SolarCache+

the PV energy use maximiser

User Guide

(*SolarCache+Duo Plus* display shown)

Congratulations on your purchase of a *SolarCache+* system, the intelligent proportional controller that heats your water. This guide will to help you to understand how it works and what the different elements on the display means. *SolarCache+* is automatic; turn it on, and it just works!

What is *SolarCache+*?

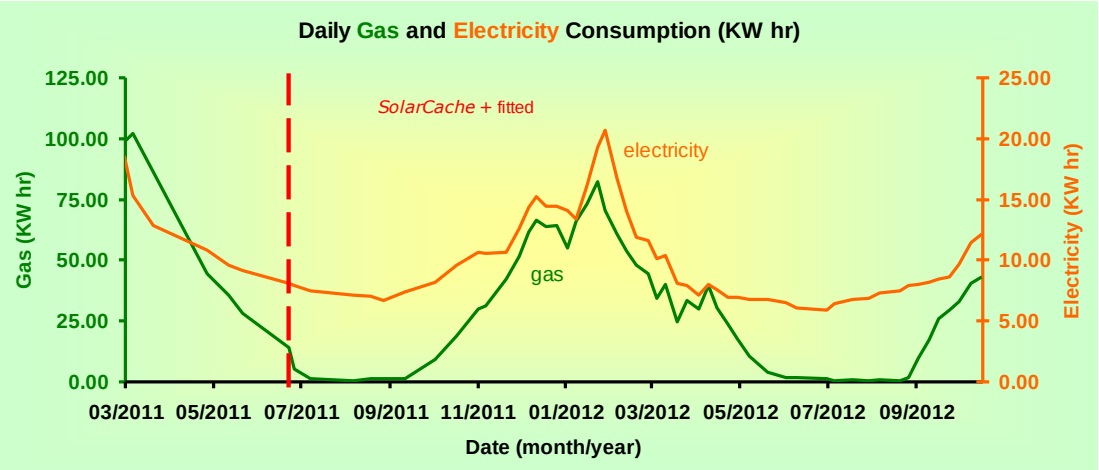
SolarCache+ is a valuable addition to your solar PV installation which maximises your use of generated electricity. It controls the immersion heater in your hot water tank. It automatically adjusts the power going into your hot-water tank so as to use up excess power from the solar panels.

Having had PV solar panels installed on your roof, you have probably realised that you generate more power than you can use whenever the Sun comes out. This excess electrical power is normally "exported" via your electricity meter to the National Grid, where it is "sold" to your electricity supplier. However, it costs you a lot more to buy the same amount of electricity back. Your *SolarCache+* water heater controller will help you use up this excess power by diverting it into your hot water tank. This reduces your normal water heating bill and saves you money, whether you heat your water by gas, oil, wood, coal, or electricity.

SolarCache+ responds immediately to changes in how much electricity you use in your house and to changes in the sunlight. Turn the kettle on, and *SolarCache+* makes the exact adjustment to ensure that only the excess power goes into your tank. When the Sun goes behind a cloud, the immersion heater power is reduced by just the right amount.

Does *SolarCache+* really work?

Yes it does, and here is proof.



The chart shows the actual measured daily consumption figures of gas and electricity in a house using gas central heating and water heating, which had solar panels installed in March 2011, and a *SolarCache+* water heater controller fitted in June 2011. The date is shown in black along the bottom of the chart. The green curve indicates the gas consumption, which should be read against the green vertical scale on the left-hand side of the chart. The orange curve indicates the electricity consumption, and this should be read against the orange vertical scale on the right-hand side of the chart.

You can see at once the drop in the gas consumption when the *SolarCache+* water heater controller had been fitted. In fact, the householder turned off her gas hot-water heating shortly afterwards and used virtually no gas at all during the summer months whilst still having more steaming hot water than she knew what to do with! She did this again the

following summer. Note that the electricity consumption did not go up, despite all this hot water being produced by the electric immersion heater. This is because *SolarCache+* responds immediately and continuously to changes in conditions.

How does it work?

SolarCache+ measures not only how much power is flowing through your electricity meter, but also in which direction. Only when you are exporting more than 50 Watts does it bring up the immersion heater, always adjusting the exact level so as to maintain the exported power below about 200 Watts. You can turn electric appliances on and off in your house without worrying about it. Make a cup of tea: *SolarCache+* will turn down the immersion heater as soon as you switch on your electric kettle, and turn it up again afterwards.

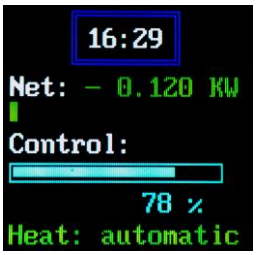
SolarCache+ versions

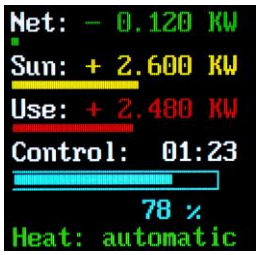
SolarCache+ comes in several versions. All of them divert your excess solar PV power into your hot-water tank (or other heating system). *SolarCache+Mono* displays the power flowing through your electricity meter on its bright colour screen, showing you how much electricity you are buying (in red) or exporting (in green). It also tells you how much has been saved in your hot-water tank today. Its three-position slider switch lets you turn the heat on continuously or for just one hour, or turn it off altogether.

With *SolarCache+Duo Plus* you can also see how much power is being generated by your solar panels right now and how much electricity you have generated in total today. You can set up to three boost periods, according to your own requirements. *SolarCache+Wi-Link* is our exceptionally versatile model. It provides for up to two independently-controlled heaters, one connected by wires as with the other models, and one connected by a radio link. The radio link will also connect with other devices. Ask for more details.

What does the display mean?

The *SolarCache+* display shows several lines of text and numbers and their associated coloured bars. On the left is shown a typical display of *SolarCache+Mono*, and on the right that of the *Duo* and *Wi-Link* versions.





The clock time is shown in the blue box at the top of the *Mono* screen (16:29), and after the label 'Control:' in the *Duo Plus* and *Wi-Link* screens (01:23).

Net:

The top line begins with the word '**Net:**' and is followed by a plus or minus sign, a number, and the letters '**KW**'. Immediately underneath, you will see a bar whose length is proportional to the displayed number. The larger the absolute value of the number, the longer is the bar. The number and bar are displayed in green if the number is negative, and in red if it is zero or positive.

The **Net:** figure is measured directly by *SolarCache+* using a clip-on current transformer around the live cable at the electricity meter and it indicates the total power flowing in the cable between your house and the electricity supply company. In the pictures shown above, this is -0.120 Kilowatts (KW) (or -120 Watts (W), as 1 KW is 1000 W). The negative sign shows that you are exporting power from your house to the electricity grid. When the number is positive, the number and bar turn red and then you are importing power from the electricity supply which you pay for on your electricity bill. Green is good; red is expensive. To be precise, you pay for the *energy* you consume, usually designated in Kilowatt hours (KWh), or 'Units' for short, with one Unit being one Kilowatt hour. The power is the *rate* of using energy, designated in Watts, or Kilowatts. To find the energy in Units, you need to multiply the power in KW by the number of hours of use. Running a 2 KW electric heater for 3 hours uses 6 Kilowatt hours of energy, and you will be charged for 6 Units on your bill, unless your solar panels are providing the power instead.

Sun:

The next line down (not *Mono*), beginning with the word '**Sun:**', indicates how well your solar panels are doing. The number and the bar are always displayed in yellow, and they show the power being generated by your solar panels whenever this is 10 W or more. This number is also measured directly by *SolarCache+* using a clip-on current transformer around the live cable from your solar PV system. The number should be zero at night and several KW when the Sun is shining directly on to your panels. The picture above indicates that you are generating 2.6 KW (2600 W). This value is displayed for information, but is not used by *SolarCache+* to control your immersion heater.

Use:

The third line down (not *Mono*) begins with the word '**Use:**'. It is always displayed in red, and it shows the power you are actually using in the house, i.e. all the power being consumed by everything plugged in and switched on, such as your lights, refrigerator, washing machine, electric kettle etc. It also includes the power going into your immersion heater. According to the display, you are using 2.48 KW (2480 W). This number is not measured directly by *SolarCache+*, but is calculated from the **Net:** and **Sun:** figures.

Control:

The next line down has the label '**Control:**'. The blue bar and percentage number underneath it indicate the setting of your immersion heater. *SolarCache+* adjusts the amount of power consumed by your immersion heater between zero and one hundred per cent. The number indicated is the percentage of the maximum control setting. In this case, it is 78%. Zero per cent shows that your immersion heater is consuming no power at all, and one hundred per cent shows that your immersion heater is full on. The figures in between

give you a *rough* guide as to how much power is going in to your hot water, but the relationship between the control percentage and the power depends on details of the installation, so you should not try to interpret the figures too closely. However, a correction is made internally so that the energy stored value (see below) is quite accurate.

When the control percentage is zero, the display will register '**Off**'. When the control percentage is 100%, the display will register '**Max/Temp/Off'**, indicating that one the following four conditions is true:

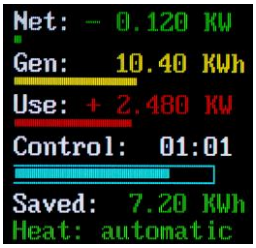
(1) the Sun is shining brightly and your water is not yet up to temperature, so your immersion heater is full on (**Max**);

(2) 50 W or more of solar power are being generated and your water is up to temperature so that the immersion heater thermostat has disconnected it (**Temp)**;

(3) 50 W or more of solar power are being generated and you have turned off the immersion heater yourself (**Off**); or

(4) you have switched the override switch to the left, or you are in a 1-hr boost period, or you are in a night-time boost period (not *Mono*), forcing the immersion heater to be energised continuously (see below).

Every six seconds, two lines in the display change to show the energy that you have generated today (not *Mono*), and the energy that you have saved in your hot water tank:



Gen:

The '**Sun:**' line changes to show the accumulated number of units, or KWh, that your solar panels have provided today (not *Mono*). It begins with the word '**Gen:**' and is followed by an indication of the number of KWh generated, 10.40 KWh in the example above. The figure gives a good indication of the energy generated, but may differ slightly from the figure indicated on your PV inverter, or that recorded by your generation meter. This is normal and is because the calibration of *SolarCache+* is affected by some details of your installation and how much sunshine there is.

Saved:

The percentage line changes to show how many units of energy you have saved in your hot water tank today, 7.20 KWh in the example above. This energy would otherwise have been exported from your house to the grid. You can easily see how much money *SolarCache+* is saving you. Multiply the number of units saved as shown on the display by the cost per unit

that you pay to your electricity supplier. In this example, if the cost per unit is 12 pence, the householder has saved 12 x 7.2 = 86.4 pence so far today. *SolarCache+* soon pays for itself! As with the '**Gen:**' figure, the actual energy put into the hot water tank may differ slightly because of a small variation in the calibration. It is also calculated based on the power rating figure that you enter for your immersion heater when setting the parameters (see below).

Both the '**Gen:**' figure and the '**Saved:**' figure are reset to zero at midnight.

What does the switch do?

The three-position switch is located on the top right-hand side of the *SolarCache+* controller. It is a slide switch and operates as follows:

SolarCache+ Mono:

> **Left position**: the heater is fully on, and *SolarCache+Mono* has no effect. The legend "**Heat: continuous**" appears in red at the bottom of the display, and the blue "Control:" bar should be at full length.
>
> **Mid position:** the heater is controlled automatically by *SolarCache+Mono.* The legend "**Heat: automatic**" or "**Heat: 1-hr boost**" (see below) appears in green (or yellow) at the bottom of the display. This is the normal position.
>
> **Right position:** the heater is turned off and *SolarCache+Mono* has no effect.
>
> **Mid-left-mid movement**: if you move the switch from the mid position to the left position, wait for the words "**Heat: continuous**" to appear, and then slide it back to the mid position, the heater is turned fully on for 1 hour. This is useful for all-electric systems to boost the heat. Repeat the process to cancel this function. During the boost period, the legend "**Heat: 1-hr boost**" will appear in yellow at the bottom of the display, and the blue "Control:" bar should be at full length.

SolarCache+Duo Plus and *SolarCache+Wi-Link*:

> **Left position**: the heater is fully on, and *SolarCache+* has no effect. The legend "**Heat: continuous**" appears in red at the bottom of the display, and the blue "Control:" bar should be at full length.
>
> **Mid position:** the heater is controlled automatically by *SolarCache+*. The legend "**Heat: automatic**" or "**Heat: 1-hr boost**" (see below) appears in green (or yellow) at the bottom of the display. This is the normal position.
>
> **Right position:** the heater is controlled automatically by *SolarCache+*. However, the heater is turned fully on during the boost periods under the control of the internal clock. You can set up to three boost periods (see below). This switch setting is intended for Economy 7 (or similar reduced rate tariff) users. The legend "**Heat: auto/night**" appears in yellow at the bottom of the display. The legend changes to "**Heat: boost 1**", "**Heat: boost 2**"or "**Heat: boost 3**" during the corresponding boost period, and the blue "Control:" bar should be at full length.

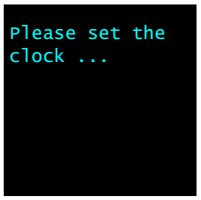
Mid-left-mid movement: if you move the switch from the mid position to the left position, wait for the words "**Heat: continuous**" to appear, and then slide it back to the mid position, the heater is turned fully on for 1 hour. This is useful for all-electric systems to boost the heat. Repeat the process to cancel this function. During the boost period, the legend "**Heat: 1-hr boost**" will appear in yellow at the bottom of the display, and the blue "Control:" bar should be at full length.

System parameter setting (clock, boost periods, heater power, and connectivity)

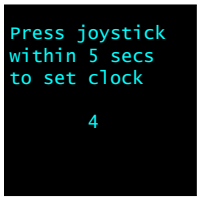
The toggle switch on the left-hand side of the display may be used to set the clock, up to three boost periods (not *Mono*), and the nominal rating of the heater in Watts. If using the *Wi-Link* version with an additional wired power throttle fitted, you can also specify which of the power throttles to connect, or both.

The toggle switch has five positions: press up (UP), press down (DN), press left (L), press right (R), and press in (IN). (These directions are appropriate for a unit mounted on a wall in the correct orientation.) When power is first applied to the unit, the legend labelled 1a (*Mono* version) or 1b (*Duo Plus* or *Wi-Link* version) appears shortly after the opening information screen. Normal operation resumes if you do nothing during the count-down period, otherwise, the legend changes to that shown at 1a.

1a

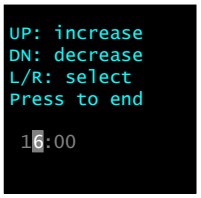


1b

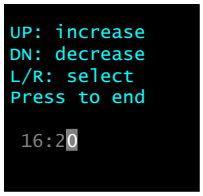


You can also get back to the first setting screen by pressing IN during normal operation when the screen is not being refreshed. (Press again if there is no response the first time.)

2a



2b



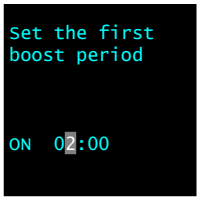
The first setting screen displays the legend shown at 2a with the current clock time in the 24-hour format HH:MM in dark gray. The right-hand digit of the hour's part of the time has a lighter gray background and the digit appears in white. This is the selected digit, and you can increase (press UP) or decrease (press DN) the value shown in the HH field in the range 00 to 23. For example, if the current time is twenty past four in the afternoon (16:20) you would set this to 16 as shown.

You can switch between the HH and MM fields by pressing L or R. The left-hand digit of the MM field will then be selected, and you can set the MM field in the range 00 to 59. You would set this to 20 (as shown at 2b).

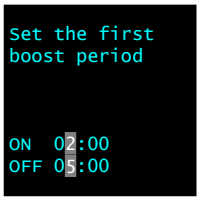
When you are satisfied, press IN to start the clock at the time shown by the digits on the screen. The words Clock set appear briefly, and then the setting screen for setting the three boost periods (*Duo Plus* and *Wi-Link* versions only.) The setting screen for the first period of heat boost appears (shown at 3a). This is the time at which the heater is turned on (default value 02:00) during the first period of boosting. Set the digits to your requirement, and then press IN to set the turn-off time (3b).

Press in again when you have entered the time at which you want the first boost period to end.

3a



3b



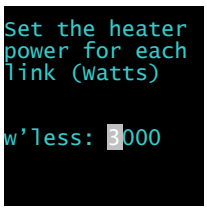
You can set the on and off times of the second and third heat boosting periods in a similar fashion. By default, these are set to 00:00 and 00:00 respectively. The controller will ignore a boost period altogether if the on and off times are the same. Make sure that the first, second and third boost periods **do not** overlap with each other! You should also note that a boost period must **not** include midnight, so ON at 23:00 and OFF at 01:00 will cause unexpected results!

Press IN after setting the off time of the third boost period to set the nominal heater power. This defaults to 3000 (i.e. a 3 KW immersion heater) shown at 4. The power field is a four-digit decimal number which may be set in the range 0000 to 9999. You may select any of the digits by pressing L or R. Press IN to exit the parameter setting pages (*Mono* or *Duo Plus* versions).

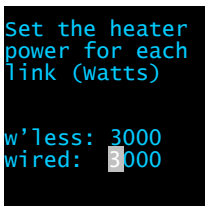
4

You can set two heater powers with the Wi-Link version, corresponding to the heater connected to the wireless power throttle (w'less) and the wired power throttle (if fitted). The displays are illustrated at 5a and 5b. You can also set which of the two, or both, is connected to the *SolarCache+* controller (illustrated at 5c). Press IN to complete the parameter setting.

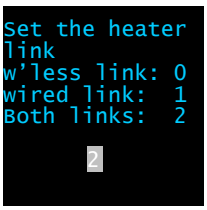
5a



5b



5c



Appendix A: control settings

Suggested settings for *SolarCache+* and water heating controls
Legend: *SolarCache+Mono* (*M*); *SolarCache+Duo Plus* (*DP*); *SolarCache+WiLink* (*W*)

Customer Requirement	Existing hot water system	*SolarCache+* settings	Boiler hot water settings	Comments
Full tank of hot water first thing every morning	Fuel fired boiler system	**Heat: automatic** The water will be heated using surplus generated power during the day (*M, DP, W*)	Set to come on 2 hours in the morning before hot water is required	Ensure that the boiler controls do not request the boiler to reheat the water once it has been used first thing in the morning
Full tank of hot water first thing every morning	Economy 7 or E10 off-peak electricity tariffs	**Heat: auto/boost** The water will be heated using surplus generated power during the day and also at night during the settable boost periods to benefit from the off-peak cheaper electricity rates (*DP, W*)		Use the **Heat: 1-hr boost** or **Heat: continuous** override functions to top up the hot water temperature at any time (*M, DP, W*)
No requirement for full tank of hot water first thing every morning Full tank of hot water required at the end of the day	Fuel fired boiler system	**Heat: automatic** The water will be heated using surplus generated power during the day (*M, DP, W*)	Set to come on at the end of the day 1 hour before the hot water is required to top-up the water temperature	Ensure that the boiler controls do not request the boiler to reheat the water once it has been used
No requirement for full tank of hot water first thing every morning Full tank of hot water required at the end of the day	Economy 7 or E10 off-peak electricity tariffs	**Heat: automatic** The water will be heated using surplus generated power during the day (*M, DP, W*)		Use the **Heat: 1-hr boost** or **Heat: continuous** override functions to top up the hot water temperature at any time (*M, DP, W*)
Full tank of hot water first thing every morning and full tank of hot water at the end of the day	Fuel fired boiler system	**Heat: automatic** The water will be heated using surplus generated power during the day (*M, DP, W*)	Set to come on 2 hours in the morning before hot water is required and again at the end of the day 1 hour before the hot water is required to top-up the water temperature	Ensure that the boiler controls do not request the boiler to reheat the water once it has been used first thing in the morning
Full tank of hot water first thing every morning and full tank of hot water at the end of the day	Economy 7 or E10 off-peak electricity tariffs	**Heat: auto/boost** The water will be heated using surplus generated power during the day and also at night during the settable boost periods to benefit from the off-peak cheaper electricity rates (*DP, W*)		Use the **Heat: 1-hr boost** or **Heat: continuous** override functions to top up the hot water temperature at any time (*M, DP, W*)

Appendix B: trouble-shooting guide

A guide to assist with commissioning and to understand the proper correct operation of *SolarCache+*

Legend: *SolarCache+Mono* (*M*); *SolarCache+Duo Plus* (*DP*); *SolarCache+Wi-Link* (*W*)

Problem	Possible Cause	Action	Test and comments
The **Sun:** value displays zero even though the PV plant is generating power, or you see the warning message **Solar PV CT is REVERSED** (*DP*, *W*)	The PV Generation current transformer is fitted the wrong way around	Remove the PV generation current transformer, rotate it by 180 degrees and re-fit. Ensure that the poles are clear of dust or debris and that the latch is properly secured	Compare the generation value from the PV plant with the value shown on the *SolarCache+* display. These should be within 10% of each other
The **Net:** display value increases in red when the PV system is generating surplus power (*M*, *DP*, *W*)	The export/import current transformer is fitted the wrong way around	Remove the export/import current transformer, rotate it by 180 degrees and re-fit. Ensure that the poles are clear of dust or debris and that the latch is properly secured	Make a note of the **Net:** value shown on the *SolarCache+* display and then turn on a high-power appliance, such as an electric kettle. The **Net:** figure should increase, i.e. become more positive.
The general power consumption has increased since *SolarCache+* was fitted (*M*, *DP*, *W*)	The export/import current transformer is fitted the wrong way around	Remove the export/import current transformer, rotate it by 180 degrees and re-fit. Ensure that the poles are clear of dust or debris and that the latch is properly secured	Make a note of the **Net:** value shown on the *SolarCache+* display and then turn on a high-power appliance, such as an electric kettle. The **Net:** figure should increase, i.e. become more positive.
The value of either **Net:** or **Sun:** appear to be incorrect	One or both current transformers are poorly fitted	Re-fit the offending current transformer ensuring that the poles are clear of dust or debris and that the latch is properly secured	Check the display and compare the values.
The water is not hot enough	The Sun has not been shining enough!	Use the **Heat: 1-hr boost** or **Heat: continuous** override functions to top up the hot water temperature at any time (*M*, *DP*, *W*)	Remember to reselect the previous function when the water is hot enough
The water is not hot enough	The immersion heater integral thermostat is set too low	Adjust the integral immersion heater thermostat to the desired setting	 Always select a safe temperature setting to avoid the risk of scalding
The *SolarCache+* display is blank (no illumination)	Power failure to *SolarCache+*	Check the MCB supplying the power throttle is switched on. Use an AC mains voltage tester to measure the voltage across the L & N input terminals of the power throttle. Use an AC low voltage tester to measure the voltage across the 9V AC screw terminals.	Expect 230 – 250 VAC rms Expect 8.5 – 12 VAC rms
The *SolarCache+* display is blank (no illumination)	The *SolarCache+* computer needs re-starting	Switch off the supply MCB for 10 seconds and then turn it back on again. If that fails, re-boot *SolarCache+* by pressing the black button located on the back circuit board, to the right of blue LED, then unplug the low voltage power plug from socket P within the *SolarCache+* controller case and re-insert after 10 seconds.	Check the display to confirm that the re-start has been successful. Check the display to confirm that the re-start has been successful.

Appendix C: the *SolarCache+* display

A description of the information shown on the controller display screen

Display	Example	Units	Description
Net:	-0.500	Kilowatts	Export value: surplus generated power is being exported to the grid
Net:	0.500	Kilowatts	Import value: power is being imported from the grid
Sun:	1.500	Kilowatts	Generation value: the power being generated by the PV plant
Gen:	5.500	Kilowatt hours	The total energy generated by the PV plant so far since middnight
Use:	1.500	Kilowatts	Use value: the total power being consumed within the property, including the immersion heater
Control:	66%	Percentage	The percentage of the total power being delivered to the immersion heater (approximately)
Saved:	5.500	Kilowatt hours	Saved energy: the energy delivered to your hot water tank so far since middnight
Heat: automatic			The automatic function has been selected. The function switch on *SolarCache+* has been set to the central position to provide automatic operation delivering surplus power to the load
Heat: 1-hr boost			The 1-hour boost function has been selected. The function switch on *SolarCache+* has been moved to the left position and then back to central position to provide full power to the load for 1 hour. See the User Guide for information about how to set this function
Heat: continuous			The continuous heat function has been selected. The function switch on *SolarCache+* has been moved to the left position. The load is operating at full power
Heat: auto/boost			Automatic and economy tariff function has been selected. The function switch on *SolarCache+* has been set to the right position to provide automatic operation of *SolarCache+* system delivering surplus power to load whenever available and full power to the load between the times set for boosting. See the User Guide for information about how to set this function
Max/Temp/Off			Max: the immersion heater (load) is operating at full power Temp: the hot water is up to temperature Off: the immersion heater (load) is not consuming any power

Technical Support

Please contact our technical support team at DSM Energy Control Ltd., if you have any questions regarding the operation of the *SolarCache+* systems. The email address is support@solarcache.co.uk or you can call the telephone number given below.

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Company No. 08044291
The Old School, High Street, Horningsea,
Cambridge CB25 9JG
Telephone: 01223 440100
www.solarcache.co.uk

DSM *Energy Control Limited*

DSM Energy Control Limited: product warranty

The *SolarCache+* product is protected for three years against defects in material and workmanship, subject to the provisions described below. If this product fails to perform as described within the warranted period, it will be repaired or replaced with the same or functionally equivalent product by DSM Energy Control Limited, at its discretion, free of charge provided you: (1) return the failed product to DSM Energy Control Limited, properly packaged against damage in transit, with shipping charge prepaid, and (2) provide DSM Energy Control Limited with proof of the original date of purchase. Returned or replacement products will be returned to you with shipping charges prepaid by DSM Energy Control Ltd.

Replacement products may be refurbished or contain refurbished materials. If DSM Energy Control Limited, at its sole determination, is unable to repair or replace the defective product, it will refund the depreciated purchase price of the product.

The warranty does not apply if, in the judgement of DSM Energy Control Limited, the product has failed because of damage during shipment, handling, storage, accident, abuse, misuse, or if it has been used or maintained in a manner not conforming to product manual instructions, has been modified in any way, or has had any serial number removed or defaced. Repair by anyone other than DSM Energy Control Limited or an approved agent will void this warranty. The maximum liability of DSM Energy Control Limited under this warranty is limited to the purchase price of the product covered by the warranty.

The end customer or the reseller from whom the end customer originally purchased the product, must obtain a return authorisation number from DSM Energy Control Limited, before returning the defective product.

All defective products should be returned to DSM Energy Control Limited with shipping charges prepaid. DSM Energy Control Limited will not accept collect shipments.

Except as specifically provided in this agreement or as required by law, the warranties and remedies stated above are exclusive and in lieu of all others, oral or written, express or implied. Any and all other warranties, including implied warranties or merchantability, fitness for a particular purpose and non infringement of third party rights, are expressly excluded. DSM Energy Control Limited shall not under any circumstances be liable to any person for any special, incident, indirect or consequential damages, including without limitation, damages resulting from use or malfunction of the products, loss of profits or revenues or costs of replacement goods, even when DSM Energy Control Limited is informed in advanced of the possibility of a claim for such damages.