SENZTEK

smart energy management

SolaSmart Plus™
INSTALLATION GUIDE

www.senztek.com

CE ISO9001 TECHNOLOGY & QUALITY AWARD Z985

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For technical help contact your distributor.

Distributor Details:

www.senztek.com

BEFORE YOU BEGIN INSTALLATION

Assemble the Components You Will Need

The SolaSmart™ Controller is supplied with the following components:

- ⇨ Plug In Roof sensor
- ⇨ Tank sensor
- ⇨ Inlet sensor
- ⇨ Mains cable
- ⇨ Pump cable
- ⇨ Associated screws
- ⇨ Screw covers

Continued on next page

BEFORE YOU BEGIN INSTALLATION, CONTINUED

Assemble the Tools You Will Need

You will need the following tools to install the SolaSmart Plus™:

Philips1 screwdriver for lid screws.

Pozi 2 screwdriver for mounting screws.

READ THESE SAFETY PRECAUTIONS and LIMIT OF LIABILITY BEFORE YOU BEGIN

The following pages contain instructions for qualified personnel only. They involve potentially hazardous adjustments and high voltage mains wiring information.

General Safety Precautions

The following general safety precautions should be noted:

This installation guide is for the installation of SolaSmart Plus™ Controller only and is not an installation guide for any other part.

The complete installation should be checked at least annually for damage or malfunction.

All servicing must be carried out by an authorised service agent only.

All aspects of the installation must comply with local electrical and plumbing regulations (and any special solar hot water regulations).

Continued on next page

BEFORE YOU BEGIN INSTALLATION, CONTINUED

Installation Precautions

Installers need to ensure the following:

The controller must be installed away from water sources such as rain, leaking pipes, or wet floors; and must not be installed in damp areas like bathrooms. The controller must have a waterproof enclosure if it is installed outside.

Make sure the controller is installed away from direct sunlight, flammable liquids or radiant heat sources.

Power leads must face directly down, not sideways or upwards.

Ensure the controller is in a safe environment for users to inspect display panel.

Follow instructions carefully when mounting sensors. Incorrect sensor mounting can lead to a poorly controlled solar hot water system with safety issues (e.g. overheating; over pressure damage to the plumbing; freezing damage to the solar collector).

The unit settings are factory programmed to optimise efficiency and safety. Alteration of the programmed values can lead to dangerous conditions and/or damage to parts of the solar hot water system.

CAUTION:
Dangerous Voltages may be present. The SolaSmart™ has no user serviceable parts.
Protective enclosure must only be opened by qualified personnel.
Remove ALL power sources before removing protective cover.

Continued on next page

BEFORE YOU BEGIN INSTALLATION, CONTINUED

Electrical Precautions

When undertaking electrical installations, please note the following:

All mains voltage electrical work must be carried out by a qualified electrician, especially external power outlet socket installation.

A readily accessible disconnect device, over current device and RCD Protection rated to suit the size of the pump plus 5VA must be incorporated in the power supply wiring. The over current device for a 1500W, 240Vac pump must not exceed 10Amps.

The SolaSmart-Plus controller power source must be earth leak current protected such as a Residual Current Device no more than 30mA trip current.

Sensor leads should be kept 300mm (12 inches) away from mains and comms cables if run parallel to those cables.

Do not use mains power extension cords unless approved by the manufacturer. Water resistant plugs and sockets should be used.

The SolaSmart™ controlled output (PUMP) will be connected to the input power supply wiring and is not isolated from it. Supply voltages will be output through this outlet during activation.

The HWC outlets are isolated contacts. A supply wire and an output wire will need to be wired to each HWC outlet.

If the HWC port is not used (no HWC control) then this hole must be sealed for safety reasons. This hole is 16mm dia and will match most 16mm conduit fittings; one of these could be used to seal off this hole.

Always use the unit within specified voltage and load ranges. Never use with damaged leads, plugs or sockets.

Do not allow the sensor cable to come within 10mm of the high voltage connectors or components inside the enclosure.

The electric element should have a fuse that is rated within the stated maximum of the relay driving the element.

Do not connect the mains or the pump to a circuit that could be switched off by your electricity supplier to manage peak loads (ripple control).

Comply with all local and relevant electrical regulations.

Warning

These products are not designed for use in, and should not be used for, applications which are in conjunction with items that are critical to any person's health (e.g. life support systems).

In any critical installation, an independent fail-safe back-up system must always be implemented.

INSTALLING THE SOLASMART™ CONTROLLER

Which Boost Element Control System?

You must select one of 3 modes;

1. **Single Element**; 2 options for single element
   a. **Standard**; element is **below** inlet sensor
   b. **Mid Element**; where the element is **above** inlet sensor
2. **Dual Element**; dual elements have same power source for both elements and inlet sensor above lower element and tank sensor above upper element.
3. **Night Rate**; separate power sources for each element with switched night rate (controlled by the power company) going to lower element and continuous supply to the upper element. Inlet sensor must be above the lower element and tank sensor above the upper element.

Which Topout?

Advanced Top Out; Allows for automatic early recovery form collector lockout due to a Topout condition which later clears (user draw off from tank). Controller pulses the pump to clear steam and vapour and safely bring the collector back online with minimal water hammer from steam implosions.

Important

Can only be used with systems that have the return pipe from the collector below the 'Tank' sensor (upper sensor). If return pipe is above Tank sensor then only 'Simple TopOut' setting can be used otherwise the hot water tank can be damaged by overheating.

Simple Topout; Traditional Topout that once the collector passes lockout temperature (due to Topout) cannot be bought back online until the collector cools down below the lockout temperature (usually after sundown).

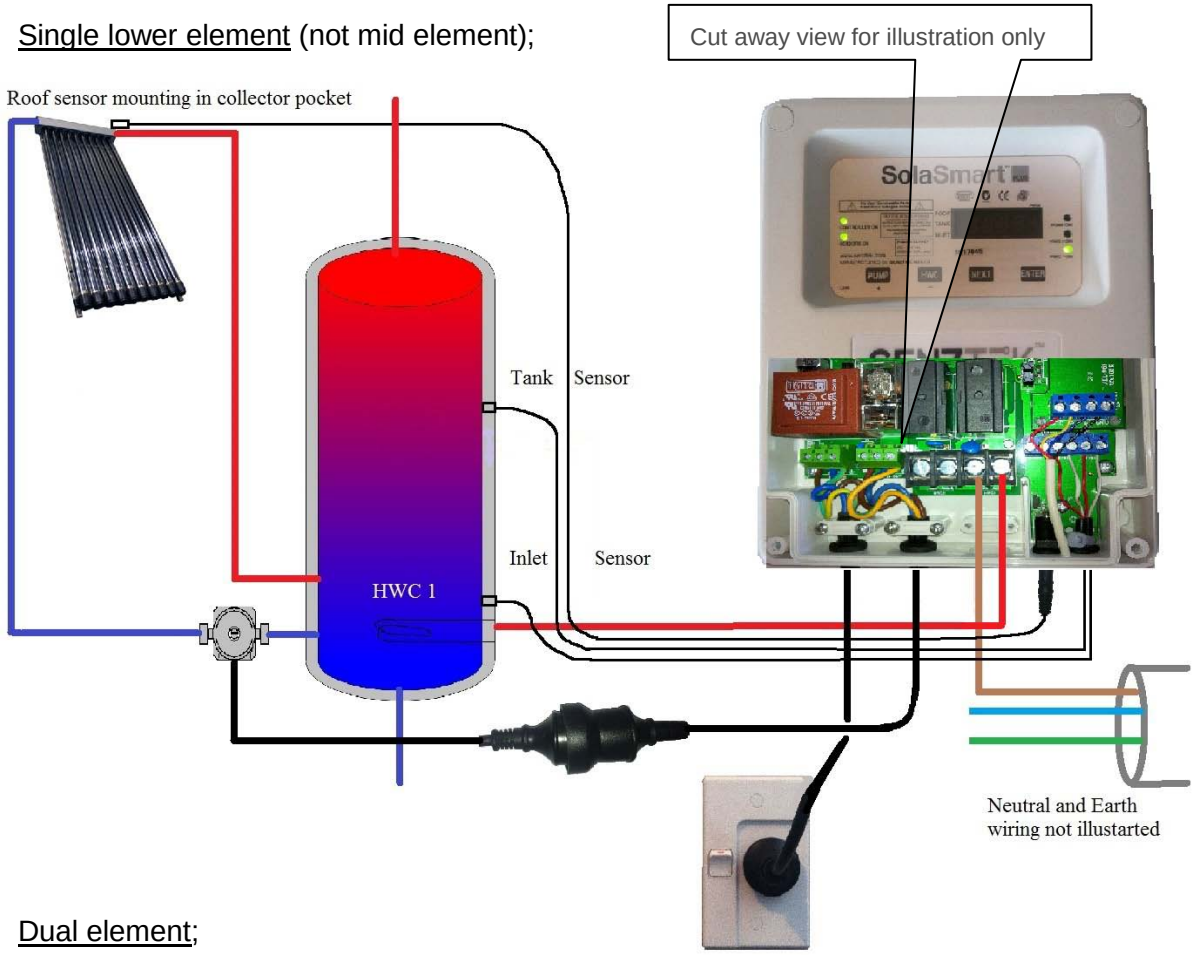
More information on Topout options are on Page 15

Overview

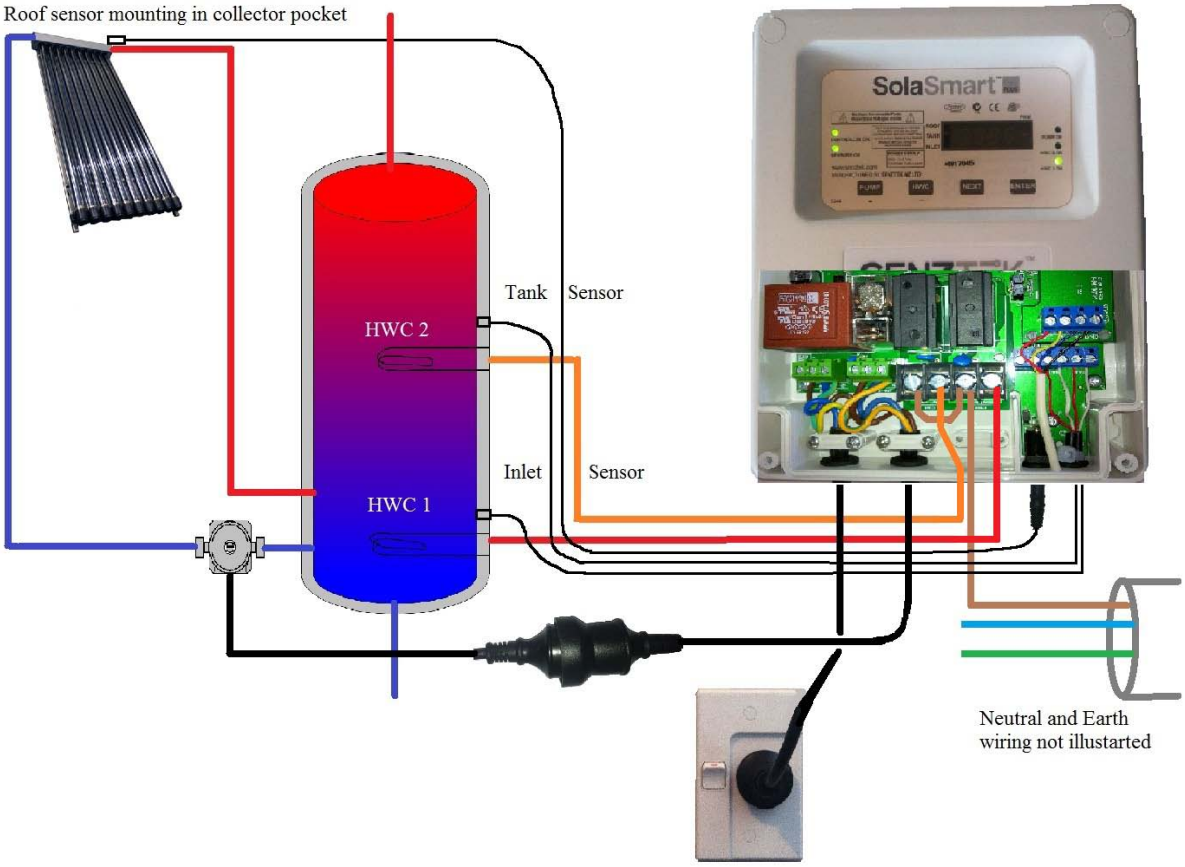
The example diagrams (next page) show how the SolaSmart Plus™ is typically connected to the hot water cylinder (**HWC**), the collector, and the three sensors (**ROOF, TANK** and **INLET**) and their relative positions in a typical system. These are simplified diagrams only and do not include many plumbing components and some wiring details.

Specific wiring details for the electric element/s appear later in this manual.

Single lower element (not mid element);



Dual element;



INSTALLING THE SOLASMART™ CONTROLLER, CONTINUED

Where to Mount the SolaSmart™

The SolaSmart™ should be mounted so that:

1. It is against a flat surface with sufficient strength to hold the enclosure and any additional weight from the plugs, sockets and cables,
2. Power Leads face down not sideways or up,
3. It is safe for users to inspect, and
4. Allowance is made for cable runs, location of power outlets and lengths of wires.

Mounting the SolaSmart™

Follow these steps:

1. Allow for the enclosure dropping 5mm (1/5 inch) from screw centres once mounted (keyhole mounting).
2. Place the drill guide template against the wall, checking for level alignment. Four screws are supplied: two chipboard screws and two combination plasterboard/wood screws.

   All four mounting holes should be used with at least two firmly secured into wood.

   The outer plastic plasterboard anchors will self tap into plasterboard and their inner metal screws fix into the centre of the plastic anchors.
3. Mark and drill/screw as appropriate leaving the heads of the screws above the surface by approximately 3mm (1/8 inch).
4. Place the unit over the four screw heads. The unit should slide down 5mm into the 'key' slots and become secured to the wall. You will need to adjust the screw height to obtain a secure fit.

Sensor Mounting

It is critical the sensors are mounted correctly for accurate readings, safe and efficient operation of the system, durability of the sensors and protection of collector and tank.

The instructions on the next page specifically cover the sensor mounting;

Positioning the ROOF Sensor

1. The **ROOF** sensor should be fitted into a metal immersion 'pocket' in the collector, either a custom sensor well or in an adaptor well in the hot water outlet such that the sensor is inside the collector manifold.
2. Apply plenty of heat transfer compound (available from your distributor) between the sensor and the lining of the sensor pocket.
3. **Seal the sensor cable against rain where it exits the sensor pocket with neutral cure sealant and secure the cable to a rigid structure such as the pipe insulation or collector stand with cable ties or similar. The cable should also be insulated from the bare pipe.**
4. Ensure that the sensor cable is not in contact with any exposed sharp metallic surface on the roof.
5. **Secure the ROOF sensor cable so it cannot move due to wind. This is important to stop wire fatigue breakages. This might require several cable ties or other such method.**
6. To prevent physical damage to the cable by birds and vermin it is recommended that the cable is run in appropriate electrical conduit that will prevent damage to the sensor cable. The conduit needs to be run from the collector to the controller such that all cable is protected. Make sure the conduit is not in contact with the collector such that heat damage could occur to the conduit.

NOTE: The vast majority of sensor problems are due to wire conductor breakages. Either metal fatigue (wind) or being cut/ broken by the roof cladding or vermin. These may not always be visible externally.

Positioning the Tank (Upper Tank) Sensor

The Tank (Upper Tank) Sensor must always be fitted above the Solar Collector return pipe. Labelled 'TANK' on the circuit board. It must also always be fitted above all electric heating elements.

WARNING: Damage to the Hot Water Cylinder can occur if the Upper Tank sensor is not mounted correctly.

The Upper Tank sensor should be fitted into a metal immersion 'pocket' in the upper region of the hot water cylinder (HWC) (typically 1/3 of the way down from the top of the HWC).

If a 'pocket' is not available Senztek has an 'S3' surface mounting option

Apply plenty of heat transfer compound (available from your distributor) between the sensor and the lining of the 'pocket'.

If the tank is outdoors then seal where the cable exists the hot water tank with neutral cure silicon.

If this sensor is mounted on the hot water outlet pipe the system will not function correctly and possibly not safely.

Positioning the Inlet (Lower Tank) Sensor

The Inlet (Lower Tank) sensor should be fitted into a metal immersion 'pocket' near the bottom and close to the level where the pipe that feeds the solar collector exits the tank. Labelled 'INLET' on the circuit board.

If a 'pocket' is not available Senztek has an 'S3' surface mounting option

Apply plenty of heat transfer compound (available from your distributor) between the sensor and the lining of the 'pocket'.

If the tank is outdoors then seal where the cable exists the hot water tank with neutral cure silicon.

If this sensor is mounted on the cold water inlet pipe the solar harvesting system will not function correctly and possibly inefficiently.

Precautions

Please note:

Removing or cutting the cladding may void the hot water tank warranty.

The sensor must not be immersed in water.

Unless the temperature probe is designed for immersion in water, temperature probe pockets need to be completely dry before you insert the probe into the pocket and the pocket must be protected against moisture entry after the probe is fitted.

Sensor leads should not be run parallel to the mains and communications cables. Keep at least 300mm (12 inches) away.

Make sure the correct sensors are mounted in the right positions!

Continued on next page

Connect the Wiring

The SolaSmart-Plus™ is supplied pre-wired with mains plug and pump socket, tank and inlet sensors.

1. Connect the wiring from the SolaSmart™ Controller to the **ROOF** sensor, the **TANK** sensor and the **INLET** sensor.
2. Connect the mains wiring.
3. Connect the wiring for the hot water cylinder element.
4. Connect the wiring from the SolaSmart™ Controller to the pump.

1. Connect the mains wiring.

   Do NOT connect the controller mains wiring to a circuit that could be switched off by your electricity supplier to manage peak loads (ripple control)

2. Connect the wiring from the controller to the, the TANK sensor and the INLET sensor (as labelled).
Plug in the ROOF sensor.

4. Dual Element HWC:
Connect the wiring from the controller to the hot water cylinder element. Upper element in a dual element tank

Make sure that the electric element has a fuse that is rated within the stated maximum of the relay driving the element.
This is a simple (clean) set of normally open contacts that interrupt the Active/Phase wire that powers the element.
Do not bypass any thermostats or cut-outs.
Ensure mechanical thermostat is adjusted to maximum so controller can operate HWC.

NOTE: **WIRING OF HWC MUST BE DONE BY A REGISTERED ELECTRICIAN.**

3. Single Element HWC:
Connect the wiring from the controller to the hot water cylinder element. Lower element or single element

Make sure that the electric element has a fuse that is rated within the stated maximum of the relay driving the element.
This is a simple (clean) set of normally open contacts that interrupt the Active/Phase wire that powers the element.
Do not bypass any thermostats or cut-outs.
Ensure mechanical thermostat is adjusted to maximum so controller can operate HWC.

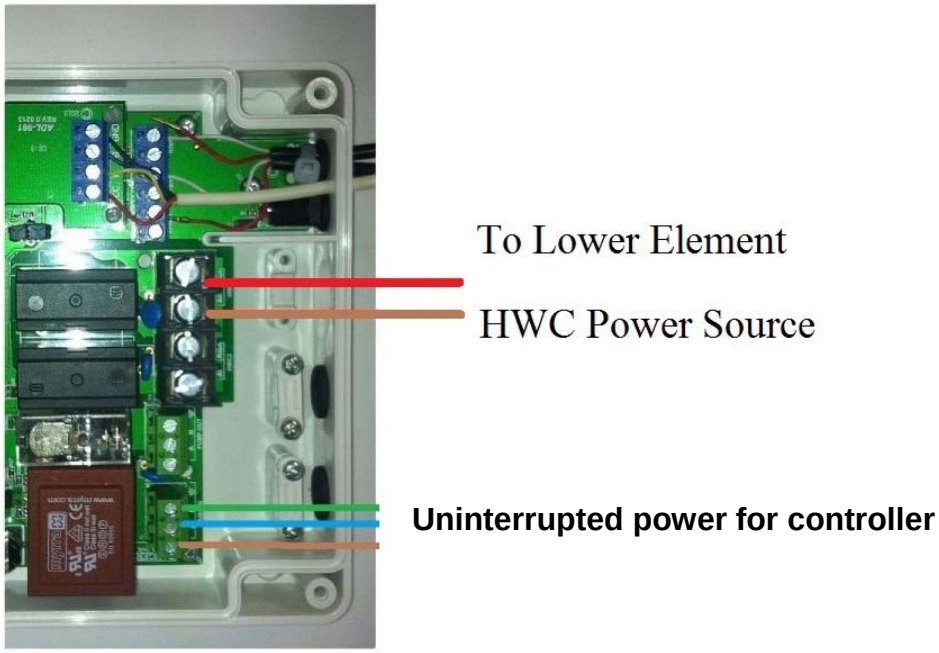
NOTE: **WIRING OF HWC MUST BE DONE BY A REGISTERED ELECTRICIAN.**

WIRING FOR HOT WATER ELEMENT CONTROL;

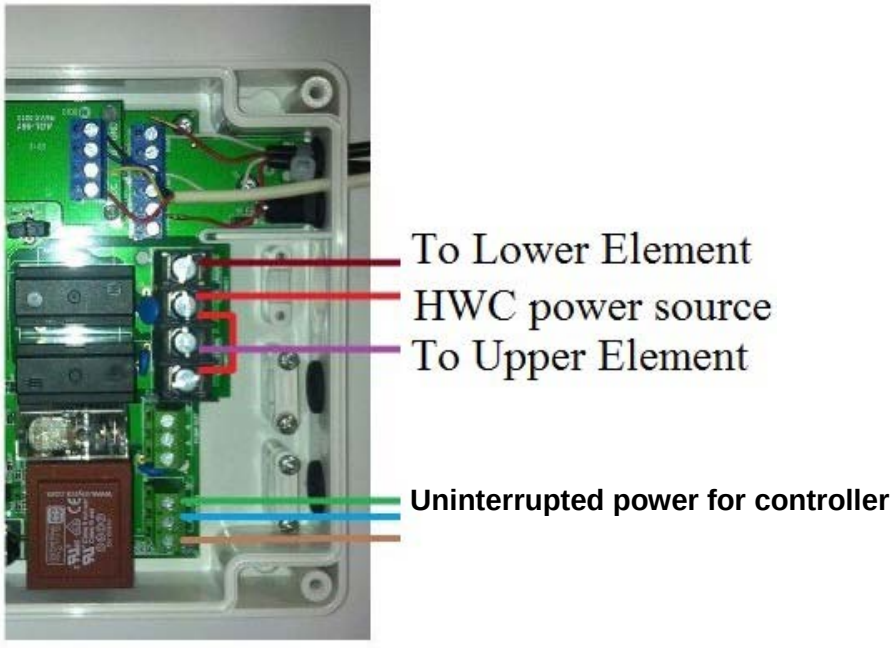
Note: Only Active / Phase wires are illustrated, Neutral and Earth of the HWC wiring have been omitted for clarity.

- Wire the HWC contacts in series with tank thermostat and safety cut-out, do not bypass.
- Adjust tank thermostat to maximum
- HWC entry port is 16mm diameter and designed to allow conduit gland or similar connection. If this port is not used in the installation it must be sealed to prevent an electric shock

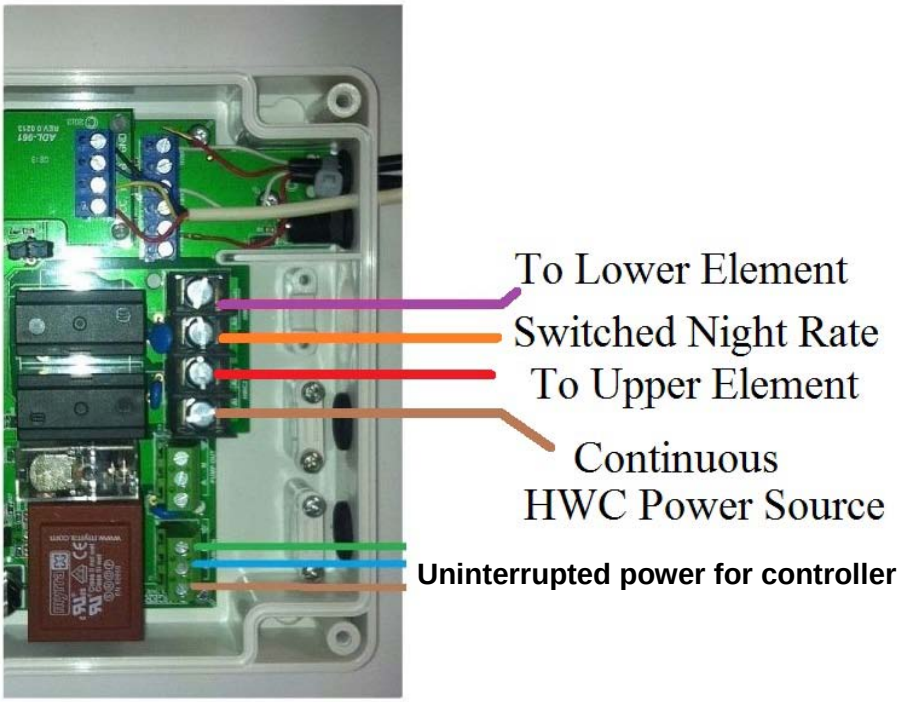
Single Lower Element or Mid Element



Dual Element



Night Rate



POWERING UP

Before you Connect the Power

Before you power up, make sure you have:

Read the safety instructions, warnings and liability statements.

Completed installation.

Securely mounted the unit in place before you connect power to the unit.

Checked that no water, metal shavings or other electrical hazards are anywhere near the plug, socket and/or surrounding environment.

NOTE:

The power outlet socket must be installed by a registered electrician.

The SolaSmart™ must be installed by a qualified person.

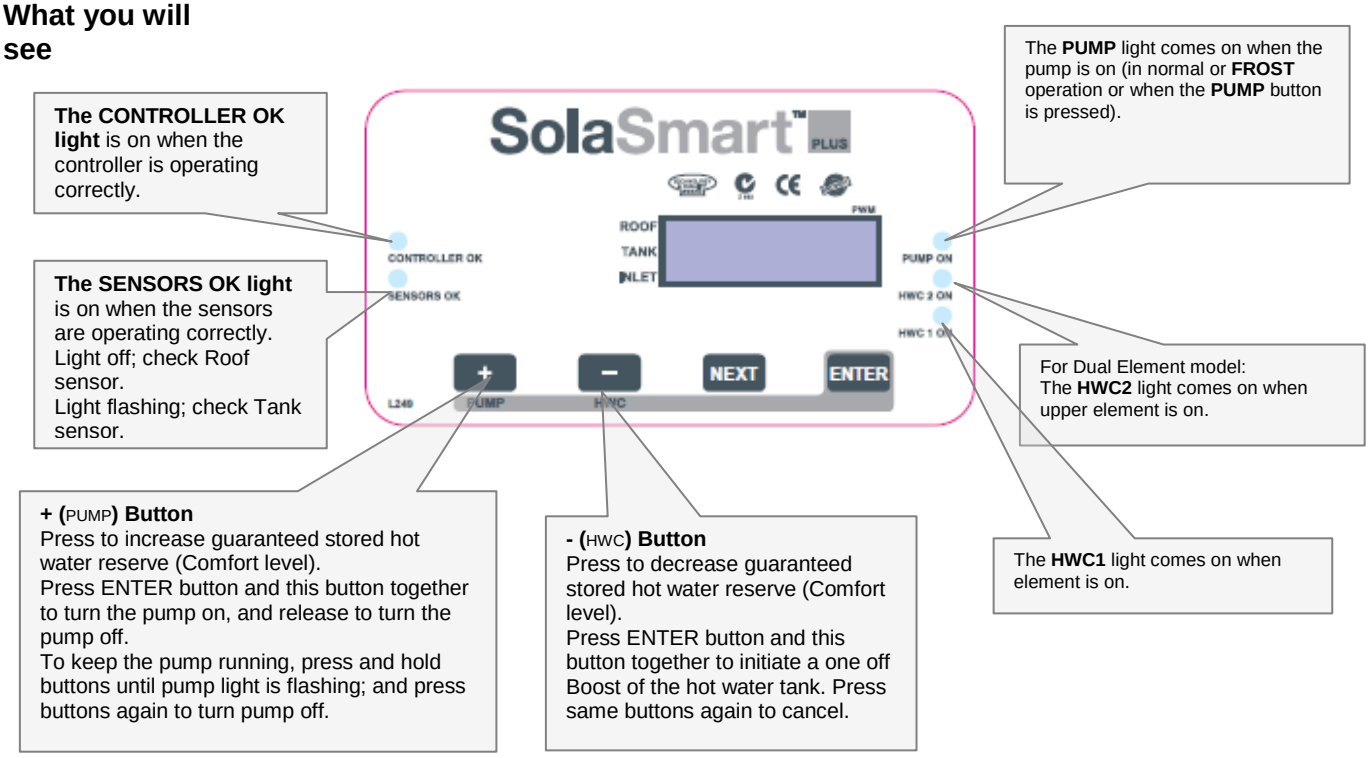
Ensure suitable over-current protection and RCD protection for the SolaSmart™ is in place.

The mechanical hot water thermostat for the electric element/s should be set to the maximum. This is for the HWC Control Mode to operate correctly. (The hot water thermostat is now only used as a failsafe feature and under normal conditions will not interrupt power)

If you intend to use the DisplaySmart-Plus as a programmer then you MUST NEVER insert or remove the interface board with the controller powered on. This can destroy the controller. Always turn off the SolaSmart-Plus V2 while inserting or removing the interface board.

It is safe to plug/unplug at the DisplaySmart itself with controller power on.

What you will see



On power up the display will show all LED segments lit for 5 seconds then the software version number for 5 seconds.

After which the stand 3 sensor temperatures will cycle through Roof – Tank – Inlet. Indicated by the single dot next to label on the display.

Pressing + or the – button will not only adjust the comfort level but also display what the comfort percentage is for 10 seconds after the last button press.

Pressing the NEXT button will cycle through an extended range of screens including the time, what heating profile the controller is using, what speed the pump is running at (%) and diagnostics. These are explained later in the manual.

SOLAR CONTROL

Differential

The SolaSmart™ solar harvesting works by turning the pump on when the **difference** between the temperature at the solar hot water collector (ROOF) and the lower part of the tank (INLET) is at a set level 'Pump On'

The pump turns off again when the difference is less 'Pump Off' (Collector has cooled and/or tank has heated up)

For example, using the standard settings:

PUMP ON = 10°C and PUMP OFF = 5°C:

The solar hot water collector (ROOF) water temperature has heated to 60°C and the INLET sensor is 50°C, the pump turns on because 60°C -50°C = 10°C difference. If the Collector drops to 56°C and the Inlet rises to 51°C then 56°C - 51°C = 5°C difference and the pump turns off. Now that the Inlet is at 51°C the pump will come on again when the ROOF heats to 61°C.

This process is repeated as the tank heats up.

FROST Function

The **FROST** function is designed to protect your collector and hot water system from freezing and bursting. When this temperature is reached, the pump will come on just enough to raise the temperature of water by 2-3°C Only a small amount of warm water is needed to protect the collector and plumbing.

When the unit is in Frost Mode, the **PUMP** light will come on.

PWM Pump Function

The PWM output is a signal that can communicate with an intelligent variable speed pump such as the Grundfos Solar PM 15-85. This is a signal only and not a power source.

A PWM pump uses less electricity to pump the same amount of water as a standard induction pump and will harvest solar energy more efficiently with the SolaSmart controller using a control method that self adjusts to the maximum energy transfer.

This function will operate between Pump On and Pump Off values
I.E. At Pump On °C Then Pump will be running at MAX speed and at MIN speed at Pump Off °C

It is not uncommon for the pump to run continuously while the sun is shining.

Note: It is not recommended to switch the intelligent pump's power on/off with the Solar Pump power outlet as the pump has an embedded computer and will need to start-up each time, causing a delay. Best to leave it permanently connected to the mains power.

Topout Function

The Topout temperature is the maximum temperature that the system will allow the tank to heat to. Temperatures beyond the specification of the tank can cause damage (especially for ceramic lined tanks) – both from heat, and from high pressures.

Topout Simple

The standard Topout method (Topout Simple) is the function that stops the solar pump from working when the tank reaches Topout temperature. Topout also works with the collector (roof) temperature so that BOTH the Tank and the Collector must be below their respect maximum temperatures (Collector Lockout selectable 110°C or 140°C). When the pump stops on a sunny day the collector may heat above this Lockout temperature (this is called stagnation) and so even if the tank cools (e.g. considerable hot water draw off) the solar harvesting cannot re-start until the collector cools down also (often after sun down)

Advanced Topout

Advanced Topout function is an alternative to Topout Simple that will allow the system to re-start solar harvesting if the tank temperature falls below Topout but the Collector is still at Stagnation temperatures.

This function can only work safely if the solar return pipe is below the upper tank sensor (Tank).

Recovery is achieved by a three stage system which includes pulsing water through the collector, the delay between pulses allows the dissipation of heat in the pipes such that any steam should condense and not be present when the water re-enters the tank and thus avoiding steam implosions (loud banging noises in tank).

There are different options for different pipe return lengths and collector

Also the Advanced Topout delays the onset of Stagnation with a 3 stage system of actions starting when the temperature of the tank gets close to Topout. This starts at Topout °C minus 6°C. E.g. If the Topout is 75°C then at 69°C the solar differential will change (might exceed 100°C), then short duration pulses then full Topout as the tank gradually gets higher in temperature.

Topout types		
Type	**DisplaySmart type**	**Comment**
1	**AD01**	Low pressure systems
2	**AD02**	Short solar return pipe runs
3	**AD03**	Standard / typical system plumbing
4	**AD04**	Large collectors
5	**AD05**	Long solar return pipe runs
6	**Simple 130**	Topout Simple with 130°C lockout
7	**Simple 110**	Topout Simple with 110°C lockout

BIOSAFE, AND BOOST FUNCTIONS

Collector BioSafe

During BioSafe the pump is run for two minutes once the tank is above the target temperature to sterilise the collector pipes

BioSafe Modes

BioSafe runs periodically according to the settings. When heating for BioSafe sterilisation the controller will start heating with the upper element (in a dual element tank) first before completing the cycle by then heating with the lower element. The BioSafe examination will continually reset while the tank temperature is above BioSafe levels, so the sterilisation will only occur if the tank has not attained BioSafe conditions during 1 week.

For installations where the Inlet (lower tank) sensor is below the electric element, this is known as a 'Mid Element' configuration and the controller configuration must be set up for this in the installer settings. BioSafe will use the Tank (upper tank) sensor for control and will run every 24 hours to comply with AS 3498 Clause 7.1 (j)

BioSafe uses the Real Time Clock to determine when it should run and is therefore immune to power outages of less than 14 days.

There are 3 settings for BioSafe

1. 55 which will heat to 55°C for 1 hour once a week (special setting)
2. 60 which will heat to 60°C for 32 minutes once a week
3. OFF which is BioSafe disabled.

- **BioSafe Target**

The controller ensures that the whole tank is above this temperature during BioSafe Mode.

- **BioSafe Band**

BioSafe will start at the highest set tariff band or immediately if all bands the same.

Boost

This a 'one –off' operation that will reset when the Boost target temperature is attained

Boost can be initiated when the hot water is below the maximum boost temperature (with a Solar installation this temperature might already be surpassed).

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TARIFF TABLES

Introduction

The Tariff Tables allow the controller to be setup in such a way as to minimise the home owners electricity cost by matching the houses hot water use and expectations to 4 different time bands for each day. Thus not heating too much hot water. There are 3 to choice from to best suit the user.

Because the user can 'turn down' the profile with the comfort control feature (the tables here = 100% user comfort setting) the table must represent the likely **maximum** expected stored reserved hot water.
The options are;

1. MAX - non overrideable by user comfort control
2. High
3. Med
4. Low
5. Off – will not heat during this time period

Table 1 shows all the variables in Tariff Table. Only entire tables can be selected on stand-alone SolaSmart-Plus™ controllers.

These Tariff table settings are fully adjustable with the optional accessory DisplaySmart-Plus™ and other future accessories.

H1 (Standard)				
	Band 1	**Band 2**	**Band 3**	**Band 4**
Band Start Time	7:00	9:00	15:00	23:00
Hot Water Level	High	High	High	High

H2 (Night On)				
	Band 1	**Band 2**	**Band 3**	**Band 4**
Band Start Time	7:00	9:00	20:00	23:00
Hot Water Level	High	High	High	Max

H3 (Night Off)				
	Band 1	**Band 2**	**Band 3**	**Band 4**
Band Start Time	7:00	9:00	20:00	23:00
Hot Water Level	High	High	High	Low

H4 Eco1				
	Band 1	**Band 2**	**Band 3**	**Band 4**
Band Start Time	4:00	9:00	15:00	20:00
Hot Water Level	Max	Low	High	Low

H5 Eco2				
	Band 1	**Band 2**	**Band 3**	**Band 4**
Band Start Time	4:00	9:00	15:00	20:00
Hot Water Level	Max	Low-Med	Med-High	Low-Med

Comfort Control

The + and − buttons on the front panel will by default adjust the 'comfort level' and the 7 segment display will indicate what the comfort % setting is after each update. There are also optional external devices which can adjust this value in addition to the front panel of the controller.

The Comfort Control manages the electric boost heating only.

The Comfort Level is an easily adjustable user control that allows the efficiency vs guaranteed hot water storage (backup) balance of the system to be managed.

- Set higher for more guaranteed hot water
- Set lower for more savings

This control was included as a solution to the problem that different users have different hot water usage vs savings expectations.

The Comfort Level percentage is not a direct temperature control; rather it uses sophisticated computer logic to determine the best temperatures and which sensors or elements in conjunction with the selected HWC profile to realise an optimised system for the user's expectations of stored hot water.

At first it might be best to start with a maximum or high setting and gradually reduce over some time (maybe days) until the best balance is found.

The control is so easy to adjust it can be altered at anytime to suit changing circumstances, weather, guests in house and such.

Comfort set to 0% = Holiday mode and the tank will not heat with the electric elements except if BioSafe sterilisation is required.

Note: The last Comfort setting is written to permanent memory 5 minutes after the last adjustment. If power is removed before the 5 minutes has elapsed the setting will revert to the previous stored value.

DISPLAY AND DIAGNOSTICS

Introduction

The Display is normally a scrolling display of 3 screens. Every 5 seconds the display scrolls to the next screen.

Screen 1: Roof °C

The dot next to the “ROOF” will be lit up when the Roof Temperature is on the display. If the sensor is faulty, “Opn” or “Shrt” will be displayed depending on the fault condition.

Screen 2: Tank °C

The dot next to the “TANK” will be lit up when the Upper Tank Temperature is on the display.

Screen 3: Inlet °C

The dot next to the “INLET” will be lit up when the Inlet (Lower Tank) Temperature is on the display.

Note: To view screens 4-6, press NEXT This will activate advanced diagnostics mode for 10 minutes, after which time it will revert to the temperatures only.

Screen 4: PWM Duty Cycle %

Shows the speed of your variable speed pump (0 to 100%). Only applies when using a PWM pump.

Screen 5: Time

Time is shown in HH:MM format.

Screen 6: Diagnostics

Segment 1:
Solar Rule that is currently active

- = IDLE
F = Frost
d = Differential
t = TopOut (D1 Stage 1, D2 Stage 2 , D1 & D2 Stage 3)
b = Collector BioSafe
E = Error

Segment 2:
HWC Rule that is currently active
- = IDLE
r = Reheat
b = BioSafe
0 = Boost
E = Error

Segment 3:
Active Element: L = Lower, U = Upper

Segment 4:
Active Tariff Band: 1 to 4

E.G. drU2 = The solar pump is running (differential), the tank is using an element to heat the tank (reheat) and that element is the upper It is time period 2.

Programming the System Parameters

This will use the following Parameters

1. Differential On; Solar Pump turns on at this value (Roof – Inlet)
2. Differential Off; Solar Pump turns off at this value (Roof – Inlet)
3. Frost; Frost protection temperature
4. Topout type; Refer to topout type table for type to use.
5. Topout temperature; Maximum the tank will be allowed to heat to.
6. Boost; Maximum temperature the electric boost can heat to.
7. Tariff; Profile used to control the boost heating
8. Mid Element; Mid element tank? (Is Inlet Sensor below element) Yes/No
   Note: With Mid Element setting BioSafe is performed once a day.
9. BioSafe; Choose 55°C for 1 hour or 60°C for 32 minutes or no BioSafe
10. Configuration; Choose Single element, Dual element or Dual element Night Rate element control.

SETTINGS			
SOLAR Settings			
Setting names	**Typical Value**	**Range**	**Units**
Differential Pump On dFOn	10	3-50	ºC
Differential Pump Off dFOF	5	1-48	ºC
Frost On FrSt	5	1-20	ºC
Topout Type ttYP		AD1, AD2,AD3, AD4, AD5, Simple 130, Simple 110	
Topout ºC toPO	80	1-95	ºC
HWC Settings			
Settings	**Value**	**Range**	**Units**
Boost bOSt	65	20-90	ºC
Tariff tArF	H3		
Mid Element MdEL	no	Yes/ No	
BioSafe bio5	60	55 /60 /Off	ºC
Configuration cnF9	2E	1E / 2E/ 2ENR	

The settings the controller was programmed with when it left the factory are printed on the carton and on the back of the controller.

Setting the Time and Hot Water Profile

Note: This is also adjustable by the user

Procedure:

1. Press and hold ENTER for 10 seconds
2. The 'Hours' digits flash
3. Adjust with + and −
4. Press NEXT
5. The 'Minutes' digits flash
6. Adjust with + and −
7. The present Hot Water Profile number will flash e.g. H3
8. Adjust with + and −
9. Press NEXT
10. Press ENTER to save and exit

Setting the System Parameters

Note: This is adjustable only by the installer

Procedure:

1. Press and hold ENTER AND NEXT for 10 seconds
2. dFOn flashes
3. Adjust with + and −
4. Press ENTER
5. Press NEXT
6. dFOF flashes
7. Adjust with + and −
8. Press ENTER
9. Press NEXT
10. tEYP flashes
11. Continue on filling in the parameters until you reach the SAvE screen
12. Press ENTER

The SolaSmart Plus™ is now fully installed and should be working.

It is best to observe some solar hot water pump cycles, but this will depend on the sun shining.

Check all functions are working correctly before leaving the installation.

See **'Trouble Shooting'** section on pages 25-26 of this guide if the system is not working correctly.

SENSOR MAINTENANCE

CAUTION:
Dangerous Voltages may be present. The SolaSmart-Plus™ has no user serviceable parts.
Protective enclosure must only be opened by qualified personnel.
Remove ALL power sources before removing protective cover.

Lengthening Sensor Wire

The sensor wire can be lengthened within certain guidelines:

The absolute maximum cable length is 100m (328 feet).

Over 20m (66 feet), care must be taken to avoid electrical interference being picked up.

In noisier electrical environments, screened cable may be required.

Firmly attach wires to each other by either soldering (heatshrink over each joint) or by quality screw terminals. Joints must be kept dry.

Wire normally used for lengthening is twin 0.5mm^2 (20 AWG) stranded speaker wire.

Replacing a Sensor

A ROOF sensor is easily replaced at the controller by unplugging the old one and plug-in a replacement.

To replace the TANK or INLET sensors;

Remove the mains power supply. Make sure no other power source is feeding back through other connections.

1. Remove the four screw covers on each corner of the lid of the enclosure. This will require a fine tipped tool such as a screw driver. Be careful not to damage the lid. Always press the tool away from you to avoid injury if you slip.
2. Remove the four screws that hold the lid on.
3. Unscrew the damaged sensor from the terminal block.
4. Cut the cable clamp for the sensor leads.
5. Carefully pull the wire back through the opening in the bottom case.
6. Thread the new sensor wire back through where the old one came from.

7. Place the wires of the new sensor into the terminal block where the old sensor came from and secure with a replacement cable tie and glue with neutral cure silicon.
8. Do not allow the sensor cable to come within 10mm of the high voltage connectors or components inside the enclosure. Tighten the screws on the cable clamp.
9. Replace the lid, replace the four screws and tighten.
10. Push in four new screw covers available from your distributor or Senztek NZ Ltd. **NOTE:** There are locating lugs to ensure correct orientation.
11. Reconnect the SolaSmart-Plus™ and turn on the power.
12. Check that the sensor is reading correctly.

Sensor Resistances

The table below has the correct resistance values of the sensor at different temperatures. The sensor must be removed from the SolaSmart™ to measure these values correctly.

Follow the above procedure to remove a sensor.

Sensor Resistances		
Temperature	**Resistance in kΩ**	A 'short' circuit can be caused by the sensor wires being connected together. Check the wires are not partially cut and that moisture is not getting into the sensor causing corrosion.
0°C	27.25	
25°C	10.00	
50°C	4.162	
75°C	1.925	An 'open' circuit can be caused by the sensor wires being broken. Check the wires are not cut and that moisture is not getting into the sensor causing corrosion.
100°C	0.973	
Above 300°C or 'shrt' on display Sensor light Off	<.050	
Below -40°C or 'oPn' on display Sensor light Flashing	>200	

TROUBLE SHOOTING GUIDE

Basic;

Symptom	Possible Cause	Solution
No operation, no lights ON	⇨ No power/fault	⇨ Check mains outlet. ⇨ Press enter and pump button. If pump light comes on controller is o.k.
Sensor O.K. light OFF	⇨ Roof sensor not detected ⇨ Possible broken sensor cable	⇨ Check sensor is plugged in ⇨ Plug a spare Roof sensor in to test ⇨ If test sensor O.K then replace Roof sensor
Sensor O.K. light flashing	⇨ Inlet or Tank sensor not detected	⇨ Replace sensor in either sensor port until Sensor O.K. light is ON
Pump not running, while sunny outside. Pump light ON	⇨ Pump damaged or disconnected. ⇨ Pump timer has turned pump off ⇨ Controller fault	⇨ See if pump has become unplugged ⇨ Wait one minute for the pump to restart. ⇨ Test controller pump outlet if power is present. If power present replace the pump. If no power replace controller
Pump not running, while sunny outside. Pump light OFF	⇨ System in Topout ⇨ Sensor mounting problem	⇨ Check diagnostics display if in Topout. If so then this is normal. ⇨ Check sensor readings. If readings do not match real water/plumbing temperatures check sensor is making good contact with pocket/ surface. Thermal paste required to make good thermal conductivity.
Pump is running continuously	⇨ Pump is cavitating ⇨ Special Installation ⇨ Airlock in pipe ⇨ Setting does not match plumbing used	⇨ If pump sounds like stones are passing through it, the pump may be cavitating and so not moving water. ⇨ Long pump times may be normal for a variable speed pump or a special installation ⇨ Unplug pump for 1 minute. If system behaves normally after plugging back in then an airlock was present. ⇨ If return pipe temperature losses are greater than 'pump off' value system may lock on for extended periods of time. Insulate return pipe better or change pump off value.
Pump only comes ON when Roof sensor is above 100ºC	⇨ Advanced Topout method	⇨ Normal operation for Advanced Topout.
Pump only comes ON for few seconds every few minutes	⇨ T2 Advanced Topout and recovery method in action	⇨ Normal operation for Advanced Topout and Recovery. This prevents banging in tank (steam implosions)

Continued on next page

TROUBLE SHOOTING GUIDE, CONTINUED

Symptom	Possible Cause	Solution
Hot water stored drops significantly at night, yet little or no draw off by user	⇨ System is reverse thermo-siphoning ⇨ System is in a high frost area ⇨ Tank is losing heat	⇨ The non-return method is not effective or is malfunctioning. May be associated with night time pump activities. Check roof sensor reading at night to verify. ⇨ Discuss non-frost sensitive options with your energy provider ⇨ Install better insulation on hot water tank
HWC light stays on too long (more than 6 hours)	⇨ HWC power not getting to controller ⇨ HWC power not getting to element ⇨ Element open circuit (blown) ⇨ Excess water draw off or leak	⇨ Is HWC circuit drawing expected current (typ 10 -16 Amps)? **Qualified personnel only**. If yes verify excess hot water is not being drawn off ⇨ If NO then power is not able to heat the water to the target ºC ⇨ Read tank temperature at controlling sensor. ⇨ If < 50ºC issue will be interrupted power or a faulty element. **Qualified personnel only**; Check for tariff / load control. Check power into the controller HWC contacts. Check power comes out of HWC contacts. Check correct HWC output used. Check wiring is correct. Check element is not blown. ⇨ If > 50ºC issue will be tank thermostat. Ensure tank thermostat is turned up to max. If this doesn't work then thermostat is too inaccurate for this application. ⇨
Tank heats excessively beyond Topout temperature.	⇨ Incorrect Topout method selected	⇨ Advanced Topout (options 1 to 5 on topout type programming) require that the solar return pipe MUST be below the tank sensor. ⇨ Either change sensor or pipe positions to suit OR Change Topout type to Option 6 (Simple 130).

SPECIFICATIONS

Power Supply:

Supply Voltage	240 Vac +/- 10% 50 to 60 Hz
Quiescent power usage	3VA typical

Relay Outputs:

Pump: 10A max (240Vac) Resistive (element)
½ HP/375W (240Vac) Motor rating (0.4cos theta) max
Minimum Load: 2watts @ 240Vac
Zero Crossing contact closure / open
Voltage from input switched through this output

2x HWC: 16A max @ 240Vac (3.6kW max) Resistive (element)
1.5 HP/1100W max (240Vac) Motor rating (0.4cos theta)
Minimum Load: 2watts @ 240Vac to 110Vac or -
100mA at 60 Vdc or less
Zero Crossing contact closure / open
Isolated contacts

PWM Output: (Only for connection to an intelligent variable speed pump e.g. Grundfos Solar PM 15-85)

1kHz +/- 10% pulse repetition rate
Max drive 5mA avg at 9-14 volts. Peak 1.5Amps
Max 5 meter cable to pump

Sensors:

PVC Sensors	-20 ~ +120°C tip 5.8mm diameter stainless steel
	-20 ~ +105°C cable, UV resistant
Teflon Sensor	-20 ~ +250°C peak tip, 5.8mm diameter stainless steel
	-20 ~ +180°C cable, UV resistant
Accuracy	+/-1°C @ 25°C

Real Time Clock:

Backup interval (no power)	14 days min
	(After 4 hour full charge cycle)
Accuracy	Max 30 sec per month drift

EMC and Safety Compliances:

Emissions	EN 55022-A, CTick
Immunity	EN 50082-1
Safety Compliance	AS/NZ 60950.1:2003, CTick
	AS/NZ 3820:2009
	AS/NZ 2712: 2007

Continued on next page

SPECIFICATIONS, CONTINUED

General Specifications: (Unless otherwise stated in other input specifications)

Control Range	-40 ~ +299°C
Operating Temperature	0~60°C
Operating Humidity	5 ~ 85% RH. Non-Condensing
Enclosure Construction	Polycarbonate - Impact Resistant UL94 V-2 Non Burning, UV A & B Stabilized Water resistant to IP54
Dimensions (excluding glands and cables)	L = 167mm W = 142mm H = 40mm
Weight	1600grams

(Standard model + cables + sensors + packaging)

Note: Do not exceed these specification limits. Exceeding these limits can result in damage to the unit and voiding of the warrantee.

Product Liability. This information describes our products. It does not constitute guaranteed properties and is not intended to affirm the suitability of a product for a particular application. Due to ongoing research and development, designs, specifications, and documentation are subject to change without notification.

Regrettably, omissions and exceptions cannot be completely ruled out. No liability will be accepted for errors, omissions or amendments to this specification. Technical data are always specified by their average values and are based on Standard Calibration Units at 25°C, unless otherwise specified. Each product is subject to the ‘Conditions of Sale’.

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