

Partial FCC RF Test Report

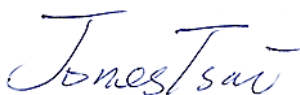
APPLICANT : Qualcomm Atheros, Inc.
EQUIPMENT : PCIE 802.11a/b/g/n 2.4GHz/5GHz + USB BT 4.0 card
BRAND NAME : Atheros
MODEL NAME : AR5B22
FCC ID : PPD-AR5B22
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

This is a partial report which is included the Conducted Power and Radiated Band Edges and Spurious Emission Measurement items. The product was received on Dec. 14, 2013 and testing was completed on Dec. 30, 2013. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown to be compliant with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.



Reviewed by: Joseph Lin / Supervisor



Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR3D1404B	Rev. 01	Initial issue of report	Feb. 11, 2014
FR3D1404B	Rev. 02	Revising applicant information in cover page and section 1.1.	Feb. 25, 2014



SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(d)	RSS-210 A8.5	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 6.31 dB at 2321.970 MHz
3.2	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Qualcomm Atheros, Inc.

1700 Technology Drive, San Jose, CA 95110

1.2 Manufacturer

Qualcomm Atheros, Inc.

1700 Technology Drive, San Jose, CA 95110

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	PCIE 802.11a/b/g/n 2.4GHz/5GHz + USB BT 4.0 card
Brand Name	Atheros
Model Name	AR5B22
Sample 1	EUT with Antenna 1
Sample 2	EUT with Antenna 2
FCC ID	PPD-AR5B22
Installed into host	Equipment Name: Tablet PC Brand Name: Lenovo Marketing Name: Lenovo Miix 2 11
EUT supports Radios application	WLAN 11a/b/g/n HT20/HT40 Bluetooth v2.1 + EDR Bluetooth v4.0 + LE
EUT Stage	Production Unit

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	4.00 dBm (0.0025 W)
Antenna Type	PIFA Antenna type with gain 1.87 dBi
Type of Modulation	Bluetooth 4.0 - LE : GFSK

Antenna Information			
Antenna 1	Manufacturer	WNC	
	P/N	Main: 025.9000X.0001	Aux:025.9000Y.0001
	Antenna Type	Main: PIFA Antenna	Aux.: PIFA Antenna
	Antenna connector	RF	
	Peak gain	Main Antenna : WLAN (2.4G) : 1.87 dBi WLAN (5G) : -0.16 dBi Bluetooth: 1.87 dBi	Aux. Antenna : WLAN (2.4G) : 0.69 dBi WLAN (5G) : 2.73 dBi
Antenna 2	Manufacturer	HT	
	P/N	Main: 025.9000X.0011	Aux.: 025.9000Y.0011
	Antenna Type	Main: PIFA Antenna	Aux.: PIFA Antenna
	Antenna connector	IPEX	
	Peak gain	Main Antenna : WLAN (2.4G) : -1.63 dBi WLAN (5G) : 1.84 dBi Bluetooth: -1.63 dBi	Aux. Antenna : WLAN (2.4G) : -0.35 dBi WLAN (5G) : 1.07 dBi

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Site

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-3273456 / FAX: +886-3-3284978		
Test Site No.	Sporton Site No.		FCC/IC Registration No.
	TH02-HY	03CH06-HY	722060/4086B-1

Note: The test site complies with ANSI C63.4 2003 requirement.

1.7 Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01
- ♦ ANSI C63.4-2003

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

The RF output power was recorded in the following table:

Channel	Frequency	Bluetooth 4.0 – LE RF Output Power
		Data Rate / Modulation
		GFSK
		1Mbps
Ch00	2402MHz	3.58 dBm
Ch19	2440MHz	3.98 dBm
Ch39	2480MHz	4.00 dBm

Channel	Frequency	Average Bluetooth 4.0 – LE RF Output Power
		Data Rate
		1Mbps
Ch00	2402MHz	3.07 dBm
Ch19	2440MHz	3.61 dBm
Ch39	2480MHz	3.89 dBm
Duty Cycle (%)		70.70

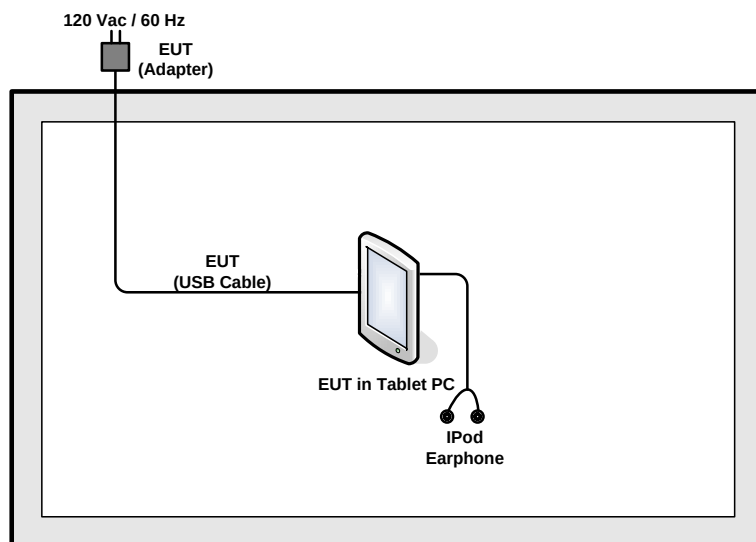
The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). Pre-scanned tests, X, Y, Z in three orthogonal panels to determine the final configuration (X plane as worst plane) from all possible combinations.

2.2 Test Mode

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth 4.0 – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Remark: All test items were performed with Sample1, Battery 1, and Ant. Port 1.	

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A

2.5 EUT Operation Test Setup

For Bluetooth function, the RF utility, "BtUSBTool" was installed in Tablet PC which was programmed in order to make the Tablet PC get into the engineering modes to continuous transmitting and receiving signals.

3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r01.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; $VBW \geq RBW$; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.

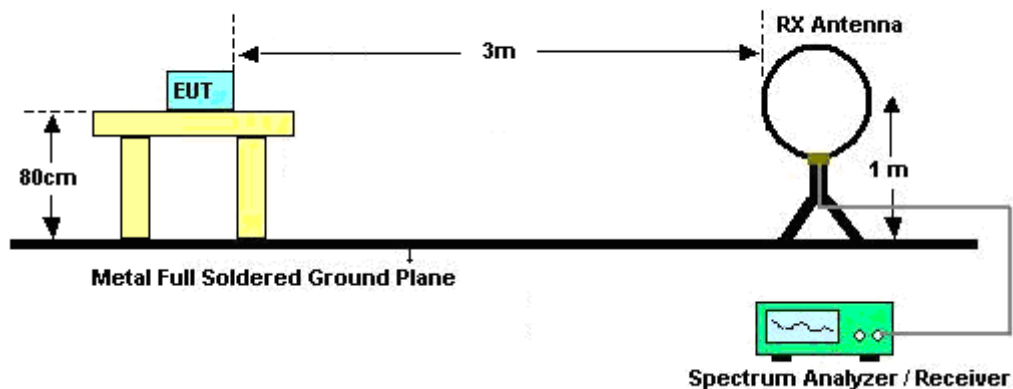
For average measurement:

 - $VBW = 10$ Hz, when duty cycle is no less than 98 percent.
 - $VBW \geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

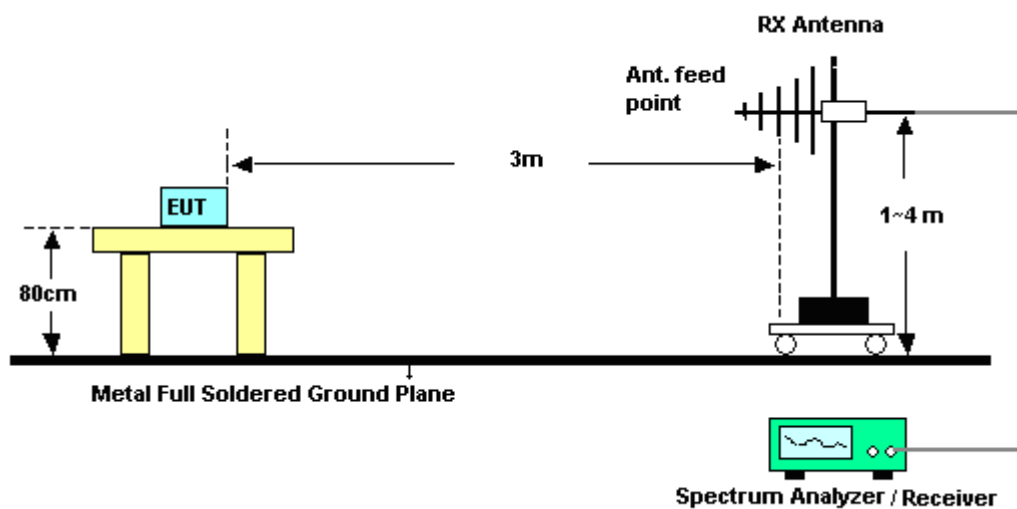
Band	Duty Cycle(%)	T(μ s)	1/T(kHz)	VBW Setting
Bluetooth 4.0 - LE	70.70	444.00	2.252	3kHz

3.1.4 Test Setup

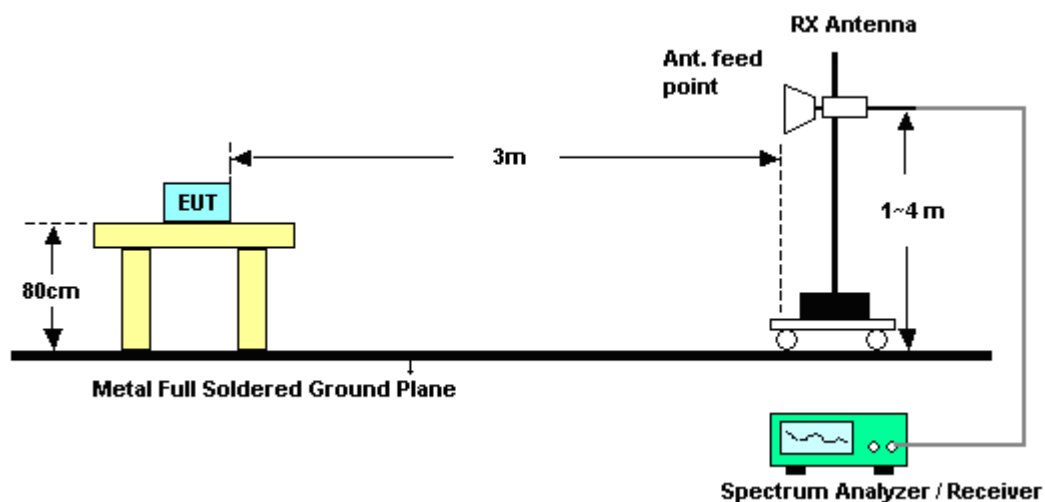
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.1.6 Test Result of Radiated Spurious at Band Edges

Test Mode :	Mode 1	Temperature :	22~24°C
Test Channel :	00	Relative Humidity :	47~49%
		Test Engineer :	Marlboro Hsu

ANTENNA POLARITY : HORIZONTAL										
Frequency (MHz)	Level (dBμV /m)	Over Limit (dB)	Limit Line (dBμV /m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2322.060	51.85	-22.15	74.00	47.99	31.86	6.35	34.35	100	262	Peak
2321.970	47.69	-6.31	54.00	43.83	31.86	6.35	34.35	100	262	Average

ANTENNA POLARITY : VERTICAL										
Frequency (MHz)	Level (dBμV /m)	Over Limit (dB)	Limit Line (dBμV /m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2322.060	48.50	-25.50	74.00	44.64	31.86	6.35	34.35	101	45	Peak
2321.970	41.93	-12.07	54.00	38.07	31.86	6.35	34.35	101	45	Average

Test Mode :	Mode 3	Temperature :	22~24°C
Test Channel :	39	Relative Humidity :	47~49%
		Test Engineer :	Marlboro Hsu

ANTENNA POLARITY : HORIZONTAL										
Frequency (MHz)	Level (dBμV /m)	Over Limit (dB)	Limit Line (dBμV /m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.65	51.5	-22.5	74	47.22	31.99	6.59	34.3	169	6	Peak
2483.5	43.58	-10.42	54	39.3	31.99	6.59	34.3	169	6	Average

ANTENNA POLARITY : VERTICAL										
Frequency (MHz)	Level (dBμV /m)	Over Limit (dB)	Limit Line (dBμV /m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.62	47.91	-26.09	74	43.63	31.99	6.59	34.3	177	242	Peak
2483.5	40.01	-13.99	54	35.73	31.99	6.59	34.3	177	242	Average

3.1.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Note: Pre-scanned all test modes and only choose the worst case mode recorded in the test report for radiated spurious emission below 1GHz.

Test Mode :	Mode 1	Temperature :	22~24°C
Test Channel :	00	Relative Humidity :	47~49%
Test Engineer :	Marlboro Hsu	Polarization :	Horizontal
Remark :	1. 2402 MHz is fundamental signal which can be ignored. 2. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
154.74	24.16	-19.34	43.5	44.31	10.2	1.4	31.75	-	-	Peak
196.86	23.68	-19.82	43.5	44.77	9.14	1.52	31.75	-	-	Peak
268.14	26.2	-19.8	46	43.03	13.09	1.81	31.73	-	-	Peak
480.6	27.69	-18.31	46	39.68	17.61	2.31	31.91	-	-	Peak
797	33.66	-12.34	46	42.52	20.03	3.06	31.95	-	-	Peak
907.6	34.18	-11.82	46	41.25	21.02	3.37	31.46	100	18	Peak
2402	94.74	-	-	90.7	31.92	6.45	34.33	100	262	Average
2402	96.44	-	-	92.4	31.92	6.45	34.33	100	262	Peak
4803	47.08	-26.92	74	58.07	34.41	10.16	55.56	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 1	Temperature :	22~24°C
Test Channel :	00	Relative Humidity :	47~49%
Test Engineer :	Marlboro Hsu	Polarization :	Vertical
Remark :	1. 2402 MHz is fundamental signal which can be ignored. 2. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
40.8	31.16	-8.84	40	49.97	12.24	0.74	31.79	100	163	Peak
91.56	26	-17.5	43.5	47.8	8.9	1.06	31.76	-	-	Peak
157.44	22.44	-21.06	43.5	42.6	10.16	1.43	31.75	-	-	Peak
480.6	27.09	-18.91	46	39.08	17.61	2.31	31.91	-	-	Peak
601	24.09	-21.91	46	33.97	19.41	2.77	32.06	-	-	Peak
798.4	26.78	-19.22	46	35.65	20.02	3.06	31.95	-	-	Peak
2402	91.01	-	-	86.97	31.92	6.45	34.33	101	45	Average
2402	92.86	-	-	88.82	31.92	6.45	34.33	101	45	Peak
4803	46.68	-27.32	74	57.67	34.41	10.16	55.56	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 2	Temperature :	22~24°C
Test Channel :	19	Relative Humidity :	47~49%
Test Engineer :	Marlboro Hsu	Polarization :	Horizontal
Remark :	1. 2440 MHz is fundamental signal which can be ignored. 2. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2440	96.74	-	-	92.58	31.96	6.52	34.32	184	293	Average
2440	98.36	-	-	94.2	31.96	6.52	34.32	184	293	Peak
4881	46.8	-27.2	74	57.92	34.37	10.19	55.68	100	0	Peak
7320	48.47	-25.53	74	58.17	35.6	10.94	56.24	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 2	Temperature :	22~24°C
Test Channel :	19	Relative Humidity :	47~49%
Test Engineer :	Marlboro Hsu	Polarization :	Vertical
Remark :	1. 2440 MHz is fundamental signal which can be ignored. 2. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2440	96.13	-	-	91.97	31.96	6.52	34.32	176	248	Average
2440	97.8	-	-	93.64	31.96	6.52	34.32	176	248	Peak
4881	47.41	-26.59	74	58.53	34.37	10.19	55.68	100	0	Peak
7320	49.05	-24.95	74	58.75	35.6	10.94	56.24	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 3	Temperature :	22~24°C
Test Channel :	39	Relative Humidity :	47~49%
Test Engineer :	Marlboro Hsu	Polarization :	Horizontal
Remark :	1. 2480 MHz is fundamental signal which can be ignored. 2. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2480	98.35	-	-	94.07	31.99	6.59	34.30	169	6	Average
2480	99.83	-	-	95.55	31.99	6.59	34.30	169	6	Peak
4959	47.54	-26.46	74	58.85	34.32	10.21	55.84	100	0	Peak
7440	49.41	-24.59	74	58.98	35.53	10.90	56.00	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 3	Temperature :	22~24°C
Test Channel :	39	Relative Humidity :	47~49%
Test Engineer :	Marlboro Hsu	Polarization :	Vertical
Remark :	1. 2481 MHz is fundamental signal which can be ignored. 2. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2481	94.35	-	-	90.07	31.99	6.59	34.30	177	242	Average
2481	95.84	-	-	91.56	31.99	6.59	34.30	177	242	Peak
4959	47.34	-26.66	74	58.65	34.32	10.21	55.84	100	0	Peak
7440	49.13	-24.87	74	58.70	35.53	10.90	56.00	100	0	Peak

Note: Other harmonics are lower than background noise.

3.2 Antenna Requirements

3.2.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.2.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Agilent	E4416A	GB412923 44	300MHz~40GHz	Feb. 05, 2013	Jan. 25, 2013	Feb. 04, 2014	Conducted (TH02-HY)
Power Sensor	Agilent	E9327A	US404415 48	300MHz~40GHz	Feb. 05, 2013	Dec. 25, 2013	Feb. 04, 2014	Conducted (TH02-HY)
Spectrum Analyzer	R&S	FSP30	101067	9kHz ~ 30GHz	Nov. 20, 2013	Dec. 30, 2013	Nov. 19, 2014	Radiation (03CH06-HY)
Spectrum Analyzer	Agilent	E4408B	MY442110 30	9kHz ~ 26.5GHz	Dec. 02, 2013	Dec. 30, 2013	Dec. 01, 2014	Radiation (03CH06-HY)
EMI Test Receiver	R&S	ESVS10	834468/00 03	20MHz ~ 1000MHz	May 06, 2013	Dec. 30, 2013	May 05, 2014	Radiation (03CH06-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	860004/00 01	9kHz ~ 30MHz	Jul. 03, 2012	Dec. 30, 2013	Jul. 02, 2014	Radiation (03CH06-HY)
Bilog Antenna	Schaffner	CBL6112B	2885	30MHz ~ 2GHz	Oct. 10, 2013	Dec. 30, 2013	Oct. 09, 2014	Radiation (03CH06-HY)
Double Ridge Horn Antenna	EMCO	3117	00066583	1GHz ~ 18GHz	Aug. 02, 2013	Dec. 30, 2013	Aug. 01, 2014	Radiation (03CH06-HY)
Amplifier	Agilent	310N	186713	9kHz ~ 1GHz	Apr. 12, 2013	Dec. 30, 2013	Apr. 11, 2014	Radiation (03CH06-HY)
Pre Amplifier	EMCI	EMC051845	SN980048	1GHz ~ 18GHz	Jul. 18, 2013	Dec. 30, 2013	Jul. 17, 2014	Radiation (03CH06-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170 251	15GHz ~ 40GHz	Oct. 03, 2013	Dec. 30, 2013	Oct. 02, 2014	Radiation (03CH06-HY)
Preamplifier	Agilent	8449B	3008A019 17	1GHz ~ 26.5GHz	Apr. 12, 2013	Dec. 30, 2013	Apr. 11, 2014	Radiation (03CH06-HY)
Turn Table	INN-CO	DS2000	420/650/00	0 ~ 360 degree	N/A	Dec. 30, 2013	N/A	Radiation (03CH06-HY)
Antenna Mast	MF	MF-7802	MF780208 212	1 m ~ 4 m	N/A	Dec. 30, 2013	N/A	Radiation (03CH06-HY)



5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.50
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