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Introduction

This draft standard is based on European discussions in which the UK has taken an active part. Your comments on this draft are welcome and will assist in the preparation of the consequent British Standard. Comment is particularly welcome on national, legislative or similar deviations that may be necessary.

Even if this draft standard is not approved by the UK, if it receives the necessary support in Europe, the UK will be obliged to publish the official English Language text unchanged as a British Standard and to withdraw any conflicting standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with reasons) or positive vote on this draft.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



69/523/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 61851-23 ED2	
DATE OF CIRCULATION: 2017-07-07	CLOSING DATE FOR COMMENTS: 2017-09-29
SUPERSEDES DOCUMENTS: 69/461/CD,69/490A/CC	

IEC TC 69 : ELECTRIC ROAD VEHICLES AND ELECTRIC INDUSTRIAL TRUCKS	
SECRETARIAT: Belgium	SECRETARY: Mr Peter Van den Bossche
OF INTEREST TO THE FOLLOWING COMMITTEES: SC 23E, SC 23H, TC 64	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:
Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 23: DC electric vehicle supply equipment

FOREWORD

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- International Standard IEC 61851-23 has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

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

FDIS	Report on voting
69/XX/FDIS	69/XX/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.

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

255 This standard is to be read in conjunction with IEC 61851-1:201x.

256 The clauses of particular requirements in this standard supplement or modify the
 257 corresponding clauses in IEC 61851-1:201X. Where the text of subsequent clauses indicates
 258 an "addition" to or a "replacement" of the relevant requirement, test specification or
 259 explanation of Part 1, these changes are made to the relevant text of Part 1, which then
 260 becomes part of this standard. Where no change is necessary, the words "This clause of
 261 Part 1 is applicable" are used. The new clauses, which are not included in Part 1, have a
 262 clause number starting from 101, e.g. 3.101, 101.1, etc. The annexes of this standard are
 263 numbered using double-alphabet, e.g. Annex AA, to avoid confusion with the annexes in Part
 264 1.

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

267 In this document, the following print types are used:

- 268 – *test specifications: italic type.*
- 269 – notes: smaller roman type.

270

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

- 274 • reconfirmed,
- 275 • withdrawn,
- 276 • replaced by a revised edition, or
- 277 • amended.

278

279 The National Committees are requested to note that for this publication the stability date
 280 is XX.

281 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
 282 DELETED AT THE PUBLICATION STAGE.

283

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284

285

INTRODUCTION

286

287

288 The introduction and commercialisation of electric vehicles has been accelerated in the global
289 market, responding to the global concerns on CO₂ reduction and energy security.
290 Concurrently, the development of charging infrastructure for electric vehicles has also been
291 expanding. As a complement to the AC charging system, DC charging is recognized as an
292 effective solution to extend the available range of electric vehicles. The international
293 standardization of charging infrastructure is indispensable for the diffusion of electric vehicles,
294 and this document is developed for the manufacturers' convenience by providing general and
295 basic requirements for DC EV charging stations for conductive connection to the vehicle.

296

ELECTRIC VEHICLE CONDUCTIVE CHARGING SYSTEM –

Part 23: DC electric vehicle supply equipment

1 Scope

This part of IEC 61851 applies to the DC EV supply equipment, including the DC EV charging station (herein also referred to as "DC charger") for charging electric road vehicles, with a rated supply voltage up to 1 000 V AC or up to 1 500 V DC and a rated output voltage up to 1 500 V DC.

This part also provides the requirements for bi-directional power flow as specified in Annex DD, with reverse output voltage up to 1 000 V AC or 1 500 V DC. Unless otherwise provided for, the requirements for DC charger in this document is also applicable to the DC EV charging/discharging station.

DC reverse output voltage to DC supply network or DC standard socket-outlets is not covered by this edition.

NOTE 1 This document includes information on EV for conductive connection, but limited to the necessary content for describing the power and signalling interface.

NOTE 2 Typical diagrams and variation of DC charging systems are shown in Annex EE .

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

This part specifies the DC charging systems A, B and C as defined in Annexes AA, BB and CC.

NOTE 3 Typical configurations of DC EV charging systems are shown in Annex EE.

EMC requirements for DC EV charging stations are defined in IEC 61851-21-2 (under preparation).

This standard provides the general requirements for the control communication between a DC EV charging station and an EV. The requirements for digital communication between DC EV charging station and electric vehicle for control of DC charging, and between the DC EV charging/discharging station and the EV, are defined in IEC 61851-24.

Requirements for non-isolated system are under consideration, and are not in this edition.

Requirements for DC charging with an autoconnect charging device are given in IEC 61851-23-1 (under preparation).

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition:

IEC 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC 61439-1:2011, *Low voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61557-8, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

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

- 341 IEC 61851-24:201X³, *Electric vehicle conductive charging system – Part 24: Digital*
342 *communication between a DC EV charging station and an electric vehicle for control of DC*
343 *charging*
- 344 IEC 62052-11, *Electricity metering equipment (AC) – General requirements, tests and test*
345 *conditions – Part 11: Metering equipment*
- 346 IEC 62053-21, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static*
347 *meters for active energy (classes 1 and 2)*
- 348 IEC 62477-1, *Safety requirements for power electronic converter systems and equipment –*
349 *Part 1: General*
- 350 IEC 62909-1(under development), *Bi-directional grid connected power converters – Part 1:*
351 *General requirements*
- 352 ISO 11898-1, *Road vehicles – Controller area network (CAN) – Part 1: Data link layer and*
353 *physical signalling*
- 354 ISO/IEC 15118-2:2014, *Road Vehicles – Vehicle to grid communication interface – Part 2:*
355 *Technical protocol description and Open Systems Interconnections (OSI) layer requirements*
- 356 DIN SPEC 70121, *Electromobility - Digital communication between a DC EV charging station*
357 *and an electric vehicle for control of DC charging in the Combined Charging System*

358 **3 Terms and definitions**

359 This clause of Part 1 is applicable except as follows:

360 *Addition:*

361 The definitions included in this part are those having general application herein. Definitions
362 applying to isolating transformers, safety isolating transformers, switch mode power supplies,
363 and their construction are included in IEC 61558-1.

364 **3.1 Electric supply equipment**

365 **3.1.101**

366 **DC EV charging system**

367 a system composed of a DC charger, cable assembly and the equipment on EV that is
368 required to fulfil the charging function including digital communication for charging control

369 **3.1.102**

370 **isolated DC EV charging station**

371 DC EV charging station where the DC output circuit is electrically separated by protective
372 separation from the AC supply network

373 **3.1.103**

374 **non-isolated DC EV charging station**

375 DC EV charging station where the DC output circuit is not electrically separated by protective
376 separation from the AC supply network

377 **3.1.104**

378 **regulated DC EV charging station**

379 DC EV charging station that supplies vehicle battery with a charging current or charging
380 voltage in accordance with the request from vehicle

³ Under preparation

381 **3.1.105**
382 **non-regulated DC EV charging station**

383 under consideration

384 **3.1.106**
385 **plug and cable DC EV charging station**

386 DC EV charging station which is intended to be connected to the AC supply network using a
387 cable and plug according to IEC 60309-1 and IEC 60309-2 for industrial type, IEC 60884-1 for
388 domestic type, relevant national standards, or other standard plugs and socket outlets

389 **3.1.107**
390 **charging/discharging station**

391 a system composed of an EVPS and cable assembly that is required to fulfill the charging and
392 discharging functions including digital communication for charging and discharging control

393 **3.1.108**
394 **electric vehicle power system**
395 **EVPS**

396 equipment or a combination of equipment providing dedicated functions to provide AC or DC
397 reverse power to socket-outlets or a bi-directional grid connected power converter according
398 to IEC 62909 from an EV. It can provide dedicated functions to supply electric energy from a
399 fixed electrical installation or AC supply network to an EV for the purpose of charging.

400 **3.1.109**
401 **controlled current charging**
402 **CCC**

403 energy transfer method that the DC EV charging station regulates charging current according
404 to the current value requested by the vehicle

405 **3.1.110**
406 **controlled voltage charging**
407 **CVC**

408 energy transfer method that the DC EV charging station regulates charging voltage according
409 to the voltage value requested by the vehicle

410 **3.1.111**
411 **charging state**
412 a physical status of DC EV charging system

413 **3.1.112**
414 **discharging**
415 all functions necessary to condition energy of the RESS to a regulated voltage/current level to
416 AC or DC supply network or standard socket-outlets.

417 **3.1.113**
418 **power electronic converter**
419 **PEC**

420 device or part thereof for the purpose of electronic power conversion, including signalling,
421 measurement, control circuitry and other parts, if essential for the power conversion function

422 **3.1.114**
423 **(bi-directional) grid-connected power converter**
424 **GPC**

425 converter connecting to the grid by bi-directional inverter with multiple DC-port interfaces

426 **3.1.115**
427 **DC connection interface**

428 internal system DC high voltage lines between PEC and bi-directional inverter in GPC

429 **3.1.116**
430 **DC port interface**
431 interface of DC/DC converter that connects to EV and the interface between DC-connection
432 interface and EV in the case that DC-connection interface is directly connected to the EV
433 without DC/DC converter

434 **3.1.117**
435 **maximum current control**
436 **MCC**
437 energy transfer method that a DC EV charging/discharging station regulates
438 charging/discharging current according to the current value limited by the vehicle
439

440 **3.2 Insulation**

441 **3.2.101**

442 **isolation**

443 function intended to make dead for reasons of safety all or a discrete section of the electrical
444 installation by separating the electrical installation or section from every source of electric
445 energy

446 [SOURCE: IEC 826-17-01]

447 **3.2.102**

448 **(electrically) protective separation**

449 separation of one electric circuit from another by means of:

- 450 – double insulation; or
- 451 – basic insulation and electrically protective screening (shielding); or
- 452 – reinforced insulation

453 [SOURCE: IEC 195-06-19]

454 **3.3 Functions**

455 **3.3.101**

456 **control circuit**

457 circuit for signal and digital communication with vehicle, and for the management of charging
458 control process

459 **3.3.102**

460 **DC charging control function**

461 **DCCCF**

462 a function embedded in a DC EV charging station which controls DC power output following
463 VCCF direction

464 **3.3.103**

465 **DC charging/discharging control function**

466 **DCCDCF**

467 a function embedded in a DC EV charging/discharging station which controls DC power
468 input/output following VDCDF request
469

470 **3.3.104**

471 **vehicle charging control function**

472 **VCCF**

473 a function in a vehicle which controls the charging parameters of off-board DC EV charging
474 station

- 475 **3.3.105**
 476 **vehicle charging/discharging control function**
 477 **VCDCF**
 478 a function in a vehicle which controls the charging/discharging parameters of off-board DC EV
 479 charging/discharging station
- 480 **3.3.106**
 481 **normal shutdown**
 482 termination of the charging process initiated by the user, by the vehicle or by the DC EV
 483 charging station, and not caused by a failure
- 484 **3.3.107**
 485 **error shutdown**
 486 termination of the charging process caused by a failure detected by the DC EV charging
 487 station or the vehicle
- 488 **3.3.108**
 489 **emergency shutdown**
 490 urgent termination of the charging process caused by a failure detected by the DC EV
 491 charging station or the vehicle, due to a safety hazard
- 492 **3.3.109**
 493 **thermal sensing**
 494 means for providing temperature data of accessories, cable assemblies or parts thereof
- 495 **3.3.110**
 496 **thermal transport**
 497 means for managing heat dissipation of accessories, cable assemblies or parts thereof
 498 independent from changing the current
- 499 **3.3.111**
 500 **thermal exchange**
 501 means for cooling and dissipating thermal energy from the thermal transport
- 502 **3.3.112**
 503 **thermal management system**
 504 means including thermal sensing, thermal transport and thermal exchange in order to keep
 505 the temperature in the allowed limit
- 506 **3.4 Vehicle**
- 507 **3.4.101**
 508 **maximum voltage limit**
 509 upper limit value of charging voltage sent by the vehicle to the DC EV charging station
- 510 **3.4.102**
 511 **maximumdischarging current of the vehicle**
 512 maximum limit of the discharging current of the vehicle which may change over time
 513
- 514 **3.4.103**
 515 **maximum charging current of the vehicle**
 516 maximum limit of the charging current of the vehicle which may change over time
- 517 **3.5 Cords, cables and connection means**
- 518 **3.5.101**
 519 **independent standard socket-outlet**
 520 dedicated outlet placed in a house and building, and isolated from the grid. It enables the
 521 power supply from a vehicle during blackout etc.

522 3.7 General terms

523 3.7.101

524 primary circuit

525 a circuit that is directly connected to the AC supply network, and includes the primary
526 windings of transformers, other loading devices and the means of connection to the AC
527 supply network

528 3.7.102

529 secondary circuit

530 a circuit that has no direct connection to a primary circuit and derives its power from a
531 transformer, converter or equivalent isolation device

532 3.7.103

533 rated current

534 current assigned to the accessory by the manufacturer for a specified operating condition of
535 an accessory

536 [SOURCE: IEC 442-01-02]

537 3.7.104

538 contact assembly

539 power contact with a terminal and additional components if any

540

541 Note 1 to entry: e.g. termination, contact support, thermal sensing, thermal transport

542 4 General requirements

543 This clause of Part 1 is applicable, except as follows:

544 *The following sentence is not applicable:*

545 Assemblies for EV supply equipment shall comply with IEC TS 61439-7 with the exception or
546 additions as indicated in clause 13.

547 *Addition:*

548 NOTE In some countries, the DC EV charging stations are designed to be used at an altitude up to 1 000 m
549 according to the national standard: Japan.

550 5 Classification

551 This clause of Part 1 is applicable except as follows:

552 *Addition:*

553 DC EV supply equipments and systems may be classified as follows.

554 5.101 Category

555 5.101.1 According to system structure:

556 – isolated DC EV charging station, according to the type of insulation between input and
557 output:

558 a) basic insulation with electrically protective screening (shielding);

559 b) reinforced insulation,

560 c) double insulation,

561 – non-isolated DC EV charging station.

562 5.101.2 According to system control:

- 563 – regulated DC EV charging station:
- 564 a) controlled current charging,
- 565 b) controlled voltage charging,
- 566 c) combination of a) and b),
- 567 – non-regulated DC EV charging station.

568 **5.101.3** According to the system used:

- 569 – system A (see Annex AA),
- 570 – system B (see Annex BB),
- 571 – system C (see Annex CC).

572 **5.102 Rating**

573 According to DC output voltage:

- 574 – up to and including 60 V,
- 575 – over 60 V up to and including 1 500 V.

576

577 **6 Charging modes and functions**

578 This clause of Part 1 is applicable except as follows:

579 **6.2 Charging modes**

580 **6.2.1 Mode 1**

581 *Not applicable*

582 **6.2.2 Mode 2**

583 *Not applicable*

584 **6.2.3 Mode 3**

585 *Not applicable*

586

587 *Replacement:*

588 **6.3 Functions provided in Mode 4**

589 *Replacement:*

590 **6.3.1 Mandatory functions in Mode 4**

591 **6.3.1.1 General**

592 *Replacement:*

593 The DC EV charging station shall supply a DC current or voltage to the vehicle battery in
594 accordance with a VCCF request.

595 For non-regulated charging, under consideration.

596 The following functions shall be provided by DC EV supply equipment as given below:

- 597 – continuous continuity checking of the protective conductor according to 6.3.1.2;
- 598 – verification that the EV is properly connected to the EV supply equipment according to
599 6.3.1.3;

- 600 – energization of the power supply to the EV according to 6.3.1.4;
- 601 – de-energization of the power supply to the EV according to 6.3.1.5;
- 602 – maximum allowable current according to 6.3.1.6.
- 603 – DC supply for EV according to 6.3.1.101;
- 604 – measuring current and voltage according to 6.3.1.102;
- 605 – retaining / releasing of the vehicle coupler according to 6.3.1.103;
- 606 – locking of the coupler according to 6.3.1.104;
- 607 – compatibility assessment according to 6.3.1.105;
- 608 – insulation check before charging according to 6.3.1.106;
- 609 – protection against overvoltage at the interface according to 6.3.1.107;
- 610 – verification of vehicle connector voltage according to 6.3.1.108;
- 611 – control circuit supply integrity according to 6.3.1.109;
- 612 – short circuit test before charging according to 6.3.1.110;
- 613 – user initiated shutdown according to 6.3.1.111;
- 614 – overload protection for parallel conductors (conditional function) according to 6.3.1.112;
- 615 – voltage limitation between DC output and protective conductor according to 6.3.1.113.
- 616 – shutdown of DC EV charging station according to 6.3.1.114.

617 *Replacement:*

618 6.3.1.2 Continuous continuity checking of the protective conductor

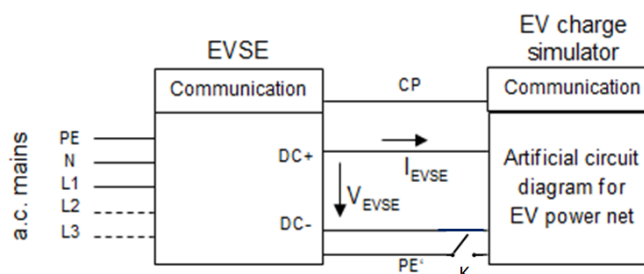
619 The protective conductor continuity between the DC EV charging station and the vehicle shall
 620 be monitored continuously. For the rated voltage of DC 60 V or higher, the DC EV charging
 621 station shall trigger an emergency shutdown within 10 ms after a loss of electrical continuity
 622 of the protective conductor between DC EV charging station and EV.

623 NOTE protective conductor continuity is monitored by the control pilot, see Annex AA.3.6.2, BB.4.4, CC.4.4

624 NOTE The isolated DC EV charging station can be disconnected from AC supply network when protective
 625 conductor continuity is lost.

626 *Compliance is checked by the following test.*

627 *This test case applies to DC EV charging stations with the maximum output voltage ≥ 60 V.*
 628 *The test system is shown in Figure 101.*



629
 630 **Key**

K	switch or relay	L1, L2, L3	power line
CP	control pilot		
PE	protective conductor	I_{EVSE}	output current of EV supply equipment
N	neutral contact	V_{EVSE}	output voltage of EV supply equipment

NOTE Artificial load refers to Figure 121 and is specified in 102.2.3 unless otherwise specified.

631 **Figure 101 – Effective earth continuity test system**

The test shall be performed according to the following procedure:

- 1) *Connect the DC EV charging station to artificial load specified in 102.2.3. For System A, the test load, EV or EV simulator which has control pilot circuits shown in Figure AA.2 shall be used. The control pilot circuits of test load shall comply with the requirement in AA.3.12.*
- 2) *Measure the voltage ($V_{EVSE\ output}$) and current ($I_{EVSE\ output}$) of the high voltage line continuously.*
- 3) *Start charging with the procedure specified by charger manufacturer.*
- 4) *Confirm that the DC bus is energized at the rated voltage and the DC EV charging station is operating at the maximum rated output current.*
- 5) *Stop charging by open the relay K.*
- 6) *Check that the DC EV charging station terminates the charging process and transfers to shutdown stage, displaying a relevant alarm or error information, if any.*
- 7) *Check the result in Table 101.*

Table 101 – Verification criterion

System	Verification criterion
A	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within $t_{\text{detection}} + t_{\text{fall}}$ after the loss of protective conductor continuity. where $t_{\text{detection}}$ is 10 s for isolated systems t_{fall} is fall time based on the output current descending speed for normal shutdown in Table AA.6
B	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within t_{pe} after the loss of protective conductor continuity. t_{pe} includes the detection time and fall time of the current. See BB.4.4 for the specific time.
C	See CC.XX

- 8) *Confirm that the DC high voltage line between DC charger and EV is de-energized to voltage less than 60 V.*

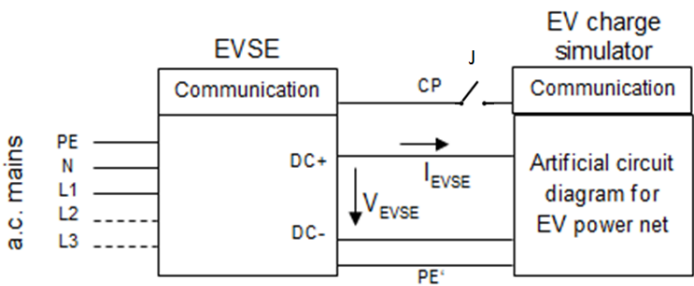
For System C, see Annex CC.

6.3.1.4 Energization of the power supply to the EV

Addition:

Compliance is checked by the following test.

The test system is shown in Figure 102.



Key

J	switch or relay	L1, L2, L3	power line
CP	control pilot	I_{EVSE}	output current of EV supply equipment
PE	protective conductor	V_{EVSE}	output voltage of EV supply equipment
N	neutral		

Figure 102 – Control pilot test system

- The test shall be performed according to the following procedure:
- 1) Connect the DC EV charging station to an EV, a resistive load, or an electronic load.
 - 2) Measure the voltage ($V_{EVSE\ output}$) of the high voltage line continuously.
 - 3) Simulate the open circuit of control pilot by opening the relay J. The control pilot lines to be tested for each system are shown below:
 - System A: CP3 (see Figure AA.2)
 - System B: CC1 (see Figure BB.x)
 - System C: CP (see Figure CC.x)
 - 4) Start charging with the procedure specified by the manufacturer.
 - 5) Confirm that the high voltage line at point B has not been energized.

6.3.1.5 De-energization of the power supply to the EV

Addition:

Compliance is checked for system A by the test in AA.3.1.2, for System B by the test in BB.5.2, and for system C by the test in Table CC.11.3.3.

In the case of failure in control circuit of DC EV charging station, such as short-circuit, earth leakage, CPU failure or excess temperature, the DC EV charging station shall terminate the supply of charging current, and disconnect the supply of control circuit.

In the case where earth fault or overcurrent is detected, the conductor shall be disconnected from its supply.

Compliance is checked according to ISO 26262 or IEC 61508.

Addition:

6.3.1.101 DC supply for EV

The DC EV charging station shall supply DC voltage and current to the vehicle battery in accordance with VCCF's controlling.

For regulated systems, the DC EV charging station shall supply regulated DC voltage or current (not simultaneously, but as requested by the vehicle during charging) to the vehicle battery in accordance with VCCF's controlling. Requirements for charging performance of regulated DC current / voltage are given in 101.2.1.1, 101.2.1.2, 101.2.1.3 and 101.2.1.4.

687 In either case mentioned above, the maximum ratings of the DC EV charging station shall not
688 be exceeded.

689 The vehicle can change the requested current and/or requested voltage.

690 NOTE Electric vehicles are equipped with different technologies and different voltages of battery. In order to
691 avoid any error during charging and to guarantee that the DC EV charging station will be able to charge all existing
692 and future batteries, any charging process is controlled by the vehicle. Any vehicle that is to be connected to a DC
693 EV charging station is equipped with a VCCF for controlling the charging process.

694 6.3.1.102 Measuring current and voltage

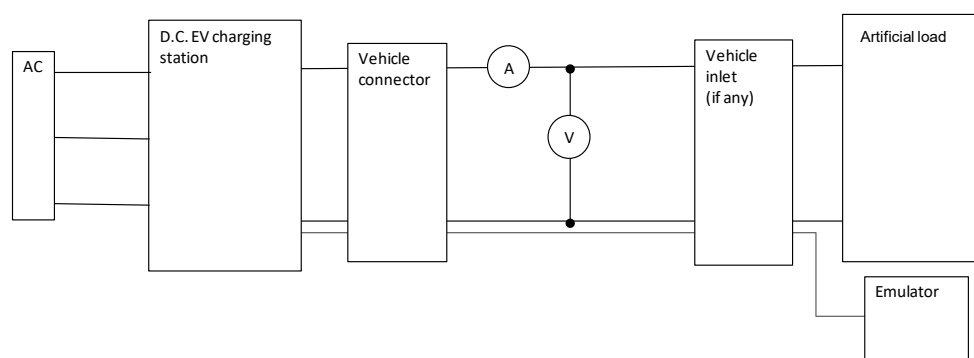
695 The DC EV charging station shall measure the output current and output voltage that is
696 supplied to the EV. The accuracy of these measurements shall meet the defined accuracy for
697 each system in Annexes AA and CC.

698 This clause is applicable to System A and System C. For specific requirements, see AA.7 for
699 System A and CC.XX (TBD) for System C.

700 The measured values of voltage and current shall be provided by the DC charger to the EV
701 through digital communication.

702 *Compliance is checked by the following test.*

703 *The test system is shown in Figure 103.*



704

705 **Key**



current measuring device



voltage measuring device

706

Figure 103 – DC supply test system

707 *The test shall be performed according to the following procedure:*

708 1) *An artificial load with emulator of VCCF are connected to DC EV charging station*
709 *correctly under normal operation.*

710 NOTE Artificial load indicates Figure 119 unless otherwise specified.

711 2) *Start charging with the procedure specified by charger manufacturer.*

712 3) *Set the CCC target values at I_{max} , I_{avg} and I_{min} of the DC charger.*

713 4) *Set the CVC target values at V_{max} , V_{ave} and V_{min} of the DC charger. For System A, the*
714 *output current shall be adjusted to set the output voltage at V_{max} , V_{ave} and V_{min} of the DC*
715 *charger.*

716 5) *Trend chart of output voltage and current which is measured at output terminals of the DC*
717 *charger and vehicle coupler.*

718 6) *Check that the difference between the measured values of the DC EV charging station*
719 *and the measuring instrument are within the limits specified in AA.4.4, BB.4.1 or CC.6.5.*

720 I_{max} , I_{avg} , I_{min} , V_{max} , V_{ave} and V_{min} are defined by each system.

721 System A:

722 I_{max} = Maximum rated current specified by each manufacturer

723 $I_{avg} = I_{max} / 2$

724 $I_{min} = 5A$

725 V_{max} = Maximum voltage specified by the manufacturer

726 $V_{ave} = (V_{max} + V_{min}) / 2$

727 V_{min} = Minimum voltage specified by the manufacturer

728

729 System B:

730 I_{max} = Maximum current specified by each manufacturer

731 $I_{med} = (I_{max} + I_{min}) / 2$

732 I_{min} = The greater value between 5 A and minimum rated current specified by each
733 manufacturer

734 V_{max} = Maximum rated voltage specified by each manufacturer

735 $V_{med} = (V_{max} + V_{min}) / 2$

736 V_{min} = Minimum rated voltage specified by each manufacturer

737 System C: see Annex CC

738 6.3.1.103 Retaining / releasing of the vehicle coupler

739 A means shall be provided to retain and release the vehicle coupler. Such means may be
740 mechanical, electrical interlock, or combination of both.

741 6.3.1.104 Locking of the coupler

742 A vehicle connector used for DC charging shall be locked on a vehicle inlet if the voltage is
743 higher than 60 V DC.

744 The vehicle connector shall not be unlocked (if the locking mechanism is engaged) when
745 hazardous voltage is detected through charging process including after the end of charging. In
746 case of charging system malfunction, a means for safe disconnection may be provided.

747 NOTE The actuation portion of the locking function can be in either the vehicle connector or the vehicle inlet.

748 The DC EV charging station shall have the following functions when the locking is done by the
749 DC EV charging station:

- 750 – electrical or mechanical locking function to retain the locked status, and
- 751 – function to detect the disconnection of the electrical circuits for the locking function.

752 NOTE 2 The locking function for each system is defined in Annexes AA, BB and CC.

753 NOTE 3 An example of lock function and disconnection detection circuit is shown in Annex AA.

754 Vehicle connectors and vehicle inlets shall comply with the requirements of IEC 62196-1 and
755 IEC 62196-3. See also clause 9.101.

756 6.3.1.105 Compatibility assessment

757 Compatibility of EV and DC EV charging station shall be checked with the information
758 exchanged at the initialization phase as specified in 7.105.1.

759 The compliance is checked by the following test.

- 760 1) Connect the DC EV charging station to an artificial load with a dedicated EV simulator for
761 each system.

- 2) *Start charging with the procedure specified by charger manufacturer.*
- 3) *Using the EV simulator, transmit the data or message in Table 102 to the DC EV charging station via digital communication. For System A, perform the test separately for each case.*

Table 102 - Data/message for transmission test

System	Data /Message (refer to IEC 61851-24)	Value
A (Case 1)	Target battery voltage	420 V
	Maximum battery voltage	410 V
A (Case 2)	Target battery voltage	min (available output voltage +10V, 595) V
	Maximum battery voltage	600 V
B	battery maximum allowable charging voltage	battery maximum allowable charging voltage ≤ maximum rated voltage specified by each manufacturer
	battery target charging voltage	battery target charging voltage > battery maximum allowable charging voltage
C	See CC.11.3.1	

- 4) *For each case, check that the DC EV charging station terminates the charging process and transfers to shutdown stage, displaying a relevant alarm or error information, if any. For system B, check the DC EV charging station terminates the charging process and transfer to shutdown stage, or output voltage value of the DC EV charging station is adjusted to battery maximum allowable charging voltage. The DC EV charging station of System B displays a relevant alarm or error information, if any.*
- 5) *Confirm that the DC high voltage line between the DC EV supply equipment and the EV is de-energized to voltage less than 60 V.*

6.3.1.106 Insulation check before charging

The DC EV charging station shall confirm the insulation resistance between its DC output circuit and protective conductor to the vehicle chassis, including the charging station enclosure, before the EV contactors are allowed to close.

If the required value is not met, the DC EV charging station shall prevent charging and indicate the vehicle that the charging is not allowed.

Insulation resistance shall be measured as follows:

For each output, the appropriate relays in the DC output circuit of the DC EV charging station shall be closed during the insulation check.

The required value of insulation resistance R shall be as shown in Formula (1):

$$R \geq 100 \, \Omega/V \times U \quad (1)$$

where

U is rated output voltage of the DC EV charging station.

Compliance is checked by the tests in AA.4.3.3, BB.8, and CC.11.3.16.1.2AA.

6.3.1.107 Protection against overvoltage at the interface

The DC EV charging station shall trigger an error shutdown within the maximum time given in Table 103 and disconnect its supply to prevent overvoltage at the interface after occurrence of the fault according to Table 103. In case of vehicle failure, disconnection from AC supply network may not be necessary.

NOTE The vehicle can change the maximum voltage limit during charging process. The vehicle should consider some margin between the target battery voltage and maximum voltage limit communicated to the DC EV charging station to avoid unwanted stop of the charging process.

Table 103 – Error shutdown trigger timing

System	Fault	Maximum time after occurrence of the fault to trigger error shutdown
A	Output voltage exceeds the maximum voltage limit sent by the vehicle	2 s
B	Output voltage exceeds the maximum voltage limit sent by the vehicle.	500 ms
C	Output voltage exceeds the maximum voltage limit sent by the vehicle for 400 consecutive milliseconds	10 ms

Compliance is checked by the following test.

The test shall be performed according to the following procedure:

- 1) *Connect the DC EV charging station to a test load with a dedicated EV simulator appropriate for the system under test. The setup of the test load in Figure 121 is in Table 104.*

Table 104 - Test load setup

System	Switches					Circuit parameter setup
	S0	S1	S3	Sa	Sb	
A	close	close	open	open	close	L1: 0 H R1, R5: 0 Ω (bypassed) V1: Not used U1: An electronic load operating under constant voltage mode shall be used.
B	close	close	open	close	open	L1: 0 H R1: 0 Ω R2: Variable V1: controlled voltage source C2: 5 600 µf (different case depended)
C	See CC.XX					

- 2) *Measure the voltage ($V_{EVSE\ output}$) and current ($I_{EVSE\ output}$) of the high voltage line continuously.*
- 3) *Start charging with the procedure specified by charger manufacturer.*
- 4) *Using the EV simulator, transmit the data or message in Table 105 to the DC EV charging station via digital communication.*

Table 105 - Data/message for transmission test

System	Data /Message Name	Value
A	Target battery voltage	410 V
	Maximum battery voltage	420 V
	Target battery current	$I_{EVSE\ max}$
B	battery maximum allowable charging voltage	battery maximum allowable charging voltage ≤ maximum rated voltage specified by each manufacturer

	battery target charging voltage,	battery target charging voltage = battery maximum allowable charging voltage - 10 V
C	See CC.XX	

5) *Confirm that the DC high voltage line between the DC EV supply equipment and the EV is energized at the rated voltage and the DC EV charging station is operating at the designated voltage and current.*

6) *Simulate overvoltage at the interface by the method(s) in Table 106 and check the results.*

Table 106 - Charging stop method

System	Method(s) to simulate overvoltage at the interface	Verification criterion
A	Set U1 = voltage higher than the maximum battery voltage	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within 3 s after the change in the value of the Target battery voltage.
B	Set V1 = voltage higher than battery maximum allowable charging voltage	The output current ($I_{EVSE\ output}$) is reduced to 5 A or less within 1 s after the change in the value of battery charging voltage.
C	See CC.XX	

7) *Check that the DC EV charging station terminates the charging process and transfers to shutdown stage, displaying a relevant alarm or error information (if any).*

6.3.1.108 Verification of vehicle connector voltage

This clause is only applicable for charging stations which are responsible for locking of vehicle connector, such as System A and System B.

The DC EV charging station shall not energize the charging cable when the vehicle connector is unlocked. The voltage at which the vehicle connector unlocks shall be lower than 60 V.

Compliance is checked by inspection, operation and the following test (under consideration).

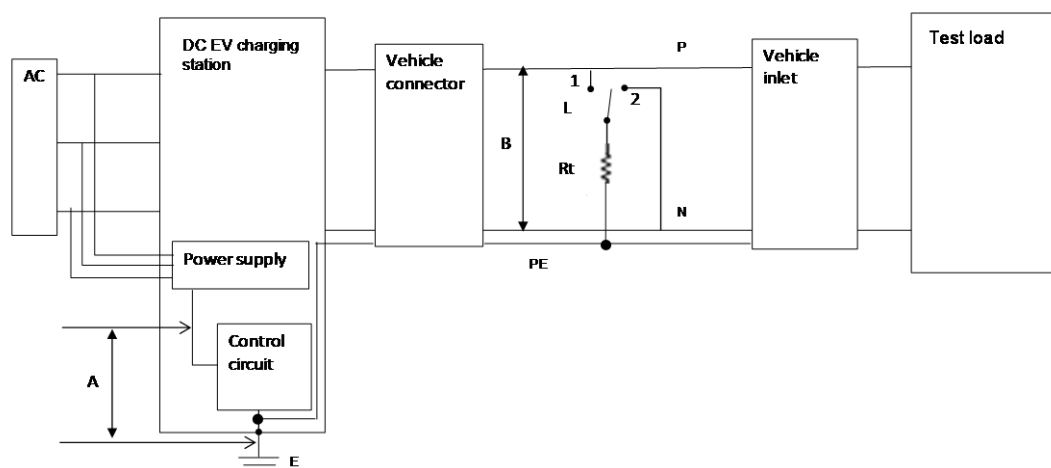
6.3.1.109 Control circuit supply integrity

If an earth fault, short circuit or overcurrent is detected in the output circuit of DC EV charging station, the power circuit shall be disconnected from its supply, but the power supply for control circuit shall not be interrupted until the charging sequence is completed and the vehicle coupler is safely unlocked.

The compliance is checked by the following tests.

a) *Earth-fault test*

The test system is shown in Figure 104.



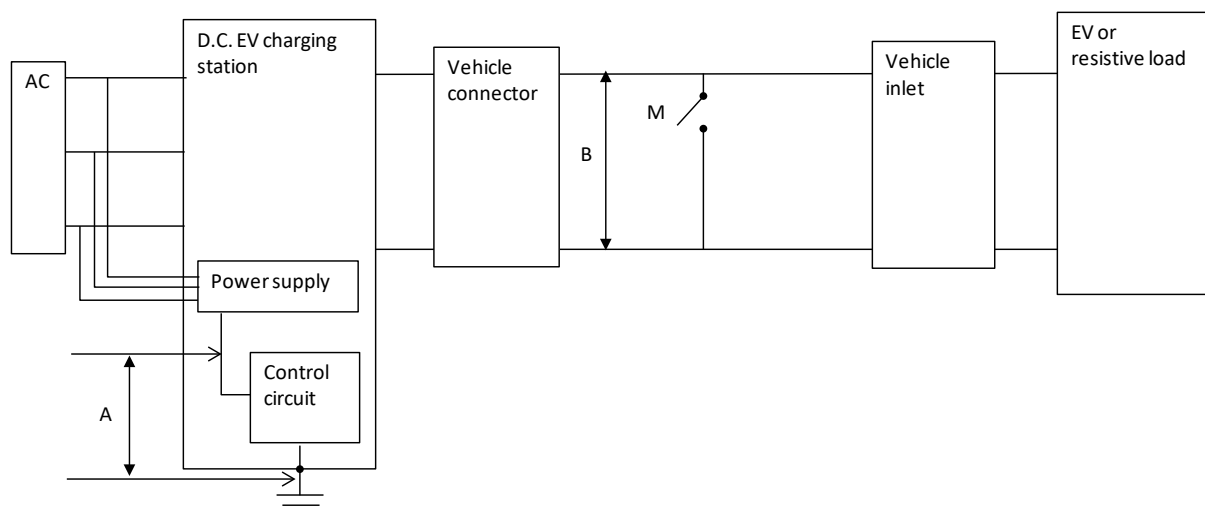
836

837 **Key**

A	voltage of the power supply for control circuit	N	negative
B	voltage of the high voltage line	P	positive
E	earth	PE	protective conductor
L	selector switch	Rt	earth-fault resistance
1	terminal 1 to replicate earth-fault between P and E		
2	terminal 2 to replicate earth-fault between N and E		

838

Figure 104 – Earth-fault test system839 *The test shall be performed for Systems A and C only, according to the following procedure.*840 1) *A test load with a dedicated EV simulator for each system (see 102.2.3) is connected*
841 *to DC EV charging station correctly under normal operation.*842 2) *The high voltage line is energized at the rated voltage.*843 3) *The DC EV charging station is operated in the constant voltage charging mode (in*
844 *case of System C) and constant current charging mode (in case of System A).*845 4) *Simulate the earth-fault by changing the position of the relay or switch L from open to*
846 *1.*847 5) *Check that the earth-fault is detected properly and the DC charger transfers to a fault*
848 *state.*849 6) *Confirm that the voltage of the power supply for control circuit at point A remains the*
850 *same or within a specified range that ensures the normal operation of the control*
851 *circuit.*852 7) *Confirm that the voltage of the high voltage line at point B is less than 60V within 1s*
853 *after the DC EV supply equipment detects the earth-fault in 5).*854 8) *Repeat the procedures 1) to 7) for the case in which the position of the relay or*
855 *switch L is changed from open to 2 in 4).*856 *b) Short-circuit test*857 *The test system is shown in Figure 105. For System A, design check of the DC charger is also*
858 *required.*



Key

- A voltage of the power supply for control circuit
- B voltage of the high voltage line
- M switch or relay to replicate short-circuit

Figure 105 – Short-circuit test system

The test shall be performed according to the following procedure.

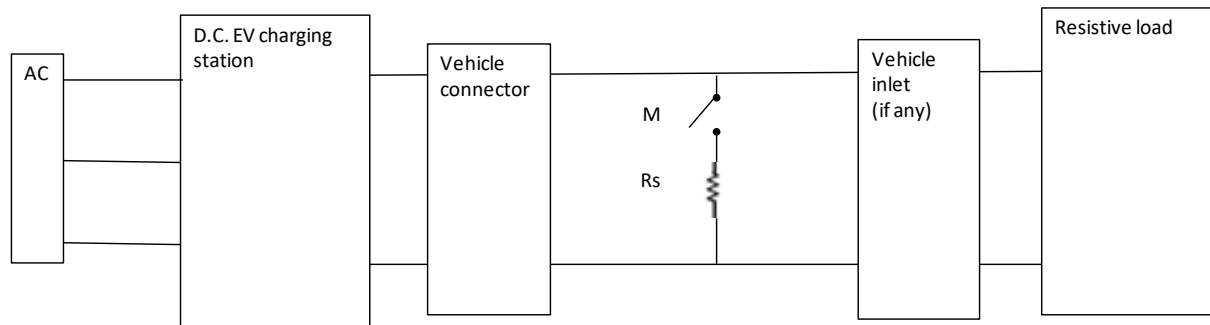
- 1) *An EV, a resistive load, or an electronic load is connected to the DC EV charging station correctly under normal operation. If an electronic load is used, it shall not interfere with the measurement.*
- 2) *The high voltage line is energized at the rated voltage.*
- 3) *The DC EV charging station is operated in the constant voltage charging mode (in case of System B and System C) and constant current charging mode (in case of System A and System B).*
- 4) *Simulate the short circuit by closing the relay or switch M.*
- 5) *Check that the short circuit was detected properly and the DC charger transferred to a fault state.*
- 6) *Confirm that the voltage of the power supply for control circuit at point A remains the same or within a specified range that ensures the normal operation of the control circuit.*
- 7) *Confirm that the voltage of the high voltage line at point B is less than 60 V within 1 s after the DC EV charging station detects the short circuit in 5).*

6.3.1.110 Short-circuit test before charging

With the EV connected to the DC EV charging station and before the EV contactor is closed, the DC EV charging station shall have a means to check for a short circuit between DC output circuit positive and negative for the cable and vehicle coupler.

Compliance is checked by the following test.

The test system is shown in Figure 106.

**Key**

M switch or relay

Rs short-circuit resistance

Figure 106 – Short circuit test system

The test shall be performed according to the following procedure.

- 1) Connect the DC EV charging station to an artificial load correctly under normal operation.
- 2) The EV contactors are open.
- 3) The short-circuit resistance R_s shall be $100\ \Omega$.
- 4) Switch M is open.
- 5) Simulate the short circuit of the high voltage line by closing the switch M .
- 6) Start charging with the procedure specified by charger manufacturer.
- 7) Check that the short-circuit test is performed properly and the DC charger transfers to a fault state.

6.3.1.111 User initiated shutdown

The DC EV charging station shall have a means to allow the user to initiate the normal shutdown.

NOTE For System A, a means to trigger an error shutdown is also possible.

Compliance is checked by the tests in AA.8, BB.5.4, and CC.11.3.20.

6.3.1.112 Overload protection for parallel conductors (conditional function)

If more than one conductor or wire and/or vehicle connector contact is used in parallel for DC current supply to the vehicle, the DC EV charging station shall have a means to ensure that none of the conductors or wires will be overloaded.

Compliance is checked by inspection, and the following test (under consideration).

NOTE E.g. the currents on the different path can be monitored or more than one power source can be used.

6.3.1.113 Voltage limitation between DC output and protective conductor**6.3.1.113.1 Maximum voltage between DC+/- and protective conductor in conditions without earth fault**

Under normal operation no voltage higher than the DC output voltage plus 50 V shall occur between DC+/- and protective conductor at the output of the DC EV charging station. This voltage limitation does not apply for transients overvoltages. See Figure 107 and Figure 108.

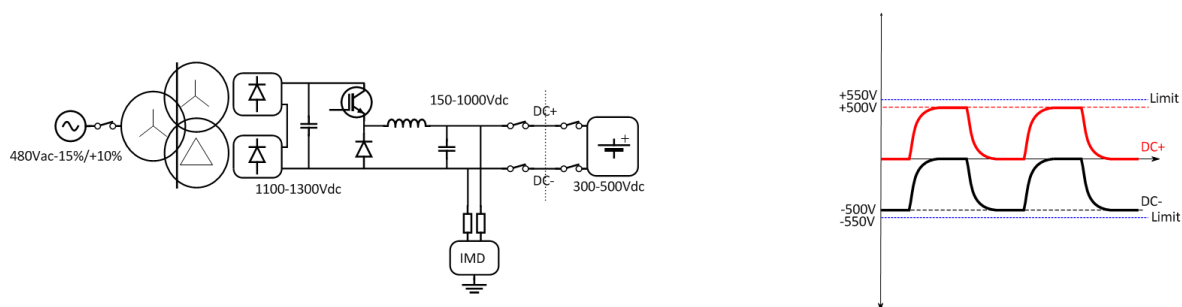


Figure 107 - Typical voltages between DC+/- and protective conductor in conditions without earth fault

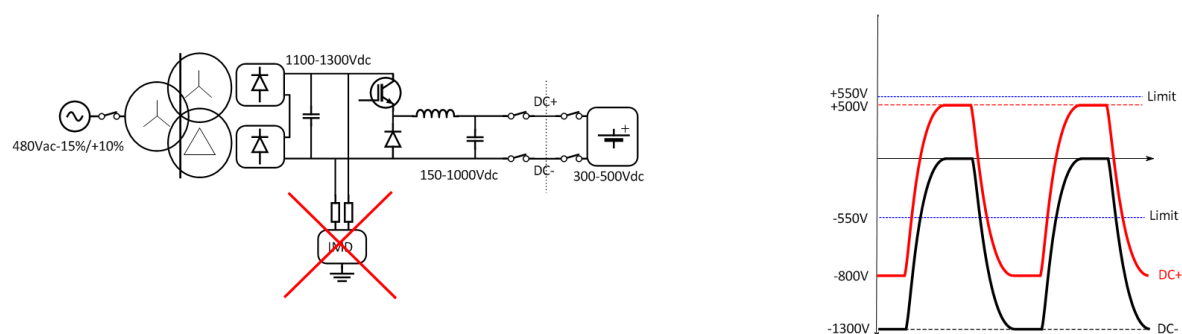


Figure 108 - IMD connection which results in exceedance of maximum voltage limits

6.3.1.113.2 Maximum voltage between DC+/- and protective conductor in conditions with a single earth fault

For DC EV charging stations serving a maximum rated output voltage up to 500 V, no voltage higher than 550 V shall occur for more than 5 s at the output between DC+ and protective conductor or between DC- and protective conductor.

If a voltage higher than 550 V is present for more than 1 s between DC+ and protective conductor or between DC- and protective conductor, the DC EV charging station shall have completed an emergency shutdown within 5 s after occurrence of the overvoltage.

For DC EV charging stations serving a maximum output voltage above 500 V and up to 1 000 V, no voltage higher than 110 % of DC output voltage shall occur for more than 5 s at the output between DC+ and protective conductor or between DC- and protective conductor.

If a voltage higher than 110 % of the DC output voltage is present for more than 1 s between DC+ and protective conductor or between DC- and protective conductor, the DC EV charging station shall have completed an emergency shutdown within 5 s after occurrence of the overvoltage.

For voltage above 1 000 V, under consideration.

Within the first 5 s of an earth fault condition, the DC EV charging station shall limit the temporary overvoltage V_{tov} as defined in ISO 6469-3 and IEC 60664-1 between DC+/- and protective conductor to:

$$(2 U_{min} + 1\,000) \times 1,41 \text{ V or;}$$

$$(U_{min} + 1\,200) \times 1,41 \text{ V, whichever is less}$$

where

U_{min} is the minimum rated DC charger output voltage.

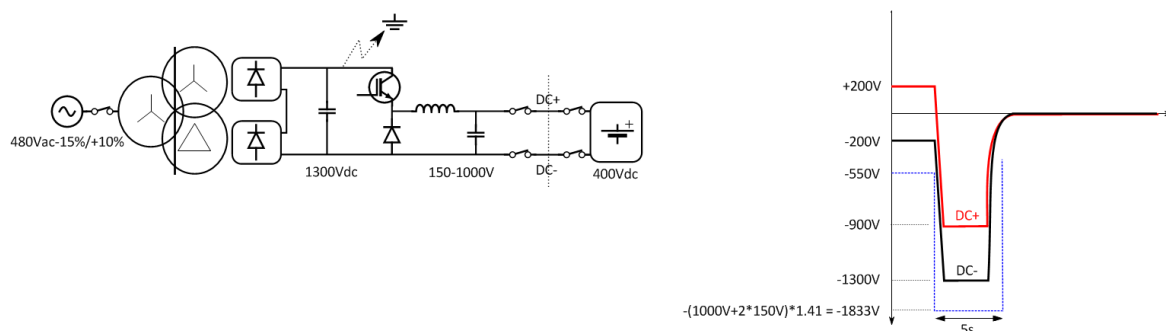
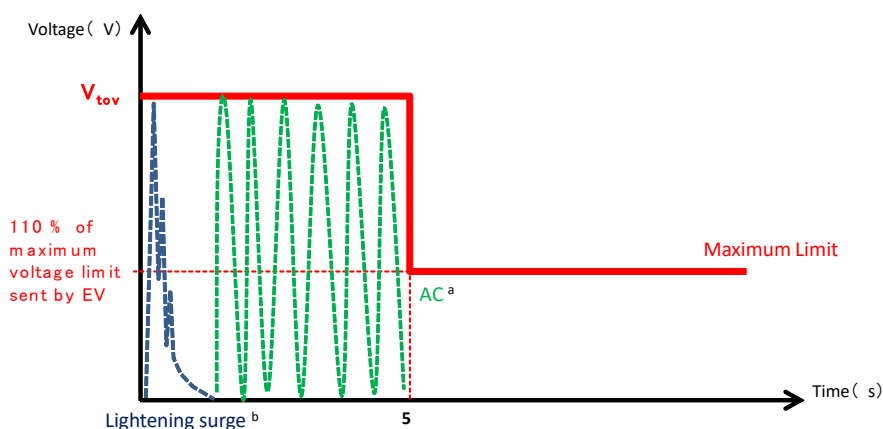


Figure 109 - Maximum voltage between DC+/- and protective conductor in conditions with a single earth fault

Figure 110 shows an example of temporary voltage waveform and the maximum voltage limit at the DC output.



EXAMPLE

^a If an earth-fault occurs in a non-isolated DC EV charging station, an AC waveform may appear at the common-mode DC output.

^b Lightning surge appears at the common-mode DC output as a result of its input to the AC-input circuit of DC EV charging station.

Figure 110 – Examples of temporary voltage waveform and the maximum voltage limit at the DC output

6.3.1.114 Shutdown of DC EV charging station

6.3.1.114.1 Normal shutdown

Normal shutdown shall occur as a result of an intrinsic reaction of the vehicle or the DC EV charging station or a user interaction, for other reasons than the presence of a failure.

The timing sequence shall be according to IEC 61851-24. Further requirements are specified in Annexes AA, BB and CC.

6.3.1.114.2 Error shutdown

The DC EV charging station shall reduce:

- DC output voltage ≤ 60 V (for Systems B and C) and
- DC output current ≤ 5 A

within

- 3 s for System A

- 500 ms for System B, and

- 1 s for Systemes C,

after the error shutdown was triggered by the DC EV charging station.

For compliance check, see 6.3.1.114.3.

Further requirements are specified in Annexes AA, BB and CC.

6.3.1.114.3 Emergency shutdown

The DC EV charging station shall reduce:

- DC output current ≤ 5 A

within 30 ms after the emergency shutdown was triggered and shall be designed such that

- DC output voltage ≤ 60 V (between DC+ and DC- and between DC+ and protective conductor, and DC- and protective conductor)

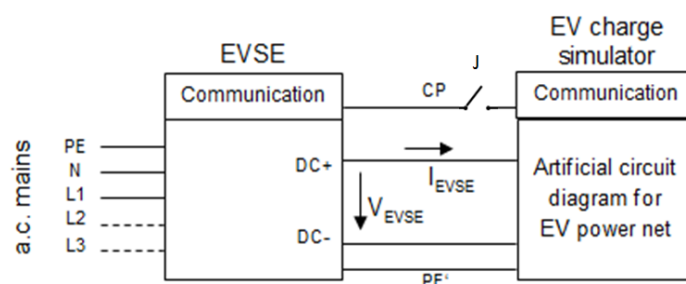
within 1 s for Systems A and C, and 500 ms for System B, after the emergency shutdown was triggered.

Further requirements are specified in Annexes AA, BB and CC.

NOTE A welded contactor on the vehicle can prevent the DC EV charging station to reduce the voltage.

Compliance is checked by the following test.

The test system is shown in Figure 111.



Key

J	switch or relay	L1, L2, L3	power line
CP	control pilot	I_{EVSE}	output current of EV supply equipment
PE	protective conductor	V_{EVSE}	output voltage of EV supply equipment
N	neutral		

Figure 111 – Control pilot test system

The test shall be performed according to the following procedure.

1) Connect the DC EV charging station to an EV, a resistive load or an electronic load. For System C, use a test load with a dedicated EV simulator.

2) Start charging with the procedure specified by charger manufacturer.

3) Confirm that the DC high voltage line between DC charger and EV is energized at the rated voltage and the DC EV charging station is operating at the maximum rated output current.

1001 4) *Initiate emergency shutdown by the methods in Table 107.*

1002 **Table 107 - Error shutdown and emergency shutdown methods**

Sys tem	Method(s) to initiate shutdown	Verification criterion
A	[Emergency shutdown] Turn off the control pilot CP3 or other control pilot (CP or CP2) specified by manufacturer (See Table AA.1) e.g. by opening the switch/mechanical relay J.	An emergency shutdown is triggered within 10 ms after the loss of control pilot. Thereafter, the DC EV charging station performs the error shutdown.
	[Error shutdown] Replicate one of the following errors in accordance with the specification of the DC EV Charging Station: - Ground fault - Earth fault - Overvoltage at the battery - Under-voltage at the battery (for bi-directional station only) - Loss of protective conductor - Other (specified by the manufacturer of System A station)	An error shutdown is triggered within 9 s after one of the errors have been replicated, and all of the criteria below are satisfied: 1. The following messages are sent by the station via digital communication: ["Station malfunction" (H'109.5.1) = 1 or "Charging system error" (H'109.5.4) = 1] and ["Station stop control" (H'109.5.5) = 1] 2. The output current is 5A or less within 3s after the transmission of the messages above. (To be skipped for emergency shutdown.) 3. The output current descending speed is 200A/s or higher. 4. CP1 and CP2 are both open within 2s after EV contactors are opened and the station receives the message ["Vehicle status" (H'102.5.3) = 1] by digital communication. 5. The output voltage is reduced to 10V or less within 2s after the opening of CP1 and CP2.
B	[Emergency shutdown] Replicate one of the following errors: -Control pilot CC1 error; e.g. by opening the mechanical switch S; - Loss of protective conductor; - Charger intrinsic fault - Vehicle fault	1. An emergency shutdown is triggered within 20 ms after switch S is opened or the coupler is unmated(CC1 error),or protective conductor error. 2. An emergency shutdown is triggered within 70ms when a charger intrinsic fault occurs . Thereafter, the DC EV charging station performs the error shutdown within 30 ms.
	[Error shutdown] Replicate one of the following errors: - Overvoltage at the battery - Communication error, e.g. ture off the S+,S- communication lines	1. An error shutdown is triggered within 500 ms after an overvoltage error occurs. 2. An error shutdown is triggered within 9,5 s after an communication error occurs. Thereafter, the DC EV charging station performs the error shutdown within 500 ms.

1003 5) *Check that the DC EV charging station terminates the charging process and transfers to*
1004 *shutdown stage, displaying a relevant alarm or error information, if any.*

1005 *Confirm that the DC high voltage line between DC charger and EV is de-energized to voltage*
1006 *less than 60 V, within 1s for Systems A and B, and (TBD) s for System C.*

1007 *Replacement of title 6.3.2:*

1008 **6.3.2 Optional functions for Mode 4**

1009 **6.3.2.1 General**

1010 *Replacement:*

1011 The following functions, if provided, shall be provided by DC EV supply equipment as given
1012 below:

- 1013 – ventilation during supply of energy according to 6.3.2.2;
- 1014 – Mode 4 using the combined charging system according to 6.3.2.4;
- 1015 – wake up of DC EV charging station by EV according to 6.3.2.101;
- 1016 – detection/adjustment of the real time available load current of the DC EV charging station
- 1017 according to 6.3.2.102;
- 1018 – selection of charging current;
- 1019 – indicating means to notify users of locked status of vehicle coupler.
- 1020 Other additional functions may be provided.

1021 NOTE 1 Un-intentional live disconnect avoidance functions may be incorporated in the latching function interlock
1022 system.

1023 NOTE 2 A positive means to prevent unintentional disconnect is required in some countries: US

1024 NOTE 3 Primary protection against overvoltage and overcurrent of vehicle battery is the responsibility of the
1025 vehicle.

1026 *Addition:*

1027 **6.3.2.101 Wake up of DC EV charging station by EV**

1028 The DC EV charging station may support a standby mode to minimize power consumption. In
1029 this case, the DC EV charging station shall be able to be woken up by the EV.

1030 *Compliance is checked by the following test.*

1031 *The test shall be performed according to the following procedure.*

- 1032 1) *DC EV supply equipment at standby mode*
- 1033 2) *Send a proper signal from EV emulator to DC EV charging station.*
- 1034 3) *For System A, check the transfer from DC-B1 to DC-B2 in Table AA.7*
- 1035 *For System B, check the transfer xx*
- 1036 *For System C, check the transfer from B2 to C2 or B2 to D2..*

1037 **6.3.2.102 Detection/adjustment of the real time available load current of the DC EV** 1038 **charging station (smart charging)**

1039 The DC EV charging station may support the smart charging operation. In such case, the DC
1040 EV charging station may change the available current and shall transmit it to vehicle via
1041 digital communication. The vehicle should limit the output current command value in
1042 accordance with the change in the available current. The current command value shall be less
1043 than or equal to the available current

1044 This clause is applicable to System A and System C. For specific requirements, see AA.7 for
1045 System A and CC.XX (TBD) for System C. For System B, not applicable.

1046 **7 Communications**

1047 This clause of Part 1 is applicable except as follows:

1048 **7.1 Digital communication between the EV supply equipment and the EV**

1049 *Replacement*

1050 **7.1.101 General**

1051 This clause provides the general requirements for the control communication function and the
1052 system between EV and DC EV charging station. The specific requirements of digital
1053 communication of charging control between off-board DC charging system and electric road
1054 vehicle are defined in IEC 61851-24.

1055 Requirements on the communication for bidirectional power flow control are specified in
1056 Annex DD, and specific requirements are specified in IEC 61851-24.

1057 EVs are equipped with propulsion batteries with different technologies and voltage.
1058 Accordingly, the charging process shall be managed by the vehicle in order to ensure the
1059 charging of different types of on-board energy storage systems.

1060 EVs are equipped with VCCF for charging process management. The DC EV charging
1061 stations shall have a means allowing the vehicles to control the charging parameters of DC
1062 EV charging station.

1063 **7.1.102 System configuration**

1064 The communication between the DC EV charging station and the vehicle can be established
1065 via basic communication and high level communications.

1066 Key steps in the charging control process, such as start of charging and normal/emergency
1067 shutdown, shall be managed through the basic communication with signal exchange via the
1068 control pilot lines in DC EV charging system.

1069 In addition to the basic communication, the DC EV charging station shall be equipped with
1070 digital communication means in order to exchange the control parameters for DC charging
1071 between the DC EV charging station and the vehicle through the high level communication.
1072 The following digital communication means are used by the systems defined in Annexes AA,
1073 BB and CC:

1074 a) Control area network (CAN) over dedicated digital communication circuit according to ISO
1075 11898-1, or

1076 b) Power line communication (PLC) over control pilot circuit.

1077 *Compliance is checked by inspection and measurement.*

1078 **7.1. 103 Basic communication**

1079 **7.1.103.1 Interface**

1080 Typical interfaces of control pilot function on DC EV charging systems are specified in
1081 Annexes AA, BB and CC. Each system shall carry out control pilot function through the control
1082 pilot conductors and terminals specified in IEC 62196-3.

1083 **7.1.104 Digital communication**

1084 Digital communication is specified in IEC 61851-24.

1085 **7.1.105 Charging control process and state**

1086 **7.1.105.1 General**

1087 Charging control process of DC EV charging stations consist of the following three stages:

1088 – process before the start of charging (initialization): Initialization includes pre-charge if
1089 required. Pre-charge is the final stage of initialization.;

1090 – process during charging (energy transfer);

1091 – process of shutdown (shutdown).

1092 The DC EV charging station and the vehicle synchronize control process with each other. The
1093 following signals and information are used for the synchronization:

1094 – signals through the pilot wire circuit;

1095 – parameters through the digital communication circuit;

1096 – measurement values such as voltage and current level of the DC charging circuit through
1097 the digital communication circuit.

1098 The DC EV charging station and the vehicle preserve specified time constraints and control
1099 timings for ensuring smooth charging control and operation.

1100 Charging sequence diagrams are system specific and described in Annex AA, Annex BB, and
1101 Annex CC. Digital communication parameters, formats, and other communication
1102 requirements are specified in IEC 61851-24.

1103 **7.1.105.2 Description of the process before the start of charging (initialization)**

1104 In this process, the vehicle and the DC EV charging station exchange their operational
1105 limitations and relevant parameters for charging control. Messages, such as the voltage limit,
1106 maximum charging current, etc. are also transferred to each other. Circuit voltage shall be
1107 measured for checking whether the batteries and the DC EV charging station are connected
1108 before the start of charging and whether the batteries and the DC EV charging station are
1109 disconnected after the end of charging. The DC EV charging station shall not proceed with the
1110 next stage of charging process unless it verifies the compatibility with the vehicle. After
1111 compatibility check, the DC EV charging station shall conduct the insulation check between
1112 the DC power lines and the enclosures, including vehicle chassis. The vehicle connector is
1113 locked before the insulation check.

1114 **7.105.3 Description of the process during charging (energy transfer)**

1115 In this process, the vehicle continues to send a setting value of charging current or voltage to
1116 the DC EV charging station throughout charging process. Either of the following two
1117 algorithms is taken.

1118 a) CCC

- 1119 – The vehicle battery can be charged using CCC with the vehicle as master and the DC
1120 EV charging station as slave.
- 1121 – The DC EV charging station receives the charging current value the vehicle requested
1122 (command value), throughout the charging control process.
- 1123 – The DC EV charging station sets the command value as control target, and regulate
1124 the DC charging current.
- 1125 – The command value from the vehicle is notified to the DC EV charging station at
1126 regular intervals according to the system requirements.
- 1127 – The DC EV charging station regulates the DC charging current responding to the
1128 change of command value of the vehicle.

1129 b) CVC

- 1130 – The vehicle battery can be charged using CVC with the vehicle as master and the DC
1131 EV charging station as slave.
- 1132 – The DC EV charging station receives the charging voltage value the vehicle requested
1133 (command value) throughout the charging process.
- 1134 – The DC EV charging station sets the command value as control target, and regulate
1135 the DC charging voltage.
- 1136 – The command value from the vehicle is notified to the DC EV charging station at
1137 regular intervals according to the system requirements.
- 1138 – The DC EV charging station regulates the DC charging voltage responding to the
1139 change of command value of the vehicle.

1140 **7.1.105.4 Description of process of shutdown**

1141 After completion of charging session, the shutdown phase allows the vehicle and the DC EV
1142 charging station to return to the conditions so that the user can safely handle the charging
1143 cable and the vehicle connector. When the end of charging is notified by the vehicle, the DC
1144 EV charging station reduces the charge current to zero. The vehicle side contactors open at
1145 near zero current. The DC EV charging station or the vehicle unlocks the vehicle connector
1146 only if the voltage at the inlet between DC+ and DC- is less than 60 V DC (see 6.3.1.108).

8 Protection against electric shock

This clause of Part 1 is applicable except as follows:

8.1 Degrees of protection against access to hazardous-live-parts

Addition:

Following requirement is applied to the vehicle connector if the voltage between any contacts exceeds 60 V DC or 30 V AC (rms) during charging.

The vehicle connector shall comply with at least one of the following requirements if its contacts do not fulfil IPXXB in accordance with IEC 60529:

- The charge between any contacts shall be below 50 µC within 1 s after disconnection of the vehicle connector from the vehicle inlet.
- The voltage between any contacts shall be below or equal to 60 V DC and 30 V AC (rms) within 1 s after disconnection of the vehicle connector from the vehicle inlet.

The vehicle connector shall comply with at least one of the following requirements if its contacts have IPXXB in accordance with IEC 60529:

- The energy between any contacts shall be below 0,2 J within 10 s after disconnection of the vehicle connector from the vehicle inlet.
- The voltage between any contacts shall be below or equal to 60 V DC and 30 V AC (rms) within 10 s after disconnection of the vehicle connector from the vehicle inlet.

The voltage or energy shall be measured at the unmated vehicle connector.

The test shall be performed according to the following procedure:

[Case 1: Stop sequence and the output voltage]

- 1) *The DC EV charging station is connected to an artificial load as defined in 102.2.3.*
- 2) *The high voltage line is energized at the maximum output voltage.*
- 3) *Stop charging based on the stop sequence defined by each system.*
- 4) *Check that the voltage values between any contacts fall to less than 60 V in 1 s or less after disconnecting all the signal lines or the connector lock circuit. For System A, check that the stored energy in the output circuit of DC EV charging station is less than the value above.*

[Case 2]

The stored energy shall be less than the defined value above. The Energy is calculated by using the corresponding values of capacitances determined before and the documented voltage 1s after triggering. See Formula (2).

$$E = 0,5 \times C \times V^2 \quad (2)$$

where

E is the energy 1 s after triggering in Joule;

C is the capacity in Farad;

V is the voltage 1 s after triggering in Volt.

8.3 Fault protection

Addition:

The types of DC EV charging stations covered by these requirements, including all accessible conductive parts on the equipment shall have the following protective measures as described in IEC 61140:

- 1189 – protective measures by automatic disconnection of supply by connecting all exposed-
- 1190 conductive-parts to a protective conductor during battery charging, unless protective
- 1191 measure by reinforced or double insulation or protective measure by electrical separation
- 1192 is used for the DC EV charging stations.

1193 **8.5 Residual current protective devices**

1194 *Addition:*

1195 Class II chargers shall have a lead-through protective conductor with double insulation for
1196 earthing the EV chassis.

1197 Plug and cable DC EV charging stations shall be compatible with residual current device with
1198 characteristics of Type A.

1199 Compatibility with a Type-A RCD upstream can be achieved by:

- 1200 – double or reinforced insulation of the circuit that can cause a DC leakage current to any
- 1201 other circuit and protective conductor, or;

- 1202 – 6 mA DC leakage detection and disconnect of the circuit that causes the DC leakage
- 1203 current.

1204 Fixed installations may rely on a RCD upstream as defined in the installation manual of the
1205 EV supply equipment. The protective measures against fault current can rely on the fixed
1206 installations in accordance with IEC 60364-7-722. Appropriate protection against DC residual
1207 current may depend on the level of the DC residual current in normal conditions. Plug and
1208 cable DC EV charging station shall be provided with an RCD on the cable or within the EV
1209 supply equipment.

1210 NOTE In some countries, the RCD must be located within 0,3 m of the plug of the DC charger or in the plug: US,
1211 Canada

1212 *Compliance is checked by inspection.*

1213 *Addition:*

1214 **8.101.1 Requirements of the isolated DC EV charging station**

1215 In isolated DC EV supply equipment, secondary DC power circuit shall be galvanically
1216 separated from AC supply network, and galvanically isolated from earth. In isolated DC EV
1217 supply equipment, the insulation between the isolated circuits and earth, and between the
1218 isolated circuits and exposed conductive parts of vehicle and DC EV supply equipment shall
1219 be monitored.(see Figure 112)

1220 When a fault condition related to the electrical isolation is detected, the secondary DC power
1221 circuit shall be automatically de-energized or disconnected by the isolated DC EV supply
1222 equipment.

1223 In isolated DC EV supply equipment, the isolation monitoring between AC supply network and
1224 the secondary circuit may not be required.

1225 Requirements for the isolated DC EV supply equipment for protection against electric shock
1226 are defined for each system in Annexes AA (AA.3.1), BB (BB.2) or CC (CC.4.1).

1227 In addition, if the DC EV charging station has multiple DC outputs designed for simultaneous
1228 operation, each output circuit shall be isolated from each other by basic insulation, double or
1229 reinforced insulation.

1230 NOTE In the following countries, both isolated and non-isolated electric vehicle supply equipment and DC EV
1231 charging stations comply with the requirements in national standards: US, CA

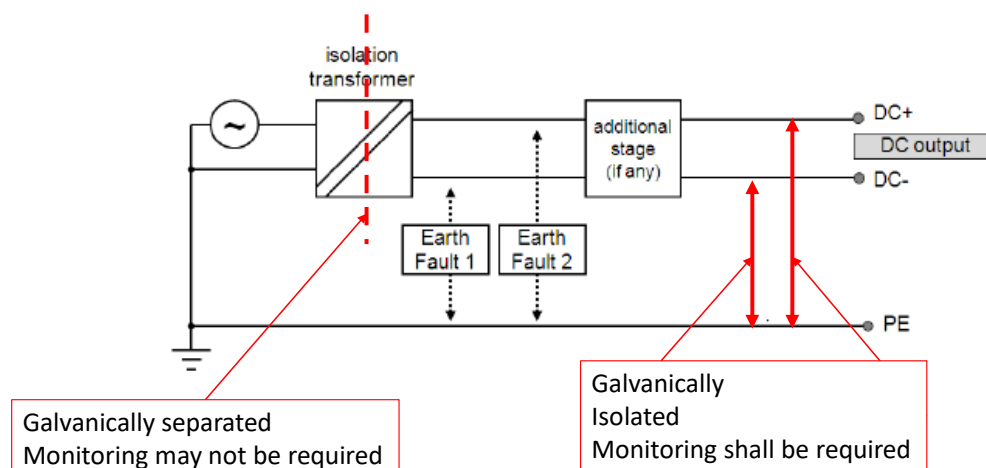


Figure 112 - Requirements for isolation and monitoring

8.101.2 Requirements of the non-isolated DC EV charging station

For non-isolated DC EV charging stations, under consideration.

NOTE In the following countries, both isolated and non-isolated electric vehicle supply equipment and DC EV charging stations comply with the requirements in national standards: US

8.102 Protective conductor dimension cross-sectional area

The protective earthing conductor or protective conductor shall be designed according to Clause 543.1 of IEC 60364-5-54.

NOTE In some countries, the size and rating of the protective earthing conductor is specified in national code and regulation: US, CA

Compliance is checked by inspection and measurement.

9 Conductive electrical interface requirements

This clause of Part 1 is applicable except as follows:

9.1 General

Replacement:

The physical conductive electrical interface requirements between the vehicle and the DC EV charging station are as defined in IEC 62196-3.

For non-isolated systems, under consideration.

9.2 Functional description of standard accessories

Not applicable.

9.3 Functional description of the basic interface

Not applicable.

9.7 Wiring of the neutral conductor

Not applicable except the following:

Wiring instructions shall be provided in the manual (See 17.1).

Addition:

1259 **9.101 Avoidance of breaking under load**

1260 For DC charging, the vehicle couplers are rated "not for current interruption." A disconnection
1261 shall not take place under load.

1262 In the case of disconnection under DC load due to a fault, no hazardous condition shall occur.

1263 Avoidance of breaking under load can be achieved by a specific means on the vehicle
1264 connector or a system with interlock.

1265 *Compliance is checked by inspection and operation.*

1266 In addition to locking mechanism defined in 6.3.1.104, in case of unintended disconnection of
1267 the vehicle coupler, the output current of the DC EV charging station shall be turned off within
1268 a defined time to contain a possible arc within the vehicle coupler housing. This turn-off time
1269 shall comply with the value specified in Annexes AA, BB and CC, using a speed of separation
1270 of the vehicle connector of $0,8 \pm 0,1$ m/s according to IEC 60309-1.

1271 Disconnection of vehicle coupler can be detected when one of the following occurs:

- 1272 – loss of digital communication;
- 1273 – interruption of interlock circuit(s), e.g. control pilot, proximity circuit, to mitigate electrical
1274 arcing and shock hazards.

1275 *Compliance is checked by the test in 6.3.1.114.*

1276 The system specific requirement for breaking capacity and system redundancy are defined in
1277 Annexes AA, BB and CC.

1278 **10 Requirements for adaptors**

1279 This clause of Part 1 is applicable.

1280 **11 Cable assembly requirements**

1281 This clause of Part 1 is applicable, except as follows.

1282 **11.7 Cable management and storage means for cables assemblies**

1283 *Addition:*

1284 For vehicle connector, a storage means shall be provided to protect the contacts of the
1285 vehicle connector at least IP44. This can be a part of the DC charger or a separately installed
1286 holder for the cable assembly and the vehicle connector.

1287 **12 EV supply equipment constructional requirements and tests**

1288 This clause of Part 1 is applicable except as follows:(to be checked)

1289 **12.4 IP degrees**

1290 *Addition:*

1291 For the DC EV charging station of stationary type, the test conditions can be defined in
1292 accordance with installation conditions.

1293 **12.5 Insulation resistance**

1294 *Add the following sentence:*

1295 Insulation resistance does not include components bridging insulation according to 1.5.6 and
1296 1.5.7 of IEC 60950-1:2005.

1297 NOTE The test is made without an insulation monitoring system.

1298 **12.6 Touch current**

1299 *Replacement:*

1300 This subclause defines the measurement of current through networks simulating the
1301 impedance of the human body (touch current).

1302 *Addition:*

1303 **12.6.101 Touch-current limit**

1304 The touch current between any AC supply network poles and the accessible metal parts
1305 connected with each other and with a metal foil covering insulated external parts shall not
1306 exceed the values indicated in Table 1 of Part 1.

1307 The test shall be made when the DC electric vehicle charging station is functioning with an
1308 artificial load according to Figure 121 at rated output power.

1309 For Class I DC EV charging station, if the test touch current exceeds 3.5 mA, 12.6.106 is
1310 applicable.

1311 Circuitry which is connected through a fixed resistance or referenced to protective conductor
1312 (for example, EV connection check) should be disconnected before this test.

1313 *Compliance is checked by the test in 12.5.102.*

1314 **12.6.102 Test**

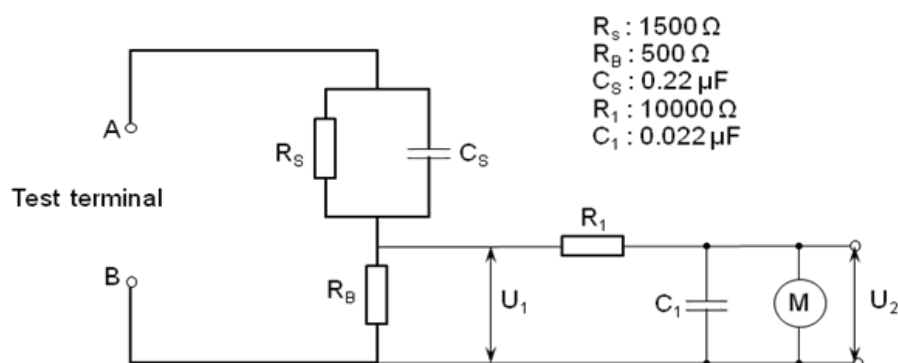
1315 **12.6.102.1 Test configuration**

1316 Test configurations for measurement of leakage current are given in 5.4.1 of IEC 60990:1999.

1317 **12.6.102.2 Application of measuring network**

1318 The measuring network is defined in Figure 113. Terminal B of the measuring network is
1319 connected to the earthed (neutral) conductor of the supply. Terminal A of the measuring
1320 network is connected to each conductive or unearthed accessible surface in turn. All
1321 accessible conductive or unearthed surfaces are to be tested for touch currents. Figure 113 is
1322 from Figure 4 of IEC 60990:1999.

1323 For an accessible non-conductive part, the test is made to metal foil having dimensions of
1324 100 mm by 200 mm in contact with the part.



1325

1326 **Key**

A	terminal of the measuring network	U_1, U_2	output voltage
B	terminal of the measuring network	R_1, R_B, R_S	resistor
C_1, C_S	capacitor	$\bigcirc, M$	measuring instrument

1327 **Figure 113 - Measuring network of touch current weighted for perception or reaction**

12.6.102.3 Test condition

The touch current shall be measured after the damp heat test, with the DC EV charging station connected to AC supply network in accordance with 6 of IEC 60990:1999. The supply voltage shall be 1,1 times the nominal rated voltage.

Measurements shall be made with each of the applicable fault conditions specified in 6.2.2 of IEC 60990:1999.

12.6.102.4 Test measurements

The r.m.s. value of the voltage, U_2 , shall be measured using the measuring instrument in Figure 113. Formula (3) shall be used to calculate the touch current:

$$\text{TOUCH CURRENT(A)} = U_2 / 500 \quad (3)$$

None of the values measured in accordance with 12.5.102.3 shall exceed the relevant limits specified in 12.5.101.

12.6.103 Protection measures for the touch current exceeding 3,5 mA

For Class I DC EV charging station, if the test touch current exceeds 3,5 mA r.m.s, any of the following requirements shall be met. The touch current shall be measured under the fault condition with earthing conductor closed.

a) The protective conductor shall have a cross-sectional area of at least 10 mm² Cu or 16 mm² Al, through its total run.

b) Where the protective conductor has a cross-sectional area of less than 10 mm² Cu or 16 mm² Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm² Cu or 16 mm² Al.

NOTE This can require that the DC EV charging station has a separate terminal for a second protective conductor.

c) Automatic disconnection of the supply in case of loss of continuity of the protective conductor.

A caution symbol  shall be placed on the outside of the DC EV charging station, visible to the user.

The minimum size of the protective earthing conductor shall comply with the local safety regulations, and shall be indicated in the installation manual.

Addition:

12.7.101 Suppression of overvoltage (insulation coordination)

The DC EV charging station shall reduce overvoltage between DC+/- and protective conductor to 2 500 V.

Primary circuit of DC charging station in outdoor is overvoltage category (OVC) III according to Part 1.

Compliance is checked by circuit analysis.

NOTE 1 The overvoltage reduction can be achieved by combination of one or more attenuation means in accordance with 4.3.3.6 of IEC 60664-1:2007

The DC EV charging station shall reduce overvoltage between DC+ and DC- conductor to (TBD) V.

NOTE 2 Annex E of IEC 61851-21-2 specifies peak-to-peak voltage limits between DC+/- and PE and between DC+ and DC- during the application of voltage surges at EMC immunity test.

1372 *Addition:*

1373 **13 Overload and short circuit protection**

1374 This clause of Part 1 is applicable except as follows:

1375 *Replacement:*

1376 **13.3 Short-circuit protection of the DC connection**

1377 The DC EV charging station shall provide short circuit protection device to protect the vehicle
1378 side power supply circuit and the cable assembly. For system specific details, see relevant
1379 annex.

1380 When the vehicle connector is equipped with short circuit protection means, the short circuit
1381 withstand rate of the charging cable may be lower than the I^2t protection provided by the
1382 vehicle.

1383 The cross sectional area of live conductor of the DC supply circuit to the EV, i.e. charging
1384 cable, shall be selected taking into account the characteristic of short-circuit protection device
1385 in EV.

1386 The cut-off current i_c [IEV 441-17-12] supplied by the DC EV charging station shall not exceed
1387 30 kA (TBD) at the contacts of the vehicle connector.

1388 The short-circuit shall be shut-off within 1 s (TBD) after the start of the short-circuit condition.

1389 NOTE The requirements for EV are specified in ISO17409.

1390 **14 Automatic reclosing of protective devices**

1391 This clause of Part 1 is applicable.

1392 **15 Emergency switching or disconnect (optional)**

1393 This clause of Part 1 is applicable.

1394 **16 Marking and instructions**

1395 This clause of Part 1 is applicable except as follows:

1396 **16.4 Marking of charging cable assemblies case B**

1397 *Not applicable.*

1398 *Addition:*

1399 **101 Specific requirements for DC EV charging station**

1400 NOTE In some countries, national regulations provide requirements on the enclosure of DC EV charging station:
1401 US, JP

1402 **101.1 Protection against uncontrolled reverse power flow from vehicle**

1403 The DC EV charging station shall be equipped with a protective means against the
1404 uncontrolled reverse power flow from vehicle. Uncontrolled power flow does not include
1405 instantaneous reverse power flow, which may occur with closing of contactors within the
1406 tolerances and duration specified in Annexes AA, BB and CC.

1407 **101.2 Specific requirements for isolated systems**

1408 **101.2.1 DC output**

1409 **101.2.1.1 Ranges for output voltage, output current, and output power**

1410 The manufacturer of the DC EV charging station shall specify the operating range of the DC
1411 EV charging station using the following parameters, and indicate them in the product data
1412 sheet:

- 1413 - output voltage range [V_{min} , V_{max}],
- 1414 - output current range [I_{min} , I_{max}],
- 1415 - maximum output power P_{max} ,
- 1416 - ambient operating temperature range,
- 1417 - maximum operating altitude above sea level.
- 1418 NOTE Part 24 specified which of these parameters shall be communicated to the EV using digital communication,
1419 and how this is carried out.
- 1420 The ambient operating temperature range shall at least cover the range from -5 °C to $+40\text{ °C}$.
- 1421 The maximum operating altitude above sea level shall not be less than 1 000 m above sea
1422 level.
- 1423 The manufacturer of the DC EV charging station may specify one or more additional operating
1424 ranges of the DC EV charging station by specifying:
 - 1425 - an ambient operating temperature range wider than the one referred to above, and/or
 - 1426 - a maximum operating altitude above sea level higher than the one referred to above.
- 1427 In such a case, the other parameter ranges applicable for those/this additional operating
1428 range(s) may deviate from the ones referred to above, e.g.
 - 1429 - an output voltage range smaller than the one referred to above, and/or
 - 1430 - an output current range smaller than the one referred to above, and/or
 - 1431 - a maximum output power smaller than the one referred to above.
- 1432 Within each operating range specified in such a way, in particular with the output voltage
1433 request from the EV being in the range [V_{min} , V_{max}] and the output current request from the
1434 EV being in the range [I_{min} , I_{max}], the DC EV charging station shall be able to provide
1435 electrical energy with an output quality as specified in clause XX.XX output quality
1436 requirements.
- 1437 The DC EV charging station shall not exceed its specified maximum output power, even if the
1438 power requested by the EV is beyond the maximum output power of DC EV charging station.
- 1439 The DC EV charging station may also be able to operate outside a specified operating range,
1440 e.g. provide output current less than given by I_{min} or output voltage less than given by V_{min} ,
1441 without the need to fulfill all requirements given in clause XX.XX output quality requirements.
- 1442 **101.2.1.2 Output voltage and current tolerance**
- 1443 **101.2.1.2.1 Output current regulation in CCC**
- 1444 The variation of the output current of the DC EV charging station from the required value
1445 (target current) sent by the electric vehicle in steady state operation shall be less than or
1446 equal to $\pm 2,5\text{ A}$ for the requirement below 50 A, and less than or equal to $\pm 5\%$ of the
1447 required value of 50 A or more.
- 1448 Requirements for System C are specified in CC.6.4.
- 1449 101.2.1.2.1 is not applicable to the bi-directional power flow system operating in EV
1450 charging/discharging seamless-switchover mode.
- 1451 *Compliance is checked by the following test.*
- 1452 *The test shall be performed according to the following procedure:*

- 1) Connect the DC EV charging station to a test load with a dedicated EV simulator appropriate for the system. The setup of the test load for each system is shown in AA.3.9 and BB.7.
 - 2) Measure the voltage (V_{EVSE} output) and current (I_{EVSE} output) of the high voltage line continuously.
 - 3) Start charging with the procedure specified by charger manufacturer.
 - 4) Record current command value $I_{EV\ target}$ and $I_{EVSE\ output}$ at the operation points as specified in Annexes AA and BB. For operation point, see 102.2.4.
 - 5) During the voltage/current sweep (transition from one OP to another) and for each operation point, check that the difference between the measured current values and the required value sent by the EV simulator are within the limits specified in 101.2.1.2.1.
- Compliance test for System C is specified in CC.11.3.12.

101.2.1.2.2 Output voltage regulation in CVC

The variation of the output voltage of the DC EV charging station from the required value (target voltage) sent by the electric vehicle in steady state operation shall not be greater than $\pm 2\%$ of the maximum rated voltage of the DC EV charging station throughout its operational voltage range.

For CVC, the maximum voltage deviation during pre-charge state and during charging of the vehicle/traction battery shall not exceed $\pm 5\%$ of the requested voltage, or $\pm 2\%$ of the maximum rated voltage of the DC EV charging station, whichever deviation is smaller (see Figure 114).

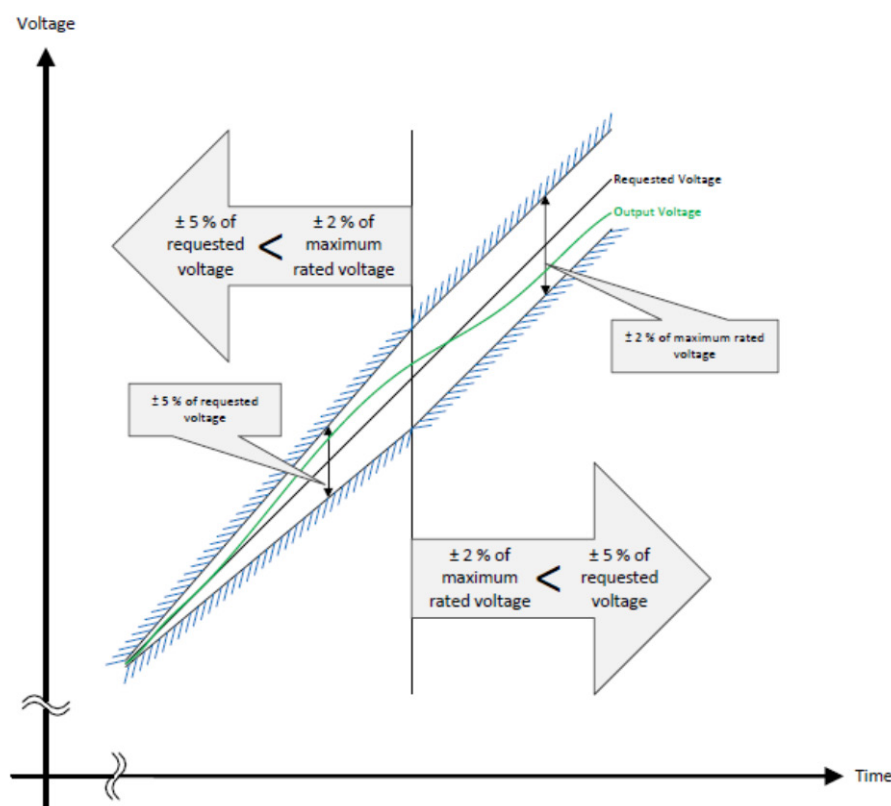


Figure 114 - Voltage tolerances

These requirements are for System B and System C.

Compliance is checked by the tests in BB.9 and CC.11.3.13..

101.2.1.3 Control delay of charging current in CCC

The DC EV charging station shall control the output current within 1 s after acknowledging reception of the request from the vehicle according to Part 24, with a current control accuracy specified in 101.2.1.2.1, and with a changing rate $dI_{\min}$ of 20 A/s or more.

If the vehicle requests a target current I_N , which shows deviation lower than or equal to 20 A compared to the base current value I_0 , the output current of DC EV charging station shall be within the tolerance limits given in 101. 2.1.2.1 within a delay time of 1 s after acknowledging reception of the request from the vehicle according to Part 24.

If the vehicle requests any target current I_N , which shows deviation higher than 20 A compared to the base current value I_0 , the output current of DC EV charging station shall be within the tolerance limits given in 101. 2.1.2.1 within a delay time T_d as defined in Formula (4), and as shown in Figure 115.

$$T_d \leq \frac{|I_N - I_0|}{dI_{\min}} \quad \text{for } |I_N - I_0| \geq 20 A \quad (4)$$

where

T_d is the control delay of charging current;

I_N is the value for the target current;

I_0 is the value for the base current, i.e. output current at the time of new request;

$dI_{\min}$ is the minimum current change rate.

$|I_N - I_0|$ gives the absolute value of the difference between I_N and I_0 .

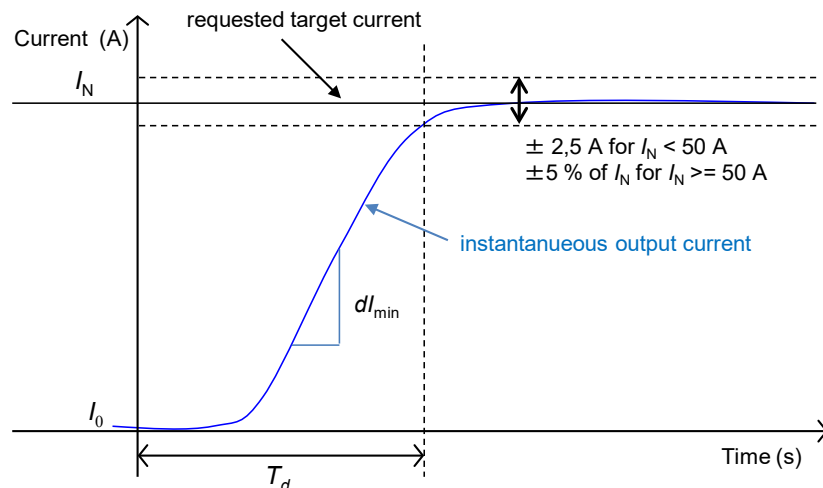


Figure 115 - Step response for constant value control

Compliance for System A and System B is checked by the following test. For system C, see CC.11.3.14.

- 1) The DC EV charging station is connected to the vehicle control simulator and an EV battery simulation system or artificial load, and operating in CCC mode.
- 2) The time of the vehicle control simulator sending the output current command shall be recorded, and the actual value of output current in a certain period of time shall be also recorded.
- 3) The vehicle requests a target current

- 1507 • deviation lower than or equal to 20 A
- 1508 • deviation higher than 20 A
- 1509 4) For System A, change the operation point (see Figure 122) from
- 1510 • OP1 to OP3, OP4, OP5, OP6
- 1511 • OP2 to OP3, OP4, OP5, OP6
- 1512 • OP3, OP4, OP5, OP6 to OP1
- 1513 • OP3, OP4, OP5, OP6 to OP2
- 1514 For System B without the function of constant power charging, change the operation point
- 1515 (see Figure BB.5) from
- 1516 • OP1 to OP5'
- 1517 • OP8 to OP6', OP9'
- 1518 • OP2 to OP3
- 1519 • OP5' to OP1
- 1520 • OP6', OP9' to OP8
- 1521 • OP3 to OP
- 1522 For System B with the function of constant power charging, change the operation point
- 1523 (see Figure BB.5) from
- 1524 • OP1 to OP5
- 1525 • OP8 to OP6, OP9
- 1526 • OP10 to OP4
- 1527 • OP2 to OP3
- 1528 • OP5 to OP1
- 1529 • OP9, OP6 to OP8
- 1530 • OP4 to OP10
- 1531 • OP3 to OP2
- 1532 5) The DC EV charging station shall control the output current,
- 1533 • within 1 s after the request
- 1534 • within a delay time T_d as defined in Formula (4), and as shown in Figure 111.
- 1535 101.2.1.3 is not applicable to the bi-directional power flow system operating in EV
- 1536 charging/discharging seamless-switchover mode.
- 1537 **101.2.1.4 Descending rate of charging current**
- 1538 The DC EV charging station shall be able to reduce current with the descending rate of 100
- 1539 A/s or more in case of a normal shutdown.
- 1540 Higher descending rates for error shutdown may be required. For detailed values refer to
- 1541 Annex AA (for System B TBC).
- 1542 Compliance is checked by the following test.
- 1543 This test shall simulate the stop charge command from EV, to detect the actual output current
- 1544 changes of DC EV charging station during the normal charging process.
- 1545 The test shall be performed according to the following procedure:
- 1546 1) The DC EV charging station is connected to the vehicle control simulator or artificial load,
- 1547 and operating in CCC mode.

1548 2) *The time of the vehicle control simulator sending the output current command shall be*
 1549 *recorded, and the actual value of output current in a certain period of time shall be also*
 1550 *recorded.*

1551 3) *For normal operation*

1552 *for System A, change the operation point from*

1553 • *OP3, OP4, OP5, OP6 to OP1*

1554 • *OP3, OP4, OP5, OP6 to OP2*

1555 *for System B without the function of constant power charging, change the operation point*
 1556 *from*

1557 • *OP5' to OP1*

1558 • *OP6', OP9' to OP8*

1559 • *OP3 to OP2*

1560 *for System B with the function of constant power charging, change the operation point*
 1561 *from*

1562 • *OP5 to OP1*

1563 • *OP9, OP6 to OP8*

1564 • *OP4 to OP10*

1565 • *OP3 to OP2*

1566 4) *For emergency shutdown, perform the emergency shutdown from*

1567 • *OP1, OP2, OP3, OP4, OP5 and OP6 (for System A and C)*

1568 • *OP1, OP2, OP3, OP5', OP6' (for System B without the function of constant power*
 1569 *charging)*

1570 • *OP1, OP2, OP3, OP4, OP5, OP6 (for System B with the function of constant power*
 1571 *charging)*

1572 5) *Check that the descending rate is 100 A/s or more for normal operation test, and the*
 1573 *system specific requirements for emergency shutdown test.*

1574 **101.2.1.5 Periodic and random deviation (current ripple)**

1575 Current ripple of DC EV charging station during current regulation shall not exceed the limit
 1576 as defined in Table 108. Measurement shall be made at maximum rated power and maximum
 1577 rated current, or in the worst case where the output voltage and output current correspond
 1578 theoretically to the maximum current ripple. The current ripple is not included in the tolerance
 1579 defined in 101.2.1.2.1.

1580 The artificial load according to Figure 121 shall be used.

1581 **Table 108 - Current ripple limit of DC EV charging station**

Limit a	Frequency
1,5 App	frequency band above 0 Hz and below 10 Hz
6 App	frequency band above 0 Hz and below 5 kHz
9 App	frequency band above 0 Hz and below 150 kHz
a difference between positive peak top and negative peak top at full scale output	

1582

1583 *Compliance is checked by the following test.*

1584 *Execute the test in the maximum rated output power and maximum rated output current point*
 1585 *of the DC EV charging station.*

1586 *The DC EV charging station is connected to a resistive load and a designated smoothing*
 1587 *capacitor.*

1588 *The DC EV charging station shall operate at the proper operation points (see Figure122) and*
 1589 *the test case shall be executed in single steps as indicated below. In each step, the EV shall*
 1590 *issue a current request as given in the list below.*

1591 *For system A, only OP4 should be checked. The ripple in the maximum rated current shall be*
 1592 *measured.*

1593 *For System B without the function of constant power charging, OP1, OP2, OP3, OP5', OP6'*
 1594 *should be checked (see Figure BB.5). For System B with the function of constant power*
 1595 *charging, OP1, OP2, OP3, OP4, OP5, OP6 should be checked.*

1596 *For system C, see CC.11.3.12.*

1597 **1) Step 1: Preparation for test**

1598 $I_{EV\ target1} = I_{EVSE\ min}$

1599 *Wait for T_{dmax1} (s) until steady state operation is reached:*

1600 $T_{dmax1} > 1s + I_{EV\ target1} [A] / 20 [A/s]$

1601 *where*

1602 $I_{EV\ target1}$ *is the initial current command value from EV for OP1;*

1603 T_{dmax1} *is the maximum delay time 1 for steady state OP1.*

1604

1605 **2) Step 2: Request OPn1 with following restrictions to $I_{EV\ target}$ and $V_{EV\ target}$:**

1606 $I_{EV\ targetn1} < 50\ A \leq I_{EVSE\ max}$

1607 $I_{EV\ targetn1} = I_{EVSE\ min} + 10\ A$

1608 $V_{EVSE\ min} \leq V_{EV\ targetn1} < V_{EVSE\ max}$

1609 $I_{EV\ targetn1} \times V_{EV\ targetn1} \leq P_{EVSE\ max}$

1610 *where*

1611 $V_{EV\ target1}$ *is the initial voltage command value from EV for OP1 (for System B and C only);*

1612 $I_{EV\ targetn1}$ *is the current command value 1 from EV for OPn1*

1613 $P_{EVSE\ max}$ *is the maximum power of EV supply equipment*

1614 *Wait for T_{dmax2} (s) until steady state operation is reached:*

1615 $T_{dmax2} > 1s + (I_{EV\ targetn2} - I_{EV\ target1}) [A] / 20 [A/s]$

1616 *where*

1617 T_{dmax2} *is the maximum delay time 2 for steady state OPn1;*

1618 $I_{EV\ targetn2}$ *is the current command value 2 from EV for OP4*

1619 *Measure output current $I_{EVSE\ output}$ and output voltage $V_{EVSE\ output}$ for frequencies below 10 Hz,*
 1620 *5000 Hz and 150 kHz.*

1621 NOTE 1 Measuring time depends on selected measurement method.

1622 NOTE 2 Specification and performance requirements for the measuring equipment are shown below.

1623

1624

Item	Performance
Oscilloscope	Bandwidth: DC - 300 kHz or more Sampling rate: 1 MS/s or more Record length: 1 M point or more Record span: 1,1 s or more Vertical resolution: 12 bits or more
Current probe	Rated current: Maximum output current of the charging station or more Bandwidth: DC - 300 kHz or more Measurement accuracy: within $\pm 1\%$ rdg

1625

1626 3) Step 3: Request OP_{n2} with following restrictions to $I_{EV\ target}$ and $V_{EV\ target}$:

1627 $I_{EV\ targetn2} \geq 50\ A \geq I_{EVSE\ min}$

1628 $I_{EV\ targetn2} = 0,95 * I_{EVSE\ max} - 5\ A$

1629 $V_{EVSE\ min} \leq V_{EV\ targetn1} < V_{EVSE\ max}$

1630 $I_{EV\ targetn1} \times V_{EV\ targetn1} \leq P_{EVSE\ max}$

1631 Wait for $T_{dmax3}(s)$ until steady state operation is reached:

1632 $T_{dmax3} > 1\ s + (I_{EV\ targetn2} - I_{EV\ targetn1})\ [A] / 20\ [A/s]$

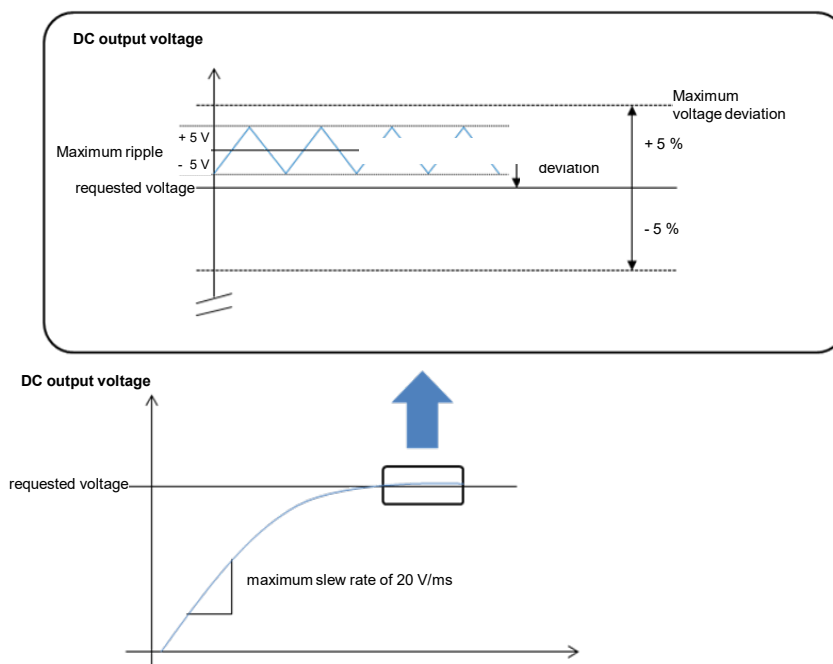
1633 where

1634 T_{dmax3} is the maximum delay time 3 for steady state OP4

1635 Current ripple of the DC EV charging station shall not exceed the limits in Table 108.

1636 101.2.1.6 Periodic and random deviation (Voltage ripple in CVC)

1637 The maximum voltage ripple in normal operation shall not exceed $\pm 5\ V$. For explanation of
1638 terms, see Figure 116.



1639

1640

Figure 116 – Maximum ratings for voltage dynamics