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Wiring and Plumbing of Solar Heat Dumps

This document outlines the integration of Solar panels and a central heating system to diver excess heat from the solar panels to the heating system. Using a heat dump allows the solar panel installation to be much larger (compared to the cylinder) and hence far more effective throughout the year. There are several methods which are described below. ***Normally a relay (or some other method) is used to interrupt the heating system wiring so the solar controller can open motorised valves and turn on pumps regardless of the state of the existing heating system controller.***

Disclaimer

This document has been researched but not tested in the field yet. It remains as a discussion document to be validated. In particular, Ports A & B may be reversed. It is important to read and take into account relevant manufacturers instructions / datasheets.

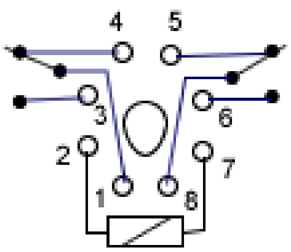
2 and 3 Change Over Contact Relays

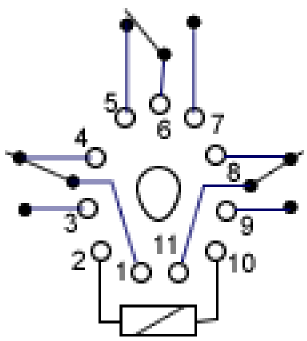
First an introduction to suitable relays, they are very common and can be bought in most electrical wholesalers, or on-line via Radionics or Farnell etc.
Normally relays with three change over contacts are more useful as less of them can be used. If a contact is unused that is not a problem. Alternatively relays with 2 change over contacts can be easier to get and may be used as an alternative.

Note however that the pin numbers are different, and more may be required.

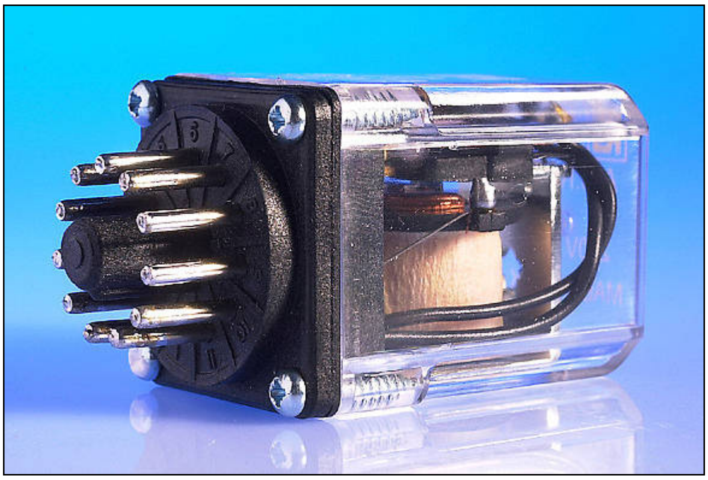
It is very important to MAKE SURE that the coils are 230V AC. NOT 24 or 12v DC (or some other voltage).

Sometimes relays are sold as replacement parts without the bases, so make sure that the bases are ordered.

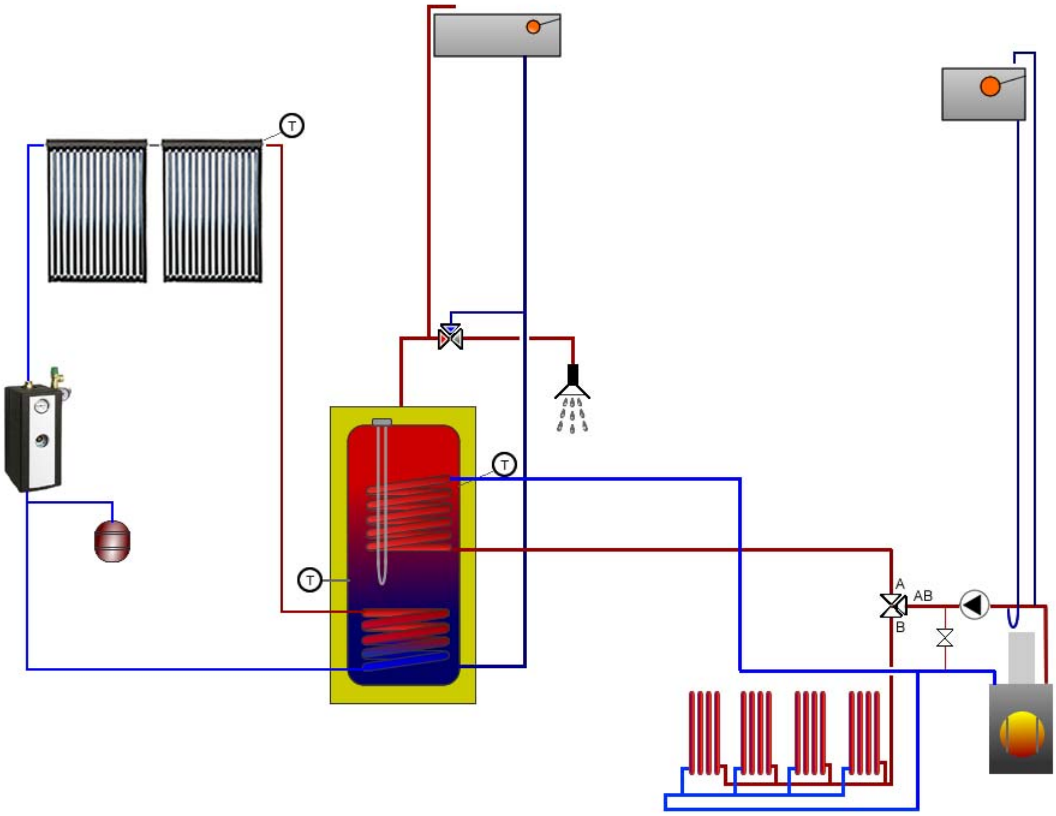




2 change over contacts – 8 pin relay



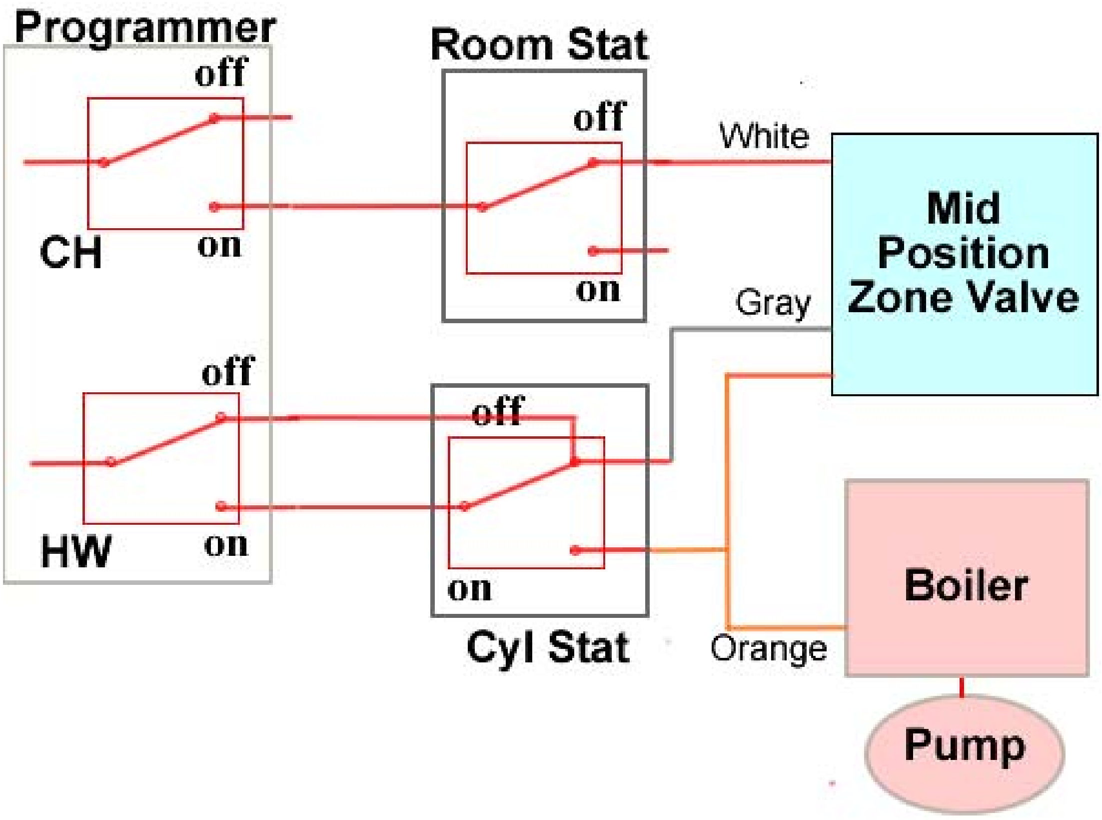
3 change over contacts – 11 pin relay



Divert Valve (AB to A, AB to B, AB to A&B)

There are two varieties of 3-port valve, mid-position and diverter. With a mid-position valve the middle port is connected to flow from the boiler and the water is directed to port 'A', 'A and B' or 'B' as requested.

A domestic mid position motorised valve is a fairly simple device , using some very basic components. It utilises a small synchronous motor to energise the valve and a spring to pull it back when de-energised.



Central heating only. (AB to B)

Energise the WHITE wire to operate the valve to mid position.
Energise the GREY wire to bring the valve from the mid position to fully OPEN.
When valve is fully OPEN the ORANGE wire (normally to boiler) is connected via a limit switch to the WHITE wire. i.e. ORANGE is LIVE when fully OPEN.

Hot water only. (AB to A)

De-Energise the WHITE wire.
De-Energise the GREY wire to allow valve to spring close.
A link to the ORANGE wire via the cylinder stat is required (as shown above), so that the boiler is powered up even though the GREY wire is de-energised.

Mid Position. (AB to A and B) - Not normally used

Energise the WHITE wire to operate the valve to mid position.
De-Energise the GREY wire.
Because the valve is in mid position, the ORANGE wire (for boiler) will not get a feed from the WHITE wire, so it is necessary to also energise the ORANGE wire via the controller to feed the boiler. Simply feeding the boiler via the cylinder stat, means that the boiler will work until the cylinder reaches temperature and then turn off the boiler (even though the heating may not be satisfied).

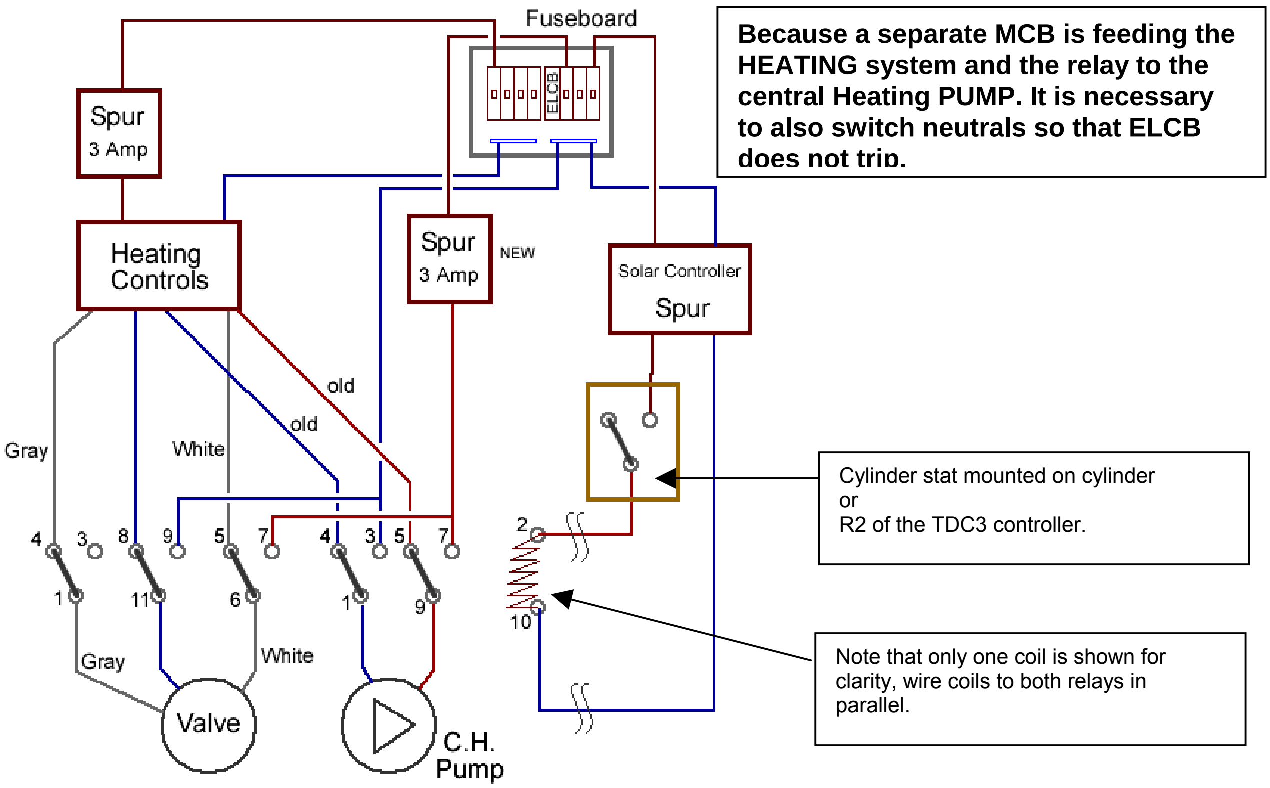
Heat Dump from Solar Panel

In cases where the solar panel is overpowering the cylinder, and the cylinder reaches its upper temperature set-point, we need start diverting the heat from the cylinder via the heating coil to the heating system. To do this the boiler pump is energised and the divert valve is brought to mid position.

For this ONE or TWO three-pole (3 change-over contacts) relays are required. If alternative power to the valves and central heating pump is supplied via a different MCB on the fuseboard, it will normally be necessary to switch the neutrals so that the ELCB does not detect a voltage imbalance and trip power to the house sockets.

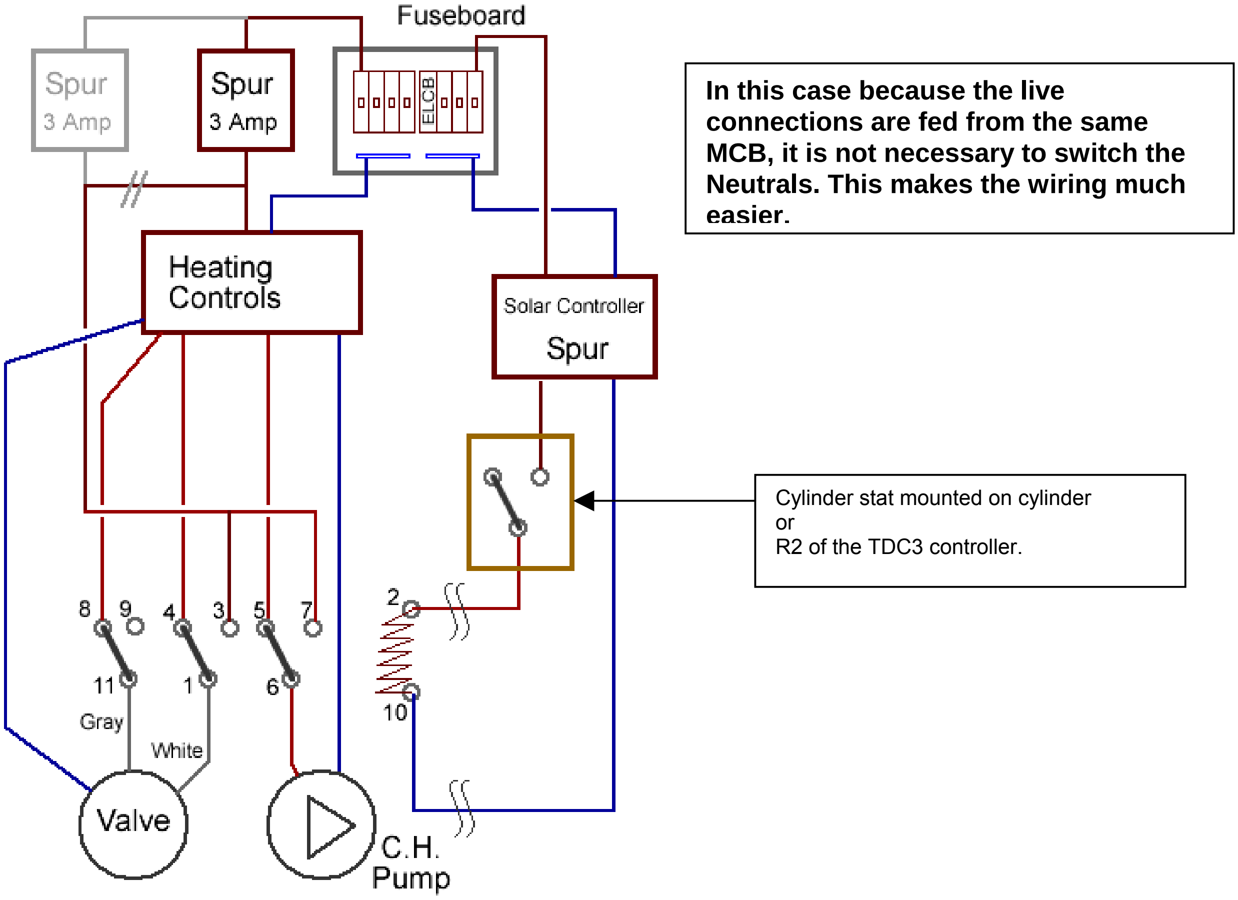
If you are providing the alternative power from the same MCB (e.g. via a spur on the heating system), then there is no need to switch the neutrals.

Wiring diagram 1 (Neutrals switched)



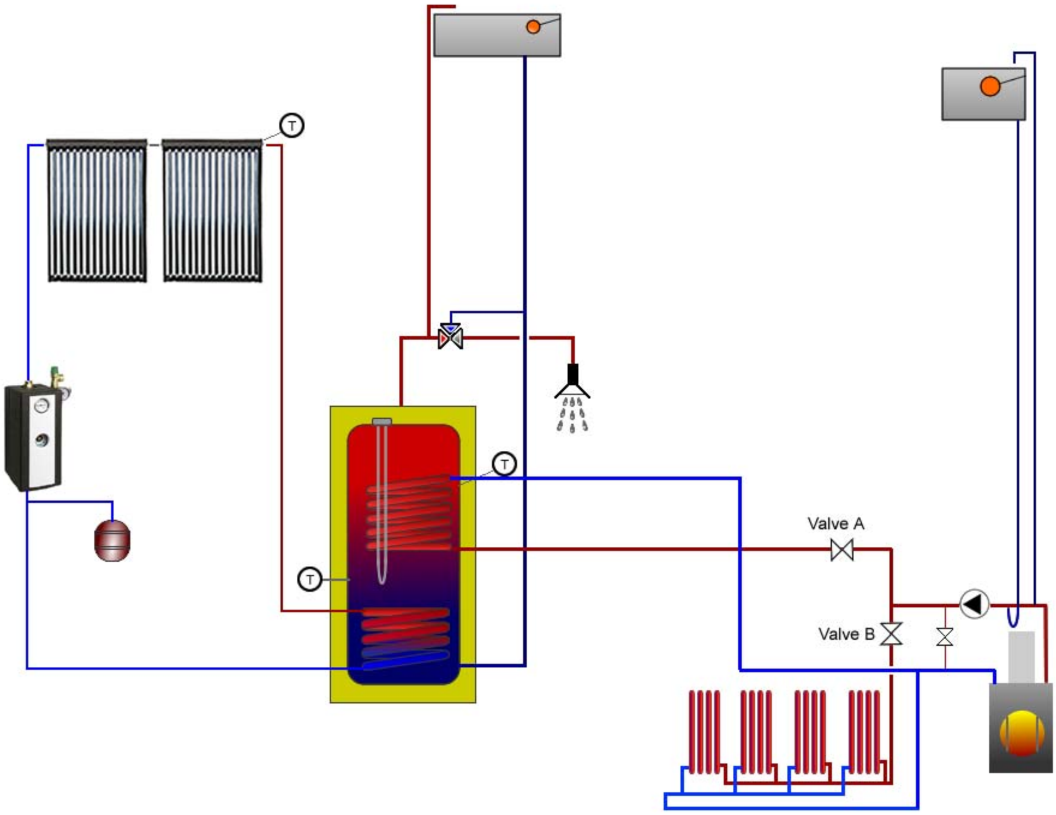
Step 1. **Isolate and make sure power cannot be reconnected without you knowing!!!**
Step 2. Cut the cables to the pump and to the valves leaving enough slack to work with, connect to the relay bases following the diagram above.
Step 3. If two relays are required, the coils of **both** relays can be wired in parallel. Coil terminals are also denoted as A1 and A2.

Wiring Diagram 2 (Neutrals not switched)



In this case, because we have provided our alternative power from the same source as the heating system, we do not need to switch the neutrals. This makes the wiring much easier and only one 3 contact relay is required.

Systems using 2 port valves.



Two port valves offer easier to understand controls.

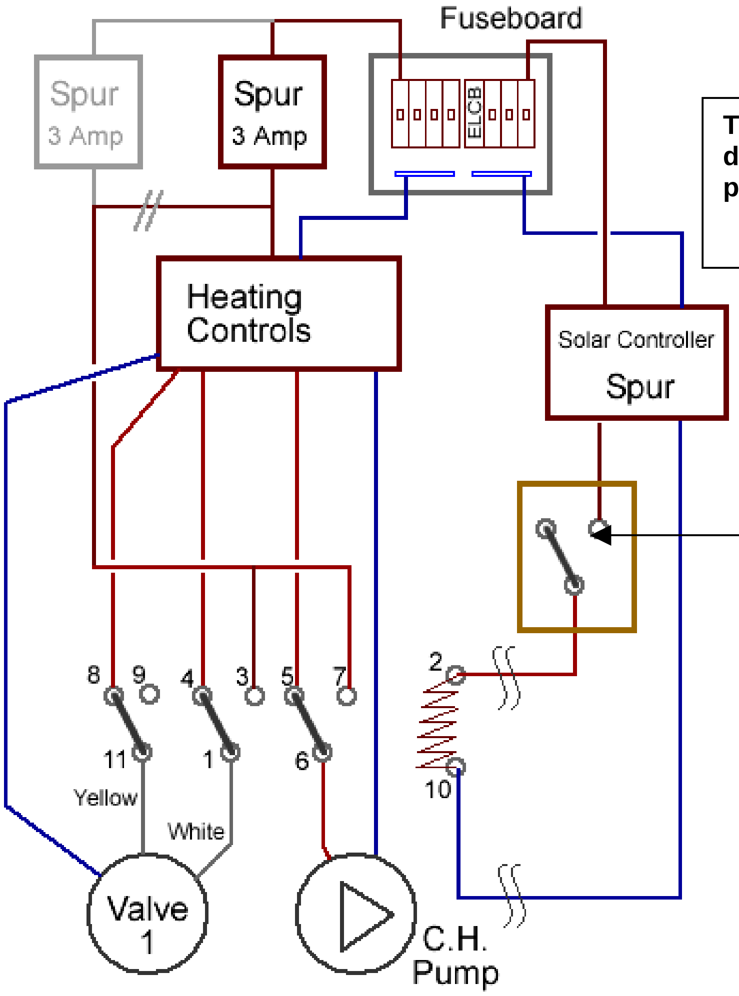
Supply on WHITE Opens valve
Supply on YELLOW Closes valve
ORANGE is live when the valve fully OPENS
PINK (if present) is live when valve is fully CLOSED
BLUE is neutral
YELLOW/ GREEN is earth

Wiring Diagram

When the heat dump is active, both valves need to be opened, and the central heating pump turned energised.

As before if the valves are fed from a separate MCB, the neutrals need to be switched. (another relay may be required).

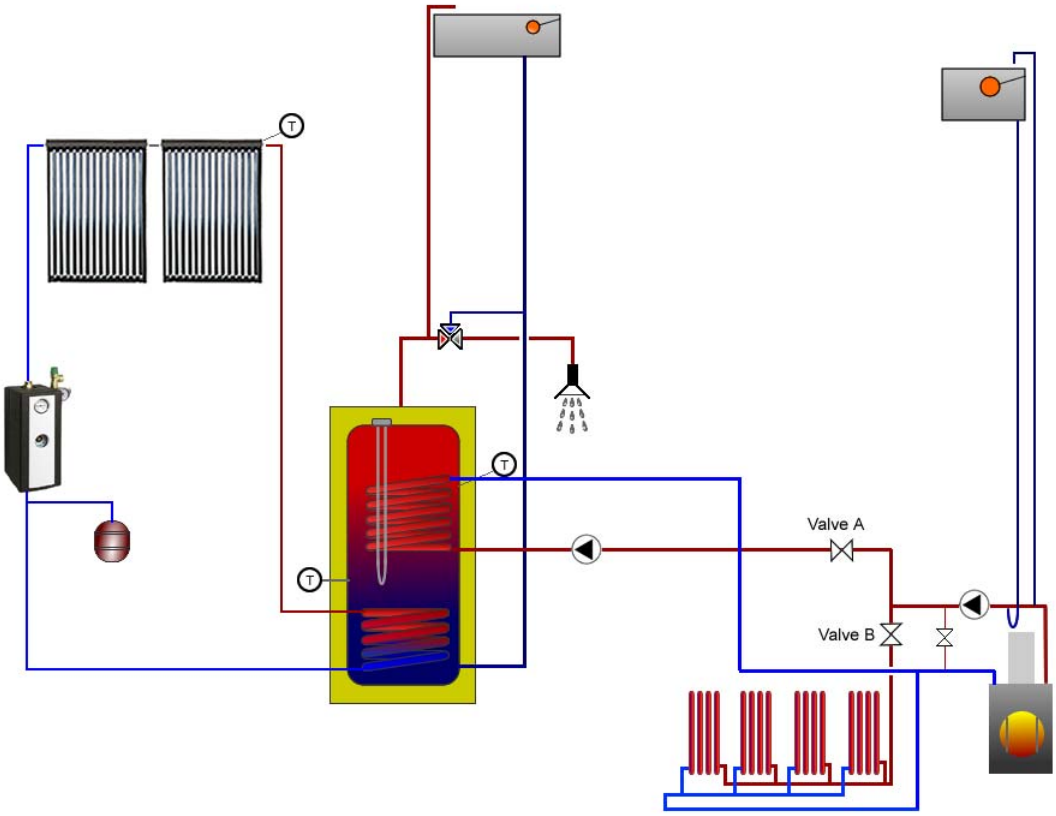
One point to note on the two port valve wiring is that no power is provided to pin 9 of the relay, this is to prevent the valve trying to open via the heat dump and close via the heating system, which would lead to the demise of the valve!



The wiring on Valve 1 needs to be duplicated on Valve 2 (without the CH pump).

Cylinder stat mounted on cylinder
or
R2 of the TDC3 controller.

Installing an extra pump in the circuit.



In many retrofit situations, it is not possible to feed a cable to the pump on the boiler. In this case the easiest work-around is the fitting of an extra pump on the heating coil of the cylinder. It is very important that the new pump is pumping in the same direction as the central heating pump.

This pump can be connected directly to the second output of a solar controller (e.g. Sorel TDC3) or to a cylinder stat (see note below).

Any manual summer valves should be opened and disabled.

If motorised valves are present in the system, then the same wiring diagrams as shown earlier should be used but without the connections to the existing central heating pump.

The Sorel TDC3 controller has a function which can turn on a relay (which we connect to the second pump) when the cylinder reaches a pre-set temperature. This circulates the water in the heating system through the heating coil without turning on the boiler and causes the nearest radiators to heat cooling the cylinder.

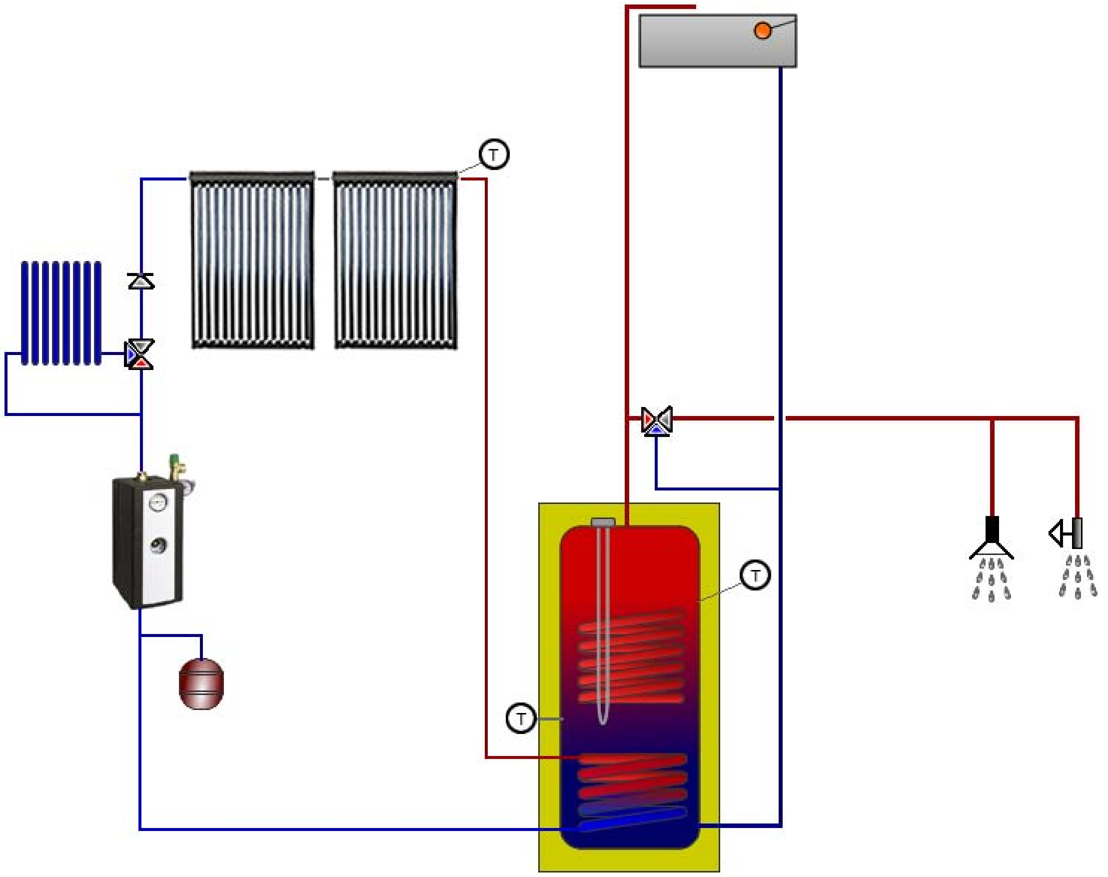
In practice, this is a very good solution, it is quick and easy to install and brings excess heat into the house. It does not lead to overheating in summer as the panel output in peak conditions is the equivalent of one full radiator, and will not work at night (for obvious reasons). Feedback from customers has been excellent, as they have used this to dry clothes in good weather.

A special feature of the Sorel TDC3 controller is the ability to turn on its outputs for 5 seconds every day. This prevents a pump that is seldom used from seizing.

A cylinder stat can also be used to control the pump but the pump should be manually turned on regularly (via the cylinder stat) so that the pump is exercised to keep it in good condition.

Heat dumping without the central heating system.

It normally advantageous to use the existing heating system as a heat dump, however there may be times when this is not possible (e.g. passive house). In this case the following diagram can be used.



This system uses a thermostatic valve which diverts heat to the attic radiator on the return side of solar loop if the cylinder temperature reaches 60 C or greater. The circuit tends to keep the cylinder temperature to between 60 and 65C in practice. However some looses occur because the valve does not seal completely at lower temperatures.

The most exposed part of the circuit is the ESBE mixing valve, this valve is rated to operate continuously at 90C. Once the radiator is large enough to dump the maximum amount of heat generated by the panel into a hot attic space then this is a very elegant way of eliminating the possibility of overheating during normal pumped operation.The control part of the ESBE mixing valve consists of a wax plug which expands with heat. If the valve is overheated, this wax plug deforms. Afterwards the valve will probably continue to control (based on the level of overheat it was exposed to), albeit its settings will be distorted and it will in fact control to a higher temperature. Most importantly because the valve is made of brass and uses compression fittings will not leak if it is exposed to high temperature water (>90C), however steam is harder to seal against.

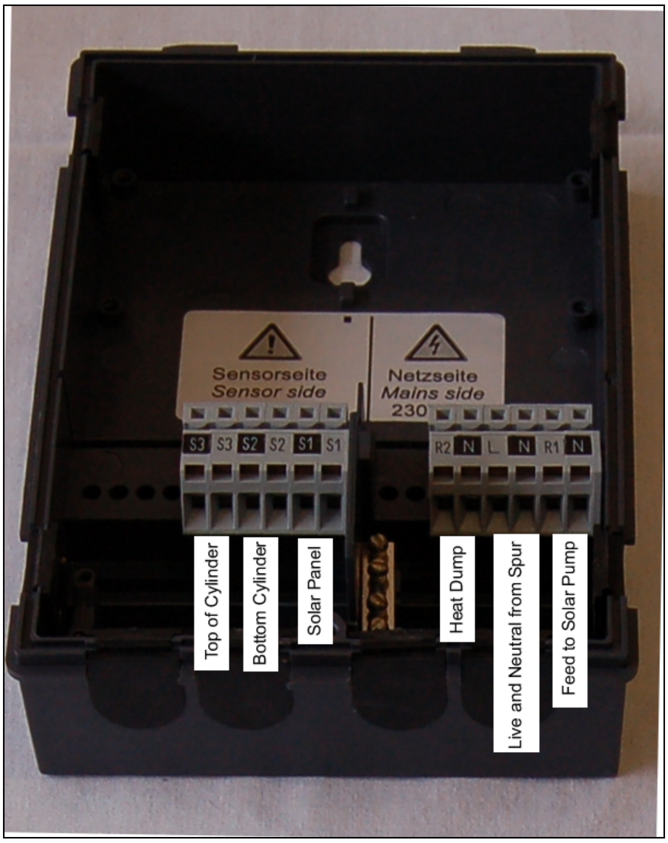
It is important to use a thermostatic valve that does not have an overheat cut-off. This prevents the pump trying to pump against a closed valve should the radiator and cylinder not be able to dump sufficient heat to keep the output (mixed) temperature (of the valve) to (just over) 60C.

1/2" ESBE valve without overheat cut-off - VTA312 - 31050200

The NRV (Non Return Valve - flap type) 1 meter above the mixing valve is to help force all expansion (in the event of a power failure and the system steaming up) through the coil of the cylinder. However there is also a NRV within the pumping station so this is extra protection for the mixing valve. Flap Type NRVs do not contain any plastic and springs and are more reliable long term particularly in working conditions that may include periodic exposure to high temperatures. They must however be faced arrow pointing up or horizontally to work correctly.

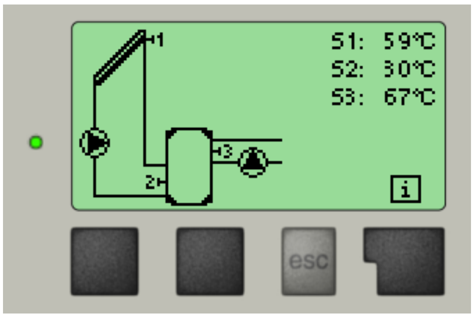
Wiring the TDC3 controller.

A 3Amp switched fused spur should be used to connect mains to the controller. Internally the controller should be wired as per the picture below. The terminals are spring loaded to prevent over tightening. **Note:** A small flat head screwdriver is required.

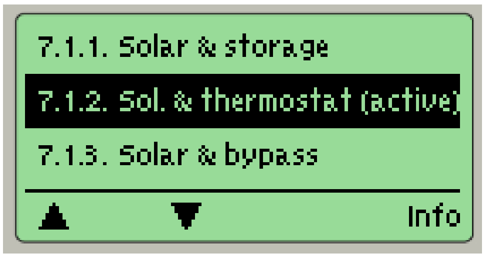


Programming the TDC 3 controller

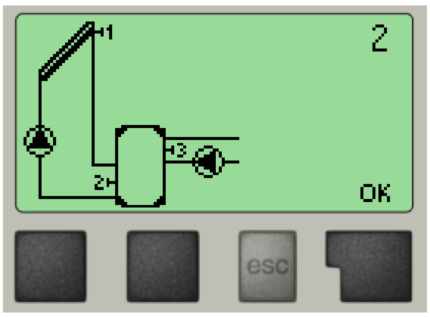
Wire the controller as per the instructions below. The terminals are spring loaded to prevent over tightening. Note: A small flat head screwdriver is required to access terminals.



Use left buttons to access menu. Choose Special functions

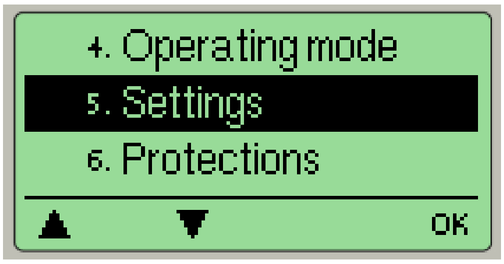


Select Sol. & Thermostat (active)



Choose **OK**

Next return to main menu and choose “Settings”



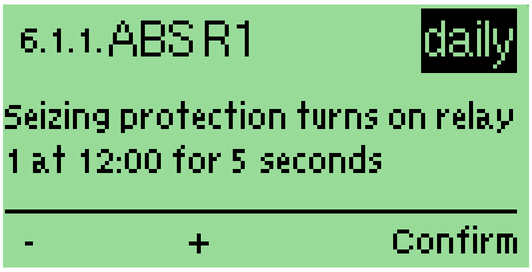
Program the following settings

TminS1 15°C
TmaxS1 70 °C
ΔTR1 16°C
Tset S3 65°C
Hysteresis -5°C

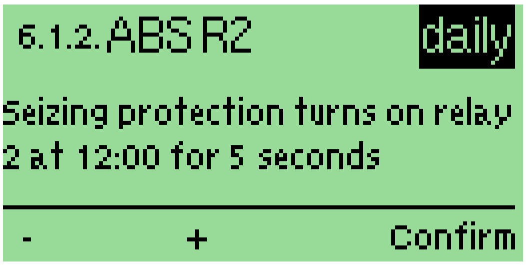
Operation: The solar controller will keep the panel in operation until S2 (bottom sensor) reaches 70C, when the solar panel will turn off.

However because we choose the thermostat function and set this at 65C, when S3 reaches 65C, relay R2 on the controller is turned on which is connected via a relay to the central heating pump or a second pump on the central heating line.

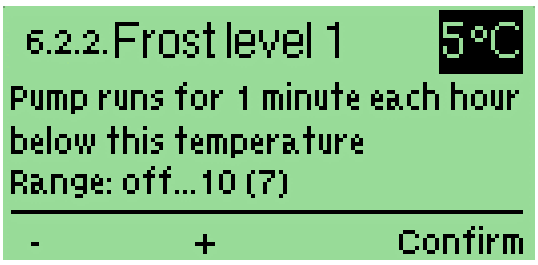
The hysteresis set at –5C will keep relay 2 turned on until the temperature measured at S3 reduces to 60C. (i.e. Tset S3 + hysteresis). It is important to set the hysteresis to a negative value, a positive value will tell the controller that you are trying to heat the cylinder with an external heat source and it will try to turn off relay R2 at 70C.

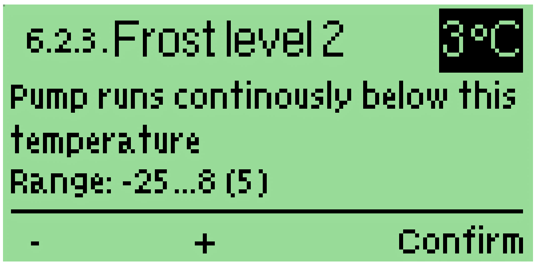


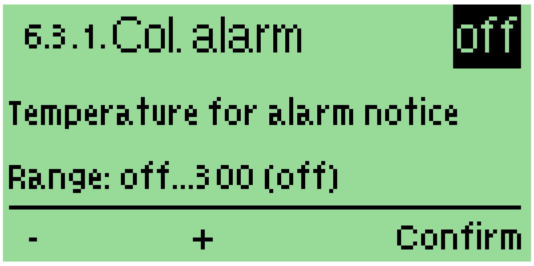
This prevents the pump on Relay 1 from seizing should no solar be available for several months.



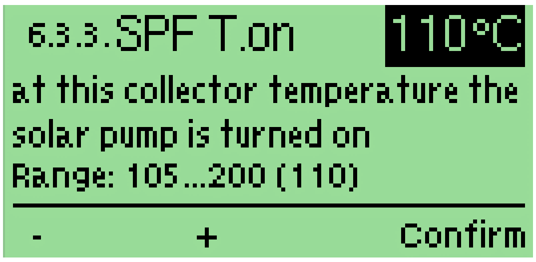
Anti-Seizing protection for overheat pump. This is far more important as it is likely that this pump will only run during the summer.

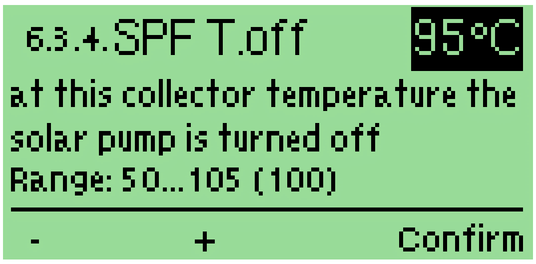


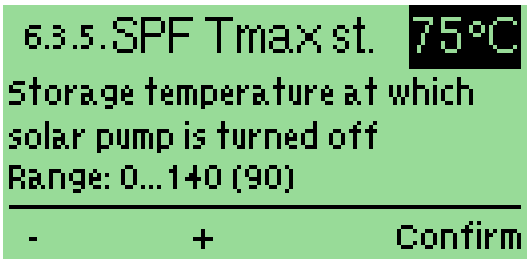




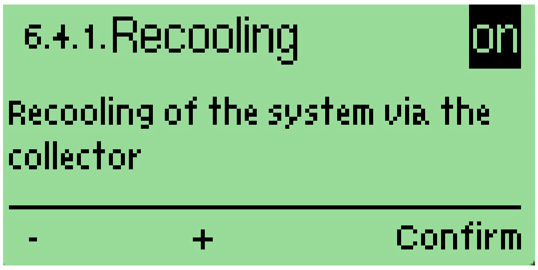
This function is very important for systems without heat dumps. Basically it is used to keep the solar panel below a preset (safe) temperature, if the panel goes above the preset temperature then the solar pump is activated and the water in the panel is circulated unit the panel drops below the reset temperature. This continues until a second maximum cylinder temperature is reached (e.g. 85C with a mixing valve), and at this point the SPF function is deactivated to protect the cylinder.

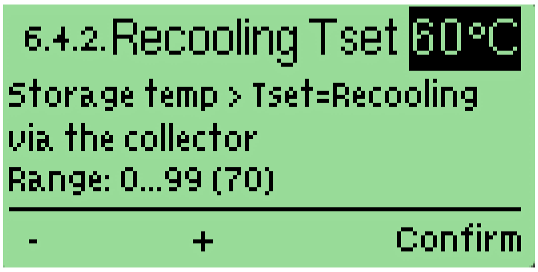






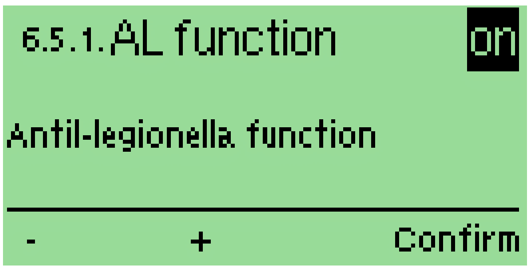
If a heat dump is used, then this function can be disabled. However if it is used when using a system without a heat dump then the “re-cooling” function should be set to ON. The recool turns the solar pump on when the panel temperature is 20C cooler than the cylinder and continues until it reaches Tset.

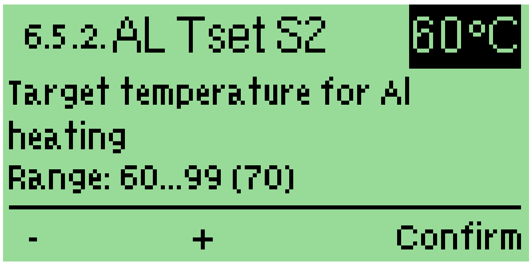


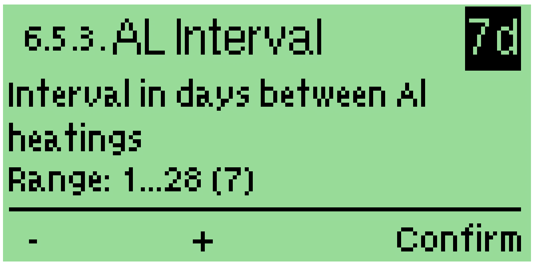


Anti-legionalla

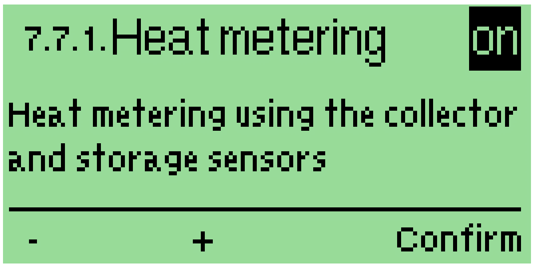
This is purely an Anti-legionalla function which relies on solar energy to heat the cylinder to 60C. If there is not sufficient solar energy to do so, then it reverts to normal control.

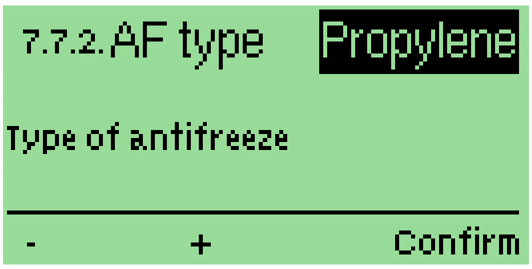


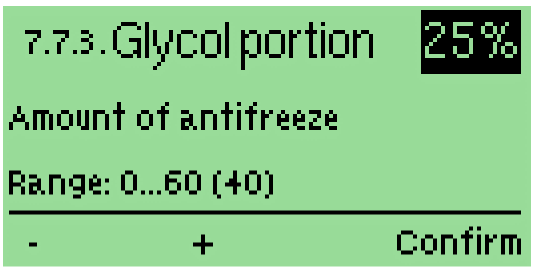




This allows the customer to estimate how much energy the solar panel has produced.







(change if Anti-freeze concentration is different).

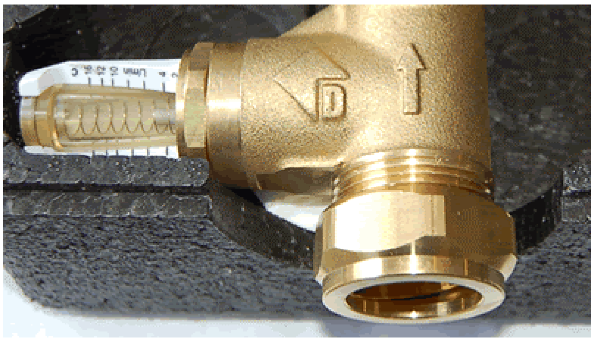
7.7.4. Flow rate **240l/h**

nominal flow rate of the system

Range: 10...5000 (500)

\-   +   Confirm

(240 Litres per hour is the equivalent of 4 litres per minute). When running the pump at full speed, read flow rate on pump-station indicator.



7.7.5. ΔT offset **0%**

Heat metering ΔT correction factor

Range: -50...50 (0)

\-   +   Confirm

Starting aid for vacuum tubes.

7.8.1. Starting aid **on**

Function for vacuum tubes

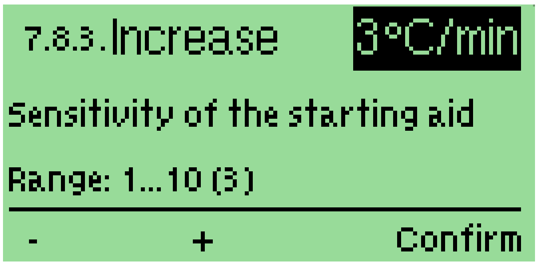
\-   +   Confirm

7.8.2. Circulation time **5s**

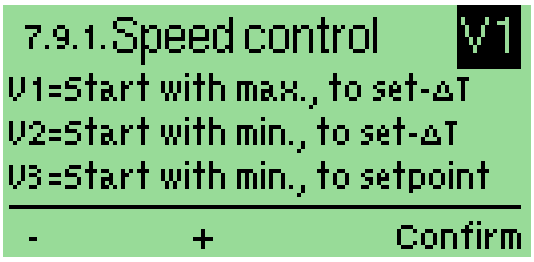
Circulation time of the starting aid

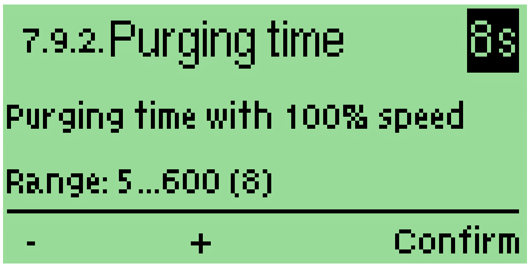
Range: 2...30 (5)

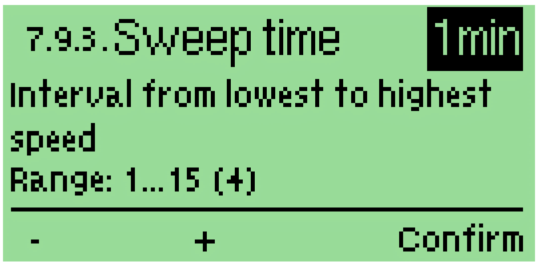
\-   +   Confirm

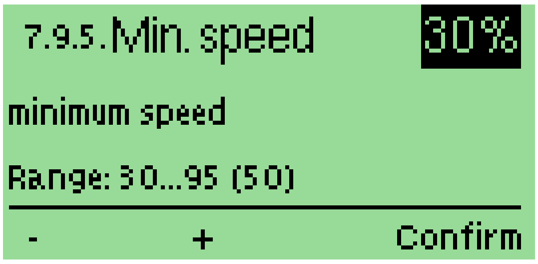


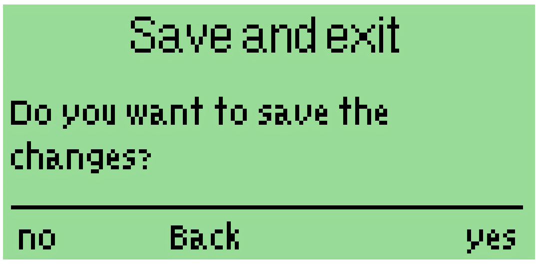
This is important because it matches the pump speed to the available solar energy. This keeps a steady “delta-T” and avoids the inefficiencies the inevitably result because of the delay of the sensor in reading actual panel temperature. (i.e. panel over-heats before pump is turned on and over-cools before solar pump is turned off)








7.9.5. Min. speed
30%
minimum speed
Range: 30...95 (50)
-
+
Confirm


Save and exit
Do you want to save the changes?
no
Back
yes