

FCC RF Test Report

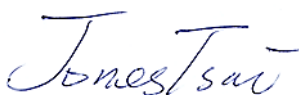
APPLICANT : Broadcom Corporation
EQUIPMENT : Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth 4.0
NGFF2230 Mini Card
BRAND NAME : Broadcom
MODEL NAME : BCM943162ZP
FCC ID : QDS-BRCM1075
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

This is a partial report. The product was received on May 27, 2014 and testing was completed on Jun. 29, 2014. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance 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



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FCC ID : QDS-BRCM1075

Page Number : 1 of 21

Report Issued Date : Jul. 28, 2014

Report Version : Rev. 01



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR452709-01B	Rev. 01	Initial issue of report	Jul. 28, 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 4.04 dB at 2483.500 MHz
3.2	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Broadcom Corporation

190 Mathilda Place Sunnyvale CA 94086 U.S.A.

1.2 Manufacturer

Broadcom Corporation

190 Mathilda Place Sunnyvale CA 94086 U.S.A.

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth 4.0 NGFF2230 Mini Card
Brand Name	Broadcom
Model Name	BCM943162ZP
FCC ID	QDS-BRCM1075
Installed into Notebook	Brand Name: lenovo Model Name: TP00067A
EUT supports Radios application	WLAN 11/b/g/n (HT20/HT40) WLAN 11ac VHT20/VHT40/VHT80 Bluetooth v4.0EDR/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 subjective to this standard

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	3.91 dBm (0.0025 W)
Type of Modulation	Bluetooth LE : GFSK

Lonestar Antenna Information			
Antenna 1	Manufacturer	Speed	
	Antenna Type	Main: PIFA Antenna	Aux.: PIFA Antenna
	Antenna P/N	DC330018300	DC330018310
	Peak gain	Main Antenna : WLAN(2.4GHz):0.29dBi WLAN(5GHz):0.97dBi	Aux. Antenna : WLAN(2.4GHz):-0.11dBi Bluetooth :-0.11dBi WLAN(5GHz):0.34dBi
Antenna 2	Manufacturer	Yageo	
	Antenna Type	Main:PIFA Antenna	Aux.: PIFA Antenna
	Antenna P/N	DC330018100	DC330018110
	Peak gain	Main Antenna : WLAN(2.4GHz):1.92dBi WLAN(5GHz):1.26dBi	Aux. Antenna : WLAN (2.4GHz) :-2.84dBi Bluetooth : -2.84dBi WLAN(5GHz):-0.73dBi

1.5 Modification of EUT

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

1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

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: +886-3-327-3456 FAX: +886-3-328-4978	
Test Site No.	Sporton Site No.	
	TH02-HY	03CH06-HY



1.7 Applicable 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 v03r02
- ♦ 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	2.66 dBm
Ch19	2440MHz	3.47 dBm
Ch39	2480MHz	3.91 dBm

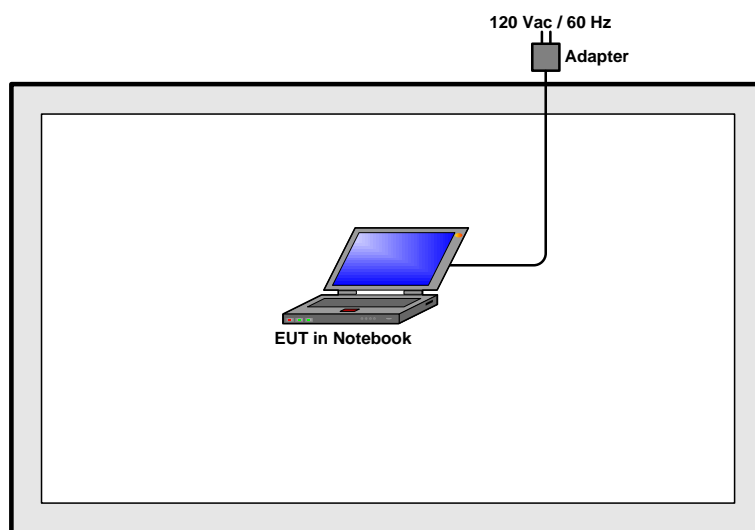
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

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
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

2.3 Connection Diagram of Test System



2.4 EUT Operation Test Setup

For Bluetooth function, the RF utility, "BTTool" was installed in EUT which was programmed in order to make the EUT get into the engineering modes for continuously 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 v03r02.
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.

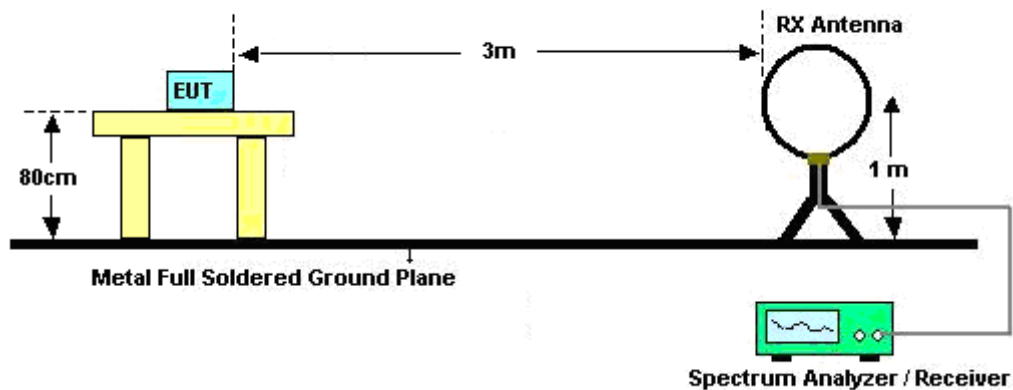
For average measurement:

 - 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.

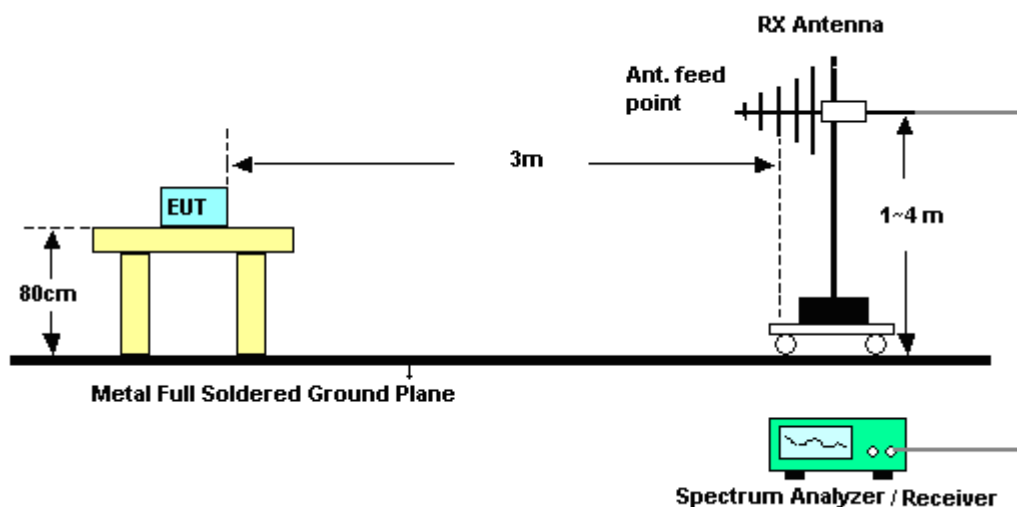
Band	Duty Cycle(%)	T(μ s)	1/T(kHz)	VBW Setting
Bluetooth 4.0 - LE	62.42	391	2.557544757	3kHz

3.1.4 Test Setup

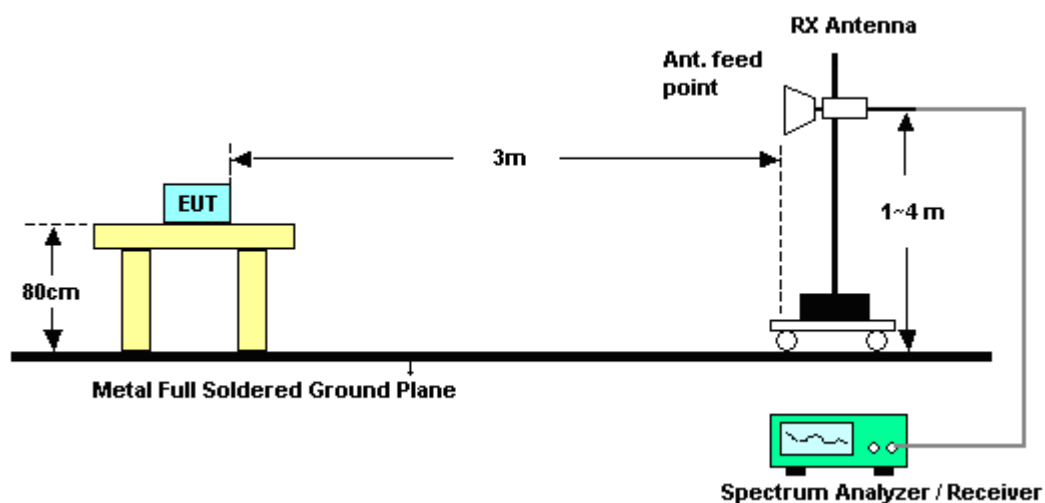
For radiated emissions below 30MHz



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 :	20~22°C
Test Channel :	00	Relative Humidity :	50~52%
		Test Engineer :	Abi Lin and Donny Tang

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
2362.83	48.48	-25.52	74	44.82	31.89	6.42	34.65	154	346	Peak
2388.66	37.6	-16.4	54	33.88	31.92	6.45	34.65	154	346	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
2353.92	48.48	-25.52	74	44.86	31.89	6.38	34.65	100	191	Peak
2369.4	37.36	-16.64	54	33.69	31.9	6.42	34.65	100	191	Average

Test Mode :	Mode 3	Temperature :	20~22°C
Test Channel :	39	Relative Humidity :	50~52%
		Test Engineer :	Abi Lin and Donny Tang

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
2483.5	54.79	-19.21	74	50.84	31.99	6.59	34.63	134	86	Peak
2483.5	49.96	-4.04	54	46.01	31.99	6.59	34.63	134	86	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
2483.5	54.13	-19.87	74	50.18	31.99	6.59	34.63	100	144	Peak
2483.5	49.14	-4.86	54	45.19	31.99	6.59	34.63	100	144	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 :	20~22°C
Test Channel :	00	Relative Humidity :	50~52%
Test Engineer :	Abi Lin and Donny Tang	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
2402	91.35	-	-	87.62	31.92	6.45	34.64	154	346	Average
2402	92.15	-	-	88.42	31.92	6.45	34.64	154	346	Peak
4803	43.03	-30.97	74	59.32	34.41	10.16	60.86	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 1	Temperature :	20~22°C
Test Channel :	00	Relative Humidity :	50~52%
Test Engineer :	Abi Lin and Donny Tang	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
2402	91.03	-	-	87.3	31.92	6.45	34.64	100	191	Average
2402	91.75	-	-	88.02	31.92	6.45	34.64	100	191	Peak
4803	41.8	-32.2	74	58.09	34.41	10.16	60.86	100	0	Peak

Note: Other harmonics are lower than background noise.



Test Mode :	Mode 2	Temperature :	20~22°C
Test Channel :	19	Relative Humidity :	50~52%
Test Engineer :	Abi Lin and Donny Tang	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	91.84	-	-	88	31.96	6.52	34.64	133	213	Average
2440	92.77	-	-	88.93	31.96	6.52	34.64	133	213	Peak
4881	43.51	-30.49	74	59.64	34.37	10.19	60.69	100	0	Peak
7320	44.57	-29.43	74	58.56	35.6	10.94	60.53	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 2	Temperature :	20~22°C
Test Channel :	19	Relative Humidity :	50~52%
Test Engineer :	Abi Lin and Donny Tang	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	91.89	-	-	88.05	31.96	6.52	34.64	100	173	Average
2440	92.69	-	-	88.85	31.96	6.52	34.64	100	173	Peak
4881	42.79	-31.21	74	58.92	34.37	10.19	60.69	100	0	Peak
7320	43.9	-30.1	74	57.89	35.6	10.94	60.53	100	0	Peak

Note: Other harmonics are lower than background noise.

Test Mode :	Mode 3	Temperature :	20~22°C
Test Channel :	39	Relative Humidity :	50~52%
Test Engineer :	Abi Lin and Donny Tang	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
37.56	13.94	-26.06	40	31.07	13.94	0.72	31.79	-	-	Peak
156.36	17.24	-26.26	43.5	37.39	10.18	1.42	31.75	-	-	Peak
296.22	22.93	-23.07	46	39.64	13.12	1.89	31.72	-	-	Peak
382.6	22.4	-23.6	46	36.84	15.22	2.14	31.8	-	-	Peak
648.6	22.06	-23.94	46	31.79	19.51	2.8	32.04	-	-	Peak
857.2	26.86	-19.14	46	34.52	20.8	3.25	31.71	131	135	Peak
2480	94.8	-	-	90.85	31.99	6.59	34.63	134	86	Average
2480	95.7	-	-	91.75	31.99	6.59	34.63	134	86	Peak
4959	43.85	-30.15	74	59.8	34.32	10.21	60.48	100	0	Peak
7440	45.37	-28.63	74	59.52	35.53	10.9	60.58	100	0	Peak

Note: Other harmonics are lower than background noise.



Test Mode :	Mode 3	Temperature :	20~22°C
Test Channel :	39	Relative Humidity :	50~52%
Test Engineer :	Abi Lin and Donny Tang	Polarization :	Vertical
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 (dB μ V/m)	Over Limit (dB)	Limit Line (dB μ V/m)	Read Level (dB μ V)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
59.97	11.72	-28.28	40	36.02	6.6	0.87	31.77	-	-	Peak
225.75	22.5	-23.5	46	42.8	9.8	1.64	31.74	-	-	Peak
271.92	20.4	-25.6	46	37.35	12.96	1.82	31.73	-	-	Peak
412.7	19.96	-26.04	46	33.12	16.45	2.22	31.83	-	-	Peak
568.8	23.06	-22.94	46	33.16	19.3	2.62	32.02	-	-	Peak
757.1	23.91	-22.09	46	32.64	20.2	3.05	31.98	200	314	Peak
2480	94.35	-	-	90.4	31.99	6.59	34.63	100	144	Average
2480	95.2	-	-	91.25	31.99	6.59	34.63	100	144	Peak
4959	42.57	-31.43	74	58.52	34.32	10.21	60.48	100	0	Peak
7440	43.61	-30.39	74	57.76	35.53	10.9	60.58	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	GB41292344	300MHz~40GHz	Jan. 28, 2014	Jun. 06, 2014	Jan. 27, 2015	Conducted (TH02-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Jan. 28, 2014	Jun. 06, 2014	Jan. 27, 2015	Conducted (TH02-HY)
Spectrum Analyzer	R&S	FSP30	101067	9kHz ~ 30GHz	Nov. 20, 2013	Jun. 26, 2014 ~ Jun. 29, 2014	Nov. 19, 2014	Radiation (03CH06-HY)
Spectrum Analyzer	Agilent	E4408B	MY44211030	9kHz ~ 26.5GHz	Dec. 02, 2013	Jun. 26, 2014 ~ Jun. 29, 2014	Dec. 01, 2014	Radiation (03CH06-HY)
EMI Test Receiver	R&S	ESVS10	834468/0003	20MHz ~ 1000MHz	May 06, 2014	Jun. 26, 2014 ~ Jun. 29, 2014	May 05, 2015	Radiation (03CH06-HY)
Bilog Antenna	Schaffner	CBL6112B	2885	30MHz ~ 2GHz	Oct. 10, 2013	Jun. 26, 2014 ~ Jun. 29, 2014	Oct. 09, 2014	Radiation (03CH06-HY)
Double Ridge Horn Antenna	EMCO	3117	00066583	1GHz ~ 18GHz	Aug. 02, 2013	Jun. 26, 2014 ~ Jun. 29, 2014	Aug. 01, 2014	Radiation (03CH06-HY)
Amplifier	SONOMA	310N	186713	9kHz ~ 1GHz	Apr. 16, 2014	Jun. 26, 2014 ~ Jun. 29, 2014	Apr. 15, 2015	Radiation (03CH06-HY)
Pre Amplifier	EMCI	EMC051845	SN980048	1GHz ~ 18GHz	Jul. 18, 2013	Jun. 26, 2014 ~ Jun. 29, 2014	Jul. 17, 2014	Radiation (03CH06-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	15GHz ~ 40GHz	Oct. 03, 2013	Jun. 26, 2014 ~ Jun. 29, 2014	Oct. 02, 2014	Radiation (03CH06-HY)
Preamplifier	Agilent	8449B	3008A01917	1GHz ~ 26.5GHz	Apr. 10, 2014	Jun. 26, 2014 ~ Jun. 29, 2014	Apr. 09, 2015	Radiation (03CH06-HY)
Turn Table	INN-CO	DS2000	420/650/00	0 ~ 360 degree	N/A	Jun. 26, 2014 ~ Jun. 29, 2014	N/A	Radiation (03CH06-HY)
Antenna Mast	MF	MF-7802	MF780208212	1 m ~ 4 m	N/A	Jun. 26, 2014 ~ Jun. 29, 2014	N/A	Radiation (03CH06-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	860004/0001	9 kHz~30 MHz	Jul. 03, 2012	Jun. 26, 2014 ~ Jun. 29, 2014	Jul. 03, 2014	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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