



BSI Standards Publication

In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)

National foreword

This British Standard is the UK implementation of EN 62752:2016+A1:2020. It is identical to IEC 62752:2016, incorporating amendment 1:2018 and corrigendum February 2019. It supersedes BS EN 62752:2016, which will be withdrawn on 8 May 2023.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted to Technical Committee PEL/23/1, Circuit breakers and similar equipment for household use.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected
31 March 2019	Implementation of IEC corrigendum February 2019: Figures 10b), 11a), 11b) and 11c) replaced
31 March 2020	Supersession details updated in national foreword
31 May 2020	Implementation of IEC amendment 1:2018 with CENELEC endorsement A1:2020

English Version

**In-cable control and protection device for mode 2 charging of
electric road vehicles (IC-CPD)
(IEC 62752:2016)**

Appareil de contrôle et de protection intégré au câble pour
la charge en mode 2 des véhicules électriques (IC-CPD)
(IEC 62752:2016)

Ladeleitungsintegrierte Steuer- und Schutzeinrichtung für
die Ladebetriebsart 2 von Elektro-Straßenfahrzeugen (IC-
CPD)
(IEC 62752:2016)

This European Standard was approved by CENELEC on 2016-04-08. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 23E/919/FDIS, future edition 1 of IEC 62752, prepared by SC 23E “Circuit-breakers and similar equipment for household use” of IEC/TC 23 “Electrical accessories” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62752:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-02-19
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-12-31

This European Standard partially supersedes EN 61851-1:2011 for what concerns the product IC-CPD as a cable assembly for mode 2 EV charging. The DOW will be 2017-12-31.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directives see informative Annexes ZZA and ZZB, which are integral parts of this document.

Endorsement notice

The text of the International Standard IEC 62752:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60269-1:2006	NOTE	Harmonized as EN 60269-1:2007 (not modified).
IEC 60364 Series	NOTE	Harmonized as HD 384/HD 60364 Series.
IEC 60364-7-722	NOTE	Harmonized as HD 60364-7-722.
IEC 60999-1:1999	NOTE	Harmonized as EN 60999-1:2000 (not modified).
IEC 60947-1:2007	NOTE	Harmonized as EN 60947-1:2007 (not modified).
IEC 61008-1:2010	NOTE	Harmonized as EN 61008-1:2012 (modified).
IEC 62423:2009	NOTE	Harmonized as EN 62423:2009 (modified).

Foreword to amendment A1

The text of document 23E/1055/FDIS, future IEC 62752/A1, prepared by SC 23E "Circuit-breakers and similar equipment for household use" of IEC/TC 23 "Electrical accessories" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62752:2016/A1:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-11-08
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-05-08

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For the relationship with EU Directive(s), see informative Annex ZZ.

Endorsement notice

The text of the International Standard IEC 62752:2016/A1:2018 was approved by CENELEC as a European Standard without any modification.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60065 (mod)	-	Audio, video and similar electronic apparatus - Safety requirements	EN 60065	2014
			+ A11	2017
IEC 60068-2-1	-	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	2007
IEC 60068-2-5	-	Environmental testing – Part 2-5: Tests – Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing	EN IEC 60068-2-5	2018
IEC 60068-2-11	-	Basic environmental testing procedures - Part 2-11: Tests - Test Ka: Salt mist	EN 60068-2-11	1999
IEC 60068-2-27	-	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	2009
IEC 60068-2-30	-	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60068-2-31	-	Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens	EN 60068-2-31	2008
IEC 60068-2-64	-	Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance	EN 60068-2-64	2008
			+ A1	2019
IEC 60068-3-4	-	Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	EN 60068-3-4	2002
IEC 60112	-	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112	2003
			+ A1	2009

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60227	series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V	EN 50525	series
IEC 60245	series	Rubber insulated cables - Rated voltages up to and including 450/750 V	EN 50525	series
IEC 60309	series	Plugs, socket-outlets and couplers for industrial purposes	EN 60309	series
IEC 60309-1	1999	Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements	EN 60309-1	1999
+ A1 (mod)	2005		+ A1	2007
+ A2	2012		+ A2	2012
IEC 60309-2		Plugs, socket-outlets and couplers for industrial purposes - Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories	EN 60309-2	1999
			+ A1 (mod)	2007
			+ A2	2012
IEC 60364-4-44 (mod)	2007	Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances	HD 60364-4-442	2012
IEC 60384-14	series	Fixed capacitors for use in electronic equipment - Part 14: Sectional specification - Fixed capacitors for electromagnetic interference suppression and connection to the supply mains	EN 60384-14	series
IEC 60417	1973 ¹	Graphical symbols for use on equipment. - Index, survey and compilation of the single sheets.		-
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529	1991
-	-		+ corrigendum May 1993	1993
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60664-3	-	Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	2017
IEC 60695-2-10	-	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2013

¹ Dated as no equivalent European Standard exists.

EN 62752:2016+A1:2020 (E)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60695-2-11	-	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (GWEPT)	EN 60695-2-11	2014
IEC 60884-1	2002	Plugs and socket-outlets for household and similar purposes -- Part 1: General requirements	-	-
+ A1	2006		-	-
+ A2	2013		-	-
IEC 61249-2	series	Materials for printed boards and other interconnecting structures	EN 61249-2	series
IEC/TS 61439-7	2014	Low-voltage switchgear and controlgear - assemblies - Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations	-	-
IEC 61540	-	Electrical accessories - Portable residual current devices without integral overcurrent protection for household and similar use (PRCDs)	HD 639 S1 (mod)	2002
-	-		+ A1	2003
-	-		+ corrigendum	Jul. 2003
-	-		+ A2	2010
IEC 61543	1995	Residual current-operated protective devices (RCDs) for household and similar use - Electromagnetic compatibility	EN 61543	1995
+ A1	2004		-	-
-	-		+ corrigendum	1997 Dec.
-	-		+ A11	2003
-	-		+ A12	2005
+ A2	2005		+ A2	2006
IEC 61851-1	2017	Electric vehicle conductive charging system - Part 1: General requirements	EN IEC 61851-1	2019
IEC 62196	series	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles	EN 62196	series
IEC 62196-1	-	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 1: General requirements	EN 62196-1 (mod)	2014
IEC 62196-2	-	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories	EN 62196-2	2017

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 14	series	Electromagnetic compatibility Requirements for household appliances, electric tools and similar apparatus	- EN 55014	series
CISPR 14-1	2016	Electromagnetic compatibility Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission	- EN 55014-1	2017
-	-		+ A11	2020
ISO 178	2019	Plastics – Determination of flexural properties	EN ISO 178	2019
ISO 179	series	Plastics - Determination of Charpy impact properties	EN ISO 179	series
ISO 179-1	-	Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test	EN ISO 179-1	2010
ISO 2409	-	Paints and varnishes - Cross-cut test	EN ISO 2409	2013
ISO 4628-3	-	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 3: Assessment of degree of rusting	EN ISO 4628-3	2016
ISO 4892-2	2013	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps	EN ISO 4892-2	2013
ISO 16750-5	2010	Road vehicles_ - Environmental conditions - and testing for electrical and electronic equipment_ - Part_5: Chemical loads		-
ISO 17409	2015	Electrically propelled road vehicles - - Connection to an external electric power supply - Safety requirements		-

Annex ZB (normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions.

NOTE If it affects harmonization, it forms part of the European Standard or Harmonization Document.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

<u>Country</u>	<u>Clause</u>	<u>Special national condition</u>
Denmark	1	IC-CPD: For IC-CPDs supplied with a plug for household and similar use, repeated continuous loads of long duration, shall be limited to 6 A.
Finland	1	IC-CPD: The following additional requirement applies: for IC-CPDs supplied with a plug for household and similar use the maximum charging current is 8 A for long lasting charging.
Norway	4.3.4	IC-CPD: In Norway, pluggable types where connector is part of the ICCB shall not be used.
Switzerland	5.3.2	IC-CPD: In Switzerland, simplified control pilot circuit is not allowed.
Switzerland	5.3.2	IC-CPD: In Switzerland, the use of EN 60309-2 accessories is recommended for mode 2 connections for more than 8 A (2 kVA).
France	8.1	IC-CPD: In France, the use of solid brass pins is required.
France	8.3.1	IC-CPD: In France, For a rated current above 8 A, rewirable connections of the household plug are not allowed. Connection between the household plugs and cable shall use terminations (see definition 3.2.3).
Switzerland	8.3.1	IC-CPD: In Switzerland, the use of EN 60309-2 accessories is recommended for mode 2 connections for more than 8 A (2 kVA).
Belgium	9.7.7.4	IC-CPD: In Belgium, an IC-CPD shall be able to function properly in both LNE and LLE configurations, provided the correct voltage is available.

Annex ZC (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN-CENELEC national member.

This European Standard falls under Directives 2014/35/EU and 2014/30/EU.

NOTE (from CEN/CENELEC IR Part 2:2015, 2.16) Where standards fall under EC Directives or Regulations, it is the view of the Commission of the European Communities (OJ No C 59; 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted within the EC except under the safeguard procedure provided for in the relevant Directive or Regulation.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

<u>Country</u>	<u>Clause</u>	<u>A-deviation</u>
Denmark	General	The requirements in this standard cannot replace or change any part of the Danish National requirements for plugs for household and similar use according to DS 60884-2-D1.

Annex ZZ (informative)

Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered

This European Standard has been prepared under a Commission's standardization request relating to harmonized standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZ.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZZ.1 – Correspondence between this European standard and Article 3 of Directive 2014/35/EU [2014 OJ L153]

Safety Objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
(1)(a)	1, 2, 3, 4, 5, 6 and 9.3	
(1)(b)	8.1, 8.2, 8.3, 9.4, 9.6, 9.20, 9.21, 9.22, 9.23, 9.24 and 9.25	
(1)(c)	7, 9.1 and 9.2 plus Annex B	
(2) (a)	8.5, 8.8, 8.6, 8.9, 8.15, 8.16, 8.23, 8.22, 9.4, 9.5, 9.7, 9.7.7, 9.7.10, 9.8, 9.13, 9.15, 9.16 and 9.14 plus Annex A	
(2) (b)	8.7, 8.9, 8.10, 8.17, 9.6, 9.8 and 9.9 plus Annex A	
(2) (c)	8.4.2, 8.14, 9.7 and 9.13	
(2) (d)	8.4.3, 8.6, 8.19, 9.5, 9.19, 9.27, 9.28 and 9.34 plus Annex C	
(3) (a)	8.11, 8.18, 8.25, 9.10, 9.17, 9.18, 9.29, 9.32 and 9.36	
(3) (b)	8.12, 8.13, 8.16, 8.20, 8.21, 8.24, 9.7.3.7, 9.7.3.8, 9.11, 9.12, 9.16, 9.26, 9.29, 9.30, 9.31, 9.32, 9.33, 9.34 and 9.35	
(3) (c)	8.7, 8.10, 9.6 and 9.10	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Annex ZZA (informative)

Relationship between this European standard and the essential requirements of Directive 2014/30/EU [2014 OJ L96] aimed to be covered

This European standard has been prepared under a Commission's standardisation request as regards harmonised standards in support of Directive 2014/30/EU relating to electromagnetic compatibility, to provide one voluntary means of conforming to essential requirements of Directive 2014/30/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 electromagnetic compatibility [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

**Table ZZA.1 – Correspondence between this European standard and Annex I of Directive
2014/30/EU [2014 OJ L96]**

Essential requirements of Directive 2014/30/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
All requirements are covered by complying clause 9.26 of the standard	§9.26	

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

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Annex ZZB
(informative)**Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered**

This European standard has been prepared under a Commission's standardisation request relating to harmonised standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/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 electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding safety objectives of that Directive, and associated EFTA regulations.

Table ZZB.1 – Correspondence between this European standard and Annex I of Directive 2014/35/EU [2014 OJ L96]

Safety objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
Within the limits of the scope, all requirements are covered by complying all clauses of the standard.	All normative clauses	

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

IN-CABLE CONTROL AND PROTECTION DEVICE FOR MODE 2 CHARGING OF ELECTRIC ROAD VEHICLES (IC-CPD)

FOREWORD

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International Standard IEC 62752 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories, in co-operation with ISO TC 22/SC 37 Electrically propelled vehicles.

It is published as a double logo standard.

The text of this standard is based on the following documents:

FDIS	Report on voting
23E/919/FDIS	23E/938/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 11 P members out of 12 having cast a vote.

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

In this standard, the following print types are used:

- Requirements proper, in roman type;
- *Test specifications, in italic type;*
- NOTES, in smaller roman type.

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

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

Ⓐ₁ Text deleted Ⓐ₁

The contents of the corrigendum of February 2019 have been included in this copy.

INTRODUCTION

The essential purpose of this standard is safe and reliable access of electric vehicles to a supply system. The definition for mode 2 charging of electric vehicle is described in IEC 61851-1.

For all charging modes, protection against electric shock in case of failure of basic protection and/or fault protection is provided, at least by a type A RCD (see IEC 60364-7-722 and IEC 61851-1).

For mode 2 charging including the situation where it cannot be guaranteed that the installation is equipped with RCDs, for example charging the electric vehicle at an unknown installation, a dedicated protection is used for the connected electric vehicle. The intention of this standard is to describe the relevant requirements for an in-cable control and protection device (IC-CPD) to be used for mode 2 charging.

A1 Text deleted **A1**

IN-CABLE CONTROL AND PROTECTION DEVICE FOR MODE 2 CHARGING OF ELECTRIC ROAD VEHICLES (IC-CPD)

1 Scope

This International Standard applies to in-cable control and protection devices (IC-CPDs) for mode 2 charging of electric road vehicles, hereafter referred to as IC-CPD including control and safety functions.

This standard applies to portable devices performing simultaneously the functions of detection of the residual current, of comparison of the value of this current with the residual operating value and of opening of the protected circuit when the residual current exceeds this value.

The IC-CPD according to this standard

- **A1** • has a control pilot function controller in accordance with IEC 61851-1:2017, Annex A; **A1**
 - checks supply conditions and prevents charging in case of supply faults under specified conditions;
 - may have a switched protective conductor.

These IC-CPDs are intended for use in TN-, and TT-systems.

The use of IC-CPDs in IT systems may be limited.

Residual currents with frequencies different from the rated frequency, d.c. residual currents and specific environmental situation are considered.

This standard is applicable to IC-CPDs performing the safety and control functions as required in IEC 61851-1 for mode 2 charging of electric vehicles.

This standard is applicable to IC-CPDs for single-phase circuits not exceeding 250 V or multi-phase circuits not exceeding 480 V, their maximum rated current being 32 A.

NOTE 1 In Denmark, the following additional requirement applies: for IC-CPDs supplied with a plug for household and similar use the maximum charging current is 8 A, if the charging cycle can exceed 2 h.

NOTE 2 In Finland, the following additional requirement applies: for IC-CPDs supplied with a plug for household and similar use the maximum charging current is 8 A for long lasting charging.

This standard is applicable to IC-CPDs to be used in a.c. circuits only, with preferred values of rated frequency 50 Hz, 60 Hz or 50/60 Hz. IC-CPDs according to this standard are not intended to be used to supply electric energy towards the connected grid.

This standard is applicable to IC-CPDs having a rated residual operating current not exceeding 30 mA and are intended to provide additional protection for the circuit downstream of the IC-CPD in situations where it cannot be guaranteed that the installation is equipped with an RCD with $I_{\Delta n} \leq 30$ mA.

The IC-CPD consists of:

- a plug for connection to a socket-outlet in the fixed installation;
- one or more subassemblies containing the control and protection features;
- a cable between the plug and the subassemblies (optional);

- a cable between the subassemblies and the vehicle connector (optional);
- a vehicle connector for connection to the electric vehicle.

For plugs for household and similar use the respective requirements of the national standard and specific requirements defined by the national committee of the country where the product is placed on the market apply. If no national requirements exist, IEC 60884-1 may be used. For industrial plugs IEC 60309-2 applies. For specific applications and areas non interchangeable industrial plugs may be used. In this case IEC 60309-1 applies

NOTE 3 In Denmark: the requirements in this standard cannot replace or change any part of the Danish National requirements for plugs for household and similar use according to DS 60884-2-D1.

Plugs, connectors and cables which are part of the IC-CPD are not tested according to this standard. These parts are tested separately according to their specific product standard.

NOTE 4 In the following countries, requirements for EV (mode 2) Cord Sets are covered by NMX-J 677-ANCE-2013/ CSA C22.2 No. 280-13/ UL 2594: Standard for Electric Vehicle Supply Equipment: US, CA, MX.

The switching contacts of the IC-CPD are not required to provide isolation, as isolation can be ensured by disconnecting the plug.

The IC-CPD may have a non-replaceable integral fuse in the phase(s) and/or neutral current path.

A1 The IC-CPD is not considered to be a protective device for use in fixed installations. **A1**

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-5, *Environmental testing – Part 2-5: Tests – Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing*

IEC 60068-2-11, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h+ 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 60068-3-4, *Environmental testing – Part 2-34: Supporting documentation and guidance – Damp heat tests*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750V*

IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*

IEC 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60309-1:1999/AMD1:2005

IEC 60309-1:1999/AMD2:2012

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60384-14 (all parts), *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417, *Graphical symbols for use on equipment* (available at: <http://www.graphical-symbols.info/equipment>)

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60884-1:2002, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*¹

IEC 60884-1:2002/AMD1:2006

IEC 60884-1:2002/AMD2:2013

IEC 61249-2 (all parts), *Materials for printed boards and other interconnecting structures*

A1 IEC TS 61439-7:2014, *Low-voltage switchgear and controlgear assemblies – Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations* **A1**

¹ A consolidated edition (3.2) exists including IEC 60884-1 (2002) and its Amendment 1 (2006) and Amendment 2 (2013).

IEC 61540, *Electrical accessories – Portable residual current devices without integral overcurrent protection for household and similar use (PRCDs)*

IEC 61543:1995, *Residual current-operated protective devices (RCDs) for household and similar use – Electromagnetic compatibility*

IEC 61543:1995/AMD1:2004

IEC 61543:1995/AMD2:2005

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

 IEC 62196 (all parts), *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles* 

IEC 62196-1, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements*

IEC 62196-2, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories*

 Text deleted 

CISPR 14 (all parts), *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus*

 CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission* 

ISO 178, *Plastics – Determination of flexural properties*

ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

ISO 179-1, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 2409, *Paints and varnishes – Cross-cut test*

ISO 4628-3, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting*

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 16750-5:2010, *Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 5: Chemical loads*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE 1 Where the terms "voltage" and "current" are used, they imply r.m.s. values, unless otherwise specified.

NOTE 2 Throughout this standard, the word "earthing" is used for "protective earthing".

NOTE 3 The term "accessory" is used as a general term covering plugs, socket-outlets, [vehicle connectors](#) and [vehicle couplers](#).

3.1 Terms and definitions relating to plugs and socket-outlets

3.1.1

plug

accessory intended for frequent use by ordinary persons, having pins designed to engage with the contacts of a socket-outlet, also incorporating means for the electrical connection and mechanical retention of one flexible cable

Note 1 to entry: For special purposes such as lighting chains (see also IEC 60598-2-20), two or three single-core cables can be connected within the plug.

[SOURCE: IEC 60884-1:2002/AMD2:2013, 3.1]

3.1.2

socket-outlet

accessory intended for frequent use by ordinary persons, having socket contacts designed to engage with the pins of a plug and having terminals or terminations for the connection of cable

[SOURCE: IEC 60884-1:2002/AMD2:2013, 3.2]

3.1.3

non-rewirable plug

non-rewirable vehicle connector

accessory so constructed that it forms a complete unit with the flexible cable or cord after connection and assembly by the manufacturer of the accessory

Note 1 to entry: See also 14.1 of IEC 60884-1:2002.

3.1.4

rewirable accessory by manufacturer

accessory so constructed that the flexible cable can be replaced

Note 1 to entry: The accessory is so constructed that it can only be rewired, repaired or replaced by the manufacturer's authorized personnel, its agent or similar qualified person.

3.1.5

vehicle coupler

electric vehicle coupler

means enabling the connection at will of a flexible cable to an electric vehicle

Note 1 to entry: It consists of two parts: a vehicle connector and a vehicle inlet

[SOURCE: IEC 62196-1:2014, 3.3]

3.1.6

vehicle connector

electric vehicle connector

part of a vehicle coupler integral with, or intended to be attached to, one flexible cable

[SOURCE: IEC 62196-1:2014, 3.3.1]

3.1.7

vehicle inlet

electric vehicle inlet

part of a vehicle coupler incorporated in, or fixed to, the electric vehicle

[SOURCE: IEC 62196-1:2014, 3.3.2]

3.1.8

pluggable

electrical connection which is intended to be plugged or unplugged by the end-user

3.1.9

portable equipment

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

3.1.10

adaptor

portable accessory constructed as an integral unit incorporating both a plug portion and one socket-outlet portion

3.2 Terms and definitions relating to terminals

3.2.1

clamping unit

part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure

[SOURCE: IEC 60999-1:1999, 3.1]

3.2.2

terminal

conductive part of one pole, composed of one or more clamping unit(s) and insulation if necessary

[SOURCE: IEC 60999-1:1999, 3.2]

3.2.3

termination

conductive part of a device, provided for reusable electrical connection to external circuits

3.2.4

screw-type terminal

terminal for the connection and subsequent disconnection of a conductor or for the interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

3.2.5

screw terminal

screw-type terminal in which the conductor is clamped under the head of the screw at which the clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device

3.2.6

screwless terminal

connecting terminal for the connection and subsequent disconnection of one conductor or the dismantlable interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc., without special preparation of the conductor other than removal of insulation

[SOURCE: IEC 61008-1:2010, 3.6.8]

3.3 Terms and definitions relating to residual current functions

3.3.1 Terms and definitions relating to currents flowing from live parts to earth

3.3.1.1

earth fault current

current flowing to earth due to an insulation fault

[SOURCE: IEC 61008-1:2010, 3.1.1]

3.3.1.2

earth leakage current

current flowing from the live parts of the installation to earth in the absence of an insulation fault

[SOURCE: IEC 61008-1:2010, 3.1.2]

3.3.1.3

pulsating direct current

current of pulsating waveform which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding 0,006 A d.c. during one single interval of time, expressed in angular measure, of at least 150°

[SOURCE: IEC 61008-1:2010, 3.1.3]

3.3.1.4

current delay angle α

time, expressed in angular measure, by which the starting instant of current conduction is delayed by phase control

[SOURCE: IEC 61008-1:2010, 3.1.4]

3.3.1.5

supply failure

- open neutral;
- open line(s).

Note 1 to entry: See 3.3.3.18 for hazardous live protective conductor.

[SOURCE: IEC 62335:2008, 3.2.1.6, modified – "open protective earth" has been deleted.]

3.3.1.6

smooth direct current

direct current which is ripple free

[SOURCE: IEC 62423:2009, 3.1]

3.3.1.7

composite current

current which consists of more than one significant sinusoidal frequency

3.3.2 Terms and definitions relating to the energization of the residual current function

3.3.2.1 residual current

I_{Δ}
vector sum of the instantaneous values of the current flowing in the main circuit of the residual current function (expressed as r.m.s. value)

[SOURCE: IEC 61008-1:2010, 3.2.3, modified – “RCCB” has been replaced by “residual current function”]

3.3.2.2 residual operating current

value of residual current which causes the residual current function to operate under specified conditions

[SOURCE: IEC 61008-1:2010, 3.2.4, modified – replacement of “RCCB” by “residual current function”]

3.3.2.3 residual non-operating current

value of residual current at and below which the residual current function does not operate under specified conditions

[SOURCE: IEC 61008-1:2010, 3.2.5, modified – replacement of “RCCB” by “residual current function”]

3.3.3 Terms and definitions relating to the operation and to the functions of the IC-CPD

3.3.3.1 residual current function

function incorporating the means of detection of a residual current, of comparison of its value to the residual current operating value and of opening the protected circuit when the residual current exceeds this value

3.3.3.2 IC-CPD in-cable control and protection device

assembly of linked parts or components including cables, plug and vehicle connector for supplying electric vehicles in charging mode 2, which performs control functions and safety functions

Note 1 to entry: For the use of the IC-CPD, see Figure 32.

Note 2 to entry: This note applies to the French language only.

3.3.3.3 switching device

device designed to make or break the current in one or more electric circuits

[SOURCE: IEC 61008-1:2010, 3.3.6]

3.3.3.4 break-time

time which elapses between the instant when the residual operating current is suddenly attained and the instant of arc extinction in all poles of an IC-CPD

3.3.3.5

closed position

position in which the predetermined continuity of the main circuit of the IC-CPD is secured

[SOURCE: IEC 61008-1:2010, 3.3.12, modified – "RCCB" has been replaced by "IC-CPD".]

3.3.3.6

open position

position in which the predetermined clearance between open contacts in the main circuit of the IC-CPD is secured

[SOURCE: IEC 61008-1:2010, 3.3.13, modified – replacement of "RCCB" by "IC-CPD".]

3.3.3.7

pole

part of an IC-CPD associated exclusively with one electrically separated conducting path of its main circuit provided with contacts intended to connect and disconnect the main circuit itself and excluding those portions which provide means for mounting and operating the poles together

[SOURCE: IEC 61008-1:2010, 3.3.14, modified – replacement of "RCCB" by "IC-CPD".]

3.3.3.8

main circuit

all conductive parts of an IC-CPD included in the current paths

3.3.3.9

control circuit

 circuit (other than a path of the main circuit) intended for the closing operation or the opening operation, or both, of an IC-CPD 

Note 1 to entry: See Figure E.1.

3.3.3.10

test device

device incorporated in the IC-CPD simulating the residual current conditions for the operation of the IC-CPD under specified conditions

3.3.3.11

IC-CPD type LNSE

device with a switched protective conductor that is used on a line (phase) to neutral supply (L, N, PE)

Note 1 to entry: See Annex D for examples.

3.3.3.12

IC-CPD type LLSE

device with a switched protective conductor that is used on a line (phase) to line (phase) supply (L1, L2, PE)

Note 1 to entry: See Annex D for examples.

3.3.3.13

IC-CPD type LLLNSE

device with a switched protective conductor that is used on a multiphase supply (L1, L2, L3, N, PE)

Note 1 to entry: A type LLLNSE IC-CPD uses one or more phases of a multiphase supply.

3.3.3.14

IC-CPD type LNE

device with a non-switched protective conductor that is used on a line (phase) to neutral supply (L, N, PE)

3.3.3.15

IC-CPD type LLE

device with a non-switched protective conductor that is used on a line (phase) to line (phase) supply (L1, L2, PE)

3.3.3.16

IC-CPD type LLLNE

device with a non-switched protective conductor that is used on a multiphase supply (L1, L2, L3, N, PE)

Note 1 to entry: A type LLLNE IC-CPD uses one or more phases of a multiphase supply.

3.3.3.17

protective conductor

PE (identification)

conductor provided for purposes of safety, for example protection against electric shock

[SOURCE: IEC 60050-195, 195-02-09:1998]

3.3.3.18

hazardous live protective conductor

miswiring or fault condition where the protective contact of the socket outlet is live

Note 1 to entry: See 3.3.1.5 for supply failure.

3.3.3.19

control pilot function controller

function controller which generates a PWM-signal and detects a charging state

Note 1 to entry: See Figure E.1

3.3.3.20

switching function

device to switch power and / or protective conductor to the EV to provide charging

Note 1 to entry: See Figure E.1.

3.3.4 Terms and definitions relating to values and ranges of energizing quantities

3.3.4.1

non-operating overcurrent

maximum value of overcurrent of a single-phase load in the main circuit which, in the absence of any fault to frame or to earth, and in the absence of an earth leakage current, can flow through a two-pole IC-CPD without causing the IC-CPD to open the circuit

3.3.4.2

residual short-circuit withstand current

maximum value of the residual current for which the operation of the IC-CPD is ensured under specified conditions and above which the device may be damaged

[SOURCE: IEC 61008-1:2010, 3.4.3, modified – replacement of "RCCB" by "IC-CPD", and "undergo irreversible alterations" by "be damaged".]

3.3.4.3

prospective current

current that would flow in the circuit, if each main current path of the IC-CPD and of the overcurrent protective device (if any) were replaced by a conductor of negligible impedance

Note 1 to entry: This definition applies also in the same manner as an actual current, for example prospective breaking current, prospective peak current, prospective residual current.

[SOURCE: IEC 61008-1:2010, 3.4.4, modified – replacement of "RCCB" by "IC-CPD", and replacement of the note to entry.]

3.3.4.4

making capacity

value of the a.c. component of a prospective current that an IC-CPD is capable of making at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.7, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.5

breaking capacity

value of the a.c. component of a prospective current that an IC-CPD is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.8, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.6

residual making and breaking capacity

value of the a.c. component of a residual prospective current which an IC-CPD can make, carry for its opening time and break under specified conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.9, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.7

conditional short-circuit current

value of the a.c. component of a prospective current, which an IC-CPD protected by a suitable short-circuit protective device (hereinafter referred to as SCPD) in series, can withstand under specified conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.10, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.8

conditional residual short-circuit current

value of the a.c. component of a residual prospective current which an IC-CPD, protected by a suitable SCPD in series, can withstand under specified conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.11, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.9

U_x

limiting value U_x of the line voltage for IC-CPDs to perform its intended functions as declared by the manufacturer for IC-CPDs

3.3.4.10

I^2t

joule integral

integral of the square of the current, over a given time interval (t_0 , t_1):

$$I^2 t = \int_{t_0}^{t_1} I^2 dt$$

3.3.4.11

recovery voltage

voltage which appears across the supply connections of an IC-CPD after the breaking of the current

Note 1 to entry: This voltage comprises two successive intervals of time, one during which a transient voltage exists, followed by a second one during which power-frequency voltage alone exists.

[SOURCE: IEC 61008-1:2010, 3.4.14, modified – replacement of "a pole of an RCCB" by "the supply connections of an IC-CPD" and replacement of the note to entry.]

3.3.4.11.1

transient recovery voltage

recovery voltage during the time in which it has a significant transient character

Note 1 to entry: The transient voltage is an oscillatory or non-oscillatory or a combination of these depending on the characteristics of the circuit and of the IC-CPD.

[SOURCE: IEC 61008-1:2010, 3.4.14.1, modified – replacement of "RCCB" by "IC-CPD" and deletion of the last sentence of the note to entry.]

3.3.4.11.2

power-frequency recovery voltage

recovery voltage after the transient voltage phenomena have subsided

[SOURCE: IEC 61008-1:2010, 3.4.14.2]

3.3.5 Terms and definitions relating to values and ranges of influencing quantities

3.3.5.1

influencing quantity

any quantity likely to modify the specified behaviour of an IC-CPD

3.3.5.2

ambient air temperature

temperature, determined under the prescribed conditions, of the air surrounding the IC-CPD

[SOURCE: IEC 61008-1:2010, 3.5.6, modified – replacement of "RCCB (for an enclosed RCCB it is the air outside the enclosure)" by "IC-CPD".]

3.3.6 Conditions of operation

3.3.6.1

operation

transfer of the moving contact(s) from the open position to the closed position or vice versa

Note 1 to entry: If distinction is necessary, an operation in the electrical sense (e.g. make or break) is referred to as a switching operation and an operation in the mechanical sense (e.g. close or open) is referred to as a mechanical operation.

[SOURCE: IEC 61008-1:2010, 3.7.1]

3.3.6.2

closing operation

operation by which the IC-CPD is brought from the open position to the closed position

[SOURCE: IEC 61008-1:2010, 3.7.2, modified – replacement of "RCCB" by "IC-CPD".]

3.3.6.3

opening operation

operation by which the IC-CPD is brought from the closed position to the open position

[SOURCE: IEC 61008-1:2010, 3.7.3, modified – replacement of "RCCB" by "IC-CPD".]

3.3.6.4

operating cycle

succession of operations from one position to another and back to the first position

[SOURCE: IEC 61008-1:2010, 3.7.4, modified – deletion of "through all other positions, if any".]

3.3.6.5

sequence of operation

succession of specified operations with specified time intervals

[SOURCE: IEC 61008-1:2010, 3.7.5]

3.3.7 Terms and definitions relating to control functions between electric vehicle and IC-CPD

3.3.7.1

pilot function

any means, electronic or mechanical, that insures the conditions related to the safety or the transmission of data required for the mode of operation

[SOURCE: IEC 61851-1:2010, 3.17]

3.3.7.2

system state

A1 state that indicates different states during the charging process according to IEC 61851-1:2017, Annex A

EXAMPLE Connected, ready to charge, charging. **A1**

3.4 Terms and definitions relating to tests

3.4.1

type test

test of one or more devices made to a certain design to show that the design meets certain requirements

[SOURCE: IEC 61008-1:2010, 3.8.1]

3.4.2

routine test

test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

[SOURCE: IEC 61008-1:2010, 3.8.2]

3.4.3

self test

automatically initiated verification of the ability of the IC-CPD to detect a residual current

3.5 Terms and definitions relating to construction

3.5.1

function box

control functions and / or safety functions integrated in appropriate enclosures which are part of the IC-CPD

Note 1 to entry: The function box is located in a detachable cable assembly or connector or plug that is not part of the fixed installation.

3.5.2

class I equipment

equipment with basic insulation as provision for basic protection and protective bonding as provision for fault protection

[SOURCE: IEC 62335:2008, 3.1.22]

4 Classification

4.1 According to the supply

4.1.1 General

An IC-CPD can be classified to be compatible with more than one supply system.

4.1.2 IC-CPD supplied from one phase and neutral (LNSE or LNE)

IC-CPDs according to this classification are supplied from one phase and neutral.

4.1.3 IC-CPD supplied from two phases (LLSE or LLE)

IC-CPDs according to this classification are supplied from two phases.

4.1.4 IC-CPD supplied from three phases and neutral (LLLNSE or LLLNE)

IC-CPDs according to this classification are supplied from three phase and neutral.

NOTE This classification covers IC-CPDs using one or more phases of a multiphase supply.

4.2 According to the construction

4.2.1 General

An IC-CPD can be classified according to one of the following constructions.

4.2.2 IC-CPD including the function box separated from the plug and connector

Residual current function, switching device and control pilot function controller integrated into a function box between the plug and the vehicle connector (see Figure F.1)

4.2.3 IC-CPD with the function box integrated together with the plug

Residual current function, switching device and control pilot function controller integrated into the plug (see Figure F.2).

NOTE 1 The requirements for the plug parts are covered by the relevant standards.

NOTE 2 The maximum torque is given in 9.23.

4.2.4 Modular IC-CPD

A modular IC-CPD can be one of the following constructions:

- a) residual current function and switching device integrated into the plug and control pilot function controller integrated into a separate function box between the plug and the vehicle connector (see Figure F.3);

NOTE 1 In the following countries, the IC-CPD function box is required to be an integral part of the attachment plug or shall be located in the power-supply cord not more than 300 mm from the attachment plug: US

- b) residual current function and switching device integrated into the plug and control pilot function controller integrated into the vehicle connector (see Figure F.4).

NOTE 2  In the following countries, the control pilot circuit function controller is not permitted within the body of the vehicle connector: US 

4.3 According to the method of connecting the cable(s)

4.3.1 General

Cables in-between different components of the IC-CPD can be connected to these components by different methods. If in one cord set different connection methods are used the IC-CPD shall be classified to all methods used and the different parts shall be declared separately.

4.3.2 Non-rewirable IC-CPDs

The IC-CPD or the declared part is provided as a full functional cord set including all components. Cables in-between plug, in-cable housing (if any) and vehicle connector are not intended to be replaced or exchanged by the user or others after connection and assembly by the manufacturer.

4.3.3 IC-CPDs wired by the manufacturer

A connection to the IC-CPD or the declared part such that any replacement can be made only by the manufacturer, its service agent or similar qualified person using a special tool.

The IC-CPD is provided as a full functional cord set or only the unit(s) containing the residual current function and control pilot function controller are provided (see 3.1.4).

4.3.4 Pluggable IC-CPD

The IC-CPD or the declared part includes at least one pluggable electrical connection which is intended to be plugged or unplugged by the end-user or others to fit, replace or exchange components of the IC-CPD cable assembly.

NOTE 1 In the following countries pluggable types where connector is part of the ICCB shall not be used: NO.

NOTE 2 In the following countries the connect to the output side of the ICCB (function box) shall not be pluggable: US

4.4 Classification according to the protective conductor path

4.4.1 General

An IC-CPD can be classified to have a switched or a non-switched protective conductor.

4.4.2 IC-CPDs with switched protective conductor

This classification covers IC-CPDs which have a switched protective conductor.

NOTE In the following countries, a switched protective earthing conductor is not permitted: US.

4.4.3 IC-CPDs with non-switched protective conductor

This classification covers IC-CPDs which have a non-switched protective conductor.

4.5 Classification according to behaviour in case of open protective conductor

4.5.1 General

An IC-CPD can be classified according to the behaviour related to the availability of the upstream protective conductor.

4.5.2 IC-CPD with verification of the availability of the upstream protective conductor

IC-CPD detecting the presence and continuity of the protective conductor upstream of the socket-outlet. In IT-systems it may happen that these devices cannot be used as the protective conductor verification will not be successful.

-  An IC-CPD classified according to 4.5.2 can have a function to deactivate the verification check of the availability of the upstream protective conductor. After plugging into a socket outlet, it shall be indicated for at least 30 s by a visual or audible signal that the detection function is deactivated. 

4.5.3 IC-CPD without verification of the availability of the upstream protective conductor

IC-CPD not detecting the presence and continuity of the protective conductor upstream of the socket-outlet. These devices are also suitable for use in IT-systems.

NOTE In the following countries either an IC-CPD according to 4.5.2 is allowed or the IC-CPD shall be capable of detecting a 5 mA leakage: US.

4.6 Classification according to the usage

4.6.1 IC-CPD for portable use

IC-CPD that can be used as mobile device.

4.6.2 IC-CPD for wall mounting

IC-CPD designed to be used only when hung in the intended operating position. Such devices can be easily removed from their hanging location.

NOTE 1 This classification includes all positions in a height giving the same degree of protection as wall mounting, for example mounted on ceiling, pillars, etc.

NOTE 2 In the following countries, the use of IC-CPDs according to 4.6.2 is not allowed: CH.

4.6.3 IC-CPD for portable use and for wall mounting

IC-CPD that can be used both as a mobile device and when hung in the intended operating position. Such devices can be easily removed from their hanging location. 

5 Characteristics of IC-CPDs

5.1 Summary of characteristics

IC-CPDs are provided with switching contacts for line(s) and neutral, if applicable. IC-CPDs according to 4.4.2 are provided with a switching contact for the protective conductor.

IC-CPDs have a defined residual current operation function. This function provides protection against electric shock for the connected electric vehicle in case of failure of basic protection and / or fault protection in accordance with IEC 61851-1.

The residual current function of the IC-CPD shall be ensured

- for residual sinusoidal alternating currents and residual pulsating direct currents;
- for a residual pulsating direct current superimposed on a smooth d.c. residual current up to 6 mA;
- for composite residual currents intended for circuit supplied between phase and neutral;
- with or without phase angle control, independent of polarity, whether suddenly applied or slowly rising.

In addition IC-CPDs shall have a defined behaviour in case of supply failures or miswiring according to 9.7.7.

In addition the IC-CPD:

- checks by means of the pilot signal that the protective conductor is connected to the electric vehicle,
- trips if the d.c. residual currents exceeds 6 mA.
NOTE 1 Regarding this characteristic see also the Foreword.
- verify that the electric vehicle is connected,
NOTE 2 The connection to the electric vehicle is checked by the pilot signal.

- switches on or off in response to the system states according to IEC 61851-1:2017, Annex A. 

5.2 Rated quantities and other characteristics

5.2.1 Rated voltages

5.2.1.1 Rated operational voltage (U_o)

The value of voltage or the voltage range, assigned by the manufacturer, to which the performance of the IC-CPD is referred.

NOTE The same IC-CPD can be assigned to more than one rated voltage.

5.2.1.2 Rated insulation voltage (U_i)

The value of voltage, assigned by the manufacturer, to which dielectric test voltages and creepage distances of the IC-CPD are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the IC-CPD. In no case shall the maximum rated voltage exceed the rated insulation voltage.

5.2.2 Rated current (I_n)

The value of current, assigned to the IC-CPD by the manufacturer, which the IC-CPD can carry under permanent load conditions.

5.2.3 Rated residual operating current ($I_{\Delta n}$)

The value of residual operating current (see 3.3.2.2), assigned to the IC-CPD by the manufacturer, at which the IC-CPD shall operate under specified conditions.

5.2.4 Rated residual non-operating current ($I_{\Delta no}$)

The value of residual non-operating current (see 3.3.2.3), assigned to the IC-CPD by the manufacturer, at which the IC-CPD does not operate under specified conditions.

5.2.5 Rated frequency

The power frequency for which the IC-CPD is designed and to which the values of the other characteristics correspond.

The same IC-CPD may be assigned to more than one rated frequency.

5.2.6 Rated making and breaking capacity (I_m)

The r.m.s. value of the a.c. component of prospective current (see 3.3.4.3), assigned by the manufacturer, which an IC-CPD can make, carry and break under specified conditions.

The conditions are those specified in 9.9.2.2.

5.2.7 Rated residual making and breaking capacity ($I_{\Delta m}$)

The r.m.s. value of the a.c. component of residual prospective current (see 3.3.2.1 and 3.3.4.3), assigned by the manufacturer, which an IC-CPD can make, carry and break under specified conditions.

The conditions are those specified in 9.9.2.3.

5.2.8 Operating characteristics in case of residual currents comprising a d.c. component

The operating characteristics of an IC-CPD are such that tripping is ensured for residual sinusoidal alternating currents, residual pulsating direct currents and smooth residual direct currents exceeding 6mA, whether suddenly applied or slowly rising.

5.2.9 Insulation coordination including creepage distances and clearances

Creepage and clearance distances are given in 8.4.3.

5.2.10 Coordination with short-circuit protection devices (SCPDs)

5.2.10.1 General

Coordination between IC-CPDs and SCPDs shall be verified under the general conditions of 9.9.2.1, by means of the tests described in 9.9.2.4 which verify that there is adequate protection against currents up to the rated conditional short-circuit current I_{nc} and up to the rated conditional residual short-circuit current $I_{\Delta c}$.

5.2.10.2 Rated conditional short-circuit current (I_{nc})

The r.m.s. value of prospective current, assigned by the manufacturer, which an IC-CPD protected by an SCPD can withstand under specified conditions without undergoing alterations impairing its functions. The conditions are those specified in 9.9.2.4a).

5.2.10.3 Rated conditional residual short-circuit current ($I_{\Delta c}$)

The value of residual prospective current, assigned by the manufacturer, which an IC-CPD, protected by an SCPD, can withstand under specified conditions without undergoing damage. The conditions are those specified in 9.9.2.4 c).

5.3 Standard and preferred values

5.3.1 Preferred values of rated operational voltage (U_e)

Preferred values of rated voltage are 120 V, 230 V, 400 V and 480 V.

Wherever in this standard there is a reference to 230 V or 400 V, they may be read as 220 V or 240 V, 380 V or 415 V, respectively.

Wherever in this standard there is a reference to 120 V or 120/240 V or 240 V, they may be read as 100 V or 100/200 V or 200 V, respectively.

Wherever in this standard there is a reference to 240 V three phases, it may be read as 100 V or 120/208 V.

5.3.2 Preferred values of rated current (I_n)

The preferred values of the rated current are indicated in Table 1.

Table 1 – Preferred values of rated current and corresponding preferred values of rated voltages

Type	Rated voltage V	Rated current A
Three-phase systems	480 ^a	6, 8, 10, 13, 15, 16, 20, 24, 30, 32
	400	6, 8, 10, 13, 15, 16, 20, 25, 32
	240	15, 20, 30
Single- and two-phase systems	230	6, 8, 10, 13, 15, 16, 20, 25, 30, 32
	120	6, 8, 10, 12, 15, 16, 20, 30, 32.
^a Only for mid-point or star-point earthed systems with voltage to earth 240 V or 277 V, as applicable.		

If the IC-CPD supports simplified control pilot circuit the rated current shall be 10 A or higher.

NOTE 1 In some countries simplified control pilot circuit is not allowed: US, CH.

The rated current shall not be higher than 32A.

NOTE 2 In the following countries, the use of IEC 60309-2 accessories is recommended for mode 2 connections for more than 8 A (2 kVA): CH.

A1 NOTE 3 In the following countries, the use of IEC 60309-2 accessories is recommended for mode 2 connections for more than 10 A: IT. **A1**

5.3.3 Standard values of rated residual operating current ($I_{\Delta n}$)

Standard values of rated residual operating current are:

0,006 A – 0,01 A – 0,015 A – 0,02 A – 0,03 A.

NOTE In the following countries, the residual operating current is frequency dependent and limited according to national standards: US, CA, MX.

5.3.4 Standard value of rated residual non-operating current ($I_{\Delta no}$)

The standard value of alternating residual non-operating current is 0,5 $I_{\Delta n}$.

If for IC-CPD according to 4.4.2 the protective conductor is passed with more turns than the live conductors through the current transformer on a $I_{\Delta n} = 30$ mA device this value may be reduced to $0,25 I_{\Delta n}$.

5.3.5 Standard minimum value of the non-operating overcurrent through the IC-CPD

The standard minimum value of the non-operating overcurrent through the IC-CPD is $4 I_n$.

5.3.6 Preferred values of rated frequency

Preferred values of rated frequency are 50 Hz, 60 Hz or 50/60 Hz.

NOTE In the following countries, a device which measures leakage current over a range of frequencies and trips at predefined levels of leakage current, based upon the frequency, is required by national standards: US, CA, MX.

5.3.7 Minimum value of the rated making and breaking capacity (I_m)

The minimum value of the rated making and breaking capacity I_m is 100 A.

5.3.8 Minimum value of the rated residual making and breaking capacity ($I_{\Delta m}$)

The minimum value of the rated residual making and breaking capacity is 100 A.

5.3.9 Standard value of the rated conditional short-circuit current (I_{nc})

The standard value of the rated conditional short-circuit current is 1 500 A.

5.3.10 Standard value of the rated conditional residual short-circuit current ($I_{\Delta c}$)

The standard value of the rated conditional residual short-circuit current is 1 500 A.

5.3.11 Limit values of break time

The limit values of break time are given in Table 2 for a.c. residual currents, in Table 3 for smooth d.c. residual currents and in Table 4 for residual pulsating direct currents which may result from rectifying circuits supplied from two or three phases.

Table 2 – Limit values of break time for a.c. residual currents at rated frequency

Limit values of break time at a residual current (I_{Δ}) equal to			
s			
$I_{\Delta n}$	$2 I_{\Delta n}$	$5 I_{\Delta n}$	5 A, 10 A, 20 A, 50 A, 100 A ^a
0,3	0,15	0,04	0,04
The maximum value of the test current should not exceed I_m .			
NOTE For operation with residual currents having a d.c. component, see 9.7.4.			
^a The tests at 5 A, 10 A, 20 A, 50 A and 100 A are only made during the verification of the correct operation as mentioned in 9.7.3.5.			

Table 3 – Limit values of break time for smooth d.c. residual currents

Limit values of break time at a d.c residual current equal to		
s		
6 mA	60 mA	300 mA
10,0	0,3	0,04

Table 4 – Limit values of break time for residual pulsating direct currents which may result from rectifying circuits supplied from two or three phases

Limit values of break time at a residual pulsating direct current (I_{Δ}) equal to			
s			
$2 I_{\Delta n}$	$4 I_{\Delta n}$	$10 I_{\Delta n}$	5 A, 10 A, 20 A, 50 A
0,3	0,15	0,04	0,04

6 Marking and other product information

6.1 Data to be marked on the IC-CPD

The IC-CPD shall be marked in a durable manner with the following data:

- the manufacturer's or distributor's name or trademark;
- type designation, catalogue number or serial number;
- rated voltage;
- rated frequency, if the IC-CPD is designed for frequencies other than 50 Hz and 60 Hz (see 5.3.6);
- rated current;
- rated residual operating current;
- degree of protection. The IP degree is applicable only to the function box and marking g) shall be on the function box;
- the marking with the name of the product: IC-CPD;

-  j) IC-CPD shall be marked with the symbol , indicating the lowest ambient temperature, -25°C or lower, within the symbol. If a lower value than -25°C is declared by the manufacturer, the declared value shall be a multiple of 5°C ; the symbol shall indicate this value; 

- for IC-CPD according to 4.5.2, a statement that the IC-CPD may not operate if used on IT or other unearthed systems such as an isolated winding generator or isolating transformer.

Marking with the following symbol:  IEC 60417-6293 (2015-05);

A statement is not needed for an IC-CPD according to 4.5.2 with a function to deactivate the verification check of the availability of the upstream protective conductor.

NOTE 1 This information can be on a durable label attached to the cord.

- value of the residual non-operating current $I_{\Delta no}$, if different from $0,5 I_{\Delta n}$;
- indication according to the design of the protective conductor path as follows:

– classified according to 4.4.2 with marking  IEC 60417-6289 (2015-03)



- classified according to 4.4.3 with marking: IEC 60417-6290 (2015-03)

The symbol may be integrated in a wiring diagram;

- n) additional information about technical data at higher altitudes, if applicable;
- o) the maximum charging current of the IC-CPD, if lower than the rated current;

A1 Text deleted A1

For the marking of rated current and rated voltage marking, numbers alone may be used. These figures shall be placed on one line, separated or not by an oblique line, or the number for rated current shall be placed above the number for rated voltage, separated by a horizontal line.

The marking for the nature of supply shall be placed next to the marking for rated current and rated voltage.

Examples of marking for current, voltage and nature of supply:

16 A 230 V~, or $\frac{16}{230}$ ~, or 16 A 230 V a.c., or 16/230 a.c., etc.

When symbols are used, they shall be as follows:

- amperes A
- volts V
- alternating current ~ IEC 60417-5032 (2002-10)
- neutral N
- protective earth; protective ground  IEC 60417-5019 (2006-08)

For details of the symbols for a.c. and protective conductor, see IEC 60417.

The markings a), b), c), d), e), f), h), j), k), l), m) and o) shall be on the enclosure of the function box itself or on a nameplate or nameplates attached to the IC-CPD and shall be located so that they are visible and legible when the IC-CPD is assembled as for normal use.

Information k) shall also be given in the instruction sheet.

NOTE 2 This information can be given within the car manual.

Information n) shall be given in the instruction sheet.

For IC-CPD without the integrated function to trip at maximum 6 mA smooth d.c. residual currents, in addition to information p) on the product, detailed information shall be given in the instruction sheet, including the information, that this IC-CPD shall not be used for vehicles which may cause smooth d.c. residual currents under first fault conditions.

This requirement including p) is limited to the transition period (see Foreword) and is not applicable afterwards.

Operating and indication means shall be marked in accordance with the operating instruction.

Terminals exclusively intended for the connection of the neutral circuit shall be indicated by the letter "N".

For non-rewirable IC-CPD, the indication of "N" is not necessary.

NOTE 3 In the following countries, the terminal for the neutral conductor shall also be colored silver or white: US

If it is necessary to distinguish between the supply and the load terminals, they shall be clearly marked (e.g. by "line" and "load" placed near the corresponding terminals or by arrows indicating the direction of power flow).

Terminals intended for the protective conductor shall be indicated by the symbol for protective earth; protective ground  IEC 60417-5019 (2006-08).

NOTE 4 In the following countries, the terminal for the protective conductor shall also be colored green: US.

In addition, screwless terminals of devices according to 4.3.3 shall be marked with an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal.

Marking shall be indelible, legible and shall not be placed on screws, washers or other removable parts.

Compliance is checked by inspection and by the test of 9.3.

6.2 Information to be provided to the end-user

The information to be provided to the end-user is:

- a) information for the user about the automatic process of verification for the self test;
- b) information that the device shall not be used if it fails to operate correctly in accordance with the instructions and to seek advice from the manufacturer, responsible vendor or an electrician;
- c) information warning against storage or use beyond the service conditions given in Table 5 and against misuse such as dropping, immersion, etc.;
- d) information instructing the user that the IC-CPD shall be plugged in without the use of an adaptor except if the adaptor is part of the IC-CPD and meets the requirements of a pluggable IC-CPD.;
- e) information instructing the user that the IC-CPD shall be plugged in directly into the fixed socket-outlet without the use of an extension cord;
- f) information about the detected failures and the related indications given by the product in this case;
- g) information that the components of a pluggable IC-CPD shall not be connected or disconnected while the IC-CPD is in use (infrastructure plug connected in a socket-outlet or the vehicle connector is engaged in a vehicle inlet);
-  h) a list of instructions about how to connect the IC-CPD to the socket-outlet and to the car, and how to store it properly. This includes the information to the user that it is recommended for the electrical installation intended for EV charging to be checked by an electrical installer;
- i) information about which components of a pluggable IC-CPD are allowed to be used in combination. 

Compliance is checked by inspection.

7 Standard conditions for operation in service and for installation

7.1 Standard conditions

IC-CPDs complying with this standard shall be capable of operating under the standard conditions shown in Table 5.

Table 5 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ^e
Ambient temperature ^{a, f, h}	–25 °C to +45 °C ^b	23 °C	±5 °C
Altitude	Up to 2 000 m ^g		
Relative humidity (maximum value at 40 °C)	75 % ^c		
External magnetic field	Not exceeding five times the earth's magnetic field in any direction	Earth's magnetic field	^d
Frequency	Reference value ±5 %	Rated value	±2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %
^a The maximum value of the mean daily temperature is +35 °C. ^b  Values outside this range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user. The declared values shall be a multiple of 5 °C.  ^c Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C). ^d IC-CPDs should not be used in the proximity of a strong magnetic field. In this case, supplementary requirements may be necessary. ^e The tolerances given apply unless otherwise specified in the relevant test. ^f Extreme limits of –40 °C and 85 °C, for IC-CPDs are admissible during storage and transportation. ^g For higher altitudes it is necessary to take into account the reduction of the dielectric strength and the cooling effect of the air. Therefore the increased clearances and creepage distances according to Table 7 shall be considered and the manufacturer shall provide additional information about technical data for use at higher altitudes. ^h If the IC-CPD is equipped with a plug according to a standard with a lower standard maximum temperature or a higher standard minimum value then this temperature is applicable for the whole IC-CPD. For plugs according to IEC 60884-1 the maximum temperature is 35 °C, the minimum temperature is –5 °C and for plugs according to IEC 60309-1 the upper temperature is 40 °C the minimum temperature is –25 °C unless higher performances are stated by the manufacturer.			

7.2 Conditions for installations

IC-CPDs shall be used in accordance with their instructions.

8 Requirements for construction and operation

8.1 Mechanical design

IC-CPDs shall be so designed and constructed that in normal use their performance is reliable and the risk of danger to the user or surroundings, even in the case of miswiring conditions as defined in this standard, is minimised.

For devices according to 4.3.2 (non re-wirable) and 4.3.4, it shall be verified that it is not possible to change wiring of the device without leaving permanent and visible damage.

For devices according to 4.3.3 (wired by the manufacturer), it shall be verified that the user cannot re-wire the device without leaving permanent and visible damage.

Pluggable IC-CPDs according to 4.3.4 shall be provided with a retaining means which holds accessories in position when properly engaged and prevents their unintentional withdrawal.

Pluggable IC-CPDs according to 4.3.4 shall not be operational without engaged retaining means.

The IC-CPD shall not be functional until all mandatory functions are properly connected.

The IC-CPD, without considering plugs and vehicle connector, shall have a minimum degree of protection of IPXXD according to IEC 60529 after assembly as for normal use.

Components of pluggable IC-CPDs according to 4.3.4 shall have a minimum degree of protection of IPXXB according to IEC 60529 before being connected to each other.

A maximum length of cord of 1,7 m is allowed between the plug and the function box.

NOTE 1 In the following countries, the interrupting device of the personnel protection system (IC-CPD) shall be located within 0,3 m from the plug or be an integral part of the plug according to national rules: US, MX.

If the function box(es) is (are) located at more than 0,3 m of the plug it/they shall have drive-over capability as defined in 9.34.

If a pluggable electrical connection of a pluggable IC-CPD according to 4.3.4 is located at more than 0,3 m of the plug, it shall have drive-over capability in a mated position as defined in 9.34.

For IC-CPDs the protective conductor shall be coloured green and yellow.

NOTE 2 In the following countries, the color for the protective conductor may be solid green: US.

There shall be no provision to alter the residual operating characteristics of IC-CPDs.

The plugs of the IC-CPDs shall be mechanically and electrically compatible with the socket outlet system in which they are intended to be used, and the requirements of the national standard shall be used. If no national requirements exist, the requirements of IEC 60884-1 shall apply for plugs for household and similar use and the IEC 60309 series shall apply for industrial plugs.

It is recommended to use plugs with solid brass pins, if plugs are pin type.

NOTE 3 In the following countries the use of solid brass pins is required: FR.

For specific applications and areas, non interchangeable industrial plugs may be used in conjunction with the IEC 60309 series.

Where reference is made to vehicle connectors the IEC 62196 series applies.

Compliance is checked by inspection and by the tests of the relevant clauses.

NOTE 4 In the following countries IC-CPD according to 4.1.2 or 4.1.3 must fulfil both 4.1.2 and 4.1.3 specification and requirements: NO.

8.2 Pluggable electrical connections of pluggable IC-CPDs according to 4.3.4

8.2.1 General

A1 Connections of an IC-CPD shall be designed in a way that only accessories fulfilling the requirements of 8.2 can be connected. Components of a pluggable IC-CPD shall not be intermateable in any other way than declared by the manufacturer. Notably, pluggable connections at the function box shall not comply with standard products, for example IEC 62196 (all parts) or IEC 60309 (all parts). **A1**

If components of an IC-CPD with different rated currents are intermateable, an automatic means which the end-user cannot influence shall be provided to limit the maximum current