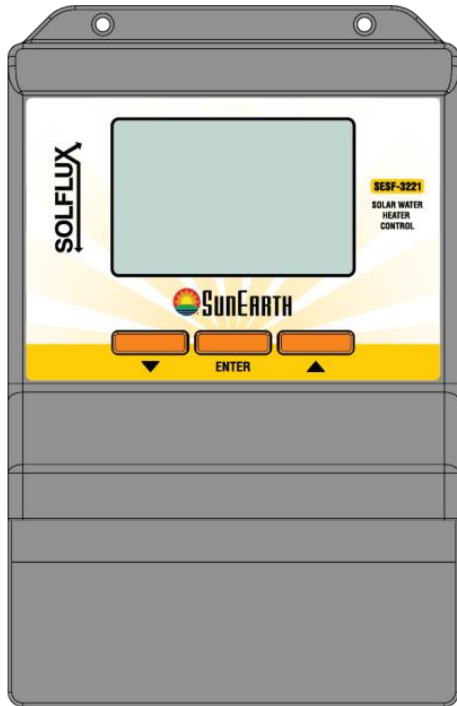




Smart Solar Water Heating Controller

Installation and Operating Instructions

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INTRODUCTION

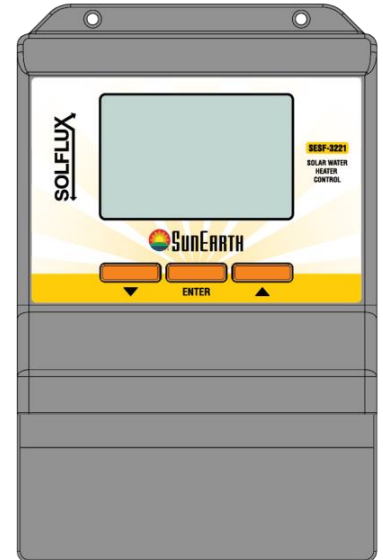
This manual will assist with the installation, setting, troubleshooting and general maintenance requirements for the controller. To ensure the safe and reliable operation of this controller, you must first read this manual in detail taking particular note to any and all warnings or caution directions prior to connecting AC power.

- This manual is part of the product
- Consult a professional in the event of any ambiguities
- The solar energy system can be damaged by improper operation of the device
- The device must not be connected to AC power when:
 - The casing is open or damaged.
 - Any cables are damaged
- Factory labels and markings must never be altered, removed or rendered unreadable

Please consult and install the solar heating equipment in accordance with the manufacturer's recommendations.

QR CODE

Each SESF-3221 is labelled with a QR code, which when scanned will link to a digital version of this manual. If this manual is ever lost or damaged, simply scan the QR code with a compatible device to download the latest manual version.



Receipt & inspection

After receiving, inspect the unit for any possible physical damage that may have occurred during transportation.



WARNING: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Safety Symbols

**Extreme Hazard**

This action poses a serious threat that could result in personal injury or death as well as permanent damage to the equipment. Proceed with caution.

**Point of Interest**

This point clarified pertinent information, or brings you attention to an action that may have adverse effects on the installation process.

**Drawing Reference**

Refer to the specified electrical or mechanical drawing at the back of the manual.

**Disconnect Power Source**

The presence of low voltage (24 DC) or high voltage (120/240 VAC) could result in personal injury or permanent damage to components or equipment.

**Moderate Hazard**

This action may cause personal injury or have adverse effects on the installation process if handled incorrectly.

Safety Warnings



WARNING: Only suitable qualified individuals with formal training in electrical and solar controls should attempt the installation of this equipment. Incorrect wiring and installation will affect the warranty provided with this unit. Wiring must be completed in accordance with the codes and standards application to the authority having jurisdiction for the installation location.



WARNING: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.



EXTREME HAZARD: The SunEarth SESF-3221 is a microprocessor based controller and as such is not to be regarded as a safety (limit) control. Please consult and install the heating appliance in accordance with the manufacturer's recommendations.



WARNING: Use only copper conductor supply wire suitable for at least 105 °C



WARNING: All circuits must have a common disconnect and be connected to the same pole of the disconnect.



WARNING: To reduce the risk of electric shock, this product has a grounding type plug that has a third (grounding) pin. This plug will only fit into a grounding type power outlet. If the plug does not fit into the outlet, contact a qualified electrician to install the proper outlet. Do not change the plug in any way.

Description

The SESF-3221 is designed to be a stand-alone Solar Water Heating Control device. The purpose and function of the SESF-3221 is to provide control for multiple standard solar water heating system designs. The system designs are selectable through push button operation on the programming interface and consist of Direct, Drainback 1, Drainback 2, Indirect Heat Transfer Fluid 1 or Indirect Heat Transfer Fluid 2.

System Designs

Direct

The use of the SESF-3221 as a direct, open-loop, solar water heating system control allows the capability to monitor energy savings, control up to 2 additional devices such as a hot water recirculating pump and backup heating device.

Drainback 1

The use of the SESF-3221 as a single pumped drainback , immersed heat exchanger, solar water heating system control allows the capability to monitor energy savings, control up to 2 additional devices such as a drainback booster pump and backup heating device.

Drainback 2

The use of the SESF-3221 as a double pumped drainback, external heat exchanger, solar water heating system control allows the capability to monitor energy savings, control up to 1 additional device such as a backup heating device.

Indirect Heat Transfer Fluid 1

The use of the SESF-3221 as a single pumped indirect HTF, immersed heat exchanger, solar water heating system control allows the capability to monitor energy savings, monitor solar circuit pressure, control up to 2 additional devices such as a hot water recirculating pump and backup heating device.

Indirect Heat Transfer Fluid 2

The use of the SESF-3221 as a double pumped indirect HTF, external heat exchanger, solar water heating system control allows the capability to monitor energy savings, monitor solar circuit pressure, control up to 1 additional devices such as a backup heating device.

Features

- Up to 5 Temperature Readings
- Flow measurement utilizing Grundfos VFS sensor
- Pressure measurement utilizing Grundfos RPS sensor
- Multiple pump control
- High Efficiency Pump Control (0-10VDC & PWM)
- High Power Output, max 4.5kW, 240 VAC
- Collector Stagnation Protection, vacation and freeze recirculation functions.
- Energy savings monitoring
- Remote Two-way System Status Communication with Web or Mobile Application.
- Line cord and receptacle for ease of electrical connection on 120VAC models.

Technical Data & Dimensions

Technical Data

Specifications:

- 3 x RTD Input (1k Ohm)
 - 1 x Grundfos VFS Input
 - 1 x Grundfos RPS (0-10 bar) Input
 - 1 x 0-10VDC or PWM Output
 - 2 x Pump Output
 - 120VAC 1/6hp, FLA or LRA 5A Max
 - 240VAC 1/2hp, FLA or LRA 5A Max
 - 1 x Backup Output Dry Contact (240VAC 30A Max)
- Input 120VAC Model: 120VAC +/- 10% 60Hz 10A Max
 Input 240AC Model: 240VAC +/- 10% 60Hz 10A Max

Weight: 1.8lbs

Dimensions: 4.76in W x 74in H x 2.6in

ETL Listings:

Meets CSA C22.2 No.24

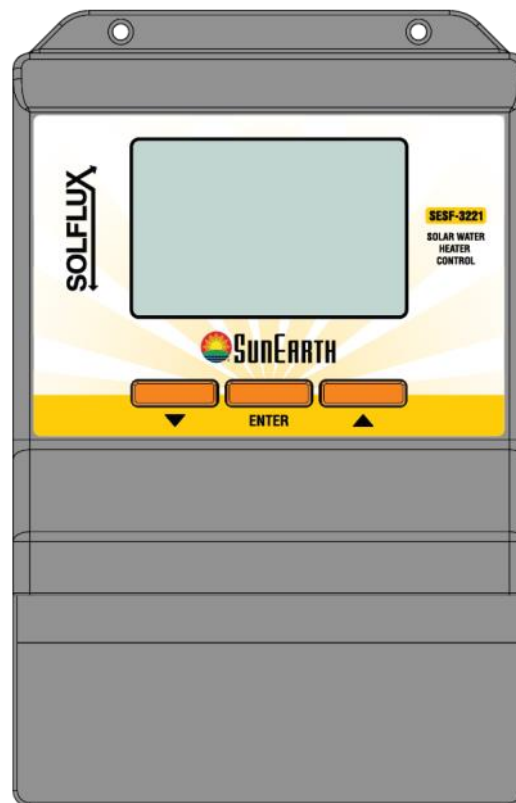
Meets UL Standard 873

ETL Control No. 3068143

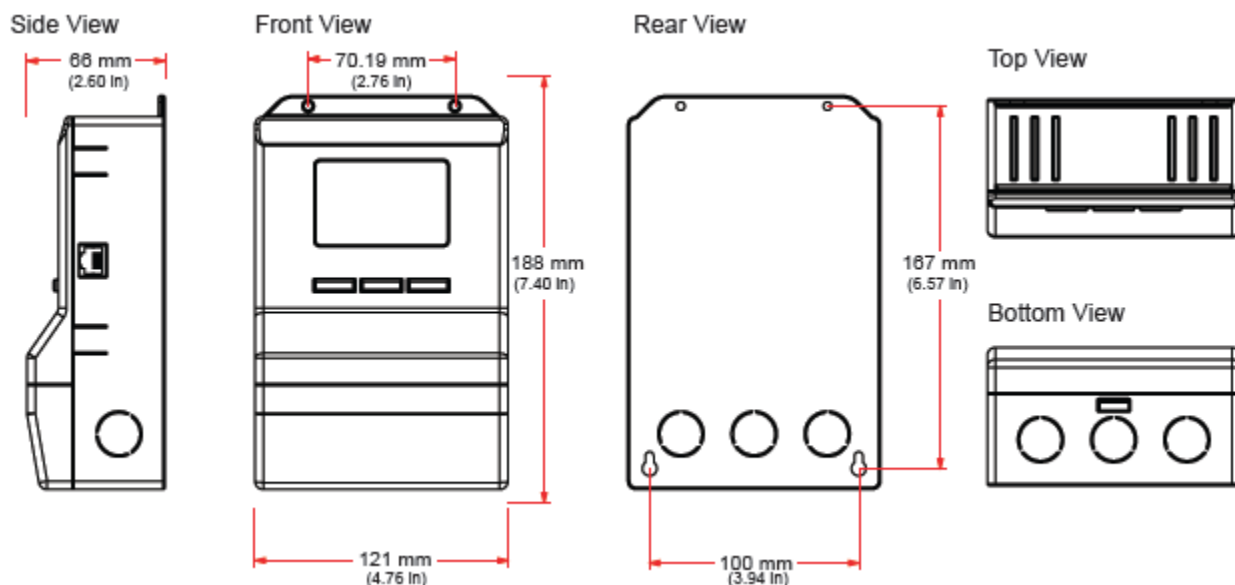
Storage: 50°F to 104°F

RF Info:

Contains IC : 8169A-G2M5477



Dimensions



Installation

Select Location for the Controller

- The SESF-3221 is designed to be wall mounted or installed in a separate electrical enclosure.
- The mounting surface should be vertical with the SESF-3221 installed vertically.

The unit should be mounted indoors and protected from falling water and high humidity conditions. With all the cover plates installed it is designed to protect any individual from accidental electrical shock. It is not suitable for installation in hazardous locations and should not be placed close to any electromagnetic fields.

Danger

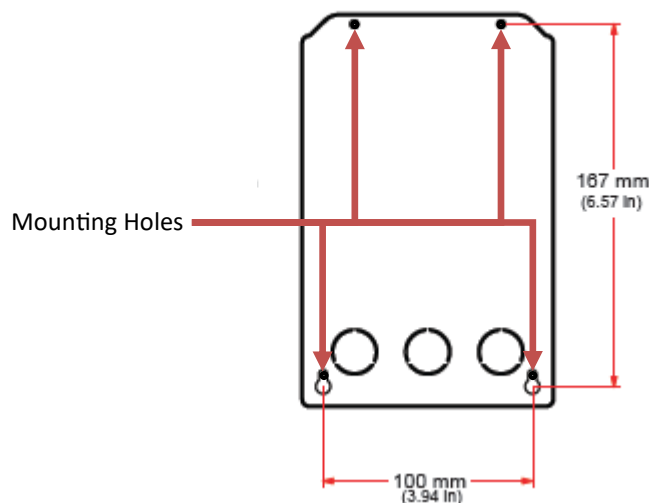
- **Disconnect the controller from the power supply before opening the casing.**
- **Make sure that the power supply cannot be unintentionally switched on when the casing is open.**
- **Do not use the casing as a drilling template.**



Mounting the Controller

1. Identify the four mounting holes on the SESF-3221, mark on the mounting surface the desired location of mounting. Ensure controller will be installed is level and square.
2. Predrill, anchor and start the two bottom screws for mounting. Screw head should have clearance of $\sim 1/4$ " from the mounting surface.
3. Remove the terminal cover.
4. Hang SESF-3221 and tighten bottom screws. Fasten top screws at his time.
5. Complete wiring connections in accordance with terminal locations.

Rear View



Wiring

Power Cable		B/U Cable		Signal Cable	
Conductor size		Conductor Size		RTD cable length	Less than 330ft, including extension
Solid	#AWG 14 max	Solid	#AWG 10 max	RTD cable size	Min #AWG 18 for lengths less than 165ft
Stranded	#AWG 14 max	Stranded	#AWG 12 max		Min #AWG 16 for lengths greater than 165ft

Signals

1,2: 0-10VDC / PWM

High Efficiency Pump Speed Control

3,4: Temperature Sensor Input T1

Pt1000 temperature sensor

5,6: Temperature Sensor Input T2

Pt1000 temperature sensor

7,8: Temperature Sensor Input T3

Pt1000 temperature sensor

9: Grundfos VFS Sensor Input

VFS Flow/Temperature sensor

10: Grundfos RPS Sensor Input

RPS Flow/Temperature sensor

Power Input

11,12,13: Supply Power 120VAC or 240VAC

Control power and Pump 1 & Pump 2 Output Power

20, 21: Backup Supply Power 240VAC max

Output

14,15,16: Pump 1

Power output for Pump 1 or as assigned

17,18,19: Pump 2

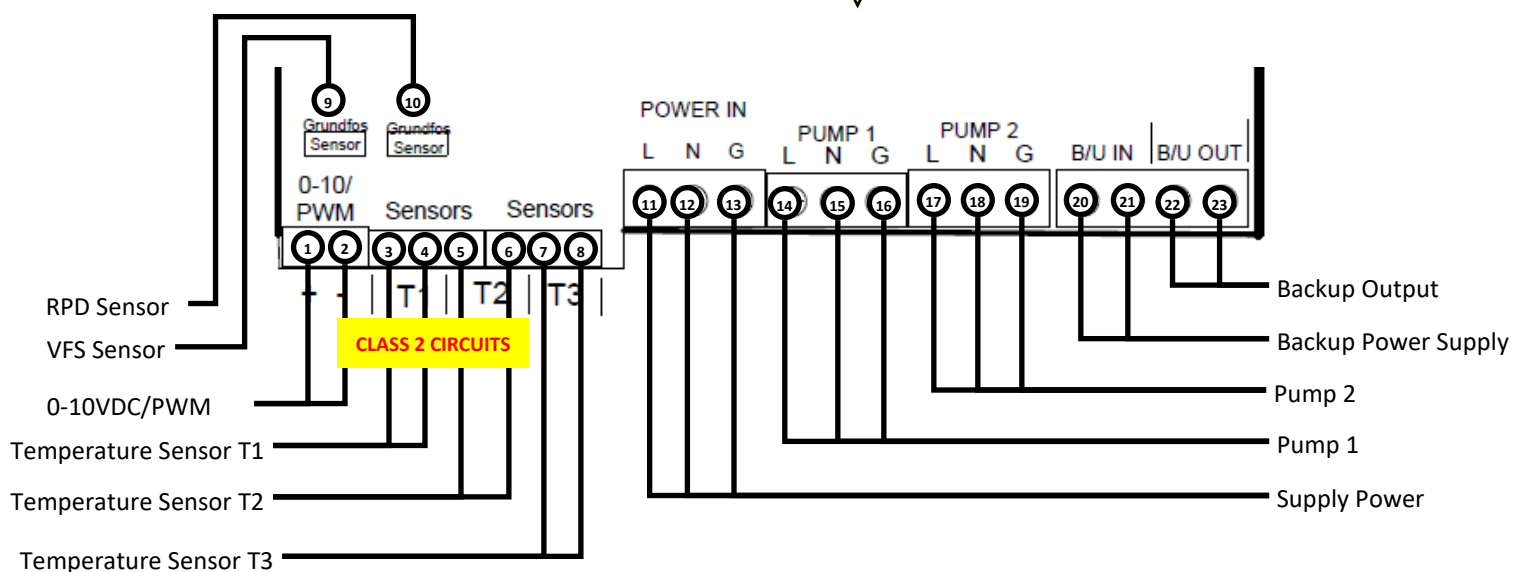
Power output for Pump 2 or as assigned

22,23: Backup Output

Power output for Auxiliary backup or as assigned



Pump 1 and Pump 2 Relay output power equivalent to Supply Power max 5 Amps



Wiring



Wiring Connections

Risk of death by electrocution! Ensure that the following conditions are satisfied when performing the work described in this section:

- All wires leading to the controller must be disconnected from the power supply and ensured that they cannot be unintentionally reconnected during installation.
- Each terminal must only be connected to a single conductor.
- The protective earth conductors (G) from the power supply cable, pumps, valves or other must be connected to a protective earth ground terminal (G)
- All wires must be secured so that they do not create a trip hazard.
- The wires must satisfy the requirements listed on page 7.
- The local power supply must match the specifications on the rating plate of the controller.
- The power supply cabling is to be connected to the power supply as follows:
 - Using a plug connected to a wall receptacle.
 - Via a wire isolating method approved by the authority having jurisdiction ensuring complete isolation for permanent wiring.
- The power supply shall be installed in conformation with all applicable legal guidelines by the authority having jurisdiction and in conformance with regulations of the local electricity supplier.

Notice

Danger of damage and malfunction.

- Only connect components that do not overload the controller inputs and outputs. See rating plate and Page 7.
- Any connection polarity may be used for T1-T3.
- Only type Pt1000 temperature sensors may be used.
- Run the sensor cables at least 4 inches away from the power cables.
- Use shielded sensor cables when inductive sources are present, e.g. high-voltage lines, radio transmitters, microwave devices.

Preparing the Case Wire Openings

The wires and cables can be fed through openings in the rear wall and bottom of the casing. The openings are pre-punches and must be prepared as required before installation.

1. Break out the 1/2" knockout cable openings with suitable tool and deburr the edges.
2. Install appropriate cable/conduit adaptor.
3. Pull wires and cables through opening.

Connecting the wires and cables

Ensure wires and cables are voltage free.

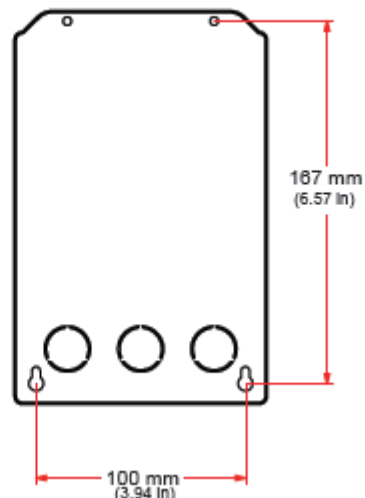
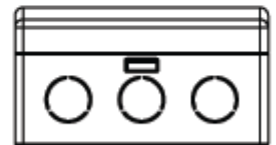
1. Power supply and outputs first connect G, then N and L.
2. Exposed conductor to allow full depth of terminal insertion without exposure of conductor outside the terminal block.
3. Ensure strain relief measures are implemented and secured for cable/wires not run through conduit chases.

Rear View

Top View



Bottom View



Programming

Initial Start Up

Note

- After initial start up of the controller for the first time, it is configured in such a manner that it can be used in most applications without changes.
- After completing start up, later start up is not necessary.
- Start up must also be performed after the controller has been factory reset.

CHOOSE SYSTEM TYPE

When the control is first powered the technician must select the appropriate control type for the solar heating system design. To scroll through selections use the “up” or “down” buttons confirming selection with use of the enter button. System types include, Direct, Drain Back 1, Drain Back 2, Indirect HTF 1 and Indirect HTF 2. Definitions of these control types are listed below.

CHOOSE CONTROL TYPE

- 1) DIRECT
- 2) DRAIN BACK 1
- 3) DRAIN BACK 2
- 4) INDIRECT HTF 1
- 5) INDIRECT HTF 2

Direct System Type

One Pump system type. Solar fluid is also solar storage fluid. Generally solar fluid is potable water. Standard system type for moderate weather locations where freezing temperature and water quality resulting in collector degradation is never experienced.

Drain Back 1 System Type

One Pump system type. Solar fluid is separated from potable water through a immersed or wrap around heat exchanger. System type for weather locations where freezing temperatures and or water quality resulting in collector degradation is experienced. Solar circuit is not pressurized when solar pump is deactivated.

Drain Back 2 System Type

Two Pump system type. Solar fluid is separated from potable water through an external heat exchanger. System type for weather locations where freezing temperatures and or water quality resulting in collector degradation is experienced. Solar circuit is not pressurized when solar pump is deactivated.

Indirect HTF 1 System Type

One Pump system type. Solar fluid is separated from potable water through a immersed or wrap around heat exchanger. System type for weather locations where freezing temperatures and or water quality resulting in collector degradation is experienced. Solar circuit is pressurized when solar pump is deactivated.

Indirect HTF 2 System Type

Two Pump system type. Solar fluid is separated from potable water through an external heat exchanger. System type for weather locations where freezing temperatures and or water quality resulting in collector degradation is experienced. Solar circuit is pressurized when solar pump is deactivated.

Programming

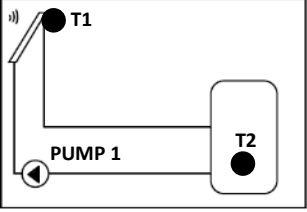
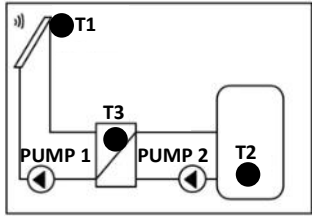
Initial Start Up

Terminal Assignments

For each solar energy system type that can be selected at the controller, the external components (pumps, valves, temperature sensors) must be connected to particular terminals.

The following table provides information on

- The graphic of the solar energy system on the controller display (the graphic is only intended to provide an overview and is not a technical drawing)
- The terminal pin assignments of the connected components.

Display	Legend	Terminal layout
DIRECT / DRAIN BACK 1 / INDIRECT HTF 1		
	T1: COLLECTOR ARRAY TEMPERATURE SENSOR T2: LOWER STORAGE TANK TEMPERATURE SENSOR PUMP 1: SOLAR CIRCUIT PUMP	T1 T2 L, N, G OR 120VAC RECEPTACLE
DRAIN BACK 2 / INDIRECT HTF 2		
	T1: COLLECTOR ARRAY TEMPERATURE SENSOR T2: LOWER STORAGE TANK TEMPERATURE SENSOR T3: HEAT EXCHANGER TEMPERATURE PUMP 1: SOLAR CIRCUIT PUMP PUMP 2: HEAT TRANSFER CIRCUIT PUMP	T1 T2 T3 L, N, G OR 120VAC RECEPTACLE L, N, G

Controller is Now Operable

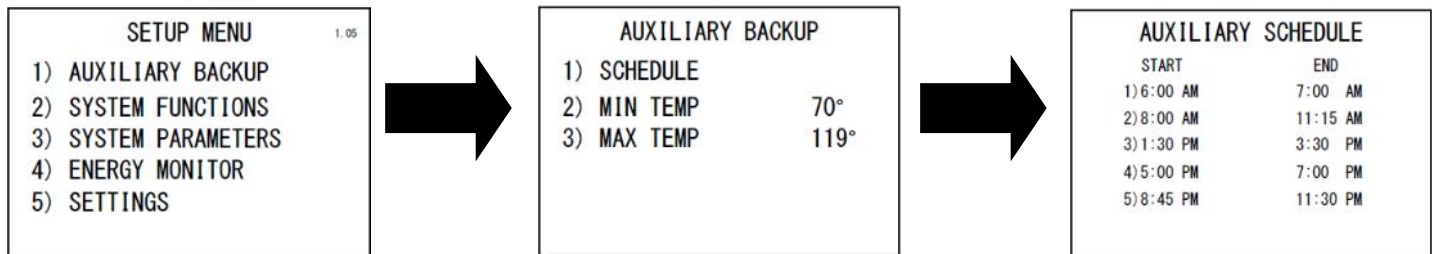
Following selection of a CONTROL SYSTEM TYPE the controller will immediately begin operation with default settings.



Programming

Setup

The setup menu is used for entering values for auxiliary backup, additional system functions, parameters, system monitoring and device settings. This menu can be reached by holding the ENTER button from the controllers main operation screen. To scroll through selections use the “up” or “down” buttons confirming selection with use of the enter button.



To select a parameter align the cursor arrow with the desired parameter and press the ENTER button. The arrow will become solid, which indicated that a parameter has been selected.

Adjust the setting to the desired value with the “up” or “down” buttons. Once the correct value is set, push the ENTER button.

In order to revert to a previous screen, push and hold the ENTER button. If a menu is open for more than 90 seconds, the display will revert to the main operation screen.

Multicolor backlit Display

The Multicolor backlit display is one of the key features of the SESF-3221 Solar Water Heating Control. Depending on the operational status is screen color will change to indicate information about the status of the system.

Operation Status Screen Colors

Light Blue—Standby solar energy not sufficient for collection. Solar Pump(s) OFF

Green—Solar Energy sufficient for collection. collection. Solar Pump(s) ON.

Red—Error



Programming

Auxiliary Backup

This setting is used to control the solar water heating systems backup heating device to optimize of solar energy collection through input of a energy saving schedule, water is heated only with solar energy during the defined time windows.

Auxiliary Backup Setup

SETUP MENU		1.05
1)	AUXILIARY BACKUP	
2)	SYSTEM FUNCTIONS	
3)	SYSTEM PARAMETERS	
4)	ENERGY MONITOR	
5)	SETTINGS	

Auxiliary Backup Setup

This setting is used to configure the Auxiliary backup for time of day and temperature settings. Installation of temperature sensing device is required near the backup heat source *Note this setting is not to be used as a safety device.



Schedule Setup

AUXILIARY BACKUP	
1)	SCHEDULE
2)	MIN TEMP 70°
3)	MAX TEMP 119°

Schedule

This setting allows input of up to 5 discrete time windows in which the auxiliary backup will be powered.

AUXILIARY SCHEDULE	
START	END
1) 6:00 AM	7:00 AM
2) 8:00 AM	11:15 AM
3) 1:30 PM	3:30 PM
4) 5:00 PM	7:00 PM
5) 8:45 PM	11:30 PM

Time

Time must be entered in AM/PM format. Indicator arrow will solidify when time range is editable. It is suggested at a minimum separation of 30 minutes be allotted between ranges.

Minimum / Maximum Temperature Setup

AUXILIARY BACKUP	
1)	SCHEDULE
2)	MIN TEMP 70°
3)	MAX TEMP 119°

Minimum Temperature

This setting established a minimum temperature in which logic of the Auxiliar Backup control will be overridden. Function can protect backup against the possibility of freeze. Indicator will solidify when editable following press of ENTER.

(32°F to 180°F) Default 70°F

AUXILIARY BACKUP	
1)	SCHEDULE
2)	MIN TEMP 70°
3)	MAX TEMP 119°

Maximum Temperature

This setting established a maximum backup temperature for the auxiliary backup during an time window.

(32°F to 180°F) Default 120°F



Programming

System Function—Vacation Settings

This setting is used to reduce, or even avoid, system stagnation duration. The is accomplished by activating the solar pump(s) to reduce the storage tank temperature during the night.

Vacation Settings

SYSTEM FUNCTIONS

- 1) VACATION SETTIGNS
- 2) STAG PROTECT ON
- 3) FREEZE RECIRC OFF
- 4) PULSE INTERVAL
- 5) SETPOINT
- 6) DIFF SETPOINT

Vacation Settings

If the storage tank rises to 20°F below the maximum tank temperature during the day, the circulating pump(s) will activate at night cooling the tank to the programmed minimum tank temperature. Setting Overrides Auxiliary Backup when activated.



Duration Setup

VACATION SETTINGS

- 1) VACATION MODE OFF
- 2) DURATION 10°
- 3) MIN TANK 95°

Duration

This setting allows input of how many days the setting will be activated once turned on. Once duration is reached the vacation function will automatically revert to OFF status.

(1 to 999 days) Default 10 days

Minimum Temperature Setup

VACATION SETTINGS

- 1) VACATION MODE OFF
- 2) DURATION 10°
- 3) MIN TANK 95°

Minimum Temperature

This setting established a minimum storage tank temperature in which logic of the Vacation Function will operate when in storage tank cooling operation. Indicator will solidify when editable following press of ENTER.

(32°F to 180°F) Default 95°F

Programming

System Function—Stagnation Protection

This setting delays the end of the storage tank's maximum heating phase in order to reduce, or even eliminate the collectors stagnating at high temperatures.

Stagnation Protection Setting



SYSTEM FUNCTIONS

- 1) VACATION SETTINGS
- 2) STAG PROTECT ON
- 3) FREEZE RECIRC OFF
- 4) PULSE INTERVAL
- 5) SETPOINT
- 6) DIFF SETPOINT

Stagnation Protection Setting

When the storage tank rises to 20°F below the maximum tank temperature during the day, the circulating pump(s) will be stopped until the collector temperature reaches 40°F below Collector Maximum Temperature. Once reached the pump(s) will activate until the collector temperature is 60°F below Collector Maximum Temperature. The cycling continues until the solar tank reaches its maximum temperature setting or the off differential is reached.

ON/OFF Setup

SYSTEM FUNCTIONS

- 1) VACATION SETTINGS
- 2) STAG PROTECT ON
- 3) FREEZE RECIRC OFF
- 4) PULSE INTERVAL
- 5) SETPOINT
- 6) DIFF SETPOINT

ON/OFF

Indicator will solidify when editable following press of ENTER. Arrow up or down to change setting between ON and OFF pressing ENTER to confirm selection.

Programming

System Function—Pulse Interval

This setting periodically switches the solar circuit pump on and off in order to measure collector temperature. Useful for collector types the temperature sensor cannot be installed in a suitable location. Not available for Drainback system types

Pulse Interval Settings

SYSTEM FUNCTIONS	
1) VACATION SETTINGS	
2) STAG PROTECT	ON
3) FREEZE RECIRC	OFF
4) PULSE INTERVAL	
5) SETPOINT	
6) DIFF SETPOINT	

Pulse Interval Settings

The delay between 2 switch-on operations and the switch-on duration can be set. The function can also be time restricted to prevent unnecessary operation at night.



Schedule Setup

PULSE INTERVAL	
1) TIME WINDOW	
2) WAIT TIME	1 _m
3) DURATION	1 _s

Time Window

This setting allows input of up to 5 discrete time windows in which the function will be activated.

TIME WINDOW	
START	END
1) 6:00 AM	7:00 AM
2) 8:00 AM	11:15 AM
3) 1:30 PM	3:30 PM
4) 5:00 PM	7:00 PM
5) 8:45 PM	11:30 PM

Time

Time must be entered in AM/PM format. Indicator arrow will solidify when time range is editable. It is suggested at a minimum separation of 30 minutes be allotted between ranges.

Wait Time Setup

PULSE INTERVAL	
1) TIME WINDOW	
2) WAIT TIME	1 _m
3) DURATION	1 _s

Wait Time

This setting establishes the delay between 2 pump switch on operations.

(1-999 minutes) Default: 15 minutes

Duration Setup

PULSE INTERVAL	
1) TIME WINDOW	
2) WAIT TIME	1 _m
3) DURATION	1 _s

Duration

This setting establishes the length of time in seconds of a pump switch on operation.

(3-999 seconds) Default: 5 seconds

Programming

System Function—Freeze Recirculation

This setting attempts to prevent freezing of the collectors by pumping heat from the storage tank into the collectors.

***Not available for drain back system types**

Freeze Recirculation Setting



SYSTEM FUNCTIONS	
1) VACATION SETTIGNS	
2) STAG PROTECT	ON
3) FREEZE RECIRC	OFF
4) PULSE INTERVAL	
5) SETPOINT	
6) DIFF SETPOINT	

Freeze Recirculation Setting

When the collector temperature is below 40°F the solar circuit pump(s) is switched on.

When the collector temperature is above 45°F the solar circuit pump(s) is switched off.

ON/OFF Setup

SYSTEM FUNCTIONS	
1) VACATION SETTIGNS	
2) STAG PROTECT	ON
3) FREEZE RECIRC	OFF
4) PULSE INTERVAL	
5) SETPOINT	
6) DIFF SETPOINT	

ON/OFF

Indicator will solidify when editable following press of ENTER. Arrow up or down to change setting between ON and OFF pressing ENTER to confirm selection.

WARNING: Despite the freeze recirculation function being activated, the solar system can freeze under the following conditions:

- In a power outage.
- If frost is expected

Therefore, solar systems exposed to frost should not utilize be of direct system type.

Programming

System Function—Setpoint

This setting switches an output on and off, depending on the temperature reading of designated sensor.

Setpoint Settings

SYSTEM FUNCTIONS	
1) VACATION SETTINGS	
2) STAG PROTECT	ON
3) FREEZE RECIRC	OFF
4) PULSE INTERVAL	
5) SETPOINT	
6) DIFF SETPOINT	

Setpoint Settings

The reference sensor, output relay as well as on temperature off temperature and time window can be set. When being set for heating Ton must be greater than Toff. When being set for cooling Ton must be less than Toff.



Sensor Setup

SETPOINT	
1) SETPOINT	T1
2) ON TEMP	75°
3) OFF TEMP	100°
4) TIME WINDOW	
5) RELAY	RELAY 2

Sensor Selection

This setting allows selection of any connected temperature measurement device.

(T1, T2, T3, VFS, RPS)

Temperature Setup

SETPOINT	
1) SETPOINT	T1
2) ON TEMP	75°
3) OFF TEMP	100°
4) TIME WINDOW	
5) RELAY	RELAY 2

ON Temperature

Temperature setting which activates selected relay.

(32°F to 350°F) Default 75°F

SETPOINT	
1) SETPOINT	T1
2) ON TEMP	75°
3) OFF TEMP	100°
4) TIME WINDOW	
5) RELAY	RELAY 2

OFF Temperature

Temperature setting which deactivates selected relay.

(32°F to 350°F) Default 75°F

Time Window Setup

TIME WINDOW	
START	END
1) 6:00 AM	7:00 AM
2) 8:00 AM	11:15 AM
3) 1:30 PM	3:30 PM
4) 5:00 PM	7:00 PM
5) 8:45 PM	11:30 PM

Time

Time must be entered in AM/PM format. Indicator arrow will solidify when time range is editable. It is suggested at a minimum separation of 30 minutes be allotted between ranges.

Relay Setup

SETPOINT	
1) SETPOINT	T1
2) ON TEMP	75°
3) OFF TEMP	100°
4) TIME WINDOW	
5) RELAY	RELAY 2

Relay Selection

This setting allows selection of any available relay.

(RELAY 1, RELAY 2, AUX)

Programming

System Function—Differential Setpoint

This setting switches an output on and off, depending on the temperature differential of designated sensors.

Differential Setpoint Settings

SYSTEM FUNCTIONS

- 1) VACATION SETTINGS
- 2) STAG PROTECT ON
- 3) FREEZE RECIRC OFF
- 4) PULSE INTERVAL
- 5) SETPOINT
- 6) DIFF SETPOINT

Differential Setpoint Settings

The reference sensors, output relay as well as on temperature differential off temperature differential and time window can be set. When the temperature difference exceeds **Ton**, the relay is switched on until the temperature difference drops below **Toff**. In addition loading of the heat sink can be limited to a maximum temperature.



Differential Temperature Setup

DIFF SETPOINT

- 1) ON TEMP 12°
- 2) OFF TEMP 4°
- 3) SENSOR SELECTION
- 4) SINK MAX 140°
- 5) TIME WINDOW
- 6) RELAY RELAY 2

ON Differential Temperature

Temperature difference which activates selected relay.

(4°F to 110°F) Default 12°F

DIFF SETPOINT

- 1) ON TEMP 12°
- 2) OFF TEMP 4°
- 3) SENSOR SELECTION
- 4) SINK MAX 140°
- 5) TIME WINDOW
- 6) RELAY RELAY 2

OFF Differential Temperature

Temperature difference which deactivates selected relay.

(2°F to 110°F) Default 4°F

Sensor Selection Setup

SENSOR SELECTION

- 1) T SOURCE T1
- 2) T SINK T2

Sensor Selection

This setting allows selection of any connected temperature measurement device as either the temp source or temp sink.

(T1, T2, T3, VFS, RPS)

Sink Temperature Maximum Setup

DIFF SETPOINT

- 1) ON TEMP 12°
- 2) OFF TEMP 4°
- 3) SENSOR SELECTION
- 4) SINK MAX 140°
- 5) TIME WINDOW
- 6) RELAY RELAY 2

Sink Temperature Maximum

This setting limits the maximum sink temperature in which the function will be active.

(32°F to 210°F) Default 140°F

Time Window Setup

DIFF SETPOINT

- 1) ON TEMP 12°
- 2) OFF TEMP 4°
- 3) SENSOR SELECTION
- 4) SINK MAX 140°
- 5) TIME WINDOW
- 6) RELAY RELAY 2

Time

Time must be entered in AM/PM format. Indicator arrow will solidify when time range is editable. It is suggested at a minimum separation of 30 minutes be allotted between ranges.



Programming

System Function—Differential Setpoint

This setting switches an output on and off, depending on the temperature differential of designated sensors.

Differential Setpoint Settings

SYSTEM FUNCTIONS

- 1) VACATION SETTINGS
- 2) STAG PROTECT ON
- 3) FREEZE RECIRC OFF
- 4) PULSE INTERVAL
- 5) SETPOINT
- 6) DIFF SETPOINT

Differential Setpoint Settings

The reference sensors, output relay as well as on temperature differential off temperature differential and time window can be set. When the temperature difference exceeds **Ton**, the relay is switched on until the temperature difference drops below **Toff**. In addition loading of the heat sink can be limited to a maximum temperature.



Relay Setup

DIFF SETPOINT

- 1) ON TEMP 12°
- 2) OFF TEMP 4°
- 3) SENSOR SELECTION
- 4) SINK MAX 140°
- 5) TIME WINDOW
- 6) RELAY RELAY 2

Relay Selection

This setting allows selection of any available relay.

(RELAY 1, RELAY 2, AUX)



Programming

System Parameter —Tank Temperatures

These settings limits function of the solar pump(s) below or above tank temperature setpoints.

Tank Temperatures Settings

SYSTEM PARAMETERS	
1) TANK TEMP	
2) COLLECTOR TEMPS	
3) SOLAR DIFF TEMPS	
4) PUMP SETTINGS	
5) DRAIN BACK	

Tank Temperature Settings

This setting by referencing the sensor for Tank temperature , T2, limits the operation of solar pump(s) through maximum and minimum tank temperature limits.



Tank Temperature Setup

TANK TEMPS	
1) MINIMUM	100°
2) MAXIMUM	145°

Minimum Temperature

If minimum temperature is reached the solar pump(s) operation in vacation mode is deactivated until the minimum tank temperature is exceeded by **6°F or ON** differential is met.

(40°F to 212°F) Default 100°F

TANK TEMPS	
1) MINIMUM	100°
2) MAXIMUM	145°

Maximum Temperature

When is maximum temperature is reached the solar pump(s) operation is deactivated until the temperature drops **2°F** below the Maximum Tank setting

(32°F to 200°F) Default 145°F



Programming

System Parameter —Solar Collector Temperatures

These settings limit function of the solar pump(s) below or above collector temperature setpoints.

Collector Temperatures Settings

SYSTEM PARAMETERS

- 1) TANK TEMP
- 2) COLLECTOR TEMPS
- 3) SOLAR DIFF TEMPS
- 4) PUMP SETTINGS
- 5) DRAIN BACK

Collector Temperature Settings

This setting by referencing the sensor for Collector temperature , T1, limits the operation of solar pump(s) through maximum and minimum collector temperature limits.



Collector Temperature Setup

COLLECTOR TEMPS

- 1) MINIMUM 32°
- 2) MAXIMUM 270°

Minimum Temperature

In vacation mode If minimum temperature is reached the solar pump(s) operation is deactivated until the minimum collector temperature setting is exceeded by **6°F**

(32°F to 300°F) Default 32°F

COLLECTOR TEMPS

- 1) MINIMUM 32°
- 2) MAXIMUM 270°

Maximum Temperature

When is maximum temperature is reached the solar pump(s) operation is deactivated until the temperature drops **6°F** below the Maximum Collector setting

(75°F to 350°F) Default 270°F

Programming

System Parameter —Solar Differential (DELTA) Temperatures

These settings provides the basic functional parameter of the solar pump(s) when heating the solar storage tank.

Solar Differential Temperature Settings

SYSTEM PARAMETERS

- 1) TANK TEMP
- 2) COLLECTOR TEMPS
- 3) SOLAR DIFF TEMPS
- 4) PUMP SETTINGS
- 5) DRAIN BACK

Solar Differential Temperature Settings

These settings reference the sensor for Collector temperature , T1, Tank temperature, T2. For Drainback 2/Indirect HTF 2 system types heater exchanger also includes temperature T3.



Solar Differential Temperature Setup

SOLAR DELTA T TEMPS

- 1) ON 12°
- 2) OFF 4°
- 3) DUAL PUMP 12°

ON Differential Temperature

When the ON differential temperature between the collector and storage tank is reached the solar circuit pump is activated.

(4°F to 110°F) Default 12°F

SOLAR DELTA T TEMPS

- 1) ON 12°
- 2) OFF 4°
- 3) DUAL PUMP 12°

OFF Differential Temperature

When the OFF differential temperature between the collector and storage tank is reached the solar circuit pump is deactivated.

(2°F to 100°F) Default 4°F

SOLAR DELTA T TEMPS

- 1) ON 12°
- 2) OFF 4°
- 3) DUAL PUMP 12°

DUAL PUMP Differential Temperature (Drainback 2/Indirect HTF 2 System Types only)

When the DUAL PUMP differential temperature between the heat exchanger and storage tank is reached the heat transfer circuit pump is activated.

(4°F to 100°F) Default 12°F

Programming

System Parameter — Pump Settings

These settings provides option for use of a high efficiency solar circuit pump utilizing PWM or 0-10VDC speed control signals.

Pump Settings

SYSTEM PARAMETERS

- 1) TANK TEMP
- 2) COLLECTOR TEMPS
- 3) SOLAR DIFF TEMPS
- 4) PUMP SETTINGS
- 5) DRAIN BACK

Pump Settings

These settings must be set when using a high efficiency pump modulated through PWM or 0-10VDC speed control signals and must not be used when using a standard (induction motor) pump.



Pump Setup

PUMP SETTINGS

- 1) MIN SPEED 25%
- 2) USE MOD P 1P OFF
- 3) OUTPUT 1-10 Vdc

Minimum Speed

This setting sets the minimum allowable speed for the solar circuit pump. If a lower speed is necessary to maintain solar circuit operation the pump will be deactivated.

(0% to 100%) Default 25%

PUMP SETTINGS

- 1) MIN SPEED 25%
- 2) USE MOD P 1P OFF
- 3) OUTPUT 1-10 Vdc

Use Modulating Pump

Setting must be turned to ON to allow speed control function.

PUMP SETTINGS

- 1) MIN SPEED 25%
- 2) USE MOD P 1P OFF
- 3) OUTPUT 1-10 Vdc

Output

This setting allows for selection of PWM or 0-10VDC speed control signal types. **WARNING** must match pump model requirements.



Programming

System Parameter — Drain Back Settings

These settings provides for adjustment of operation parameters specific for drainback system types.

Drain Back Settings

SYSTEM PARAMETERS

- 1) TANK TEMP
- 2) COLLECTOR TEMPS
- 3) SOLAR DIFF TEMPS
- 4) PUMP SETTINGS
- 5) DRAIN BACK

Drain Back Settings

These settings must be set for drainback systems types. Filling time, stabilization time, drain time and utilization of a booster pump are drainback pump operational characteristics can be adjusted.



Drain Back Setup

DRAIN BACK

- 1) FILL TIME 4m
- 2) STABLE TIME 4m
- 3) DRAIN TIME 5m
- 4) BOOSTER PUMP OFF

Filling Time

This setting sets the duration of the filling time in order to pump the solar heat transfer fluid into the collector. The collector OFF differential is not referenced during this time.

(1 minute to 15 minutes) Default 4 minutes

DRAIN BACK

- 1) FILL TIME 4m
- 2) STABLE TIME 4m
- 3) DRAIN TIME 5m
- 4) BOOSTER PUMP OFF

Stabilization Time

After the filling time has expired, the solar circuit pump continues to run for the duration of the stabilization time. The collector OFF differential is not referenced during the duration of this time.

(1 minute to 20 minutes) Default 4 minutes

DRAIN BACK

- 1) FILL TIME 4m
- 2) STABLE TIME 4m
- 3) DRAIN TIME 5m
- 4) BOOSTER PUMP OFF

Drain Time

The solar circuit pump is deactivated during the drain time. This allows the heat transfer fluid to flow back into the drainback reservoir. The collector ON differential is not referenced during this time.

(1 minute to 30 minutes) Default 5 minutes

DRAIN BACK

- 1) FILL TIME 4m
- 2) STABLE TIME 4m
- 3) DRAIN TIME 5m
- 4) BOOSTER PUMP OFF

Booster Pump

The booster pump activates during the solar circuit filling time only.

Programming

Energy Monitor

Calculates heat energy utilizing a selected Hot Temperature, Cold Temperature and assigned or measured volumetric flow rate.

Energy Monitor

SETUP MENU		1.05
1) AUXILIARY BACKUP		
2) SYSTEM FUNCTIONS		
3) SYSTEM PARAMETERS		
4) ENERGY MONITOR		
5) SETTINGS		

Energy Monitor Settings

These settings must be set to monitor energy. Hot temperature, cold temperature, flow type and flow rate. Energy not monitored if hot temperature reference is less than cold temperature reference.



Energy monitor Setup

ENERGY MONITOR	
1) HOLD TEMP	T1
2) COLD TEMP	T2
3) FLOW TYPE	GRUNDFOS
4) FLOW RATE	1-20

Hot Temperature

This setting sets the temperature reading that will be used as the hot reference temperature.

(T1, T2, T3, Grundfos 1, Grundfos 2) Default T1

ENERGY MONITOR	
1) HOLD TEMP	T1
2) COLD TEMP	T2
3) FLOW TYPE	GRUNDFOS
4) FLOW RATE	1-20

Cold Temperature

This setting sets the temperature reading that will be used as the cold reference temperature.

(T1, T2, T3, Grundfos 1, Grundfos 2) Default T2

ENERGY MONITOR	
1) HOLD TEMP	T1
2) COLD TEMP	T2
3) FLOW TYPE	GRUNDFOS
4) FLOW RATE	1-20

Flow Type

This setting is used to indicate assigned or measured volumetric flow rate.

(Manual or GRUNDFOS) Default GRUNDFOS

ENERGY MONITOR	
1) HOLD TEMP	T1
2) COLD TEMP	T2
3) FLOW TYPE	GRUNDFOS
4) FLOW RATE	1-20

Flow Rate

This setting is used to input flowrate for manual flow type or input VFS sensor model used for measured flow rate.

(1-100) Default 1 or (1-20 , 2-40, 5-100, 10-200, 20-400) Default 1-20



Programming

Settings

These settings allow configuration of locational values.

Settings Menu



Settings

The settings that can be configured include unit of measure, internal time clock, manual operation of output relays and wireless network access.



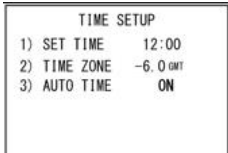
Settings Menu



Unit

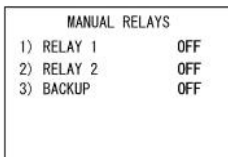
This setting sets the units of measure to be reported by the control.

(US, SI) Default US



Setup Time

This is the menu to set the time. Auto time uses location of internet connection to set and adjust internal clock.



Set Relays

This menu allows relay's to be manually overridden for troubleshooting of the system.

(ON/OFF) Default OFF



Wifi Settings

This menu allows for connection to a local wireless network for connection of the control to web and mobile application



Factory Restore

This menu allows for reset of control settings and/or stored energy generation values.

Programming

Connecting to a Wireless Network

These setting allow the control to be connected to a local wireless network.

Wireless Menu

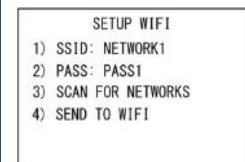


Wireless Menu

The settings that can be configured to connect to a local wireless network.

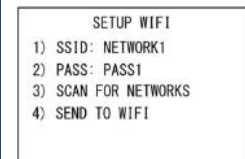


Setup Wifi Menu



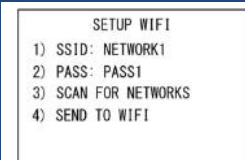
SSID

This will display the connected network or can also be selected to manually enter a network.



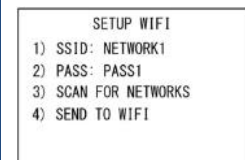
Password

This will display the entered password for the wireless network. Password must be entered manually by scrolling through each character and pressing enter to move to the next character space.



Scan for Networks

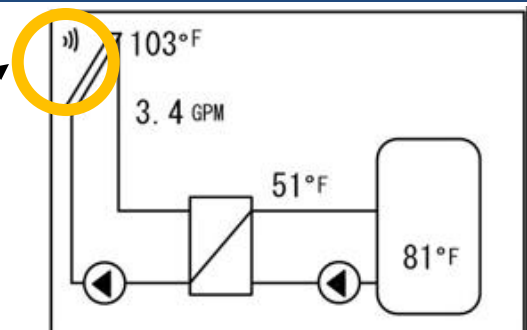
Selecting this will automatically scan for all available networks.



Send to Wifi

Select this once you have correctly entered the password to the selected network. The control will send the SSID and password upon which it will automatically connect. Press and hold enter button for 2 seconds to return to the Setup Wifi screen. Connection should notate SERVER. Once this happens the control is now connected to the network.

Once connected, the SESF-3221 control will display a constant Wi-Fi symbol on the top left hand corner of the main status screen, and in the Wi-Fi menu Connection will note SERVER



Connecting to Mobile App



SensorLinX™ Mobile App

The Sensorlinx™ mobile app is available for Apple iOS (APP Store) and Android® devices (Google Play). The mobile app allows for remote monitoring and control for HBX Controls devices.

Now available on the Apple App Store and Google Play

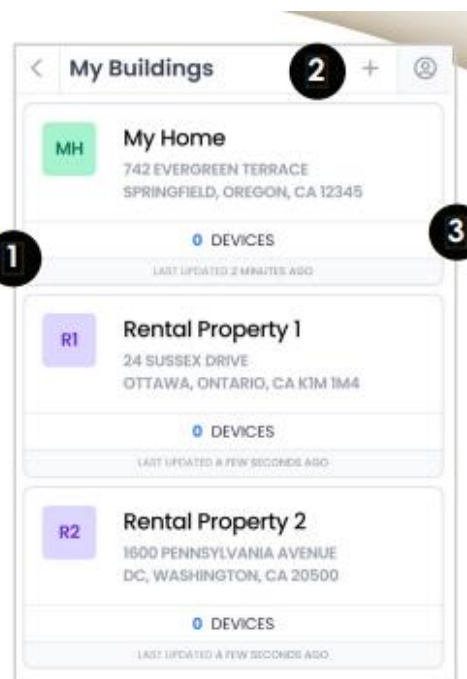
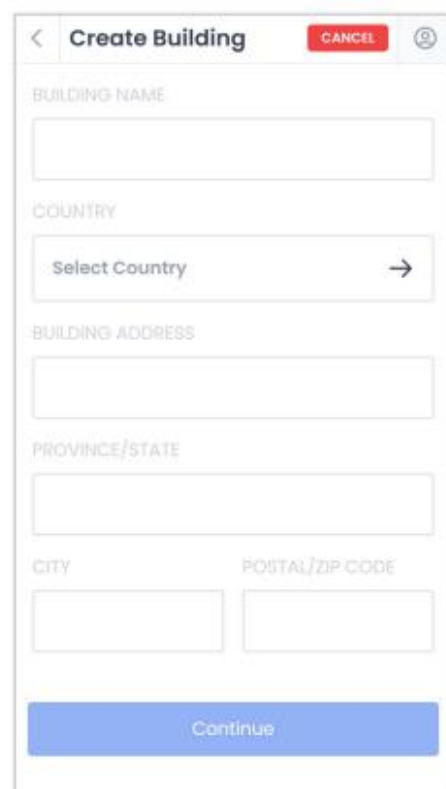
For detailed instructions on setting up the SensorLinX mobile app please refer to the SensorLinX app manual

Creating & Managing Buildings

1 Under My Buildings will be a list of the available Building locations to choose from. Each building will have the total number of HBX devices linked to that building, name, and address.

2 To add a Building, go to the Plus Symbol on the right of My Buildings and this will go to the Create Building page. Each of the fields under Create Building must be filled out to proceed, but they can be altered later under the Building Icon. Pressing Cancel or hitting the back button will delete the previous information on the page and will go back to My Buildings.

3 Once a Building has been created you will be redirected to the Devices page. This page will show all the devices linked to the Building as well as the outside temperature and current forecast based on the address information you've entered. If no devices have been added yet it will say No devices and provide a button to Link Devices.

Connecting to Mobile App

Creating & Managing Devices

Link Devices will go to a page that will say Scan Device QR Code, Enter Manually and Finished. The QR Code on the physical device can be scanned under this screen to enter in the device's information or it can be entered in manually by using the Sync Code and Device PIN. Both the Sync Code and Device PIN will be on the device itself. Once the information has been added click Add Device and then Finish. The device added and any devices linked together will populate under Devices. If any of the devices do not appear under this page then go to the Plus Symbol next to the outside weather to add further devices.

1

Each device will have its targets, sensor readings and demands displayed on this page. Clicking on any device will allow for these targets and demands to be changed.

2

3 The name and type of the device

A green dot next to the device name will indicate that the device is connected and communicating to the network. A caution symbol next to the device name will indicate that the device is no longer communicating to the network.

4

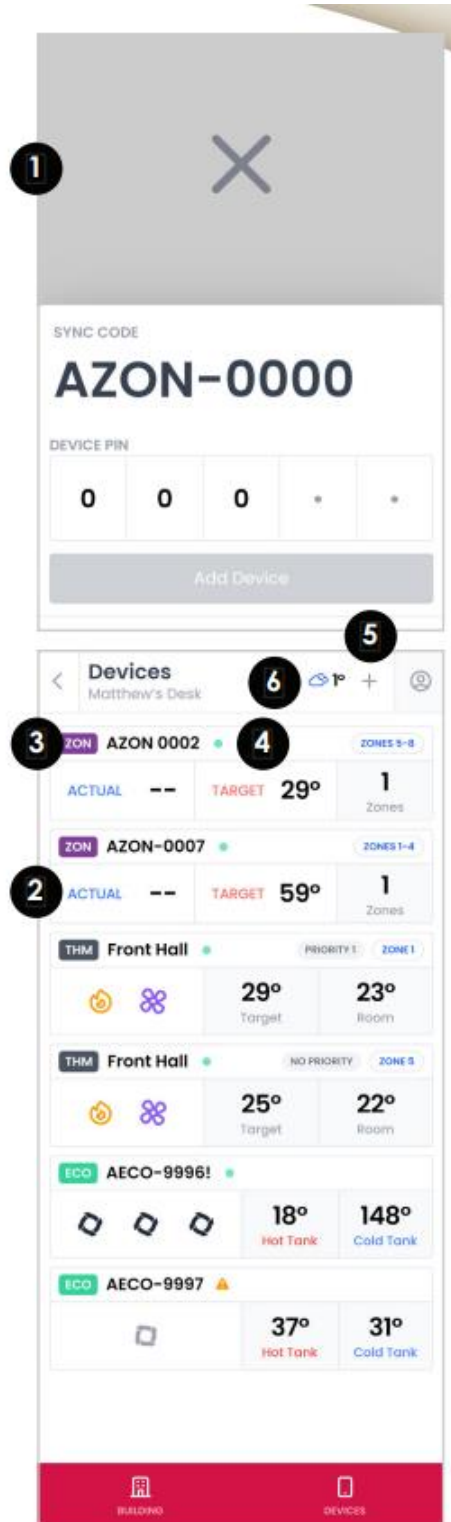
This will bring up with the Create Building page or the Link Device page to add additional buildings and devices.

5

6 This shows the outdoor temperature.

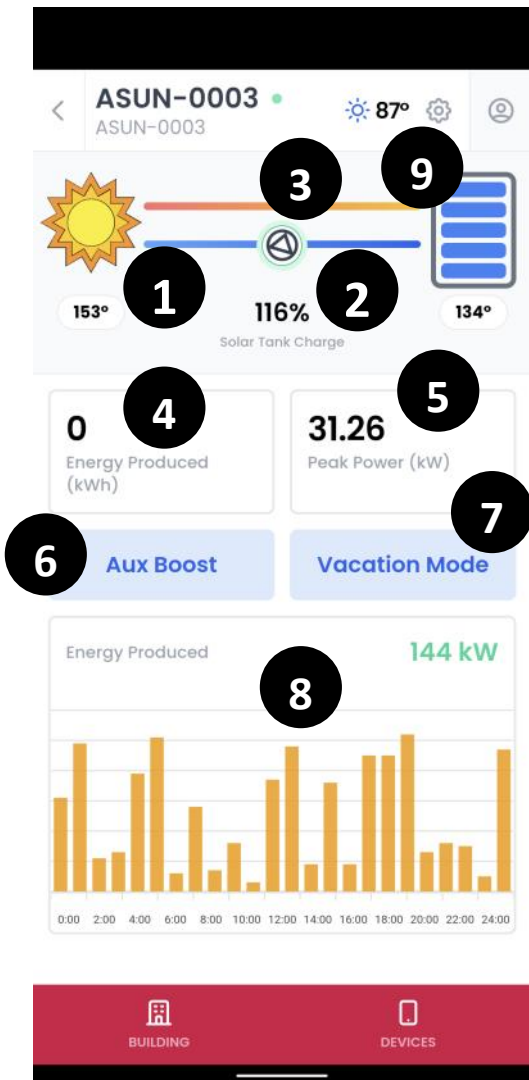
7

Goes to Account Settings. Changes to a user's account are made here.



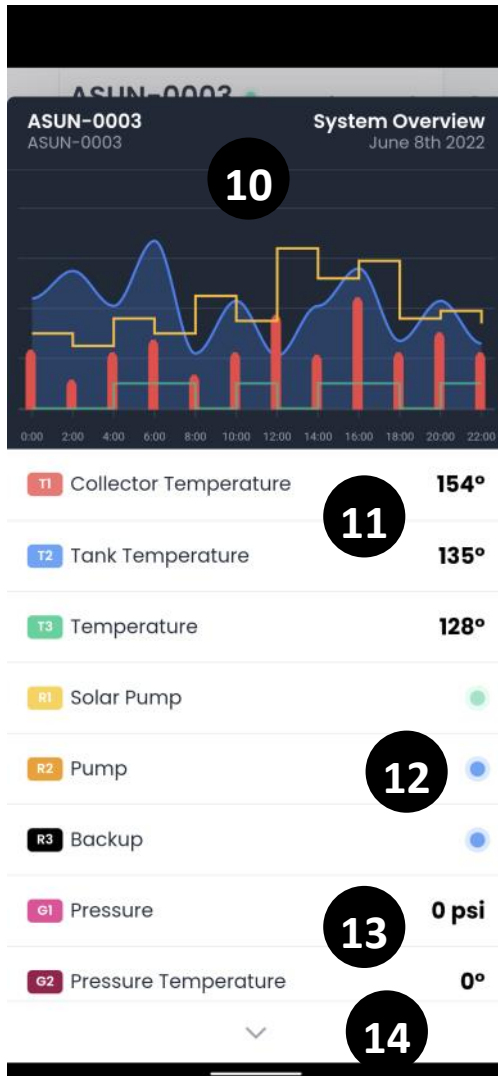
Connecting to Mobile App

Solflux Home Screen with the Sensorlinx mobile App



1. Each system control sensor (Collector, Tank, Heat Exchanger) will indicate current readings.
2. Solar tank state of charge percentage will be shown with tank charging indicated by flashing bars.
3. Pump(s) ON status indicated through rotating triangle symbol and glowing green ring.
4. Cumulative energy production shown if enabled.
5. Peak power produced shown if enabled.
6. One touch Auxiliary (Backup) logic override.
7. Quick Vacation Mode Access
8. Daily Energy Production Graph by Hour
9. Controller Settings menu

Connecting to Mobile App

Solflux System Overview Screen with the Sensorlinx mobile App

10. 24hr Graph of sensor readings. Tap to bring up longer history.

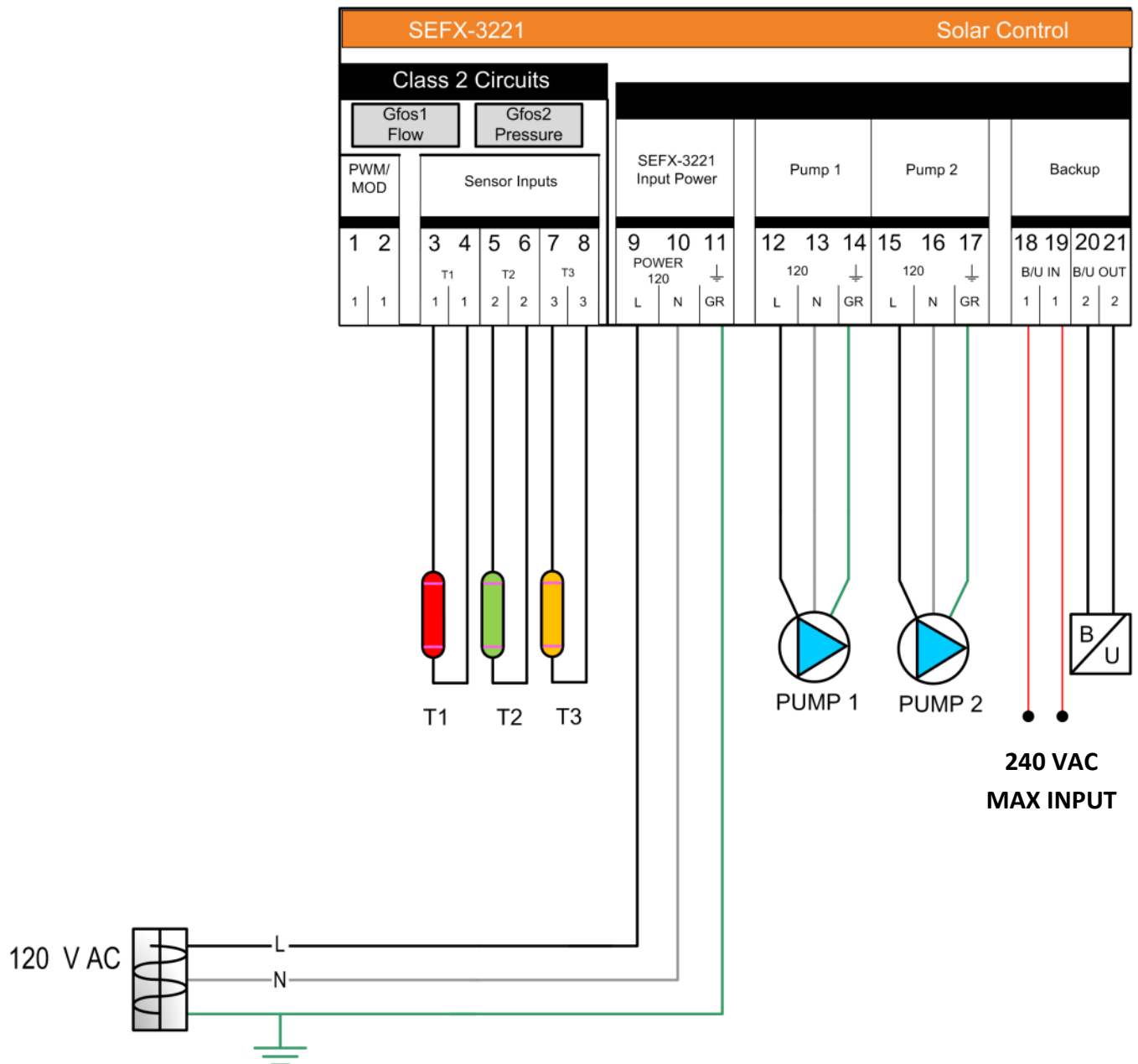
11. Current Temperature Sensor Readings. Labeling modifiable to user preferences.

12. Pump and Relay Status. Labeling modifiable to user preferences. Indicator Colors, Green = Enabled, Blue = Standby, Red = Error

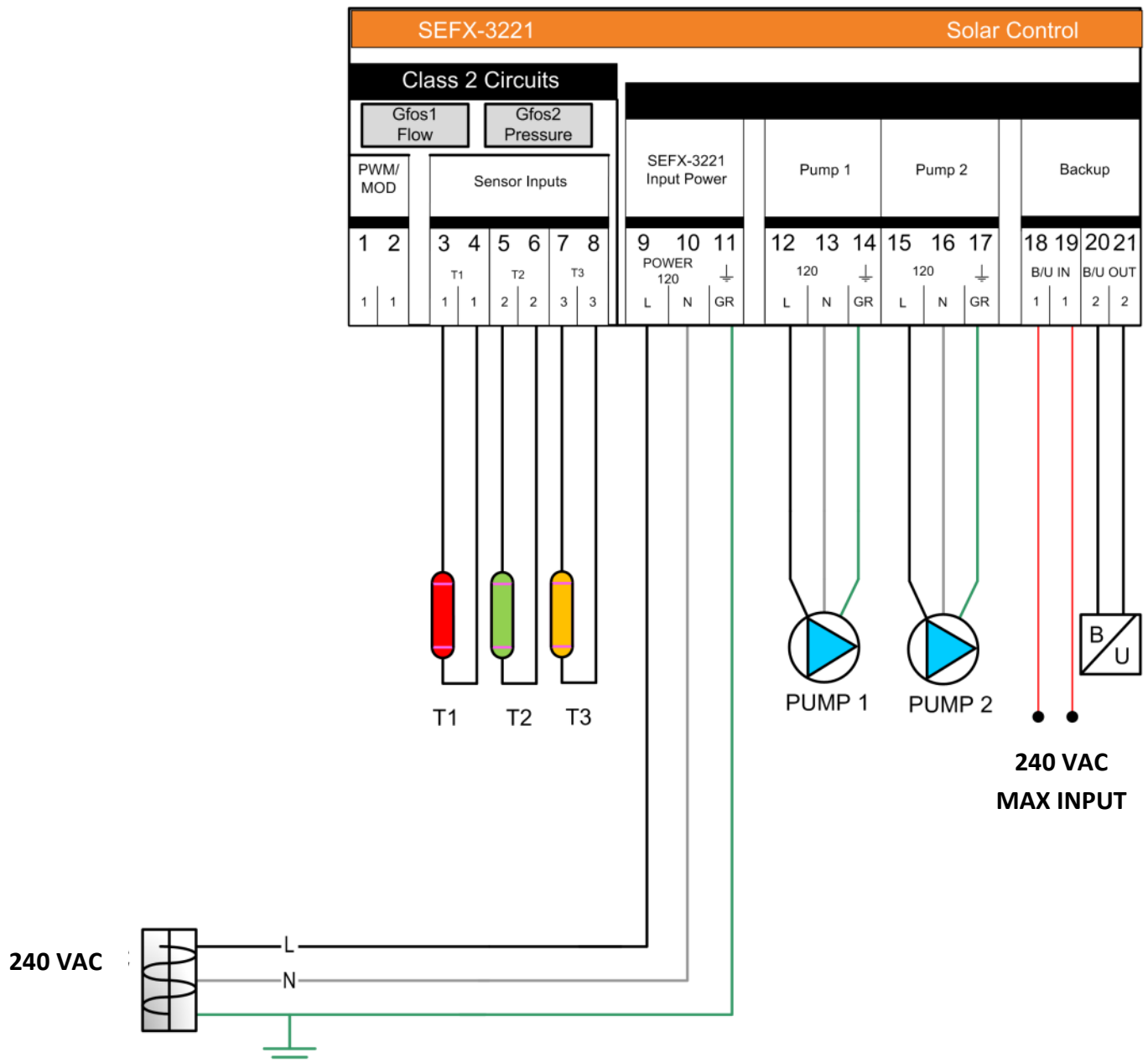
13. Current Pressure/Temperature Sensor Reading if enabled.

14. Current Flow/Temperature Sensor Reading if enabled.

Wiring Diagram: 120 VAC Model



Wiring Diagram: 240 VAC Model



Troubleshooting

General Faults

General Faults are not identified by error codes but possible causes and remedies are outlined below

General Faults	Possible Cause	Remedy
Controller not functioning at all, Display empty dark.	Controller power supply is interrupted.	- Check the controller power cable. - Check circuit breaker for power to circuit
Circuit pumps not operating and pump enable is fulfilled	- Pump power supply is interrupted - Pump has seized	- Check pump power cable. - Get pump working again, replace if necessary
Circuit pumps operating and pump enable is not fulfilled	- A function has enabled pump operation - A override has enabled pump operation	- Deactivate the relevant function if necessary - No, fault.
Circuit pumps operating and enable is fulfilled but no heat transfer to storage tank	- Air is in the solar circuit - Isolation Valve(s) closed - Blockage in solar circuit	- Check solar circuit for air. - Check isolating valves. - Clean/flush solar circuit.
Circuit pump cycles too often	- Temperature difference too small. - Collector sensor incorrectly placed	- Adjust temperature difference in System Parameters menu. - Check position of the collector sensor and correct if necessary.

Troubleshooting

Error Codes

Error Messages are displayed on the control display and mobile application.



Error Code	Description	Remedy
1	Temperature Sensor T1 control detects an interruption	Check the cable and sensor connected to the controller sensor input
2	Temperature Sensor T1 control detects a short-circuit.	Check the cable and sensor connected to the controller sensor input
3	Temperature Sensor T2 control detects an interruption	Check the cable and sensor connected to the controller sensor input
4	Temperature Sensor T2 control detects a short-circuit.	Check the cable and sensor connected to the controller sensor input
5	Temperature Sensor T3 control detects an interruption	Check the cable and sensor connected to the controller sensor input
6	Temperature Sensor T3 control detects a short-circuit.	Check the cable and sensor connected to the controller sensor input
7	A permanently high temperature difference exists between the collector and storage tank.	- Bleed air from system - Check isolating valve - Check the pump
8	System pressure is below low setting.	Check system for leaks
9	Collector Temperature over maximum setting	- Bleed air from system - Check isolating valve - Check the pump



SESF-3221 Solar Water Heating Control

Limited Warranty

SunEarth Inc. warrants each of its products to be free from defects in workmanship and materials under use and service for a period of 24 months from date of manufacture or 12 months from date of purchase from an SunEarth Authorized Dealer, if within the above documented period after date of manufacture.

If the product proves to be defective within the applicable warranty period, SunEarth on its sole discretion will repair or replace said product. Replacement product may be new or refurbished of equivalent or better specifications, relative to the defective product. Replacement product need not be of identical design or model. Any repair or replacement product pursuant to this warranty shall be warranted for not less than 90 days from date of such repair, irrespective of any earlier expiration of original warranty period. When SunEarth provides replacement, the defective product becomes the property of SunEarth Incorporated.

Warranty Service, within the applicable warranty period, may be obtained by contacting your nearest SunEarth office via the original Authorized Agent and requesting a Return Material Authorization Number (RMA #). Proof of purchase in the form a dated invoice/receipt must be provided to expedite the issuance of a Factory RMA.

After an RMA number has been issued, the defective product must be packaged securely in the original or other suitable shipping package to ensure that it will not be damaged in transit. The RMA number must be visible on the outside of the package and a copy included inside the package. The package must be mailed or otherwise shipped back to HBX with all costs of mailing/shipping/insurance prepaid by the warranty claimant.

Any package/s returned to SunEarth without an approved and visible RMA number will be rejected and shipped back to purchaser at purchaser's expense. SunEarth reserves the right, if deemed necessary, to charge a reasonable levy for costs incurred, additional to mailing or shipping costs.

Limitation of Warranties

If the SunEarth product does not operate as warranted above the purchasers sole remedy shall be, at SunEarth's option, repair or replacement. The foregoing warranties and remedies are exclusive and in lieu of all other warranties, expressed or

implied, either in fact or by operation of law, statutory or otherwise, including warranties of merchantability and fitness for a particular purpose/application. SunEarth neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale, installation maintenance or use of SunEarth products.

SunEarth shall not be liable under this warranty; if its testing and examination discloses that the alleged defect in the product does not exist or was caused by the purchasers or third persons misuse, neglect, improper installation or testing, unauthorized attempts to repair or any other cause beyond the range of intended use, or by accident, fire, lightning or other hazard.

Limitation of Liability

In no event will SunEarth be liable for any damages, including loss of data, loss of profits, costs of cover or other incidental, consequential or indirect damages arising out of the installation, maintenance, commissioning, performance, failure or interruption of an SunEarth product, however caused and on any theory of liability. This limitation will apply even if HBX has been advised of the possibility of such damage.

Local Law

This limited warranty statement gives the purchaser specific legal rights. The purchaser may also have other rights which vary from state to state in the United States, from Province to Province in Canada and from Country to Country elsewhere in the world.

To the extent this Limited Warranty Statement is inconsistent with local law, this statement shall be deemed modified to be consistent with such local law. Under such local law, certain disclaimers and limitations of this statement may not apply to the purchaser. For example, some states in the United States, as well as some governments outside the United States (including Canadian Provinces), may:

Preclude the disclaimers and limitations in this statement from limiting the statutory rights of a consumer (e.g. United Kingdom);

Otherwise restrict the ability of a manufacturer to enforce such disclaimers or limitations; or

Grant the purchaser additional warranty rights which the manufacturer cannot disclaim, or not allow limitations on the duration of implied warranties.