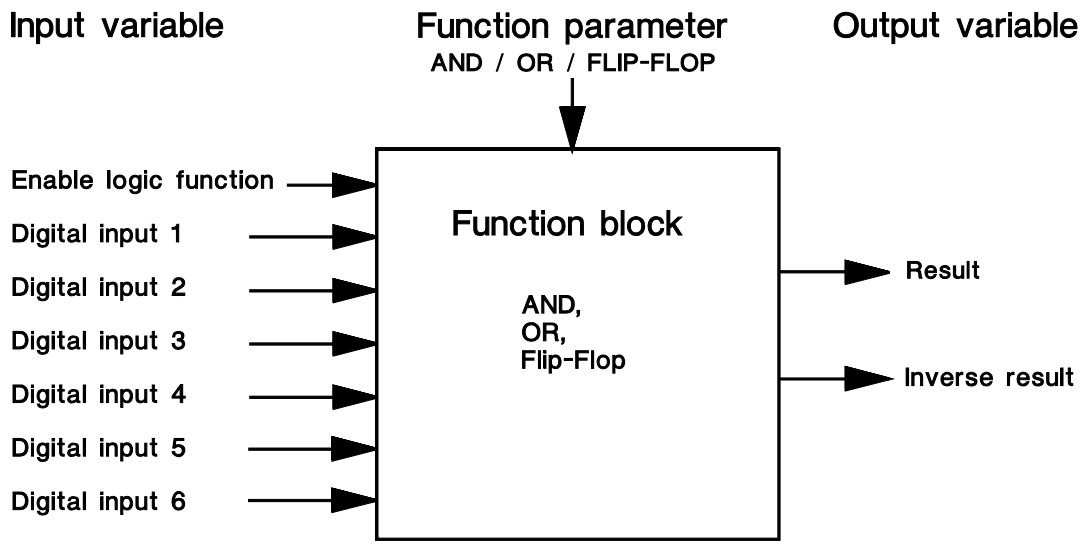
Entire menu view:

`DES: PROFILE`	
`INPUT VARIABLE:`	
`OUTPUT VARIABLE:`	
`FNCT.VAR: Temperat.`	The values are interpreted as temperature
`cyclical: no`	No repeat after the profile has ended
`Int. Sync: 24.0 Hrs`	Switch to the next value every 24 hours (Adjustment range 1 sec. to 48 hours)
`START PROFILE`	Press the scroll wheel to manually start the function. The following will appear when started: `STOP PROFILE` (Display only if the input variable "Start Profile“ is set to *User*)
`CURRENT STAGE: 3`	
`NOM.VALUE: 26.0 °C`	The nominal value of stage 3 is 26°C
`Stage 1: 20 °C`	
`Stage 2: 23 °C`	
`Stage 3: 26 °C`	
`Stage 4: 30 °C`	
`Stage 5: 35 °C`	
`Stage 6: OFF`	No profile is active on the sixth day, output of the nominal value, if Enable = OFF
`Stage 7: 30 °C`	
`Stage 8: 26 °C`	
`Stage 9: 22 °C`	
`If ENABLE = Off 0.0 °C`	If the profile mode has not been released, the module outputs 0°C

If the output variable "PROFILE ACTIVE" is now assigned to the heating circuit pump and the function module "MIXER CONTROL" handles the nominal value, a pavement floor heat drying program has been created for nine days. Here, make sure that a heating circuit regulator module does not simultaneously control the output. To be on the safe side, set the enable for the heating circuit controller to *User OFF* during the process.

Logic function

Basic diagram:



Input variables:	Output variables:
Enable Logic Function Digital Input Variables 1 - 6	Status Result, indication of the output Status Inverse Result, indication of the output

Simple description of the function:

AND- function: Output = ON only if all inputs are ON.
OR- function: Output = ON if at least one input is ON.
FLIP FLOP- function: Output = Saves the status of the inputs

Special features:

- After having registered the function in the function list the indication of the number of digital inputs is possible. Thus, not all six inputs have to be assigned.
- The FLIP-FLOP function (also known as holding circuit) works according to the following formula:
  - Output = constantly ON if at least one of the inputs I1, I3, I5 were set to ON (set holding circuit), even if the input decreases again afterwards (set pulse).
  - Output = constantly OFF if at least one of the inputs I2, E4, I6 were set to ON (delete holding circuit). The "Delete" command dominates. Hence, no setting is possible when a delete input is ON (reset pulse).
- The function "OFF" is also available. In this way, the function is inactivated by the easiest means. The status OFF applies to the direct output and the status ON to the inverse output.
- In addition to the direct output, the inverse output function is also available.
- If the module is blocked via enable, both the direct and the inverse output are OFF.

Logic function

Example:
The heating circuit is to be released based on the two thermostat functions "comparison_1" and "comparison_2" when one of the two (OR-function) is triggered. When this function was called, the number of input variables was already set at two. The following parameters are now set in the submenu *INPUT VARIABLE*:

```
INPUT VARIABLE  1:
Source: COMP.1
1 : Va > Vb + diff
Mode:   normal
Status:   ON

INPUT VARIABLE  2:
Source: COMP.2
1 : Va > Vb + diff
Mode:   normal
Status:   OFF
```

Input variable 1 is the output of the thermostat function COMP.1

Adoption of normal start condition of the module
We see current status ON

Input variable 2 is the output of the thermostat function COMP.2

Adoption of normal start condition of the module
We see current status OFF

Thus, the function forms the command ON as the output variable. In the function *heating circuit controller*, it now allows the release of the pump as an input variable if either the "boiler thermostat" **or** the "buffer thermostat" has exceeded the required temperature.

Value table based on two inputs + enable:

AND

Enable:	Input 1:	Input 2:	Result:	Inv. result	Commentary:
ON	OFF	OFF	OFF	ON	
ON	ON	OFF	OFF	ON	
ON	OFF	ON	OFF	ON	
ON	ON	ON	ON	OFF	
OFF	X	X	OFF	OFF	Both outputs OFF

OR

Enable:	Input 1:	Input 2:	Result:	Inv. result	Commentary:
ON	OFF	OFF	OFF	ON	
ON	ON	OFF	ON	OFF	
ON	OFF	ON	ON	OFF	
ON	ON	ON	ON	OFF	
OFF	X	X	OFF	OFF	Both outputs OFF

FLIP FLOP

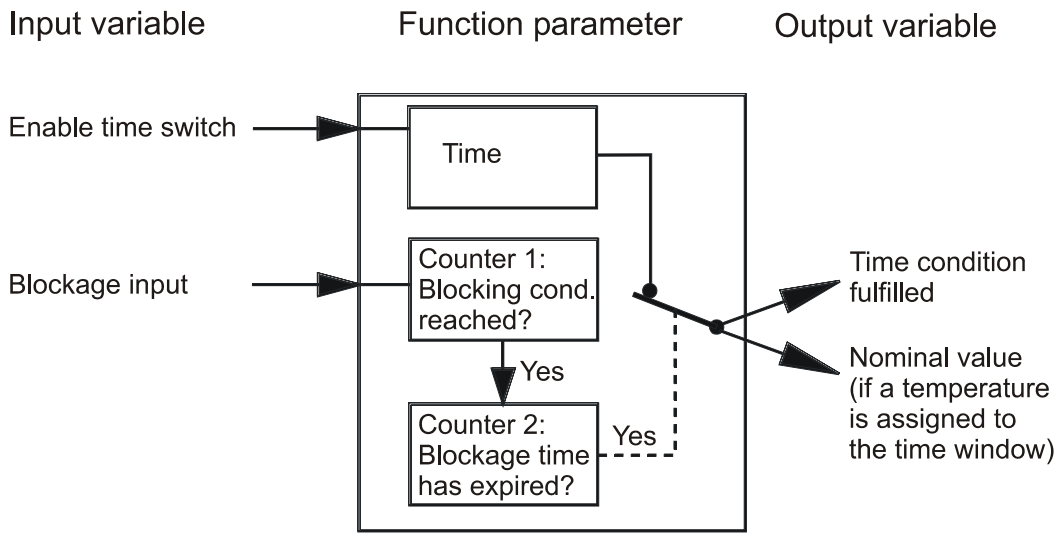
Enable:	Input 1:	Input 2:	Result:	Inv. result	Commentary:
ON	OFF	OFF	OFF	ON	Previous status
ON	ON	OFF	ON	OFF	I1 is saved!
ON	OFF	OFF	ON	OFF	Previous status
ON	OFF	ON	OFF	ON	I2 deletes output
ON	ON	ON	OFF	ON	I2 dominant
OFF	X	X	OFF	OFF	Both outputs OFF

OFF

Enable:	Input 1:	Input 2:	Result:	Inv. result	
ON	X	X	OFF	ON	
OFF	X	X	OFF	OFF	Both outputs OFF

Time switch

Basic diagram:



Input variables:	Output variables:
Enable Time Switch	Nominal value (if a temperature is assigned to the time window) Status Time Condition fulfilled
Blocking Input	Indication of the output

Simple description of the function:
There are a maximum of 5 time programs each with 3 time windows available per module.
As a freely usable time switch clock this function can be employed in various ways. For instance, this function could be used to provide a Time control for filter pumps in swimming pools or for fan motors in hot-air heating systems. The function block has the same operational structure as all other time switch functions, such as in the heating control unit function.
If the function Time switch is put before another function (such as load pump) as an INPUT VARIABLE/ENABLE, the function receives additional time conditions. As with all other function blocks, the time switch can be entered several times in the function list, i.e. multiple time switches can be available.

Special features:
When the function is set up, the question "with nominal value?" *yes/no* appears next to the questions about scope (time programs, window). If you enter *no*, you'll have a normal digital time switch. If yes is entered, the user can assign a temperature to each time window that will later be available as an output variable according to the time windows. A nominal value can be entered simultaneously if the time program is not full.

- If *User* is entered as the "source" for the input variable BLOCKING INPUT, a simple time switch function is the result.
- If another function is assigned as the "source" to the input variable BLOCKING INPUT, the time switch can be blocked for a certain period if certain events occur.

Time switch

Example:
Time switch with two time programs, each with three time windows

Entire menu view:

DES: TIME	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
Mo Tu We Th Fr Sa Su	The first time program is active on all workdays
06.00 - 07.30 h	Switched on on workdays at 06:00 AM and off at 07:30 AM
12.00 - 21.00 h	etc.
00.00 - 00.00 h	Time window not used
Mo Tu We Th Fr **Sa Su**	The second time window is active on the weekend
05.00 - 07.00 h	Switched on at 05:00 AM and off at 07:00 AM
12.00 - 22.00 h	etc.
00.00 - 00.00 h	Time window not used

If using a nominal value, the following lines appear according to the time matrix:

Nominal Val if TP not fulfilled: 5° C	Entry of a nominal value outside the time window

If another function uses the blockage input, the following will appear:

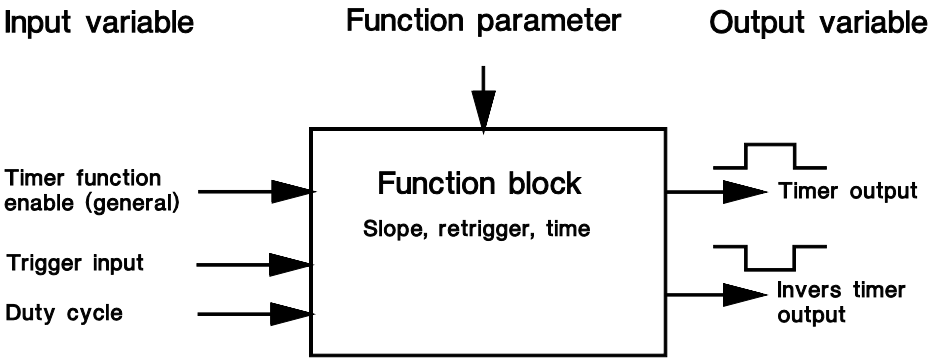
Min.Time Block.Cond:	
0 Days 5.0 Min	The condition has to be met for at least five minutes
Blocking Time:	
0 Days 10.0 Hrs	Then, the time switch is blocked for 10 hours

Legionella protection is another example. Here, the time switch function is used to heat up the tank to 60°C at night to prevent legionella from forming. If this temperature is reached anyway during the day (such as by the solar system), there is no need of additional heating, and the function is blocked:
A comparison function (thermostat) at the blockage input lets the first counter run (“Min.time block.cond”) as long as the tank is hotter than 60°C. If the set counter time has been reached (five minutes), a second time counter blocks the time switch until it has expired (10 hours). The tank is therefore not heated up once again at night using oil, gas, or electricity if the protective temperature was already reached during the day.

While the time switch is already blocked once the first counter time (“Min.time block.cond ”) has been reached, the second counter (blocking time of time switch) only begins to run when the blockage input returns to the status "OFF."

Timer

Basic diagram:



Input variables:	Output variables:
Enable Timer Trigger Input = Input signal for starting the timer Duty Cycle = Relation between input and output signal	Status Timer Output, indication of the output Status Inverse Timer Output, indication of the output

Simple description of the function:
Independent time elements can switch time sequences between functions. An input status triggers a time laps of the timer function (= pulse time), which runs irrespective of the time of day. The pulse time can be set up to 90 seconds in increments of seconds in addition to various stages of up to 48 hours.

Special features:

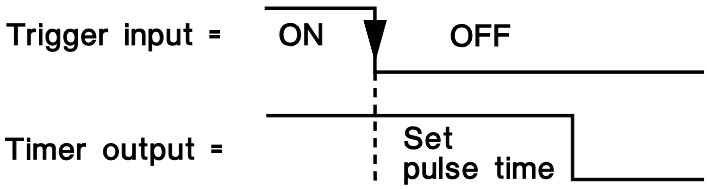
- The set pulse time can be varied from 0-100 percent via the input "DUTY CYCLE." The pulse time can thus be varied via signals and computer values. To make it an adjustable value in the menu, *User* has to be entered as "source".
- Use the command MODE to choose between six basic functions:

Entire menu view:

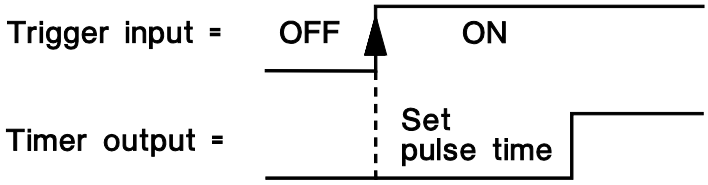
DES: TIMER FUNCTION STATUS: INPUT VARIABLE: OUTPUT VARIABLE:	
MODE: Delay	Input affects output with a certain delay
TRIGGER: Retrigger: yes	A second trigger while the timer is running restarts the timer
PULSE TIME: 8 Sec DUTY CYC.: 100 %	Timer runtime 100% of 8 seconds = 8 seconds!
HAND: TIMER START	The timer can be launched using the scroll wheel and stopped before it has expired.

Timer

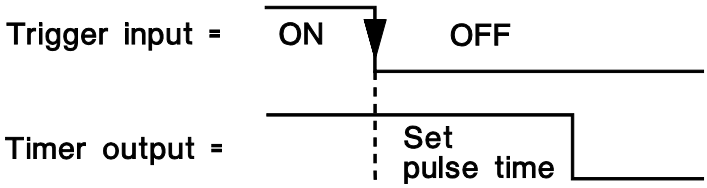
After run: The ON signal at the trigger input immediately switches the output on. If the input drops (OFF), the output remains ON for the duration of the timer period.



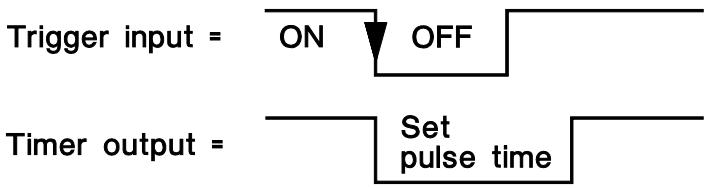
Delay: The ON signal at the trigger input is only passed on when the timer period at the output has elapsed. An OFF signal at the trigger input causes immediate switching off of the output.



Minimum run: The ON signal at the trigger input immediately switches the output on. If the input drops during the timer window (OFF), the output remains switched on nonetheless until the timer window has expired.

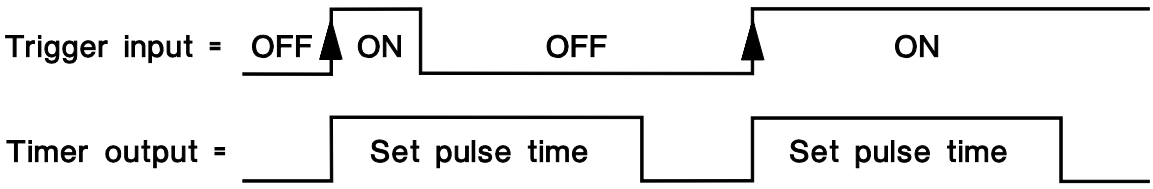


Blockage: The ON signal at the trigger input only switches the output on, after the timer window has expired since the last ON signal.

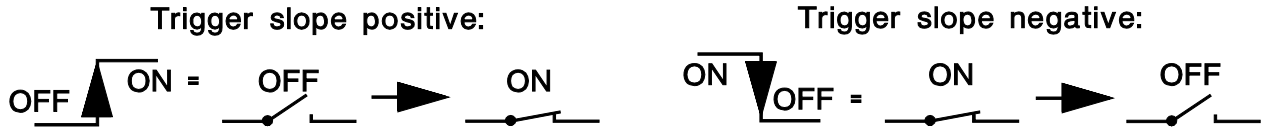


Instable: By indicating a switch-on and off time, a pulse generator is created without a trigger input. If the pulse-duty factor is also used for controls, it changes the switch-on time. The setting switch-off time = 0 is a special case: The switch-on time then corresponds to the entire period, and the pulse-duty factor to the relationship between the switch-on and the switch-off time

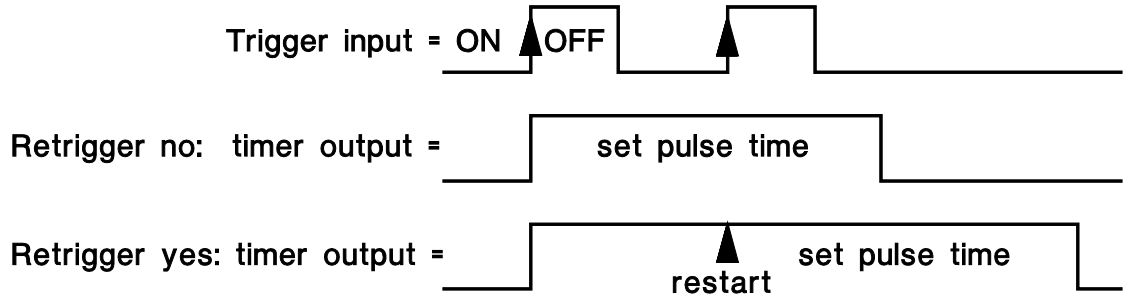
Pulse: If the selected trigger slope occurs, the output for the timer time switches on. A trigger input status change during the pulse time does not change the output status.



The trigger slope is positive if the input status changes from "OFF" to "ON" or from "switch open" to "switch closed" (= closing). A change from closed to open (= opening) is a negative trigger slope. TRIGGER SLOPE = *pos/neg* starts the timer anytime there is a status change at the input.



The properties of **retriggering** based on the example of a positive trigger slope:



Synchronisation

Simple description of the function:
This module provides an output variable relative to the date and time based on the date and time information of the device. In this way, periodic signals that directly relate to the time, day of the week, date, or season and allow for date or time-specific releases are available to control other function modules.

Input variables:	Output variables:
Enable Synchronisation	Status Time Condition Fulfilled, indication of the output Status Summer time ON/OFF Status Controller Start = Starting up of the control unit

Special features:
- The function allows up to five date or time windows. The number has to be set after calling the module.
- Via the command “MODE”: periodic time windows in intervals of hours up to one year can be programmed.
- The setting "cyclical/singular" determines whether the window whose parameters are set is to occur once or repeatedly (cyclical).
- The output "Contr. Start" only generates a 30 second pulse when the device is switched on or reset.

Example:
Assuming that a damp basement room is to be periodically heated, a time laps is prepared for other modules that then handle the heating. This procedure is to take place four times a year in the summer when there is enough solar energy in the buffer tank.

Entire menu view:

```
DES: SYNC.
INPUT VARIABLE:
OUTPUT VARIABLE:

MODE:      Year
       cyclical

Day Mon      Day Mon
15.  06. -  17. 06.

05.  07. -  07. 07.
25.  07. -  27. 07.
10.  08. -  12. 08.
```

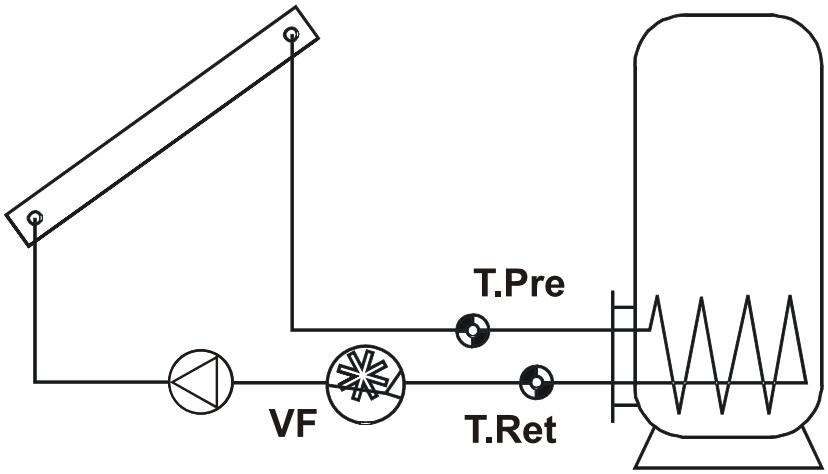
Procedure within one calendar year repeating every year

Output variable ON from the 15th 00:00 hours to the 17th of June 00:00 hours, etc.

N.B.: In modes "Year" and "Month" the time window begins and ends respectively with 00:00 hours for the specified days.

Heat quantity counter

Basic diagram:



Input variables:	Output variables:
Enable Heat Quantity Counter **Flow Temperature** = T.Flow **Return Temperature** = T.Ret Volume Flow = VF Counter Reset	Current Power Count Kilowatt Hours Count Megawatt Hours

Simple description of the function:
Calculation of the heat output and quantity via the temperature difference and volume flow with consideration of the share of frost protection in the heat medium.

Use as an electrical energy counter:

1. The sources of the input variables flow temperature and return temperature are set to *User* / *unused*.
2. The impulses of the electrical counter are captured as input 15 or 16 (Setting: Type: Impulse, Measurement variable: Flow rate). In this case the quotient setting does not correspond to litre/impulse, rather Wh/Impulse. This input must be defined as the input variable "*Flow rate*".
3. If the setting range (Wh/Impulse) of the input is insufficient, then this can be increased in the function menu by a factor (between 1 and 100).

For each impulse, the heat quantity counter is increased by the Quotient * Factor (Wh).

Special features:

- When the temperature difference is calculated, the tolerance of the sensors and the measuring device may lead to large errors (if the difference is 10°K, the error is approximately 30%). To compensate for these errors, the device has a patented calibration method that can be found in the service menu.
- The collector sensor can also be used as the flow sensor. However, it always has to be installed on the flow outlet of the collector bar using an immersion sleeve. The heat quantity measured then also contains the losses from the solar flow line.
- Counter reset function in the input variables and in the service menu.
- The output variables (power, MWh, kWh) can be taken up by other modules and input variables.
- A fixed value can be set as the flow rate instead of the transducer if *User* is in the input variable "volume flow."

Heat quantity counter

WARNING: Although the counter of the function module Heat quantity counter is recorded every 6 hours in internal memory, it is lost when loading new function data (load factory settings, load backup copy, data transfer from Bootloader)! Therefore for this reason, should a power failure occur, up to 6 hours counter data can be lost.

Calibration mode
During calibration, it is important that both temperatures (flow and return) measure the same temperatures. Here, both of the sensor tips are tied together using tape or a wire. In addition, the two sensors should already be equipped with the line expansions. When using the collector sensor, the required line length has to be estimated approximately and integrated. The sensors must be connected to both parameterized inputs of the flow and return lines and are both submerged in a hot water bath (i.e. both measure the same temperature).

Overall submenu view - SERVICE MENU:

RESET COUNTER: no	Reset the heat quantity counter
HEAT QUANT.: 123.4 kWh	Total heat quantity in kWh
CALIBRATION START: no	Start command for calibration
Status: UNCALIBRATED	The heat counter has not been calibrated
DIFFERENCE 0.56 K	Display of the difference measured during the calibration process

Calibration process:

1. Submerge the sensors in the water bath.
2. Start the calibration process by selecting "START *yes*"
3. After successful calibration, the status "CALIBRATED" appears. The measured difference value is displayed.

By simultaneously measuring the same temperature with both sensors, the computer can ascertain the deviation of the sensors from each other and include it as a correction factor when calculating the heat quantity in the future.

Entire menu view:

DES: HQC.1 INPUT VARIABLE: SERVICE MENU:	
Status: CALIBRATED	
FROST PROTECTION:45 %	Indication of frost protection share in %
T.Flow: 62.4 °C	The flow temperature is 62.4°C
T.Return: 53.1 °C	The return temperature is 53.1°C
DIFF: 9.3 K	The difference between the flow and the return is 9.3°K
FLOW R.: 372 l/h	The current flow rate is 372 l/h
POWER: 3.82 kW	The current output is 3.82 kW
HEAT QUANT.: 19 834.6 kWh	The current heat quantity is 19,834.6 kWh

Counter

Simple description of the function:
As a operating hours counter or pulse counter (such as for the burner requirement) this function represents another service function.

Input variables:	Output variables:
Enable Counter (Max. 6 digital) Input Variables Counter Reset	Count

Special features:

- When the counter function is entered in the function list, the number of "input variables" must be given. This can be changed later via "CHANGE FUNCTION." Both sensor inputs and other functions or output can be considered functions involved.
- In MODE *OP.HRS.COUNT,* the counter runs if **at least** one function involved is switched on. Only whole minutes are counted.
- In MODE *PULSE COUNT,* as long as the status of one variable is “ON” with multiple input variables, the pulses of the other input variables are ignored. In addition, a divider can be indicated. If this divider is set to, say, 2, only every second pulse at the input variables raises the counter by one. The counter can count pulses up to a maximum frequency of 1 Hz (=1 pulse per second). The minimum pulse duration across inputs 1 to 14 is 500 ms, across inputs 15 and 16, 50 ms.
- The count can be reset using input variables or the service menu.
- The output variable "count," which is not visible, can be taken over by other modules as an input variable.

Entire menu view:

```
DES: COUNTER
INPUT VARIABLE:
SERVICE MENU:

MODE: OP.HRS.COUNT

Operating Time:
    324 Hrs   18 Min

COUNTER Prev.Day:
      4 Hrs   37 Min
```

WARNING: Although the counter of the function module Counter is recorded every 6 hours in internal memory, it is lost when loading new function data (load factory settings, load backup copy, data transfer from Bootloader)! Therefore for this reason, should a power failure occur, up to 6 hours counter data can be lost.

Maintenance

This function is intended as a service function for the chimney sweeper and/or as a simple burner switch for the exhaust measurement. The preset output (generally 100%) is switched on for the set time after the burner has been started. In addition, the heating circuits set in the input variables are activated **with the maximum admissible flow temperature T.FlowMAX**. The value of the output variable T.flow.NOM of this heating circuit is set to 5°C during the active maintenance function.

These targets could also be reached via the manual mode (switch corresponding outputs to MANUAL/ON). Assuming that the user does not have a manual for the controller or that the person does not have enough time to read the entire manual, this function should make things easier.
Use the input variable "EXTERNAL SWITCH" to activate the maintenance function via a specially installed switch or via a switch output of another function without any inputs at the controller being activated. An "External switch" must be set to "ON" for the duration of the maintenance function (no runtime limit). The function must be deactivated again via this switch.

Input variables:	**Output variables:**
External Switch **Functions Involved** = Indication of the heating circuits	Status Burner Requirement, indication of the output Burner Performance, indication of the RPM control output

Entire menu view:

```
FUNCTION START
--------------------
DES:   CH.SWEEP
Status:      OFF
Run Time:      0 Min

INPUT VARIABLE:
OUTPUT VARIABLE:

Tot.Runtime:  20 Min
Burner Perf.:   100%
```

Press the scroll wheel to activate the burner and the heating circuits => number `FUNCTION STOP`

The function is deactivated (stopped)
Remaining burner runtime

Automatic burner runtime after function start
Desired burner performance during service time

The function block provides the burner performance as an output variable. It can be assigned to a speed output or the analog output. For instance, the burner performance can be controlled (assuming you have the appropriate burner technology) via analog output 15 or 16 (analog output 0 - 10V).
The output of the burner performance is dominant in the maintenance function. In other words, no other analog signal is allowed during maintenance (such as from warm water requirement). However, digital signals can overwrite the analog value at any time.
Once the burner requirement has been switched off (function stopped), the heating circuits involved still remain active for three minutes to take the residual heat from the boiler. If the mixer behaviour is detected as "close" in the heating circuit, then the mixer is set to "closed" for 20 minutes (= maximum remaining run time) and the heating circuit pump is switched off. Only then does the heating circuit return to the set operating mode.

Function control

In the solar and heating section, a number of functions perform important tasks that could lead to wrong reactions if there's a malfunction. For instance, if a defective tank sensor in the solar system detects temperatures that are too low, the solar system will run under false premises and take heat out of the tank. The module FUNCTION CONTROL can be used to monitor various operating modes and will issue an error message if there's a malfunction or block the inoperable function via its enable.

Input variables:	Output variables:
Control Value a Control Value b Enable Differential control	Status Error Value, indication of the output Status Error Difference, indication of the output

Simple description of the function:
This function allows for two sensors (control value a, b) to be monitored in order to detect a short-circuit, an interruption and the maximum admissible temperature difference. Likewise, it is possible to monitor a sensor or temperature via a defined threshold value.

Special features:

- If there is interruption or short-circuit that affects the basic function of the module, an error message is issued only after 30 seconds.
- In addition, a temperature threshold or difference can be monitored using "ENABLE DIFF.CTRL." If this control has been enabled, then the following applies:
  - If sensors are assigned to both control values, the monitoring of the differences is active.
  - If control value b is set to *User*, it is an adjustable temperature threshold that applies for the control value a as a limit value to be monitored.
- If the monitoring of the difference is not enabled, the message DIFFERENCE OK appears in the error display nevertheless. It generally suffices to monitor the circulation of just one circuit in solar warm water systems with multiple consumers (via enable). If another circuit is running, the message of monitoring should still be displayed.
- If only one sensor is monitored (control value b = *User*) or if the difference is monitored, a malfunction is only messaged after an error time that can be set. This helps to prevent unjustified error messages caused by temperature peaks when the system is starting.
- The parameters are found in their own parameter menu to provide an overview of the error evaluation at all times.
- Via the command " Save error: yes," the display **ERROR** remains until it is manually deleted even after the error has disappeared.

Warning:
Sometimes it makes sense to link one of the output variables directly to the control output to create a 0 to 10 V or PWM signal. Linking this function is only allowed using control output A15, not with output A16.

Function control

Entire menu view:

(No error)

```
DES: FUNC CTRL
INPUT VARIABLE:
OUTPUT VARIABLE:
PARAMETER:

T.Collector    OK
57.4  °C
T.ST.Lower     OK
48.9  °C
DIFFERENCE     OK
 8.5  K

Store Error:    yes

Delete Error Displ?
```

(With error)

```
BEZ.: KONTR.SOL1
INPUT VARIABLE:
OUTPUT VARIABLE:
PARAMETER:

T.Collector    ERROR
9999  °C  Interruption
T.ST.Lower     OK
48.9  °C
DIFFERENCE     ERROR
9999  K   Too High

Store Error:    yes

Delete Error Displ?
```

The parameter menu contains the following if monitoring a difference:

```
Error if on
at least       30 Min
CVa - CVb  >    50  K
```

Error minimum time setting
Difference threshold setting

Or if value a is being monitored, for example:

```
Error if on
at least       30 Min
CVa        >    30°C
```

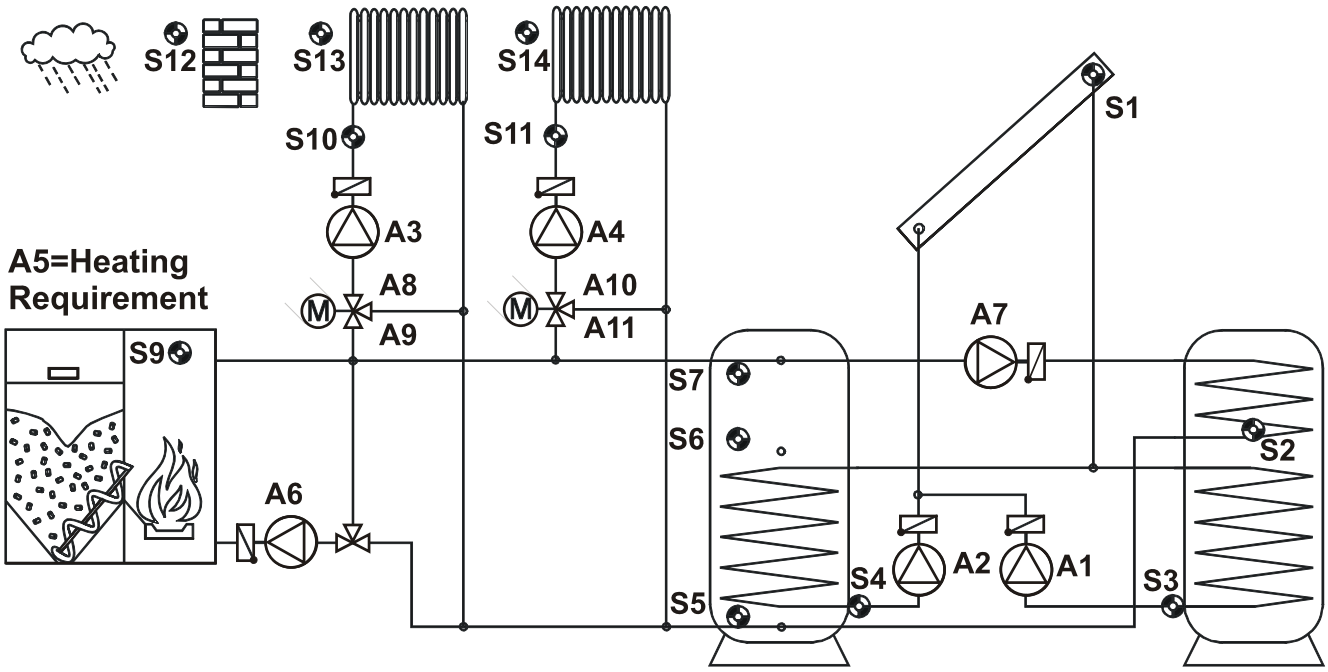
Error minimum time setting
Error threshold setting

Troubleshooting:

"Store Error: yes" **ERROR** remains displayed even after the remedy has been provided until the user presses the scroll wheel to confirm "Delete error display?" If the error continues after deletion, the message will be reissued after a certain delay.
"Store Error: no" **ERROR** is automatically deleted once the error has disappeared.
If an output has been assigned in the output variables, it responds the same as the display.
The status lines of the function control should also be entered in the function overview using the user interface editor. In this way, users will always have the information they need in their menu.

Typical hydraulics as factory setting

The TA factory setting can be loaded by simultaneously pressing the two input keys and scroll wheel when starting up the controller. The factory settings are based on the following hydraulic diagram for solar warm water system with a buffer and service water tank, a boiler fired with wood pellets or oil/gas, and two heating circuits:



The assignments of sensors in outputs according to the diagram are based on the special properties of the various inputs and outputs. The following sensors are not used:
S8: input for all sensor types or control voltage 0-10V or current 4-20 mA.
S15, 16: input for all sensor types including volume flow encoder (pulse input)
They are thus available for other functions, such as the heat quantity counter.
Outputs with speed control properties were assigned to the solar and load pumps to ensure that any PID function blocks can be switched.

The diagram above has the following desired functions:

A **SOLAR CONTROL** from S1 > S3 ⇨ A1 and another one from S1 > S4 ⇨ A2
SOLAR PRIORITY, with S1 > S3 ⇨ A1 having priority over S1 > S4 ⇨ A2
TWO **HEATING CIRCUIT CONTROLS** with S10, S12, S13 ⇨ A3, A8, A9 and S11, S12, S14 ⇨ A4, A10, A11, and the two flow nominal temperatures ⇨ **ANALOG MODULE**
Requirement warm water with S2 ⇨ **ANALOG MODULE**
REQUIREMENT HEATING based on a greater flow nominal temperature in both heating circuits and the effective nominal temperature of the **REQUIREMENT WARM WATER** compared to the tank temperature of S7 ⇨ A5
Three **LOAD PUMPS** with S9, S5 ⇨ A6 and S9, S2 ⇨ A7 and S7, S2 ⇨ A7 - an additional service water load is thus possible from the buffer and the boiler.

Factory setting

The "**REQUIREMENT HEATING**" shows that the ◆ **ANALOG FUNCTION** (MAX = look for the highest temperature in the input variables) is required to determine the greater flow nominal temperature of the two heating circuits and the effective nominal warm water temperature.
The two heating circuit pumps A3 and A4 should not be released unless the temperature in the boiler or the buffer is high enough. Therefore, a ◆ **COMPARATIVE FUNCTION** is needed at boiler sensor S9 and buffer sensor S7. They are designed as simple thermostat functions (= compare the sensor to an adjustable temperature). However, it is also possible to use the compare function of buffer sensor S7 to compare the sensor with the flow nominal temperature of the respective heating control unit via two separate comparison functions.
Only one input variable is available to enable the heating circuit pumps in the respective function. However, as the temperature in either the boiler **or** the buffer has to be high enough and this information is gathered from two functions (comparison), the information has to be gleaned via the ◆ **LOGIC FUNCTION** (output variable = input variable 1 or 2).

In other words, the following functions are added:

ANALOG FUNCTION (MAX) with two flow nominal temperatures and the effective nominal warm water temperature as an input variable and the result ⇨ heater requirement (nominal value for the temperature comparison)
Two **COMPARISON FUNCTIONS** with S7 and S9 ⇨ logic function
A **LOGIC FUNCTION (OR)** with the comparison functions and input variable and the result ⇨ heater regulator 1 and 2 (Enable pump). If S7 is divided up across two comparison functions as described in a comment above, separate logic functions are required for the two heating circuits.

If the system that is planned only deviates slightly from the one described here, the functions not needed should be deleted (such as only one heating circuit) or the functions should be changed (such as for a warm water system with a pump / valve system) or new functions added (such as an additional boiler fired by solid fuel).
If the differences are great, it makes most sense to delete all of the functions and then start a new function list with new parameters.

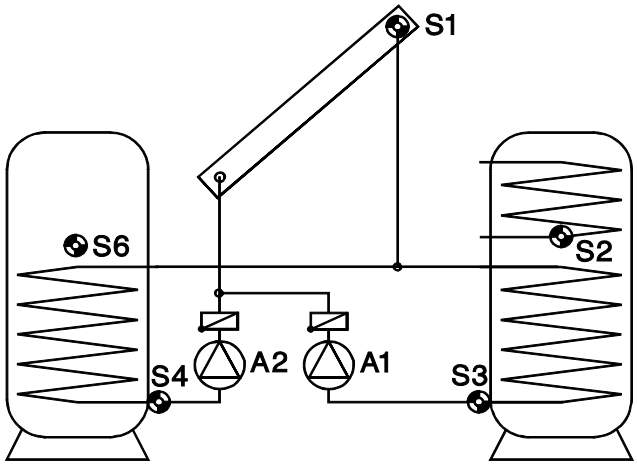
Factory settings via TAPPS

On the manufacturer's homepage (http://www.ta.co.at), the development tool TAPPS (technical alternative planning and programming system) is available under download link to program the controller using a PC and the Bootloader. Here, the data record of the factory settings described is available as a completely programmed example.

Detailed description of the factory setting

The solar part:

Function modules:
Solar thermal control / SOLAR 1
Solar thermal control / SOLAR 2
Solar priority / SOLPRIOR.



Solar thermal control / SOLAR 1

Input variables:	Output variables:
Enable Solar Circuit = User ON (constantly enabled) **Collector Temperature** = Source: Input 1: T.Collector **Reference Temperature** = Source: Input 3: T. Warm Water 2 Limit Temperature = Source: Input 2: T. Warm Water 1	Status Solar Circuit = Output 1

Simple description of the function:
Release of the solar pump A, if the temperature in the collector S1 is greater by a difference than the reference temperature S3, which is the temperature of the (outlet) of the tank. In addition, S2 must not have reached its upper limit yet.

Entire menu view:

DES: SOLAR1	
INPUT VARIABLE:	
OUTPUT VARIABLE:	
COLLECTOR TEMP.:	
T.Coll.ACT: 74.3 °C	Current collector temperature
T.Coll.MAX: 130 °C	Pump is blocked when T.Coll.MAX has been reached
Hysteresis: 10 K	Release at T.Coll.MAX minus hysteresis
REFERENCE TEMP.:	
T.Ref.ACT: 65.7 °C	Current tank temperature (bottom/return)
T.Ref.MAX: 70 °C	Tank limit
Hysteresis: 3.0 K	Release at T.Ref.MAX minus hysteresis

Factory setting

DIFFERENCE COLL-REF:	
DIFF.ON: 7.0 K	Switch-on differential T.Coll – T.Ref
DIFF.OFF: 4.0 K	Switch-off differential T.Coll – T.Ref
LIMIT TEMPERATURE:	
T.Lim.ACT: 54.0 °C	Current temperature of the additional sensor
T.Lim.MAX: 70 °C	Blocked by the additional sensor
Hysteresis: 3.0 K	Release at T.Lim.MAX minus hysteresis

Options / special features:

- The system comes to a standstill when the collector exceeds the temperature of 130°C to prevent damage from steam. This means that the heat medium is no longer circulated, so that T.Coll has an adjustable maximum limit (T.Coll.MAX) including hysteresis.
- If no additional limit sensor is used, it suffices to indicate *User* as the "source:" in the input variables.

The function **SOLAR 2** is not described as it has the same parameters except for the MAX values and only has different input and output variables (sensor and output assignment).

Solar priority / SOL PRIORITY

Input variables:	**Output variables:**
Enable Solar Priority = User ON (constantly enabled) Radiation = User / unused (no radiation sensor) **Functions Involved** = SOLAR 1 (first solar function) SOLAR 2 (second solar function)	Status Rinsing Process = Indication of the output A1 for the rinsing

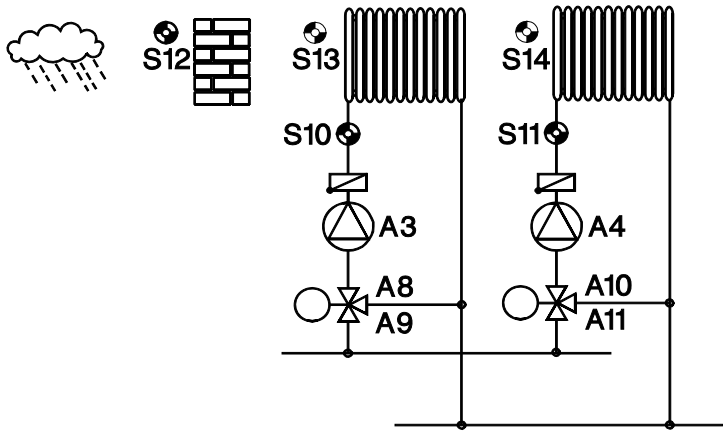
Entire menu view:

SOLAR1 1	Solar 1 has top priority
SOLAR2 2	Solar 2 has second priority
RANKING TIMER:	
From Pri Stage 1	
Run Time: 20 Min	Run-time for the consumer of next-lower priority until timer starts
Waiting: 5 Min	The collector must reach the temperature of the priority tank within five minutes; otherwise, the tank of lower priority will be charged

As described above in the basic description of functions for solar priorities, the priority function automatically affects the blockage and enable of the "Involved Functions" (SOLAR 1 and SOLAR 2) without assignment of other variables.

The heating control unit part:

Function modules:
Heating circuit control / HEAT.CIR. 1
Heating circuit control / HEAT.CIR. 2



Heating circuit control / HEAT.CIR. 1:

Input variables:	Output variables:
Enable Heating Circuit = User ON (constantly enabled) Enable Pump = Source: OR (from the logic function) Enable Mixer = User ON (constantly enabled) Room Temperature = Source: Input 13: T.Room1 Flow Temperature = Source: Input 10: T.Heat.Cir.P 1 Outdoor Temperature = Source: Input 12: T.Outdoor	Nominal Temp. of the Flow = Temperature of the pre-run calculated by the control unit T.FlowNOM Status Heating Circuit = Output A3 Status Mixer = Output A8 (open) and A9 (enclosed)

Simple description of the function:
Release of heating circuit pump A3 if there is a command from comparison function 1 **or** an appropriate boiler or buffer temperature via the logic function (OR). The mixer control is not affected by the room temperature and works with two time programs, each with three time windows. The heating circuit switches to lowering mode if the calculated flow temperature T.FlowNOM is less than MIN.

Entire basic menu overview:

`OPERATE: RAS` `NORMAL`	The heater is controlled by a room sensor currently running in heating mode (*NORMAL*)
`ROOM TEMPERATURE:`	
`T.Room.ACT: 20.7 °C`	Current temperature that the room sensor is measuring
`T.Room.LOWER: 16 °C`	Desired room temperature doing lowering time
`T.Room.NORMAL: 20 °C`	Desired room temperature doing heating time
`TIME PROG:`	Opens the Time menu (normal - lowering mode) with two programs, each with three windows

Factory setting

Rate time: 0 Min	Always at the beginning of the heating period according to time program
T.Room.EFF: 20°C	Current desired room temperature = 20°C (current heating operation)
FLOW TEMPERATURE:	
T.FlowACT: 58.4 °C	Current flow temperature
T.FlowNOM: 58.2 °C	Calculated flow temperature
HEAT CURVE:	Settings for the calculation of the flow temperature
OUTDOOR TEMPERATURE:	
T.Out.ACT: 13.6 °C	Current outdoor temperature
AVG.TIME:	Settings for calculation of outdoor temperature for the calculation of flow temperature and switch-off of the pump
SWITCH-OFF COND.:	Close switch-off of heating circuit pump and mixer if T.FlowNOM < T. FlowMIN
FROST PROTECTION:	Below an average outdoor temperature of 0°C, the room is kept at 5°C

HEAT CURVE:

The following in entries are found in this submenu:

HEAT.CIR.1	
MODE:	
CONTROL : Out.Temp	Control using the outdoor sensor
HEAT CURVE: Temp.	Heating curve via temperature points +10°C and -20°C
Room Infl.: 0%	Room temperature not taken into consideration for calculation of the flow
Increasing on Start 0%	The previous lowering time does not lead to an increase in the flow temperature, decreasing over time
T.Flow+10°C: 35 °C	Desired flow temp. at +10°C outdoor temp. (heating curve)
T.Flow-20°C: 60 °C	Desired flow temp. at -20°C outdoor temp. (heating curve)
T.FlowMAX: 65 °C	The flow must not exceed this limit
T.FlowMIN: 20 °C	The flow must not fall below this limit

AVERAGE outdoor temperature:

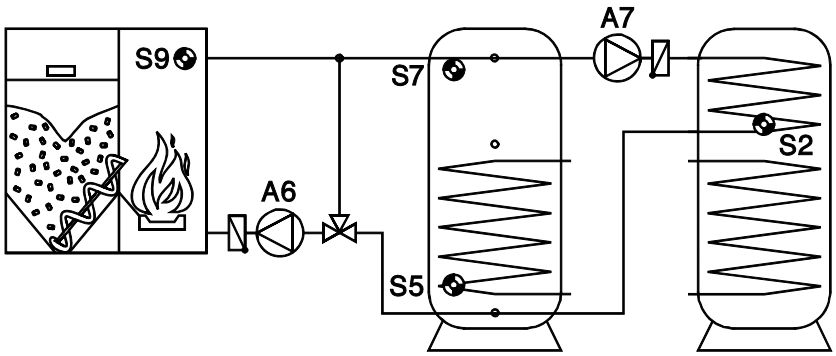
The outdoor temperature is averaged for the calculation of the heating curve for 10 minutes and for 30 minutes for the switch-off condition of the pump. The switch-off condition of the pump via the average outdoor temperature is, however, not activated. The heating circuit pump is only switched off: 1. via the input variable "Enable Pump" linked to the logic function OR or 2. if the flow temperature falls below T.FlowMIN.

Heating circuit control / HEAT.CIR. 2:

The function heating circuit 2 has the same values in all parameters as circuit 1 and only has different input and output variables (sensor and output assignment).

The load pump section:

Function modules:
Load pump / LD PUMP 1
Load pump / LD PUMP 2
Load pump / LD PUMP 3



Load pump / LD PUMP 2:

Input variables:	Output variables:
Enable Pump = User ON (constantly enabled) Feeder Temperature = Source: Input 7: T.ST.Upper Reference Temperature = Source: Input 2: T. Warm Water 1 Minimum T.Feed = Source: User (simple MIN threshold) Maximum T.Ref = Source: User (simple MAX threshold)	Status of the Load Pump = Output A7

Simple description of the function:
Release of load pump A7 if the temperature on the buffer S7 (feed temperature T.Feed) is higher than the minimum temperature and one differential higher than reference temperature T.Ref. = S2. In addition, T.Ref = S2 must not have reached its maximum limit yet.

Entire menu view:

FEEDER TEMPERATURE:	
T.Feed.ACT: 74.3 °C	Current temperature of buffer S7
T.Feed.MIN: 60 °C	Basic switch-on threshold at sensor T.Feed = S7
DIFF.ON: 5.0 K	Switch-on differential to T.Feed.MIN (here, 65°C)
DIFF.OFF: 1.0 K	Switch-off differential to T.Feed.MIN (here, 61°C)
REFERENCE TEMP.:	
T.Ref.ACT: 65.7 °C	Current tank temp. of S2
T.Ref.MAX: 90 °C	Tank limit at S2
DIFF.ON: 1.0 K	Switch-on differential to T.Ref.MAX (here, 91°C)
DIFF.OFF: 5.0 K	Switch-off differential to T.Ref.MAX (here, 95°C)
DIFFERENCE FEED-REF:	
DIFF.ON: 5.0 K	Switch-on difference FEED - REF = S7 - S2
DIFF.OFF: 2.0 K	Switch-off difference FEED - REF = S7 - S2

LD PUMP 3 also switches A7 but with the difference S9 to S2.
LD PUMP 1 switches A6 with the difference S9 to S5 with parameters similar to those described above. This module is prepared for the inclusion of a solid fuel-fired tank to charge the whole buffer volume (S5) if necessary.

The burner requirement warm water:

Function module:
Requirement WW / WW_REQ.

Input variables:	Output variables:
Enable Req WW = User ON (constantly enabled) **Warm Water Temp**. = Source: Input 2: T. Warm Water 1 Nominal Temp = Source: User (simple MAX threshold)	Effective Nominal Temp = Desired warm water temp. T.WW.EFF Status Requirement = No output assignment Burner Performance = No output assignment

Simple description of the function:
Output of effective nominal warm water temperature if the temperature in tank S2 (warm water temperature T.WW) drops below the specified nominal temperature T.WW.NOM within a time window or below the specified nominal temperature T.WW.MIN outside the time window. When the desired tank temperature is reached, the module outputs the effective nominal warm water temperature of 5°C. The analog module transfers the nominal temperature to the module requirement heating for a comparison to the buffer temperature and does not make a direct burner requirement.
Another method is direct triggering of burner output A5 and no transfer of the nominal warm water temperature to the analog module. It is assumed that if the buffer temperature is high enough the load pump function LD PUMP 2 will always refill the warm water tank fast enough to 60°C so that S2 only drops below 50°C if the buffer is cold and sends a burner requirement via this function.

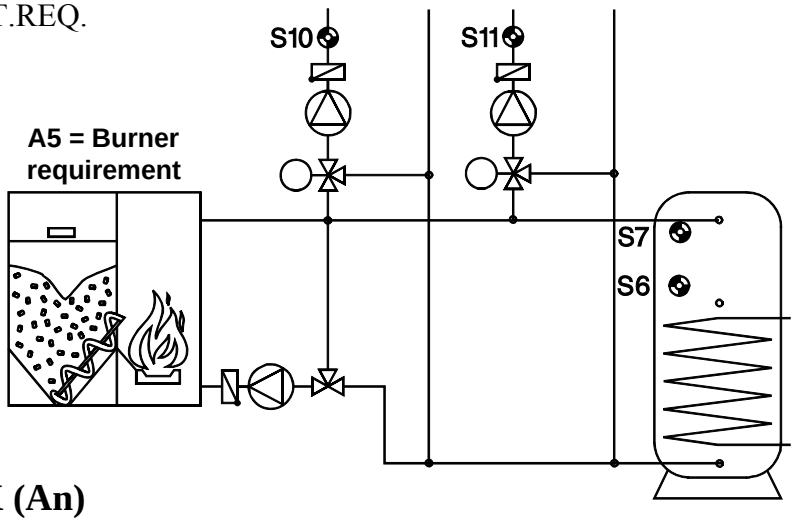
Entire menu view:

WARM WATER TEMP.:	
T.WW.ACT: 58.3 °C	Current temperature of the warm water tank
T.WW.NOM: 50 °C	Nominal temperature at S2 of the warm water tank
TIME PROG:	Opens the Time menu (see **Time programs**)
T.WW.MIN: 40 °C	Minimum temperature of the warm water tank
DIFF.ON: 2.0 K	Switch-on diff. to T.WW.NOM and T.WW.MIN (52°C; 42°C)
DIFF.OFF: 5.0 K	Switch-off diff. to T.WW.NOM and T.WW.MIN (55°C; 45°C)
Burner Perf.: 100 %	Specification for burner performance

The burner requirement heating:

Some modules such as: HEATING CIRCUIT CONTROL or REQUIREMENT WW provide the current demand temperature as an output variable. The boiler (burner) should only be running if the buffer cannot cover one of the demand temperatures.

Function modules:
Analog function / MAX (on)
Heating requirement / HEAT.REQ.



Analog functions/MAX (An)

Input variables:	Output variables:
Enable Analog Function = User ON (constantly enabled) Input Variable 1 = Source: HEAT.CIR.1 Flow nom. temp. Input Variable 2 = Source: HEAT.CIR.2 Flow nom. Temp. Input Variable 3 = Source: WW REQ Effective Nominal WW Temperature	This result does not have a direct assignment (= input variable of the requirement heating)

Entire menu view:

`FNCT.VAR: Temperat.`	All inputs are temperatures
`FUNCTION: MAX`	Output of the highest temperature of the inputs
`VAR. 1: 53.6 °C`	Nominal flow temperature of the function HEAT.CIR.1
`VAR. 2: 66.4 °C`	Nominal flow temperature of the function HEAT.CIR.2
`VAR. 3: 5.0 °C`	Effective temperature of the function WW REQ
`If ENABLE = Off 1 °C`	If the analog mode has not been released, module outputs 1°C (user issues release)
`RESULT: 66.4 °C`	The module HEAT.REQ takes over this result for a comparison to the upper buffer temperature

The analog function therefore uses the command MAX to provide the greater calculated temperature and input variable for the function "requirement heating."

Factory setting

Requirement heating/HEAT.REQ.

Input variables:	Output variables:
Enable Requirement Heating = User ON (constantly enabled) **Requirement Temperature** = Source: Input 7: T.ST.Upper Switch-off temp = Source: Input 6: T.ST.Center Nominal Value Requirement = Source: MAX(An) from previous function Nominal Value Switch-off = Source: MAX(An) from previous function	Status Requirement = Output A5

Simple description of the function:
Release of burner A5 if the temperature in the top of buffer tank S7 (requirement temperature T.Req) falls below the higher flow nominal temperature of the two heating control units or the effective nominal WW temperature. Switch off if the temperature S6 in the middle of the tank (shut-off temperature T.Off) rises above the greater flow nominal temperature of the two heating control units or the effective nominal WW temperature.
The same sensor S7 could be used for the shut-off temperature. In addition, *User* can be indicated as the source of the input variable "nominal value switch-off". The requirement is then based on need (result from the analog module) and switches off when the buffer reaches a maximum temperature set by the user.

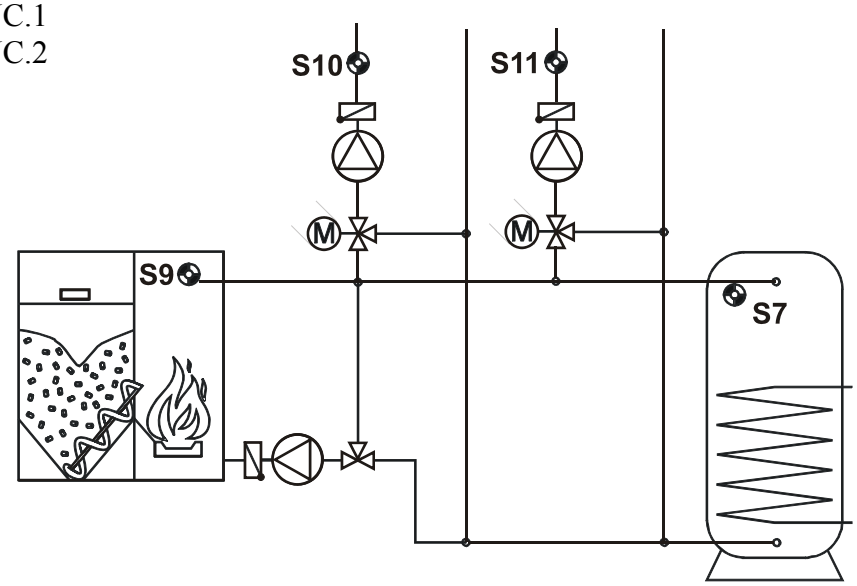
Entire menu view:

`REQ.TEMPERATURE:`	
`T.Req.ACT:  74.3 °C`	Current temperature of sensor S7
`T.Req.NOM:  61.4 °C`	The greater flow nominal temperature
`DIFF.ON:  1.0 K`	Switch-on differential to T.Req (here, 62.4°C)
`SHUT-OFF TEMP.:`	
`T.Off.ACT:  44.3 °C`	Current temperature of sensor S6
`T.Off.NOM:  61.4 °C`	The greater flow nominal temperature
`DIFF.OFF:  9.0 K`	Switch-on differential to `T.Off` (here, 70.4°C)
`Base Temperature:`	
`T.Req.MIN:  0 °C`	No minimum tank temperature
`Minimum Runtime`	
`Burner:  0 Sec`	

Release of the heating circuit pumps:

NOTICE:
The method described below with comparison and logic functions is intended to explain the technology of linked modules and releases. This is the main reason it is included in the factory settings. In many cases, the free decision made by the heating control units suffices without a release of the feed temperatures. Set *User* ON in "Enable pump" for the heating circuit control units.

Function blocks:
Comparison function / MIN FUNC.1
Comparison function / MIN FUNC.2
Logic function / OR



Comparison function / MIN FUNC.1:

Input variables:	Output variables:
Enable Comparison user ON (constantly enabled) **Comparative Value a** = Source: Input 9: T.Boiler Flow Comparative Value b = Source user	Status Va > Vb + diff = No direct assignment (= input variable of logic function OR**)**

Simple description of the function:
A simple minimal thermostat function on the boiler temperature S9 (comparison S9 = VALUE a with an adjustable threshold = VALUE b) releases via the logic function OR the heating circuit pumps.

Entire menu view:

FNCT.VAR: Temperat.	Comparison of two temperatures
VALUEa: 39.1 °C	Current temperature at boiler flow S9
VALUEb: 60 °C	Minimum temperature at boiler flow S9
DIFF.ON: 5.0 K	Pump enabled if boiler flow S9 rises above 65°C
DIFF.OFF: 2.0 K	Pump blockage if boiler flow S9 falls below 62°C

Factory setting

Comparison function / MIN FUNC.2:

Input variables:	Output variables:
Enable Comparison user ON (constantly enabled) **Comparative Value a =** Source: Input 7: T.ST.Upper Comparative Value b = Source user	Status Va > Vb + diff = No direct assignment (= input variable of logic function OR**)**

Simple description of the function:
A simple minimal thermostat function on the top buffer temperature S7 (comparison S7 = VALUE a with an adjustable threshold = VALUE b) releases via the logic function OR the heating circuit pumps.

Entire menu view:

FNCT.VAR: Temperat.	Comparison of two temperatures
VALUEa: 74.3°C	Current temperature at top of buffer S7
VALUEb: 30°C	Minimum temperature at top of buffer S7
DIFF.ON: 5.0 K	Pump release if S7 (top of buffer) rises above 35°C
DIFF.OFF: 2.0 K	Pump blockage if S7 (top of buffer) falls below 32°C

Logic function / OR:

Input variables:	Output variables:
Enable Logic Function = User ON (constantly enabled) Input Variable 1 = Source: MIN FUNC.1 1: Va > Vb + diff Input Variable 2 = Source: MIN FUNC.2 1: Va > Vb + diff	The result does not have a direct assignment (= input variable of the heating circuit pump enable for the two heating circuit control units)

Entire menu view:

FUNCTION: OR	(Output = Input Variable 1 / ON **or** Input Variable 2 / ON)

The heating circuit pumps are therefore released when either the boiler temperature S9 exceeds 65°C or sensor S7 at the top of the buffer exceeds 35°C. The input variable "Enable pump" of the two heating control units contains the entry: source: OR
This entry merely allows you to release. Each heating control unit then decides separately whether it makes sense to have a pump running.

Installation instructions

Sensor installation

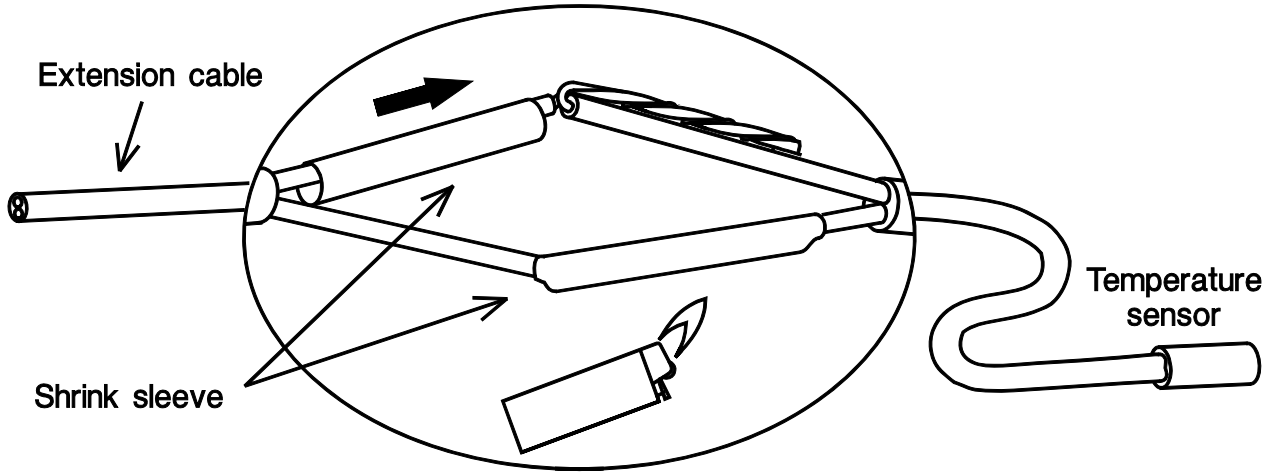
The sensors must be arranged and installed properly for the system to function correctly. To this end, make sure also that they are completely inserted in the immersion sleeves. The threaded cable connections provided serve as a strain relief. The clip-on sensors must be insulated to protect them from being influenced by the ambient temperature. Water must be kept out of the immersion sleeves when used outdoors (**damage from freezing**).
In general, the sensors may not be exposed to moisture (such as condensation water), which might enter the cast resin and damage the sensor. If this happens, heating the sensor to 90°C for an hour might help. When using immersion sleeves in NIRO tanks (inoxydable) or pools, pay attention to their **non-corrosion properties**.

- **Collector sensor (red or grey cable with connection box)**: Insert either in the tube directly soldered or riveted to the absorber and sticking out of the collector's frame or set a t-shaped connector on the outer collector's flow collector tube. Screw an immersion sleeve with an MS (brass) threaded cable connection (= to protect from moisture) into the t-shaped connector and insert the sensor. To protect from lightening, the connection box has an overvoltage protection which is fixed in a parallel way between the sensor and the expansion cable.
- **Boiler sensor (boiler flow):** This sensor is either screwed into the boiler using an immersion sleeve or at a short distance from the boiler on the flow.
- **Tank sensor**: The sensor that the solar power system needs should be used with an immersion sleeve for fin coil heat exchangers just above the exchanger or, if integrated bare-tube heat exchangers are used, on the lower third of the exchanger or the exchanger's return line so that the immersion sleeve is inside the exchanger's tube. The sensor that monitors the heating of the tank from the boiler is installed at the level of the desired amount of warm water during the heating season. The plastic threaded cable connections provided can be used to provide strain relief. It should not be installed below the respective register or heat exchanger in any case.
- **Buffer sensor**: The sensor that the solar power system needs is installed on the bottom of the tank just below the solar heat exchanger using the immersion sleeve provided. The plastic threaded cable connections provided can be used to provide strain relief. It is recommended that the sensor between the middle and the upper third of the buffer tank be used together with the immersion sleeve as a reference sensor for the heater's hydraulics or - flush with the tank's wall – inserted under the insulation.
- **Pool sensor (swimming pool):** Put a T-shaped connector on the suction line immediately on the line leading from the pool and screw the sensor in with an immersion sleeve. In the process, make sure that the material used is non-corroding. Another option is to put the sensor on the same spot using hose clamps or adhesive tape and to provide thermal insulation for ambient influences.
- **Clip-on sensor**: Use pipe clamps, hose clamps, and the like must be attached to the respective line. Make sure the material used is adequate (corrosion, temperature resistance, etc.). Then, the sensor has to be well insulated so that the tube temperature is measured exactly and the ambient temperature does not influence the measurement.

Installation instructions

- **Warm water sensor**: When the control system is used in warm water systems with an external heat exchanger and speed-controlled pump, changes in the amount of water have to be **reacted to quickly**. Hence, the warm water sensor has to be put directly on the heat exchanger's outlet. A t-shaped connector should be used to insert the ultrafast sensor (special accessory) in the outlet using an o-ring. The heat exchanger has to be installed upright with the warm water outlet on top.
- **Radiation sensor:** To get a measurement according to the collector's position, it should be parallel to the collector. It should thus be screwed onto the metal sheet or next to the collector along an expansion of the assembly rail. To this end, the sensor case has a blind hole that can be opened at any time.
- **Room sensor:** This sensor is intended for installation in the living room (as a reference room). The room sensor should not be installed near a source of heat or near a window.
- **Outdoor temperature sensor:** This sensor is installed on the coldest wall side (usually the north) some two meters above ground. Avoid temperature influences from nearby air shafts, open windows, etc.

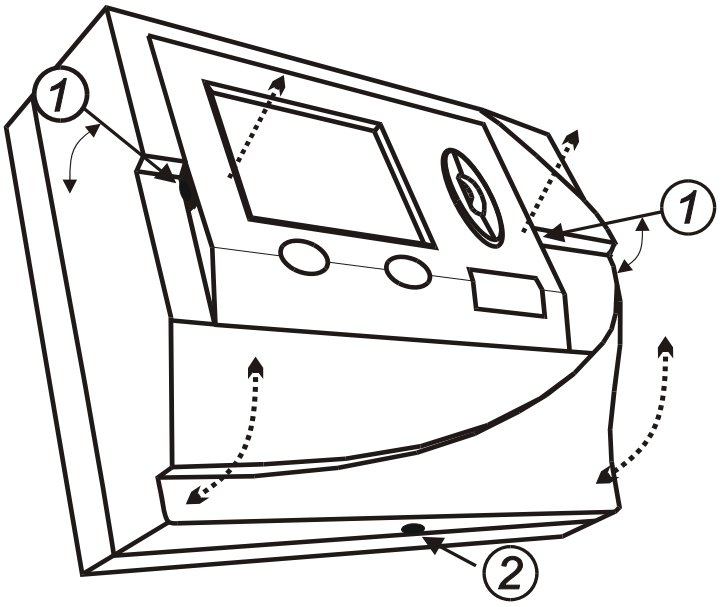
Line expansion:
All of the sensor cables with a cross-section of 0.75mm^2 can be extended up to 30m. Beyond 30m they can be extended by use of a suitably larger cross section. The sensor and the probe can be connected by putting the heat-shrinkable sleeve truncated to 4 cm over a wire and twisting the bare ends. Then the heat-shrinkable sleeve is put over the bare, twisted ends and carefully heated (such as with a lighter) until it has wrapped the connection tightly.



Cable laying:
In order to prevent measurement fluctuations, the sensor cables must not be subject to external influences to ensure fault-free signal transmission.
When using non-screened cables, sensor cables and 230V-network cables must be laid either in separate cable channels or at a minimum distance of 20 cm.

Installing the device

WARNING! ALWAYS PULL THE MAINS PLUG BEFORE OPENING THE CASING!

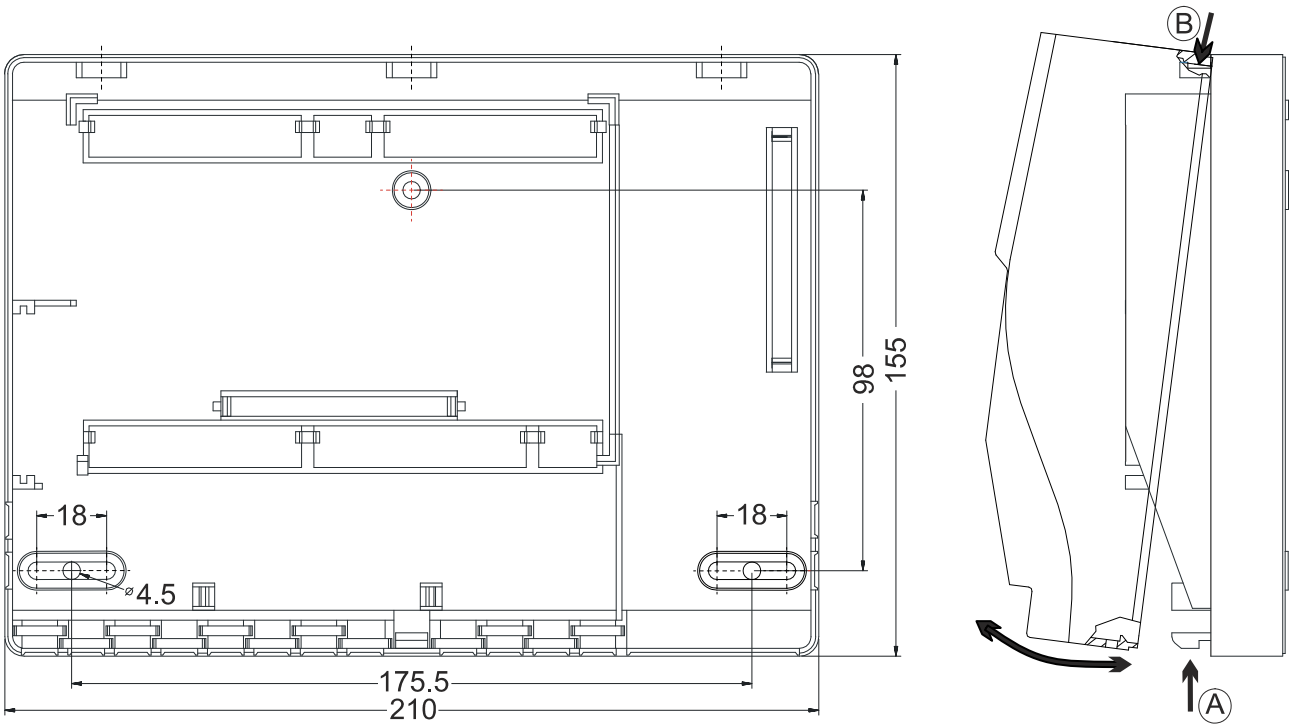


To open the console the control unit has to be separated from it as follows:

Use two big screwdrivers to remove the clamps (labeled 1 in the sketch to the left) and list the device out of the console with the screwdrivers.
Once the control device has been removed, unlock the clip by pushing with a small screwdriver (point 2 sketch left), flip the lid up and to the back, and remove it.

Attach the console at eye-level (approximately 1.6 meters high) to the wall using the installation material provided so that the cable outputs are at the bottom. The console has a separate lead for each power supply cable. The very fine separation bridges sometimes break when the openings are popped out. As each power cable will later have its own strain relief, this is not a problem.

Drawing:



Control cabinet version UVR1611S:
The opening in the cabinet must have a size of at least 138x91 mm; the insertion depth is 70 mm including the power strips.

Cables and network topology

Shielded twisted pairs have proven useful in CANopen networks. This cable has a twisted pair of wires shielded together. This cable is relatively resistant to electromagnetic compatibility malfunctions and can still carry 50 kbit/s for up to 1000 m. The CANopen recommendations (CiA DR 303-1) for cable cross sections are given in the table below.

Bus length [m]	Resistance in terms of length [mΩ/m]	Cross-section [mm²]
0-40	70	0.25-0.34
40-300	< 60	0.34-0.60
300-600	< 40	0.50-0.60
600-1000	< 26	0.75-0.80

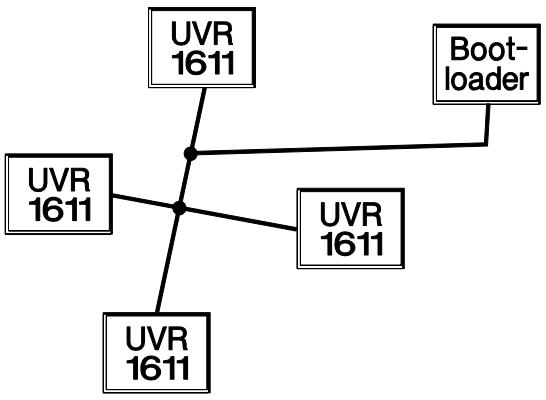
The maximum line length also depends on the number of node [n] linked with the bus cable and the cable cross-section [mm²].

Cable cross-section [mm²]	Maximum length [m]	
	n=32	n=63
0.25	200	170
0.50	360	310
0.75	550	470

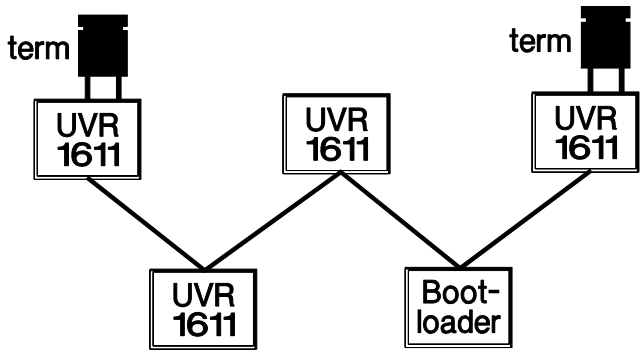
Recommendation:
A 2x2-pin shielded twisted-pair (twisting CAN-L with CAN-H resp. +12V with GND) with a cable cross-section of at least 0.5mm² and a line to line capacity of no more than 60 pF/meter and a characteristic impedance of 120 ohms. The bus speed of the UVR1611 is 50 kbit/s. Theoretically, the bus could be 500 m long and still ensure reliable transmission. **The Unitronic®-Bus CAN 2x2x0.5** cable is recommended**.**

Wiring
A CAN bus should never have a star topology. Rather, the correct topology is a string from the first device (with terminal) to the second and so forth. The final bus connection has the terminal bridge.

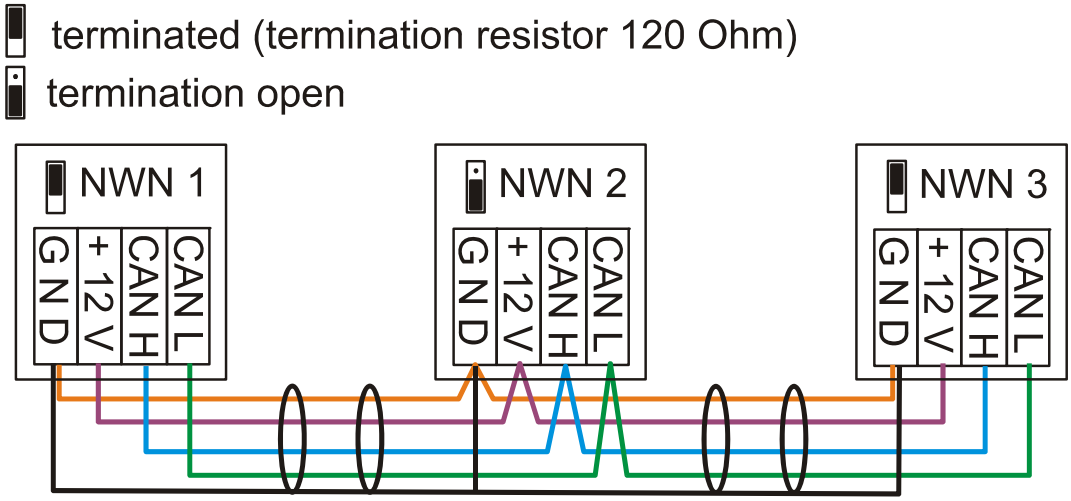
INCORRECT



CORRECT



Example: Connection of three network nodes (NWN) with a 2x2-pin cable and termination of the end of the network nodes.



Each CAN network has to have a 120 ohm bus terminal (done using a jumper) for the first and last participant in the network. A CAN network therefore always has two termination resistors on each end. Stub cables and a star topology are not admissible in accordance with the official specifications.

As you can see from the tables, reliable transmission depends on a number of factors (cable type, cross-section, length, number of nodes, etc.). All of this information can be considered relatively conservative so that no problem should occur if you are prudent when dimensioning.

Experiments ex works have shown that

1) A star topology only reaching out a few dozen meters does not detrimentally affect transmission.
2) Up to a bus length of 150 m with only a few nodes, the **CAT 5 24AWG** (typically used as an answer that cable in PC networks) can also be used. It can best be used without further reduce any normal indoor installation.
3) A star topology with only one central node and a few participants with 100 m stub cables also works well if no end resistance is used at all. To do so, a separate resistance of 60 ohms has to be connected in the middle of the star between CAN-H and CAN-L.

However, such networks do not by any means fulfill the recommended specifications and should be tested before the network is put into operation with cables 50% longer just to be on the safe side!

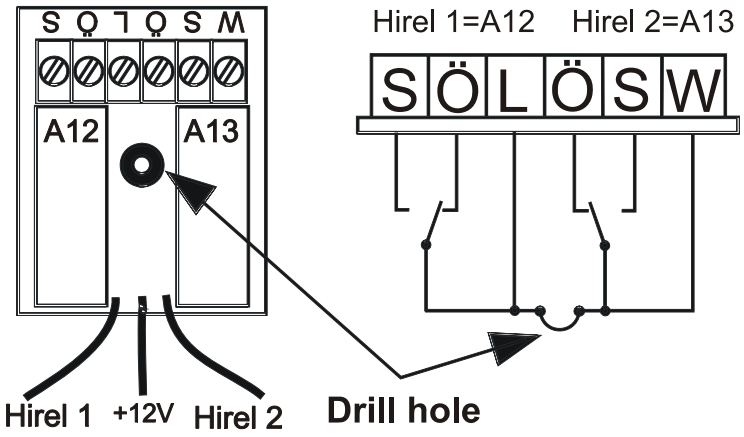
Electrical connection

It should only be made by a professional electrician in accordance with the relevant local guidelines. The sensor lines must not be laid in the same cable as the supply voltage (standard, regulations). In a commonly used cable channel, appropriate shielding has to be provided.

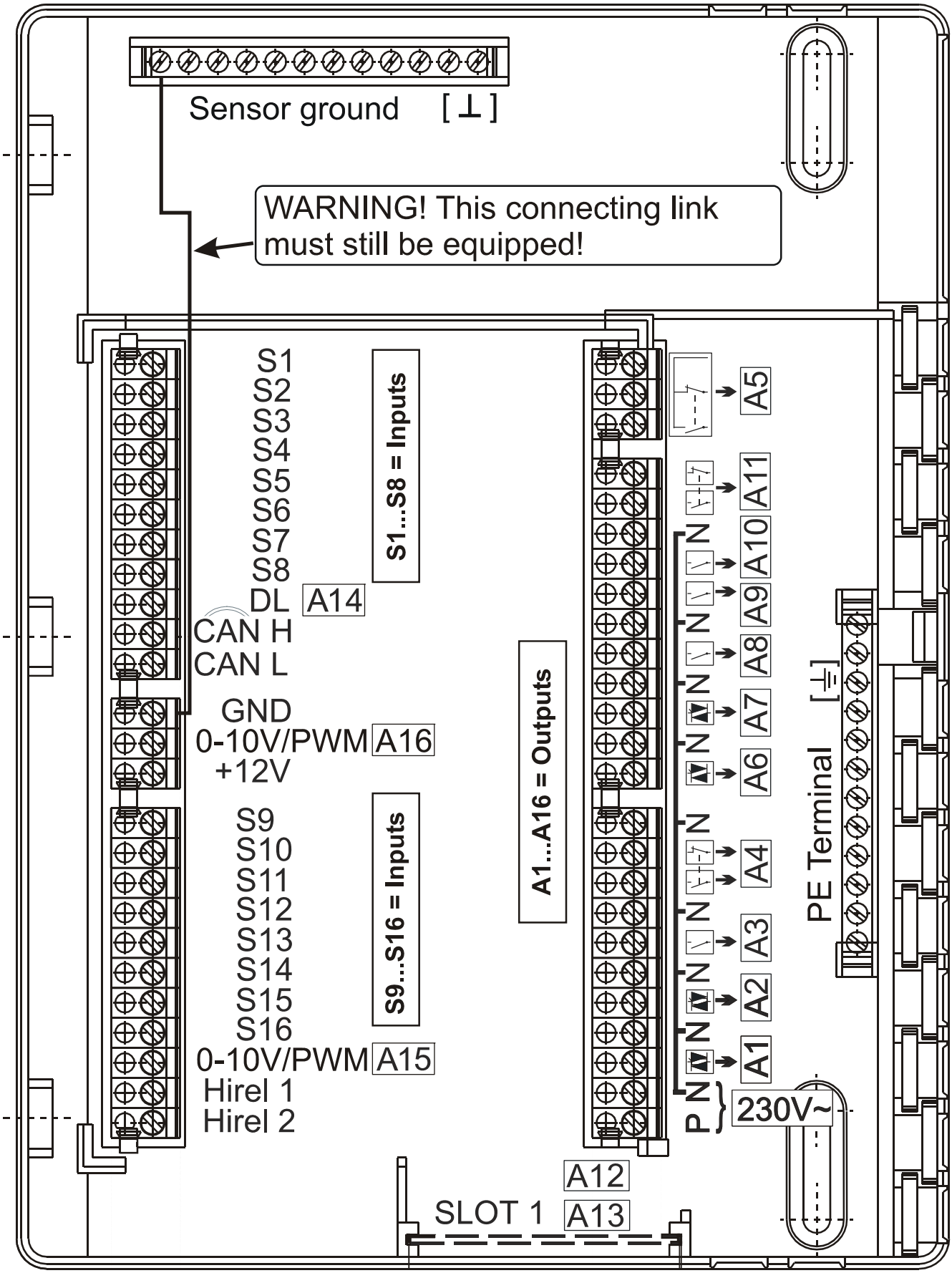
Notice: The system has to be grounded properly to protect it from damage due to lightening. Sensor failures due to storms and static electricity are usually the result of improper grounding.
Cable channels for power and sensor lines may cause a disturbance in the sensor lines if they lie too close to each other over long stretches. If no fast signals (such as ultrafast sensors) are transmitted, these disturbances can be filtered out by averaging the sensor inputs. However a minimum distance of 20 cm between the two cable ducts or the use of shielded sensor cabling is recommended.

Caution: Only work inside the console with the power cable disconnected. If you assemble the device with the power connected, the device may be damaged.
All sensors and pumps/valves must be connected as they are numbered in the design selected. For grade power, cross sections of 1 - 1.5² fine-strand are recommended except for the feed line. A strip terminal above the inlets is available for the protective conductors. During assembly, this strip terminal can also be removed to make it easier. All cables can be fixed with a clamp (= strain relief) immediately after being connected. A side cutter is needed to remove the clamps; therefore, more parts than necessary are provided. Once all of the power connections have been made (without the protective conductor), the protective conductor terminal is inserted, and the remaining ground wires are connected.
There is only one connection to ground for all of the sensors on the protective low voltage side. There is thus a mass terminal at the top right of the console, which must be connected before the sensors are clamped.
A cross-section of 0.75² is sufficient for the sensor lines. One pole for these lines is put through the cable channel the right side of the console and the bridge for the particular terminal, while the second pole is connected to the ground line at the top right.

The device has two clamps (HiRel 1 and 2) for an additional relay module. These clamps can be used with +12 V from the HiRel1611 for expansion outputs A12 and A13 (at “slot 1”). The relay contacts are floating, and both roots are connected ex works. Widen the hole between the two relays to at least 6 mm in diameter to separate the potential for both outputs in accordance with industry standards.



S.... Make contact NO (German “Schliesser”)
O.... Break contact NC (Opener) (German “Öffner”)
L..... Root contact for both outputs without widen hole / only for A12 with widen hole
W..... Root contact for both outputs without widen hole / only for A13 with widen hole



Caution: Output A5 is potential free – thus not connected with the supply voltage.
Slot 1 is intended for the relay module for two other outputs (A12, 13).

Technical data UVR1611

All sensor inputs	For temperature sensors of type KTY (2 kΩ/25°C), PT1000 and room sensors RAS or RASPT, radiation sensors, voltages up to 5V DC, as well as digital input
Sensor input 8	Additional for current loop (4 -20 mA), voltage (0-10 V DC) or resistance (0-12.50kΩ)
Sensor input 15, 16	Additional pulse input, such as for volume flow encoder
Output 1	Speed-adjustable for conventional circulating pumps and ventilators.
Output 2,6,7	Rpm adjustable for all conventional circulator pumps
Output 3,4,8-11	Relay outputs, partially with opener and closer
Output 5	Change-over contact relay – potential free
Outputs 12.13	Accommodation for later expansions by a double auxiliary relay module
Output 14	Data link (DL bus) to capture suitable sensors and log data (in special cases configurable with 12V relay as switch output)
Max. bus load (DL bus)	100 %
Outputs 15,16	Analogue outputs 0-10V/20mA or PWM (10V/2kHz)
CAN- Bus	Data 50 kb/sec., power supply for external units 12V= / 100mA
Differential tempera-tures	Equipped with separate switch-on/off differential
Threshold values	Partially set up with an adjustable hysteresis or as an alternative with separate switch-on/off threshold
Speed control	30 speed stages constitute a quantity change of max. 10 Regulation by absolute value, difference and absolute value to event
Temperature display	-50 until +199°C with a dissolution of 0.1K
Accuracy	Typ. 0.4 and max. +-1K for the range of 0 - 100°C
Max. breaking capacity	**A1: 230V/0,7A**, A2,6.7: each 230V/1A relay outputs max. each 230/ 3A
Connection	230V, 50- 60Hz, (outputs and units are fused along with 6.3A quick-acting)
Supply cable	3x 1mm² H05VV-F conforming to EN 60730-1 (corresponding cable with safety plug contained in the basic package)
Power draw	Max. 4 W (without accessory equipment)
Protection:	IP40
Permissible ambient temperature:	+5 to +45°C

Quantity delivered

UVR1611K: The UVR1611, console including all terminals, while attachment material, 2 ground terminals, 16 strain reliefs, operating instructions

UVR1611S: Device with rear panel shaped as bushings, 2 ground terminals, 2 3-pin and 4 11-pin plug-in terminal screws, operating instructions.

Accessories

TAPPS (Technische Alternative planning and programming system):
Software to make programming the UVR1611 easy on a PC (graphic interface via function modules). The software is available at our homepage http://www.ta.co.at as a free download. The Bootloader is required to transfer the data from the PC to the controller.

Hirel 1611:
Expansion of the universal controller to include two potential-free outputs (A12, A13).
Order designation: 01/HIREL1611

CAN I/O module 44 and CAN I/O 35:
Expansion of the universal control by three relay outputs, one analogue output (0-10V) and four inputs (CAN I/O 44) or three relay outputs, two analogue outputs and three inputs (CAN-I/O 35).
Order designation: 01/ CAN-I/O 44 and 01/CAN-I/O 35

CAN Monitor:
UVR1611 units for room sensor, display, and operation.
Same operating concept as the control, communication via CAN bus.
More than one CAN Monitor can access a controller just as one CAN monitor can access several controllers in the network.
Order designation: 01/CAN-MT

Bootloader BL-NET:
To back up data, update operating systems, and log data
1) Back up all of the function data for the UVR1611 on a PC and second backup.
2) Update of the UVR1611's operating system
3) Data logging of temperatures and output conditions via DL and CAN bus
4) Ethernet interface for direct access to CAN bus subscribers via a browser
5) Optional GSM module for messages and commands via SMS
Order designation: 01/BL-NET

D-LOGG:
Data logs of temperatures and output statuses
Unlike the BL-NET, this device can only log data via no more than 2 data links; the transfer of function data and updates of operating systems are not possible.
Order designation: 01/D-LOGG

Simulation board:
In combination with a UVR1611K for programming and simulations (every input can be simulated from -10°C to +125°C, and digital simulation is also possible for input 15 and 16).
Order designation: 01/SIM-BOARD1611

Development set:
Development environment with control, Bootloader, simulation board, and data cables for PC and CAN bus. To program and test new function data.
Order designation: 01/ENTW

CAN bus converter:
Two CAN bus interfaces, optionally available in optical waveguide model
EIB or KNX interface; M bus interface.
Order name: 01/CAN-BC/C, 01/CAN-BC/E or 01/CAN-BC/L

The manuals for the products are available for download at our homepage: http://www.ta.co.at.

Tips on troubleshooting

If there is **no display**, there has been a power outage. First check the fuse (6.3A, quick-blow) that protects the device and the outputs (pumps, valves, etc.) from short circuits and the outputs in connection with the integrated overvoltage protection. The glass tube fuse is located on the rear side of the controller behind a screw cap.

Realistic temperature values but outputs not operating properly indicate false settings or connections. If it is possible to switch the outputs on and off in the manual mode, the device is in order, and all of the settings and the terminal should be checked.

- Do endurance runs and standstills lead to the same reaction at the output? In other words, does this pump really run if the solar pump is activated manually, or does the heating circuit pump go into operation instead of the solar pump?
- Are all of the sensors connected with the right terminal (heat up the sensor using a cigarette lighter and check the temperature display)?

If you still cannot find any error in the system, install a data logger (Bootloader or D-LOGG) in the system and record the temperature curve and switching statuses. Output 14 has to be switched to data line for this purpose.

Improper temperatures can have the following causes:

- If a value such as -999 is displayed when a sensor short-circuits or 9999 if there is a sensor interruption, the cause may not be a material or terminal error. Is the proper sensor type selected in the entry menu (KTY, PT1000, SPS, GBS, etc.)?
- The sensor can also be checked without a measuring device simply by changing the sensor that is probably defective with one that works at the strip terminal and checking the temperature display. If the error is reproduced, the problem is probably the sensor. However, if the problem remains on the same input of the device, the error is either due to the settings for sensor type, or the input itself is defective (such as defective overvoltage protection).

The following values should be found if the sensors are checked with an ohmmeter.

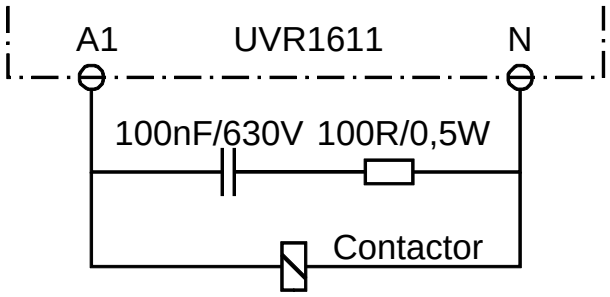
Temp. [°C]	0	10	20	25	30	40	50	60	70	80	90	100
R(KTY)[Ω]	1630	1772	1922	2000	2080	2245	2417	2597	2785	2980	3182	3392
R(PT1000) [Ω]	1000	1039	1078	1097	1117	1155	1194	1232	1271	1309	1347	1385

If the sensor is defective, pay attention to the type of sensor you exchange it with. While it is possible to use a different type of sensor, the parameters for that input also have to be set to the type used.

Not possible to manually switch an output:

- If the output has speed control (A1, A2, A6 or A7) and is actually set to speed control, pay attention to the speed stage when using manual mode. Set to stage 30 when testing the pump's basic function.
- **Electronic pumps** cannot be operated speed-controlled due to their internal structure. Connection to one of the A1, A2, A6 or A7 outputs as switch output is, however, possible.
- If a valve or contactor is to be triggered using a speed-controlled output (also along with a pump), the parameters for this output have to be set as a switch output because the speed control cannot work on such a consumer!

- Speed-controlled outputs may not be able to switch **small loads** reliably (< 5 W, such as valves, contactor, etc.). This is especially true for output A1 with its integrated power line filter, which can only be operated with a minimum load ≥ 20 W. If the speed-controlled outputs (A2, A6, A7) **only** control small loads, an additional parallel load or the subsequent RC component is necessary to make switching reliable.



- Make sure that outputs 5, 12, and 13, are potential-free and do not have power. It is thus only possible to directly switch a 230V consumer when the proper wiring has been made.
- If it is not possible to switch an output on or off in manual mode because the cursor could not be positioned next to the proper parameter, there are the following two options:
  - A message is currently active and switches the relative output dominant ON or OFF (display of message in the function overview). In this case, manual mode is not possible.
  - An expert has set the setting User interlock (outputs) to yes. By this, only experts can manually operate the outputs.

Troubleshooting - hardware

If the cause of the error is clearly defective hardware, please send the equipment to your retailer or manufacturer for repairs. Please do not forget to describe the error when sending back the device (simply saying "the device does not work, please repair" is insufficient). Only then can the control system be repaired quickly and inexpensively.

Troubleshooting - programming

The manufacturer can help you find a remedy if the proper documentation and data are provided. The following are indispensable:

- A hydraulic diagram by fax (best option) or e-mail (WMF, JPG, ENG)
- Complete programming by means of TAPPS files (*projectname*.ENG and *projectname*.PAR) or, at least, the function data by e-mail
- Operating system version for the control system
- All existing LOG files or at least the (temperature) values of the inputs at the time the system malfunctioned
- A telephone call to describe the problem - a written description of the error does not suffice, and the manufacturer cannot accept it.

TECHNISCHE ALTERNATIVE
ELEKTRONISCHE STEUERUNGSGERÄTEGESELLSCHAFT M. B. H.
A-3872 Amaliendorf, Langestraße 124

EC- DECLARATION OF CONFORMITY

Document- Nr.: / Date	TA10006 / 24.06.2010	
Company / Manufacturer:	Technische Alternative elektronische SteuerungsgerätegesmbH.	
Address:	A- 3872 Amaliendorf, Langestraße 124	
Product:	UVR 1611K, UVR1611S, UVR1611E-NM, UVR1611E-NP	
The stated above product complies with the following essential requirements:		
EU requirements:	*2006/95/EG*	*Low voltage standard*
	2004/108/EG	*Electromagnetic compatibility*

Employed standards:

EN 60730-1:2009 08 01	Automatic electrical controls for household and similar use - Part 1: General requirements
EN 61000-6-3:2007 11 01	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
EN 61000-6-2:2006 05 01	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
Position of CE - label:	On packaging, manual and type label

CE

Issuer: Technische Alternative
elektronische SteuerungsgerätegesmbH.
A- 3872 Amaliendorf, Langestraße 124

This declaration is submitted by:

Kurt Bidlo

General management

This declaration certifies the agreement with the named standards, contains however no warranty of characteristics.
The security advices of included product documents are to be considered.

Guarantee conditions

Note: The following guarantee conditions do not in any way limit the legal right to a guarantee, rather expand your rights as a consumer.

1. The company Technische Alternative elektronische Steuerungsgerätegesellschaft m. b. H. provides a two-year guarantee from the date of purchase by the end consumer for all the devices and parts which it sells. Defects must be reported immediately upon detection and within the guarantee period. Technical support knows the correct solution for nearly all problems. In this respect, contacting us immediately will help to avoid unnecessary expense or effort in troubleshooting.

2. The guarantee includes the free of charge repair (but not the cost of on site fault-finding, removal, refitting and shipping) of operational and material defects which impair operation. In the event that a repair is not, for reasons of cost, worthwhile according to the assessment of Technische Alternative, the goods will be replaced.

3. Not included is damage resulting from the effects of overvoltage or abnormal ambient conditions. Likewise, no guarantee liability can be accepted if the device defect is due to: transport damage for which we are not responsible, incorrect installation and assembly, incorrect use, non-observance of operating and installation instructions or incorrect maintenance.

4. The guarantee claim will expire if repairs or actions are carried out by persons who are not authorised to do so or have not been so authorised by us or if our devices are operated with spare, supplementary or accessory parts which are not considered to be original parts.

5. The defective parts must be sent to our factory with an enclosed copy of the proof of purchase and a precise description of the defect. Processing is accelerated if an RMA number is applied for via our home page www.ta.co.at. A prior clarification of the defect with our technical support is necessary.

6. Services provided under guarantee result neither in an extension of the guarantee period nor in a resetting of the guarantee period. The guarantee period for fitted parts ends with the guarantee period of the whole device.

7. Extended or other claims, especially those for compensation for damage other than to the device itself are, insofar as a liability is not legally required, excluded.

TECHNISCHE ALTERNATIVE
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