

AMPHENOL

HSBridge+ Series Products

超高速汽车 USB 系列产品



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Content 内容

1.0 OBJECTIVE 目的.....	2
2.0 SCOPE 范围.....	2
3.0 APPLICABLE DOCUMENTS 引用文件.....	2
3.1 APPLICATION 应用.....	3
3.2 REFERENCE STANDARDS 测试标准.....	3
3.3 OTHER STANDARDS AND SPECIFICATIONS 其他标准和规范.....	3
4.0 REQUIREMENTS 要求	
4.1 LAB CONDITIONS 实验室条件.....	4
4.2 MATERIAL 材料.....	4
4.3 FINISH 表面处理.....	4
4.4 MATING 配插.....	4
4.5 WORKMANSHIP 工艺.....	4
5.0 CHARACTERISTICS 特点.....	5
5.1 ELECTRICAL CHARACTERISTICS 电气特性.....	5
5.1.1 Current Rating 额定电流.....	5
5.1.2 Contact Resistance 接触阻抗.....	5
5.1.3 Voltage drop 电压降.....	5
5.1.4 Isolation Resistance 绝缘阻抗.....	6
5.1.5 Dielectric Withstanding Voltage 电耐压.....	6
5.2 MECHANICAL CHARACTERISTICS 机械测试.....	6
5.2.1 Connector-Connector Mating/Unmating/Retention 连接器与连接器的插拔力/保持力.....	6
5.2.2 Durability 耐久.....	7
5.2.3 Vibration/ Mechanical Shock 振动/机械冲击.....	7
5.2.4 Cable Retention force 线端保持力.....	7
5.2.5 Connector Drop test 连接器跌落测试.....	8
5.2.6 Connector to connector Audible Click 连接器至连接器可听见的卡塔响.....	8
5.2.7 Polarization Feature Effectiveness 极化特殊效果.....	8
5.3 ENVIRONMENTAL CHARACTERISTICS 环境测试.....	8
5.3.1 Thermal Shock 冷热冲击.....	8
5.3.2 Temperature/Humidity Cycling 温湿度循环.....	9
5.3.3 High Temperature Exposure 高温暴露.....	9
5.3.4 Resistance to Soldering Heat (PCB side connector)回流焊高温抗性(板端连接器).....	9
5.3.5 Solderability 可焊性.....	10
5.4 SI TEST 高频测试.....	10
5.4.1 SI Data(connector)针对连接器的高频测试.....	10
5.4.2 SI Data(cable assembly)针对线缆组件的高频测试.....	11
6.0 QUALITY ASSURANCE PROVISIONS质量保证条款.....	11
6.1 EQUIPMENT CALIBRATION 设备校准.....	12
6.2 INSPECTION CONDITION 检验条件.....	12
6.3 SAMPLE QUANTITY AND DESCRIPTION 样品数量和描述.....	12
6.4 ACCEPTANCE 验收.....	12

6.5 QUALIFICATION TESTING 合格性测试.....	13
6.6 RE-QUALIFICATION TESTING 重新鉴定测试.....	13
TABLE 1: QUALIFICATION TESTING SEQUENCES 表1：合格性测试顺序.....	14

1 OBJECTIVE 目的

This specification defines the performance, test, quality and reliability requirements of Amphenol HSBridge+ series products.

本规格书定义了超高速汽车 USB 连接器产品的性能、测试、质量以及可靠性要求。

2 SCOPE 范围

This Specification includes the Materials/Finishing, Mechanical Characteristics, Electrical Characteristics and Environmental requirements of Amphenol HSBridge+ series products.

本规范包括超高速汽车 USB 连接器产品的材料/表面处理、机械特性、电气特性和环境要求。

3 APPLICABLE DOCUMENTS 应用文件

3.1 Application应用

3.1.1 Engineering drawings 工程图纸

3.2 Reference Standards参考标准

3.2.1 SAE/USCAR-2: Performance Specification for Automotive Electrical Connector Systems

SAE/USCAR-2 汽车电气连接器系统性能规范

3.2.2 SAE/USCAR-30: Performance Specification for Automotive Universal Serial Bus (USB) Connection System

SAE/USCAR-30 汽车 USB 连接器系统性能规范

3.2.3 IEEE 100BASE-T1 Definitions for Communication Channel 高频测试规范

3.2.4 MIL-STD-202F: Test Methods for Electronic Components Parts 电子元件的测试方法

3.3 Other Standards and Specifications 其他标准和规范

3.4.1 Safety Requirements 安全要求:

Flammability class: UL94 V-0, 防火等级: UL94 V-0

UL-Recognized: ECBT2 (UL 1977) UL 认可: ECBT2 (UL 1977)

3.4.2 EIA-364: Electrical Connector/Socket Test Procedures Including Environmental Classifications 电气连接器测试程序包括环境分类

4 REQUIREMENTS 要求

4.1 Lab conditions 实验室条件

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein. Unless otherwise specified, all measurements shall be performed within the following lab conditions: 根据本规范连接器提供应以满足指定的资格测试需求,除非另有规定,所有测试应当执行以下的实验条件:

Temperature 温度 : 15 to 35°C

Relative Humidity 相对湿度 : 20% to 80%

Atmospheric Pressure 大气压力: 650mm to 800mm of Hg (86 ~106Kpa)

4.2 Material 材料

Material for each part shall be specified herein, or equivalent. Substitute material shall meet the performance requirements of this specification. 每个零件的材料应在此指定,或同等替代材料应符合本规范的性能要求。

4.2.1 HSBridge+ for automotive connector 超高速汽车 USB 连接器

Housing Material/Contact Material/ Shell Material 主体材料/端子材料/屏蔽壳材料:

For the basic material, refer to the latest engineering drawing. 基本材料参见最新工程图纸。

4.3 Finish 表面处理

Plated finished for qualification components shall be as specified here or equivalent.

合格部件的表面处理应依此规格书或同等条件下指定。

Plating: please refer to the latest engineering drawing.

电镀:请参照最新工程图纸。

4.4 Mating 配插

The connectors shall be capable of mating and un-mating manually without the use of special tools. 连接器应能够在不使用特殊工具的情况下手动进行插拔。

4.5 Workmanship 工艺

Connectors shall be uniform in quality and shall be free from burrs, scratches, cracks, voids, chips, blisters, pin holes, sharp edges, and other (specific reference value range AICC HSBridge+ appearance standard) defects that will adversely affect product's life or serviceability.

连接器在品质上应一致,无毛刺、划痕、裂纹、孔洞、碎屑、气泡、针孔、锐边和其他(特定的参考值范围依 AICC 超高速汽车 USB 连接器外观标准)会对产品寿命及适应性产生不利影响的缺陷。

5 CHARACTERISTICS 特点**5.1 ELECTRICAL CHARACTERISTICS 电气特性****5.1.1 Current Rating 额定电流**

Reference: USCAR-2, 5.3.4 参考 USCAR-2, 5.3.4

a) Current: 5.0 A For VBUS Pins A4, A9, B4, and B9;

1.25 A For VCONN pin (B5), terminated through the corresponding GND pins (pins A1, A12, B1, and B12);

A minimum current of 0.25 A for all the other contacts.

额定电流: 5 安培适用于 VBUS Pins A4, A9, B4, and B9;

1.25 安培适用于 VCONN pin (B5), terminated through the corresponding GND pins (pins A1, A12, B1, and B12);

最小 0.25 安培适用于所有其他 pins.

b) Acceptance criteria: the temperature of any terminal interface must not exceed a 55°C rise over ambient at any time during the test.

验收标准: 在试验期间, 任何接触位置的温度不得超过环境温度 55°C。

5.1.2 Contact Resistance 接触阻抗

Mated with applicable connector, the low level contact resistance is 40m ohm maximum initial when measured in accordance with SAE/USCAR-2 5.3.1, the contact resistance of after environmental exposure shall not exceed 15m ohm maximum angle from initial. (For contact resistance of male and female connectors only, excluding CABLE) Cable Resistance depends on the length of cable.

与适用的连接器匹配, 根据 SAE/USCAR-2 5.3.1 测量, 接触电阻为 40m 欧姆最大初始值。(仅针对公母头连接器对插接触电阻, 不包含 CABLE), 线材电阻取决于电缆的长度。

The following details shall apply 满足如下要求:

a) Test Voltage 测试电压: 25mV DC maximum at open circuit. 25 毫伏直流最大在开路下测试.

b) Test Current 测试电流: not to exceed 100mA. 不超过 100 毫安培。

5.1.3 Voltage drop 电压降

Reference: USCAR-2, 5.3.2 参考: USCAR-2, 5.3.2 进行测试

Acceptance criteria in accordance with USCAR-2, 5.3.2.4 maximum voltage drop: 50 mV

允收标准依照 USCAR-2, 5.3.2.4 最大电压降: 50 mV

5.1.4 Isolation Resistance 绝缘阻抗

Reference: USCAR-2, 5.5.1

参考 USCAR-2, 5.5.1 规范

The following details shall apply: 应满足如下要求:

- a) Test Voltage: 500V DC 测试电压: 500 伏直流电
- b) Acceptance criteria: the resistance between every combination of two adjacent terminals in the connection must exceed 100 M Ω at 500 VDC.

验收标准: 在 500 V 直流电下, 连接中两个相邻端子的每一个组合之间的电阻必须超过 100 M Ω 。

- c) Electrification Time 带电时间 : 1 minute. 1 分钟
- d) Point of Measurement 测试点: Between adjacent contacts. 相邻近的端子

5.1.5 Dielectric Withstanding Voltage 绝缘耐压

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (0.5mA max) when the mated connectors are tested in accordance with Customer. The following details shall apply: 与配插端配插进行测试时, 没有任何证据表明有电弧、绝缘损坏或过度泄漏电流 (0.5 毫安培最大)

- a) Test Voltage: 100V AC 测试电压: 100 伏交流电
- b) Test Duration: 1 minute. 测试持续时间: 1 分钟
- c) Points of measurement: Between adjacent contacts. 测试点: 相邻的端子
- d) Per EIA-364-20C 依 EIA-364-20C 电子连接器耐电压测试方法

5.2 MECHANICAL CHARACTERISTICS 机械特性

5.2.1 Connector-Connector Mating/Un-mating/Retention 连接器与连接器的插拔力/保持力

The following details shall apply: 应满足如下要求:

- a) Reference: USCAR-2 5.4.2.3 参考 USCAR-2 5.4.2.3
- b) Insert and withdraw connectors at the speed rate of 50 \pm 10mm/minute.
以 50 \pm 10 mm/分钟的速度插入和拔出连接器。
- c) Mating force must be \leq 45 Newton.
连接器整体插入力小于或等于 45 牛。
- d) Un-mating force must be \geq 110 Newton with the connector lock fully engaged.
锁扣破坏力需大于或等于 110N。
- e) Un-mating force (Lock fully disengaged or disabled) $>$ 10 Newton and \leq 75 Newton.
拔出力(破坏锁扣) 大于 10 牛顿并小于或等于 75 牛顿。
- f) Acceptance criteria according to USCAR-2, 5.4.2.4
需符合 USCAR-2, 5.4.2.4 的验收标准。

5.2.2 Durability 耐久测试

Mating and un-mating with the applicable connector at the speed rate of less than 10 cycles per minute. 以每分钟不低于 10 次的速度进行插拔。

- a) Reference: EIA 364-09C. 依 EIA-364-09C 电子连接器的耐久测试方法
- b) Number of Cycles: 10 cycles. 插拔次数: 10 次
- c) Acceptance criteria: No physical damage.

验收标准: 无物理性损伤

5.2.3 Vibration/ Mechanical Shock 振动/机械冲击

Per SAE/USCAR-2 5.4.6 依照SAE/USCAR-2 5.4.6章

Test Condition: Random 5 Hz - 1000 Hz, 1.81 g's RMS overall

测试条件: 以5HZ-1000HZ的频率随机振动, 加速度为1.81G.

Duration: 8 Hours per axis. 持续时间: 8小时每轴

Direction: each of 3 orthogonal axis 方向: X,Y,Z 三个互相垂直的轴向

No discontinuities greater than 1 μ s, when measured in accordance with SAE/USCAR-2

5.4.6 V1 level

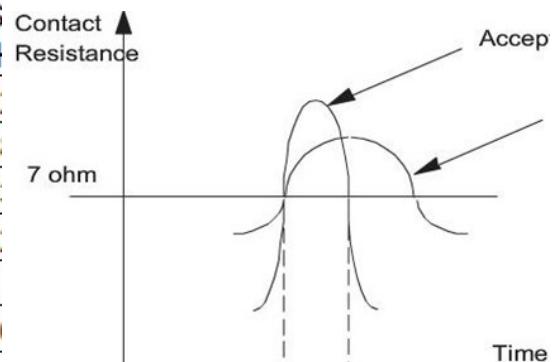
根据 SAE/USCAR-2 5.4.6 V1级测量时, 不连续性不得大于1微秒。

Acceptance criteria: No damage allowed

验收标准: 无物理性损伤

V1 - Random

F (Hz)	PSD ¹	PS g ² /l
5.0	0.192	0.00
12.5	23.8	0.24
77.5	0.307	0.00
145.0	0.192	0.00
200.0	1.13	0.01
230.0	0.031	0.00



5.2.4 Cable Retention force 线端保持力

Cable Retention force (Axial): 110N Min.

电缆保持力 (轴向): 最小 110N。

Acceptance criteria: Between wire and housing No damage allowed

验收标准: 线材与胶壳之间无物理性损伤

5.2.5 Connector drop test 连接器跌落试验

- a) Reference: USCAR-2, 5.4.8 参考 USCAR-2, 5.4.8 进行测试.
- b) Acceptance criteria according to USCAR-2, 5.4.8.4
需符合 USCAR-2, 5.4.8.4 的验收标准.

5.2.6 Connector to connector Audible Click 连接器至连接器可听见的卡塔响.

- a) USCAR-2, 5.4.7.3 参考 USCAR-2, 5.4.7.3 进行测试.
- b) Acceptance criteria according to USCAR-2, 5.4.7.4
需符合 USCAR-2, 5.4.7.4 的验收标准.

5.2.7 Polarization Feature Effectiveness 极化特征效果.

Secure the cable connector and header (different ports or the same ports but different codes) in the appropriate fixtures of the force tester. Adjust the force tester to attempt insertion of the Male Connector into the Female Connector in the orientation selected in USCAR-2, 5.4.4.3 Step 3.
将线端连接器和板端连接器 (不同的端口或相同的端口但代码不同的公母头)固定在插拔力机上, 调节插拔力机并按照 USCAR-2 5.4.4.3 第三步中选择的方向进行插拔.

Requirement: 90 N minimum. 要求: 90 牛/最小

Acceptance criteria : SAE/USCAR-2 , 5.4.4.4 需符合 USCAR-2, 5.4.4.4 的验收标准.

5.3 ENVIRONMENTAL CHARACTERISTICS 环境特性

After exposure to the following environmental conditions in accordance with the specified test procedures and/or details, the product shall show no physical damage and shall meet the electrical and mechanical requirements per paragraphs 5.0 and 6.0 as specified in Table 1 test sequence. Product subjected to these environmental tests must be applied to printed circuit boards. Unless otherwise specified, the assemblies shall be mated during exposure.
根据规定的试验程序或细节, 在暴露于以下环境条件中后, 产品应无物理损伤, 并应符合表 1 试验顺序中的电气和机械要求。接受这些环境试验的产品必须应用于印刷电路板。除非另有规定, 否则组件应在暴露期间匹配。

5.3.1 Thermal Shock 冷热冲击

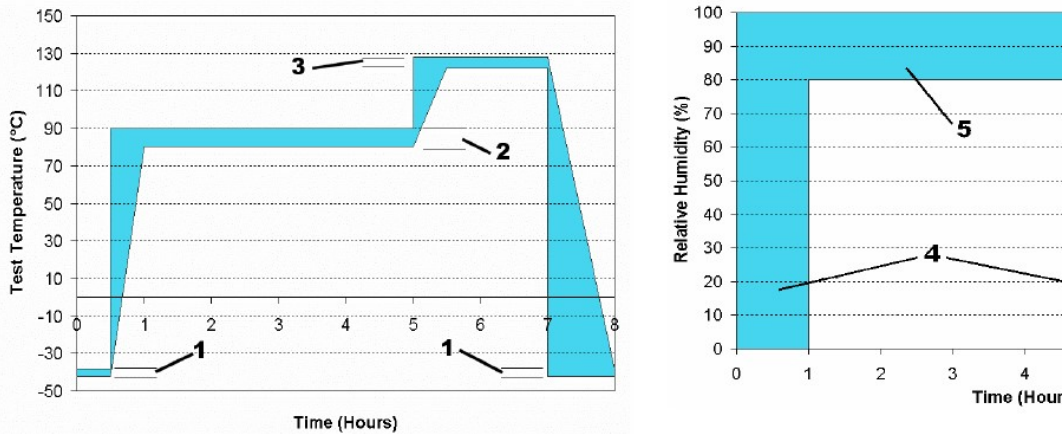
- a) Per SAE/USCAR-2 5.6.1 依照 SAE/USCAR-2 5.6.1 章
- b) Determine the Temperature Class for the intended application of the connector system from table 5.1.4.1. with Class T2. 选择连接器系统表 5.1.4.1 预期应用温度等级为等级 T2。
- c) Repeat Steps 4 and 5 ninety nine (99) more times. 重复步骤 4 和 5 九十九次以上。
- d) The resistance of any terminal pair not exceeds 7.0Ω for more than 1us.
瞬断电阻 7Ω 不大于 1 微秒.

5.3.2 Temperature/Humidity Cycling 温湿度循环

a) Per SAE/USCAR-2 5.6.2 依照 SAE/USCAR-2 5.6.2 章

b) Cycle the test samples 40 times using the cycling schedule shown in Figure 5.6.2.3. The cycle begins with the sample at -40 ° C to +100 ° C, 0%-95%RH. Completion of the schedule shown in Figure 5.6.2.3 will constitute one cycle. Use the Maximum Ambient Temperature for hours 5 through 7 as determined from Table 5.1.4.1 level T2 .

使用图 5.6.2.3 所示的循环时间表循环试验样品 40 次,循环从-40℃到+100℃, 0%-95%相对湿度, 完成图 5.6.2.3 所示的计划构成一个周期。根据表 5.1.4.1 等级 T2 确定的最大环境温度, 第 5 至第 7 小时。



5.3.3 High Temperature Exposure 高温暴露

a) Per SAE/USCAR-2 依照 SAE/USCAR-2 5.6.3 章

b) Place the samples in the chamber, set to the maximum ambient temperature, so that there is no substantial obstruction to air flow across and around the samples, and the samples are not touching each other. Leave the samples in the chamber for 1008 hours.

将样品放入室内,设置好最高周围温度,以便样品与样品周围空气流动没有实质性阻碍,样品也没有相互接触,样品留下在室内 1008 小时。

c) Determine the Temperature Class for the intended application of the connector system from table 5.1.4.1. with Class T2. 选择连接器系统表 5.1.4.1 预期应用温度等级为等级 T2。

5.3.4 Resistance to Soldering Heat (Board connector) 回流焊高温抗性 (针对板端连接器)

a) Per EIA-364-56 依照 EIA-364-56

b) Method 4.5 level 3(Refer to the following temperature profile) 方法 4.5 等级 3 (参照如下温度曲线)

c) 1 Time 1 次测试

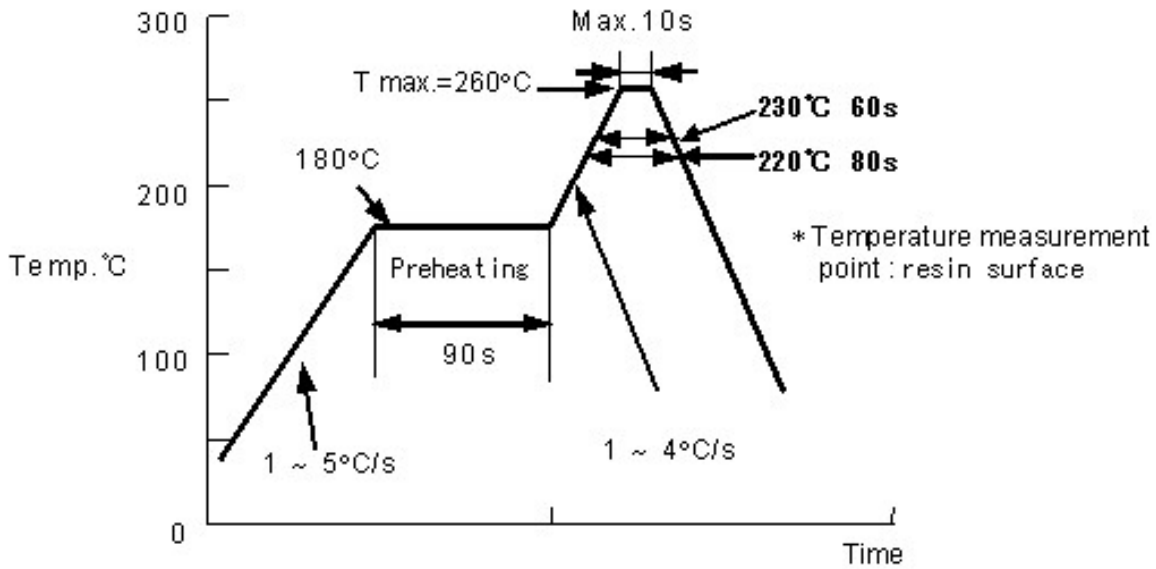


Figure 1 Recommended temperature profile of infrared reflow

5.3.5 Solderability 可焊性

- a) Per EIA-364-52 依照 EIA-364-52 电子连接器可焊性测试方法
- b) Solder Time 焊接时间: 5 ± 0.5 seconds(秒)
- c) Solder Temperature 焊接温度: $245 \pm 5^\circ\text{C}$ (摄氏度)
- d) Solder area shall have minimum of 95% solder coverage. 焊接面积应至少 95%的焊料覆盖。

5.4 SI TEST 高频测试

5.4.1 SI Data (connector, 针对连接器)

The differential impedance of a mated connector shall be within $90 \Omega \pm 15 \Omega$, as seen from a 50 ps (20%-80%) risetime of a differential TDR. Figure 5-4-1 illustrates the impedance limits of a mated connector.

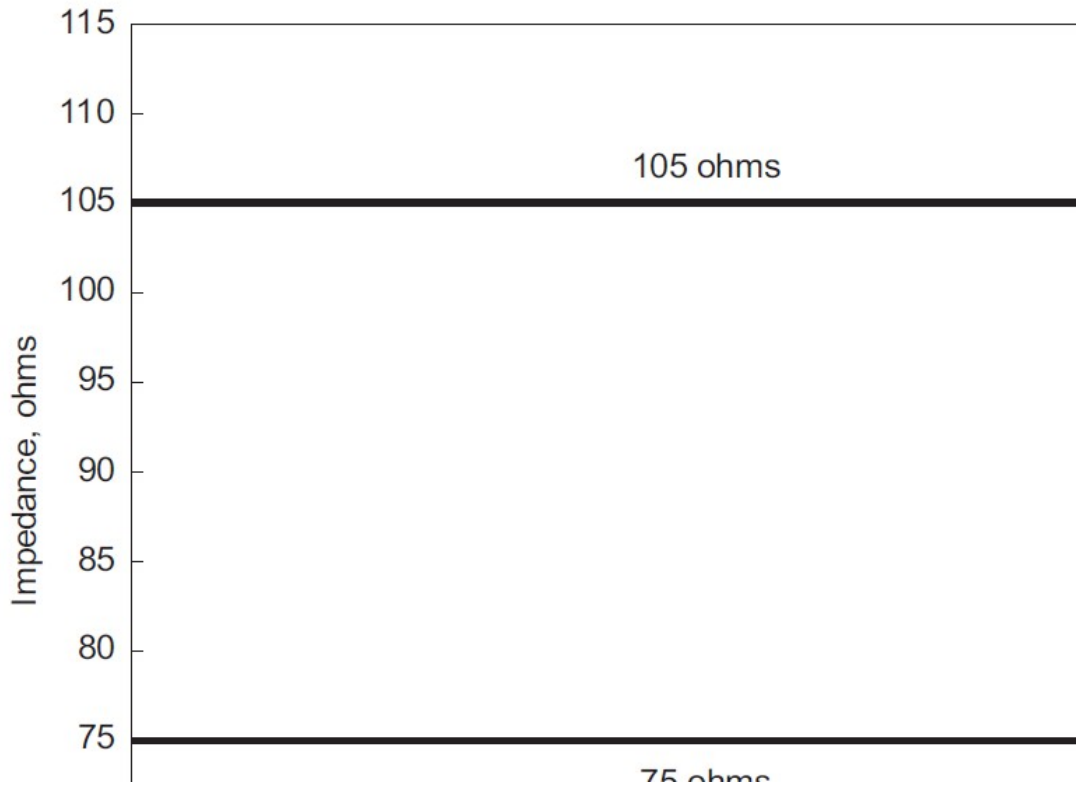


Figure 5-4-1. Impedance Limits of a Mated Connector

5.4.2 SI Data (cable assembly, 针对线缆组件)

A mated cable assembly refers to a cable assembly mated with the corresponding receptacles mounted on a test fixture at the both ends. The requirements are for the entire signal path of the mated cable assembly, from the host receptacle contact solder pads or through-holes on the host system board to the device receptacle contact solder pads or through holes on the device system board, not including PCB traces, as illustrated in Figure 5-4-2; the measurement is between TP1 (test point 1) and TP2 (test point 2).

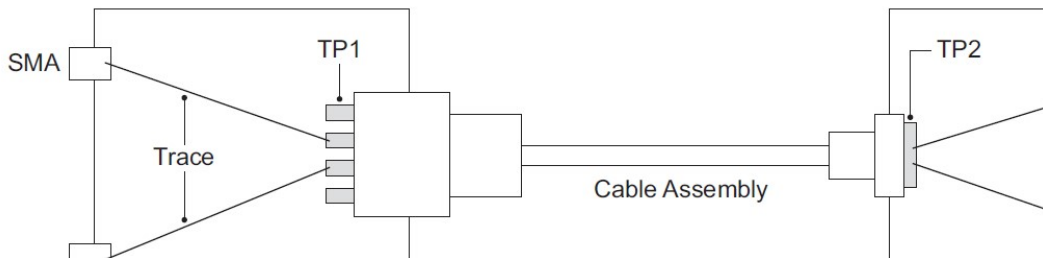


Figure 5-4-2. Illustration of Test Points for a Mated Cable Assembly

类别	试验参数
Standalone Communication Channel(单通道)	CIDM(Characteristic Impedance Differential Mode) 差分阻抗 Raw cable: 90 Ω +/- 7 Ω, Rise time=200 ps (10%-90%)
	IL(Insertion Loss)插入损耗: (100 MHz, ≥-1.5 dB), (1.25 GHz, ≥-5.0 dB), (2.5 GHz, ≥-7.5 dB), and (7.5 GHz, ≥-25 dB).
	Differential to Common Mode Conversion 差模转共模: up to 7.5GHz, ≤-20 dB.
Multi- Communication Channel (多通道)	Differential Near-End Crosstalk Between SuperSpeed Pairs 近端串扰 (高速信号对之间): (100 MHz, ≤-27 dB), (2.5 GHz, ≤-27 dB), (3 GHz, ≤-23 dB) and (7.5GHz, ≤-23 dB).
	Differential Crosstalk Between D+/D- and SuperSpeed Pairs 近端/远端串扰 (高速信号和 USB 2.0 信号对): (100 MHz, ≤-21 dB), (2.5 GHz, ≤-21 dB), (3.0 GHz, ≤-15 dB) and (7.5 GHz, ≤-15 dB).

6.0 QUALITY ASSURANCE PROVISIONS 质量保证条款

6.1 Equipment Calibration. 设备校准

All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with MIL-C-45662 and ISO 9000.

所有测试设备和检验设施用于测试时的性能应符合 MIL- C - 45662 和 ISO 9000 的校准系统的规定。

6.2 Inspection Condition. 检验条件

Unless otherwise specified herein, all inspections shall be performed under the following ambient conditions: 除非另有说明,所有的检查应在下列环境条件下进行:

- a) Temperature 温度 : 25 ± 5°C
- b) Relative Humidity 相对湿度 : 30% ~ 60%
- c) Barometric Pressure 气压: Local ambient 当地的环境

6.3 Sample Quantity and Description 样本数量和描述

The numbers of samples to be tested in each group shown in Qualification Testing Sequences are defined as follows: Groups A through K:

5 samples in each group: All samples must be free of defects that would impair normal connector operation. All samples must meet dimensional requirements of connector.

样品的数量在每组测试资格如下所示:A 组到 K 组,每组 5 个样品,所有的样品必须是无缺陷的,所有样品必须符合尺寸要求。

6.4 Acceptance 验收

6.4.1 Electrical and mechanical requirements placed on test samples as indicated in Paragraphs

5.2 and 5.3 shall be established from test data using appropriate statistical techniques or

shall otherwise be customer specified, and all samples tested in accordance with this product specification shall meet the stated requirements.

测试样本应符合在段落 5.2 和 5.3 的机械与电气要求,测试数据使用适当的统计技术或按客户指定的规定,所有样品测试符合本产品规范所规定的要求。

6.4.2 Failures attributed to equipment, test setup, or operator error shall not disqualify the product. If product failure occurs, corrective actions shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification.

测试失败归因于设备、测试设置或操作错误的原因不得取消产品认证。如果产品测试因以上原因,应采取纠正措施和再次提交样品认证。

6.5 Qualification Testing. 资格测试

Qualification testing shall be performed on sample units produced with equipment and procedures normally used in production. The test sequence shall be as shown in Qualification Testing Sequences.

进行资格应测试样本应与通过正常生产设备和制程的产品一致。所示的测试序列应当体现在资格测试序列中。

Visual Examination: Per SAE/USCAR-2 5.1.8 外观检查: 依照 SAE/USCAR-2 5.1.8 章

6.6 Re-qualification Testing. 重新资格测试

If any of the following conditions occur, the responsible product engineer shall initiate re-qualification testing consisting of all applicable parts of the qualification test matrix Table 1. 如果出现下列情形之一的,产品工程师应启动重测表 1 中所有的测试。

- A significant design change is made to the existing product which impacts the product form, fit or function. Examples of significant changes shall include, but not be limited to, changes in the plating material composition or thickness, normal force, contact surface geometry, insulator design, contact base material, or contact lubrication requirements.
重大的设计变更影响现有产品形状或功能.明显的变化的例子包括但不限于改变电镀材料成分或厚度、正向力、接触表面形状,绝缘体、端子底材或接触润滑要求发生改变。
- b) A significant change is made to the manufacturing process, which impacts the product form, fit or function.
生产过程的显著变化,影响产品形状,安装或功能的变化。
- c) A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.
在生产过程中有重大事件发生或最终使用要求纠正产品设计或制造过程。

Table 1: Qualification Testing Sequences 测试实验顺序

TEST OR EXAMINATION 测试或检验		TEST GROUP 测试群组											
Sequence ID 序列号		A	B	C	D	E	F						
Visual Examination	6.2	1,4	1,3	1	1,3	1,3	1,3						
Current rating	5.1.1	3											
Contact Resistance	5.1.2												
Insulation Resistance	5.1.4												

Voltage Drop	5.1.3													
Dielectric Withstanding Voltage	5.1.5													
Connector-Connector Mating/Unmating/Retention	5.2.1				2									
Durability	5.2.2	2												
Vibration/ Mechanical Shock	5.2.3													
Cable Retention	5.2.4		2											
Connector Drop Test	5.2.5						2							
Connector to connector Audible Click	5.2.6			2										
Polarization Feature Effectiveness	5.2.7					2								
Thermal Shock	5.3.1													
Temperature/Humidity Cycling	5.3.2													
High Temperature Exposure	5.3.3													
Solderability	5.3.4													

TEST OR EXAMINATION 测试或检验		TEST GROUP 测试群组												
Sequence ID 序列号		M	N	O	P	Q	R	S						
Visual Examination	6.2	1,4	1,7	1,7	1,9	1,3	1,7	1,3						
Current rating	5.1.1													
Contact Resistance	5.1.2		3,5	3,5	3,5		3,5							
Insulation Resistance	5.1.4	3			7									
Voltage Drop	5.1.3		6	6	6		6							
Dielectric Withstanding Voltage	5.1.5				8									
Connector-Connector Mating/Unmating/Retention	5.2.1													
Durability	5.2.2	2	2	2	2		2							
Vibration/ Mechanical Shock	5.2.3		4											
Cable Retention force	5.2.4													
Connector Drop Test	5.2.5													
Terminal to Terminal engage/Disengage Force	5.2.8													
Terminal Bend Resistance	5.2.9													
Connector to connector Audible Click	5.2.10													
Cavity Damage Susceptibility	5.2.11													
Polarization Feature	5.2.12													

Effectiveness													
Terminal/Cavity Polarization Test	5.2.13												
Thermal Shock	5.3.1			4									
Temperature/Humidity Cycling	5.3.2				4								
High Temperature Exposure	5.3.3					4							
Resistance to Soldering Heat (PCB side connector)	5.3.4						2						
Solderability	5.3.5					2							

SI 测试另外测试并记录在另一份单独的报告。

Remarks 备注:

1. SI testing shall be performed and recorded in another separate report.