



# **Communication Industrial Standard of PRC**

**YD/T 1591-2006**

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## **Technical Requirement and Test Method of Charger and Interface for Mobile Telecommunication Terminal Equipment**

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## Foreword

This standard is prepared referring to the following standards:

1. GB4943-2001 Security of Information Technical Equipment
2. YD 1268.2-2003 Security Requirement and Test Method of Lithium Battery Charger for the Mobile Communication Terminal
3. GB9254 Wireless Interference Limit and Measure Method of Information Technical Equipment
4. GB17465.1 Housing and Similar Appliance Coupler Part I: Universal Requirement
5. GB 17625.1 Magnetic Compatibility Limit Emission Limit for Harmonic Current
6. GB 17625.2 Magnetic Compatibility Limit Limit for the Voltage Fluctuation Generated by the Equipment with the Rated Current Less than 16A in the Low-Voltage Supply System.

When the charger simultaneously works with the mobile communication terminal, its magnetic compatibility feature should respectively meet the magnetic compatibility requirement of the mobile communication terminal in different modes. Meanwhile, during the preparing process of the standard, it also refers to the electric feature and mechanical structure of “universal serial bus specification (version 2.0)” interface.

With the development of the technology, the related standards will be continually prepared. After this standard is issued, we will conduct researches on the technical requirement and test methods of the equipment such as on-board DC charger and plan to supplement the corresponding parts as the supplementary documents of this standard if necessary.

This standard is proposed and managed by China Communication Standardization association.

Drafted by: Telecom Research Institute of Ministry of Information and Industry

Konka Group Co., Ltd

Key drafters: Liu Jun, Men Meng, Yuan Weijun, Yuan Yuan, Zhang Xia, He Guili, Li Hongtao, Du Yong

## Introduction

This standard is prepared to guarantee the security of the product and availability, meanwhile, it enables the mobile communication terminals with different types to use the charger having the same specification to reduce the electronic waste, protect the environment, save resource and reduce the use cost of the mobile communication terminal through the uniform interface mode and technical requirement.

Considering the requirement for the data exchange between the mobile communication terminal and peripheral equipment and sharing possibility of the charging cable, this standard refers to the A series interface specification of the Universal Serial Bus (USB) to improve the application efficiency and convenience of the related components.

Considering the individual development of the mobile communication terminal, this standard regulates the uniform connection interface and sets it on the charger side, and the connection interface on the mobile communication terminal side is identified by the designer and manufacturer of the products.



# Technical Requirement and Test Method of Charger and Interface for The Mobile Communication Terminal

## 1 Scope

This standard regulates the technical requirement and test method of charger and interface of the mobile communication terminal (hereafter called as the “terminal”), including the physical feature, electric feature, security feature, magnetic compatibility and environment adaptability of the AC charger and interface.

This standard is applicable to the interface of the terminal charger, AC charger and connection cable.

## 2 Specification reference document

The articles in the following document become the articles of this standard through the reference of this reference. For any reference document with the date, its subsequent modified contents (not including corrected content) or revision versions are not applicable to this standard, however, it is encouraged that all parties reaching this agreement on this standard study whether the latest versions of these documents can be used. For any reference files without the date, its latest version is not applicable to this standard.

GB 2099.1-1996	Housing and Similar Plug and Socket Part I: Universal Requirement
GB 4943-2001	Security of Information Technical Equipment
GB 5023.5-1997	Insulation Cable Polythene below the Rated Voltage 450/750V Part V: Software Cable (chord)
GB9254	Wireless Interference Limit and Measure Method of the Information Technology Equipment
GB 17465.1-1998	Housing and Similar Appliance Coupler Part I Universal Requirement
GB 17625.1	Magnetic compatibility Limit Emission Limit for Harmonic Wave Current
GB 17625.2	Magnetic compatibility Limit Limit for the Voltage Fluctuation and Flickering Generated by the Equipment with the Rated Current less than 16A in the Low-Voltage Supply System
GB/T 17626.2	Magnetic Compatibility Test and Measure Technology Anti-Interference Test for Static Discharging
GB/T 17626.4	Magnetic Compatibility Test and Measure Technology Anti-Interference Test for Electric Quick and Instantaneous Pulse Cluster
GB/T 17626.5	Magnetic Compatibility Test and Measure Technology Surge (impact) Anti-Interference Test
YD 1268.2-2003	Security Requirement and Test Method of the Lithium Charger for the Mobile Communication Terminal

ISO 7637-2:2004 Vehicle Electric Interference of Conduction and Coupling Part II:  
Instantaneous Conduction along the Line

### 3 Definitions and abbreviations

The following definitions and abbreviation are proper for the standard.

#### 3.1 Definition

##### 3.1.1 Connection plug

The connection cable terminal and connection plug with the charger

##### 3.1.2 Connection socket-outlet

The socket of the charger with the connection cable

##### 3.1.3 Direct plug-in charger

The AC power plug and shell of the charger are composed of a whole and its weight is supported by the socket on the wall.

##### 3.1.4 Class II equipment

The shock-resistance not only protects the basic insulation, but also adopts the equipment with the attached security protection measure. This type of equipment does not depend on the protection grounding and protection measure of the installation environment.

##### 3.1.5 Class V-0 material

Tested by the GB 4943-2001 appendix A, this material can combust or scorch, but the average duration does not exceed 5s, the released scorching particle or combustion drop upon combustion does not lead to the combustion of the absorbent cotton.

##### 3.1.6 Class V-1 material

Tested by the GB 4943-2001 appendix A, this material can combust or scorch, but the average duration does not exceed 25s, the released scorching particle or combustion drop upon combustion does not lead to the combustion of the absorbent cotton.

##### 3.1.7 Connection mode with AC power

###### 3.1.7.1 Detachable power supply cord

The cord using the proper appliance connection to connect with the charger and used for power supply

###### 3.1.7.2 Non-detachable power supply cord

The cord fixed on the charger or installed with the charger for power supply

###### 3.1.7.3 The side of mobile telecommunication terminal

Generally it indicates the mobile communication terminal connection cable and plug connected to the DC output plug of the charger

###### 3.1.7.4 The side of charger

Generally it indicates the plug connecting with the charger and DC output.

#### 3.2 Abbreviation

USB universal serial bus

PVC polyvinyl chloride

VBus voltage bus

GND ground

AWG American wire gauge

STC stranded Tin copper

## 4 Technical requirement

### 4.1 Connection structure

The interface of the terminal and charger involved in this standard is set on the charger side and is defined by the mechanical fitting between the plug and socket and electric performance; the charger is connected to the terminal on another side through the connection cable to realize the charger function. The interface between the terminal and connection cable is designed by the designer, as shown in the figure 1 and figure 2.

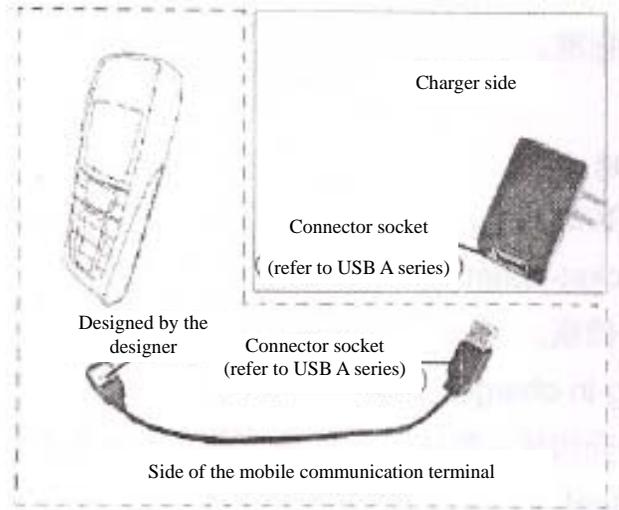


Figure 1 Illustration I for connection structure

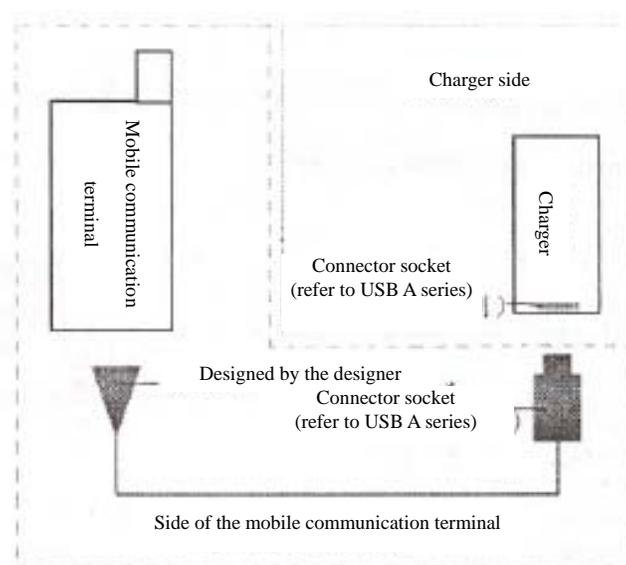
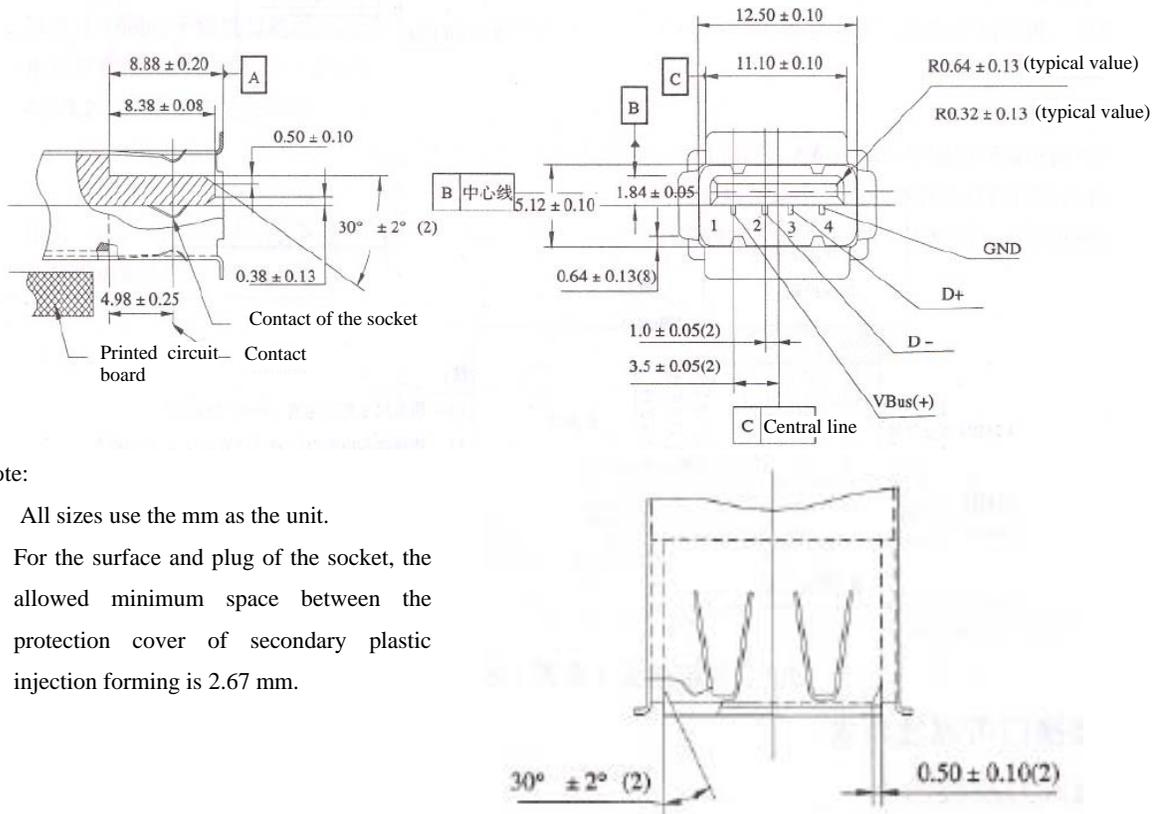


Figure 2 Illustration II for connection structure

### 4.2 Connection interface

#### 4.2.1 Mechanical structure of the connection interface

The connection interface adopts the connection plug and socket of the universal serial bus interface shown in the figure 3 and figure 4 (refer to USB A series).



Note:

- 1) All sizes use the mm as the unit.
- 2) For the surface and plug of the socket, the allowed minimum space between the protection cover of secondary plastic injection forming is 2.67 mm.

Figure 3 Structure and size of the connection plug (USA A series)

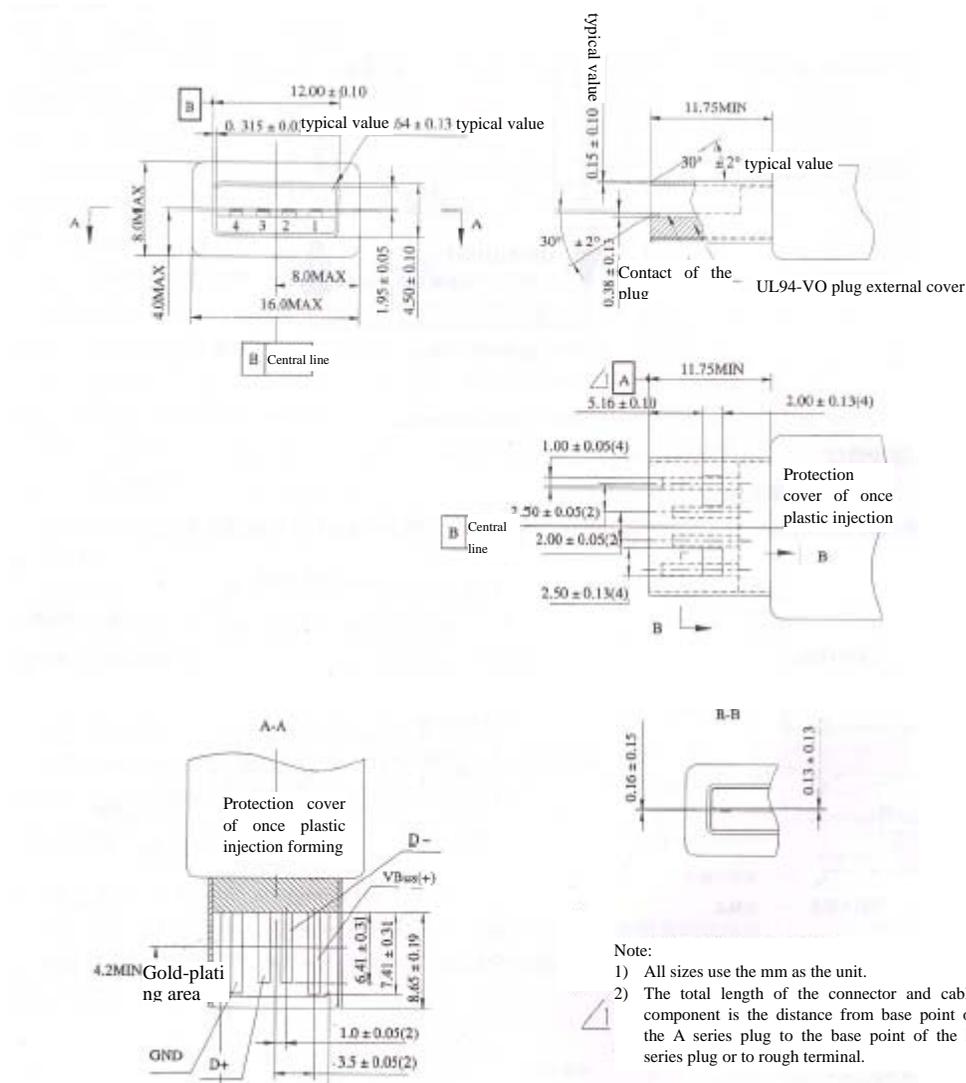


Figure 4 Structure and size of the connection plug (refer to USB A series) II

#### 4.2.2 Reliability requirement of the connection interface

##### 4.2.2.1 Insertion force and pulling force

The plugging is allowed between the plug and socket, when the speed of the plug does not exceed 12.5 mm/min, maximum force for inserting fully the plug into the socket can not exceed 35N and the required force for pulling the plug from the socket can not be less than 10N.

##### 4.2.2.2 Plug lifetime

Plug in/plug out for 15000 periods at the maximum speed during the 200 periods of one hour, after the plugging ends, the mechanical structure should not be damaged. The required minimum force for pulling the connection plug out from the socket is not less than 8N, the electric performance should meet the requirement in the 4.2.3.

#### 4.2.3 Electric performance of the connection interface

##### 4.2.3.1 Electric performance requirement of the connection interface on the terminal side

(1) The DC input voltage of the terminal charging interface is 5V(1±5%): maximum

absorption current is 1800mA. Regardless of the input power of the charger, the charging control circuit on the terminal side should be securely charged according to self requirement and the phenomena such as the over heating, combustion, explosion and other circuit damage should not occur.

- (2) The charging control circuit on the terminal side should include the voltage limit protection set. when the charging interface of the terminal is imported by over 6V voltage, if the secure charging can not be guaranteed, the charging control circuit on the terminal side should securely charge according to self requirement, the phenomena such as the over heating, combustion, explosion and other circuit damage should not occur.
- (3) When the connecting power supply set is not standard regulated charger (such as the built-in USB A series interface of the computer or portable computer).
- (4) Considering that absorption current's security to the power supply set when the terminal is charging which has been produced and sold before this standard is implemented, the designer should carefully consider whether the sold terminals meet the secure charging measure regulated in the standard, when this standard is adopted, the physical design of the interface between the terminal and connection cable different from old design should be used, or the connection cable should be installed by the recognition and current limit set to prevent the user from risk generated upon mistaken operation.

#### 4.2.3.2 Interface requirement of the charger side

- (1) USB (refer to USB A series) on the charger side is shown as the figure 5, where VBus is the anode pole of the output DC power, GND is the output DC power's cathode pole (ground). D+ and D- should be short-circuit and does not connect to any part of the charger inside the charger. As a specific connection, it can enable to the terminal to recognize that the connected USB (refer to USB A series) is charger set defined in this standard.

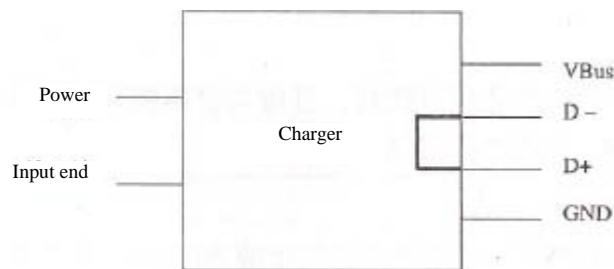


Figure 5 Short circuit from D+ to D- in the charger

- (2) Outputted voltage of the charger is 5V; the output current range is 300-1800mA. The charger product should mark the detailed rated output voltage and current.

#### 4.2.3.3 Insulation resistance

The insulation resistance of the connection interface should not be lower than 1000MΩ.

#### 4.2.3.4 Voltage resistance of the insulation material

The insulation material of the connection interface should support the valid 500V AC voltage, the duration is 1 min voltage resistance test, no penetration, flame or flashing arc

occur. The current leakage should not exceed 0.5mA. It should bear the instantaneous voltage caused by the switch, surge and similar phenomena.

#### 4.2.3.5 Contact resistance of the low level

Test the contact resistance of one pair of connection contact, the test requires that the insulation film (if any) should not destroy and lead to the surface fusion; when the one pair of connection contacts are open, and the test value is under maximum 20mV and 100mA, the maximum value of the resistance is 30mΩ.

#### 4.2.3.6 Contact capacitance

For the capacitance between the conduction parts of the connection interface, maximum capacitance value between each unconnected contact should not exceed 2pF.

#### 4.2.4 Combustion resistance of the connection interface

The insulation material of the connection interface should reach V-0 level or higher level.

### 4.3 Connection cable

- 1) The connection cable should meet the structure requirement shown as the figure 6 when it is used for the data transmission and charging (same to the USB A series connection cable). The connection cable consists of the 4 leads, in which two leads are used for the power lead (VBus is the anode pole of the power, GND is the cathode pole), in addition, two (D+ and D-) leads are the signal leads.
- 2) The length of the connection cable is 50-200cm.

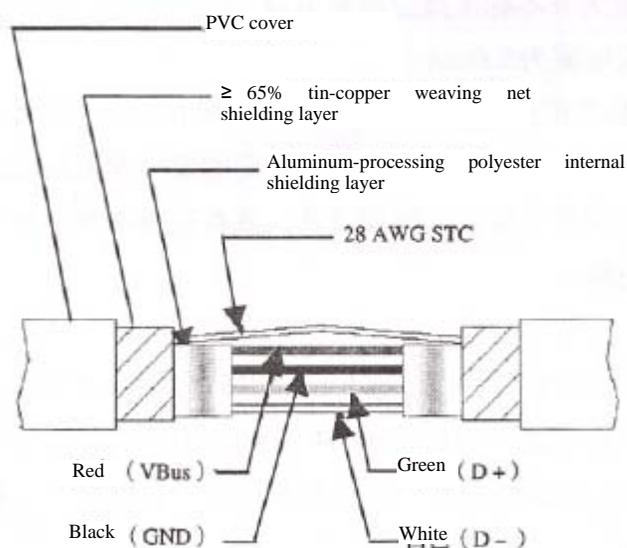


Figure 6 Structure of connection cable

#### 4.3.1 PVC coat of the connection cable

PVC coat should enclose the fully shielded power and signal line pair and should be directly connected to the external shielding of the tin and copper-plating lead. The thickness of the rated insulation should be 0.64mm, the external diameter of the rated cable should be 4.06 mm.

#### 4.3.2 Lead requirement of the connection cable

The insulation material of the lead should be semi-rigid PVC; the thickness of the rated insulation layer should be 0.25 mm, the typical power line (VBus) should be red insulation line, the typical GND line should be black insulation line, the external diameter of the

rated lead is 0.406mm.

**4.3.3 Electric performance requirement of the connection cable**

The maximum resistance of the lead of the connection cable should be not exceed 0.232Ω /m.

**4.3.4 Combustion resistance of the connection cable**

The combustion resistance of the insulation material of the connection cable should reach V-0 level or higher level.

**4.3.5 Recognition of the power supply set**

When the terminal detects that the D+ and D- of the interface of the connected power supply set is under short circuit state, it indicates that the connected set is the charger defined by this standard. However, it indicates that the connected unit does not belong to the charger defined by this standard, under this case, the terminal side should start the current limit measure, and the absorption current should not exceed 500mA.

**4.4 Requirement for the charger**

**4.4.1 Plug and socket on the side of input and output**

The input plug of the AC charger should meet the related requirement of the GB2099.1-1996. If the input end of the charger is the removable power cord, it should meet the requirement of the GB 5023.5-1997 and GB 17465.1-1998. The output socket should meet the requirement in the section 4.2 of this standard.

**4.4.2 Adaptation scope of the input voltage**

The adaptable scope of the input rated AC voltage of the AC charger should be 100-240V, the capacitance different is ±10%. Under the normal load condition and within the +10%--10% range of the rated voltage, its stable input current should not exceed the 1.1 times of the rated current and can normally operate.

**4.4.3 Adaptable range of the input frequency**

The AC charger should be adaptable to power condition of the 50/60 Hz input rated frequency. Under the normal load condition and within the +10%--10% range of the rated voltage, its stable input current should not exceed the 1.1 times of the rated current and can normally operate.

**4.4.4 Output voltage**

The rated output voltage of the charger should be DC 5V and the capacitance different is ±5%.

**4.4.5 Output current**

The range of the rated output current of the charger should be 300-1800mA.

**4.4.6 Relation between the features of the output voltage and output current (rated current is 800mA)**

The corresponding relation between the output voltage and output current of the charger meets the requirement of the figure 1 and figure 7.

Table 1 Corresponding relation between the output voltage and output current (rated current is 800mA)

Output voltage	Output current
----------------	----------------

5.25V	0-800Ma
5.00V	0-800
4.75v	500-800
1.00V	500-800
Short circuit	500-950

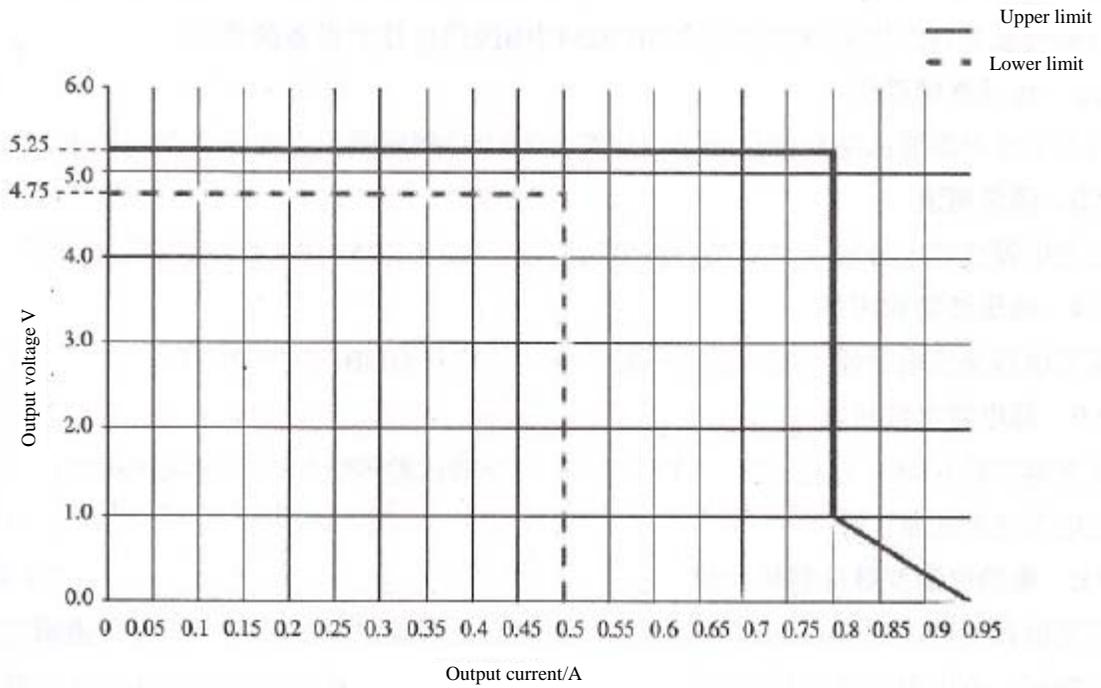


Figure 7 Feature curve of the output voltage and output current of the charger (rated current is 800mA)

**4.4.7 Output wave**

**4.4.7.1 Output current wave**

Input voltage	Simulate voltage range of the load	Output wave limit
90-264V	1.50-4.75V	≤100mA peak value

**4.4.7.2 Output voltage wave**

Input voltage	Simulate voltage range of the load	Output wave limit
90-264V	1.50-4.75V	≤100mA peak value

**4.4.8 Short circuit current**

Input voltage	load	Short circuit current limit
90-264V	Short circuit	<950Ma

**4.4.9 Back current**

Under any case, no matter whether the charger is plugged in the power, the current from

the terminal side to the charger should not exceed 5mA.

#### 4.4.10 Energy consumption without load

Input voltage	Load	Power consumption limit
90-264V	Open circuit	<300Mw

#### 4.4.11 Average power of the charger

The average power of the charger should be less than 50%.

#### 4.4.12 Requirement for output capacitance

The output capacitance range of the charger is recommended to be 150-680  $\mu$ F.

#### 4.4.13 Requirement for magnetic compatibility

##### 4.4.13.1 Requirement for magnetic compatibility under the charging mode of the terminal

When the terminal is under the charging mode, it should meet the corresponding requirement of the magnetic compatibility standard.

##### 4.4.13.2 Magnetic compatibility requirement for the charger

###### 4.4.13.2.1 Continued emission interference

The emission interference of the charger shell port should meet the requirement of the class B information technical equipment in GB 9254.

###### 4.4.13.2.2 Continued conduction interference

The conduction interference of the AC power input port of the charger should meet the requirement of the class B information technical equipment in GB 9254.

###### 4.4.13.2.3 Harmonic wave current

The harmonic wave current of AC power input port of the AC charger should meet the limit requirement for class A equipment in GB 17625.1.

###### 4.4.13.2.4 Voltage fluctuation and flickering

The voltage fluctuation and flickering of the AC power input port of the AC charger should meet the requirement of GB 17625.2.

###### 4.4.13.2.5 Interference-resistance of the static discharging

The shell port of the AC charger should pass the static discharging anti-interference test under the test grade regulated in 5.4.13.2.5. During the test period and after test, the charger should be able to normally operate.

###### 4.4.13.2.6 Anti-interference of current fast instantaneous pulse cluster

The shell port of the AC charger should pass the anti-interference test of current fast instantaneous pulse cluster under the test grade regulated in 5.4.13.2.6. During the test, the charger should keep normal operation, and the level of current fast instantaneous pulse cluster leaked at the output port of the charger DC power should be less than the 10% of the test level of AC input port. After test, the charger should be able to normally operate.

###### 4.4.13.2.7 Surge (impact) anti-interference

The AC power input port of the AC charger should pass the surge (impact) anti-interference test under the test grade regulated in 5.4.13.2.7. During the test and after test, the charger should be able to normally operate.

#### 4.4.14 requirement for the charger security performance

##### 4.4.14.1 Mechanical intensity

The mechanical intensity of the AC charger should meet the related requirement in GB

4943-2001.

**4.4.14.2 Structure security**

The structure security of the AC charger should meet the related requirement in GB 4943-2201.

**4.4.14.4 Anti-electric intensity**

The first circuit of the AC charger to the second circuit should be able to bear 50Hz or 60Hz, 3000V AC voltage or 4242 DC voltage, the duration is 1 min and no penetration or flying arc occur.

**4.4.14.5 Contact current**

The contact current of the AC charger from AC power to the terminal through the charger can not exceed 0.25mA.

**4.4.14.6 Shock and energy risk**

The AC charger should meet the requirement in the related articles in YD 1268.2-2003.

**4.4.14.7 Connection cable**

The AC charger should meet the requirement in the related articles in YD 1268.2-2003.

**4.4.14.8 Temperature increase of the shell surface**

The AC charger should meet the requirement in the related articles in YD 1268.2-2003.

**4.4.14.9 Short circuit protection of the connection socket**

The AC charger should meet the requirement in the standard 4.4.8 and can protect self for the short circuit; when the failure is eliminated, it should be able to recover the normal operation.

**4.4.14.10 Requirement for abnormal operation and failure condition**

The AC charger should meet the requirement in the related articles in YD 1268.2-2003.

**4.4.14.11 Shell combustion resistance**

The AC charger requires that the combustion resistance grade of the insulation material reach the class V-1 or higher class.

**4.4.15 Capability requirement for environment adaptability**

**4.4.15.1 Low temperature**

**4.4.15.1.1 Low temperature storage**

The AC charger is stored for 16h under the  $(-40\pm 3)^{\circ}\text{C}$ , After it is recovered under the normal gas pressure condition, the mechanical structure is not damaged, the electric performance should meet the requirement of 4.4.4, 4.4.5, 4.4.7 and 4.4.14.4.

**4.4.15.1.5 low-temperature operation**

After the AC charger is tested for 2 h under the operation state  $(-10\pm 3)^{\circ}\text{C}$ , the electric performance should meet the requirement in 4.4.4, 4.4.5 and 4.4.7.

**4.4.15.2 High temperature**

**4.4.15.2.1 High temperature storage**

After the AC charger is stored for 16 h under the  $(70\pm 3)^{\circ}\text{C}$  and is recovered under the normal air pressure, the mechanical structure should not be damaged, the electric performance should meet the requirement in 4.4.4, 4.4.5, 4.4.7 and 4.4.14.4.

**4.4.15.2.2 High temperature operation**

After the AC charger is stored for 2h under the  $(40\pm 3)^{\circ}\text{C}$ , the electric performance should meet the requirement in 4.4.4, 4.4.5 and 4.4.7.

**4.4.15.3 Humidity heat**

After the AC charger passes the environment test of  $(40\pm 2)^{\circ}\text{C}$  and relative humidity  $93\pm 2\% -3\%$ , the mechanical structure should not be damaged, the electric performance should meet the requirement in 4.4.4, 4.4.5, 4.4.7 and 4.4.14.4.

**4.4.15.4 Vibration**

After the AC charger passes the frequency 10-55Hz placement and 0.35 scanning frequency and vibration, the mechanical structure should not be damaged, the electric performance should meet the requirement in 4.4.4, 4.4.5, 4.4.7 and 4.4.14.4.

**4.4.15.6 Falling**

After the AC charger falls to the concrete surface from the  $(10\pm 0.10)$ m height, except for the surface erosion, the mechanical structure should not be loosened or damaged, it should be able to normally operate.

**4.4.16 Identification requirement****4.4.16.1 Nameplate flag**

The nameplate of the AC charger should include the following contents:

Input and output rated voltage value	V (unit)
Input and output rated current value	mA or A (unit)
Rated frequency of AC charger	Hz (unit)
The power nature should meet (only for DC)	-----
Manufacturer name or trademark or mark	
Type regulated by the manufacturer	
“Back” character, only proper for class II equipment	

**4.4.16.2 Endurance of nameplate**

The AC charger nameplate be durable and remarkable, and should meet the related requirement in the GB 4943-2001.

**5 Test method****5.1 Test requirement**

The test point on the terminal side should be measured at the connection plug position and should connect the connection cable reliably to the terminal.

**5.2 Test of the connection interface****5.2.1 Mechanical structure test of the connection interface**

Measure whether the mechanical structure of the plug and socket meets the requirement through the measure which precision is not less than 0.005mm.

**5.2.2 Reliability test of the connection interface****5.2.2.1 Test for plug-in force and plug-out force**

Fix the plug on the clamp, and the plug is connected to the force meter in rigid manner. The plug should be inserted into the socket at the speed not less than 12.5mm/min till it is fully inserted, the test should be repeated for 5 times, the average of the maximum values in each test is the test result of the plug-in force. After the plug is fully connected to the socket, give the pulling force on the plug and gradually increase the pulling on the plug till the plug is separated from the socket, the test should be repeated for 5 times, the average of the maximum value in each test is the test result for the plug-out force.

**5.2.2.2 Test for plug lifetime**

Respectively fix the plug and socket on the special equipment repeatedly, the frequency should not exceed 200 periods in one hour, total 1500 periods of plug are implemented, after the plugging terminates, it is tested by using the test method regulated in 5.2.2.1 and 5.2.3.

**5.2.4 Electric performance test of the connection interface****5.2.3.1 Electric performance test of connection interface on the terminal side**

During test, the tested terminal is under the maximum charging load condition.

- (1) Check the charging voltage and current mark or explanation of the terminal; the simulated charger power set and amperemeter which rated voltage is 5 V and maximum output power is 10W, and power changes with the load are connected to the terminal for 20 min, observe the maximum absorption current of the terminal, meanwhile, observe whether the phenomena such as over heat, combustion, explosion and other circuit damages occur and whether the terminal can normally operate.
- (2) Use the adjustable and constant-voltage simulation charger and amperemeter to connect to the terminal, the adjustable value is from 4V to the design value of the secure protection voltage of the product. Observe whether the protection set has action and voltage value upon action, and next stop at the designed value of the secure protection voltage of the product for 60min, meanwhile, the surface temperature of the terminal is monitored and observe whether the phenomena the overheat, combustion, explosion and other circuit damage occur, and whether the terminal can normally operate.
- (3) Use the simulation set and amperemeter meeting USB specification (USB A series) to connect to the terminal, observe and measure the charging absorption current of the terminal.
- (4) Check the related flag or explanation of the terminal.

#### **5.2.3.2 Interface test of the charger**

- (1) Check whether the anode and cathode of the interface on the charger side is correct, check whether D+ and D- is short circuit and test whether the D+ or D- and VBus line, ground line and other charger circuits are insulated.
- (2) Check whether the related normal voltage and current marked by the charger is correct

#### **5.2.3.3 Test for the insulation resistance**

Respectively use the DC 500V and 1000V test voltage to measure insulation resistance of each insulation layer.

The insulation resistance should be measured between the nearest contacts, and between the plug and socket shell, or between bottom plate and nearest contact. Under each case, it is tested for 6 times (3 adjacent contacts and/or 3 contacts connecting to the shell and/or 3 contacts connecting to the bottom plate), the resistance takes the value of the minimum limit or the larger part of the 10% of all contacts. When the insulation resistance is tested, each time same contact area of a given plug and socket should be used.

The test duration is 1 min, the minimum value in the test is recorded as the test result. When the current condition has influences on the insulation feature of the insulation resistance, the insulation test should be instantly tested within 2 min after the current is released.

#### **5.2.3.4 Voltage endurance test of the insulation material**

The test voltage increases from 0 to 500V at the 500V/s speed and the keep 1 min at this voltage.

- a) The test voltage should be imposed between the nearest interval contacts or contact

between the shell of the plug and socket and nearest shell.

- b) The test voltage should be imposed between the adjacent contacts.
- c) The test voltage should be imposed on each contact alternately, all other contacts and shell should be connected together.

During the voltage endurance test, the error and current leakage indicator should be monitored as the evidence of the cracking discharging and current leakage. The tested sample should be checked and measured to identify the effect of the voltage endurance of the current media under the special work feature, observe whether the phenomena the penetration, flame and flying arc occur, whether the leaked current exceeds 0.5mA.

#### **5.2.3.5 Contact resistance test of the low level**

Use a 4-line micro-ohm meter. This micro-ohm meter should adopt a method to correct the thermal current magnetic field. This test method includes the AC, pulse DC or current return. Generally the integrated micro-ohm meter measures the practical test current and voltage drop of the tested sample. The measured resistance is computed internally and displayed.

#### **5.2.3.6 Test for the contact capacitance**

The capacitance should be tested under the following configuration at the defined frequency.

The lowest impedance path is used to connect to the ground between one contact and the ground including the following several parts.

- All other contacts;
- All metal part
- Bottom plate

The following part will be connected to the ground at a common point between two any adjacent contacts:

- All other contacts
- All metal part
- Bottom plate

#### **5.2.4 Combustion test of the connection interface**

Test in accordance with the method in the appendix A of GB 4943-2001.

#### **5.3 Test of the connection cable**

- (1) Check whether the ranking sequence of the contacts at both ends of the connection cable is correct.
- (2) Adopt the length measure tool to measure the length of the connection cable.

##### **5.3.1 PVC coat test of the connection cable**

Adopt the length measure tool and special measure to test whether the mechanical structure of the connection cable meet the requirement.

##### **5.3.2 Test of the connection cable**

Adopt the length measure tool and special measure to test whether the mechanical structure of the connection cable meet the requirement.

##### **5.3.3 Electric performance test of the connection cable**

Use the impedance analyzer or resistance meter to respectively measure the resistance between each corresponding end of the connection cable.

**5.3.4 Combustion test of the connection cable**

Test in accordance with the method in the appendix A of GB 4943-2001.

**5.3.5 Recognition test of the power supply set**

Connect the set and amperemeter which output voltage is 5V and output current is higher than 500mA and meet the USB A series interface specification with the terminal to observe the value of the absorption current.

Connect the charger and amperemeter which output voltage is 5V and output current is higher than 500mA to observe the value of the absorption current.

**5.4 Test of the charger****5.4.1 Test for the plug and socket at the input and output end**

Check whether the plug and socket at the input and output end meet.

**5.4.2 Test of adaptable range of the input voltage**

Under the normal load condition of the tested equipment, test the equipment when the input voltage is within +10%--10% range of the rated voltage.

If the equipment has a rated voltage, the input current should be tested at this rated voltage.

If the equipment has a rated voltage range, the input current should be tested at any end voltage within the rated voltage range.

The higher input current measured within the related voltage range should be used for judgement.

Under each case, read when the input current keeps stable.

**5.4.3 Test of the adaptation range of the input frequency**

Under the normal load condition of the tested equipment, test the equipment when the input voltage is within +10%--10% range of the rated voltage.

If the equipment has two frequencies, the input is tested at two frequencies.

The higher input current measured within the related voltage range should be used for judgement.

Under each case, read when the input current keeps stable.

**5.4.4 Test of output voltage**

Connect the simulated load with the tested charger, adjust the impedance of the simulated load and monitor the output voltage.

**5.4.5 Test of the output current**

Connect the simulated load with the tested charger, adjust the impedance of the simulated load and monitor the output voltage.

**5.4.6 Test of the feature relation of the output voltage and output current**

Connect the simulated load with the tested charger, adjust the impedance of the simulated load and monitor the output voltage and output current.

**5.4.7 Test of the output wave**

Input the voltage regulated in the 4.4.7 at the input end of the tested charger, the input end is connected to the simulated load, adjust the simulated load, use the oscillograph to measure the output wave of the tested charger and record the maximum peak value.

**5.4.8 Test of the short circuit current**

Adjust simulated load resistance of the charger to 0Ω, meanwhile, monitor the loop current

and record it.

**5.4.9 Test of the back current**

Continually adjust the simulated power from 0V to 5V and monitor the stable current to the charger. Notice that when the power supply is adjusted, the power energy caused by the output end capacitance of the flow-in or flow-out charger can not be calculated as the stable current. The test method is shown as the figure 8.

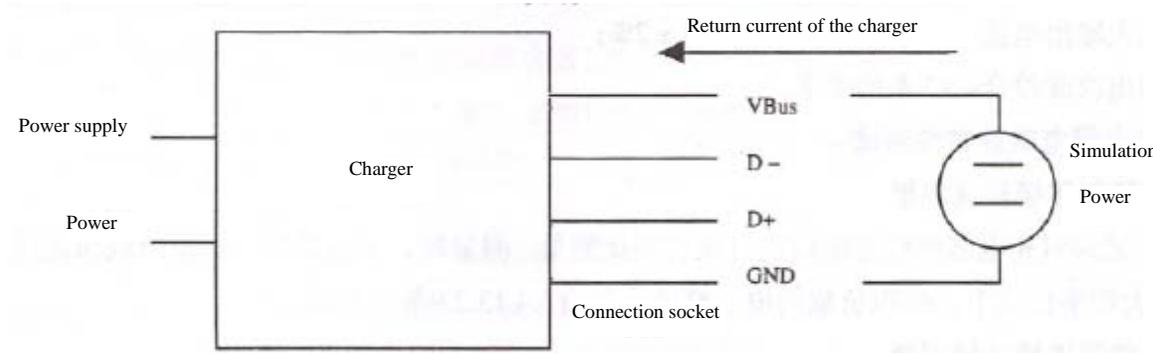


Figure 8 Connection of the back current test

**5.4.10 Test of non-load energy consumption**

Use the power meter to measure the power and record when the charger is under the non load state.

**5.4.11 Test of the average charger power**

Under the testing condition of the heated machine, the input voltage is set as 220V, adjust the simulated load to respectively test the charger efficiency when the load current is respectively under 100%, 75%, 50% and 25% of the rated output current, next takes their average value.

$$\text{Efficiency} = \text{DC output efficiency} / \text{AC input active power} = U_o I_o / P_i \times 100\%$$

In this equation:

U<sub>o</sub>: load voltage (V)

I<sub>o</sub>: load current (A)

P<sub>i</sub>: the AC input active power of the current-adjusting equipment(W), the active power is the visual power is multiplied by the power factor. The input voltage is multiplied by the input current to get the visual power. The power meter can read the power factor, or directly read the input power.

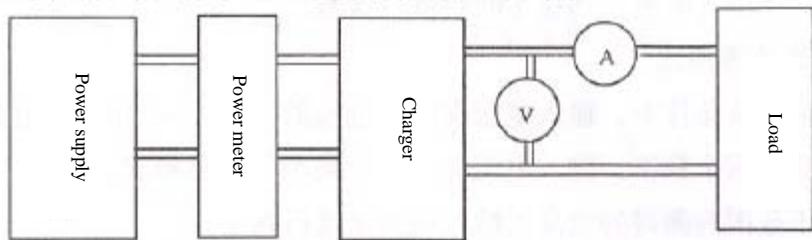


Figure 9 Test connection of the average charger power

**5.4.12 Test of the output capacitance**

The test of the output capacitance is considered when the charger designer designs it.

**5.4.13 Test of magnetic compatibility**

**5.4.13.1 Test for the magnetic compatibility under the charging mode on the terminal side**

**5.4.13.1.1 Introduction**

When the magnetic compatibility is tested under the charging mode on the terminal side, the auxiliary DC power should be used to charge the terminal side, the electric performance of the auxiliary DC power supply should meet the requirement in the article 5.4.13.1.2.

When the magnetic interference is tested, the DC power port on the terminal side should be connected to the auxiliary DC power through the manual power network, so it can avoid that the auxiliary DC power affects the measure results of the magnetic interference of the terminal. In accordance with the requirement in GB 9254, the proper power network should be selected.

When the anti-interference is tested, the DC power port of the terminal should be connected to the auxiliary DC power through the de-coupling network, so it can avoid that the auxiliary DC power affects the measure results of the anti-interference of the terminal. In accordance with test requirement for anti-interference, the proper de-coupling network should be selected.

#### **5.4.13.1.2 The electric performance of the auxiliary DC power**

The electric performance of the auxiliary DC power should meet the following requirements:

- (1) The output voltage should be 5V, the capacitance different  $\pm 2\%$
- (2) The maximum output current is not less than 2000Ma, the capacitance different  $\pm 2\%$ ;
- (3) The output ripple meets the requirement in the article 4.4.7.

#### **5.4.13.2 Test of the magnetic compatibility of the charger**

##### **5.4.13.2.1 Measure of the continual emission interference**

Measure the emission interference of the shell port of the charger in according with the standard GB 9254. Upon measure, the charger should be connected to the simulated load to make the charger operate under the maximum power mode. The electric performance of the simulated load should meet the requirement in the article 5.4.13.2.9.

##### **5.4.13.2.2 Measure of the continual conduction interference**

Measure the continual conduction interference of the power port of the charger in according with the standard GB 9254. Upon measure, the charger should be connected to the simulated load to make the charger operate under the maximum power mode. The electric performance of the simulated load should meet the requirement in the article 5.4.13.2.9.

##### **5.4.13.2.3 Measure of the harmonic wave**

Measure the harmonic wave current of the AC power input port of the charger in according with the standard GB 17625.1. Upon measure, the charger should be connected to the simulated load to make the charger operate under the maximum power mode. The electric performance of the simulated load should meet the requirement in the article 5.4.13.2.9.

##### **5.4.13.2.4 Measure of voltage fluctuation and flickering**

Measure the voltage fluctuation and flickering of the AC power input port of the

charger in according with the standard GB 17625.2. Upon measure, the charger should be connected to the simulated load to make the charger operate under the maximum power mode. The electric performance of the simulated load should meet the requirement in the article 5.4.13.2.9.

#### 5.4.13.2.5 Test of the static discharging anti-interference

Test the static discharging anti-interference on the shell port of the charger in accordance with the standard GB/T 17626.2.

The test class is:

- (1) test level of the contact discharging is  $\pm 2\text{kV}$  and  $\pm 4\text{kV}$ .
- (2) The test level of the air discharging is  $\pm 2\text{kV}$ ,  $\pm 4\text{kV}$  and  $\pm 8\text{kV}$ .

The charger should be tested under the following two modes:

- (1) Maximum power mode: the output port of the charger is connected to the simulated load under the maximum power mode, the electric performance of the simulated load should meet the requirement in 5.4.13.2.9.
- (2) Backup mode: the charger is not connected to the AC or DC power network and other loads.

#### 5.4.13.2.6 Test of the current fast instantaneous pulse cluster anti-interference

Test the current fast instantaneous pulse cluster anti-interference of the power input port of the AC charger in accordance with the GB/T 17626.4. The test level is 2kV. Upon test, the charger should be connected to the simulated load to make the charger operate under the maximum power mode. The electric performance of the simulated load should meet the requirement in the article 5.4.13.2.9.

Use the auxiliary monitoring equipment to measure the pulse cluster level of the DC output port of the charger.

#### 5.4.13.2.7 Test of surge (impact) anti-interference

Test the surge (impact) anti-interference of the power input port of the AC charger in accordance with the GB/T 17626.5.

The test class is:

- (1) The line-to-line test level is 1kV.
- (2) The line-to-ground test level should be 2kV
- (3) The test wave is 1.2/50 $\mu\text{s}$ .

Upon test, the charger should be connected to the simulated load to make the charger operate under the maximum power mode. The electric performance of the simulated load should meet the requirement in the article 5.4.13.2.9.

#### 5.4.13.2.8 Electric performance of the simulated load

The simulated load should be pure-resistance resistance, its electric parameters should meet the regulation in the table 2.

Table 2 Electric parameters of the simulated load

Rated output current of the charger	Resistance of the simulated load	Capacitance different of simulated load resistance	Rated power of the simulated load
-------------------------------------	----------------------------------	--	-----------------------------------

800Ma	6.25Ω	±10%	Not less than 10W
Other	Compute the resistance in accordance with the equation (1)	±10%	Not less than 10W

The resistance of the simulated load=rated output voltage of the charger/rated output current of the charger

#### **5.4.14 Test of the security performance of the charger**

##### **5.4.14.1 Test of the mechanical intensity**

###### **5.4.14.1.1 Test of the constant action**

Test in accordance with the testing method for the constant action test in the GB 4923-2001.

###### **5.4.14.1.2 test of the torque of the direct plug-in equipment**

Test in accordance with the testing method for the direct plug-in equipment in the GB 4923-2001.

##### **5.4.14.2 Structure test**

Test in accordance with the testing method regulated in the GB 4923-2001.

##### **5.4.14.3 Insulation resistance**

Test the insulation resistance in accordance with the testing method regulated in the GB 1268.2-2003.

##### **5.4.14.4 Anti-current intensity**

After the insulation resistance is tested in the article 5.4.14.3, test in accordance with the testing method regulated in the anti-current intensity of the GB 4923-2001.

##### **5.4.14.5 Contact current**

Test in accordance with the testing method regulated in the YD 1268.2-2003.

##### **5.4.14.6 Shock and energy risk**

Test in accordance with the testing method regulated in the YD 1268.2-2003.

##### **5.4.14.7 Connection layout**

Test in accordance with the testing method regulated in the YD 1268.2-2003.

##### **5.4.14.8 Test of the temperature increase of the shell surface**

Test in accordance with the testing method regulated in the YD 1268.2-2003.

##### **5.4.14.9 Test of the short-circuit protection of the connection socket**

The AC charger is under the maximum rated voltage and makes the power end and grounding end be short at the output port of the connection socket. Check whether the charge can protect itself. After the failure is eliminated, electrify again under the non-load state and check whether it can automatically recover to operation

##### **5.4.14.10 Test under the abnormal operation and failure condition**

Test in accordance with the testing method regulated in the YD 1268.2-2003.

##### **5.4.14.11 Test of the combustions resistance of the charger shell**

Test in accordance with the testing method regulated in the appendix A of the GB 4923-2001.

#### **5.4.5 Test of the environment adaptability**

##### **5.4.15.1 Low temperature**

**5.4.15.1.1 Low temperature storage**

The tested sample is placed into the low temperature test box without any packing. Start the temperature box, make the temperature inside the box gradually reduce to be  $-40^{\circ}\text{C}$  at the average speed less than  $1^{\circ}\text{C}/\text{min}$ , after the tested sample keeps the stable temperature for 16h, take out the tested sample and place it under the standard test condition for 2h, next make the test in the 5.4.4, 5.4.5, 5.4.7 and 5.4.14.4.

**5.4.15.1.2 Low temperature operation**

The tested sample is placed into the low temperature test box without any packing. Start the temperature box, make the temperature inside the box gradually reduce to be  $-10^{\circ}\text{C}$  at the average speed less than  $1^{\circ}\text{C}/\text{min}$ , keep this temperature till the tested sample reaches the stable temperature, the tested sample starts to operate, after 2 h, make the test in the 5.4.4, 5.4.5 and 5.4.7.

**5.4.15.2 High temperature****5.4.15.2.1 High temperature storage**

The tested sample is placed into the low temperature test box without any packing. Start the temperature box, make the temperature inside the box gradually increase to be  $70^{\circ}\text{C}$  at the average speed less than  $3^{\circ}\text{C}/\text{min}$ , after the tested sample keeps the stable temperature for 16h, take out the tested sample and place it under the standard test condition for 2h, next make the test in the 5.4.4, 5.4.5, 5.4.7 and 5.4.14.4.

**5.4.15.2.2 High temperature operation**

The tested sample is placed into the low temperature test box without any packing. Start the temperature box, make the temperature inside the box gradually increase to be  $-40^{\circ}\text{C}$  at the average speed less than  $3^{\circ}\text{C}/\text{min}$ , keep this temperature till the tested sample reaches the stable temperature, the tested sample starts to operate, after 2 h, make the test in the 5.4.4, 5.4.5 and 5.4.7.

**5.4.15.3 Humid heat**

The tested sample is placed into the test box without any packing, switch on the power of the humid heat box to make the temperature inside the box increase to be  $40^{\circ}\text{C}$ , next, increase the humidity and mix the air inside the box, when the temperature meets the requirement and the relative humidity is between 90% and 95%, keep it for 48 h, next make the test in the 5.4.4, 5.4.5, 5.4.7 and 5.4.14.4.

**5.4.15.4 Vibration**

The tested is fixed on the vibration table. Within the frequency 10Hz to 55Hz range, the amplitude is 0.35mm, scan for the 5 times along the three axis direction, the test time of each axis is 25 min, after the test ends, make the test in the 5.4.4, 5.4.5, 5.4.7 and 5.4.14.4.

**5.4.15.5 Impact**

The tested sample is fixed on the impact table without any packing, the sample should be installed according to the requirement in the GB/T 2423.43. the tested sample keeps semi-sine pulse for 18ms at the peak acceleration  $300\text{m}/\text{s}^2$ , impose the 3 times of the continual impacts along each direction of the 3 mutually vertical axis, namely total time is 18 times, after the test ends, make the test in the 5.4.4, 5.4.5, 5.4.7 and 5.4.14.4.

**5.4.15.6 Falling**

Place the tested sample at the plane with the height  $(1.0\pm 0.10)$  m without any packing and make freely fall to the concrete ground, fall for two times on each side, total 12 times are for 6 sides, after the test ends, observe the appearance and check the function.

**5.4.16 Mark test**

Test in accordance with the testing method regulated in the GB 4923-2001.