



EV Charging Infrastructure applications

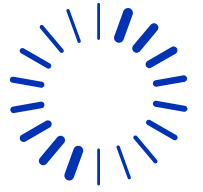
LEM International

life
energy
motion

A decorative graphic consisting of numerous blue lines of varying lengths radiating from a central point, creating a sunburst or starburst effect. The lines are arranged in a circular pattern and are set against a dark blue background.

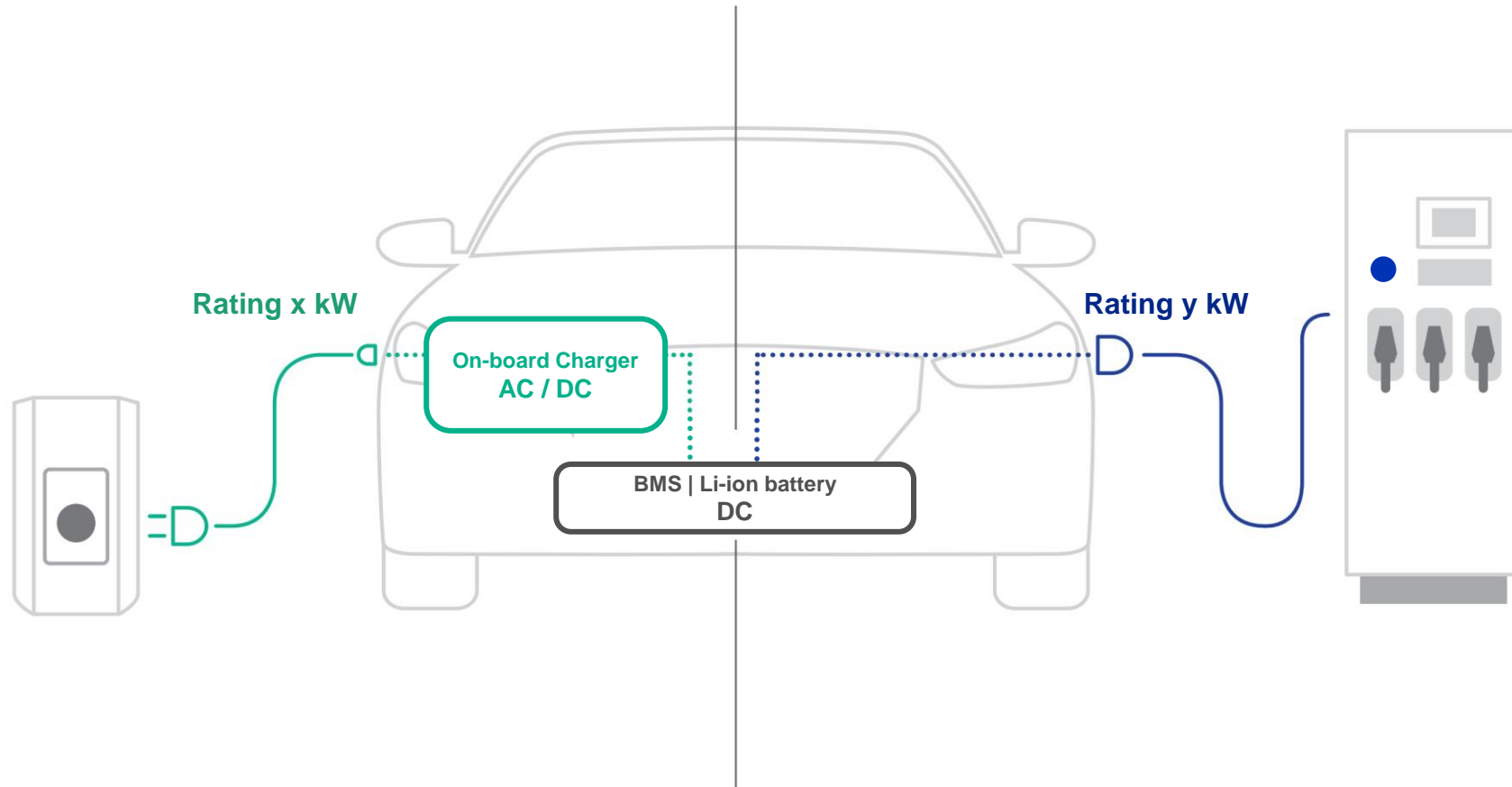
E-mobility infrastructure

How to charge a BEV | AC and DC chargers



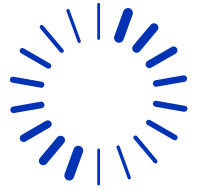
AC destination charger

DC fast charger



EV charging usage

AC or DC charging ? A question of use case



Home charging
Private

- **Low power**, overnight charging
- **Affordable**
- **Services** (V2Home, load balancing)

7,4kW – 22kW AC



Workplace charging
Public, Private

- **Charging in 4-6 hours**
- **Transparent** (tariff, payment)
- **Services** (V2G, load balancing)

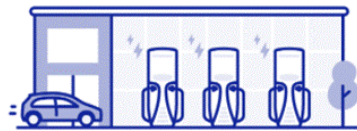
11 - 22kW AC

1

2

3

4



En-route charging
Public

- **Highest charging speed**
- **Harmonized** and easy to use
- **Convenient** access & billing
- **Simple search and booking**

> 100kW DC



Destination charging
Public

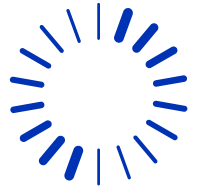
- **Charging in 1-2 hours**
- **Transparent** (tariff, payment)
- **Services** (V2G, load balancing)

11 - 22kW AC

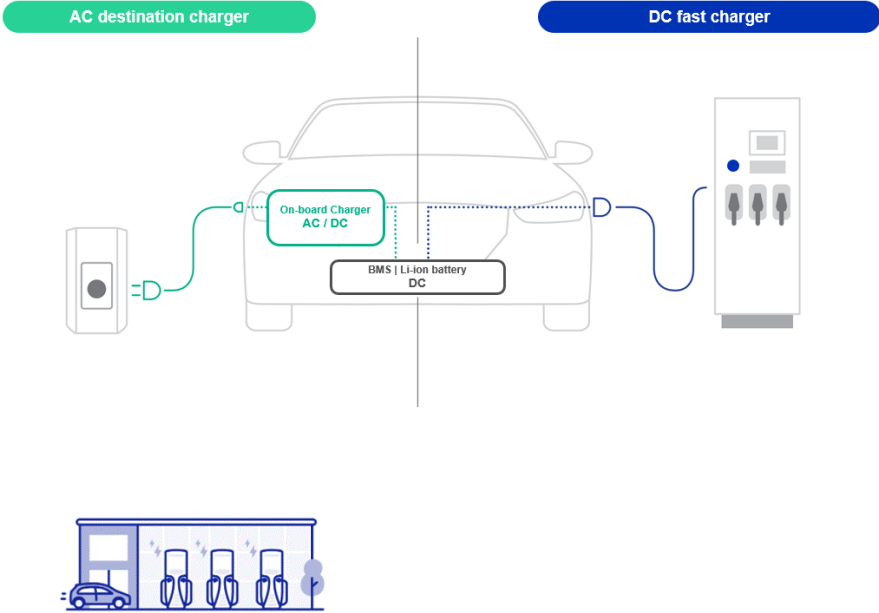
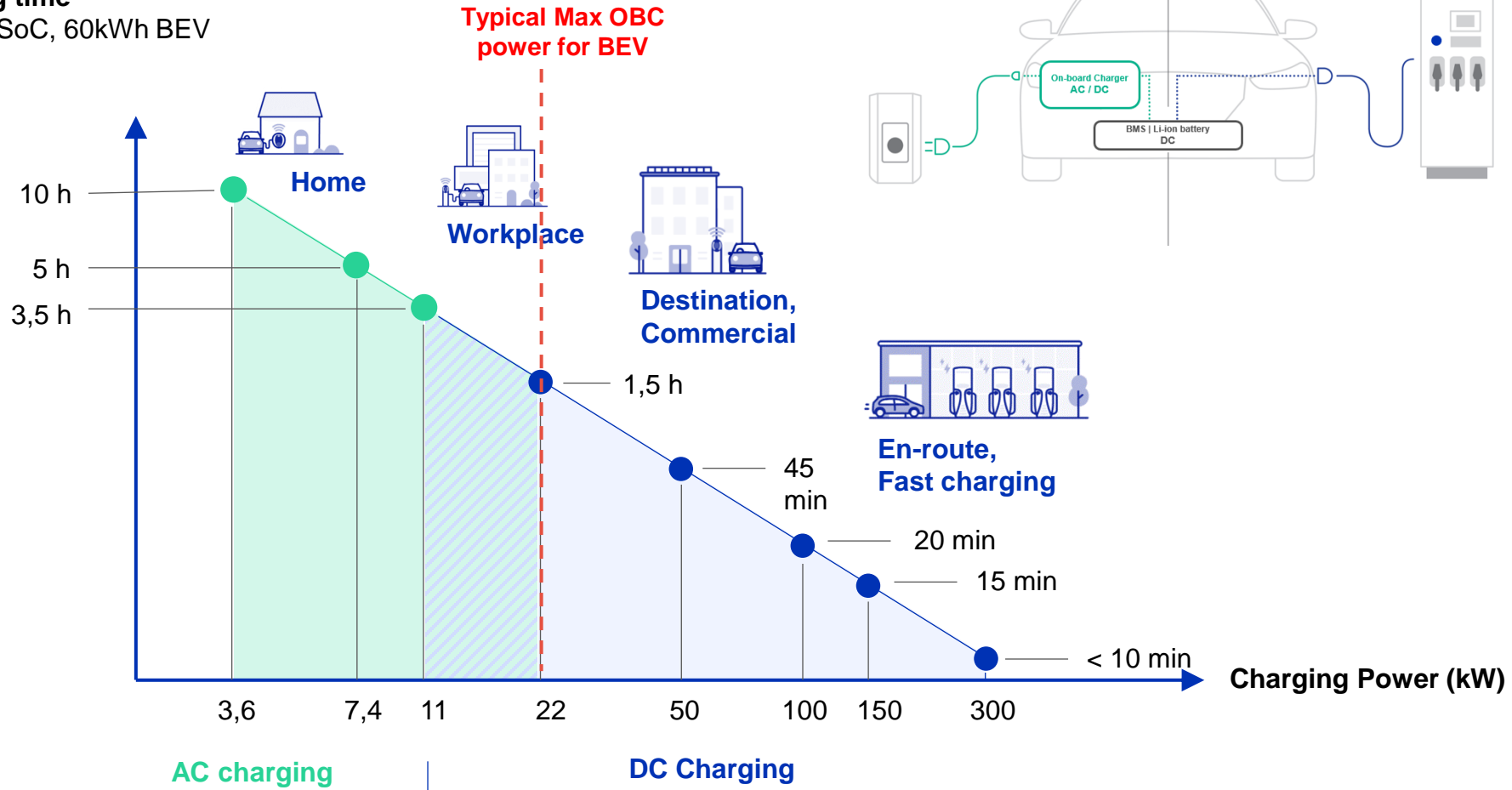
< 50kW DC

> 100kW DC

EV charging segmentation

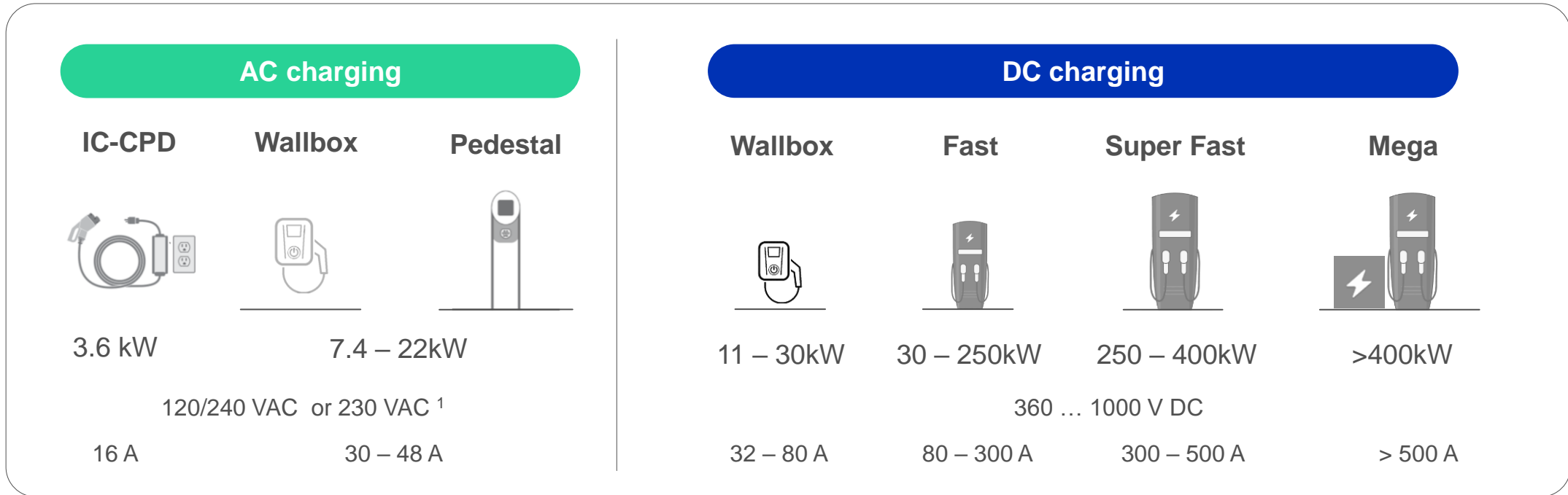
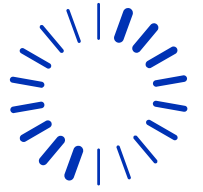


Charging time
20-80 % SoC, 60kWh BEV



E-mobility infrastructure

AC or DC chargers | Use cases



¹ Supply voltage dependent on region and AC grid voltage

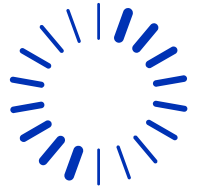


DC charging stations application

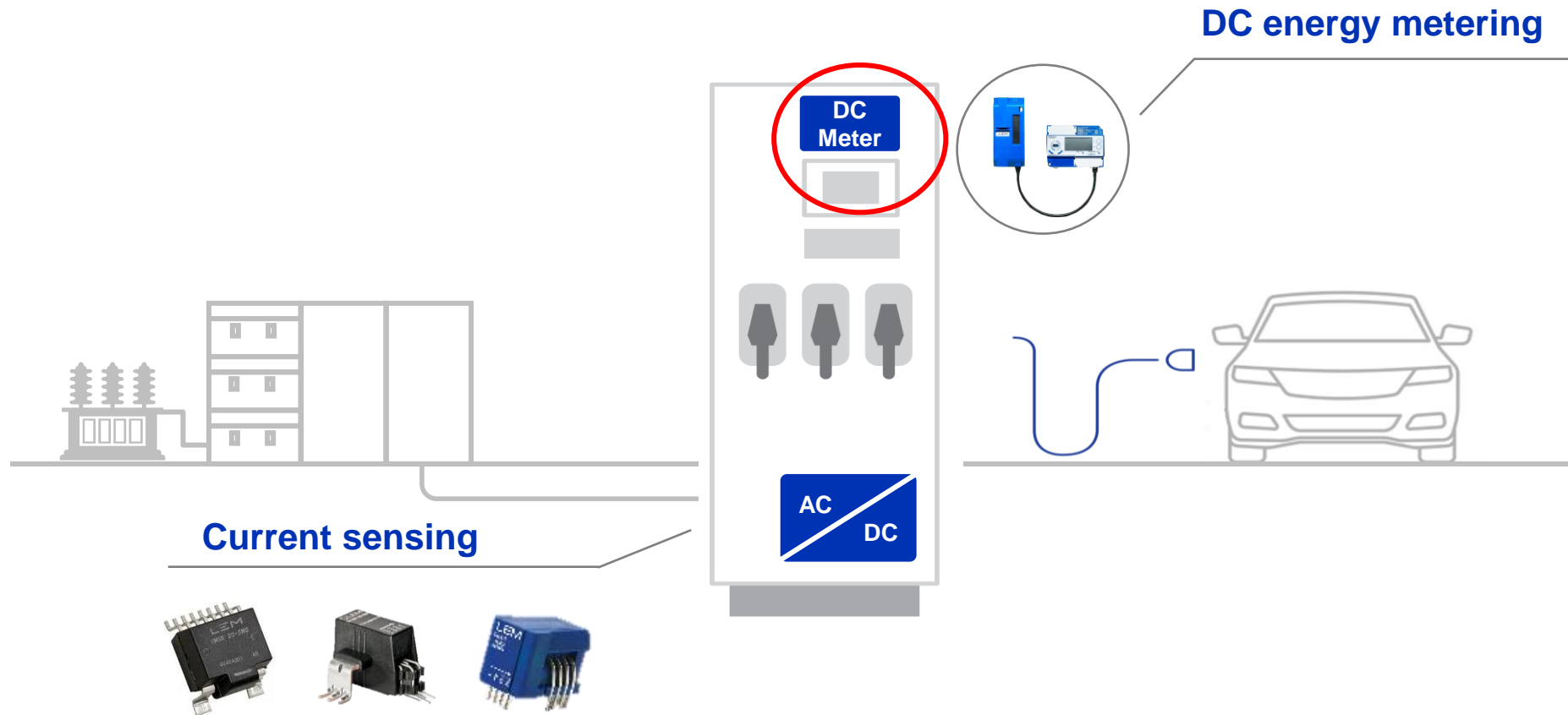
LEM's solutions



LEM provides solutions for power converters and meters

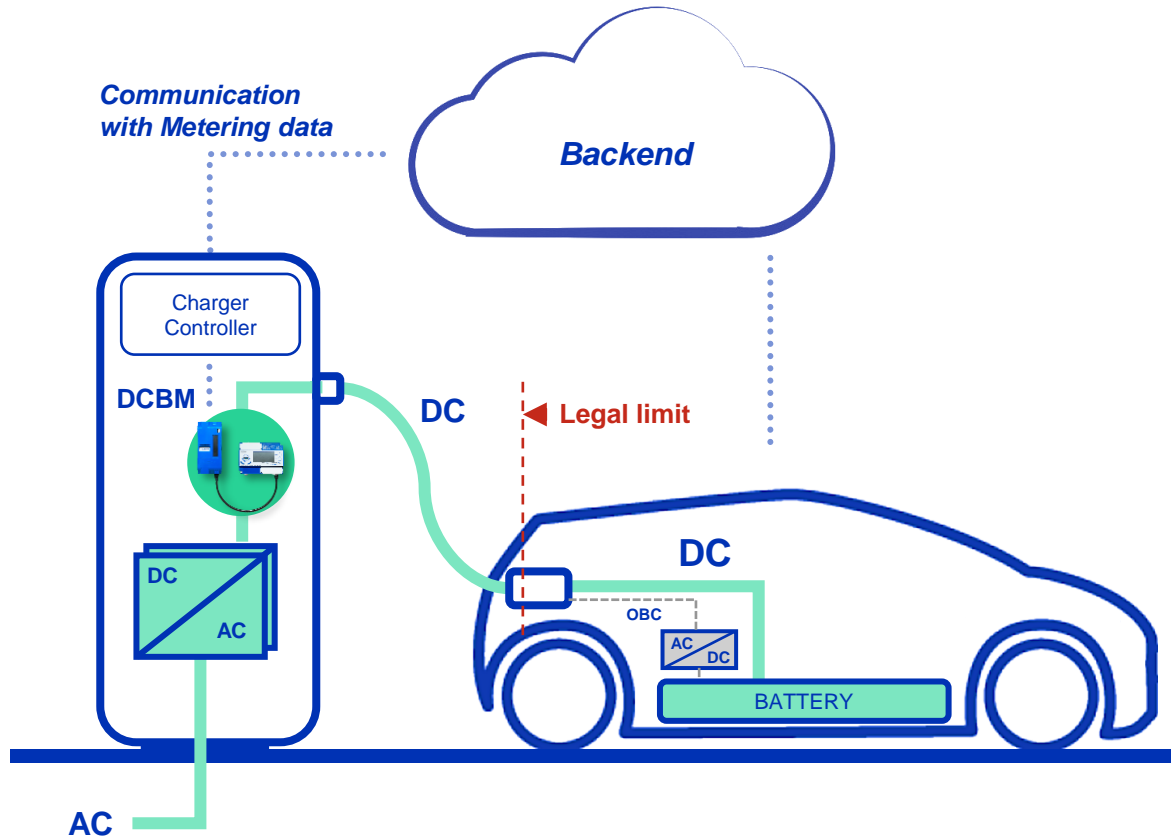
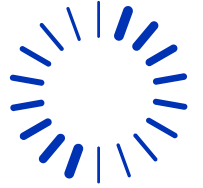


DC chargers



DC charging & Energy metering

DCBM Integration into DC charger



- **Energy metering in DC Fast Charging**

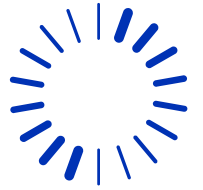
- ENERGY billing of charging sessions (kWh)
- METROLOGY regulates energy metering
- TRUST, PERFORMANCE ensure end-user protection

- **DC Meter roles**

- INTEGRATION of metering within DC charger
- COMPLIANCE with metrology regulations
- PROTECTION of user data / charging data
- Display of charging session information
- Monitoring of DC Fast Chargers (current, voltage, temperature)

A view on global regulations

Development of Metrology in the global EV charging eco-system



North America

- Regulated at charger level, with **DC energy metering**
- NIST Handbook 44
- **CTEP / NTEP**
- **National Electric Vehicle Infrastructure (NEVI) Formula Program**

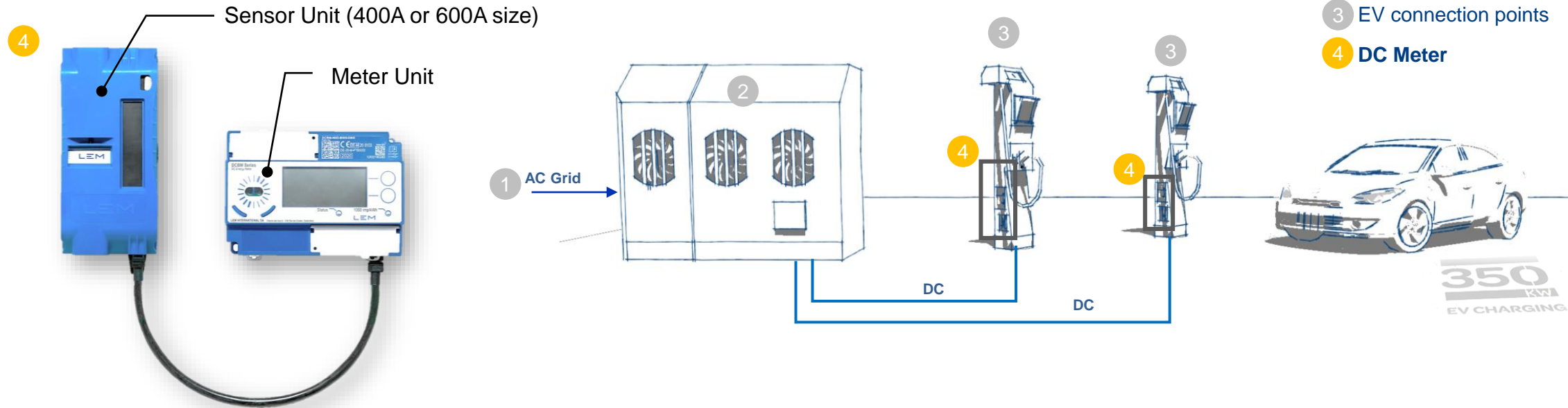
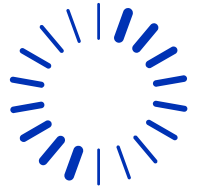


Europe

- Germany initiated the move with **Eichrecht** (Germany, Austria)
- **MID** (2014/32/EU, Annex V), historically made for AC, with trend to integrate DC
- **National regulation** in France
- **Listed in Alternative Fuel Infrastructure Directive (AFIR) draft**

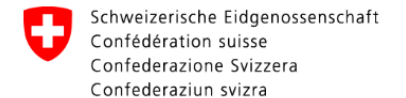
DCBM 400/600 – DC Energy Metering

A complete metering solution for DC Fast Charging

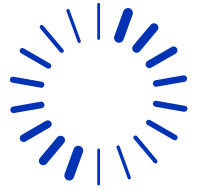


A Complete DC Meter Solution

- **kWh-based billing in DC fast charging**
- **Certified by PTB and MID (2014/32/EU), UL Recognized**
- **400 A or 600 A, 1000 V DC**
- **Operating temperature -40 °C ... +85 °C (accuracy class B)**
- **Ethernet HTTP** interface easy to integrate, with **security**



DCBM400/600 certifications and approvals



Germany – MessEV / MessEG

MID – 2014/32/EU

UL Recognized

Physikalisch-Technische Bundesanstalt
Nationales Metrologienstitut

KBS
Konformitätsbewertungsstelle

TIFIKAT
TIFICATE
TIFICAT
TIFICATO
TIFICADO

CSA GROUP

Baumusterprüfbescheinigung
Type-examination Certificate

Ausgestellt für: LEM International SA
Routte du Nord-d'Avril 152
1217 Meyrin SCHWEIZ

gemäß: Anlage 4 Modul B der Mess- und Eichverordnung vom 11.12.2014 (BGM, I S, 2010)
Anlage 4 Modul B of the Measures and Verification Ordinance dated 11.12.2014 (Federal Law Gazette I, p. 2010)

Gerätart: Gleichstromzähler (elektronisches Messwerk)
Type of instrument

Typbezeichnung: DCBM...
Type designation

Nr. der Bescheinigung: DE-20-M-PTB-0075, Revision 2
Certificate No.

Gültig bis: 05.10.2030
Valid until

Anzahl der Seiten: 45
Number of pages

Geschäftszeichen: PTB-2-3-4108843
Reference No.

Nr. der Stelle: 0102
Body No.

Zertifizierung: Braunschweig, 26.01.2022
Certification

Im Auftrag: *Dr. Christoph Lecht*
On behalf of PTB

Bewertung: Braunschweig, 26.01.2022
Evaluation

Im Auftrag: *Dr. Michael Blaz*
On behalf of PTB

Signatures: *Dr. Christoph Lecht*, *Dr. Michael Blaz*

Seal: [PTB Seal]

Text: Baumusterprüfbescheinigungen ohne Unterschrift und Siegel haben keine Gültigkeit. Diese Baumusterprüfbescheinigung darf nur unter Beachtung der geltenden Vorschriften verwendet werden. Auszüge bedürfen der Genehmigung der Physikalisch-Technischen Bundesanstalt. Type-examination Certificates without signature and seal are not valid. The Type-examination Certificate may not be reproduced or other than in full. Extracts may be taken only with the permission of the Physikalisch-Technische Bundesanstalt.

CSA Group Bayern GmbH is a notified body in accordance with Directive 2014/32/EU
File: CSA_B_P50_27_Rev_0

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Institute of Technology METAS

EU Type Examination Certificate No CH-MI003-21039-00

Applicant: LEM INTERNATIONAL SA
152, Route du Nord-d'Avril
1217 MEYRIN
Switzerland

Requirements: Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments and the instrument specific annex MI-003.
Ordinance of 15 February 2008 on Measuring Instruments (SR 941.210) and Ordinance of the FDUP of 26 August 2015 on Electrical Energy Meters (SR 941.201)

Conformity standards: EN50470-1 (2008), EN50470-3 (2008) and CLC/TR 50079
The tests were supplemented with a susceptibility test against symmetrically flowing currents in the frequency range 2 kHz to 150 kHz.

Type of instrument: DC-Meters (DCM)
Type designation: DCBM 400 / 600 Series
Accuracy class(es): B

Characteristics:
Meter type: direct connected meters
Reference voltage U_N: 150 ... 500 V
Reference current I_N: 0, 120 A
Maximum current I_{max}: 400, 600 A
Minimum current I_{min}: 0, 5 A
Reference frequency f_N: 0 Hz (DC)
Operating temperature range: -40 ... +70 °C
Casing protection class: IP 20 (integrated in the cabinet)
Protection class of connections: IP 10
Protection class (application): Class II (indoor meter)

Certificate valid until: 16 February 2032
Notified body: Conformity Evaluation Body METAS-Cert No. 1259
3003 Berner-Webern, 17 February 2022

Approved by: *Gulian Courvoisier*, Head of sector
METAS-Cert

Text: This document is only valid and applicable in its entirety. Please observe the information given on any labels attached.

METAS
Untermythenstr. 38, 3003 Bern, Switzerland, Telephone: +41 78 387 01 11, www.metas.ch

CERTIFICATE OF COMPLIANCE

Certificate Number: 2022-10-18-E330077
Report Reference: E330077-D1005-1/A0/C0-UL
Date: 2022-10-18

Issued to: LEM International SA
Applicant Company: Rue du Nord-d'Avril, 152
Meyrin 1217 CH, Switzerland

Listed Company: Same as Applicant

This is to certify that representative samples of: Energy Usage Monitoring System
DCBM 400 (see GPI for details), DCBM 600 (see GPI for details)

Standards for Safety: UL 61010-1, 3rd Edition, May 11, 2012, Revised July 19, 2019, CAN/CSA-C22.2 No. 61010-1(2012-05), 3rd Edition, with revisions through 2018-11
UL 61010-2-030, Edition 2, Issue Date 12/21/2018
CSA C22.2 No. 61010-2-030, Edition 2, Issue Date 12/2018
See the UL Online Certifications Directory at <https://ul.certsolutions.com> for additional information.

Additional Standards: UL 61010-2-030, Edition 2, Issue Date 12/21/2018
Additional Information: See the UL Online Certifications Directory at <https://ul.certsolutions.com> for additional information.

Text: This Certificate of Compliance does not provide authorization to apply the UL Recognized Component Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark. Only those products bearing the UL Recognized Component Mark should be considered as being UL Certified and covered under UL's Follow-Up Services. Look for the UL Recognized Component Mark on the product.

Signatures: *[Signature]*
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Page 1

Module B
DE-20-M-PTB-0075, Revision 2

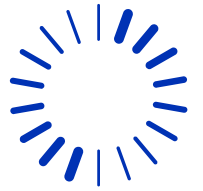
Module B
CH-MI003-21039-00

Module D
DE CSA 22 D 002

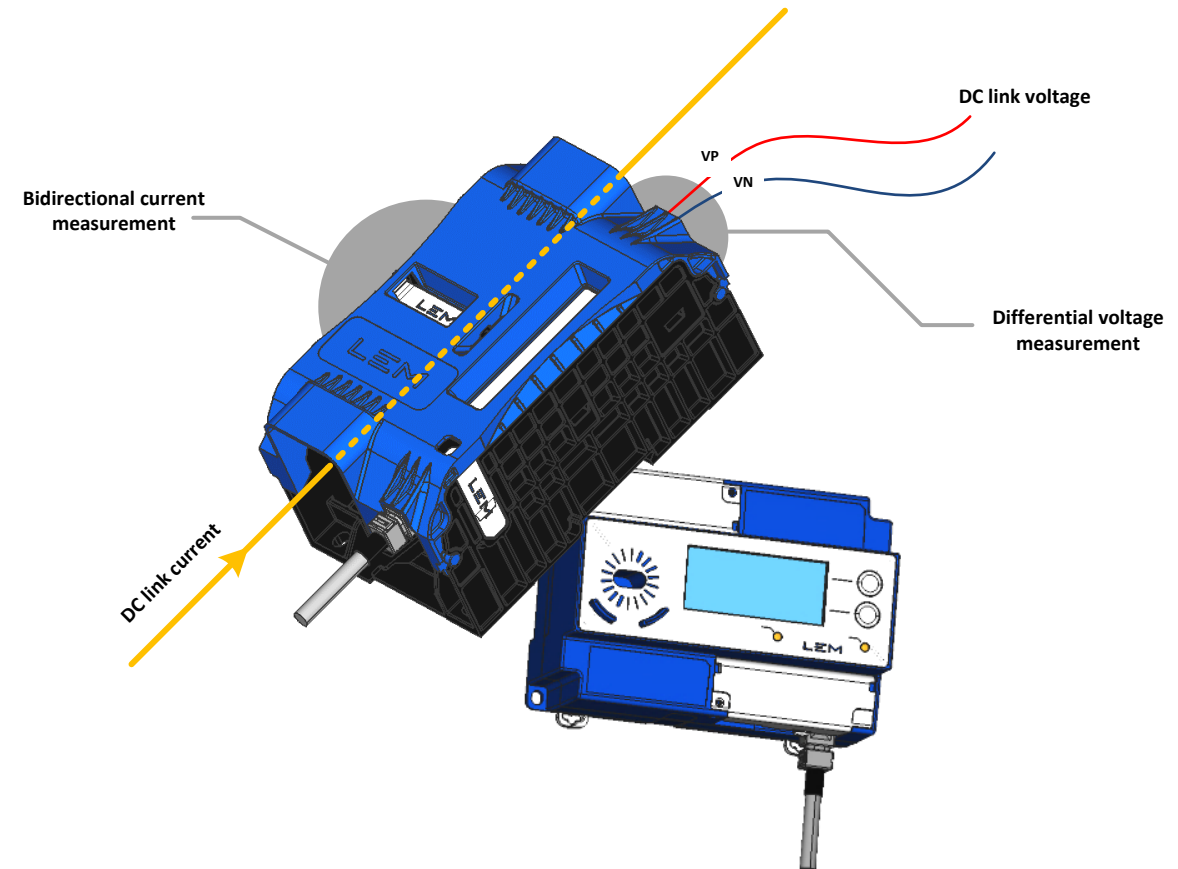
Module D
6030-01644



Focus on DCBM400/600 specifications

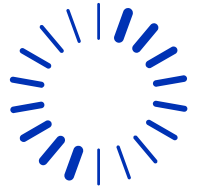


Parameter	DCBM400	DCBM600
Voltage specification	150 ... 1000 V DC	
Current specification	Ist : 320 mA Imin : 4 A Itr : 8 A Iref : 80 A Imax : 400 A	Ist : 480 mA Imin : 6 A Itr : 12 A Iref : 120 A Imax : 600 A
Accuracy class	Class B	
Power terminal	Studs, Tin plated	
Operating Temperature Sensor Unit	-40 °C ... +85 °C	
Insulation	1000 V DC, Reinforced	
Loss compensation	0 ... 14 mΩ (selectable / fixed)	
Voltage measurement	Differential, 4-wire	
Counting direction	Bidirectional	
Communication	Ethernet, HTTP, OCMF	
Data & Security	Transaction & Signature, S.A.F.E.	

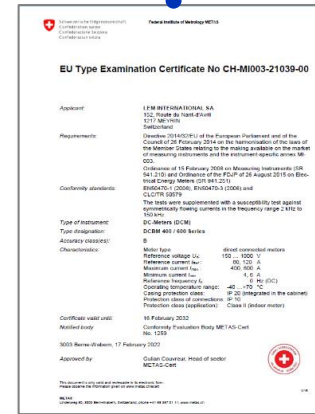


Single DC meter family covers multiple certifications

DCBM designations and certifications

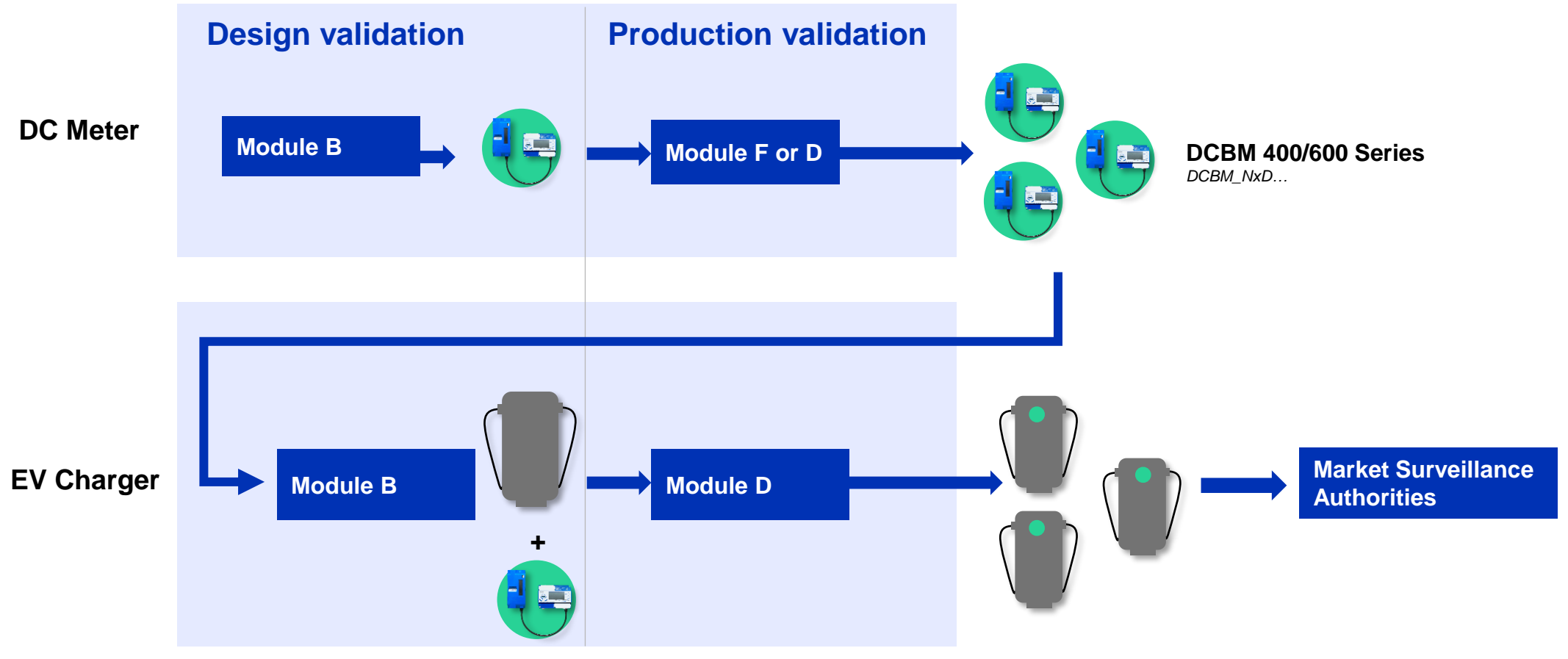
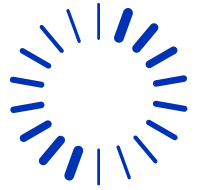


	DCBM_N00...	DCBM_NxD...	DCBM_NxM...
Products	DCBM400 and DCBM600		
Certification / Approvals	CE marking UL Recognized	Eichrecht Module B / Module F → D	MID Module B / Module D
Coming			France (Regulation 22.00.570.001.1)



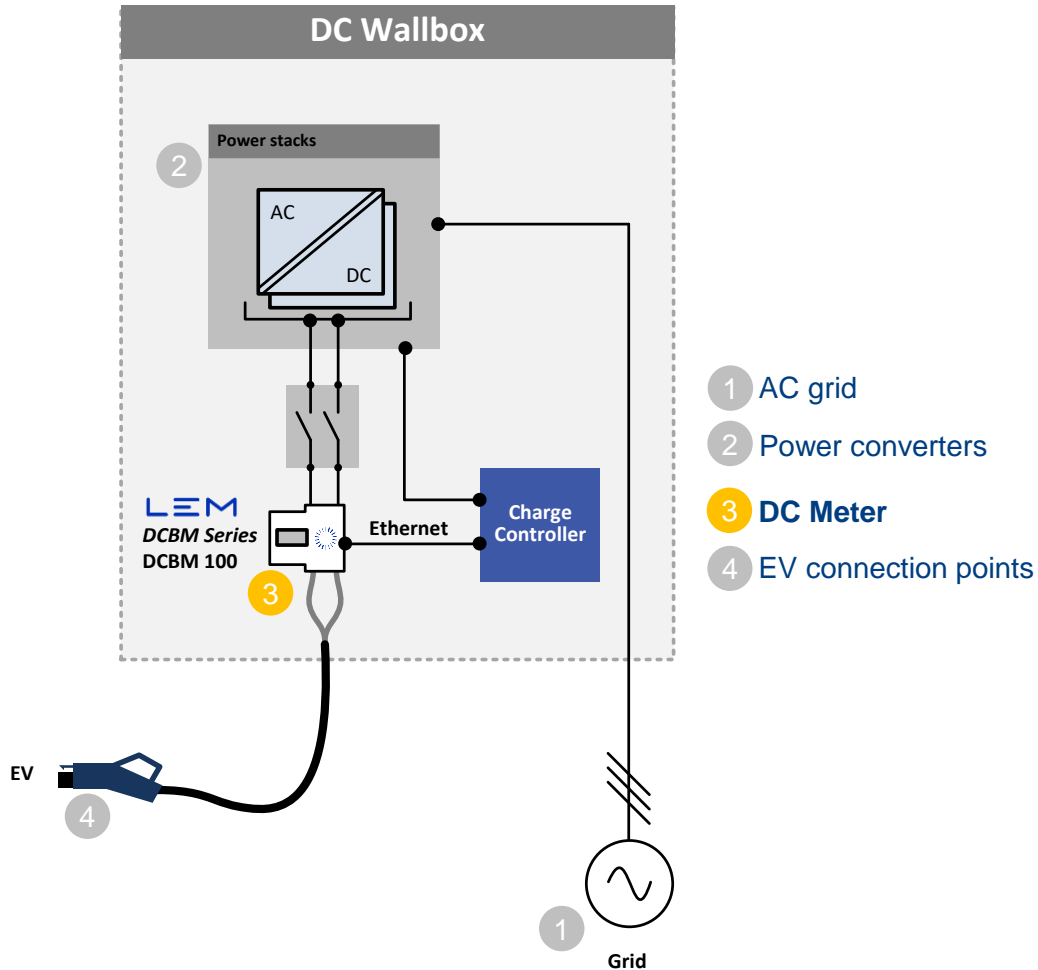
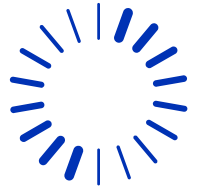
German Eichrect Certification Process

End-to-end certification process



Destination DC charging

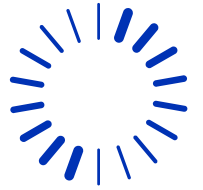
DC wallboxes will be an essential brick in the charging landscape: acceptable charging times at affordable costs for the Charging Point Operators (CPOs)



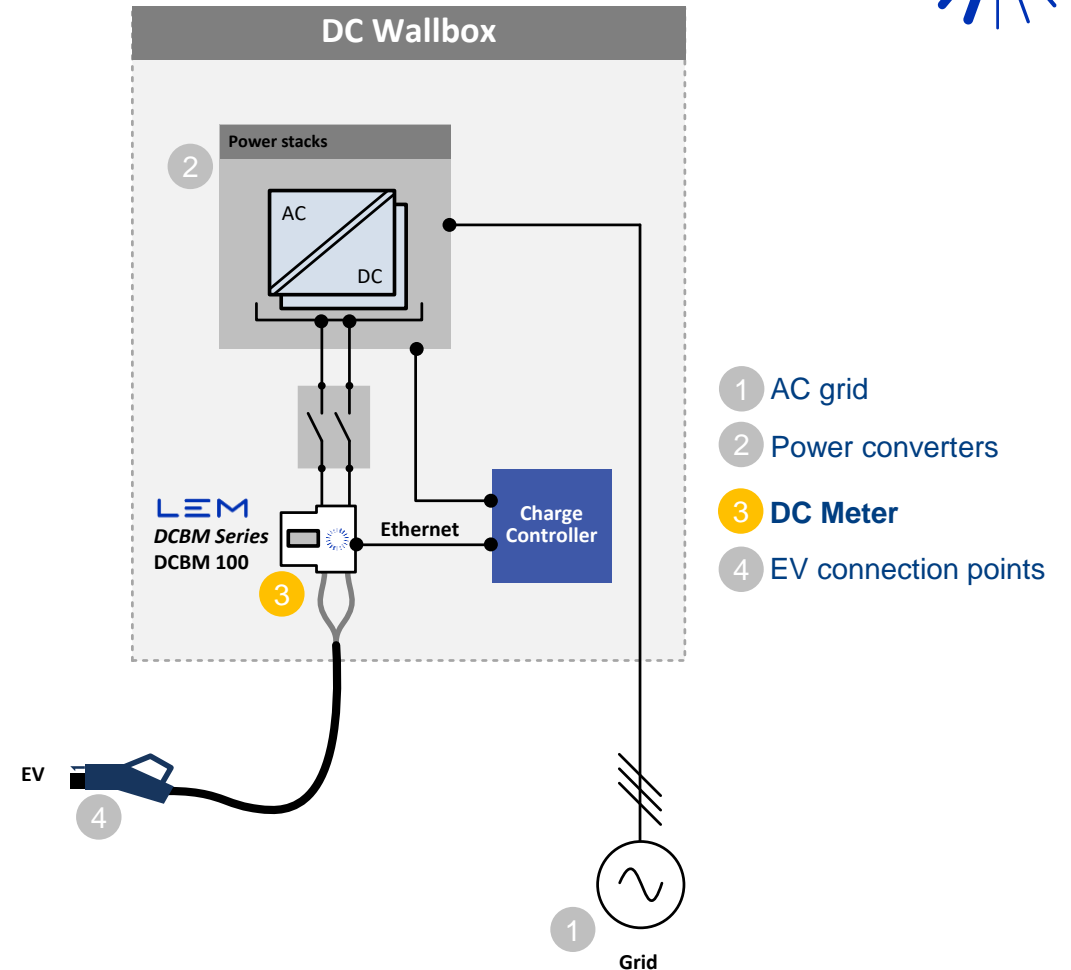
LEM DC energy meter for DC wallboxes : DCBM100

- For DC wallboxes, ready for **800V**-platform EVs and **V2G**
- Accuracy class B, **-40°C ... +80°C**, **I_{max} 80 A**, **1000 VDC**
- Ethernet **HTTP**, Plug&Play with **Open API profile**
- **OCMF Readout** data pre-formatted for metrology regulations
- **Monitoring** of the DC link (with current / voltage / temperature)

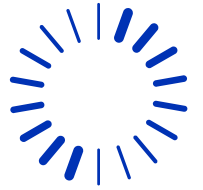
Focus on DCBM100 specifications



Parameter	DCBM100
Voltage specification	150 ... 1000 V DC
Current specification	Ist : 64 mA Imin : 0,8 A Imax : 80 A
Accuracy class	Class B
Power terminal	35 mm ²
Operating Temperature Sensor Unit	-40 °C ... +80 °C
Insulation	1000 V DC, Reinforced
Loss compensation	Selectable / fixed
Counting direction	Bidirectional
Communication	Ethernet, HTTP, OCMF
Data & Security	Transaction & Signature, S.A.F.E.
Certification	Eichrecht / MID / UL



DCBM Family



DC Charging Infrastructure Integration

- Ethernet communication
- Compliant with latest EVSE protocols (OCMF / SAFE V1.2)
- Charging session handling
- Accuracy Class B
- Current / Voltage / temperature monitoring



DCBM 100

- DC Destination
- < 50 kW
- 1000 VDC / 80A
- Plug and play
- Cable connection 35mm²
- Operating +80°C

* **B samples July 2022** *

* **C samples Oct 2022** *

* **SOP Q3 2023***



Available

DCBM 400

- DC Fast Charging
- 50 ... 150kW range
- 1000VDC / 400A
- Split design
- Loss compensation
- Cable / busbar
- Operating +85°C
- PTB / MID

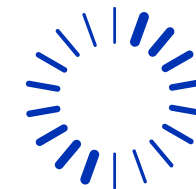


Available

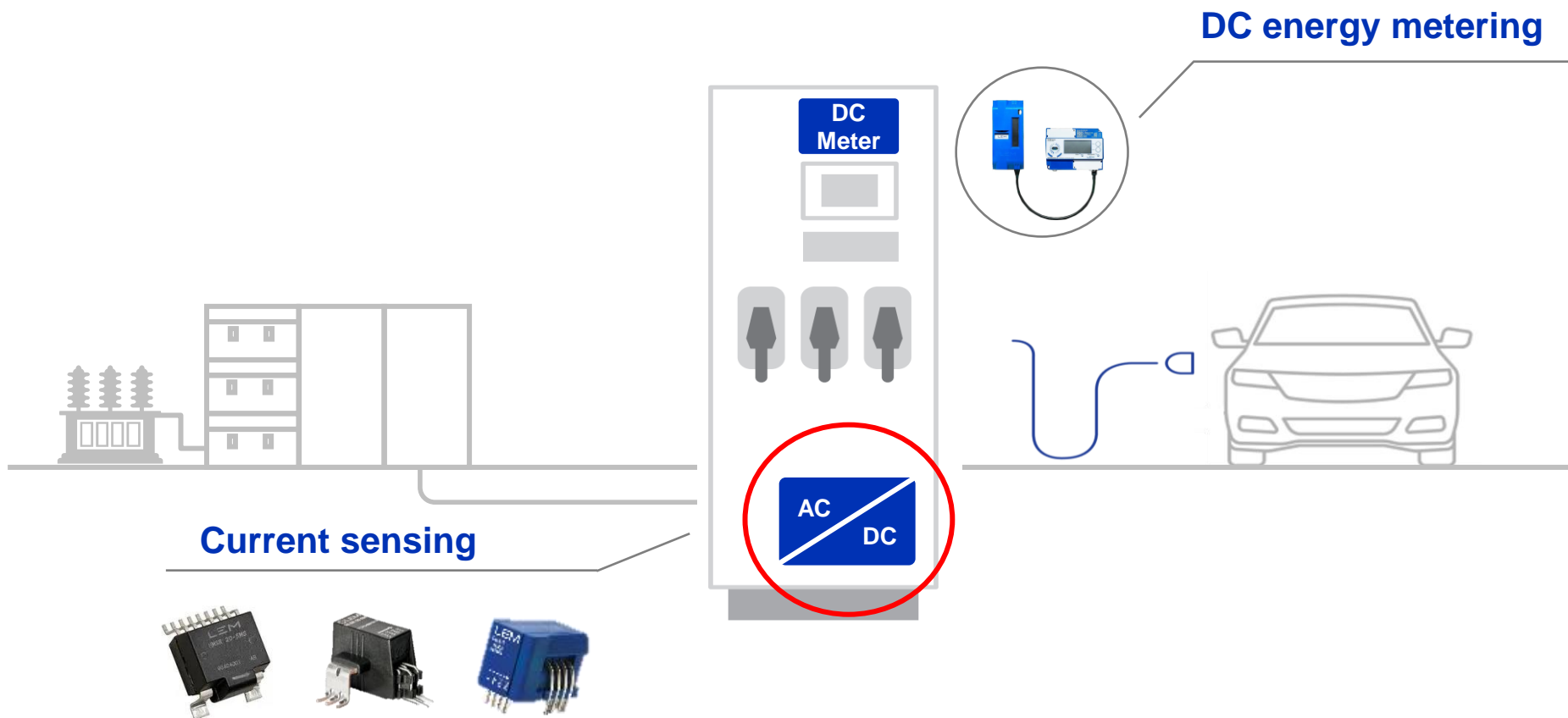
DCBM 600

- DC Fast Charging
- Up to 400kW
- 1000VDC / 600A
- Split design
- Loss compensation
- Cable / busbar
- Operating +85°C
- PTB / MID

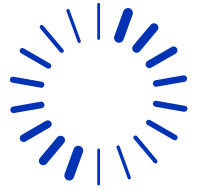
LEM sensors can be used in the AC/DC module



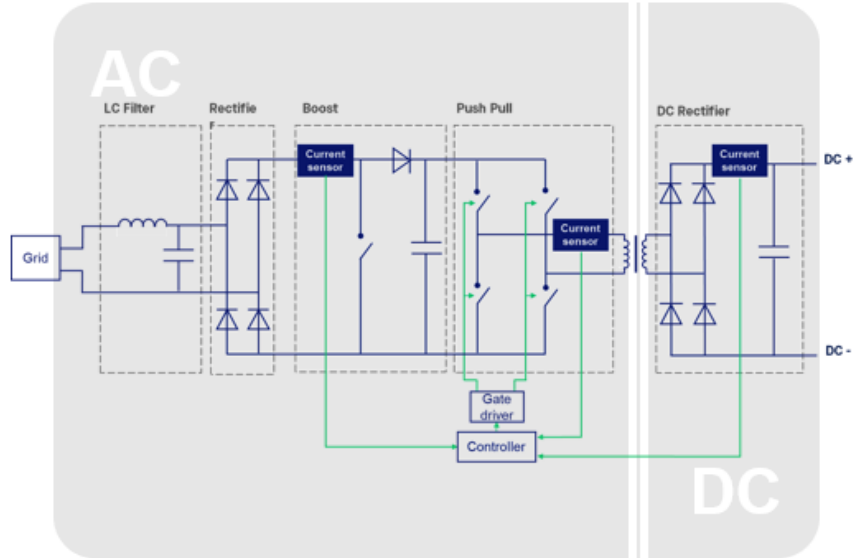
DC chargers



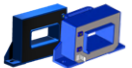
Fast charging stations integrate growing power densities



Power modules AC/DC | Control command function



LF X10



HAT HAX



HLSR 100 LZSR



GXL HLSR CKSR



HLSR GO HMSR

5kW 10kW 20kW 30kW 50kW 100kW 200kW 500kW



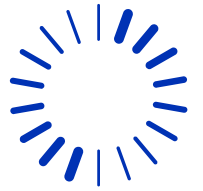
Multiple stacked power module (AC/DC converters)

Module characteristics:







- 1000V insulation
- 30-50kW
- Up to 150A DC



LEM has a wide range of products to cover all needs



DC chargers | Product portfolio for power module AC/DC

	GO	HMSR	GXM	GXL	HLSR	HLSR 100	CKSR	LZSR
								
Technology	ICS	ICS	ICS	ICS	O/L	O/L	C/L	C/L
Current range max	± 75A	± 75A	± 125	± 200	± 125A	± 200A	± 180A	± 450A
Current RMS max	30A	30A	50A	80A	80A	100A	75A	200A
Output	Voltage	Voltage, $\Sigma\Delta^*$	Voltage	Voltage	Voltage, $\Sigma\Delta$	Voltage, $\Sigma\Delta$	Voltage	Voltage
Accuracy at 25°C	<1%	<1%	<1%	<1%	1%	1 %	0.4%	0.4%
Accuracy -40°C .. 85°C	2.7%	2.5%	2.5%	2.5%	3%	3%	1%	1%
Response time	2 μ s	2 μ s	2 μ s	2 μ s	2.5 μ s	2.5 μ s	2.5 μ s	3 μ s
Bandwidth (-3dB)	300 kHz	300 kHz	300 kHz	300 kHz	400 kHz	90 kHz	300 kHz	200 kHz
Supply voltage	+5V / 3.3V*	+5V / 3.3V*	+5V / 3.3V*	+5V / 3.3V*	+5V	+5V	+5V	+5V
Creepage & Clearance (prim/Sec)	7.5 mm 8.0 mm	8.0 mm 8.0 mm	8.2 mm 8.2 mm	6.0 mm 6.0/ mm	9.42 mm 9.42 mm	9.42 mm 9.42 mm	7.5 mm 7.5 mm	12.9 mm 12.9 mm
Implementation	SOIC 8 or 16	SOIC 16	QFN	QFN	PCBA	PCBA	PCBA	PCBA / Aperture

*ICS SOP timings to be updated by end of January 2023





Thank you

