FCC EMI TEST REPORT

REPORT NO.	:	**FD733173-02**
MODEL NO.	:	**ePMP Force 190**
RECEIVED DATE	:	**Mar. 30, 2017**
FINAL TESTED DATE	:	**Aug. 01, 2017**
ISSUED DATE	:	**Aug. 18, 2017**
TEST STANDARD	:	**47 CFR FCC Rules and Regulations Part 15 Subpart B, Class B Digital Device** **Canada Standard ICES-003, Issue 6, Class B**
Filing Type	:	**Declaration of Conformity**
APPLICANT	:	**Cambium Networks Inc.**
ADDRESS	:	**3800 Golf Road, Suite 360 Rolling Meadows, IL 60008, USA**
Manufacturer	:	**Cambium Networks Inc.**
ADDRESS	:	**3800 Golf Road, Suite 360 Rolling Meadows, IL 60008, USA**
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.
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- This test report is only applicable to U.S.A. / Canada.

Testing Laboratory
1190

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History of This Test Report

REPORT NO.	VERSION	ISSUED DATE	Description
FD733173-02	Rev. 01	Aug. 18, 2017	Initial issue of report

Project No: CB10608091

VERIFICATION OF COMPLIANCE

EQUIPMENT NAME	**:**	**ePMP Force 190**
BRAND NAME	**:**	**Cambium Networks**
MODEL NO.	**:**	**ePMP Force 190**
APPLICANT	**:**	**Cambium Networks Inc.**
ADDRESS	**:**	**3800 Golf Road, Suite 360 Rolling Meadows, IL 60008, USA**
FINAL TESTED DATE	**:**	**Aug. 01, 2017**
TEST STANDARD	**:**	**47 CFR FCC Rules and Regulations Part 15 Subpart B, Class B Digital Device Canada Standard ICES-003, Issue 6, Class B**

I **HEREBY** DECLARE THAT:

The measurements shown in this test report were made in accordance with the procedures given in **ANSI C63.4 – 2014**.

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 EMI characteristics under the conditions specified in this report.

Beck Wu

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.

EMISSION			
Test Standard	**Test Type**	**Result**	**Remarks**
47 CFR FCC Rules and Regulations Part 15 Subpart B, Class B Digital Device and Canada Standard ICES-003, Issue 6, Class B	AC Power Port Conducted emission test 150 kHz – 30 MHz	PASS	Meet minimum passing margin is -4.09dB at 11.8930MHz.
	Radiated emission test 30 MHz – 1,000 MHz @ 3 m 1,000 MHz – 18,000 MHz @ 3 m 18,000 MHz – 30,000 MHz @ 1 m	PASS	Meet minimum passing margin is -3.37dB at 600.36MHz.

2. General Description of Equipment under Test

Product Detail	
Equipment Name	ePMP Force 190
Model No.	ePMP Force 190
Brand Name	Cambium Networks
Power Supply	From PoE

2.1. Feature of Equipment under Test

1. The EUT supports 5GHz wireless function.
2. Antenna Information

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	-	-	Printed	N/A	22
	2	-	-	Printed	N/A	22
2	1	-	-	Printed	N/A	2
	2	-	-	Printed	N/A	2

Note: Port 1 and Port 2 can be used as transmitting/receiving antenna.
Port 1 and Port 2 could transmit/receive simultaneously.

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

2.2. Modification of EUT

Please refer to the technical specifications of EUT.

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	Normal Link - EUT with Ant. 1
2	Normal Link - EUT with Ant. 2
Mode 2 generated the worst test result, so it was recorded in this report.	

Radiated Emissions	
Test Mode	Description
1	Normal Link - EUT with Ant. 1
2	Normal Link - EUT with Ant. 2
For Radiated Emission test below 1GHz: Mode 1 generated the worst test result, so it was recorded in this report. For Radiated Emission test above1GHz: Mode 1 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.	

Note: 1. The EUT can only be used at Z axis position.

2. PoE information as below:

The EUT was powered by PoE, and the PoE was for measurement only, would not be marketed.

Support Unit	Brand	Model
PoE	Cambium	G1021-300-0265

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.

For AC Power Port Conducted emission test:

Support Unit	Brand	Model	FCC ID
NB*2	DELL	E6430	DoC
PoE	Cambium	G1021-300-0265	DoC

For Radiated emission test:

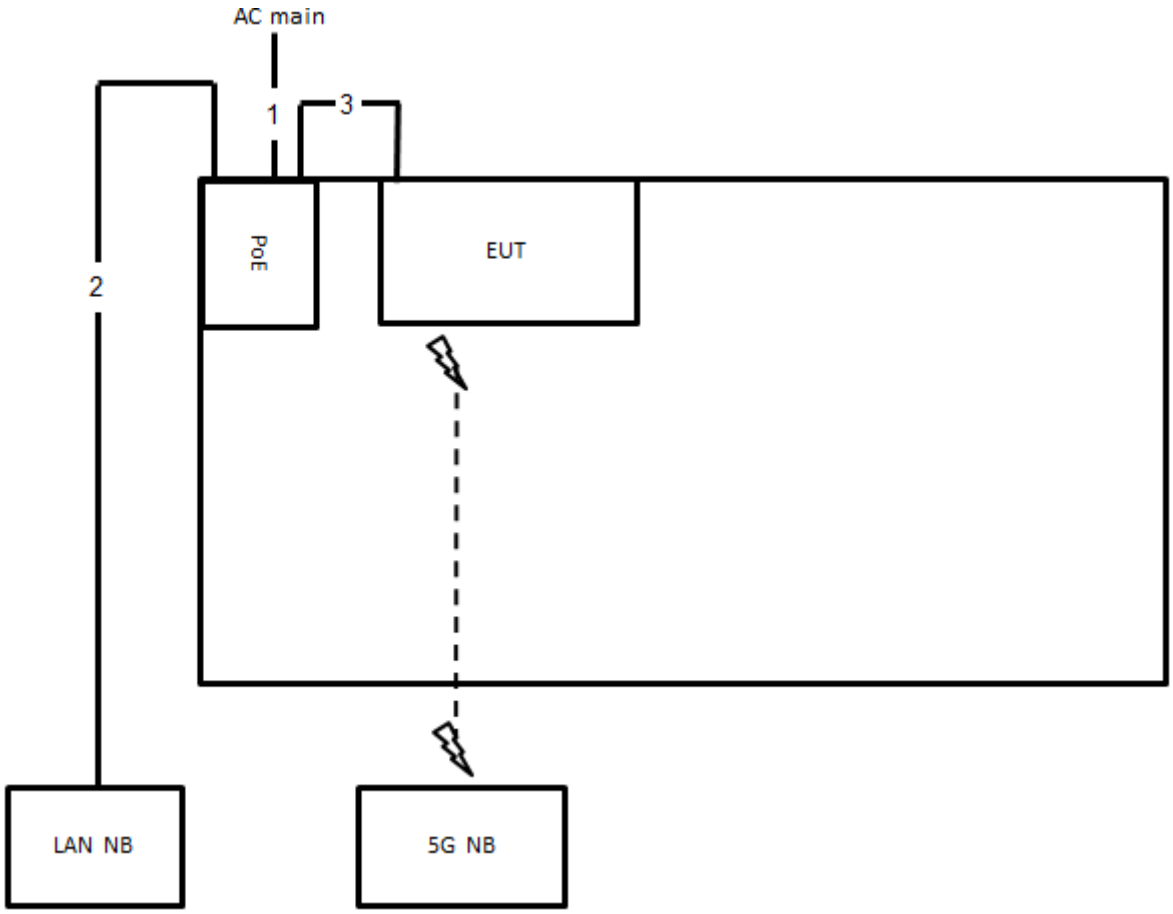
Support Unit	Brand	Model	FCC ID
NB*2	DELL	E4300	DoC
PoE	Cambium	G1021-300-0265	DoC

3.3. EUT Operation Condition

During the test, the remote notebook executed “ping.exe” under WIN7 to link with the EUT to maintain the connection by LAN and WLAN

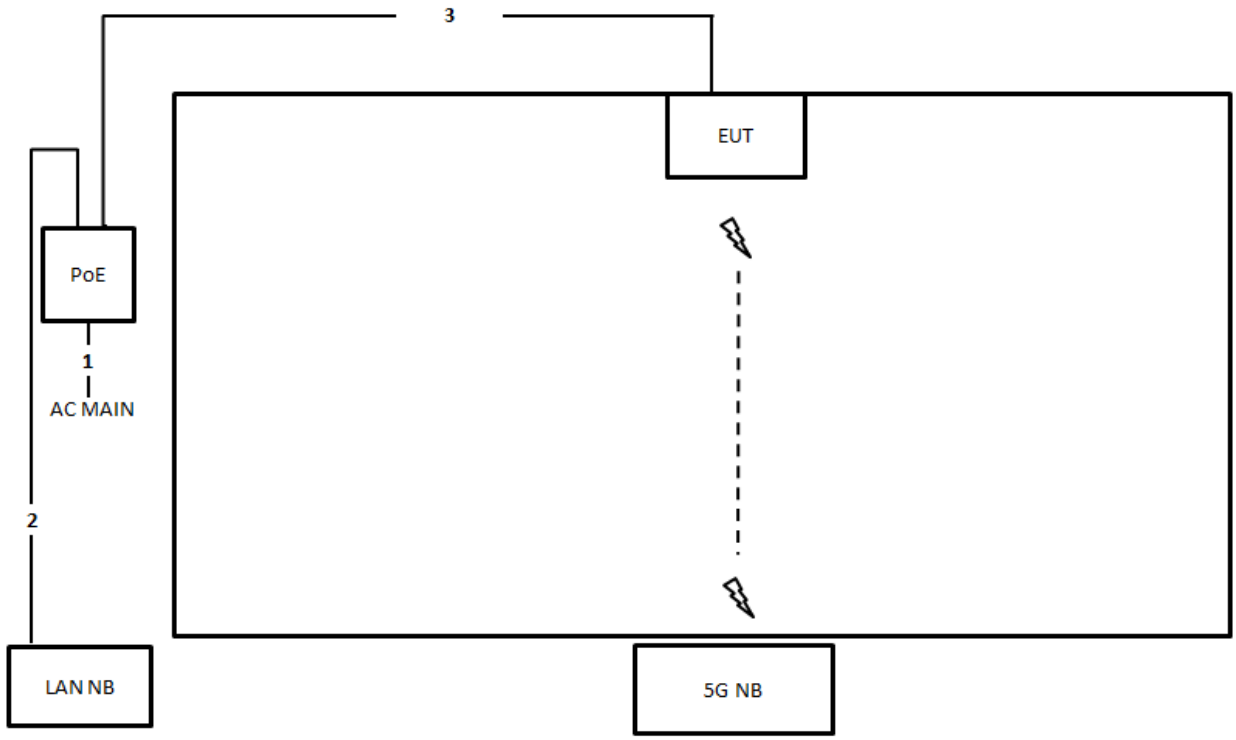
3.4. Connection Diagram of Test System

3.4.1. AC Power Line Conduction Emissions Test Configuration



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

3.4.2. Radiation Emissions Test Configuration



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

4. General Information of Test

4.1. Test Facility

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: 03CH01-CB

4.2. Test Voltage

Power Type	Test Voltage
AC Power Supply	120 V / 60 Hz

4.3. Standard for Methods of Measurement

ANSI C63.4-2014

4.4. Frequency Range Investigated

Test Items	Frequency Range
Conducted emission test	150 kHz to 30 MHz
Radiated emission test	30 MHz to 30,000 MHz

4.5. Test Distance

Test Items	Test Distance
Radiated emission test below 1 GHz (30 MHz to 1,000 MHz)	3 m
Radiated emission test above 1 GHz (1,000 MHz to 18,000 MHz)	3 m
Radiated emission test above 1 GHz (18,000 MHz to 30,000 MHz)	1 m

5. Test of Conducted Emission

5.1. Limit

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

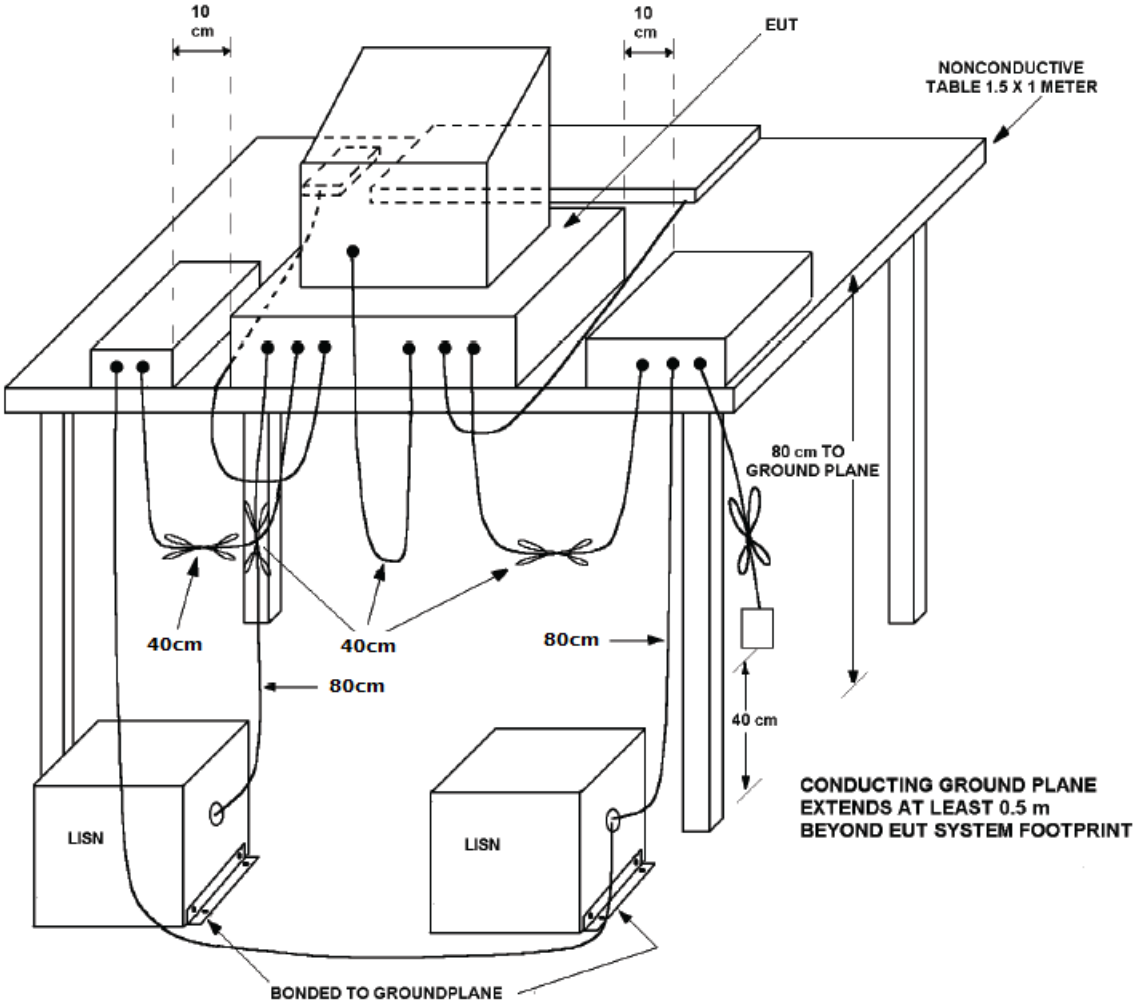
5.2. Description of Major Test Instruments

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 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
b. Connect EUT to the power mains through a line impedance stabilization network (LISN).
c. All the support units are connect to the other LISN.
d. The LISN provides 50 Ω coupling impedance for the measuring instrument.
e. The FCC states that a 50 Ω, 50 uH LISN should be used.
f. Both sides of AC line were checked for maximum conducted interference.
g. The frequency range from 150 kHz to 30 MHz was searched.
h. 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

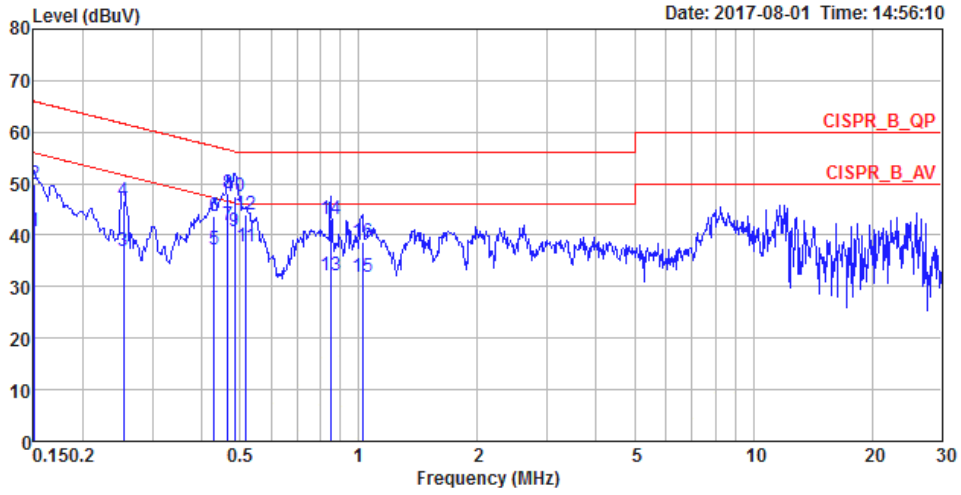


5.5. Test Result of AC Power Ports

Temperature	22℃	Humidity	54%
Test Engineer	Howard Liu	Frequency Range	0.15 MHz to 30 MHz
Test Mode	Mode 2		

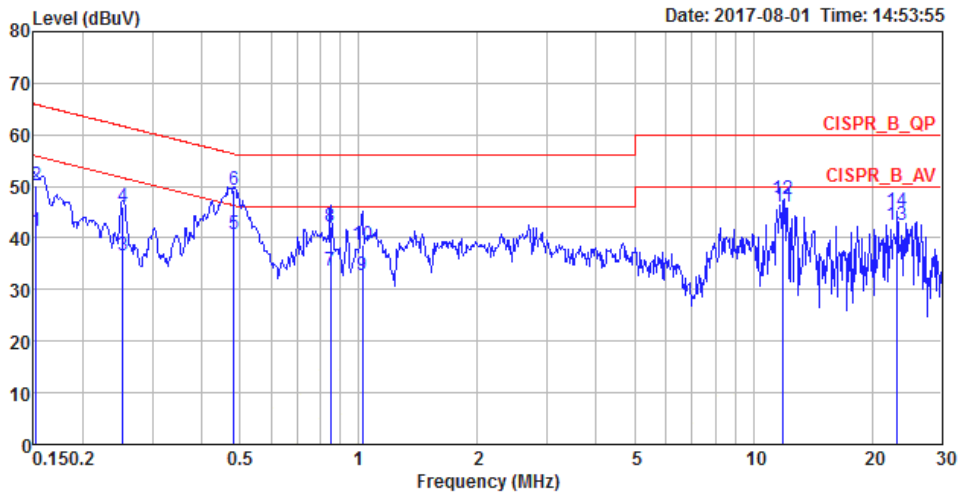
- Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level
- Margin = - Limit + (Read Level + LISN Factor + Cable Loss)
- All emissions not reported here are more than 10 dB below the prescribed limit.
- The test was passed at the minimum margin that marked by a frame in the following table

Line



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1508	40.76	-15.20	55.96	30.60	10.00	0.16	Average	LINE
2	0.1508	49.89	-16.07	65.96	39.73	10.00	0.16	QP	LINE
3	0.2535	36.91	-14.73	51.64	26.90	9.92	0.09	Average	LINE
4	0.2535	46.74	-14.90	61.64	36.73	9.92	0.09	QP	LINE
5	0.4302	37.29	-9.96	47.25	27.32	9.95	0.02	Average	LINE
6	0.4302	43.81	-13.44	57.25	33.84	9.95	0.02	QP	LINE
7	0.4664	41.84	-4.74	46.58	31.85	9.95	0.04	Average	LINE
8	0.4664	48.14	-8.44	56.58	38.15	9.95	0.04	QP	LINE
9	0.4838	40.84	-5.43	46.27	30.84	9.95	0.05	Average	LINE
10	0.4838	47.50	-8.77	56.27	37.50	9.95	0.05	QP	LINE
11	0.5180	37.65	-8.35	46.00	27.64	9.95	0.06	Average	LINE
12	0.5180	43.98	-12.02	56.00	33.97	9.95	0.06	QP	LINE
13	0.8475	32.27	-13.73	46.00	22.15	9.96	0.16	Average	LINE
14	0.8475	43.24	-12.76	56.00	33.12	9.96	0.16	QP	LINE
15	1.0211	31.92	-14.08	46.00	21.77	9.96	0.19	Average	LINE
16	1.0211	38.71	-17.29	56.00	28.56	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	0.1525	41.33	-14.53	55.86	31.07	10.10	0.16	Average	NEUTRAL
2	0.1525	50.24	-15.62	65.86	39.98	10.10	0.16	QP	NEUTRAL
3	0.2528	36.54	-15.13	51.67	26.37	10.08	0.09	Average	NEUTRAL
4	0.2528	46.15	-15.52	61.67	35.98	10.08	0.09	QP	NEUTRAL
5	0.4836	40.88	-5.40	46.28	30.60	10.23	0.05	Average	NEUTRAL
6	0.4836	49.30	-6.98	56.28	39.02	10.23	0.05	QP	NEUTRAL
7	0.8483	33.58	-12.42	46.00	23.32	10.10	0.16	Average	NEUTRAL
8	0.8483	42.24	-13.76	56.00	31.98	10.10	0.16	QP	NEUTRAL
9	1.0211	32.80	-13.20	46.00	22.56	10.05	0.19	Average	NEUTRAL
10	1.0211	38.62	-17.38	56.00	28.38	10.05	0.19	QP	NEUTRAL
11	11.8930	45.91	-4.09	50.00	35.51	10.23	0.17	Average	NEUTRAL
12	11.8930	47.46	-12.54	60.00	37.06	10.23	0.17	QP	NEUTRAL
13	23.1291	42.60	-7.40	50.00	31.96	10.41	0.23	Average	NEUTRAL
14	23.1291	45.30	-14.70	60.00	34.66	10.41	0.23	QP	NEUTRAL

6. Test of Radiated Emission

6.1. Limit

Radiated Emission below 1 GHz test at 3 m:

Frequency (MHz)	QP (dBuV/m)
30~88	40
88~216	43.5
216~960	46
Above 960	54

Radiated Emission 1~18 GHz test at 3 m:

Frequency (MHz)	PK (dBuV/m)	AV (dBuV/m)
1,000 to 18,000	74	54

Radiated Emission 18~30 GHz test at 1 m:

Frequency (MHz)	PK (dBuV/m)	AV (dBuV/m)
18,000 to 30,000	83.54	63.54

6.2. Description of Major Test Instruments

6.2.1. 30 MHz ~ 1,000 MHz

Receiver Parameter	Setting
Start Frequency	30 MHz
Stop Frequency	1000 MHz
RBW	120 kHz for QP

6.2.2. Above 1 GHz

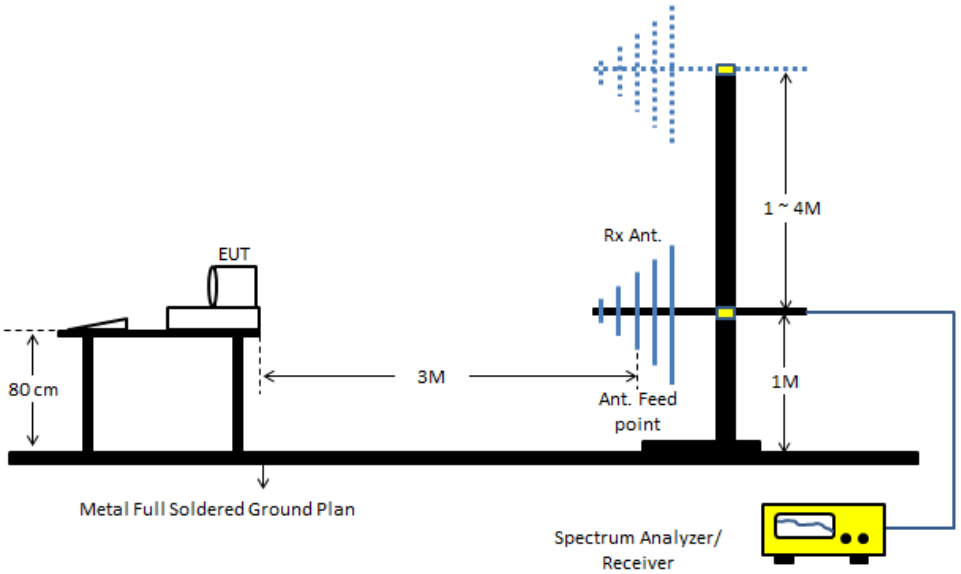
Spectrum Parameter	Setting
Start Frequency	1000 MHz
Stop Frequency	30 GHz
RBW / VBW	1 MHz / 3 MHz for Peak ; 1 MHz / 1 Hz for Average

6.3. Test Procedures

a. The EUT was placed on a rotatable table top 0.8 meter above ground.
b. The EUT was set 3m (below 1GHz) / 3m (1GHz-18GHz) / 1m (18GHz-30GHz) 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 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.
h. For testing above 1GHz, the 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.

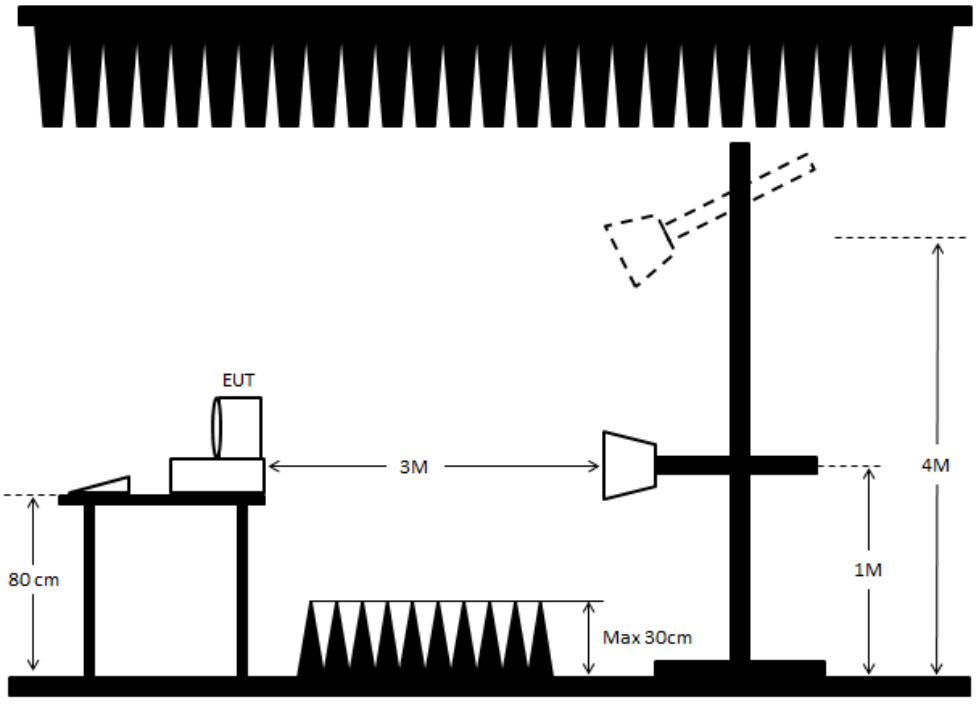
6.4. Typical Test Setup Layout of Radiated Emission

<Below 1 GHz>:

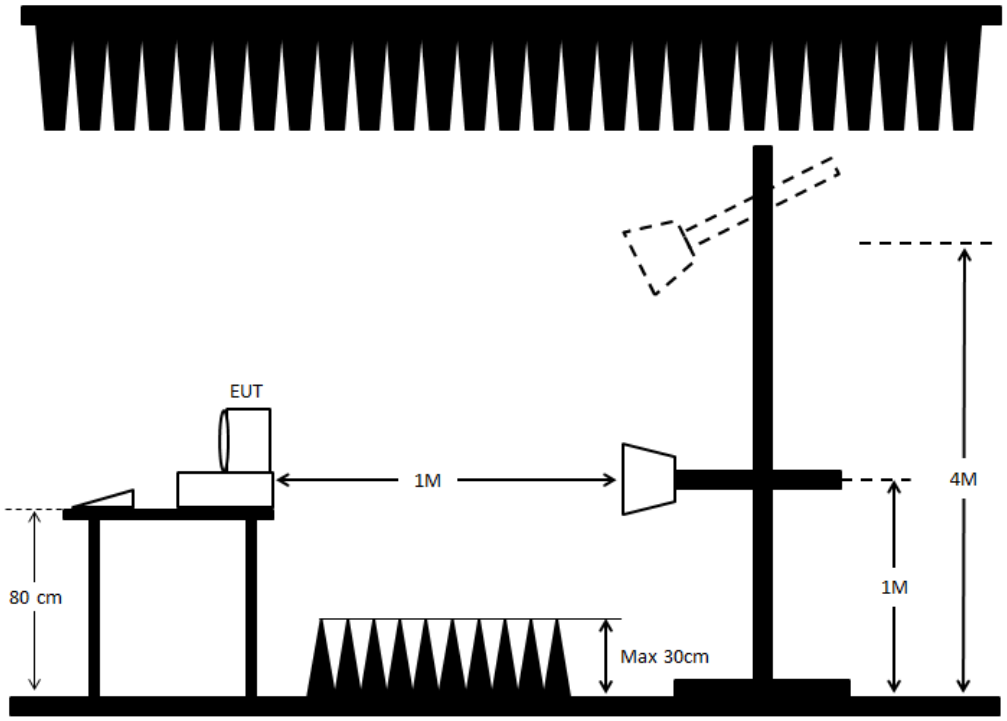


<Above 1 GHz>:

1,000~18,000 MHz



18,000~30,000 MHz

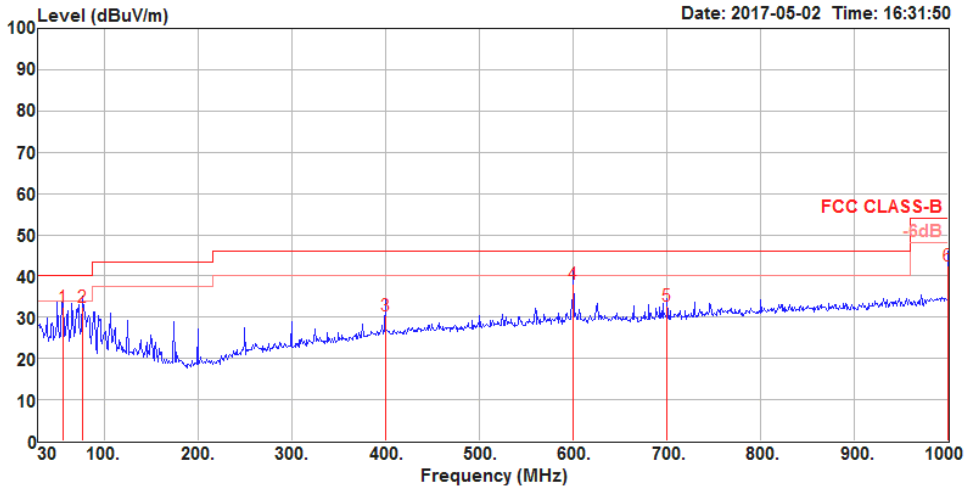


6.5. Test Result of Radiated Emission below 1 GHz

Temperature	22℃	Humidity	54%
Test Engineer	Lucke Hsieh / Paul Chen	Frequency Range	30 MHz to 1,000 MHz
Test Mode	Mode 1		

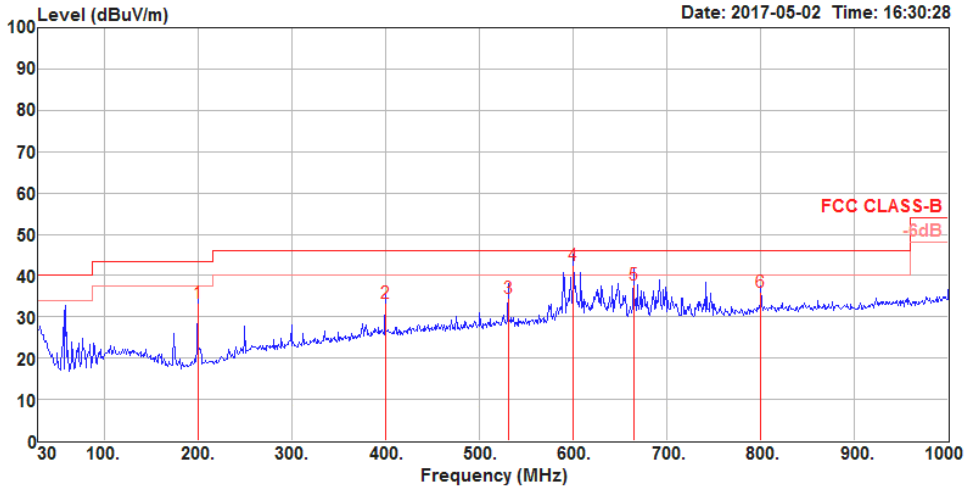
- Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
- Margin = - Limit + (Read Level + Antenna Factor + Cable Loss - Preamp Factor)
- The test was passed at the minimum margin that marked by the frame in the following test record

Vertical 30 MHz to 1,000 MHz



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	56.19	32.56	40.00	-7.44	50.77	0.73	13.47	32.41	100	346	QP	VERTICAL
2	76.56	32.49	40.00	-7.51	50.93	0.83	13.13	32.40	125	144	QP	VERTICAL
3	399.57	30.44	46.00	-15.56	38.41	1.95	22.37	32.29	125	124	QP	VERTICAL
4	600.36	38.03	46.00	-7.97	43.08	2.44	24.90	32.39	200	247	QP	VERTICAL
5	700.27	32.72	46.00	-13.28	37.02	2.55	25.50	32.35	125	1	QP	VERTICAL
6	1000.00	42.56	54.00	-11.44	41.87	3.18	28.20	30.69	125	11	QP	VERTICAL

Horizontal 30 MHz to 1,000 MHz



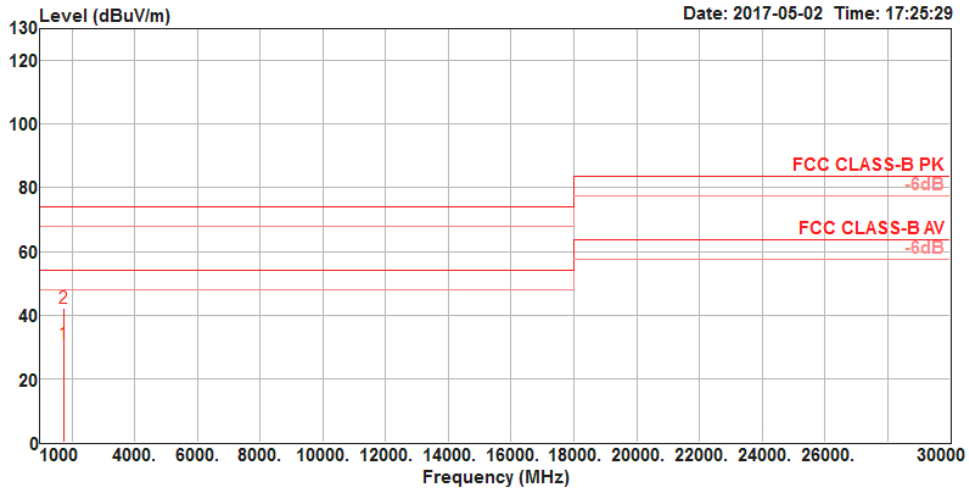
	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	199.75	33.28	43.50	-10.22	47.93	1.36	16.30	32.31	150	122	QP	HORIZONTAL
2	399.57	33.28	46.00	-12.72	41.25	1.95	22.37	32.29	200	202	QP	HORIZONTAL
3	530.52	34.58	46.00	-11.42	40.46	2.24	24.23	32.35	300	138	QP	HORIZONTAL
4	600.36	42.63	46.00	-3.37	47.68	2.44	24.90	32.39	125	295	QP	HORIZONTAL
5	664.38	37.74	46.00	-8.26	42.20	2.47	25.43	32.36	150	284	QP	HORIZONTAL
6	800.18	35.89	46.00	-10.11	38.39	3.02	26.60	32.12	100	333	QP	HORIZONTAL

6.6. Test Result of Radiated Emission above 1 GHz

Temperature	22℃	Humidity	54%
Test Engineer	Lucke Hsieh / Paul Chen	Frequency Range	1,000 MHz to 30,000 MHz
Test Mode	Mode 1		

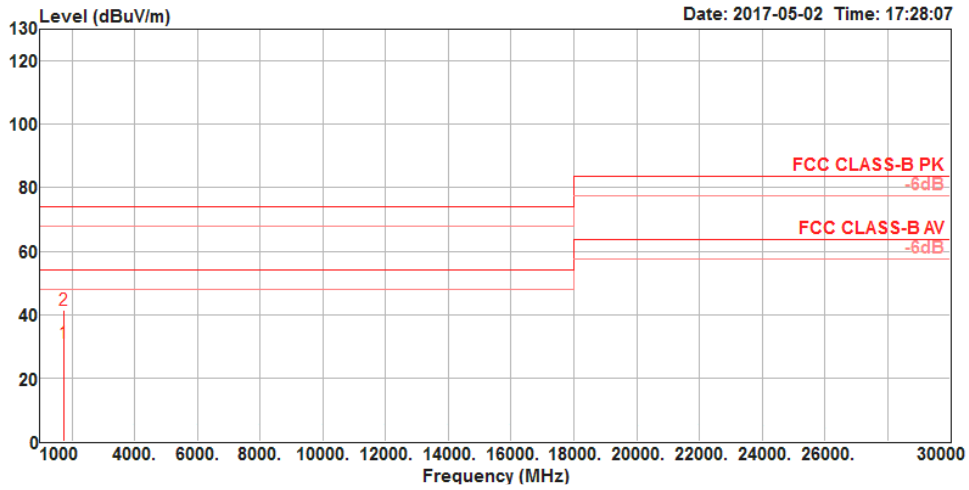
- Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
- Margin = - Limit + (Read Level + Antenna Factor + Cable Loss - Preamp Factor)
- The test was passed at the minimum margin that marked by the frame in the following test record

Vertical 1,000 MHz to 30,000 MHz



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1749.97	31.22	54.00	-22.78	32.11	5.18	28.67	34.74	100	349	Average	VERTICAL
2	1750.10	42.35	74.00	-31.65	43.24	5.18	28.67	34.74	100	349	Peak	VERTICAL

Horizontal 1,000 MHz to 30,000 MHz



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1750.00	31.23	54.00	-22.77	32.12	5.18	28.67	34.74	150	24	Average	HORIZONTAL
2	1750.26	41.32	74.00	-32.68	42.21	5.18	28.67	34.74	150	24	Peak	HORIZONTAL

7. List of Measuring Equipment Used

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)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	May 24, 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)
BILOG ANTENNA with 6dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37880 & AT-N0609	20MHz ~ 2GHz	Aug. 30, 2016	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Nov. 10, 2016	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 25, 2016	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 05, 2017	Radiation (03CH01-CB)
Pre-Amplifier	EMCI	EMC330N	980332	20MHz ~ 3GHz	May 02, 2017	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 16, 2017	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jun. 28, 2016	Radiation (03CH01-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jul. 10, 2017	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 22, 2016	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100355	9kHz ~ 2.75GHz	May 16, 2016	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100355	9kHz ~ 2.75GHz	May 06, 2017	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#1	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#2	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)

※ Calibration Interval of instruments listed above is one year.

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

8. Uncertainty of Test Site

Test Items	Uncertainty	Remark
Conducted Emissions	3.2 dB	Confidence levels of 95%
Radiated Emissions below 1GHz	3.6 dB	Confidence levels of 95%
Radiated Emissions 1GHz ~ 18GHz	3.7 dB	Confidence levels of 95%
Radiated Emissions 18GHz ~ 40GHz	3.5 dB	Confidence levels of 95%

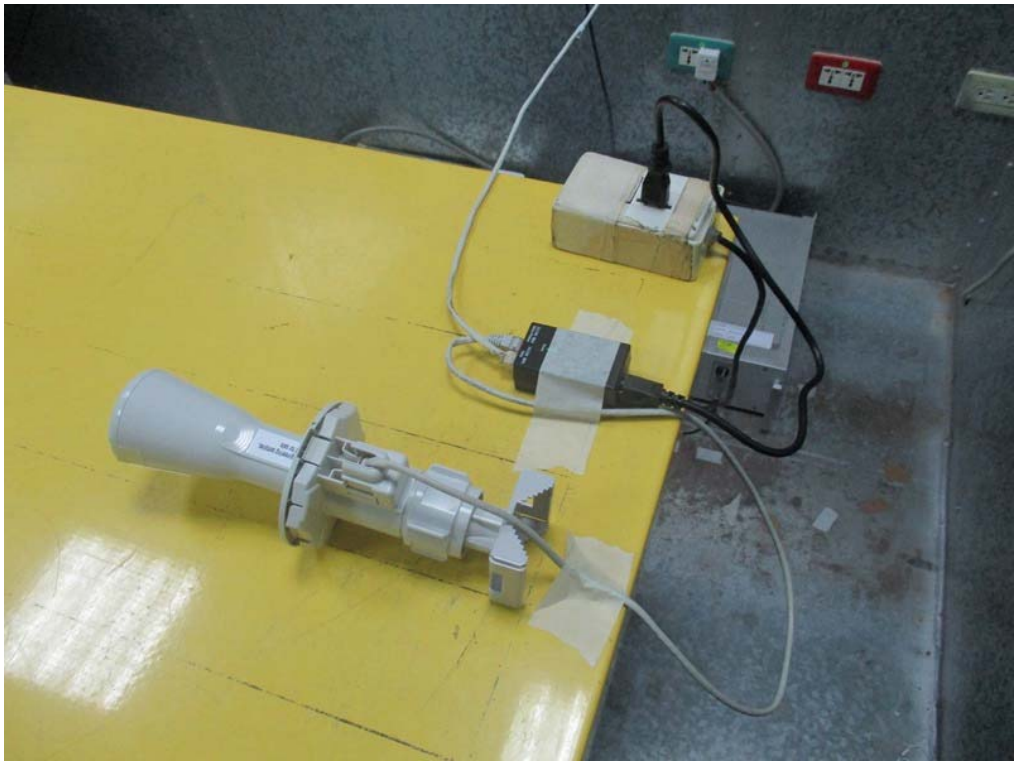
Appendix A. Test Photos

1. Photographs of Conducted Emissions Test Configuration

Test Mode: Mode 2

FRONT VIEW

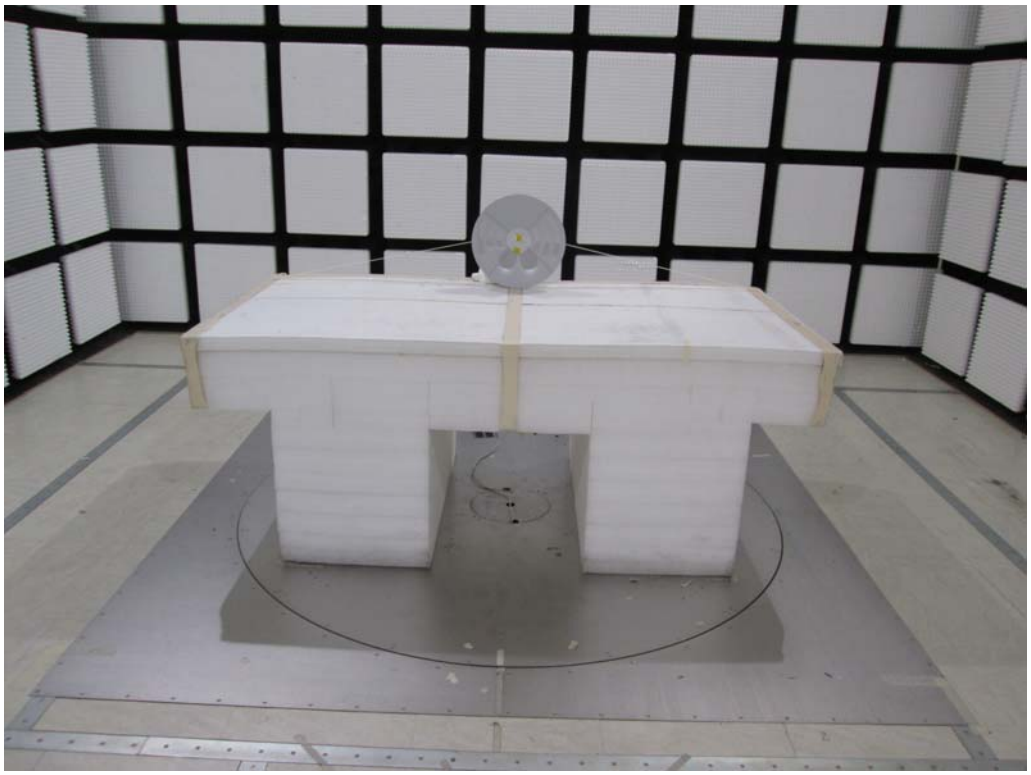
REAR VIEW



2. Photographs of Radiated Emissions Test Configuration

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

FRONT VIEW



REAR VIEW

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

FRONT VIEW

REAR VIEW