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Revision History 更改记录

Rev. 版本	DCN No. 文件更改通知编号	Effective 生效日期	Description 更改摘要
001	--	2015-10-12	New Release
002	DCN-16-0066	2019-06-26	①更改文件名为《ESD 测试工作指引》 ②删除目录页 ③更换为中文内容 ④删除第 1 节“General”内容 ⑤更换仪器信息
003		2022-01-17	①增加英文翻译 ②更新目录页 ③增加第七章节‘参考文献’ ④增加间接测试内容和测试图片

Control Document 文件控制	Approved 批核	Signature 签名	Date 日期
	Draft		
	Approval		

Contents

1. Purpose

To evaluate the product performance under ESD test.
评估样品遭受静电放电时的性能，避免不必要的损失。

2. Scope

This instruction applies to all products' ESD test in Inventus Power Technical Center.
这份指引适用于 TC 所有项目的 ESD 测试。

3. Terms and Definition

3.1 ESD

Electrostatic Discharge 静电放电
Transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact.
具有不同静电电位的物体相互靠近或直接接触引起的电荷转移。

3.2 Direct Application 直接放电

Application of the discharge directly to the EUT.
直接对受试设备实施放电。

3.3 Indirect Application 间接放电

Application of the discharge to a coupling plane in the vicinity of the EUT to simulate personnel discharge to objects which are adjacent to the EUT.
对受试设备附近的耦合板实施放电，以模拟人员对受试设备附近的物体的放电。

3.4 Contact Discharge Method 接触放电方法

Method of testing in which the electrode of the test generator is kept in contact with the EUT or coupling plane and the discharge is actuated by the discharge switch within the Generator.
试验发生器的电极保持与受试设备接触并由发生器内的放电开关激励放电的一种试验方法。

3.5 Air Discharge Method 空气放电方法

Method of testing in which the charged electrode of the test generator is moved towards the EUT until it touches the EUT.
将试验发生器的充电电极靠近受试设备并由火花对受试设备激励放电的一种试验方法。

3.6 EUT (Equipment Under Test) 受试设备

3.7 GRP (Ground Reference Plan) 接地参考平面

Flat conductive surface whose potential is used as a common reference.

一块导电平面， 其电位用作公共参考电位。

3.8 Coupling Plane 耦合板

Method of testing in which the charged electrode of the test generator is moved towards the EUT until it touches the EUT.

一块金属片或金属板，对其放电用来模拟对受试设备附近物体的静电放电。

3.8.1 HCP: Horizontal Coupling Plane 水平耦合板

3.8.2 VCP: Vertical Coupling Plane 垂直耦合板

3.9 Degradation of Performance 性能降低

Undesired departure in the operational performance of any device, equipment or system from its intended performance.

装置、设备或系统的工作性能与正常性能的非期望偏离。

Note: Degradation can apply to either temporary or permanent failure.

注：术语“性能降低”可应用于暂时性的或永久性的故障。

4. Test Device 测试设备

4.1 Standard ESD Test Table 标准静电放电测试台

4.2 Coupling Plane 耦合板（包括水平和垂直耦合板）

4.3 Insulating Backing (Thickness: 0.5mm) 绝缘衬垫

4.4 ESD Generator 静电放电测试仪

- Model: 索莘 ESD 30K
- ID Code: 177
- Output: Contact ±10kV; Air ±30kV

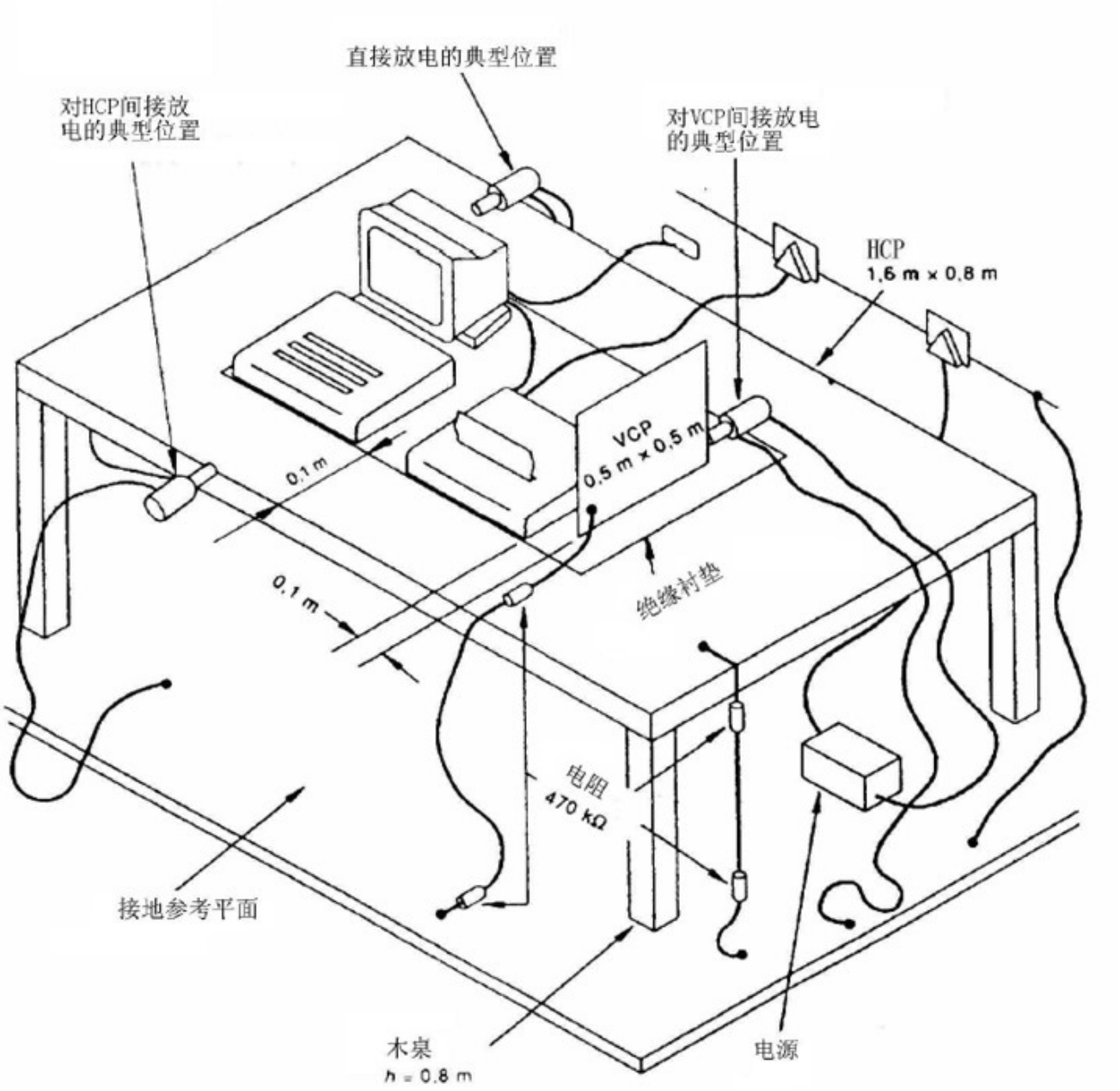


图 1

Figure-1 ESD test device

5. Test Environment

5.1 Operation Temperature: 15℃ ~ 35℃

5.2 Relative Humidity: 30% ~ 60%

5.3 Atmospheric Pressure: 86 kPa(860 mbar) ~ 106 kPa(1060 mbar)

6. Test Process

6.1 EUT check action 受试设备的检查:

Before ESD test, check and make sure all function of the EUT is normal.
测试开始前，检查并确保受试设备的功能正常。

6.2 EUT placement 受试设备的摆放：

Place EUT on the standard ESD table 受试设备在 ESD 台上的摆放

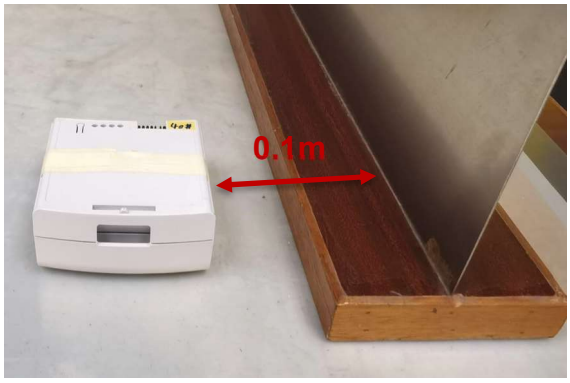
1) The distance between EUT and ESD tester should > 0.2m
在实施放电的时候，ESD 的放电回路电缆与受试设备的距离至少应保持 0.2m。

Figure-2 Distance between grounding probe and ESD generator

2) While doing indirect discharge to HCP, the generator of ESD tester should be perpendicular to HCP and the distance between generator and EUT is 0.1m.
水平耦合测试时，静电放电发生器垂直地置于与受试设备距 0.1m 处。

Figure-3 Indirect application – HCP

3) While doing indirect discharge to VCP, the VCP should be parallel to the EUT and the distance between VCP and EUT is 0.1m. Four sides of the EUT(Front/Rear/Left/ Right side) need to test indirect discharge with VCP.
垂直耦合测试时，受试设备的放置应与耦合板保持 0.1m 的距离。受试设备的四个面（前后左右）都要受到非直接接触式垂直耦合放电试验。



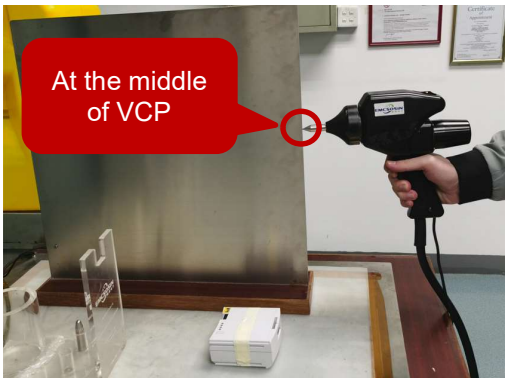


Figure-4 Indirect application – VCP

Note: If the top of the EUT can't be implement VCP test by adjusting its placement, the tester needs to inform related engineering managers.
注意：若受试设备的顶部无法通过调整设备的摆放位置实施 VCP 测试，测试人员需要告知相关的工程经理。

6.3 Selection of test point 测试点的选择

1) Direct Contact 直接接触:
The electrostatic discharges shall be applied only to those points and surfaces of the EUT which are accessible to persons during normal use.
操作人员正常使用受试设备时可能接触的点和表面上。
Note: Contact discharge test shall be performed on the touchable conductive points or metal body on the surfaces of the EUT, while air discharge test shall be performed on the non-direct points and insulating surfaces of the test equipment.
注意：接触放电点一般选择 EUT 可接触的导电点或表面的一些金属体，空气放电点

一般选择 EUT 的绝缘表面和非直接接触的金属点。

E.g.，Points on metallic sections of a cabinet which are electrically isolated from ground.

比如：与地绝缘的金属外壳上的一些点。

E.g.，Any point in the control or keyboard area and any other point of man-machine communication, such as switches, knobs, buttons, indicators, LEDs, slots, grilles, connector hoods and other operator-accessible areas.

比如：控制或键盘区域任何点和人机通讯的其他任何点如开关、键、按钮，以及其他操作人员易于接触的区域。

- E.g., LCDs, LEDs, slots, grills and etc.

比如：指示器、发光二极管、缝隙、栅格等。

2) Indirect Contact 间接接触:

HCP test point 水平耦合板测试点选择:

在受试设备六个面每侧的一些点上，在放电电极触及耦合板的情况下，应将静电发生器垂直置于与受试设备为 0.1m 处。

At some points on each side of EUT, the electrostatic generator shall be placed vertically at a distance of 0.1m from the test equipment in the case that the discharge electrode touches the coupling plate.

VCP test point 垂直耦合版测试点选择:

耦合板平行于受试设备放置且保持 0.1m 的距离，放电应施加在耦合板垂直边的中心处，且需要调整耦合板的位置使受试设备的四个面（前，后，左，右）都受测试。

The coupling plan is placed parallel to, and positioned at a distance of 0.1m from the EUT. Discharges shall be applied to the coupling plane, with sufficient different positions such that the four faces of the EUT are completely illuminated.

6.4 ESD test level 测试等级:

1a-Contact Discharge		1b-Air Discharge	
Level	Voltage (KV)	Level	Voltage (KV)
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15
5	10	5	18
X[1)]	TBD	X[1)]	TBD
1) "X" is open level, it is specially specified in the specification.			

Our design needs to comply with contact 10KV/Air 18KV level.

我们设计的所有产品都需要满足接触 10KV/空气 18KV 的测试等级。

Note: Medical product minimum requirement is contact 8KV/Air 15KV level.
IT and home appliance minimum requirement is contact 4KV/Air 8KV level.

注意：医疗产品的最低限度要求是接触 8KV/空气 15KV。
IT 和家用产品的最低限度要求是接触 4KV/空气 8KV。

6.5 ESD test requirement 测试要求

Test ESD from lowest level to the requirement level. After the completion of ESD each level test, tester should check the EUT function, any abnormal condition should be described detail. The test shall be performed with single discharges. On each pre-selected point at least 10 single discharges (in the most sensitive polarity) shall be applied. For the time interval between successive single discharges an initial value of 1s is recommended.

In the case of contact discharges, the ESD generator should contact the EUT then discharge.
In the case of air discharges, the ESD generator shall approach the EUT as fast as possible until contact between the electrode and the EUT is made (without causing mechanical damage).
The ESD generator shall be held perpendicular, whenever possible, to the surface to which the discharge is applied. This improves repeatability of the test results. If the ESD generator cannot be held perpendicular to the surface, the test condition used to perform the discharges shall be recorded in the test report.
ESD 测试应该从低标准逐渐到要求的标准。在完成 ESD 每一个等级测试后，应检查 EUT 功能，任何异常情况应详细说明。每个测试点“+”和“-” 各 10 次放电，间隔最小 1 秒。
接触放电时应在放电电极接触后再按放电开关；空气放电时，放电电极的圆形放电端应尽快靠近(不造成机械损伤)接触 EUT。
在任何时候 ESD 枪应保持垂直于测试点表面，如果在测试过程中 ESD 枪无法垂直于测试面，应在测试报告中记录。

6.6 Simulate ESD test with all operation scenarios 模拟操作场景的 ESD 测试

For battery pack(SOC should be in 20%-80% range), ESD performance should be verified in standby mode, charge/discharge mode.
对于电池包产品（电池容量应在 20%-80%范围区间），应在待机模式，充放电模式下验证 ESD 性能。
For big battery pack(SOC should be in 20%-80% range), ESD performance should be verified in standby mode and discharge mode.
对于大电池包（电池容量应在 20%-80%范围区间），，应在待机和放电两种模式下验证 ESD 性能。
For charger/power supply, ESD performance should be verified in power off, power on with no load/loading mode.
对于充电器、适配器产品，应在无电源接入模式、电源接入空载/带载模式下进行验证。

6.7 Test result criterion 测试结果标准判定

The test results shall be classified in terms of the loss of function or degradation of performance of the equipment under test, relative to a performance level defined by its manufacturer or the requestor of the test, or agreed between the manufacturer and the purchaser of the product. The recommended classification is as follows:
测试结果应根据被测试设备的功能丧失或性能退化进行分类，相对于其制造商或测试请求者定义的或制造商与产品采购方商定的性能水平。推荐的分类如下:

a) normal performance within limits specified by the manufacturer, requestor or purchaser.
在制造商、请求者或购买者指定范围内的正常性能。
b) temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention.
干扰停止后暂时的功能丧失或性能下降，在没有操作人员的干预情况下，受试设备能

恢复正常性能。

c) temporary loss of function or degradation of performance, the correction of which requires operator intervention.
功能展示丧失或性能下降，需要操作人员干预才能纠正。

d) loss of function or degradation of performance, which is not recoverable, owing to damage to hardware or software, or loss of data.
由于硬件或软件损坏或数据丢失而导致无法恢复的功能丧失或下降。

Note: EUT output performance needs to be verified by LED indicator.
受试设备输出性能必须通过 ESD 测试夹具灯进行判定。

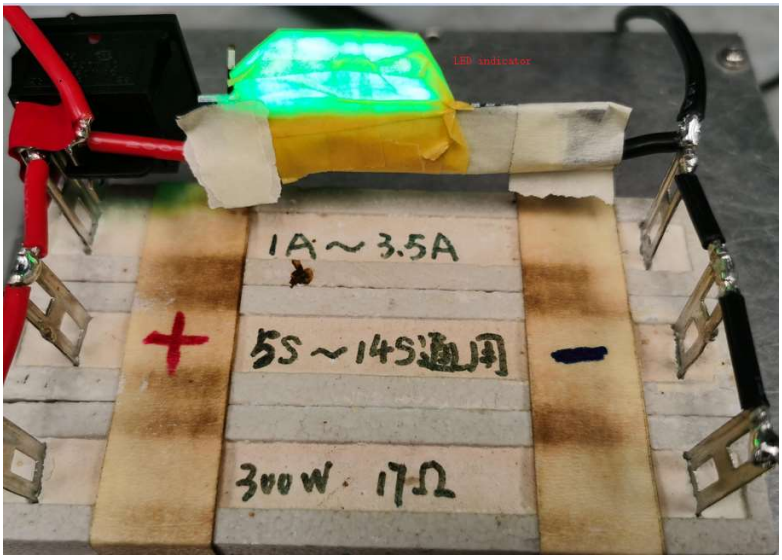


Figure-5 LED Indicator

7. Reference document

IEC-61000-4-2 Edition 2.0 2018-12