EM511

Energy analyzer for 1-phase systems

Description

EM511 is an energy analyser for 1-phase systems up to 240 V L-N and current up to 45 A. In addition to a digital input, the unit can be equipped, according to the model, with a static output (pulse or alarm), a Modbus RTU communication port or an M-Bus communication port.

Benefits

- **Enhanced readability.** The backlit display ensures perfect visibility even in low light. The different size of the digits preceding and following the dot makes the displayed values easier to read, while the essential style of the units of measure allows you to readily understand the available variables.
- **Easy browsing.** Page configuration and browsing are very intuitive, thanks to the user interface with 2 mechanical keys. The slideshow function automatically displays the desired measurements in sequence, without having to use the keyboard; the page filter allows you to hide unnecessary information.
- **Quick configuration.** The configuration wizard which runs when the system is started up for the first time allows you to commission the unit without errors in a matter of seconds. The UCS configuration software is available for download free of charge.
- **Accurate measuring.** EM511 complies with the accuracy international standard IEC/EN62053- 21, EN50470- 3 and with the performance requirements (power and active energy) set out by IEC/EN61557-12.
- **Fiscal metrology.** EM511 can be sealed to prevent any tampering with the connections, allowing the unit, thanks to the MID certification, to perform measurements for fiscal purposes and a reinforced protection toward the power terminals.
- **Bidirectional.** Both imported and exported energy meters (kWh+ and kWh-) are MID certified.

Applications

EM511 can be installed in any low-voltage switchboard with rated current up to 45 A, thanks to the 10 mm^2/8 AWG screw terminals, to monitor the energy consumption, the main electrical variables and the harmonic distortion.

If used to monitor a single machine or a specific load, it provides all the main electrical variables to identify any possible malfunction in its early stage and can correlate the energy consumption with the hours of operation, to plan maintenance and prevent failures. The partial meter reset function, easily implementable by means of a digital input, allows you to monitor each individual machine cycle.

The MID-certified version can be used for fiscal metrology and can be installed in residential or commercial buildings to split the costs among the different units, or as a component of machines or equipment requiring measurement certification.

Thanks to the fast communication refresh time and the high resolution of the variables, EM511 can also be used as a data source for control actions, such as avoiding feeding energy into the electricity grid in a photovoltaic joint installation with energy storage.

Main functions

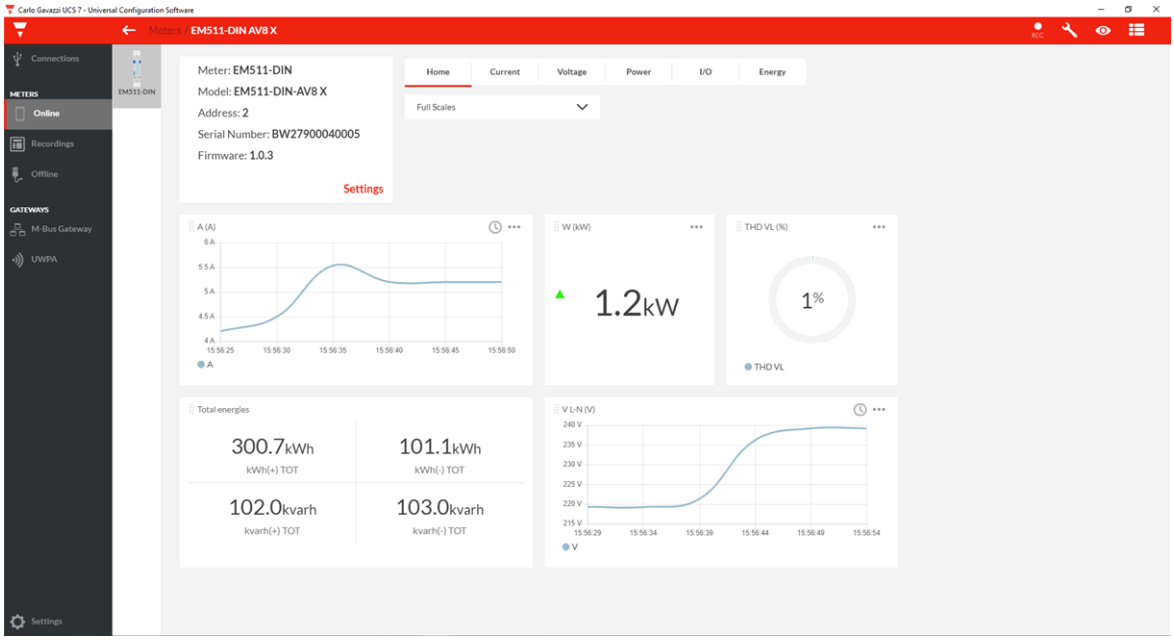
- Measure active, reactive and apparent energy
- Measure the main electrical variables
- Measure the load run hours of the analyser
- Measure the total harmonic distortion (THD) of current and voltages
- Transmit data to other systems through Modbus RTU or M-Bus
- Manage a digital output for pulses or alarm transmission
- Visualize the measured variables on the display

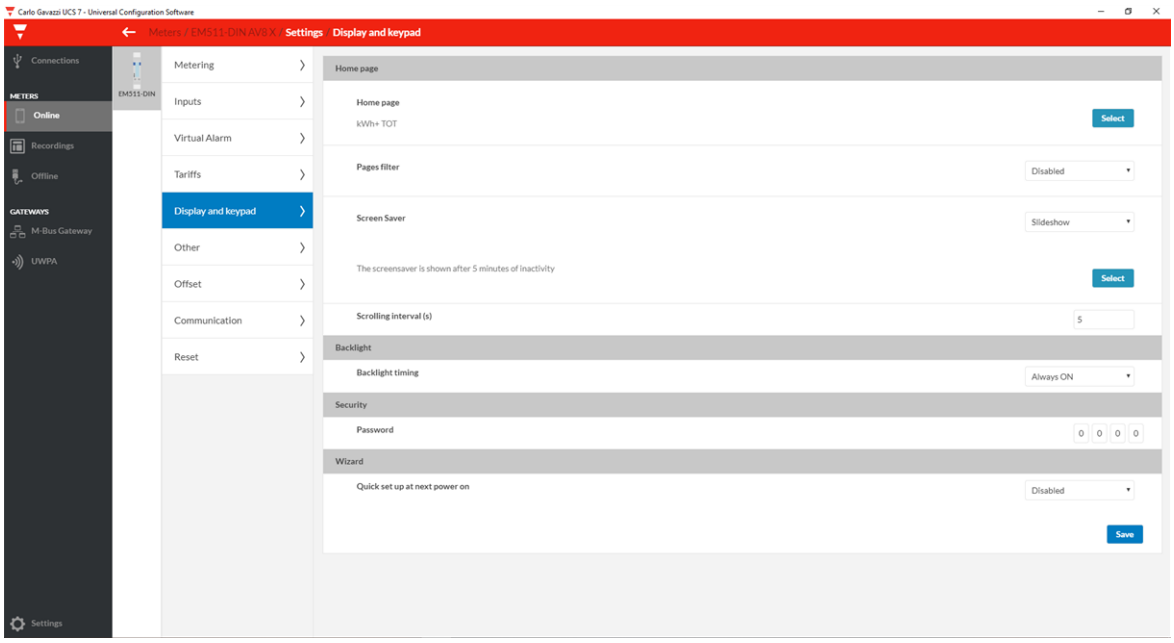
Main features

- Real time variables (V L-N, A, W/var, VA, PF, Hz)
- Displaying the consumed active energy with a resolution of 0.001 kWh
- The frequency value is available via Modbus, with a resolution of 0.001 Hz
- Average value calculation (dmd) for current and power (kW / kVA)
- Modbus RTU RS485 or M-Bus communication (data refresh every 100 ms)
- Continuous sampling of voltage and current
- Backlit LCD display
- MID-certified meter resolution 0.001 kWh
- cULus approved (UL 61010)
- Compliance with the performance requirements set out by IEC/EN61557-12 (power and active energy)

UCS software

- Free download from Carlo Gavazzi website
- Configuration through RS485 from PC or trough UWP3.0 via LAN or the web (UWP Secure Bridge function)
- Setups can be saved offline for serial programming with a single command
- Real time data view for testing and diagnostics





Structure

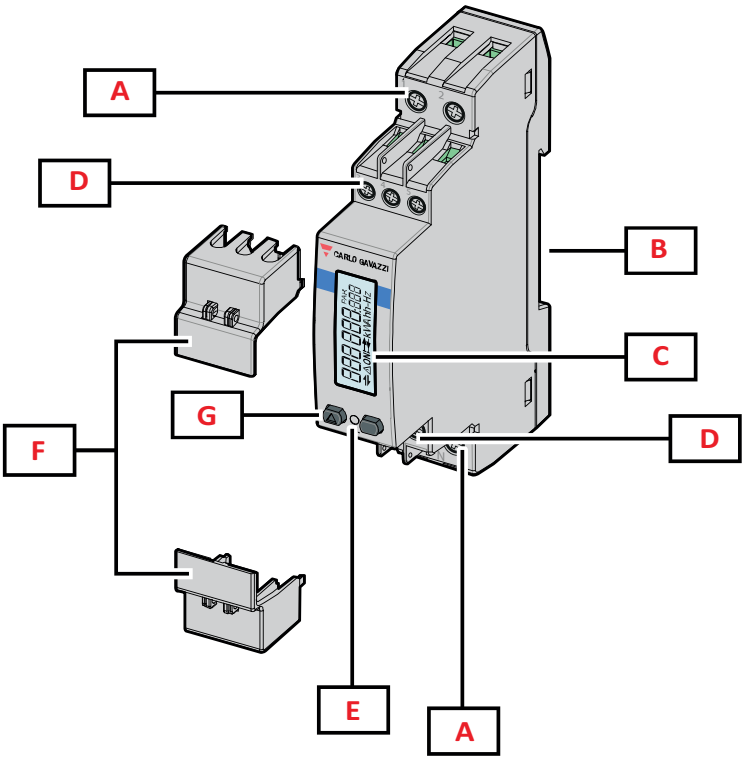


Fig. 1 *Front*

Area	Description
A	Voltage inputs/Current inputs
B	DIN - rail mounting bracket
C	Display
D	Digital input, digital output and communication connections
E	LED
F	Sealable covers
G	Browsing and configuration buttons

Features

General

Material	Housing: PBT Transparent cover: polycarbonate
UL flammability class	Housing: V-0 Transparent cover: V-2
Protection degree	Front: IP40 Terminals: IP20
Terminals	Measurement inputs: 2.5 to 10 mm^2/8 to 14 AWG, 1.1 Nm/9.74 lb-in Inputs, outputs and communication: min: 0.2 to 2.5 mm^2/14 to 24 AWG, 0.4 to 0.8 Nm/3.54 to 7.08 lb-in
Overvoltage category	Cat. III
Pollution degree	2
Mounting	DIN rail
Weight	155 g/0.34 lb(packaging included)

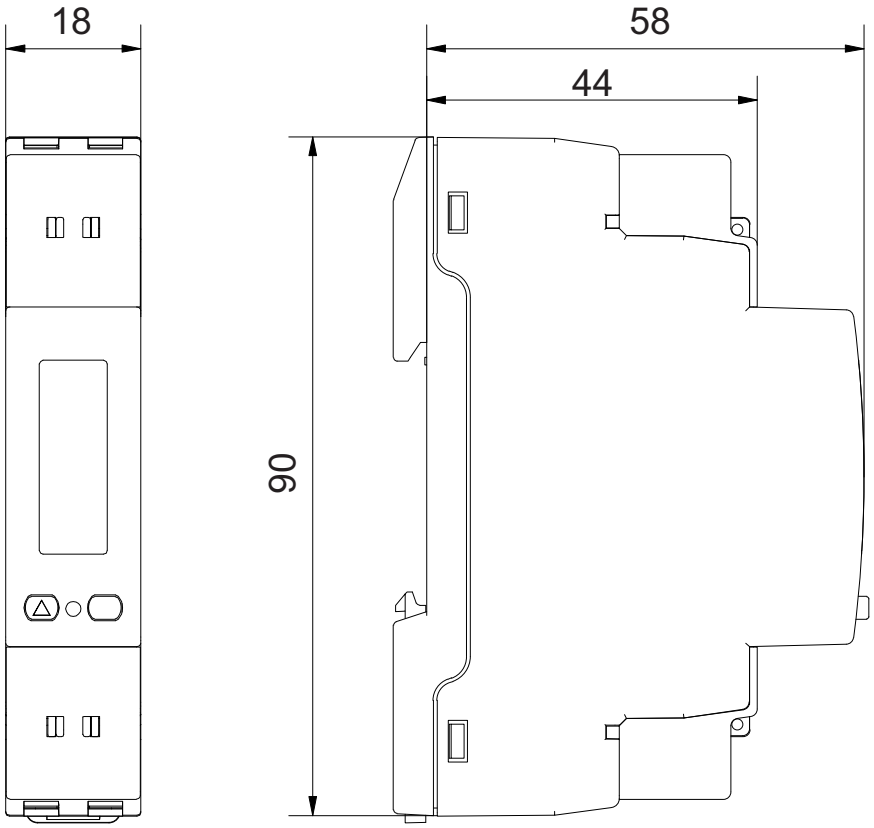


Fig. 2

Environmental specifications

Operating temperature	From -25 to +55 °C/from -13 to +131 °F
Storage temperature	From -25 to +70 °C/from -13 to +158 °F
Electromechanical environmental condition	E2
Mechanical environmental condition	M2

***Note**: R.H. < 90 % non-condensing @ 40 °C / 104 °F.*

Input and output insulation

Type	Measurement inputs	Digital input	Digital outputs	RS485 serial port	M-Bus serial port
Measurement inputs	-	Double/Reinforced	Double/Reinforced	Double/Reinforced	Double/Reinforced
Digital input	Double/Reinforced	-	none	none	none
Digital outputs	Double/Reinforced	none	-	-	-
RS485 serial port	Double/Reinforced	none	-	-	-
M-Bus serial port	Double/Reinforced	none	-	-	-

According to: EN 61010-1, EN 50470-1 (MID). Overvoltage category III. Pollution degree 2.

Compatibility and conformity

Directives	2014/32/EU (MID) 2014/35/EU (LVT - Low Voltage) 2014/30/EU (EMC - Electro Magnetic Compatibility) 2011/65/EU (Electric-electronic equipment hazardous substances)
Standards	Electromagnetic compatibility (EMC) - emissions and immunity: EN 62052-11 , EN 50470-1 (MID) Electrical safety: EN 61010-1 , EN 50470-1 (MID) Metrology: EN62053-21, EN62053-23, EN 50470-3 (MID), IEC/EN61557-12 (active power and active energy, MID models only) Pulse output: IEC 62053-31
Approvals	CE c UL LISTED UK CA

Electrical specifications

Electrical system	
Managed electrical system	Single-phase

Voltage inputs - MID	
Voltage connection	Direct
Rated voltage L-N	230 V
Voltage tolerance	From 0.8 to 1.15 Un
Input impedance	Refer to “Power supply”
Frequency	50 Hz

Voltage inputs - non MID	
Voltage connection	Direct
Rated voltage L-N (from Un min to Un max)	120 to 240 V
Voltage tolerance	From 0.8 to 1.15 Un
Input impedance	Refer to “Power supply”
Frequency	50/60 Hz

Current inputs	
Current connection	Direct
Base current (Ib)	5 A
Minimum current (Imin)	0.25 A
Maximum current (Imax)	45 A
Start-up current (Ist)	0.02 A
Overload	For 10 ms: 30 Imax (1350 A)
Input impedance	<1.4 VA
Crest factor	2.5

Power supply

Type	Self power supply
Consumption	< 0.6 W/1.8 VA

Measurements

Method	TRMS measurements of distorted waveforms
Sampling	1600 samples/s @50 Hz 1920 samples/s @60 Hz

Available measurements

Active energy	**Unit**
Imported (+) Total	kWh+
Imported (+) partial	kWh+
Exported (-) Total	kWh-
Exported (-) partial	kWh-
Imported (+) tariff 1	kWh+
Imported (+) tariff 2	kWh+

Reactive energy	**Unit**
Imported (+) Total	kvarh+
Imported (+) partial	kvarh+
Exported (-) Total	kvarh-
Exported (-) partial	kvarh-

Apparent energy	**Unit**
Total	kVAh
Partial	kVAh

Run hour meter	**Unit**
Total (kWh+)	hh:mm
Partial (kWh+)	hh:mm
Total (kWh-)	hh:mm -
Partial (kWh-)	hh:mm -
Total ON time	hh:mm

Electrical variable	**Unit**
Voltage L-N	V
Current	A
DMD	A
DMD MAX	A
Active power	kW
DMD	kW

Electrical variable	Unit
DMD MAX	kW
Apparent power	kVA
DMD	kVA
DMD MAX	kVA
Reactive power	kvar
Power factor	PF
Frequency	Hz
THD Current*	%
THD Voltage*	%

* Up to 15th harmonic

***Note**: total imported active energy (kWh+ TOT) and Total exported active energy (kWh- TOT) are the only MID certified meters. Apparent energy, reactive energy are not MID certified. Partial meters are not MID certified.*

Energy metering

Energy metering depends on the measurement type you choose (selectable in non-MID models, according to the model in MID-certified models).

A measurement (MID PFA models)

Easy connection function: irrespective of the current direction, the power always has a plus sign and contributes to increase the positive energy meter. The negative energy meter is not available.

B measurement (MID PFB models)

Bidirectional: according to the power sign, the positive or the negative energy meter increases.

Measurement accuracy

Current	
From 0.5 A to 45 A	± 0.5% rdg
From 0.25 A to 0.5 A	± 1% rdg

Voltage	
From 0.8 Un min to 1.15 Un max	± 0.5% rdg

Active and apparent power	
From 0.5 A to 45 A (PF=0.5L, 1, 0.8C)	± 1% rdg
From 0.25 A to 0.5 A (PF=1)	± 1.5% rdg

Reactive power	
From 1 A to 45.0 A (sinϕ=0.5L, 0.5C) From 0.5 A to 45 A (sinϕ=1)	± 2% rdg
From 0.5 A to 1.0 A (sinϕ=0.5L, 0.5C) From 0.25 A to 0.5 A (PF=1)	± 2.5% rdg

Energy	
Active energy	Class 1 (EN62053-21), Class B EN50470-3 (MID)
Reactive energy	Class 2 (EN62053-23)

Frequency	
From 45 to 65 Hz	± 0.1% rdg

Measurement resolution

Variable	Display resolution	Resolution by serial communication
Energy	0.001 kWh/kvarh/kVAh	
Power	0.001 kW/kvar/kVA	0.1 W/var/VA
Current	0.001 A	
Voltage	0.1 V	
Frequency	0.001 Hz	
THD	0.01 %	
Power factor	0.01	0.001
Hour meter	1 min	

Display

Type	Segments
Refresh time	500 ms
Description	Backlit LCD
Variable readout	Instantaneous: 5+1 dgt, 5+2 dgt or 5+3 dgt Power factor: 1+3 dgt Energy: 6+3 dgt

LED

Front	Red. Pulse weight: proportional to energy consumption: 0.001 kWh per pulse

Digital outputs/inputs

Digital inputs

Connection type	Screw terminals
Number of inputs	1
Type	Free contact
Function	Remote status Tariff management Partial meter start/pause Partial meter reset
Features	Open contact voltage: 5 Vdc +/- 5% Closed contact current: 5 mA max Input impedance: 11.6 k Ω Open contact resistance: ≥ 25 kΩ Closed contact resistance: ≤ 840 Ω Maximum voltage applicable with no damages: 30 V ac
Configuration parameters	Input function
Configuration mode	Via keypad or UCS software

Digital ouput (O1 version)

Connection type	Screw terminals
Maximum number of outputs	1
Type	Opto-Mosfet
Function	Pulse output or alarm output
Features	V_{ON} 2.5 V ac/dc, max 100 mA V_{OFF} 42 V ac/dc
Configuration parameters	Output function (pulse/alarm) Pulse weight (from 0.001 to 10 kWh per pulse) Pulse duration (30 or 100 ms) Output normal status (NO or NC)
Configuration mode	Via keypad

Communication ports

Modbus RTU (S1 version)

Protocol	Modbus RTU
Devices on the same bus	Max 247 (1/8 unit load)
Communication type	Multidrop, bidirectional
Connection type	2 wires
Configuration parameters	Modbus address (from 1 to 247) Baud rate (9.6 / 19.2 / 38.4 / 115.2 kbps) Parity (None/ Even)
Refresh time	≤ 100 ms
Configuration mode	Via keypad or UCS software

M-Bus (M1 version)

Protocol	M-Bus according to EN13757-3:2013
Unit loads	1.5
Connection type	2 wires
Configuration parameters	Primary address (1 to 250) Baud rate (0.3/ 2.4 / 9.6 kbps)
Refresh time	≤ 100 ms
Configuration mode	Via keypad

Connection Diagrams

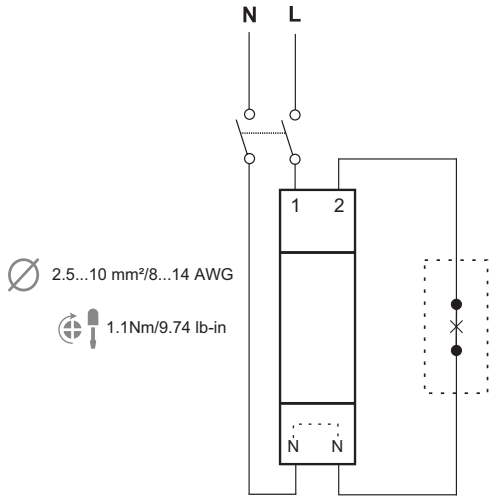


Fig. 3 *Single-phase system (solution A)*

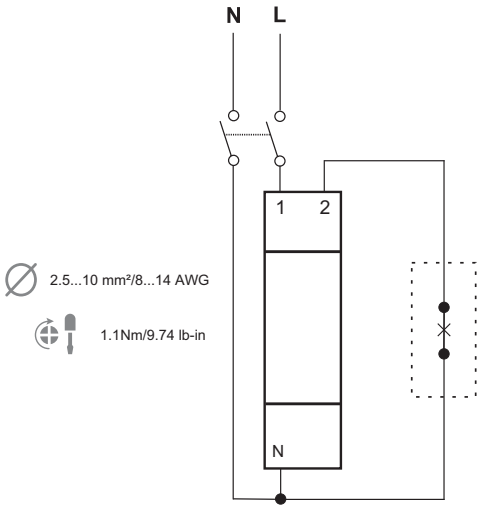


Fig. 4 *Single-phase system (solution B)*

Digital outputs/inputs

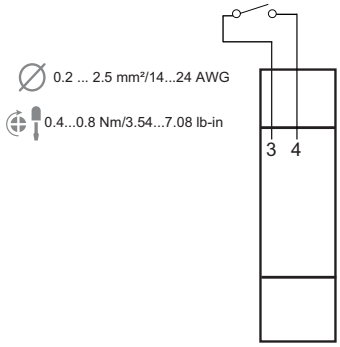


Fig. 5 *Digital input*

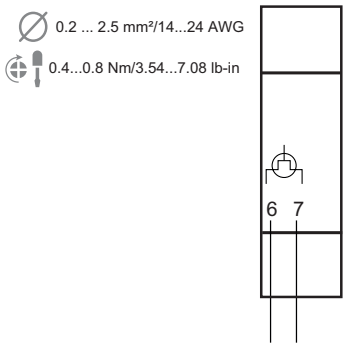


Fig. 6 *Digital output*

Communication

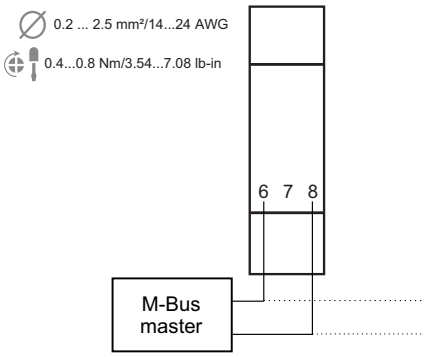


Fig. 7 *M-Bus*

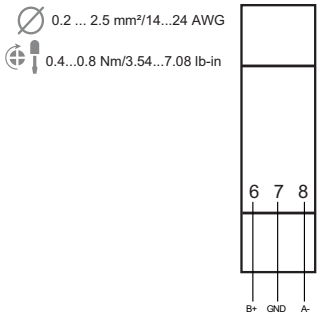


Fig. 8 *RS485 port*

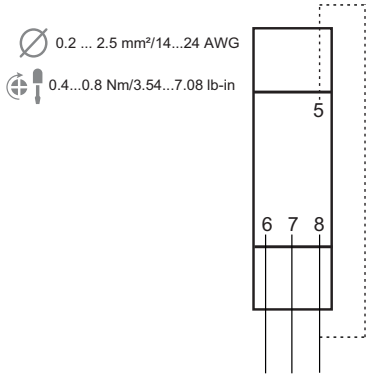


Fig. 9 *Last device on RS485*

References

Order code

EM511 DIN AV8 1X ☐☐ X

Enter the code option instead of ☐

Code	Options	Description
EM511 DIN AV8 1X	-	-
☐	O1	Digital output
	S1	RS485 Modbus RTU
	M1	M-Bus
☐	X	Non MID models, cULus approval
	PFA	MID, easy connection
	PFB	MID bidirectional
	SFA	MID for Switzerland and Austria, easy connection

- PFA and SFA models: irrespective of the current direction, the power always has a plus sign and contributes to increase the positive energy meter. The negative energy meter is not available
- PFB models: according to the power sign, the positive or the negative energy meter increases. Both kWh+ and kWh- are MID certified meters.