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AUTOMOBILE INDUSTRY STANDARD  
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**Automobile USB power adapter**

汽车用 USB 功率电源适配器

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# Automobile USB power adapter

## 1 Scope

This document specifies the technical requirements and test methods for automobile USB power adapters, including inspection rules and markings, packaging, transportation, storage for automobile USB power adapters.

This document applies to automobile USB power adapters (hereinafter referred to as power adapters), that use USB Type A sockets, on categories M, N, O, G motor vehicles.

## 2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for the dated references, only the version corresponding to the date is applicable to this document; for the undated references, the latest version (including all amendments) is applicable to this document.

GB/T 191 Packaging - Pictorial marking for handling of goods (ISO 780:1997, MOD)

GB/T 2408-2008 Plastics - Determination of burning characteristics - Horizontal and vertical test (IEC 60695-11-10:1999, IDT)

GB/T 2423.17-2008 Environmental testing for electric and electronic products - Part 2: Test method - Test Ka: Salt mist (IEC 60068-2-11:1981, IDT)

GB/T 13306 Plates

GB/T 18655-2018 Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers (CISPR25:2016, IDT)

GB/T 19951 Road vehicles - Disturbances test methods for electrical/electronic component from electrostatic discharge (ISO 10605:2008, MOD)

GB/T 21437.2-2008 Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along power lines (ISO 7637-2:2004, IDT)

GB/T 28046.2-2019 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 2: Electrical loads (ISO 16750-2:2006,

MOD)

GB/T 28046.3-2011 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads (ISO 16750-3:2007, MOD)

GB/T 28046.4-2011 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 4: Climatic loads (ISO 16750-4:2006, MOD)

GB/T 28046.5-2013 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 5: Chemical loads (ISO 16750-5:2010, MOD)

GB/T 30038 Road vehicles - Degrees of protection (IP-Code) (ISO 20653:2006, MOD)

GB/T 33014.2-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 2: Absorber-lined shielded enclosure (ISO 11452-2:2004 MOD)

GB/T 33014.4-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 4: Bulk current injection (BCI)/(ISO 11452-4:2005 MOD)

QC/T 238 Storage and preservation for automotive parts

IEC 62680-1-2:2017 Universal serial bus interfaces for data and power - Part 1-2: Common components - USB Power Delivery specification

### 3 Terms and definitions

The following terms and definitions apply to this document.

#### 3.1

##### **Universal serial bus, USB**

Abbreviation for Universal Serial Bus, which is a serial bus standard for connecting computer systems and external devices.

#### 3.2

##### **Automobile USB power adapter**

A device, that converts the DC power input from the automobile into the DC power output, based on the USB interface, through a transformer controller, referred to as

The force, which is required for the mating plug to be fully inserted into the USB socket of the power adapter, at a rate not greater than 12.5 mm/min, shall not be less than 10 N and not more than 35 N.

#### **4.2.2 Pull-out force**

The force, which is required to completely unplug the mating plug from the USB socket of the power adapter, at a rate of not more than 12.5 mm/min, shall not be less than 10 N and not more than 35 N.

#### **4.2.3 Plug-in/pull-out life**

At the maximum rate of 200 cycles (1 cycle is composed of 1 plug-in and 1 pull-out)/h, the mating plug is inserted/removed from the USB socket of the power adapter, for 10000 cycles. The force, which is required to completely remove the mating plug from the USB socket of the power adapter, shall not be less than 10 N. After the test, the power adapter shall be powered on for testing. The performance shall meet the requirements of 4.3.1 and 4.3.2.

#### **4.2.4 Vibration performance**

The power adapter shall be subjected to the vibration performance test. It shall meet the requirements of 4.3.1 and 4.3.2, after the test.

#### **4.2.5 Free drop**

The power adapter shall be subjected to a free drop test. It shall meet the requirements of 4.3.1 and 4.3.2, after the test. The product shall not be broken, fractured or severely deformed.

### **4.3 Electrical properties**

#### **4.3.1 Rated output voltage**

The rated output voltage of the power adapter shall be 5 V, with a tolerance of  $\pm 5\%$ . If there are other output voltages, the rated output voltage shall be marked, with a tolerance of  $\pm 5\%$ .

#### **4.3.2 Rated output current**

Under general test conditions, the rated output current of the power adapter is 2.1A, with a tolerance of -3%.

#### **4.3.3 Conversion efficiency**

Under general test conditions, for 12V system, the conversion efficiency of the power adapter shall not be less than 89%; for 24V system, the conversion efficiency of the power adapter shall not be less than 87%.

#### **4.3.4 Load short-circuit current**

Under general test conditions, after the load at the output end of the power adapter is short-circuited, the short-circuit average current shall be less than 0.2 times the rated output current.

#### **4.3.5 No-load current**

The no-load current of the power adapter shall be specified in the product technical conditions; the size of the no-load current shall be negotiated by both the supplier and the buyer.

#### **4.3.6 Contact resistance**

The contact resistance of the USB socket of the power adapter shall be not greater than 30 mΩ.

#### **4.3.7 Overvoltage**

The power adapter shall be subjected to the overvoltage test. The performance, during the test, may not meet the requirements of 4.3.1 and 4.3.2. However, after the input voltage returns to normal, the performance of the power adapter shall meet the requirements of 4.3.1 and 4.3.2.

#### **4.3.8 Reverse voltage**

The power adapter shall be subjected to the reverse voltage test; the performance of the power adapter shall meet the requirements of 4.3.1 and 4.3.2, after the test.

#### **4.3.9 Ramp-down and ramp-up of supply voltage**

The power adapter shall be subjected to the power supply voltage ramp-down and ramp-up tests. Within the power supply voltage range in Table 1, the performance of the power adapter shall meet the requirements of 4.3.1 and 4.3.2, during and after the test. Outside the power supply voltage range, the performance of power adapter may not meet the requirements of 4.3.1 and 4.3.2, during the test.

#### **4.3.10 Transient drop in supply voltage**

The power adapter shall be subjected to the transient drop test of the power supply voltage; the performance after the test shall meet the requirements of 4.3.1 and 4.3.2.

#### **4.3.11 Reset characteristics**

The power adapter shall be subjected to the reset characteristic test; the performance shall meet the requirements of 4.3.1 and 4.3.2, after the test.

#### **4.3.12 Insulation resistance**

## 4.4 Electromagnetic compatibility

### 4.4.1 General test requirements

The power adapter shall be tested, according to the requirements of the product drawings and technical documents. It shall not be tested, with any auxiliary equipment or measures other than those specified in the product drawings and technical documents. The power adapter is divided into a single unit (see Figure A.1), a module (see Figure A.2), an extension cable (see Figure A.3), an adapter device (see Figure A.4). The power adapter is as follows, when it is under the working states at rated load:

- a) Single unit: The unit is in the rated load working state;
- b) Module: When the load, which is connected to the USB interface in the module is in the rated load working state, other electronic and electrical products, which are combined with it, shall also be in the rated load working state;
- c) Extension cable: When the load, which is connected to the USB interface in the extension cable, is in the rated load working state, the transformer controller in the extension cable shall also be in the rated load working state;
- d) Adapter device: When the load, which is connected to the USB interface in the adapter device, is in the rated load working state, the transformer controller in the adapter device shall also be in the rated load working state.

When it is mentioned that the power adapter is under the rated load working state below, the above definitions apply.

### 4.4.2 Electromagnetic radiation immunity

#### 4.4.2.1 Electromagnetic radiation immunity - Bulk current injection (BCI)

The power adapter is in the rated load working state, according to 8 in GB/T 33014.4-2016. The performance of the power adapter, during and after the test, shall meet the requirements of 4.3.1 and 4.3.2.

#### 4.4.2.2 Electromagnetic radiation immunity - Anechoic chamber method

The power adapter is in the rated load working state, according to 8 in GB/T 33014.2-2016. The performance of the power adapter, during and after the test, shall meet the requirements of 4.3.1 and 4.3.2.

### 4.4.3 Electrical transient conducted immunity along power lines

The power adapter is in the rated load working state, according to 5 in GB/T 21437.2-2008. It shall meet the requirements of Table 5 or Table 6, during the test; meet requirements of 4.3.1 and 4.3.2, after the test.

#### **4.4.4 Electromagnetic disturbance characteristics**

**4.4.4.1** When the power adapter is under rated load working state, it shall be carried out in accordance with 6.3 (voltage method) in GB/T 18655-2018; the limit value shall meet level 4.

**4.4.4.2** When the power adapter is under rated load working state, it shall be carried out according to 6.5 (ALSE method) in GB/T 18655-2018; the limit value shall meet level 4.

#### **4.4.5 Electrostatic discharge**

The power adapter is in the rated load working state and in the power-off state, according to the requirements in GB/T 19951. It shall meet the requirements of 4.3.1 and 4.3.2, during and after the test.

#### **4.5 Climatic performance**

##### **4.5.1 High temperature storage performance**

The power adapter shall be subjected to the high temperature storage test. It shall meet the requirements of 4.1.4, 4.3.1, 4.3.2, after the test.

##### **4.5.2 High temperature working performance**

The power adapter shall be subjected to the high temperature working test. It shall meet the requirements of 4.1.4, 4.3.1, 4.3.2, during and after the test.

##### **4.5.3 Low temperature storage performance**

The power adapter shall be subjected to the low temperature storage test. It shall meet the requirements of 4.1.4, 4.3.1, 4.3.2, after the test.

##### **4.5.4 Low temperature working performance**

The power adapter shall be subjected to the low temperature working test. It shall meet the requirements of 4.1.4, 4.3.1, 4.3.2, during and after the test.

##### **4.5.5 Resistance to temperature cycling**

The power adapter shall withstand the high and low temperature cycle performance test. It shall meet the requirements of 4.1.4, 4.3.1, 4.3.2, during and after the test.

##### **4.5.6 Resistance to cyclic damp heat**

The power adapter shall be subjected to the cyclic damp heat resistance test. It shall meet the requirements of 4.1.4, 4.3.1, 4.3.2, during and after the test.

## 5 Test methods

### 5.1 General requirements

#### 5.1.1 Test environmental conditions for the test

Unless otherwise specified, all tests are performed under the following conditions:

- Ambient temperature:  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ ;
- Relative humidity: 25% ~ 75%;
- Atmospheric pressure: 86 kPa ~ 106 kPa.

#### 5.1.2 Test voltage

When the test voltage of the power adapter is not specified, if the nominal voltage range  $U_N$  is 12 V, the test voltage  $U_A$  is  $14\text{ V} \pm 0.2\text{ V}$ ; if the nominal voltage  $U_N$  is 24 V, the test voltage  $U_A$  is  $28\text{ V} \pm 0.2\text{ V}$ .

#### 5.1.3 Test instruments and equipment

Test instruments and equipment are required to have sufficient resolution, accuracy, stability, to ensure that the error limit is within the allowable range of the item under test:

- a) The accuracy of the test voltmeter, ammeter, multimeter shall not be lower than level 0.5;
- b) The accuracy of the temperature measuring instrument shall not be lower than  $0.5\text{ }^{\circ}\text{C}$ ;
- c) The ripple coefficient of the DC stabilized power supply for the test shall not be greater than 0.1%;
- d) When the power adapter is tested, the simulated load is a DC electronic load, the power is more than 200 W, the number of channels is more than two;
- e) For all tests with load in this document, it shall add a wire harness, which has a voltage drop of not more than 50 mV under the condition of 1 A current, to the output end of the power adapter;
- f) Use a digital oscilloscope (minimum single-stroke sweep sampling frequency of 2 GHz/s, bandwidth of 400 MHz or more, input sensitivity of at least 5 mV/scale) for the test; record the test results.

#### 5.1.4 Appearance



The appearance and sign of the power adapter shall be checked visually.

### **5.1.5 Dimensions**

The external dimension of the power adapter is detected, by a general or special measuring tool.

## **5.2 Mechanical property test**

### **5.2.1 Insertion force**

Fix the power adapter on the fixture. Connect the mating plug rigidly to the dynamometer. Insert the mating plug into the USB socket of the power adapter, at a rate of not more than 12.5 mm/min, until it is fully inserted. Use a dynamometer, to make 10 measurements. The arithmetic mean of the maximum value in each test is the test value of insertion force.

### **5.2.2 Pull-out force**

After the mating plug is completely connected with the USB socket of the power adapter, pull out the mating plug from the USB socket of the power adapter, at a rate of not more than 12.5 mm/min. During this process, apply tension to the plug, until the plug is completely separated from the USB socket of the power adapter. Use a dynamometer, to make 10 measurements. The arithmetic mean of the maximum values, in each test, is the test value of pull-out force.

### **5.2.3 Plug-in/pull-out life**

Respectively fix the mating plug and the power adapter on the special equipment. Plug in/pull out the mating plug in/out of the USB socket of the power socket, for 10000 cycles, at the maximum rate of 200 cycles (one cycle is composed of 1 plug-in and 1 pull-out)/h.

### **5.2.4 Vibration performance test**

#### **5.2.4.1 Passenger car elastomer (body)**

It is carried out, in accordance with 4.1.2.4 of GB/T 28046.3-2011.

#### **5.2.4.2 Commercial vehicle elastomers**

It is carried out, in accordance with 4.1.2.7 of GB/T 28046.3-2011.

### **5.2.5 Free drop test**

When the power adapter is in a non-working state during the test, it shall be carried out, according to 4.3 of GB/T 28046.3-2011.

Note: The minimum discharge interval is 5 s.
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<sup>a</sup> See Appendix C for details.
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## **5.5 Climate performance test**

### **5.5.1 High-temperature storage performance test**

It is carried out, in accordance with 5.1.2.1 of GB/T 28046.4-2011.

### **5.5.2 High-temperature working performance test**

It is carried out, in accordance with 5.1.2.2 of GB/T 28046.4-2011.

### **5.5.3 Low-temperature storage performance test**

It is carried out, according to 5.1.1.1 of GB/T 28046.4-2011.

### **5.5.4 Low-temperature working performance test**

It is carried out, according to 5.1.1.2 of GB/T 28046.4-2011.

### **5.5.5 Test of resistance to temperature cycle**

It is carried out, in accordance with 5.3 of GB/T 28046.4-2011.

### **5.5.6 Test of resistance to cyclic damp heat**

It is carried out, according to 5.6 of GB/T 28046.4-2011.

### **5.5.7 Test of resistance to steady-state damp heat**

It is carried out, according to 5.7 of GB/T 28046.4-2011.

### **5.5.8 Salt spray resistance test**

It is carried out, according to 6 of GB/T 2423.17-2008.

## **5.6 Durability performance test**

Under the general test conditions, the power adapter works continuously for 800 h, under rated load.

### **5.7 Flame retardance test**

It is carried out, according to 8.2 and 9.2 of GB/T 2408-2008.

### **5.8 Degree of protection**

It is carried out, according to the relevant requirements in GB/T 30038.

commodity bar codes, etc. Items can also be added, according to the requirements of users.

**7.1.1.2** The nameplate of the product shall comply with the provisions of GB/T 13306 (except for special circumstances).

### **7.1.2 Packaging marks**

The basic contents of the packaging marks include:

- a) Product marking content related to delivery: product name and trademark, product model, specifications, applicable models;
- b) The name, detailed address, postal code, telephone number of the manufacturer;
- c) The production date (or serial number) or production batch number;
- d) The serial number of the implemented product standard (national standard, industry standard, local standard or registered enterprise standard);
- e) Graphical signs for packaging, storage, transportation (in compliance with the relevant provisions of GB/T 191);
- f) The text of the transportation operation: The volume (length x width x height) dimensions of the packing box; the quantity of the products in each box; the total mass of the products per box;
- g) The quality grade mark;
- h) Other marks, such as safety certification qualification marks, electromagnetic compatibility certification qualification marks, quality certification qualification marks, etc.

The above items g) and h) may not be marked, according to the specific conditions of the product, whilst the other items shall be marked.

## **7.2 Packaging**

**7.2.1** Considerations for product packaging:

- a) Requirements for moisture-proof, vibration-proof, dust-proof;
- b) Relevant requirements for adapting to transportation and loading and unloading;
- c) The mating parts of ferrous metal parts without protective layer of the product before packaging shall be provided with temporary anti-rust protection measures.

### **7.2.2** Packaging boxes

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Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

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