SPORTON LAB.

Project No : EC390419-02

VERIFICATION OF COMPLIANCE

Equipment : **AC-DC Switching Power Supply**
Model No. : TXH 060-105、TXH 060-112、TXH 060-115、
TXH 060-124、TXH 060-148、TXH 060-105-U、
TXH 060-112-U、TXH 060-115-U、TXH 060-124-U、
TXH 060-148-U、TXH 060-105-O、TXH 060-112-O、
TXH 060-115-O、TXH 060-124-O、TXH 060-148-O
Applicant : **Traco Electronic AG**
Sihlbruggstrasse 111, 6340 Baar, Switzerland

SPORTON LAB.

I HEREBY **DECLARE THAT :**

The equipment is in accordance with the procedures are given in **EUROPEAN COUNCIL DIRECTIVE 2014/30/EU**. The equipment was **Passed** the test performed according to **European Standard EN 55022:2010/AC:2011 Class B, EN 61000-3-2:2014, EN 61000-3-3:2013 and EN 55024:2010 (IEC 61000-4-2 Edition 2.0 2008-12,IEC 61000-4-3 Edition 3.2 2010-04, IEC 61000-4-4 Edition 3.0 2012-04,IEC 61000-4-5 Edition 3.0 2014-05, IEC 61000-4-6 Edition 4.0 2013-10,IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03) and EN 61000-6-2:2005 (IEC 61000-4-2 Edition 2.0 2008-12, IEC 61000-4-3 Edition 3.2 2010-04, IEC 61000-4-4 Edition 3.0 2012-04, IEC 61000-4-5 Edition 2.0 2005-11, IEC 61000-4-6 Edition 3.0 2008-10, IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03)**
The test was carried out on **Jul. 16, 2016** at **SPORTON INTERNATIONAL INC.** LAB.

William Li
Supervisor

CE EMC TEST REPORT

according to

**European Standard EN 55022:2010/AC:2011 Class B,
EN 61000-3-2:2014, EN 61000-3-3:2013 and
EN 55024:2010 (IEC 61000-4-2 Edition 2.0 2008-12,
IEC 61000-4-3 Edition 3.2 2010-04, IEC 61000-4-4 Edition 3.0 2012-04,
IEC 61000-4-5 Edition 3.0 2014-05, IEC 61000-4-6 Edition 4.0 2013-10,
IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03)**

Equipment : AC-DC Switching Power Supply

**Model No. : TXH 060-105、TXH 060-112、TXH 060-115、
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TXH 060-112-U、TXH 060-115-U、TXH 060-124-U、
TXH 060-148-U、TXH 060-105-O、TXH 060-112-O、
TXH 060-115-O、TXH 060-124-O、TXH 060-148-O**

Applicant : Traco Electronic AG
Sihlbruggstrasse 111, 6340 Baar, Switzerland

Statement

- The test result refers exclusively to the test presented test model / sample.
- Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.
- This test report is only applicable to European Community.

Testing Laboratory
1190

SPORTON International Inc.
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.).

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History of this test report

Report No.	Version	Description	Issued Date
EC390419-02	Rev. 01	Initial issue of report	Aug. 10, 2016

Verification No. : EC390419-02

VERIFICATION OF COMPLIANCE

according to

**European Standard EN 55022:2010/AC:2011 Class B,
EN 61000-3-2:2014, EN 61000-3-3:2013 and
EN 55024:2010 (IEC 61000-4-2 Edition 2.0 2008-12,
IEC 61000-4-3 Edition 3.2 2010-04, IEC 61000-4-4 Edition 3.0 2012-04,
IEC 61000-4-5 Edition 3.0 2014-05, IEC 61000-4-6 Edition 4.0 2013-10,
IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03)**

Equipment : AC-DC Switching Power Supply

**Model No. : TXH 060-105、TXH 060-112、TXH 060-115、
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TXH 060-148-U、TXH 060-105-O、TXH 060-112-O、
TXH 060-115-O、TXH 060-124-O、TXH 060-148-O**

Applicant : Traco Electronic AG
Sihlbruggstrasse 111, 6340 Baar, Switzerland

I **HEREBY** CERTIFY THAT :

The measurements shown in this test report were made in accordance with the procedures given in **EUROPEAN COUNCIL DIRECTIVE 2014/30/EU.** The equipment was ***passed*** the test performed according to **European Standard EN 55022:2010/AC:2011 Class B,
EN 61000-3-2:2014, EN 61000-3-3:2013 and EN 55024:2010 (IEC 61000-4-2 Edition 2.0 2008-12,
IEC 61000-4-3 Edition 3.2 2010-04, IEC 61000-4-4 Edition 3.0 2012-04,
IEC 61000-4-5 Edition 3.0 2014-05, IEC 61000-4-6 Edition 4.0 2013-10,
IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03).**
The product sample received on May. 03, 2016 and completely tested on ***May 24, 2016*** **at SPORTON International Inc.** LAB.

William Li / Supervisor

SPORTON International Inc.
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

1. General Description of Equipment under Test

1.1. Applicant

Traco Electronic AG

Sihlbruggstrasse 111, 6340 Baar, Switzerland

1.2. Manufacturer

Same as 1.1

1.3. Basic Description of Equipment under Test

Equipment	:	AC-DC Switching Power Supply
Model No.	:	TXH 060-105、TXH 060-112、TXH 060-115、TXH 060-124、TXH 060-148、TXH 060-105-U、TXH 060-112-U、TXH 060-115-U、TXH 060-124-U、TXH 060-148-U、TXH 060-105-O、TXH 060-112-O、TXH 060-115-O、TXH 060-124-O、TXH 060-148-O
Trade Name	:	TRACO
Power Supply Type	:	Switching
AC Power Cord	:	Non-Shielded, 1.5 m, 2 pin

1.4. Feature of Equipment under Test

Please refer to user manual.

2. Test Configuration of Equipment under Test

2.1. Test Manner

a. During testing, the interface cables and equipment positions were varied according to European Standard EN 55022.

b. The equipment under test were performed the following test modes:

Test Items	Description of test modes
AC Conducted Emission	Mode 1. TXH 060-105-O Mode 2. TXH 060-105-U Mode 3. TXH 060-105 Cause "mode 1" generated the worst test result; it was reported as final data.
Radiated Emissions	Mode 1. TXH 060-105-O Mode 2. TXH 060-105-U Mode 3. TXH 060-105 Cause "mode 1" generated the worst test result; it was reported as final data.
Harmonic and Flicker Emissions	Mode 1. TXH 060-105-O Mode 2. TXH 060-105-U Mode 3. TXH 060-105
EMS	Mode 1. TXH 060-105-O Mode 2. TXH 060-105-U Mode 3. TXH 060-105

c. Frequency range investigated: Conduction 150 kHz to 30 MHz, Radiation 30 MHz to 1,000 MHz.

d. Frequency range investigated immunity test: CS 150 kHz to 80 MHz, RS 80 MHz to 1,000 MHz.

2.2. Description of Test System

< EMI >

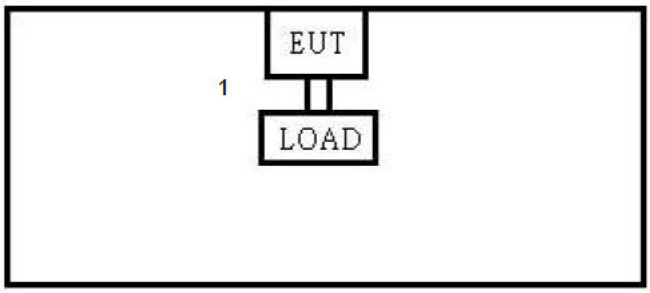
<For conducted emission and radiated emission below 1GHz >

No.	Peripheral	Manufacturer	Model Number	Cable / Spec. Description
Local				
1	Load	[redacted]	3.9Ω	---

< EMS >

No.	Peripheral	Manufacturer	Model Number	Cable / Spec. Description
Local				
1	Multi-meter	YFE	YF-370A	Probe Cable, Non-Shielded 1.0m Extension Cable, Non-Shielded 0.5m
2	Load	[redacted]	3.9Ω	---

2.3. Connection Diagram of Test System for Radiated Emission



1. The power cable was connected from EUT to the support unit 1

3. Test Software

No test software was used during testing.

4. General Information of Test

4.1. Test Facility

<EMI>

Test Site : SPORTON INTERNATIONAL INC.

Test Site Location : No. 3, Ln. 238, Kangle St., Neihu Dist., Taipei City, Taiwan (R.O.C.)
TEL : 886-2-2631-5551
FAX : 886-2-2631-9740

Test Site No. : CO01-NH/OS02-NH

<EMS>

Test Site Location : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)
TEL : 886-3-327-3456
FAX : 886-3-327-0973

4.2. Test Voltage

AC 230V / 50Hz

4.3. Measurement Procedure

EMI Test	:	European Standard EN 55022 Class B
Harmonics Test	:	European Standard EN 61000-3-2
Voltage Fluctuations Test	:	European Standard EN 61000-3-3
EMS Test	:	European Standard EN 55024

(ESD: IEC 61000-4-2, RS: IEC 61000-4-3, EFT: IEC 61000-4-4, SURGE: IEC 61000-4-5, CS: IEC 61000-4-6, Power Frequency Magnetic Field: IEC 61000-4-8, DIPS: IEC 61000-4-11)

4.4. Test in Compliance with

EMI Test	:	European Standard EN 55022 Class B
Harmonics Test	:	European Standard EN 61000-3-2
Voltage Fluctuations Test	:	European Standard EN 61000-3-3
EMS Test	:	European Standard EN 55024

(ESD: IEC 61000-4-2, RS: IEC 61000-4-3, EFT: IEC 61000-4-4, SURGE: IEC 61000-4-5, CS: IEC 61000-4-6, Power Frequency Magnetic Field: IEC 61000-4-8, DIPS: IEC 61000-4-11)

4.5. Frequency Range Investigated

a. Conducted emission test: from 150 kHz to 30 MHz
b. Radiated emission test: from 30 MHz to 1,000 MHz
c. Radio frequency electromagnetic field immunity test: 80-1000 MHz

4.6. Test Distance

a. The test distance of radiated emission test from antenna to EUT is 10 M (from 30MHz~1GHz).
b. The test distance of radio frequency electromagnetic field immunity test from antenna to EUT is 3 M.

5. Conducted Emissions Measurement

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 kHz and return leads of the EUT according to the methods defined in European Standard EN 55022 Clause 9. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meter above the ground plane. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position producing maximum conducted emissions.

5.1. Test Procedures

a. The EUT was warmed up for 15 minutes before testing started.
b. The EUT was placed on a desk 0.8 meter height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meter from any other grounded conducting surface.
c. Connect EUT to the power mains through a line impedance stabilization network (LISN).
d. Connect Telecommunication port to ISN (Impedance Stabilization Network).
e. All the support units are connect to the other LISN.
f. The LISN provides 50 ohm, coupling impedance for the measuring instrument.
g. The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
h. Both sides of AC line were checked for maximum conducted interference.
i. The frequency range from 150 kHz to 30 MHz was searched.
j. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

5.2. Typical Test Setup Layout of AC Powerline Conducted Emissions

a. AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
b. EUT is connected to one artificial mains network (AMN).
c. All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
d. Rear of EUT to be flushed with rear of table top.
e. Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if this is an acceptable installation practice, shall be placed directly on the top of the controller.
f. If cables, which hang closer than 40 cm to the horizontal metal ground plane, cannot be shortened to appropriate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long.
g. Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.
h. Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage.

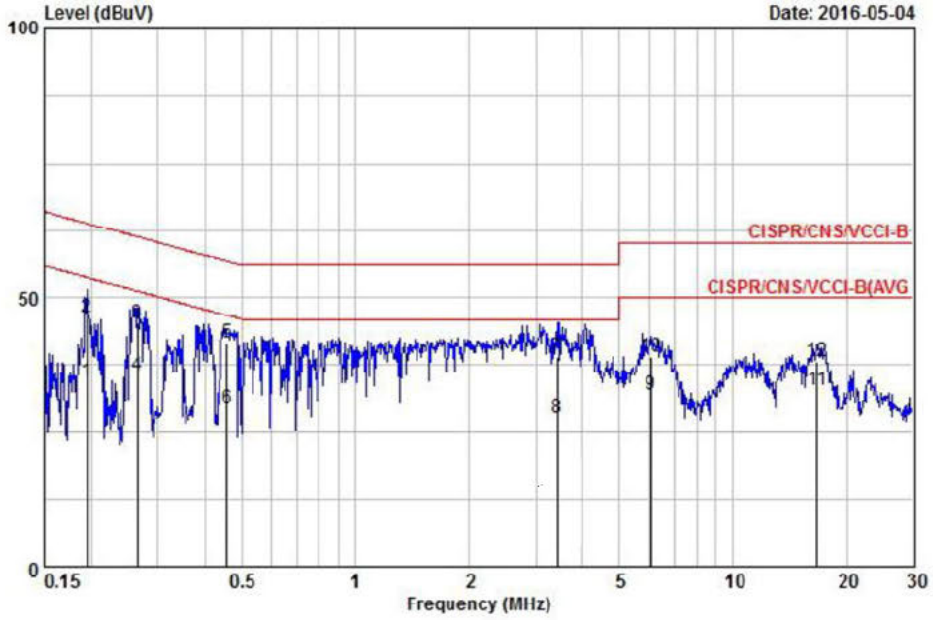
5.3. Typical Test Setup Layout of Disturbance at Telecommunication Ports

a. AMN and ISN are 80 cm from the EUT and at least 80 cm from other units and other metal planes.
b. EUT is connected to one artificial mains network (AMN).
c. All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
d. Rear of EUT to be flushed with rear of table top.
e. Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if this is an acceptable installation practice, shall be placed directly on the top of the controller.
f. If cables, which hang closer than 40 cm to the horizontal metal ground plane, cannot be shortened to appropriate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long.
g. Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.
h. Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage.

5.4. Test Result of AC Powerline Conducted Emission

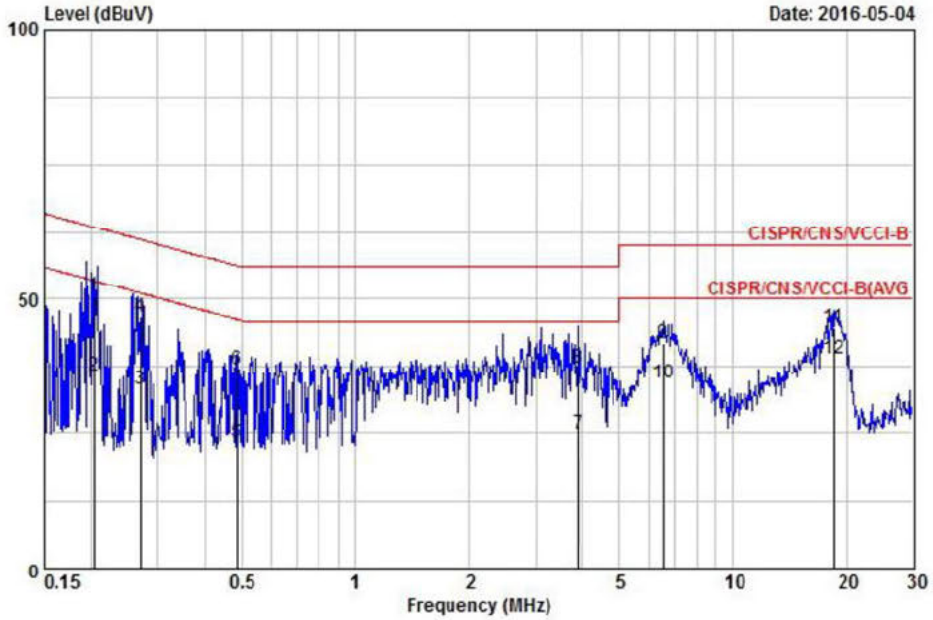
Test Mode	Mode 1	Test Site No.	CO01-NH
Test Frequency	0.15 MHz ~ 30 MHz	Test Engineer	Willy
Temperature	24 ℃	Relative Humidity	52 %
Note: 1. Corrected Reading (dBμV) = LISN Factor + Cable Loss + Read Level = Level			
2. All emissions not reported here are more than 10 dB below the prescribed limit.			
■ The test was passed at the minimum margin that marked by the frame in the following data			

Line



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.194	34.53	-19.31	53.84	24.38	10.05	0.10	AVERAGE
2	0.194	46.49	-17.35	63.84	36.34	10.05	0.10	QP
3	0.264	45.29	-16.01	61.29	35.14	10.05	0.10	QP
4	0.264	35.58	-15.72	51.29	25.43	10.05	0.10	AVERAGE
5	0.456	41.64	-15.12	56.76	31.49	10.04	0.10	QP
6	0.456	29.28	-17.48	46.76	19.13	10.04	0.10	AVERAGE
7	3.417	39.07	-16.93	56.00	28.79	10.10	0.18	QP
8	3.417	27.67	-18.33	46.00	17.39	10.10	0.18	AVERAGE
9	6.056	31.80	-18.20	50.00	21.45	10.16	0.20	AVERAGE
10	6.056	39.16	-20.84	60.00	28.81	10.16	0.20	QP
11	16.661	32.68	-17.32	50.00	22.01	10.37	0.30	AVERAGE
12	16.661	38.32	-21.68	60.00	27.65	10.37	0.30	QP

Neutral



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.204	50.62	-12.83	63.46	40.04	10.48	0.10	QP
2	0.204	35.78	-17.67	53.46	25.20	10.48	0.10	AVERAGE
3	0.270	33.47	-17.64	51.12	22.89	10.48	0.10	AVERAGE
4	0.270	46.75	-14.36	61.12	36.17	10.48	0.10	QP
5	0.486	23.25	-22.98	46.23	12.67	10.48	0.10	AVERAGE
6	0.486	37.05	-19.18	56.23	26.47	10.48	0.10	QP
7	3.881	25.15	-20.85	46.00	14.42	10.53	0.20	AVERAGE
8	3.881	37.41	-18.59	56.00	26.68	10.53	0.20	QP
9	6.523	41.89	-18.11	60.00	31.09	10.59	0.20	QP
10	6.523	34.61	-15.39	50.00	23.81	10.59	0.20	AVERAGE
11	18.426	44.76	-15.24	60.00	33.59	10.87	0.30	QP
12 @	18.426	39.17	-10.83	50.00	28.00	10.87	0.30	AVERAGE

5.5. Test Result of Disturbance at Telecommunication Ports

The EUT does not have the communication port.

6. Radiated Emission Measurement

Radiated emissions from 30 MHz to 6,000 MHz were measured with a bandwidth of 120 kHz for 30 MHz to 1,000 MHz and 1 MHz for above 1GHz according to the methods defines in European Standard EN 55022, Clause 10. The EUT was placed on a nonmetallic stand, 0.8 meter above the ground plane. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions.

6.1. Test Procedures

For Below 1GHz

a. The EUT was placed on a rotatable table top 0.8 meter above ground.
b. The EUT was set 10 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
c. The table was rotated 360 degrees to determine the position of the highest radiation.
d. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
f. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
g. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.

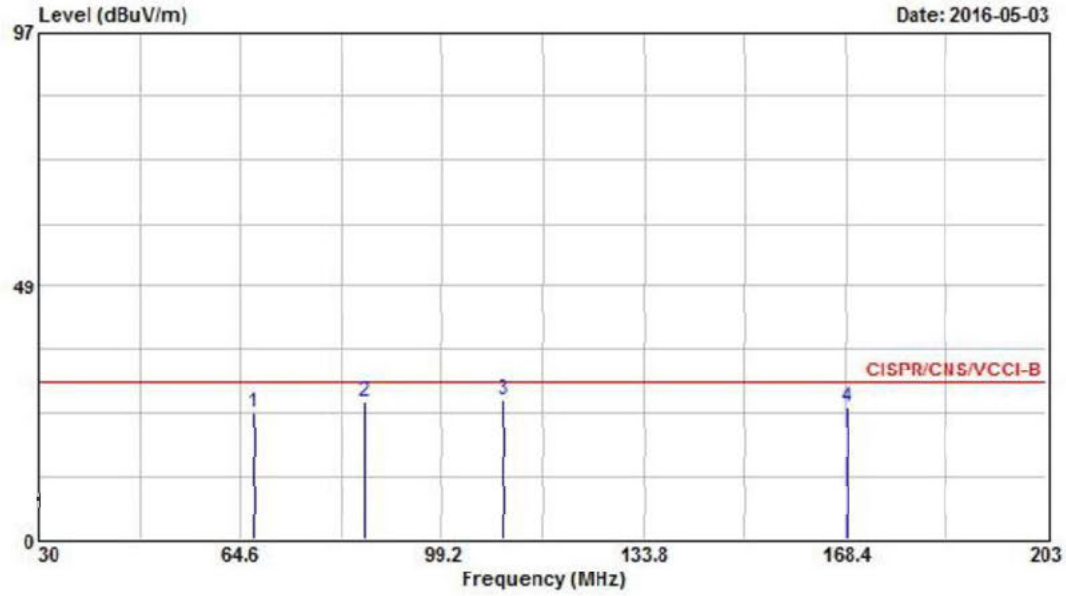
For above 1GHz

a. Same test set up as below 1GHz radiated testing.
b. The EUT was set 3 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
c. There should be absorber placed between the EUT and Antenna and its located size should let the test site meet CISPR16-1-4 requirement.
d. The table was rotated 360 degrees to determine the position of the highest radiation.
e. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
f. Set the DRG Horn Antenna at 1M height, then run the turn table to get the maximum noise reading from Horizontal and Vertical polarity separately.
g. When EUT locating on the turn-table, and its height is over 172cm (Antenna's 3dB beam width of 6GHz is 27∘), the DRG Horn Antenna must be raised up and descended down, then turning around the turn-table to get the maximum noise reading of the Horizontal and Vertical polarity separately. Note the maximum raise up height is same as the top of EUT.
h. If emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

6.2. Test Result of Radiated Emission for Below 1GHz

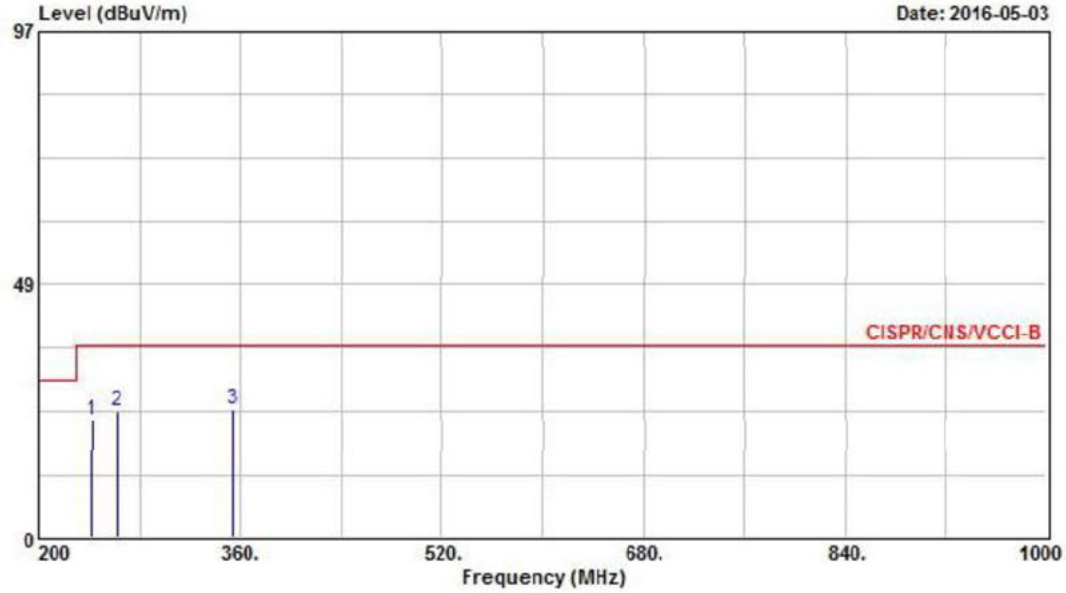
Test mode	Mode 1	Test Site No.	OS02-NH
Test frequency	30 MHz ~ 1000 MHz	Test Engineer	Chas
Temperature	25 ℃	Relative Humidity	50 %
Note: 1. Emission level (dBμV/m) = 20 log Emission level (μV/m)			
2. Corrected Reading : Antenna Factor + Attenuator+ Cable Loss + Read Level – Preamp Factor = Level			
■ The test was passed at the minimum margin that marked by the frame in the following data			

Vertical



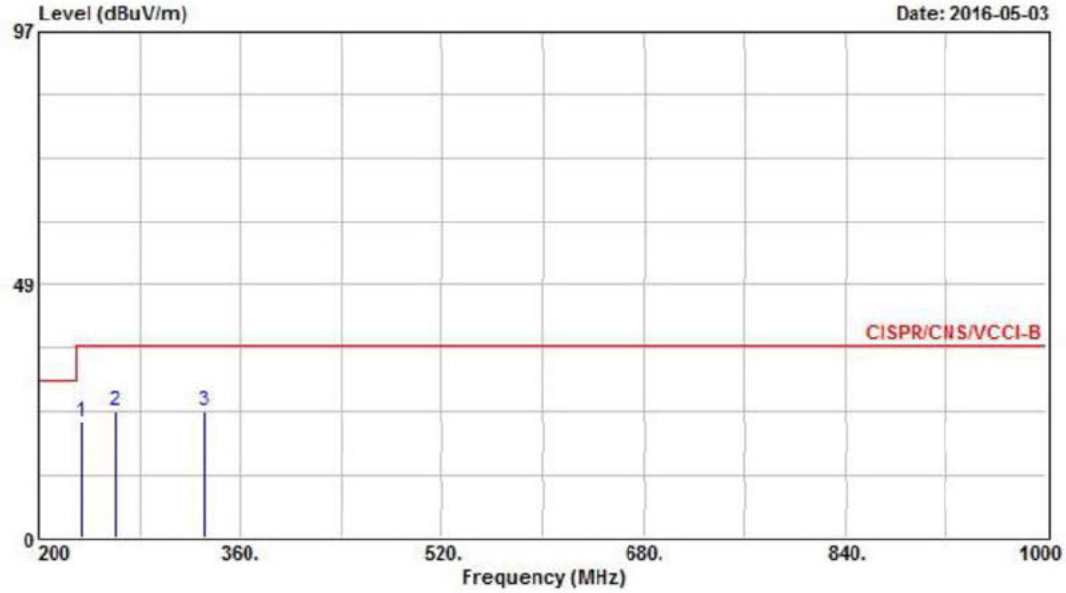
	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	67.020	24.20	-5.80	30.00	43.50	11.26	1.23	31.79	Peak	---	---
2 @	85.880	26.26	-3.74	30.00	43.20	13.40	1.38	31.72	QP	---	---
3 @	109.750	26.66	-3.34	30.00	39.99	16.80	1.52	31.65	QP	100	180
4 @	168.750	25.37	-4.63	30.00	40.27	14.75	1.87	31.52	Peak	---	---

Vertical



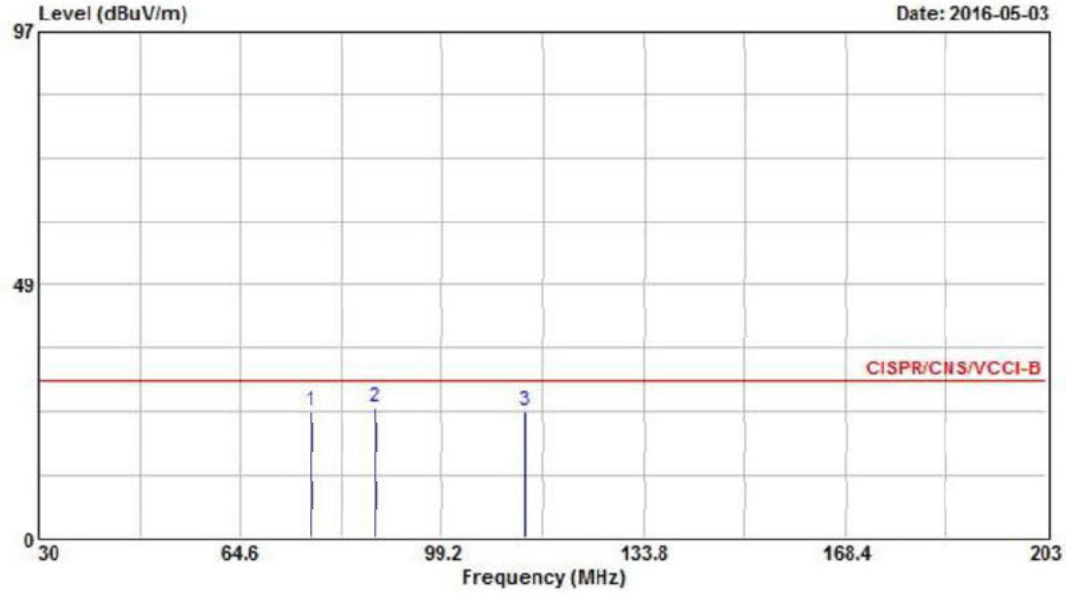
	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	242.400	22.52	-14.48	37.00	34.87	16.80	2.27	31.42	Peak	---	---
2	262.400	24.39	-12.61	37.00	34.80	18.63	2.37	31.41	Peak	---	---
3	354.400	24.73	-12.27	37.00	33.81	19.51	2.78	31.37	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	233.600	22.21	-14.79	37.00	35.64	15.78	2.22	31.43	Peak	---	---
2	260.800	24.28	-12.72	37.00	34.52	18.81	2.36	31.41	Peak	---	---
3	331.200	24.15	-12.85	37.00	33.84	19.00	2.69	31.38	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	76.710	24.21	-5.79	30.00	42.81	11.84	1.31	31.75	Peak	---	---
2 @	87.780	25.10	-4.90	30.00	41.63	13.80	1.39	31.72	Peak	---	---
3	113.390	24.16	-5.84	30.00	37.36	16.91	1.54	31.65	Peak	---	---

6.3. Test Result of Radiated Emission for Above 1GHz

The maximum internal frequency generated of the EUT is 10 MHz, so the measurement above 1GHz is not required.

7. Harmonic Current Emissions Measurement

7.1. Standard

- Standard : EN 61000-3-2

7.2. Test Procedure

The measurement of harmonic currents shall be performed as follows:

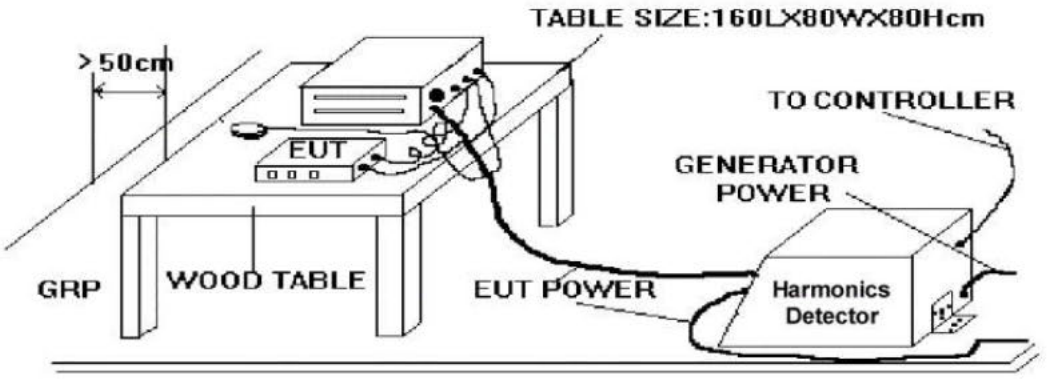
– for each harmonic order, measure the 1.5 s smoothed r.m.s. harmonic current in each DFT time window as defined in EN / IEC 61000-4-7: 2002.

– calculate the arithmetic average of the measured values from the DFT time windows, over the entire observation period Short cyclic (Tcycle ≦ 2.5 min). Because of synchronisation to meet the requirements for repeatability in 5%.

7.3. Test Equipment Settings

Harmonic Parameters	Setting
Line Voltage	230 V
Line Frequency	50 Hz
Device Class	-
Current Measurement Range	High
Measurement Delay	10.0 seconds
Test Duration	10.0 minutes
Class determination Pre-test Duration	10.0 seconds

7.4. Typical Test Setup Layout of Harmonic Current Emissions



7.5. Test Result of Harmonic Current Emissions

<Mode 1>

Highest parameter values during test:

V_RMS (Volts):	230.50	Frequency(Hz):	50.00
I_Peak (Amps):	2.636	I_RMS (Amps):	0.571
I_Fund (Amps):	0.259	Crest Factor:	4.626
Power (Watts):	57.7	Power Factor:	0.446

<Mode 2>

Highest parameter values during test:

V_RMS (Volts):	230.51	Frequency(Hz):	50.00
I_Peak (Amps):	2.697	I_RMS (Amps):	0.564
I_Fund (Amps):	0.245	Crest Factor:	4.787
Power (Watts):	54.7	Power Factor:	0.423

<Mode 3>

Highest parameter values during test:

V_RMS (Volts):	230.51	Frequency(Hz):	50.00
I_Peak (Amps):	2.561	I_RMS (Amps):	0.542
I_Fund (Amps):	0.234	Crest Factor:	4.740
Power (Watts):	52.1	Power Factor:	0.428

As specified on clause 7 of EN 61000-3-2, the limits are not specified for equipment with a rated power of 75W or less.
The EUT meets the above condition, so it conforms to EN 61000-3-2.

8. Voltage Fluctuations and Flicker Measurement

8.1. Standard

- Product Standard : EN 61000-3-3

8.2. Test Procedure

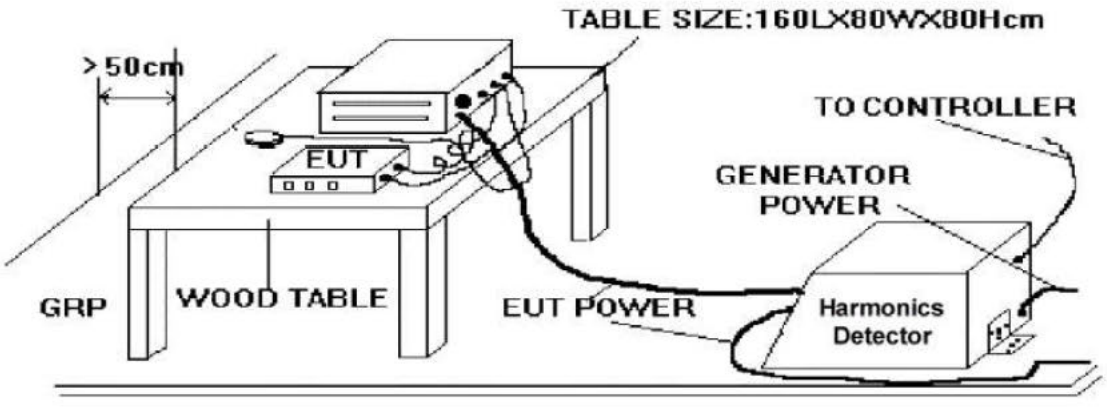
The equipment shall be tested under the conditions of **Clause 5.**

The total impedance of the test circuit, excluding the appliance under test, but including the internal impedance of the supply source, shall be equal to the reference impedance. The stability and tolerance of the reference impedance shall be adequate to ensure that the overall accuracy of ±8% is achieved during the whole assessment procedure.

8.3. Test Equipment Settings

Flicker Parameters	Setting
Line Voltage	230 V
Line Frequency	50 Hz
Measurement Delay	10.0 seconds
Pst Integration Time	10.0 minutes
Pst Integration Periods	1
Test Duration	10.0 minutes

8.4. Typical Test Setup Layout of Voltage Fluctuations and Flicker



8.5. Test Result of Voltage Fluctuation and Flicker

Test mode	Mode 1
Final Test Result	***PASS***
Temperature	25 ℃
Relative Humidity	46 %
Atmospheric Pressure	101 kPa
Test Date	May 20, 2016
Test Engineer	Easton

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.41			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.03	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.248	Test limit:	1.000	Pass

Test mode	Mode 2
Final Test Result	***PASS***
Temperature	25 ℃
Relative Humidity	46 %
Atmospheric Pressure	101 kPa
Test Date	May 20, 2016
Test Engineer	Easton

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.38			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.03	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.263	Test limit:	1.000	Pass

Test mode	Mode 3
Final Test Result	***PASS***
Temperature	25 ℃
Relative Humidity	46 %
Atmospheric Pressure	101 kPa
Test Date	May 20, 2016
Test Engineer	Easton

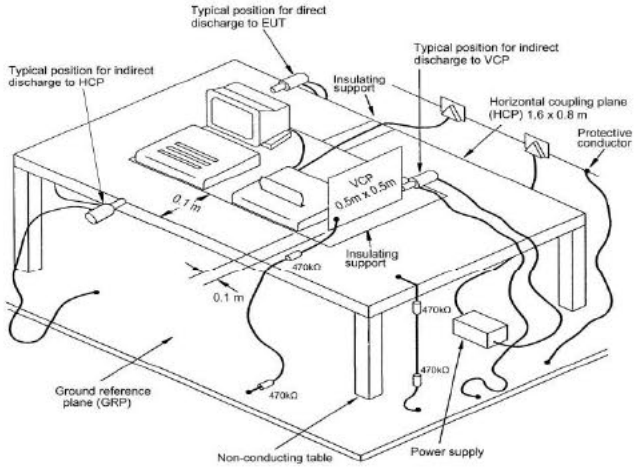
Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.37			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.03	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.250	Test limit:	1.000	Pass

9. Electrostatic Discharge Immunity Measurement (ESD)

Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	**A** ±2 / ±4 / ±8 kV for air discharge
	A ±2 / ±4 kV for contact discharge
Required Performance Criteria	**B** ±2 / ±4 / ±8 kV for air discharge
	B ±2 / ±4 kV for contact discharge
Basic Standard	IEC 61000-4-2
Product Standard	EN 55024:2010
Level	3 for air discharge
	2 for contact discharge
Test Voltage	±2 / ±4 / ±8 kV for air discharge
	±2 / ±4 kV for contact discharge
Discharge Impedance	330 ohm / 150 pF
Temperature	24 ℃
Relative Humidity	46 %
Atmospheric Pressure	101 kPa
Test Date	May 20, 2016
Test Engineer	Easton
Observation	The test points, please refer to section 9.5.

9.1. Test Setup



The test setup consists of the test generator, EUT and auxiliary instrumentation necessary to perform DIRECT and INDIRECT application of discharges to the EUT as applicable, in the follow manner:

a. CONTACT DISCHARGE to the conductive surfaces and to coupling plane;
b. AIR DISCHARGE at insulating surfaces.

The preferred test method is that of type tests performed in laboratories and the only accepted method of demonstrating conformance with this standard. The EUT was arranged as closely as possible to arrangement in final installed conditions.

9.2. Test Setup for Tests Performed in Laboratory

A ground reference plane was provided on the floor of the test site. It was a metallic sheet (copper or aluminum) of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness. In the SPORTON EMC LAB., we provided 1 mm thickness aluminum ground reference plane or 1 mm thickness stainless steel ground reference plane. The minimum size of the ground reference plane is 1 m x 1 m, the exact size depending on the dimensions of the EUT. It was connected to the protective grounding system.

The EUT was arranged and connected according to its functional requirements. A distance of 1 m minimum was provided between the EUT and the wall of the Lab., and any other metallic structure. In cases where this length exceeds the length necessary to apply the discharges to the selected points, the excess length shall, where possible, be placed non-inductively off the ground reference plane and shall not come closer than 0.2 m to other conductive parts in the test setup.

Where the EUT is installed on a metal table, the table was connected to the reference plane via a cable with a 470k ohm resister located at each end, to prevent a build-up of charge. The test setup was consist a wooden table, 0.8 m high, standing on the ground reference plane. A HCP, 1.6 m x 0.8 m, was placed on the table. The EUT and cables was isolated from the HCP by an insulating support 0.5 mm thick. The VCP size, 0.5 m x 0.5 m.

9.3. ESD Test Procedure

a. In the case of air discharge testing the climatic conditions shall be within the following ranges:
   - ambient temperature: 15 °C to 35 °C;
   - relative humidity : 30 % to 60 %;
   - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).

b. Test programs and software shall be chosen so as to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, but permitted only where it can be shown that the EUT is being comprehensively exercised.

c. The test voltage shall be increased from the minimum to the selected test severity level, in order to determine any threshold of failure. The final severity level should not exceed the product specification value in order to avoid damage to the equipment.

d. The test shall be performed with both air discharge and contact discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on air discharge. On preselected points at least 25 single discharges (in the most sensitive polarity) shall be applied on contact discharge.

e. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be necessary to determine whether a system failure has occurred.

f. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

g. In the case of painted surface covering a conducting substrate, the following procedure shall be adopted:
   - If the coating is not declared to be an insulating coating by the equipment manufacturer, then the pointed tip of the generator shall penetrate the coating so as to make contact with the conducting substrate.
   - Coating declared as insulating by the manufacturer shall only be submitted to the air discharge.
   - The contact discharge test shall not be applied to such surfaces.

h. In the case of air discharges, the round discharge tip of the discharge electrode shall be approached as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.

9.4. Test Severity Levels

9.4.1. Contact Discharge

Level	Test Voltage (kV) of Contact discharge
1	±2
2	±4
3	±6
4	±8
X	Specified
Remark : "X" is an open level.	

9.4.2. Air Discharge

Level	Test Voltage (kV) of Air Discharge
1	±2
2	±4
3	±8
4	±15
X	Specified
Remark : "X" is an open level.	

9.5. Test Points

9.5.1. Test Result of Air Discharge

Test Point	No. of Discharges	Air Discharge/Round Tip						Test Record
		+2kV	-2kV	+4kV	-4kV	+8kV	-8kV	
AC input	10	A	A	A	A	A	A	Normal
DC output	10	A	A	A	A	A	A	Normal

9.5.2. Test Result of Contact Discharge

Direct discharge

Test Point	No. of Discharges	Contact Discharge/Pointed Tip				Test Record
		+2kV	-2kV	+4kV	-4kV	
Case	25	A	A	A	A	Normal
Screw	25	A	A	A	A	Normal

Indirect discharge to HCP and VCP

Test Point	No. of Discharges	Contact Discharge/Pointed Tip				Test Record
		+2kV	-2kV	+4kV	-4kV	
HCP (At Front)	25	A	A	A	A	Normal
HCP (At Left)	25	A	A	A	A	Normal
HCP (At Right)	25	A	A	A	A	Normal
HCP (At Rear)	25	A	A	A	A	Normal
VCP (At Front)	25	A	A	A	A	Normal
VCP (At Left)	25	A	A	A	A	Normal
VCP (At Right)	25	A	A	A	A	Normal
VCP (At Rear)	25	A	A	A	A	Normal

10. Radio Frequency Electromagnetic Field Immunity Measurement (RS)

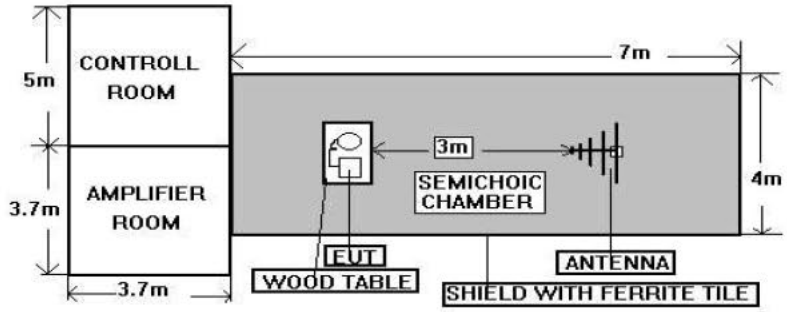
Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	A
Basic Standard	IEC 61000-4-3
Product Standard	EN 55024:2010
Level	2
Frequency Range	80-1000 MHz
Field Strength	3 V/m (unmodulated, r.m.s) 80% AM (1 kHz)
Temperature	22 ℃
Relative Humidity	45 %
Atmospheric Pressure	101 kPa
Test Date	May 24, 2016
Test Engineer	Easton

10.1. Test Record

Frequency Band: 80-1000 MHz

Sides of the EUT have been exposed to the field	Antenna positioned	Test field strength Level	Test field strength (V/m)	Test Record
Front	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Left	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Back	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Right	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)

10.2. Test Setup



NOTE : The SPORTON 7m x 4m x 4m semi-anechoic chamber is compliance with the sixteen point's uniform field requirement as stated in IEC 61000-4-3 Section 6.2.

The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

10.3. Test Procedure

a. The equipment to be tested is placed in the center of the enclosure on a wooden table. The equipment is then connected to power and signal leads according to pertinent installation instructions.

b. The bilog antenna which is enabling the complete frequency range of 80-1000MHz is placed 3m away from the equipment. The required field strength is determined by placing the field strength meter(s) on top of or directly alongside the equipment under test and monitoring the field strength meter via a remote field strength indicator outside the enclosure while adjusting the continuous-wave to the applicable antennae.

c. The test is normally performed with the generating antenna facing each of four sides of the EUT. The polarization of the field generated by the broadband (bilog) antenna necessitates testing each position twice, once with the antenna positioned vertically and again with the antenna positioned horizontally.

d. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies e.g. clock frequency(ies) and harmonics or frequencies of dominant interest shall be analyzed separately.

e. At each of the above conditions, the frequency range is swept 80-1000MHz, pausing to adjust the R.F. signal level or to switch oscillators and antenna. The rate of sweep is in the order of 1.5*10-3 decades/s. The sensitive frequencies or frequencies of dominant interest may be discretely analyzed.

10.4. Test Severity Levels

Frequency Band : 80-1000MHz

Level	Test field strength (V/m)
1	1
2	3
3	10
X	Specified
Remark : "X" is an open class.	

11. Electrical Fast Transient/Burst Immunity Measurement (EFT/BURST)

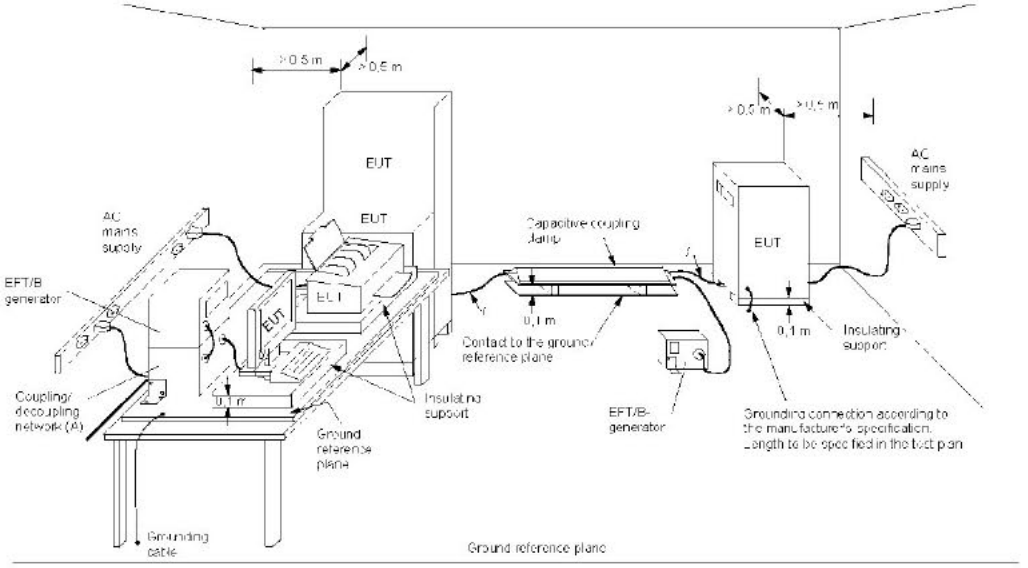
Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	B
Basic Standard	IEC 61000-4-4
Product Standard	EN 55024:2010
Level	on input power ports – 2
Test Voltage	on input power ports -- ± 0.5 / ± 1.0 kV
Impulse wave shape	5/50 ns (Tr/Th)
Impulse frequency	5 kHz
Test Repetition Rate	1 time / minute
Temperature	25 ℃
Relative Humidity	58 %
Atmospheric Pressure	101 kPa
Test Date	May 14, 2016
Test Engineer	Easton
Observation	Normal

11.1. Test Record

■ **on Input power ports:**

Test Location	Polarity	Test Level	Voltage (Peak)	Test Record
L+N	+	2	0.5 / 1.0 kV	Normal (No influencing)
	–	2	0.5 / 1.0 kV	Normal (No influencing)

11.2. Test setup



Key

l length between clamp and the EUT to be tested (should be 0,5 m ± 0,05 m)

(A) location for supply line coupling

(B) location for signal lines coupling

The EUT was placed on a ground reference plane and was insulated from it by an insulating support about 0.1 m thick. If the EUT is table-top equipment, it was located approximately 0.8 m above the GRP. The GRP. Was a metallic sheet (copper or aluminum) of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness. It shall project beyond the EUT by at least 0.1 m on all sides and connected to the protective earth. In the SPORTON EMC LAB., We provided 1 mm thickness aluminum ground reference plane or 1 mm thickness stainless steel ground reference plane. The minimum size of the ground reference plane is 1 m x 1 m, the exact size depending on the dimensions of the EUT. It was connected to the protective grounding system. The EUT was arranged and connected according to its functional requirements. The minimum distance between the EUT and other conductive structures, except the GRP. Beneath the EUT, was more than 0.5 m. using the coupling clamp, the minimum distance between the coupling plates and all other conductive structures, except the GRP. Beneath the EUT, was more than 0.5 m. The length of the signal and power lines between the coupling device and the EUT was 0.5 m or less.

11.3. Test on Power Line

a. The EFT/B-generator was located on the GRP. The length from the EFT/B-generator to the EUT as not exceeds 0.5 m.
b. The EFT/B-generator provides the ability to apply the test voltage in a non-symmetrical condition to the power supply input terminals of the EUT.

11.4. Test on Communication Lines

a. The coupling clamp is composed of a clamp unit for housing the cable (length more than 3 m), and was placed on the GRP.
b. The coupling clamp provides the ability of coupling the fast transient/bursts to the cable under test.

11.5. Test Procedure

a. In order to minimize the effect of environmental parameters on test results, the climatic conditions when test is carrying out shall comply with the following requirements:
   - ambient temperature: 15 °C to 35 °C;
   - relative humidity : 45 % to 75 %;
   - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).
b. In order to minimize the effect of environmental parameters on test results, the electromagnetic environment of the laboratory shall not influence the test results.
c. The variety and diversity of equipment and systems to be tested make it difficult to establish general criteria for the evaluation of the effects of fast transients/bursts on equipment and systems.
d. The test results may be classified on the basic of the operating conditions and the functional specification of the equipment under test, according to the following performance criteria :
   - Normal performance within the specification limits.
   - Temporary degradation or loss of function or performance which is self-recoverable.
   - Temporary degradation or loss of function or performance which requires operator intervention or system reset.
   - Degradation or loss of function which is not recoverable due to damage of equipment (components).

11.6. Test Severity Levels

The following test severity levels are recommended for the fast transient/burst test :

Open circuit output test voltage ± 10%		
Level	**On Input power ports**	**On signal port and telecommunication ports**
1	0.5 kV	0.25 kV
2	1.0 kV	0.50 kV
3	2.0 kV	1.00 kV
4	4.0 kV	2.00 kV
X	Specified	Specified
Remark : " X " is an open level. The level is subject to negotiation between the user and the manufacturer or is specified by the manufacturer.		

12. Surge Immunity Measurement

Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	**A**
Required Performance Criteria	B for Input power ports
Basic Standard	IEC 61000-4-5
Product Standard	EN 55024:2010
Surge wave form (Tr/Th)	1,2/50 (8/20) μs for input power ports
Level	on input power ports – 3
Test Voltage	on Input Power Port -- ± 1.0 / ± 2.0 kV
Phase Angle	0°, 90°, 180°, 270°
Number of surges	5 positive and 5 negative pulses
Pulse Repetition Rate	1 time / min. (maximum)
Temperature	23 ℃
Relative Humidity	47 %
Atmospheric Pressure	101 kPa
Test Date	May 14, 2016
Test Engineer	Easton
Observation	Please refer to section 12.1

12.1. Test Record

■ on Input power ports:

Test Location	Voltage (kV)	Polarity	Phase Angle				Test Record
			0°	90°	180°	270°	
L - N	0.5	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
	1.0	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
L - PE	0.5	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
	1.0	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
	2.0	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
N - PE	0.5	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
	1.0	−	A	A	A	A	Normal (No influencing)
		+	A	A	A	A	Normal (No influencing)
	2.0	−	A	A	A	A	Normal (No influencing)
		+	A	A	A	A	Normal (No influencing)

Remark : PE = Earth reference

12.2. Test Severity Levels

Level	Open-circuit test voltage, ± 10%, kV
1	0.5
2	1.0
3	2.0
4	4.0
x	Specified
Remark : " X " is an open level. This level can be specified in the product specification.	

12.3. Test Procedure

a. Climatic conditions

The climatic conditions shall comply with the following requirements :

- ambient temperature : 15 °C to 35 °C
- relative humidity : 10 % to 75 %
- atmospheric pressure : 86 kPa to 106 kPa (860 mbar to 1060 mbar).

b. Electromagnetic conditions

The electromagnetic environment of the laboratory shall not influence the test results.

c. The test shall be performed according the test plan that shall specify the test set-up with

- generator and other equipment utilized;
- test level (voltage/current);
- generator source impedance;
- internal or external generator trigger;
- number of tests : at least five positive and five negative at the selected points;
- repetition rate : maximum 1/min.
- inputs and outputs to be tested;
- representative operating conditions of the EUT;
- sequence of application of the surge to the circuit;
- phase angle in the case of a.c. power supply;
- actual installation conditions, for example :

  AC : neutral earthed,

  DC : (+) or (-) earthed to simulated the actual earthing conditions.

d. If not otherwise specified the surges have to be applied synchronized to the voltage phase at the zero-crossing and the peak value of the a.c. voltage wave (positive and negative).

e. The surges have to be applied line to line and line(s) and earth. When testing line to earth, the test voltage has to be applied successively between each of the lines and earth, if there is no other specification.

f. The test procedure shall also consider the non-linear current-voltage characteristics of the equipment under test. Therefore the test voltage has to be increased by steps up to the test level specified in the product standard or test plan.

g. All lower levels including the selected test level shall be satisfied. For testing the secondary protection, the output voltage of the generator shall be increased up to the worst-case voltage breakdown level (let-through level) of the primary protection.

h. If the actual operating signal sources are not available, the may be simulated. Under no circumstances may the test level exceed the product specification. The test shall be carried out according the test plan.

i. To find all critical points of the duty cycle of the equipment, a sufficient number of positive and negative test pulses shall be applied. For acceptance test previously unstressed equipment shall be used to the protection devices shall be replaced.

12.4. Operating Condition

Full system

13. Conducted Disturbances Induced by Radio-Frequency Field Immunity Measurement (CS)

Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	A
Basic Standard	IEC 61000-4-6
Product Standard	EN 55024:2010
Level	2
Test Voltage	3 V (unmodulated, r.m.s), 80% AM (1 kHz)
Frequency Range	0.15 MHz to 80 MHz
Test Port	on Input Power Port
Dwell time	2.9 seconds
Frequency step size	1 %
Coupling mode	CDN M016 M2 for AC power Port
Temperature	24 ℃
Relative Humidity	46 %
Atmospheric Pressure	101 kPa
Test Date	May 14, 2016
Test Engineer	Easton

13.1. Test Record

Test Port	Test field strength level	Test field strength (V rms)	Test Record
Input power port	2	3	Normal (No influencing)

13.2. Test Severity Levels

Level	Voltage Level (EMF)
1	1 V rms
2	3 V rms
3	10 V rms
x	Specified
Remark : " X " is an open level. This level can be specified in the product specification.	

13.3. Operating Condition

Full system

13.4. Test Procedure

a. The EUT shall be operated within its intended climatic conditions. The temperature and relative humidity should be recorded.

b. This test method test can be performed without using a sell shielded enclosure. This is because the disturbance levels applied and the geometry of the setups are not likely to radiated a high amount of energy, especially at the lower frequencies. If under certain circumstances the radiated energy is too high, a shielded enclosure has to be used.

c. The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn while the other non-excited RF-input ports of the coupling devices are terminated by a 50 ohm load resistor.

d. The frequency range is swept from 150 kHz to 80 MHz, using the signal levels established during the setting process, and with the disturbance signal 80% amplitude modulated with a 1kHz sine wave, pausing to adjust the RF-signal level or to switch coupling devices as necessary. The rate of sweep shall no exceed 1.5×10^{-3} decades/s. Where the frequency is swept incrementally, the step size shall no exceed 1% of the start and thereafter 1% of the preceding frequency value.

e. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies e.g. clock frequency(ies) and harmonics or frequencies of dominant interest shall be analyzed separately.

f. In cases of dispute, the test procedure using a step size not exceeding 1% of the start and thereafter 1% of preceding frequency value shall take precedence.

g. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

h. The use of special exercising programs is recommended.

i. Testing shall be performed according to a Test Plan, which shall be included in the test report.

j. It may be necessary to carry out some investigatory testing in order to establish some aspects of the test plan.

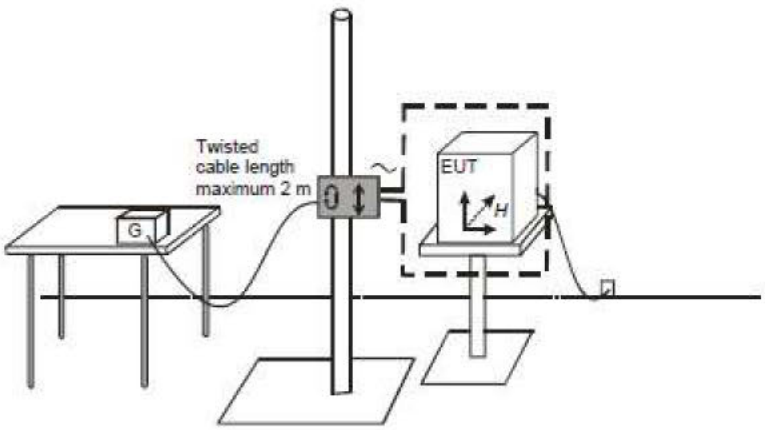
14. Power Frequency Magnetic Field immunity Measurement (PFMF)

Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	A
Basic Standard	IEC 61000-4-8
Product Standard	EN 55024:2010
Temperature	25 ℃
Relative Humidity	48 %
Atmospheric Pressure	101 kPa
Test Date	May 14, 2016
Test Engineer	Easton
Observation	Please refer to section 14.1

14.1. Test Record

Power Frequency Magnetic Field	Testing duration	Coil Orientation	Test Record
50Hz,1A/m	1.0 Min	X-axis	Normal (No influencing)
50Hz,1A/m	1.0 Min	Y-axis	Normal (No influencing)
50Hz,1A/m	1.0 Min	Z-axis	Normal (No influencing)

14.2. Test Setup



EUT : Equipment under test G : Test Generator

15. Voltage Dips and Voltage Interruptions Immunity Measurement (DIP)

Test mode	Mode 1-3
Final Test Result	***PASS***
Pass Performance Criteria	**C** for voltage interruption, **A** for voltage dips
Required Performance Criteria	C for voltage interruption, C/B for voltage dips
Basic Standard	IEC 61000-4-11
Product Standard	EN 55024:2010
Test Port	Input power ports
Temperature	24 ℃
Relative Humidity	46 %
Atmospheric Pressure	101 kPa
Test Date	May 14, 2016
Test Engineer	Easton
Observation	Please refer to section 15.1 and 15.2

15.1. Test Record of Voltage Interruption

Voltage (V)	Performance Criterion (Phase Angle)		Reduction Voltage	Duration (Periods)
	0°	180°		
100/240	C	C	>95 %	250
Observation	After the interruption, the power of EUT reset automatically.			

15.2. Test Record of Voltage Dips

Voltage (V)	Performance Criterion (Phase Angle)		Reduction Voltage	Duration (Periods)
	0°	180°		
100/240	A	A	30 %	25
100/240	A	A	>95 %	0.5

15.3. Testing Requirement and Procedure

The test was based on IEC 61000-4-11

15.4. Test Conditions

a. Source voltage and frequency : 100/240V, 50Hz, Single phase.
b. Test of interval : 10 sec.
c. Level and duration : Sequency of 3 dips/interrupts.
d. Voltage rise (and fall) time : 1 ~ 5 μs.

15.5. Operating Condition

Full system

16. List of Measuring Equipment Used

< Conducted Emission >

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Receiver	R&S	ESCS 30	100357	9 kHz - 2.75 GHz	Jan. 29, 2016	Conduction (CO01-NH)
LISN	SCHAFFNER	NNB41	06/10024	9kHz - 30MHz	Dec. 14, 2015	Conduction (CO01-NH)
Power Filter	CORCOM	MR12030	N/A	30A*2	NCR	Conduction (CO01-NH)
RF Cable-CON	Suhner Switzerland	RG223/U	CB004	9kHz - 30MHz	Dec. 10, 2015	Conduction (CO01-NH)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

< Radiated Emission below 1GHz >

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Open Area Test Site	SPORTON	OATS-10	OS02-NH	30 MHz - 1 GHz 10m, 3m	Dec. 28, 2015	Radiation (OS02-NH)
Amplifier	BURGEON	BPA-530	100203	0.01 MHz - 3 GHz	May. 20, 2015	Radiation (OS02-NH)
Spectrum Analyzer	Advantest	R3261C	81720147	9 kHz – 2.6 GHz	Nov. 09, 2015	Radiation (OS02-NH)
Receiver	R&S	ESCS 30	838251/002	9 kHz - 2.75 GHz	Nov. 20, 2015	Radiation (OS02-NH)
Bilog Antenna With 5dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-05	35377 & AT-N0518	30 MHz ~ 2 GHz	Nov. 12, 2015	Radiation (OS02-NH)
Turn Table	EMCO	2080	9508-1805	0 - 360 degree	NCR	Radiation (OS02-NH)
Antenna Mast	ETS	2075-2	2385	1 m - 4 m	NCR	Radiation (OS02-NH)
RF Cable-R10m	MIYAZAKI	5DFB	CB044	30 MHz - 1 GHz	Aug. 28, 2015	Radiation (OS02-NH)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

< EMS >

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
ESD Simulator	SCHAFFNER	NSG 437	192	Air: 0 ~ 30kV Contact: 0 ~ 30kV	Oct. 03, 2015	ESD
RS immunity Test system	ROHDE& SCHWARZ	RSF	RS-01	80M~3GHz	May 20, 2016	RS
Amplifier	AMPLIFIER& RESEARCH	250W 1000AM	0332909	80MHz ~ 1GHz	Mar. 16, 2016	RS
DUAL DIRECTIONAL COUPLER	AMPLIFIER& RESEARCH	DC6180A	312453	0.08 ~ 1GHz	Oct. 14, 2015	RS
INTEGRATED MEASUREMENT SYSTEM	ROHDE& SCHWARZ	IMS	100007	9kHz ~ 3GHz	May 16, 2016	RS
NRP-Z91 POWER SENSOR 6GHZ	ROHDE& SCHWARZ	NRP-Z91 1168.8004.02	100095	9kHz ~ 3GHz	May 13, 2016	RS
Antenna	FRANKONIA	BTA-L	02002L	26MHz ~ 1GHz	May 04, 2016	RS
Probe	ETS-LINDGREN	HI-6005	00052473	0.1MHz ~ 5GHz	Nov. 18, 2015	RS
EFT Generator	TESEQ	FTM3425	0180	0 ~ 4kV	Jan. 18, 2016	EFT
EFT/Clamp	TESEQ	CDN 3425	1705	0 ~ 2kV	Jan. 18, 2016	EFT
SURGE Generator	TESEQ	CWN 3650	0429	0 ~ 6 kV/2Ω 0~ 6 kV/12Ω	Jan. 18, 2016	SURGE
Conducted Immunity Test System	TESEQ	NSG4070	34293	9kHz ~ 1GHz	Aug. 23, 2015	CS
Attenuator	BIRD	100-SA-MFB-06	0232	150kHz ~ 230MHz	Aug. 25, 2015	CS
Coupling/Decoupling Network	SCHAFFNER	CDN M016	16670	150kHz ~ 230MHz	Jul. 15, 2015	CS
Magnetic field Immunity Loop	FCC (KEYTEK)	F-1000-4-8-G-125A	05004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	Dec. 30, 2015	PFMF
Magnetic Generator	FCC (KEYTEK)	F-1000-4-8/9/10-L-1M	03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	Dec. 30, 2015	PFMF
DIP Generator	TESEQ	VAR 3005-S16	0804	230VA/50Hz/60Hz 0%Open/5S 0%Short/5S 40%0.10S 70%/0.01S	Jan. 18, 2016	DIP
Harmonic/Flicker Test System	SCHAFFNER	CCN1000-1	72471	4000VA 16A PEAK	May 23, 2015	Harmonics, Flicker
AC Power Source	TESEQ	NSG 1007	1510A00144	16A PEAK	May 23, 2015	Harmonics, Flicker

Note: Calibration Interval of instruments listed above is one year.

17. Uncertainty of Test Site

Emission Test Measurement Uncertainty

Test Items	Test Site No.	Uncertainty	Remark
Conducted Emissions	CO01-NH	± 2.6dB	Confidence levels of 95%
Radiated Emissions below 1GHz	OS02-NH	± 3.0dB	Confidence levels of 95%

Immunity Test Measurement Uncertainty

◆ **ESD Immunity (IEC 61000-4-2)**

Negative Discharge Current

From Standard				From calibration certificate					
2kV	First Peak Current	Current at 30ns	Current at 60ns	Measured First Peak Current	1st Peak Worst case. **+5%**	Measured Current at 30ns	30ns Worst case. **+5%**	Measured Current at 60ns	60ns Worst case. **-5%**
Nominal	7.5	4	2	7.48	7.85	4.2	4.41	2.01	2.11
Min	6.75	2.8	1.4		6.75		2.8		1.4
Max	8.25	5.2	2.6		8.25		5.2		2.6
Tolerance in %	10%	30%	30%						

4kV	First Peak Current	Current at 30ns	Current at 60ns	First Peak Current	1st Peak Worst case. **+5%**	Measured Current at 30ns	30ns Worst case. **+5%**	Measured Current at 60ns	60ns Worst case. **+5%**
Nominal	15	8	4	15.12	15.88	8.03	8.43	3.68	3.86
Min	13.5	5.6	2.8		13.5		5.6		2.8
Max	16.5	10.4	5.2		16.5		10.4		5.2
Tolerance in %	10%	30%	30%						

6kV	First Peak Current	Current at 30ns	Current at 60ns	First Peak Current	1st Peak Worst case. **-5%**	Measured Current at 30ns	30ns Worst case. **+5%**	Measured Current at 60ns	60ns Worst case. **+5%**
Nominal	22.5	12	6	22.78	23.92	12.37	12.99	5.45	5.72
Min	20.25	8.4	4.2		20.25		8.4		4.2
Max	24.75	15.6	7.8		24.75		15.6		7.8
Tolerance in %	10%	30%	30%						

Negative Discharge Current

From Standard				From calibration Certificate					
8kV	First Peak Current	Current at 30ns	Current at 60ns	First Peak Current	1st Peak Worst case. +5%	Measured Current at 30ns	30ns Worst case. +5%	Measured Current at 60ns	60ns Worst case. +5%
Nominal	30	16	8	30.26	31.77	16.13	16.94	7.39	7.76
Min	27	11.2	5.6		27		11.2		5.6
Max	33	20.8	10.4		33		20.8		10.4
Tolerance in %	10%	30%	30%						

Negative Discharge Voltage

Standard Parameters				Measured Values
Indicated Voltage.	Tolerance.	Max.	Min.	
kV	%	kV	kV	kV
2	10	2.20	1.80	2.05
4	10	4.40	3.60	4.027
6	10	6.60	5.40	5.955
8	10	8.80	7.20	7.916
15	10	16.50	13.50	14.839

Negative Rise Time

Standard Parameters	
T max.	1ns
T min	0.7ns

Measured Values			
Indicated Voltage.	Measured Rise Time.	Worst Case max. +6%	Worst Case min. -6%
2kV	0.851	0.902	0.799
4kV	0.780	0.827	0.733
6kV	0.750	0.795	0.705
8kV	0.772	0.818	0.726

It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95% confidence

◆ RF Radiated Immunity (IEC 61000-4-3)

Symbol	Source of Uncertainty	Value	Probability distribution	Divisor	$u_i(y)$
F_{SM}	Felds Strength monitor	1.5	Normal 2	2.000	0.75
FS_{AW}	Field Strength acceptability window	0.50	Rectangular	1.732	0.29
PAH	Power Amplifier Harmonics	0.50	Rectangular	1.732	0.29
R_S	Measurement System Repeatability	0.50	normal 1	1.000	0.50
R_{EUT}	Repeatability of EUT	0.00	normal 1	1.000	0.00
$u_c(F_S)$	Combined Standard Uncertainty	-	normal	-	0.83
$U(F_S)$	**Expanded Uncertainty**	-	**normal k= 2**		**1.66**

Specified Level (V/m)	Test level (V/m)
For 1 Volts	1.25
For 3 Volts	3.33
For 10 Volts	11.22

◆ EFT/BURST Immunity (IEC 61000-4-4)

Voltage Output

Standard Parameters				Measured Values
Indicated Voltage.	Tolerance.	Max.	Min.	
kV	%	kV	kV	kV
0.5	10	0.55	0.45	0.489
1	10	1.1	0.9	1.006
2	10	2.2	1.8	2.016
4	10	4.4	3.6	3.830
- 0.5	10	- 0.55	- 0.45	- 0.489
- 1	10	- 1.1	- 0.9	- 0.972
- 2	10	- 2.2	- 1.8	- 1.961
- 4	10	- 4.4	- 3.6	- 3.770

Spike frequency

Standard Parameters					Measured Values
Indicated Voltage.		Tolerance.	Max.	Min.	
kV	kHz	%	kHz	kHz	kHz
0.5	5	10	5.5	4.5	5.00
1	5	10	5.5	4.5	4.98
2	5	10	5.5	4.5	4.98
4	2.5	10	2.75	2.25	2.49
4	5	10	5.5	4.5	5.01

Burst width

Standard Parameters					Measured Values
Indicated Voltage.		Tolerance.	Max.	Min.	
kV	ms	%	ms	ms	ms
0.5	15	20	18	12	14.97
1	15	20	18	12	14.94
2	15	20	18	12	14.91
4	15	20	18	12	14.95

Burst period

Standard Parameters					Measured Values
Indicated Voltage.		Tolerance.	Max.	Min.	
kV	ms	%	ms	ms	ms
0.5	300	20	360	240	299.7
1	300	20	360	240	300.5
2	300	20	360	240	299.2
4	300	20	360	240	300.2

It has been demonstrated that the EFT/BURST generator meets the specified requirements in the standard with at least a 95% confidence

◆ Surge Immunity (IEC 61000-4-5)

Surge Voltage Output

Standard Parameters				Measured Values
Indicated Voltage.	Tolerance.	Max.	Min.	
kV	%	kV	kV	kV
0.5	10	0.55	0.45	0.488
1	10	1.1	0.9	0.964
2	10	2.2	1.8	1.984
4	10	4.4	3.6	3.94
6	10	6.6	5.4	5.91
- 0.5	10	- 0.55	- 0.45	- 0.484
- 1	10	- 1.1	- 0.9	- 0.977
- 2	10	- 2.2	- 1.8	- 1.992
- 4	10	- 4.4	- 3.6	- 3.95
- 6	10	- 6.6	- 5.4	- 5.91

Output Wave

Standard Parameters			Measured Values
+ 6 kV			
	Max.	Min.	
Rise Time	1.56 µs	0.84 µs	1.24 µs
Duration Time	60 µs	40 µs	52.83 µs
+ 6 kV			
Rise Time	1.56 µs	0.84 µs	1.30 µs
Duration Time	60 µs	40 µs	54.72 µs

It has been demonstrated that the Surge generator meets the specified requirements in the standard with at least a 95% confidence

◆ RF Conducted Immunity (IEC 61000-4-6)

Symbol	Source of Uncertainty	Value	Probability distribution	Divisor	$u_i(y)$
S_A	Spectrum Analyzer	1.50	Rectangular	1.732	0.87
C_C	Current coil Calibration	1.00	normal 2	2.000	0.50
M	Mismatch	-0.5	U-shaped	1.414	-0.35
M	Mismatch	-0.3	U-shaped	1.414	-0.35
R_S	Measurement System Repeatability	0.50	normal 1	1.000	0.50
R_{EUT}	Repeatability of EUT	0.00	normal 1	1.000	0.00
$u_c(F_S)$	Combined Standard Uncertainty	-	normal	-	1.57
$U(F_S)$	**Expanded Uncertainty**	-	**normal k= 2**		**3.14**

Specified Level (V)	Test level (V)
For 1 Volts	1.30
For 3 Volts	3.88
For 10 Volts	12.15

◆ Magnetic Field Immunity (IEC 61000-4-8)

Current output

Standard Parameters					Measured Values
Magnetic Field Strength	Output Current	Tolerance.	Max.	Min.	
A/m	A	%	A	A	A
1	6	5	6.3	3.8	6.1
3	50	5	52.5	47.5	49.0
10	180	5	189	171	188.0

It has been demonstrated that the Magnetic generator meets the specified requirements in the standard with at least a 95% confidence

◆ Voltage Variation Immunity (IEC 61000-4-11)

Short Dip period

Standard Parameters					Measured Values
Degree	Duration	Tolerance.	Max.	Min.	
	ms	%	ms	ms	ms
90	4	5	4.2	3.8	4.17
180	8	5	8.4	7.6	8.33
270	12	5	12.6	11.4	12.50
360	16	5	16.8	15.2	16.67

Long Dip period

Standard Parameters					Measured Values
Degree	Duration	Tolerance.	Max.	Min.	
	ms	%	ms	ms	ms
90	16	5	16.8	15.2	16.38
180	50	5	55	45	50.04
270	100	5	110	90	99.64
360	150	5	165	135	149.3

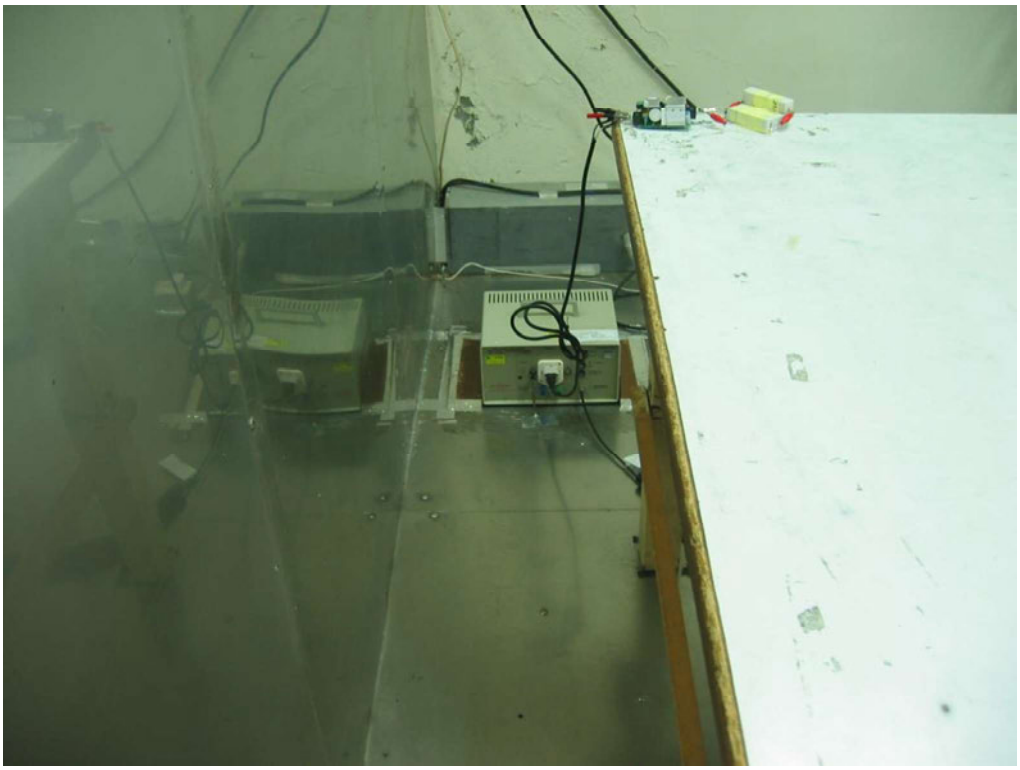
It has been demonstrated that the Dip generator meets the specified requirements in the standard with at least a 95% confidence

Appendix A. Test Photos

1. Photographs of Conducted Emissions Test Configuration

Front view

Rear view



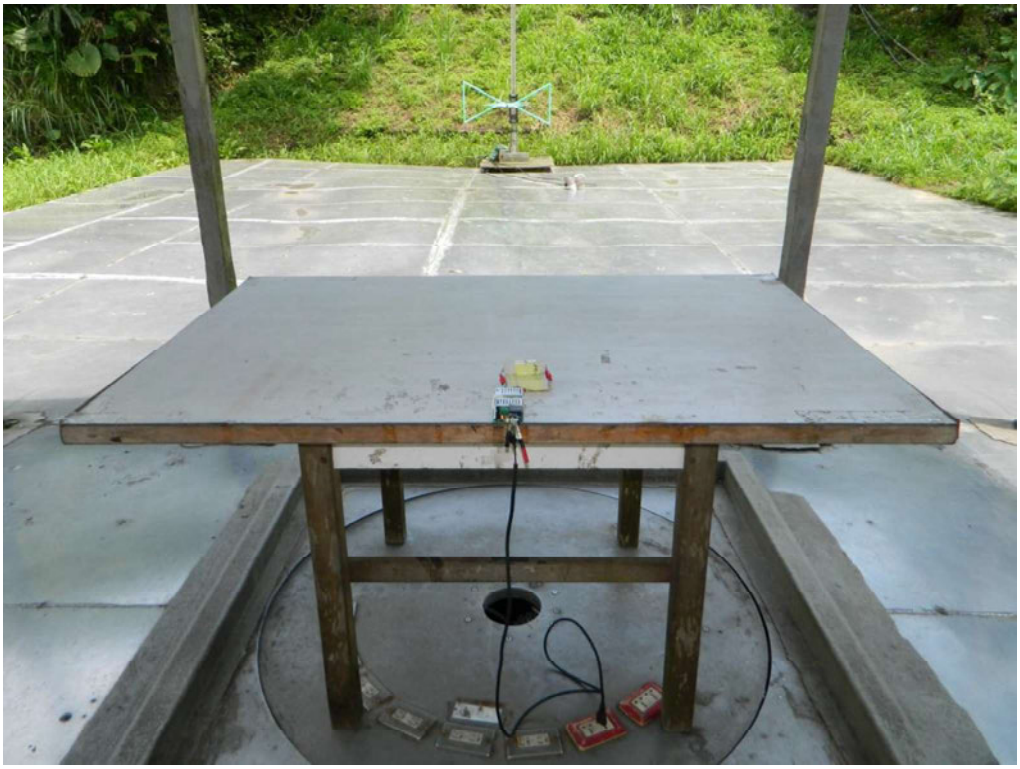
Side view

2. Photographs of Radiated Emissions Test Configuration

For radiated emissions below 1GHz

Front view

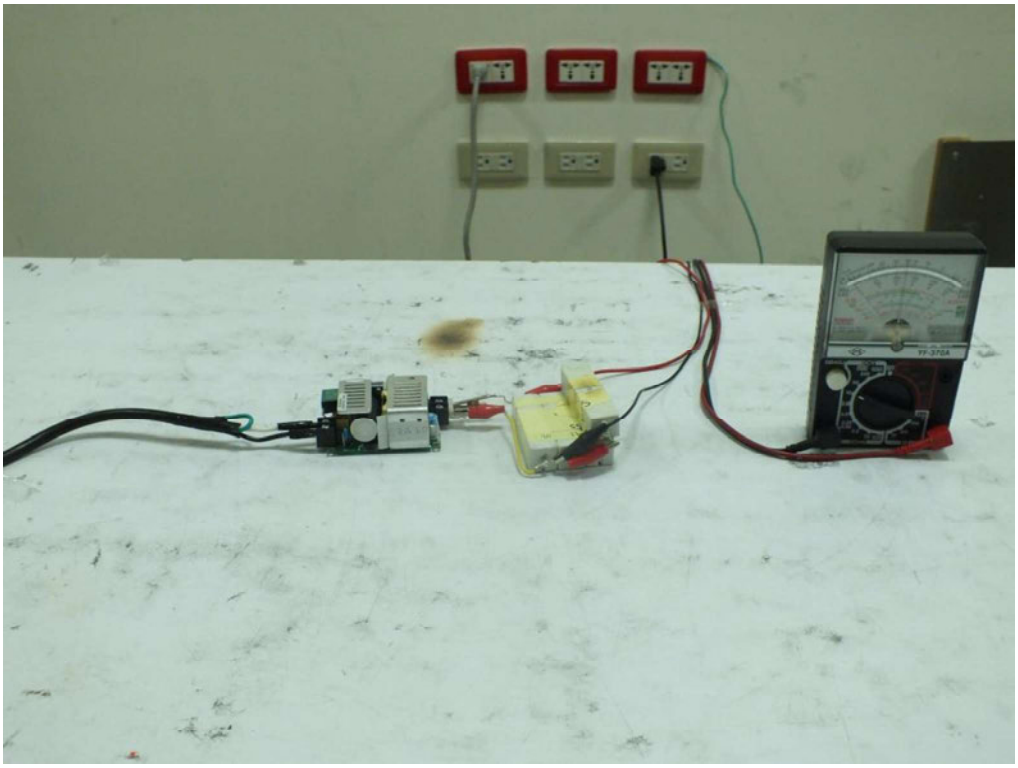
Rear view



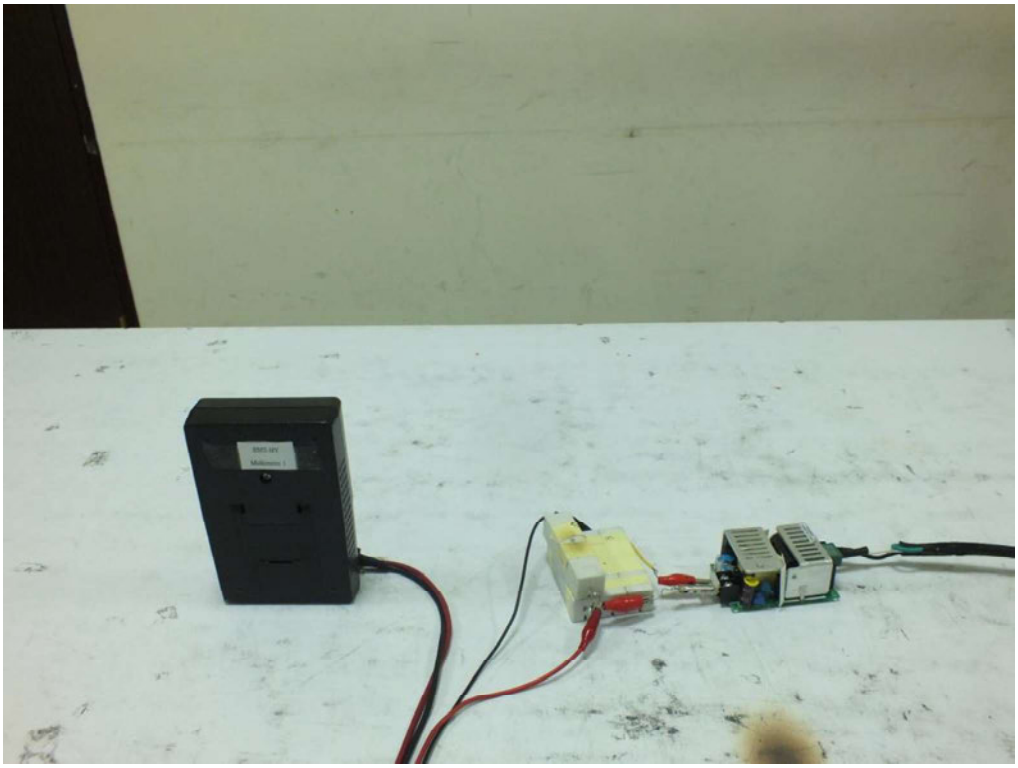
3. Photographs of Harmonic, Flicker, Surge, Dip Test Configuration

Mode1

Front view

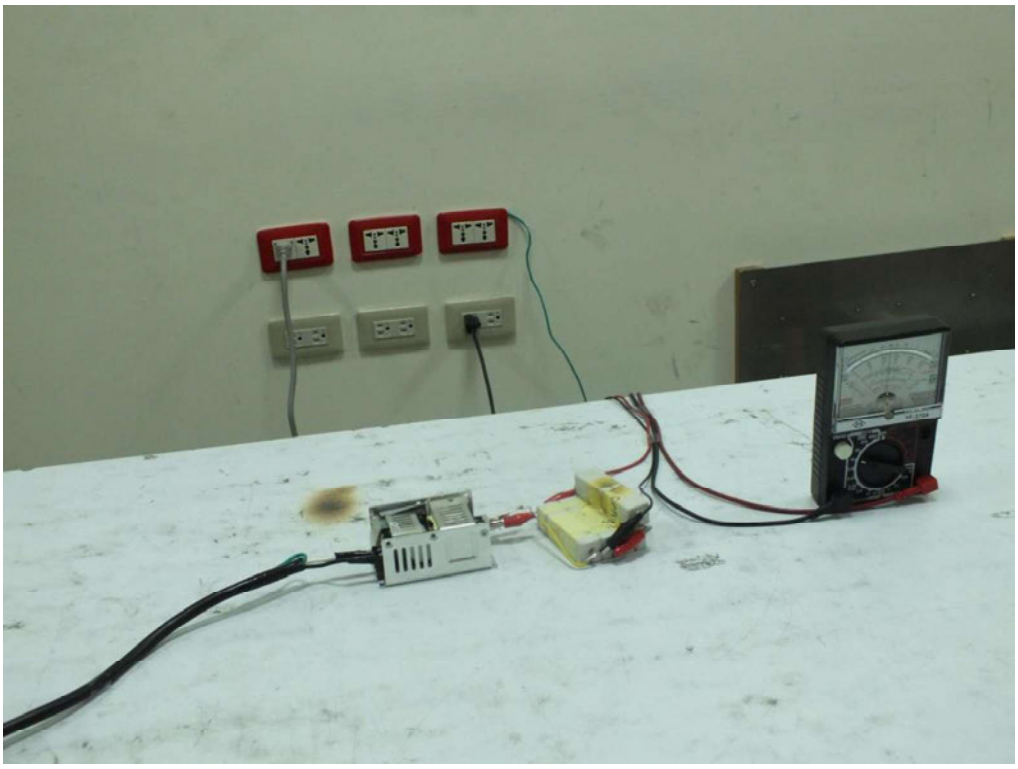


Rear view

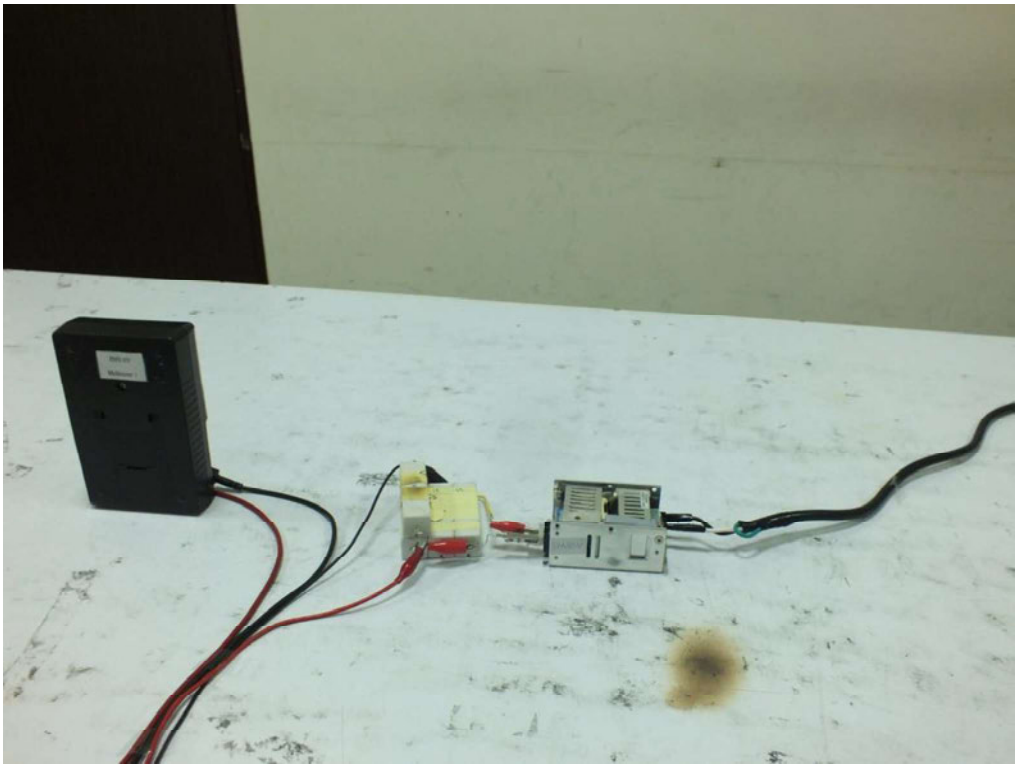


Mode2

Front view



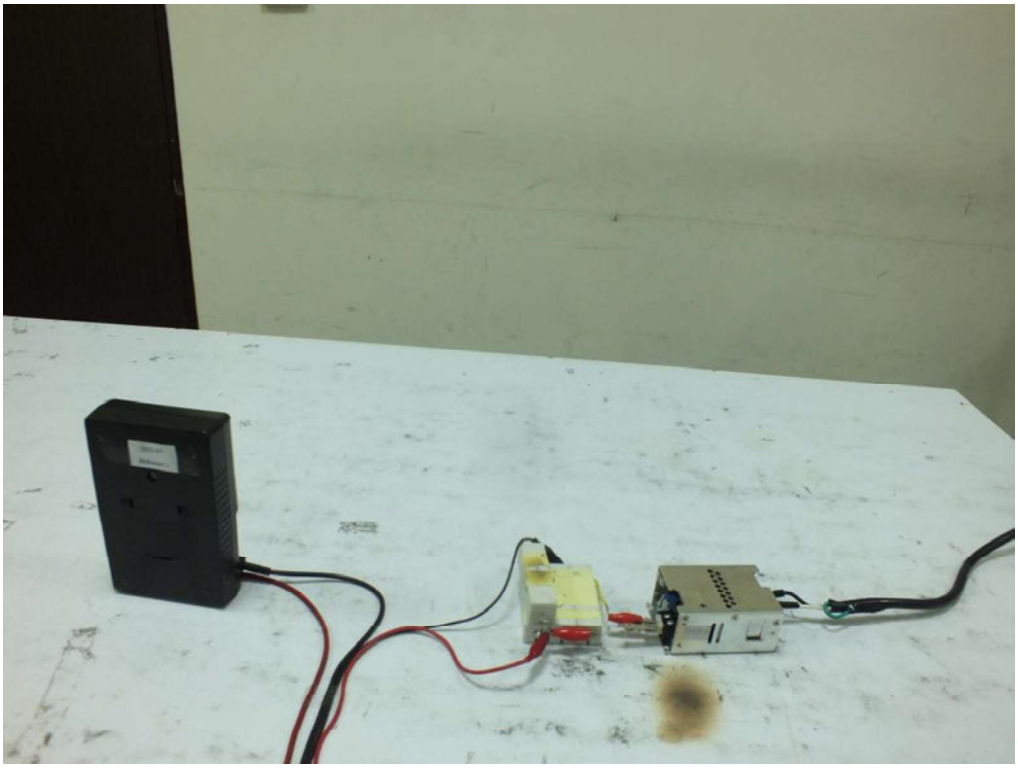
Rear view



Mode3

Front view

Rear view

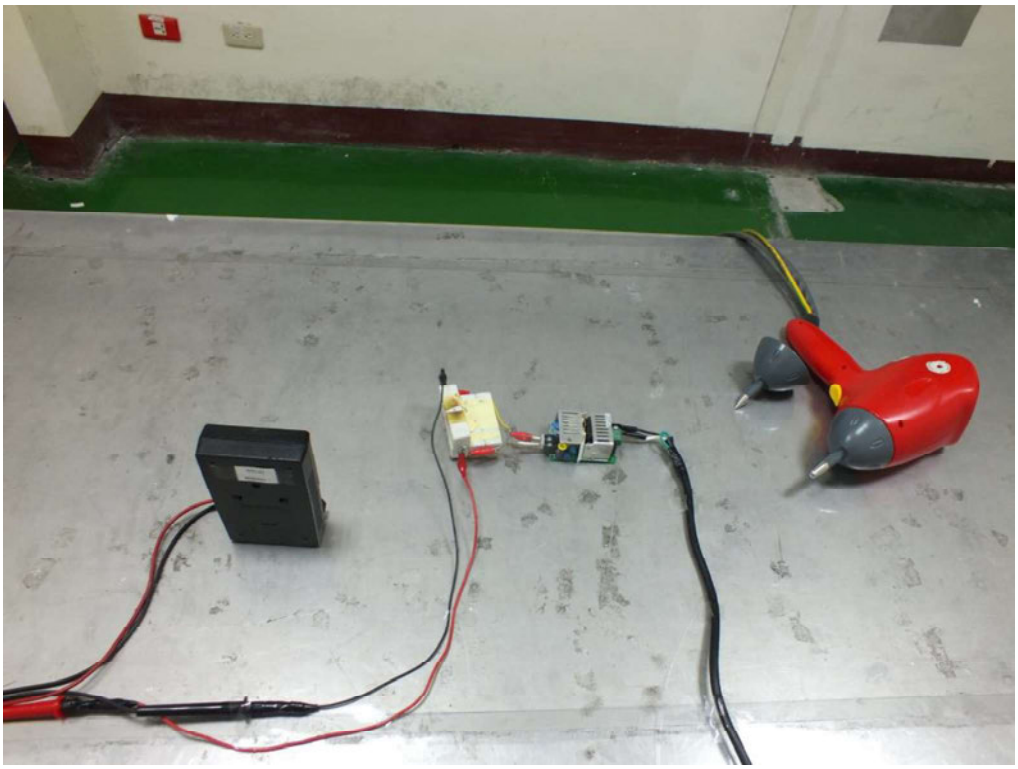


4. Photographs of ESD Immunity Test Configuration

Mode1

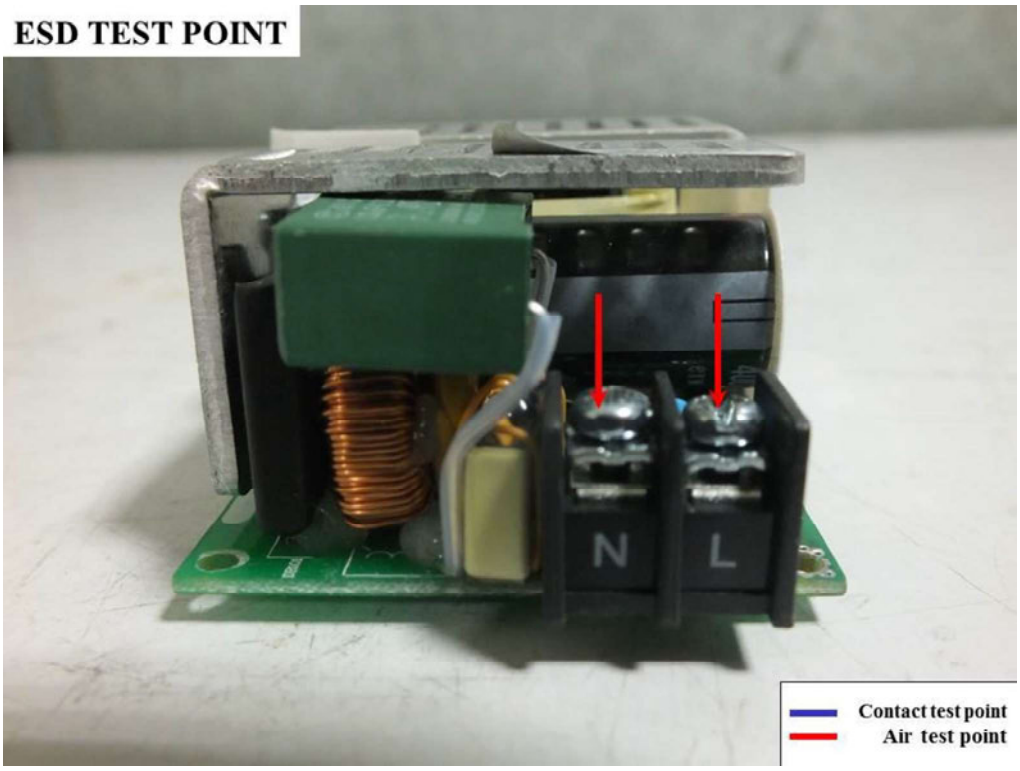
Front view

Rear view

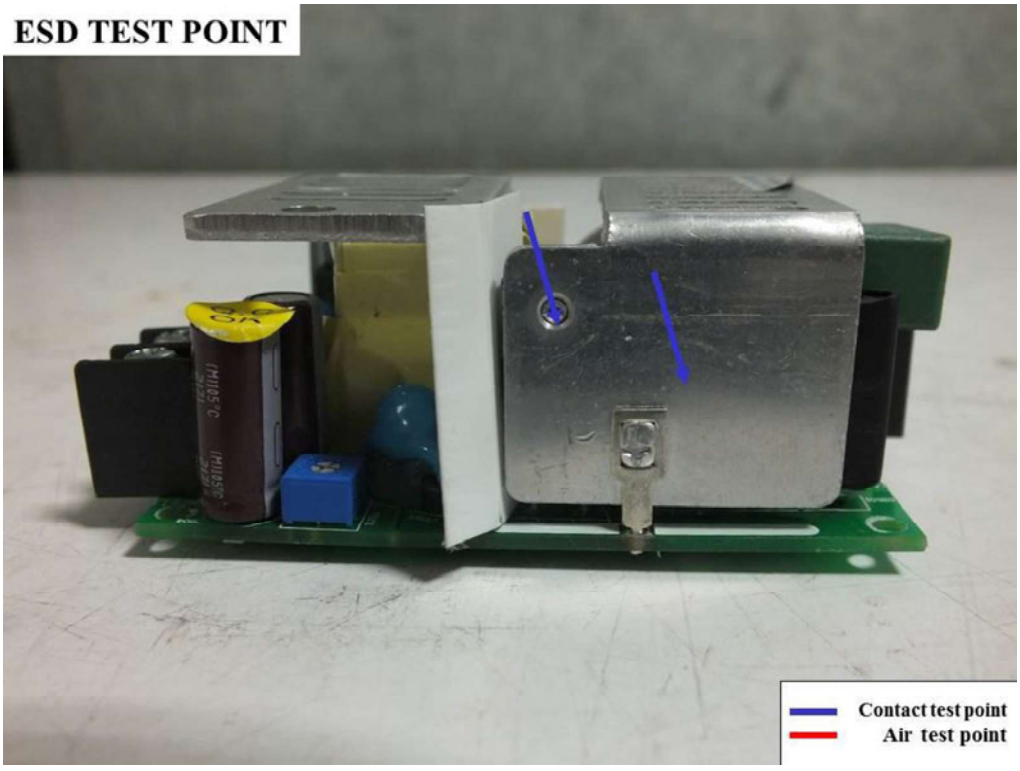


Test Points

Contact test point
Air test point



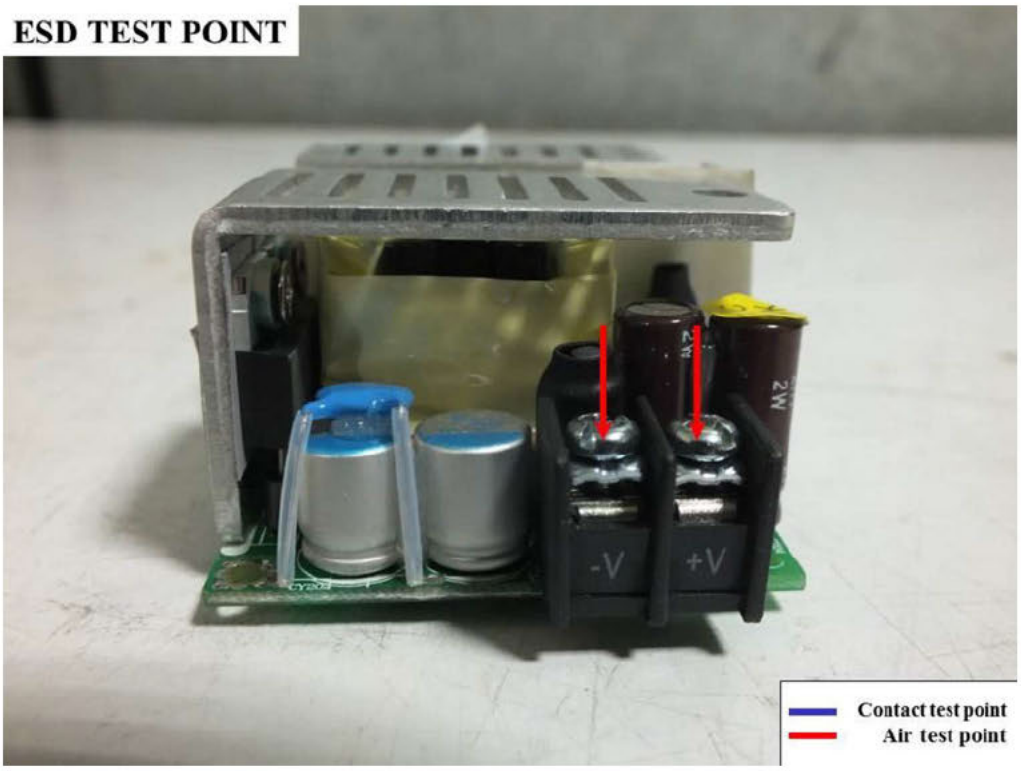
Contact test point
Air test point



Test Points

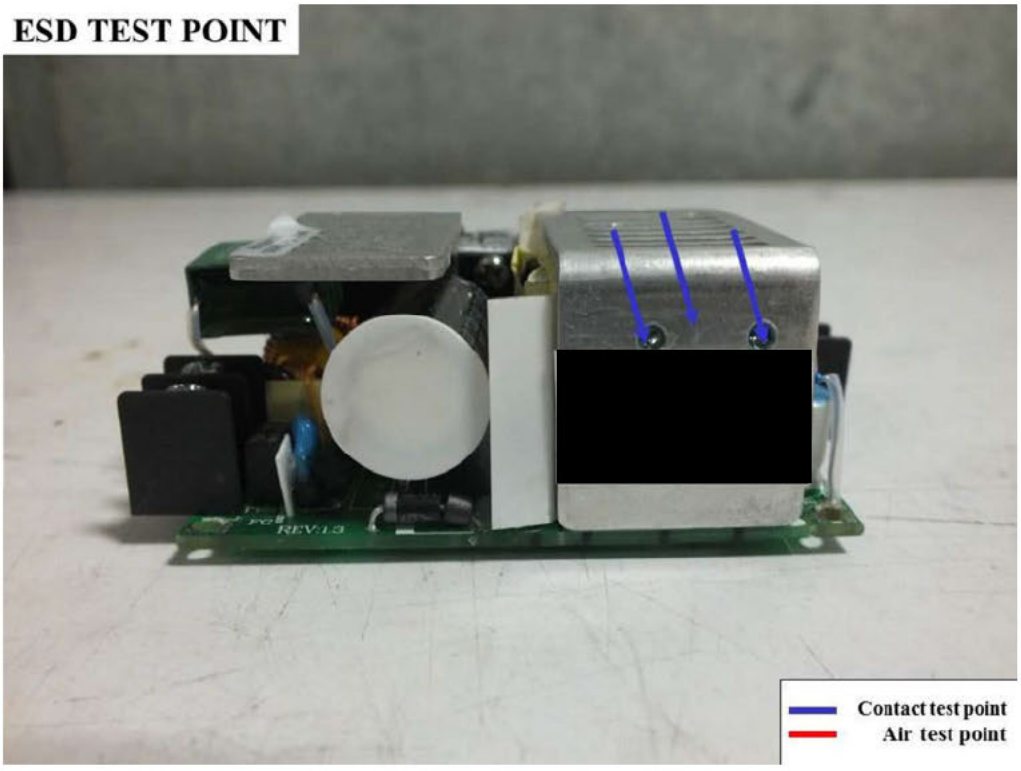
Contact test point
Air test point

ESD TEST POINT



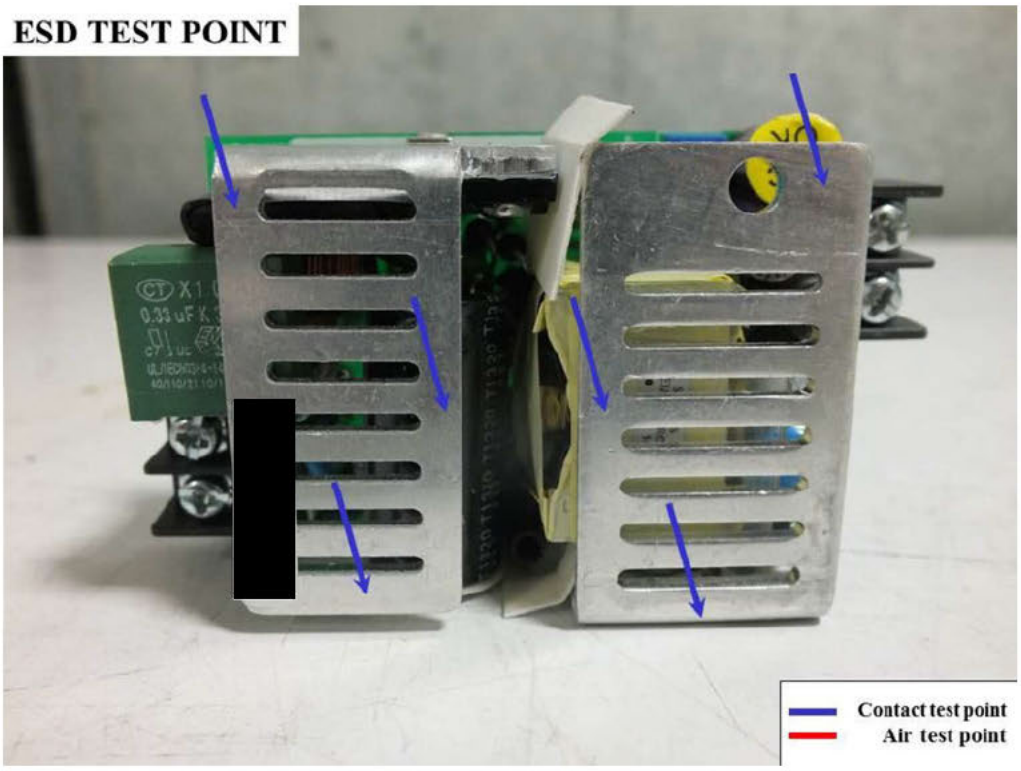
Contact test point
Air test point

ESD TEST POINT



Test Points

Contact test point
Air test point



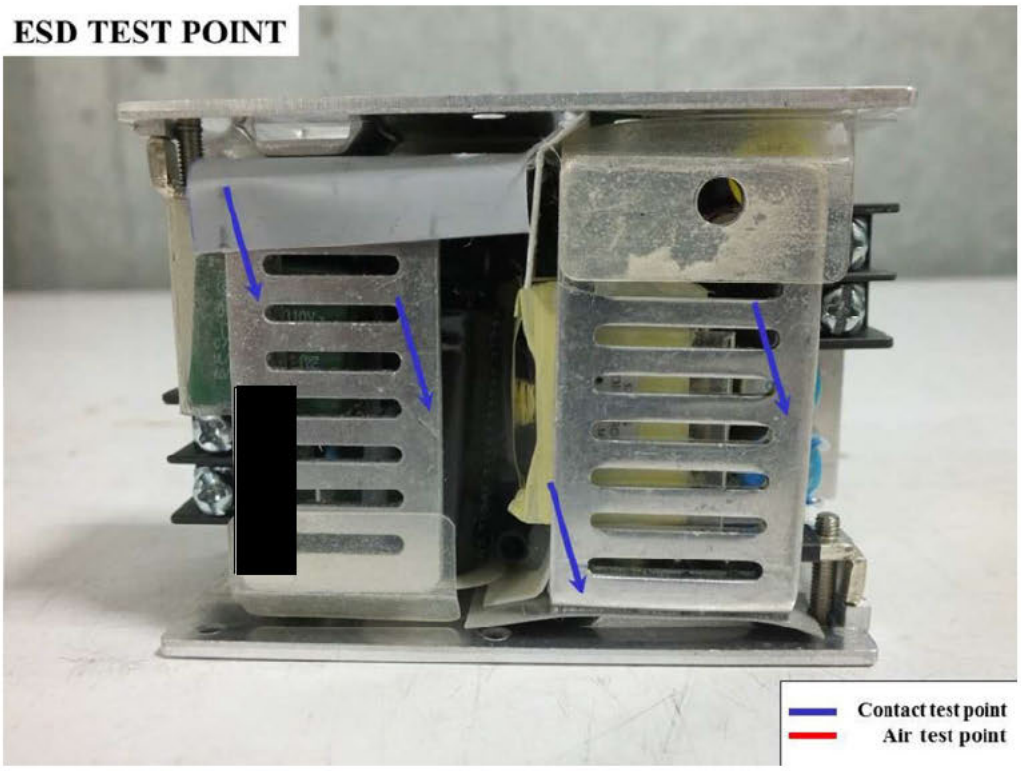
Mode2

Front view

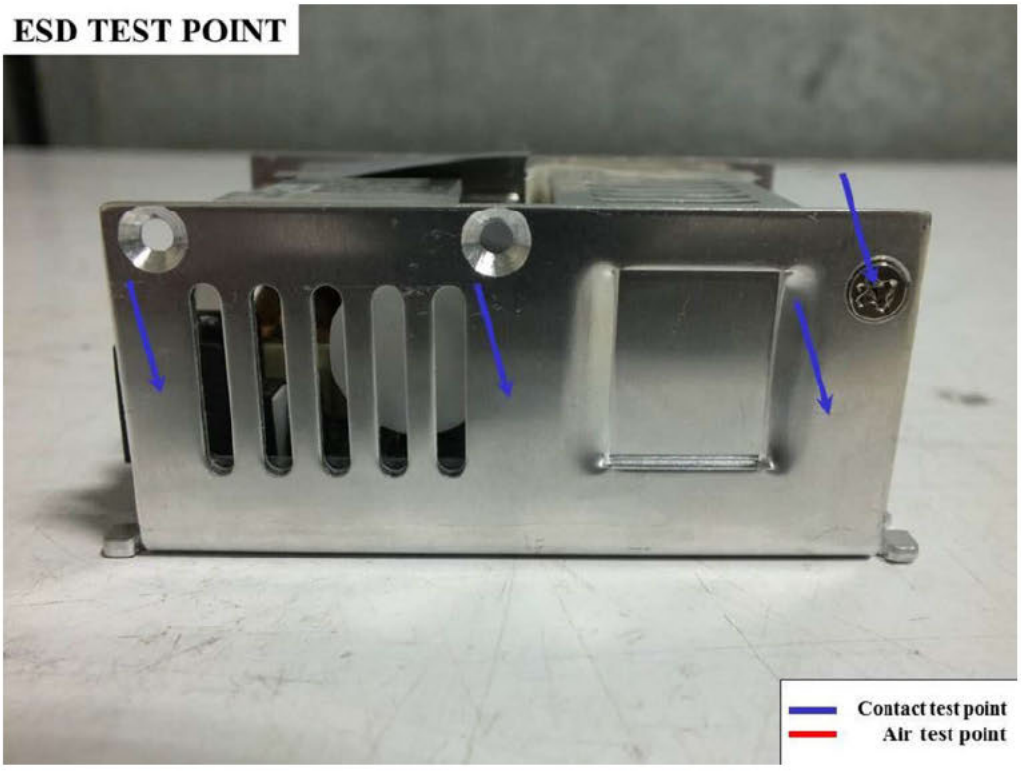
Rear view

Test Points

Contact test point
Air test point



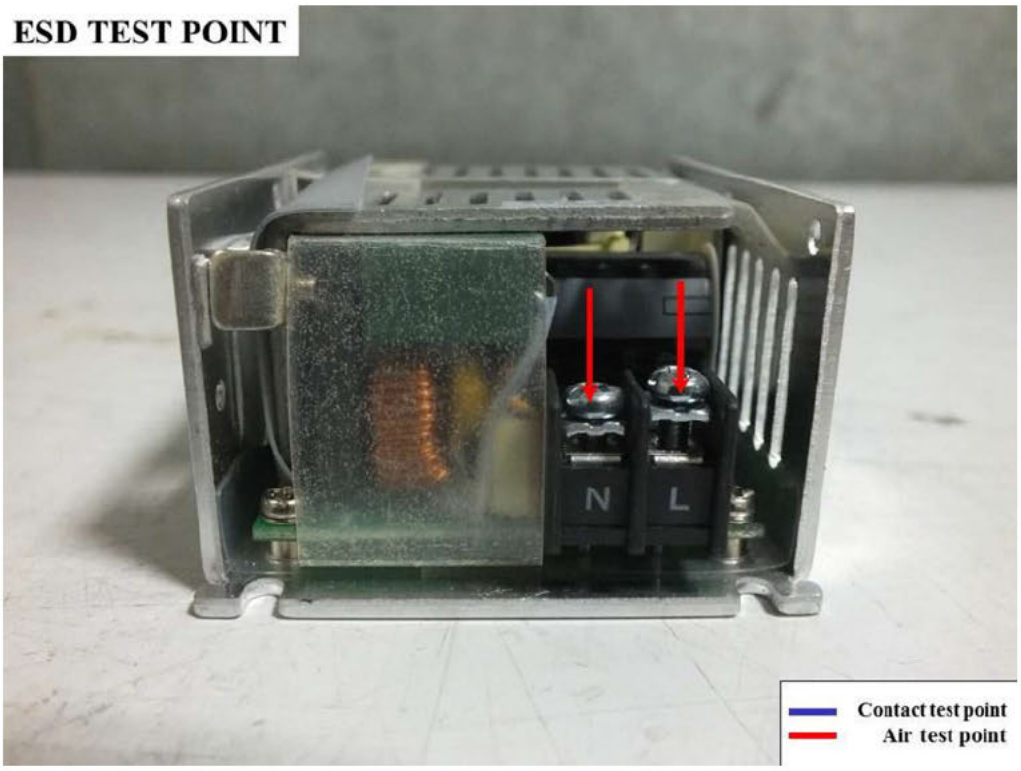
Contact test point
Air test point



Test Points

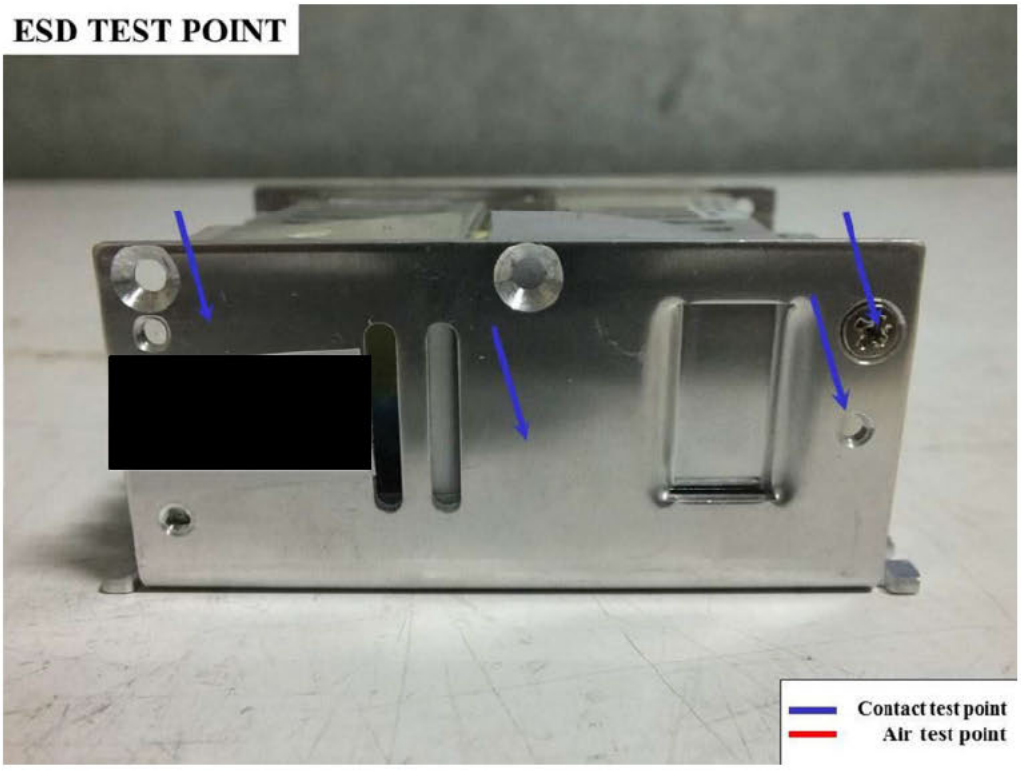
Contact test point
Air test point

ESD TEST POINT

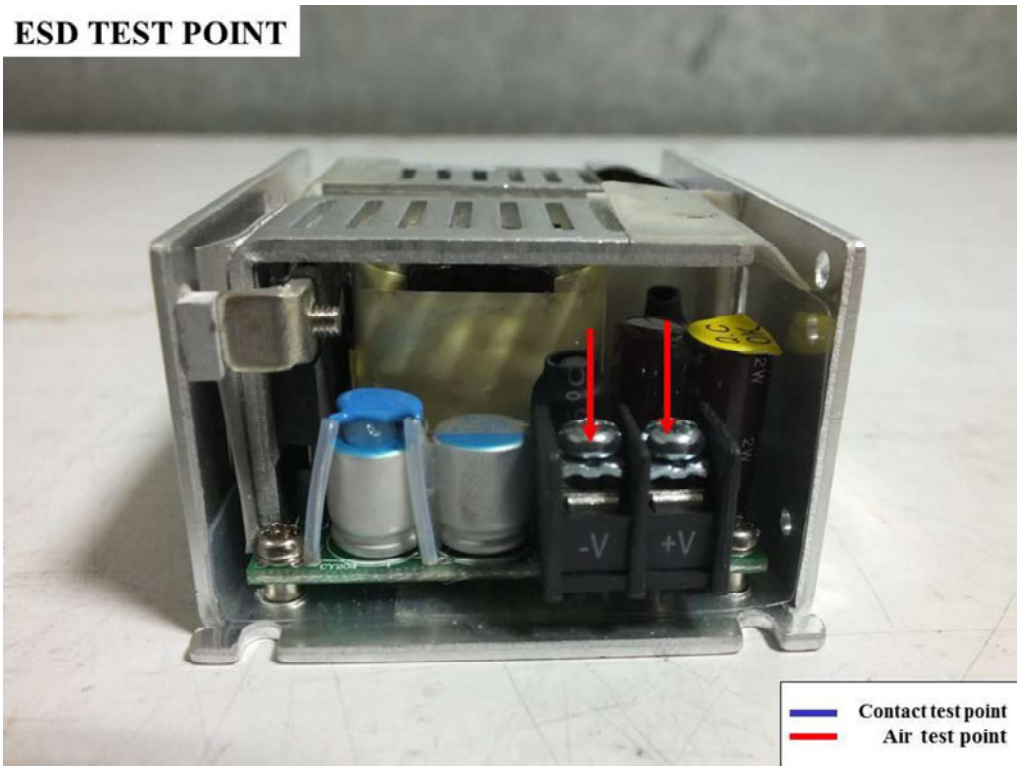


Contact test point
Air test point

ESD TEST POINT

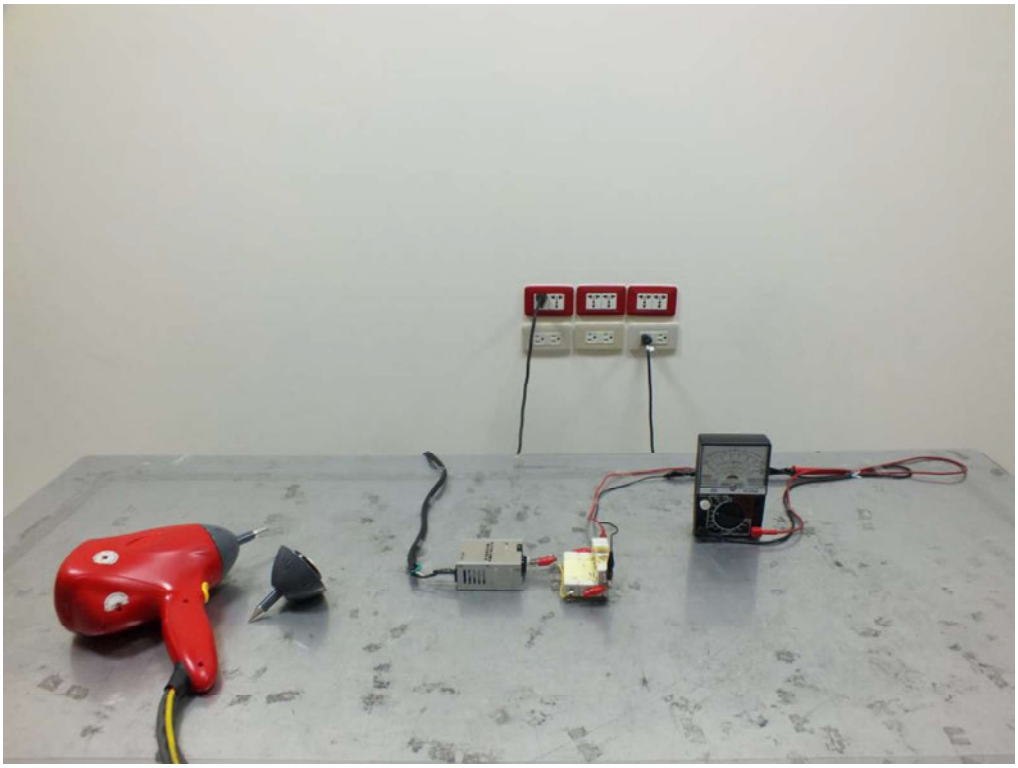


Test Points



Mode3

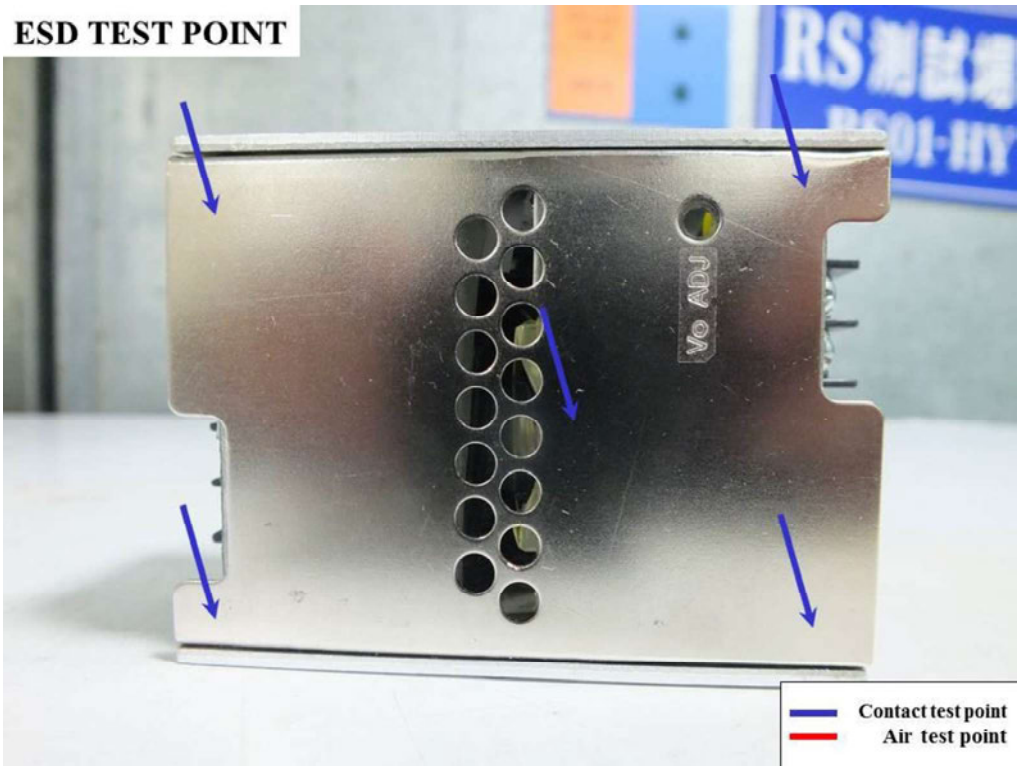
Front view



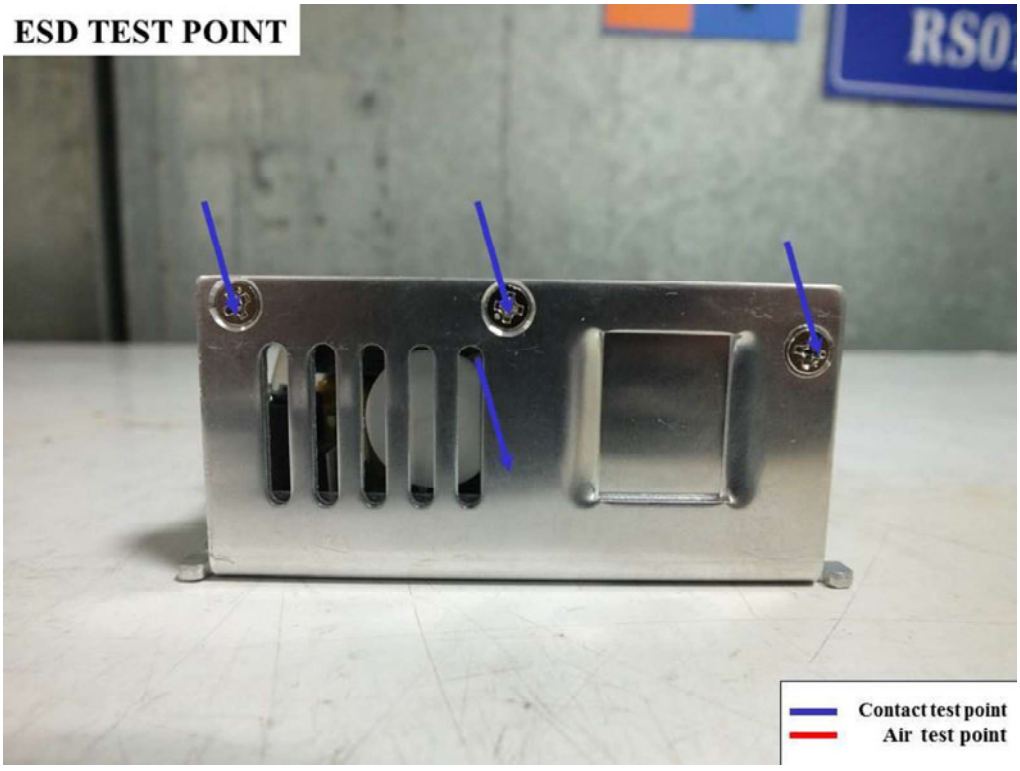
Rear view

Test Points

Contact test point
Air test point



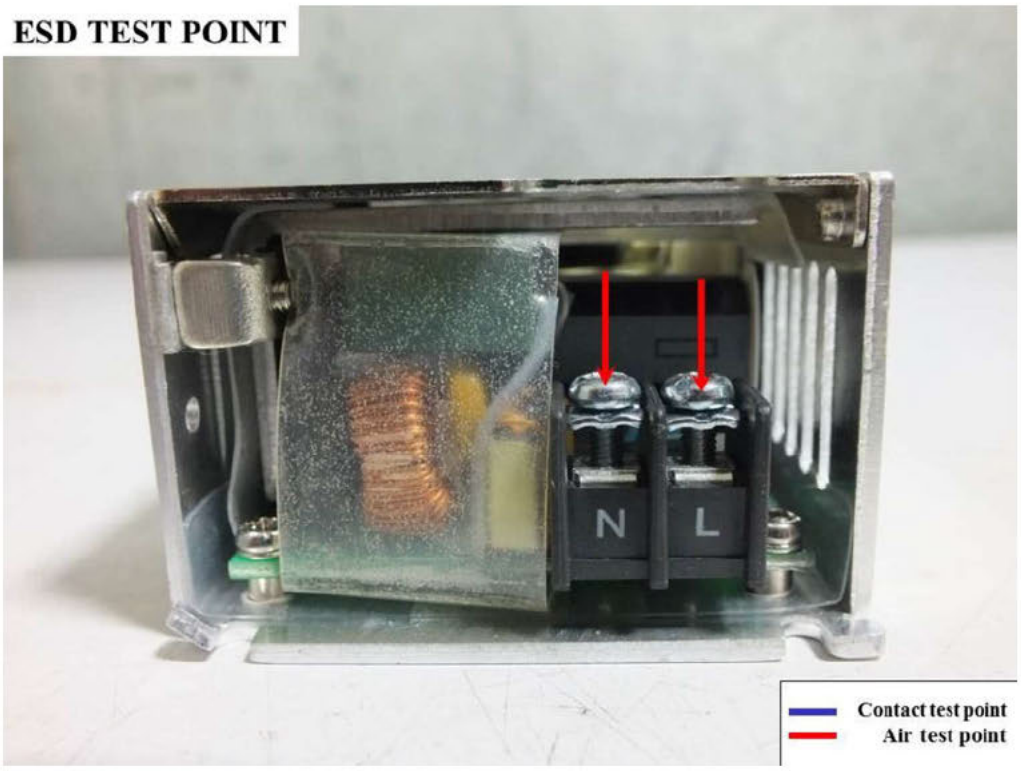
Contact test point
Air test point



Test Points

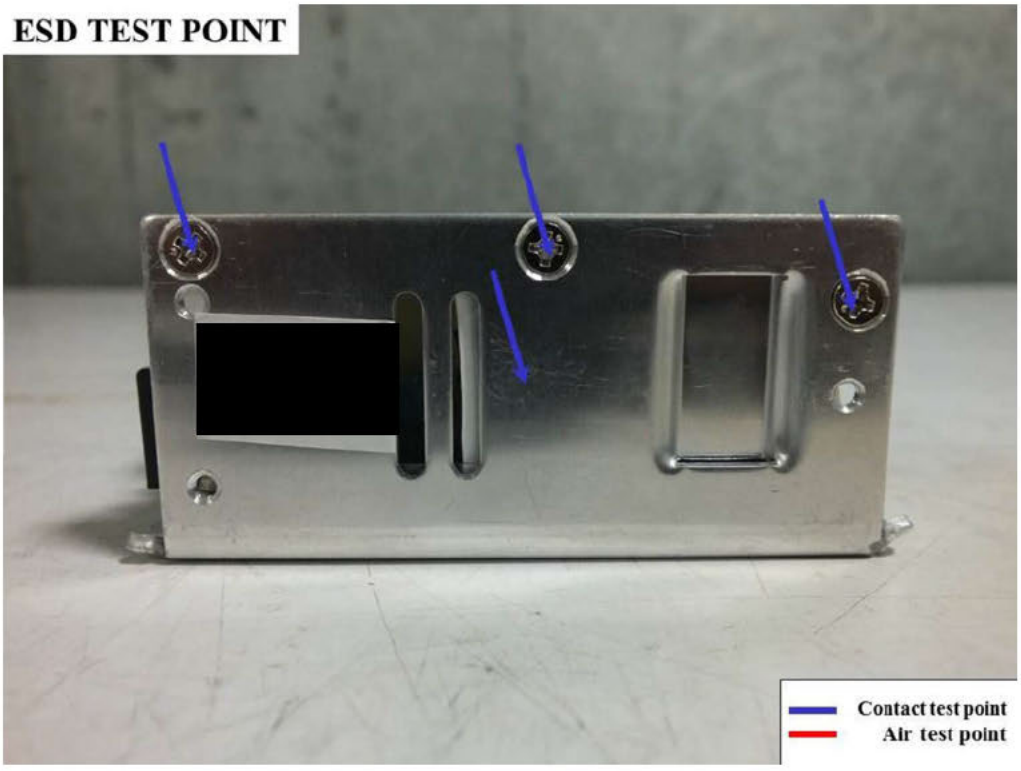
Contact test point
Air test point

ESD TEST POINT

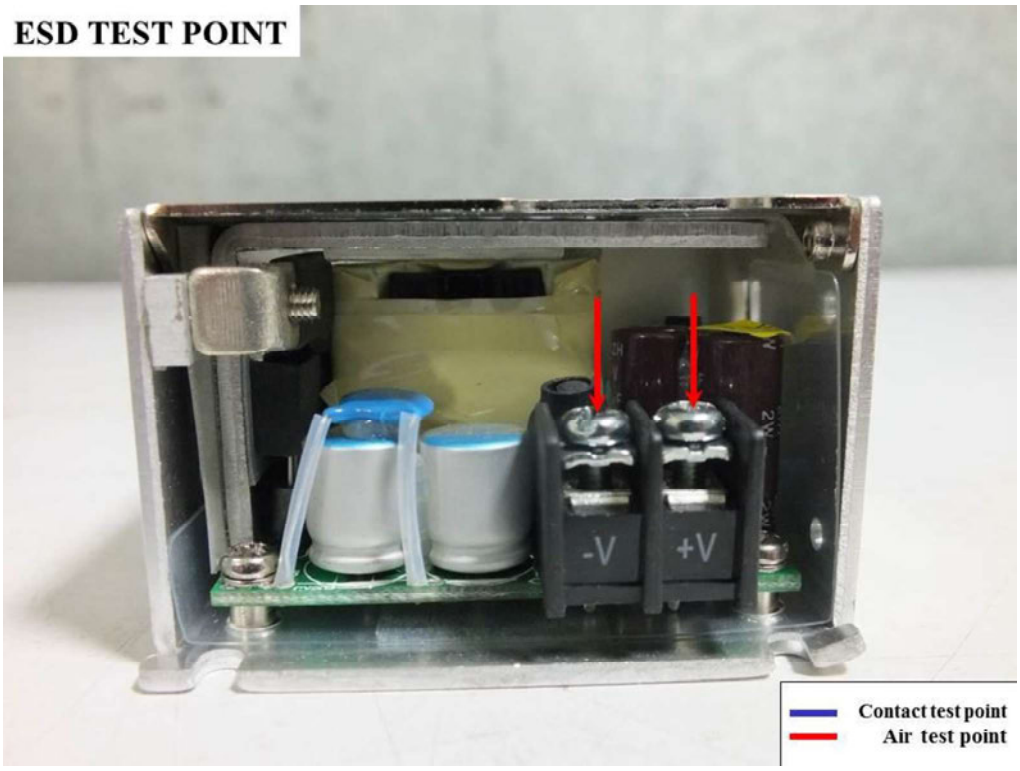


Contact test point
Air test point

ESD TEST POINT



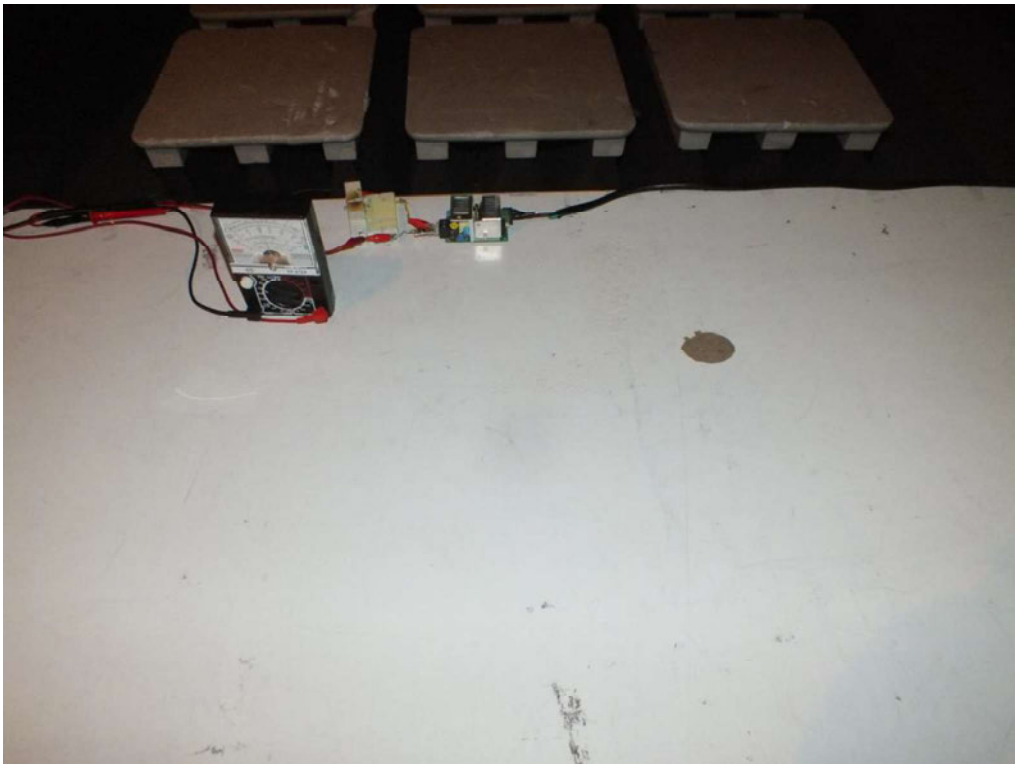
Test Points



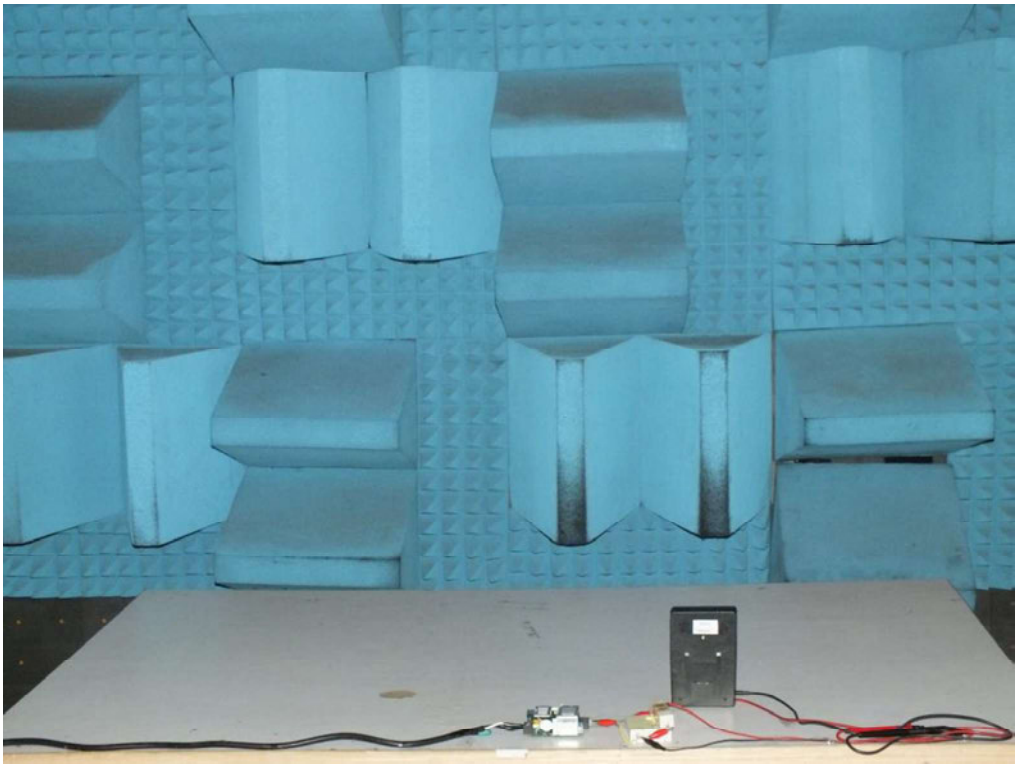
5. Photographs of RS Immunity Test Configuration

Mode1

Front view

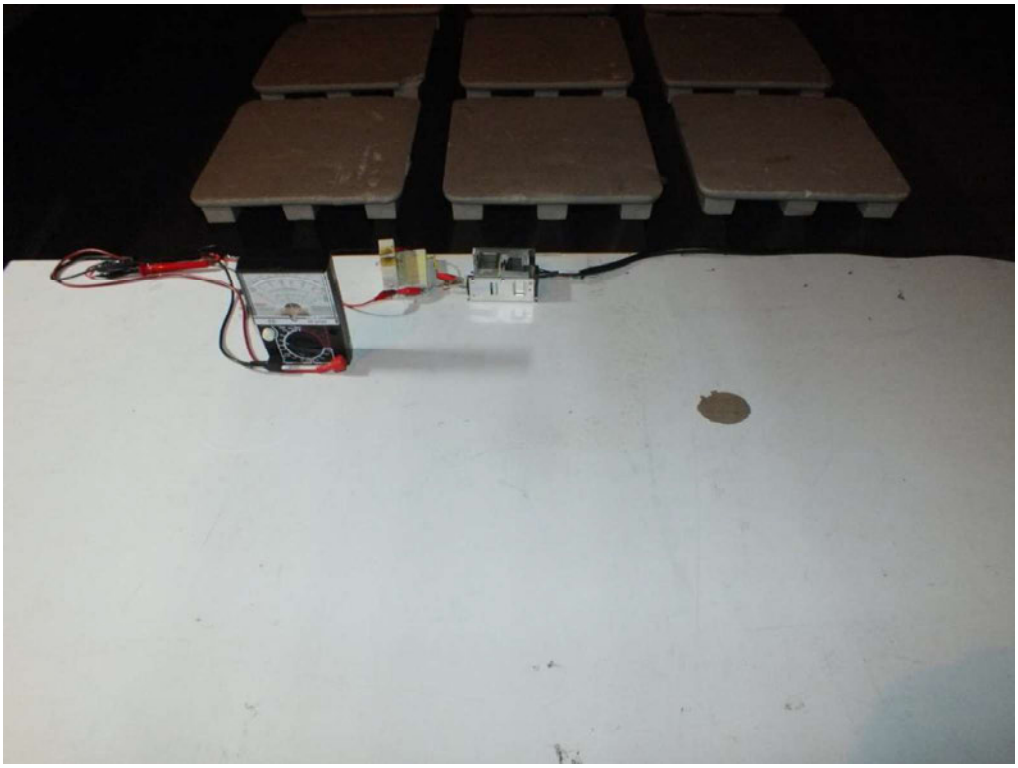


Rear view

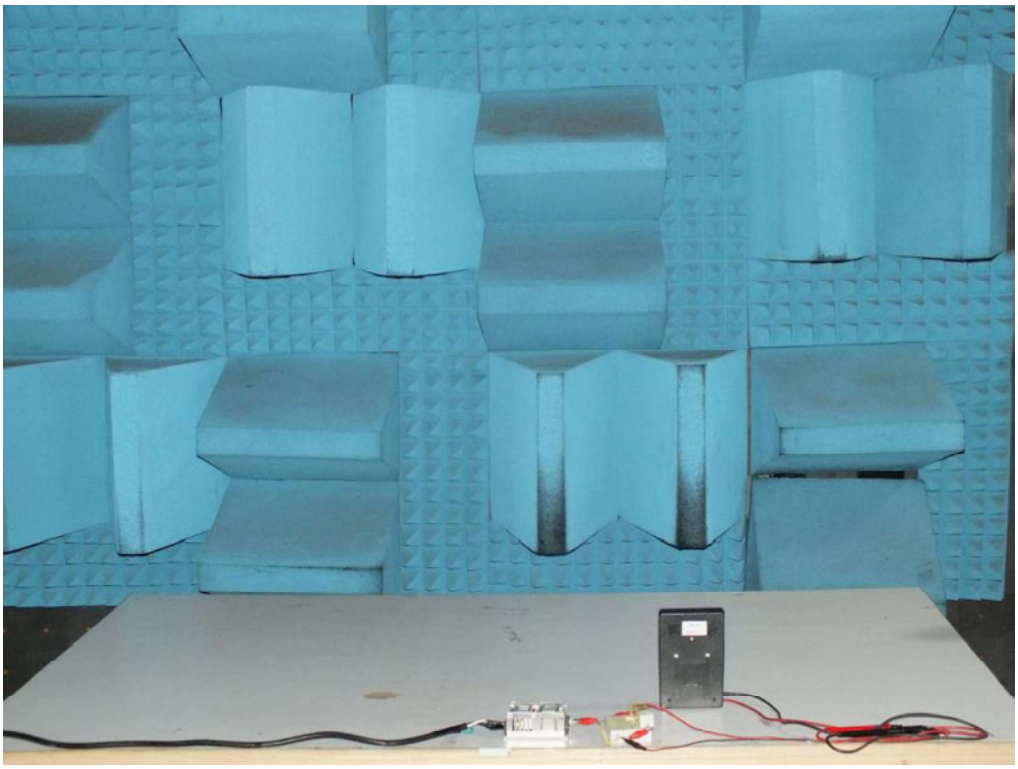


Mode2

Front view

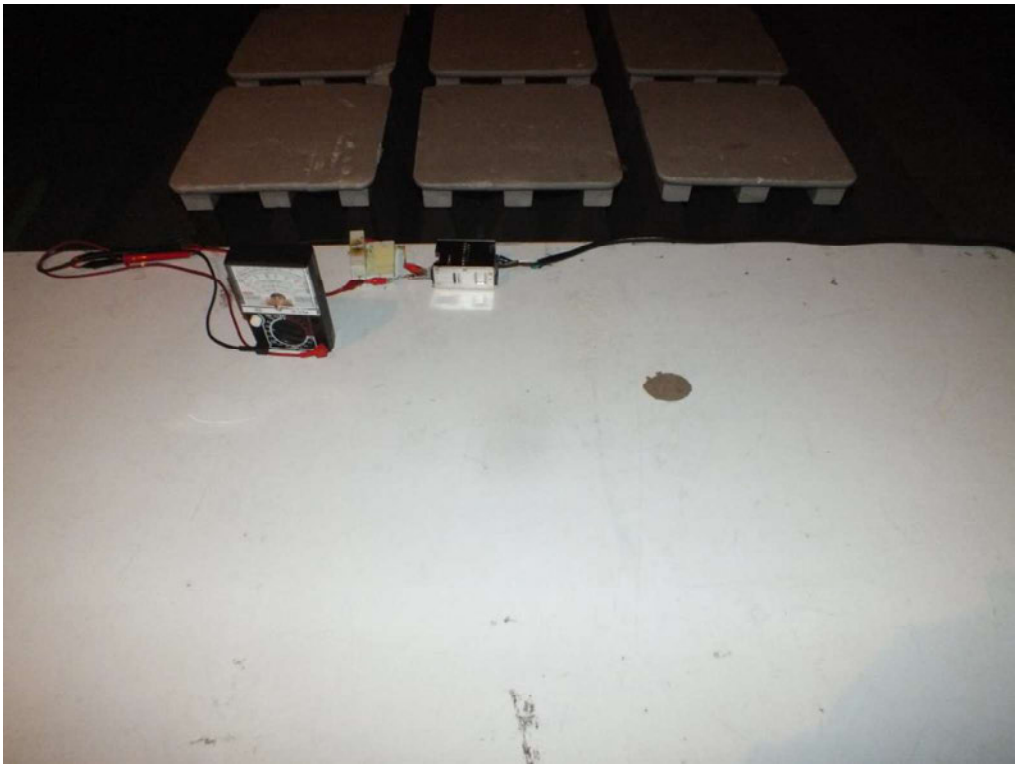


Rear view

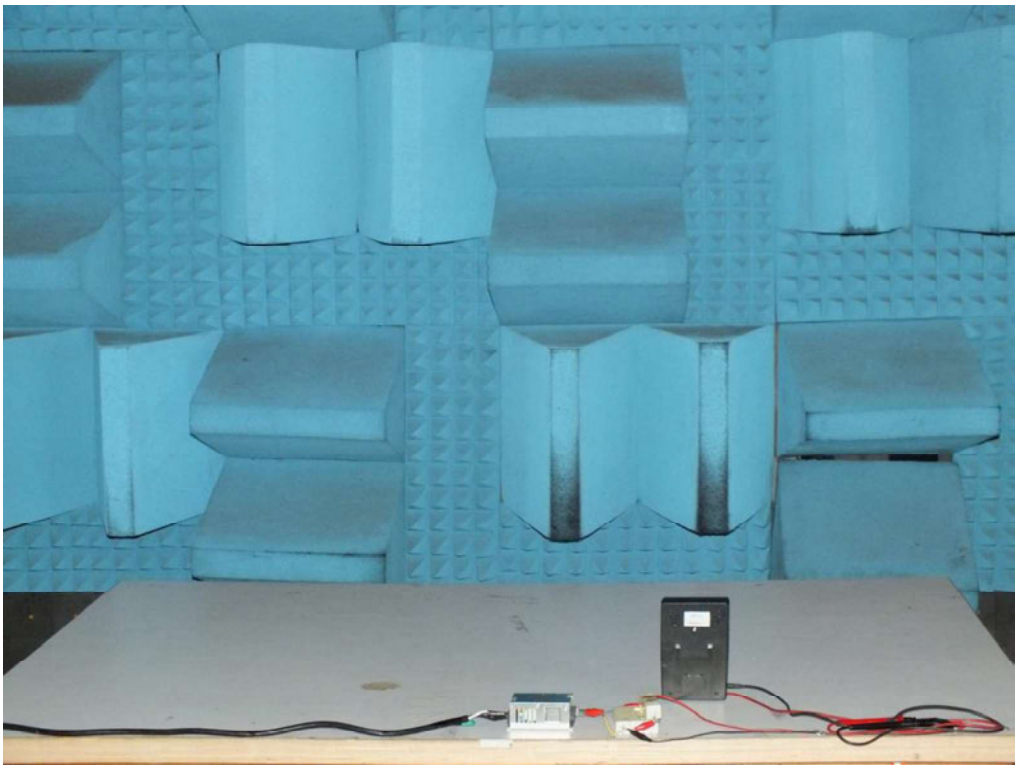


Mode3

Front view



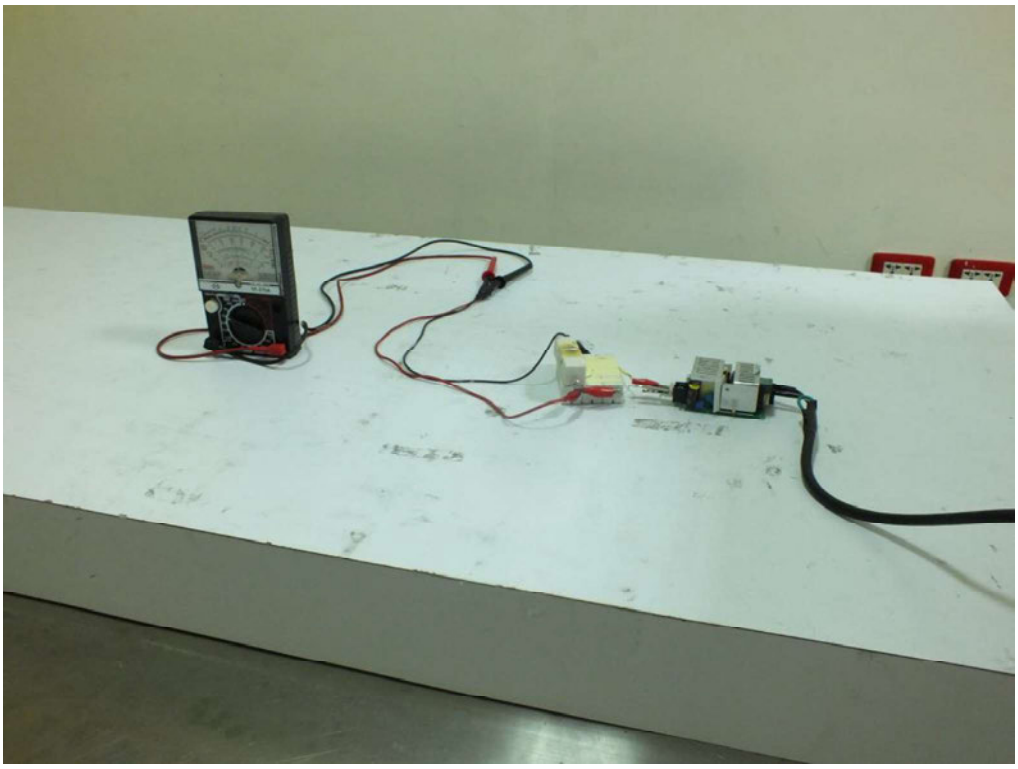
Rear view



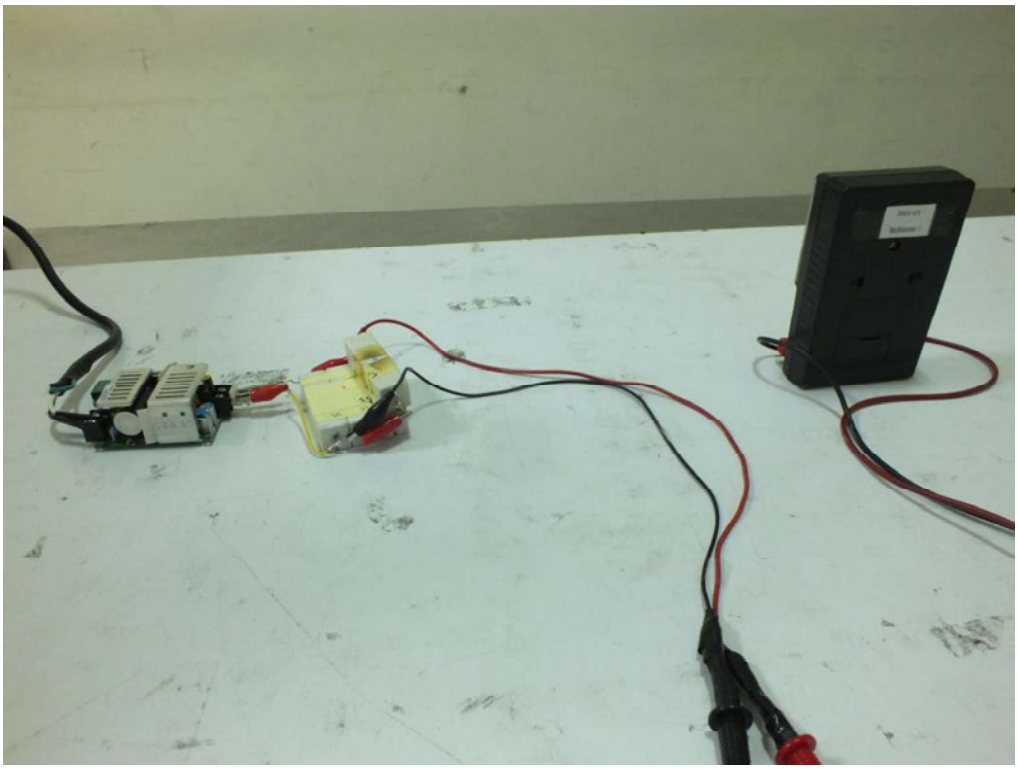
6. Photographs of EFT Test Configuration

Mode1

Front view

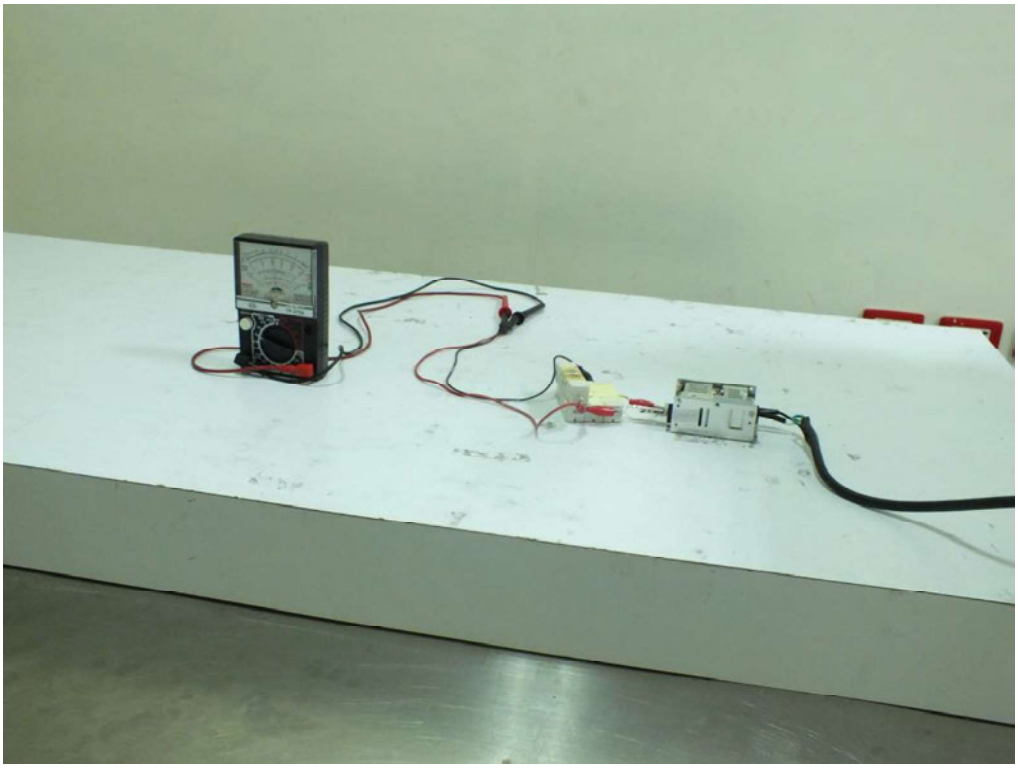


Rear view

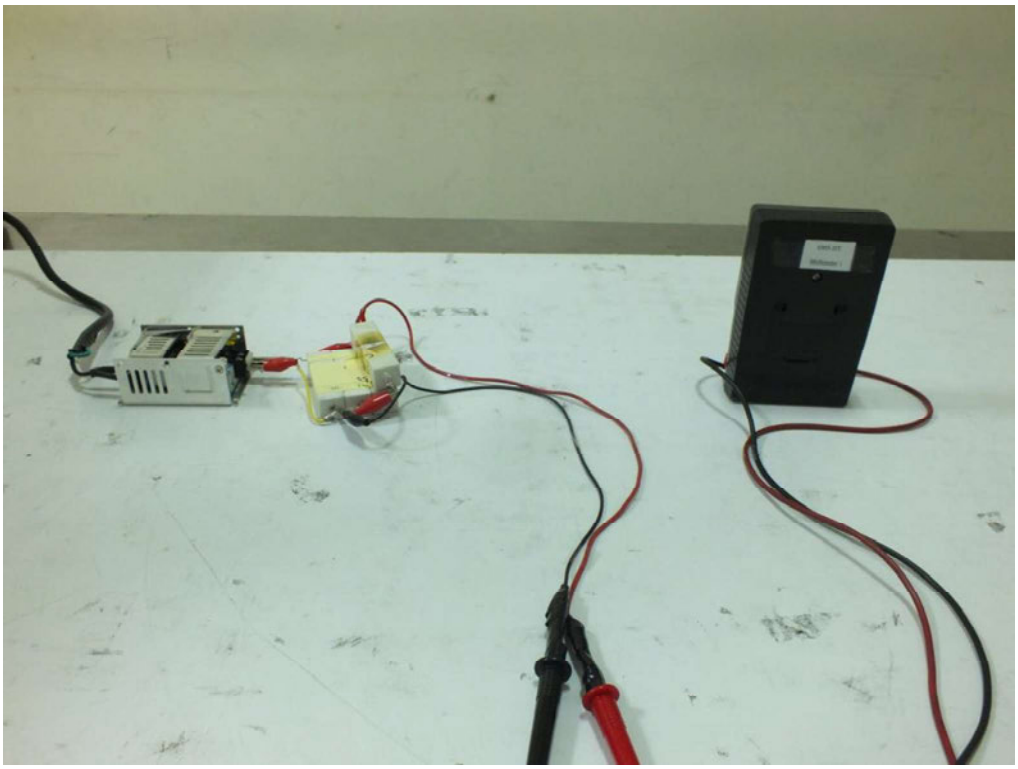


Mode2

Front view

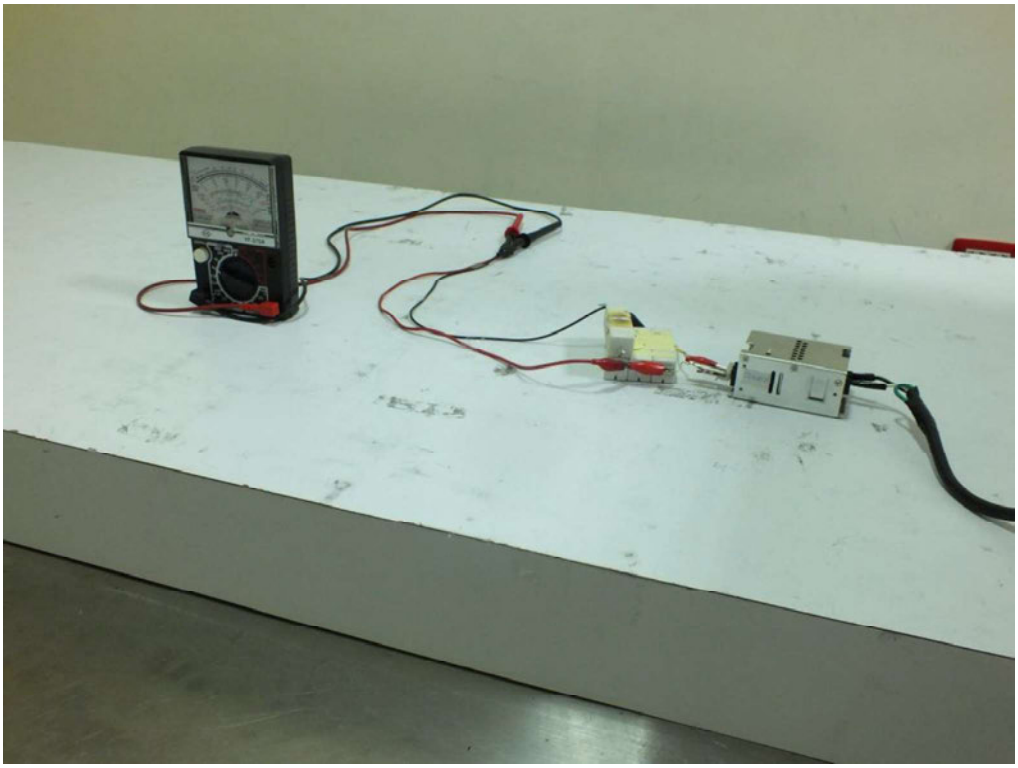


Rear view

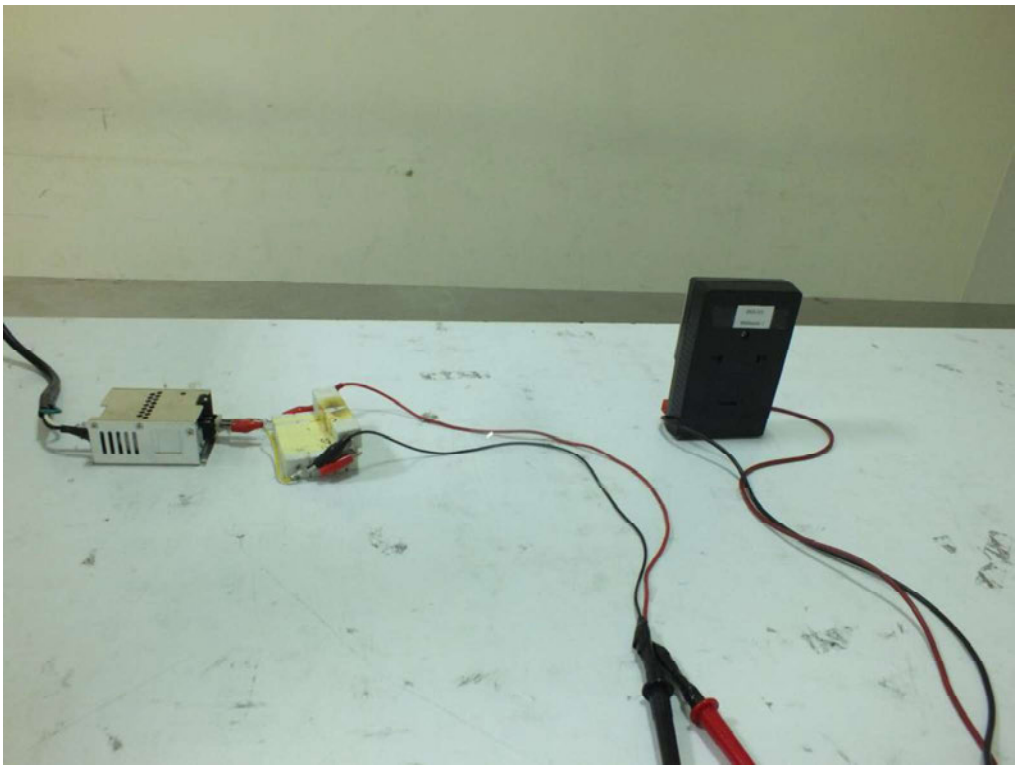


Mode3

Front view



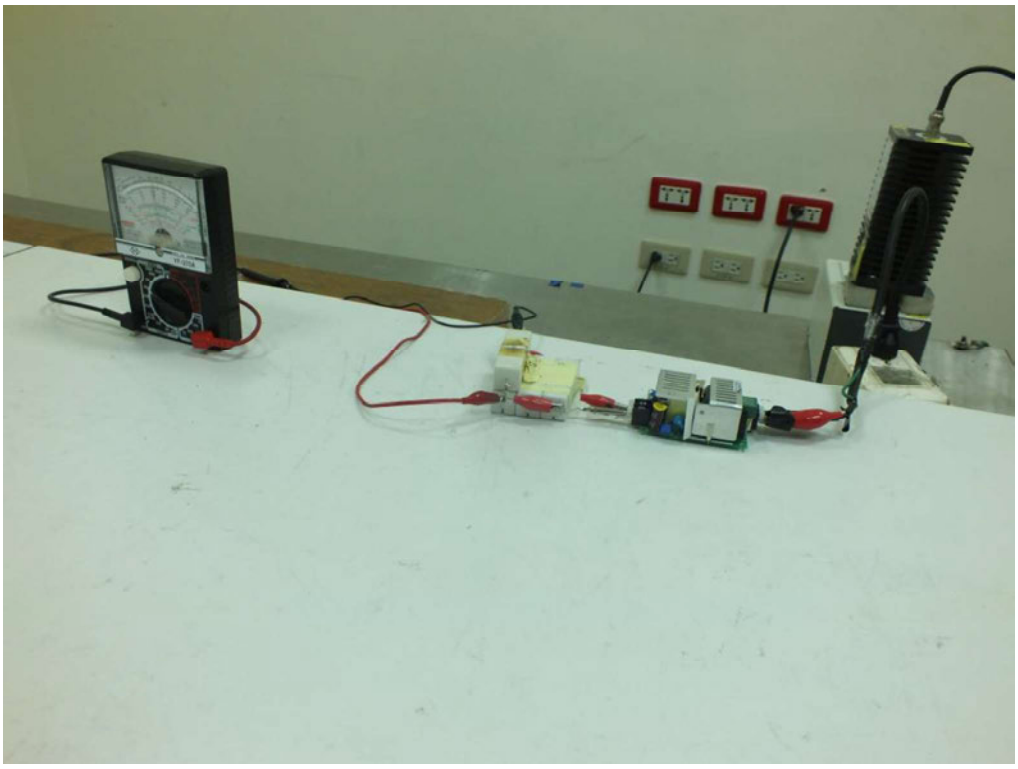
Rear view



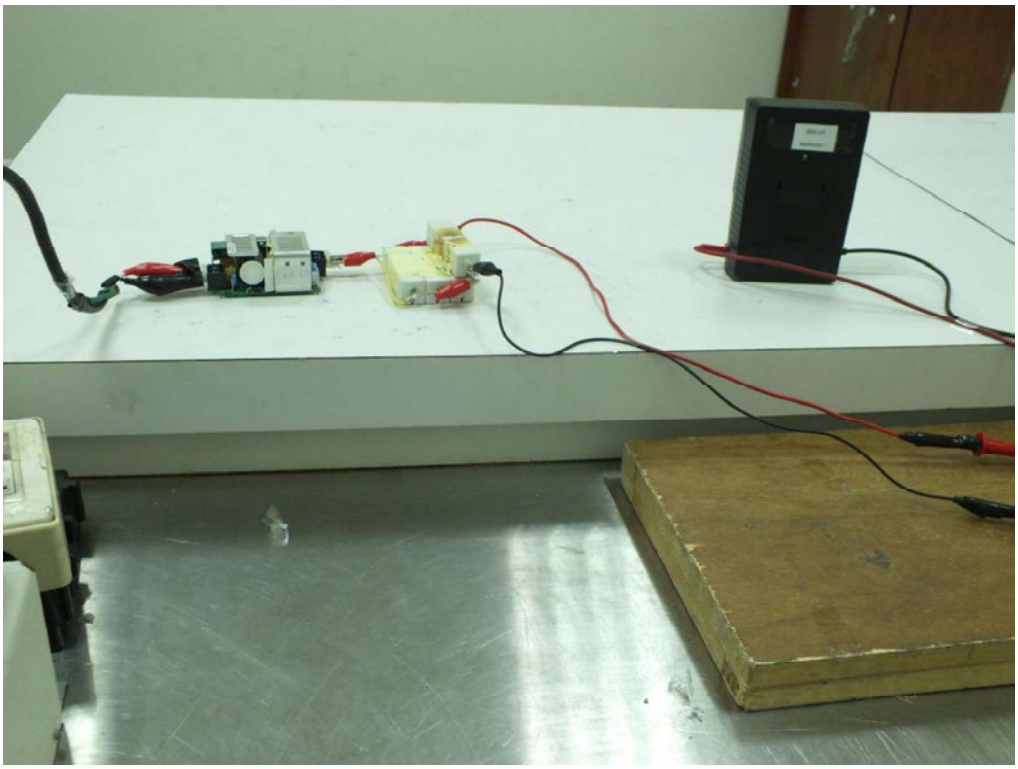
7. Photographs of CS Immunity Test Configuration

Mode1

Front view

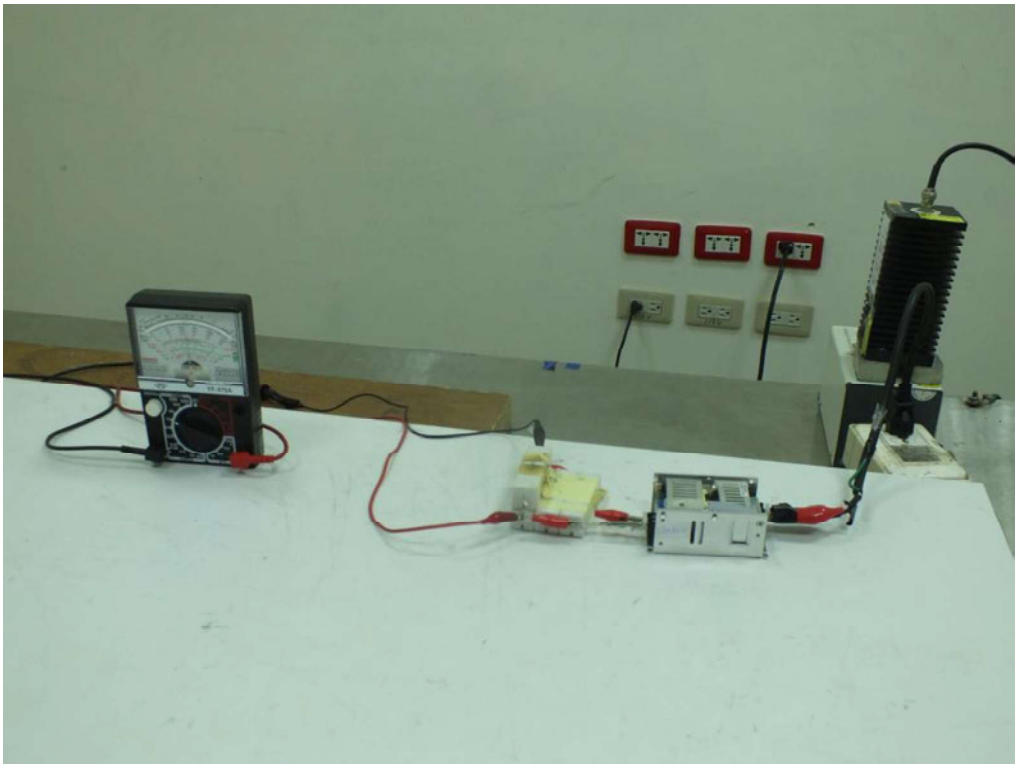


Rear view

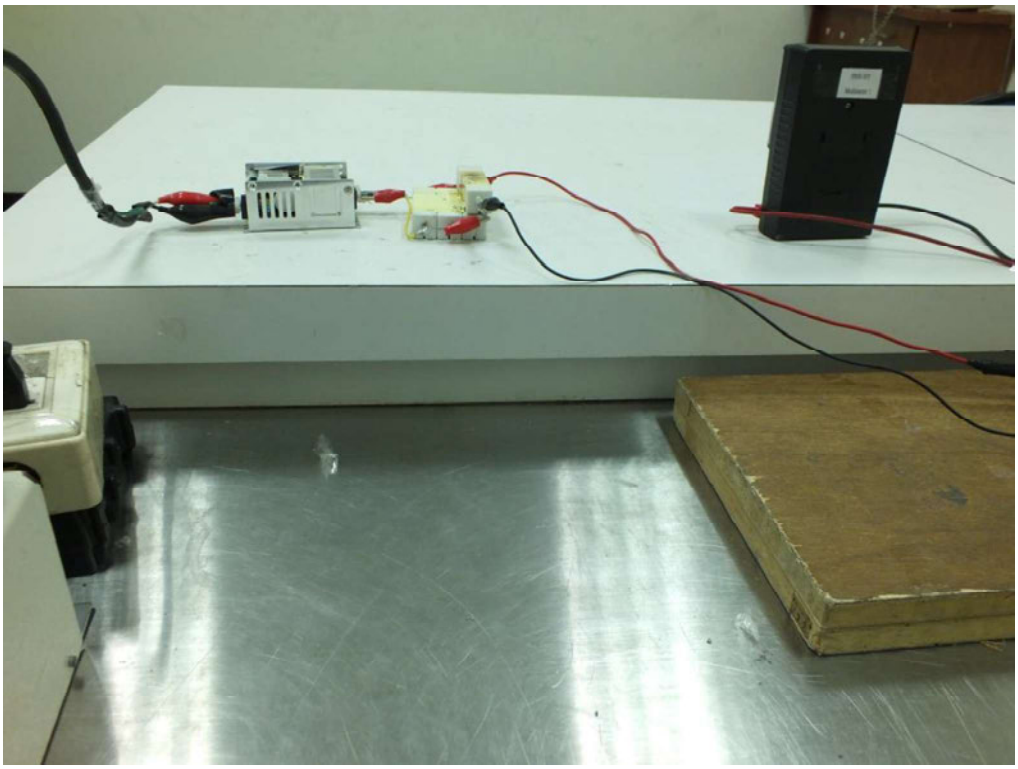


Mode2

Front view

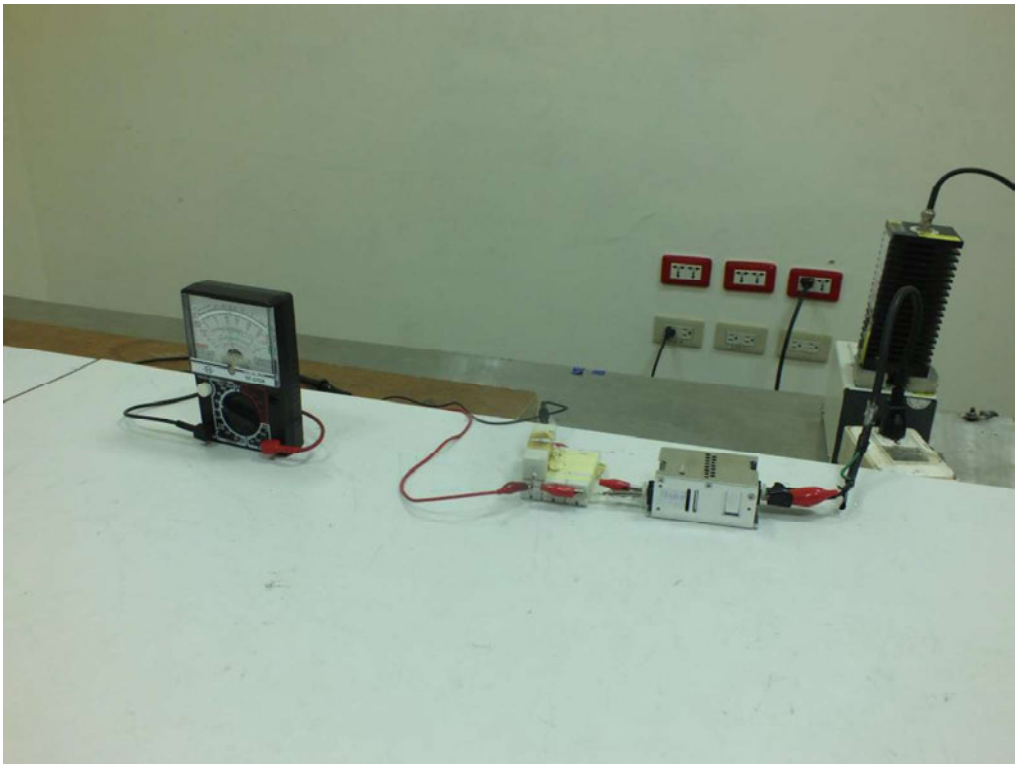


Rear view

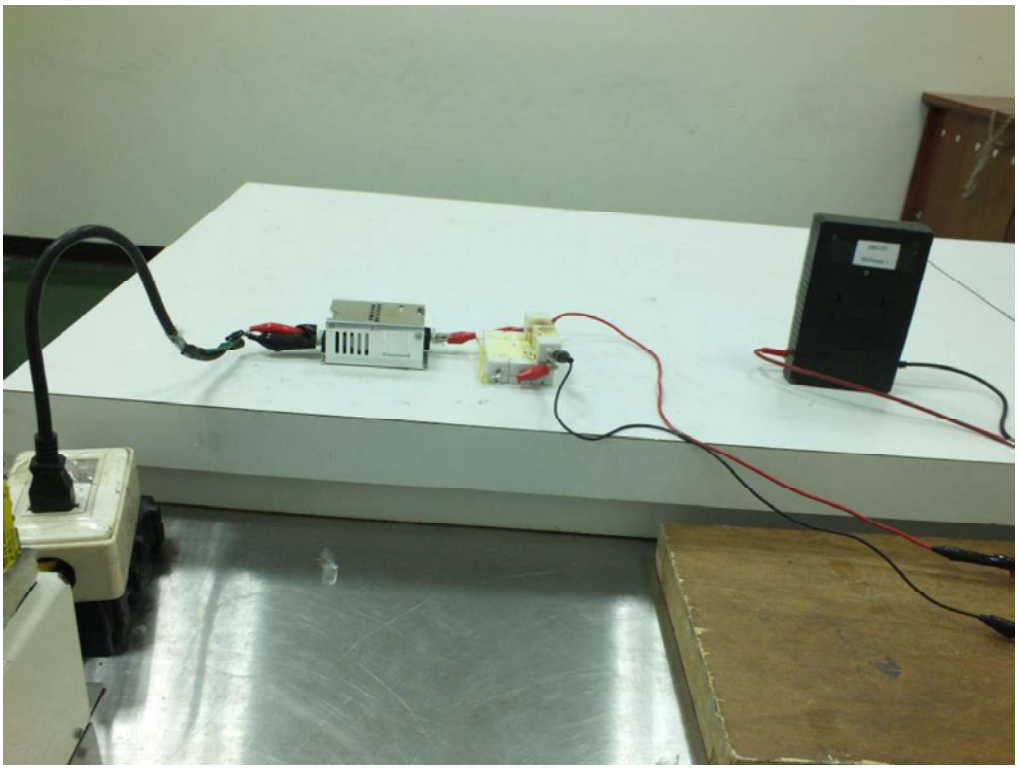


Mode3

Front view



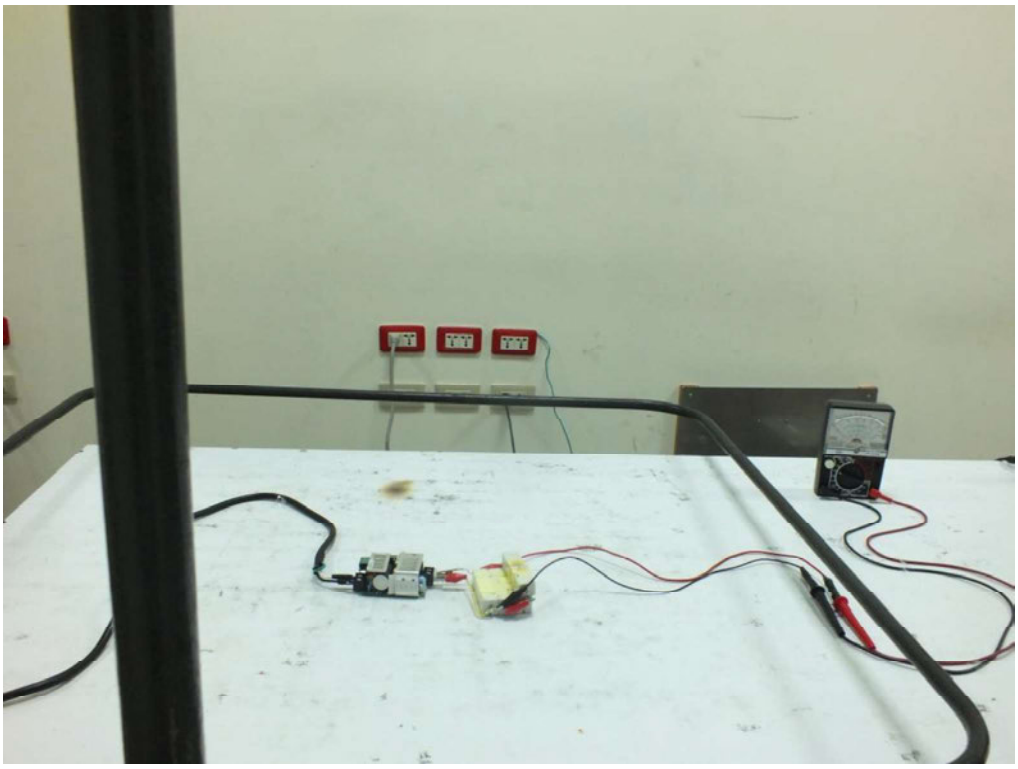
Rear view



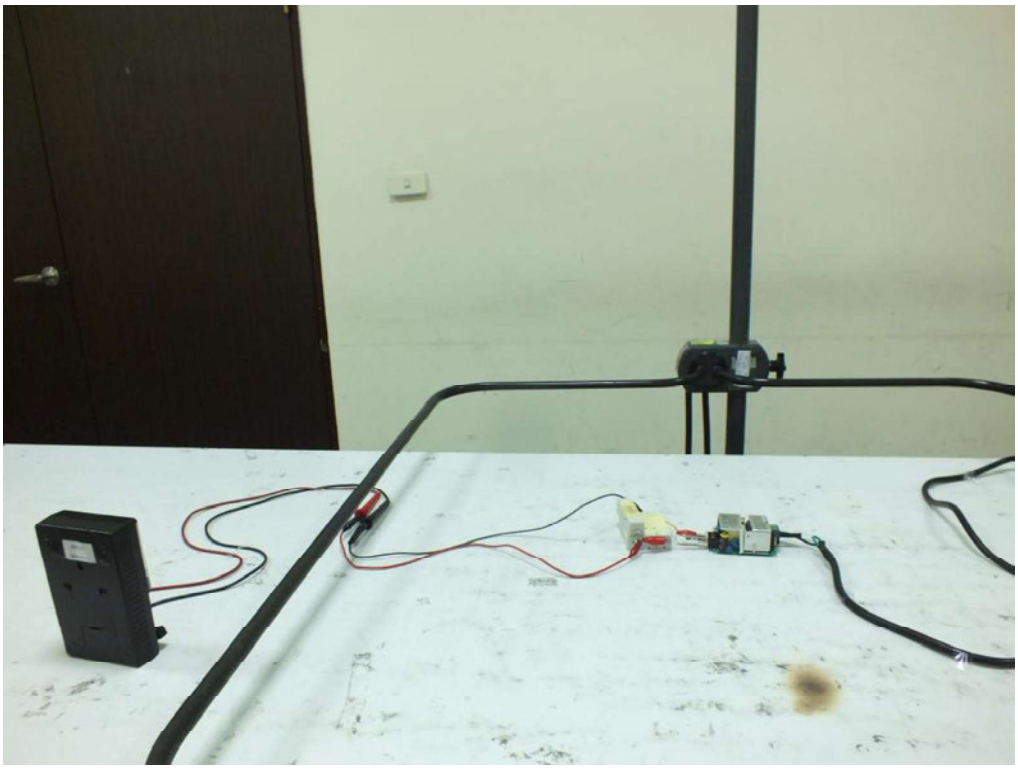
8. Power Frequency Magnetic Field immunity Measurement (PFMF)

Mode1

Front view

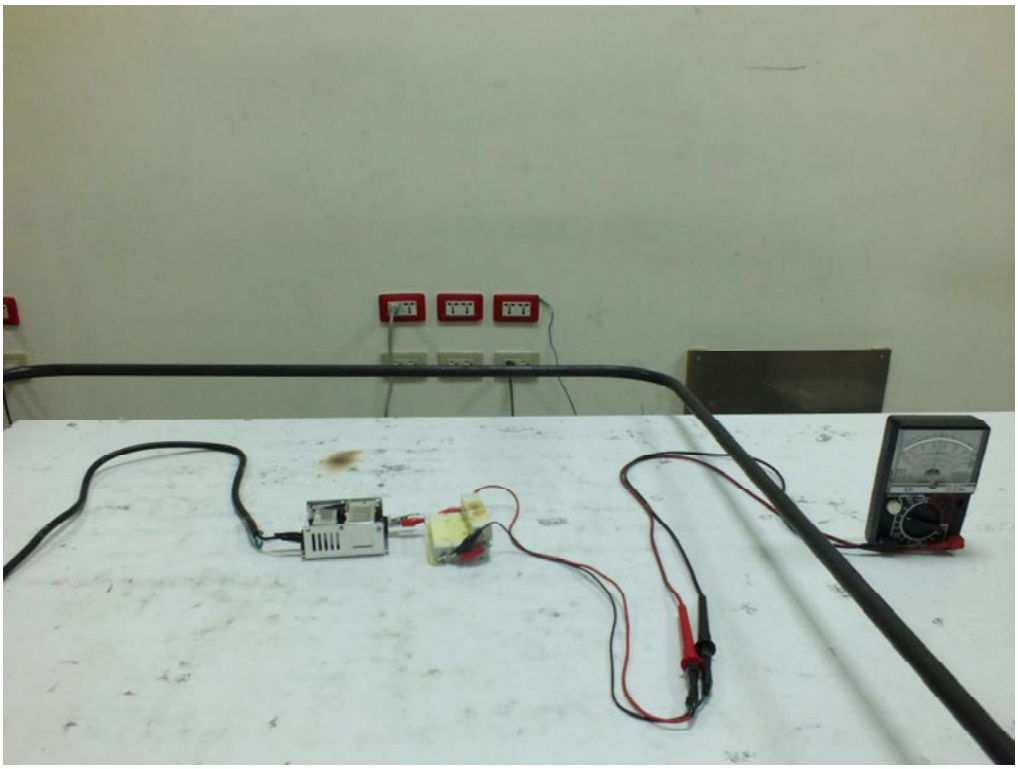


Rear view

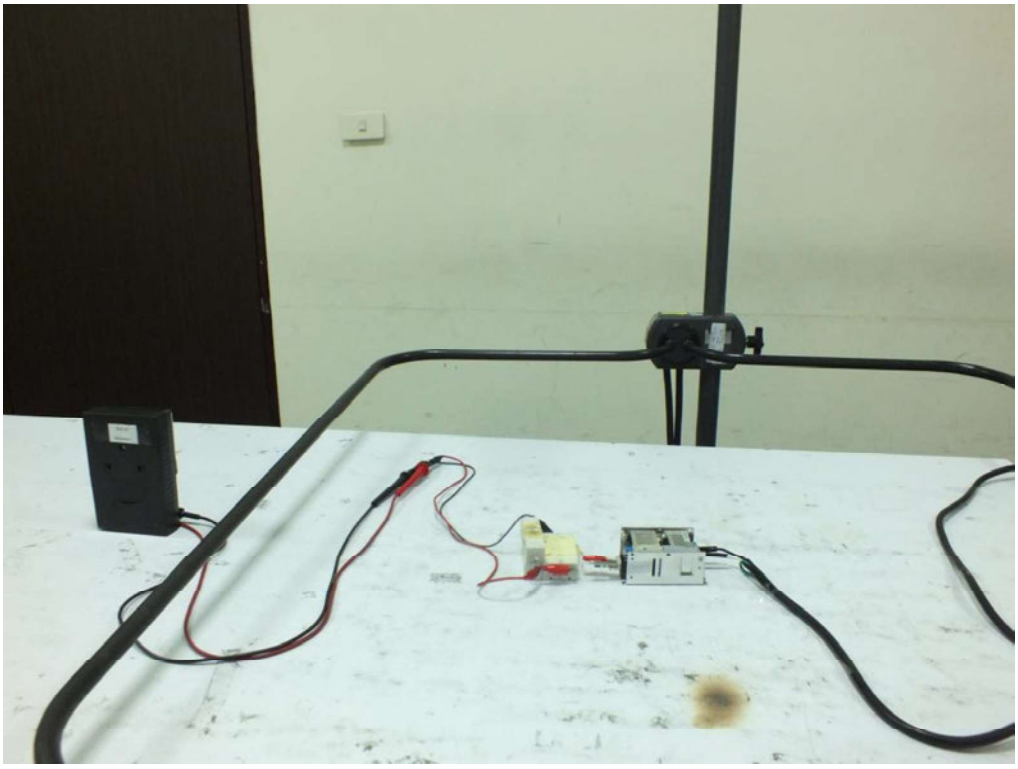


Mode2

Front view

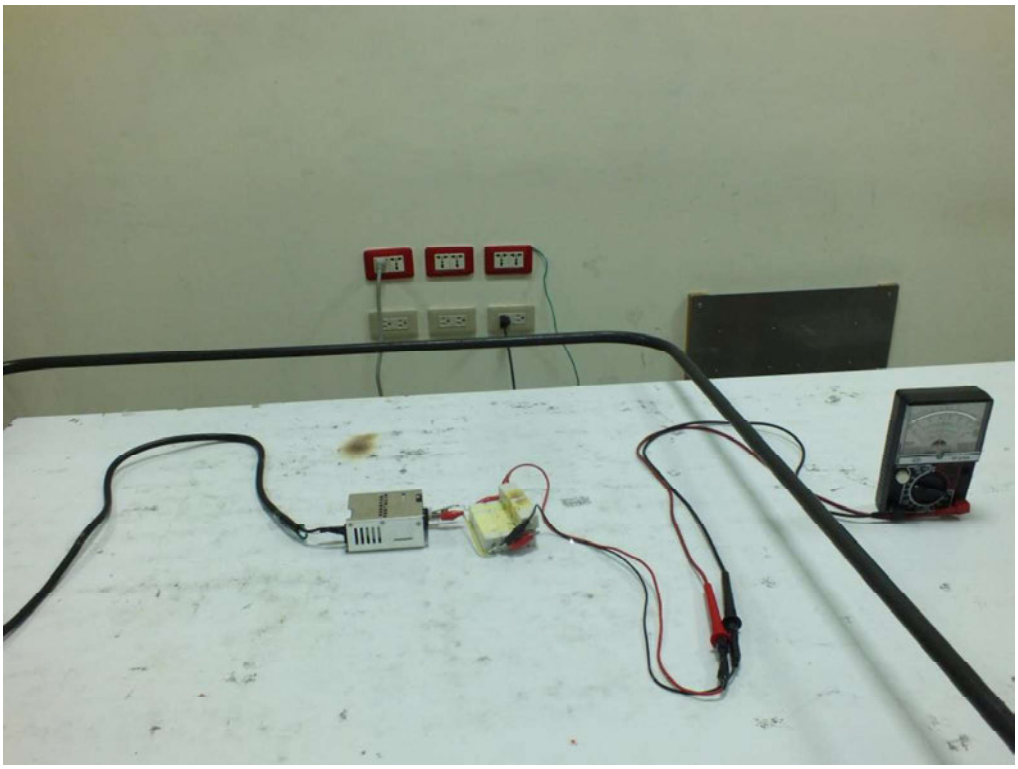


Rear view

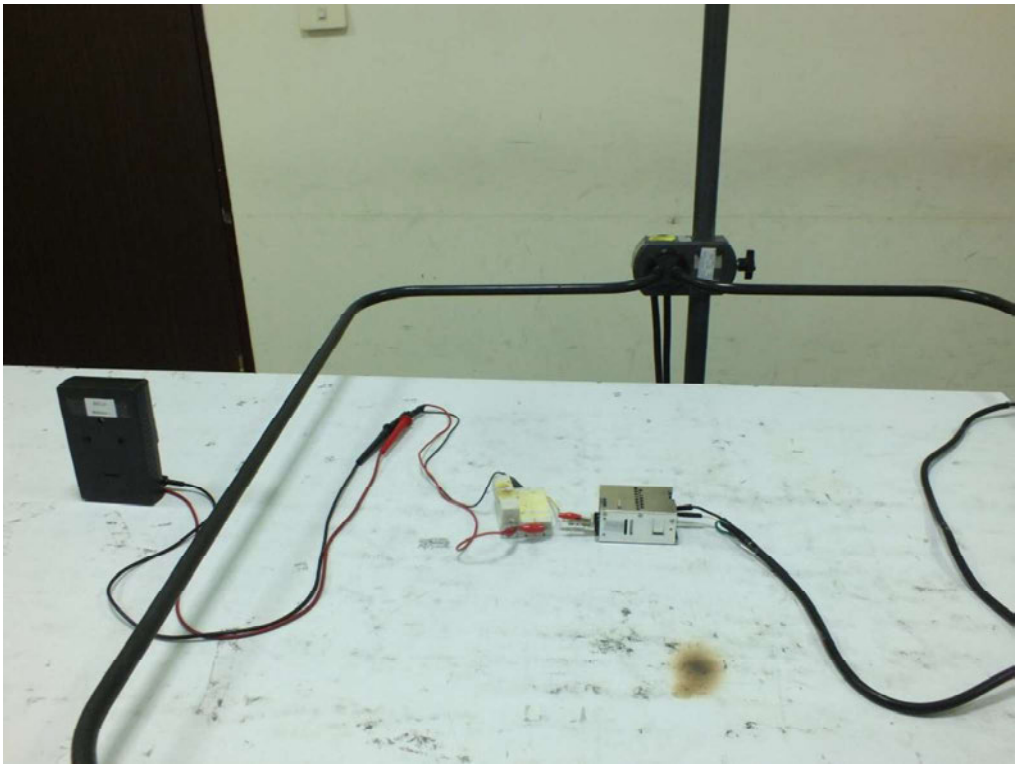


Mode3

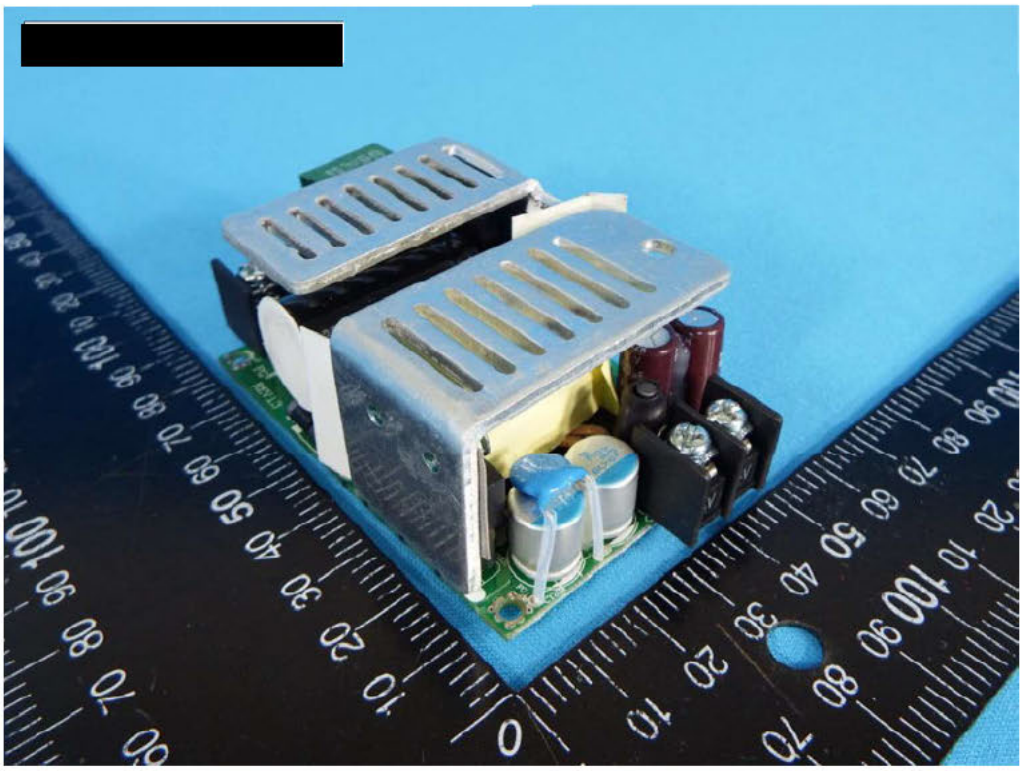
Front view

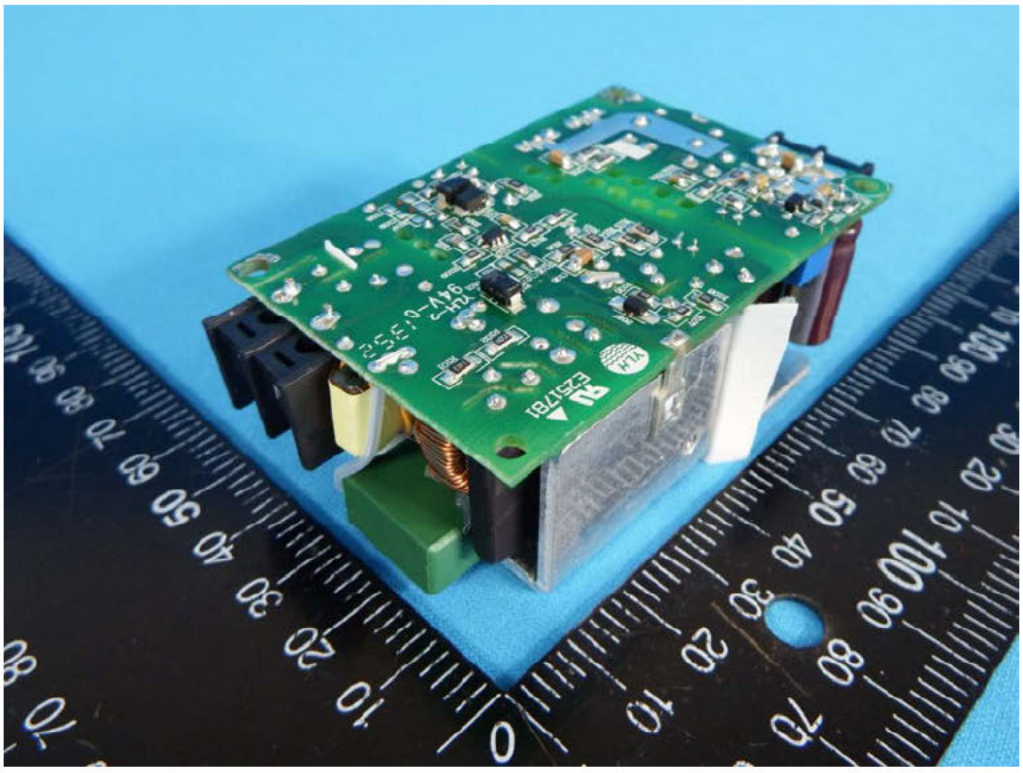


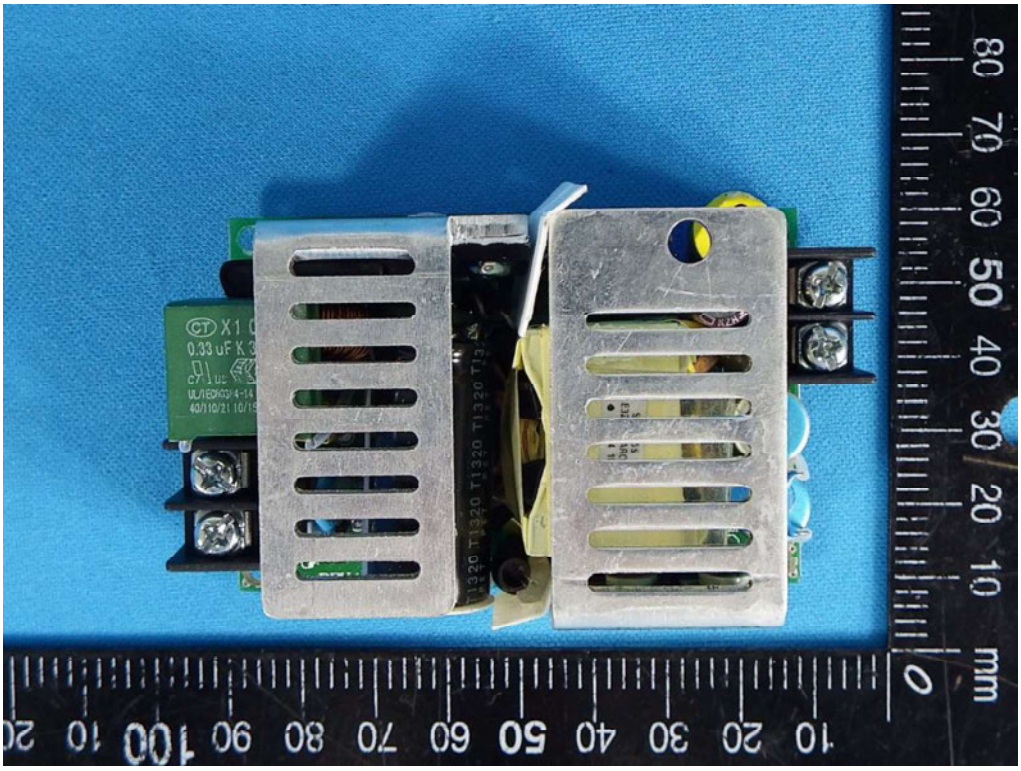
Rear view

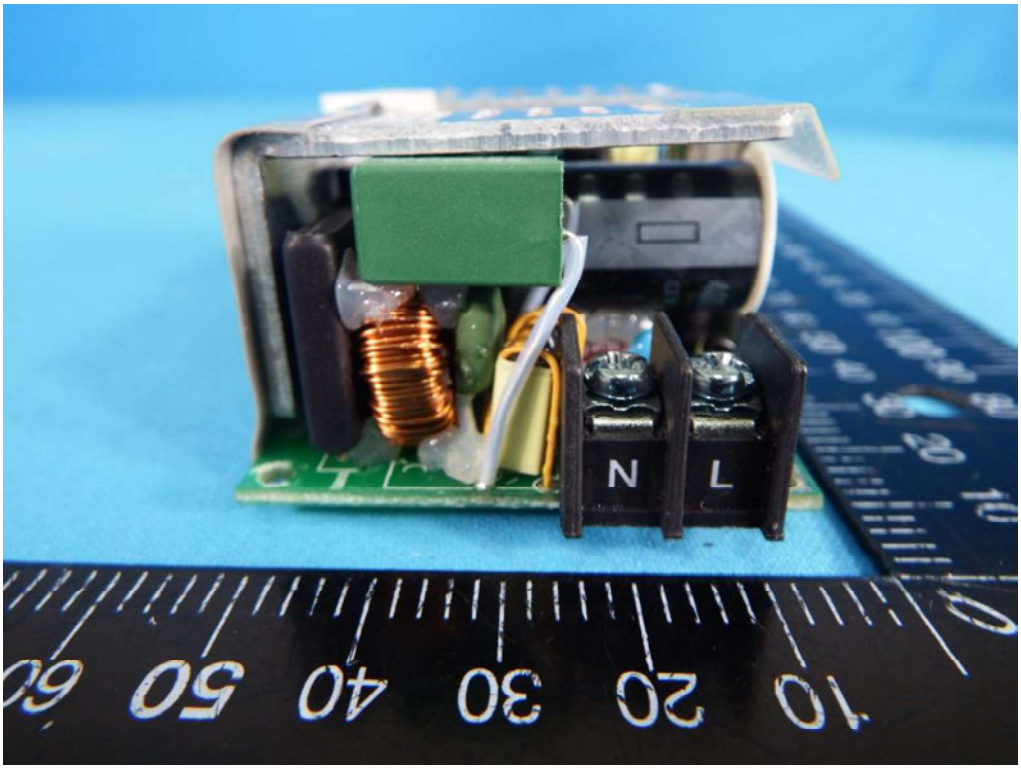


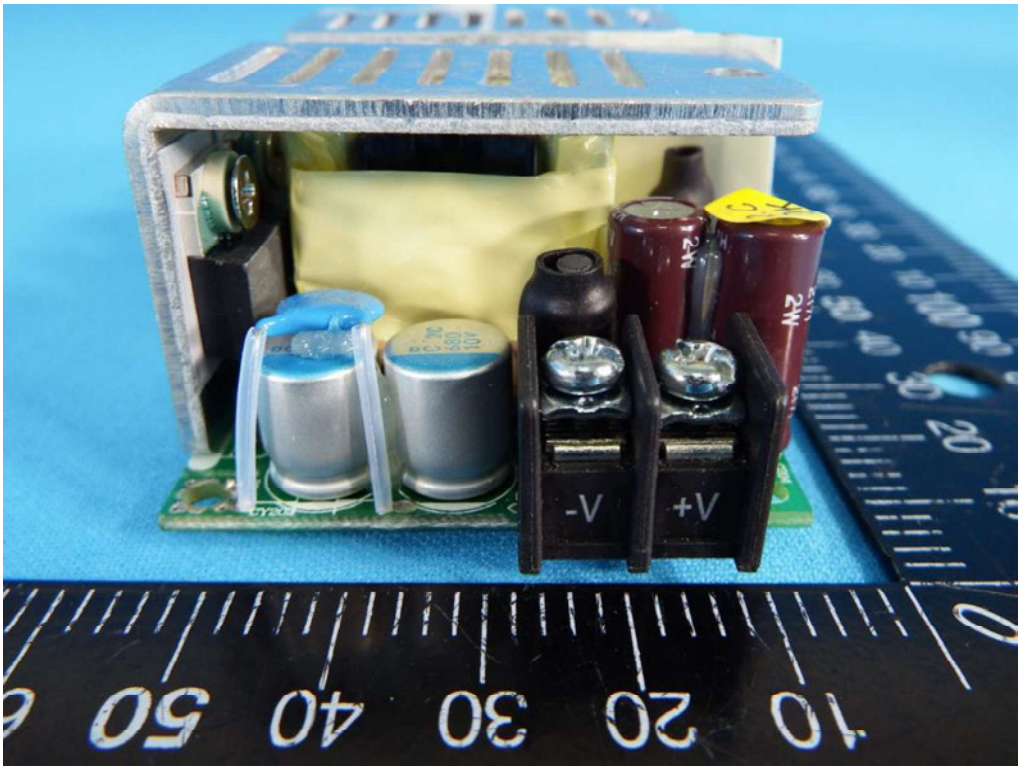
APPENDIX B. Photographs of EUT

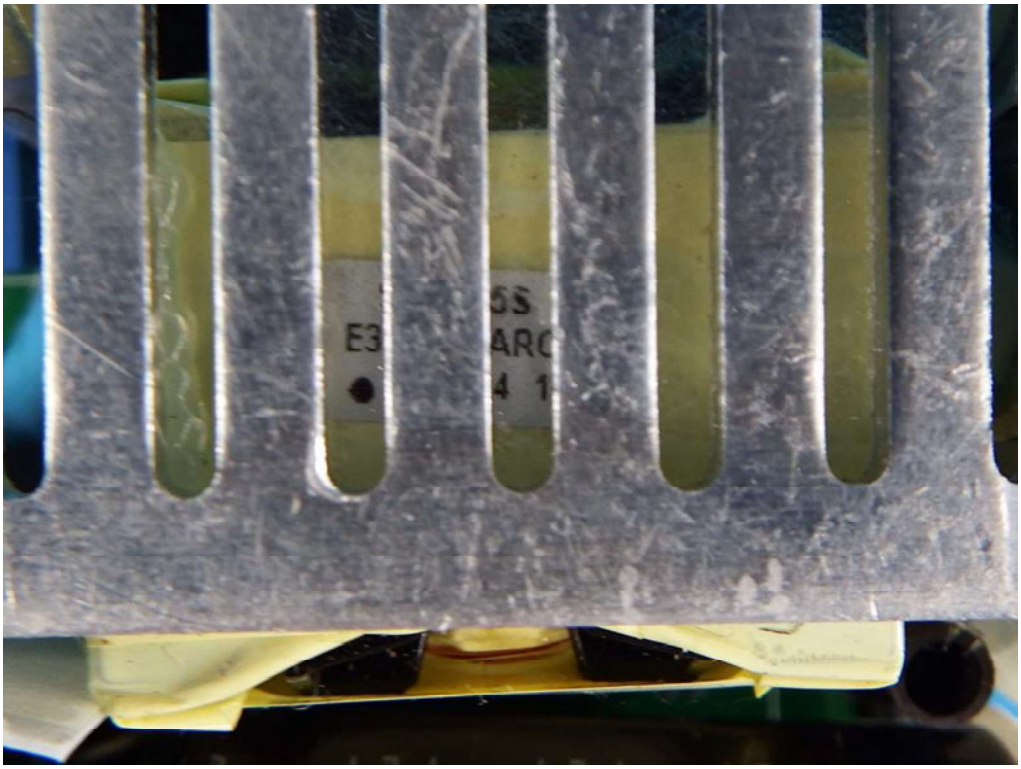


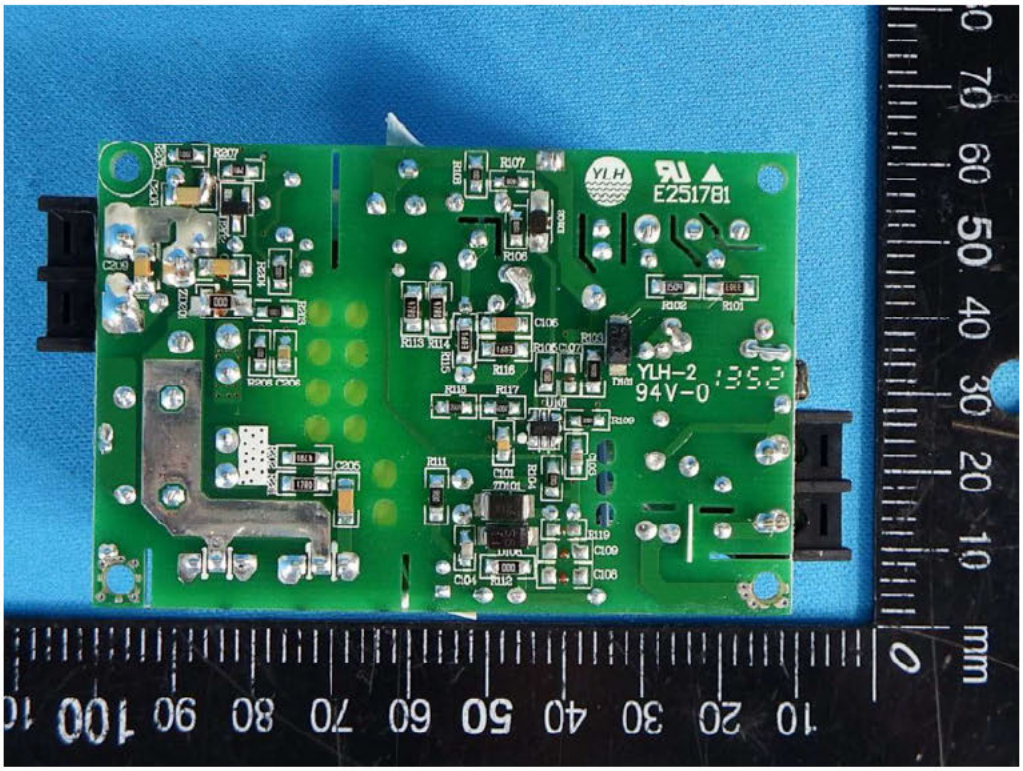


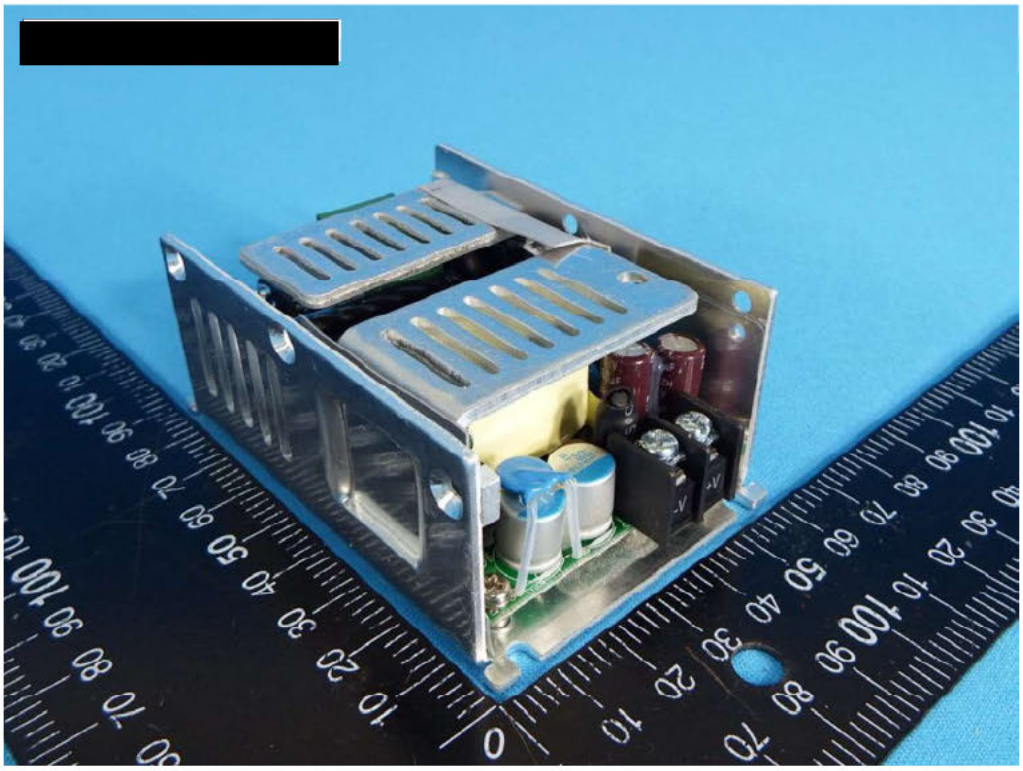


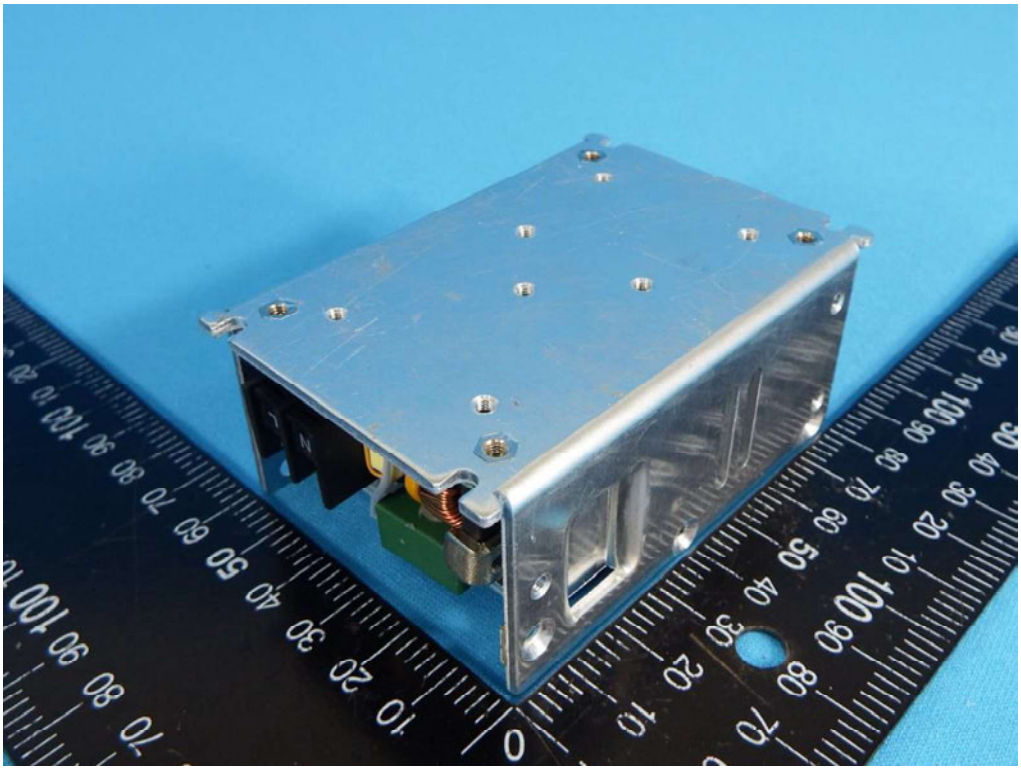

N
L

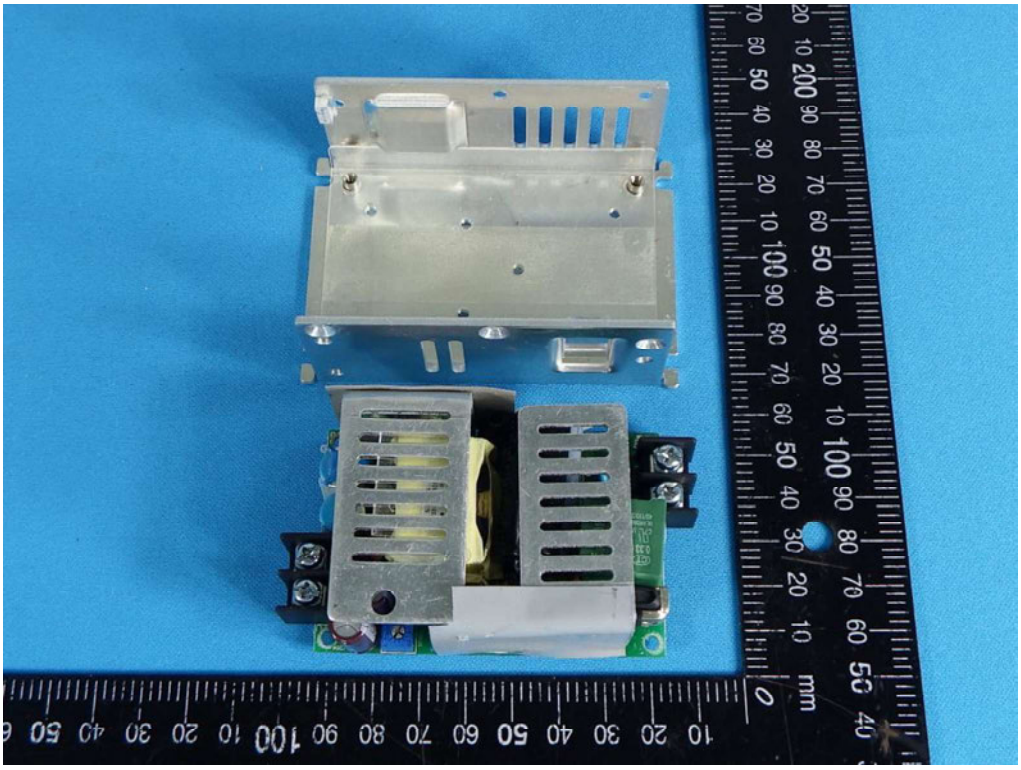

-V
+V
10 20 30 40 50

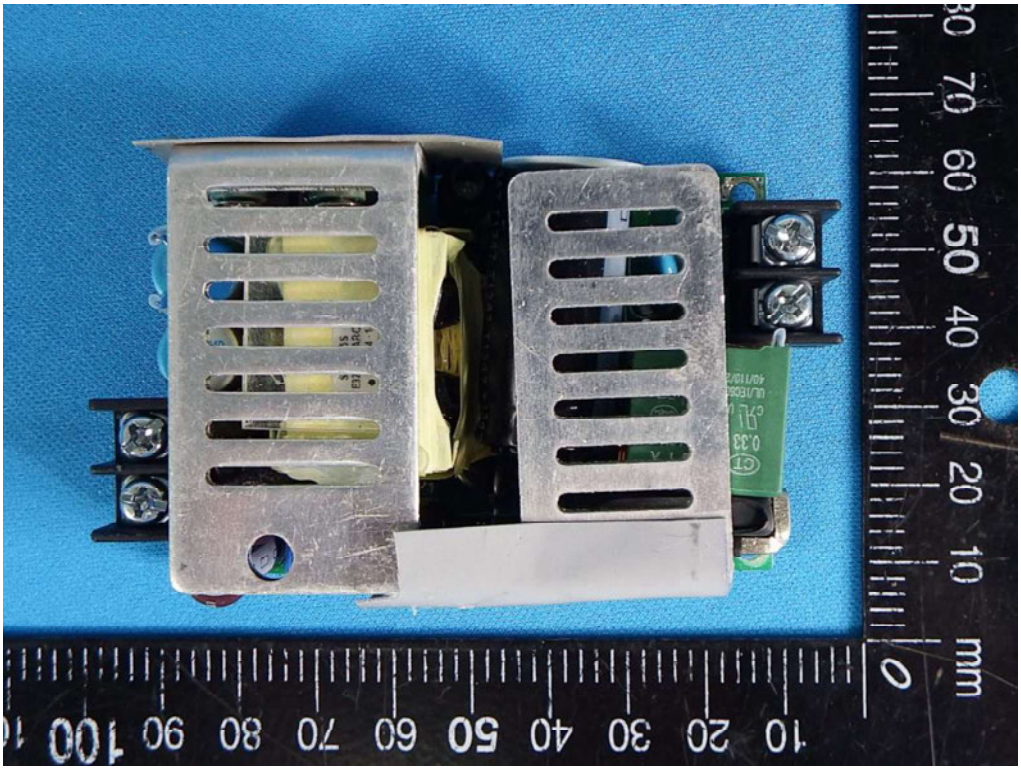

E3

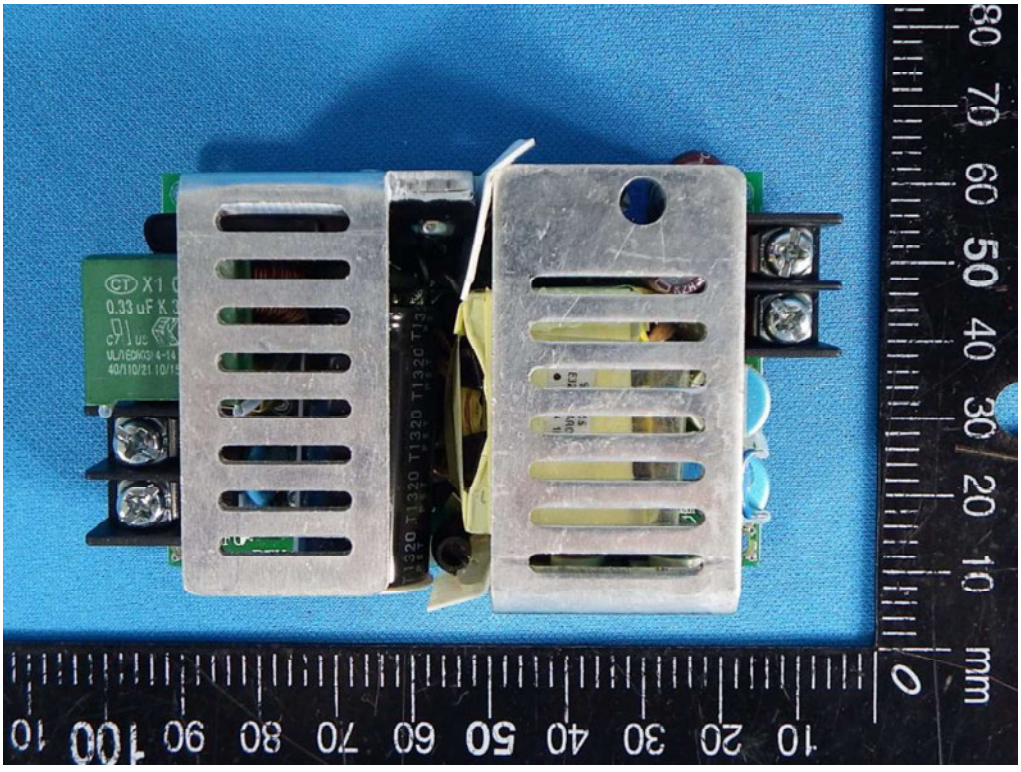

E251781
YLH-2
94V-0
mm

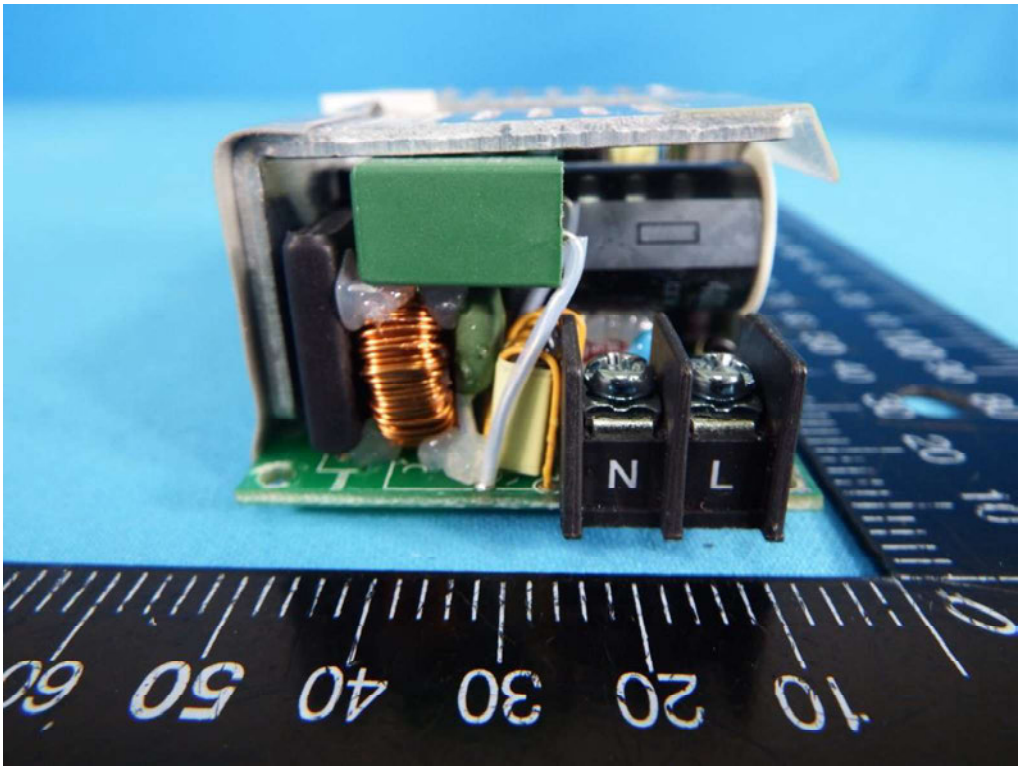


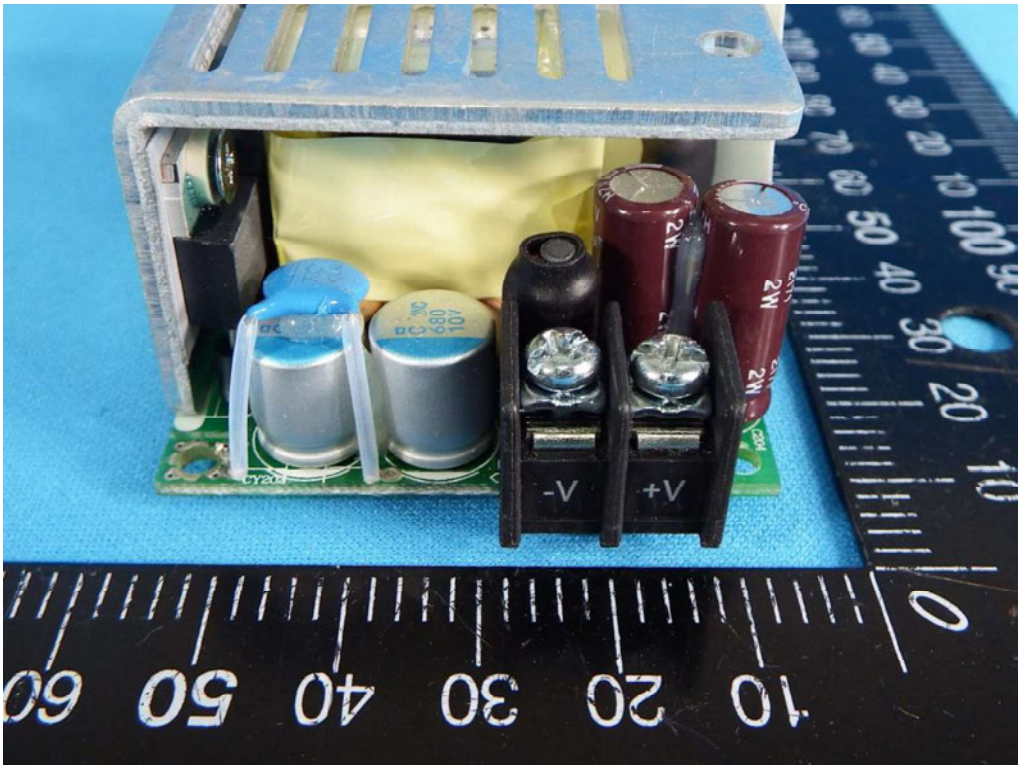


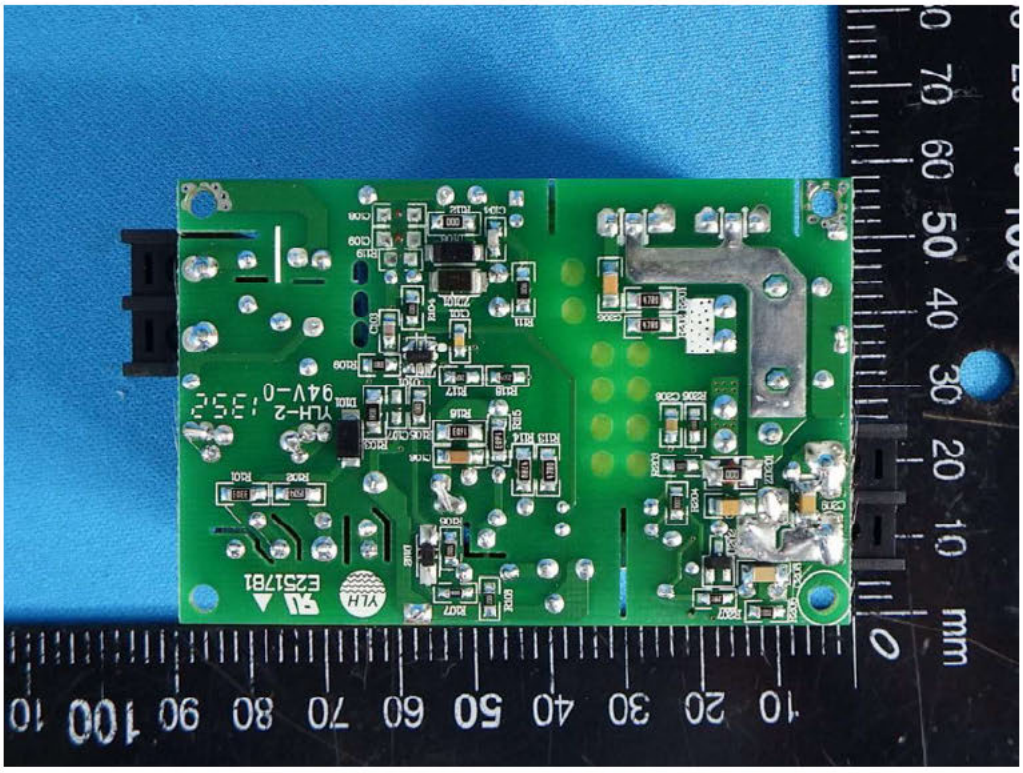


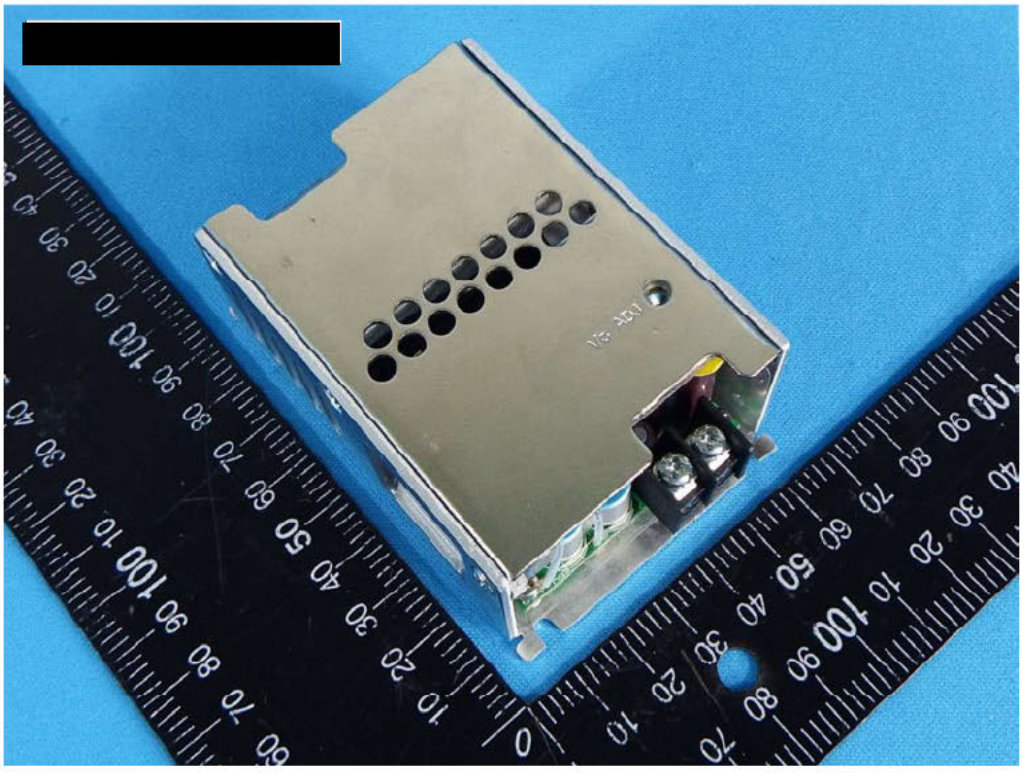


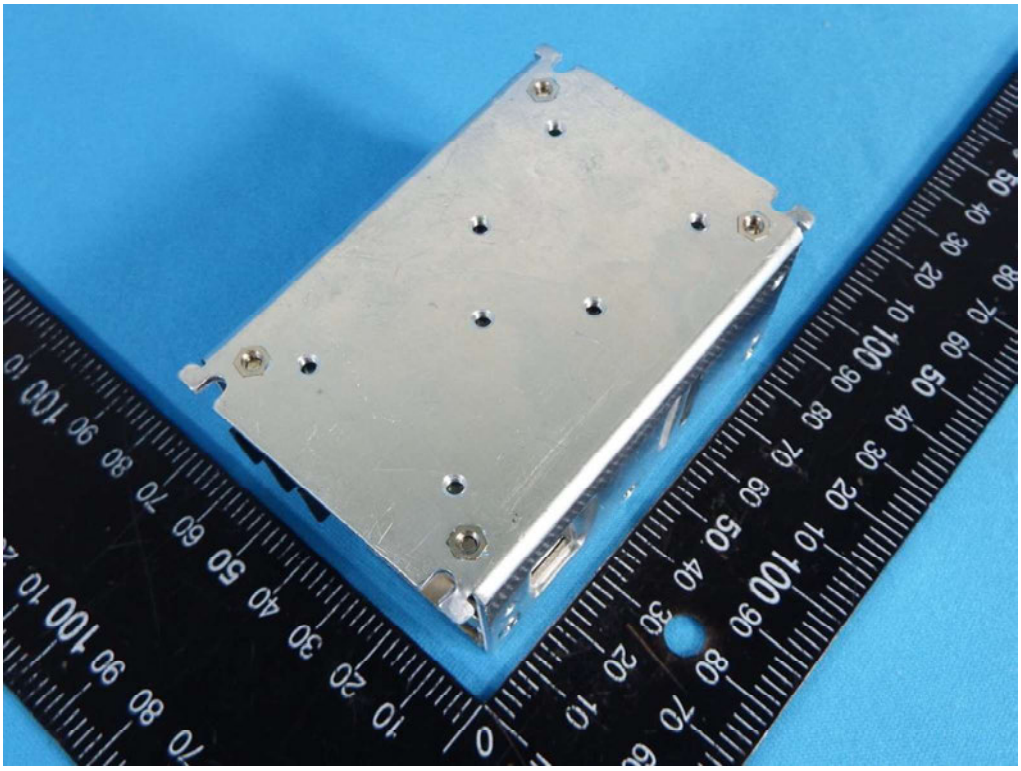


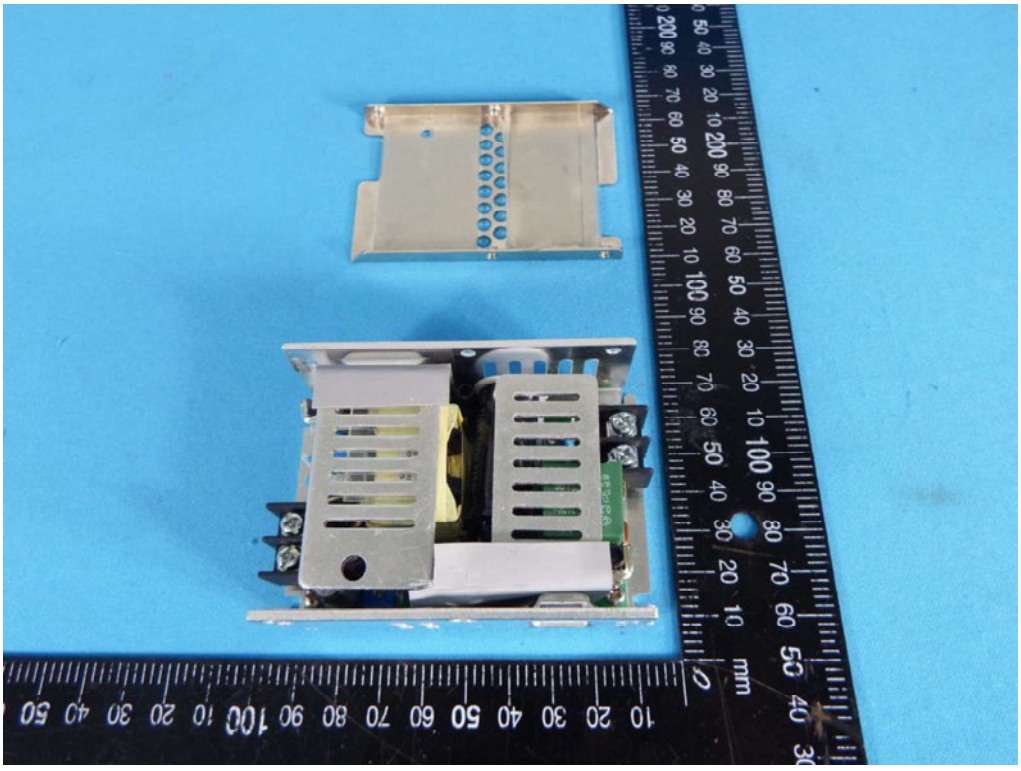

N
L

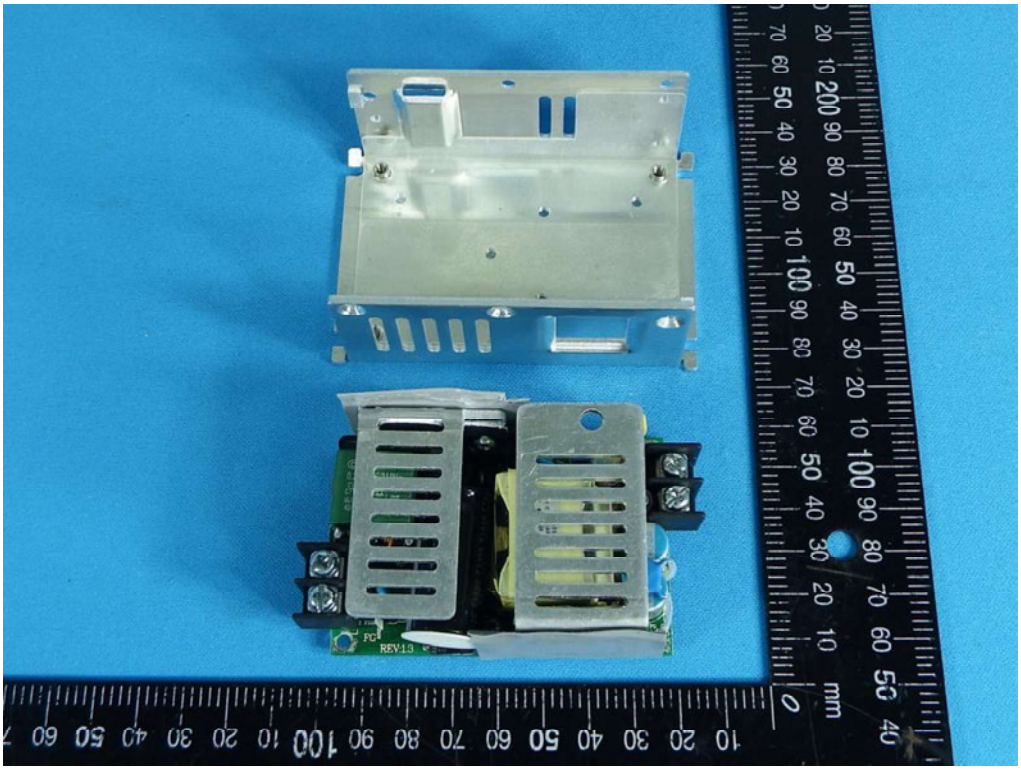

-V
+V

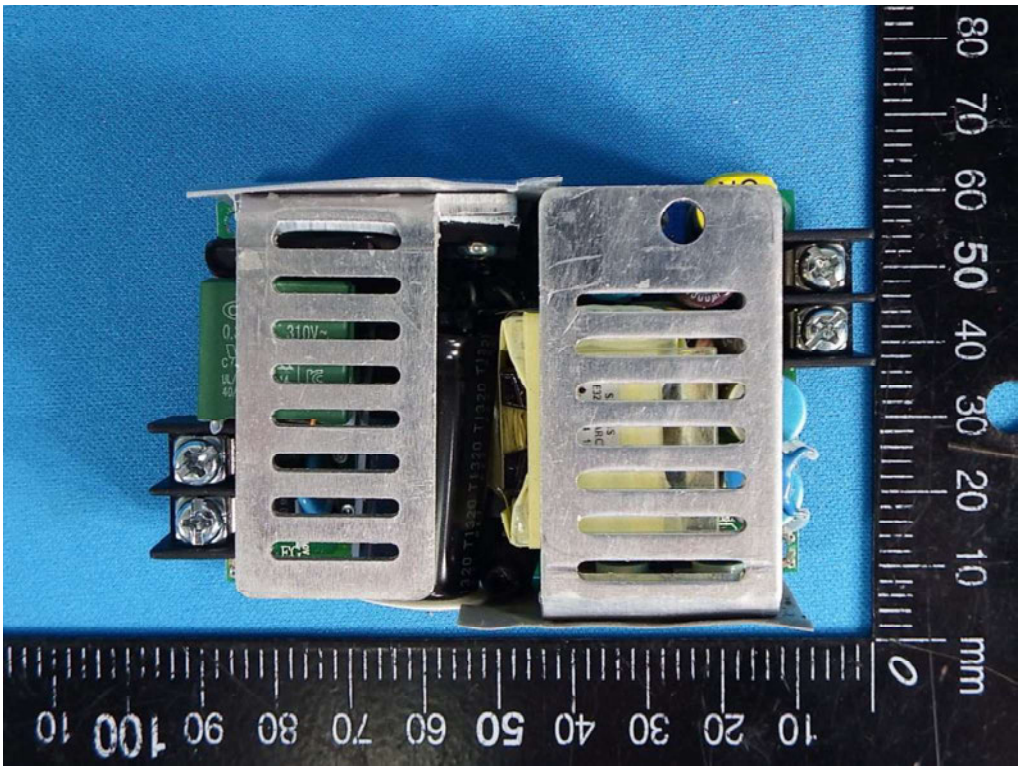


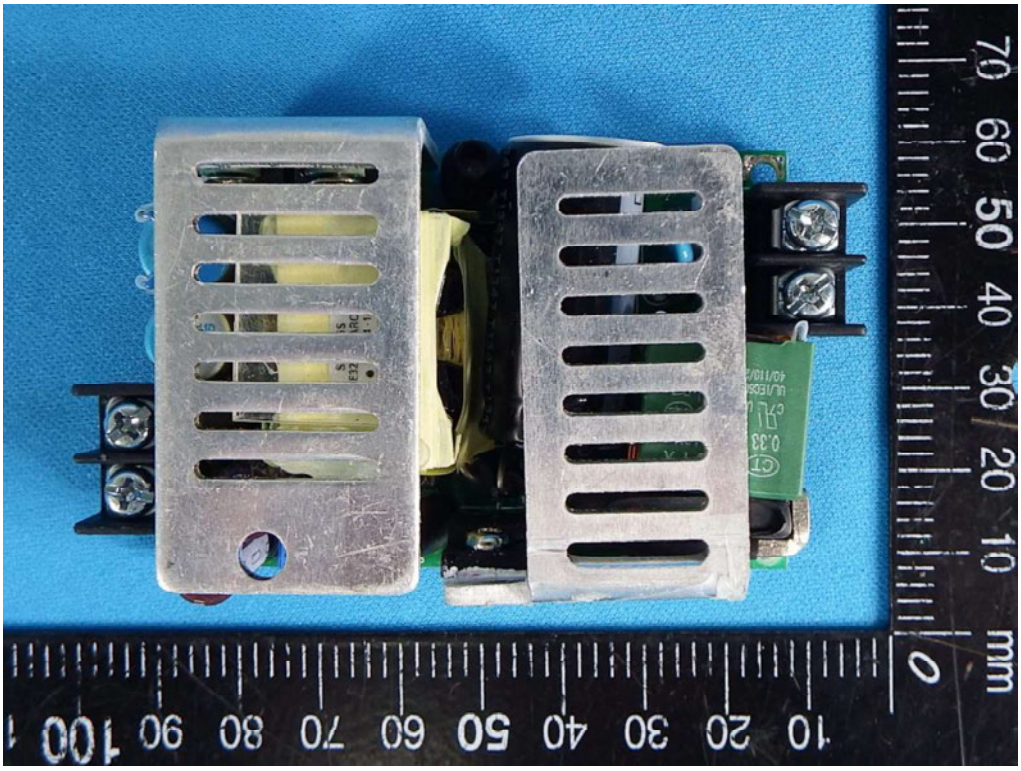


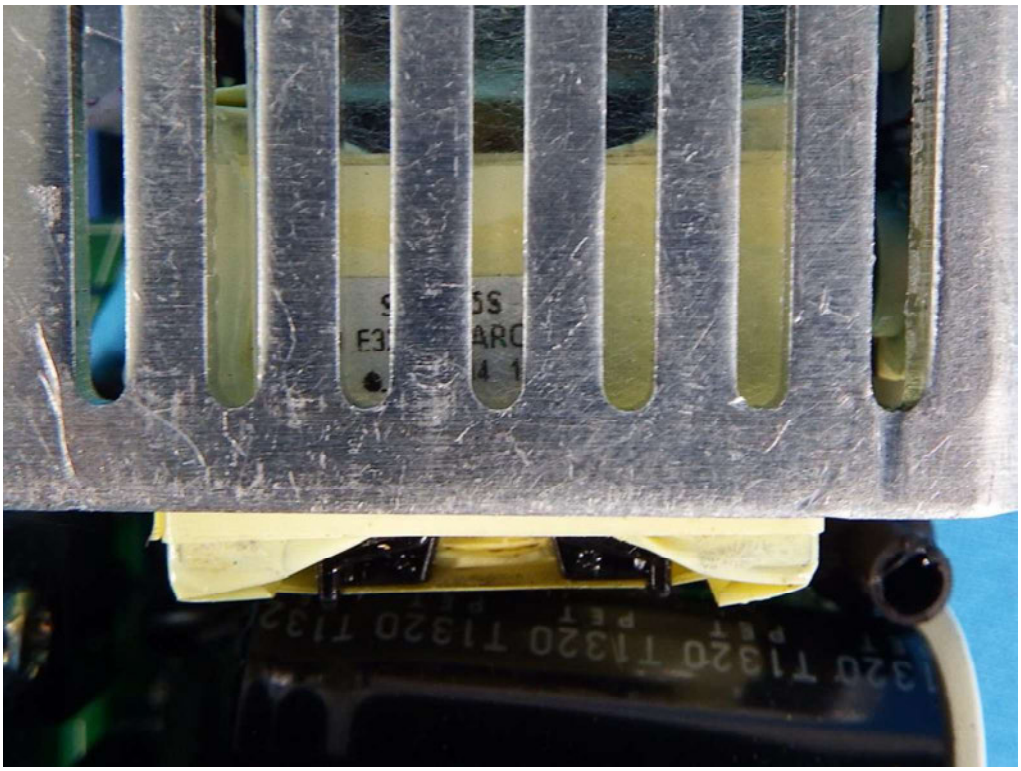


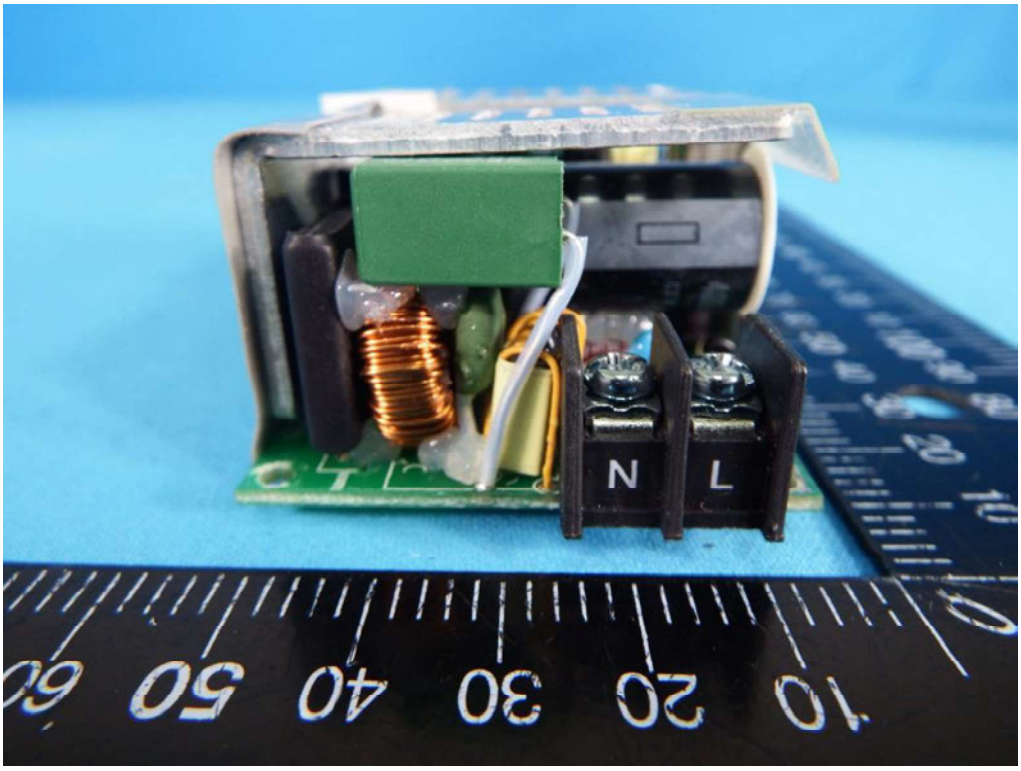


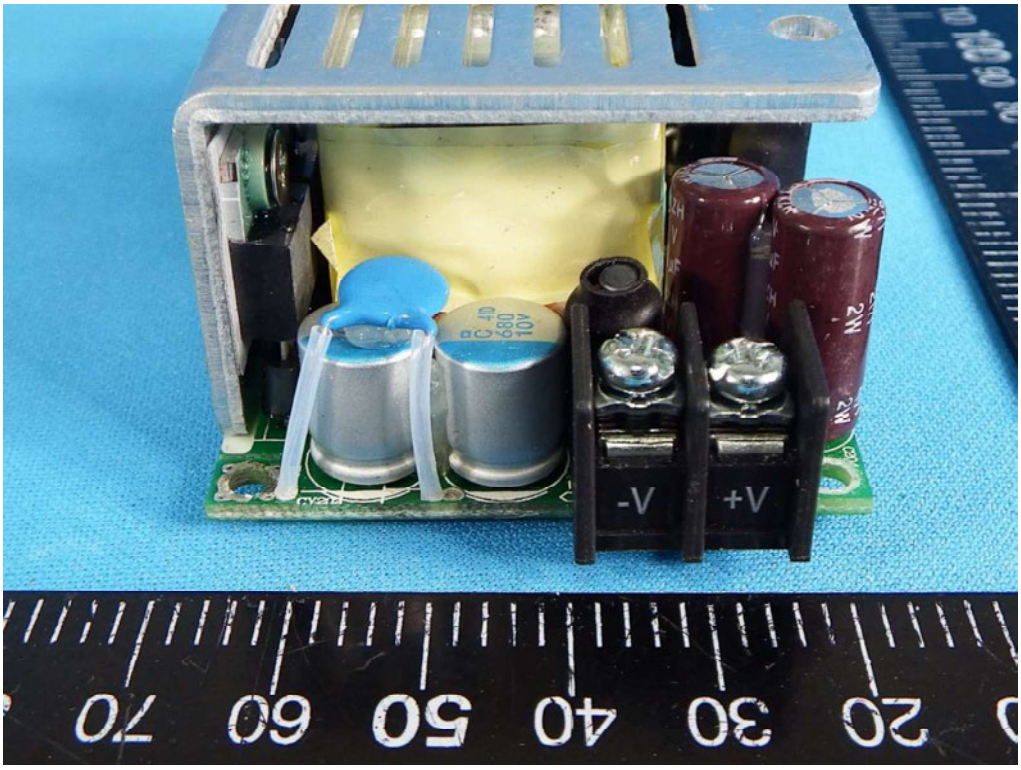


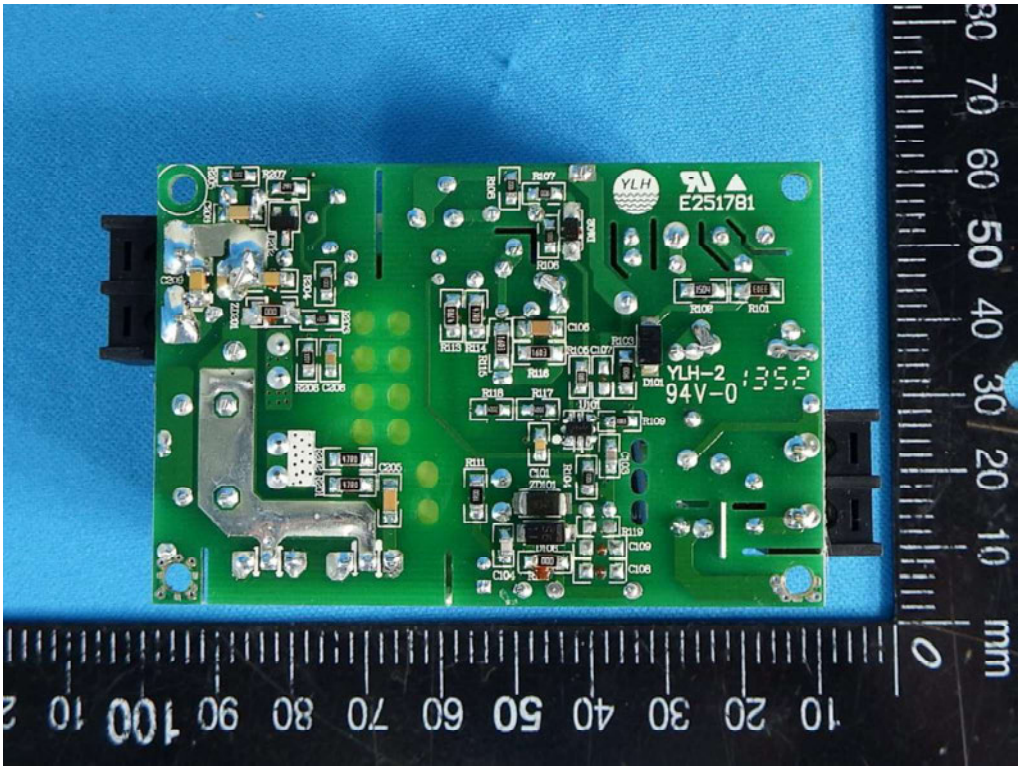



70 60 50 40 30 20 10 0 mm
10 20 30 40 50 60 70 80 90 100




N
L


-V
+V


YLH
E251781
YLH-2
94V-0
mm

Appendix C. Attachment of Report for Additional Measurement Data

The equipment of this attachment is the same as the Equipment under Test of original test report no. **EC390419-02**, except for the following difference.

Original Information:

Equipment : AC-DC Switching Power Supply

Model No. : TXH 060-105、TXH 060-112、TXH 060-115、TXH 060-124、TXH 060-148、TXH 060-105-U、TXH 060-112-U、TXH 060-115-U、TXH 060-124-U、TXH 060-148-U、TXH 060-105-O、TXH 060-112-O、TXH 060-115-O、TXH 060-124-O、TXH 060-148-O

Applicant : Traco Electronic AG
Sihlbruggstrasse 111, 6340 Baar, Switzerland

Additional Information:

1) EN 61000-6-2 measurement data.

This attachment should be filed together with original test report, Report No.: **EC390419-02** for reference.

William Li / Supervisor

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No. 52, Huaya 1st Rd., Guishan Dist.,
Taoyuan City, Taiwan (R.O.C.)
Tel: 886-3-327-3456
Fax: 886-3-327-0973

C.1 Test Configuration of Equipment under Test

C.1.1 Test Manner

a. The EUT has been associated with personal computer and peripherals pursuant to European Standard EN 61000-6-2.

b. The equipment under test were performed the following test modes:

c. Test equipment Model No. [redacted]

Test Items	Description of test modes
Harmonic and Flicker Emissions	Mode 1. Full Load
EMS	Mode 1. Full Load

d. Frequency range investigated: CS 150 kHz to 80 MHz, RS 80 MHz to 2,700 MHz.

C.1.2 Description of Test System

No.	Peripheral	Manufacturer	Model Number	Cable / Spec. Description
For Local				
1.	Multi-meter	YFE	YF-370A	Probe Cable, Non-Shielded 1.0m Extension Cable, Non-Shielded 0.5m
2.	LOAD	[redacted]	3.9Ω	---

C.2 Harmonic Current Emissions Measurement

C.2.1 Standard

- Standard : EN 61000-3-2

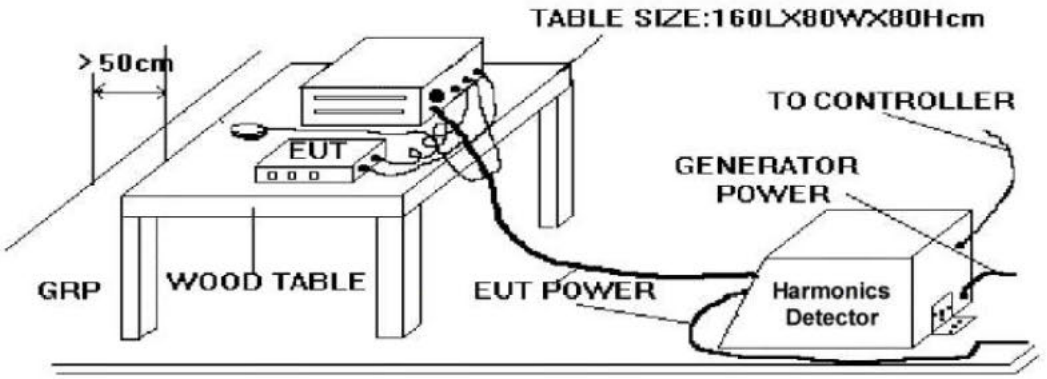
C.2.2 Test Procedure

The measured values of the harmonics components of the input current, including line current and neutral current, shall be compared with the limits given in Clause 7 of EN 61000-3-2.

C.2.3 Test Equipment Settings

Harmonic Parameters	Setting
Line Voltage	230 V
Line Frequency	50 Hz
Device Class	-
Current Measurement Range	High
Measurement Delay	10.0 seconds
Test Duration	10.0 minutes
Class determination Pre-test Duration	10.0 seconds

D.2.4 Typical Test Setup Layout of Harmonic Current Emissions



C.2.5 Test Result of Harmonic Current Emissions

V_RMS (Volts):	230.60	Frequency(Hz):	50.00
I_Peak (Amps):	2.648	I_RMS (Amps):	0.577
I_Fund (Amps):	0.262	Crest Factor:	4.604
Power (Watts):	58.5	Power Factor:	0.447

As specified on clause 7 of EN 61000-3-2:2014, the limits are not specified for equipment with a rated power of 75W or less.

C.3 Voltage Fluctuations and Flicker Measurement

C.3.1 Standard

- Product Standard : EN 61000-3-3

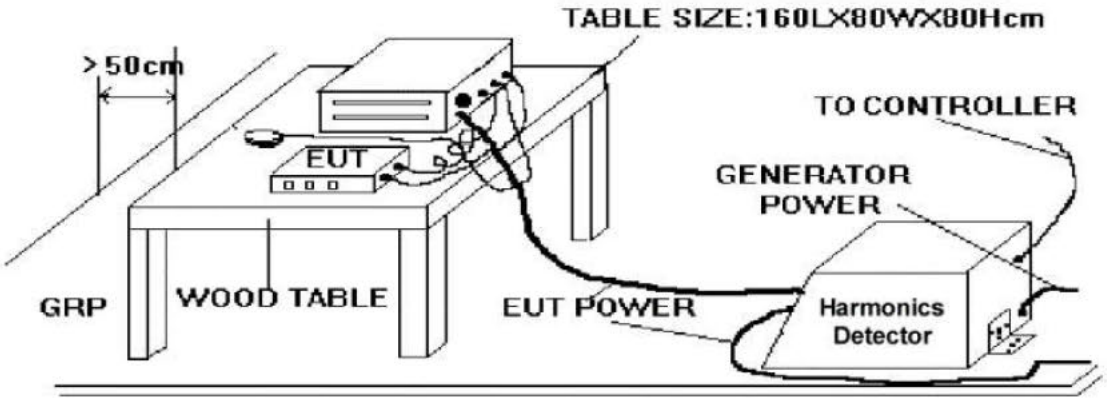
C.3.2 Test Procedure

The equipment shall be tested under the conditions of **Clause 5.**
The total impedance of the test circuit, excluding the appliance under test, but including the internal impedance of the supply source, shall be equal to the reference impedance. The stability and tolerance of the reference impedance shall be adequate to ensure that the overall accuracy of ±8% is achieved during the whole assessment procedure.

C.3.3 Test Equipment Settings

Flicker Parameters	Setting
Line Voltage	230 V
Line Frequency	50 Hz
Measurement Delay	10.0 seconds
Pst Integration Time	10.0 minutes
Pst Integration Periods	1
Test Duration	10.0 minutes

C.3.4 Typical Test Setup Layout of Voltage Fluctuations and Flicker



C.3.5 Test Result of Voltage Fluctuation and Flicker

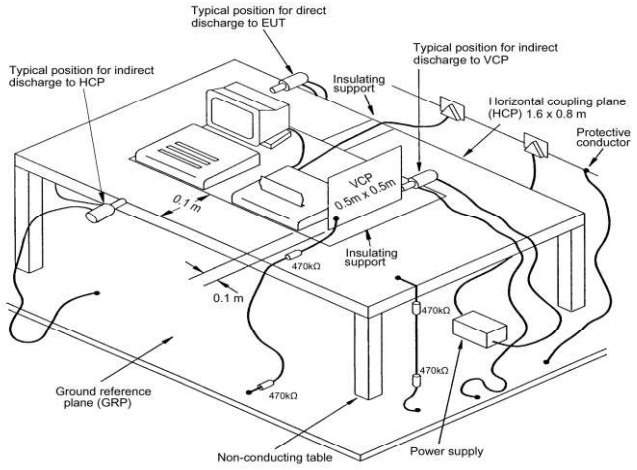
Test mode	Mode 1
Final Test Result	***PASS***
Temperature	32 ℃
Relative Humidity	52 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton

Vrms at the end of test (Volt):	**230.46**			
Highest dt (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
T-max (mS):	**0**	**Test limit (mS):**	**500.0**	**Pass**
Highest dc (%):	**0.00**	**Test limit (%):**	**3.30**	**Pass**
Highest dmax (%):	**0.03**	**Test limit (%):**	**4.00**	**Pass**
Highest Pst (10 min. period):	**0.261**	**Test limit:**	**1.000**	**Pass**

C.4 Electrostatic Discharge Immunity Measurement (ESD)

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	**A** ±2 / ±4 / ±8 kV for air discharge
	A ±2 / ±4 kV for contact discharge
Required Performance Criteria	**B** ±2 / ±4 / ±8 kV for air discharge
	B ±2 / ±4 kV for contact discharge
Basic Standard	IEC 61000-4-2
Product Standard	EN 61000-6-2:2005
Level	3 for air discharge
	2 for contact discharge
Test Voltage	±2 / ±4 / ±8 kV for air discharge
	±2 / ±4 kV for contact discharge
Discharge Impedance	330 ohm / 150 pF
Temperature	25 ℃
Relative Humidity	44 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	The test points, please refer to section C.4.5

C.4.1 Test Setup



The test setup consists of the test generator, EUT and auxiliary instrumentation necessary to perform DIRECT and INDIRECT application of discharges to the EUT as applicable, in the follow manner:

a. CONTACT DISCHARGE to the conductive surfaces and to coupling plane;
b. AIR DISCHARGE at insulating surfaces.

The preferred test method is that of type tests performed in laboratories and the only accepted method of demonstrating conformance with this standard. The EUT was arranged as closely as possible to arrangement in final installed conditions.

C.4.2 Test Setup for Tests Performed in Laboratory

A ground reference plane was provided on the floor of the test site. It was a metallic sheet (copper or aluminum) of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness. In the SPORTON EMC LAB., we provided 1 mm thickness aluminum ground reference plane or 1 mm thickness stainless steel ground reference plane. The minimum size of the ground reference plane is 1 m x 1 m, the exact size depending on the dimensions of the EUT. It was connected to the protective grounding system.

The EUT was arranged and connected according to its functional requirements. A distance of 1 m minimum was provided between the EUT and the wall of the Lab., and any other metallic structure. In cases where this length exceeds the length necessary to apply the discharges to the selected points, the excess length shall, where possible, be placed non-inductively off the ground reference plane and shall not come closer than 0.2 m to other conductive parts in the test setup.

Where the EUT is installed on a metal table, the table was connected to the reference plane via a cable with a 470k ohm resister located at each end, to prevent a build-up of charge. The test setup was consist a wooden table, 0.8 m high, standing on the ground reference plane. A HCP, 1.6 m x 0.8 m, was placed on the table. The EUT and cables was isolated from the HCP by an insulating support 0.5 mm thick. The VCP size, 0.5 m x 0.5 m.

C.4.3 ESD Test Procedure

a. In the case of air discharge testing the climatic conditions shall be within the following ranges:
   - ambient temperature: 15 °C to 35 °C;
   - relative humidity : 30 % to 60 %;
   - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).

b. Test programs and software shall be chosen so as to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, but permitted only where it can be shown that the EUT is being comprehensively exercised.

c. The test voltage shall be increased from the minimum to the selected test severity level, in order to determine any threshold of failure. The final severity level should not exceed the product specification value in order to avoid damage to the equipment.

d. The test shall be performed with both air discharge and contact discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on air discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on contact discharge.

e. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be necessary to determine whether a system failure has occurred.

f. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

g. In the case of painted surface covering a conducting substrate, the following procedure shall be adopted:
   - If the coating is not declared to be an insulating coating by the equipment manufacturer, then the pointed tip of the generator shall penetrate the coating so as to make contact with the conducting substrate.
   - Coating declared as insulating by the manufacturer shall only be submitted to the air discharge.
   - The contact discharge test shall not be applied to such surfaces.

h. In the case of air discharges, the round discharge tip of the discharge electrode shall be approached as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.

C.4.4 Test Severity Levels

C.4.4.1 Contact Discharge

Level	Test Voltage (kV) of Contact discharge
1	±2
2	±4
3	±6
4	±8
X	Specified
Remark : "X" is an open level.	

C.4.4.2 Air Discharge

Level	Test Voltage (kV) of Air Discharge
1	±2
2	±4
3	±8
4	±15
X	Specified
Remark : "X" is an open level.	

C.4.5 Test Points

C.4.5.1 Test Result of Air Discharge

Test Point	No. of Discharges	Air Discharge/Round Tip						Test Record
		+2kV	-2kV	+4kV	-4kV	+8kV	-8kV	
AC input	10	A	A	A	A	A	A	Normal
DC output	10	A	A	A	A	A	A	Normal

C.4.5.2 Test Result of Contact Discharge

Direct discharge

Test Point	No. of Discharges	Contact Discharge/Pointed Tip				Test Record
		+2kV	-2kV	+4kV	-4kV	
Case	25	A	A	A	A	Normal
Screw	25	A	A	A	A	Normal

Indirect discharge to HCP and VCP

Test Point	No. of Discharges	Contact Discharge/Pointed Tip				Test Record
		+2kV	-2kV	+4kV	-4kV	
HCP (At Front)	10	A	A	A	A	Normal
HCP (At Left)	10	A	A	A	A	Normal
HCP (At Right)	10	A	A	A	A	Normal
HCP (At Rear)	10	A	A	A	A	Normal
VCP (At Front)	10	A	A	A	A	Normal
VCP (At Left)	10	A	A	A	A	Normal
VCP (At Right)	10	A	A	A	A	Normal
VCP (At Rear)	10	A	A	A	A	Normal

C.5 Radio Frequency Electromagnetic Field Immunity Measurement (RS)

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	A
Basic Standard	IEC 61000-4-3
Product Standard	EN 61000-6-2:2005
Level	3 / 2 /1
Frequency Range	80-1000 MHz, 1400-2700 MHz
Field Strength	10 V/m (unmodulated, r.m.s) 80% AM (1 kHz) – for 80-1000 MHz 3 V/m (unmodulated, r.m.s) 80% AM (1 kHz) – for 1400-2000 MHz 1 V/m (unmodulated, r.m.s) 80% AM (1 kHz) – for 2000-2700 MHz
Temperature	26 ℃
Relative Humidity	45 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	Normal

C.5.1 Test Record

Frequency Band: 80-1000 MHz

Sides of the EUT have been exposed to the field	Antenna positioned	Test field strength Level	Test field strength (V/m)	Test Record
Front	Vertical	3	10	Normal (No influencing)
	Horizontally	3	10	Normal (No influencing)
Left	Vertical	3	10	Normal (No influencing)
	Horizontally	3	10	Normal (No influencing)
Back	Vertical	3	10	Normal (No influencing)
	Horizontally	3	10	Normal (No influencing)
Right	Vertical	3	10	Normal (No influencing)
	Horizontally	3	10	Normal (No influencing)

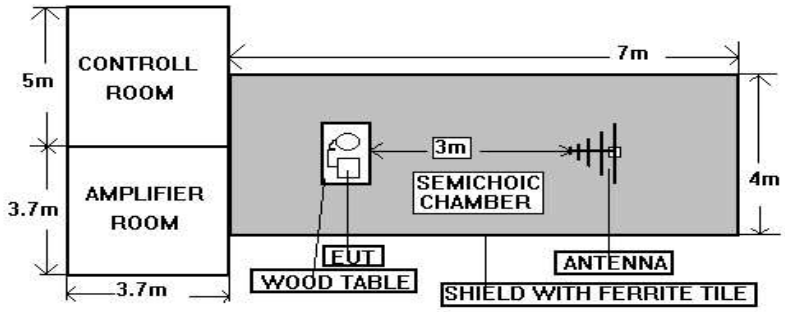
Frequency Band: 1400-2000 MHz

Sides of the EUT have been exposed to the field	Antenna positioned	Test field strength Level	Test field strength (V/m)	Test Record
Front	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Left	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Back	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Right	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)

Frequency Band: 2000-2700 MHz

Sides of the EUT have been exposed to the field	Antenna positioned	Test field strength Level	Test field strength (V/m)	Test Record
Front	Vertical	1	1	Normal (No influencing)
	Horizontally	1	1	Normal (No influencing)
Left	Vertical	1	1	Normal (No influencing)
	Horizontally	1	1	Normal (No influencing)
Back	Vertical	1	1	Normal (No influencing)
	Horizontally	1	1	Normal (No influencing)
Right	Vertical	1	1	Normal (No influencing)
	Horizontally	1	1	Normal (No influencing)

C.5.2 Test Setup



NOTE : The SPORTON 7m x 4m x 4m semi-anechoic chamber is compliance with the sixteen point's uniform field requirement as stated in IEC 61000-4-3 Section 6.2.

The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

C.5.3 Test Procedure

a. The equipment to be tested is placed in the center of the enclosure on a wooden table. The equipment is then connected to power and signal leads according to pertinent installation instructions.

b. The bilog antenna which is enabling the complete frequency range of 80-1000MHz, 1400-2700MHz is placed 3m away from the equipment. The required field strength is determined by placing the field strength meter(s) on top of or directly alongside the equipment under test and monitoring the field strength meter via a remote field strength indicator outside the enclosure while adjusting the continuous-wave to the applicable antennae.

c. The test is normally performed with the generating antenna facing each of four sides of the EUT. The polarization of the field generated by the broadband (bilog) antenna necessitates testing each position twice, once with the antenna positioned vertically and again with the antenna positioned horizontally.

d. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies e.g. clock frequency(ies) and harmonics or frequencies of dominant interest shall be analyzed separately.

e. At each of the above conditions, the frequency range is swept 80-1000MHz, 1400-2700MHz, pausing to adjust the R.F. signal level or to switch oscillators and antenna. The rate of sweep is in the order of 1.5*10-3 decades/s. The sensitive frequencies or frequencies of dominant interest may be discretely analyzed.

C.5.4 Test Severity Levels

Frequency Band : 80-1000MHz, 1400-2700MHz

Level	Test field strength (V/m)
1	1
2	3
3	10
X	Specified
Remark : "X" is an open class.	

C.6 Electrical Fast Transient/Burst Immunity Measurement (EFT/BURST)

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	B
Basic Standard	IEC 61000-4-4
Product Standard	EN 61000-6-2:2005
Level	on input power ports –3
Test Voltage	on input power ports -- ±0.5 / ±1.0 / ±2.0 kV
Impulse wave shape	5/50 ns (Tr/Th)
Impulse frequency	5 kHz
Test Repetition Rate	1 time / minute
Temperature	32 ℃
Relative Humidity	52 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	Normal

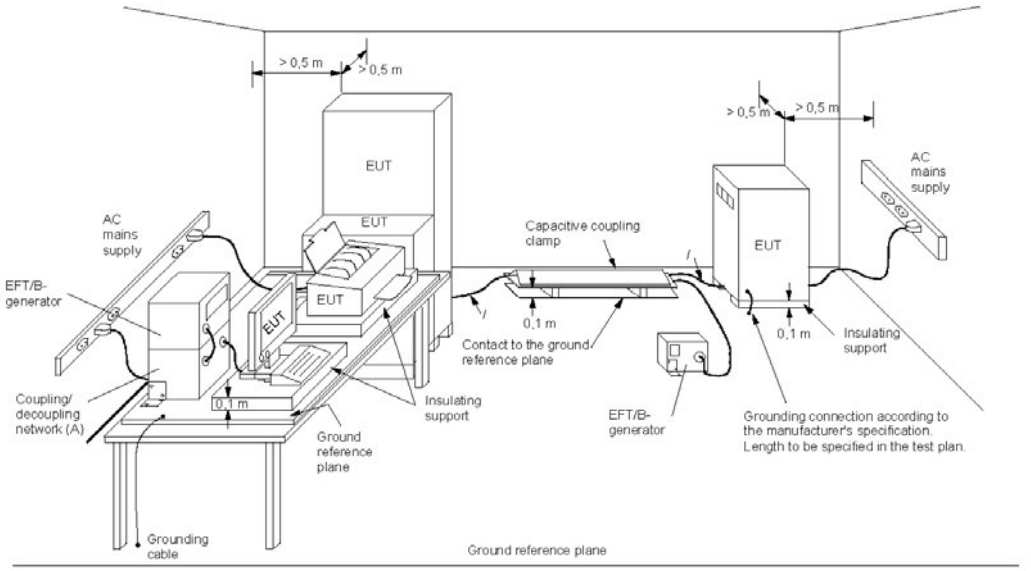
C.6.1 Test Record

■ **Input power port:**

Test Location	Polarity	Test Level	Voltage (Peak)	Test Record
L+N	+	3	0.5 / 1.0 / 2.0 kV	Normal (No influencing)
	–	3	0.5 / 1.0 / 2.0 kV	Normal (No influencing)

Remark : PE = Earth reference

C.6.2 Test setup



Key

/ length between clamp and the EUT to be tested (should be 0,5 m ± 0,05 m)

(A) location for supply line coupling

(B) location for signal lines coupling

The EUT was placed on a ground reference plane and was insulated from it by an insulating support about 0.1 m thick. If the EUT is table-top equipment, it was located approximately 0.8 m above the GRP. The GRP. Was a metallic sheet (copper or aluminum) of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness. It shall project beyond the EUT by at least 0.1 m on all sides and connected to the protective earth. In the SPORTON EMC LAB., We provided 1 mm thickness aluminum ground reference plane or 1 mm thickness stainless steel ground reference plane. The minimum size of the ground reference plane is 1 m x 1 m, the exact size depending on the dimensions of the EUT. It was connected to the protective grounding system. The EUT was arranged and connected according to its functional requirements. The minimum distance between the EUT and other conductive structures, except the GRP. Beneath the EUT, was more than 0.5 m. using the coupling clamp, the minimum distance between the coupling plates and all other conductive structures, except the GRP. Beneath the EUT, was more than 0.5 m. The length of the signal and power lines between the coupling device and the EUT was 1 m or less.

C.6.3 Test on Power Line

a. The EFT/B-generator was located on the GRP. The length from the EFT/B-generator to the EUT as not exceeds 1 m.

b. The EFT/B-generator provides the ability to apply the test voltage in a non-symmetrical condition to the power supply input terminals of the EUT.

C.6.4 Test on Communication Lines

a. The coupling clamp is composed of a clamp unit for housing the cable (length more than 3 m), and was placed on the GRP.

b. The coupling clamp provides the ability of coupling the fast transient/bursts to the cable under test.

C.6.5 Test Procedure

a. In order to minimize the effect of environmental parameters on test results, the climatic conditions when test is carrying out shall comply with the following requirements:
   - ambient temperature: 15 °C to 35 °C;
   - relative humidity : 45 % to 75 %;
   - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).

b. In order to minimize the effect of environmental parameters on test results, the electromagnetic environment of the laboratory shall not influence the test results.

c. The variety and diversity of equipment and systems to be tested make it difficult to establish general criteria for the evaluation of the effects of fast transients/bursts on equipment and systems.

d. The test results may be classified on the basic of the operating conditions and the functional specification of the equipment under test, according to the following performance criteria :
   - Normal performance within the specification limits.
   - Temporary degradation or loss of function or performance which is self-recoverable.
   - Temporary degradation or loss of function or performance which requires operator intervention or system reset.
   - Degradation or loss of function which is not recoverable due to damage of equipment (components).

C.6.6 Test Severity Levels

The following test severity levels are recommended for the fast transient/burst test :

Open circuit output test voltage ± 10%		
Level	**On Input power ports**	**On signal port and telecommunication ports**
1	0.5 kV	0.25 kV
2	1.0 kV	0.50 kV
3	2.0 kV	1.00 kV
4	4.0 kV	2.00 kV
X	Specified	Specified
Remark : " X " is an open level. The level is subject to negotiation between the user and the manufacturer or is specified by the manufacturer.		

C.7 Surge Immunity Measurement

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	**A** for Input Power Port
Required Performance Criteria	B for Input power ports,
Basic Standard	IEC 61000-4-5
Product Standard	EN 61000-6-2:2005
Surge wave form (Tr/Th)	1,2/50 (8/20) μs for input power ports 1,2/50 (8/20) μs for input signal ports
Level	on input power ports – 3
Test Voltage	on Input Power Port -- ± 1.0 / ± 2.0 kV
Phase Angle	0°, 90°, 180°, 270°
Number of surges	5 positive and 5 negative pulses
Pulse Repetition Rate	1 time / min. (maximum)
Temperature	30 ℃
Relative Humidity	49 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	Please refer to section C.7.1

C.7.1 Test Record

■ **Input power ports:**

Test Location	Voltage (kV)	Polarity	Phase Angle				Test Record
			0°	90°	180°	270°	
L - N	1.0	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
L - PE	2.0	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)
N - PE	2.0	+	A	A	A	A	Normal (No influencing)
		−	A	A	A	A	Normal (No influencing)

Remark : PE = Earth reference

C.7.2 Test Severity Levels

Level	Open-circuit test voltage, ± 10%, kV
1	0.5
2	1.0
3	2.0
4	4.0
x	Specified
Remark : " X " is an open level. This level can be specified in the product specification.	

C.7.3 Test Procedure

a. Climatic conditions
The climatic conditions shall comply with the following requirements :

- ambient temperature : 15 °C to 35 °C
- relative humidity : 10 % to 75 %
- atmospheric pressure : 86 kPa to 106 kPa (860 mbar to 1060 mbar)

b. Electromagnetic conditions
The electromagnetic environment of the laboratory shall not influence the test results.

c. The test shall be performed according the test plan that shall specify the test set-up with
- generator and other equipment utilized;
- test level (voltage/current);
- generator source impedance;
- internal or external generator trigger;
- number of tests : at least five positive and five negative at the selected points;
- repetition rate : maximum 1/min.
- inputs and outputs to be tested;
- representative operating conditions of the EUT;
- sequence of application of the surge to the circuit;
- phase angle in the case of a.c. power supply;
- actual installation conditions, for example :
  AC : neutral earthed,
  DC : (+) or (-) earthed to simulated the actual earthing conditions.

d. If not otherwise specified the surges have to be applied synchronized to the voltage phase at the zero-crossing and the peak value of the a.c. voltage wave (positive and negative).

e. The surges have to be applied line to line and line(s) and earth. When testing line to earth, the test voltage has to be applied successively between each of the lines and earth, if there is no other specification.

f. The test procedure shall also consider the non-linear current-voltage characteristics of the equipment under test. Therefore the test voltage has to be increased by steps up to the test level specified in the product standard or test plan.

g. All lower levels including the selected test level shall be satisfied. For testing the secondary protection, the output voltage of the generator shall be increased up to the worst-case voltage breakdown level (let-through level) of the primary protection.

h. If the actual operating signal sources are not available, the may be simulated. Under no circumstances may the test level exceed the product specification. The test shall be carried out according the test plan.

i. To find all critical points of the duty cycle of the equipment, a sufficient number of positive and negative test pulses shall be applied. For acceptance test previously unstressed equipment shall be used to the protection devices shall be replaced.

C.7.4 Operating Condition

Full system

C.8 Conducted Disturbances Induced by Radio-Frequency Field Immunity Measurement (CS)

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	A
Basic Standard	IEC 61000-4-6
Product Standard	EN 61000-6-2:2005
Level	3
Test Voltage	10 V (unmodulated, r.m.s), 80% AM (1 kHz)
Frequency Range	0.15 MHz to 80 MHz
Test Port	on Input Power Port
Dwell time	2.9 seconds
Frequency step size	1 %
Coupling mode	CDN M016 M2 for AC power Port
Temperature	32 ℃
Relative Humidity	52 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	Normal

C.8.1 Test Record

Test Port	Test field strength level	Test field strength (V rms)	Test Record
Input power port	3	10	Normal (No influencing)

C.8.2 Test Severity Levels

Level	Voltage Level (EMF)
1	1 V rms
2	3 V rms
3	10 V rms
x	Specified
Remark : " X " is an open level. This level can be specified in the product specification.	

C.8.3 Operating Condition

Full system

C.8.4 Test Procedure

a. The EUT shall be operated within its intended climatic conditions. The temperature and relative humidity should be recorded.

b. This test method test can be performed without using a sell shielded enclosure. This is because the disturbance levels applied and the geometry of the setups are not likely to radiated a high amount of energy, especially at the lower frequencies. If under certain circumstances the radiated energy is too high, a shielded enclosure has to be used.

c. The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn while the other non-excited RF-input ports of the coupling devices are terminated by a 50 ohm load resistor.

d. The frequency range is swept from 150 kHz to 80 MHz, using the signal levels established during the setting process, and with the disturbance signal 80% amplitude modulated with a 1kHz sine wave, pausing to adjust the RF-signal level or to switch coupling devices as necessary. The rate of sweep shall no exceed 1.5×10^{-3} decades/s. Where the frequency is swept incrementally, the step size shall no exceed 1% of the start and thereafter 1% of the preceding frequency value.

e. The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies e.g. clock frequency(ies) and harmonics or frequencies of dominant interest shall be analyzed separately.

f. In cases of dispute, the test procedure using a step size not exceeding 1% of the start and thereafter 1% of preceding frequency value shall take precedence.

g. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

h. The use of special exercising programs is recommended.

i. Testing shall be performed according to a Test Plan, which shall be included in the test report.

j. It may be necessary to carry out some investigatory testing in order to establish some aspects of the test plan.

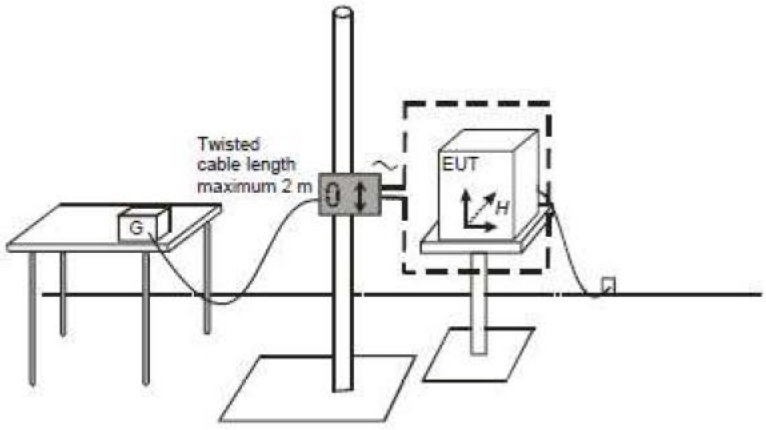
C.9 Power Frequency Magnetic Field immunity Measurement (PFMF)

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	A
Required Performance Criteria	A
Basic Standard	IEC 61000-4-8
Product Standard	EN 61000-6-2:2005
Temperature	30 ℃
Relative Humidity	49 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	Please refer to section D.9.1

C.9.1 Test Record

Power Frequency Magnetic Field	Testing duration	Coil Orientation	Test Record
50Hz, 30A/m	1.0 Min	X-axis	Normal (No influencing)
50Hz, 30A/m	1.0 Min	Y-axis	Normal (No influencing)
50Hz, 30A/m	1.0 Min	Z-axis	Normal (No influencing)

C.9.2 Test Setup



EUT : Equipment under test G : Test Generator

C.10 Voltage Dips and Voltage Interruptions Immunity Measurement (DIP)

Test mode	Mode 1
Final Test Result	***PASS***
Pass Performance Criteria	***B*** for voltage interruption, ***B/A/A*** for voltage dips
Required Performance Criteria	C for voltage interruption, B/B/C for voltage dips
Basic Standard	IEC 61000-4-11
Product Standard	EN 61000-6-2:2005
Test Port	Input power ports
Temperature	32 ℃
Relative Humidity	52 %
Atmospheric Pressure	101 kPa
Test Date	Jul. 16, 2016
Test Engineer	Easton
Observation	Please refer to section C.10.1 and C.10.2

C.10.1 Test Record of Voltage Interruption

Voltage	Phase	Residual voltage	Duration (Cycle)	Frequency	Criteria	
					100V	240V
Interruptions	0/180	0%	250/300	50/60Hz	B	B
Dip	0/180	40%	10/12	50/60Hz	B	A
Dip	0/180	70%	25/30	50/60Hz	A	A
Dip	0/180	0%	1	50/60Hz	A	A

Criteria B:

During the test at cycle 250/300, the voltage of EUT down to 0V. After the test the power of EUT reset automatically.

Criteria B:

During the test at cycle 10/12, the voltage of EUT down to 4V. After the test the power of EUT reset automatically.

C.10.3 Testing Requirement and Procedure

The test was based on IEC 61000-4-11

C.10.4 Test Conditions

1. Source voltage and frequency : 100/240V, 50Hz, Single phase.
2. Test of interval : 10 sec.
3. Level and duration : Sequency of 3 dips/interrupts.
4. Voltage rise (and fall) time : 1 ~ 5 μs.

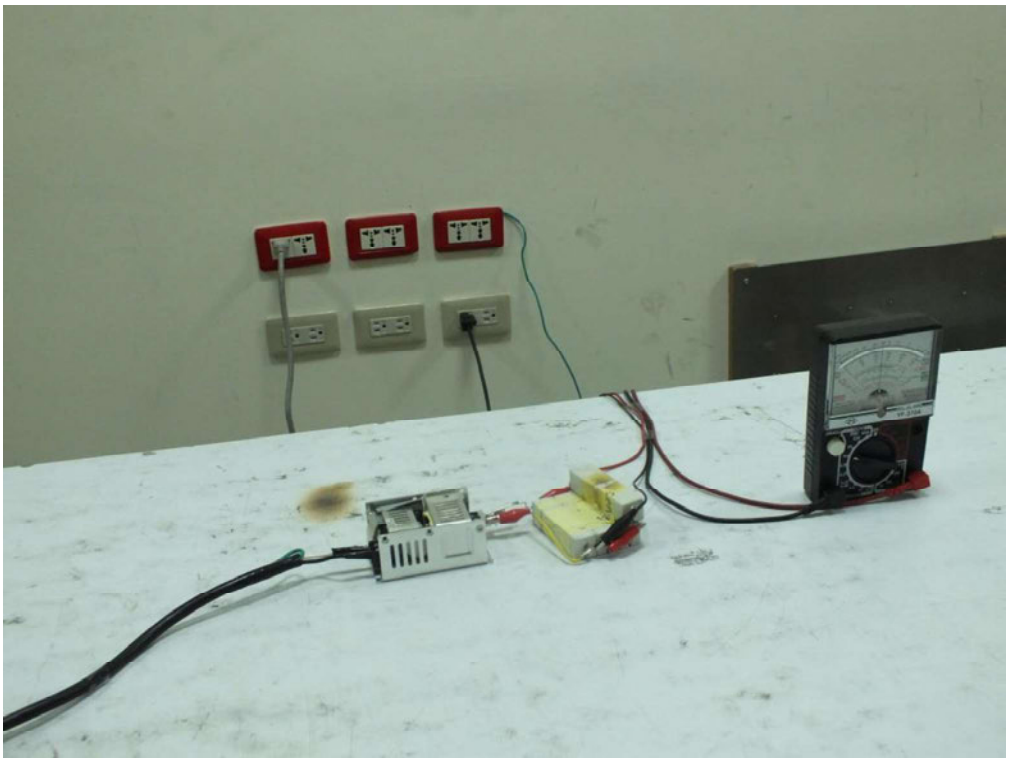
C.10.5 Operating Condition

Full system

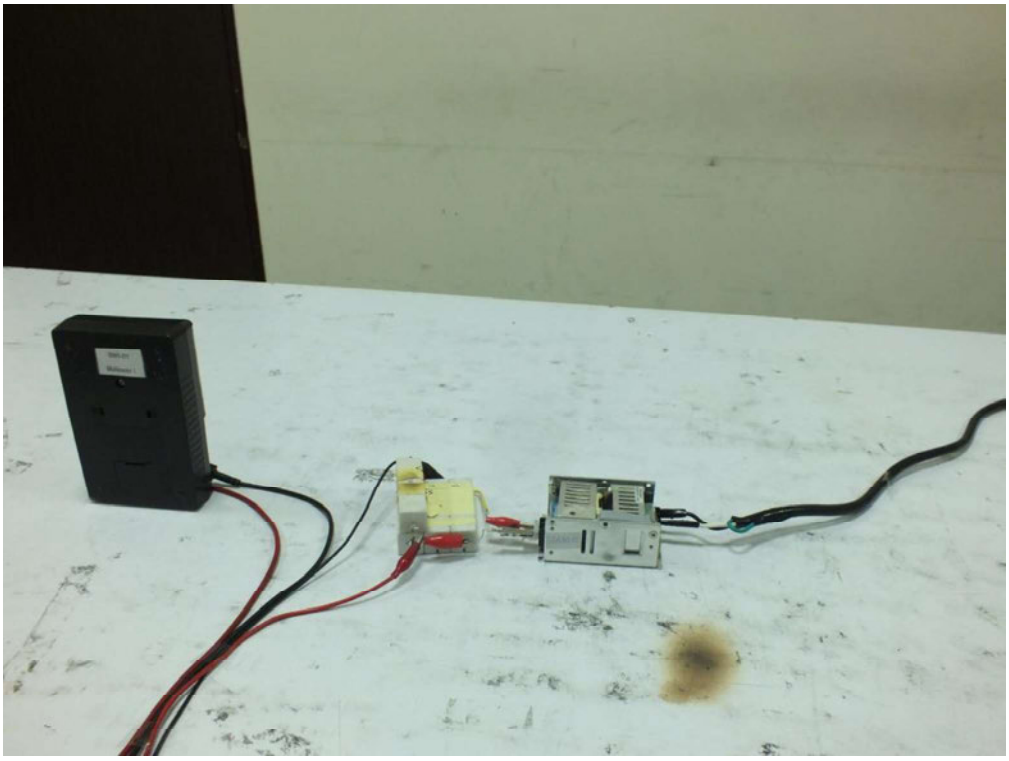
C.1 Photographs of Test Configuration

C.1.1 Photographs of Flicker, Surge, Dip Test Configuration

Front view



Rear view



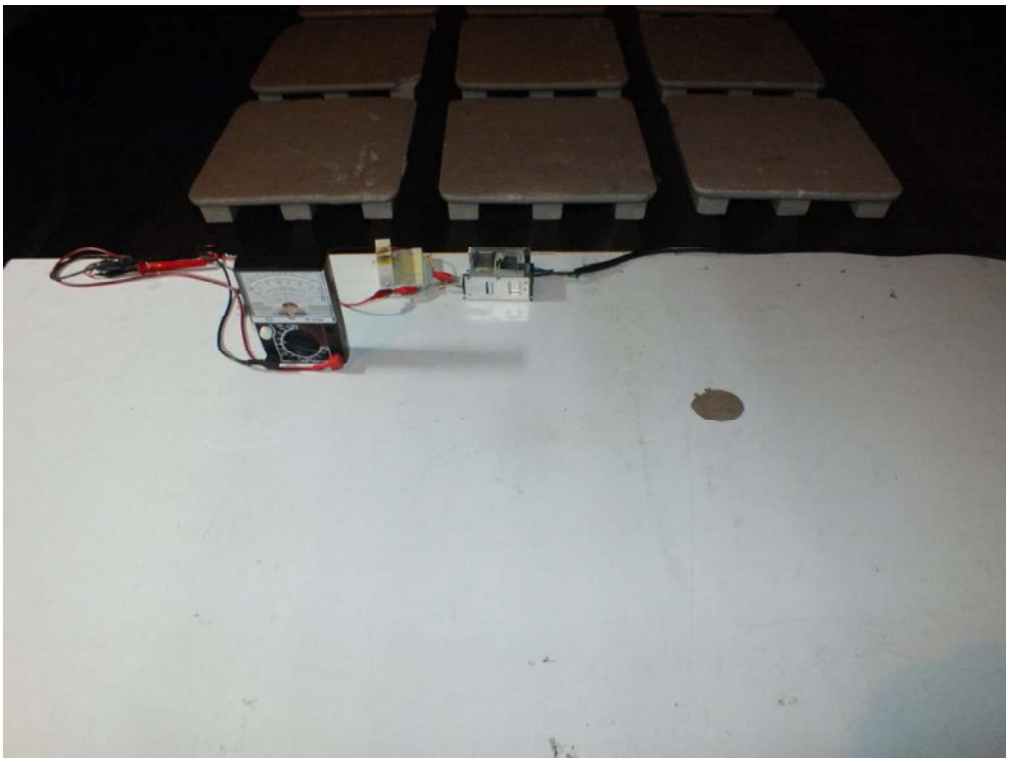
C.1.2 Photographs of ESD Immunity Test Configuration

Front view

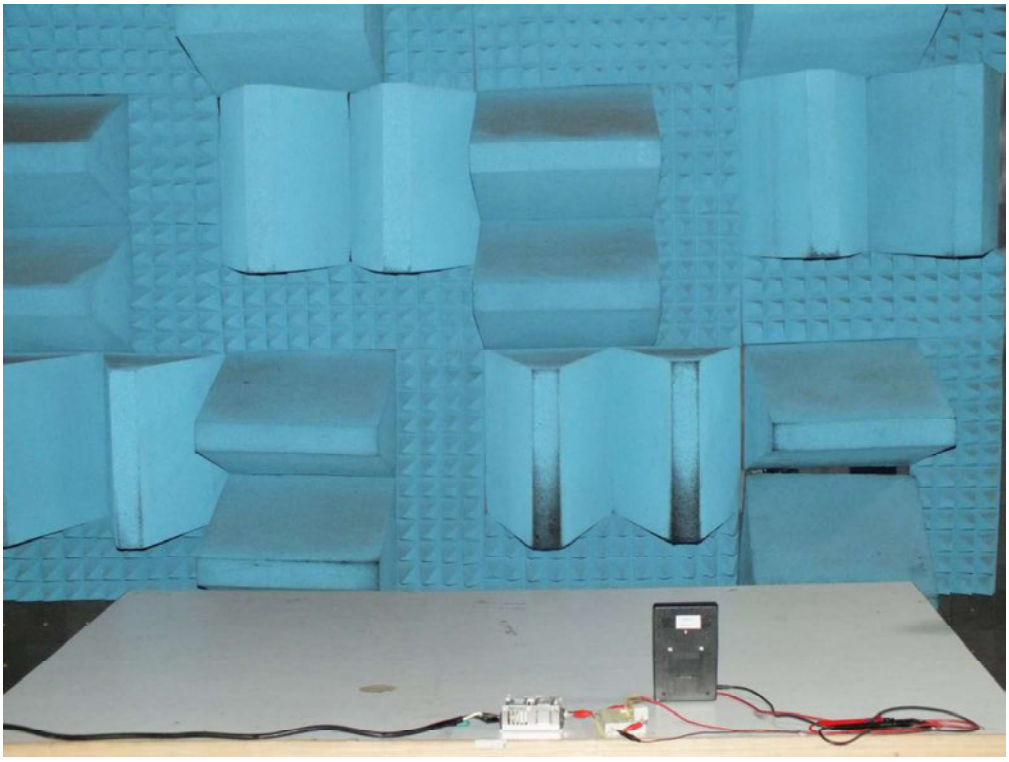
Rear view

C.1.3 Photographs of RS Immunity Test Configuration

Front view

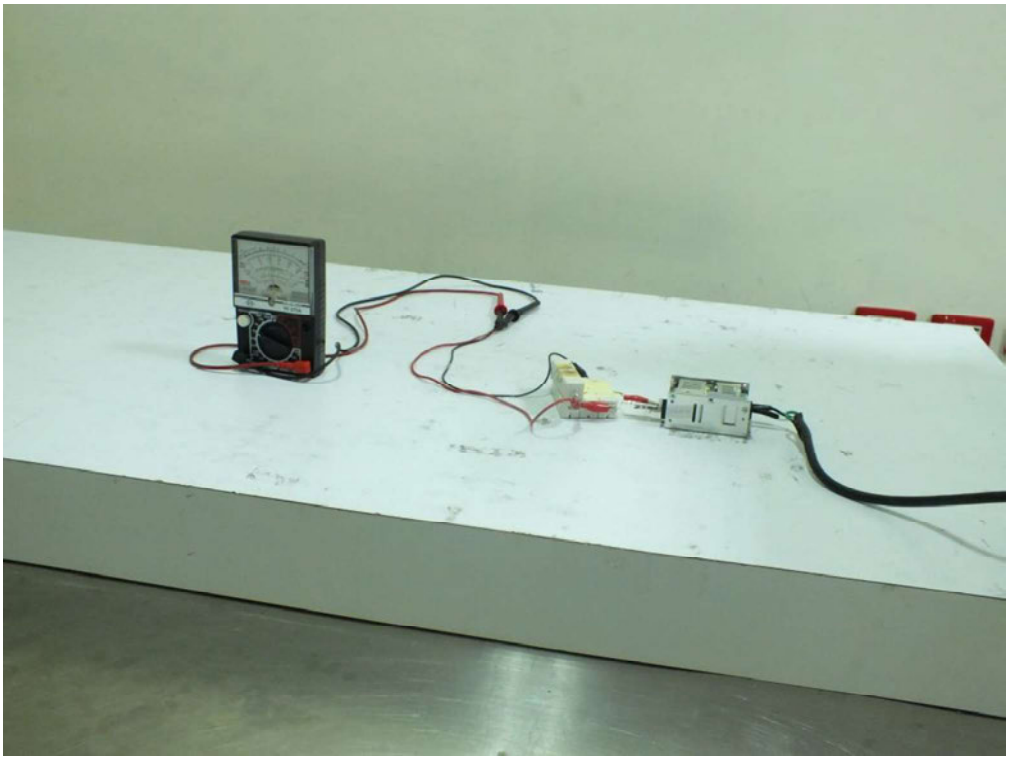


Rear view

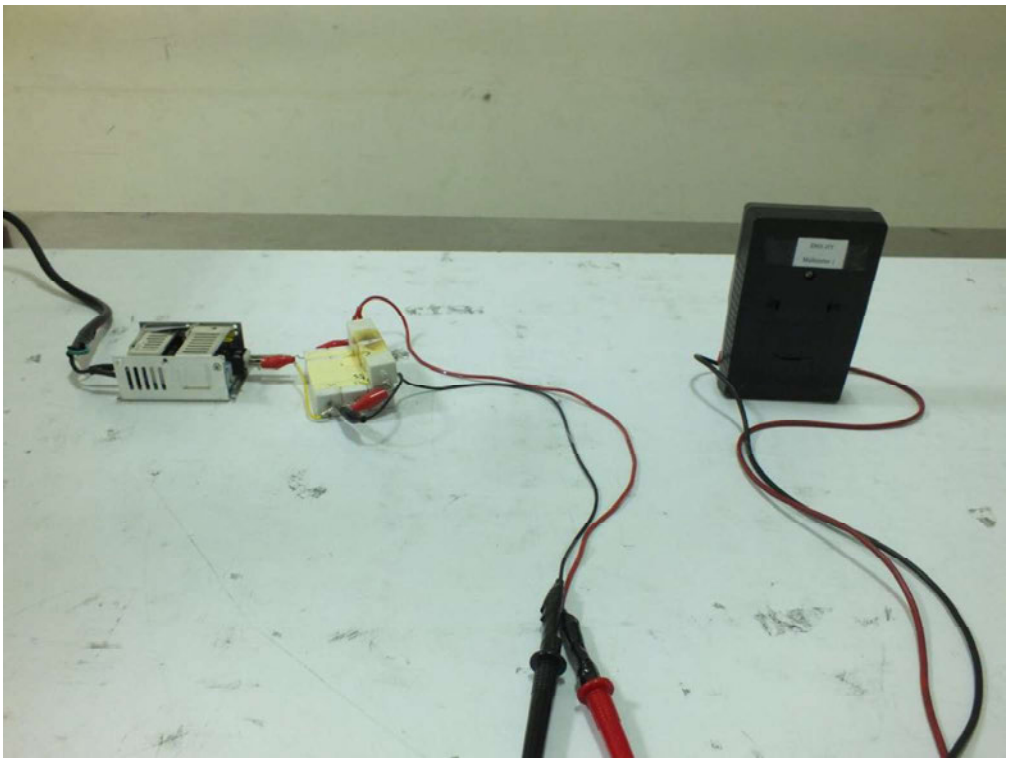


C.1.4 Photographs of EFT Test Configuration

Front view

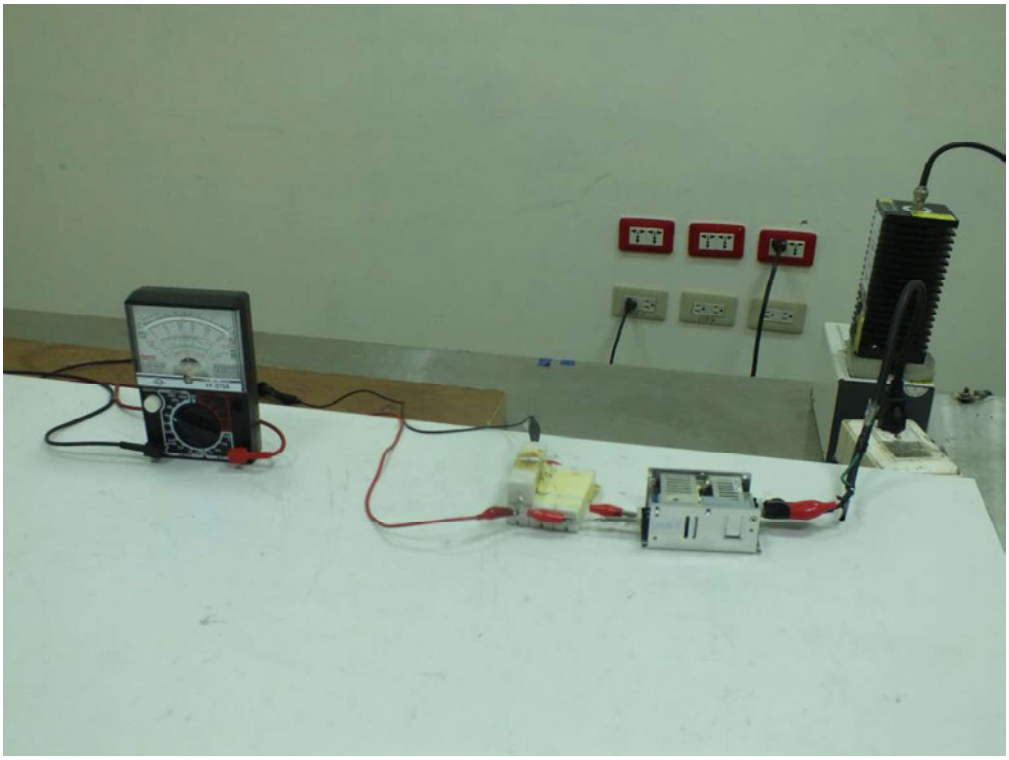


Rear view

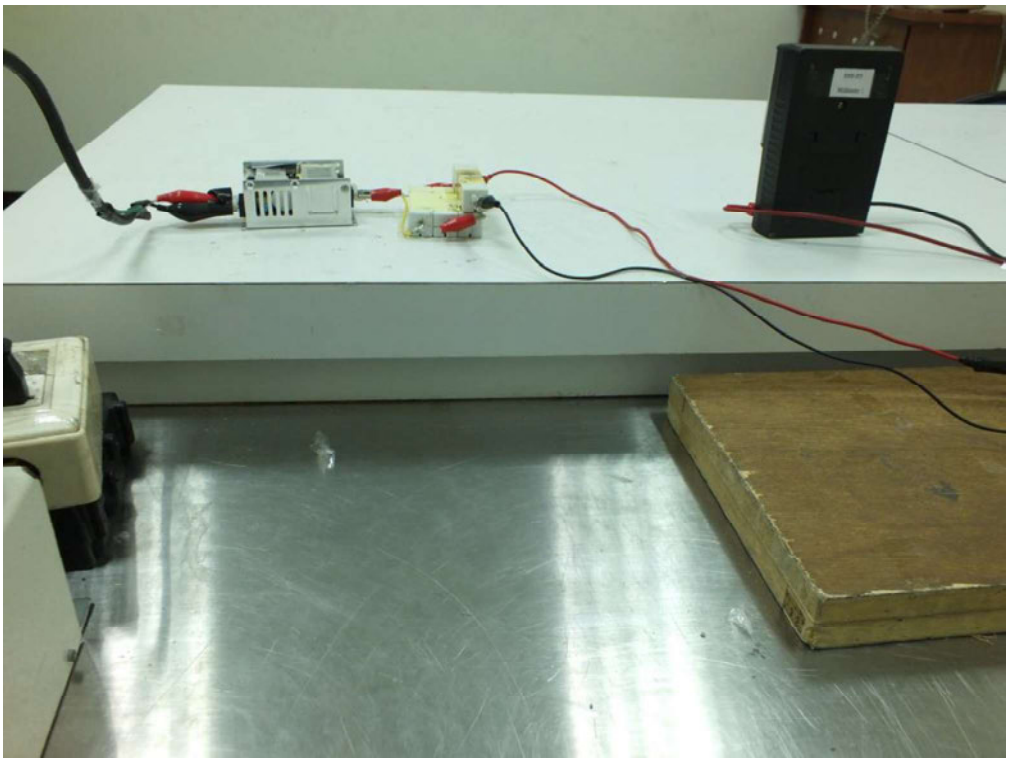


C.1.5 Photographs of CS Immunity Test Configuration

Front view

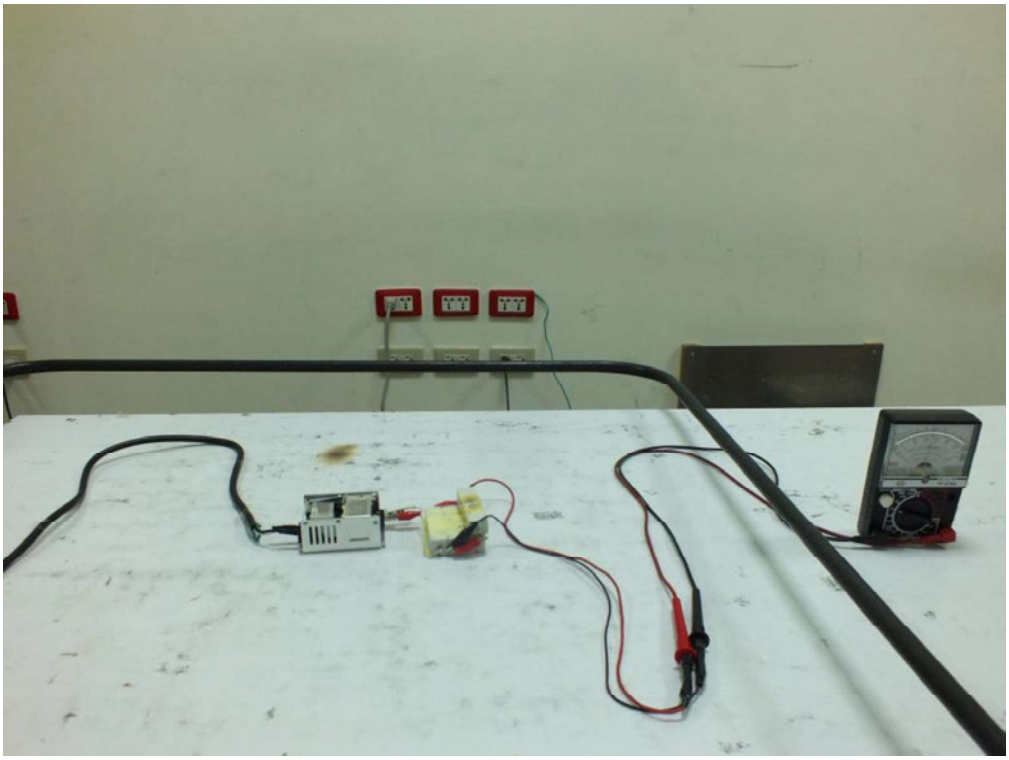


Rear view

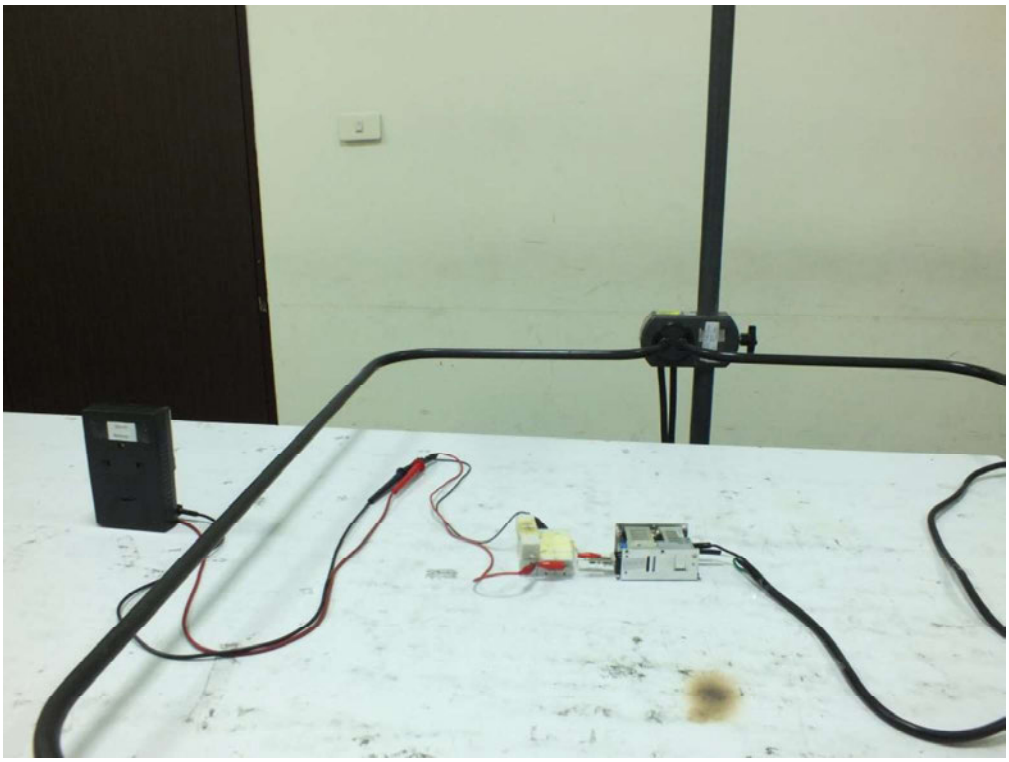


C.1.6 Power Frequency Magnetic Field immunity Measurement (PFMF)

Front view



Rear view



C.2 List of Measuring Equipment Used

EMS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
ESD Simulator	SCHAFFNER	NSG 437	192	Air: 0 ~ 30kV Contact: 0 ~ 30kV	Oct. 03, 2015	ESD
RS immunity Test system	ROHDE& SCHWARZ	RSF	RS-01	80M~3GHz	May 20, 2016	RS
Amplifier	AMPLIFIER& RESEARCH	250W 1000AM	0332909	80MHz ~ 1GHz	Mar. 16, 2016	RS
Amplifier	AMPLIFIER& RESEARCH	30S1G3	312505	800M~3GHz	Oct. 14, 2015	RS
DUAL DIRECTIONAL COUPLER	AMPLIFIER& RESEARCH	DC6180A	312453	0.08 ~ 1GHz	Oct. 14, 2015	RS
DUAL DIRECTIONAL COUPLER	AMPLIFIER& RESEARCH	DC7144A	312782	0.8 ~ 4.2GHz	Oct. 14, 2015	RS
INTEGRATED MEASUREMENT SYSTEM	ROHDE& SCHWARZ	IMS	100007	9kHz ~ 3GHz	May 16, 2016	RS
NRP-Z91 POWER SENSOR 6GHZ	ROHDE& SCHWARZ	NRP-Z91 1168.8004.02	100095	9kHz ~ 3GHz	May 13, 2016	RS
Antenna	FRANKONIA	BTA-L	02002L	26MHz ~ 1GHz	May 04, 2016	RS
Antenna	AR	AT4002A	312601	800MHz ~ 5GHz	May 04, 2016	RS
Probe	ETS-LINDGREN	HI-6005	00052473	0.1MHz ~ 5GHz	Nov. 18, 2015	RS
EFT Generator	TESEQ	FTM3425	0180	0 ~ 4kV	Jan. 18, 2016	EFT
SURGE Generator	TESEQ	CWN 3650	0429	0 ~ 6 kV/2Ω 0~ 6 kV/12Ω	Jan. 18, 2016	SURGE
Conducted Immunity Test System	TESEQ	NSG4070	34293	9kHz ~ 1GHz	Aug. 23, 2015	CS
Attenuator	BIRD	100-SA-MFB-06	0232	150kHz ~ 230MHz	Aug. 25, 2015	CS
Coupling/Decoupling Network	SCHAFFNER	CDN M016	16670	150kHz ~ 230MHz	Jul. 06, 2016	CS
Magnetic field Immunity Loop	FCC (KEYTEK)	F-1000-4-8-G-125A	05004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	Dec. 30, 2015	PFMF
Magnetic Generator	FCC (KEYTEK)	F-1000-4-8/9/10-L-1M	03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	Dec. 30, 2015	PFMF
DIP Generator	TESEQ	VAR 3005-S16	0804	230VA/50Hz/60Hz 0%Open/5S 0%Short/5S 40%0.10S 70%/0.01S	Jan. 18, 2016	DIP
Harmonic/Flicker Test System	SCHAFFNER	CCN1000-1	72471	4000VA 16A PEAK	May 24, 2016	Harmonics, Flicker
AC Power Source	TESEQ	NSG 1007	1510A00144	16A PEAK	May 24, 2016	Harmonics, Flicker

Note: Calibration Interval of instruments listed above is one year.