EM580

Energy analyzer for three-phase and single-phase systems

Description

EM580 is a direct connection energy meter, for single-phase and three-phase systems up to 400 V L-L and current up to 65 A. It is equipped with Modbus RS485 communication port, and a 128x96 matrix LCD display.

Benefits

- **User-friendly interface.** The 128x96 matrix LCD with backlight display ensures perfect visibility and readability of the information. Page configuration and browsing are very intuitive, thanks to the user interface with 3 mechanical keys. Finally, the page filter allows you to hide the unnecessary information.
- **Secure and signed data transmission.** EM580 is conceived to be secure and safe: sealable terminal caps prevent external intervention and tampering, while data authenticity is ensured by the digital signature and the OCMF file.
- **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.
- **Fiscal metrology.** EM580 is the perfect solution for fiscal metrology; in fact, the product conforms with the most important European standards for fiscal metrology in EV chargers, in particular German calibration law and MID regulation.
- **Flexible installation.** It can be installed in Single-phase and three-phase with neutral systems: thanks to its compact housing and intelligent design it can be connected both from the bottom or the top, thus it is easy to collocate into the EV charger and allows effective integration with the controller.

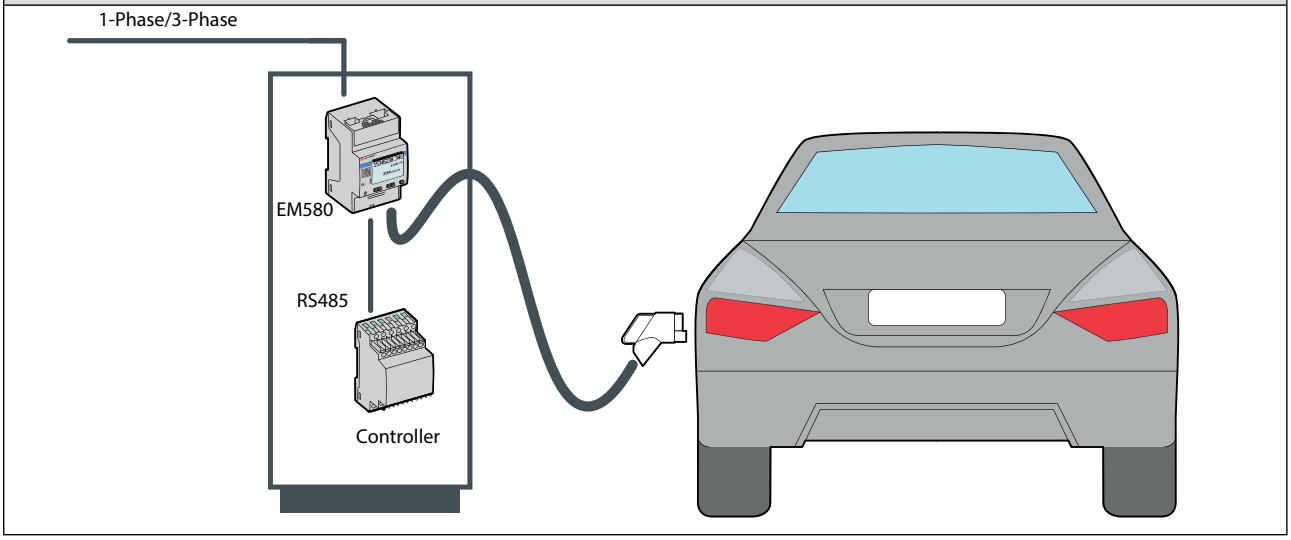
Applications

EM580 can be implemented in EV chargers for installation in both one-phase and three-phase systems. Thanks to its easy integration with the controller through Modbus RTU, wide temperature range up to 70 °C / 185 °F and bidirectional MID certification, it's the optimal solution to provide reliable and accurate measurement for fiscal billing in EV chargers. EM580 is also compliant with the Eichrecht requirements for the German market.

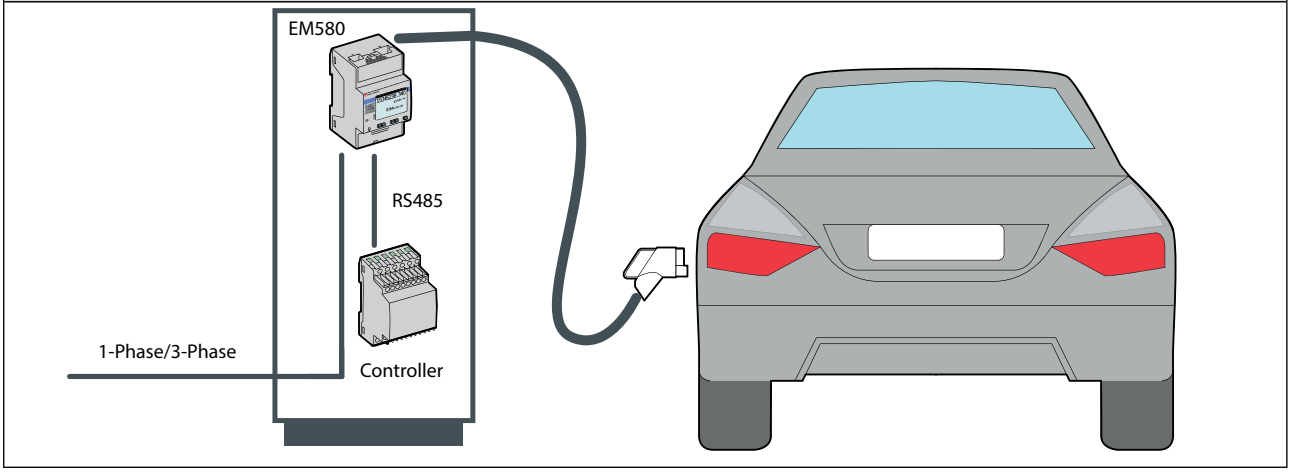
Architecture

EM580 is designed to fit installation needs dictated by the EV charger internal configuration; voltage and current inputs are collocated both on the top and the bottom of the product, allowing different adaptations. Images below illustrate two possible solutions:

Top-down connection



Bottom-up connection



Main functions

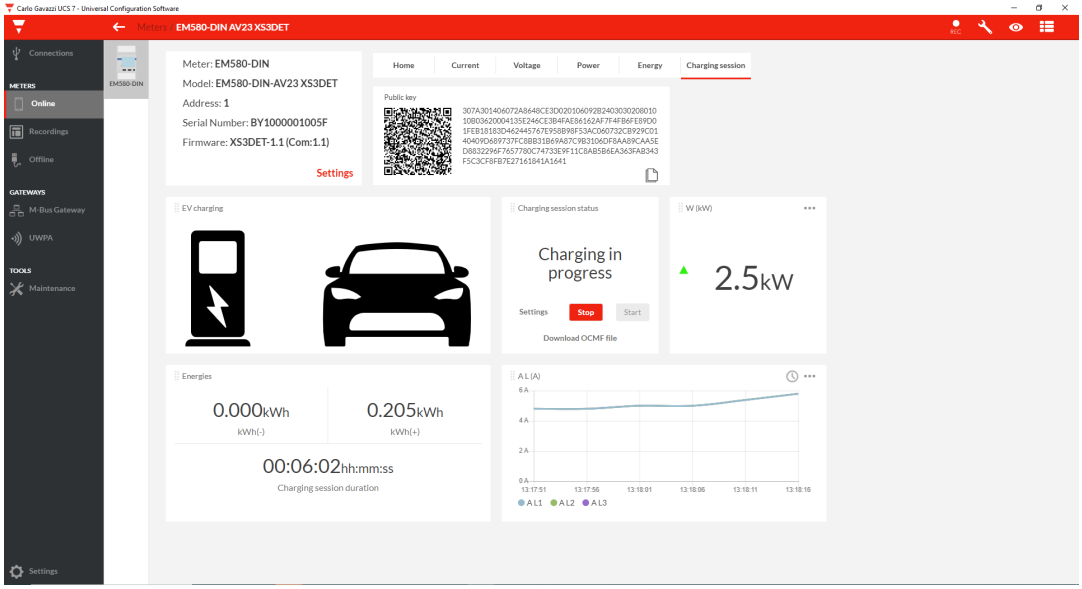
- Measure active, reactive and apparent energy
- Measure the main electrical variables
- Transmit data to other systems through Modbus RTU
- Visualize the measured variables on the display
- Charging session management and automatic display update
- Cable loss compensation
- Signed data transmission using OCMF file (according to the S.A.F.E standard and Transparency software)

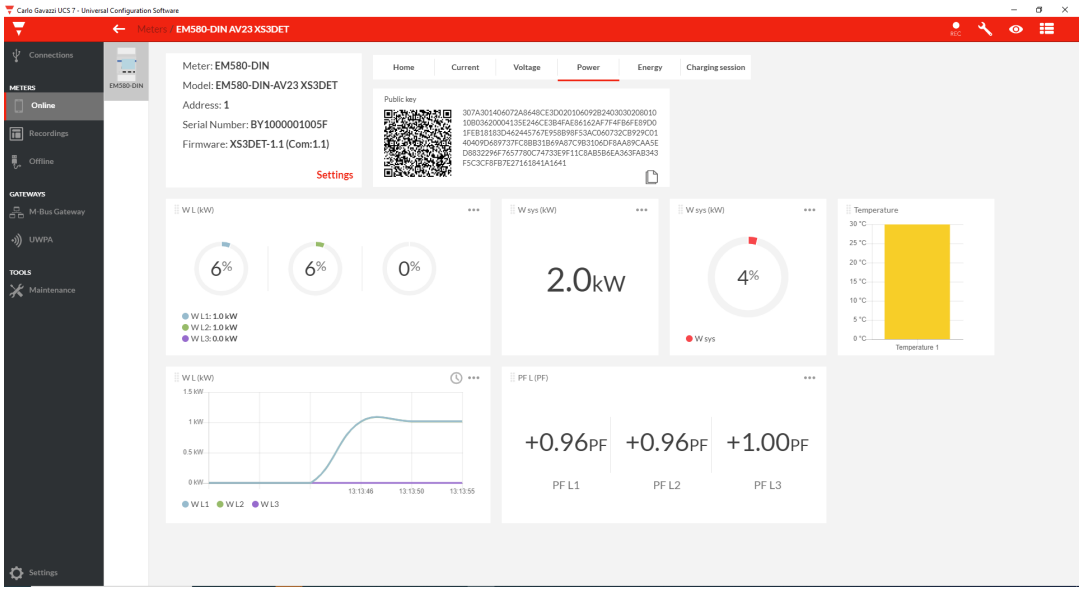
Main features

- Real time variables (V, A, W)
- 0.001 kWh resolution via Modbus communication
- The frequency value is available via Modbus, with a resolution of 0.001 Hz
- Streamlined user interface featuring 3 mechanical buttons
- Modbus RTU RS485 (data refresh every 100 ms)
- Continuous sampling of each voltage and current
- 128x96 matrix LCD display
- Works up to 70 °C / 185 °F temperature
- Quick setup wizard
- MID and Eichrecht certificate

UCS software

- Free download from Carlo Gavazzi website
- Configuration through RS485 from PC or through UWP3.0/UWP4.0 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
- Notification of possible wiring errors and display of the corrective steps, reassignment of the correct association of the phases or the direction of the currents via software control.





Structure

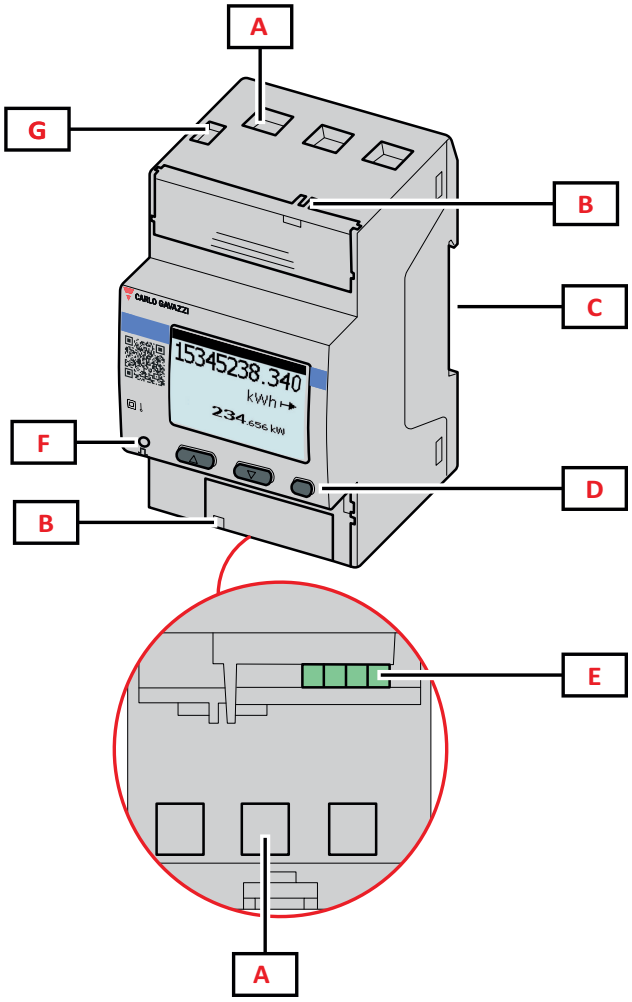


Fig. 1 *Front*

Area	Description
A	Voltage inputs / Current inputs
B	MID seal housing
C	DIN rail mounting bracket
D	Browsing and configuration buttons
E	Modbus RS485 port
F	LED
G	Neutral connection

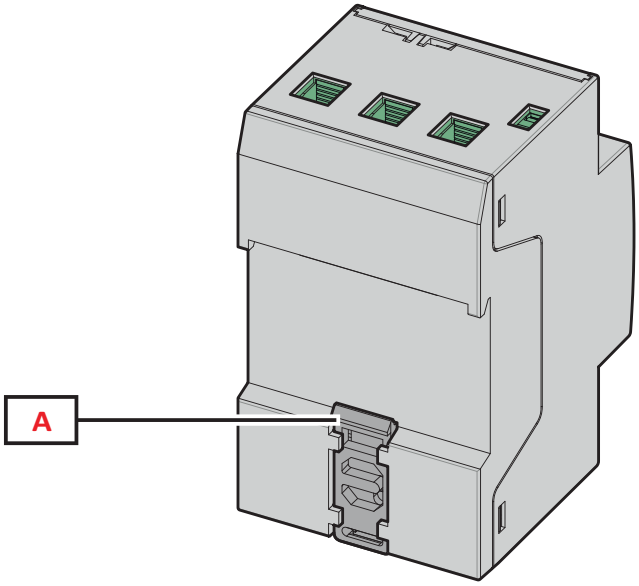
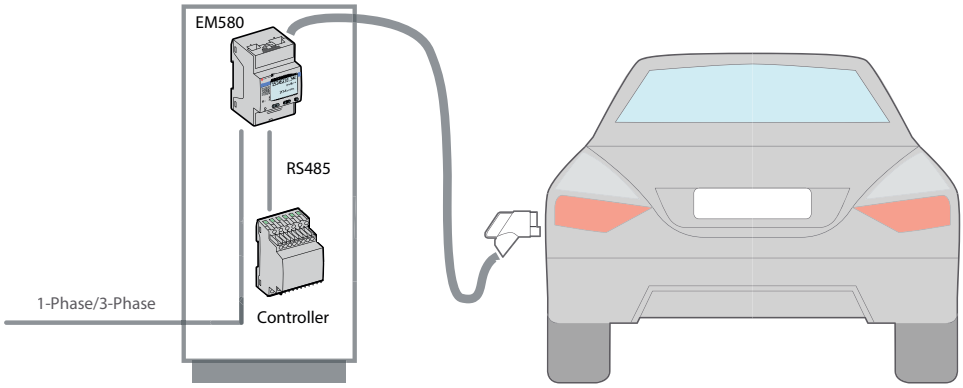


Fig. 2 *Back*

Area	Description
A	DIN rail mounting bracket

Charging Session management



EM580 participates actively during the charging session, in particular:

- **Charging session process**: EM580 communicates with the controller during the charging session process to show the relevant information,
- **OCMF file generation**: EM580 creates the OCMF file, the controller reads it via Modbus and saves it locally or in the cloud.

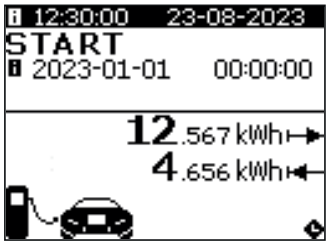
Charging session process

In the following tables it is possible to follow step by step the charging session process, tables help visualize the communication between the controller and the EM580:

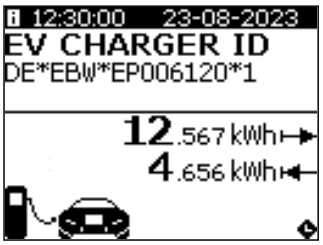
Session start

Controller	EM580
Sends CLOCK SYNCRONIZATION command to EM580* Writes session parameters Sends START command to EM580	
	Shows on the display the following information, read from the controller: • START time • Charger ID • Transaction ID

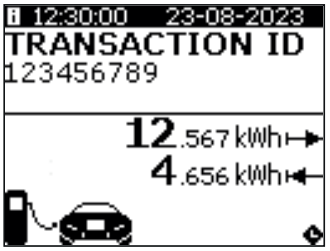
**Note*: *If synchronized, the EM580 clock shows the Local Time during the charging session; the user shall set the clock following the procedure (see Communication Protocol).*



Start time



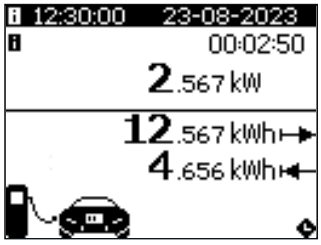
Charger ID



Transaction ID

Session in progress

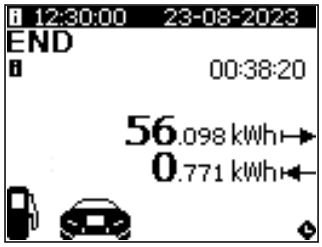
Controller	EM580
Read real time data (optional) Read real time temperature	Show on the display the following information: • Clock • Duration • Power • Energy



Charging session in progress information

Session end

Controller	EM580
Sends STOP command	
	Shows on the display the following information: • Clock • Duration • Energy Generates signed OCMF file
Reads OCMF file Saves OCMF file to cloud or local storage	
	Allows confirmation only if all the OCMF file registers have been read
Saves OCMF file to cloud or local storage	



Charging session end information

OCMF file

The Open Charge Metering Format is an independent and generally usable data format for recording meter readings from charging stations that are relevant under calibration law. In addition, it permits the implementation of the evaluation and signature verification of the format by the Transparency Software. The file, written in JSON format, is compiled and saved on the cloud or local server once the charging session ends.

Further readings

Information	Where to find it
OCMF format	https://github.com/SAFE-eV/OCMF-Open-Charge-Metering-Format/blob/master/OCMF-en.md
Transparency software	https://safe-ev.org/en/transparency-software/e-mobilists/

Features

General

Material	Housing: PBT Cover: polycarbonate UL flammability class: UL-94 V0
Protection degree	Front: IP40 Terminals: IP20
Protective class (Double square equivalent)	Class II
Terminals	Measurement inputs (Phase 1, 2, 3); 2.5 to 16 mm^2 / 5 to 13 AWG, 2.5 Nm / 22.12 lbin max Neutral; 0.06 to 2.5 mm^2 / 13 to 29 AWG, 0.5 Nm / 4.43 lbin max Communication; 0.08 to 0.82 mm^2 / 18 to 28 AWG, 0.2 Nm / 1.77 lbin max raccomanded
Overvoltage category	Cat. III
Rated impulse voltage	4 kV
Utilization category	UC2
Pollution degree	2
Mounting	DIN rail
Weight	370 g / 0.82 lb (packaging included)
Dimensions	3-DIN modules

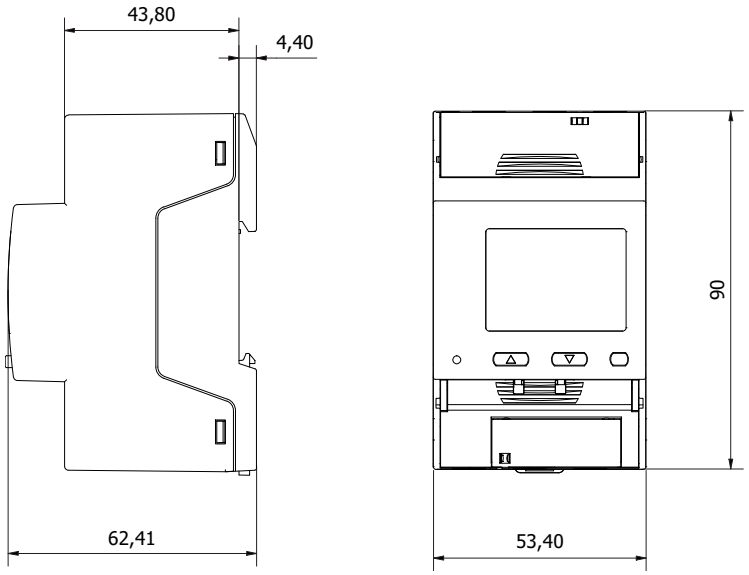


Fig. 3

Environmental specifications

Operating temperature	From -25 to +70 °C / from -13 to +158 °F
Storage temperature	From -40 to +85 °C / from -40 to 185 °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	RS485 serial port
Measurement inputs	-	Double/Reinforced
RS485 serial port	Double/Reinforced	-

According to: EN 61010-1. Overvoltage category III. Pollution degree 2.

Compatibility and conformity

Directives	2014/32/EU (MID) 2014/35/EU (LVD - Low Voltage) 2014/30/EU (EMC - Electro Magnetic Compatibility) 2011/65/EU, 2015/863/EU (Electric-electronic equipment hazardous substances)
Standards	**EMC - Electro Magnetic Compatibility**: EN IEC 61000-6-3, EN IEC 61000-6-2, EN IEC 62052-11 **Electrical Safety**: EN IEC 61010-1, EN IEC 62052-31 **Metrology**: EN 50470-3 (Class B), REA 6A+PTB 50.7 (Eichrecht versions), EN IEC 62053-21 (Class 1) **SW security**: WELMEC 7.2
Approvals	CE

Electrical specifications

Electrical system	
Managed electrical system	Three-phase with neutral (4-wire) One-phase with neutral (2-wire)

Voltage inputs	
Voltage connection	Direct
Rated voltage L-N	From 120 to 230 V
Rated voltage L-L	From 208 to 400 V
Voltage tolerance	From 0.8 to 1.15 Un
Overload	Continuous: 1.5 Un max
Frequency	50 Hz

Current inputs	
Current connection	Direct
Base current (I_b)	5 A
Minimum current (I_{min})	0.25 A
Maximum current (I_{max})	65 A
Start-up current (I_{st})	20 mA
Overload	For 10 ms: 30 Imax (1950 A)
Input impedance	< 1.13 VA
Crest factor	4 (Imax peak 92A)

Power supply

Type	Self power supply
Consumption	< 1.5 W / 2.8 VA
Frequency	50 Hz

Measurements

Method	TRMS measurements of distorted waveforms
Energy update rate	100 ms

Available measurements

Active energy	Unit	System	Phase
Imported (+) Total	kWh+	●	-
Exported (-) Total	kWh-	●	-

Reactive energy	Unit	System	Phase
Imported (+) Total	kvarh+	●	●
Exported (-) Total	kvarh-	●	●

Apparent energy	Unit	System	Phase
Total	kVAh	●	●

Electrical variable	Unit	System	Phase
Voltage L-N	V	●	●
Voltage L-L	V	●	●
Current	A	-	●
Active power	W	●	●
Apparent power	VA	●	●
Reactive power	Var	●	●
Power factor	PF	●	●
Frequency	Hz	●	-

Charging session measurements

Active energy	Unit
Imported (+) Total	kWh+
Exported (-) Total	kWh-
Duration	hh:mm:ss

***Note**: the available variables depend on the type of system set.*
DEA model:Total imported active energy (kWh TOT) is the only MID certified meter. Apparent energy, reactive energy and exported active energy are not MID certified.
DEB and DET models: 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.
Energy calculation is not affected by the selected System.

Energy metering

Energy metering depends on the measurement type you chose (according to the model).

DEA measurement

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.

DEB/DET measurement

For each measuring time interval, the individual phase energies with a plus sign are summed to increase the positive energy meter (kWh+), while the others increase the negative one (kWh-).

Example:
P L1= +2 kW, P L2= +2 kW, P L3= -3 kW
Integration time = 1 hour
kWh+ = (2+2) x1h = 4 kWh
kWh- = 3 x 1h= 3kWh

Measurement accuracy

Current	
From I_{tr} A to I_{max} A	± 0.5% rdg
From I_{min} A to I_{tr} A	± 1% rdg

Phase-phase voltage	
From Un min -20% to Un max +15%	± 0.5% rdg

Phase-neutral voltage	
From Un min -20% to Un max +15%	± 0.5% rdg

Active and apparent power	
From I_{tr} A to I_{max} A (PF=0.5L - 1 - 0.8C)	± 1% rdg
From I_{min} A to I_{tr} A (PF=1)	± 1.5% rdg

Reactive power	
From 1.0 A to 2.0 A (sinϕ=0.5L - 0.5C) From 0.5 A to 1.0 A (sinϕ=1)	± 2% rdg
From 2.0 A to 65.0 A (sinϕ=0.5L - 0.5C) From 1.0 A to 65.0 A (PF=1)	± 2.5% rdg
Active energy	Class B EN50470-3 (MID)
Reactive energy	Class 1 (EN62053-23)

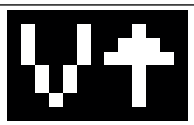
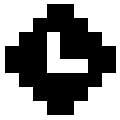
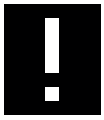
Frequency	
50 Hz	± 0.1% rdg

Display

Type	Graphical matrix display
Refresh time	500 ms
Description	128x96 backlit LCD
Variable readout	Instantaneous: 5+1 dgt or 5+3 dgt Energy: 7+3 dgt

Display icons description

The table reports the icons that can appear on the display and explains their meaning.

Icon	Description
	Current overrange, the measured value is still displayed
	Voltage overrange, the measured value is still displayed
	Communication: reading or writing command is addressed to EM580
	Clock synchronized
	Internal failure
	Communication module error or disconnection

Measurement resolution

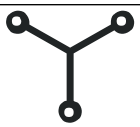
Variable	Display resolution	Resolution by serial communication
Energy	0.001 kWh/kvarh/kVAh	
Single phase energy	-	0.001 kWh
Power	0.001 kW/kvar/kVA	0.1 W/var/VA
Current	0.001 A	
Voltage	0.1 V	
Frequency	0.001 Hz	
Power factor	0.01	0.001

LED

Function	Red. Pulse weight: proportional to energy consumption
Constant	1000 pulse/kWh

Symbols

The table describes all the symbols that you can find in the documents and on the product.

Symbol	Description
	Dangerous voltage
	Danger, live parts
	Caution
	Provides essential information on completing the task that should not be neglected
	Manual symbol
	Safety sign notice
	The product is not to be discarded with normal household waste
	Single phase
	Three phase
	Double insulation

Communication ports

Modbus RTU

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 (9.6/19.2/38.4/57.6/115.2 kbps) Parity (None/ Even)
Refresh time	≤ 100 ms
Configuration mode	Via keypad or UCS software

Connection Diagrams

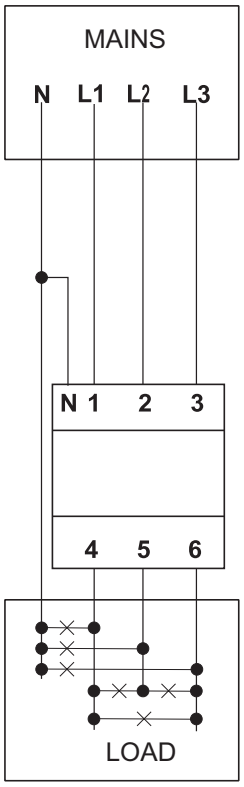


Fig. 4 *DET model: three-phase with neutral (4-wire).*

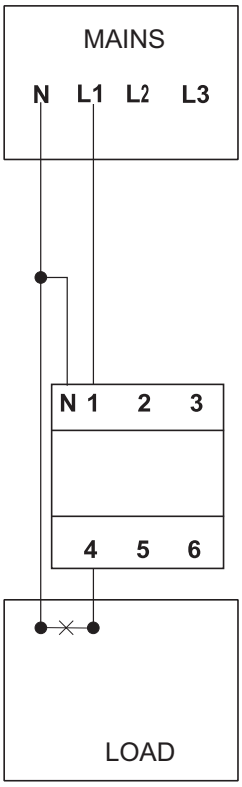


Fig. 5 *DET model: single-phase with neutral (2-wire).*

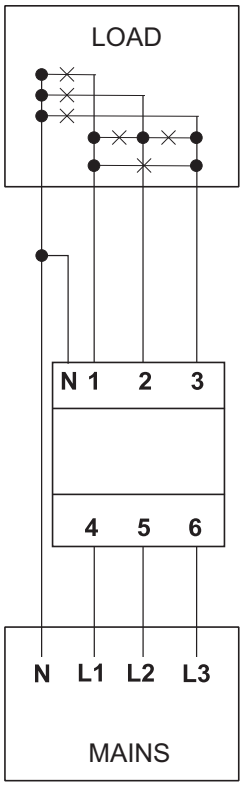


Fig. 6 *DEA and DEB models: three-phase with neutral (4-wire).*

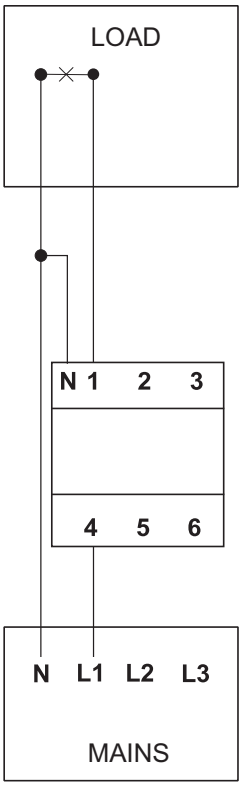


Fig. 7 *DEA and DEB models: single-phase with neutral (2-wire).*

Communication

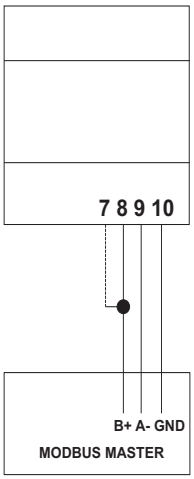


Fig. 8 *Last device on RS485.*

References

Order code

EM580 DIN AV2 3X ☐☐

Enter the code option instead of ☐

Code	Options	Description
EM580	-	Model
DIN	-	DIN rail mounting
AV2	-	400 V L-L, 5(65) A
3	-	Three-phase and one-phase system
X	-	Self power supply
☐	S2	RS485 Modbus RTU, 256-bit signature
	S3	RS485 Modbus RTU, 384-bit signature
☐	DEA	MID + Eichrecht
	DEB	MID + Eichrecht, Bidirectional, Bottom-up connection
	DET	MID + Eichrecht, Bidirectional, Top-down connection

- DEA: Easy connection, the energy totalizer (kWh+) is certified according to MID;
- DEB and DET: Bidirectional, total imported active energy (kWh+ TOT) and total exported active energy (kWh- TOT) are MID certified meters;

  Note: for each measuring time interval, the individual phase energies with a plus sign are summed up to increase the positive energy meter (kWh+), while the others increase the negative one (kWh-).

CARLO GAVAZZI compatible components

Purpose	Component name/code key	Notes
Configure meter via desktop application	UCS software	Available for free download at: www.gavazziautomation.com
Aggregate, store and transmit data to other systems	UWP 3.0, UWP 4.0	See relevant datasheet at: www.gavazziautomation.com