

DCM₁

Energy meter for DC systems



Description

DCM1 is a direct connection energy Meter for DC systems up to 1000 V dc and current up to 600 A dc. Specifically designed for installation in EV fast chargers, it has two components: a transducer for voltage and current connection and a display unit featuring both Modbus RTU and Modbus TCP communication port. The cable that links the two parts is included and connected to the transducer, making installation easy and fast.

Benefits

- Fiscal metrology. State of the art technology, high accuracy and modern architecture allow DCM1 to be the perfect solution for billing purposes, in fact, the product conforms with the most important international standards for fiscal metrology in EV chargers: MID, Eichrecht, CTEP.
- Secure and signed data transmission. DCM1 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.
- User-friendly interface. The 128x96 matrix LCD with backlight display presents clearly readable information to the user. In addition, the interface can be easily programmed and customized, with a straightforward setting procedure using UCS software or the 3 mechanical keys.
- Maximum connection flexibility. The intelligent design of the DCM1 makes it easy to integrate inside the EV charger architecture: the display is detached from the measuring component and both Modbus RTU and Modbus TCP are in the same unit, allowing different connection layouts.
- Temperature calibrated. Able to work in an extremely wide temperature range thanks to the temperature drift compensation exploiting a calibration method based on two temperature sensors.
- Clear and effective diagnostics. Correct operation is immediately visible through the LEDs and the warning status icons on the display. Diagnostic alerts and realtime temperature values are also available via Modbus to permit constant monitoring.

A

Applications

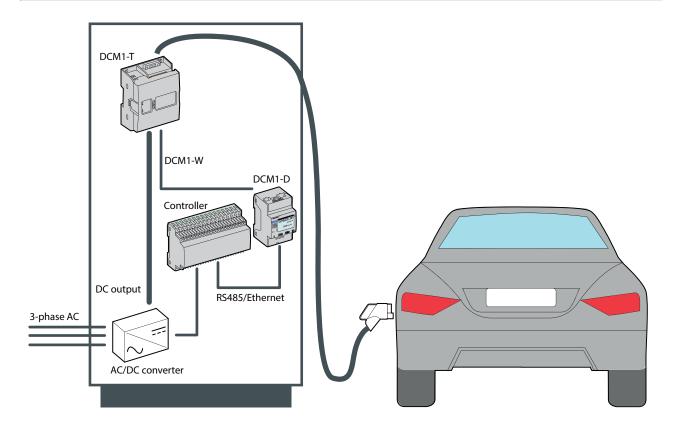
DCM1 can be installed in any DC switchboard with a rated current up to 600 A to monitor energy consumption or production and the main electrical variables. The main application is within a DC fast charger for electric vehicles, thanks to the $70 \, ^{\circ}\text{C}$ / $158 \, ^{\circ}\text{F}$ maximum ambient temperature and allowed maximum current and voltage.

DCM1 is compliant with the German calibration law (Eichrecht) and the European MID directive for fiscal metrology. Furthermore, thanks to its high accuracy and resolution, DCM1 is also suited for EV chargers addressed to the US market, where CTEP and cURus approvals are needed. Both imported and exported energy are certified, making DCM1 the perfect solution also for vehicle to grid applications.



High accuracy (class 1 according to EN IEC 62053- 41) permits the installation also in applications with lower maximum current, considering that DCM1 offers 1% accuracy from 12 to 600 A or 5 to 300 A. Cable loss compensation is able to calculate the losses due to the cable resistance from DCM1 to the connection point to measure only the energy actually provided to the car.

Architecture





3

Main functions

- Charging session management and automatic display update (Eichrecht versions)
- · Measure energy and ampere-hour
- · Measure power, voltage and current
- · Measure the load run hours and the total on-time
- Transmit data to controller or other systems through Modbus RTU or Ethernet port
- Signed data transmission using OCMF file according to the S.A.F.E standard and Transparency software (Eichrecht versions)
- Internal temperature monitoring to ensure timely intervention in case of overheating
- · Cable loss compensation

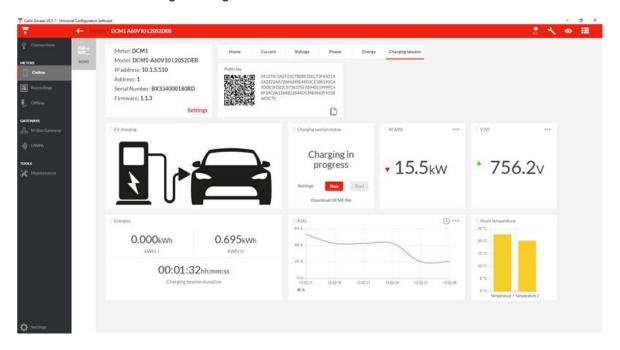
Main features

- Real time variables (V, A, W)
- Quick setup wizard
- · 3 mechanical push buttons
- Data refresh time: ≤ 200 ms both in Modbus RTU and Ethernet port
- · Continuous sampling of voltage and current
- MID certified
- · Eichrecht and CTEP compliant
- cURus approved (UL 61010)
- Class 1 accuracy according to EN IEC 62053-41
- · 128x96 Matrix LCD display with backlight
- 0.0001 kWh resolution via Modbus communication



UCS software

- Free download from Carlo Gavazzi's website
- Configuration through RS485 from PC or trough 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





Installation flexibility

DCM1-T is designed to achieve maximum installation flexibility. Here you can see 3 examples:

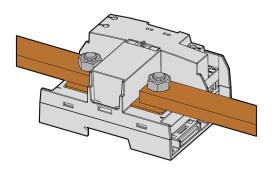


Fig. 1 Bar-bar mounting

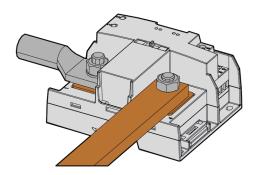


Fig. 2 Horizontal screw-bar mounting

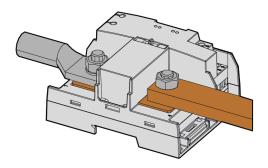


Fig. 3 Vertical screw-bar mounting



Structure DCM1-D

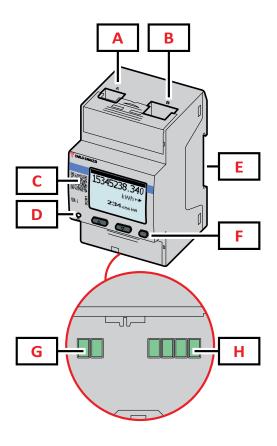
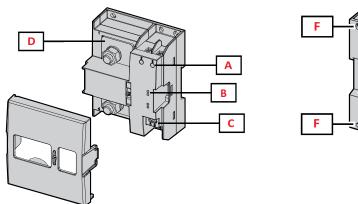


Fig. 4 DCM1-D Display

Area	Description	
Α	DCM1-W cable port	
В	Ethernet port	
С	Display	
D	LED	
E	DIN-rail mounting bracket	
F	Browsing and configuration buttons	
G	Power supply	
Н	RS485 port	



Structure DCM1-T





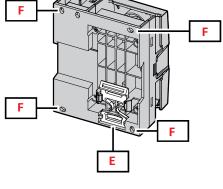


Fig. 6 DCM1-T back

Description	
Voltage inputs	
LEDs	
Power supply from DCM1-D	
Current inputs	
Bracket for DIN rail mounting (optional)	
Holes for back panel mounting by screw terminals (mandatory)	



Structure DCM1-W

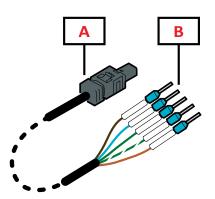
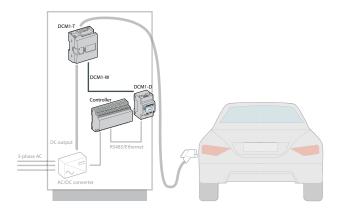


Fig. 7 DCM1-D Front

Area	Description
Α	Connector for DCM1-D
В	Cable lugs connection for DCM1-T (factory pre-wired)



Charging Session management (Eichrecht versions)



DCM1 participates actively during the charging session, in particular:

- Charging session process: DCM1 communicates with the controller during the charging session process to show the relevant information,
- OCMF file generation: DCM1 creates the OCMF file, the controller reads it via Modbus and saves it locally or in the cloud.

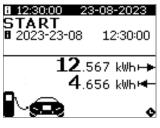
Charging session process

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 DCM1:

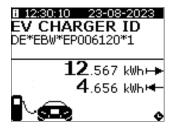
Session start

Controller	DCM1
Sends CLOCK SYNCRONIZATION command to DCM1*	
Writes session parameters	
Sends START command to DCM1	
	Shows on the display the following information, read from
	the controller:
	• START time
	Charger ID
	Transaction ID

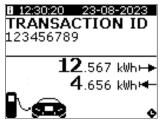
*Note: If synchronized, the DCM1-D clock shows the Local Time during the charging session; the user shall set the clock following the procedure (see Communication Protocol).



START time



Charger ID

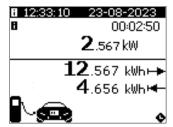


Transaction ID



Session in progress

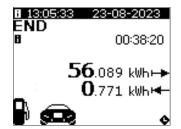
Controller	DCM1
Read real time data (optional)	Show on the display the following information:
Read real time temperature	• Clock
	Duration
	• Power
	• Energy



Charging session in progress information

Session end

Controller	DCM1
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

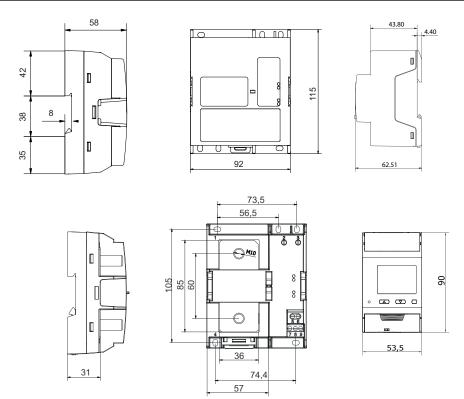
Information	Where to find it
OCMF format	https://github.com/SAFE-eV/OCMF-Open-Charge-Metering-Format/blob/master/OCMF-en.md
Transparency software	https://safe-ev.org/en/transparency-software/e-mobilists/



Features

General

Component	DCM1-T	DCM1-D	
Material	PBT	Housing: PBT	
Material	1 01	Transparent cover: polycarbonate	
UL flammability class	UL-9	94 V0	
Protection degree	Front: IP10	Terminal : IP20	
Protection degree	FIOHE IF TO	Front: IP40	
Protective class	II		
Terminals	Current inputs: cable or lug. Max: 50x10 mm; M10 hole; recommended torque: 20 Nm / 4.43 Ibin; Voltage input: 0.5 to 2.5 mm ² / 13 to 20 AWG, max 0.5 Nm / 4.43 Ibin	Power supply and RS485 port: 0.5 to 2.5 mm ² / 13 to 20 AWG, max 0.5 Nm / 4.43 lbin	
Overvoltage category	Cat. II		
Rated impulse voltage	6 kV		
Pollution degree	2		
Mounting	DIN rail and back panel by screw terminals	DIN Rail	
Weight	1150 g / 2.53 lb (package included)		





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
Max temperature on shunt	DCM1-T: 120 °C / 248 °F
Mechanical environmental condition	M2

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

*Note: All the tests required by CE, cURus, MID, Eichrecht compliance have been performed in the above stated operating temperature range. In addition, communication functionality and measurement accuracy have been tested without anomalies at temperature down to -40°C / -40°F.



Input and output insulation

Туре	Measurement inputs	Power supply	RS485 serial port	Ethernet
Measurement inputs	-	Double/Reinforced	Double/Reinforced	Double/Reinforced
Power supply	Double/Reinforced	-	-	-
RS485 serial port	Double/Reinforced	-	-	-
Ethernet	Double/Reinforced	-	-	-



Compatibility and conformity

European 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 (MID versions) Metrology: EN IEC 62053-41, EN50470-4 (MID versions), REA 6A+PTB 50.7 (Eichrecht versions) SW security: WELMEC 7.2	
Approvals	C E US	



Electrical specifications

Electrical system	
Managed electrical system	DC

Voltage inputs	
Voltage connection	Direct
Rated voltage (Un)	From 150 to 1000 V
Voltage tolerance	From 0.8 to 1.15 Un
Input impedance	3.2 ΜΩ

Current inputs	300 A	600 A
Current connection	Direct	Direct
Base current (I _b)	50 A	120 A
Minimum current (I _{min})	2.5 A	6 A
Threshold current (I _{tr})	5 A	12 A
Maximum current (I _{max})	300 A	600 A
Start-up current (I _{st})	0.2 A	0.48 A
Input impedance	0.05 mΩ	0.025 mΩ

Power supply

Туре	Auxiliary power supply
Consumption	1.3 W
Power supply range (V)	From 12 to 24 V dc ±20%

Measurements

Method	Average
Energy update rate	200 ms



Available measurements

Active energy	Unit	Communication	Display
Imported (+) Total	kWh+	•	•
Imported (+) partial	kWh+	•	-
Exported (-) Total	kWh-	•	•
Exported (-) partial	kWh-	•	-

Ampere-hour	Unit	Communication	Display
Imported (+) Total	Ah+	•	•
Imported (+) partial	Ah+	•	-
Exported (-) Total	Ah-	•	•
Exported (-) partial	Ah-	•	-

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

Electrical variable	Unit
Voltage	V
Current	A
Active power	W

Shunt temperature	Unit
Upstream	°C
Downstream	°C

Charging session measurements (Eichrecht versions)

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





Energy metering

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

Easy connection

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

Bidirectional

Bidirectional: voltage, current, and power are measured using the proper sign. The positive or the negative energy increases according to the power sign.

Measurement accuracy

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

Voltage	
From Un min -20% to Un max +15%	± 0.5% rdg

Power		
From I _{tr} to I _{max} A	± 1% rdg	
From I _{min} to I _{tr} A	± 1.5% rdg	

Energy		
Class	Class 1 according to EN IEC 62053-41	
	Class B according to EN 50470-4 (MID)	



Display

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



Display icons

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

Symbol	Description		
24	Current overrange, the measured value is still displayed		
V٠	Voltage overrange, the measured value is still displayed		
	Temperature on the shunt overrange		
+	Communication: reading or writing command is addressed to DCM1		
•	Clock synchronized		
	Internal failure		

Measurement resolution

Variable	Resolution by serial communication	Display resolution
Energy	0.0001 kWh	0.001 kWh
Ampere-hour 0.001 Ah 0.001 A		0.001 Ah
Power	0.001 kW	0.001 kW
Current	0.001 A	0.001 A
Voltage 0.1 V		0.1 V
Run-hour meter	0.01 h	1 m
Shunt temperature	0.1 °C	0.1 °C



LED

	DCM1-T	DCM1-D
Function	Green colour, power on and communication; Amber colour, warning overrange (temperature, current, voltage) or fatal error	Red colour, proportional to energy con- sumption or energy export, according to the selected Display page (see user manual)
Constant	-	1000 pulse/kWh



Symbols

The table reports the symbols that can appear on the device and in the related documents.

Symbol	Description		
A	Dangerous voltage		
\wedge	Danger, live parts		
A	Caution		
•	Provides essential information on completing the task that should not be neglected		
Ţ <u>i</u>	Manual symbol		
0	Safety sign notice		
	The product is not to be discarded with normal household waste		
	Single 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 (1-247) Baud rate (9.6/19.2/38.4/115.2 kbps) Parity (None/ Even)	
Refresh time	≤ 200 ms	
Configuration mode	Via keypad or UCS software	

Ethernet port

Protocol	Modbus TCP/IP		
Devices on the same bus	Maximum 5 TCP connections simultaneously		
Connection type	RJ45 connector (10 Base-T, 100 Base-TX)		
	maximum distance 100 m		
	IP address		
Configuration	Subnet mask		
Configuration	Gateway		
parameters	TCP/IP port		
	DHCP enabling		
Refresh time	≤ 200 ms		
Configuration mode	Via keypad or UCS software		



Connection Diagrams

Voltage and current

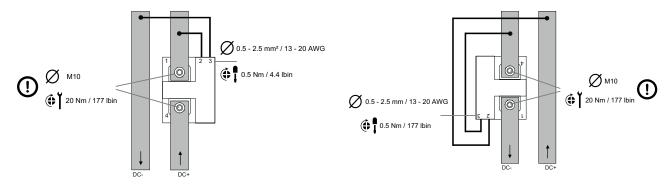


Fig. 8 Current (option A) and voltage inputs

Fig. 9 Current (option B) and voltage inputs

Communication and power supply

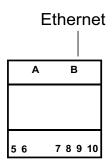


Fig. 10 Ethernet

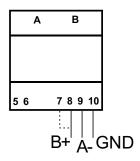


Fig. 11 RS485 terminalization. Last device on RS485

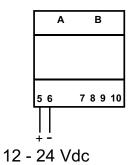
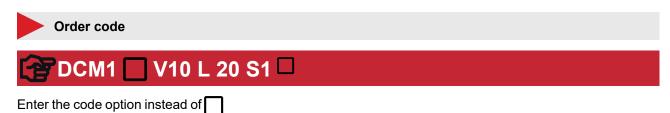


Fig. 12 Power supply



References



Code	Options	Description	
DCM1	-	Model	
	A30	Max current: 300 A	
	A60	Max current: 600 A	
V10	-	Max voltage: 1000 V	
L	-	Power supply: 12-24 V dc	
20	-	200 cm cable length	
S1	-	Ethernet Modbus TCP + RS485 Modbus RTU (no signature)	
	ULB	cURus + CTEP compliance (Bidirectional)	
	PFA	cURus + CTEP compliance + MID	
	PFB	cURus + CTEP compliance + MID	

Enter the code option instead of

Code	Options	Description	
DCM1	-	Model	
	A30	Max current: 300 A	
	A60	Max current: 600 A	
V10	-	Max voltage: 1000 V	
L	-	Power supply: 12-24 V dc	
20	-	200 cm cable length	
	S2	Ethernet Modbus TCP + RS485 Modbus RTU (256-bit signature)	
	S3	Ethernet Modbus TCP + RS485 Modbus RTU (384-bit signature)	
DEB	-	cURus + CTEP compliance + MID + Eichrecht (Bidirectional)	



CARLO GAVAZZI compatible components

Purpose	Component name/code key	Notes
Configure analyzer 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



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<u>DCM1A30V10L20S1PFA</u> <u>DCM1A30V10L20S2DEB</u> <u>DCM1A30V10L20S3DEB</u> <u>DCM1A30V10L20S1ULB</u> <u>DCM1A30V10L20S1PFB</u> <u>DCM1A60V10L20S2DEB</u> <u>DCM1A60V10L20S1PFB</u> <u>DCM1A60V10L20S1PFA</u> <u>DCM1A60V10L20S3DEB</u> <u>DCM1A60V10L20S1ULB</u>