IEC 61851-21-2

Edition 1.0 2018-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electric vehicle conductive charging system –
Part 21-2: Electric vehicle requirements for conductive connection to an AC/DC supply – EMC requirements for off-board electric vehicle charging systems

Système de charge par conduction pour véhicules électriques –
Partie 21-2: Exigences applicables aux véhicules électriques pour connexion par conduction à une alimentation en courant alternatif ou courant continu – Exigences CEM concernant les systèmes de charge non embarqués pour véhicules électriques

IEC 61851-21-2:2018-04(en-fr)

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FOREWORD

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International Standard IEC 61851-21-2 has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

This bilingual version (2019-01) corresponds to the monolingual English version, published in 2018-04.

This first edition, together with IEC 61851-21-1, cancels and replaces IEC 61851-21:2001. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61851-21:2001:

a) this document addresses now only EMC related tests instead of other electrical tests;
b) Clauses 2 and 3 have been updated;

c) the port definition, the test-setups and their corresponding limits as well as the operation modes are defined more precisely;

d) Annexes A to F have been added.

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

FDIS	Report on voting
69/531/FDIS	69/545/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 21-2: Electric vehicle requirements for conductive connection to an AC/DC supply – EMC requirements for off-board electric vehicle charging systems

1 Scope

This part of IEC 61851 defines the EMC requirements for any off-board components or equipment of such systems used to supply or charge electric vehicles with electric power by conductive power transfer (CPT), with a rated input voltage, according to IEC 60038:2009, up to 1 000 V AC or 1 500 V DC and an output voltage up to 1 000 V AC or 1 500 V DC.

This document covers off-board charging equipment for mode 1, mode 2, mode 3 and mode 4 charging as defined in IEC 61851-1:2017.

Cables where there is no electronics or no electric/electronic switching are considered as passive (benign) and are deemed to comply with the emission and immunity requirements of this document without any need for testing.

This document does not apply to any on-board components or equipment of charging or power supply systems being part of the vehicles. The EMC requirements for such equipment are covered by IEC 61851-21-1: 2017.

Compliance with the emission and immunity requirements of this document is verified where it can be demonstrated that the equipment under test (EUT) meets the respective limits, during type tests in the measuring arrangement of this document.

Requirements for electric vehicle wireless power transfer (WPT) systems are covered in IEC 61980 (all parts).

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 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General requirements*

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

IEC 60038:2009, *IEC standard voltages*

IEC 62053-21:2003, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)*

IEC 61000-3-2:2014, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connexion*

IEC 61000-3-11:2017, *Electromagnetic compatibility (EMC) – Part 3-11 – Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 75 A and subject to conditional connection*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) – Part 3-12 – Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*
IEC 61000-4-11:2004/AMD1:2017

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009

IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*
IEC 61000-6-3:2006/AMD1:2010

IEC 61000-6-4:2006, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*
IEC 61000-6-4:2006/AMD1:2010

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*

CISPR 16-1-4:2010, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*
CISPR 16-1-4:2010/AMD1:2012
CISPR 16-1-4:2010/AMD2:2017

CISPR 25:2008, *Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of on-board receivers*[1]

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

MIL-STD-461F:2007, *Department of Defense interface standard requirements for the control of electromagnetic interference characteristics of subsystems and equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61851-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
associated equipment
AE
equipment needed to exercise and/or monitor the operation of the EUT

3.2
port
particular interface of the specified apparatus with external electromagnetic environment

Note 1 to entry: See Figure 1.

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1 3rd edition (2008). This 3rd edition has been replaced in 2016 by a 4th edition CISPR 25:2016, Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers.

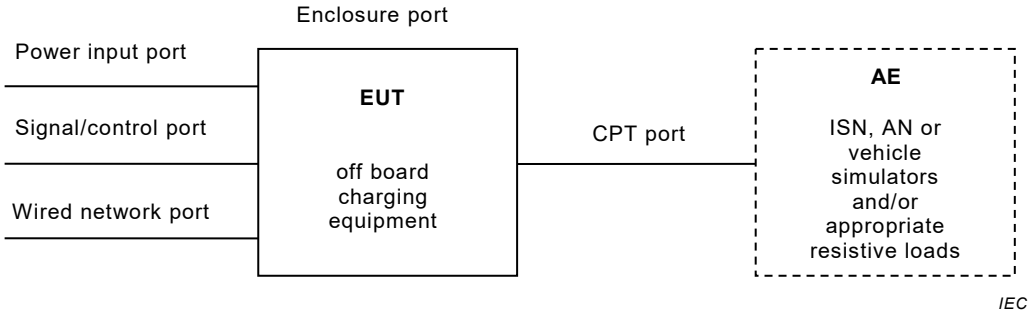

Figure 1 – Examples of ports of off- board charging equipment

3.3
enclosure port
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge on

[SOURCE: IEC 60050-445:2010, 445-07-04, modified – The words "time relay" have been replaced by "apparatus".]

3.4
power input port
input port at which a conductor or cable carrying the electrical power needed for the operation (functioning) of an apparatus or associated apparatus is connected to the apparatus

Note 1 to entry: A power input port can be AC or DC.

3.5
wired network port
port of connection for voice, data and signaling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network

Note 1 to entry: Examples of these include CATV, PSTN, ISDN, xDSL, LAN and similar networks.

Note 2 to entry: These ports can support screened or unscreened cables and can also carry AC or DC power where this is an integral part of the telecommunication specification.

[SOURCE: CISPR 32:2015, 3.1.32]

3.6
signal/control port
port at which a cable or conductor is connected for the purpose of transmission of signals excluding wired network and CPT ports

Note 1 to entry: Examples include RS-232, Universal Serial Bus (USB), High-Definition Multimedia Interface (HDMI), IEEE Standard 1394 ("Fire Wire"), analogue/digital input/outputs.

Note 2 to entry: An example of a control port is a port used to start the charging operation when a signal indicates that the energy tariff is lower and/or charging is delayed for energy management purposes.

3.7
conductive power transfer port
CPT port
power output port of charging equipment for electric vehicles serving conductive power transfer (CPT) of LV AC or DC electrical energy to the secondary device of the charging system (i.e. to the load to be charged or supplied with power) and also providing all required signaling/controlling and/or communication functions, for example control pilot, CAN and private PLC/T

3.8
equipment under test
EUT
off-board components or equipment of systems that are used to supply or charge electric vehicles with electric power by conductive power transfer (CPT) which are covered by the scope of this document

3.9
powerline telecommunication
PLT
powerline communication
PLC
signal transmission technology used for connection to a wire-line PSTN (public switched telephone network) via the LV AC (or DC) mains grid

Note 1 to entry: PLT/C is a transmission technology used for communications, data transfer, signaling/controlling and similar purposes in private and/or local area networks via a variety of types of power lines such as charger cables of off-board charging equipment for electric vehicles.

3.10
portable equipment
cord and plug connected equipment, cable assembly, adaptors or other accessories that are capable to be carried by one person and designed and intended to be carried within the EV

[SOURCE: IEC 61851-1:2017, 3.6.5]

3.11
high voltage
HV
operating voltage between 60 V to 1 000 V

Note 1 to entry: The term "high voltage" may be defined with a different voltage range in other standards.

3.12
low voltage
LV
operating DC voltage below 60 V, for example nominal voltages of 12 V, 24 V or 48 V

Note 1 to entry: The term "low voltage" may be defined with a different voltage range in other standards.

4 Test plan

4.1 General

An EMC test plan shall be established prior to testing. It shall contain, as a minimum, the elements given in Clause 4.

4.2 Configuration of EUT

All tests shall be carried out using a representative EUT and charge cable (at the conductive power transfer port – CPT port) to the AE/vehicle simulator as supplied by the manufacturer. Where the charge cable is not provided with the EUT (e.g. case B according to IEC 61851-1:2017), tests shall be performed with a typical length and geometry of the charge cable.

The contents of the standards referenced in this document are not repeated here; however modifications or additional information needed for practical application of the measurements of EUT's is given in this document.

The tests shall be carried out within the specified operating range of the EUT and at its rated supply voltage.

Test setups according to Annex A shall be used for the immunity and emission tests above 150 kHz.

In-cable control and protection devices (IC-CPDs), other portable equipment and mode 2 equipment shall be tested as per table top equipment.

4.3 Termination of the EUT during testing

All ports of the EUT shall be terminated with ANs/ISN or respectively CDNs as appropriate. The power input port, signal control port and wired network port shall be terminated according to Annex C.

The CPT port of the EUT shall be connected to the associated equipment (AE) covering the artificial networks (ANs) and/or impedance stabilization networks (ISNs) according to Annex C forming the vehicle simulator and connecting to an appropriate load.

The signalling/control lines of the CPT port shall be terminated according to Annex C and provide communication by respective simulation and fed in via suitable coupling devices.

4.4 Operating and test conditions

4.4.1 General

The following measurements and assessments may be performed in any order.

4.4.2 Immunity

The immunity requirements are specified in Table 1, Table 2, Table 3 and Table 4 according to the type of power input (AC or DC) and environmental classification (residential or non-residential) of the EUT to be tested.

Testing shall be performed in the following two operating modes:

- waiting mode: to simulate when the EUT is fully powered up and connected to a vehicle but not charging (for example, when the batteries are fully charged or if waiting for the power grid to decide when to charge);
- charge mode: during testing, the EUT shall be operated at 20 % of the maximum rated power ±10 %. If this is not possible according to IEC 61851-1:2017, the percentage may be raised.

It has been considered that no assessment is required when no load is connected since waiting mode adequately addresses this mode of operation.

In-cable control and protection devices (IC-CPD) shall be tested as off-board AC charging equipment.

The mode of operation shall be specified and the actual conditions, during the tests, shall be precisely noted in the test report.

4.4.3 Emissions

Emission requirements are specified in Table 7 to Table 14 and Table 16 to Table 19.

Testing shall be performed in the following operating modes:

- 20 % of maximum rated power ±10 % (if this is not possible according to IEC 61851-1:2017 the percentage may be raised); and
- 80 % of maximum rated power ±10 %; or
- with any load allowing the operation of the electrical vehicle supply equipment (EVSE), if the power input and output are directly connected in charge mode (mode 2 and mode 3 EVSE using mechanical switching devices). In this special case, testing with 20 % and 80 % is not necessary.

For low frequency phenomena (Table 5), tests shall be performed in accordance with the applicable product family standards (IEC 61000-3-X series).

The operating mode for testing according to 6.2.3 shall be one complete charge cycle with all outlets.

During the test time, all power output ports (CPT ports) shall be controlled according to the procedure described here:

- the single outlets/CPT ports shall be started/set in charge mode one by one (sequentially);
- all outlets/CPT ports shall be operated in charge mode simultaneously;
- the single outlets/CPT ports shall be stopped one by one (sequentially).

If parallel operation is not possible the power outputs shall be operated one by one (sequentially) in the test time. The power output (CPT port) shall operate with a constant load, and the power input of the EUT shall reach at least 80 % of maximum rated power ±10 % during testing.

If communication over control pilot circuits or other signal lines (e.g. powerline communication – PLC) is used between the EUT and the vehicle, for example to control the charging, tests shall be performed with the worst case communication signals, for example with (highest) data rates according to the manufacturer's specification.

If the data rate is limited by the EUT, this maximum data rate shall be used for testing.

4.4.4 Environmental conditions/limitations

This document has been prepared taking into account the normal EMC environments for all types of EUTs. By their very nature however, EUTs can be used and installed in a variety of locations. This document covers all residential, commercial, light industrial (see IEC 61000-6-1:2016, and IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010) and industrial environments (see IEC 61000-6-2:2005, and IEC 61000-6-4:2006 and IEC 61000-6-4:2006/AMD1:2010) irrespective of whether the equipment is located indoor or outdoor. Where the EUT manufacturer does not define the environment in which the EUT is intended to be used, the most stringent emission and immunity tests shall be performed (i.e. the lowest emission limits and highest immunity test levels shall be applied).

5 Immunity requirements

5.1 General

In addition to the normal EMC environments for all types of EUTs in the scope of the generic EMC standards of IEC 61000-6 (all parts), the specific EUTs in the scope of this document have a dedicated port (CPT port) to connect to electric vehicles (see Figure 1).

Testing shall be performed against one of the tables (Table 1, Table 2, Table 3 and Table 4) as appropriate, based on the type of EUT and environment in which it is intended to be operated (see also 4.4.4).