



# FCC RF Test Report

**APPLICANT** : Bullitt Group  
**EQUIPMENT** : Rugged Smart Phone  
**BRAND NAME** : CAT  
**MODEL NAME** : S30  
**FCC ID** : ZL5S30  
**STANDARD** : FCC Part 15 Subpart C §15.247  
**CLASSIFICATION** : (DTS) Digital Transmission System

The product was received on Jul. 01, 2015 and testing was completed on Jul. 15, 2015. 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.

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Reviewed by: Joseph Lin / Supervisor

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Approved by: Jones Tsai / Manager

**SPORTON INTERNATIONAL INC.**

**No. 52, Hwa Ya 1<sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.**

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**SPORTON INTERNATIONAL INC.**

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : ZL5S30

Page Number : 1 of 44

Report Issued Date : Aug. 11, 2015

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## REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR570160B	Rev. 01	Initial issue of report	Aug. 11, 2015



## SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	RSS-247 5.2(1)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	RSS-Gen 6.6	99% Bandwidth	-	Pass	-
3.2	15.247(b)(1)	RSS-247 A5.4(4)	Peak Output Power	$\leq 30\text{dBm}$	Pass	-
3.3	15.247(e)	RSS-247 5.2(2)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	-
3.4	15.247(d)	RSS-247 5.5	Conducted Band Edges and Spurious Emission	$\leq 20\text{dBc}$	Pass	-
3.5	15.247(d)	RSS-247 5.5	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 5.32 dB at 62.940 MHz
3.6	15.207	RSS-GEN 8.8	AC Conducted Emission	15.207(a)	Pass	Under limit 9.60 dB at 0.190 MHz
3.7	15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-



# 1 General Description

## 1.1 Applicant

**Bullitt Group**

One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR United Kingdom

## 1.2 Manufacturer

**Compal Electronics, INC.**

No. 385, Yangguang St. Neihu District, Taipei City 11491, Taiwan, R.O.C

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Rugged Smart Phone
Brand Name	CAT
Model Name	S30
FCC ID	ZL5S30
EUT supports Radios application	GSM/EGPRS/WCDMA/HSPA/LTE WLAN 11b/g/n HT20 Bluetooth v4.1 EDR/LE
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.

## 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	0.58 dBm (0.0011 W)
99% Occupied Bandwidth	1.062MHz
Antenna Type	PIFA Antenna type with gain 1.915 dBi
Type of Modulation	Bluetooth LE : GFSK

**<Sample Information>**

S30 has 2 different Variant	
Sample 1	Dual SIM
Sample 2	Single SIM
The HW difference is SIM holder	

## 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.

<b>Test Site</b>	SPORTON INTERNATIONAL INC.	
<b>Test Site Location</b>	No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978	
<b>Test Site No.</b>	<b>Sporton Site No.</b>	
	TH02-HY	CO05-HY

<b>Test Site</b>	SPORTON INTERNATIONAL INC.	
<b>Test Site Location</b>	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd., Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-0868 FAX: +886-3-327-0855	
<b>Test Site No.</b>	<b>Sporton Site No.</b>	
	03CH10-HY	

**Note:** The test site complies with ANSI C63.4 2009 requirement.



## **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 v03r03
- ♦ ANSI C63.10-2009

### **Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. FCC permits the use of the 1.5 meter table as an alternative in C63.10-2013 through inquiry tracking number 961829.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

## 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	-0.17 dBm
Ch19	2440MHz	<b>0.58 dBm</b>
Ch39	2480MHz	-0.64 dBm

- 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: 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 to determine the final configuration (X plane as worst plane) from all possible combinations.
- AC power line Conducted Emission was tested under maximum output power.



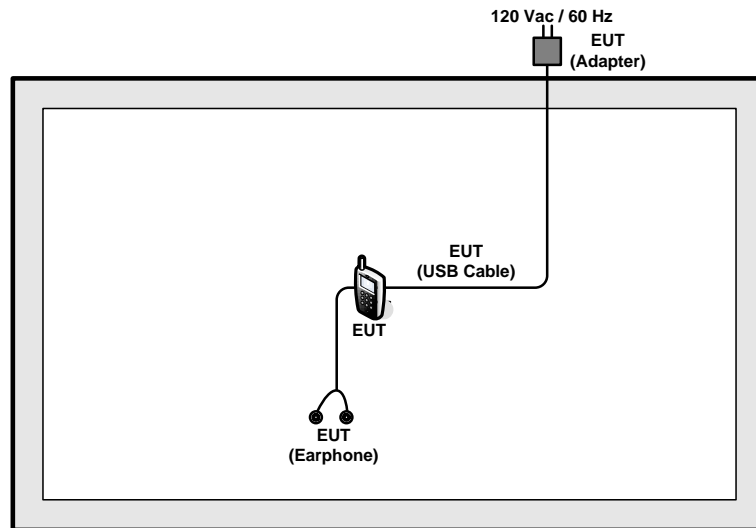
## 2.2 Test Mode

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

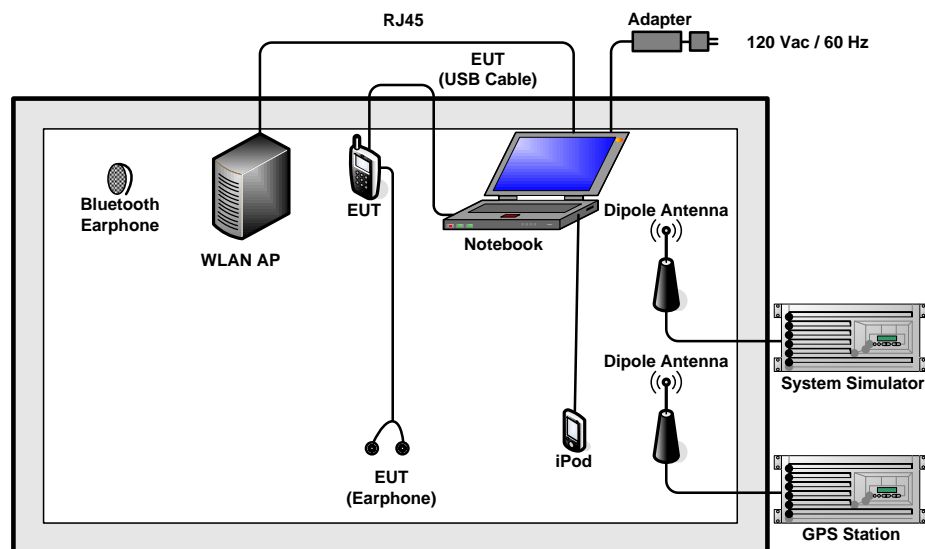
Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth 4.0 – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps
AC Conducted Emission	Mode 1: LTE Band 4 Idle + Bluetooth Link + WLAN Link + GPS Rx + Earphone + Battery + USB Cable (Data Link with Notebook) + SIM1 with Sample 1
Remark: All radiated test cases were performed with earphone 1, USB cable, adapter 1, and sample 1.	

## 2.3 Connection Diagram of Test System

### <Bluetooth 4.0 – LE Tx Mode>



### <AC Conducted Emission Mode>



## 2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	GPS Station	Pendulum	GSG-54	N/A	N/A	Unshielded, 1.8 m
3.	WLAN AP	D-Link	DIR-865L	KA2IR865LA1	N/A	Unshielded, 1.8 m
4.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
6.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A
7.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A

## 2.5 EUT Operation Test Setup

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

## 2.6 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

*Offset = RF cable loss + attenuator factor.*

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\
 &= 4.2 + 10 = 14.2 \text{ (dB)}
 \end{aligned}$$

### 3 Test Result

#### 3.1 6dB and 99% Bandwidth Measurement

##### 3.1.1 Limit of 6dB and 99% Bandwidth

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

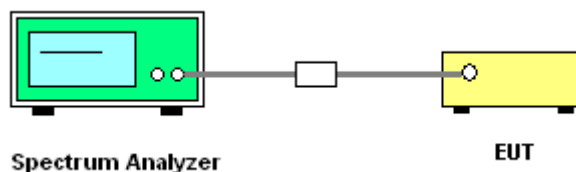
##### 3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

##### 3.1.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. 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.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30kHz and set the Video bandwidth (VBW) = 100kHz.
6. Measure and record the results in the test report.

##### 3.1.4 Test Setup

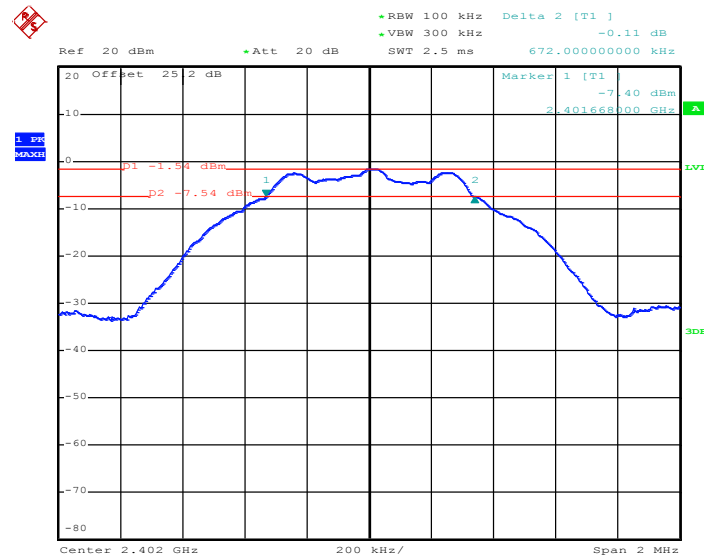


### 3.1.5 Test Result of 6dB Bandwidth

<b>Test Mode :</b>	Bluetooth 4.0 - LE	<b>Temperature :</b>	22~25℃
<b>Test Engineer :</b>	Luffy Lin	<b>Relative Humidity :</b>	51~55%

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	6dB Bandwidth Min. Limit (MHz)	Pass/Fail
00	2402	0.672	0.5	Pass
19	2440	0.668	0.5	Pass
39	2480	0.664	0.5	Pass

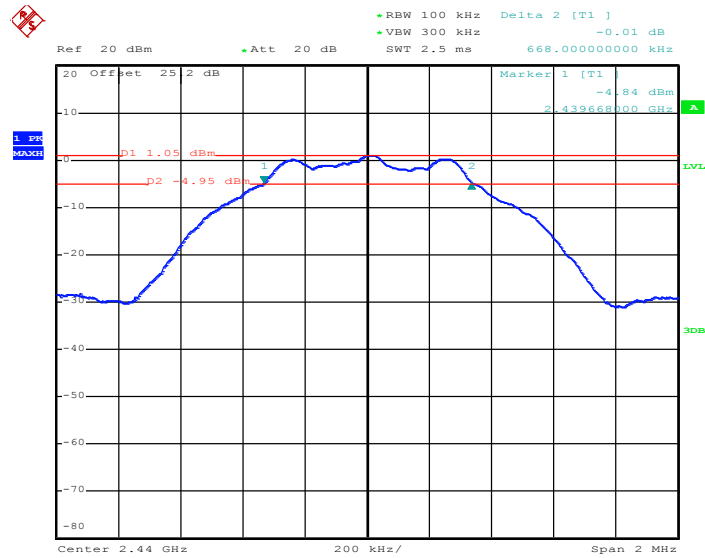
### 6 dB Bandwidth Plot on Channel 00



Date: 4.JUL.2015 01:32:49

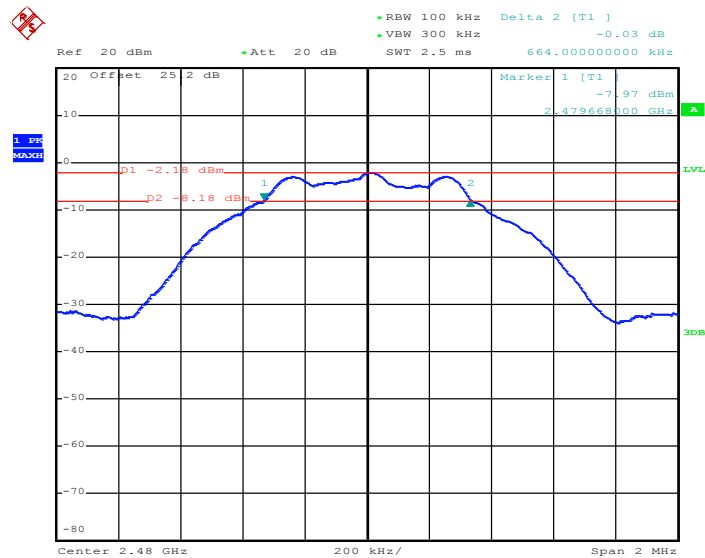


6 dB Bandwidth Plot on Channel 19



Date: 4.JUL.2015 01:39:43

6 dB Bandwidth Plot on Channel 39



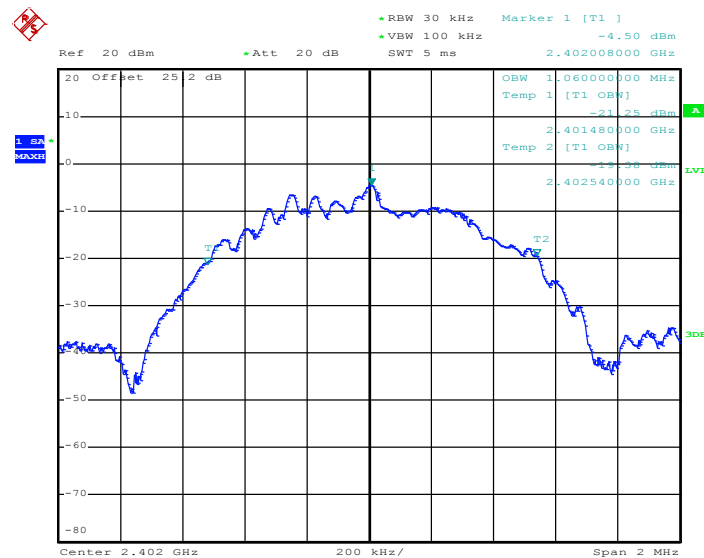
Date: 4.JUL.2015 01:44:43

### 3.1.6 Test Result of 99% Occupied Bandwidth

Test Mode :	Bluetooth 4.0 - LE	Temperature :	22~25°C
Test Engineer :	Luffy Lin	Relative Humidity :	51~55%

Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.060
19	2440	1.058
39	2480	1.062

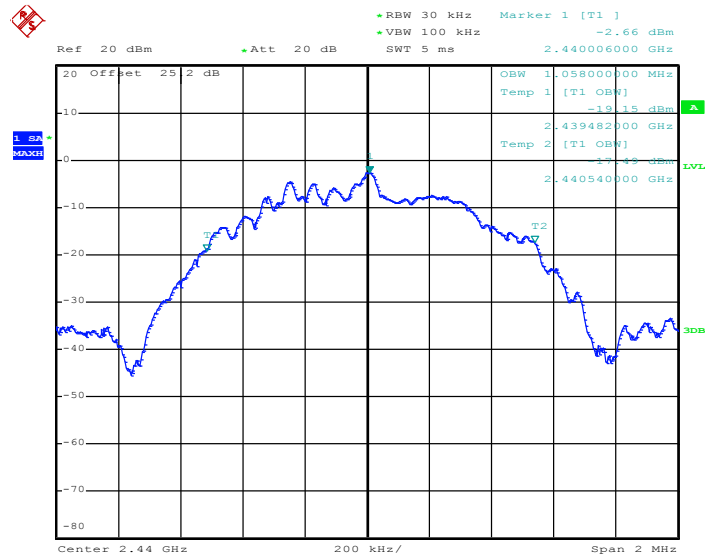
**99% Bandwidth Plot on Channel 00**



Date: 4.JUL.2015 01:35:17

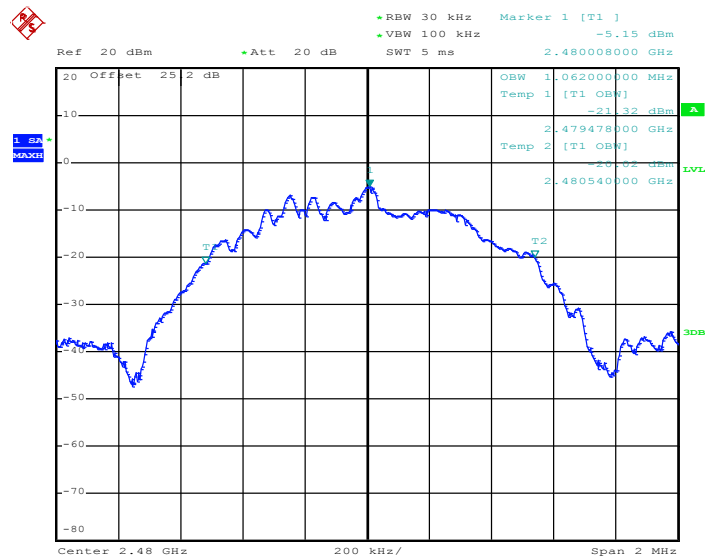


99% Occupied Bandwidth Plot on Channel 19



Date: 4.JUL.2015 01:41:30

99% Occupied Bandwidth Plot on Channel 39



Date: 4.JUL.2015 01:46:55

Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.



## 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 is 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.

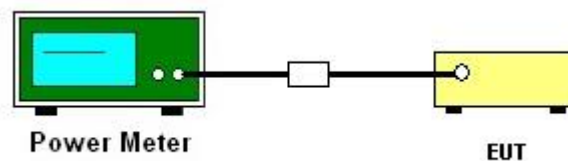
### 3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

### 3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v03r03.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. 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. 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**

<b>Test Mode :</b>	Bluetooth 4.0 - LE	<b>Temperature :</b>	22~25℃
<b>Test Engineer :</b>	Luffy Lin	<b>Relative Humidity :</b>	51~55%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	-0.17	30.00	Pass
19	2440	0.58	30.00	Pass
39	2480	-0.64	30.00	Pass

### 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.

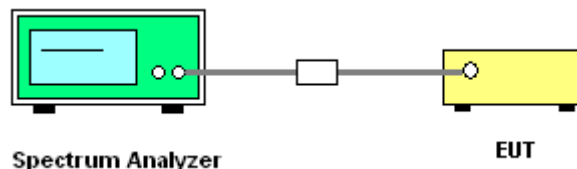
#### 3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

#### 3.3.3 Test Procedures

1. The testing follows Measurement Procedure 10.2 Method PKPSD of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. 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) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
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.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

#### 3.3.4 Test Setup



### 3.3.5 Test Result of Power Spectral Density

<b>Test Mode :</b>	Bluetooth 4.0 - LE	<b>Temperature :</b>	22~25℃
<b>Test Engineer :</b>	Luffy Lin	<b>Relative Humidity :</b>	51~55%

Channel	Frequency (MHz)	Power Density		Max. Limits (dBm/3kHz)	Pass/Fail
		PSD/100kHz (dBm)	PSD/3kHz (dBm)		
00	2402	-1.550	-16.840	8	Pass
19	2440	0.300	-14.900	8	Pass
39	2480	-2.170	-17.410	8	Pass

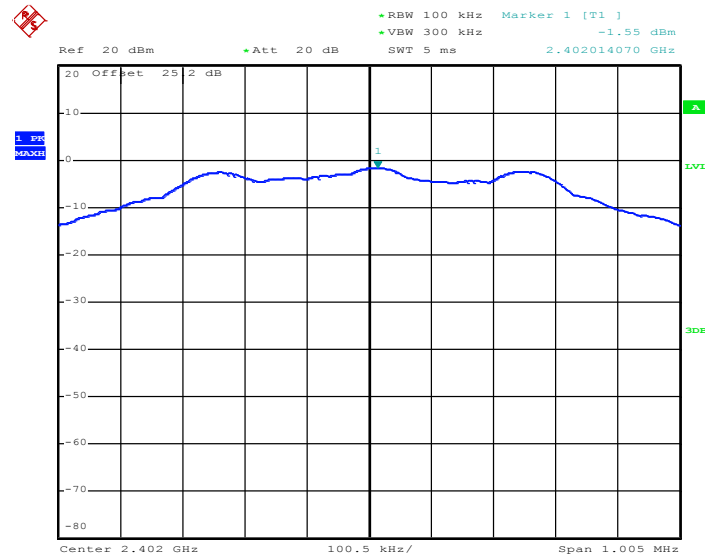
**Note:**

1. Measured power density (dBm) has offset with cable loss.
2. The Measured power density (dBm)/ 100kHz is reference level and used as 20dBc down for Conducted Band Edges and Conducted Spurious Emission limit line.



### 3.3.6 Test Result of Power Spectral Density Plots (100kHz)

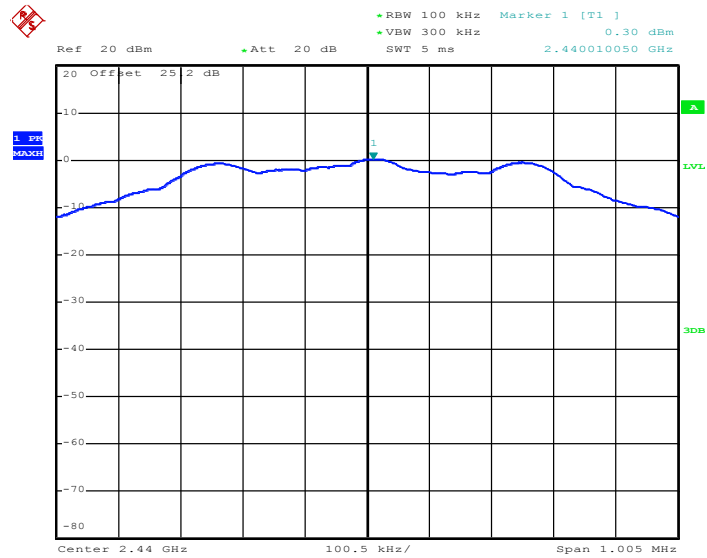
PSD 100kHz Plot on Channel 00



Date: 4.JUL.2015 01:33:44

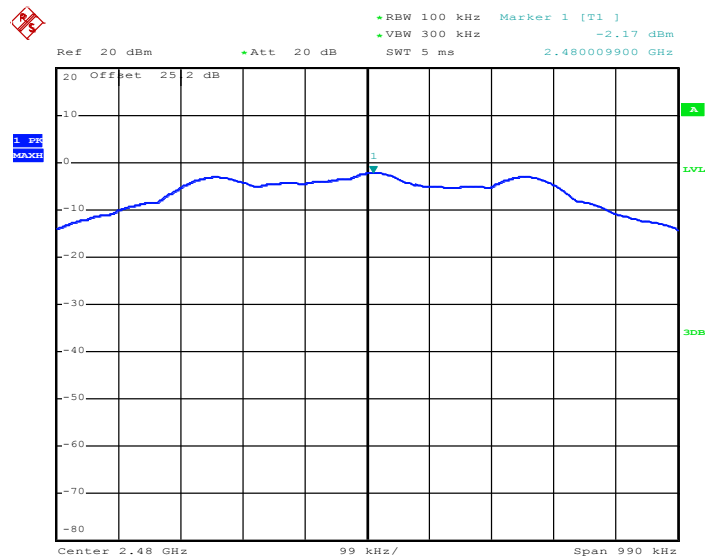


### PSD 100kHz Plot on Channel 19



Date: 4.JUL.2015 01:40:33

### PSD 100kHz Plot on Channel 39

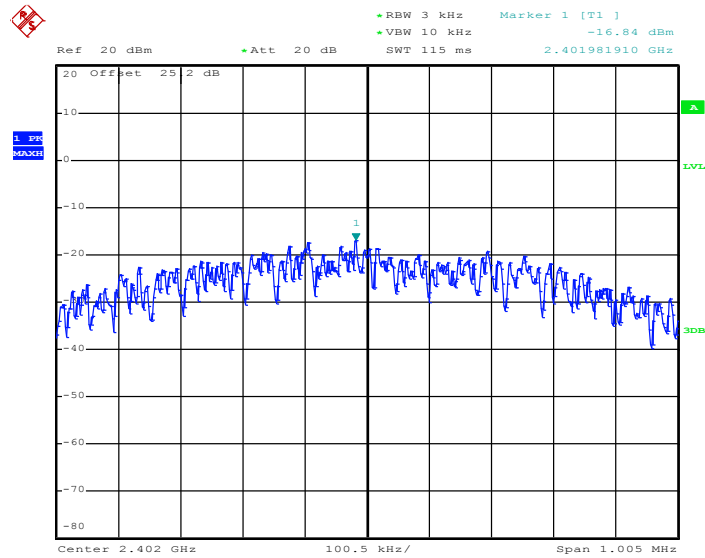


Date: 4.JUL.2015 01:45:36



### 3.3.7 Test Result of Power Spectral Density Plots (3kHz)

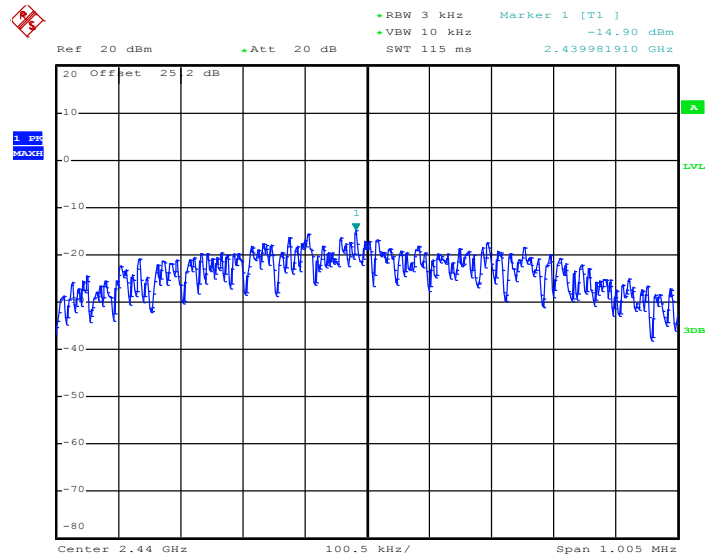
PSD 3kHz Plot on Channel 00



Date: 4.JUL.2015 01:33:13

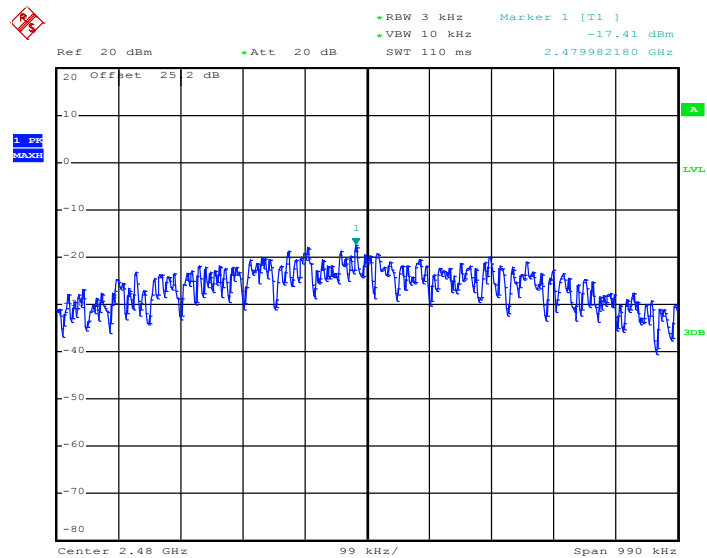


### PSD 3kHz Plot on Channel 19



Date: 4.JUL.2015 01:40:07

### PSD 3kHz Plot on Channel 39



Date: 4.JUL.2015 01:45:13



### 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.

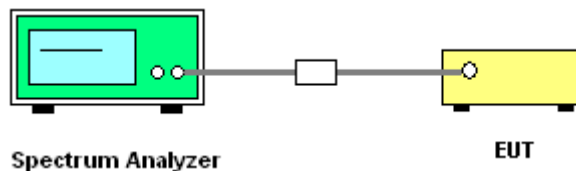
#### 3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

#### 3.4.3 Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. 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. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. 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).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

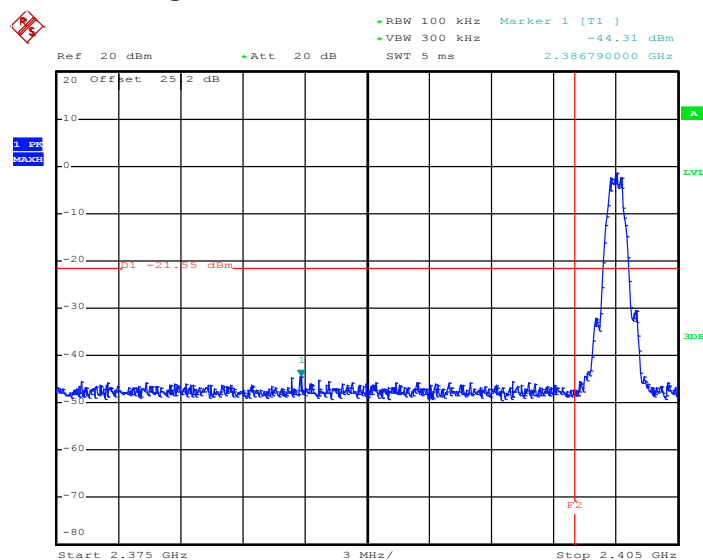
#### 3.4.4 Test Setup



### 3.4.5 Test Result of Conducted Band Edges

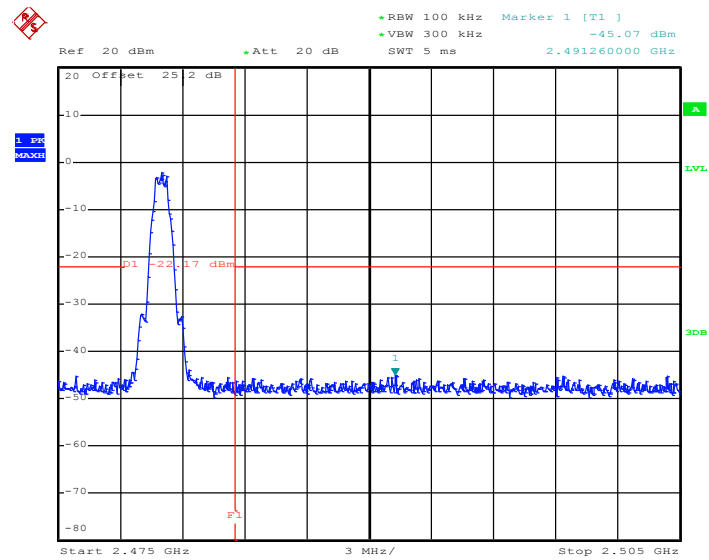
<b>Test Mode :</b>	Bluetooth 4.0 - LE	<b>Temperature :</b>	22~25℃
<b>Test Channel :</b>	00 and 39	<b>Relative Humidity :</b>	51~55%
		<b>Test Engineer :</b>	Luffy Lin

### Low Band Edge Plot on Channel 00



Date: 4.JUL.2015 01:34:19

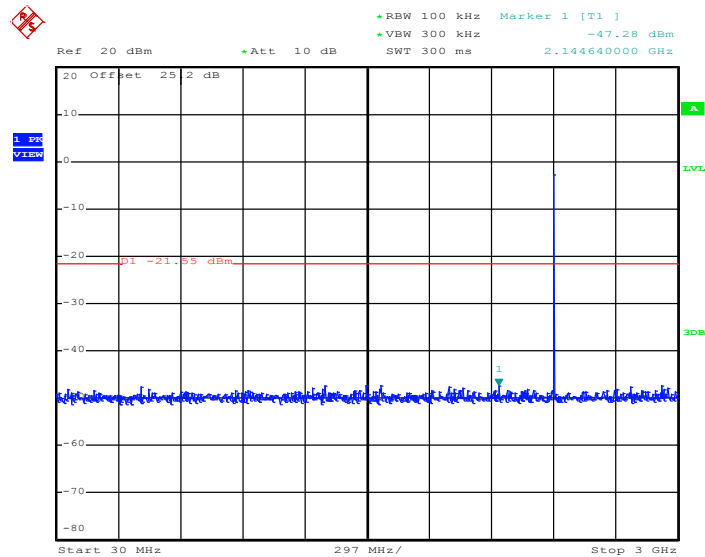
### High Band Edge Plot on Channel 39



Date: 4.JUL.2015 01:45:53

**3.4.6 Test Result of Conducted Spurious Emission**

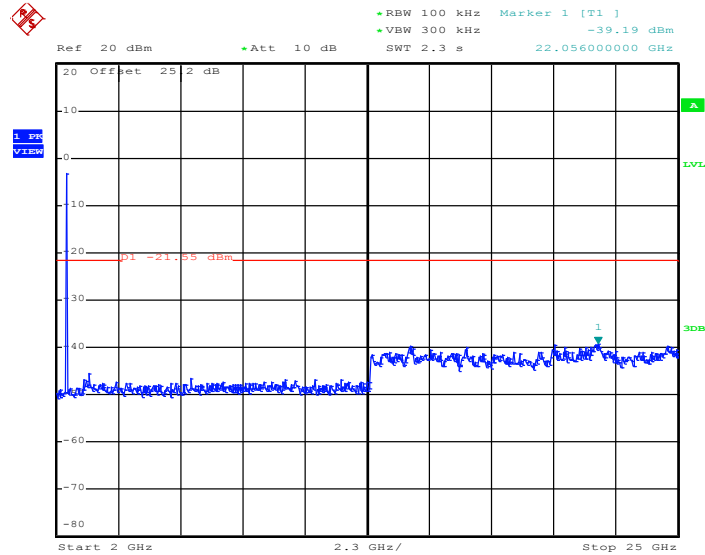
Test Mode :	Bluetooth 4.0 - LE	Temperature :	22~25°C
Test Channel :	00	Relative Humidity :	51~55%
		Test Engineer :	Luffy Lin

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

Date: 4.JUL.2015 01:34:46



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

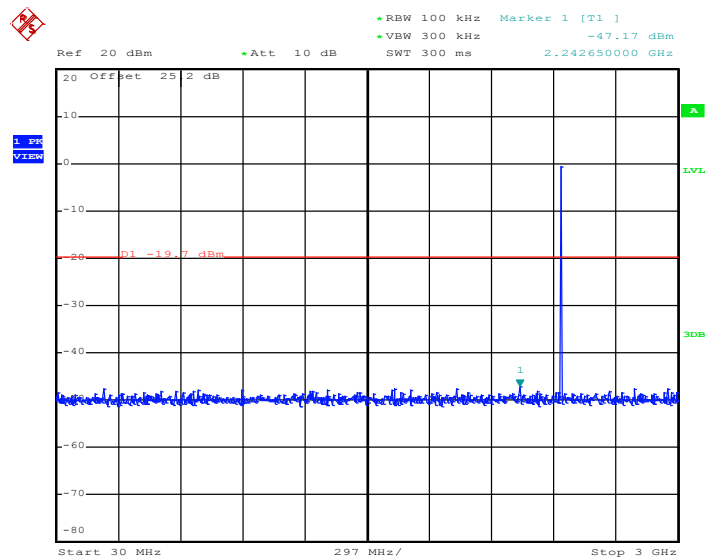


Date: 4.JUL.2015 01:35:04

<b>Test Mode :</b>	Bluetooth 4.0 - LE	<b>Temperature :</b>	22~25℃
<b>Test Channel :</b>	19	<b>Relative Humidity :</b>	51~55%
		<b>Test Engineer :</b>	Luffy Lin

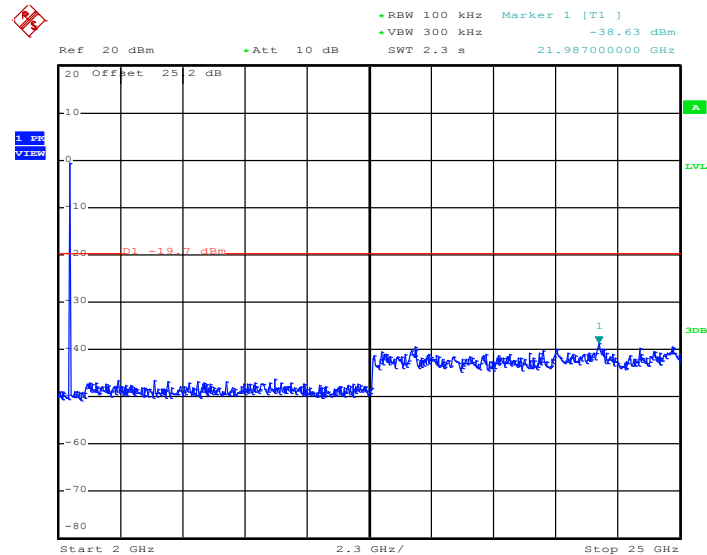
### Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

## GFSK Channel 19



Date: 4.JUL.2015 01:40:58

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

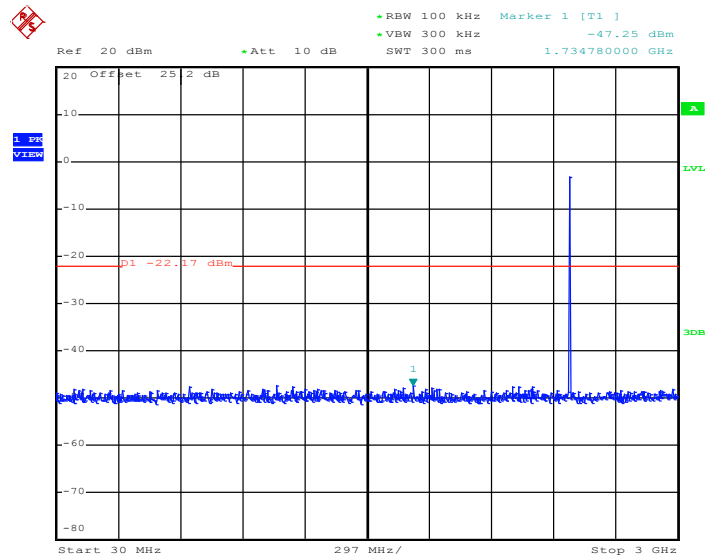


Date: 4.JUL.2015 01:41:16



Test Mode :	Bluetooth 4.0 - LE	Temperature :	22~25°C
Test Channel :	39	Relative Humidity :	51~55%
		Test Engineer :	Luffy Lin

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

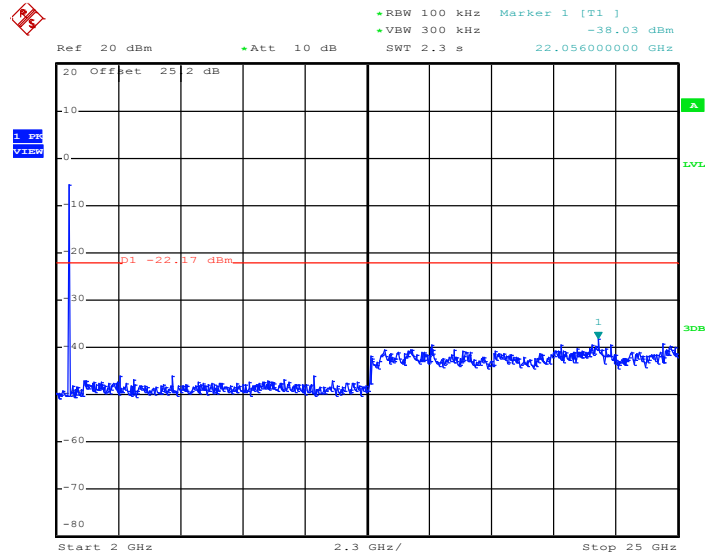


Date: 4.JUL.2015 01:46:15





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



Date: 4.JUL.2015 01:46:32

### 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. 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

#### 3.5.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

### 3.5.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03.
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 for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively 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.

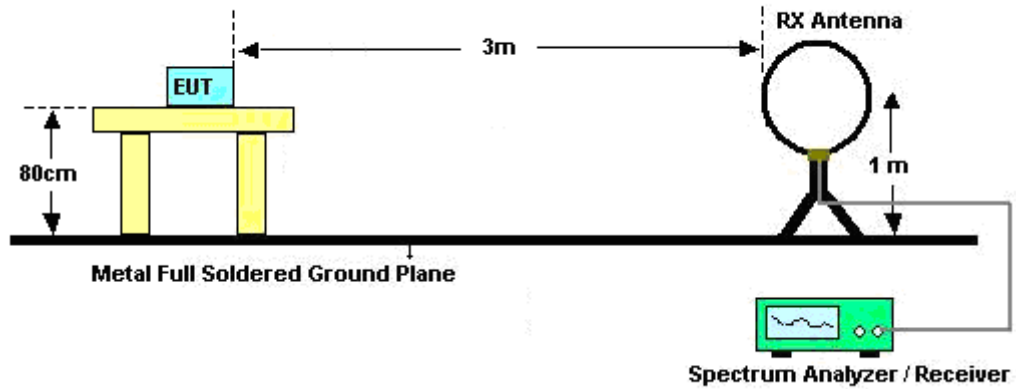
For average measurement:

  - 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.

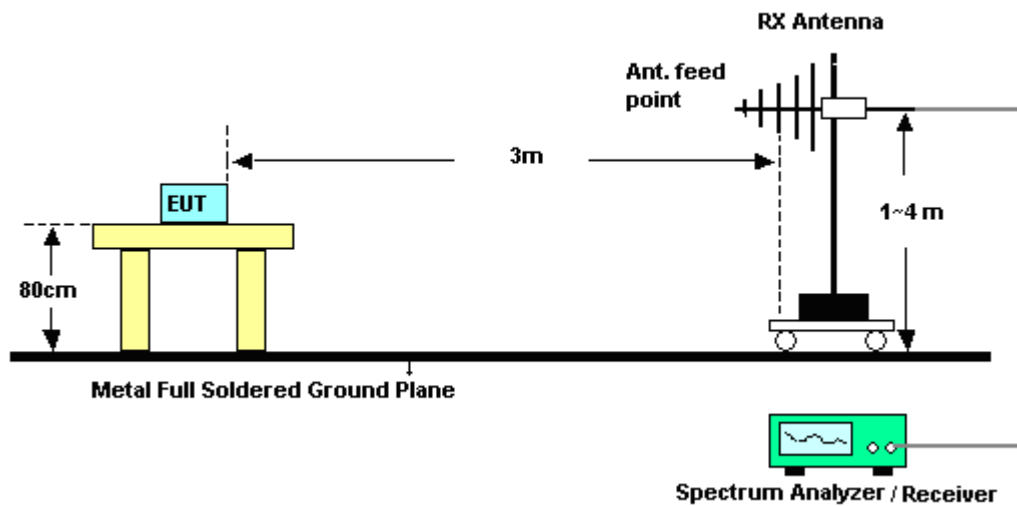
Band	Duty Cycle(%)	T( $\mu$ s)	1/T(kHz)	VBW Setting
Bluetooth 4.0 - LE	62.66	396	2.53	3kHz

### 3.5.4 Test Setup

For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



### 3.5.5 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.

### 3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A.

### 3.5.7 Test Result of Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)

Please refer to Appendix A.

### 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 (dB $\mu$ V)	
	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

The section 4.0 of List of Measuring Equipment of this test report is used for test.

#### 3.6.3 Test Procedures

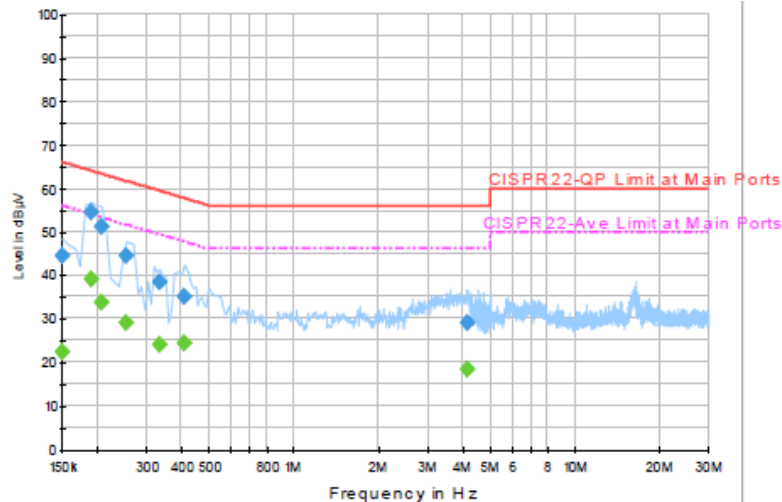
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.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

### 3.6.4 Test Setup



### 3.6.5 Test Result of AC Conducted Emission

<b>Test Mode :</b>	Mode 1	<b>Temperature :</b>	23~25°C
<b>Test Engineer :</b>	Eric Jeng	<b>Relative Humidity :</b>	56~60%
<b>Test Voltage :</b>	120Vac / 60Hz	<b>Phase :</b>	Line
<b>Function Type :</b>	LTE Band 4 Idle + Bluetooth Link + WLAN Link + GPS Rx + Earphone + Battery + USB Cable (Data Link with Notebook) + SIM1 with Sample 1		



#### Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	44.5	Off	L1	19.5	21.5	66.0
0.190000	54.4	Off	L1	19.5	9.6	64.0
0.206000	51.3	Off	L1	19.4	12.1	63.4
0.254000	44.5	Off	L1	19.4	17.1	61.6
0.334000	38.4	Off	L1	19.5	21.0	59.4
0.406000	35.2	Off	L1	19.6	22.5	57.7
4.174000	29.2	Off	L1	19.7	26.8	56.0

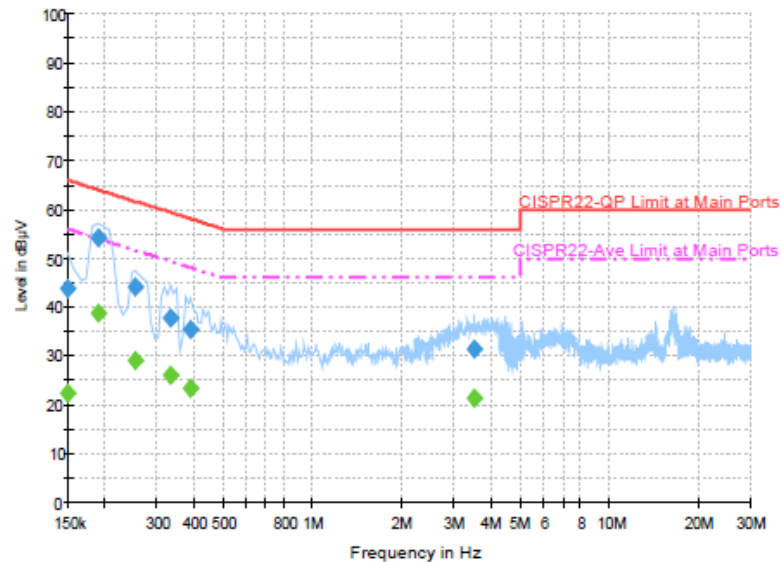
#### Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	22.3	Off	L1	19.5	33.7	56.0
0.190000	39.0	Off	L1	19.5	15.0	54.0
0.206000	33.7	Off	L1	19.4	19.7	53.4
0.254000	29.0	Off	L1	19.4	22.6	51.6
0.334000	24.1	Off	L1	19.5	25.3	49.4
0.406000	24.5	Off	L1	19.6	23.2	47.7
4.174000	18.4	Off	L1	19.7	27.6	46.0





Test Mode :	Mode 1	Temperature :	23~25°C
Test Engineer :	Eric Jeng	Relative Humidity :	56~60%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	LTE Band 4 Idle + Bluetooth Link + WLAN Link + GPS Rx + Earphone + Battery + USB Cable (Data Link with Notebook) + SIM1 with Sample 1		

**Final Result : Quasi-Peak**

Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	43.9	Off	N	19.5	22.1	66.0
0.190000	54.3	Off	N	19.5	9.7	64.0
0.254000	44.1	Off	N	19.4	17.5	61.6
0.334000	37.7	Off	N	19.5	21.7	59.4
0.390000	35.5	Off	N	19.5	22.6	58.1
3.510000	31.5	Off	N	19.7	24.5	56.0

**Final Result : Average**

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	22.6	Off	N	19.5	33.4	56.0
0.190000	38.9	Off	N	19.5	15.1	54.0
0.254000	29.0	Off	N	19.4	22.6	51.6
0.334000	26.1	Off	N	19.5	23.3	49.4
0.390000	23.3	Off	N	19.5	24.8	48.1
3.510000	21.4	Off	N	19.7	24.6	46.0



## **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 Anti-Replacement Construction**

An embedded-in antenna design is 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
Power Meter	Agilent	E4416A	GB41292344	300MHz~40GHz	Jan. 14, 2015	Jul. 04, 2015	Jan. 13, 2016	Conducted (TH02-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Jan. 14, 2015	Jul. 04, 2015	Jan. 13, 2016	Conducted (TH02-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100057	9kHz-40GHz	Oct. 17, 2014	Jul. 04, 2015	Oct. 16, 2015	Conducted (TH02-HY)
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 03, 2014	Jul. 11, 2015	Nov. 02, 2015	Radiation (03CH10-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jul. 28, 2014	Jul. 11, 2015	Jul. 27, 2015	Radiation (03CH10-HY)
Amplifier	SONOMA	310N	187311	9kHz~1GHz	Nov. 24, 2014	Jul. 11, 2015	Nov. 23, 2015	Radiation (03CH10-HY)
Bilog Antenna	TESEQ	CBL 6111D	35413	30MHz~1GHz	Oct. 24, 2014	Jul. 11, 2015	Oct. 23, 2015	Radiation (03CH10-HY)
EMI Test Receiver	Keysight	N9038A	MY54130085	20Hz ~ 8.4GHz	Nov. 05, 2014	Jul. 11, 2015	Nov. 04, 2015	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Oct. 03, 2014	Jul. 11, 2015	Oct. 02, 2015	Radiation (03CH10-HY)
Preamplifier	Keysight	83017A	MY53270078	1GHz~26.5GHz	Nov. 20, 2014	Jul. 11, 2015	Nov. 19, 2015	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHZ	Oct. 14, 2014	Jul. 11, 2015	Oct. 13, 2015	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Jul. 11, 2015	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0-360 degree	N/A	Jul. 11, 2015	N/A	Radiation (03CH10-HY)
Preamplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 02, 2015	Jul. 11, 2015	Jun. 01, 2016	Radiation (03CH10-HY)
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100356	9kHz – 2.75GHz	Dec. 01, 2014	Jul. 15, 2015	Nov. 30, 2015	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Dec. 02, 2014	Jul. 15, 2015	Dec. 01, 2015	Conduction (CO05-HY)
AC Power Source()	ChainTek	APC-1000W	N/A	N/A	N/A	Jul. 15, 2015	N/A	Conduction (CO05-HY)
LISN (for auxiliary equipment)	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Dec. 08, 2014	Jul. 15, 2015	Dec. 07, 2015	Conduction (CO05-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
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### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.90
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