Varient IC RF Test Report

APPLICANT	**:**	**Texas Instruments Incorporated**
EQUIPMENT	**:**	**WiFi and Bluetooth Module**
BRAND NAME	**:**	**Texas Instruments**
MODEL NAME	**:**	**WL18MODGB**
IC	**:**	**451I-WL18SBMOD**
STANDARD	**:**	**IC RSS-247 issue 1**

The product was received on Oct. 23, 2014 and testing was completed on Aug. 14, 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.

Reviewed by: Joseph Lin / Supervisor

Approved by: Jones Tsai / Manager

SPORTON INTERNATIONAL INC.
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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
CR4O2349A	Rev. 01	This is a variant report by adding 6 new antennas. All the test cases were performed on original report which can be referred to Sporton Report Number CR3N2752-01ATX. Based on the original report, only the peak output power and conducted spurious emission and cabinet radiation were performed.	Aug. 28, 2015

SUMMARY OF TEST RESULT

Report Section	IC Rule	Description	Limit	Result	Remark
3.1	RSS-247 5.4(2)	Peak Output Power	≤ 125 mW	Pass	-
3.2	RSS-247 5.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 9.23 dB at 216.840 MHz
3.3	N/A	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

Texas Instruments Incorporated
12500 TI Boulevard, M/S 8751, Dallas, TX 75243, USA

1.2 Manufacturer

Jorjin Technologies Inc
17F, No.239, Sec. 1, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	WiFi and Bluetooth Module
Brand Name	Texas Instruments
Model Name	WL18MODGB
IC	451I-WL18SBMOD
EUT supports Radios application	WLAN 11b/g/n HT20/HT40 Bluetooth v4.0 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	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Maximum Output Power to Antenna	Bluetooth BR(1Mbps) : 11.90 dBm (0.0155 W) Bluetooth EDR (2Mbps) : 9.78 dBm (0.0095 W) Bluetooth EDR (3Mbps) : 9.85 dBm (0.0097 W)
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : π/4-DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

Antenna Information		
Antenna Type	**Brand**	**2.4GHz~2.5GHz**
PCB	Ethertronics	-0.6
Dipole	LSR	2
PCB	Laird	2
Chip	Pulse	3.2
PIFA	LSR	2

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 1st 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	
Test Site No.	**Sporton Site No.**	
	TH05-HY	

Test Site	SPORTON INTERNATIONAL INC.	
Test Site Location	No. 58 , Aly. 75, Ln. 564, Wenhua 3rd Rd., Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-0855	
Test Site No.	**Sporton Site No.**	**IC Registration No.**
	03CH10	4086H-1

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
- ANSI C63.10-2013

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 ICES003, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Channel	Frequency	Bluetooth RF Output Power		
		Data Rate / Modulation		
		GFSK	π/4-DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	**11.90** dBm	9.78 dBm	9.85 dBm
Ch39	2441MHz	11.37 dBm	9.39 dBm	9.58 dBm
Ch78	2480MHz	11.50 dBm	9.31 dBm	9.34 dBm

Remark:

1. All the test data for each data rate were verified, but only the worst case was reported.
2. The data rate was set in 1Mbps for all the test items due to the highest RF output power.

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.

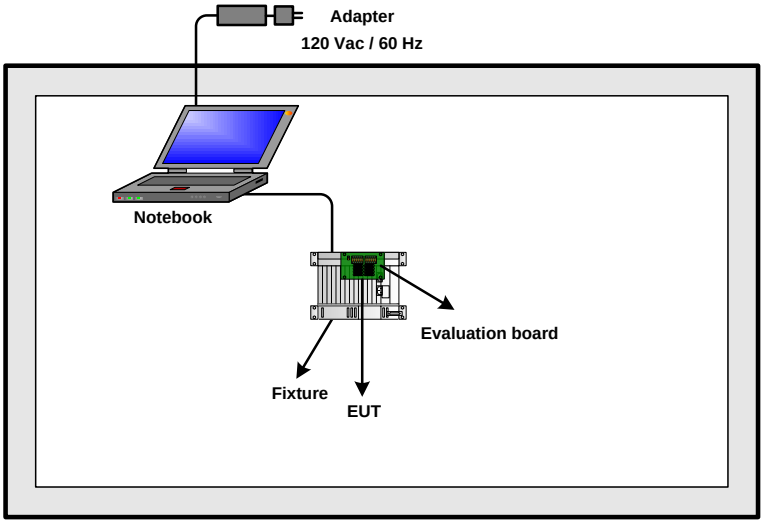
Summary table of Test Cases			
Test Item	**Data Rate / Modulation**		
	Bluetooth BR 1Mbps GFSK	**Bluetooth EDR 2Mbps π/4-DQPSK**	**Bluetooth EDR 3Mbps 8-DPSK**
Conducted Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz	Mode 4: CH00_2402 MHz Mode 5: CH39_2441 MHz Mode 6: CH78_2480 MHz	Mode 7: CH00_2402 MHz Mode 8: CH39_2441 MHz Mode 9: CH78_2480 MHz
Radiated Test Cases	**Bluetooth BR 1Mbps GFSK**		
	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz		

Remark:

For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and the conducted spurious emissions and conducted band edge measurement for each data rate are no worse than 1Mbps, and no other significantly frequencies found in conducted spurious emission.

2.3 Connection Diagram of Test System

<Bluetooth Tx Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	Lenovo	E335 (with WiFi module TP00034A)	FCC DoC/ Contains FCC ID:QDS-BRCM1058	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

For Bluetooth function, programmed RF utility, “HCI Tester” 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.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 Peak Output Power Measurement

3.1.1 Limit of Peak Output Power

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps is 1watt, and for 2Mbps, 3Mbps and AFH are 0.125 watts.

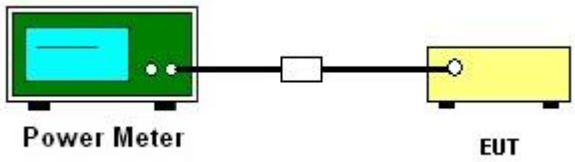
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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 with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of Peak Output Power

Test Mode :	1Mbps	Temperature :	24 - 26℃
Test Engineer :	Bill Kuo	Relative Humidity :	48 – 51%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	**11.90**	20.97	Pass
39	2441	11.37	20.97	Pass
78	2480	11.50	20.97	Pass

Note: For AFH mode using 20 hopping channels, the maximum output power limit is 20.97dBm.

Test Mode :	2Mbps	Temperature :	24 - 26℃
Test Engineer :	Bill Kuo	Relative Humidity :	48 – 51%

Channel	Frequency (MHz)	RF Power (dBm)		
		π /4-DQPSK	Max. Limits (dBm)	Pass/Fail
		2 Mbps		
00	2402	9.78	20.97	Pass
39	2441	9.39	20.97	Pass
78	2480	9.31	20.97	Pass

Test Mode :	3Mbps	Temperature :	24 - 26℃
Test Engineer :	Bill Kuo	Relative Humidity :	48 – 51%

Channel	Frequency (MHz)	RF Power (dBm)		
		8-DPSK	Max. Limits (dBm)	Pass/Fail
		3 Mbps		
00	2402	9.85	20.97	Pass
39	2441	9.58	20.97	Pass
78	2480	9.34	20.97	Pass

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 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

3.2.2 Measuring Instruments

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

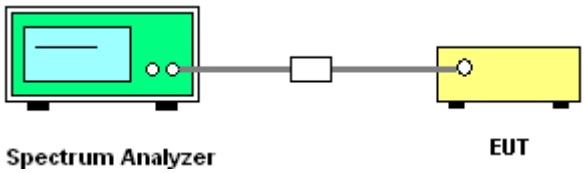
3.2.3 Test Procedures

1. 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.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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 to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. 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, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

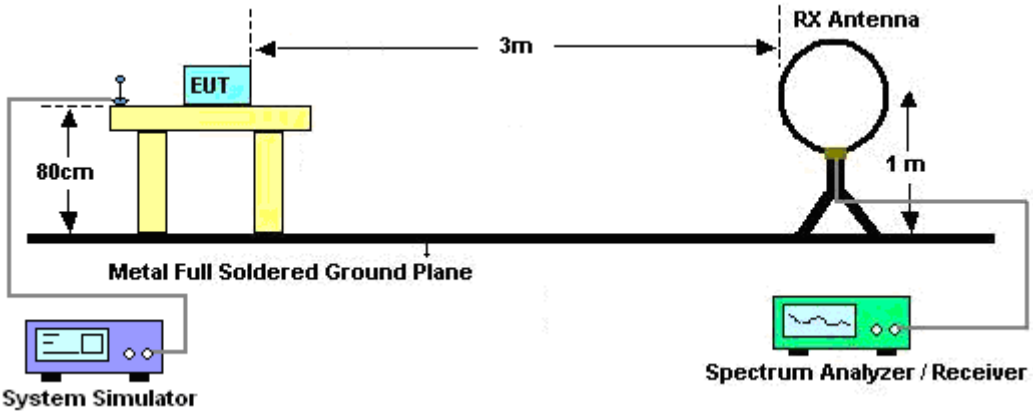
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (24.73dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.2.4 Test Setup

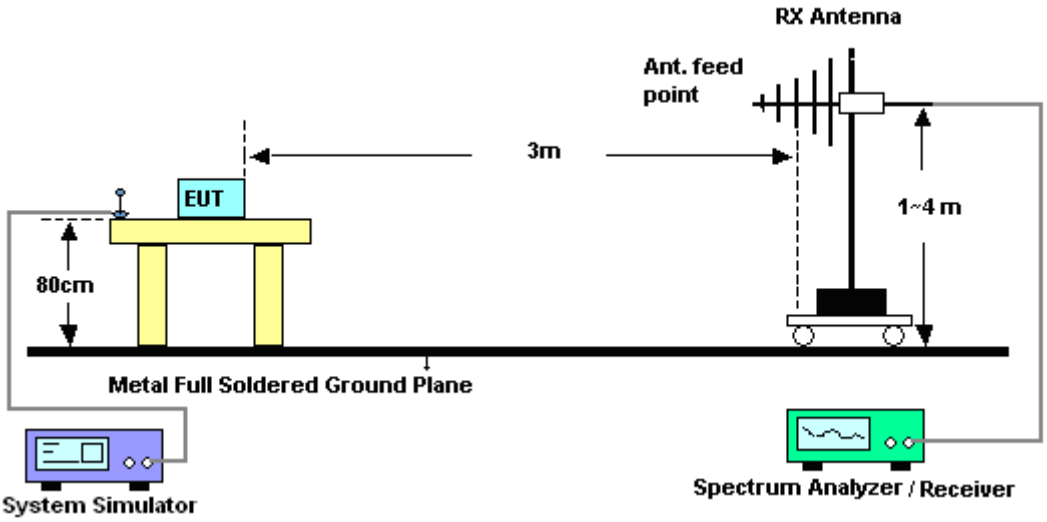
For Conducted Measurement Setup:



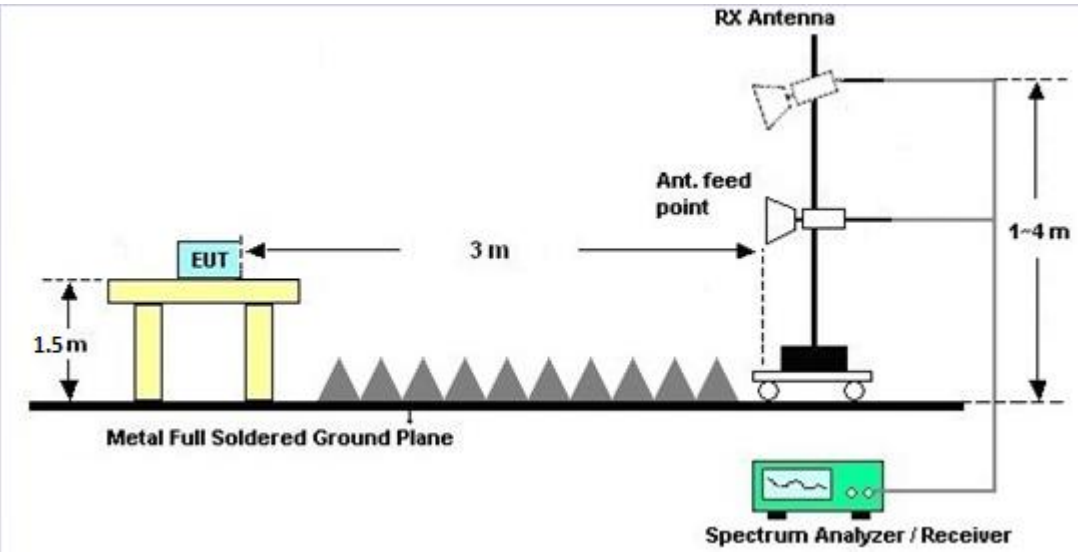
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

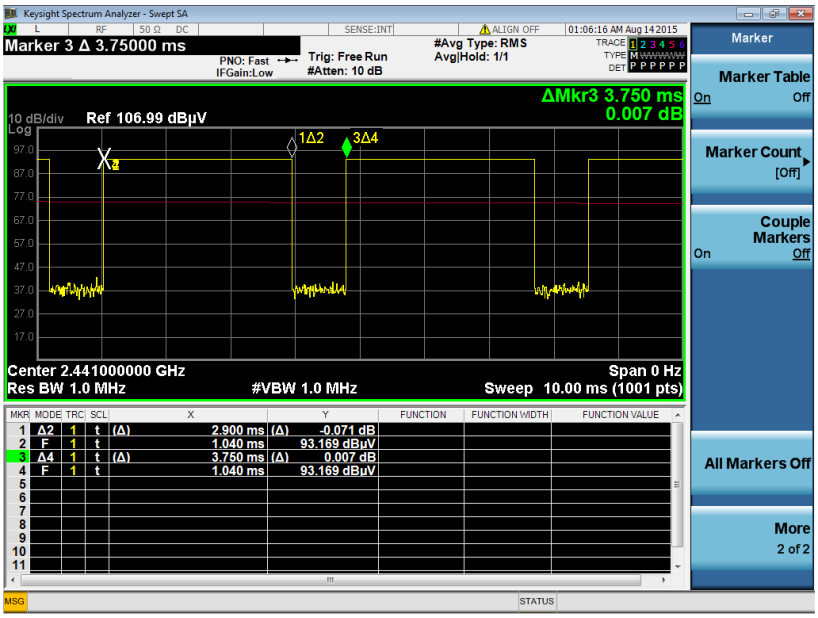


3.2.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

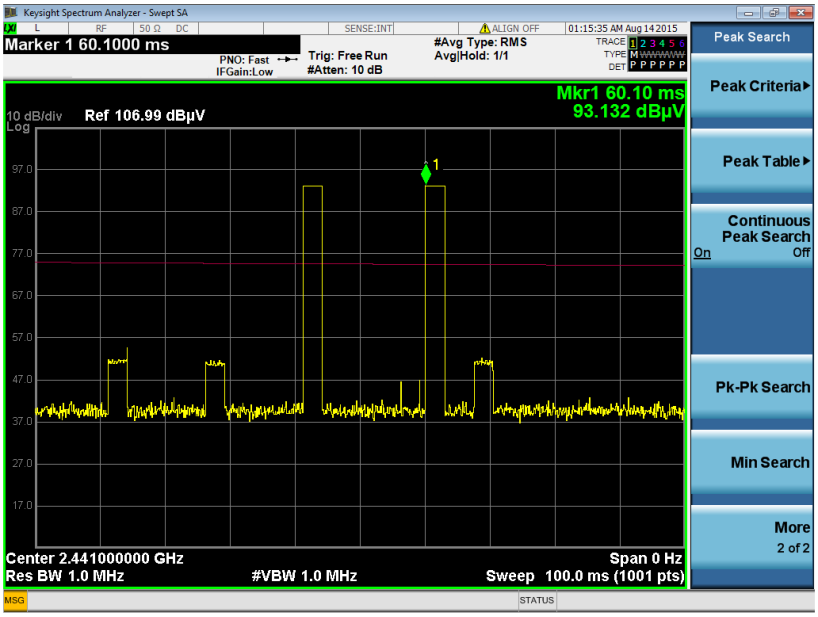
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.2.6 Duty cycle correction factor for average measurement

DH5 on time (One Pulse) Plot on Channel 39



DH5 on time (Count Pulses) Plot on Channel 39



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.90 / 100 = 5.80 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.73 dB
3. DH5 has the highest duty cycle worst case and is reported.

Duty Cycle Correction Factor Consideration for AFH mode:

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

2.90 ms x 20 channels = 58.0 ms

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100ms / 57.6ms] = 2 hops

Thus, the maximum possible ON time:

2.90 ms x 2 = 5.80 ms

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

20 x log(5.80 ms/100ms) = -24.73 dB

3.2.7 Test Result of Conducted Spurious at Band Edges in the Restricted Band

Please refer to Appendix A.

3.2.8 Test Result of Conducted Spurious Emission in the Restricted Band

Please refer to Appendix A.

3.2.9 Test Result of Cabinet Radiated Spurious at Band Edges

Please refer to Appendix B.

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

Please refer to Appendix B.

3.3 Antenna Requirements

3.3.1 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.

3.3.2 Antenna Anti-Replacement Construction

Non-standard antenna connector is used.

3.3.3 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	Aug.12, 2015~ Aug.13, 2015	Jan. 13, 2016	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Jan. 14, 2015	Aug.12,2015~ Aug.13,2015	Jan. 13, 2016	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz-40GHz	Jun. 18, 2015	Aug.12, 2015~ Aug.13, 2015	Jun. 17, 2016	Conducted (TH05-HY)
BT Base Station(Measure)	Rohde & Schwarz	CBT	101136	BT 3.0 & 4.0	Sep. 24, 2014	Aug.12, 2015~ Aug.13, 2015	Sep. 23, 2015	Conducted (TH05-HY)
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 03, 2014	Aug. 13, 2015~ Aug. 14, 2015	Nov. 02, 2015	Radiation (03CH10-HY)
Loop Antenna	TESEQ	HLA 6120	31244	9kHZ~30MHz	Feb. 02, 2015	Aug. 13, 2015~ Aug. 14, 2015	Feb. 01, 2016	Radiation (03CH10-HY)
Amplifier	SONOMA	310N	187311	9kHz~1GHz	Nov. 24, 2014	Aug. 13, 2015~ Aug. 14, 2015	Nov. 23, 2015	Radiation (03CH10-HY)
Bilog Antenna	TESEQ	CBL 6111D	35413	30MHz~1GHz	Oct. 24, 2014	Aug. 13, 2015~ Aug. 14, 2015	Oct. 23, 2015	Radiation (03CH10-HY)
EMI Test Receiver	Keysight	N9038A	MY54130085	20Hz ~ 8.4GHz	Nov. 05, 2014	Aug. 13, 2015~ Aug. 14, 2015	Nov. 04, 2015	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Oct. 03, 2014	Aug. 13, 2015~ Aug. 14, 2015	Oct. 02, 2015	Radiation (03CH10-HY)
Preamplifier	Keysight	83017A	MY53270078	1GHz~26.5GHz	Nov. 20, 2014	Aug. 13, 2015~ Aug. 14, 2015	Nov. 19, 2015	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHZ	Oct. 14, 2014	Aug. 13, 2015~ Aug. 14, 2015	Oct. 13, 2015	Radiation (03CH10-HY)
Controller	EMEC	EM 1000	N/A	Control Turn table & Ant Mast	N/A	Aug. 13, 2015~ Aug. 14, 2015	N/A	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Aug. 13, 2015~ Aug. 14, 2015	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0-360 degree	N/A	Aug. 13, 2015~ Aug. 14, 2015	N/A	Radiation (03CH10-HY)
Preamplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 02, 2015	Aug. 13, 2015~ Aug. 14, 2015	Jun. 01, 2016	Radiation (03CH10-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))	**4.90**

Appendix A. Test Result of Conducted Spurious Emission

Test Result of Conducted Spurious at Band Edges in the Restricted Band

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Gain	Cable Loss	Grounding Factor	Peak Avg
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dBi)	(dB)	(dB)	(P/A)
BT CH00 2402MHz		2376.69	-31.47	-10.27	-21.2	-35.93	3.2	1.26	0	P
		2376.69	-59.21	-18.01	-41.2	-	-	-	0	A
	*	2402.505	-9.15	-	-	-13.62	3.2	1.27	0	P
	*	2402.505	-36.89	-	-	-	-	-	0	A
BT CH39 2441MHz		2389.56	-39.19	-17.99	-21.2	-43.66	3.2	1.27	0	P
		2389.56	-66.93	-25.73	-41.2	-	-	-	0	A
	*	2441.833	-9.21	-	-	-13.69	3.2	1.28	0	P
	*	2441.833	-36.95	-	-	-	-	-	0	A
		2491.84	-37.59	-16.39	-21.2	-42.08	3.2	1.29	0	P
		2491.84	-65.33	-24.13	-41.2	-	-	-	0	A
BT CH78 2480MHz	*	2480.912	-9.12	-	-	-13.6	3.2	1.28	0	P
	*	2480.995	-36.86	-	-	-	-	-	0	A
		2483.52	-24.54	-3.34	-21.2	-29.02	3.2	1.28	0	P
		2483.52	-52.28	-11.08	-41.2	-	-	-	0	A

Test Result of Conducted Spurious Emission in the Restricted Band

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Gain	Cable Loss	Grounding Factor	Peak Avg
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dBi)	(dB)	(dB)	(P/A)
BT CH00 2402MHz		32.91	-67.44	-12.24	-55.2	-75.51	3.2	0.17	4.7	P
		168.71	-79.72	-28.02	-51.7	-87.92	3.2	0.3	4.7	P
		444.19	-79.3	-30.1	-49.2	-87.64	3.2	0.44	4.7	P
		627.52	-80.38	-31.18	-49.2	-88.81	3.2	0.53	4.7	P
		800.18	-66.17	-16.97	-49.2	-74.64	3.2	0.57	4.7	P
		948.59	-80.66	-31.46	-49.2	-89.19	3.2	0.63	4.7	P
		4804	-30.61	-9.41	-21.2	-35.48	3.2	1.67	0	P
		4804	-58.35	-17.15	-41.2	-	-	-	0	A
		7206	-49.06	-27.86	-21.2	-54.14	3.2	1.88	0	P
BT CH39 2441MHz		45.52	-76.35	-21.15	-55.2	-84.44	3.2	0.19	4.7	P
		72.68	-77.68	-22.48	-55.2	-85.79	3.2	0.21	4.7	P
		318.09	-80.46	-31.26	-49.2	-88.74	3.2	0.38	4.7	P
		558.65	-79.74	-30.54	-49.2	-88.13	3.2	0.49	4.7	P
		703.18	-72.38	-23.18	-49.2	-80.83	3.2	0.55	4.7	P
		813.76	-51.07	-1.87	-49.2	-59.56	3.2	0.59	4.7	P
		4882	-29.57	-8.37	-21.2	-34.47	3.2	1.70	0	P
		4882	-57.31	-16.11	-41.2	-	-	-	0	A
		7323	-53.87	-32.67	-21.2	-59.04	3.2	1.97	0	P
BT CH78 2480MHz		45.52	-75.81	-20.61	-55.2	-83.9	3.2	0.19	4.7	P
		140.58	-79.43	-27.73	-51.7	-87.6	3.2	0.27	4.7	P
		438.37	-80.21	-31.01	-49.2	-88.55	3.2	0.44	4.7	P
		552.83	-79.89	-30.69	-49.2	-88.28	3.2	0.49	4.7	P
		703.18	-73.03	-23.83	-49.2	-81.48	3.2	0.55	4.7	P
		827.34	-49.91	-0.71	-49.2	-58.4	3.2	0.59	4.7	P
		4960	-30.74	-9.54	-21.2	-35.67	3.2	1.73	0	P
		4960	-58.48	-17.28	-41.2	-	-	-	0	A
		7440	-48.68	-27.48	-21.2	-53.95	3.2	2.07	0	P

Appendix B. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BT CH00 2402MHz		2389.3	43.91	-30.09	74	44.53	27.23	5.39	33.24	126	214	P	H
		2389.3	19.18	-34.82	54							A	H
	*	2401.91	95.24	-	-	95.84	27.23	5.39	33.22	126	214	P	H
	*	2401.91	70.51	-	-							A	H
													H
													H
		2376.82	46	-28	74	46.66	27.19	5.39	33.24	351	360	P	V
		2376.82	21.27	-32.73	54							A	V
	*	2402.17	91.93	-	-	92.53	27.23	5.39	33.22	351	360	P	V
	*	2402.17	67.2	-	-							A	V
													V
													V
BT CH 39 2441MHz		2389.23	43.74	-30.26	74	44.36	27.23	5.39	33.24	139	210	P	H
		2389.23	19.01	-34.99	54							A	H
	*	2441.29	92.82	-	-	93.23	27.37	5.42	33.2	139	210	P	H
	*	2441.29	68.09	-	-							A	H
		2484.99	43.2	-30.8	74	43.46	27.46	5.46	33.18	139	210	P	H
		2484.99	18.47	-35.53	54							A	H
		2355.6	42.76	-31.24	74	43.54	27.14	5.33	33.25	336	328	P	V
		2355.6	18.03	-35.97	54							A	V
	*	2441.1	90.54	-	-	90.95	27.37	5.42	33.2	336	328	P	V
	*	2441.1	65.81	-	-							A	V
		2488.98	42.54	-31.46	74	42.76	27.5	5.46	33.18	336	328	P	V
		2488.98	17.81	-36.19	54							A	V

BT CH 78 2480MHz	*	2479.98	91.4	-	-	91.68	27.46	5.44	33.18	107	212	P	H
	*	2479.98	66.67	-	-							A	H
		2489.5	44.3	-29.7	74	44.52	27.5	5.46	33.18	107	212	P	H
		2489.5	19.57	-34.43	54							A	H
													H
													H
	*	2479.91	88.74	-	-	89.02	27.46	5.44	33.18	366	326	P	V
	*	2479.91	64.01	-	-							A	V
		2484.04	43.28	-30.72	74	43.54	27.46	5.46	33.18	366	326	P	V
		2484.04	18.55	-35.45	54							A	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4806	61.05	-12.95	74	82.69	31.42	7.58	60.64	100	0	P	H
		4806	36.32	-17.68	54							A	H
													H
													H
		4806	58.76	-15.24	74	80.4	31.42	7.58	60.64	100	0	P	V
		4806	34.03	-19.97	54							A	V
													V
													V
BT CH 39 2441MHz		4884	60.62	-13.38	74	81.76	31.56	7.82	60.52	100	0	P	H
		4884	35.89	-18.11	54							A	H
		7320	45.08	-28.92	74	60.35	36.22	9.49	60.98	100	0	P	H
		7320	20.35	-33.65	54							A	H
		4884	59.13	-14.87	74	80.27	31.56	7.82	60.52	100	0	P	V
		4884	34.4	-19.6	54							A	V
		7320	50.15	-23.85	74	65.42	36.22	9.49	60.98	100	0	P	V
		7320	25.42	-28.58	54							A	V
BT CH 78 2480MHz		4962	58.05	-15.95	74	78.63	31.73	8.05	60.36	100	0	P	H
		4962	33.32	-20.68	54							A	H
		7440	46.14	-27.86	74	61.38	36.49	9.61	61.34	100	0	P	H
		7440	21.41	-32.59	54							A	H
		4962	56.47	-17.53	74	77.05	31.73	8.05	60.36	100	0	P	V
		4962	31.74	-22.26	54							A	V
		7440	47.65	-26.35	74	62.89	36.49	9.61	61.34	100	0	P	V
		7440	22.92	-31.08	54							A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BT LF		99.66	28.91	-14.59	43.5	50	10.4	1.14	32.63			P	H
		132.06	30.48	-13.02	43.5	49.83	11.98	1.33	32.66			P	H
		216.84	36.77	-9.23	46	57.62	10.26	1.62	32.73	206	1	P	H
		385.4	32.17	-13.83	46	46.74	16.12	2.13	32.82			P	H
		650.7	32.99	-13.01	46	43.12	20.21	2.67	33.01			P	H
		722.8	35.34	-10.66	46	44.43	21.05	2.82	32.96			P	H
													H
													H
													H
													H
													H
													H
		63.48	28.6	-11.4	40	54.07	6.34	0.93	32.74	100	0	P	V
		119.91	24.5	-19	43.5	44.11	11.9	1.14	32.65			P	V
		192.81	29.82	-13.68	43.5	51.45	9.61	1.48	32.72			P	V
		399.4	28	-18	46	42.21	16.5	2.13	32.84			P	V
		602.4	32.4	-13.6	46	43.24	19.62	2.57	33.03			P	V
		722.8	28.36	-17.64	46	37.45	21.05	2.82	32.96			P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBµV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBµV/m) – Limit Line(dBµV/m)

For Peak Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBµV) – 35.86 (dB)

= 55.45 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 55.45(dBµV/m) – 74(dBµV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBµV) – 35.86 (dB)

= 43.54 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 43.54(dBµV/m) – 54(dBµV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix C. Setup Photographs

<Radiated Emission>

LF

HF