

INTERNATIONAL STANDARD

**Electric vehicle conductive charging system -
Part 23-3: DC electric vehicle supply equipment - Megawatt charging systems**

CONTENTS

FOREWORD	4
INTRODUCTION	6
1 Scope	7
2 Normative references	7
3 Terms and definitions	8
4 General requirements	9
5 Classification	9
6 Charging modes and functions	9
7 Communications	18
8 Protection against electric shock	19
9 Conductive electrical interface requirements	23
10 Requirements for adaptors	24
11 Cable assembly requirements	24
12 EV supply equipment constructional requirements and tests	24
13 Overload and short-circuit protection	25
14 Automatic reclosing of protective devices	26
15 Emergency switching or disconnect (optional)	26
16 Marking and instructions	26
101 Specific requirements for EV supply equipment	27
102 Test methods	33
Annexes	37
Annex AA (normative) EV supply equipment of system A	38
Annex BB (normative) EV supply equipment of system B	39
Annex CC (normative) EV supply equipment of system C	40
Annex EE (normative) Test load impedance verification	135
Annex FF (normative) Multi-side B separated EV supply equipment	137
Annex GG (informative) Communication and energy transfer process between the EV supply equipment and the EV	139
Annex HH (informative) Touch current and touch impulse current	140
Annex AAA (informative) Auxiliary power supply through the insertion detection circuit	144
Bibliography	147
Figure 201 – Typical voltages between side B live parts (DC+/DC–) and protective conductor under normal operation	13
Figure 202 – Measurement of the touch leakage current	15
Figure 203 – Examples of a fault between the secondary circuit and the protective conductor	16
Figure 204 – Example of the voltage range for active and passive voltage balancing with a system Y-capacitance according to Table 203	20
Figure 205 – Insulation barriers	21
Figure 206 – Test arrangement MCS_0	30
Figure 207 – General test setup for system MCS	34
Figure 208 – Test load example	35

Figure CC.201 – Circuit diagram for an EV supply equipment of configuration HH.....	42
Figure CC.202 – Example of a filtering circuit for the charge enable circuit.....	47
Figure CC.203 – Example of a filtering circuit for the insertion detection circuit.....	47
Figure CC.204 – Equivalent disabled side B of the EV supply equipment	49
Figure CC.205 – Sequence diagram for normal start up.....	53
Figure CC.206 – Sequence diagram for normal shutdown during energy transfer by EV or EV supply equipment	58
Figure CC.207 – Sequence diagram for EV supply equipment and EV initiated error shutdown.....	62
Figure CC.208 – Sequence diagram for an emergency shutdown executed by the EV	66
Figure CC.209 – Sequence diagram for an emergency shutdown executed by the EV supply equipment	68
Figure CC.210 – Sequence diagram for pause before cable-check phase by EV supply equipment using ISO 15118-20:2022 and ISO 15118-20:2022/AMD1:2026.....	71
Figure CC.211 – Sequence diagram for pause after pre-charge phase and before energy transfer stage by the EV supply equipment using ISO 15118-20:2022 and ISO 15118-20:2022/AMD1:2026.....	75
Figure CC.212 – Worst case equivalent circuit during pre-charge	85
Figure CC.213 – Restart methods sequence for the EV supply equipment.....	87
Figure CC.214 – Restart verification method on the EV supply equipment.....	88
Figure CC.215 – Example of a CE state B0 – B transition	88
Figure CC.216 – Restart methods sequence for the EV	89
Figure CC.217 – Example of a B0 – EC – B0 toggle.....	90
Figure CC.218 – Approaching a single test point TP in CCM (example 1).....	95
Figure CC.219 – Approaching multiple test points TP_n CCM (example 2)	95
Figure CC.26 – Voltage at the vehicle connector.....	107
Figure CC.220 – Test setup for IMD measurement connections.....	131
Figure EE.201 – Magnitude of the impedance of the test load between DC+ and DC– for system MCS.....	135
Figure HH.201 – C_1 limit: Y-capacitance considering a human body resistance of 575 Ω	142
Table 201 – Comparison between IEC 61851-23 and IEC 61851-23-3.....	6
Table 202 – Voltage threshold for emergency shutdown reaction.....	11
Table 203 – Maximum Y-capacitance of the EV supply equipment at side B	19
Table 204 – Minimum protective measures.....	22
Table 205 – Current ripple limit of the EV supply equipment.....	27
Table 206 – Recommended circuit parameters of the test load	36
Table CC.201 – EV supply equipment component values and tolerances for configuration HH	42
Table CC.202 – EV component values and tolerances for configuration HH.....	43
Table CC.203 – System states of configuration HH based on the CE voltage.....	44
Table CC.204 – Charge enable states and voltage ranges for the EV supply equipment	44
Table CC.205 – Charge enable states and voltage ranges for the EV.....	45
Table CC.206 – Insertion detection states and voltage ranges for the EV supply equipment	45

Table CC.207 – Insertion detection states and voltage ranges for the EV	46
Table CC.208 – EV supply equipment components for charge enable and insertion detection filtering.....	48
Table CC.209 – EV components for charge enable and insertion detection filtering	48
Table CC.210 – Component limits for the disabled side B of the EV supply equipment.....	50
Table CC.211 – Message code mapping for sequence diagram.....	52
Table CC.212 – Sequence description for normal start up.....	54
Table CC.213 – Sequence description for normal shutdown during energy transfer by EV or EV supply equipment	59
Table CC.214 – Overview of error and emergency shutdown cases	61
Table CC.215 – Sequence description for EV supply equipment and EV initiated error shutdown.....	63
Table CC.216 – Sequence diagram for an emergency shutdown executed by the EV.....	67
Table CC.217 – Sequence diagram an emergency shutdown executed by the EV supply equipment	69
Table CC.218 – Sequence description for pause before cable-check phase by EV supply equipment using ISO 15118-20:2022 and ISO 15118-20:2022/AMD1:2026.....	72
Table CC.219 – Sequence description for pause after pre-charge phase and before energy transfer stage by the EV supply equipment using ISO 15118-20:2022 and ISO 15118-20:2022/AMD1:2026.....	76
Table CC.220 – Insulation states and EV supply equipment reaction based on the insulation resistance	82
Table CC.221 – Values to design the EV supply equipment during pre-charge based on Figure CC.212.....	85
Table CC.222 – Current ripple limits.....	104
Table CC.223 – Component valued for the inrush current limit test	109
Table CC.224 – Current ripple limits	111
Table CC.225 – Test setup values to measure side B voltage regulation in CVM during pre-charge	112
Table CC.226 – Current ripple limits.....	114
Table CC.227 – EV simulator characteristics	125
Table EE.201 – Test load parameters for system MCS	135
Table AAA.1 – Auxiliary voltage source of the EV supply equipment X_{S1}	144
Table AAA.2 – Auxiliary voltage source of the EV X_{V2}	146

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Electric vehicle conductive charging system -
Part 23-3: DC electric vehicle supply equipment -
Megawatt charging systems**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61851-23-3 has been prepared by IEC technical committee 69: Electric power/energy transfer systems for electrically propelled road vehicles and industrial trucks. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
69/1132/FDIS	69/1147/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This document is to be read in conjunction with IEC 61851-1:2017 and IEC 61851-23:2023.

The clauses of particular requirements in this document supplement or modify the corresponding clauses in IEC 61851-23:2023 and IEC 61851-1:2017. Where the text of subsequent clauses indicates an "addition", an "amendment" to or a "replacement" of the relevant requirement, test specification or explanation of IEC 61851-23:2023 or IEC 61851-1:2017, these changes are made to the relevant text of IEC 61851-23:2023 or IEC 61851-1:2017, which then becomes part of this document. Where no change is necessary, the words "IEC 61851-23:2023, [clause], is applicable" are used, where [clause] indicated the relevant clause. Replaced tables and figures are numbered starting from 201. Any additional items (clause, subclause, figure, etc.), which are not included in IEC 61851-23:2023, have a number starting from 201, for example 3.201, 201.1, etc. The new annexes of this document are numbered using triple-alphabet, for example Annex AAA to avoid confusion with the annexes of IEC 61851-23:2023.

In this document, the following print types are used:

- *test specifications: italic type.*
- notes: smaller roman type.

A list of all parts in the IEC 61851 series, published under the general title *Electric vehicle conductive charging system*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

Responding to the global challenges of CO₂ reduction and energy security, the automobile industry has started the development and commercialization of heavy-duty electric vehicles (EV). These heavy duty EVs are equipped with significantly larger batteries than passenger cars or light commercial vehicles. The charging power provided by standards published before the publication of this document does not allow recharging of these batteries within the time needed for a commercial application of heavy duty EVs – especially considering long routes with limited time for intermediate charging. Consequently, this document allows for superior charging power up to several megawatts and describes the related safety and interoperability requirements. Table 201 shows the comparison between IEC 61851-23 and this document.

Table 201 – Comparison between IEC 61851-23 and IEC 61851-23-3

Topic	IEC 61851-23:2023	IEC 61851-23-3
Rated maximum voltage of the EV supply equipment at side B (EV side)	1 000 V	1 250 V
Rated continuous current of the EV supply equipment at side B (EV side)	Maximum as defined in IEC 62196-3	As defined in IEC TS 63379
Basic signalling	CP and PP (Annex CC)	CE and ID
Digital communication	HomePlug GreenPHY (IEC 61851-24) with ISO 15118-2, ISO 15118-20 or DIN SPEC 70121 as application layer	Ethernet 10BASE-T1S (ISO 15118-10) with ISO 15118-20 as application layer

Although the system described in this document has been developed for heavy duty EVs, its application is not limited practically to these.

1 Scope

This part of IEC 61851 applies to the EV supply equipment to provide energy transfer between the supply network and electric vehicles (EVs), with a rated maximum voltage at side A (supply network side) up to 1 000 V AC or up to 1 500 V DC and a rated maximum voltage at side B (EV side) up to 1 250 V DC.

NOTE A rated maximum voltage of the EV supply equipment at side B of up to 1 500 V DC is under consideration.

This document specifies the EV supply equipment of megawatt charging system (MCS) equipped with a coupler according to IEC TS 63379. Systems different to MCS using a coupler specified in IEC TS 63379 are under consideration.

The requirements for bidirectional power flow systems are under consideration.

This document does not cover all safety aspects related to maintenance.

This document specifies systems with protective separation between side A and side B.

The requirements for digital communication between the EV supply equipment and the EV for control of energy transfer are defined in ISO 15118-10 and ISO 15118-20.

EV supply equipment in compliance with this document is not intended to provide energy transfer to a single EV using

- multiple vehicle connectors of the same EV supply equipment, or
- multiple EV supply equipment.

The requirements for such use cases are not specified in this document but are under consideration.

The requirements for EVs mated to EV supply equipment according to this document are specified in ISO 5474-3:2024, Annex B.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60364-4-43:2023, *Low-voltage electrical installations - Part 4-43: Protection for safety - Protection against overcurrent*

IEC 60364-5-54:2011, *Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors*

IEC 61851-23:2023, *Electric vehicle conductive charging system - Part 23: DC electric vehicle supply equipment*

IEC TS 63379:2026, *Vehicle connector, vehicle inlet and cable assembly for megawatt DC charging*

ISO 5474-3:2024, *Electrically propelled road vehicles - Functional and safety requirements for power transfer between vehicle and external electric circuit - Part 3: DC power transfer*

ISO 15118-10:2025, *Road vehicles - Vehicle-to-grid communication interface - Part 10: Physical layer and data link layer requirements for single-pair Ethernet*

ISO 15118-20:2022, *Road vehicles - Vehicle-to-grid communication interface - Part 2: 2nd generation network layer and application layer requirements*
ISO 15118-20:2022/AMD1:2026

IEEE 802.3-2022, *IEEE Standard for Ethernet*

10BASE-T1S channel and components requirements for link segments - Electrical requirements and measurements specification for 10BASE-T1S channels and components [online], Open Alliance Inc. Version 1.1, 2025, [viewed 2026-02-05]. Available at: <https://opensig.org/wp-content/uploads/2025/06/10BASE-T1S-Channel-and-Component-Requirements-for-Link-Segments.pdf>

Bibliography

IEC 60479 (all parts), *Effects of current on human beings and livestock*

IEC 60479-1:2018, *Effects of current on human beings and livestock - Part 1: General aspects*

IEC 60479-2:2019, *Effects of current on human beings and livestock - Part 2: Special aspects*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests*

IEC 60664-1:2020/AMD1:2025

IEC 61557-18, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC - Equipment for testing, measuring or monitoring of protective measures - Part 18: DC EV supply equipment monitoring device*⁷

IEC 61851-23:2014, *Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station*⁸

IEC 61851-23, *Electric vehicle conductive charging system - Part 23: DC electric vehicle supply equipment*⁹

IEC 61851-24, *Electric vehicle conductive charging system - Part 24: Digital communication between a DC EV supply equipment and an electric vehicle for control of DC charging*

IEC 62196-3, *Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3: Dimensional compatibility requirements for DC and AC/DC pin and contact-tube vehicle couplers*

IEC 62477-1:2022, *Safety requirements for power electronic converter systems and equipment - Part 1: General*

ISO 15118-2:2014, *Road vehicles - Vehicle-to-grid communication interface - Part 2: Network and application protocol requirements*

ISO 5474 (all parts), *Electrically propelled road vehicles - Functional and safety requirements for power transfer between vehicle and external electric circuit*

ISO 5474-1:2024, *Electrically propelled road vehicles - Functional and safety requirements for power transfer between vehicle and external electric circuit - Part 1: General requirements for conductive power transfer*

ISO 6469-3:2011, *Electrically propelled road vehicles - Safety specifications - Part 3: Protection of persons against electric shock*¹⁰

ISO 17409:2015, *Electrically propelled road vehicles - Connection to an external electric power supply - Safety requirements*¹¹

⁷ Under preparation. Stage at the time of publication: IEC/CCDV 61557-18:2025.

⁸ This publication has been withdrawn.

⁹ Edition 3 under preparation. Stage at the time of publication: IEC/CD 61851-23:2025.

¹⁰ This publication has been withdrawn.

¹¹ This publication has been withdrawn.

ISO/PAS 19295:2016, *Electrically propelled road vehicles - Specification of voltage sub-classes for voltage class B*¹²

DIN SPEC 70121:2014, *Electromobility - Digital communication between a DC EV charging station and an electric vehicle for control of DC charging in the combined charging system*

UL 2231-2:2012, *Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems*

¹² This publication has been withdrawn.