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. The partitioned concept, operating currents and operating temperature range offered by DCBM 400/600 series ease integration, meet the specific constraints of electric vehicle charging systems and meet legal metrology requirements. 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.

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 °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 ... +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_{Ni} 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
- PTB, MID, LNE approved, UL recognized.

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
- Directive 2014/32/EU (MID)
- Regulation n° 22.00.570.001.1 (France)
- IEC 62052-11: 2003
- IEC 61000-6-2: 2016
- IEC 61000-6-3: 2016
- UL FTRZ 2/8
- UL94-V0
- UL 61010-1: May 11, 2012: 2019.
- UL 61010-2-030:2018
- CAN/CSA-CSA C22.2: 2018.

Application Domains

- Industrial
- Renewable energies.

List of CLEM products'numbers: see pages 12, 13

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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.

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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

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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	U_{Nm}	V DC	1000	
Case material			V0	According to UL 94
Insulation between live parts and accessible parts				
- Insulation type			Reinforced	Insulation is provided by the Sensor Unit. The Meter Unit operates in safety extra low voltage.
- Overvoltage category			II	
- 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				
- Insulation type			Basic	Insulation between VP and VN
- Impulse withstand voltage	U_{Ni}	kV	4	
- RMS voltage for AC insulation test	U_d	V	2200	

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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	At rated conventional thermal current
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	U_C	V DC	+12		+48	±5 %
Supply current	I_C	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 inerface 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	$\overline{\lambda}$	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

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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 bandwith			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 desigation)
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.

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Connection and terminals

Sensor Unit

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

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	

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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
Energy registering resolution	1 Wh 0.1 Wh	DCBM_NxD and DCBM_NxM DCBM_N00
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	Asymetric 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	> 16000 > 20000	DCBM_NxD and DCBM_NxM DCBM_N00 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 −3 sigma 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.

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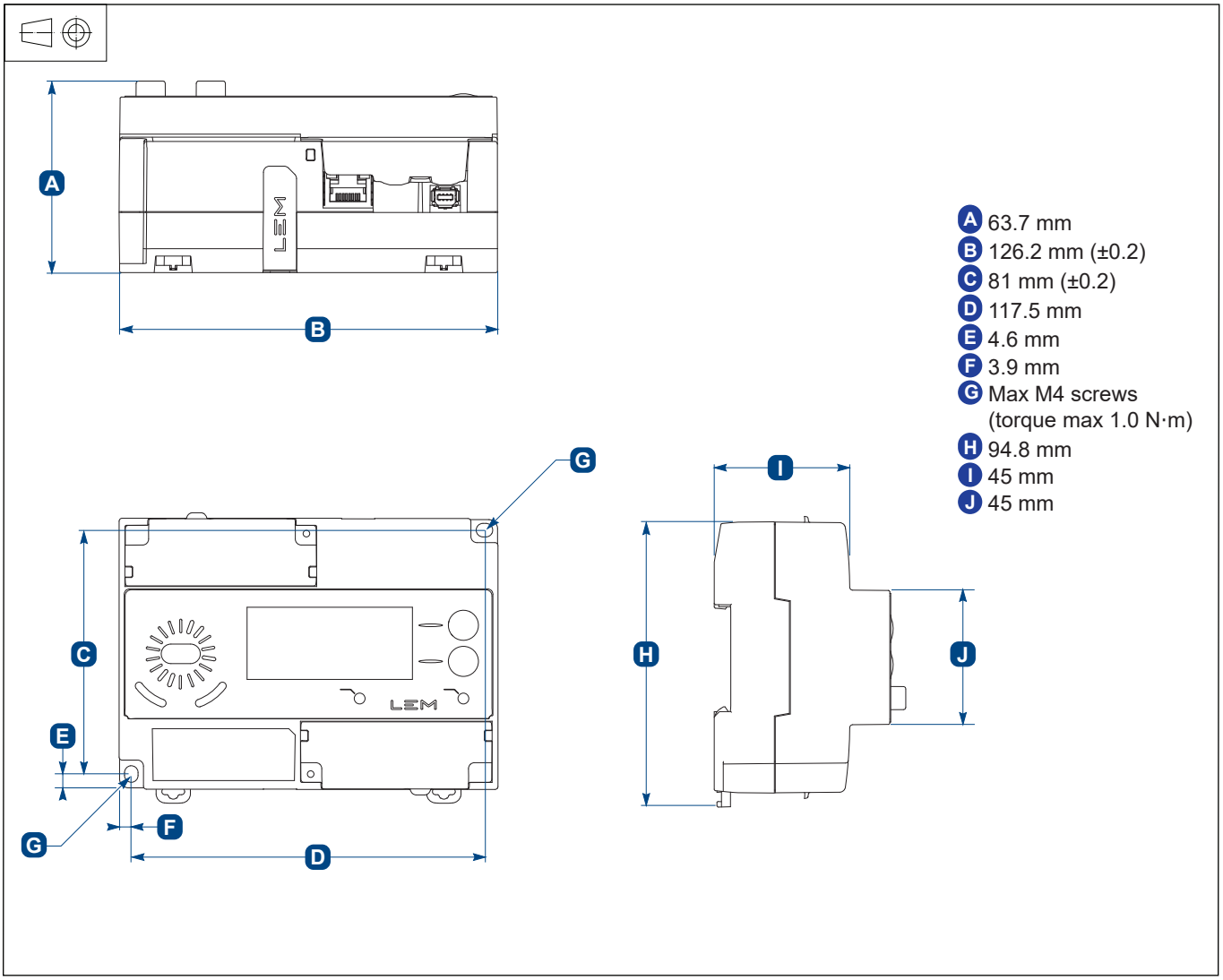
Meter Unit dimensions



A 63.7 mm
B 126.2 mm (±0.2)
C 81 mm (±0.2)
D 117.5 mm
E 4.6 mm
F 3.9 mm
G Max M4 screws (torque max 1.0 N·m)
H 94.8 mm
I 45 mm
J 45 mm

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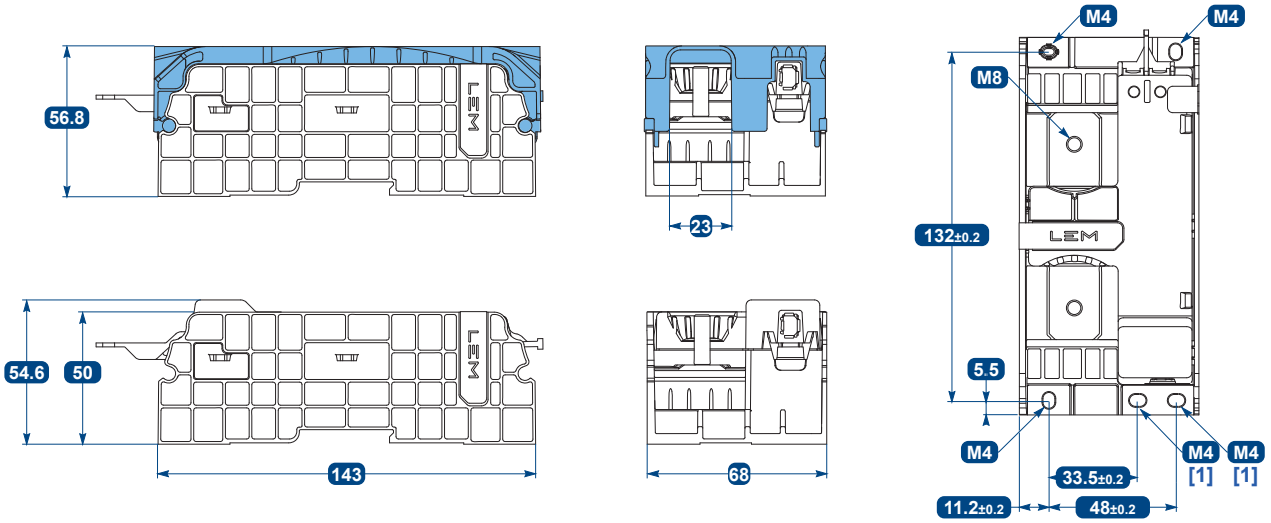
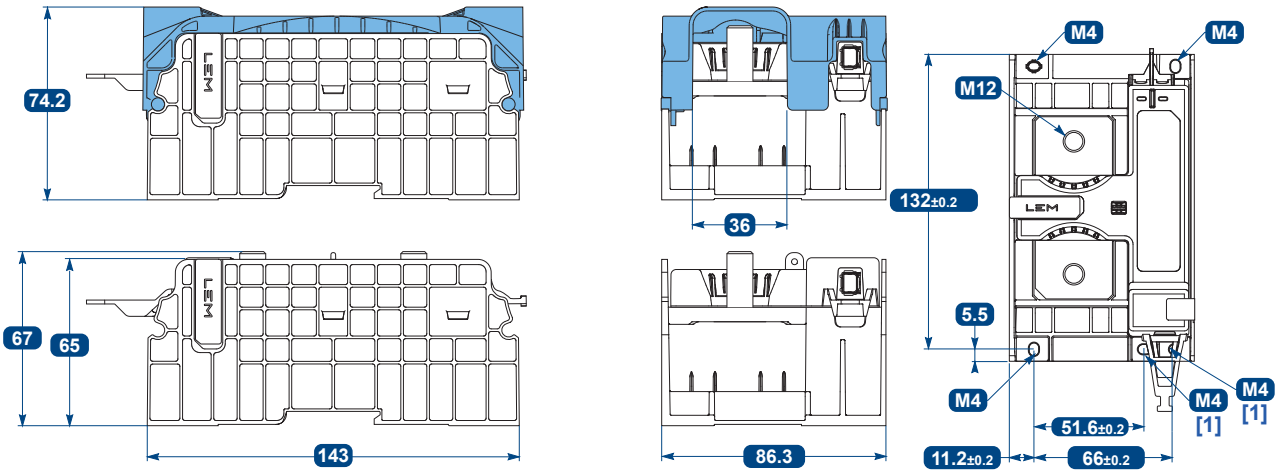
Sensor Unit dimensions (in mm)

DCBM 400



DCBM 600



[1] Possible choice

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Description and Codification

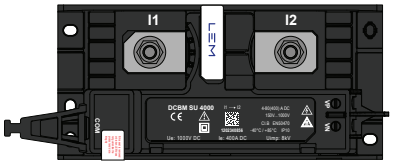
The full codification includes a DC Meter and a data link cable.
For example, DCBM_N0M_4000C20_0000C00 codification includes the following elements:

- A DC Meter reference DCBM_N0M_4000_0000
- A data link cable of length 2.0 m

	D	C	B	M	_	N	0	M	_	4	0	0	0	C	2	0	_	0	0	0	0	C	0	0
Meter family DCBM: Direct Current Billing Meter	■	■	■	■																				
Time Source N: Time synchronization 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: CE Marking CE Marking (Generic product for EU market, without legal metrology certification) + UL recognized D: MessEV (German national certification) M: Legal metrology (EU) certification								■																
Current Range 40: 400 A 60: 600 A 0 / 1: Direct I1 → I2 or reverse I1 → I2 0: Reserved										■	■	■	■											
Delivery Option A / B: SP Product (VW) C: Cable														■										
Cable length 00: Without cable or accessory 03: 0.3 m (only for DCBM 400) 15: 1.5 m 20: 2 m 25: 2.5 m 30: 3 m 35: 3.5 m															■	■								
Series 0000: Serie 1																		■	■	■	■			
Reserved field C: Reserved																						■		
Reserved field 00: Reserved																							■	■

Note: [1] Current flow direction for imported energy registration. For example, DCBM_N0M_4000C20_0000C00 registers imported energy when current flows from I1 terminal to I2 terminal.

Below figure shows identification of the terminals:



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CLEM products'numbers (DCBM 400)

Below tables summarize the codifications for products.
For other references, minimum quantities apply, please contact your local LEM support.

CLEM N°	Product name
90.W1.48.000.0	DCBM_N0D_4000C20_0000C00
90.W1.48.001.0	DCBM_N0D_4010C20_0000C00
90.W1.48.002.0	DCBM_N0D_4000C03_0000C00
90.W1.48.003.0	DCBM_N0D_4000C15_0000C00
90.W1.48.004.0	DCBM_N0D_4010C03_0000C00
90.W1.48.005.0	DCBM_N0D_4010C15_0000C00
90.W1.48.006.0	DCBM_N0D_4000C35_0000C00
90.W1.48.007.0	DCBM_N1D_4000C20_0000C00
90.W1.48.008.0	DCBM_N2D_4000C20_0000C00
90.W1.48.009.0	DCBM_N3D_4000C20_0000C00
90.W1.48.010.0	DCBM_N4D_4000C20_0000C00
90.W1.48.011.0	DCBM_N1D_4010C20_0000C00
90.W1.48.012.0	DCBM_N2D_4010C20_0000C00
90.W1.48.013.0	DCBM_N3D_4010C20_0000C00
90.W1.48.014.0	DCBM_N4D_4010C20_0000C00
90.W1.48.015.0	DCBM_N1D_4010C03_0000C00
90.W1.48.016.0	DCBM_N00_4000C35_0000C00
90.W1.48.017.0	DCBM_N00_4000C20_0000C00
90.W1.48.018.0	DCBM_N4D_4000C15_0000C00
90.W1.48.019.0	DCBM_N00_4010C20_0000C00
90.W1.48.020.0	DCBM_N2D_4000A20_0000C00
90.W1.48.021.0	DCBM_N2D_4000C15_0000C00
90.W1.48.022.0	DCBM_N1D_4000A20_0000C00
90.W1.48.023.0	DCBM_N1D_4000B20_0000C00
90.W1.48.024.0	DCBM_N3D_4000C35_0000C00
90.W1.48.025.0	DCBM_N3D_4000C25_0000C00
90.W1.48.026.0	DCBM_N1D_4000C35_0000C00
90.W1.48.027.0	DCBM_N0D_4010C35_0000C00
90.W1.48.028.0	DCBM_N1D_4000C15_0000C00
90.W1.48.029.0	DCBM_N3D_4010C15_0000C00
90.W1.48.030.0	DCBM_N00_4010C30_0000C00
90.W1.48.031.0	DCBM_N20_4010C15_0000C00

CLEM N°	Product name
90.W1.48.200.0	DCBM_N0M_4010C20_0000C00
90.W1.48.201.0	DCBM_N1M_4000A20_0000C00
90.W1.48.202.0	DCBM_N1M_4000B20_0000C00
90.W1.48.203.0	DCBM_N3M_4000C20_0000C00
90.W1.48.204.0	DCBM_N0M_4000C20_0000C00
90.W1.48.205.0	DCBM_N2M_4000C20_0000C00
90.W1.48.206.0	DCBM_N2M_4010C20_0000C00
90.W1.48.207.0	DCBM_N3M_4000C35_0000C00
90.W1.48.208.0	DCBM_N4M_4000C20_0000C00
90.W1.48.209.0	DCBM_N3M_4010C15_0000C00
90.W1.48.210.0	DCBM_N3M_4010C20_0000C00
90.W1.48.211.0	DCBM_N1M_4000C35_0000C00
90.W1.48.212.0	DCBM_N2M_4010C25_0000C00
90.W1.48.213.0	DCBM_N3M_4010C25_0000C00
90.W1.48.214.0	DCBM_N1M_4000C15_0000C00
90.W1.48.215.0	DCBM_N4M_4000C03_0000C00
90.W1.48.216.0	DCBM_N1M_4000C20_0000C00
90.W1.48.217.0	DCBM_N2M_4010C15_0000C00
90.W1.48.218.0	DCBM_N0M_4000C35_0000C00

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CLEM products'numbers (DCBM 600)

Below tables summarize the codifications for products.
For other references, minimum quantities apply, please contact your local LEM support.

CLEM N°	Product name
90.W1.52.000.0	DCBM_N0D_6000C20_0000C00
90.W1.52.001.0	DCBM_N0D_6010C20_0000C00
90.W1.52.002.0	DCBM_N0D_6000C15_0000C00
90.W1.52.003.0	DCBM_N0D_6010C15_0000C00
90.W1.52.004.0	DCBM_N0D_6000C25_0000C00
90.W1.52.005.0	DCBM_N1D_6000C20_0000C00
90.W1.52.006.0	DCBM_N2D_6000C20_0000C00
90.W1.52.007.0	DCBM_N3D_6000C20_0000C00
90.W1.52.008.0	DCBM_N4D_6000C20_0000C00
90.W1.52.009.0	DCBM_N1D_6010C20_0000C00
90.W1.52.010.0	DCBM_N2D_6010C20_0000C00
90.W1.52.011.0	DCBM_N3D_6010C20_0000C00
90.W1.52.012.0	DCBM_N4D_6010C20_0000C00
90.W1.52.013.0	DCBM_N1D_6000C15_0000C00
90.W1.52.014.0	DCBM_N00_6000C25_0000C00
90.W1.52.015.0	DCBM_N00_6000C35_0000C00
90.W1.52.016.0	DCBM_N0D_6000C35_0000C00
90.W1.52.017.0	DCBM_N3D_6010C25_0000C00
90.W1.52.018.0	DCBM_N00_6000C20_0000C00
90.W1.52.019.0	DCBM_N00_6010C20_0000C00
90.W1.52.020.0	DCBM_N3D_6010C35_0000C00
90.W1.52.021.0	DCBM_N4D_6010C30_0000C00
90.W1.52.022.0	DCBM_N3D_6000C25_0000C00
90.W1.52.023.0	DCBM_N3D_6000C35_0000C00
90.W1.52.024.0	DCBM_N1D_6000C35_0000C00
90.W1.52.025.0	DCBM_N4D_6010C35_0000C00
90.W1.52.026.0	DCBM_N4D_6000C35_0000C00
90.W1.52.027.0	DCBM_N00_6000C15_0000C00
90.W1.52.028.0	DCBM_N00_6010C30_0000C00
90.W1.52.029.0	DCBM_N3D_6010C30_0000C00
90.W1.52.030.0	DCBM_N1D_6010C30_0000C00
90.W1.52.031.0	DCBM_N2D_6000C15_0000C00
90.W1.52.032.0	DCBM_N00_6010C15_0000C00
90.W1.52.033.0	DCBM_N20_6000C20_0000C00
90.W1.52.034.0	DCBM_N00_6000C03_0000C00
90.W1.52.035.0	DCBM_N2D_6010C15_0000C00

CLEM N°	Product name
90.W1.52.200.0	DCBM_N0M_6000C15_0000C00
90.W1.52.201.0	DCBM_N0M_6000C20_0000C00
90.W1.52.202.0	DCBM_N0M_6000C35_0000C00
90.W1.52.203.0	DCBM_N1M_6000C20_0000C00
90.W1.52.204.0	DCBM_N1M_6000C35_0000C00
90.W1.52.205.0	DCBM_N2M_6000C20_0000C00
90.W1.52.206.0	DCBM_N3M_6000C35_0000C00
90.W1.52.207.0	DCBM_N3M_6010C30_0000C00
90.W1.52.208.0	DCBM_N4M_6000C20_0000C00
90.W1.52.209.0	DCBM_N0M_6010C20_0000C00
90.W1.52.210.0	DCBM_N0M_6010C35_0000C00
90.W1.52.212.0	DCBM_N3M_6010C35_0000C00
90.W1.52.213.0	DCBM_N0M_6010C15_0000C00
90.W1.52.214.0	DCBM_N2M_6010C20_0000C00
90.W1.52.215.0	DCBM_N1M_6000C15_0000C00
90.W1.52.216.0	DCBM_N1M_6010C15_0000C00
90.W1.52.217.0	DCBM_N0M_6010C30_0000C00
90.W1.52.218.0	DCBM_N3M_6000C20_0000C00
90.W1.52.219.0	DCBM_N0M_6000C30_0000C00
90.W1.52.220.0	DCBM_N3M_6000C15_0000C00
90.W1.52.221.0	DCBM_N2M_6010C25_0000C00
90.W1.52.222.0	DCBM_N2M_6000C35_0000C00

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