EOS

Технические характеристики

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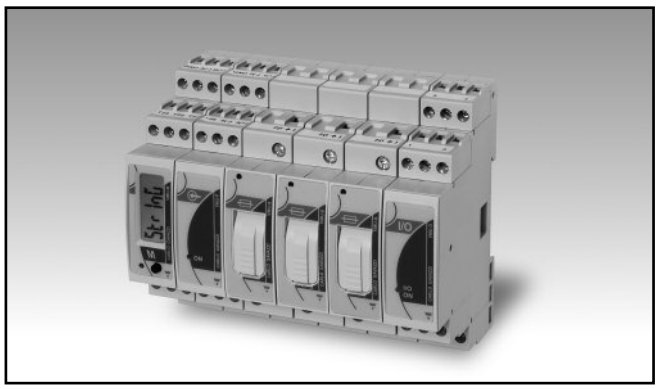
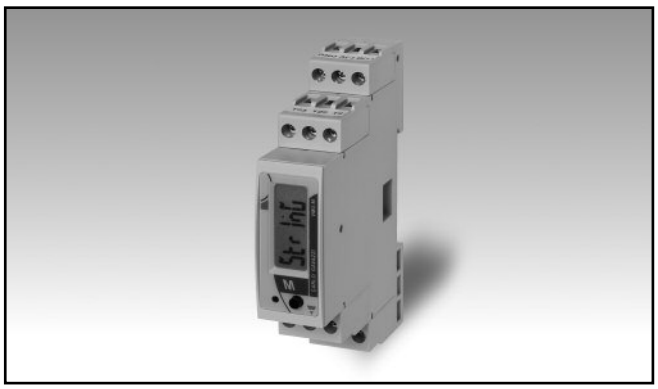
Energy Management
Control solution for solar PV applications
Type Eos-Array



- **Modular local control system for PV plants**
- **Up to 17 DIN modules configuration equivalent to 280mm width**
- **Eos-ArraySoft freeware software for easy product configuration**
- **Eos-Array can be formed by maximum 17 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;**
  - **max 1 VMU-1.**

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 provide 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

- **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.

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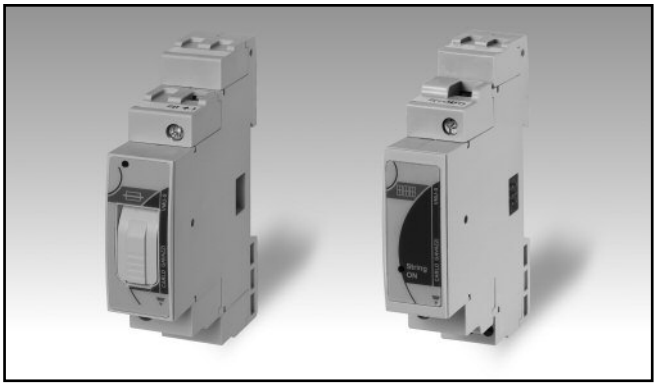
VMU-S, string measuring unit



- **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

Model
Range
Power supply
Communication
Option

Type Selection

Range

AV10: 1000V DC, 16A (Direct connection) **(*)**
AV30: 1000V DC, 30A (Direct connection) **(**)**. In this case the "Option" is "XX".

Power supply

X: from 12 to 28VDC, self-power supply from VMU-M unit

Communication

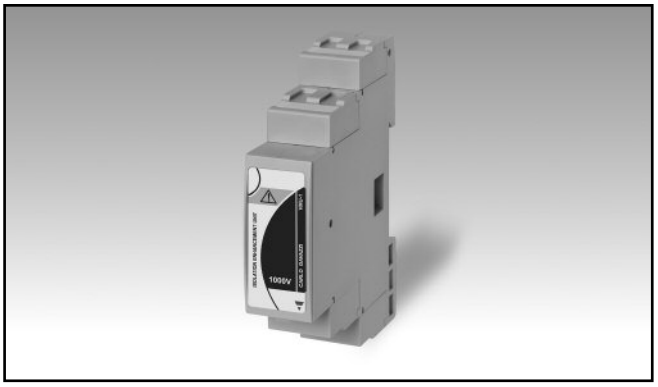
S: auxiliary communication bus, compatible only to VMU-M module **(*)**

Option

XX: none (no fuse holder)
FX: with fuse holder

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

VMU-1, isolation enhancement unit



- **Isolation enhancement of voltage measuring inputs to earth of VMU-S: from 800VDC (without VMU-1) to 1000VDC max.**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Isolation enhancement unit suitable to be used in combination with VMU modules. VMU-1 allows to enhance the isolation of the voltage measuring input to earth from 800VDC to 1000VDC. The module is to be mounted between the first VMU-S and all the other VMU modules. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-1 1000

Standard model

Type Selection

Standard model

Isolation voltage 1000V: isolation enhancement on VMU-S voltage measuring input to earth from 800VDC (without module) to 1000VDC.
Note: only one VMU-1 is needed per Eos-Array

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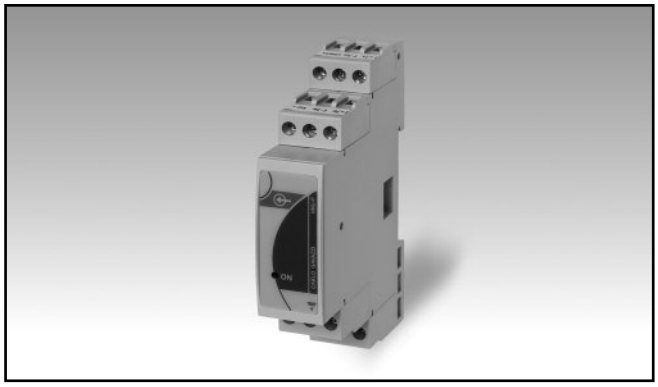
VMU-P, environment variable unit



- **Measurements: PV module temperature, air temperature, sun irradiation, wind speed**
- **Two temperature inputs: Pt100 or Pt1000**
- **One 120mV or 20mA 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

Model
Range
Power supply
Communication
Option

Type Selection

Range	Power supply	Communication	Option
2TIW: Two "Pt" temperature type probes, mV 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
2TCW: Two "Pt" temperature type probes, mA sun irradiation and wind speed measuring inputs (*)			

(*) as standard.

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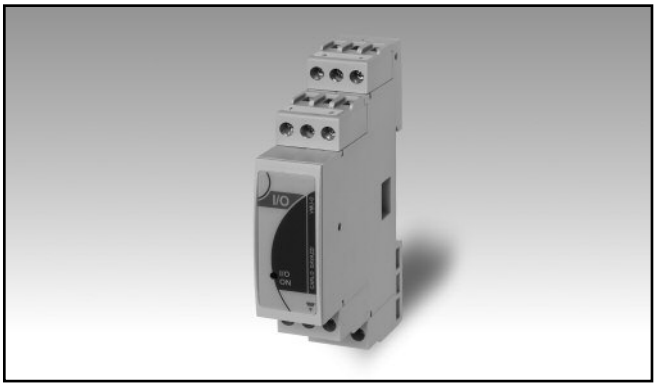
VMU-O, inputs/outputs unit



- **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

- **Model**
- **Power supply**
- **Inputs**
- **Outputs**
- **Option**

Type Selection (Standard model)

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

Type Selection (Antitheft model)

Power supply		Inputs		Outputs		Option	
X:	from 12 to 28VDC, self-power supply from VMU-M unit	**I3:**	three digital inputs **(*)**	**R1:**	one relay outputs **(*)**	**AT:**	antitheft compability

Note: in case of “Antitheft application” every single Eos-Array can manage the combination of one VMU-O.X.I3.R1.AT module and up to three VMU-O.X.I2.R2.X modules.

(*) as standard.

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VMU-AT, Antitheft sensor for VMU-O with “AT” option

- **Plastic fibre optic sensor**
- **Sensing distance up to 200m**
- **Static output compatible with VMU-O “AT” option**
- **Auxiliary power supply from VMU-O “AT” option**
- **Dimensions: 14 x 31 x 73 mm housing**
- **Protection degree (front): IP50**

Product Description

Antitheft plastic fibre optic sensor to be used in combination with VMU-O “AT” I/O unit, suitable to carry out an antitheft control on PV modules which are passed by 2.2 mm plastic fibre optic. The maximum loop distance which can be covered by the sensor is 200m. Housing for DIN-rail mounting, IP50 (front) protection degree.

How to order

VMU-AT X P M C X

Model
Power supply
Plastic fibre
200m sensing distance
Output
Option

Type Selection

Power supply

X: from 12 to 28VDC, self-power supply from VMU-O “AT” option unit

Fibre optic

P: plastic **(*)**

Sensing distance

M: 200m **(*)**

Output

C: open collector

Option

X: none

(*) as standard.

Product Description

PFO22-1000 is a specific plastic fibre optic cable which is made for VMU-AT sensor and is supplied in a quantity of 1000m. The working temperature is -55 to 70°C.

How to order

PFO22 1000

Model
Fibre optic cable length: 1000m

VMU-M Display and LED specification

Display	
Type	1 line (max: 6-DGT) 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 AV10 range code	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 list above.The cycling time is approx. 1 second.
Colour AV30 range code	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.

VMU-P LED specification

LED	
Type	Multicolor
Status and colour	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
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: 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.

VMU-AT LED specification

LED	
Power supply status	Green: the power supply is ON
Loop status	Red: the optical loop is closed

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/°C
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

Rated inputs	
Current type	1 (shunt)
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
Voltage	AV10 range: 1000V DC AV30 range: 1000V DC
Accuracy	(@25°C ±5°C, R.H. ≤60%)
AV10 range code	
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)

VMU-S input specifications (cont.)

Start up current	0.05A
Start up voltage	10V
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)
Energy	±(1% RDG)
Start up current	0.2A
Start up voltage	10V
Temperature drift	≤200ppm/°C
Measurement sampling time	2 sec.
Variables format	
Instantaneous variables	4-DGT (A, W), 5-DGT (V)
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	
AV10 range code	
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
AV30 range code	
Voltage	> 2.5M
Current	< 0.003Ω @ 0.5 Nm (screw terminal torque).
Voltage Overloads	
Continuous	1100V
For 500ms	1600V
To earth	800V (extended to 1000V in case of combined use of VMU-1.1000V unit)
Current Overloads	
Continuous	AV10 range: 16A AV30 range: 30A
For 1s	AV10 range: 100A max AV30 range: 150A max
Protection	
Fuse holder	Integrated into the module
Fuse type	gPV
Fuse size	10x38mm (IEC60269-1-6)
Fuse current	Fuse NOT provided. Note: the fuse rated current has to be ≥1.4 Isc at 45°C ambient temperature. See fuse manufacturer specifications for further details including de-rating caused by higher ambient temperature.

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: air)
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/°C
Engineering unit	Selectable °C or °F
Insulation	See the table "Insulation between inputs and communication bus"
Irradiation sensor inputs (range code: 2TIW)	
Number of inputs	1
Range	0 to 120mVDC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS; ±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm/°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 150.0 (mVDC) - Display: programmable range from 0 to 9999 (kW/m², kW/ft²)
Decimal point position	Fixed.
Impedance	> 30KΩ
Overload	
Continuous	10VDC (measurement available up to 150mV on both display and communication bus)
For 1s	20VDC
Insulation	See the table "Insulation between inputs and communication bus"
Irradiation sensor input (range code: 2TCW	
Number of inputs	1
Range	0 to 20mADC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS;

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VMU-P input specifications (cont.)

	±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm/°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 25.0 (mADC) - Display Data format: programmable range from 0 to 9999 (kW/m^2, kW/ft^2)
Decimal point position	Fixed
Impedance	≤23Ω
Overload	
Continuous	50mADC (measurement available up to 25mA on both display and communication bus)
For 1s	150mADC
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; ±(0.01%RDG+1DGT) 25% to 110% FS.
(Display + RS485)	
Temperature drift	±150ppm/°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 999.9 (Hz) - Display: programmable range from 0 to 299.9 (m/s, ft/s)
Decimal point position	Fixed and depending on the input/display scale.
Impedance	680Ω
Operating input	2.5V_{peak} to 9V_{peak}/5mA_{peak} to 35mA_{peak}, duty cycle 50%
Impedence	220Ω
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 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 Parity: none
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
Special functions	None
Insulation	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; - 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).
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	3.3VDC
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”

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-O with “AT” option, Input/Output specifications

Maximum number of module managed by every single VMU-M module	Up to 1
Digital inputs	
Number of inputs	3
Working mode	Detection of ON/OFF status
Purpose	Detection of the output status of up to 3 VMU-AT units, the same inputs can be used also to detect standard free of voltage contacts of other devices.
Working logic	The inputs in case of Antitheft purpose selection work as an OR logic (EosArraySoft), if this function is not enabled every input works independently from each other.
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”
Digital output	
Number of outputs	1
Purpose	Antitheft notification in case of function enabling (EosArraySoft) or 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 modules).
Type	Relay, SPST type AC1 - 5A @ 250VAC AC15 - 1A @ 250VAC
Insulation	See the table “Insulation between inputs and outputs”

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VMU-AT Antitheft sensor specifications

Maximum number of sensors managed by every single VMU-O "AT" module	Up to 3
Optical sensing	
Maximum operational distance	200m (loop)
Sensitivity	Automatic adjusted
Light source	GaAlAs, LED 660 nm
Light type	Red modulated
Operating frequency	1Khz
Response time on fibre breaking	0.5 seconds
Fibre Optic	
Material	Plastic
Diameter	2.2 mm
Compatible model	PGU-CD1001-22
Working temperature	-55 to +70°C
Digital output	
Number of outputs	1
Type	Open collector
Insulation	Operational insulation only (50VACRMS)
Power Supply	12 to 28 VDC
Connection	
Cable	Length: 0.5m, black colour, PVC material

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"

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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”), 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 at the same instant from

Main Function (Cont.)

	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.
Fuse blow detection (only AV10 range code)	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.

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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, Ch3	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, Ch3	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 (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".
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) Electrostatic discharges	According to EN61000-6-2 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) Radio frequency suppression	According to EN61000-6-3 According to CISPR 22

CARLO GAVAZZI

General specifications (cont.)

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

Connections

VMU-M	
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 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
VMU-S AV10	
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 positive for string input and 1 positive for string output (to the Inverter)
1.5 mm^2	3 screw terminals: not power input, only for negative voltage signal measurement
VMU-S AV30	
Connections	Screw-type
Cable cross-section area	
Current (+)	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
Voltage (-)	Max 1.5 mm^2, Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes	
16 mm2	1+1 screw terminals: 1 positive for string input and 1 positive for string output (to the Inverter)
1.5 mm^2	3 screw terminals: not power input, only for negative voltage signal measurement
VMU-P	
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 probes 2 screw terminals used for wind speed sensor, 2 screw terminals used for solar irradiation sensor
VMU-O	
Connections	Screw-type
Cable cross-section area	
Relay outputs and digital inputs	Max 1.5 mm^2 Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
"X" type Screw terminal purposes	
1.5 mm^2	2+2 screw terminals: two for 1st relay output and two for 2nd relay output (SPST type) 2+2 screw terminals: two for 1st digital input and two for 2nd digital input
"AT" type Screw terminal purposes	
1.5 mm^2	2 screw terminals for relay output (SPST type) 2+2+2 screw terminals: two for 1st digital input, two for 2nd digital input and two for 3rd digital input
Weight (all modules)	Approx. 100 g (packing included)

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

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 without antitheft functionality

VMU-S units	VMU-O units	VMU-P units	Consumption	Start up current	Power supply part number
From 1 to 3	None	None	PS_W: $2.5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 1 to 3	Up to 1	Up to 1	PS_W: $5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 4 to 10	From 2 to 4	Up to 1	PS_W: $11W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
From 11 to 14	Up to 1	Up to 1	PS_W: $10W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
Max. 14	Max. 7	Max. 1			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-M unit without any antitheft management. For different units combination 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.

Sizing of Carlo Gavazzi DC power supply with antitheft functionality

VMU-S units	VMU-O.X units	VMU-O AT units	VMU-AT units	VMU-P units	Consumption	Start up current	Power supply part number
10 to 14	None	Up to 1	Up to 3	None	PS_W: $12W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
10 to 13	Up to 1	Up to 1	Up to 3	Up to 1	PS_W: $13W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
10 to 12	Up to 2	Up to 1	Up to 3	Up to 1	PS_W:$14W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
10	Up to 3	Up to 1	Up to 3	Up to 1	PS_W:$14W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
Max. 14	Max. 3	Max. 1	Max. 3	Max. 1			Note: VMU-P as 1.8W includes also the CG (part number DWS-V) wind sensor consumption.

Nota: in order to carry out, in the Eos-Array, the proper antitheft functionality, one VMU-O.X.I3.R1.AT unit and up to three VMU-AT.X.P,M,C,X sensors have to be added, in this case the maximum equivalent added consumed power is 4W. For different units combination not mentioned above the consumption calculation is the following: PS_W:<1W+n_{VMU-S}*0.5W+$n_{VMU-O.X}$*0.7W+$n_{VMU-O\ AT}$*0.7W+n_{VMU-AT}*1.1+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 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" 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 (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 colour 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)
7	tHEFt	Theft warning: removal of the PV modules in the fibre optic loop controlled by the relevant VMU-AT sensor. The THEFT information is given in combination with the LED alarm on VMU-M and the LED colour code on the relevant VMU-O.AT module.

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.

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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	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.

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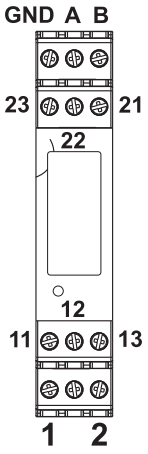
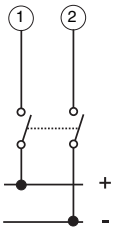
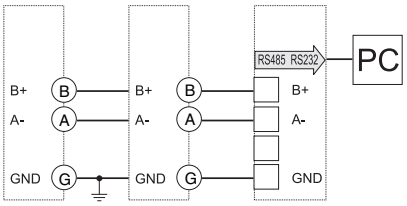
VMU-M connections



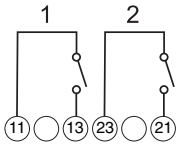
Power supply **Fig. 1**



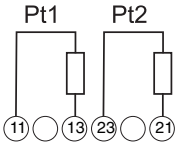
RS485 port **Fig. 2**



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

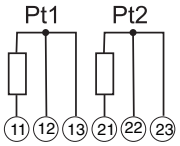


Temperature input 1 and input 2 **Fig. 4**



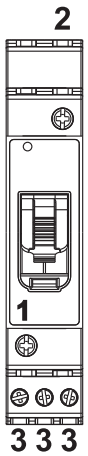
2-wire connections

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



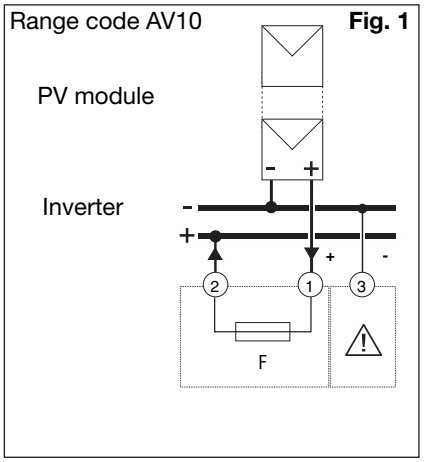
3-wire connections

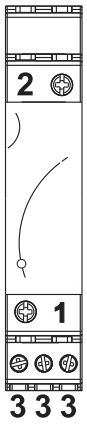
VMU-S (AV10 and AV30) connections



AV10

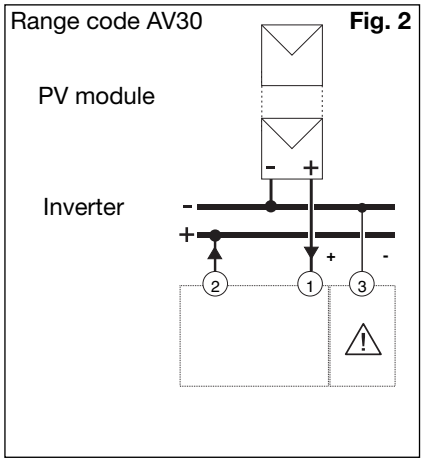
Range code AV10 **Fig. 1**





AV30

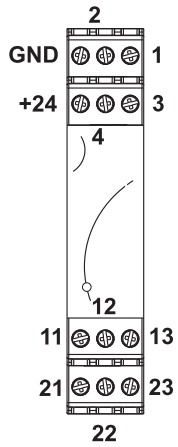
Range code AV30 **Fig. 2**



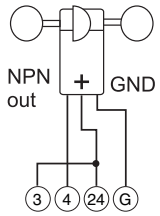
F= 10.3x38mm (IEC269-2-1) 1.25 Isc DC

⚠ = Not power input, only for voltage signal measurement.

VMU-P (2TIW) connections

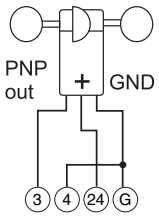


Wind speed input **Fig. 1**
Sensor model DWS-V



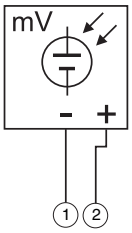
NPN output

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

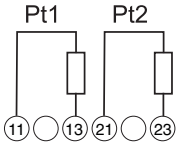


PNP output

mV irradiation input **Fig. 3**

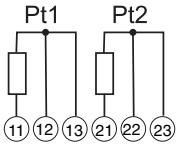


Temperature input 1 and input 2 **Fig. 4**



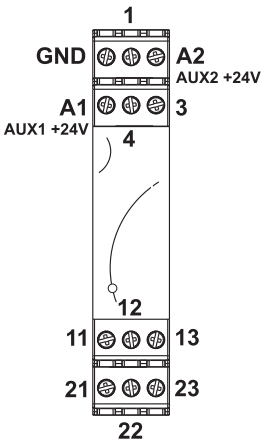
2 wires connections

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

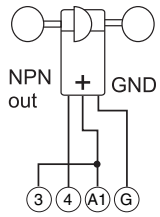


3 wires connections

VMU-P (2TCW) connections

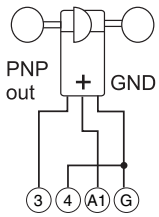


Wind speed input **Fig. 1**
Sensor model DWS-V



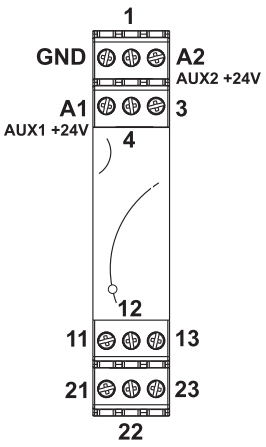
NPN output

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

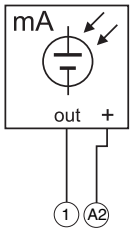


PNP output

VMU-P (2TCW) connections (cont.)

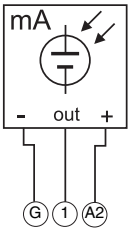


20mA irradiation input **Fig. 3**



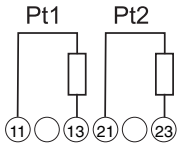
2 wires connections

20mA irradiation input **Fig. 4**



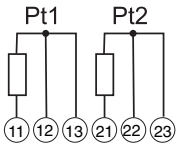
3 wires connections

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



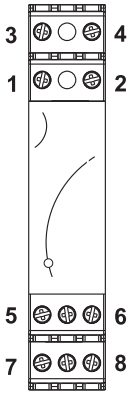
2 wires connections

Temperature input 1 and input 2 **Fig. 6**

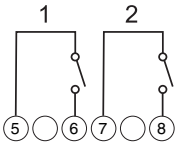


3 wires connections

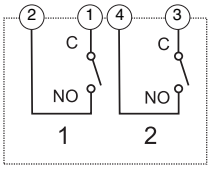
VMU-O connections



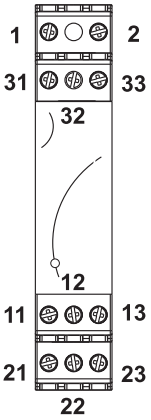
Digital input 1 and 2 **Fig. 1**



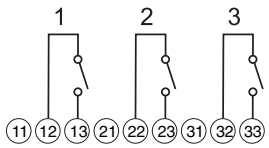
Digital outputs 1 and 2 **Fig. 2**



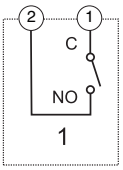
VMU-O “AT” option connections



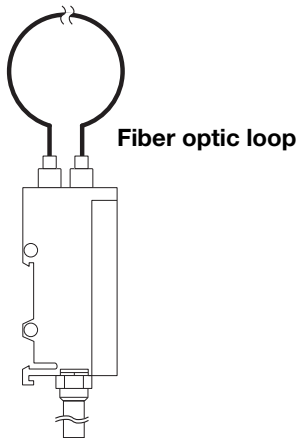
Digital input 1, 2 and 3 **Fig. 1**

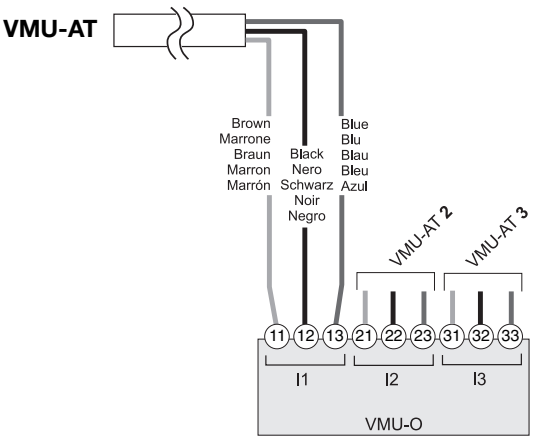


Digital output **Fig. 2**

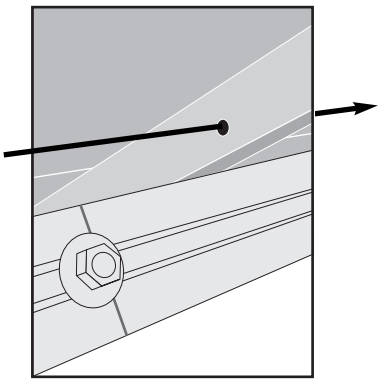


VMU-AT connections

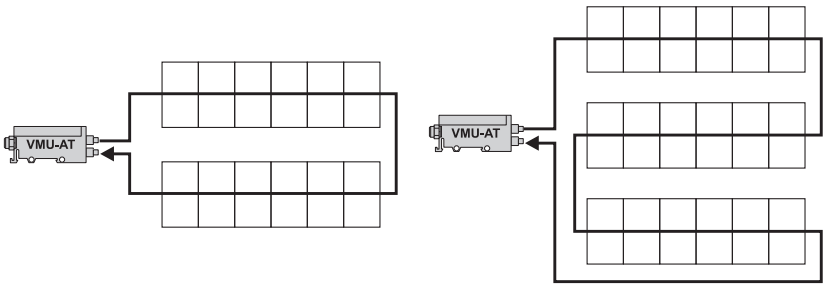




VMU-AT mounting and use

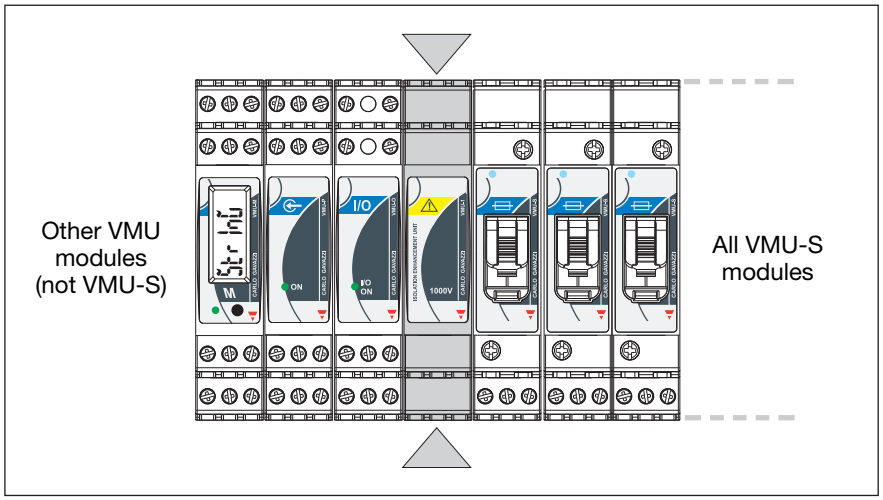


Fibre optic through PV panel



Example of fibre optic loop through PV panels

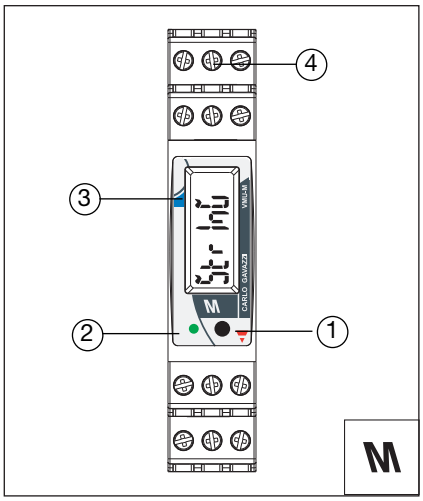
VMU-1 mounting and positioning



The VMU-1 has to be mounted between the group of VMU-S and all the other modules as shown in the example picture on the left.

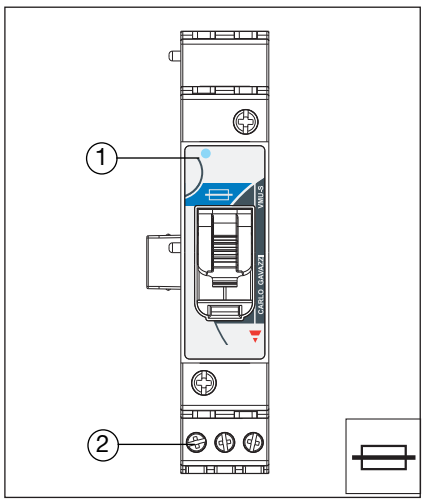
Every Eos-Array has to be equipped only with one VMU-1.

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

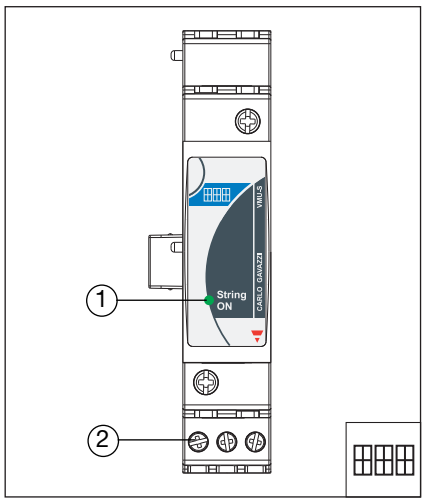
VMU-S Front panel description (AV10 range code: 16A)



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

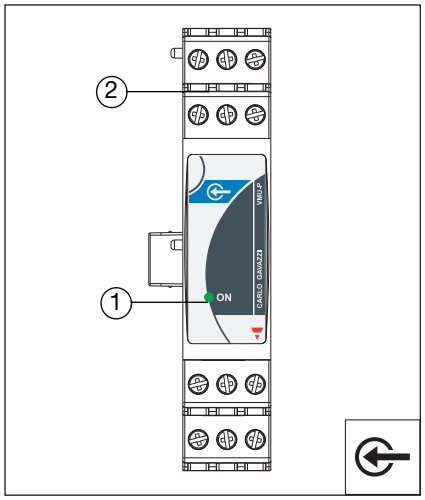
VMU-S Front panel description (AV30 range code: 30A)



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

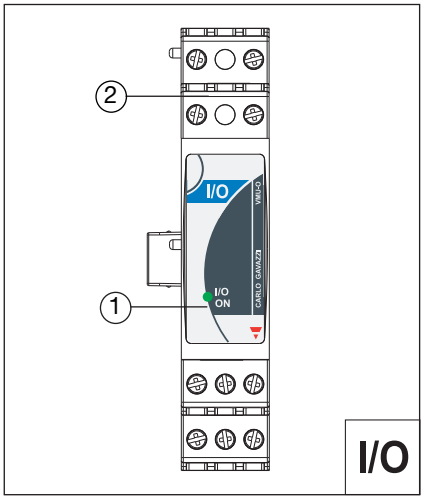
VMU-P Front panel description



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 connection**s**

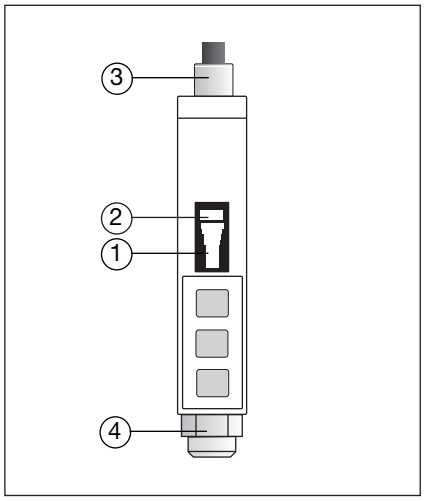
VMU-O/VMU-O AT Front panel description



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 up to three 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.

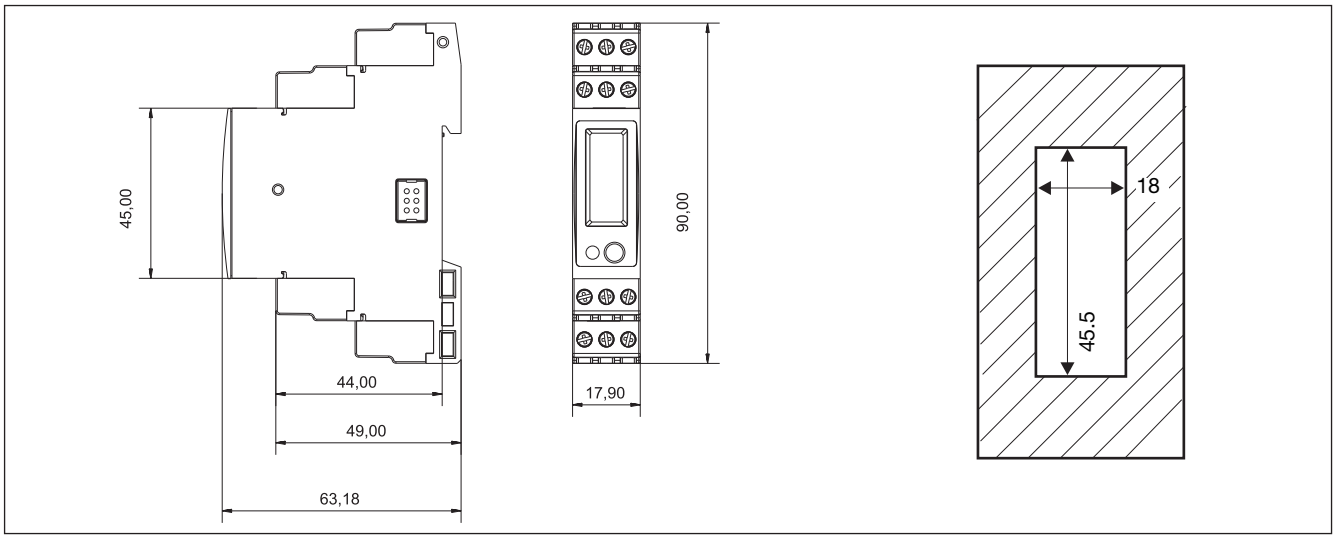
2. **Screw terminals**
   For digital inputs and outputs connections

VMU-AT Front panel description

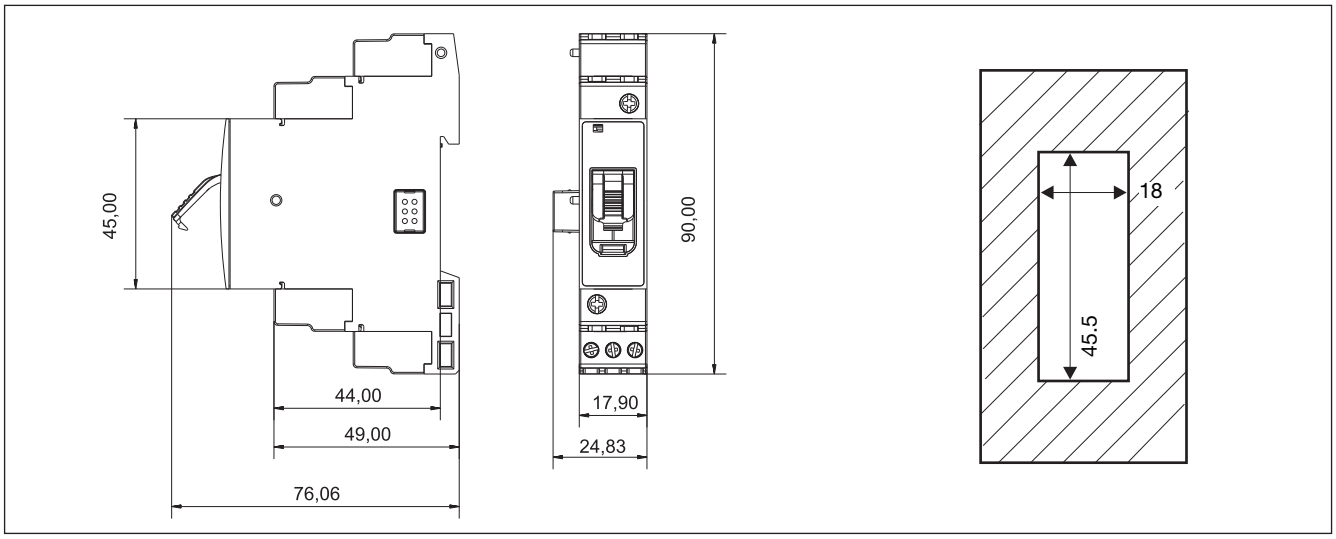


1. **Green LED**
   The power supply is ON
2. **Red LED**
   The optical signal loop is working
3. **Optical fibre connectors**
   One RX and one TX optical fibre connector
4. **One cable**
   Cable for power supply and signal output.

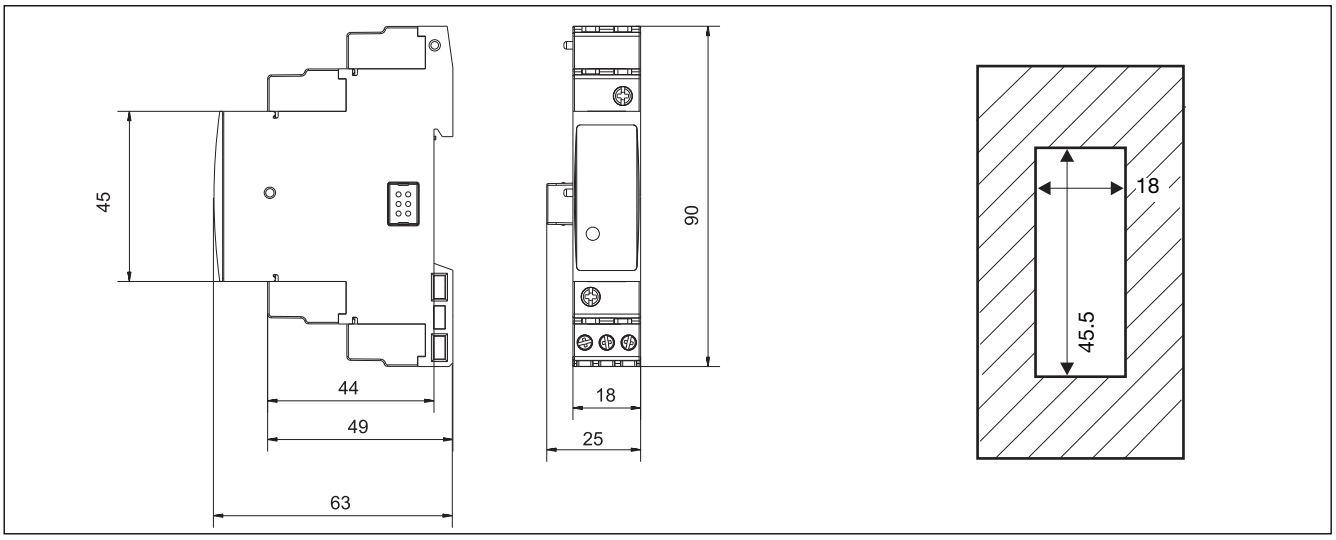
VMU-M Dimensions and panel cut-out (mm)



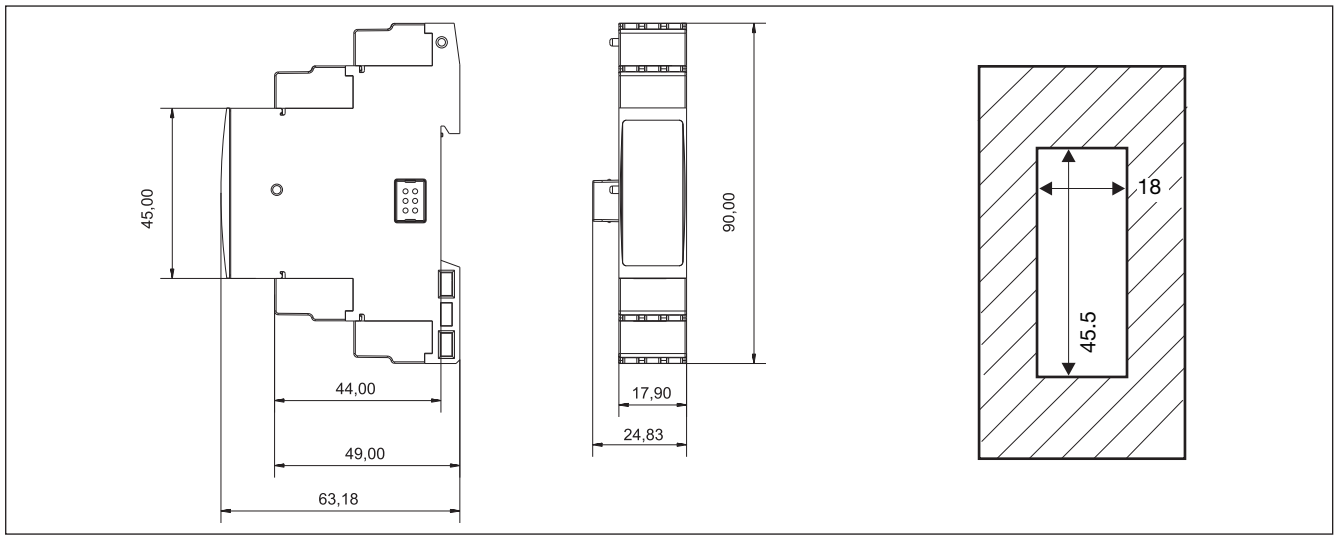
VMU-S (AV10) Dimensions and panel cut-out (mm)



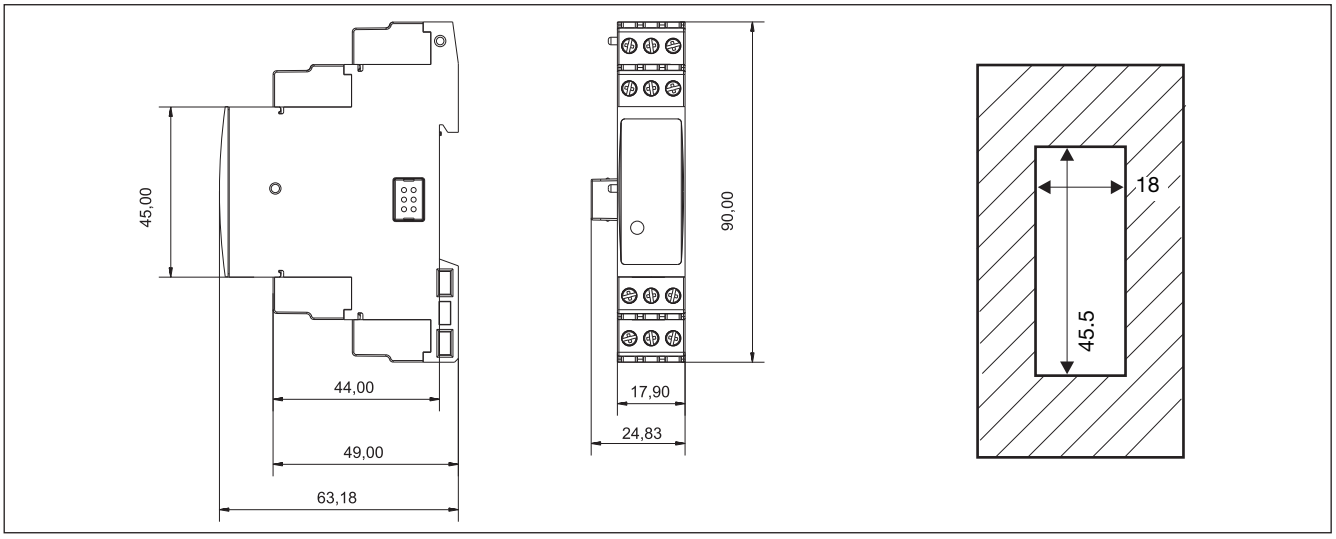
VMU-S (AV30) Dimensions and panel cut-out (mm)



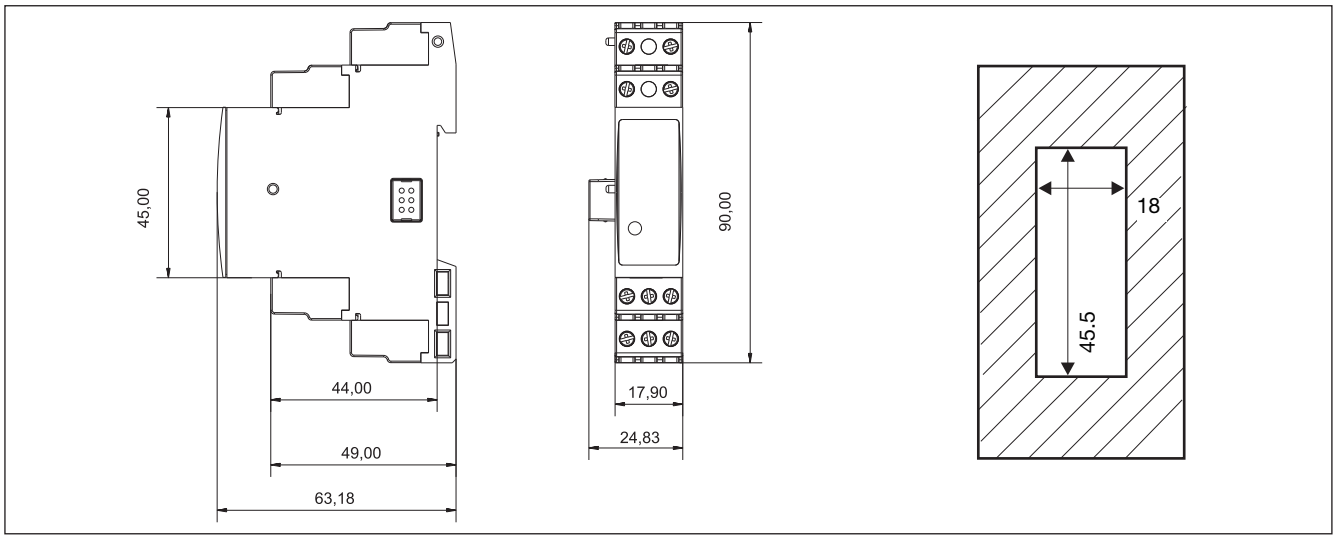
VMU-1 Dimensions and panel cut-out (mm)



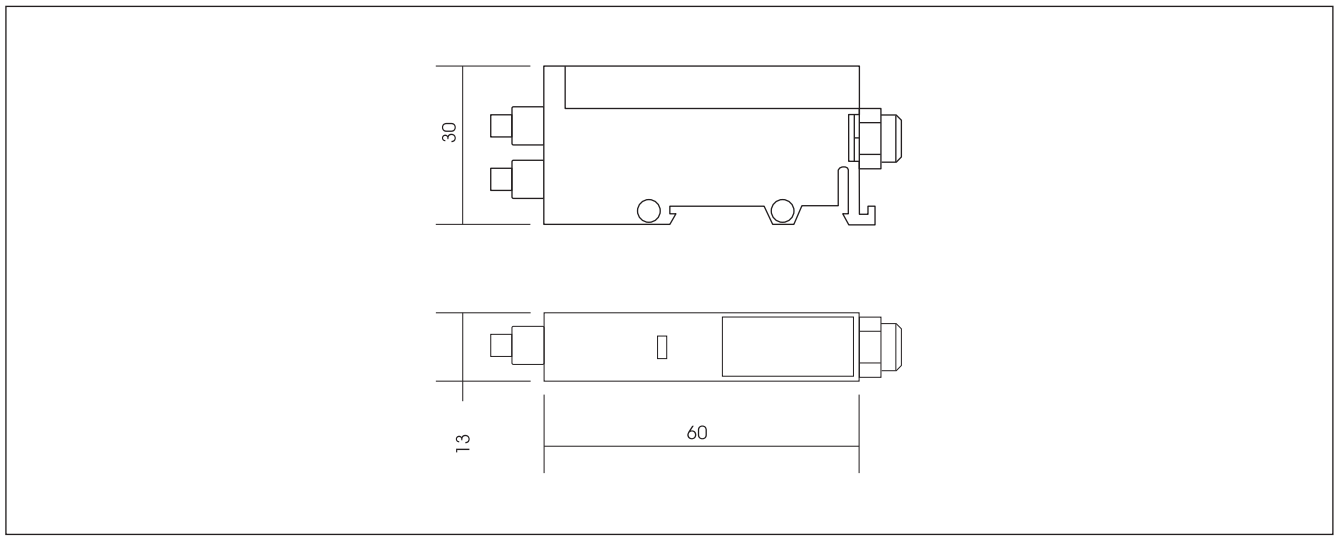
VMU-P Dimensions and panel cut-out (mm)



VMU-O/VMU-O AT Dimensions and panel cut-out (mm)



VMU-AT Dimensions (mm)



Mean time to failure (MTTF)

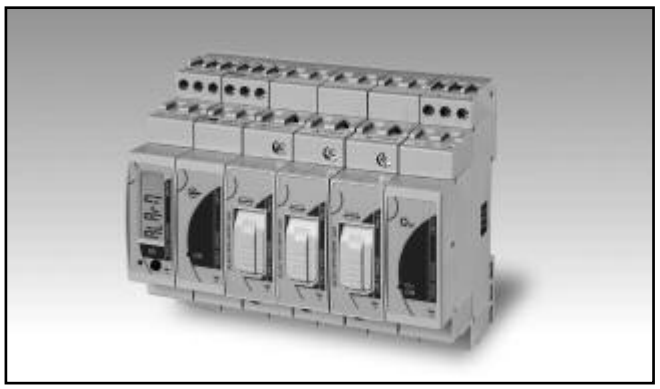
Model	MTTF/MTBF - Years	Test conditions	Standard
VMU-M	24.2	gf, 50° C	MIL-HDBK-217F
VMU-S	35.4	gf, 50° C	MIL-HDBK-217F
VMU-P	65.4	gf, 50° C	MIL-HDBK-217F
VMU-O	31.7	gf, 50° C	MIL-HDBK-217F

gf: ground, fixed.

Eos-ArraySoft parameter programming and variable reading software

Eos-ArraySoft	Multi-language software (Italian, English, French, German, Spanish) for variable reading and parameters programming. The program runs under Windows XP/Vista/7.	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.
Application	Up to two different applications can be selected: - 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.	Data storing	In pre-formatted XLS files (Excel data base).
		Data download	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, air temperature, irradiation and wind speed.
		Alarm set-up	Alarm parameters.
		Modem management	GSM/GPRS modem configuration (connected to the PC) SMS messages.

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



- **Modular local control system for PV plants**
- **Up to 17 DIN modules configuration equivalent to 280mm width**
- **Eos-ArrayLSoft freeware software for easy product configuration**
- **Eos-Array can be formed by maximum 17 units**
- **Eos-Array can manage in addition to VMU-ML master unit up to:**
  - **max 1 VMU-P unit;**
  - **max 15 VMU-S0 units;**
  - **max 1 VMU-O units.**
  - **max 1 VMU-1**

VMU-ML, master unit

- **Master communication capability**
- **RS485 communication port (Modbus)**
- **Local communication bus management up to 15 mixed VMU-S0, VMU-P and VMU-O units**
- **Single virtual or real alarm set-point connectable to any available variable**
- **Display readout: 6 DGTs**
- **12 to 28 VDC power supply**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Eos-Array Lite is a combination of modules which performs mainly a current and voltage control of a photovoltaic plant. The core unit is VMU-ML which performs the local bus management of VMU-S0, VMU-P both measuring units and VMU-O output unit. VMU-ML assigns the proper local unit address automatically (up to 15 units) and gathers all the local measurements coming from VMU-S0 and VMU-P measuring units. VMU-ML can provide by means of VMU-O modules one relay output so to manage up to 1 real alarm. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-M L A S1 XX X

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

Type Selection

Function

L: Lite **(*)**

Power supply

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

Communication

S1: RS485 Modbus **(*)**

Inputs

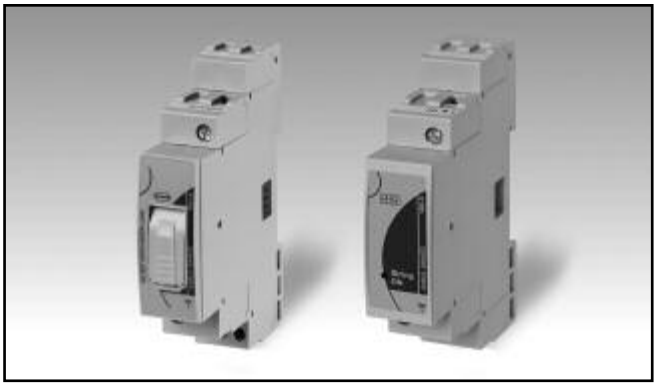
XX: none **(*)**

Option

X: none

(*) as standard.

VMU-S0, string measuring unit



- **Direct DC voltage measurement up to 1000V**
- **Direct DC current measurement up to 16A or up to 30A without fuse**
- **Instantaneous variables data format: 4 DGTs**
- **Instantaneous variables: V, A.**
- **Accuracy: ±0.5 RDG (current/voltage)**
- **Auxiliary power supply from VMU-ML unit**
- **String alarm management by means of VMU-ML unit**
- **Integrated 10.3x38mm fuse holder for string protection**
- **Fuse blow detection by means of VMU-ML unit only**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Variables measuring unit with built-in protection fuseholder (the fuse is not provided), particularly indicated for DC current, voltage, 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. Moreover the unit is provided with an auxiliary serial communication bus. Alarms, fuse blow detection, and serial communication are managed by means of VMU-ML module. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-S0 AV10 X S FX

Model
Range
Power supply
Communication
Option

Type Selection

Range

AV10: 1000V DC, 16A (Direct connection) **(*)**
AV30: 1000V DC, 30A (Direct connection) **(**)**
In this case the "Option" is "XX".

Power supply

X: from 12 to 28VDC, self-power supply from VMU-ML unit

Communication

S: auxiliary communication bus, compatible only to VMU-ML module **(*)**

Option

XX: none (no fuse holder)
FX: with fuse holder **(*)**

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

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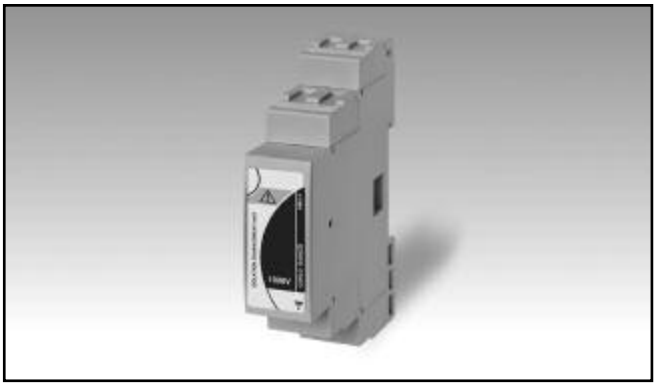
VMU-1, isolation enhancement unit



- **Isolation enhancement of voltage measuring inputs to earth of VMU-S0: from 800VDC (without VMU-1) to 1000VDC max.**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Isolation enhancement unit suitable to be used in combination with VMU modules. VMU-1 allows to enhance the isolation of the voltage measuring input to earth from 800VDC to 1000VDC. The module is to be mounted between the first VMU-S0 and all the other VMU modules. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-1 1000

Standard model

Type Selection

Standard model

Isolation voltage 1000V: isolation enhancement on VMU-S0 voltage measuring input to earth from 800VDC (without module) to 1000VDC.
Note: only one VMU-1 is needed per Eos-Array.

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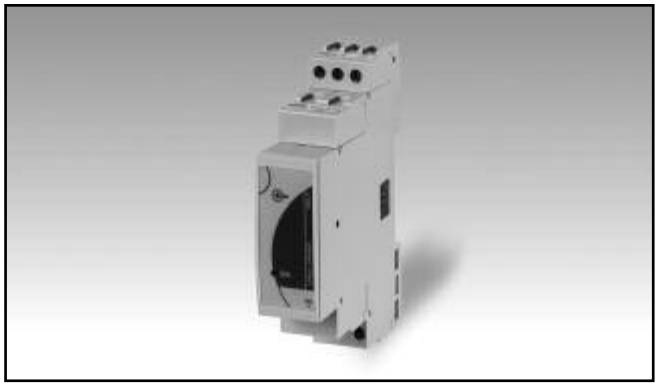
VMU-P, environment variables unit



- **Measurements: PV module temperature or air temperature, sun irradiation**
- **One temperature input: Pt100 or Pt1000 type**
- **One 120mV or 20mA DC input with scaling capability for irradiation measurement**
- **Auxiliary communication bus to VMU-ML unit**
- **Auxiliary power supply from VMU-ML unit**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Environment variables measurement unit particularly indicated for PV module temperature or air temperature and sun irradiation, 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-ML module. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-P 1TI X S X

Model
Range
Power supply
Communication
Option

Type Selection

Range

1TI: One “Pt” temperature type probe, mV sun irradiation input **(*)**
1TC: One “Pt” temperature type probe, mA sun irradiation input **(*)**

Power supply

X: from 12 to 28VDC, self-power supply from VMU-ML unit

Communication

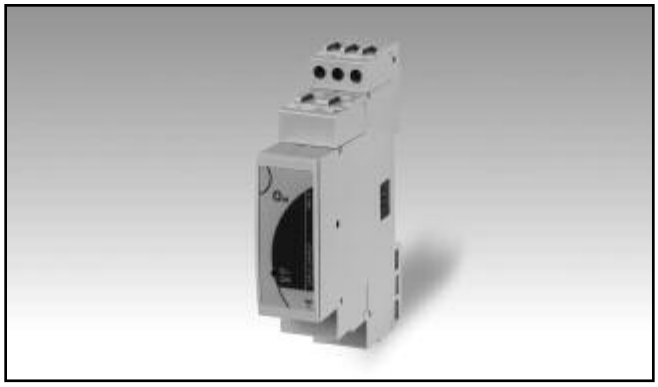
S: auxiliary communication bus, compatible only to VMU-ML module **(*)**

Option

X: none

(*) as standard.

VMU-O, relay outputs unit



- One relay output managed by the VMU-ML module
- Auxiliary power supply from VMU-ML unit
- Dimensions: 1-DIN module
- Protection degree (front): IP40

VMU-O Product Description

Relay output unit suitable to be used in combination with VMU-ML module. VMU-O allows to add one relay output to a VMU-ML based system so to manage local alarms. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-O X XX R1 X

- **Model**
- **Power supply**
- **Inputs**
- **Outputs**
- **Option**

Type Selection

Power supply		Inputs		Outputs		Option	
X:	from 12 to 28VDC, self-power supply from VMU-ML unit **(*)**	**XX:**	none	**R1:**	one relay output **(*)**	**X:**	none

(*) as standard.

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VMU-ML Display and LED specifications

Display	1 line (max: 6-DGT)
Type	LCD, h 7mm
Information read-out	4-DGT
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-P LED specifications

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

VMU-O LED specifications

LED	
Type	Multicolor
Status and colour	Green: the power supply is ON. White: the unit is enabled by VMU-ML module for data reading and displaying. Blue: digital output is 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.

VMU-ML input specifications

Key-pad	1 push-button for variable scrolling and for some parameters programming. Full programming can be carried out only using Eos-ArrayLSoft.

VMU-S0 input specifications

Rated inputs	
Current type	1 (shunt)
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
Voltage	AV10 range: 1000V DC AV30 range: 1000V DC
Accuracy	(@25°C ±5°C, R.H. ≤60%)
AV10 range code	
Current	±(0.5%RDG+2 DGT) from 0.05A to 16A
Voltage	±(0.5%RDG+2 DGT) from 20V to 1000V
Start up current	0.05A
Start up voltage	10V
AV30 range code	
Current	±(0.5%RDG+2 DGT) from 0.2A to 30A
Voltage	±(0.5%RDG+2 DGT) from 20V to 1000V
Start up current	0.2A
Start up voltage	10V
Temperature drift	≤200ppm/°C
Measurement sampling time	2 sec.
Variables format	
Instantaneous variables	4-DGT (A), 5-DGT (V)
Resolution	0.1V; 0.01A.

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VMU-S0 input specifications (cont.)

Max. and Min. data format	See “Variables format”
Input impedance	
AV10 range code	
Voltage	> 2.5MΩ
Current	< 0.006Ω(+ fuse impedance) @ 0.5 Nm (screw terminal torque). The maximum dissipation power has not to exceed 2W.
AV30 range code	
Voltage	> 2.5M
Current	< 0.003Ω @ 0.5 Nm (screw terminal torque)
Voltage Overloads	
Continuous	1100V
For 500ms	1600V
To earth	800V (extended to 1000V in case of combined use of VMU-1.1000V unit)
Current Overloads	
Continuous	AV10 range: 16A AV30 range: 30A
For 1s	AV10 range: 100A max AV30 range: 150A max
Protection	
Fuse holder	Integrated into the module
Fuse type	gPV
Fuse size	10x38mm (IEC60269-1-6)
Fuse current	Fuse NOT provided. Note: the fuse rated current has to be ≥1.4 Isc at 45°C ambient temperature. See fuse manufacturer specifications for further details including de-rating caused by higher ambient temperature.

VMU-P input specifications

Temperature drift	≤200ppm/°C
Variables format	
Instantaneous variables	4 DGT (Temperature, solar irradiation)
Resolution	0.1°C/0.1°F; 1W/m², 1W/ft²;
Max. and Min. data format	See “Variables format”
Temperature probe input	
Number of inputs	1
Temperature probe	Pt100 or Pt1000
Number of wires	Up to 3-wire connection
Wire compensation	Up to 10Ω.
Accuracy (@25°C ±5°C, R.H. ≤60%) (Display + RS485)	See table “Temperature input characteristics”
Temperature drift	±150ppm /°C
Engineering unit	Selectable °C or °F
Insulation	See the table “Insulation between inputs and communication bus”
Irradiation sensor inputs (range code: 1TI)	
Number of inputs	1
Range	0 to 120mVDC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS; ±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm /°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 150.0 (mVDC) - Display: programmable range from 0 to 9999 (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”
Irradiation sensor inputs (range code: 1TC)	
Number of inputs	1
Range	0 to 20mA DC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS; ±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm /°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 25.0 (mADC) - Display: programmable range from 0 to 9999 (kW/m², kW/ft²)
Decimal point position	Fixed.
Impedance	≤23Ω
Overload	
Continuous	50mADC (measurement available up to 25mA on both display and communication bus)
For 1s	150mADC
Insulation	See the table “Insulation between inputs and communication bus”

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VMU-P Temperature input characteristics

Probe	Range	Accuracy (@25°C ±5°C, R.H. ≤60%)	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-ML Output specifications

RS485	Slave function
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 “List of the variables that can be...”
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.
Special functions	None
Insulation	See the table “Insulation between inputs and outputs”

Auxiliary communication bus	This is the communication bus to the VMU-S0, VMU-P and VMU-O units where VMU-ML performs the master function in this network. VMU-ML unit can gather the following information from the bus: - All variables available on the bus; - Antitheft status; - PV reverse voltage and current polarity; - PV module status. The local address in the VMU-S0, VMU-P and VMU-O units is automatically assigned by VMU-ML 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 Output specifications

Maximum number of modules managed by every single VMU-ML module	Up to 1
Digital output	
Number of outputs	1
Purpose	Alarm notification as a String alarm and other alarms (see “List of the variables that can be connected to...”

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”

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Main Function

Displaying	1 parameter per page
VMU-ML module	"Alarm and diagnostics messages"
When a VMU-S0 module is selected	All the information related to the status of the string being selected by means of the front key (see 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 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 output being selected by means of the front key (see 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
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"
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-S0 units). The highest value of the measured string current among those available is used as a reference value. The alarm set-point is a value that 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-S0 module individually. Within the VMU-ML system all values coming at the same instant from every VMU-S0 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 current 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 variable alarms	The alarms can be connected also to the string voltage.
Fuse blow detection (only AV10 range code)	Warning message transmission through the local port to the VMU-ML unit.
Wrong PV module connection	Warning message transmission through the local port to the VMUML unit.

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Insulation between inputs and outputs

Module		Any	VMU-ML		VMU-P		VMU-O	VMU-S0		
	Type of input/output	Local bus	DC Power supply	RS485	Temperature: Ch1	Solar irradiation	Relay outputs: Ch1	String input (V-)	String input (A+)	String output (A+)
Any	Local bus	-	0kV	0kV	0kV	0kV	4kV	4kV	4kV	4kV
VMU-ML	DC Power supply	0kV	-	0kV	0kV	0kV	4kV	4kV	4kV	4kV
	RS485	0kV	0kV	-	0kV	0kV	4kV	4kV	4kV	4kV
VMU-P	Temperature: Ch1	0kV	0kV	0kV	-	0kV	4kV	4kV	4kV	4kV
	Solar irradiation	0kV	0kV	0kV	0kV	-	4kV	4kV	4kV	4kV
VMU-O	Relay outputs: Ch1	4kV	4kV	4kV	4kV	4kV	-	4kV	4kV	4kV
VMU-S0	String input (V-)	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV	>5MΩ
	String input (A+)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV
	String output (A+)	4kV	4kV	4kV	4kV	4kV	4kV	>5MΩ	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 (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. Remove the fuse only when the disconnecting breaker is switched off. The fuse is only for over-current protection (it has not to be considered as a disconnecting device).

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General specifications

Operating temperature	See table “String current vs. operating temperature”.
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 supply 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

Connections

VMU-ML	
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 screw terminals used for RS485 communication 2 screw terminals used for power supply
VMU-S0 AV10	
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: not power input, only for negative voltage signal measurement
VMU-S0 AV30	
Connections	Screw-type
Cable cross-section area	
Current (+)	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
Voltage (-)	Max 1.5 mm^2, Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes	
16 mm2	1+1 screw terminals: 1 positive for string input and 1 positive for string output (to the Inverter)
1.5 mm^2	3 screw terminals: not power input, only for negative voltage signal measurement
VMU-P	
Connections	Screw-type
Cable cross-section area	1.5 mm^2 max. Min./Max. screws tightening torque:

Connections (cont.)

Screw terminal purposes 1.5 mm²	0.4 Nm / 0.8 Nm 3 screw terminals used for temperature probe 2 screw terminals used for solar irradiation sensor
VMU-O	
Connections	Screw-type
Cable cross-section area	Max 1.5 mm² Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm

Screw terminal purposes 1.5 mm²	2 screw terminals: for relay output (SPST type)
Weight (all model)	Approx. 100 g (packing included)

Power supply specifications

VMU-ML	
Power supply	12 to 28 VDC
Power consumption	≤1W

VMU-S0-P-O	
Power supply	Self-power supplied through the communication bus
Power consumption	≤0.7W

Sizing of Carlo Gavazzi DC power supply

VMU-S0 units	VMU-O units	VMU-P units	Consumption	Start-up current	Power supply part number
From 1 to 3	None	None	PS_W: $2.5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 1 to 3	Up to 1	Up to 1	PS_W: $5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 4 to 10	From 2 to 4	Up to 1	PS_W: $11W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
From 11 to 14	Up to 1	Up to 1	PS_W: $10W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
Max. 14	Max. 7	Max. 1			

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-S0}*0.5W+n_{VMU-O}*0.7W+n_{VMU-P}*1.8W. where “n” is number of power supplied units.

Variables format

No.	Module	Variable	Data format	Notes
1	VMU-S0	V	0.0 to 1250.0	
2	VMU-S0	A	0.0 to 50.0	
3	VMU-P	Temperature	-60 to 400.0	Temperature (°C/°F). The range is extended to cover both °C and °F indications
4	VMU-P	Solar irradiation (IRR)	0.0 to 9.999	Irradiation kW/m2 (kW/feet2) (e.g. in: 0 to 1kW/m2 (1kW/feet2), out: 0 to 100mV)

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Alarm and diagnostics messages

No.	Message	Notes
1	Conn.CY (AV10 only)	Fuse blow detection.
2	StrinG	String failure warning: the “String control” function has detected a failure.
3	Conn.PY	Reverse string current or voltage
4	SYSteM	Power-up self-test error
5	buS	Auxiliary bus communication error
6	ALArM	Variables alarm (any)

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-ML, VMU-P	-25 to + 65°C	-13°F to 149°F
12A DC max.	3.0A	VMU-ML, VMU-P	-25 to + 60°C	-13°F to 140°F
14A DC max.	3.5A	VMU-ML, VMU-P	-25 to + 55°C	-13°F to 131°F
15A DC max.	4.0A	VMU-ML, VMU-P	-25 to + 50°C	-13°F to 122°F
16A DC max.	5.0A	VMU-ML, VMU-P	-25 to + 40°C	-13°F to 104°F
VMU-S AV30 Input current				
20A DC max.	2.5A	VMU-ML, VMU-P	-25 to + 65°C	-13°F to 149°F
25A DC max.	3.0A	VMU-ML, VMU-P	-25 to + 60°C	-13°F to 140°F
30A DC max.	3.5A	VMU-ML, VMU-P	-25 to + 55°C	-13°F to 131°F

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

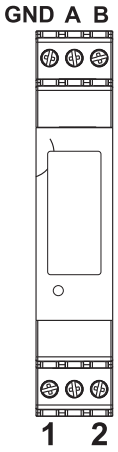
List of the variables that can be displayed and connected to ...

- RS485 communication port
- Real and virtual alarms and events

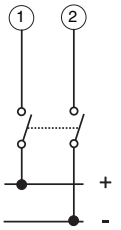
No	Variable	Event-logging	Data-logging	Alarm output	Module (from)	Notes
1	Error: 1	Yes	No	Yes (a)	VMU-ML	Local bus communication problems
2	Error: 2	Yes	No	Yes (a)	VMU-ML	Changed system modules configuration
3	Error: 3	Yes	No	Yes (a)	VMU-ML	Incoherent programming parameters
4	Error: 4	Yes	No	Yes (a)	VMU-ML	More than one VMU-P unit connected to the bus
5	Status: 1	Yes	No	No	VMU-ML	Local programming access
6	Status: 2	Yes	No	No	VMU-ML	Power ON/OFF
7	V	Yes	Yes	Yes	VMU-S0	Available from every string
8	A	Yes	Yes	Yes	VMU-S0	Available from every string
9	Status: 1	Yes	No	Yes	VMU-S0	Incoherent programming parameters
10	Status: 2	Yes	No	Yes	VMU-S0	Fuse blow detection
11	Status: 3	Yes	No	Yes	VMU-S0	Reverse string current or voltage
12	Status: 4	Yes	No	Yes	VMU-S0	High temperature inside VMU-S0 unit
13	String control	Yes	Yes	Yes	VMU-S0	
14	°C (°F) input	Yes	Yes	Yes	VMU-P	PV module temperature
15	kWp/m^2 (kWp/ft^2)	Yes	Yes	Yes	VMU-P	Solar irradiation
16	Error: 1	Yes	No	Yes	VMU-P	Incoherent programming parameters
17	Error: 2	Yes	No	Yes (c)	VMU-P	Short circuit on probe input
18	Error: 3	Yes	No	Yes (c)	VMU-P	Open circuit on probe input
19	Status: input 1	Yes	No	No	VMU-O	ON /OFF status detection
20	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.

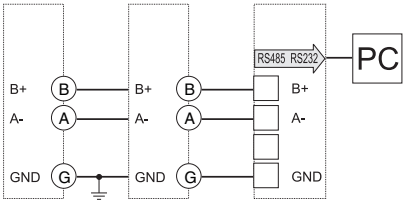
VMU-ML connections



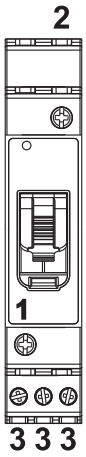
Power supply **Fig. 1**



RS485 port **Fig. 2**

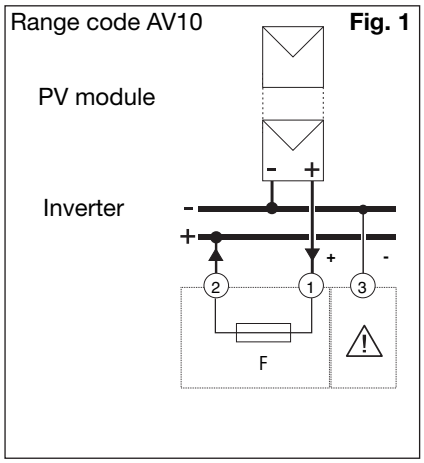


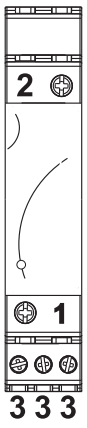
VMU-S0 (AV10 and AV30) connections



AV10

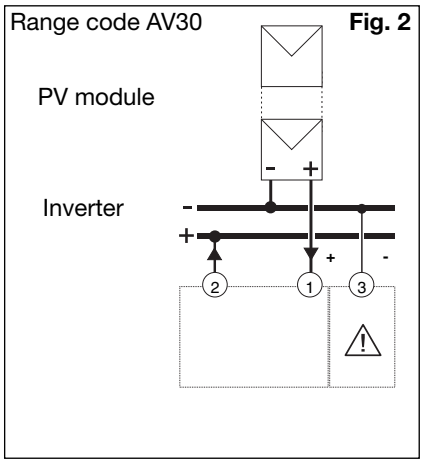
Range code AV10 **Fig. 1**





AV30

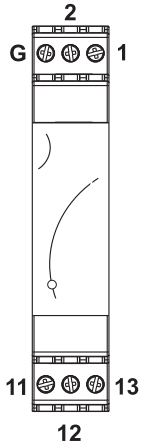
Range code AV30 **Fig. 2**



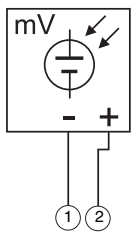
F= 10.3x38mm (IEC269-2-1) 1.25 Isc DC

⚠ = Not power input, only for voltage signal measurement.

VMU-P (1TI) connections



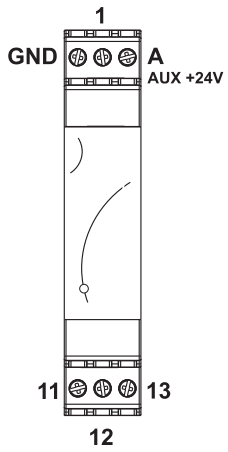
Irradiation input mV **Fig. 1**



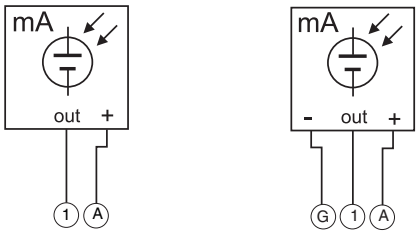
Temperature input 1 and input 2 **Fig. 2**

2 and 3 wires connections

VMU-P (1TC) connections

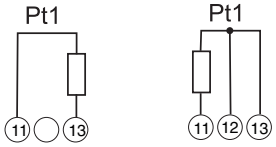


Irradiation input 20mA **Fig. 1**



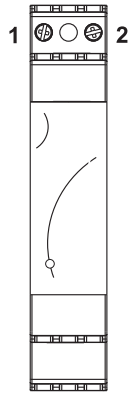
2 and 3 wires connections

Temperature input 1 and **Fig. 2**

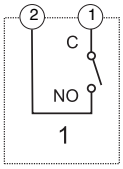


2 and 3 wires connections

VMU-O connections

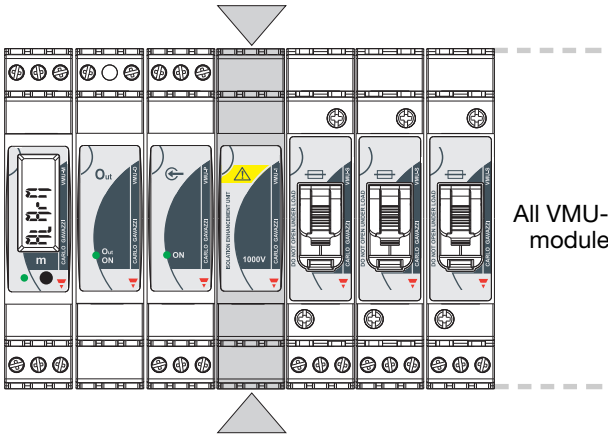


Digital outputs **Fig. 1**



VMU-1 mounting and positioning

Other VMU modules (not VMU-S0)

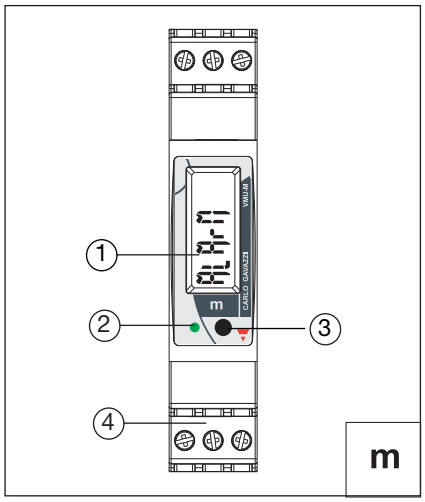


All VMU-S0 modules

The VMU-1 has to be mounted between the group of VMU-S0 and all the other modules as shown in the example picture on the left.

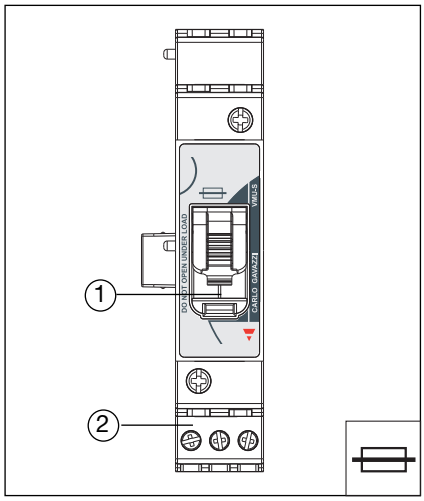
Every Eos-Array Lite has to be equipped only with one VMU-1.

VMU-ML Front panel description



1. **Display.**
   LCD-type with alphanumeric indications to:
   - display some configuration parameters;
   - display some measured variables.
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. **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.
4. **Screw terminals.**
   For power supply, bus and digital inputs/output connections

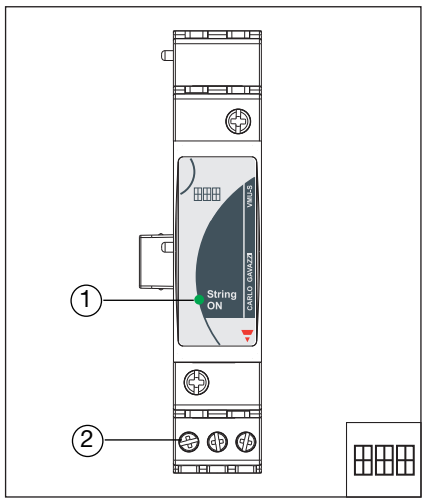
VMU-S0 Front panel description (AV10 range code: 16A)



1. **Fuse holder cover**
   For fuse holding and protection.

2. **Screw terminals**
   For string connections

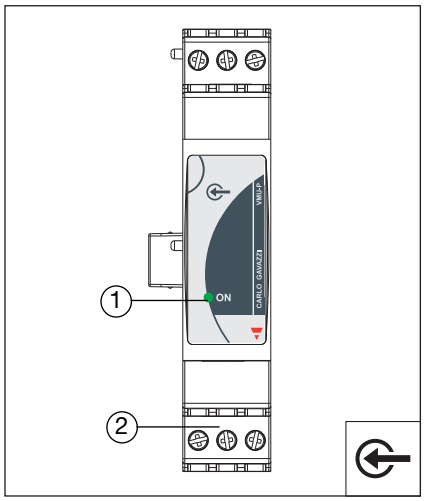
VMU-S0 Front panel description (AV30 range code: 30A)



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.

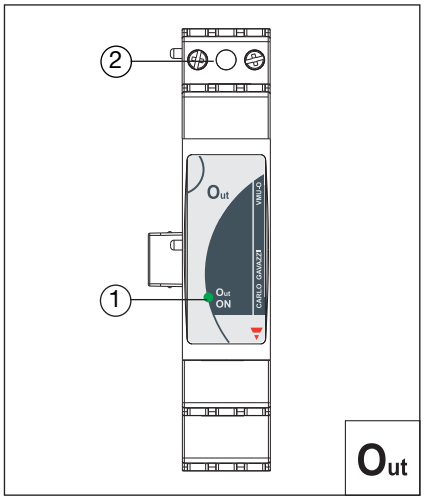
2. **Screw terminals**
   For string connections

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-ML module for data reading and displaying
   .
2. **Screw terminals**
   For measuring input connection**s**

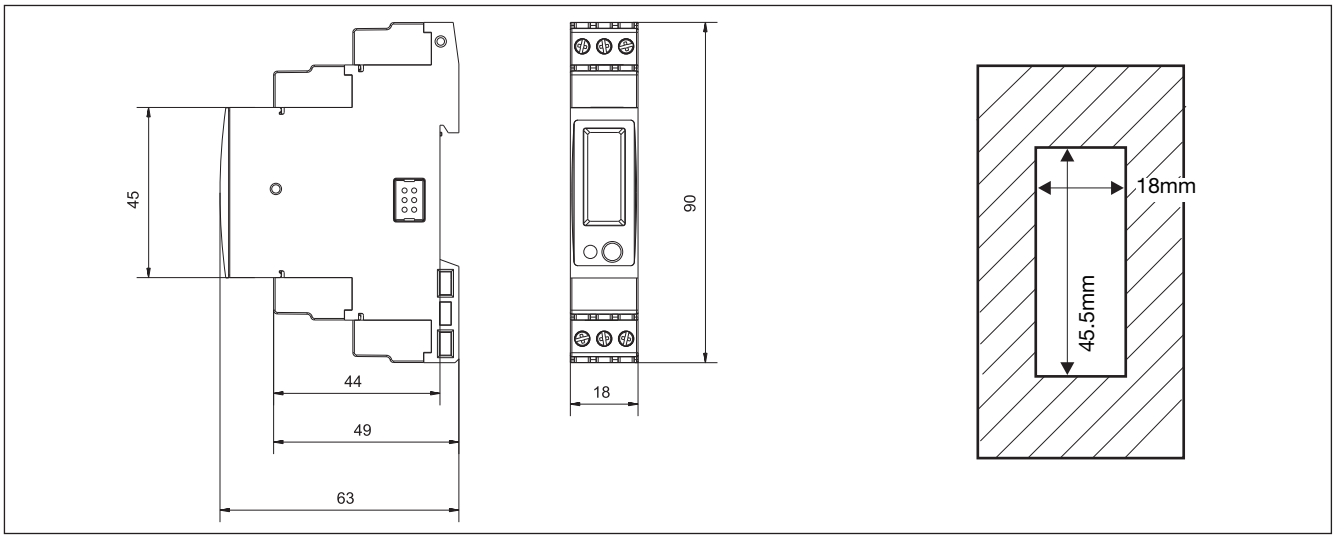
VMU-O Front panel description



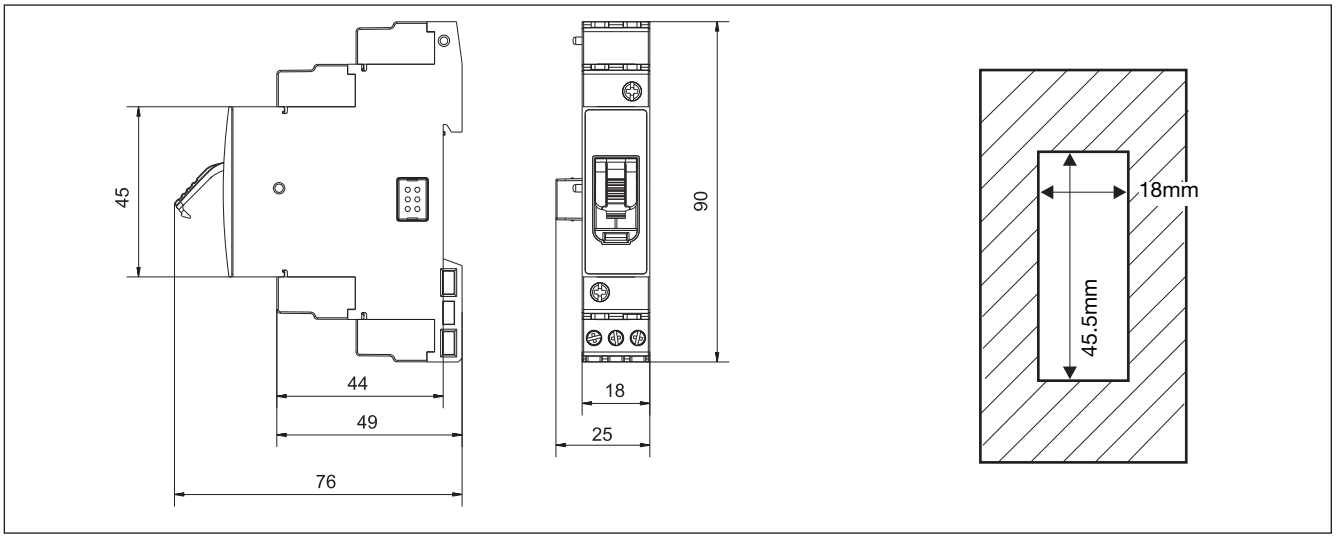
1. **LED**
   Green: the power supply is ON
   White: the unit is enabled by VMU-ML module for data reading and displaying.
   Red: one or both digital inputs are activated
   Blue: one or both digital outputs are activated
   Cycling from one colour to any other one: the unit shows the status of the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

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

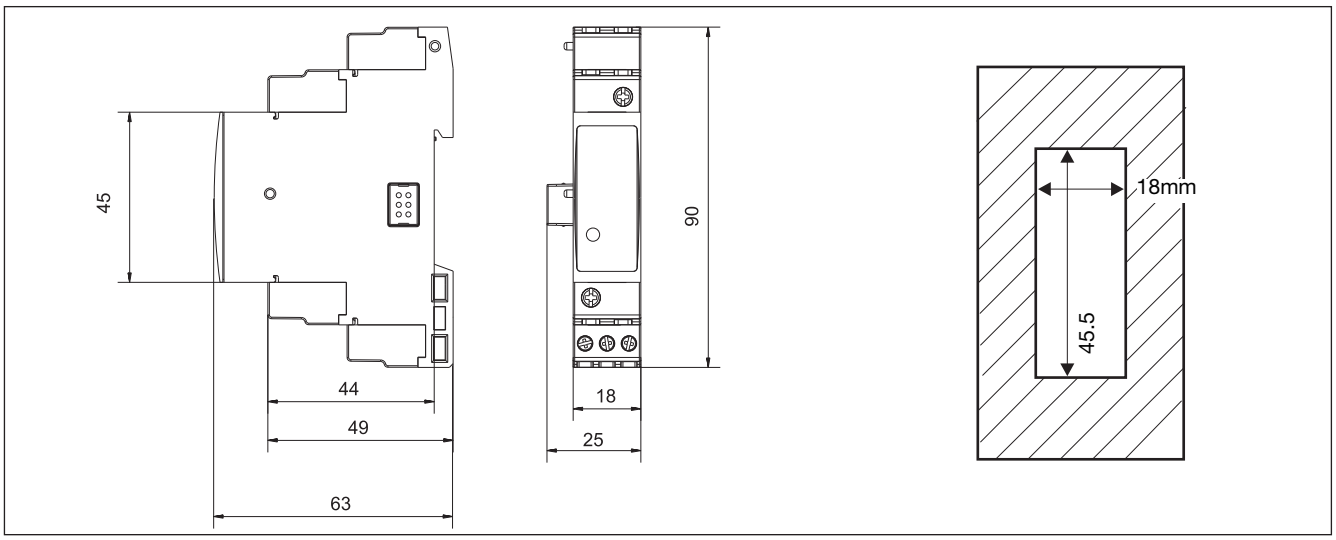
VMU-ML Dimensions and panel cut-out (mm)



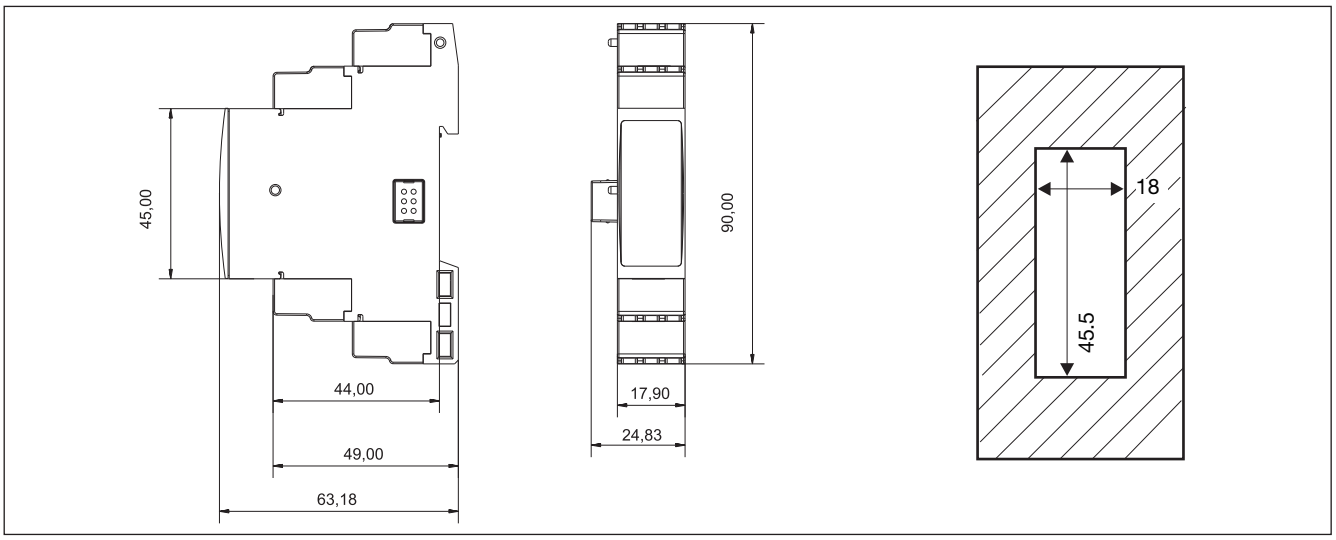
VMU-S0 (AV10) Dimensions and panel cut-out (mm)



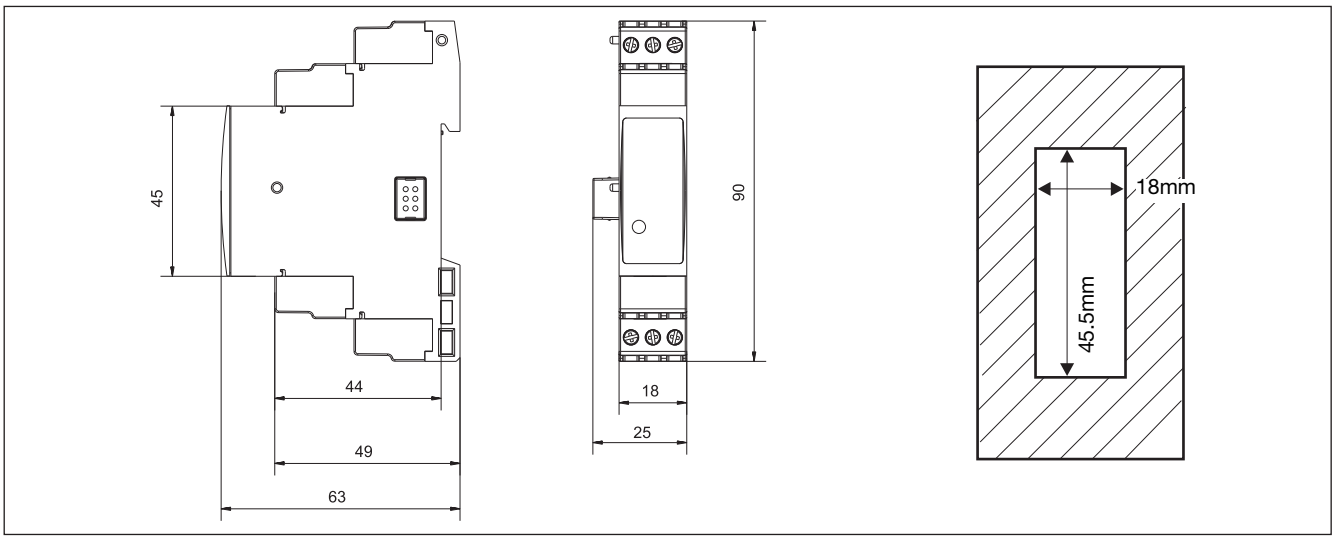
VMU-S0 (AV30) Dimensions and panel cut-out (mm)



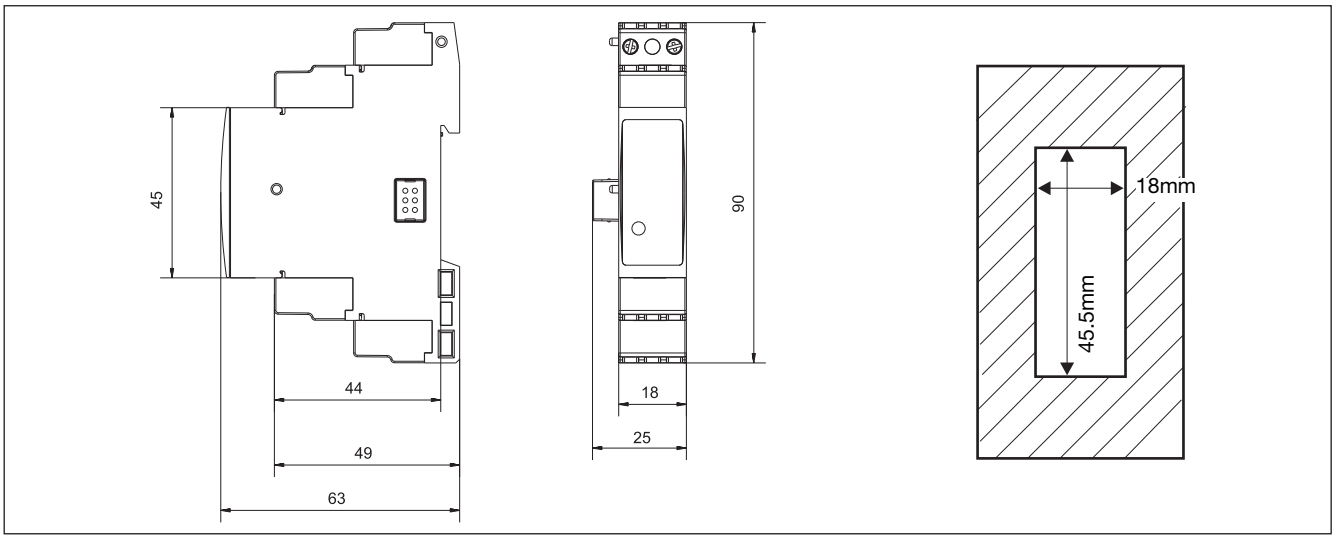
VMU-1 Dimensions and panel cut-out (mm)



VMU-P Dimensions and panel cut-out (mm)



VMU-O Dimensions and panel cut-out (mm)



Mean time to failure (MTTF)

Model	MTTF/MTBF - Years	Test conditions	Standard
VMU-ML	24.2	gf, 50° C	MIL-HDBK-217F
VMU-S0	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-ArrayLSoft parameter programming and variable reading software

Eos-ArrayLSoft	Multi-language software (Italian, English, French, German, Spanish) for variable reading and parameters programming. The program runs under Windows XP/Vista	Configuration mode	There are two configuration levels: - the RS485 communication network which can include either one or more VMU-ML units; - the auxiliary network with all the parameters relevant to the following modules: VMU-ML, VMU-S0, VMU-P, VMU-O.
Application	One / three different applications can be selected: - Solar: a management of a limited network where Eos-ArrayLSoft manages basically one VMU-ML unit with relevant VMU-S0, VMU-P and VMU-O modules and maybe an energy meter connected to the VMU-ML digital input; - Solar extended: a management of a complex network where Eos-ArrayLSoft manages many VMU-ML modules and relevant sub networks (VMU-S0, VMU-P and VMU-O units) and maybe an energy meter (EM21-72D, EM24-DIN, EM26-96) connected to the same RS485 bus.	Data displaying	The following matrix are available: - String 1: V-A - String 2: V-A - String n: V-A - Main: temperature, irradiation and AC energy. - Plant alarms and errors alarm - Relay output status.

Energy Management
Control solution for Solar PV applications
Type Eos-Box

- **100 to 240VAC power supply**
- **Dimensions(WxHxD): 225 x 225 x 45 mm**
- **Protection degree (front): IP20**

- **Fan-less embedded PC with Web-server capability**
- **Windows XP embedded operating system**
- **Managed information: V, A, kW, kWh, sun-irradiation, cell-temperature, air- temperature, wind speed on the DC part of the photovoltaic park and V, A, kW, kWh on the AC part and from both inverters and energy meters.**
- **Efficiency calculation and control on three different levels: string, BOS and total**
- **Variables shown as graphs and numbers in formatted tables**
- **Alarms control and automatic e-mailing and SMS management in case of GPRS modem external connection**
- **All data exports on XLS format**
- **Data storage up to 15 years in a 8GB DOM Memory**
- **Four RS485 communication ports (Modbus)**
- **One Ethernet port**

Product description

Eos-Box is a fan-less embedded PC with Web-server capability suitable to gather photovoltaic plant information from Eos-Array, inverters, energy meters and interface protection. Eos-Box provides information in a quick and automatic fashion via the internet using a standard browser, so the data is available wherever you are. Eos-Box shows information such as: V, A, kW, kWh, sun-irradiation, cell-temperature, air-temperature, wind speed on the DC part of the photovoltaic park and V, A, kW, kWh on the AC part coming from both inverters and energy meters. All data are available as graphs and numbers in formatted tables. Eos-Box performs alarms control managing also automatic e-mailing and SMS when proper GPRS modem is connected. All available data can be exported as spread sheets for further analysis.

How to order

Eos-Box D XX X

Model
Power supply
Option
Special features

Type Selection

Power supply		Option		Special features		
D:	from 100 to 240VAC **(*)**	**XX:**	none **(*)**	**X:**	none **(*)**	**(*)** as standard.

Hardware

Type	Embedded PC
Operating system	Windows XP embedded
Operation	Fan-less
Processor	AMD LX800 500 MHz
Chipset	AMD LX+CS5536+ITE8888G
BIOS	Phoenix-Award 4Mbit with RPL/PXE LAN Boot ROM. SmartView and customer CMOS backup
Memory	
DDR	256MB SODIMM
DOM	8GB
Back-up Industrial CompactFlash™	8GB Type II (on request)

Communication ports	
RS485	3 ports for Eos-Array bus management 1 port for Inverter, Interface protection and Energy meters
Ethernet	1 for internet/LAN connection 1 for local access
Other ports	
USB	3, for local access and service

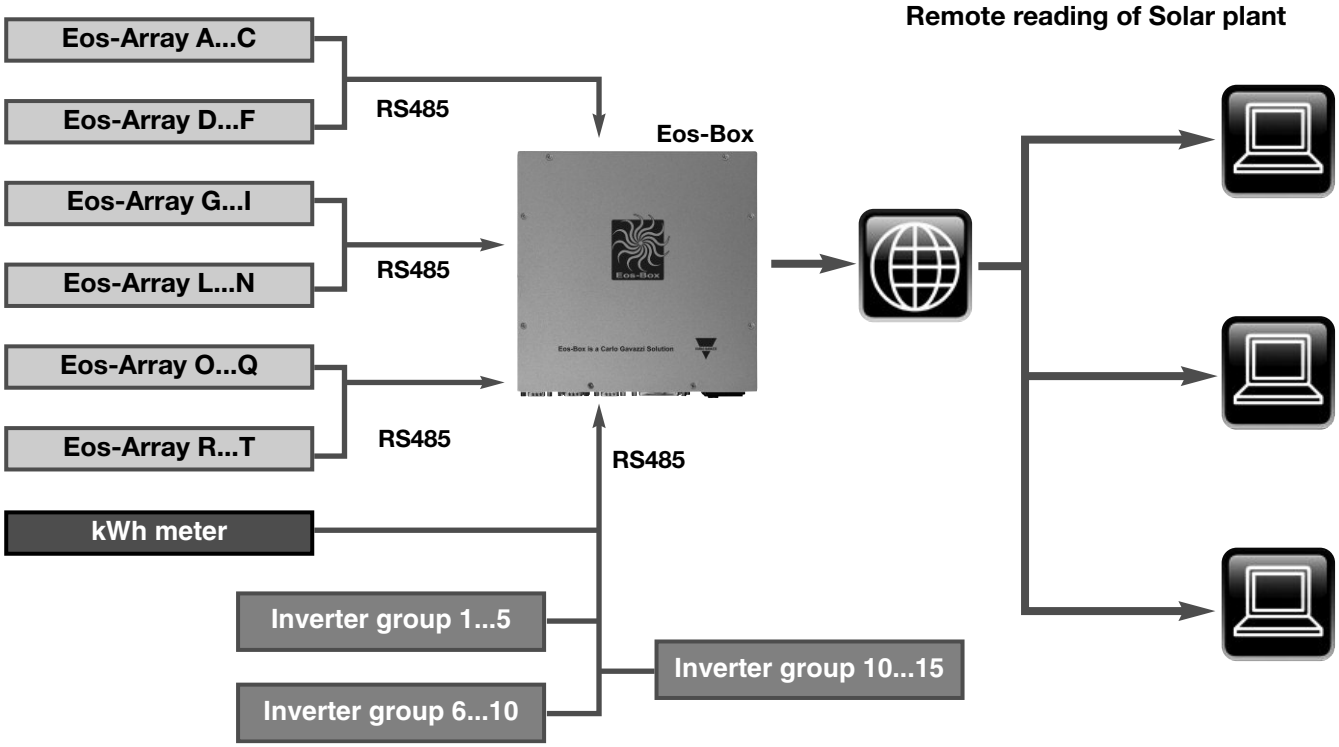
Hardware (cont.)

LED Status and colour	Green for power-on Orange for DOM memory access	Ethernet USB	RJ-45 connector (10/100Base-T) High speed USB 2.0
Connections RS485	3 pole detachable screw terminal block per port		

RS485 communications ports

Type	Master function, Multidrop, bidirectional (static and dynamic variables)	Baud-rate	mark/space parity,1/1.5/2 stop bit Selectable: 9600, 19200, 38400, 115200 bits/s
Connections	2-wire. Max. distance 1000m	Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
Addresses	247		
Protocol	MODBUS/JBUS (RTU)		
Data (bidirectional)	All variables	Insulation	See the table “Insulation between inputs and outputs”
Data format	Selectable: 1 start bit, 7/8 data bit, no/odd/even/		

Example of communication architecture



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Eos-Box Management capability

Max. number of Eos-Array systems which can be managed by one Eos-Box						
Every Eos-Array is equipped with 15 VMU-S			Max. number of Eos-Array which can be connected to one port at the given communication speed			
Data logger time interval (minutes)	Total number of Eos-Array	Total number of VMU-S	@ 9600 bits/s	@ 19200 bits/s	@ 38400 bits/s	@ 115200 bits/s
1	18	270	13	18	18	18
5	84	1260	65	84	84	84
10	168	2520	130	168	168	168
15	247	3705	195	247	247	247
30	494	7410	247	247	247	247
60	741	11115	247	247	247	247
RS485 communication ports: 2-3-4						

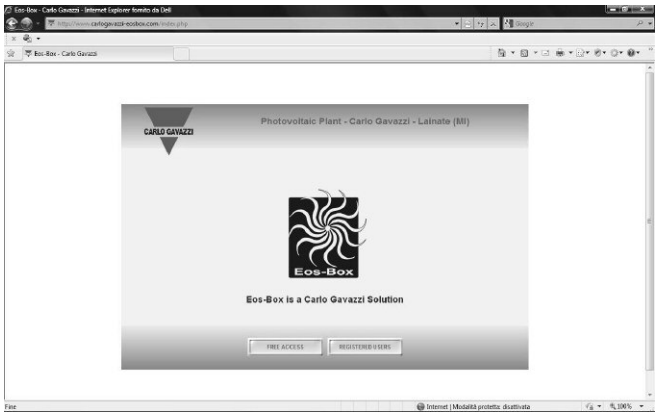
- All the details of the daily logged data will be available and therefore displayable as graphs from 6 months (in case of 1 minute time interval) to 10 years (in case of 30 minutes time interval) for “Day” selection. The single day data will be available and displayable as graphs for 10 years (either “Month” or “Year” selection).
- 6 months and 10 years are worst conditions, they consider, according to the time interval, the maximum number of managed Eos-Array, if those latter ones decrease, the single data time availability will increase proportionally.

Max. number of Inverters and energy meters which can be managed by one Eos-Box		
Max. number of inverters	Maximum number of energy meters to be connected to one Eos-Box	
30	10 (with RS485 communication port)	1 (with pulse output and only from one VMU-M as kWh)
• All inverters have to be connected on "COM1". The refresh time of the data depends on the inverter's communication speed. • The data (power, energy, AC and DC) are stored with a time interval of 15 minutes. • Those data will be available for graph displaying for maximum 10 years.	**RS485 communication port:** • The information acquired from every single energy meter is the metered active energy and where possible also the active power. The limit of number of connected energy meters is mainly due to the maximum number of inverters connected to the same port. • During the set-up of Eos-Box only one energy meter can be selected as main yield energy meter. • All the details of the daily logged data will be available and therefore displayable as graphs from 6 months (in case of 1 minute time interval) to 10 years (in case of 30 minutes time interval) “Day” selection. The single day data will be available and displayable as graphs for 10 years (either “Month” or “Year” selection).	
Inverter, Energy meters and interface protection use the same RS485 communication port 1		

Max. number of sensors which can be managed by one Eos-Box	
Max. number of irradiation and wind speed sensors	Maximum number of temperature sensors
Depending on the number of VMU-P units available in the network	2 (VMU-M) + 2 (VMU-P)
• The irradiation and wind speed sensors can be as much as the number VMU-P units managed in the same network. • All the details of the daily logged data will be available and therefore displayable as graphs from 6 months (in case of 1 minute time interval) to 10 years (in case of 30 minutes time interval) “Day” selection. The single day data will be available and displayable as graphs for 10 years (either “Month or “Year” selection). • Only one irradiation sensor within one Eos-Box has to be used as a reference for the efficiency calculation.	• The temperature sensors can be as many as the number of VMU-P (being 2 channel inputs available per unit) + VMU-M (being 2 channel inputs available per unit). • All the details of the daily logged data will be available and therefore displayable as graphs from 6 months (in case of 1 minute time interval) to 10 years (in case of 30 minutes time interval) “Day” selection. The single day data will be available and displayable as graphs for 10 years (either “Month” or “Year” selection). • Only one air or cell temperature sensor within one Eos-Box has to be used as a reference for the efficiency calculation.

WEB-server displaying and control functionalities

Access page of Eos-Box



This page has a double access:

- "Free access": there is access at one web page which has been formerly selected by the "Administrator".
- "Registered users": the access is with "User name" and "Password" and has different privileges according to the type of user:
- As "User": in this case the user has access to the "Home" page and all the other graphs and tables pages.
- As an "Administrator": in this case the user has access to all pages as per "User" above but in addition also to all "Settings" and to the "Account" management.

Home page

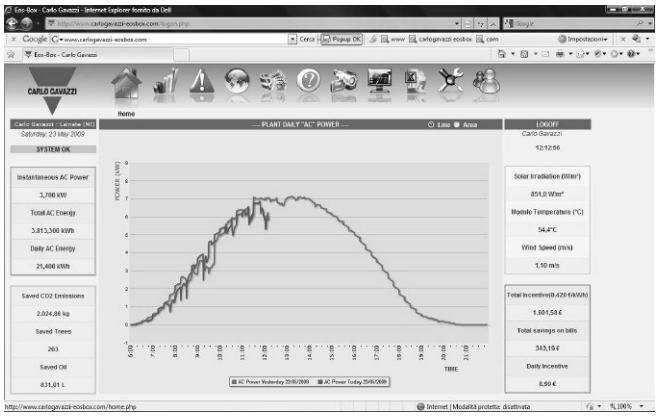


Fig. 1

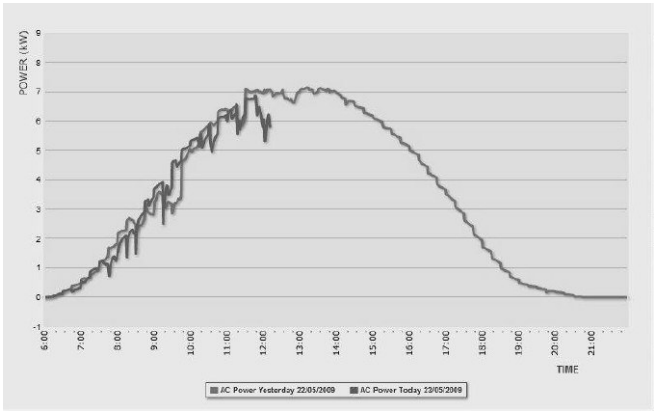


Fig. 2

The page is divided in four areas:

1 **On the top. 11 icons are available to have direct access to different functionalities like (Fig.1):**

- Home page: Plant daily AC power;
- Plant page: Detailed graphs and data table of all available variables;
- Alarms page: alarms, warning, events, commands list;
- Map page: alarms localisation on the photovoltaic park;
- Economy page: economical parameters of the installation;
- Information page: plant description with relevant technical data, financial highlights, energy production data source;
- IP cam page: live images from the photovoltaic park;
- Monitor page: combination of main graphs for accurate plant analysis;
- Export page: data base export in Excel spreadsheet;
- Setting page: access to the configuration of all parameters of Eos-Box;
- Account page: access to LAN and Internet configuration.

2 **On the middle (Fig.2).** The plant daily power graph which allows to compare the actual AC power vs. the day before AC power. The graph is available as either a line or an area graph. The showed power may come directly either from the inverters or from the energy meters (selectable).

WEB-server displaying and control functionalities (cont.)

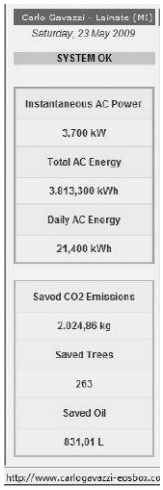


Fig. 3 and Fig 4

3 On the left hands (Fig.3). Power and Savings information such as:

- Instantaneous AC power (kW);
- Total AC energy (kWh);
- Daily AC energy (kWh);
- Saved CO2 emissions (kg);
- Saved trees (qty.);
- Saved oil (l/gallons).

4 On the right hands (Fig.4). Environment and Economic information such as:

- Solar irradiation (W/m2, W/ft2);
- Module temperature (°C/°F);
- Wind speed (m/s, ft/s);
- Total incentive (currency/kWh);
- Total savings on bills (currency);
- Daily incentive (currency)

Plant pages

The page has access to 6 different and specialised menus like:

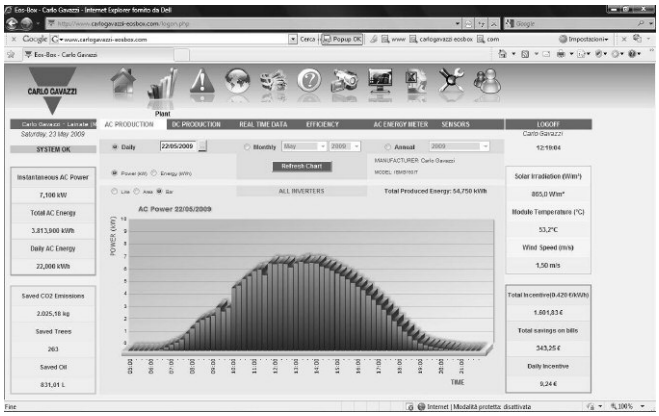


Fig. 5

1 AC production and then the following selections (Fig.5):

- All inverter, with the possibility to display AC kW, DC kW and AC kWh.
- Single inverters, with the possibility to display AC kW, DC, kW and AC kWh.

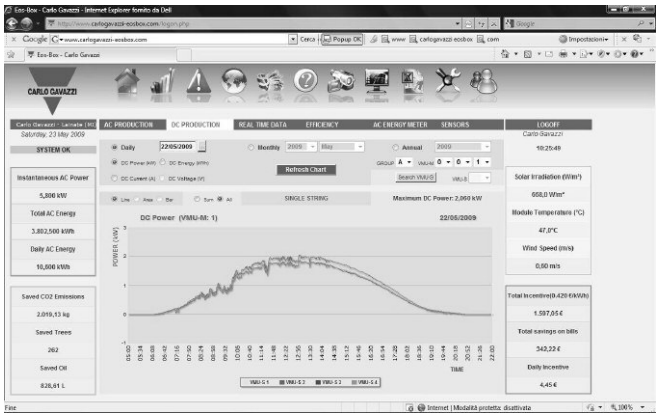


Fig. 6

2 DC production and then the following selections (Fig.6):

- All strings, with the possibility to display DC kW, DC A and DC kWh.
- Single strings, with the possibility to display DC kW, DC A, DC V and DC kWh. The measurements are available either as single graphs where, by group, they appear all at the same time with different colours so to allow an easy comparison of the different strings or as a sum of kW, A and kWh. A specific tool (see fig.7) allows to select the requested string for proper analysis.

3 Real time data and then the following selections (Fig.8):

- Inverter: a table with one line per inverter with the following information will appear: inverter name (label), V AC, A AC, kW AC, V DC, A DC, kW DC, AC kWh from energy meter and the inverter status.
- Eos-Array: a table with one line per string (VMU-S) with the following information will appear: VMU-S position (label), V DC, A DC, kW DC and VMU-S status. A specific tool (see fig.7) allows to select the requested string for proper analysis.
- AC energy meter: a table with one line per energy meter with the following information will appear: Name, Type (label), AC kW, AC kWh.

WEB-server displaying and control functionalities (cont.)

Fig. 7

Fig. 8

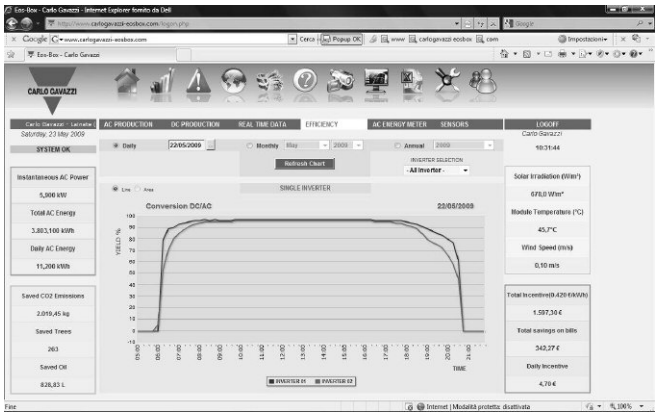


Fig. 9

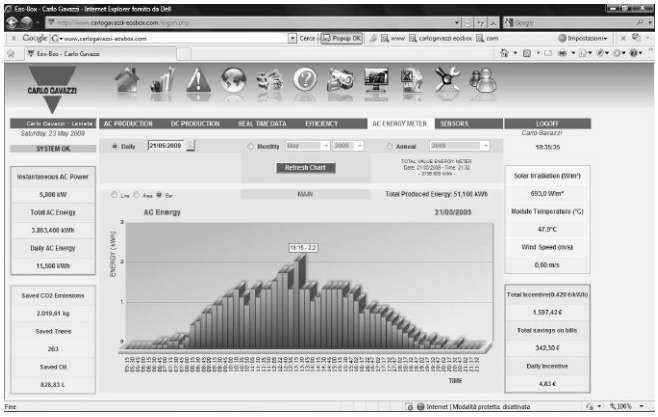


Fig. 10

4 Efficiency and then the following selections (Fig.9):

- Total: this graph shows the efficiency of the whole photovoltaic park under control (DC and AC part);
- Eos-Array: these combinations of graphs show the efficiencies of the DC part of the installation. The selection can be either “All strings” or “Single strings” and allows to analyse in case of “Total String” selection the behaviour of the efficiency of all strings together. In case of “Single string” selection a group of single strings will be shown with its own efficiency. This graph will allow the user to analyse the behaviour of the photovoltaic park. A specific tool (see fig.7) allows to select the requested string for proper analysis.
- Inverter: these combinations of graphs show the efficiencies of the DC to AC conversion inside the inverters. The selection can be either “All inverters” or “Single inverters” and allows to analyse in case of “Total inverters” selection the behaviour of the efficiency of all inverters together. In case of “Single inverter” selection a group of single inverter will be shown with its own efficiency. It is possible to select with a proper tool all the inverters in the network.
- BOS: this graph shows the efficiency of the AC part photovoltaic park under control.

5 AC energy meter and then the following selections (Fig.10):

- Main: the graph shows the total AC energy production to grid.
- Partial: the graph shows the partial (when the photovoltaic park is split in several parts) AC energy production to grid.

6 Sensors and then the following selections (Fig.11):

- Solar irradiation: the graph shows the solar irradiation which also used to calculate the string efficiency.
- Temperature: there is the possibility to select and to show many different graphs of temperature depending on the VMU-M and VMU-P settings, example: cell temperature, air temperature, string box temperature and so on.
- Wind speed: the graph shows the wind speed.

WEB-server displaying and control functionalities (cont.)

Fig. 11

Every single page has the possibility to show, according to the kind of variable, the graphs in three different ways: line, area, bar. The user has access to the database based on daily graph, with 24 hours time interval. The needed day is selectable by means of a calendar functionality. The same database can be displayed as “Month” (31 days) with “Month” and “Year” selection or “Year” graph (12 months) with “Year” selection.

Alarms page

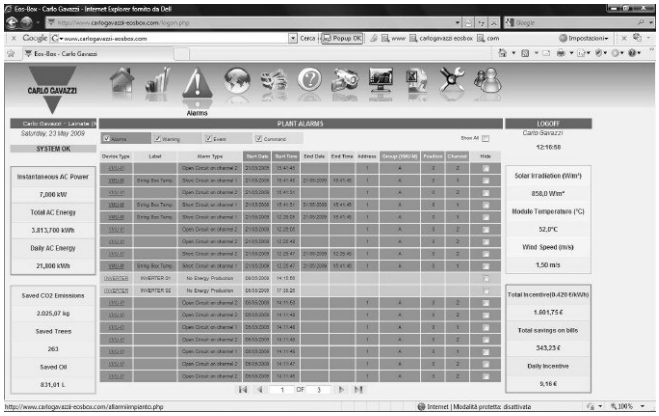


Fig. 12

The page has access to the list of all available anomalies not yet disappeared and not yet acknowledged such as:

- Alarms: alarms set by the user as high priority types;
- Warning: alarms set by the user as low priority types;
- Events: any kind of event recorded by Eos-Array;
- Commands: closing/opening contact detected by Eos-Array.

The page is split in two main parts which are then sub-split in some columns:

- Device type, Label, Alarm type, Start date, Start time, End date, End time: these information are all details relevant to the recorded alarm. Every line is a new alarm.
- Address, Group (VMU-M), Position, Channel: these are the information of the same line above but relevant to the device which has generated the alarm.
- All alarms according the privilege of the user can be hidden.

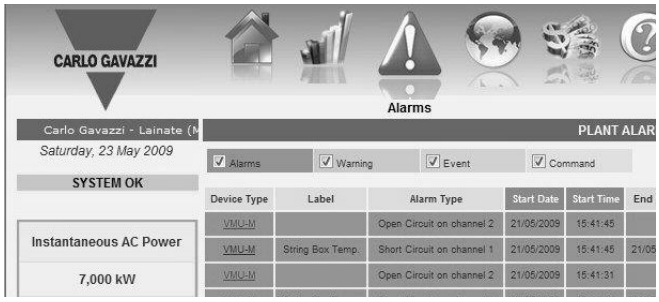


Fig. 13

One box (Fig.13) on the left hands upper corner shows at a glance the status of the photovoltaic park. Two type of messages may appear:

- STATUS OK (green): there are no alarms or low priority alarms;
- ALARM with message (red): there are high priority alarms.

WEB-server displaying and control functionalities (cont.)

Map page

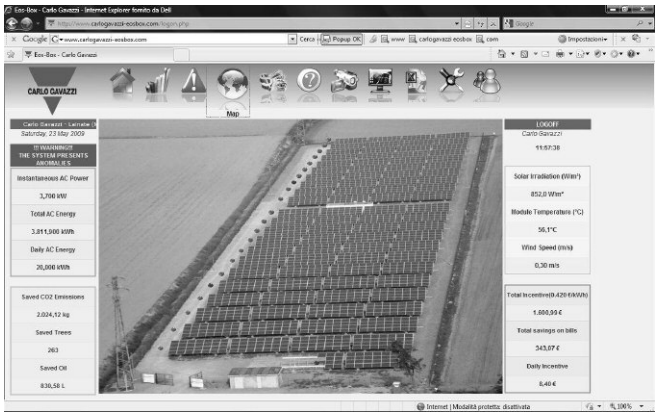


Fig. 14

This page shows, based on a map picture (JPG) loaded by the user the status of alarms on the photovoltaic park. The status is shown with:
Green LED: no anomalies;
Red LED: high priority alarms detected by the local Eos-Array systems.
Clicking with the mouse on the LED there is a direct access on the string managed by Eos-Array. If the LED is red the access is to Alarm list page (Fig.12), if the LED is green the access is to the relevant String (VMU-S) graph.

Economy page

This page shows to the user :

- the ROI (Return of Investment) status, current vs. expected;
- the delay in “days” of the investment payback;
- the total invested capital and the capital interests;
- the daily capital earnings;
- the total capital earnings;
- the feed-in tariff parameters.

Information page

Fig. 15

This page shows to the user:

- the plant description such as: plant name, plant location, plant property, installer, PV module installation date and Eos-Box installation date;
- the technical data such as: plant type, total area of PV modules, number of inverters, number of strings, peak power of plant;
- the financial highlights such as: energy system, incentive paid per kWh, kWh purchasing price, % of sold energy vs. total produced energy, price per sold kWh;
- the energy production data source: inverter or energy meter which has been selected in settings.

IP cam page

This page shows to the user live images of the photovoltaic park. There are two possible selections:

- “Select IP cam” where the user can chose to which IP cam to connect and upload the image;
- “Mosaic” where the user can see four IP cams simultaneously.

Eos-Box is capable to manage any kind of IP cam, it is independent from the type, as long as it is an IP type. Also DVR IP cams can be managed and those with remote position control.

WEB-server displaying and control functionalities (cont.)

Monitor page

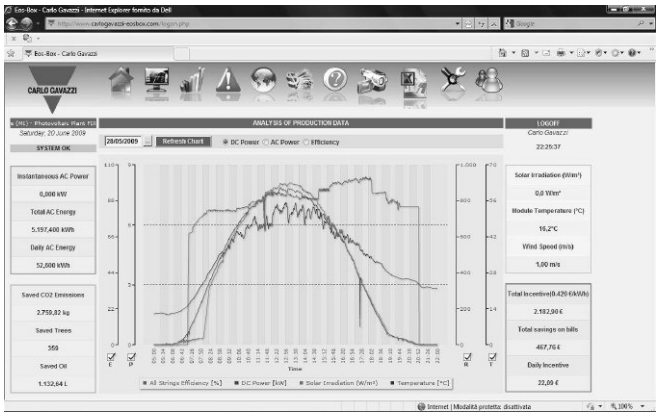


Fig. 16

This page shows to the user:
Three combinations of variables which will let the user to understand how the photovoltaic park behaves and if there are problems such low efficiencies.

- DC Power as a combination of 4 graphs: all strings efficiency, DC power, Solar irradiation, Cell or air temperature (depending on the selection made by the user). The time interval of the graphs is depending on settings of Eos-Array system;
- AC Power as a combination of 4 graphs: Total efficiency, AC power (three sources are selectable: inverter, energy meter, inverter + energy meter), Solar irradiation, Cell or air temperature (depending on the selection made by the user). The time interval of the graphs is 30 minutes;
- Efficiency as a combination of 3 graphs: all strings efficiency, BOS efficiency and Total efficiency.

Export page

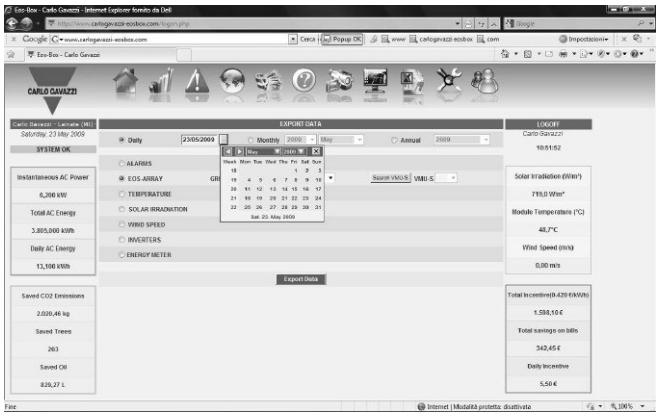


Fig. 17

The database of the whole photovoltaic park managed by the Eos-Box can be downloaded as an Excel spreadsheet and is available according to the following selection:
Daily: 24 hours time interval with the selection of the needed “Day” using a calendar tool;
Monthly: max. 31 days with the selection of the needed “Month” and “Year”;
Annual: 12 months with the selection of the needed “Year”.

In order to help the user to focus on the desired information a further criteria is available:

- Alarms
- Eos-Array
- Temperature
- Solar irradiation
- Wind speed
- Inverters
- Energy meter

Configuration

Setting page

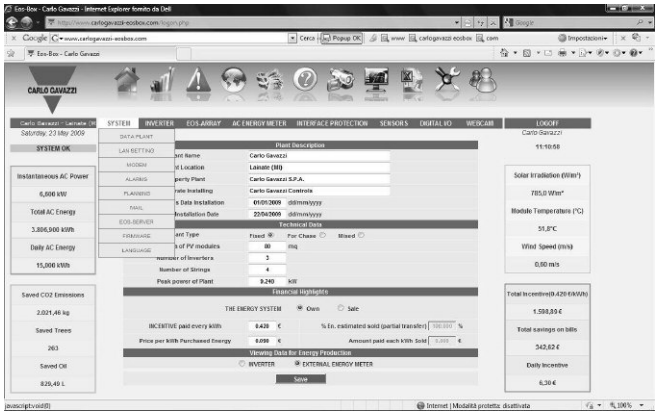


Fig. 18

This main configuration menu allows the user to access to all parameters relevant to the Eos-Box such as:

- System: all main parameters of Eos-Box;
- Inverter: all communication parameters of the connected inverters;
- Eos-Array: all communication parameters of the connected Eos-Arrays;
- AC energy meter: all communication parameters of the connected energy meters;
- Interface protection: all communication parameters of the connected interface protection device;
- Sensors: all information of the used sensors;
- Digital I/O: all information of the used I/Os;
- IP cam: all communication parameters of the connected IP cams.

Most of the listed settings are provided with sub-menus as explained in the next figures.

System

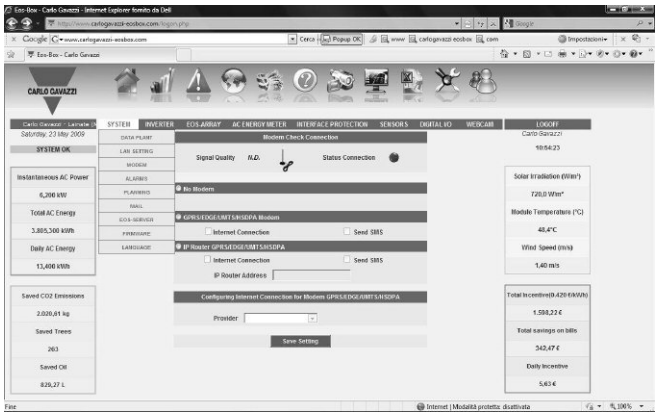


Fig. 19

This first menu allows the user to configure the following sub-menus:

- Data plant: the setting of all parameters as already explained at the figure 15 above.
- LAN setting: the Eos-Box label and the Network settings like: automatic IP address (DHCP) or manual: IP address, subnet mask, default gateway; automatic DNS server address or manual DNS server address (preferred and alternative DNS server).
- Modem (Fig.19 and Fig.20): this sub-menu allows not only to configure the connected wireless modem but also to check if it works. The following parameters can be set: No modem; GPRS/EDGE/UMTS/HSDPA modem with internet connection and/or SMS; IP router based GPRS/EDGE/UMTS/HSDPA with internet connection and/or SMS, and IP router address; configuration of Internet connection selecting also the provider.
- Alarms: this sub-menu is used to configure the management of all alarms, the labels to be displayed at the figure 12 and the link of variable versus type of anomaly: high priority alarm (alarm), low priority alarm (warning), events and commands.
- Planning: this-sub-menu is used to enable the automatic e-mailing based on daily, weekly and monthly shipments with pre-set time, the list of the e-mail addresses and the relevant attachments. The enabling of alarms, the setting of the relevant messages and attachments.
- Mail: this sub-menu allows to configure the classical e-mail parameters to manage the communication.
- Eos-Server: this sub menu is used to configure the communication to an Eos-Server which is a machine capable to gather data from several Eos-Boxes also in different locations so to work out a global service.
- Firmware: this particular sub-menu allows the service people to upgrade the firmware running into the Eos-Box.

Fig. 20

Configuration (cont.)

Inverter

Fig. 21 and Fig. 22

This sub-menu allows the user to:

- "Add" a new inverter to the network managed by Eos-Box;
- "Update" the parameters of an existing inverter;
- "Delete" an already configured inverter.

The main parameters which can be configured are:

- Inverter name as a label;
- Serial number of the inverter being connected;
- Manufacturer, selectable among the following brands: Carlo Gavazzi, Delta, Fronius, Magnetek, Power-one, SMA, Schuko, Siemens, Siel, Elettronica Santerno, Astrid, Kaco. Other brands will be added in the future.
- Model shown in accordance to the selected manufacturer. Other models will be added in the future.
- Subject/notes: a text which can be typed in by the user;
- Communication type: RS485 (COM1) or RS232 (COM1) and relevant address;
- Some advanced communication functionalities like: baud rate, data bit number, parity, stop bit number.

Eos-Array

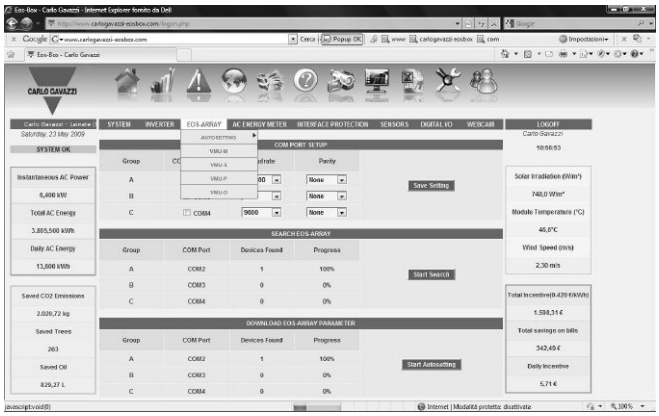


Fig. 23

This sub-menu is split in several other menus such as:

- Auto-setting, Set-up and Update, see details below;
- VMU-M: it is possible to label the device and read all configured parameters;
- VMU-S: it is possible to label the device and also to link it to the relevant inverter, moreover the page shows all the
- VMU-S configured parameters;
- VMU-P it is possible to label the device and read all configured parameters;
- VMU-O it is possible to label the device and read all configured parameters;

For security reasons the Eos-Array parameters can be set only locally and by using its configuration software Eos-ArraySoft. The only parameters which can be changed from Eos-Box are the alarm set-points, which can be adjusted for installation fine tuning.

Auto-setting: the "Set-up" menu allows the user to configure all the communication parameters of Eos-Arrays being connected to the network. The page is split in three parts:

- "Communication port setup" where it is possible to select for each group A-B-C (corresponding to each communication port) the communication port enable, the baud rate and the parity. This represents the first step.
- "Search Eos-Array" where it is possible to start the relevant search, this is the second step.
- "Download Eos-Array parameters" as auto-setting start.

Configuration (cont.)

AC Energy Meter

As for the inverters also here it is possible to “Add”, “Update” and “Delete a device which is in this case an energy meter.
The main parameters which can be configured are:

- Meter name as a label;
- Serial number of the meter being connected;
- Manufacturer, selectable among the following brands: Carlo Gavazzi, others. Other brands will be added in the future.
- Model shown in accordance to the selected manufacturer. Other models will be added in the future.
- Subject/notes: a text which can be typed in by the user;
- Meter reference for BOS and Total efficiency calculation;
- Communication type: RS485 (COM1) and relevant address or pulses coming from VMU-M;
- Energy metering as exported or imported energy;
- Energy offset;
- Some advanced communication functionalities like: baud rate, data bit number, parity, stop bit number.

Interface protection

This sub-menu allows to configure:

- Device name as a label;
- Serial number of the device being connected;
- Manufacturer, selectable among the following brands: Carlo Gavazzi, others. Other brands will be added in the future.
- Model shown in accordance to the selected manufacturer. Other models will be added in the future.
- Subject/notes: a text which can be typed in by the user;
- Communication type: RS485 (COM1) and relevant address.

Sensors

This sub-menu allows to configure the type of sensor in the Eos-Array system such as:

- Solar irradiation;
- Temperature;
- Wind speed.

For every single sensor it is possible to configure the following parameters:

- Device name as a label;
- Sensor state: enabled/disabled;
- Reference device for efficiency calculation.

Digital I/O

This sub-menu allows to configure the “Name” as a label of every single device in the Eos-Array system.

IP cam

This sub-menu allows to configure the

- “Name” as a label of every single IP cam in the network;
- Management parameters of the IP cam;
- Network settings like: automatic IP address (DHCP) or manual: IP address, subnet mask, default gateway; automatic DNS server address or manual DNS server address (preferred and alternative DNS server).

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Insulation between inputs and outputs

Type of input/output	Ac Power supply	RS485 port 1 (Inverter, energy meters and interface protection)	RS485 port 2 (Eos-Array)	RS485 port 3 (Eos-Array)	RS485 port 4 (Eos-Array)	Ethernet port 1 (LAN/Internet)	Ethernet port 2 (Service)	USB ports (Service)
Ac Power supply	-	4kV	4kV	4kV	4kV	4kV	4kV	4kV
RS485 port 1 (Inverter, energy meters and interface protection)	4kV	-	0kV	0kV	0kV	4kV	4kV	4kV
RS485 port 2 (Eos-Array)	4kV	0kV	-	0kV	0kV	4kV	4kV	4kV
RS485 port 3 (Eos-Array)	4kV	0kV	0kV	-	0kV	4kV	4kV	4kV
RS485 port 4 (Eos-Array)	4kV	0kV	0kV	0kV	-	4kV	4kV	4kV
Ethernet port 1 (LAN/Internet)	4kV	4kV	4kV	4kV	4kV	-	4kV	4kV
Ethernet port 2 (Service)	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV
USB ports (Service)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-

0kV	Inputs / outputs are not insulated.
4kVrms	EN61010-1, IEC60664-1 - Over-voltage category III, Pollution degree 2, double insulation on systems with max. 300Vrms to ground

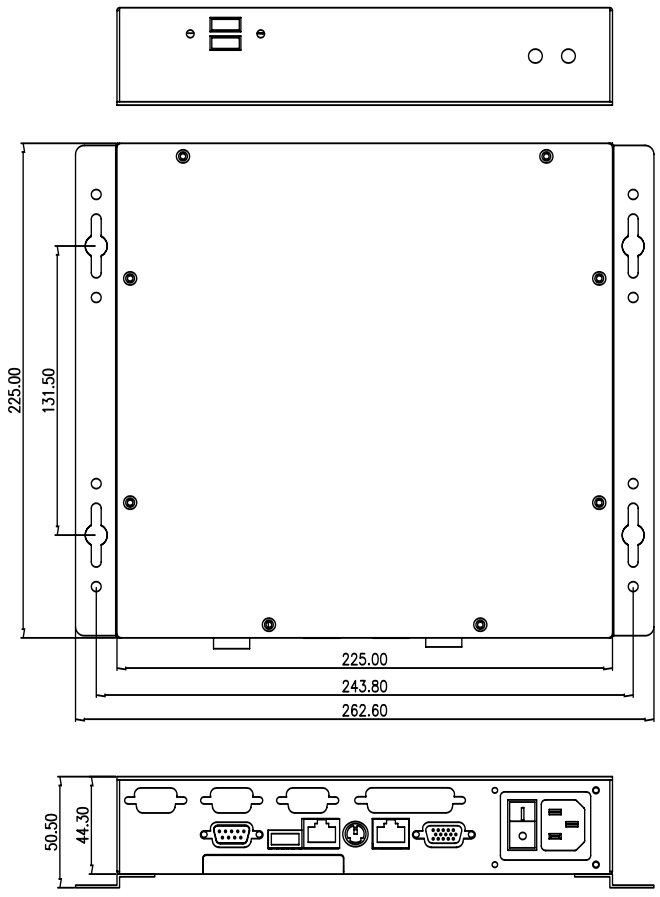
General specifications

Operating temperature	-20 to +50°C (-4°F to 122°F) (R.H. from 0 to <90% non-condensing @ 40°C) See also "VMU-S input specifications"
Storage temperature	-20 to +80°C (-4°F to 176°F) (R.H. < 90% non-condensing @ 40°C)
Approvals	CE
Housing	
Dimensions (WxHxD)	225 x 225 x 45 mm
Material	Aluminium and Heavy-duty steel
Mounting	Wall and DIN-rail with additional bracket
Vibration endurance	2G RMS W/CF 5-500Hz, X-Y-Z direction
Failure tests	
Electrical stress condition	50%
PI-Q	1.0 (Quality Level II)
Failure rate	12 567.29 FITs (Failure In Time)
Environment condition 1	Grounded, fixed, uncontrolled GF (PI-E = 2.0)
Test temperature	60°C
MTBF @ PI-E = 2.0	79 571 hours (Mean Time Between Failures)
Environment condition 2	Grounded, fixed, controlled GB (PI-E = 1.0)
Test temperature	40°C
MTBF @ PI-E = 1.0	195 710 hours (Mean Time Between Failures)
Protection degree	
Front	IP20
Screw terminals	IP20
Weight	2.15Kg

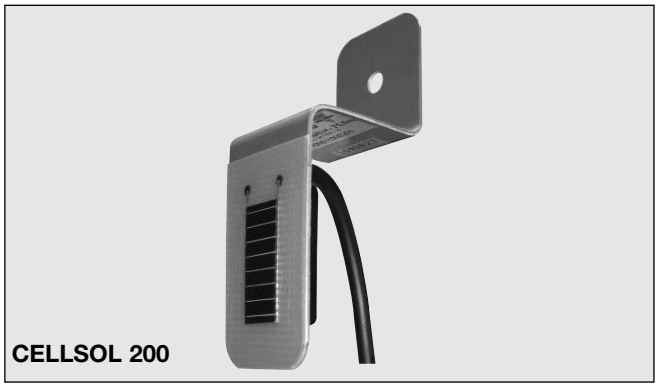
Power supply specifications

Power supply	100 to 240VAC	**Power consumption**	70W

Overall dimensions



Irradiation Sensor
Model CELLSOL 200


CELLSOL 200

- Solar irradiation measure
- Output ~75mV @ 1000W/m²
- Light and strong device with an easy installation
- Two wire cable, UV proof, length 3m

Product Description

CELLSOL 200 is a silicon sensor for the measurement of the solar irradiation. The device provides a voltage output in mV, proportional to the standard irradiation of 1000W/m².

Every sensor brings in plate the value calibrated in mV related to the full scale.
Normally used for controlling the efficiency of the photovoltaic plants.

Ordering Key

CELLSOL 200

Model

General Specification

Range	**from 0 to 1500W/m²**
Accuracy	**±5%, annual average**
Output	**Approx. 75mV @ 1000W/m²** **(true value is reported on the label)**

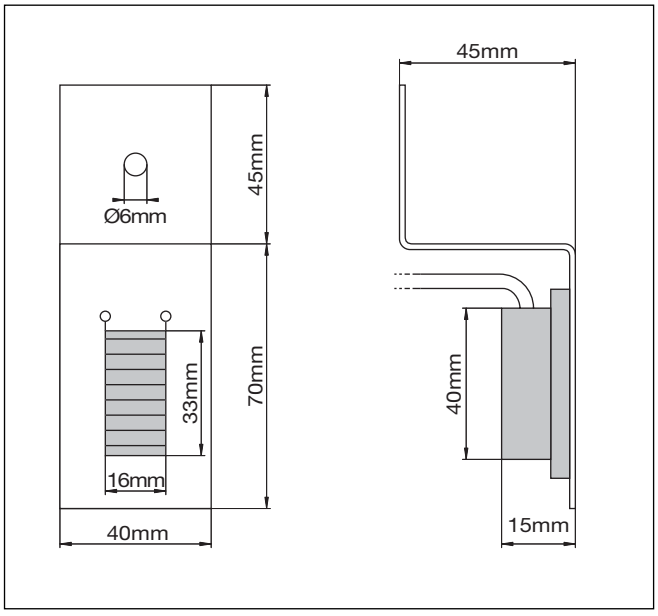
Sensor Characteristics

Sensor type	**Mono-crystalline cell**
Mounting	**Novaflon and EVA sheet**
Cell dimension	**6 x 33mm**

Mechanical Specification

Main structure	**Anodized aluminium**
Cable dimension	**110 x 40 x 40mm** **UV proof 3m**
Fixing	**1 hole Ø6mm**
Weight	**~200g (with cable)**
Warranty	**2 years**

Dimensions



Monitoring Relays
Surge Arresters for PV system
Type DSF D

- **Type 2 (class C) according to EN61643-11 (VDE 0675, part 6-11)**
- **Approved UL1449 3rd Edition**
- **Complies with IEC-61643-1, VTE C 61-740-51**
- **Do not require backup fuse up to 200kArms (UL 1449 3rd Ed.)**
- **Innovative tecnology to prevent dangerous failures in case of temporary overvoltages**
- **Suitable for unstable networks where sustainend over-voltages may persist for some minutes or longer**
- **Plug-in cartridges**
- **Optical indication of exhausted cartridges (red window)**
- **Voltage-free contact, for remote function monitoring**
- **Including thermal and dynamic separating device**
- **Assembled unit ready for mounting**
- **Marked connections**
- **For DIN-rail mounting**

Product Description

DSF D is a Type 2 (Class C) surge arrester according to EN 61643-11 (VDE 0675, part 6-11) and UL1449 3rd edition suitable for protecting DC systems from transient overvoltage due to both indirect atmospheric discharges and switching actions.
It is available both in 2-pole or 3-pole configurations, allowing both differential and common mode protection.
The control windows (no/red indication) and the contact allow both a local and a remote monitoring of the status of the plug-in cartridges, warning the operator about the need to promptly replace the cartridges themselves.
In installation without external LPS (Lightning Protection System) or where the distance between the LPS elements and the solar panel frames is >50cm, DSF can be used in the DC side of photovoltaic generation plants, and can be installed on a DIN-rail in every commercially available distribution box.

Ordering Key

DSF 53 C D 1200 PV

Description	Code
Mounting	
DIN-rail	D
Function	
Surge arresters	S
Type	
Type 2 (class C) “Fuseless”	F
Cartridge dimensions	
17.5 mm	5
Configuration	
2-pole	2
3-pole	3
Contact	
None	X
1 (relay)	C
Network	
DC	D
Range	
600 VDC	600
1000 VDC	1000
1200 VDC	1200
Application	
Photovoltaic system	PV

Type Selection

Code	Description	Max. cont. operating voltage	Output relay	Cartridge
DSF52CD600PV	2-pole surge arrester for PV installations	600 VDC	SPDT	2x DS0600F
DSF52XD1000PV	2-pole surge arrester for PV installations	1000 VDC	NO	2x DS1000F
DSF52CD1000PV	2-pole surge arrester for PV installations	1000 VDC	SPDT	2x DS1000F
DSF53XD1200PV	3-pole (Y) surge arrester for PV installations	1200 VDC	NO	3x DS0600F
DSF53CD1200PV	3-pole (Y) surge arrester for PV installations	1200 VDC	SPDT	3x DS0600F

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Product specifications

Max. continuous operating voltage DC	**Uc**
DSF52CD600PV	600 VDC
DSF52xD1000PV	1000 VDC
DSF53xD1200PV	1200 VDC
SPD (Surge Protection Device) according to EN 61643-11	
DSF5xCDxxxxPV	Type 2
SPD (Surge Protection Device) according to IEC 61643-1	
DSF5xCDxxxxPV	Class II
LPZ (Lightning Protection Zone)	
DSF5xCDxxxxPV	1 --> 2
Nominal discharge surge current (8/20)	**In**
	+ or - to PE
DSF52CD600PV	20 kA
DSF52xD1000PV	12.5 kA
DSF53xD1200PV	20 kA
	+ and - to PE
DSF52CD600PV	40 kA
DSF52xD1000PV	25 kA
DSF53xD1200PV	20 kA
Max. discharge surge current (8/20)	**Imax**
	+ or - to PE
DSF52CD600PV	40 kA
DSF52xD1000PV	25 kA
DSF53xD1200PV	40 kA
	+ and - to PE
DSF52CD600PV	80 kA
DSF52xD1000PV	50 kA
DSF53xD1200PV	40 kA

Voltage protection level	**Up**
DSF52CD600PV	< 2.2 kV
DSF52xD1000PV	< 2.8 kV
DSF53xD1200PV	< 4.4 kV
Response time	**t_A**
DSF5xxDxxxx	< 25 ns
Protection fuse size (UL 1449 3rd Ed.)	
DSF5xxDxxxx	Not required up to 200 kA rms
Follow current	
DSF5xxDxxxx	No
Short-circuit withstand current (data for AC applications according to EN 61643-11)	25kA/50Hz
Front window	
DSF5xxDxxxx	No indication: working cartridge. Red: exhausted cartridge (to be replaced)
Operating temperature	
DSF5xxDxxxx	-40 to +80 °C

Output Specifications

Output	
DSF5xCDxxxxPV	SPDT
Rating	AC: 250V/0.5A 125V/3A
Cable cross-section area	max 1.5 mm^2
Terminal torque	0.25 Nm max

General Specifications

Protection degree	IP 20
Dimensions	
DSF52CD600PV	36 x 90 x 72 mm
DSF52xD1000PV	36 x 90 x 72 mm
DSF53xD1200PV	54 x 90 x 72 mm
Screw terminals	
Cable cross-section area	25 mm^2 (stranded) 35 mm^2 (solid)
Terminal torque	4.5 Nm max
Housing material	Thermoplastic, extinguishing degree UL 94 V-0
Approvals	CE, UL1449 3rd Edition

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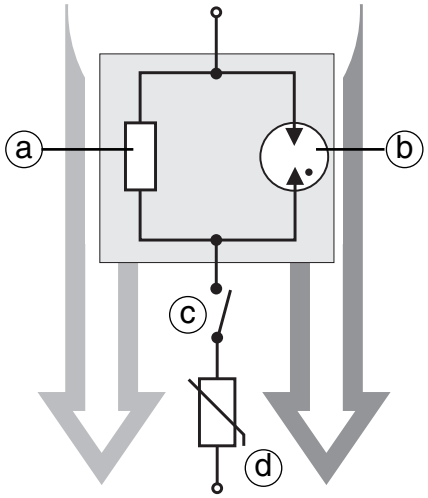
No backup-fuse tecnology

Long duration overvoltage path

The arrester is activated in the event of electric power system failure. The voltages are much lower than transient voltages but substantially more destructive. The system is composed of a current limiter and a varistor. In the event of increased voltage level the current limiter circuit limits the current through the varistor. When the normal condition is re-established (rated line voltage), the surge arrester continues to perform its normal function.



Transient (short duration) overvoltage path

The arrester is activated at the occurence of instantaneous high voltage surges lasting only a few microseconds. Such condition states are experienced at switching operations and atmospheric discharges. The system is composed of a gas tube surge arrester and a varistor. Both components have a very short response time which is reflected in a low protective residual voltage level. This provides an efficient protection of sensitive electronic devices.

a) Current limiter **b**) Gas tube **c**) Thermal disconnector **d**) Varistor

Installation notes

Protection distance

• If DSF is installed less than 10 m from the device to be protected, the distance can be ignored.

• If DSF and its connection wires have a total protection level $U_{p/f}$ (U_{prot}) <0.5 U_w, where U_w is the breaking voltage of the device to be protected, the distance can be neglected.

• If the protection distance is longer than 10 m, the real protection distance ℓ_{po} can be calculated by the following formula:

$\ell_{po} = (U_w - U_{p/f}) / K$ [m]

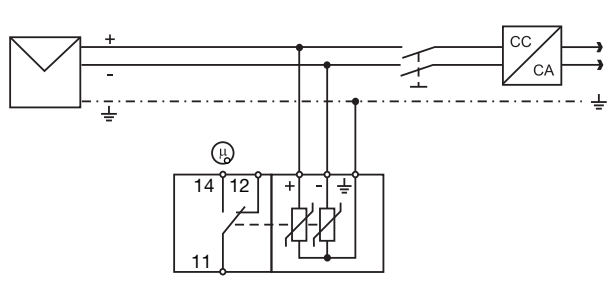
with K = 25 V/m.

Protection against overcurrents and indirect contacts

DSF can be installed without further integrative protections even if a general circuit breaker/fuses with nominal current >125 kA is installed and if in the DSF installation point the short circuit current is >25 kA (but <200kArms). No protection fuses are needed for backup protection.

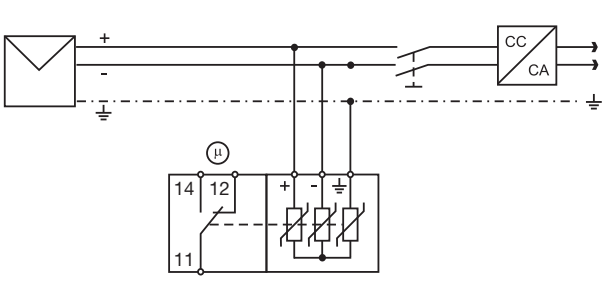
Wiring Diagrams

DSF52CDxxxx



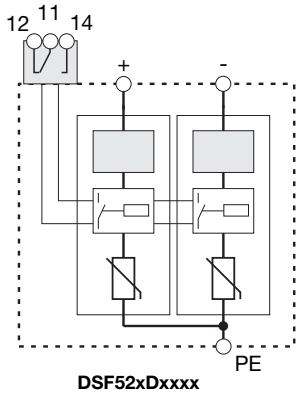
Relay output (11-12-14): only C option

DSF53CDxxxx

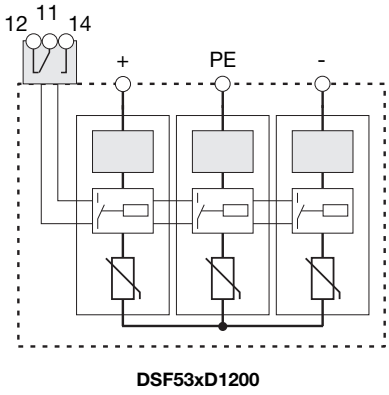


Relay output (11-12-14): only C option

Connection Diagrams

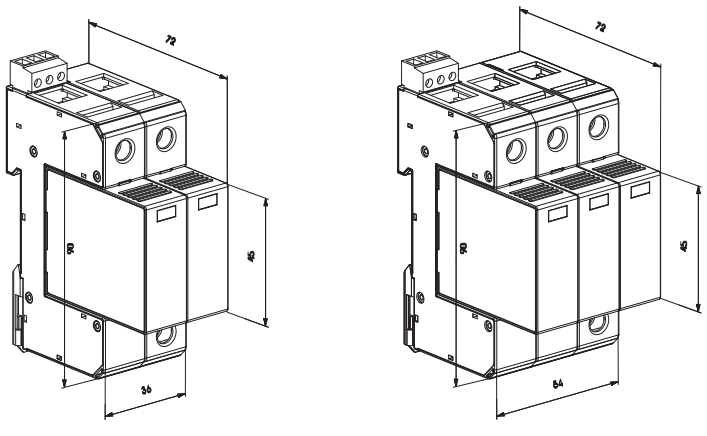


DSF52xDxxxx

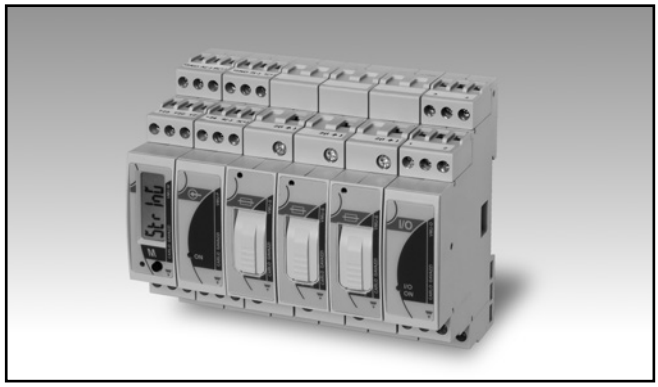


DSF53xD1200

Dimensions

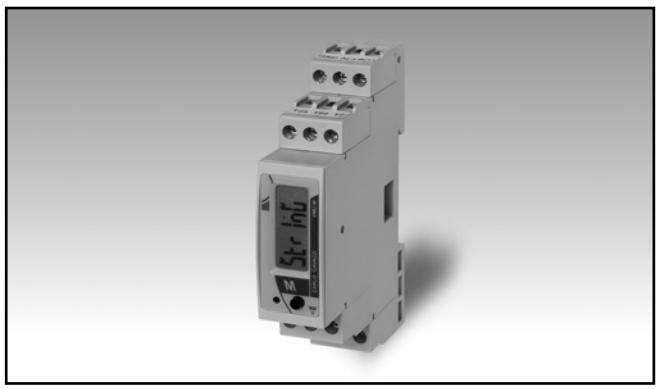


Energy Management
Control solution for solar PV applications
Type Eos-Array



- **Modular local control system for PV plants**
- **Up to 17 DIN modules configuration equivalent to 280mm width**
- **Eos-ArraySoft freeware software for easy product configuration**
- **Eos-Array can be formed by maximum 17 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;**
  - **max 1 VMU-1.**

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**
- **1 Metal-ion non-replaceable battery; 0.04 g.**
  Note: The device contains metal-ion batteries. For the sending, you must comply with the relevant packaging and labeling regulation.

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 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

- **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.

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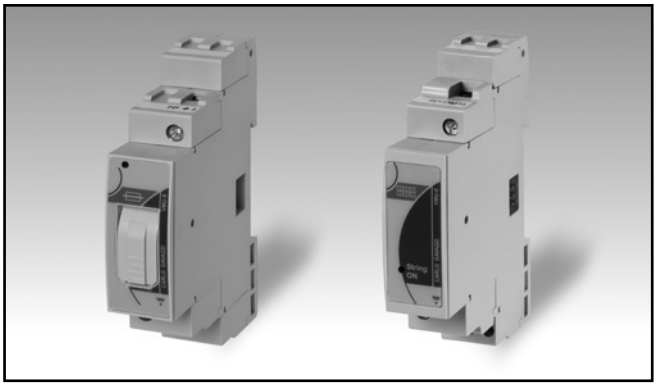
VMU-S, string measuring unit



- **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

Model
Range
Power supply
Communication
Option

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)
AV30: 1000V DC, 30A (Direct connection) **(**)**. In this case the "Option" is "XX".			**FX:** with fuse holder

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

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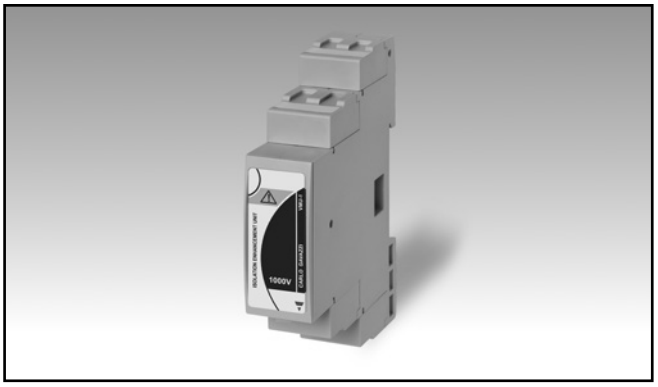
VMU-1, isolation enhancement unit



- **Isolation enhancement of voltage measuring inputs to earth of VMU-S: from 800VDC (without VMU-1) to 1000VDC max.**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Isolation enhancement unit suitable to be used in combination with VMU modules. VMU-1 allows to enhance the isolation of the voltage measuring input to earth from 800VDC to 1000VDC. The module is to be mounted between the first VMU-S and all the other VMU modules. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-1 1000

Standard model

Type Selection

Standard model

Isolation voltage 1000V: isolation enhancement on VMU-S voltage measuring input to earth from 800VDC (without module) to 1000VDC.
Note: only one VMU-1 is needed per Eos-Array

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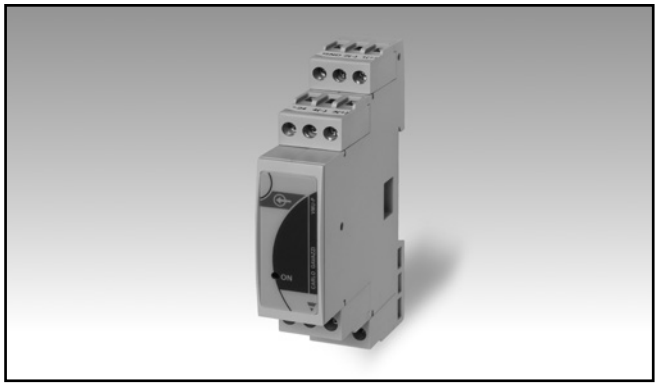
VMU-P, environment variable unit



- **Measurements: PV module temperature, air temperature, sun irradiation, wind speed**
- **Two temperature inputs: Pt100 or Pt1000**
- **One 120mV or 20mA 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

Model
Range
Power supply
Communication
Option

Type Selection

Range		Power supply		Communication		Option	
2TIW:	Two “Pt” temperature type probes, mV 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
2TCW:	Two “Pt” temperature type probes, mA sun irradiation and wind speed measuring inputs (*)						

(*) as standard.

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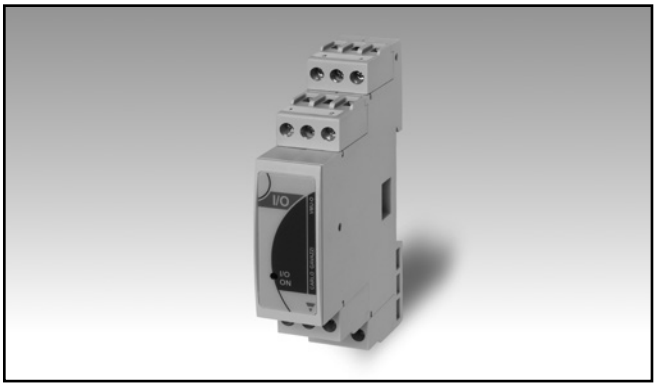
VMU-O, inputs/outputs unit



- **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

- **Model**
- **Power supply**
- **Inputs**
- **Outputs**
- **Option**

Type Selection (Standard model)

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

Type Selection (Antitheft model)

Power supply		Inputs		Outputs		Option	
X:	from 12 to 28VDC, self-power supply from VMU-M unit	**I3:**	three digital inputs **(*)**	**R1:**	one relay outputs **(*)**	**AT:**	antitheft compability

Note: in case of “Antitheft application” every single Eos-Array can manage the combination of one VMU-O.X.I3.R1.AT module and up to three VMU-O.X.I2.R2.X modules.

(*) as standard.

VMU-AT, Antitheft sensor for VMU-O with "AT" option

- **Plastic fibre optic sensor**
- **Sensing distance up to 200m**
- **Static output compatible with VMU-O "AT" option**
- **Auxiliary power supply from VMU-O "AT" option**
- **Dimensions: 14 x 31 x 73 mm housing**
- **Protection degree (front): IP50**

Product Description

Antitheft plastic fibre optic sensor to be used in combination with VMU-O "AT" I/O unit, suitable to carry out an antitheft control on PV modules which are passed by 2.2 mm plastic fibre optic. The maximum loop distance which can be covered by the sensor is 200m. Housing for DIN-rail mounting, IP50 (front) protection degree.

How to order

VMU-AT X P M C X

Model
Power supply
Plastic fibre
200m sensing distance
Output
Option

Type Selection

Power supply

X: from 12 to 28VDC, self-power supply from VMU-O "AT" option unit

Fibre optic

P: plastic **(*)**

Sensing distance

M: 200m **(*)**

Output

C: open collector

Option

X: none

(*) as standard.

Product Description

PFO22-1000 is a specific plastic fibre optic cable which is made for VMU-AT sensor and is supplied in a quantity of 1000m. The working temperature is -55 to 70°C.

How to order

PFO22 1000

Model
Fibre optic cable length: 1000m

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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 AV10 range code	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 list above.The cycling time is approx. 1 second.
Colour AV30 range code	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.

VMU-P LED specification

LED	
Type	Multicolor
Status and colour	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
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: 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.

VMU-AT LED specification

LED	
Power supply status	Green: the power supply is ON
Loop status	Red: the optical loop is closed

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/°C
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

Rated inputs	
Current type	1 (shunt)
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
Voltage	AV10 range: 1000V DC AV30 range: 1000V DC
Accuracy	(@25°C ±5°C, R.H. ≤60%)
AV10 range code	
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)

VMU-S input specifications (cont.)

Start up current	0.05A
Start up voltage	10V
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)
Energy	±(1% RDG)
Start up current	0.2A
Start up voltage	10V
Temperature drift	≤200ppm/°C
Measurement sampling time	2 sec.
Variables format	
Instantaneous variables	4-DGT (A, W), 5-DGT (V)
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	
AV10 range code	
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
AV30 range code	
Voltage	> 2.5M
Current	< 0.003Ω @ 0.5 Nm (screw terminal torque).
Voltage Overloads	
Continuous	1100V
For 500ms	1600V
To earth	800V (extended to 1000V in case of combined use of VMU-1.1000V unit)
Current Overloads	
Continuous	AV10 range: 16A AV30 range: 30A
For 1s	AV10 range: 100A max AV30 range: 150A max
Protection	
Fuse holder	Integrated into the module
Fuse type	gPV
Fuse size	10x38mm (IEC60269-1-6)
Fuse current	Fuse NOT provided. Note: the fuse rated current has to be ≥1.4 Isc at 45°C ambient temperature. See fuse manufacturer specifications for further details including de-rating caused by higher ambient temperature.

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: air)
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/°C
Engineering unit	Selectable °C or °F
Insulation	See the table "Insulation between inputs and communication bus"
Irradiation sensor inputs (range code: 2TIW)	
Number of inputs	1
Range	3 to 120mVDC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS; ±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm/°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 3 to 150.0 (mVDC) - Display: programmable range from 0 to 9999 (kW/m², kW/ft²)
Decimal point position	Fixed.
Impedance	> 30KΩ
Overload	
Continuous	10VDC (measurement available up to 150mV on both display and communication bus)
For 1s	20VDC
Insulation	See the table "Insulation between inputs and communication bus"
Irradiation sensor input (range code: 2TCW	
Number of inputs	1
Range	0 to 20mADC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS;

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VMU-P input specifications (cont.)

	±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm/°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 25.0 (mADC) - Display Data format: programmable range from 0 to 9999 (kW/m^2, kW/ft^2)
Decimal point position	Fixed
Impedance	≤23Ω
Overload	
Continuous	50mADC (measurement available up to 25mA on both display and communication bus)
For 1s	150mADC
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/°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 999.9 (Hz) - Display: programmable range from 0 to 299.9 (m/s, ft/s)
Decimal point position	Fixed and depending on the input/display scale.
Impedance	680Ω
Operating input	$2.5V_{peak}$ to $9V_{peak}$/$5mA_{peak}$ to $35mA_{peak}$, duty cycle 50%
Impedence	220Ω
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 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 Parity: none
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
Special functions	None
Insulation	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; - 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).
Insulation	See the table “Insulation between inputs and outputs”

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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	3.3VDC
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 AC1: 5A @ 250VAC AC15: 1A @ 250VAC Available by means of VMU-O module only
Insulation	See the table “Insulation between inputs and outputs”

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-O with “AT” option, Input/Output specifications

Maximum number of module managed by every single VMU-M module	Up to 1
Digital inputs	
Number of inputs	3
Working mode	Detection of ON/OFF status
Purpose	Detection of the output status of up to 3 VMU-AT units, the same inputs can be used also to detect standard free of voltage contacts of other devices.
Working logic	The inputs in case of Antitheft purpose selection work as an OR logic (EosArraySoft), if this function is not enabled every input works independently from each other.
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”
Digital output	
Number of outputs	1
Purpose	Antitheft notification in case of function enabling (EosArraySoft) or 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 modules).
Type	Relay, SPST type AC1: 5A @ 250VAC AC15: 1A @ 250VAC
Insulation	See the table “Insulation between inputs and outputs”

CARLO GAVAZZI

VMU-AT Antitheft sensor specifications

Maximum number of sensors managed by every single VMU-O "AT" module	Up to 3
Optical sensing	
Maximum operational distance	200m (loop)
Sensitivity	Automatic adjusted
Light source	GaAlAs, LED 660 nm
Light type	Red modulated
Operating frequency	1Khz
Response time on fibre breaking	0.5 seconds
Fibre Optic	
Material	Plastic
Diameter	2.2 mm
Compatible model	PGU-CD1001-22
Working temperature	-55 to +70°C
Digital output	
Number of outputs	1
Type	Open collector
Insulation	Operational insulation only (50VACRMS)
Power Supply	12 to 28 VDC
Connection	
Cable	Length: 0.5m, black colour, PVC material

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 calen-dar. Activation: NO/YES
Daylight-saving enabling	Houre:minutes with selectable
Time format	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, irra-diation, wind speed, string efficiency and BOS effi-ciency.
Storage interval	Selectable: 1-5-10-15-30-60 minutes
Sampling management	The sample stored within the selected time interval results from the continu-ous average calculation of the measured values. The average is calculated with an interval within two fol-lowing 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 vir-tual alarms), string alarms (see “String control”), VMU-M 1st digital input status change. The events are recorded as soon as they occur. For more infor-mation 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-Array-Soft.
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 meas-ured 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 refer-ence value below which there is the alarm condi-tion. - 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

Main Function (Cont.)

	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.
Fuse blow detection (only AV10 range code)	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, Ch3	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, Ch3	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 (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".
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) Electrostatic discharges	According to EN61000-6-2 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) Radio frequency suppression	According to EN61000-6-3 According to CISPR 22

CARLO GAVAZZI

General specifications (cont.)

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

Connections

VMU-M	
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 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
VMU-S AV10	
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. Screws tightening torque: Max 1.1 Nm
Voltage (-)	Max 1.5 mm^2. Screws tightening torque: Max 0.5 Nm
Screw terminal purposes	
10 mm^2	1+1 screw terminals: 1 positive for string input and 1 positive for string output (to the Inverter)
1.5 mm^2	3 screw terminals: not power input, only for negative voltage signal measurement
VMU-S AV30	
Connections	Screw-type
Cable cross-section area	
Current (+)	Min. 2.5 mm^2, max 10 mm^2 in case of flexible wire, Max. 16 mm^2 in case of rigid wire. Hole dimension: 7.2x5.1mm. Screws tightening torque: Max 0.7 Nm
Voltage (-)	Max 1.5 mm^2. Screws tightening torque: Max 0.5 Nm
Screw terminal purposes	
16 mm^2	1+1 screw terminals: 1 positive for string input and 1 positive for string output (to the Inverter)
1.5 mm^2	3 screw terminals: not power input, only for negative voltage signal measurement
VMU-P	
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 probes 2 screw terminals used for wind speed sensor, 2 screw terminals used for solar irradiation sensor
VMU-O	
Connections	Screw-type
Cable cross-section area	
Relay outputs and digital inputs	Max 1.5 mm^2 Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
"X" type Screw terminal purposes	
1.5 mm^2	2+2 screw terminals: two for 1st relay output and two for 2nd relay output (SPST type) 2+2 screw terminals: two for 1st digital input and two for 2nd digital input
"AT" type Screw terminal purposes	
1.5 mm^2	2 screw terminals for relay output (SPST type) 2+2+2 screw terminals: two for 1st digital input, two for 2nd digital input and two for 3rd digital input
Weight (all modules)	Approx. 100 g (packing included)

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

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 without antitheft functionality

VMU-S units	VMU-O units	VMU-P units	Consumption	Start up current	Power supply part number
From 1 to 3	None	None	PS_W: $2.5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 1 to 3	Up to 1	Up to 1	PS_W: $5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 4 to 10	From 2 to 4	Up to 1	PS_W: $11W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
From 11 to 14	Up to 1	Up to 1	PS_W: $10W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
Max. 14	Max. 7	Max. 1			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-M unit without any antitheft management. For different units combination 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.

Sizing of Carlo Gavazzi DC power supply with antitheft functionality

VMU-S units	VMU-O.X units	VMU-O AT units	VMU-AT units	VMU-P units	Consumption	Start up current	Power supply part number
10 to 14	None	Up to 1	Up to 3	None	PS_W: $12W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
10 to 13	Up to 1	Up to 1	Up to 3	Up to 1	PS_W: $13W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
10 to 12	Up to 2	Up to 1	Up to 3	Up to 1	PS_W:$14W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
10	Up to 3	Up to 1	Up to 3	Up to 1	PS_W:$14W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
Max. 14	Max. 3	Max. 1	Max. 3	Max. 1			Note: VMU-P as 1.8W includes also the CG (part number DWS-V) wind sensor consumption.

Nota: in order to carry out, in the Eos-Array, the proper antitheft functionality, one VMU-O.X.I3.R1.AT unit and up to three VMU-AT.X.P,M,C,X sensors have to be added, in this case the maximum equivalent added consumed power is 4W. For different units combination not mentioned above the consumption calculation is the following: PS_W:<1W+n_{VMU-S}*0.5W+$n_{VMU-O.X}$*0.7W+$n_{VMU-O\ AT}$*0.7W+n_{VMU-AT}*1.1+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

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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" 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 (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 colour 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)
7	tHEFt	Theft warning: removal of the PV modules in the fibre optic loop controlled by the relevant VMU-AT sensor. The THEFT information is given in combination with the LED alarm on VMU-M and the LED colour code on the relevant VMU-O.AT module.

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.

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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	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.

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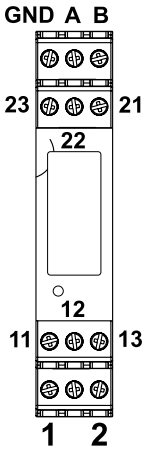
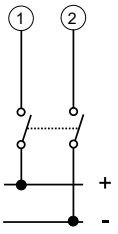
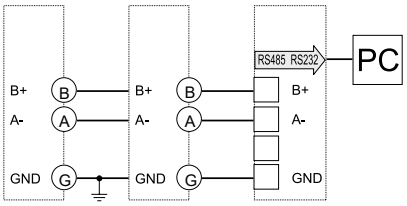
VMU-M connections



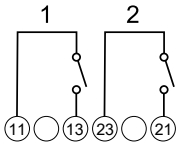
Power supply **Fig. 1**



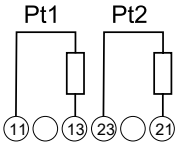
RS485 port **Fig. 2**



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

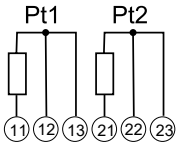


Temperature input 1 and input 2 **Fig. 4**



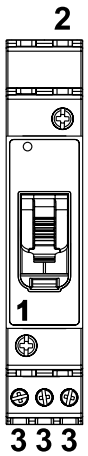
2-wire connections

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



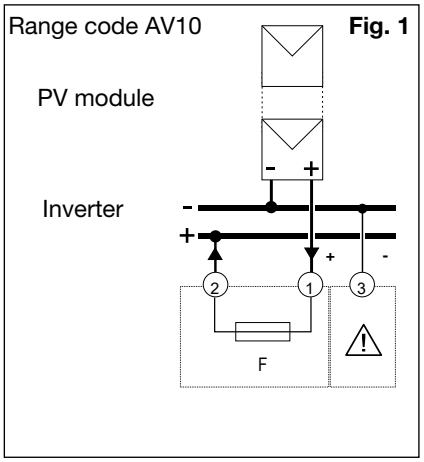
3-wire connections

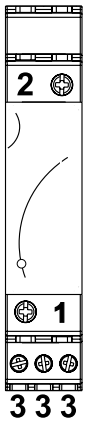
VMU-S (AV10 and AV30) connections



AV10

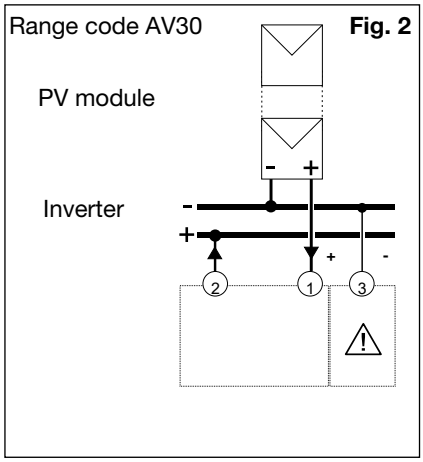
Range code AV10 **Fig. 1**





AV30

Range code AV30 **Fig. 2**



F= 10.3x38mm (IEC269-2-1) 1.25 Isc DC

⚠ = Not power input, only for voltage signal measurement.

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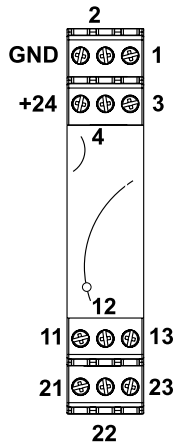
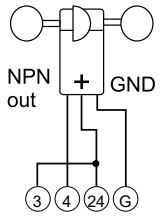
VMU-P (2TIW) connections

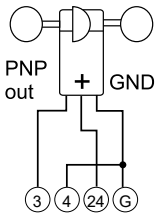


Wind speed input **Fig. 1**
Sensor model DWS-V



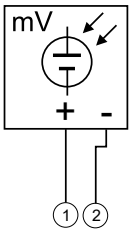
NPN output

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

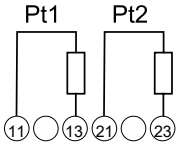


PNP output

mV irradiation input **Fig. 3**

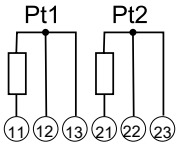


Temperature input 1 and input 2 **Fig. 4**



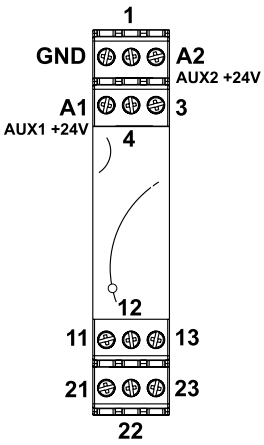
2 wires connections

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

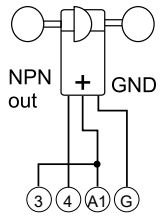


3 wires connections

VMU-P (2TCW) connections

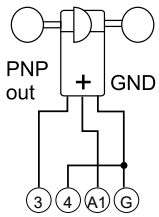


Wind speed input **Fig. 1**
Sensor model DWS-V



NPN output

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



PNP output

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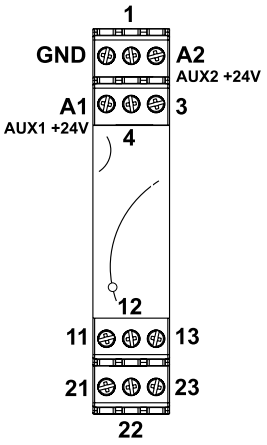
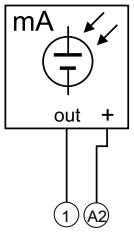
VMU-P (2TCW) connections (cont.)

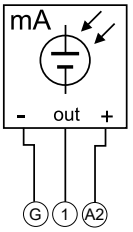


20mA irradiation input **Fig. 3**



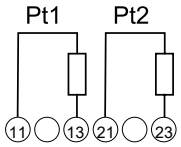
2 wires connections

20mA irradiation input **Fig. 4**



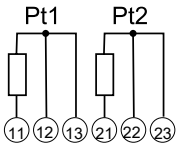
3 wires connections

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



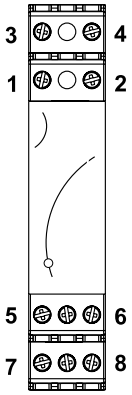
2 wires connections

Temperature input 1 and input 2 **Fig. 6**

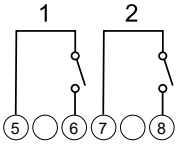


3 wires connections

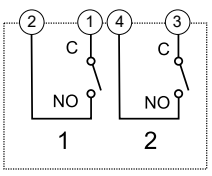
VMU-O connections



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



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



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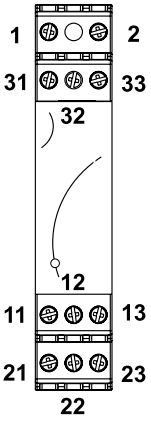
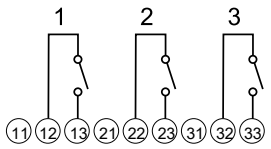
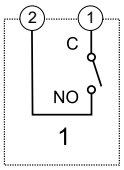
VMU-O "AT" option connections



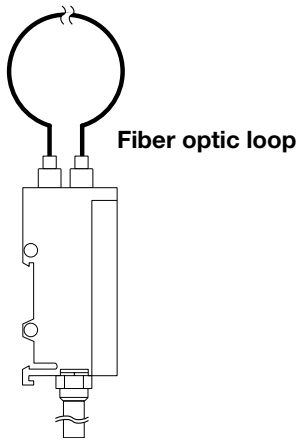
Digital input 1, 2 and 3 **Fig. 1**

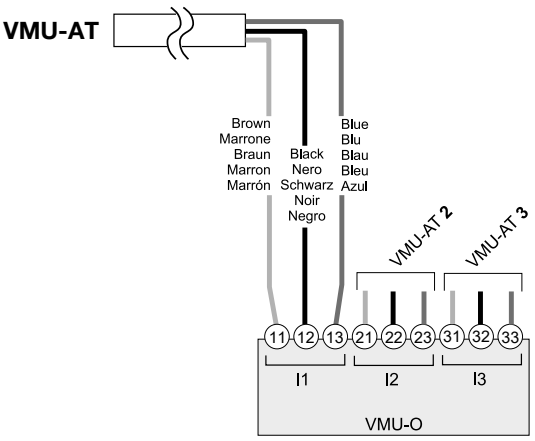


Digital output **Fig. 2**

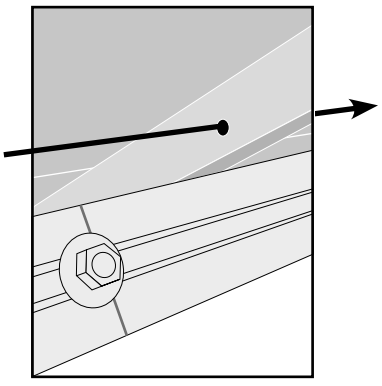


VMU-AT connections

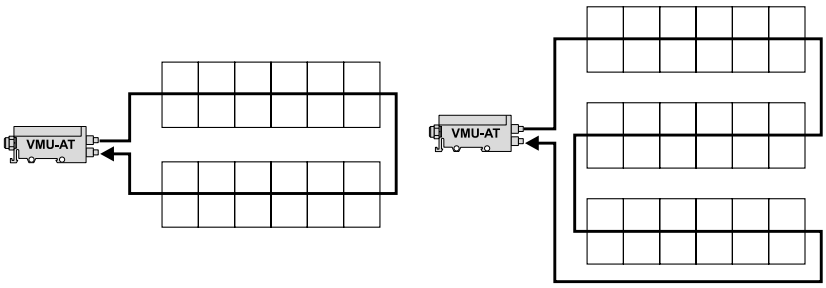




VMU-AT mounting and use

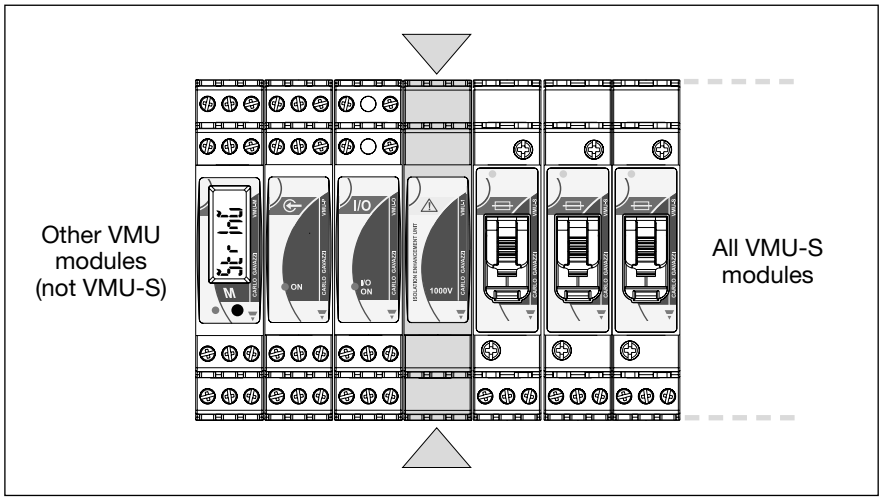


Fibre optic through PV panel



Example of fibre optic loop through PV panels

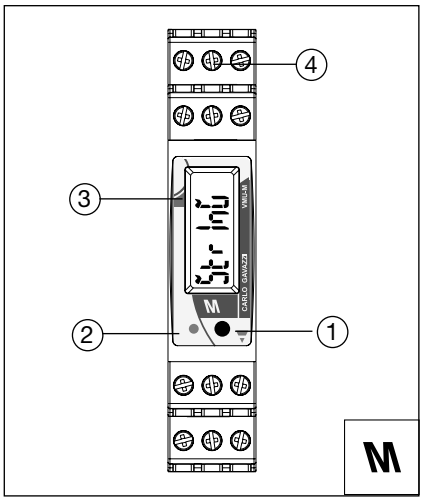
VMU-1 mounting and positioning



The VMU-1 has to be mounted between the group of VMU-S and all the other modules as shown in the example picture on the left.

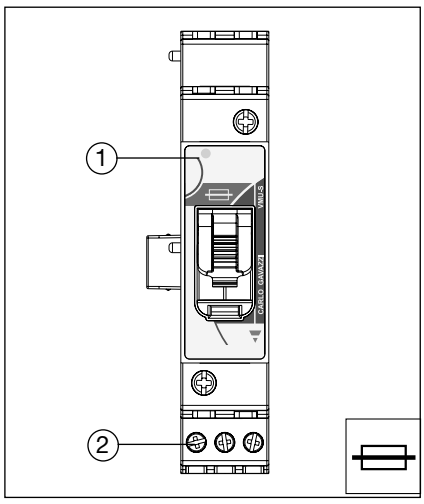
Every Eos-Array has to be equipped only with one VMU-1.

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

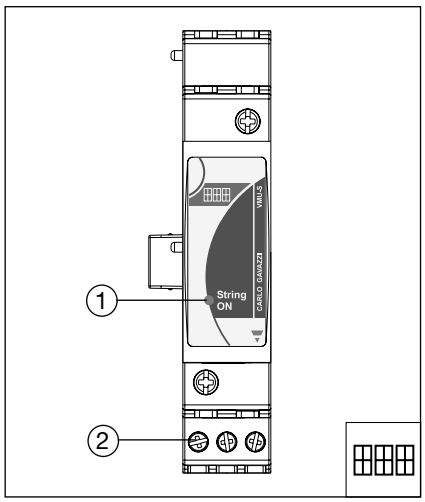
VMU-S Front panel description (AV10 range code: 16A)



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

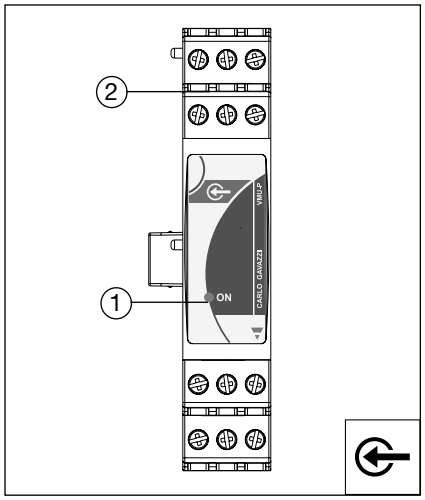
VMU-S Front panel description (AV30 range code: 30A)



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

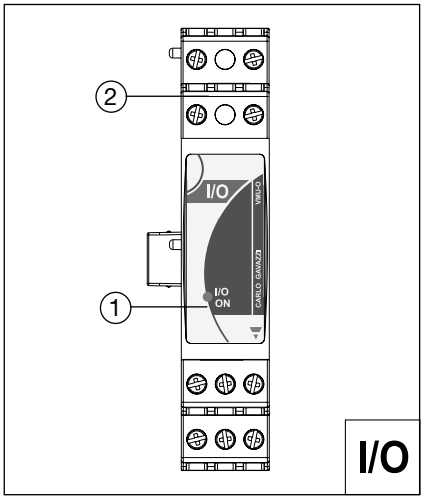
VMU-P Front panel description



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 connection**s**

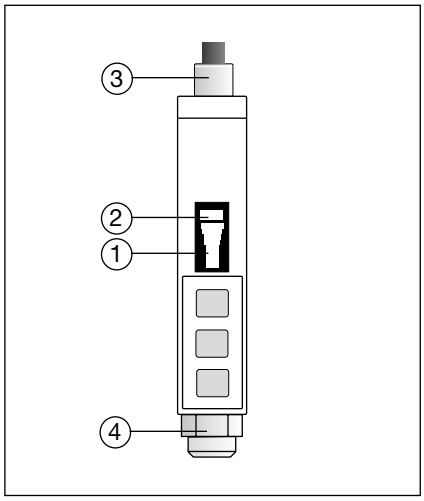
VMU-O/VMU-O AT Front panel description



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 up to three 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.

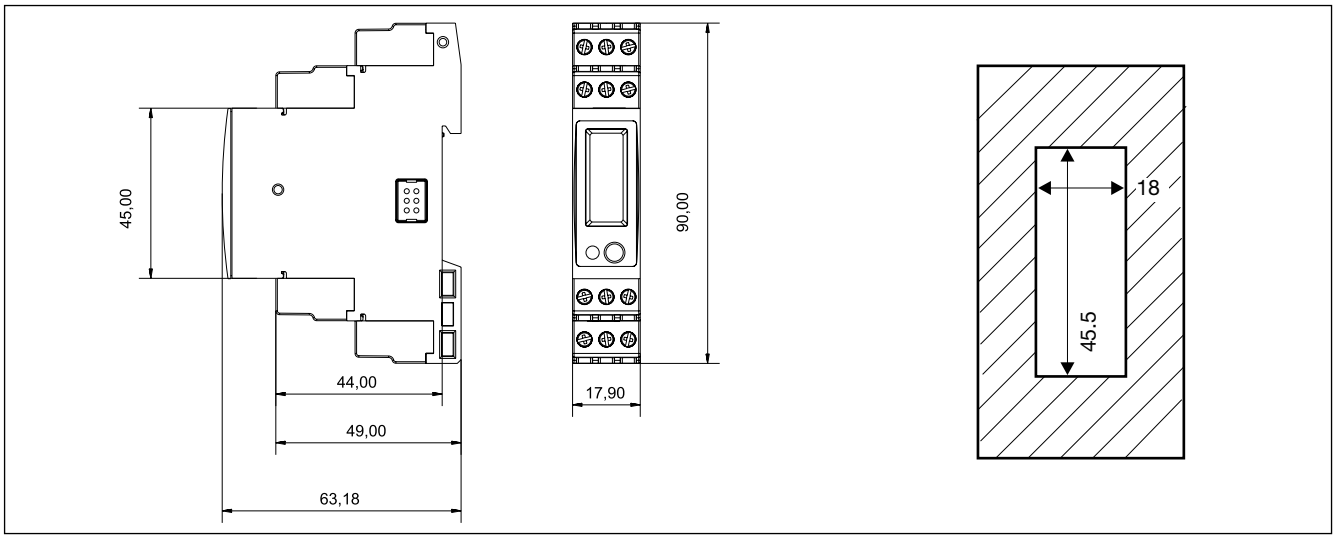
2. **Screw terminals**
   For digital inputs and outputs connections

VMU-AT Front panel description

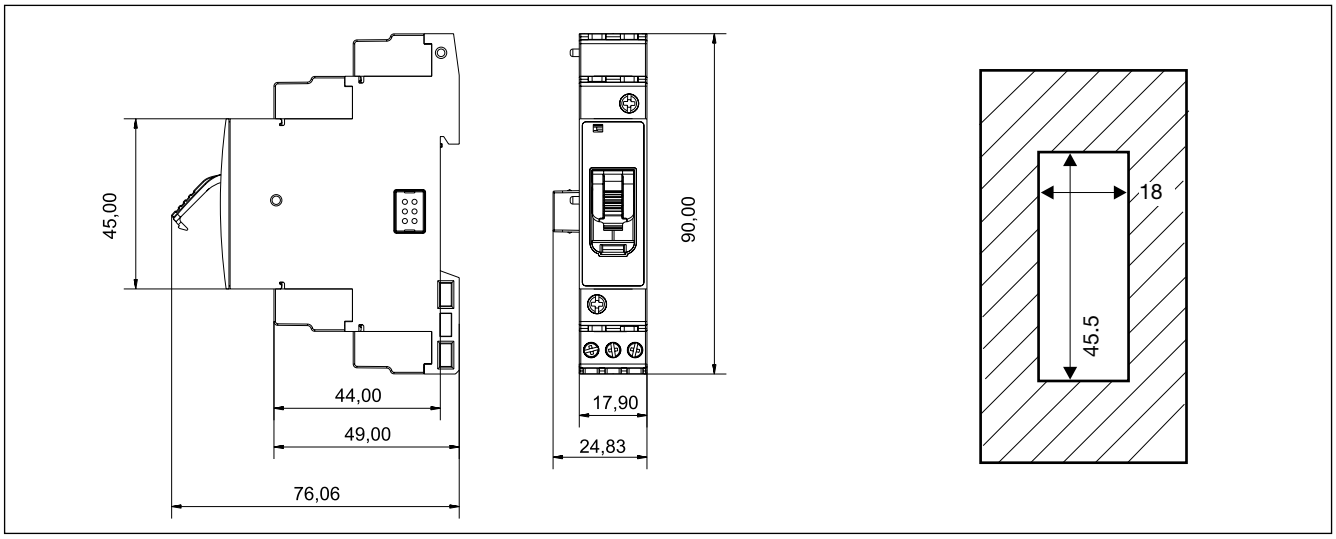


1. **Green LED**
   The power supply is ON
2. **Red LED**
   The optical signal loop is working
3. **Optical fibre connectors**
   One RX and one TX optical fibre connector
4. **One cable**
   Cable for power supply and signal output.

VMU-M Dimensions and panel cut-out (mm)



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



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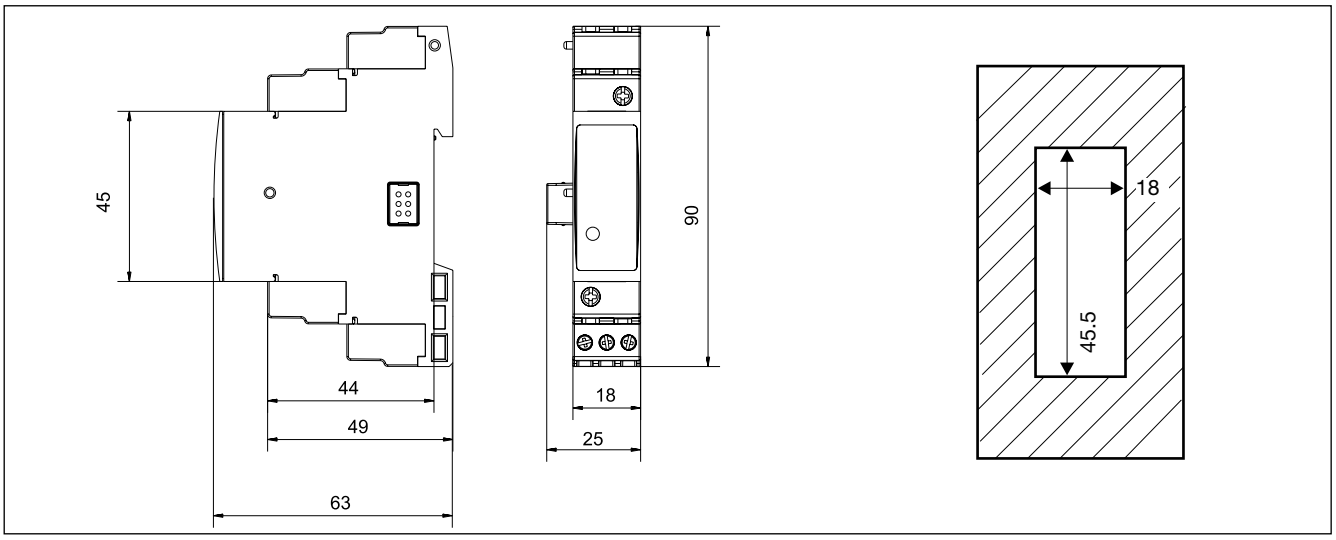
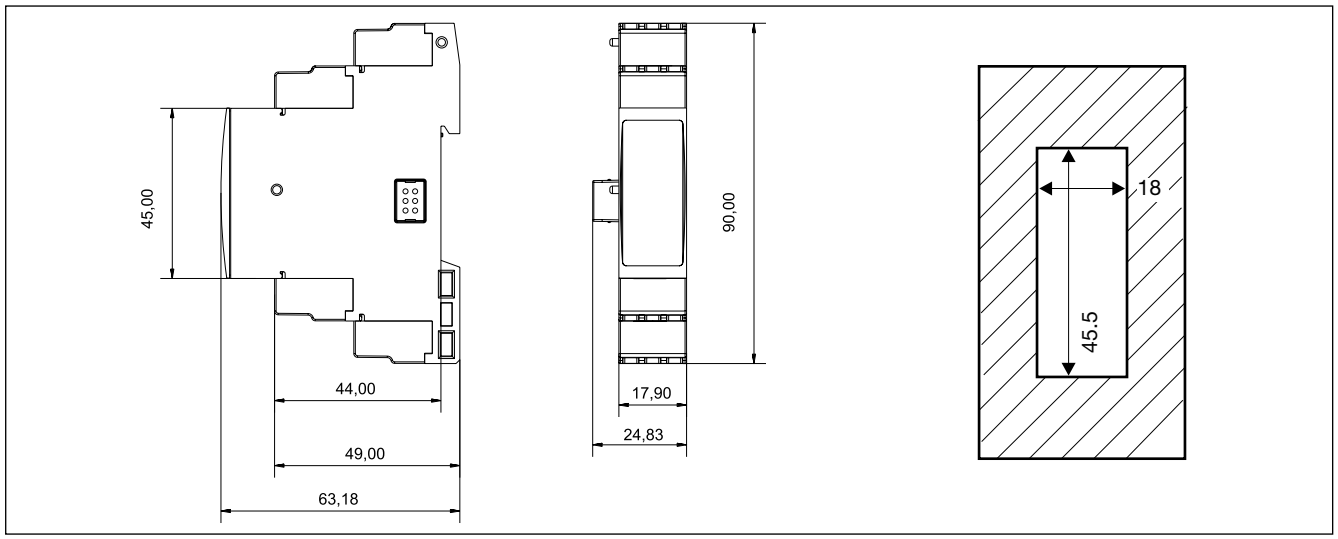
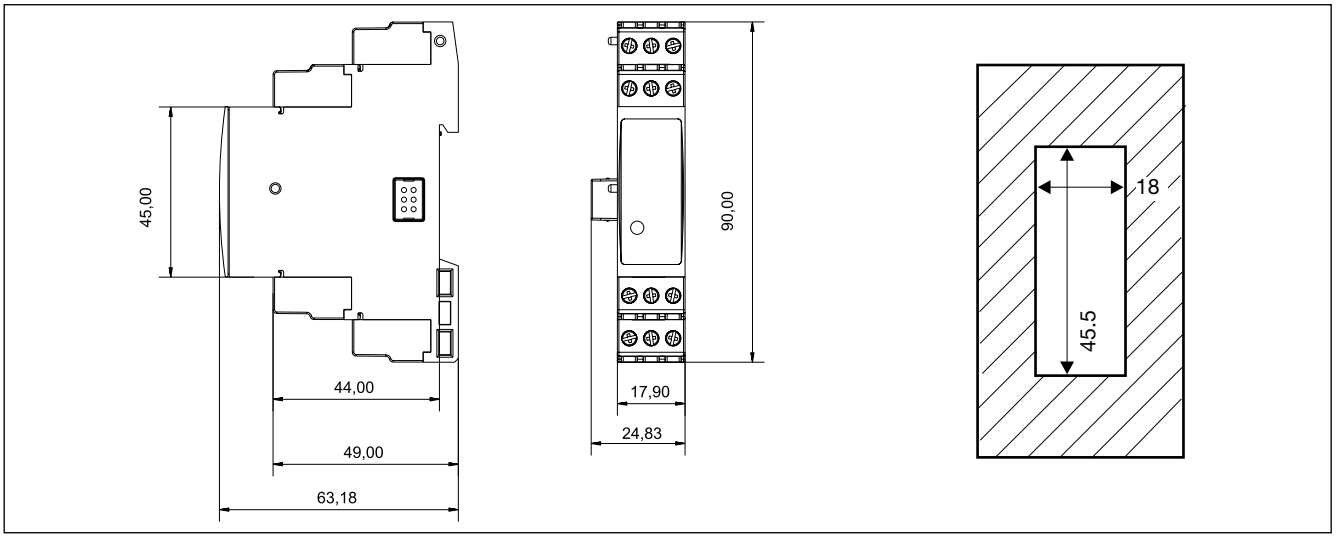
VMU-S (AV30) Dimensions and panel cut-out (mm)



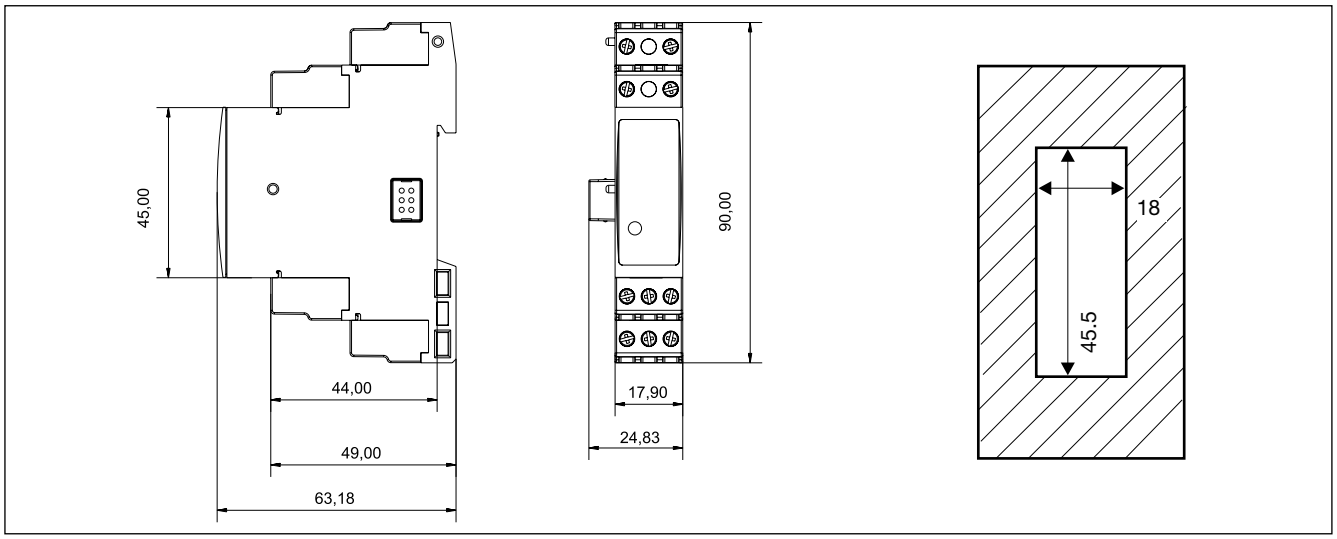
VMU-1 Dimensions and panel cut-out (mm)



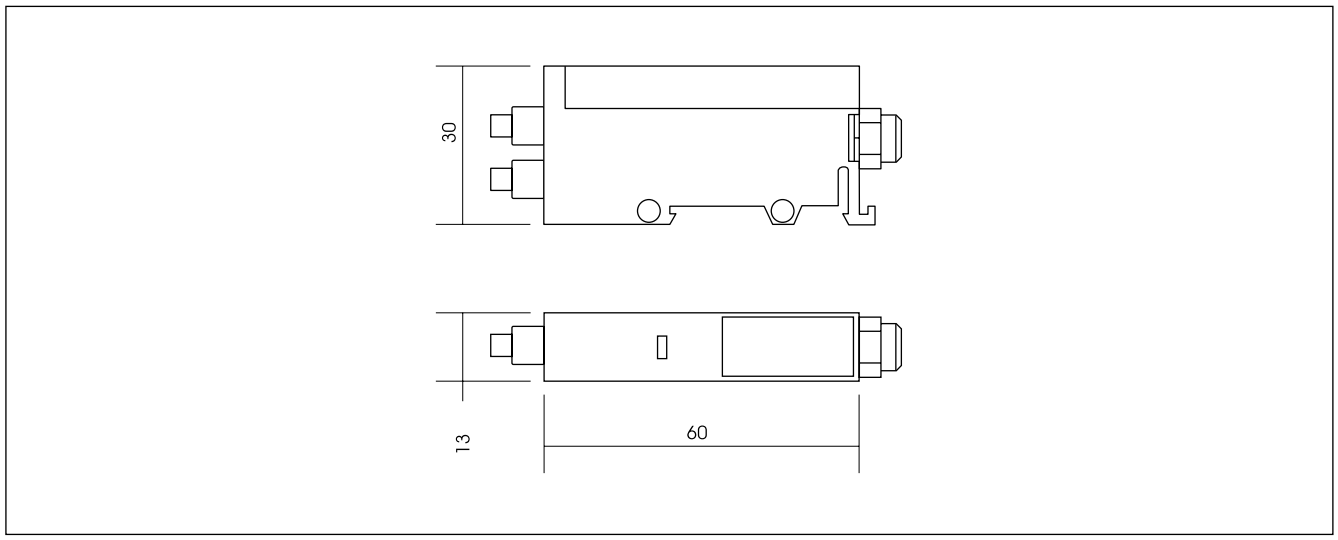
VMU-P Dimensions and panel cut-out (mm)



VMU-O/VMU-O AT Dimensions and panel cut-out (mm)



VMU-AT Dimensions (mm)



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

Eos-ArraySoft

Multi-language software (Italian, English, French, German, Spanish) for variable reading and parameters programming. The program runs under Windows XP/ Vista/7.

Application

Up to two different applications can be selected:
- 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.

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.

Data storing

In pre-formatted XLS files (Excel data base).

Data download

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, air temperature, irradiation and wind speed.

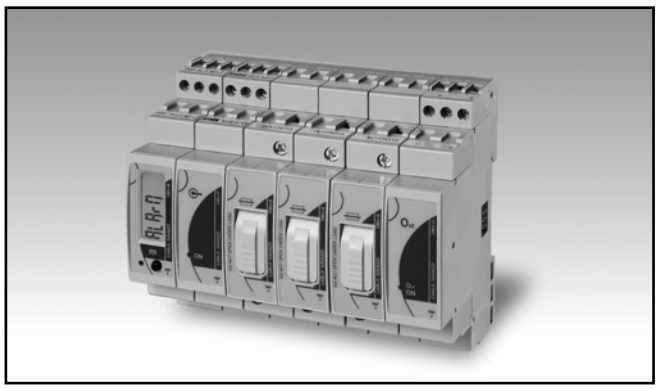
Alarm set-up

Alarm parameters.

Modem management

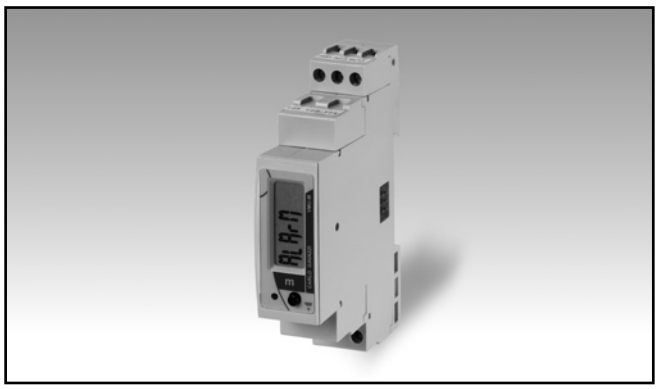
GSM/GPRS modem configuration (connected to the PC) SMS messages.

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



- Modular local control system for PV plants
- Up to 17 DIN modules configuration equivalent to 280mm width
- Eos-ArrayLSoft freeware software for easy product configuration
- Eos-Array can be formed by maximum 17 units
- Eos-Array can manage in addition to VMU-ML master unit up to:
  - max 1 VMU-P unit;
  - max 15 VMU-S0 units;
  - max 1 VMU-O units.
  - max 1 VMU-1

VMU-ML, master unit



- Master communication capability
- RS485 communication port (Modbus)
- Local communication bus management up to 15 mixed VMU-S0, VMU-P and VMU-O units
- Single virtual or real alarm set-point connectable to any available variable
- Display readout: 6 DGTs
- 12 to 28 VDC power supply
- Dimensions: 1-DIN module
- Protection degree (front): IP40

Product Description

Eos-Array Lite is a combination of modules which performs mainly a current and voltage control of a photovoltaic plant. The core unit is VMU-ML which performs the local bus management of VMU-S0, VMU-P both measuring units and VMU-O output unit. VMU-ML assigns the proper local unit address automatically (up to 15 units) and gathers all the local measurements coming from VMU-S0 and VMU-P measuring units. VMU-ML can provide by means of VMU-O modules one relay output so to manage up to 1 real alarm. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-M L A S1 XX X

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

Type Selection

Function

L: Lite **(*)**

Power supply

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

Communication

S1: RS485 Modbus **(*)**

Inputs

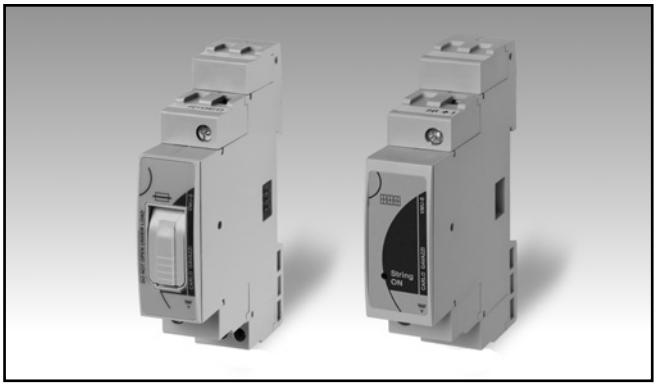
XX: none **(*)**

Option

X: none

(*) as standard.

VMU-S0, string measuring unit



- Direct DC voltage measurement up to 1000V
- Direct DC current measurement up to 16A or up to 30A without fuse
- Instantaneous variables data format: 4 DGTs
- Instantaneous variables: V, A.
- Accuracy: ±0.5 RDG (current/voltage)
- Auxiliary power supply from VMU-ML unit
- String alarm management by means of VMU-ML unit
- Integrated 10.3x38mm fuse holder for string protection
- Fuse blow detection by means of VMU-ML unit only
- Dimensions: 1-DIN module
- Protection degree (front): IP40

Product Description

Variables measuring unit with built-in protection fuseholder (the fuse is not provided), particularly indicated for DC current, voltage, 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. Moreover the unit is provided with an auxiliary serial communication bus. Alarms, fuse blow detection, and serial communication are managed by means of VMU-ML module. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-S0 AV10 X S FX

- **Model**
- **Range**
- **Power supply**
- **Communication**
- **Option**

Type Selection

Range

AV10: 1000V DC, 16A (Direct connection) **(*)**
AV30: 1000V DC, 30A (Direct connection) **(**)** In this case the "Option" is "XX".

Power supply

X: from 12 to 28VDC, self-power supply from VMU-ML unit

Communication

S: auxiliary communication bus, compatible only to VMU-ML module **(*)**

Option

XX: none (no fuse holder)
FX: with fuse holder **(*)**

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

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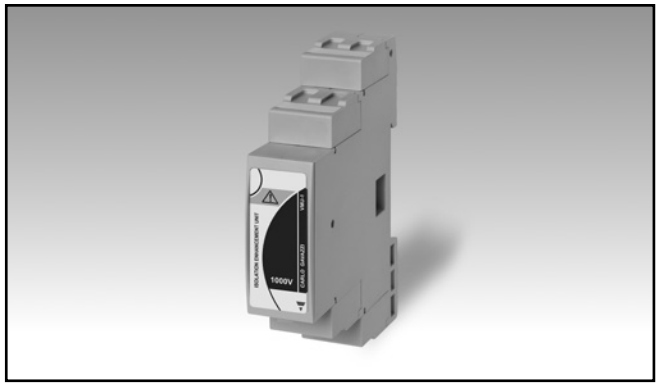
VMU-1, isolation enhancement unit



- **Isolation enhancement of voltage measuring inputs to earth of VMU-S0: from 800VDC (without VMU-1) to 1000VDC max.**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Isolation enhancement unit suitable to be used in combination with VMU modules. VMU-1 allows to enhance the isolation of the voltage measuring input to earth from 800VDC to 1000VDC. The module is to be mounted between the first VMU-S0 and all the other VMU modules. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-1 1000

Standard model

Type Selection

Standard model

Isolation voltage 1000V: isolation enhancement on VMU-S0 voltage measuring input to earth from 800VDC (without module) to 1000VDC.
Note: only one VMU-1 is needed per Eos-Array.

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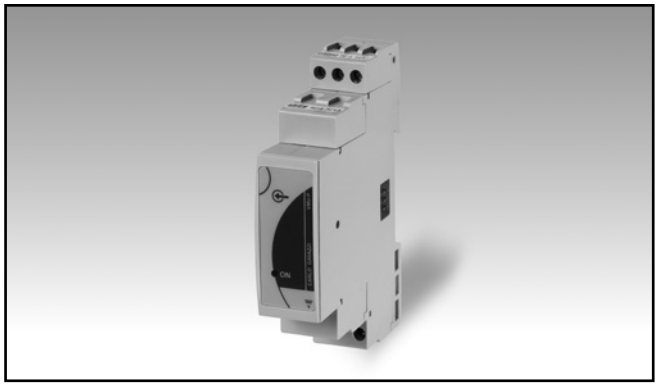
VMU-P, environment variables unit



- **Measurements: PV module temperature or air temperature, sun irradiation**
- **One temperature input: Pt100 or Pt1000 type**
- **One 120mV or 20mA DC input with scaling capability for irradiation measurement**
- **Auxiliary communication bus to VMU-ML unit**
- **Auxiliary power supply from VMU-ML unit**
- **Dimensions: 1-DIN module**
- **Protection degree (front): IP40**

Product Description

Environment variables measurement unit particularly indicated for PV module temperature or air temperature and sun irradiation, 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-ML module. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-P 1TI X S X

- **Model**
- **Range**
- **Power supply**
- **Communication**
- **Option**

Type Selection

Range

1TI: One “Pt” temperature type probe, mV sun irradiation input **(*)**

1TC: One “Pt” temperature type probe, mA sun irradiation input **(*)**

Power supply

X: from 12 to 28VDC, self-power supply from VMU-ML unit

Communication

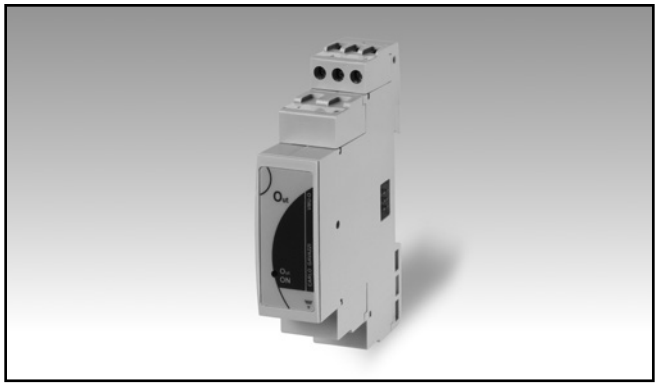
S: auxiliary communication bus, compatible only to VMU-ML module **(*)**

Option

X: none

(*) as standard.

VMU-O, relay outputs unit



- One relay output managed by the VMU-ML module
- Auxiliary power supply from VMU-ML unit
- Dimensions: 1-DIN module
- Protection degree (front): IP40

VMU-O Product Description

Relay output unit suitable to be used in combination with VMU-ML module. VMU-O allows to add one relay output to a VMU-ML based system so to manage local alarms. Housing for DIN-rail mounting, IP40 (front) protection degree.

How to order

VMU-O X XX R1 X

- **Model**
- **Power supply**
- **Inputs**
- **Outputs**
- **Option**

Type Selection

Power supply		Inputs		Outputs		Option	
X:	from 12 to 28VDC, self-power supply from VMU-ML unit **(*)**	**XX:**	none	**R1:**	one relay output **(*)**	**X:**	none

(*) as standard.

VMU-ML Display and LED specifications

Display	1 line (max: 6-DGT)
Type	LCD, h 7mm
Information read-out	4-DGT
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-P LED specifications

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

VMU-O LED specifications

LED	
Type	Multicolor
Status and colour	Green: the power supply is ON. White: the unit is enabled by VMU-ML module for data reading and displaying. Blue: digital output is 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.

VMU-ML input specifications

Key-pad	1 push-button for variable scrolling and for some parameters programming. Full programming can be carried out only using Eos-ArrayLSoft.

VMU-S0 input specifications

Rated inputs	
Current type	1 (shunt)
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
Voltage	AV10 range: 1000V DC AV30 range: 1000V DC
Accuracy	(@25°C ±5°C, R.H. ≤60%)
AV10 range code	
Current	±(0.5%RDG+2 DGT) from 0.05A to 16A
Voltage	±(0.5%RDG+2 DGT) from 20V to 1000V
Start up current	0.05A
Start up voltage	10V
AV30 range code	
Current	±(0.5%RDG+2 DGT) from 0.2A to 30A
Voltage	±(0.5%RDG+2 DGT) from 20V to 1000V
Start up current	0.2A
Start up voltage	10V
Temperature drift	≤200ppm/°C
Measurement sampling time	2 sec.
Variables format	
Instantaneous variables	4-DGT (A), 5-DGT (V)
Resolution	0.1V; 0.01A.

VMU-S0 input specifications (cont.)

Max. and Min. data format	See “Variables format”
Input impedance	
AV10 range code	
Voltage	> 2.5MΩ
Current	< 0.006Ω(+ fuse impedance) @ 0.5 Nm (screw terminal torque). The maximum dissipation power has not to exceed 2W.
AV30 range code	
Voltage	> 2.5M
Current	< 0.003Ω @ 0.5 Nm (screw terminal torque)
Voltage Overloads	
Continuous	1100V
For 500ms	1600V
To earth	800V (extended to 1000V in case of combined use of VMU-1.1000V unit)

Current Overloads	
Continuous	AV10 range: 16A AV30 range: 30A
For 1s	AV10 range: 100A max AV30 range: 150A max
Protection	
Fuse holder	Integrated into the module
Fuse type	gPV
Fuse size	10x38mm (IEC60269-1-6)
Fuse current	Fuse NOT provided. Note: the fuse rated current has to be ≥1.4 Isc at 45°C ambient temperature. See fuse manufacturer specifications for further details including de-rating caused by higher ambient temperature.

VMU-P input specifications

Temperature drift	≤200ppm/°C
Variables format	
Instantaneous variables	4 DGT (Temperature, solar irradiation)
Resolution	0.1°C/0.1°F; 1W/m², 1W/ft²;
Max. and Min. data format	See “Variables format”
Temperature probe input	
Number of inputs	1
Temperature probe	Pt100 or Pt1000
Number of wires	Up to 3-wire connection
Wire compensation	Up to 10Ω.
Accuracy (@25°C ±5°C, R.H. ≤60%) (Display + RS485)	See table “Temperature input characteristics”
Temperature drift	±150ppm /°C
Engineering unit	Selectable °C or °F
Insulation	See the table “Insulation between inputs and communication bus”
Irradiation sensor inputs (range code: 1TI)	
Number of inputs	1
Range	0 to 120mVDC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS; ±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm /°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 150.0 (mVDC) - Display: programmable range from 0 to 9999 (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”
Irradiation sensor inputs (range code: 1TC)	
Number of inputs	1
Range	0 to 20mA DC
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%)	±(0.2%RDG+1DGT) 0% to 25% FS; ±(0.1%RDG+1DGT) 25% to 120% FS.
Temperature drift	±150ppm /°C
Scaling factor	
Operating mode	Dual scale: - Input: programmable range from 0 to 25.0 (mADC) - Display: programmable range from 0 to 9999 (kW/m², kW/ft²)
Decimal point position	Fixed.
Impedance	≤23Ω
Overload	
Continuous	50mADC (measurement available up to 25mA on both display and communication bus)
For 1s	150mADC
Insulation	See the table “Insulation between inputs and communication bus”

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VMU-P Temperature input characteristics

Probe	Range	Accuracy (@25°C ±5°C, R.H. ≤60%)	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-ML Output specifications

RS485	Slave function
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 “List of the variables that can be...”
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.
Special functions	None
Insulation	See the table “Insulation between inputs and outputs”

Auxiliary communication bus	This is the communication bus to the VMU-S0, VMU-P and VMU-O units where VMU-ML performs the master function in this network. VMU-ML unit can gather the following information from the bus: - All variables available on the bus; - Antitheft status; - PV reverse voltage and current polarity; - PV module status. The local address in the VMU-S0, VMU-P and VMU-O units is automatically assigned by VMU-ML 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 Output specifications

Maximum number of modules managed by every single VMU-ML module	Up to 1
Digital output	
Number of outputs	1
Purpose	Alarm notification as a String alarm and other alarms (see “List of the variables that can be connected to...”

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”

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Main Function

Displaying	1 parameter per page
VMU-ML module	"Alarm and diagnostics messages"
When a VMU-S0 module is selected	All the information related to the status of the string being selected by means of the front key (see 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 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 output being selected by means of the front key (see 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
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"
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-S0 units). The highest value of the measured string current among those available is used as a reference value. The alarm set-point is a value that 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-S0 module individually. Within the VMU-ML system all values coming at the same instant from every VMU-S0 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 current 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 variable alarms	The alarms can be connected also to the string voltage.
Fuse blow detection (only AV10 range code)	Warning message transmission through the local port to the VMU-ML unit.
Wrong PV module connection	Warning message transmission through the local port to the VMUML unit.

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Insulation between inputs and outputs

Module		Any	VMU-ML		VMU-P		VMU-O	VMU-S0		
	Type of input/output	Local bus	DC Power supply	RS485	Temperature: Ch1	Solar irradiation	Relay outputs: Ch1	String input (V-)	String input (A+)	String output (A+)
Any	Local bus	-	0kV	0kV	0kV	0kV	4kV	4kV	4kV	4kV
VMU-ML	DC Power supply	0kV	-	0kV	0kV	0kV	4kV	4kV	4kV	4kV
	RS485	0kV	0kV	-	0kV	0kV	4kV	4kV	4kV	4kV
VMU-P	Temperature: Ch1	0kV	0kV	0kV	-	0kV	4kV	4kV	4kV	4kV
	Solar irradiation	0kV	0kV	0kV	0kV	-	4kV	4kV	4kV	4kV
VMU-O	Relay outputs: Ch1	4kV	4kV	4kV	4kV	4kV	-	4kV	4kV	4kV
VMU-S0	String input (V-)	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV	>5MΩ
	String input (A+)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV
	String output (A+)	4kV	4kV	4kV	4kV	4kV	4kV	>5MΩ	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 (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. Remove the fuse only when the disconnecting breaker is switched off. The fuse is only for over-current protection (it has not to be considered as a disconnecting device).

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General specifications

Operating temperature	See table “String current vs. operating temperature”.
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 supply 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

Connections

VMU-ML	
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 screw terminals used for RS485 communication 2 screw terminals used for power supply
VMU-S0 AV10	
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. Screws tightening torque: Max 1.1 Nm
Voltage (-)	Max 1.5 mm^2. Screws tightening torque: Max 0.5 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: not power input, only for negative voltage signal measurement
VMU-S0 AV30	
Connections	Screw-type
Cable cross-section area	
Current (+)	Min. 2.5 mm^2, max 10 mm^2 in case of flexible wire, Max. 16 mm^2 in case of rigid wire. Hole dimension: 7.2x5.1mm. Screws tightening torque: Max 0.7 Nm
Voltage (-)	Max 1.5 mm^2. Screws tightening torque: Max 0.5 Nm
Screw terminal purposes	
16 mm^2	1+1 screw terminals: 1 positive for string input and 1 positive for string output (to the Inverter)
1.5 mm^2	3 screw terminals: not power input, only for negative voltage signal measurement
VMU-P	
Connections	Screw-type
Cable cross-section area	1.5 mm^2 max. Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm

Connections (cont.)

Screw terminal purposes 1.5 mm²	3 screw terminals used for temperature probe 2 screw terminals used for solar irradiation sensor
VMU-O	
Connections	Screw-type
Cable cross-section area	Max 1.5 mm² Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Screw terminal purposes 1.5 mm²	2 screw terminals: for relay output (SPST type)
Weight (all model)	Approx. 100 g (packing included)

Power supply specifications

VMU-ML	
Power supply	12 to 28 VDC
Power consumption	≤1W
VMU-S0-P-O	
Power supply	Self-power supplied through the communication bus
Power consumption	≤0.7W

Sizing of Carlo Gavazzi DC power supply

VMU-S0 units	VMU-O units	VMU-P units	Consumption	Start-up current	Power supply part number
From 1 to 3	None	None	PS_W: $2.5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 1 to 3	Up to 1	Up to 1	PS_W: $5W_{typ}$	1.5A for 1s	SPD 24 18 1B or SPM3 24 1
From 4 to 10	From 2 to 4	Up to 1	PS_W: $11W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
From 11 to 14	Up to 1	Up to 1	PS_W: $10W_{typ}$	1.5A for 1s	SPD 24 30 1B or SPM3 24 1
Max. 14	Max. 7	Max. 1			

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-S0}*0.5W+n_{VMU-O}*0.7W+n_{VMU-P}*1.8W. where “n” is number of power supplied units.

Variables format

No.	Module	Variable	Data format	Notes
1	VMU-S0	V	0.0 to 1250.0	
2	VMU-S0	A	0.0 to 50.0	
3	VMU-P	Temperature	-60 to 400.0	Temperature (°C/°F). The range is extended to cover both °C and °F indications
4	VMU-P	Solar irradiation (IRR)	0.0 to 9.999	Irradiation kW/m2 (kW/feet2) (e.g. in: 0 to 1kW/m2 (1kW/feet2), out: 0 to 100mV)

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Alarm and diagnostics messages

No.	Message	Notes
1	Conn.CY (AV10 only)	Fuse blow detection.
2	StrinG	String failure warning: the “String control” function has detected a failure.
3	Conn.PY	Reverse string current or voltage
4	SYSteM	Power-up self-test error
5	buS	Auxiliary bus communication error
6	ALArM	Variables alarm (any)

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-ML, VMU-P	-25 to + 65°C	-13°F to 149°F
12A DC max.	3.0A	VMU-ML, VMU-P	-25 to + 60°C	-13°F to 140°F
14A DC max.	3.5A	VMU-ML, VMU-P	-25 to + 55°C	-13°F to 131°F
15A DC max.	4.0A	VMU-ML, VMU-P	-25 to + 50°C	-13°F to 122°F
16A DC max.	5.0A	VMU-ML, VMU-P	-25 to + 40°C	-13°F to 104°F
VMU-S AV30 Input current				
20A DC max.	2.5A	VMU-ML, VMU-P	-25 to + 65°C	-13°F to 149°F
25A DC max.	3.0A	VMU-ML, VMU-P	-25 to + 60°C	-13°F to 140°F
30A DC max.	3.5A	VMU-ML, VMU-P	-25 to + 55°C	-13°F to 131°F

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

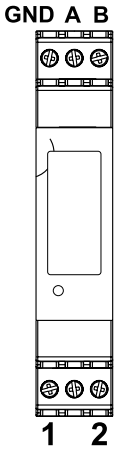
List of the variables that can be displayed and connected to …

- RS485 communication port
- Real and virtual alarms and events

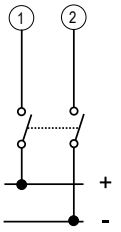
No	Variable	Event-logging	Data-logging	Alarm output	Module (from)	Notes
1	Error: 1	Yes	No	Yes (a)	VMU-ML	Local bus communication problems
2	Error: 2	Yes	No	Yes (a)	VMU-ML	Changed system modules configuration
3	Error: 3	Yes	No	Yes (a)	VMU-ML	Incoherent programming parameters
4	Error: 4	Yes	No	Yes (a)	VMU-ML	More than one VMU-P unit connected to the bus
5	Status: 1	Yes	No	No	VMU-ML	Local programming access
6	Status: 2	Yes	No	No	VMU-ML	Power ON/OFF
7	V	Yes	Yes	Yes	VMU-S0	Available from every string
8	A	Yes	Yes	Yes	VMU-S0	Available from every string
9	Status: 1	Yes	No	Yes	VMU-S0	Incoherent programming parameters
10	Status: 2	Yes	No	Yes	VMU-S0	Fuse blow detection
11	Status: 3	Yes	No	Yes	VMU-S0	Reverse string current or voltage
12	Status: 4	Yes	No	Yes	VMU-S0	High temperature inside VMU-S0 unit
13	String control	Yes	Yes	Yes	VMU-S0	
14	°C (°F) input	Yes	Yes	Yes	VMU-P	PV module temperature
15	kWp/m^2 (kWp/ft^2)	Yes	Yes	Yes	VMU-P	Solar irradiation
16	Error: 1	Yes	No	Yes	VMU-P	Incoherent programming parameters
17	Error: 2	Yes	No	Yes (c)	VMU-P	Short circuit on probe input
18	Error: 3	Yes	No	Yes (c)	VMU-P	Open circuit on probe input
19	Status: input 1	Yes	No	No	VMU-O	ON /OFF status detection
20	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.

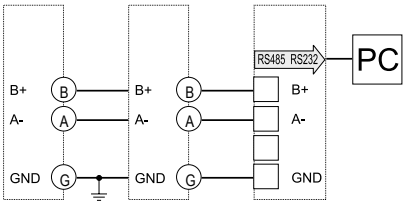
VMU-ML connections



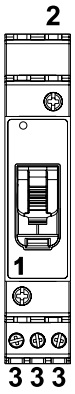
Power supply **Fig. 1**



RS485 port **Fig. 2**

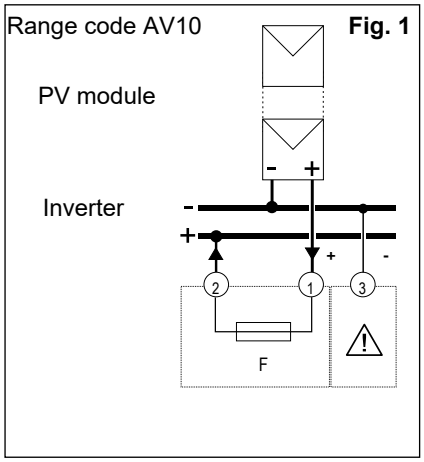


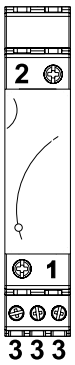
VMU-S0 (AV10 and AV30) connections



AV10

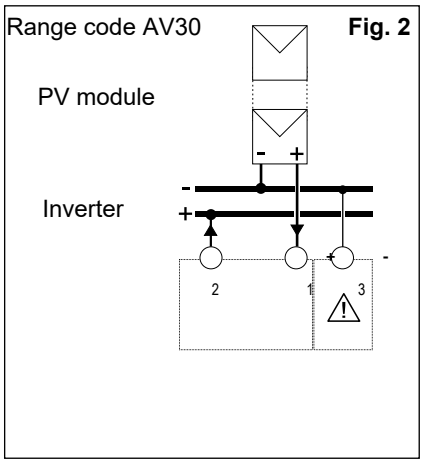
Range code AV10 **Fig. 1**





AV30

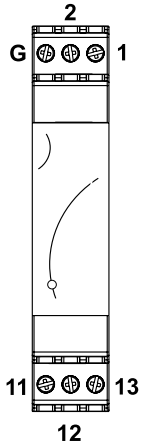
Range code AV30 **Fig. 2**



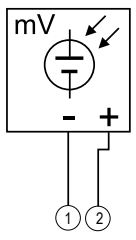
F= 10.3x38mm (IEC269-2-1) 1.25 Isc DC

⚠ = Not power input, only for voltage signal measurement.

VMU-P (1TI) connections



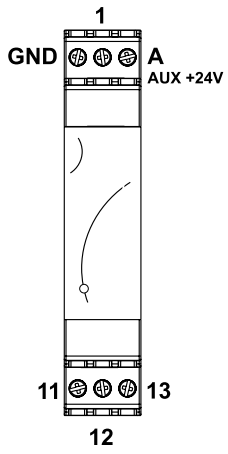
Irradiation input mV **Fig. 1**



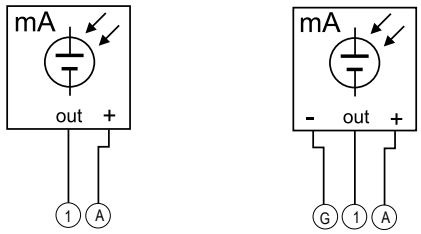
Temperature input 1 and input 2 **Fig. 2**

2 and 3 wires connections

VMU-P (1TC) connections

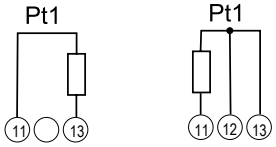


Irradiation input 20mA **Fig. 1**



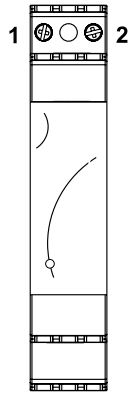
2 and 3 wires connections

Temperature input 1 and **Fig. 2**

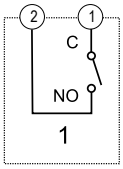


2 and 3 wires connections

VMU-O connections

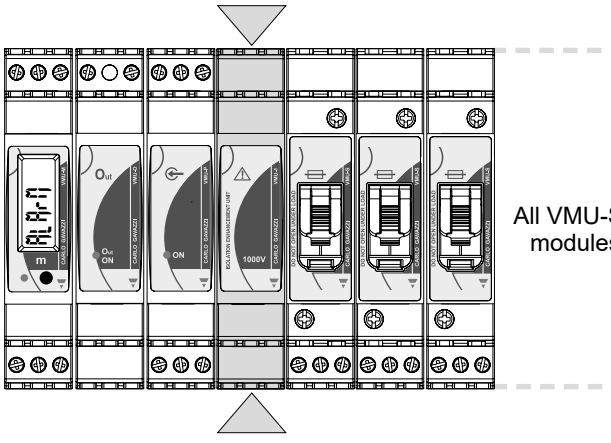


Digital outputs **Fig. 1**



VMU-1 mounting and positioning

Other VMU modules (not VMU-S0)

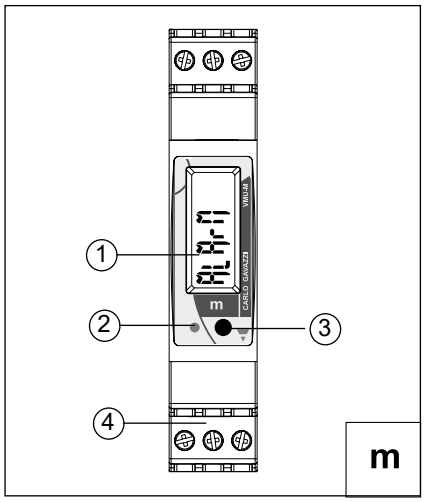


All VMU-S0 modules

The VMU-1 has to be mounted between the group of VMU-S0 and all the other modules as shown in the example picture on the left.

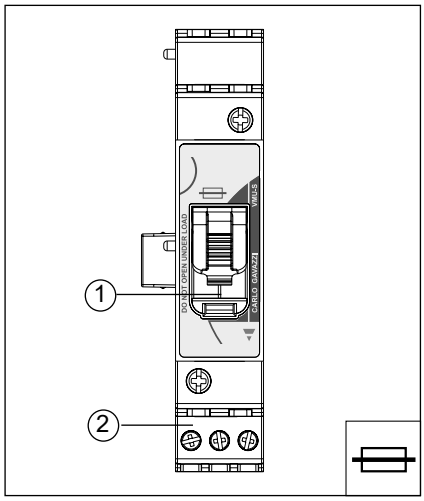
Every Eos-Array Lite has to be equipped only with one VMU-1.

VMU-ML Front panel description



1. **Display.**
   LCD-type with alphanumeric indications to:
   - display some configuration parameters;
   - display some measured variables.
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. **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.
4. **Screw terminals.**
   For power supply, bus and digital inputs/output connections

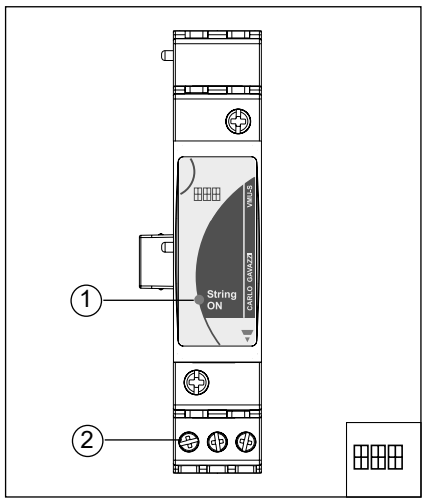
VMU-S0 Front panel description (AV10 range code: 16A)



1. **Fuse holder cover**
   For fuse holding and protection.

2. **Screw terminals**
   For string connections

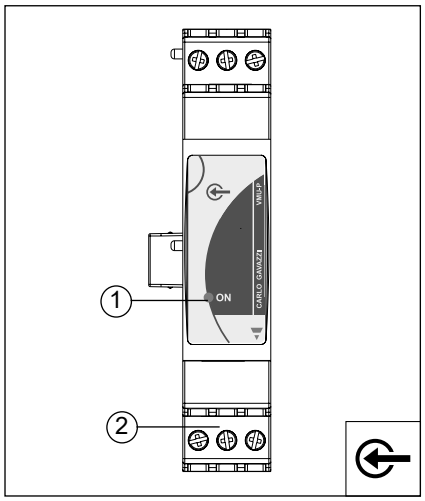
VMU-S0 Front panel description (AV30 range code: 30A)



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

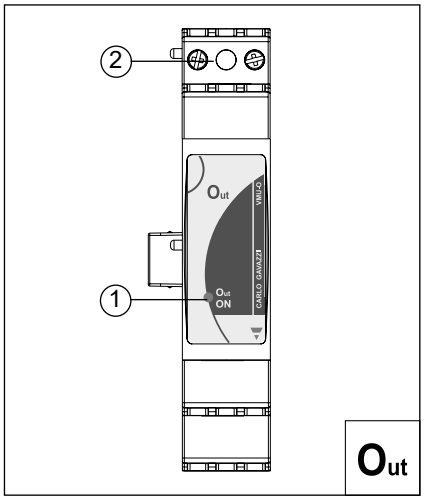
VMU-P Front panel description



1. **LED**
   ON steady light: the module is power supplied.
   Green: the power supply is ON.
   White: the unit is enabled by VMU-ML module for data reading and displaying.

2. **Screw terminals**
   For measuring input connection**s**

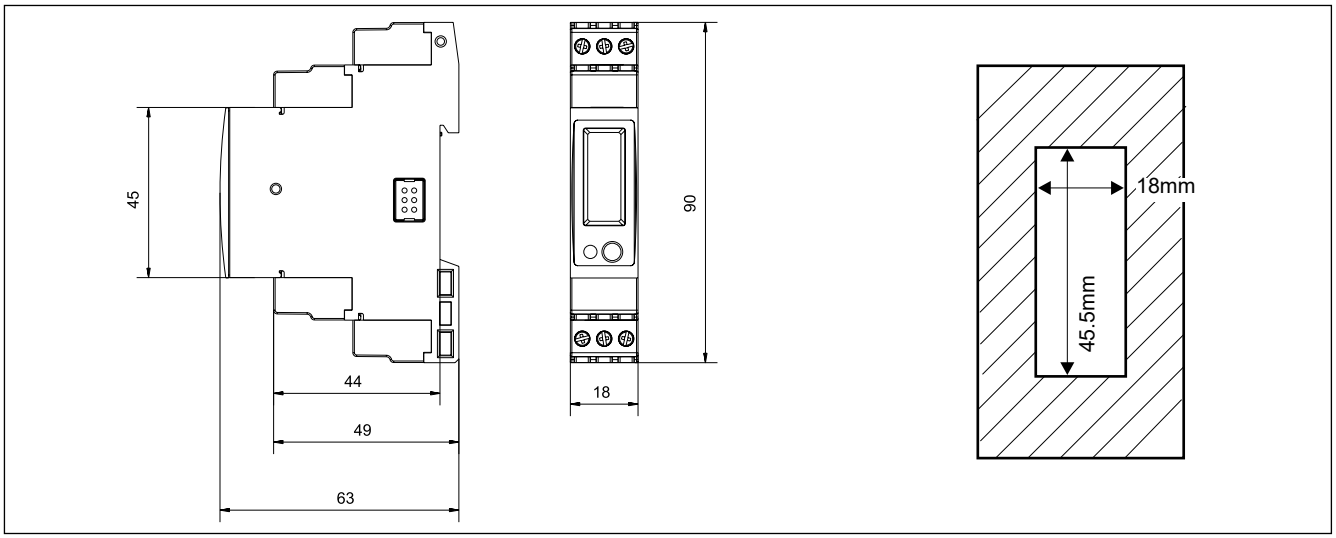
VMU-O Front panel description



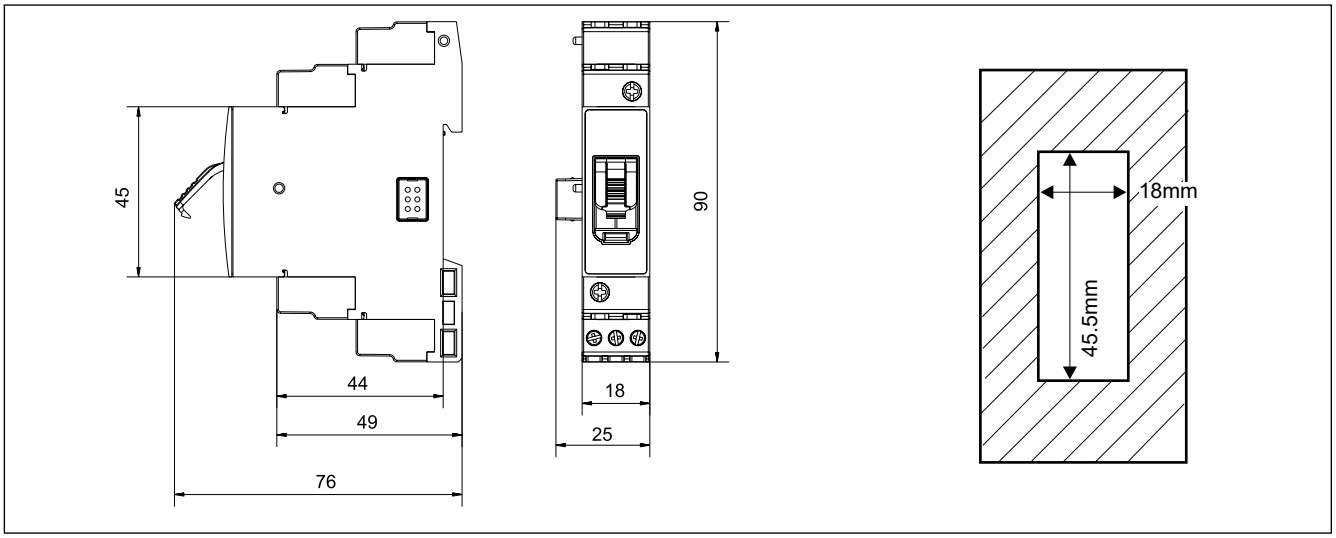
1. **LED**
   Green: the power supply is ON
   White: the unit is enabled by VMU-ML module for data reading and displaying.
   Red: one or both digital inputs are activated
   Blue: one or both digital outputs are activated
   Cycling from one colour to any other one: the unit shows the status of the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

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

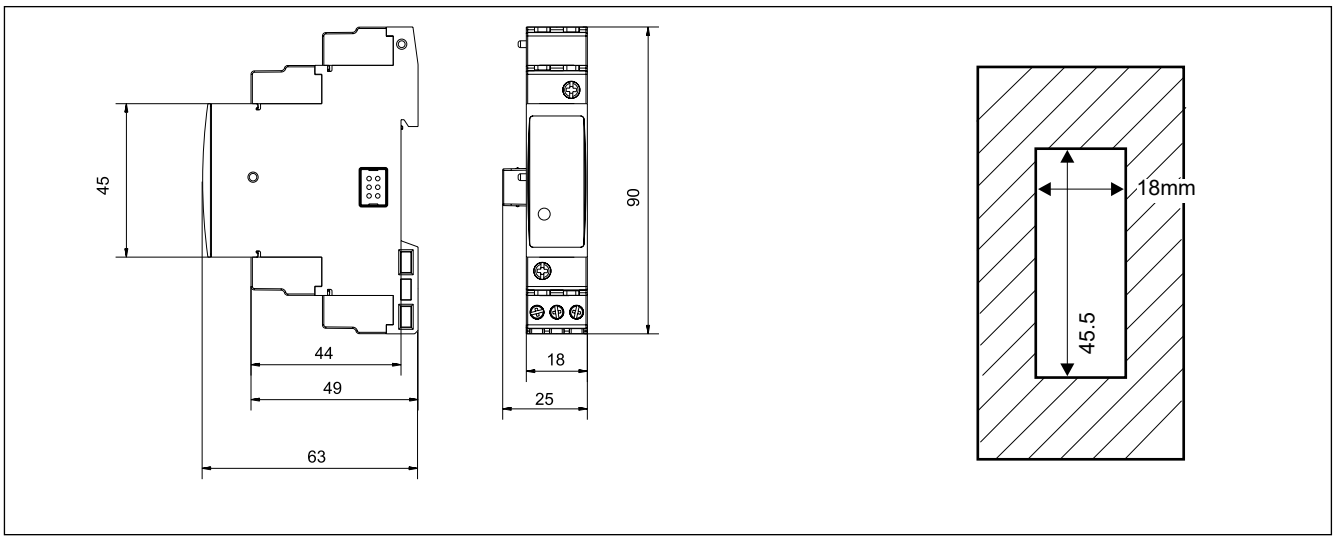
VMU-ML Dimensions and panel cut-out (mm)



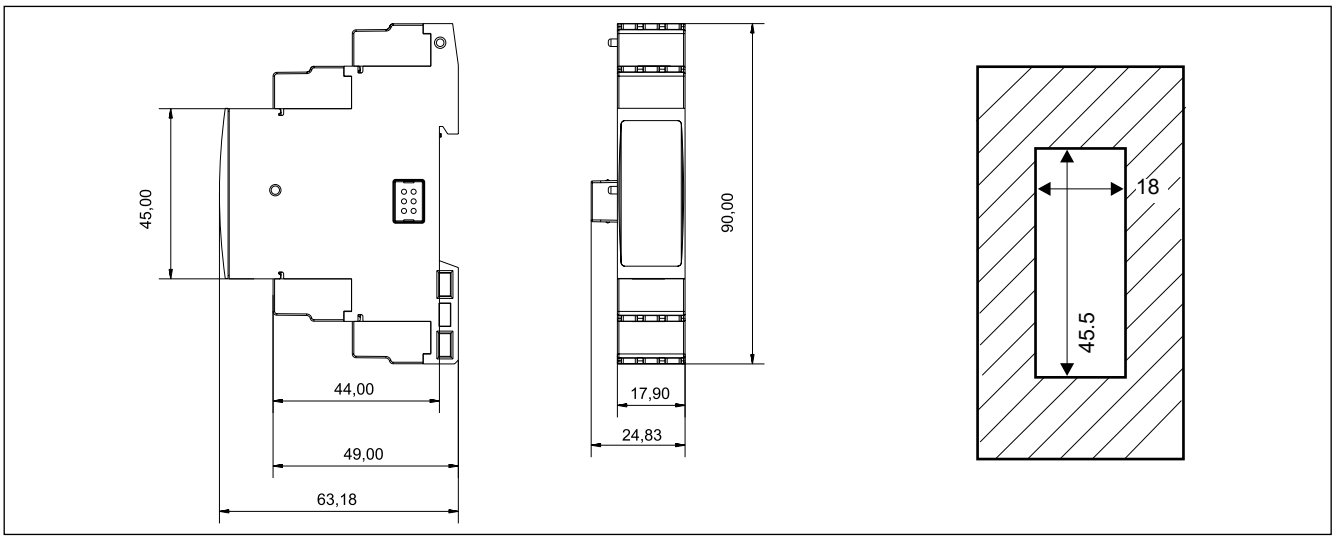
VMU-S0 (AV10) Dimensions and panel cut-out (mm)



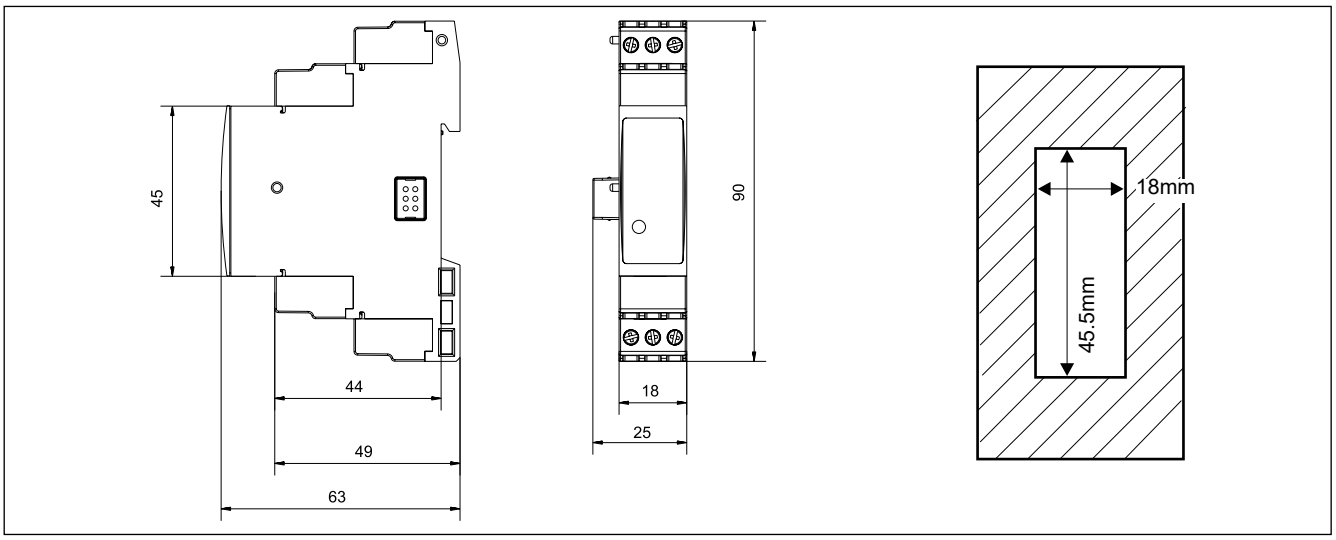
VMU-S0 (AV30) Dimensions and panel cut-out (mm)



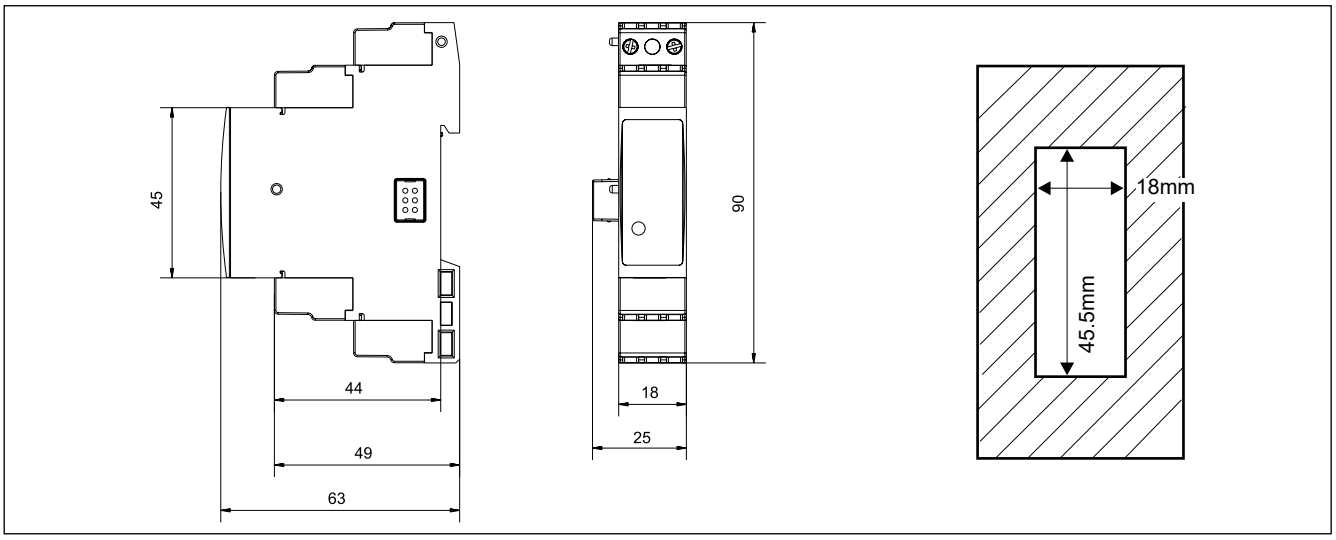
VMU-1 Dimensions and panel cut-out (mm)



VMU-P Dimensions and panel cut-out (mm)



VMU-O Dimensions and panel cut-out (mm)



Mean time to failure (MTTF)

Model	MTTF/MTBF - Years	Test conditions	Standard
VMU-ML	24.2	gf, 50° C	MIL-HDBK-217F
VMU-S0	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-ArrayLSoft parameter programming and variable reading software

Eos-ArrayLSoft	Multi-language software (Italian, English, French, German, Spanish) for variable reading and parameters programming. The program runs under Windows XP/Vista	Configuration mode	There are two configuration levels: - the RS485 communication network which can include either one or more VMU-ML units; - the auxiliary network with all the parameters relevant to the following modules: VMU-ML, VMU-S0, VMU-P, VMU-O.
Application	One / three different applications can be selected: - Solar: a management of a limited network where Eos-ArrayLSoft manages basically one VMU-ML unit with relevant VMU-S0, VMU-P and VMU-O modules and maybe an energy meter connected to the VMU-ML digital input; - Solar extended: a management of a complex network where Eos-ArrayLSoft manages many VMU-ML modules and relevant sub networks (VMU-S0, VMU-P and VMU-O units) and maybe an energy meter (EM21-72D, EM24-DIN, EM26-96) connected to the same RS485 bus.	Data displaying	The following matrix are available: - String 1: V-A - String 2: V-A - String n: V-A - Main: temperature, irradiation and AC energy. - Plant alarms and errors alarm - Relay output status.

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