

FCC RF Test Report

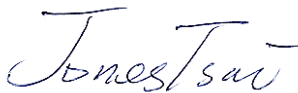
APPLICANT : Bullitt Group
EQUIPMENT : Rugged Smart Phone
BRAND NAME : CAT
MODEL NAME : S50
FCC ID : ZL5S50
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DSS) Spread Spectrum Transmitter

The product was received on Jun. 30, 2014 and testing was completed on Aug. 01, 2014. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

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



Reviewed by: Joseph Lin / Supervisor



Approved by: Jones Tsai / Manager



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FCC ID : ZL5S50

Page Number : 1 of 78

Report Issued Date : Aug. 19, 2014

Report Version : Rev. 01

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR463004A	Rev. 01	Initial issue of report	Aug. 19, 2014

SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(1)	RSS-210 A8.4(2)	Number of Channels	$\geq 15\text{Chs}$	Pass	-
3.2	15.247(a)(1)	RSS-210 A8.1(b)	Hopping Channel Separation	$\geq 2/3$ of 20dB BW	Pass	-
3.3	15.247(a)(1)	RSS-210 A8.1(d)	Dwell Time of Each Channel	$\leq 0.4\text{sec}$ in 31.6sec period	Pass	-
3.4	15.247(a)(1)	RSS-210 A8.1(a)	20dB Bandwidth	NA	Pass	-
3.4	-	RSS-Gen 4.6.1	99% Bandwidth	-	Pass	-
3.5	15.247(b)(1)	RSS-210 A8.1(b)	Peak Output Power	$\leq 125\text{ mW}$	Pass	-
3.6	15.247(d)	RSS-210 A8.5	Conducted Band Edges	$\leq 20\text{dBc}$	Pass	-
3.7	15.247(d)	RSS-210 A8.5	Conducted Spurious Emission	$\leq 20\text{dBc}$	Pass	-
3.8	15.247(d)	RSS-210 A8.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 7.14 dB at 145.290 MHz
3.9	15.207	RSS-Gen 7.2.4	AC Conducted Emission	15.207(a)	Pass	Under limit 6.80 dB at 0.190 MHz
3.10	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Bullitt Group

No. 4, The Aquarium, King Street, Reading, RG1 2AN 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	S50
FCC ID	ZL5S50
EUT supports Radios application	GSM/EGPRS/WCDMA/HSPA/LTE/NFC WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 Bluetooth v4.0 EDR/LE
HW Version	DVT1
SW Version	LTE_S0201121.0_S50_0.006.00
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) : 8.14 dBm (0.0065 W) Bluetooth EDR (2Mbps) : 8.87 dBm (0.0077 W) Bluetooth EDR (3Mbps) : 9.16 dBm (0.0082 W)
99% Occupied Bandwidth	Bluetooth BR(1Mbps) : 0.884MHz Bluetooth EDR (2Mbps) : 1.168MHz Bluetooth EDR (3Mbps) : 1.148MHz
Antenna Type	PIFA Antenna type with gain 1.73 dBi
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

1.5 Modification of EUT

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

1.6 Testing Location

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

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-3273456 / FAX: +886-3-3284978		
Test Site No.	Sporton Site No.		
	TH02-HY	CO05-HY	03CH07-HY



1.7 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC Public Notice DA 00-705
- ♦ ANSI C63.4-2003

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.

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	$\pi/4$ -DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	6.63 dBm	7.28 dBm	7.58 dBm
Ch39	2441MHz	8.14 dBm	8.87 dBm	9.16 dBm
Ch78	2480MHz	6.10 dBm	6.71 dBm	7.02 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 3Mbps for all the test items due to the highest RF output power.
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: 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, and different data rates were conducted to determine the final configuration (X plane as worst plane) from all possible combinations, and the worst mode of radiated spurious emissions is Bluetooth 3Mbps mode, and recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

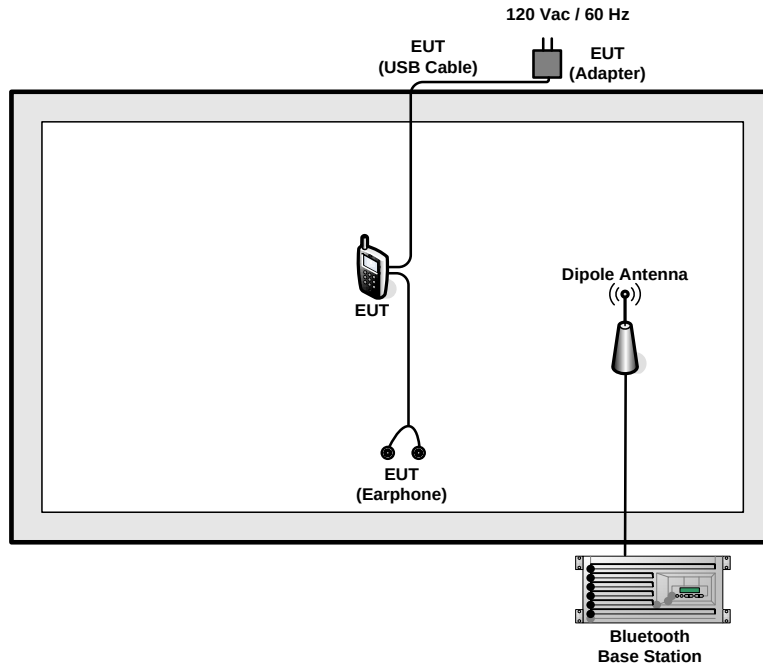
2.2 Test Mode

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

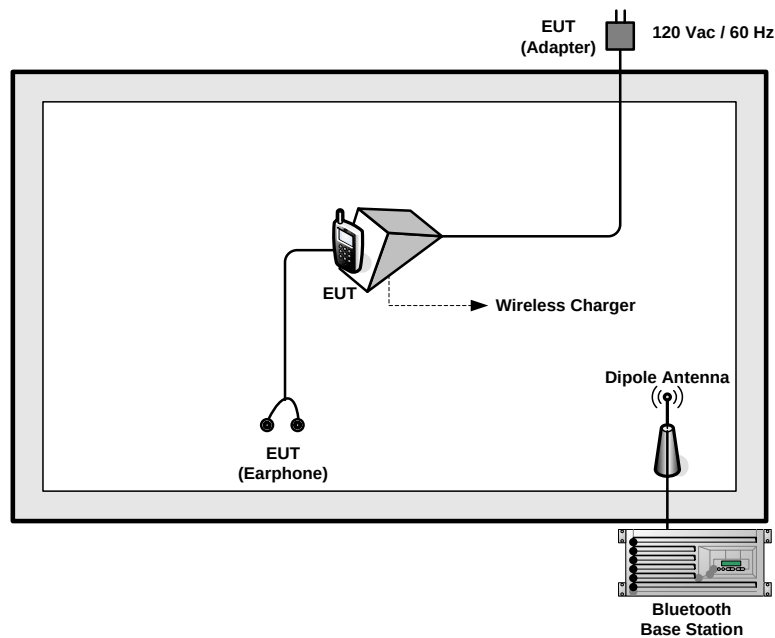
Summary table of Test Cases			
Test Item	Data Rate / Modulation		
	Bluetooth BR 1Mbps GFSK	Bluetooth EDR 2Mbps $\pi/4$ -DQPSK	Bluetooth EDR 3Mbps 8-DPSK
Conducted Test Cases	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz	Mode 4: CH00_2402 MHz Mode 5: CH39_2441 MHz Mode 6: CH78_2480 MHz	Mode 7: CH00_2402 MHz Mode 8: CH39_2441 MHz Mode 9: CH78_2480 MHz
Radiated Test Cases	Bluetooth EDR 3Mbps 8-DPSK		
	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz Mode 4: CH78_2480 MHz with WPC		
AC Conducted Emission	Mode 1 :GSM1900 Idle + WLAN Link + Bluetooth Link + Earphone + USB Cable (Data Link with Notebook) + GPS Rx + Battery		
Remark: For radiated test cases, the worst mode data rate 3Mbps 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 3Mbps, and no other significantly frequencies found in conducted spurious emission.			

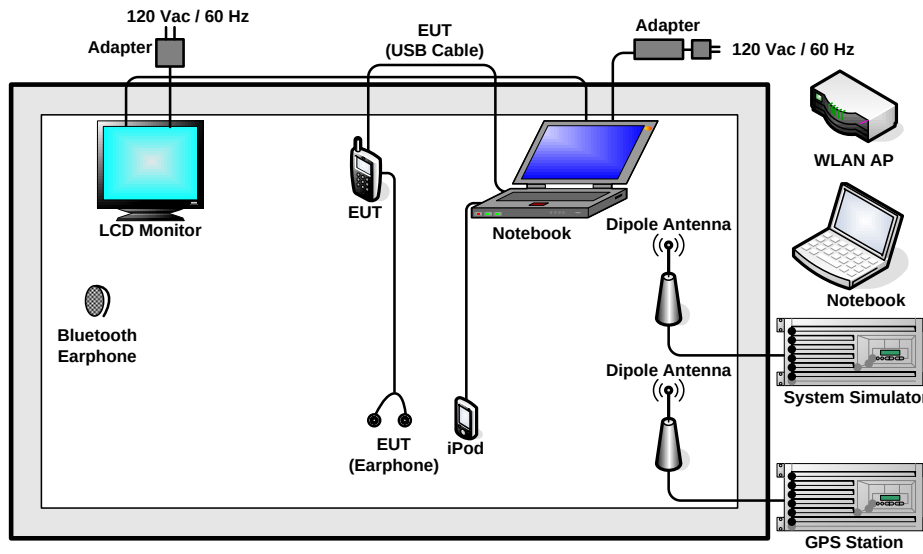
2.3 Connection Diagram of Test System

<Bluetooth Tx Mode>



< Bluetooth Tx Mode with WPC Charging>



<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	R&S	CMU 200	N/A	N/A	Unshielded, 1.8 m
2.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m
3.	GPS Station	Pendulum	GSG-54	N/A	N/A	Unshielded, 1.8 m
4.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
5.	WLAN AP	D-Link	DIR-628	KA2DIR628A2	N/A	Unshielded, 1.8 m
6.	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
7.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A
8.	LCD Monitor	DELL	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
9.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	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 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

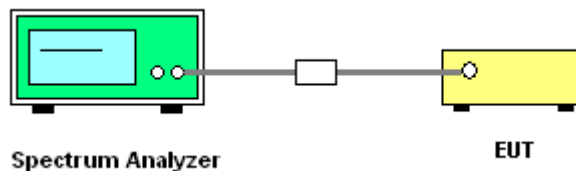
3.1.2 Measuring Instruments

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

3.1.3 Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW $\geq$ 1% of the span; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

3.1.4 Test Setup

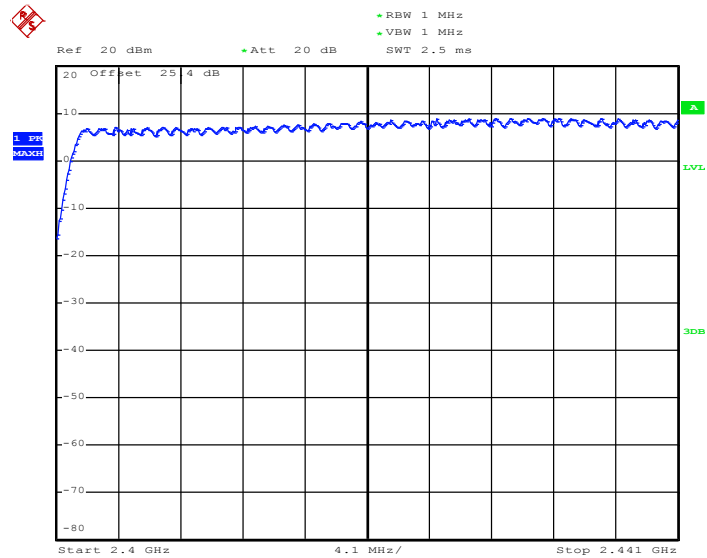


3.1.5 Test Result of Number of Hopping Frequency

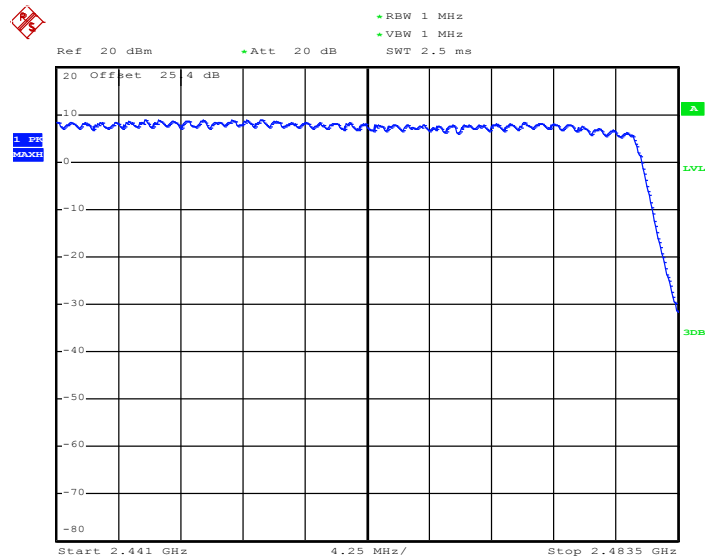
Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%
Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
79	20	> 15	Pass



Number of Hopping Channel Plot on Channel 00 - 78



Date: 1.AUG.2014 06:42:31



Date: 1.AUG.2014 06:44:53

3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

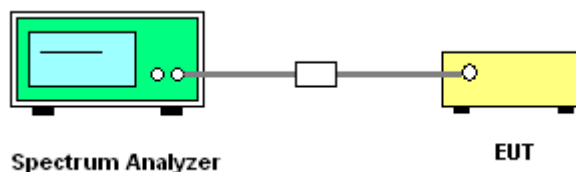
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels; RBW $\geq$ 1% of the span;
VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.2.4 Test Setup



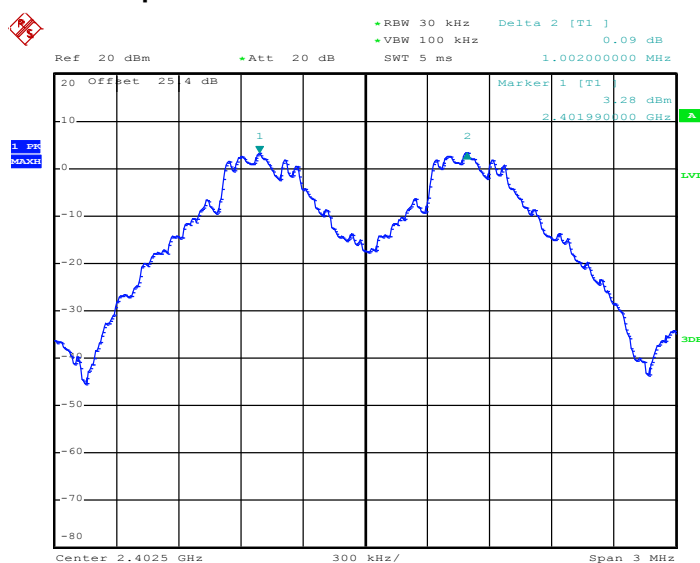


3.2.5 Test Result of Hopping Channel Separation

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1.002	0.6293	Pass
39	2441	1.002	0.6267	Pass
78	2480	1.002	0.6053	Pass

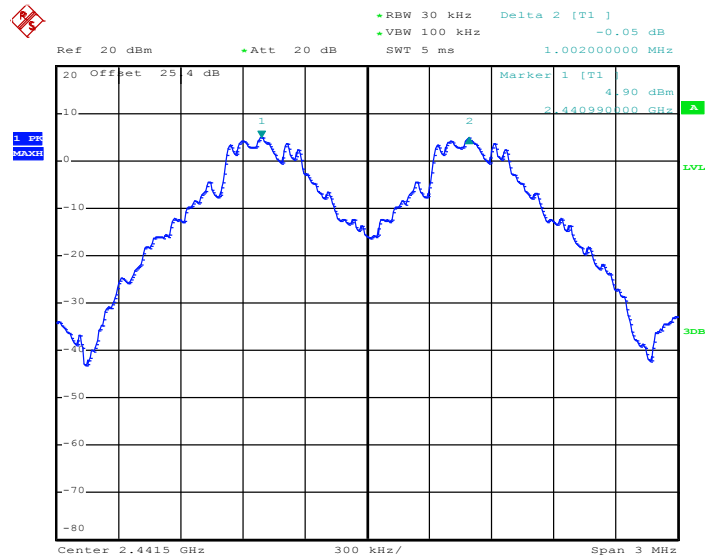
Channel Separation Plot on Channel 00 - 01



Date: 1.AUG.2014 05:56:21

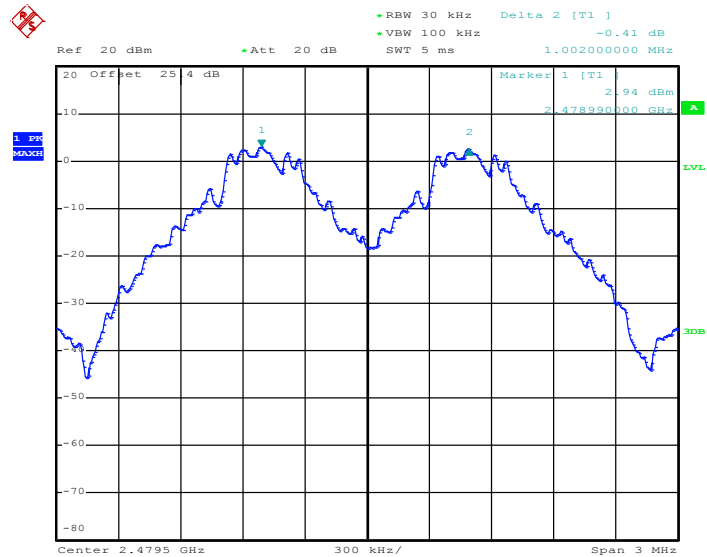


Channel Separation Plot on Channel 39 - 40



Date: 1.AUG.2014 05:55:29

Channel Separation Plot on Channel 77 - 78

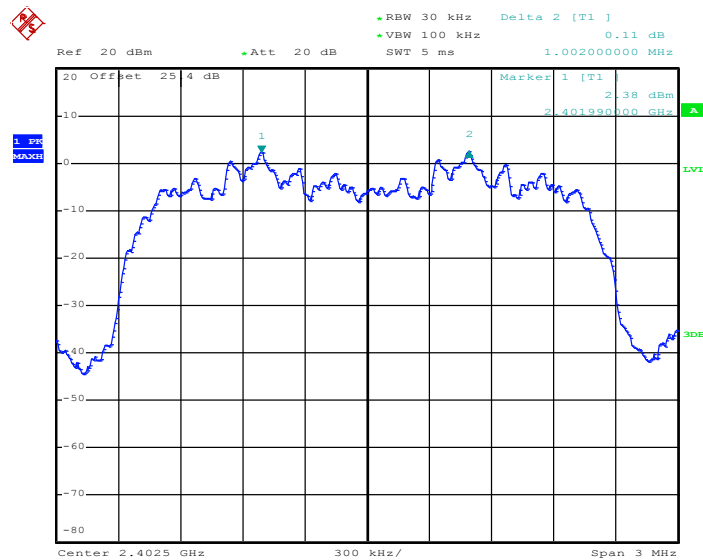


Date: 1.AUG.2014 05:57:14



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

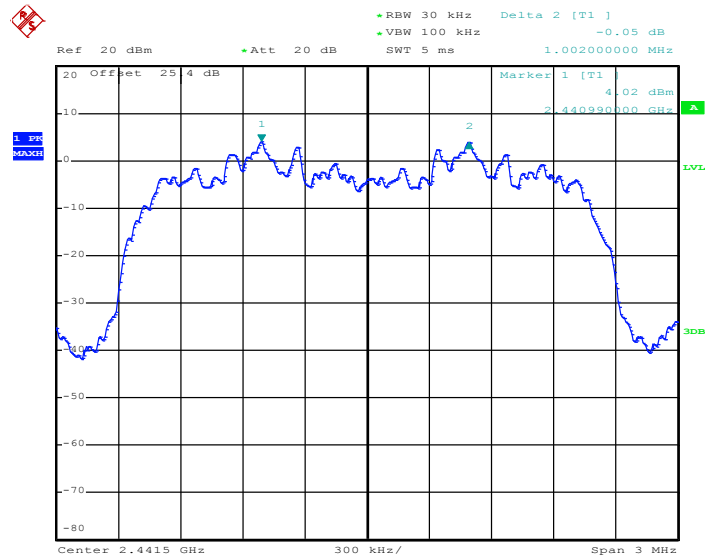
Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1.002	0.8480	Pass
39	2441	1.002	0.8480	Pass
78	2480	1.002	0.8480	Pass

Channel Separation Plot on Channel 00 - 01

Date: 1.AUG.2014 05:59:36

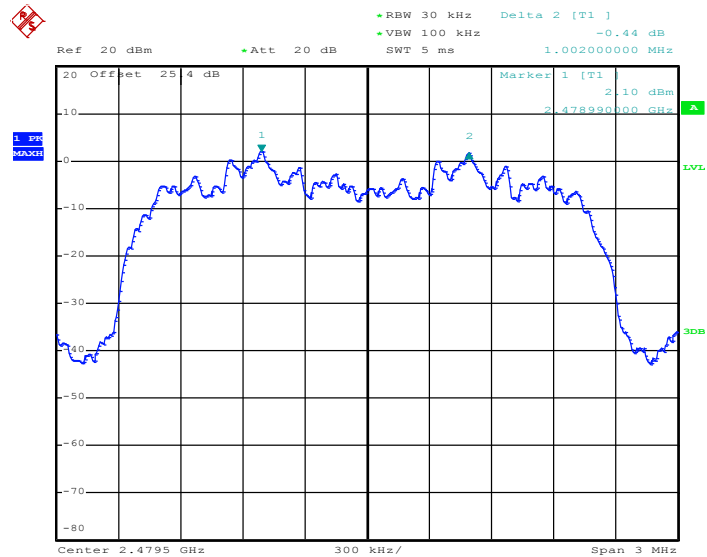


Channel Separation Plot on Channel 39 - 40



Date: 1.AUG.2014 05:58:36

Channel Separation Plot on Channel 77 - 78

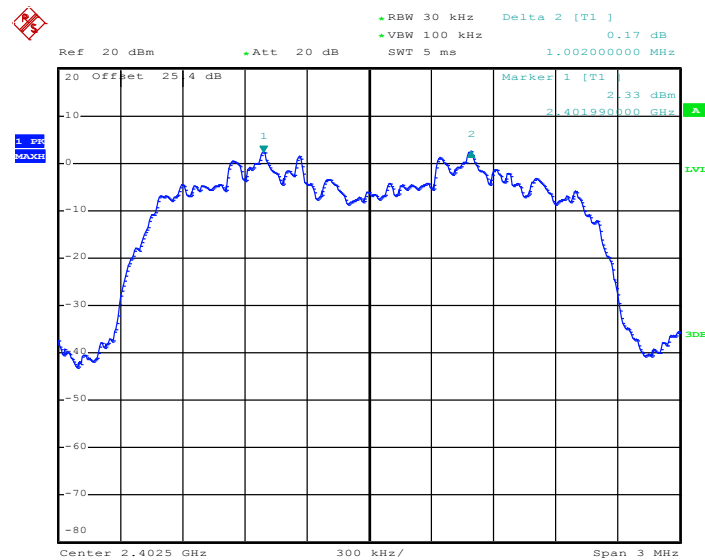


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Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

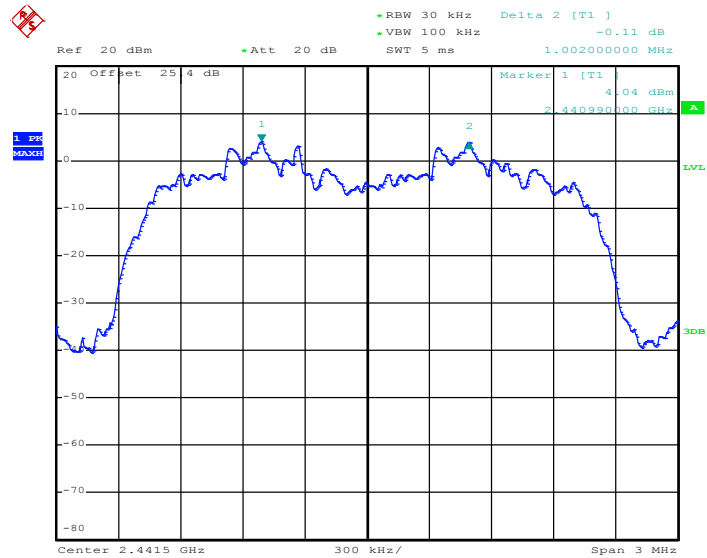
Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1.002	0.8280	Pass
39	2441	1.002	0.8280	Pass
78	2480	1.002	0.8400	Pass

Channel Separation Plot on Channel 00 - 01

Date: 1.AUG.2014 06:03:28

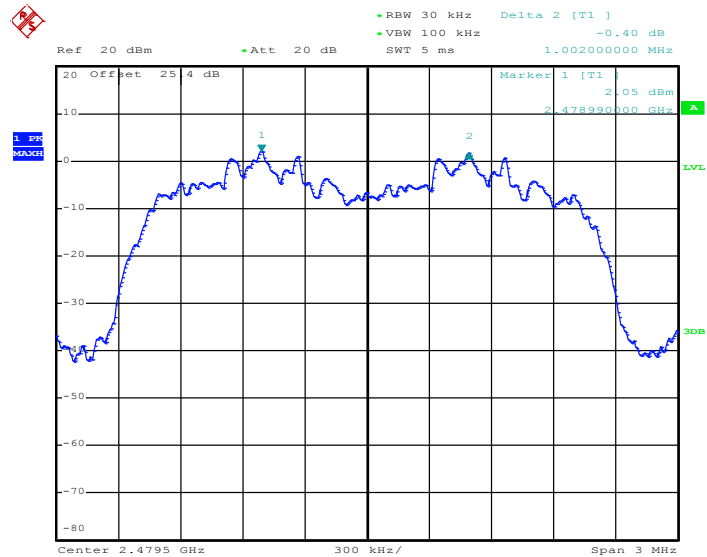


Channel Separation Plot on Channel 39 - 40



Date: 1.AUG.2014 06:02:08

Channel Separation Plot on Channel 77 - 78



Date: 1.AUG.2014 06:04:28

3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

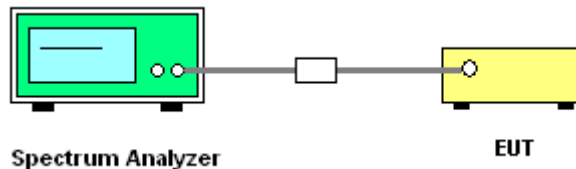
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the 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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW $\geq$ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.3.4 Test Setup



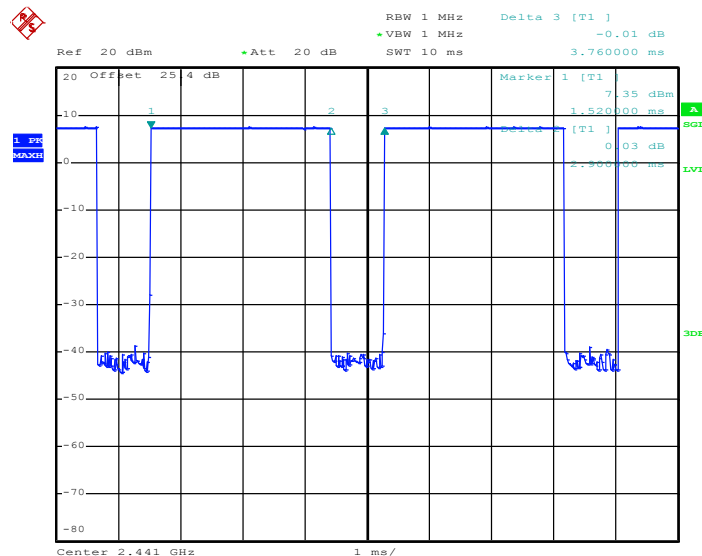
3.3.5 Test Result of Dwell Time

Test Mode :	DH5	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

Mode	Hopping Channel Number	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Normal	79	106.67	2.90	0.31	0.4	Pass
AFH	20	53.33	2.90	0.16	0.4	Pass

Remark:

1. In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.
With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4 x 79) (s),
Hops Over Occupancy Time comes to (1600 / 6 / 79) x (0.4 x 79) = 106.67 hops.
2. In AFH mode, hopping rate is 800 hops/s with 6 slots in 20 hopping channels.
With channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 x 20) (s),
Hops Over Occupancy Time comes to (800 / 6 / 20) x (0.4 x 20) = 53.33 hops.
3. Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

Package Transfer Time Plot


Date: 18.JUL.2014 18:35:13

3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

Reporting only

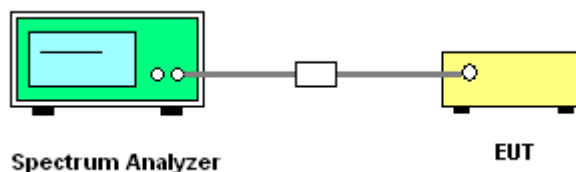
3.4.2 Measuring Instruments

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

3.4.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the 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. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel;
RBW $\geq$ 1% of the 20 dB bandwidth; VBW $\geq$ RBW; Sweep = auto; Detector function = peak;
Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.
For 99% Bandwidth measurement, the RBW=30kHz, and VBW = 100kHz. Sweep = auto ;
Detector function = sample. Trace = max hold.
6. Measure and record the results in the test report.

3.4.4 Test Setup

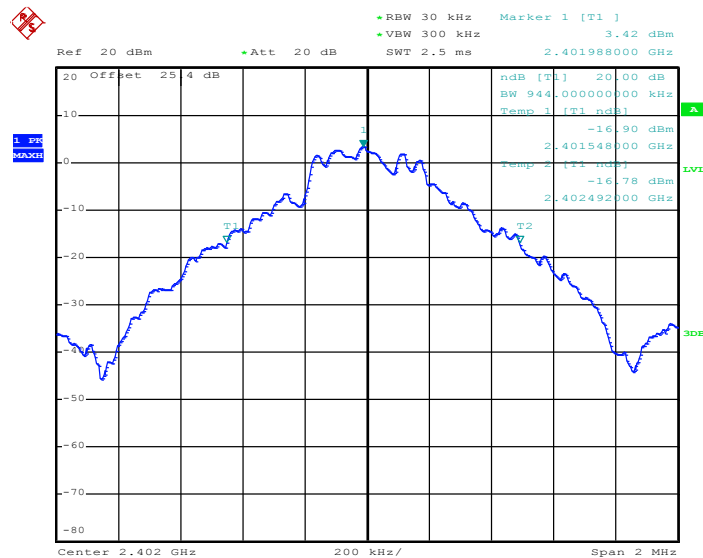


3.4.5 Test Result of 20dB Bandwidth

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	0.944
39	2441	0.940
78	2480	0.908

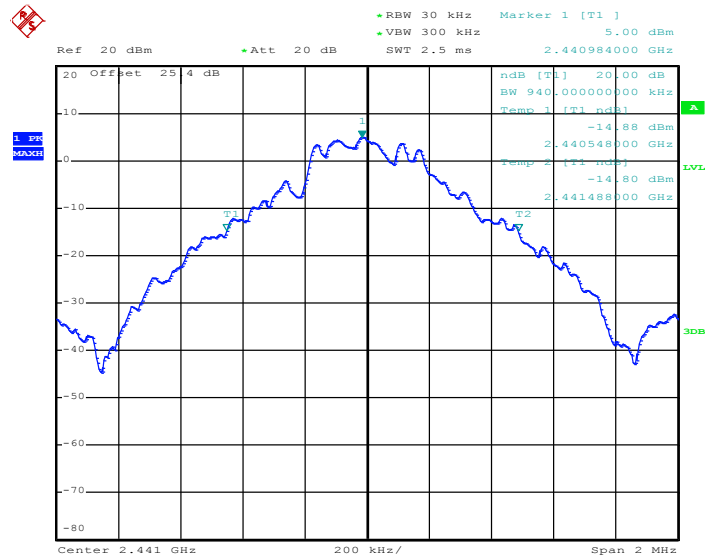
20 dB Bandwidth Plot on Channel 00



Date: 1.AUG.2014 06:06:27

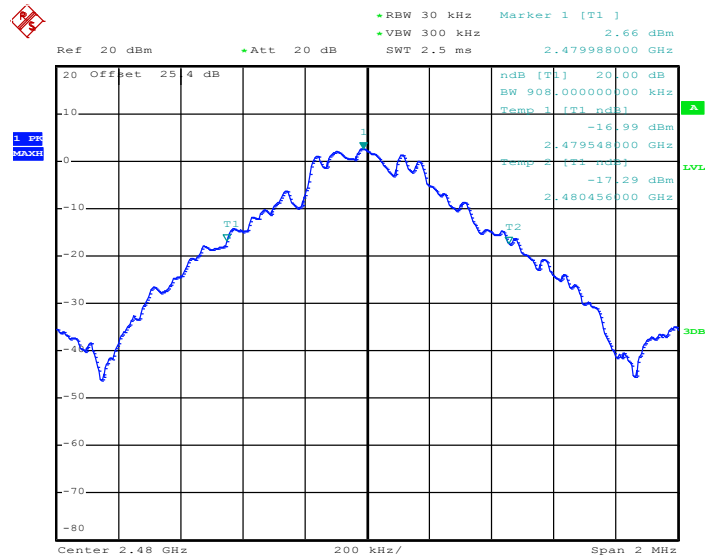


20 dB Bandwidth Plot on Channel 39



Date: 1.AUG.2014 06:05:57

20 dB Bandwidth Plot on Channel 78

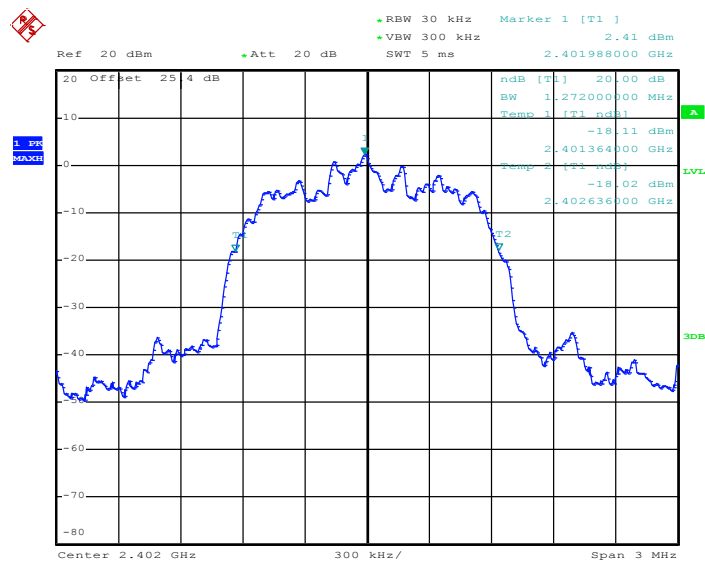


Date: 1.AUG.2014 06:06:57



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

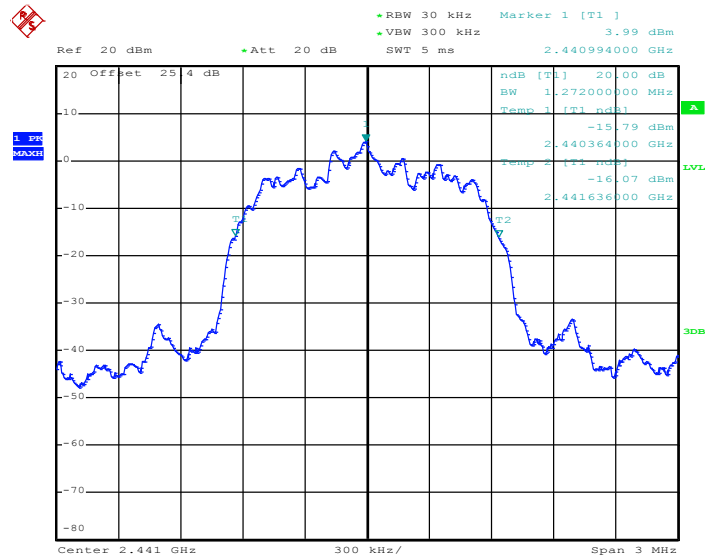
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.272
39	2441	1.272
78	2480	1.272

20 dB Bandwidth Plot on Channel 00

Date: 1.AUG.2014 06:08:19

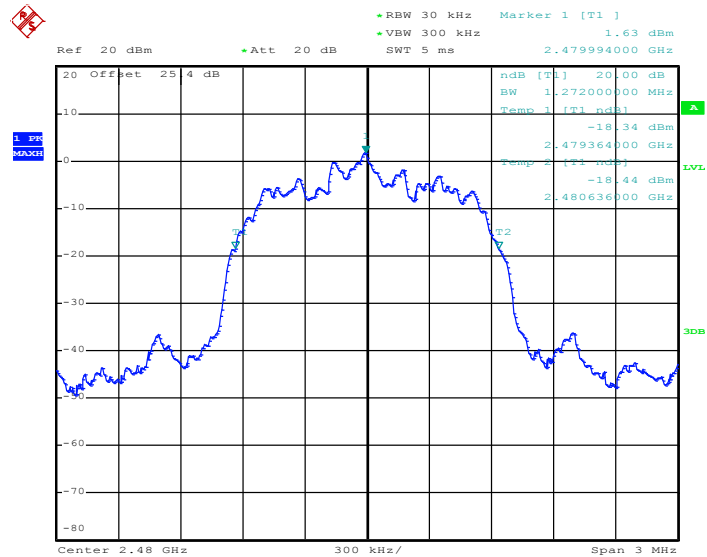


20 dB Bandwidth Plot on Channel 39



Date: 1.AUG.2014 06:07:40

20 dB Bandwidth Plot on Channel 78

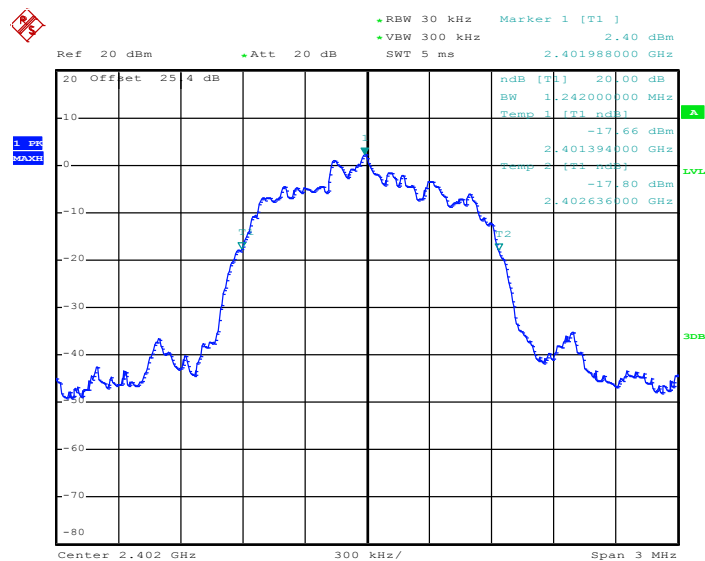


Date: 1.AUG.2014 06:08:55



Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

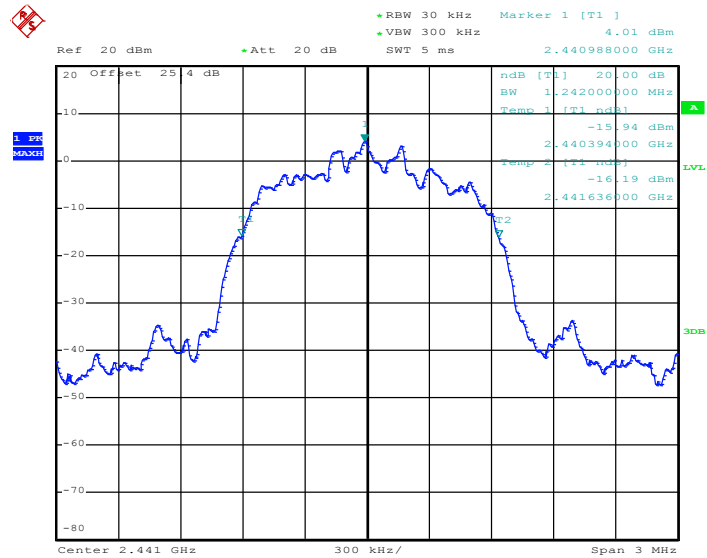
Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.242
39	2441	1.242
78	2480	1.260

20 dB Bandwidth Plot on Channel 00

Date: 1.AUG.2014 06:10:27

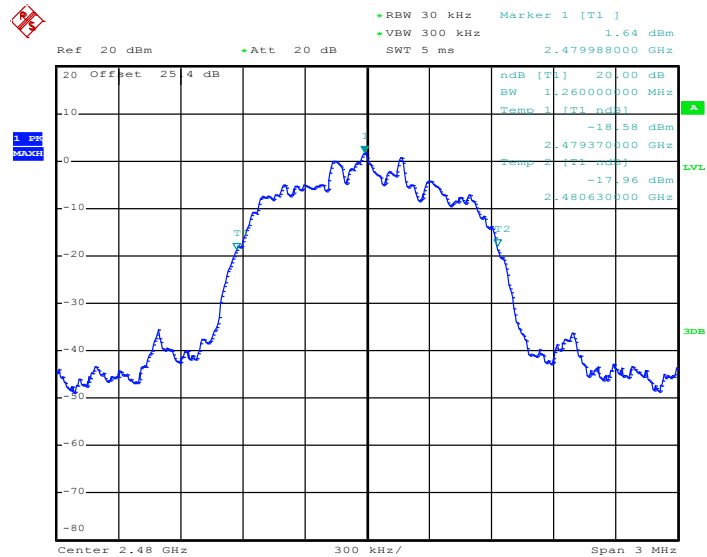


20 dB Bandwidth Plot on Channel 39



Date: 1.AUG.2014 06:09:45

20 dB Bandwidth Plot on Channel 78

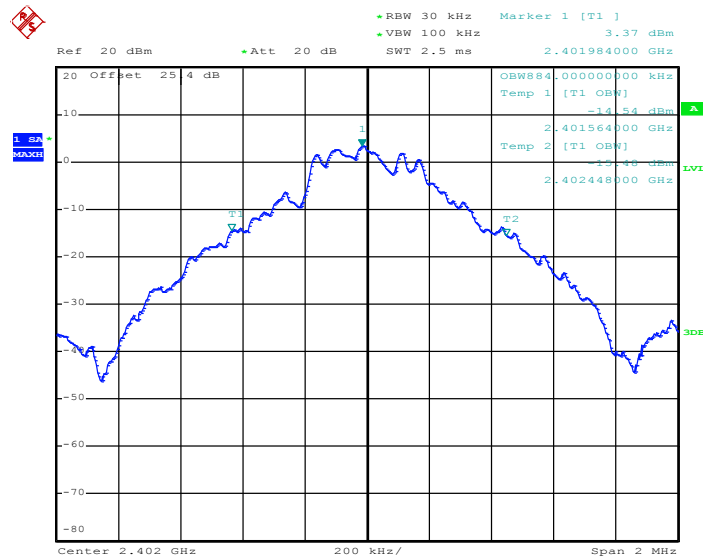


Date: 1.AUG.2014 06:11:06

3.4.6 Test Result of 99% Occupied Bandwidth

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

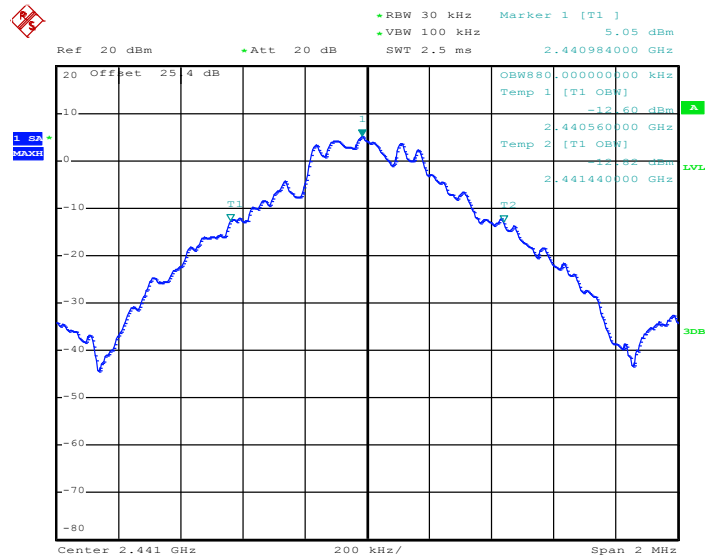
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	0.884
39	2441	0.880
78	2480	0.880

99% Occupied Bandwidth Plot on Channel 00


Date: 1.AUG.2014 06:13:37

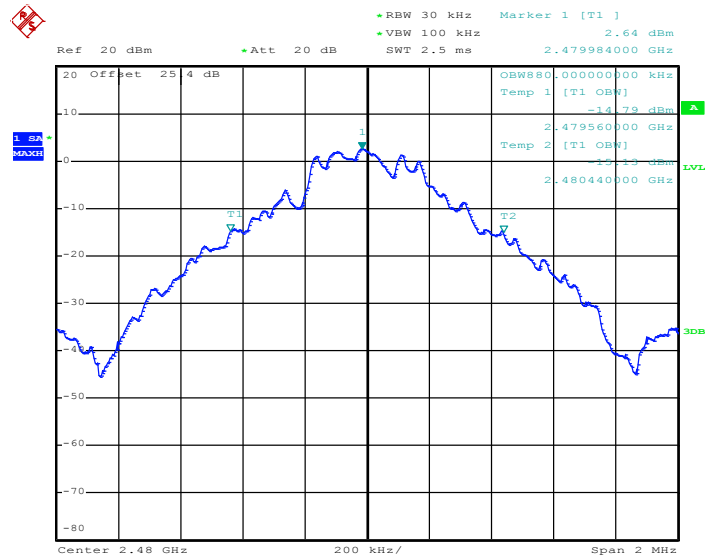


99% Occupied Bandwidth Plot on Channel 39



Date: 1.AUG.2014 06:12:54

99% Occupied Bandwidth Plot on Channel 78

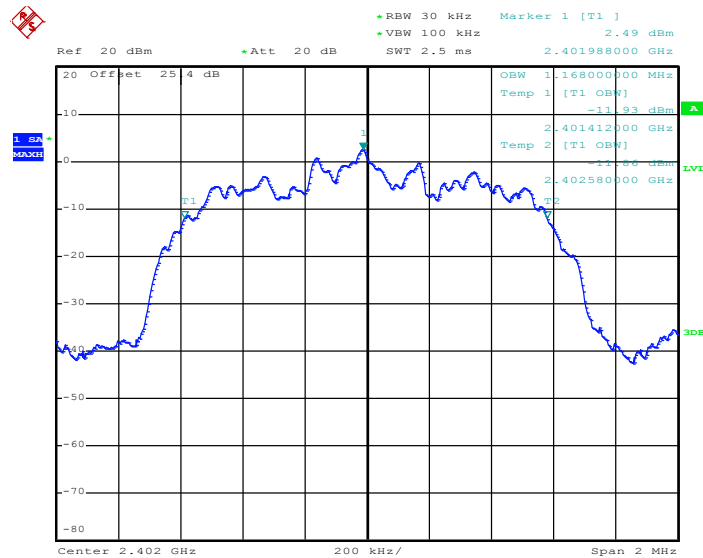


Date: 1.AUG.2014 06:14:19



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

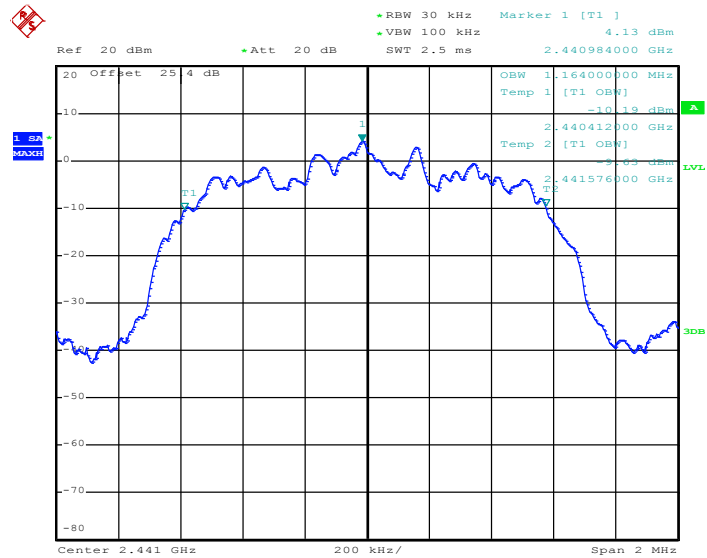
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.168
39	2441	1.164
78	2480	1.164

99% Occupied Bandwidth Plot on Channel 00

Date: 1.AUG.2014 06:16:08

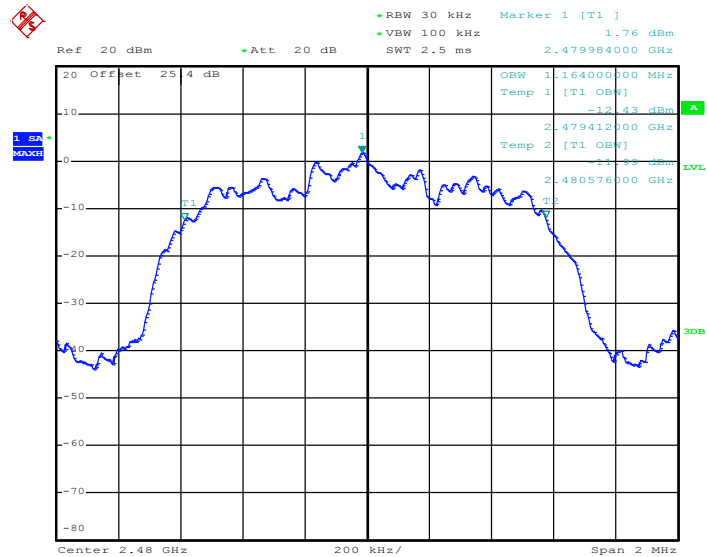


99% Occupied Bandwidth Plot on Channel 39



Date: 1.AUG.2014 06:15:22

99% Occupied Bandwidth Plot on Channel 78

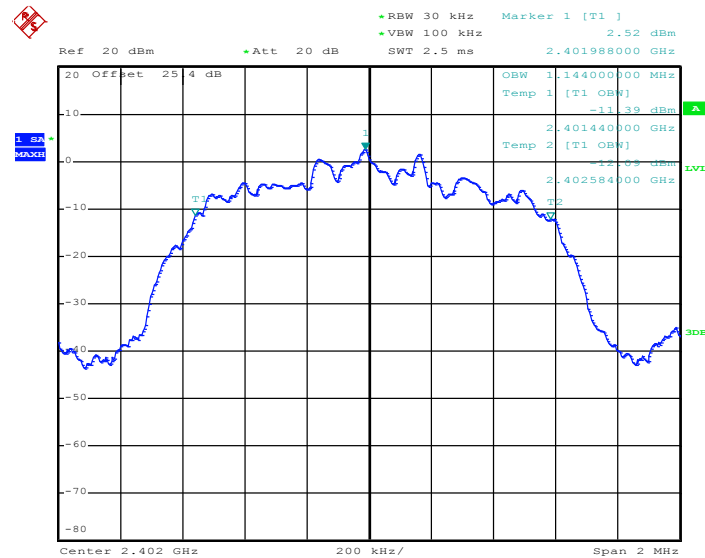


Date: 1.AUG.2014 06:16:52



Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

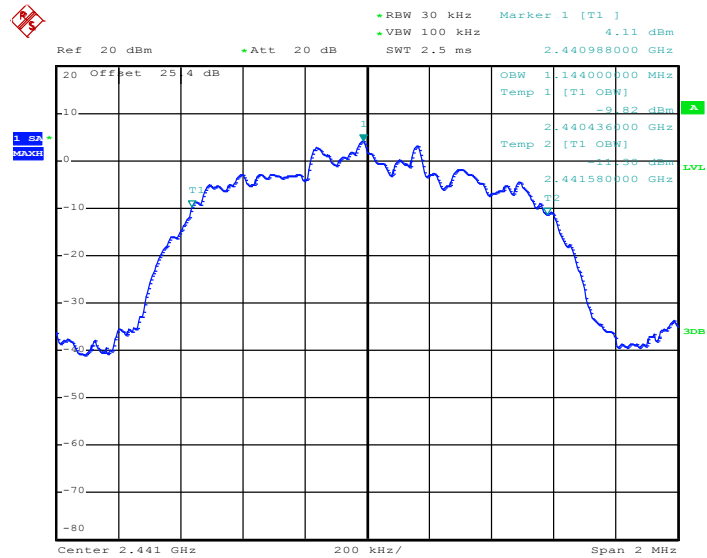
Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.144
39	2441	1.144
78	2480	1.148

99% Occupied Bandwidth Plot on Channel 00

Date: 1.AUG.2014 06:18:36

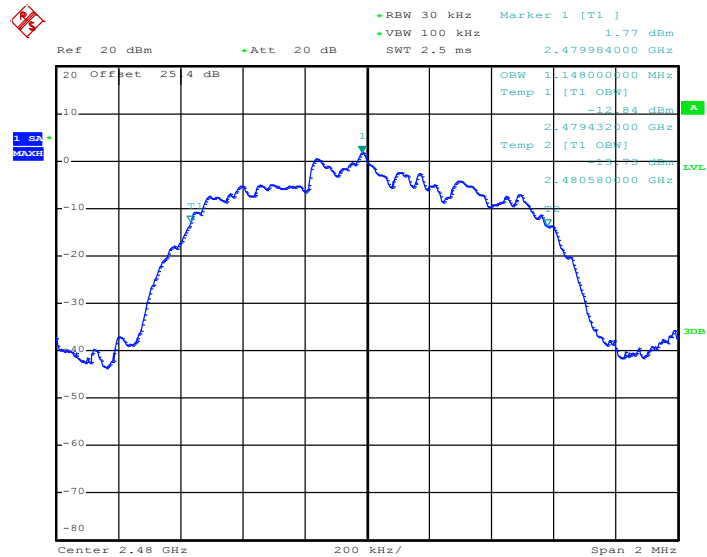


99% Occupied Bandwidth Plot on Channel 39



Date: 1.AUG.2014 06:17:56

99% Occupied Bandwidth Plot on Channel 78



Date: 1.AUG.2014 06:19:37

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

3.5 Peak Output Power Measurement

3.5.1 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.

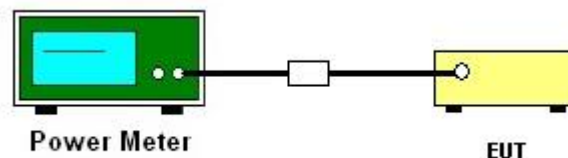
3.5.2 Measuring Instruments

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

3.5.3 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.

3.5.4 Test Setup



3.5.5 Test Result of Peak Output Power

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	6.63	20.97	Pass
39	2441	8.14	20.97	Pass
78	2480	6.10	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°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

Channel	Frequency (MHz)	RF Power (dBm)		
		$\pi/4$ -DQPSK	Max. Limits (dBm)	Pass/Fail
		2 Mbps		
00	2402	7.28	20.97	Pass
39	2441	8.87	20.97	Pass
78	2480	6.71	20.97	Pass

Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

Channel	Frequency (MHz)	RF Power (dBm)		
		8-DPSK	Max. Limits (dBm)	Pass/Fail
		3 Mbps		
00	2402	7.58	20.97	Pass
39	2441	9.16	20.97	Pass
78	2480	7.02	20.97	Pass

3.6 Conducted Band Edges Measurement

3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

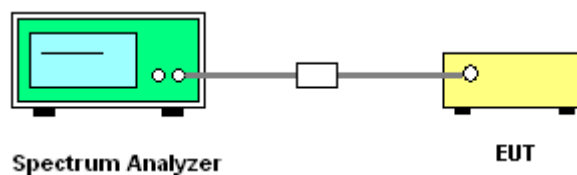
3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

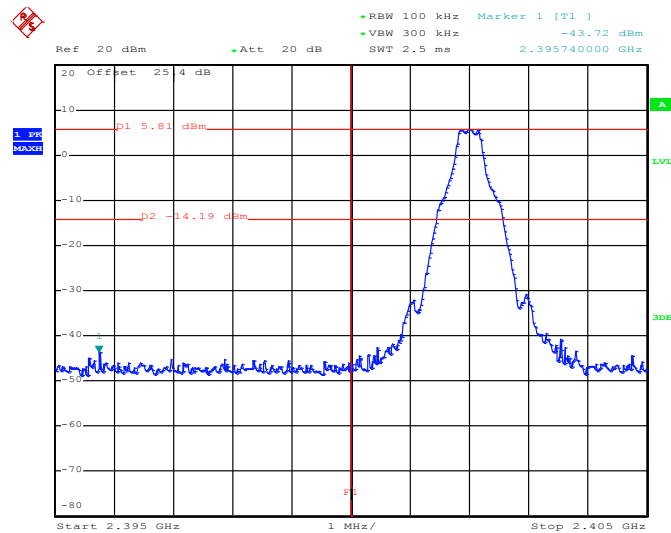
1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz ($\geq 1\%$ span=10MHz), VBW = 300kHz ($\geq$ RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

3.6.4 Test Setup

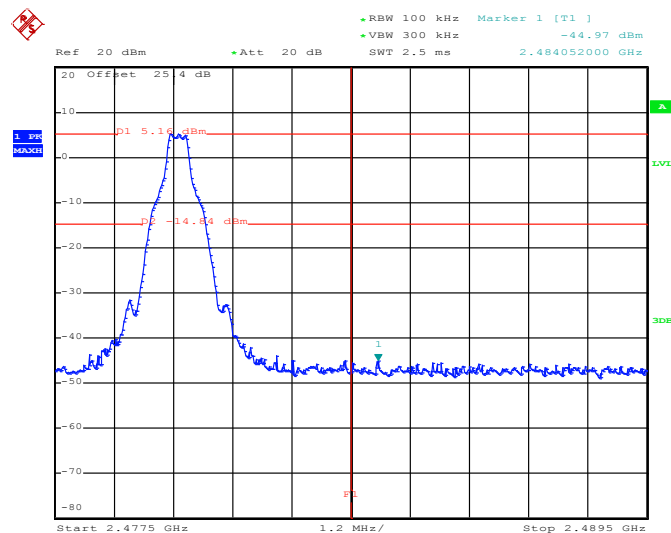


**3.6.5 Test Result of Conducted Band Edges**

Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	00 and 78	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

Low Band Edge Plot on Channel 00

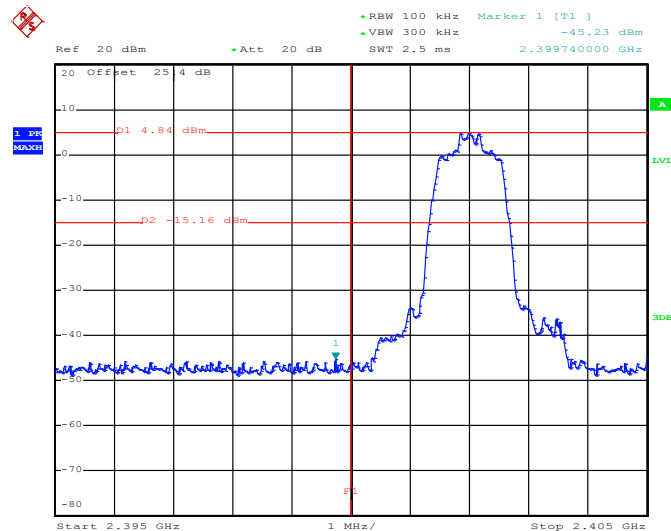
Date: 1.AUG.2014 06:49:26

High Band Edge Plot on Channel 78

Date: 1.AUG.2014 06:49:50

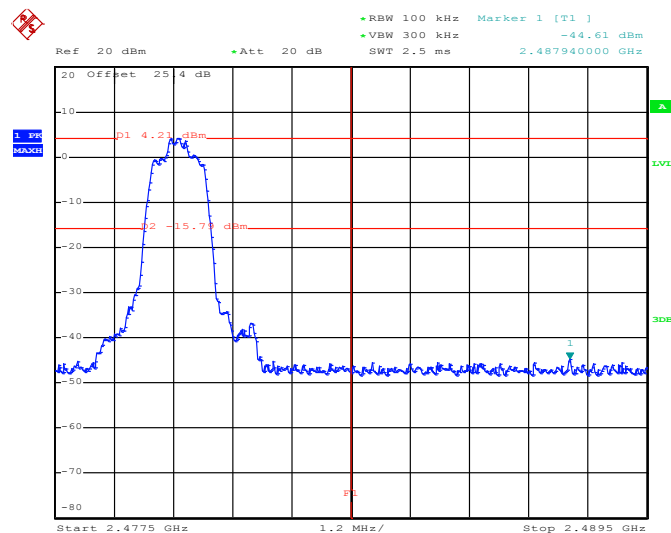
Test Mode :	2Mbps	Temperature :	24~26℃
Test Channel :	00 and 78	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

Low Band Edge Plot on Channel 00



Date: 1.AUG.2014 06:50:24

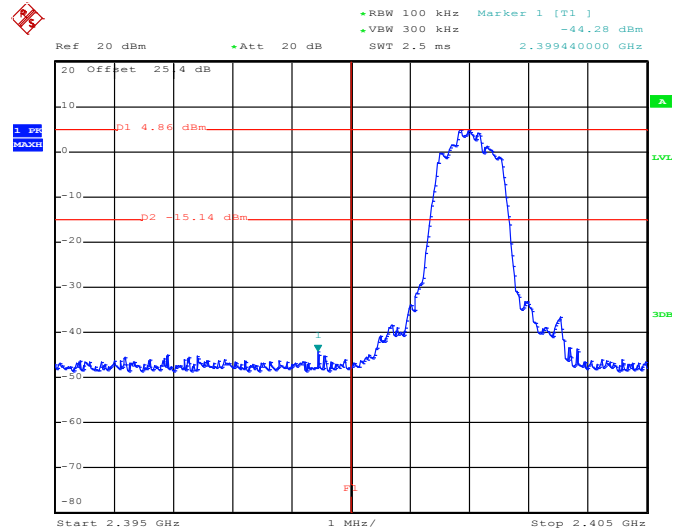
High Band Edge Plot on Channel 78



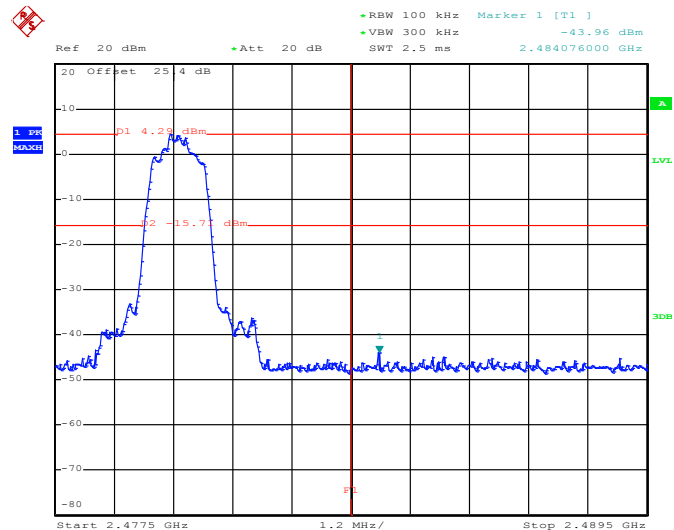
Date: 1.AUG.2014 06:50:55



Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	00 and 78	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

Low Band Edge Plot on Channel 00

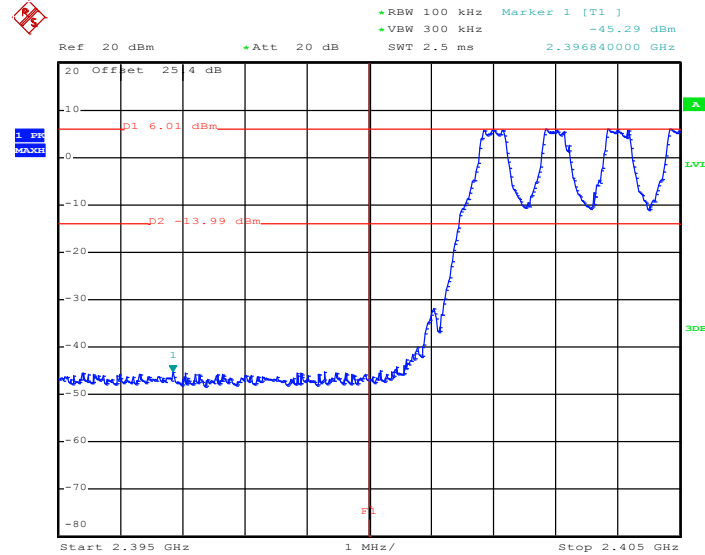
Date: 1.AUG.2014 06:51:43

High Band Edge Plot on Channel 78

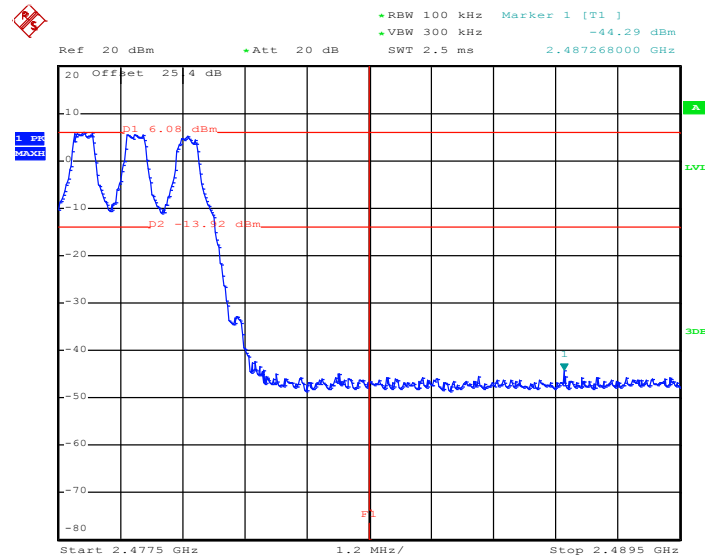
Date: 1.AUG.2014 06:52:29

3.6.6 Test Result of Conducted Hopping Mode Band Edges

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

1Mbps Hopping Mode Low Band Edge Plot


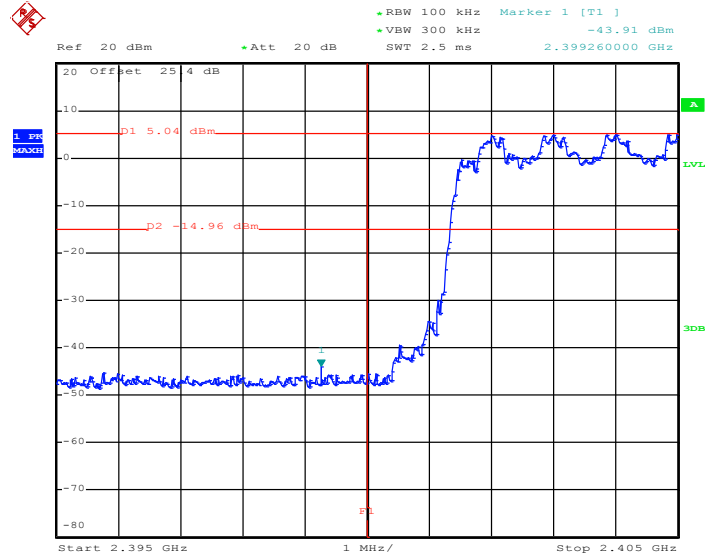
Date: 1.AUG.2014 06:45:45

1Mbps Hopping Mode High Band Edge Plot


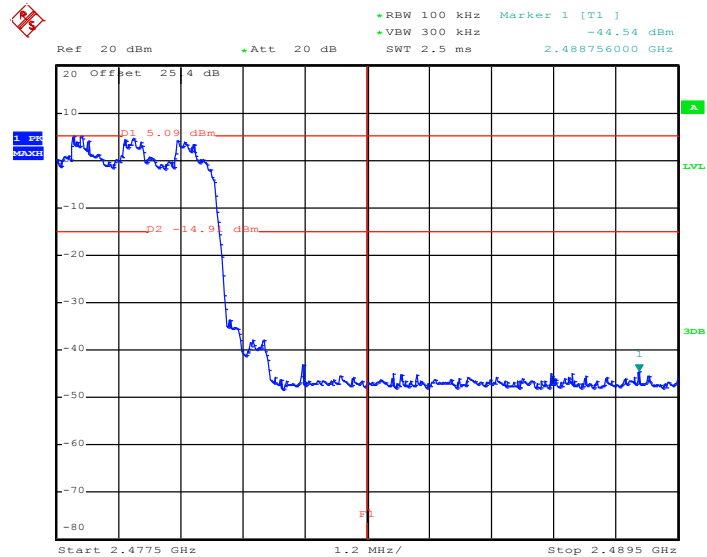
Date: 1.AUG.2014 06:46:19



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

2Mbps Hopping Mode Low Band Edge Plot

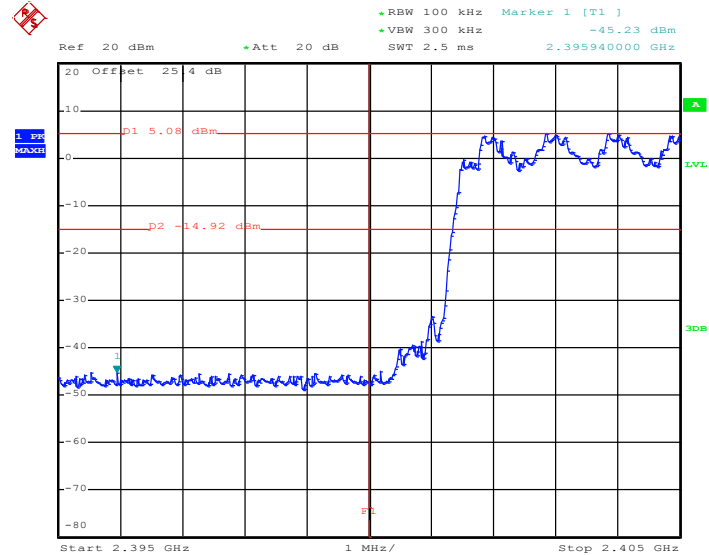
Date: 1.AUG.2014 06:47:03

2Mbps Hopping Mode High Band Edge Plot

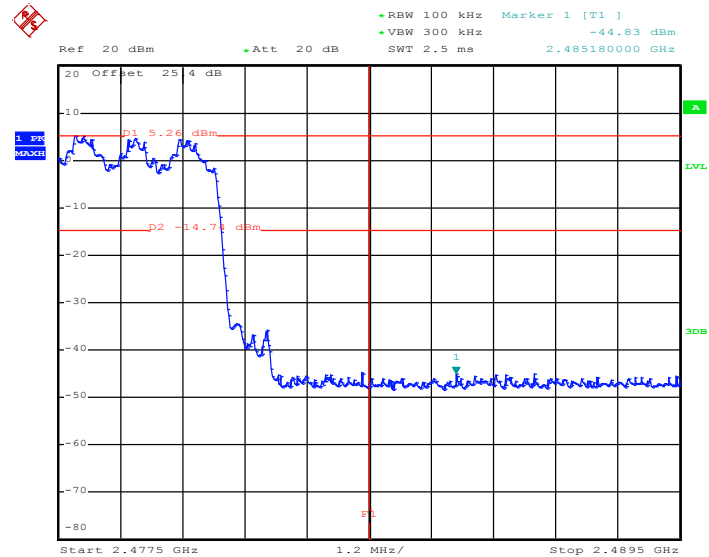
Date: 1.AUG.2014 06:47:30



Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Osolemio Chang	Relative Humidity :	50~53%

3Mbps Hopping Mode Low Band Edge Plot

Date: 1.AUG.2014 06:48:15

3Mbps Hopping Mode High Band Edge Plot

Date: 1.AUG.2014 06:48:47

3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

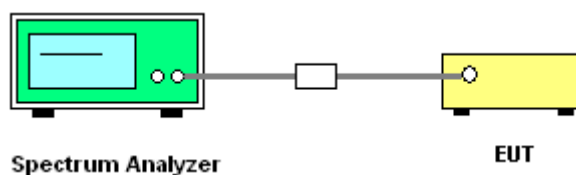
3.7.2 Measuring Instruments

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

3.7.3 Test Procedure

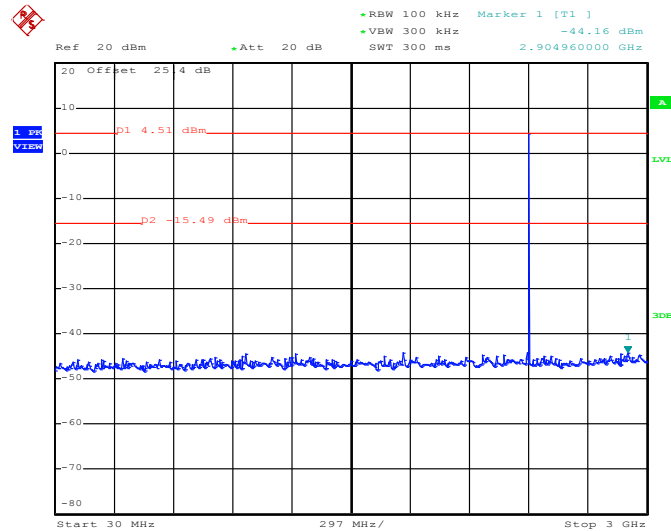
1. The testing follows the guidelines in Spurious RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
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.

3.7.4 Test Setup

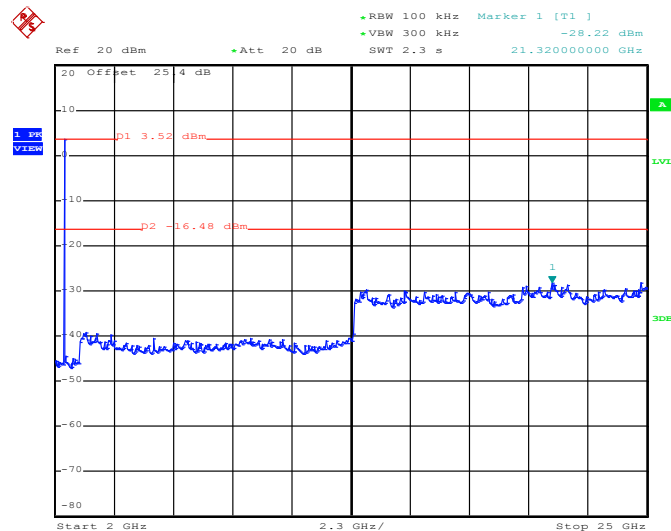


**3.7.5 Test Result of Conducted Spurious Emission**

Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	00	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

1Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz

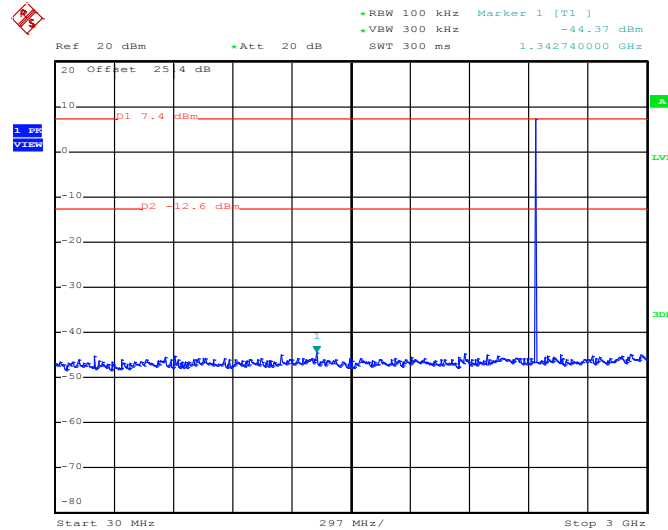
Date: 1.AUG.2014 06:31:31

1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

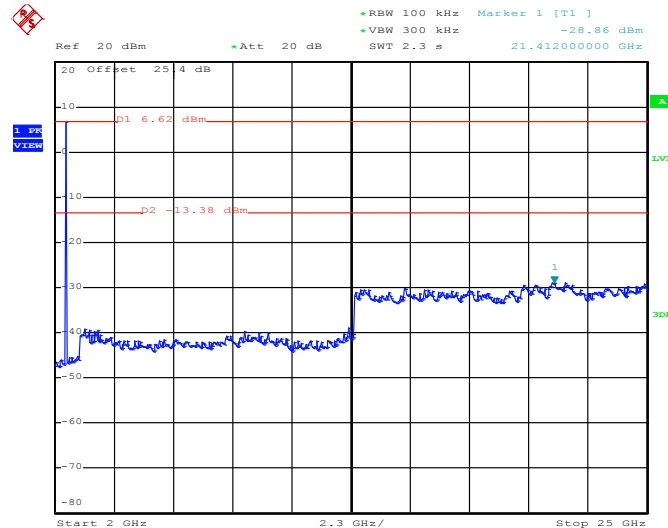
Date: 1.AUG.2014 06:31:53



Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	39	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

1Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz

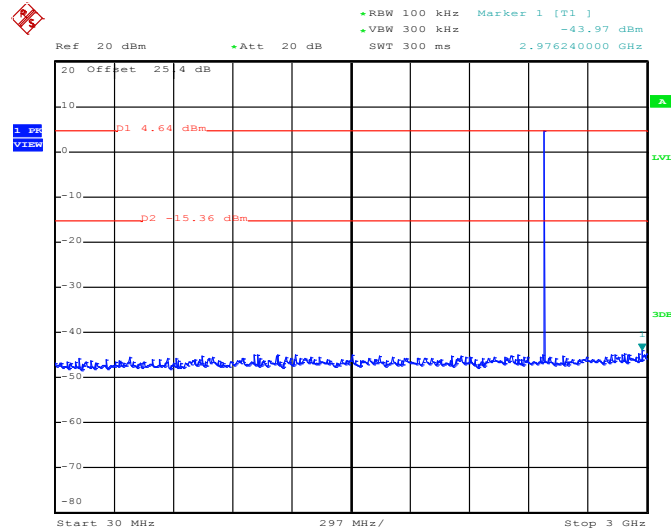
Date: 1.AUG.2014 06:32:25

1Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

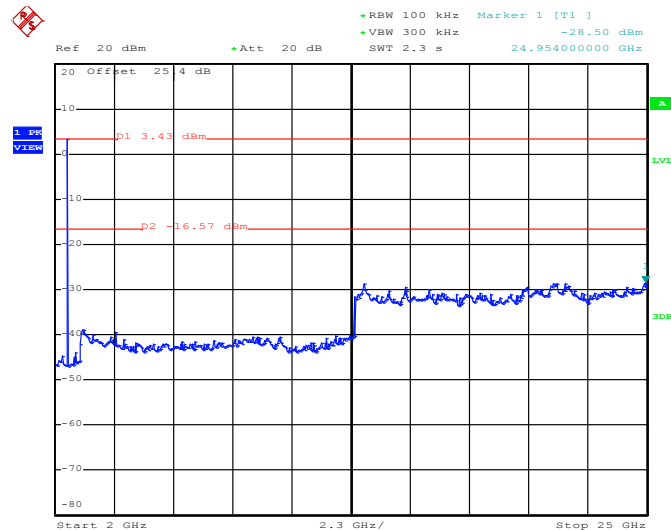
Date: 1.AUG.2014 06:32:47



Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	78	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

1Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz

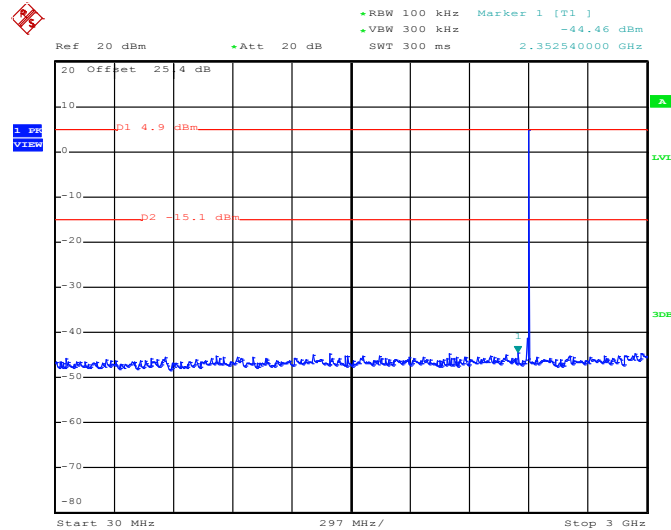
Date: 1.AUG.2014 06:33:22

1Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

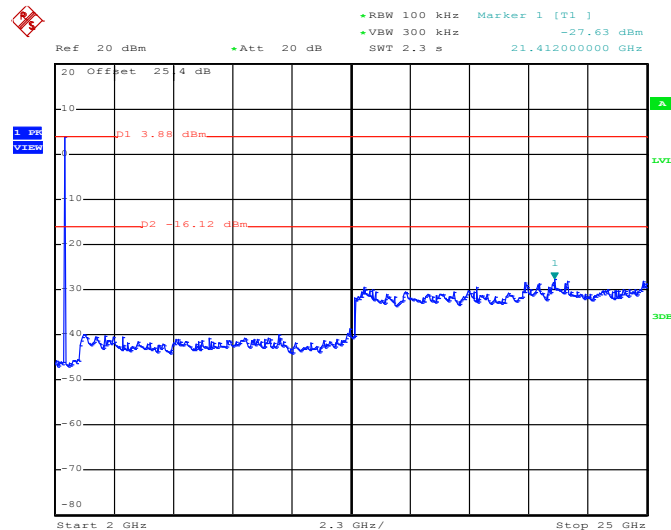
Date: 1.AUG.2014 06:33:44



Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	00	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

2Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz

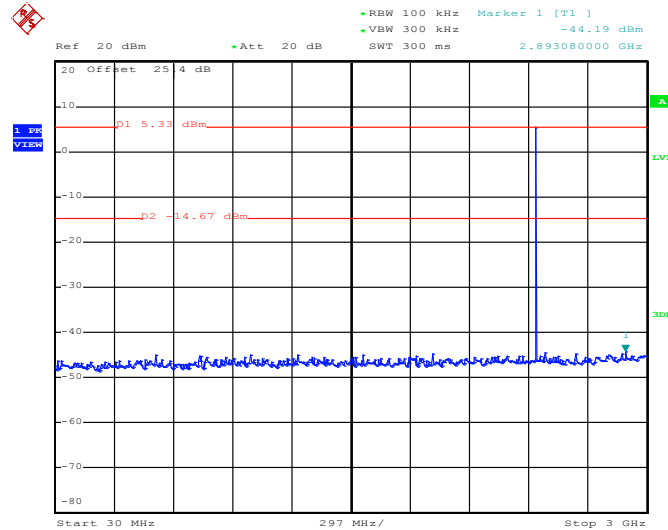
Date: 1.AUG.2014 06:34:24

2Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

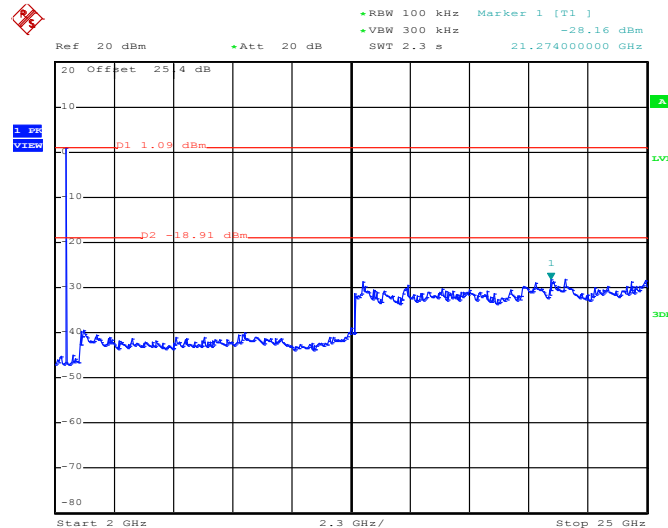
Date: 1.AUG.2014 06:34:46



Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	39	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

2Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz

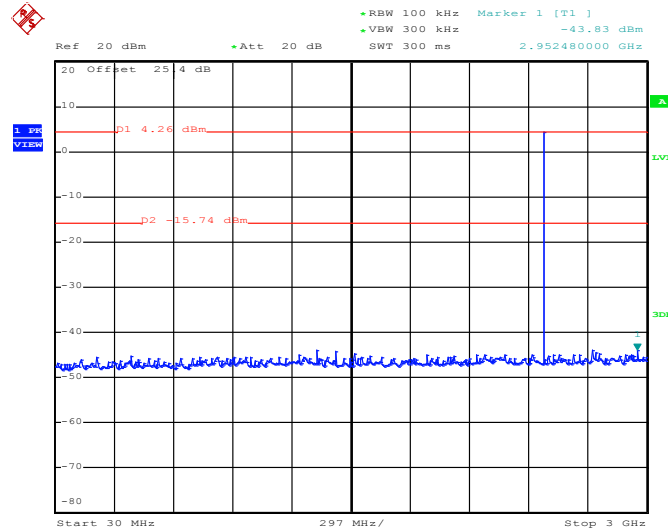
Date: 1.AUG.2014 06:36:03

2Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

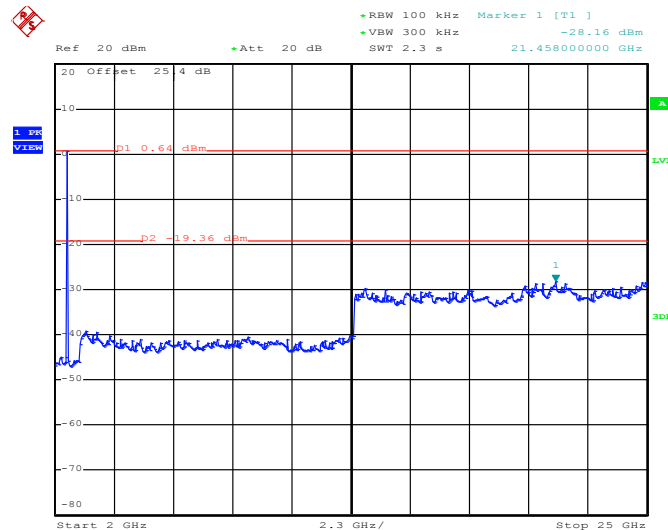
Date: 1.AUG.2014 06:36:25



Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	78	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

2Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz

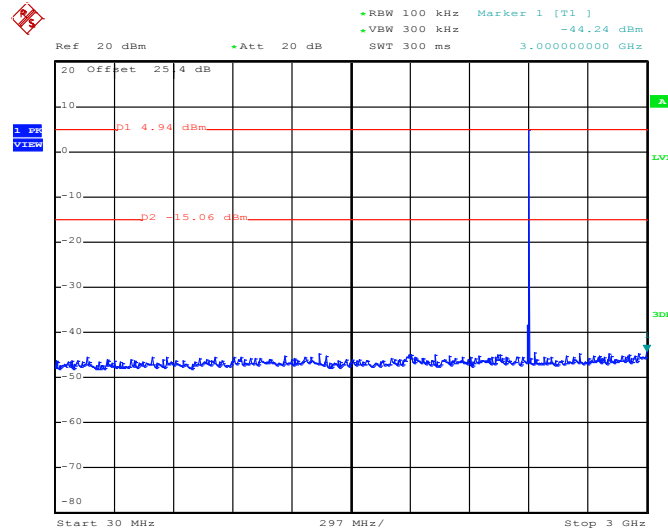
Date: 1.AUG.2014 06:36:56

2Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

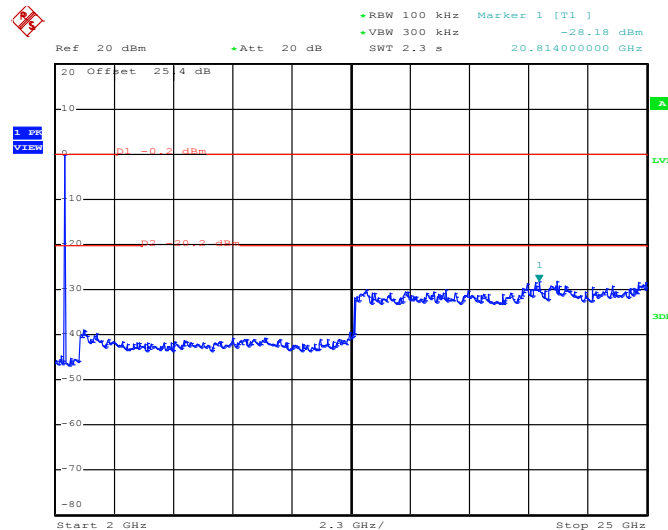
Date: 1.AUG.2014 06:37:18



Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	00	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

3Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz

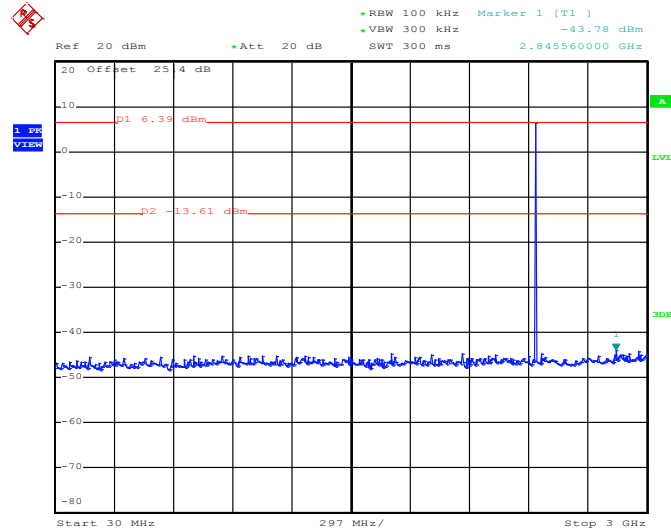
Date: 1.AUG.2014 06:37:53

3Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

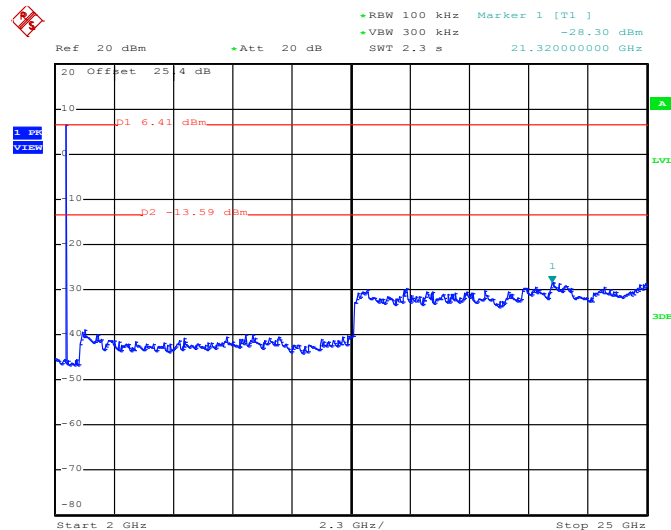
Date: 1.AUG.2014 06:38:15



Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	39	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

3Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz

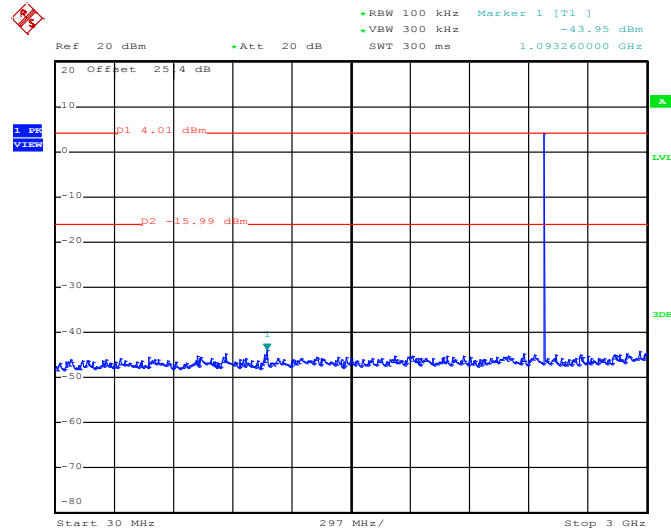
Date: 1.AUG.2014 06:38:51

3Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

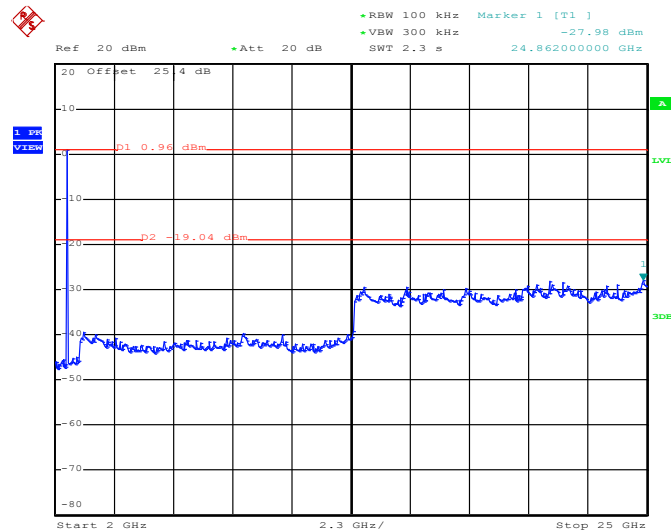
Date: 1.AUG.2014 06:39:13



Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	78	Relative Humidity :	50~53%
		Test Engineer :	Osolemio Chang

3Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz

Date: 1.AUG.2014 06:39:43

3Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

Date: 1.AUG.2014 06:40:05

3.8 Radiated Band Edges and Spurious Emission Measurement

3.8.1 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

3.8.2 Measuring Instruments

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



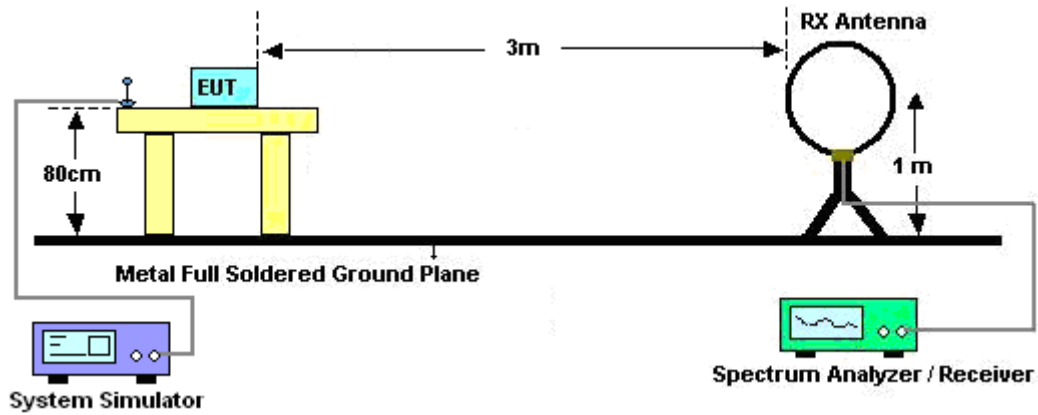
3.8.3 Test Procedures

1. The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. The EUT was placed on a turntable with 0.8 meter above ground.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. 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.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. 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 $f > 1$ GHz ; VBW $\geq$ 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 = $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$
Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
Average Emission Level = Peak Emission Level + $20 * \log(\text{Duty cycle})$
7. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

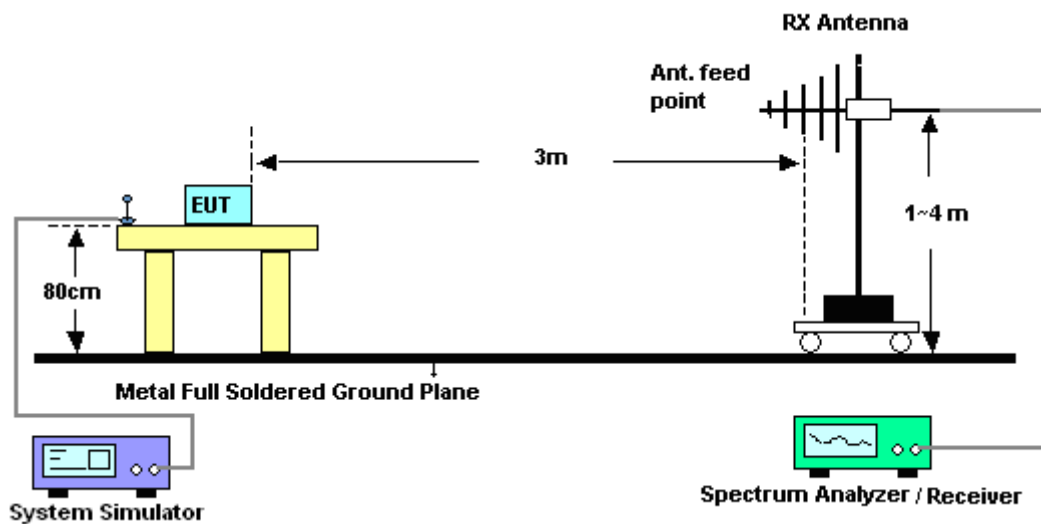
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from $20 \log(\text{dwell time}/100\text{ms})$. This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.8.4 Test Setup

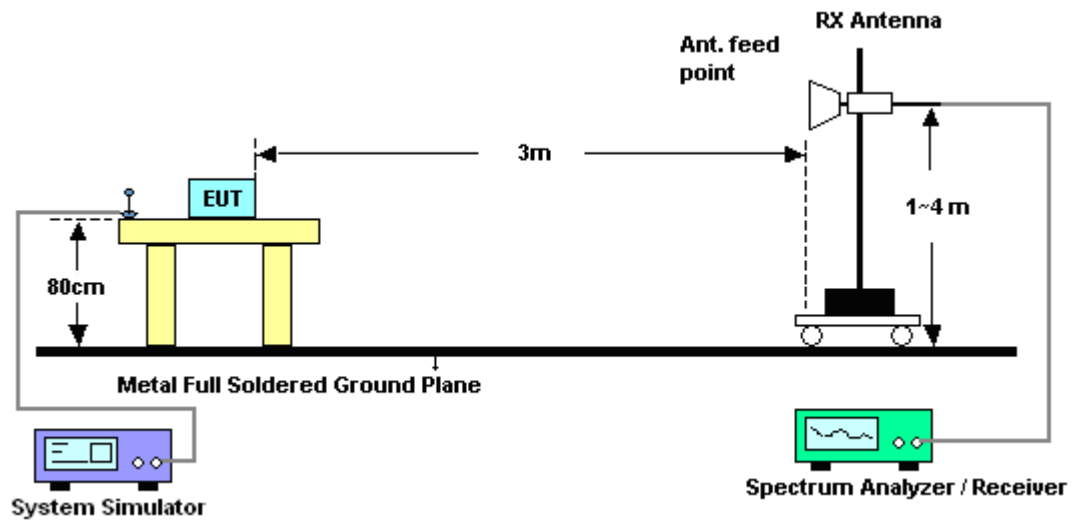
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	Bluetooth Tx CH78 with WPC Charging Mode	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Horizontal

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
0.01206	33.03	-92.95	125.98	12.46	20.28	0.29	-	-	Average
0.08904	24.67	-83.94	108.61	4.33	20.05	0.29	-	-	Average
0.10336	26.1	-81.22	107.32	5.76	20.05	0.29	-	-	QP
0.12664	58.69	-46.86	105.55	38.38	20.02	0.29	-	-	Average
0.14168	21.98	-82.6	104.58	1.67	20.02	0.29	-	-	Average
0.46042	45.11	-49.23	94.34	24.92	19.9	0.29	-	-	Average
0.49	44.02	-29.78	73.8	23.83	19.9	0.29	100	223	QP
8.896	36.47	-33.53	70	16.33	19.76	0.38	-	-	QP
21.175	37.52	-32.48	70	16.98	20.11	0.43	-	-	QP
25.16	36.16	-33.84	70	15.39	20.32	0.45	-	-	QP

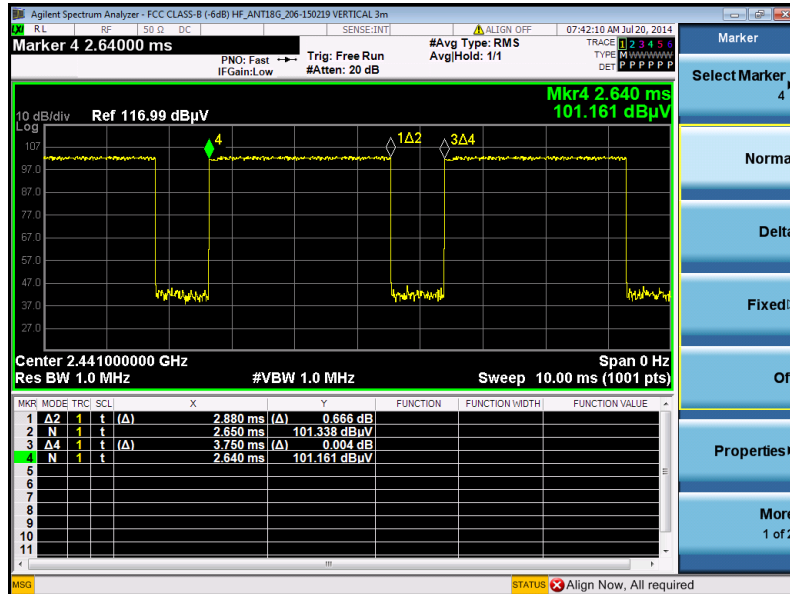


Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	Bluetooth Tx CH78 with WPC Charging Mode	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Vertical

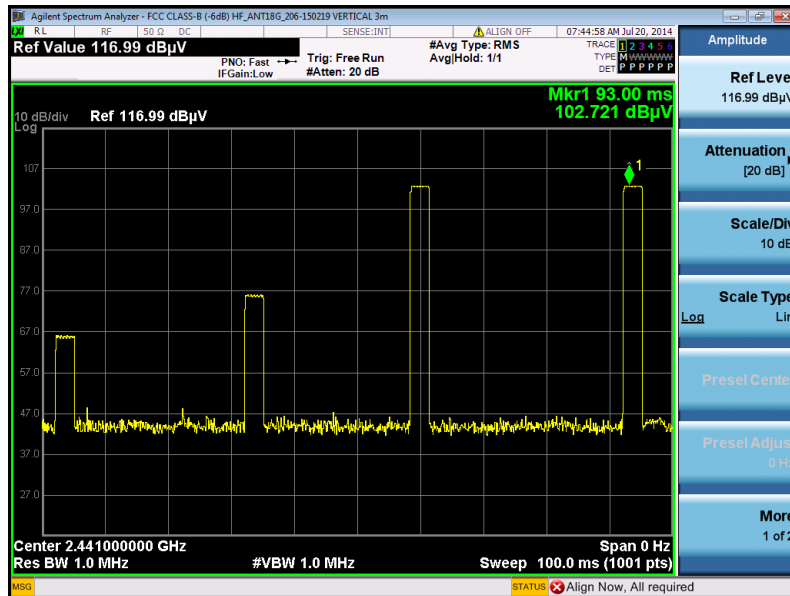
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
0.0116	27.66	-98.65	126.31	7.09	20.28	0.29	-	-	Average
0.08061	22.78	-86.7	109.48	2.42	20.07	0.29	-	-	Average
0.09248	24.51	-83.77	108.28	4.17	20.05	0.29	-	-	QP
0.12616	51.34	-54.25	105.59	31.03	20.02	0.29	-	-	Average
0.14176	23.04	-81.53	104.57	2.73	20.02	0.29	-	-	Average
0.4543	42.68	-51.78	94.46	22.49	19.9	0.29	-	-	Average
0.49	41.65	-32.15	73.8	21.46	19.9	0.29	-	-	QP
15.96	36.98	-33.02	70	16.9	19.67	0.41	-	-	QP
24.739	43.43	-26.57	70	22.67	20.31	0.45	-	-	QP
25.615	43.64	-26.36	70	22.84	20.33	0.47	100	14	QP

3.8.6 Duty cycle correction factor for average measurement

3DH5 on time (One Pulse) Plot on Channel 39



3DH5 on time (Count Pulses) Plot on Channel 39



Note:

1. Worst case Duty cycle = on time/100 milliseconds = $2 * 2.88 / 100 = 5.76 \%$
2. Worst case Duty cycle correction factor = $20 * \log(\text{Duty cycle}) = -24.79 \text{ dB}$
3. 3DH5 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

$$2.88 \text{ ms} \times 20 \text{ channels} = 57.6 \text{ ms}$$

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. $[100\text{ms} / 57.6\text{ms}] = 2 \text{ hops}$

Thus, the maximum possible ON time:

$$2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$$

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

$$20 \times \log(5.76 \text{ ms}/100\text{ms}) = -24.79 \text{ dB}$$



3.8.7 Test Result of Radiated Spurious at Band Edges

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	00	Relative Humidity :	46~48%
		Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen

ANTENNA POLARITY : HORIZONTAL										
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2382.27	40.89	-33.11	74	42.67	27.17	4.23	33.18	136	180	Peak
2382.27	16.1	-37.9	54	-	-	-	-	-	-	Average

ANTENNA POLARITY : VERTICAL										
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2369.13	41.04	-32.96	74	42.87	27.13	4.22	33.18	100	158	Peak
2369.13	16.25	-37.75	54	-	-	-	-	-	-	Average

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	78	Relative Humidity :	46~48%
		Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen

ANTENNA POLARITY : HORIZONTAL										
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.74	46.09	-27.91	74	47.49	27.45	4.29	33.14	100	63	Peak
2483.74	21.3	-32.7	54	-	-	-	-	-	-	Average

ANTENNA POLARITY : VERTICAL										
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.74	45.24	-28.76	74	46.64	27.45	4.29	33.14	100	157	Peak
2483.74	20.45	-33.55	54	-	-	-	-	-	-	Average

Note: Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79dB)

**<Bluetooth Tx Mode with WPC Charging Mode>**

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	78	Relative Humidity :	46~48%
		Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen

ANTENNA POLARITY : HORIZONTAL

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2483.5	49.91	-24.09	74	51.31	27.45	4.29	33.14	103	76	Peak
2483.5	25.12	-28.88	54	-	-	-	-	-	-	Averaeg

ANTENNA POLARITY : VERTICAL

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2485	41.85	-32.15	74	43.24	27.46	4.29	33.14	100	170	Peak
2485	17.06	-36.94	54	-	-	-	-	-	-	Averaeg

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

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

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	00	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Horizontal
Remark :	2403 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2403	101.33	-	-	103.02	27.23	4.25	33.17	136	180	Peak
2403	76.54	-	-	-	-	-	-	-	-	Average
4803	41.8	-32.2	74	36.47	31.56	6.2	32.43	100	0	Peak
4803	17.01	-36.99	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	00	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Vertical
Remark :	2402 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2402	100.76	-	-	102.45	27.23	4.25	33.17	100	158	Peak
2402	75.97	-	-	-	-	-	-	-	-	Average
4803	42.1	-31.9	74	36.77	31.56	6.2	32.43	100	0	Peak
4803	17.31	-36.69	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)



Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	39	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Horizontal
Remark :	2442 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2442	101.12	-	-	102.66	27.34	4.27	33.15	100	60	Peak
2442	76.33	-	-	-	-	-	-	-	-	Average
4881	42.95	-31.05	74	37.41	31.66	6.29	32.41	100	0	Peak
4881	18.16	-35.84	54	-	-	-	-	-	-	Average
7323	49.55	-24.45	74	38.23	36.64	8.4	33.72	100	0	Peak
7323	24.76	-29.24	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)

Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	39	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Vertical
Remark :	2442 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
2442	99.97	-	-	101.51	27.34	4.27	33.15	100	158	Peak
2442	75.18	-	-	-	-	-	-	-	-	Average
4881	42.19	-31.81	74	36.65	31.66	6.29	32.41	100	0	Peak
4881	17.4	-36.6	54	-	-	-	-	-	-	Average
7323	48.81	-25.19	74	37.49	36.64	8.4	33.72	100	0	Peak
7323	24.02	-29.98	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)



Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	78	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Horizontal
Remark :	2480 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
62.67	19.79	-20.21	40	33.88	13.29	0.66	28.04	-	-	Peak
141.51	19.61	-23.89	43.5	33.19	13.55	1.01	28.14	-	-	Peak
266.79	25.01	-20.99	46	38.8	13.07	1.31	28.17	-	-	Peak
521.9	27.52	-18.48	46	35.2	18.41	1.85	27.94	-	-	Peak
703.9	28.32	-17.68	46	32.43	21.36	2.22	27.69	-	-	Peak
893.6	29.67	-16.33	46	30.56	23.72	2.54	27.15	100	122	Peak
2480	101.28	-	-	102.69	27.44	4.29	33.14	100	63	Peak
2480	76.49	-	-	-	-	-	-	-	-	Average
4959	42.49	-31.51	74	36.76	31.75	6.38	32.4	100	0	Peak
4959	17.7	-36.3	54	-	-	-	-	-	-	Average
7440	49.57	-24.43	74	38.28	36.94	8.17	33.82	100	0	Peak
7440	24.78	-29.22	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)



Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	78	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Vertical
Remark :	2481 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
50.52	26.55	-13.45	40	39.58	14.37	0.6	28	-	-	Peak
73.2	27.99	-12.01	40	44.18	11.16	0.72	28.07	100	52	Peak
227.1	21.02	-24.98	46	36.55	11.43	1.21	28.17	-	-	Peak
550.6	27.76	-18.24	46	34.96	18.82	1.89	27.91	-	-	Peak
764.1	27.73	-18.27	46	30.77	22.24	2.28	27.56	-	-	Peak
811	29.89	-16.11	46	32.22	22.73	2.38	27.44	-	-	Peak
2481	96.85	-	-	98.25	27.45	4.29	33.14	100	157	Peak
2481	72.06	-	-	-	-	-	-	-	-	Average
4959	42.63	-31.37	74	36.9	31.75	6.38	32.4	100	0	Peak
4959	17.84	-36.16	54	-	-	-	-	-	-	Average
7440	48.92	-25.08	74	37.63	36.94	8.17	33.82	100	0	Peak
7440	24.13	-29.87	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)



Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	Bluetooth Tx CH78 with WPC Charging Mode	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Horizontal
Remark :	2480 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
86.16	30.79	-9.21	40	49.46	8.68	0.75	28.1	-	-	Peak
145.29	36.36	-7.14	43.5	49.84	13.66	1	28.14	100	185	Peak
195.78	35.94	-7.56	43.5	52.2	10.77	1.13	28.16	-	-	Peak
374.9	26.12	-19.88	46	36.95	15.75	1.55	28.13	-	-	Peak
470.1	25.31	-20.69	46	33.73	17.8	1.79	28.01	-	-	Peak
866.3	29.96	-16.04	46	31.36	23.4	2.45	27.25	-	-	Peak
2480	100.67	-	-	102.08	27.44	4.29	33.14	103	76	Peak
2480	75.88	-	-	-	-	-	-	-	-	Average
4959	41.66	-32.34	74	35.93	31.75	6.38	32.4	100	0	Peak
4959	16.87	-37.13	54	-	-	-	-	-	-	Average
7440	47.01	-26.99	74	35.72	36.94	8.17	33.82	100	0	Peak
7440	22.22	-31.78	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)



Test Mode :	3Mbps	Temperature :	22~24°C
Test Channel :	Bluetooth Tx CH78 with WPC Charging Mode	Relative Humidity :	46~48%
Test Engineer :	Kyle Jhuang, Abi Lin and Derreck Chen	Polarization :	Vertical
Remark :	2480 MHz is fundamental signal which can be ignored.		

Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
88.32	33.15	-10.35	43.5	52.14	8.35	0.76	28.1	-	-	Peak
142.05	34.49	-9.01	43.5	48.06	13.56	1.01	28.14	-	-	Peak
191.73	36.27	-7.23	43.5	52.39	10.93	1.11	28.16	100	47	Peak
367.2	30.07	-15.93	46	41.07	15.58	1.55	28.13	-	-	Peak
601.7	25.58	-20.42	46	31.16	20.21	2.06	27.85	-	-	Peak
957.3	34.77	-11.23	46	34.53	24.53	2.62	26.91	-	-	Peak
2480	90.63	-	-	92.04	27.44	4.29	33.14	100	170	Peak
2480	65.84	-	-	-	-	-	-	-	-	Average
4959	42.96	-31.04	74	37.23	31.75	6.38	32.4	100	0	Peak
4959	18.17	-35.83	54	-	-	-	-	-	-	Average
7440	48.39	-25.61	74	37.1	36.94	8.17	33.82	100	0	Peak
7440	23.6	-30.4	54	-	-	-	-	-	-	Average

Note: 1. Other harmonics are lower than background noise.

2. Average Emission Level = Peak Emission Level + duty cycle correction factor(-24.79)

3.9 AC Conducted Emission Measurement

3.9.1 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 μ 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.

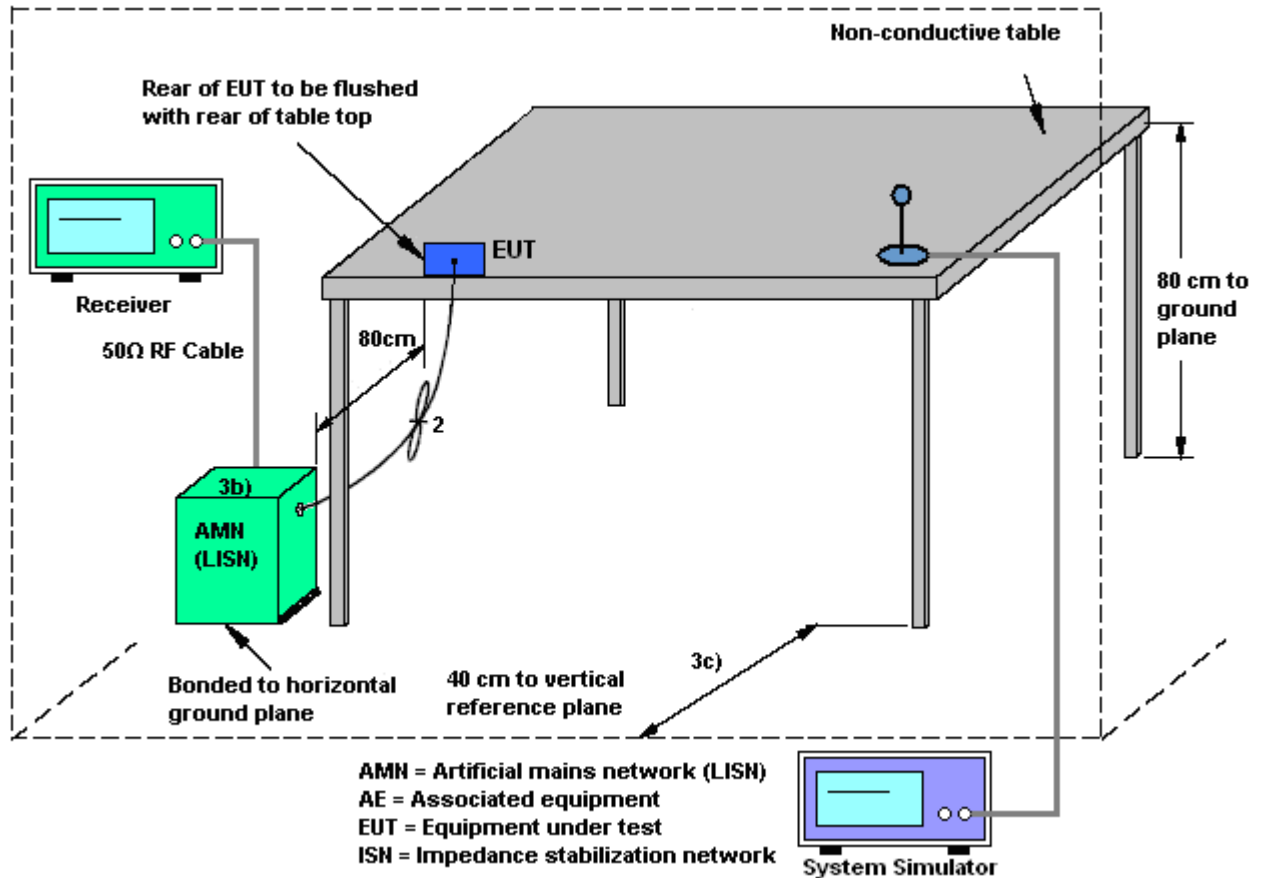
3.9.2 Measuring Instruments

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

3.9.3 Test Procedures

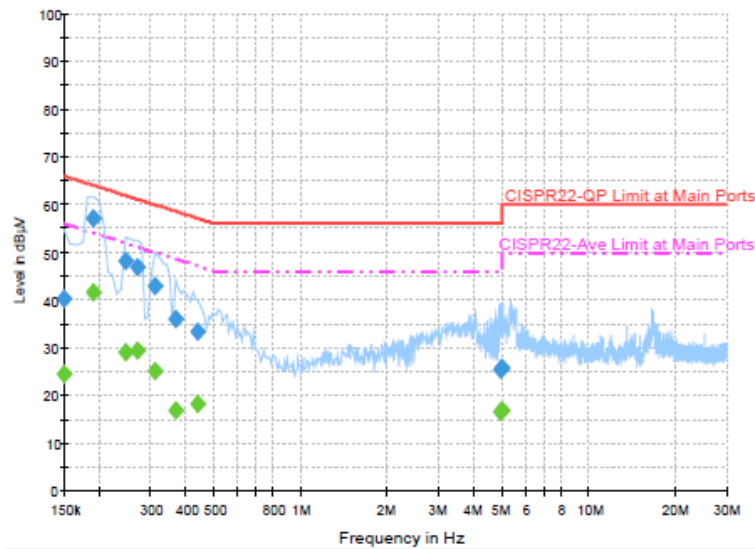
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
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.

3.9.4 Test Setup



3.9.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Cosmo Xu	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	GSM1900 Idle + WLAN Link + Bluetooth Link + Earphone + USB Cable (Data Link with Notebook) + GPS Rx + Battery		



Final Result : Quasi-Peak

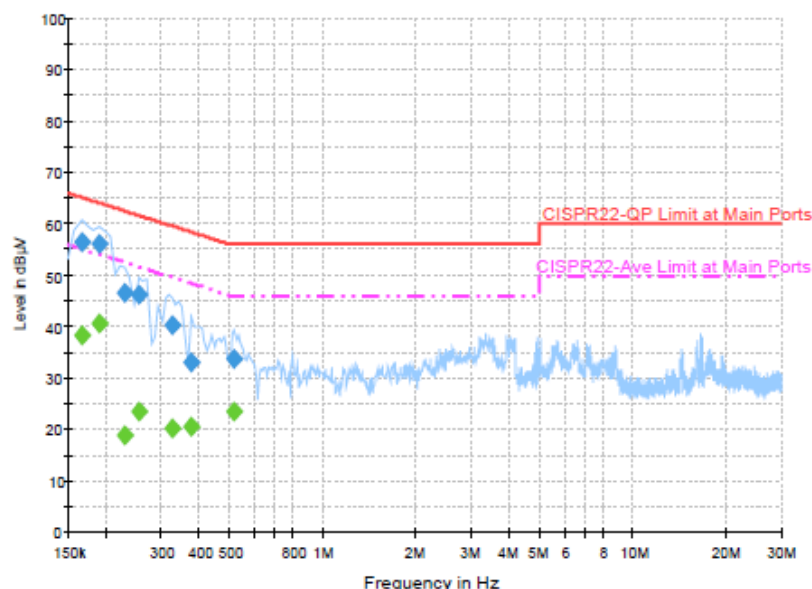
Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	40.2	Off	L1	19.3	25.8	66.0
0.190000	57.2	Off	L1	19.3	6.8	64.0
0.246000	48.1	Off	L1	19.4	13.8	61.9
0.270000	46.9	Off	L1	19.4	14.2	61.1
0.310000	42.9	Off	L1	19.4	17.1	60.0
0.366000	36.1	Off	L1	19.4	22.5	58.6
0.438000	33.4	Off	L1	19.4	23.7	57.1
4.886000	25.4	Off	L1	19.6	30.6	56.0
4.950000	25.9	Off	L1	19.6	30.1	56.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	24.3	Off	L1	19.3	31.7	56.0
0.190000	41.6	Off	L1	19.3	12.4	54.0
0.246000	29.0	Off	L1	19.4	22.9	51.9
0.270000	29.4	Off	L1	19.4	21.7	51.1
0.310000	25.2	Off	L1	19.4	24.8	50.0
0.366000	16.7	Off	L1	19.4	31.9	48.6
0.438000	18.3	Off	L1	19.4	28.8	47.1
4.886000	16.7	Off	L1	19.6	29.3	46.0
4.950000	16.7	Off	L1	19.6	29.3	46.0



Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Cosmo Xu	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	GSM1900 Idle + WLAN Link + Bluetooth Link + Earphone + USB Cable (Data Link with Notebook) + GPS Rx + Battery		



Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.166000	56.5	Off	N	19.3	8.7	65.2
0.190000	56.2	Off	N	19.3	7.8	64.0
0.230000	46.6	Off	N	19.4	15.8	62.4
0.254000	46.1	Off	N	19.4	15.5	61.6
0.326000	40.2	Off	N	19.4	19.4	59.6
0.374000	33.0	Off	N	19.4	25.4	58.4
0.518000	33.6	Off	N	19.4	22.4	56.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.166000	38.4	Off	N	19.3	16.8	55.2
0.190000	40.6	Off	N	19.3	13.4	54.0
0.230000	18.9	Off	N	19.4	33.5	52.4
0.254000	23.4	Off	N	19.4	28.2	51.6
0.326000	20.2	Off	N	19.4	29.4	49.6
0.374000	20.5	Off	N	19.4	27.9	48.4
0.518000	23.4	Off	N	19.4	22.6	46.0



3.10 Antenna Requirements

3.10.1 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.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 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	Rohde & Schwarz	FSP40	100055	9kHz~40GHz	Jun. 09, 2014	Jul. 18, 2014~ Aug. 01, 2014	Jun. 08, 2015	Conducted (TH02-HY)
Power Meter	Agilent	E4416A	GB41292344	300MHz~40GHz	Jan. 28, 2014	Jul. 18, 2014~ Aug. 01, 2014	Jan. 27, 2015	Conducted (TH02-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Jan. 28, 2014	Jul. 18, 2014~ Aug. 01, 2014	Jan. 27, 2015	Conducted (TH02-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9 kHz~7 GHz	Sep. 06, 2013	Jul. 20, 2014~ Jul. 26, 2014	Sep. 05, 2014	Radiation (03CH07-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	101749	10Hz ~ 30GHz	Feb. 10, 2014	Jul. 20, 2014~ Jul. 26, 2014	Feb. 09, 2015	Radiation (03CH07-HY)
Loop Antenna	TESEQ	HLA 6120	31244	9 kHz~30 MHz	Dec. 02, 2012	Jul. 20, 2014~ Jul. 26, 2014	Dec. 03, 2014	Radiation (03CH07-HY)
Bilog Antenna	Schaffner	CBL6111C	2726	30 MHz ~ 1 GHz	Oct. 10, 2013	Jul. 20, 2014~ Jul. 26, 2014	Oct. 09, 2014	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	75962	1 GHz~18 GHz	Aug. 22, 2013	Jul. 20, 2014~ Jul. 26, 2014	Aug. 21, 2014	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	15 GHz- 40 GHz	Oct. 03, 2013	Jul. 20, 2014~ Jul. 26, 2014	Oct. 02, 2014	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10 MHz ~ 1 GHz	Mar. 17, 2014	Jul. 20, 2014~ Jul. 26, 2014	Mar. 16, 2015	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1 GHz~26.5 GHz	Nov. 29, 2013	Jul. 20, 2014~ Jul. 26, 2014	Nov. 28, 2014	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	159075	1 GHz ~18 GHz	Apr. 21, 2014	Jul. 20, 2014~ Jul. 26, 2014	Apr. 20, 2015	Radiation (03CH07-HY)
Turn Table	ChainTek	ChainTek 3000	N/A	0 ~ 360 degree	N/A	Jul. 20, 2014~ Jul. 26, 2014	N/A	Radiation (03CH07-HY)
Antenna Mast	ChainTek	ChainTek 3000	N/A	N/A	N/A	Jul. 20, 2014~ Jul. 26, 2014	N/A	Radiation (03CH07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100356	9kHz ~ 2.75GHz	Nov. 15, 2013	Jul. 31, 2014	Nov. 14, 2014	Conduction (CO05-HY)
LISN (for auxiliary equipment)	Rohde & Schwarz	ENV216	100081	9kHz ~ 30MHz	Dec. 12, 2013	Jul. 31, 2014	Dec. 11, 2014	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz ~ 30MHz	Dec. 04, 2013	Jul. 31, 2014	Dec. 03, 2014	Conduction (CO05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Jul. 31, 2014	N/A	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% ($U = 2Uc(y)$)	4.50
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