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Specification for electric vehicle off-board bi-directional charger

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Table of Contents

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1 Scope

This Standard specifies the basic composition, functional requirements, technical requirements, inspection rules, test methods, and identification of electric vehicle off-board bi-directional charger (hereinafter referred to as the bi-directional charger).

This Standard is applicable to the electric vehicle off-board bi-directional charger that uses conductive charging and discharging.

2 Normative references

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

GB/T 2421.1, *Environmental Testing for Electric and Electronic products - General and Guidance* (IEC60068-1:1988, IDT)

GB/T 2423.1, *Environmental testing - Part 2: Test methods - Tests A: Cold* (IEC 60068-2-1:2007, IDT)

GB/T 2423.2, *Environmental testing - Part 2: Test methods - Tests B: Dry heat* (IEC 60068-2-2:2007, IDT)

GB/T 2423.4, *Environmental testing for electric and electronic products - Part 2: Test method - Test Db: Damp heat，cyclic (12h+12h cycle)* (IEC 60068-2-30:2005, IDT)

GB/T2423.5, *Environmental testing for electric and electronic products Part 2: Test methods Test Ea and guidance: Shock* (IEC 68-2-27:1987, IDT)

GB/T2423.10, *Environmental testing for electric and electronic products - Part 2: Tests methods - Test Fc: Vibration (sinusoidal)* (IEC 60068-2-6:1995, IDT)

GB/T 2423.55, *Environmental testing for electric and electronic products - Part 2: Test methods - Test Eh: hammer tests* (IEC 60068-2-75:1997, IDT)

GB/T 3859.1, *Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements* (IEC 60146-1-1:2009, MOD)

GB 4208, *Degrees of Protection Provided By Enclosure (IP Code)* (IEC 60529: 2001, IDT)

GB 9254, *Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement* (IEC/CISPR 22: 2006, IDT)

GB/T 17626.2, *Electromagnetic compatibility - Testing and measurement techniques - Electrostatic discharge immunity test* (IEC 61000-4-2:2001, IDT)

GB/T 17626.3, *Electromagnetic compatibility - Testing and measurement techniques - Radiated，radio-frequency，electromagnetic field immunity test* (IEC 61000-4-3: 2002, IDT)

GB/T 17626.4, *Electromagnetic compatibility - Testing and measurement techniques - Electrical fast transient/burst immunity test* (IEC 61000-4-4: 2004, IDT)

GB/T 17626.5, *Electromagnetic compatibility - Testing and measurement techniques - Surge immunity test* (IEC 61000-4-5: 2005, IDT)

GB/T 18487.1, *Electric vehicle conductive charging system - Part 1: General requirements*

GB/T 19826 2005, *General specification and safety requirement for DC power supply equipment of power projects*

GB/T 29317, *Terminology of electric vehicle charging/battery swap infrastructure*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 18487.1 and GB/T 29317 as well as the followings apply.

bi-directional charger

a device for realizing bidirectional electric energy conversion between an electric vehicle battery system and a power grid

7.1.1 Working environment temperature: 20°C ~ +50°C.

7.1.2 Relative humidity: 5% ~ 95% (according to no-condensation design).

7.1.3 Altitude: no more than 2000m.

7.1.4 In special circumstances, the use of the bi-directional charger shall be negotiated between the manufacturer and the user.

7.1.5 The place of use must not have explosive medium, and there are no harmful gases and conductive media surrounding corrosive and damaging insulation.

7.2 Normal electrical conditions

7.2.1 Frequency variation range: 50Hz ± 1Hz.

7.2.2 AC power supply voltage fluctuation range: 380V power grid is 323V ~ 437V, 220V power grid is 187V ~ 253V.

7.2.3 AC power supply voltage asymmetry does not exceed 5%.

7.2.4 Non-sinusoidal content of AC power supply voltage waveform is not more than 10%.

7.3 Environmental resistance

7.3.1 Protection level

The casing protection level of the bi-directional charger shall not be lower than IP30 (indoor) or IP54 (outdoor) in GB 4208.

7.3.2 Three anti-proof (anti-moist, anti-mildew, anti-salt spray) protection

Circuits such as printed circuit boards and connectors in the bi-directional charger shall be protected against moisture, mildew and salt spray.

7.3.3 Rust prevention (antioxidation prevention)

The iron casing of the bi-directional charger and the exposed iron brackets and parts shall adopt double-layer anti-rust measures. Non-ferrous metal casings shall also have an oxidation protection film or be treated with oxidation protection.

7.3.4 Anti-theft

The bi-directional charger for outdoor operation shall have the necessary anti-theft measures.

110% of the rated current.

7.7.12 The bi-directional charger shall be equipped with an emergency stop switch, which can stop charging and discharging urgently by manual or remote command.

7.7.13 When the bi-directional charger is properly connected to the battery, the charging process can be allowed to start. When the bi-directional charger detects that the connection with the battery is abnormal, it must stop charging and discharging immediately.

7.7.14 During the charging and discharging process, the bi-directional charger shall have obvious warning signs and text prompts to prevent personnel from mis-operation.

7.8 DC output

7.8.1 DC side voltage

DC side voltage preferred range: 50V ~ 100V, 75V ~ 150V, 150V ~ 350V, 300V ~ 500V, 450V ~ 700V.

7.8.2 DC side current

DC side rated current preferred values: 10A, 20A, 50A, 100A, 160A, 200A, 250A, 315A, 400A, 500A.

7.8.3 Steady current accuracy

In the constant current state, the output/input DC current is within the range of 20% to 100% of the rated value, and the output/input current regulation accuracy should not exceed ±1%.

7.8.4 Steady voltage accuracy

Under constant voltage conditions, the DC side voltage regulation accuracy shall not exceed ±0.5%.

7.8.5 Ripple coefficient

In the constant voltage state, the ripple effective value coefficient shall not exceed ±0.5%, and the ripple peak coefficient shall not exceed ±1%.

7.8.6 Current error

In the constant current state, the output/input DC current is set within the range of 20% to 100% of the rated value. When the set output/input DC current is greater than or equal to 30A, the output/input current setting error should not exceed ±1%. When the set output/input DC current is less than 30A, the

ground according to the installation method specified in the technical standards and instructions for use of the testing bi-directional charger.

9.1.2.3 The testing bi-directional charger shall be balanced with the ambient temperature before being energized.

9.1.3 Test instrument

9.1.3.1 The instrumentation equipment for testing shall have a certificate of conformity and a metrological verification certificate within the validity period.

9.1.3.2 The instrumentation equipment used for testing the performance of the bi-directional charger shall have sufficient resolution, accuracy and stability, and at least one level higher than the corresponding technical indicators of the tested bi-directional charger.

9.2 Environmental condition test

9.2.1 Low temperature test

Perform the test according to the method specified in GB/T 2423.1 "Test Ad: Low temperature test of temperature test sample temperature grading - test sample is energized after temperature starts to stabilize". In the test, the low temperature test temperature is the minimum working environment temperature specified in 7.1.1, and the test duration is 2h. Before and after the test, during the test and after the end of the test, the bi-directional charger shall be able to work normally, and the accuracy of the test voltage regulation shall comply with the provisions of 7.8.4.

NOTE Normal operation means that the charging, communication, display and various protection functions of the bi-directional charger shall be normal, and no function loss is allowed.

9.2.2 High temperature test

Perform the test according to the method specified in GB/T 2423.2 "Test Bd: High temperature test for temperature gradient of heat test sample - Test sample is not energized during temperature rise regulation". In the test, the high temperature test temperature is the highest working ambient temperature specified in 7.1.1, and the test duration is 2h. Before and after the test, during the test and after the end of the test, the bi-directional charger shall be able to work normally, and the accuracy of the test voltage regulation shall comply with the provisions of 7.8.4.

9.2.3 Damp heat test

Test according to the method specified in GB/T 2423.4, high temperature: (40 ± 2)°C: number of cycles: 2. Perform the power frequency withstand test and measurement of insulation resistance 2h before the end of the test. The test

Pretreatment of the bi-directional charger before the test shall be carried out in accordance with the relevant requirements of GB/T 3859.1. The bi-directional charger shall not be electrically connected between the live circuits, between the independent live circuits and the ground (metal casing), according to the working voltage, it shall be able to withstand the power frequency withstand test for 1min as specified in Table 3. There shall be no insulation breakdown and flashover during the test.

9.6.4 Impact withstand voltage test

The surge voltage is respectively applied between the charging circuits of the bi-directional charger and between the charging circuits to the ground (metal casing). Other circuits and exposed conductive parts are grounded together. According to the test voltage specified in Table 3, add 3 times positive polarity and 3 times negative polarity standard lightning wave short-time surge voltage, each interval is not less than 5s. The test site shall have no breakdown discharge during the test.

9.7 Safety test

9.7.1 DC side current limiting, voltage limiting function test

a) The bi-directional charger operates under a constant current charging state, and the load resistance is adjusted to increase the DC output voltage. When the output voltage exceeds the limit voltage setting value, it shall be able to automatically limit the increase of the output DC voltage. Automatically resume operation when the output voltage drops below the limit voltage.

b) The bi-directional charger operates under constant voltage charging state, and the load resistance is adjusted to increase the DC output current. When the output current exceeds the current limit setting value, it shall be able to automatically limit the increase of DC output current. Automatically resume operation when the output current is reduced below the limit current.

c) The bi-directional charger operates in a constant current discharge state, and when the DC side voltage exceeds the limit voltage setting value, the discharge shall be automatically stopped.

9.7.2 DC side overvoltage, overcurrent, short circuit protection test

a) Set the DC side overvoltage protection action value, adjust the output parameters, artificially simulate overvoltage fault, and the bi-directional charger shall be protected according to the method specified by the product standard (automatic stop charging and discharging or alarm prompt).

The bi-directional charger is tested in accordance with the provisions of 6.6 of GB/T 19826 2005 under the conditions of charging and discharging. The power factor of bi-directional charger shall meet the requirements of 7.10.2.

9.11 Current sharing imbalance test

The bi-directional charger is tested in accordance with the provisions of 6.7 of GB/T 19826-2005 under the state of charging and discharging. The current sharing imbalance of the high frequency switching power supply module shall meet the requirements of 7.11.

9.12 Electromagnetic compatibility test

9.12.1 Electrostatic discharge immunity test

The test shall be carried out in accordance with the method specified in GB/T 17626.2, and the experimental results shall comply with the provisions of 7.12.1.1.

9.12.2 Radio frequency electromagnetic field radiation immunity test

The test shall be carried out in accordance with the method specified in GB/T 17626.3, and the experimental results shall comply with the provisions of 7.12.1.2.

9.12.3 Electrical fast transient burst immunity test

The test shall be carried out in accordance with the method specified in GB/T 17626.4, and the experimental results shall comply with the provisions of 7.12.1.3.

9.12.4 Surge (impact) immunity test

The test shall be carried out in accordance with the method specified in GB/T 17626.5, and the experimental results shall comply with the provisions of 7.12.1.4.

9.12.5 Radiation disturbance test

The bi-directional charger operates under rated load. Carry out the test in accordance with the requirements of GB 9254, the test results shall comply with the provisions of Table 6 of 7.12.2.1.

9.12.6 Conducted disturbance test

The bi-directional charger operates under rated load. Carry out the test in accordance with the requirements of GB 9254, the test results shall comply with the provisions of Table 7 and Table 8 of 7.12.2.2.

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