

FCC RF Test Report

APPLICANT : Lenovo(Shanghai) Electronics
Technology Co., Ltd.
EQUIPMENT : Mirage Camera
BRAND NAME : Lenovo
MODEL NAME : Lenovo VR-4501F
FCC ID : O57VR4501F
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Jul. 14, 2017 and testing was completed on Aug. 08, 2017. 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.



Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.

***No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335
China***



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR771401B	Rev. 01	Initial issue of report	Sep. 12, 2017



SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	RSS-247 5.2(a)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	RSS-Gen 6.6	99% Bandwidth	-	Pass	-
3.2	15.247(b)	RSS-247 5.4(d)	Power Output Measurement	$\leq 30\text{dBm}$	Pass	-
3.3	15.247(e)	RSS-247 5.2(b)	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 3.01 dB at 2483.52 MHz
3.6	15.207	RSS-GEN 8.8	AC Conducted Emission	15.207(a)	Pass	Under limit 9.27 dB at 0.686 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, 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	Mirage Camera
Brand Name	Lenovo
Model Name	Lenovo VR-4501F
FCC ID	O57VR4501F
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5 GHz 802.11a/n HT20/HT40 WLAN 5 GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth v 4.2 LE
HW Version	DVT2
SW Version	VR4501F_S100025_170622
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	2412 MHz ~ 2462 MHz
Maximum (Peak) Output Power to antenna	802.11b : 21.42 dBm (0.1387 W) 802.11g : 25.46 dBm (0.3516 W) 802.11n HT20 : 25.48 dBm (0.3532 W) 802.11n HT40 : 24.85 dBm (0.3055 W)
99% Occupied Bandwidth	802.11b : 13.24MHz 802.11g : 18.63MHz 802.11n HT20 : 19.43MHz 802.11n HT40 : 36.96MHz
Antenna Type / Gain	LDS Antenna Type with gain 0.5 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)

1.5 Specification of Accessory

Specification of Accessory				
AC Adapter 1 (EU)	Brand Name	Lenovo(Huntkey)	Model Name	C-P57
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 1 (US)	Brand Name	Lenovo(Huntkey)	Model Name	C-P56
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 1 (AU)	Brand Name	Lenovo(Huntkey)	Model Name	C-P59
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 1 (AR)	Brand Name	Lenovo(Huntkey)	Model Name	C-P60
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 1 (Korea)	Brand Name	Lenovo(Huntkey)	Model Name	C-P61
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 2 (EU)	Brand Name	Lenovo(Acbel)	Model Name	C-P57
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 2 (US)	Brand Name	Lenovo(Acbel)	Model Name	C-P56
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 2 (UK)	Brand Name	Lenovo(Acbel)	Model Name	C-P58
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 2 (IN)	Brand Name	Lenovo(Acbel)	Model Name	C-P45
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
AC Adapter 3 (UK)	Brand Name	Lenovo(Huntkey)	Model Name	C-P58
	Power Rating	I/P: 100-240Vac, 150mA, O/P: 5Vdc, 1000mA		
Battery 1	Brand Name	Lenovo (Sunwoda)	Model Name	L17D1P34
	Power Rating	3.82Vdc,2200mAh	Type	Li-ion, Polymer
Battery 2	Brand Name	Lenovo (SCUD)	Model Name	L17D1P34
	Power Rating	3.82Vdc,2200mAh	Type	Li-ion, Polymer
USB Cable	Brand Name	Lenovo (SGE)	Model Name	SGE-A025A
	Signal Line	1.0meter, shielded cable, without core		

1.6 Component List

There are two samples under test, the difference between two samples are shown as below table, the difference will not affect RF performance, so we only choose sample 1 to perform RF test:

Component	Sample 1	Sample 2
Memory(2+16G)	HYNIX H9TQ17ABJTBCUR-KUM	SAMSUNG KMQE60013M-B318

1.7 Modification of EUT

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



1.8 Testing Location

Sporton Lab is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0) and the FCC designation No. is CN5013.

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.		FCC Test Firm Registration No.
	TH01-KS	CO01-KS	630927

Note: The test site complies with ANSI C63.4 2014 requirement.

Sporton Lab is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600156-0) and the FCC designation No. is CN5019

Test Site	Sporton International (Shenzhen) Inc.		
Test Site Location	No. 3 Bldg the third floor of south, Shahe River west, Fengzeyuan Warehouse, Nanshan District Shenzhen City Guangdong Province 518055 China TEL: +86-755-3320-2398		
Test Site No.	Sporton Site No.		FCC Test Firm Registration No.
	03CH04-SZ		577730

Note: The test site complies with ANSI C63.4 2014 requirement.



1.9 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 v04
- ♦ ANSI C63.10-2013
- ♦ IC RSS-247 Issue 2
- ♦ 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 (Z plane) were recorded in this report.

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 Test Mode

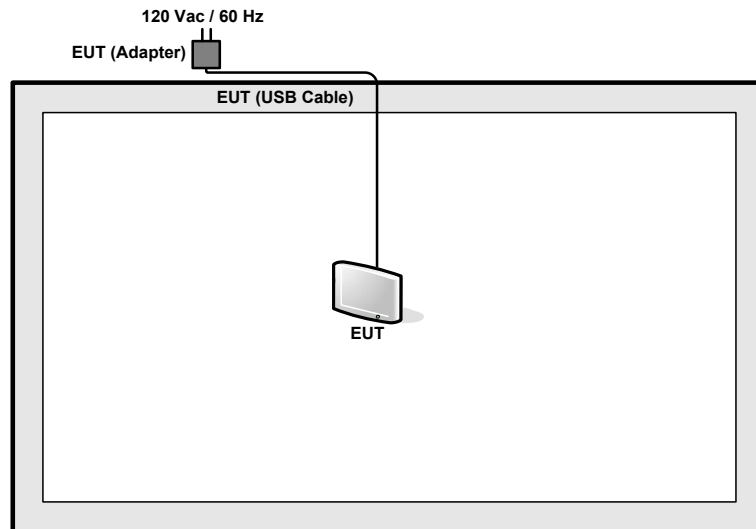
Final test mode of conducted test items and radiated spurious emissions are considering the modulation and worse data rates as below table.

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

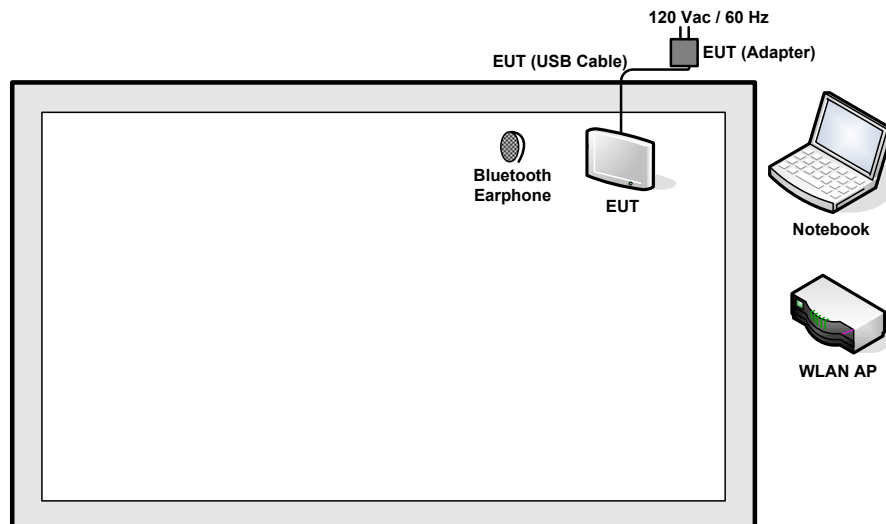
Test Cases	
AC Conducted Emission	Mode 1: Bluetooth Link + WLAN Link(2.4G) + USB Cable (Charging from Adapter1) + Battery 1 Mode 2: Bluetooth Link + WLAN Link(2.4G) + USB Cable (Charging from Adapter 2) + Battery 2
Remark: 1. The worst case of conducted emission is mode 2; only the test data of it was reported. 2. For Radiated TCs, The tests were performance with Adapter 1, Battery 1, and USB Cable.	

2.3 Connection Diagram of Test System

<WLAN Tx Mode>



<AC Conducted Emission Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	LINKSYS	WRT600N	Q87-WRT600NV11	N/A	Unshielded, 1.8 m
2.	Notebook	Lenovo	G480	N/A	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
3.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A
4.	SD Card	Kingston	8GB	N/A	N/A	N/A

2.5 EUT Operation Test Setup

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

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 5.5 dB and 10dB attenuator.

$$\begin{aligned}
 \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\
 &= 5.5 + 10 = 15.5 \text{ (dB)}
 \end{aligned}$$

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.

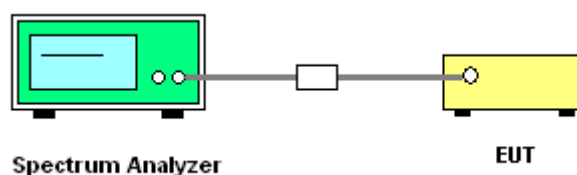
3.1.2 Measuring Instruments

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 v04.
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.

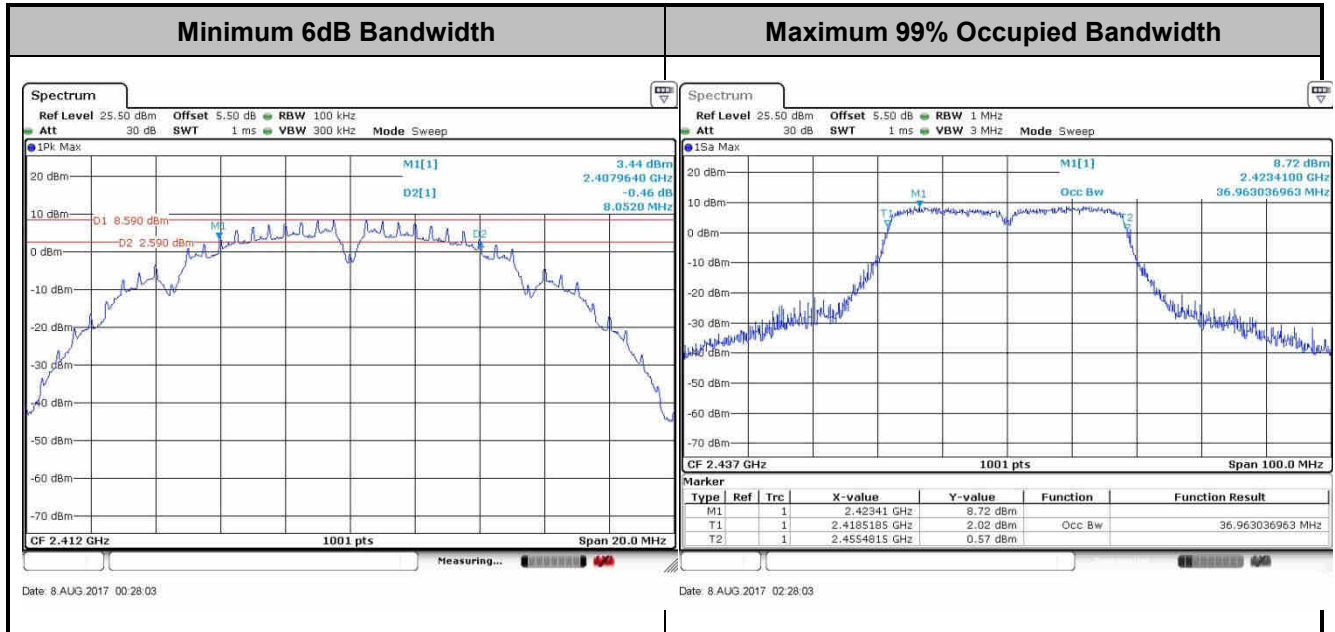
3.1.4 Test Setup





3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.



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

3.2 Output Power Measurement

3.2.1 Limit of Output Power

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

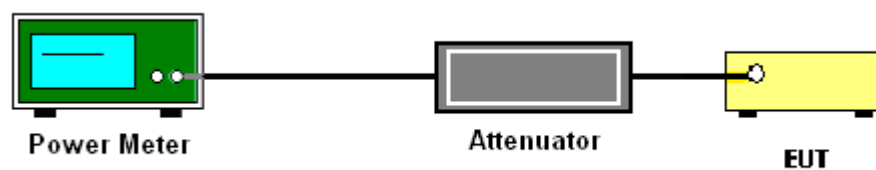
3.2.2 Measuring Instruments

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 v04 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.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average output Power (Reporting Only)

Please refer to Appendix A.

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 v04
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.

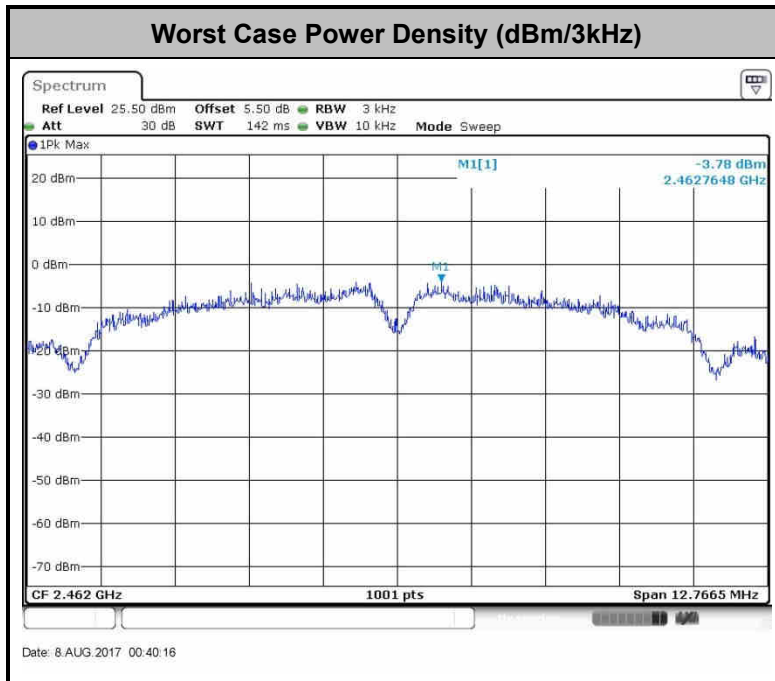
3.3.4 Test Setup





3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



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.

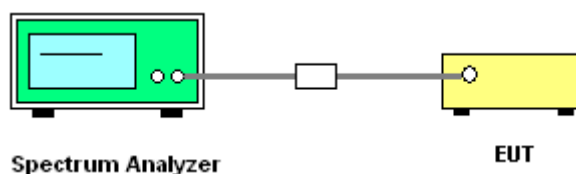
3.4.2 Measuring Instruments

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 v04.
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.
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.

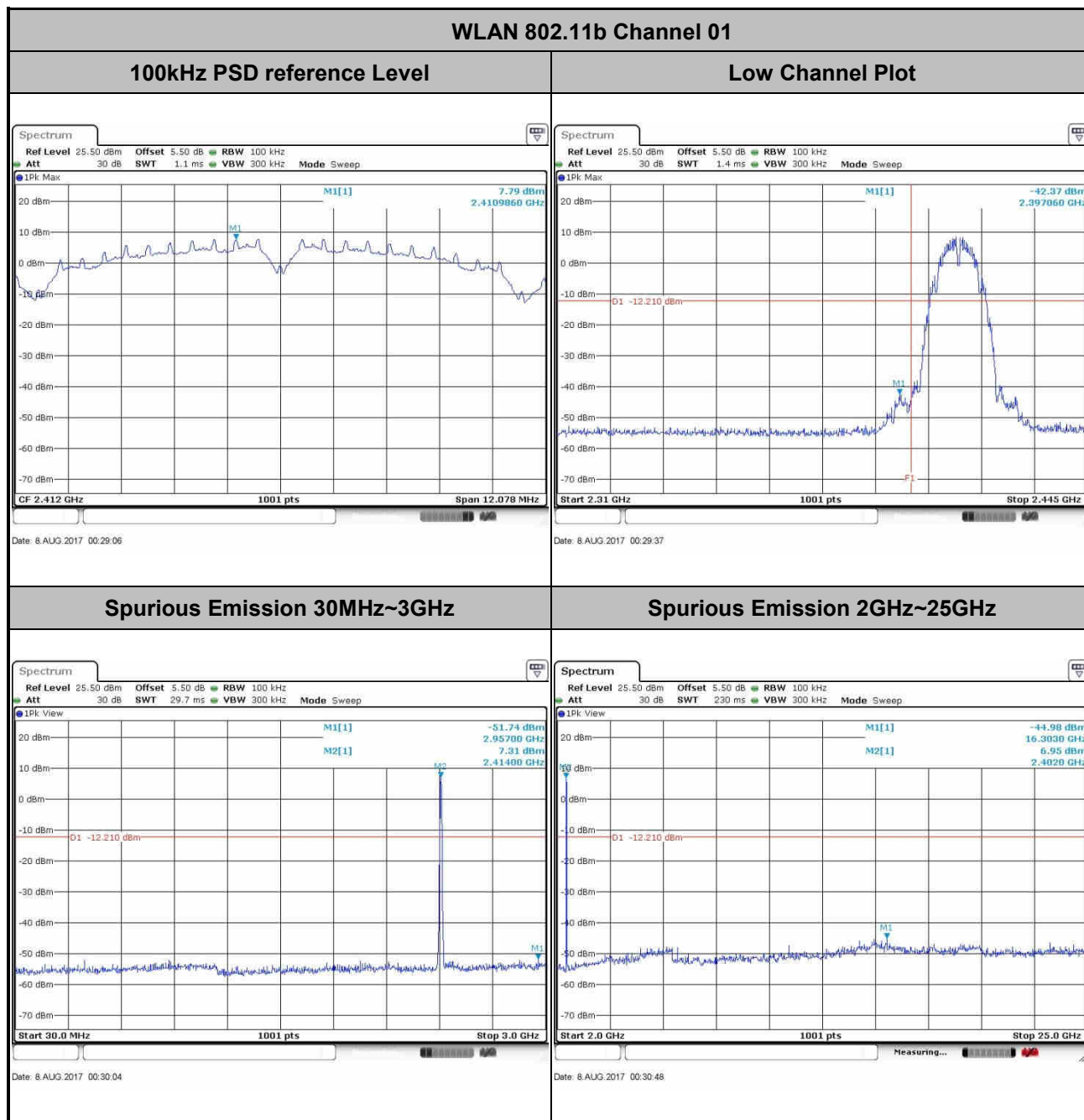
3.4.4 Test Setup





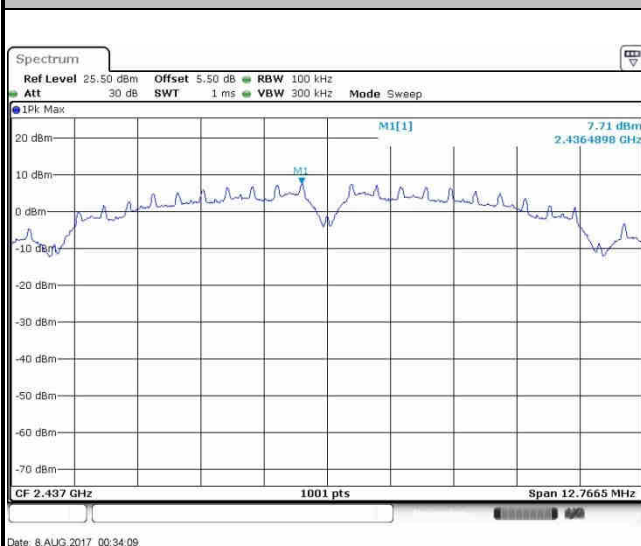
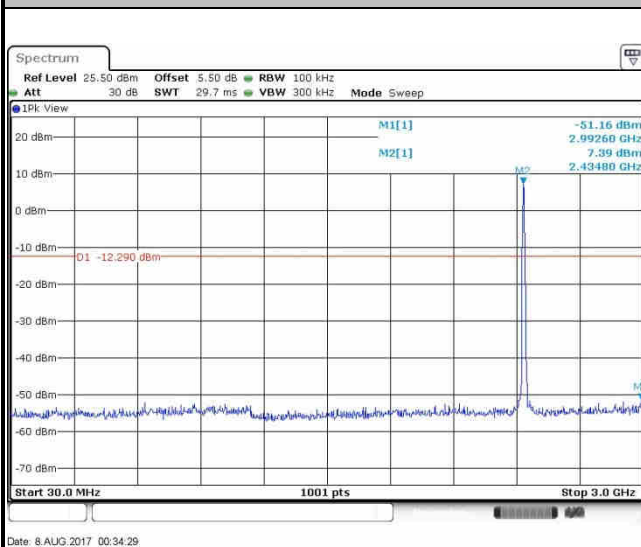
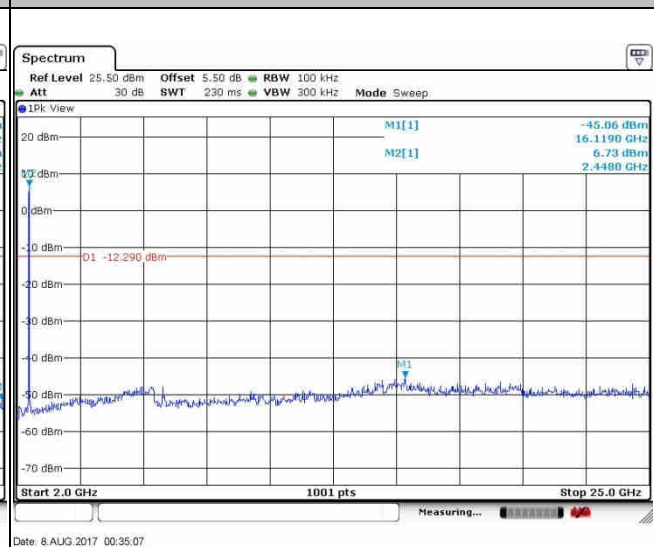
3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Test Mode :	802.11b	Temperature :	21~25°C
Test Band :	2.4GHz Low	Relative Humidity :	51~55%
Test Channel :	01	Test Engineer :	Silent Hai



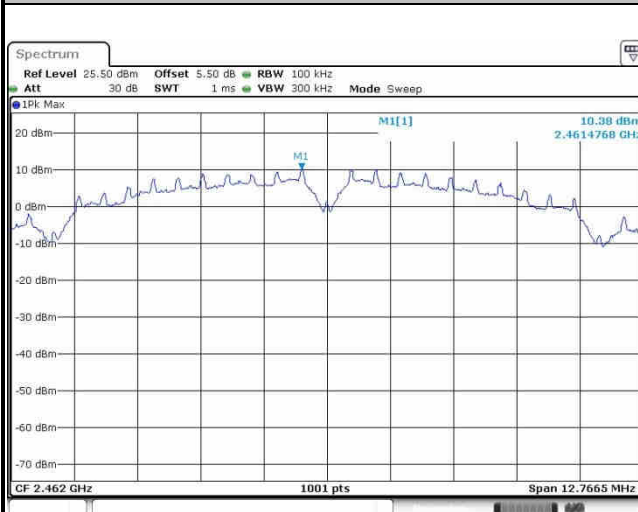


Test Mode :	802.11b	Temperature :	21~25°C
Test Band :	2.4GHz Mid	Relative Humidity :	51~55%
Test Channel :	06	Test Engineer :	Silent Hai

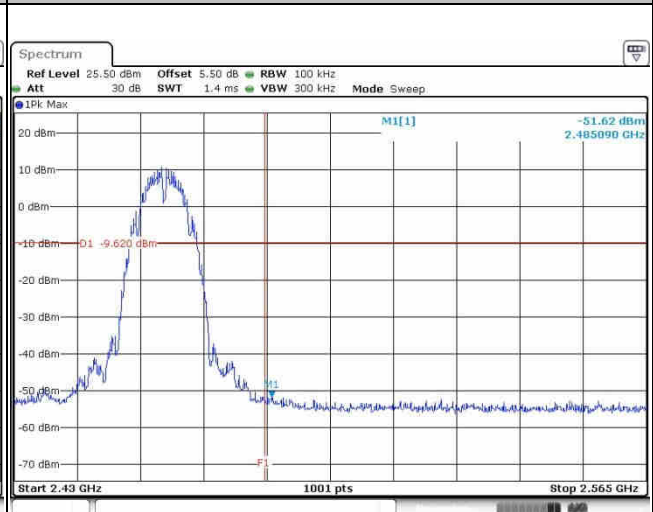
WLAN 802.11b Channel 06**100kHz PSD reference Level****Mid Channel Plot****Spurious Emission 30MHz~3GHz****Spurious Emission 2GHz~25GHz**



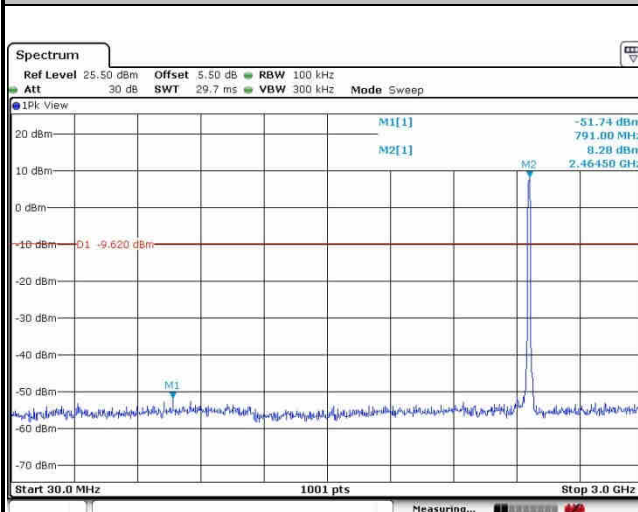
Test Mode :	802.11b	Temperature :	21~25°C
Test Band :	2.4GHz High	Relative Humidity :	51~55%
Test Channel :	11	Test Engineer :	Silent Hai

WLAN 802.11b Channel 11**100kHz PSD reference Level**

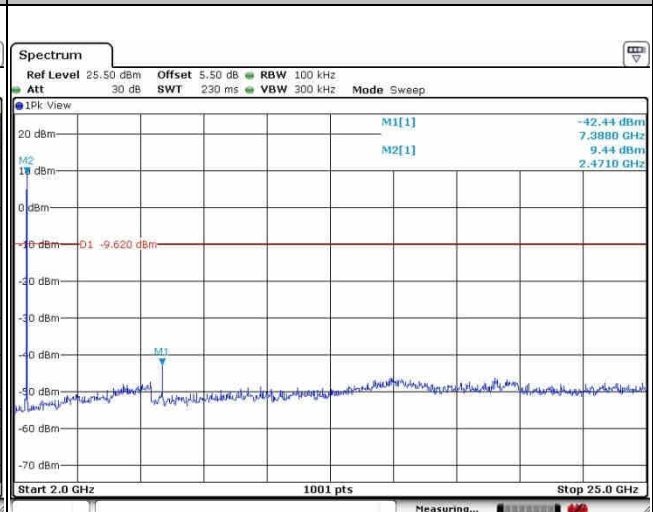
Date: 8.AUG.2017 00:40:47

High Channel Plot

Date: 8.AUG.2017 00:41:03

Spurious Emission 30MHz~3GHz

Date: 8.AUG.2017 00:42:20

Spurious Emission 2GHz~25GHz

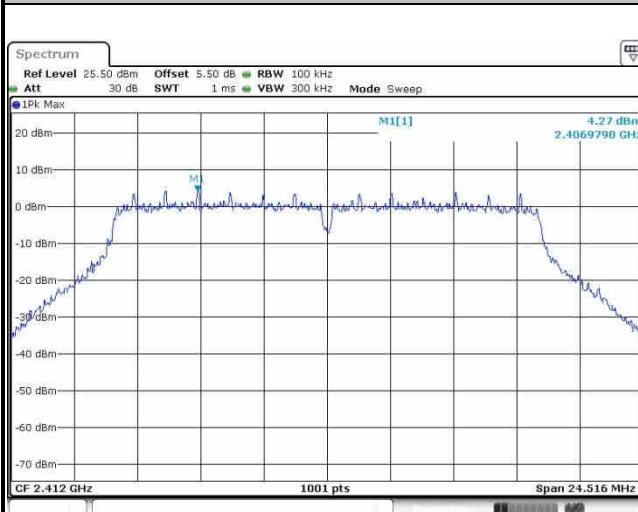
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Test Mode :	802.11g	Temperature :	21~25°C
Test Band :	2.4GHz Low	Relative Humidity :	51~55%
Test Channel :	01	Test Engineer :	Silent Hai

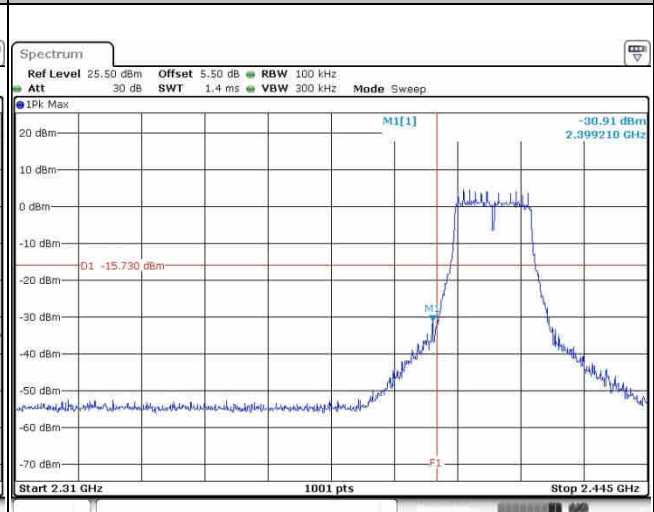
WLAN 802.11g Channel 01

100kHz PSD reference Level



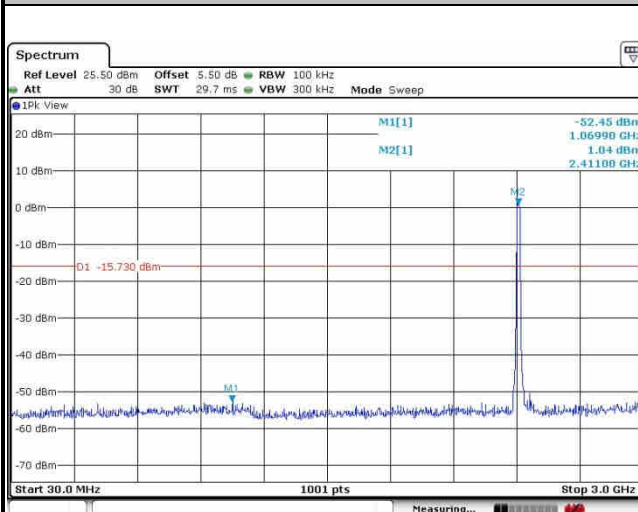
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Low Channel Plot



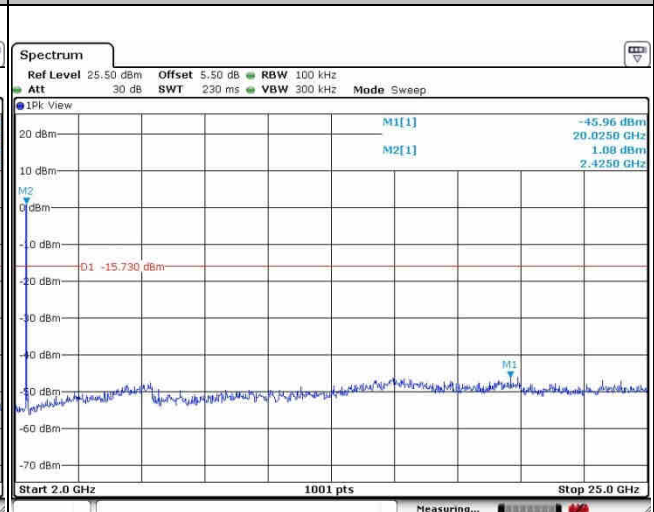
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Spurious Emission 30MHz~3GHz



Date: 8.AUG.2017 01:34:47

Spurious Emission 2GHz~25GHz



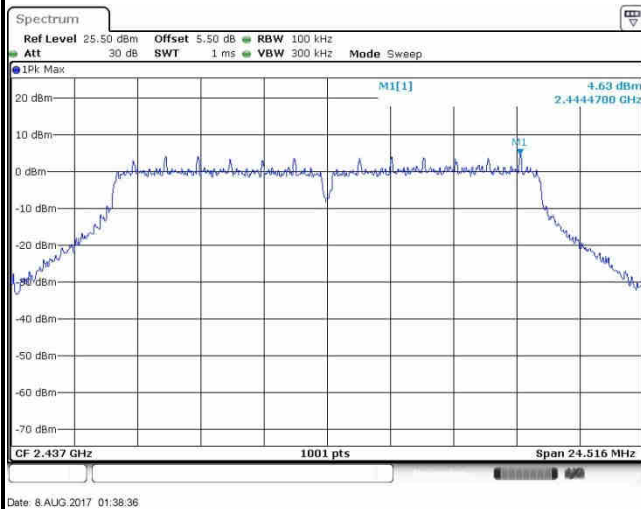
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Test Mode :	802.11g	Temperature :	21~25°C
Test Band :	2.4GHz Mid	Relative Humidity :	51~55%
Test Channel :	06	Test Engineer :	Silent Hai

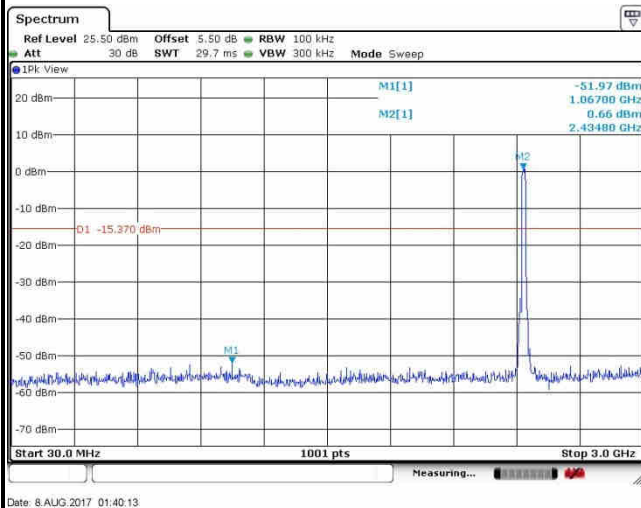
WLAN 802.11g Channel 06

100kHz PSD reference Level

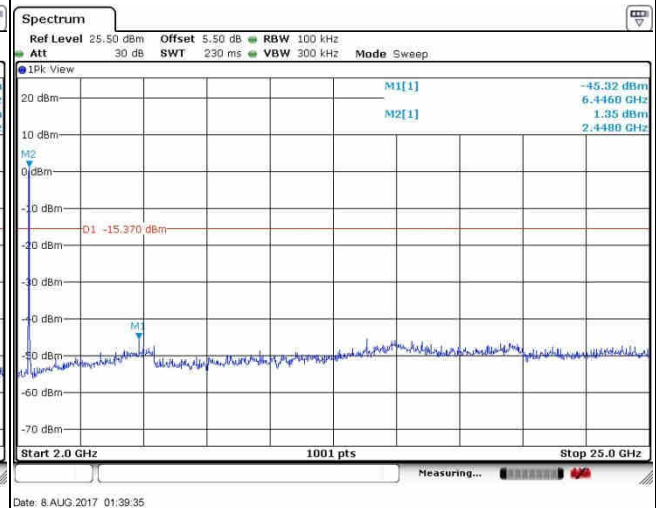


Mid Channel Plot

Spurious Emission 30MHz~3GHz

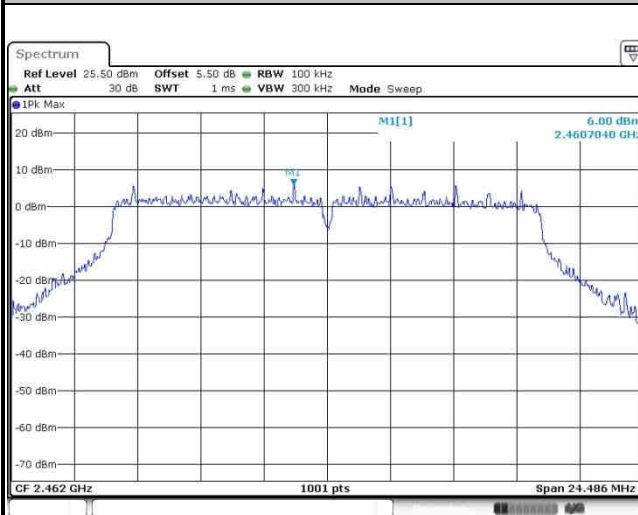
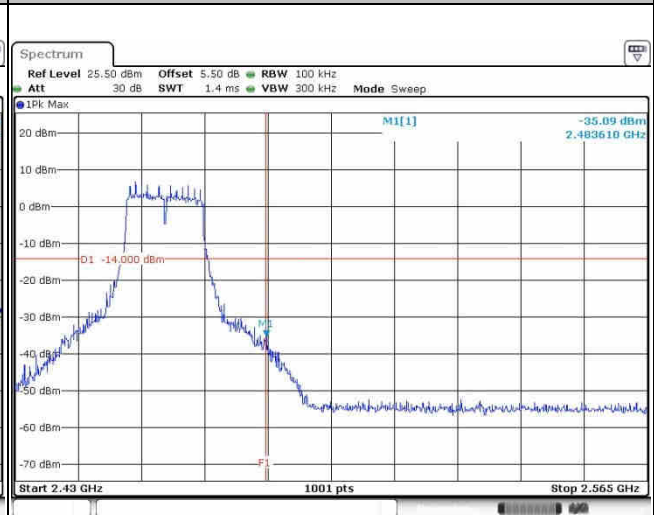
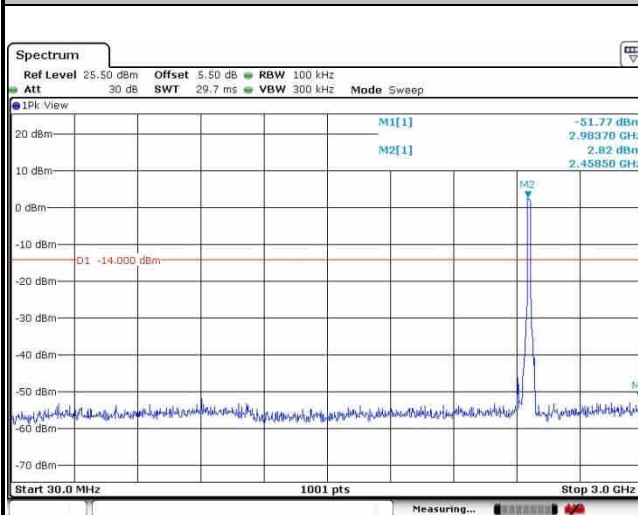
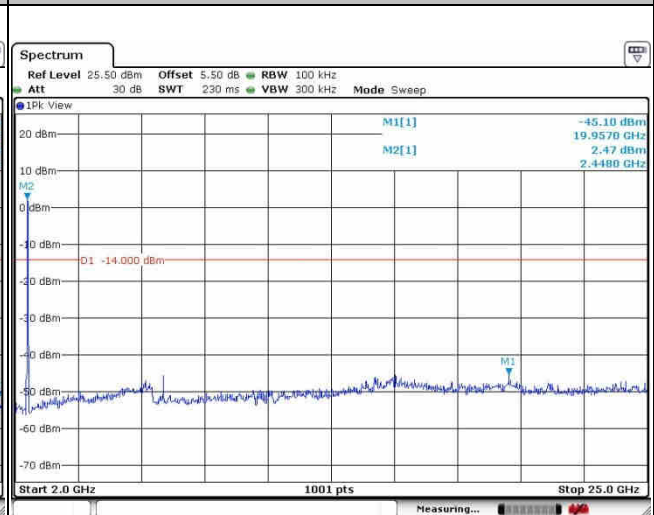


Spurious Emission 2GHz~25GHz



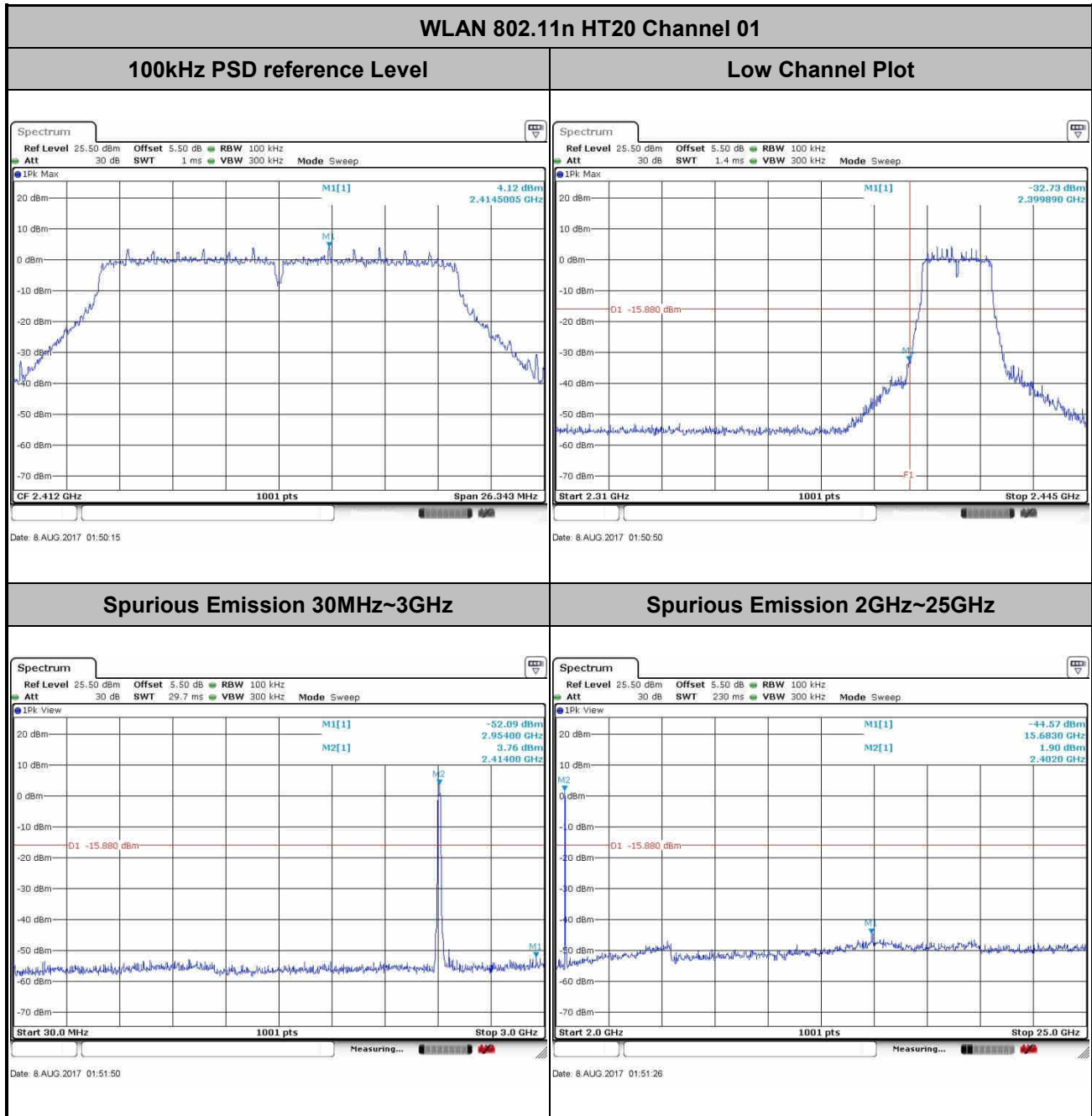


Test Mode :	802.11g	Temperature :	21~25°C
Test Band :	2.4GHz High	Relative Humidity :	51~55%
Test Channel :	11	Test Engineer :	Silent Hai

WLAN 802.11g Channel 11**100kHz PSD reference Level****High Channel Plot****Spurious Emission 30MHz~3GHz****Spurious Emission 2GHz~25GHz**

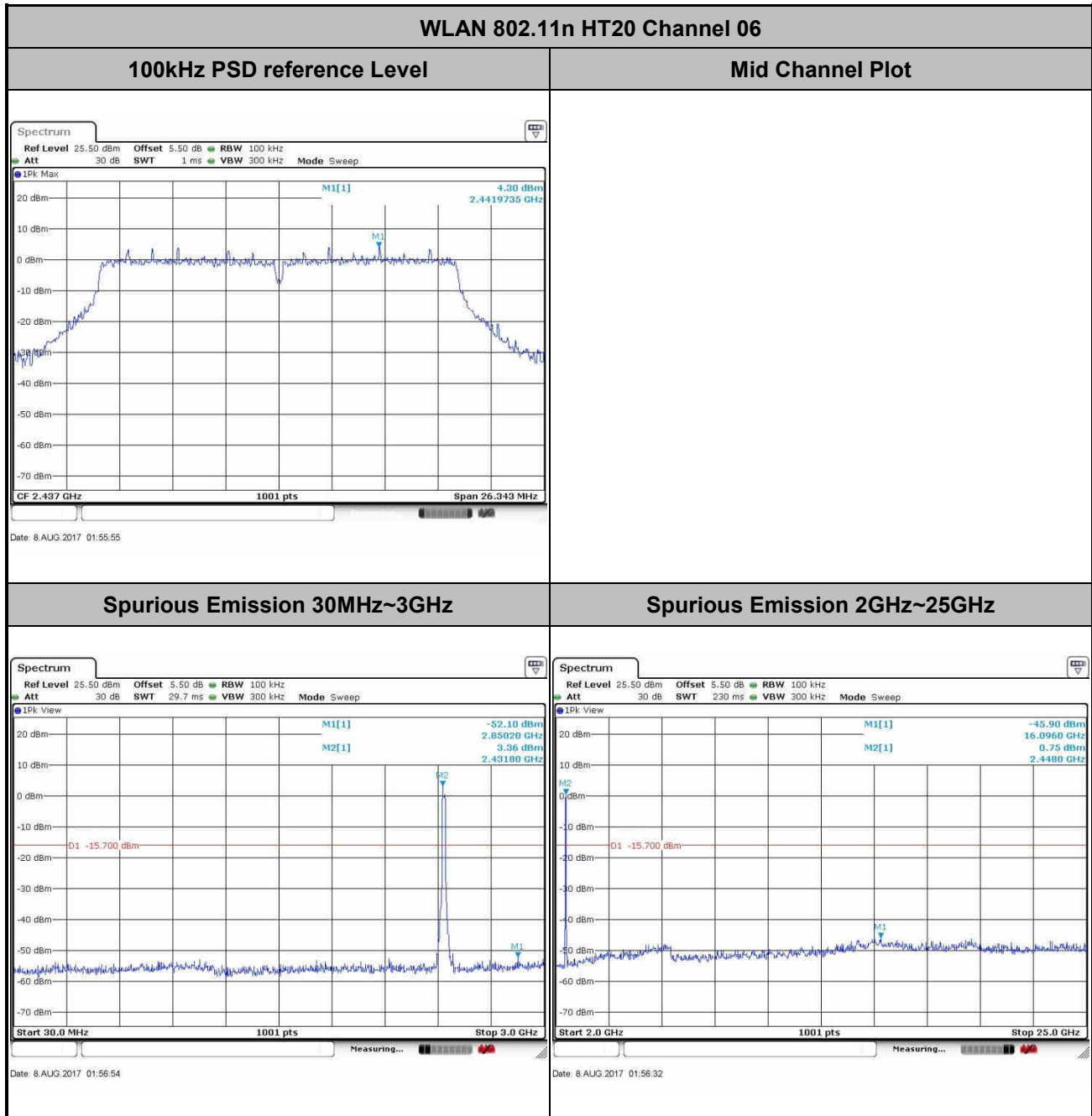


Test Mode :	802.11n HT20	Temperature :	21~25°C
Test Band :	2.4GHz Low	Relative Humidity :	51~55%
Test Channel :	01	Test Engineer :	Silent Hai



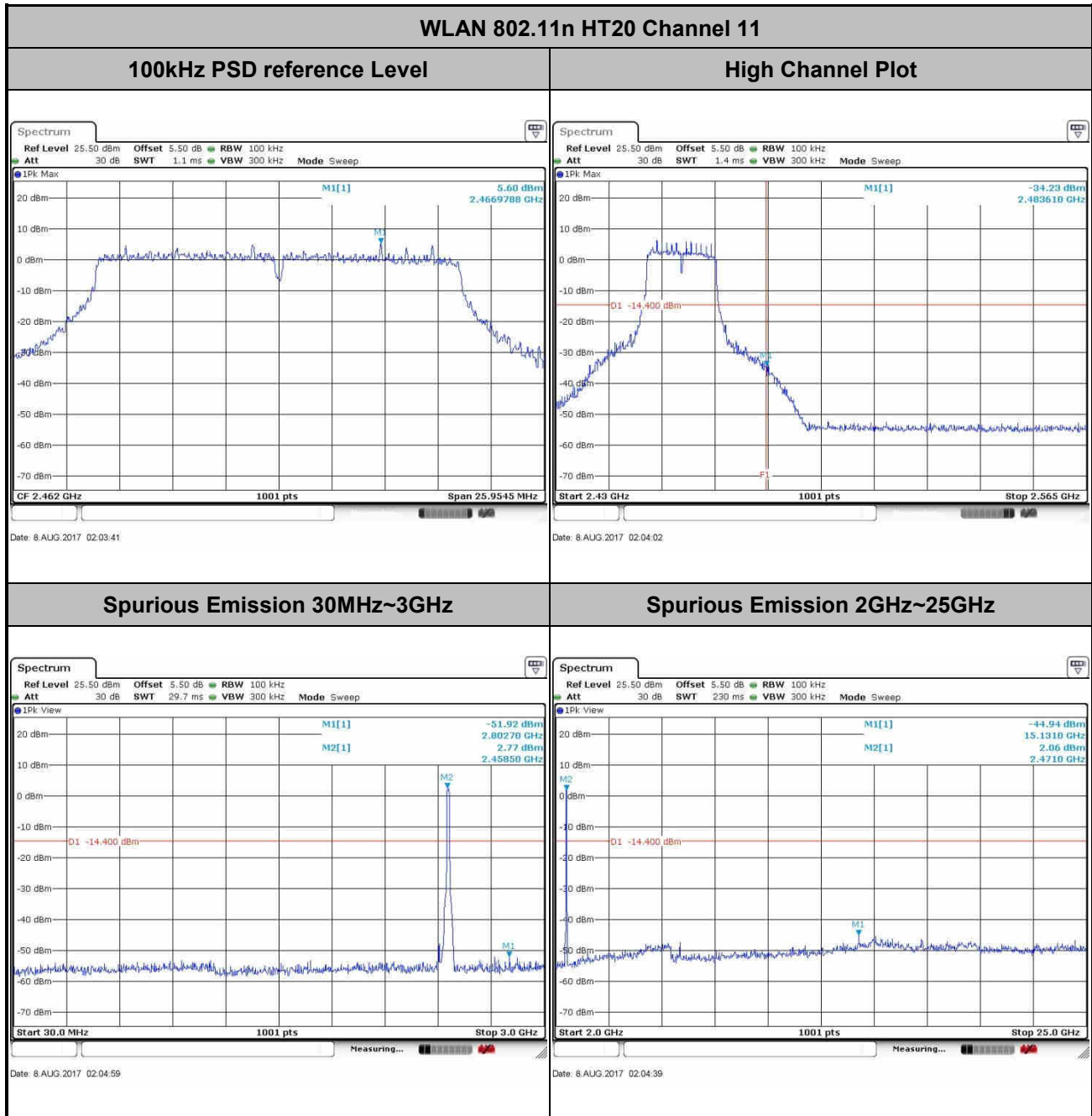


Test Mode :	802.11n HT20	Temperature :	21~25°C
Test Band :	2.4GHz Mid	Relative Humidity :	51~55%
Test Channel :	06	Test Engineer :	Silent Hai



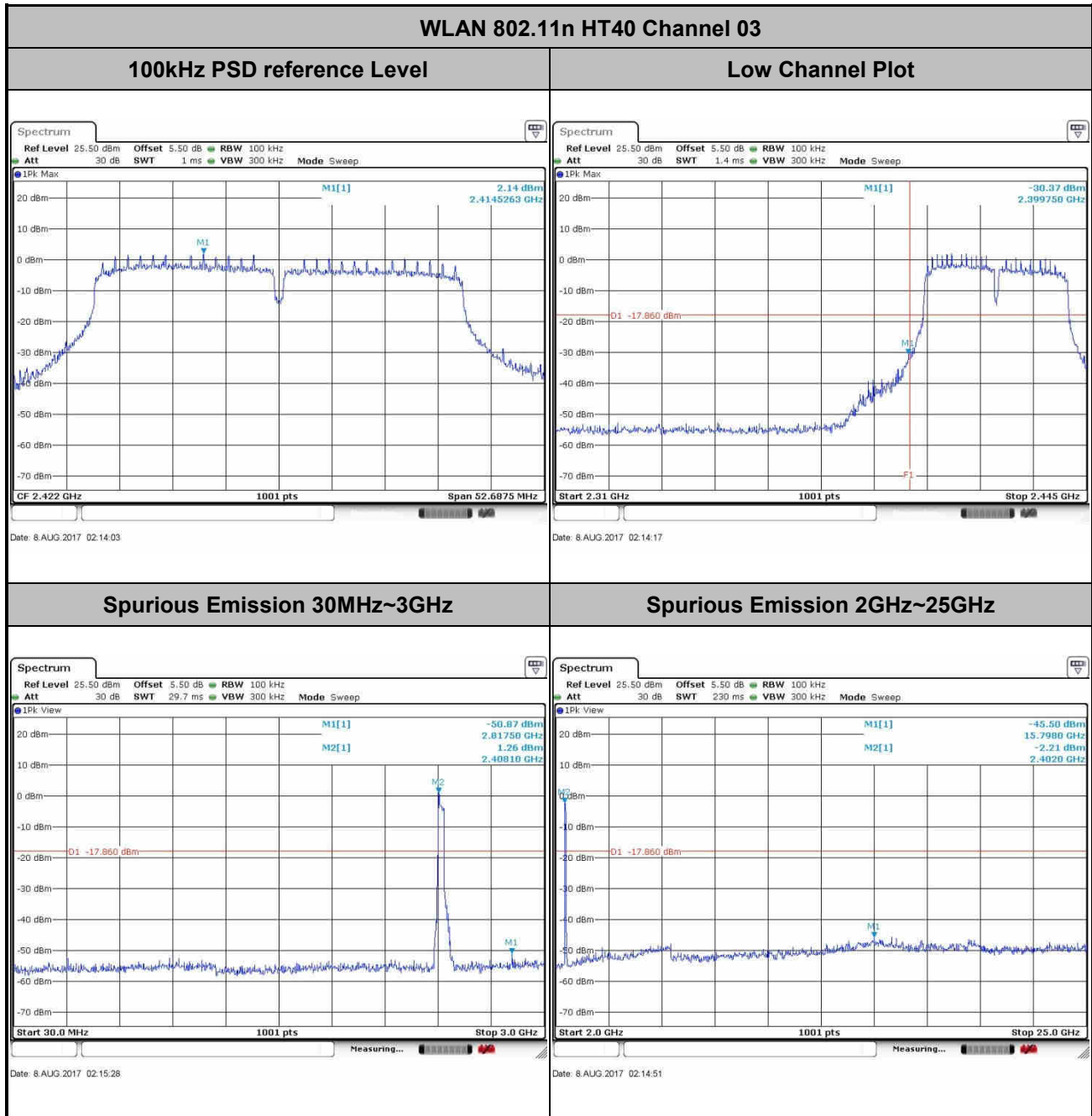


Test Mode :	802.11n HT20	Temperature :	21~25°C
Test Band :	2.4GHz High	Relative Humidity :	51~55%
Test Channel :	11	Test Engineer :	Silent Hai



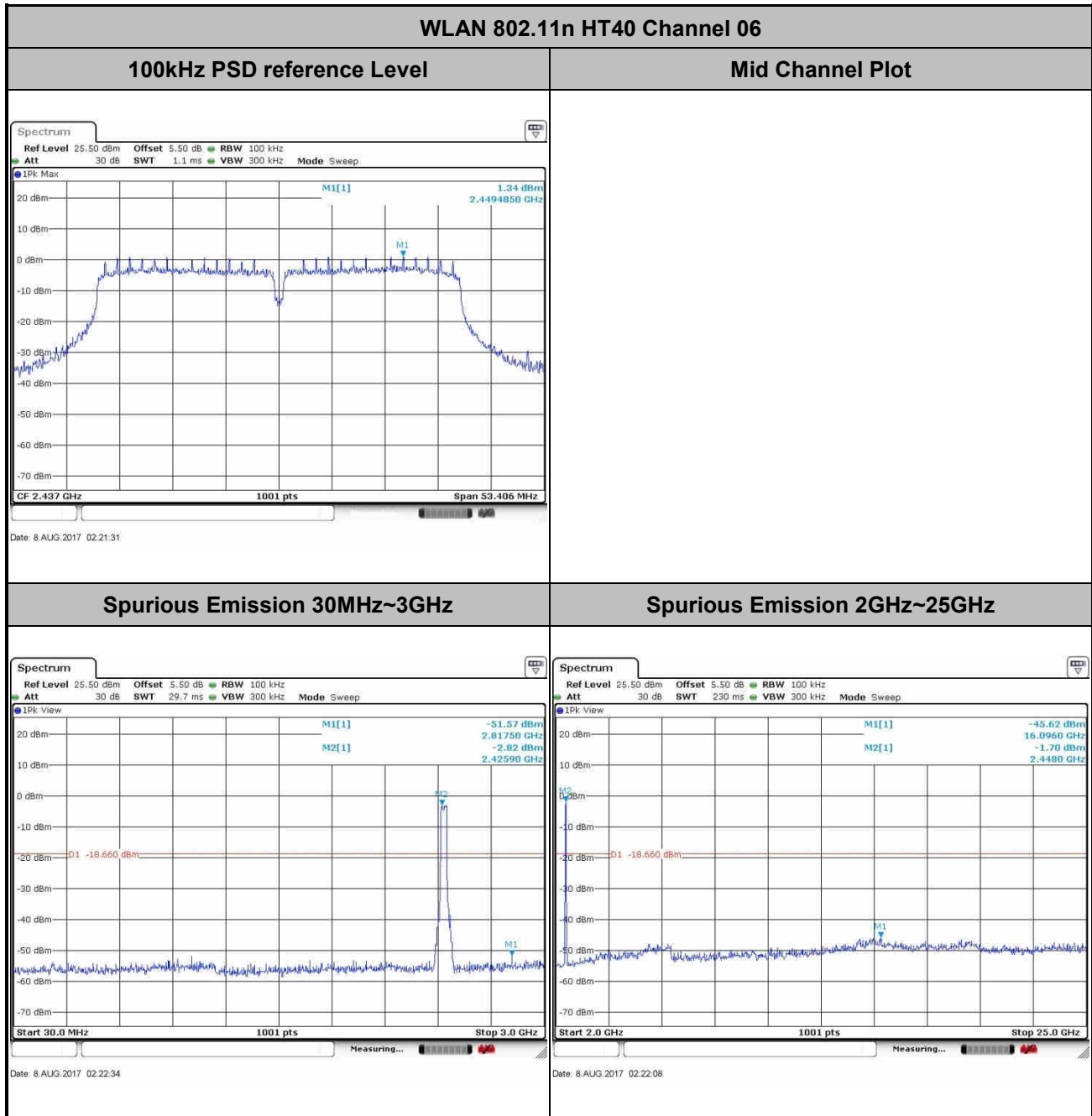


Test Mode :	802.11n HT40	Temperature :	21~25°C
Test Band :	2.4GHz Low	Relative Humidity :	51~55%
Test Channel :	03	Test Engineer :	Silent Hai



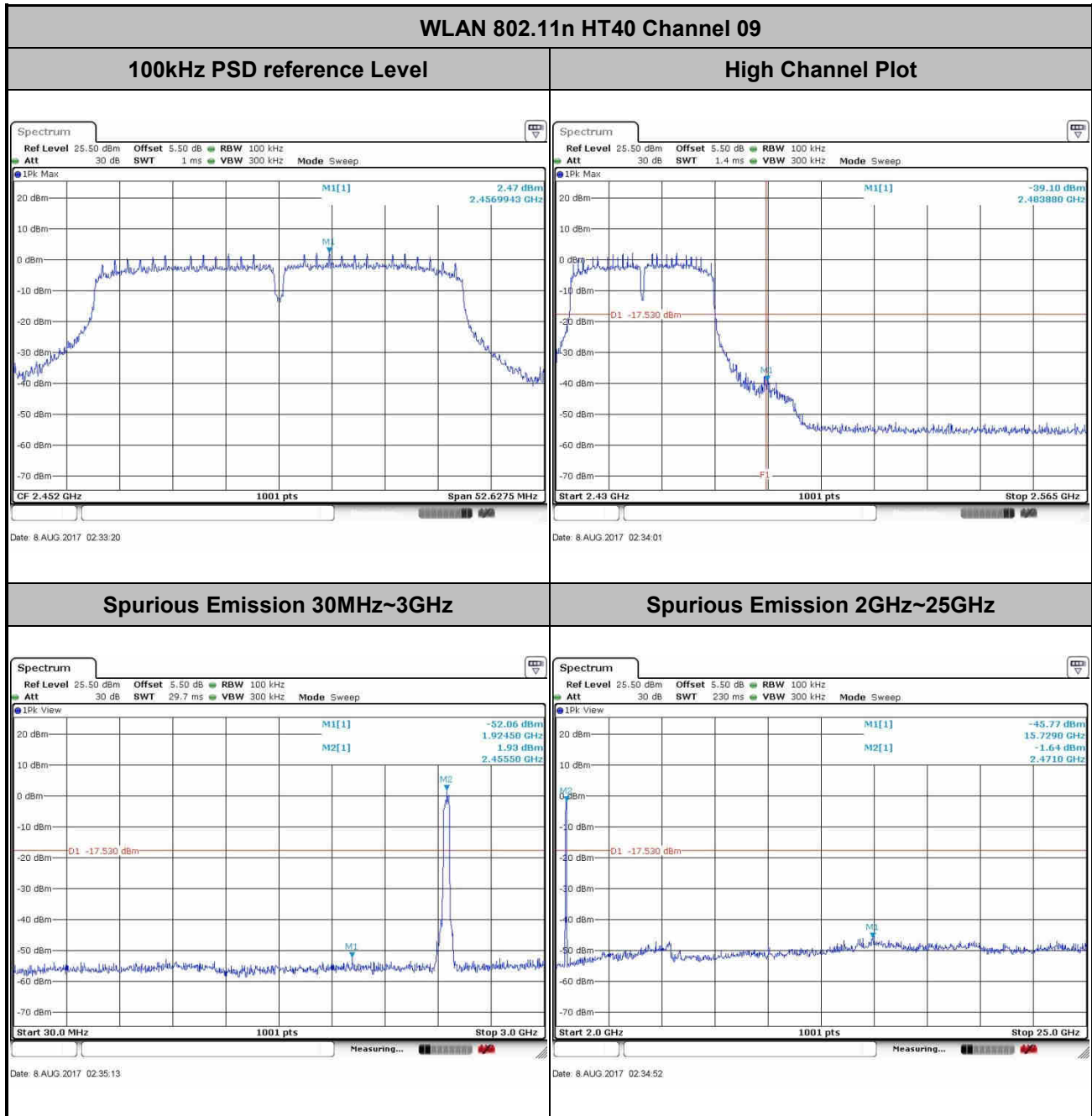


Test Mode :	802.11n HT40	Temperature :	21~25°C
Test Band :	2.4GHz Mid	Relative Humidity :	51~55%
Test Channel :	06	Test Engineer :	Silent Hai





Test Mode :	802.11n HT40	Temperature :	21~25°C
Test Band :	2.4GHz High	Relative Humidity :	51~55%
Test Channel :	09	Test Engineer :	Silent Hai



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 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 Procedures

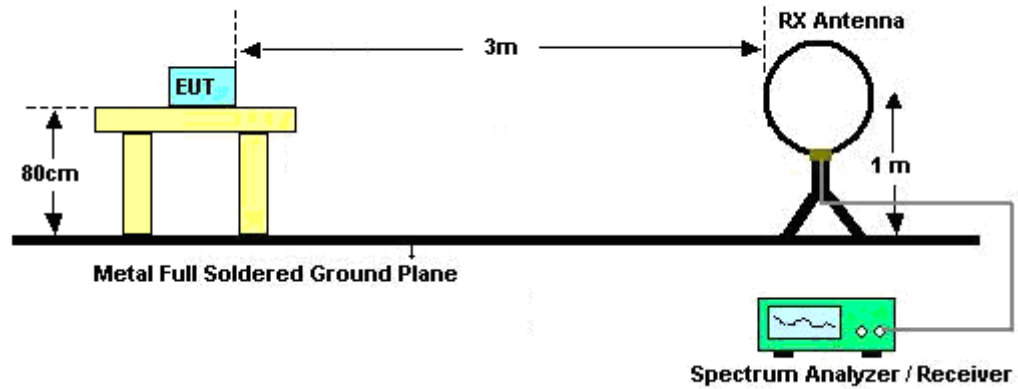
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test 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:

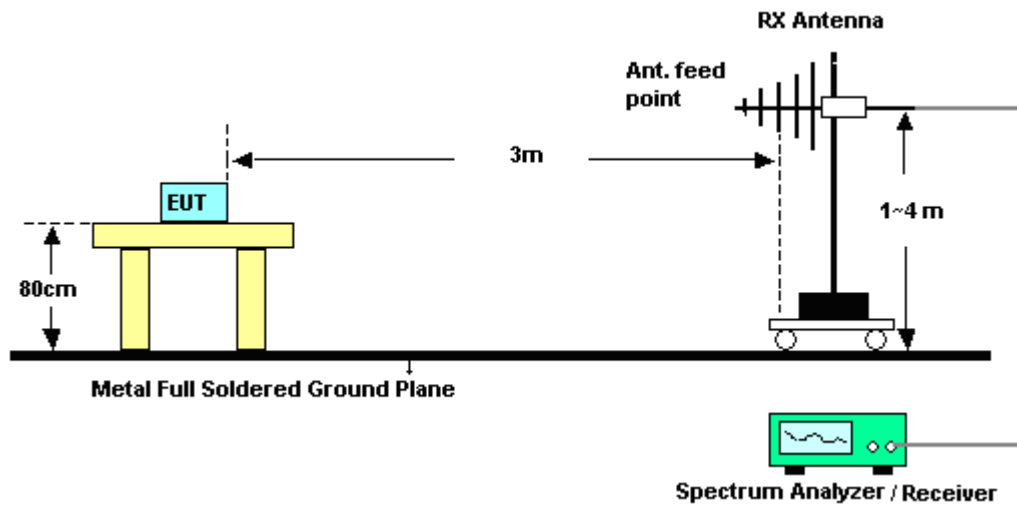
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

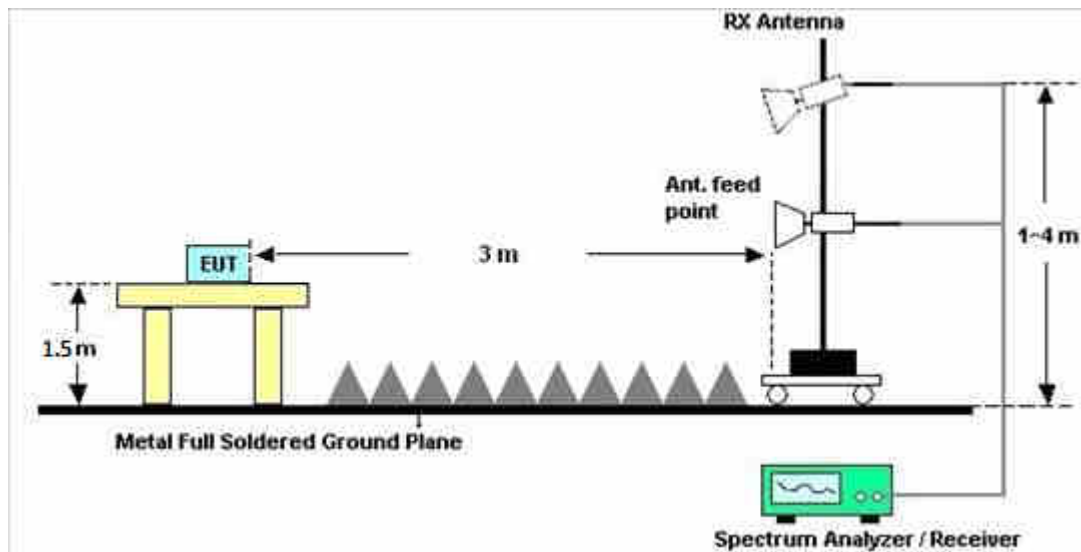
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (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 was not reported.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.5.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix B.

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.

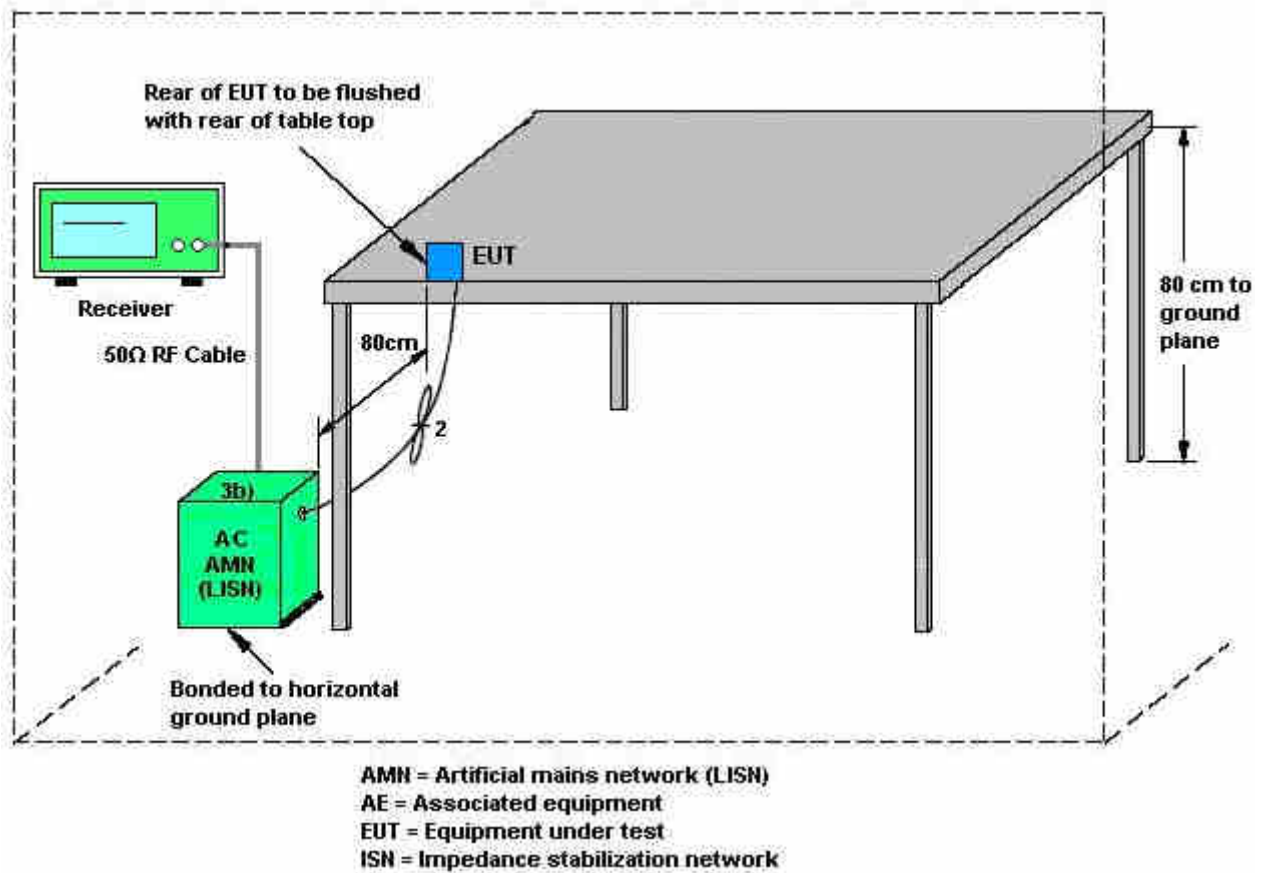
3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

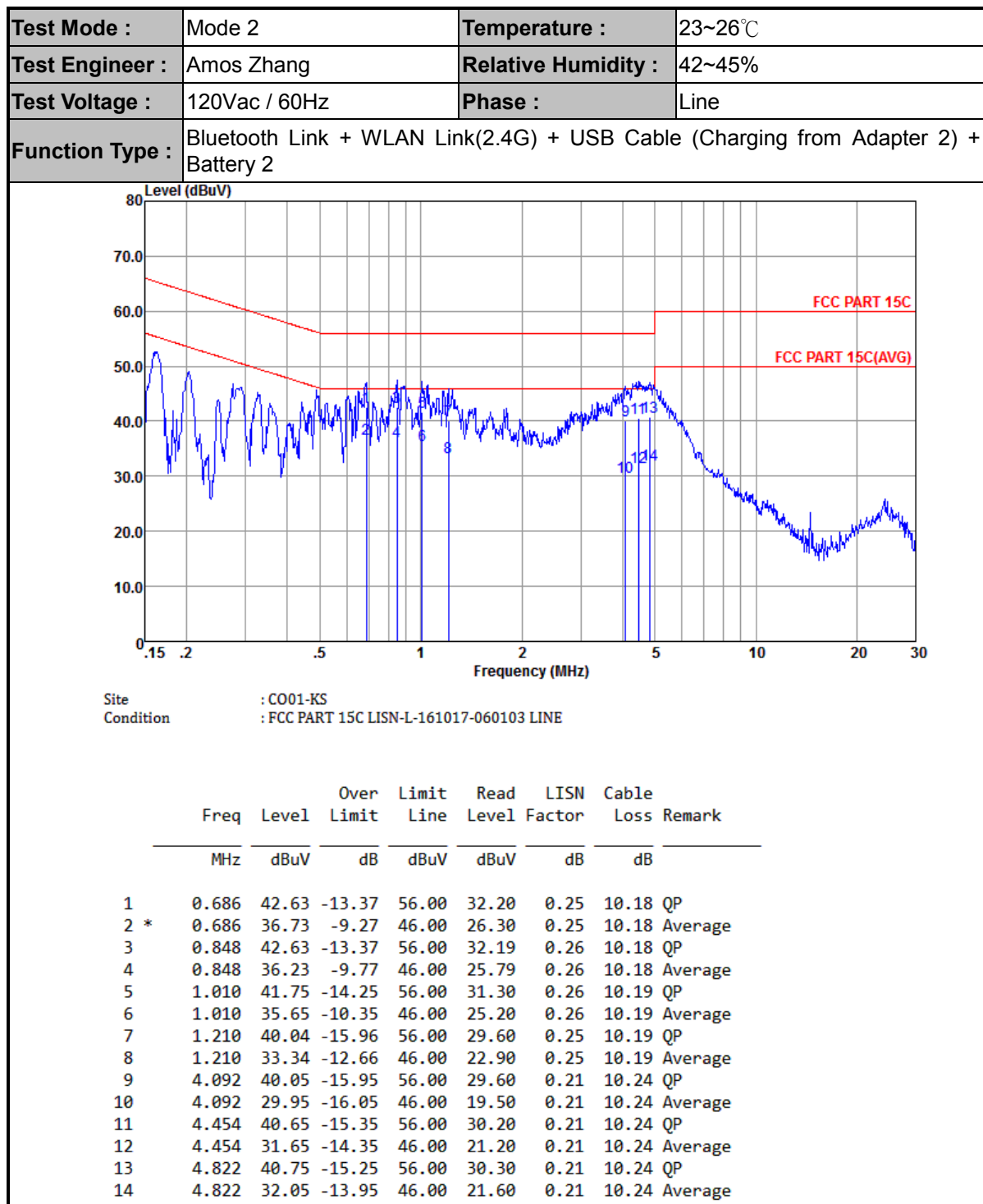
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other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



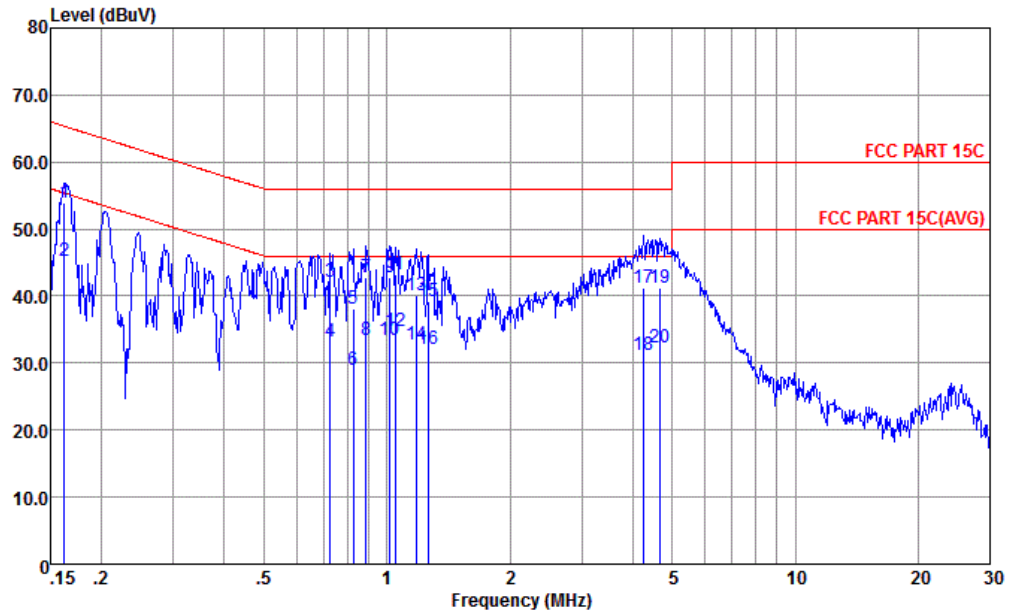


3.6.5 Test Result of AC Conducted Emission





Test Mode :	Mode 2	Temperature :	23~26°C
Test Engineer :	Amos Zhang	Relative Humidity :	42~45%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Link + WLAN Link(2.4G) + USB Cable (Charging from Adapter 2) + Battery 2		



Site : CO01-KS
Condition : FCC PART 15C LISN-N-161017-060103 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.162	53.91	-11.43	65.34	43.19	0.34	10.38	QP
2 *	0.162	45.31	-10.03	55.34	34.59	0.34	10.38	Average
3	0.727	42.16	-13.84	56.00	31.60	0.38	10.18	QP
4	0.727	33.16	-12.84	46.00	22.60	0.38	10.18	Average
5	0.826	38.16	-17.84	56.00	27.59	0.39	10.18	QP
6	0.826	28.86	-17.14	46.00	18.29	0.39	10.18	Average
7	0.890	42.77	-13.23	56.00	32.20	0.39	10.18	QP
8	0.890	33.47	-12.53	46.00	22.90	0.39	10.18	Average
9	1.016	42.79	-13.21	56.00	32.20	0.40	10.19	QP
10	1.016	33.49	-12.51	46.00	22.90	0.40	10.19	Average
11	1.049	43.19	-12.81	56.00	32.60	0.40	10.19	QP
12	1.049	34.79	-11.21	46.00	24.20	0.40	10.19	Average
13	1.178	40.19	-15.81	56.00	29.60	0.40	10.19	QP
14	1.178	32.69	-13.31	46.00	22.10	0.40	10.19	Average
15	1.262	39.19	-16.81	56.00	28.60	0.40	10.19	QP
16	1.262	32.19	-13.81	46.00	21.60	0.40	10.19	Average
17	4.247	41.23	-14.77	56.00	30.60	0.39	10.24	QP
18	4.247	31.13	-14.87	46.00	20.50	0.39	10.24	Average
19	4.647	41.23	-14.77	56.00	30.61	0.38	10.24	QP
20	4.647	32.23	-13.77	46.00	21.61	0.38	10.24	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. 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 rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Aug. 08, 2017	Aug. 08, 2017	Aug. 07, 2018	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 19, 2017	Aug. 08, 2017	Jan. 18, 2018	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 19, 2017	Aug. 08, 2017	Jan. 18, 2018	Conducted (TH01-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 20, 2017	Jul. 22, 2017	Apr. 19, 2018	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2016	Jul. 22, 2017	Oct. 12, 2017	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Oct. 13, 2016	Jul. 22, 2017	Oct. 12, 2017	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 13, 2016	Jul. 22, 2017	Oct. 12, 2017	Conduction (CO01-KS)
EMI Test Receiver	R&S	ESR7	101404	9kHz~7GHz	Apr. 20, 2017	Aug. 06, 2017	Apr. 19, 2018	Radiation (03CH04-SZ)
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY55150213	10Hz~44GHz	Apr. 20, 2017	Aug. 06, 2017	Apr. 19, 2018	Radiation (03CH04-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	May 14, 2017	Aug. 06, 2017	May 13, 2018	Radiation (03CH04-SZ)
Bilog Antenna	TeseQ	CBL6111D	41909	30MHz~1GHz	May 16, 2017	Aug. 06, 2017	May 15, 2018	Radiation (03CH04-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1474	1GHz~18GHz	Jan. 12, 2017	Aug. 06, 2017	Jan. 11, 2018	Radiation (03CH04-SZ)
Horn Antenna	SCHWARZBECK	BBHA9170	9170#679	15GHz~40GHz	May 17, 2017	Aug. 06, 2017	May 16, 2018	Radiation (03CH04-SZ)
Amplifier	Burgeon	BPA-530	102211	0.01Hz~3000MHz	Oct. 11, 2016	Aug. 06, 2017	Oct. 10, 2017	Radiation (03CH04-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 11, 2016	Aug. 06, 2017	Oct. 10, 2017	Radiation (03CH04-SZ)
Amplifier	Agilent Technologies	83017A	MY53270156	500MHz~26.5GHz	Apr. 20, 2017	Aug. 06, 2017	Apr. 19, 2018	Radiation (03CH04-SZ)
AC Power Source	Chroma	61601	N/A	N/A	NCR	Aug. 06, 2017	NCR	Radiation (03CH04-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Aug. 06, 2017	NCR	Radiation (03CH04-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Aug. 06, 2017	NCR	Radiation (03CH04-SZ)

NCR: No Calibration Required.

5 Uncertainty of Evaluation

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

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.1 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.1 dB
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Appendix A. Conducted Test Results

A1 - DTS Part

Test Engineer:	Silent Hai	Temperature:	21~25	°C
Test Date:	2017/08/08	Relative Humidity:	51~55	%

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
11b	1Mbps	1	1	2412	12.94	8.05	0.50	Pass
11b	1Mbps	1	6	2437	13.24	8.51	0.50	Pass
11b	1Mbps	1	11	2462	12.94	8.51	0.50	Pass
11g	6Mbps	1	1	2412	18.13	16.34	0.50	Pass
11g	6Mbps	1	6	2437	18.63	16.34	0.50	Pass
11g	6Mbps	1	11	2462	18.33	16.32	0.50	Pass
HT20	MCS0	1	1	2412	18.98	17.56	0.50	Pass
HT20	MCS0	1	6	2437	19.43	17.56	0.50	Pass
HT20	MCS0	1	11	2462	19.13	17.30	0.50	Pass
HT40	MCS0	1	3	2422	35.56	35.13	0.50	Pass
HT40	MCS0	1	6	2437	36.96	35.60	0.50	Pass
HT40	MCS0	1	9	2452	36.36	35.09	0.50	Pass

TEST RESULTS DATA
Peak Power Table

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
11b	1Mbps	1	1	2412	19.12	30.00	0.50	19.62	36.00	Pass
11b	1Mbps	1	6	2437	18.63	30.00	0.50	19.13	36.00	Pass
11b	1Mbps	1	11	2462	21.42	30.00	0.50	21.92	36.00	Pass
11g	6Mbps	1	1	2412	24.65	30.00	0.50	25.15	36.00	Pass
11g	6Mbps	1	6	2437	23.65	30.00	0.50	24.15	36.00	Pass
11g	6Mbps	1	11	2462	25.46	30.00	0.50	25.96	36.00	Pass
HT20	MCS0	1	1	2412	24.56	30.00	0.50	25.06	36.00	Pass
HT20	MCS0	1	6	2437	23.82	30.00	0.50	24.32	36.00	Pass
HT20	MCS0	1	11	2462	25.48	30.00	0.50	25.98	36.00	Pass
HT40	MCS0	1	3	2422	24.29	30.00	0.50	24.79	36.00	Pass
HT40	MCS0	1	6	2437	23.81	30.00	0.50	24.31	36.00	Pass
HT40	MCS0	1	9	2452	24.85	30.00	0.50	25.35	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

2.4GHz Band						
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
11b	1Mbps	1	1	2412	0.11	16.29
11b	1Mbps	1	6	2437	0.11	15.92
11b	1Mbps	1	11	2462	0.11	18.17
11g	6Mbps	1	1	2412	0.58	15.29
11g	6Mbps	1	6	2437	0.58	15.50
11g	6Mbps	1	11	2462	0.58	17.23
HT20	MCS0	1	1	2412	0.62	15.14
HT20	MCS0	1	6	2437	0.62	15.64
HT20	MCS0	1	11	2462	0.62	17.35
HT40	MCS0	1	3	2422	0.64	14.49
HT40	MCS0	1	6	2437	0.64	14.28
HT40	MCS0	1	9	2452	0.64	15.08

TEST RESULTS DATA
Peak Power 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
11b	1Mbps	1	1	2412	-6.51	0.50	8.00	Pass
11b	1Mbps	1	6	2437	-5.35	0.50	8.00	Pass
11b	1Mbps	1	11	2462	-3.78	0.50	8.00	Pass
11g	6Mbps	1	1	2412	-9.73	0.50	8.00	Pass
11g	6Mbps	1	6	2437	-9.50	0.50	8.00	Pass
11g	6Mbps	1	11	2462	-7.83	0.50	8.00	Pass
HT20	MCS0	1	1	2412	-10.58	0.50	8.00	Pass
HT20	MCS0	1	6	2437	-9.52	0.50	8.00	Pass
HT20	MCS0	1	11	2462	-8.64	0.50	8.00	Pass
HT40	MCS0	1	3	2422	-12.77	0.50	8.00	Pass
HT40	MCS0	1	6	2437	-13.42	0.50	8.00	Pass
HT40	MCS0	1	9	2452	-12.22	0.50	8.00	Pass



Appendix B. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

WIFI 802.11b (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamplifier Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2389.065	42.35	-31.65	74	42.61	27.43	5.64	33.33	100	188	P	H
		2389.695	32.23	-21.77	54	32.49	27.43	5.64	33.33	100	188	A	H
	*	2412	98.47	-	-	98.66	27.49	5.64	33.32	100	188	P	H
	*	2412	94.69	-	-	94.88	27.49	5.64	33.32	100	188	A	H
		2346.855	41.25	-32.75	74	41.75	27.24	5.59	33.33	106	119	P	V
		2389.8	31.88	-22.12	54	32.13	27.43	5.64	33.32	106	119	A	V
	*	2412	101.54	-	-	101.73	27.49	5.64	33.32	106	119	P	V
	*	2412	95.82	-	-	96.01	27.49	5.64	33.32	106	119	P	V
802.11b CH 06 2437MHz		2383.64	41.25	-32.75	74	41.62	27.37	5.59	33.33	150	189	P	H
		2389.66	31.65	-22.35	54	31.91	27.43	5.64	33.33	150	189	A	H
	*	2437	98.58	-	-	98.6	27.61	5.68	33.31	150	189	P	H
	*	2437	95.1	-	-	95.12	27.61	5.68	33.31	150	189	A	H
		2490.2	42.27	-31.73	74	42.06	27.8	5.72	33.31	150	189	P	H
		2484.04	32.06	-21.94	54	31.91	27.74	5.72	33.31	150	189	A	H
		2389.52	49.67	-24.33	74	49.93	27.43	5.64	33.33	100	117	P	V
		2389.94	33.59	-20.41	54	33.84	27.43	5.64	33.32	100	117	A	V
	*	2437	103	-	-	103.02	27.61	5.68	33.31	100	117	P	V
	*	2437	99.35	-	-	99.37	27.61	5.68	33.31	100	117	A	V
		2490.41	45.94	-28.06	74	45.73	27.8	5.72	33.31	100	117	P	V
		2489.92	33.79	-20.21	54	33.58	27.8	5.72	33.31	100	117	A	V



802.11b CH 11 2462MHz	*	2462	99.99	-	-	99.94	27.68	5.68	33.31	145	188	P	H
	*	2462	96.26	-	-	96.21	27.68	5.68	33.31	145	188	A	H
		2487.96	59.53	-14.47	74	59.32	27.8	5.72	33.31	145	188	P	H
		2485.12	32.88	-21.12	54	32.73	27.74	5.72	33.31	145	188	A	H
	*	2462	106.14	-	-	106.09	27.68	5.68	33.31	100	117	P	V
	*	2462	102.4	-	-	102.35	27.68	5.68	33.31	100	117	A	V
		2485.28	46.69	-27.31	74	46.54	27.74	5.72	33.31	100	117	P	V
		2483.84	35.88	-18.12	54	35.73	27.74	5.72	33.31	100	117	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b CH 01 2412MHz		4824	45.89	-28.11	74	63.18	31.49	7.82	56.6	147	360	P	H
		4824	43.23	-30.77	74	60.52	31.49	7.82	56.6	147	360	P	V
802.11b CH 06 2437MHz		4874	40.97	-33.03	74	58.45	31.61	7.82	56.91	153	360	P	H
		7311	43.9	-30.1	74	56.56	36.17	9.17	58	153	360	P	H
		4874	40.21	-33.79	74	57.69	31.61	7.82	56.91	153	360	P	V
		7311	43.63	-30.37	74	56.29	36.17	9.17	58	153	360	P	V
802.11b CH 11 2462MHz		4924	48.45	-25.55	74	64.98	31.73	7.82	56.08	147	360	P	H
		7386	43.41	-30.59	74	55.93	36.28	9.21	58.01	147	360	P	H
		4924	44.86	-29.14	74	61.39	31.73	7.82	56.08	147	360	P	V
		7386	47.13	-26.87	74	59.65	36.28	9.21	58.01	147	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



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

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 01 2412MHz		2389.275	54.93	-19.07	74	55.19	27.43	5.64	33.33	152	186	P	H
		2389.17	43.55	-10.45	54	43.81	27.43	5.64	33.33	152	186	A	H
	*	2412	98.13	-	-	98.32	27.49	5.64	33.32	152	186	P	H
	*	2412	89.6	-	-	89.79	27.49	5.64	33.32	152	186	A	H
		2389.59	58.37	-15.63	74	58.63	27.43	5.64	33.33	100	235	P	V
		2389.485	45.06	-8.94	54	45.32	27.43	5.64	33.33	100	235	A	V
	*	2412	103.17	-	-	103.36	27.49	5.64	33.32	100	235	P	V
	*	2412	95.43	-	-	95.62	27.49	5.64	33.32	100	235	A	V
802.11g CH 06 2437MHz		2384.48	42.68	-31.32	74	43.05	27.37	5.59	33.33	123	189	P	H
		2384.9	33.44	-20.56	54	33.76	27.37	5.64	33.33	123	189	A	H
	*	2437	98.46	-	-	98.48	27.61	5.68	33.31	123	189	P	H
	*	2437	91.08	-	-	91.1	27.61	5.68	33.31	123	189	A	H
		2489.5	49.31	-24.69	74	49.1	27.8	5.72	33.31	123	189	P	H
		2489.43	35.89	-18.11	54	35.68	27.8	5.72	33.31	123	189	A	H
		2389.66	46.47	-27.53	74	46.73	27.43	5.64	33.33	118	117	P	V
		2384.62	35.52	-18.48	54	35.84	27.37	5.64	33.33	118	117	A	V
	*	2437	103.42	-	-	103.44	27.61	5.68	33.31	118	117	P	V
	*	2437	95.89	-	-	95.91	27.61	5.68	33.31	118	117	A	V
		2490.34	47.63	-26.37	74	47.42	27.8	5.72	33.31	118	117	P	V
		2489.36	38.93	-15.07	54	38.72	27.8	5.72	33.31	118	117	A	V



802.11g CH 11 2462MHz	*	2462	99.07	-	-	99.02	27.68	5.68	33.31	119	188	P	H
	*	2462	91.76	-	-	91.71	27.68	5.68	33.31	119	188	A	H
		2483.84	63.49	-10.51	74	63.34	27.74	5.72	33.31	119	188	P	H
		2483.64	46.75	-7.25	54	46.6	27.74	5.72	33.31	119	188	A	H
	*	2462	104.4	-	-	104.35	27.68	5.68	33.31	134	108	P	V
	*	2462	96.87	-	-	96.82	27.68	5.68	33.31	134	108	A	V
		2484.04	66.29	-7.71	74	66.14	27.74	5.72	33.31	134	108	P	V
		2483.52	50.99	-3.01	54	50.84	27.74	5.72	33.31	134	108	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 01 2412MHz		4824	43.51	-30.49	74	60.8	31.49	7.82	56.6	153	360	P	H
		4824	43.35	-30.65	74	60.64	31.49	7.82	56.6	153	360	P	V
802.11g CH 06 2437MHz		4874	41.08	-32.92	74	58.56	31.61	7.82	56.91	153	360	P	H
		7311	43.09	-30.91	74	55.75	36.17	9.17	58	153	360	P	H
		4874	40.85	-33.15	74	58.33	31.61	7.82	56.91	153	360	P	V
		7311	47.41	-26.59	74	60.07	36.17	9.17	58	153	360	P	V
802.11g CH 11 2462MHz		4924	43.4	-30.6	74	59.93	31.73	7.82	56.08	153	360	P	H
		7386	42.28	-31.72	74	54.8	36.28	9.21	58.01	153	360	P	H
		4924	42.16	-31.84	74	58.69	31.73	7.82	56.08	153	360	P	V
		7386	42.28	-31.72	74	54.8	36.28	9.21	58.01	153	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		2389.8	58.16	-15.84	74	58.41	27.43	5.64	33.32	152	189	P	H
		2389.485	39.65	-14.35	54	39.91	27.43	5.64	33.33	152	189	A	H
	*	2412	99.28	-	-	99.47	27.49	5.64	33.32	152	189	P	H
	*	2412	90.55	-	-	90.74	27.49	5.64	33.32	152	189	A	H
		2389.38	70.5	-3.5	74	70.76	27.43	5.64	33.33	100	117	P	V
		2389.59	43.29	-10.71	54	43.55	27.43	5.64	33.33	100	117	A	V
	*	2412	104.05	-	-	104.24	27.49	5.64	33.32	100	117	P	V
	*	2412	95.6	-	-	95.79	27.49	5.64	33.32	100	117	A	V
802.11n HT20 CH 06 2437MHz		2385.46	42.46	-31.54	74	42.78	27.37	5.64	33.33	119	189	P	H
		2385.32	34.42	-19.58	54	34.74	27.37	5.64	33.33	119	189	A	H
	*	2437	99.31	-	-	99.33	27.61	5.68	33.31	119	189	P	H
	*	2437	90.79	-	-	90.81	27.61	5.68	33.31	119	189	A	H
		2488.52	45.7	-28.3	74	45.49	27.8	5.72	33.31	119	189	P	H
		2488.8	37.33	-16.67	54	37.12	27.8	5.72	33.31	119	189	A	H
		2389.24	45.67	-28.33	74	45.93	27.43	5.64	33.33	100	120	P	V
		2385.32	37.36	-16.64	54	37.68	27.37	5.64	33.33	100	120	A	V
	*	2437	104.22	-	-	104.24	27.61	5.68	33.31	100	120	P	V
	*	2437	96.79	-	-	96.81	27.61	5.68	33.31	100	120	A	V
		2490.27	50.47	-23.53	74	50.26	27.8	5.72	33.31	100	120	P	V
		2488.73	43.62	-10.38	54	43.41	27.8	5.72	33.31	100	120	A	V



802.11n HT20 CH 11 2462MHz	*	2462	98.62	-	-	98.57	27.68	5.68	33.31	116	187	P	H
	*	2462	90.69	-	-	90.64	27.68	5.68	33.31	116	187	A	H
		2483.8	63.15	-10.85	74	63	27.74	5.72	33.31	116	187	P	H
		2484.12	49.92	-4.08	54	49.77	27.74	5.72	33.31	116	187	A	H
	*	2454	104.44	-	-	104.39	27.68	5.68	33.31	100	120	P	V
	*	2460	99.49	-	-	99.44	27.68	5.68	33.31	100	120	A	V
		2483.8	66.4	-7.6	74	66.25	27.74	5.72	33.31	100	120	P	V
		2483.64	49.3	-4.7	54	49.15	27.74	5.72	33.31	100	120	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



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

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		4824	42.81	-31.19	74	60.1	31.49	7.82	56.6	153	360	P	H
		4824	43.29	-30.71	74	60.58	31.49	7.82	56.6	153	360	P	V
802.11n HT20 CH 06 2437MHz		4874	40.47	-33.53	74	57.95	31.61	7.82	56.91	147	360	P	H
		7311	44.47	-29.53	74	57.13	36.17	9.17	58	147	360	P	H
		4874	40.69	-33.31	74	58.17	31.61	7.82	56.91	147	360	P	V
		7311	42.95	-31.05	74	55.61	36.17	9.17	58	147	360	P	V
802.11n HT20 CH 11 2462MHz		4924	43.42	-30.58	74	59.95	31.73	7.82	56.08	147	360	P	H
		7386	42.53	-31.47	74	55.05	36.28	9.21	58.01	147	360	P	H
		4924	43.25	-30.75	74	59.78	31.73	7.82	56.08	147	360	P	V
		7386	42.14	-31.86	74	54.66	36.28	9.21	58.01	147	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40 CH 03 2422MHz		2388.54	60.53	-13.47	74	60.79	27.43	5.64	33.33	100	187	P	H
		2389.94	43.19	-10.81	54	43.44	27.43	5.64	33.32	100	187	A	H
	*	2422	96.52	-	-	96.64	27.55	5.64	33.31	100	187	P	H
	*	2422	87.71	-	-	87.83	27.55	5.64	33.31	100	187	A	H
		2488.73	49.74	-24.26	74	49.53	27.8	5.72	33.31	100	187	P	H
		2483.62	37.14	-16.86	54	36.99	27.74	5.72	33.31	100	187	A	H
		2389.94	61.32	-12.68	74	61.57	27.43	5.64	33.32	100	129	P	V
		2388.82	49.7	-4.3	54	49.96	27.43	5.64	33.33	100	129	A	V
	*	2422	101.09	-	-	101.21	27.55	5.64	33.31	100	129	P	V
	*	2422	92.6	-	-	92.72	27.55	5.64	33.31	100	129	A	V
		2489.43	48.96	-25.04	74	48.75	27.8	5.72	33.31	100	129	P	V
		2489.71	40.08	-13.92	54	39.87	27.8	5.72	33.31	100	129	A	V
802.11n HT40 CH 06 2437MHz		2389.94	53.36	-20.64	74	53.61	27.43	5.64	33.32	100	188	P	H
		2389.66	46.23	-7.77	54	46.49	27.43	5.64	33.33	100	188	A	H
	*	2437	94.69	-	-	94.71	27.61	5.68	33.31	100	188	P	H
	*	2437	87.33	-	-	87.35	27.61	5.68	33.31	100	188	A	H
		2484.25	54.13	-19.87	74	53.98	27.74	5.72	33.31	100	188	P	H
		2484.39	47.66	-6.34	54	47.51	27.74	5.72	33.31	100	188	A	H
		2389.94	62.59	-11.41	74	62.84	27.43	5.64	33.32	100	129	P	V
		2389.94	43.38	-10.62	54	43.63	27.43	5.64	33.32	100	129	A	V
	*	2437	101.51	-	-	101.53	27.61	5.68	33.31	100	129	P	V
	*	2437	91.96	-	-	91.98	27.61	5.68	33.31	100	129	A	V
		2483.76	61.14	-12.86	74	60.99	27.74	5.72	33.31	100	129	P	V
		2484.81	49.41	-4.59	54	49.26	27.74	5.72	33.31	100	129	A	V



802.11n HT40 CH 09 2452MHz		2389.52	42.4	-31.6	74	42.66	27.43	5.64	33.33	341	130	P	H
		2389.8	33.66	-20.34	54	33.91	27.43	5.64	33.32	341	130	A	H
	*	2452	93.9	-	-	93.92	27.61	5.68	33.31	341	130	P	H
	*	2452	86.57	-	-	86.59	27.61	5.68	33.31	341	130	P	H
		2486.14	61.98	-12.02	74	61.83	27.74	5.72	33.31	341	130	P	H
		2484.6	48.39	-5.61	54	48.24	27.74	5.72	33.31	341	130	A	H
		2389.1	46.55	-27.45	74	46.81	27.43	5.64	33.33	100	129	P	V
		2389.94	34.97	-19.03	54	35.22	27.43	5.64	33.32	100	129	A	V
	*	2452	100.23	-	-	100.25	27.61	5.68	33.31	100	129	P	V
	*	2452	91.95	-	-	91.97	27.61	5.68	33.31	100	129	A	V
		2484.18	65.13	-8.87	74	64.98	27.74	5.72	33.31	100	129	P	V
		2484.32	49.71	-4.29	54	49.56	27.74	5.72	33.31	100	129	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz
WIFI 802.11n HT40 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n		4844	40.95	-33.05	74	58.18	31.53	7.82	56.58	153	360	P	H
HT40		7266	44.22	-29.78	74	57.22	36.13	9.14	58.27	153	360	P	H
CH 03		4844	41.34	-32.66	74	58.57	31.53	7.82	56.58	153	360	P	V
2422MHz		7266	43.98	-30.02	74	56.98	36.13	9.14	58.27	153	360	P	V
802.11n		4874	40.66	-33.34	74	58.14	31.61	7.82	56.91	153	360	P	H
HT40		7311	42.73	-31.27	74	55.39	36.17	9.17	58	153	360	P	H
CH 06		4874	40.55	-33.45	74	58.03	31.61	7.82	56.91	153	360	P	V
2437MHz		7311	44	-30	74	56.66	36.17	9.17	58	153	360	P	V
802.11n		4904	41.69	-32.31	74	58.53	31.69	7.82	56.35	153	360	P	H
HT40		7356	41.88	-32.12	74	54.42	36.23	9.19	57.96	153	360	P	H
CH 09		4904	42.37	-31.63	74	59.21	31.69	7.82	56.35	153	360	P	V
2452MHz		7356	41.84	-32.16	74	54.38	36.23	9.19	57.96	153	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

2.4GHz WIFI 802.11g (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.	
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz 802.11g LF		30	27.76	-12.24	40	35.9	17.28	0.65	26.07	100	0	P	H
		457.77	25.97	-20.03	46	33.12	17.24	1.73	26.12	-	-	P	H
		665.35	28.93	-17.07	46	33.88	19.39	2.05	26.39	-	-	P	H
		831.22	31.43	-14.57	46	34.49	20.76	2.26	26.08	-	-	P	H
		947.62	32.17	-13.83	46	33.4	21.87	2.41	25.51	-	-	P	H
		993.21	32.13	-21.87	54	32.53	22.29	2.47	25.16	-	-	P	H
		30	27.82	-12.18	40	35.96	17.28	0.65	26.07	100	0	P	V
		104.69	22.1	-21.4	43.5	34.7	12.19	0.96	25.75	-	-	P	V
		453.89	26.22	-19.78	46	33.4	17.19	1.73	26.1	-	-	P	V
		778.84	30.21	-15.79	46	33.91	20.31	2.2	26.21	-	-	P	V
		936.95	31.18	-14.82	46	32.6	21.76	2.41	25.59	-	-	P	V
		989.33	32.14	-21.86	54	32.58	22.28	2.47	25.19	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

**Note symbol**

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



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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(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

1. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

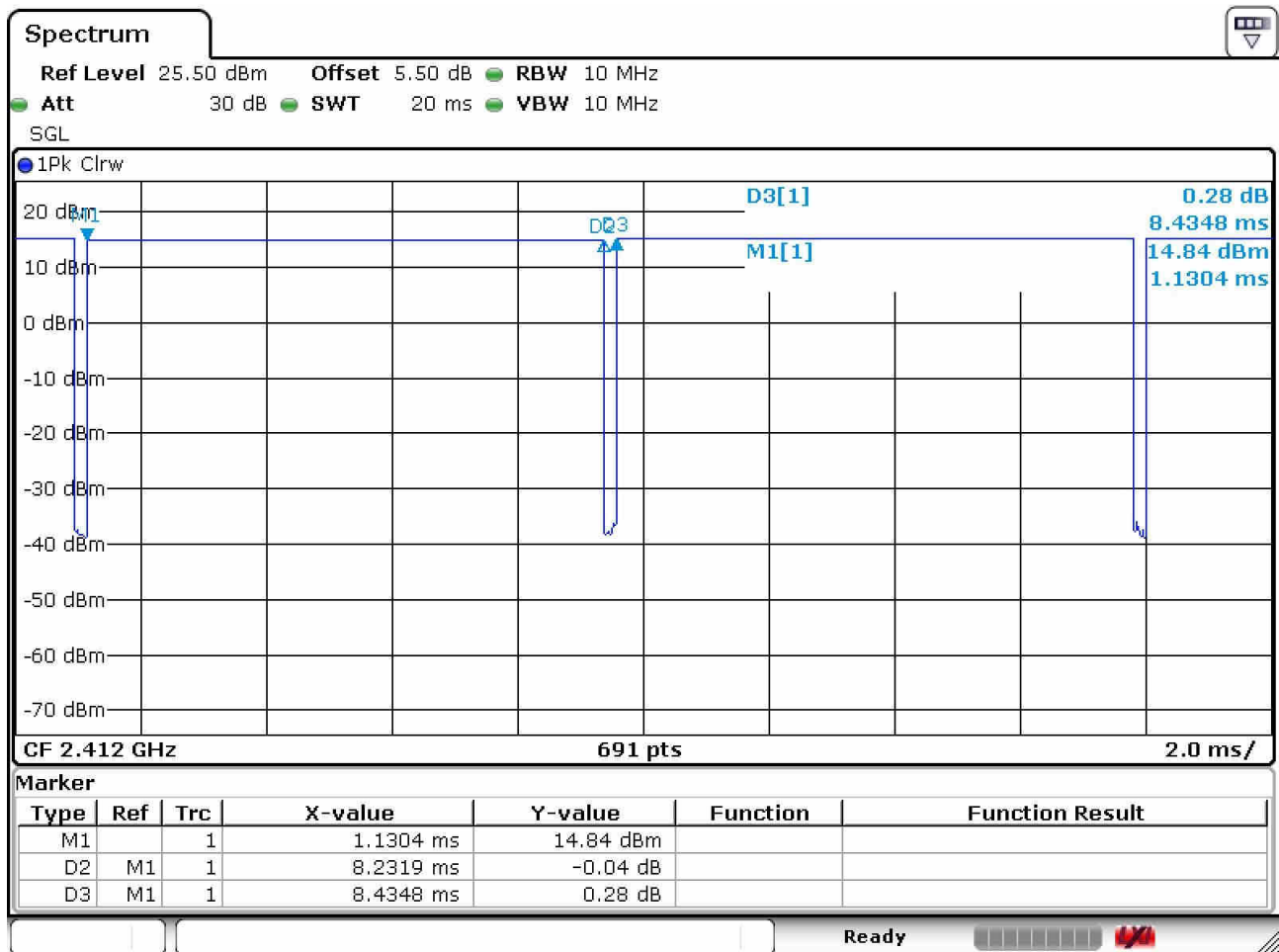
Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix C. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(KHz)	VBW Setting
802.11b	97.59	8.232	0.121	300Hz
802.11g	87.44	1.362	0.734	1KHz
802.11n HT20	86.70	1.275	0.784	1KHz
802.11n HT40	86.29	1.232	0.812	1KHz

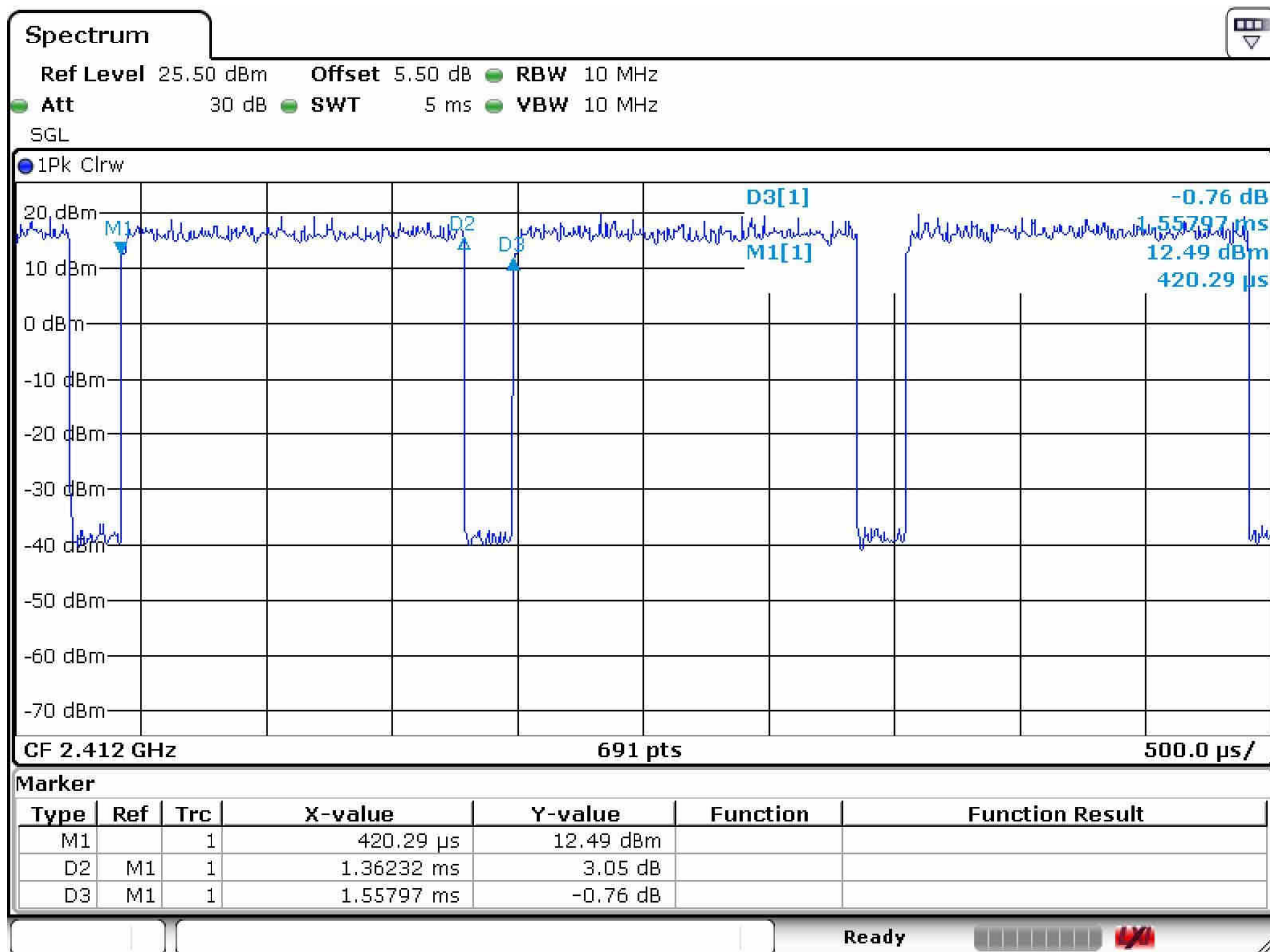


802.11b



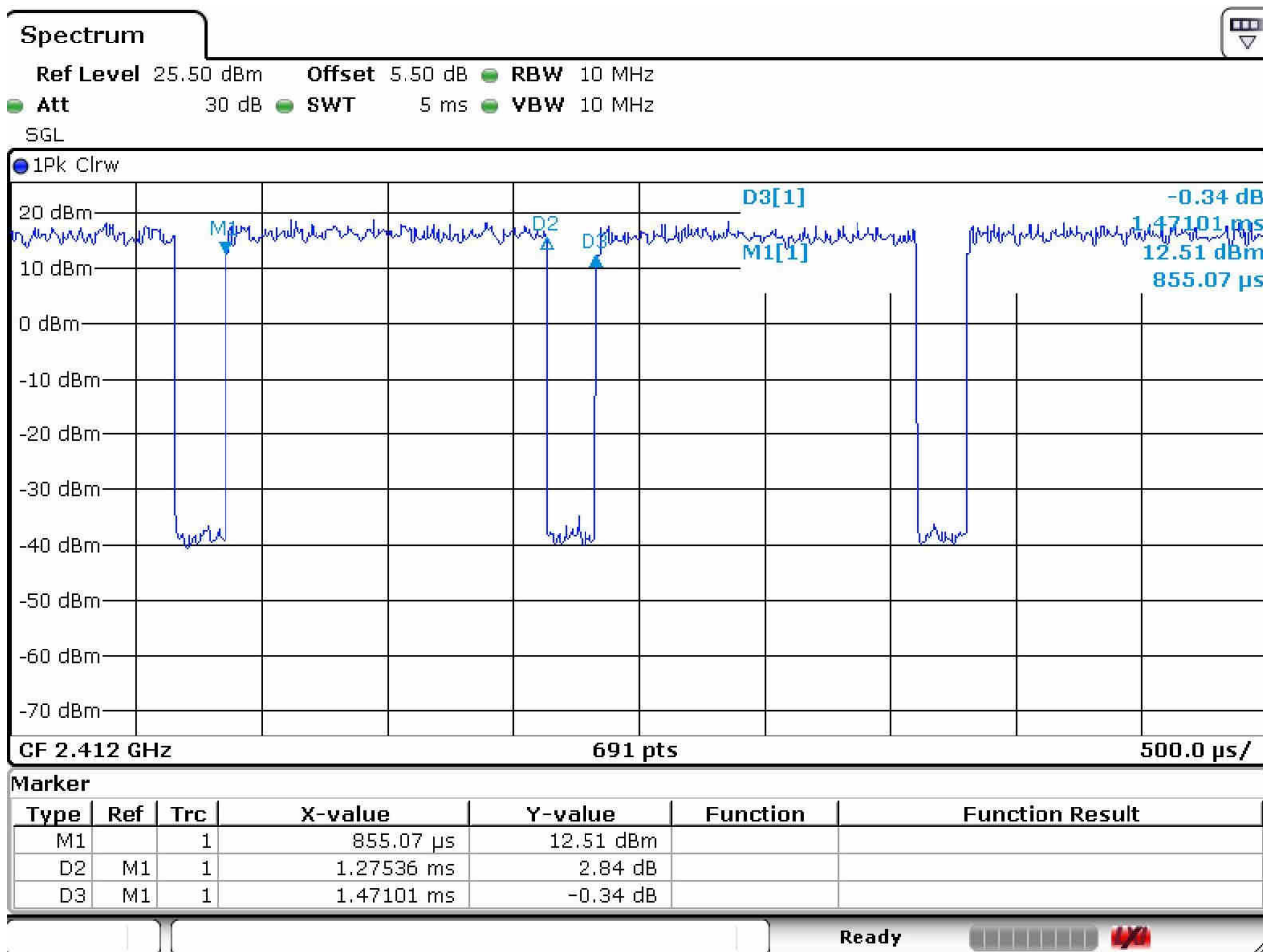


802.11g





802.11n HT20





802.11n HT40

