



Delivering Sustainable Hot Water Solutions



Installation & Operation

MFC-1 Solar Controller

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WARNING



Electric Shock!

Always disconnect the power supply before installing or servicing.

Read through these warnings and all installation instructions before beginning installation. Failure to do so can result in fire, shock, property damage, personal injury and/or death. Installation, operation and maintenance must be performed by qualified personnel in accordance with applicable codes standards and practices.

Apricus Solar Co., Ltd or Apricus Inc are not responsible for any damages or injuries that result from improper installation, modification, use or applications/configurations other than those detailed in this document.

This controller is designed to be mounted indoors. It should be protected from extremes in temperature and humidity.

**KEEP THIS INSTRUCTION MANUAL AND MAKE IT AVAILABLE FOR ALL
END USERS.**

1. Features

The Apricus Multifunction Controller (MFC-1) offers a wide range of functionality for solar thermal hot water systems as well as solar thermal systems integrated with pool and space heating. Through software pack expansion options, it can also be used to realize almost any other function the hardware can support.

Key Features:

- Large back lit display
- Full text menus for easy navigation
- SD card interface for:
 - Data Logging
 - Software Upgrades
- Basic on screen data logging even without SD card installed.
- Adjustable logging frequency
- Software packs for large number of systems
- 5 Temperature Inputs (PT1000)
- 3 Dry Contact Inputs
- 1 Grundfos VFS Input
- 1 Variable Speed Relay (semiconductor)
- 3 Standard Relays
- Safety Shutdown mode
- Detailed Error logging
- Technician & User modes to manage access to advanced functions
- RS232 communication port for future wifi and input/output expansion kits.

2. Technical Specifications

Housing: ABS plastic

Dimensions: 199x100x54mm / 7.83x3.93x2.12"

Net Weight: 0.46kg / 1lb

Ambient Temperature: 0°C~40°C / 32°F~104°F

Power Supply: AC 110-240V 50/60Hz

Battery (for memory): CR 2023 (user replaceable)

Fuse: Ø5x20mm, 250V 8A (user replaceable)

Standby Power Consumption: 4W

Inputs:

- 1 x PT1000 sensor (-40°C~220°C / -40°F~428°F)
- 4 x PT1000 sensor (-20°C~105°C / -4°F~221°F)
- 3 x dry contact signal inputs (WL1, WL2, FS)
- Grundfos VFS flow and temperature sensor input

Outputs:

- 1 x 4A variable speed semiconductor relay
- 3 x 5A standard relays

Communication & Expansion: RS232 plug (for future expansion hardware)

Protection Type: IP 20

Protection Class: I

Certifications:

- ETL: UL 873, CSA C22.2 No. 23-93
- CE: EMC 2004/108/EC, LVD 2006/95/EC

SD Card:

- Sandisk 4GB SD memory card (FAT32 format)



3. Scope of Manual

The Apricus MFC-1 is designed to be extremely modular, able to realize almost any function that the hardware can support. To achieve this while keeping the software and menu structure simple and usable, software packs offering a limited range of system configurations or “arrangements” are used.

Apricus offers a set of standard software packs that are suitable for the most common solar thermal installations, but if you have special requirements a custom software pack can be developed upon request (some fees may apply).

Software packs are simply a small data file which can be copied onto the SD card and then loaded onto the controller using the [Software Update](#) operation function.

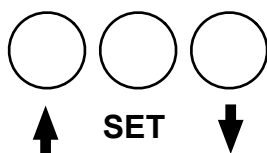
This manual covers basic operation and safety. Each software pack has a accompanying manual that provides an overview of the functions and settings.

For the most up to date version of this document and software packs please visit www.apricus.com.

4. Display and Menus

4.1. Control

The front panel of the controller has three buttons.



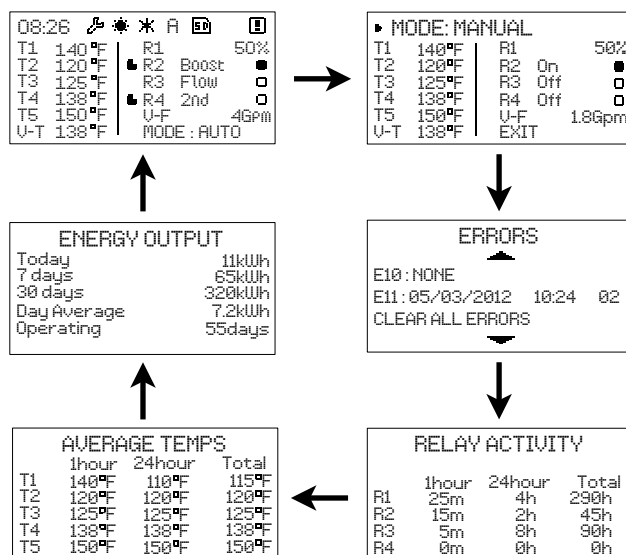
Pressing buttons together or one button for extended periods can activate certain functions depending on the software pack functions.

4.2. Menu Navigation

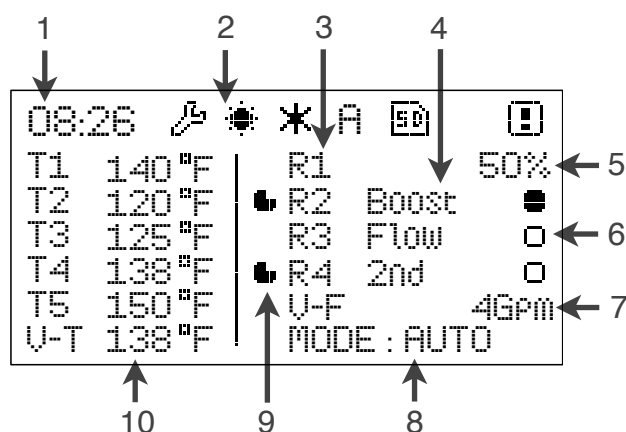
- Press the SET button to to:
 - Enter the menu screen
 - Proceed to sub-menu
 - Select functions
 - Confirm changes
- The currently selected item has a black background.
- Press the ↑ or ↓ buttons to scroll through the menu items.
- Scroll down to EXIT and press SET to return to the previous menu.
- Press ↑ or ↓ together to quickly return directly to the main screen from any menu level.

4.2. Display Screens

There are 6 main display screens. Cycle through screens with the ↑ and ↓ buttons:



4.2.1. Home Screen



1. Current Time
2. Icons (differs by software pack)
3. Relays
4. Relay 2,3 & 4 assigned function name
5. Variable relay (R1) speed
6. Relay ON/OFF status
7. Flow rate
8. Controller operation mode
9. Relay timer status
10. Temp sensor readings

4.2.2. Master Control Screen

MODE: MANUAL			
T1 140°F	R1	50%	
T2 120°F	R2 On		●
T3 125°F	R3 Off		○
T4 138°F	R4 Off		○
T5 150°F	U-F	1.8Gpm	
U-T 138°F	EXIT		

Displays system control status. See section [5.2. Master Control](#) for more information. The master control screen is only available when the controller is set to [Technician](#) menu.

4.2.3. Error Information Screen

ERRORS			
▲			
E10: NONE			
E11:	05/03/2012	10:24	02
CLEAR ALL ERRORS			
▼			

Displays the date and time of the most recent errors along with total number of occurrences.

Refer also to section [8. Error Management](#)

4.2.4. Relay Activity Screen

RELAY ACTIVITY			
	1hour	24hour	Total
R1	25m	4h	290h
R2	15m	2h	45h
R3	5m	8h	90h
R4	0m	0h	0h

Displays a summary of relay activity over various time periods.

See section [12. Datalogging](#) for more information.

4.2.5. Average Temperature Screen

AVERAGE TEMPS			
	1hour	24hour	Total
T1	140°F	110°F	115°F
T2	120°F	120°F	120°F
T3	125°F	125°F	125°F
T4	138°F	138°F	138°F
T5	150°F	150°F	150°F

Displays a summary of average temperatures over various time periods.

See section [12. Datalogging](#) for more information.

4.2.6. Energy Output Screen

ENERGY OUTPUT	
Today	11kWh
7 days	65kWh
30 days	320kWh
Day Average	7.2kWh
Operating	55days


Displays a summary of total energy output (by solar collector) over various time periods as well as total operating time since last data reset.

See section [12. Datalogging](#) for more information.

5. Operation Modes

5.1. User & Technician Menus

By holding both ↑ or ↓ for 10 seconds the controller can be switched between User and Technician menu selections.

- *Technician* menu allows viewing and changing all the available functions (based on the software pack being used). When Technician menu is active the  icon will appear on the top row of the home screen.
- *User* menu only provides a limited set of functions, as defined by the software pack.

⚠ WARNING

Controller should always be returned to **User** menu after service has been completed.

Settings available in **Technician** menu should only be adjusted by qualified persons.

Incorrect settings may cause dangerous system operation that could result in serious injury or death.

5.2. Master Control

Master control allows the controller to be set in OFF, AUTO or MANUAL modes.

OFF: All relays are permanently OFF. The controller will start in this mode after software upgrade or reset to Default Settings.

AUTO: All relays operate in accordance with function settings.

MANUAL: Relays can be manually turned ON and OFF and the speed of R1 set. This is useful when commission or troubleshooting the system.

► MODE: MANUAL			
T1	140°F	R1	50%
T2	120°F	R2	On <input checked="" type="checkbox"/>
T3	125°F	R3	Off <input type="checkbox"/>
T4	138°F	R4	Off <input type="checkbox"/>
T5	150°F	V-F	1.8Gpm
V-T	138°F	EXIT	

To change the mode:

- Using ↑ or ↓, navigate the ► to beside MODE (as shown above). Press SET, the current mode setting will flash.
- Press ↑ or ↓ to change the mode.
- Press SET to confirm. A confirmation screen will display for a few seconds.

To manually operate relays:

- In MANUAL mode press ↑ or ↓ to move the ► to beside the relay that needs to be managed.
- Press SET then ↑ or ↓ buttons to turn relays on or off. Press SET again to confirm.
- For R1, the speed of operation can also be set.

To return to home screen:

Navigate the ► to EXIT and press SET. Exit is required to allow system to return to normal operation once AUTO has been selected.

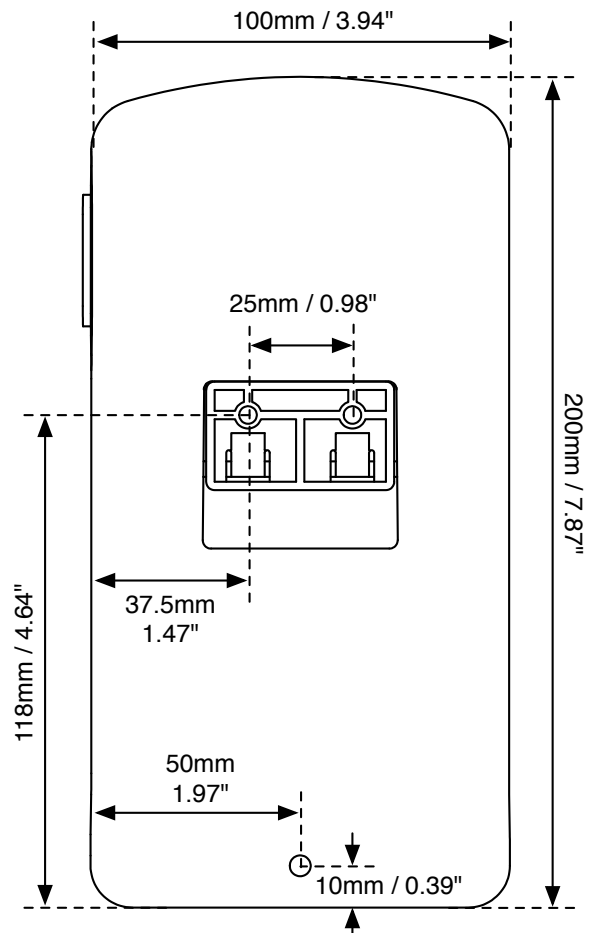
6. Mounting and Wiring

6.1. Mounting Instructions

Wall mounting is achieved through use of a mounting bracket. The controller clips onto the bracket, allowing easy removal.

To mount the controller, slide the controller over the bracket and then down. The controller will clip into place. To remove tilt the bottom of the controller slightly away from the wall and lift upwards. To secure more completely punch out the hole in the rear case below the wiring terminals and secure to the mounting surface with the supplied screws and plastic wall plugs, or suitable format.

Below are the dimensions of the mounting bracket and bottom punch out for additional mounting screw.



6.2. Knock Outs & Strain Relief

Use the provided strain relief bars to secure cables neatly in place. Because the thickness of cables varies it may be difficult to achieve effective strain relief so run cables in conduit through the rear or base knockout holes.



The BASE of the controller casing has 2 knockouts sized for standard ½" conduit or cable gland strain relief devices (ø0.88" / 22.3mm).

The REAR of the controller casing has 2 large (ø0.63" / 16mm) and 2 small conduit holes (ø0.47" / 12mm).



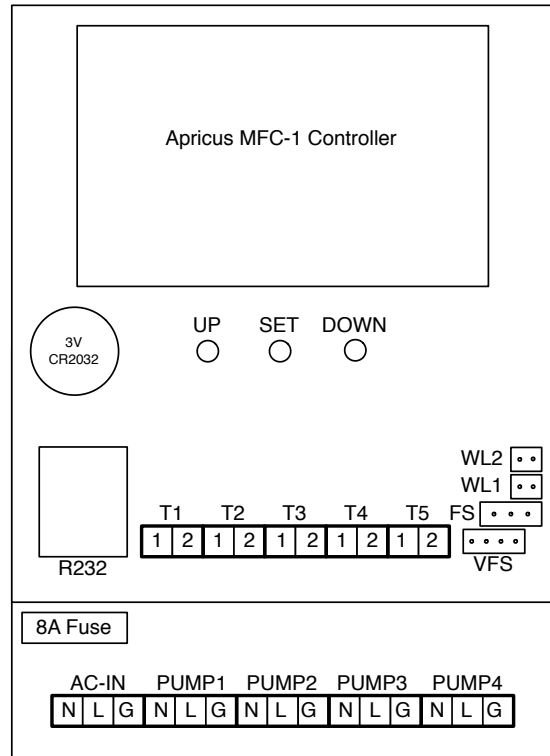
⚠ WARNING

All wiring must comply with local codes. In the event that local codes are not available please refer to your National Electrical Code.

6.3. Power Cable

The Apricus MFC-1 controller should be wired with a 3 wire power cable rated for up to 10Amp that meets local electrical and safety standards.

6.4. Wiring Diagram



N = Negative, L = Live, G = Ground/Earth
PUMP1,2,3,4 = RELAY1,2,3,4

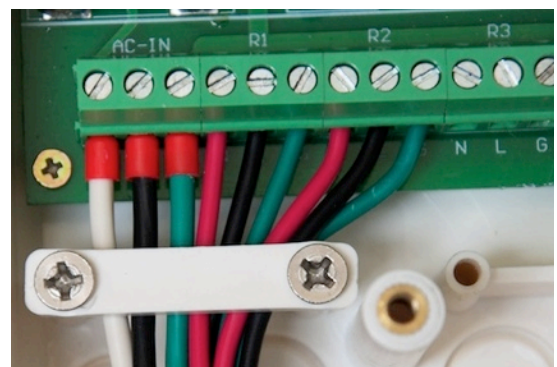
6.5. Making Connections

⚠ WARNING

⚡ Electric Shock!

Always disconnect the controller from a power source before performing any maintenance. Failure to do so could result in serious injury or death.

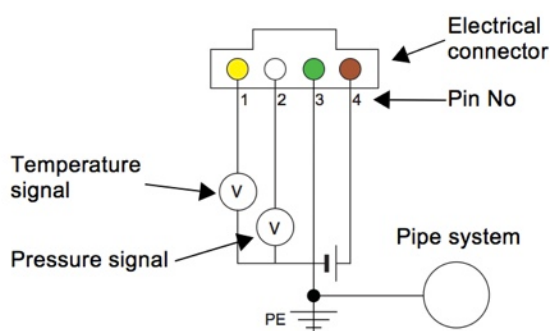
Connect wiring to the power relays on the bottom of the controller before wiring other components.



PT1000 sensor cables are connected to the top circuit board (T1,T2,T3,T4&T5). The sensors are polarity free. Refer to section [13. Temperature Sensors](#) for information on extending sensor cables, calibrating, checking sensor operation and section [8.2. Changing Error Setting](#) to turn OFF any sensors that are not installed.

If the software pack supports the additional inputs (WL1, WL2, FS) connect those with suitable plugs available from Apricus.

Grundfos VFS flow sensors connects into the 4 plug port labelled VFS.

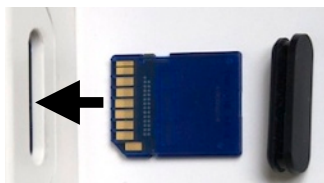


The VFS requires its ground wire to be connected to the metal pipework. Rather than cutting the VFS cable, a ground wire can be run from any of the 5 temperature sensor #2 terminals. This will not effect the reading of the temperature sensor.

6.6. SD Card

SD card is used to record data and update software packs.

- SD card is inserted face DOWN, pins UP and only when the controller disconnected from power, otherwise the controller may not recognize the card.
- SD card CAN be removed while the controller is ON. The controller may take up to 30seconds for the icon



on the screen to update the SD card status.

- Flashing SD icon indicates writing to SD card.
- Do not save any other files on the card as it may effect controller system operation.
- SD card must be formatted to FAT32 (supplied SD card is correctly formatted)
- Use the ScanDisk brand of SD card (as supplied with the controller) for best compatibility.
- Always replace the rubber cover to prevent dust or moisture entry.

7. System Set Up

7.1. Why Software Packs?

Having software packs avoids the software from becoming too bloated and complicated to use due to an excessive number of functions and rules.

It allows bug fixes and updates to be easily installed, and provides the opportunity to implement almost any function the hardware can support.

The controller may come pre-installed with a software pack depending on the country and supplier.

There is also the option of having Apricus provide a custom software pack to meet specific requirements.

Please contact your local Apricus supplier for more information.

7.2. Choosing Software

Check the Apricus [website](#) for available software packs.

Each software pack represents one or more system configuration(s), sometimes referred to as arrangements. A pdf guide is provided with each software pack with an overview of the functions and setting options.

7.3. Updating Software

Software update is achieved using the SD card. To copy software packs onto the SD card a compatible SD card to USB reader may be required. Some modern computers also have a SD card reader built in.



7.3.1. PREPARING SOFTWARE ON SD CARD

1. Open the SD card on a computer. If the SD card has not yet been used in the controller it will be blank. If it has been used a folder called DATA will be present containing data-logging files.
2. To upgrade to a different software pack, create a folder called "BOOT" on the SD card at the root/top level. Copy the required software pack's ".txt" file into the "boot" folder and rename the new software file to "boot" on a computer running Windows, or "boot.txt" if running the Macintosh (OS X) system.
3. Insert the SD card into the controller with the power off. Note the SD card inserts face DOWN. Turn power supply to the controller on.

7.3.2. UPDATE METHOD 1 (POWER ON)

Use this method if the controller power supply cannot be easily turned off while operating the controller.

1. Once at the main screen, press SET to enter the menu then navigate to SETUP > UPDATE SOFTWARE
2. Press SET, then ↑ or ↓ to select YES.
3. Press SET, then immediately press the ↑ button for 2 seconds.
4. The screen will go blank and then display the message "SYSTEM INIT" and "SYSTEM UPDATE"

5. After 20-30seconds the controller screen will display "UPDATE FINISHED" and will then reboot.

7.3.3. UPDATE METHOD 2 (POWER OFF)

Use this method if the power can be disconnected while operating the controller, if Method 1 fails or if controller fails to start-up due to failed update.

1. Turn power off, insert SD card.
2. While holding down ↑ button turn power on.
3. Release button once UPDATING SOFTWARE is displayed. After ~30seconds the software will be updated and the controller will start-up normally.

7.3.4. POST UPDATE ACTIONS

Navigate to SETUP > DEFAULT SETTINGS to clean out any settings from the previous software pack from the controller's memory.

Navigate to SETUP > RESET DATA to clear previous datalogging settings (if required).

7.4. SETUP Menu

The same SETUP menu is present in all software packs and includes the following items:

7.4.1. Time Set

Set the internal controller clock using hour and minutes in a 24 hour clock format.

7.4.2. Date Set

Choose the appropriate date format from: MM/DD/YYYY, DD/MM/YYYY or YYYY/MM/DD

Set the date using the selected format.

7.4.3. Units

Select the units for display and data logging.

Choose from: °F & Gpm or °C & Lpm

7.4.4. Energy

Select the energy units for display and data logging:

Choose from: kBtu or kWh

7.4.5. Default Settings

Select YES to restore the controller to the default settings for the installed software pack.

7.4.6. Reset Data

Select YES to reset the temperature, relay and energy data presented on the main screens. Data on the SD card will NOT be deleted, but energy recording will be reset to zero.

To delete files from the SD card a computer must be used. If using an Apple Mac computer, be sure to empty the Trash to ensure files are actually deleted from the SD card.

7.4.7. Data Interval

Select the frequency that data is collected and stored on the SD card. Intervals can adjusted from 30 seconds to 60 minutes. (1 minute default)

The 4GB SD card is able to store years of data even at the shortest 30 sec interval.

See section [12. Datalogging](#) for more information.

7.4.8. Update Software

Used to change the software pack.

See section [7.3. Updating Software](#) for instructions.

8. Error Management

8.1. Error Menu

All software packs will include a menu item called ERRORS. This menu provides a list of all available Error functions with the ability to turn them ON/OFF or in some cases to set a temperature value.

Errors are numbered E1, E2, E3... with E1-E5 always representing signal failure of the sensors T1, T2, T3, T4 & T5. The number and functions of the errors depends on the software pack.

E5 T5 FAIL	ON
E6 VFS FAIL	ON
E7 TANK HIGH	95°C
E8 TANK LOW	5°C

Examples of additional types of errors:

- VFS signal failure
- Temperature exceeded (above or below)
- Exceeded time period
 - Temperature has not been reached
 - Relay has NOT been ON for...
 - Relay has been ON for...
- Switch input ON/OFF

8.2. Changing Error Settings

8.2.1. ON/OFF only errors

For Errors such as "E1 T1 FAIL", an ON/OFF status will be displayed on the screen.

Press SET, ↑ or ↓ to toggle between ON and OFF, SET to confirm. This will prevent any error recording if a sensor is not installed.

8.2.2. Adjustable errors

For Errors such as **TANK HIGH**, that can shutdown the system if the tank exceeds 95°C / 203°F, the Error menu allows this temperature setting to be edited.

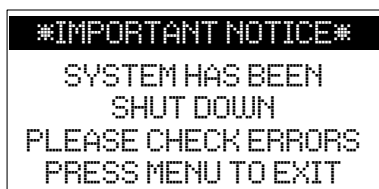
To turn this kind of error OFF, press SET, then ↑ or ↓ to exceed the upper or lower range, the screen will change from a temperature value to OFF.

8.3. Safety Shutdown

Depending on software pack features, there may be a number of errors that implement a Safety Shutdown (SS) such as a sensor failure or exceeding TANK HIGH limit.

During Safety Shutdown all relay activity ceases and "Clear All Errors" must be completed from within the [Error summary screen](#) before normal operation can occur.

During Safety Shutdown 5 audible beeps will be heard, the screen will display an error message and will flash intermittently until the SET button is pressed.



8.4. Viewing and Clearing Errors

The Error Information Screen (not the ERROR MENU) is accessed directly by cycling through the top level screens with the ↑ or ↓ buttons.

The ERROR Information Screen displays the date and time of the most recent errors along with total number of occurrences.



Some errors cause a System Shutdown (SS) and require "CLEAR ALL ERRORS" to be selected and confirmed before normal operation can return.

Error recording can occur without SD card installed.

Refer to the installed software pack documentation for details of each error.

Refer also to section [8. Error Management](#)

9. Additional Inputs

9.1. Switch Inputs

In addition to the PT-1000 sensor inputs, the controller has 3 "dry contact" switch inputs named WL1, WL2 and FS.

The signal from the 3 input switches can turn ON or OFF a relay that powers a device such as a pump or solenoid valve, and/or report an error.

An example is a low water switch that powers a solenoid fill valve or activates a low water cutoff safety shutdown of the system.



WL1 (R2, R3, R4 or Error)

Closing of the WL1 dry contact circuit will turn ON or OFF a chosen relay and/or generate an error.

WL2 (R2, R3, R4 or Error)

Closing of the WL2 dry contact circuit will turn ON or OFF a chosen relay and/or generate an error.

FS (R2, R3, R4 or Error)

Closing of the FS dry contact circuit will turn ON or OFF a chosen relay and/or generate an error.

9.2. Grundfos VFS Input



The controller can accept input signal from a [Grundfos VFS](#) temperature and flow sensor allowing more accurate energy measurements.

If VFS input is supported by the software pack there will be choice to turn this function on and select the correct model from VFS 1-12, 1-20, 2-40, 5-100, 10-200 or 20-400. Model name is the L/min range.

10. Solar Energy Measurement

10.1. How to Measure Solar Energy

Measurement of solar energy output requires a flowrate value and temp rise ($\Delta T = \text{return} - \text{flow}$) through the collector(s) :

- FLOW (T2 or VFS temperature)
- RETURN (T1 or T4 if installed on return line and SOLAR-IQ function active)

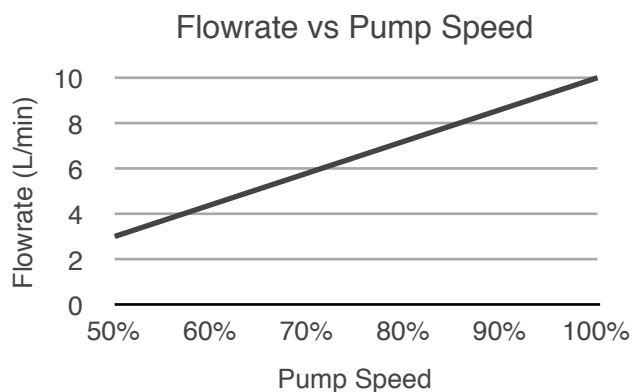
The most accurate measurements are achieved using a [Grundfos VFS](#) to measure flowrate and temperature. If not installed the controller can estimate the energy output based on flow rate values entered into the controller software by the Technician.

For FIXED flow rates (not variable speed) a single flow rate is entered. For VARIABLE speed pump operation a MIN and MAX flowrate are entered based on measurements during system commissioning.

The controller will estimate the flowrate based on a straight line relationship between flow rate and pump speed. This is not entirely accurate but provides a reasonable "estimated" value.

For example:

- MIN pump speed of 50% flow = 3 L/min
- MAX pump speed of 100% = 10L/min



10.2. Liquid Type Adjustment

If using a liquid other than plain water for the solar collector loop, an adjustment to the energy calculation must be made to account for the difference in specific heat.

Specific heat changes slightly with temperature, but for the purpose of simple energy measurements a single adjustment factor based on average solar collector operating temperature of 50°C / 122°F can be used.

For software packs that support this adjustment a menu item called "R1 LIQUID" or similar shall be included that requires entry of a % adjustment value.

The table below provides values for various concentrations of glycol based liquids such as Dowfrost HD and Clariant Antifrogen SOL HT.

For other liquids please calculate the specific heat as a % of water specific heat at 50°C / 122°F which is 4.120kJ/kg.K or 0.998 Btu/lb.°F

Glycol %	Adjustment %
0% (plain water)	100%
10% glycol	99%
20% glycol	98%
30% glycol	95%
40% glycol	92%
50% glycol	89%

11. Variable Speed Control

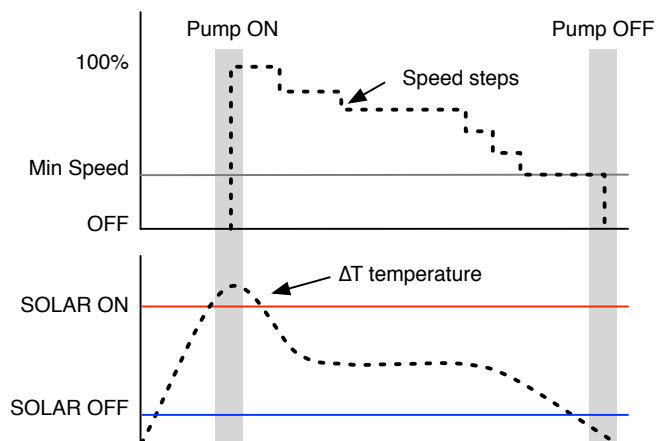
The follow overview is based on the R1 variable speed relay being used for solar collector circulation. Depending on the software pack installed it may be used for other functions. Refer to the software pack manual for more information.

11.1. Variable Speed Overview

Variable speed pumping allows the flow rate to be adjusted based on measured temperature differential between the collector (or return line) and the storage tank. This is much more efficient than a simple fixed speed ON or OFF circulation for a number of reasons:

- Variable speed control can maintain the solar collector within a defined operating temperature range, improving efficiency.
- Circulation pump ON/OFF cycling is reduced, preventing hot slugs/batches of water sitting and cooling in the return line.
- Average power usage is lower as the pump can be reduced to a much lower wattage draw.
- Variable speed circulation is important for drainback systems that require initial high head circulation to flood the line.

11.2. Variable Speed Operation



The diagram above provides an overview of how variable speed control works. The controller monitors the SOLAR ON/OFF ΔT temperature and slows or speeds up the pump speed in incremental steps based on the ΔT value.

Speed values are calculated based on the ΔT range and the MIN and MAX pump speed with a linear relationship established.

Once the SOLAR ON ΔT is exceeded R1 is turned ON.

1. If the ΔT drops below the SOLAR ON value the pump speed will begin to drop
2. The pump speed will fluctuate to try and maintain a temperature midway between the SOLAR ON and SOLAR OFF temperatures.
3. If the ΔT drops below SOLAR OFF R1 is turned off.

11.3. Pump Operation

The variable speed operation is achieved using a semiconductor to break the electrical current into short ON/OFF periods. The length of these periods will depend on the pump speed, but are only a fraction of a second.

During lower speeds it will be possible to hear or feel the pump pulsing slightly. This is normal and will not damage the pump.

For most applications a minimum variable speed of 50% is recommended. The system should be tested in [Manual Mode](#) to check if adequate flow (overcoming line losses) can still be achieved at the lowest pump setting.

12. Datalogging

Refer to section [6.6. SD Card](#) for information on SD card usage and [7.4.4. Data Interval](#) for setting the recording time interval.

12.1. Data Files

Data from the controller is saved on the SD card in comma separated txt files in a folder called DATA on the SD card.

- **DAILY Detailed data files** includes full set of data at each time interval period. New file started each day.

Data includes:

- Temp : Temperature Format = C or F
- Energy : Energy Format = kWh or kBtu
- Year/Month/Day, Hour:Min:Sec
- Energy-1day: Accumulative energy record for day
- T1,T2,T3,T4,T5 : Temperature sensor values
- VFST : Grundfos VFS Temperature
- VFSF : Grundfos VFS Flowrate
- R1,R2,R3,R4 : Relay Speed. R2, R3 and R4 are not variable speed so will be 0 or 100 (%).
- WL1,WL2,FS : Switch Operation.
0 = OFF, 1 = ON

- **DAILY Summary file** includes a data entry each day.

New file started each year. Data includes:

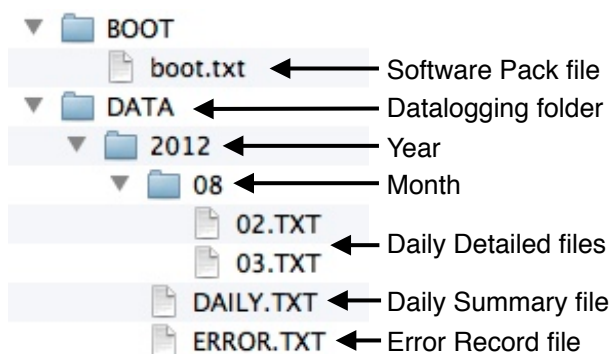
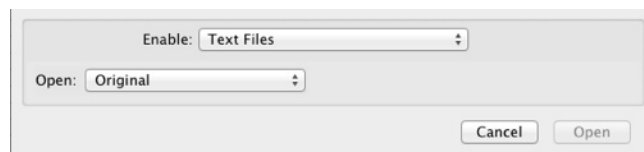
- Temp : Temperature Format = C or F
- Energy : Energy Format = kWh or kBtu
- Operating Days (since last data reset)
- Date (Year/Month/Day format)
- Energy-1day = Energy output for last 24 hours.
- T1,T2,T3,T4,T5 = Average temperatures for last 24 hour period
- R1,R2,R3,R4 = Operating time of each relay for last 24 hour period

- **Error File** includes record of each Error with date and time of occurrence. New file is started each year. Entry is saved for both start of error and also when error stops.

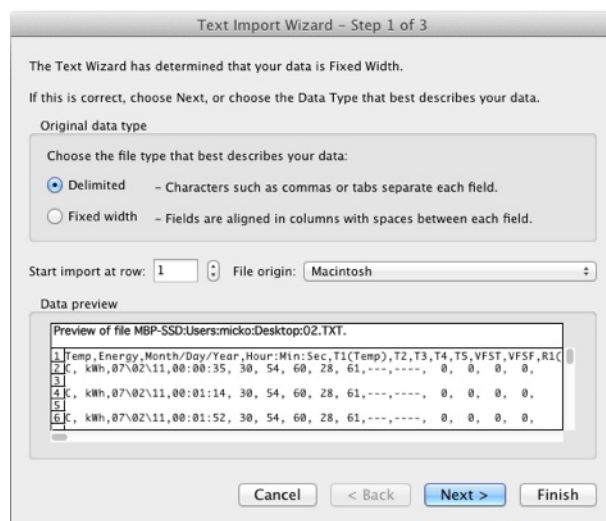
12.2. Opening Files in Excel

For detailed analysis of data, the .txt files can be imported into excel with the following process:

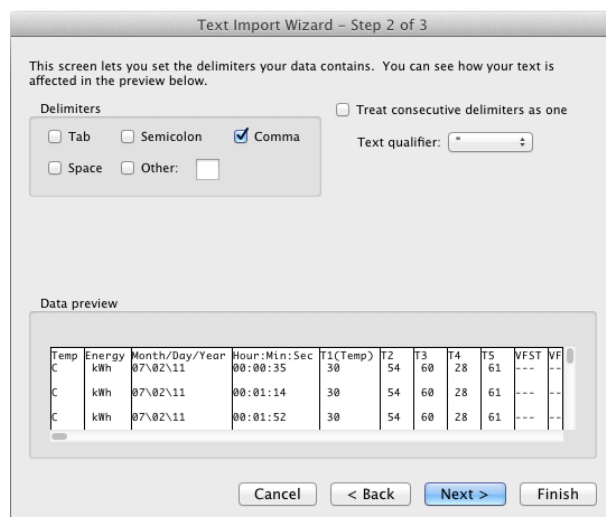
- Open Excel, then select File > Open



- Choose "Text File", open the .txt data file. A Text Import Wizard should start.
- Step 1: Choose "Delimited" press Next >



- Step 2: Choose "Comma" as the delimiter



- Step 3: Choose “General” as the Column data format, then Finish.
- Data will be imported in columns for easy analysis.

13. Temperature Sensors

13.1. Extending Sensors

To extend sensors (or switch inputs) use AWG18 / 1mm² shielded twin wire and make sure all connections are secure and water-proofed. The longer the extension the higher the resistance and so the sensors must be calibrated as outlined in 13.2 below.

13.2. Sensor Calibration

All software packs have a menu item called CALIBRATE which allows adjustment of the temperature reading of each sensor to account for variances in resistance (Ω ohms) readings. This is often required if the sensor cable is extended.

To calibrate, measure the sensors at a temperature in the middle of the standard operating range.

Compare to other sensors on the controller or an accurate thermometer. Adjust the sensor calibration value up or down until the main screen display shows the correct temperature.



T1	-3°C
T2	0°C
T3	0°C
T4	0°C

13.3. Sensor Resistance

To check if a sensor is working correctly the resistance (Ohms) can be checked with a multimeter.

Refer to the chart below for the corresponding resistance at difference temperatures.

Test with only the base sensor length (1.5m / 5') as longer cables will have higher resistance values.

Temp	Ω ohms	Temp	Ω ohms
-14°F / -10°C	960	140°F / 60°C	1232
32°F / 0°C	1000	158°F / 70°C	1271
50°F / 10°C	1039	176°F / 80°C	1309
68°F / 20°C	1077	194°F / 90°C	1347
86°F / 30°C	1116	212°F / 100°C	1385
104°F / 40°C	1155	248°F / 120°C	1461
122°F / 50°C	1194	284°F / 140°C	1535

13.4. Turning OFF Sensors

If one or more sensors are NOT installed, turn them off in the ERROR menu. See section [8.2. Changing Error Settings](#) for details.


14. Troubleshooting

Always begin any troubleshooting by reading the software pack manual.


Controller Not Turning ON

- Check fuse and [replace](#) if blown.
- Check power supply to controller.

Relay's Not Turning On

- Make sure controller is in [AUTO mode](#).
- Check relay [cable connections](#).
- Check to see if Relay has timer setting, indicated by  symbol to left of relay on the [Home Screen](#).
- [Check Errors](#) and “Clear All Errors” if required. Certain Errors may cause System Shutdown, disabling all relay activity.

Incorrect Function Operation

- Ensure functions are assigned to correct relay.
- Check all function settings.
- Check to see if Relay has timer setting, indicated by  symbol to left of relay on the [Home Screen](#).
- Reset to [Default Settings](#)

Incorrect Temperature Readings

- [Calibrate](#) the sensors
- Check the [sensor resistance](#) (ohm) readings.
- Check for damaged cables or poor connections.

Incorrect Error Reporting

- Check to see if the [error is turned ON/OFF](#).
- Check [error settings](#).

Settings Lost after Power Disconnect

- [Replace battery](#)

Controller Won't Boot Past INIT message

- Reinstall software pack using [update method 2](#).

15. Hardware Problems

WARNING

Always disconnect the controller from a power source before performing any maintenance. Failure to do so could result in serious injury or death.

15.1. Battery

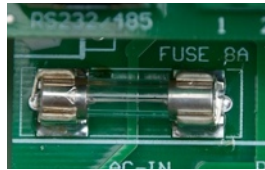
A CR 2032 3V battery is used to save settings and data when the power is disconnected.

The battery should last 4-5 years.

Only replace with matching model.



15.2. Fuse Replacement



Excessive power demand >8Amp or a power short may cause the fuse to blow.

Replace only with matching ø5x20mm, 250V 8Amp type.

16. Manufacturer Limited Warranty

LIMIT OF LIABILITY

EXCEPT FOR THE EXPRESS LIMITED WARRANTY PROVIDED FOR HEREIN APRICUS HEREBY DISCLAIMS AND EXCLUDES ANY AND ALL OTHER WRITTEN OR ORAL EXPRESS WARRANTIES OR REPRESENTATIONS. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE MUST ARISE UNDER STATE LAW TO APPLY, AND IS HEREBY LIMITED IN DURATION TO THE DURATION OF THE WRITTEN LIMITED WARRANTIES PROVIDED HEREIN UNLESS OTHERWISE BARRED BY ANY APPLICABLE STATUTE OF LIMITATION. APRICUS DISCLAIMS ANY RESPONSIBILITY FOR SPECIAL, INDIRECT, SECONDARY, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM OWNERSHIP OR USE OF THESE PRODUCTS, INCLUDING PERSONAL INJURY, INCONVENIENCE, LOSS OF USE OR LOSS OF INCOME. NO AGENT OR REPRESENTATIVE OF APRICUS HAS ANY AUTHORITY TO EXTEND OR MODIFY THIS WARRANTY UNLESS SUCH EXTENSION OR MODIFICATION IS MADE IN WRITING BY A CORPORATE OFFICER. WHERE ANY DISCLAIMERS AND LIMITATIONS CONFLICT WITH APPLICABLE STATE LAW, APPLICABLE STATE LAW SHALL PREVAIL.

Some states do not allow the exclusion or limitation of incidental or consequential damages and some states do not allow limitations on how long implied warranties may last, so the above limitations may not apply to you.

WITH RESPECT TO ANY END-USER OTHER THAN A CONSUMER END-USER WHICH PURCHASES APRICUS PRODUCTS FOR COMMERCIAL, INSTITUTIONAL, INDUSTRIAL OR OTHER NON-RESIDENTIAL PURPOSES, APRICUS DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND FURTHER DISCLAIMS ANY LIABILITY FOR SPECIAL, INDIRECT, SECONDARY, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM OWNERSHIP OR USE OF THESE PRODUCTS, INCLUDING PERSONAL INJURY, INCONVENIENCE, LOSS OF USE OR LOSS OF INCOME.

Apricus assumes no responsibility under this Limited Warranty for any damage to the Products caused after they have left the control of Apricus, including but not limited to damages caused by any trades people or visitors on the job site, or damage caused as a result of post-installation work. This Limited Warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the Products.

GENERAL

Apricus warrants its Solar Collectors and Accessories (the "Products") to be free from defects in workmanship under normal usage for the applicable Warranty Period from the date of installation. This Limited Warranty extends to the End-User of the product at the original installation location, and is not transferable.

In the event of a defect, malfunction or other failure of the Products occurring within the applicable Warranty Period which is not caused by any misuse or damage to the Product while in the possession of the End-User, Apricus will remedy the failure or defect within a reasonable amount of time. The remedy will consist of repair or replacement of the Products, or refund of the purchase price, in Apricus's sole discretion. However, Apricus will not elect to refund the purchase price unless it is unable to provide a replacement, and repair is not commercially practical and cannot be made within a reasonable timeframe. After a reasonable number of attempts by Apricus to remedy any defects or malfunction, the End-User will be entitled to either a refund or replacement of the product or its component parts. The remedies stated herein are the sole remedies for defects within the applicable warranty period.

WARRANTY PERIOD

The "Effective Date" of warranty coverage is the installation date as recorded on the installation record form, purchase invoice date, or, if neither are available, the date of manufacture plus sixty (60) days.

Component	Coverage
MFC-1 Controller (Electronic components & sensors)	Two years parts

WARRANTY EXCLUSIONS

This warranty shall be void and shall have no effect if:

- The design or structure of the Product is attempted to be modified or altered in any way, including by not limited to attaching non-Apricus approved appliances or equipment;
- The Product is not installed or repaired in accordance with applicable local codes;
- The Product is not installed by qualified, suitably licensed persons;
- The installation was not completed in line with the guidelines of the then current Apricus installation manual;
- Product serial tag or other identification is defaced or removed;
- Any operation exceeds the documented design limits of the system components or materials.
- Temperature sensors fail due to water ingress, electrical shorting, or electrical interference;
- Product is installed in an environment that exceeds the specified operating range;
- Failure is due to lightning damage, electrical power interruption or dirty power supply;

END USER OBLIGATIONS

In order to obtain performance of any obligation under this warranty, the End-User must:

- Firstly determine if the Product is within the applicable Warranty Periods. This can be determined by referring to the installation record form, or alternatively the original purchase invoice. If neither documents are available, the serial number and manufacturing date will need to be read off the Product serial tag. Some Products may be installed in a location that is not accessible to the End-User and so the information may only be obtained by a qualified service technician.
- Contact the company who installed the original Product, or, if unknown or unable to be contacted, contact Apricus directly.

The following information may be required to determine if the Product issue is eligible for coverage under the terms of this Limited Warranty.

- Information related to the manner in which the Product(s) were installed.
- The history of operation.
- Any repairs that may have been made.
- Evidence that the Product(s) were installed by a qualified, licensed contractor.
- Evidence that the Product(s) were installed in accordance with the applicable Products Installation Manuals and any special written design or installation guidelines by Apricus for this project.
- Evidence that the Product(s) were installed in accordance with all applicable local building, plumbing and electrical codes.

CUSTOMER SATISFACTION

We believe you will be fully satisfied by the service you receive from the local Apricus representatives and from Apricus. However, because our aim is your complete and lasting satisfaction, Apricus adds another feature to your warranty's protection. In the unlikely event that you feel our response to a warranty service request is not satisfactory, Apricus offers you an opportunity to air your complaint in an impartial Mediation process.

The opportunity to mediate any complaint made by an End-User is hereby extended to all End-Users. If you are a Consumer End-User, local Warranty Laws may provide that you may not file suit against Apricus until your claim has been submitted to Mediation for an informal dispute settlement and a decision has been reached.