

Direct Current Billing Meter - DCBM 400/600 Series

Ref: DCBM 400, DCBM 600

DCBM 400/600 series is a direct connected energy meter dedicated to DC applications. Split concept, range of operating currents and operating temperatures offered by DCBM 400/600 series ease integration and meet the specific constraints of electric vehicle charging systems. DCBM 400/600 series offers power loss compensation system and 4-wire connection possibilities to measure energy as close as possible to the electric vehicle. The product also offers OCMF format compliant with S.A.F.E verification software and HTTP communication with a full set of APIs for quick start-up and easy integration.



CE RoHS



Features

- Split concept for easy integration
- Range of operation 150 ... 1000 V DC
- Two sizes: I_{max} 400 A and I_{max} 600 A
- Wide current terminals, compliant with busbars
- Bi-directional energy metering (V2G)
- Accuracy Class B, -40°C to $+85^{\circ}\text{C}$
- Compliant with 4-wire measurement
- Cable loss compensation
- Ethernet communication with HTTP/HTTPS
- Signed data readouts in OCMF or LEM format
- Monitoring of current / voltage / temperature / energy
- Integrated display with backlight
- Transaction handling with start & stop tags, user data fields and authentication
- Auxiliary power supply range $+12 \dots +48$ V DC
- DIN rail 35 mm and screw mounting
- Length of Datalink cable from 30 cm up to 3.5 m
- Reinforced insulation at 1000 V DC, U_{imp} 8 kV
- Sealing of terminals and interfaces .

Advantages

- Easy integration into systems
- Flexible integration with busbars or cables
- OCMF readouts compliant with S.A.F.E
- Compliant for energy billing or parking time billing
- System monitoring.

Applications

- Electric Vehicle Charging infrastructures
- Data centers
- DC grids & Energy Monitoring
- Energy storage, renewables.

Standards

- EN 50470-1: 2006
- EN 50470-3: 2006
- PTB-A 50.7
- PTB-A 20.1
- CISPR32 Class-B emission
- IEC 62052-11: 2003
- IEC 61000-6-2: 2016
- IEC 61000-6-3: 2016
- UL94-V0.

Application Domain

- Industrial
- Renewable energies.

97.W1.48.000.0; 97.W1.48.001.0; 97.W1.48.002.0; 97.W1.48.003.0; 97.W1.48.004.0; 97.W1.48.005.0; 97.W1.48.006.0; 97.W1.48.007.0; 97.W1.48.008.0; 97.W1.48.009.0; 97.W1.48.010.0; 97.W1.48.011.0; 97.W1.48.012.0; 97.W1.48.013.0; 97.W1.48.014.0; 97.W1.48.015.0; 97.W1.48.016.0; 97.W1.48.017.0; 97.W1.48.018.0; 97.W1.48.019.0; 97.W1.48.020.0; 97.W1.52.000.0; 97.W1.52.001.0; 97.W1.52.002.0; 97.W1.52.003.0; 97.W1.52.004.0; 97.W1.52.005.0; 97.W1.52.006.0; 97.W1.52.007.0; 97.W1.52.008.0; 97.W1.52.009.0; 97.W1.52.010.0; 97.W1.52.011.0; 97.W1.52.012.0; 97.W1.52.013.0; 97.W1.52.014.0; 97.W1.52.015.0; 97.W1.52.016.0; 97.W1.52.017.0; 97.W1.52.018.0; 97.W1.52.019.0; 97.W1.52.020.0

Safety



Caution

In order to guarantee safe operation of the product and to be able to make proper use of all features and functions, please read these instructions thoroughly!

Safe operation can only be guaranteed if the product is used for the purpose it has been designed for and within the limits of the technical specifications.

Ensure you get up-to-date technical information that can be found in the latest associated datasheet under www.lem.com. The used data link cable between product's elements shall be the one delivered by LEM.

Time source to set product's time must be provided by the customer. Product must be time synchronized to operate. Product's Ethernet interface mustn't be exposed to a public network; network must be private and secured.

To ensure proper operation, product's logbook completion must be checked periodically; the maximum number of entries is 40000; product's operation stops if logbook is full.

The meter must be installed in an enclosure IP51 (indoor) or IP54 (outdoor) according to EN 50470-1: 2006.



Caution, risk of electrical shock

Electrical equipment should be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by LEM International SA for any consequences arising out of the use of this material. A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

When installing or changing the product, the conductor to which the product is connected must be de-energized. Ignoring the warnings can lead to serious injury and/or cause damage!

The appropriate torque as defined by the manufacturer shall be applied on product's terminals.

Product overview



- A** Sensor Unit
- B** 2 Nuts with captive washer
- C** Protection Cover
- D** Meter Unit
- E** Data link cable
- F** Ferrite

Operating conditions

Sensor Unit

| Parameter | Symbol | Unit | Min | Typ | Max | Comment |
|--|-------------|------|-----|------|-------------------|---|
| Ambient operating temperature | T_A | °C | -40 | | +85 ¹⁾ | |
| Ambient storage temperature | $T_{A\ st}$ | °C | -40 | | +85 | |
| Relative humidity | RH | % | | | 95 | |
| Mass | m | g | | | 300 415 | DCBM 400 series DCBM 600 series |
| Impact rating | | | | IK05 | | According to IEC 62262, with protection cover mounted |
| Ingress protection rating | | | | IP10 | | On current terminals |
| Maximum temperature of current terminals | | °C | | | 110 | |

Note: ¹⁾ In any case, maximum temperature of current terminals must not be exceeded.

Meter Unit

| Parameter | Symbol | Unit | Min | Typ | Max | Comment |
|-------------------------------|-------------|------|-----|------|-----|--|
| Ambient operating temperature | T_A | °C | -25 | | +70 | Display operation & readability may be limited below minimum operating temperature |
| Ambient storage temperature | $T_{A\ st}$ | °C | -40 | | +85 | |
| Relative humidity | RH | % | | | 95 | |
| Mass | m | g | | | 200 | |
| Impact rating | | | | IK05 | | According to IEC 62262 |
| Ingress protection rating | | | | IP20 | | According to IEC 60664-1 |

Data link cable

| Parameter | Symbol | Unit | Min | Typ | Max | Comment |
|-------------------------------|--------|------|-----|-----|------|--|
| Ambient operating temperature | T_A | °C | -50 | | +120 | |
| Test insulation voltage | | kV | | 3.5 | | |
| Length | | m | 0.3 | | 3.5 | See product designation for complete product reference |

Insulation coordination

| Parameter | Symbol | Unit | Value | Comment |
|--|----------|------|---------------|---|
| Pollution degree | | PD | 2 | |
| Rated altitude | | m | 2000 | |
| Rated insulation voltage | | V DC | 1000 | |
| Case material | | | V0 | According to UL 94 |
| Insulation between live parts and accessible parts | | | Reinforced II | Insulation is provided by the Sensor Unit. The Meter Unit operates in safety extra low voltage. |
| - Insulation type | | | | |
| - Overvoltage category | | | | |
| - Impulse withstand voltage | U_{Ni} | kV | 8 | |
| - RMS voltage for AC insulation test | U_d | V | 4400 | 100 % tested in production |
| Insulation between voltage terminals | | | Basic 4 | Insulation between VP and VN |
| - Insulation type | | | | |
| - Impulse withstand voltage | U_{Ni} | kV | 4 | |
| - RMS voltage for AC insulation test | U_d | V | 2200 | |

General electrical specifications

Sensor Unit

| Parameter | Symbol | Unit | DCBM 400 | DCBM 600 | Comment |
|------------------------------------|-------------------|------|--------------------|----------|--------------|
| Rated conventional thermal current | | A | 400 | 600 | |
| Rated operational voltage | | V | 1000 | | |
| Rated duty | | | Uninterrupted duty | | |
| Insertion loss in current path | | W | 10 | 10 | |
| Power consumption in voltage path | | W | 0.13 | | At 1000 V DC |
| Rated withstand peak current | $\hat{I}_{P\max}$ | kA | 12 | 18 | 10 ms |

Meter Unit

| Parameter | Symbol | Unit | Min | Typ | Max | Comment |
|--|--------|------|-----|-----|-----|------------|
| Supply voltage | | V DC | +12 | | +48 | ±5 % |
| Supply current | | mA | | | 400 | @ +12 V DC |
| Supply bridging time | | s | 0.3 | 0.5 | | |
| Start-up time ¹⁾ | | s | | | 10 | @ +24 V DC |
| Energy reserve charging time ²⁾ | | min | 2 | | | |

Notes: ¹⁾ Start-up time is the wait to get communication functionality over the HTTP interface after power is restored.

²⁾ Energy reserve charging time is the wait to get supply bridging capabilities. Power supply must be stable during this period. Product must be powered-up at nominal voltage during this time before starting a transaction. It is further recommended not to switch on the product for less than the Energy reserve charging time.

RAMS data

| Parameter | Symbol | Unit | DCBM 400 | DCBM 600 | Comment |
|-------------------|-----------------|-----------------|----------|----------|--|
| Mean failure rate | $\bar{\lambda}$ | h ⁻¹ | 1/537000 | 1/476000 | DCBM 400: 150 kW application, 1000 V DC, warm climate, 8760 power cycles per year. DCBM 600: 350 kW application, 1000 V DC, warm climate, 17520 power cycles per year |

Energy measurement and accuracy

| Parameter | Symbol | Unit | DCBM 400 | DCBM 600 | Comment |
|--|-----------|---------|------------------------|----------|---|
| Accuracy class | | | B | | According to EN 50470-3: 2006 and EN 50470-1: 2006 |
| Meter type | | | Direct connected meter | | |
| Energy measurement bandwidth | | | DC | | |
| Current specification | | | | | |
| - Starting current | I_{st} | mA | 320 | 480 | |
| - Minimum current | I_{min} | A | 4 | 6 | |
| - Transitional current | I_{tr} | A | 8 | 12 | |
| - Reference current | I_{ref} | A | 80 | 120 | |
| - Maximum current | I_{max} | A | 400 | 600 | |
| Voltage specification | | | | | |
| - Reference voltage | U_{ref} | V DC | 150 ... 1000 | | |
| - Maximum limit range of operation | U_{max} | V DC | 1100 | | |
| - Minimum limit range of operation ¹⁾ | U_{min} | V DC | 135 | | |
| Cable loss compensation ²⁾ | | mΩ | 0-14 | | By steps of 2 mΩ, imported energy only. Selectable by charging station or fix value (see product designation) |
| Test Output LED ³⁾ | | Imp/kWh | 1000 | | |
| Counting direction | | | Bidirectional | | Imported and exported energy registers |

Notes: ¹⁾ Creep mode is enabled if DC bus voltages goes below 110 V DC.

²⁾ Depending on product reference, fix or dynamic cable loss compensation is available, refer to product's name and codification to select cable loss compensation type. With dynamic compensation, the value is selected between 0-14 mΩ (by step of 2 mΩ) at start of transaction. With fix compensation, the value is locked to the fix value. Cable loss compensation is enabled only during a transaction (between start and stop tags), outside of a transaction no compensation is applied.

³⁾ After reboot, the test output LED is lit as long as the creep mode conditions are met.

Connection and terminals

Sensor Unit

| Parameter | Unit | DCBM 400 | DCBM 600 | Comment |
|---|-----------------|--|----------|---------|
| Current terminals | | Stud Tin plated | | |
| - Type | | M8 | M12 | |
| - Terminal finish | | 2 × 70 | 2 × 150 | |
| - Size | | 20 × 8 | 30 × 10 | |
| - Rated cross section (cable) ¹⁾ | mm ² | 10 | 36 | |
| - Rated cross section (busbar) | mm | 25 | 50 | |
| - Minimum tightening torque | N·m | | | |
| - Maximum tightening torque | N·m | | | |
| Voltage measurement terminals | | Screwless spring type 0.25 - 2.5 mm ² without ferrule 0.25 - 1.5 mm ² with ferrule | | |
| - Type | | | | |
| - Rated cross section | | | | |

Meter Unit

| Parameter | Value | Comment |
|-----------------------------|----------------------------|---------|
| Ethernet interface | RJ45 | |
| Power supply terminal | | |
| - Type | Screw terminal | |
| - Rated cross section | 0.13 - 1.5 mm ² | |
| - Maximum tightening torque | 0.6 N·m | |

Interfaces and communication

| Parameter | Value | Comment |
|-------------------------------|--|--|
| Display technology | LCD with backlight | |
| Display navigation | 2 × Push buttons | |
| Ethernet interface | HTTP / HTTPS | APIs list: - /setting - /status - /legal - /ocmf - /logbook - /livemeasure |
| IP settings | Fix IP / DHCP | |
| System monitoring | Current / Voltage / Temperature / Power / Energy | Monitoring with "/livemeasure" API, at 1 Hz refresh rate |
| Readout data format | LEM format / OCMF | OCMF format compliant with S.A.F.E. transparency software |
| Data authenticity | Asymmetric cryptography with public key | Signature on "/legal", "/ocmf", "/logbook" APIs. Public key available from "/setting" API and laser marked on Meter Unit |
| Number of transactions stored | 20399 | Roll out of memory when maximum number of transactions is reached |
| Logbook entries | 40000 | New transactions are blocked when logbook is full |
| Time synchronization | SNTP / from API | Time synchronization with SNTP service, or set with the "/setting" API |
| Transaction identification | Start / Stop commands | Charging session identifiers and 128 bytes user data field in "/legal" API |
| Transaction status LED | Active during transaction | |

Definition of typical, minimum and maximum values

Minimum and maximum values for specified limiting and safety conditions have to be understood as such as well as values shown in "typical" graphs.

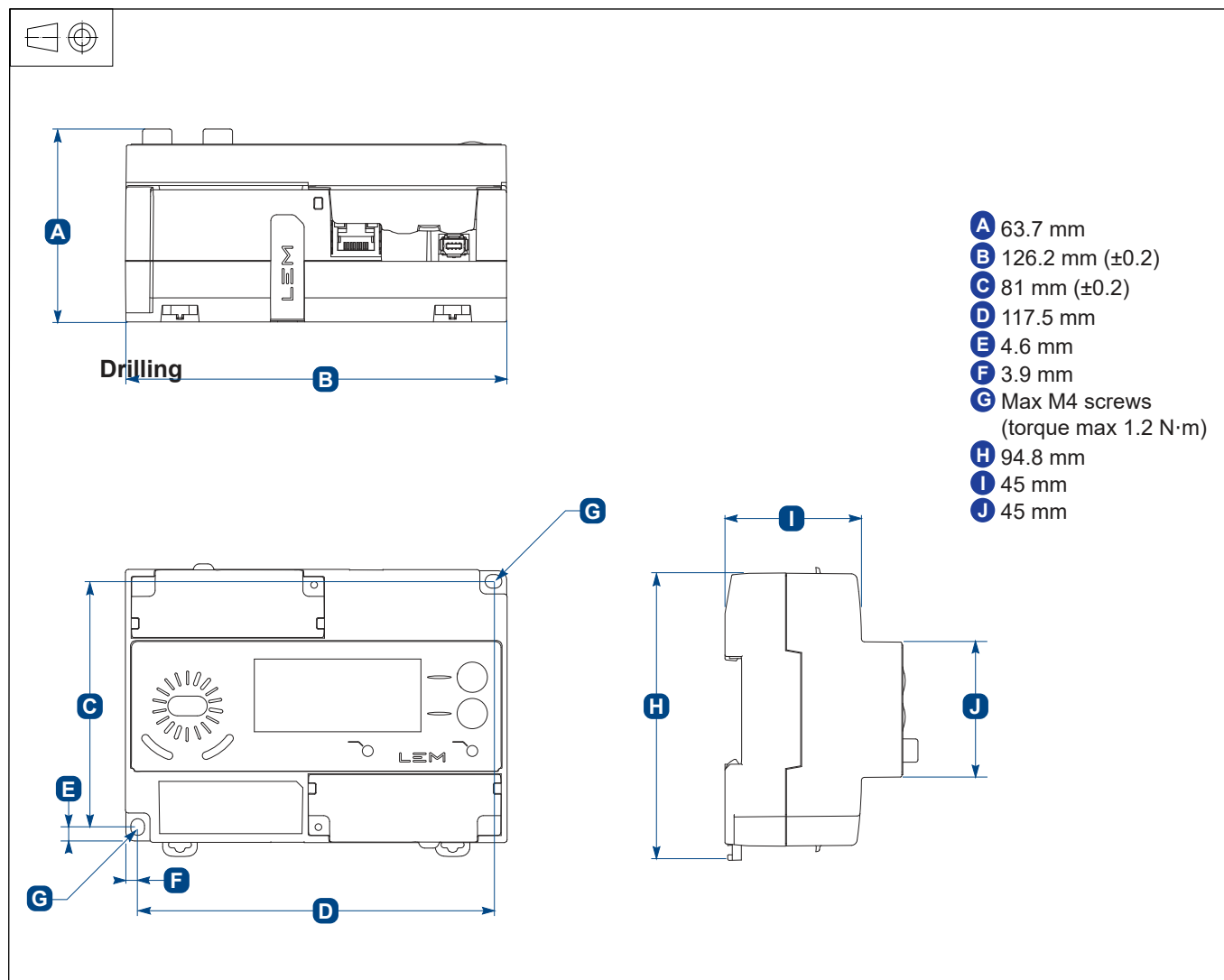
On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval.

Unless otherwise stated (e.g. "100 % tested"), the LEM definition for such intervals designated with "min" and "max" is that the probability for values of samples to lie in this interval is 99.73 %.

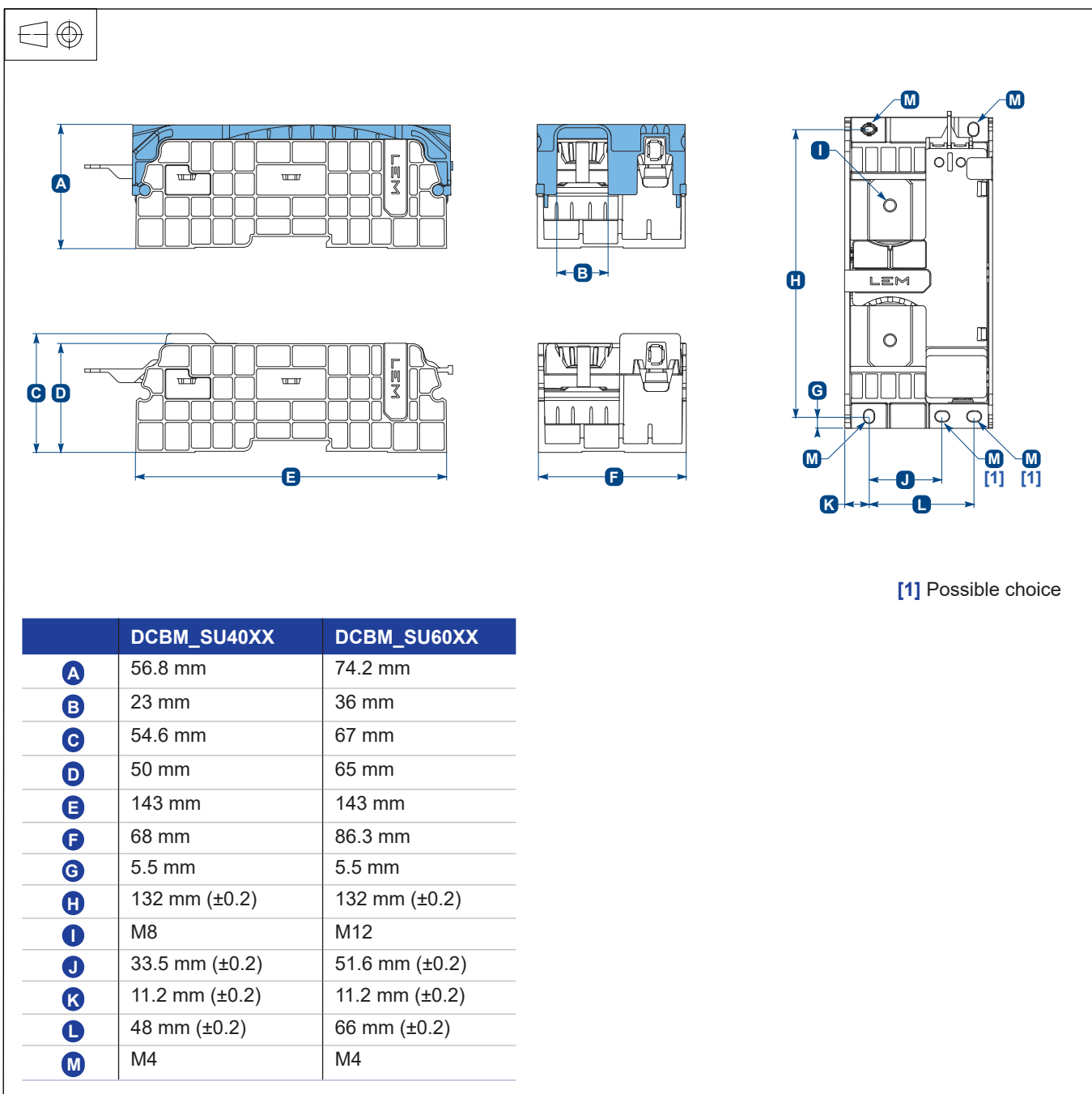
For a normal (Gaussian) distribution, this corresponds to an interval between -3σ and $+3\sigma$. If "typical" values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between $-\sigma$ and $+\sigma$ for a normal distribution.

Typical, maximal and minimal values are determined during the initial characterization of the product.

Meter Unit dimensions



Sensor Unit dimensions (in mm)



Description and Codification

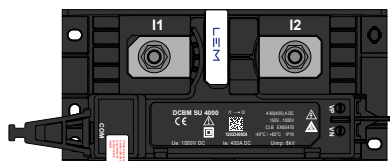
The full codification includes a DC Meter and a data link cable.

For example, DCBM_N0D_4010C20_0000C00 codification includes the following elements:

- A DC Meter reference DCBM_N0D_4010_0000
- A data link cable of length 2.0 m

| | D | C | B | M | _ | N | 0 | D | _ | 4 | 0 | 0 | 0 | C | 2 | 0 | _ | 0 | 0 | 0 | C | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Meter family DCBM: Direct Current Billing Meter | | | | | | | | | | | | | | | | | | | | | | | |
| Time source N: Info time with NTP or API | | | | | | | | | | | | | | | | | | | | | | | |
| Cable loss compensation 0: Dynamic 0 - 14 mΩ (2 mΩ steps) 1: No compensation 2: Fix compensation - 2 mΩ 3: Fix compensation - 4 mΩ 4: Fix compensation - 6 mΩ | | | | | | | | | | | | | | | | | | | | | | | |
| Certification 0: Without certification D: Without conformity certificate | | | | | | | | | | | | | | | | | | | | | | | |
| Current range 40: 400 A version 60: 600 A version ¹⁾ | | | | | | | | | | | | | | | | | | | | | | | |
| Counting direction 00: direct (I1 -> I2) 10: reverse (I2 -> I1) | | | | | | | | | | | | | | | | | | | | | | | |
| Datalink Cable Length C35: 3.5 m C30: 3.0 m C25: 2.5 m C20: 2.0 m C15: 1.5 m C03: 0.3 m (only for DCBM 400 Series) | | | | | | | | | | | | | | | | | | | | | | | |
| Reserved field 1 0000C00: default | | | | | | | | | | | | | | | | | | | | | | | |

Note: ¹⁾ Current flow direction for imported energy registration. For example, DCBM_N0D_4000C20_0000C00 registers imported energy when current flows from I1 terminal to I2 terminal. Below figure shows identification of the terminals.



Below table summarizes the codifications for generic products.

For other references, minimum quantities apply, please contact your local LEM support.

| Codification |
|--------------------------|
| DCBM_N00_4000C20_0000C00 |
| DCBM_N00_4010C20_0000C00 |
| DCBM_N0D_4000C20_0000C00 |
| DCBM_N0D_4010C20_0000C00 |
| DCBM_N00_6000C20_0000C00 |
| DCBM_N00_6010C20_0000C00 |
| DCBM_N0D_6000C20_0000C00 |
| DCBM_N0D_6010C20_0000C00 |