FCC Test Report

Application No.:	HKES150500080501
Applicant:	S.E.M. INDUSTRIES
Address:	35/F., Tower A, Billion Centre No.1 Wang Kwong Road, Kowloon Bay, Kowloon Hong Kong
Product Information:	
Product Description:	Portable Speaker
Model:	X-2808-BTFM3U~4AH, X-2808-BTFM3U, X-2808, X2808BTFM3U4AH, X2808BTFM3U, X2808, Submarine (X-2808), X-2808(Submarine), MW601 ♣ ♣ Please refer to section 2 of this report which indicates which item was actually tested and which were electrically identical.
Brand Name:	S.E.M./ S-LOGO/ NIL/ S-DIGITAL/ SDIGITAL/ S.E.M. AUDIO LABORATORIES/ Memorex
Product Class :	Low Power Communication Device – Transmitter (2.4 GHz)
FCC ID:	2AANA-SEM-X2808
Requirement:	CFR 47 FCC PART 15 SUBPART C, 2014 - Intentional Radiators (Section 15.249)
Date of Receipt:	2015-05-11
Date of Test:	2015-05-19 to 2015-05-26
Date of Issue:	2015-05-28
Test Result :	**PASS***

In the configuration tested, the EUT complied with the requirements for the relevant clauses of Federal Communications Commission Rules as specified above.

Authorized Signature:

CHEN Jian-feng, Jeffrey

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS IECC Limited or testing done by SGS IECC Limited in connection with, distribution or use of the product described in this report must be approved by SGS IECC Limited in writing.

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2 Test Summary

Test	Test Requirement	Test Method	Result
Conducted Emission (150KHz to 30MHz)	FCC PART 15, SUBPART C: 2014	ANSI C63.4:2003	PASS
Radiated Emission (9kMHz to 1GHz)	FCC PART 15, SUBPART C: 2014	ANSI C63.4:2003	PASS
Radiated Emission above 1 GHz	FCC PART 15, SUBPART C: 2014	ANSI C63.4:2003	PASS
Band edge / 20 dB Bandwidth	FCC PART 15, SUBPART C: 2014	ANSI C63.4:2003 Marker-Detla measurement	PASS

♣ **Item no.:** X-2808-BTFM3U~4AH, X-2808-BTFM3U, X-2808, X2808BTFM3U4AH, X2808BTFM3U, X2808, Submarine (X-2808), X-2808(Submarine), MW601

According to the confirmation from the applicant, the above models are identical in all electrical aspects in relating to the circuit design, PCB layout and construction. The differences are the model no. trade name, color, cosmetic outlook and silkscreen.

Therefore only the item X-2808-BTFM3U~4AH was tested in this report.

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4 General Information

4.1 General Description of EUT

Product Description: Portable Speaker
Model No: X-2808-BTFM3U~4AH
Serial No.: --

4.2 Details of EUT

Power Supply: AC 100-240V 50/60Hz to DC 5V adaptor: AS050-050-UA100
DC 3.7V (Rechargeable battery x1)
Power Cable: 2 wires unscreened USB adaptor cable (1 meter length)
Operating Frequency 2402-2480MHz
Antenna Type: Integral antenna
Bluetooth version V4.0 single mode
Modulation Type: Π/4-DQPSK and 8DPSK

Modulation	Packet	Packet Type	Packet Size
(π/4)DQPSK	2DH1	20	54
	2DH3	26	367
	2DH5	30	379
8DPSK	3DH1	24	83
	3DH3	27	552
	3DH5	31	1021

4.3 Conditions of EUT

The received sample was under good condition.

4.4 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Notebook	HP	OmniBook 6000 series	(S) TW22204704
BT test board	Supported by client		
Test software	BlueSuite_2_5		
Cable	Aux in cable (3.5mm jack) with 22k Ohm Terminator		
Cable	USB charging cable with 5 Ohm Terminator		
Note: USB charging cable, aux in cable and notebook are provided by SGS IECC Ltd.			

All field strength measures in this test report were done by the aid of test software which places the device in continuous transmission under different package type and the test software above allowed to set the frequency fixed and hopping stopped.

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4.5Standards Applicable for Testing

CFR 47, FCC Part 15, 2014
ANSI C63.4:2003

4.6 Test Location

All tests were performed at:

SGS IECC Limited (Member of the SGS Group (SGS SA))

Units 303-305, 3/F., 31 Lok Yip Road, On Lok Tsuen, Fanling, N.T., Hong Kong

Tel: +852 2305 2570 Fax: +852 2756 4480

4.7 Test Facility

Measurement facility located at Fanling (Hong Kong), placed on file with the FCC Pursuant to Section 2.948 of the FCC Rules (FCC Registration No. : 97774).

The test facility is recognized, certified, or accredited by the following organizations:

FCC – CAB Registration No.: 446297

Measurement facility located at Fanling (Hong Kong), accredited as a Conformity Assessment Body (CAB) and was designated by FCC to perform compliance testing on equipment subject to Declaration Of Conformity (DOC) and Certification under Part 15 and 18 of the Commission's Rules.

4.8 Deviation from Standards

None.

4.9 Abnormalities from Standard Conditions

None.

4.10 Declaration of Family Grouping

None.

4.11 Abbreviations

N/A: Not Applicable
EUT: Equipment Under Test

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5 Equipments Used during Test

Conducted Emission				
Equipment	**Manufacturer**	**Model / Serial No.**	**Cal. Date**	**Cal. Due Date**
Test Receiver	Rohde & Schwarz	ESHS 30 / 839667/002	2014/10/17	2015/10/16
Artificial Mains Network (LISN)	Schwarzbeck	NSLK 8127 / 8127312	2014/4/8	2016/4/19
Impulse Limiter	Rohde & Schwarz	ESH-3-Z2 / 375881052	2015/2/2	2017/2/1

Radiated Emission				
Equipment	**Manufacturer**	**Model / Serial No.**	**Cal. Date**	**Cal. Due Date**
3m Semi-Anechoic Chamber (pre-test)	--	--	--	--
3m / 10m Open Aera Test Site	--	--	2012-3-17	2018-3-10
Test Receiver	Rohde & Schwarz	ESCS 30 / 100388	2014/10/17	2015/10/16
Spectrum Analyzer	Rohde & Schwarz	FSP 30 / 101474	2014/6/16	2015/6/15
Loop antenna	Rohde & Schwarz	HFH2-Z2 / 871336/48	2012/12/27	2015/12/26
Antenna 30-1000MHz	Schaffner	CBL6111C / 2791	2014/10/19	2016/10/18
Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D / 9120D-1070	2014/1/13	2016/1/12
Horn Antenna 15-26.5GHz	Schwarzbeck	BBHA9170 / 9170-492	2014/11/24	2016/11/23
Preamplifier 1-18GHz	Schwarzbeck	BBV9718 / 9718-223	2015/1/29	2016/1/28
Preamplifier 18- 26.5GHz	Schwarzbeck	BBV9719 / 9719-019	2014/11/19	2016/11/18
Coaxial Cable	--	E167	2014/06/25	2015/06/24
RF Cable	HUBER+SUHNER	E207	2014/11/17	2016/11/16
Antenna Mast System	Schwarzbeck	AM9104 / -	--	--
Turntable with Controller	Drehtisch	DT312 / -	--	--

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General Use Equipment				
Equipment	**Manufacturer**	**Model / Serial No.**	**Cal. Date**	**Cal. Due Date**
Digital Multimeter	Fluke	189 / 83640020	2014/4/8	2016/4/19
Temperature / Humidity meter	-	E158	2014-11-14	2015/11/13

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6 Test Results

6.1 Conducted Emissions Mains Terminals, 150kHz to 30MHz

Test Requirement: FCC Part15 C
Test Method: ANSI C63.4
Test Date: 2015-05-19
Frequency Range: 150kHz to 30MHz
Class / Severity: Class B
Detector: Peak for pre-scan (9kHz Resolution Bandwidth)
Quasi-Peak if maximised peak within 6dB of Quasi-Peak limit

Limit:

Frequency range MHz	Class B Limits dB (µV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note:
1) The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.
2) The lower limit is applicable at the transition frequency.

6.1.1 EUT Operation

Operating Environment:

Temperature: 23°C Humidity: 59% RH

EUT Operation: Pre-test with adaptor or battery operate and Peak detector with the following mode(s):
1: Transmission with Π/4-DQPSK (packet 2DH1/2DH3/2DH5)
2: Transmission with 8DPSK (packet 3DH1/3DH3/3DH5)

Final test with adaptor and Quasi-Peak detector with the following mode(s):
1: Transmission with Π/4-DQPSK (packet 2DH5)

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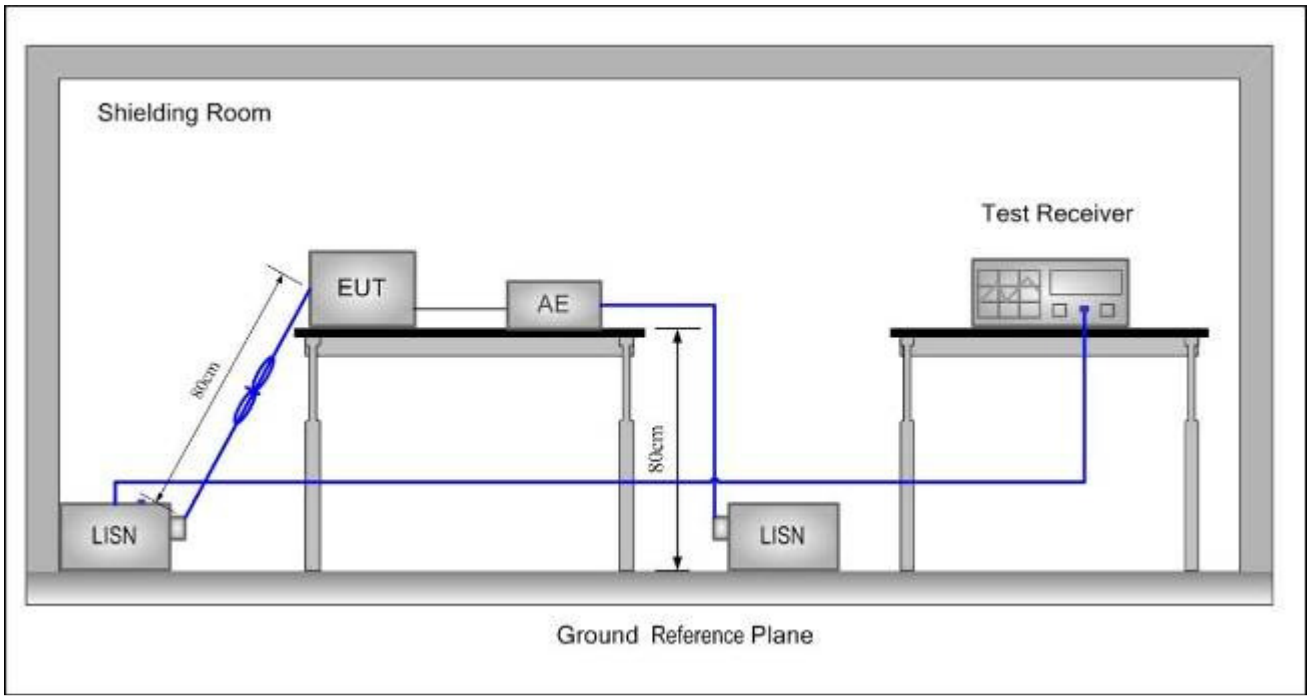
6.1.2 Test Setup and Procedure



1. The mains terminal conducted emission test was conducted in a shielded room.
2. The EUT was connected to AC power source through a LISN (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. For Load terminal voltage measurement, a voltage probe was used on the load terminals. Measurement at control terminals were carried out by means of an impedance stabilization network (ISN). The ISN was bounded to ground.
3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.
4. The EUT kept a distance of at least 0.8m from any other earthed conducting surface. The Artificial Mains Network was situated at a distance of 0.8m from the EUT. The mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m.

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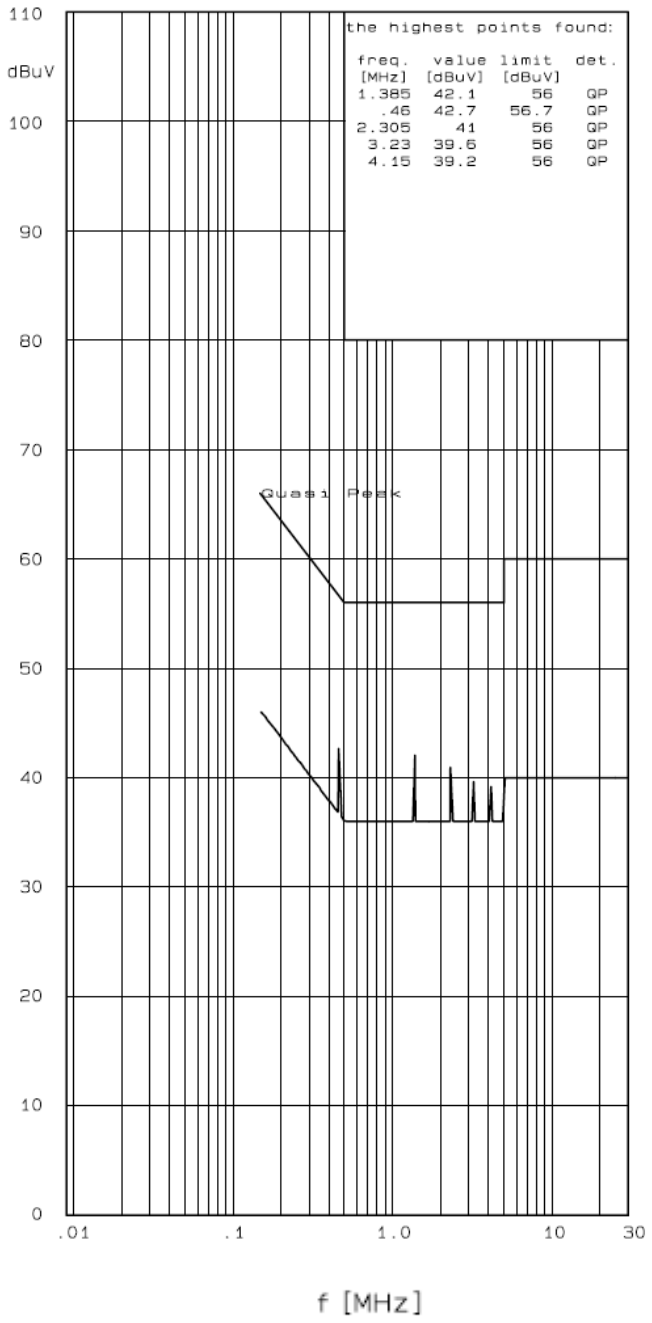
6.1.3 Measurement Data

Live Line:

BT mode

Quasi-peak measurement:



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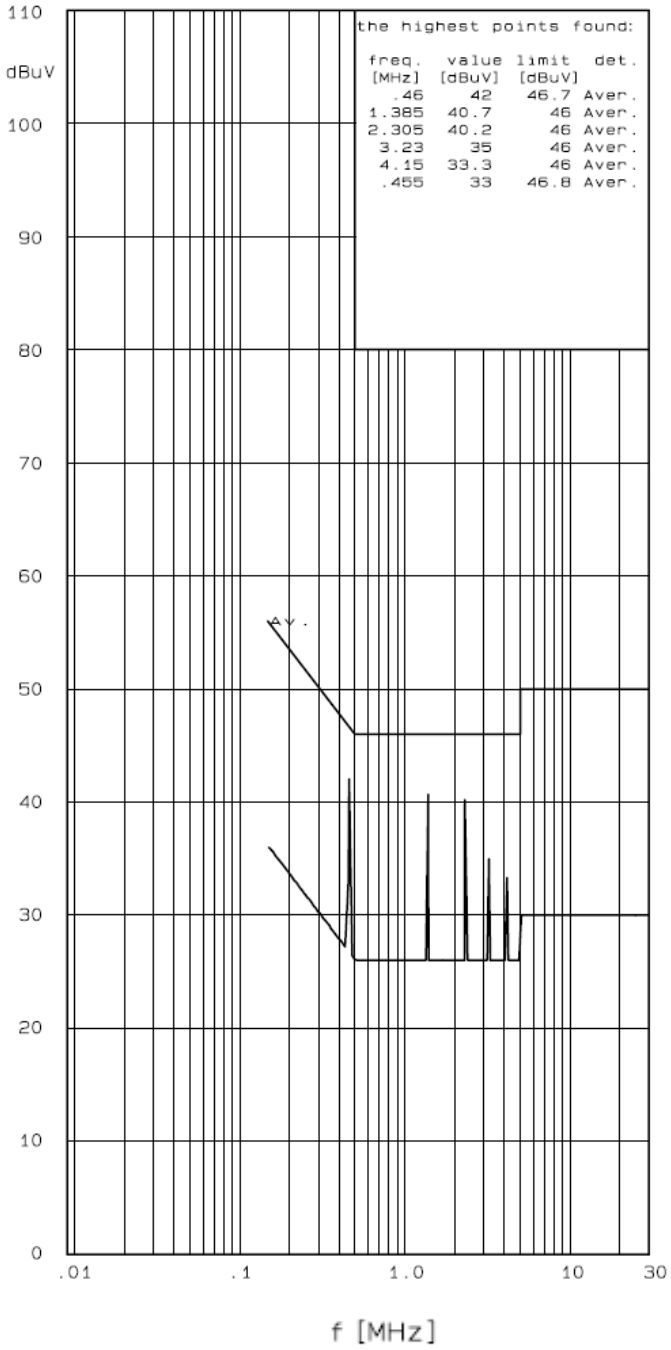
Live Line:

BT mode

Average measurement:



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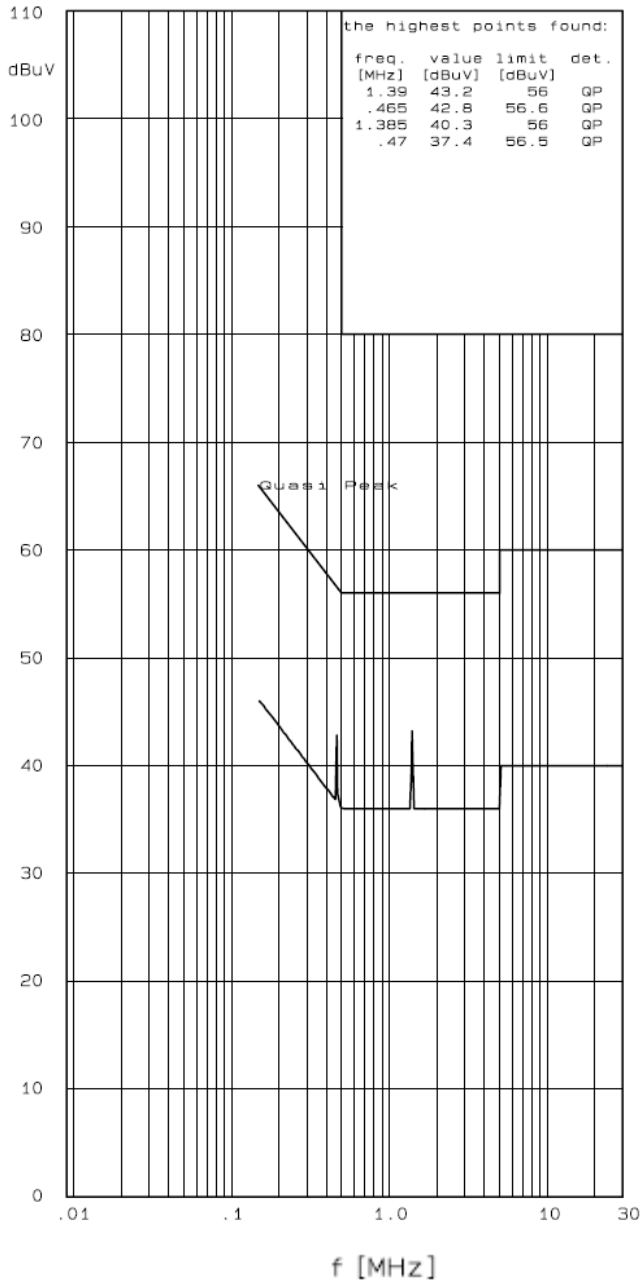
Neutral Line:

BT mode

Quasi-peak measurement:



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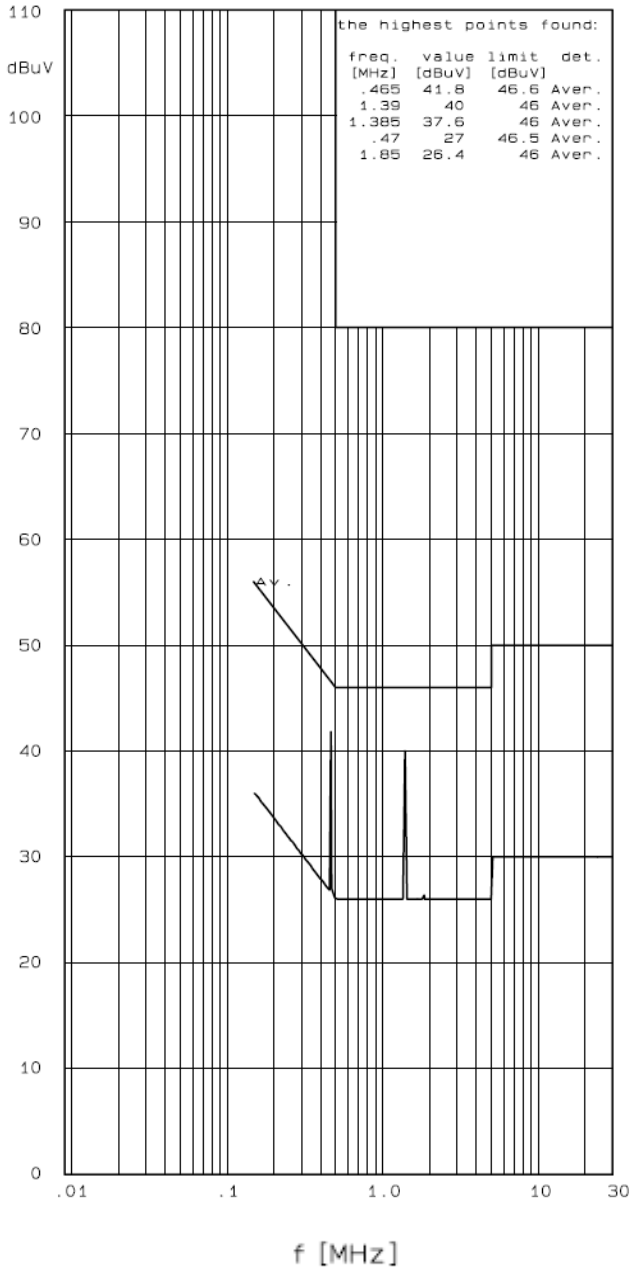
Neutral Line:

BT mode

Average measurement:



Remark 1: USB port and aux in port are terminated by resistor during test.

Remark 2: Emission below limit 20dB is not shown on the graph.

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6.2 Radiated Emissions, 9kHz to1GHz

Test Requirement: FCC Part15 Subpart C Section 15.209 and 15.249(d)

Test Method: ANSI C63.4:2003

Test Date: 2015-05-22

Frequency Range: The lowest frequency generated by EUT, 32.768kHz to 1GHz

Measurement Distance: 3m

Detector: Peak for pre-scan

(200Hz resolution bandwidth and 1kHz video bandwidth for measurement between 9kHz – 150kHz)

(9kHz resolution bandwidth and 100kHz video bandwidth for measurement between 150kHz – 30MHz)

120kHz resolution bandwidth and 1MHz video bandwidth for measurement between 30MHz to 1GHz)

Quasi-Peak if maximised peak within 6dB of limit

Limit :

Frequency range MHz	Quasi-peak limits dB (μV/m)
0.009 – 0.490	-72.4 – 20logF(MHz)
0.490 – 1.705	-12.4 – 20logF(MHz)
1.705 – 30.0	-10.5
30 to 88	40
88 to 216	43.5
216 to 960	46
Above 960	54
Note: 1) At transitional frequencies the lower limit applies. 2) F is the frequency of the spurious emission measured in MHz. 3) Limit from 0.009 – 30 MHz is converted from measuring distance 300m or 30m to 3m with the formulat provided in FCC Part 15, section 15.31(f)(2)	

6.2.1 EUT Operation

Operating Environment:

Temperature: 25 °C Humidity: 58%

EUT Operation: Pre-test with adaptor or battery operate and Peak detector with the following mode(s):

1: Transmission with Π/4-DQPSK (packet 2DH1/2DH3/2DH5)
2: Transmission with 8DPSK (packet 3DH1/3DH3/3DH5)

Final test with adaptor and Quasi-Peak detector with the following mode(s):

1: Transmission with Π/4-DQPSK (packet 2DH5)

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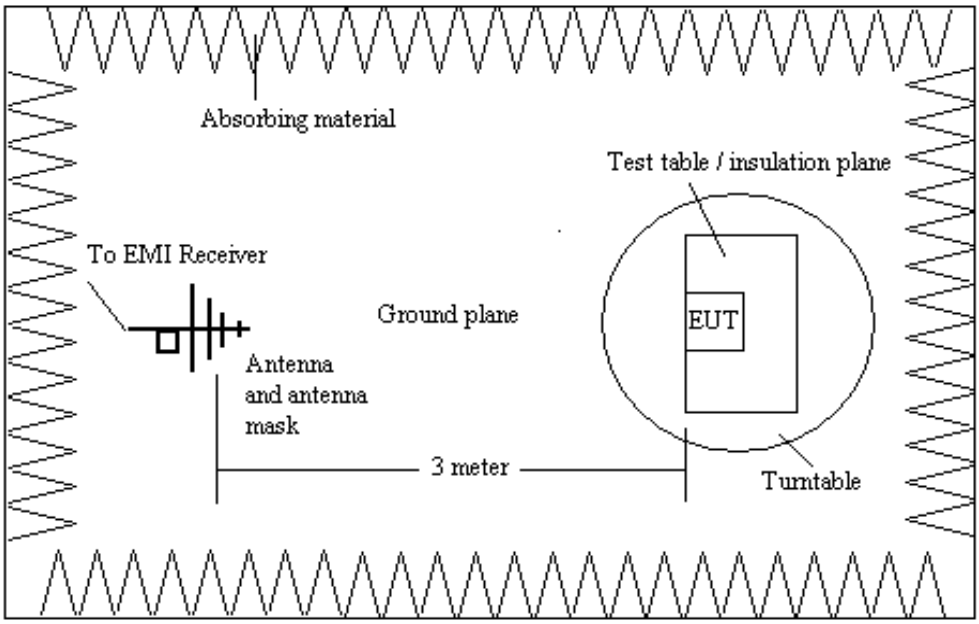
6.2.2 Test Setup and Procedure



1. The pre-test of the radiated emissions test was conducted in a semi-anechoic chamber and the final measurement was conducted in the open area test site.
2. The EUT was connected to AC power source through a mains power outlet which was bonded to the ground reference plane. The EUT was placed upon a non-metallic table 0.8m above the ground reference plane.
3. Loop antennat and Bilog antenna was used for the frequency range from the lowest generated frequency to 30MHz and 30MHz to 1GHz respectively
4. Before final measurements of radiated emissions, a pre-scan was performed in the spectrum mode with the peak detector to find out the maximum emissions spectrum plots of the EUT with located frequencies.
5. The actual frequencies of maximum emission were confirmed in the final radiated emissions measurement. At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters for Bilog antenna (Loop antenna is still maintain in 1m hight) in order to determine the maximum disturbance. Measurements were performed for both horizontal and vertical antenna polarization.

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6.2.3 Measurement Data

An initial pre-scan was performed in the 3m chamber using the spectrum analyser in peak detection mode. The EUT was measured by Bilog antenna with 2 orthogonal polarities and frequencies of peak emissions from the EUT were detected within 6dB of the limit line. Final measurement was conducted in the open area test site with data as follows:

Test results:

(1) Operation Frequency : 2402MHz

Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
37.563	V	16.4	17.8	34.2	40.0	-5.8
71.888	V	9.2	18.9	28.1	40.0	-11.9
126.460	V	11.6	13.0	24.6	43.5	-18.9
228.000	V	10.7	16.0	26.7	46.0	-19.3
420.000	H	17.4	7.6	25.0	46.0	-21.0
817.125	H	21.8	2.1	23.9	46.0	-22.1

Test results:

(2) Operation Frequency : 2440MHz

Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
31.563	V	18.8	12.3	31.1	40.0	-8.9
37.688	V	16.3	18.1	34.4	40.0	-5.6
72.000	V	9.2	17.9	27.1	40.0	-12.9
129.431	V	11.6	11.3	22.9	43.5	-20.6
284.000	H	13.8	5.9	19.7	46.0	-26.3
650.563	V	20.2	3.9	24.1	46.0	-21.9

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Test results:

(3) Operation Frequency : 2480MHz

Frequency (MHz)	Antenna Polarization	Correction Factor (dB/m)	Receiver QP Reading (dBµV)	Emission Level (dBµV/m)	Limit (dBµV/m)	Over Limit (dB)
31.563	V	18.8	13.0	31.8	40.0	-8.2
37.688	V	16.3	18.5	34.8	40.0	-5.2
72.063	V	9.2	18.0	27.2	40.0	-12.8
127.625	V	11.6	11.3	22.9	43.5	-20.6
228.000	V	10.7	16.7	27.4	46.0	-18.6
412.000	H	17.2	6.5	23.7	46.0	-22.3

Note:

1) **All readings are Quasi-Peak values.**
2) **Correction Factor = Antenna Factor + Cable Loss.**
3) **The above results were the worst case results with the EUT positioned in all 3 axis during the test. The EUT was positioned vertically and horizontally on the table for vertical and horizontal measurement respectively.**
4) **Other emissions more than 20dB below the limit are not shown on the above table and only worst six emissions below 1GHz are listed.**
5) **Aux in port and USB port are terminated by resistor during test.**

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6.3 Radiated Emissions above 1 GHz

Test Requirement:	FCC Part15 Subpart C Section 15.209 & 15.249(a) & (d)
Test Method:	ANSI C63.4:2003
Test Date:	2015-05-20
Frequency Range:	1GHz – 26GHz
Measurement Distance:	3m
Detector:	Peak for pre-scan (≥ 1MHz resolution bandwidth, ≥ 1MHz video bandwidth) Average and Peak detector for final test

Limit :

Fundamental Frequency :

Frequency range MHz	Limits (Peak) dB (μV/m)	Limits (Average) dB (μV/m)
2400 to 2483.5	114	94

Spurious Emission:

Frequency range MHz	Limits (Peak) dB (μV/m)	Limits (Average) dB (μV/m)
Over 1000	74	54

6.3.1 EUT Operation

Operating Environment:

Temperature: 27 °C Humidity: 57%

EUT Operation: Pre-test with adaptor or battery operate and Peak detector with the following mode(s):

1: Transmission with Π/4-DQPSK (packet 2DH1/2DH3/2DH5)
2: Transmission with 8DPSK (packet 3DH1/3DH3/3DH5)

Final test with adaptor and Peak and Average detector with the following mode(s):

1: Transmission with Π/4-DQPSK (packet 2DH5)

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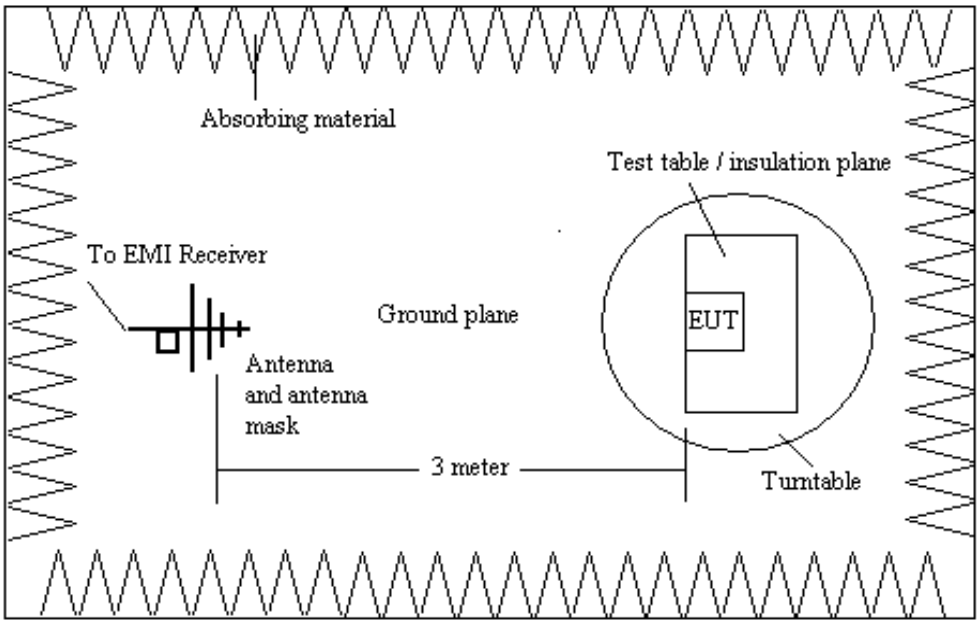
6.3.2 Test Setup and Procedure



1. The pre-test of the radiated emissions test was conducted in a semi-anechoic chamber and the final measurement was conducted in the open area test site.
2. The EUT was connected to AC power source through a mains power outlet which was bonded to the ground reference plane. The EUT was placed upon a non-metallic table 0.8m above the ground reference plane.
3. Horn antenna was used for the frequency over 1GHz
4. Before final measurements of radiated emissions, a pre-scan was performed in the spectrum mode with the peak detector to find out the maximum emissions spectrum plots of the EUT with located frequencies.
5. The actual frequencies of maximum emission were confirmed in the final radiated emissions measurement. At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the maximum disturbance. Measurements were performed for both horizontal and vertical antenna polarization.

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6.3.3 Measurement Data

An initial pre-scan was performed in the 3m chamber using the spectrum analyser in peak detection mode. The EUT was measured with 2 orthogonal polarities and frequencies of average emissions from the EUT were measured as follows:

Test results:

(1) Fundamental Frequency

Frequency (MHz)	Antenna Polarization	Emission Level (dBµV/m)		Limit (dBµV/m)		Remark
		Peak	Average	Peak	Average	
2402.0	H	90.79	84.85	114	94	Pass
2402.0	V	85.99	83.14	114	94	Pass
2441.0	H	96.07	91.38	114	94	Pass
2441.0	V	91.53	87.77	114	94	Pass
2480.0	H	94.97	90.33	114	94	Pass
2480.0	V	90.09	89.36	114	94	Pass

(2) Spurious Emission

Operation Frequency: 2402.0 MHz

Frequency (MHz)	Antenna Polarization	Emission Level (dBµV/m)		Limit (dBµV/m)		Remark
		Peak	Average	Peak	Average	
1210	V	24.46	9.49	74	54	Pass
3205	V	43.78	23.20	74	54	Pass
4804	V	43.87	31.31	74	54	Pass
7206	H	51.61	44.27	74	54	Pass
8634	H	50.84	34.60	74	54	Pass
10468	H	52.83	36.98	74	54	Pass

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Operation Frequency: 2440.0 MHz

Frequency (MHz)	Antenna Polarization	Emission Level (dBµV/m)		Limit (dBµV/m)		Remark
		Peak	Average	Peak	Average	
1220	V	24.56	9.50	74	54	Pass
3201	V	43.03	23.16	74	54	Pass
4880	V	46.33	36.74	74	54	Pass
7325	V	51.77	41.20	74	54	Pass
8683	V	51.55	34.95	74	54	Pass
10478	H	53.67	37.59	74	54	Pass

Operation Frequency: 2480.0 MHz

Frequency (MHz)	Antenna Polarization	Emission Level (dBµV/m)		Limit (dBµV/m)		Remark
		Peak	Average	Peak	Average	
1465	V	26.42	7.56	74	54	Pass
3190	V	43.54	23.84	74	54	Pass
4960	V	45.53	36.82	74	54	Pass
7440	H	55.52	49.59	74	54	Pass
8684	H	51.35	34.97	74	54	Pass
10670	H	53.72	38.05	74	54	Pass

Note:

1) **The above results were the worst case results with the EUT positioned in all 3 axis during the test. The EUT was positioned vertically and horizontally on the table for vertical and horizontal measurement respectively.**
2) **Other emissions more than 20dB below the limit are not shown on the above table and only worst six emissions below 1GHz are listed.**
3) **Aux in port and Usb port are terminated by resistor during test.**

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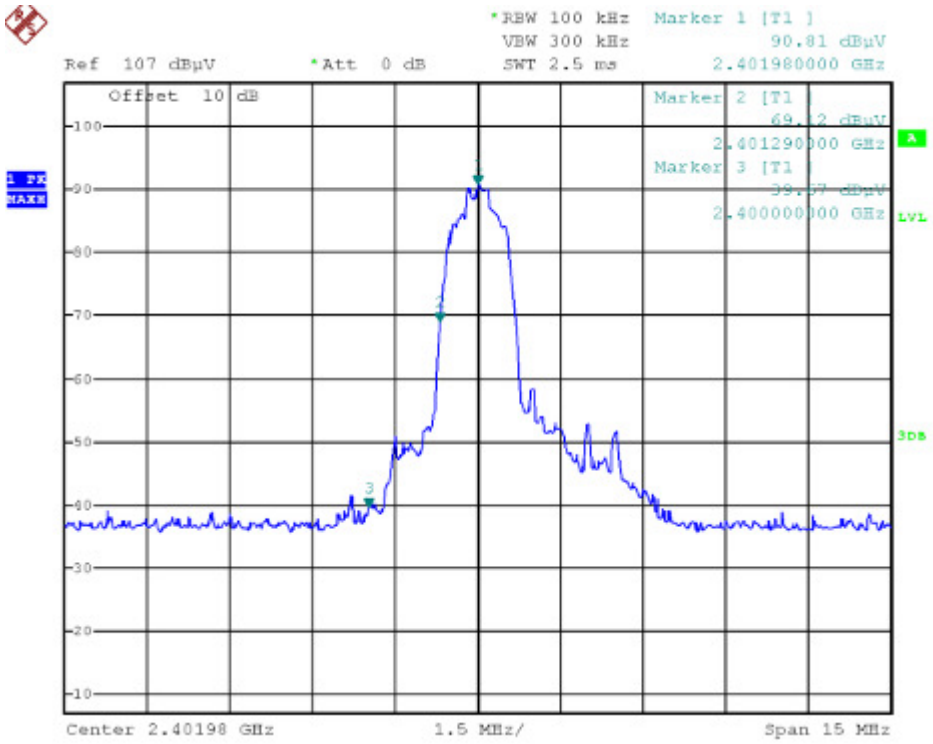
6.4 Band Edge / 20 dB Bandwidth

Test Requirement:	FCC Part15 Subpart C Section 15.215, 15.249(d)
Test Method:	ANSI C63.4:2003 and Marker-Delta Method
Test Date:	2015-05-26
EUT Operation:	1: Transmission with Π/4-DQPSK; 2: Transmission with 8DPSK;
Result:	Pass

Test Plot : (Worst case: Transmission with 8DPSK)

Operation frequency: 2402.0 MHz



According to the page 20 of this report, the emission of the fundamental frequency 2402MHz is 90.79dBuV/m for peak respectively. Based on the delta method, the emission at the bandedge, 2400MHz, is more than 50dB below the fundamental and 20dB bandwidth falls in assigned band. It is deemed to comply with section 15.215. Besides, it is below the limit of 74dBuV/m and 54dBuV/m for peak and average level under 15.209. It is deemed to comply with section 15.249(d).

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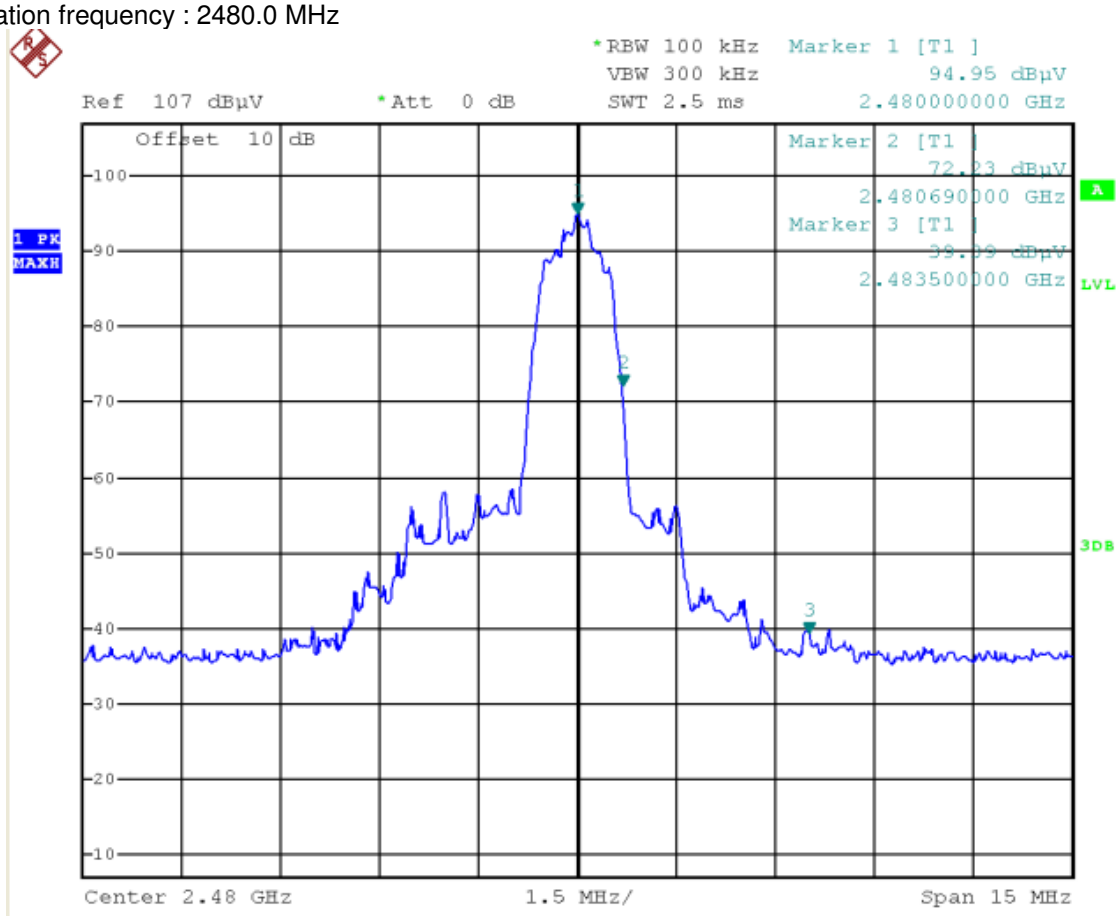
Test Plot : (Worst case: Transmission with 8DPSK)

Operation frequency : 2480.0 MHz



According to the page 18 of this report, the emission of the fundamental frequency 2480MHz is 94.97dBuV/m for peak level respectively. Based on the delta method, the emission at the bandedge, 2483.5MHz, is more than 50dB below the fundamental and 20dB bandwidth falls in the assigned band. It is deemed to comply with section 15.215. Besides, it is below the limit of 74dBuV/m and 54dBuV/m for peak and average level under 15.209. It is deemed to comply with section 15.249(d).

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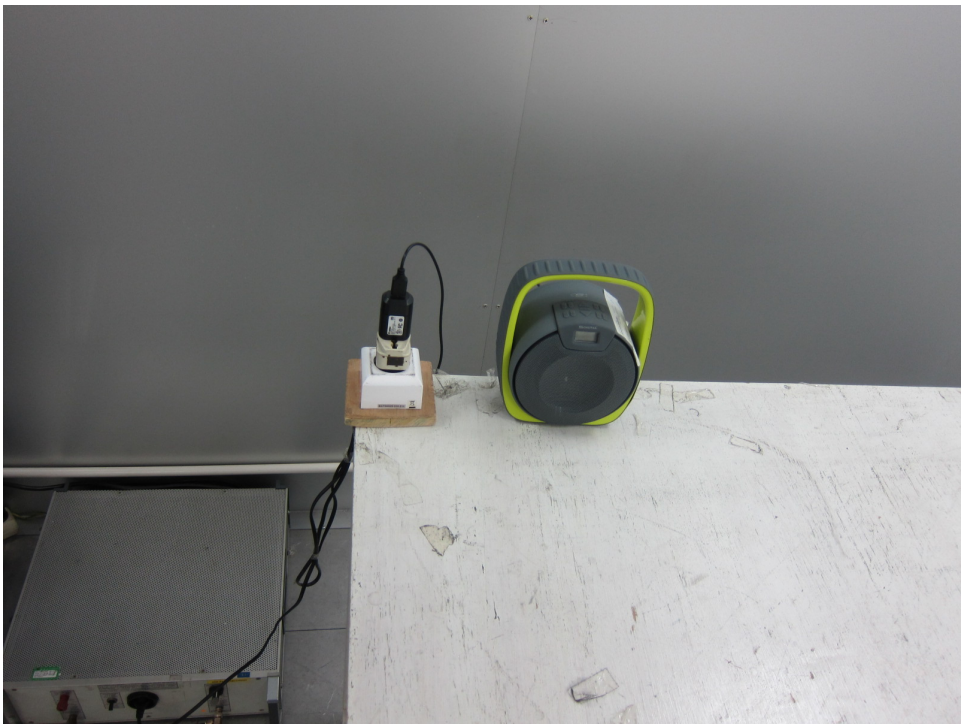
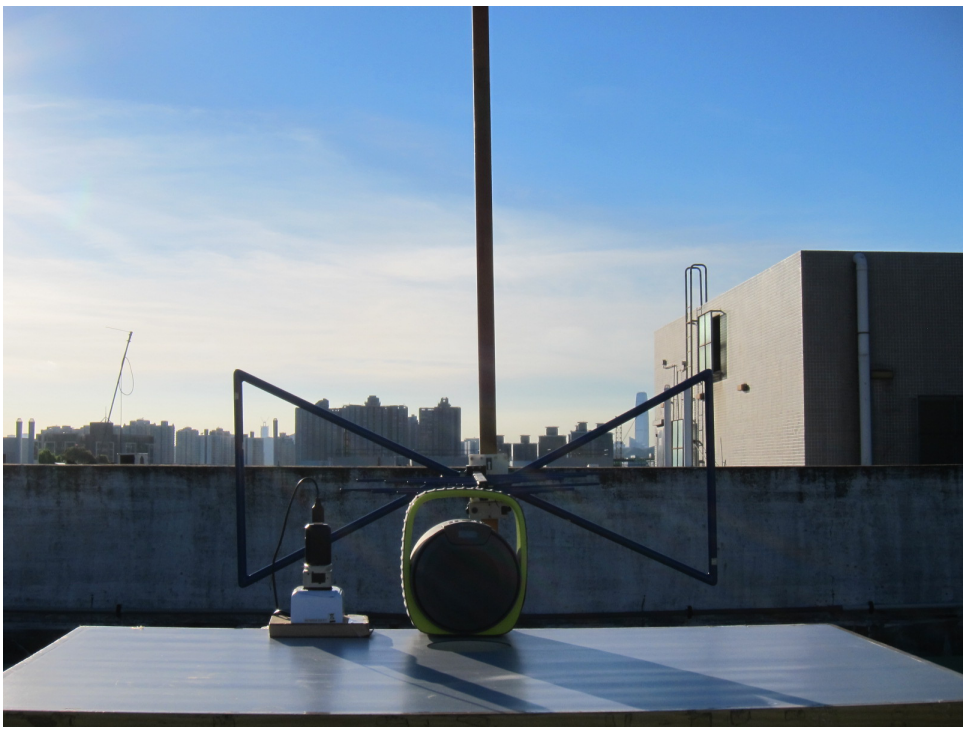
7 Photographs

7.1 Conduct Emission Test Setup



7.2 Radiated Emission Test Setup



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7.3 EUT Constructional Details

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