TEST REPORT
EN 61851-23
Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station

Report Number. ..... :	SHES240601275201-02
Date of issue ..... :	2024-07-03
Total number of pages ..... :	54
Name of Testing Laboratory preparing the Report ..... :	SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. 588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China.
Applicant's name ..... :	Shanghai SUNNIC New Energy Technology Co., Ltd
Address ..... :	6/F, building C3, district C, Changyang chuanggu, 1687 Changyang Road, Yangpu District, Shanghai, China
Test specification:	
Standard ..... :	EN 61851-23:2014, EN 61851-23:2014/AC:2016-06 for use in conjunction with EN 61851-1:2011
Test procedure ..... :	SGS-CSTC
Non-standard test method ..... :	N/A
Test item description ..... :	EV DC Charging Station
Trade Mark ..... :	SUNNIC
Manufacturer ..... :	Shanghai SUNNIC New Energy Technology Co., Ltd 6/F, building C3, district C, Changyang chuanggu, 1687 Changyang Road, Yangpu District, Shanghai, China
Model/Type reference ..... :	See SGS Report No.: SHES240601275201-01
Ratings ..... :	See SGS Report No.: SHES240601275201-01

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**Testing Laboratory:**	SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.	
Testing location/ address.....:		588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China.	
Tested by (name, function, signature).....:		Jazz Yan	
Approved by (name, function, signature)...:		Vince Cheng	
☐	**Testing procedure: CTF Stage 1:**		
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address.....:			
Tested by (name + signature).....:			
Witnessed by (name, function, signature) .:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 3:**		
☐	**Testing procedure: CTF Stage 4:**		
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Witnessed by (name, function, signature) .:			
Approved by (name, function, signature)...:			
Supervised by (name, function, signature) :			

List of Attachments (including a total number of pages in each attachment):

See SGS Report No.: SHES240601275201-01

Summary of testing:

This report was based on original test report no. SHES240200338904-02, issued on 2024-07-02, only with following changes:

-- change the applicant and manufacturer to Shanghai SUNNIC New Energy Technology Co., Ltd

6/F, building C3, district C, Changyang chuanggu, 1687 Changyang Road, Yangpu District, Shanghai, China

-- change the trademark to 

-- change referred Report Number from SHES240200338904-01 to SHES240601275201-01

-- change referred Report Number from SHES240200338904-03 to SHES240601275201-03

-- change the model number to SKBDC240KE-xx(x), SKBDC180KE-xx(x), SKBDC160KE-xx(x), SKBDC150KE-xx(x), SKBDC120KE-xx(x), SKBDC80KE-xx(x), SKBDC60KE-xx(x), SKBDC50KE-xx(x) which are identical with the previous models no. YLUXD240KE-xx(x), YLUXD180KE-xx(x), YLUXD160KE-xx(x), YLUXD150KE-xx(x), YLUXD120KE-xx(x), YLUXD80KE-xx(x), YLUXD60KE-xx(x), YLUXD50KE-xx(x) in the original report and only different on the models no., see below for details

Report No.	SHES240601275201-02	SHES240200338904-02
Model No.	SKBDC240KE-xx(x)	YLUXD240KE-xx(x)
	SKBDC180KE-xx(x)	YLUXD180KE-xx(x)
	SKBDC160KE-xx(x)	YLUXD160KE-xx(x)
	SKBDC150KE-xx(x)	YLUXD150KE-xx(x)
	SKBDC120KE-xx(x)	YLUXD120KE-xx(x)
	SKBDC80KE-xx(x)	YLUXD80KE-xx(x)
	SKBDC60KE-xx(x)	YLUXD60KE-xx(x)
	SKBDC50KE-xx(x)	YLUXD50KE-xx(x)
Note: 1. “xx(x)” in sample model can be: “xx” can be 01, 02, 05, 06, 13 or 14. “(x)” only can be A. 2. For example, SKBDC240KE-01 is identical with YLUXD240KE-01, SKBDC240KE-01(A) is identical with YLUXD240KE-01(A). Based on the above two examples, the models correspond one by one.		

After inspection, no additional tests were considered necessary.

Tests performed (name of test and test clause):	**Testing location:**
Full test.	CQC-Guochuang Testing Technology(Jiangsu) Co., Ltd. No.67 Fuyang Road,Tianning District, Changzhou, Jiangsu,China

Summary of compliance with National Differences (List of countries addressed):

UK Differences

☒ The product fulfils the requirements of IEC 61851-23:2014, IEC 61851-23:2014/COR1:2016 for use in conjunction with IEC 61851-1:2010.

Copy of marking plate:

See SGS Report No.: SHES240601275201-01

Test item particulars.....:	
Equipment mobility .....:	☐ movable ☐ hand-held ☐ transportable ☒ stationary ☐ for building-in ☐ direct plug-in
Connection to the mains .....:	☐ pluggable equipment ☐ type A ☐ type B ☒ permanent connection ☐ detachable power supply cord ☐ non-detachable power supply cord ☐ not directly connected to the mains
Access location .....:	☒ operator accessible ☐ service access area ☐ restricted access location
Over voltage category (OVC) .....:	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV ☐ other:
Class of equipment .....:	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Mains supply tolerance (%) or absolute mains supply values .....:	±10%
Considered current rating (A) .....:	See SGS Report No.: SHES240601275201-01
Pollution degree (PD) .....:	☐ PD 1 ☐ PD 2 ☒ PD 3
IP protection class .....:	IP54
Altitude during operation (m) .....:	Up to 2000m
Output Connector Interface Type.....:	CCS2: IEC 62196-3 Configuration FF; CHAdeMO: IEC 62196-3 Configuration AA
Mass of equipment (kg) .....:	< 500kg
Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing.....:	
Date of receipt of test item .....:	2023-12-07(Original date)
Date (s) of performance of tests.....:	2023-12-08 to 2024-02-02(Original date)
General remarks:	

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided ..... :	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) ..... :	Winline Technology (Changshu) Co., Ltd. Buildings 10-3 and 12-3, Jiadi Industrial Park, No. 1150, Dongnan Avenue, Changshu City, Suzhou City, Jiangsu Province, 215500, P. R. China

General product information:

See SGS Report No.: SHES240601275201-01

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
5	**RATING OF THE SUPPLY VOLTAGE**		**P**
	Equipment operates as intended within a supply voltage tolerance of ±10%	3-phase: 400Va.c.±10%	P
	Equipment operates as intended within a frequency tolerance of ±1%		P
6	**GENERAL SYSTEM REQUIREMENTS AND INTERFACE**		P
6.1	**General Description**		**P**
	Method of charging uses an on-board charger	Off-board charger	N/A
	Method of charging uses an off-board charger		P
6.2	**EV Charging Modes**		P
	EV charging mode is Mode 4, utilizing a d.c. EV charging station (e.g. off-board charger) where the control pilot function extends to the d.c. EV charging station.	Mode 4 Charging	P
	Pluggable d.c. EV charging stations, which are intended to be connected to the a.c. supply network (mains) using standard plugs and socket outlets, shall be compatible with residual current device with characteristics of type A.	Stationary charging station.	N/A
	The pluggable d.c. EV charging station shall be provided with an RCD, and may be equipped with an overcurrent protection device.	Stationary charging station.	N/A
6.3	**Types of EV Connection**		P
6.3.1	General description		P
	The connection of EVs using cables shall be carried out in case of C connection		P
6.3.2	Cord extension sets not provided	No cord extension	P
	Vehicle instructions indicate no cord extensions		P
	Cable assembly provided cannot be used as a cord extension		P
6.3.3	Adaptors shall not be used to connect a vehicle connector to a vehicle inlet.		P
6.4	**Functions provided in each charging mode**		P
	The d.c. EV charging station shall supply a d.c. current or voltage to the vehicle battery in accordance with a VCCF request.		P
6.4.1	Mode 4 charging functions		P
	- verification that the vehicle is properly connected;		P
	- protective conductor continuity checking (6.4.3.2);		P
	- energization of the system;		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	- de-energization of the system (6.4.3.4);		P
	- d.c supply for EV (6.4.3.101);		P
	- measuring current and voltage (6.4.3.102);		P
	- retaining / releasing coupler (6.4.3.103);		P
	- locking of the coupler (6.4.3.104);		P
	- compatibility assessment (6.4.3.105)		P
	- insulation test before charging (6.4.3.106)		P
	- protection against overvoltage at the battery (6.4.3.107);		P
	- verification of vehicle connector voltage (6.4.3.108);		P
	- control circuit supply integrity (6.4.3.109);		P
	- short circuit test before charging (6.4.3.110);		P
	- user initiated shutdown (6.4.3.111);		P
	- overload protection for parallel conductors (conditional function) (6.4.3.112);		P
	- protection against temporary overvoltage (6.4.3.113).		P
	- emergency shutdown (6.4.3.114)		P
6.4.2	Optional function		P
	- determination of ventilation requirements of the charging area;	With ventilation fan inside.	P
	- detection/adjustment of the real time available load current of the DC charger;	Charging status display in screen.	P
	- selection of charging current;		P
	- wake up of d.c. EV charging station by EV (6.4.4.101);		P
	- indicating means to notify users of locked status of vehicle coupler.		P
	Other additional functions may be provided.		N/A
6.4.3	Details of functions for DC charging		P
6.4.3.1	Verification that the vehicle is properly connected		P
	The EVSE are able to determine that the connector is properly inserted in the vehicle inlet and properly connected to the EVSE.	EVSE can recognize the connector when inserted.	P
	Vehicle movement by its own propulsion system is impossible as long as the vehicle is physically connected to the EVSE as required in ISO 6469-2.		P
6.4.3.2	Protective conductor continuity checking		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	For isolated systems, protective conductor continuity between the d.c. EV charging station and the vehicle shall be monitored.		P
	For the rated voltage of d.c. 60 V or higher, the d.c. EV charging station shall perform an emergency shutdown (see 6.4.3.114) within 10 s after a loss of electrical continuity of the protective conductor between d.c. EV charging station and EV (emergency shutdown).	The EVSE immediately stop charging when cut off the PE connection.	P
	For non-isolated systems, in case of loss of earthing conductor continuity, the non-isolated d.c. EV charging station shall be disconnected from a.c supply network (mains).		N/A
	Earthing conductor continuity between the d.c. EV charging station and the vehicle shall be monitored. For the rated voltage of d.c. 60 V or higher, the d.c. EV charging station shall perform an emergency shutdown within 5 s after a loss of electrical continuity of the protective conductor between d.c. EV charging station and EV.		N/A
6.4.3.3	Energization of the system		P
	Energization of the system did not performed until the pilot function between EVSE and EV has been established correctly.	EVSE cannot start charging without CP connection.	P
	Energization may also be subject to other conditions being fulfilled.		P
6.4.3.4	De-energization of the system		P
	If the pilot function is interrupted, the power supply to the cable assembly is interrupted but the control circuit may remain energized.	EVSE stop charging when losing of CP signal.	P
	In the case of failure in control circuit of d.c. EV charging station, such as short-circuit, earth leakage, CPU failure or excess temperature, the d.c. EV charging station shall terminate the supply of charging current, and disconnect the supply of control circuit.	EVSE stop charging and waring fault when detected failures.	P
	In addition, the conductor, in which earth fault or overcurrent is detected, shall be disconnected from its supply.		P
	Requirement for disconnection of EV is defined in 7.2.3.1.		N/A
6.4.3.101	DC supply for EV		P
	The d.c. EV charging station shall supply d.c. voltage and current to the vehicle battery in accordance with VCCF’s controlling.	DC Charing pile need VCCF’s control to start charging.	P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	For regulated systems, the d.c. EV charging station shall supply regulated d.c. voltage or current to the vehicle battery in accordance with VCCF's controlling.		P
	Requirements for charging performance of regulated d.c. current / voltage are given in 101.2.1.1, 101.2.1.2 and 101.2.1.3 and 101.2.1.4.		P
	In either case mentioned above, the maximum ratings of the d.c EV charging station shall not be exceeded.		P
	The vehicle can change the requested current and/or requested voltage.	According to vehicle side charge parameter request.	P
6.4.3.102	Measuring current and voltage		P
	The d.c. EV charging station shall measure the output current and output voltage. The accuracy of output measurement is defined for each system in Annexes AA, BB and CC.		P
6.4.3.103	Retaining/releasing coupler		P
	A means shall be provided to retain and release the vehicle coupler. Such means may be mechanical, electrical interlock, or combination of interlock and latch.		P
6.4.3.104	Locking of the coupler		P
	A vehicle connector used for d.c. charging shall be locked on a vehicle inlet if the voltage is higher than 60 V d.c.	With safety protective interlock.	P
	The vehicle connector shall not be unlocked (if the locking mechanism is engaged) when hazardous voltage is detected through charging process including after the end of charging. In case of charging system malfunction, a means for safe disconnection may be provided.		P
	The d.c. EV charging station shall have the following functions in case the locking is done by the d.c. EV charging station:		P
	– electrical or mechanical locking function to retain the locked status, and		P
	– function to detect the disconnection of the electrical circuits for the locking function.		P
6.4.3.105	Compatibility assessment		P
	Compatibility of EV and d.c. EV charging station shall be checked with the information exchanged at the initialization phase as specified in 102.5.1.		P
6.4.3.106	Insulation test before charging		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The d.c. EV charging station shall confirm the insulation resistance between its d.c. output circuit and protective conductor to the vehicle chassis, including the charging station enclosure, before the EV contactors are allowed to close.	This EV charging station has the insulation test before charging.	P
	If the required value is not met, the d.c. EV charging station shall send the signal to the vehicle that the charging is not allowed.		P
	Conformance is determined by measuring the insulation resistance as follows:		P
	Any relays in the d.c. output circuit of the d.c. EV charging station shall be closed during the test.		P
	The required value of insulation resistance R shall be: R ≥100 Ω/V x U U is rated output voltage of the d.c. EV charging station.		P
6.4.3.107	Protection against overvoltage at the battery		P
	The d.c. EV charging station shall perform an emergency shutdown and disconnect its supply to prevent overvoltage at the battery, if output voltage exceeds maximum voltage limit sent by the vehicle. In case of vehicle failure, disconnection from a.c. mains may not be necessary.	EVSE stop charging once the voltage exceed 10% the maximum value at the output side.	P
	Specific requirement for detection and shutdown are defined in Annexes AA, BB and CC.		P
	The vehicle can change the maximum voltage limit during charging process.		P
	Compliance is checked according to the following test.		P
	The d.c. EV charging station is connected to a d.c. voltage source or artificial load.		P
	The voltage of the d.c. voltage source or artificial load should be within the operating range of the charging station.		P
	The d.c. EV charging station is set to charge the d.c. voltage source at a current of more than 10 % of the maximum rated current of d.c. EV charging station.		P
	A maximum voltage limit command lower than the voltage of the voltage source shall be sent to the d.c. EV charging station.		P
	Both the time between when the command is sent and the beginning of charging current reduction, and the rate of reduction shall be measured.		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The voltage of the voltage source, the way the command voltage limit is sent and the value of the voltage limit may be chosen freely to comply with this test.		P
6.4.3.108	Verification of vehicle connector voltage		P
	This clause is only applicable for charging stations which are responsible for locking of vehicle connector, such as system A and system B.	Locking device is provided in the CHAdeMO connector.	P
	The d.c. 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.		N/A
6.4.3.109	Control circuit supply integrity		P
	If an earth fault, short circuit or overcurrent is detected in output circuit of d.c. EV charging station, the power circuit shall be disconnected from its supply, but the power supply for control circuit shall not be interrupted unless the power circuit interruption is due to a loss of a.c. supply network (mains).	The auxiliary power circuit is installed before the Main Breaker.	P
6.4.3.110	Short circuit test before charging		P
	With the EV connected to the d.c. EV charging station and before the EV contactor is closed, the d.c. EV charging station shall have a means to check for a short circuit between d.c. output circuit positive and negative for the cable and vehicle coupler.	The module shut down immediately and cannot start to work.	P
6.4.3.111	User initiated shutdown		P
	The d.c. EV charging station shall have a means to allow the user to shut down the charging process.	EVSE has the function for user to stop charging.	P
6.4.3.112	Overload protection for parallel conductors (conditional function)		P
	If more than one conductor or wire and/or vehicle connector contact is used in parallel for d.c. current supply to the vehicle, the d.c. EV charging station shall have a mean to ensure, that none of the conductors or wires will be overloaded.		P
6.4.3.113	Protection against temporary overvoltage		P
	For stations serving a maximum 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 PE or between DC- and PE.	No voltage higher than 550 V and shut down in 5s.	P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	For stations serving a maximum output voltage above 500 V and up to 1 000 V, no voltage higher than 110 % of d.c. output voltage shall occur for more than 5 s at the output between DC+ and PE or between DC- and PE.	No voltage higher than 110 % of d.c. output voltage and shut down in 5s.	P
	For voltage above 1000V:under consideration.		N/A
	The d.c. EV charging station shall terminate the supply of charging current and disconnect the d.c. power circuit from its supply within 5 s, to remove the source of overvoltage. This shall also apply in case of a first earth fault within the isolated output part of the d.c. EV charging station.		N/A
	For Un, as the minimum DC charger output voltage, the d.c. EV charging station shall limit the voltage between DC+/- and PE at: - (2Un + 1 000) x 1,41 V or; - (Un + 1 200) x 1,41 V.		N/A
6.4.3.114	Emergency shutdown		P
	When the d.c. EV charging station detects an abnormality in the station and/or the vehicle, the safety shall be ensured by the emergency shutdown. Stop charging by:	Stop charging when abnormal actions occurs.	P
	a) controlled expedited interruption of charging current or voltage to the vehicle, where d.c. current descends with a controlled slope, and appropriate signalling to the vehicle, or		P
	b) uncontrolled abrupt termination of charging under specific fault conditions, where there is no control of current, and the vehicle may not be informed in time.		P
	Under specific conditions, the following disconnection, for example, is required according to the risk assessment of the abnormality in the station or the vehicle:		P
	– disconnection of the supply to the conductor in which an earth leakage is detected;	With leakage protector.	P
	– disconnection of the conductor in which an overcurrent is detected;	Current protective breakers.	P
	– disconnection of the d.c. power circuit from the supply if an insulation failure is detected.	With insulation detection.	P
	General procedure of shutdown in the charging control process is given in 102.5.3.		P
6.4.4	Details of Optional Functions		N/A
6.4.4.1	Determination of ventilation requirements during charging		N/A

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	If additional ventilation is required during charging, charging is only allowed if such ventilation is provided.		N/A
6.4.4.2	Detection/adjustment of the real time available load current of the supply equipment		N/A
	Means is provided to ensure that the charging rate did not exceed the real time available load current of the EVSE and its power supply.		N/A
6.4.4.4	Selection of charging rate		N/A
	A manual or automatic means is provided to ensure that the charging rate does not exceed the rated capacity of the a.c. supply network (mains), vehicle or battery capabilities.		N/A
6.4.4.101	Wake up of d.c. EV charging station by EV		P
	The charging station may support a standby mode to minimize power consumption. In this case, the station shall be able to be woken up by the EV.		P
6.4.5	Details of Pilot Function		P
	Control pilot function is mandatory. The control pilot function shall be capable of performing at least the mandatory functions described in 6.4.3.1, 6.4.3.2, 6.4.3.3 and 6.4.3.4, and may also be capable of contributing to optional functions described in 6.4.4.		P
6.5	**Serial data communication**		**P**
	Serial data communication exchange shall be provided		P
	Serial communication shielded or earthed twisted pair..... :		P
6.101	**Classification**		**P**
6.101.1	Category		P
6.101.1.1	According to system structure:		P
	- isolated d.c. EV charging station, according to the type of insulation between input and output:	☒ basic insulation ☐ reinforced insulation ☐ double insulation	P
	- non-isolated d.c. EV charging station.		N/A
6.101.1.2	According to system control ..... :		P
	- regulated d.c. EV charging station ..... :	☐ controlled current charging ☐ controlled voltage charging ☒ combination of controlled current and voltage charging	P
	- non-regulated d.c. EV charging station.		N/A

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
6.101.1.3	According to power receiving .....:	☒ d.c. EV charging station connected to a.c. mains ☐ d.c. EV charging station connected to d.c. mains	P
6.101.1.4	According to environmental conditions .....:	☒ outdoor use ☒ indoor use	P
6.101.1.5	According to the system used .....:	☒ system A (see Annex AA), ☐ system B (see Annex BB), ☒ system C (see Annex CC)	P
6.101.2	Rating		P
	According to d.c. output voltage .....:	☐ up to and including 60 V, ☒ over 60 V up to and including 1 500 V.	P

7	**PROTECTION AGAINST ELECTRIC SHOCK**		**P**
7.1	**General Requirements**		**P**
	Hazardous live parts are not accessible		P
	Exposed conductive parts not live under normal conditions		P
	Exposed conductive parts not live under single fault conditions		P
7.2	**Protection against direct contact**		P
7.2.1	One or more provisions prevent contact..... :		P
7.2.2	Accessibility of live parts		P
	Hazardous live parts are not accessible before or after removal of parts not requiring a tool for removal		P
	Accessibility with finger probe does not allow contact with hazardous live parts		P
7.2.3	Stored energy – discharge of capacitors		P
7.2.3.1	Disconnection of EV		P
	Voltage after 1 second shall be less than 60V .....:	<60Vdc after 1s	P
	Stored energy available shall be less than 20J .....:		P
	Warning label provided		P
7.2.3.2	Disconnection of d.c. EV charging station		P
	Voltage after 1 second shall be less than 60V .....:	<60Vdc after 1s	P
	Stored energy available shall be less than 20J .....:		P
	Warning label provided		P
7.3	**Fault Protection**		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	One or more provisions prevent indirect contact....:	With RCD and earth protection.	P
7.4	**Supplementary Measures**		N/A
	Only applicable to mobile d.c. EV charging station		N/A
	An RCD (IΔn ≤ 30 mA) shall be provided as a part of the EV conductive supply equipment for earthed systems. The RCD shall have a performance at least equal to Type A and be in conformity with standard IEC 60364-4-4.		N/A
	Where power supply circuits that are galvanically separated from mains and are galvanically isolated from earth, electrical isolation between the isolated circuits and earth, and between the isolated circuits and exposed conductive parts of vehicle and EVSE shall be monitored. When a fault condition related to the electrical isolation is detected, the power supply circuits shall be automatically de-energized or disconnected by the EVSE.		N/A
7.5	**Protective measures for d.c. EV charging stations**		P
	The types of d.c. EV charging stations covered by these requirements, including all accessible conductive parts on the equipment shall have the following protective measures.	With RCD and earth protection.	P
	– protective measures by automatic disconnection of supply by connecting all exposed conductive-parts to a protective conductor during battery charging, unless protective measure by reinforced or double insulation or protective measure by electrical separation is used for the d.c. EV charging stations.		P
7.5.101	Requirements of the isolated d.c. EV charging station	Isolated DC EV charging station	P
	Requirements for the isolated d.c. EV charging station for protection against electric shock are defined for each system in AA.3.1, BB.2 or CC.4.1.		P
	In addition, if the d.c. EV charging station has multiple d.c. outputs designed for simultaneous operation, each output circuit shall be isolated from each other by basic insulation or reinforced insulation.		P
7.5.102	Requirements of the non-isolated d.c. EV charging station		N/A
	under consideration.		N/A
7.5.103	Protective conductor dimension cross-sectional area		P
	Protective conductor shall be of sufficient cross-sectional area to satisfy the requirements of IEC 60364-5-54.		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
7.6	**Additional requirements**		P
	The d.c. EV charging station shall be compatible with RCD Type A in the installation, i.e. a.c. supply network (mains).		P
	Class II chargers may have a lead- through protective conductor for earthing the EV chassis.		N/A
8	**CONNECTION BETWEEN THE POWER SUPPLY AND THE EV**		P
8.1	**General**		P
	Type of interface being used .....:	CCS2: IEC 62196-3 Configuration FF; CHAdeMO: IEC 62196-3 Configuration AA;	P
8.2	**Contact Sequencing**		P
	For all d.c. interfaces, the contact sequence during the connection process shall be: – Protective Earth (if any) – d.c. power contacts – Isolation monitor contacts – Proximity detection or connection switch contact – Control pilot contact During disconnection the order shall be reversed.		P
8.3	**Functional description of a standard interface**		N/A
	Not applicable.		N/A
8.4	**Functional description of a basic interface**		N/A
	Not applicable.		N/A
8.5	**Functional description of a universal interface**		P
	Universal interface intermateable with either high power ac or high power dc connector		P
	Means provided to ensure dc power connector cannot be mated with ac inlet and vice versa		P
	Electrical ratings comply with level 1		P
9	**SPECIFIC REQUIREMENTS FOR VEHICLE COUPLER**		P
9.1	**General requirements**		P
	The construction and performance requirements of vehicle coupler are specified in IEC 62196-1.	Approved connector used.	P
	The requirements for the d.c. interfaces are specified in IEC 62196-3.		P
9.2	**Operating temperature**		P
	Operating temperature .....:	-30°C to +50ºC	P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
9.3	**Service life of vehicle coupler**		P
	Service life of vehicle coupler ..... :		P
9.4	**Breaking Capacity**		P
	For d.c. charging, the vehicle couplers are rated "not for current interruption." A disconnection shall not take place under load.		P
	In the case of disconnection under d.c. load due to a fault, no hazardous condition shall occur.	EVSE stop charging.	P
	Avoidance of breaking under load can be achieved by a specific means on the vehicle connector or a system with interlock.		P
	In addition to locking mechanism defined in 6.4.3.104, in case of unintended disconnection of the vehicle coupler, the output current of the d.c. EV charging station shall be turned off within a defined time to contain a possible arc within the vehicle coupler housing. This turn-off time shall comply with the value specified in Annexes AA, BB and CC, using a speed of separation of the vehicle connector of (0,8 ± 0,1) m/s according to IEC 60309-1.		P
	Disconnection of vehicle coupler can be detected when one of the following occurs:		P
	– loss of digital communication; – interruption of interlock circuit(s), e.g. control pilot, proximity circuit, to mitigate electrical arcing and shock hazards.		P
	The system specific requirement for breaking capacity and system redundancy are defined in Annexes AA, BB and CC.		P
9.5	**IP Degrees**		P
	Complies with 11.3		P
9.6	**Insertion and Extraction Forces**		P
	Complies with IEC 62196-1		P
9.7	**Latching of the retaining device**		P
	Latching or retaining if required may be a function of the complete system or the connector.		P

10	**CHARGING CABLE ASSEMBLY REQUIREMENTS**		P
10.1	**Electrical Rating**		P
	The rated voltage and current of each conductor shall correspond to the rated voltage and current of the d.c. output of the d.c. EV charging station.	Approved cable used.	P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
10.2	**Electrical characteristics**		P
	Voltage and current ratings of the cable are compatible with the ratings of the EVSE.....:		P
	Cable insulation is wear resistant and maintains flexibility over the full ambient range		P
10.3	**Dielectric Withstand Characteristics**		P
	Complies with 11.4		P
10.4	**Mechanical Characteristics**		P
	Meets or exceeds the characteristics specified in IEC 60245-6		P
	Cable is fire resistant		P
	Cable withstands chemical exposure		P
	Cable is rated for UV exposure		P
10.5	**Functional characteristics**		P
	The maximum cord length may be specified by national codes	≤ 7,5m	P
11	**EVSE REQUIREMENTS**		**P**
11.1	**General Test Requirements**		**P**
	Tests performed in an ambient of 20°C ± 5°C unless otherwise specified		P
11.2	**Classification**		P
	EVSE is considered indoor use only		N/A
	EVSE is considered indoor/outdoor use		P
11.3	**IP Degrees for basic and universal interfaces**		P
11.3.1	IP Degrees for ingress of objects		P
	Indoor Use (IP).....:		P
	Vehicle inlet mated with connector is IP 21		P
	Connector for Case “C” when not connected is IP 21		N/A
	Outdoor Use (IP).....:		P
	Vehicle inlet mated with connector is IP 44		P
	All Cable Assemblies.....:		P
	Inlet in “road” position is IP 55 with or without assistance from vehicle design……..:		N/A
	Connector when not mated is IP 24		N/A
11.3.2	Protection against electric shock		P
	Vehicle inlet mated with connector is IP XXD		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	Connector for Mode 1 not connected is IP XXD		N/A
	Connector for Mode 2 and Mode 3 not connected is IP XXB		P
11.4	**Dielectric Withstand Characteristics**		**P**
11.4.1	Dielectric Withstand Voltage	See appended Table 11.4.1	P
	No breakdown indicated		P
11.4.2	Impulse dielectric withstand		P
	No breakdown indicated		P
11.4.101	Suppression of overvoltage category		P
	The isolated d.c. EV charging station shall reduce overvoltage to the EV to the rated impulse voltage of 2 500 V.		P
	Primary circuit of d.c. charging station in outdoor is overvoltage category (OVC) III according to Part 1.	OVC III	P
11.5	**Insulation Resistance**		**P**
	Insulation resistance measurement is greater than 1 MΩ	See appended Table 11.5	P
11.6	**Clearance and Creepage Distances**		**P**
	Clearance and Creepage Distances meet the minimum values	Refer to table 12.3 in SGS Test Report No.: SHES240601275201-01	P
11.7	**Leakage – Touch Current**		P
11.7.101-11.7.105	Leakage current	See appended Table 11.7	P
11.7.106	Protection measures for the touch current exceeding 3.5 mA	Not exceed 3.5mA	N/A
	For Class I d.c. EV charging station, if the test touch current exceeds 3.5 mA r.m.s, any of the following requirements shall be met:		N/A
	a) The protective conductor shall have a cross-sectional area of at least 10mm² Cu or 16 mm² Al, through its total run.		N/A
	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.		N/A
	c) Automatic disconnection of the supply in case of loss of continuity of the protective conductor.		N/A
	A caution symbol ⚠ shall be placed on the outside of the d.c. EV charging station, visible to the user.		N/A

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The minimum size of the protective earthing conductor shall comply with the local safety regulations, and shall be indicated in the installation manual.		N/A
11.8	**Environmental Tests**		**P**
11.8.1	General		P
	Equipment meets the original requirements after each test		P
11.8.2	Ambient air temperature		P
	Manufacturer's rated ambient temperature range (°C)……..:	-30°C to +50ºC	P
	Equipment operates as intended within full range of ambient temperatures	Tested under the condition range.	P
11.8.3	Ambient Humidity		P
	Test in accordance with IEC 60068-2-78, test Ca, at 40°C ± 2°C and 93% relative humidity for four days:	40°C, 93%	P
	Test in accordance with IEC 60068-2-30, test Db, at 40°C ± 2°C for 6 cycles .....:		N/A
11.8.4	Ambient Air Pressure		P
	Designed for operation between 860 hPa and 1060 hPa		P
11.9	**Permissible Surface Temperature**		**P**
	Temperature limits on surfaces are not exceeded	Refer to table 12.8 of part 1	P
11.10	**Environmental Conditions**		**P**
	The EVSE is designed to resist the effect of normal automotive solvents and fluids, vibration and shock, material flammability standards and other conditions appropriate to the application.		P
11.11	**Mechanical Environmental Tests**		**P**
11.11.2	Mechanical Impact	IK10	P
	No damage to the enclosure, and no access to internal live parts after impact		P
11.12	**Electromagnetic Compatibility tests**		**P**
	The EMC requirements for d.c. EV charging stations are defined in IEC 61851-21-2.		P
11.13	**Latching of the retaining device**		**P**
	Latching device used to prevent disconnection under load		P
11.14	**Service**		**P**
	Parts are designed such that they can be removed, serviced and replaced when necessary		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
11.15	**Marking and Instructions**		**P**
11.15.1	Connection Instructions		P
	Instructions for proper connection of the vehicle to the EVSE shall appear in the vehicle manual		N/A
	Instructions for proper connection of the vehicle to the EVSE shall appear in the owner's manual		N/A
	Instructions for proper connection of the vehicle to the EVSE shall appear on the EVSE product		P
11.15.2	All marking comply with the legibility requirements after the rub tests		P
11.15.3	Marking of Electric Vehicle Charging Station		P
	The EVSE product is marked with all relevant information		P
	Name of manufacturer ..... :	T-RAY Power Source LTD.	P
	Model number ..... :	See models list	P
	Serial number ..... :	See marking label	P
	Date of manufacturer ..... :	See marking label	P
	Rated voltage (V) ..... :	AC 400 ±10%	P
	Rated frequency (Hz)..... :	50Hz	P
	Rated current (A) ..... :	See models list	P
	Number of phases ..... :	3P+N+PE	P
	IP Degrees ..... :	IP54 for enclosure	P
	"Indoor use Only" if the product is intended for indoor use only		N/A
	Class II stations marked with Class II symbol		N/A
11.16	**Telecommunication Network**		**N/A**
	Telecommunication networks comply with IEC 60950-1		N/A
11.101	**Metering**		**N/A**
	If electric metering is provided, it shall comply with IEC 62052-11 and IEC 62053-21.		N/A

101	**SPECIFIC REQUIREMENTS FOR D.C. EV CHARGING STATION**		**P**
101.1	**General Requirements**		**P**
101.1.1	Emergency switching		P
	An emergency disconnection device may be installed to isolate the a.c. supply network (mains) from the d.c. electric vehicle charging station in case of risk of electric shock, fire or explosion.		P

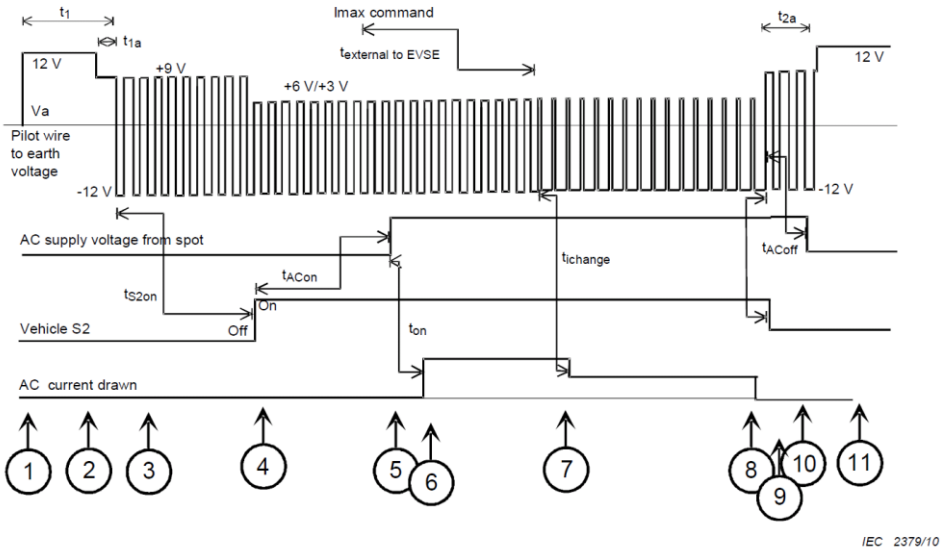
EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The disconnection device may be provided with a means to prevent accidental operation.		P
101.1.2	IP degrees for ingress of objects		P
	The minimum IP degrees shall be as specified: - indoor: IP21 - outdoor: IP44	IP54	P
101.1.3	Storage means of the cable assembly and vehicle connector		P
	For d.c. EV charging stations, a storage means shall be provided for the cable assembly and vehicle connector when not in use.		P
	The storage means provided for the vehicle connector shall be located at a height between 0.4m and 1.5m above ground level.	With the connector place area.	P
101.1.4	Stability		P
	The d.c. electric vehicle charging station shall be installed as intended by the manufacturer's installation instructions.	With the retaining screws at the bottom side.	P
	A force of 500 N shall be applied for 5 min in the horizontal direction to the top of the d.c. electric vehicle charging station in each of the four directions or in the worst possible horizontal direction.	Without any displacement.	P
	There shall be neither deterioration of the d.c. electric vehicle charging station nor deformation at its summit greater than: – 50 mm during the load application; – 10 mm after the load application.		P
101.1.5	Protection against uncontrolled reverse power flow from vehicle	With output protective diode in power module.	P
	The d.c. EV charging station shall be equipped with a protective device against the uncontrolled reverse power flow from vehicle.		P
101.2	**Specific requirements for isolated systems**		**P**
101.2.1	DC output		P
101.2.1.1	Rated outputs and maximum output power		P
	The d.c. EV charging station may limit its maximum current under the given condition independent of the rated and demanded power.	With the current limitation.	P
	The d.c. EV charging station shall be able to deliver d.c. power in the voltage range [Vmin, V max] and the regulated current range [Imin, Imax] within the limit of its maximum rated power [Pmax] at the ambient temperature –5°C to 40°C below 1 000 m above sea level.		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The d.c. EV charging station shall not exceed its maximum rated power, even if the maximum power requested by the EV is beyond the rated maximum power of DC charger. Outside this operating range the DC charger is allowed to de-rate the power or the current.	The charging station may limit the charging power under the rated value.	P
101.2.1.2	Output voltage and current tolerance		P
101.2.1.2.1	Output current regulation in CCC		P
	The tolerance between the output current of the d.c. EV charging station compared to the required value sent by the electric vehicle shall be ± 2,5 A for the requirement below 50 A, and ± 5 % of the required value for 50 A or more.	See appended Table 101.2.1.2.1	P
101.2.1.2.2	Output voltage regulation in CVC		P
	The tolerance between the output voltages of the d.c. EV charging station compared to the required value sent by the electric vehicle in steady state operation shall not be greater than 2 % for the maximum rated voltage of the d.c. EV charging station.	See appended Table 101.2.1.2.2	P
101.2.1.3	Control delay of charging current in CCC		P
	The d.c. EV charging station shall control the output current within 1 s after the request from vehicle, 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.	See appended Table 101.2.1.3	P
	If target current I_N deviated from base current I_0 lower than or equal to 20A, control delay should be <1s		P
	If target current I_N deviated from base current I_0 higher than 20A, control delay T_d should be $T_d \leq \frac{\lvert I_N - I_0 \rvert}{dI_{min}}$		P
101.2.1.4	Descending rate of charging current		P
	The d.c. EV charging station shall be able to reduce current with the descending rate of 100 A/s or more in normal operation.	See appended Table 101.2.1.4	P
	For emergency shutdown and for fulfilling general requirements in 9.4, even much higher descending rates are necessary. For detailed values refer to Annexes AA, BB and CC.		P
101.2.1.5	Periodic and random deviation (current ripple)		P
	Current ripple of d.c. EV charging station during current regulation shall not exceed the limit.	See appended Table 101.2.1.5	P
101.2.1.6	Periodic and random deviation (voltage ripple in CVC)		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	For CVC, the maximum voltage deviation during pre-charge state and during charging of the vehicle/traction battery shall not exceed ±5 % of the requested voltage.	See appended Table 101.2.1.6	P
	The maximum voltage ripple in normal operation shall not exceed ±5 V.		P
101.2.1.7	Load dump		P
	In any case of load dump, voltage overshoot shall not exceed the limit specified for each system in Annexes AA, BB or CC.		P
	Maximum slew rate of output voltage in case of load dump shall not exceed 250 V/ms.	See appended Table 101.2.1.7	P
101.2.2	Effective earth continuity between the enclosure and the external protective circuit		P
	Exposed conductive part of d.c. EV charging station shall be connected to the terminal for the external protective conductor.		P
	The test shall be conducted in accordance with 10.5.2 in IEC 61439-1:2011 unless otherwise specified by national regulations.	Between exposed conductive part and external protective conductor:0,038 Ω Between protective conductor and Front Enclsure:0,044 Ω Between protective conductor and Front Enclsure:0,087 Ω	P
102	**COMMUNICATION BETWEEN EV AND D.C. EV CHARGING STATION**		P
102.1	**General**		**P**
	This clause provides the general requirements for the control communication function and the system between EV and d.c. EV charging station. The specific requirements of digital communication of charging control between off-board d.c. charging system and electric road vehicle are defined in IEC 61851-24.	See SGS Report No.: SHES240601275201-03	P
102.2	**System configuration**		P
	The communication between the d.c. EV charging station and the vehicle can be established via basic communication and high level communications.		P
	Key steps in the charging control process, such as start of charging and normal/emergency shutdown, shall be managed through the basic communication with signal exchange via the control pilot lines in d.c. EV charging system.		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	In addition to the basic communication, the d.c. EV charging station shall be equipped with digital communication means in order to exchange the control parameters for d.c. charging between the d.c. EV charging station and the vehicle through the high level communication.		P
	Digital communication means used:		P
102.3	**Basic communication**		P
102.3.1	Interface		P
	Typical interfaces of control pilot function on d.c. EV charging systems are specified in Annexes AA, BB and CC. Each system shall carry out control pilot function through the control pilot conductors and terminals specified in IEC 62196-3.		P
102.3.2	Charging state		P
	The charging states show physical status of d.c. EV charging system. The d.c. EV charging station and the vehicle can exchange their charging state through the signal communication and the digital communication.		P
102.4	**Digital communication**		**P**
	Digital communication is specified in IEC 61851-24.	See SGS Report No.: SHES240601275201-03	P
102.5	**Charging control process and state**		P
102.5.1	General		P
	Charging control process of general-purpose d.c. EV charging stations shall consist of the following three stages: - process before the start of charging (initialization); - process during charging (energy transfer); - process of shutdown (shutdown).		P
	The d.c. EV charging station and the vehicle shall synchronize control process with each other. The following signals and information shall be used for the synchronization: - signals through the pilot wire circuit; - parameters through the digital communication circuit; - measurement values such as voltage and current level of the d.c. charging circuit.		P
	The d.c. EV charging station and the vehicle shall preserve specified time constraints and control timings for ensuring smooth charging control and operation.		P

EN 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	Charging control process as system action level is shown in Table 103. General sequence diagrams are specified in Annex AA, Annex BB, and Annex CC. Digital communication parameters, formats, and other communication requirements are specified in IEC 61851-24.		P
102.5.2	Description of the process before the start of charging (initialization)		P
	In this process, the vehicle and the d.c. EV charging station exchange their operational limitations and relevant parameters for charging control.		P
102.5.3	Description of the process during charging (energy transfer)		P
	In this process, the vehicle continues to send a setting value of charging current or voltage to the d.c. EV charging station throughout the charging process.	CCC and CVC	P
	Either of the following two algorithms shall be taken: a) CCC b) CVC		P
102.5.4	Description of process of shutdown		P
	Normal shutdown shall occur when the vehicle battery capacity reaches a certain limit, or when the charging process is stopped by the user with a normal stop means.		P
	Emergency shutdown shall occur under a fault condition.		P

A	**ANNEX A (NORMATIVE), PILOT FUNCTION THROUGH A CONTROL PILOT CIRCUIT USING PWM MODULATION AND A CONTROL PILOT WIRE**		**P**
A.1	**General**		**P**
A.2	**Control pilot circuit**	5% duty circuit for digital communication for models with CCS2 connectors Parameter of PWM in state C: Positive voltage: 6,29V Negative voltage: -12,41 V Frequency: 999,9 Hz Duty cycle: 5,0%	**P**
	 Figure A.3 – Typical charging cycle under normal operating conditions		--
	Table A.4 – description of connecting sequences as shown on Figure A.3		--

	--	State	Conditions	--
	1	A	Vehicle unconnected – the full generator voltage is measured by the EVSE at Va (see Figure A.1). The generator signal Vg is a +12 V DC voltage	P
	2	B	The cable assembly is connected to the vehicle and to the EVSE. This condition is detected by the 9 V signal measured at Va. The voltage from the signal generator (Vg) may be either a steady state +12 V DC or a ±12 V, 1 kHz signal in conformity with Table A.1 if the EVSE is immediately available f or the supply of energy.	P
	3	B	The EVSE is now able to supply energy and indicated the available current to the vehicle by the duty cycle in conformity with Table A.5. The presence of the diode D (see Figure A.1) is detected by the – 12 V and gives added guarantee that the 9 V signal is a reliable indication of a vehicle connected.	P
	4	B → C,D	S2 is closed by vehicle as a function of requirements to indicate that the vehicle can receive energy. There are no timing requirements for the closing of On.	P
	5	C,D	EVSE closes circuit. The timing of switch closure may be subject other requirements (payment, data exchange). If state D is detected, the switch will close only if ventilation requirements are met.	P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

	6	C,D	Current drawn from the vehicle. The timing and current profile are determined by the vehicle. Current may not exceed that indicated by the duty cycle (Table A.5).	P
	7	C,D	External demand for power reduction. Such a demand may originate from the grid or by manual setting on EVSE. The Vehicle adjusts the current demand to that indicated by the duty cycle.	P
	8	C,D	End of charge, decided by the vehicle.	P
	9	C,D →B	Vehicle asks for disconnect. This may be the result of the proximity contact being opened	P
	10	B	EVSE detects state B (created by opening of S2 on vehicle) and opens the contactor.	P
	11	A	Complete removal of cable assembly from vehicle or EVSE is detected by the 12V signal.	P
	NOTE The EVSE should allow removal of the plug if the end of the charging session is ended by entering state A.			--

Annex AA	**DC EV CHARGING STATION OF SYSTEM A**		**P**
AA.3	**Specific safety requirements**		**P**
AA.3.1	Fault protection in the secondary circuit		P
AA.3.1.1	General		P
	For fault protection in the secondary circuit, system A station shall have the following measures: a) reinforced isolating transformer; b) earth leakage current measurement using a grounding resistor between the d.c. power lines DC+/DC- and earth (enclosure and chassis); c) automatic disconnection of supply to d.c. power circuit at the first d.c. earth fault; d) charging cable consisting of line conductors that are individually insulated.		P
	When PE forms part of a charging cable, the cross-sectional area of PE shall be determined by the formula in 543.1.2 of IEC 60364-5-54:2011.		P
AA.3.1.2	Automatic disconnection and earth fault monitoring		P
	System A station shall measure the earth leakage current between the secondary circuit and its enclosure, or between the secondary circuit and the vehicle chassis.	For 200V, 20kΩ less than 1s; For 300V, 30kΩ less than 1s; For 400V, 40kΩ less than 1s; For 500V, 50kΩ less than 1s	P
	When an earth fault is detected during charging, the station shall reduce the d.c. output current to 5A or less.		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	Then, the switch d1 shall be open in order to prevent the vehicle to close EV contactor. The line-to-line voltage of d.c. output Vdc shall be reduced to less than 60 V The automatic disconnection process shall be accomplished within 5 s from the detection of earth fault.		P
	A method to detect a d.c. fault current is required for the first earth fault.		P
AA.3.2	Voltage measurement of d.c. power line for vehicle connector unlock		P
	The vehicle connector shall not be unlocked when hazardous voltage is detected. To unlock the vehicle connector, the voltage of d.c. power line shall be measured and be confirmed to be within safe levels, i.e. 10 V or less.		P
AA.3.3	Prevention of the hazard due to vehicle battery short-circuit		P
	Overcurrent protection device, such as current-limiting fuse u, shall be provided in the output circuit of system A station in order to prevent the hazard due to short-circuit current of vehicle battery caused by the reverse connection of charging cable by mistake.		P
	The overcurrent protection device shall have a current rating of 250 A or less, and be a quick-break type.		P
AA.3.4	Lock and latch monitoring for vehicle connector		P
	The vehicle connector shall have a means of mechanical latching, electrical locking, and lock and latch monitoring.		P
	In case of failure of mechanical latching or electrical locking of the vehicle connector, the station shall not energize the d.c. power lines connected to the vehicle connector.		P
	If the failure is detected during charging, the station shall reduce the d.c. output current to 5 A or less within 2 s. Then, the switch d1 shall open.		P
	The vehicle connector shall have a means to provide system A station with information on anomaly detection in monitoring of latch and electrical locking.		P
AA.3.5	Protection of EV contactor		P
	In order to prevent the welding of EV contactor, switches d1 and d2 shall not open at current exceeding 5 A.		P
AA.3.6	Emergency shutdown at control pilot disconnection		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	If a control pilot is disconnected during charging, system A station shall decrease output current to 5 A or less within 30 ms.		P
AA.3.7	Turn on inrush current for vehicle circuit		P
	Inrush current on d.c. power line of system A station shall not exceed 20 A at vehicle connector.		P
AA.3.8	Protection against overvoltage at the battery		P
	System A station shall reduce the d.c. output current to 5 A or less of rated current within 3 s to prevent overvoltage at the battery, if output voltage exceeds maximum voltage limit sent by the vehicle.	The protection against overvoltage is achieved by the EVSE detected the voltage of charging connector exceeded the maximum voltage limit.	P
AA.3.9	Load dump		P
	In any case of load dump, voltage overshoot of d.c. output of the station shall not exceed 600 V.		P
AA.4	**Charging process and communication between the d.c. EV charging station and the vehicle for charging control**		**P**
	Communication between the station and the vehicle is carried out through the control pilots CP, CP2 and CP3, proximity circuit CS, the digital communication circuits COM1 and COM2.		P
AA.4.2	Charging control process		P
AA.4.2.1	State transition diagram and sequence diagram		P
	The charging process of system A shall conform to the state transition diagram as shown in Figure AA.5. Figure AA.6 gives the charging control sequence under normal conditions		P
AA.4.2.2	Start of charging		P
	When the charging process is initiated by system A station, d1 shall be closed. The switch d2 shall be open until the end of insulation test in AA.4.2.3.		P
AA.4.2.3	Insulation test before charging		P
	The insulation test shall not start until the vehicle provides system A station with a permission signal through CP3, and permission parameters by digital communication as shown in Annex A of IEC 61851-24:— Before the insulation test, system A station shall inform the vehicle through digital communication that the vehicle connector is locked.		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The insulation test shall be performed in accordance with 6.4.3.106 and as per the following procedure. a) Before the test, the station shall measure Vdc of d.c. power line and confirm that the EV contactors open. The voltage of d.c. power line, measured at Vdc, shall be 10 V or less. If the measured voltage exceeds 10 V, the charging process shall be shut down (see Figure AA.5). b) The voltage U that is applied to the d.c. power line shall be the maximum output voltage of the station. c) After the test, it shall be confirmed that the voltage at Vdc is 20 V or less. Then, the station shall inform the vehicle of the termination of test with closing d2 switch.		P
	During the insulation test, the earth fault shall be monitored in accordance with AA.3.1.2.		P
AA.4.2.4	Energy transfer		P
	System A shall continuously monitor the charging current value requested by the vehicle. The charging current shall be changed responding to the vehicle requested value, in accordance with CCC requirements in 101.2.1.2.1 and 101.2.1.3. The characteristics of charging current control shall meet Table AA.5 and Figure AA.8.		P
AA.4.2.5	Shutdown		P
	In order to terminate the charging safely, system A station shall comply with the following procedure.		P
	a) The station shall notify the vehicle of start of shutdown process by digital communication.		P
	b) The station shall reduce the output current to 5 A or less.		P
	c) In normal conditions, switches d1 and d2 shall not be open until the welding detection of EV contactor by vehicle is finished.		P
	d) After d1 and d2 open, and before the vehicle connector unlocks, it shall be confirmed that the voltage at Vdc is 10 V or less.		P
AA.4.3	Measuring current and voltage		P
	The accuracy of output measurement of system A shall be within the following values: – current: ± (1,5% of actual current + 1) A; – voltage: ±5 V.		P
AA.5	**Response to vehicle command on charge current**		**P**

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	System A station shall supply d.c. current to the vehicle using CCC with the vehicle as the master and DC charger as the slave. Recommended specification for the charge current request from the vehicle and the response performance of system A station are given in Table AA.5 and Figure AA.7 for the vehicle, and in Table AA.6 and Figure AA.8 for system A station.		P
Annex BB	**DC EV CHARGING STATION OF SYSTEM B**		N/A
BB.3	**The operation and control procedure of charging process**		N/A
BB.3.1	Measurement accuracy of current and voltage		N/A
	The accuracy of output measurement of system B shall be within the following values:		---
	- voltage measurement: ± 0,5%		N/A
	- current measurement: a) ±2 % of the actual current if the actual current is above (>) 50 A; b) ±1 A if the actual current is less than or equal to (≤) 50 A.		N/A
BB.3.2	Proximity function		N/A
	When the vehicle connector is inserted into the vehicle inlet, the proximity function will be active. Namely once the voltage of detecting point 2 changes from 12 V to 6 V, the vehicle confirms the presence of the vehicle connector.		N/A
BB.3.3	Confirmation of connection state of vehicle interface (state 3).		N/A
	When the operator initiates the charging configuration for the d.c. EV charging station, the DC charger control unit can determine whether the vehicle connector is properly connected to the vehicle inlet by the voltage measurement of detecting point 1.		N/A
	When the operator completes the human-machine interaction setup and the d.c. EV charging station is properly connected, the DC charger control unit retains electrical interlock.		N/A
	The releasing of electrical interlock cannot be achieved unless the following three conditions are fully met: – charging terminates (there is no charging current output); – K1 – K6 are all disconnected; – unlock command is received from operator.		N/A
BB.3.4	DC charger self-detection is finished (state 4)		N/A

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	After the vehicle interface is properly connected, if the DC charger self-detection (including insulation monitoring) is finished, close K3 and K4 to initiate low voltage auxiliary supply circuit.		N/A
	After the energy is transferred to the low voltage supply power circuit by DC charger, the EV vehicle control unit determines whether the vehicle interface is properly connected by the voltage measurement of detecting point 2.		N/A
	If the voltage of detecting point 2 is 6 V, then the vehicle control unit begins to send “vehicle control unit (or battery management system) identification broadcast message” periodically.		N/A
	The signal can be considered as one of the trigger conditions of non-driving state.		N/A
BB.3.5	Charger ready (state 5)		N/A
	After handshaking and configuration for the vehicle control unit and the DC charger control unit is finished by communication, the vehicle control unit closes K5 and K6 to energize charging supply output circuit; and the DC charger control unit closes K1 and K2 to energize the d.c. power supply circuit.		N/A
BB.3.6	Charging stage (state 5)		N/A
	During the whole charging process, the vehicle control unit controls the charging process by sending the battery charge level requirements to the DC charger control unit. The DC charger control unit adjusts the charging voltage and current to ensure normal operation of charging procedure according to the battery charge level requirements. In addition, the vehicle control unit and the DC charger control unit send charging status to each other.		N/A
BB.3.7	Terminate charging in normal condition		N/A
	The vehicle control unit determines when to stop charging according to the charged status of the battery system or whether there is a message of “Terminate Charger Request/Response” from the d.c. EV charging station.		N/A
	When one of the above charging termination conditions is met, the vehicle control unit starts to send “Vehicle control unit (or battery management system) Terminate Charger Request/Response” periodically, and makes the charger stop charging before K1, K2, K5 and K6 are opened.		N/A

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	After communication is closed, K3 and K4 shall be opened, then release the electrical interlock. Finally the vehicle coupler could be disconnected and the whole charging process is finished.		N/A
BB.3.8	Safety protection under failure mode		N/A
BB.3.8.1	Safety protection under general failures		N/A
	During the charging process, when there are general failures, the DC charger control unit automatically stops charging (shutdown charging current output), then contactors K1, K2, K5, K6, K3 and K4 are opened by the DC charger control unit and the vehicle control unit before the operators release the electrical interlock through the DC charger setup, pull out the vehicle connector or carry out the error checks.		N/A
BB.3.8.2	Protection against overvoltage at the battery		N/A
	The system B station shall reduce the d.c. output current to less than 5 A within 2 s, to prevent overvoltage at the battery, if the output voltage exceeds the maximum voltage limit of the battery system for 1 s.		N/A
BB.3.8.3	Requirements for load dump		N/A
	In any case of load dump, the voltage overshoot shall not exceed 110 % of the maximum voltage limit requested by the vehicle.		N/A
BB.4	**Sequence diagram of charging process**		N/A
	The sequence diagram of charging process should comply with Figure BB.2.		N/A

Annex CC	**DC EV CHARGING STATION OF SYSTEM C (COMBINED CHARGING SYSTEM)**		**P**
CC.2	**Communication**		**P**
CC.2.1	The general definitions and functions of the Proximity (PP) and Pilot (CP) – signals / contacts are according to IEC 61851-1 (including detailed resistor definitions in Clause B.5) and SAE J1772™ with specific resistor values for configurations DD and FF given in Table CC.2. A CP duty cycle of 5% shall be used according Annex A of IEC 61851-1:2010.	Duty cycle: 5%	P
CC.2.2	Charge control communications between the d.c. supply and the EV are specified in IEC 61851-24	See SGS Report No.: SHES240601275201-03	P
	The physical layer for charge control communications shall comply with ISO/IEC 15118-3. Equivalent requirements for the physical layer of communications are in SAE J2931/4.		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	Communication is achieved by PLC on CP and PE/ground contacts. Contact assignments of the different connectors are in IEC 62196-3.		P
	Charge control communications shall comply with DIN SPEC 70121. Charge control communications shall also comply with ISO/IEC 15118-2. Equivalent requirements for charge control communications are in SAE J2836/2™, SAE J2847/2 and SAE J2931/1.		P
CC.3	**Process of energy supply**		**P**
	The process of supplying energy to the EV by the d.c. supply is initiated and controlled by the messages sent over PLC and shall follow the sequences shown in Figures CC.1 to CC.4.		P
CC.3.2	Normal start up		P
	Sequence diagram for normal start up shall follow Figure CC.1 and Table CC.3.		P
CC.3.3	Normal shutdown		P
	Sequence diagram for normal shutdown shall follow Figure CC.2 and Table CC.4.		P
CC.3.4	DC supply initiated emergency shutdown		P
	An emergency shutdown of the output current to less than 5 A within 1s with a current descending rate of 200 A/s or more shall be applied by the d.c. supply.		P
	DC supply shall indicate supply initiated emergency shutdown by turning off CP oscillator.		P
CC.3.5	EV initiated emergency shutdown		P
	EV triggers emergency shutdown by opening S2 and changing CP state from C/D to B.		P
	DC supply shall acknowledge emergency shutdown request from the EV by performing emergency shutdown according to CC.3.3.		P
CC.4	**Safety measures**		**P**
CC.4.1	IT (isolated terra) system requirements		P
	The secondary circuit (output side) of the d.c. supply shall be designed as an IT system and protection measures in accordance with 411 of IEC 60364-4-41:2005 shall be applied.		P
	In case of using an insulation monitoring device (IMD), it shall comply with IEC 61557-8 or equivalent. The d.c. supply shall perform insulation monitoring between DC+ and PE and DC and PE during the supply process and communicate the current state (Invalid, Valid, Warning, Fault) of the system periodically to the EV.		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	Prior to each supply cycle the following tests shall be performed. During these tests the d.c. output voltage shall not exceed 500 V at vehicle connector.		P
	a) A self-test of the insulation monitoring function of the d.c. supply shall be done by applying a defined fault resistor between d.c. output rail and equipotential bonding (e.g. PE). At least one of the following three possibilities for time management of self-test shall be applied:		P
	1) directly prior to supply cycle with vehicle connector plugged into vehicle inlet; 2) at regular intervals with maximum period of 1 h; 3) after self-test has successfully been performed the station may stay in Valid state for a maximum time of 1 h and during supply session under normal conditions.		P
	b) An insulation check of the system according to 6.4.3.106, e.g. by IMD shall be performed:		P
	1) vehicle connector not plugged into vehicle inlet: system comprises station, cable and vehicle connector, or		P
	2) vehicle connector plugged into vehicle inlet: system comprises station, charging cable, vehicle connector, vehicle inlet and vehicle cables.		P
	The insulation states of the system are defined as follows: invalid state, valid state, warning state, fault state, no IMD state.		P
CC.4.2	Temperature monitoring		P
	Temperature monitoring of the vehicle connector is required and shall be done by the d.c. supply to avoid overheating of vehicle connector.		P
	The station shall shutdown when the lower of the following 2 limits is exceeded: – the vehicle connector contact temperature limit is exceeded; or – the vehicle connector cable temperature rating is exceeded.		P
CC.4.3	Combined coupler lock function		P
	For all types of d.c. connectors according to Table CC.1, the vehicle inlet shall provide a locking function to mitigate unintentional disconnecting of the vehicle connector from the vehicle inlet during energy supply.		P
CC.4.4	CP lost shutdown (for all connectors of configuration CC)		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	Fast emergency shutdown of the output current to less than 5 A within 30 ms shall be applied by the d.c. supply.		N/A
	Shutdown is initiated by direct change of pilot from state C to state A due to interruption of the CP line. If an interruption of the pilot occurs the station shall latch the fault, which will prevent the station from going into ready mode until the station is serviced.		P
	De-energization of the system shall be done within 100 ms according to Table A.7 in Part 1.		P
CC.4.5	PP lost shutdown (additionally with using connector configurations CC and EE)		P
	Fast emergency shutdown of the output current by the d.c. supply within 30 ms shall be applied. Shutdown is initiated by the EVSE and vehicle detecting the Proximity Circuit transitioning from no Proximity Circuit fault detected, S3 closed, to any other state.		P
CC.4.6	Voltage check at initialization		P
	At beginning of supply session, with CP state A or B, the d.c. supply shall check if voltage on the cable is less than 60 V and shall terminate supply session if 60 V is exceeded.		P
CC.4.7	DC EV charging station maximum output Y capacitance		P
	The maximum total parallel Y capacitance shall not exceed 1 µF. This implies Y capacitance ≤500 nF across each d.c. rail and ground for a d.c. EV charging station with Y capacitance equally distributed between each d.c. rail and ground.		P
CC.5	**Additional functions**		**P**
CC.5.1	Pre-charging		P
	Pre-charging for voltage matching shall be done by d.c. EV charging station according to the requirements given in 101.2.1.6.		P
CC.5.2	Wake up of d.c. supply by EV		N/A
	The d.c. supply may support a standby mode to minimize power consumption as described as optional function in 6.4.4.101.		N/A
	In this case it is mandatory for the d.c. supply to wake up and resume energy supply according to the following method.		N/A
	If the vehicle attached to the d.c. supply has not changed the control pilot from state B2 to C2 or D2 for more than 2 min, the station may go to sleep.		N/A

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The control pilot signal B1 shall be supplied continuously by the d.c. supply to enable a wake up of the station triggered by the EV changing into state C1 or D1.		N/A
CC.5.3	Provision for manual unlocking of vehicle connector		P
	A means may be provided by the EV to manually unlock the vehicle connector even in case the voltage at the output stays higher than 60 V after the termination of the energy supply.		P
CC.5.4	Configuration CC connector latch position switch (S3) activation		N/A
	Latch position switch (S3) of the configuration CC connector shall not be able to be actuated when the vehicle connector is locked to the vehicle inlet.		N/A
CC.5.5	Configuration CC connector latch and latch position switch (S3) verification		N/A
	A supply cycle shall only be allowed once the d.c. EV charging station checks for the existence of the configuration CC connector latch and the function of the latch position switch (S3) prior to connecting the vehicle connector to the vehicle inlet.		N/A
CC.6	**Specific requirements**		**P**
CC.6.1	Turn on inrush current (d.c. side)		P
	Any inrush current on d.c. side in both directions when closing of EV disconnection device and station contactors, if any, shall not exceed 2 A. DC supply shall be responsible for limiting the inrush current, e.g. by applying a pre-charging circuit as shown in Figure CC.3.	Measured high current values for short time under 1ms.	P
CC.6.2	Protection against overvoltage of battery		P
	The d.c. supply shall trigger a d.c. supply initiated emergency shutdown according to CC.3.4 in order to prevent overvoltage at the battery, if output voltage exceeds maximum voltage limit sent by the vehicle for 400 ms.		P
CC.6.3	Requirements for load dump		P
	In any case of load dump, voltage overshoot shall not exceed 110 % of the maximum voltage limit requested by the vehicle.		P
	Maximum slew rate of output voltage in case of load dump shall not exceed 250 V/ms.		P
CC.6.4	DC output current regulation		P
	When in current regulation mode, the DC charger shall provide direct current to the vehicle.		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict
	The maximum allowable error between the actual average d.c. current value and the vehicle commanded current value is: – ±150 mA when the commanded current value is less than or equal to 5 A; – ±1.5 A when the commanded current value is greater than 5 A but less than or equal to 50A; – ±3 % of the DC charger's maximum current output when the commanded current value is greater than 50 A.		P
CC.6.5	Measuring current and voltage		P
	The accuracy of output measurement of system C shall be within the following values: – voltage: ±10 V		P
	The measured current reported shall be within ±1,5% of reading, but not better than ± 0,5 A.		P

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

11.4.1	TABLE: Dielectric Strength		P
Test voltage applied between:		**Test potential applied (V)**	**Breakdown / flashover (Yes/No)**
Between live parts of Input and Output to metal enclosure		DC 2023V	☐ Yes / ☒ No
Between AC Output to earthing terminals		DC 2023V	☐ Yes / ☒ No
Between DC Output to earthing terminals		DC 2023V	☐ Yes / ☒ No
Between AC input and DC output		DC 2023V	☐ Yes / ☒ No
Between Input circuits and communication circuits		DC 4045V	☐ Yes / ☒ No
Between Output circuits and communication circuits		DC 4045V	☐ Yes / ☒ No
Supplementary information: The tripping current of the generator shall be adjusted to a tripping current of 100 mA. (IEC 61439-1, CL 10.9.2.2)			

11.4.2	TABLE: impulse tests(1.2/50μs)		P
Test voltage applied between:		**Test voltage applied (V)**	**Breakdown / flashover (Yes/No)**
Input circuits to metal enclosure		4000	☐ Yes / ☒ No
Output circuits to metal enclosure		4000	☐ Yes / ☒ No
Input circuits to SELV circuits		6000	☐ Yes / ☒ No
Output circuits to SELV circuits		6000	☐ Yes / ☒ No
Supplementary information:			

11.5	TABLE: insulation resistance measurements	P
Insulation resistance R between:	**R (MΩ)**	**Required R (MΩ)**
Between AC input to earthing terminal	113,2	＞1
Between DC output to earthing terminal	9311	＞1
Input circuits to output circuits	9564	＞1
Between input circuit and communication circuit	＞50000	＞1
Between output circuit and communication circuit	＞50000	＞1
Supplementary information:		

11.7	TABLE: Touch current and protective conductor current		P
	Test circuit	240	—
	Supply voltage (Volt) ..... :	1000	—
	Frequency (Hz) ..... :	50	—
—	—	—	Touch Current (mA r.m.s.)

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Terminal A (Switch “s”) of Measuring Instrument Connected to:	Switch “e” Position	Component Disconnected	Polarity P1/Primary Switch Condition			
—	—	—	Normal/ EUT On	Normal/ EUT Off	Reverse/ EUT On	Reverse/ EUT Off
Metal enclosure	Open	-	2,152	2,038	2,287	2,008
Miss phase (Metal enclosure)	Open	-	-	2,088	-	2,122
Supplementary information:						

11.9	**TABLE: Heating Test**		**P**
Test condition			
Output voltage and current: 1000V/240A		Single CCS2	—
Output voltage and current: 800V/300A		Single CCS2	—
Output voltage and current: 400V/300A+500V/125A		CCS2+CHAdeMO	—
Condition 1#			
Thermocouple Locations		**Max. temperature measured, (ºC)**	**Max. temperature limit, (ºC)**
Input L1		35,9	110
Input L2		41,7	110
Input L3		39,2	110
Input N		26,7	110
Charging module(Input L1)		66,2	110
Charging module(Output DC+)		64,1	110
MCCB		42,2	70
MCCB(Output L1)		73,2	110
MCCB(Output L2)		70,8	110
MCCB(Output L3)		71,1	110
SPD		38,5	80
Meter		26,2	55
MCB		37,1	70
Fuse（DC+）		78,3	110
Input Terminal(DC+ fuse)		72,8	120
Input Terminal(DC+ fuse)		77,1	120
Relay(DC +)		56,2	85
Input Terminal(DC+ Relay)		77,9	110
Output Terminal(DC+ Relay)		73,7	110

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Shunt	76,8	110
Input Terminal(DC- shunt)	73,2	110
Output Terminal(DC- shunt)	74,9	110
Relay(DC -)	58,5	85
Input Terminal(DC- Relay)	73,7	110
Output Terminal(DC- Relay)	72,3	110
DC+ Relay before Shunt	52,5	85
DC- Relay before Shunt	52,9	85
Output DC+	70,2	110
Output DC-	64,9	110
AC contactor(KM6)	45,2	75
AC contactor(KM5)	43,2	75
Switching power supply(UP4)	45,2	75
Switching power supply(UP3)	45,5	75
Switching power supply(UP1)	46,2	75
Main PCB	55,3	85
Intermediate relay(KA3)	40,5	85
Terminal Block(J2)	43,4	110
Enclosure	30,9	85
Screen	31,6	70
Handle	23,9	70
Charging Connector	25,2	70
Charging Cable	35,4	110
Emergency Button	33,8	70
Ambient	22,5	Ref.
Supplementary information:		

Condition 2#		
Thermocouple Locations	**Max. temperature measured, (ºC)**	**Max. temperature limit, (ºC)**
Input L1	35,2	110
Input L2	41,1	110
Input L3	37,4	110
Input N	26,4	110
Charging module(Input L1)	73,2	110

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Charging module(Output DC+)	70,2	110
MCCB	40,2	70
MCCB(Output L1)	64,8	110
MCCB(Output L2)	65,2	110
MCCB(Output L3)	64,2	110
SPD	37,2	80
Meter	27,1	55
MCB	36,8	70
Fuse（DC+）	80,2	110
Input Terminal(DC+ fuse)	68,1	120
Input Terminal(DC+ fuse)	75,2	120
Relay(DC +)	56,2	85
Input Terminal(DC+ Relay)	77,3	110
Output Terminal(DC+ Relay)	70,2	110
Shunt	78,8	110
Input Terminal(DC- shunt)	72,9	110
Output Terminal(DC- shunt)	78,6	110
Relay(DC -)	56,2	85
Input Terminal(DC- Relay)	78,7	110
Output Terminal(DC- Relay)	74,4	110
DC+ Relay before Shunt	51,2	85
DC- Relay before Shunt	53,2	85
Output DC+	64,8	110
Output DC-	62,3	110
AC contactor(KM6)	46,4	75
AC contactor(KM5)	44,1	75
Switching power supply(UP4)	41,6	75
Switching power supply(UP3)	44,2	75
Switching power supply(UP1)	47,2	75
Main PCB	51,2	85
Intermediate relay(KA3)	40,9	85
Terminal Block(J2)	40,5	110
Enclosure	32,1	85
Screen	31,9	70
Handle	25,2	70

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Charging Connector	25,3	70
Charging Cable	35,1	110
Emergency Button	32,3	70
Ambient	22,4	Ref.
Supplementary information:		

Condition 3#		
Thermocouple Locations	**Max. temperature measured, (ºC)**	**Max. temperature limit, (ºC)**
Input L1	32,8	110
Input L2	35,2	110
Input L3	36,2	110
Input N	28,6	110
Charging module(Input L1)	67,3	110
Charging module(Output DC+)	63,9	110
SPD	35,7	80
Meter	27,5	55
MCB	35,7	70
MCCB	34,8	70
MCCB(Output L1)	53,2	110
MCCB(Output L2)	50,5	110
MCCB(Output L3)	59,2	110
AC contactor(KM6)	35,1	75
AC contactor(KM5)	37,8	75
Switching power supply(UP4)	38,3	75
Switching power supply(UP3)	37,2	75
Switching power supply(UP1)	40,5	75
Main PCB	49,9	85
Intermediate relay(KA3)	39,8	85
Terminal Block(J2)	40,5	110
Input Terminal(Connector B)	47,8	110
Shunt(DC-)(Connector B)	50,9	110
Shunt(DC+)(Connector B)	70,4	110
Relay(DC-)(Connector B)	55,4	110
Relay(DC+)(Connector B)	50,9	110

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Relay before Shunt(DC+)	44,9	85
Enclosure	27,8	85
Screen	31,7	70
Handle	25,3	70
Emergency Button	27,7	70
Charging Connector B	25,2	70
Charging Cable(Connector B)	32,2	110
Ambient	22,1	Ref.
Supplementary information:		

101.2.1.2.1	**TABLE: output current regulation in CCC**	**P**

For CCS2 System

Required output current (A)	Current measured (A)	Deviation (A)	Limit (A)	Remark
5	5,02	0,02	±2,5 A	1000V
50	49,89	-0,11	±2,5 A	1000V
150	149,42	-0,58	±7,5 A	1000V
240	237,87	-2,13	±12 A	1000V
5	5,01	0,01	±2,5 A	800V
50	49,89	-0,11	±2,5 A	800V
150	149,21	-0,79	±7,5 A	800V
300	297,27	2,73	±15 A	800V
5	4,98	-0,02	±2,5 A	750V
50	49,97	-0,03	±2,5 A	750V
150	149,21	-0,79	±7,5 A	750V
300	296,22	-3,78	±15 A	750V
5	4,97	-0,03	±2,5 A	600V
50	49,89	-0,11	±2,5 A	600V
150	149,2	-0,8	±7,5 A	600V
300	296,33	-3,67	±15 A	600V
5	4,97	-0,03	±2,5 A	400V
50	49,92	-0,08	±2,5 A	400V
150	149,44	-0,56	±7,5 A	400V
300	296,12	-3,87	±15 A	400V
5	4,975	-0,025	±2,5 A	300V
50	49,88	-0,12	±2,5 A	300V

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

150	150,2	0,02	±7,5 A	300V
167	165,92	-1,08	±8,35 A	300V
300	296,45	-3,55	±2,5 A	300V
5	4,98	-0,02	±2,5 A	200V
50	49,96	-0,04	±2,5 A	200V
150	148,87	-1,13	±7,5 A	200V
300	297,42	-2,58	±15 A	200V
For CHAdeMO System				
Required output current (A)	Current measured (A)	Deviation (A)	Limit (A)	Remark
5	4,97	-0,03	±2,5 A	200V
60	59,92	-0,08	±3,0 A	200V
120	118,74	-1,26	±6,0 A	200V
5	5,15	0,15	±3,0 A	480V
60	62,56	2,56	±6,25 A	480V
125	124,32	-0,68	±3,0 A	480V
5	5,02	0,02	±2,5 A	500V
60	60,09	0,09	±3,0 A	500V
125	124,44	-0,56	±6,25 A	500V
Supplementary information:				

101.2.1.2.2	**TABLE: output voltage regulation in CVC**			**P**
For CCS2 System				
Required output voltage (V)	Voltage measured (V)	Deviation (V)	Limit (V)	Remark
1000V/0A	999,10	-0,90	± 20	--
1000V/5A	998,50	-1,50	± 20	--
1000V/50A	998,90	-1,10	± 20	--
1000V/150A	998,00	-2,00	± 20	--
1000V/240A	997,10	-2,90	± 20	--
800V/0A	799,40	-0,60	± 20	--
800V/5A	798,90	-1,10	± 20	--
800V/50A	798,80	-1,20	± 20	--
800V/150A	798,40	-1,60	± 20	--
800V/300A	797,10	-2,90	± 20	--
750V/0A	749,60	-0,40	± 20	--
750V/5A	749,00	-1,00	± 20	--

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

750V/50A	749,00	-1,00	± 20	--
750V/150A	748,40	-1,60	± 20	--
750V/300A	747,30	-2,70	± 20	--
600V/0A	599,80	-0,20	± 20	--
600V/5A	599,10	-0,90	± 20	--
600V/50A	599,30	-0,70	± 20	--
600V/150A	598,90	-1,10	± 20	--
600V/300A	597,40	-2,60	± 20	--
400V/0A	399,20	-0,80	± 20	--
400V/5A	399,36	-0,64	± 20	--
400V/50A	399,30	-0,70	± 20	--
400V/150A	398,37	-1,63	± 20	--
400V/300A	397,01	-2,99	± 20	--
300V/0A	299,20	-0,80	± 20	--
300V/5A	299,25	-0,75	± 20	--
300V/50A	299,20	-0,80	± 20	--
300V/150A	298,45	-1,55	± 20	--
300V/167A	298,25	-1,75	± 20	--
300V/300A	297,00	-3,00	± 20	--
200V/0A	199,12	-0,88	± 20	--
200V/5A	199,15	-0,85	± 20	--
200V/50A	198,88	-1,12	± 20	--
200V/150A	198,13	-1,87	± 20	--
200V/300A	196,78	-3,22	± 20	--
For CHAdeMO System				
Required output voltage (V)	Voltage measured (V)	Deviation (V)	Limit (V)	Remark
200V/5A	199,09	-0,91	± 20	--
200V/60A	199,21	-0,79	± 20	--
200V/120A	201,02	1,02	± 20	--
480V/5A	478,52	-1,48	± 20	--
480V/60A	479,21	-0,79	± 20	--
480V/125A	480,64	0,64	± 20	--
500V/5A	498,45	-1,55	± 20	--
500V/60A	499,25	-0,75	± 20	--
500V/125A	497,37	-2,63	± 20	--

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information:

101.2.1.3	TABLE: Control delay of charging current in CCC			P
For CCS2 System				
Current range of change	Reaction time of EV charging station (s)	Delay time (s)	Limit (s)	Remark
5-20A	0,12	0,068	1	DC 1000V
5-80A	0,12	0,232	3,75	DC 1000V
5-120A	0,12	0,328	5,75	DC 1000V
5-240A	0,12	0,422	11,75	DC 1000V
5-200A	0,12	0,416	9,75	DC 600V
5-300A	0,12	0,442	14,75	DC 800V
For CHAdeMO System				
Current range of change	Reaction time of EV charging station (s)	Delay time (s)	Limit (s)	Remark
5-20A	0,12	0,097	1	DC 500V
5-125A	0,12	0,179	6,0	DC 500V
Supplementary information:				

101.2.1.4	Descending rate of charging current					P
For CCS2 System						
Base current I0 (A)	Target current IN (A)	Output voltage (V)	Measured delay time(ms)	Limit of delay time(s)	Measured change rate(A/s)	Limit of change rate(A/s)
Normal shutdown						
80	0	1000	24,0ms	0,8s	3333,33	≥100A/s
120	0	1000	28,4ms	1,2s	4225,35	≥100A/s
200	0	600	37.6ms	2,0s	5319,15	≥100A/s
240	0	1000	7,3ms	2,4s	32876,71	≥100A/s
300	0	800	34,6ms	3,0s	8670,52	≥100A/s
Emergency shutdown						
120	0	1000	599,2ms	0,6s	200,27	≥200A/s
200	0	600	576,2ms	1,0s	347,10	≥200A/s
240	0	1000	591,2ms	1,2s	405,95	≥200A/s
300	0	800	587,2ms	1,5s	510,90	≥200A/s
For CHAdeMO System						

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

Base current I0 (A)	Target current IN (A)	Output voltage (V)	Measured delay time(ms)	Limit of delay time(s)	Measured change rate (A/s)	Limit of change rate (A/s)
Normal shutdown						
125	0	480	47,6ms	1,25s	2626,05A/s	≥100A/s
Emergency shutdown						
125	0	480	578,0ms	0,625s	216,26A/s	≥200A/s
Supplementary information:						

101.2.1.5	**TABLE: Periodic and random deviation(current ripple)**				**P**
For CCS2 system					
Output voltage (V)	Output current (A)	Current ripple (A)	Frequency (Hz)	Limit (A)	Remark
200	300	0,06	10	1,5	--
200	300	1,33	5,000	6	--
200	300	1,78	150,000	9	--
300	300	0,54	10	1,5	--
300	300	2,04	5,000	6	--
300	300	3,13	150,000	9	--
400	300	0,14	10	1,5	--
400	300	1,72	5,000	6	--
400	300	2,02	150,000	9	--
600	300	0,18	10	1,5	--
600	300	1,91	5,000	6	--
600	300	2,39	150,000	9	--
800	300	0,36	10	1,5	--
800	300	1,88	5,000	6	--
800	300	2,21	150,000	9	--
1000	240	0,42	10	1,5	--
1000	240	2,08	5,000	6	--
1000	240	2,73	150,000	9	--
For CHAdeMO system					
Output voltage (V)	Output current (A)	Current ripple (A)	Frequency (Hz)	Limit (A)	Remark
200	125	0,11	10	1,5	
200	125	2,67	5,000	6	

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

200	125	2,08	150,000	9	
400	125	0,62	10	1,5	
400	125	1,05	5,000	6	
400	125	2,18	150,000	9	
500	125	0,38	10	1,5	
500	125	2,01	5,000	6	
500	125	2,54	150,000	9	
Supplementary information:					

101.2.1.6 TABLE: Periodic and random deviation(voltage ripple in CVC)

For CCS2 system

Required output voltage (V)	Output voltage (V)	Voltage deviation (%)	Limit (%)	Voltage ripple	Limit (%)	Voltage Slew rate(V/mS)	Limit (V/mS)
1000V/0A	999,10	-0,09%	±10%	0,582	±5	1,102	±20
1000V/150A	998,00	-0,20%	±10%	1,975	±5	1,332	±20
1000V/240A	997,10	-0,29%	±10%	3,243	±5	1,105	±20
800V/0A	799,40	-0,07%	±10%	0,63	±5	0,832	±20
800V/150A	798,40	-0,20%	±10%	1,869	±5	1,129	±20
800V/300A	797,10	-0,36%	±10%	2,658	±5	1,047	±20
750V/0A	749,60	-0,05%	±10%	0,595	±5	0,992	±20
750V/150A	748,40	-0,21%	±10%	1,628	±5	1,187	±20
750V/300A	747,30	-0,36%	±10%	2,753	±5	1,467	±20
600V/0A	599,80	-0,03%	±10%	0,572	±5	2,112	±20
600V/150A	598,90	-0,18%	±10%	1,404	±5	1,864	±20
600V/300A	597,40	-0,43%	±10%	2,943	±5	1,054	±20
400V/0A	399,20	-0,20%	±10%	0,629	±5	0,939	±20
400V/150A	398,37	-0,41%	±10%	2,119	±5	1,576	±20
400V/300A	397,01	-0,74%	±10%	2,342	±5	1,379	±20
300V/0A	299,20	-0,27%	±10%	0,687	±5	0,858	±20
300V/150A	298,45	-0,51%	±10%	2,007	±5	1,642	±20
300V/167A	298,25	-0,58%	±10%	1,933	±5	1,118	±20
300V/300A	297,00	-1,00%	±10%	2,063	±5	0,997	±20
200V/0A	199,12	-0,44%	±10%	0,875	±5	2,009	±20

IEC 61851-23			
Clause	Requirement + Test	Result - Remark	Verdict

200V/150A	198,13	-0,94%	±10%	2,753	±5	1,598	±20
200V/300A	196,78	-1,61%	±10%	1,707	±5	1,387	±20
For CHAdeMO system							
Required output voltage (V)	Output voltage (V)	Voltage deviation (%)	Limit (%)	Voltage ripple	Limit (%)	Voltage Slew rate(V/mS)	Limit (V/mS)
200V/0A	199,25	-0,38%	±10%	0,828	±5	0,997	±20
200V/62,5A	199,11	-0,45%	±10%	0,976	±5	1,761	±20
200V/125A	198,62	-0,69%	±10%	1,068	±5	1,422	±20
480V/0A	479,53	-0,09%	±10%	0,899	±5	0,873	±20
480V/62,5A	479,45	-0,11%	±10%	1,459	±5	1,009	±20
480V/125A	478,76	-0,26%	±10%	2,407	±5	1,798	±20
500V/0A	497,62	-0,48%	±10%	0,515	±5	0,352	±20
500V/62,5A	497,36	-0,52%	±10%	1,225	±5	2,017	±20
500V/125A	496,80	-0,64%	±10%	2,619	±5	1,039	±20
Supplementary information:							

101.2.1.7	**Load dump**				**P**
For CCS2 system					
Output voltage	Current	Voltage overshoot		Voltage slew rate	
(V)	(A)	Measured (V)	Limit (V)	Measured (V/ms)	Limit(V/ms)
1000	240	1029,0	1100	111,54	<250
600	300	635,1	660	73,13	<250
300	300	317,6	330	73,33	<250
For CHAdeMO system					
Output voltage		Current		Voltage overshoot	
(V)	(A)	Measured (V)	Limit (V)	Measured (V/ms)	Limit (V/ms)
500	125	522,0	550	55,43	<250
480	125	502,7	528	184,65	<250
400	125	417,9	440	100,57	<250
Supplementary information:					

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