Module 8

enerworks
Solar Heating and Cooling

Controller And Monitor Programming Guide

Software Ver. 1.1.0.9

Solar Water Heating Appliances

EnerWorks Inc.
969 Juliana Drive
Woodstock, ON
N4V 1C1, Canada
Tel: (519) 268-6500
Toll-free: 1-877-268-6502
Fax: (519) 268-6292
www.enerworks.com

Rev. 2013,03,03

Foreword

Use this Controller and Monitor Programming Guide to program the EnerWorks Performance Controller and SolarView Monitor and to commission the EnerWorks Solar Water Heating Appliance. This manual complements installation training available through EnerWorks or approved distributors. EnerWorks training is mandatory to become an EnerWorks-authorized dealer.

EnerWorks encourages installers of EnerWorks products to always keep workmanship, best practices and safety in mind. An organized installation will benefit both installer and end-user.

The EnerWorks Performance Controller is certified for use in the United States of America and in Canada by the Canadian Standards Association (CSA). Wireless communication capabilities of the Controller and Monitor are approved by the Federal Communication Commission (FCC), and by Industry Canada (IC). Certifications or approvals do not imply endorsement or warranty by FCC, IC, or CSA.

232023

FCC ID: VFC070501

IC: 7193A070501

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

FCC Information to Users @ FCC 15.21 & 15.105

For Class B Unintentional Radiators:
This equipment has been tested and found to comply with limits for a Class B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning equipment off and on, user is encouraged to try to correct interference by one of more of the following measures:

- Reorient or relocate receiving antenna
- Increase separation between equipment and receiver
- Connect equipment into an outlet on a circuit different from that to which receiver is connected.
- Consult dealer or an experienced radio/TV technician for help.

Warning to Users @ FCC 15.21 & 15.105

Warning: Changes or modifications not expressly approved by EnerWorks void user's authority to operate equipment.

Contents

Appliance must only be installed by an EnerWorks-authorized dealer or warranty is void.

Recognize this symbol as an indication of important safety information!

EnerWorks Residential Solar Water Heating Appliances must be installed as directed by this manual by an EnerWorks-authorized dealer or warranty is void.

1- Safety

EnerWorks assumes no responsibility for damage, loss or injury related to installation of this appliance.

Observe any and all regulations relating to installation of solar appliances and to plumbing to potable water supply. Plumbing and/or building permits may be necessary. EnerWorks Solar Water Heating Appliances utilize single and double-wall heat exchangers.

Assemblies and materials used during installation shall meet requirements of local, regional, state, provincial, and federal regulations and fire codes. Any penetrations made in drywall or any other firewall must be fixed to maintain integrity of fire protection.

Cover on Energy Station is designed to protect components from damage, and to protect users from injury. Do not operate with Energy Station cover removed.

Electrical connections may have to be completed by a licensed electrician. Observe all local codes and regulations.

Do not modify any electrical connections in the EnerWorks Energy Station unless expressly directed to by this manual.

Do not modify Controller programming or factory default settings unless expressly directed by this manual.

Programmed settings are responsible for controlling Appliance operation and ensuring safety. Modification of settings other than as directed by this manual may result in equipment damage and risk to safety. Modification of settings other than as directed by this manual will void warranty.

Energy Station and SolarView Monitor are to be installed indoors and they must remain above freezing conditions.

2 – Performance Controller and SolarView Monitor Programming

Temperature sensors, flow sensor, and power must all be connected before programming Controller. Controller must be correctly programmed to provide homeowner with accurate feedback.

There are three Controller modes:

- **Output Mode**
- **User Programming Mode**
- **Installer Programming Mode**

Output Mode is default mode of both Controller and Monitor. Output Mode displays dollar and carbon dioxide (CO_2) saved, solar energy delivered, hot water used, temperature measurements, etc. Pressing up and down buttons scrolls through displays. Factory-set default display is cumulative dollars saved. To change, scroll to desired display, then press and hold enter ⏎ button for five seconds to set as default display.

User Programming Mode allows user to change between metric units (°C, m^3, L, tonnes, kWh, etc.) and US customary units (°F, ft^3, gal, tons, BTU, etc.). It allows user to reset recorded values of maximum and minimum temperatures. User Programming Mode also allows user to define type and cost of traditional water-heater fuel being displaced: electricity, natural gas, propane or oil. User may also define generation mix (if displacing electricity) which influences CO_2 savings.

Installer Programming Mode is for EnerWorks-authorized installers only. It allows installer to set communication address of wireless SolarView Monitor. Commissioning date is also set, establishing service date intervals and notifications. Installer must define type of system as Pre-Heat (two-tank) or Single Tank Appliance.

2.1 Installer Programming Mode

a. Press ☰ to enter USER PROGRAMMING MODE (Fig. 1)

b. Press and hold ☰, ⌂ and ⌄ simultaneously for at least 5 seconds (but less than 10 seconds) to enter Installer Programming Mode. Communication address is displayed – four digits of: 0123456789AbcdEF (Fig. 2)

Fig. 1

2.1.1 Communication Address

Flashes when Monitor is searching for Controller signal. Monitor will not receive Controller signal unless Monitor address matches that of Controller. To synchronize the monitor with the controller appliance follow these steps:

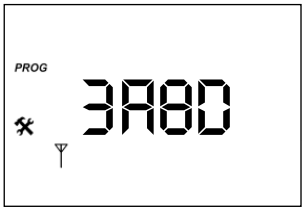


Fig. 2

a. Insert the batteries (supplied) into the Monitor.

b. Press and hold [⇧] and [⇩] (on Monitor) for at least 5 seconds (but less than 10 seconds) until four digit communication address is displayed (Fig. 3).

c. Press [⇧] to change digit and [⇩] to accept until Monitor address matches Controller address. Monitor will start displaying Controller information after about 1 minute.

d. Press [↵] (on Controller) and proceed with the following steps on the Controller.

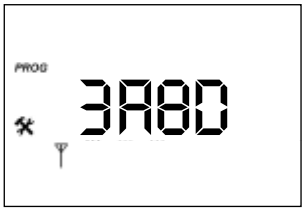


Fig. 3

Do not modify following settings unless indicated.

Do not modify unless flow meter is **not** installed. Default is on (✓). Press [↵].

2.40 Do not modify unless flow meter installed is of a different rating. Default is 2.40. Press [↵].

Direct System Option

This feature is inactive by default (✗), (Fig. Direct System). It should be made active only when setting the controller to operate on a direct system (water based system). Enabling this option for a Pre-Heat or Single-Tank system (glycol based system) will cause erroneous operation and/or damage to the system.

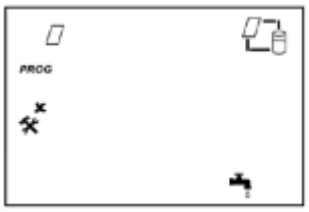


Fig. Direct System

Having the system configured differently than installed will cause erroneous operation and/or damage the system.

EnerWorks-On-demand Combo Unit Option

This alternative was specifically designed to integrate an EnerWorks system with an On-demand system using one shared storage tank. This option can be enabled from the Installer Programming Menu, and it will be displayed after the commissioning date (number of tank's screen). Configuration is as follows:

For a Pre-Heat system, number of tank should be set to: "2" (Default option); for a Single-Tank system, number of tank should be set to "1"; and for an EnerWorks-On-demand Combo unit, number of tank should be set to "0".

Do not modify unless energy delivered by the auxiliary tank is desired. Default is off (✗). Press ↵
This alternative is optional, but if energy delivered by the auxiliary tank is desired, an additional thermistor is to be installed upstream of the anti-scalding valve (if there is one). This thermistor is to be wired into connector **D** on the back of the Controller pins 7 and 8. To activate this option, press ↑ or ↓ to change to (✓) and press ↵ .

Secondary Application. Default is off (✗). Do not modify unless energy monitoring on a secondary loop is desired. Press ↵.
This alternative is optional, and if energy monitoring on a secondary loop is enabled, an additional flow and temperature sensor will have to be installed along with a thermistor (contact EnerWorks for details on the installation).

Do not modify. Default is 18 °F (10 °C). Press ↵ .

Do not modify. Default is 9 °F (5 °C). Press ↵ .

Important: enabling the Direct-System function and/or EnerWorks-On-Demand combo option, while the controller is being used on a Pre-Heat or Single-Tank appliance will cause erroneous operation and/or severe damage to the system.

IT IS NOT PERMISSIBLE TO ALTER, MODIFY OR CHANGE ANY PARAMETERS SETTINGS ON THE CONTROLLER UNLESS OTHERWISE SPECIFIED ON THE CONTROLLER INSTALLATION MANUAL.

Changing PRGM settings other than operating mode or temperature units may lead to equipment malfunction or damage, to poor performance, and to health and safety risks. Altering any default PRGM setting other than the specified on the installation manual will void the warranty.

Do not modify. Default is 41 °F (5 °C). Press ↵ .

Do not modify. Default is 37 °F (3 °C). Press ↵ .

MIN Do not modify. Default is 39 °F (4 °C). Press ↵ .

MIN Do not modify. Default is 43°F (6 °C). Press ↵ .

MAX (Maximum storage temperature shut-off)

- **Pre-Heat Appliance:** Do not modify. Default is 185 °F (85 °C). Press ↵ .

- **Single Tank Appliance:** Use ↑ and ↓ to modify to 122 °F (50 °C). Press ↵ to accept.

MAX (Maximum storage temperature for operation)

- **Pre-Heat Appliance:** Do not modify. Default is 176 °F (80 °C). Press ↵ .

- **Single Tank Appliance:** Use ↑ and ↓ to modify to 113 °F (45 °C). Press ↵ to accept.

2.1.2 Commissioning Date

Establishes service intervals and notifications (annual check-up and triennial fluid replacement), and is the start date for cumulative measurements.

a. Press ↵ on Controller until year (2007) is displayed. Use ↑ and ↓ to set current year (365) and press ↵ to accept.

b. Use ↑ and ↓ to select current month (31). Press ↵ to accept.

c. Use ⌃ and ⌄ to select current day (1). Press ↵ to accept. Figs. 4–6 show progression for setting April 7, 2008 (2008,04,07).

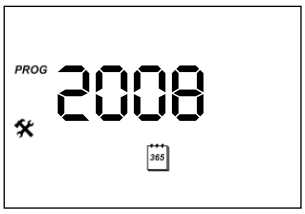


Fig. 4

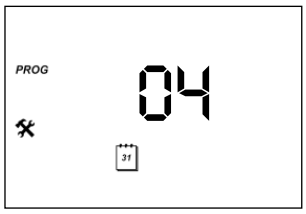


Fig. 5

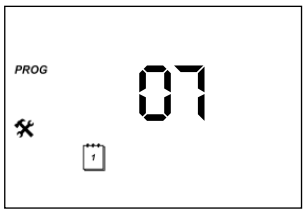


Fig. 6

Once COMMISSIONING DATE is set, it cannot be changed without rebooting to factory defaults. If an error is made in setting COMMISSIONING DATE, Controller must also be rebooted. See section below, **Reboot to factory defaults.**

2.1.3 Appliance Type

- Pre-Heat Appliance (APPLIANCE TYPE 2):

a. Default is "**2**" (**two** tanks: solar pre-heat tank + auxiliary heater). Press ↵ to accept.

- Single Tank Appliance (APPLIANCE TYPE 1):

b. Use ⌃ or ⌄ to select "**1**" (**one** tank: solar+electric combined) and press ↵ to accept (Fig. 7).

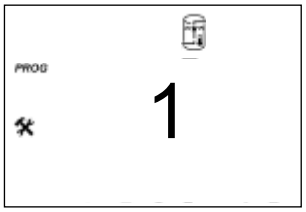


Fig. 7

c. If needed (see below), use ⌃ and ⌄ to modify heating element power rating. Press ↵ to accept.

Controller measures total (solar + electric) energy delivered to home and subtracts electric energy used by heating element to accurately determine solar energy delivered. Single Tank Appliance tank heating element power rating is 4500 W at 240 VAC (default, Fig.8).

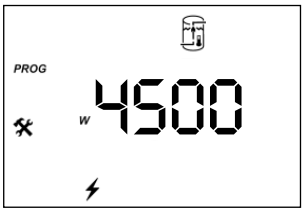


Fig. 8

To accurately measure heating element operation, Controller must be connected to heating element as described in 4.8 Controller connections of Single Tank Appliance Installation Manual. Cable connecting Controller to heating element must meet National or Canadian Electric Code standards for 240 VAC service.

If installed with 208 VAC (4500 W rating is reduced to 3880 W) or if a larger (6000 W) heating element is installed, power rating must be modified. Check tank manufacturer wattage specifications and determine whether voltage is 240 VAC or 208 VAC.

Voltage may fluctuate due to varying grid load characteristics. As tank ages and if mineral scale builds up on heating element, more power may be required for auxiliary heating and solar fraction will decrease.

d. NOT AVAILABLE. Default is off ( ). Do not modify. Press [↵].

2.1.4 Resetting Data

"**rst?**" appears with collector, tank and thermometer icons Fig. 9. This screen will allow you to reset all minimum and maximum temperature values collected by the controller. It is recommended to perform this reset if system is being commissioned. Press and hold [△] and [▽] simultaneously for 5 seconds to zero or reset accumulated performance values. Screen will flash to confirm values have been reset. Press [↵].

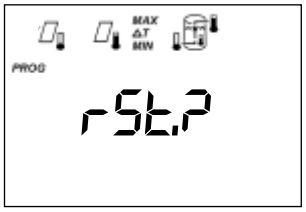


Fig. 9

"rst?" appears with icons for the accumulated data for day, month, year, etc. Fig. 10. This screen will allow you to reset all the accumulative data (energy saved, dollar saved, water usage, CO_2 displaced, etc.). It is recommended to perform this reset if system is being commissioned. Press and hold [△] and [▽] simultaneously for 5 seconds to zero or reset accumulated performance values. Screen will flash to confirm values have been reset. Press [↵]

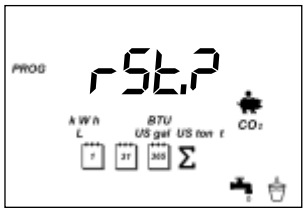


Fig. 10

2.1.5 Rebooting To Factory Defaults

Rebooting should only be completed if necessary. If rebooting is not required, press [↵] to exit INSTALLER PROGRAMMING MODE and return to OUTPUT MODE.

To change error in COMMISSIONING DATE and/or to reset programmed settings to factory defaults, Controller must be rebooted.

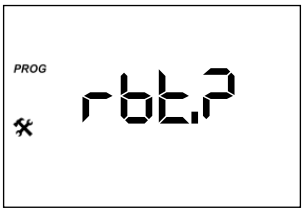


Fig. 11

a. From INSTALLER PROGRAMMING MODE, press ↵ until "**rbt?**" is visible (Fig.11).

b. Press and hold ☰ , ⇧ and ⇩ simultaneously for 7 seconds until display briefly flashes and returns to OUTPUT MODE.

c. Controller must be re-initialized before Appliance operation. Return to INSTALLER PROGRAMMING MODE (*PROG* 🛠) and start over.

Set up within INSTALLER PROGRAMMING MODE is now complete. Press ↵ to exit INSTALLER PROGRAMMING MODE and return to OUTPUT MODE.

2.2 User Programming Mode *PROG*

Type of fuel being displaced by solar and unit cost of displaced fuel is entered in USER PROGRAMMING MODE (***PROG***). This mode is accessible to homeowner. Current date and time and units of measure may be selected, and stored data may be cleared or reset.

To enter USER PROGRAMMING MODE, press ☰ and ***PROG*** is displayed (Pressing ☰ again from any display will return to OUTPUT MODE).

Use ⇧ and ⇩ to toggle values, and press ↵ after each to accept and continue.

2.2.1 Pump Control (automatic/manual) *AUTO MAN*

Default mode for pump is automatic (***AUTO***). If ***AUTO*** is desired, press ↵ to accept and continue.

While charging or servicing Appliance, it may be necessary to turn pump on or off manually. Pressing ⇧ or ⇩ will alternate between automatic (***AUTO***) and manual (***MAN***) pump modes.

If manual pump control is desired, select ***MAN*** and press ↵. Press ⇧ or ⇩ to select on (✔) or off (✘). Fig. 12 shows all visible segments for pump control.

Press ↵ to accept and continue.

Fig. 12

A pump set to run manually (MAN ✓) will operate, unless unplugged, for fifteen minutes then revert to automatic mode. A pump turned off manually (MAN ✗) will not operate unless pump control setting is returned to automatic or is manually turned on.

2.2.2 Units Of Measure

Default units of measure are metric (°C, m^3, L, tonnes). "**S.I.**" (Système Internationale) is displayed (not "5.1") (Fig.13). To change to US customary units (°F, ft^3, gal, tons):

a. Press [≡] once to enter USER PROGRAMMIN MODE

b. Press [↵] and "S.I." (Système Internationale) is displayed (not 5.1), indicating Metric units (Fig. 13)

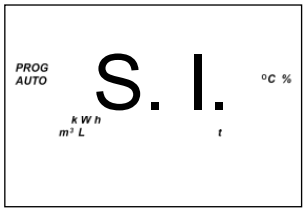


Fig. 13

c. Press [△] or [▽] to display "**U.S.**" (Fig. 14).

d. Press [↵] to accept.

e. Press [△] or [▽] to choose the units to display solar energy (kWh or BTU).

f. Press [↵] to accept.

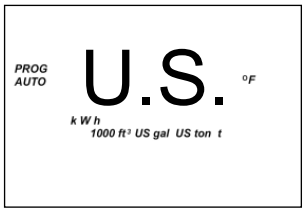


Fig. 14

2.2.3 Auxiliary Fuel Type

Due to geography and weather conditions, solar energy collected may not be sufficient to meet hot-water demand and to ensure adequate sterilization of domestic water. Back-up or "auxiliary" heating must be in place. Auxiliary water-heating typically requires electricity, natural gas, propane, or oil. Auxiliary fuel selection affects carbon dioxide emissions.

Depending on the installation setting and whether it is a Pre-Heat appliance or a Single Tank appliance, options will vary as follows:

- Single Tank Appliance (APPLIANCE TYPE 1):

a. Press [↵] to accept default auxiliary fuel: electricity (⚡). See Fig. 15.

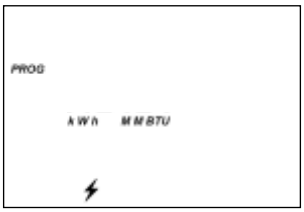


Fig. 15

- Pre-Heat Appliance (APPLIANCE TYPE 2):

a. Press ⌂ or ⌄ to select auxiliary fuel: electricity (, default Fig. 15), natural gas (, Fig. 16), oil (, Fig. 17), or propane (, Fig. 18).

b. Press ↵ to accept and continue.

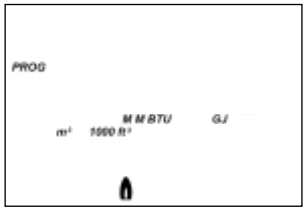


Fig. 16

2.2.4 Auxiliary Fuel Units

Auxiliary fuel icon will flash, and default units of measurement are displayed. Units of measurement may be modified to better suit utility billing convention.

- For electricity ( ), default is ***k W h*** (Fig. 15) but may be changed to .
- For natural gas ( ), default is ***m³*** or ***1000 ft³*** (Fig. 16) but may be changed to ***GJ*** or ***M M BTU*** If therms is the common unit of measure, select ***1000 ft³*** .

1000 ft³ natural gas = 10 therm = 1 MMBTU (1,000,000 BTU)
1 therm natural gas = 100 ft³ = 0.1 MMBTU (100,000 BTU)

M M BTU

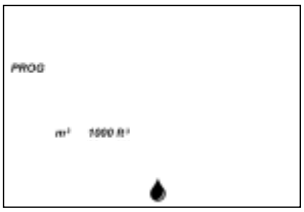


Fig. 17

- For oil ( ), default is ***L*** or ***US gal*** (Fig. 17).

- For propane ( ), default is ***L*** or ***US gal*** (Fig. 18).

Fig. 18

a. To modify units, press ⌂ or ⌄ .

b. To select and continue, press ↵ .

2.2.5 Auxiliary Fuel Cost

Controller calculates dollars saved based on fuel displaced by solar and its unit cost.

a. Set unit cost of selected auxiliary fuel by pressing ⌂ (and holding, if necessary, for rapid increase).

b. Press ↵ to accept and continue.

For natural gas: to convert **$ / therm to $ / 1000 ft³**, multiply by 10.
Ex. $1.831/therm = $18.31/1000 ft³

To determine household's fuel cost, divide total monthly bill by usage. This provides a good estimate of unit cost of fuel.

Actual real unit cost of fuel is difficult to determine accurately and may fluctuate due to time of day rate differences (peak vs. off-peak), fixed fees (delivery, transmission, debt servicing, etc.), taxes and market conditions.

To achieve accurate savings calculations, home owner should be encouraged to access USER PROGRAMMING MODE to regularly adjust auxiliary fuel cost.

Fig. 19 shows an example of electricity unit cost of $0.143/kWh (14.3 ¢/kWh). In addition to reviewing homeowner's power or gas bill, get your local fuel price by contacting or visiting website of local utility or power authority or by visiting the Energy Information Administration website (http://tonto.eia.doe.gov/state/).

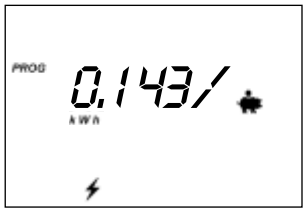


Fig. 19

If auxiliary fuel is natural gas ( ), oil ( ), or propane ( ). Controller will return to OUTPUT MODE. Proceed to set Appliance clock and calendar, and clear or zero saved temperature and accumulated performance values.

2.2.6 Electricity Generation Mix %

If auxiliary fuel is electricity ( ), electricity generation mix must be entered to properly estimate carbon dioxide (CO_2) reduction.

Generation mix inputs are of format g. p %, where g is generation source code (see Tables 1 & 2), and p is percentage of total generation mix (Fig. 20). See Tables 1-3 for example data and inputs.

a. Press ⇧ or ⇩ (and hold, if necessary, for rapid change) to enter generation mix percentage.

b. Press ↵ to accept and continue. Repeat for next generation source until all ten percentages have been entered.

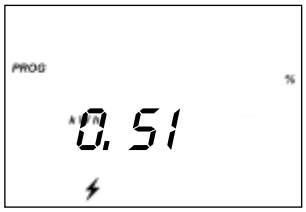


Fig. 20

For each generation source, up to 100% may be entered, but total for all ten may not exceed 100%. Final total is not required to sum to 100% as there may be additional sources not accounted for (such as tidal, which may be bundled into a CO_2-neutral category).

Determine electricity generation mix by visiting local utility or power authority Website, Energy Information Administration (EIA) website, Department of Energy or Ministry of Energy website.

For state generation mix: visit http://tonto.eia.doe.gov/state/

Table 1. Example data for Washington state from Energy Information Administration (EIA) web site.

Net Electricity Generation	Washington	Share of U.S.	Period
Total Net Electricity Generation	10,664 thousand MWh	3.3%	May-08
Petroleum-Fired	1 thousand MWh	0.1%	May-08
Natural Gas-Fired	203 thousand MWh	0.3%	May-08
Coal-Fired	331 thousand MWh	0.2%	May-08
Nuclear	752 thousand MWh	1.2%	May-08
Hydroelectric	8,986 thousand MWh	31.8%	May-08
Other Renewables	360 thousand MWh	3.5%	May-08

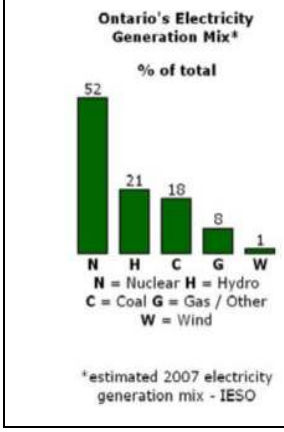
Table 2. Example Controller inputs for Washington state using above example data.

Generation code	Generation source	Generation source / Total (1,000 MWh)	**Controller Input**
0.	Coal	331 / 10,664 = 3 %	***0 . 03***
1.	Petroleum	1 / 10,664 = 0 %	***1 . 00***
2.	Natural gas	203 / 10,664 = 2 %	***2 . 02***
3.	Nuclear	752 / 10,664 = 7 %	***3 . 07***
4.	Hydro-electric	8,986 / 10,664 = 84 %	***4 . 84***
5.	Gasoline	- / 10,664 = 0 %	***5 . 00***
6.	Diesel	- / 10,664 = 0 %	***6 . 00***
7.	Solar photovoltaic (PV)	360 / 10,664 = 03 % (Other Renewables)	***7 . 01****
8.	Wind		***8 . 01****
9.	Biomass		***9 . 01****

* 3% “Other Renewables” arbitrarily split into 1% PV, 1% wind and 1% biomass.

For Provincial generation mix: check your Provincial Ministry of Energy website (Table 3) or the NATIONAL INVENTORY REPORT, 1990-2005: GREENHOUSE GAS SOURCES AND SINKS IN CANADA. **http://www.ec.gc.ca/pdb/ghg/inventory_report/2005_report/a9_eng.cfm#fa9_2**

Table 3. Example Controller inputs for Ontario (www.energy.gov.on.ca)



Generation code	Generation source	Generation mix	**Controller Input**
0.	Coal	18 %	***0 . 18***
1.	Petroleum	0 %	***1 . 00***
2.	Natural gas	8 %	***2 . 08***
3.	Nuclear	52 %	***3 . 52***
4.	Hydro-electric	21 %	***4 . 21***
5.	Gasoline	0 %	***5 . 00***
6.	Diesel	0 %	***6 . 00***
7.	Solar photovoltaic (PV)	0 %	***7 . 00***
8.	Wind	1 %	***8 . 01***
9.	Biomass	0 %	***9 . 00***

2.2.7 Water Required For Electricity Generation

Electricity generation requires water. Water may be used directly to drive hydroelectric turbines, but it is more often converted to steam in nuclear and fossil fuel power plants to drive steam turbines.

Fresh water is removed from rivers, lakes and aquifers and lost to the atmosphere. Displacing electricity with solar water-heating helps conserve fresh water. Controller calculates and displays volume of fresh water conserved.

a. Using ⇧ or ⇩, enter desired volume measurement units (**L** or **US gal**) (Fig. 21).
Press ↵ to accept.

b. Using ⇧ and ⇩, enter volume of fresh water required to generate 1 kWh of electricity in your state or province.
Default is 3.00 US gal / kWh (11 L / kWh). US average is 25 US gal / kWh (95 L / kWh). See note below.

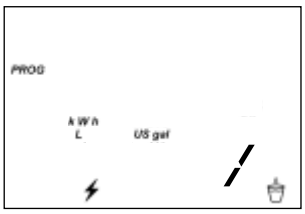


Fig. 21

c. Press ↵ to accept and return to OUTPUT MODE.

When Controller defaults were programmed, available data indicated 3 US gal was required to generate 1 kWh of electricity (in the state of Georgia). Further research indicates that average water consumption for thermoelectric power generation in United States is 25 US gal per kWh (95 L / kWh).
(Virginia Water Resources Research Center, www.vwrrc.vt.edu/watercooler_apr08.html)

2.3 Appliance Clock And Calendar

Establishes intervals of saved performance data (daily, monthly and annual totals).

a. Press ☰ to enter USER PROGRAMMING MODE (**PROG**).

b. Press ☰ again and Fig. 22 is displayed
(with only one of **AM** and **PM**).

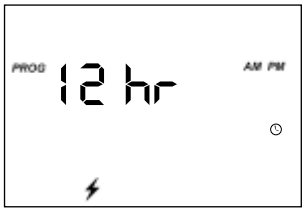


Fig. 22

c. Use ⇧ or ⇩ to select desired time format: 12hr or 24hr clock. Press ↵ to accept.

d. Use [⌃] or [⌄] (and hold, if necessary, for rapid change) to set hour (clock must be rolled over to change between **AM** and **PM**). Press [↵] to accept.

e. Use [⌃] or [⌄] (and hold, if necessary, for rapid change) to set minute. Press [↵] to accept.

f. Use [⌃] or [⌄] to set current year ([365]) (Fig. 23). Press [↵] to accept.

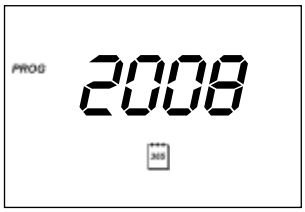


Fig. 23

g. Use [⌃] or [⌄] to set current month ([31]) (Fig. 24). Press [↵] to accept.

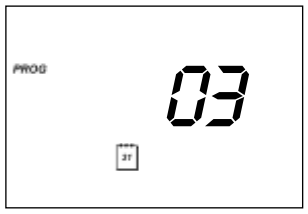


Fig. 24

h. Use [⌃] or [⌄] to set current day ([1]) (Fig. 25).

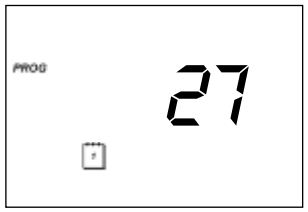


Fig. 25

i. This screen (Fig. 26) will show total hours of pump operation accumulated since commissioning date (if is a new install it will display 0). Press [↵] to accept.

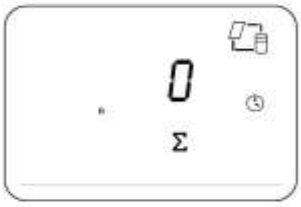


Fig. 26

j. This Screen (Fig. 27) will display total hours of stagnation accumulated since the commissioning date (if is a new install it will display 0). Press [↵] to accept.

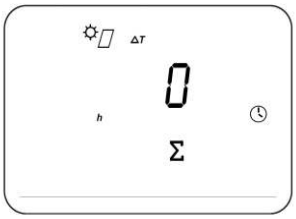


Fig. 27

k. This screen (Fig. 28) will show the cumulative hours of the appliance operation, (if is a new install it will display 1). Press ↵ to accept.

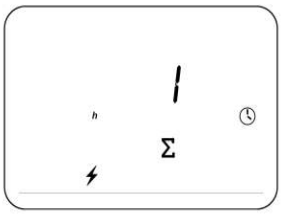


Fig. 28

l. The numbers 1.1.0.9 indicates the software version within the controller. Press ↵ to accept and to return to the OUTPUT MODE screen.

3. Reset Maximum And Minimum Values

When commissioning or after servicing, stored maximum and minimum temperatures should be cleared or reset.

a. Press ☰ to enter USER PROGRAMMING MODE (**PROG**).

b. Press and hold ☰ , ⌂ and ⌄ simultaneously for 5 seconds to enter INSTALLER PROGRAMMING MODE.
Communication address is displayed – four digits of:
01234567890AbcdEF. (Fig. 29)

Fig. 29

c. As all installation parameters have previously been set, press ↵ to accept and proceed through each setting until "**rst?**" appears with collector, tank and thermometer icons (Fig. 30). (this screen is after the appliance selection screen)

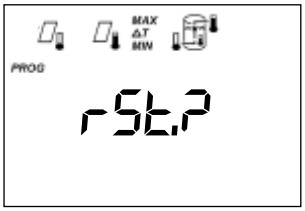


Fig. 30

d. Press and hold ⌂ and ⌄ simultaneously for 5 seconds to clear or reset stored maximum and minimum temperatures. Screen will flash and return to OUTPUT MODE.

4. Reset Performance Values

When commissioning, accumulated performance values should be zeroed or reset.

a. Press ☰ to enter USER PROGRAMMING MODE (**PROG**).

b. Press and hold ☰ , ⌂ and ⌄ simultaneously for 5 seconds to enter INSTALLER PROGRAMMING MODE, PROG 🛠
Communication address is displayed – four digits of:
01234567890AbcdEF. (Fig. 31)

Fig. 31

c. As all installation parameters have previously been set, press ⏎ to accept and proceed through each setting until "rst?" appears with icons for the accumulated data: day, month, year, etc. (Fig. 32). (this screen is located after the Min and Max values reset screen)

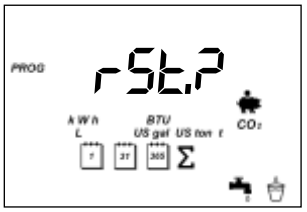


Fig. 32

d. Press and hold ⌂ and ⌄ simultaneously for 5 seconds to clear or reset accumulated performance values. Screen will flash and return to OUTPUT MODE.

5. Software Version

a. Press ☰ to enter USER PROGRAMMING MODE (***PROG***).

b. Press ☰ again and Fig. 32 is displayed (with only one of ***AM*** and ***PM***).

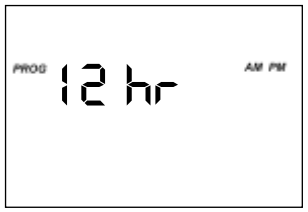


Fig. 33

c. Press ⏎ to accept and proceed through clock, calendar, hours of pump operation, hours of stagnation, and hours of appliance operation, until software version is visible (Fig. 34). – Current software version 1.1.0.8

d. Press ☰ or ⏎ to return to OUTPUT MODE.

Fig. 34

6. Service Notification

One year after COMMISSIONING DATE, "SERVICE NOTIFICATION" icon with superscript 1 ( ) is displayed, indicating annual service is recommended. Fluid should be checked for quality, filter should be cleaned, and settings checked for accuracy.

Three years from COMMISSIONING DATE, SERVICE NOTIFICATION icon with subscript 2 ( ) is displayed, indicating triennial service is required. Filter should be cleaned and fluid must be replaced to maintain warranty coverage.

If SERVICE NOTIFICATION is displayed after annual or triennial service is completed, to reset:

a. Press to enter USER PROGRAMMING MODE, **PROG** (Fig. 35).

Fig. 35

b. Press and hold , and simultaneously for 5 seconds to enter INSTALLER PROGRAMMING MODE, **PROG** . Communication address is displayed – four digits of: 0123456789AbcdEF (Fig. 36).

Fig. 36

c. Press repeatedly to move through INSTALLER PROGRAMMING MODE settings until SERVICE NOTIFICATION is displayed (immediately after date display) (Figs. 37 & 38).

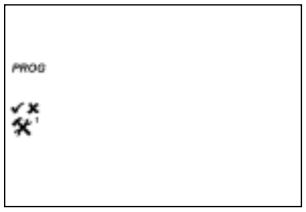


Fig. 37

d. Annual SERVICE NOTIFICATION ( ) or triennial SERVICE NOTIFICATION ( ) will be displayed with , indicating service has not been completed. When service is complete, press or to display and press .

Controller sets next SERVICE NOTIFICATION one year and three years from present service date and is no longer based on COMMISSIONING DATE. Figs. 37 & 38 show annual and triennial SERVICE NOTIFICATION with both and .

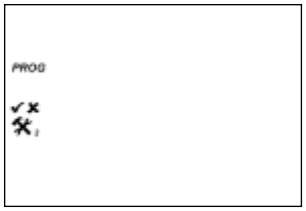


Fig. 38

Appendices

Icon reference

Error codes

Connection descriptions

7.1 Icon Reference

Icon	Description
	No solar energy available / minimum collector temperature Collector with cloud indicates insufficient solar energy for Appliance operation (ΔT less than 5 °C (9 °F)). In OUTPUT MODE, collector and thermometer with MIN indicates historical minimum collector temperature. In INSTALLER PROGRAMMING MODE, collector and thermometer indicate minimum allowable collector operating temperature.
	Solar energy available/(maximum) collector temperature Collector with sun indicates sufficient solar energy for Appliance operation (ΔT >10 °C (18 °F)). In OUTPUT MODE, collector and thermometer indicate current collector temperature. Collector and thermometer with MAX indicate historical maximum collector temperature.
MAX ΔT MIN	Maximum / ΔT / Minimum MAX / MIN for setting and displaying maximum/minimum values. ΔT indicates temperature difference between collector(s) and cold inlet to heat exchanger.
	Tank status Thermometer on left represents cold mains water inlet temperature (measured by flow meter). Thermometer inside tank represents storage temperature (measured by blue-wired thermistor at bottom of storage). Thermometer on right represents hot-water outlet temperature (measured by red-wired thermistor). Arrow inside tank flashes when hot water is used in home.
	Pump status Pump operation indicated by clockwise flashing of horizontal and vertical lines, representing heat-transfer fluid lines between collector(s) and storage tank.
PROG	Programming mode Indicates Controller is in programming mode. Used for both USER PROGRAMMING MODE and INSTALLER PROGRAMMING MODE (INSTALLER PROGRAMMING MODE also displays service icon).
AUTO MAN	Pump setting Automatic (AUTO) mode – pump operation controlled by controller logic and temperature differential. Manual (MAN) mode – pump is either on (✓) or off (✗). MAN ✓ – pump operates for up to 15 min before defaulting back to (AUTO) mode. MAN ✗ – pump remains off until controller is switched to (AUTO) or (MAN ✓) mode.
8.8:8.8/	Seven-segment digits plus decimals, colon, and slash Four digits display input/output values along with decimals. Colon used only with time. Slash used when setting fuel price and amount of water needed to generate electricity. Hexadecimal digits include: 0123456789AbcdEF

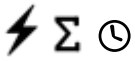
7.1 Icon Reference

Icon	Description
AM PM	AM/PM Used for displaying and setting 12-hour clock.
°F °C	Temperature units Metric and imperial units for displaying temperature.
%	Percentage Used for setting generation mix of electricity.
✓ ✗	Checkmark / "X" Used to indicate on/off or enabled/disabled.
1 2	Service status Hammer and wrench indicates INSTALLER PROGRAMMING MODE. Icon with "1" indicates that annual maintenance is required. Icon with "2" appears triennially to indicate required replacement of heat-transfer fluid. Icon flashes with error message to indicate a problem.
M k W	Power units (metric); mega kilo Watt Used for (instantaneous) power, such as with flow sensor and when programming electrical element in Single-Tank Appliance. Unit of energy (metric); mega kilo Watt hour
M k W h	Used for energy readings such as solar energy delivered to household and to input fuel prices in programming mode. ~~Unit of energy (imperial); thousand British thermal units~~
M M BTU	Used for energy readings such as solar energy delivered to household and to input fuel prices in programming mode. ~~Unit of energy unit (metric); gigajoule~~
GJ	Used as measurement of natural gas energy. Unit of volume unit (metric); cubic metre
m^3	Used as measurement of natural gas. Unit of volume (metric); litre
L	Used as measurement of propane, oil, and water. Unit of volume; thousand cubic feet

7.1 Icon Reference

Icon	Description
1000 ft³	US customary unit for measurement of natural gas.
US gal	Unit of volume; US gallon US customary unit for measurement of propane, oil, and water.
US ton	Unit of weight; US ton (short ton) = 2000 lbs US customary unit for measuring amount of carbon-dioxide.
t	Unit of mass (metric); tonne (tonne = 1000 kg) Used for measuring amount of carbon-dioxide.
	Currency symbol Typically represents monetary savings. Used in programming modes for setting auxiliary fuel prices. Default configuration is dollars, but Controller will function with any currency.
CO_2 Σ	Carbon dioxide Indicates carbon dioxide saved (in tons or tonnes)
	Low-battery warning (Monitor only)
	Elapsed time and calendar "1" = day, "31" = month, "365" = year, " " = cumulative. Calendar pages used for daily, monthly, yearly data outputs and for day, month, year of date. Cumulative icon represents totals since commissioning.
	Auxiliary fuel types Electricity, natural gas, heating oil, and propane. Used for setting energy prices and for displaying energy equivalency to solar offset.
	Water used Volume of hot water delivered (L or US gal) through EnerWorks Solar Water Heating Appliance.
	Water saved Volume of water saved (L or US gal) by offsetting electricity (only). Used for setting amount of water needed to generate one unit of electricity.

7.1 Icon Reference

	Auxiliary tank energy measurement The combination of these two icons is used to identify the energy being delivered by the auxiliary tank <when activated from the installer programming mode menu>
	Secondary application This icon is displayed in combinations with other icons to show energy monitoring, flow, and temperatures for the secondary loop. <when activated from the installer programming mode menu>
	Hours of pump operation This icon is used to indicate the total amount of hours for pump operation of the system since installation.
	Hours of stagnation Used to show the total amount of hours that the system has been under stagnation condition since the installation date.
	Hours of appliance operation Used to show the total amount of hours that the system has been operating since the installation date.

7.2 Error Codes

If an error occurs, Controller and Monitor will display an error code (see table) every minute, alternating with reading corresponding to faulty sensor.

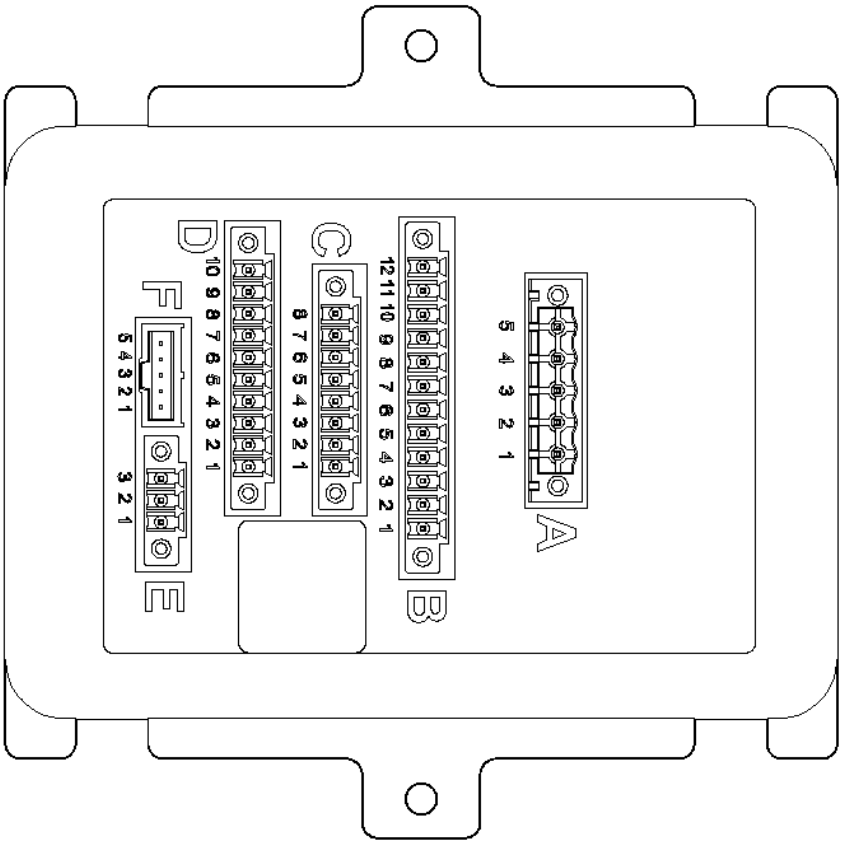
SERVICE NOTIFICATION () will also be displayed.

Error	Description
Err	Collector thermistor short or open circuit
Err1	Storage thermistor short or open circuit
Err2	Mains temperature-sensor short or open circuit
Err3	Hot outlet thermistor short or open circuit
Err4	Mains flow-sensor short or open circuit
Err5	N/A
Err6	Secondary application cold temperature-sensor short or open circuit *<optional feature>*
Err7	Hot outlet thermistor on secondary application short or open circuit *<optional feature>*
Err8	Secondary application flow-sensor short or open circuit *<optional feature>*
Err9	Hot outlet thermistor on auxiliary tank short or open circuit *<optional feature>*

7.3. Connection Description

Table 1 – Connector information:

Connector	Number of Pins	Description
A	5	120 VAC line; Switched 120 VAC line to AC pump; 240 VAC heating element monitoring in *Solaraide* tank
B	12	10 VAC from transformer
C	8	Grundfos flow sensor 1 and grounding wire <Flow sensor 2 optional>
D	10	Thermistors for storage water, hot water out, and collector
E	3	<reserved>
F	5	Gateway device



Controller Terminal Banks

Table 2 – Detailed description:

Connector	Pin	Signal Description
A	1	Tank heating element; 240 VAC line 2 *Line from heating element in* Solaraide *tank; Single Tank Appliance only*
A	2	Tank heating element; 240 VAC line 1 *Line from heating element in* Solaraide *tank; Single Tank Appliance only*
A	3	<reserved>
A	4	Switched 120 VAC line to AC pump 1 *Series connection to tank thermostat in Pre-Heat Appliance. Direct connection to pump in Single Tank Appliance.*
A	5	120VAC line in *Power in from household outlet.*
B	1	10 VAC from transformer *Power for Controller delivered from transformer.*
B	2	10 VAC from transformer *Power for Controller delivered from transformer.*
B	3	<reserved>
B	4	<reserved>
B	5	<reserved>
B	6	<reserved>
B	7	<reserved>
B	8	<reserved>
B	9	<reserved>
B	10	<reserved>
B	11	<reserved>
B	12	<reserved>
C	1	Temperature sensor on flow sensor 1 (mains cold water in) *Yellow wire from Grundfos VFS 2-40 for Energy Station.*
C	2	Flow sensing signal on Grundfos flow sensor 1 *White wire from Grundfos VFS 2-40 for Energy Station.*
C	3	DC ground to flow sensor 1 *Green wire from Grundfos VFS 2-40 for Energy Station.*
C	4	+5 VDC to flow sensor 1 *Brown wire from Grundfos VFS 2-40 for Energy Station.*
C	5	Temperature sensor on flow sensor 2 (cold inlet) *Yellow wire from Grundfos VFS 2-40 / 5-100 for secondary application.* <optional>
C	6	Flow sensing signal on Grundfos flow sensor 2 *White wire from Grundfos VFS 2-40 / 5-100 for secondary application.* <optional>
C	7	Ground wire to ground screw & DC ground to flow sensor 2 *Grounding wire to Energy Station,* and DC ground to flow sensor 2 *Green wire from Grundfos VFS 2-40 / 5-100 for secondary application.*<optional>
C	8	+5 VDC to flow sensor 2 *Brown wire from Grundfos VFS 2-40 / 5-100 for secondary application.* <optional>

Table 2 – Detailed description:

Connector	Pin	Signal Description
D	1	Thermistor, storage water *Blue-wired thermistor attached to cold side of thermosiphon loop. Control wire.*
D	2	Thermistor, storage water *Blue-wired thermistor attached to cold side of thermosiphon loop. Control wire.*
D	3	Thermistor, hot water out *Red-wired thermistor attached to hot outlet of solar storage tank. Monitoring wire.*
D	4	Thermistor, hot water out *Red-wired thermistor attached to hot outlet of solar storage tank. Monitoring wire.*
D	5	Thermistor, collector *Thermistor embedded in the collector. Control wire.*
D	6	Thermistor, collector *Thermistor embedded in the collector. Control wire*
D	7	Thermistor, hot water out on auxiliary tank *Red-wired thermistor attached to hot outlet of auxiliary storage tank. Monitoring wire.* <optional>
D	8	Thermistor, hot water out on auxiliary tank *Red-wired thermistor attached to hot outlet of auxiliary storage tank. Monitoring wire.* <optional>
D	9	Thermistor, hot outlet for secondary application energy monitoring *Red-wired thermistor attached to hot outlet of secondary application. Monitoring wire.* <optional>
D	10	Thermistor, hot outlet for secondary application energy monitoring *Red-wired thermistor attached to hot outlet of secondary application. Monitoring wire.* <optional>
E	1	<reserved>
E	2	<reserved>
E	3	<reserved>
F	1	<reserved>
F	2	<reserved>
F	3	<reserved>
F	4	<reserved>
F	5	<reserved>

Table 3 – Voltage and current ：

Connector	Pin	Voltage and maximum current
A	1	240 VAC, 50mA
A	2	240 VAC, 50mA
A	3	125 VAC, 0.5A
A	4	125 VAC, 0.5A
A	5	125 VAC, 1A
B	1	10V~14 VAC, 0.5A
B	2	10V~14 VAC, 0.5A
B	3	-
B	4	-
B	5	-
B	6	-
B	7	-
B	8	-
B	9	0V, 5A
B	10	0V, 5A
B	11	12VDC, 0.1A
B	12	12VDC/0V, 0.1A
C	1	0~5VDC, 1mA
C	2	0~5VDC, 1mA
C	3	0V, 5mA
C	4	5VDC, 5mA
C	5	0~5VDC, 1mA
C	6	0~5VDC, 1mA
C	7	0V, 5mA
C	8	5VDC, 5mA
D	1	3VDC, 1mA
D	2	3VDC, 1mA
D	3	3VDC, 1mA
D	4	3VDC, 1mA
D	5	3VDC, 1mA
D	6	3VDC, 1mA
D	7	3VDC, 1mA
D	8	3VDC, 1mA
D	9	3VDC, 1mA
D	10	3VDC, 1mA
E	1	3VDC, (TBD)
E	2	0~3VDC, (TBD)
E	3	0V, (TBD)
F	1	0V, (TBD)
F	2	5V/0V, (TBD)
F	3	5V/0V, (TBD)
F	4	5V/0V, (TBD)
F	5	5VDC, (TBD)