

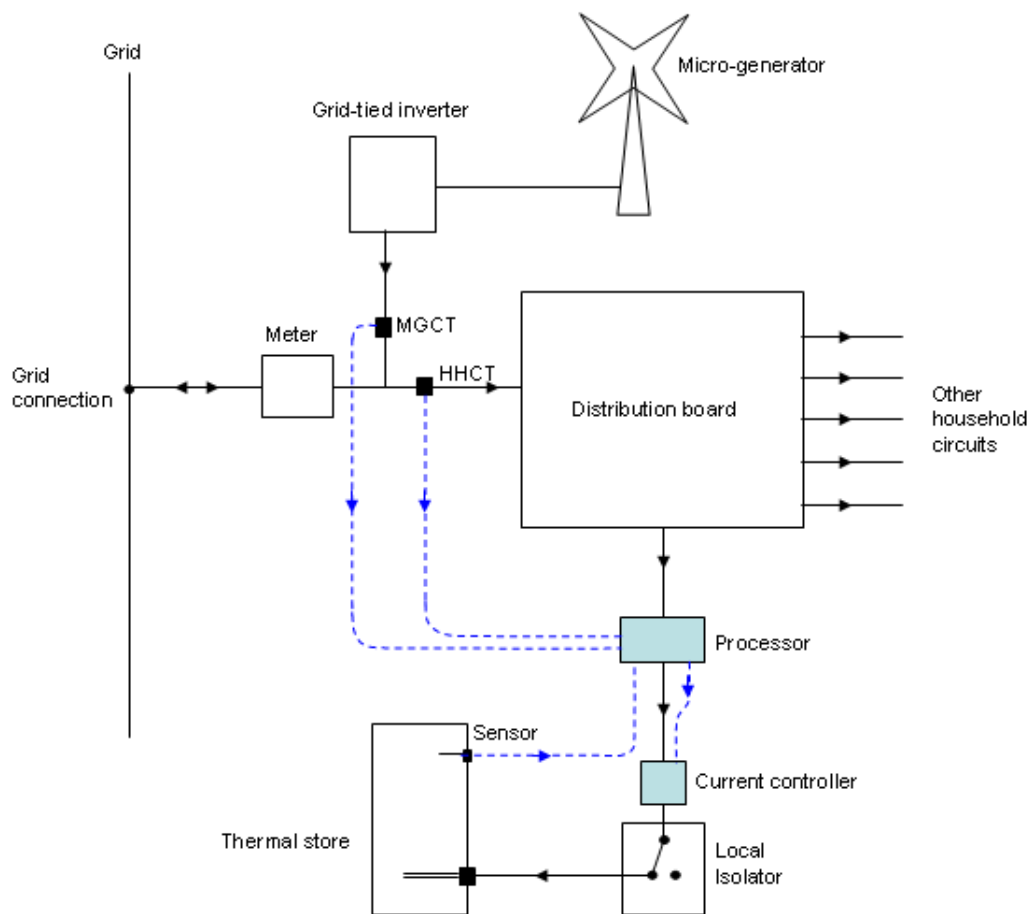
EMMA GVS ::: TECHNICAL SUMMARY V05

ENERGY AND MICRO-GENERATOR MANAGER — GRID VOLTAGE STABILISATION

MUCH SMARTER THAN SMART METERS

The new EMMA GVS increases the rate of return on your micro-generator AND is able to limit export to the grid where required by the Grid Operator.

BASIC EMMA DESIGN

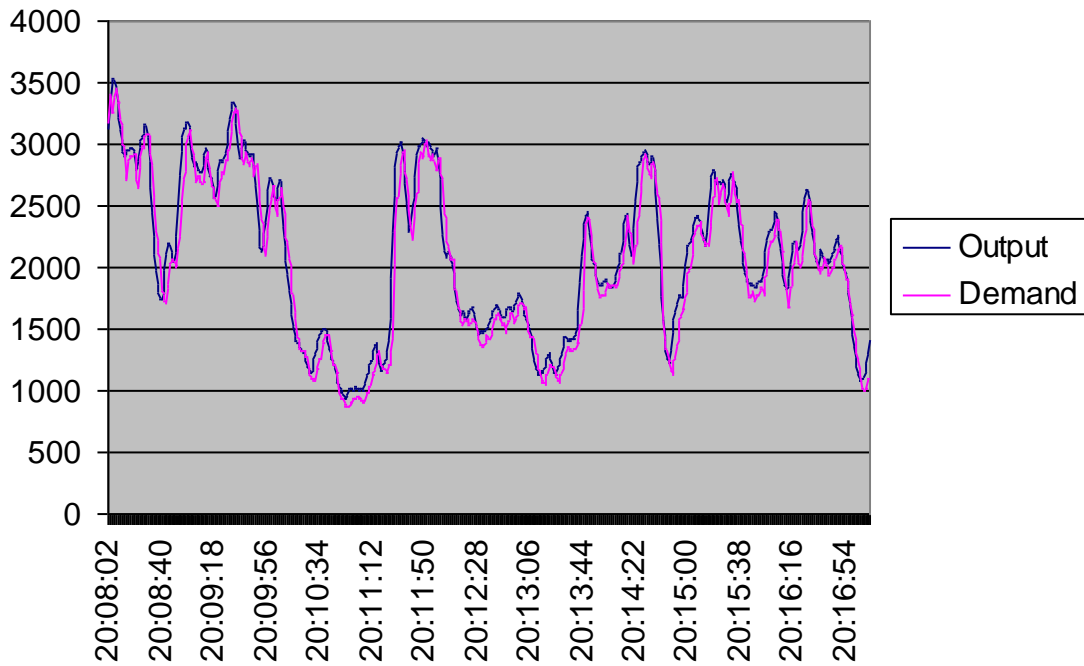


PERFORMANCE OF BASIC EMMA UNIT

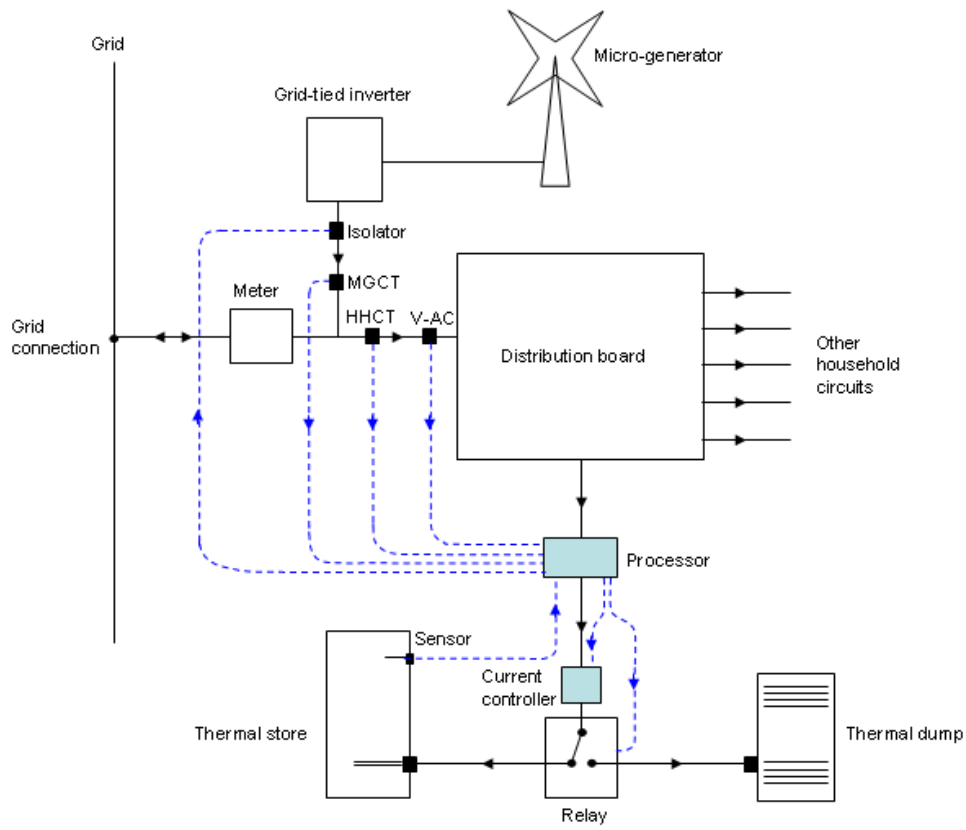
The basic EMMA unit controls enough power consuming plant and equipment in a household to enable it to adjust the total household load with reference to the micro-generator output and to thereby exercise precise real-time control over the amount of power imported from and exported to the grid.

The example below shows the ability of the basic EMMA unit to keep total household load precisely equal to micro-generator output; and in doing so to keep the amount of power imported and exported close to zero. This data was collected from a site near Schull in Co Cork where a 6 kW wind turbine is being used to generate heat and power for a medium sized house. It shows the highly variable output from the wind turbine and EMMA's ability to keep the total household load tracking the turbine output with remarkable precision.

The data shows the slight lag between turbine output and household load (c.1 second) and the offset built into the control strategy (c.75 W) to ensure that demand doesn't exceed output because of this slight lag.



PROPOSED EXPORT CONTROL EMMA GVS DESIGN



PERFORMANCE OF EMMA GVS UNIT

The Export Control EMMA GVS unit has the ability to ensure that the amount of power exported to the grid is restricted to that permitted by the Network Operator. The limit set by the Network Operator can be either a fixed maximum export current or capacity or an export current or capacity that varies depending on supply voltage. A thermal dump load is included in the system to ensure that there is capacity to divert sufficient current or power at all times. This unit also has the ability to isolate the micro-generator in the event of export current or power exceeding the specified limit because of a component (Thermal Dump, for example) failure.

TECHNICAL DESCRIPTION OF EMMA GVS CONTROL FUNCTION

1. KEY ASSUMPTIONS

EMMA GVS technology is being used to manage export current from sites with RE micro-generators.

It is not being used for fault and safety related protection and control. This remains the function of the EN 50438 (G59/G83) compliant inverter which is not directly affected by the use of EMMA GVS technology. EMMA GVS technology prevents micro-generators from contributing to voltage control difficulties on the grid and should, therefore, reduce the frequency of EN 50438 (G59/G83) related isolation events.

EMMA GVS technology uses precisely measured grid-voltage together with a site-specific curve or table of set points to calculate the level of safe/permitted export current or power in real time. EMMA GVS technology manages household load with reference to the micro-generator output in real time to ensure that export current or power does not exceed these safe/permitted levels at any time.

EMMA GVS technology was developed in collaboration with United Utilities Plc., with reference to the standards contained in EN 50160.

2. MEASURING DEVICES

The single phase EMMA GVS uses two AC Current Transducers and one AC Voltage Transducer to monitor import and export current and supply voltage. Three phase EMMA GVS units use six current transducers and three voltage transducers.

LEM current transducers type AT-B10 are used to generate a 0-10 DC voltage output proportional to the RMS current being monitored.

Electrical data			
Primary nominal current rms	Output voltage	Type	
I_{PN} (A.t.Rms)	V_{OUT} (V DC)		
5	0-10	AT 5 B10	
10	0-10	AT 10 B10	
20	0-10	AT 20 B10	
50	0-10	AT 50 B10	
100	0-10	AT 100 B10	
150	0-10	AT 150 B10	
R_L	Load resistance	≥ 2	M Ω
V_C	Supply voltage	self-powered	
V_{SZ}	Output clamping voltage	15	V
I_P	Overload capability - continuous	120	% of I_{PN}
	- 1 min	150	% of I_{PN}
Performance data			
X	Accuracy @ I_{PN} , $T_A = 25^\circ\text{C}$ (excluding offset)	$< \pm 1.5$	% of I_{PN}
ϵ_L	Linearity error	$< \pm 0.5$	% of I_{PN}
t_r	Response time to 90% of I_{PN} step	< 300	ms
BW	Frequency bandwidth	50/60	Hz
General data			
T_A	Ambient operating temperature	- 20 .. + 60	$^\circ\text{C}$
T_S	Ambient storage temperature	- 20 .. + 85	$^\circ\text{C}$
m	Mass	90	g
IPxx	Protection degree	IP40	

Features

- RMS (average) output
- 0-10V DC voltage output
- Split-core type
- \varnothing 16 mm sensing aperture for non-contact measurement
- Terminal output
- Isolated plastic case recognized according to UL 94-V0.

Advantages

- High isolation between primary and secondary circuits
- Compact case
- Cost-effective solution
- Easy installation

Applications

- **Automation and Supervision**
Current measurement for process regulation by distributed PLCs or remote control (e.g. SCADA software)
- **Safety and Condition Monitoring**
Load monitoring for protection systems and predictive maintenance (e.g. conveyers, pumps or HVAC motors)

Application domain

- Energy and Automation

Performance data for LEM AC B10 Current Transducer

A Paladin voltage transducer type 253-TVZW-B7MS-C5 is used to generate a 0-10 DC voltage output proportional to the RMS supply voltage within the range of 207V to 253V AC.

AC Voltage Suppressed Zero - Auxiliary Powered

Single or three-phase models offering 'expanded scale' measurements at critical voltage levels, indicating small changes within a large voltage span. Average sensing and calibrated to indicate the RMS value of a sine wave less than 1% distortion. Isolation is provided between input, output and auxiliary.

Model	Accuracy	Function	Connection Diag
253-TVZ	Class 0.5	AC voltage RMS sensing suppressed zero, 50mm(2") case	15
256-XVZ	Class 0.2	AC voltage RMS sensing suppressed zero, 3-phase 4-wire, 3 dc outputs, 150mm(6") case	15

Specifications

Input*:	Between +/-10% and +/-30% of nominal 63.5V, 100V, 110V, 120V, 139V, 208V, 220V, 240V, 250V, 277V, 380V, 400V, 415V, 440V, & 480V ac
Output:	0/1mA, 0/5mA, 0/10mA or 0/20mA dc 0/1V, 0/5V or 0/10V dc
Frequency:	50Hz, 60Hz

Performance data for Paladin 253-TVZ Voltage Transducer

3. INTERFACE SOFTWARE

The 0-10 DC voltage outputs from the above sensors are converted to a value equal to 10 times the DC voltage by the EMMA analog input module. This input module generates the above value by averaging the DC voltage over a period specified in seconds and multiplying the result by ten. The periods specified in the basic EMMA strategy are;

Generator output current:	2 seconds
Household supply current:	0 seconds
Grid supply voltage:	0 seconds

4. CONTROL STRATEGY

The above sensors and input modules enable the EMMA GVS unit to limit output current or power to that specified in a table, curve or formula that defines the maximum permitted export current for various supply voltage conditions.

5. PROTECTION & ISOLATION

5.1 START-UP

The micro-generator isolator is activated automatically if the EMMA GVS controller is switched off or fails. The isolator is deactivated 300 seconds after the EMMA GVS starts operating.

5.2 EXPORT CURRENT EXCEEDS PERMITTED LEVEL

Export current is logged at two second intervals. This data is used to generate a running sixty second average export current. The running average export current is compared with the permitted instantaneous export current at c.80 millisecond intervals. If the running average export current exceeds the permitted instantaneous export by more than a set margin for more than 60 seconds the generator is isolated immediately and remains isolated for 300 seconds.

6. THERMAL STORE/DUMP RELAY

This relay will switch from store to the dump if the temperature in the store exceeds the maximum safe temperature. This will happen instantly. This relay will switch from the dump to the store five minutes after the temperature in the store falls below the maximum safe temperature.

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