

# CE EMC TEST REPORT

**REPORT NO. : EH760927**  
**MODEL NO. : RBwAPG-60ad**  
**RECEIVED DATE : Jun. 29, 2017**  
**FINAL TESTED DATE : Aug. 07, 2017**  
**ISSUED DATE : Aug. 15, 2017**

**TEST STANDARD : Draft EN 301 489-1 V2.2.0 (2017-03), Class A**  
**Draft EN 301 489-17 V3.2.0 (2017-03)**

**APPLICANT : Mikrotikls SIA**  
**ADDRESS : Pernavas 46, Riga, LV-1009 Latvia**

**MANUFACTURER : Mikrotikls SIA**  
**ADDRESS : Pernavas 46, Riga, LV-1009 Latvia**

**ISSUED BY : SPORTON International Inc.**  
**LAB ADDRESS : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park,**  
**Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.**

- 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.



## Table of Contents

VERIFICATION OF COMPLIANCE .....	1
1. Summary of Test Results .....	2
2. General Description of Equipment under Test.....	4
3. Test Configuration of Equipment under Test.....	5
4. General Information of Test.....	9
5. Test of Conducted Emission .....	11
6. Test of Radiated Emission.....	18
7. Harmonics Test.....	28
8. Voltage Fluctuations and Flicker Test.....	30
9. General Performance Criteria Description of Immunity Test.....	32
10. Electrostatic Discharge Immunity Test (ESD).....	33
11. Radio Frequency Electromagnetic Field Immunity Test (RS).....	45
12. Electrical Fast Transient/Burst Immunity Test (EFT/BURST) .....	48
13. Surge Immunity Test .....	53
14. Conducted Disturbances Induced by Radio-Frequency Field Immunity Test (CS).....	57
15. Voltage Dips and Voltage Interruptions Immunity Tests .....	60
16. List of Measuring Equipment Used .....	62
17. Uncertainty of Test Site .....	65
Appendix A. TEST PHOTOS .....	A1 ~ A19
Photographs of EUT V01	

### History of This Test Report

REPORT NO.	VERSION	ISSUED DATE	Description
EH760927	Rev. 01	Aug. 15, 2017	Initial issue of report

## VERIFICATION OF COMPLIANCE

EQUIPMENT NAME : RouterBOARD wAP G-60ad

BRAND NAME : RouterBOARD

MODEL NO. : RBwAPG-60ad

APPLICANT : Mikrotiks SIA

ADDRESS : Pernavas 46, Riga, LV-1009 Latvia

FINAL TESTED DATE : Aug. 07, 2017

TEST STANDARD : Draft EN 301 489-1 V2.2.0 (2017-03), Class A  
Draft EN 301 489-17 V3.2.0 (2017-03)

I **HEREBY** DECLARE THAT:

The above equipment has been tested by **SPORTON International Inc. LAB.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.



Beck Wu

SPORTON INTERNATIONAL INC.

## 1. Summary of Test Results

After estimating all the combination of every test mode, the result shown as below is the worst case.

The EUT has been tested according to the following specifications.

<b>Applicable Standard: Draft EN 301 489-1 V2.2.0 (2017-03)</b>			
<b>Test Standard</b>	<b>Test Type</b>	<b>Result</b>	<b>Remarks</b>
EN 55032:2015	AC Power Port Conducted emission test 150 kHz – 30 MHz	PASS	Meet minimum passing margin is -25.50dB at 0.5641 MHz.
	Telecom Port Conducted emission test 150 kHz – 30 MHz	PASS	Meet minimum passing margin is -15.13dB at 0.4609MHz.
	Radiated emission test 30 MHz – 1,000 MHz @ 10 m 1,000 MHz – 6,000 MHz @ 3 m	PASS	Meet minimum passing margin is -5.83dB at 72.68MHz.
EN 61000-3-2:2014	Harmonic Current emission test	-	Note1
EN 61000-3-3:2013	Voltage Fluctuations and Flicker tests	PASS	Meet the requirements.

Note1: The power consumption of EUT is lower than 75W, so the limit is not specified in EN 61000-3-2:2014 .

<b>Applicable Standard: Draft EN 301 489-1 V2.2.0 (2017-03)</b>		
<b>Test Standard</b>	<b>Test Type</b>	<b>Pass Criterion</b>
EN 61000-4-2:2009	<b>Electrostatic discharge immunity test</b> ± 2, 4 kV Contact Discharge ± 2, 4, 8 kV Air Discharge Standard Criterion B	<b>A</b>
EN 61000-4-3:2006/A1:2008/A2:2010	<b>Radiated immunity test</b> Frequency Range : 80 MHz to 6,000 MHz Electromagnetic field : 3 V/m (unmodulated, r.m.s) Amplitude modulated : 80 % AM (1 kHz) Standard Criterion A	<b>A</b>
EN 61000-4-4:2012	<b>Electrical fast transient / burst immunity test</b> AC ports 5/50 ns, ± 1 kV, 5 kHz I/O ports 5/50 ns, ± 0.5 kV, 5 kHz Standard Criterion B	<b>A</b>
EN 61000-4-5:2014	<b>Surge immunity test</b> AC ports (1.2/50 us) : line to line : ± 0.5, 1 kV Telecommunication/Signal ports : indoor (1.2/50 us) : ± 0.5 kV Standard Criterion B	<b>A</b>
EN 61000-4-6:2014/AC:2015	<b>Conducted immunity test</b> Frequency Range : 150 kHz to 80 MHz Electromagnetic field : 3 V (unmodulated, r.m.s) Amplitude modulated : 80 % AM (1 kHz) Standard Criterion A	<b>A</b>
EN 61000-4-11:2004	<b>Voltage dips, short interruptions and voltage variations immunity tests</b> 1. Dip 0% residual 10 ms (0.5 cycles) – Standard Criterion B	<b>A</b>
	2. Dip 0% residual 20 ms (1.0 cycles) – Standard Criterion B	<b>A</b>
	3. Dip 70% residual 500 ms (25 cycles) – Standard Criterion B	<b>C</b>
	4. Interruption 0% residual 5000 ms (250 cycles) – Standard Criterion C	<b>C</b>

## 2. General Description of Equipment under Test

Product Detail	
Equipment Name	RouterBOARD wAP G-60ad
Model No.	RBwAPG-60ad
Brand Name	RouterBOARD
Power Supply	From Power Adapter or PoE

### 2.1. Feature of Equipment under Test

1. The EUT support 60GHz wireless function.
2. Accessories

Power	Brand	Model	Rating
Adapter	MLF	MLF-A00122400380FE0141	Input:100-240V~50/60 Hz, 0.4Amax Output:24V, 0.38A
PoE	MikroTik	RBGPOE	Input: 9-48V

3. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

### 3. Test Configuration of Equipment under Test

#### 3.1. Test Mode

The following table is a list of the test modes shown in this test report.

Conducted Emissions	
Test Mode	Description
1	EUT with Adapter
2	EUT with PoE

Mode 1 generated the worst test result, so it was recorded in this report.

Disturbances at Telecommunication Ports	
Test Mode	Description
1	EUT with Adapter + LAN 1000 Mbps
2	EUT with PoE + EUT LAN 1000 Mbps
3	EUT with PoE + PoE data + power 1000 Mbps
4	EUT with PoE + PoE data 1000 Mbps

Mode 2, 3 and Mode 4 are worst test result among Mode 1 ~ Mode 4, and the test result of those three modes are selected to record in the test report.

Radiated Emissions	
Test Mode	Description
1	EUT in Y axis with Adapter
2	EUT in Z axis with Adapter

Mode 1 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.

3	EUT in Y axis with PoE
---	------------------------

For Radiated Emission test below 1GHz:  
Mode 3 generated the worst test result, so it was recorded in this report.  
For Radiated Emission test above 1GHz:  
Mode 3 generated the worst test result for Radiated emission below 1GHz test, thus the measurement for Radiated emission above 1GHz test will follow this same test configuration.

Harmonic Current Emissions 、 Voltage Fluctuations and Flicker 、 ESD 、 RS 、 EFT 、 Surge 、 CS 、 DIP	
Test Mode	Description
1	EUT with Adapter
2	EUT with PoE

### 3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Support Unit	Brand	Model	FCC ID
NB*2	DELL	E6430	DoC
Device	Mikrotikls SIA	wAP G 60ad	N/A

### 3.3. EUT Operation Condition

#### <EMI>

#### For AC Power Port Conducted emission and Radiated emission test:

During the test, the following programs under WIN 7 were executed:

The remote notebook executed " winbox " and let the EUT connect with device via 60GHz.

The remote notebook executed " ping.exe " to link with the EUT to maintain the connection by LAN.

#### For Telecom Port Conducted emission test:

At the same time, the remote notebook executed "LAN TEST" to link with the EUT to traffic packet data generated software and keep maximum traffic load by LAN.

#### <EMS>

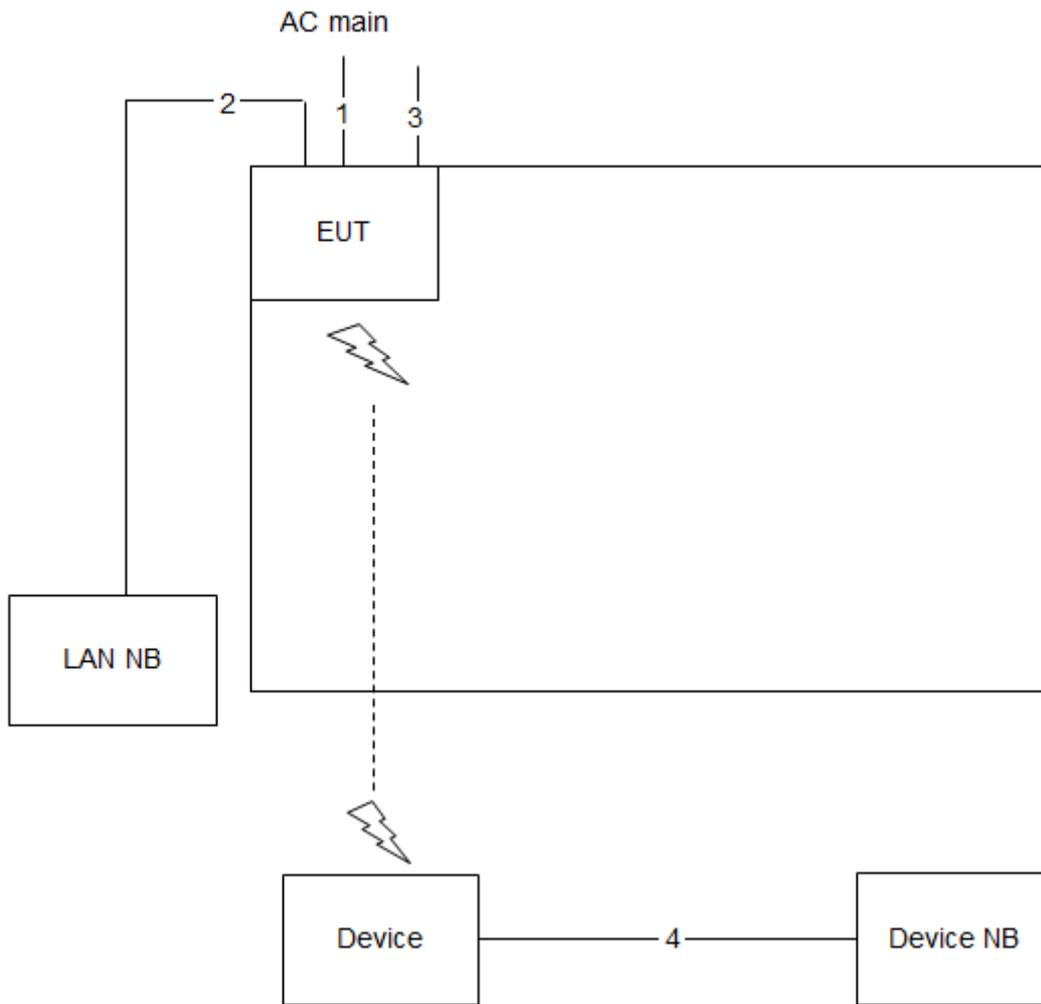
During the test, the following programs under WIN 7 were executed:

The remote notebook executed " winbox " and let the EUT connect with device via 60GHz.

The remote notebook executed " ping.exe " to link with the EUT to maintain the connection by LAN.

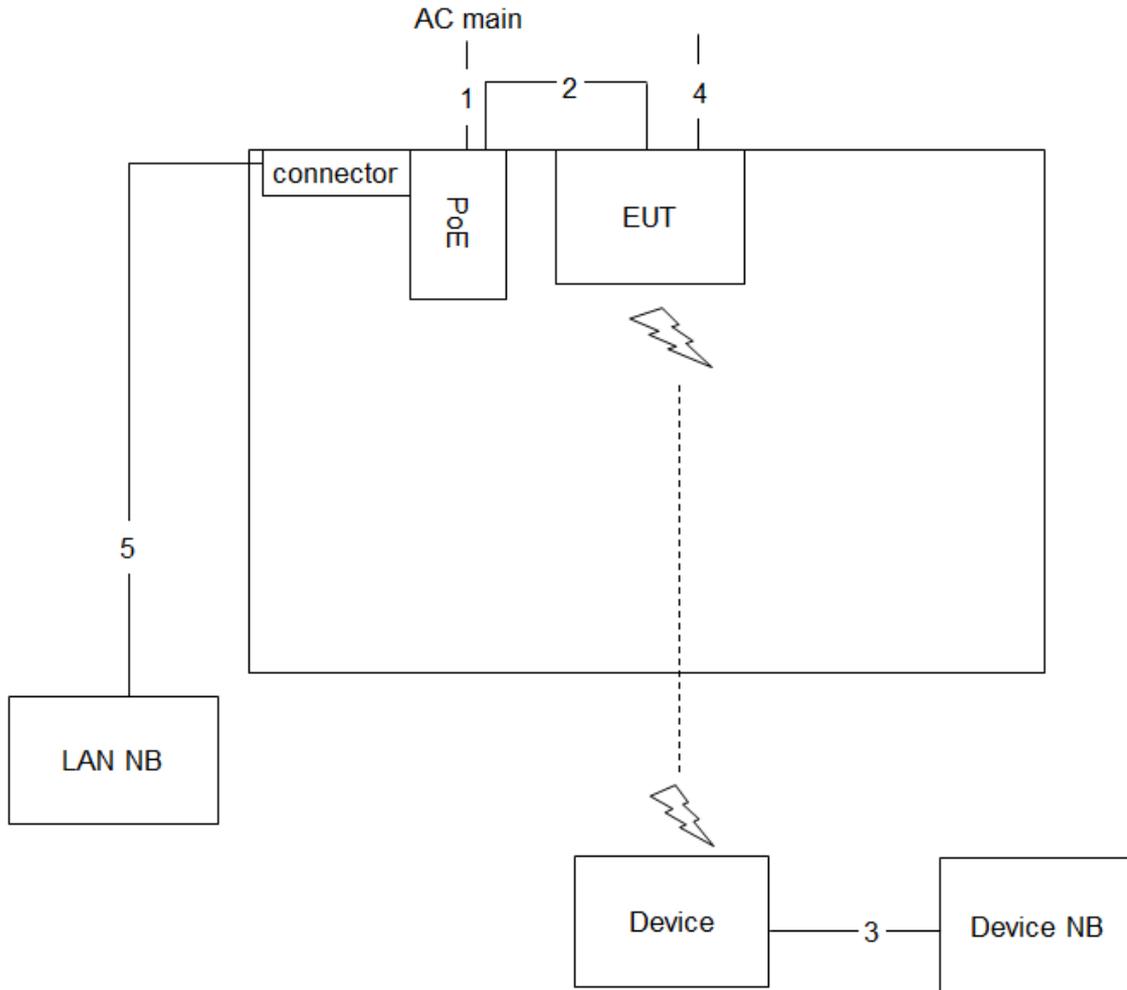
### 3.4. Connection Diagram of Test System

#### 3.4.1. AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	1.5m
2	RJ-45 cable	No	10m
3	Ground cable	No	1.5m
4	RJ-45 cable	No	1.5m

3.4.2. Radiation Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	1.5m
2	RJ-45 cable	No	1.5m
3	RJ-45 cable	No	1.5m
4	Ground cable	No	1.5m
5	RJ-45 cable	No	10m

## 4. General Information of Test

### 4.1. Test Facility

**<EMI>**

Test Site Location : No.8, Lane 724, Bo-ai St., Jhubei City,  
Hsinchu County 302, Taiwan, R.O.C.

TEL : 886-3-656-9065

FAX : 886-3-656-9085

Test Site No. : Conduction: CO01-CB  
Radiation: 10CH01-CB

**<EMS>**

**For Other Test**

Test Site Location : No.8, Lane 724, Bo-ai St., Jhubei City,  
Hsinchu County 302, Taiwan, R.O.C.

TEL : 886-3-656-9065

FAX : 886-3-656-9085

**For RS (Above 1GHz)**

Test Lab Address : International Certification Corp

Test Site Location : No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist.,  
Tao Yuan City , Taiwan (R.O.C.)

TEL : 886-3-271-8666

TAF Number : 2732

Tested by : JN Chen

Approval by : Eason Chang

### 4.2. Test Voltage

Power Type	Test Voltage
AC Power Supply	230 V / 50 Hz

### 4.3. Frequency Range Investigated

EMI Test Items	Frequency Range
Conducted emission test	150 kHz to 30 MHz
Radiated emission test	30 MHz to 6,000 MHz
EMS Test Items	Frequency Range
Radio frequency electromagnetic field immunity test	80 MHz to 6,000 MHz
Conducted immunity test	150 kHz to 80 MHz

**4.4. Test Distance**

Test Items	Test Distance
Radiated emission test below 1 GHz (30 MHz to 1,000 MHz)	10 m
Radiated emission test above 1 GHz (1,000 MHz to 6,000 MHz)	3 m
Radio frequency electromagnetic field immunity test (80 MHz to 1,000 MHz)	3 m
Radio frequency electromagnetic field immunity test (1,000 MHz to 6,000 MHz)	1m

## 5. Test of Conducted Emission

### 5.1. Limit

5.1.1. Limit for AC power ports :

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	79	66
0.5~30	73	60

5.1.2. Limit for Telecommunication ports :

Frequency (MHz)	Voltage Limit (dBuV)		Current Limit (dBuA)	
	QP	AV	QP	AV
0.15~0.5	97~87	84~74	53~43	40~30
0.5~30	87	74	43	30

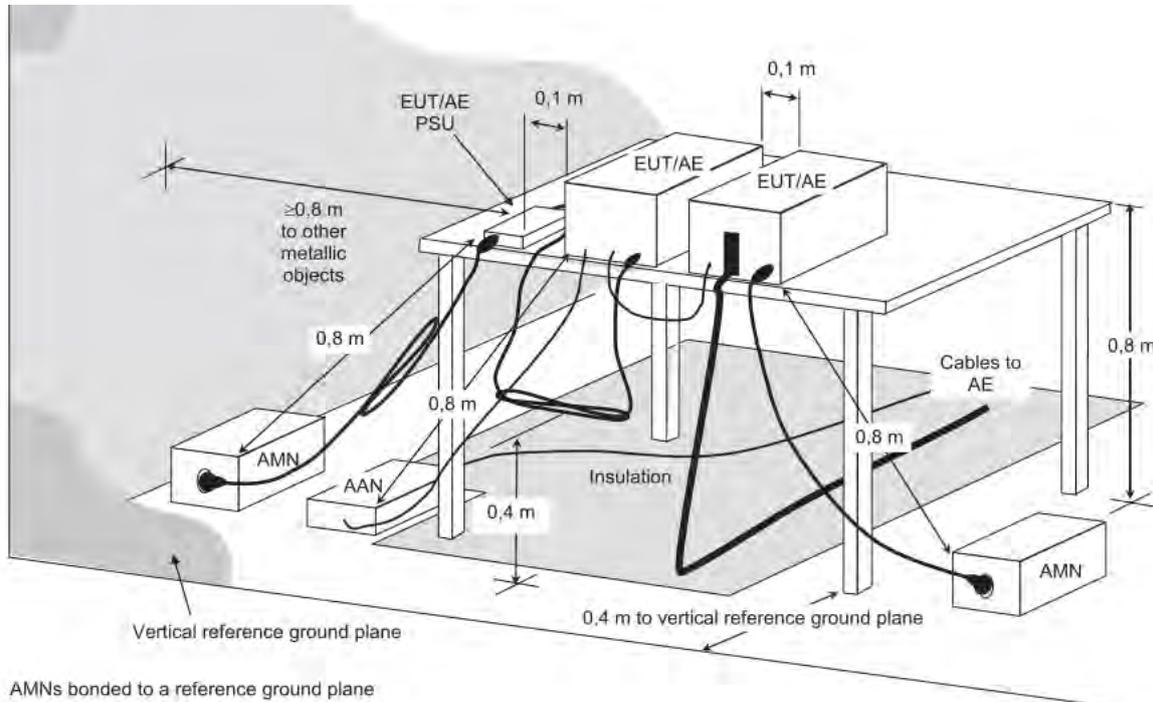
### 5.2. Description of Major Test Instruments

Test Receiver	Setting
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

### 5.3. Test Procedures

- a. The EUT was placed on a desk 0.8 meters 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 meters from any other grounded conducting surface.
- b. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- c. Connect Telecommunication port to ISN (Impedance Stabilization Network).
- d. All the support units are connect to the other LISN.
- e. The LISN provides 50  $\Omega$  coupling impedance for the measuring instrument.
- f. The CISPR states that a 50  $\Omega$ , 50  $\mu$ H LISN should be used.
- g. Both sides of AC line were checked for maximum conducted interference.
- h. The frequency range from 150 kHz to 30 MHz was searched.
- i. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

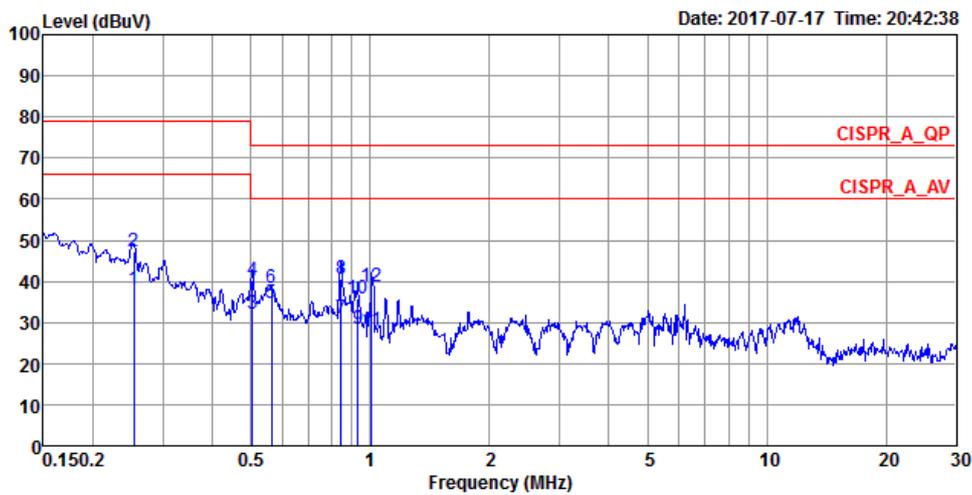
**5.4. Typical Test Setup Layout of Conducted Emission and disturbances at telecommunication ports**



**5.5. Test Result of AC Power Ports**

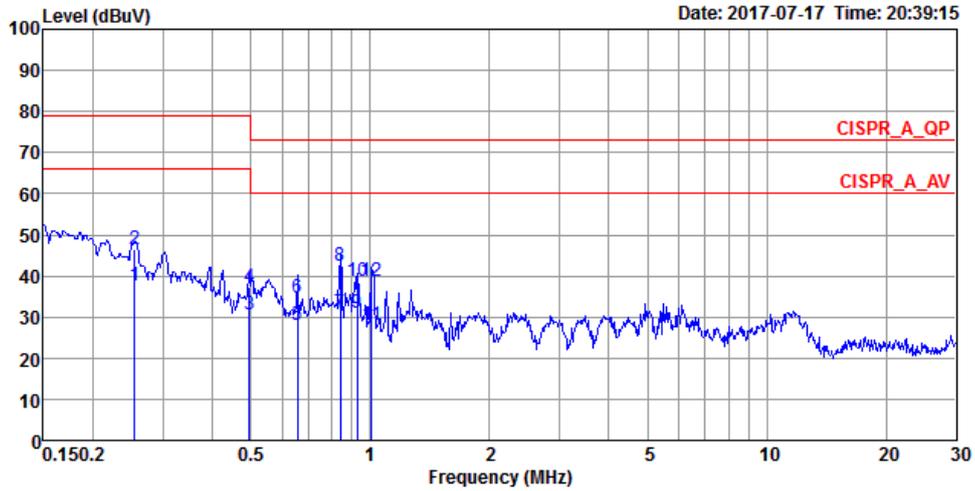
<b>Temperature</b>	25°C	<b>Humidity</b>	60%
<b>Test Engineer</b>	Rick Yeh	<b>Frequency Range</b>	0.15 MHz to 30 MHz
<b>Test Mode</b>	Mode 1		
<ul style="list-style-type: none"> <li>▪ Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level</li> <li>▪ Margin = - Limit + (Read Level + LISN Factor + Cable Loss)</li> <li>▪ All emissions not reported here are more than 10 dB below the prescribed limit.</li> <li>▪ The test was passed at the minimum margin that marked by a frame in the following table</li> </ul>			

**Line**



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2535	38.07	-27.93	66.00	28.06	9.92	0.09	Average	LINE
2	0.2535	47.31	-31.69	79.00	37.30	9.92	0.09	QP	LINE
3	0.5047	32.10	-27.90	60.00	22.10	9.95	0.05	Average	LINE
4	0.5047	40.32	-32.68	73.00	30.32	9.95	0.05	QP	LINE
5	0.5641	34.50	-25.50	60.00	24.47	9.95	0.08	Average	LINE
6	0.5641	38.47	-34.53	73.00	28.44	9.95	0.08	QP	LINE
7	0.8438	31.00	-29.00	60.00	20.88	9.96	0.16	Average	LINE
8	0.8438	40.76	-32.24	73.00	30.64	9.96	0.16	QP	LINE
9	0.9331	28.32	-31.68	60.00	18.18	9.96	0.18	Average	LINE
10	0.9331	35.61	-37.39	73.00	25.47	9.96	0.18	QP	LINE
11	1.0103	27.94	-32.06	60.00	17.79	9.96	0.19	Average	LINE
12	1.0103	38.65	-34.35	73.00	28.50	9.96	0.19	QP	LINE

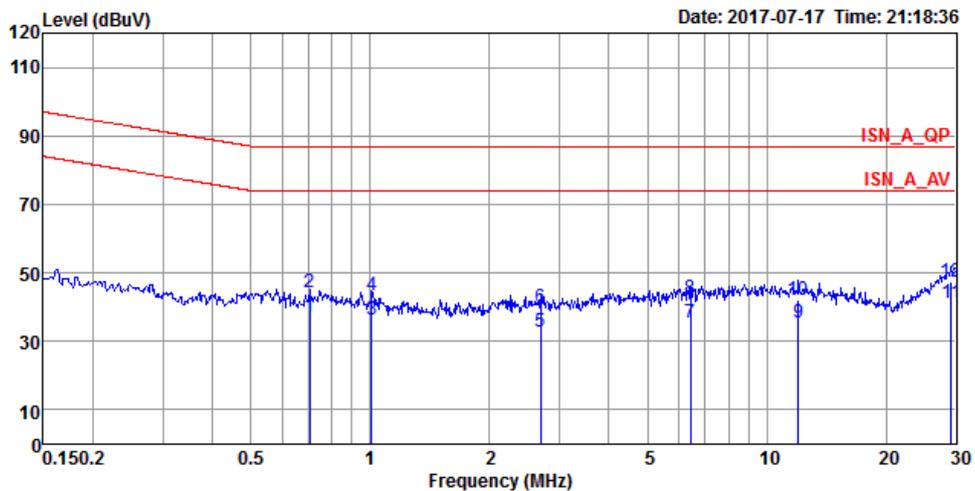
**Neutral**



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2548	37.77	-28.23	66.00	27.60	10.08	0.09	Average	NEUTRAL
2	0.2548	46.48	-32.52	79.00	36.31	10.08	0.09	QP	NEUTRAL
3	0.4967	30.65	-35.35	66.00	20.37	10.23	0.05	Average	NEUTRAL
4	0.4967	37.40	-41.60	79.00	27.12	10.23	0.05	QP	NEUTRAL
5	0.6543	27.94	-32.06	60.00	17.66	10.17	0.11	Average	NEUTRAL
6	0.6543	34.64	-38.36	73.00	24.36	10.17	0.11	QP	NEUTRAL
7	0.8421	30.85	-29.15	60.00	20.59	10.10	0.16	Average	NEUTRAL
8	0.8421	42.46	-30.54	73.00	32.20	10.10	0.16	QP	NEUTRAL
9	0.9282	30.83	-29.17	60.00	20.58	10.07	0.18	Average	NEUTRAL
10	0.9282	38.76	-34.24	73.00	28.51	10.07	0.18	QP	NEUTRAL
11	1.0103	28.06	-31.94	60.00	17.82	10.05	0.19	Average	NEUTRAL
12	1.0103	38.73	-34.27	73.00	28.49	10.05	0.19	QP	NEUTRAL

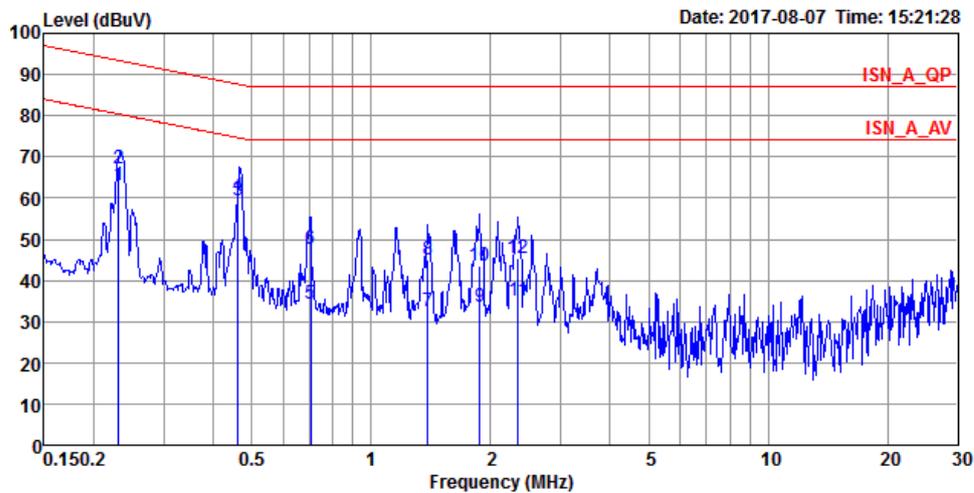
**5.6. Test Result of Telecommunication Ports**

<b>Temperature</b>	25°C	<b>Humidity</b>	60%
<b>Test Engineer</b>	Rick Yeh	<b>Frequency Range</b>	0.15 MHz to 30 MHz
<b>Test Mode</b>	Mode 2 - EUT with PoE + EUT LAN 1000 Mbps		
<ul style="list-style-type: none"> <li>▪ Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level</li> <li>▪ Margin = - Limit + (Read Level + LISN Factor + Cable Loss)</li> <li>▪ All emissions not reported here are more than 10 dB below the prescribed limit.</li> <li>▪ The test was passed at the minimum margin that marked by a frame in the following table</li> </ul>			



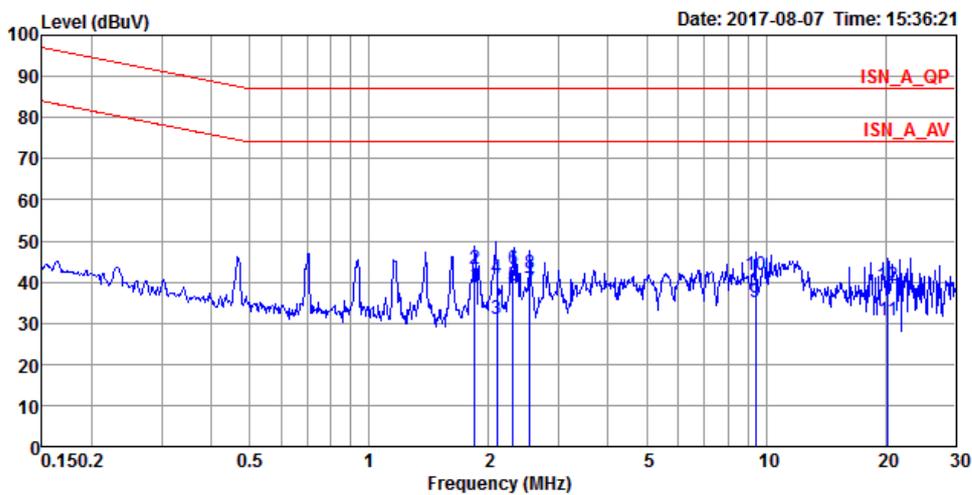
	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.7047	37.27	-36.73	74.00	27.52	9.63	0.12	Average	
2	0.7047	44.37	-42.63	87.00	34.62	9.63	0.12	QP	
3	1.0103	36.49	-37.51	74.00	26.71	9.59	0.19	Average	
4	1.0103	43.40	-43.60	87.00	33.62	9.59	0.19	QP	
5	2.6925	32.75	-41.25	74.00	23.08	9.51	0.16	Average	
6	2.6925	39.71	-47.29	87.00	30.04	9.51	0.16	QP	
7	6.4198	35.36	-38.64	74.00	25.75	9.48	0.13	Average	
8	6.4198	42.35	-44.65	87.00	32.74	9.48	0.13	QP	
9	11.9962	35.51	-38.49	74.00	25.81	9.53	0.17	Average	
10	11.9962	42.20	-44.80	87.00	32.50	9.53	0.17	QP	
11	29.2157	41.00	-33.00	74.00	30.65	10.07	0.28	Average	
12	29.2157	47.47	-39.53	87.00	37.12	10.07	0.28	QP	

<b>Temperature</b>	25°C	<b>Humidity</b>	60%
<b>Test Engineer</b>	Rick Yeh	<b>Frequency Range</b>	0.15 MHz to 30 MHz
<b>Test Mode</b>	Mode 3 - EUT with PoE + PoE data + power 1000 Mbps		
<ul style="list-style-type: none"> <li>▪ Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level</li> <li>▪ Margin = - Limit + (Read Level + LISN Factor + Cable Loss)</li> <li>▪ All emissions not reported here are more than 10 dB below the prescribed limit.</li> <li>▪ The test was passed at the minimum margin that marked by a frame in the following table</li> </ul>			



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2311	63.10	-17.31	80.41	52.99	10.06	0.05	Average	
2	0.2311	67.32	-26.09	93.41	57.21	10.06	0.05	QP	
3	0.4609	59.55	-15.13	74.68	49.64	9.87	0.04	Average	
4	0.4609	60.50	-27.18	87.68	50.59	9.87	0.04	QP	
5	0.7047	34.18	-39.82	74.00	24.33	9.80	0.05	Average	
6	0.7047	47.56	-39.44	87.00	37.71	9.80	0.05	QP	
7	1.3884	32.63	-41.37	74.00	22.84	9.72	0.07	Average	
8	1.3884	45.19	-41.81	87.00	35.40	9.72	0.07	QP	
9	1.8779	33.59	-40.41	74.00	23.81	9.70	0.08	Average	
10	1.8779	43.50	-43.50	87.00	33.72	9.70	0.08	QP	
11	2.3460	35.00	-39.00	74.00	25.23	9.68	0.09	Average	
12	2.3460	45.31	-41.69	87.00	35.54	9.68	0.09	QP	

<b>Temperature</b>	25°C	<b>Humidity</b>	60%
<b>Test Engineer</b>	Rick Yeh	<b>Frequency Range</b>	0.15 MHz to 30 MHz
<b>Test Mode</b>	Mode 4 - EUT with PoE + PoE data 1000 Mbps		
<ul style="list-style-type: none"> <li>▪ Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level</li> <li>▪ Margin = - Limit + (Read Level + LISN Factor + Cable Loss)</li> <li>▪ All emissions not reported here are more than 10 dB below the prescribed limit.</li> <li>▪ The test was passed at the minimum margin that marked by a frame in the following table</li> </ul>			



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	1.8443	38.97	-35.03	74.00	29.20	9.69	0.08	Average	
2	1.8443	43.07	-43.93	87.00	33.30	9.69	0.08	QP	
3	2.1016	31.05	-42.95	74.00	21.27	9.70	0.08	Average	
4	2.1016	40.94	-46.06	87.00	31.16	9.70	0.08	QP	
5	2.3046	39.18	-34.82	74.00	29.38	9.71	0.09	Average	
6	2.3046	43.31	-43.69	87.00	33.51	9.71	0.09	QP	
7	2.5348	38.17	-35.83	74.00	28.36	9.72	0.09	Average	
8	2.5348	41.99	-45.01	87.00	32.18	9.72	0.09	QP	
9	9.4015	35.10	-38.90	74.00	25.07	9.85	0.18	Average	
10	9.4015	41.75	-45.25	87.00	31.72	9.85	0.18	QP	
11	20.2696	30.80	-43.20	74.00	20.54	10.01	0.25	Average	
12	20.2696	38.93	-48.07	87.00	28.67	10.01	0.25	QP	

## 6. Test of Radiated Emission

### 6.1. Limit

Radiated Emission below 1 GHz test at 10 m:

Frequency (MHz)	QP (dBuV/m)
30~230	40
230~1,000	47

Radiated Emission above 1 GHz test at 3 m:

Frequency (MHz)	PK (dBuV/m)	AV (dBuV/m)
1,000~3,000	76	56
3,000~6,000	80	60

### 6.2. Description of Major Test Instruments

#### 6.2.1. 30 MHz ~ 1,000 MHz

Amplifier	Setting
RF Gain	25 dB
Signal Input	9 kHz to 1.3 GHz

Spectrum Analyzer	Setting
Start Frequency	30 MHz
Stop Frequency	1000 MHz
Resolution Bandwidth	120 kHz
Signal Input	9 kHz to 30 GHz

Test Receiver	Setting
Start Frequency	30 MHz
Stop Frequency	1000 MHz
Resolution Bandwidth	120 kHz
Signal Input	9 kHz to 3 GHz

#### 6.2.2. Above 1 GHz

Amplifier	Setting
RF Gain	35 dB
Signal Input	1 GHz to 26.5 GHz

Spectrum Analyzer	Setting
Start Frequency	1 GHz
Stop Frequency	6 GHz
Resolution Bandwidth	1 MHz
Signal Input	9 kHz to 30 GHz

### 6.3. Test Procedures

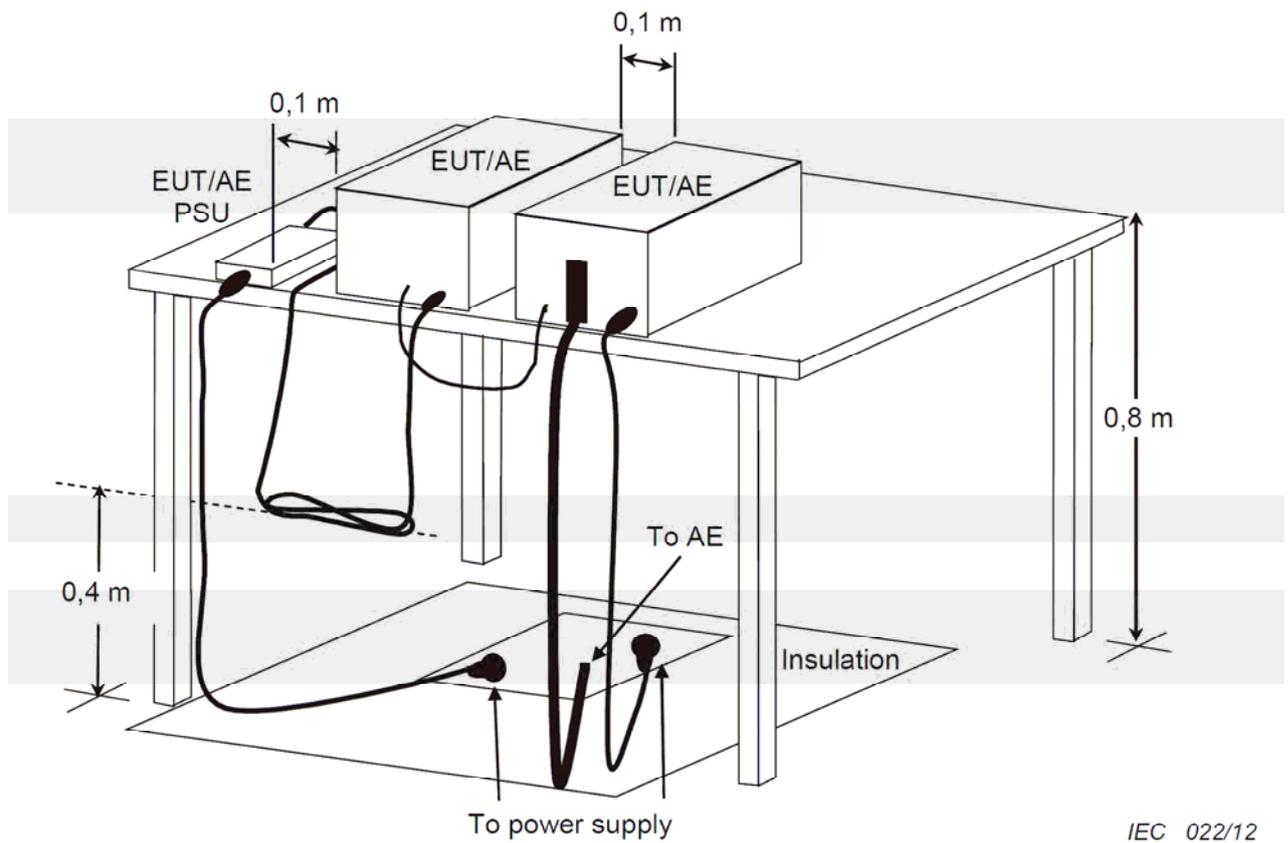
#### <Below 1 GHz>:

- 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.

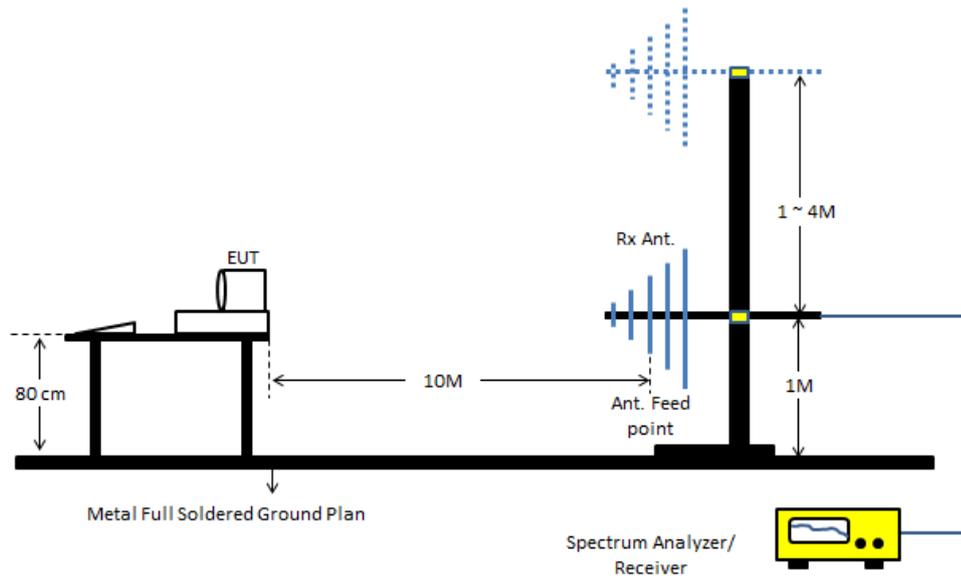
#### <Above 1 GHz>:

- a. Same test set up as below 1 GHz 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 172 cm (Antenna's 3dB beam width of 6 GHz is  $27^\circ$  ), 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 20 dB 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.

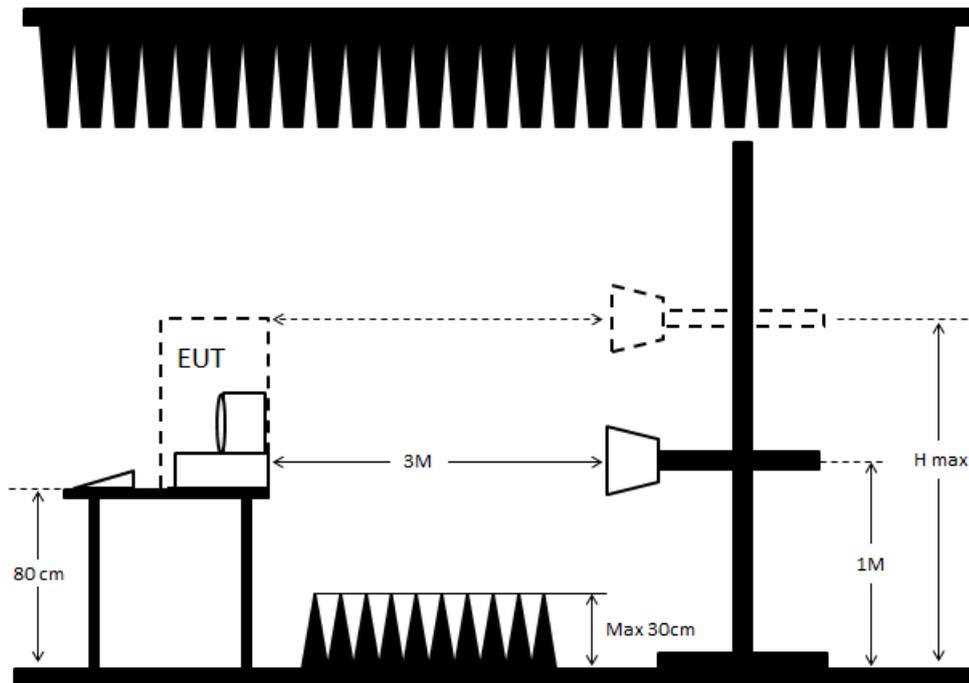
### 6.4. Typical Test Setup Layout of Radiated Emission



**<Below 1 GHz>**



**<Above 1 GHz>**

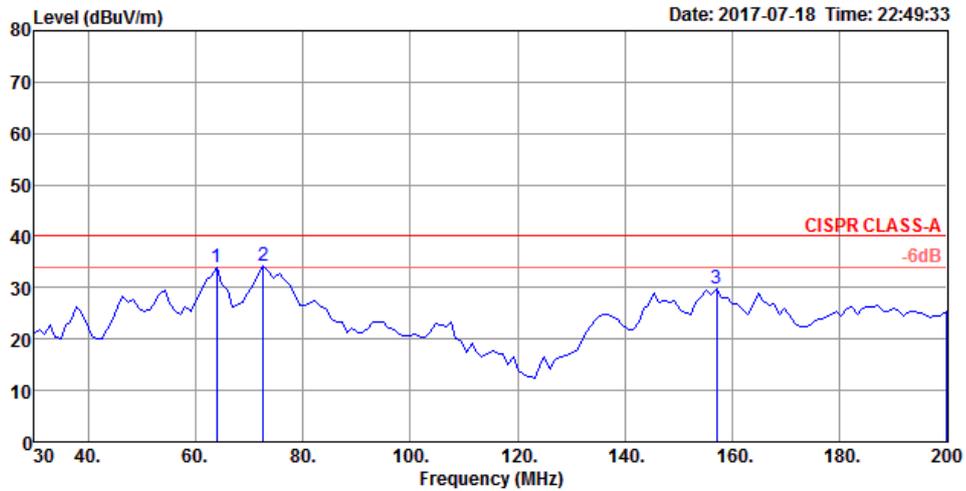


Remark : When EUT height is over 172cm , H max = Top of EUT

**6.5. Test Result of Radiated Emission below 1 GHz**

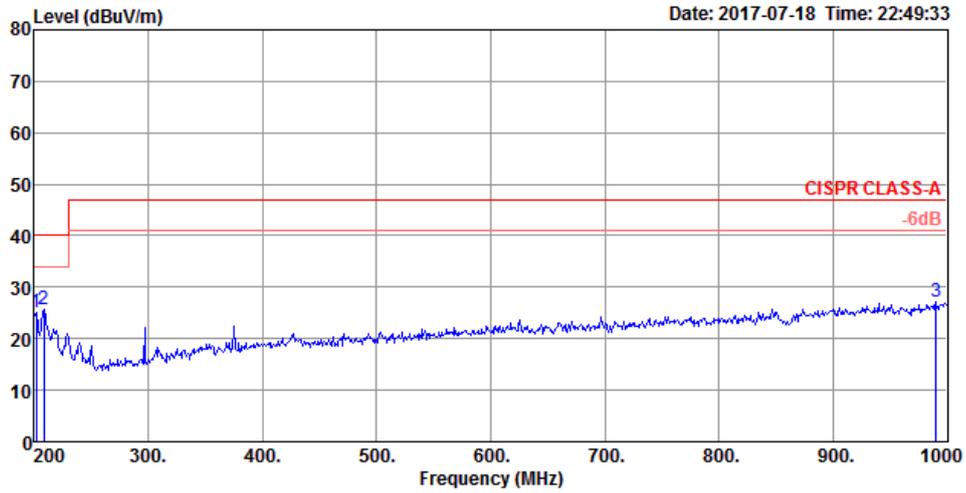
<b>Temperature</b>	21°C	<b>Humidity</b>	62%
<b>Test Engineer</b>	GN Hou	<b>Frequency Range</b>	30 MHz to 1,000 MHz
<b>Test Mode</b>	Mode 3		
<ul style="list-style-type: none"> <li>▪ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level</li> <li>▪ Margin = - Limit + (Read Level + Antenna Factor + Cable Loss - Preamp Factor)</li> <li>▪ The test was passed at the minimum margin that marked by the frame in the following test record</li> </ul>			

**Vertical 30 MHz to 200 MHz**



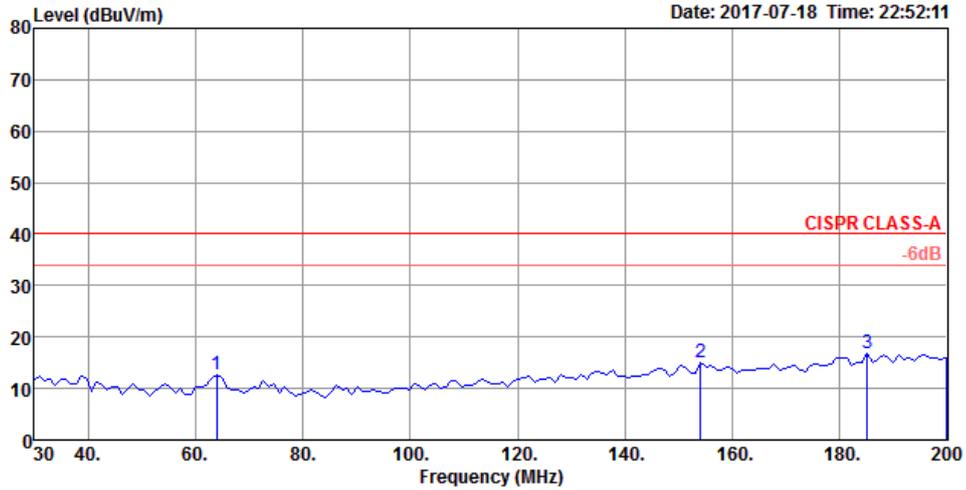
	Freq	Level	Limit	Over	Read	Preamp	Antenna	Cable	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	63.95	33.88	40.00	-6.12	50.62	28.55	9.42	2.39	Peak	200	284	VERTICAL
2	72.68	34.17	40.00	-5.83	50.92	28.52	9.22	2.55	Peak	200	148	VERTICAL
3	157.07	29.87	40.00	-10.13	42.33	28.16	11.97	3.73	Peak	100	357	VERTICAL

**Vertical 200 MHz to 1,000 MHz**



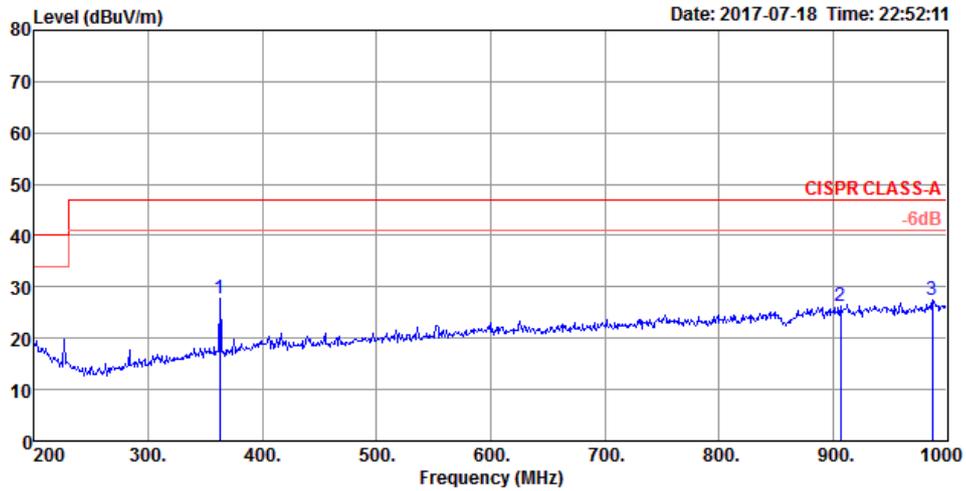
	Freq	Level	Limit Line	Over Limit	Read Level	Preamp Factor	Antenna Factor	Cable Loss	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	201.69	25.23	40.00	-14.77	32.73	27.66	16.63	3.53	Peak	100	53	VERTICAL
2	208.48	25.70	40.00	-14.30	33.88	27.64	15.88	3.58	Peak	200	32	VERTICAL
3	990.30	27.22	47.00	-19.78	24.90	27.45	22.55	7.22	Peak	200	305	VERTICAL

**Horizontal 30 MHz to 200 MHz**



	Freq	Level	Limit	Over	Read	Preamp	Antenna	Cable	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	63.95	12.84	40.00	-27.16	29.58	28.55	9.42	2.39	Peak	200	268	HORIZONTAL
2	154.16	14.94	40.00	-25.06	27.46	28.17	11.94	3.71	Peak	200	32	HORIZONTAL
3	185.20	16.84	40.00	-23.16	27.04	28.03	13.64	4.19	Peak	100	6	HORIZONTAL

**Horizontal 200 MHz to 1,000 MHz**

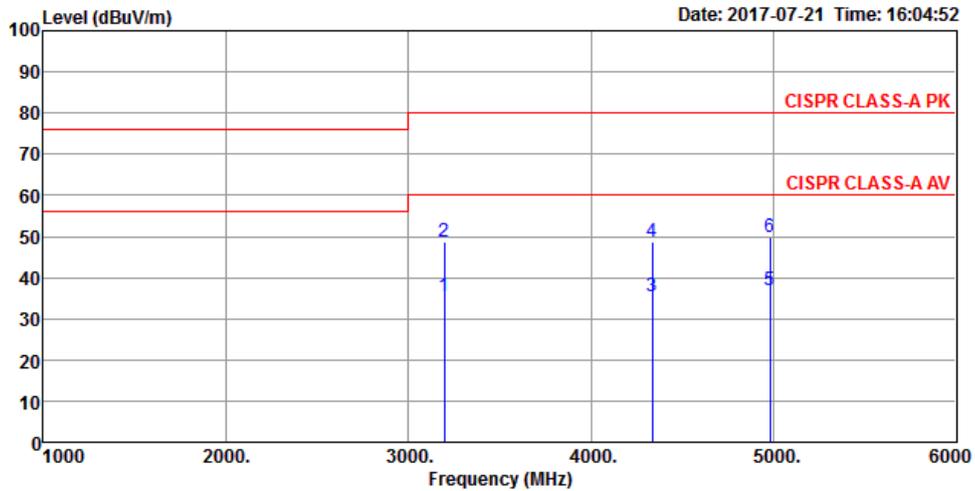


	Freq	Level	Limit	Over	Read	Preamp	Antenna	Cable	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	362.71	27.64	47.00	-19.36	35.08	27.86	15.72	4.70	Peak	200	318	HORIZONTAL
2	906.88	26.25	47.00	-20.75	25.30	27.77	21.64	7.08	Peak	200	179	HORIZONTAL
3	987.39	27.48	47.00	-19.52	25.22	27.45	22.49	7.22	Peak	200	104	HORIZONTAL

**6.6. Test Result of Radiated Emission above 1 GHz**

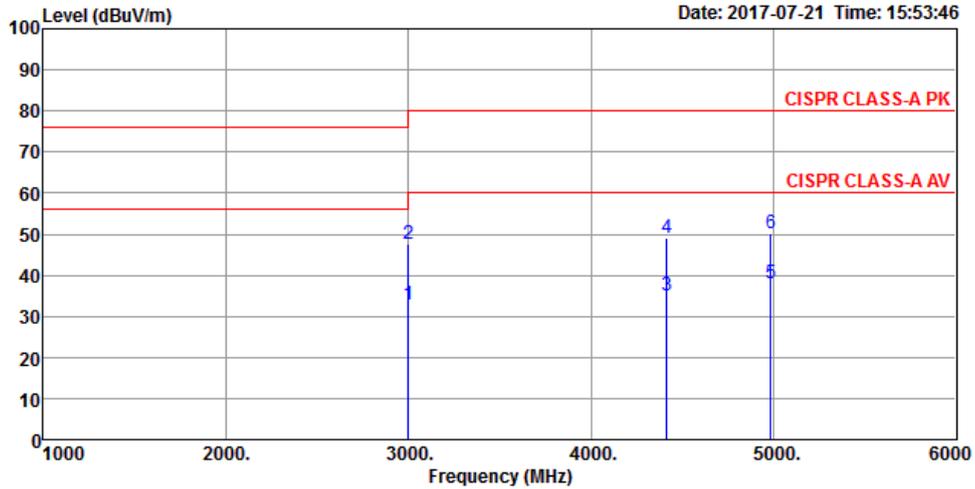
<b>Temperature</b>	21°C	<b>Humidity</b>	62%
<b>Test Engineer</b>	GN Hou	<b>Frequency Range</b>	1,000 MHz to 6,000 MHz
<b>Test Mode</b>	Mode 3		
<ul style="list-style-type: none"> <li>Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level</li> <li>Margin = - Limit + (Read Level + Antenna Factor + Cable Loss - Preamp Factor)</li> <li>The test was passed at the minimum margin that marked by the frame in the following test record</li> </ul>			

**Vertical 1,000 MHz to 6,000 MHz**



	Freq	Level	Limit Line	Over Limit	Read Level	Preamp Factor	Antenna Factor	Cable Loss	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	3195.00	35.36	60.00	-24.64	28.14	36.20	33.02	10.40	Average	100	17	VERTICAL
2	3195.00	48.61	80.00	-31.39	41.39	36.20	33.02	10.40	Peak	100	17	VERTICAL
3	4335.00	35.38	60.00	-24.62	26.18	36.19	33.83	11.56	Average	100	358	VERTICAL
4	4335.00	48.67	80.00	-31.33	39.47	36.19	33.83	11.56	Peak	100	358	VERTICAL
5	4980.00	36.84	60.00	-23.16	26.33	36.12	34.29	12.34	Average	100	12	VERTICAL
6	4980.00	49.74	80.00	-30.26	39.23	36.12	34.29	12.34	Peak	100	12	VERTICAL

**Horizontal 1,000 MHz to 6,000 MHz**



	Freq	Level	Limit Line	Over Limit	Read Level	Preamp Factor	Antenna Factor	Cable Loss	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	3000.00	32.73	56.00	-23.27	25.80	36.22	33.10	10.05	Average	100	190	HORIZONTAL
2	3000.00	47.74	76.00	-28.26	40.81	36.22	33.10	10.05	Peak	100	190	HORIZONTAL
3	4415.00	35.07	60.00	-24.93	25.76	36.20	33.92	11.59	Average	100	344	HORIZONTAL
4	4415.00	49.08	80.00	-30.92	39.77	36.20	33.92	11.59	Peak	100	344	HORIZONTAL
5	4985.00	38.04	60.00	-21.96	27.53	36.12	34.29	12.34	Average	100	341	HORIZONTAL
6	4985.00	50.05	80.00	-29.95	39.54	36.12	34.29	12.34	Peak	100	341	HORIZONTAL

## 7. Harmonics Test

### 7.1. Standard

- EN 61000-3-2:2014

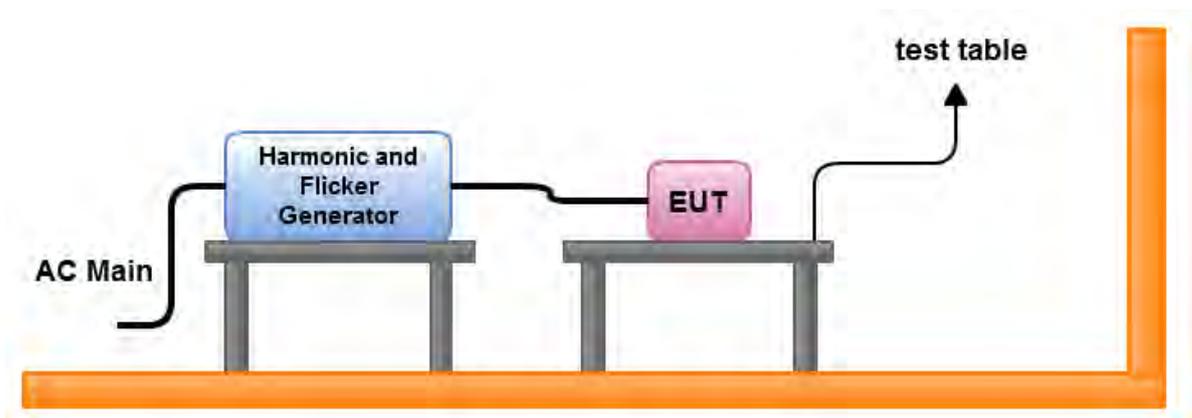
### 7.2. Test Procedure

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.

### 7.3. Test Equipment Settings

Line Voltage	230 V
Line Frequency	50 Hz
Device Class	A

### 7.4. Test Setup



**7.5. Test Result of Current Harmonics Test**

<b>Temperature</b>	22°C	<b>Humidity</b>	56%
<b>Test Engineer</b>	Tony Chen/Deven Huang	<b>Test Date</b>	Jul. 13, 2017
<b>Test Mode</b>	Mode 1		
<b>Highest parameter values during test:</b>			
V_RMS (Volts):	230.36	Frequency(Hz):	50.00
I_Peak (Amps):	0.246	I_RMS (Amps):	0.034
I_Fund (Amps):	0.013	Crest Factor:	7.377
Power (Watts):	2.2	Power Factor:	0.294
<i>Note: The power consumption of EUT is lower than 75W, so the limit is not specified in</i>			
<u>EN 61000-3-2:2014.</u>			

<b>Temperature</b>	22°C	<b>Humidity</b>	56%
<b>Test Engineer</b>	Tony Chen/Deven Huang	<b>Test Date</b>	Jul. 13, 2017
<b>Test Mode</b>	Mode 2		
<b>Highest parameter values during test:</b>			
V_RMS (Volts):	230.36	Frequency(Hz):	50.00
I_Peak (Amps):	0.274	I_RMS (Amps):	0.037
I_Fund (Amps):	0.014	Crest Factor:	7.879
Power (Watts):	2.5	Power Factor:	0.301
<i>Note: The power consumption of EUT is lower than 75W, so the limit is not specified in</i>			
<u>EN 61000-3-2:2014.</u>			

## 8. Voltage Fluctuations and Flicker Test

### 8.1. Standard

- EN 61000-3-3:2013

### 8.2. Test Procedure

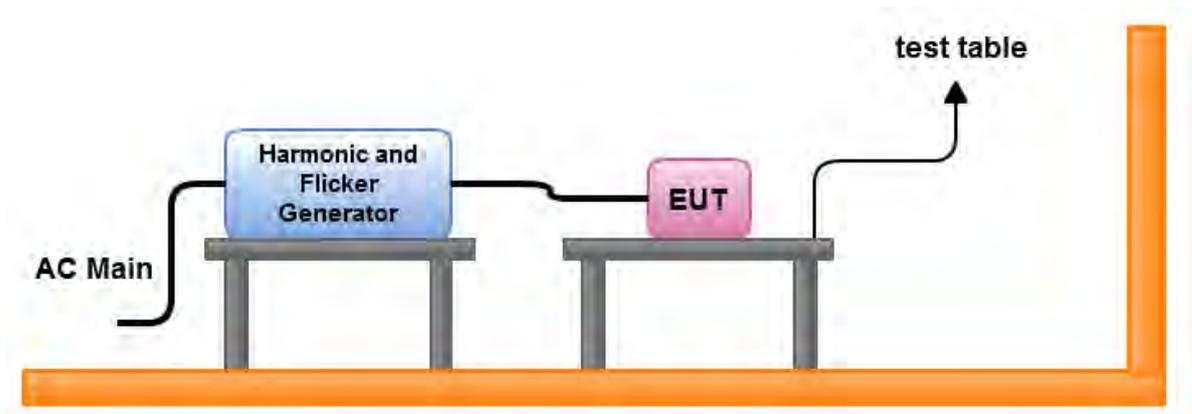
The equipment shall be tested under the conditions of **Clause 5**.

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  $\pm 8\%$  is achieved during the whole assessment procedure.

### 8.3. Test Equipment Settings

Line Voltage	230 V
Line Frequency	50 Hz

### 8.4. Test Setup



**8.5. Test Result of Voltage Fluctuation and Flicker Test**

<b>Temperature</b>	22°C	<b>Humidity</b>	56%
<b>Test Engineer</b>	Tony Chen/Deven Huang	<b>Test Date</b>	Jul. 13, 2017
<b>Test Mode</b>	Mode 1	<b>Final Test Result</b>	Pass
<b>Vrms at the end of test (Volt):</b> 229.99 <b>Highest dt (%):</b> 0.00 <b>Test limit (%):</b> 3.30 <b>Pass</b> <b>T-max (mS):</b> 0 <b>Test limit (mS):</b> 500.0 <b>Pass</b> <b>Highest dc (%):</b> 0.00 <b>Test limit (%):</b> 3.30 <b>Pass</b> <b>Highest dmax (%):</b> 0.03 <b>Test limit (%):</b> 4.00 <b>Pass</b> <b>Highest Pst (10 min. period):</b> 0.213 <b>Test limit:</b> 1.000 <b>Pass</b>			

<b>Temperature</b>	22°C	<b>Humidity</b>	56%
<b>Test Engineer</b>	Tony Chen/Deven Huang	<b>Test Date</b>	Jul. 13, 2017
<b>Test Mode</b>	Mode 2	<b>Final Test Result</b>	Pass
<b>Vrms at the end of test (Volt):</b> 230.32 <b>Highest dt (%):</b> 0.00 <b>Test limit (%):</b> 3.30 <b>Pass</b> <b>T-max (mS):</b> 0 <b>Test limit (mS):</b> 500.0 <b>Pass</b> <b>Highest dc (%):</b> 0.00 <b>Test limit (%):</b> 3.30 <b>Pass</b> <b>Highest dmax (%):</b> 0.03 <b>Test limit (%):</b> 4.00 <b>Pass</b> <b>Highest Pst (10 min. period):</b> 0.213 <b>Test limit:</b> 1.000 <b>Pass</b>			

**9. General Performance Criteria Description of Immunity Test**

The following describes the general performance criteria.

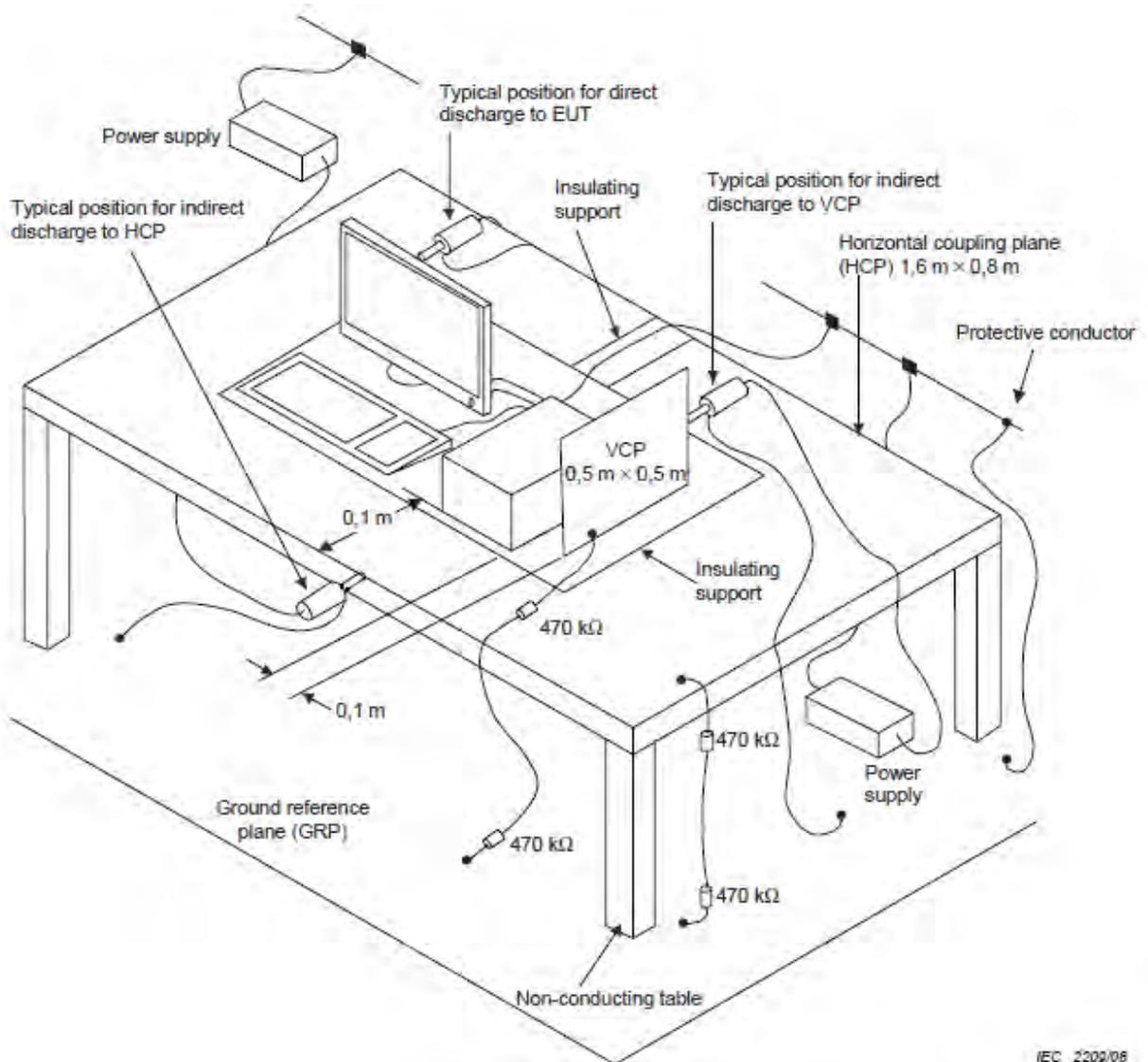
<p><b>CT / CR (Criterion A)</b></p>	<p><b>Performance criteria for continuous phenomena applied to transmitters and receivers</b></p> <p>During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.</p> <p>During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.</p>
<p><b>TT / TR (Criterion B)</b></p>	<p><b>Performance criteria for transient phenomena applied to transmitters and receivers</b></p> <p>After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended.</p> <p>In some cases this permissible performance level may be replaced by a permissible loss of performance.</p>
<p><b>TT / TR (Criterion C)</b></p>	<p><b>Only for voltage interruption</b></p> <p><b>Performance criteria for transient phenomena applied to transmitters and receivers</b></p> <p>In the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator</p>

## 10. Electrostatic Discharge Immunity Test (ESD)

### 10.1. Test Specification

<b>Reference Standard</b>	EN 61000-4-2
<b>Discharge Impedance</b>	330 ohm / 150 pF
<b>Contact Discharge</b>	±2, 4 kV
<b>Air Discharge</b>	±2, 4, 8 kV
<b>Rise Time</b>	0.8 ns +/-25 %
<b>Current at 30 ns</b>	+/- 30 %
<b>Current at 60 ns</b>	+/- 30 %
<b>Polarity</b>	Positive / Negative
<b>Number of Discharge</b>	Air Discharge 20 times at each test point
	Contact Discharge 20 times at each test point
<b>Single Discharge Mode</b>	1 discharge per 1s

## 10.2. Test Setup



IEC 2209/08

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 following 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.

### 10.3. 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 1m 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 0.2m 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 resistor located at each end, to prevent a build-up of charge. The test setup was consist a wooden table, 0.8m 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.

#### 10.4. 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. 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.
- e. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.
- f. 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.
- g. 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.

**10.5. Test Result**

<b>Temperature</b>	22°C	<b>Humidity</b>	53%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/Deven Huang
<b>Test Mode</b>	Mode 1	<b>Test Date</b>	Aug. 04, 2017
<b>Standard</b>	Required Criteria B		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

**Direct Application :**

Test Point	Tested Voltage (kV)	Contact Discharge (Performance Criteria)	Air Discharge (Performance Criteria)
1~3	± 2, 4, 8	-	A
4,5	± 2, 4	A	-
6~8	± 2, 4, 8	-	A

**Indirect Application :**

Coupling Plan	Coupling Side	Test Voltage (kV)	Performance Criteria
HCP	Front / Rear / Right / Left	± 2, 4	A
VCP	Front / Rear / Right / Left	± 2, 4	A

<b>Temperature</b>	22°C	<b>Humidity</b>	53%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/Deven Huang
<b>Test Mode</b>	Mode 2	<b>Test Date</b>	Aug. 04, 2017
<b>Standard</b>	Required Criteria B		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

**Direct Application :**

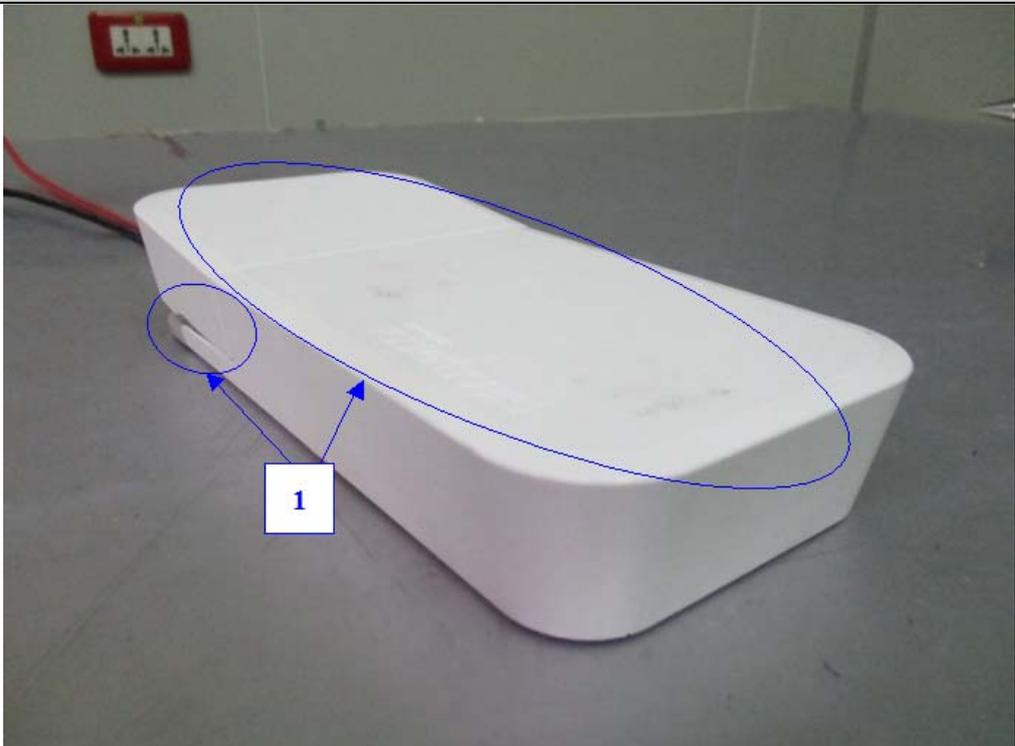
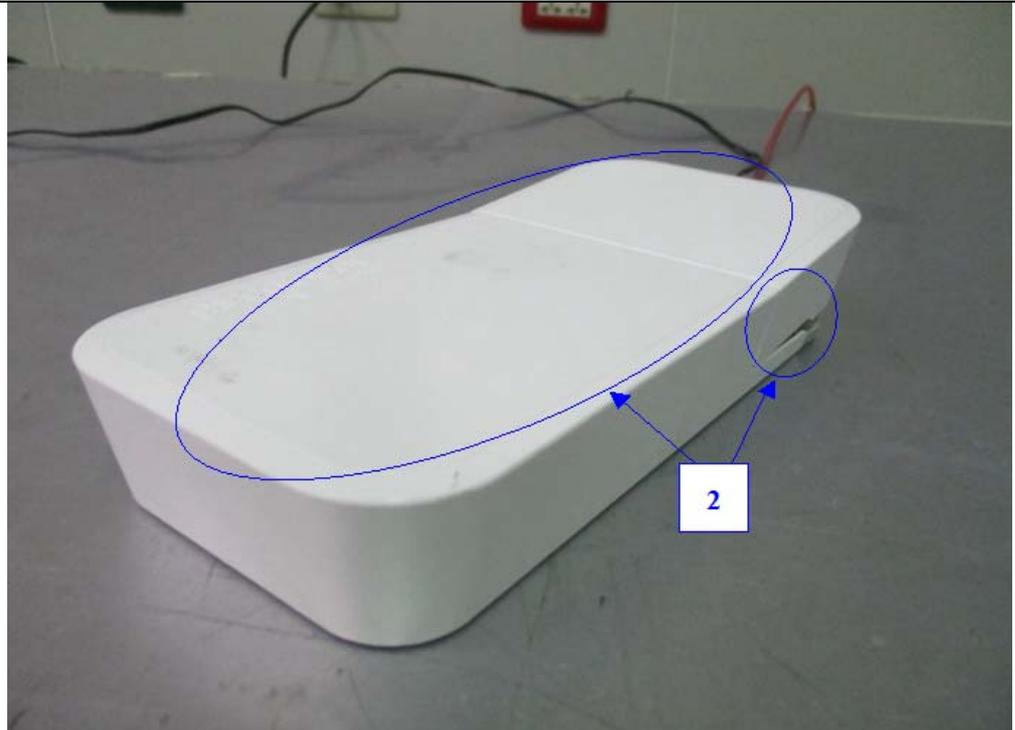
Test Point	Tested Voltage (kV)	Contact Discharge (Performance Criteria)	Air Discharge (Performance Criteria)
1~3	± 2, 4, 8	-	A
4,5	± 2, 4	A	-
6,7	± 2, 4, 8	-	A
8	± 2, 4	A	-

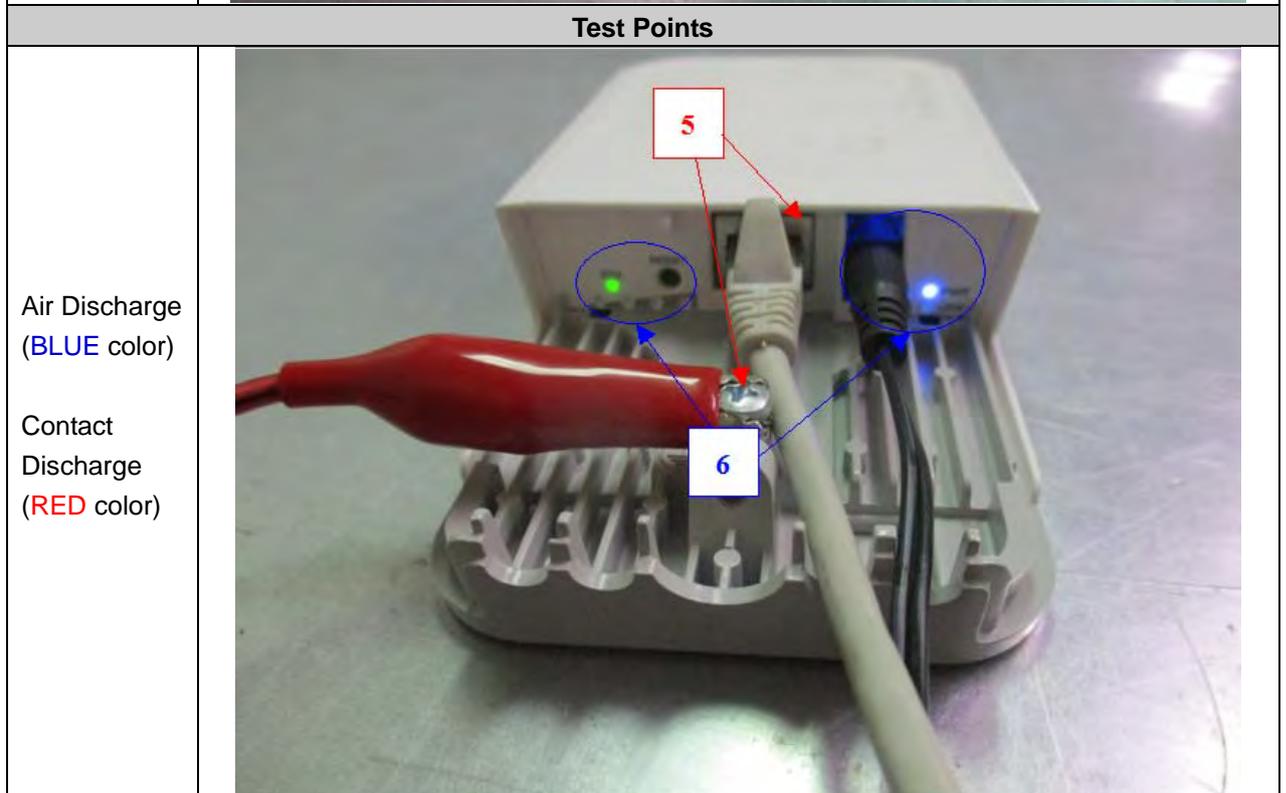
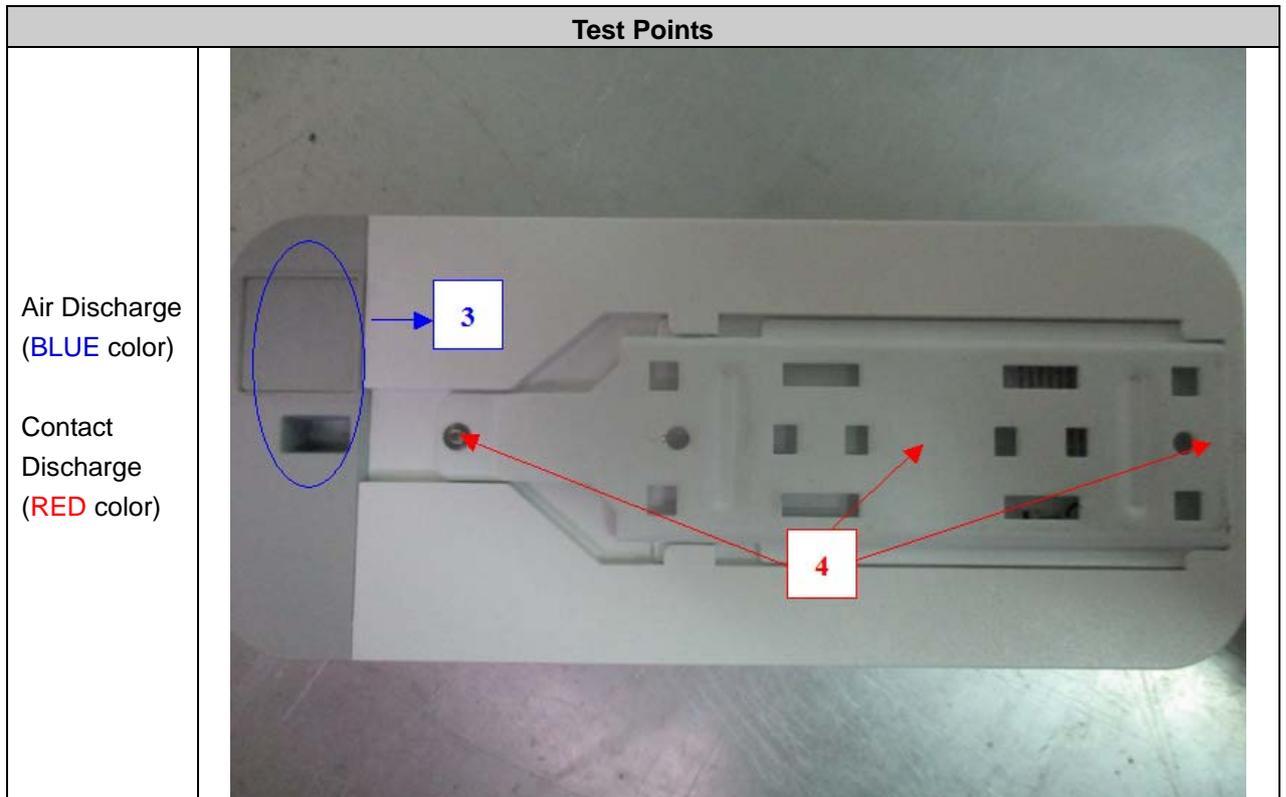
**Indirect Application :**

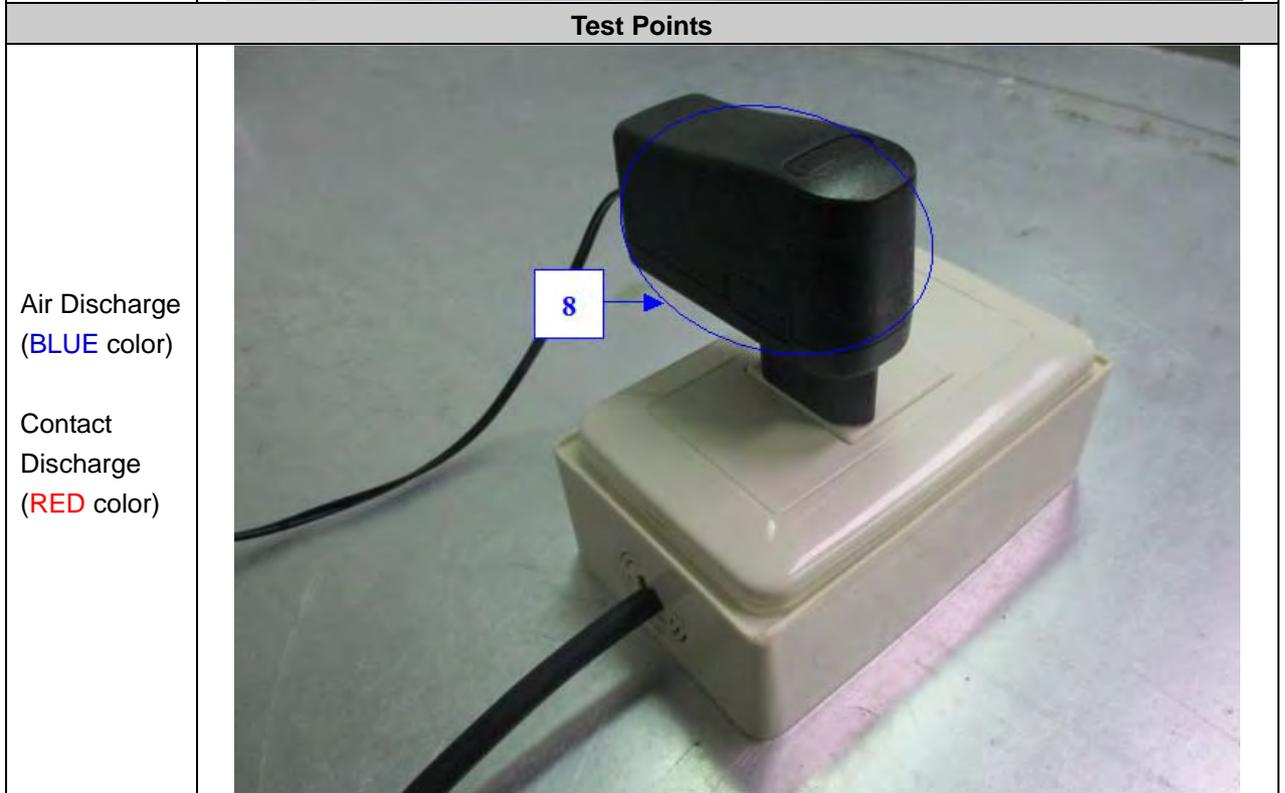
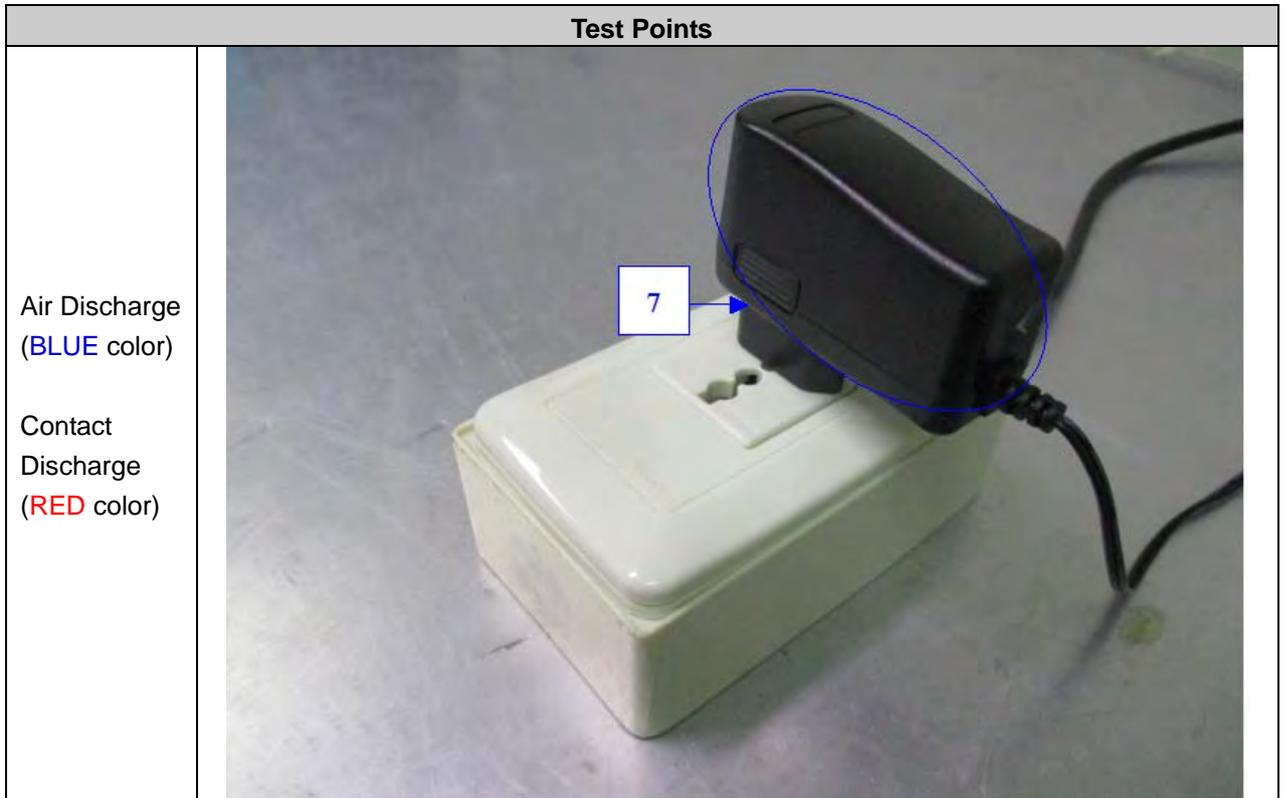
Coupling Plan	Coupling Side	Test Voltage (kV)	Performance Criteria
HCP	Front / Rear / Right / Left	± 2, 4	A
VCP	Front / Rear / Right / Left	± 2, 4	A

**10.6. Photographs of Electrostatic Discharge Immunity Test**

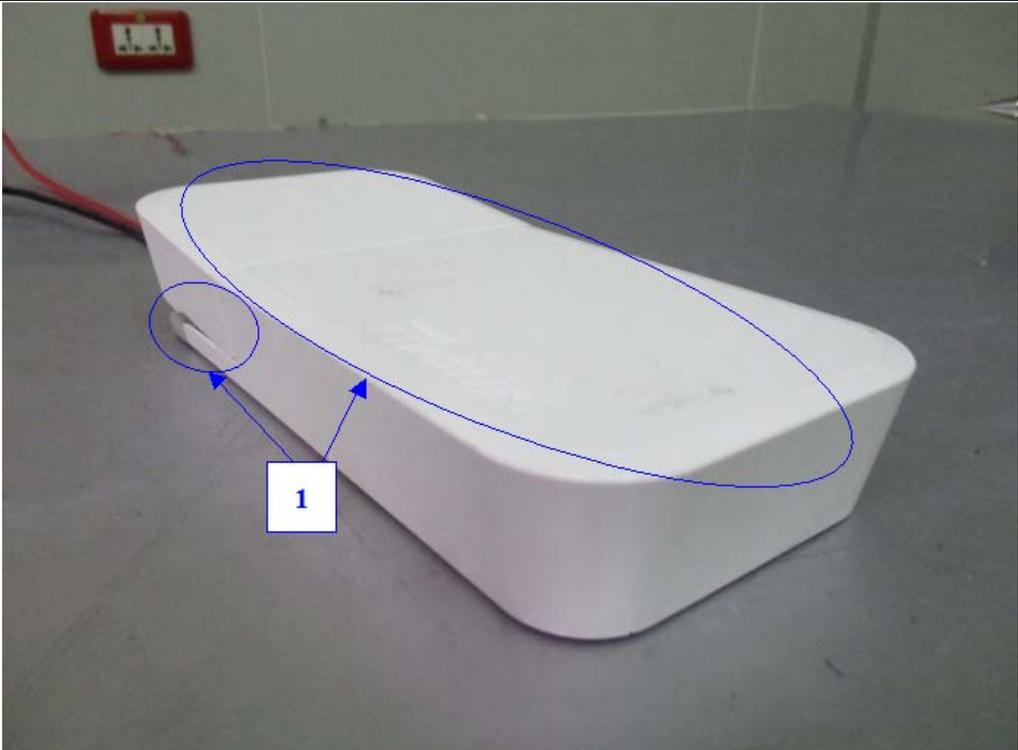
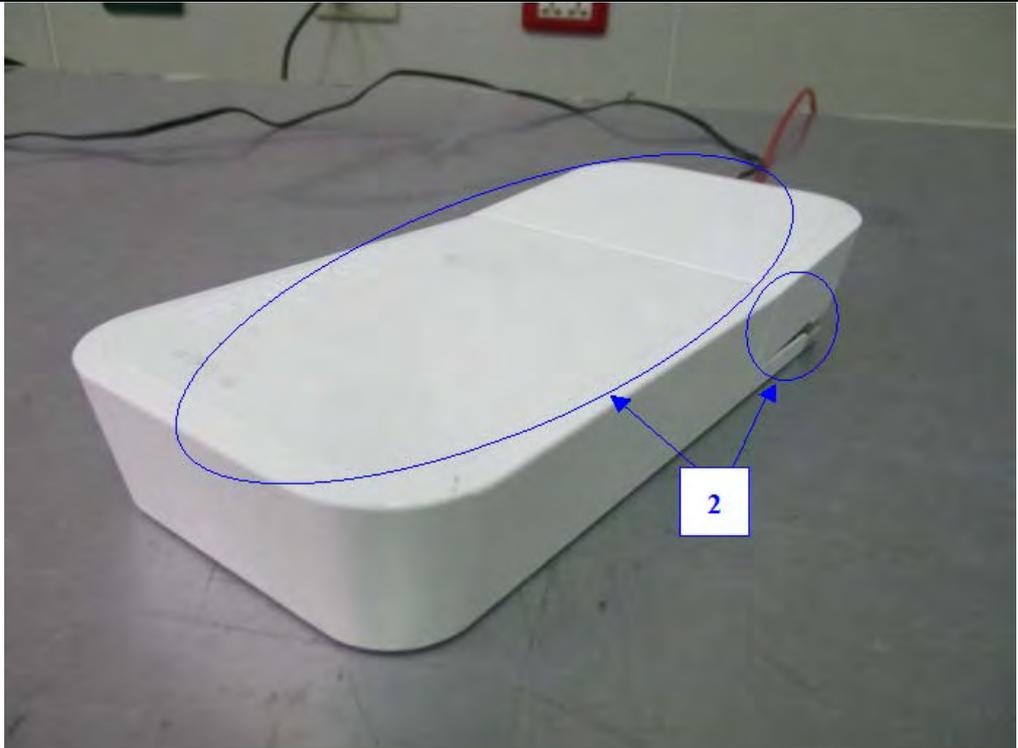
Test Mode: Mode 1

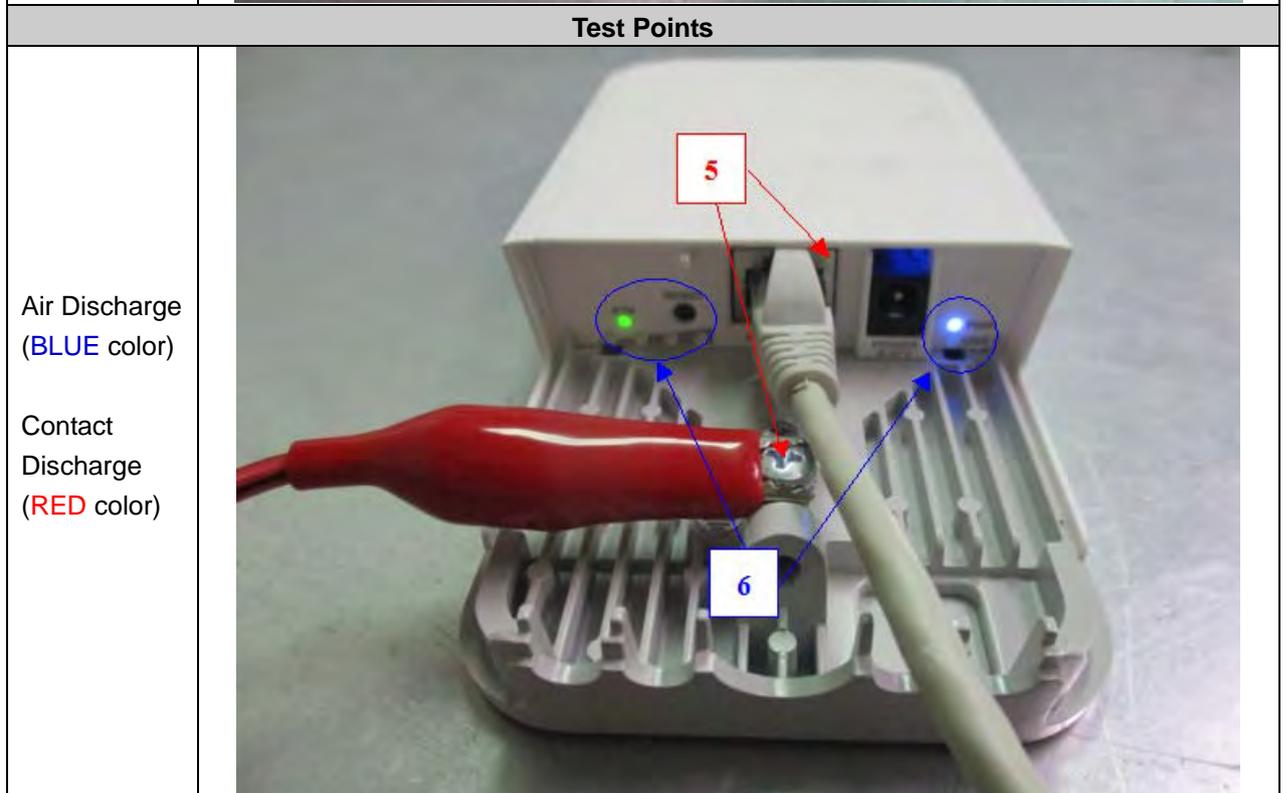
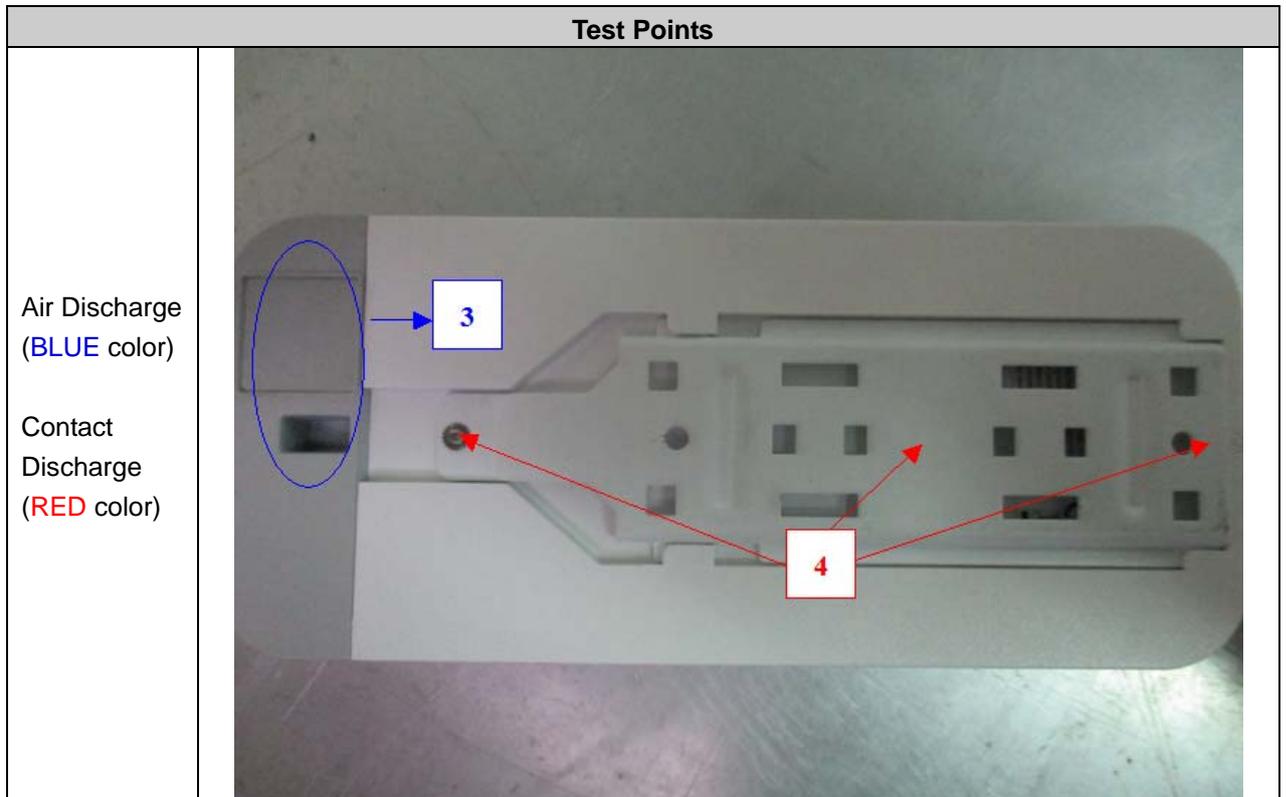
Test Points	
<p>Air Discharge (BLUE color)</p> <p>Contact Discharge (RED color)</p>	
Test Points	
<p>Air Discharge (BLUE color)</p> <p>Contact Discharge (RED color)</p>	

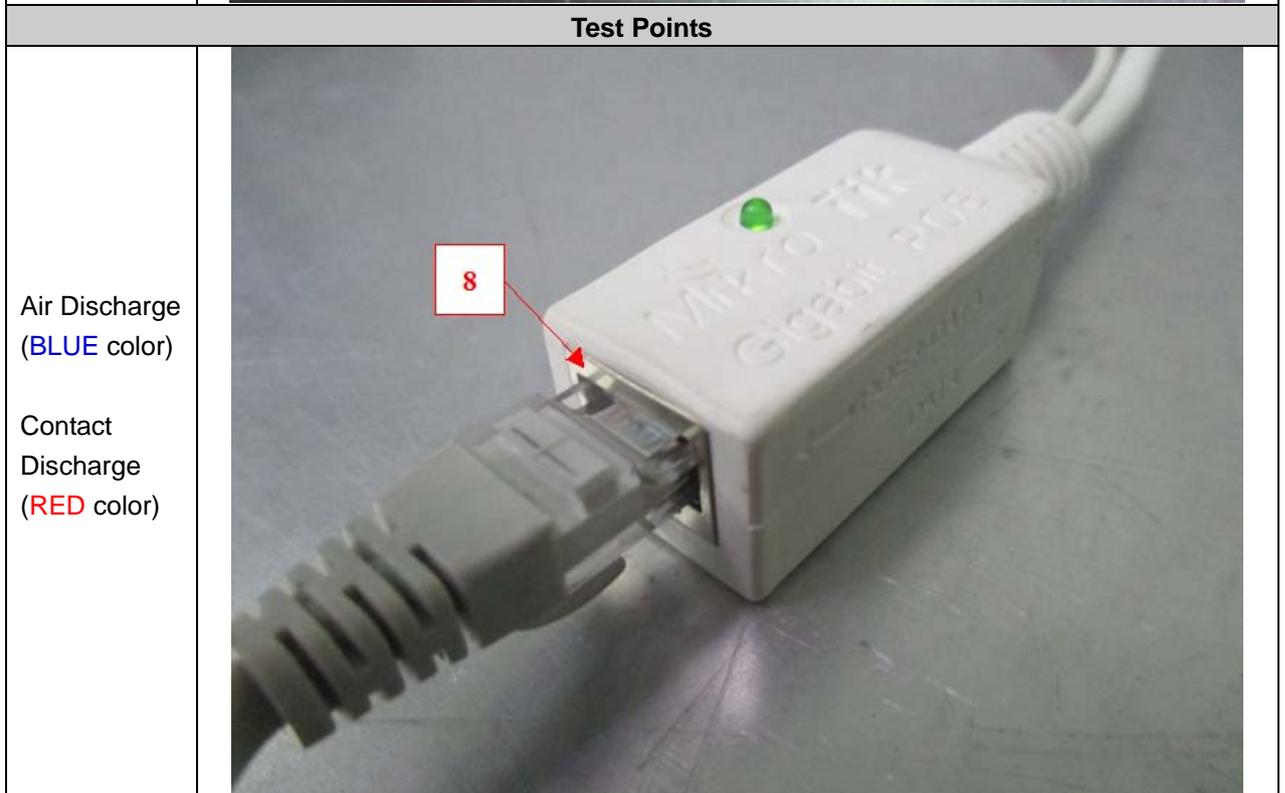
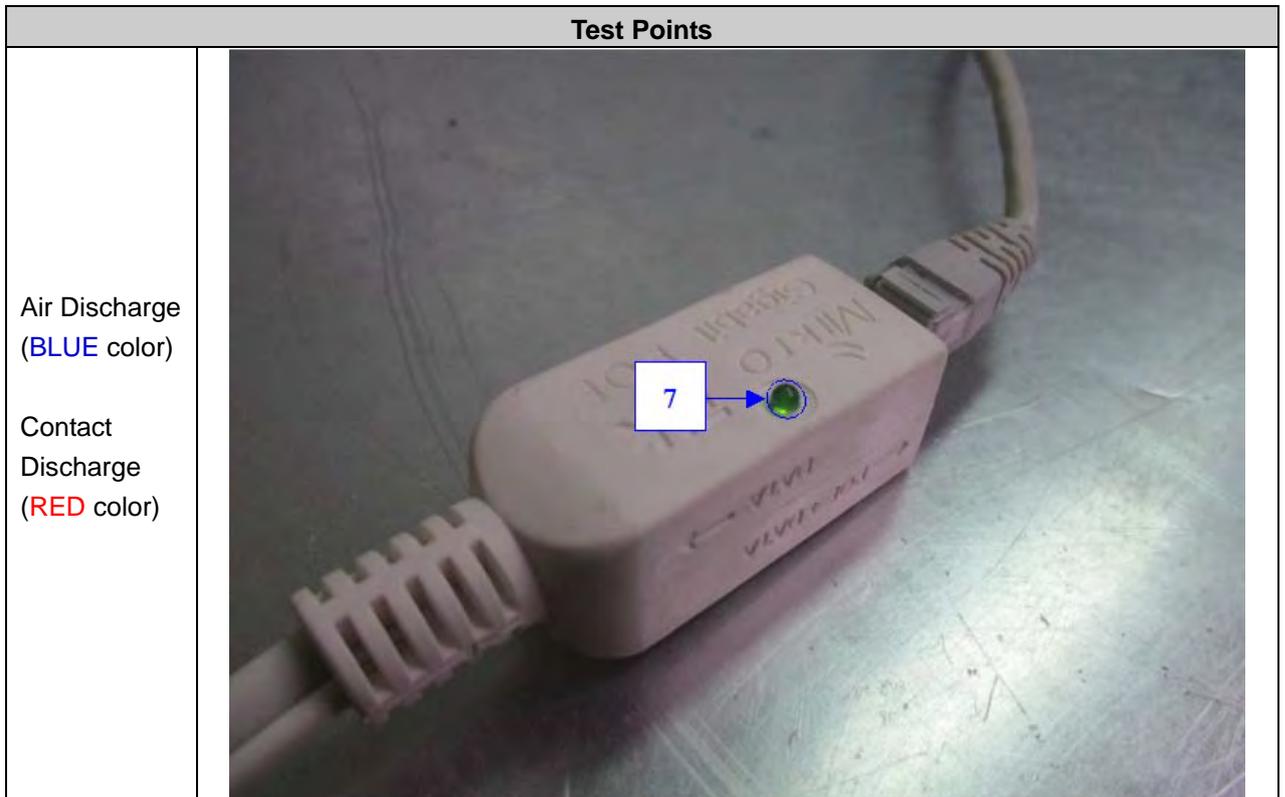




**Test Mode: Mode 2**

Test Points	
<p>Air Discharge (BLUE color)</p> <p>Contact Discharge (RED color)</p>	
Test Points	
<p>Air Discharge (BLUE color)</p> <p>Contact Discharge (RED color)</p>	



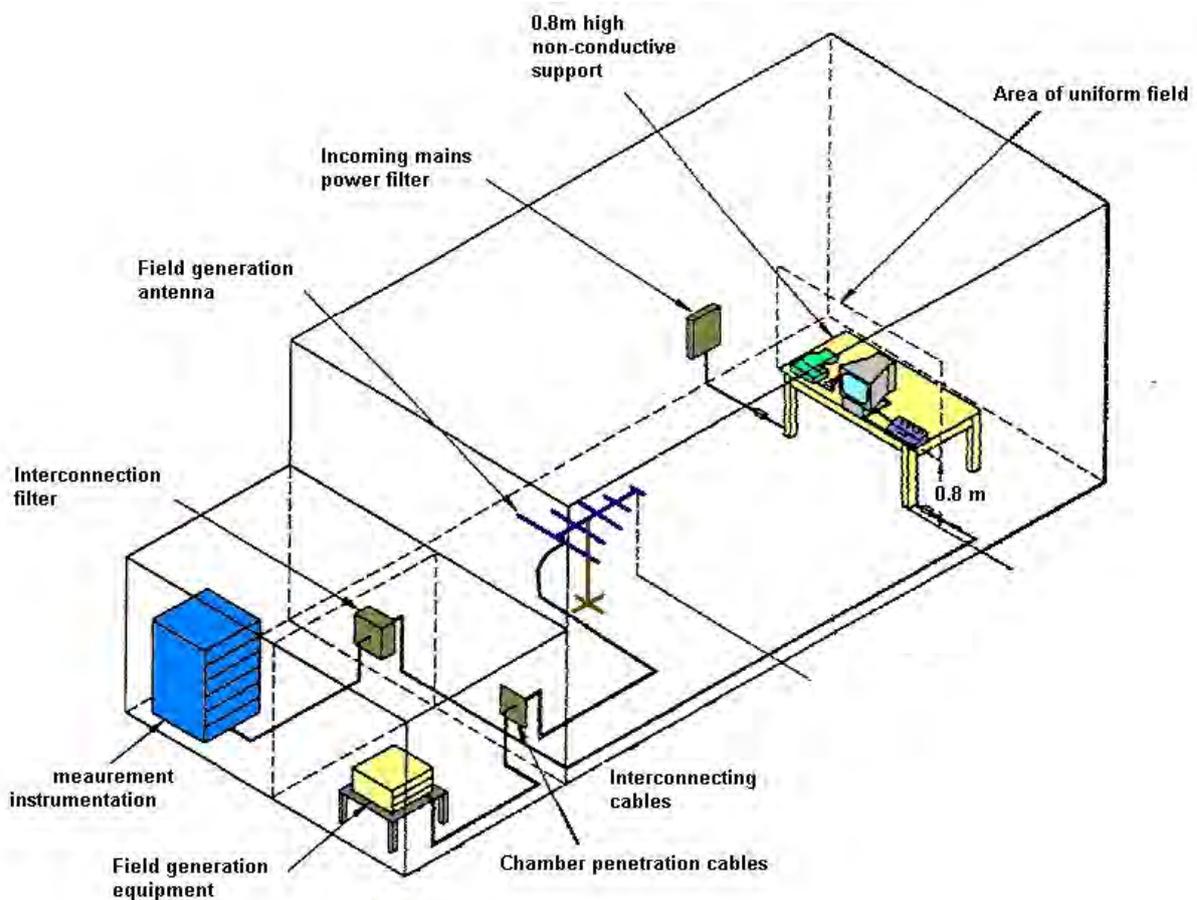


## 11. Radio Frequency Electromagnetic Field Immunity Test (RS)

### 11.1. Test Specification

Reference Standard	EN 61000-4-3
Frequency Range	80 MHz to 6,000 MHz
Field Strength	3 V/m (un-modulated, r.m.s) 80% AM (1 kHz)
Frequency Step	1 %
Dwell Time	2.9 sec
Antenna Polarity	Vertical / Horizontal

### 11.2. Test Setup



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.

### 11.3. 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 MHz - 1,000 MHz / 1,000 MHz - 6,000 MHz is placed 3m / 1m 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. At each of the above conditions, the frequency range is swept 80 MHz - 6,000 MHz, pausing to adjust the R.F. signal level or to switch oscillators and antenna. The rate of sweep is in the order of  $1.5 \times 10^{-3}$  decades/s. The sensitive frequencies or frequencies of dominant interest may be discretely analyzed.

**11.4. Test Result**

<b>Temperature</b>	23°C	<b>Humidity</b>	57%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Wei Li
<b>Test Mode</b>	Mode 1 and Mode 2	<b>Test Date</b>	Aug. 04, 2017
<b>Standard</b>	Required Criteria A		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

Frequency Range MHz	Field V/m	Antenna Polarization	EUT Face Exposed	Performance Criteria
80~1,000	3	Vertical	Front/Back/Right/Left	A
80~1,000	3	Horizontal	Front/Back/Right/Left	A

<b>Temperature</b>	22°C	<b>Humidity</b>	63%
<b>Pressure</b>	101.3 kPa	<b>Test Engineer</b>	JN Chen
<b>Test Mode</b>	Mode 1 and Mode 2	<b>Test Date</b>	Jul. 18, 2017
<b>Standard</b>	Required Criteria A		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

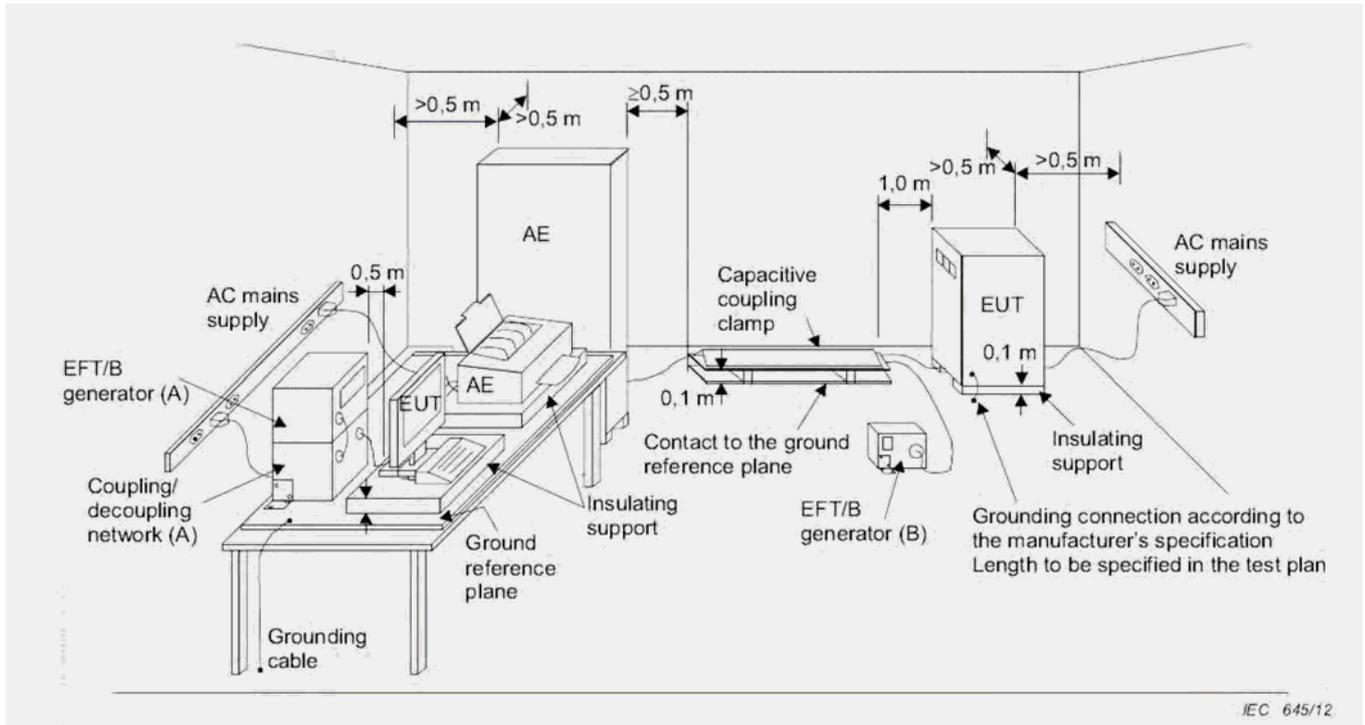
Frequency Range MHz	Field V/m	Antenna Polarization	EUT Face Exposed	Performance Criteria
1,000~6,000	3	Vertical	Front/Back/Right/Left	A
1,000~6,000	3	Horizontal	Front/Back/Right/Left	A

## 12. Electrical Fast Transient/Burst Immunity Test (EFT/BURST)

### 12.1. Test Specification

<b>Reference Standard</b>	EN 61000-4-4
<b>Test Voltage</b>	AC Power Line: $\pm 1$ kV
	Telecommunication/Signal Line: $\pm 0.5$ kV
<b>Polarity</b>	Positive / Negative
<b>Rise time of the pulses</b>	5 ns
<b>Impulse duration</b>	50 ns
<b>Burst duration</b>	15 ms
<b>Burst period</b>	300 ms
<b>Impulse Frequency</b>	Power: 5 kHz
	Telecommunication/Signal: 5 kHz (Except xDSL port)
<b>Duration</b>	1 min

## 12.2. Test Setup



The EUT was placed on a ground reference plane and was insulated from it by an insulating support about 0.1m 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 0.5m or less.

### 12.3. 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).

**12.4. Test Result**

<b>Temperature</b>	24°C	<b>Humidity</b>	57%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/Wei Li
<b>Test Mode</b>	Mode 1	<b>Test Date</b>	Aug. 07, 2017
<b>Standard</b>	Required Criteria B		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

**AC Power Port :**

AC Phase	Test Voltage (kV)
	±1 kV
L	A
N	A
L-N	A

**Telecommunication Port :**

Telecommunication Port	Test Voltage (kV)
	±0.5 kV
LAN	A

<b>Temperature</b>	24°C	<b>Humidity</b>	57%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/ Wei Li
<b>Test Mode</b>	Mode 2	<b>Test Date</b>	Aug. 07, 2017
<b>Standard</b>	Required Criteria B		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

**AC Power Port :**

AC Phase	Test Voltage (kV)
	±1 kV
L	A
N	A
L-N	A

**Telecommunication Port :**

Telecommunication Port	Test Voltage (kV)
	±0.5 kV
EUT LAN	A
PoE data+power	A
PoE data	A

### 13. Surge Immunity Test

#### 13.1. Test Specification

<b>Reference Standard</b>	EN 61000-4-5
<b>Test Voltage</b>	AC Power Port: $\pm 0.5, 1$ kV
	Indoor Telecommunication/Signal Port: $\pm 0.5$ kV
<b>Polarity</b>	Positive / Negative
<b>Wave Shape</b>	Power Port: 1.2/50 $\mu$ s Open-circuit voltage 8/20 $\mu$ s Short-circuit current
	Telecommunication/Signal port: Indoor 1.2/50 $\mu$ s Open-circuit voltage 8/20 $\mu$ s Short-circuit current
<b>Phase Angle</b>	0° , 90° , 180° , 270°
<b>Time between successive pulses</b>	60 sec.
<b>Number of test</b>	5 positive and 5 negative

#### 13.2. Test Setup



### 13.3. 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. If the actual operating signal sources are not available, they may be simulated. Under no circumstances may the test level exceed the product specification. The test shall be carried out according to the test plan.
- h. 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 a previously unstressed equipment shall be used to the protection devices shall be replaced.

**13.4. Test Result**

<b>Temperature</b>	20°C	<b>Humidity</b>	63%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/Wei Li
<b>Test Mode</b>	Mode 1	<b>Test Date</b>	Aug. 07, 2017
<b>Standard</b>	Required Criteria B		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

**AC Power Port:**

Voltage (kV)	Test Location	Polarity	Phase Angle			
			0°	90°	180°	270°
0.5, 1 kV	L - N	+	A	A	A	A
		-	A	A	A	A

**Telecommunication Port:**

Voltage (kV)	Test Location	Polarity	Performance Criteria
0.5 kV	LAN	+	A
		-	A

<b>Temperature</b>	20°C	<b>Humidity</b>	63%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/Wei Li
<b>Test Mode</b>	Mode 2	<b>Test Date</b>	Aug. 07, 2017
<b>Standard</b>	Required Criteria B		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

**AC Power Port:**

Voltage (kV)	Test Location	Polarity	Phase Angle			
			0°	90°	180°	270°
0.5, 1 kV	L - N	+	A	A	A	A
		-	A	A	A	A

**Telecommunication Port:**

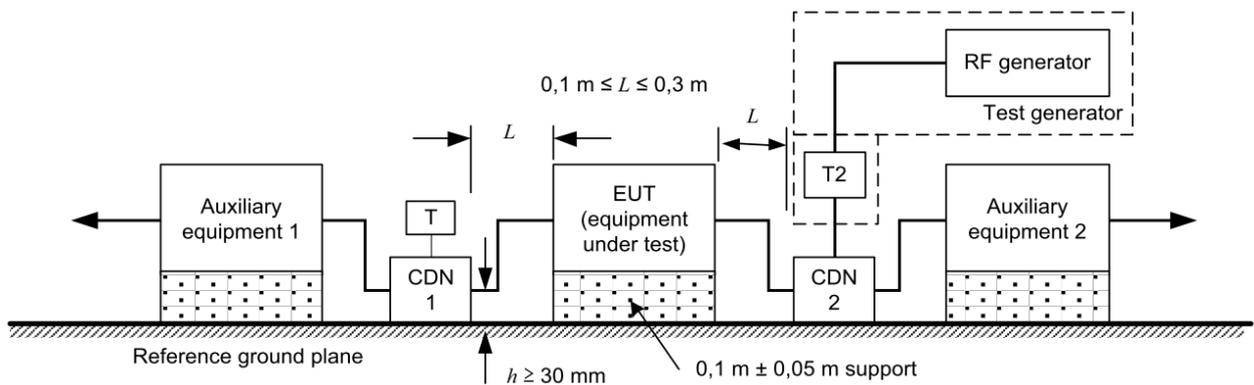
Voltage (kV)	Test Location	Polarity	Performance Criteria
0.5 kV	EUT LAN(indoor)	+	A
		-	A
0.5 kV	PoE data+power (indoor)	+	A
		-	A
0.5 kV	PoE data(indoor)	+	A
		-	A

## 14. Conducted Disturbances Induced by Radio-Frequency Field Immunity Test (CS)

### 14.1. Test Specification

Reference Standard	EN 61000-4-6
Frequency Range	150 kHz~80 MHz
Field Strength	3 V <sub>r.m.s</sub> (un-modulated, r.m.s) 80% AM (1 kHz)
Frequency Step	1 %
Dwell Time	2.9 sec
Coupling mode	CDN M016(M2), CDN T8-10, CDN ST08

### 14.2. Test Setup



### 14.3. 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 self-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 sinewave, pausing to adjust the RF-signal level or to switch coupling devices as necessary. The rate of sweep shall no exceed  $1.5 \times 10^{-3}$  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.

**14.4. Test Result**

<b>Temperature</b>	23°C	<b>Humidity</b>	56%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Wei Li
<b>Test Mode</b>	Mode 1	<b>Test Date</b>	Aug. 04, 2017
<b>Standard</b>	Required Criteria A		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

Frequency Range MHz	V (r.m.s)	CDN	Coupling port	Performance Criteria
0.15 ~ 80	3	M016(M2)	AC	A
0.15 ~ 80	3	T8-10	LAN	A

<b>Temperature</b>	23°C	<b>Humidity</b>	56%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Wei Li
<b>Test Mode</b>	Mode 2	<b>Test Date</b>	Aug. 04, 2017
<b>Standard</b>	Required Criteria A		
<b>Test Recorded</b>	There was no abnormal situation during the test compared with initial operation.		

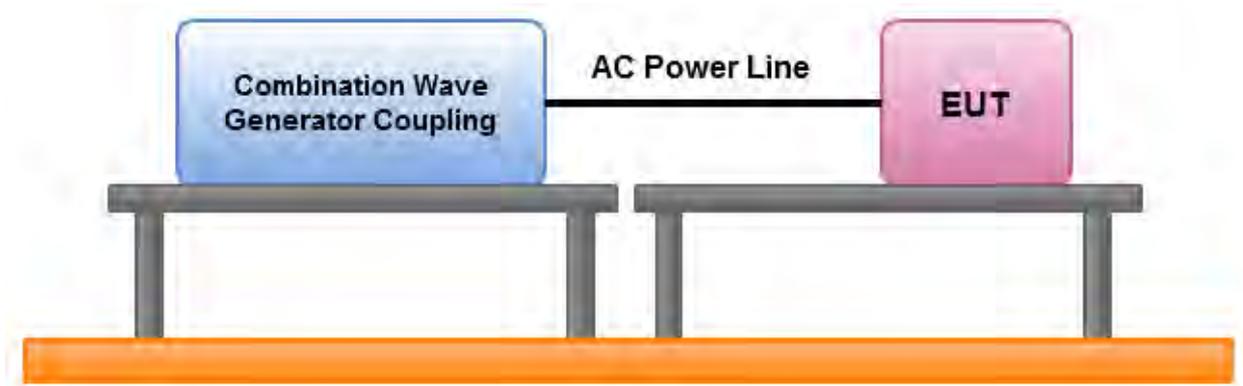
Frequency Range MHz	V (r.m.s)	CDN	Coupling port	Performance Criteria
0.15 ~ 80	3	M016(M2)	AC	A
0.15 ~ 80	3	T8-10	EUT LAN	A
0.15 ~ 80	3	ST08	PoE data	A
0.15 ~ 80	3	T8-10	PoE data+power	A

## 15. Voltage Dips and Voltage Interruptions Immunity Tests

### 15.1. Test Specification

Reference Standard	EN 61000-4-11
Test Voltage	Voltage Dip :
	1. 0% residual, 0.5 period
	2. 0% residual, 1.0 period
	3. 70% residual, 25 period
	Voltage interruptions
4. 0% residual, 250 period	
Test Duration Time	3 times
Intervals between event	10 sec.
Test Angle	0, 180°

### 15.2. Test Setup



### 15.3. Test Conditions

1. Source voltage and frequency: 100/230/240V / 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  $\mu$ s.

**15.4. Test Result**

<b>Temperature</b>	23°C	<b>Humidity</b>	50%
<b>Pressure</b>	101.0 kPa	<b>Test Engineer</b>	Tony Chen/Wei Li
<b>Test Mode</b>	Mode 1 and Mode 2	<b>Test Date</b>	Jul. 13, 2017
<b>Standard</b>	Required Criteria B/B/B/C		
<b>Test Recorded</b>	The EUT had "reboot" situation happened during the test, but could be self-recoverable after the test.		

**Voltage Dip & Interruption :**

Voltage (V)	Frequency (Hz)	% Residual	Periods	ms	Performance Criteria
100	50	0%	0.5	10	A
		0%	1.0	20	A
		70%	25	500	C
		Interruption 0%	250	5000	C

Voltage (V)	Frequency (Hz)	% Residual	Periods	ms	Performance Criteria
230	50	0%	0.5	10	A
		0%	1.0	20	A
		70%	25	500	C
		Interruption 0%	250	5000	C

Voltage (V)	Frequency (Hz)	% Residual	Periods	ms	Performance Criteria
240	50	0%	0.5	10	A
		0%	1.0	20	A
		70%	25	500	C
		Interruption 0%	250	5000	C

## 16. List of Measuring Equipment Used

<EMI>

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Jan. 23, 2017	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 14, 2016	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 21, 2016	Conduction (CO01-CB)
Impedance Stabilization Network	Teseq	ISN T800	24557	150kHz ~ 230MHz	Nov. 01, 2016	Conduction (CO01-CB)
Coupling Decoupling Network	Teseq	ST08	24348	150kHz ~ 230MHz	Nov. 29, 2016	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	May 23, 2017	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	Conduction (CO01-CB)
10m Semi Anechoic Chamber	TDK	NSA	10CH01-CB	30MHz~1GHz 10m	Mar. 18, 2017	Radiation (10CH01-CB)
10m Semi Anechoic Chamber	TDK	VSWR	10CH01-CB	1GHz~40GHz 3m	Mar. 17, 2017	Radiation (10CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10783	9kHz ~ 1.3GHz	Mar. 27, 2017	Radiation (10CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10784	9kHz ~ 1.3GHz	Mar. 13, 2017	Radiation (10CH01-CB)
Low Cable	Woken	SUCOFLEX 104	-	25MHz ~ 1GHz	Nov. 30, 2016	Radiation (10CH01-CB)
High Cable	Woken	SUCOFLEX 104	-	25MHz ~ 1GHz	Nov. 30, 2016	Radiation (10CH01-CB)
Biconical Antenna	Schwarzbeck	VHBB 9124	324	30MHz ~ 200MHz	May 03, 2017	Radiation (10CH01-CB)
EMI Test Receiver	Rohde&Schwarz	ESCI	100186	9kHz ~ 3GHz	Jul. 12, 2017	Radiation (10CH01-CB)
Spectrum Analyzer	Rohde&Schwarz	FSV30	101026	9kHz ~ 30GHz	Jan. 03, 2017	Radiation (10CH01-CB)
Horn Antenna	ESCO	3117	00081283	1GHz ~ 18GHz	Nov. 29, 2016	Radiation (10CH01-CB)
Amplifier	Agilent	8449B	3008A02660	1GHz ~ 26.5GHz	May 25, 2017	Radiation (10CH01-CB)
CABLE(1~40G)	Woken	SUCOFLEX 104	-	1GHz ~ 40GHz	Nov. 30, 2016	Radiation (10CH01-CB)
Software	Audix	E3	6.120210m	-	N.C.R.	Radiation (10CH01-CB)

※ Calibration Interval of instruments listed above is one year.

※ N.C.R. means Non-Calibration required.

**<EMS>**

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Harmonic/Flicker	Teseq	CCN 1000-1	1306A00130	N/A	Mar. 15, 2017	Harmonic/Flicker
Software	Teseq	WIN2100V3	-	-	N.C.R.	Harmonic/Flicker
ESD Simulator	Teseq QG	NSG 437	1053	Air: 0 kV ~ 30 kV, Contact: 0 kV ~ 30kV	Nov. 12, 2016	ESD
Integrated Measurement System	R&S	IMS	100002	9kHz ~ 3GHz	Apr. 19, 2017	RS
Average Power Sensor	R&S	NRP-Z91	101117	9kHz ~ 6GHz	Apr. 07, 2017	RS
RF Power Amplifier	AR	250W1000A	0323202	80MHz ~1GHz, 250W	Apr. 14, 2017	RS
Log-Periodic Antenna	AR	AT1080	0323130	80MHz ~ 1GHz	N.C.R.	RS
Software	R&S	EMC32	5.20.1	-	N.C.R.	RS
Signal Generator	R & S	SMB100A	103294HA	9kHz ~ 6GHz	Oct. 19, 2016	RS01-WS
Power Sensor	R & S	NRP-Z91	101094-UL	9kHz ~ 6GHz	Oct. 14, 2016	RS01-WS
Power Sensor	R & S	NRP-Z91	101095-KY	9kHz ~ 6GHz	Oct. 14, 2016	RS01-WS
Power Amplifier	BONN	BLMA 1060-100D	107972B	1GHz ~ 6GHz	N/A	RS01-WS
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	0.7GHz ~ 10.5GHz	N/A	RS01-WS
Surge/EFT/Dip Generator	Teseq AG	NSG 3060	1534	Surge 0 ~ 6kV EFT 0 kV ~ 4.4 kV Dip 100~240V/ 50Hz /60Hz	Apr. 06, 2017	Surge EFT Dip
Burst/EFT Dataline Coupling Clamp	Teseq AG	CDN 3425	1776	0.25kV~4kV	Feb. 09, 2017	EFT
Surge Coupling Decoupling Network	Teseq GebH	CDN HSS-2	34283	0.25kV~4kV	Jun. 15, 2017	Surge
Software	Teseq AG	NSG3000	-	-	N.C.R.	Surge/ EFT/Dip
RF-Generator	Teseq GmbH	NSG 4070B-30	035084	150kHz~230MHz	May 01, 2017	CS
Coupling decoupling network	Teseq GmbH	CDN M016	34634	150kHz~80MHz	Apr. 18, 2017	CS
Coupling decoupling network	Teseq GmbH	ST08	32629	150kHz~230MHz	Apr. 19, 2017	CS

Coupling decoupling network	Teseq GmbH	CDN T8-10	41243	150kHz~230MHz	Oct. 21, 2016	CS
Software	Tesq	NSG4070	030593.V1.2 8	-	N.C.R.	CS

※ Calibration Interval of instruments listed above is one year.

※ N.C.R. means Non-Calibration required.

**17. Uncertainty of Test Site**

Test Items	Uncertainty	Remark
Conducted Emissions	3.2 dB	Confidence levels of 95%
Radiated Emissions below 1GHz	4.3 dB	Confidence levels of 95%
Radiated Emissions above 1GHz	5.0 dB	Confidence levels of 95%

**Immunity Test Measurement Uncertainty**

**Electrostatic Discharge Immunity (ESD)**

**Negative Discharge Current**

From Standard			
2kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	7.5	4.0	2.0
Min.	6.4	2.8	1.4
Max.	8.6	5.2	2.6
Tolerance in %	0.2	0.3	0.3

From calibration certificate						
	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%
Positive	6.9	7.2	3.6	3.8	1.9	2.0
Negative	7.3	7.7	3.7	3.9	1.9	2.0
Min.		6.4		2.8		1.4
Max.		8.6		5.2		2.6

From Standard			
4kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	15.0	8.0	4.0
Min.	12.8	5.6	2.8
Max.	17.3	10.4	5.2
Tolerance in %	0.2	0.3	0.3

From calibration certificate						
	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%
Positive	14.4	15.1	7.6	7.9	3.8	4.0
Negative	14.1	14.8	7.4	7.8	4.0	4.2
Min.		12.8		5.6		2.8
Max.		17.3		10.4		5.2

From Standard			
6kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	22.5	12.0	6.0
Min.	19.1	8.4	4.2
Max.	25.9	15.6	7.8
Tolerance in %	0.2	0.3	0.3

From calibration certificate						
	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%
Positive	21.2	22.2	11.2	11.7	5.8	6.1
Negative	20.7	21.7	11.1	11.7	6.0	6.2
Min.		19.1		8.4		4.2
Max.		25.9		15.6		7.8

From Standard			
8kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	30.0	16.0	8.0
Min.	25.5	11.2	5.6
Max.	34.5	20.8	10.4
Tolerance in %	0.2	0.3	0.3

From calibration certificate						
	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%
Positive	27.8	29.1	14.7	15.4	7.6	8.0
Negative	28.4	29.8	15.0	15.7	7.8	8.1
Min.		25.5		11.2		5.6
Max.		34.5		20.8		10.4

**Negative Discharge Voltage**

Standard Parameters					Calculated Range		
Indicated Voltage (kV)	Polarity	Tolerance (%)	Max. (kV)	Min. (kV)	Calibration (kV)	Max. (kV)	Min. (kV)
2	Positive	15.0	2.3	1.7	2.0	2.0	2.0
	Negative	15.0	2.3	1.7	2.1	2.6	2.6
4	Positive	15.0	4.6	3.4	4.0	4.0	4.0
	Negative	15.0	4.6	3.4	4.1	4.1	4.1
6	Positive	15.0	6.9	5.1	6.0	6.0	6.0
	Negative	15.0	6.9	5.1	6.1	6.1	6.1
8	Positive	15.0	9.2	6.8	8.0	8.0	7.9
	Negative	15.0	9.2	6.8	8.1	8.1	8.1
15	Positive	15.0	17.3	12.8	15.2	15.2	15.2
	Negative	15.0	17.3	12.8	14.9	14.9	14.9

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

**Radio Frequency Electromagnetic Field Immunity (RS)  
For 80 MHz to 1,000 MHz:  
IMS**

Frequency 10MHz Output Check	
Standard	Reading
10 MHz	9,999,985.8 Hz

Frequency Accuracy/offset : 1.4E-07  
Frequency Stability : 5E-09/1.0S  
Uncertainty: 4.0E-06

Gain Flatness Measurement (For 80 MHz to 1 GHz Amp.)		
Freq. (MHz)	Reading (dB)	Expected (dB)
80.0	62.6	> 54
100.0	62.4	> 54
200.0	61.6	> 54
300.0	62.0	> 54
400.0	58.8	> 54
500.0	60.4	> 54
600.0	58.4	> 54
700.0	58.8	> 54
800.0	59.3	> 54
900.0	58.3	> 54
1000.0	55.8	> 54

Gain Flatness Measurement (For 1 GHz to 3 GHz Amp.)		
Freq. (GHz)	Reading (dB)	Expected (dB)
0.8	47.6	> 40
1.0	48.0	> 40
1.5	47.9	> 40
2.0	47.8	> 40
2.5	46.4	> 40
3.0	46.3	> 40

VSWR Measurement (input port)		
Freq. (MHz)	Actual (dB)	Hige Range (dB)
80.0	1.7	< 2.00
100.0	1.5	< 2.00
200.0	1.6	< 2.00
300.0	1.5	< 2.00
400.0	1.5	< 2.00
500.0	1.4	< 2.00
600.0	1.4	< 2.00
700.0	1.4	< 2.00
800.0	1.4	< 2.00
900.0	1.5	< 2.00
1000.0	1.4	< 2.00

Power Linearly Measurement								
Freq. (MHz)	Reading (Watts)	Standard (Watts)	Freq. (MHz)	Reading (Watts)	Standard (Watts)	Freq. (MHz)	Reading (Watts)	Standard (Watts)
80.0	20.0	23.2	200.0	200.0	226.9	800.0	100.0	97.7
80.0	50.0	63.9	200.0	250.0	279.7	800.0	150.0	147.2
80.0	100.0	122.4	500.0	20.0	21.3	800.0	200.0	196.1
80.0	150.0	173.4	500.0	50.0	52.6	800.0	250.0	244.9
80.0	200.0	234.7	500.0	100.0	103.8	1000.0	20.0	16.5
80.0	250.0	302.2	500.0	150.0	155.4	1000.0	50.0	45.2
200.0	20.0	22.4	500.0	200.0	206.8	1000.0	100.0	87.3
200.0	50.0	58.3	500.0	250.0	258.1	1000.0	150.0	131.9
200.0	100.0	107.6	800.0	20.0	19.1	1000.0	200.0	175.9
200.0	150.0	166.7	800.0	50.0	48.6	1000.0	250.0	220.0

Standard Power Measurement					
For 80 MHz to 1 GHz			For 800 MHz to 3 GHz		
Freq.	Expected (WATTS)	Standard (WATTS)	Freq.	Expected (WATTS)	Standard (WATTS)
80.0	> 250	348.0	0.8	> 30	30.3
100.0	> 250	335.0	1.0	> 30	34.2
200.0	> 250	340.0	1.5	> 30	39.9
300.0	> 250	329.0	2.0	> 30	36.7
400.0	> 250	324.0	2.5	> 30	34.0
500.0	> 250	282.0	3.0	> 30	34.3
600.0	> 250	318.0			
700.0	> 250	329.0			
800.0	> 250	306.0			
900.0	> 250	294.0			
1000.0	> 250	271.0			

Uncertainty: 3%

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

For 1,000 MHz to 6,000 MHz:

Measuring Uncertainty for a Level of Confidence of 95% ( $U=2Uc(y)$ )	1.96dB
---	--------

**Electrical Fast Transient/Burst Immunity (EFT/BURST)  
Voltage**

Impedance	Voltage Setting(V)	Expected (V)	Actual (V)	Uncertainty (%)	T1	Uncertainty (%)	T2	Uncertainty (%)
50Ω	500	250	253	8.2	5.39	4.4	46.49	4.4
50Ω	1000	500	504	8.2	5.7	4.4	45.98	4.4
50Ω	2000	1000	971	8.2	5.57	4.4	44.89	4.4
50Ω	4000	2000	1972	8.2	5.38	4.4	46.07	4.4
50Ω	-500	-250	-248	8.2	4.66	4.4	88.31	4.4
50Ω	-1000	-500	-496	8.2	5.23	4.4	86.25	4.4
50Ω	-2000	-1000	-962	8.1	5.11	4.4	85.48	4.4
50Ω	-4000	-2000	-1960	8.2	5.04	4.4	87.83	4.4
1kΩ	500	500	476	8.2	5.81	4.4	87.87	4.4
1kΩ	1000	1000	933	8.2	5.42	4.4	88.38	4.4
1kΩ	2000	2000	1814	8.2	5.35	4.4	89.78	4.4
1kΩ	4000	4000	3674	8.2	5.98	4.4	85.91	4.4
1kΩ	-500	-500	-460	8.2	6.03	4.4	37.78	4.4
1kΩ	-1000	-1000	-918	8.2	6.24	4.4	36.86	4.4
1kΩ	-2000	-2000	-1877	8.2	6.16	4.4	37.23	4.4
1kΩ	-4000	-4000	-3599	8.2	6.42	4.4	37.53	4.4

**EFT Repetition Frequency (Voltage @ 1 kV)**

Setting (kHz)	Actual (kHz)	Uncertainty (%)	Tolerance (%)
5	5	4.4	20%
100	100.01	4.4	20%

**Burst Duration (Voltage @ 1 kV)**

Setting (ms)	Repetition Freq. (kHz)	Actual (ms)	Uncertainty (%)	Tolerance (%)
15	5	14.82	4.4	20%
0.75	100	0.74	4.5	20%

**Burst Period ( Voltage @ 1 kV )**

Setting (ms)	Repetition Freq. (kHz)	Actual (ms)	Uncertainty (%)	Tolerance (%)
300	5	300	4.4	20%
300	100	300	4.4	20%

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

**Surge Immunity**
**Open Circuit Output Voltage Waveform check:**

Impedance	Voltage Setting(V)	Actual (V)	Uncertainty (%)	T3	Uncertainty (%)	T4	Uncertainty (%)
L-N 2Ω	500.0	503.0	3.9	1.3	3.7	54.0	3.7
L-N 2Ω	4000.0	4020.0	3.9	1.2	3.7	51.2	3.7
L-N 2Ω	-500.0	-503.0	3.9	1.3	3.7	50.8	3.7
L-N 2Ω	-4000.0	-4068.0	3.9	1.1	3.7	50.3	3.7
L-G 2Ω	500.0	485.0	3.9	1.3	3.7	29.7	3.7
L-G 2Ω	4000.0	3948.0	3.9	1.0	3.7	28.2	3.7
L-G 2Ω	-500.0	-480.0	3.9	1.3	3.7	28.3	3.7
L-G 2Ω	-4000.0	-3900.0	3.9	1.1	3.7	28.0	3.7
N-G 2Ω	500.0	490.0	3.9	1.3	3.7	29.5	3.7
N-G 2Ω	4000.0	3900.0	3.9	1.2	3.7	27.9	3.7
N-G 2Ω	-500.0	-478.0	3.9	1.3	3.7	28.4	3.7
N-G 2Ω	-4000.0	-3900.0	3.8	1.2	3.7	28.2	3.7
Impulse	500.0	511.0	3.9	1.5	3.7	53.4	3.7
Impulse	1000.0	1041.0	3.9	1.3	3.7	51.9	3.7
Impulse	2000.0	2022.0	3.9	1.2	3.8	53.3	3.7
Impulse	4000.0	4044.0	3.9	1.3	3.6	53.3	3.7
Impulse	-500.0	-503.0	3.9	1.5	3.7	52.6	3.7
Impulse	-1000.0	-1023.0	3.9	1.3	3.7	51.9	3.7
Impulse	-2000.0	-2022.0	3.9	1.2	3.7	51.4	3.7
Impulse	-4000.0	-4044.0	3.9	1.3	3.7	51.4	3.7

**Short Circuit Output Voltage Waveform check:**

Impedance	Voltage Setting(V)	Actual (V)	Uncertainty (%)	T5	Uncertainty (%)	T6	Uncertainty (%)
L-N 2Ω	500.0	231.0	2.5	7.7	2.1	19.6	2.1
L-N 2Ω	4000.0	1854.0	2.5	7.4	2.1	19.9	2.1
L-N 2Ω	-500.0	-228.0	2.5	7.7	2.1	19.8	2.1
L-N 2Ω	-4000.0	-1818.0	2.5	7.6	2.1	19.9	2.1
L-G 2Ω	500.0	42.0	3.0	2.6	2.1	25.3	2.1
L-G 2Ω	4000.0	326.0	2.5	2.5	2.1	25.1	2.1
L-G 2Ω	-500.0	-42.0	2.8	2.6	2.1	25.0	2.1
L-G 2Ω	-4000.0	-337.0	2.5	2.4	2.1	25.0	2.1
N-G 2Ω	500.0	41.0	3.0	2.8	2.1	26.4	2.1
N-G 2Ω	4000.0	325.0	2.5	2.7	2.1	25.9	2.1
N-G 2Ω	-500.0	-41.0	2.7	2.9	2.1	26.1	2.1
N-G 2Ω	-4000.0	-323.0	2.5	2.6	2.1	25.8	2.1
Impulse	500.0	243.0	2.5	6.8	2.1	22.2	2.1
Impulse	1000.0	494.0	2.5	6.9	2.1	22.3	2.1
Impulse	2000.0	999.0	2.5	6.8	2.1	22.3	2.1
Impulse	4000.0	2022.0	2.5	7.1	2.1	22.3	2.1
Impulse	-500.0	-251.0	2.5	7.2	2.1	22.6	2.1
Impulse	-1000.0	-497.0	2.5	7.0	2.1	22.3	2.1
Impulse	-2000.0	-987.0	2.5	6.9	2.1	22.3	2.1
Impulse	-4000.0	-1986.0	2.5	7.0	2.1	22.4	2.1

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

**Conducted Disturbances Induced by Radio-Frequency Field Immunity (CS)**

RF Frequency Measurement Check		RF Generator Second Harmonic Check
Reading	Standard	Harmonic (dBc)
9.000 kHz	8.99997282 kHz	-45.6
50.000 kHz	49.998570 kHz	-42.3
100.000 kHz	99.9997118 kHz	-43.5
1.000000 MHz	0.999997073 MHz	-45.6
5.000000 MHz	4.99998552 MHz	-47.8
10.000000 MHz	9.99997043 MHz	-48.4
50.000000 MHz	49.9998556 MHz	-47.1
100.000000 MHz	99.9997100 MHz	-46.2
500.000000 MHz	499.998548 MHz	-49.9
1000.000000 MHz	999.997093 MHz	-52.6

RF Generator AM Modulation Measurement Check (1 kHz ; 80 %)			
Frequency	Mod. Freq.	Reading	Standard
100.000 kHz	1 kHz	80.0%	81.4%
1.000000 MHz	1 kHz	80.0%	81.3%
5.000000 MHz	1 kHz	80.0%	81.2%
10.000000 MHz	1 kHz	80.0%	81.1%
50.000000 MHz	1 kHz	80.0%	81.3%
100.000000 MHz	1 kHz	80.0%	81.1%
500.000000 MHz	1 kHz	80.0%	81.5%
1000.000000 MHz	1 kHz	80.0%	80.8%

RF Generator Response and Accuracy Measurement Check		
Frequency	Reading (dBm)	Standard (dBm)
9.000 kHz	0	-43.0
50.000 kHz	0	0.0
100.000 kHz	0	-0.1
1.000000 MHz	0	0.1
5.000000 MHz	0	0.1
10.000000 MHz	0	0.1
50.000000 MHz	0	-0.2
50.000000 MHz	-10	-10.2
50.000000 MHz	-20	-20.3
50.000000 MHz	-30	-30.3
50.000000 MHz	-40	-40.3
50.000000 MHz	-50	-50.3
100.000000 MHz	0	0.1
500.000000 MHz	0	0.0
1000.000000 MHz	0	-0.3

RF Power Meter Measurement Check			
Frequency (MHz)		Standard (dBm)	Reading (dBm)
CH 1	50	10	9.7
CH 1	50	0	-0.3
CH 1	50	-10	-10.3
CH 1	50	-15	-15.3
CH 2	50	10	9.7
CH 2	50	0	-0.3
CH 2	50	-10	-10.3
CH 2	50	-15	-15.3
CH 3	50	10	9.7
CH 3	50	0	-0.4
CH 3	50	-10	-10.3
CH 3	50	-15	-15.3

Power Amplifier Gain Flatness Measurement		Power Amplifier Standard Measurement (Input: 10 dBm)		Power Amplifier Second Harmonic Measurement Check
Frequency	Reading (dB)	Result (dBm)	Spec. (dBm)	Reading (dBc)
150.000 kHz	50.1	48.1	> 44.77	-48.6
1.000000 MHz	51.2	48.3	> 44.77	-47.8
5.000000 MHz	51.2	48.4	> 44.77	-53.6
10.000000 MHz	51.1	48.4	> 44.77	-48.7
50.000000 MHz	50.4	48.4	> 44.77	-49.2
100.000000 MHz	49.6	48.2	> 44.77	-44.7
200.000000 MHz	49.4	47.0	> 44.77	-54.3
2300.000000 MHz	49.6	46.4	> 44.77	-57.5

Uncertainty: Frequency:  $1.9 \times 10^{-9}$

Linear: 0.9 dB

RF Power Level: 1.2 dB

Harmonic: 2.0 dB

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

**Voltage Dips and Voltage Interruptions Immunity****PQF Measurement: (Input Voltage: 230V/50Hz)**

Level	Load	Actual ( V )	Uncertainty ( mV/V )	Tolerance (%)
80%	100Ω	182.5	17	184 +/- 5%
70%	100Ω	161.7	17	161 +/- 5%
40%	100Ω	93.2	17	92 +/- 5%
0%	100Ω	5.3	17	-

**VAR Check: (Input Voltage: 230V/50Hz)**

Level	Load	Actual ( V )	Uncertainty ( mV/V )	Tolerance (%)
80%	100Ω	182.5	17	184 +/- 5%
70%	100Ω	161.7	17	161 +/- 5%
40%	100Ω	93.2	17	92 +/- 5%
0%	100Ω	5.3	17	-

**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

Test Mode: Mode 1

FRONT VIEW



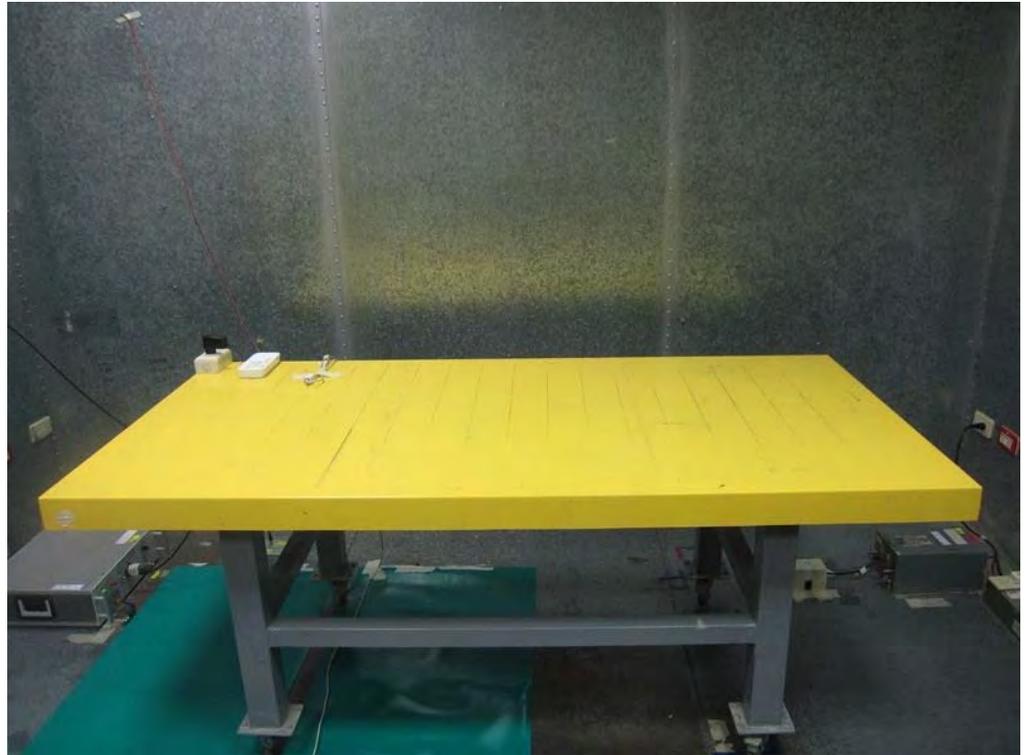
REAR VIEW



## 2. Photographs of Telecommunication Line Conducted Emissions Test Configuration

Test Mode: Mode 2 and Mode 3

**FRONT VIEW**



**REAR VIEW**

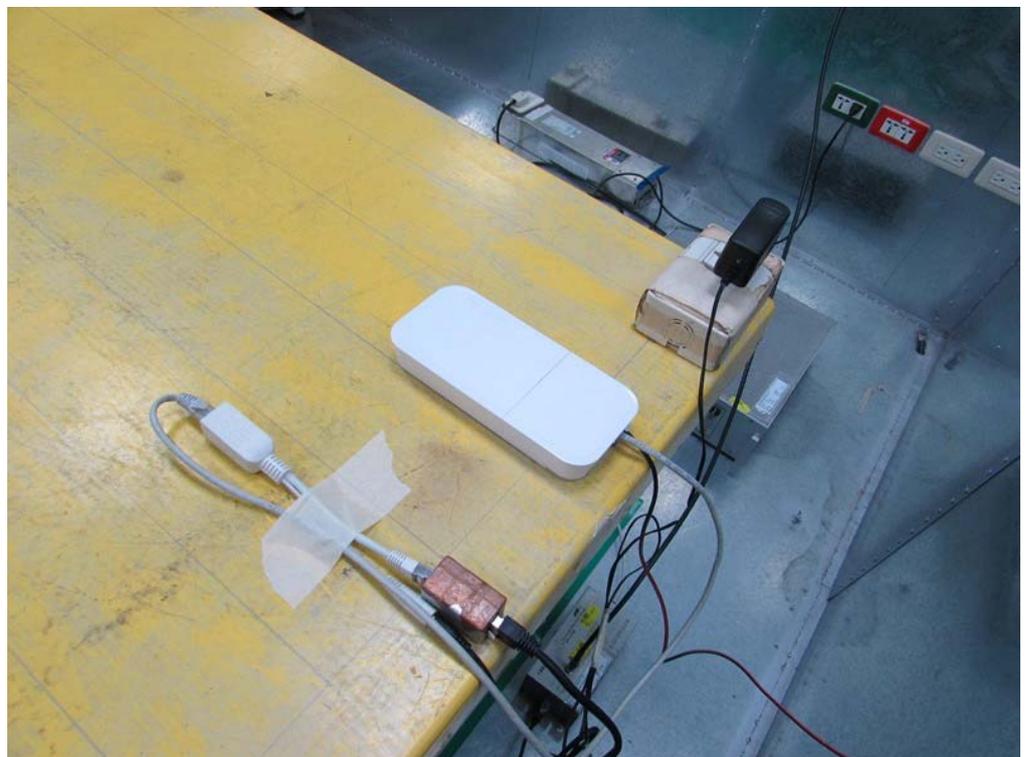


Test Mode: Mode 4

FRONT VIEW



REAR VIEW



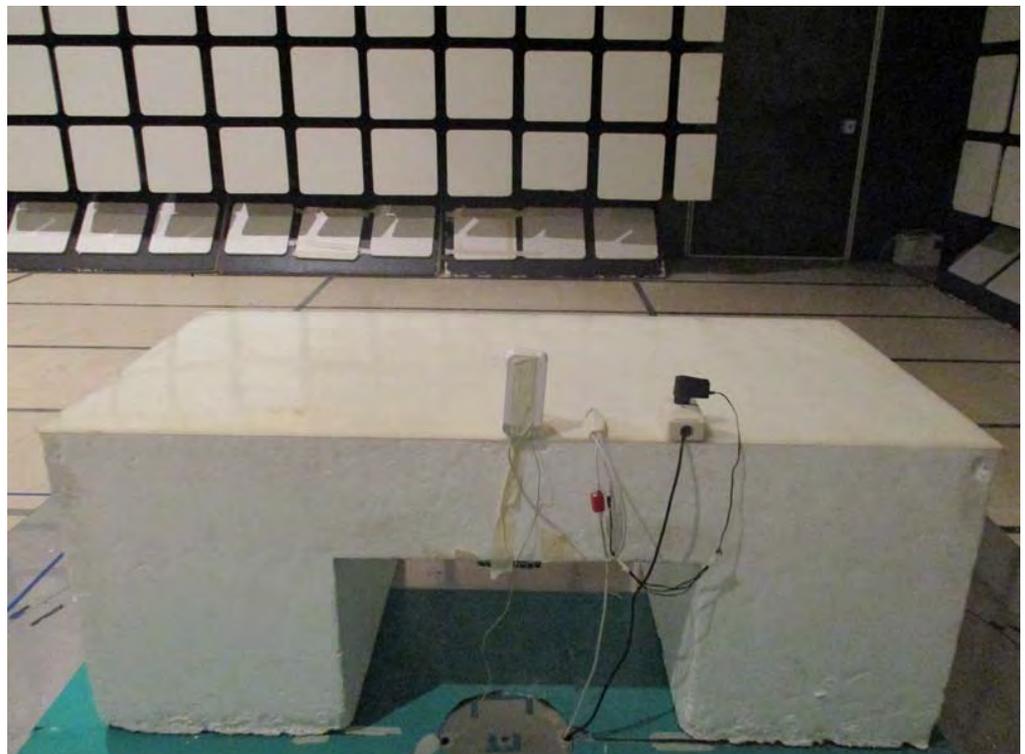
### 3. Photographs of Radiated Emissions Test Configuration

Test Configuration: 30MHz~1GHz / Test Mode: Mode 3

**FRONT VIEW**



**REAR VIEW**

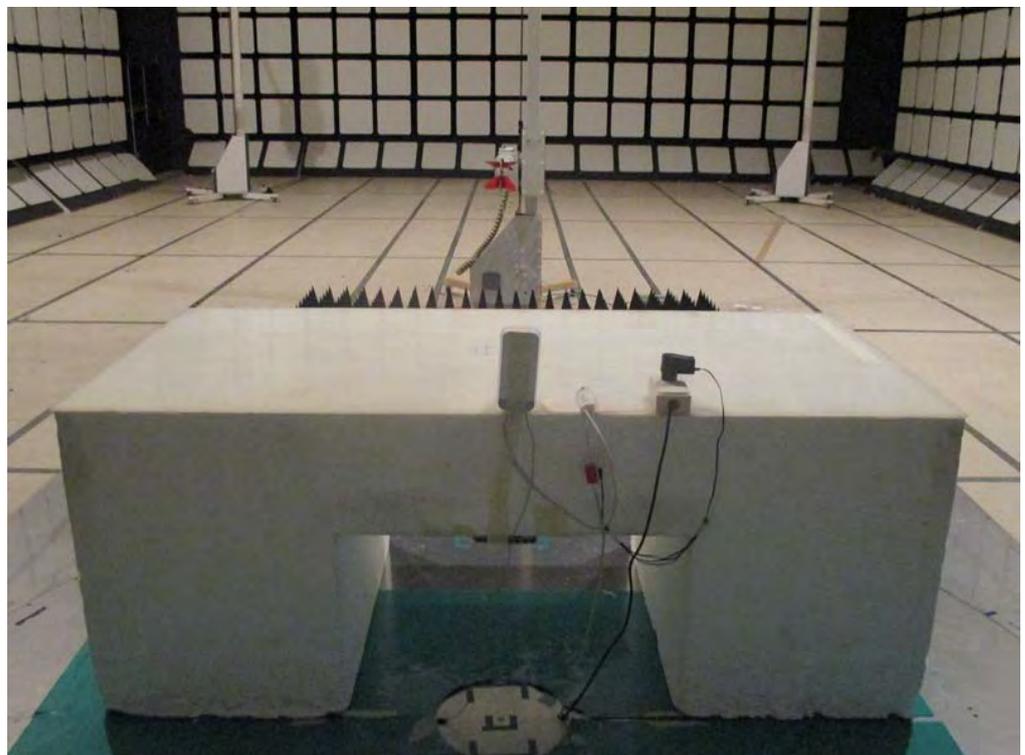


Test Configuration: Above 1GHz / Test Mode: Mode 3

**FRONT VIEW**



**REAR VIEW**



#### 4. Photographs of Harmonic, Flicker Test Configuration

Test Mode: Mode 1

FRONT VIEW



Test Mode: Mode 2

FRONT VIEW



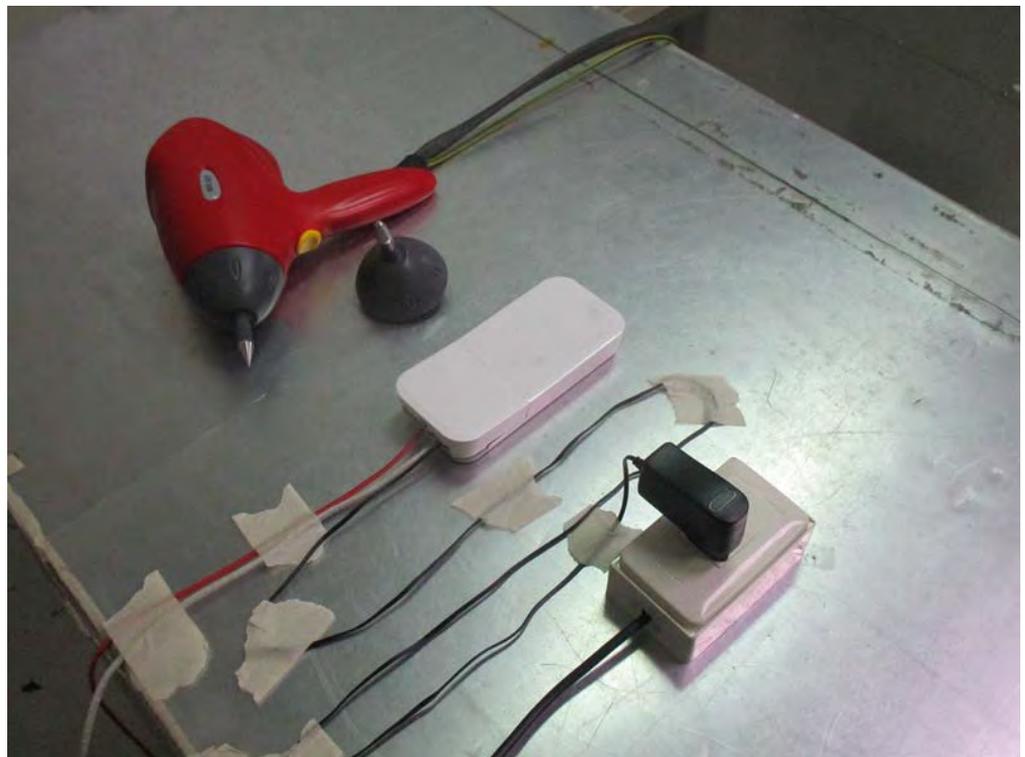
## 5. Photographs of ESD Immunity Test Configuration

Test Mode: Mode 1

FRONT VIEW

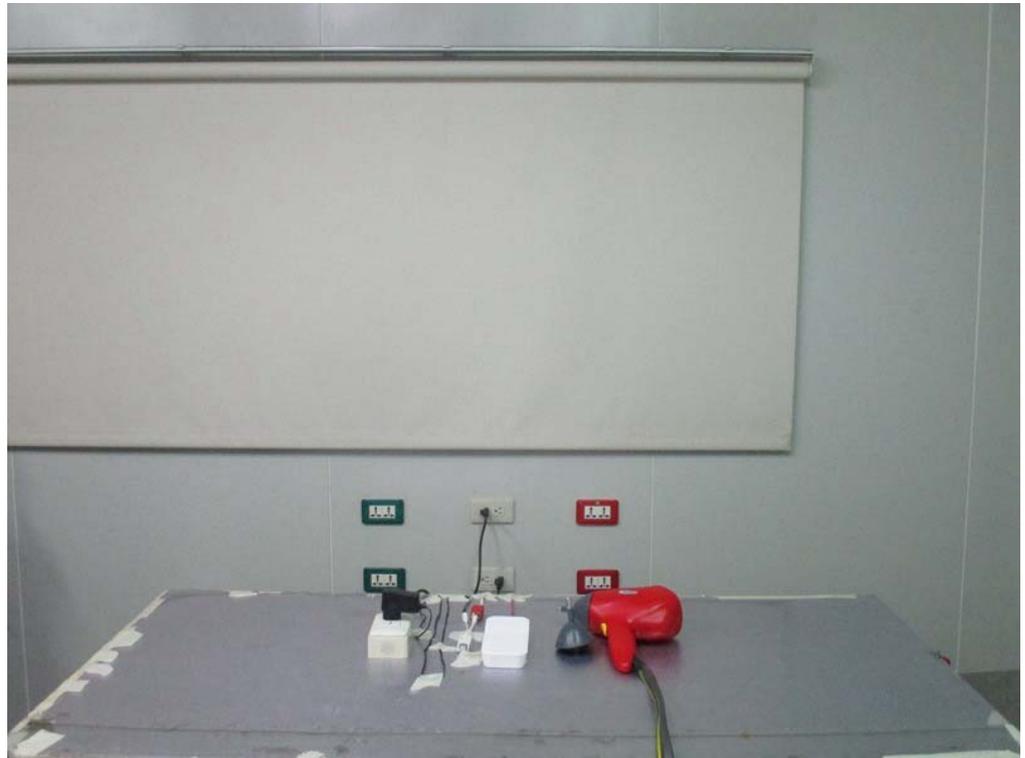


REAR VIEW

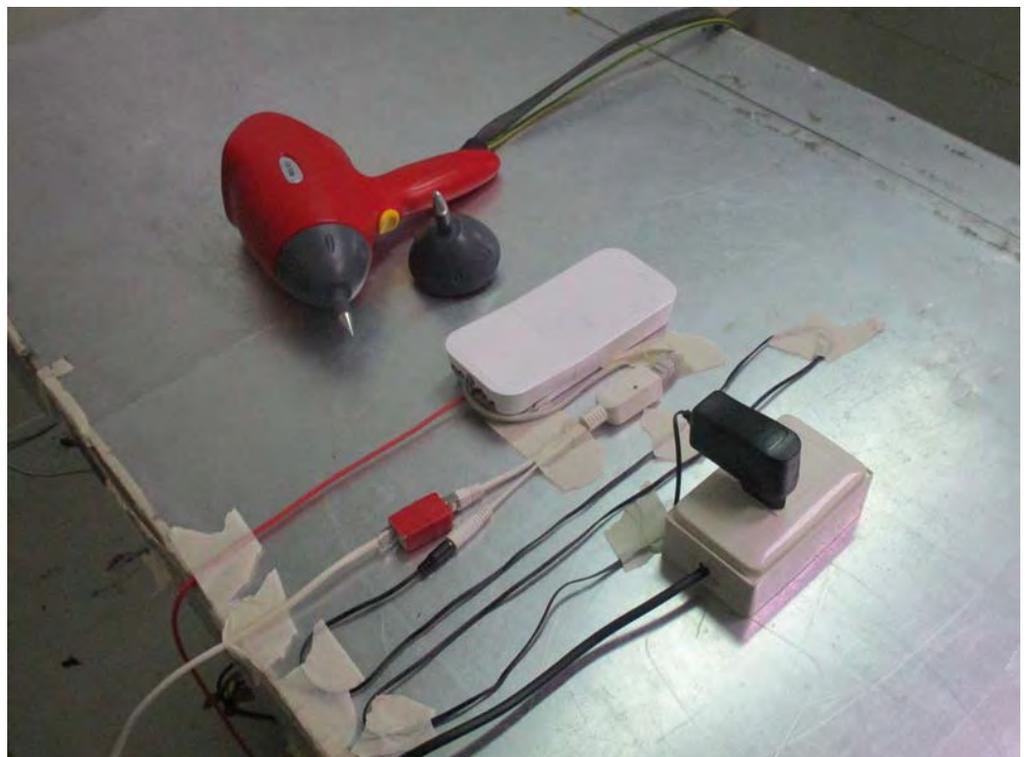


Test Mode: Mode 2

FRONT VIEW



REAR VIEW

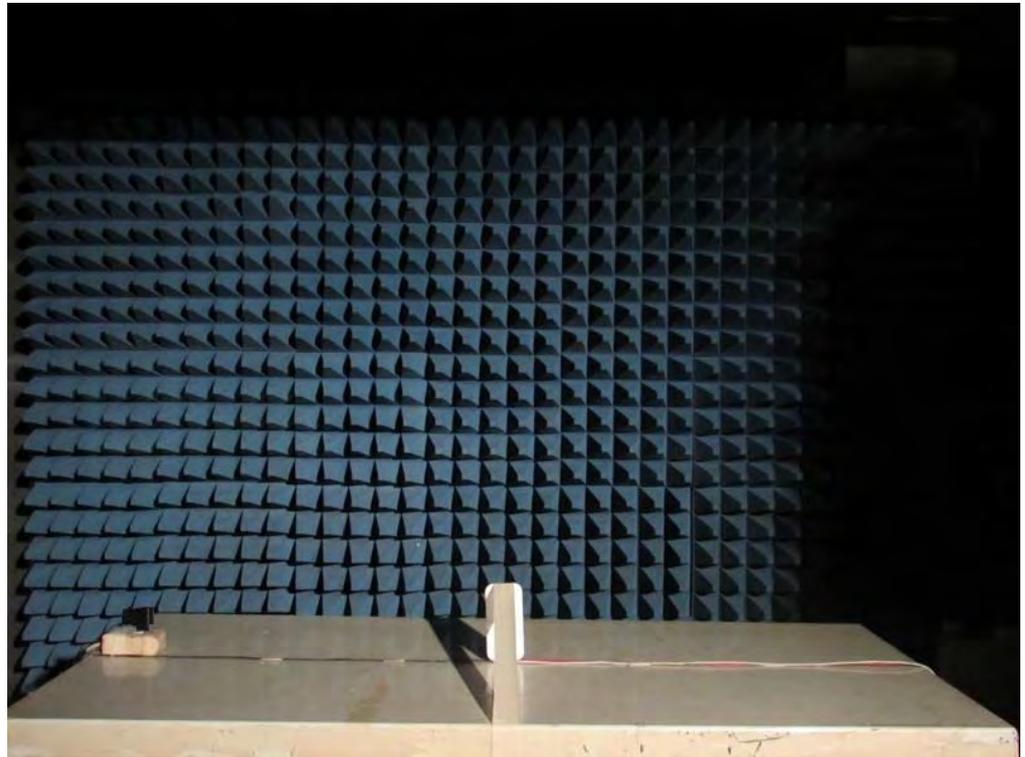


## 6. Photographs of RS Immunity Test Configuration

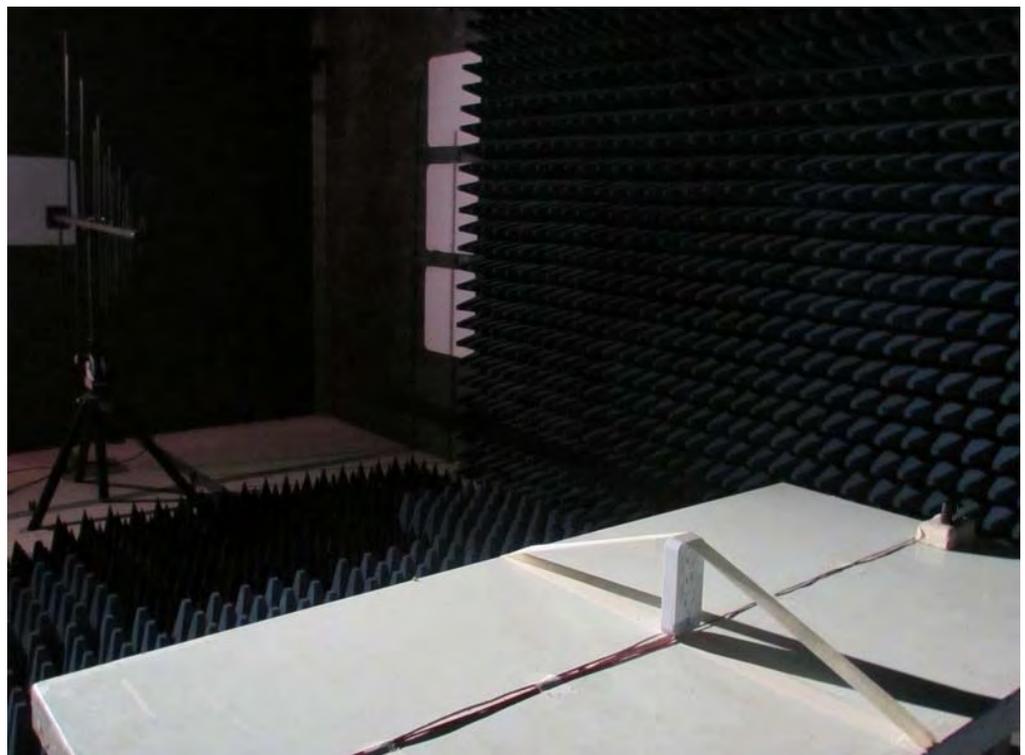
Test Mode: Mode 1

For 80 MHz to 1,000 MHz:

FRONT VIEW

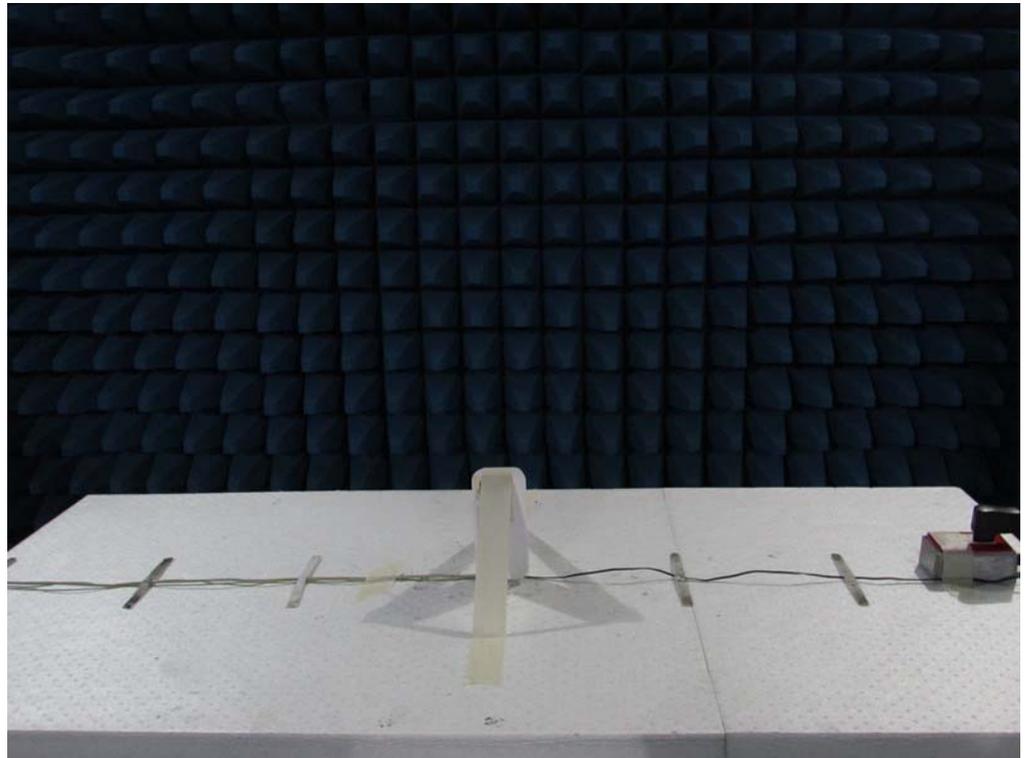


REAR VIEW

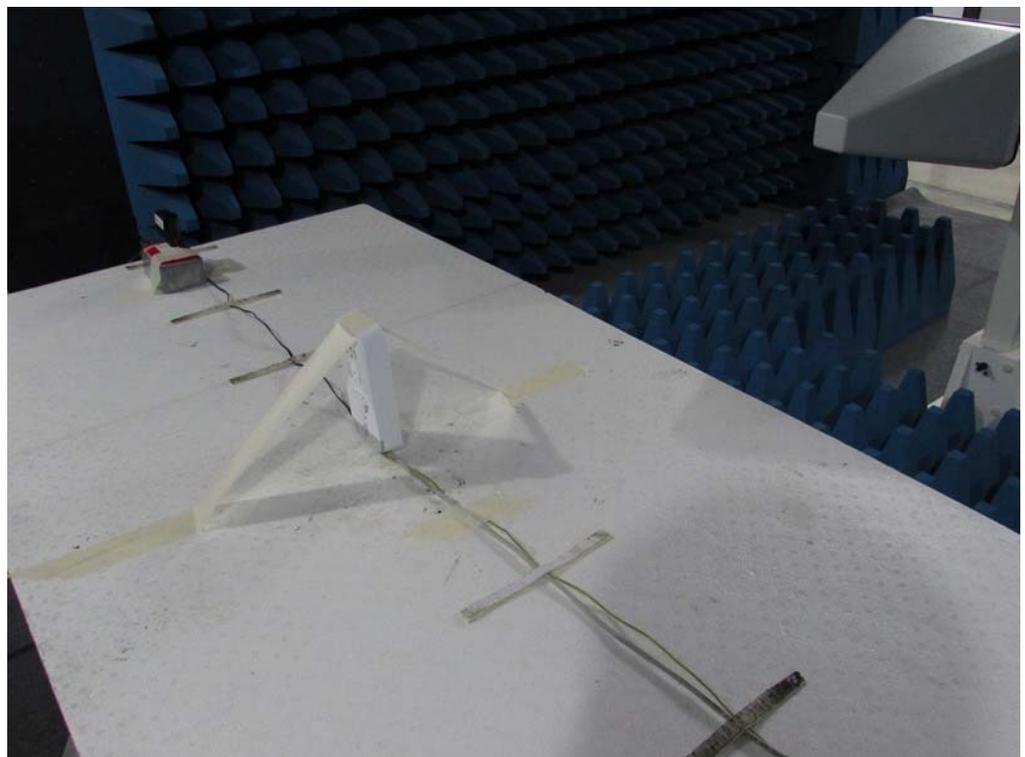


For 1,000 MHz to 6,000 MHz:

**FRONT VIEW**



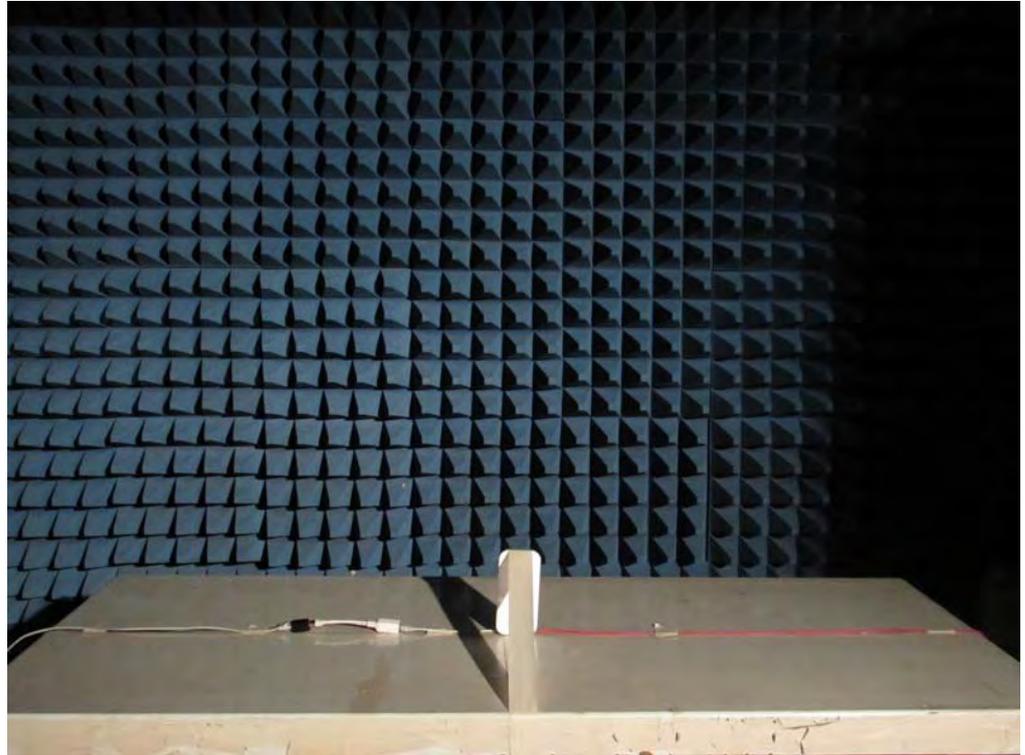
**REAR VIEW**



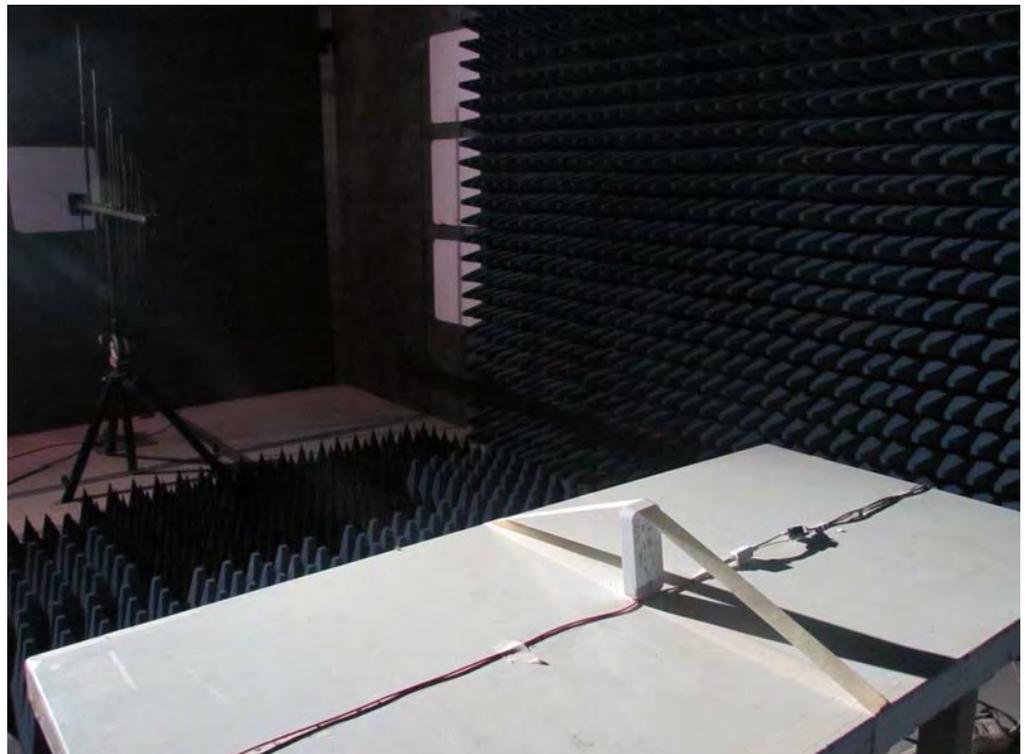
Test Mode: Mode 2

For 80 MHz to 1,000 MHz:

FRONT VIEW

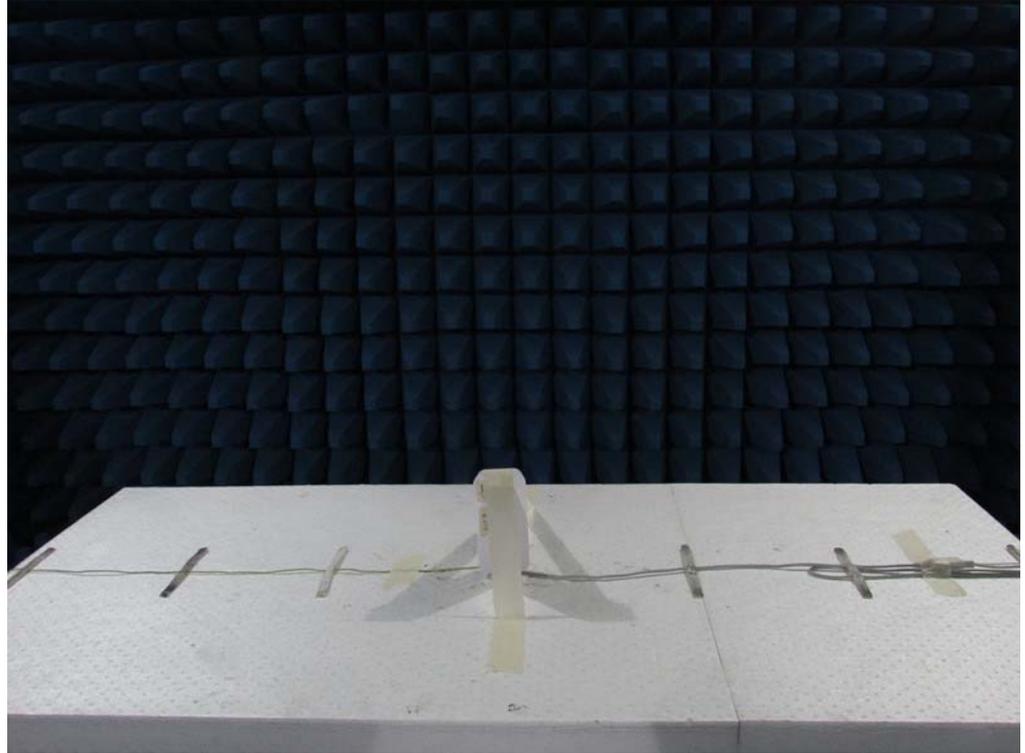


REAR VIEW

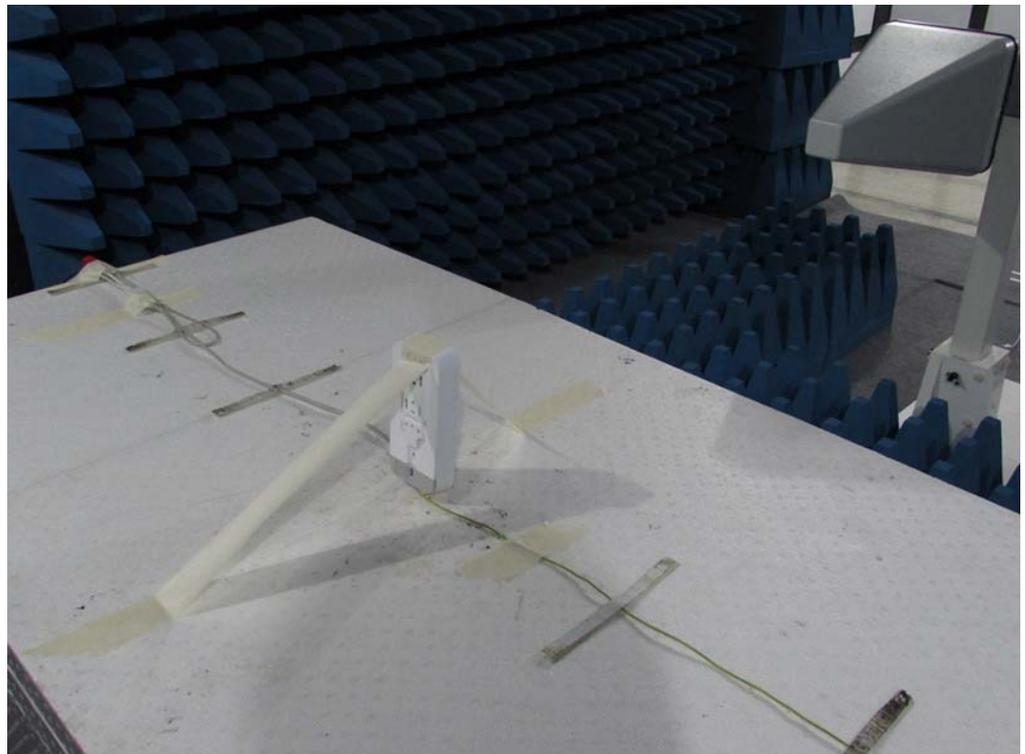


For 1,000 MHz to 6,000 MHz:

FRONT VIEW



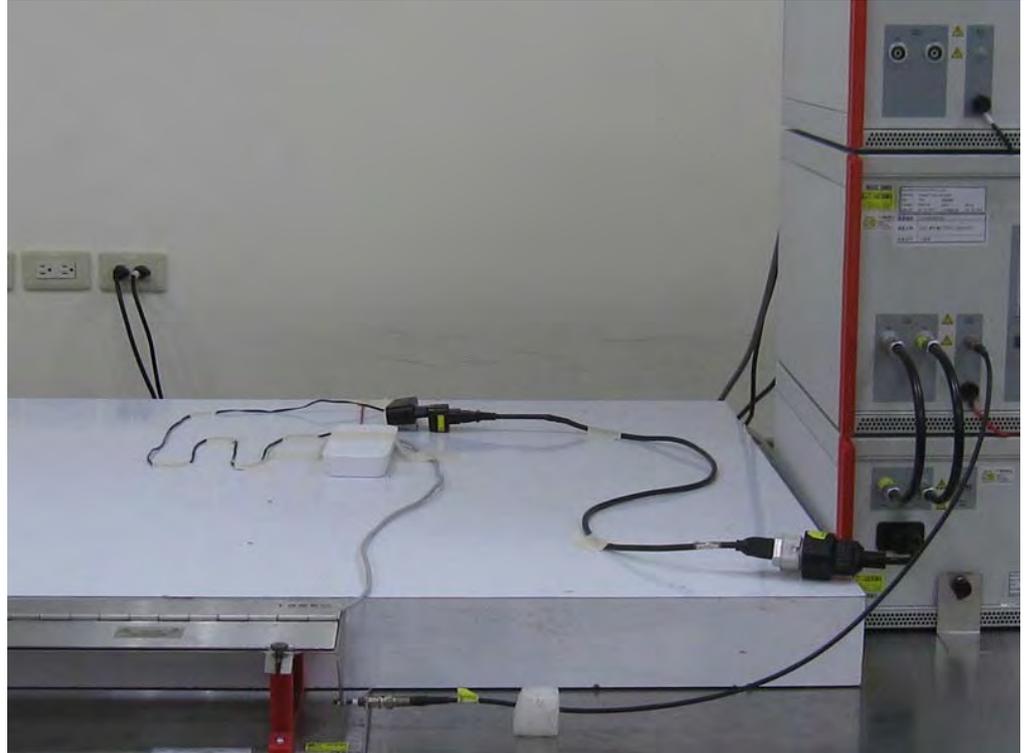
REAR VIEW



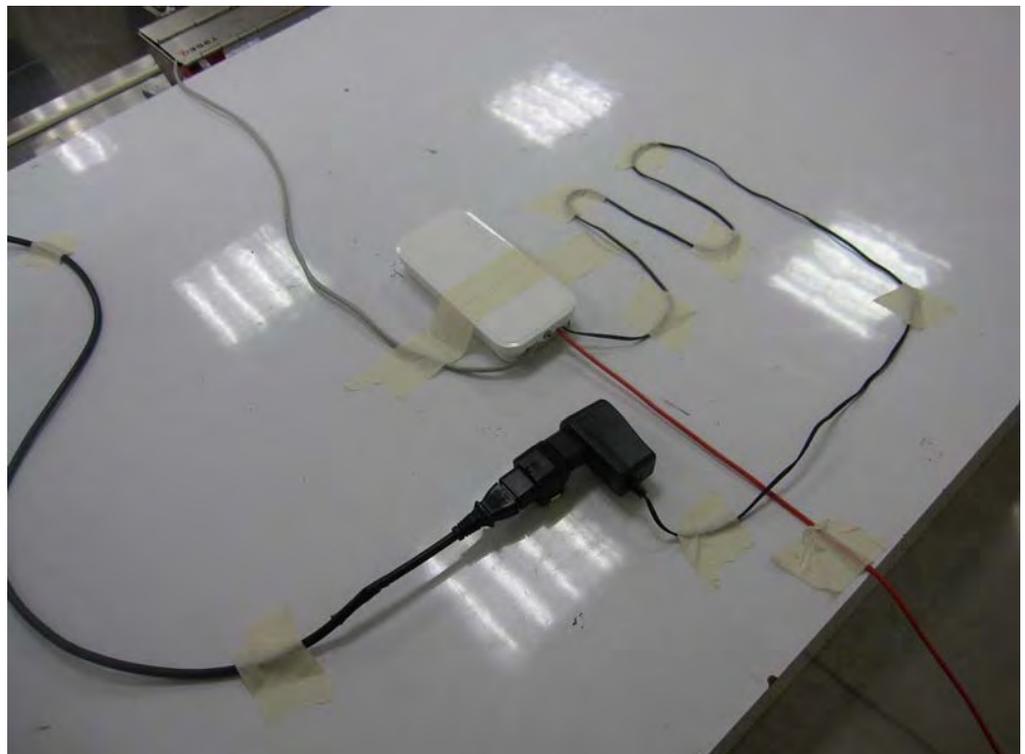
## 7. Photographs of EFT Test Configuration

Test Mode: Mode 1

FRONT VIEW

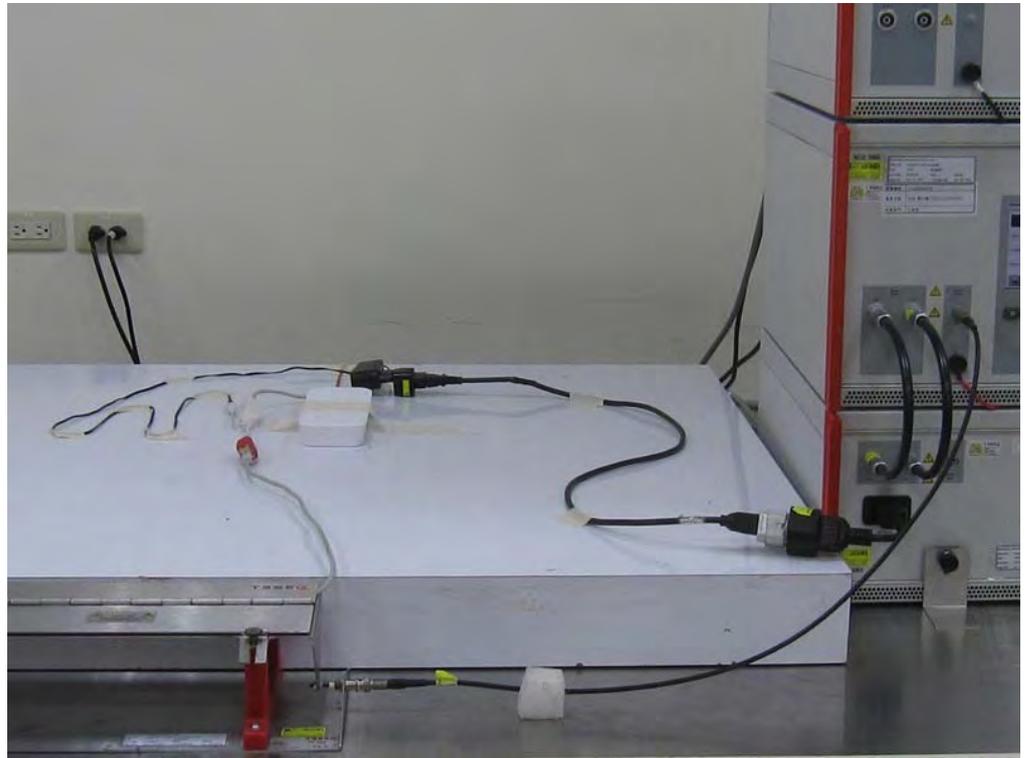


REAR VIEW

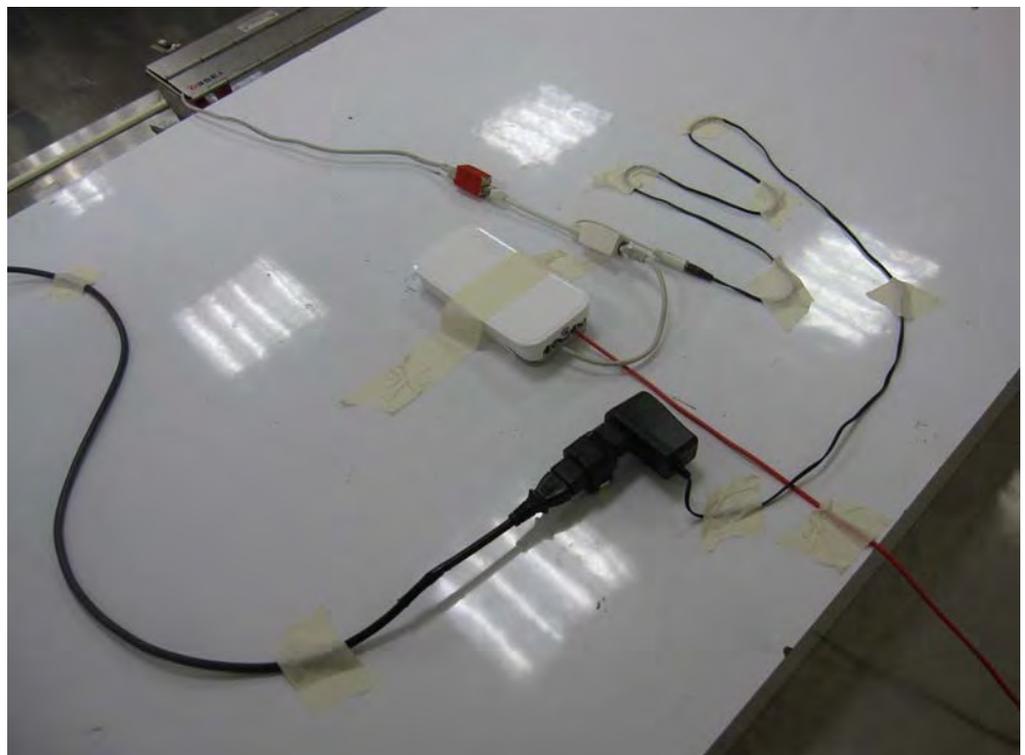


Test Mode: Mode 2

FRONT VIEW



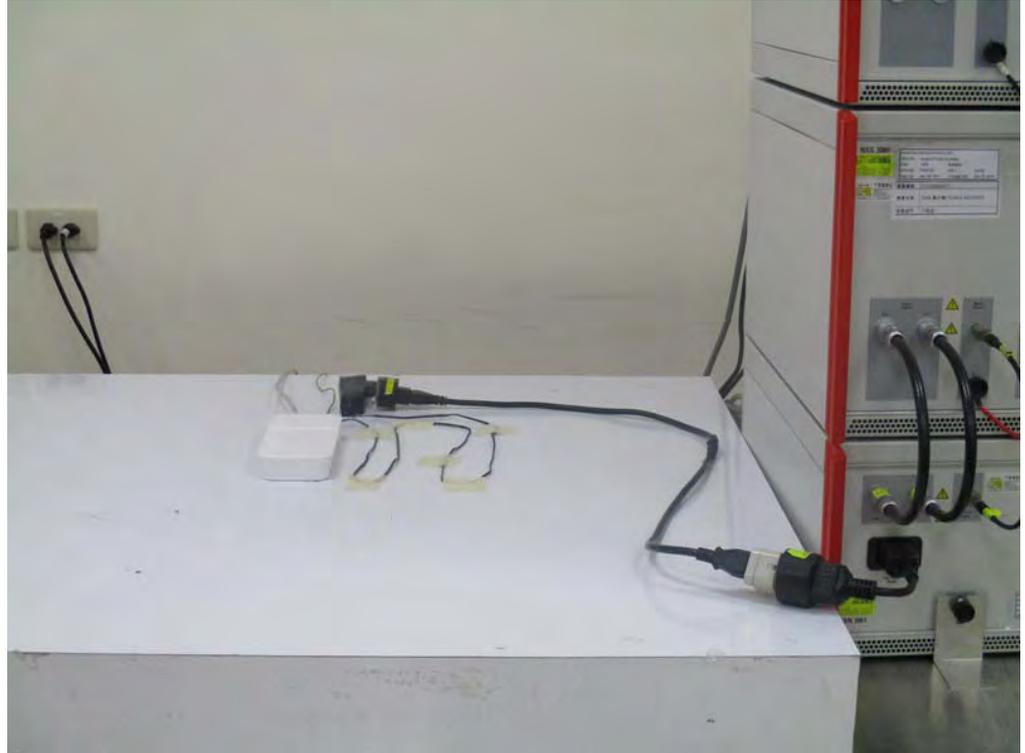
REAR VIEW



## 8. Photographs of Surge Test Configuration

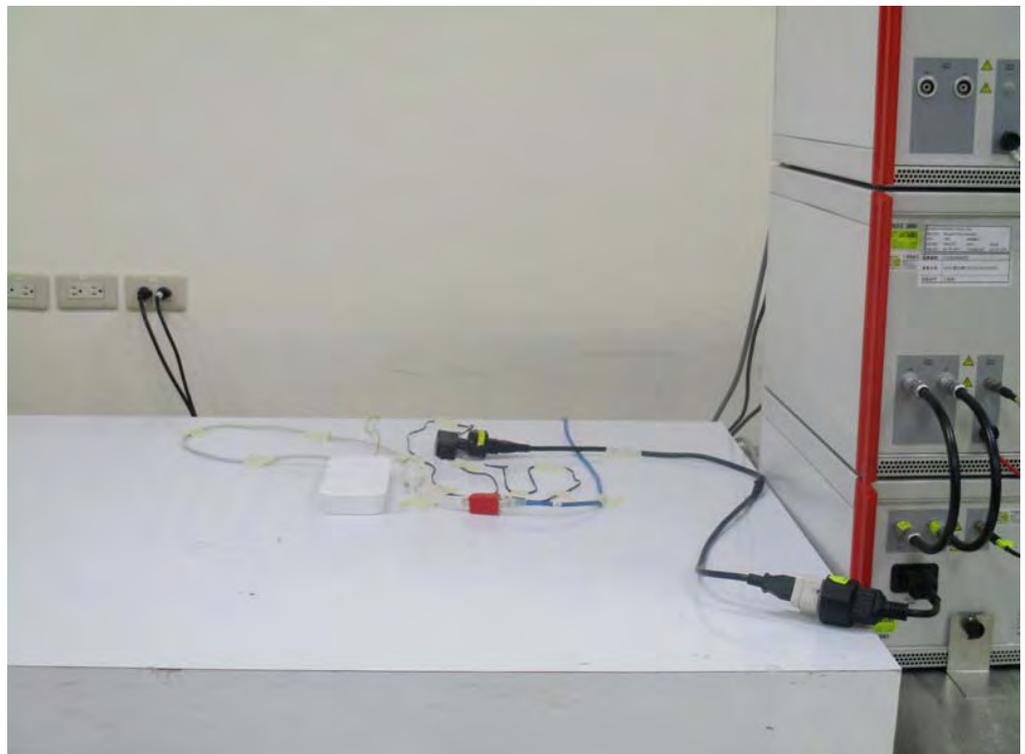
Test Mode: Mode 1

FRONT VIEW



Test Mode: Mode 2

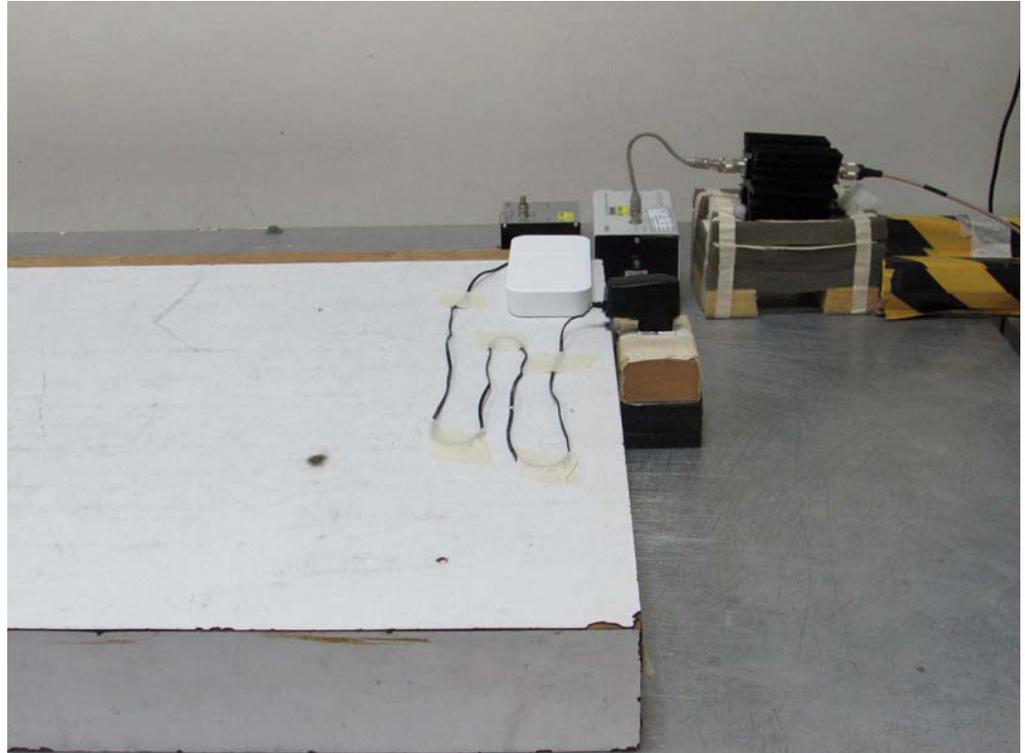
FRONT VIEW



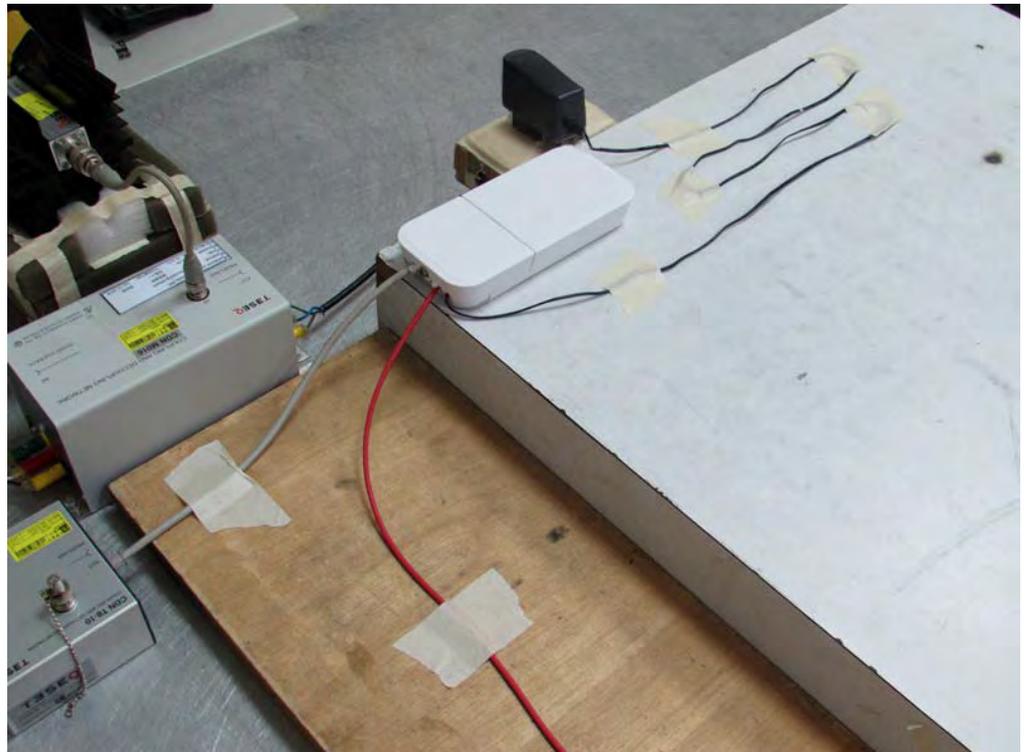
## 9. Photographs of CS Immunity Test Configuration

Test Mode: Mode 1

FRONT VIEW



REAR VIEW

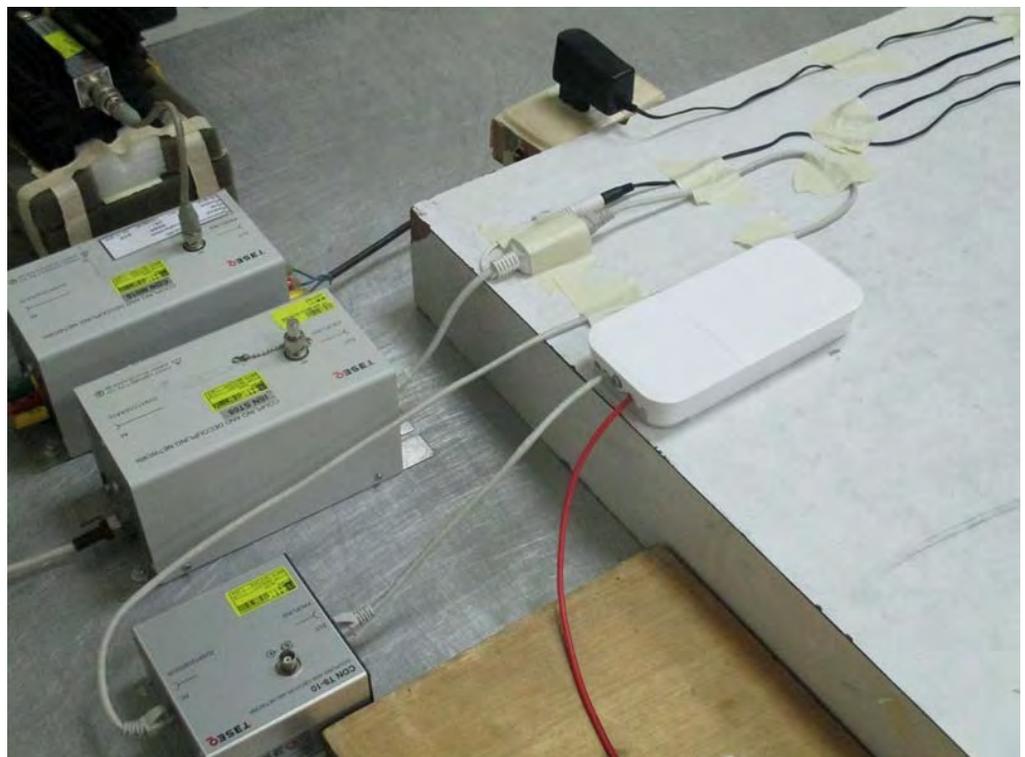


Test Mode: Mode 2

FRONT VIEW



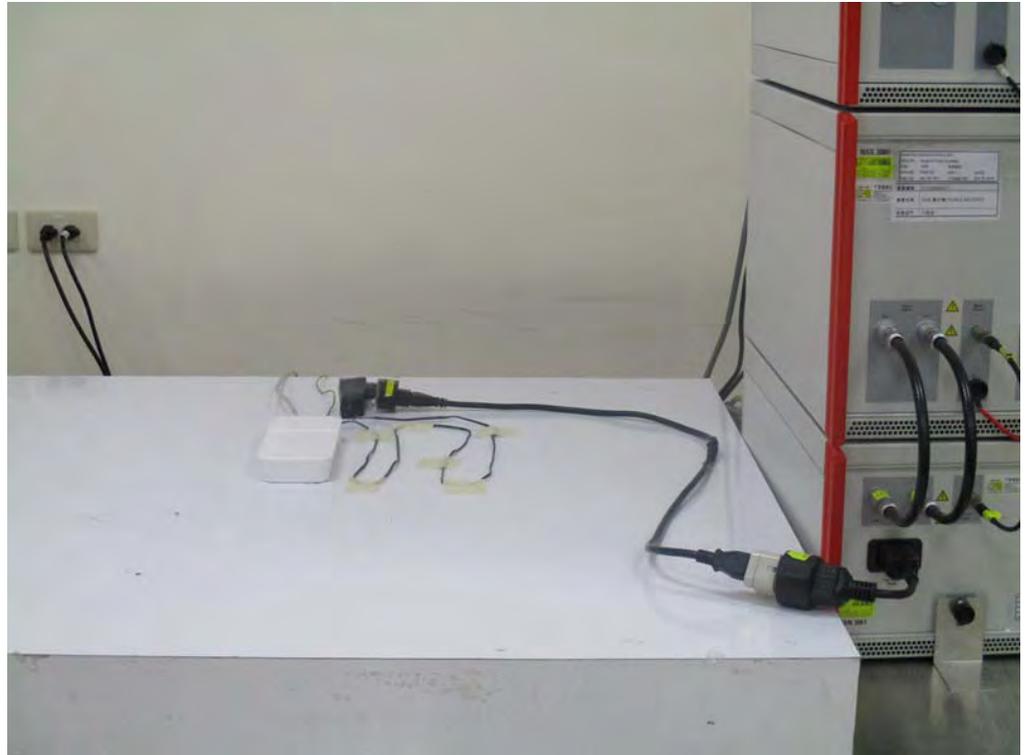
REAR VIEW



## 10. Photographs of DIP Test Configuration

Test Mode: Mode 1

FRONT VIEW



Test Mode: Mode 2

FRONT VIEW

