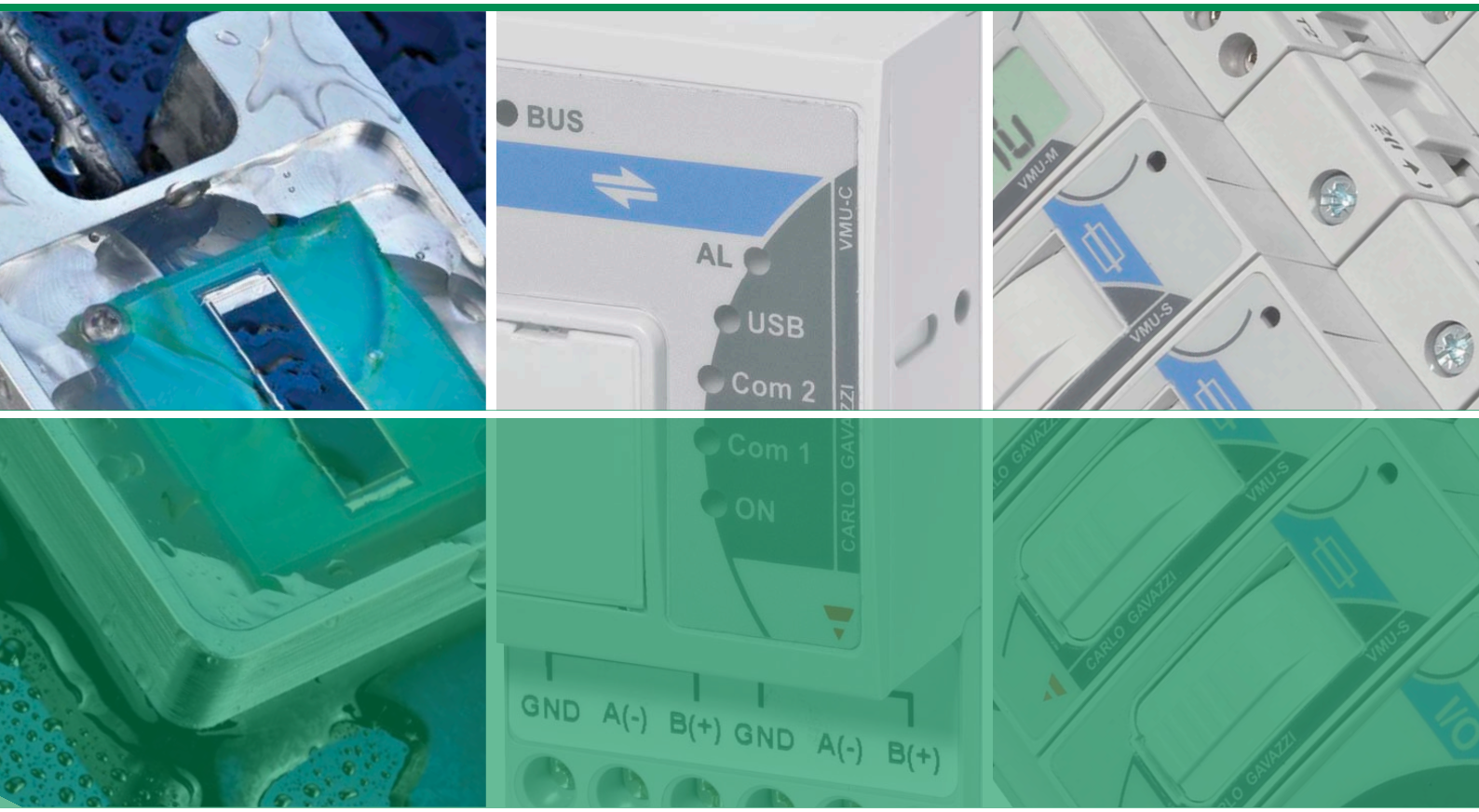
CARLO GAVAZZI
Automation Components

CARLO GAVAZZI



The evolution of Photovoltaic monitoring

Controls

EOS

Eos-Web, Eos-Server, VMU-Y PV

Protecting the environment is a fundamental ideal that requires dedication and care, which is why every solar project is a vital project. It needs the same attention that we devote to the things we love.
Care and attention, are essential values for Carlo Gavazzi, when developing the control system for photovoltaic plants. This ensures the solar investment is a solid investment. The Carlo Gavazzi solution develops with Eos-Array, Eos-Web and Eos-Server or VMU-Y PV depending upon the requirements and complexity of the photovoltaic plant. Eos-Array and Eos-Array Lite are systems comprised of individual modular elements that, when interacting with one another, provide efficient local control to the solar plant. Whether it's a small/medium power or high power plant, you are assured there is effective information management.

EOS is a family of products designed to interact each other so as to build a comprehensive solution to monitor both single photovoltaic installations and portfolios of plants.
The EOS family of products includes the VMU-C embedded datalogger and web-server, the Eos-Array string monitoring solution the VMU-Y PV embedded software solution, the Eos-Server software customer cloud solution and the PVS1 and PVS2 families of irradiance sensors.
EOS products can be integrated together, while allowing at the same time an easy interfacing with third party devices; monitored data are gathered from inverters, energy meters, string monitoring devices and environmental sensors, stored locally or remotely, transmitted through internet, presented and managed according to user needs.

The evolution of Photovoltaic monitoring

Comprehensiveness…
Eos-Web performs all the tasks necessary to monitor photovoltaic installations, from measurement (AC and DC monitoring, environmental sensing, alarm logging), to communication (mobile and wired internet communication, web based access), to data management (local and remote database, advanced alarming and analysis functions)

…with ease
Ease of use is the pillar around which Eos-Web works:
- ease of start-up (modular components, embedded communication drivers, plug'n play interfacing between devices);
- ease of operation (data and alarms provided when, where and how they are needed to monitor the installation);
- ease of maintenance (hardware and software components built to interoperate with reliability).

The Evolution of Photovoltaic Monitoring by Carlo Gavazzi

How much money will you lose if your solar system stops for three days?

To ensure you don't lose money then you need a CONTROL solution.

A solar installation, never mind if it's small or large it's always an important investment.
You can protect your investment if:

- You meet the performance limits!
- You know the system is working properly!
- You realize the hoped-for solar electric performance level!
- You prove that you've produced results!
- You payback the investment!

A reliable control ... has to be an independent control!

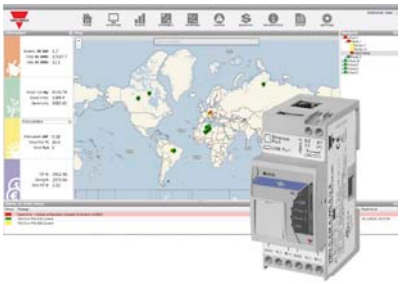
Providing you with dependable and accurate data, promptly advising when:

- The photovoltaic modules are not performing;
- The photovoltaic modules are not correctly connected;
- The modules are removed (theft)
- The inverter fails.

Moreover, focused control on every single string provides an immediate localization of the fault reducing significantly the service time and the missed yield costs.

The remote monitoring advantages

No other solution in the market provides the same level of integration between hardware and software; a user interface tailored on application specific needs allows users to get the necessary information when they are needed and where they are useful.
Modularity at any level is the key to grant reliability, flexibility and efficient communication with inverters and environmental sensors besides the Eos-Array DC monitoring solution.
The VMU-C PV Embedded PC is the key product to build a PV monitoring architecture fitting the users needs, thanks to its flexible and scalable concept



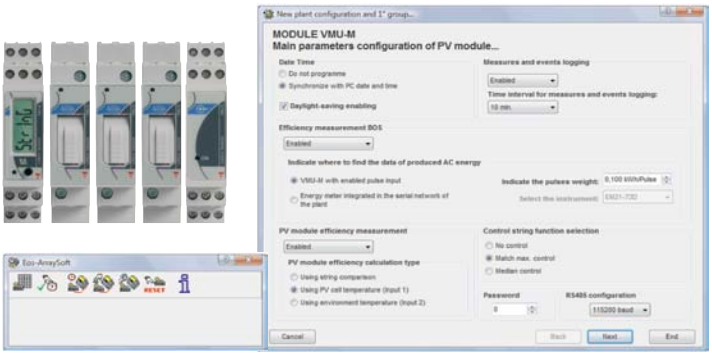
Eos Array and Eos-Web: versatile, a characteristic that makes work easier

Eos-Array is modular and can be formed by: VMU-M the master unit and data logger; VMU-S the string controller; VMU-P the environment variable unit, VMU-O the I/O unit, VMU-AT the antitheft sensor and VMU- 1 the isolation enhancement unit.
All Eos-Array functionalities can be available on your browser simply adding now VMU-C the Web-Server if a wired internet is available or adding a further VMU-W a GPRS-EDGE-UMTS-HSPA modem for wireless communication. On top of portfolio of plants powered by VMU-C PV, it is easy to build up multi-site monitoring architectures by means of the Eos-Server cloud aggregation server and the VMU-Y PV embedded aggregation system.

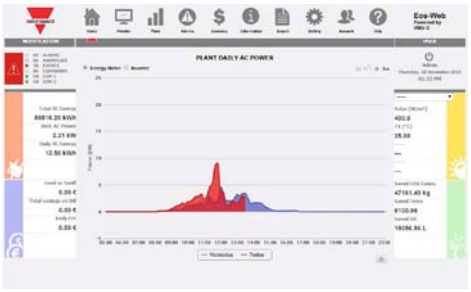
EOS
Eos Array and Eos Array Lite

Information and control... everywhere

Local
Eos-Array control with local alarm output and with the additional possibility to be connected to a PC running freeware Eos-ArraySoft.
Cost effective yield efficiency and plant failure warning with additional manual or automatic database download for easy plant history analysis.



Remote
Eos-Web as a compact Web-Server gathers and saves data from Eos-Arrays, Inverters and Energy meters; any useful information is accessible by the user from any place in the World just by using his web-browser. Plant failure warning by means of proper SMS or e-mail notifications.



Advanced
VMU-C PV interexchanges data with ease with SCADA solutions and customers' portals by means of standard Internet protocols. PV plants' owners and installers may use Eos-Server or VMU-Y PV to aggregate data from multiple sites.

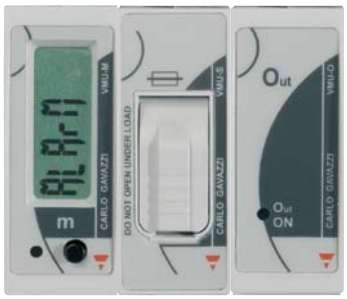
Eos Array Lite

Eos-Array Lite is the answer to those photovoltaic applications where a less sophisticated control is needed. This solution is based on the same overall concept of Eos-Array such as modularity, integrated string fuse protection but being focused to measure and control only the string current and voltage. As undoubted result this string control provides an immediate string failure detection and localisation of the wrong PV panel connection, a faster plant commissioning and future maintenance. Eos-Array Lite is specifically developed to be integrated in either a small or medium size photovoltaic park where all the most significant data are transmitted via RS485 Modbus at a maximum speed of 115.2 kbit/s to the local PV Energy Management System. An essential working tool is represented by Eos-ArrayLSoft a freeware software which allows the user to easily configure Eos-Array Lite, check the communication wiring and remotely read the available measurement data.

Why to choose Eos-Array or Eos-Array Lite

As each application has unique requirements, Carlo Gavazzi has designed distinctive products for solar applications offering an advanced control solution:
• Eos-Array
or a simplified control solution:
• Eos-Array Lite

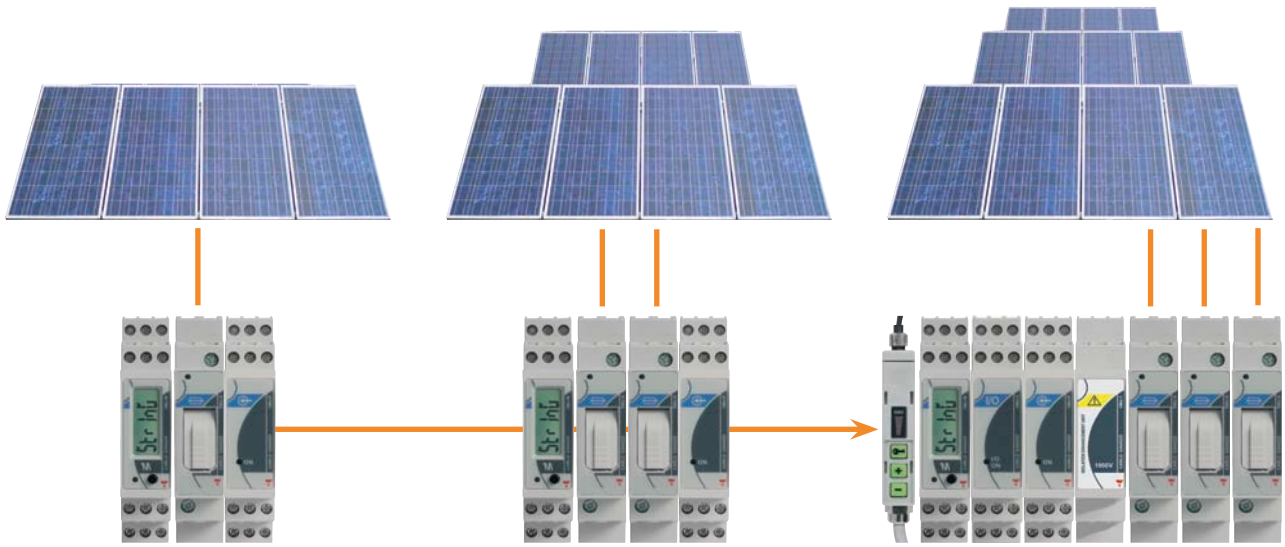
Eos-Array, completeness of control,



Eos-Array Lite, synthesis of control.

Integrated fuse holder with string control functions

Versatility of Eos-Arry and Eos-Array Lite



EOS-Array can be formed by:
1 VMU-M, up to 15 VMU-S, up to 7 VMU-O, up to 1 VMU-P but not exceeding 16 units and up to 3 additional VMU-AT antitheft sensors.

EOS-Array Lite can be formed by:
1 VMU-ML, up to 15 VMU-S0, up to 2 VMU-O, up to 1 VMU-P but not exceeding 16 units in total.

If an isolation to earth up to 1000VDC (instead of standard 800VDC) is requested, one VMU-1 can be added between the VMU-S/VMU-S0 group of units and all the other units, in this latter case the total number of units cannot exceed 17.

EOS
Eos-Array

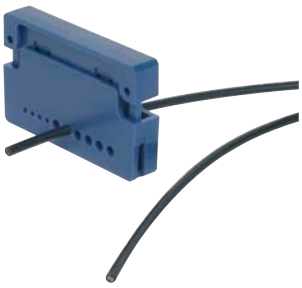
The EOS comprehensive monitoring solution

Increase the security of your PV plant adding the specific Eos-Array antitheft solution

Eos-Array, in addition to all its remarkable features can also be provided with an antitheft system which allows you to protect the whole PV installation, particularly when it is a ground mounted type. This security system is based on a cost effective plastic fibre optic technology which is easy to install and doesn't need expensive and specific fibre optic mounting skills. The optical sensing part is represented by VMU-AT which provides a theft alarm as soon as the plastic fibre, in its sensing loop, is broken because of PV panel removal attempt.

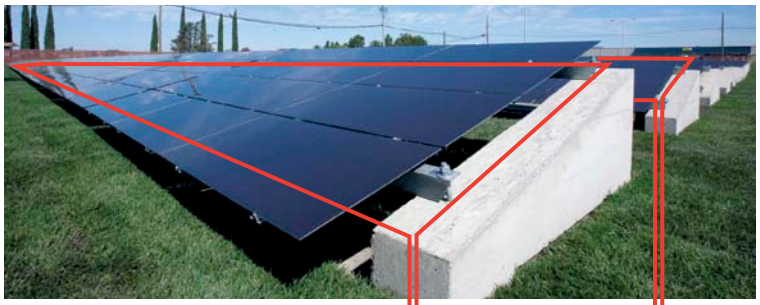
VMU-O.AT and VMU-AT overall features

- Every Eos-Array (string-box) can manage up to 3 VMUAT modules in combination with VMU-O "AT" with one relay output.
- The maximum allowed length of the fibre optic is 200m/ VMU-AT.
- The theft status is managed by the VMU-M unit which transmits the status to management system by means of the RS485 communication port (either wired or glass fibre optic based).
- VMU-AT sensor power supply from Eos-Array solution
- PFO22.1000: fibre optic roll of 1000m.



Fibre optic specific supplied cutter.

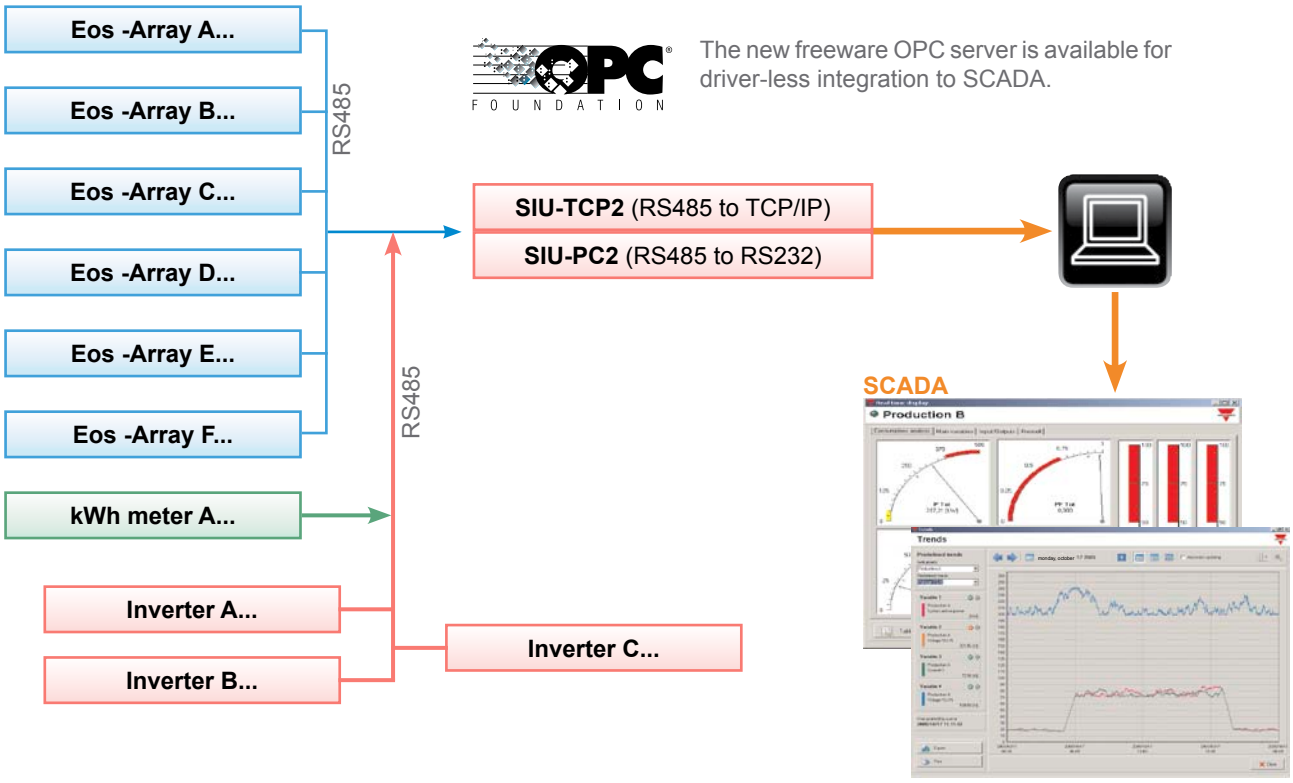
VMU-AT sensors in an Eos-Array context



VMU-AT
from 1 up to 3

The EOS comprehensive monitoring solution

Monitoring solution based on System Integrator's own SCADA software



- Architecture freedom
- Measurement features depending on Eos-Array selected solution (either Eos-Array or Eos-Array Lite)
- Free Eos-Array communication protocol available on request.

SIU-FO the solution in case of high electrical disturbed environment

This unit converts the standard Mod-Bus communication from RS485 wired to fibre-optic type with the aim to increase the communication distance and provide an extremely high communication immunity in case of combined centralised inverters, Eos-Array devices and Eos-Box or other equivalent devices.

Overall features

- RS485 to glass fibre optic adaptor.
- Dual way communication capability (wire to fibre optics and fibre optics to wire).
- Fibre optic single loop communication (cascade connection: communication loss in case of loop cut).
- Fibre optic dual loop communication (dual cascade connection: partial communication loss in case of one loop cut).
- Fibre optic dual loop communication (redundant communication: no communication loss in case of one loop cut).
- 10 to 24VDC/12 to 18VAC power supply.
- DIN-rail mounting type.

Fibre type and communication distances

- Single-mode and multimode glass fibre optic compatibility.
- Point to point distance up to 800m with 50/125 µm multimode fibre.
- Point to point distance up to 2000m with 62.5/125 µm multimode fibre.

Eos-Web
Flexible and scalable solution

Adding a control solution with Web access is now easy!

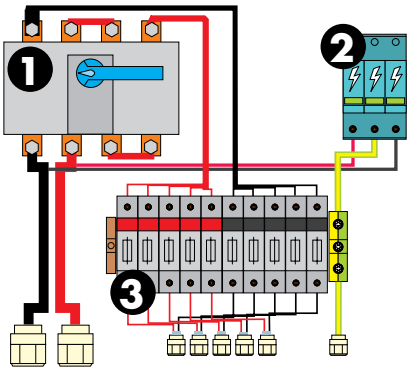
Replacement of standard “positive” fuse holders with same space Eos-Array VMU-M and VMU-S solution providing a cost effective control without need of replacement of existing string box. Full local variable measurement with data and local switch disconnector trip alarm and surge protection status logging for an efficient and effective string and plant local and remote monitoring and control.
String box with switch disconnector, surge and fuses protection with measurements of V-A-kW-kWh (VMU-S), cell-air temperatures-irradiation-wind speed (VMU-P) and extended control features (VMU-O).

Existing String-Box

String box with switch disconnector, surge and fuses protection.

Benefits
Apparently cheap solution, which becomes very expensive, in a large installation, because of the long fault searching time and the relevant missed production.

1 DC switch disconnector
2 Surge arrester
3 Fuses

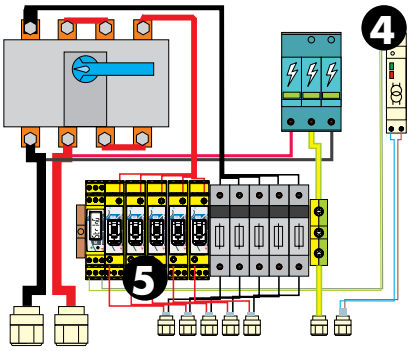


Retrofitted String-Box and slave unit

String-Box with switch disconnector, surge and fuses protection with added measurement features.

Benefits
Replacement of standard “positive” fuse holders with same space Eos-Array VMU-M/ML and VMU-S/S0 solution providing a cost effective control without need of replacement of existing string box.

4 Power supply
5 Eos-Array or Eos-Array Lite

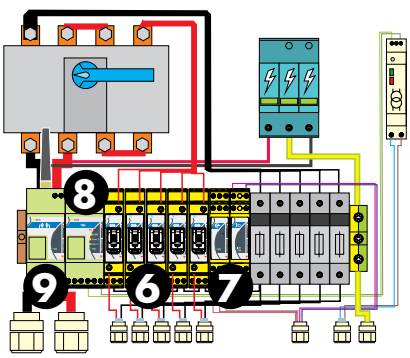


Advanced String-Box with Master function and Web-server capability

Master string box with switch disconnector, surge and fuses protection with measurements of V-A-kWkWh (VMUS), cell-air temperatures, irradiation, wind speed (VMUP) and extended control features (VMU-O) and integrated master and web-server capability.

Benefits
Full local variable measurement with data, protection-trip alarms and surge protection status logging for an efficient and effective string and plant remote internet access monitoring and control. The VMU-C unit may also be installed in the Inverter cabin, so as to manage multiple string boxes at the same time.”

6 Eos-Array
7 Antitheft
8 VMU-C - Web-Server
9 VMU-W - Mobile modem



Compare and refine your investment

The main features of the two monitoring solutions

Module	Functions and features	Eos-Web
All	Modular concept	■
VMU-C	Master unit with 12 to 28VDC power supply	■
	Web-Server and FTP/HTTP communication	■
	One RS485 com port for up to 10+1 Eos-Array systems	■
	One RS485 com port for up to 32+1 Inverters/Energy meters	■
	High speed USB 2.0 "Host" port + one mini USB "Device" port	■
	Back-up memory: micro SD/SDHC type up to 16GB (disaster recovery function)	■
	All data and event logger with most popular spread-sheet download capability	■
	Functions: total string-Zone-BOS efficiencies, PR and yield indices	■
VMU-W	Mobile modem: GSM, GPRS, EDGE, UMTS, HSPA (mini SIM)	■
	Automatic dual or quad band setting (850-900Mhz, 1800-1900/2100Mhz)	■

Module	Functions and features	Eos-Array Lite	Eos-Array
VMU-M "Local Bus Manager"	12 to 28VDC power supply	■	■
	Local display with programming pushbutton	■	■
	Measurement of single string current from VMU-S only	■	■
	Alarm management on measured variables	■	■
	Current string monitoring	■	
	Power string monitoring		■
	String efficiency		■
	Event-logger: variables, functions and system alarms		■
	Data-logger: V, A, W, Wh, PV cell temperature, air temperature, irradiation		■
	Two temperature inputs: Pt100/Pt1000 or one energy counting input		■
	Clock		■
	Compatibility with VMU-C		■
VMU-P	Irradiation sensor input: max. 120mV or 20mA	■	■
	Two temperature probe inputs: Pt100/Pt1000 (3-wire)	Only one input	■
	Short/open circuit on probe inputs diagnostics	■	■
	Wind speed sensor measuring input (pulse)		■
VMU-S "String Controller"	Local status monitoring by means of LED		■
	6-DGT data format for energy		■
	4-DGT data format for instantaneous variables	■	■
	Integrated fuse holder	■	■
	String voltage measurement up to 1000V (±0.5% RDG)	■	■
	String current measurement up to 14A@55°C (±0.5% RDG)	■	■
	String current measurement up to 30A@55°C (±0.5% RDG)	■	■
	String power measurement (±1.0% RDG)		■
	String energy measurement (class 1)		■
	Fuse blow alarm	■	■
	Fuse temperature alarm	■	■
	Wrong connection (reverse current or voltage) detection	■	■
VMU-O	Two relay outputs activated by local alarm or as remote control	Only one output	■
	Two digital inputs (for trip protection detection or other purpose)		■
	VMU-AT: three digital inputs and one alarm relay output		■
VMU-AT	Antitheft control combined with VMU-O.AT three digital inputs unit		■

VMU-C PV

The evolution in PV monitoring

An integrated wired or wireless Web-Server and Web-Service solution

The memory

Since plant data are very important, VMU-C dedicates 4 GB of memory to secure data storage. VMU-C provides also a micro SD slot (up to 32 GB SDHC cards) and a hot-swap USB interface (for direct memory stick connection) on the top of the unit to perform, in case of failure, an efficient “disaster recovery” function.

Ethernet and mini USB

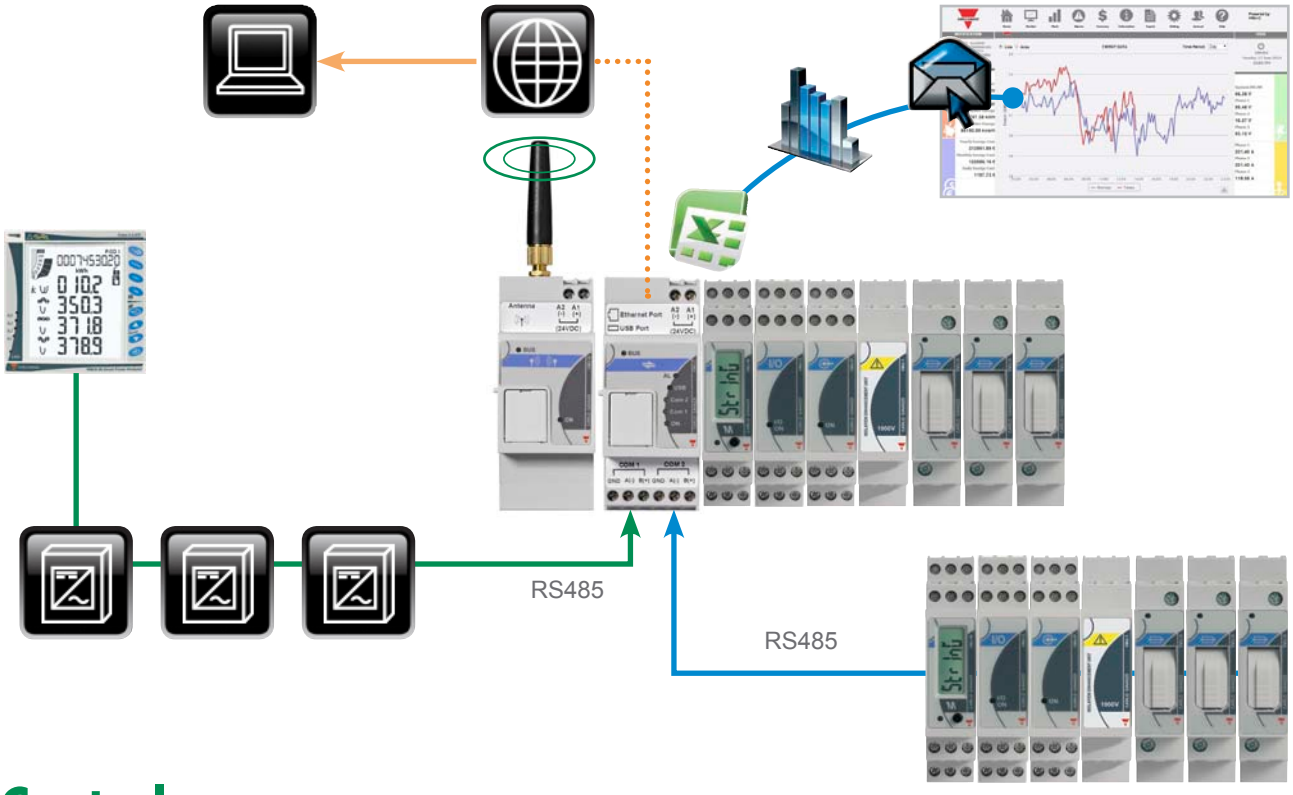
The Ethernet interface allows to operate and configure the VMU-C, by means of LAN or direct connection to a PC, thanks to the integrated web-interface. In the case Ethernet cannot be accessed, the mini USB can be connected to a PC .

Mobile Modem

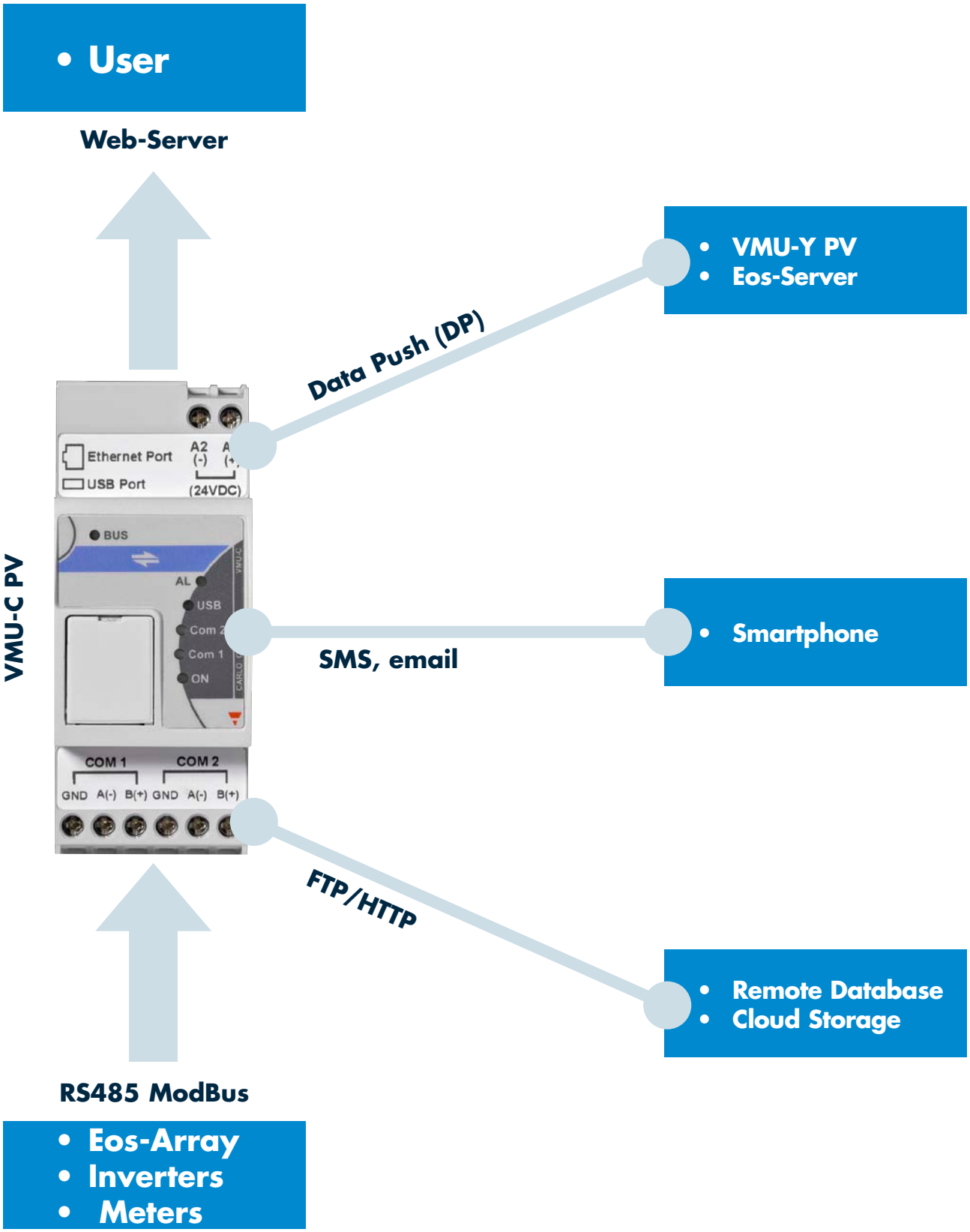
Where wired Internet access is not available, Carlo Gavazzi provides a specific mobile modem, the VMU-W, to be added to the VMU-C which transforms the system into the ideal monitoring solution for any remote application.

Monitoring solution based on web-server communication capability

Example of communication architecture with wired Internet access (only with “VMU-C”) unit or, where wired Internet, is not available, with additional mobile GPRS-EDGE-UMTS-HSPA “VMU-W” plug-in unit.



The heart of the system



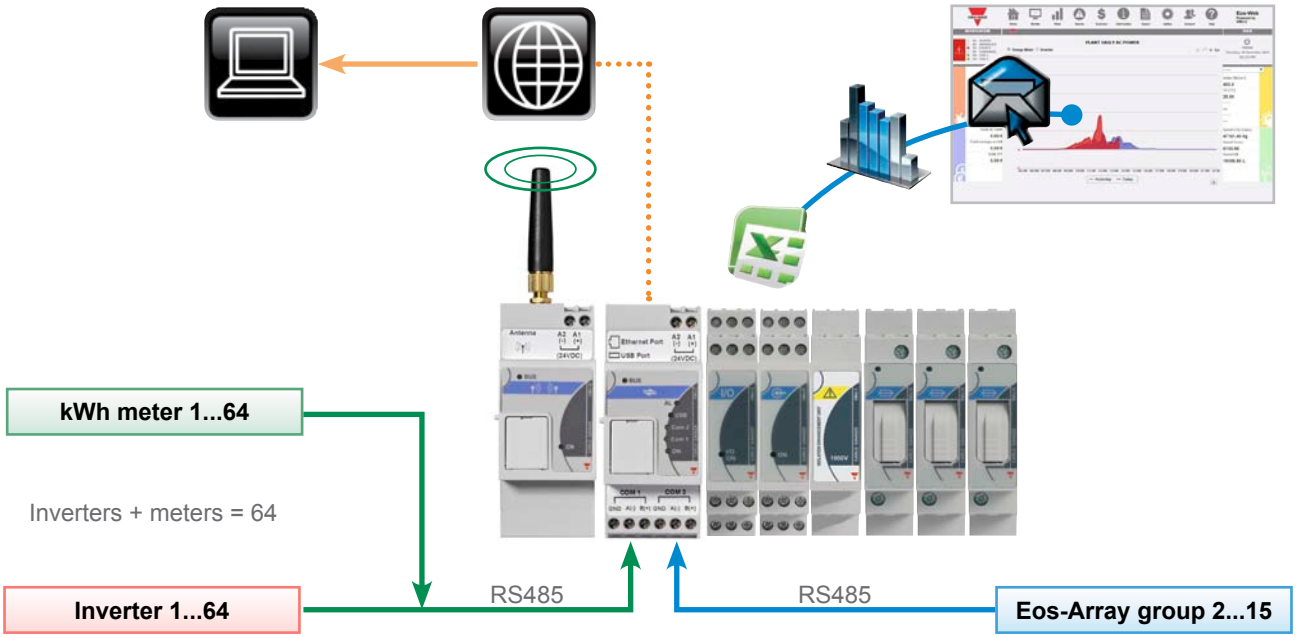
VMU-C PV

The evolution in PV monitoring

Eos-Web powered by VMU-C PV: a solution for multiple scenarios

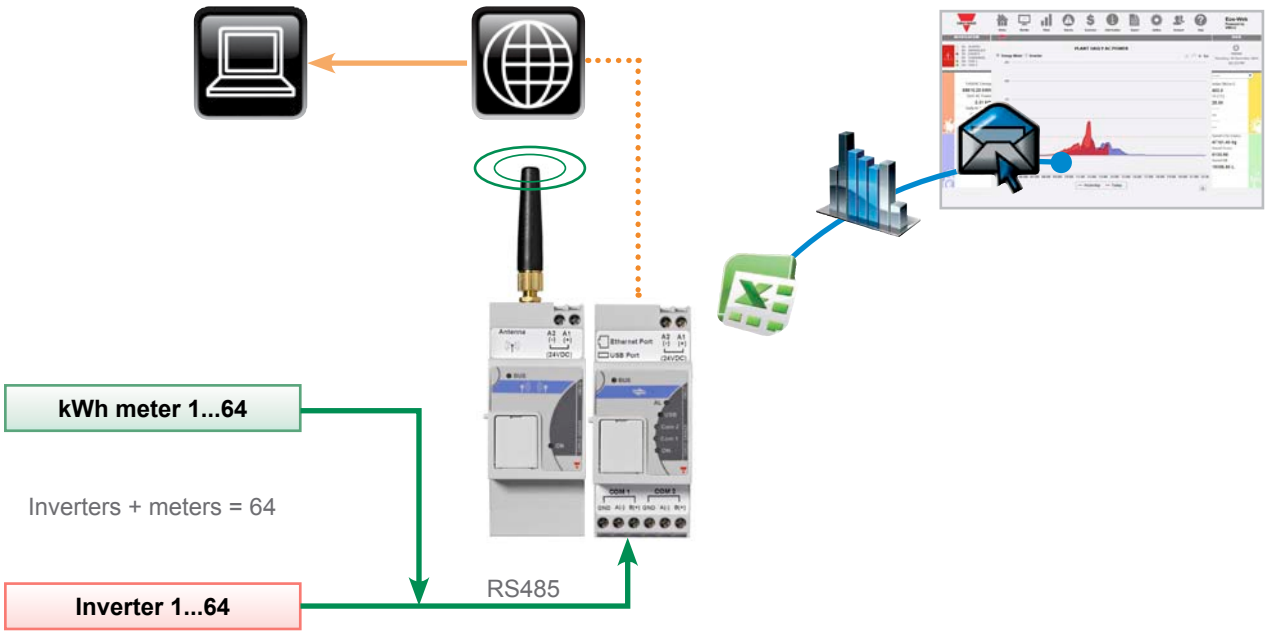
String monitoring (typical scenario: medium/big ground or rooftop plant)

Example of communication architecture with wired Internet access only with “VMU-C” unit or where Internet, for any reason is not available, with additional mobile GPRS-EDGE-UMTS-HSPA “VMU-W” plug-in unit. The whole set of variables and alarms from inverters and string-boxes are under VMU-C’s control.



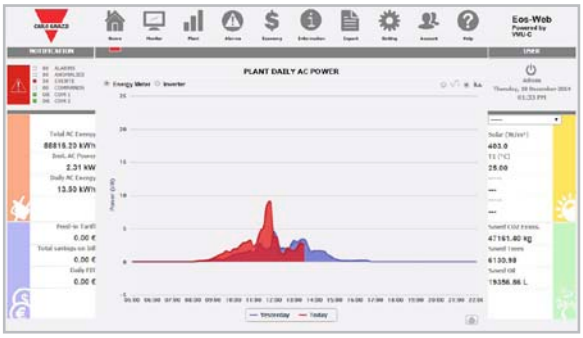
Inverter monitoring (typical scenario: small/medium rooftop plant)

For smaller installations where string control is not requested, VMU-C allows to monitor all the connected inverters (up to 64). It is possible to scale up to managing portfolio of sites by means of the VMU-Y and Eos-Server aggregation servers, or by interexchanging information with third party solutions by standard FTP and HTTP protocols.



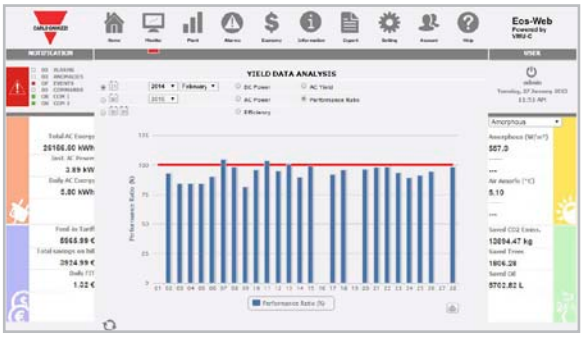
Eos-Web powered by VMU-C PV: the comprehensive monitoring solution

Examples of Eos-Web powered by VMU-C PV main pages



Home page with the following information available at a glance:
- electrical plant information such as kW, daily and total produced kWh;
- environmental savings such as CO_2, trees and oil;
- environmental parameters such as solar irradiation, temperature and wind speed;
- financial information such as daily, total incentives and bill savings.

The main graph shows actual yield vs. the day before.



Yield index with an example of daily trend over the month. This information allows the PV plant owner to understand at a glance how the installation is performing versus the original engineering so to judge the investment payback time.

Combined string efficiency, DC power, solar irradiation and temperature trends.
The aim of this important page is to understand how the plant is performing keeping under control the efficiency and power of PV modules vs. irradiation-temperature couple.
An inefficiency highlight would need further investigations by service people so to clearly identify the nature of the problem.

A further analysis support is represented, among many, by a single or multiple inverter power graph and also, proving the flexibility of this solution, by the download selection page which allows the user to combine data in an Excel spreadsheet so to customise the data analysis by type of variable and needed time period.

VMU-Y PV

The evolution in PV monitoring

Embedded solution for multi-site applications

VMU-Y PV allows to aggregate information replicated by up to 10 VMU-C EM units within a single centralized database; information may be accessed by users from wherever by using a standard web-browser.

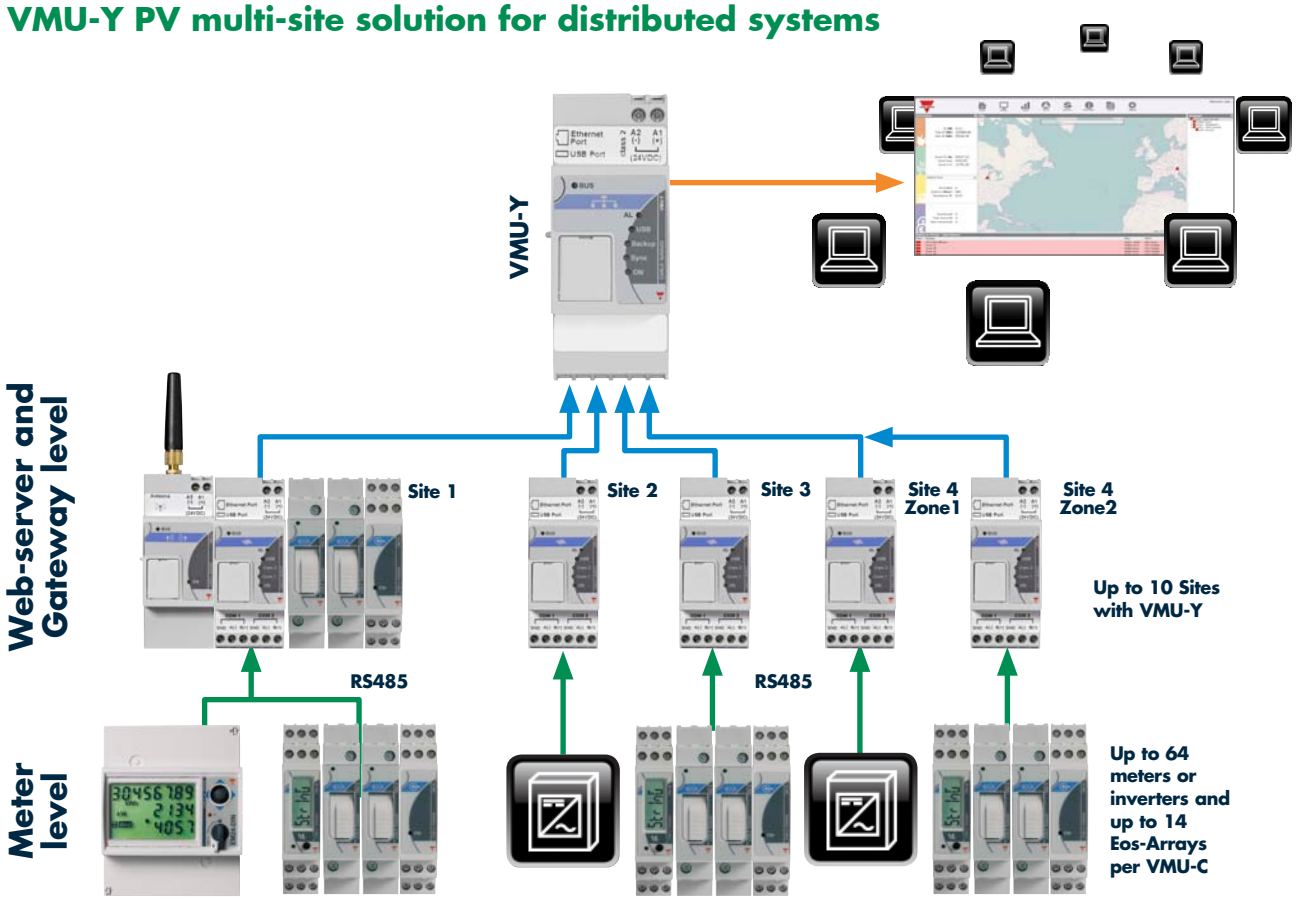
Embedded solution

VMU-Y PV embeds in a compact 2-DIN module ta comprehensive multi-site energy management database and software, without the need of installing any software and operating any IT infrastructure: just set up the network interface and configure the link from VMU-C PV.

Mobile connection

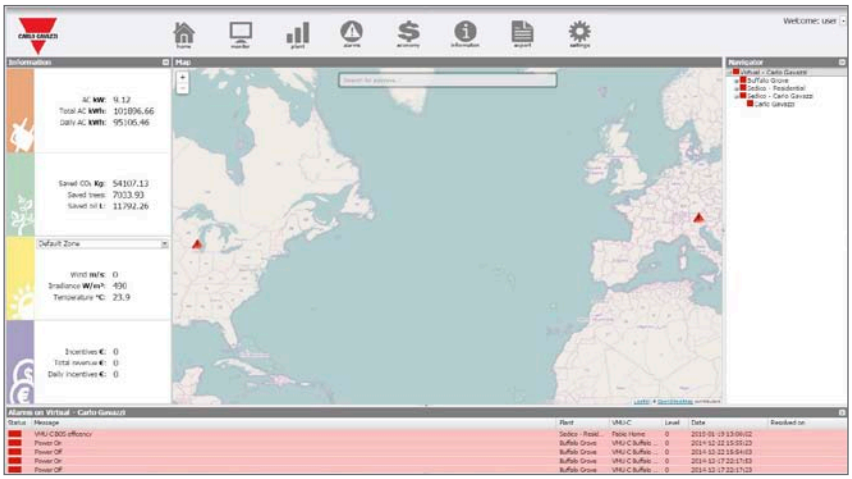
The VMU-W mobile 3G modem is available as a backup in the case the wired Internet connection fails; the mobile communication may be started up and shut down remotely by SMS commands as soon as the wired connection works again.

VMU-Y PV multi-site solution for distributed systems



Integrated web based interface

Concurrent access by Internet is possible by using a standard browser. User access to stored information may be allowed or restricted according to company's policies at the level of single meter.

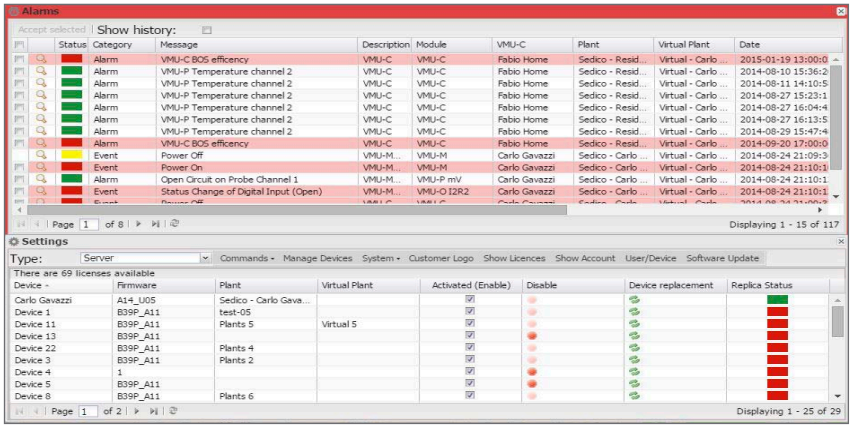


Responsive user interface

The toolbar on the top, the Navigator on the right, tha alarms view on the bottom, the main boxes on the left and the map in the center as the main tools, always available to the user for an immediate feedback.

Monitoring and analyzing

Monitor and Analysis are powerful tools which allow users to display both present and historycal data from the different sections of the PV plant such as: String Boxes, Inverters, Meters, and Environmental sensors.



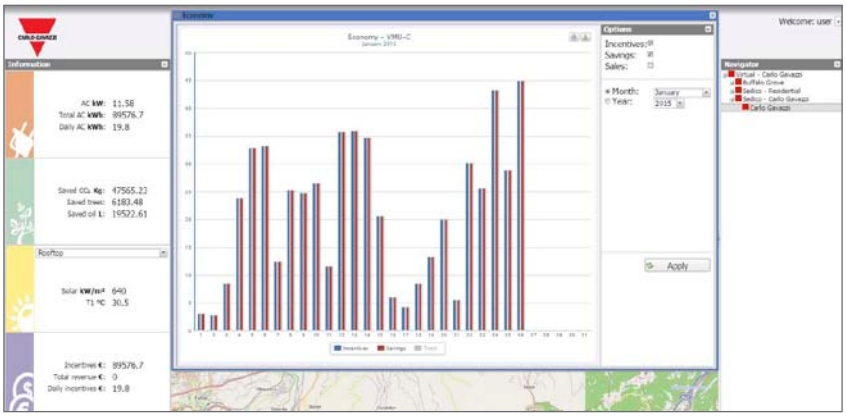
Portfolio management

Alarms and warnings logged by the VMU-C units may be checked and acknowledged while single VMU-C status can be monitored at the same time.

VMU-Y PV

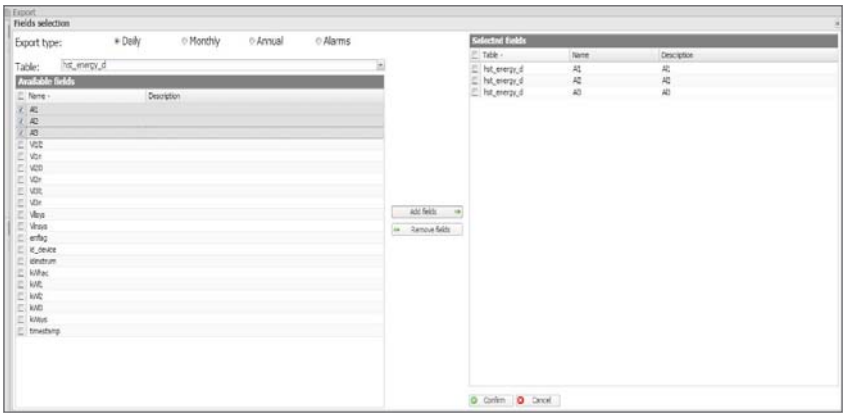
The evolution in PV monitoring

Enhanced features for PV plant monitoring



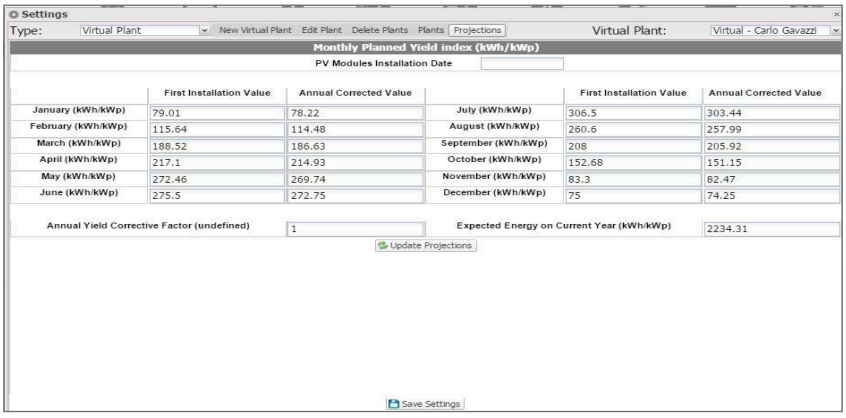
Economy analysis

Multiple business plans including feed-in tariff, sales and cost-saving profiles may be defined, checked and displayed for specific plants and plant intervals.



XLS export and custom charts

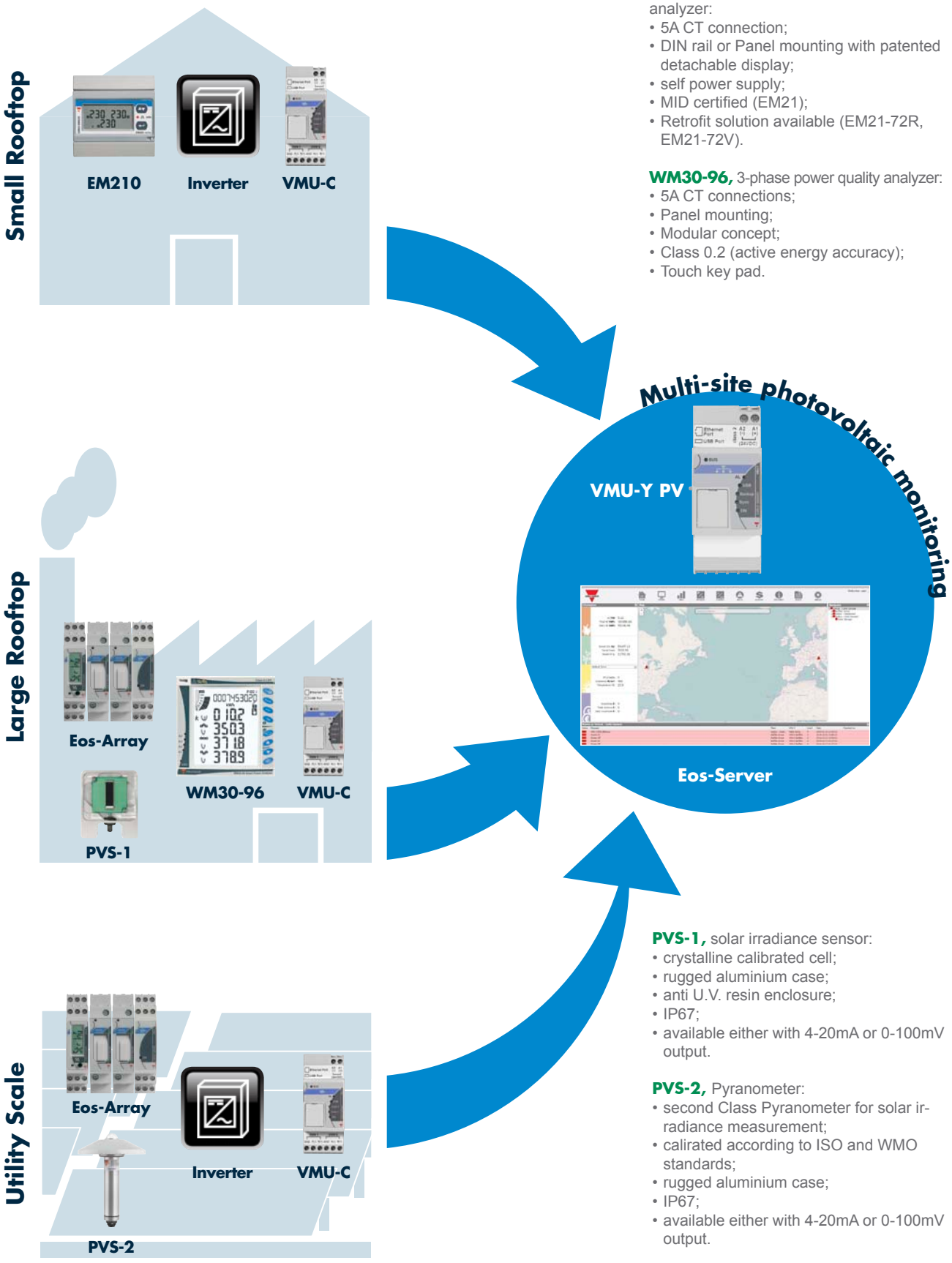
It is possible to extract any combination of variables from whatever meter either as Excel file or as a customized chart; extraction profiles can be saved for later use.



Virtual plants creation and management

It is possible to create virtual plants as aggregation of real plants, allowing to consolidate information and managing effectively portfolios of installations, restricting user access to the desired scope.

Improving Energy Efficiency with Carlo Gavazzi solutions



EM21 or EM210, 3-phase energy analyzer:
- 5A CT connection;
- DIN rail or Panel mounting with patented detachable display;
- self power supply;
- MID certified (EM21);
- Retrofit solution available (EM21-72R, EM21-72V).

WM30-96, 3-phase power quality analyzer:
- 5A CT connections;
- Panel mounting;
- Modular concept;
- Class 0.2 (active energy accuracy);
- Touch key pad.

PVS-1, solar irradiance sensor:
- crystalline calibrated cell;
- rugged aluminium case;
- anti U.V. resin enclosure;
- IP67;
- available either with 4-20mA or 0-100mV output.

PVS-2, Pyranometer:
- second Class Pyranometer for solar irradiance measurement;
- calirated according to ISO and WMO standards;
- rugged aluminium case;
- IP67;
- available either with 4-20mA or 0-100mV output.

Eos-Server

The evolution in PV monitoring

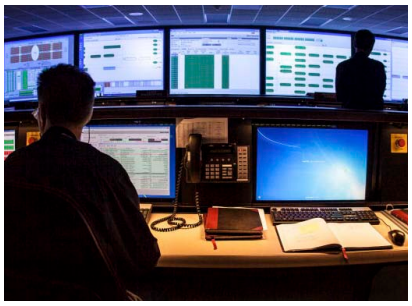
Cloud solution for multi-site applications

Eos-Server allows to aggregate information replicated by up to 100 VMU-C PV units within a single centralized database; information may be accessed by users from wherever by using a standard web-browser.

Cloud Solution

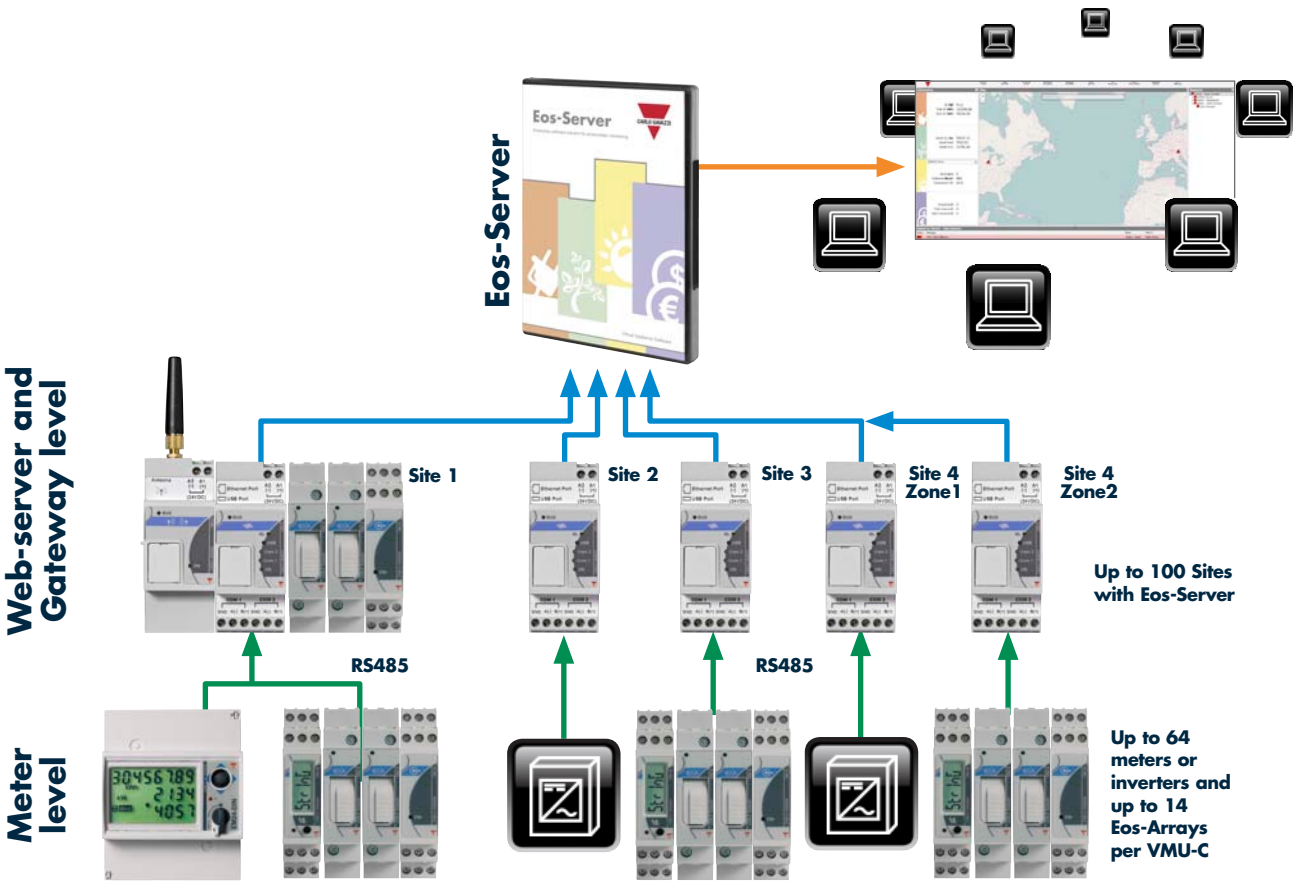
Eos-Server is a software solution provided as a Virtual Machine software appliance, to be hosted in the cloud, either in the customer's facility or in a hosting farm.
Therefore no service fees to be paid and data in the place where the customer wants them to be.

Centralized database



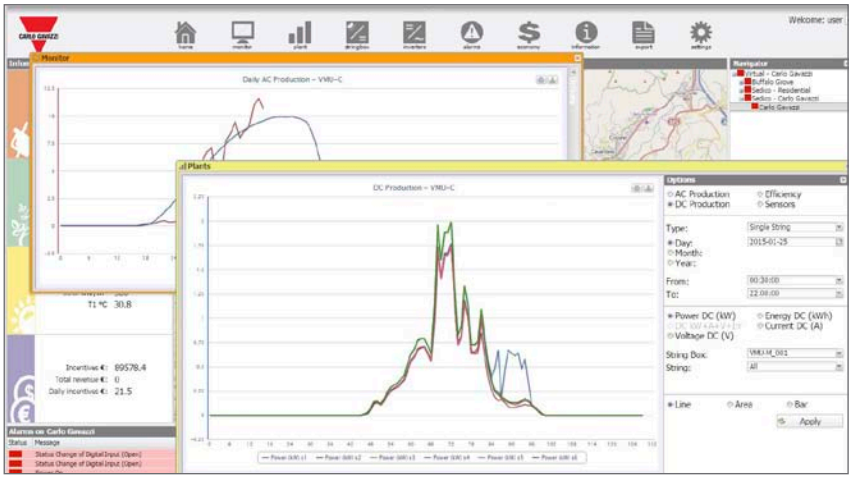
Installation and operation of Eos-Server are based on the flexibility and ease of the Virtual Machine technology.
Setting up Internet communication between VMU-C PV and Eos-Server is a plug'n play process based on the reliability and effectiveness of the Carlo Gavazzi's DP (Data Push) protocol.

Eos-Server multi-site solution for centralized data management



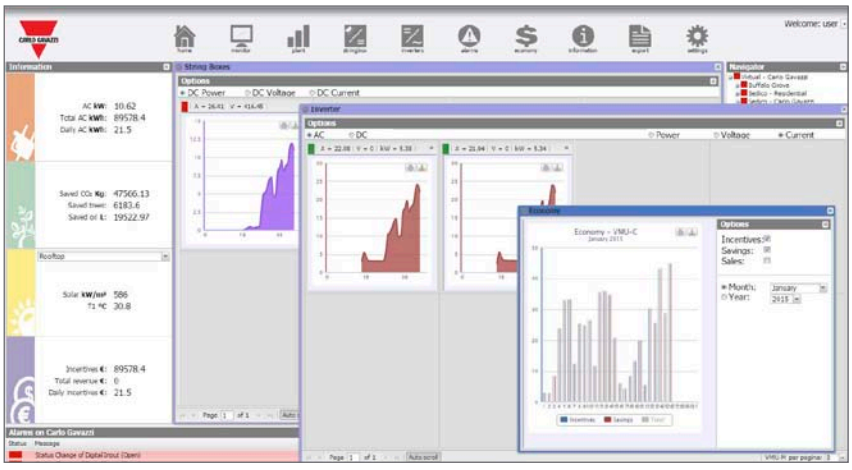
Centralized data base and web server

Eos-Server is the solution for aggregating data from multiple installations, including the database and the web interface in the same comprehensive package.



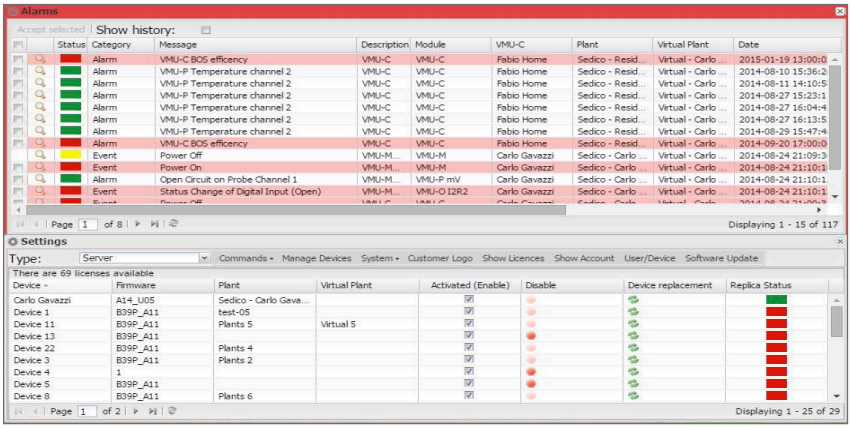
Multiple screens, multiple views

Eos-Server's web interface allow users to match the needs of control rooms, by allowing the simultaneous displaying of different charts and information on the same monitor or on multiple screens. Position and size of the desired displaying tools can be saved for later use.



Multi-site information management

By using the Map and Navigator tools it is possible to locate information from distributed installations with ease, according to user's access rights. Present or historical values and charts are displayed according to the selected parameters and filters.



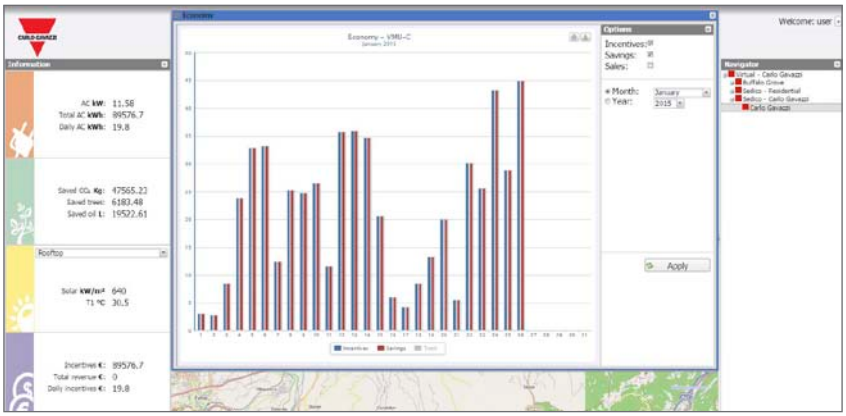
Devices' status and installations' alerts monitoring

Dedicated tools allow user to immediately check if any abnormal situation or unexpected condition is affecting the monitored plants and the monitoring devices. Distributed VMU-C PV units can be surfed via VPN, and commands may be broadcasted to pools of units.

Eos-Server

The evolution in PV monitoring

Powerful data analysis and management tools



Economy analysis

Multiple business plans including feed in tariff, sales and cost-saving profiles may be defined, checked and displayed for specific plants and plant intervals.

String-Box monitoring

Up to date information from string boxes are displayed in a graphical format so as to highlight immediately any abnormal or undesired condition by comparing different sections of the plant.

Inverter monitoring

Up to date information from inverters are displayed in a graphical format so as to compare the behaviour of different inverters and figure out if the plant is working correctly.

Web solution features matrix

Group	Feature	VMU-C PV	VMU-C PV + VMU-Y PV	VMU-C PV + Eos-Server
Installation type and scalability	Single Installation	YES	YES	YES
	Multiple installations portfolio	NO	UP TO 10	UP TO 100
User management	User and Admin profiles (multiple users)	YES	YES	YES
	Access rights management at meter level	NO	YES	YES
	Online Help	YES	YES	YES
Variable monitoring	Variables Monitoring	YES	YES	YES
	Plant analysis tool	YES	YES	YES
	Virtual plant management	YES	YES	YES
	String-box Synoptic	NO	NO	YES
	Inverter Synoptic	NO	NO	YES
Economy	Business plan management	Fixed	Multiple records/plans	Multiple records/plans
Alarms management	Dedicated web-view	YES	YES	YES
	Email	YES	YES	YES
	SMS	With optional VMU-W on VMU-C	With optional VMU-W on VMU-C	With optional VMU-W on VMU-C
VMU-C remote management	SMS commands	With optional VMU-W on VMU-C	With optional VMU-W on VMU-C	With optional VMU-W on VMU-C
	Remote broadcast commands via Web interface	N/A	YES	YES

EOS
Environment and control

Environmental monitoring and I/O modules

Eos-Web powered by VMU-C PV is not only a comprehensive platform dedicated to electrical variables monitoring but also a system capable of gathering environmental data (necessary to benchmark PV plant's performances, log the status of external devices such as DC breakers and Surge Protection devices) by digital inputs, and switch ON/OFF loads by means of its relay outputs.

VMU-P and VMU-O

VMU-P is a comprehensive environmental module capable of monitoring air temperature, PV cell temperature, solar irradiance and wind speed. It is available in 2 versions for solar irradiance sensors with 0-100mV output the former and with 4-20 mA the latter.

VMU-O is a flexible I/O module with 2 digital inputs and 2 digital outputs. Outputs may be controlled by triggers based on alert conditions or set-points.

VMU-P

VMU-O

Technical Specifications

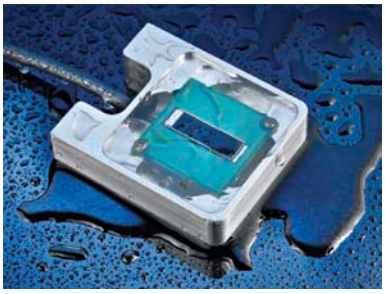
	VMU-P	VMU-O
Size (mm)	1-DIN	1-DIN
Digital inputs	-	2
Relay outputs	-	2 SPST
Solar irradiance input	1 (4-20mA or 0-100 mV)	-
Temperature inputs	2 (Pt100 or Pt1000)	-
Wind speed sensor input	1	-

PVS-1 solar irradiance sensor for efficiency calculation

The Eos-Web modular solution allows those in charge of operating and maintaining photovoltaic plants to monitor all the necessary variables and conditions and to effectively and reliably manage this huge amount of data.

The VMU-P module being part of it can gather data from one irradiation sensor, two temperature sensors (Pt100 or Pt1000) and one wind speed sensor. The VMU-M master module and the VMU-C web-server allow to easy log, manage and show the data coming from the sensors, to correlate it to the nominal and actual electrical data and to calculate the plant efficiency. The VMU-W module provides mobile communication capabilities.

Rugged environmental sensors to be installed in harsh environments

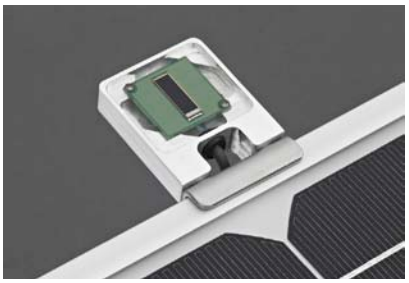


A calibrated photovoltaic cell is the right technology to measure solar irradiance. A calibrated cell installed on the same spatial plane and with the same tilt and azimuth as the photovoltaic modules, allows to measure accurately the solar irradiation, in the same wavelength band of the photovoltaic modules. The PVS-1 family sensors are based on a crystalline calibrated cell, supplied in a rugged aluminium enclosure and encapsulated within a transparent resin designed to insulate the inside electronics. An anti-ageing treatment is part of the manufacturing process to insure that the sensor has stable characteristics. Two versions available:

- PVS-1V: mV output, self powered.
- PVS-1A: 4-20 mA output, powered by the VMU-P module.

Technical Specifications

	PVS-1V	PVS-1A
Size (mm)	57 x 48 x 15	62 x 48 x 15
Calibration	According to IEC 60904-2 and IEC 60904-4	
Irradiation range	0 to 1250 W/m² STC	
Temperature range	-10 to 80°C (14 to 176°F)	
Output range	80 mV @ 1000 W/m² STC	from 4mA @ 0 W/m² STC to 20mA @ 1200 W/m² STC
Accuracy	±3%	
Power supply	Self-powered	Powered by the VMU-P module

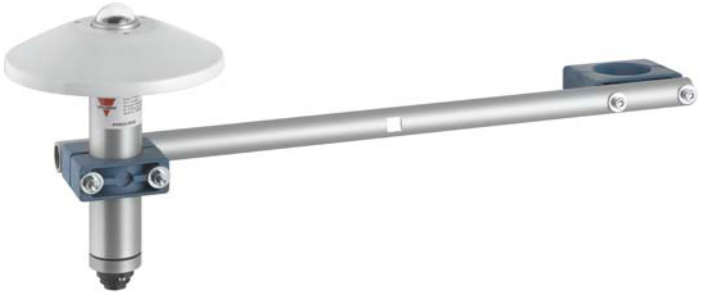


EOS

PVS-2 the Pyranometer

A certified irradiance sensor for environmental monitoring

Solar irradiance sensing is mandatory in many applications, both to understand if the given installation is working as expected (e.g. photovoltaic plant efficiency calculation) and to take into account the huge amount of solar energy which impacts on the behaviour of the monitored system (e.g. green building climate control). If we want the solar irradiance to be measured according to standards valid worldwide, so as to compare data from different locations and to base our monitoring system on solid foundations, we need to rely on specific technologies and guidelines.



Thermopile based pyranometers for solar irradiance measurement according to ISO and WMO standards

A thermopile-based pyranometer measures solar irradiance with a flat spectral response immune to temperature changes and according to WMO (World Meteorological Organization) and ISO standards. Measurements from pyranometers can be compared across sites throughout the world, with data from meteorological networks and satellite information. PVS-2A is a rugged aluminium thermopile-based pyranometer and it is the ideal solution for photovoltaic plant monitoring and for any application requiring the measurement of global solar irradiance in a standard and reliable way.

Technical Specifications

Size	162 x 215 x 40 mm (not including clamp)
Calibration	According to ISO9847
Irradiation range	From 0 to 2000 W/m^2 STC
Temperature range	-40 to 80°C (-40 to 176°F)
Output Voltage range	4-20mA @ 0-2000 W/m^2
Accuracy	Class 2
Power supply	10 to 28VDC

Compliancy to Norms for connection to grid

Connecting power plants to the grid require installers to insure the system is compliant with the relevant Norms. Interface protection devices make sure that the connection to grid is protected according to standards. There is not one common standard valid for all countries; for this reason Carlo Gavazzi provides a family of solutions.
The PI family of products is the right solution in the case of specific interface protection is requested by norms. Thanks to their comprehensive set of features and their ease of use, PI products fulfill country specific rules with the necessary reliability.

PI family

PI-DIN.0021

With its compact size (4 DIN) and features, PI-DIN.0021 is the ideal solution for interface protection in those installations which need compliancy with CEI 0-21:2012-06 Italian standard. The user friendly menu and the big display allow installers to set-up the system with ease.

PI-DIN.0126

With its comprehensive set of features, PI-DIN.0126 matches the needs of those installations in which compliancy either to VDE 0126-1—1:2013 or VDE-AR-N 4105:2011 (German standards) is necessary including anti islanding detection by ROCOF and phase shift detection.

PI-96

PI-96 is the solution for those cases in which advanced event logging and variable reading features are necessary, besides to interface protection according to CEI 0-21:2012-06 Italian standard.

PI family
Interface protection

Features matrix

Main function	Feature	PI-DIN.0021	PI-DIN.0126	PI-96
Standard	Compliance with CEI 0-21:2012-06	YES		YES
Standard	Compliance with VDE 0126-1—1:2013		YES	
Standard	Compliance with VDE-AR-N 4105:2011		YES	
System	1-phase	YES	YES	YES
System	3-phase	YES	YES	YES
System	3-phase with Neutral	YES	YES	YES
Monitoring	Overvoltage/undervoltage	YES	YES	
Monitoring	Overfrequency/underfrequency	YES	YES	
Monitoring	Phase sequence	YES	YES	
Monitoring	Extended variables reading range (VLL,VLN, Hz, AL, An, kVA, kW, kvar, THD, kWh, kvarh)			YES
Monitoring	ROCOF and Phase shift		YES	
Datalogging	Last 10 Events with date and time	YES	YES	
Datalogging	Last 1000 Events – Virtual alarms on variable set points			YES
I/O	Relay outputs	2	2	4
I/O	Digital inputs	4	2	6
Communication	RS485/Modbus	YES	YES	YES
User interface	LCD Display	YES	YES	YES
User interface	Touch keyboard			YES
User Interface	Joystick	YES	YES	
Power Supply	115VAC and 230VAC	YES	YES	YES
Power Supply	24VDC	YES	YES	YES

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