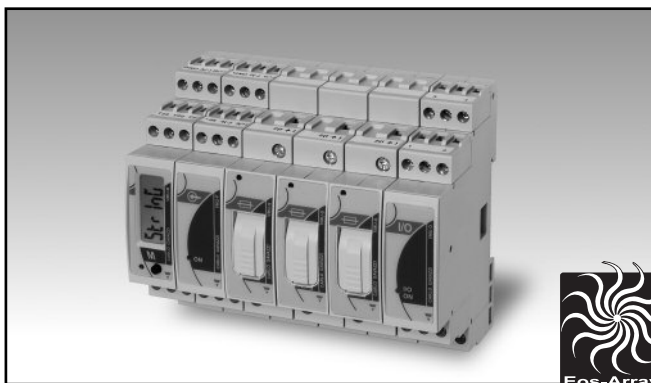


Energy Management Control solution for solar PV applications Type Eos-Array



- 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 module and data logger



- 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 and event stamping system
- Display readout: 6 DGTs
- 12 to 28 VDC power supply
- Dimensions: 1-DIN module
- Protection degree (front): IP40

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 pro-

vide by means of VMU-O modules two relay outputs so to 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.

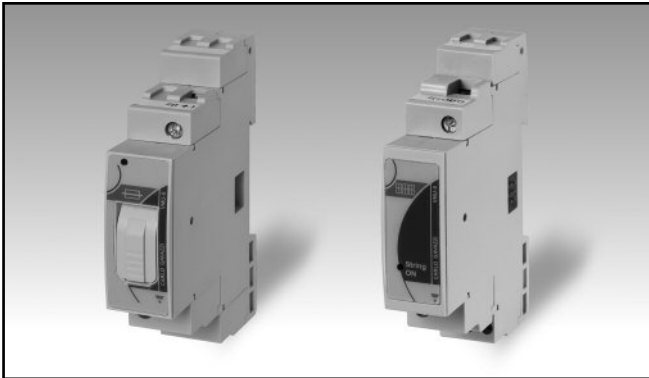
How to order **VMU-M 4 A S1 T2 X**



Type Selection

Function	Power supply	Communication	Inputs
4: Data storage 4Mbyte (*)	A: From 12 to 28VDC (*)	S1: RS485 Modbus (*)	T2: two temperature inputs or two digital inputs for free of voltage reading contacts (*)
Option	(*) as standard.		
X: none			

VMU-S, string measuring unit



- Direct DC voltage measurement up to 1000V
- Energy measurements: kWh
- Direct DC current measurement up to 16A or up to 30A without fuse
- Instantaneous variables data format: 4 DGTs
- 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

- Integrated 10.3x38mm fuse holder for string protection
- Dimensions: 1-DIN module
- Protection degree (front): IP40

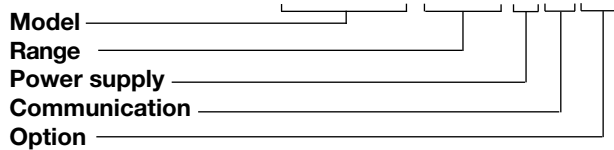
- String alarm management by means of VMU-M unit only
- Fuse blow detection by means of VMU-M unit only
- PV module connection control by means of VMU-M unit only

Product Description

Variables measuring unit with built-in protection fuse-holder (the fuse is not provided); particularly indicated for DC current, voltage, 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

or 30A depending on the model. Moreover the unit is provided with an auxiliary serial communication bus. Alarms, 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**



Type Selection

Range	Power supply	Communication	Option
AV10: 1000V DC, 16A (Direct connection) (*)	X: from 12 to 28VDC, self-power supply from VMU-M unit	S: auxiliary communication bus, compatible only to VMU-M module (*)	XX: none (no fuse holder) FX: with fuse holder
AV30: 1000V DC, 30A (Direct connection) (**). In this case the "Option" is "XX".			

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

VMU-P, environment variable unit

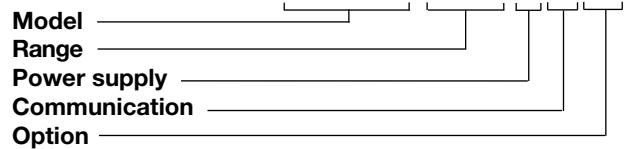


- Measurements: PV module temperature, air temperature, sun irradiation, wind speed
- Two temperature inputs: Pt100 or Pt1000
- One 120mV DC input with scaling capability for irradiation measurement
- One pulse input for wind speed measurement
- Auxiliary communication bus to VMU-M unit
- Auxiliary power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

Product Description

Environment variable measurement unit particularly indicated for PV module temperature, air 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**



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.

VMU-O, inputs/outputs unit



- Expansion I/O module (digital inputs and outputs)
- 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

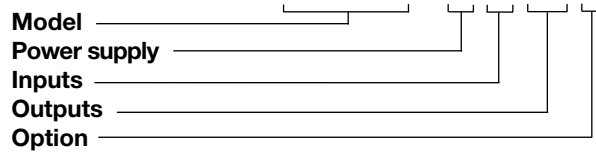
Product Description

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



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.



VMU-M Display and LED specification

Display Type Information read-out	1 line (max: 6-DGT) LCD, h 7mm From 4 to 6-DGT depending on the information.	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.
LED Type Status and colour	Dual colour Green steady light: the module is power supplied and there is no communication on the RS485 bus.	

VMU-S LED specification

LED Type Status Colour AV10 range code	Multicolor ON steady light: the module is power supplied and there is no alarm. 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. Green ⇒ OFF: module not acknowledged in the Eos-Array. Cycling from blue to any other colour listed above (from yellow to red): string alarm. Cycling from blue to green: 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 AV30 range code	colour list above. The cycling time is approx. 1 second. Green: the power supply is ON, there is a string current up to 1A; Yellow: there is a string current from 1.1 to 6A; Light orange: there is a string current from 6.1 to 12A; Orange: there is a string current from 12.1 to 16A; Dark orange: there is a string current from 16.1 to 20A; Red: there is a string current higher than 20A; White: the unit is enabled by VMU-M module for data reading and displaying. Green ⇒ OFF: module not acknowledged in the Eos-Array. Cycling from blue to any other colour listed above (from yellow to red): string alarm. 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.
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VMU-P LED specification

LED Type Status and colour	Multicolor Green: the power supply is ON.	White: the unit is enabled by VMU-M module for data reading and displaying.
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VMU-O LED specification

LED		
Type	Multicolor	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.
Status and 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:	

VMU-M input specifications

Digital inputs		Insulation	See the table "Insulation between inputs and outputs"
Number of inputs	2	Temperature inputs	2 Pt100, Pt1000 2 or 3-wire connection Up to 10Ω. See "Temperature input characteristics" ±150ppm/°C Selectable °C or °F See the table "Insulation between inputs and outputs"
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.	Temperature drift Engineering unit Insulation	
Input frequency	20Hz max, duty cycle 50%	Key-pad	1 push-button for variable scrolling and programming. Full programming can be carried out only using Eos-ArraySoft.
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		

VMU-S input specifications

Rated inputs			
Current type	1 (shunt)	Voltage	from 0.05A to 16A ±(0.5%RDG+2 DGT)
Current range	AV10 range: 16A DC @ 40°C, 15A @ 50°C, 14A @ 55°C, 12A @ 60°C, 10A @ 65°C AV30 range: 30A DC @ 55°C, 25A DC @ 60°C, 20A DC @ 65°C	Power	from 20V to 1000V ±(1% RDG+ 2DGT)
Voltage	AV10 range: 1000V DC AV30 range: 1000V DC	Energy	±(1% RDG)
Accuracy	(@25°C ±5°C, R.H. ≤60%)	Start up current	0.05A
AV10 range code		Start up voltage	10V
Current	±(0.5%RDG+2 DGT)	AV30 range code	
		Current	±(0.5%RDG+2 DGT) from 0.2A to 30A
		Voltage	±(0.5%RDG+2 DGT) from 20V to 1000V
		Power	±(1% RDG+ 2DGT)

VMU-S input specifications (cont.)

Energy	±(1% RDG)	AV30 range code	
Start up current	0.2A	Voltage	> 2.5M
Start up voltage	10V	Current	< 0.003Ω @ 0.5 Nm (screw terminal torque).
Temperature drift	≤200ppm/°C		
Measurement sampling time	2 sec.	Voltage Overloads	
Variables format		Continuous	1100V
Instantaneous variables	4-DGT (A, W), 5-DGT (V)	For 500ms	1600V
Resolution	0.1V; 0.01A; 0.01kW	To earth	800V
Energies	Total: 5+1 DGT (0.1KWh)	Current Overloads	
Max. and Min. data format	See "Stored set of variables coming from ..."	Continuous	AV10 range: 16A
			AV30 range: 30A
Input impedance		For 1s	AV10 range: 100A max
AV10 range code			AV30 range: 150A max
Voltage	> 2.5MΩ	Protection	
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	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)

VMU-P input specifications

Temperature drift	≤200ppm/°C		
Variables format		Temperature drift	25% to 120% FS.
Instantaneous variables	4 DGT (Temperature, solar irradiation and wind speed)	Scaling factor	±150ppm/°C
Resolution	0.1°C/0.1°F; 1W/m ² , 1W/ft ² ; 0.1m/s, 0.1ft/s	Operating mode	Dual scale:
Max. and Min. data format	See "Stored set of variables coming from ..."		- Input: programmable range from 0 to 999.9 (mVDC)
			- Display: programmable range from 0.000 to 9.999 (kW/m ² , kW/ft ²)
Temperature probe inputs		Decimal point position	Fixed.
Number of inputs	2 (Input 1: PV module; Input 2: air)	Impedance	> 30KΩ
Temperature probe	Pt100 or Pt1000	Overload	10VDC (measurement available up to 1V on both display and communication bus)
Number of wires	Up to 3-wire connection	Continuous	20VDC
Wire compensation	Up to 10Ω.		See the table "Insulation between inputs and communication bus"
Accuracy (Display + RS485)	See table "Temperature input characteristics"		
Temperature drift	±150ppm/°C	For 1s	
Engineering unit	Selectable °C or °F	Insulation	
Insulation	See the table "Insulation between inputs and communication bus"		
Irradiation sensor inputs		Wind speed sensor inputs	
Number of inputs	1	Number of inputs	1
Range	0 to 120mVDC	Range	0 to 1000Hz max, duty cycle 50%
Accuracy (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT)	Accuracy (@25°C ±5°C, R.H. ≤60%)	±(0.02%RDG+1DGT)
(Display + RS485)	0% to 25% FS; ±(0.1%RDG+1DGT)		0% to 25% FS;



VMU-P input specifications (cont.)

(Display + RS485)	$\pm(0.01\%RDG+1DGT)$ 25% to 110% FS. $\pm 150ppm/^{\circ}C$	Impedance Operating input	680 Ω 2.5V _{peak} to 9V _{peak} /5mA _{peak} to 35mA _{peak} , duty cycle 50% 220 Ω
Temperature drift	Dual scale: - Input: programmable range from 0 to 999.9 (Hz) - Display: programmable range from 0 to 299.9 (m/s, ft/s)	Impedance Overload	7V _{RMS} /25mA _{RMS} (AC/DC) 14V _{RMS} /50mA _{RMS} (AC/DC) See the table "Insulation between inputs and com- munication bus"
Scaling factor		Continuous	
Operating mode		For 1s Insulation	
Decimal point position	Fixed and depending on the input/display scale.		

VMU-M and VMU-P Temperature input characteristics

Probe	Range	Accuracy	Min Indication	Max Indication
Pt100	-50 $^{\circ}C$ to +200.0 $^{\circ}C$	$\pm(0.5\%RDG +5DGT)$	-50.0	+200.0
Pt100	-58 $^{\circ}F$ to +392 $^{\circ}F$	$\pm(0.5\%RDG +5DGT)$	-58.0	+392.0
Pt1000	-50 $^{\circ}C$ to +200.0 $^{\circ}C$	$\pm(0.5\%RDG +5DGT)$	-50.0	+200.0
Pt1000	-58 $^{\circ}F$ to +392 $^{\circ}F$	$\pm(0.5\%RDG +5DGT)$	-58.0	+392.0

VMU-M Output specifications

RS485		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; - Blown protection fuse; - 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). See the table "Insulation between inputs and outputs"
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 Parity: none		
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.	Insulation	
Special functions	None		
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 output	
Digital inputs		Number of outputs	2
Number of inputs	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). Relay, SPST type AC 1-5A @ 250VAC AC 15-1A @ 250VAC Available by means of VMU-O module only
Working mode	Detection of OPEN/CLOSED contact status	Type	Relay, SPST type AC 1-5A @ 250VAC AC 15-1A @ 250VAC Available by means of VMU-O module only
Purpose	Trip of protection detection, the status is transmitted only by means of the communication port.	Insulation	See the table "Insulation between inputs and outputs"
Input frequency	2Hz max, duty cycle 50%		
Contact reading voltage	3.3VDC		
Contact reading current	<2mA		
Contact resistance	≤300Ω closed contact; ≥10kΩ open contact		
Insulation	See the table "Insulation between inputs and outputs"		

Main Function

Displaying			
Own VMU-M module	1 parameter per page See "Stored set of variables from ..." and "Alarm and diagnostics messages"	1st level	2 protection levels of the programming data: Password "0", no protection;
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...").	2nd level	Password from 1 to 9999, all data are protected
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...").	Reset	By means of the front push-button when the relevant VMU-S is selected
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...").	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"
Password	Numeric code of max. 4 digits;		

Main Function (Cont.)

Clock Functions Daylight-saving enabling Time format Date format Battery life	Universal clock and calendar. Activation: NO/YES Hours:minutes with selectable 24 hours or AM/PM 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. 10 years	Event logging Data displaying Function enabling Type of stored events Number of events Data reset Data format Storage method Memory type Memory retention time	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. Activation: NO/YES VMU-O digital input/output status change (real and virtual alarms), string alarms (see "String control"), 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" Max. 10 000. The reset can be carried out only using Eos-ArraySoft. Event, date (dd:mm:yy) and time (hh:mm:ss) Circular FIFO Flash 10 years
Data logging Data Function enabling Function description Stored data type Storage interval Sampling management Storage duration Data format Storage method Memory type Memory retention time	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. Activation: NO/YES All the events gathered from both VMU-S, VMU-O and VMU-P modules are stored individually into the internal memory. Variables: V, A, W, Wh, PV module temperature, ambient temperature, irradiation, wind speed, string efficiency and BOS efficiency. Selectable: 1-5-10-15-30-60 minutes 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. Before overwriting: depending on the storage interval, see "Historical data storing time table" Variables, date (dd:mm:yy) and time (hh:mm:ss) Circular FIFO Flash 10 years	String control Function enabling Function selection Function description	Activation: NO/YES Match max. control or median control 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 at the same instant from

Main Function (Cont.)

<p>String window alarm</p> <p>Other alarms</p>	<p>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. 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.</p> <p>The alarms can be connected also to: A and V.</p>	<p>Control type “1”</p> <p>Control type “2”</p> <p>BOS efficiency measurement</p> <p>Fuse blow detection (only AV10 range code)</p>	<p>The VMU-P module is present and both PV module temperature and irradiation are measured to calculate the reference value for the efficiency calculation.</p> <p>The VMU-P module is present and both ambient temperature and irradiation are measured to calculate the reference value for the efficiency calculation.</p> <p>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.</p>
<p>“PV string” efficiency measurement</p> <p>Function enabling</p> <p>Control type “0”</p>	<p>Activation: NO/YES</p> <p>Three type of controls are available</p> <p>The VMU-P unit is not available therefore the single strings are used to calculate the reference value for the efficiency calculation.</p>	<p>Wrong PV string connection</p>	<p>Warning message transmission through the local port to the VMU-M unit.</p> <p>Warning message transmission through the local port to the VMU-M unit.</p>

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.

Insulation between inputs and outputs

Module	Type of input/output	Any	VMU-M			VMU-P			VMU-O		VMU-S		
		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 string (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 string (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 $\leq 4kV$ (surge suppressor) the system insulation can be considered as reinforced for string output voltage up to 1000V (800V to earth). 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 disconnecting device).

General specifications

Operating temperature	See table "String current vs. operating temperature".	Dielectric strength	4000 VAC RMS for 1 minute
Storage temperature	-30 to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C)	Noise rejection CMRR	65 dB, 45 to 65 Hz
Over voltage category	Cat. III (IEC 60664, EN60664) For inputs from string: equivalent to Cat. I, reinforced insulation.	EMC (Immunity) Electrostatic discharges	According to EN61000-6-2 EN61000-4-2: 8kV air discharge, 4kV contact;
Insulation (for 1 minute)	See table "Insulation between inputs and outputs"	Immunity to irradiated Electromagnetic fields	EN61000-4-3 : 10V/m from 80 to 3000MHz; EN61000-4-4: 4kV on power lines, 2kV on single lines;
		Immunity to Burst	

General specifications (cont.)

Immunity to conducted disturbances	EN61000-4-6: 10V from 150KHz to 80MHz; EN61000-4-5: 500V on power supply; 4kV on string inputs.	Approvals	CE, cULus Listed
Surge		Housing Dimensions (WxHxD) Material	17.5 x 90 x 67 mm Noryl, self-extinguishing: UL 94 V-0
EMC (Emission) Radio frequency suppression	According to EN61000-6-3 According to CISPR 22	Mounting	DIN-rail
Standard compliance Safety	IEC60664, IEC61010-1 EN60664, EN61010-1	Protection degree Front Screw terminals	IP40 IP20

Connections

VMU-M Connections Cable cross-section area	Screw-type 1.5 mm ² max, Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm	Voltage (-)	Max 1.5 mm ² , Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes 1.5 mm ²		Screw terminal purposes 16 mm ²	1+1 screw terminals: 1 (+) for string input and 1 (+) for string output (to the Inverter) 3 screw terminals: for negative connection of string
VMU-S AV10 Connections Cable cross-section area Current (+)	Screw-type 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	VMU-P Connections Cable cross-section area	Screw-type 1.5 mm ² max. Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Voltage (-)		Screw terminal purposes 1.5 mm ²	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
Screw terminal purposes 10 mm ²	1+1 screw terminals: 1 (+) for string input and 1 (+) for string output (to the Inverter) 3 screw terminals: for negative connection of string	VMU-O Connections Cable cross-section area Relay outputs and digital inputs	Screw-type Max 1.5 mm ² Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
1.5 mm ²		Screw terminal purposes 1.5 mm ²	2+2 screw terminals: two for 1st relay output and two for 2nd relay output (SPST type) 4 screw terminals: for two digital inputs
VMU-S AV30 Connections Cable cross-section area Current (+)	Screw-type Min. 2.5 mm ² , max 10 mm ² in case of flexible wire, Max. 16 mm ² in case of rigid wire. Min./Max. Hole dimension: 7.2x5.1mm, screws tightening torque: 0.5 Nm / 1.1 Nm	Weight (all modules)	Approx. 100 g (packing included)

Power supply specifications

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

VMU-S AV10 Input current	VMU-O Max. contact current	Other modules	Operating temperature	
10A DC max.	2.5A	VMU-M, VMU-P	-25 to + 65°C	-13°F to 149°F
12A DC max.	3.0A	VMU-M, VMU-P	-25 to + 60°C	-13°F to 140°F
14A DC max.	3.5A	VMU-M, VMU-P	-25 to + 55°C	-13°F to 131°F
15A DC max.	4.0A	VMU-M, VMU-P	-25 to + 50°C	-13°F to 122°F
16A DC max.	5.0A	VMU-M, VMU-P	-25 to + 40°C	-13°F to 104°F
VMU-S AV30 Input current				
20A DC max.	2.5A	VMU-M, VMU-P	-25 to + 65°C	-13°F to 149°F
25A DC max.	3.0A	VMU-M, VMU-P	-25 to + 60°C	-13°F to 140°F
30A DC max.	3.5A	VMU-M, VMU-P	-25 to + 55°C	-13°F to 131°F

R.H. < 90% non condensing @ 40°C (104°F)

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

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

No.	Variable	Data format	Sub-address	Notes
1	V	0.0 to 1250.0	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" efficiency 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 (Environment)	-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

Alarm and diagnostics messages

No.	Message	Notes
1	Conn.CY (AV10 only)	Fuse blow detection. The status of each fuse is indicated by the color change of the relevant LED on the VMU-S module.
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.PY	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.

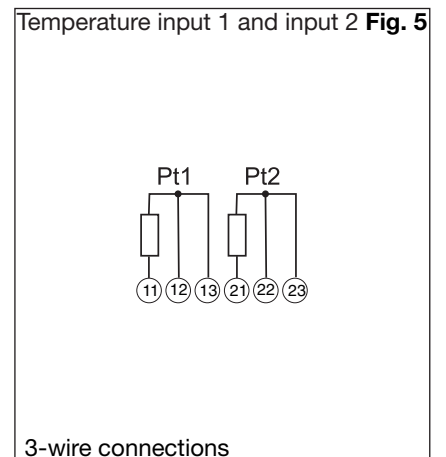
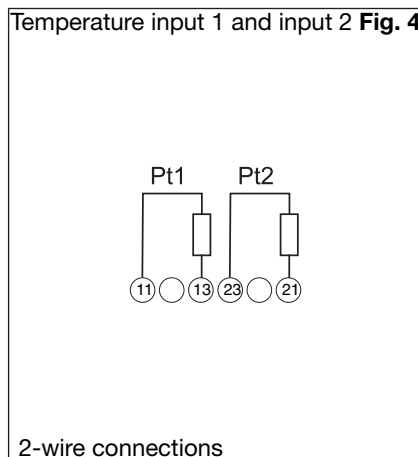
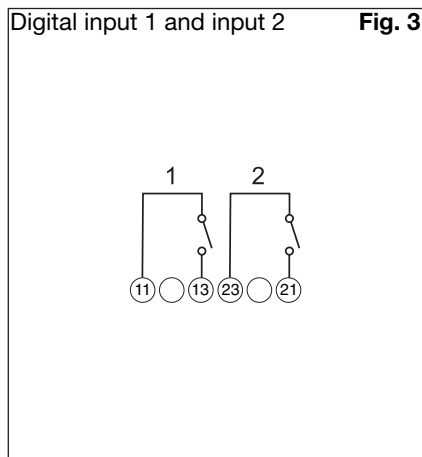
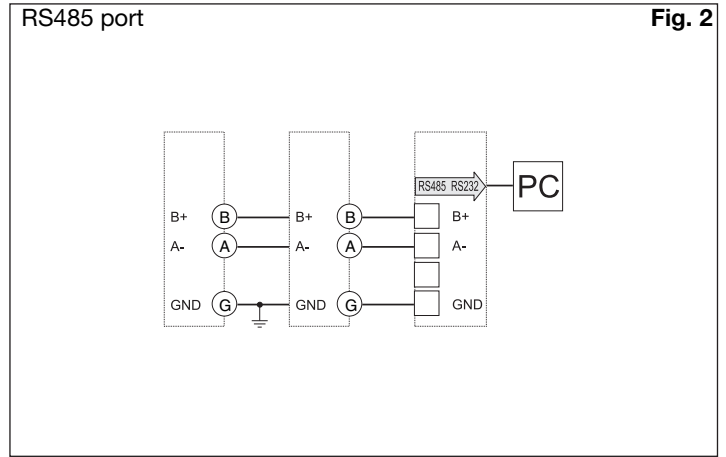
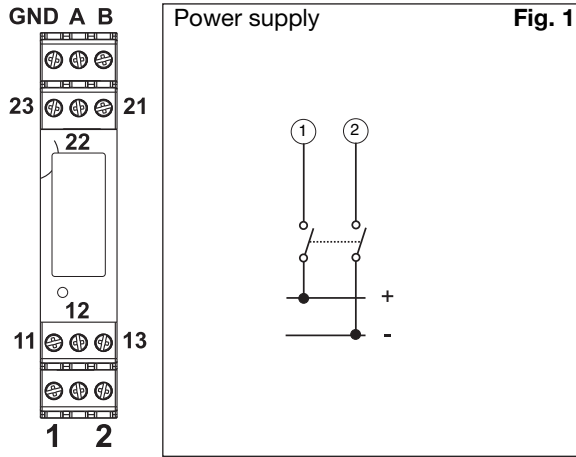
List of the variables that can be displayed and connected to ...

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

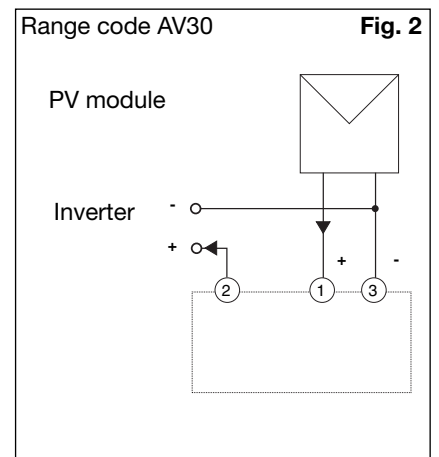
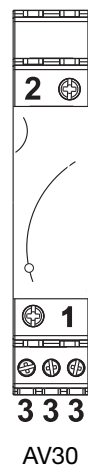
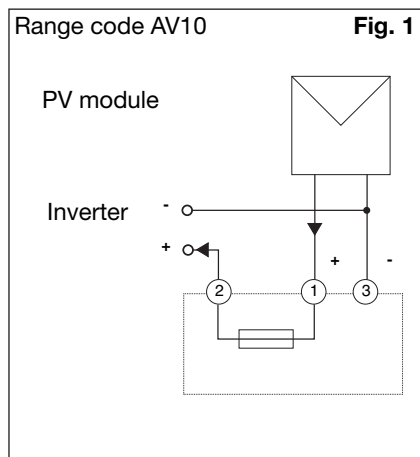
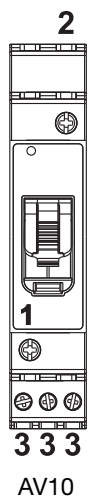
No	Variable	Event-logging	Data-logging	Alarm output	Module (from)	Notes
1	°C (°F) (input 1)	Yes	Yes	Yes	VMU-M	As alternative of status detection (4)
2	°C (°F) (input 2)	Yes	Yes	Yes	VMU-M	As alternative of variable (5)
3	% BOS efficiency	Yes	Yes	Yes	VMU-M	BOS efficiency calculation of the PV plant (in case of one VMU-M unit only). In all other cases the calculation 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	Fuse blow detection
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.

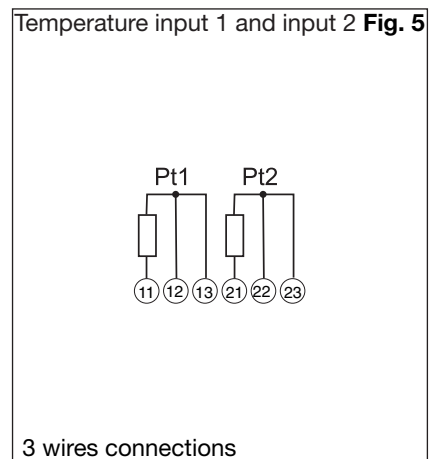
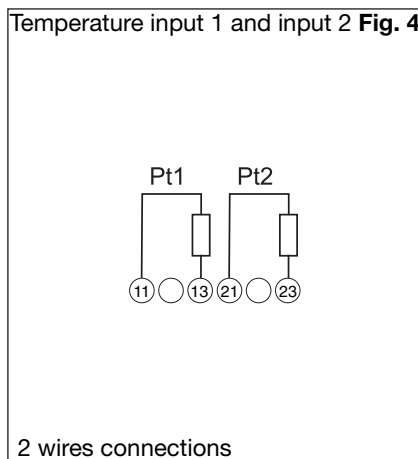
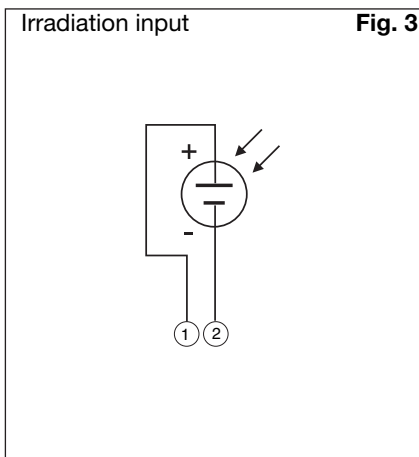
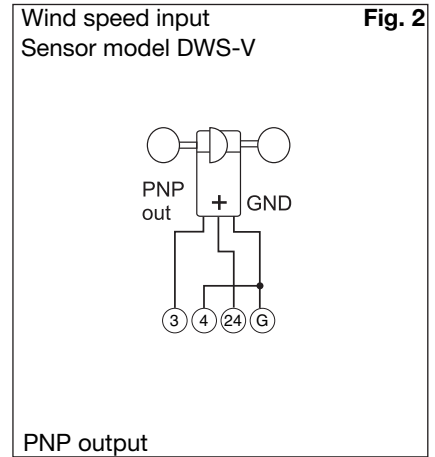
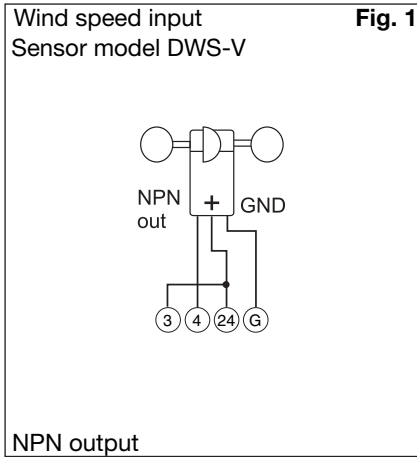
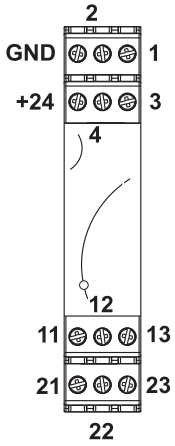
VMU-M connections



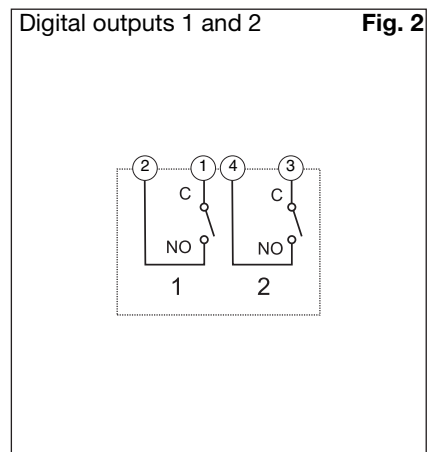
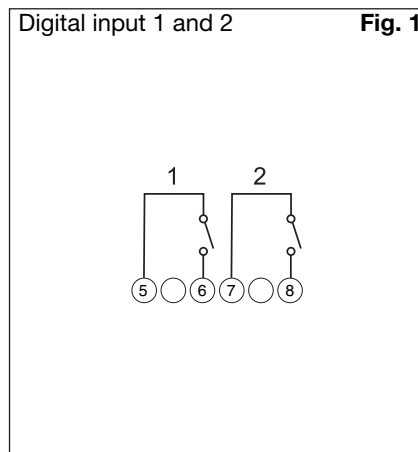
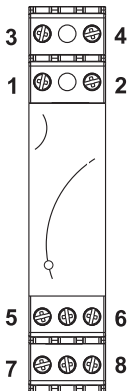
VMU-S (AV10 and AV30) connections



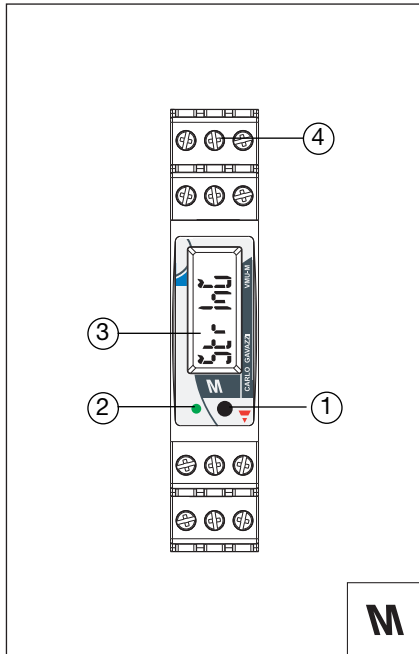
VMU-P connections



VMU-O connections



VMU-M Front 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.

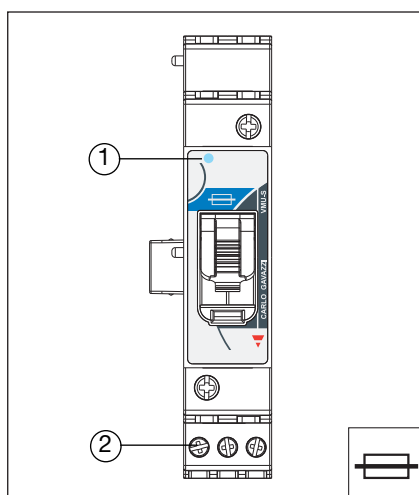
LCD-type with alphanumeric indications to:

- display some configuration parameters;
- display some measured variables.

4. Screw terminals.

For power supply, bus and digital inputs/output connections

VMU-S Front panel description (AV10 range code: 16A)



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;

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: blown fuse.

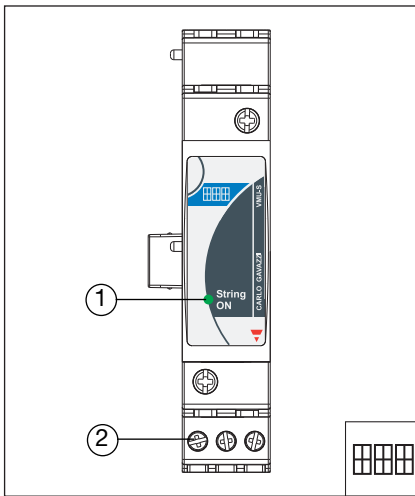
Cycling from blue to violet: inverted string polarity.

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-S Front panel description (AV30 range code: 30A)



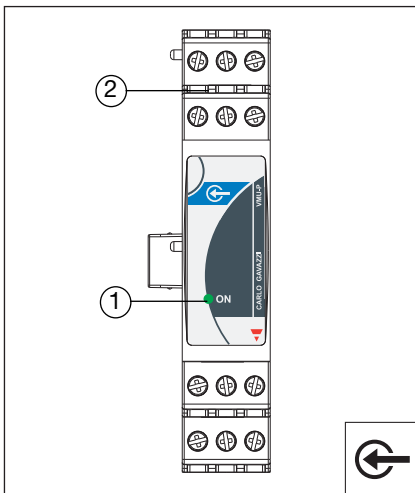
1. LED

Green: the power supply is ON, there is a string current up to 1A;
 Yellow: there is a string current from 1.1 to 6A;
 Light orange: there is a string current from 6.1 to 12A;
 Orange: there is a string current from 12.1 to 16A;
 Dark orange: there is a string current from 16.1 to 20A;
 Red: there is a string current higher than 20A;
 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 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 Front panel description



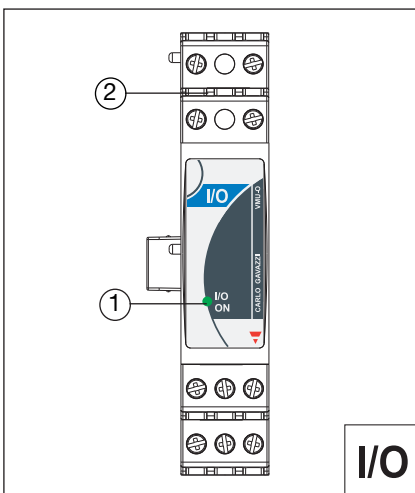
1. LED

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 connections

VMU-O Front panel description



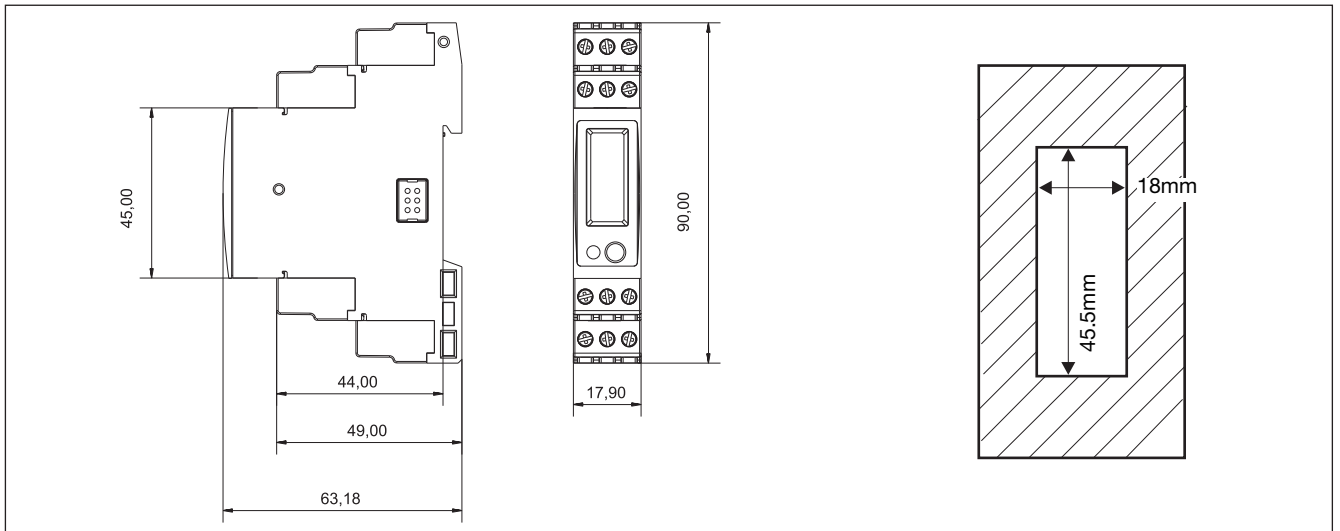
1. LED

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.

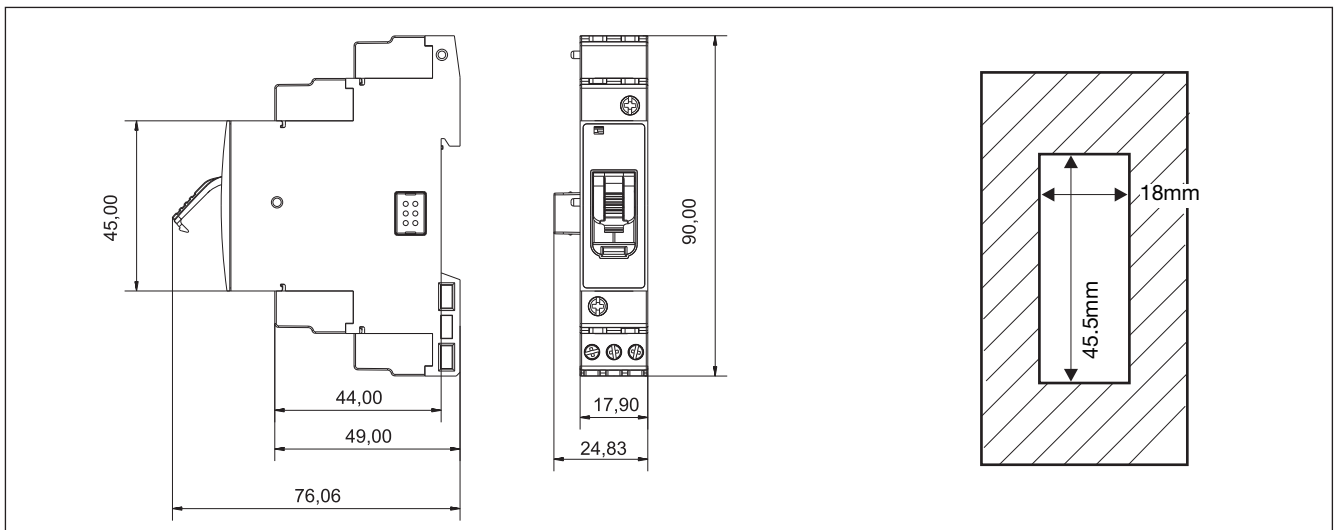
2. Screw terminals

For digital inputs and outputs connections

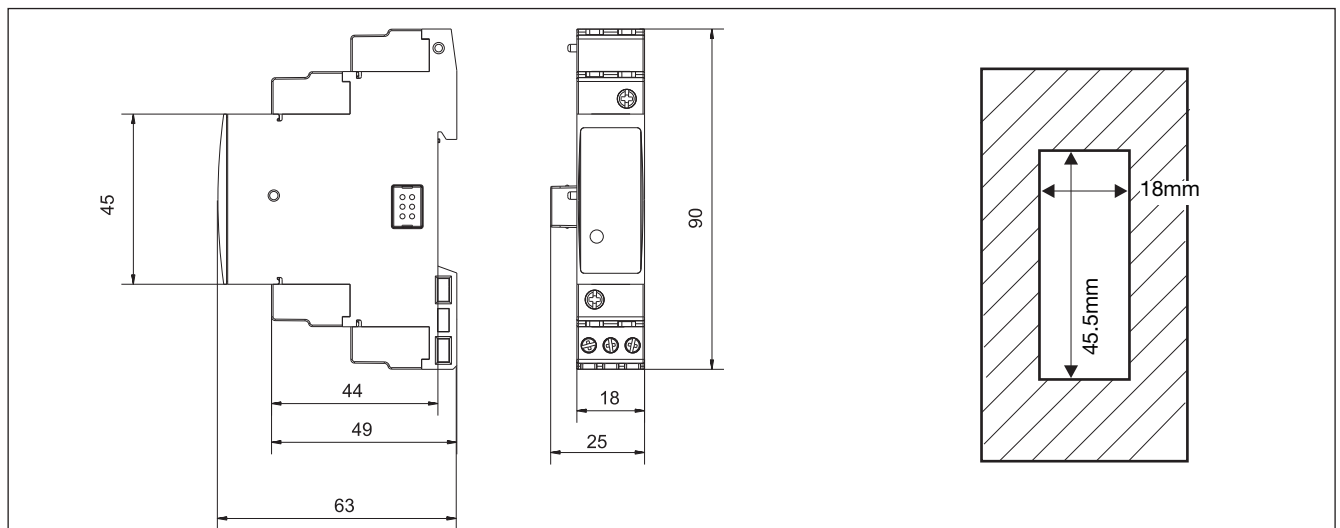
VMU-M Dimensions and panel cut-out



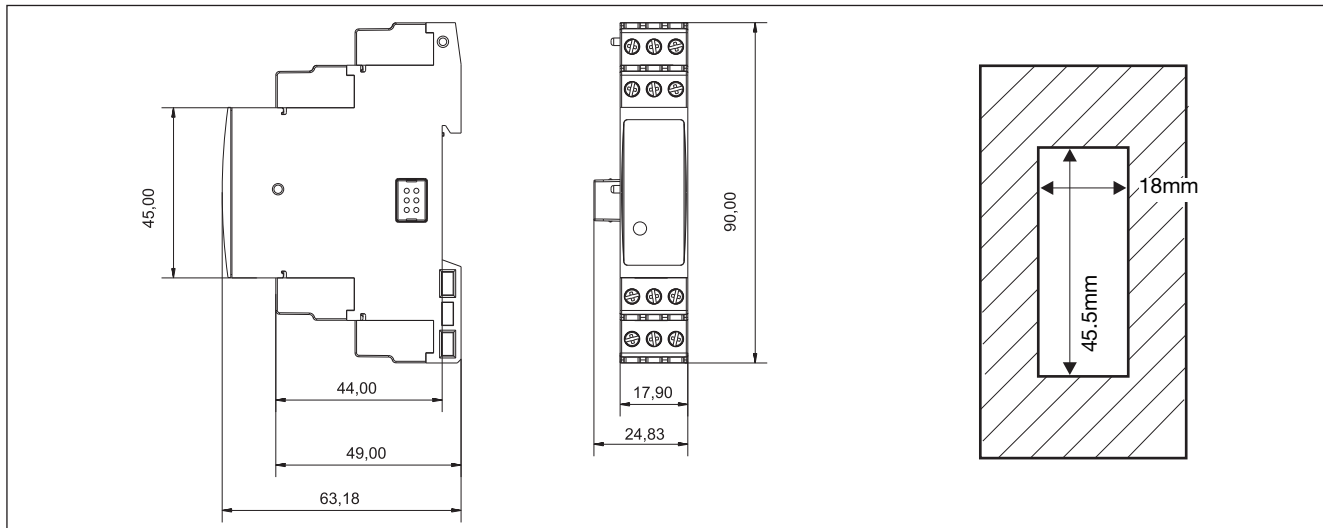
VMU-S (AV10) Dimensions and panel cut-out



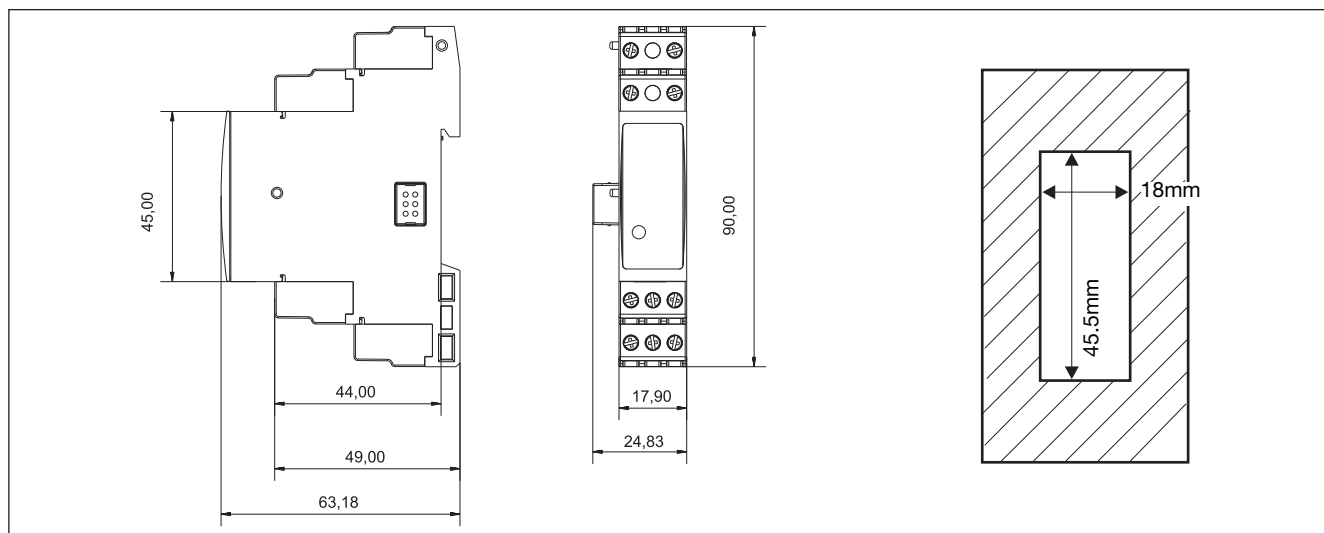
VMU-S (AV30) Dimensions and panel cut-out



VMU-P Dimensions and panel cut-out



VMU-O Dimensions and panel cut-out



Mean time to failure (MTTF)

Model	MTTF/MTBF - Years	Test conditions	Standard
VMU-M	24.2	gf, 50° C	MIL-HDBK-217F
VMU-S	35.4	gf, 50° C	MIL-HDBK-217F
VMU-P	65.4	gf, 50° C	MIL-HDBK-217F
VMU-O	31.7	gf, 50° C	MIL-HDBK-217F

gf: ground, fixed.

Eos-ArraySoft parameter programming and variable reading software

<p>Eos-ArraySoft</p> <p>Application</p>	<p>Multi-language software (Italian, English, French, German, Spanish) for variable reading and parameters programming. The program runs under Windows XP/Vista.</p> <p>Up to two different applications can be selected:</p> <ul style="list-style-type: none"> - Solar: a 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; - Solar extended: a management of a complex network where Eos-ArraySoft manages many VMU-M modules and relevant sub networks (VMU-S, VMU-P and VMU-O units) and maybe an energy meter (EM21-72D, EM24-DIN, EM26-96) connected to the same RS485 bus. 	<p>Configuration mode</p> <p>Data storing</p> <p>Data download</p> <p>Data displaying</p> <p>Alarm set-up</p> <p>Modem management</p>	<p>There are two configuration levels:</p> <ul style="list-style-type: none"> - 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. <p>In pre-formatted XLS files (Excel data base).</p> <p>Manual or automatic at programmable intervals.</p> <p>The following matrix is available:</p> <ul style="list-style-type: none"> - String 1: V-A-kW-kWh; - String 2: V-A-kW-kWh; - String n: V-A-kW-kWh. - Main: PV module temperature, air temperature, irradiation and wind speed. <p>Alarm parameters.</p> <p>GSM/GPRS modem configuration (connected to the PC) SMS messages.</p>
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