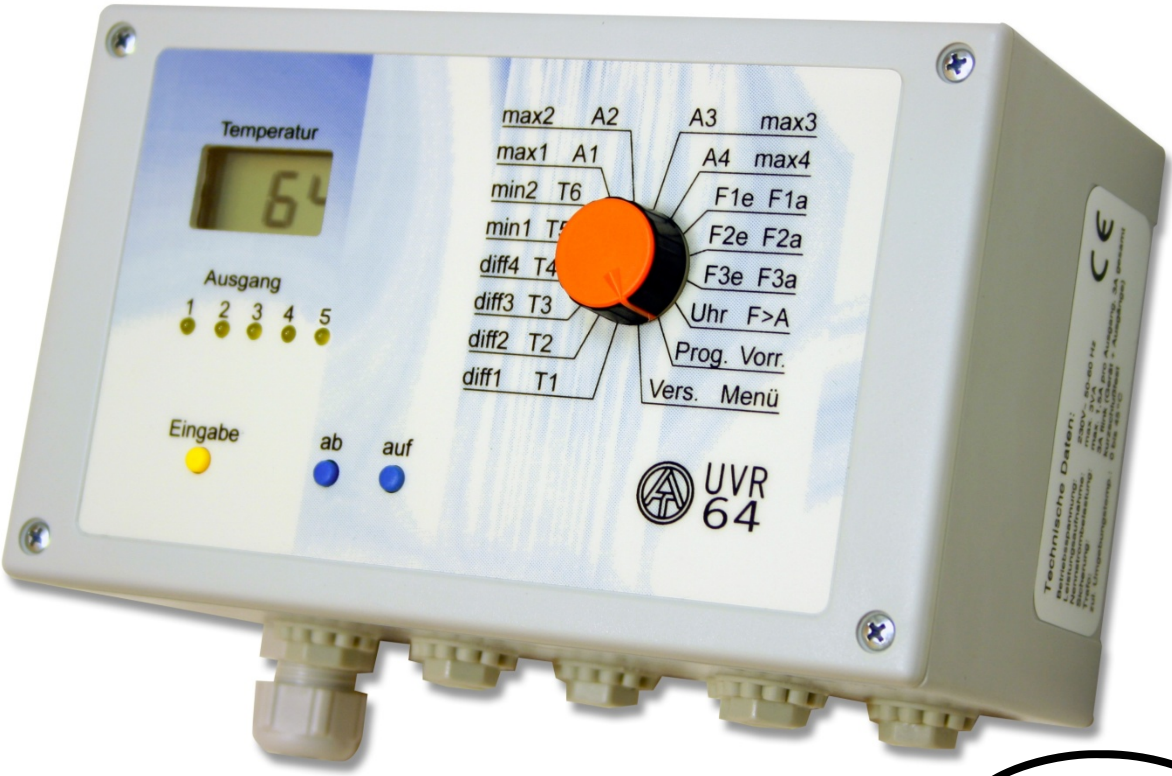
UVR 64

Version P5.3 EN

Manual Version 2

Four - Circuit Universal Controller



en

Operation

Installation instructions

TECHNISCHE ALTERNATIVE

Informations

The hydraulic diagrams of this manual are only diagrams in principle. They do not describe or replace a professional system development. There is no guarantee for function if directly copied.

The settings of the **menu functions ex works** can be restored at any time using the yellow key ("Eingabe" = entry) when plugging the unit in.

The settings of **all the parameters and menu functions ex works** can be restored at any time using both blue keys ("ab/auf" = up/down) when plugging the unit in.

Table of 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. Do not use cleansers and/or solvents such as trichlorethene.

As none of the components relevant to accuracy are under loads when used properly, they have a long service life without much drift. The unit thus does not have any adjustment options. No adjustments are needed.

The design characteristics of the unit must not be changed during repairs. Spare parts must correspond to the original spare parts and be as good as new.

Generally applicable rules for the proper use of this unit:

- When used for floor and wall heaters: here, a safety thermostat must be used just as with conventional heater controllers. It has to switch off the heating loop pump if there is overheating regardless of the output from the controller to prevent indirect damage from excess temperatures.
- It is necessary to set all „***Required settings***“ mentioned in the hydraulic diagrams.
- Relay output A4 can be made potential-free by resetting the jumpers.
- All programs +1 (+2, +4, +8)" indicates that the selected program number can be increased by the sum total of these numbers.

  Example: Diagram 0, program 1 = pump-valve system

  All programs +2: program also includes the boiler temperature T5

  1+2 = 3 ⇨pump-valve system including the boiler temperature T5
- **Linking of outputs**: Possibility to cancel out the numbered outputs listed in the program diagram against each other (e.g. A1 with A2, A1 with A3 or A2 with A3, etc.). By this means it is possible to assign the speed output at will. Addition of following numbers to the selected program number:

Linking of outputs	A1 with A3 ..... +100	A1 with A4 ..... +200
	A2 with A3 ..... +300	A2 with A4 ..... +400
	A1 with A3 & A2 with A4 ..... +500	A3 with A4 ..... +600

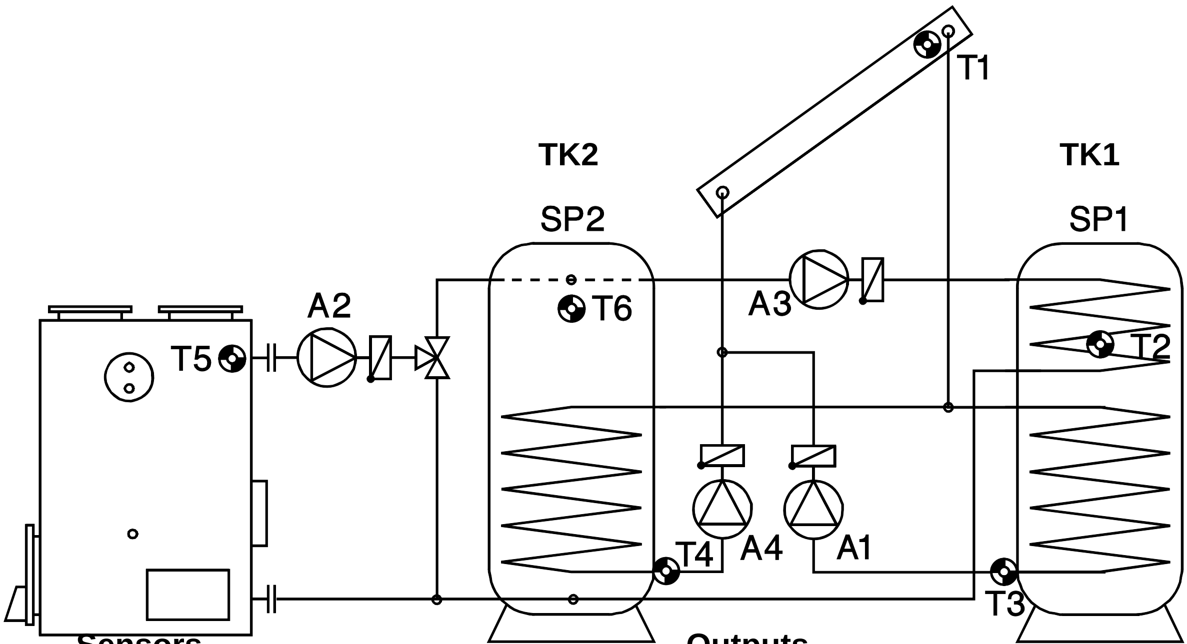
Program selection

The following hydraulic diagrams are basic functions. Changes resp. additional functions are described and defined by program numbers. The program number is the most important key to correct function of the control system. Only by input of this number the controller knows, which controlling business has to be done.

The program number is selected in the switch position ***Prog*** by the blue keys ***ab/auf (=down/up)***.

Hydraulic diagrams

Diagram 0: Solar power system with 2 consumers and 2 feed pumps



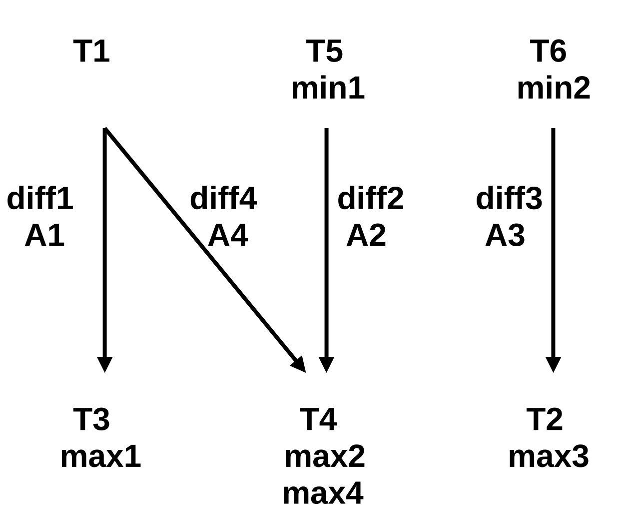
Sensors

T1…. Collector
T2…. Tank 1 top
T3…. Tank 1 bottom
T4…. Tank 2 bottom
T5…. Boiler
T6…. Tank 2 top

Outputs

A1…. Solar pump circuit 1
A2…. Feed pump tank 2
A3…. Feed pump tank 1
A4…. Solar pump circuit 2

Program 0: Function according to diagram



Required settings:

diff1 … coll. T1 – TK1 T3 ⇨ **A1**
diff2 … boiler T5 – TK2 T4 ⇨ **A2**
diff3 … TK2 T6 – TK1 T2 ⇨ **A3**
diff4 … coll. T1 – TK2 T4 ⇨ **A4**
min1 … switch-on temp. boiler T5 ⇨ **A2**
min2 … switch-on temp. TK2 T6 ⇨ **A3**
max1 … limit TK1 T3 ⇨ **A1**
max2 … limit TK 2 T4 ⇨ **A2**
max3 … limit TK 1 T2 ⇨ **A3**
max4 … limit TK 2 T4 ⇨ **A4**

Additional: Priority ***Vorr***:
(typical: A11, A20, A30, A42)

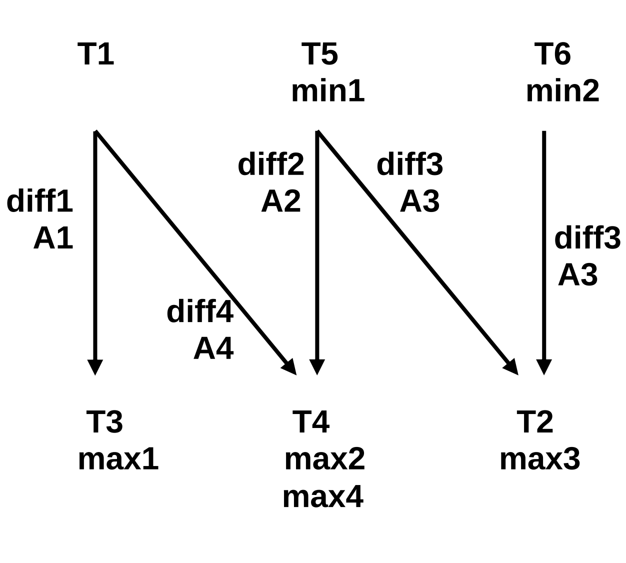
A1 = T1 > (T3 + diff1) & T3 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T2 + diff3) & T6 > min2 & T2 < max3
A4 = T1 > (T4 + diff4) & T4 < max4

Diagram 0

Program 1: Instead of the two solar pumps, one pump and a three-way valve are used (pump-valve system). The speed control (if activated) only operated when filling tank 1. Without a priority allocation, tank 2 is filled by priority.

A1... common pump
A4... Valve (A4/S receives power when filling tank)

All programs +2: In program 0 the feed of tank **TK1** by pump **A3** is only controlled by difference **TK2 T6 – TK1 T2**. This program also includes the boiler temperature. When feeding tank **TK1** by pump **A3** the difference boiler **T5 – TK1 T2** will be considered additionally (same setting ***diff3***). Both ***min*** thresholds are active.



Required settings:

diff1	…coll. T1 – TK1 T3	⇨	**A1**
diff2	…boiler T5 – TK2 T4	⇨	**A2**
diff3	…boiler T5 – TK1 T2	⇨	**A3**
	TK2 T6 – TK1 T2	⇨	**A3**
diff4	…Coll. T1 – TK2 T4	⇨	**A4**
min1	…switch-on temp. boiler T5	⇨	**A2,3**
min2	…switch-on temp. TK2 T6	⇨	**A3**
max1	…limit TK1 T3	⇨	**A1**
max2	…limit TK2 T4	⇨	**A2**
max3	…limit TK1 T2	⇨	**A3**
max4	…limit TK2 T4	⇨	**A4**

Additional: Priority ***Vorr***:
(typical: A11, A20, A30, A42)

A1 = T1 > (T3 + diff1) & T3 < max1
A2 = T5 > (T4 + diff2) & T4 < max2 & T5 > min1
A3 = T6 > (T2 + diff3) & T2 < max3 & T6 > min2
or T5 > (T2 + diff3) & T2 < max3 & T5 > min1
A4 = T1 > (T4 + diff4) & T4 < max4

All programs +4: If both tanks have reached their maximum temperature due to the solar power system, solar pump **A1** and feed pump **A3** are switched on (**reverse cooling function**). ***A3 ... or T3 > max1 & T6 < T3***

All programs +8: If both tanks have reached their maximum temperature due to the solar power system, solar pump **A4** and feed pump **A2** are switched on (**reverse cooling function**). ***A2 ... or T4 > max2 & T5 < T4***

Note: If a solar pump is switched off manually, the controller works during **reverse cooling** as the tank limit would be reached.

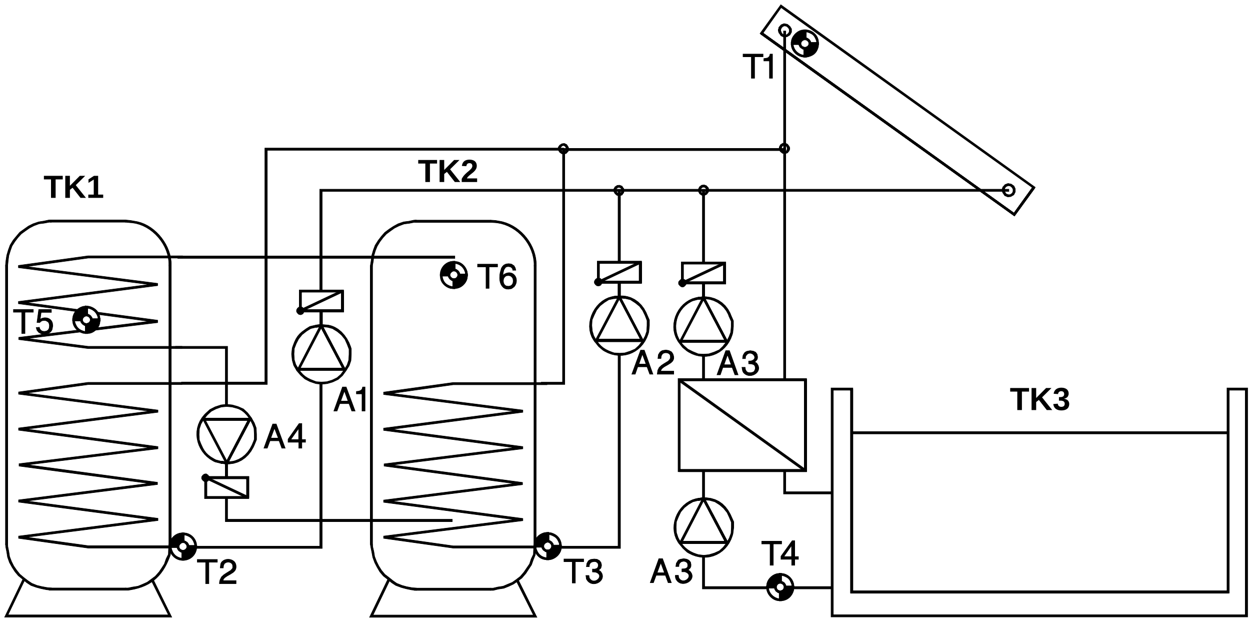
Program 12: The output **A2** becomes available, if the feed function of tank **TK2** is done by the boiler controller. In this program **A2** only switches with the thermostat function ***max2*** at **T5** (e.g. burner requirement)

Program 13: Function like program 12, but with pump–valve system at the solar sector (see program 1)

Program 14: Similar to Program 12. The burner requirement **A2** switches on at ***min1*** on **T5**. Switch off appears when **T2** has exceeded the threshold ***max2***.

Program 15: Function like Program 14, but with pump–valve system in the solar system.

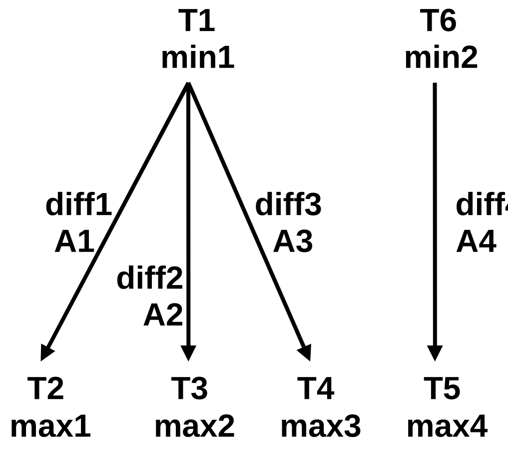
Diagram 16: Solar power system with 3 consumers and feed pump function.



Sensors
T1…. Collector
T2…. Tank 1 bottom
T3…. Tank 2 bottom
T4…. Tank 3 (pool)
T5…. Tank 1 top
T6…. Tank 2 bottom

Outputs
A1…. Solar pump tank TK1
A2…. Solar pump buffer TK2
A3…. Solar pump pool TK3
A4…. Feed pump

Program 16: Function according to diagram



Required settings:
diff1 …coll. T1 – TK1 T2 ⇨ **A1**
diff2 …coll. T1 – TK2 T3 ⇨ **A2**
diff3 …coll. T1 – TK3 T4 ⇨ **A3**
diff4 …TK2 T6 – TK1 T5 ⇨ **A4**
min1 switch-on temp. coll. T1 ⇨ **A1**,**A2**,**A3**
min2 …switch-on temp. TK2 T6 ⇨ **A4**
max1 …limit TK1 T2 ⇨ **A1**
max2 …limit TK2 T3 ⇨ **A2**
max3 …limit TK3 T4 ⇨ **A3**
max4 …limit TK1 T5 ⇨ **A4**
Additional: Priority ***Vorr***:
(typical: A11, A22, A33, A40)

A1 = T1 > (T2 + diff1) & T1 > min1 & T2 < max1
A2 = T1 > (T3 + diff2) & T1 > min1 & T3 < max2
A3 = T1 > (T4 + diff3) & T1 > min1 & T4 < max3
A4 = T6 > (T5 + diff4) & T6 > min2 & T5 < max4

Diagram 16

Program 17: Pump-valve system between **TK1** und **TK2**. **TK1** and **TK2** are fed by a common pump **A1** and a three-way valve **A2**. The speed control (if activated) only operated when filling tank 1.

A1... common pump

A2... valve (A2/S receives power when filling tank **TK2**)

Program 18: Pump-valve system between **TK1** und **TK3**.

A1... common pump

A3... valve (A3/S receives power when filling tank **TK3**)

Program 19: A common pump feeds all **three** tanks. Valve **A3** switches between **TK2** and **TK3** and – in series – valve **A2** between **TK1** and **TK2**. I.e. if both valves are free from tension, **TK1** will be fed. The speed control (if activated) only operated when filling tank 1.

A1... common pump

A2... valve (A2/S receives power when filling tank **TK2**)

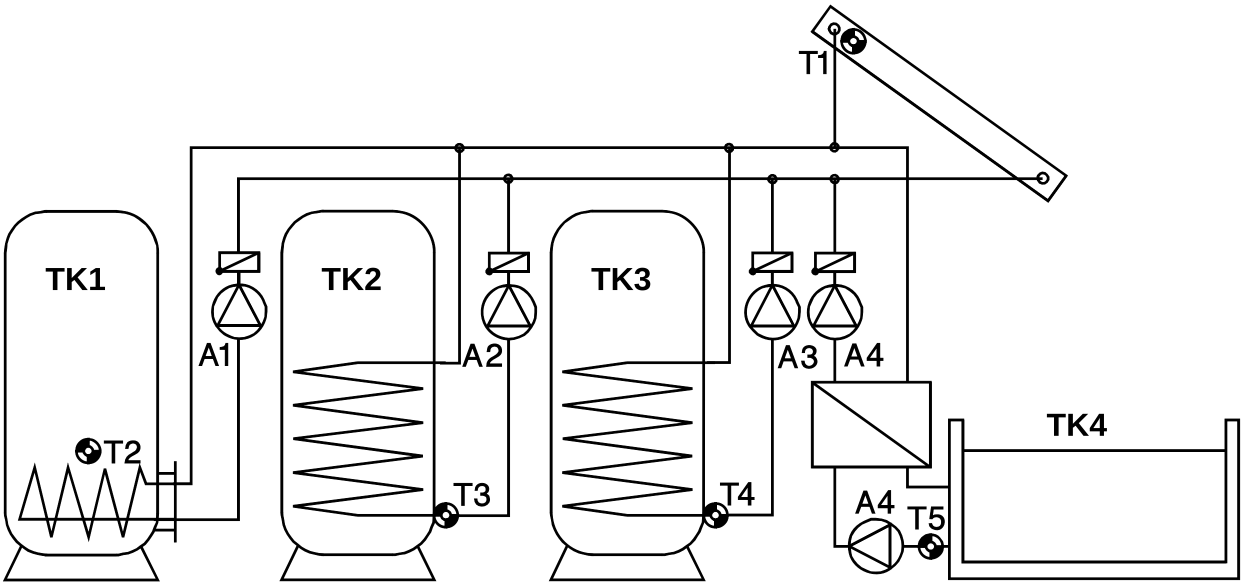
A3... valve (A3/S receives power when filling tank **TK3**)

If there is an active priority allocation, the two valves **A2** and **A3** are never switched on simultaneously: when filling into tank 2, only pump **A1** and valve **A2** are switched on, when filling into tank 3, only pump **A1** and valve **A3** are switched on.

All programs +4: A4 is only a signal contact which shows, that all tanks have reached their ***max***-thresholds.

All programs +8: If all tanks have reached their maximum temperature due to the solar power system, tank **TK2** will be fed regardless of ***max2***.

Diagram 32: Solar power system with 4 consumers



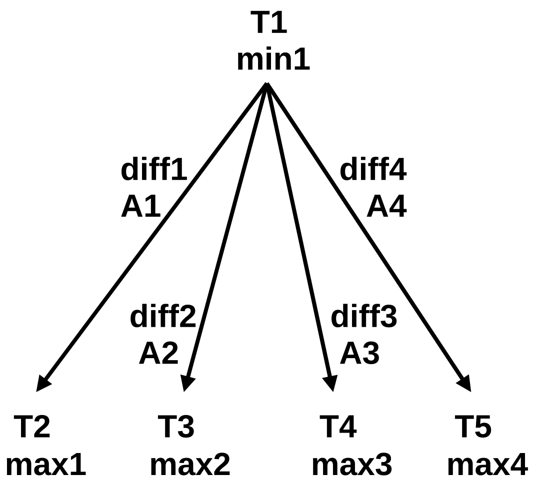
Sensors

T1…. Collector
T2…. Tank 1 (TK1)
T3…. Tank 2 (TK2)
T4…. Tank 3 (TK3)
T5…. Tank 4 (pool TK4)
T6…. Freely usable

Outputs

A1…. Solar pump TK1
A2…. Solar pump buffer TK2
A3…. Solar pump buffer TK3
A4…. Solar pump pool TK4

Program 32: Function according to diagram



Required settings:

diff1 …coll. T1 – TK1 T2 ⇨ **A1**
diff2 …coll. T1 – TK 2 T3 ⇨ **A2**
diff3 …coll. T1 – TK 3 T4 ⇨ **A3**
diff4 …coll. T1 – TK 4 T5 ⇨ **A4**
min1 …switch-on temp. coll. T1 ⇨ **A1**, **A2**, **A3**, **A4**
max1 …limit TK 1 T2 ⇨ **A1**
max2 …limit TK 2 T3 ⇨ **A2**
max3 …limit TK 3 T4 ⇨ **A3**
max4 …limit TK 4 T5 ⇨ **A4**
Additional: Priority ***Vorr***:
(typical: A11, A22, A33, A44)

A1 = T1 > (T2 + diff1) & T1 > min1 & T2 < max1
A2 = T1 > (T3 + diff2) & T1 > min1 & T3 < max2
A3 = T1 > (T4 + diff3) & T1 > min1 & T4 < max3
A4 = T1 > (T5 + diff4) & T1 > min1 & T5 < max4

Diagram 32

Program 33: Pump-valve system between **TK1** und **TK2**. **TK1** and **TK2** are fed by a common pump **A1** and a three-way valve **A2**. The speed control (if activated) only operated when filling tank 1.

A1... common pump

A2... valve (A2/S receives power when filling tank **TK2**)

All programs +2: Pump-valve system between **TK1** und **TK3**.

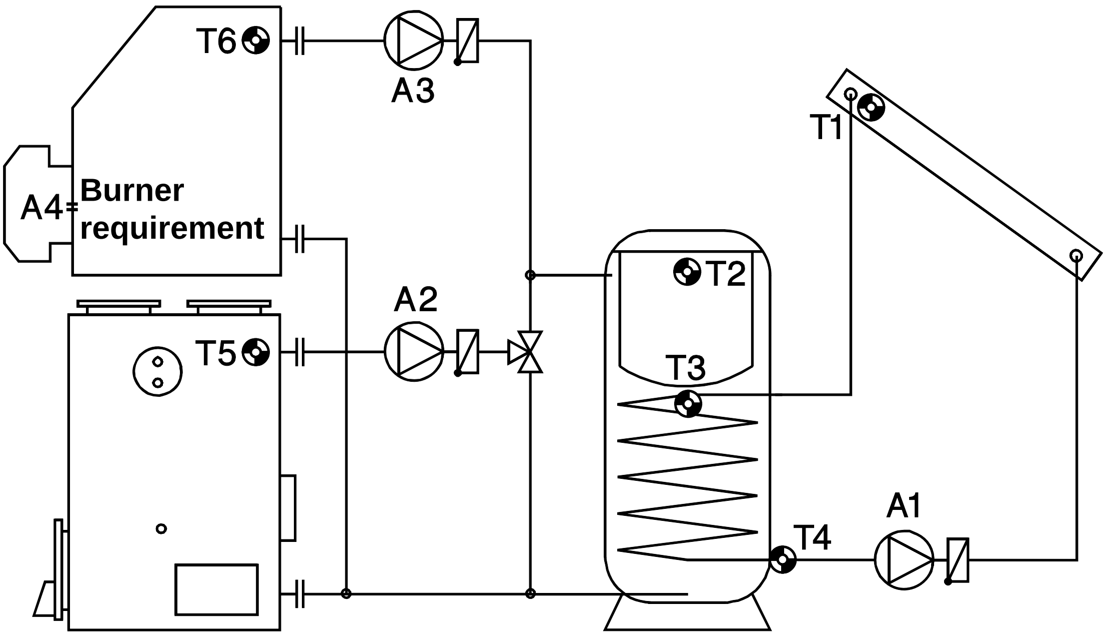
A1... common pump
A3... valve (A3/S receives power when filling tank **TK3**)

All programs +4: Pump-valve system between **TK1** und **TK4**.

A1... common pump
A4... valve (A4/S receives power when filling tank **TK4**)

All programs +8: If all tanks have reached their maximum temperature due to the solar power system, tank **TK2** will be fed regardless of ***max2***.

Diagram 48: Burner requirement, 2 feed pumps and simple solar power unit



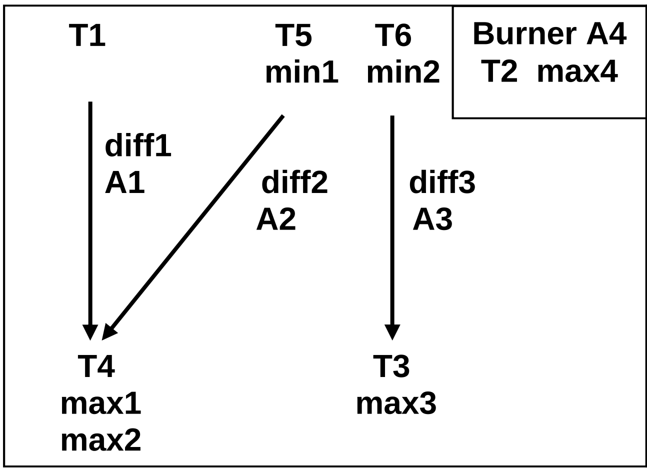
Sensors

T1…. Collector
T2…. Tank top
T3…. Tank center
T4…. Tank bottom
T5…. Solid fuel boiler ("sfb")
T6…. Oil/gas boiler ("ogb")

Outputs

A1…. Solar pump
A2…. Feed pump solid fuel boiler
A3…. Feed pump oil/gas boiler
A4…. Burner requirement

Program 48: Function according to diagram



Required settings:

diff1	…coll. T1 – TK T4	⇨ **A1**
diff2	…sf-boiler T5 – TK T4	⇨ **A2**
diff3	…oil boiler T6 – TK T3	⇨ **A3**
diff4	…see all programs +8	
min1	…switch-on temp. sfb T5	⇨ **A2**
min2	…switch-on temp. ogb T6	⇨ **A3**
max1	…limit TK T4	⇨ **A1**
max2	…limit TK T4	⇨ **A2**
max3	…limit TK T3	⇨ **A3**
max4	…burner requirement TK T2	⇨ **A4**

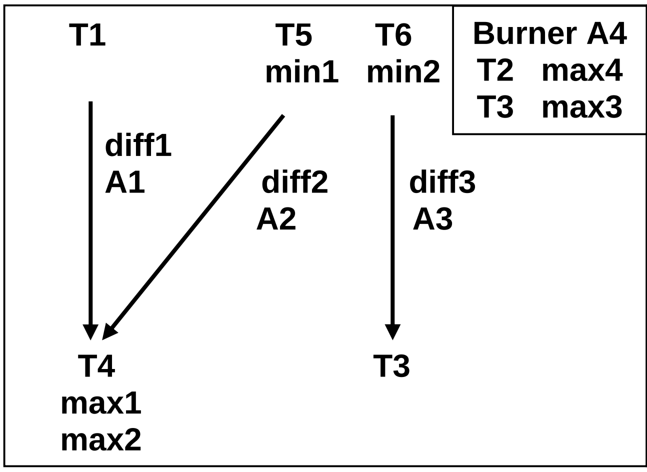
A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
A4 (on) = T2 < max4 – hysteresis
A4 (off) = T2 > max4

Diagram 48

Program 49: If the tank has reached its maximum temperature due to the solar power system, solar pump **A1** and feed pump **A2** are switched on (**reverse cooling function**).

A2 ... or ***T4 > max1 & T5 < T4***

All Programs +2: Output **A4** (burner requirement) switches on when **T2** falls below threshold ***max4*** and switches off when **T3** exceeds ***max3***. ***Max3*** is no longer the tank limit for the oil/gas boiler feed pump.

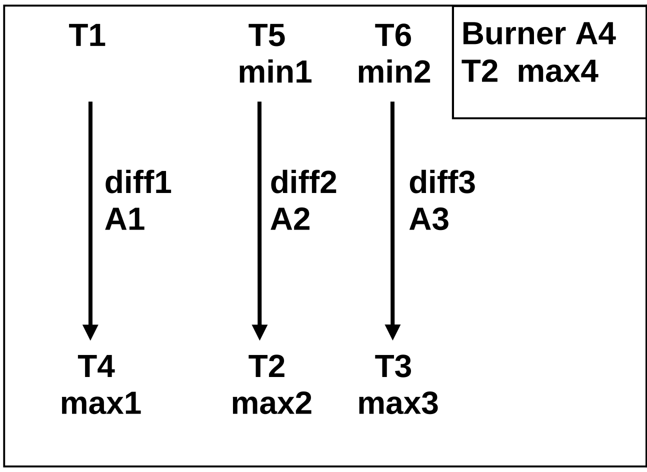


Required settings:

diff1	…coll. T1 – TK T4	⇨ **A1**
diff2	…sf-boiler T5 – TK T4	⇨ **A2**
diff3	…oil boiler T6 – TK T3	⇨ **A3**
min1	…switch-on temp. sfb T5	⇨ **A2**
min2	…switch-on temp. ogb T6	⇨ **A3**
max1	…limit TK T4	⇨ **A1**
max2	…limit TK T4	⇨ **A2**
max3	…burner requ. OFF TK T3	⇨ **A4**
max4	…burner requ. ON TK T2	⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T3 + diff3) & T6 > min2
A4 (on) = T2 < max4 – hysteresis
A4 (off) = T3 > max3

All Programs +4: Three independent differential loops. The tank feeding **A2** from the solid fuel boiler is controlled by the difference ***diff2*** between boiler sensor **T5** and the sensor **T2** (tank top)



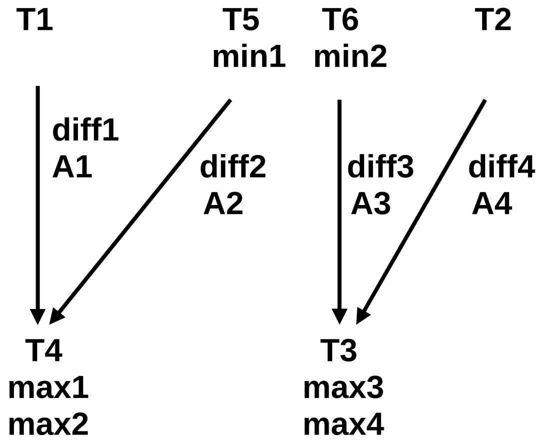
Required settings:

diff1	…coll. T1 – TK T4	⇨ **A1**
diff2	…sf-boiler T5 – TK T2	⇨ **A2**
diff3	…oil boiler T6 – TK T3	⇨ **A3**
min1	…switch-on temp. sfb T5	⇨ **A2**
min2	…switch-on temp. ogb T6	⇨ **A3**
max1	…limit TK T4	⇨ **A1**
max2	…limit TK T2	⇨ **A2**
max3	…limit TK T3	⇨ **A3**
max4	…burner requirement TK T2	⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T2 + diff2) & T5 > min1 & T2 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
A4 (on) = T2 < max4 – hysteresis
A4 (off) = T2 > max4

Diagram 48

All Programs +8: This program enables controlling of two generators to each one consumer. Output **A4** is switched with the difference ***diff4*** between **T2** and **T3** instead of burner requirement. **T2** is available for an additional forth generator. In this case threshold ***max4*** operates at **T3**.

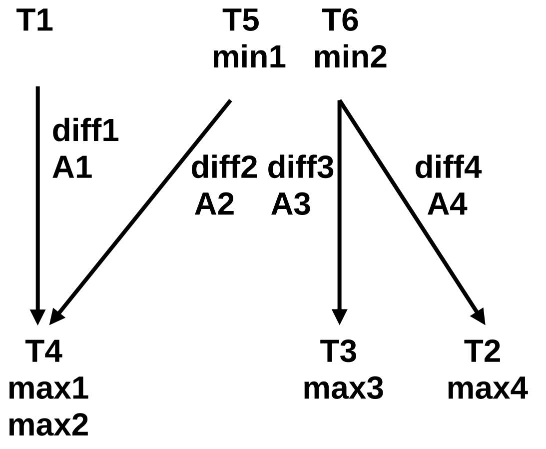


Required settings:

diff1	…coll. T1 – TK T4	⇨ **A1**
diff2	…sf-boiler T5 – TK T4	⇨ **A2**
diff3	…oil boiler T6 – TK T3	⇨ **A3**
diff4	…generator T2 – TK T3	⇨ **A4**
min1	…switch-on temp. sfb T5	⇨ **A2**
min2	…switch-on temp. ogb T6	⇨ **A3**
max1	…limit TK T4	⇨ **A1**
max2	…limit TK T4	⇨ **A2**
max3	…limit TK T3	⇨ **A3**
max4	…limit TK T3	⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
A4 = T2 > (T3 + diff4) & T3 < max4

Program 60: The whole function offers switching of two generators to one consumer and one generator to two consumers. Output **A4** gets an additional difference function instead of burner requirement. **A4** switches, if sensor **T6** is increasing ***min2*** and is greater than **T2** by ***diff4*** and **T2** has not exceeded ***max4***.



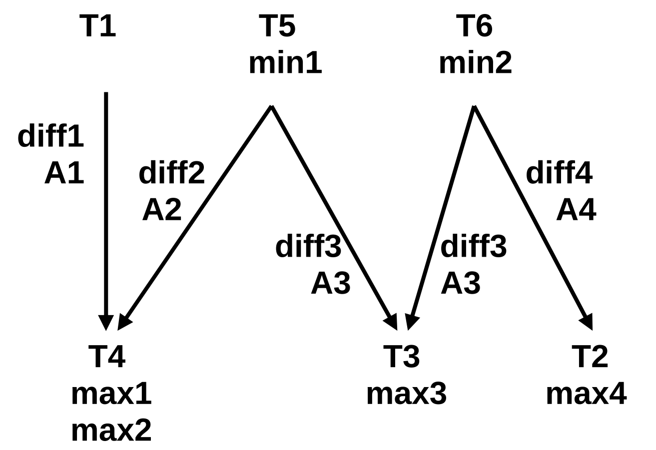
Required settings:

diff1	…coll. T1 – TK T4	⇨ **A1**
diff2	…sf-boiler T5 – TK T4	⇨ **A2**
diff3	…oil boiler T6 – TK T3	⇨ **A3**
diff4	…oil boiler T6 – TK T2	⇨ **A4**
min1	…switch-on temp. sfb T5	⇨ **A2**
min2	…switch-on temp. ogb T6	⇨ **A3,4**
max1	…limit TK T4	⇨ **A1**
max2	…limit TK T4	⇨ **A2**
max3	…limit TK T3	⇨ **A3**
max4	…limit TK T2	⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
A4 = T6 > (T2 + diff4) & T6 > min2 & T2 < max4

Diagram 48

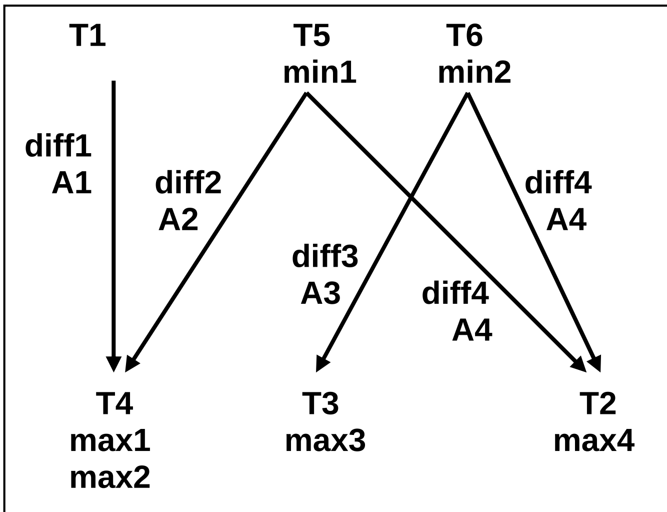
Program 61: Function similar to Program 60, but output **A3** does not only switch by the origin function, but additionally, if **T5** is increasing ***min1*** and is greater than **T3** by ***diff3***



Required settings:
diff1 …coll. T1 – TK T4 ⇨ **A1**
diff2 …sf-boiler T5 – TK T4 ⇨ **A2**
diff3 …oil boiler T6 – TK T3 ⇨ **A3**
diff3 …sf-boiler T5 – TK T3 ⇨ **A3**
diff4 …oil boiler T6 – TK T2 ⇨ **A4**
min1 …switch-on temp. sfb T5 ⇨ **A2,3**
min2 …switch-on temp. ogb T6 ⇨ **A3,4**
max1 …limit solar TK T4 ⇨ **A1**
max2 …limit TK T4 ⇨ **A2**
max3 …limit TK T3 ⇨ **A3**
max4 …limit TK T2 ⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
or T5 > (T3 + diff3) & T5 > min1 & T3 < max3
A4 = T6 > (T2 + diff4) & T6 > min2 & T2 < max4

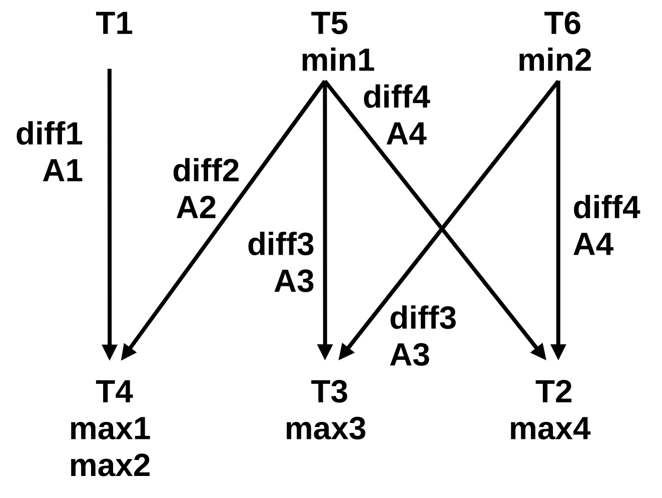
Program 62: Additionally to program 60 output **A4** switches, if **T5** is increasing ***min1*** and is greater than **T2** by **diff4**.



Required settings:
diff1 …coll. T1 – TK T4 ⇨ **A1**
diff2 …sf-boiler T5 – TK T4 ⇨ **A2**
diff3 …oil boiler T6 – TK T3 ⇨ **A3**
diff4 …oil boiler T5 – TK T2 ⇨ **A4**
sf-boiler T6 – TK T2 ⇨ **A4**
min1 …switch-on temp. sfb T5 ⇨ **A2,4**
min2 …switch-on temp. ogb T6 ⇨ **A3,4**
max1 …limit TK T4 ⇨ **A1**
max2 …limit TK T4 ⇨ **A2**
max3 …limit TK T3 ⇨ **A3**
max4 …limit TK T2 ⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T4 + diff2) & T5 > min1 & T4 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
A4 = T6 > (T2 + diff4) & T6 > min2 & T2 < max4
or T5 > (T2 + diff4) & T5 > min1 & T2 < max4

Program 63: Output **A3** switches as described in program 61 and **A4** as per program 62.



Required settings:

diff1	…col. T1 – TK T4	⇨ **A1**
diff2	…boiler T5 – TK T4	⇨ **A2**
diff3	…boiler T5 – TK T3	⇨ **A3**
	…boiler T6 – TK T3	⇨ **A3**
diff4	…boiler T5 – TK T2	⇨ **A4**
	…boiler T6 – TK T2	⇨ **A4**
min1	…switch-on temp. T5	⇨ **A2,3,4**
min2	…switch-on temp. T6	⇨ **A3,4**
max1	…limit TK T4	⇨ **A1**
max2	…limit TK T4	⇨ **A2**
max3	…limit TK T3	⇨ **A3**
max4	…limit TK T2	⇨ **A4**

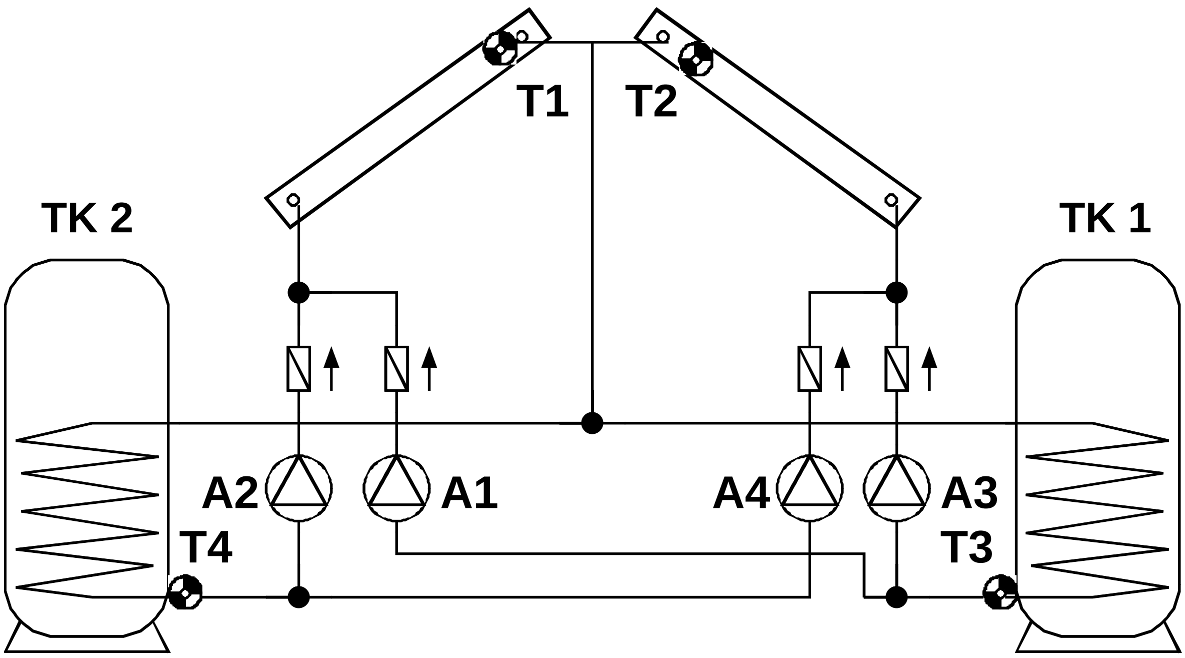
$$A1 = T1 > (T4 + diff1) \ \& \ T4 < max1$$
$$A2 = T5 > (T4 + diff2) \ \& \ T5 > min1 \ \& \ T4 < max2$$
$$A3 = T5 > (T3 + diff3) \ \& \ T5 > min1 \ \& \ T3 < max3$$
or
$$T6 > (T3 + diff3) \ \& \ T6 > min2 \ \& \ T3 < max3$$
$$A4 = T5 > (T2 + diff4) \ \& \ T5 > min1 \ \& \ T2 < max4$$
or
$$T6 > (T2 + diff4) \ \& \ T6 > min2 \ \& \ T2 < max4$$

Diagram 64

Diagram 64: Solar power system with two solar panels and two consumers

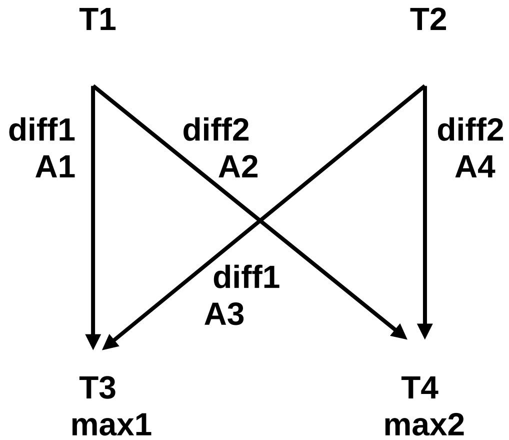
Note: Setting the time switch, the definition of the output corresponds to the actual output, but setting the priority it corresponds to the basic function of program 64.

Program 64: Each tank is fed from each solar panel by 4 separate pumps. No feed pump function!



Sensor	**Outputs**
T1…. Collector 1	A1…. Pump collector 1 – TK1
T2…. Collector 2	A2…. Pump collector 1 – TK2
T3…. Tank 1 bottom	A3…. Pump collector 2 – TK1
T4…. Tank 2 bottom	A4…. Pump collector 2 – TK2
T5…. Freely usable	
T6…. Freely usable	

Program 64: Function according to diagram



Required settings:

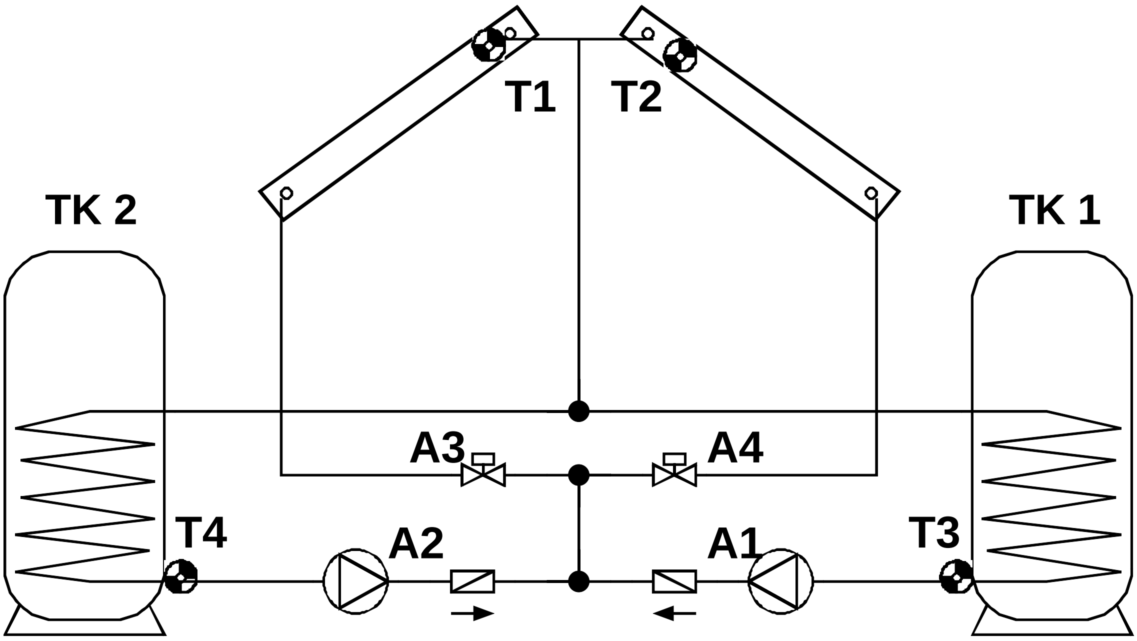
diff1	…coll. T1 – TK1 T3	⇨ **A1**
	coll. T2 – TK1 T3	⇨ **A3**
diff2	…coll. T1 – TK2 T4	⇨ **A2**
	coll. T2 – TK2 T4	⇨ **A4**
diff3	…see all programs +1	
max1	…limit TK1 T3	⇨ **A1,3**
max2	…limit TK2 T4	⇨ **A2,4**

Additional: Priority ***Vorr***:
(typical: A11, A22, A31, A42)

A1 = T1 > (T3 + diff1) & T3 < max1
A2 = T1 > (T4 + diff2) & T4 < max2

A3 = T2 > (T3 + diff1) & T3 < max1
A4 = T2 > (T4 + diff2) & T4 < max2

Program 66: 2 stop valves and 2 pumps instead of the 4 pumps in program 64. No feed pump function!
Attention! If both valves are closed, both pumps will be switched off.

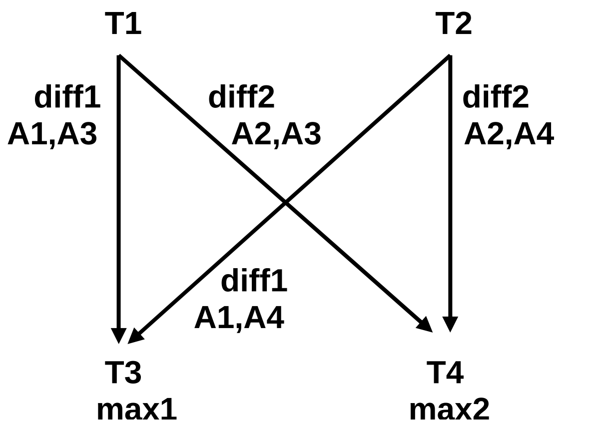


Sensors

T1…. Collector 1
T2…. Collector 2
T3…. Tank 1 bottom
T4…. Tank 2 bottom
T5…. Freely usable
T6…. Freely usable

Outputs

A1…. Pump TK1
A2…. Pump TK2
A3…. Valve Collector panel 1
A4…. Valve Collector panel 2



Required settings:

diff1	…coll. T1 – TK1 T3	⇨ **A1,3**
	coll. T2 – TK1 T3	⇨ **A1,4**
diff2	…coll. T1 – TK2 T4	⇨ **A2,3**
	coll. T2 – TK2 T4	⇨ **A2,4**
diff3	…see all programs +1	
max1	…limit TK1 T3	⇨ **A1,3,4**
max2	…limit TK2 T4	⇨ **A2,3,4**

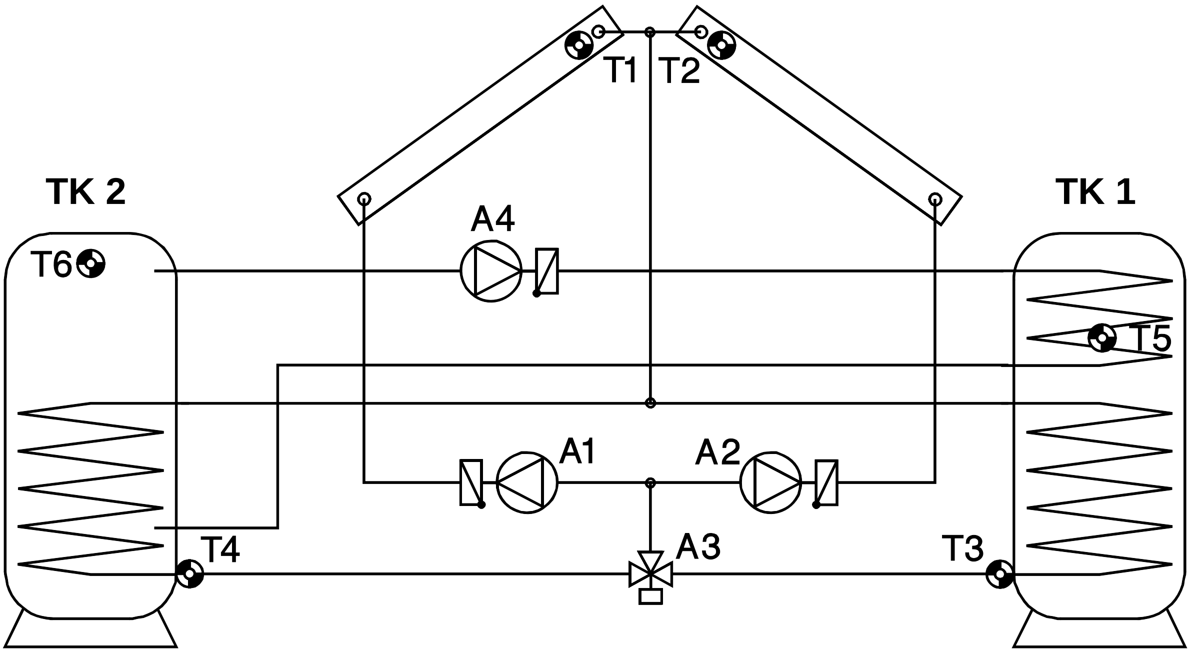
Additional: Priority ***Vorr***:
(typical: A11, A22, A31, A42)

A1 & A3 = T1 > (T3 + diff1) & T3 < max1
A1 & A4 = T2 > (T3 + diff1) & T3 < max1
A2 & A3 = T1 > (T4 + diff2) & T4 < max2
A2 & A4 = T2 > (T4 + diff2) & T4 < max2

A system of **one pump and a three-way valve** instead of two pumps can be realized by using the auxiliary output A5: Pump = A1, three-way valve = A2; the auxiliary output A5 switches simultaneously with A2 the pump A1 (setting: A2o).

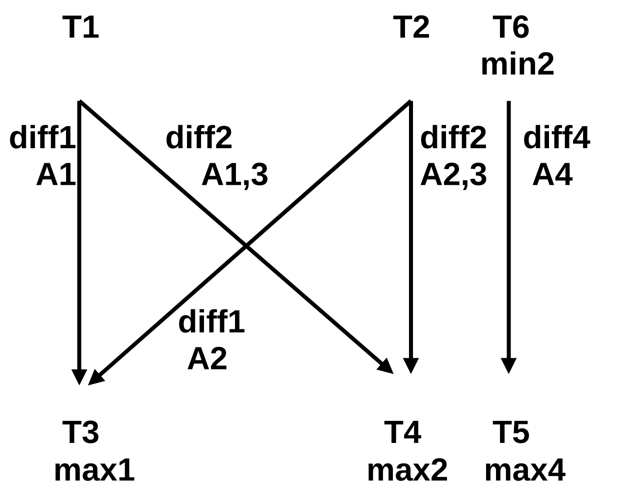
Diagram 64

Program 68: Function according to diagram.
The three-way valve **A3** receives power when filling tank **TK2**.



Sensors
T1…. Collector 1
T2…. Collector 2
T3…. Tank 1 bottom
T4…. Tank 2 bottom
T5…. Tank 1 top
T6…. Tank 2 top

Outputs
A1…. Solar pump collector panel 1
A2…. Solar pump collector panel 2
A3…. Three-way valve (feeding tanks)
A4…. Feed pump



Required settings:

diff1	…coll. T1 – TK1 T3	⇨ **A1**
	coll. T2 – TK1 T3	⇨ **A2**
diff2	…coll. T1 – TK2 T4	⇨ **A1,3**
	coll. T2 – TK2 T4	⇨ **A2,3**
diff3	…see all programs +1	
diff4	…TK2 T6 – TK1 T5	⇨ **A4**
min2	…switch-on temp. T6	⇨ **A4**
max1	…limit TK1 T3	⇨ **A1,2**
max2	…limit TK2 T4	⇨ **A1,2,3**
max4	…limit TK1 T5	⇨ **A4**

Additional: Priority ***Vorr***:
(typical: A11, A22, A31, A42)

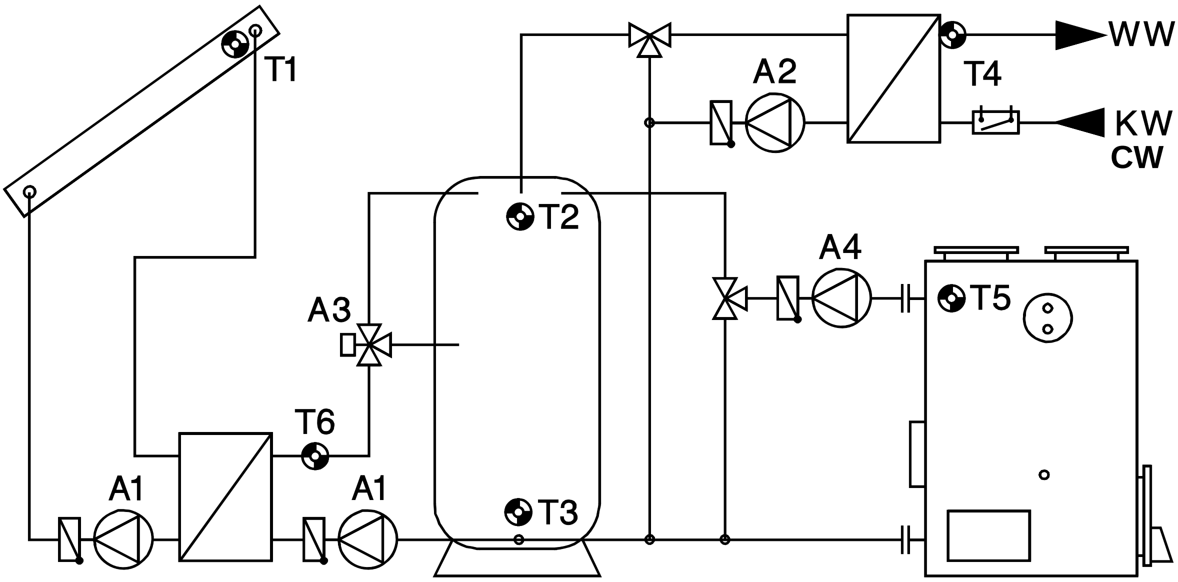
A1 = T1 > (T3 + diff1) & T3 < max1
A1 & A3 = T1 > (T4 + diff2) & T4 < max2

A2 = T2 > (T3 + diff1) & T3 < max1
A2 & A3 = T2 > (T4 + diff2) & T4 < max2

A4 = T6 > (T5 + diff4) & T6 > min2 & T5 < max4

All Programs +1: If the difference between collector sensors **T1** and **T2** exceeds the difference ***diff3***, the colder collector is switched off. This prevents heat from being lost in the colder collector when temperatures are mixed.

Diagram 80: Layering storage tank, feed pump and domestic hot water preparation



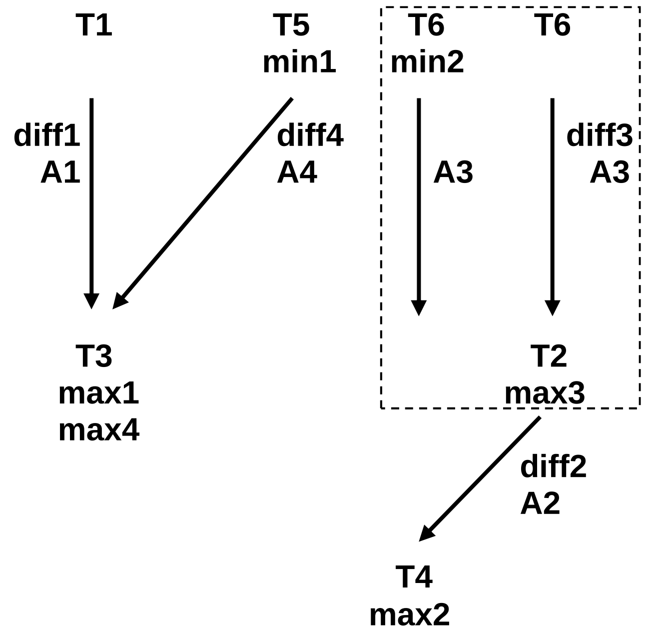
Sensors

T1…. Collector
T2…. Tank top
T3…. Tank bottom
T4…. Hot water (ultra-fast sensor)
T5…. Boiler
T6…. Solar flow

Outputs

A1…. Solar pumps
A2…. Heat exchanger pump (hot water)
A3…. Three-way valve layering storage
A4…. Feed pump

Program 80: Function according to diagram



Required settings:

diff1	…coll. T1 – TK T3	⇨	**A1**
diff2	…tank T2 – WW T4	⇨	**A2**
diff3	…flow T6 – TK T2	⇨	**A3**
diff4	…boiler T5 – TK T3	⇨	**A4**
min1	…switch-on temp. boiler T5	⇨	**A4**
min2	…switch-on temp. flow T6	⇨	**A3**
max1	…limit TK T3	⇨	**A1**
max2	…limit WW T4	⇨	**A2**
max3	…threshold TK T2	⇨	**A3**
max4	…limit feed pump TK T3	⇨	**A4**

Additional: Both speed controls ***Pd1, Pd2***

A1 = T1 > (T3 + diff1) & T3 < max1
A2 = T2 > (T4 + diff2) & T4 < max2
A3 = (T6 > min2 <u>or</u> T6 > (T2 + diff3)) & T2 < max3
A4 = T5 > (T3 + diff4) & T5 > min1 & T3 < max4

Diagram 80

Program 80: Function according to diagram

Both solar pumps are switched on by the difference ***diff1***. The three-way valve **A3** switches to the tank top, when **T6** is increasing ***min2 or*** is greater than **T2** by ***diff3***, but **T2** has not exceeded the threshold **max3**.

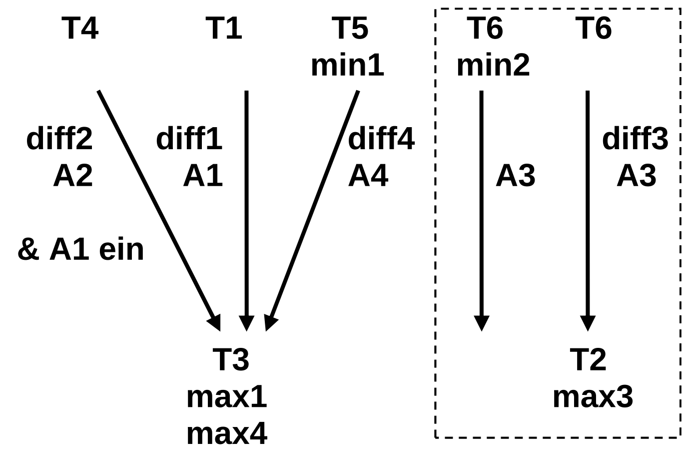
The speed controlled output **A2** is used for domestic hot water preparation. The detection of a flow is possible by using a volume flow switch, electrically switched in series to sensor **T4**.

Sensor **T4** is kept constant by the speed control (absolute value control). When **T2** decreases, the controller keeps the difference between **T2** and **T4** constant (setting of the value ***d*** in menu speed control) for avoiding the mixing inside the tank because of too high pump speed (differential control). The slower of the two speeds "wins out".

Program 81: If **T2** has reached ***max3***, the quick warm-up phase has been completed, and the speed control for **A1** is thus blocked ⇒ optimal efficiency.

Program 82: The speed control for A1 is blocked, when the three-way valve switches to the bottom (A3 = off). In this case the priority control is active for the possibility of switching back to the top tank area at high enough solar radiation.

All Programs +4: The domestic hot water preparation is not applicable. **A2** is the secondary pump in the solar loop. **T4** should be mounted in the primary solar loop. **A2** switches, when **A1** is already active and **T4** is greater than **T3** by ***diff2***.



Required settings:

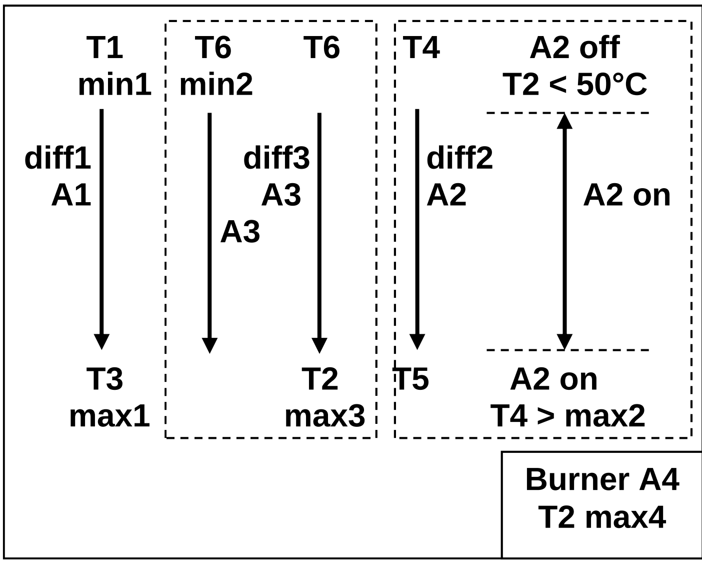
diff1 …coll. T1 – TK T3 ⇨ **A1**
diff2 …solar flow T4 – TK T3 ⇨ **A2**
diff3 …flow T6 – TK T2 ⇨ **A3**
diff4 …boiler T5 – TK T3 ⇨ **A4**
min1 …switch-on temp. boiler T5 ⇨ **A4**
min2 …switch-on temp. flow T6 ⇨ **A3**
max1 …limit TK T3 ⇨ **A1**
max3 …threshold. TK T2 ⇨ **A3**
max4 …limit. feed pump TK T3 ⇨ **A4**

Additional: Both speed controls ***Pd1, Pd2***

A1 = T1 > (T3 + diff1) & T3 < max1
A2 = T4 > (T3 + diff2) & (A1 = on)
A3 = (T6 > min2 <u>or</u> T6 > (T2 + diff3)) & T2 < max3
A4 = T5 > (T3 + diff4) & T5 > min1 & T3 < max4

Diagram 80

Program 88: A1 gets additionally the threshold ***min1*** at **T1**. The solid fuel boiler is not applicable. The domestic hot water preparation by **A2** is also switching, if **T4** is greater than **T5** by ***diff2***. **T5** could be a volume flow switch. **A4** is used for burner requirement. **A4** switches when **T2** has not exceeded ***max4***.



Required settings:

diff1	…coll. T1 – TK T3	⇨	**A1**
diff2	…sensor T4 – sensor T5	⇨	**A2**
diff3	…flow T6 – TK T2	⇨	**A3**
min1	…switch-on temp. coll. T1	⇨	**A2**
min2	…switch-on temp. flow T6	⇨	**A3**
max1	…limit TK T3	⇨	**A1**
max2	…limit WW T4	⇨	**A2**
max3	…threshold TK T2	⇨	**A3**
max4	…burner requirement T2	⇨	**A4**

Additional: Both speed controls ***Pd1, Pd2***

A1 = T1 > min1 & T1 > (T3 + diff1) & T3 < max1

A2 = T4 > (T5 + diff2) <u>or</u> (T2 > 50°C & T4 < max2)

A3 = (T6 > min2 <u>or</u> T6 > (T2 + diff3)) & T2 < max3

A4 (on) = T2 < max4 – hysteresis
A4 (off) = T2 > max4

Program 89: according to program 88, but: If **T4** has reached ***max3***, the quick warm-up phase has been completed, and the speed control of **A1** is thus blocked ⇒ optimal efficiency.

Program 92: according to program 88, but: the changing between tank center and top is done by a thermic valve. Therefore **A3** is free for an additional feed pump function. **A3** switches when **T6** is increasing ***min2*** <u>**and**</u> is greater than **T3** by ***diff3*** and **T3** has not exceeded ***max3***.

A1 = T1 > min1 & T1 > (T3 + diff1) & T3 < max1

A2 = T4 > (T5 + diff2) <u>or</u> (T2 > 50°C & T4 < max2)

A3 = T6 > min2 & T6 > (T3 + diff3) & T3 < max3

A4 (on) = T2 < max4 – hysteresis
A4 (off) = T2 > max4

Program 94: according to program 92, but: the sensor **T2** in the tank top is used for the feed pump function **A3**. Therefore this function is better suitable for oil or gas boilers.

A1 = T1 > min1 & T1 > (T3 + diff1) & T3 < max1

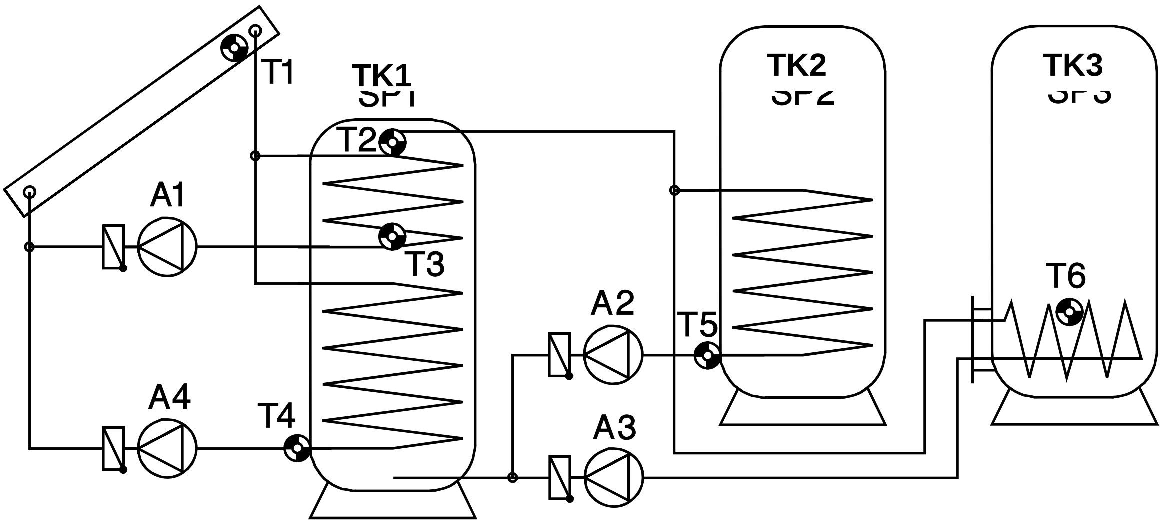
A2 = T4 > (T5 + diff2) <u>or</u> (T2 > 50°C & T4 < max2)

A3 = T6 > min2 & T6> (T2 + diff3) & T2 < max3.

A4 (on) = T2 < max4 – hysteresis
A4 (off) = T2 > max4

Diagram 96

Diagram 96: Solar power system with two consumers and two feed pump functions



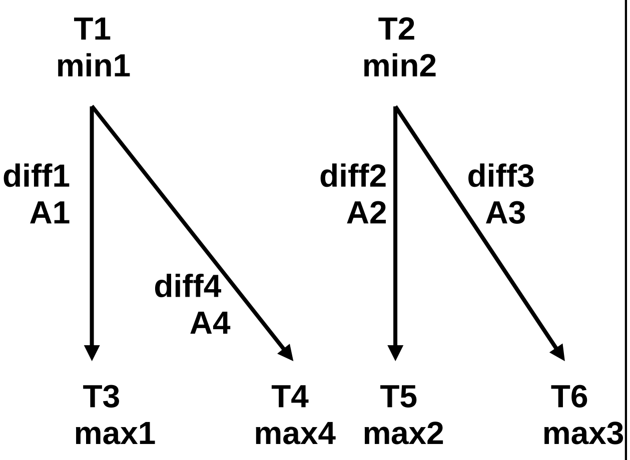
Sensors

T1…. Collector
T2…. Tank TK1 top
T3…. Tank TK1 center
T4…. Tank TK1 bottom
T5…. Tank TK2 bottom
T6…. Tank TK3 bottom

Outputs

A1…. Solar pump loop 1
A2…. Feed pump TK2
A3…. Feed pump TK3
A4…. Solar pump loop 2

Program 96: Function according to diagram.



Required settings:

diff1	…coll. T1 – TK1 T3	⇨	**A1**
diff2	…TK 1 T2 – TK 2 T5	⇨	**A2**
diff3	…TK 1 T2 – TK 3 T6	⇨	**A3**
diff4	…Coll. T1 – TK 1 T4	⇨	**A4**
min1	…switch-on temp. coll. T1	⇨	**A1,4**
min2	…switch-on temp. TK 1 T2	⇨	**A2,3**
max1	…limit TK1 T3	⇨	**A1**
max2	…limit TK2 T5	⇨	**A2**
max3	…limit TK3 T6	⇨	**A3**
max4	…limit TK1 T4	⇨	**A4**

Additional: Priority ***Vorr***:
(typical: A11, A20, A30, A42)

A1 = T1 > (T3 + diff1) & T1 > min1 & T3 < max1
A2 = T2 > (T5 + diff2) & T2 > min2 & T5 < max2
A3 = T2 > (T6 + diff3) & T2 > min2 & T6 < max3
A4 = T1 > (T4 + diff4) & T1 > min1 & T4 < max4

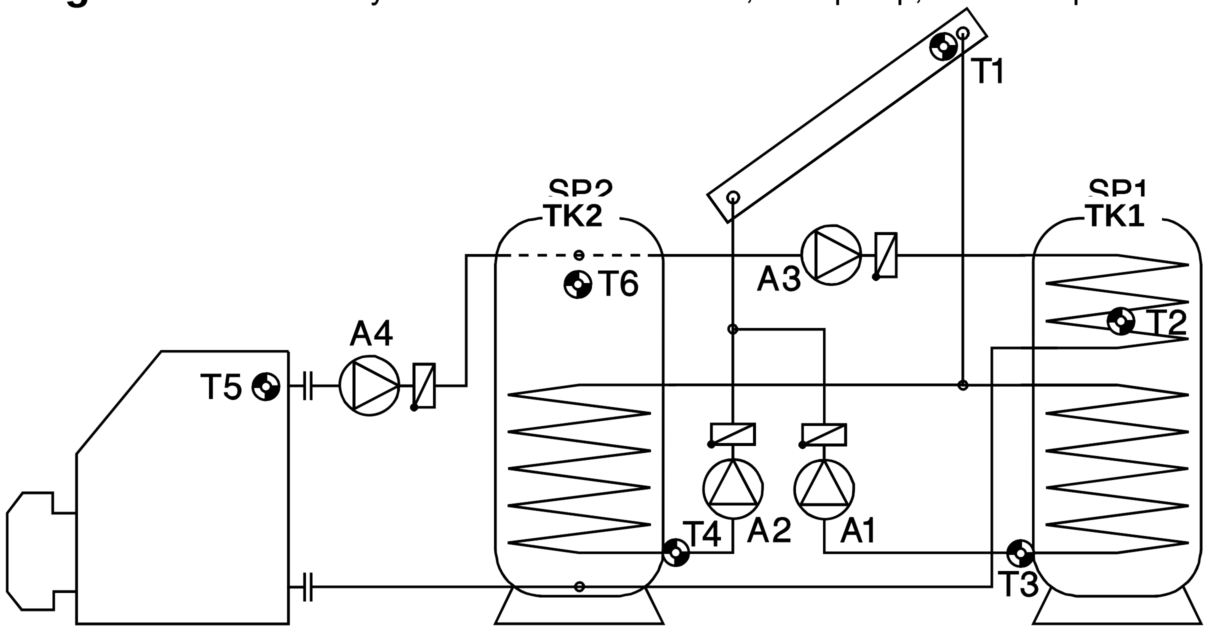
Program 97: Instead of the two **solar pumps**, one pump and a three-way valve are used (pump-valve system). The speed control (if activated) only operated when filling **loop 1** (**T3**).

A1... common pump
A4... Valve (A4/S receives power when filling tank **TK1** bottom)

All Programs +2: Instead of the two **feed pumps**, one pump and a three-way valve are used (pump-valve system). The speed control (if activated) only operated when filling **loop TK2 (T5)**.

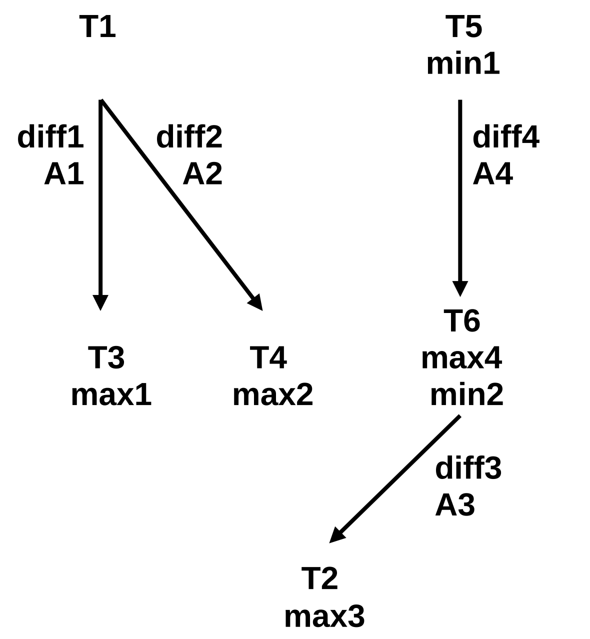
A2... common pump
A3... Valve (A3/S receives power when filling tank **TK3**)

Diagram A0: Solar system with two consumers, feed pump, burner requirement



Sensors	**Outputs**
T1…. Collector	A1…. Solar pump loop 1
T2…. Tank TK1 top	A2…. Solar pump loop 2
T3…. Tank TK1 bottom	A3…. Feed pump TK1
T4…. Tank TK2 bottom	A4…. Feed pump TK2
T5…. Boiler	
T6…. Tank TK2 top	

Program A0: Function according to diagram.



Required settings:

diff1	…coll. T1 – TK1 T3	⇨	**A1**
diff2	…coll. T1 – TK2 T4	⇨	**A2**
diff3	…TK2 T6 – TK1 T2	⇨	**A3**
diff4	…boiler T5 – TK2 T6	⇨	**A4**
min1	…switch-on temp. boiler T5	⇨	**A4**
min2	…switch-on temp. TK2 T6	⇨	**A3**
max1	…limit TK1 T3	⇨	**A1**
max2	…limit TK2 T4	⇨	**A2**
max3	…limit TK1 T2	⇨	**A3**
max4	…limit TK2 T6	⇨	**A4**

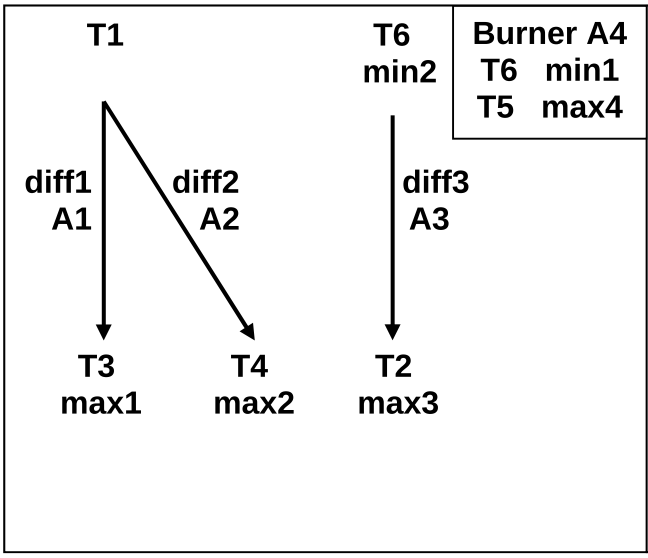
Additional: Priority ***Vorr***:
(typical: A11, A22, A30, A40)

A1 = T1 > (T3 + diff1) & T3 < max1
A2 = T1 > (T4 + diff2) & T4 < max2
A3 = T6 > (T2 + diff3) & T6 > min2 & T2 < max3
A4 = T5 > (T6 + diff4) & T5 > min1 & T6 < max4

All Programs +1: Instead of the two solar pumps, one pump and a three-way valve are used (pump-valve system). The speed control (if activated) only operated when filling **TK 1** (**T3**).

A1... common pump
A2... Valve (A2/S receives power when filling tank **TK2**)

All Programs +2: Output **A4** is used for burner requirement with separated on and off thresholds instead of feed pump function.



Required settings:

diff1	…coll. T1 – TK1 T3	⇨	**A1**
diff2	…coll. T1 – TK2 T4	⇨	**A2**
diff3	…TK2 T6 – TK1 T2	⇨	**A3**
min1	…burner requ. ON T6	⇨	**A4**
min2	…switch-on temp. TK2 T6	⇨	**A3**
max1	…limit TK1 T3	⇨	**A1**
max2	…limit TK2 T4	⇨	**A2**
max3	…limit TK1 T2	⇨	**A3**
max4	…burner requ. OFF T5	⇨	**A4**

Additional: Priority ***Vorr***:
(typical: A11, A22, A30, A40)

$$A1 = T1 > (T3 + diff1)\ \&\ T3 < max1$$
$$A2 = T1 > (T4 + diff2)\ \&\ T4 < max2$$
$$A3 = T6 > (T2 + diff3)\ \&\ T6 > min2\ \&\ T2 < max3$$
$$A4\ (on) = T6 < min1 \qquad A4\ (off) = T5 > max4$$

Program A4: The feed pump function of output **A4** is active between boiler **T5** and tank 1 **T2**.

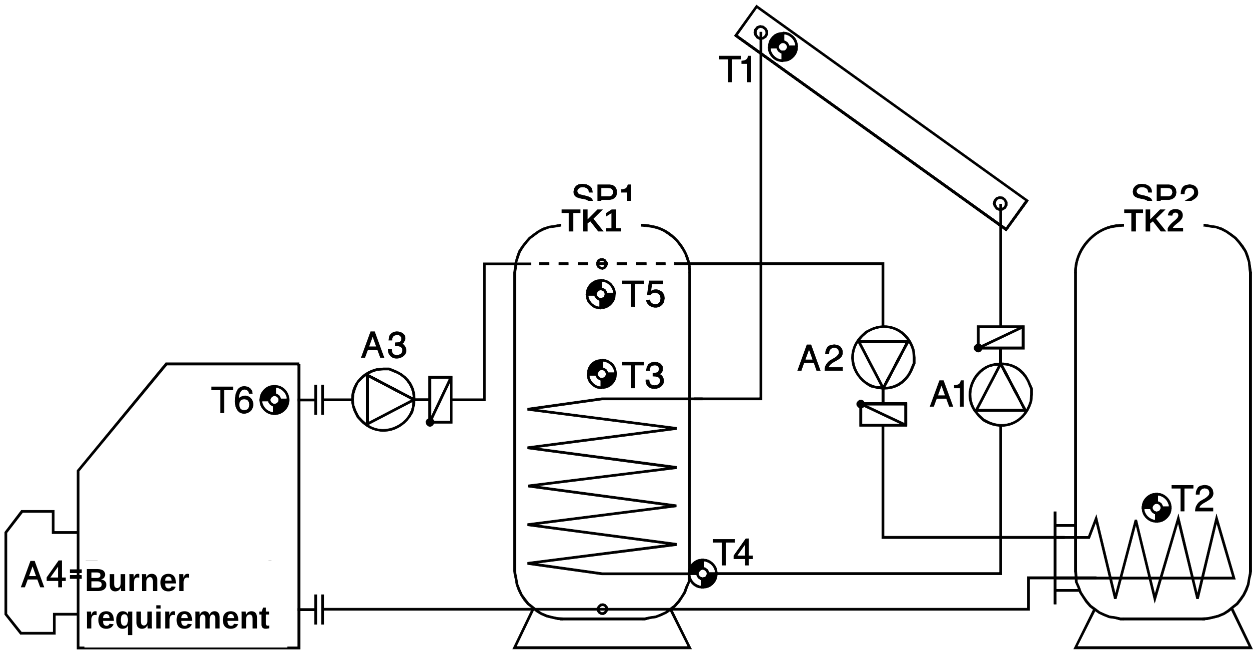
$$A1 = T1 > (T3 + diff1)\ \&\ T3 < max1$$
$$A2 = T1 > (T4 + diff2)\ \&\ T4 < max2$$
$$A3 = T6 > (T2 + diff3)\ \&\ T6 > min2\ \&\ T2 < max3$$
$$A4 = T5 > (T2\ \&\ diff4)\ \&\ T5 > min1\ \&\ T2 < max4$$

Program A6: Burner requirement **A4** (on), when **T5** < ***min1***
Burner requirement **A4** (off), when **T2** > ***max4***

$$A1 = T1 > (T3 + diff1)\ \&\ T3 < max1$$
$$A2 = T1 > (T4 + diff2)\ \&\ T4 < max2$$
$$A3 = T6 > (T2 + diff3)\ \&\ T6 > min2\ \&\ T2 < max3$$
$$A4\ (on) = T5 < min1 \qquad A4\ (off) = T2 > max4$$

Diagram B0

Diagram B0: Solar power system, 2 feed pump functions, burner requirement



Sensors
T1…. Collector
T2…. Tank TK2 bottom
T3…. Tank TK1 center
T4…. Tank TK1 bottom
T5…. Tank TK1 top
T6…. Boiler

Outputs
A1…. Solar pump
A2…. Feed pump TK2
A3…. Feed pump TK1
A4…. Burner requirement

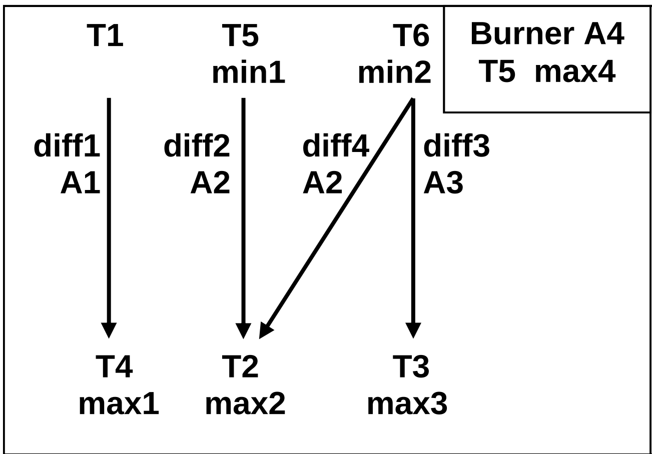
Program B0: Function according to diagram.

T1	T5 min1	T6 min2	Burner A4 T5 max4
diff1 A1 ↓	diff2 A2 ↓	diff3 A3 ↓	
T4 max1	T2 max2	T3 max3	

Required settings:		
diff1	…coll. T1 – TP1 T4	⇨ **A1**
diff2	…TK1 top T5 – TK2 T2	⇨ **A2**
diff3	…boiler T6 – TK1 T3	⇨ **A3**
diff4	…see all programs +1	
min1	…switch-on temp. TK1 T5	⇨ **A2**
min2	…switch-on temp. boiler T6	⇨ **A3**
max1	…limit TK1 T4	⇨ **A1**
max2	…limit TK2 T2	⇨ **A2**
max3	…limit TK1 T3	⇨ **A3**
max4	…burner requirement T5	⇨ **A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T2 + diff2) & T5 > min1 & T2 < max2
A3 = T6 > (T3 + diff3) & T6 > min2 & T3 < max3
A4 (on) = T5 < max4 – hysteresis
A4 (off) = T5 > max4

All Programs +1: The feeding of the hot water tank is normally done by the difference buffer **T5** – hot water tank **T2**. This program considers also the boiler temperature **T6**.



Required settings:

diff1	…coll. T1 – TP1 T4	⇨	**A1**
diff2	…TK1 top T5 – TK2 T2	⇨	**A2**
diff3	…boiler T6 – TK1 T3	⇨	**A3**
diff4	…boiler T6 – TK2 T2	⇨	**A2**
min1	…switch-on temp. TK1 T5	⇨	**A2**
min2	…switch-on temp. boiler T6	⇨	**A2, 3**
max1	…limit TK1 T4	⇨	**A1**
max2	…limit TK2 T2	⇨	**A2**
max3	…limit TK1 T3	⇨	**A3**
max4	…burner requirement T5	⇨	**A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T5 > (T2 + diff2) & T2 < max2 & T5 > min1
or T6 > (T2 + diff4) & T2 < max2 & T6 > min2
A3 = T6 > (T3 + diff3) & T3 < max3 & T6 > min2
A4 (on) = T5 < max4 – hysteresis
A4 (off) = T5 > max4

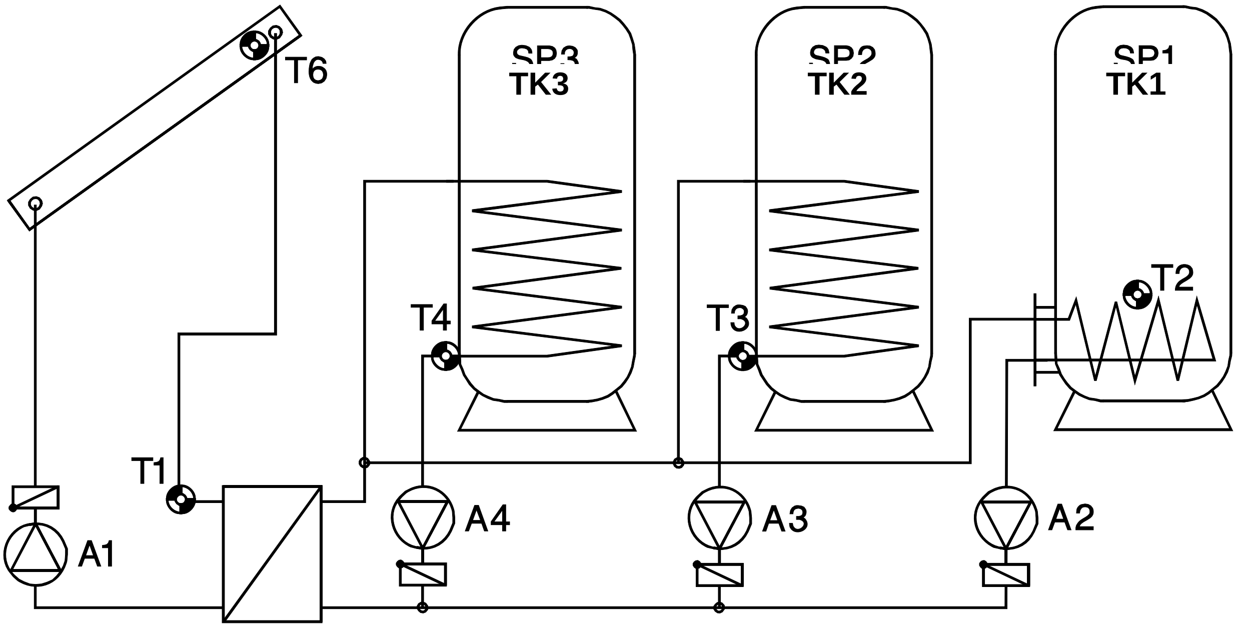
All Programs +2: Separated on and off thresholds for the burner requirement

A3 = T6 > (T3 + diff3) & T6 > min2
A4 (on) = T5 < max3
A4 (off) = T3 > max4

All Programs +4: Diagram with solid fuel boiler instead of a solar power system. The threshold ***min1*** affects not at **T5** but at **T1**.

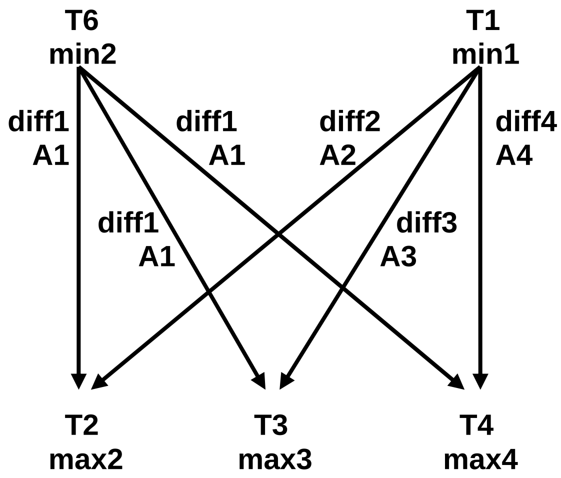
Diagram C0

Diagram C0: Solar power system with 3 consumers, bypass function



Sensors	**Outputs**
T1…. Flow solar loop	A1…. Primary solar pump
T2…. Tank TK1	A2…. Solar pump TK1
T3…. Tank TK2	A3…. Solar pump TK2
T4…. Tank Tk3	A4…. Solar pump TK3
T5…. Freely usable	
T6…. Collector	

Program C0: Function according to diagram. The primary and the secondary side are separated hydraulically. The secondary pumps are switched separated from the primary pumps.



Required settings:

diff1	…coll. T6 – TK T2, T3, T4	⇨ **A1**
diff2	…flow T1 – TK1 T2	⇨ **A2**
diff3	…flow T1 – TK2 T3	⇨ **A3**
diff4	…flow T1 – TK3 T4	⇨ **A4**
min1	switch-on temp. flow T1	⇨ **A2**,**A3**,**A4**
min2	…switch-on temp. coll. T6	⇨ **A1**
max2	…limit TK1 T2	⇨ **A1**,**2**
max3	…limit TK2 T3	⇨ **A1**,**3**
max4	…limit TK3 T4	⇨ **A1**,**4**

Additional: Priority ***Vorr***:
(typical: A10, A21, A32, A43)

A1 = (T6 > (T2 + diff1) or T6 > (T3 + diff1) or T6 > (T4 + diff1))
& T6 > min2 & (T2 < max2 or T3 < max3 or T4 < max4)
A2 = T1 > (T2 + diff2) & T1 > min1 & T2 < max2
A3 = T1 > (T3 + diff3) & T1 > min1 & T3 < max3
A4 = T1 > (T4 + diff4) & T1 > min1 & T4 < max4

All Programs +1:
Instead of both pumps **A2** and **A3** one pump **A2** and a three-way valve **A3** are deployed. (pump-valve system between TK1 and TK2).

A2... common pump or bypass valve
A3... Valve (A3/S receives power when filling tank **TK2** (**T3**))

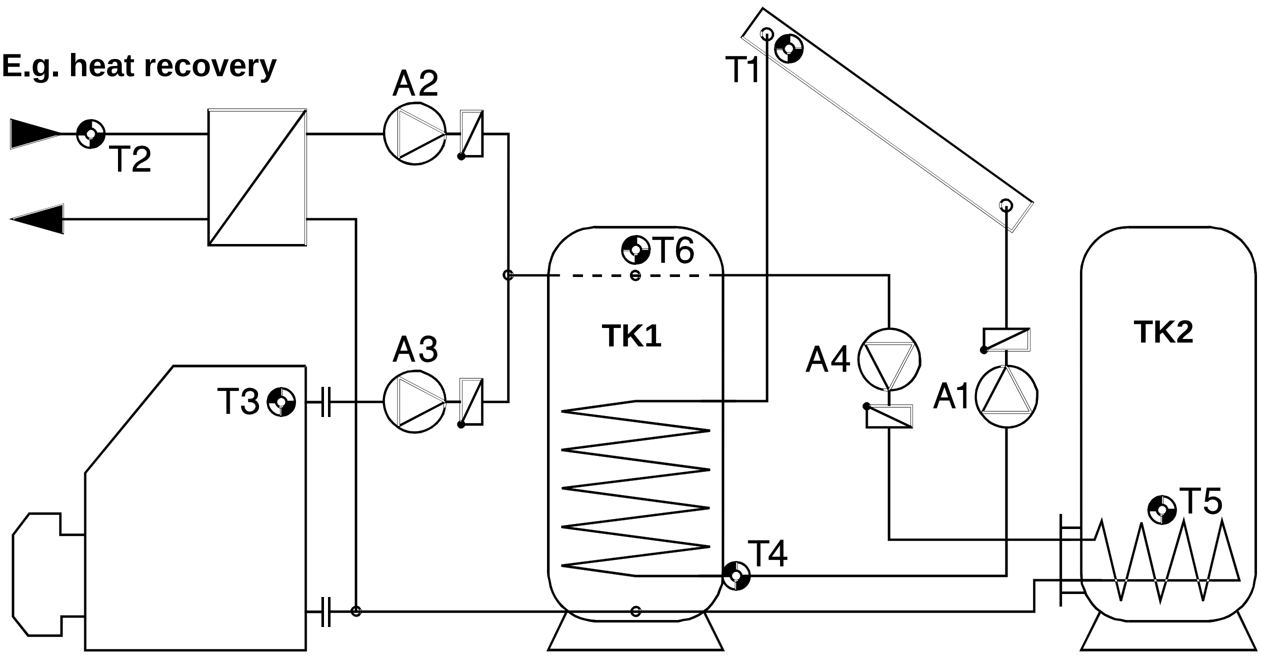
All Programs +2:
Instead of both pumps **A2** and **A4** one pump **A2** and a three-way valve **A4** are deployed. (pump-valve system between TK1 and TK3).

A2... common pump or bypass valve
A4... Valve (A4/S receives power when filling tank **TK3** (**T4**))

All Programs +4: If all of the tanks have reached their maximum temperature, loading to **TK2 (T3)** continues regardless of ***max3***.

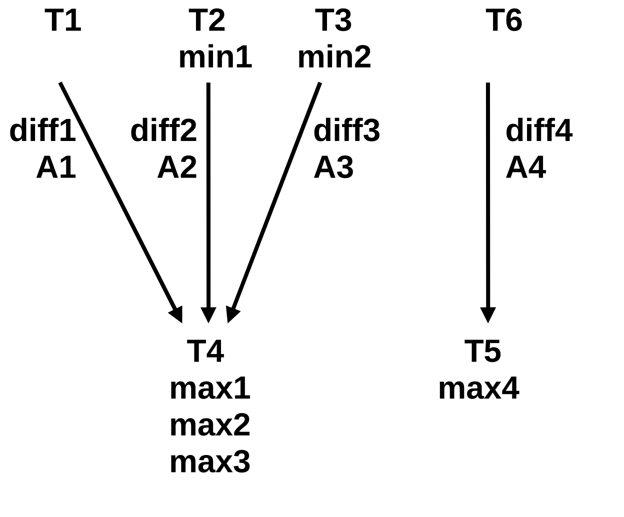
Diagram D0

Diagram D0: Simple solar power system, 2 feed pumps, feed pump for domestic hot water tank



Sensors	**Outputs**
T1…. Collector	A1…. Solar pump
T2…. Heat source	A2…. Feed pump TK1
T3…. Boiler	A3…. Feed pump TK1
T4…. Tank TK1 bottom	A4…. Feed pump TK2
T5…. Tank TK2 bottom	
T6…. Tank TK1 top	

Program D0: Function according to diagram.



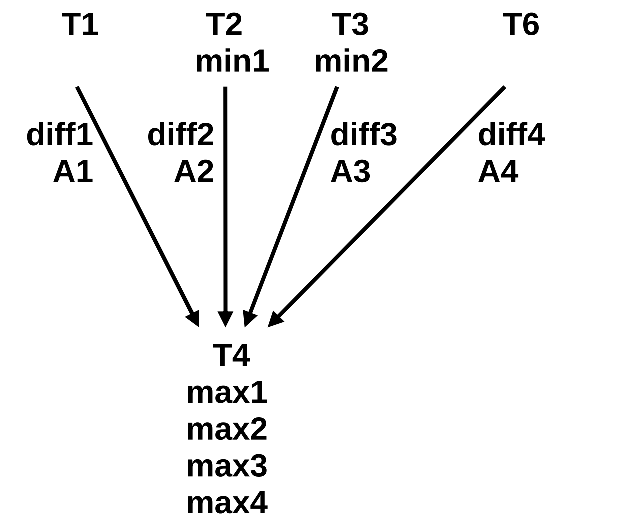
Required settings:

diff1	…coll. T1 – SP1 T4	⇨	**A1**
diff2	…heat source T2 – TK1 T4	⇨	**A2**
diff3	…boiler T3 – TK1 T4	⇨	**A3**
diff4	…TK1 T6 – TK2 T5	⇨	**A4**
min1	…heat source T2	⇨	**A2**
min2	…boiler T3	⇨	**A3**
max1	…limit TK1 T4	⇨	**A1**
max2	…limit TK1 T4	⇨	**A2**
max3	…limit TK1 T4	⇨	**A3**
max4	…limit TK2 T5	⇨	**A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T2 > (T4 + diff2) & T2 > min1 & T4 < max2
A3 = T3 > (T4 + diff3) & T3 > min2 & T4 < max3
A4 = T6 > (T5 + diff4) & T5 < max4

Program D1: Threshold ***min2*** is active at sensor **T6** and switches output **A4**.

Program D2: instead of the independent temperature difference between **T6** and **T5** the difference between **T6** and **T4** applies. Hence it is possible to heat one consumer from four generators.

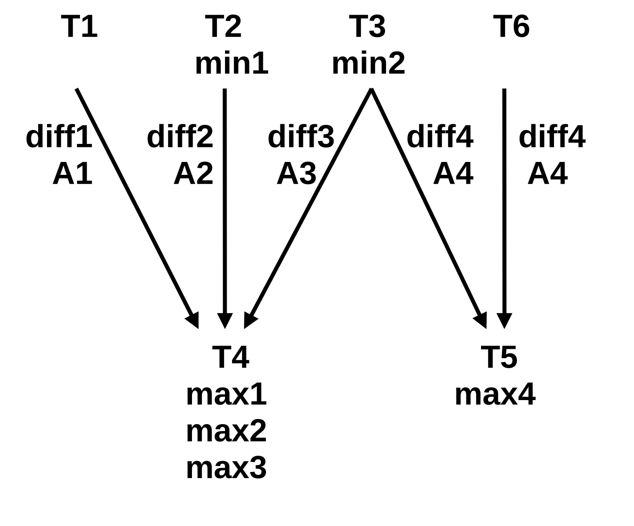


Required settings:

diff1	…coll. T1 – TK T4	⇨	**A1**
diff2	…heat source T2 – TK T4	⇨	**A2**
diff3	…boiler T3 – TK T4	⇨	**A3**
diff4	…heat sourceT6 – TK T4	⇨	**A4**
min1	…heat source T2	⇨	**A2**
min2	…boiler T3	⇨	**A3**
max1	…limit TK1 T4	⇨	**A1**
max2	…limit TK1 T4	⇨	**A2**
max3	…limit TK1 T4	⇨	**A3**
max4	…limit TK1 T4	⇨	**A4**

A4 = T6 > (T4 + diff4) & T4 < max4

Program D4: Sensor **T3** will be compared with **T5** additionally to sensor **T4**. Hence the boiler can feed tank **TK1** (**T4**) as well as tank **TK2** (**T5**).



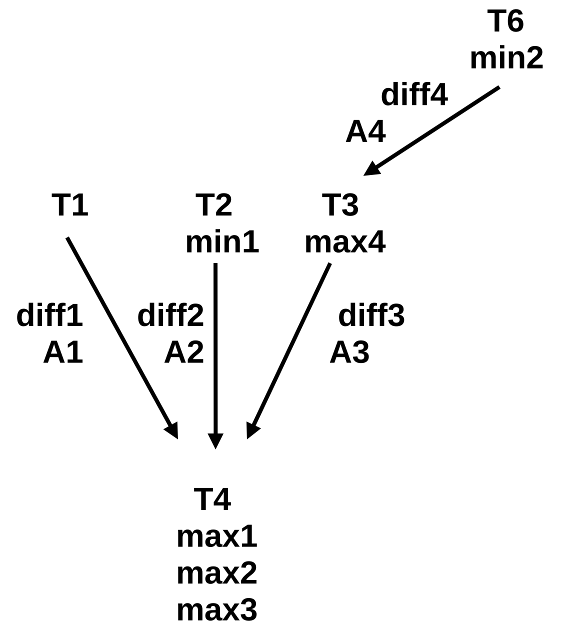
Required settings:

diff1	…coll. T1 – TK1 T4	⇨	**A1**
diff2	…heat source T2 – TK1 T4	⇨	**A2**
diff3	…boiler T3 – TK1 T4	⇨	**A3**
diff4	…TK1 T6 – TK2 T5	⇨	**A4**
	boiler T3 – TK2 T5	⇨	**A4**
min1	…heat source T2	⇨	**A2**
min2	…boiler T3	⇨	**A3, A4**
max1	…limit TK1 T4	⇨	**A1**
max2	…limit TK1 T4	⇨	**A2**
max3	…limit TK1 T4	⇨	**A3**
max4	…limit TK2 T5	⇨	**A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T2 > (T4 + diff2) & T2 > min1 & T4 < max2
A3 = T3 > (T4 + diff3) & T3 > min2 & T4 < max3
A4 = T6 > (T5 + diff4) & T5 < max4
or T3 > (T5 + diff4) & T3 > min2 & T5 < max4

Diagram D0

Program D5: Instead of the independent temperature difference **T6** – **T5** the controller compares the sensors **T6** and **T3**.

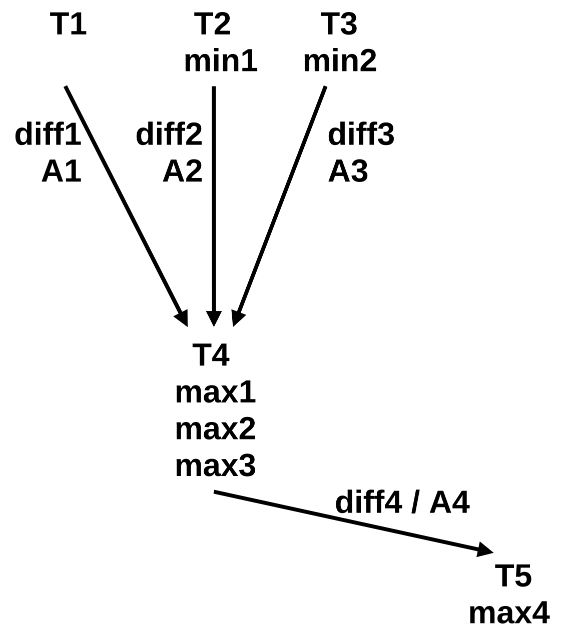


Required settings:

diff1	…coll. T1 – TK1 T4	⇨	**A1**
diff2	…heat source. T2 – TK1 T4	⇨	**A2**
diff3	…sensor T3 – TK1 T4	⇨	**A3**
diff4	…sensor T6 – sensor T3	⇨	**A4**
min1	…heat source T2	⇨	**A2**
min2	…Sensor T6	⇨	**A4**
max1	…limit TK1 T4	⇨	**A1**
max2	…limit TK1 T4	⇨	**A2**
max3	…limit TK1 T4	⇨	**A3**
max4	…limit sensor T3	⇨	**A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T2 > (T4 + diff2) & T2 > min1 & T4 < max2
A3 = T3 > (T4 + diff3) & T4 < max3
A4 = T6 > (T3 + diff4) & T6 > min2 & T3 < max4

Program D6: Output **A4** switches only because of the following function.



Required settings:

diff1	…coll. T1 – TK1 T4	⇨	**A1**
diff2	…heat source T2 – TK1 T4	⇨	**A2**
diff3	…boiler T3 – TK1 T4	⇨	**A3**
diff4	…TK1 T4 – TK2 T5	⇨	**A4**
min1	…heat source T2	⇨	**A2**
min2	…boiler T3	⇨	**A3**
max1	…limit TK1 T4	⇨	**A1**
max2	…limit TK1 T4	⇨	**A2**
max3	…limit TK1 T4	⇨	**A3**
max4	…limit TK2 T5	⇨	**A4**

A1 = T1 > (T4 + diff1) & T4 < max1
A2 = T2 > (T4 + diff2) & T2 > min1 & T4 < max2
A3 = T3 > (T4 + diff3) & T3 > min2 & T4 < max3
A4 = T4 > (T5 + diff4) & T5 < max4

Program D7: Outputs **A3** and **A4** switch only because of the following function.

A3 = T3 > (T4 + diff3) & T4 < max3
A4 = T4 > (T5 + diff4) <u>& T4 > min2</u> & T5 < max4

Installing instructions

Installing the sensor(s):

The sensors must be arranged and installed properly for the system to function correctly. To this end, make sure that they are completely inserted in the immersion sleeves. The threaded cable connections provided can be used to provide 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 black 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 in a t-shaped connector on the outer collector's supply line collector tube. Screw an immersion sleeve with an MS (brass) threaded cable connection (= to protect from moisture) into this T-shaped connector and insert the sensor. To protect from lightening, the connection box has parallel overvoltage protection between the sensor and the extension cable.
- **Boiler sensor (boiler supply line):** This sensor is either screwed into the boiler with an immersion sleeve or attached to the boiler's supply line at a slight distance.
- **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 hot water during the heating season. The plastic threaded cable connections provided can be used to provide strain relief. They must not be installed below the register / exchanger.
- **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 be used between the middle and the upper third of the buffer tank using the immersion sleeve as a reference sensor for the heater's hydraulics or - flush with the tank's wall - 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 that suitable material is used (corrosion and temperature resistance, etc.). Then, the sensor has to be well insulated so that the tube temperature can be taken exactly and influences from the ambient temperature can be ruled out.

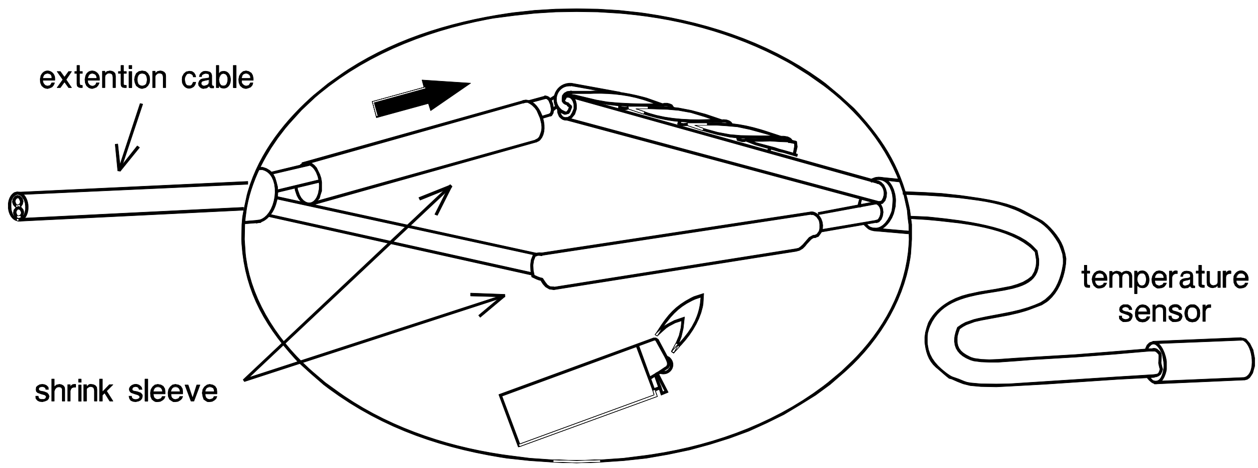
Installing instructions

Hot water sensor: When the control system is used in hot water systems with an external heat exchanger and variable-speed pump, changes in the amount of temperature have to be **reacted to quickly**. Hence, the hot 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 along the NIRO tube (inoxydable). The heat exchanger has to be installed upright with the hot 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 extension of the assembly rail. To this end, the sensor case has a blind hole that can be opened at any time.

Line extension

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 obtain interference-free signal transmission (to avoid measurement fluctuations) the sensor lines must not be subject to interference factors. With the generally accepted use of unshielded cables sensor lines are to be laid in their own cable channel at least 20 cm away from mains cables.

Installing the unit

<u>CAUTION</u>! ALWAYS PULL THE MAINS PLUG BEFORE OPENING THE CASE!

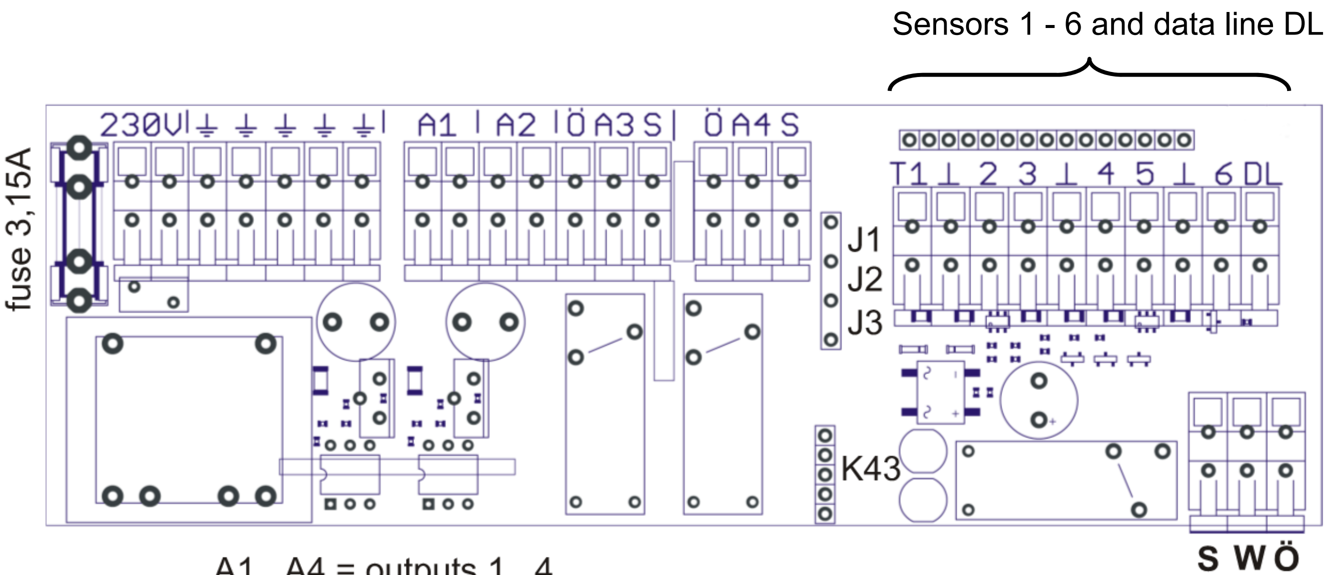
Unscrew the 4 screws at the edges of the case. The controlling electronic is situated in the cover plate and is connected by a ribbon cable to the mains module, which is set in the basin of the case. The basin of the case can be screwed on through the two holes to the wall using the fastening screws provided (**with the cable bushings downwards**). For easier handling the mains module can be token out of the case.

Electrical connection:

Warning: The electrical connection should only be made by a professional electrician in accordance with the relevant local guidelines. The sensor lines may not be fed through the same cable channel as the supply voltage.

<u>Attention:</u> Only work on the control system when it is dead. Assembling the device should always be done without tension.

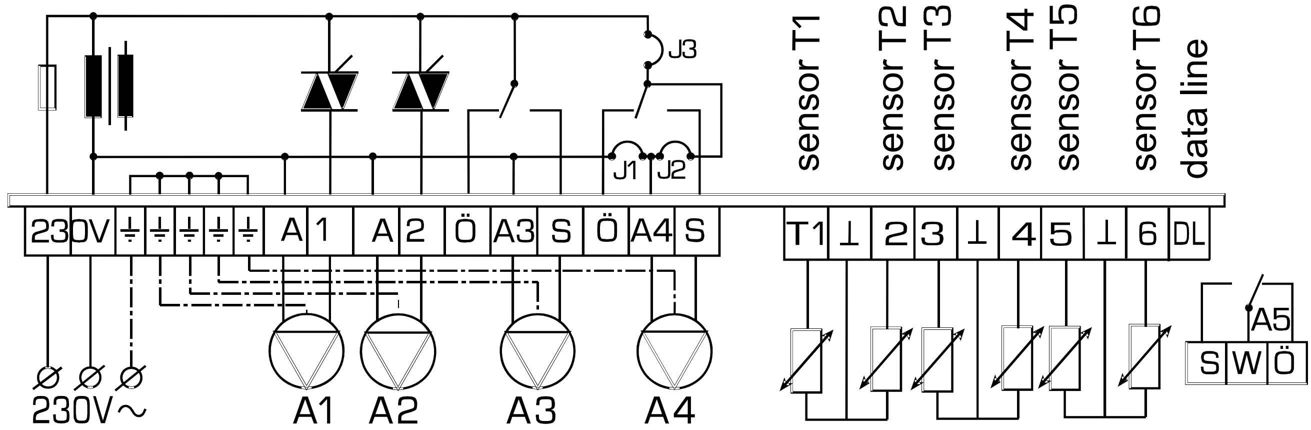
All sensors and pumps resp. valves must be connected to the controller according to the numbering of the chosen diagram.



The relay output A4 can be made potential-free by setting the **jumpers** J1-J2-J3. For this purpose the jumper J2 must be set in the center instead of jumpers J1 and J3 (standard).

All sensor ground wires are internally looped and can be exchanged as need be.

Installing instructions



W..... root C
S...... make contact NO
Ö......break contact NC

Note: 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.

Data line (DL)

The data line was specially developed for the UVR series and is only compatible with the products of Technische Alternative. It is only made for generating outputs and is suitable as interface to the PC for transferring the measured temperatures and output states.

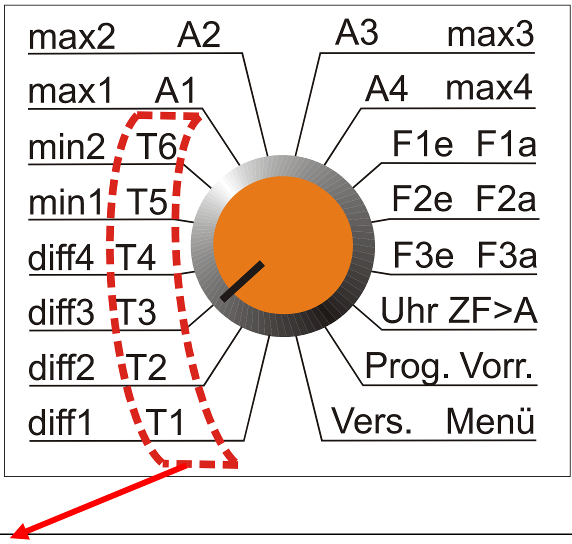
Any cable with a cross section of 0.75 mm² can be used for the data link (e.g. twin-strand) having a max. length of 30 m. For longer cables, we recommend the use of shielded cable.

Interface to PC: The data is cached via the data converter **D-*LOGG*** or boot loader **BL-NET** and transferred to the PC on request. An individual power pack (CAN-NT) is necessary for supplying power to the **BL-NET**!

Selector switch

The selector switch has 16 different positions. Each position has two functions (e.g. switch position ***diff2* / T2**). The value, which is nearer to the selector switch, will be displayed without pressing of the yellow key "***Eingabe***" (e.g. **T2**). By pressing the yellow key "***Eingabe***" (= input) the second value will be displayed (e.g. ***diff2***). The blue keys "***ab***" (= down) resp. "***auf***" (= up) change the settings. Holding the key pressed increases resp. decreases constantly the value, short taps cause a change of 1.

The interior legend (e.g. **T5** = displayed temperature of sensor 5) has **no direct connection** to the outside legend (e.g. ***min1*** = temperature limit of the tank). E.g. in diagram 0 the sensor **T5** has connection with ***min1***, but **T3** corresponds with ***max1***.



T1 - T6	Actual temperature of the sensors
A1 - A4	State of the outputs („Ein" = ON, „Aut" = automatic mode, „Aus" = OFF) The changing occurs by pressing the blue keys *ab/auf* (down/up).
diff1 - 4	Difference temperatures, setting range: 0 to 99 K
min1, 2	Minimal thresholds, setting range: 0 to 150 °C
max1 - 4	Limit of storage temperature, setting range: 0 to 150 °C
F1e - F3e	Switch-on time of time windows 1 to 3
F1a - F3a	Switch-off time of time windows 1 to 3
Uhr	Time (resolution: 10 minutes), setting by the blue keys *ab*/*auf* (down/up).
F>A	Assignment menu (which time window interacts with which output) Setting: see chapter „Assignment of the time windows"
Prog	Selection of the program number according to the chosen diagram. The program number defines the **basic function** of the controller and is the **most important input**. Setting by the blue keys *ab*/*auf* (down/up)
Vorr	Priority menu. Assignment of priority 0 to 4 to the outputs: 0 = no priority, 1 = highest, 4 = lowest priority; setting: see chapter "Assignment of priority"
Vers	Actual software version (important for enquiry calls); it cannot be changed.
Menü	Main menu for access to the sub menus of the controller

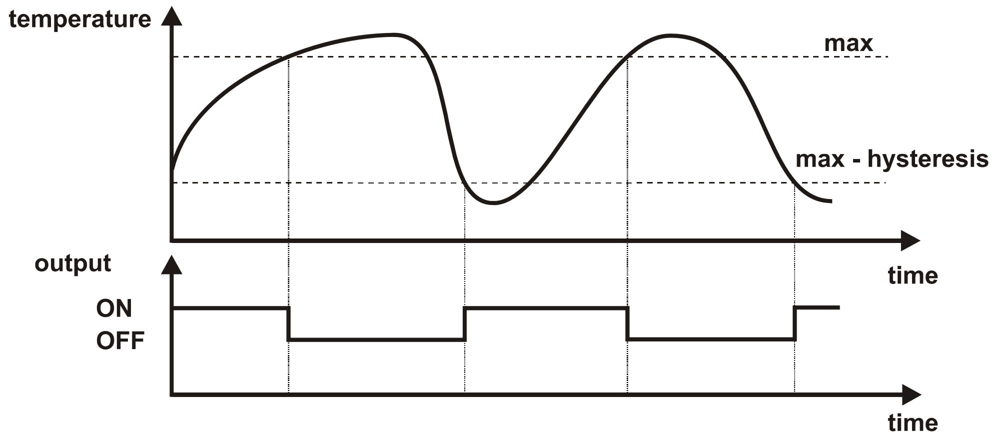
Selector switch

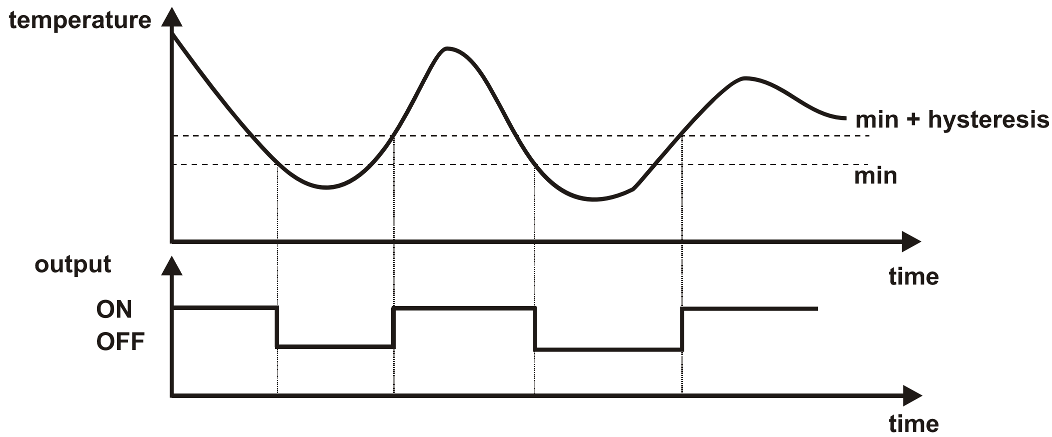
diff: The output will be released, when the temperature difference between two set sensors exceeds this value. ***diff*** is the basic function (differential control) of this unit for most programs. Recommendation: In solar applications, ***diff*** should be set to 7 - 10K. Somewhat lower values suffice for the feed pump program. The hysteresis has an increasing effect, i.e. reaching the temperature difference plus hysteresis the output will switch on, falling below the difference it will switch off. (ex works = 5,0K)

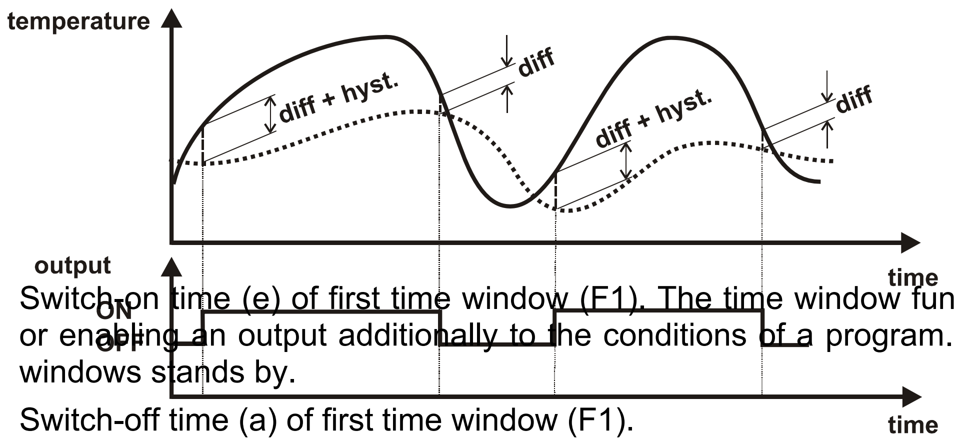
min: The minimal threshold ***min*** generally prevents boilers from being clogged with soot. Recommended value in this case: 60 to 70°C. The hysteresis has an increasing effect, i.e. reaching the threshold plus hysteresis the output will switch on, falling below the threshold it will switch off. (ex works = 0°C)

max: The maximum function limits the storage of tanks. The hysteresis has a decreasing effect, i.e. reaching the threshold the output will switch off, falling below the threshold minus hysteresis it will switch on again. (ex works = 90 °C)

Schematic representation of setting values:







F1e: Switch-on time (e) of first time window (F1). The time window function allows blocking or enabling an output additionally to the conditions of a program. A total of three time windows stands by.

F1a: Switch-off time (a) of first time window (F1).

Uhr: Setting of the actual time, important for correct function of time windows. The controller has a power reserve of approx. 24 hours, i.e. when blackout longer than 24 hours occurs, time must be set again.

F>A: Menu for assignment of each time window to one of the 4 outputs.

Assignment of time windows (F>A)

Position of selector switch: Uhr / F>A

Eingabe (2 Sek.) Pressing the yellow „***Eingabe***" key for 2 seconds causes entry or exit to/from the sub menu

Eingabe normal (short) pressing switches from one position to the next

ab auf The value can be changed with the blue keys ***ab/auf*** (down/up).

ew ex works = original setting by the factory

14.5 **14.5** – actual time = 2:50 pm. Setting by pressing the blue keys ***ab/auf***.

Eingabe (2 Sek.) Pressing the yellow „***Eingabe***" key for 2 seconds causes entry to the sub menu **F>A**

F 14 **F14** – Assignment of time window **1** to output **A4**. In the time window (**F1e – F1a**) the respective program determines the status of the selected output (**A4**). Outside the time window it is switched off.
ew = F10 (time window 1 inactive)

F 23 **F23** - Assignment of time window **2** to output **A3**. In the time window (**F2e – F2a**) the respective program determines the status of the selected output (**A3**). Outside the time window it is switched off.
ew = F20 (time window 2 inactive)

F 30 **F30** – Time window **F3e – F3a** is not assigned to an output. Therefore it is inactive.
ew = F30 (time window 3 inactive)

F 14 **F14** – Pressing the yellow „***Eingabe***" key at the end of the menu, the run starts again. Going back to normal operation happens by pressing the yellow key „***Eingabe***" for 2 seconds, turning the selector switch or automatically after one minute.

Selector switch

Program selection (Progr.), assignment of priority (Vorr.)

Position of selector switch: Prog. / Vorr.

Eingabe (2 Sek.) — Pressing the yellow „***Eingabe***“ key for 2 seconds causes entry or exit to/from the sub menu

Eingabe — normal (short) pressing switches from one position to the next

ab auf — The value can be changed with the blue keys ***ab/auf*** (down/up).

ew — ex works = original setting by the factory

P 16 — **P16** – Actual used program : 16
Setting by pressing the blue keys ***ab/auf***.

Eingabe (2 Sek.) — Pressing the yellow „***Eingabe***” key for 2 seconds causes entry to the sub menu **Vorr.** (= priority)

A 12 — **A12** – Assignment of **second** priority to the output **A1**. I.e. the output will be enabled, when all superior outputs with priority 1 are switched off.
ew = A10 (output **A1** switches independently)

A 21 — **A21** – Output **A2** has the highest priority 1.
ew = A20 (output **A2** switches independently)

A 31 — **A31** – Output **A3** has the same (highest) priority 1 as **A2**.
ew = A30 (output **A3** switches independently)

A 40 — **A40** – Output **A4** has assigned no priority. It can switch independently from all other outputs.
ew = A40 (output **A4** switches independently)

A 12 — **A12** – Pressing the yellow „***Eingabe***” key at the end of the menu, the run starts again. Going back to normal operation happens by pressing the yellow „***Eingabe***” key for 2 seconds, turning the selector switch or automatically after one minute.

Vers: In this switch position the software version of the computer is displayed (e.g. E5.2). It shows the “intelligence” of the controller and must be advertised to the manufacturer for enquiry calls. It cannot be changed.

Menü: „Menü“ (= menu) allows the setting of about 50 different parameters, which are set ex works to standard settings. Sometimes it is necessary to change them. A change of these values should only be done, if the user has knowledge of all functions as these settings can change the basic features of the controller. Different parameters are stored in sub menus.

Additional functions

Programming procedure („Menü“)

Position of selector switch: Vers. / Menü

Eingabe 2 Sek. — Pressing the yellow „***Eingabe***“ key for 2 seconds causes entry or exit to/from the sub menu

Eingabe — normal (short) pressing switches from one position to the next

ab auf — The value can be changed with the blue keys ***ab/auf*** (down/up).

ew — ex works = original setting by the factory

E5.0 — **E5.0** – **software version** of controller: It shows the „intelligence“ of the device and cannot be changed.

2 Sek. — ⇨ Pressing the yellow „***Eingabe***“ key for 2 seconds causes entry to the sub menu section

SEn — **SEn** – **sensor type**: Selection of sensor type KTY (=semi-conductor) or Pt1000 (=platinum)

ew = all sensors Pt1000

2 Sek. — ⇨ Entry to sub menu „**sensor type**“

FCo — **FCo** – **function control**: Activating of the detection function (sensor failure, circulation problems). Error messages are displayed, if a failure occurs.

ew = function control deactivated

2 Sek. — ⇨ Entry to sub menu „**function control**“

Utb — **Utb** – **collector excess temperature limit** – switch-off function when too high collector temperature occurs.

ew = collector excess temperature limit function **active**

2 Sek. — ⇨ Entry to sub menu „**collector excess temperature limit**“

StF — **StF** – **start function**: settings for start-up of pumps in time for solar power systems (ideal for tube collectors)

ew = start function deactivated

2 Sek. — ⇨ Entry to sub menu “**start function**”

Pri — **Pri** – **solar priority**: settings for priority conditions

ew = all values are set to „standard system“

2 Sek. — ⇨ Entry to sub menu „**solar priority**“

PnL — **PnL** – **after-running time**: Settings for each output

ew = no after-running times

Additional functions

⇨ Entry to sub menu „ **after-running time** “

HSt – **hystereses**: Setting of the hystereses for exact balancing of the system

ew = all hystereses at 3K per 64°C

⇨ Entry to sub menu „ **hystereses** “

Pd1 – **pump speed control** for output **A1**: Sub menu for the speed processor for activation and alignment of speed control for output A1

ew = pump speed control function deactivated

⇨ Entry to sub menu „**pump speed control** output 1“

Pd2 - **pump speed control** for output **A2**: Sub menu for the speed processor for activation and alignment of speed control for output A2

ew = pump speed control function deactivated

⇨ Entry to sub menu „**pump speed control** output 2“

Hau – **auxiliary output** A5: Linking of the auxiliary output **A5** to the outputs A1 – A4 and the time windows F1 – f3

ew = AUS (=off) (auxiliary output switched off)

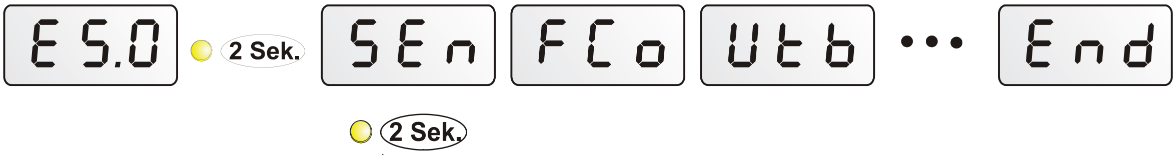
⇨ Entry to sub menu „ **auxiliary output** A5 “

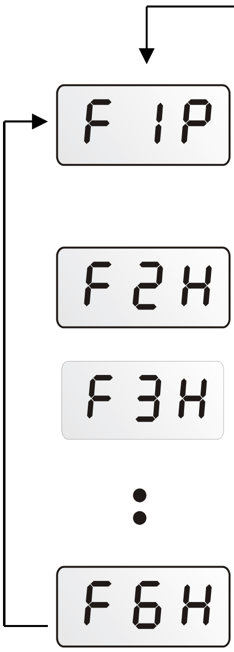
End – end of the passage: the passage can be repeated. Exit from each display to normal operation happens by pressing the yellow „***Eingabe***“ key for 2 seconds, turning the selector switch or automatically after one minute.

Sensor type

Solar collectors reach standstill temperatures of 200 to 300°C. No value above 200°C is expected due to the sensor installation point and physical properties (dry steam does not conduct heat well, for instance). The standard Pt1000 series sensors can be permanently exposed to 250°C and briefly to 300°C. KTY10 sensors are designed for brief use at 200°C. The **Sensor type** menu enables changing over of the individual sensor inputs between Pt1000 and KTY types.

As default factory setting all inputs are set to Pt1000 type.





F1P – Sensor 1 is set to **Pt1000** (standard). Changing to **KTY** by pressing the blue “*ab/auf*” keys (down/up). A short tap at the yellow key “*Eingabe*” switches to the next sensor.
ew = F1P

F2H – Sensor 2 is set to **KTY** .
ew = F2P

F3H - Sensor 3 is set to **KTY**.
ew = F3P

ew = F4P
ew = F5P

F6H – Sensor 6 is set to **KTY**. A short tap at the yellow key “*Eingabe*” switches back to the first sensor. The passage can be repeated.
ew = F6P

The radiation sensor **GBS** can be connected to each sensor input (sensor type **KTY**) and assigned to the start or the priority function.

Additional functions

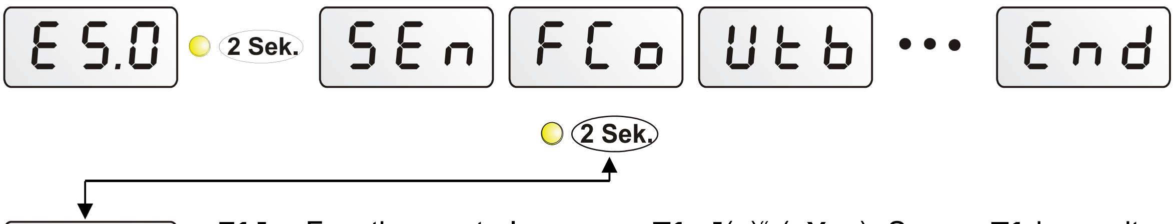
FCo Function control

Function control allows detection of sensor interruption or short circuit (error code **FF1** – **FF6**), missing circulation caused by too high temperatures (>40K) between solar panel and consumer after 10 minutes pump-run (error code **FF7**) and circulation error (error code **FF8**) of the solar power system.
For detection of circulation error a temperature sensor gets a threshold temperature. Circulation error applies, if the sensor exceeds the set threshold temperature between 00:00 to 5:00 am.
If an error occurs the display shows alternating to the usual display an error code in one-second-intervals.

FF1...... **FF6**......Short circuit or interruption T1 to T6

FF7...... Temperature difference between solar collector and tank is more than 40K after 10 minutes pump run. Probably no circulation!

FF8...... Circulation error. The sensor selected under ***Fc*** has exceeded the temperature threshold ***L*** in the period 00:00 to 05:00 am.



F1J

F1J – Function control – sensor **T1** „**J**(a)“ (=**Yes**): Sensor **T1** is monitored for interruption and short circuit. If an error occurs the message “**FF1**” (=function error at sensor **T1**) will be displayed during normal operation
ew = F1n

F2n

F2n – Function control – sensor **T2** “**no**”: Sensor **T2** is not monitored. Nevertheless during normal operation an interruption (= 999°C) or a short circuit (= -99°C) will be displayed at the sensor temperatures.
ew = F2n
ew = F3n
ew = F4n
ew = F5n

F6n

F6n – Function control – sensor **T6** “**no**”
ew = F6n

FdJ

FdJ – Function control – difference temperature “**J**(a)” (=**Yes**): If in the just active solar circuit after more than 10 minutes pump run the temperature difference is still more than 40K, an error code FF7 is displayed.
ew = Fdn

Fc4

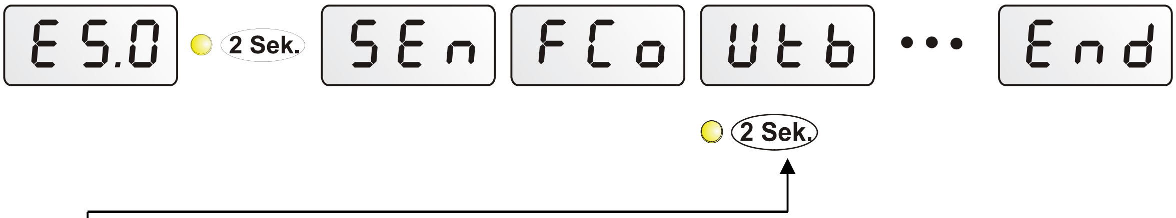
Fc4 – Function control – circulation error at sensor **T4**. If sensor **T4** exceeds between 00:00 and 05:00 am the value “***L***”, error code **FF8** is displayed during normal operation.
ew = Fc0 (off)

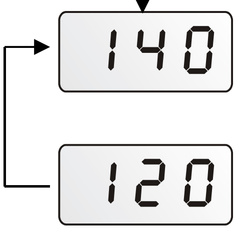
L35

L35 – Increases the temperature at sensor „***Fc***“ between 00:00 and 05:00 am over **35**°C the error code **FF8** is displayed. “***L***” will not be displayed, if function control for circulation error is not activated.
ew = 70

Collector excess temperature limit

Steam builds up when the system is not circulating. When it automatically switches on again, the pump does not have the pressure to lift the fluid level above the highest point in the system (collector feed line). If there is no circulation, the load on the pump is enormous. This function allows the pump to be blocked above a set collector temperature threshold until a second set threshold is fallen short of.





Temperature above which the output is to be blocked (as long as the output is set to „automatic")

ew = 140

Temperature threshold releasing the output.

ew = 100

The higher temperature is the switch-off temperature; the lower is the temperature, at which the solar pump will be switched on again.

Switch-off temperature can be set up to 199°C. Setting over this value „**AUS**" is displayed (=off). That means that the function is deactivated.

Additional functions

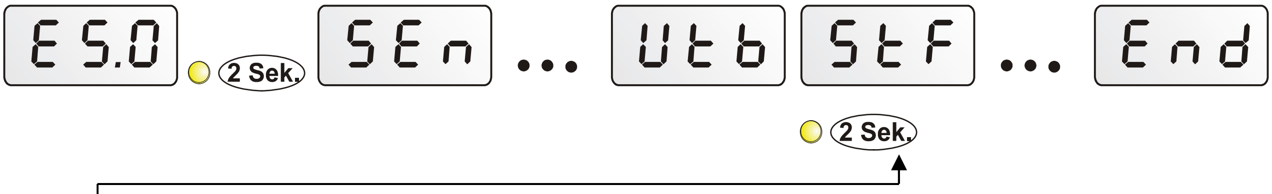
Start function (ideal for tube collectors)

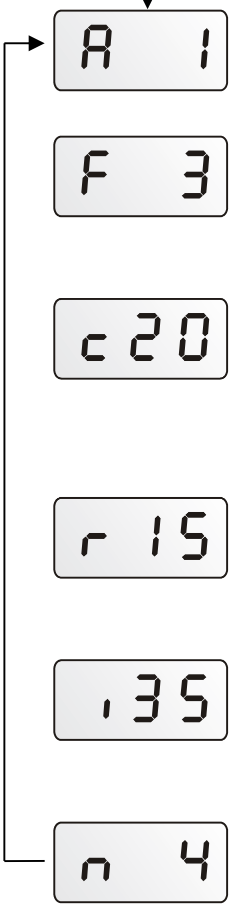
In the morning, solar power systems sometimes do not “start” quickly enough because the warm heat transfer medium does not reach the collector sensor. Flat collector panels and **forced-circulation vacuum tubes** generally lack sufficient gravitational force.

The start function tries to release a rising interval while the collector temperature is constantly monitored. The computer first determines the weather conditions based on the constant measurements of the collector temperatures. It thus determines the right time for a short rinsing interval to maintain the actual temperature for normal operation.

When the radiation sensor is used, the solar radiation is used for the calculation of the start function (radiation sensor **GBS 01** - non-standard accessory).

The start function is deactivated ex works.





A 1 – **Activation** of start function. **A 1** means start function active, **A 0** = start function deactivated
ew = A 0

F 3 – Connection of a radiation sensor to sensor input **T3**. **F 0** means, that the average temperature (long-term mean regardless of the weather) is calculated instead of the radiation sensor value.
ew = F 0

c20 – **radiation threshold** 200W/m², above which rinsing is allowed. Without a radiation sensor, the computer calculates the necessary temperature increase for the long-term mean that launches rinsing from this value.
ew = 15

r15 – **Pump runtime** (rinsing time) in seconds. During this time, the pump should have pumped roughly half of the content of the collector’s heat transfer medium past the collector sensor.
ew = 15

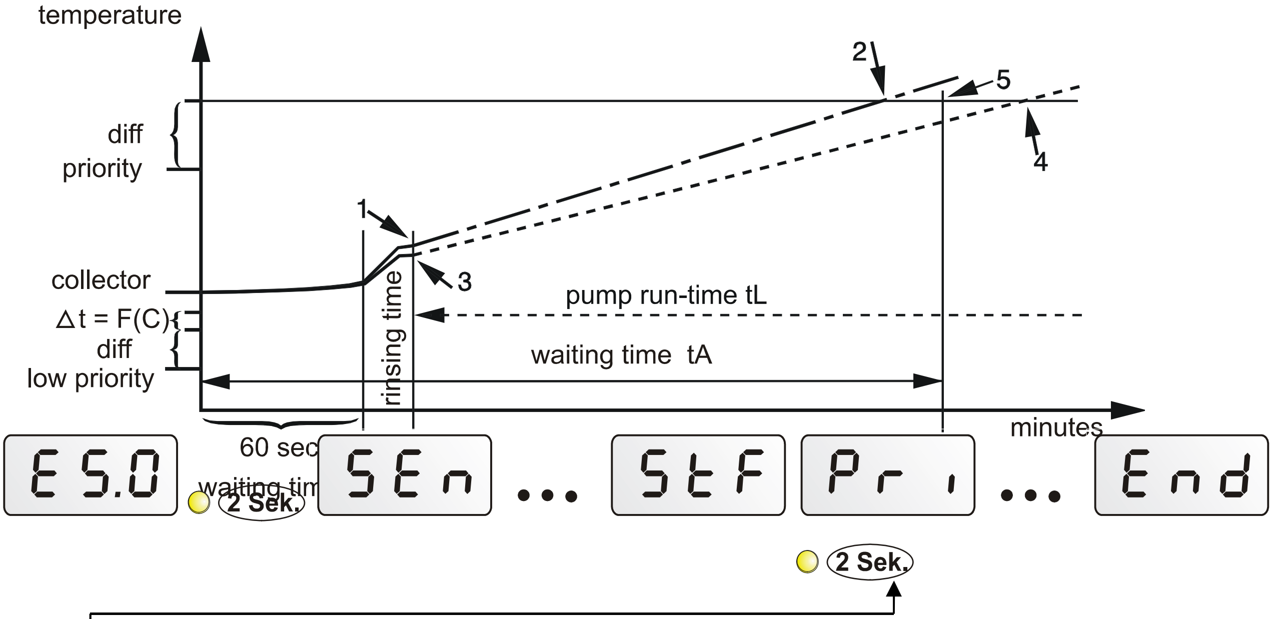
i35 – Maximum allowable **interval** between two rinses in minutes (example: 35 minutes). This time is automatically reduced according to the temperature increase after rinsing.
ew = 20

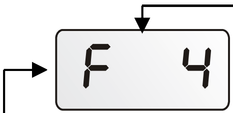
n 4 – **Number of start attempts** (= counter). The system is automatically reset for a start attempt if the last start attempt was more than four hours ago.

Priority menu

When the consumers with lower priority are being filled, the unit monitors the irradiation at the radiation sensor or the collector temperature. If a radiation threshold C is reached or the collector temperature is exceeded by a value calculated from the threshold for the low-priority consumer, the priority timer is activated. The pump then switches off for a set waiting time of 60 sec (waiting time 1)

After the rinsing time (1, 3), the computer calculates the increase in collector temperature. It detects whether the set waiting time tA has been reached to heat the collector to the priority temperature. In the second case, the unit waits until the priority has been reached to switch. If the computer detects that the increase will not suffice within the tA time (4, 5), it discontinues the process and reactivates the time again after tL. **At tL=0, the low-priority is only allowed when the maximum threshold for the priority is reached (=absolute priority).**





F 4 – Sensor **T4** is a **radiation sensor** starting the priority timer. If the radiation sensor exceeds the radiation threshold "***c***", the priority timer is launched. Without the radiation sensor, the launch is based on the collector temperature. Setting range: F0 (= no radiation sensor) to F4
ew = F 0

c20 – **radiation threshold** in W/m² (e.g. 200 W/m²) above which rinsing is allowed. Without a radiation sensor (**F 0**), the computer calculates the necessary temperature increase for the long-term mean that launches rinsing from this value. Setting range: c 0 to 99
ew = 30

tA5 – **Waiting time of low priority** (5 minutes). This is the time in which the collector should reach the temperature necessary for priority operation. Setting range: 0 to 9 minutes (tA0 to tA9)
ew = 5

tL3 – **Pump run-time** of low-priority (e.g. 30 minutes). If the solar radiation to switch to priority is not sufficient, the low priority is allowed again for this time. Setting range: 0 to 90 minutes (tl0 to tl9) in increments of 10 minutes, **ew** = 2

Additional functions

PnL After-running time

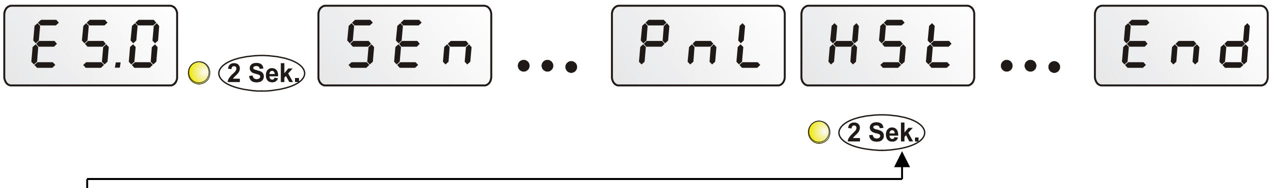
During the start phase, the pumps may repeatedly switch on and off for a long time, especially with solar and heating systems with long hydraulic system lines. This response can be reduced by using a speed control or increasing the pump after-run time. After access of the sub menu **PnL** the display for the after-running time for output 1 is visible:
(Setting range: 10 sec to 9 min; 0 = no after-running time)

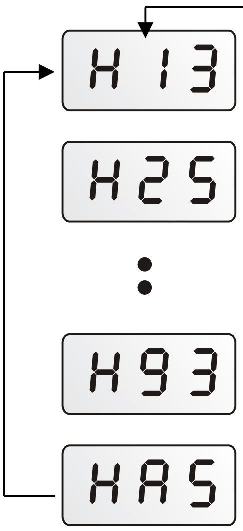
E.g.: **t1.3** - after-running time of output 1 is 30 seconds.
E.g.: **t13** - after-running time of output 1 is 3 minutes.

A short tap at the yellow key “***Eingabe***” switches to the after-running time of output 2. Setting ex works for all outputs is 0 (t10, t20, t30, t40).

HSt Hystereses

Hysteresis means the difference between switch-on and switch-off temperature. I.e. a thermostat with hysteresis 10K, which is set to 70°C, switches off at 70°C and switches on again at 60°C. Hystereses in UVR 64 are not constant, but they change according to the temperature and can be set from 1 to 9 K per 64°C.





H13 – hysteresis of switch function 1 (diff1) is 3K per 64°C.
ew = H13

H25 - hysteresis of switch function 2 (diff2) is 5K per 64°C.
ew = H23

H3…diff3 **H4**…diff4 **H5**…min1 **H6**…min2 **H7**…max1 **H8**..max2
ew = H3 to H8 : 3K/64°C

H93 - hysteresis of switch function 9 (max3) is 3K per 64°C.
ew = H93

HA5 - hysteresis of switch function 10 = A (max4) is 5K per 64°C.
ew = HA3

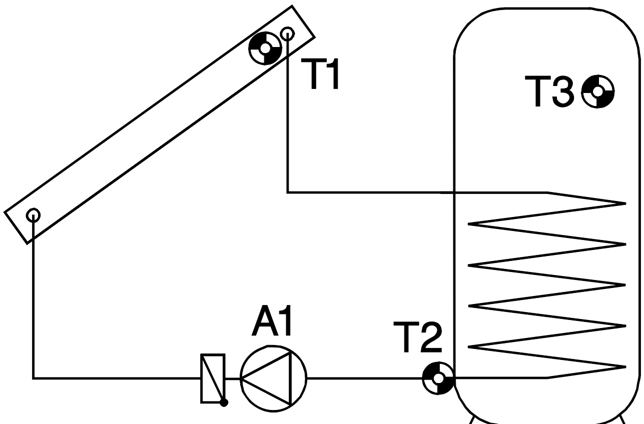
The advantage of hystereses change according to the temperature is, that different consumers resp. tanks can be used with same settings. Thus a swimming pool with maximum temperature of 30°C gets a lower hysteresis than a buffer with maximum temperature of 90°C.
Example: Maximum for pool is set to 30°C, hysteresis = 3K/64°C (=ex works).
The hysteresis at 30°C results to approximately the half – therefore ca. 1.5K. Feed is blocked at 30°C and is enabled at approx. 28.5°C.
Hystereses of difference values diff 1 to 4 refer to the colder sensor. E.g. if the colder sensor has 64°C, the output will be switched on exceeding the difference ***diff*** + hysteresis 3K and switched off falling below the difference ***diff***.

Pd1 Pd2 Pump speed control

The pump speed control can be used to change the delivered quantity - i.e. the volume flow - of usual commercial circulating pumps in 30 steps. This provides constant levels of (differential) temperatures in the system.

Setting of optional sensors and temperatures is possible. The pump speed control is – if activated – allowed, when the normal difference- and/or thermostat function enables the output, i.e. it is like a device, which is connected after the normal controller.

This simple solar diagram will now be used to show the possibilities of this process:



◆ **Absolute value control A** = maintaining a sensor

T1 can be kept at one temperature (such as 60°C) very well by using the speed control. If the solar radiation is reduced, **T1** becomes colder. The control unit then lowers the speed and hence the flow rate. However, that causes the warm-up time of the heat transfer medium in the collector to increase, thus increasing **T1** again.

A constant return (**T2**) may make sense as an alternative in various systems (such as boiler feeds). **Inverse** control characteristics are necessary for this (identified by a minus). If **T2** increases, the heat exchanger does not provide enough energy to the tank. The flow rate will then be reduced. The longer dwell time in the exchanger cools the heat transfer medium more, thus reducing **T2**.

It does not make sense to keep **T3** constant as the variation in the flow rate does not directly affect **T3**; hence, no regulator circuit will result.

Additional functions

<u>Differential control F</u> = keeps the temperature constant between two sensors.

Keeping the temperature difference constant between **T1** and **T2**, for instance, allows for “shifting” operation of the collector. If **T1** drops due to lower irradiation, the difference between **T1** and **T2** thus drops. The control unit then lowers the speed, which increases the dwell time of the medium in the collector and hence the difference between **T1** and **T2**.

An inversely written ***F*** means an inverse speed characteristic, i.e. the speed increases with falling difference.

Note: This difference “***d***” always has to be greater than the switch-off difference ***diff*** of the basic function. If „***d***“ is lower, the basic function of pump release blocks before the speed control has reached the desired value.

◆ **<u>Limiter function L</u>** = If a set temperature event occurs, the speed control starts, thus keeping a sensor constant.

If, for instance, **T3** reaches 55°C (activation threshold), the collector should be kept at a certain temperature. Maintaining a sensor then works as with absolute value control. An inversely written ***L*** means an inverse speed characteristic, i.e. the speed increases with falling temperature.

The three described methods can be activated all together. If the absolute value control (maintaining a sensor) and the differential control (maintaining the difference between two sensors) are both active, the slower of the two speeds “wins out”. The limiter function “overwrites” the speed results from other control methods. A set limit can thus block the control of absolute values or differences.

In the example, keeping the collector temperature at 60°C with the absolute value control is blocked when the tank has already reached 55°C at the top = the fast provision of hot 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 value automatically requires full speed (such as S1 = 10°C) has to be entered as the new desired temperature in the event control.

<u>Waveform</u>

Wave packets - only for circulating pumps with standard motor dimensions. Here, individual half cycles are bled in to the pump motor. The pump runs on pulses and only produces a smooth flow of the heat transfer medium when the rotor’s moment of inertia has been overcome.

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.

Pump standstill

The wave packet method (standard) allows for variations in the volume flow by a factor of 10 in 30 increments. If the flow rate is too low, flap valves may cause a system standstill. In addition, low power stages at low speeds may cause the rotors to stop. Such a standstill may sometimes be desired, which is why stage 0 is allowed as the lowest stage.

The best speed limit is found in a simple test. Use the command "***u***" to set a speed for testing. When setting the parameter "***u***", the pump runs with the desired speed for system control. Remove the rotor lid to see the rotor. Then lower the speed until the rotor stops. Set the limit three increments above this point to ensure safe pumping.

Stability problems

The speed control has a PID controller. It ensures an exact and fast adjustment of the actual value to the set point. **In applications such as solar power systems or feed pumps, the following parameters should be left in factory settings.** With a few exceptions, the system will run stably. These two values have to be balanced, however, especially for hygienic hot water from the external heat exchanger. In addition, in this case the use of an ultrafast sensor (non-standard accessory) is recommended at the hot water outlet.

The parameters ***Pr***, ***In***, and ***di*** can also be determined in a test: Assume that the pump is running in automatic mode in a unit that is ready for operation with appropriate temperatures. With ***In*** and ***di*** set to zero (= switched off), ***Pr*** is reduced every 30 seconds starting at 9 until the system is instable. In other words, the pump speed changes rhythmically and can be read in the menu "***n***" (=actual speed). The proportional part that becomes instable is noted as P_{krit} just as the duration of the oscillation (= time between the two highest speeds) is noted as t_{krit}. The following formulas can be used to determine the correct parameters.

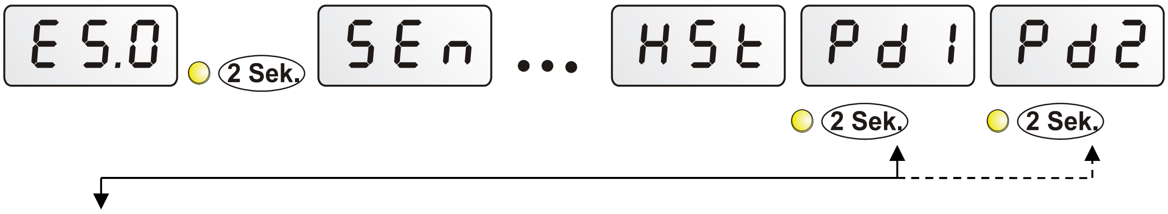
$$Pr = 1,6 \times Pr_{krit} \qquad In = \frac{t_{krit} \times Pr}{20} \qquad di = \frac{Pr \times 8}{t_{krit}}$$

A typical result of hygienic service water with the ultrafast sensor is ***Pr*** = 8, ***In*** = 9, ***di*** = 3.

For reasons not entirely understood, the setting ***Pr*** = 3, ***In*** = 1, ***di*** = 4 has proven practical. Probably, the control unit is so unstable that it oscillates very quickly and appears to be balanced due to the system's and the fluid's inertia.

Additional functions

Pump speed processor



A 2 – **absolute value control**: Sensor **T2** being kept constant by pump speed. The speed increases as temperature **T2** does.
A-2 means that speed increases as temperature **T2** drops (= inverse mode)
ew = A 0 (switched off)

c60 – desired value for absolute value control: When “**A**” is activated, the controller tries to keep constant the sensor „**A**“ at the value „**c**“ (e.g. 60°C).
ew = 50

F13 – **differential control**: Keeping the temperature difference constant between **T1** and **T3**. **T1** is the warmer sensor. Speed increases, if difference between **T1** and **T3** does. Inverse **F** means inverse mode.
ew = F 0 (switched off)

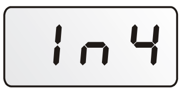
d5.8 – desired value for differential control. When “**F**” is activated, the controller tries to maintain the difference between the two sensors under ”**F**” at the value „**d**“ (e.g. 5.8K).
ew = 10

L31 – limiter function: If the sensor **T3** increases the set limit „**b**“, the controller tries to maintain the sensor **T1** at the maximum value „**h**“.
ew = L 0 (switched off)

b75 – limiter value: If sensor „**L**“ (e.g. **T3**) exceeds the maximum „**b**“ (e.g. 75°C), the controller tries to maintain the second sensor (e.g. **T1**) at the temperature „**h**“.
WE = 60

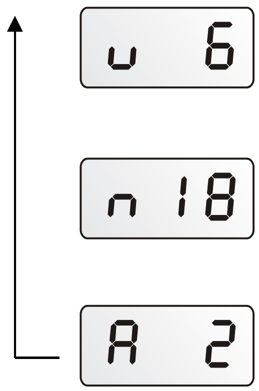
h85 – maximum value: After occurring the event “**b**” the second sensor (e.g. **T1**) will be kept constant at the maximum value (e.g. 85°C). “**h**” are temperatures below 100°C, but “**H**” is more than 100°C.
ew = H30 (=130°C)

Pr8 – proportional part (amplification of controlling): The speed is changed by one increment for each 0.**8**K of deviation from the desired value. A large number leads to a more stable system but also to more deviation from the predefined temperature. **ew** = 5



In4 – integral part: For each **1**K of deviation from the desired value, the speed changes one increment every **4** seconds. A large number provides a more stable system, but it then takes longer to reach the desired value. **In0** = no integral part, **ew** = 5

di5 – Differential part: The faster a deviation occurs between the desired and the current value, the greater the short-term overreaction will be to provide the fastest compensation possible. If the desired value deviates at a rate of 0.**5**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. Optimal values depend on the system and have to be checked experimentally.



di0 = no differential part, **ew** = 5

u6 – Lower speed limit: Limiting the speed for avoiding a rotor standstill. The controller varies the speed between step 30 and down to “**u**” (e.g. 6)

ew = 1

n18 – actual speed stage: if speed control is activated, „**n 2**“ shows the actual speed stage. At “**n 0**” the pump stands, at “**n 1**” it has the slowest speed and at “**n30**” full speed. This value is a check value and not changeable.

The passage starts again with absolute value control. Going back to normal operation happens by pressing the yellow key for 2 seconds, turning the selector switch or automatically after one minute.

HAu Auxiliary output A5

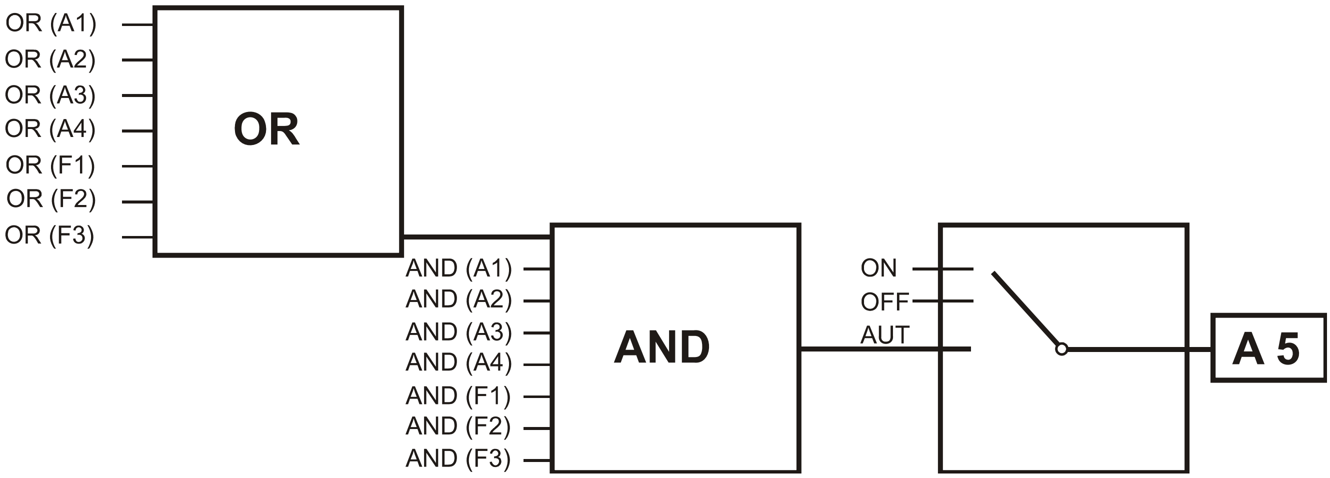
The auxiliary output can be linked via "**AND**" **(u)** (German: und) resp. "**OR**" **(o)** conditions with the outputs 1 to 4 or/and the time windows 1 to 3.

Inverse mode is possible **(ū, ō):** Auxiliary output is linked with the switched off output resp. the not fulfilled time window.

The auxiliary output is switched on, if **at least** one of the outputs (time windows) identified by "o " is switched on **or at least one** of the outputs (time windows) identified by "ō " is switched off **and all** of the outputs (time windows) identified by "u " are switched on **and all** of the outputs (time windows) identified by "ū " are switched **off**.

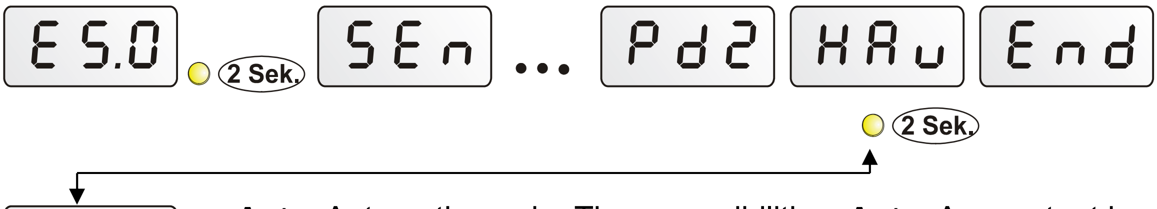
Note: The condition „**AND**" is only possible in combination with at least one condition „**OR**". To achieve an "**AND**" condition it is necessary to define at least one output with "o " or "ō ".

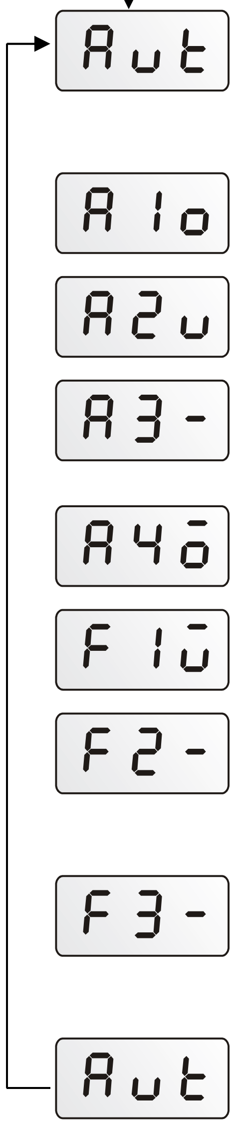
Schematic representation of operating mode:



The terminals of the auxiliary output 5 are potential free.

Example: (using all linking symbols):





Aut – Automatic mode. Three possibilities: **Aut** – Aux. output is switched according to the links. **AUS** (OFF) – Aux. output is switched off permanently. **Ein** (On) – Aux. output is switched on permanently.

ew = AUS

A1o – Aux. output is linked by „**OR**“ to **output 1**

ew = - (deactivated)

A2u – Aux. output is linked by „**AND**“ to **output 2**

ew = - (deactivated)

A3- - Output 3 is **not linked** to aux. output. The switching state of output 3 has no consequences to the switching state of the aux. output.

ew = - (deactivated)

A4ō – Aux. output is linked by **inverse** „**OR**“ to **output 4**

ew = - (deactivated)

F1ū – Aux. output is linked by **inverse** „**AND**“ to **time window 1**

ew = - (deactivated)

F2- - **Time window 2** is **not linked** to aux. output. The switching state of time window 2 has no consequences to the switching state of the aux. output.

ew = - (deactivated)

F3- - **Time window 3** is **not linked** to aux. output. The switching state of time window 3 has no consequences to the switching state of the aux. output.

ew = - (deactivated)

The passage starts again. Going back to normal operation happens by pressing the yellow key for 2 seconds, turning the selector switch or automatically after one minute.

In this example the auxiliary output switches on if:

- output 1 is switched on **or** output 4 is switched off **and**
- output 2 is switched on **and**
- time window 1 is switched off.

Instructions for troubleshooting:

In general, all of the settings in the menus and the terminals should be checked if there is an error.

Malfunction, but "realistic" temperatures:

- Check the program number.
- Check the thresholds for on/off (min/max) and the set differential temperatures (diff). Have the thermostat and differential thresholds been (resp. not been) reached?
- Are time windows linked to outputs?
- Which priority is defined?
- What is changed in the sub menus?
- Can the output be switched on/off in manual mode? - If endurance runs and standstill at the output produce an appropriate reaction, the unit is definitely not broken.
- Are all of the sensors connected to the right terminals? - Heat the sensor using a lighter and check the display.

Incorrect temperature displayed:

- If a value such as -999 is displayed when a sensor short-circuits or 999 if there is an interruption, the cause may not be a material or terminal error. Are the correct sensor types (KTY or Pt1000) selected under the menu ***SEn***? The factory settings have all inputs set to **P** (Pt1000).
- The sensor can also be checked without a measuring device simply by changing the part that is probably defective with one that works at the strip terminal and checking the display. The resistance measured with an ohmmeter should have the following value according to the temperature:

Temp. [°C]	0	10	20	25	30	40	50	60	70	80	90	100
R (Pt1000) [Ω]	1000	1039	1078	1097	1117	1155	1194	1232	1271	1309	1347	1385
R (KTY) [Ω]	1630	1772	1922	2000	2080	2245	2417	2597	2785	2980	3182	3392

If the unit does not run when it has power, the quick-blow fuse 3.15A that protects the control system and the output should be checked and exchanged if necessary.

The **settings of the menu functions ex works** can be **restored** at any time using the yellow key „***Eingabe***" when plugging the unit in.

As the programs are constantly being revised and improved, there may be a difference in the numbering of the sensors, pumps, and programs. Only the instruction manual provided with the device delivered applies (identical version number). The version number of the manual must correspond to the one for the device.

If the control system malfunctions despite these checks as described above, please contact your retailer or the manufacturer directly. The cause of the error can only be determined if the **table of settings has been completely filled** in along with a description of the error. If possible, also include a hydraulic diagram of the system.

Table of settings:

If the control system fails unexpectedly, all of the settings should be reset for initial configuration. In this case, problems are inevitable if all of the setting values are entered in the following table. **If there are questions, this table has to be provided.** Only then is a simulation possible to reproduce the error.

ew = factory setting (ex works) **cs = controller settings**

	ew	cs		ew	cs
Values					
Sensor **T1**		°C	Output **A1**	Aut	
Sensor **T2**		°C	Output **A2**	Aut	
Sensor **T3**		°C	Output **A3**	Aut	
Sensor **T4**		°C	Output **A4**	Aut	
Sensor **T5**		°C			
Sensor **T6**		°C			
Program **Prog.**	0		Version		

Basic parameters PAR					
diff1	5 K	K	Hysteresis **H1**	3K/64°C	K/64°C
diff2	5 K	K	Hysteresis **H2**	3K/64°C	K/64°C
diff3	5 K	K	Hysteresis **H3**	3K/64°C	K/64°C
diff4	5 K	K	Hysteresis **H4**	3K/64°C	K/64°C
min1	0 °C	°C	Hysteresis **H5**	3K/64°C	K/64°C
min2	0 °C	°C	Hysteresis **H6**	3K/64°C	K/64°C
max1	90 °C	°C	Hysteresis **H7**	3K/64°C	K/64°C
max2	90 °C	°C	Hysteresis **H8**	3K/64°C	K/64°C
max3	90 °C	°C	Hysteresis **H9**	3K/64°C	K/64°C
max4	90 °C	°C	Hysteresis **HA**	3K/64°C	K/64°C

Time window *F*					
Time window F1 on	7:00		Time window F1 off	8:00	
Time window F2 on	11:00		Time window F2 off	13:00	
Time window F3 on	18:00		Time window F3 off	20:00	
Time window F1 > output	10				
Time window F2 > output	20				
Time window F3 > output	30				

Priority assignment *Vorr.*					
Output A1	10		Output A2	20	
Output A3	30		Output A4	40	

Sensor type *SEn*					
Sensor **T1**	F1P		Sensor **T2**	F2P	
Sensor **T3**	F3P		Sensor **T4**	F4P	
Sensor **T5**	F5P		Sensor **T6**	F6P	

	ew	cs		ew	cs
Function control *FCo*					
Sensor **T1**	F1n		Difference temperature	Fdn	
Sensor **T2**	F2n		Circulation error	Fc0	
Sensor **T3**	F3n		Value **L**	L70	°C
Sensor **T4**	F4n				
Sensor **T5**	F5n				
Sensor **T6**	F6n				

Collector excess temperature *Utb*			**Start function *StF***		
Switch-off temperature	140°C	°C	Start function active	A 0	
Switch-on temperature	100°C	°C	Connection radiation sensor	F 0	
			Radiation threshold	c15	W/m²
			Pump run time	r15	s
			Interval time	i20	min
			Number of start attempts	n 0	

Priority menu *Pri*			**After-running time *PnL***		
Connection radiation sensor	F 0		Output 1	t10	min
Radiation threshold	c30	W/m²	Output 2	t20	min
Waiting time	tA5	min	Output 3	t30	min
Pump run time	tL2	min	Output 4	t40	min

Speed control					
Speed control 1 *Pd1*			**Speed control 2 *Pd2***		
Absolute value control	A 0		Absolute value control	A 0	
Desired value for A	c50	°C	Desired value for A	c50	°C
Differential control	F 0		Differential control	F 0	
Desired value for F	d10	K	Desired value for F	d10	K
Limiter function	L 0		Limiter function	L 0	
Limit for L	b60	°C	Limit for L	b60	°C
Maximum value for L	H30	°C	Maximum value for L	H30	°C
Proportional part	Pr5		Proportional part	Pr5	
Integral part	In5		Integral part	In5	
Differential part	di5		Differential part	di5	
Minimum speed	U 1		Minimum speed	U 1	

Auxiliary output *HAu*					
Automatic/ON/OFF	AUS				
Output A1	A1-		Time window F1	F1-	
Output A2	A2-		Time window F2	F2-	
Output A3	A3-		Time window F3	F3-	
Output A4	A4-				

Technical data

Power supply: 230V +-10%, 50- 60Hz,
Power input: max. 3 VA
Fuse: 3.15 a fast acting (device & output)
Supply cable: 3x 1mm² H05VV-F conforming to EN 60730-1
Protection class: IP40
Allowed ambient temperature: 0 to 45°C
Sensors: Pt1000, accuracy between 0 and 1000°C: +-0.35K
Tank sensor BFPT1000: Diameter 6 mm, according to immersion sleeves, incl. 2 m cable (up to 90°C continuous load)
Collector sensor KFPT1000: Diameter 6 mm, according to immersion sleeves, incl. 2 m cable (up to 180°C) with connection box and overvoltage protection
Difference temp.: adjustable from 0 to 99°C (diff)
Thresholds: adjustable from 0 to 150°C (min, max)
Hysteresis: adjustable from 1 to 9°C per 64°C
Speed control: 30 speed stages result in change of amount of max. 1:10 .

Possible speed control modes: absolute value, difference and absolute value at occurrence of an event.

Temperature display: from -50 to +199°C
Resolution: from -9.9 to 100°C with 0.1°C, otherwise 1°C
Accuracy: typ. 0.4 and max. +-1°C in range 0 to 100°C
Outputs: Triac output 1 and output 2 (minimum load of 20W required)

Relay contacts outputs 3, 4 and aux. output 5

Rated current load A1, A2: 250V / 1.5 A,
Rated current load A3, A4, A5: 250V / 2.5A

Quantity delivered:
Controller with 6 temperature sensors (5 x BFPT1000, 1 x KFPT1000), 4 immersion sleeves TH 140 mm, mounting material, mains cable with plug

Information on the Eco-design Directive 2009/125/EC

Product	Class[1, 2]	Energy efficiency[3]	Standby max. [W]	Typ. power consumption [W][4]	Max. power consumption [W][4]
UVR61-3	1	1	1.8	1.49 / 2.37	1.8 / 2.8

[1]Definitions according to Official Journal of the European Union C 207 dated 03/07/2014

[2] The classification applied is based on optimum utilisation and correct application of the products. The actual applicable class may differ from the classification applied.

[3] Contribution of the temperature controller to seasonal central heating efficiency in percent, rounded to one decimal place

[4] No output active = standby / all outputs and the display active

EU Declaration of conformity

Document- Nr. / Date:	TA17010 / 02/02/2017
Company / Manufacturer:	Technische Alternative RT GmbH
Address:	A- 3872 Amaliendorf, Langestraße 124

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Product name:	UVR64
Product brand:	Technische Alternative RT GmbH
Product description:	Four - Circuit Universal Controller

The object of the declaration described above is in conformity with Directives:

2014/35/EU	Low voltage standard
2014/30/EU	Electromagnetic compatibility
2011/65/EU	RoHS Restriction of the use of certain hazardous substances
2009/125/EC	Eco-design directive

Employed standards:

EN 60730-1: 2011	Automatic electrical controls for household and similar use – Part 1: General requirements
EN 61000-6-3: 2007 +A1: 2011 + AC2012	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
EN 61000-6-2: 2005 + AC2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 50581: 2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Position of CE - label: On packaging, manual and type label

CE

Issuer: Technische Alternative RT GmbH
A- 3872 Amaliendorf, Langestraße 124

This declaration is submitted by

Dipl.-Ing. Andreas Schneider, General manager,
02/02/2017

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 RT GmbH 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's 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 RT GmbH

A-3872 Amaliendorf Langestraße 124
Tel ++43 (0)2862 53635 Fax ++43 (0)2862 53635 7
E-Mail: mail@ta.co.at --- www.ta.co.at ---