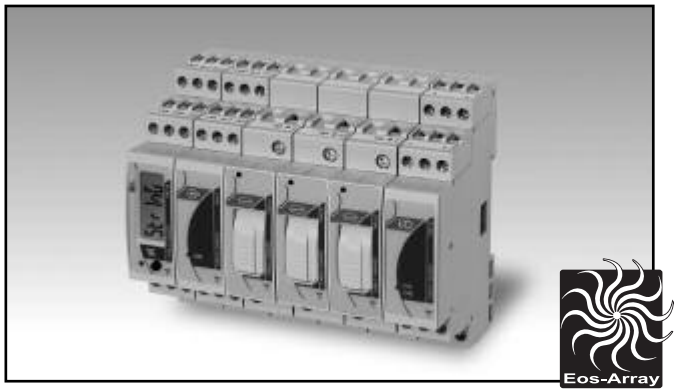
Energy Management
Control solution for solar PV applications
Type Eos-Array



- **Modular local control system for PV plants**
- **Up to 16 DIN modules configuration equivalent to 280mm width**
- **Eos-ArraySoft freeware software for easy product configuration**
- **Eos-Array can be formed by maximum 16 units**
- **Eos-Array can manage in addition to VMU-M master unit up to:**
  - **1 VMU-P unit;**
  - **max 15 VMU-S units;**
  - **max 7 VMU-O units.**

VMU-M, master unit

- **Master communication capability**
- **RS485 communication port (Modbus)**
- **Local communication bus management up to 15 mixed VMU-S, VMU-P and VMU-O units**
- **Two digital inputs**
- **Two temperature inputs: Pt100 or Pt1000**
- **Single virtual or real alarm set-point connectable to any available variable**
- **Data stamping system**
- **Display readout: 6 DGTs**
- **12 to 28 VDC power supply**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

VMU-M Product Description

Eos-Array is a combination of modules which performs a complete control of a photovoltaic plant. The core unit is VMU-M which performs the local bus management of VMU-S, VMU-P both measuring units and VMU-O I/O unit. VMU-M assigns the proper local unit address automatically (up to 15 units) and gathers all the local measurements coming from VMU-S and VMU-P measuring units. VMU-M can provide by means of VMU-O modules two relay outputs so the manage alarms or/and external loads (like a lighting system; a module washing system and so on) and two temperature inputs. These latter two measuring inputs can become, according to the programmed function also two digital inputs. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-M 4 A S1 T2 X

- **Model**
- **Function**
- **Power supply**
- **Communication**
- **Inputs**
- **Option**

Type Selection

Function

4: Data storage 4Mbyte **(*)**

Power supply

A: From 12 to 28VDC **(*)**

Communication

S1: RS485 Modbus **(*)**

Inputs

T2: two temperature inputs or two digital inputs for free of voltage reading contacts **(*)**

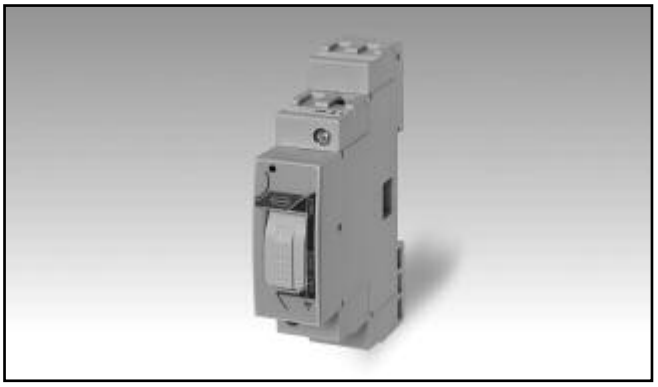
Option

X: none

(*) as standard.
(**) on request.

CARLO GAVAZZI

VMU-S, string unit



- **Direct DC voltage measurement up to 1000V**
- **Energy measurements: kWh**
- **Direct DC current measurement up to 16A**
- **Instantaneous variables data format: 4 DGT**
- **Energies data format: 6 DGT**
- **Instantaneous variables: V, A, W.**
- **Accuracy: Class 1 (kWh) ±0.5 RDG (current/voltage)**
- **Auxiliary power supply from VMU-M unit**

- **PV module connection control by means of VMU-M unit only**
- **Integrated 10.3x32mm fuse holder for string protection**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**
- **String alarm management by means of VMU-M unit only**
- **Antitheft control by means of VMU-M unit only**
- **Fuse blow detection by means of VMU-M unit only**

VMU-S Product Description

Variables measuring unit with built-in protection fuseholder (the fuse is not provided); particularly indicated for DC current, voltage, active power and energy metering in PV solar applications. The current inputs/outputs and also the voltage inputs are made so to simplify the string common connections. Direct connection up to 16A. Moreover the unit is provided with an auxiliary serial communication bus. Alarms, antitheft control, fuse blow detection, PV module connection and serial communication are managed by means of VMU-M module. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-S AV10 X S FX

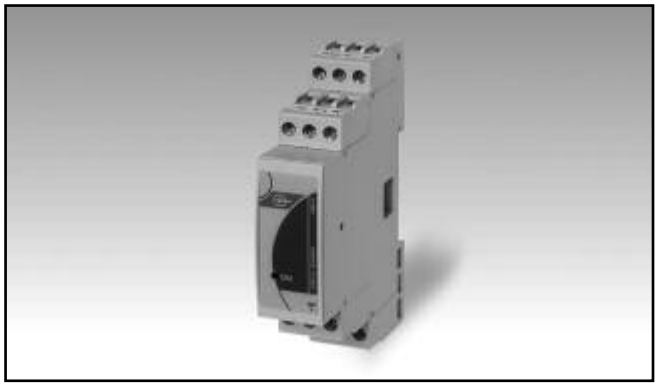
Model
Range
Power supply
Communication
Option

Type Selection

Range	Power supply	Communication	Option
AV10: 1000V DC **(*)**	**X:** from 12 to 28VDC, self-power supply from VMU-M unit **(*)**	**S:** auxiliary communication bus, compatible only to VMU-M module **(*)**	**FX:** with fuse holder

(*) as standard.
(**) on request.

VMU-P, measuring unit



- **Measurements: PV module temperature, ambient temperature, sun irradiation, wind speed**
- **Two temperature inputs: Pt100 or Pt1000**
- **One 120mV DC input with scaling capability for irradiation measurement**
- **One pulse input for wind speed measurement**
- **Auxiliary communication bus to VMU-M unit bus**
- **Auxiliary power supply from VMU-M unit**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

VMU-P Product Description

Environment variable measurement unit particularly indicated for PV module temperature, ambient temperature, sun irradiation, wind speed metering in PV solar applications. Moreover the unit is provided with a specific serial communication bus which is managed by means of the additional VMU-M module. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-P 2TIW X S X

Model
Range
Power supply
Communication
Option

Type Selection

Range	Power supply	Communication	Option
2TIW: Two "Pt" temperature type probes, sun irradiation and wind speed measuring inputs **(*)**	**X:** from 12 to 28VDC, self-power supply from VMU-M unit **(*)**	**S:** auxiliary communication bus, compatible only to VMU-M module **(*)**	**X:** none

(*) as standard.
(**) on request.

VMU-O, inputs/outputs unit

- **I/O module**
- **Two relay outputs managed by the VMU-M module**
- **Two digital inputs managed by the VMU-M module**
- **Auxiliary power supply from VMU-M module**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

VMU-O Product Description

I/O unit suitable to be used in combination with VMU-M modules. VMU-O allows to add, for every single unit, two digital inputs and two relay outputs to a VMU-M based system. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-O X I2 R2 X

Model
Power supply
Inputs
Outputs
Option

Type Selection

Power supply		Inputs		Outputs		Option	
X:	from 12 to 28VDC, self-power supply from VMU-M unit **(*)**	**I2:**	two digital inputs **(*)**	**R2:**	two relay outputs **(*)**	**X:**	none

(*) as standard.
(**) on request.

VMU-M Display and LED specification

Display	1 line (max: 6-DGT)	
Type	LCD, h 7mm	
Information read-out	From 4 to 6-DGT depending on the information.	
LED		
Type	Dual colour	
Status and colour	Green steady light: the module is power supplied and there is no communication on the RS485 bus.	Green blinking light: the communication on the RS485 bus is working. Red: alarm detected (any). In case of alarm/communication condition the LED alternates its colour from red (alarm) to green. The blinking time is approx. 1 second.

VMU-S LED specification

LED		
Type	Multicolor	
Status	ON steady light: the module is power supplied and there is no alarm.	
Colour	Green: the power supply is ON, there is a string current up to 1A; Yellow: there is a string current from 1.1 to 3A; Light orange: there is a string current from 3.1 to 6A; Orange: there is a string current from 6.1 to 8A; Dark orange: there is a string current from 8.1 to 10A; Red: there is a string current higher than 10A; White: the unit is enabled by VMU-M module for data	reading and displaying. Cycling from blue to any other colour listed above (from yellow to red): string alarm. Cycling from blue to green: PV modules removed or blown fuse. Cycling from blue to violet: inverted string polarity. Cycling from white to any other colour: the unit is enabled by VMU-M module for data reading and displaying and shows the status of the module according to the colour list above.The cycling time is approx. 1 second.

VMU-P LED specification

LED		
Type	Multicolor	
Status	ON steady light: the module is power supplied.	
Colour	Green: the power supply is ON.	White: the unit is enabled by VMU-M module for data reading and displaying.

VMU-O LED specification

LED		
Type	Multicolor	
Status	ON steady light: the module is power supplied.	
Colour	Green: the power supply is ON. White: the unit is enabled by VMU-M module for data reading and displaying.	Red: one or both digital inputs are activated. Blue: one or both digital outputs are activated. Cycling from one colour to any other one: the unit shows the status of the module according to the colour list above.

VMU-M input specifications

Digital inputs	
Number of inputs	2
Working mode	First input: detection of ON/OFF status Second input: counting of pulses coming from an energy meter
Purpose	- First input: trip of protection detection, the status is transmitted only by means of the communication port. - Second input: trip counter, interfacing with an energy meter (-kWh) so to measure the total efficiency of the system.
Input frequency	20Hz max, duty cycle 50%
Pre-scaler adjustment	From 0.001 to 10.000 kWh/pulse (only for the second input)
Contact measuring voltage	3.3VDC
Contact measuring current	<1mA
Contact resistance	≤1kΩ closed contact; ≥20kΩ open contact
Insulation	See the table “Insulation between inputs and outputs”
Temperature inputs	
Number of inputs	2
Temperature probe	Pt100, Pt1000
Number of wires	2 or 3-wire connection
Wire compensation	Up to 10Ω.
Accuracy (Display + RS485)	See “Temperature input characteristics”
Temperature drift	±150ppm
Engineering unit	Selectable °C or °F
Insulation	See the table “Insulation between inputs and outputs”
Key-pad	1 push-button for variable scrolling and programming. Full programming can be carried out only using Eos-ArraySoft.

VMU-S input specifications

Digital inputs	
Current type	1 (shunt)
Current range	AV10: 16A DC @ 40°C, 15A @ 50°C, 14A @ 55°C,12A @ 60°C
Voltage	AV10: 1000V DC
Accuracy	(@25°C ±5°C, R.H. ≤60%)
Input type AV10	
Current	±(0.5%RDG+2 DGT) from 0.05A to 16A
Voltage	±(0.5%RDG+2 DGT) from 20V to 1000V
Power	±(1% RDG+ 2DGT)
Energy	±(1% RDG)
Start up current	0.05A
Start up voltage	10V
Temperature drift	≤200ppm/°C
Measurement sampling time	2 sec.
Variables format	
Instantaneous variables	4-DGT (V, A, W)
Resolution	0.1V; 0.01A; 0.01kW
Energies	Total: 5+1 DGT (0.1KWh)
Max. and Min. data format	See “Stored set of variables coming from …
Input impedance	
Voltage	> 2.5MΩ
Current	< 0.006Ω+ fuse impedance) @ 0.5 Nm (screw terminal torque). For current input of 16A the fuse has therefore a nominal current of 32A AC. The maximum dissipation power has not to exceed 2W.
Voltage Overloads	
Continuous	1100V
For 500ms	1600V
To earth	800V
Current Overloads	
Continuous	AV10: 16A
For 1s	AV10: 100A max
Protection	
Fuse holder	Integrated into the module
Fuse size	10.3x38mm (IEC269-2-1)
Fuse current	fuse NOT provided (it has to be 1.25 Isc for DC current)

CARLO GAVAZZI

VMU-P input specifications

Temperature drift	≤200ppm/°C
Variables format	
Instantaneous variables	4 DGT (Temperature, solar irradiation and wind speed)
Resolution	0.1°C/0.1°F; 1W/m², 1W/ft²; 0.1m/s, 0.1ft/s
Max. and Min. data format	See "Stored set of variables coming from …
Temperature probe inputs	
Number of inputs	2 (Input 1: PV module; Input 2: environment)
Temperature probe	Pt100 or Pt1000
Number of wires	Up to 3-wire connection
Wire compensation	Up to 10Ω.
Accuracy (Display + RS485)	See table "Temperature input characteristics"
Temperature drift	±150ppm
Engineering unit	Selectable °C or °F
Insulation	See the table "Insulation between inputs and communication bus"
Irradiation sensor inputs	
Number of inputs	1
Range	0 to 120mVDC
Accuracy (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS;
(Display + RS485)	±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 999.9 (mVDC) - Display: programmable range from 0.000 to 9.999 (kW/m², kW/ft²)
Decimal point position	Fixed.
Impedance	> 30KΩ
Overload	
Continuous	10VDC (measurement available up to 1V on both display and communication bus)
For 1s	20VDC
Insulation	See the table "Insulation between inputs and communication bus"
Wind speed sensor inputs	
Number of inputs	1
Range	0 to 1000Hz max, duty cycle 50%
Accuracy @25°C ±5°C, R.H. ≤60%)	±(0.02%RDG+1DGT) 0% to 25% FS;
(Display + RS485)	±(0.01%RDG+1DGT) 25% to 110% FS.
Temperature drift	±150ppm
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 999.9 (Hz) - Display: programmable range from 0.1 to 299.9 (m/s, ft/s)
Decimal point position	Fixed
Operating input	2.5V_{peak} to 9V_{peak}/5mA_{peak} to 35mA_{peak}, duty cycle 50%
Impedence	220Ω
Contact measuring voltage	10 to 50VDC
Contact measuring current	<10mA
Contact resistance	≤100Ω closed contact; ≥500kΩ open contact
Overload	
Continuous	7V_{RMS}/25mA_{RMS} (AC/DC)
For 1s	14V_{RMS}/50mA_{RMS} (AC/DC)
Insulation	See the table "Insulation between inputs and communication bus"

VMU-M and VMU-P Temperature input characteristics

Probe	Range	Accuracy	Min Indication	Max Indication
Pt100	-50°C to +200.0°C	±(0.5%RDG +5DGT)	-50.0	+200.0
Pt100	-58°F to +392°F	±(0.5%RDG +5DGT)	-58.0	+392.0
Pt1000	-50°C to +200.0°C	±(0.5%RDG +5DGT)	-50.0	+200.0
Pt1000	-58°F to +392°F	±(0.5%RDG +5DGT)	-58.0	+392.0

VMU-M Output specifications

RS485	
Type	Multidrop, bidirectional (static and dynamic variables)
Connections	2-wire. Max. distance 1000m
Addresses	247, selectable by means of the front push-button
Protocol	MODBUS/JBUS (RTU)
Data (bidirectional)	
Dynamic (reading only)	All variables, see table “Measured variables, data format and messages” in the VMU-S document
Static (writing only)	All the configuration parameters.
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baud-rate	Selectable: 9600, 19200, 38400, 115200 bits/s
Driver input capability	Parity: none
Special functions	1/5 unit load. Maximum 160 transceivers on the same bus.
Insulation	None See the table “Insulation between inputs and outputs”

Auxiliary communication bus	This is the communication bus to the VMU-S, VMU-P and VMU-O units where VMU-M performs the master function in this network. VMU-M unit can gather the following information from the bus: - All variables available on the bus; - Antitheft status; - Blown protection fuse; - PV connection problems; - PV reverse voltage and current polarity. The local address in both the VMU-S, VMU-P and VMU-O units is automatically assigned by VMU-M master unit based on their positions. It can manage up to 15 different addresses (units).
Insulation	See the table “Insulation between inputs and outputs”

VMU-O Input/Output specifications

Maximum number of modules managed by every single VMU-M module	Up to 7
Digital inputs	
Number of inputs	2
Working mode	Detection of OPEN/CLOSED contact status
Purpose	Trip of protection detection, the status is transmitted only by means of the communication port.
Input frequency	2Hz max, duty cycle 50%
Contact reading voltage	10 to 30VDC
Contact reading current	<2mA
Contact resistance	≤ 300Ω closed contact; ≥ 10kΩ open contact
Insulation	See the table “Insulation between inputs and outputs”

Digital output	
Number of outputs	2
Purpose	Alarm notification as a String alarm or as a digital input status changing (OR function); activation of a lighting system (by means of the internal clock or as a remote control); activation of a module washing system (by means of the internal clock, as a remote control or as a changing of efficiency of the PV panels).
Type	Relay, SPST type AC 1-5A @ 250VAC AC 15-1A @ 250VAC Available by means of VMU-O module only
Insulation	See the table “Insulation between inputs and outputs”

Main Function

Displaying	1 parameter per page
Own VMU-M module	See “Stored set of variables from …” and “Alarm and diagnostics messages”
When a VMU-S module is selected	All the information related to the status of the string being selected by means of the front key (see “Variable” in the table “List of the variables that can be...”).
When a VMU-P module is selected	All the information related to the status of the environment probes being selected by means of the front key (see “Variable” in the table “List of the variables that can be...”).
When a VMU-O module is selected	All the information related to the status of the inputs/outputs being selected by means of the front key (see “Variable” in the table “List of the variables that can be...”).
Password	Numeric code of max. 4 digits;
	2 protection levels of the programming data:
1st level	Password “0”, no protection;
2nd level	Password from 1 to 9999, all data are protected
Reset	By means of the front push-button when the relevant VMU-S is selected
Alarms	
Number of alarms	One, independent for every single available variable (see the table “List of the variables that can be…”)
Alarm types	Virtual alarm or real alarm
Alarm modes	Up alarm, down alarm (see the table “List of the variables that can be connected to …”)
Set-point adjustment	From 0 to 100% of the display scale
Hysteresis	From 0 to full scale
On-time delay	0 to 3600s
Output status	Selectable; normally de-energized or normally energized
Min. response time	≤ 700ms, set-point on-time delay: “0 s”

CARLO GAVAZZI

Main Function (Cont.)

Clock	
Functions	Universal clock and calendar.
Daylight-saving enabling	Activation: NO/YES
Time format	Houre:minutes with selectable 24 hours or AM/PM
Date format	Month-Day, where the month is displayed in a three letter format (e.g.: JAN-FEB-MAR) and the date as a number. Year is displayed in a two digit format.
Battery life	10 years
Data logging	
Data	The data are not available on the display but they can be both checked and downloaded using RS485 communication port in combination with Eos-ArraySoft software.
Function enabling	Activation: NO/YES
Function description	All the events gathered from both VMU-S, VMU-O and VMU-P modules are stored individually into the internal memory.
Stored data type	Variables: V, A, W, Wh, PV module temperature, ambient temperature, irradiation, wind speed, string efficiency and BOS efficiency.
Storage interval	Selectable: 1-5-10-15-30-60 minutes
Sampling management	The sample stored within the selected time interval results from the continuous average calculation of the measured values. The average is calculated with an interval within two following measurements of approx. 2s.
Storage duration	Before overwriting: depending on the storage interval, see “Historical data storing time table”
Data format	Variables, date (dd:mm:yy) and time (hh:mm:ss)
Storage method	Circular FIFO
Memory type	Flash
Memory retention time	10 years

Event logging	
Data displaying	The data are not available on the display but they can be both checked and downloaded using RS485 communication port in combination with Eos-ArraySoft software.
Function enabling	Activation: NO/YES
Type of stored events	VMU-O digital input/output status change (real and virtual alarms), string alarms (see “String control”) and theft alarm, VMU-M 1st digital input status change. The events are recorded as soon as they occur. For more information about the type and stored data, see “List of the variables that can be connected to ….”
Number of events	Max. 10 000.
Data reset	The reset can be carried out only using Eos-ArraySoft.
Data format	Event, date (dd:mm:yy) and time (hh:mm:ss)
Storage method	Circular FIFO
Memory type	Flash
Memory retention time	10 years
String control	
Function enabling	Activation: NO/YES
Function selection	Match max. control or median control
Function description	Match max. control: this function is helpful only if there are at least two string controls (VMU-S units). The highest value of the measured string power among those available is used as a reference value. The alarm set-point is a value which can be set by the user as a percentage of the reference value below which there is the alarm condition. - Median control: the measurement of the string power is performed by the local VMU-S module individually. Within the VMU-M system all values coming

CARLO GAVAZZI

Main Function (Cont.)

	at the same instant from every VMU-S module are used to calculate the "median" value which becomes the reference value to which the dynamic window set-point (in percentage set by the user) is linked. The abnormal condition is detected when the measured instantaneous string power is out of the set window alarm. The alarm activates, with reference to the failed string, either a relay output (only in case of "VMU-O" connection) or/and a message which is transmitted by means of the RS485 communication port to an acquisition system.
String window alarm	The alarm is set as the string power control, the value is programmable in percentage (of the measured string value) from 0.1 to 199.9.
Other alarms	The alarms can be connected also to: A and V.
"PV string" efficiency measurement	
Function enabling	Activation: NO/YES
	Three type of controls are available
Control type "0"	The VMU-P unit is not available therefore the single strings are used to calculate the reference value for the efficiency calculation.
Control type "1"	The VMU-P module is present and both PV module temperature and irradiation are measured to calculate the reference value for the efficiency calculation.
Control type "2"	The VMU-P module is present and both ambient temperature and irradiation are measured to calculate the reference value for the efficiency calculation.
BOS efficiency measurement	The total efficiency measurement is based on the comparison between the generated energy and the exported energy supplied to the grid. The grid supplied energy is measured by means of a "S0" output coming from an energy meter like EM21-72, EM24-DIN, EM26-96 where the pulsating output (-kWh) is connected to the second digital input of VMU-M.
Antitheft control	Antitheft control on PV module connected upstream the VMU-S unit. This function works only if the PV modules upstream the string current input are connected in series.Warning message transmission through the local port to the VMU-M unit.
Fuse blow detection and missing PV module connection	Warning message transmission through the local port to the VMU-M unit.
Wrong PV string connection	Warning message transmission through the local port to the VMU-M unit.

Note: the "String control", the "PV string efficiency" and the "BOS efficiency" can be carried out only in case a minimum system is available like a VMU-M, plus a VMU-S, plus a VMU-P and an energy meter with pulsating output.

CARLO GAVAZZI

Insulation between inputs and outputs

Module		Any	VMU-M			VMU-P			VMU-O		VMU-S		
	Type of input/output	Local bus	DC Power supply	Temperature or digital inputs: Ch1, Ch2	RS485	Temperature: Ch1, Ch2	Solar irradiation	Wind speed	Digital inputs: Ch1, Ch2	Relay outputs: Ch1, Ch2	Input string (V-)	Input string (A+)	Output strimg (A+)
Any	Local bus	-	0kV	0kV	0kV	0kV	0kV	0kV	4kV	4kV	4kV	4kV	4kV
VMU-M	DC Power supply	0kV	-	0kV	0kV	0kV	0kV	0kV	4kV	4kV	4kV	4kV	4kV
	Temperature or digital inputs: Ch1, Ch2	0kV	0kV	-	0kV	0kV	0kV	0kV	4kV	4kV	4kV	4kV	4kV
	RS485	0kV	0kV	0kV	-	0kV	0kV	0kV	4kV	4kV	4kV	4kV	4kV
VMU-P	Temperature: Ch1, Ch2	0kV	0kV	0kV	0kV	-	0kV	0kV	4kV	4kV	4kV	4kV	4kV
	Solar irradiation	0kV	0kV	0kV	0kV	0kV	-	0kV	4kV	4kV	4kV	4kV	4kV
	Wind speed	0kV	0kV	0kV	0kV	0kV	0kV	-	4kV	4kV	4kV	4kV	4kV
VMU-O	Digital inputs: Ch1, Ch2	0kV	0kV	0kV	0kV	0kV	0kV	0kV	-	4kV	4kV	4kV	4kV
	Relay outputs: Ch1, Ch2	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV	4kV	4kV
VMU-S	Input string (V-)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV	>5MΩ
	Input string (A+)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV
	Output strimg (A+)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	>5MΩ	4kV	-

Note: The isolation between the two relay outputs is 4kV.

0kV	Inputs / outputs are not insulated. Use insulated probes and free of voltage contacts inputs.
4kVrms	EN61010-1, IEC60664-1 - Over-voltage category III, Pollution degree 2, double insulation on systems with max. 300Vrms to ground
4kVrms	IEC60664-1 - Using protection device with clamping voltage ≤4KV (surge suppressor) the system insulation can be considered as reinforced for string output voltage up to 1000V. IEC60664-1, IEC61730-2 application class B: impulse withstand voltage 1,2/50µsec: 6000V.
4kV	Only if the fuse is not present. The fuse is only for over-current protection (it has not to be considered as a dis-connecting device).

CARLO GAVAZZI

General specifications

Operating temperature	-25 to +55°C (-13°F to 131°F) (R.H. from 0 to <90% non-condensing @ 40°C) See also "VMU-S input specifications"
Storage temperature	-30 to +70°C (-22°F to 158°F) (R.H. <90% non-condensing @ 40°C)
Over voltage category	Cat. III (IEC 60664, EN60664) For inputs from string: equivalent to Cat. I, reinforced insulation.
Insulation (for 1 minute)	See table "Insulation between inputs and outputs"
Dielectric strength	4000 VAC RMS for 1 minute
Noise rejection	
CMRR	65 dB, 45 to 65 Hz
EMC (Immunity)	According to EN61000-6-2
Electrostatic discharges	EN61000-4-2: 8kV air discharge, 4kV contact;
Immunity to irradiated Electromagnetic fields	EN61000-4-3 : 10V/m from 80 to 3000MHz;
Immunity to Burst	EN61000-4-4: 4kV on power lines, 2kV on single lines;
Immunity to conducted disturbances	EN61000-4-6: 10V from 150KHz to 80MHz;
Surge	EN61000-4-5: 500V on power supply; 4kV on string inputs.
EMC (Emission)	According to EN61000-6-3
Radio frequency suppression	According to CISPR 22
Standard compliance	
Safety	IEC60664, IEC61010-1 EN60664, EN61010-1
Approvals	CE, cULus Listed
Housing	
Dimensions (WxHxD)	17.5 x 90 x 67 mm
Material	Noryl, self-extinguishing: UL 94 V-0
Mounting	DIN-rail
Protection degree	
Front	IP40
Screw terminals	IP20

VMU-M connections

Connections	Screw-type
Cable cross-section area	1.5 mm^2 max, Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes	
1.5 mm^2	3+3 screw terminals used for two temperature inputs 3 screw terminals used for RS485 communication 2 screw terminals used for power supply
Weight	Approx. 100 g (packing included)

VMU-S connections

Connections	Screw-type
Cable cross-section area	
Current	Min. 2.5 mm^2, max 6 mm^2 in case of flexible wire, Max. 10 mm^2 in case of rigid wire. Min./Max. screws tightening torque: 0.5 Nm / 1.1 Nm
Voltage (-)	Max 1.5 mm^2, Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes	
10 mm^2	1+1 screw terminals: 1 (+) for string input and 1 (+) for string output (to the Inverter)
1.5 mm^2	3 screw terminals: for negative connection of string
Weight	Approx. 100 g (packing included)

VMU-P connections

Connections	Screw-type
Cable cross-section area	1.5 mm² max. Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes	
1.5 mm²	3+3 screw terminals used for two temperature probes
	2 screw terminals used for wind speed sensor, 2 screw terminals used for solar irradiation sensor
Weight	Approx. 100 g (packing included)

VMU-O connections

Connections	Screw-type
Cable cross-section area	
Relay outputs and digital inputs	Max 1.5 mm² Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes	
1.5 mm²	2+2 screw terminals: two for 1st relay output and two for 2nd relay output (SPST type) 4 screw terminals: for two digital inputs

Power supply specifications

VMU-M	
Power supply	12 to 28 VDC
Power consumption	≤1W
VMU-S-P-O	
Power supply	Self-power supplied through the communication bus
Power consumption	≤0.7W

Sizing of Carlo Gavazzi DC power supply

VMU-S units	VMU-O units	VMU-P units	Consumption	Power supply part number
From 1 to 3	None	None	PS_W: 2.5W	SPM1 24 1
From 1 to 3	1	1	PS_W: 5W	SPM1 24 1
From 4 to 10	From 2 to 4	1	PS_W: 10W	SPM3 24 1
From 11 to 14	1	1	PS_W: 11W	SPM3 24 1
Max. 14	Max. 7	Max. 7		Note: VMU-P as 1.8W includes also the CG (part number DWS-V) wind sensor consumption.

Note: the consumption above includes already one VMU-U unit. For different combinations not mentioned above the consumption calculation is the following: PS_W:<1W+n_{VMU-S}*0,5W+n_{VMU-O}*0,7W+n_{VMU-P}*1,8W. Where "n" is number of power supplied units.

Stored set of variables in the VMU-M module

No.	Variable	Data format	Notes
1	Temperature 1	-60.0 to 400.0	The range is extended so to cover both °C and °F indication
2	Temperature 2	-60-0 to 400.0	The range is extended so to cover both °C and °F indication
3	BOS efficiency	0.0 to 999.9	"Total efficiency" result in percentage
4	AC energy value	0.0 to 99999.9	The value is in kWh and is the result of the totalized pulses coming from external energy meter

CARLO GAVAZZI

Stored set of variables coming from every single VMU-S module

No.	Variable	Data format	Sub-address	Notes
1	V	0.0 to 999.9	From 1 to 15	
2	A	0.0 to 20.00	From 1 to 15	
3	kW	0.0 to 99.99	From 1 to 15	
4	kWh	0.0 to 99999.9	From 1 to 15	
5	String efficiency	0.0 to 999.9		"PV string" effinciency result in percentage. Every string in the network has its own data.

Stored set of variables coming from every single VMU-P module

No.	Variable	Data format	Sub-address	Notes
1	Temperature 1 (PV module)	-60.0 to 400.0	From 1 to 15	PV module temperature (°C/°F). The range is extended so to cover both °C and °F indication
2	Temperature 2 (Evironment)	-60-0 to 400.0	From 1 to 15	Ambient temperature (°C/°F). The range is extended so to cover both °C and °F indication
3	Solar irradiation	0.0 to 9.999	From 1 to 15	Irradiation kW/m^2 (kW/feet^2). (e.g. in: 0 to 1kW/m^2 (1kW/feet^2), out: 0 to 100mV)
4	Wind speed	0.0 to 299.9	From 1 to 15	Wind speed (m/s) or feet/s

Stored set of variables in the VMU-M module

No.	Message	Notes
1	tHEft	Theft warning: removal of the connected upstream PV modules or cable problems from the PV modules to the VMU-S unit. The THEFT information is given in combination with the LED alarm on VMU-M and the LED colour code on every single string.
2	StrinG	String failure warning: the "String control" function has detected a failure. The STRING information is given in combination with the LED alarm on VMU-M and the LED colour code on every single string.
3	Conn.Po	The string is wrongly connected (reverse polarity)
4	SYSteM	Power-up self-test error
5	buS	Auxiliary bus communication error
6	ALArM	Variables alarm (any)

Historical data storing time table

Time interval (minutes) **(1)**	From 1 to 15 strings			
	Data storing time			
	Min. days	Min. weeks	Min. months	Note
1	6	0	0	**(2), (3), (4)**
5	34	4	1	**(2), (3), (4)**
10	69	9	2	**(2), (3), (4)**
15	104	14	3	**(2), (3), (4)**
30	208	29	7	**(2), (3), (4)**
60	416	59	14	**(2), (3), (4)**

(1) Every value stored in the memory, is the result of the average calculation, in the selected time interval of the variable being measured and sampled every 2 seconds.
(2) A maximum of 10 000 variable sets can be stored into the memory independently from the type and quantity of managed modules (for a maximum of 15).
(3) The stored variables are coming from the VMU-P module and are: PV module temperature, ambient temperature, irradiation and wind speed.
(4) The stored variables are relevant to both String efficiency and BOS efficiency.

CARLO GAVAZZI

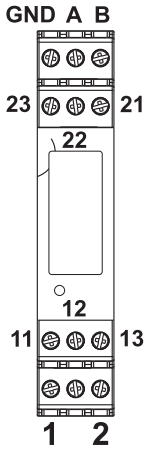
List of the variables that can be displayed and connected to ...

- RS485 communication port
- Real and virtual alarms and events
- Data-logging

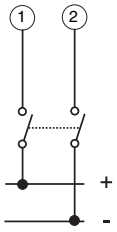
No	Variable	Event-logging	Data-logging	Alarm output	Module (from)	Notes
1	°C (°F) (input 1)	Yes	Yes	Yes	VMU-M	As alternative of status detection (4)
2	°C (°F) (input 2)	Yes	Yes	Yes	VMU-M	As alternative of variable (5)
3	% BOS efficiency	Yes	Yes	Yes	VMU-M	BOS efficiency calculation of the PV plant (in case of one VMU-M unit only). In all othre cases the calculaion is made by the software.
4	ON / OFF status (input 1)	Yes	Yes	No	VMU-M	As alternative of variable (1)
5	kWh (input 2)	Yes	Yes	No	VMU-M	Counting of pulses coming from an energy meter, as alternative of variable (2)
6	Reset kWh (input 2)	No	No	No	VMU-M	Resetting of totalized pulses from AC energy meter
7	Error: 1	Yes	No	Yes (a)	VMU-M	Local bus communication problems
8	Error: 2	Yes	No	Yes (a)	VMU-M	Changed system modules configuration
9	Error: 3	Yes	No	Yes (a)	VMU-M	Incoherent programming parameters
10	Error: 4	Yes	No	Yes (a)	VMU-M	More than one VMU-P unit connected to the bus
11	Error: 5	Yes	No	Yes (b)	VMU-M	Short circuit on probe input 1
12	Error: 6	Yes	No	Yes (b)	VMU-M	Open circuit on probe input 1
13	Error: 7	Yes	No	Yes (b)	VMU-M	Short circuit on probe input 2
14	Error: 8	Yes	No	Yes (b)	VMU-M	Open circuit on probe input 2
15	Status: 1	Yes	No	No	VMU-M	Local programming access
16	Status: 2	Yes	No	No	VMU-M	Power ON/OFF
17	V	Yes	Yes	Yes	VMU-S	Available from every string
18	A	Yes	Yes	Yes	VMU-S	Available from every string
19	kW	Yes	Yes	Yes	VMU-S	Available from every string
20	kWh	Yes	Yes	No	VMU-S	Available from every string
21	Reset string kWh	No	No	No	VMU-S	Resetting DC string energy meter
22	Reset all strings kWh	No	No	No	VMU-S	Resetting all DC string energy meters
23	% string efficiency	Yes	Yes	Yes	VMU-S	String efficiency
24	Status: 1	Yes	No	Yes	VMU-S	Incoherent programming parameters
25	Status: 2	Yes	No	Yes	VMU-S	Not connected solar string
26	Status: 3	Yes	No	Yes	VMU-S	Reverse string current or voltage
27	Status: 4	Yes	No	Yes	VMU-S	High temperature inside VMU-S unit
28	String control	Yes	Yes	Yes	VMU-S	
29	°C (°F) input 1	Yes	Yes	Yes	VMU-P	PV module temperature
30	°C (°F) input 2	Yes	Yes	Yes	VMU-P	Air temperature
31	kWp/m^2 (kWp/ft^2)	Yes	Yes	Yes	VMU-P	Solar irradiation
32	m/s (ft/s)	Yes	Yes	Yes	VMU-P	Wind speed
33	Error: 1	Yes	No	Yes	VMU-P	Incoherent programming parameters
34	Error: 2	Yes	No	Yes (c)	VMU-P	Short circuit on probe input 1
35	Error: 3	Yes	No	Yes (c)	VMU-P	Open circuit on probe input 1
36	Error: 4	Yes	No	Yes (c)	VMU-P	Short circuit on probe input 2
37	Error: 5	Yes	No	Yes (c)	VMU-P	Open circuit on probe input 2
38	Status: input 1	Yes	No	No	VMU-O	ON /OFF status detection
39	Status: input 2	Yes	No	No	VMU-O	ON /OFF status detection
40	Status: output 1	Yes	No	No	VMU-O	ON /OFF status detection
41	Status: output 2	Yes	No	No	VMU-O	ON /OFF status detection
42	Error: 1	Yes	No	Yes	VMU-O	Incoherent programming parameters

Note about "Alarm output": YES (a), YES (b) and YES (c) are according to the relevant letter "OR" logic alarms.

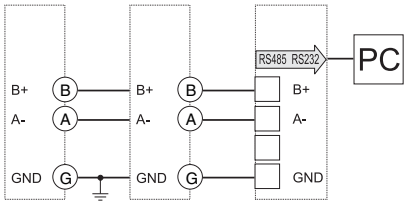
VMU-M connections



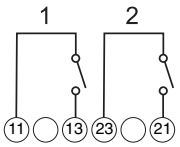
Power supply **Fig. 1**



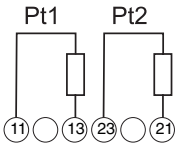
M-Bus and RS485 ports **Fig. 2**



Digital input 1 and input 2 **Fig. 3**

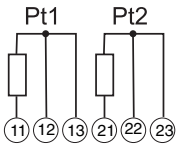


Temperature input 1 and input 2 **Fig. 4**



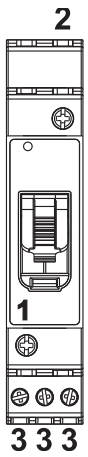
2 wires connections

Temperature input 1 and input 2 **Fig. 5**

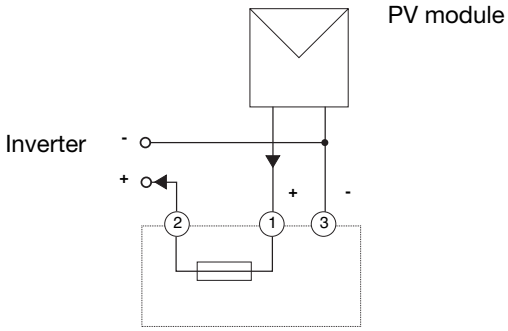


3 wires connections

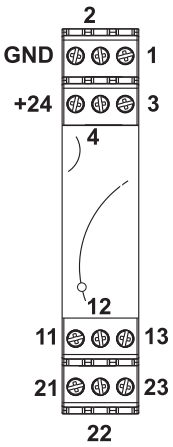
VMU-S connections



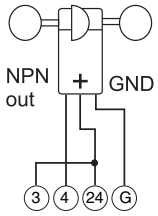
Measuring inputs **Fig. 1**



VMU-P connections

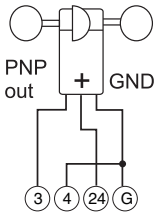


Wind speed input **Fig. 1**
Sensor model DWS-V



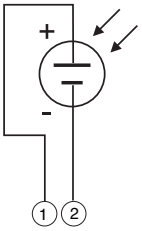
NPN output

Wind speed input **Fig. 2**
Sensor model DWS-V

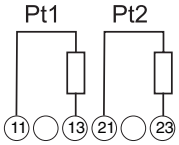


PNP output

Irradiation input **Fig. 3**

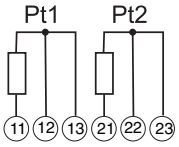


Temperature input 1 and input 2 **Fig. 4**



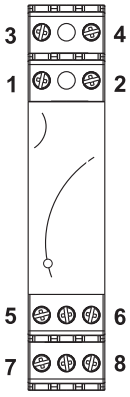
2 wires connections

Temperature input 1 and input 2 **Fig. 5**

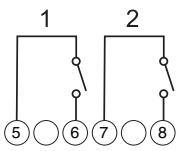


3 wires connections

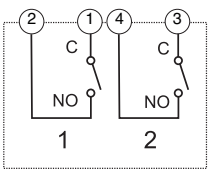
VMU-O connections



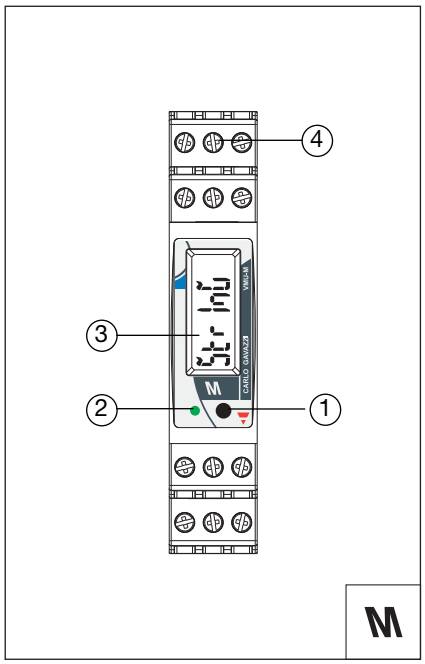
Digital input 1 and 2 **Fig. 1**



Digital outputs 1 and 2 **Fig. 2**



VMU-M Frontal panel description



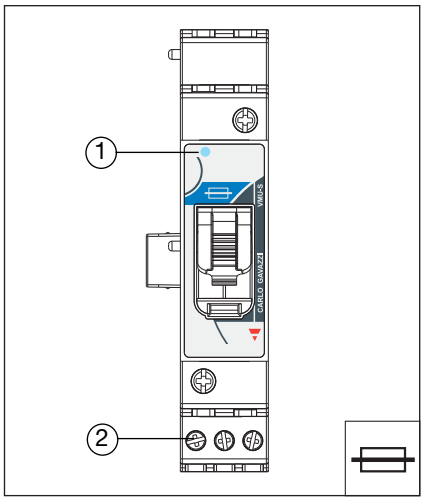
1. **Push button.**
   To program the configuration parameters and to scroll the variables. One key function: short time pushbutton click: variable scroll or parameter increasing. Long time pushbutton click: programming procedure entering, parameter selection confirmation.

2. **LED.**
   Green steady light: the module is power supplied and there is no communication on the RS485 bus. Green blinking light: the communication on the RS485 bus is working. Red: alarm detected (any). In case of alarm/communication condition the LED alternates its colour from red (alarm) to green. The blinking time is approx. 1 second.

3. **Display.**
   LCD-type with alphanumeric indications to:
   - display some configuration parameters;
   - display some measured variables.

4. **Screw terminals.**
   For power supply, bus and digital inputs/output connections

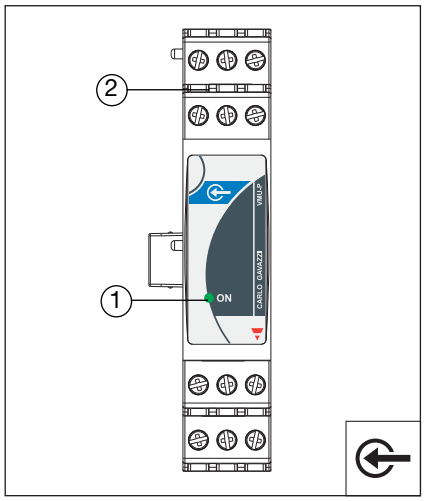
VMU-S Frontal panel description



1. **LED**
   Green: the power supply is ON, there is a string current up to 1A;
   Yellow: there is a string current from 1.1 to 3A;
   Light orange: there is a string current from 3.1 to 6A;
   Orange: there is a string current from 6.1 to 8A;
   Dark orange: there is a string current from 8.1 to 10A;
   Red: there is a string current higher than 10A;
   Cycling from blue to any other colour listed above (from yellow to red): string alarm
   Cycling from blue to green: PV modules removed or blown fuse.
   Cycling from blue to violet: inverted string polarity.
   Cycling from white to any other colour: the unit is enabled by VMU-M module for data reading and displaying and shows the status of the module according to the colour list above.

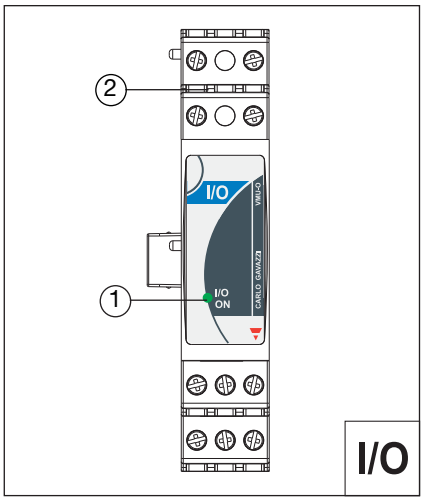
2. **Screw terminals**
   For string connections

VMU-P Frontal panel description



1. **LED**
   ON steady light: the module is power supplied.
   Green: the power supply is ON.
   White: the unit is enabled by VMU-M module for data reading and displaying
   .
2. **Screw terminals**
   For measuring input connection**s**

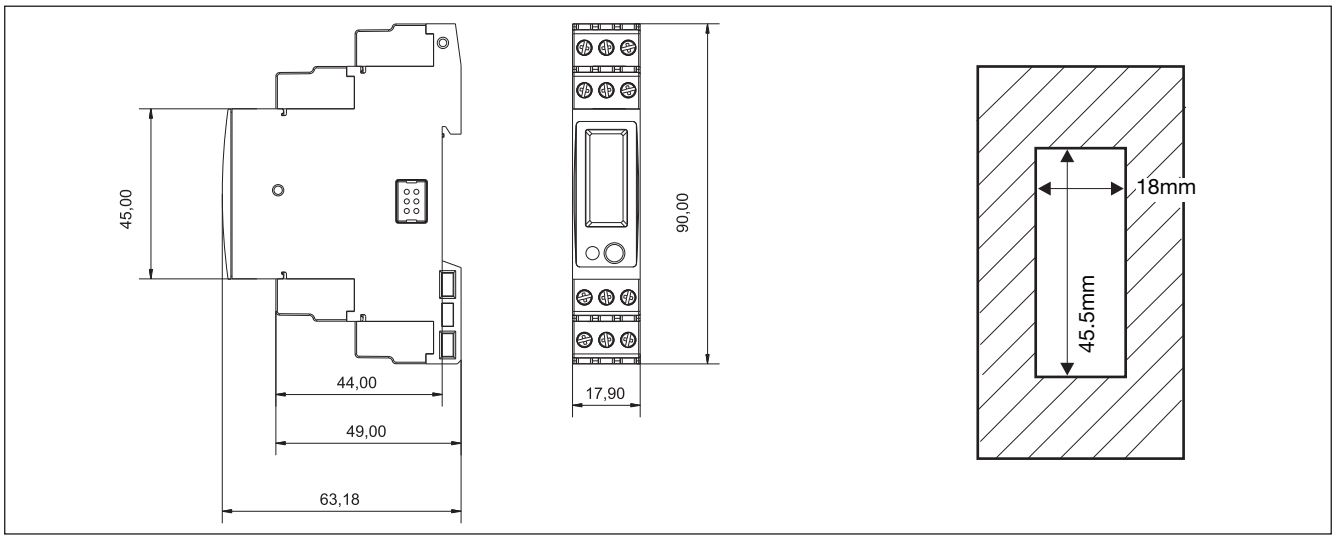
VMU-O Frontal panel description



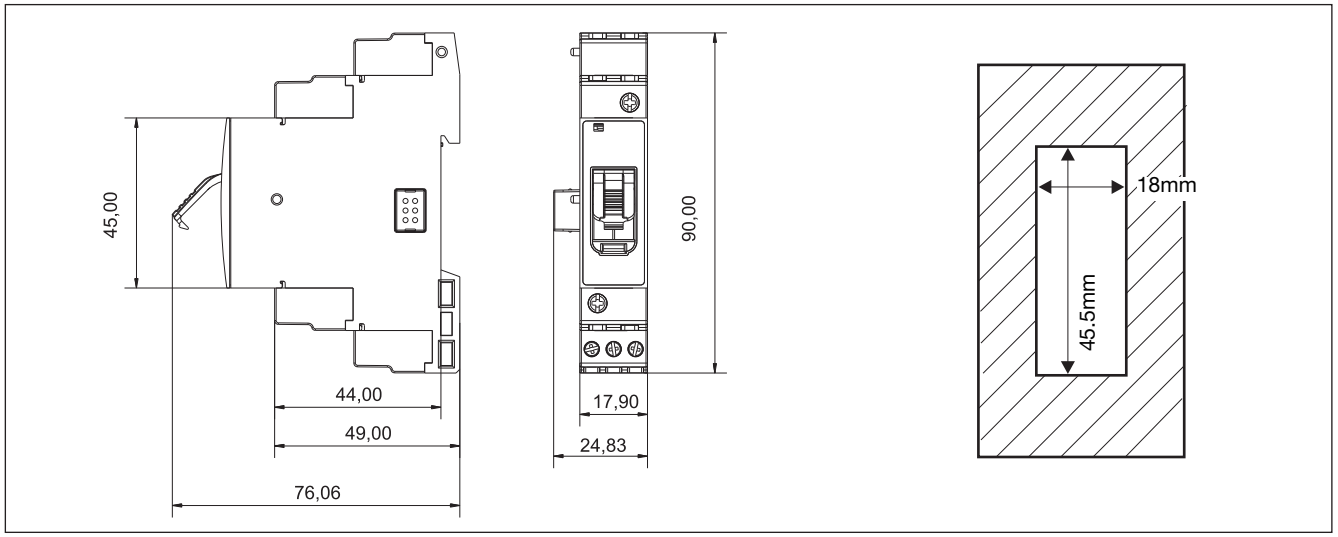
1. **LED**
   ON steady light: the module is power supplied.
   Green: the power supply is ON
   White: the unit is enabled by VMU-M module for data reading and displaying.
   Red: one or both digital inputs are activated
   Blue: one or both digital outputs are activated
   Cycling from one colour to any other one: the unit shows the status of the module according to the colour list above.
   The cycling time is approx. 1 second.

2. **Screw terminals**
   For digital inputs and outputs connections

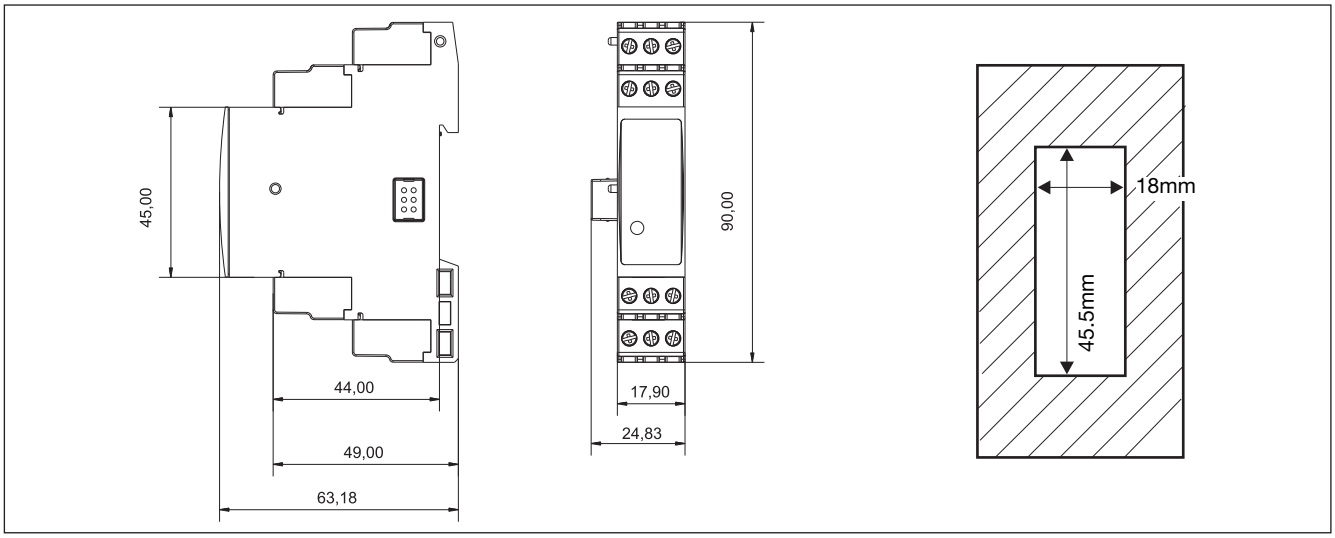
VMU-M Dimensions and panel cut-out



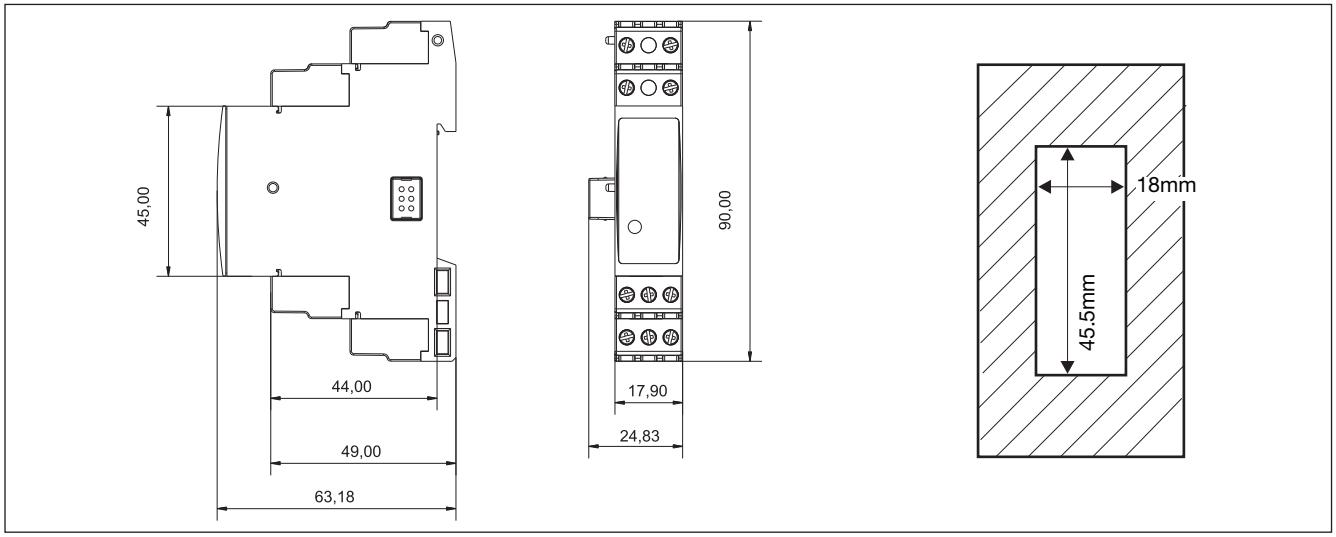
VMU-S Dimensions and panel cut-out



VMU-P Dimensions and panel cut-out



VMU-O Dimensions and panel cut-out



CARLO GAVAZZI

Eos-ArraySoft parameter programming and variable reading software

Eos-ArraySoft	Multi-language software (Italian, English, French, German, Spanish) for variable reading and parameters programming. The program runs under Windows 98/98SE/2000/ NT/XP/Vista	Data Storing	In pre-formatted XLS files (Excel data base).
		Data Transfer	Manual or automatic at programmable intervals.
		Data displaying	The following matrix is available: - String 1: V-A-kW-kWh; - String 2: V-A-kW-kWh; - String n: V-A-kW-kWh. - Main: PV module temperature, ambient temperature, irradiation and wind speed.
Application	Management of a limited network where Eos-ArraySoft manages basically one VMU-M unit with relevant VMU-S, VMU-P and VMU-O modules and maybe an energy meter connected to the VMU-M digital input	Alarm set-up	Alarm parameters and text
Configuration mode	There are two configuration levels: - the RS485 communication network which can include either one or more VMU-M units; - the auxiliary network with all the parameters relevant to the following modules: VMU-M, VMU-S, VMU-P, VMU-O.		