



FCC RF Test Report

APPLICANT : Lenovo(Shanghai) Electronics Technology Co., Ltd.
EQUIPMENT : Portable Tablet Computer
BRAND NAME : Lenovo
MODEL NAME : Lenovo YT3-X90L
FCC ID : O57YT3X90L
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Jan. 22, 2016 and testing was completed on Mar. 04, 2016. We, SPORTON INTERNATIONAL (KUNSHAN) 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 (KUNSHAN) INC., the test report shall not be reproduced except in full.

James Huang

Prepared by: James Huang / Manager



Approved by: Jones Tsai / Manager

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No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P. R. China



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR612203C	Rev. 01	Initial issue of report	Mar. 22, 2016



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)	RSS-247 A5.4(4)	Power Output Measurement	$\leq 30\text{dBm}$	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	$\leq 20\text{dBc}$	Pass	-
			Conducted Spurious Emission		Pass	-
3.5	15.247(d)	RSS-247 5.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 2.31 dB at 2483.520 MHz
3.6	15.207	RSS-GEN 8.8	AC Conducted Emission	15.207(a)	Pass	Under limit 10.41 dB at 0.590 MHz
3.7	15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Lenovo(Shanghai) Electronics Technology Co., Ltd.

NO.68 BUILDING, 199 FENJU RD., China (Shanghai) Pilot Free Trade Zone, 200131, CHINA

1.2 Manufacturer

Lenovo PC HK Limited

23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Portable Tablet Computer
Brand Name	Lenovo
Model Name	Lenovo YT3-X90L
FCC ID	O57YT3X90L
EUT supports Radios application	GPRS/EGPRS/WCDMA/HSPA/ DC-HSDPA/LTE/ HSPA+(16QAM uplink is not supported)/ WLAN 2.4GHz 802.11b/g/n HT20/ WLAN 5GHz 802.11a/n HT20/HT40/ WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/ Bluetooth v3.0+EDR/Bluetooth v4.1 LE
IMEI Code	Conducted: 867232020006749 Radiation: 867232020170255 Conduction: 867232020169935
HW Version	Lenovo YT3-X90L
SW Version	YT3-X90L_151230
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 of Equipment Under Test

Standards-related Product Specification																
Tx/Rx Channel Frequency Range	802.11b/g/n : 2412 MHz ~ 2462 MHz															
Maximum (Peak) Output Power to antenna	<p><Ant 1> 802.11b : 18.97 dBm (0.0789 W) 802.11g : 22.37 dBm (0.1726 W) 802.11n HT20 : 18.45 dBm (0.0700 W)</p> <p><Ant 2> 802.11b : 19.14 dBm (0.0820 W) 802.11g : 22.09 dBm (0.1618 W) 802.11n HT20 : 18.24 dBm (0.0667 W)</p> <p><Ant 1 + 2> 802.11n HT20 : 22.47 dBm (0.1766 W)</p>															
99% Occupied Bandwidth	802.11b : 11.79MHz 802.11g : 18.63MHz 802.11n HT20 : 19.58MHz															
Antenna Type / Gain	<p><Ant 1> 802.11b/g/n : PIFA Antenna with gain 1.10 dBi</p> <p>< Ant 2> 802.11b/g/n : PIFA Antenna with gain 1.20 dBi</p>															
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)															
Antenna Function for Transmitter	<table border="1"> <thead> <tr> <th></th> <th>Ant. 1</th> <th>Ant. 2</th> </tr> </thead> <tbody> <tr> <td>802.11 b</td> <td>V</td> <td>V</td> </tr> <tr> <td>802.11 g</td> <td>V</td> <td>V</td> </tr> <tr> <td>802.11 n SISO</td> <td>V</td> <td>V</td> </tr> <tr> <td>802.11 n MIMO</td> <td>V</td> <td>V</td> </tr> </tbody> </table>		Ant. 1	Ant. 2	802.11 b	V	V	802.11 g	V	V	802.11 n SISO	V	V	802.11 n MIMO	V	V
	Ant. 1	Ant. 2														
802.11 b	V	V														
802.11 g	V	V														
802.11 n SISO	V	V														
802.11 n MIMO	V	V														



1.5 Modification of EUT

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

1.6 Testing Location

Test Site	SPORTON INTERNATIONAL (KUNSHAN) INC.			
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P. R. China			
	TEL: +86-0512-5790-0158			
	FAX: +86-0512-5790-0958			
Test Site No.	Sporton Site No.			FCC/IC Registration No.
	TH01-KS	03CH03-KS	CO01-KS	306251/4086E

Note: The test site complies with ANSI C63.4 2014 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 v03r04
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013
- ♦ IC RSS-247 Issue 1
- ♦ IC RSS-Gen Issue 4

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

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: conducted emission (150 kHz to 30 MHz) and radiated emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases were recorded in this report.

The final configuration from all the combinations and the worst-case data rates were investigated by measuring the maximum power across all the data rates and modulation modes under section 2.2.

Based on the worst configuration found above, the RF power setting is set individually to meet FCC compliance limit for the final conducted and radiated tests shown in section 2.3.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		



2.2 Pre-Scanned RF Power

Preliminary tests were performed in different data rate and data rate associated with the highest power were chosen for full test shown in the following tables.

2.4GHz 802.11b RF Output Power (dBm)							
Power vs. Channel				Power vs. Data Rate			
Channel	Frequency (MHz)	Ant	Data Rate	Channel	2Mbps	5.5Mbps	11Mbps
			1Mbps				
CH 01	2412	1	18.74	CH 06	18.82	18.88	18.95
CH 06	2437	1	18.97				
CH 11	2462	1	18.67				
CH 01	2412	2	18.96	CH 06	18.88	18.92	19.12
CH 06	2437	2	19.14				
CH 11	2462	2	18.34				

2.4GHz 802.11g RF Output Power (dBm)											
Power vs. Channel				Power vs. MCS Index							
Channel	Frequency (MHz)	Ant	Data Rate	Channel	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
			6Mbps								
CH 01	2412	1	22.22	CH 06	22.31	21.90	21.85	22.15	22.29	22.28	21.86
CH 06	2437	1	22.37								
CH 11	2462	1	22.12								
CH 01	2412	2	21.76	CH 06	21.94	21.83	21.75	21.88	21.95	21.86	21.81
CH 06	2437	2	22.09								
CH 11	2462	2	21.88								

2.4GHz 802.11n HT20 RF Output Power (dBm)											
Power vs. Channel				Power vs. MCS Index							
Channel	Frequency (MHz)	Ant	MCS Index	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
			MCS0								
CH 01	2412	1	18.09	CH 06	18.22	18.40	18.15	18.01	17.94	18.04	17.90
CH 06	2437	1	18.45								
CH 11	2462	1	18.23								
CH 01	2412	2	17.86	CH 06	17.97	17.87	17.77	17.97	17.74	17.94	17.84
CH 06	2437	2	18.24								
CH 11	2462	2	17.96								
Channel	Frequency (MHz)	Ant	MCS Index	Channel	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
CH 01	2412	1+2(1)	19.29	CH 06	19.25	19.39	18.91	19.05	18.95	19.01	19.09
CH 06	2437	1+2(1)	19.40								
CH 11	2462	1+2(1)	19.14								
CH 01	2412	1+2(2)	19.32	CH 06	19.32	19.38	19.40	19.45	19.36	19.32	19.42
CH 06	2437	1+2(2)	19.51								
CH 11	2462	1+2(2)	19.19								
CH 01	2412	1+2	22.32	CH 06	22.30	22.40	22.17	22.26	22.17	22.18	22.27
CH 06	2437	1+2	22.47								
CH 11	2462	1+2	22.18								

Note: Ant 1+2 is a calculated result from sum of the power Ant 1+2(1) and Ant 1+2(2)



2.3 Test Mode

Final test mode of conducted test items and radiated spurious emissions are considering the modulation and worse data rates from the power table described in section 2.2.

Single Antenna

<2.4GHz>

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0

MIMO Antenna

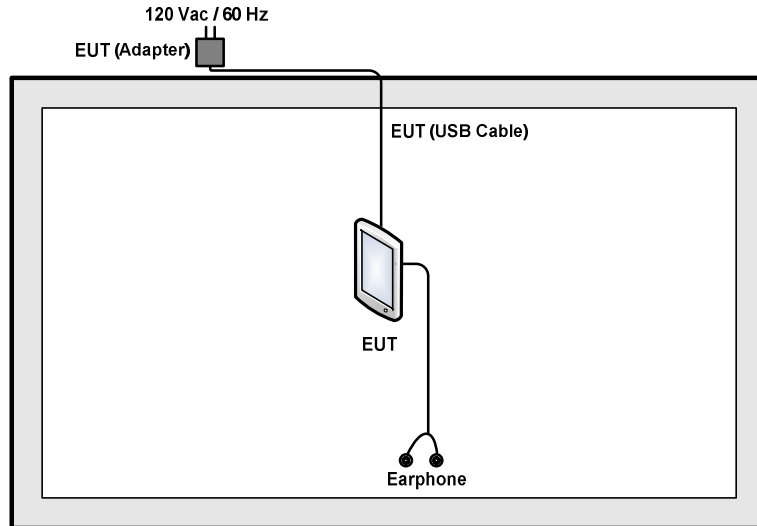
<2.4GHz>

Modulation	Data Rate
802.11n HT20	MCS8

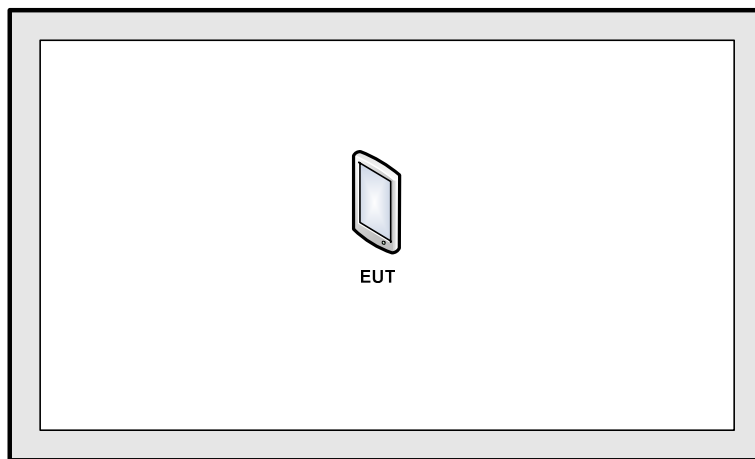
Test Cases	
AC Conducted Emission	<p>Mode 1 :GSM850 Idle + Bluetooth Link + WLAN Link(2.4G) + Earphone + Battery + USB Cable (Charging from Adapter 12V)</p> <p>Mode 2 GSM850 Idle + Bluetooth Link + WLAN Link(2.4G) + Earphone + Battery + USB Cable (Charging from Adapter 5.2V)</p>
<p>Remark:</p> <ol style="list-style-type: none"> The worst case of conducted emission is mode 1; only the test data of it was reported. For Radiated Test Cases, The tests were performance with Adapter, Earphone, and USB Cable. 	

2.4 Connection Diagram of Test System

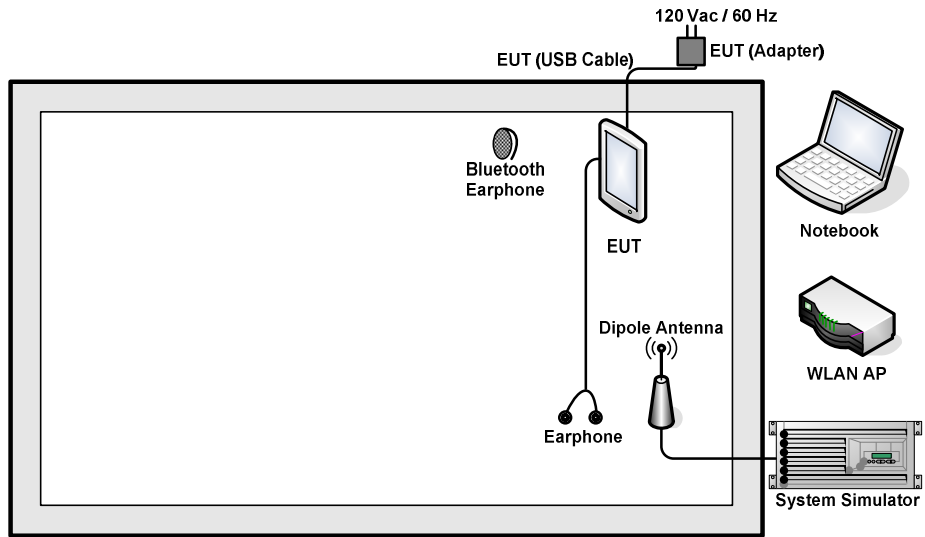
<WLAN 802.11b/g(Ant 2)/n HT20(Ant 1 + 2) Tx Mode>



<WLAN 802.11g(Ant 1) Tx Mode>



<AC Conducted Emission Mode>





2.5 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 Earphone	Lenovo	LBH505	N/A	N/A	N/A
3.	WLAN AP	LINKSYS	WRT600N	Q87-WRT600NV11	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
4.	Notebook	Lenovo	G480	N/A	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
5.	Earphone	Lenovo	SH102	N/A	Unshielded, 1.2 m	N/A
6.	Earphone	Lenovo	SH100	N/A	Unshielded, 1.2 m	N/A

2.6 EUT Operation Test Setup

For WLAN function, the engineering test program was provided and enabled to make EUT continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the notebook under large package sizes transmission.



2.7 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss 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.

Offset = RF cable loss.

Following shows an offset computation example with cable loss 5.5 dB.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)}. \\ &= 5.5(\text{dB}) \end{aligned}$$

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.

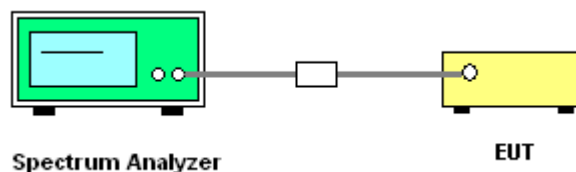
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v03r04.
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) = 1MHz and set the Video bandwidth (VBW) = 3MHz.
6. Measure and record the results in the test report.

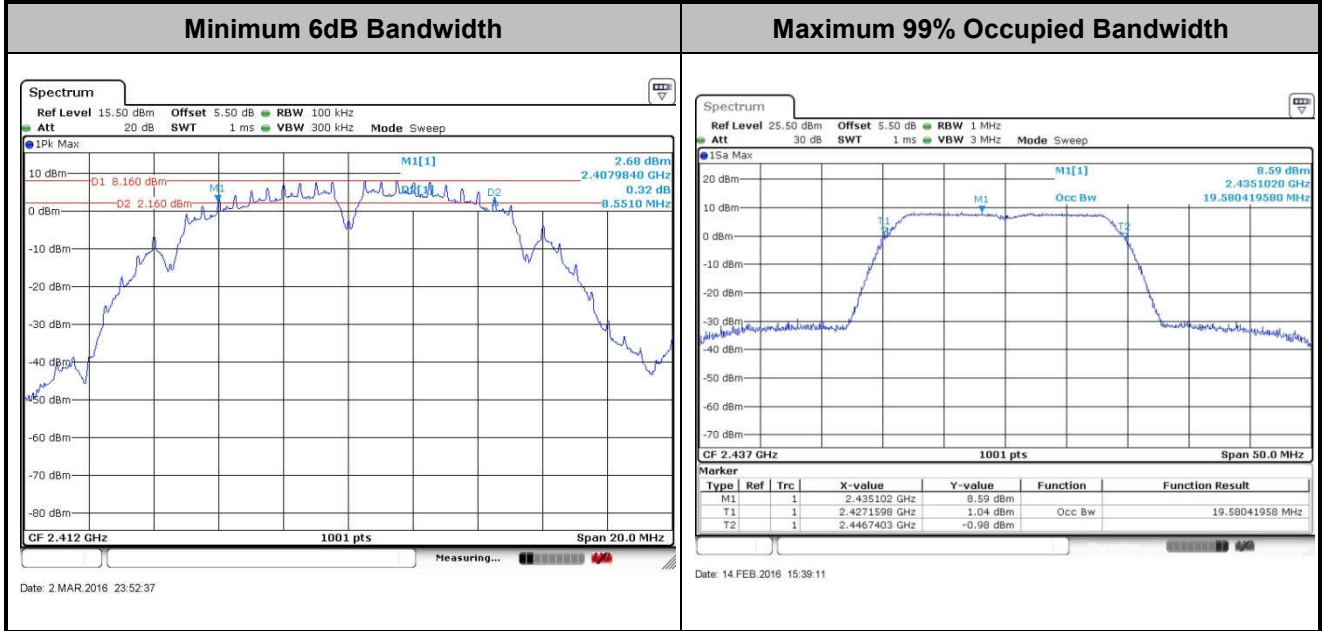
3.1.4 Test Setup





3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A of this test report.



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 with 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.

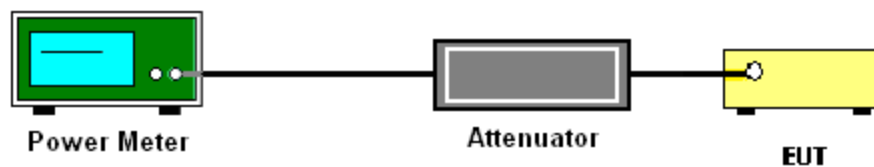
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v03r04 section 9.1.2 PKPM1 Peak power meter method.
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.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.2.4 Test Setup





3.2.5 Test Result of Peak Output Power

Please refer to Appendix A of this test report.

3.2.6 Test Result of Average output Power (Reporting Only)

Please refer to Appendix A of this test report.



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

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 v03r04.
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. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

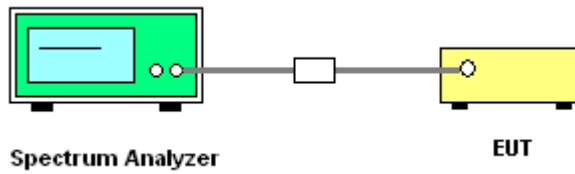
If measurements performed using method (2) plus $10 \log(N)$ exceeds the emission limit, the test should choose method (1) before declaring that the device fails the emission limit.

Method (1): Measure and sum the spectra across the outputs.

The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

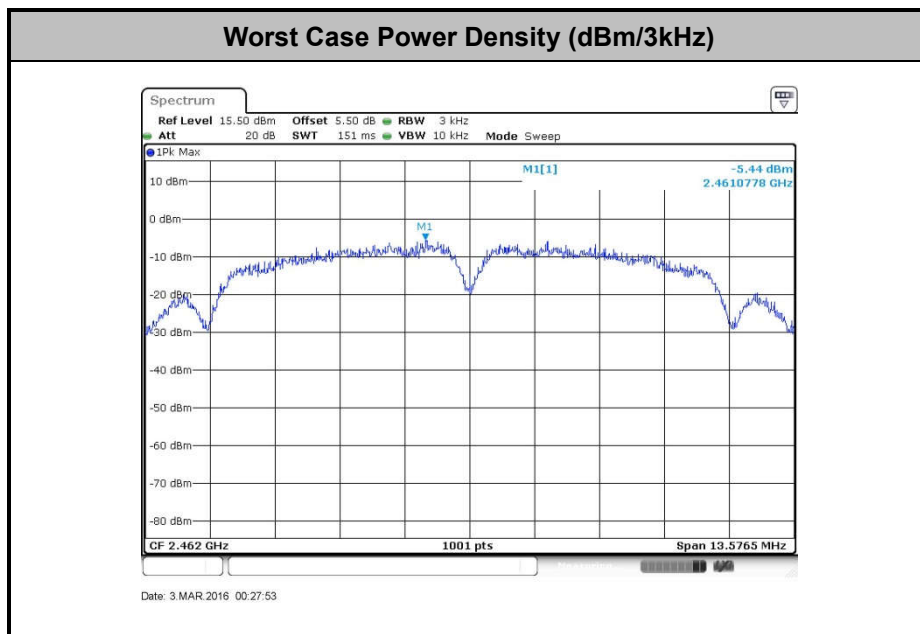
Method (2): Measure and add $10 \log(N)$ dB, where N is the number of outputs. (N=2)

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A of this test report.



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement and radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

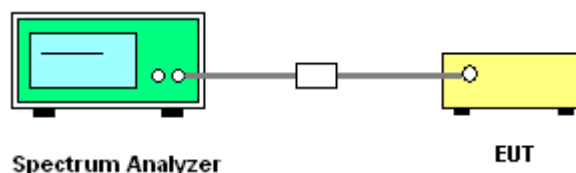
3.4.2 Measuring Instruments

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

3.4.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r04.
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

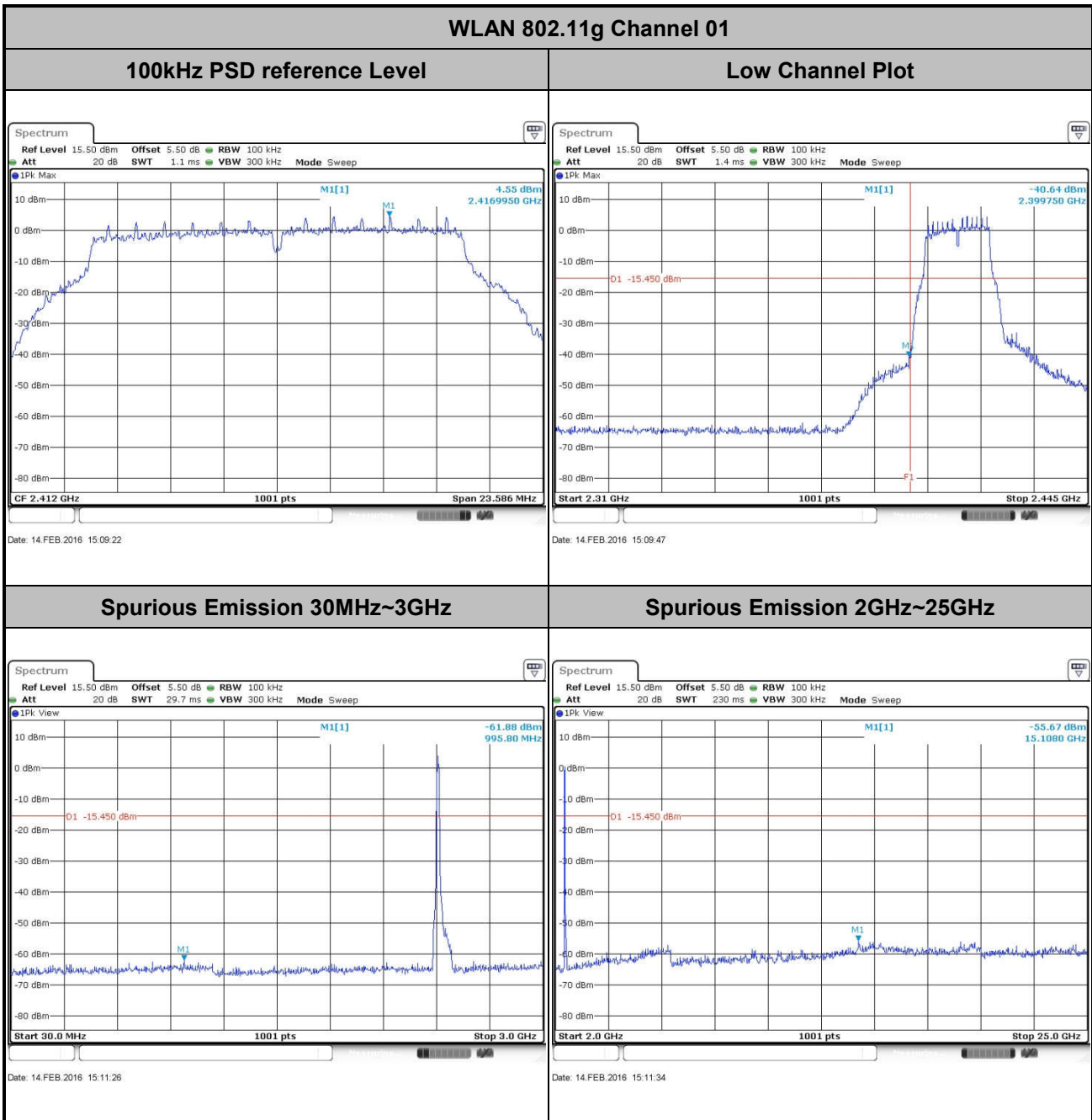




3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Number of TX = 1, Ant. 1 (Measured)

Number of TX :	1	Ant. :	1
Test Mode :	802.11g	Temperature :	21~22°C
Test Band :	2.4GHz Low	Relative Humidity :	41~42%
Test Channel :	01	Test Engineer :	Bard Li

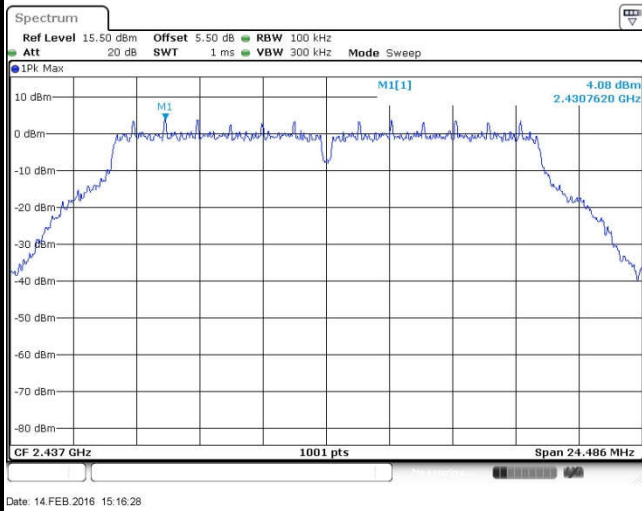




Number of TX :	1	Ant. :	1
Test Mode :	802.11g	Temperature :	21~22°C
Test Band :	2.4GHz Mid	Relative Humidity :	41~42%
Test Channel :	06	Test Engineer :	Bard Li

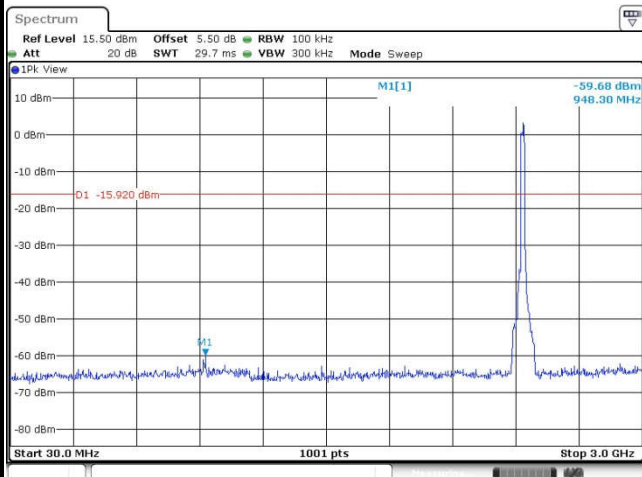
WLAN 802.11g Channel 06

100kHz PSD reference Level



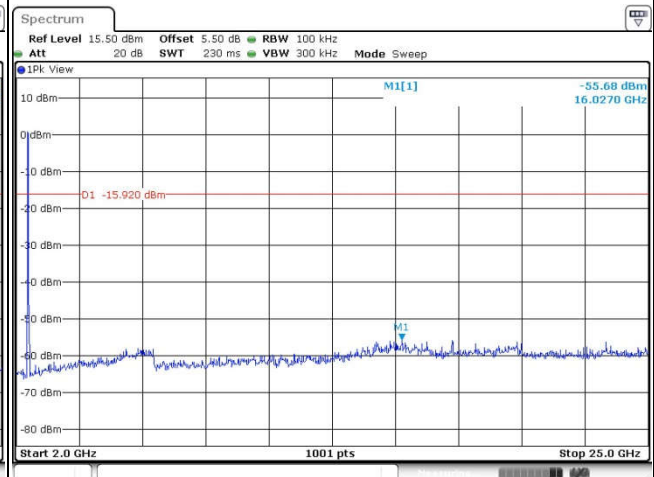
Date: 14.FEB.2016 15:16:28

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 15:16:49

Spurious Emission 2GHz~25GHz



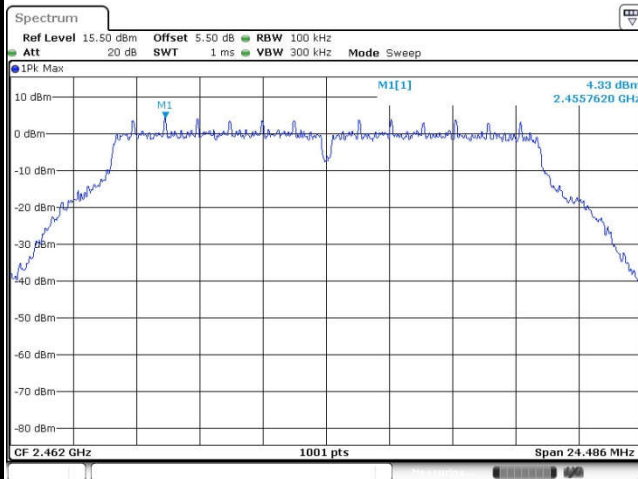
Date: 14.FEB.2016 15:16:57



Number of TX :	1	Ant. :	1
Test Mode :	802.11g	Temperature :	21~22°C
Test Band :	2.4GHz High	Relative Humidity :	41~42%
Test Channel :	11	Test Engineer :	Bard Li

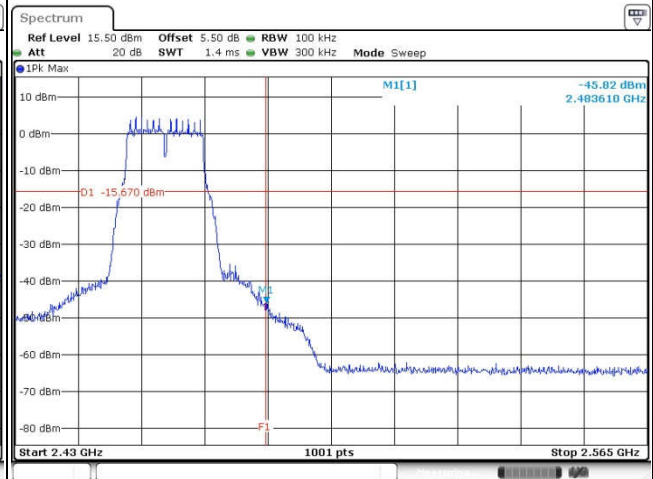
WLAN 802.11g Channel 11

100kHz PSD reference Level



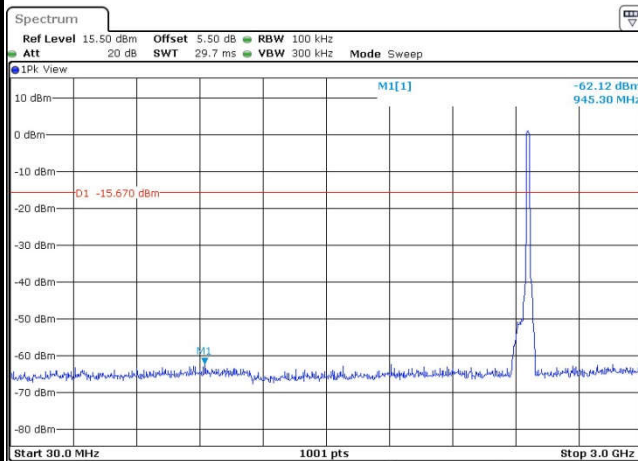
Date: 14.FEB.2016 15:22:24

High Channel Plot



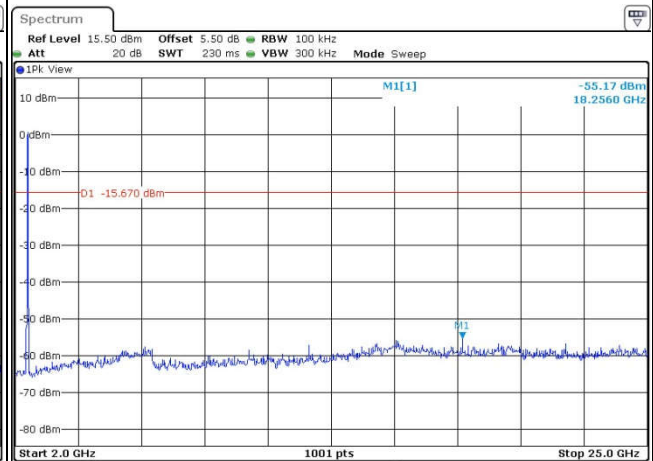
Date: 14.FEB.2016 15:23:07

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 15:24:42

Spurious Emission 2GHz~25GHz



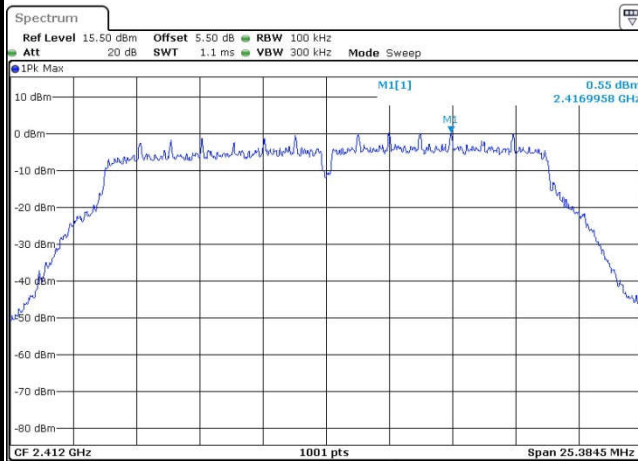
Date: 14.FEB.2016 15:24:50



Number of TX :	1	Ant. :	1
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz Low	Relative Humidity :	41~42%
Test Channel :	01	Test Engineer :	Bard Li

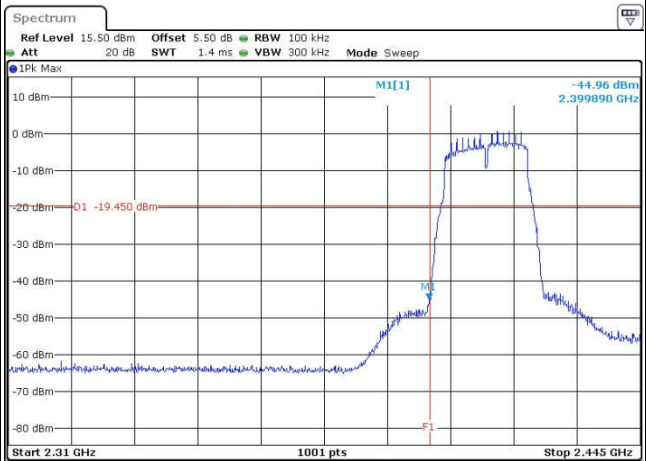
WLAN 802.11n HT20 Channel 01

100kHz PSD reference Level



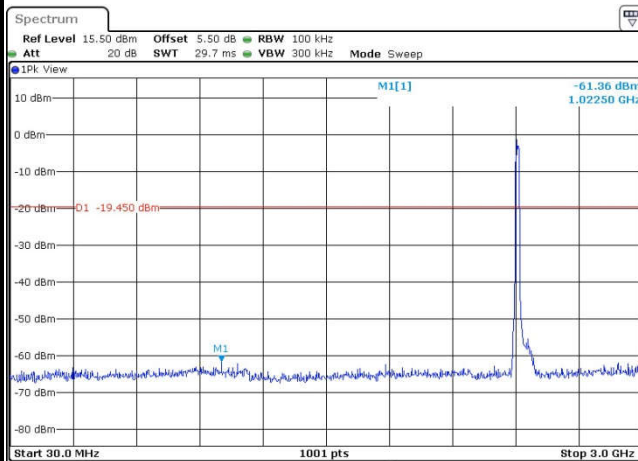
Date: 14.FEB.2016 15:31:28

Low Channel Plot



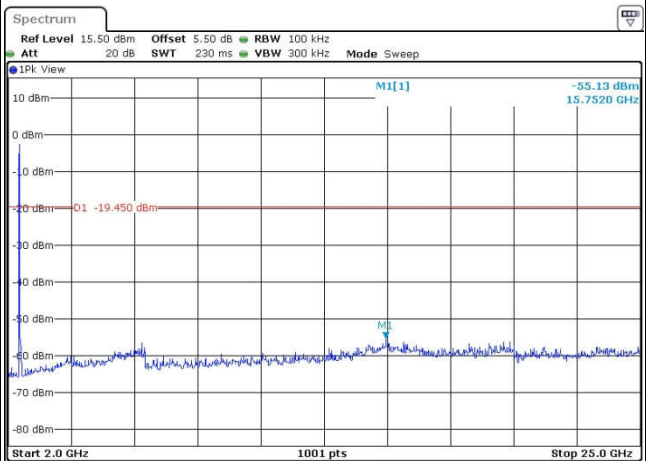
Date: 14.FEB.2016 15:32:26

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 15:32:48

Spurious Emission 2GHz~25GHz



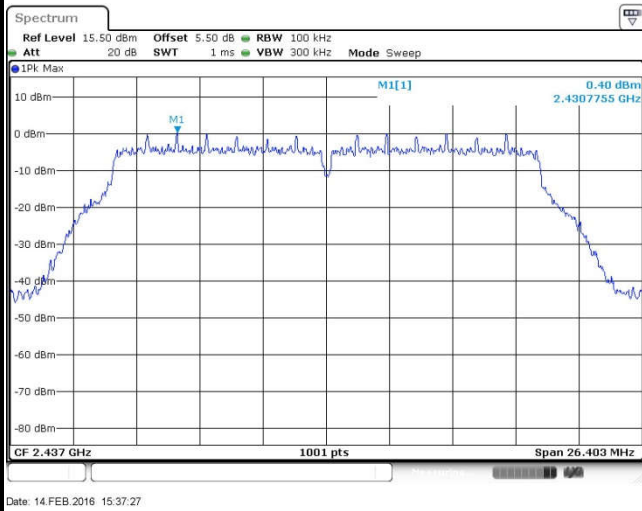
Date: 14.FEB.2016 15:32:56



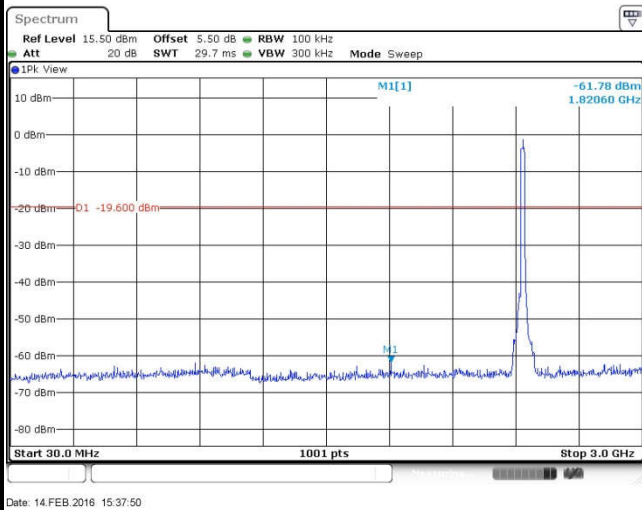
Number of TX :	1	Ant. :	1
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz Mid	Relative Humidity :	41~42%
Test Channel :	06	Test Engineer :	Bard Li

WLAN 802.11n HT20 Channel 06

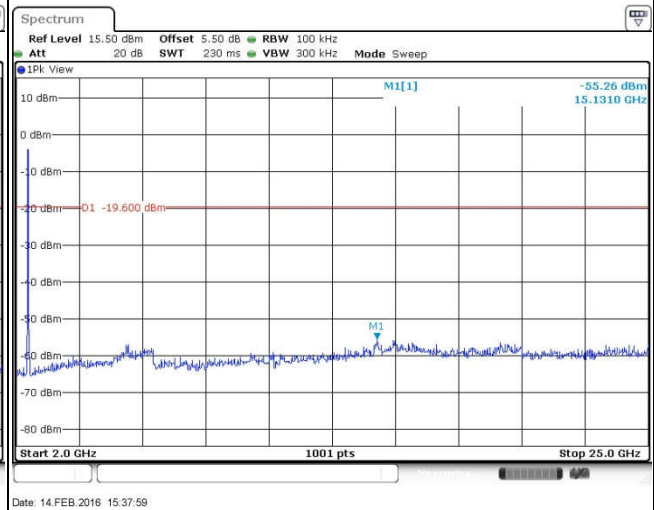
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

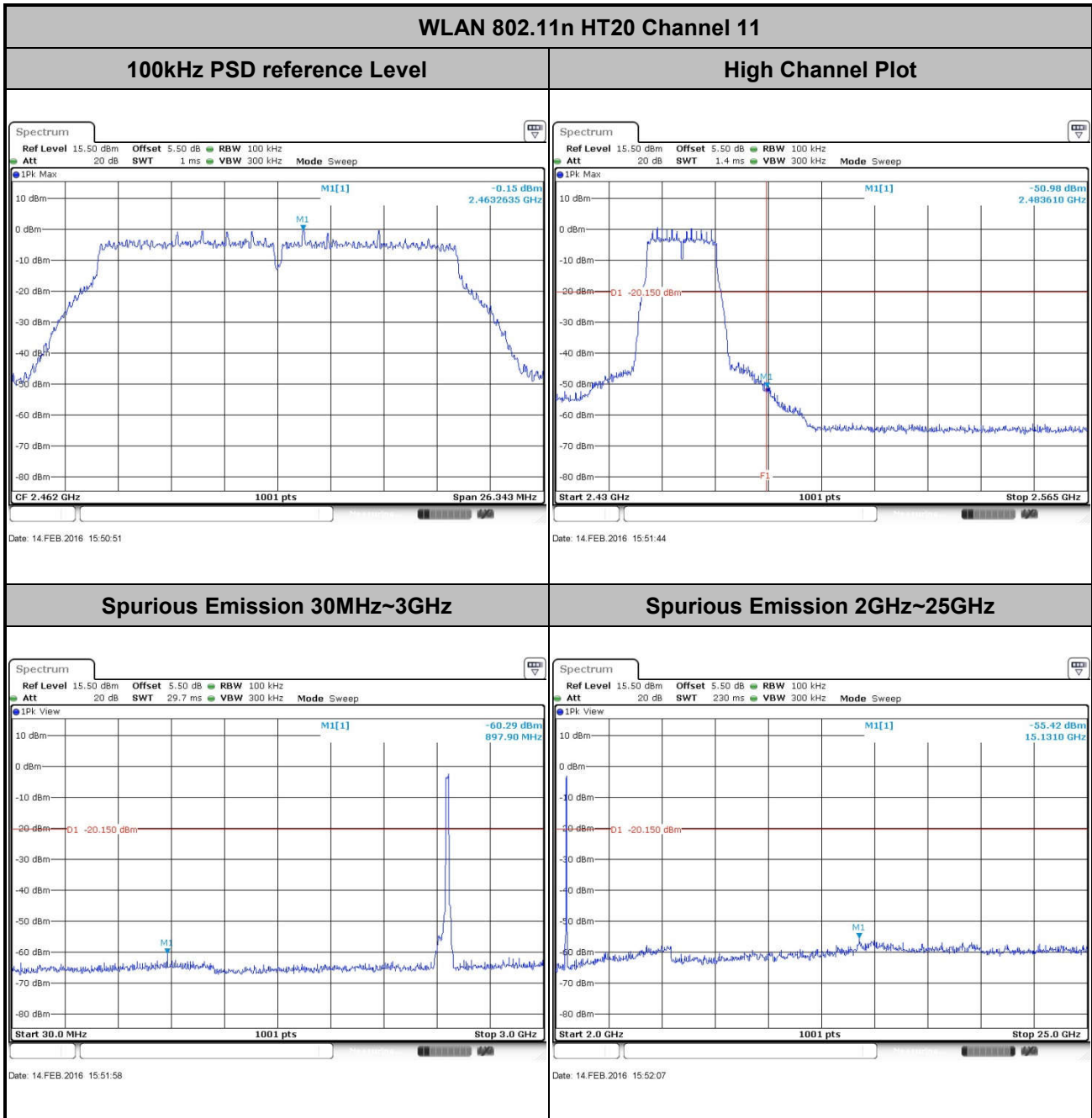


Spurious Emission 2GHz~25GHz





Number of TX :	1	Ant. :	1
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz High	Relative Humidity :	41~42%
Test Channel :	11	Test Engineer :	Bard Li



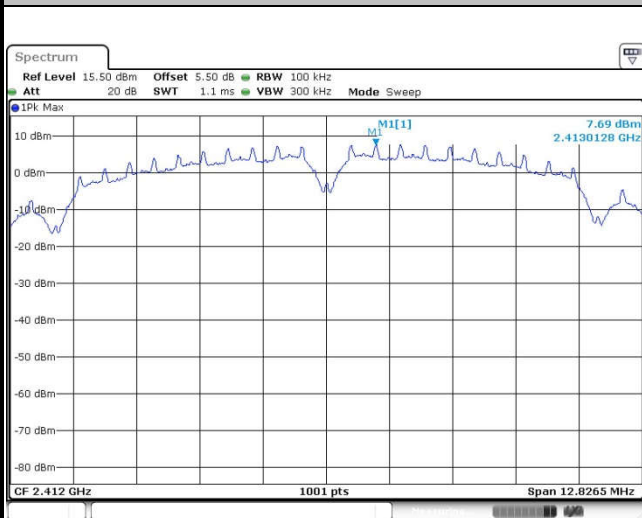


Number of TX = 1, Ant. 2 (Measured)

Number of TX	1	Ant. :	2
Test Mode :	802.11b	Temperature :	21~22°C
Test Band :	2.4GHz Low	Relative Humidity :	41~42%
Test Channel :	01	Test Engineer :	Bard Li

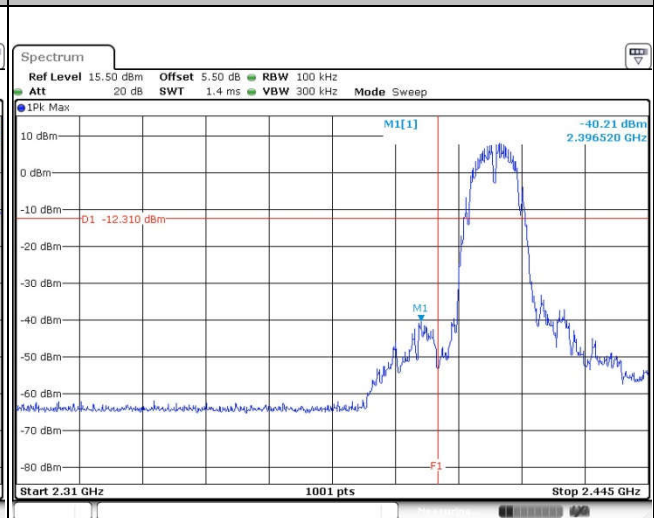
WLAN 802.11b Channel 01

100kHz PSD reference Level



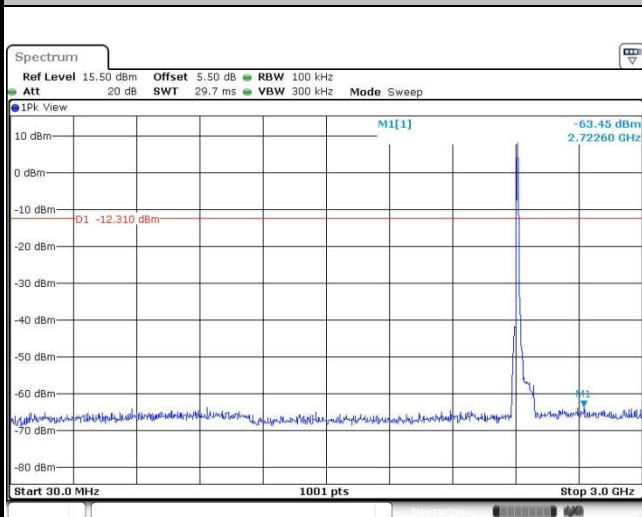
Date: 2.MAR.2016 23:54:44

Low Channel Plot



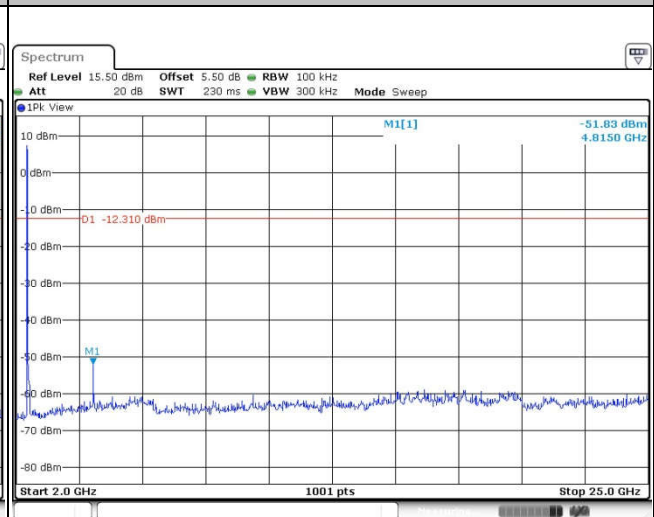
Date: 2.MAR.2016 23:55:42

Spurious Emission 30MHz~3GHz



Date: 3.MAR.2016 02:44:40

Spurious Emission 2GHz~25GHz



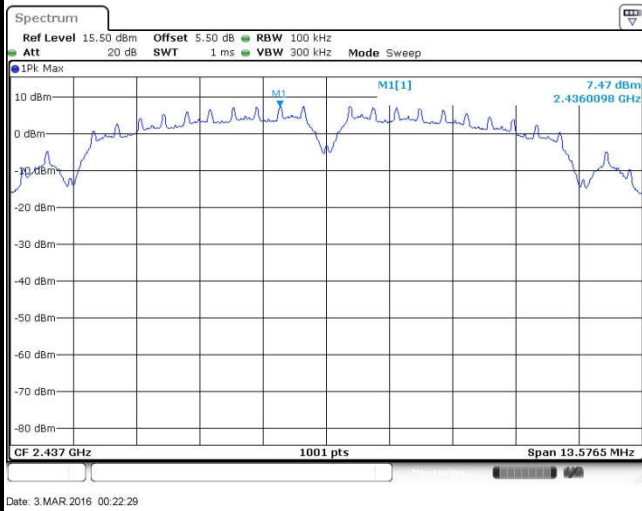
Date: 3.MAR.2016 02:44:49



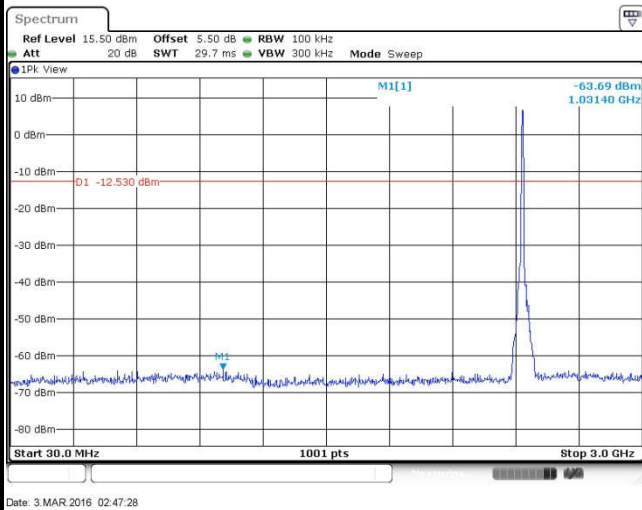
Number of TX :	1	Ant. :	2
Test Mode :	802.11b	Temperature :	21~22°C
Test Band :	2.4GHz Mid	Relative Humidity :	41~42%
Test Channel :	06	Test Engineer :	Bard Li

WLAN 802.11b Channel 06

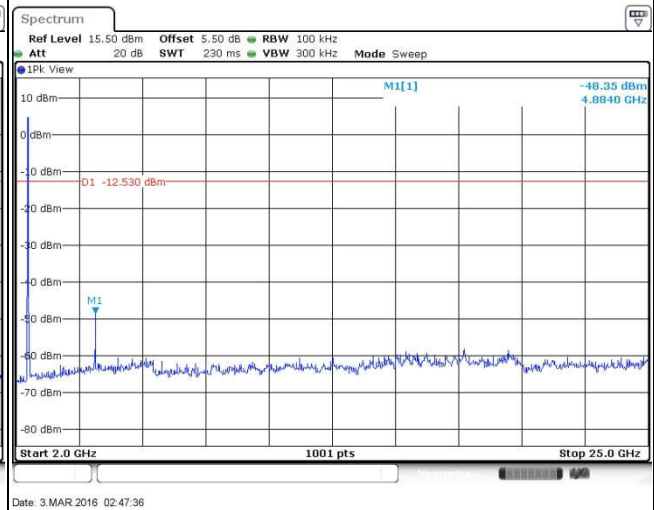
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz



Spurious Emission 2GHz~25GHz

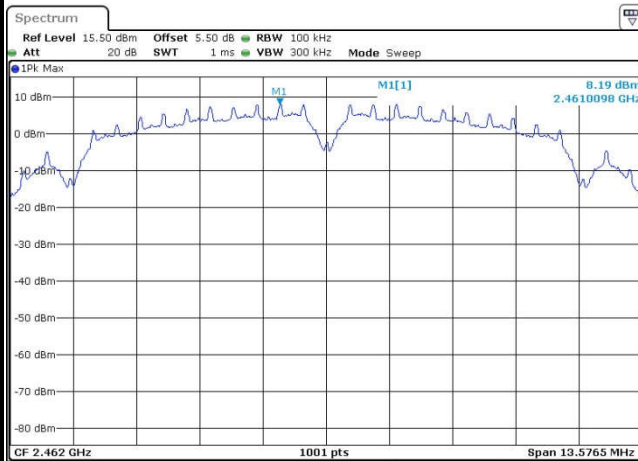




Number of TX :	1	Ant. :	2
Test Mode :	802.11b	Temperature :	21~22°C
Test Band :	2.4GHz High	Relative Humidity :	41~42%
Test Channel :	11	Test Engineer :	Bard Li

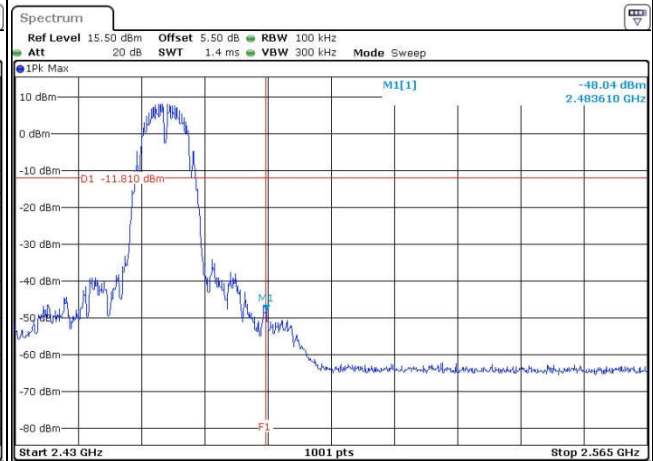
WLAN 802.11b Channel 11

100kHz PSD reference Level



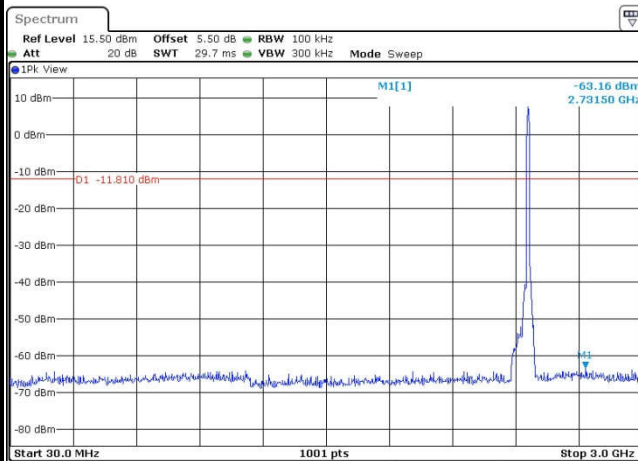
Date: 3.MAR.2016 00:28:08

High Channel Plot



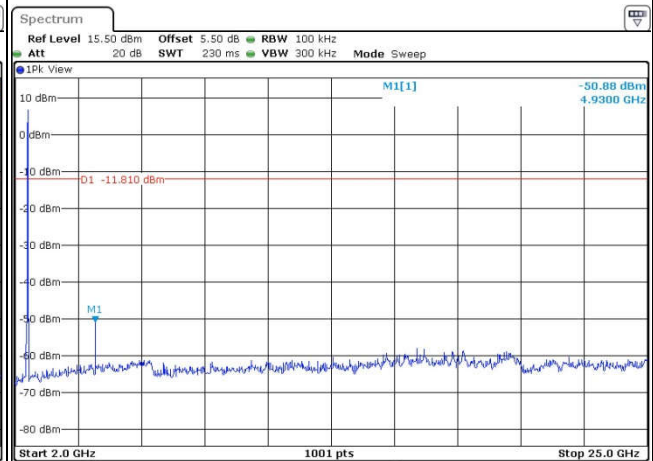
Date: 3.MAR.2016 00:29:37

Spurious Emission 30MHz~3GHz



Date: 3.MAR.2016 02:48:48

Spurious Emission 2GHz~25GHz



Date: 3.MAR.2016 02:48:56

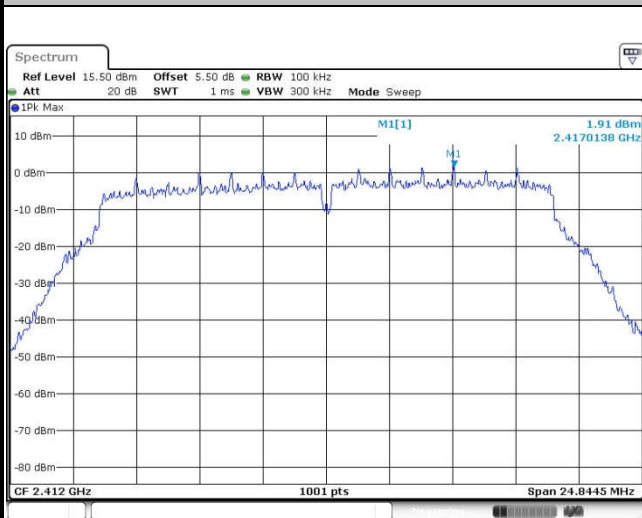


Number of TX = 2, Ant 1+2(1) (Measured)

Number of TX :	2	Ant. :	1+2(1)
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz Low	Relative Humidity :	41~42%
Test Channel :	01	Test Engineer :	Bard Li

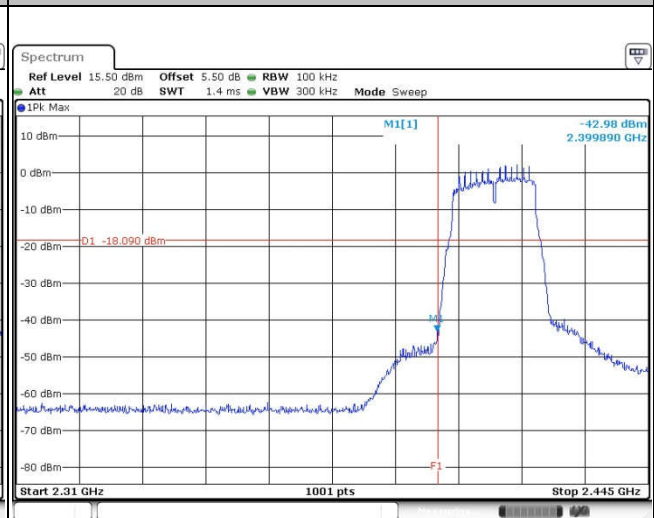
WLAN 802.11n HT20 Channel 01

100kHz PSD reference Level



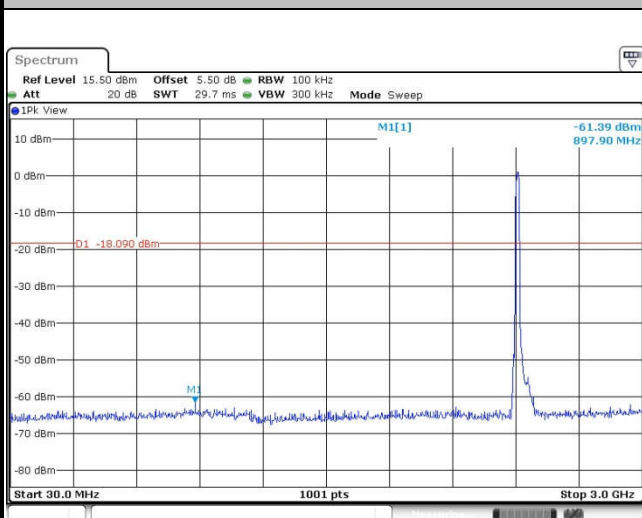
Date: 14.FEB.2016 15:58:29

Low Channel Plot



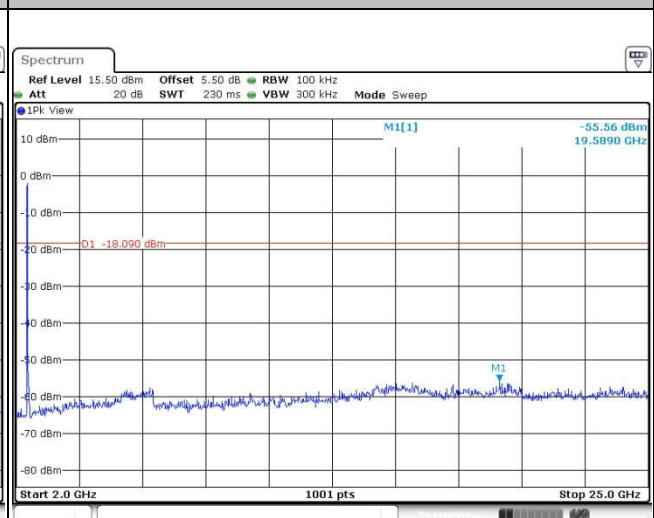
Date: 14.FEB.2016 15:59:23

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 16:02:07

Spurious Emission 2GHz~25GHz



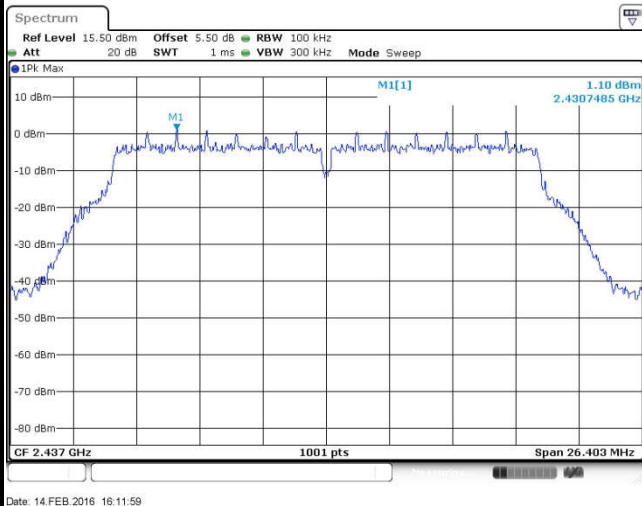
Date: 14.FEB.2016 16:02:16



Number of TX :	2	Ant. :	1+2(1)
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz Mid	Relative Humidity :	41~42%
Test Channel :	06	Test Engineer :	Bard Li

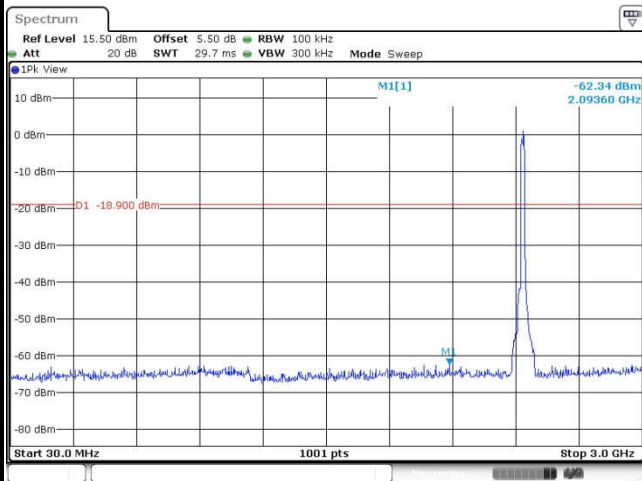
WLAN 802.11n HT20 Channel 06

100kHz PSD reference Level



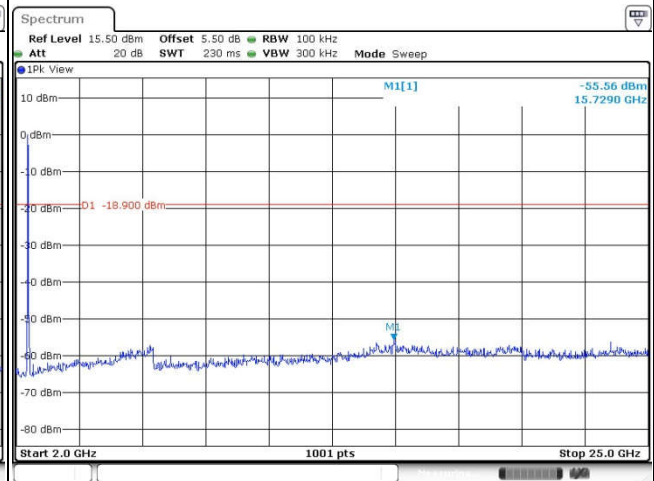
Date: 14.FEB.2016 16:11:59

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 16:13:08

Spurious Emission 2GHz~25GHz



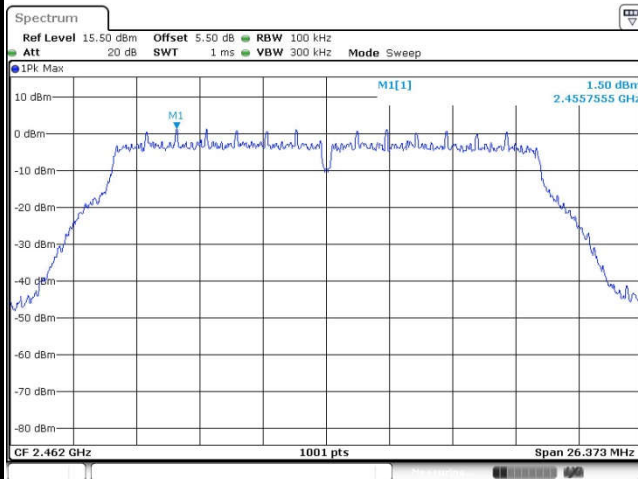
Date: 14.FEB.2016 16:13:17



Number of TX :	2	Ant. :	1+2(1)
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz High	Relative Humidity :	41~42%
Test Channel :	11	Test Engineer :	Bard Li

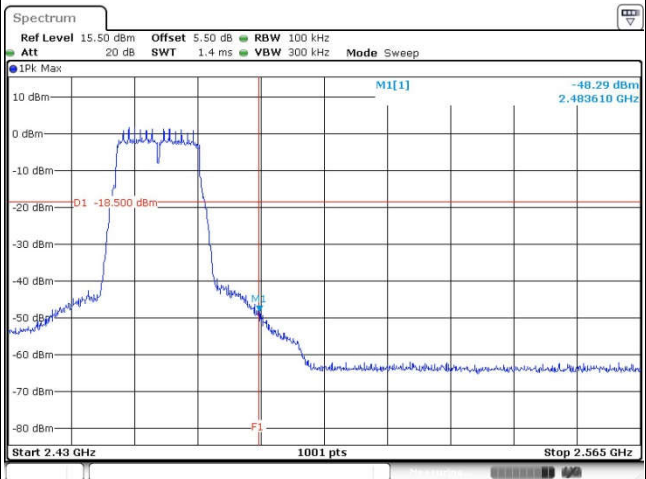
WLAN 802.11n HT20 Channel 11

100kHz PSD reference Level



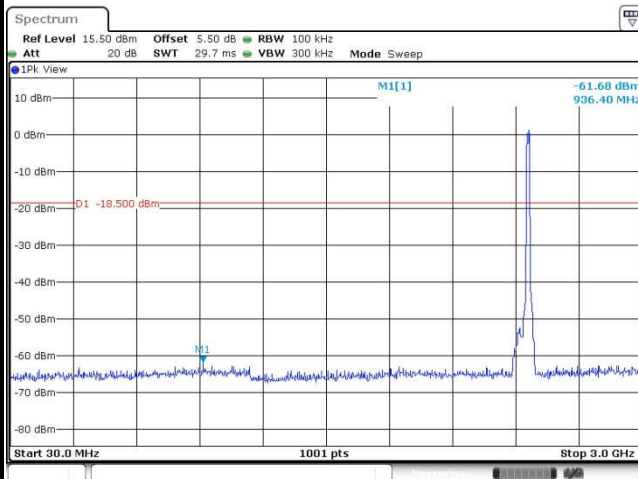
Date: 14.FEB.2016 16:21:05

High Channel Plot



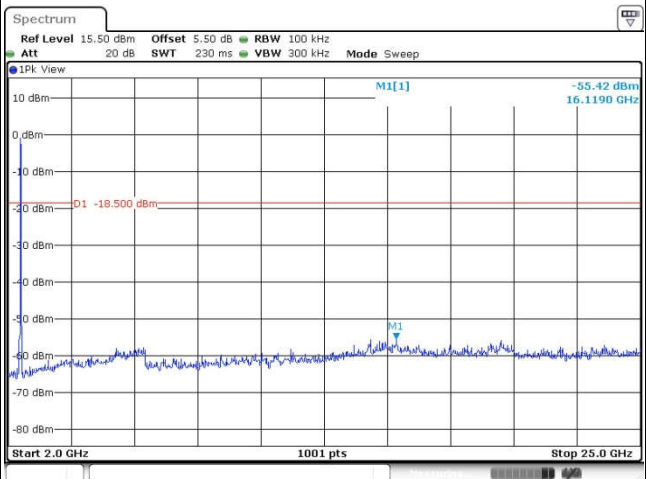
Date: 14.FEB.2016 16:22:59

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 16:24:45

Spurious Emission 2GHz~25GHz

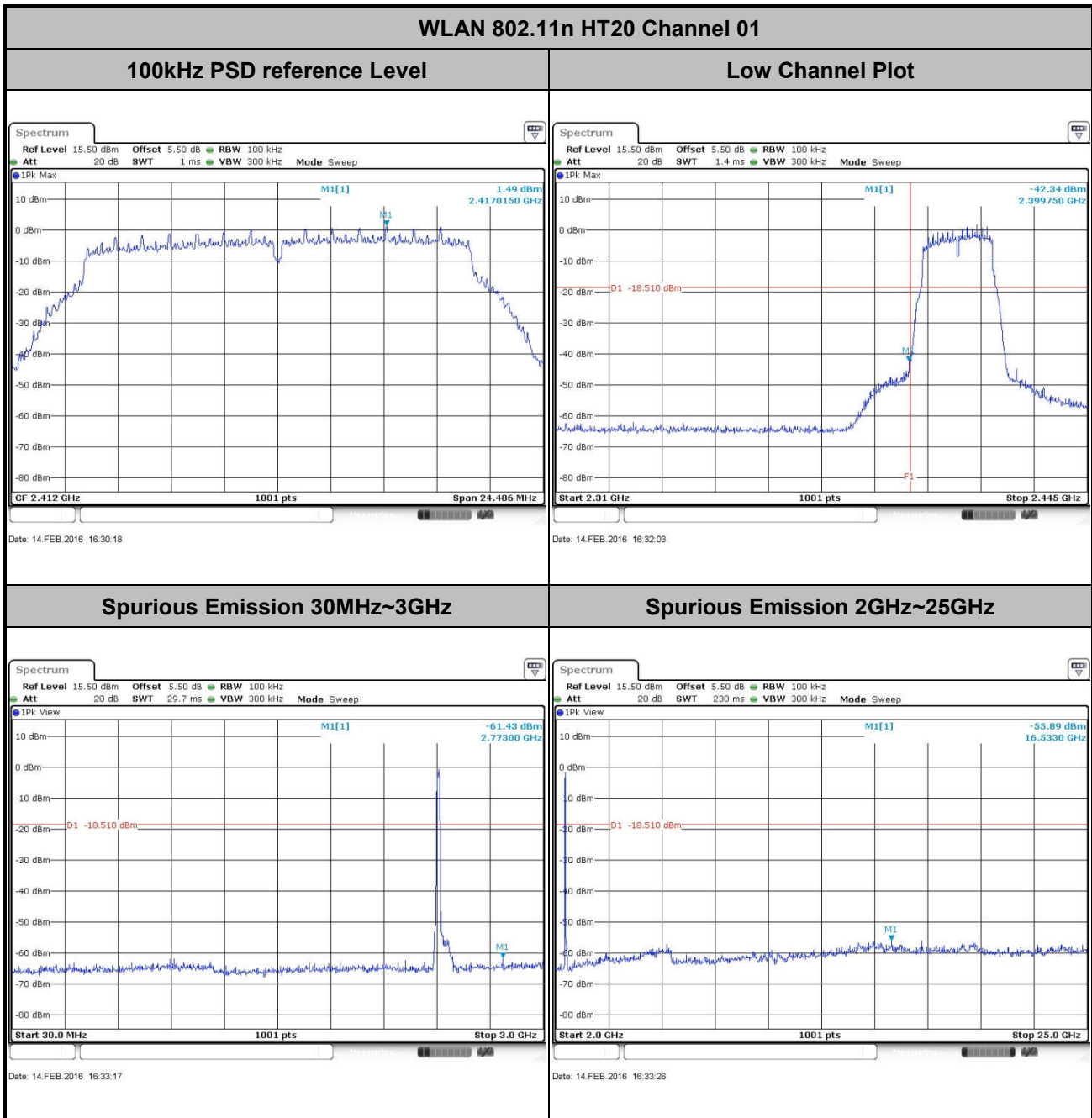


Date: 14.FEB.2016 16:24:53



Number of TX = 2, Ant 1+2(2) (Measured)

Number of TX :	2	Ant. :	1+2(2)
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz Low	Relative Humidity :	41~42%
Test Channel :	01	Test Engineer :	Bard Li

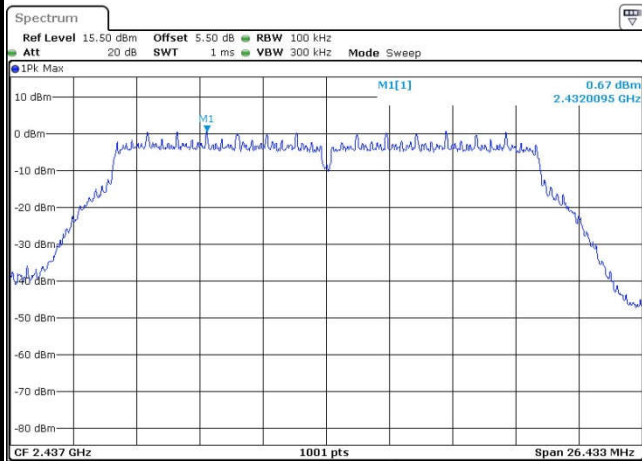




Number of TX :	2	Ant. :	1+2(2)
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz Mid	Relative Humidity :	41~42%
Test Channel :	06	Test Engineer :	Bard Li

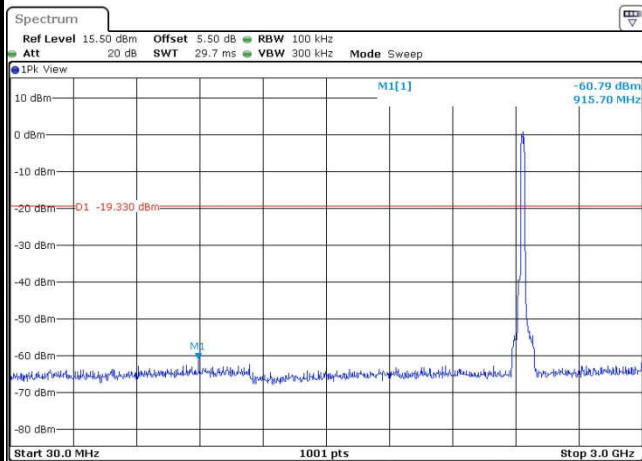
WLAN 802.11n HT20 Channel 06

100kHz PSD reference Level



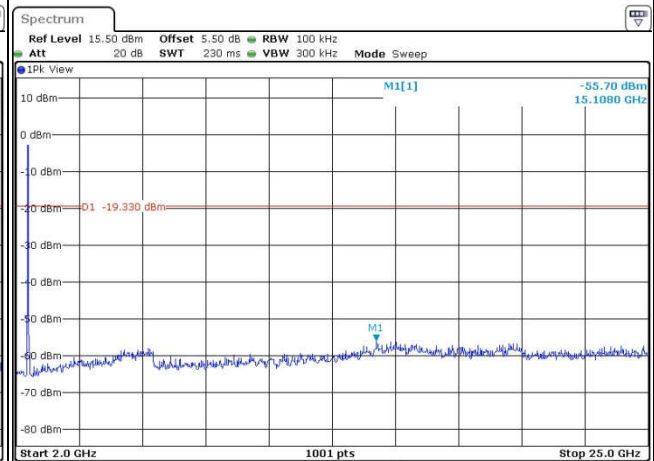
Date: 14.FEB.2016 17:05:31

Spurious Emission 30MHz~3GHz



Date: 14.FEB.2016 17:06:03

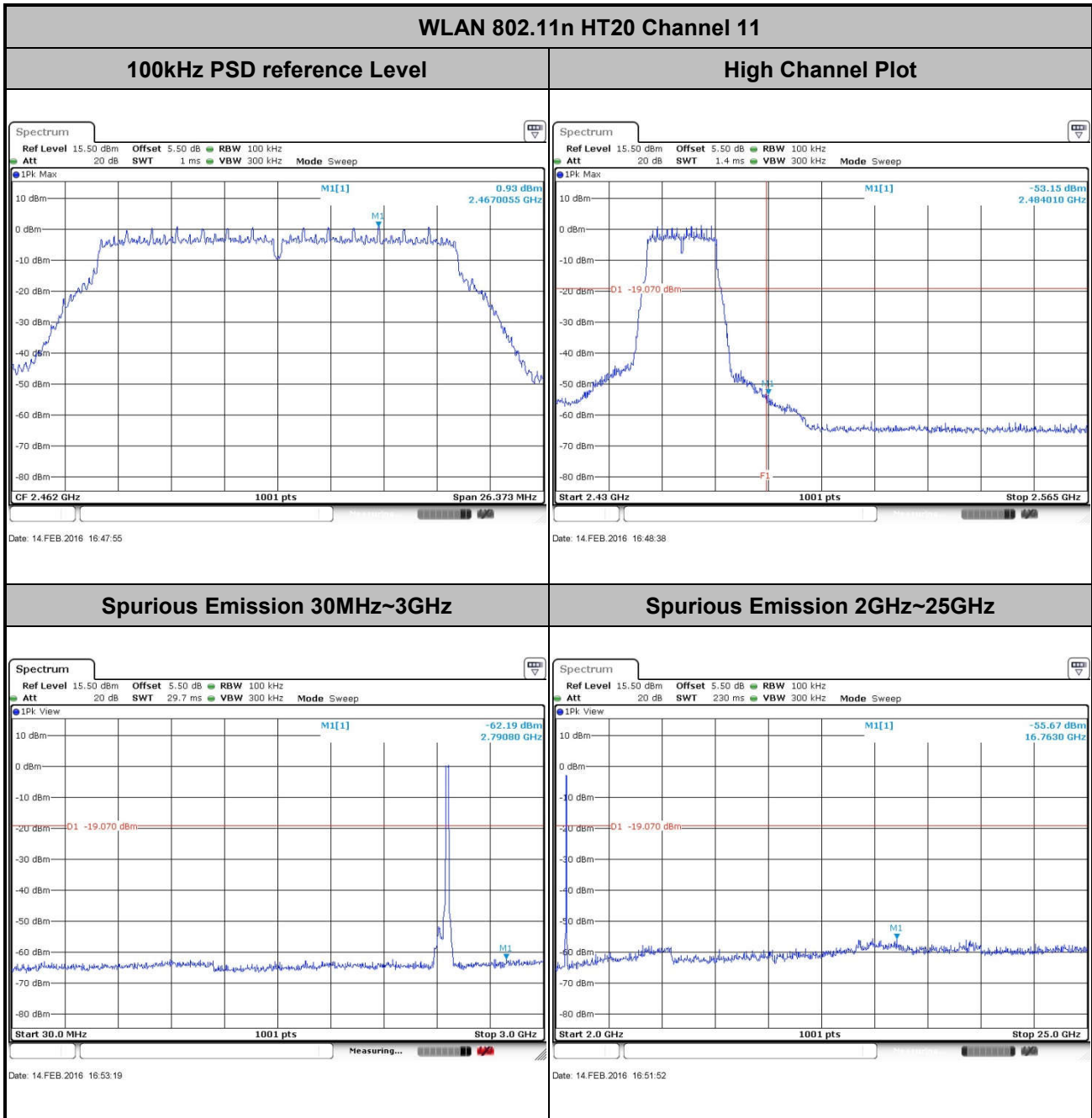
Spurious Emission 2GHz~25GHz



Date: 14.FEB.2016 17:06:12



Number of TX :	2	Ant. :	1+2(2)
Test Mode :	802.11n HT20	Temperature :	21~22°C
Test Band :	2.4GHz High	Relative Humidity :	41~42%
Test Channel :	11	Test Engineer :	Bard Li





3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

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



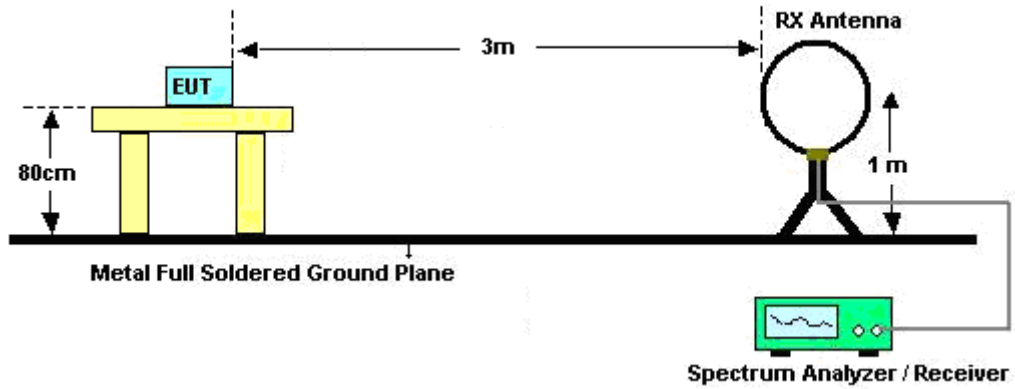
3.5.3 Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r04.
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.

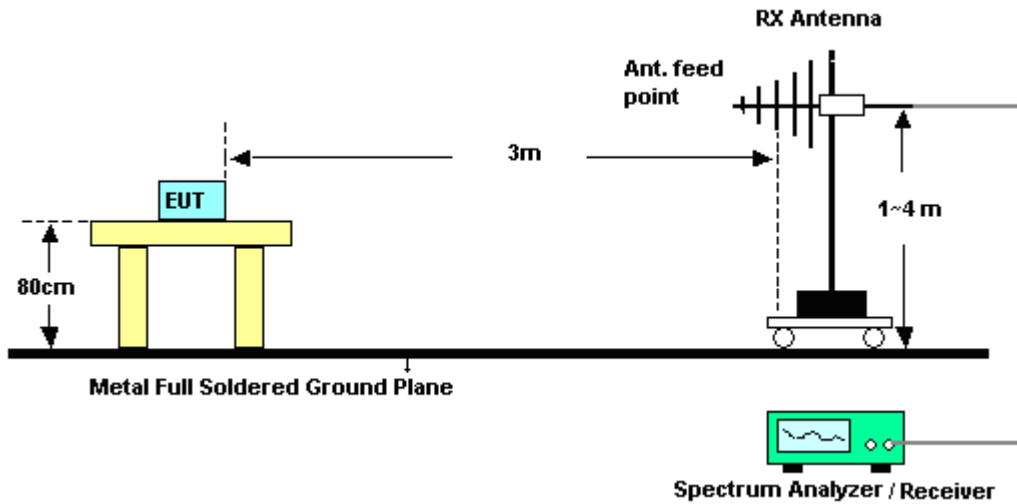
Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1	802.11b	98.62	-	-	10Hz
2	802.11b	99.08	-	-	
1	802.11g	93.46	1.43	0.70	1kHz
2	802.11g	93.46	1.43	0.70	
1 + 2	2.4GHz 802.11n HT20	91.30	0.99	1.01	3kHz

3.5.4 Test Setup

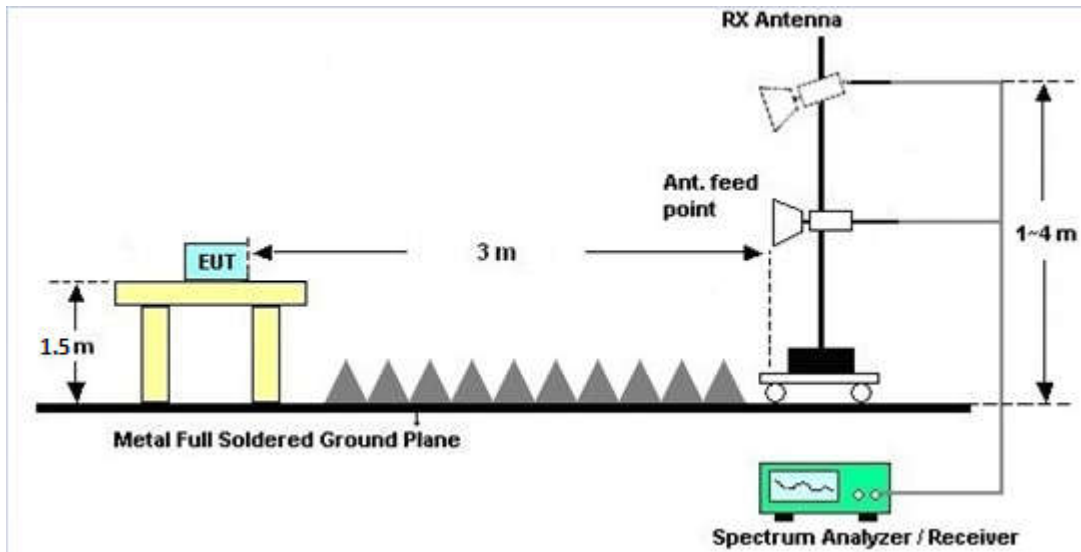
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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 B of this test report.

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

Please refer to Appendix B of this test report.



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 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.

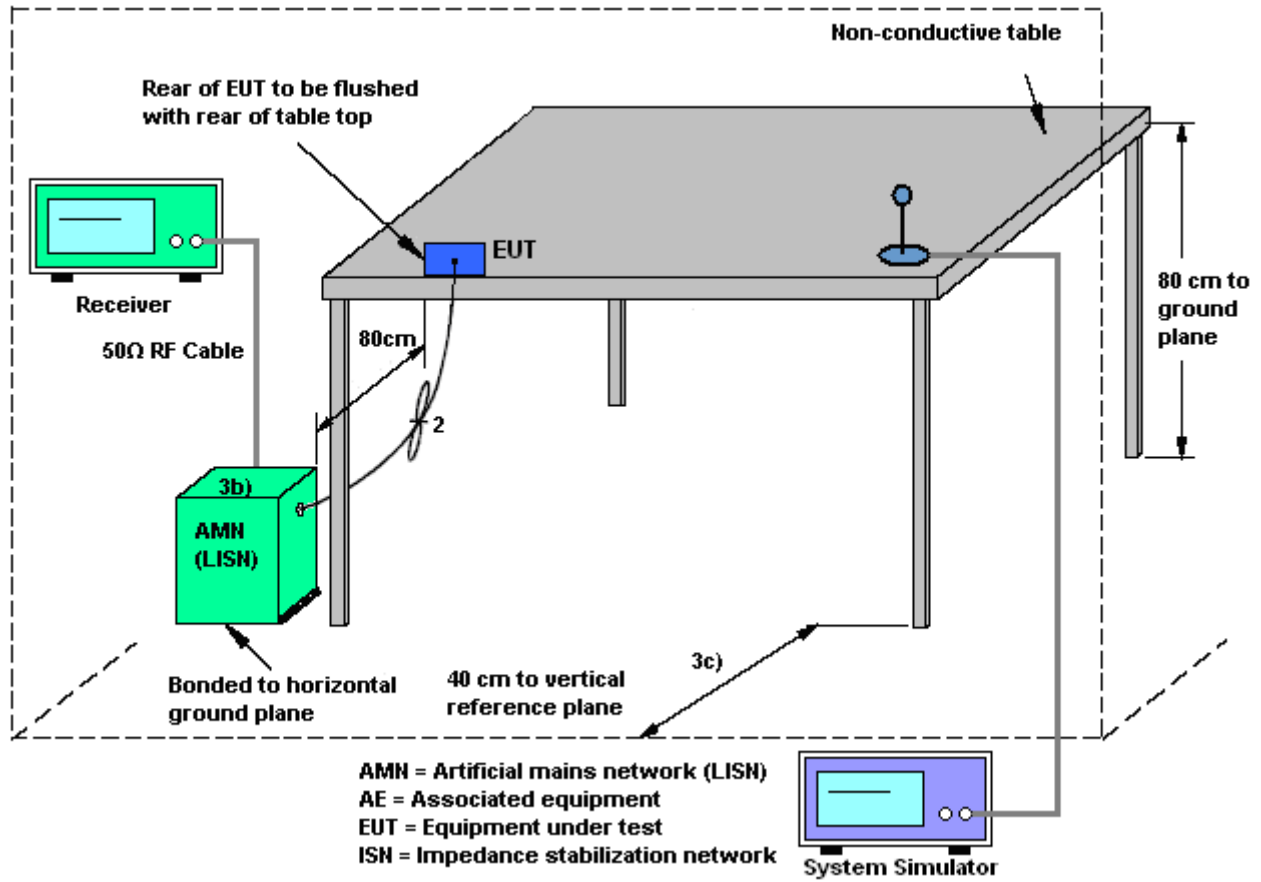
3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it 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.

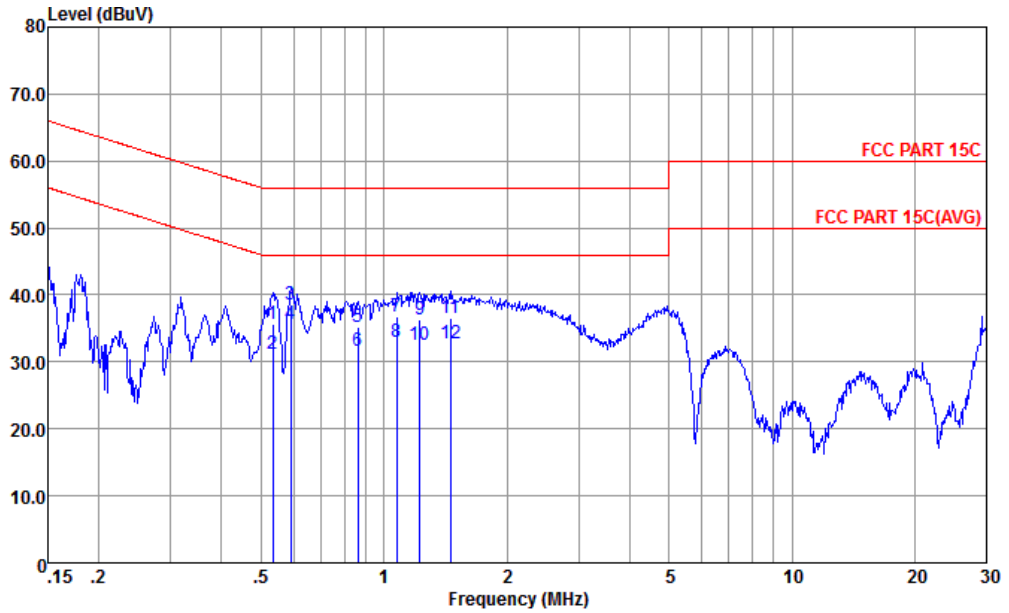
3.6.4 Test Setup





3.6.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	22~24°C
Test Engineer :	Amos Zhang	Relative Humidity :	44~46%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	GSM850 Idle + Bluetooth Link + WLAN Link(2.4G) + Earphone + Battery + USB Cable (Charging from Adapter 12V)		



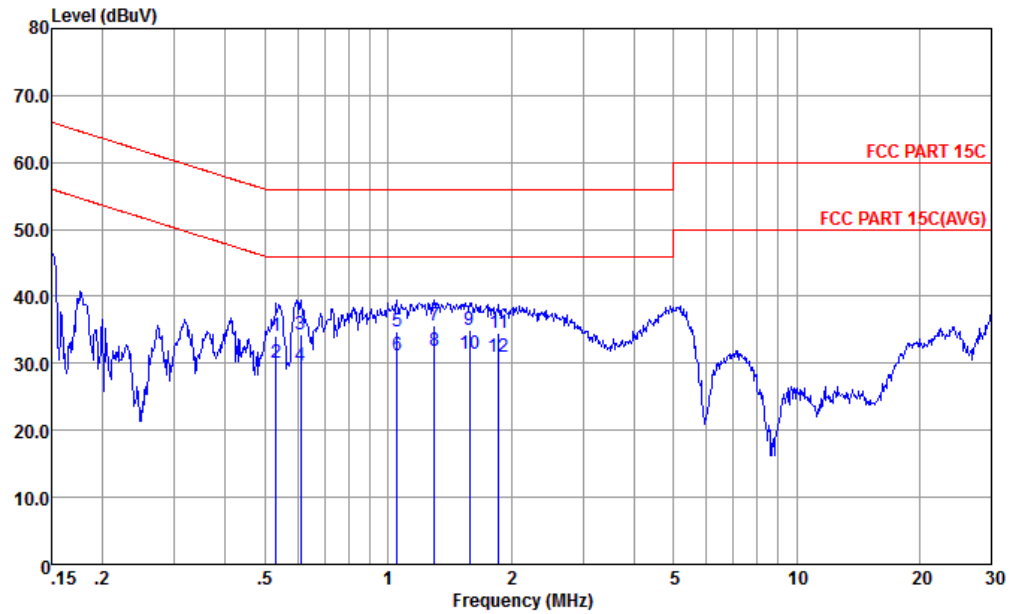
Site : CO01-KS
 Condition : FCC PART 15C LISN-L-20151024 LINE

mode : Mode 1

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.53	35.69	-20.31	56.00	25.30	0.23	10.16	QP
2	0.53	31.29	-14.71	46.00	20.90	0.23	10.16	Average
3	0.59	38.49	-17.51	56.00	28.10	0.23	10.16	QP
4 *	0.59	35.59	-10.41	46.00	25.20	0.23	10.16	Average
5	0.86	35.29	-20.71	56.00	24.90	0.25	10.14	QP
6	0.86	31.59	-14.41	46.00	21.20	0.25	10.14	Average
7	1.08	36.68	-19.32	56.00	26.30	0.24	10.14	QP
8	1.08	32.98	-13.02	46.00	22.60	0.24	10.14	Average
9	1.22	36.27	-19.73	56.00	25.90	0.23	10.14	QP
10	1.22	32.57	-13.43	46.00	22.20	0.23	10.14	Average
11	1.46	36.65	-19.35	56.00	26.30	0.21	10.14	QP
12	1.46	32.65	-13.35	46.00	22.30	0.21	10.14	Average



Test Mode :	Mode 1	Temperature :	22~24°C
Test Engineer :	Amos Zhang	Relative Humidity :	44~46%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	GSM850 Idle + Bluetooth Link + WLAN Link(2.4G) + Earphone + Battery + USB Cable (Charging from Adapter 12V)		



Site : CO01-KS
 Condition : FCC PART 15C LISN-N-20151024 NEUTRAL

mode : Mode 1

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.53	34.09	-21.91	56.00	23.61	0.32	10.16	QP
2	0.53	30.09	-15.91	46.00	19.61	0.32	10.16	Average
3	0.61	34.29	-21.71	56.00	23.80	0.33	10.16	QP
4	0.61	29.69	-16.31	46.00	19.20	0.33	10.16	Average
5	1.05	34.81	-21.19	56.00	24.30	0.37	10.14	QP
6	1.05	31.11	-14.89	46.00	20.60	0.37	10.14	Average
7	1.30	35.61	-20.39	56.00	25.10	0.37	10.14	QP
8 *	1.30	31.81	-14.19	46.00	21.30	0.37	10.14	Average
9	1.59	35.02	-20.98	56.00	24.50	0.38	10.14	QP
10	1.59	31.42	-14.58	46.00	20.90	0.38	10.14	Average
11	1.87	34.62	-21.38	56.00	24.10	0.38	10.14	QP
12	1.87	31.02	-14.98	46.00	20.50	0.38	10.14	Average



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. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the Antenna exceeds 6 dBi. 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

FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

For CDD transmissions, directional gain is calculated as

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = $10 \log(N_{ANT}/N_{SS}=1)$ dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain "DG" is calculated as following table.

	Ant. 1 (dBi)	Ant. 2 (dBi)	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
2.4 GHz	1.10	1.20	1.20	4.16	0.00	0.00

$Power\ Limit\ Reduction = DG(Power) - 6dBi, (min = 0)$

$PSD\ Limit\ Reduction = DG(PSD) - 6dBi, (min = 0)$



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV30	101338	10Hz~30GHz	May 04, 2015	Feb. 14, 2016~ Mar. 03, 2016	May 03, 2016	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 20, 2016	Feb. 14, 2016~ Mar. 03, 2016	Jan. 19, 2017	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 20, 2016	Feb. 14, 2016~ Mar. 03, 2016	Jan. 19, 2017	Conducted (TH01-KS)
EMI Test Receiver	R&S	ESR7	101403	9kHz~7GHz;Max 30dBm	Sep. 10, 2015	Mar. 04, 2016	Sep. 09, 2016	Radiation (03CH03-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz-44GHz	Jun. 05, 2015	Mar. 04, 2016	Jun. 04, 2016	Radiation (03CH03-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 10, 2015	Mar. 04, 2016	Nov. 09, 2016	Radiation (03CH03-KS)
Bilog Antenna	TeseQ	CBL6112D	23182	25MHz-2GHz	Jan. 16, 2016	Mar. 04, 2016	Jan. 15, 2017	Radiation (03CH03-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1356	1GHz~18GHz	Jun. 25, 2015	Mar. 04, 2016	Jun. 24, 2016	Radiation (03CH03-KS)
SHF-EHF Horn	com-power	AH-840	101070	18Ghz-40Ghz	Oct. 10, 2015	Mar. 04, 2016	Oct. 09, 2016	Radiation (03CH03-KS)
Amplifier	Burgeon	BPA-530	102212	0.01MHz-3000MHz	Aug. 10, 2015	Mar. 04, 2016	Aug. 09, 2016	Radiation (03CH03-KS)
Amplifier	Agilent	8449B	3008A02370	1GHz~26.5GHz	Oct. 24, 2015	Mar. 04, 2016	Oct. 23, 2016	Radiation (03CH03-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Mar. 04, 2016	NCR	Radiation (03CH03-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 04, 2016	NCR	Radiation (03CH03-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 04, 2016	NCR	Radiation (03CH03-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 04, 2015	Jan. 22, 2016	May 03, 2016	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 24, 2015	Jan. 22, 2016	Oct. 23, 2016	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Oct. 24, 2015	Jan. 22, 2016	Oct. 23, 2016	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 24, 2015	Jan. 22, 2016	Oct. 23, 2016	Conduction (CO01-KS)

NCR: No Calibration Required



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.3dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.5dB
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Appendix A. Conducted Test Results

Report Number : FR612203C

Test Engineer:	Bard Li	Temperature:	21~22	°C
Test Date:	2016/2/14 ~ 2016/3/3	Relative Humidity:	41~42	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

2.4GHz Band										
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	99% Occupied BW (MHz)		6dB BW (MHz)		6dB BW Limit (MHz)	Pass/Fail
					Ant 1	Ant 2	Ant 1	Ant 2		
11b	1Mbps	1	1	2412	-	11.59	-	8.55	0.50	Pass
11b	1Mbps	1	6	2437	-	11.79	-	9.05	0.50	Pass
11b	1Mbps	1	11	2462	-	11.64	-	9.05	0.50	Pass
11g	6Mbps	1	1	2412	18.33	-	15.72	-	0.50	Pass
11g	6Mbps	1	6	2437	18.63	-	16.32	-	0.50	Pass
11g	6Mbps	1	11	2462	18.48	-	16.32	-	0.50	Pass
HT20	MCS0	1	1	2412	19.13	-	16.92	-	0.50	Pass
HT20	MCS0	1	6	2437	19.58	-	17.60	-	0.50	Pass
HT20	MCS0	1	11	2462	19.28	-	17.56	-	0.50	Pass
HT20	MCS8	2	1	2412	19.13	18.83	16.56	16.32	0.50	Pass
HT20	MCS8	2	6	2437	19.43	19.18	17.60	17.62	0.50	Pass
HT20	MCS8	2	11	2462	19.38	19.08	17.58	17.58	0.50	Pass

TEST RESULTS DATA
Peak Output Power

2.4GHz Band																
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Peak Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2	Ant 1	Ant 2	Ant 1	Ant 2	
11b	1Mbps	1	1	2412	18.74	18.96	-	30.00	30.00	1.10	1.20	19.84	20.16	36.00	36.00	Pass
11b	1Mbps	1	6	2437	18.97	19.14		30.00	30.00	1.10	1.20	20.07	20.34	36.00	36.00	Pass
11b	1Mbps	1	11	2462	18.67	18.34		30.00	30.00	1.10	1.20	19.77	19.54	36.00	36.00	Pass
11g	6Mbps	1	1	2412	22.22	21.76		30.00	30.00	1.10	1.20	23.32	22.96	36.00	36.00	Pass
11g	6Mbps	1	6	2437	22.37	22.09		30.00	30.00	1.10	1.20	23.47	23.29	36.00	36.00	Pass
11g	6Mbps	1	11	2462	22.12	21.88		30.00	30.00	1.10	1.20	23.22	23.08	36.00	36.00	Pass
HT20	MCS0	1	1	2412	18.09	17.86		30.00	30.00	1.10	1.20	19.19	19.06	36.00	36.00	Pass
HT20	MCS0	1	6	2437	18.45	18.24		30.00	30.00	1.10	1.20	19.55	19.44	36.00	36.00	Pass
HT20	MCS0	1	11	2462	18.23	17.96		30.00	30.00	1.10	1.20	19.33	19.16	36.00	36.00	Pass
HT20	MCS8	2	1	2412	19.29	19.32	22.32	30.00		1.20		23.52		36.00		Pass
HT20	MCS8	2	6	2437	19.40	19.51	22.47	30.00		1.20		23.67		36.00		Pass
HT20	MCS8	2	11	2462	19.14	19.19	22.18	30.00		1.20		23.38		36.00		Pass

Note: Measured power (dBm) has offset with cable loss.

TEST RESULTS DATA
Average Output Power

2.4GHz Band									
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)		Average Conducted Power (dBm)		
					Ant 1	Ant 2	Ant 1	Ant 2	SUM
11b	1Mbps	1	1	2412	0.06	0.04	15.42	15.30	-
11b	1Mbps	1	6	2437	0.06	0.04	15.54	15.60	
11b	1Mbps	1	11	2462	0.06	0.04	15.35	14.92	
11g	6Mbps	1	1	2412	0.29	0.29	15.14	14.68	
11g	6Mbps	1	6	2437	0.29	0.29	15.25	14.75	
11g	6Mbps	1	11	2462	0.29	0.29	15.11	14.53	
HT20	MCS0	1	1	2412	0.23	0.22	11.16	10.72	
HT20	MCS0	1	6	2437	0.23	0.22	11.23	10.81	
HT20	MCS0	1	11	2462	0.23	0.22	11.01	10.50	
HT20	MCS8	2	1	2412	0.42	0.40	11.86	11.53	
HT20	MCS8	2	6	2437	0.42	0.40	12.12	11.67	14.91
HT20	MCS8	2	11	2462	0.42	0.40	11.90	11.46	14.69

Note: Measured power (dBm) has offset with cable loss.

TEST RESULTS DATA
Peak Power Spectral Density

2.4GHz Band												
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Peak PSD (dBm/3kHz)			DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail
					Ant 1	Ant 2	Worse + 3.01	Ant 1	Ant 2	Ant 1	Ant 2	
11b	1Mbps	1	1	2412	-	-5.75	-	1.10	1.20	8.00	8.00	Pass
11b	1Mbps	1	6	2437	-	-6.11		1.10	1.20	8.00	8.00	Pass
11b	1Mbps	1	11	2462	-	-5.44		1.10	1.20	8.00	8.00	Pass
11g	6Mbps	1	1	2412	-10.49	-		1.10	1.20	8.00	8.00	Pass
11g	6Mbps	1	6	2437	-9.58	-		1.10	1.20	8.00	8.00	Pass
11g	6Mbps	1	11	2462	-9.22	-		1.10	1.20	8.00	8.00	Pass
HT20	MCS0	1	1	2412	-14.56	-		1.10	1.20	8.00	8.00	Pass
HT20	MCS0	1	6	2437	-13.94	-		1.10	1.20	8.00	8.00	Pass
HT20	MCS0	1	11	2462	-14.23	-		1.10	1.20	8.00	8.00	Pass
HT20	MCS8	2	1	2412	-11.96	-13.10	-8.95	4.16		8.00		Pass
HT20	MCS8	2	6	2437	-13.71	-13.87	-10.70	4.16		8.00		Pass
HT20	MCS8	2	11	2462	-12.06	-13.84	-9.05	4.16		8.00		Pass

Measured power density (dBm) has offset with cable loss.



Appendix B. Radiated Spurious Emission

15C 2.4GHz 2400~2483.5MHz

WIFI 802.11b (Band Edge @ 3m)

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		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2333.85	55.56	-18.44	74	60.25	26.82	5.5	37.01	100	218	P	H
		2390	45.33	-8.67	54	49.76	27	5.59	37.02	100	218	A	H
	*	2413.277	104.54	-	-	108.8	27.13	5.61	37	100	218	P	H
	*	2413.36	101.99	-	-	106.25	27.13	5.61	37	100	218	A	H
		2388.3	56.39	-17.61	74	60.82	27	5.59	37.02	384	123	P	V
		2390	45.46	-8.54	54	49.89	27	5.59	37.02	384	123	A	V
	*	2413.193	104.29	-	-	108.55	27.13	5.61	37	384	123	P	V
	*	2413.193	101.7	-	-	105.96	27.13	5.61	37	384	123	A	V
802.11b CH 06 2437MHz	*	2435.822	102.03	-	-	106.13	27.26	5.63	36.99	100	218	P	H
	*	2435.738	99.54	-	-	103.64	27.26	5.63	36.99	100	218	A	H
	*	2435.738	103.5	-	-	107.6	27.26	5.63	36.99	327	154	P	V
	*	2435.738	100.96	-	-	105.06	27.26	5.63	36.99	327	154	A	V
802.11b CH 11 2462MHz	*	2460.788	102.88	-	-	106.66	27.51	5.67	36.96	275	216	P	H
	*	2460.788	100.4	-	-	104.18	27.51	5.67	36.96	275	216	A	H
		2484.08	56.44	-17.56	74	60.05	27.64	5.69	36.94	275	216	P	H
		2483.52	45.48	-8.52	54	49.09	27.64	5.69	36.94	275	216	A	H
	*	2460.872	104.65	-	-	108.43	27.51	5.67	36.96	353	151	P	V
	*	2460.788	102.15	-	-	105.93	27.51	5.67	36.96	353	151	A	V
		2485.6	57.16	-16.84	74	60.77	27.64	5.69	36.94	353	151	P	V
		2483.52	45.77	-8.23	54	49.38	27.64	5.69	36.94	353	151	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



15C 2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)

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		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		4824	39.21	-34.79	74	60.67	31.51	9.13	62.1	100	360	P	H
		4824	38.05	-35.95	74	59.51	31.51	9.13	62.1	100	0	P	V
802.11b CH 06 2437MHz		4875	40.35	-33.65	74	61.59	31.59	9.2	62.03	100	360	P	H
		7311	40.44	-33.56	74	54.27	34.03	11.3	59.16	100	0	P	H
		4875	38.93	-35.07	74	60.17	31.59	9.2	62.03	100	0	P	V
		7311	39.73	-34.27	74	53.56	34.03	11.3	59.16	100	360	P	V
802.11b CH 11 2462MHz		4923	38.62	-35.38	74	59.65	31.67	9.27	61.97	100	360	P	H
		7386	41.42	-32.58	74	54.96	34.29	11.29	59.12	100	0	P	H
		4923	39.02	-34.98	74	60.05	31.67	9.27	61.97	100	0	P	V
		7386	41.3	-32.7	74	54.84	34.29	11.29	59.12	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



15C 2.4GHz 2400~2483.5MHz
WIFI 802.11g (Band Edge @ 3m)

Table with 14 columns: WIFI, Note, Frequency, Level, Over, Limit, Read, Antenna, Cable, Preamp, Ant, Table, Peak, Pol. It contains test data for three channels (CH 01, CH 06, CH 11) and a final Remark section.



15C 2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

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		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 01 2412MHz		4824	38.33	-35.67	74	59.79	31.51	9.13	62.1	100	360	P	H
		4824	38.14	-35.86	74	59.6	31.51	9.13	62.1	100	0	P	V
802.11g CH 06 2437MHz		4875	37.57	-36.43	74	58.81	31.59	9.2	62.03	100	360	P	H
		7311	40.92	-33.08	74	54.75	34.03	11.3	59.16	100	0	P	H
		4875	36.97	-37.03	74	58.21	31.59	9.2	62.03	100	0	P	V
		7311	40.26	-33.74	74	54.09	34.03	11.3	59.16	100	360	P	V
802.11g CH 11 2462MHz		4923	36.91	-37.09	74	57.94	31.67	9.27	61.97	100	360	P	H
		7386	40.58	-33.42	74	54.12	34.29	11.29	59.12	100	0	P	H
		4923	37.42	-36.58	74	58.45	31.67	9.27	61.97	100	0	P	V
		7386	41.68	-32.32	74	55.22	34.29	11.29	59.12	100	360	P	V
Remark	<ol style="list-style-type: none"> No other spurious found. All results are PASS against Peak and Average limit line. 												



15C 2.4GHz 2400~2483.5MHz
WIFI 802.11b (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2386.05	57.17	-16.83	74	61.6	27	5.59	37.02	100	296	P	H
		2390	47.58	-6.42	54	52.01	27	5.59	37.02	100	296	A	H
	*	2412.024	108.09	-	-	112.35	27.13	5.61	37	100	296	P	H
	*	2410.938	105.61	-	-	109.87	27.13	5.61	37	100	296	A	H
		2389.38	57.19	-16.81	74	61.62	27	5.59	37.02	337	240	P	V
		2390	47.81	-6.19	54	52.24	27	5.59	37.02	337	240	A	V
	*	2410.604	107.98	-	-	112.24	27.13	5.61	37	337	240	P	V
	*	2410.855	105.48	-	-	109.74	27.13	5.61	37	337	240	A	V
802.11b CH 06 2437MHz	*	2438.41	106.24	-	-	110.17	27.39	5.65	36.97	100	292	P	H
	*	2438.326	103.64	-	-	107.57	27.39	5.65	36.97	100	292	A	H
	*	2438.326	107.16	-	-	111.09	27.39	5.65	36.97	373	242	P	V
	*	2438.41	104.62	-	-	108.55	27.39	5.65	36.97	373	242	A	V
802.11b CH 11 2462MHz	*	2460.705	109.25	-	-	113.03	27.51	5.67	36.96	100	297	P	H
	*	2460.788	106.76	-	-	110.54	27.51	5.67	36.96	100	297	A	H
		2487.72	59.67	-14.33	74	63.12	27.77	5.71	36.93	100	297	P	H
	!	2483.52	51.19	-2.81	54	54.8	27.64	5.69	36.94	100	302	A	H
	*	2460.621	109.23	-	-	113.01	27.51	5.67	36.96	360	251	P	V
	*	2460.788	106.68	-	-	110.46	27.51	5.67	36.96	360	251	A	V
		2484.92	60.57	-13.43	74	64.18	27.64	5.69	36.94	360	251	P	V
	!	2483.52	51.69	-2.31	54	55.3	27.64	5.69	36.94	360	251	A	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												



15C 2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		4824	41.78	-32.22	74	63.24	31.51	9.13	62.1	100	360	P	H
CH 01		4824	38.75	-35.25	74	60.21	31.51	9.13	62.1	100	0	P	V
2412MHz													
802.11b		4875	42.98	-31.02	74	64.22	31.59	9.2	62.03	100	360	P	H
CH 06		7311	40.4	-33.6	74	54.23	34.03	11.3	59.16	100	0	P	H
2437MHz		4875	41.39	-32.61	74	62.63	31.59	9.2	62.03	100	0	P	V
		7311	40.27	-33.73	74	54.1	34.03	11.3	59.16	100	360	P	V
802.11b		4923	41.75	-32.25	74	62.78	31.67	9.27	61.97	100	360	P	H
CH 11		7386	40.71	-33.29	74	54.25	34.29	11.29	59.12	100	0	P	H
2462MHz		4923	39.48	-34.52	74	60.51	31.67	9.27	61.97	100	0	P	V
		7386	40.65	-33.35	74	54.19	34.29	11.29	59.12	100	360	P	V
Remark	<p>3. No other spurious found.</p> <p>4. All results are PASS against Peak and Average limit line.</p>												



15C 2.4GHz 2400~2483.5MHz
WIFI 802.11g (Band Edge @ 3m)

Table with 14 columns: WIFI, Note, Frequency, Level, Over, Limit, Read, Antenna, Cable, Preamp, Ant, Table, Peak, Pol. It contains test results for three channels (CH 01, CH 06, CH 11) and a final Remark section.



15C 2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11g CH 01 2412MHz		4824	37.37	-36.63	74	58.83	31.51	9.13	62.1	100	360	P	H
		4824	36.95	-37.05	74	58.41	31.51	9.13	62.1	100	0	P	V
802.11g CH 06 2437MHz		4875	37.98	-36.02	74	59.22	31.59	9.2	62.03	100	360	P	H
		7311	40.42	-33.58	74	54.25	34.03	11.3	59.16	100	0	P	H
		4875	37.12	-36.88	74	58.36	31.59	9.2	62.03	100	0	P	V
		7311	40.08	-33.92	74	53.91	34.03	11.3	59.16	100	360	P	V
802.11g CH 11 2462MHz		4923	38.06	-35.94	74	59.09	31.67	9.27	61.97	100	360	P	H
		7386	40.51	-33.49	74	54.05	34.29	11.29	59.12	100	0	P	H
		4923	37.1	-36.9	74	58.13	31.67	9.27	61.97	100	0	P	V
		7386	40.83	-33.17	74	54.37	34.29	11.29	59.12	100	360	P	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												



15C Emission below 1GHz

2.4GHz WIFI 802.11b (LF)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz 802.11b LF		32.91	23.29	-16.71	40	35.4	18.18	0.69	30.98	-	-	P	H
		151.25	34.12	-9.38	43.5	49.29	13.74	1.49	30.4	151	261	P	H
		280.26	31.59	-14.41	46	45.89	14.23	1.97	30.5	-	-	P	H
		352.04	32.71	-13.29	46	45.15	15.85	2.31	30.6	-	-	P	H
		462.62	32.37	-13.63	46	42.54	17.62	2.68	30.47	-	-	P	H
		741.01	23.24	-22.76	46	29.54	20.73	3.45	30.48	-	-	P	H
	!	31.94	35.18	-4.82	40	47.2	18.32	0.68	31.02	100	187	P	V
		146.4	26.96	-16.54	43.5	42.15	13.75	1.46	30.4	-	-	P	V
		288.02	27.46	-18.54	46	41.42	14.5	2.04	30.5	-	-	P	V
		352.04	30.36	-15.64	46	42.8	15.85	2.31	30.6	-	-	P	V
		462.62	30.62	-15.38	46	40.79	17.62	2.68	30.47	-	-	P	V
	693.48	26.17	-19.83	46	32.95	20.28	3.33	30.39	-	-	P	V	
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



**15C 2.4GHz 2400~2483.5MHz
WIFI 802.11n HT20 (Band Edge @ 3m)**

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)
802.11n HT20 CH 01 2412MHz		2389.92	64.5	-9.5	74	68.93	27	5.59	37.02	100	297	P	H
	!	2389.83	51.24	-2.76	54	55.67	27	5.59	37.02	100	297	A	H
	*	2415.781	106.7	-	-	110.96	27.13	5.61	37	100	297	P	H
	*	2413.444	98.53	-	-	102.79	27.13	5.61	37	100	297	A	H
		2389.83	63.52	-10.48	74	67.95	27	5.59	37.02	386	241	P	V
	!	2389.92	49.78	-4.22	54	54.21	27	5.59	37.02	386	241	A	V
	*	2413.778	106.92	-	-	111.18	27.13	5.61	37	386	241	P	V
	*	2414.947	98.41	-	-	102.67	27.13	5.61	37	386	241	A	V
802.11n HT20 CH 06 2437MHz	*	2443.169	105.84	-	-	109.77	27.39	5.65	36.97	116	293	P	H
	*	2444.422	97.36	-	-	101.29	27.39	5.65	36.97	116	293	A	H
	*	2432.982	105.6	-	-	109.7	27.26	5.63	36.99	300	238	P	V
	*	2439.663	97.29	-	-	101.22	27.39	5.65	36.97	300	238	A	V
802.11n HT20 CH 11 2462MHz	*	2459.702	108.04	-	-	111.82	27.51	5.67	36.96	100	291	P	H
	*	2462.875	99.3	-	-	103.08	27.51	5.67	36.96	100	291	A	H
		2483.68	63.12	-10.88	74	66.73	27.64	5.69	36.94	100	291	P	H
	!	2483.52	50.04	-3.96	54	53.65	27.64	5.69	36.94	100	291	A	H
	*	2464.545	107.8	-	-	111.58	27.51	5.67	36.96	334	243	P	V
	*	2459.368	99.42	-	-	103.2	27.51	5.67	36.96	334	243	A	V
		2483.68	63.54	-10.46	74	67.15	27.64	5.69	36.94	334	243	P	V
!	2483.52	50.74	-3.26	54	54.35	27.64	5.69	36.94	334	243	A	V	
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



15C 2.4GHz 2400~2483.5MHz
WIFI 802.11n HT20 (Harmonic @ 3m)

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)
802.11n HT20 CH 01 2412MHz		4824	37.67	-36.33	74	59.13	31.51	9.13	62.1	100	360	P	H
		4824	38.45	-35.55	74	59.91	31.51	9.13	62.1	100	0	P	V
802.11n HT20 CH 06 2437MHz		4875	39.06	-34.94	74	60.3	31.59	9.2	62.03	100	360	P	H
		7311	39.97	-34.03	74	53.8	34.03	11.3	59.16	100	0	P	H
		4875	38.13	-35.87	74	59.37	31.59	9.2	62.03	100	0	P	V
		7311	40.8	-33.2	74	54.63	34.03	11.3	59.16	100	360	P	V
802.11n HT20 CH 11 2462MHz		4923	36.25	-37.75	74	57.28	31.67	9.27	61.97	100	360	P	H
		7386	39.59	-34.41	74	53.13	34.29	11.29	59.12	100	0	P	H
		4923	36.68	-37.32	74	57.71	31.67	9.27	61.97	100	0	P	V
		7386	40.3	-33.7	74	53.84	34.29	11.29	59.12	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average 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 per 15.209(c).
!	Test result is over limit line.
P/A	Peak or Average
H/V	Horizontal or Vertical



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		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

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

For Peak Limit @ 2390MHz:

- 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)
- Over Limit(dB)
= Level(dBμV/m) – Limit Line(dBμV/m)
= 55.45(dBμV/m) – 74(dBμV/m)
= -18.55(dB)

For Average Limit @ 2390MHz:

- 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)
- 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”.