

FCC RF Test Report

APPLICANT : Hewlett-Packard Company
EQUIPMENT : 2x2 802.11a/b/g/n - BT Combo SDIO module
BRAND NAME : hp
MODEL NAME : HSTNN-QR03
FCC ID : B94HNQR03
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Aug. 23, 2012 and completely tested on Sep. 07, 2012. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the 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:



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.



TABLE OF CONTENTS

REVISION HISTORY.....	3
SUMMARY OF TEST RESULT	4
1 GENERAL DESCRIPTION.....	5
1.1 Applicant.....	5
1.2 Manufacturer.....	5
1.3 Feature of Equipment Under Test.....	5
1.4 Testing Site.....	6
1.5 Applied Standards	6
1.6 Ancillary Equipment List	6
2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST.....	7
2.1 RF Output Power.....	7
2.2 Antenna Information	7
2.3 Test Mode.....	8
2.4 Connection Diagram of Test System.....	9
2.5 RF Utility	9
3 TEST RESULT	10
3.1 6dB Bandwidth Measurement	10
3.2 Peak Output Power Measurement	13
3.3 Power Spectral Density Measurement	16
3.4 Conducted Band Edges and Spurious Emission Measurement	19
3.5 Radiated Band Edges and Spurious Emission Measurement	28
3.6 AC Conducted Emission Measurement.....	40
3.7 Antenna Requirements.....	44
4 LIST OF MEASURING EQUIPMENT.....	45
5 UNCERTAINTY OF EVALUATION.....	46
APPENDIX A. PHOTOGRAPHS OF EUT	
APPENDIX B. SETUP PHOTOGRAPHS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR282317B	Rev. 01	Initial issue of report	Sep. 18, 2012

SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	A8.2(a)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	Gen 4.6.1	99% Bandwidth	-	Pass	-
3.2	15.247(b)(1)	A8.1(b)	Peak Output Power	$\leq 30\text{dBm}$	Pass	-
3.5	15.247(e)	A8.2(b)	Power Spectral Density	$\leq 8\text{dBm}$	Pass	-
3.4	15.247(d)	A8.5	Conducted Band Edges and Spurious Emission	$\leq 20\text{dBc}$	Pass	-
3.5	15.247(d)	A8.5	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.48 dB at 143.4 MHz
3.6	15.207	Gen 7.2.2	AC Conducted Emission	15.207(a)	Pass	Under limit 12.10 dB at 0.158 MHz
3.7	15.203 & 15.247(b)	A8.4	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

Hewlett-Packard Company

3000 Hanover Street, Palo Alto, California 94304, USA

1.2 Manufacturer

Qualcomm Atheros

1700 Technology Drive, San Jose, CA95110, United States

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	2x2 802.11a/b/g/n - BT Combo SDIO module
Brand Name	hp
Model Name	HSTNN-QR03
FCC ID	B94HNQR03
EUT supports Radios application	WLAN 11abgn / Bluetooth
EUT Stage	Identical Prototype

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

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	Bluetooth 4.0 - LE : 5.15 dBm (0.0033 W)
99% Occupied Bandwidth	Bluetooth 4.0 - LE : 1.024MHz
Antenna Type	PIFA Antenna with gain 3.62 dBi
Type of Modulation	Bluetooth 4.0 - LE : GFSK

1.4 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	CO05-HY	03CH05-HY	722060/4086B-1

1.5 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 v01
- ♦ FCC TCB Workshop 2012, April
- ♦ ANSI C63.4-2003 and ANSI C63.10-2009
- ♦ IC RSS-210 Issue 8
- ♦ IC RSS-Gen Issue 3

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

1.6 Ancillary Equipment List

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	DELL	Vostro 1510	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	LCD Monitor	Dell	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
3.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A

2 Test Configuration of Equipment Under Test

2.1 RF Output Power

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	2.48 dBm	
Ch19	2440MHz	5.15 dBm	
Ch39	2480MHz	3.75 dBm	

2.2 Antenna Information

Brand / Model Name	Type	Frequency Range (MHz)	Antenna Gain (dBi)
Wistron Neweb Corporation / EBJ Aux.	PIFA	2400 ~ 2500	3.62

2.3 Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2003 and ANSI C63.10-2009 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction (150 kHz to 30 MHz), 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, were conducted to determine the final configuration from all possible combinations.

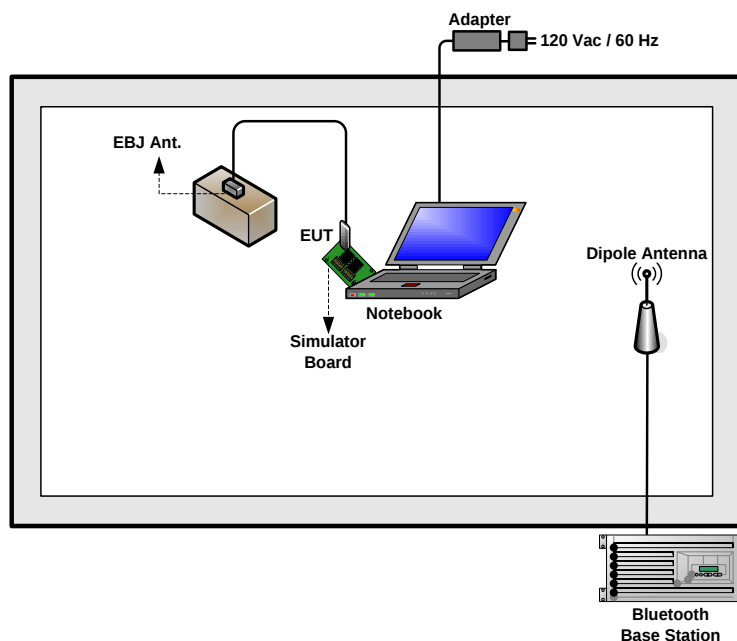
The following tables are showing the test modes as the worst cases (Y plane) and recorded in this report.

The following tables are showing the test modes as the worst cases and recorded in this report.

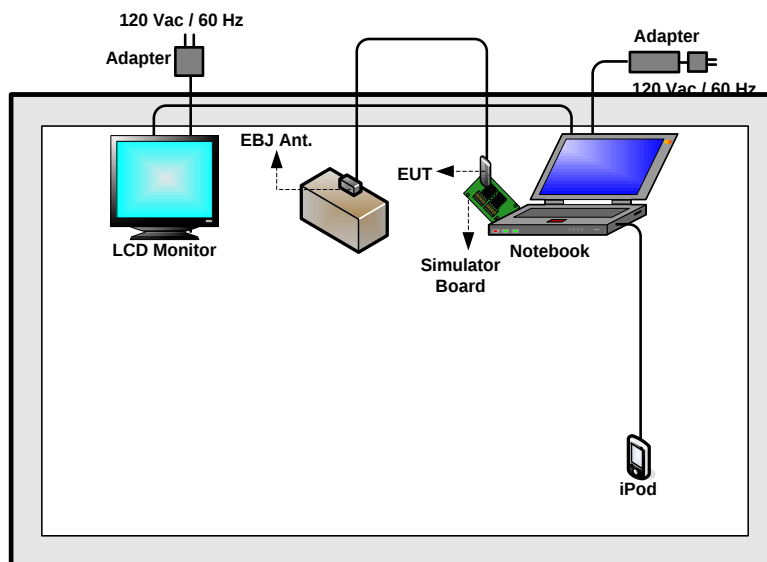
Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth 4.0 – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
AC Conducted Emission	Mode 1 :WLAN (2.4G) Tx Ch06 + EBJ Ant
	Mode 2 Bluetooth Tx Ch39 + EBJ Ant
Remark: The worst case of conducted emission is mode 2; only the test data of it was reported.	

2.4 Connection Diagram of Test System

<Bluetooth Tx Mode>



<EUT with Notebook Mode>



2.5 RF Utility

For Bluetooth function, programmed RF utility, "BtUART" installed in the notebook make the EUT provides functions like channel selection and power level for continuous transmitting and receiving signals.

3 Test Result

3.1 6dB Bandwidth Measurement

3.1.1 Limit of 6dB Bandwidth

The minimum 6 dB bandwidth shall be at least 500 KHz.

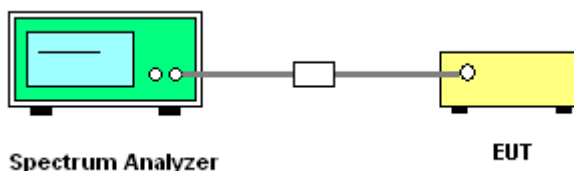
3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v01.
2. The RF output of EUT was connected to the spectrum analyzer by a low loss cable. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 KHz.

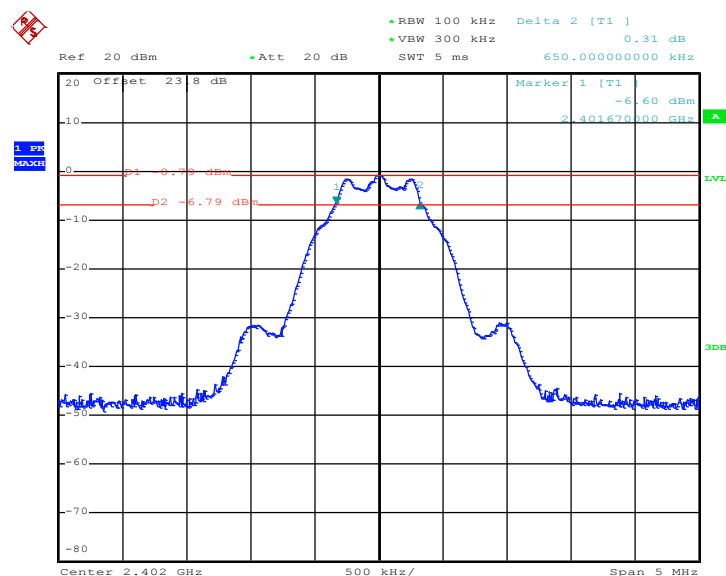
3.1.4 Test Setup



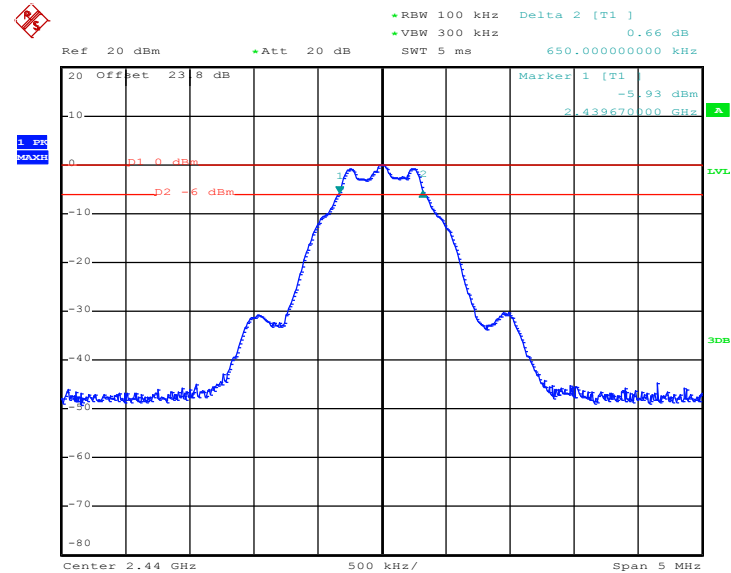


Test Mode :	Bluetooth 4.0 - LE	Temperature :	23~25℃
Test Engineer :	Hank Yu	Relative Humidity :	58~61%

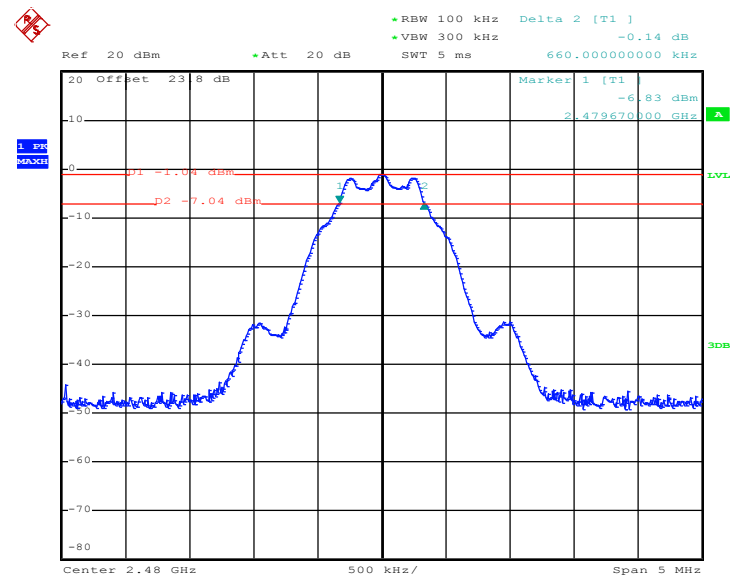
Channel	Frequency (MHz)	6dB Bandwidth (MHz)
00	2402	0.65
19	2440	0.65
39	2480	0.66



Date: 30.AUG.2012 10:26:05

6 dB Bandwidth Plot on Channel 19


Date: 30.AUG.2012 10:36:43

6 dB Bandwidth Plot on Channel 39


Date: 30.AUG.2012 10:19:21

3.2 Peak Output Power Measurement

3.2.1 Limit of Peak Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

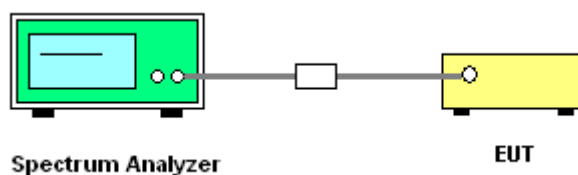
3.2.2 Measuring Instruments

See list of measuring instruments of this test report.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance and TCB Workshop 2012, April.
2. The RF output of EUT was connected to the power meter by a low loss cable
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup

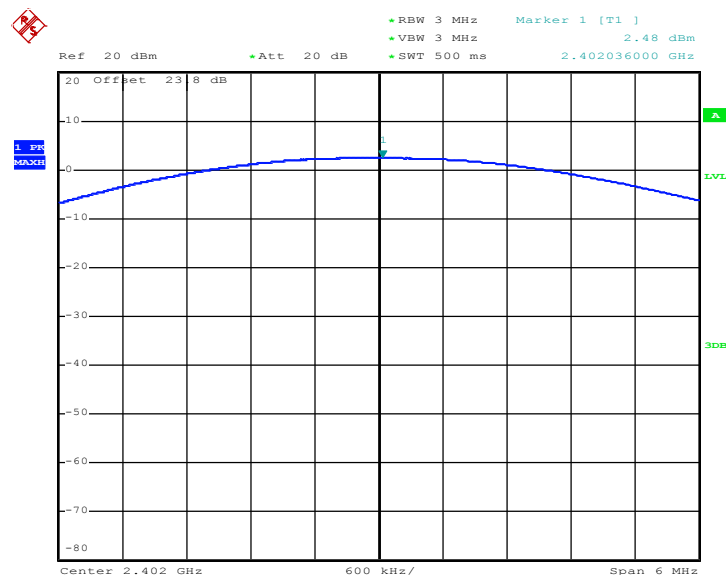


3.2.5 Test Result of Peak Output Power

Test Mode :	Bluetooth 4.0 - LE	Temperature :	23~25℃
Test Engineer :	Hank Yu	Relative Humidity :	58~61%

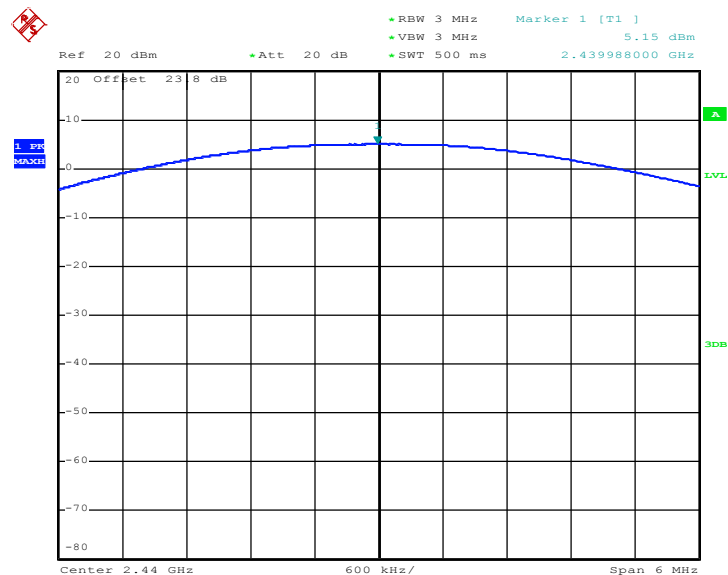
Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	2.48	30.00	Pass
19	2440	5.15	30.00	Pass
39	2480	3.75	30.00	Pass

Peak Output Power Plot on Channel 00



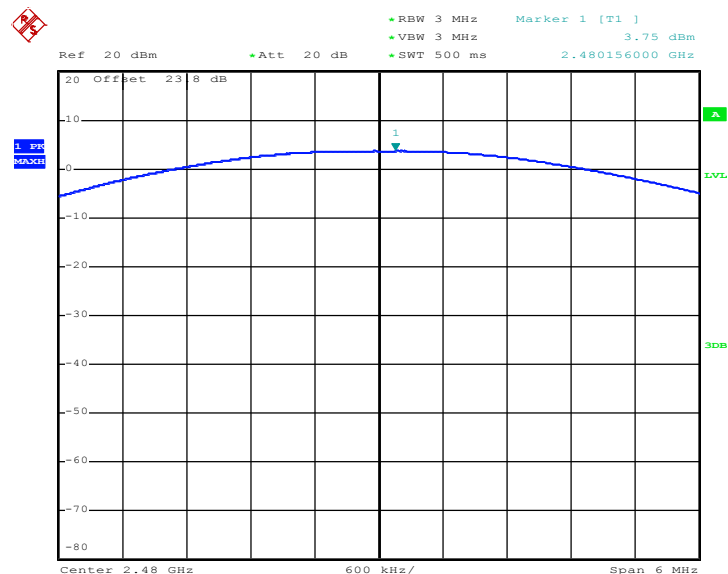
Date: 29.AUG.2012 21:48:27

Peak Output Power Plot on Channel 19



Date: 29.AUG.2012 21:47:51

Peak Output Power Plot on Channel 39



Date: 29.AUG.2012 21:49:03

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3KHz band at any time interval of continuous transmission.

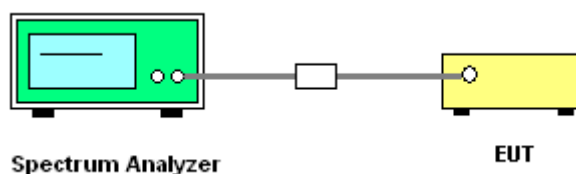
3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure PKPSD of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v01.
2. The RF output of EUT was connected to the spectrum analyzer by a low loss cable. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 KHz. Video bandwidth (VBW) $\geq$ 300 KHz In order to make an accurate measurement, set the span to 5-30% greater than Emission Bandwidth (EBW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Record the measurement data derived from spectrum analyzer.
7. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where $BWCF = 10\log(3\text{ kHz}/100\text{ kHz}) = -15.2\text{ dB}$.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

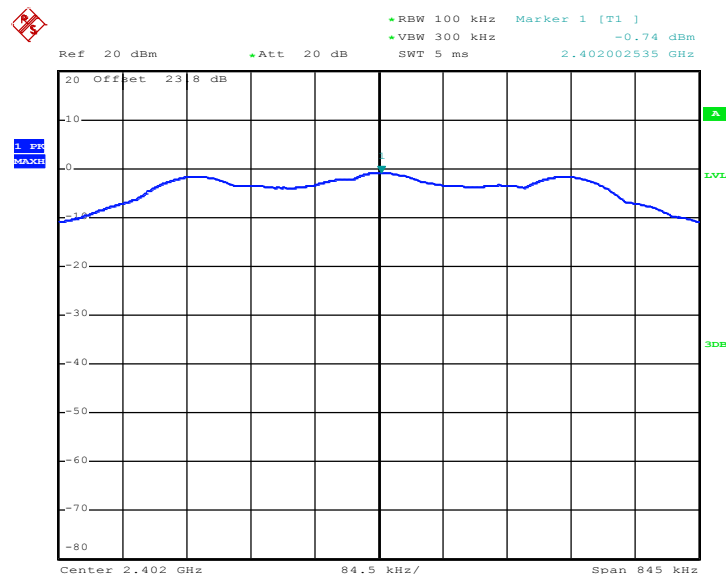
Test Mode :	Bluetooth 4.0 - LE	Temperature :	23~25℃
Test Engineer :	Hank Yu	Relative Humidity :	58~61%

Channel	Frequency (MHz)	Power Density		Max. Limits (dBm)	Pass/Fail
		Measured PSD/100KHz (dBm)	PSD/3KHz (dBm)		
00	2402	-0.74	-15.94	8	Pass
19	2440	0.01	-15.19	8	Pass
39	2480	-0.96	-16.16	8	Pass

Note:

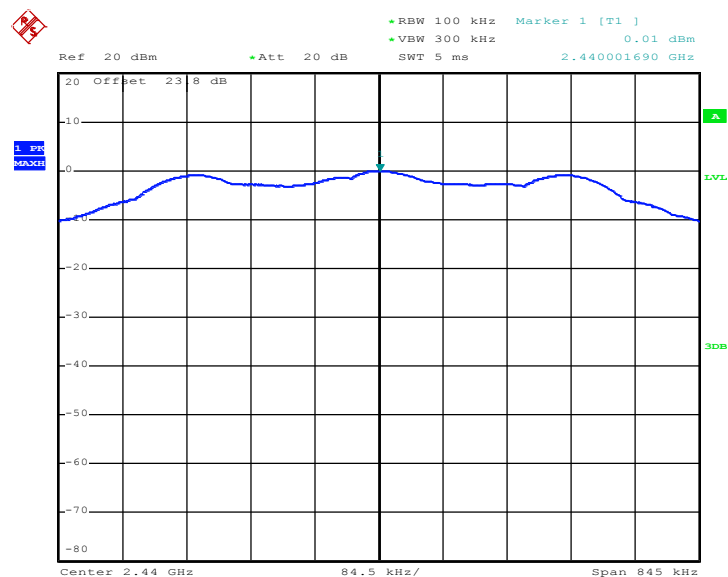
1. Measured power density (dBm) has offset with cable loss.
2. $BWCF (dB) = 10 \log (3k/100k) = -15.2 \text{ dB}$
3. $\text{Power Density/ 3kHz (dBm)} = \text{Measured power density/ 100KHz (dBm)} + BWCF (dB)$

PSD Plot on Channel 00



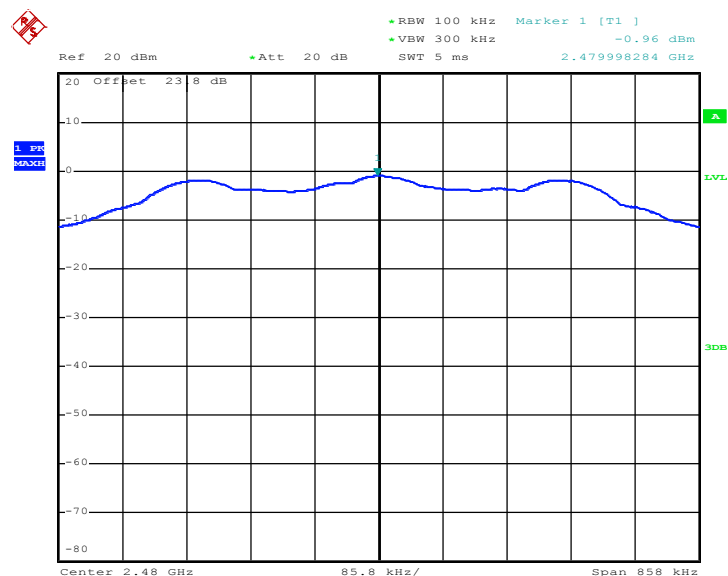
Date: 30.AUG.2012 10:26:35

PSD Plot on Channel 19



Date: 30.AUG.2012 10:38:55

PSD Plot on Channel 39



Date: 30.AUG.2012 10:20:49

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

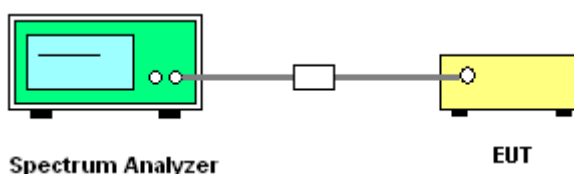
3.4.2 Measuring Instruments

See list of measuring instruments of this test report.

3.4.3 Test Procedure

1. The testing follows the guidelines in ANSI C63.4-2003 and ANSI C63.10-2009 and the Measurement Procedure of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v01.
2. The transmitter output was connected to the spectrum analyzer via a low lose cable.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 KHz, Video bandwidth (VBW) $\geq$ RBW. Out of the authorized frequency band emissions must be at least 20 dB lower than the highest emission level within the authorized band as measured with a 100 KHz RBW. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).

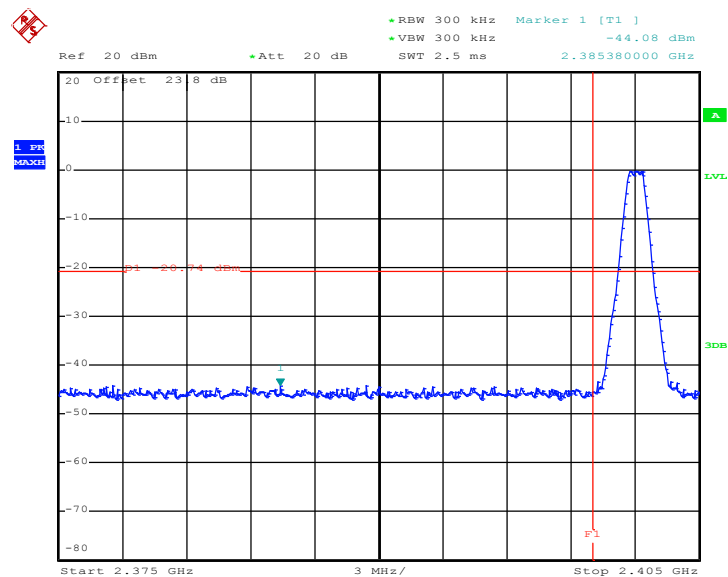
3.4.4 Test Setup



3.4.5 Test Result of Conducted Band Edges

Test Mode :	Bluetooth 4.0 - LE	Temperature :	23~25℃
Test Channel :	00 and 39	Relative Humidity :	58~61%
		Test Engineer :	Hank Yu

Low Band Edge Plot on Channel 00



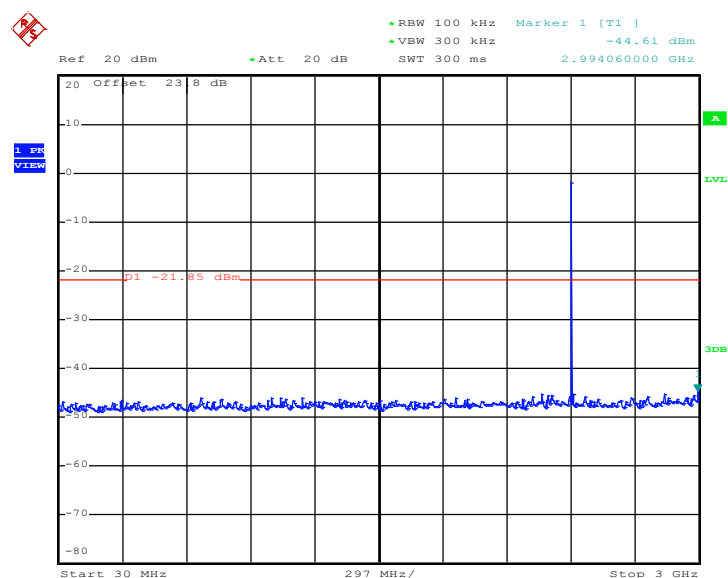
Date: 30.AUG.2012 11:22:32



3.4.6 Test Result of Conducted Spurious Emission

Test Mode :	Bluetooth 4.0 - LE	Temperature :	23~25°C
Test Channel :	00	Relative Humidity :	58~61%
		Test Engineer :	Hank Yu

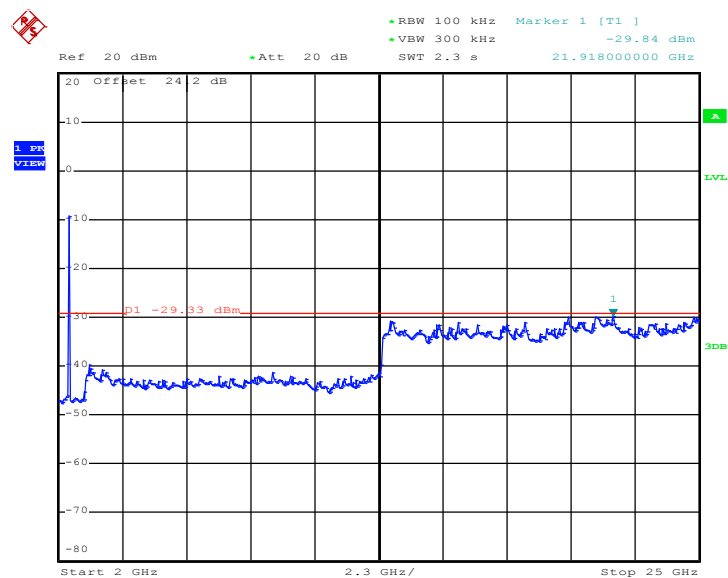
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00



Date: 30.AUG.2012 10:42:22



Conducted Spurious Emission Plot on Bluetooth LE 1Mbps
GFSK Channel 00



Date: 30.AUG.2012 10:42:44



Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19

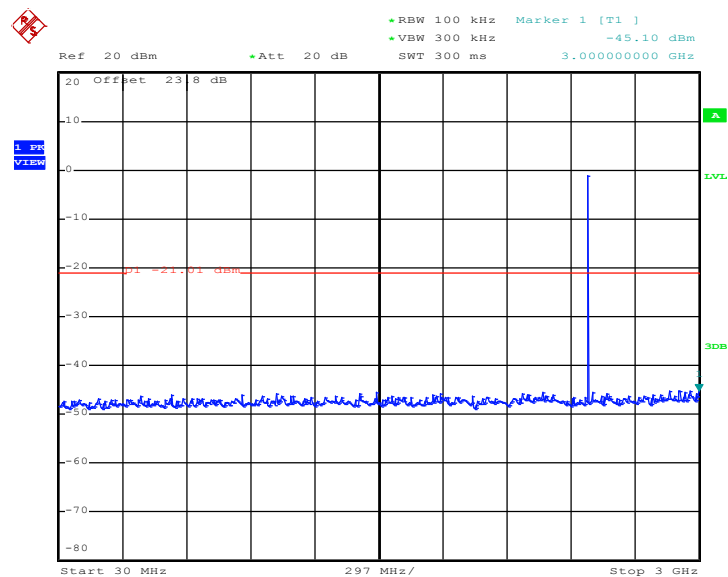






Test Mode :	Bluetooth 4.0 - LE	Temperature :	23~25°C
Test Channel :	39	Relative Humidity :	58~61%
		Test Engineer :	Hank Yu

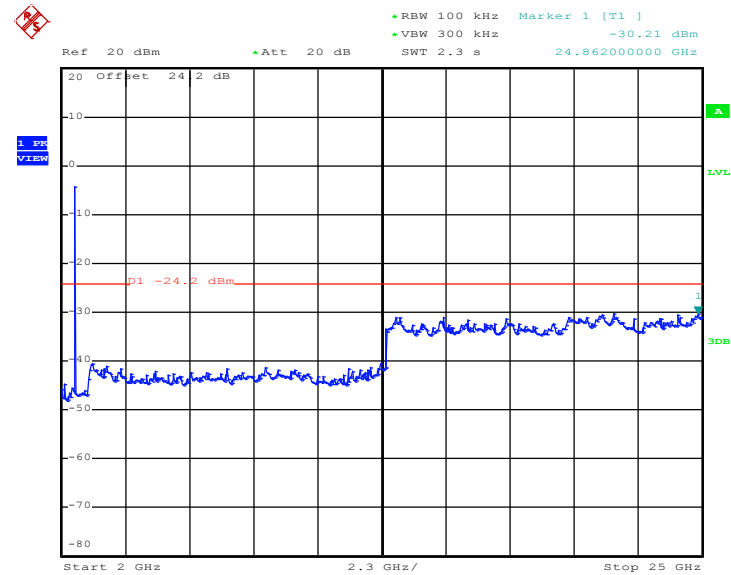
**Conducted Spurious Emission Plot on Bluetooth LE 1Mbps
GFSK Channel 39**



Date: 30.AUG.2012 10:41:27



Conducted Spurious Emission Plot on Bluetooth LE 1Mbps
GFSK Channel 39



Date: 30.AUG.2012 10:41:48

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 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. 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

3.5.2 Measuring Instruments

See list of measuring instruments of this test report.

3.5.3 Test Procedures

1. The testing follows the guidelines in ANSI C63. 10-2009
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:

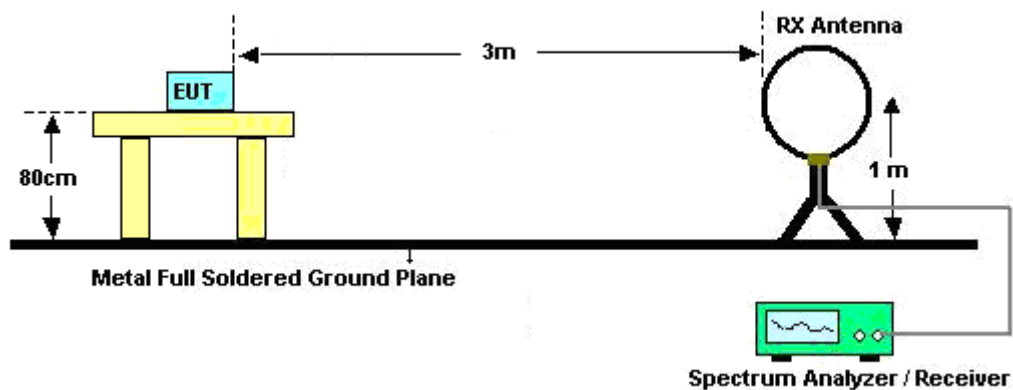
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Band	Duty Cycle(%)	T(us)	1/T(KHz)	VBW Setting
Bluetooth 4.0 - LE	92.54	248.00	4.03	10KHz

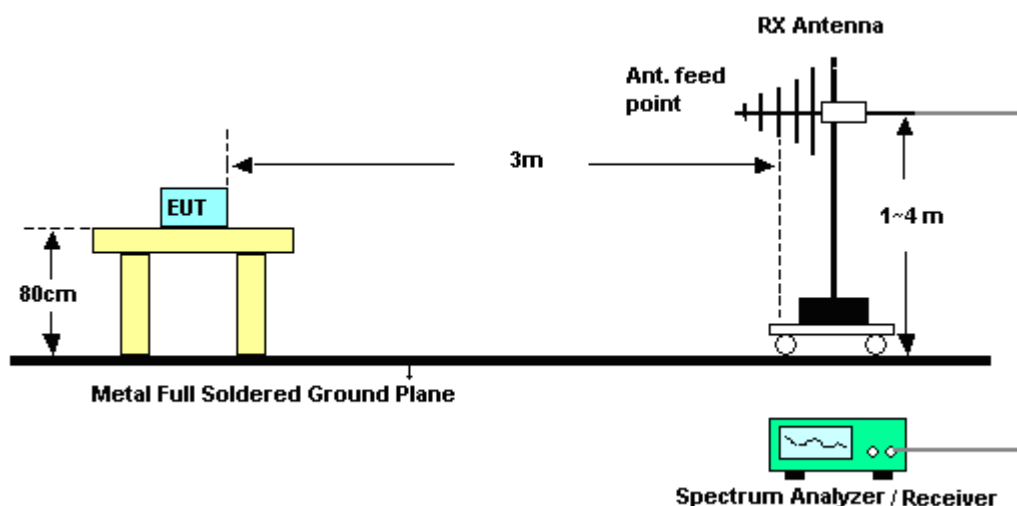
Note: For average measurement with duty cycle < 98%, use reduced VBW measurement method 4.2.3.2.3 in ANSI C63.10.

8. Test Setup

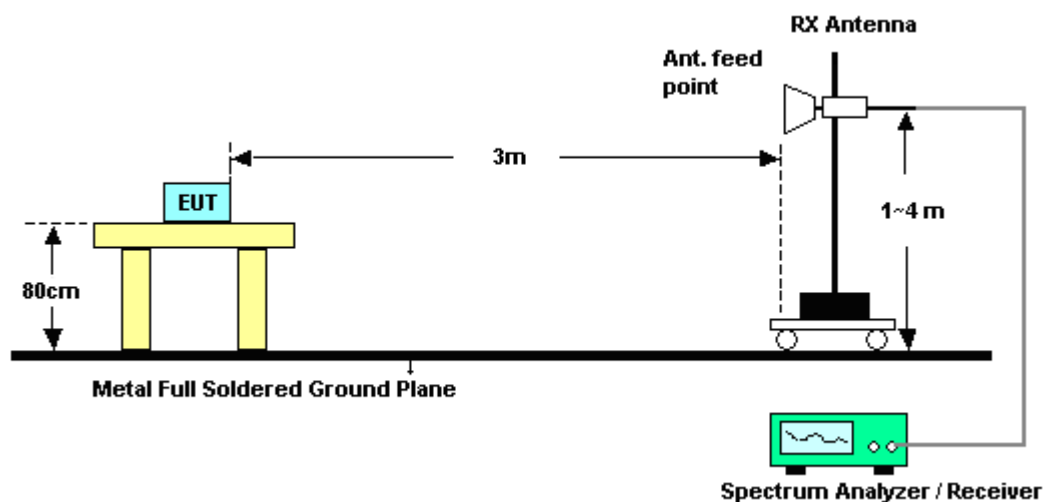
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.4 Test Results of Radiated 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.

3.5.5 Test Result of Radiated Band Edges

Test Mode :	Mode 1	Temperature :	23~25°C
Test Channel :	00	Relative Humidity :	44~47%
		Test Engineer :	David Yang

ANTENNA POLARITY : HORIZONTAL										
Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2324.58	48.09	-25.91	74	47.37	32.09	4.53	35.9	100	319	Peak
2390	36.28	-17.72	54	35.38	32.18	4.58	35.86	100	319	Average

ANTENNA POLARITY : VERTICAL										
Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2388.93	50.16	-23.84	74	49.28	32.18	4.58	35.88	103	231	Peak
2389.74	35.92	-18.08	54	35.04	32.18	4.58	35.88	103	231	Average

Test Mode :	Mode 3	Temperature :	23~25°C
Test Channel :	39	Relative Humidity :	44~47%
		Test Engineer :	David Yang

ANTENNA POLARITY : HORIZONTAL										
Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.5	54.74	-19.26	74	53.63	32.28	4.64	35.81	124	179	Peak
2483.5	50.11	-3.89	54	49	32.28	4.64	35.81	124	179	Average

ANTENNA POLARITY : VERTICAL										
Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.5	50	-24	74	48.89	32.28	4.64	35.81	100	100	Peak
2483.5	43.85	-10.15	54	42.74	32.28	4.64	35.81	100	100	Average

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

Test Mode :	Mode 1	Temperature :	23~25°C
Test Channel :	00	Relative Humidity :	44~47%
Test Engineer :	David Yang	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 (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2402	97.32	-	-	96.42	32.18	4.58	35.86	100	319	Average
2402	98.51	-	-	97.61	32.18	4.58	35.86	100	319	Peak
4804	45.96	-28.04	74	64.26	34.26	6.5	59.06	100	0	Peak

Test Mode :	Mode 1	Temperature :	23~25°C
Test Channel :	00	Relative Humidity :	44~47%
Test Engineer :	David Yang	Polarization :	Vertical
Remark :	1. 2402 MHz is fundamental signal which can be ignored. 2. Test result of emissions which are 20 dB lower than the limit is not reported per15.31 (m).		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2402	91.04	-	-	90.14	32.18	4.58	35.86	103	231	Average
2402	92.18	-	-	91.28	32.18	4.58	35.86	103	231	Peak

Test Mode :	Mode 2	Temperature :	23~25°C
Test Channel :	19	Relative Humidity :	44~47%
Test Engineer :	David Yang	Polarization :	Horizontal
Remark :	1. 2440 MHz is fundamental signal which can be ignored. 2. 9760 MHz is not within a restricted band, and its limit line is 20dB below the highest emission level. For example, 96.41 dBuV/m - 20dB = 76.41 dBuV/m. 3. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2440	95.23	-	-	94.22	32.24	4.61	35.84	101	130	Average
2440	96.41	-	-	95.4	32.24	4.61	35.84	101	130	Peak
4880	43.93	-30.07	74	61.99	34.28	6.54	58.88	100	0	Peak
9760	48.75	-27.66	76.41	57.93	37.21	9.5	55.89	100	0	Peak

Test Mode :	Mode 2	Temperature :	23~25°C
Test Channel :	19	Relative Humidity :	44~47%
Test Engineer :	David Yang	Polarization :	Vertical
Remark :	1. 2440 MHz is fundamental signal which can be ignored. 2. 9760 MHz is not within a restricted band, and its limit line is 20dB below the highest emission level. 3. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2440	87.5	-	-	86.49	32.24	4.61	35.84	100	222	Average
2440	88.58	-	-	87.57	32.24	4.61	35.84	100	222	Peak
4880	45.43	-28.57	74	63.49	34.28	6.54	58.88	100	0	Peak
9760	47.3	-21.28	68.58	56.48	37.21	9.5	55.89	100	0	Peak



Test Mode :	Mode 3	Temperature :	23~25°C
Test Channel :	39	Relative Humidity :	44~47%
Test Engineer :	David Yang	Polarization :	Horizontal
Remark :	1. 2480 MHz is fundamental signal which can be ignored. 2. 9920 MHz is not within a restricted band, and its limit line is 20dB below the highest emission level. 3. “ * ” are 25MHz harmonics and from extender card which is provided by Applicant, declared to ignore those signal due to not from WiFi module.		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
74.55	43.67	*	40	67.41	6.7	0.96	31.4	-	-	Peak
99.93	42.83	*	43.5	63.28	9.9	1.09	31.44	-	-	Peak
124.77	61.01	*	43.5	79.33	11.8	1.22	31.34	-	-	Peak
143.4	40.02	-3.48	43.5	58.84	11.17	1.27	31.26	112	268	Peak
149.88	63.89	*	43.5	82.67	11.2	1.27	31.25	-	-	Peak
154.2	39.76	-3.74	43.5	58.74	10.96	1.3	31.24	-	-	Peak
161.76	39.34	-4.16	43.5	58.85	10.34	1.35	31.2	-	-	Peak
174.99	63.11	*	43.5	83.66	9.1	1.38	31.03	-	-	Peak
199.29	57.03	*	43.5	77.59	9.1	1.46	31.12	-	-	Peak
224.13	59.28	*	46	79	9.66	1.56	30.94	-	-	Peak
249.78	52.18	*	46	68.82	12.6	1.66	30.9	-	-	Peak
273.81	57.96	*	46	74.4	12.96	1.72	31.12	-	-	Peak
298.92	56.72	*	46	72.51	13.39	1.78	30.96	-	-	Peak
323.1	47.44	*	46	62.95	13.59	1.84	30.94	-	-	Peak
349.7	43.3	*	46	58	14.5	1.9	31.1	-	-	Peak
374.9	43.34	*	46	57.34	15.05	1.96	31.01	-	-	Peak
399.4	53.38	*	46	66.57	16	2.01	31.2	-	-	Peak
424.6	61.53	*	46	73.84	16.65	2.08	31.04	-	-	Peak
435.1	39.07	-6.93	46	51.15	16.81	2.1	30.99	-	-	Peak
449.8	62.12	*	46	73.77	17.2	2.14	30.99	-	-	Peak
462.4	40.47	-5.53	46	51.82	17.45	2.16	30.96	-	-	Peak
472.9	66.46	*	46	77.46	17.63	2.18	30.81	-	-	Peak
485.5	37.85	-8.15	46	48.5	17.82	2.2	30.67	-	-	Peak



Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
498.1	50.39	*	46	60.69	18.06	2.23	30.59	-	-	Peak
522.6	49.27	*	46	59.46	18.33	2.28	30.8	-	-	Peak
549.9	39.28	*	46	48.21	19.8	2.33	31.06	-	-	Peak
574.4	39.96	*	46	48.47	19.86	2.37	30.74	-	-	Peak
599.6	36.28	*	46	44.38	19.89	2.42	30.41	-	-	Peak
624.8	54.41	*	46	61.62	20.55	2.5	30.26	-	-	Peak
647.2	31.9	*	46	39.06	20.39	2.58	30.13	-	-	Peak
674.5	54.16	*	46	61.36	20.34	2.62	30.16	-	-	Peak
699.7	37.56	*	46	44.43	20.69	2.65	30.21	-	-	Peak
722.1	47.88	*	46	53.67	21.71	2.7	30.2	-	-	Peak
749.4	46.24	*	46	51.28	22.4	2.75	30.19	-	-	Peak
774.6	37.53	*	46	42.59	22.15	2.79	30	-	-	Peak
799.8	47.95	*	46	52.83	22.1	2.83	29.81	-	-	Peak
825	48.92	*	46	52.92	22.87	2.88	29.75	-	-	Peak
846.7	43.99	*	46	47.41	23.37	2.91	29.7	-	-	Peak
874.7	48.46	*	46	52.23	23.1	2.97	29.84	-	-	Peak
899.9	38.36	*	46	42.05	23.3	3.01	30	-	-	Peak
921.6	46.07	*	46	49.16	23.93	3.03	30.05	-	-	Peak
949.6	31.41	*	46	33.66	24.8	3.06	30.11	-	-	Peak
971.3	41.76	*	54	43.52	25.08	3.14	29.98	-	-	Peak
2480	96.22	-	-	95.11	32.28	4.64	35.81	124	179	Average
2480	97.19	-	-	96.08	32.28	4.64	35.81	124	179	Peak
9920	49.46	-27.73	77.19	58.33	37.42	9.51	55.8	100	0	Peak

Test Mode :	Mode 3	Temperature :	23~25°C
Test Channel :	39	Relative Humidity :	44~47%
Test Engineer :	David Yang	Polarization :	Vertical
Remark :	1. 2480 MHz is fundamental signal which can be ignored. 2. “ * ” are 25MHz harmonics and from extender card which is provided by Applicant, declared to ignore those signal due to not from WiFi module. 3. Average measurement was not performed if peak level went lower than the average limit.		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
33.24	35.68	-4.32	40	48.83	17.76	0.72	31.63	100	189	Peak
74.82	37.27	*	40	61.01	6.7	0.96	31.4	-	-	Peak
99.93	38	*	43.5	58.45	9.9	1.09	31.44	-	-	Peak
124.77	55.1	*	43.5	73.42	11.8	1.22	31.34	-	-	Peak
149.88	59.39	*	43.5	78.17	11.2	1.27	31.25	-	-	Peak
153.93	34.68	-8.82	43.5	53.66	10.96	1.3	31.24	-	-	Peak
161.76	33.86	-9.64	43.5	53.37	10.34	1.35	31.2	-	-	Peak
174.99	62.28	*	43.5	82.83	9.1	1.38	31.03	-	-	Peak
199.29	51.49	*	43.5	72.05	9.1	1.46	31.12	-	-	Peak
224.94	49.92	*	46	69.55	9.75	1.56	30.94	-	-	Peak
250.05	44.14	*	46	60.78	12.6	1.66	30.9	-	-	Peak
274.89	50.39	*	46	66.85	12.95	1.72	31.13	-	-	Peak
300	50.37	*	46	66.13	13.4	1.78	30.94	-	-	Peak
324.5	47.17	*	46	62.63	13.65	1.84	30.95	-	-	Peak

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
349.7	41.37	*	46	56.07	14.5	1.9	31.1	-	-	Peak
374.9	45.23	*	46	59.23	15.05	1.96	31.01	-	-	Peak
399.4	50.5	*	46	63.69	16	2.01	31.2	-	-	Peak
424.6	59.18	*	46	71.49	16.65	2.08	31.04	-	-	Peak
437.2	36.39	*	46	48.41	16.85	2.11	30.98	-	-	Peak
447.7	59.81	*	46	71.51	17.14	2.14	30.98	-	-	Peak
460.3	37.76	-8.24	46	49.18	17.42	2.16	31	-	-	Peak
474.3	62.23	*	46	73.2	17.64	2.18	30.79	-	-	Peak
485.5	34.89	-11.11	46	45.54	17.82	2.2	30.67	-	-	Peak
498.1	49.58	*	46	59.88	18.06	2.23	30.59	-	-	Peak
522.6	49.95	*	46	60.14	18.33	2.28	30.8	-	-	Peak

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
547.8	39.35	*	46	48.48	19.58	2.33	31.04	-	-	Peak
574.4	44.84	*	46	53.35	19.86	2.37	30.74	-	-	Peak
597.5	36.81	*	46	44.97	19.87	2.41	30.44	-	-	Peak
624.8	53.51	*	46	60.72	20.55	2.5	30.26	-	-	Peak
647.2	31.25	*	46	38.41	20.39	2.58	30.13	-	-	Peak
672.4	52.27	*	46	59.49	20.32	2.62	30.16	-	-	Peak
696.9	33.27	*	46	40.15	20.67	2.65	30.2	-	-	Peak
722.1	42.76	*	46	48.55	21.71	2.7	30.2	-	-	Peak
750.1	39.89	*	46	44.93	22.4	2.75	30.19	-	-	Peak
774.6	33.81	*	46	38.87	22.15	2.79	30	-	-	Peak
799.8	41.59	*	46	46.47	22.1	2.83	29.81	-	-	Peak
825	45.35	*	46	49.35	22.87	2.88	29.75	-	-	Peak
849.5	41.97	*	46	45.34	23.4	2.92	29.69	-	-	Peak
874.7	44.46	*	46	48.23	23.1	2.97	29.84	-	-	Peak
899.9	35.17	*	46	38.86	23.3	3.01	30	-	-	Peak
925.1	44.55	*	46	47.52	24.05	3.04	30.06	-	-	Peak
971.3	40.84	*	54	42.6	25.08	3.14	29.98	-	-	Peak
2480	89.96	-	-	88.85	32.28	4.64	35.81	100	100	Average
2480	91.07	-	-	89.96	32.28	4.64	35.81	100	100	Peak
4960	45.5	-28.5	74	63.29	34.29	6.57	58.65	100	0	Peak

3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

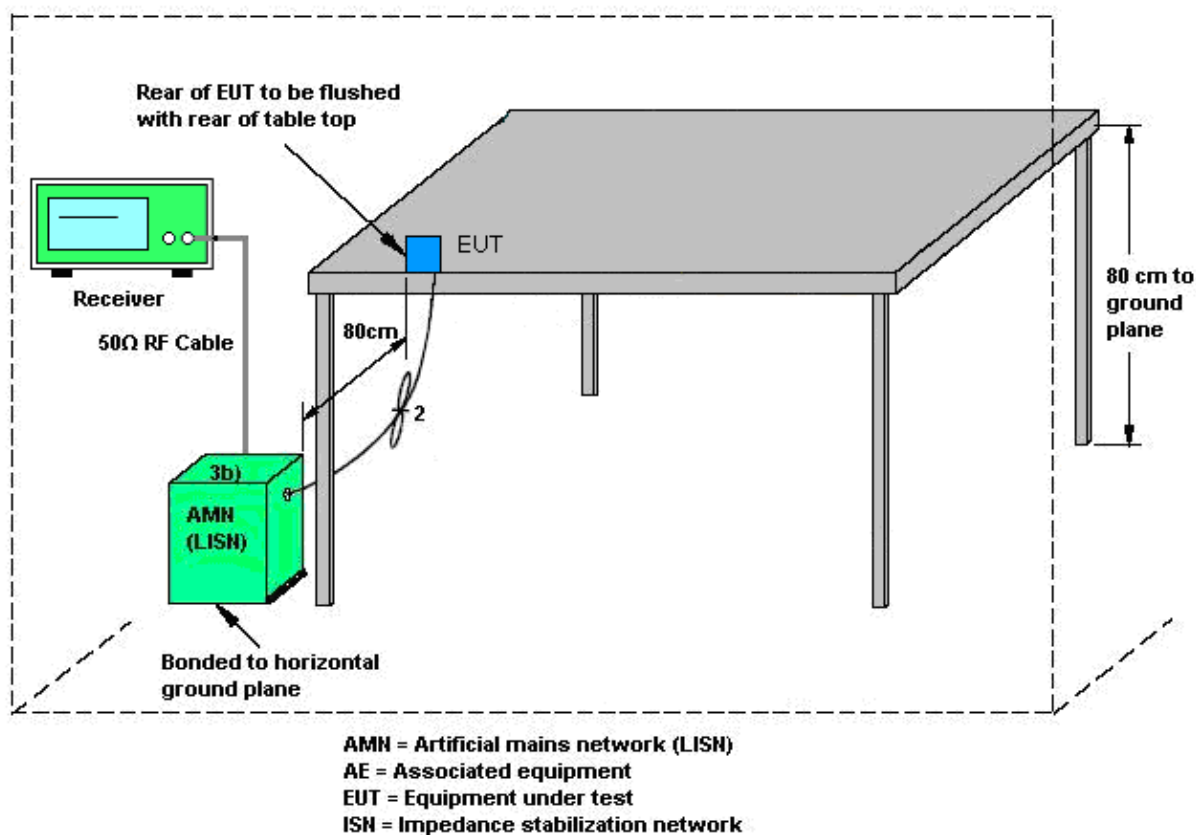
3.6.2 Measuring Instruments

See list of measuring instruments of this test report.

3.6.3 Test Procedures

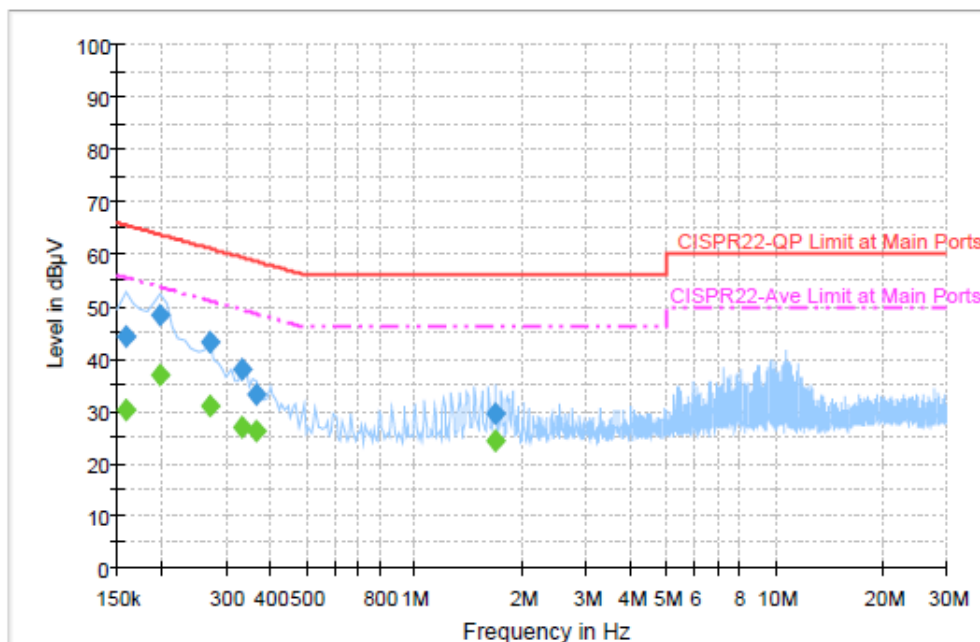
1. Please follow the guidelines in ANSI C63.4-2003 and ANSI C63.10-2009.
2. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
3. Connect EUT to the power mains through a line impedance stabilization network (LISN).
4. All the support units are connecting to the other LISN.
5. The LISN provides 50 ohm coupling impedance for the measuring instrument.
6. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
7. Both sides of AC line were checked for maximum conducted interference.
8. The frequency range from 150 kHz to 30 MHz was searched.
9. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Test Mode :	Mode 2	Temperature :	20~22℃
Test Engineer :	Slash Huang	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Tx Ch39 + EBJ Ant		
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



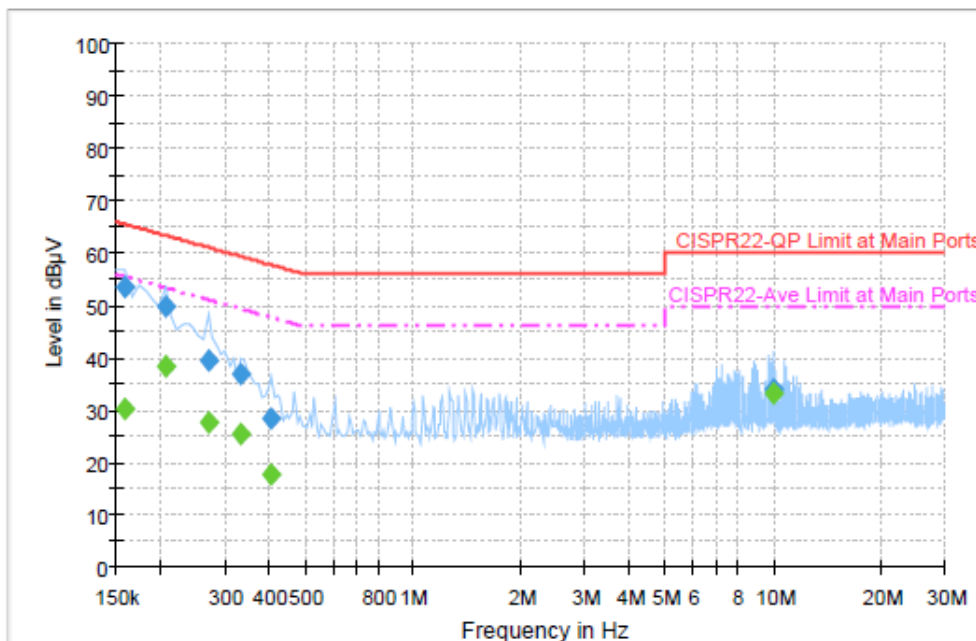
Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	44.2	Off	L1	19.3	21.4	65.6
0.198000	48.4	Off	L1	19.3	15.3	63.7
0.270000	43.1	Off	L1	19.3	18.0	61.1
0.334000	38.0	Off	L1	19.4	21.4	59.4
0.366000	33.3	Off	L1	19.4	25.3	58.6
1.678000	29.6	Off	L1	19.5	26.4	56.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	30.1	Off	L1	19.3	25.5	55.6
0.198000	36.8	Off	L1	19.3	16.9	53.7
0.270000	31.0	Off	L1	19.3	20.1	51.1
0.334000	27.0	Off	L1	19.4	22.4	49.4
0.366000	26.2	Off	L1	19.4	22.4	48.6
1.678000	24.2	Off	L1	19.5	21.8	46.0

Test Mode :	Mode 2	Temperature :	20~22°C
Test Engineer :	Slash Huang	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Tx Ch39 + EBJ Ant		
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		


Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	53.5	Off	N	19.3	12.1	65.6
0.206000	49.9	Off	N	19.4	13.5	63.4
0.270000	39.4	Off	N	19.4	21.7	61.1
0.334000	36.8	Off	N	19.4	22.6	59.4
0.406000	28.4	Off	N	19.4	29.3	57.7
9.998000	33.9	Off	N	19.7	26.1	60.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	30.2	Off	N	19.3	25.4	55.6
0.206000	38.2	Off	N	19.4	15.2	53.4
0.270000	27.7	Off	N	19.4	23.4	51.1
0.334000	25.5	Off	N	19.4	23.9	49.4
0.406000	17.8	Off	N	19.4	29.9	47.7
9.998000	33.4	Off	N	19.7	16.6	50.0



3.7 Antenna Requirements

3.7.1 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.

3.7.2 Antenna Connected Construction

Non-standard connector used.

3.7.3 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
Spectrum Analyzer	R&S	FSP40	100055	9kHz~40GHz	Jun. 06, 2012	Aug. 29, 2012 ~ Aug. 30, 2012	Jun. 05, 2013	Conducted (TH02-HY)
Bluetooth Base Station	R&S	CBT32	100519	N/A	Jun. 05, 2012	Aug. 29, 2012 ~ Aug. 30, 2012	Jun. 06, 2013	Conducted (TH02-HY)
EMI Test Receiver	R&S	ESCS 30	100356	9KHz ~ 2.75GHz	Oct. 27, 2011	Sep. 07, 2012	Oct. 26, 2012	Conduction (CO05-HY)
Two-LISN	R&S	ENV216	11-100081	9KHz ~ 30MHz	Dec. 09, 2011	Sep. 07, 2012	Dec. 08, 2012	Conduction (CO05-HY)
Two-LISN	R&S	ENV216	11-100080	9KHz ~ 30MHz	Dec. 06, 2011	Sep. 07, 2012	Dec. 05, 2012	Conduction (CO05-HY)
AC Power Source	APC	APC-1000W	N/A	N/A	N/A	Sep. 07, 2012	N/A	Conduction (CO05-HY)
Spectrum Analyzer	R&S	ESU26	100390	20Hz ~ 26.5GHz	Dec. 22, 2011	Aug. 30, 2012	Dec. 21, 2012	Radiation (03CH05-HY)
Bilog Antenna	SCHAFFNER	CBL6111C	2725	30MHz ~ 2GHz	Oct. 22, 2011	Aug. 30, 2012	Oct. 21, 2012	Radiation (03CH05-HY)
Turn Table	HD	Deis HD 2000	420/611	0 ~ 360 degree	N/A	Aug. 30, 2012	N/A	Radiation (03CH05-HY)
Antenna Mast	HD	MA 240	240/666	1 m ~ 4 m	N/A	Aug. 30, 2012	N/A	Radiation (03CH05-HY)
Horn Antenna	ESCO	3117	66584	1GHz~18GHz	Aug. 10, 2012	Aug. 30, 2012	Aug. 09, 2013	Radiation (03CH05-HY)
Pre Amplifier	COM-POWER	PA-103A	161075	10Hz ~ 1000MHz Gain:32dB	Feb. 27, 2012	Aug. 30, 2012	Feb. 26, 2013	Radiation (03CH05-HY)
Pre Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	159087	1GHz~18GHz	Feb. 27, 2012	Aug. 30, 2012	Feb. 26, 2013	Radiation (03CH05-HY)
Pre Amplifier	Agilent	8449B	3008A019 17	1GHz~26.5GHz	Aug. 28, 2012	Aug. 30, 2012	Aug. 27, 2013	Radiation (03CH05-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170 251	15GHz ~ 40GHz	Oct. 21, 2011	Aug. 30, 2012	Oct. 20, 2012	Radiation (03CH05-HY)
Bluetooth Base Station	R&S	CBT32	100519	N/A	Jun. 05, 2012	Aug. 30, 2012	Jun. 06, 2013	Radiation (03CH05-HY)
Loop Antenna	R&S	HFH2-Z2	860004/00 1	9KHz ~ 30MHz	Jul. 03, 2012	Aug. 30, 2012	Jul. 02, 2014	Radiation (03CH05-HY)

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.26
--	------

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.54
--	------

Uncertainty of Radiated Emission Measurement (1 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.72
--	------



Appendix A. Photographs of EUT

Please refer to Sporton report number EP282317 as below.