



# SolaStat

## SolaStat-Plus



# Installation Guide.

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# SolaStat-Plus. Solar Hot Water Controller.



## Features.

- Intelligent Heat Extraction From Solar Water Panels.
- Large 20mm Soft Green Digital LED Display c/w 8 Status Lights.
- High Quality, Efficiency, Reliability and +/-1C Accuracy.
- Stainless Steel, Water Resistant Temperature Sensors.
- Pre-wired with Mains Plugs and Sockets, no Electrician Required.
- Pre-Programmed to Customer's Specification at No Extra Cost.
- All Values and Functions Installer Adjustable.
- Access Code Protected Front Panel Programming.
- Sensor Diagnostics and Smart Shutdown.
- Frost Protection Prevents Panels Freezing.
- Over Temperature Protection (Topout) for Ceramic Tap and Ceramic Lined Hot Water Cylinders.
- Pump Timer for Pump Cavitation Recovery Option.
- Easy to Install with External Mounting Holes.
- Complies with Safety & EMC standards.
- Enclosure and cables UV resistant.
- Water Resistant and Rear Cable Entry Options.
- 1HP (750W) Relay Std.



SolaStat Models Include:  
 SolaStat-Eco: Controller c/w 4 Status Lights  
 SolaStat-Plus: Controller c/w Display.  
 SolaStat-Pool: Pool Controller c/w Display.  
 SolaStat-Rmt: Remote Display.  
 SolaStat-Rly: Slave Relay for HWC Control.  
 SolaData: PC Datalogging & Comms.

## Introduction.

SolaStat-Plus is Easy to Use with the advanced generation of smart, microprocessor based Differential Solar Hot Water Controllers. The SolaStat-Plus is easy to install, easy to use, easy to programme and visually appealing.

SolaStat-Plus has Advanced Functions and takes the basics of differential control, frost protection, topout and add to these sensor diagnostics, smart shutdown, comprehensive status displays, digital temperature display, with the options of pump timer for pump cavitation recovery, digital communications, remote display units, SolaData PC graphic datalogging and energy calculating software and smart control of the hot water booster element for dramatically improved energy efficiency.

Senztek NZ Ltd has experience in designing and manufacturing Solar Hot Water Controllers to Industrial Electronic Standards for over 15 years. This has earned SolaStat a reputation for Quality, Accuracy, Efficiency and Reliability.

## Ordering Information.

**SolaStat-Plus-1** Standard; 1 x 1hp Relay, Pump Timer On, Digital Display, 8 Status Lights, 2m Inlet Sensor, 2m Tank Sensor, 10m Panel Sensor, 2m Mains Cable and Pump Outlet.

**SolaStat-Plus-2** Standard; 2 x 1hp Relay, Pump Timer On, Digital Display, 8 Status Lights, 2m Inlet Sensor, 2m Tank Sensor, 10m Panel Sensor, 2m Mains Cable, Pump and HWC Outlets.

**SolaStat-Plus** -  -  -  - Adjustable Value Specify adjustable values as required.  
 Rly PT PS

SolaStat-Plus Ranging Options.											
Relay Options	Rly	Pump Timer	PT	Power Supply	PS	Adjustable Value	Specify Within	Std. Model	Adjustable Value	Specify Within	Std. Model
1 x 1hp	1	Timer ON	T	85~264Vac/dc	H	Pump Off	1~20C	6C	Reheat Upper	2~90C/OFF	55C*
2 x 1hp	2	Timer OFF	N	22~90Vdc	M	Pump On	2~21C	12C	BioSafe	50~70C/OFF	60C*
				10~28Vac/dc	L	Holdoff Timer	1~23hrs/thr/OFF	4Hrs*	Top Out	1~120C/OFF	80C
						Reheat Lower	1~70C/OFF	40C*	Frost	1~10C/OFF	4C

\* Functional with Dual Relay version only. Set to 'OFF' for Single Relay Version.

\* SolaStat-Plus with a 110C Collector Lockout option is available.

\* A dedicated swimming pool controller is available; SolaStat-Pool. It has a 2hp Relay and Pump Timer is Off. High temperature silicon sensor cable, water resistant enclosure, and rear cable entry options are available.

## Quality Assurance Programme.

The modern technology and strict procedures of the ISO9001 Quality Assurance Programme applied during design, development, production and final inspection grant the long term reliability of the instrument.

## ***SolaStat-Plus Users Guide.***

Your SolaStat-Plus has a microcomputer at its core that intelligently and automatically controls your solar hot water system at greater efficiency. The SolaStat-Plus measures water temperatures at three different places in the system and turns on a water pump at the optimum time. The pump moves hot water from the solar collector into the hot water tank.

The SolaStat-Plus-2 (with the addition of the SolaStat-Rly) allows intelligent control of the electric element used in the hot water tank (HWC control). The SolaStat-Plus-2 can prevent the electric element coming on for a programmed time interval when Solar Hot Water is already being transferred into the hot water tank (Holdoff Timer). While making sure you don't run out of hot water (Reheat) and being vigilant that safe water conditions are maintained (BioSafe). These controls should save a considerable amount of electricity.

The SolaStat-Plus has advanced features that protect the system from damage, run self diagnostics, self correction of some problems and will keep you informed as to what the SolaStat-Plus is measuring and what decisions it is making.

### **Principle of operation.**

The solar hot water collector sensor is called: 'ROOF'

The upper hot water tank sensor is called: 'TANK'

The lower hot water tank sensor is called: 'INLET'

The SolaStat-Plus is a differential solar hot water controller. The controller measures the temperature at the 'ROOF' sensor and compares this to the 'Inlet' sensor. If the difference between the roof and the inlet is greater than the programmed upper limit (typically 12C) then the pump turns on and transfers heated water from the solar collector to the tank and replaces this with cooler water from the bottom of the tank. When this happens the tank heats up and the collector tends to cool down. The heat difference is reduced to a point where the lower limit (typically 6C) is reached and the pump turns off. This cycle repeats as long as the sun shines and there is a difference in temperature, the tank heats up progressively this way.

There is a huge amount of energy in sunshine, as high as 1000 Watts per square metre. This can lead to water temperatures present in the hot water tank beyond what it is designed to handle (close to boiling). This is especially true of 'ceramic' lined tanks. Also pressure can build which can cause other plumbing problems. To protect the hot water tank and stop pressure problems a maximum temperature can be set called 'TOPOUT'. This will prevent the pump from moving any more water from the collector until the tank has cooled to a safe level.

To protect the solar collector from freezing in mild frost areas the 'FROST' function can be enabled. This will turn the pump on to move a small amount of water through the collector. Heavy frost areas may need other solutions such as glycol based systems or drain down.

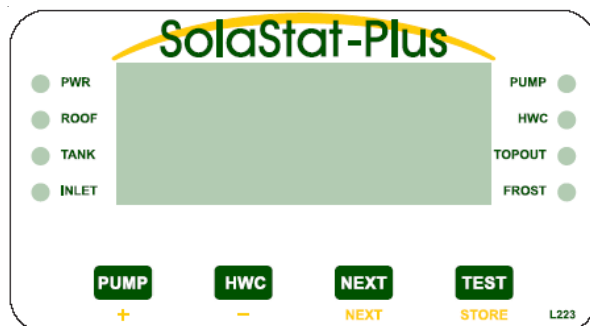
### **The SolaStat-Plus has other special features to those mentioned above.**

- **Pump Timer:** This is an optional factory setting to assist in pump cavitation recovery. After the pump has run continuously for approximately ten minutes, it will turn off for one minute. This cycle is repeated as long as the pump is required to run and will not affect normal operation in a standard hot water collector and cylinder installation. The one minute turn off period helps any accumulated air to escape from the pump and has been effective as a backup in exceptional conditions. This feature can help prevent the pump running for hours in a 'locked up' state, increasing the installation reliability. Also refer 'Plumbing Issues, Cavitation'
- **20 DegC lockout:** If the collector is less than 20C it will not contribute any useful heat, even to cold water. Therefore the controller will not turn the pump on under differential conditions ('frost' protection still works).
- **110 DegC or above lockout:** (Optional) If the collector is greater than 110C, the controller will not turn the pump on under differential conditions to prevent the pump from overheating.
- **Sensor diagnostics:** The SolaStat-Plus constantly checks the sensors. If a sensor is below -20C the display reads 'Lo'. If a sensor is above 140C the display reads 'Hi'. If the roof sensor reads 'Hi', the pump is disabled. If a sensor is outside the specified temperature range of -40C to 150C then the Display reads 'SSd' and the controller enters Smart Shutdown mode. When the display reads 'SSd' the sensor has either a steady light for a temperature above 150C (possibly shorted sensor or wire) or a flashing light for a temperature below -40C (possibly open sensor or broken wire). For example if the 'Roof' sensor wire is cut during some building work then the SolaStat-Plus display reads 'SSd', the 'Roof' light flashes and the controller enters Smart Shutdown mode until the wire is repaired.
- **Smart Shutdown (SSd):** In Smart Shutdown mode, the Display reads 'SSd' and the pump is disabled except for 'Frost' protection when the Roof sensor is working. During Smart Shutdown for the SolaStat-Plus-2, the HWC output is activated and the Hot Water Tank Temperature will be controlled by the Hot Water Tank Thermostat for the electric element.
- **Pump override:** For added flexibility you can make the pump operate manually. The pump will turn on as long as the 'Pump' button is held down unless of course the pump is already on in normal operation.

## **SolaStat-Plus Users Guide, Cont.**

- **HWC Override:** For SolaStat-Plus-2, pressing the 'HWC' button will manually initiate a reheat of the Hot Water Tank. However if Reheat Mode is active, pressing the 'HWC' button will turn off reheat of the Hot Water Tank. Refer examples and explanation of 'Reheat Adjustable Values' for more information. For SolaStat-Plus-1 pressing the 'HWC' button will flash the HWC light but has no effect on unit operation.
- **Test:** Briefly pressing this button will cause all the lights to flash on for 3 seconds then display for 3 seconds the number of times the SolaStat-Plus has operated the pump. This count will reset and start again after '999'.

## **SolaStat-Plus Display Panel Description.**



- The 'PWR' light on indicates that power is being applied to the unit.
- 'ROOF', 'TANK' and 'INLET' lights will be on to indicate which temperature is being displayed. Only 1 of the 3 can be on in normal operation. If more than 1 of these lights are on then it is in Smart Shutdown mode and 'SSd' will be on the display.
- The 'PUMP' light will be on when the pump is on. The exception to this is, if the Pump Timer is on a 1 minute recovery cycle, the light will be on but the pump will not be running during that minute. (see 'Pump Timer' explanation on previous page).
- The 'HWC' light indicates the hot water storage tank's electric element status. (SolaStat-Plus-2 Only).
  - If the HWC light is off, there is no power on the electric element.
  - If the light is on, the HWC control is no longer in 'Holdoff Timer' and is maintaining the temperature at a preset value called the 'Reheat Upper' value referred to as Thermostat Mode.
  - The light slowly flashing (once a second) means the hot water tank has become too cold and is now heating up (Reheat).
  - The light quickly flashing (3 times a second) means there might soon be a risk of biological contamination of the water so the tank is heating up to minimize the risk (BioSafe).
- 'TOPOUT' light on indicates the value stored as the maximum allowable hot water tank temperature has been reached. If lit the pump will be disabled until the temperature drops at least 2C lower.
- The 'FROST' light comes on when the value stored for the onset of a frost condition has been detected on the solar collector. To stop the collector freezing and bursting, the pump will come on just enough to raise the temperature of the collector by 2C. Only a small amount of warm water is needed to protect the collector.
- The 'PUMP' button will turn the pump on as long as the button is held down, unless of course the pump is already on in normal operation.
- For SolaStat-Plus-2, pressing the 'HWC' button will manually initiate a reheat of the Hot Water Tank. However if Reheat Mode is active, pressing the 'HWC' button will turn off reheat of the Hot Water Tank. Refer examples and explanation of 'Reheat Adjustable Values' for more information. For SolaStat-Plus-1 pressing the 'HWC' button will flash the HWC light but has no effect on unit operation.
- The 'NEXT' button will step from Roof to Tank to Inlet and the display will show the relevant temperature in C. If a sensor is below -20C the display reads 'Lo'. If a sensor is above 140C the display reads 'Hi'. If a sensor is outside the specified temperature range of -40C to 150C then the Display will read 'SSd' and the 'NEXT' button is disabled.
- The 'TEST' button will check the system (all lights flash) then display the number of times the pump has been on. This count will reset and start again after '999'.

## **Optional System Enhancements.**

- SolaStat-Rmt A remote display which repeats the display information of the SolaStat-Plus.
- SolaStat-Rly An external Slave Relay Module for HWC control.
- SolaData A data comms option that will send what the SolaStat-Plus is doing to your PC and visually present the information with graphs, logic states and status information.

**SolaStat-Plus System Adjustable Values.**

Installer to fill in at installation time or after any change in program Adjustable Values.

System Adjustable Values			
Function	SolaStat-Plus-1 Factory Values	SolaStat-Plus-2 Factory Values	Installation Values
Pump OFF	6C	6C	___C
Pump ON	12C	12C	___C
Holdoff Timer*	off	4hrs	___hrs
Reheat Lower*	off	40C	___C
Reheat Upper*	off	55C	___C
BioSafe*	off	60C	___C
Topout	80C	80C	___C
Frost	4C	4C	___C

\*Functional with SolaStat-Plus-2 only.

**Notes.**

1. Pump ON must always be higher than Pump OFF.
2. Reheat upper must always be higher than Reheat lower.
3. A disabled value is indicated by 'OFF'

**Installer Details.**

Contact: .....

Phone: .....

Address: .....

.....

.....

## ***SolaStat-Plus Safety Instructions and Limit of Liability.***

**Read safety instructions and limit of liability before proceeding with the installation.**


### **General Safety Instructions.**

1. This installation guide is for the installation of SolaStat-Plus solar hot water controllers only and is not an installation guide for any other part.
2. The complete installation should be checked at least annually for damage or malfunction.
3. All servicing to be carried out by an authorised service agent only.
4. All aspects of the installation must comply with local electrical and plumbing regulations (and any special solar hot water regulations).

### **Installation Precautions.**

1. 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.
2. Must be installed away from direct sunlight, flammable liquids or radiant heat sources.
3. Power leads must be facing directly down, not sideways or upwards.
4. Must be in a safe environment for users to inspect display panel.
5. Failure to mount sensors correctly can lead to a poorly controlled solar hot water system with safety issues like overheating and over pressure damage to the plumbing and hot water tank and freezing damage to the solar hot water collector.
6. Alteration of installer level program values outside those recommended values by Senztek NZ Ltd and other parts suppliers (especially hot water tank manufacturer's maximum recommended temperature) can lead to dangerous conditions and/ or damage to parts of the solar hot water system.

### **Electrical Precautions.**

	<b>CAUTION: Dangerous Voltages may be present. The SolaStat has no user serviceable parts. Protective enclosure only to be opened by qualified personnel. Remove ALL power sources before removing protective cover.</b>	
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1. All mains voltage electrical work to be carried out by a qualified electrician, especially external power outlet socket installation.
2. A readily accessible disconnect device, overcurrent device and RCD Protection rated to suit the size of the pump plus 5VA must be incorporated in the power supply wiring. The overcurrent device for a 1500W, 240Vac pump must not exceed 10Amps.
3. It is recommended that sensor leads be kept 300mm away from mains and comms cables.
4. Do not use mains power extension cords unless approved by the manufacturer. Water resistant plugs and sockets should be used.
5. The SolaStat-Plus controlled outputs (PUMP and HWC) are connected to the input power supply wiring and are not isolated from it. Supply voltages will be output through that outlet during activation. The HWC outlet is labelled 'AUX'.
6. Always use within specified voltage and load ranges. Never use with damaged leads, plugs or sockets.
7. Do not allow the sensor cables to come within 10mm of the high voltage connectors or components inside the enclosure.
8. The HWC output is normally used in conjunction with a SolaStat-Rly. This is due to the high power levels used by hot water electric elements, and completely isolates the AlphaStat-Plus from the HWC circuit. This will also ensure any remote hot water electric element control (eg Ripple Control) will not remove power to the SolaStat-Plus. When used with the mains cable supplied the total current must not exceed 10A maximum.

### ***Notes on Permanent Wiring.***

Permanent wiring of the SolaStat-Plus-2 directly to the HWC electric element is possible (no SolaStat-Rly). However Electricity Suppliers may remotely turn off the HWC element using controlled wiring. Do not power the SolaStat-Plus from the controlled wiring and do not bypass the controlled wiring. The recommended method is to use the SolaStat-Rly. This is a high power relay and connects between the controlled wiring and the HWC element. NO liability will be accepted by Senztek NZ Ltd or any of its authorised agents for permanent wiring installations. For permanent wiring the maximum load of the element and pump must be less than 16Amps @ 25C (Typ 3kW Max Element).

### ***Notes on Hot Water Cylinders with Over Temperature Cutout.***

Some standard electric element hot water tanks have an overtemperature cutout fitted to remove power in the event of a thermostat failure. The temperature this is set to can typically range from 75C to 95C which is adequate for electric element heating safety. However in solar hot water systems this temperature can be exceeded and the overtemperature cutout may activate turning the electric element off. The cutout needs to be manually reset by a qualified electrician. In these installations it may be necessary to modify the electricians in a manner approved by the hot water tank manufacturer or set the topout adjustable value to a temperature lower than the overtemperature cutout.

## ***SolaStat-Plus Mounting.***

### **Where to mount the SolaStat-Plus.**

1. Against a flat vertical surface with sufficient strength to hold the enclosure and any additional weight from the plugs, sockets and cables.
2. Power leads must be facing directly down, not sideways or up.
3. Safe for users to inspect.
4. The display can be easily read and buttons accessed.
5. Allow for cable runs, location of power outlets and lengths of wires.
6. Allow space for SolaStat-Rly if used to control the hot water tank electric element.

### **Mounting the SolaStat-Plus.**

1. There is no need to open the enclosure during a standard installation.
2. Allow for the enclosure dropping 5mm from screw centres once mounted (keyhole mounting system).
3. Place drill guide template against wall, checking for level alignment. 4 screws are supplied, 2 are chip board screws and 2 are combination Gib/ wood screws. It is recommended that all 4 mounting holes are used with at least 2 firmly secured into wood. The outer plastic Gib anchors will self tap into Gib board and their inner metal screws fix into the centre of the plastic anchors.
4. Mark and drill/ screw as appropriate leaving the heads of the screws above the surface by approximately 3mm.
5. Place unit over the 4 screw heads, unit should slide down 5mm into the 'key' slots and become secured to the wall. You will need to adjust screw height to obtain a secure fit.

### **Mounting the Sensors.**

#### **This is Critical to the Success of the Installation.**

The sensors are the only way the SolaStat-Plus can efficiently control and protect the system.

1. **The 10m ROOF Sensor.** (Labelled 'ROOF SENSOR' - Solar Collector.)  
The 'ROOF' sensor is best fitted into a metal immersion 'pocket' just inside the solar collector in the hot water outlet pipe. Liberally apply heat transfer compound between the sensor and the lining of the 'pocket'. Sensor should be sealed with neutral cure sealant and externally lagged, also the cable should be insulated from the bare pipe. Heat transfer compound is available from your distributor or Senztek NZ Ltd.
2. **The 2m TANK Sensor.** (Labelled 'TANK SENSOR' - HWC Upper.)  
The 'TANK' sensor is best fitted into a metal immersion 'pocket' in the upper region of the HWC. For the SolaStat-Plus-2 the position of the Tank sensor will vary the amount of water in the HWC that will be controlled at the required temperature. As an example for a 300l vertical tank mounting the sensor 1/3 of the way down from the top of the HWC will give about 100l of water that is heated within the control parameters. This increases efficiency as only the amount of water required in normal household use is controlled rather than all the water in the HWC. The sensor must be mounted above the electric element. If Topout is required caution should be exercised to allow for stratification of hot water in the tank. For Topout Adjustable Value we recommend a conservative value somewhat lower than the hot water tank manufacturers maximum temperature. Liberally apply heat transfer compound between the sensor and the lining of the 'pocket'. If a 'pocket' is not available then bond the sensor against the metal wall of the tank (not the outside cladding or insulation) using thermal transfer compound between the tank and sensor.
3. **The 2m INLET Sensor.** (Labelled 'INLET SENSOR' - HWC Lower.)  
The 'INLET' sensor is mounted as per the 'TANK' sensor only this time it is mounted near the bottom of the hot water tank.

### **Warning.**

1. Removing or cutting the cladding may void hot water tank warranty.
2. Sensors must not be immersed in water.
3. It is recommended that sensor leads be kept 300mm away from mains and comms cables.
4. Ensure the correct sensors are mounted in the correct place.
5. Failure to properly mount the 'Tank' and 'Inlet' sensors as prescribed above can result in;
  - a. The system may not operate at greatest efficiency.
  - b. There may be inaccurate 'Topout' sensing. HWC or other components may get damaged.
  - c. There may be inaccurate 'BioSafe' sensing. For dangers refer to BioSafe Adjustment Value.
  - d. Hot water readings on the display may be misleading.
6. Failure to correctly mount the 'Roof' sensor as prescribed above can result in;
  - a. The system may not operate at greatest efficiency.
  - b. Failure to detect Frost conditions. Panel can burst.
  - c. Hot water readings on the display may be misleading.

### **Warning:**

These products are not designed for use in, and should not be used for patient connected applications. In any critical installation an independent fail-safe back-up system must always be implemented.

**SolaStat-Plus Operation.**

**Connect the Pump.**

Plug in the pump to the 'PUMP' socket on the SolaStat-Plus. This should be the correct type of pump for domestic solar hot water circulation and not exceed the horse power (hp) rating as specified on the label on the side of the enclosure.

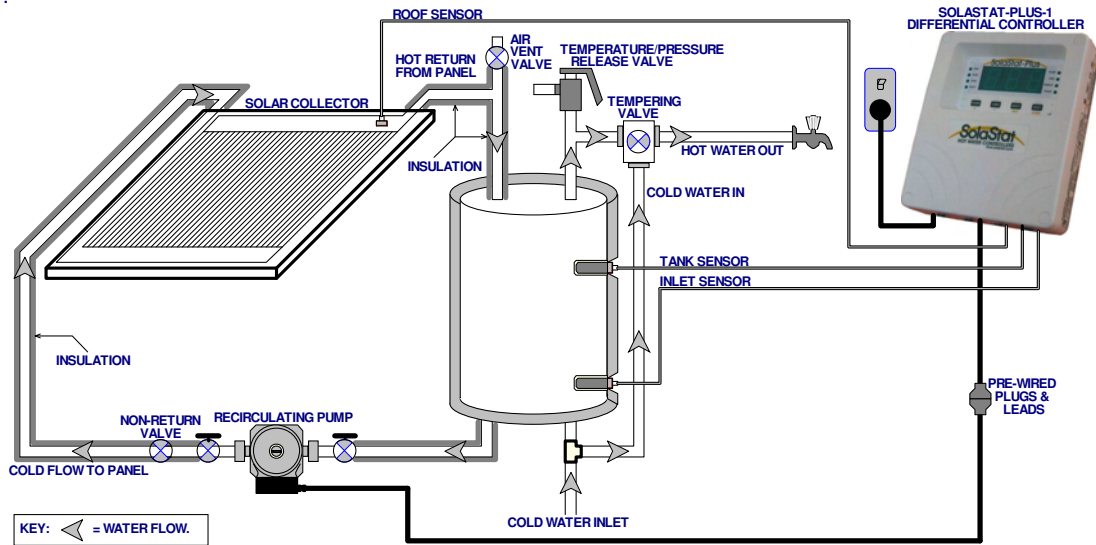
**Connect the HWC output. (SolaStat-Plus-2 Only.)**

Note: This Requires the use of the SolaStat-Rly slave relay module.

Plug in the SolaStat-Rly to the 'HWC' socket on the SolaStat-Plus labeled 'AUX' on the enclosure.

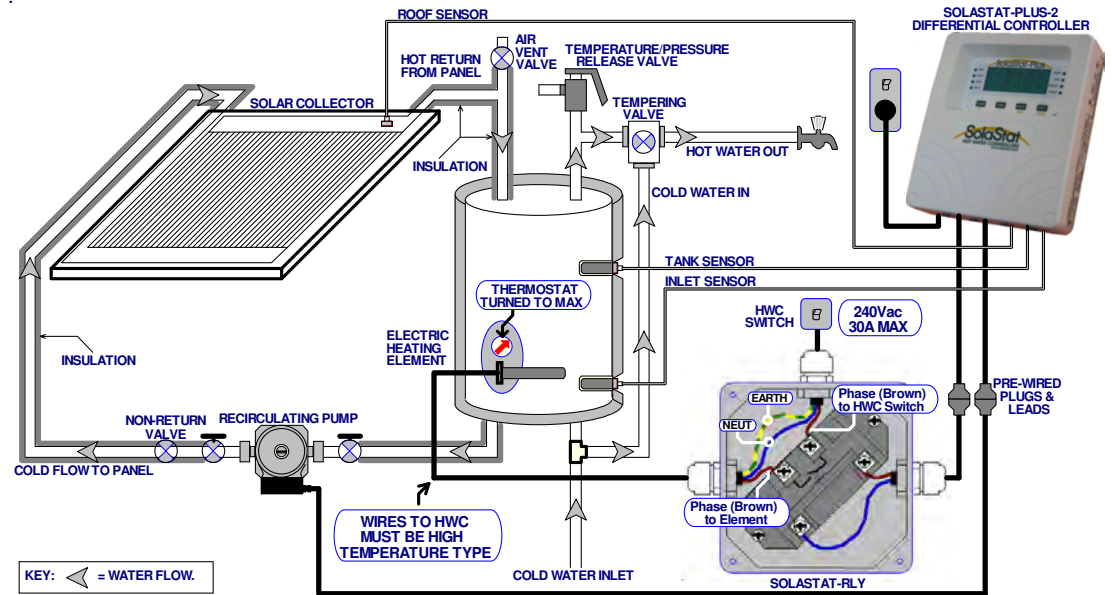
**Basic SolaStat-Plus-1 Installation.**

The SolaStat-1 controlling the Solar Collector circulating pump.



**Basic SolaStat-Plus-2 Installation.**

The SolaStat-2 controlling the Solar Collector circulating pump and the SolaStat-Rly Relay Module.



Note. These diagrams are only to be used as a general guide and not all the required components are shown. Each installation needs to be customised to suit its situation. Always use best plumbing and electrical practices, and comply to any regulatory requirements.

## **SolaStat-Plus Power Up.**

Before you connect the power;

1. Read safety instructions, warnings and limit of liability before proceeding.
2. Complete all the installation and securely mount the SolaStat-Plus.
3. Power outlet socket to be installed by a qualified electrician.
4. SolaStat-Rly to be installed by qualified person.
5. Ensure suitable over-current protection and RCD Protection for the SolaStat-Plus and pump is in place.
6. There is no water, metal shavings or other electrical hazards to contaminate the plug, socket and surrounding environment.
7. For the SolaStat-Plus-2 Only. The Hot Water Thermostat for the Electric Element MUST be installed and MUST be set higher than the temperature of the HWC BioSafe and Reheat adjustable values for the HWC Control Modes to operate correctly. The Hot Water Thermostat for the Electric Element is only used as a fail safe feature and in normal operation will never operate. We recommend setting the Hot Water Thermostat to the Maximum Temperature. Refer to the Trouble Shooting Guide for errors that can be caused by incorrect Hot Water Thermostat settings.

### **Only then;**

*Plug it in and turn it on.*

### **What You Should See.**

The first thing you should see after power up is;

1. A digital readout of the 'TANK' temperature in degrees Celsius.
2. On the left the 'PWR' light and the 'TANK' light should be on.
3. On the right the lights will be on depending on how the solar hot water system is operating.

The pump operation can be tested by pressing the 'PUMP' button. This will turn the pump on as long as the button is held down, unless of course the pump is already on in normal operation.

The SolaStat-Plus is now installed and should be working. It would be best to observe some solar hot water pump cycles but this will rely on the sun shining. Check all functions are working correctly before leaving the installation.

Note 1. See User Guide for explanation of display and status lights.

Note 2. See "Trouble shooting" section if system not working correctly.

### **Note on BioSafe After Power-up.**

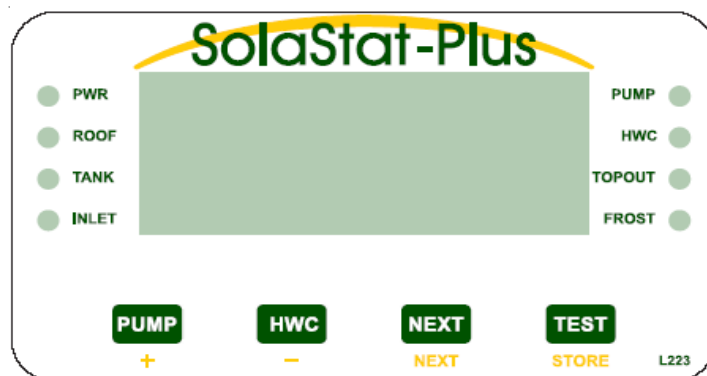
When the SolaStat-Plus is turned on either for the first time or after a power failure the BioSafe 72 hour timer starts from power up (unless the temperature in the tank is greater than the BioSafe Temperature) and the Holdoff Timer will start from the next pump activation. All timers are approximate only.

## **SolaStat-Plus Programming.**

If the Adjustable Values from the factory are inappropriate for the installation (see included document stating programmed values) then the unit needs to be programmed.

The programming access code is for distributor or installer use only, as using incorrect Adjustable Values can cause inefficiencies in the system or cause damage to the system voiding the warranty.

Once new values are 'stored' they are permanently written into memory and will be retained when power is removed.



## ***SolaStat-Plus Programming Cont.***

Note: Immediately after reprogramming please fill out the 'Installation Adjustable Values' in the 'System Adjustable Values' table in the user guide. (Page 6.)

These instructions refer to the small yellow letters/words under the buttons on the SolaStat-Plus.

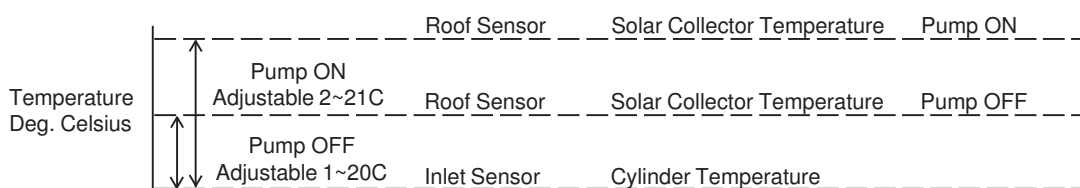
1. Enter the installer programming access code. Available from distributors.
2. Every 10 seconds the characters 'PRG' will flash on the display indicating programming mode.
3. The 'PUMP' light will be flashing to indicate the number being displayed is the 'Pump OFF' value.
4. The 'Pump OFF' can be adjusted using the '+' and '-'.
- \* Press 'NEXT' to move on to the next value.
5. Now the 'PUMP' light will be on continuously to indicate the number being displayed is the 'Pump ON' value.
6. The 'Pump ON' can be adjusted using the '+' and '-'.
- \* Press 'NEXT' to move on to the next value.
7. Now the 'HWC' light will be on continuously to indicate the number being displayed is the 'Holdoff Timer' value in hours.
8. The 'Holdoff Timer' can be adjusted using the '+' and '-'. Set to 'OFF' (>23hrs) for single relay model or Reheat Mode. Set to 'thr' (<1hr) for Thermostat Mode.
- \* Press 'NEXT' to move on to the next value.
9. Now the 'HWC' light will be flashing slowly to indicate the number being displayed is the 'reheat lower' value in °C.
10. The 'reheat lower' can be adjusted using the '+' and '-'. Set to 'OFF' (<1C) for single relay model. Will be 'OFF' when Holdoff Timer = 'thr'.
- \* Press 'NEXT' to move on to the next value.
11. Now the 'HWC' light will be flashing fast to indicate the number being displayed is the 'reheat upper' value in °C.
12. The 'reheat upper' can be adjusted using the '+' and '-'. Set to 'OFF' for single relay model. Will be 'OFF' when Holdoff Timer = 'OFF' and Reheat Lower = 'OFF'.
- \* Press 'NEXT' to move on to the next value.
13. Now no status lights will be on to indicate the number being displayed is the 'BioSafe' value in °C.
14. The 'BioSafe' can be adjusted using the '+' and '-'. Set to 'OFF' (<50C) for single relay model.
- \* Move onto the next value by pressing 'Next'.
15. Now the 'TOPOUT' light will be on continuously to indicate the number displayed is the 'topout' value.
16. The 'TOPOUT' can be adjusted using the '+' and '-'.
- \* Press 'NEXT' to move on to the next value.
17. Now the 'FROST' light will be on continuously to indicate the number displayed is the 'frost' value.
18. The 'FROST' can be adjusted using the '+' and '-'.
19. All the values are now entered. The values can be checked by simply pressing 'NEXT' to cycle through all the values noting which light is on and what value is displayed (as per SolaStat-Plus Programming Table).
20. To store all the values in permanent memory press 'STORE' at any stage. The values will be written to memory and the unit will exit programming mode and return to automatic operation. The unit will also store the values and exit if no key is pressed for a minute while in the programming mode.
21. Fill out the 'System Adjustable Values' in the user guide. (Page 6.)

## SolaStat-Plus Programming Table for Adjustable Values.

Programming Table for Adjustable Values				
Adjustable Values	Light indication	Typical	Range	Disable / Function
Pump off (differential)	Pump flashing	6C	1-20C	n/a
Pump on (differential)	Pump steady	12C	2-21C	n/a
Holdoff Timer *	HWC steady*	4hrs*	1-23hrs*	<1hr = Thermostat Mode. Display = 'thr'. >23hrs = Reheat Mode. Display = 'OFF'.
Reheat Lower *	HWC slow flash*	40C*	1-70C*	<1C or Holdoff 'thr' = Disable. Display = 'OFF'.
Reheat Upper *	HWC fast flash*	55C*	2-90C*	Holdoff 'OFF' & Reheat Lower 'OFF'. Display = 'OFF'.
BioSafe *	No lights at all*	60C*	50-70C*	<50C = Disable. Display = 'OFF'.
Topout	Topout steady	80C	1-120C	<1C = Disable. Display = 'OFF'.
Frost	Frost steady	4C	1-10C	>10C = Disable. Display = 'OFF'.

\*Functional with Dual Relay version only. Set to 'OFF' for Single Relay Version.

### SolaStat-Plus Pump ON / Pump OFF Adjustable Range.



**Notes on SolaStat-Plus Programming.** Also refer principle of operation.

1. Pump ON must always be higher than Pump OFF.
2. Reheat upper must always be higher than reheat lower.
3. A disabled value is indicated by 'OFF'
4. Fill out programming record in User Guide.

#### Pump ON and Pump OFF.

Technically Pump ON and Pump OFF values are the 'Roof' sensor temperature minus the 'Inlet' sensor temperature and are called differential temperatures.

**Example. Pump ON = 12C and Pump OFF = 6C.**

When the solar collector has risen to 12C hotter than the HWC the Pump turns on.  
When the solar collector has fallen to 6C hotter than the HWC the Pump turns off.

- In a high temperature system like domestic hot water relatively large Pump ON and pump OFF differentials like 12C Pump ON, 6C Pump OFF transfer hotter water over shorter periods of time. Lower temperature systems like swimming pools or underfloor heating gain more energy from the sun by transferring more water at lower temperatures and so have typical Adjustable Values of 5C Pump ON and 2C Pump OFF.
- Increasing the 'Pump ON' value will let the solar collector heat up more before heat is transferred to the tank. The advantage is hotter water entering the tank but may mean less operations and lost energy on partly sunny days.
- Increasing the 'Pump OFF' value will mean the overall temperature of the water coming from the solar collector is hotter on average when the pump turns off. This will help overcome heat losses in pipes ensuring the water entering the hot water tank remains hotter than the water already there but may result in less energy being transferred as above.
- The 'FROST' Adjustable Value is critical to avoid damage to solar collectors. The appropriate value depends on installation variables such as geographic location, angle and type of solar collector, sensor placement, fluid used, etc. All of these must be considered when determining the 'FROST' value. This is the installers' responsibility. We recommend 4C as a minimum for the 'FROST' Adjustable Value in mild frost areas only but this may need to be increased for some installations.
- Topout is mainly needed for ceramic lined hot water tanks and other fittings and caution should be exercised to allow for stratification of hot water in the tank. We recommend a conservative value somewhat lower than the hot water tank manufacturers' maximum temperature. It is vital the sensor is mounted as recommend in the installation guide for topout to work correctly.

**SolaStat-Plus HWC Mode.**

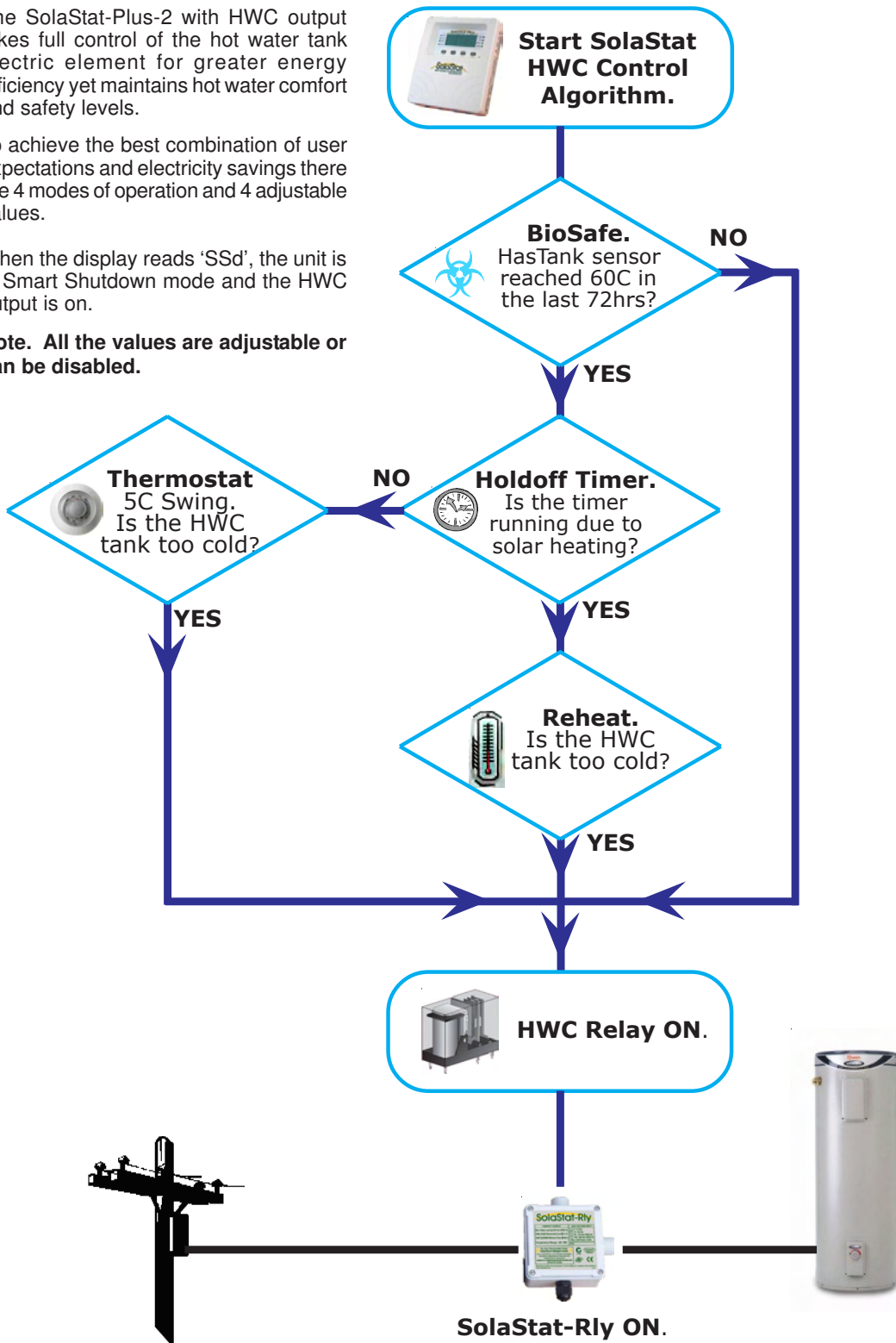
**SolaStat-Plus-2 HWC Control Flow Chart.**

The SolaStat-Plus-2 with HWC output takes full control of the hot water tank electric element for greater energy efficiency yet maintains hot water comfort and safety levels.

To achieve the best combination of user expectations and electricity savings there are 4 modes of operation and 4 adjustable values.

When the display reads 'SSd', the unit is in Smart Shutdown mode and the HWC output is on.

**Note. All the values are adjustable or can be disabled.**



## **Examples and Explanation of the HWC 4 Modes of Operation.**

### **Example of Holdoff, Reheat and BioSafe Mode.**

*Holdoff Timer = 4 hours. Reheat Lower = 40C. Reheat Upper = 55C. BioSafe = 60C.*

The BioSafe ensures the Tank reaches 60C approximately every 72 hours either from Solar Hot Water or from the electric element turning ON.

From the **last** pump operation, the electric element will be OFF for approximately 4 hours (each time the pump operates the Holdoff Timer Resets to 0 hours and starts counting up to 4 hours), unless the Tank falls to 40C and then the electric element turns ON. When the Tank reaches 55C the electric element turns OFF.

After 4 hours has elapsed from the **last** pump operation, the Reheat Upper acts as a Thermostat for the Tank. When the Tank reaches 55C the electric element turns OFF and when the Tank falls to 50C the electric element turns ON. (Note this function has a 5C Hysteresis similar to an Electromechanical Thermostat.)

### **Example of Thermostat and BioSafe Mode.**

*Holdoff Timer = thr. Reheat Lower = OFF. Reheat Upper = 55C. BioSafe = 60C.*

The BioSafe ensures the Tank reaches 60C approximately every 72 hours either from Solar Hot Water or from the electric element turning ON.

When the Tank reaches 55C the electric element turns OFF and when the Tank falls to 50C the electric element turns ON. (Note this function has a 5C Hysteresis similar to an Electromechanical Thermostat.)

### **Example of Reheat and BioSafe Mode.**

*Holdoff Timer = OFF. Reheat Lower = 40C. Reheat Upper = 55C. BioSafe = 60C.*

The BioSafe ensures the Tank reaches 60C approximately every 72 hours either from Solar Hot Water or from the electric element turning ON.

When the Tank falls to 40C the electric element turns ON. When the Tank reaches 55C the electric element turns OFF.

### **Example of BioSafe Mode.**

*Holdoff Timer = OFF. Reheat Lower = OFF. Reheat Upper = OFF. BioSafe = 60C.*

The BioSafe ensures the Tank reaches 60C approximately every 72 hours either from Solar Hot Water or the electric element turning ON.

## **Explanation of the HWC 4 Adjustment Values.**

There are 4 adjustable values that are used to give us a wide range of options and intelligent control.

### **Holdoff Timer Adjustment Value.**

Simulates a smart 24 hour timer. Needs no human intervention for long term accuracy or to adjust to changing conditions. Timer is approximate only.

From the **last** pump operation, a programmed period of time called 'Holdoff Timer' (Adjustable from 1 to 23 hours), must elapse before the element can turn ON. This stops the HWC electric element coming on when solar heated water is being pumped into the tank during the day. Refer 'Example of Holdoff, Reheat and BioSafe Mode'.

Below 1 hour the SolaStat-Plus operates in Thermostat Mode, ('thr' on display.)

Above 23 hours the SolaStat-Plus operates in Reheat Mode, ('OFF' on display.)

## ***Explanation of the HWC 4 Adjustment Values Cont.***

### **Reheat Lower Adjustment Value.**

The Reheat Lower makes sure the user doesn't run out of hot water. This is measured with the Tank Sensor.

When the Tank falls to the coldest you want the water to get, called 'Reheat Lower' (Adjustable from 1~70C), Holdoff Timer is overridden and the electric element turns ON. The temperatures selected will depend on user preferences, tank size, electric element size etc.

The Reheat Lower is OFF below 1C or if Holdoff Timer = 'thr'.

### **Reheat Upper Adjustment Value.**

The Reheat Upper (Adjustable from 2~90C), turns the electric element OFF after Reheat Lower has turned it on. This is measured with the Tank Sensor.

The Reheat Upper acts as a Thermostat for the Tank when Holdoff Timer has timed out and BioSafe is not active. Refer 'Example of Holdoff, Reheat and BioSafe Mode'.

The Reheat Upper is the temperature for the HWC override.

The Reheat Upper is OFF if Holdoff Timer = OFF and Reheat Lower = OFF.

### **BioSafe Adjustment Value.**

This is safeguard against tepid water creating a health hazard\*.

The SolaStat-Plus monitors the water temperature in the hot water tank. BioSafe must always be enabled for Potable water installations.

If the water does not reach a preset temperature called 'BioSafe' (Adjustable from 50~70C) within 72 hours at the 'Tank' sensor all other functions are overridden, the HWC light will flash fast and the electric element turns ON and heats the water to a safe level. 72 hour timer is approximate only. Biosafe is OFF below 50C.

### **BioSafe Disclaimer**

Senztek NZ Ltd makes the following observations about the BioSafe mode and bacteria in tepid water based on published scientific articles and laws passed in some countries. Senztek NZ Ltd in no way claims this information is a guarantee for safe practices or that the recommendations will prevent any or all forms of tepid water infection. Neither do these recommendations extend to other parts of the plumbing other than the hot water tank. It is recommended the entire hot water tank is heated from top to bottom to ensure no water remains at a tepid temperature. This may be achieved by such means as a de-stratification pump.

\* Dangerous organisms can multiply in tepid water (especially 30 to 45°C) and when aerosoled (e.g. in a shower) can cause pneumonia type symptoms.

If the water is raised to 50°C all growth stops, when the water is above 55°C the organisms start dying and at 60°C they die very quickly. Other factors will influence the level of growth or decimation. Copper pipes and tanks help kill these organisms, as will stainless steel (to a lesser extent) and water flow will keep the numbers down but sludge and rust deposits will enhance growth.

It is therefore prudent to ensure that any domestic hot water system storage tank is hotter than 60°C top to bottom at least once a day especially when the electric element is controlled. This is in line with regulations in some countries and the strong recommendation of Senztek NZ Ltd. As such our BioSafe function will make sure the tank is completely heated once a day to the Adjustable BioSafe Value (Senztek NZ Ltd recommends 60C), either by Solar Hot Water or by the electric element. This BioSafe temperature is adjustable only to allow for sensor interface errors or an even hotter target temperature for greater caution.



**SolaStat-Plus Sensor Maintenance.**

**Lengthening SolaStat-Plus Sensor Wire.**

The sensor wire can be lengthened within certain guidelines. Poor connections or induced interference can cause false temperature readings.

1. The sensor is not polarized- it can be connected either way around.
2. The wire normally used for sensor lengthening is twin 0.5mm<sup>2</sup> stranded speaker wire.
3. Firmly attach wires to each other by either soldering (heatshrink over each joint) or by quality screw terminals. Joins must be kept dry.
4. It is recommended that sensor leads be kept 300mm away from mains and comms cables.
5. Over 20 metres; extra care must be taken to avoid electrical interference being picked up.
6. In 'noisier' electrical environments screened cable may be required.
7. The absolute maximum cable length is 100 metres.

**Replacing a SolaStat-Plus Sensor.**

	<p><b>CAUTION: Dangerous Voltages may be present. The SolaStat has no user serviceable parts.</b>  <b>Protective enclosure only to be opened by qualified personnel.</b>  <b>Remove ALL power sources before removing protective cover.</b></p>	
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If a damaged sensor needs to be replaced then the cover of the enclosure will need to be opened unless the choice is made to join the wires externally (see "Sensor Wire Lengthening" section).

1. Remove the mains power supply, preferably remove the plug from the wall socket. Make sure no other power source is feeding back through other connections.
2. Remove the 4 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.
3. Remove the 4 screws that hold the lid on.
4. Unscrew the damaged sensor from the terminal block.
5. Loosen the cable clamp for the sensor leads.
6. Carefully pull the wire back through the opening in the bottom case.
7. Thread the new sensor wire back through where the old one came from.
8. Place the wires of the new sensor into the terminal block where the old sensor came from and retighten the screws.
9. Do not allow the sensor cables to come within 10mm of the high voltage connectors or components inside the enclosure. Tighten the screws on the cable clamp.
10. Replace the lid, replace the 4 screws and tighten.
11. Push in 4 new screw covers available from your distributor or Senztek NZ Ltd. Note: there are locating lugs to ensure correct orientation.
12. Reconnect the SolaStat-Plus and turn on the power.
13. Check sensor is reading correctly and check SolaStat-Plus operation as per "What You Should See" section of this manual.

The table below has the correct resistance values of the sensor at different temperatures. The sensor must be removed from the SolaStat-Plus to measure these values correctly. Follow the above procedure for removal of the sensor.

<b>Sensor Resistances</b>	
<b>Temperature</b>	<b>Resistance in kΩ</b>
0°C	27.25
25°C	10.00
50°C	4.162
75°C	1.925
100°C	0.973
Above 150C or 'short'. 'SSd' on Display Sensor Light On	<0.300
Below -40C or 'open'. 'SSd' on Display Sensor Light Flashing	>200

A 'short' circuit can be caused by the sensor wires being connected together. Check the wires are not partially cut. (eg Sharp roofing iron.) or moisture is not getting into the sensor causing corrosion.

An 'open' circuit can be caused by the sensor wires being broken. Check the wires are not cut. (eg Sharp roofing iron.) or moisture is not getting into the sensor causing corrosion.

## **SolaStat-Plus Specifications.**

### **Power Supply.**

Supply Voltage.	-H	85~264Vac/dc (standard model)
	-M	22~85Vdc. (Must be specified at time of ordering.)
	-L	10~28Vac/dc. (Must be specified at time of ordering.)
Max power usage.		5VA + external loads.

### **Relay Outputs.** -Three Options can be ordered. (All ratings at 240Vac.)

-1.	1 x 1hp motor.
	10A resistive flexible wiring.
-2.	2 x 1hp motor. 1hp combined load.
	10A resistive combined load flexible wiring.

### **Sensors.**

Display range	-20 ~ +140C
Control Range	-40 ~ +150C
Stainless steel tip	-40 ~ +150C; 6mm diameter x 30mm
PVC Sensor cable	-40 ~ +105C; 4mm diameter, UV resistant. (Standard Models)
Teflon Sensor Cable	-40 ~ +250C; 4mm diameter, UV resistant. (Special Order)
Accuracy	+/-1C @ 25C

### **Adjustable Values Range.** (Adjustable in programming mode.)

Pump-On	2~21C (Roof – Inlet sensor).
Pump-Off	1~20C (Roof – Inlet sensor).
Top Out Protection:	1~120C with -2C hysteresis or OFF.
Frost Protection:	1~10C with +2C hysteresis or OFF.

### **HWC Adjustable Values Range.** (Adjustable in programming mode.)

Default HWC state:	ON/OFF.
Holdoff Timer:	1~23 hours or Thermostat Mode or Reheat Mode.
Reheat lower (set):	1~70C or OFF.
Reheat upper (reset):	2~90C or OFF.

### **EMC and Safety Compliances.**

Emissions:	EN 55022-A, CTick.
Immunity:	EN 50082-1.
Safety Compliance:	EN 60950, CTick.

### **General Specifications.** (Unless otherwise stated in other input specifications.)

Operating Temperature:	0~60C
Operating Humidity:	90% RH Max. Non-Condensing
Enclosure Construction	Polycarbonate - Impact Resistant UL94 V-2 Non Burning, UV Stabilized Water resistant or rear entry option available.
Dimensions	L=167, W=142, H=40mm, excluding glands and cables
Weight.	Standard model + sensors + packaging = 1200grams

**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 at 25C and are based on Standard Calibration Units at 25C, unless otherwise specified. Each product is subject to the 'Conditions of Sale'.

## SolaStat-Plus Trouble-shooting Guide.

This is intended as an initial guide to minimise service calls.

Trouble Shooting		
Symptom	Cause	Solution
No operation, no display and no lights	a. No power.	a. Check mains outlet. b. Check fuses.
POWER light ON but no display or corrupted display.	a. Power brown out. b. Unit faulty	a. Remove power while brownout condition is present. b. Remove power for 10 minutes, repower and see if unit is operating. If not unit needs repair.
Display on, pump not running and yet is sunny outside. PUMP light is ON.	a. Pump damaged or disconnected. b. Pump Timer has turned pump off.	a. See if pump has become unplugged. b. Wait one minute for pump to restart.
Display on, pump not running and yet is sunny outside. PUMP light is OFF. TOPOUT light is OFF.	a. Roof Sensor reads 'Hi' on display. b. Sensor not mounted properly. c. Water not hot enough yet.	a. Normal Operation, pump disabled. b. Check sensor is thermally bonded to Solar Panel outlet. c. Check temperatures of Roof and Inlet, they need to be greater than the difference programmed for Pump ON. Wait.
Display on, pump will not operate and yet is sunny outside. PUMP light is OFF. TOPOUT light is ON.	a. Topout temperature exceeded	a. If Tank temperature greater than Topout programmed value then is working normally.
Pump running continuously.	a. Pump is cavitating. b. Special installation. c. Settings incorrect. d. Airlock	a. If pump is making noise like stones passing through it then it is cavitating. See SolaStat Plumbing Issues. b. Special installation where long pump on times are normal. c. Check programming. d. Air relief valves not installed/functioning
Pump runs at night. FROST light is ON.	a. Frost outside.	a. Normal operation.
Pump runs at night. FROST light is OFF.	a. System is reverse thermosiphoning.	a. The non-return valve is not fitted correctly or is faulty.
Hot Water drops significantly overnight yet little or no draw off of hot water by the user.	a. System is reverse thermosiphoning. b. System is in an high frost area. c. Tank losing heat.	a. The non-return valve is not fitted correctly or is faulty. b. Discuss non frost sensitive options with provider. c. Install better insulation on hot water tank.
HWC Light never comes on.	a. Tank Thermostat temperature is set below HWC Adjustable Values. b. Collectors are heating tank to greater than adjustable values.	a. Increase Tank Thermostat Temperature to greater than HWC Adjustable Values. b. Normal Operation.
HWC light flashing. (1Hz)	a. HWC Reheat Upper adjustable value has not been reached.	a. Wait for the tank to heat up to Reheat Upper or Tank thermostat is set below Reheat Upper or Sensors incorrectly installed.
HWC light flashing FAST. (3Hz)	a. HWC Biosafe adjustable value has not been reached.	a. Wait for the tank to heat up to Biosafe or Tank thermostat is set below Biosafe or Sensors incorrectly installed.
'Lo' on Display	a. Sensor below -20C.	a. Check Outside Temperature.
"Hi" on Display	a. Sensor above 140C.	a. Check Collector has water in it.
'SSd' on Display. ROOF Light Flashing.	a. Wire to Roof sensor broken. b. Roof Sensor Damaged. c. Roof Sensor below -40C.	a. Repair wire. b. Replace Roof Sensor. c. Check Outside Temperature.
'SSd' on Display. ROOF Light ON.	a. Wire to Roof Sensor shorted. b. Roof Sensor Damaged. c. Roof Sensor above 150C.	a. Repair Wire. b. Replace Roof Sensor. c. Check Collector has water in it.
'SSd' on Display. TANK Light Flashing.	a. Wire to Tank sensor broken. b. Tank Sensor Damaged.	a. Repair wire. b. Replace Tank Sensor.
'SSd' on Display. TANK Light ON.	a. Wire to Tank Sensor shorted b. Tank Sensor Damaged.	a. Repair Wire. b. Replace Tank Sensor.
'SSd' on Display. INLET Light Flashing.	a. Wire to Inlet sensor broken. b. Inlet Sensor Damaged.	a. Repair wire. b. Replace Inlet Sensor
'SSd' on Display. INLET Light ON.	a. Wire to Inlet Sensor shorted. b. Inlet Sensor Damaged.	a. Repair Wire. b. Replace Inlet Sensor

## ***SolaStat-Plus Plumbing Issues.***

### **Disclaimer.**

For full information on compliance and safety standards for solar hot water systems the appropriate local standards must be referred to. All plumbing to be carried out by qualified plumbers only.

We provide the following information as a guideline only to help obtain the greatest efficiency from the system. Any information supplied here is based on feedback to us by experienced solar hot water professionals and in no way represents a complete guide to plumbing such a system, as we are not plumbers and do not represent ourselves as such. Best plumbing practices must be used in all instances.

### **Introduction.**

Any solar hot water system involves professional level plumbing and water much hotter than would normally be seen in standard domestic hot water systems. For this reason Senztek NZ Ltd recommends any installation is carried out by a registered and qualified plumber. All parts including the pump must be rated for the elevated temperatures found in solar hot water systems.

### ***Solar Hot Water Specifics.***

#### **1. Tempering valve.**

There is a huge amount of energy radiated by the sun. It is not uncommon for the water from the solar collector to exceed 100C (under pressure).

Therefore it is vital a tempering or 'mixing' valve is fitted so the domestic supply from the tank does not burn the end users. The tempering valve must be installed to best plumbing practices. The tempering valve must be rated to handle these elevated temperatures.

#### **2. Non return valve.**

Hot water rises and cold water falls. If the solar collector is colder than the tank, such as during the night, the hot water from the tank can self thermosiphon up to the collector. The collector now radiates the heat to the cool night air and the water descends back down to the tank. To stop this loss of hot water at night or during cloudy skies there has to be a one way or 'non return' valve fitted.

The failure of this non return valve is a common problem with solar hot water systems. The orientation of the valve as per manufacturer's instructions is critical. Also the valve sometimes will not close when swarf or other debris get caught in the valve seat.

#### **3. Pressure relief valves.**

Solar hot water systems can run much hotter than standard domestic hot water systems. Hotter water expands more and needs high quality pressure relief valves to avoid possible catastrophic rupturing somewhere in the system, probably the tank.

Qualified plumbers using best industry practice must decide on adequate pressure relief valves, the number and placement of them.

#### **4. Air Relief Valves.**

It is important that air relief valves are fitted (especially in a low pressure system) to the highest point of both the feed to and the return from the solar water collectors. Otherwise air locks can occur within the piping etc., and not just the pump. (An air lock in the system will increase the head that the pump is working against and for some installations this is too much and the water ceases to circulate. For systems where air locks occur, the pump may need to be set to a higher speed or a higher head pump installed).

#### **5. Cavitation.**

A pump is used to circulate the water between the tank and the collector.

If the pressure at the inlet or impellor of the pump falls below the vapour pressure of the liquid being pumped, cavitation will occur. Cavitation in a pump is more likely to occur as the temperature of the water rises and/or the pressure of the water decreases.

Bubbles form when the water is sucked into the pumps impellor and collapse again as small implosions when the water is ejected out of the impellor which can be so rapid that a rumbling/cracking noise is produced (it sounds like stones passing through the pump) and there can be damage to the impellor and other sensitive components as well as a drop in water volume moved.

## ***SolaStat-Plus Plumbing Issues, Cont.***

### **To minimise cavitation.**

Mains pressure solar hot water systems are less susceptible to cavitation than low pressure systems as the extra pressure will make it less likely that vapour bubbles will form.

As cavitation gets worse, less and less water is moved, often reaching a point where no water at all moves. Since the solar hot water controller is still reading a 'differential' requiring water to flow then the pump stays on until the vapour point drops. The vapour point drops either by water pressure increasing or water temperature decreasing. When the pump is cavitating it may run continuously for several hours.

1. Make sure the pump is appropriate for the installation.
2. If a variable speed pump then select the best setting (a slower speed that still has enough head pressure is best as this will create the lowest pressure difference in the pump).
3. Mount the pump as low as is possible to achieve highest water pressure out of the tank feeding into the pump.
4. Lower the resistance to water flow into the pump, such as less bends or more gradual bends, or wider diameter pipes. Recommended minimum diameter pipe 1/2".
5. In exceptional cases a larger pump with a larger impellor may need to be fitted to reduce vacuum at the impellor.
6. Convert the system to mains pressure.

The SolaStat-Plus controllers have an optional factory setting called 'Pump Timer' to assist in pump cavitation recovery. After the pump has run continuously for approximately ten minutes, it will turn off for one minute. This cycle is repeated as long as the pump is required to run and will not affect normal operation in a standard hot water collector and cylinder installation. The one minute turn off period helps any accumulated air to escape from the pump and has been effective as a backup in exceptional conditions. This should not be considered a substitute for the afore mentioned best plumbing practices. This feature can help prevent the pump running for hours in a 'locked up' state, increasing the installation reliability.

## **SolaStat Distributor.**



SS-plus installation 250108.p65