EMMA

OPERATING INSTRUCTIONS

THE ENERGY & MICROGENERATOR MANAGER, V2.1 & 3G

1. SAFETY

All installation and maintenance work must be carried out by a properly trained and qualified electrician. It is important to ensure that the installation complies with local wiring regulations. The mains power supply must be disconnected before the cover is removed. If this unit is used in a way that doesn't comply with this manual its safety features may be impaired.

The base plate and cover of the unit are electrically connected to a green and yellow connector block inside the unit. This connector block must be connected to the household earth at all times.

2. GENERAL INFORMATION

HOW EMMA WORKS

EMMA controllers are designed for use with grid-connected micro-generators and resistive heating elements such as immersion heaters, storage heaters and electric underfloor heating.

EMMA SP15, SP40; EMMA 3G CASCADE SERIES (SINGLE PHASE)

EMMA TP45, TP120; EMMA 3G TP45, TP45 GAIA (THREE PHASE)

The standard **EMMA (Energy and Micro-generator Manager)** is designed for use with single-phase or three-phase grid-connected micro- (or larger) renewable energy generators that produce peak outputs of 3kW upwards, in conjunction with resistive heating elements (immersion heaters, storage heaters, electric underfloor heating etc.) that draw 1kW upwards (see **Selecting the Right Size** - available on www.coolpowerproducts.com).

EMMA balances household demand with real-time generator output - saving you money and reducing your carbon footprint.

HEATING YOUR HOT WATER INTELLIGENTLY

EMMA incorporates a timer that ensures that any electricity required to heat hot water is drawn from the grid only during one or two user-defined periods a day. A boost button is also supplied. This provides the user with a facility to add an extra once-off user defined period at any time, at the press of a button.

An optional clamp-on thermostat or probe/surface temperature sensor can be supplied with EMMA. This is easily fitted to the hot water cylinder and enables EMMA to minimize the electricity you need for hot water by only heating the water up to the required user-defined minimum required temperature (usually 55°C) during the above periods. Without this, the temperature reached by the water during the above periods is determined by the standard immersion heater thermostat which may heat the water excessively to your needs, therefore consuming more electricity than necessary.

For more information see the **Installation Manual**.

We have approved suppliers and installers of EMMA throughout Ireland, the UK and Europe. Call us or see our website for details.

EMMA can also ensure that if you do export electricity, it is done when feed-in tariffs are highest , and when you import electricity from the grid it is done when charges are lowest. Again, saving you money.

EMMA GVS (GRID VOLTAGE STABILISATION)

EMMA GVS (Grid Voltage Stabilisation) functions in the same way as standard **EMMA** but has the added ability to ensure that the amount of power you export to the grid at any one time is restricted to that permitted by your Electricity Network Operator.

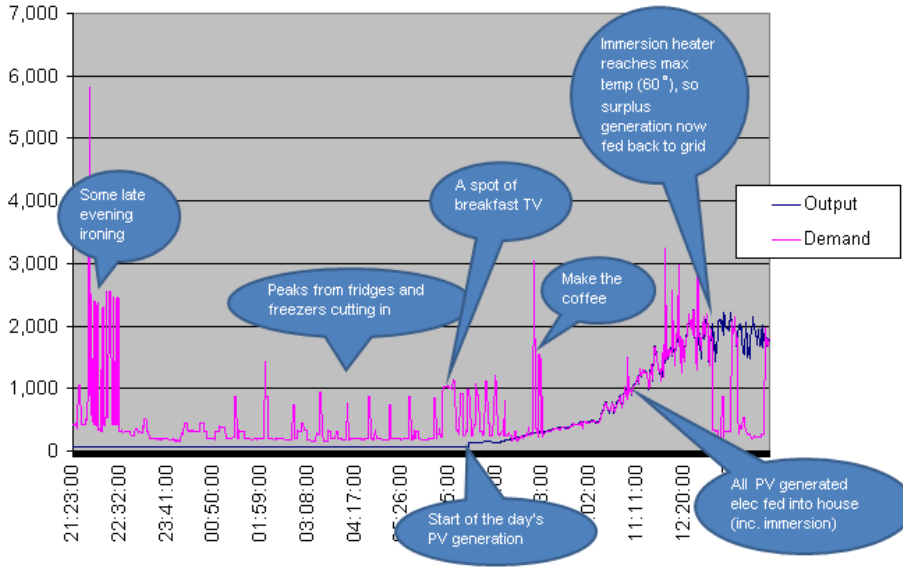


Figure 1: EMMA maintaining balance between PV output and household load (Annotations added by satisfied customer)

3. OPERATION

Standard EMMA and EMMA GVS are operated in the same way as far as the user is concerned. It is normal for the EMMA unit to emit a slight buzz when it is operating.

OPERATION OF EMMA

EMMA is a fully automatic system that starts up and runs automatically once installed. The standard, or default, display shows the following information:

Figure 2: Default Display

Output(W) – this is the total output from the generator in watts

Demand(W) – this is the total demand within the building in watts

Heater(%) – this is the percentage of output from the heating elements. If the element is a 3kW element and the percentage says 50% then 1.5kW of power is being output by the heating element. If its 100% then 3kW are being output from the element. As the size of the element can vary EMMA displays a percentage rather than an exact power output on the screen. A 3kW immersion will work fine if only 2kW is being sent to it, the water will just heat a little slower.

HW Temp – this is the temperature in Celsius of the hot water in the storage tank

The displayed figures are updated every 5 seconds.

SET-UP MENUS

When the **green** button is pressed while the default display (see above) is showing, the display shows the following information:

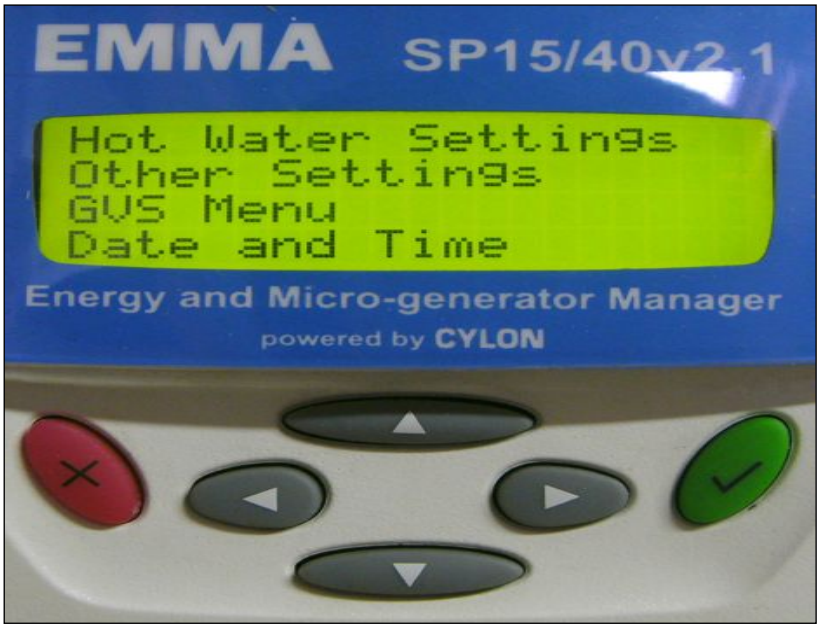


Figure 3: Main Menu

Hot Water Settings

Other Settings

GVS Menu (on GVS models only)

Date and Time

The **H** of **Hot Water Settings** is flashing – indicating that the **Hot Water Settings** option will be selected if the **green** button is pressed. The display reverts to the default display (Figure 2) if the **red** button is pressed.

If the **green** button is pressed with the **H** of **Hot Water Settings** flashing, the display shows the **Hot Water Settings** sub-menu (Figure 4).

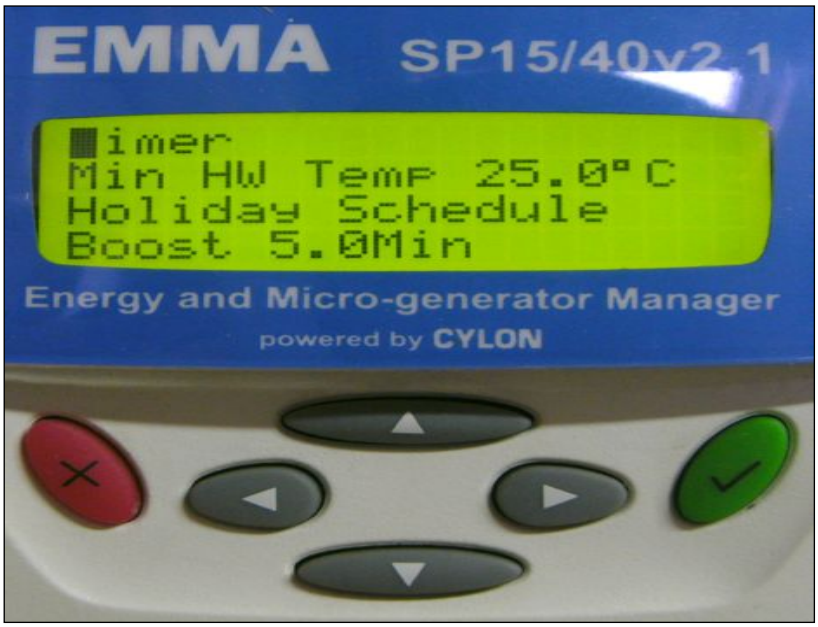


Figure 4: Hot Water Settings

Timer

Min HW Temp

Holiday Schedule

Boost

HOT WATER TIMER

The **T** of **Timer** is flashing – indicating that the **Timer** option will be selected if the **green** button is pressed. The display reverts to **Hot Water Settings** and **Other Settings** (see above) if the **red** button is pressed.

If the **green** button is pressed the display shows the following information.

SETTING THE HOT WATER TIMING

M T W T F S S

06:00 07:00

17:00 18:00

This is the setting the unit is shipped with. This means that the electric immersion heater controlled by the EMMA unit will be set to 100% from 06:00 hrs to 07:00 hrs and from 17:00 hrs to 18:00 hrs every day of the week.

These periods can be altered by using the **<** and **>** arrows to "move" sideways and the **^** and **V** arrows to change the times. The changed times are accepted and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) when the **green** button is pressed. The timer reverts to the old timer settings and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) if the **red** button is pressed.

YOU CAN PROGRAMME EMMA NOT TO DRAW GRID ELECTRICITY FOR THE HOT WATER.

This is done by setting the EMMA timing periods for hot water to be equal i.e. running, for instance, from 7am to 7am and 6pm to 6pm. That way no grid electricity is drawn. Any target temperature setting on EMMA for these periods is also then ignored. Instead, when surplus electricity is available it will be fed into the immersion as usual. If lots of surplus electricity is available the immersion will keep heating until the point at which the immersion thermostat cuts out at its default temperature. Then any further surplus will be fed into the grid. However, when no surplus electricity is available no electricity is sent to the immersion and none is drawn from the grid.

Whenever you need to, you can re-programme EMMA by changing the timing periods to be for example from 7am to 8am and 6pm to 7pm with a target hot water temperature. EMMA will then again use both surplus electricity and grid electricity to heat the water to the target temperature for those set periods.

SETTING THE MINIMUM HOT WATER TEMPERATURE

The **M** of **Min HW Temp** is flashing – indicating that the **Min HW Temp** option will be selected if the **green** button is pressed. The display reverts to **Hot Water Settings** and **Other Settings** (see above) if the **red** button is pressed. If the **green** button is pressed the display shows the following information.

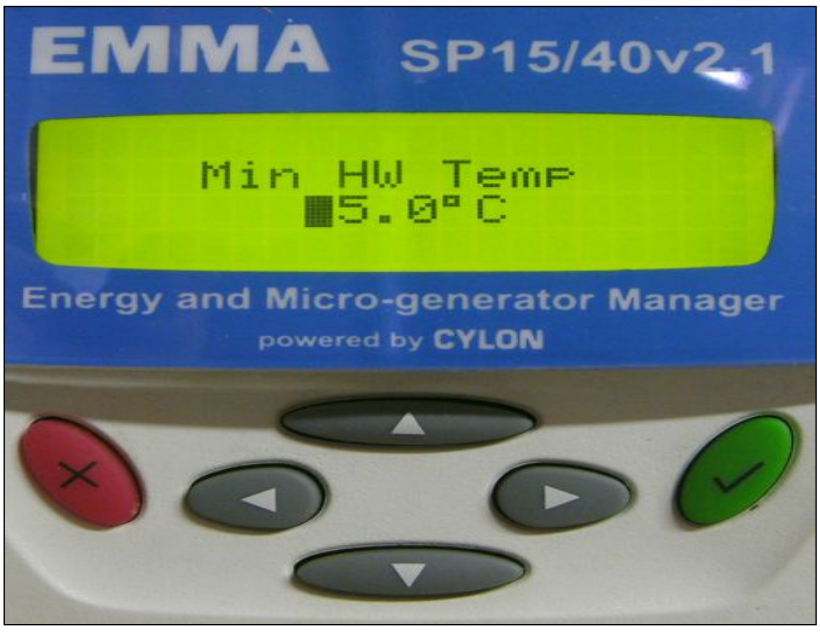


Figure 5: Min HW Temp

MIN HW TEMP

The temperature setting of 55 degrees is a minimum required temperature. EMMA will draw in power from the grid to bring the temperature up to 55 degrees during the scheduled period only if the temperature is less than 55 degrees.

The maximum temperature is governed by the thermostat in the immersion heater itself. EMMA will keep sending surplus power to the immersion heater until the thermostat opens.... usually at about 65 degrees. This enables EMMA to "supercharge" the tank when there is surplus power available.

When the tank reaches the maximum temperature the thermostat opens and EMMA can no longer send power to the immersion heater. When this happens surplus power will be exported to the grid. This will stop when the thermostat closes.

The temperature dropping is almost certainly a result of turbulence drawing cooler water up to the top of the cylinder when the immersion heater starts up. This happens in all hot water cylinders... but most people don't notice it happening.

This setting is used when a probe or plate temperature sensor is fitted. The EMMA unit is supplied with this set at 55°C. This option enables the user to alter this setting by moving the flashing cursor to the **M** of **Min HW Temp** using the ^ and V arrows and then pressing the green button. The desired temperature can then be increased or reduced using the ^ and V arrows.

The changed setting is accepted and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) when the **green** button is pressed.

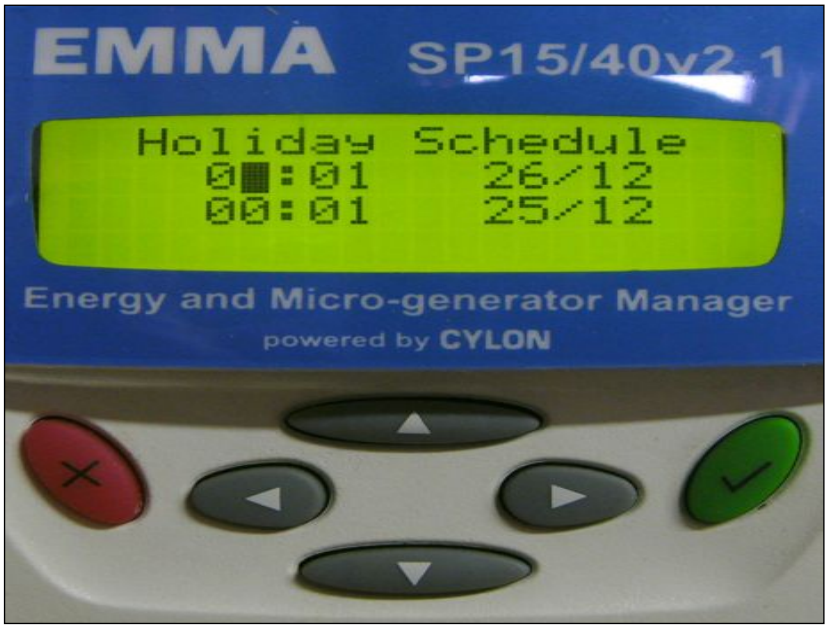
The setting reverts to the previous setting and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) if the **red** button is pressed.

HOLIDAY SCHEDULE

The **Holiday Schedule** option is used to identify a period when hot water is not required. This can be accessed by moving the flashing cursor to the **H** of **Holiday Schedule** using the **^** and **V** arrows and then pressing the green button. The start and end of the period can then be defined using the **>**, **<**, **^** and **V** arrows.

The changed **Holiday Schedule** is accepted and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) when the **green** button is pressed. No power will be supplied to the immersion heater during this period.

The **Holiday Schedule** reverts to the previous setting and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) if the **red** button is pressed.



BOOST

This option is used to adjust the one-off boost period. The EMMA unit is supplied with this set at 60 minutes. This can be changed by moving the flashing cursor to the **B** of **Boost** using the **^** and **V** arrows and then pressing the **green** button. The desired boost period can be increased or reduced in 5 minute increments using the **^** and **V** arrows (Figure 6). The permitted range is from 5 minutes to 120 minutes.

The changed period is accepted and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) when the **green** button is pressed.

The setting reverts to the previous setting and the display reverts to the **Hot Water Settings** sub-menu (Figure 4) if the **red** button is pressed.

Figure 6: Boost Period

OTHER SETTINGS

The **Other Settings** option is password protected. This is only available to trained installers. If the settings option is selected by mistake the display will show the following information;

Enter Password

>

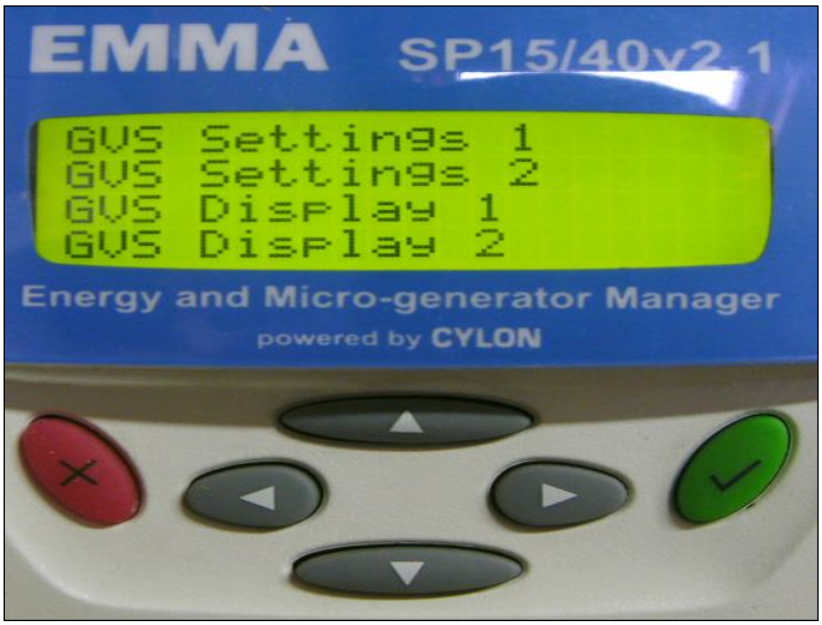
If this happens the **red** button should be pressed to go back to the **Hot Water Settings** and **Other Settings** display.

GVS MENU (GVS MODELS ONLY)

This option opens up the GVS menu from the main menu.

The **G** of **GVS Menu** is flashing – indicating that the **GVS Menu** option will be selected if the **green** button is pressed. The display reverts to the default display (see above) if the **red** button is pressed.

If the **green** button is pressed with the **G** of **GVS Menu** flashing, the display shows the following **GVS Menu** sub-menu:



GVS Settings 1

GVS Settings 2

GVS Display 1

GVS Display 2

The EMMA GVS Unit is supplied with specific GVS Settings that are password protected and GVS Display screens that are not password protected. **The GVS Settings options can only be accessed by a Cool Power Products Engineer.**

The GVS Display 1 option can be viewed by moving the flashing cursor to the **G** of **GVS Display 1** using the **^** and **V** arrows and then pressing the **green** button.

GVS DISPLAY 1

Figure 7: Store/Dump Relay

Supply(V)

MaxExp(A)

Exp(A)

The GVS Display 1 screen displays information related to the GVS.

Store/Dump Relay On indicates that the GVS is storing all excess power when On is displayed.

Store/Dump Relay Off indicates that the GVS is exporting only the DNO permitted amount when Off is displayed. The rest of the power is being sent to an alternative heating load in this scenario as the primary load has reached its desired temperature.

Supply(V) - indicates the supply voltage at that instance.

Max Exp(A) - indicates the maximum current that can be exported which is related to the DNO permitted export.

Exp(A) - indicates what you are currently exporting.

The menu reverts to the previous menu and the display reverts to the GVS Menu sub-menu (see above) if the **red** button is pressed.

GVS DISPLAY 2

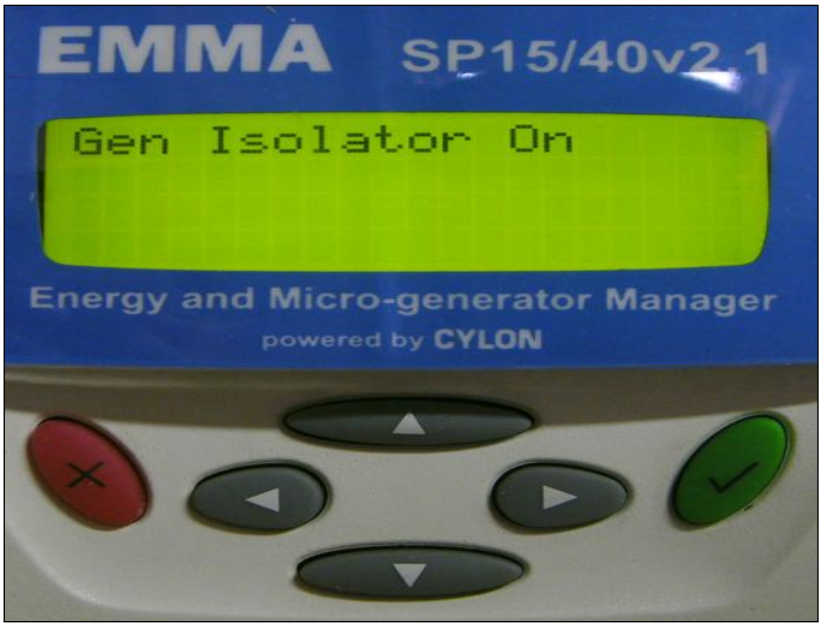


Figure 8: Gen Isolator

Gen Isolator On - indicates that the Generator Isolator is engaged and the generator is connected to the grid.

Gen Isolator Off - indicates that the Generator Isolator is disengaged and the generator is disconnected from the grid.

SETTING THE CURRENT TIME

EMMA has a very accurate on-board real time clock that is set during the pre-dispatch production line checks. It also has a back-up battery that keeps the clock running (and everything else ticking over) in the event of a power failure. The battery has a long life - well in excess of 15 years.

The clock is set to current local time when it is set up initially. It doesn't adjust for summer and winter daylight saving time so needs to be adjusted manually if/when this occurs. This can be done by pressing the green button to view the sub-menu options and then using the down arrow to step down to date and time option and pressing the green button again. You can then adjust the date and time as you like. The EMMA time will need to be adjusted manually to summer savings time.

The clock can be reset by pressing the green button and then scrolling down to date and time and then pressing the green button again. Press the green button when you have finished.

UPGRADING EMMA TO DELIVER SPACE HEATING AS WELL AS HOT WATER

The Heater figure indicates the percentage of total immersion heater load in real time:

- It should be 0% when the household load is greater than the PV output... and anything from 0 to 100% when the PV output is greater than the household load.
- It will be 100% during the time schedules when the temperature is below the desired temperature.
- This figure is not precisely linear but is a good indication of the % of the total immersion heater output being delivered.
- We would need to know the precise characteristics of your immersion heater to calculate the exact %.

We recommend that users become familiar with how EMMA controls their immersion heater before considering an upgrade to a larger EMMA to cope with storage heaters or other devices. If you find that you still have surplus electricity even after your hot water needs are met, then it might be appropriate to upgrade your system to enable it to send power to the storage heaters.

SOFTWARE VERSION

The EMMA software version is now seen by pressing the green button to view the sub-menu options and then stepping down to other settings and pressing the green button again and then entering the password... the version number is then displayed in the bottom line on the other settings screen.

MINMG SETTING

The default MinMG setting is 3, which is equivalent to 70 Watts. This works well with small Fronius inverters. This means that if EMMA detects a current flowing in the micro-generator cable that is less than the equivalent of 70 Watts it assumes that the PV array isn't generating any power and even if the household load is 0 Watts it doesn't try to divert any power to the immersion heater.

If the current flowing to your inverter at night is more than the equivalent of 70 Watts, say 150 Watts for example, EMMA will assume that the PV array is generating 150 Watts and will divert what it thinks is surplus power to the immersion heater whenever the household load drops below 150 Watts.

This would result in up to 150 Watts being delivered to the cylinder throughout the night which is not desireable.

This can be corrected by changing the MinMG setting to 7.2. ((150 divided by 23) + 10%).

PF OFFSET

The PF Offset is the margin between the household demand and the micro-generator output. The higher the PF Offset the larger this margin is, and vice-versa. This margin is intended to hold the household load slightly below the PV output to prevent power being imported. The default setting is 3 which is equivalent to 80 Watts. This isn't significant during the summer when it represents only a small percentage of the PV output. It is more significant in winter.

PF Offset is set during installation. You should not need to change it, but, if necessary, the procedure for adjusting the PF Offset is as follows:

1. Press the **green** button to get the list of sub-menus.
2. Press the down arrow once to select the **Other Settings** sub menu.
3. Press the **green** button to activate the **Other Settings** sub-menu.
4. Press the up arrow six times (the password) and then the **green** button.
5. Press the down arrow once to select the **Set Points** menu.
6. Press the **green** button to activate the **Set Points** menu.
7. Press the down arrow to select the **PF Offset**.
8. Press the **green** button to enable you to adjust the **PF Offset**.
9. Adjust the **PF Offset** using the up and down arrows.
10. Press the **green** button to accept the new **PF Offset**.
11. Press the **red** button twice to get back to where you started

USEFUL DATA DISPLAYED BY EMMA

The "Meters" display is the best way to obtain useful data from the EMMA controller. This shows cumulative output, demand, import and export. If you read this regularly and enter the readings into a spreadsheet you will build up a picture of how EMMA is managing your micro-generator's output and household load. For example, see Figure 9, below.

The figures that EMMA logs are estimates based on measured current and a standard default voltage of 230. The standard EMMA units don't have built in voltmeters. The relationship between these figures is precise but their absolute values may be slightly adrift because of variations in mains voltage.

Our Engineers use the ethernet connection to access the EMMA software and to download data from the on-board dataloggers for developmental and diagnostic purposes. This is how we produce the graphs you may have seen on our website, or such as the one below.

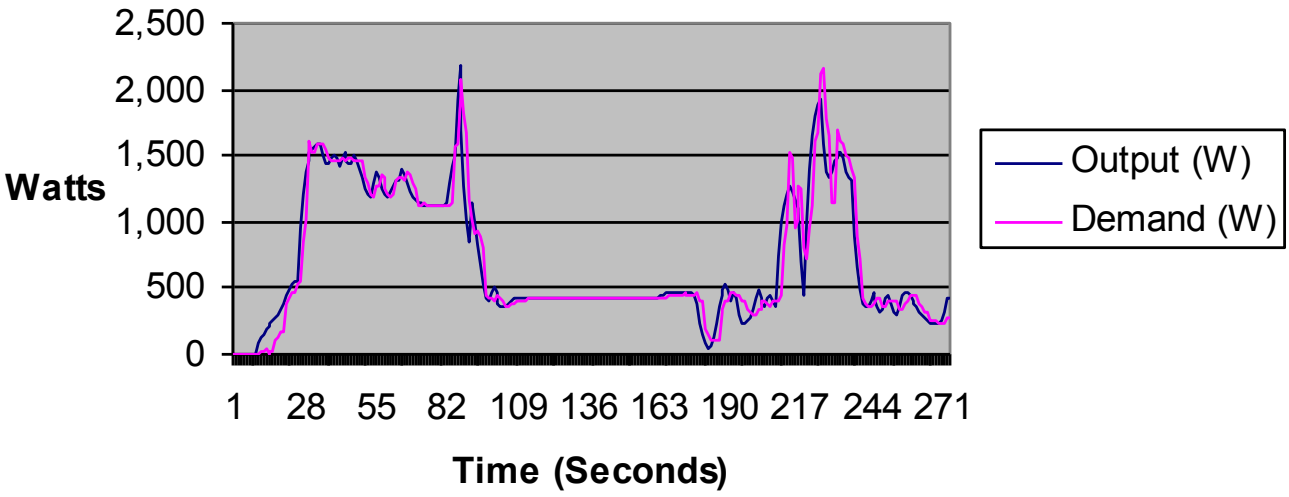


Figure 9: Sample SP15 v2.1 Data

Figure 9: Sample SP15 v2.1 Data, shows household demand being held in balance with generator output. The EMMA unit was controlling power to a 2.7 kW immersion heater. Generator output was simulated for this test. The results are summarized below.

Sampling interval	1 Second
Duration of test	5 Minutes 55 Seconds (355 measurements)
Average generator output	550 W
Average household load	553 W
Total generator output	54.40 Wh
Total household consumption	54.66 Wh
Balance (Load/Output)	100.47%

4. SUPPLY, CERTIFICATION & GUARANTEE

All EMMA units conform fully with the Directives and Standards required for CE certification, as listed below. They are supplied CE marked and with a comprehensive back to base warranty for 12 months from date of delivery.

European Directives: 2004/108/EC Electromagnetic Compatibility Directive 2006/95/EC Low Voltage Directive

Applicable standards: EN 55022: 2006 + A1: 2007 EN 55024: 2002 + A2: 2003

EN 60730-1:2000 + A1:2004 + A12:2003 + A13:2004 + A14:2005 + A16:2007 + A2:2008

EN 61000-3-12 + EN 61000-3-2

Fuses: These units contain internal fuse protection on the output to the immersion. The fuses used are:

SP15 and TP45: Ferraz Shawmut FR10GB69V20; 690 V AC GRC 20 A

SP40 and TP120: Ferraz Shawmut FR14GC69V50; 690 V AC GRC 50 A

All units must be used in conjunction with components compliant with UK Distribution Code BS 7671 and Electricity Safety Quality and Continuity Regulation requirements.

Stainless steel housing is standard on all EMMA units.

The hot water timer allows for two heating periods per day. Hot water boost is on demand.

Standard EMMA units are supplied with current transducers, one NTC 10K temperature sensor and one boost button.

EMMA GVS units are supplied with current transducers, one NTC 10K temperature sensor, one boost button and an AV voltage transducer. EMMA GVS technology was developed in collaboration with United Utilities Plc., with reference to the standards contained in EN 50160.

PATENTED/PATENTS PENDING

All rights to the design of this device are protected under Irish Short Term Patents Nos S85091 and S85092, US Patent Applications Nos 12/596,078 and 12/596,048 and European Patent Applications Nos. 08736348.7 and 08759379.4.

5. CONTACT DETAILS

Further information is available by calling your local supplier or from www.coolpowerproducts.com

FOCUS YOUR ENERGY. INTELLIGENTLY.

EMAIL: INFO@COOLPOWER.IE

TELEPHONE: + 353 1 2108344

WEB: WWW.COOLPOWERPRODUCTS.COM

coolpower Products
smart sustainable energy

Country of origin: Republic of Ireland. Cool Power Products Ltd registered no. 450079. Registered office: 89 Booterstown Avenue, Blackrock, Co. Dublin, Ireland. The company reserves the right to make any variation in technical specification to the equipment described or to withdraw or replace products without prior notification or public announcement. Cool Power Products Ltd is continuously improving its products. All descriptions, illustrations, drawings or specifications in this publication present only general particulars and shall not form part of any contract. Operating Instructions v4 Nov '11.