

FCC RF Test Report

APPLICANT : ZTE CORPORATION
EQUIPMENT : LTE/Multi-Mode Digital Mobile Phone
BRAND NAME : ZTE
MODEL NAME : ZTE A2020U Pro
FCC ID : SRQ-A2020UPRO
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Jun. 10, 2019 and testing was completed on Jul. 24, 2019. 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.



Reviewed by: Jason Jia / Supervisor



Approved by: James Huang / Manager



Sporton International (Kunshan) Inc.

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China**



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR961010C	Rev. 01	Initial issue of report	Aug. 13, 2019

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	99% Bandwidth	-	Pass	-
3.2	15.247(b)	Power Output Measurement	$\leq 30\text{dBm}$	Pass	-
3.3	15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	-
3.4	15.247(d)	Conducted Band Edges	$\leq 20\text{dBc}$	Pass	-
		Conducted Spurious Emission		Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 1.10 dB at 2483.740 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 6.55 dB at 0.157 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

ZTE CORPORATION

ZTE Plaza, Keji Road South, Hi-Tech, Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

1.2 Manufacturer

ZTE CORPORATION

ZTE Plaza, Keji Road South, Hi-Tech, Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	LTE/Multi-Mode Digital Mobile Phone
Brand Name	ZTE
Model Name	ZTE A2020U Pro
FCC ID	SRQ-A2020UPRO
EUT supports Radios application	GSM/WCDMA/LTE/NFC WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11 a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE FM Receiver /GNSS
IMEI Code	Conducted: 866550040000074 Conduction: 866550040000025 Radiation: 866550040000124
HW Version	twfB
SW Version	GEN_NA_A2020U_PROV1.0
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
- 2.

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	MIMO <Ant. 1 + 2> 802.11b : 20.34 dBm (0.1081 W) 802.11g : 21.60 dBm (0.1445 W) 802.11n HT20 : 22.07 dBm (0.1611 W) 802.11n HT40 : 23.94 dBm (0.2477 W)		
99% Occupied Bandwidth	MIMO <Ant. 1 + 2> 802.11b : 14.19MHz 802.11g : 17.58MHz 802.11n HT20 : 18.83MHz 802.11n HT40 : 36.56MHz		
Antenna Type / Gain	Ant. 1: IFA Antenna with gain 0.20 dBi Ant. 2: IFA Antenna with gain -0.39 dBi		
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)		
Antenna Function		Ant. 1	Ant. 2
	802.11b/g/n (SISO)	V	V
	802.11b/g/n (MIMO)	V	V

Note:

1. MIMO Ant. 1+2 is a calculated result from sum of the power MIMO Ant. 1 and MIMO Ant. 2.
2. For SISO & MIMO mode, the whole testing has assessed MIMO mode by referring to their higher conducted power.

1.5 Modification of EUT

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



1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	TH01-KS CO01-KS 03CH05-KS	CN1257	314309

1.7 Applicable Standards

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

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. 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

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation 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.
- b. AC power line Conducted Emission was tested under maximum output power.

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

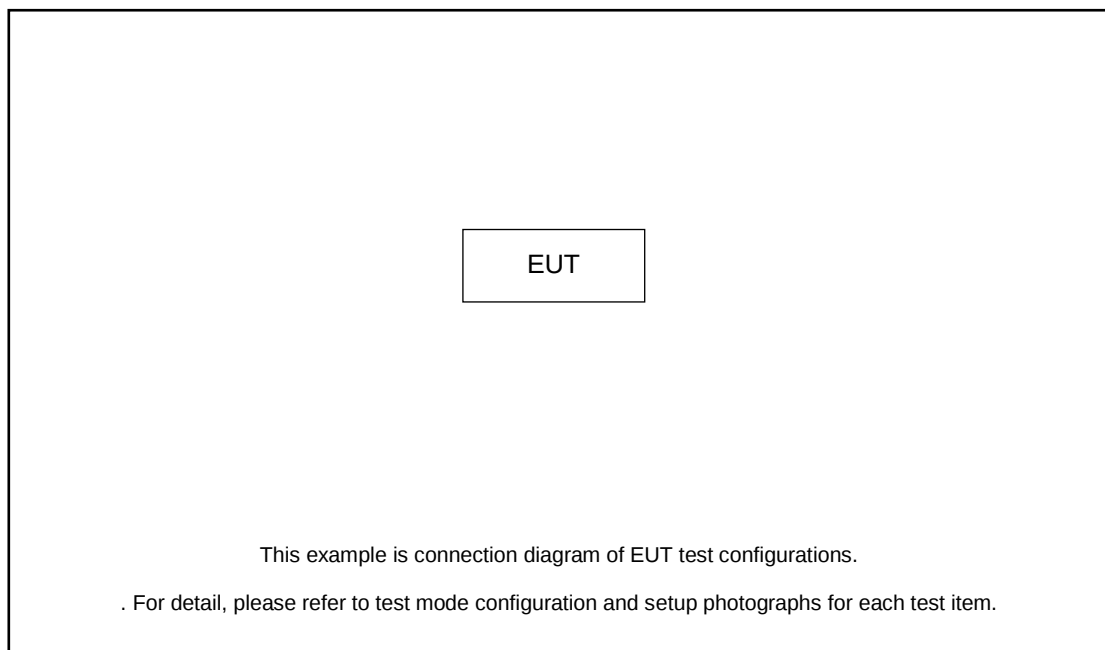
Final test modes are considering the modulation and worse data rates as below table.

MIMO Antenna

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 :GSM 850 Idle + Bluetooth Link + WLAN Link (2.4G) + USB Cable 1(Charging from Adapter)

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	R&S	CMU 200	N/A	N/A	Unshielded, 1.8 m
2.	WLAN AP	LINKSYS	WRT600N	Q87-WRT600NV11	N/A	Unshielded, 1.8 m
3.	Notebook	Lenovo	G480	PRC4	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
4.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A

2.5 EUT Operation Test Setup

For WLAN RF test items, an 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 WLAN AP under large package sizes transmission.



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 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 6.40 dB.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} . \\ &= 6.40 \text{ (dB)}\end{aligned}$$

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 ANSI C63.10-2013 clause 11.8
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.

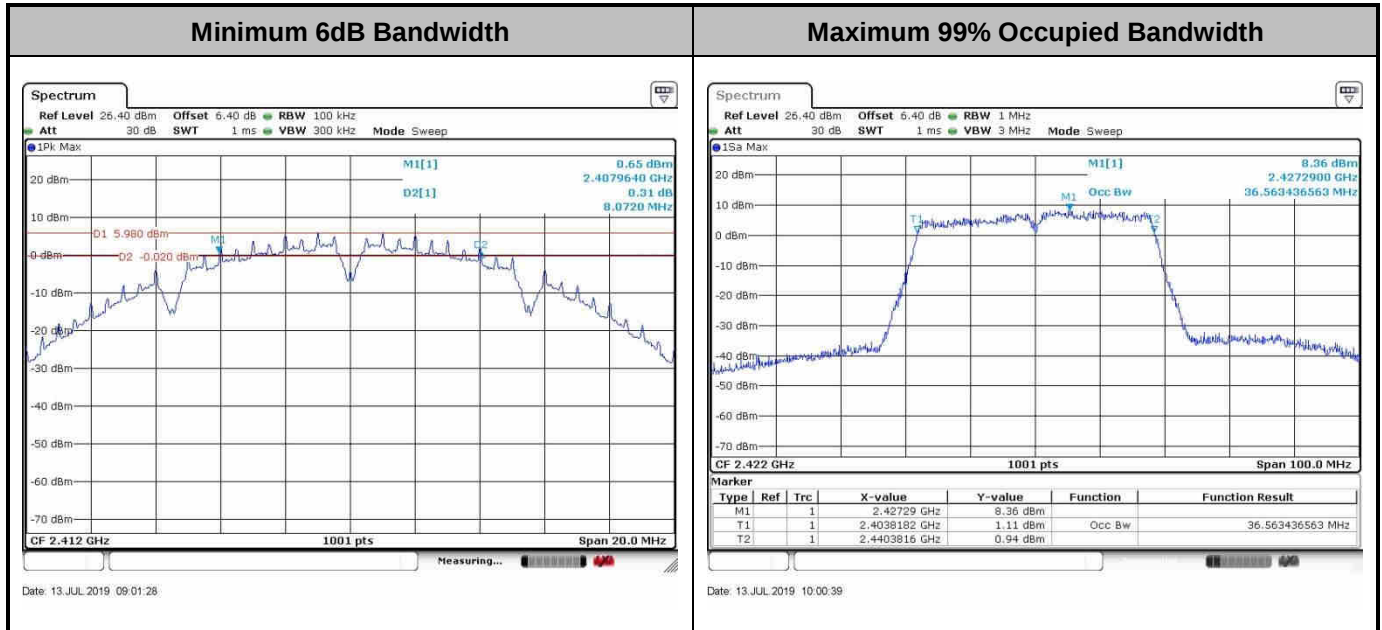
3.1.4 Test Setup





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 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 ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.2 Method AVGPM-G 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.

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 of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
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.

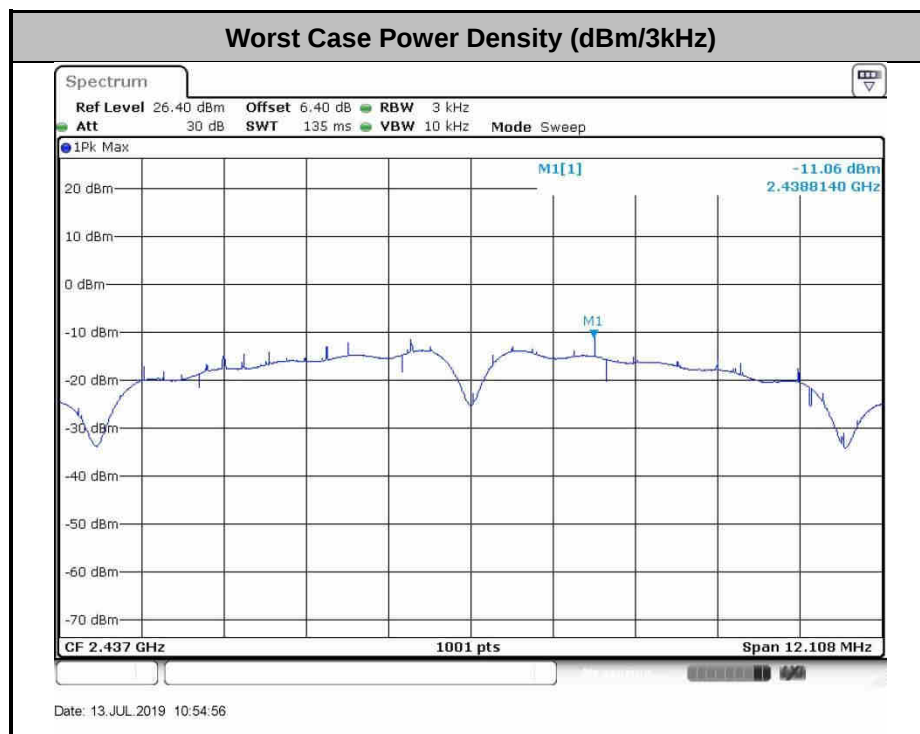
Method (2): Measure and add $10 \log(N)$ dB, where N is the number of outputs. (N=2)

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



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 ANSI C63.10-2013 clause 11.13
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



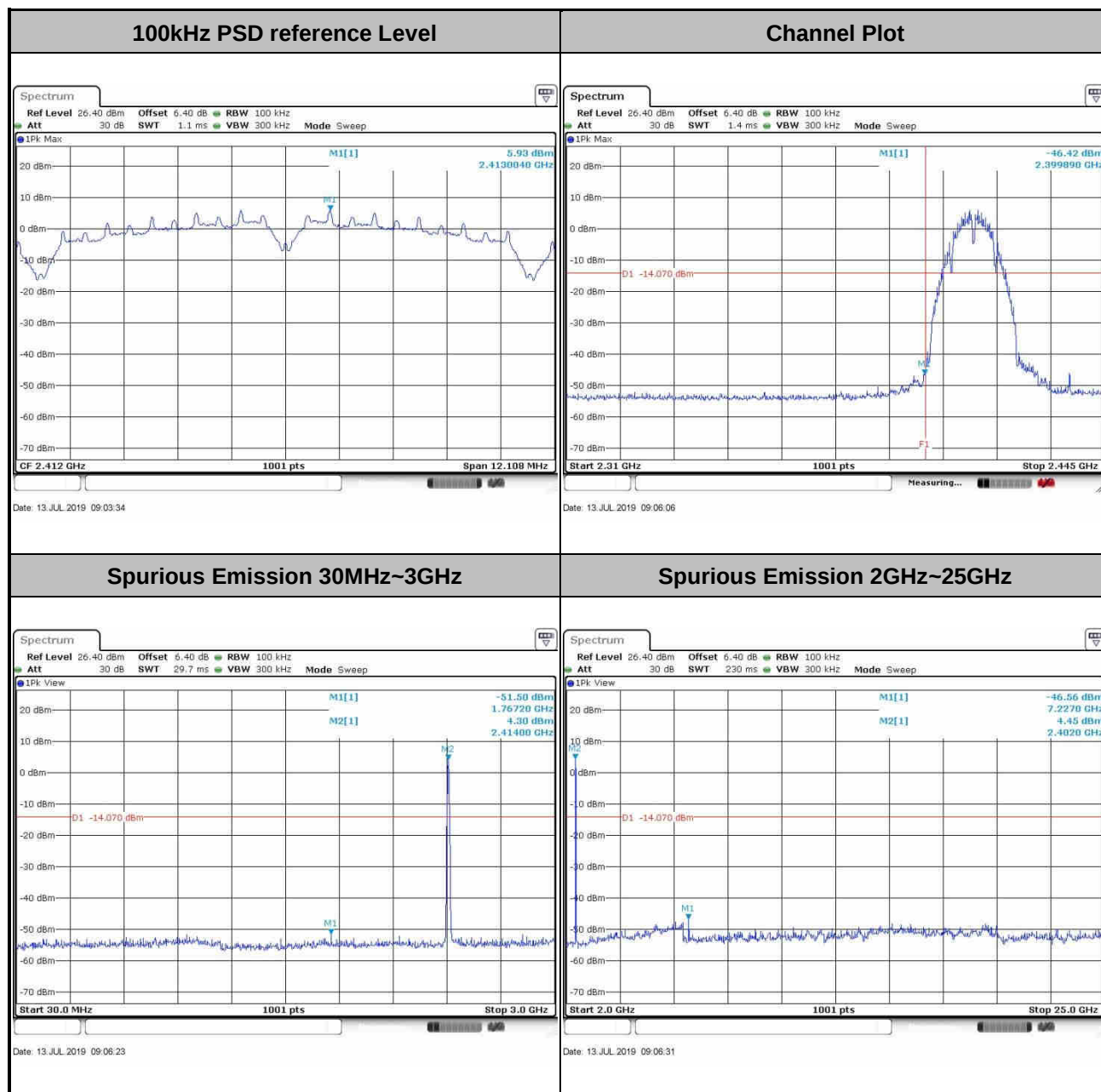


3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Test Engineer :	Aaron shen	Temperature :	21~25°C
		Relative Humidity :	51~54%

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

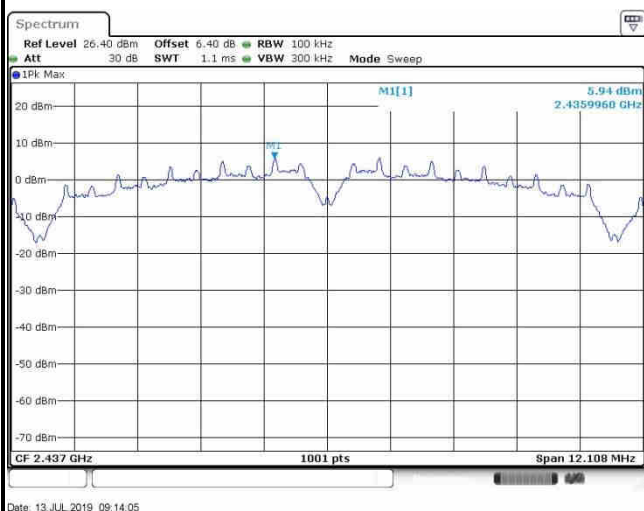
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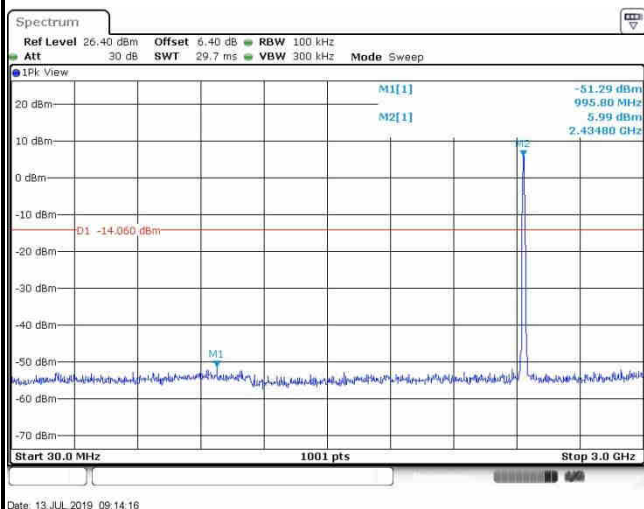


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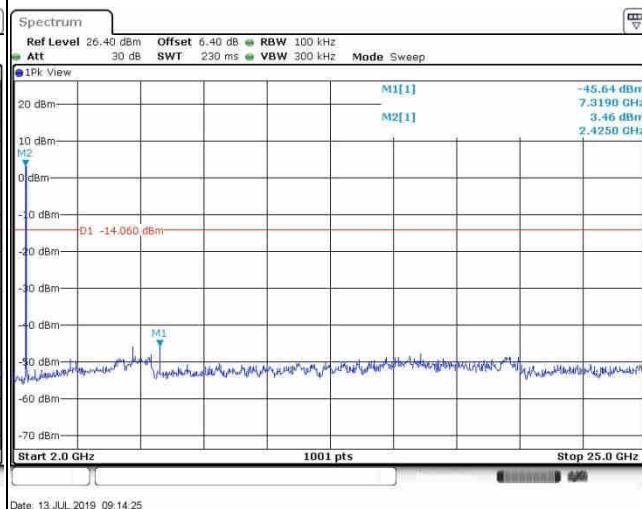
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

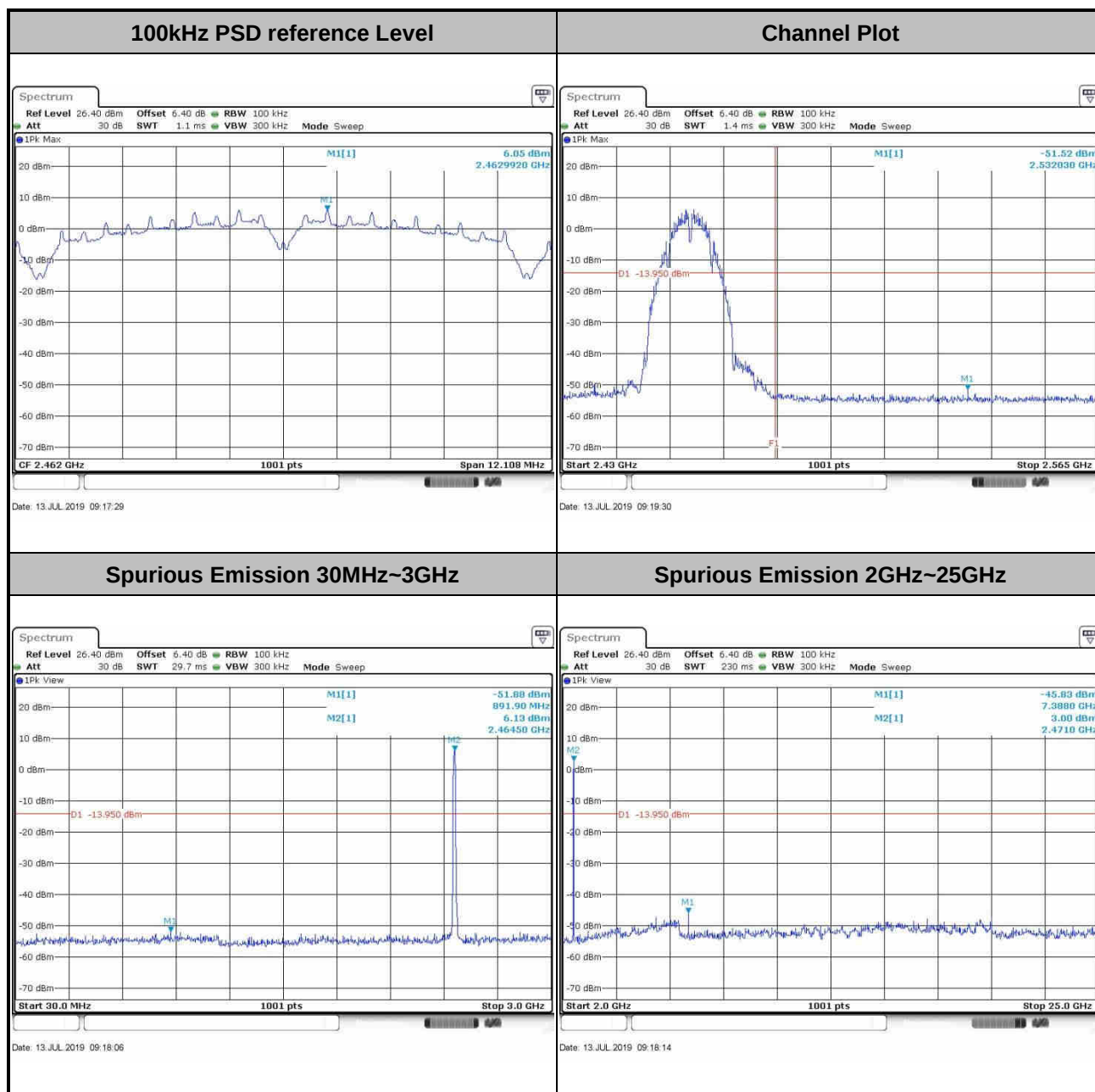


Spurious Emission 2GHz~25GHz





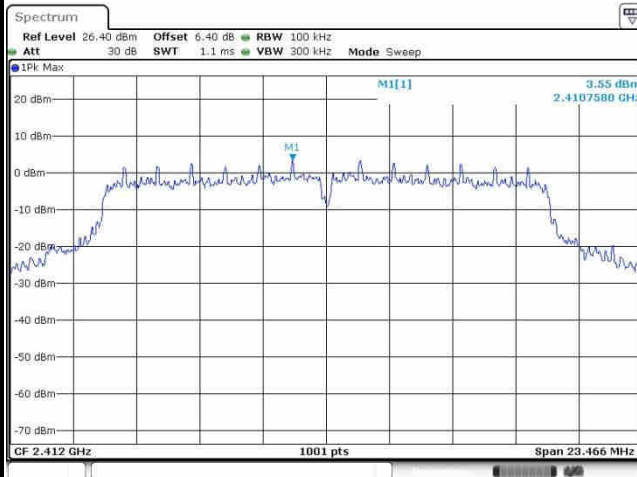
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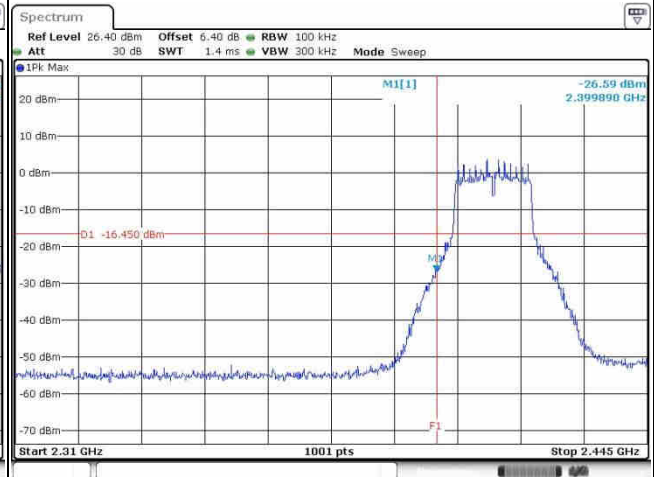


Test Mode :	802.11g	Test Channel :	01
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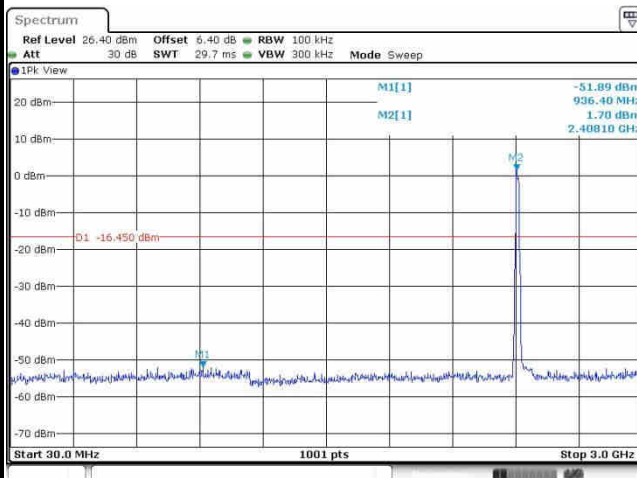
100kHz PSD reference Level



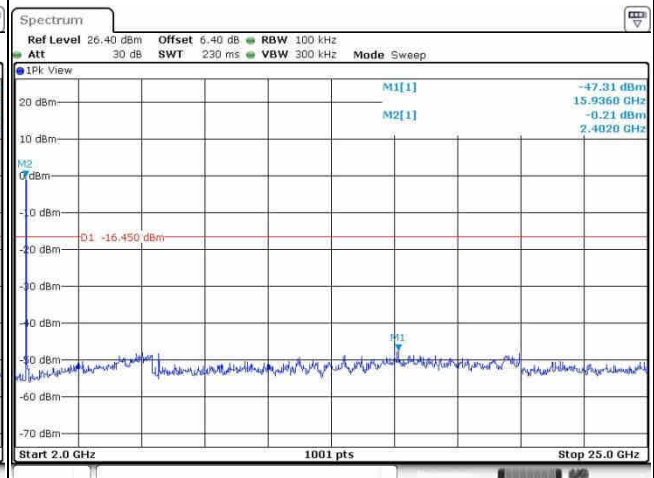
Channel Plot



Spurious Emission 30MHz~3GHz



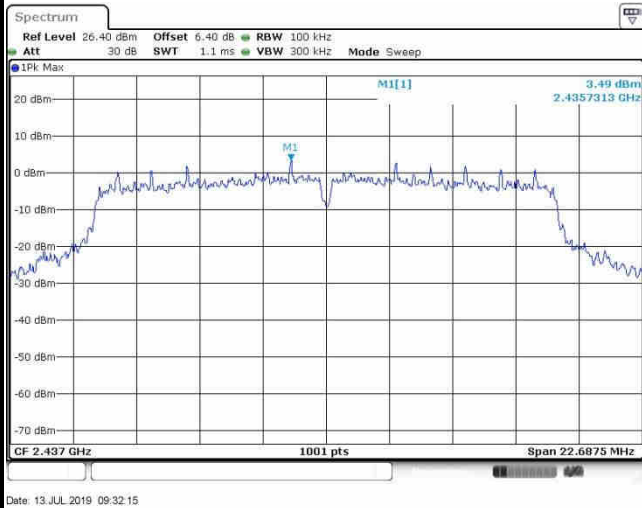
Spurious Emission 2GHz~25GHz



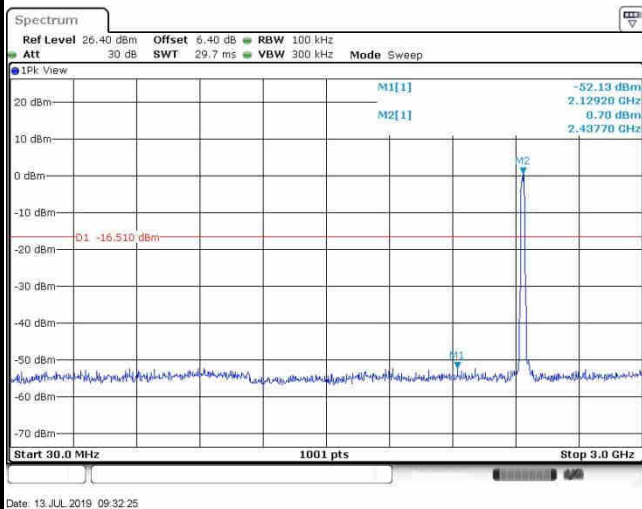


Test Mode :	802.11g	Test Channel :	06
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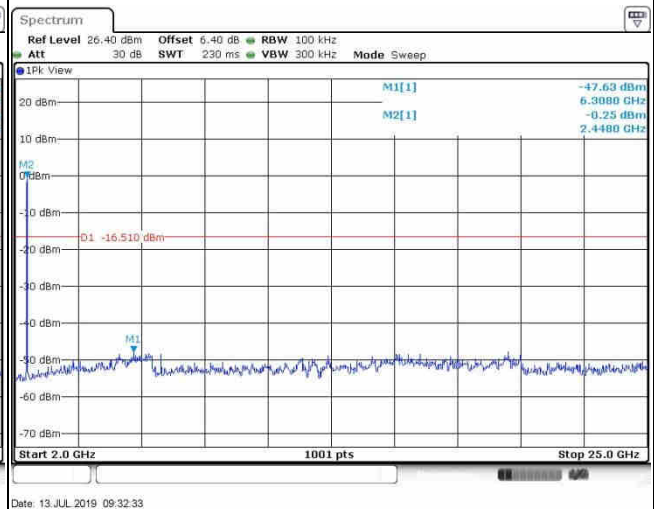
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

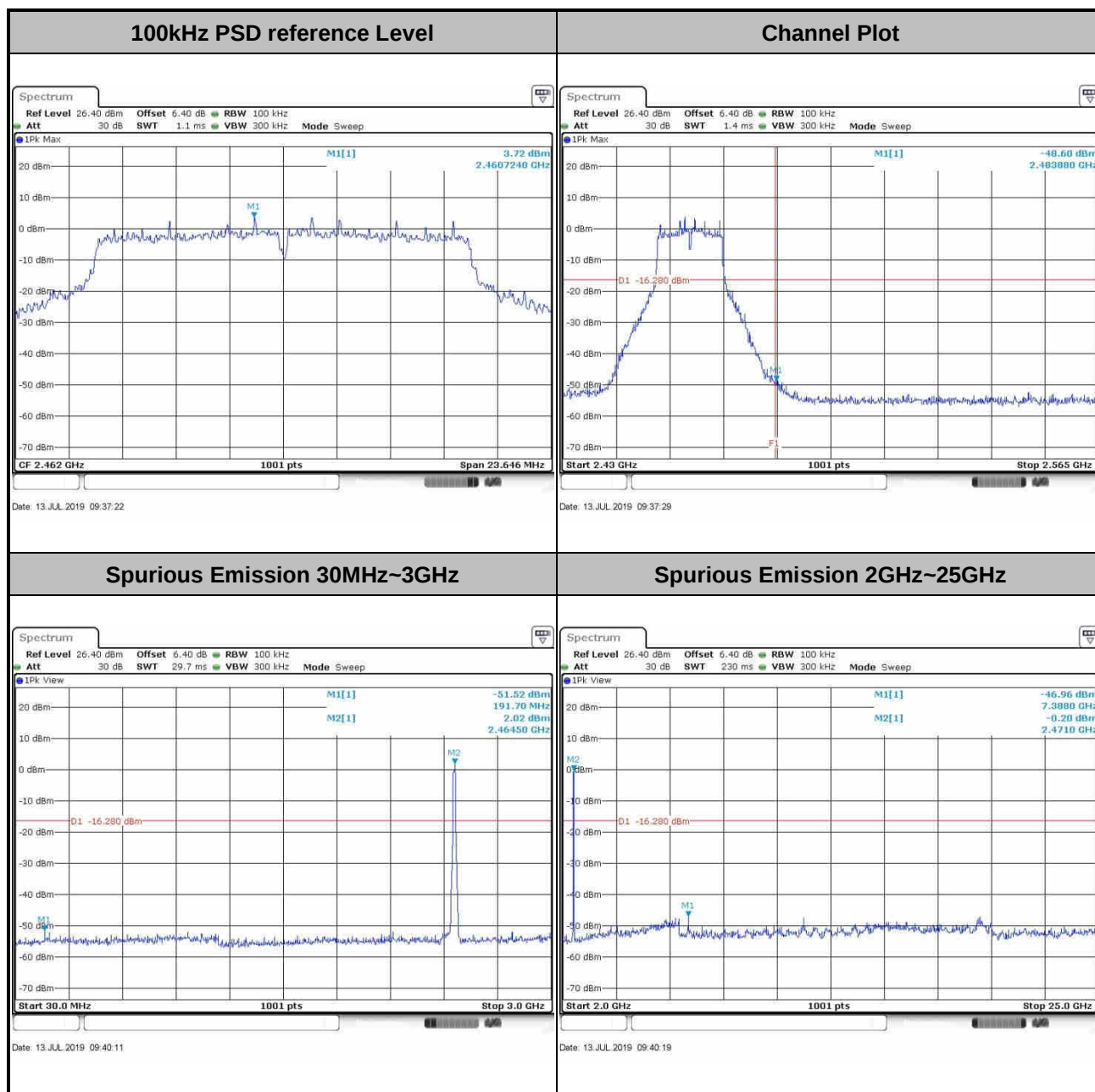


Spurious Emission 2GHz~25GHz





Test Mode :	802.11g	Test Channel :	11
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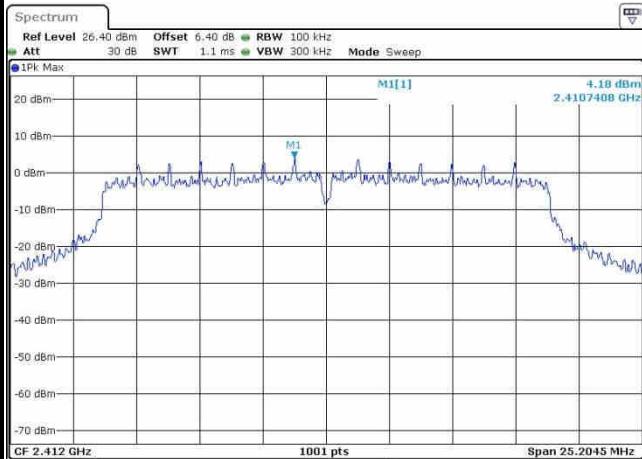




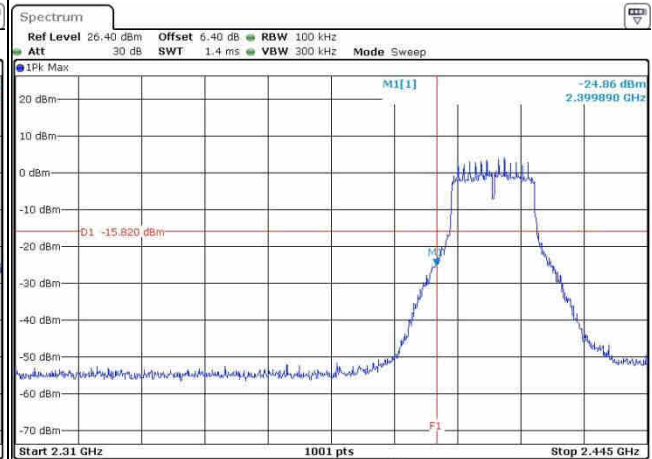
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Test Channel : 01

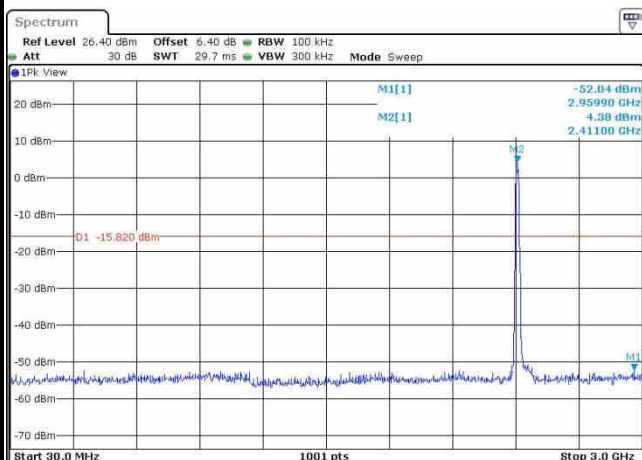
100kHz PSD reference Level



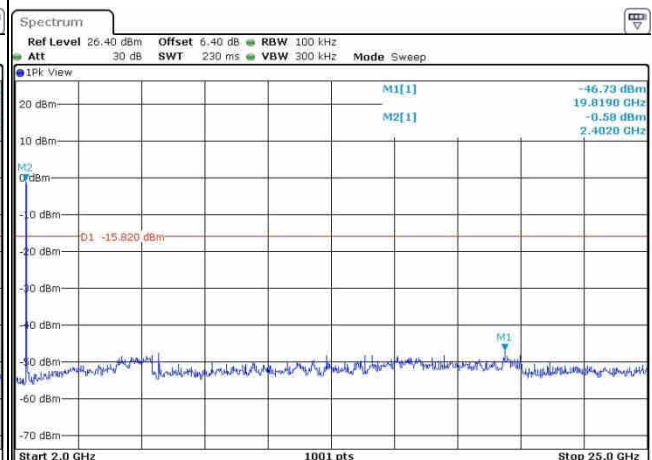
Channel Plot



Spurious Emission 30MHz~3GHz



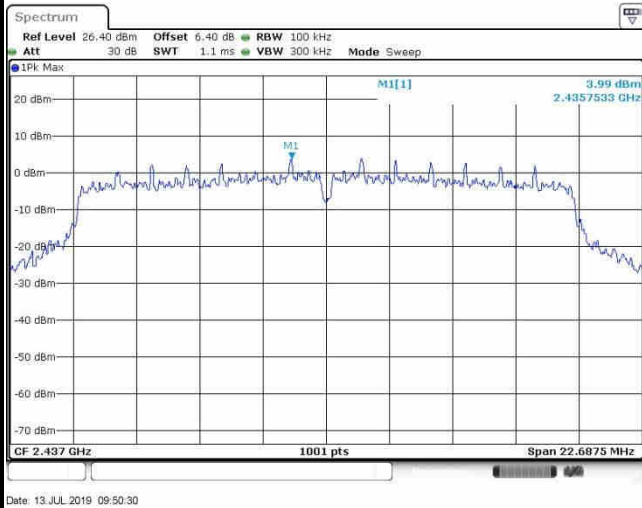
Spurious Emission 2GHz~25GHz



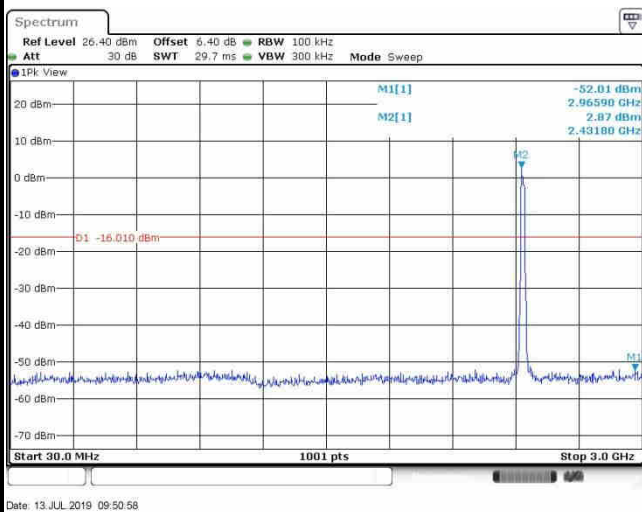


Test Mode :	802.11n HT20	Test Channel :	06
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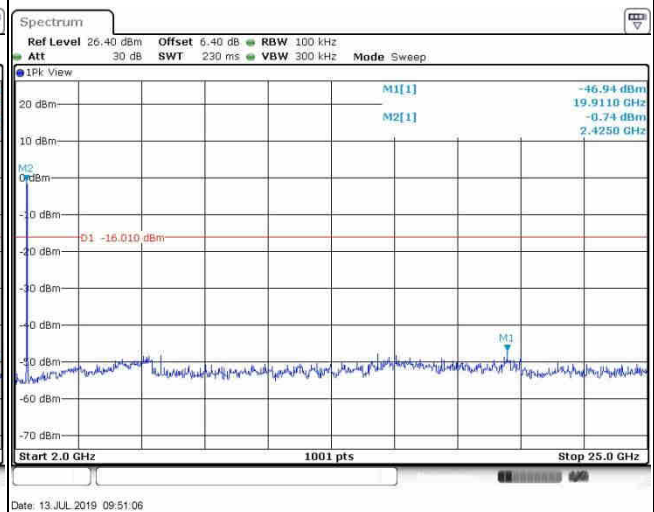
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

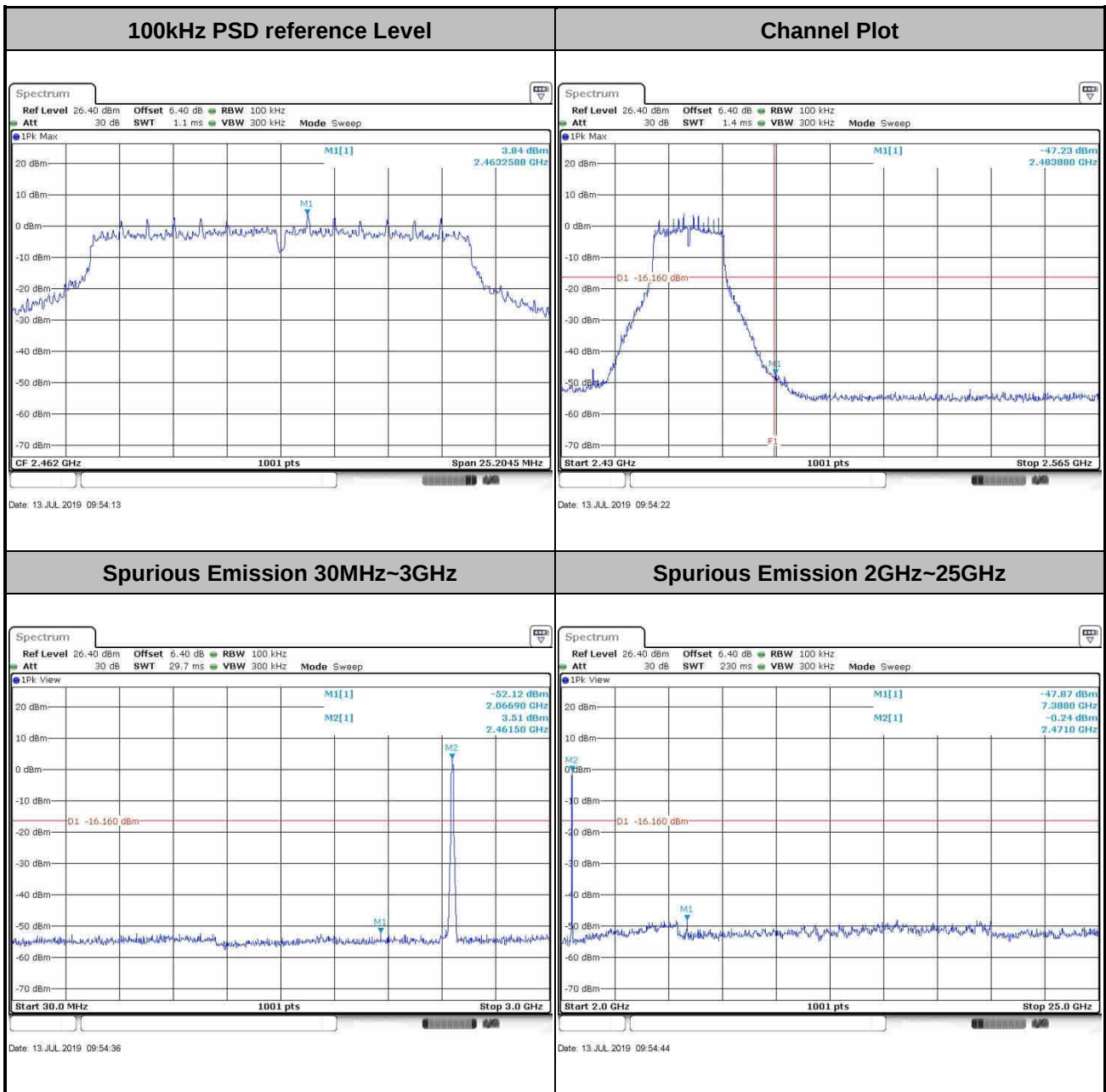


Spurious Emission 2GHz~25GHz





Test Mode :	802.11n HT20	Test Channel :	11
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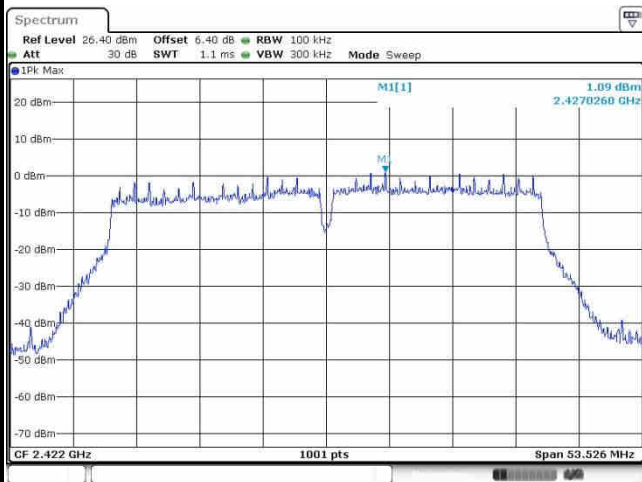




Test Mode : 802.11n HT40

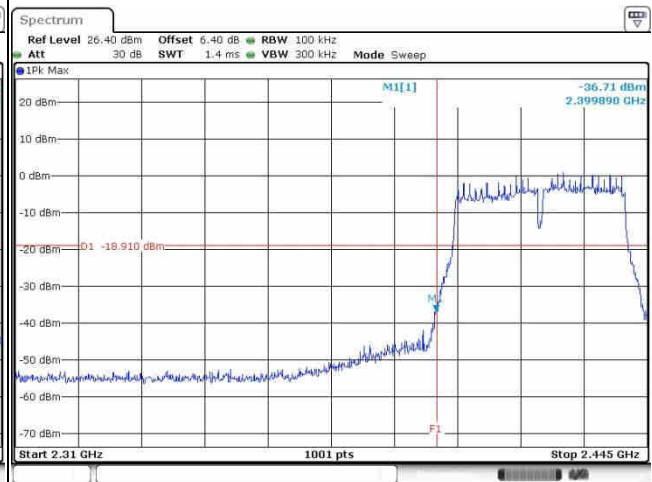
Test Channel : 03

100kHz PSD reference Level



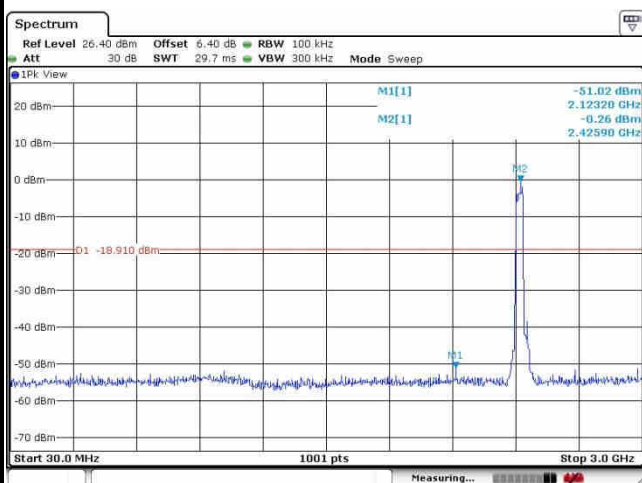
Date: 13 JUL 2019 09:58:16

Channel Plot



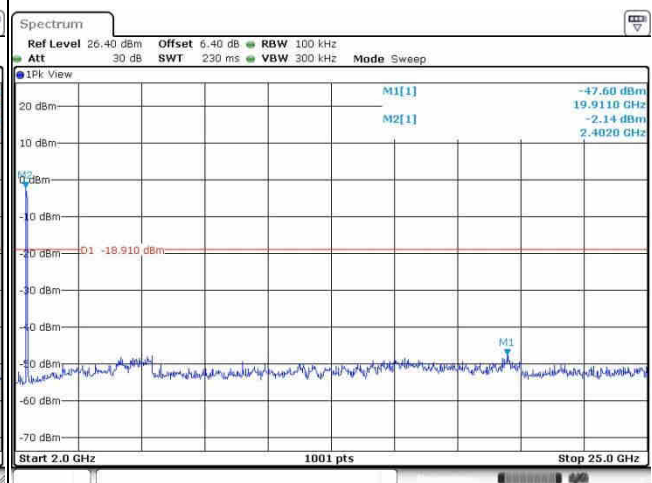
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Spurious Emission 30MHz~3GHz



Date: 13 JUL 2019 10:02:27

Spurious Emission 2GHz~25GHz

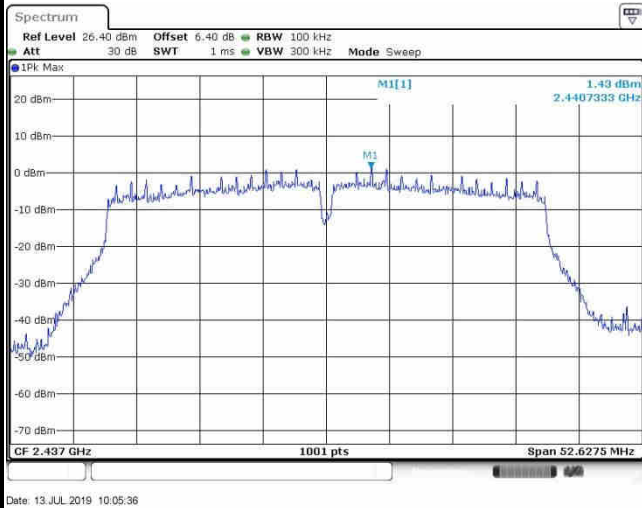


Date: 13 JUL 2019 10:00:57

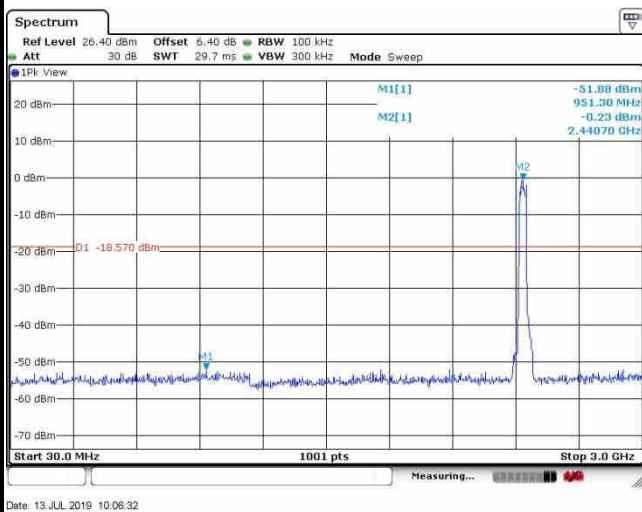


Test Mode :	802.11n HT40	Test Channel :	06
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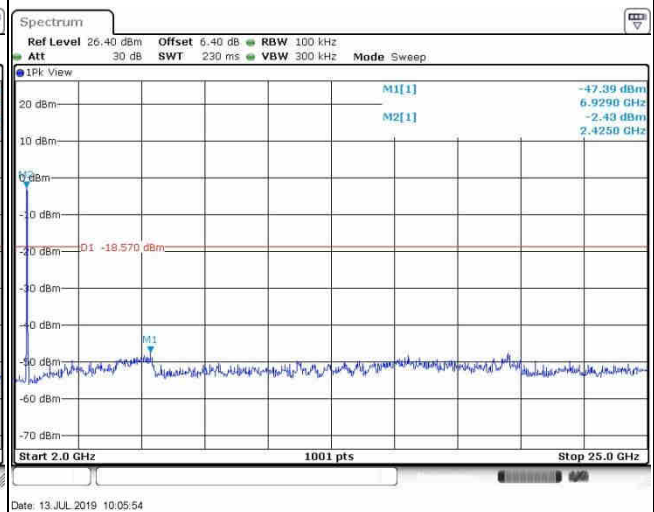
100kHz PSD reference Level

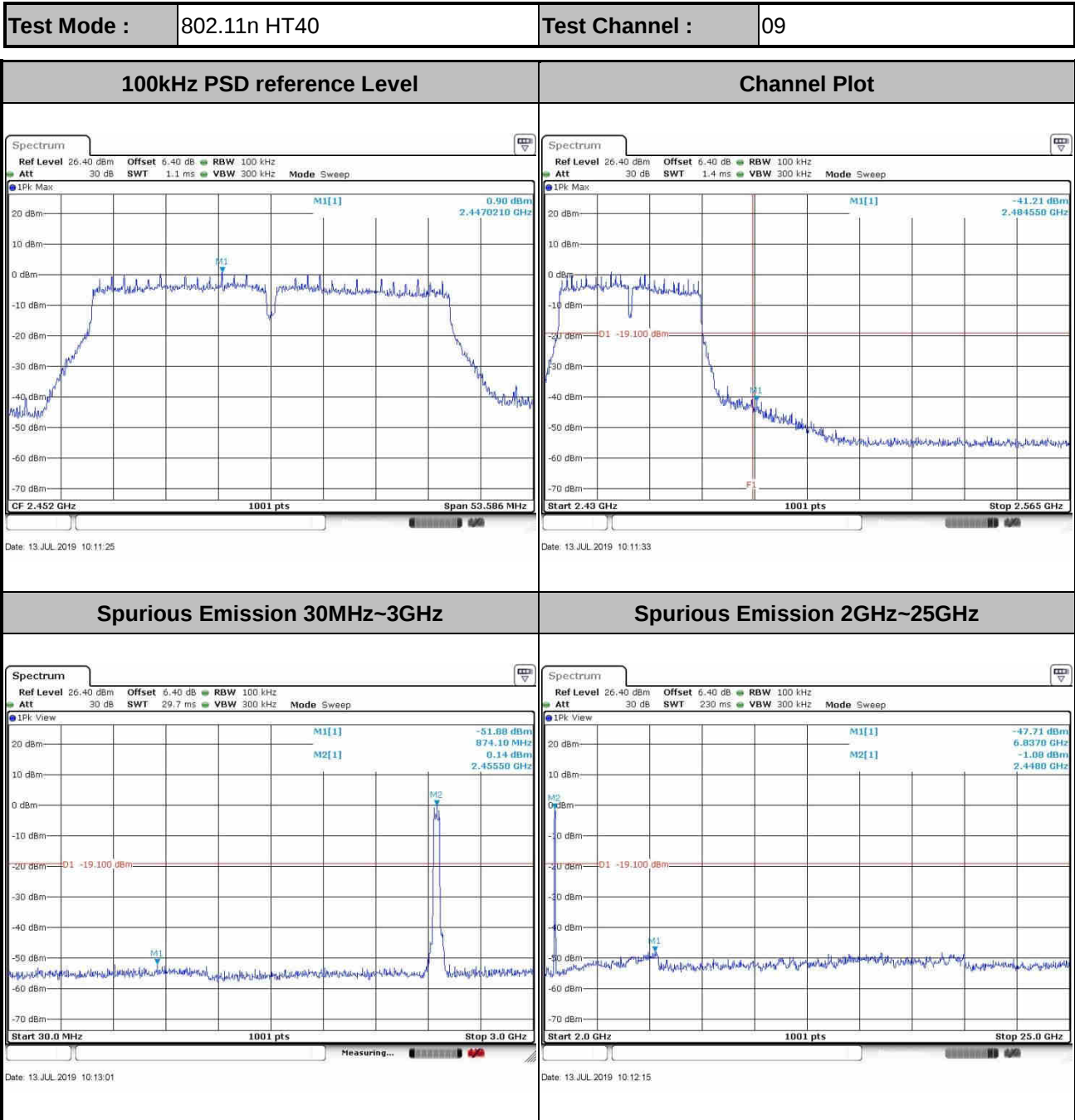


Spurious Emission 30MHz~3GHz



Spurious Emission 2GHz~25GHz

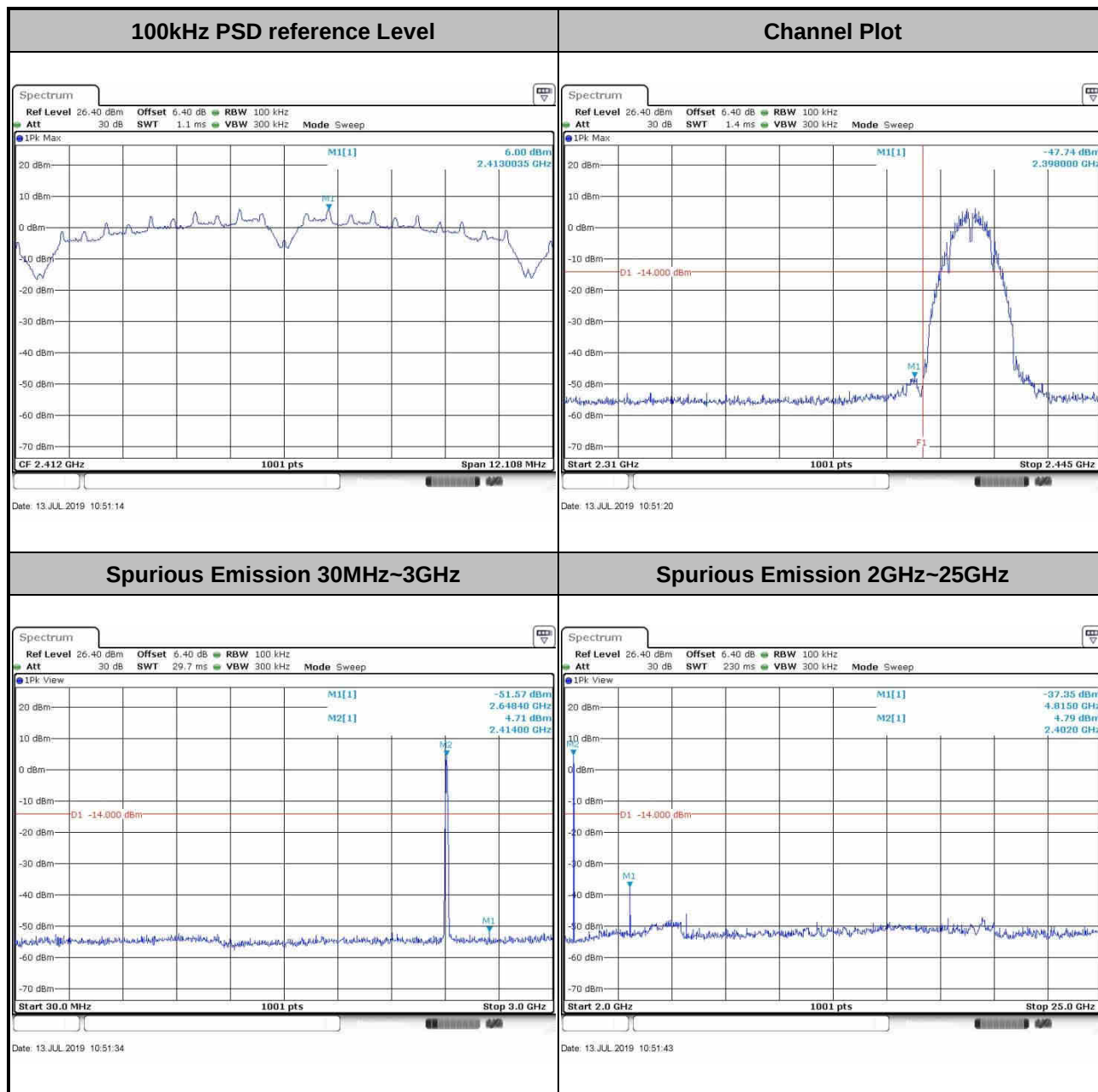






Number of TX = 2, Ant. 2 (Measured)

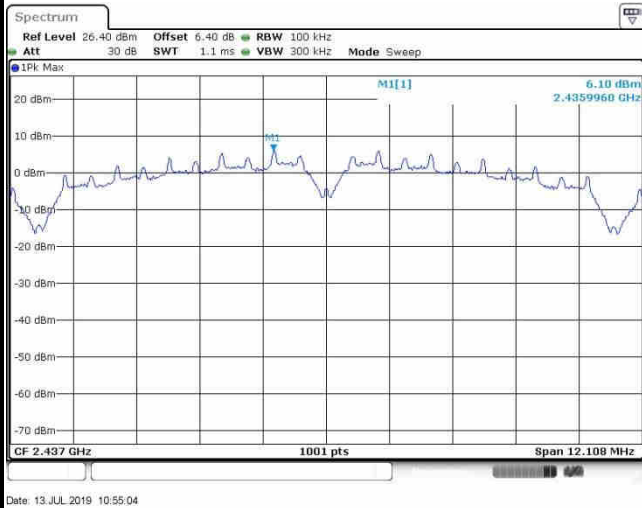
Test Mode :	802.11b	Test Channel :	01
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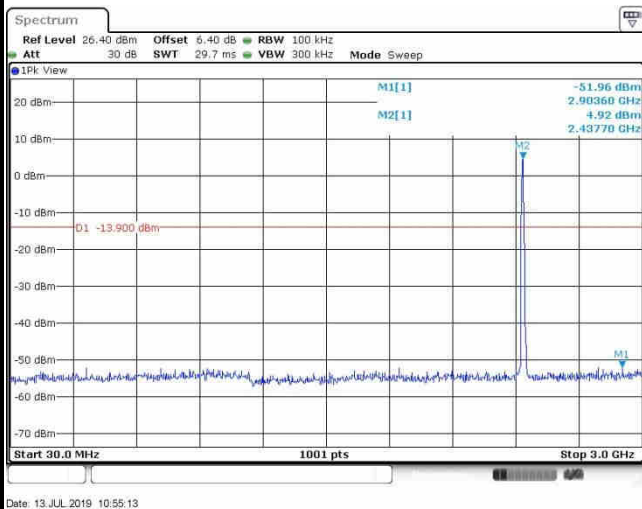


Test Mode :	802.11b	Test Channel :	06
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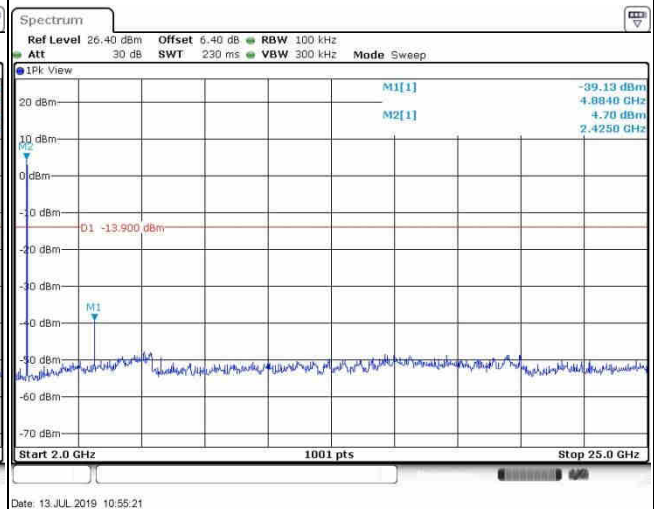
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

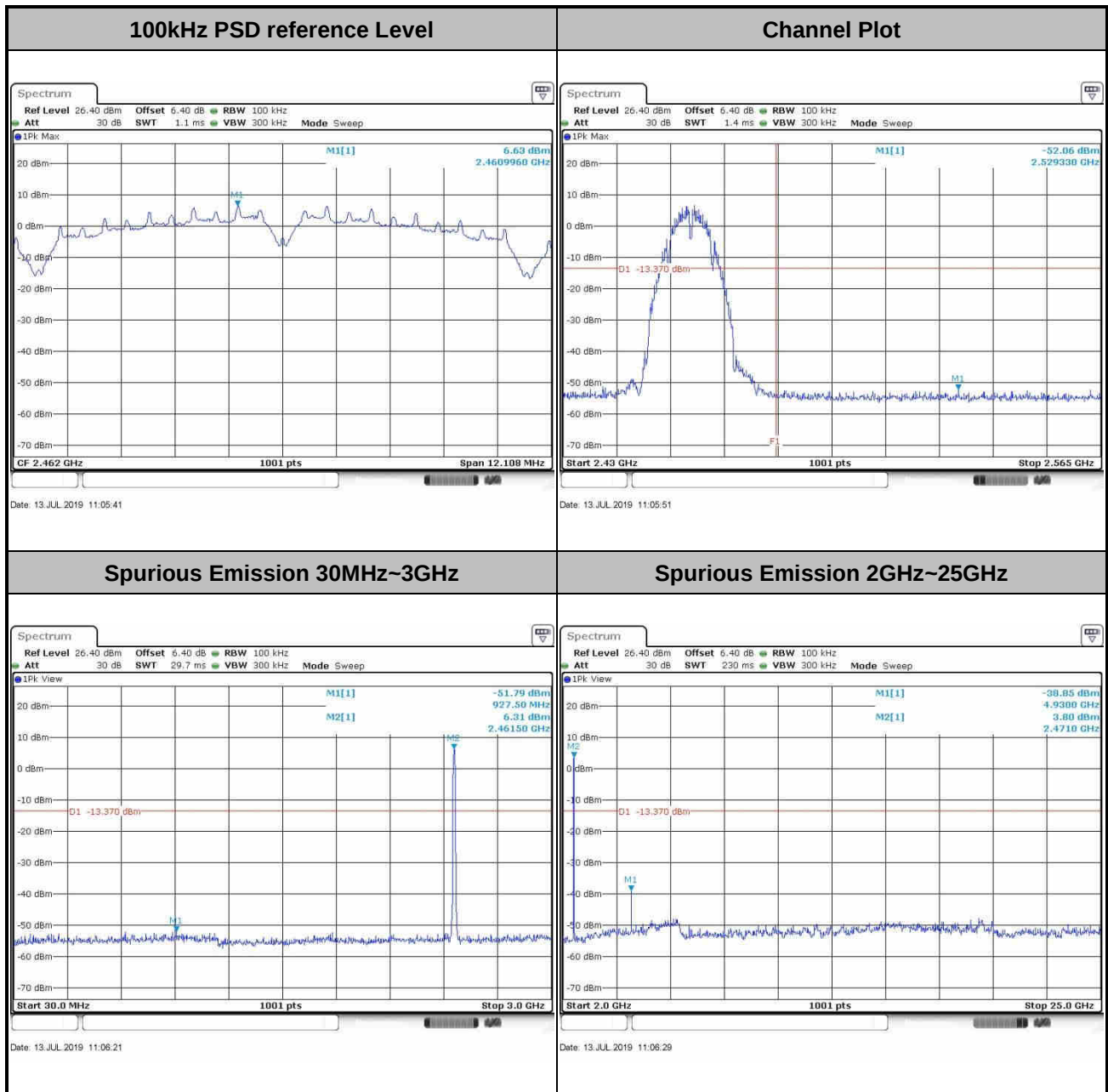


Spurious Emission 2GHz~25GHz





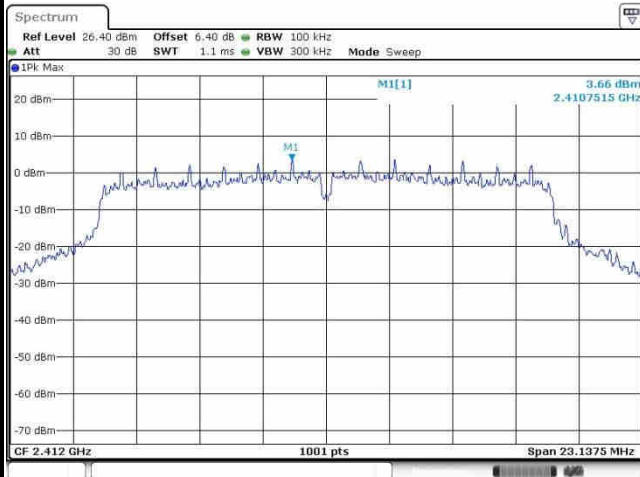
Test Mode :	802.11b	Test Channel :	11
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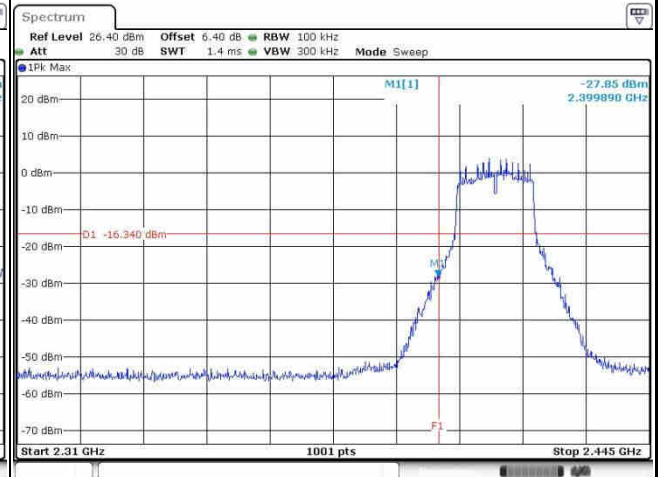
Test Mode :	802.11g	Test Channel :	01
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100kHz PSD reference Level



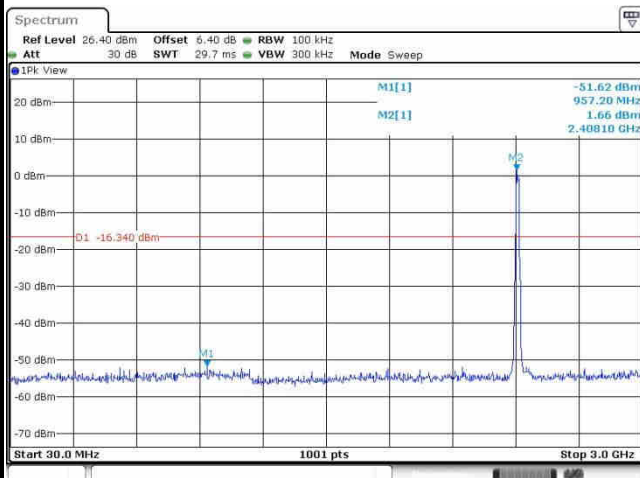
Date: 13 JUL 2019 11:10:52

Channel Plot



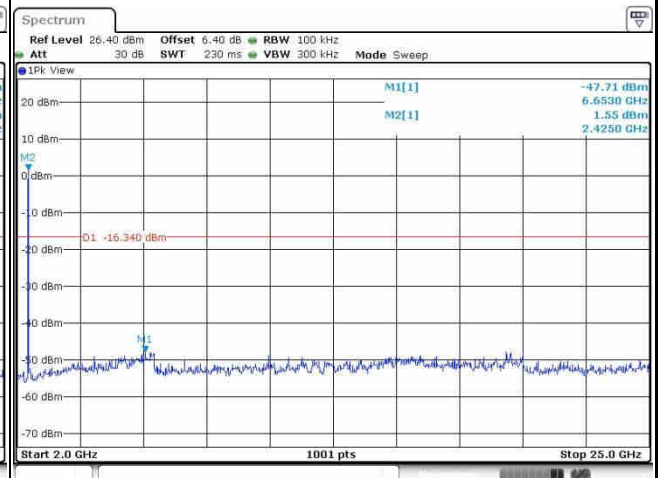
Date: 13 JUL 2019 11:10:59

Spurious Emission 30MHz~3GHz



Date: 13 JUL 2019 11:12:05

Spurious Emission 2GHz~25GHz

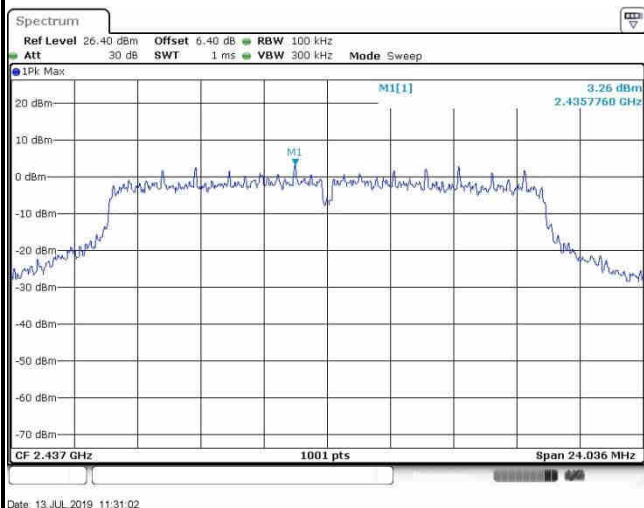


Date: 13 JUL 2019 11:12:13

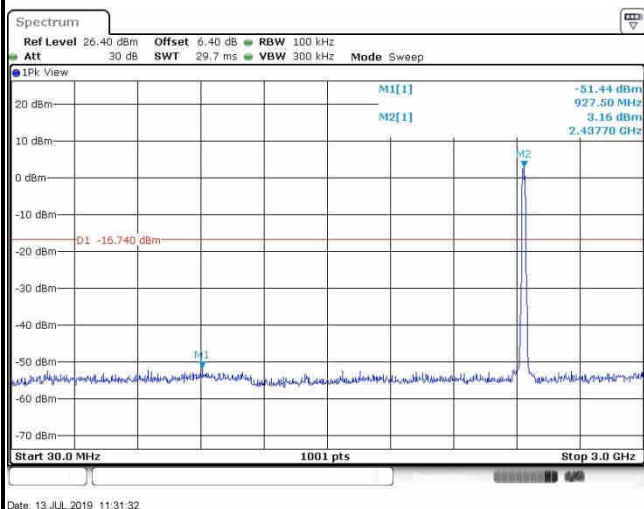


Test Mode :	802.11g	Test Channel :	06
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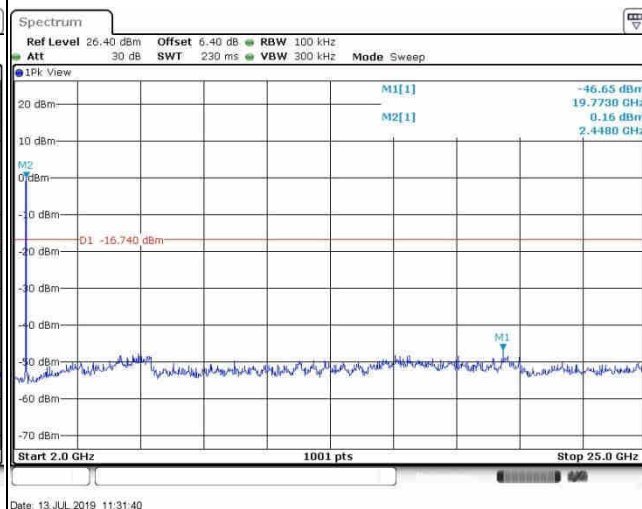
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

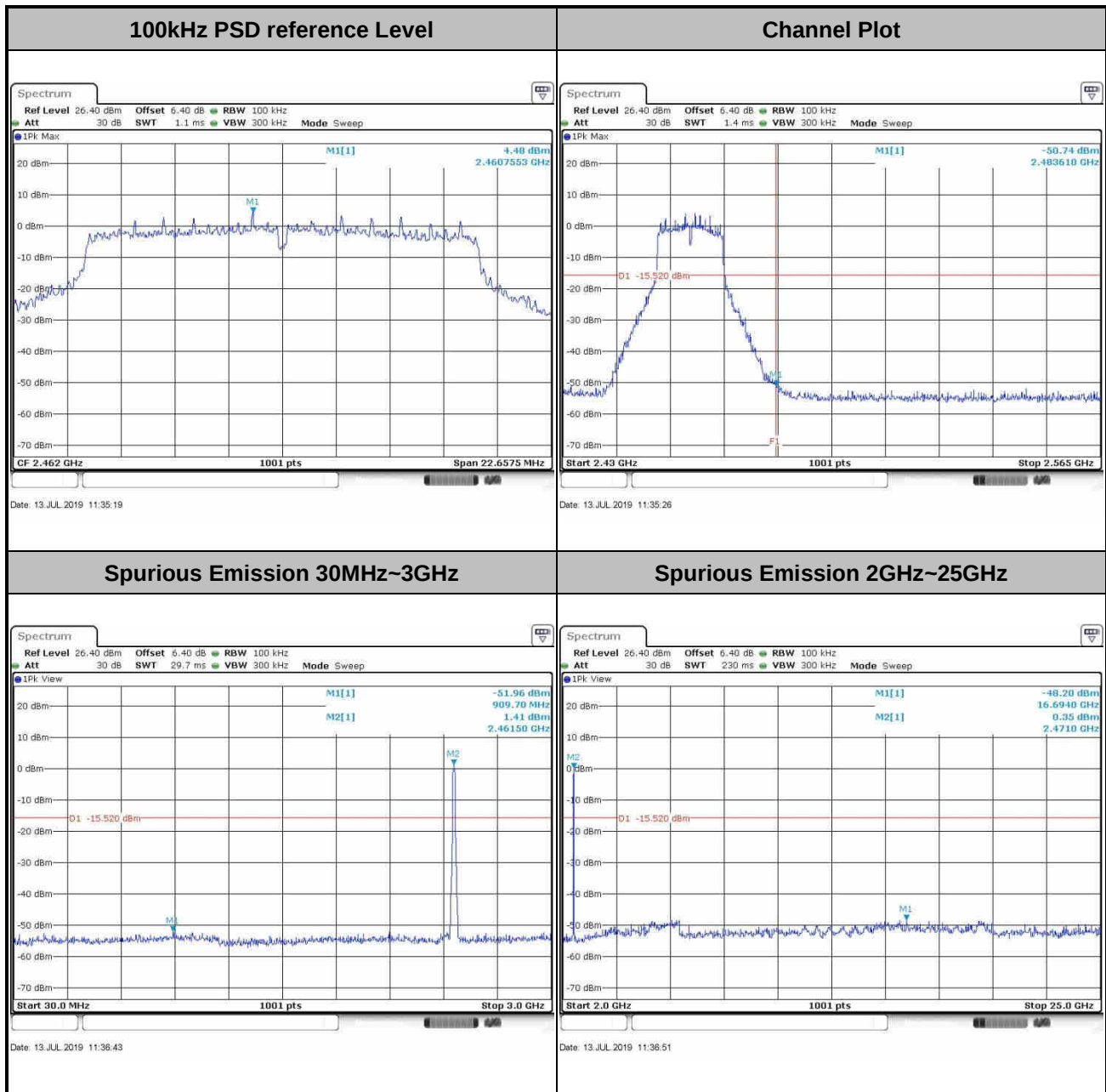


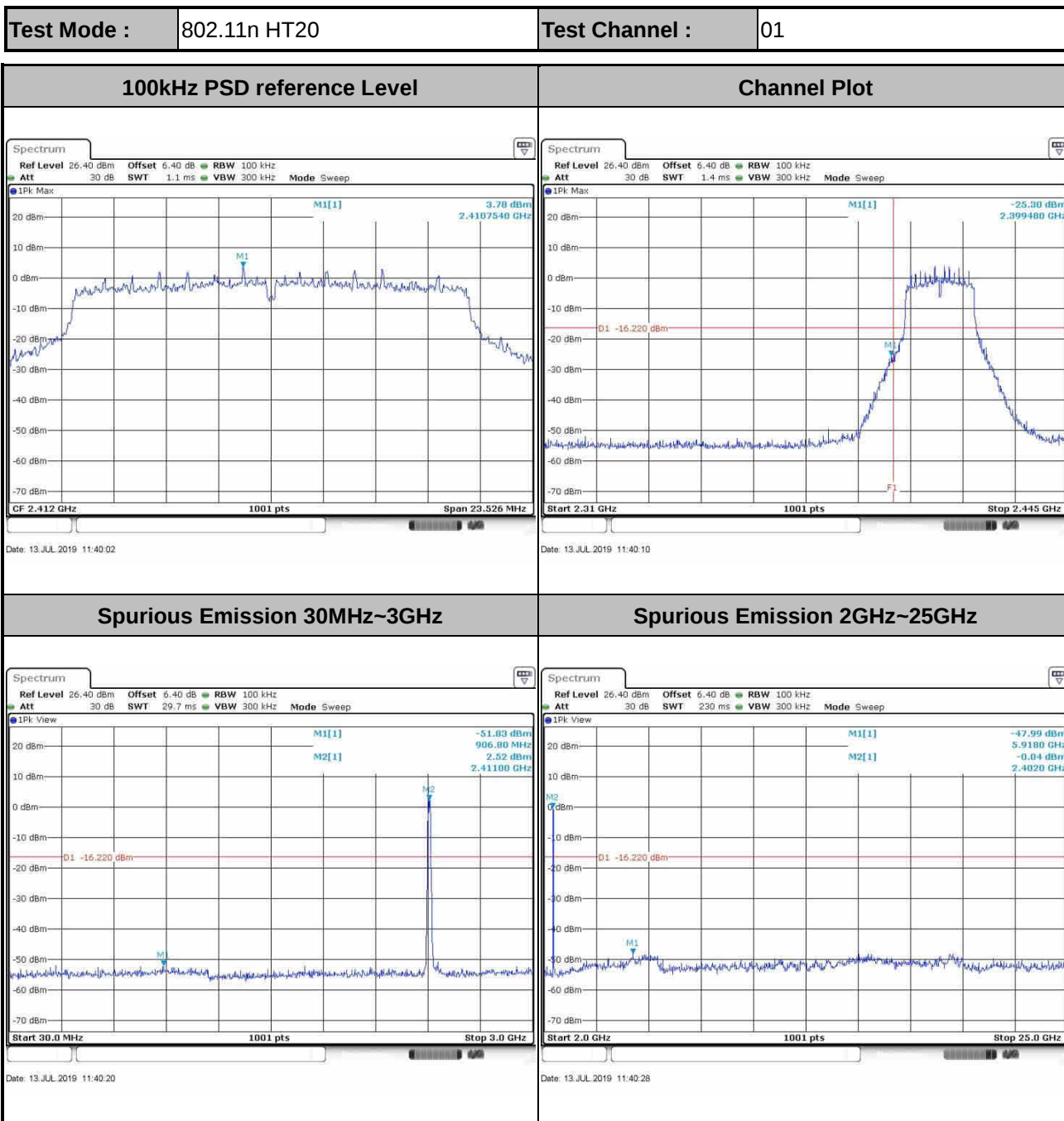
Spurious Emission 2GHz~25GHz





Test Mode :	802.11g	Test Channel :	11
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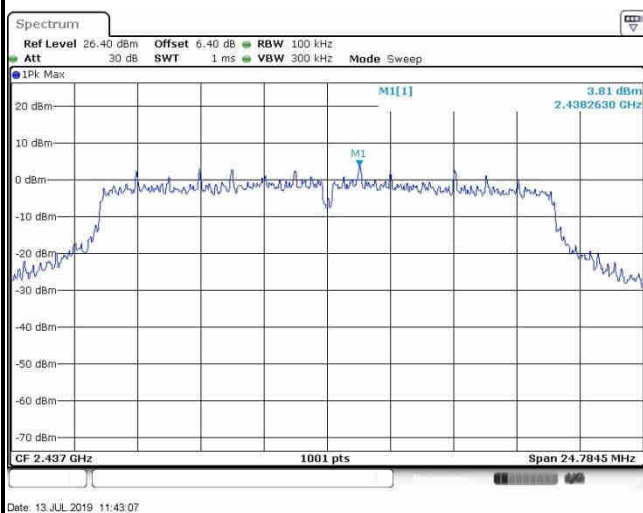




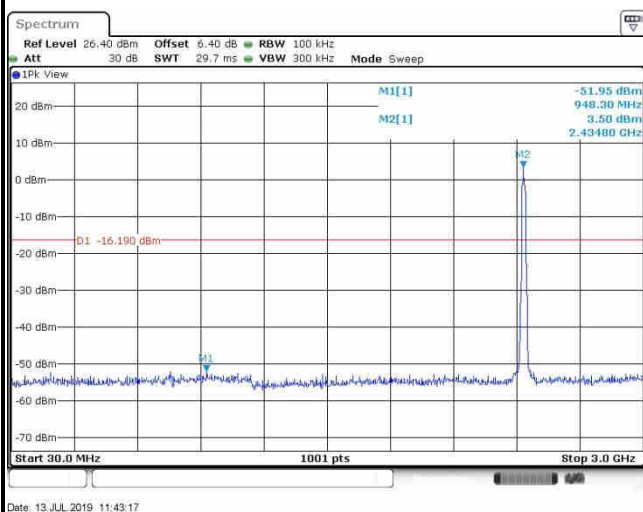


Test Mode :	802.11n HT20	Test Channel :	06
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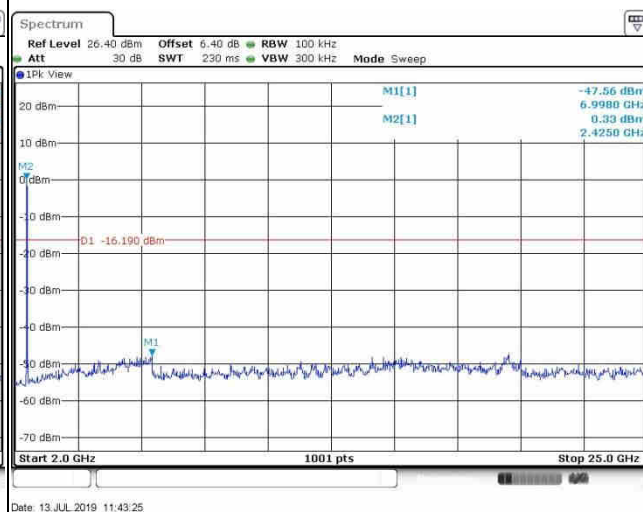
100kHz PSD reference Level

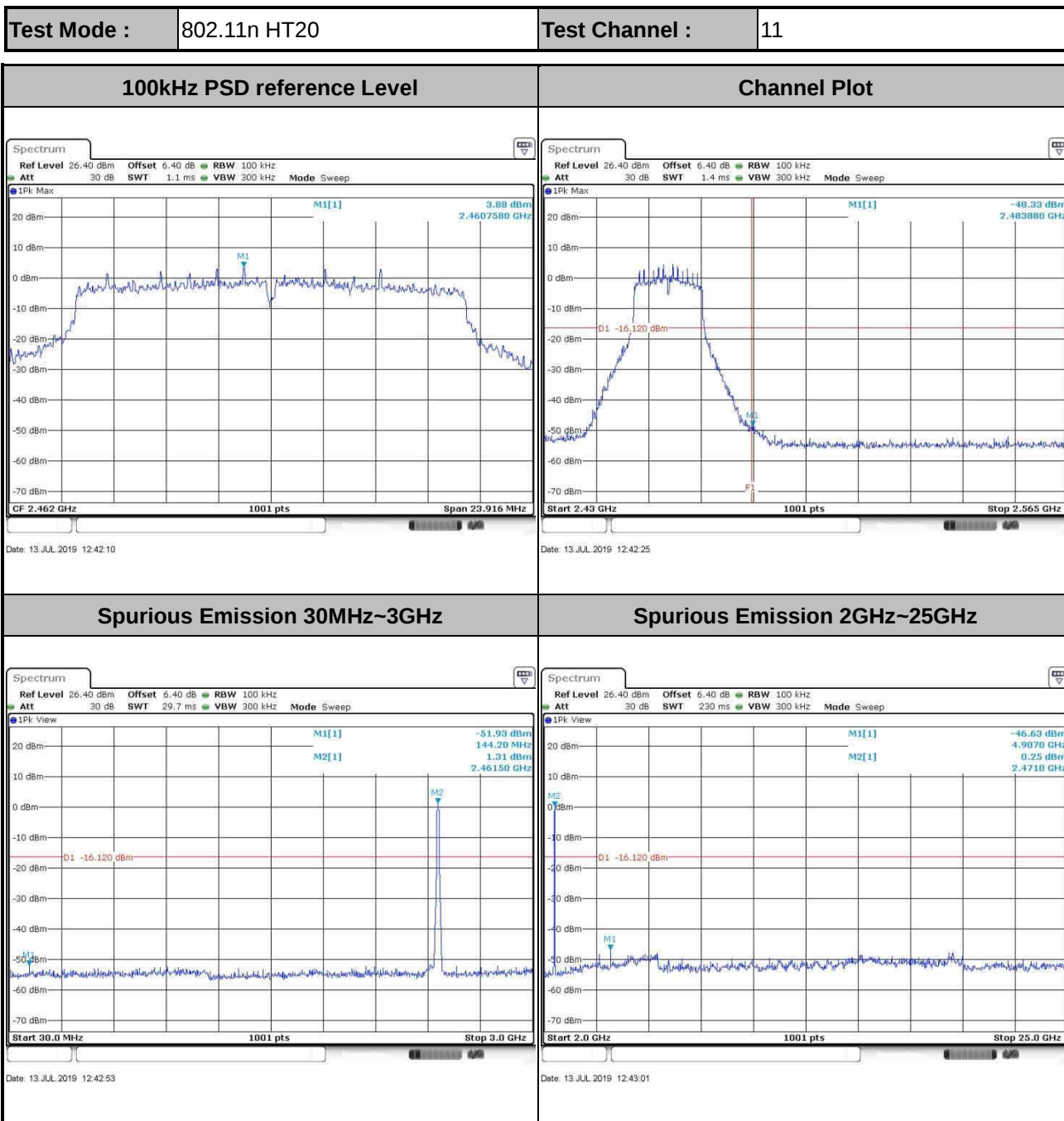


Spurious Emission 30MHz~3GHz



Spurious Emission 2GHz~25GHz



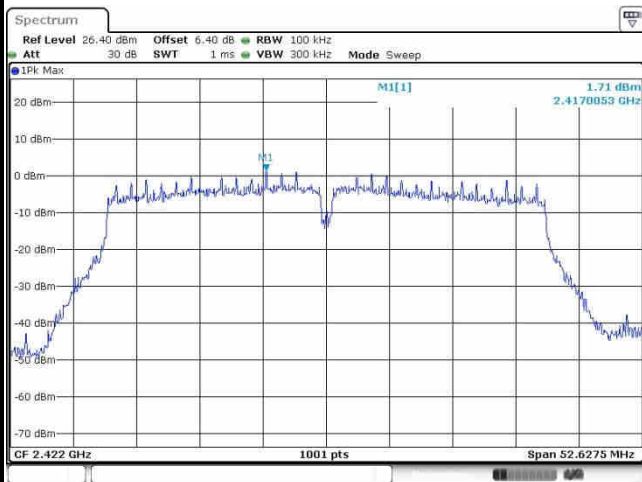




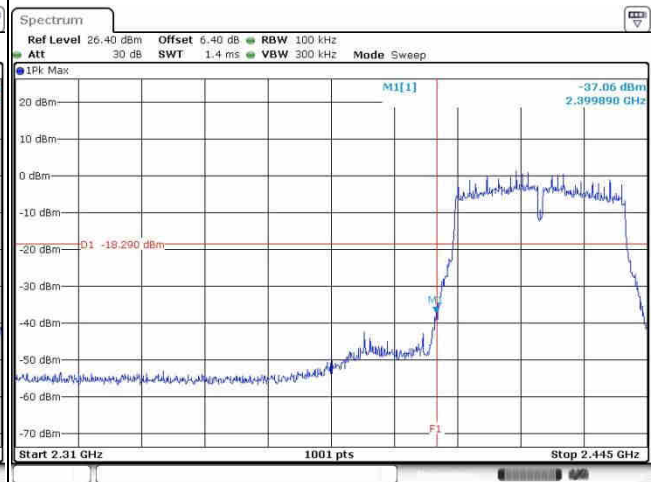
Test Mode : 802.11n HT40

Test Channel : 03

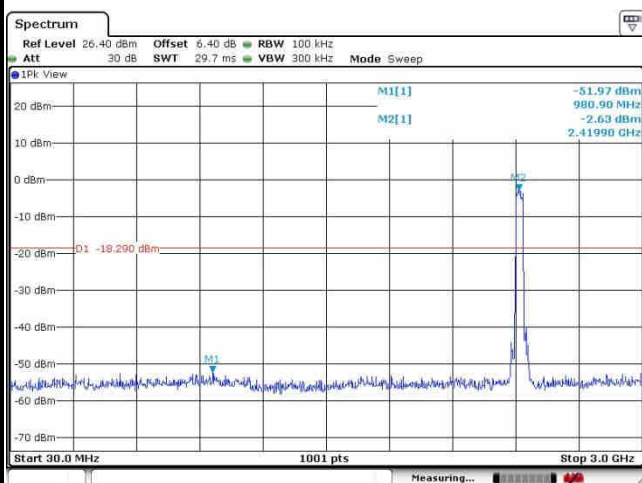
100kHz PSD reference Level



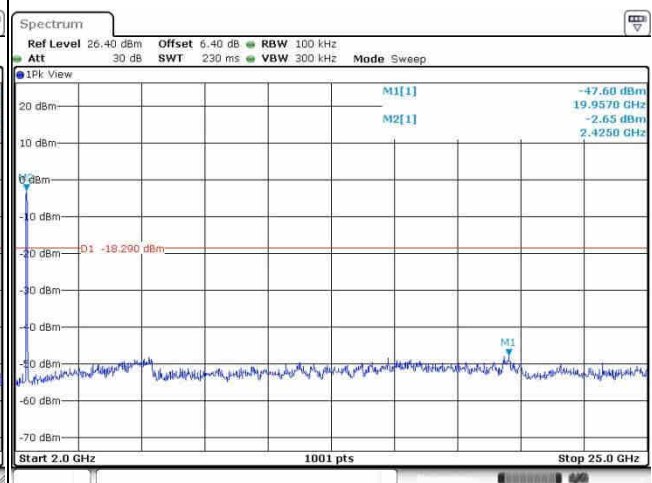
Channel Plot



Spurious Emission 30MHz~3GHz



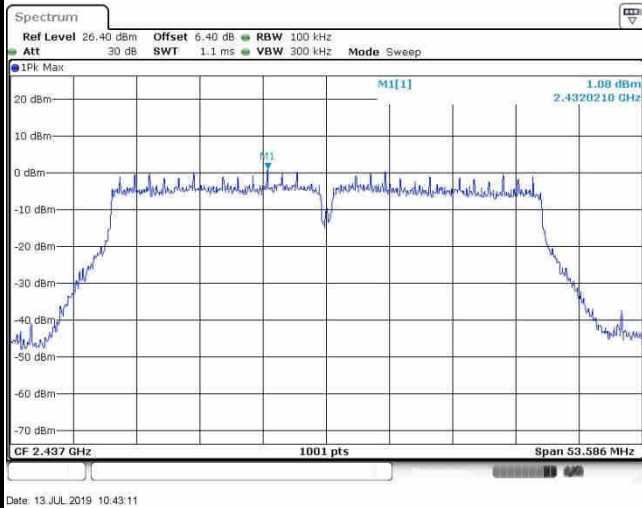
Spurious Emission 2GHz~25GHz



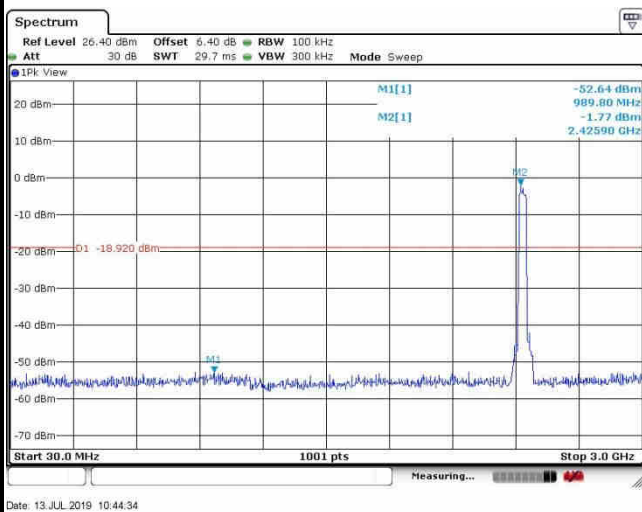


Test Mode :	802.11n HT40	Test Channel :	06
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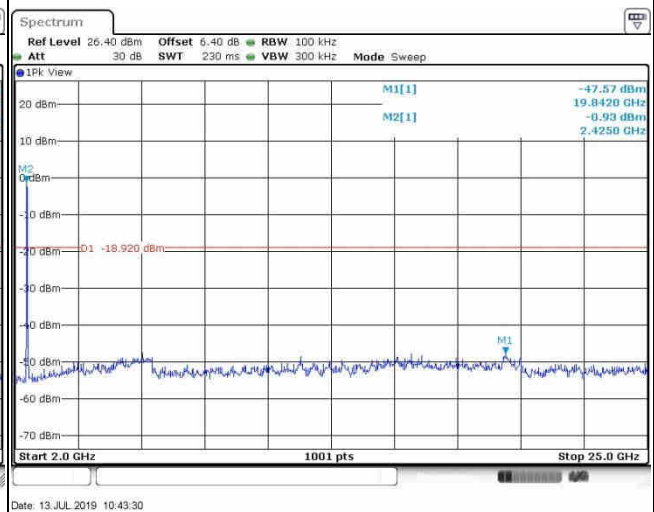
100kHz PSD reference Level



Spurious Emission 30MHz~3GHz

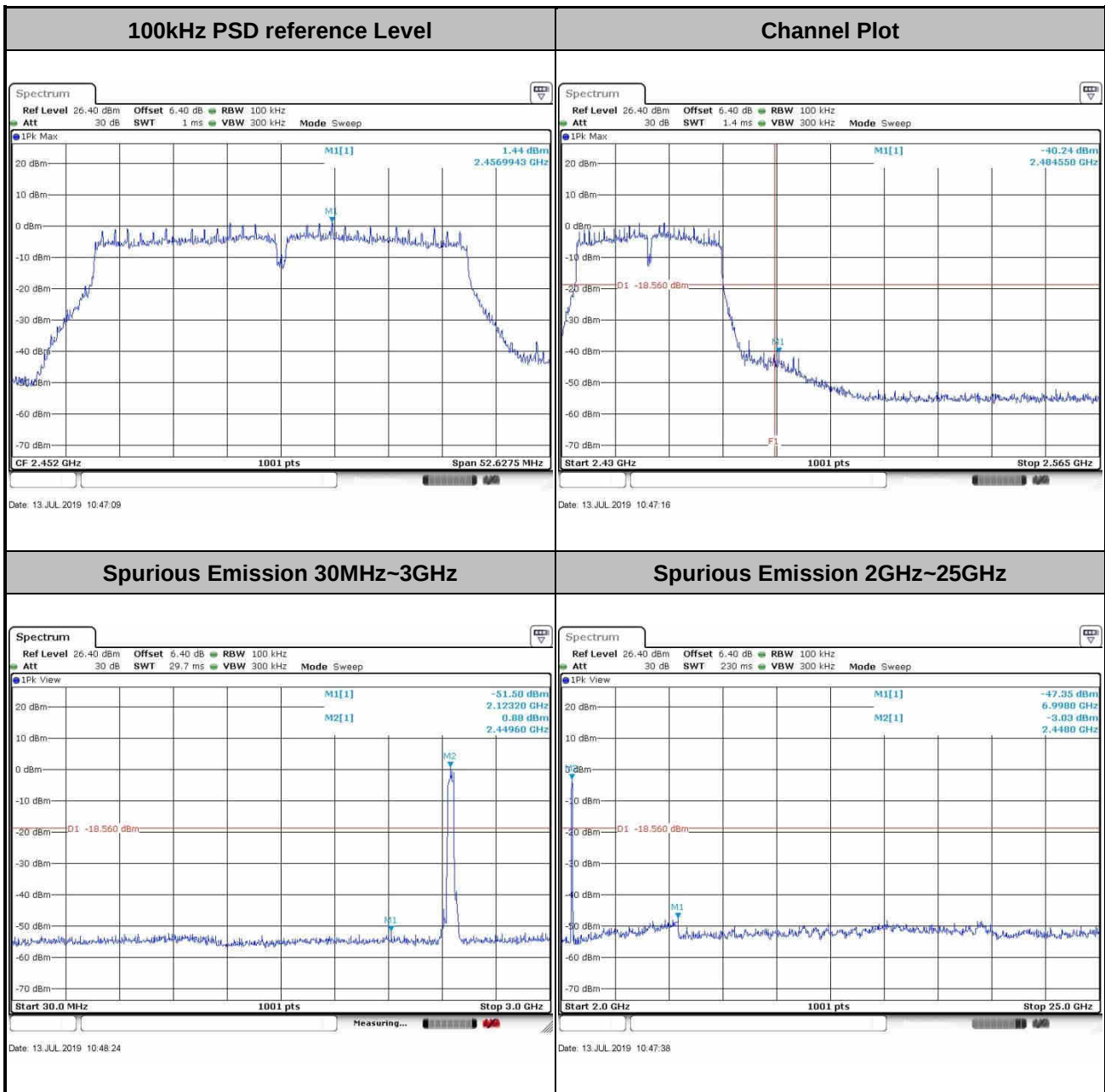


Spurious Emission 2GHz~25GHz





Test Mode :	802.11n HT40	Test Channel :	09
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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

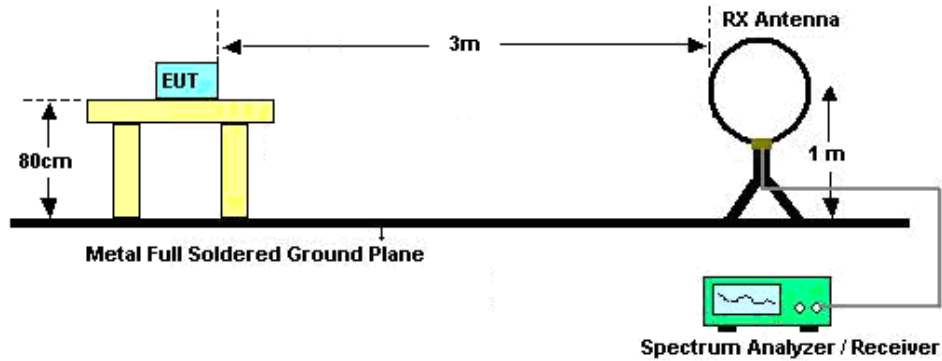
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better 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 testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. 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:

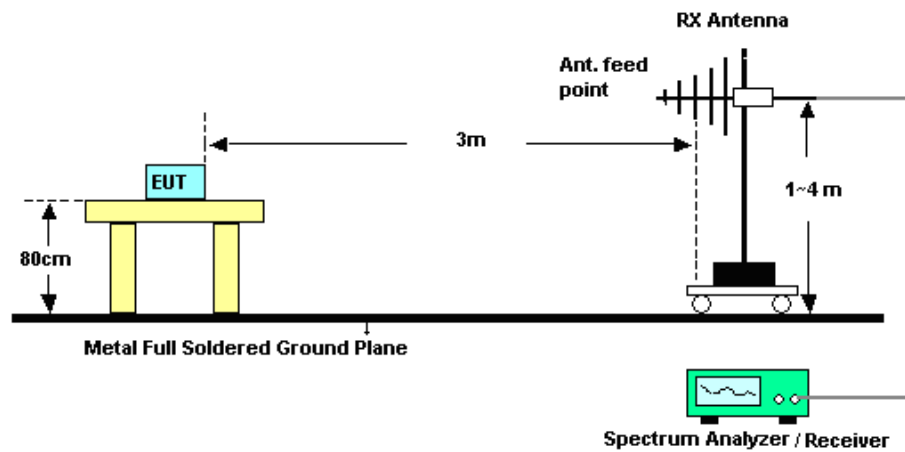
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

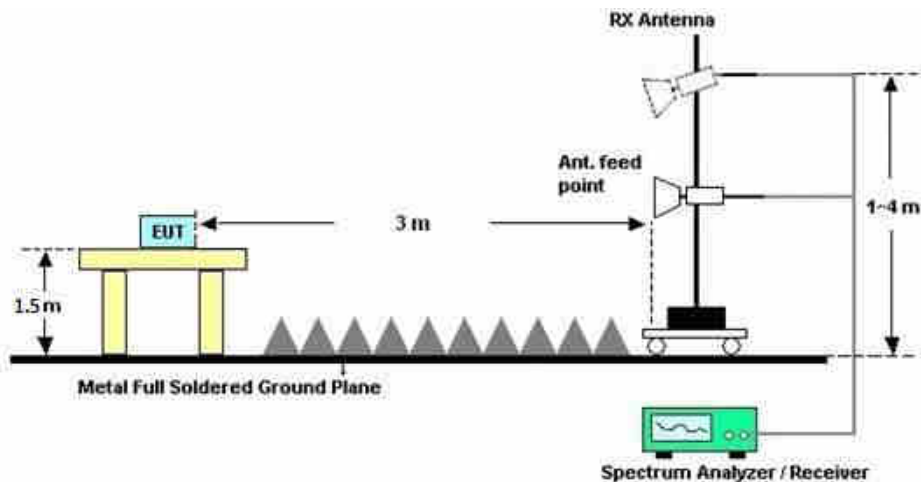
For radiated emissions below 30MHz



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.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.7 Duty Cycle

Please refer to Appendix D.

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

Please refer to Appendix C.

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.

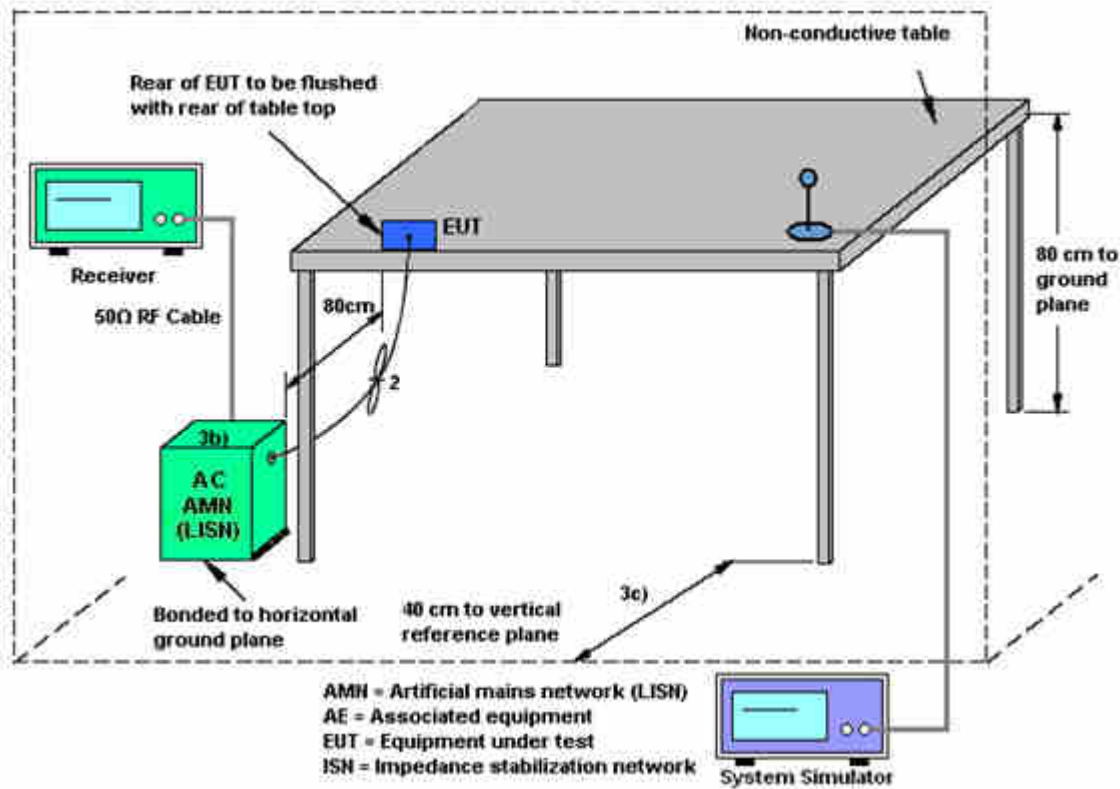
3.6.2 Measuring Instruments

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

Please refer to Appendix B.

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

<CDD Modes >

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.

For power, the directional gain G_{ANT} is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

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.

<CDD Modes>						
	Ant. 1	Ant. 2	DG for Power	DG for PSD	Power Limit Reduction	PSD Limit Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
2.4 GHz	0.20	-0.39	0.20	2.92	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	FSV40	101040	10Hz~40GHz	Aug. 07, 2018	Jul. 13, 2019	Aug. 06, 2019	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 14, 2019	Jul. 13, 2019	Jan. 13, 2020	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 14, 2019	Jul. 13, 2019	Jan. 13, 2020	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY57290151	3Hz~8.5GHz; Max 30dBm	Jun. 24, 2019	Jul. 24, 2019	Jun. 23, 2020	Radiation (03CH05-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55370528	10Hz~44GHz	Oct. 09, 2018	Jul. 24, 2019	Oct. 08, 2019	Radiation (03CH05-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 19, 2018	Jul. 24, 2019	Oct. 18, 2019	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	44483	30MHz~1GHz	Dec. 28, 2018	Jul. 24, 2019	Dec. 27, 2019	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Jan. 27, 2019	Jul. 24, 2019	Jan. 26, 2020	Radiation (03CH05-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 05, 2019	Jul. 24, 2019	Jan. 04, 2020	Radiation (03CH05-KS)
Amplifier	SONOMA	310N	187289	9KHz~1GHz	Aug. 06, 2018	Jul. 24, 2019	Aug. 05, 2019	Radiation (03CH05-KS)
Amplifier	MITEQ	TTA1840-35-HG	2014749	18~40GHz	Jan. 14, 2019	Jul. 24, 2019	Jan. 13, 2020	Radiation (03CH05-KS)
high gain Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	1Ghz~18Ghz	Aug. 17, 2018	Jul. 24, 2019	Aug. 16, 2019	Radiation (03CH05-KS)
Amplifier	Keysight	83017A	MY53270316	500MHz~26.5GHz	Dec. 22, 2018	Jul. 24, 2019	Dec. 21, 2019	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jul. 24, 2019	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jul. 24, 2019	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jul. 24, 2019	NCR	Radiation (03CH05-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 18, 2019	Jun. 25, 2019	Apr. 17, 2020	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 12, 2018	Jun. 25, 2019	Oct. 11, 2019	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Nov. 19, 2018	Jun. 25, 2019	Nov. 18, 2019	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2018	Jun. 25, 2019	Oct. 11, 2019	Conduction (CO01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage $K=2$ to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.9dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Appendix A. Conducted Test Results

Test Engineer:	Aaron shen	Temperature:	21~25	°C
Test Date:	2019/7/13	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

2.4GHz Band										
Mod.	Data Rate	NTX	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	2	1	2412	14.19	13.94	8.07	8.07	0.50	Pass
11b	1Mbps	2	6	2437	13.74	13.99	8.07	8.07	0.50	Pass
11b	1Mbps	2	11	2462	14.09	13.79	8.07	8.07	0.50	Pass
11g	6Mbps	2	1	2412	17.58	17.28	15.64	15.43	0.50	Pass
11g	6Mbps	2	6	2437	17.28	17.43	15.13	16.02	0.50	Pass
11g	6Mbps	2	11	2462	17.58	17.28	15.76	15.11	0.50	Pass
HT20	MCS0	2	1	2412	18.83	18.53	16.80	15.68	0.50	Pass
HT20	MCS0	2	6	2437	18.38	18.73	15.13	16.52	0.50	Pass
HT20	MCS0	2	11	2462	18.83	18.48	16.80	15.94	0.50	Pass
HT40	MCS0	2	3	2422	36.56	36.26	35.68	35.09	0.50	Pass
HT40	MCS0	2	6	2437	36.26	36.56	35.09	35.72	0.50	Pass
HT40	MCS0	2	9	2452	36.56	36.36	35.72	35.09	0.50	Pass

TEST RESULTS DATA
Peak Output Power

2.4GHz Band																
Mod.	Data Rate	NTx	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	16.31	15.17		30.00	30.00	0.20	-0.39	16.51	14.78	36.00	36.00	Pass
11b	1Mbps	1	6	2437	16.25	16.55		30.00	30.00	0.20	-0.39	16.45	16.16	36.00	36.00	Pass
11b	1Mbps	1	11	2462	16.45	16.63		30.00	30.00	0.20	-0.39	16.65	16.24	36.00	36.00	Pass
11g	6Mbps	1	1	2412	18.01	17.27		30.00	30.00	0.20	-0.39	18.21	16.88	36.00	36.00	Pass
11g	6Mbps	1	6	2437	18.35	18.64		30.00	30.00	0.20	-0.39	18.55	18.25	36.00	36.00	Pass
11g	6Mbps	1	11	2462	18.39	18.71		30.00	30.00	0.20	-0.39	18.59	18.32	36.00	36.00	Pass
HT20	MCS0	1	1	2412	18.13	17.22		30.00	30.00	0.20	-0.39	18.33	16.83	36.00	36.00	Pass
HT20	MCS0	1	6	2437	18.47	18.86		30.00	30.00	0.20	-0.39	18.67	18.47	36.00	36.00	Pass
HT20	MCS0	1	11	2462	18.29	18.78		30.00	30.00	0.20	-0.39	18.49	18.39	36.00	36.00	Pass
HT40	MCS0	1	3	2422	20.58	19.41	30.00	30.00	0.20	-0.39	20.78	19.02	36.00	36.00	Pass	
HT40	MCS0	1	6	2437	20.16	20.12	30.00	30.00	0.20	-0.39	20.36	19.73	36.00	36.00	Pass	
HT40	MCS0	1	9	2452	20.47	20.68	30.00	30.00	0.20	-0.39	20.67	20.29	36.00	36.00	Pass	
11b	1Mbps	2	1	2412	16.79	15.75	19.31	30.00		0.20		19.51		36.00		Pass
11b	1Mbps	2	6	2437	17.24	17.42	20.34	30.00		0.20		20.54		36.00		Pass
11b	1Mbps	2	11	2462	16.89	17.23	20.07	30.00		0.20		20.27		36.00		Pass
11g	6Mbps	2	1	2412	18.34	18.47	21.42	30.00		0.20		21.62		36.00		Pass
11g	6Mbps	2	6	2437	18.36	18.66	21.52	30.00		0.20		21.72		36.00		Pass
11g	6Mbps	2	11	2462	18.44	18.73	21.60	30.00		0.20		21.80		36.00		Pass
HT20	MCS0	2	1	2412	18.29	17.60	20.97	30.00		0.20		21.17		36.00		Pass
HT20	MCS0	2	6	2437	18.73	19.37	22.07	30.00		0.20		22.27		36.00		Pass
HT20	MCS0	2	11	2462	18.48	18.85	21.68	30.00		0.20		21.88		36.00		Pass
HT40	MCS0	2	3	2422	20.59	20.62	23.62	30.00		0.20		23.82		36.00		Pass
HT40	MCS0	2	6	2437	20.60	20.55	23.59	30.00		0.20		23.79		36.00		Pass
HT40	MCS0	2	9	2452	21.08	20.78	23.94	30.00		0.20		24.14		36.00		Pass

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

TEST RESULTS DATA
Average Output Power

2.4GHz Band									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)		Average Conducted Power (dBm)		SUM
					Ant 1	Ant 2	Ant 1	Ant 2	
11b	1Mbps	1	1	2412	0.00	0.00	13.81	13.42	
11b	1Mbps	1	6	2437	0.00	0.00	13.84	14.39	
11b	1Mbps	1	11	2462	0.00	0.00	14.04	14.18	
11g	6Mbps	1	1	2412	0.08	0.08	13.37	12.69	
11g	6Mbps	1	6	2437	0.08	0.08	13.60	14.06	
11g	6Mbps	1	11	2462	0.08	0.08	13.89	13.82	
HT20	MCS0	1	1	2412	0.08	0.08	13.16	12.69	
HT20	MCS0	1	6	2437	0.08	0.08	13.19	13.83	
HT20	MCS0	1	11	2462	0.08	0.08	13.73	13.74	
HT40	MCS0	1	3	2422	0.23	0.23	13.16	13.22	
HT40	MCS0	1	6	2437	0.23	0.23	13.76	13.66	
HT40	MCS0	1	9	2452	0.23	0.23	13.79	14.26	
11b	1Mbps	2	1	2412	0.00	0.00	14.37	13.96	17.18
11b	1Mbps	2	6	2437	0.00	0.00	14.73	14.81	17.78
11b	1Mbps	2	11	2462	0.00	0.00	14.78	14.63	17.72
11g	6Mbps	2	1	2412	0.09	0.08	13.71	13.75	16.74
11g	6Mbps	2	6	2437	0.09	0.08	14.02	14.41	17.23
11g	6Mbps	2	11	2462	0.09	0.08	13.95	14.37	17.17
HT20	MCS0	2	1	2412	0.08	0.08	13.92	13.39	16.67
HT20	MCS0	2	6	2437	0.08	0.08	14.26	14.24	17.26
HT20	MCS0	2	11	2462	0.08	0.08	14.16	14.12	17.15
HT40	MCS0	2	3	2422	0.23	0.23	13.60	13.72	16.67
HT40	MCS0	2	6	2437	0.23	0.23	14.04	14.40	17.23
HT40	MCS0	2	9	2452	0.23	0.23	14.07	14.34	17.21

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

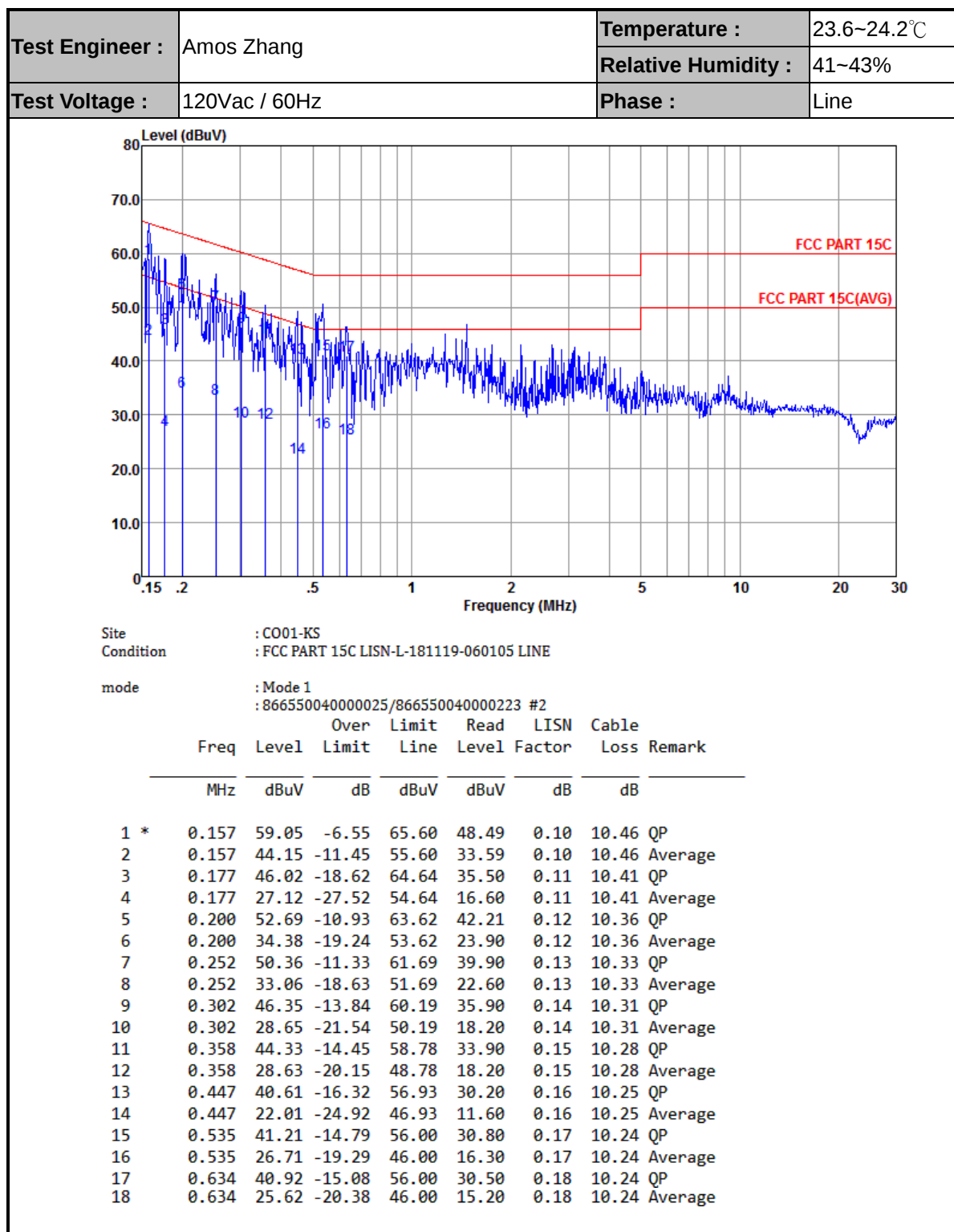
TEST RESULTS DATA
Peak Power Spectral Density

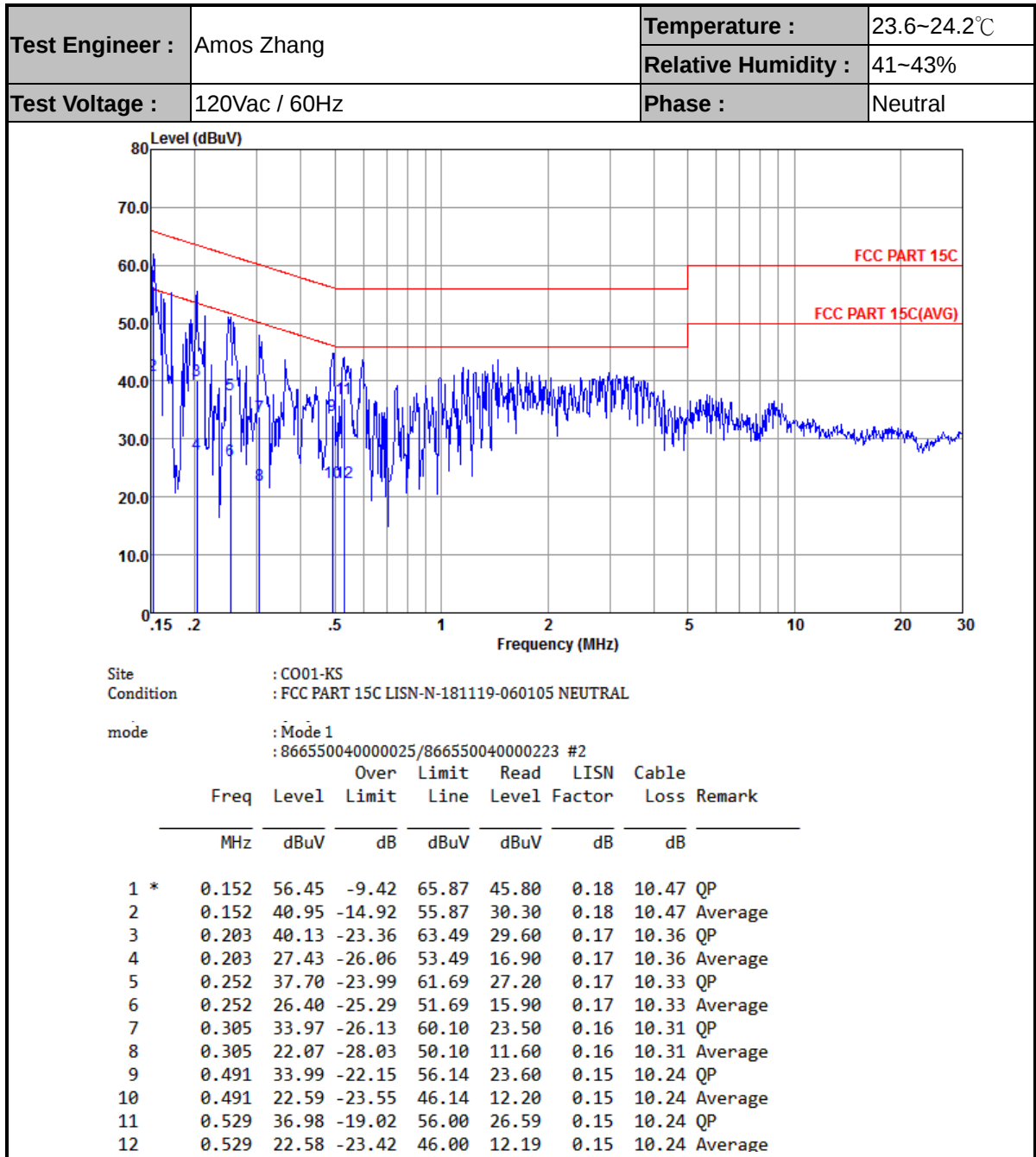
2.4GHz Band												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm/3kHz)			DG (dBi)		Peak PSD Limit (dBm/3kHz)		Pass/Fail
					Ant 1	Ant 2	Worse + 3.01	Ant 1	Ant 2	Ant 1	Ant 2	
11b	1Mbps	2	1	2412	-11.91	-11.56	-8.55	2.92		8.00		Pass
11b	1Mbps	2	6	2437	-11.07	-11.06	-8.05	2.92		8.00		Pass
11b	1Mbps	2	11	2462	-11.97	-11.06	-8.05	2.92		8.00		Pass
11g	6Mbps	2	1	2412	-13.60	-12.68	-9.67	2.92		8.00		Pass
11g	6Mbps	2	6	2437	-12.52	-12.36	-9.35	2.92		8.00		Pass
11g	6Mbps	2	11	2462	-12.65	-12.98	-9.64	2.92		8.00		Pass
HT20	MCS0	2	1	2412	-11.79	-13.47	-8.78	2.92		8.00		Pass
HT20	MCS0	2	6	2437	-12.85	-13.62	-9.84	2.92		8.00		Pass
HT20	MCS0	2	11	2462	-13.31	-13.62	-10.30	2.92		8.00		Pass
HT40	MCS0	2	3	2422	-14.55	-15.61	-11.54	2.92		8.00		Pass
HT40	MCS0	2	6	2437	-14.72	-15.31	-11.71	2.92		8.00		Pass
HT40	MCS0	2	9	2452	-14.63	-15.21	-11.62	2.92		8.00		Pass

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



Appendix B. AC Conducted Emission Test Results







Appendix C. 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	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2356.8	51.84	-22.16	74	48.17	31.21	5.43	32.97	287	132	P	H
		2388.78	40.79	-13.21	54	37.01	31.3	5.48	33	287	132	A	H
	*	2414	102.02	-	-	98.21	31.36	5.48	33.03	287	132	P	H
	*	2414	99.21	-	-	95.4	31.36	5.48	33.03	287	132	A	H
		2387.48	52.11	-21.89	74	48.33	31.3	5.48	33	100	105	P	V
		2388.78	40.97	-13.03	54	37.19	31.3	5.48	33	100	105	A	V
	*	2412	104.07	-	-	100.26	31.36	5.48	33.03	100	105	P	V
	*	2414	100.1	-	-	96.29	31.36	5.48	33.03	100	105	A	V
802.11b CH 11 2462MHz	*	2464	102.86	-	-	98.45	31.53	5.55	32.67	277	126	P	H
	*	2464	98.43	-	-	94.02	31.53	5.55	32.67	277	126	A	H
		2486.8	53.32	-20.68	74	48.67	31.59	5.55	32.49	277	126	P	H
		2483.5	41.81	-12.19	54	37.16	31.59	5.55	32.49	277	126	A	H
	*	2462	105.43	-	-	101.06	31.53	5.51	32.67	114	109	P	V
	*	2462	102.06	-	-	97.69	31.53	5.51	32.67	114	109	A	V
		2486.32	53.9	-20.1	74	49.25	31.59	5.55	32.49	114	109	P	V
		2483.5	42.5	-11.5	54	37.85	31.59	5.55	32.49	114	109	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+2	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	51.93	-22.07	74	71.06	34.89	8.1	62.12	189	197	P	H
		4824	49.71	-4.29	54	68.84	34.89	8.1	62.12	189	197	A	H
		4824	50.75	-23.25	74	69.88	34.89	8.1	62.12	191	116	P	V
		4824	46.3	-7.7	54	65.43	34.89	8.1	62.12	191	116	A	V
802.11b CH 06 2437MHz		4872	43.36	-30.64	74	62.46	34.92	8.09	62.11	100	360	P	H
		7311	42.1	-31.9	74	59.83	35.29	9.75	62.77	100	360	P	H
		4872	40.42	-33.58	74	59.52	34.92	8.09	62.11	100	0	P	V
		7311	42.39	-31.61	74	60.12	35.29	9.75	62.77	100	0	P	V
802.11b CH 11 2462MHz		4924	49.62	-24.38	74	68.7	34.95	8.06	62.09	100	360	P	H
		7386	41.08	-32.92	74	58.71	35.34	9.81	62.78	100	360	P	H
		4926	49.66	-24.34	74	68.74	34.95	8.06	62.09	100	0	P	V
		7386	39.95	-34.05	74	57.58	35.34	9.81	62.78	100	0	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+2	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		2382.8	52.21	-21.79	74	48.53	31.25	5.43	33	188	138	P	H
		2389.82	41.17	-12.83	54	37.42	31.3	5.48	33.03	188	138	A	H
	*	2414	103.55	-	-	99.74	31.36	5.48	33.03	188	138	P	H
	*	2414	95.57	-	-	91.76	31.36	5.48	33.03	188	138	A	H
		2389.43	52.19	-21.81	74	48.41	31.3	5.48	33	100	106	P	V
		2386.7	41.99	-12.01	54	38.21	31.3	5.48	33	100	106	A	V
	*	2414	103.89	-	-	100.08	31.36	5.48	33.03	100	106	P	V
	*	2412	96.21	-	-	92.4	31.36	5.48	33.03	100	106	A	V
802.11g CH 11 2462MHz	*	2464	104.56	-	-	100.15	31.53	5.55	32.67	222	139	P	H
	*	2464	96.89	-	-	92.48	31.53	5.55	32.67	222	139	A	H
		2483.5	55.68	-18.32	74	51.03	31.59	5.55	32.49	222	139	P	H
		2483.5	44.84	-9.16	54	40.19	31.59	5.55	32.49	222	139	A	H
	*	2462	105.75	-	-	101.38	31.53	5.51	32.67	114	110	P	V
	*	2462	97.99	-	-	93.62	31.53	5.51	32.67	114	110	A	V
		2484.16	55.54	-18.46	74	50.89	31.59	5.55	32.49	114	110	P	V
		2483.5	45.01	-8.99	54	40.36	31.59	5.55	32.49	114	110	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+2	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	44.47	-29.53	74	63.6	34.89	8.1	62.12	100	360	P	H
		4824	43.89	-30.11	74	63.02	34.89	8.1	62.12	100	0	P	V
802.11g CH 06 2437MHz		4872	44.42	-29.58	74	63.52	34.92	8.09	62.11	100	360	P	H
		7308	41.81	-32.19	74	59.54	35.29	9.75	62.77	100	360	P	H
		4872	41.87	-32.13	74	60.97	34.92	8.09	62.11	100	360	P	V
		7308	41.63	-32.37	74	59.36	35.29	9.75	62.77	100	360	P	V
802.11g CH 11 2462MHz		4926	40.98	-33.02	74	60.06	34.95	8.06	62.09	100	360	P	H
		7386	40.04	-33.96	74	57.67	35.34	9.81	62.78	100	360	P	H
		4926	40.63	-33.37	74	59.71	34.95	8.06	62.09	100	0	P	V
		7386	40.49	-33.51	74	58.12	35.34	9.81	62.78	100	0	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+2	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		2389.95	52.33	-21.67	74	48.58	31.3	5.48	33.03	284	144	P	H
		2389.95	41.66	-12.34	54	37.91	31.3	5.48	33.03	284	144	A	H
	*	2416	102.97	-	-	98.98	31.36	5.48	32.85	284	144	P	H
	*	2414	94.15	-	-	90.34	31.36	5.48	33.03	284	144	A	H
		2389.95	52.98	-21.02	74	49.23	31.3	5.48	33.03	115	110	P	V
		2389.95	42.74	-11.26	54	38.99	31.3	5.48	33.03	115	110	A	V
	*	2412	105.06	-	-	101.25	31.36	5.48	33.03	115	110	P	V
	*	2414	96.82	-	-	93.01	31.36	5.48	33.03	115	110	A	V
802.11n HT20 CH 11 2462MHz	*	2466	103.62	-	-	99.21	31.53	5.55	32.67	265	143	P	H
	*	2464	95.51	-	-	91.1	31.53	5.55	32.67	265	143	A	H
		2485.72	55.81	-18.19	74	51.16	31.59	5.55	32.49	265	143	P	H
		2483.5	44.91	-9.09	54	40.26	31.59	5.55	32.49	265	143	A	H
	*	2462	106.1	-	-	101.73	31.53	5.51	32.67	116	114	P	V
	*	2462	97.83	-	-	93.46	31.53	5.51	32.67	116	114	A	V
		2483.8	57.31	-16.69	74	52.66	31.59	5.55	32.49	116	114	P	V
		2483.5	45.78	-8.22	54	41.13	31.59	5.55	32.49	116	114	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+2	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	40.66	-33.34	74	59.79	34.89	8.1	62.12	100	360	P	H
		4824	40.4	-33.6	74	59.53	34.89	8.1	62.12	100	0	P	V
802.11n HT20 CH 06 2437MHz		4872	39.15	-34.85	74	58.25	34.92	8.09	62.11	100	360	P	H
		7311	41.18	-32.82	74	58.91	35.29	9.75	62.77	100	360	P	H
		4872	39.82	-34.18	74	58.92	34.92	8.09	62.11	100	0	P	V
		7311	41.56	-32.44	74	59.29	35.29	9.75	62.77	100	0	P	V
802.11n HT20 CH 11 2462MHz		4926	40.85	-33.15	74	59.93	34.95	8.06	62.09	100	360	P	H
		7386	40.42	-33.58	74	58.05	35.34	9.81	62.78	100	360	P	H
		4926	41.32	-32.68	74	60.4	34.95	8.06	62.09	100	0	P	V
		7386	40.25	-33.75	74	57.88	35.34	9.81	62.78	100	0	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+2	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		2389.56	54.56	-19.44	74	50.78	31.3	5.48	33	125	134	P	H
		2389.95	46.22	-7.78	54	42.47	31.3	5.48	33.03	125	134	A	H
	*	2432	103.18	-	-	99.11	31.41	5.51	32.85	125	134	P	H
	*	2434	94.27	-	-	90.2	31.41	5.51	32.85	125	134	A	H
		2488.48	53.09	-20.91	74	48.39	31.64	5.55	32.49	125	134	P	H
		2483.8	43.29	-10.71	54	38.64	31.59	5.55	32.49	125	134	A	H
		2386.18	54.94	-19.06	74	51.16	31.3	5.48	33	114	107	P	V
		2389.82	45.38	-8.62	54	41.63	31.3	5.48	33.03	114	107	A	V
	*	2424	103.55	-	-	99.48	31.41	5.51	32.85	114	107	P	V
	*	2424	95.34	-	-	91.27	31.41	5.51	32.85	114	107	A	V
		2491.3	54.11	-19.89	74	49.41	31.64	5.55	32.49	114	107	P	V
		2484.4	43.7	-10.3	54	39.05	31.59	5.55	32.49	114	107	A	V
802.11n HT40 CH 09 2452MHz		2384.49	51.53	-22.47	74	47.85	31.25	5.43	33	143	132	P	H
		2388.52	41.55	-12.45	54	37.77	31.3	5.48	33	143	132	A	H
	*	2440	102.16	-	-	98.03	31.47	5.51	32.85	143	132	P	H
	*	2440	93.89	-	-	89.76	31.47	5.51	32.85	143	132	A	H
		2484.88	60.17	-13.83	74	55.52	31.59	5.55	32.49	143	132	P	H
		2483.5	51.82	-2.18	54	47.17	31.59	5.55	32.49	143	132	A	H
		2333.4	52.36	-21.64	74	48.8	31.12	5.38	32.94	110	108	P	V
		2389.56	41.89	-12.11	54	38.11	31.3	5.48	33	110	108	A	V
	*	2450	102.9	-	-	98.59	31.47	5.51	32.67	110	108	P	V
	*	2450	94.96	-	-	90.65	31.47	5.51	32.67	110	108	A	V
		2484.94	61.79	-12.21	74	57.14	31.59	5.55	32.49	110	108	P	V
		2483.74	52.9	-1.1	54	48.25	31.59	5.55	32.49	110	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 802.11n HT40 (Harmonic @ 3m)

WIFI Ant. 1+2	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		4842	40.75	-33.25	74	59.88	34.9	8.09	62.12	100	360	P	H
HT40		7266	41.86	-32.14	74	59.64	35.27	9.72	62.77	100	360	P	H
CH 03		4842	40.19	-33.81	74	59.32	34.9	8.09	62.12	100	0	P	V
2422MHz		7266	41.04	-32.96	74	58.82	35.27	9.72	62.77	100	0	P	V
802.11n		4872	38.74	-35.26	74	57.84	34.92	8.09	62.11	100	360	P	H
HT40		7311	43.71	-30.29	74	61.44	35.29	9.75	62.77	100	360	P	H
CH 06		4872	41.58	-32.42	74	60.68	34.92	8.09	62.11	100	360	P	V
2437MHz		7311	41.25	-32.75	74	58.98	35.29	9.75	62.77	100	360	P	V
802.11n		4902	39.41	-34.59	74	58.49	34.94	8.07	62.09	100	0	P	H
HT40		7356	41.08	-32.92	74	58.76	35.32	9.78	62.78	100	0	P	H
CH 09		4902	41.14	-32.86	74	60.22	34.94	8.07	62.09	100	360	P	V
2452MHz		7356	40.87	-33.13	74	58.55	35.32	9.78	62.78	100	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

Emission below 1GHz

2.4GHz WIFI 802.11n HT40 (LF)

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+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz 802.11n HT40 LF		34.85	19.09	-20.91	40	28.76	22.6	0.68	32.95	-	-	P	H
		89.17	26.56	-16.94	43.5	43.65	14.77	1.06	32.92	-	-	P	H
		108.57	27.41	-16.09	43.5	42.07	17.11	1.16	32.93	-	-	P	H
		174.53	35.33	-8.17	43.5	51.38	15.43	1.46	32.94	100	36	P	H
		327.79	30.41	-15.59	46	41.41	20.07	1.99	33.06	-	-	P	H
		834.13	32.46	-13.54	46	33	28.99	3.19	32.72	-	-	P	H
		42.61	32.36	-7.64	40	46.4	18.18	0.75	32.97	100	10	P	V
		67.83	28.67	-11.33	40	48.34	12.34	0.92	32.93	-	-	P	V
		185.2	28.03	-15.47	43.5	44.49	14.95	1.51	32.92	-	-	P	V
		247.28	26.6	-19.4	46	39.4	18.45	1.74	32.99	-	-	P	V
		599.39	31.84	-14.16	46	36.7	25.79	2.7	33.35	-	-	P	V
		623.64	31.49	-14.51	46	35.89	26.18	2.75	33.33	-	-	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.	
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

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 D. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1+2(1)	802.11b	100	-	-	10Hz
1+2(2)	802.11g	98.28	-	-	10Hz
1+2(1)	802.11n HT20	98.16	-	-	10Hz
1+2(1)	802.11n HT40	94.93	0.949	1.053	1.1KHz

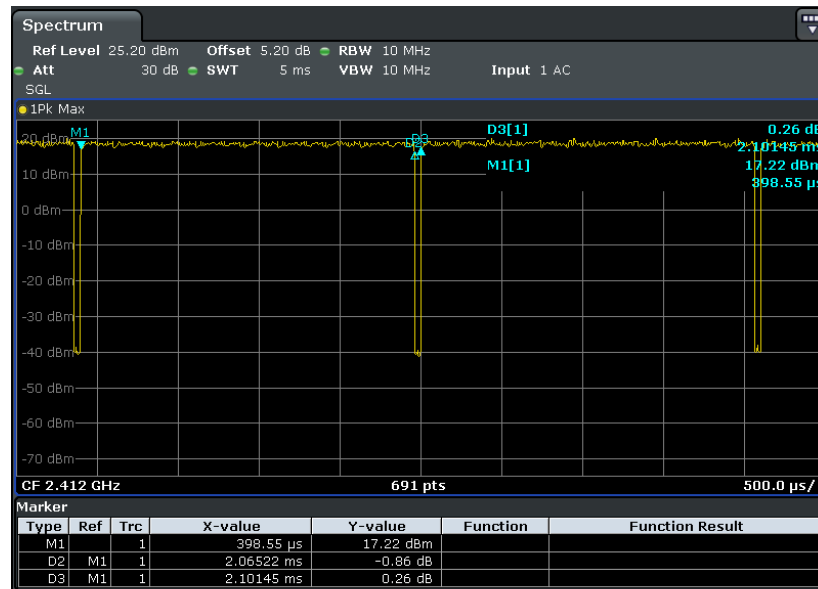
Ant. 1+2(1)

802.11b



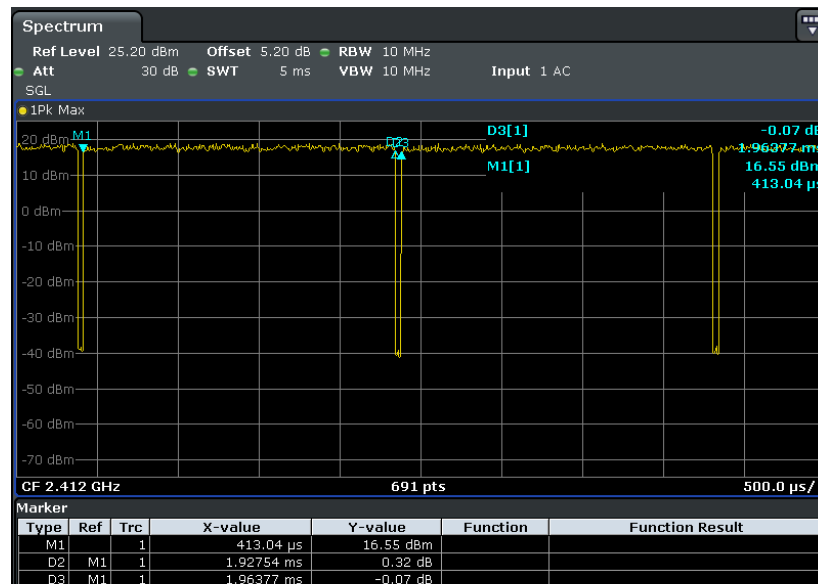
Ant. 1+2(2)

802.11g



Ant. 1+2(1)

802.11n HT20



Ant. 1+2(1)

802.11n HT40

