电源适配器和LED驱动器认证专题研讨会

主办机构：深圳市信测科技有限公司
东莞市信测科技有限公司

日期：2009年11月26日
地点：东莞市南城区宏远酒店

专心、专业，通全球

Safety Parts

电源适配器和LED驱动器Safety认证专题研讨会

- 标准介绍
- 产品结构要求
- 产品测试要求

标准介绍（电源适配器实用标准）

编号	标准	版本	产品类别
1	IEC60950-1 EN60950-1 UL60950-1	1st:2001+A11:2004 1st:2002+A11:2004 1st:2003	信息技术设备
2	IEC60950-1 EN60950-1 UL60950-1	2nd:2005 2nd:2006 2nd:2007	信息技术设备 也实用于LED Drive
3	IEC60065 EN60065 UL60065	7th:2001+A1:2005 7th:2002+A1:2006 7th:2003+A1:2007	音频、视频及类似电子设备
4	IEC60601 EN60601 UL60601	2005 2006 2003	医用电气设备
5	IEC/EN60335-1 IEC/EN60335-2-29	2001+A11+A1:2004 +A12+A2:2006+A13:2008 2002+ A1:2004	家电产品 电池充电器

标准介绍(Cont. LED驱动器实用标准)

编号	标准	版本	产品类别
6	IEC/EN61558-1 IEC/EN61558-2-17	2005 1997	变压器，电源及逆变器 开关电源特殊要求
7	IEC61347-1 EN61347-1	2000+A1:2003 2001+A1:2008	灯具控制器
	IEC61347-1 EN61347-1	2007 2008	灯具控制器
	IEC/EN61347-2-13	2006	LDE驱动电源
8	UL1310	5th 2005	Class 2 类产品
9	UL1012	7th 2005	非Class2类产品
10	UL8750	1st 2009	用于照明的LED及模组， 电源，控制电路

产品结构要求（绝缘方式定义）

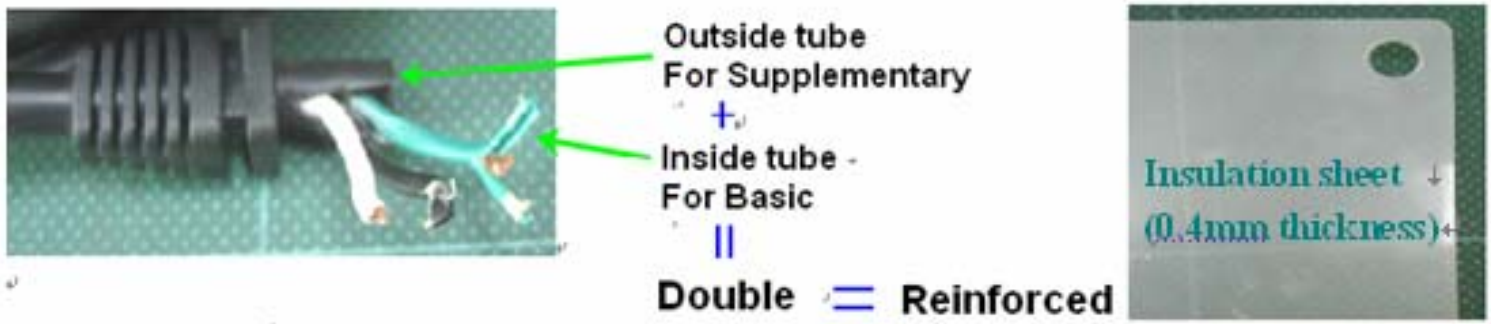
绝缘方式 Insulation

非做为电击保护者：

- 1.2.9.1 功能绝缘 (Functional Insulation)。

做为电击保护者：

- 1.2.9.2 基本绝缘 (Basic Insulation)。
- 1.2.9.3 辅助绝缘 (Supplementary Insulation)。
- 1.2.9.4 双层绝缘 (Double Insulation)，基本绝缘加辅助绝缘之总称
- 1.2.9.5 加强绝缘 (Reinforced Insulation)，相等于基本绝缘加辅助绝缘之单层绝缘。



产品结构要求 (Levels Of Protection Against Electric Shock)

Abbr.	Earth Type	LOP
FE	FUNCTIONAL EARTH	0
PE	PROTECTIVE EARTH	1

Abbr.	Insulation Type	LOP
F	FUNCTIONAL	0
B	BASIC	1
S	SUPPLEMENTARY	1
D	DOUBLE	2
R	REINFORCED	2

产品结构要求

Protection Against Electric Shock

The following combinations can be used to achieve two levels of protection against electric shock:

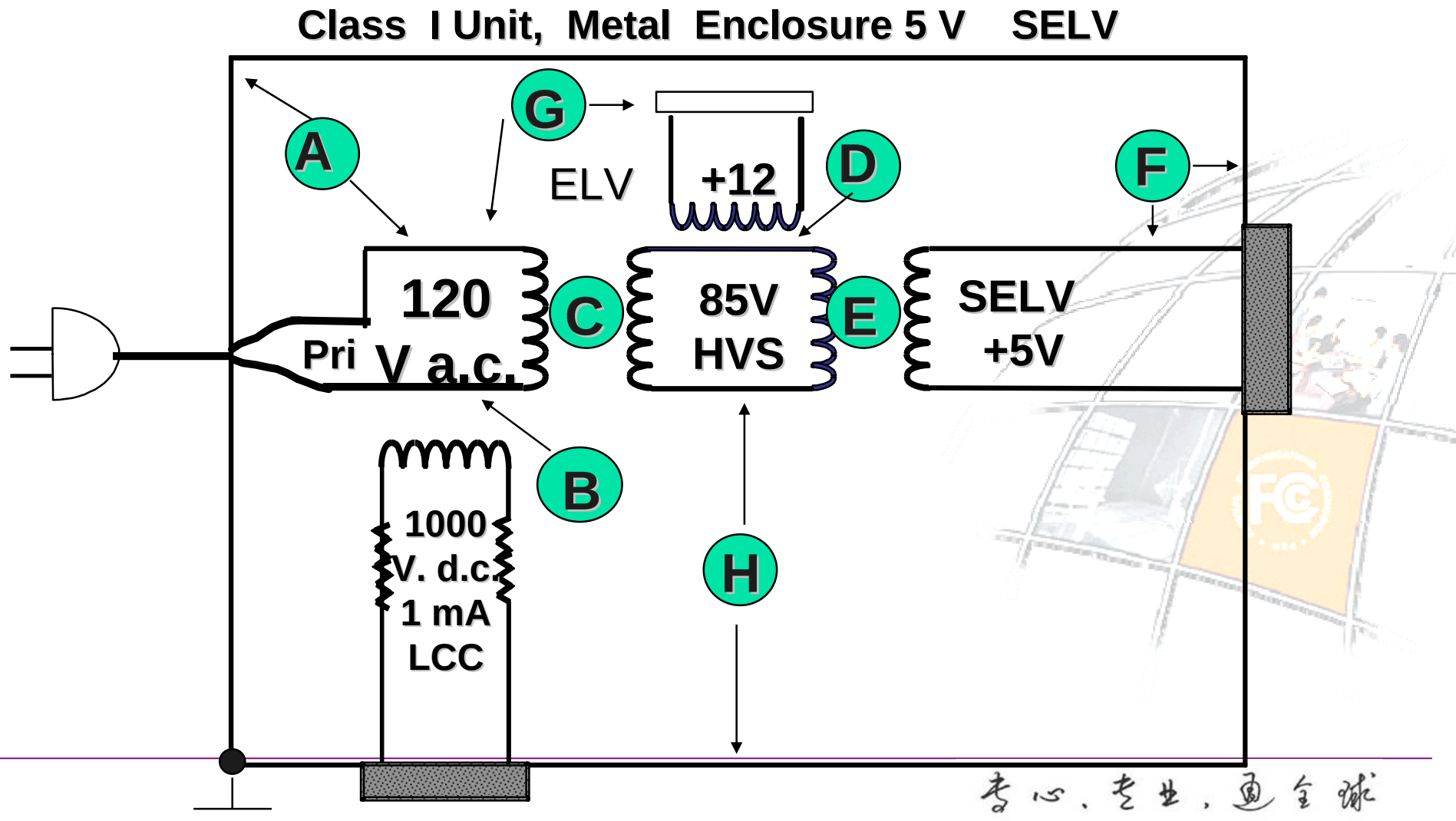
B + S = D

B + E = Two Levels of Protection

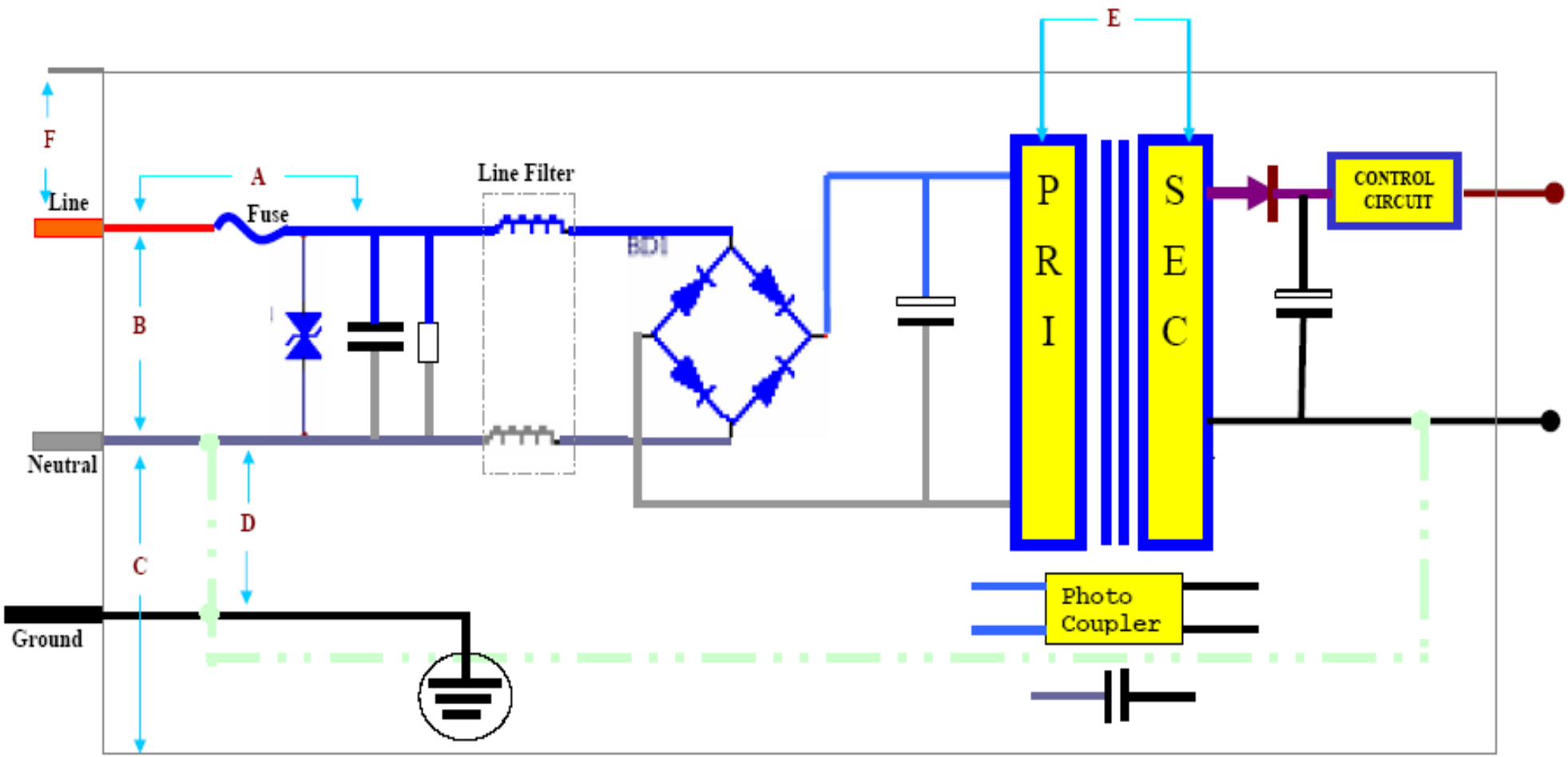
R = D

B + B ≠ D or two levels of protection

产品结构要求 (EXERCISE)



产品结构要求


E
F
Line
A
Fuse
Line Filter
B
Neutral
D
C
Ground
PRI
SEC
CONTROL CIRCUIT
Photo Coupler

产品结构要求(EXERCISE)

Area	Insulation FI, BI, SI, DI/RI	Reference voltage (V)	Required creepage (mm)	Required clearance (mm)	Measured creepage (mm)	Measured clearance (mm)	Dielectric Voltage (kV)	Remarks
A								Between Fuse two ends
B								Between for Line to Neutral
C								pri. to surface outer enclosure
D								Pri. to Earth
E								pri.circuits to sec. circuits
F								The blades to enclosure edges

电气间隙对照表

产品结构要求

电源适配器实用标准对照表. Working voltage:<250Vrms. <420Vp.k

章节	标准	Different polarity of before Fuse & Between Fuse two ends		Between Primary and Secondary Parts		Primary components to earthed trace or metal chassis		Live parts to accessible parts	
		Clearances	Creepage	Clearances	Creepage	Clearances	Creepage	Clearances	Creepage
2.10	IEC/EN/UL60950-1	1.5mm	2.5mm	4.0mm	5.0mm	2.0mm	2.5mm	4.0mm	5.0mm
13	IEC/EN/UL60065	1.5mm	2.5mm	4.0mm	5.0mm	2.0mm	2.5mm	4.0mm	5.0mm
57.1	IEC/EN/UL60601	1.6mm	3.0mm	5.0mm	8.0mm	2.5mm	4.0mm	5.0mm	8.0mm
29	IEC/EN60335-2-29	1.5mm	2.5mm	3.0mm	5.0mm	1.5mm	2.5mm	3.0mm	5.0mm

产品结构要求

LED驱动器实用标准对照表. Working voltage:<250Vrms. <420Vp.k

章节	标准	Different polarity of before Fuse & Between Fuse two ends		Between Primary and Secondary Parts		Primary components to earthed trace or metal chassis		Live parts to accessible parts	
		Clearances	Creepage	Clearances	Creepage	Clearances	Creepage	Clearances	Creepage
26	IEC/EN61558-2-17	3.0mm	3.0mm	5.5mm	5.5mm	3.0mm	3.0mm	5.5mm	5.5mm
18(Annex I.11)	IEC/EN61347-2-13	1.7mm	2.5mm	(6.0mm)	(6.0mm)	(3.0mm)	(3.0mm)	(6.0mm)	(6.0mm)
24	UL1310	6.4mm for units with openings 4.8mm for units without openings	9.5mm for units with openings 4.8mm for units without openings	6.4mm for units with openings 4.8mm for units without openings	9.5mm for units with openings 4.8mm for units without openings	12.7mm for units with openings 6.4mm for units without openings	12.7mm for units with openings 6.4mm for units without openings	6.4mm for units with openings 4.8mm for units without openings	9.5mm for units with openings 4.8mm for units without openings
7.8	UL8750	6.4mm	9.5mm	6.4mm	9.5mm	6.4mm	9.5mm	6.4mm	9.5mm

产品测试要求

实验室要求

环境 (温度与湿度)

一般要求: 10°C ~ 40°C, 45% ~ 75% RH

电压稳压调整率

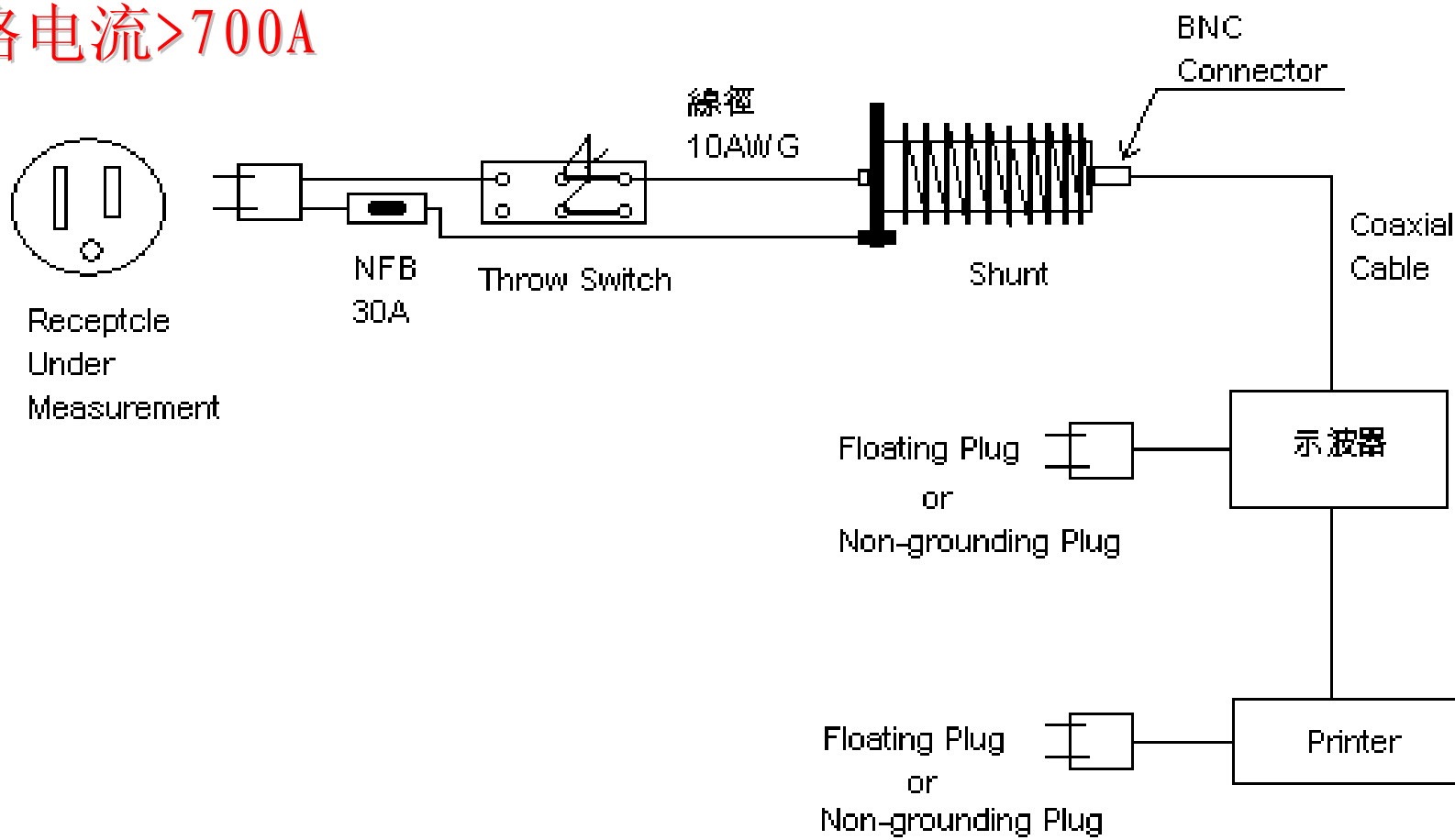
VR%= (V no load - V full load) / 120V or 240V

电压调整率的要求须小于2% for UL. (3% for IEC)

专心、专业，通全球

产品测试要求

短路电流>700A

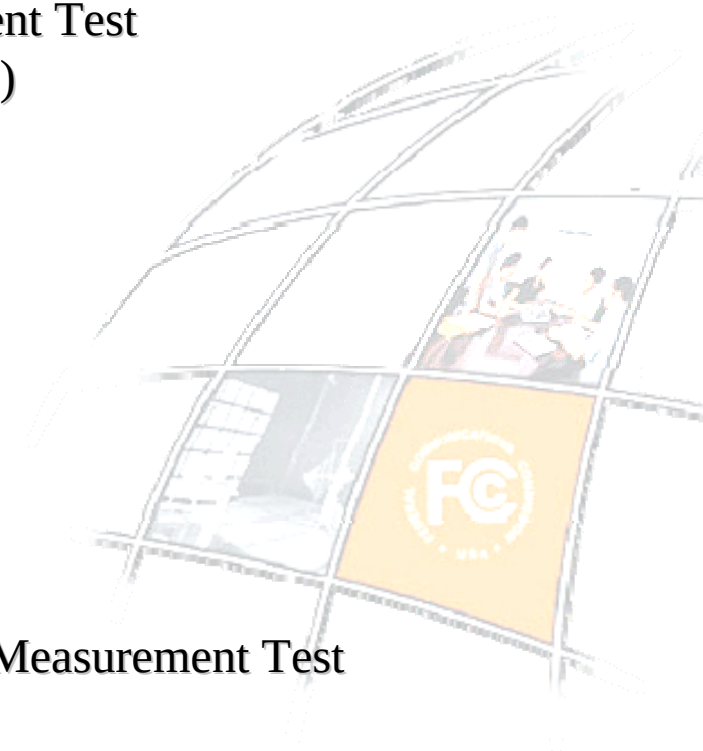


产品测试要求

以IEC60950-1测试项目为主作介绍

Tests Item for Switching Power Supply

- Maximum Output Voltage, Current, and Volt-Ampere Measurement Test
- Double or Reinforced Insulation Bridged By Components (1.5.7.1)
- Input Test (1.6.2)
- Energy Hazard Measurements (2.1.1.5)
- Capacitance Discharge Test(2.1.1.7)
- SELV Reliability Test (2.2.2)
- Limited Current Circuit Measurement
- Limited Power Source Measurements (Optional) (2.5)
- Earthing Test (2.6.3.4)
- Humidity Test (2.9.2)
- Determination of Working Voltage; Voltage Measurement Test
- Determination of Working Voltage; Hazardous Voltage (Circuit) Measurement Test (2.10.2.2)
- Transformer/Insulation Electric Strength Test (5.2)
- Strain Relief Test (3.2.6)



产品测试要求

Tests Item for Switching Power Supply (cont.)

- Impact Test (4.2.5)
- Drop Test (Direct Plug-In Equipment) (4.2.6)
- Stress Relief Test (4.2.7)
- Temperature Test (4.5.2)
- Ball Pressure Test (4.5.5)
- Touch Current Test (5.1.3)
- Electric Strength Test (5.2.2)
- Component Failure Test (5.3.7)
- Transformer Abnormal Operation Test (5.3.9)
- Power Supply Output Short-Circuit/Overload Test (5.3.9.2)

附件参考各标准测试差异对照表→

各标准测试差异对照表

产品测试要求

输入测试 Input Rating Test (Clause 1.6.2)：

1). 机器满载并正常动作，以标示之输入电压值(+6%，-10%；通常用+10%，-10%) 与频率测量值。

2). CSA 亦需量120 V与240 V 之值 (CSA nominal 值)。

3). 测量值不可大于标示值之 10%。

4). 若机器有动作周期 (duty cycle), 须标示于操作手册中。

产品测试要求

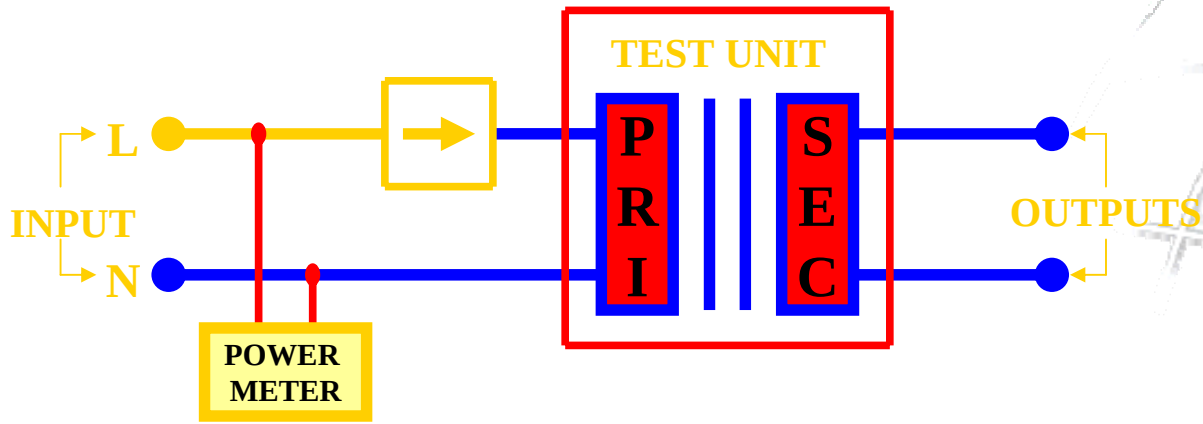
附图

TEST CONDITIONS

1. INPUT – Normal input voltage
2. OUTPUT – Normal max. load

REQUIREMENTS

Input current < rated current x 10%

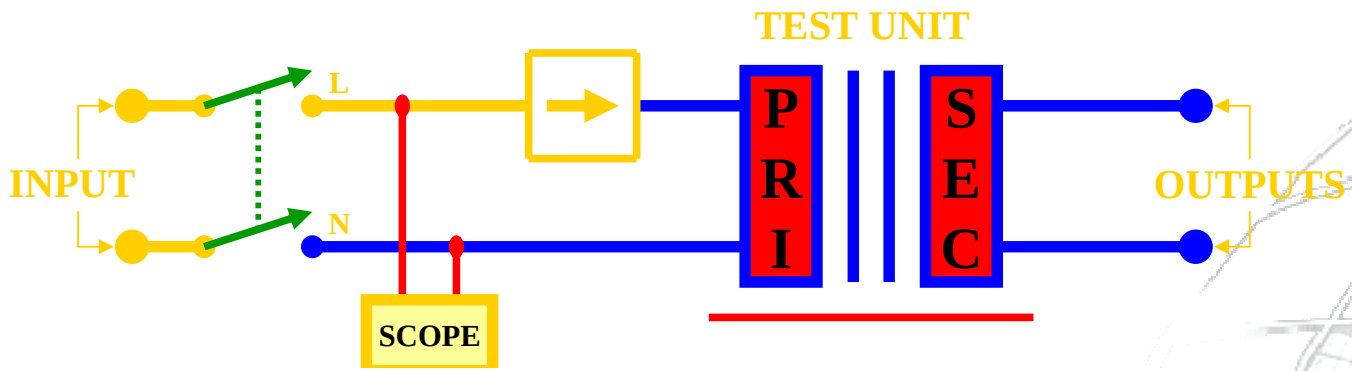


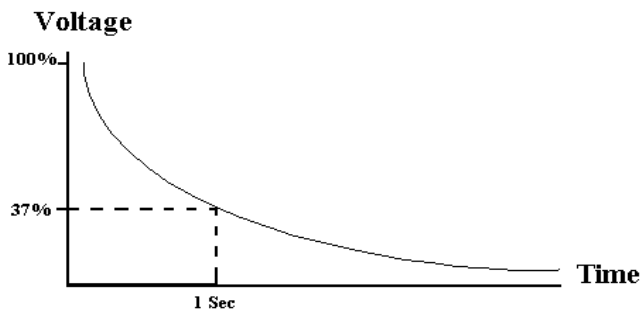
产品测试要求

输入测能量泄放测试 Energy Discharge Test (2.1.1.7) ：

1). 以标示之最高输入电压值与频率测量值。

2). 插头两端间电位，于停电一秒后需小于原电位之37%.





TEST CONDITIONS

1. INPUT – Normal input voltage
2. OUTPUT – Worse output load
3. Switch OFF

REQUIREMENTS

1 sec, < 37% Vinput

产品测试要求

安全电位测试SELV Reliability Test (Clause 2.2)：

机器正常动作时与异常(single fault)情况下，任何使用者可触及之两端点间不可超过 42.4 Vp.k or 60 Vd.c 持续 200ms (可single fault)。此外, 不可超过 71 Vp.k or 120 Vd.c.

TEST CONDITIONS

1. INPUT – Normal input voltage
2. OUTPUT – Normal max load

METHOD

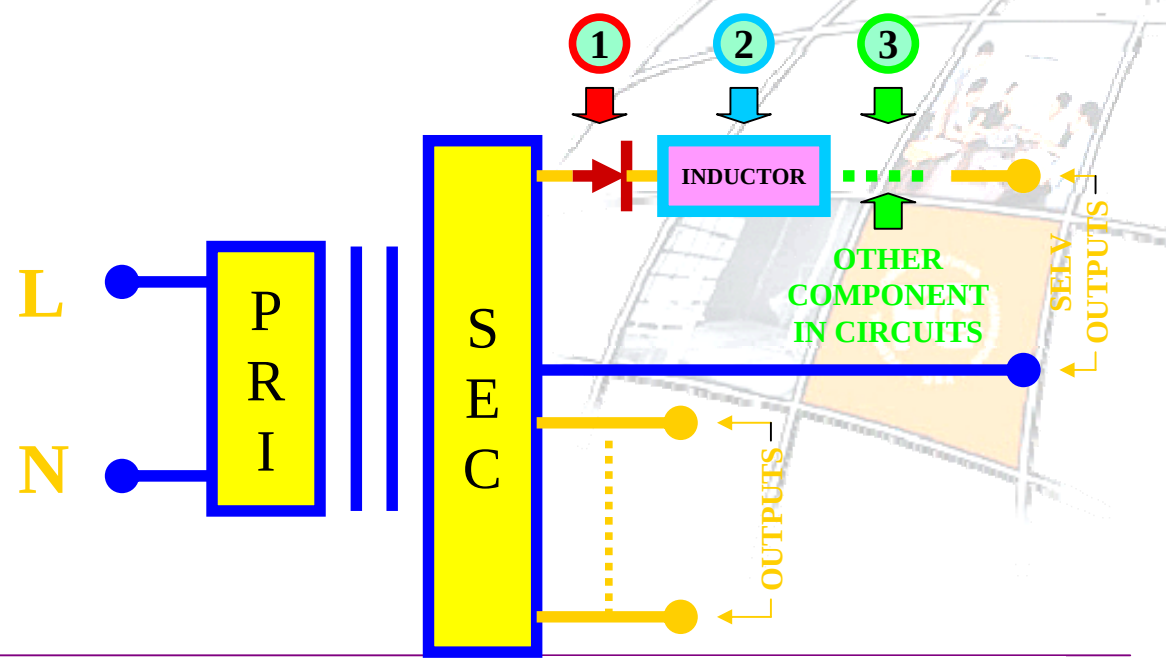
SHORT ① or ② or ③

(This component separates SELV which is less than 42.4Vpk or 60Vdc from hazardous voltage)

REQUIREMENTS OF SELV OUTPUT

< 0.2s, < 71 Vpk or 120 Vdc

> 0.2s, < 42.4 Vpk or 60 Vdc



专心、专业，通全球

产品测试要求

限电流测试 Limited Current Circuit Test (2.4) :

1). 针对超过 ELV 线路 (42.4 Vpk, 60 Vdc) 测试,
如：<1>点灯管，<2>高电压低电流。

2). 以无电感性电阻 2 kΩ 跨接于待测点两端, 量电压降换算成电流 (可single fault)。

3). 频率小于 1 kHz 时, 电流应小于 0.7 mA pk ac 或 2 mA dc

4). 频率大于 1 kHz 时, 电流应小于 0.7 mA x 频率 (kHz), 但不得大于 70 mA peak。

产品测试要求

附图 (2.4)：

TEST CONDITIONS

INPUT – Normal input voltage

OUTPUT – Normal max. load

METHOD

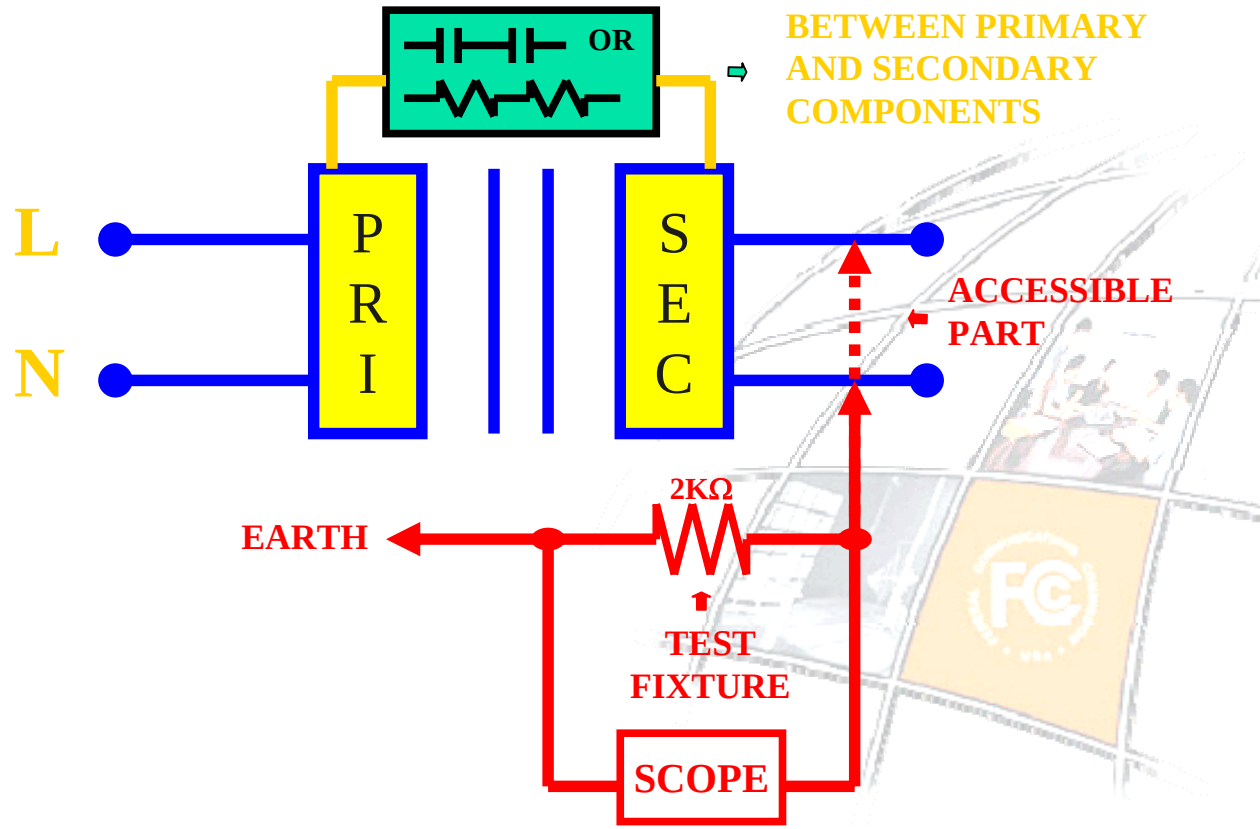
BETWEEN PRIMARY AND SECONDARY COMPONENTS

- Normal
- One basic component short

REQUIREMENTS

ON 2KΩ

- Max. 0.7 mA peak ac or
- 2 mA dc or
- 0.7 mA peak ac * ? (kHz) = ? mA, but not more than 70 mA



产品测试要求

限功率源测试 Limited Power Source Test (2.5)：

1. 若加测此测试则此power supply 连接之下游产品可视为无燃烧危险，外壳可用HB等级。

2. 产品输出于 single fault下须符合Table 2B (无过电流保护装置者) 与Table 2C（参考附件五）(有过电流保护装置者)之电流与电压限制。

产品测试要求

Table 2B – Limits for power sources without an overcurrent protective device

Output voltage [a] (U_{oc})		Output current [b d] (I_{sc})	Apparent power [c d] (S)
V a.c.	V d.c.	A	VA
≤ 30	≤ 30	≤ 8,0	≤ 100
–	30 < U_{oc} ≤ 60	≤ 150/U_{oc}	≤ 100

a U_{oc}: Output voltage measured in accordance with 1.4.5 with all load circuits disconnected. Voltages are for substantially sinusoidal a.c. and ripple free d.c. For non-sinusoidal a.c. and d.c. with ripple greater than 10 % of the peak, the peak voltage shall not exceed 42,4 V.

b I_{sc}: Maximum output current with any non-capacitive load, including a short-circuit.

c S (VA): Maximum output VA with any non-capacitive load.

d Measurement of I_{sc} and S are made 5 s after application of the load if protection is by an electronic circuit or a positive temperature coefficient device, and 60 s in other cases.

Table 2C – Limits for power sources with an overcurrent protective device

Output voltage [a] (U_{oc})		Output current [b d] (I_{sc})	Apparent power [c d] (S)	Current rating of overcurrent protective device [e]
V a.c.	V d.c.	A	VA	A
≤ 20	≤ 20	≤ 1 000/U_{oc}	≤ 250	≤ 5,0
20 < U_{oc} ≤ 30	20 < U_{oc} ≤ 30			≤ 100/U_{oc}
–	30 < U_{oc} ≤ 60			≤ 100/U_{oc}

专心、专业，通全球

产品测试要求

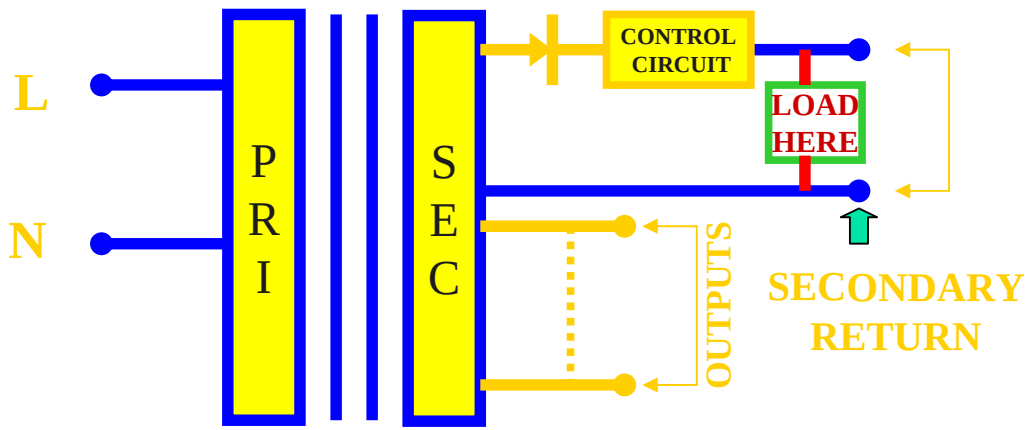
附图 (2.5)

TEST CONDITIONS

INPUT – The worse supply voltage, including
-10% and +6% (+10% in China)

REQUIREMENTS

Table 2B or 3C defined in standards for details



产品测试要求

接地导通测试 Grounding Continuity Test (2.6.3.4)

针对Class I产品:

- 测试电流值至少2倍的国家线路电路且测试时间至少120s.
(16A or less, the test current is 200% of the protective current rating applied for 120s);

- 阻抗 < 0.1 Ω。

- The test voltage shall not exceed 12V.

产品测试要求

接地导通測試 (Cont.) (2.6.3.4)

Table 2E – Test duration, a.c. mains supplies

PROTECTIVE CURRENT RATING of the circuit (I_{pc}) A	Duration of the test min
≤ 30	2
30 < I_{pc} ≤ 60	4
60 < I_{pc} ≤ 100	6
100 < I_{pc} ≤ 200	8
> 200	10

产品测试要求

附图 (2.6.3.4)

TEST CONDITIONS

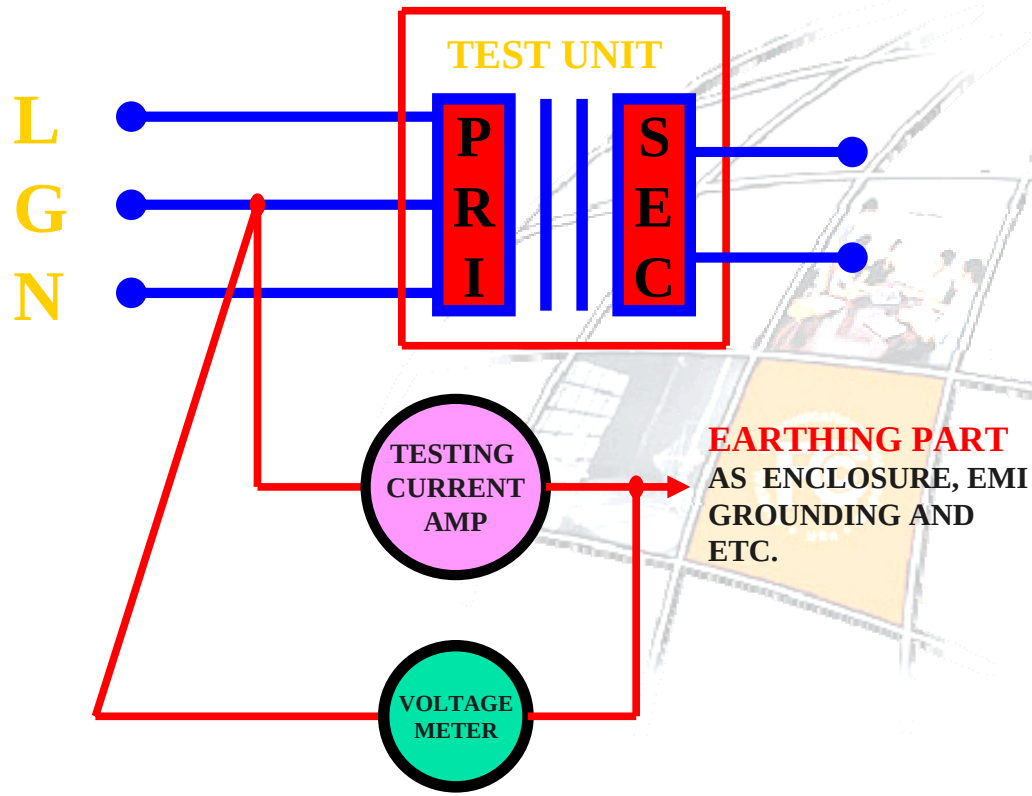
1. TEST CURRENT – 16A or less, (200%)
2. TEST VOLTAGE – Can't exceed 12V

METHOD

Input ground to earthing parts

REQUIREMENTS

Can't exceed 0.1ohm



产品测试要求

湿度测试 Humidity Test (Clause 2.9.2)

完整样品与变压器单体, 置于 20-30ºC, 湿度 91- 95% 之恒温恒湿槽48 小时后, 进行绝缘耐压测试。

(40 ºC，120hrs 为新加坡差异）

TEST CONDITIONS

Temperature :

a. 20°C - 30°C

Humidity

a. 91% - 95%;

DURATION

a. For a period of 48 hours;

REQUIREMENTS

No insulation breakdown for dielectric strength test and no spacing reduced

专心、专业，通全球

产品测试要求

电源线拉力测试 Strain Relief Test (3.2.6, Table 3C)

于外壳烤箱测试(70ºC, 7 hrs)后执行拉力25 次, 每次一秒。测试完毕后不可有超过2 mm之位移。

Table 3C – Physical tests on power supply cords

Mass (M) of the equipment kg	Pull N
Up to and including 1	30
Over 1 up to and including 4	60
Over 4	100

产品测试要求

产品稳定性测试 Stability and Mechanically Hazard Test (4.1)

1).只要求7kg以上（含7kg)的产品才需此稳定度测试。

2).产品正常使用状况下顷斜 10º 时不可顷倒。

3).大于 25 公斤之落地式产品，以自地板起不超过 2 M 高度处以任何方向施以本身重量 20% 之力(但不大于 250 N/55磅) 时，不可倾倒。

4). 落地式产品，以 800 N (180 磅) 之力向下施力时，不可失去平衡。

产品测试要求

产品固定力测试 Steady Force Test (4.2.2, 4.2.3, 4.2.4)

1). 所有零件, 除了外壳施以10N之力5秒

2). 内部外壳且使用者可触及之部分, 以测试手指探棒施以 30 N 之力五秒。

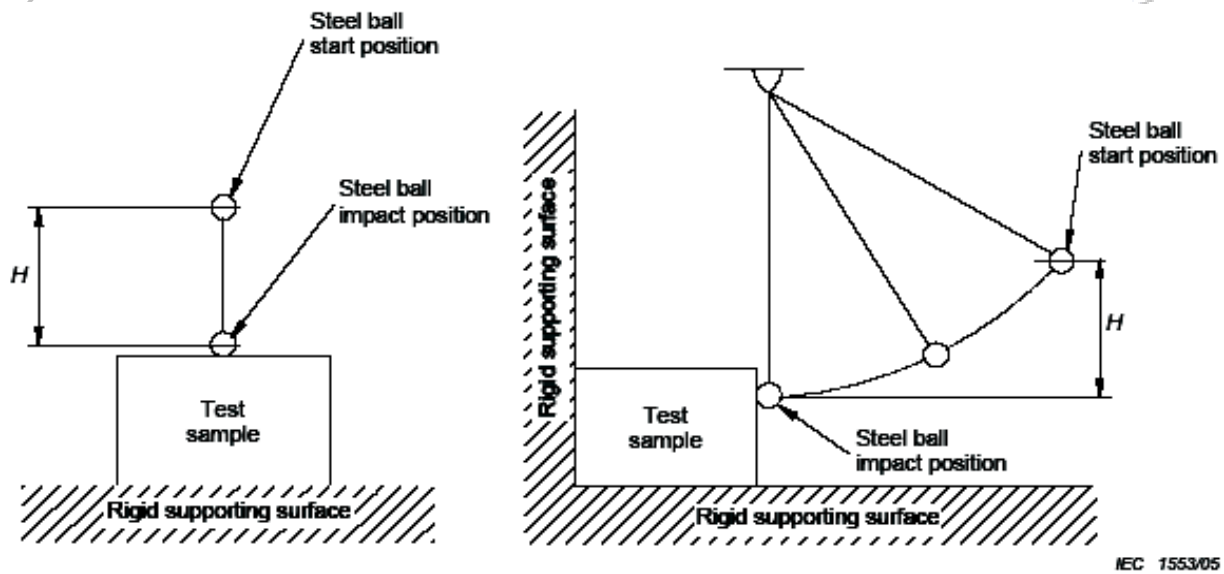
3). 外部外壳以 30 mm直径球面施以 250 N之压力五秒。

产品测试要求

撞击测试 Impact Test (Clause 4.2.5)

1). 不适用于手握式 (hand-held) 与直接插入式 (direct plug-in)产品。

2). 以50 mm直径钢球 (重约500±25 g) 于1.3 m处垂直撞击不同部位三次。若撞击测试后有破洞，则以手指探棒以30 N (6.75 磅)力推，探棒不得碰触带电零件。



产品测试要求

落地测试 Drop Test (Clause 4.2.6)

1). 仅适用于手握式 (hand-held) 产品与直接插入式(direct plug-in)產品;

2). 移动式产品(Transportable Egurprat);

3). 桌上型产品(小于5Kg, 且为三条件下任一产品).
The height of the drop shall be :

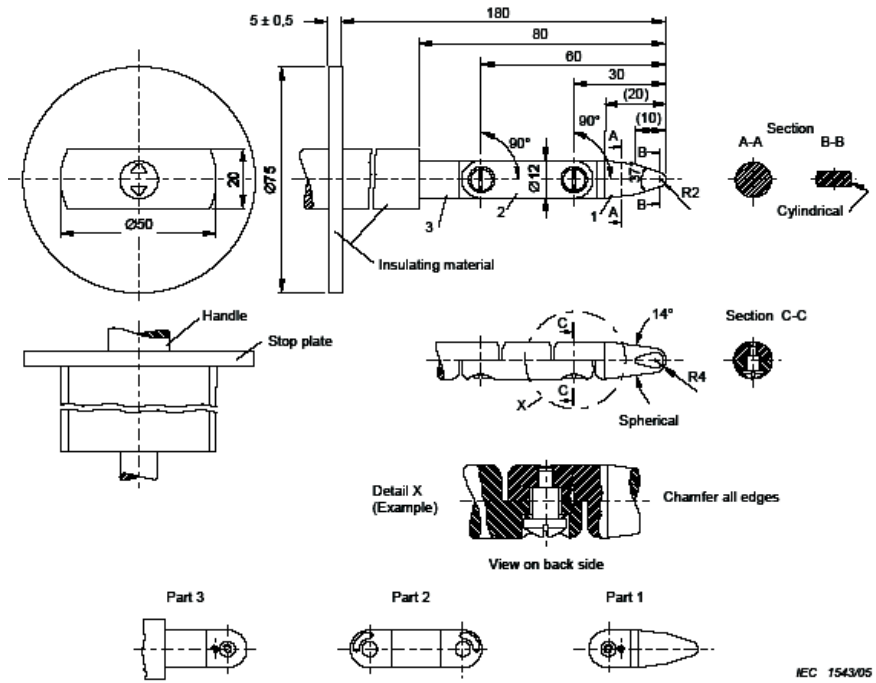
- 750mm ± 10mm for desk-top equipment as described above;
- 750mm ± 10mm for Movable equipment as described above;
- 1000mm ±10mm for HAND-HELD EOUIPMENT, DIRECT PLUG EOUIPMENT and TRANS-PORTABLE EOUIPMENT

4). 自750mm处自由落下于19-20mm厚之硬木地板上。

产品测试要求

落地测外壳烤箱测试 Stress Relief Test (Clause 4.2.7)

每种不同材质外壳均需于完整机台以正常使用位置于烤箱中烤7小时，温度设定在「温度测试」时量得之外壳温度+10K，但不得小于70ºC,结果不得因扭曲变形造成开口，可用手指探棒触及带电零件。



产品测试要求

载重测试 Loading Test (4.2.10)

产品若设计为装置于墙壁或天花板，需跟据使用手册固定好后，能耐重3倍之产品重量之力 (或不小于5 N) 一分钟，而不会导致固定装置破裂或损坏。

产品测试要求

温度测试 Temperature Tests (Clause 4.5.2, Table 4B)

1). 热耦线末端应以熔接结合。

2). 机器满载并正常运作, 于标示输入电压值 +6% 与 -10% 测量。DC Mains supply于标示输入电压值 +20% 与 -15%测量.(clause 1.4.5)

3). 输入电压为230 Vac或含中国大陆deviation时，需以标示电压值 ±10% 测量。

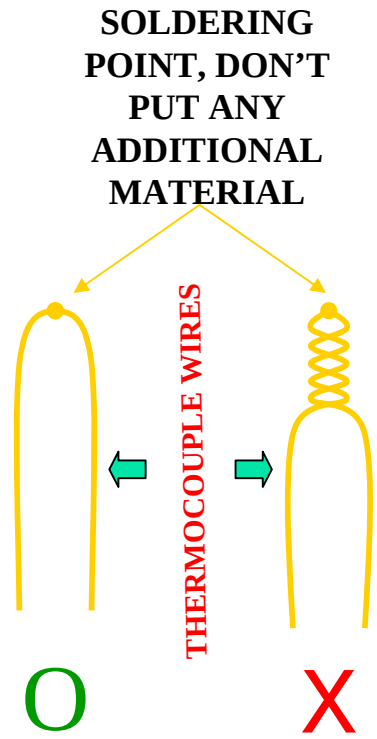
4). 通常测量变压器(线圈、铁心)，功率晶体，散热片， X/Y 电容，大电解电容，外壳上侧内部，发热零件下之 PCB。

Temperature measurement conditions:

T	is the temperature of the given part measured under the prescribed test conditions;
T_{max}	is the maximum temperature specified for compliance with the test;
T_{amb}	is the ambient temperature during test;
T_{ma}	is the maximum ambient temperature permitted by the manufacturer's specification, or 25 °C, whichever is greater.

产品测试要求

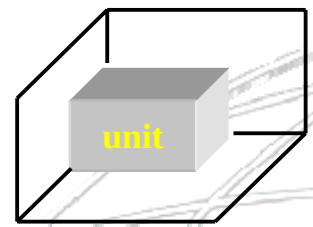
附图 (Clause 4.5.2)



TEST CONDITIONS

INPUT

a. -10% and +6%; or 115V/230V ± 10%



OUTPUT – Normal max. load

METHOD OF IEC61010 -

Test corner should be provided that consists of two walls at right angles and a floor, all of plywood approximately **10 mm thick for built-in products** , **20 mm thick for complete system** and **painted matte black**, the **dimension** of test corner should be **at least 15% greater than those of equipment** under test. Please see figure for understanding. Equipment normally used on a floor as near to the walls as possible.

REQUIREMENTS

Can't exceed the temperature limit defined in standards for details

产品测试要求

球压测试 Ball Pressure test(4.5.5)

FOR THERMOPLASTIC PARTS

直接接触危险电压之每种不同塑料材质均需下图之球压测试制具，于烤箱中烤1小时, 温度设定在「温度测试」时量得之塑料温度(T-Tamb+Tma+15 °C) ±2 °C, 但不得小于125ºC。塑料凹陷区域不得超过2 mm直径。

产品测试要求

附图 (Clause 4.5.5)

TEST CONDITIONS

1. (T-Tamb+Tma+15 °C) ±2 °C
2. Or 125°C at primary voltage
3. For a period of 1 hour
4. Down to room ambient within 10s by immersion in cold water

METHOD

- Diameter of steel ball = 5 mm
- Press on this surface by a force = 20 N

REQUIREMENTS

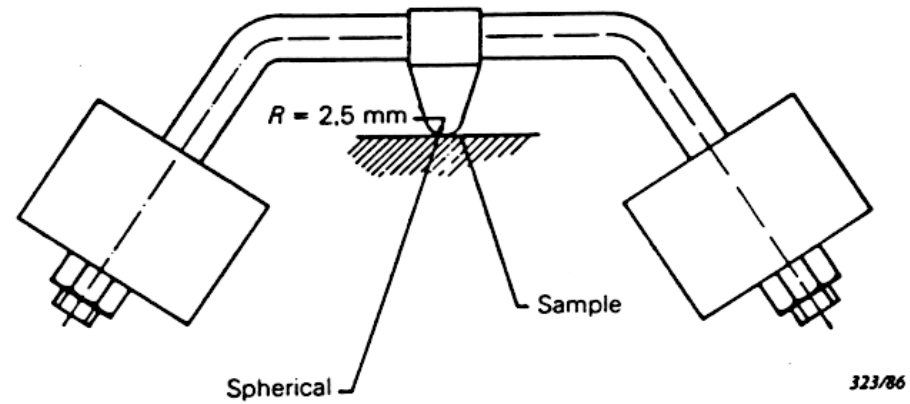
The diameter of impression < 2mm

TEST CONDITIONS

1. Tmax + 10K ≥ 70°C
2. For a period of 7 hours
3. Cool to room temperature

REQUIREMENTS

No any exposure of hazardous parts



产品测试要求

接触电流测试 Touch Current Test (Clause 5.1 Table 5A)

以隔绝变压器将产品与市电隔绝开, 于标示输入电压值 +6% 测量primary (line 或neutral)对可触及外壳金属(或金属箔)间漏电流。

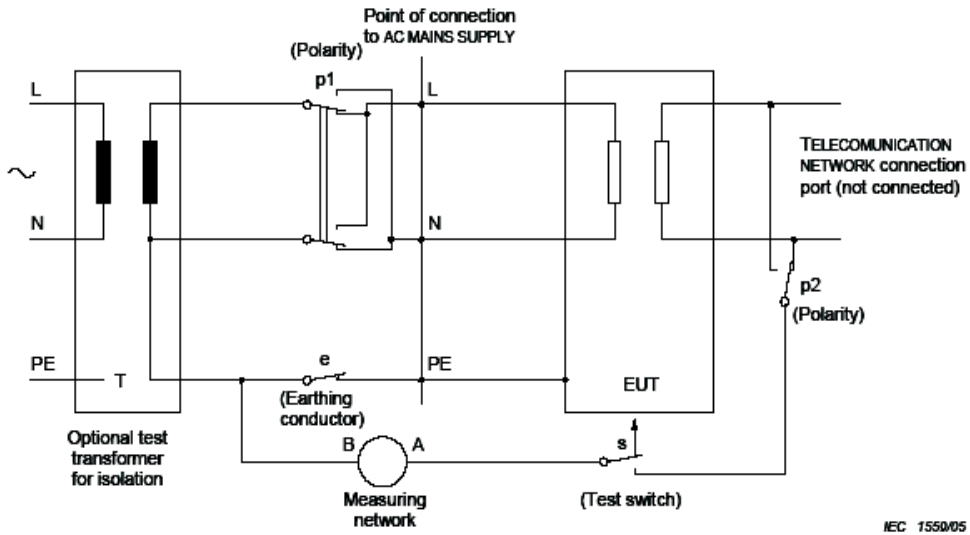
应使用Simpson 228-2，或内部结构如Figure 5A者。

0.25 mA	非接地 产品。
0.75 mA	手握式产品。
3.5 mA	移动式产品或 A 型插头固定式产品; 或不符合 Clause 5.1.7之固定式产品或B 型插头固定式产品, 输入电流之5% 符合 Clause 5.1.7之固定式产品或B 型插头式产品

产品测试要求

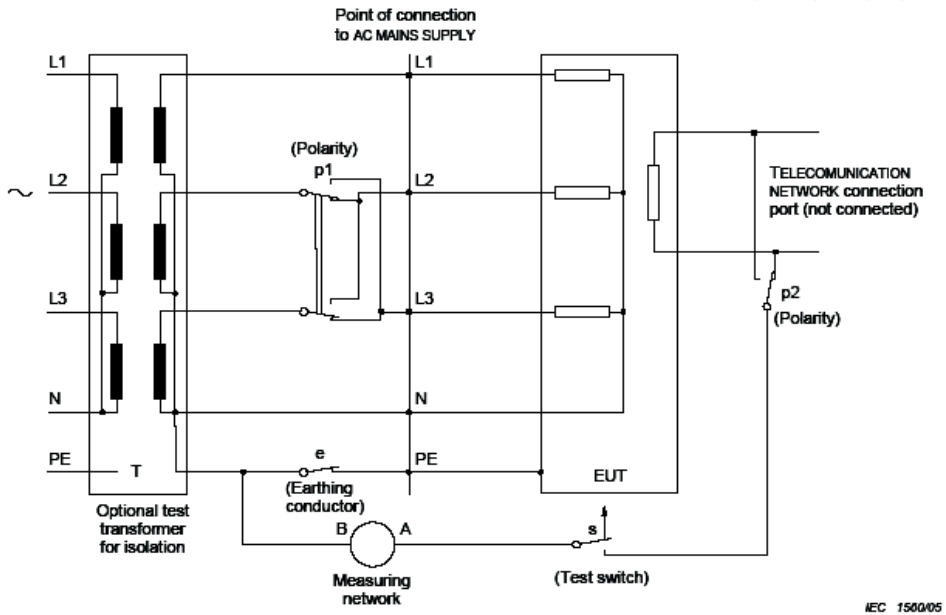
附图(Figure5A/5B)

Figure 5A – Test circuit for touch current of single-phase equipment on a star TN or TT power supply system



NOTE *This figure is derived from Figure 6 of IEC 60990.*

Figure 5B – Test circuit for touch current of three-phase equipment on a star TN or TT power supply system



产品测试要求

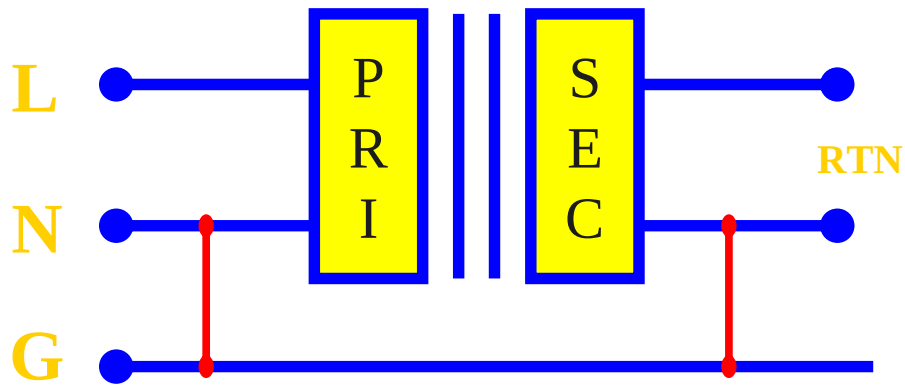
工作电压测试RMS/Peak WORKING VOLTAGE (2.10.2.2/2.10.2.3)

TEST CONDITIONS

1. INPUT – The highest normal input voltage
2. OUTPUT – Normal max. load

METHOD

Short ground, neutral and secondary return together



产品测试要求

绝缘耐压测试Electric Strength Test (Clause 5.2)

1) . 于产品热机状态测试(温度测试后)。

2). 于产品 48 小时humidity conditioning 后测试。

3). 于产品每一个异常测试 (abnormal test) 后测试。

4). 对每一个线圈类零件单体测试。

5). 每一个驰返变压器须跟据附表做绝缘耐压测试。

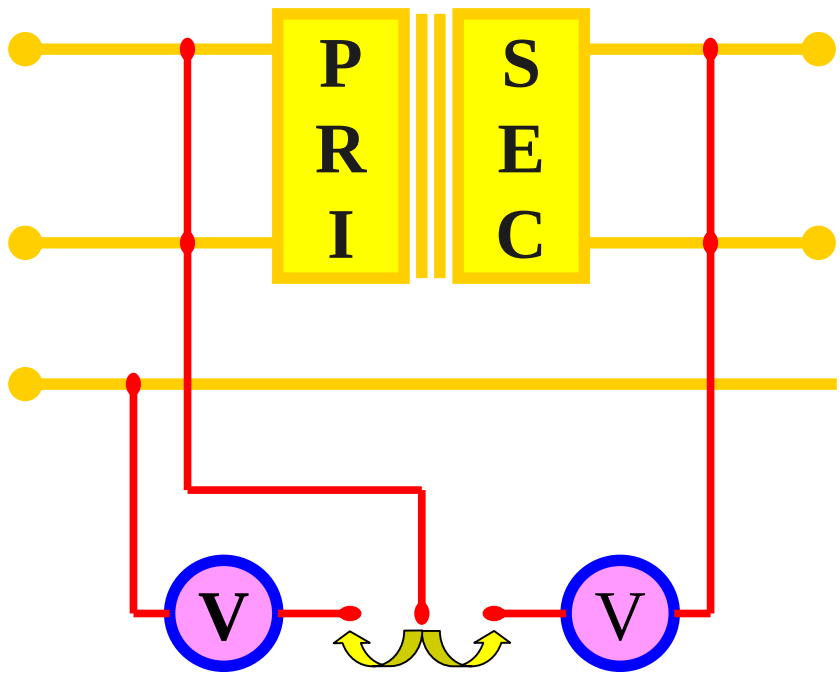
6). 绝缘耐压测试计无 cut-off current 限制, 每次测试时间为 60 秒, ac , 或乘 1.414 为 dc。

Notes: Routine tests for Factory

Where, elsewhere in this standard, ROUTINE TESTS are required to be conducted in accordance with 5.2.2, it is permitted to reduce the duration of the electric strength test to 1 s and to reduce the test voltage permitted in Table 5C, if used, by 10 %.

产品测试要求

附图 (Clause 5.2)



DANGER!
DON'T TOUCH
DURING TESTING

METHOD
- Short primary circuits together
- Short secondary circuits together

TEST LOCATION
- Primary to secondary
- Primary to ground
- Primary /secondary to core

REQUIREMENTS
No insulation breakdown

产品测试要求

异常测试 Abnormal operating and fault conditions (Clause 5.3, Annex C)

1). 以自耦变压器配合 20 A UL Listed circuit breaker, 产品上覆盖一层纱布 (cheese cloth, UL/CSA only), 产品下铺一层纸 (tissue paper, UL/CSA only), 并接3 A 接地保险丝 (UL/CSA only)。机器正常动作, 以最大之标示输入电压值与频率测量之。

2). 若测试结果由零件开路而造成终止, 必要时可更换新零件重复测试二次 (总共三次, UL/CSA only)

Blocked opening / fan locked	**Voltage mismatch**	机器夹纸
马达或风扇**lock rotor**	零件短 / 开路	输出短路
输出过载	变压器次级线圈短路	变压器次级线圈过载

产品测试要求

过载测试 Overload Test (Clause 5.3.3, Annex C, Table C1)

1). 产品输出端过载 (每次一組)。

2). 变压器次级线圈过载 (每次一組)。

Table C.1 – Temperature limits for transformer windings

Maximum temperature °C

Method of protection	Thermal class							
	105 (A)	120 (E)	130 (B)	155 (F)	180 (H)	200	220	250
Protection by inherent or external impedance	150	165	175	200	225	245	265	295
Protection by protective device that operates during the first hour	200	215	225	250	275	295	315	345
Protection by any protective device:								
– maximum after first hour	175	190	200	225	250	270	290	320
– arithmetic average during the 2nd hour and during the 72nd hour	150	165	175	200	225	245	265	295
The designations A to H, formerly assigned in IEC 60085 to thermal classes 105 to 180, are given in parentheses.								

产品测试要求

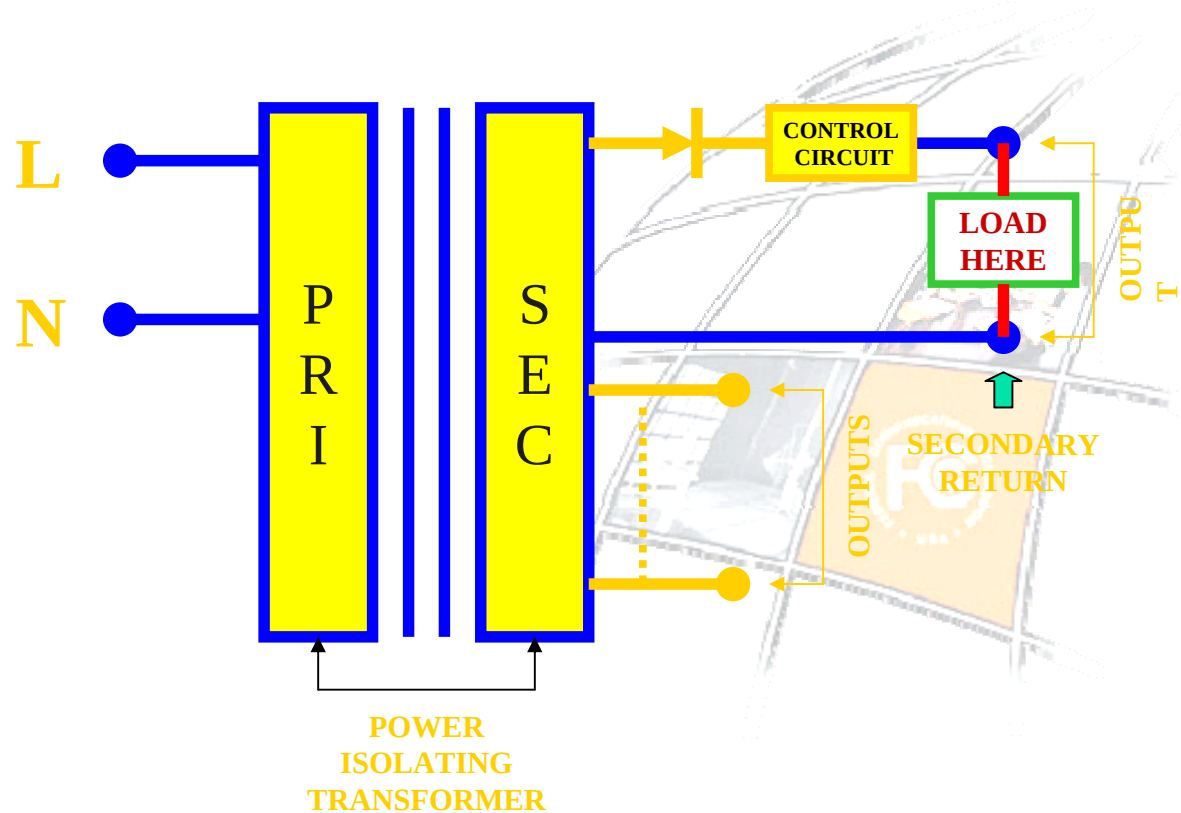
附图 (Output Overload test. Clause 5.3.1)Part 1

TEST CONDITIONS

1. INPUT – Normal input voltage
2. OUTPUT – Gradually increasing this load by10 % until results acquired or temperature stable

REQUIREMENTS

- ON POWER ISOLATING TRANSFORMER – Can't exceed the abnormal temperature limit as defined in standard
- ON UNIT – No insulation breakdown, no any hazards



专心、专业，通全球

产品测试要求

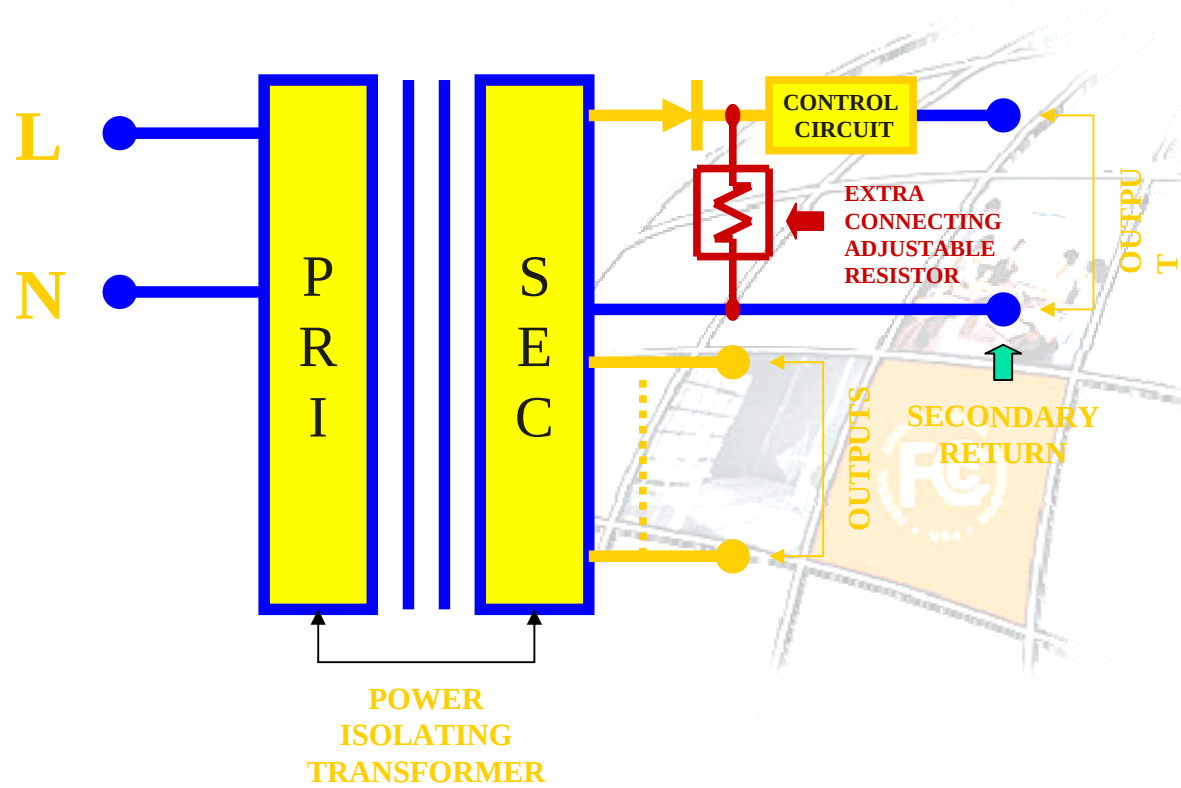
附图 (Transformer Overload test. Clause 5.3.3) Part 2

TEST CONDITIONS

1. INPUT – Normal input voltage
2. OUTPUT – Max. output load
3. EXTRA CONNECTING RESISTOR LOAD – Gradually increasing this load by 10% until results acquired or temperature stable

REQUIREMENTS

- ON POWER ISOLATING TRANSFORMER – Can't exceed the abnormal temperature limit as defined instandards for details
- ON UNIT – No insulation breakdown, no any hazards



EMC Parts

电源适配器和LED驱动器EMC检测&认证专题研讨会

此次EMC检测&认证研讨会的主要内容包括电源适配器和LED驱动器EMC检测&认证的要求.

电源适配器通常属于ITE（信息资讯类设备）， CE EMC检测依照 EN 55022 + EN 55024 + EN 61000-3-2 + EN 61000-3-3，美国FCC检测依照 FCC PART 15B。如果电源适配器指定应用在家电或AV类的产品中的话，CE EMC检测依照 EN 55014-1 + EN 55014-2 + EN 61000-3-2 + EN 61000-3-3。

LED驱动器是属于LED灯具产品，CE EMC检测依照 EN 55015 + EN 61547
+ EN 61000-3-2 + EN 61000-3-3，美国FCC检测依照FCC PART 18.

下面主要展开各个标准的项目内容进行讲解.

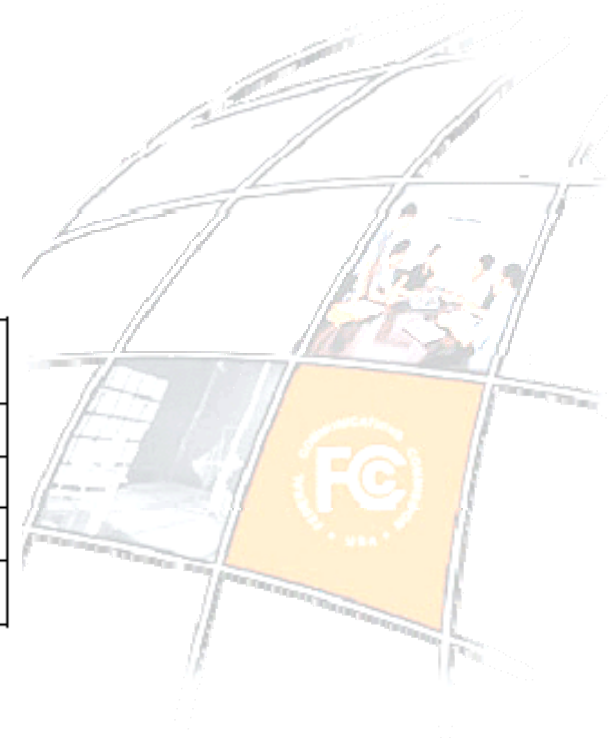
电源适配器和LED驱动器EMC检测&认证专题研讨会

一.电源适配器主要讲解ITE的CE/FCC 要求, CE 的要求如下:

1. Mains terminal disturbance voltage.(传导骚扰）

Table 1 – Limits for conducted disturbance at the mains ports of class A ITE

Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	79	66
0,50 to 30	73	60
NOTE The lower limit shall apply at the transition frequency.		



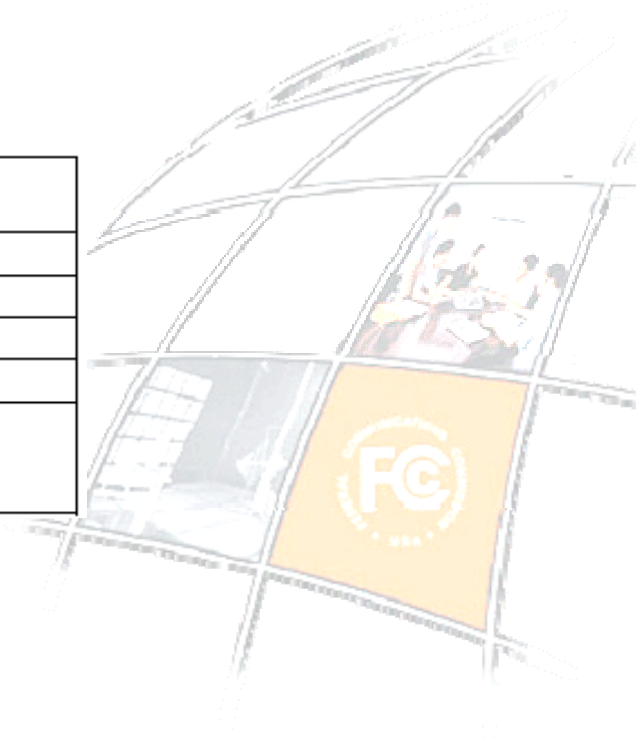
电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 2 – Limits for conducted disturbance at the mains ports of class B ITE

Frequency range MHz	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

NOTE 1 The lower limit shall apply at the transition frequencies.

NOTE 2 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.



电源适配器和LED驱动器EMC检测&认证专题研讨会

2. Radiated disturbance （辐射骚扰）

a). Below 1GHz.

Table 5 – Limits for radiated disturbance of class A ITE at a measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB(μV/m)
30 to 230	40
230 to 1 000	47
NOTE 1 The lower limit shall apply at the transition frequency. NOTE 2 Additional provisions may be required for cases where interference occurs.	

Table 6 – Limits for radiated disturbance of class B ITE at a measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB(μV/m)
30 to 230	30
230 to 1 000	37
NOTE 1 The lower limit shall apply at the transition frequency. NOTE 2 Additional provisions may be required for cases where interference occurs.	

电源适配器和LED驱动器EMC检测&认证专题研讨会

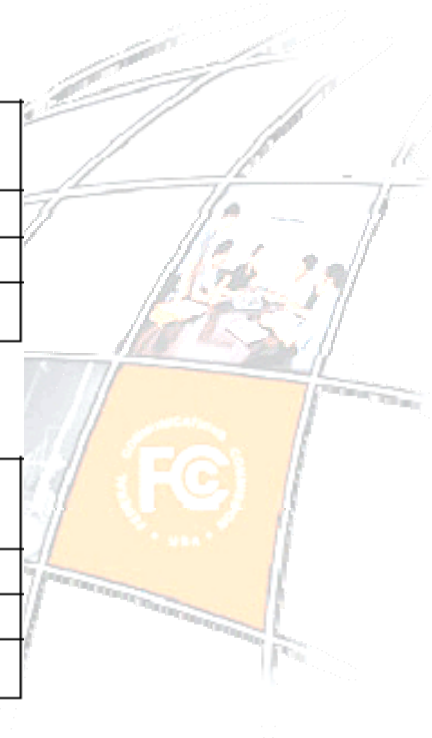
b). Above 1GHz.

Table 8 – Limits for radiated disturbance of Class A ITE at a measurement distance of 3 m

Frequency range GHz	Average limit dB(μV/m)	Peak limit dB(μV/m)
1 to 3	56	76
3 to 6	60	80
NOTE The lower limit applies at the transition frequency.		

Table 9 – Limits for radiated disturbance of Class B ITE at a measurement distance of 3 m

Frequency range GHz	Average limit dB(μV/m)	Peak limit dB(μV/m)
1 to 3	50	70
3 to 6	54	74
NOTE The lower limit applies at the transition frequency.		



电源适配器和LED驱动器EMC检测&认证专题研讨会

- **Conditional testing procedure:**

The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.

If the highest frequency of the internal sources of the EUT is less than 108 MHz, the measurement shall only be made up to 1 GHz.

If the highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz, the measurement shall only be made up to 2 GHz. ⟨A1⟩

⟨A1⟩ If the highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz, the measurement shall only be made up to 5 GHz.

If the highest frequency of the internal sources of the EUT is above 1 GHz, the measurement shall be made up to 5 times the highest frequency or 6 GHz, whichever is less. ⟨A1⟩

电源适配器和LED驱动器EMC检测&认证专题研讨会

3. Electrostatic discharges (ESD, 静电）

The test procedure shall be in accordance with IEC 61000-4-2

静电放电仅应对设备在正常使用期间可能被触及到的点或面施加，包括在用户手册中规定的用户可能触及的部位，例如：更换色带和更换纸卷时用户可能触及到的部位。

应通过两种方式进行放电：

a）对导电表面和耦合板接触放电：

EUT 应承受至少 200 次静电放电，其中正、负极性各 100 次，且这些放电应至少在 EUT 的四个试验点上进行（每点至少 50 次）。其中一个试验点应承受水平耦合板前边缘中心至少 50 次间接（接触）放电。其余三个试验点每点应至少接受 50 次直接接触放电。如果没有直接接触试验点，则应以间接放电的方式至少进行 200 次放电（见 GB/T 17626.2—1998 对垂直耦合板（VCP）进行放电的方法）。试验的最大重复率为 1 次/s。

b）对孔和缝、绝缘面进行空气放电：

当对 EUT 的某些部位无法进行接触放电试验时，应对设备进行研究并辨别使用者容易接触且易出现故障的点，例如：按键边缘的缝隙，或键盘和电话手柄的缝隙。这些部位应按空气放电方式进行试验。关于表面涂漆部分可参见 GB/T 17626.2。上述工作应局限在使用者正常操作时会触到的区域。对每个区域所选择的试验点应进行至少 10 次单次空气放电。

电源适配器和LED驱动器EMC检测&认证专题研讨会

对于表面涂漆的情况，应采用以下的操作程序：

如设备制造厂家未说明涂膜为绝缘层，则发生器的电极头应穿入漆膜，以便与导电层接触。如厂家指明涂漆是绝缘层，则应只进行空气放电。这类表面不应进行接触放电试验。

电源适配器和LED驱动器EMC检测&认证专题研讨会

4. Electrical fast transients (EFT, 电快速瞬变脉冲群)

The test procedure shall be in accordance with IEC 61000-4-4

——设备有多个相同的端口时，仅对其中之一进行试验。
——多芯电缆，例如 50 对电信电缆，应作为单根电缆进行试验。本项试验不应将电缆分开或分组。
——连接到由制造厂规定的预期长度不超过 3 m 的数据电缆的接口端口不进行此项试验。

电源适配器和LED驱动器EMC检测&认证专题研讨会

5. Continuous radiated disturbance (RS, 辐射抗扰度)

The test procedure shall be in accordance with IEC 61000-4-3

辐射场试验的推荐频率范围为 80 MHz～1 000 MHz。连续波传导试验的推荐频率范围为 0.15 MHz～80 MHz。辐射试验的起始频率可低于 80 MHz，在这种情况下，连续波传导试验（如果适用）仅需进行到这一频率。

在每一频率的驻留时间不应少于使 EUT 动作并作出响应所必需的时间，然而扫描期间在每一频率上驻留时间不应超过 5 s。

试验时，EUT 的放置应使其四个面按顺序暴露在电磁场中，并在每个位置考核 EUT 的性能。

电源适配器和LED驱动器EMC检测&认证专题研讨会

6. Continuous conducted disturbance (CS, 传导抗扰度）

The test procedure shall be in accordance with IEC 61000-4-6

7. Power-frequency magnetic fields (工频磁场)

The test procedure shall be in accordance IEC 61000-4-8

EUT 应按满足其功能要求放置和连接，并放置在磁场线圈的中心(浸没法，immersion method)。应使用设备制造厂所提供的电缆，如果设备本身没有电缆，可选择对所涉及信号合适的电缆代替。物理尺寸大的设备不需要完全放置在磁场中，仅需要将敏感的装置(例如：CRT 监视器，如果仅仅它是敏感的部分)放置在磁场中。对于这种情况如果 CRT 监视器与 ITE 连成一个系统，则 CRT 监视器或敏感装置可单独进行试验。

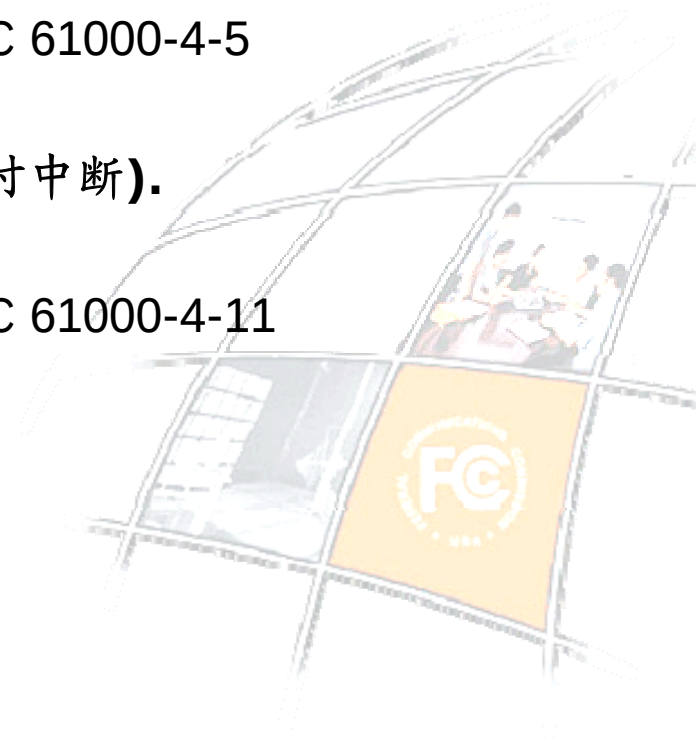
电源适配器和LED驱动器EMC检测&认证专题研讨会

8. Surges (浪涌冲击).

The test procedure shall be in accordance with IEC 61000-4-5

9. Voltage dips and interruptions (电压暂降和短时中断).

The test procedure shall be in accordance with IEC 61000-4-11



电源适配器和LED驱动器EMC检测&认证专题研讨会

10. Harmonic current emission (equipment input current ≦16A per phase).

The test procedure shall be in accordance with IEC 61000-3-2

For the purpose of harmonic current limitation, equipment is classified as follows:

Class A:

- balanced three-phase equipment;
- household appliances, excluding equipment identified as class D;
- tools, excluding portable tools;
- dimmers for incandescent lamps;
- audio equipment.

Equipment not specified in one of the three other classes shall be considered as class A equipment.

电源适配器和LED驱动器EMC检测&认证专题研讨会

Class B:

- portable tools;
- arc welding equipment which is not professional equipment.

Class C:

- lighting equipment.

Class D:

Equipment having a specified power according to 6.2.2 less than or equal to 600 W, of the following types:

- personal computers and personal computer monitors;
- television receivers.

电源适配器和LED驱动器EMC检测&认证专题研讨会

11. Voltage changes, voltage fluctuations and flicker in public low voltage supply system, equipment input current ≦16A per phase.

— the value of P_{st} shall not be greater than 1,0;
— the value of P_{lt} shall not be greater than 0,65;
— the value of $d(t)$ during a voltage change shall not exceed 3,3 % for more than 500 ms;
— the relative steady-state voltage change, d_c, shall not exceed 3,3 %;
— the maximum relative voltage change, d_{max}, shall not exceed;

电源适配器和LED驱动器EMC检测&认证专题研讨会

12. Performance criteria (性能判据).

一般性能判据

由工厂规定并在试验期间评定的一些功能的例子如下，但不限于此：

——基本工作方式和状态；

——所有外部设备(硬盘、软盘、打印机、键盘、鼠标器等)的访问测试；

——软件执行质量；

——数据显示和传输质量；

——语音传输质量。

电源适配器和LED驱动器EMC检测&认证专题研讨会

性能判据 A

无需操作人员介入，设备应能按预期持续工作。当按预期使用设备时，不允许出现低于制造厂规定的性能等级的性能降级或功能损失。可以用允许的性能降低来代替性能等级。如果制造厂不规定最低性能等级和允许的性能降低，则可从产品说明书或技术文件中得知，并且用户有理由要求所使用的设备达到此规定。

性能判据 B

在试验开始之后，无需操作人员介入，设备应能继续按预期工作。当按预期使用设备时，在施加骚扰之后，不允许出现低于制造厂规定的性能等级的性能降级或功能损失。可以用允许的性能降低来代替性能等级。

在试验期间，性能降级是允许的。然而在试验之后，工作状态不应改变，储存的数据不应丢失。

如果制造厂不规定最低性能等级和允许的性能降级，则可从制造厂说明书或技术文件中得知，并且用户有理由要求所使用的设备达到此规定。

性能判据 C

允许出现可自行恢复或能由使用者根据制造厂说明操作之后使其恢复的功能损失。

存储在非易失性存储器内的或由备用电池保护的功能和(或)信息不应丢失。

电源适配器和LED驱动器EMC检测&认证专题研讨会

13. EMS testing requirement.

Table 1 — Immunity, enclosure port

	Environmental phenomenon	Test specification	Units	Basic standard	Remarks	Performance criterion
1.1	Power-frequency magnetic field	[C] 50 1 [C]	Hz A/m (r.m.s.)	IEC 61000-4-8	See[1)]	A See Annex B
1.2	Radio-frequency electromagnetic field Amplitude modulated	[C] 80-1 000 3 80 [C]	MHz V/m (unmodulated, r.m.s) % AM (1 kHz)	IEC 61000-4-3	[C] The test level specified is prior to modulation See[2)] [C]	A
1.3	Electrostatic discharge	4 (Contact discharge) 8 (Air discharge)	kV (charge voltage) kV (charge voltage)	IEC 61000-4-2		B

[1)] Applicable only to equipment containing devices susceptible to magnetic fields, such as CRT monitors, Hall elements, electrodynamic microphones, magnetic field sensors, etc.

[2)] The frequency range is scanned as specified. However, when specified in Annex A, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies are: 80, 120, 160, 230, 434, 460, 600, 863 and 900 MHz (±1 %).

[C] *Note deleted* [C]

电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 4 — Immunity, input a.c. power ports (including equipment marketed with a separate a.c./d.c power converter)

	Environmental phenomenon	Test specification	Units	Basic standard	Remarks	Performance criterion
[C] 4.1	Radio-frequency continuous conducted	0,15–80 3 80	MHz V (unmodulated, r.m.s) % AM (1 kHz)	IEC 61000-4-6	See[1]	A [C]
4.2	Voltage dips	>95 0,5	% reduction period	IEC 61000-4-11	See[2]	B
		30 25	% reduction periods			C
4.3	Voltage interruptions	>95 250	% reduction periods	IEC 61000-4-11	See[2]	C
4.4	Surges	1,2/50 (8/20) 1 line to line 2 line to earth (ground)	Tr/Th µs kV (peak) kV (peak)	IEC 61000-4-5	See[3]	B
4.5	Fast transients	1,0 5/50 5	kV (peak) Tr/Th ns Repetition frequency kHz	IEC 61000-4-4		B

[1] The frequency range is scanned as specified. However, when specified in Annex A, an additional comprehensive functional test shall be carried out at a limited number of frequencies. The selected frequencies for conducted test are: 0,2; 1; 7,1; 13,56; 21; 27,12 and 40,68 MHz (±1 %).
[2] Changes to occur at 0 degree crossover point of the voltage waveform.
[3] When the manufacturer specifies protection measures and it is impractical to simulate these measures during the tests, then the applied test levels shall be reduced to 0,5 kV and 1 kV.
[C] *Note deleted* [C]

电源适配器和LED驱动器EMC检测&认证专题研讨会

二. 电源适配器FCC 要求如下:

1. Power line conducted emission (传导骚扰）

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

电源适配器和LED驱动器EMC检测&认证专题研讨会

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	79	66
0.5-30	73	60

电源适配器和LED驱动器EMC检测&认证专题研讨会

2. Radiated emission (辐射骚扰).

(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of Emission (MHz)	Field Strength (microvolts/meter)
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

电源适配器和LED驱动器EMC检测&认证专题研讨会

(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:

Frequency of Emission (MHz)	Field Strength (microvolts/meter)
30 - 88	90
88 - 216	150
216 - 960	210
Above 960	300

电源适配器和LED驱动器EMC检测&认证专题研讨会

三. LED 驱动器CE的要求。

1. EMI 要求如下:

1). Main terminals:

Table 2a – Disturbance voltage limits at mains terminals

Frequency range	Limits dB(μV)[a]	
	Quasi-peak	Average
9 kHz to 50 kHz	110	–
50 kHz to 150 kHz	90 to 80[b]	–
150 kHz to 0,5 MHz	66 to 56[b]	56 to 46[b]
0,5 MHz to 5,0 MHz	56[c]	46[c]
5 MHz to 30 MHz	60	50

[a] At the transition frequency, the lower limit applies.

[b] The limit decreases linearly with the logarithm of the frequency in the ranges 50 kHz to 150 kHz and 150 kHz to 0,5 MHz.

[c] For electrodeless lamps and luminaires, the limit in the frequency range of 2,51 MHz to 3,0 MHz is 73 dB(μV) quasi-peak and 63 dB(μV) average.

NOTE In Japan, the limits in the frequency range 9 kHz to 150 kHz do not apply.

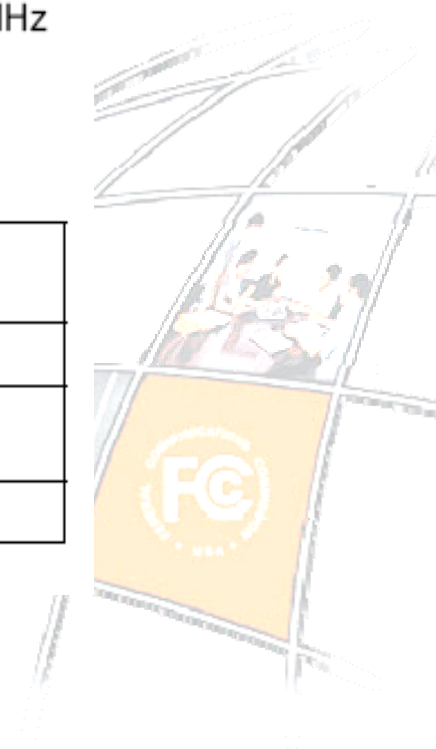
电源适配器和LED驱动器EMC检测&认证专题研讨会

The limits of the load terminal disturbance voltage for the frequency range 150 kHz to 30 MHz are given in Table 2b.

Table 2b – Disturbance voltage limits at load terminals

Frequency range MHz	Limits dB(µV)[a]	
	Quasi-peak	Average
0,15 to 0,50	80	70
0,50 to 30	74	64

[a] At the transition frequency, the lower limit applies.



电源适配器和LED驱动器EMC检测&认证专题研讨会

The limits of the control terminal disturbance voltage for the frequency range 150 kHz to 30 MHz are given in Table 2c.

Table 2c – Disturbance voltage limits at control terminals

Frequency range MHz	Limits dB(µV)	
	Quasi-peak	Average
0,15 to 0,50	84 to 74	74 to 64
0,50 to 30	74	64

NOTE 1 The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2 The voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the control terminal.

电源适配器和LED驱动器EMC检测&认证专题研讨会

2. Radiated disturbance.

Table 3a – Radiated disturbance limits in the frequency range 9 kHz to 30 MHz

Frequency range MHz	Limits for loop diameter dB(μA)[a]		
	2 m	3 m	4 m
9 kHz to 70 kHz	88	81	75
70 kHz to 150 kHz	88 to 58[b]	81 to 51[b]	75 to 45[b]
150 kHz to 3,0 MHz	58 to 22[b]	51 to 15[b]	45 to 9[b]
3,0 MHz to 30 MHz	22	15 to 16[c]	9 to 12[c]

[a] At the transition frequency, the lower limit applies.

[b] Decreasing linearly with the logarithm of the frequency. For electrodeless lamps and luminaires, the limit in the frequency range of 2,2 MHz to 3,0 MHz is 58 dB(μA) for 2 m, 51 dB(μA) for 3 m and 45 dB(μA) for 4 m loop diameter.

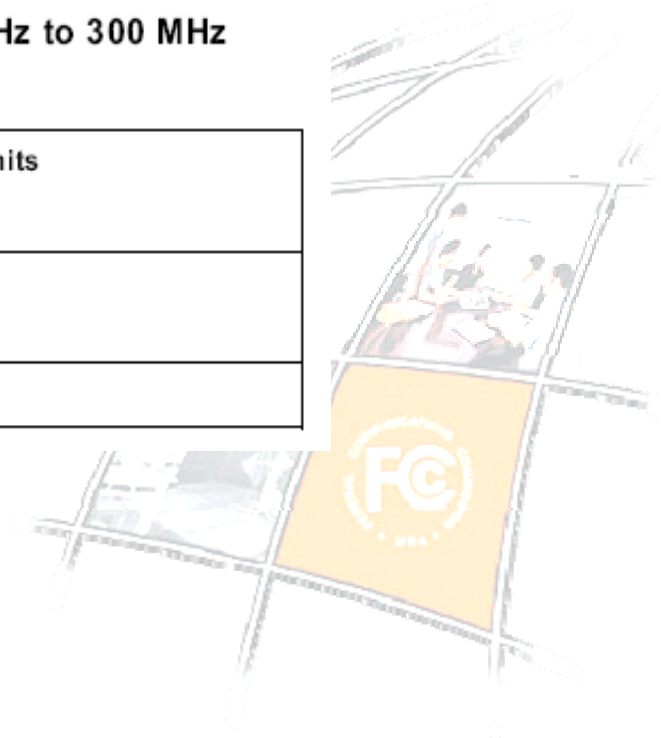
[c] Increasing linearly with the logarithm of the frequency.

NOTE In Japan, the limits for frequencies 9 kHz to 150 kHz do not apply.

电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 3b – Radiated disturbance limits in the frequency range 30 MHz to 300 MHz at a measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB(μV/m)*
30 to 230	30
230 to 300	37
* At the transition frequency, the lower limit applies.	



电源适配器和LED驱动器EMC检测&认证专题研讨会

2. EMS 要求如下：

Table 1 — Electrostatic discharges — Test levels at enclosure port

Characteristics	Test levels
Air discharge Contact discharge	8 kv 4 kv

Table 2 — Radio frequency electromagnetic fields — Test levels at enclosure port

Characteristics	Test levels
Frequency range Test level Modulation	80 MHz to 1 000 MHz 3 V/m (unmodulated) 1 kHz, 80 % AM, sine wave

Table 3 — Power frequency magnetic fields — Test levels at enclosure port

Characteristics	Test levels
Field frequency Test level	50/60 Hz 3 A/m

电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 4 — Fast transients — Test levels at ports for signal and control lines

Characteristics	Test levels
Test level	0,5 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz
NOTE 1 Only applicable to ports interfacing with cables whose total length according to the manufacturer's specification may exceed 3 m. NOTE 2 Change of state commands are not applied during the test.	

Table 5 — Fast transients — Test levels at input and output d.c. power ports

Characteristics	Test levels
Test level	0,5 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz
NOTE Not applicable to equipment not connected to the mains while in use.	

Table 6 — Fast transients — Test levels at input and output a.c. power ports

Characteristics	Test levels
Test level	1 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz

电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 7 — Injected currents — Test levels at ports for signal and control lines

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Test level	3 V r.m.s. (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE Only applicable to ports interfacing with cables whose total length according to the manufacturer's specification may exceed 1 m.	

Table 8 — Injected currents — Test levels at input and output d.c. power ports

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Test level	3 V r.m.s. (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE Not applicable to equipment not connected to the mains while in use.	

Table 9 — Injected currents — Test levels at input and output a.c. power ports

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Test level	3 V r.m.s. (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE Only applicable to ports interfacing with cables whose total length according to the manufacturer's specification may exceed 1 m.	

电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 10 — Surges — Test levels at input a.c. power ports

Characteristics		Test levels		
		Device		
		Self-ballasted lamps and semi-luminaires	Luminaires and independent auxiliaries	
			Input power	
			≤25 W	>25 W
Wave-shape data		1,2/50 µs	1,2/50 µs	1,2/50 µs
Test level	line to line	0,5 kV	0,5 kV	1,0 kV
	line to ground	1,0 kV	1,0 kV	2,0 kV

电源适配器和LED驱动器EMC检测&认证专题研讨会

Table 11 — Voltage dips and interruptions — Test levels at input a.c. power ports

Characteristics	Test levels
Voltage reduction Number of periods	30 % 10

Table 12 — Voltage dips and interruptions — Test levels at input a.c. power ports

Characteristics	Test levels
Voltage reduction Number of periods	100 % 0,5

电源适配器和LED驱动器EMC检测&认证专题研讨会

3. Harmonic current emission.
The test procedure shall be in accordance with IEC 61000-3-2.

4. Voltage changes, voltage fluctuation and interruptions.
The test procedure shall be in accordance with IEC 61000-3-3.

电源适配器和LED驱动器EMC检测&认证专题研讨会

四. LED 驱动器FCC的要求如下:

1. LINE conduction limited

(c) RF lighting devices:

Frequency (MHz)	Maximum RF line voltage measured with a 50μH/50 ohm LISN (μV)
Non-consumer equipment:	
0.45 to 1.6	1000
1.6 to 30	3000
Consumer equipment:	
0.45 to 30	250

电源适配器和LED驱动器EMC检测&认证专题研讨会

2. Radiated emission limited:

(c) The field strength limits for RF lighting devices shall be the following:

Frequency (MHz)	Field strength limit at 30 meters (μV/m)
Non-consumer equipment:	
30–88	30
88–216	50
216–1000	70
Consumer equipment:	
30–88	10
88–216	15
216–1000	20

Thanks you for your good co-operation.

Q&A?

Mr.David Lee david.lee@emtek.com.cn

Mr.David Dai david.dai@emtek.com.cn