Documentation

Generated Energy Management System

User Manual

Revision April 2014
PP9035-V01

Apollo Solar Electric Limited

Contents

Safety Information

Warranty

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Important Safety Information

All safety warnings give specific details of the potential danger/warning present and indicate how to reduce risk of injury, damage and electric shock resulting from improper use of the device. Carefully observe the following instructions:

- Installation and maintenance must be carried out by a competent person, in compliance with the manufacturer's instructions, the latest edition of the IEE wiring regulations and local safety regulations.

  If in any doubt, consult a qualified electrician.
- The device must be disconnected from the power supply before carrying out any installation work.
- A minimum of 50mm clearance must be provided each side of the device to allow adequate ventilation.
- Regulations require that the device is earthed.
- Do not remove the device cover while the power supply is connected.
- Do not operate the device with the cover removed.
- Do not attempt to repair or replace any part of the device.
- Do not touch the device with any wet part of the body.
- All Maintenance operations must be carried out by a qualified technician.
- This appliance is not suitable for outdoor use.
- The manufacturer accepts no responsibility for any damage or injury caused by improper use or failure to comply with these instructions.

Introduction

Micro generation systems are at their most efficient when all of the generated energy is used at the point of generation, i.e. within the household where the generator is sited. This results in the minimum possible use of imported energy.

The Apollo GEM Generated Energy Management system will accurately monitor micro-generation energy production together with household energy demand and then ensure that any excess energy that would have been exported is stored for later use. Since every home requires hot water, and hot water stores energy, it makes a lot of sense to use the surplus energy to produce hot water. The GEM system will capture surplus energy as it is generated which then stays stored in the form of hot water.

The GEM system works by accurately monitoring the power being imported or exported to the property and diverts sufficient power into the hot water system in order to keep the exported power to as near zero as possible whilst at the same time ensuring that no additional power is ever imported to supply the hot water store. Priority is always given to the energy demands of the household appliances and only surplus energy that would have otherwise been exported is stored in the hot water system.

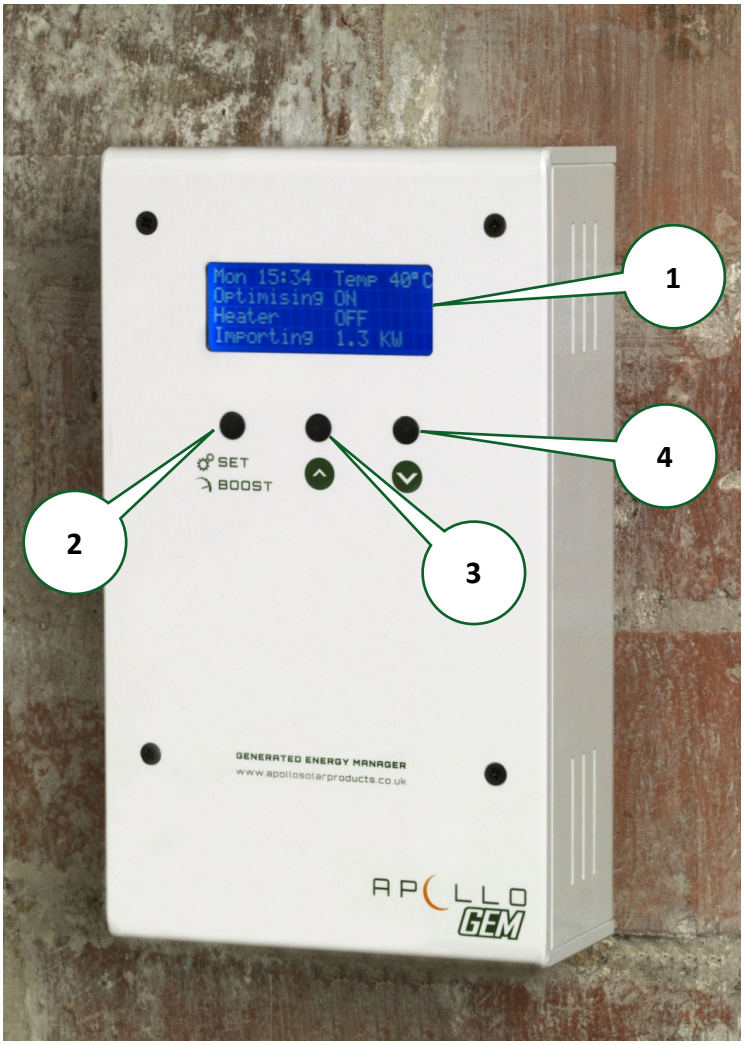
The Gem system uses a standard immersion heater element to deliver the excess electrical power generated by the PV system to the hot water cylinder.

If the water is normally heated using an electric immersion heater, the same GEM element will also perform this task using imported electricity at times when insufficient power is available from the PV system but more hot water is required. The GEM controller incorporates a full function immersion heater timer and boost facility for this purpose.

If the water is normally heated using gas or oil the GEM system will work in conjunction with your normal water heating system. On days when there is insufficient energy available from the PV system to fully heat the water your gas or oil system will 'top up' the hot water to the required temperature. Therefore the more energy that is available from the PV system on a given day, the less gas, oil or imported electricity will be needed to provide hot water.

The GEM Control Unit

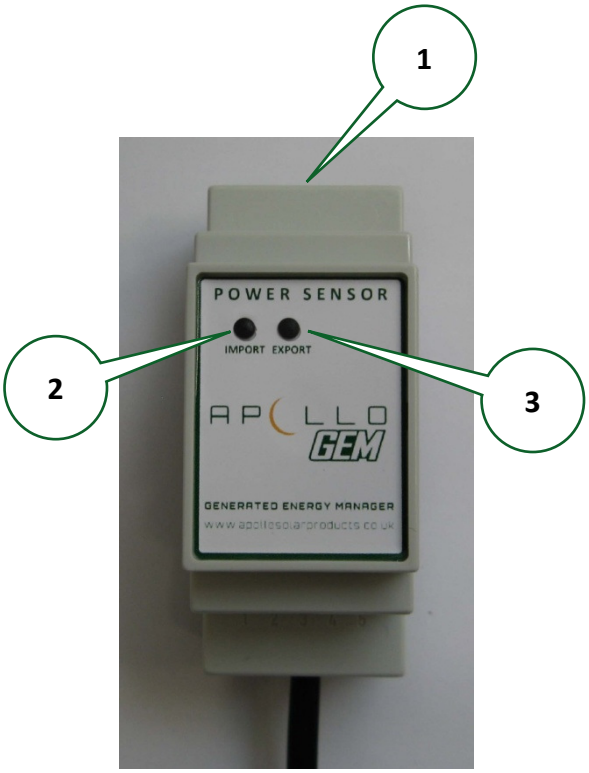
The GEM control unit is usually located near the hot water cylinder and controls the operation of the whole system. The picture below shows the GEM control unit and features.



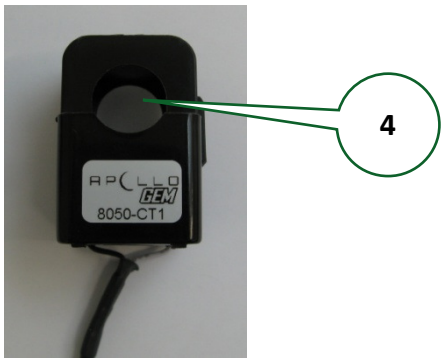
1. Four line status display
2. SET/BOOST Button used to switch on hot water boost or enter set-up mode
3. UP button used to select status display screens or make selections in set-up mode
4. DOWN button used to select status display screens or make selections in set-up mode

The GEM Power Sensor and Transmitter unit

The Gem system senses the import and export power using a clamp-on current sensor unit located near the meter or consumer unit. The current sensor is connected to the GEM transmitter module which sends information about the import and export power levels by a radio link to the GEM control unit. The Current sensor and transmitter unit are shown below.



GEM Sensor Transmitter



GEM Current Sensor

1. Connector for GEM current sensor.
2. Green IMPORT LED — Flashes when power is being imported. Flash speed is proportional to power being imported.
3. Orange EXPORT LED — Flashes when power is being exported. Flash speed is proportional to power being exported.
4. Sensor aperture for meter tail cable.

Once set up, operation is totally automatic and no user intervention is required.

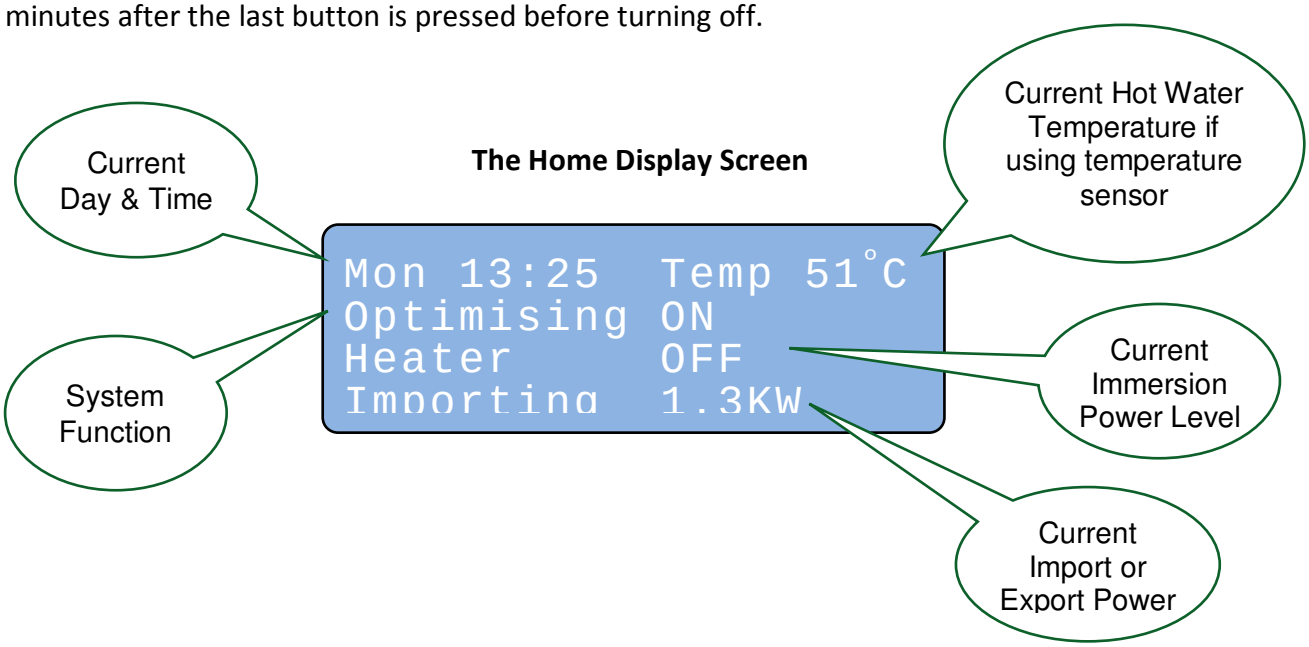
Whenever excess power is available from the PV system Gem will divert it into heating the hot water until the maximum programmed water temperature has been reached.

If insufficient excess power was available from the PV system to fully heat the water the normal hot water system will come on at its pre-programmed time in order to top up the hot water to the required temperature.

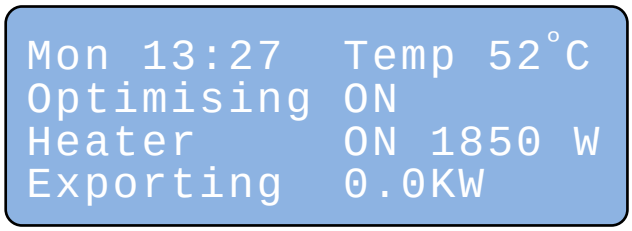
The GEM Display

Gem is provided with a 4 line illuminated LCD display to provide the user with information such as current hot water temperature, export and import power levels etc.

Press any button in order to illuminate the display. The display will stay illuminated for 30 minutes after the last button is pressed before turning off.

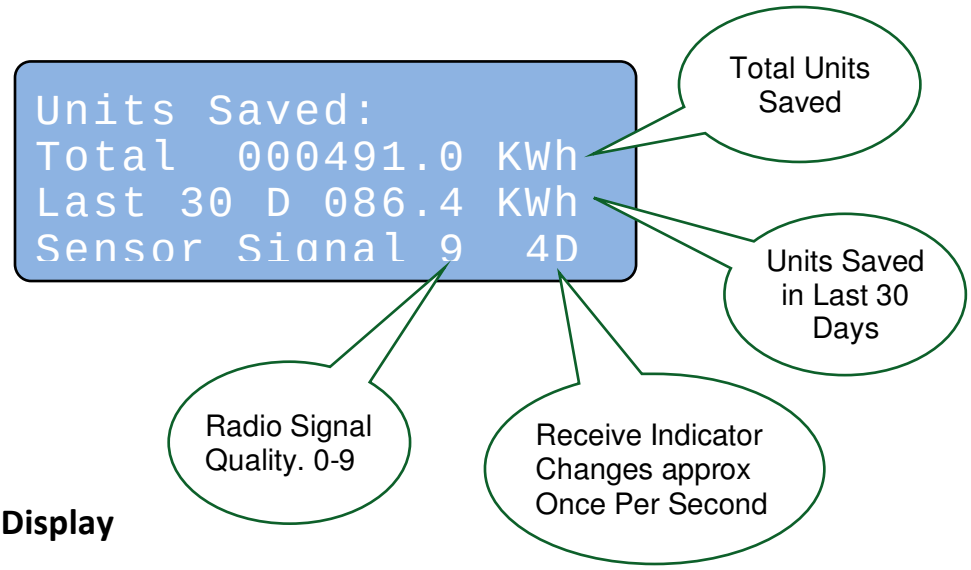


Typical Home Display Screen
Showing diverted export power



The GEM Display

Pressing either the ▲ or ▼ from the main screen will change the display to show the total export units saved and export units saved during the last 30 days.
This display also shows the status of the sensor radio link.



System Function Display

The system function messages are displayed on the 2nd line of the home display. The messages that could be displayed are shown below.

Optimising ON	This is the normal display. Optimising is on and surplus generated energy will automatically be used for water heating.
Optimising OFF	This indicates that the optimising has been turned off by the user in the set-up menu. All surplus generated energy will be exported.
Optimising DISABLED	Optimising has been disabled by the system due to the error displayed on the bottom line of the display
Boost 1 ON 58 mins	Boost mode on output 1 has been activated by pushing the boost button. The remaining boost time is displayed.
Timer 2 ON	Timer mode is enabled and immersion heater 2 is on due to timer on-time programming

Error Message Display

If no errors are detected by the system the bottom line of the display will show the current power being imported to or exported from the property.
If the system detects an error this is displayed on the bottom line of the display instead of the import/export power.

Importing 3.6KW	This is the normal display. No errors are detected and the display shows how much power is being imported to or exported from the property.
[No Sensor Signal]	Communication with the power sensor transmitter has been lost. Check the power sensor is on and is showing a green or orange light. Optimising will be disabled.
[Temp Sensor Fault]	A faulty (or unplugged) temperature sensor has been detected. All water heating functions will be disabled.
[Finding New Sensor]	Pairing with a new sensor has been requested from the set-up menu. Turning the power off then back on again to the GEM transmitter located near the consumer unit should allow normal operation to resume.
[Immersion Fault]	An immersion heater fault has been detected. The heater is not drawing any power. The immersion thermostat might be set too low.

Boost Mode

If it is required to boost the hot water temperature at any time using the immersion heater, this can be done by simply pressing the boost button.

Pressing the boost button will turn on the boost for output 1.
A second press of the boost button within 2 seconds will turn on the boost for output 2.

The system function display will then change to show “Boost 1 ON” or “Boost 2 ON” and the remaining time boost will be active. The first press of the boost button will give a 1 hour boost time. Each subsequent press of the button while boost is on will add 1 hour to the boost time up to a maximum of 4 hours.

A further press of the boost button when boost is already set for 4 hours will turn off boost mode.

Boost mode will automatically turn off when the preset temperature is reached or the boost time reaches zero.

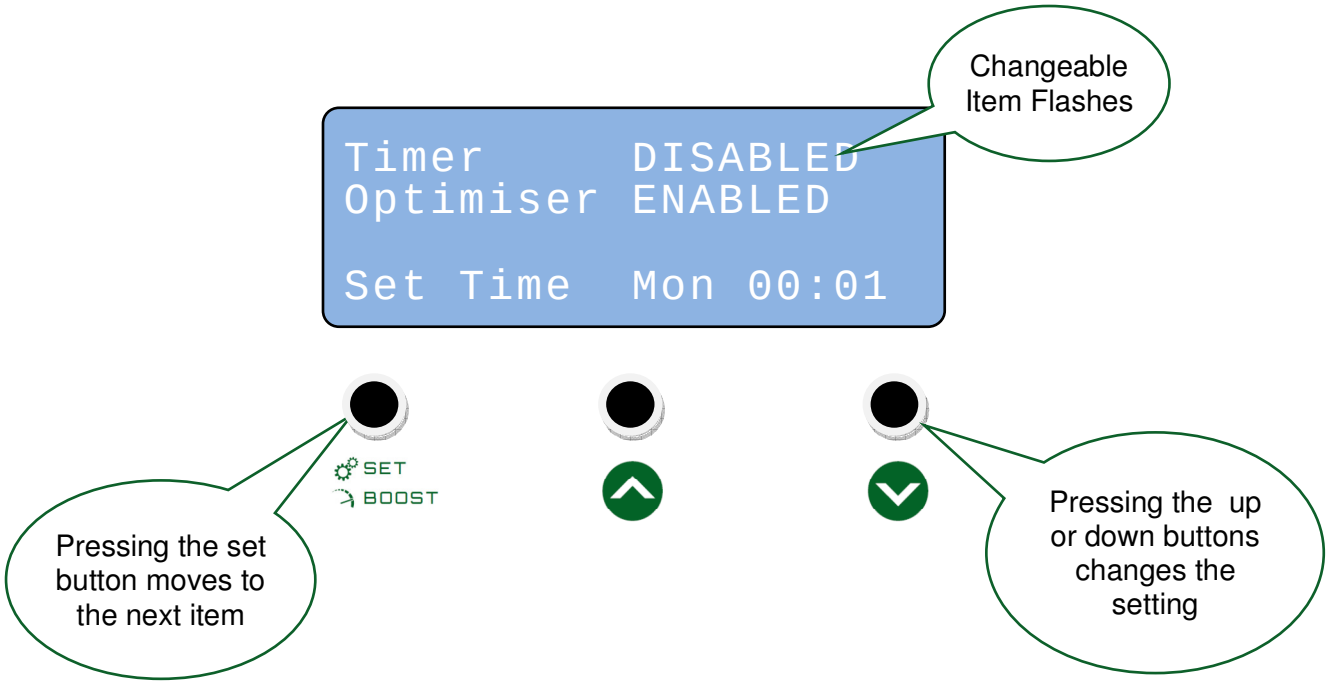
GEM Set-up

Gem set-up mode is used to program various operating parameters such as the time/date, enable or disable the optimiser or timer, program the timer on/off times, enter the required optimiser and timer hot water temperatures etc.

GEM Set-up mode is entered by pressing and holding the set/boost Button SET BOOST for at least 3 seconds.

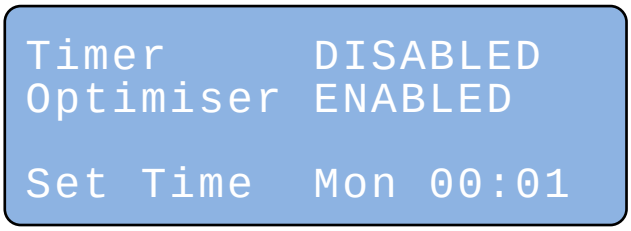
Upon entering set-up mode the first of 5 set-up screens are displayed:

- A setting which can be changed slowly flashes on and off.
- To change the setting press the UP or DOWN arrow keys.
- To move to then next setting press the SET key. SET BOOST
- When the last setting on the screen has been reached pressing the SET key will advance to the next set-up screen
- When the last item on the last set-up screen has been reached the set-up display goes back to the first set-up screen
- Holding the SET key down at any position in a setup screen provides a shortcut jump to the next set-up screen without stepping through each item.
- The changes will be saved and set-up will automatically exit after no keys are pressed for 30 seconds.



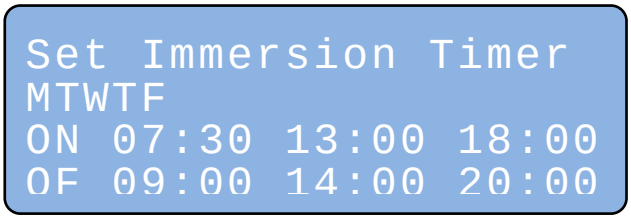
Set-up Screens

All of the GEM set-up screens are shown below.



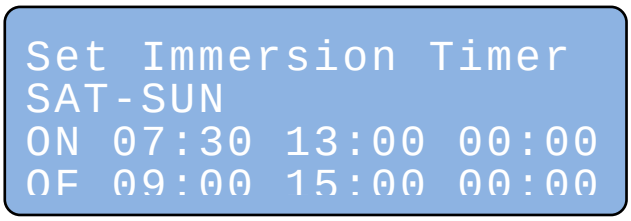
Screen 1. Timer and optimiser enable/disable

The timer and optimiser functions can be independently enabled or disabled.
This screen is also used to set the day and time.



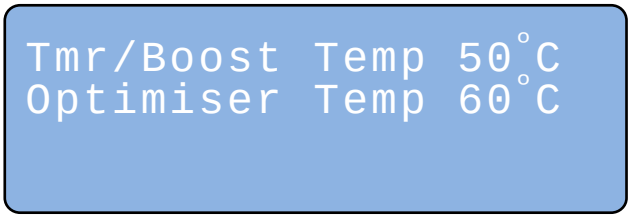
Screen 2. Weekday timer on/off programming

Up to 3 on/off time pairs can be programmed.
On/off pairs do not have to be in time order.
To make a pair unused,
program the start time to 00:00



Screen 3. Weekend timer on/off programming

As for weekday programming

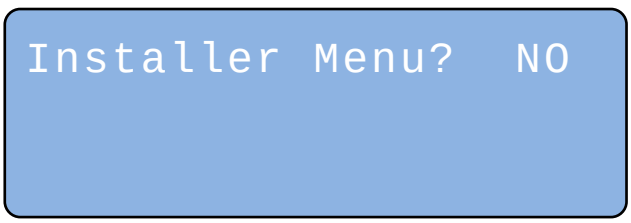


Screen 4. Temperature Settings

Tmr/Boost sets the temperature when in timer or boost mode.
Optimiser sets the temperature when using excess generated energy in optimiser mode.

Screen 5. Legionella Control

Program settings for the legionella control cycle on outputs 1 & 2



Screen 6. System Set-up Functions

These parameters would not normally be changed after system installation.
Refer to the GEM installation manual for more information on these settings.

Setting the Immersion Timer

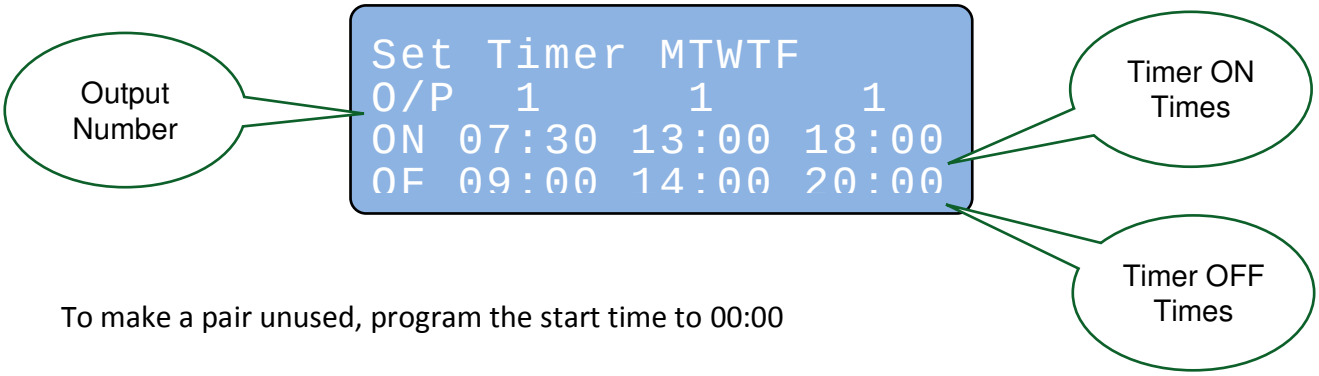
The GEM Immersion timer can be programmed to give 3 on/off times per day for Monday to Friday and 3 different on/off times for Saturday & Sunday.

When the timer is on, the water will be heated at full power regardless of whether any surplus PV power is available. This allows water to be heated during off peak electricity times (e.g. Economy7) or in the early morning before any PV power is generated.

Each timer on time can switch either output 1 or output 2.

The timer on and off times are programmed in set-up mode using set-up screen 2 for Monday to Friday times and screen 3 for Saturday and Sunday times.

The timer programming screen is shown below.



To make a pair unused, program the start time to 00:00

NOTE: It is not possible for output 1 and output 2 to be on at the same time.

The 3 ON/OFF times should not overlap. If overlapping times are programmed the timer will turn on at the first start time and output and remain on until the off time of the second, overlapped time.

Legionella Control Function

What is Legionella?

Legionellosis is the collective name given to the pneumonia-like illness caused by legionella bacteria. Legionnaires' disease is a potentially fatal form of pneumonia and everyone is susceptible to infection. However, some people are at higher risk, including:

- people over 45 years of age
- smokers and heavy drinkers
- people suffering from chronic respiratory or kidney disease
- anyone with an impaired immune system

Where does it come from?

Legionella bacteria are widespread in natural water systems, e.g. rivers and ponds. However, the conditions are rarely right for people to catch the disease from these sources.
However the legionella bacteria can multiply greatly in water storage systems where the temperature remains between 20 and 45°C

How do people get it?

People can catch legionnaires' disease by inhaling small droplets of water, suspended in the air, containing the bacteria such as a shower.

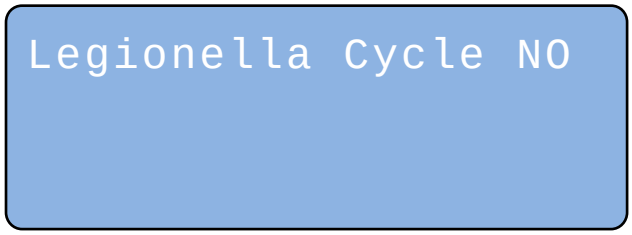
How is it controlled?

Legionella bacteria colonies can be destroyed by raising the temperature of the stored water to 60°C for a minimum of 10 minutes.
For water storage systems that do not regularly operate at 60°C or above it is recommended that a weekly heating cycle to 60°C is carried out. This will ensure that the water system stays free of the bacteria.

The Apollo GEM has a programmable built-in legionella control cycle that can be used to automatically carry out this procedure each week.

There are two programs available, one for each heater output. If only one output is used or both GEM heater outputs are in the same physical cylinder only one of the programs need be used.

Legionella control programming is performed using screen 5 in the setup menu:



Setup screen 5
Legionella Control – default is off

To enable the Legionella Control cycle set “Legionella Cycle” to “YES”
The program settings will now be displayed:

Setup screen 5
Legionella Control Settings

Each output can be programmed separately. The program for output 1 is set on the line labelled “OP1” and output 2 on line “OP2”

Press the setup button briefly to advance to each setting to be adjusted and use the ▲ or ▼ buttons to adjust to the required setting.

To disable a programme if control on only one output is needed, set the time to 00:00

The program will commence at the set starting day and time and will continue to heat the water until the programmed temperature is reached. When the programmed temperature is reached the cycle will terminate and normal PV optimising will resume.

If the GEM tank temperature sensor is not used, the temperature set by the immersion thermostat will be used, therefore this should be set to a minimum of 60°C.

The legionella cycle will always heat at full power until the required temperature is reached. If insufficient excess power is available power will be imported to complete the cycle.

To minimise energy costs is it recommended that the cycle is either programmed to start during off peak tariff times (if you have one) or around midday when PV power is likely to be at its highest.

GEM Output Modes

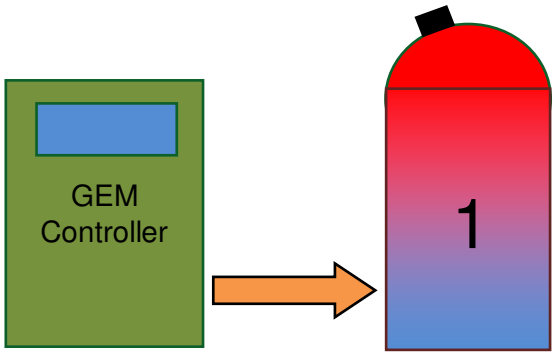
The GEM controller has two separate variable power outputs. Each output is capable of driving a standard 3KW immersion heater element or other resistive heating load up to 3KW.

The GEM outputs can be configured to operate in one of the following modes:

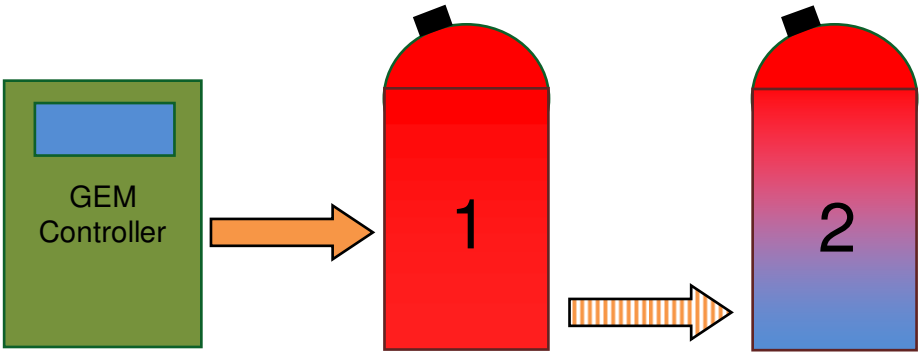
Single Output 1	Only output 1 is active during PV power optimising.
Single Output 2	Only output 2 is active during PV power optimising.
Output 1 then Output 2 (Priority Mode)	Output 1 is used for PV power optimising until the set temperature is reached and then output 2 is used. If the temperature of the heat store connected to output 1 falls below the set temperature, the system reverts to using output 1 for optimising until the set temperature is reached again.
Output 2 then Output 1 (Priority Mode)	Output 2 is used for PV power optimising until the set temperature is reached and then output 1 is used. If the temperature of the heat store connected to output 2 falls below the set temperature, the system reverts to using output 2 for optimizing until the set temperature is reached again.
Output 1 and Output 2 (Power Share Mode)	This mode will share the diverted surplus PV power during PV power optimisation equally between both heat stores connected to outputs 1 and 2. If the set temperature of either heat store is reached then all available surplus PV power is sent to the other heat store.

For larger applications such as swimming pool heating or hot water accumulator tanks the GEM system can also optionally operate together with up to 3 external GEM power modules to give a total output capability of 6, 9 or 12KW.

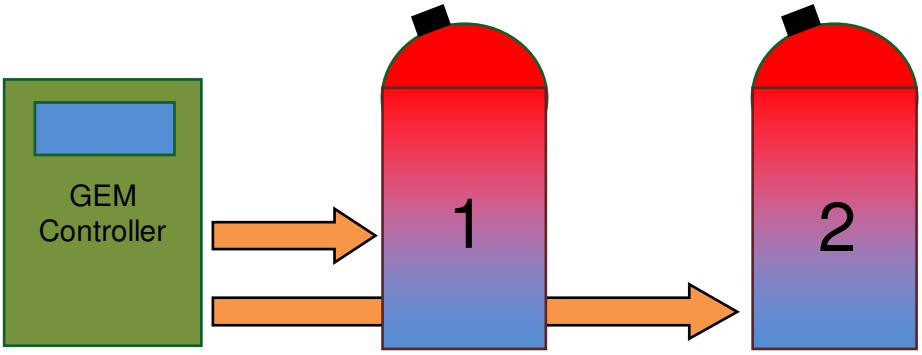
GEM Output Modes



Single Output Modes



2 Output Priority Modes



2 Output Power Share Mode

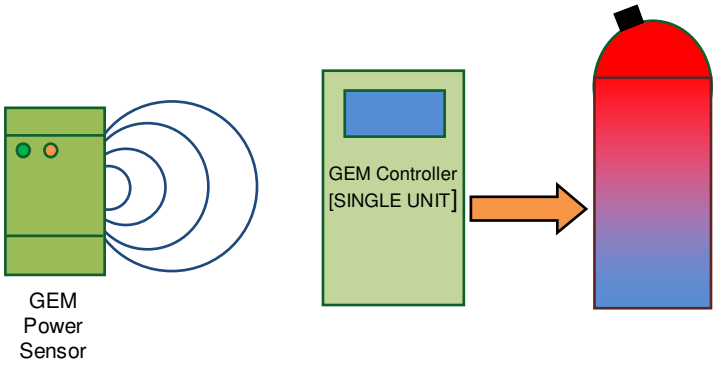
GEM Unit Modes

The GEM controller is connected to the power sensor by a wireless data link.
It is possible to configure the GEM system to use two controllers on the same wireless data network. This will allow two immersion heaters or other heating loads to operate in the PV optimizing system in different parts of a property without any power or signal interconnections between them. Note however that both parts of the property must be fed from the same utility meter.
An example would be a property with a granny annex which has a separate hot water system. In this scenario both hot water systems could take advantage of surplus power available from the PV system.

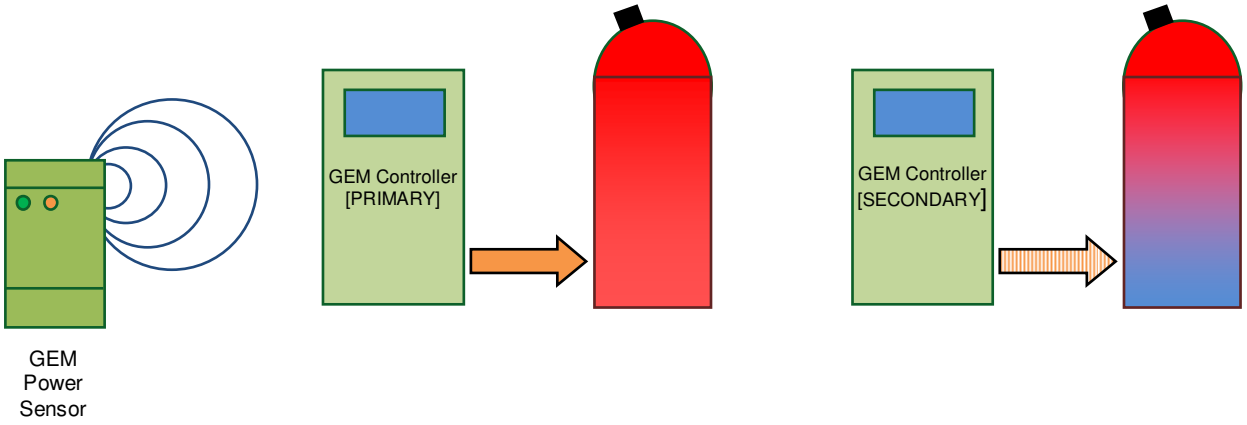
The GEM is configured to operate in one of the following modes:

SINGLE UNIT	Setting for normal single GEM controller system.
PRIMARY UNIT	Sets the controller as the primary unit in a wireless, two controller system. When surplus PV power is available the primary unit will take priority over the secondary unit. Surplus PV power will be available to the secondary unit if the primary load reaches maximum power without consuming all of the available surplus PV power or if the set temperature of the heat store is reached.
SECONDARY UNIT	Sets the controller as the secondary unit in a wireless, two controller system. The secondary unit is able to use surplus PV power when the primary unit is already at maximum power output or no longer requires power due to the primary heat store being up to temperature.
LOAD SHARE	In this mode both GEM controllers in the system will share any available surplus PV power between them. In the event that one of the controllers reaches its maximum output power or the set temperature of the heat store is reached then all further available PV surplus power is diverted to the other unit.

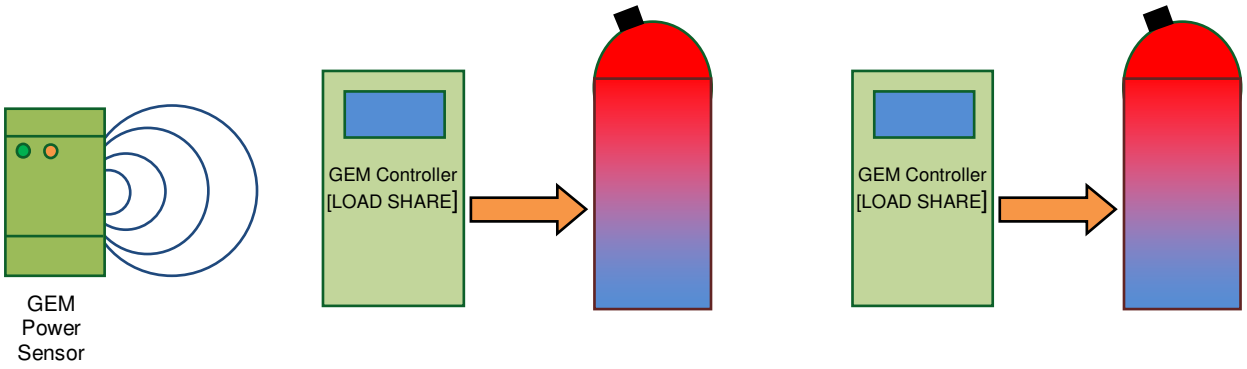
GEM Unit Modes



Single Unit Mode – 1 power sensor and 1 GEM controller



Primary/Secondary Mode – 1 power sensor and 2 GEM controllers. Primary takes priority



Load Share Mode – 1 power sensor and 2 GEM controllers. Both controllers share PV Power

Setting Water Temperatures

GEM can use one of two methods to control the water temperature.

Method 1. Using the immersion heater element thermostat (standard system)

Method 2. Using the optional GEM tank temperature sensor

The desired water temperature control method is selected in the installer menu in set-up screen 5. Set the “Use Temp Sensor?” parameter to “NO” to use method 1 or select “YES” to use method 2.

Using method 2 with the optional tank temperature sensor has a number of advantages over using the normal immersion heater thermostat:

Tank temperature display The home display screen will show a continuous reading of the current hot water temperature.

Better temperature control Water temperature is more accurately controlled than with the immersion thermostat

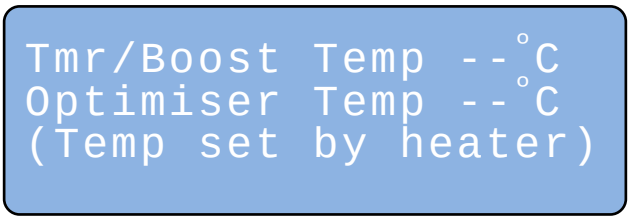
Programmable temperature The hot water temperature can be programmed from the GEM unit.

Multiple temperatures Different temperatures can be set depending on whether the water is being heated by on-site generated energy or imported energy. This enables the cost of timed water heating to be minimised whilst maximising available free energy from the generation system

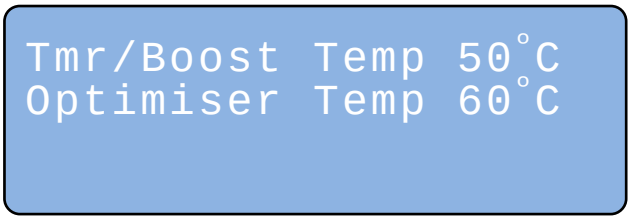
The tank temperatures are set using set-up screen 4.

If method 1 is used for water temperature control, the water temperature is controlled by the immersion heater thermostat and no temperature programming is possible using GEM.

Set-up screen 4 will display the following:



If method 2 is used for water temperature control (optional sensor installed) GEM can be programmed with two water temperature settings.



The Timer/Boost Temp setting sets the required temperature when GEM is heating the water in timer or boost modes. Since operation in these modes will usually be using imported power a lower temperature can be set to minimise the use of imported power.

The Optimiser Temp setting sets the required temperature when GEM is heating the water with "free" surplus PV power. The make the most of surplus optimised power a higher temperature can be set for this mode.

Note that to reduce the risk of scalding hot water temperature should not be set higher than 65°C.

If the hot water feed from the tank is fitted with a blending valve, a valve that mixes cold water with the hot water from the cylinder to limit the hot water output to a preset (safe) temperature, then higher tank temperatures than 65°C could be used. The advantage of a higher tank temperature is that this will enable more energy to be stored in the tank.

Note: If the GEM temperature sensor is being used to control the water temperature the immersion heater thermostat should be adjusted up to its maximum in order to prevent the immersion thermostat interfering with the GEM sensor temperature control.

Some standard immersion thermostats can only be adjusted up to a maximum of 60 or 65°C and therefore a higher temperature thermostat may need to be fitted.

Using GEM with Other Hot Water Heating Systems

GEM will work well with the existing gas or oil heating system. The more energy GEM is able to deliver to the hot water system, the less energy will be needed by the normal hot water system. On summer days it is possible that no energy will be used at all by the normal heating system.

In order to give priority to the GEM system but to ensure that sufficient hot water is always available it is recommended that the thermostat for the normal hot water system is set below that of the GEM system but high enough to give an acceptable hot water temperature.
e.g. if the GEM optimiser temperature is set for (say) 60^{o}C, set the normal water heating system thermostat for (say) 50^{o}C.

In this way if the water has been fully heated by GEM the normal water heating will be “Held off” and if there was insufficient surplus energy available to heat the water to the normal water temperature the normal hot water system will come on and “top up” to the required temperature.

Notes