FCC RF Test Report

APPLICANT	:	Honeywell International Inc.
EQUIPMENT	:	Dolphin CT60
BRAND NAME	:	Honeywell
MODEL NAME	:	CT60L1N
FCC ID	:	HD5-CT60L1N
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System

The product was received on Apr. 24, 2020 and testing was completed on May 15, 2020. 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.

Jason Jia

Reviewed by: Jason Jia / Supervisor

James Huang

Approved by: James Huang / Manager

ACCREDITED
Cert #5145.02

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
FR042407A	Rev. 01	Initial issue of report	Jun. 11, 2020

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Pass	-
3.2	15.247(b)	Power Output Measurement	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges	≤ 20dBc	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 2.24 dB at 2483.500 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 12.38 dB at 0.449 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Applicant

Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707 USA

1.2 Manufacturer

Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707 USA

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Dolphin CT60
Brand Name	Honeywell
Model Name	CT60L1N
FCC ID	HD5-CT60L1N
EUT supports Radios application	CDMA/GSM/WCDMA/LTE WLAN 2.4GHz 802.11b/g/n/ac HT20/HT40 WLAN 2.4GHz 802.11ac VHT20/VHT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE GNSS/NFC
IMEI Code	Conducted:N/A Conduction: 990010901597139 Radiation: 990010901594979
HW Version	V1.0
HW P/N	DVT
SW Version	OS.03.003-HON.02.001
SW P/N	88.00.00-DEBUG(0579)
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. This is a variant report for CT60L1N (Original FCC ID: HD5-CT60L1N, Model: CT60L1N, approval date: 03/31/2020). For change note, please refer to the change list as below. According to the difference, all test items for full test.

the detail differences between Original and Variant product are list in the following table:

Object	Original	Variant	Remark
Carrier Board	Scanner N6703 imager	Scanner change to N6803 imager	

CT60L1N have the following new parts:

RF Module	Under fill Modified
RF Module	LPDDR4x Layout Optimization
RF Module	Wi-Fi Layout Optimization
RF Module	WWAN Path Optimization
RF Module	WWAN Shielding Frame Optimization
RF Module	WWAN PA Power Optimization
RF Module	SOM PAD Mask Optimization
RF Module	Change DC regulator and WLAN amplifier DC power
RF Module	BOM Change for Optimization **
RF Module	B25 Duplexer-AVAGO-ACMD-6225-TR1
RF Module	B40 TRX filter-AVAGO-ACPF-8240-TR1
RF Module	Add New power inductor in BOM
RF Module	Remove un-used CLK trace WCN_CLK
Carrier Board	Add 1F/2.7V supercap
Carrier Board	Add MAX38888 DC/DC for supercap charge/ change discharge circuit
Carrier Board	Add low battery protection circuit
Carrier Board	Change speaker and add a connector for it
Carrier Board	Change ADS1014 to ADS1015 to add supercap voltage detection
Carrier Board	AUX antenna tuner circuit change placement location
Carrier Board	Upgrade the SOM to SOM4
Carrier Board	Add new model battery
Carrier Board	Add WIFI-AUX layout, RF WIFI AUX Matching
Carrier Board	Modify two n-PTH to PTH to reduce RSE issue.
Carrier Board	Upgrade to gen 8 scanner, adjust 2 spring contacts' location.
Carrier Board	Add a high-G sensor.
WIFI 11b	Power reduction from 18+/-1.5 dB to 17.5+/-1.5 dB
LTE 7	Power reduction from 23.4 + 1 / -2.7 dB to 23 + 1 / -2.7dB
GSM 850	Power reduction for Head with WIFI ON mode from 33.4 + 1 / - 2 dB to 32.8 + 1 / -2 dB
CDMA2K BC0	Power reduction for Head with WIFI ON mode from 24.4 +/- 1 dB to 23.8 + /- 1dB
CDMA2K BC10	Power reduction for Head with WIFI ON mode from 24.4 +/- 1 dB to 23.8 + /- 1dB

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 : 21.33 dBm (0.1358 W) 802.11g : 25.31 dBm (0.3396 W) 802.11n HT20 : 25.20 dBm (0.3311 W) 802.11n HT40 : 25.30 dBm (0.3388 W) 802.11ac VHT20 : 25.17 dBm (0.3289 W) 802.11ac VHT40 : 25.16 dBm (0.3281 W)
99% Occupied Bandwidth	**<MIMO Ant.1+2>** 802.11b : 13.09MHz 802.11g : 18.28MHz 802.11n HT20 : 18.33MHz 802.11n HT40 : 37.26MHz
Antenna Type / Gain	<Ant.1>: PIFA Antenna type with gain 0.62 dBi <Ant.2>: Monopole Antenna type with gain 2.20 dBi
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n/ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
Antenna Function	

	Ant. 1	Ant. 2
802.11b/g/n/ac SISO/MIMO	V	V

Note:

1. For 802.11n HT20 / ac VHT20 and 802.11n HT40 / ac VHT40 mode, the whole testing have assessed only 802.11n HT20/ HT40 by referring to their maximum conducted power.
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.**
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacture	Name	Version
1.	03CH06-KS	AUDIX	E3	6.2009-8-24al
2.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 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 (Y 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.

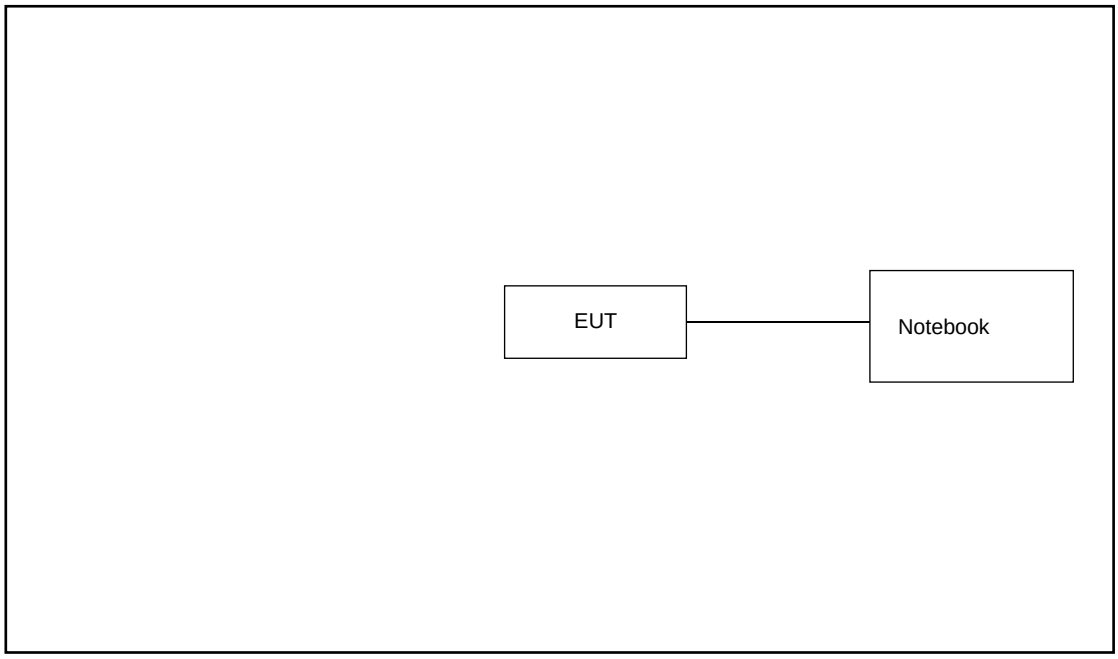
MIMO Antenna

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

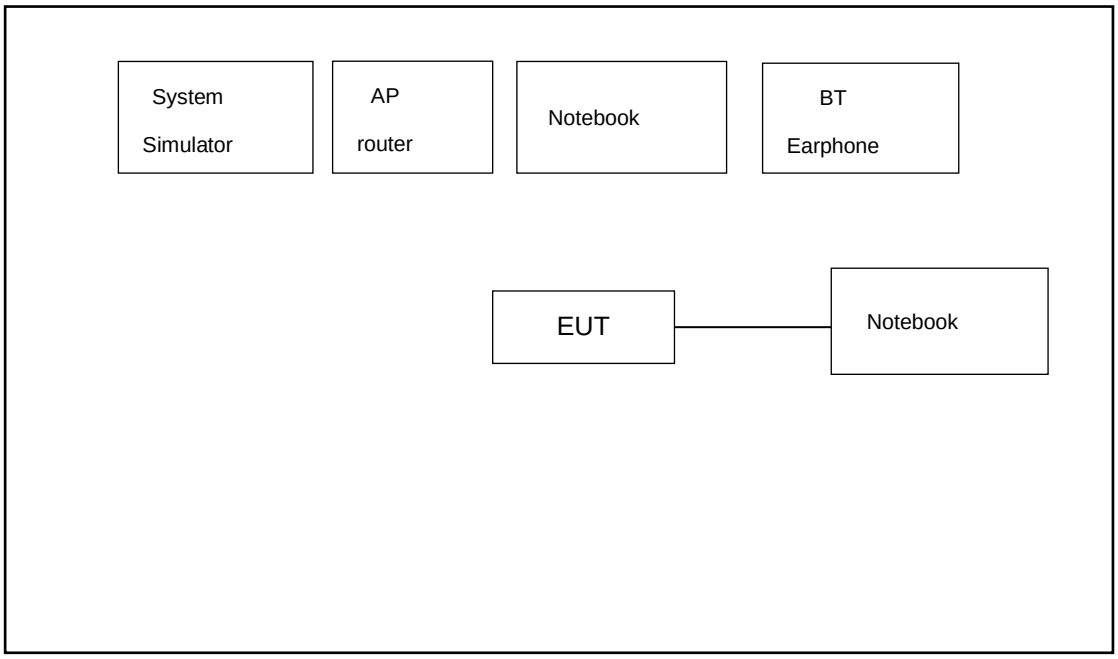
Test Cases	
AC Conducted Emission	Mode 1 :GSM 850 Idle + Bluetooth Link + WLAN Link(2.4G) + USB Link + snap on Adapter
Remark: For Radiated Test Cases, The tests were performance with Notebook	

2.3 Connection Diagram of Test System

For Radiation



For Conducted Emission



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	LTE Base Station	Anritus	MT8820C	N/A	N/A	Unshielded,1.8m
2.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
3.	Notebook	Lenovo	G480	QDS-BRCM1050I	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
5.	SD Card	Kingston	8GB	N/A	N/A	N/A
6.	Hard Disk	Lenovo	F310	DoC	Shielded, 1.2m	N/A

2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuously 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 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.

Offset = RF cable loss.

Following shows an offset computation example with cable loss 6.1 dB.

Offset(dB) = RF cable loss(dB).

= 6.1(dB)

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.

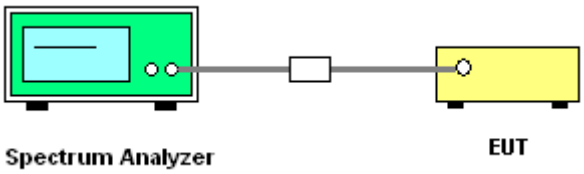
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

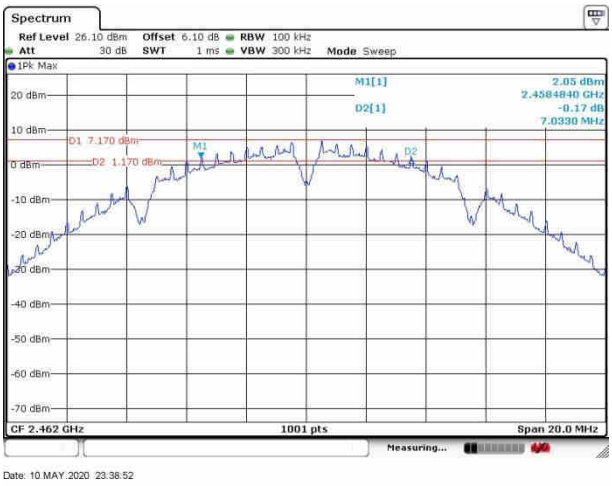
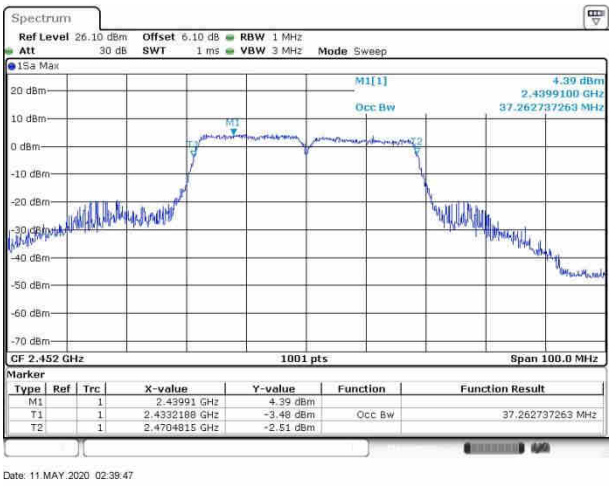
1. The testing follows ANSI C63.10-2013 clause 11.8
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement 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.

Minimum 6dB Bandwidth	Maximum 99% Occupied Bandwidth
	

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.

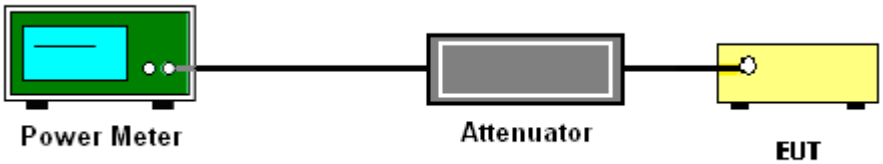
3.2.2 Measuring Instruments

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.

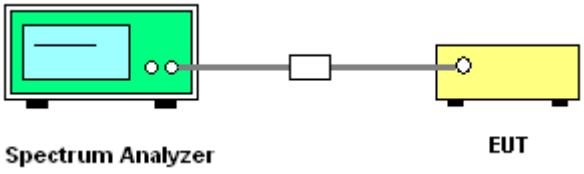
   If measurements performed using method (2) plus 10 log (N) exceeds the emission limit, the test should choose method (1) before declaring that the device fails the emission limit.

   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)

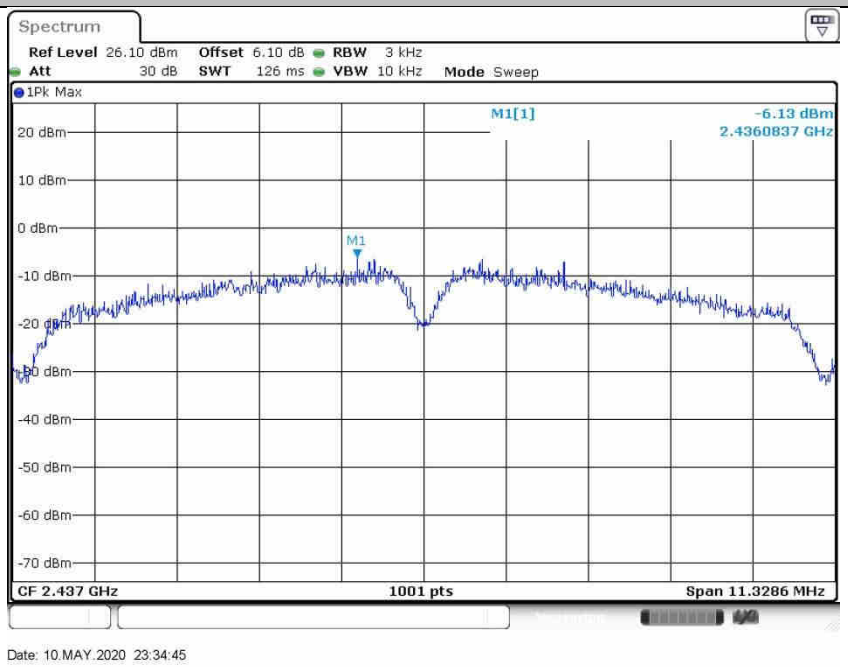
3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

Worst Case Power Density (dBm/3kHz)



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.

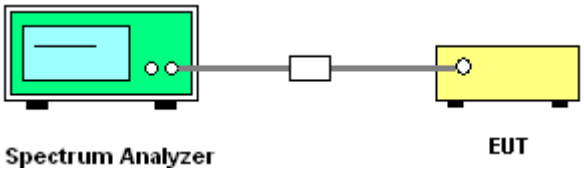
3.4.2 Measuring Instruments

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

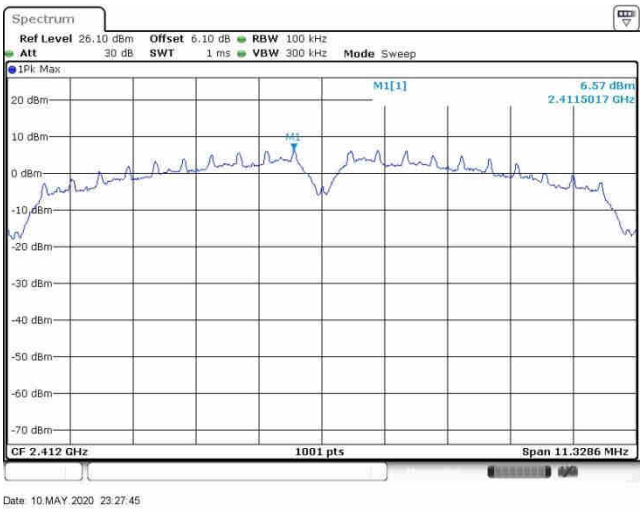
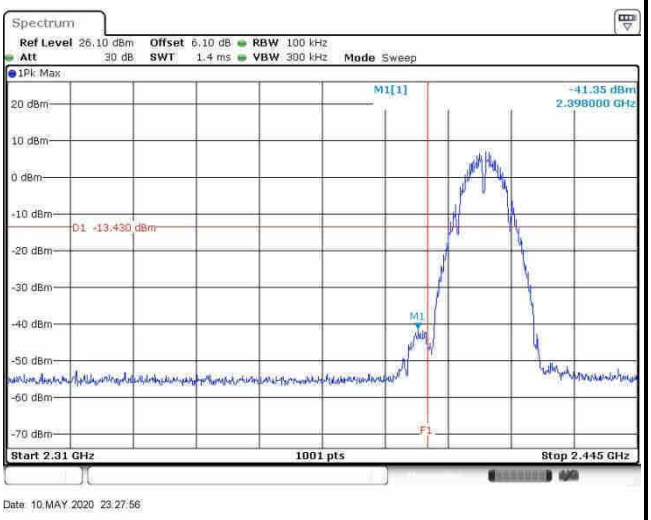
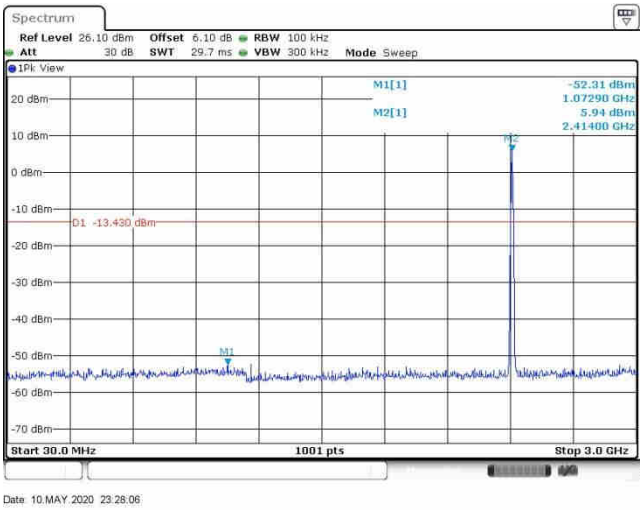
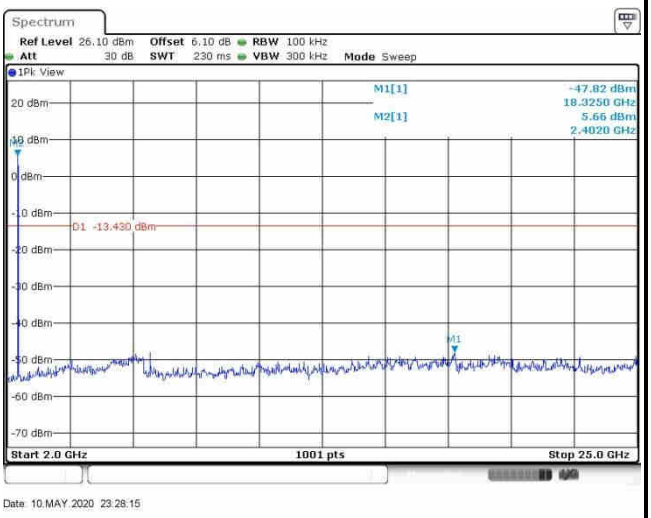


3.4.5 Test Result of Conducted Band Edges and Spurious Emission

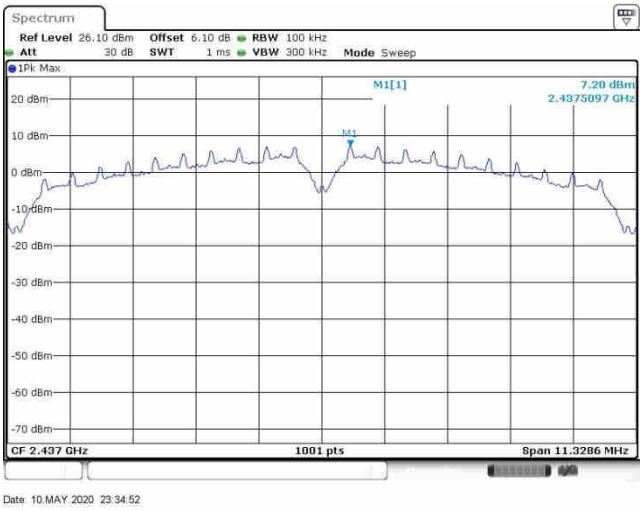
Test Engineer :	Weller Liu	**Temperature :**	0~40℃
		Relative Humidity :	51~54%

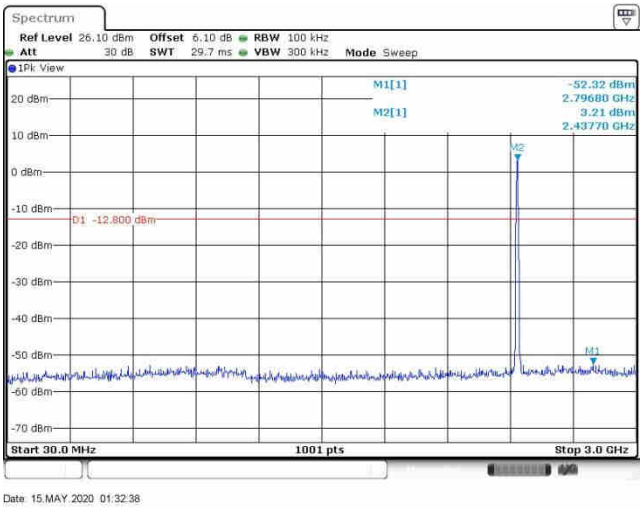
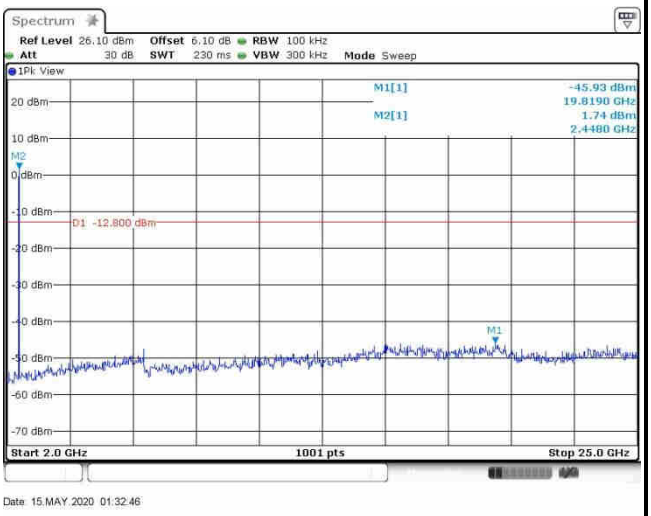
Number of TX = 1, Ant. 1 (Measured)

Test Mode :	802.11b	**Test Channel :**	01

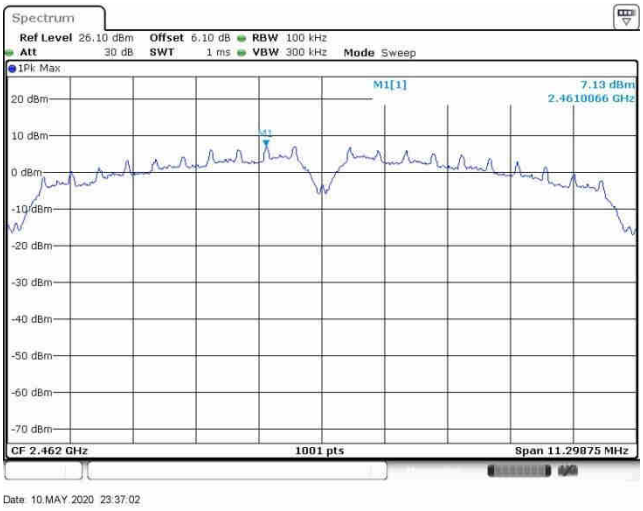
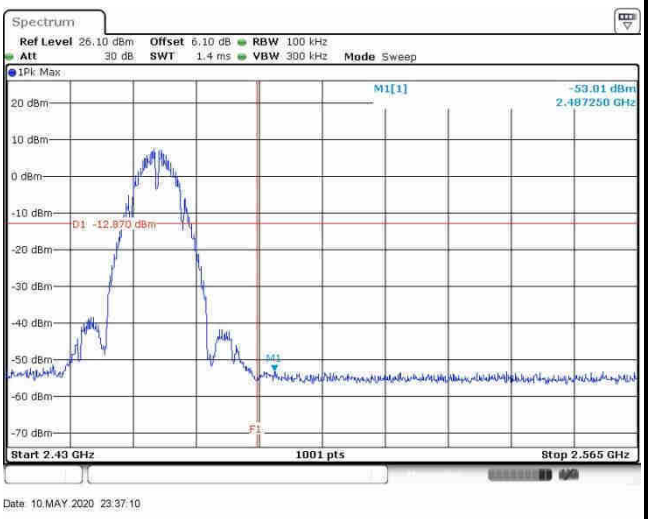
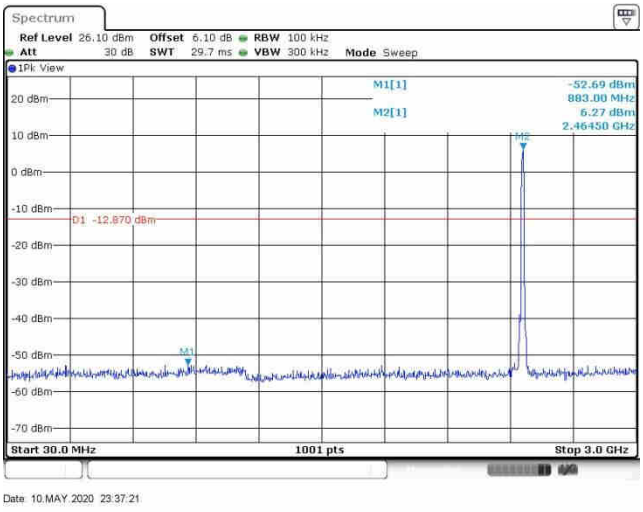
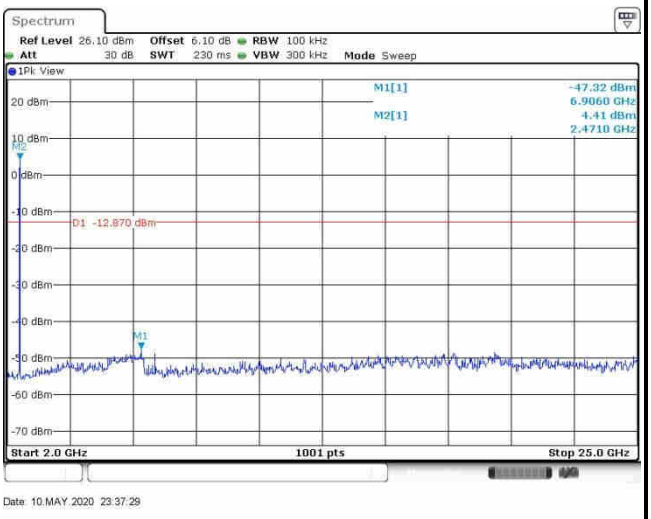
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11b	Test Channel :	06

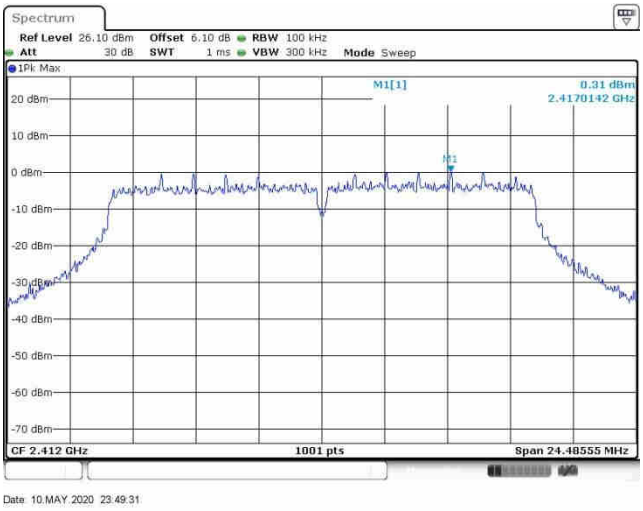
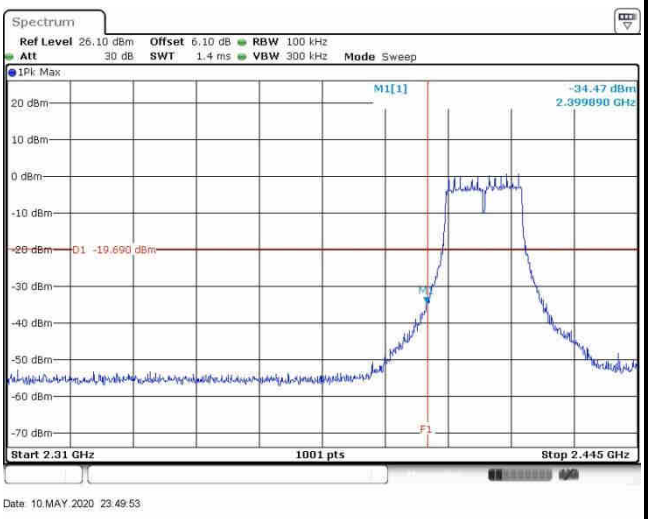
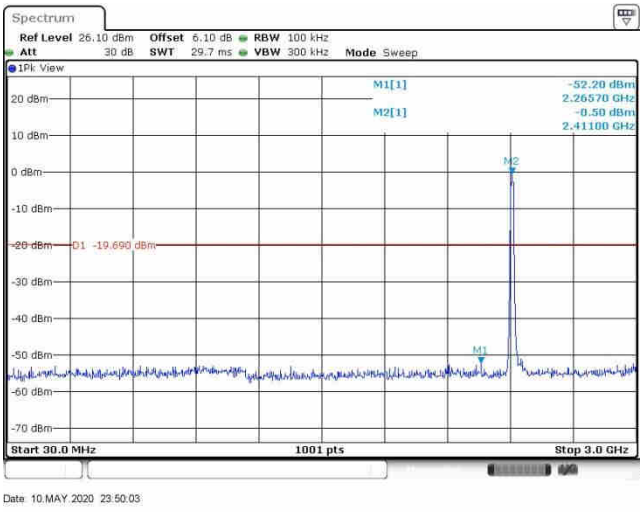
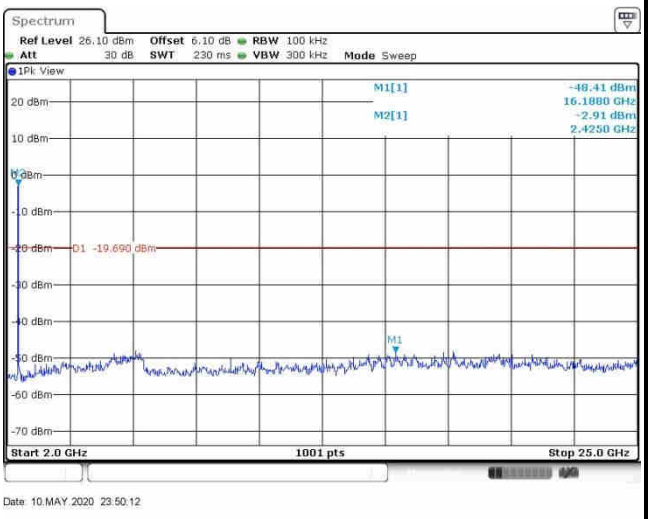
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

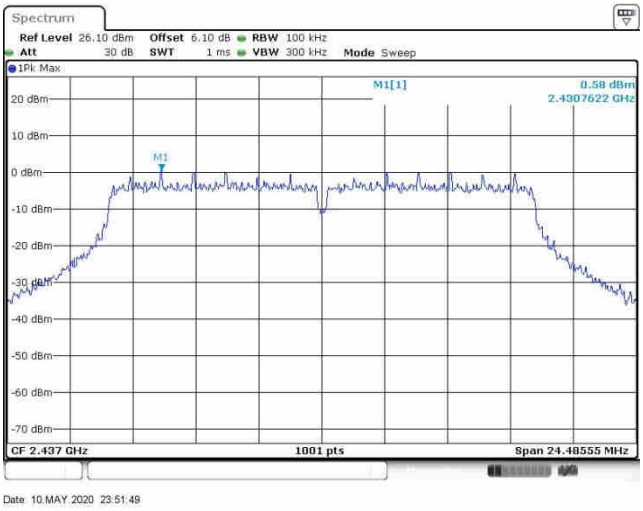
Test Mode :	802.11b	Test Channel :	11

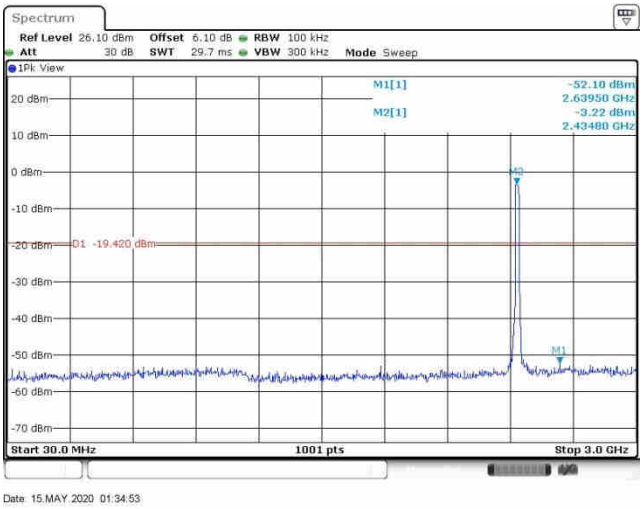
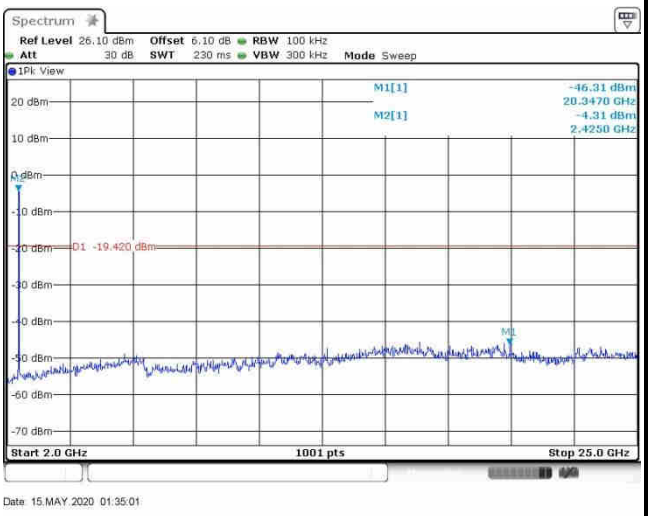
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	01

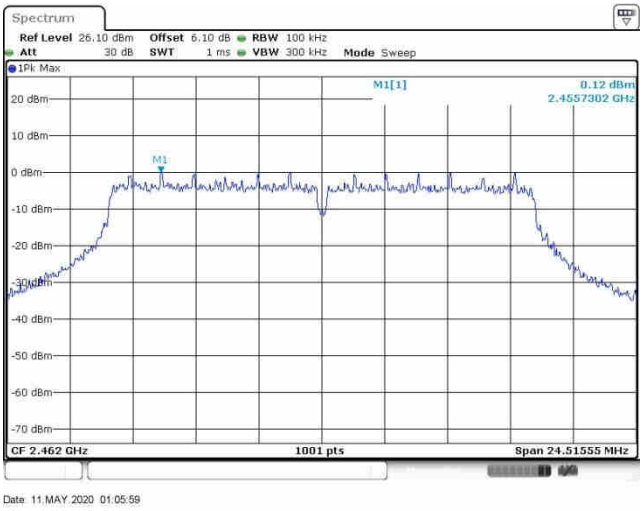
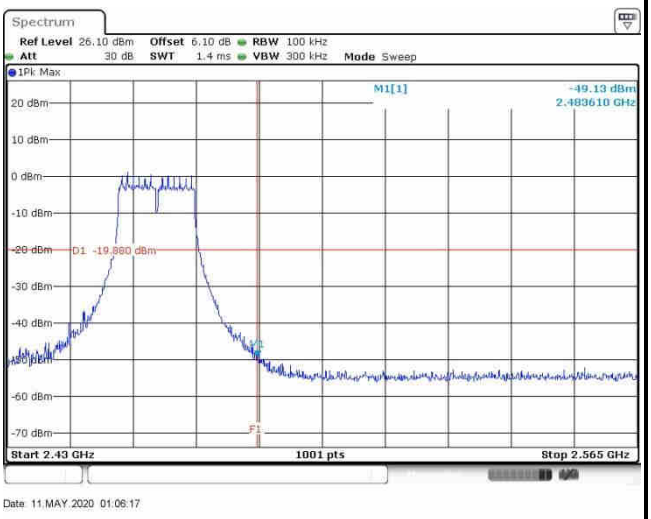
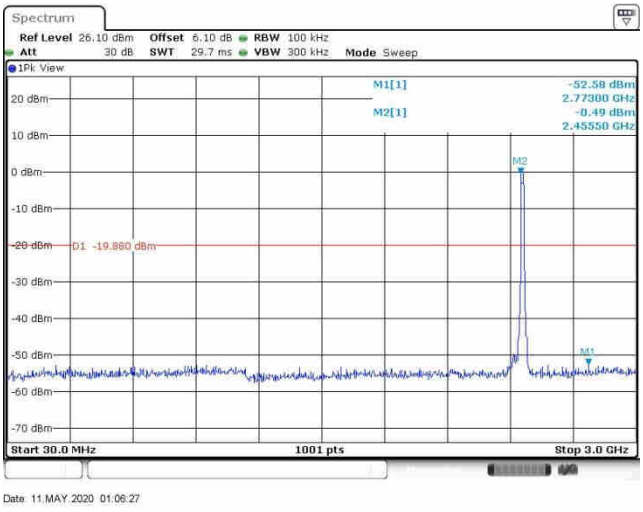
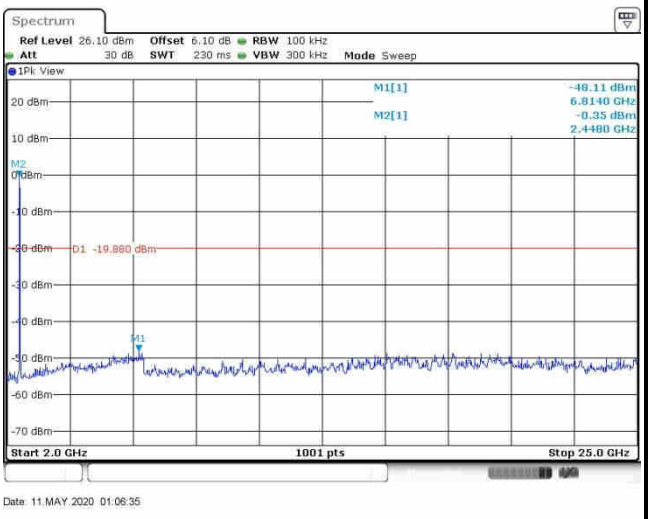
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	06

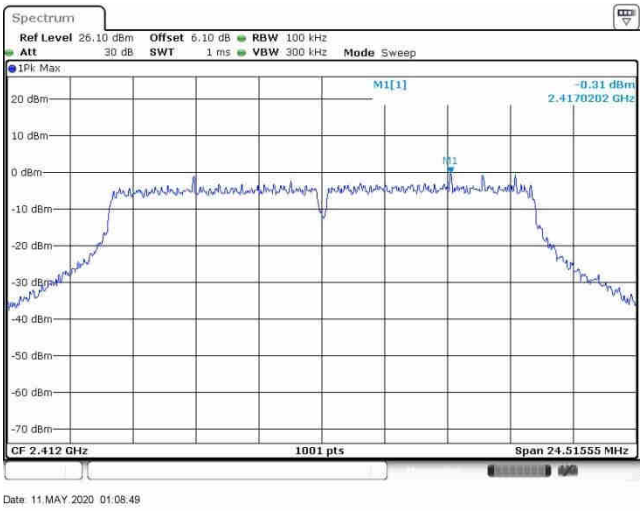
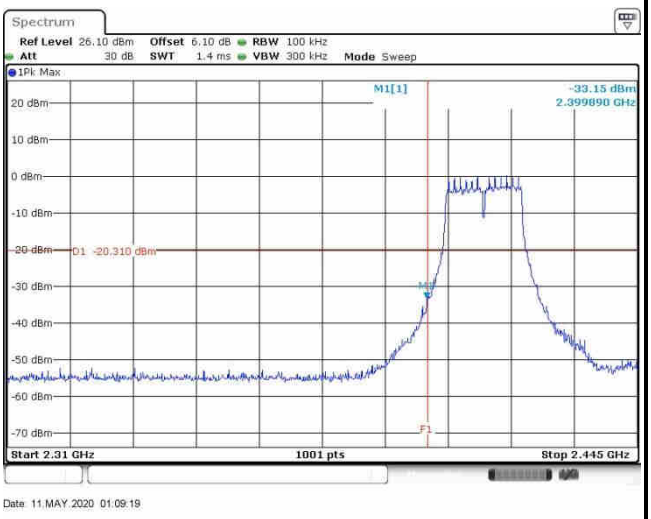
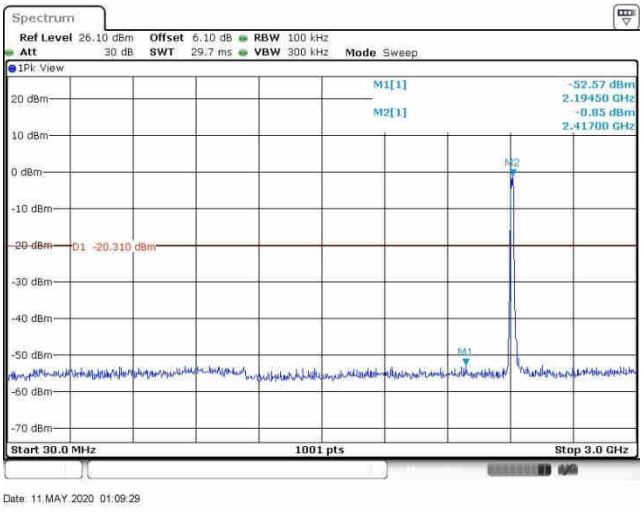
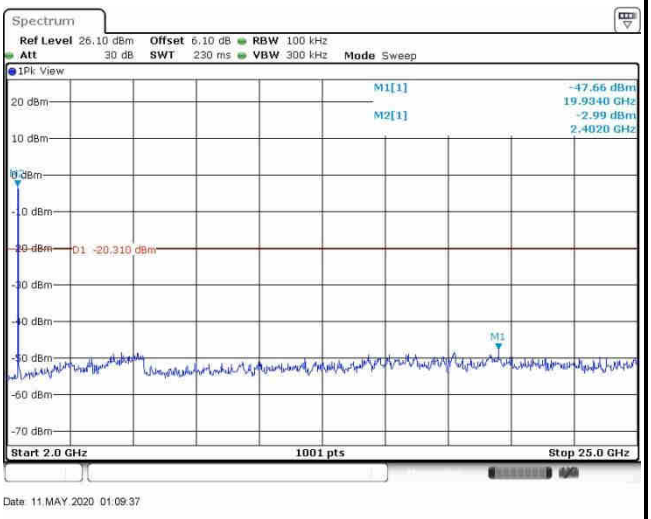
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

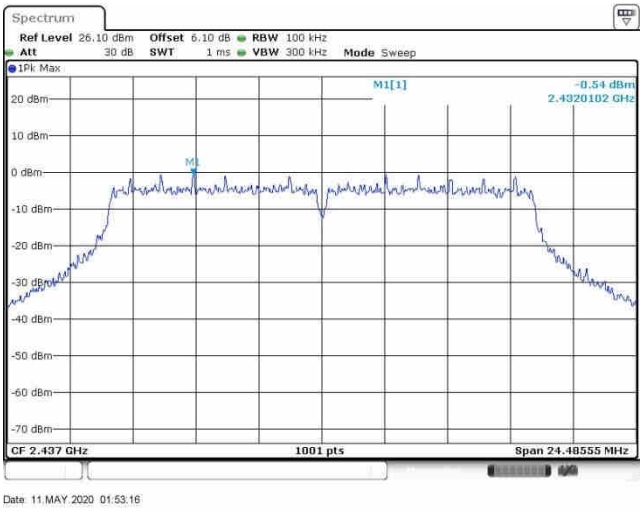
Test Mode :	802.11g	Test Channel :	11

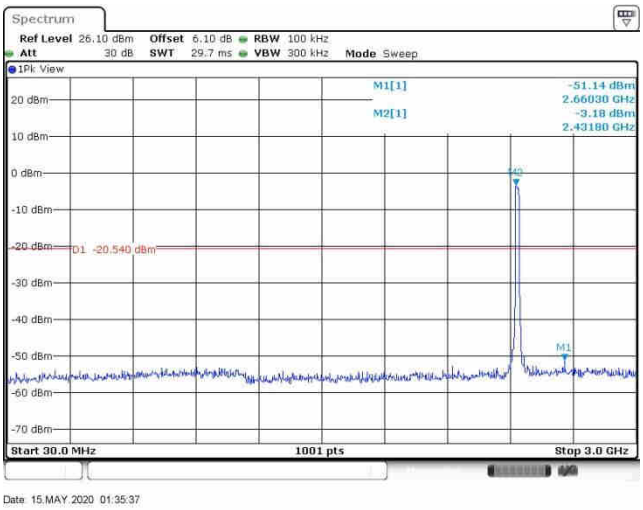
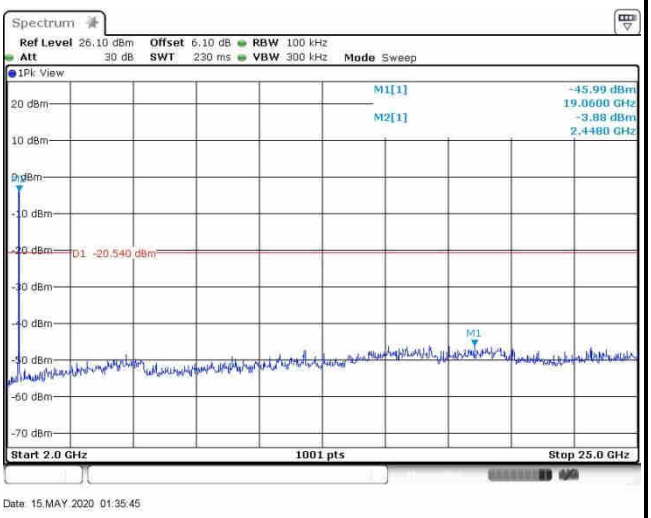
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT20	Test Channel :	01

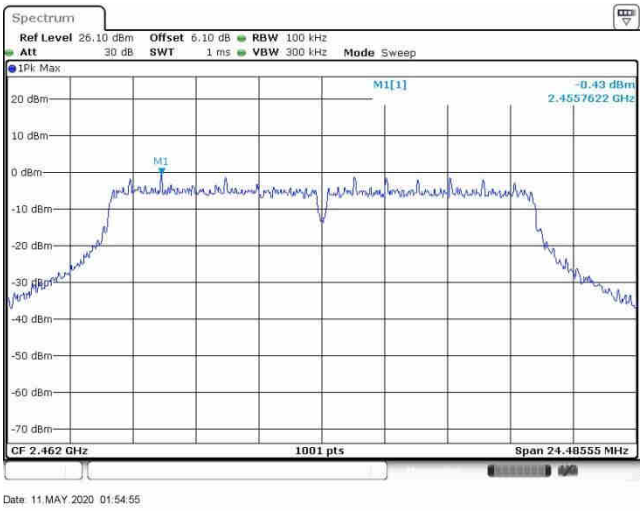
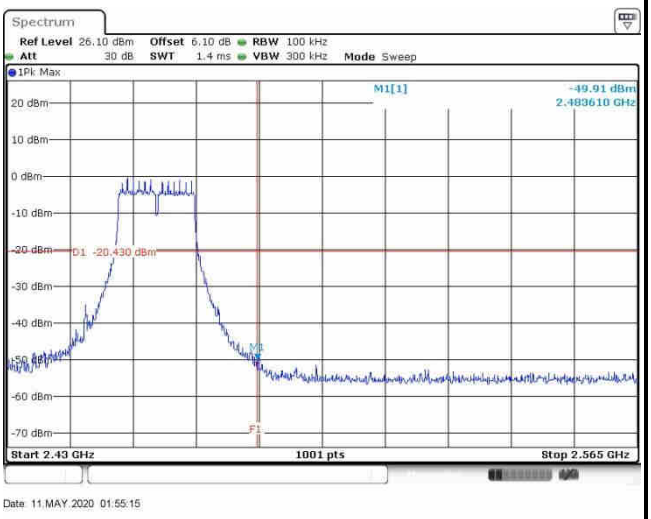
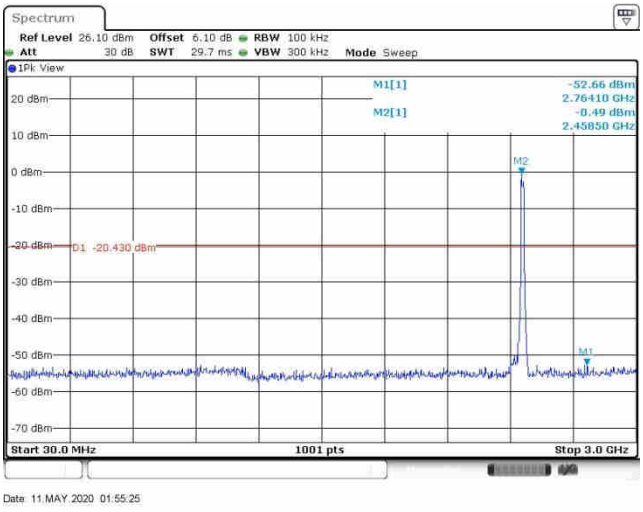
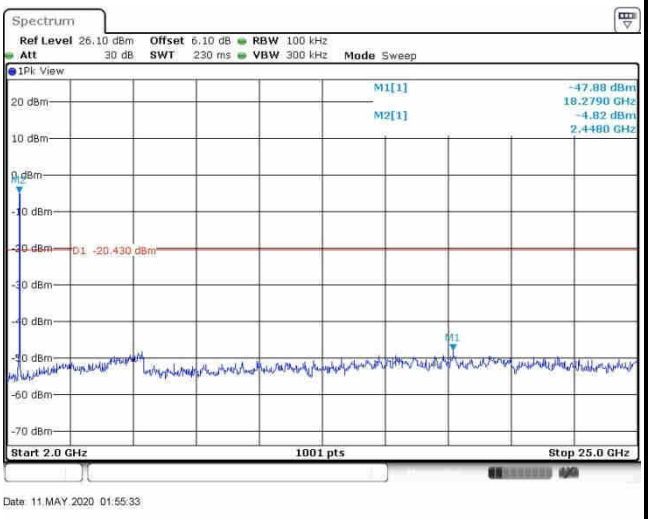
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT20	Test Channel :	06

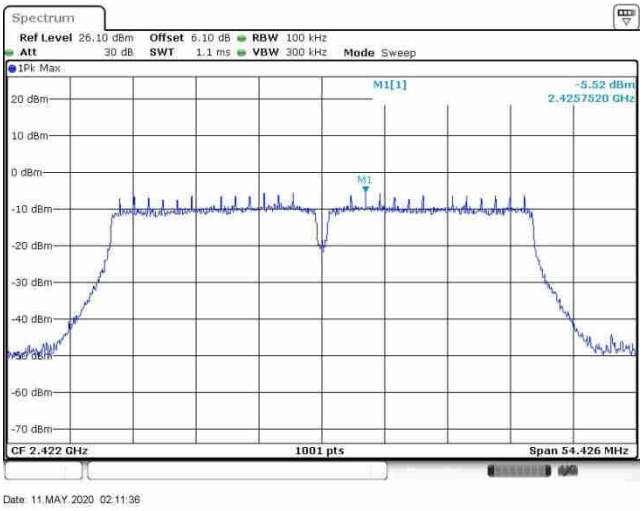
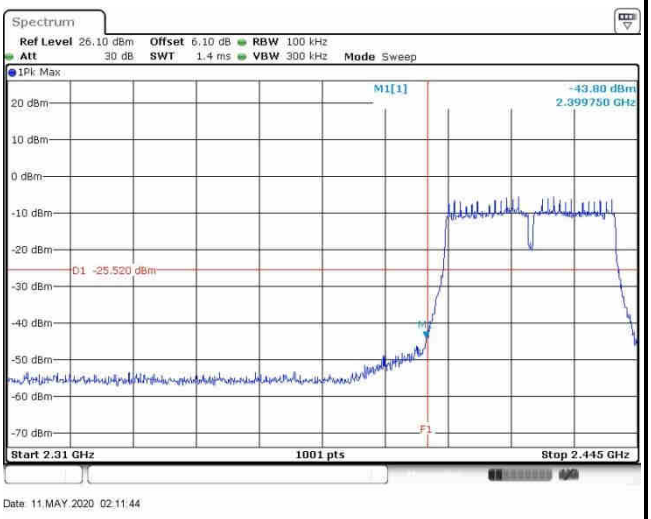
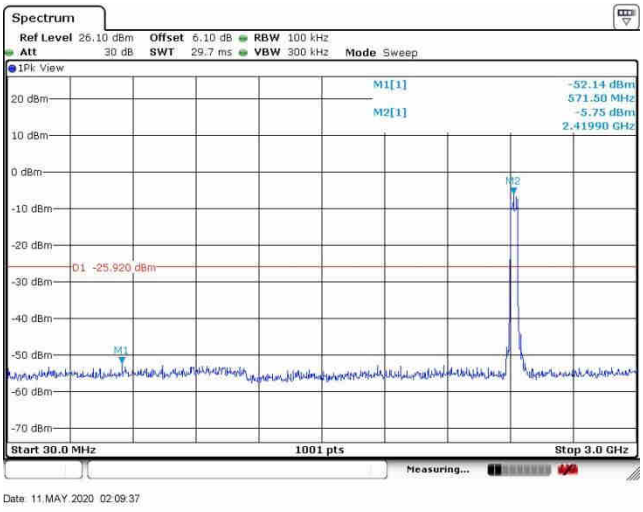
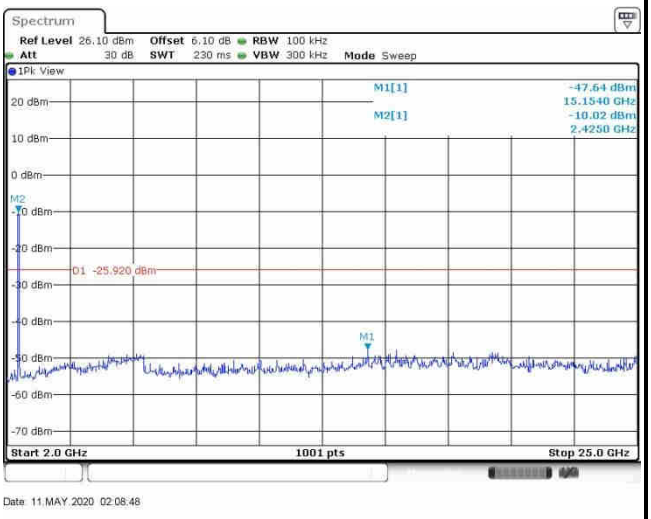
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

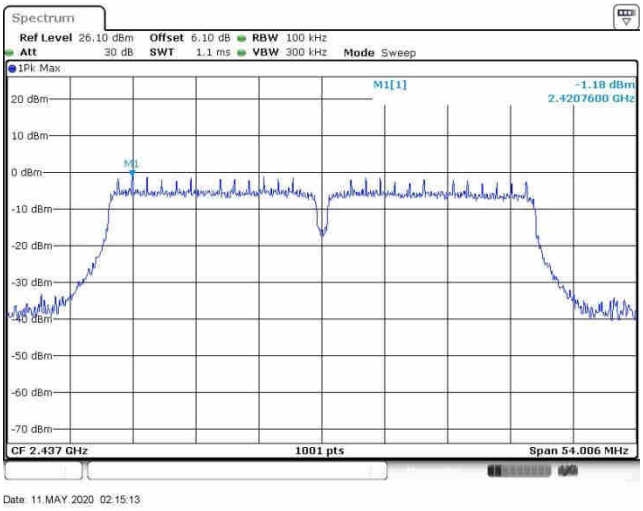
Test Mode :	802.11n HT20	Test Channel :	11

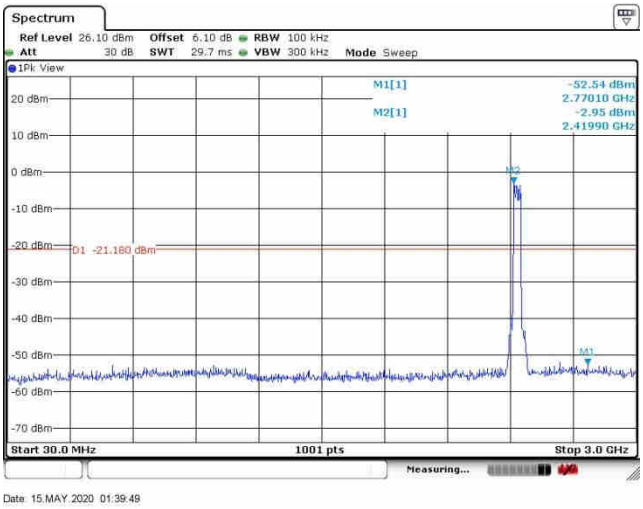
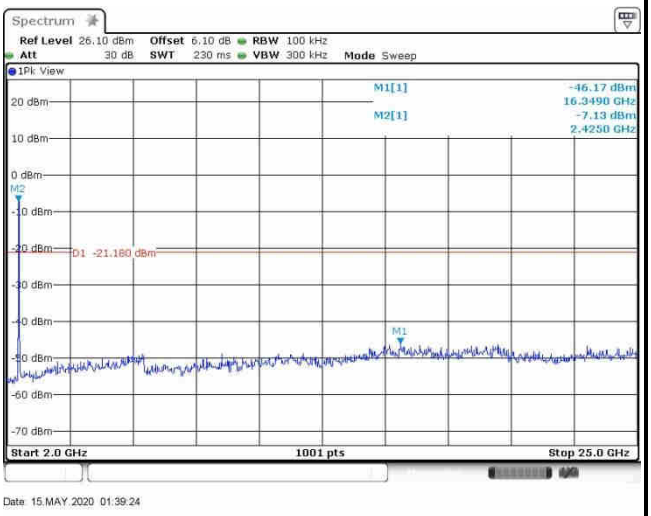
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	03

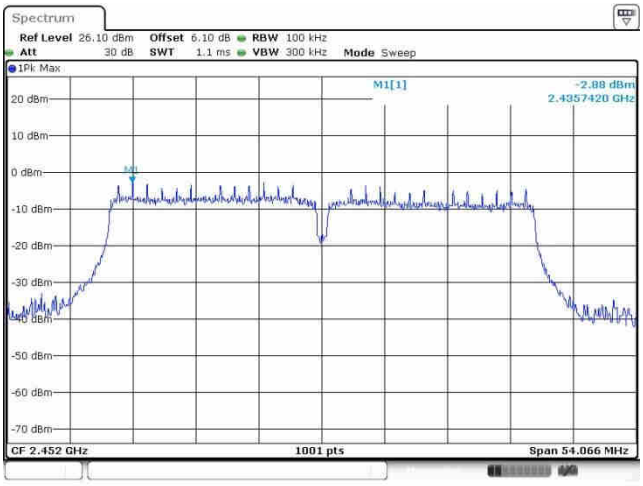
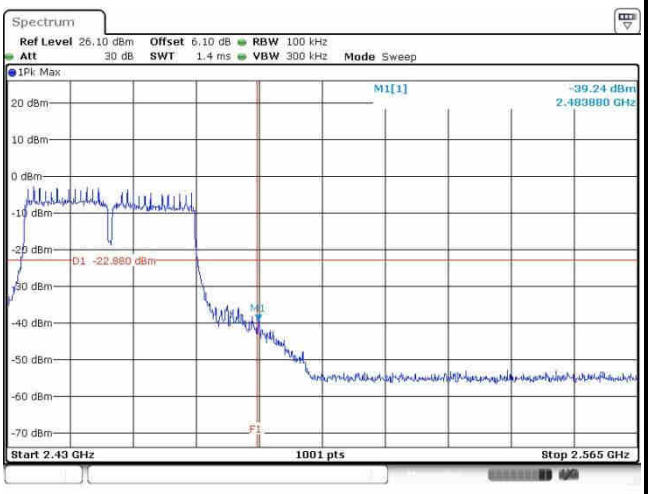
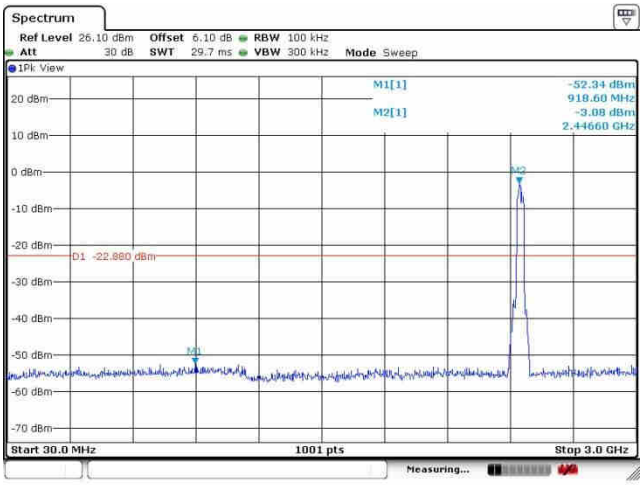
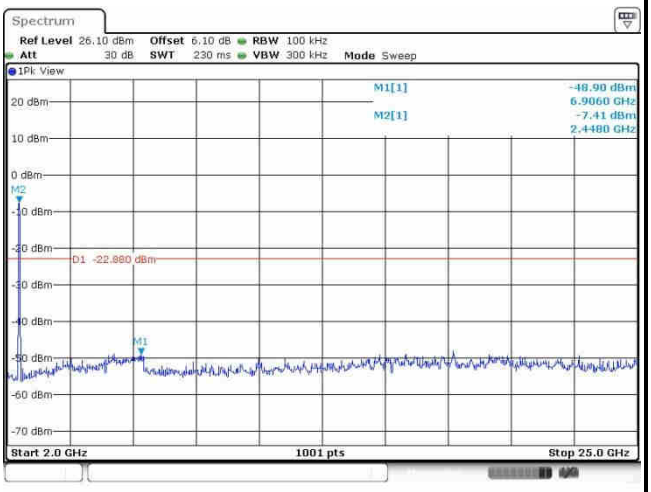
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	06

100kHz PSD reference Level	Channel Plot
	

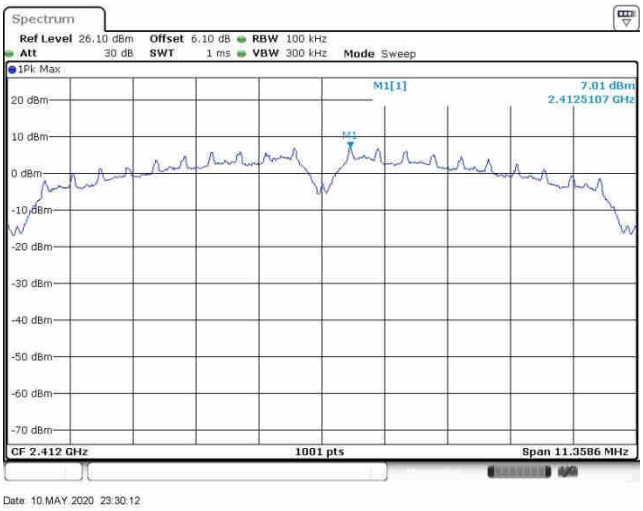
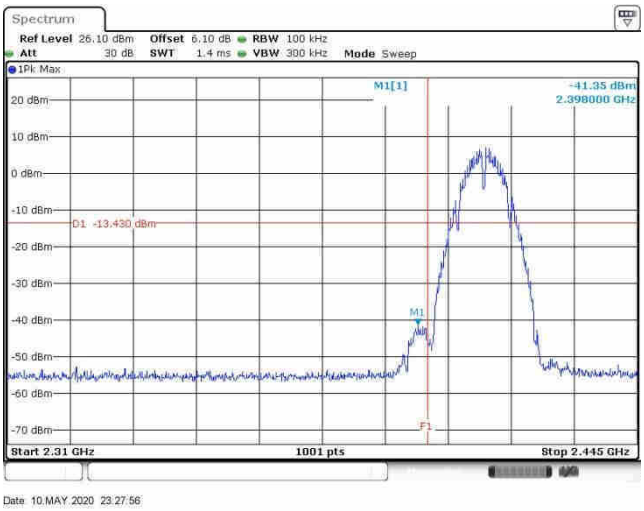
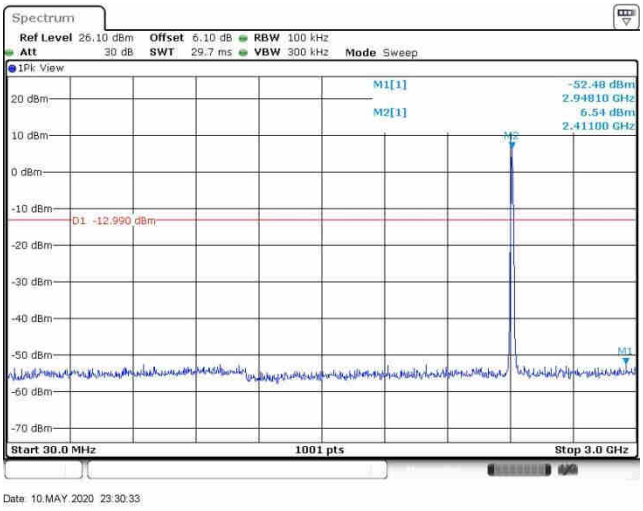
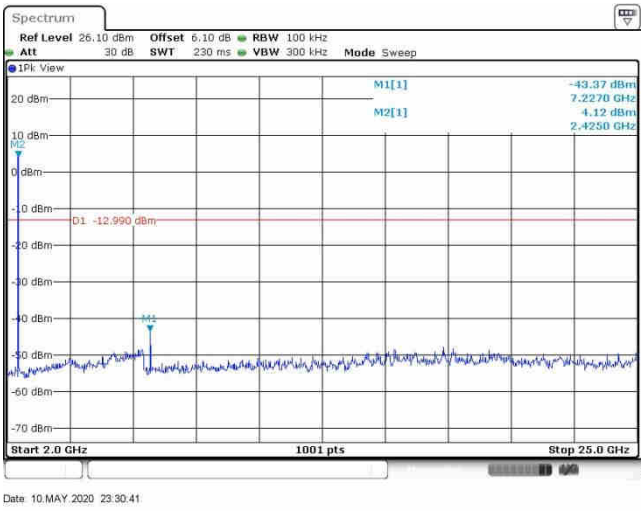
Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

Test Mode :	802.11n HT40	Test Channel :	09

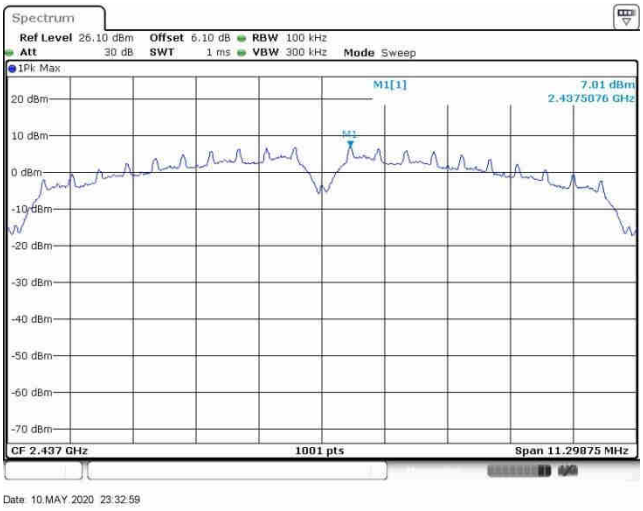
100kHz PSD reference Level	Channel Plot
	
Date: 11.MAY.2020 02:21:44	Date: 11.MAY.2020 02:21:59
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	
Date: 11.MAY.2020 02:22:57	Date: 11.MAY.2020 02:22:21

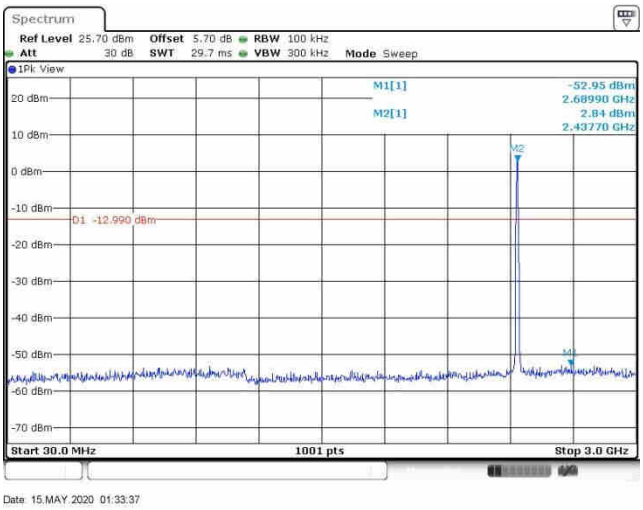
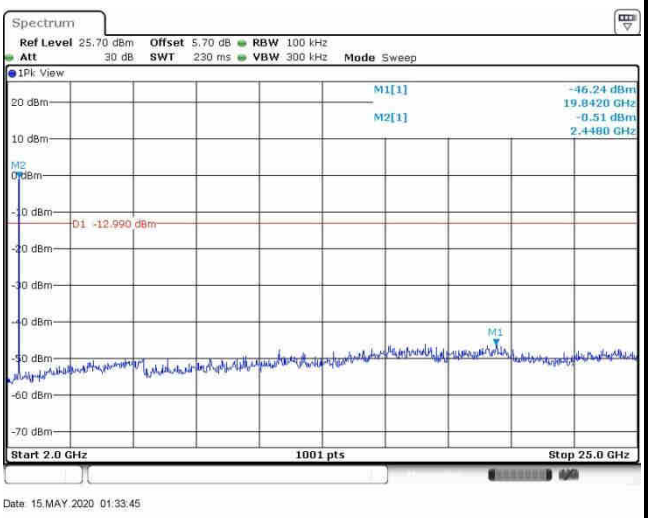
Number of TX = 1, Ant. 2 (Measured)

Test Mode :	802.11b	Test Channel :	01

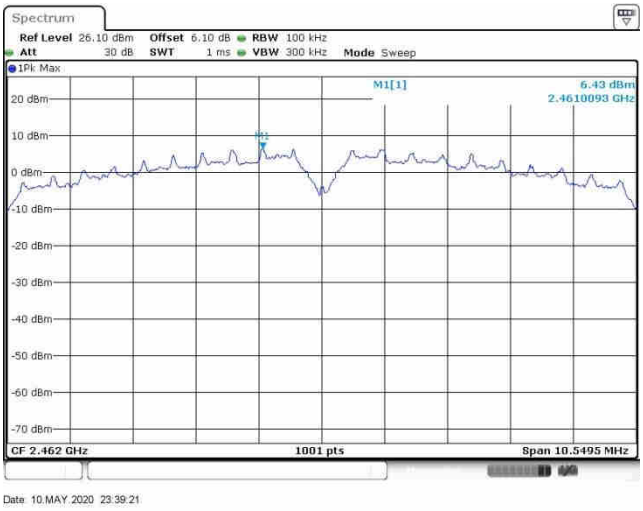
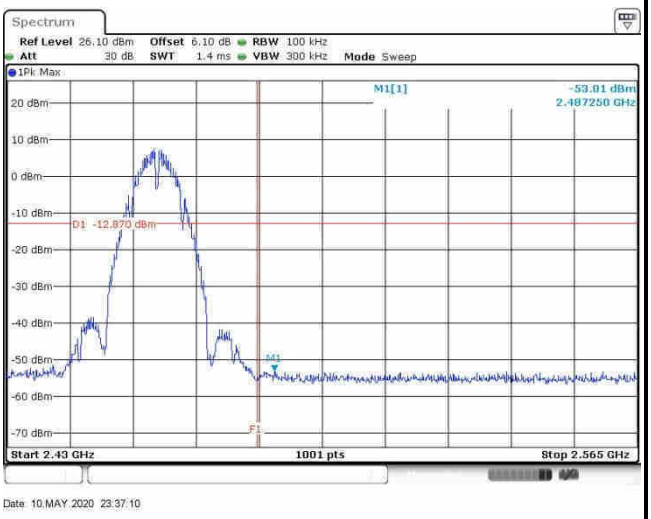
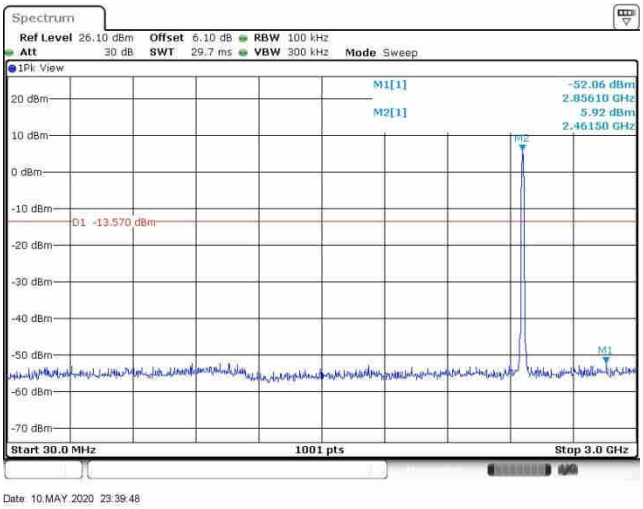
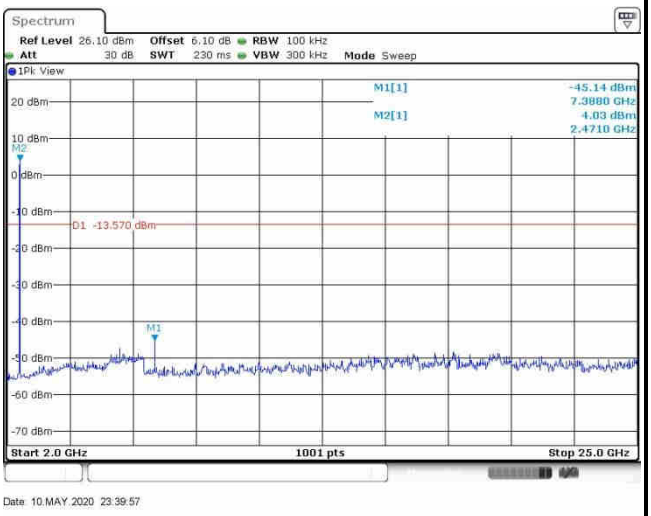
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11b	Test Channel :	06

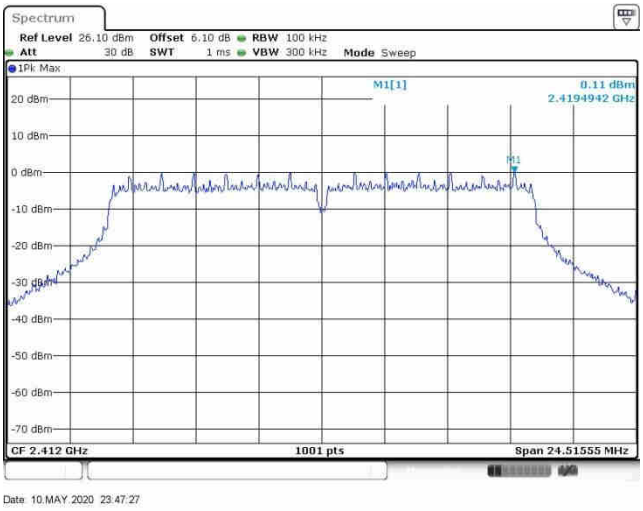
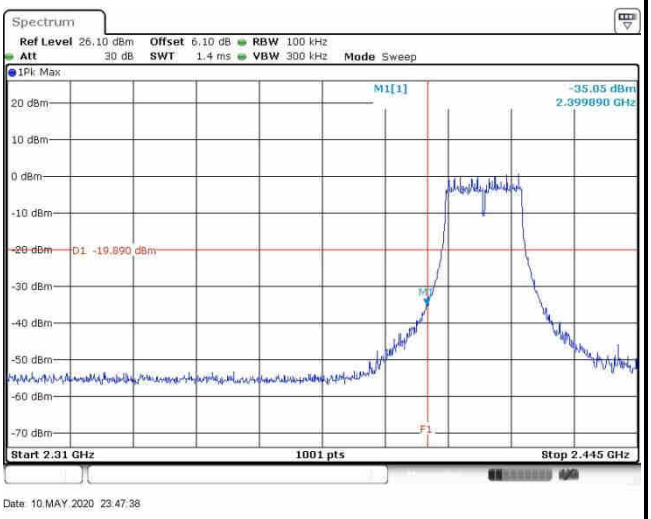
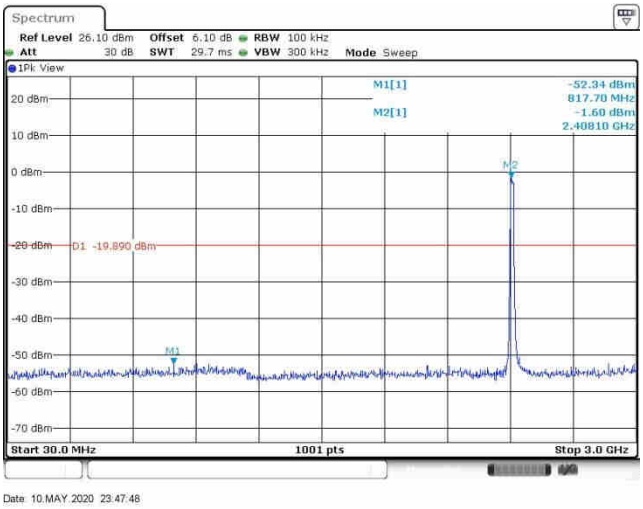
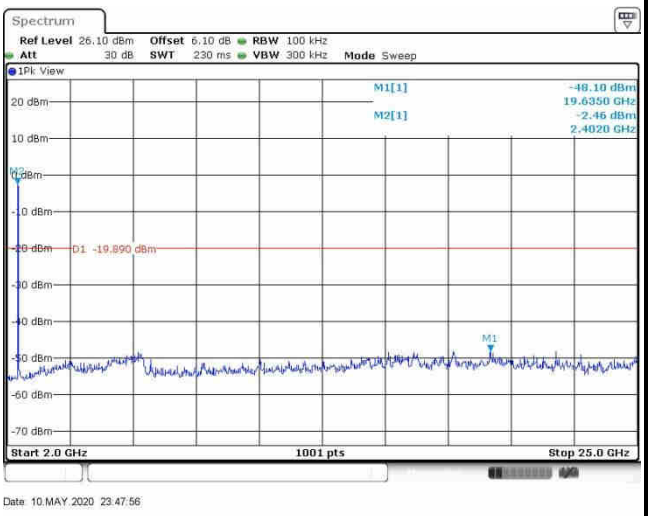
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

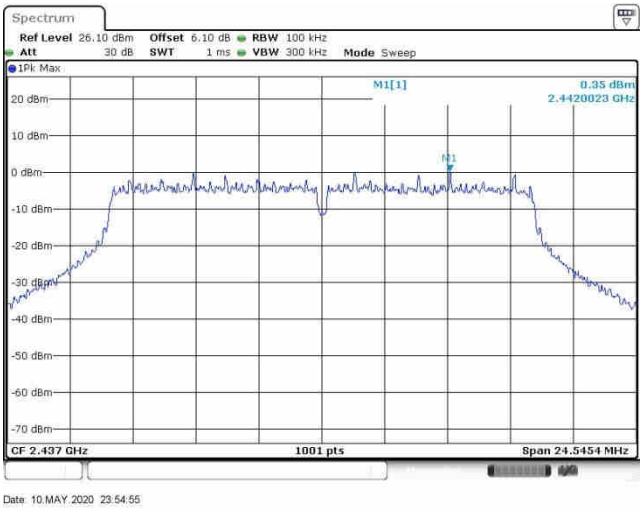
Test Mode :	802.11b	Test Channel :	11

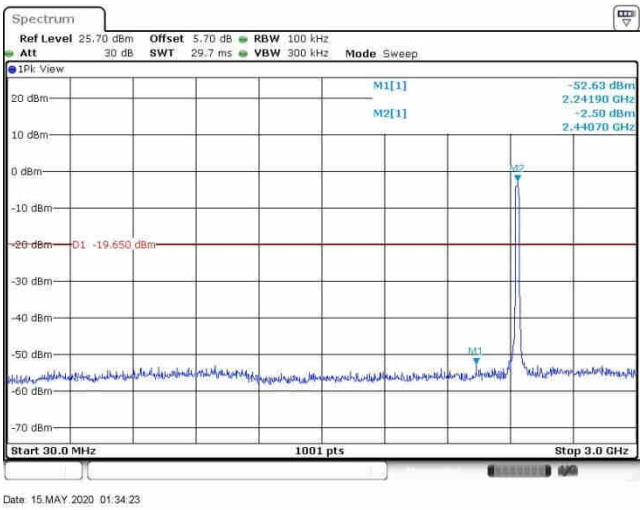
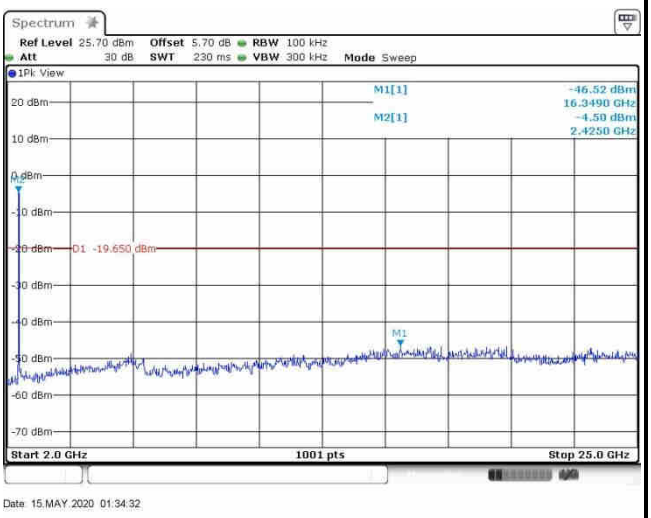
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	01

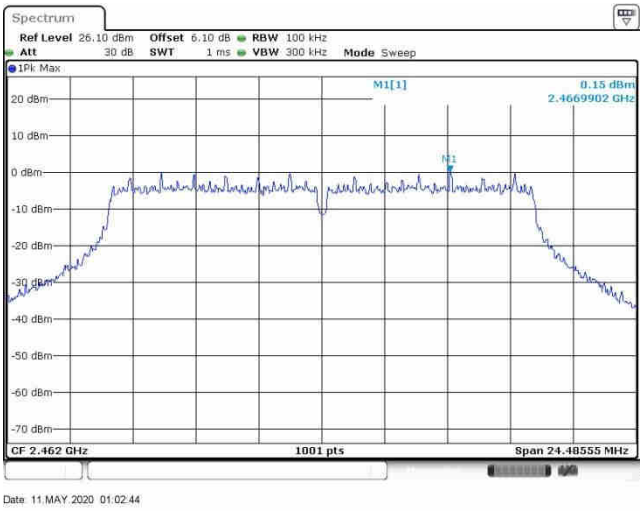
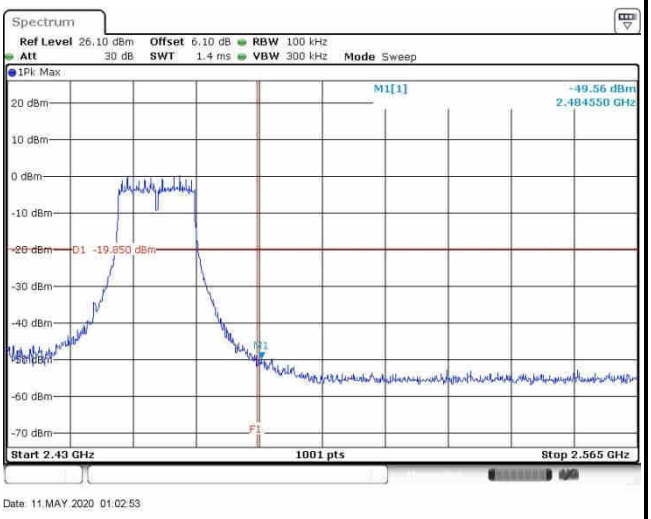
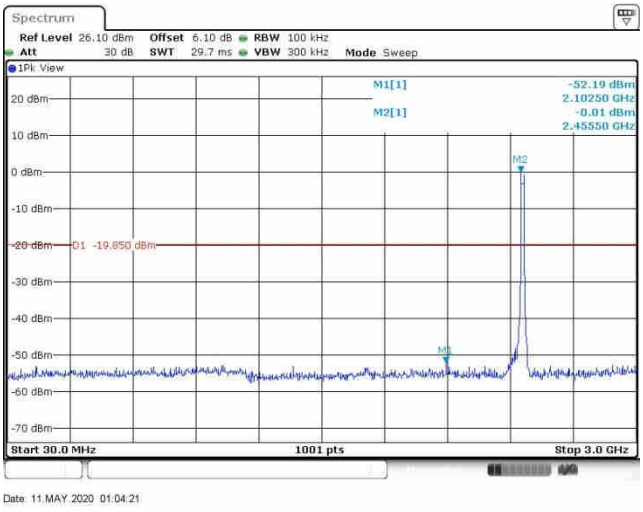
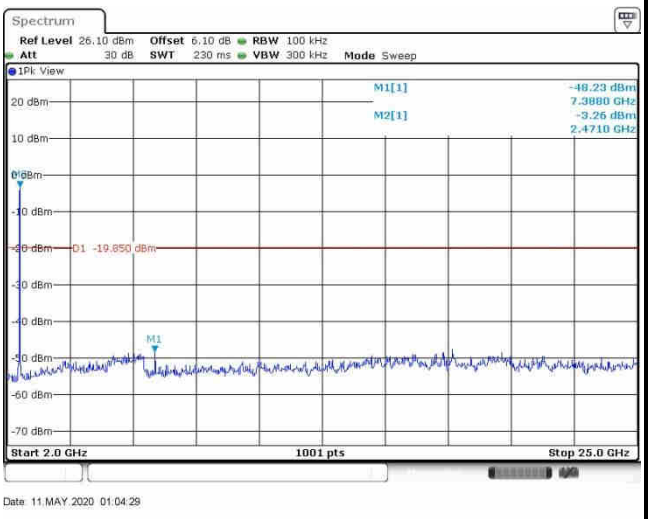
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11g	Test Channel :	06

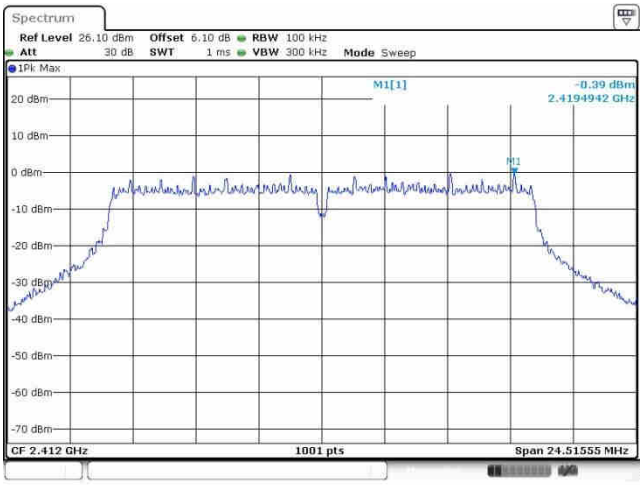
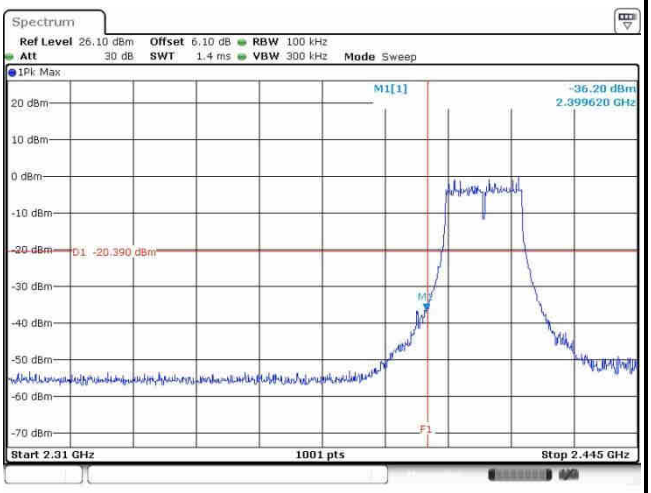
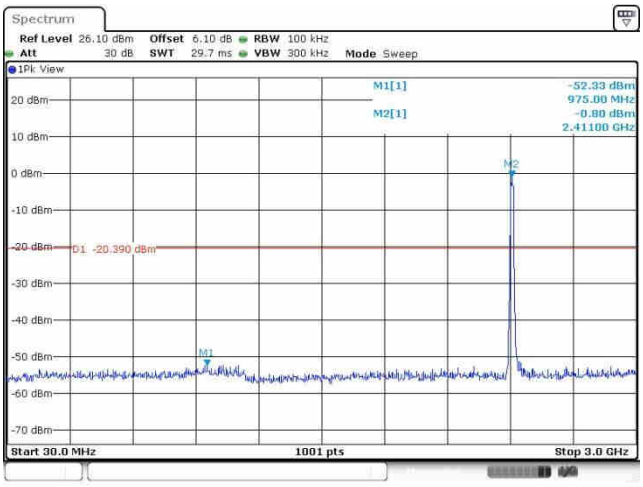
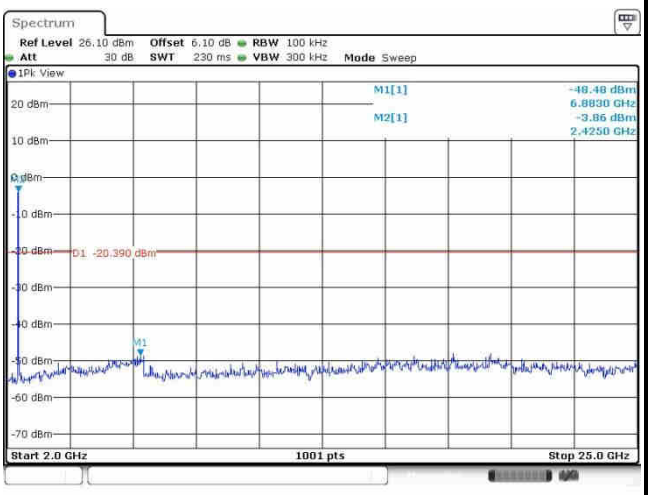
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

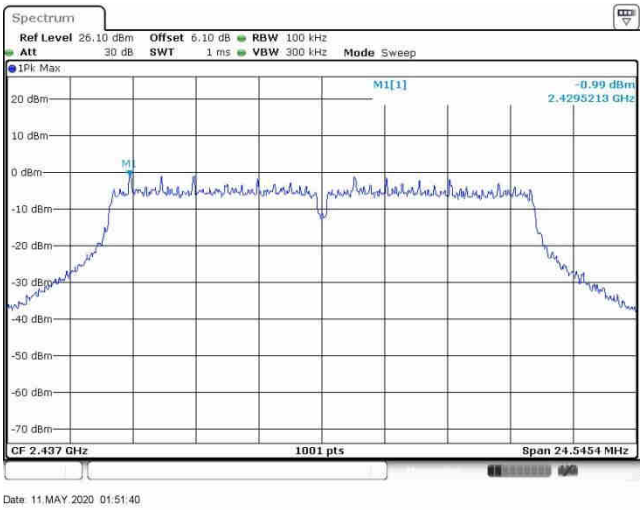
Test Mode :	802.11g	Test Channel :	11

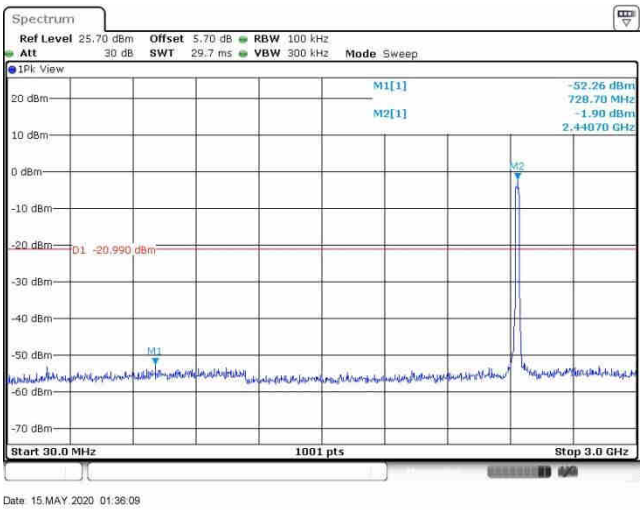
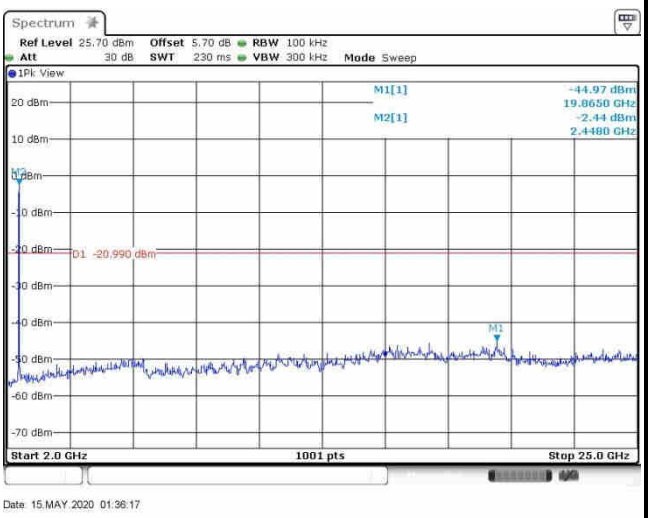
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT20	Test Channel :	01

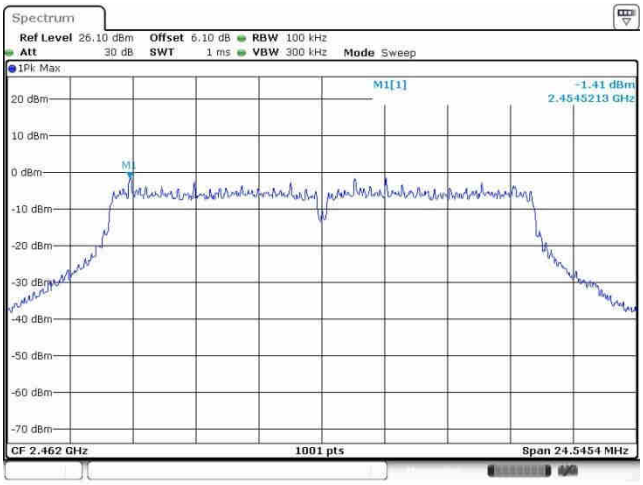
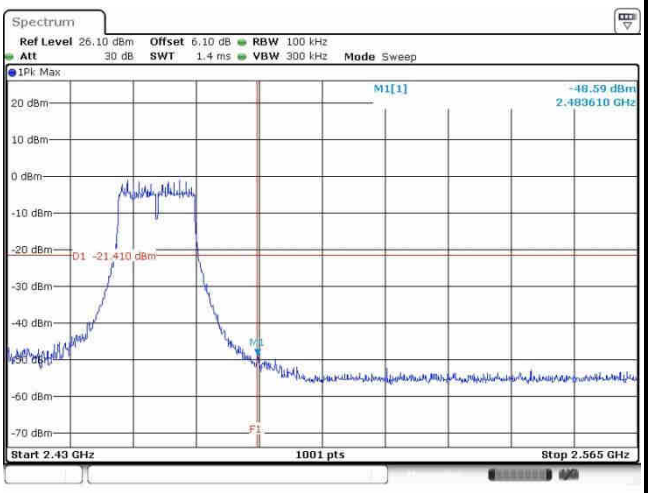
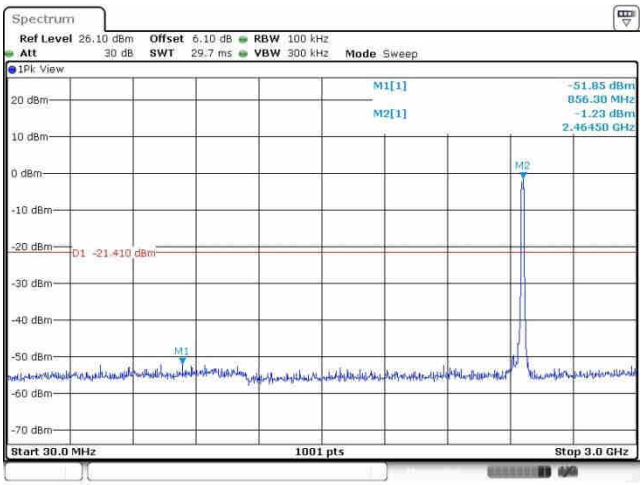
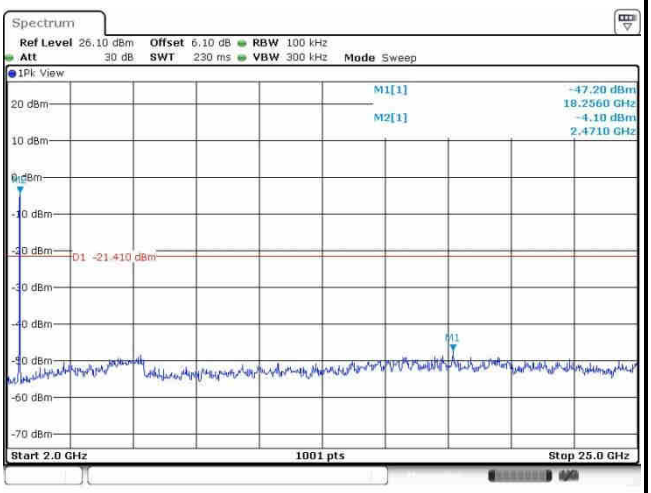
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT20	Test Channel :	06

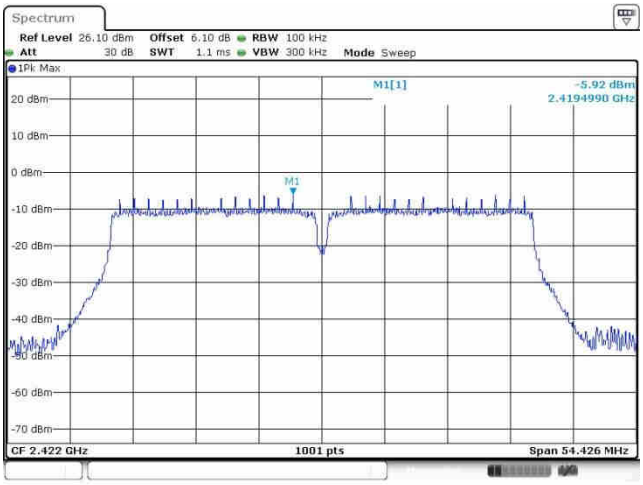
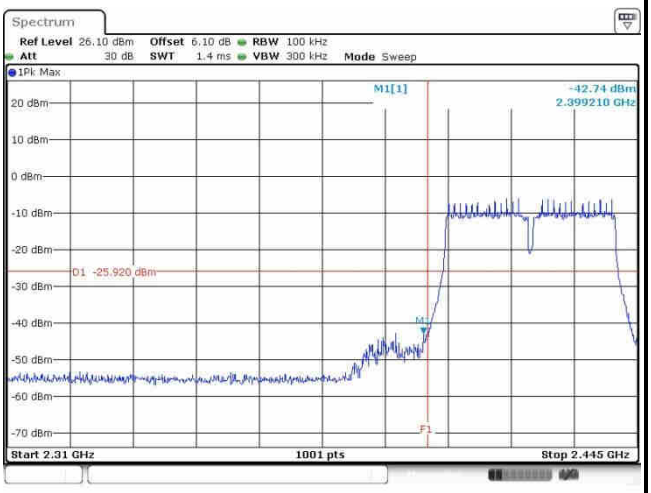
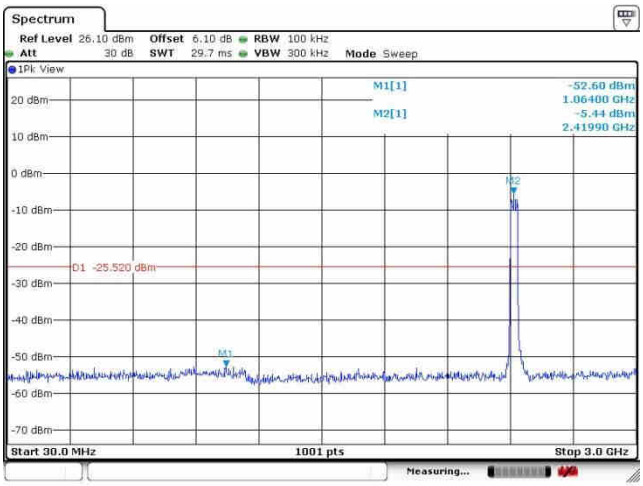
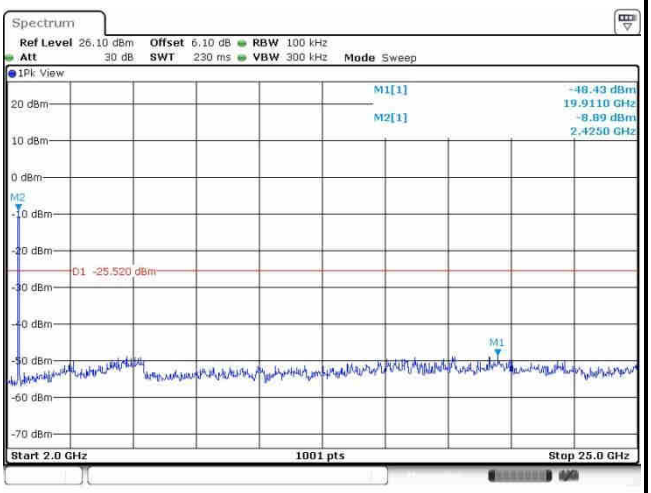
100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

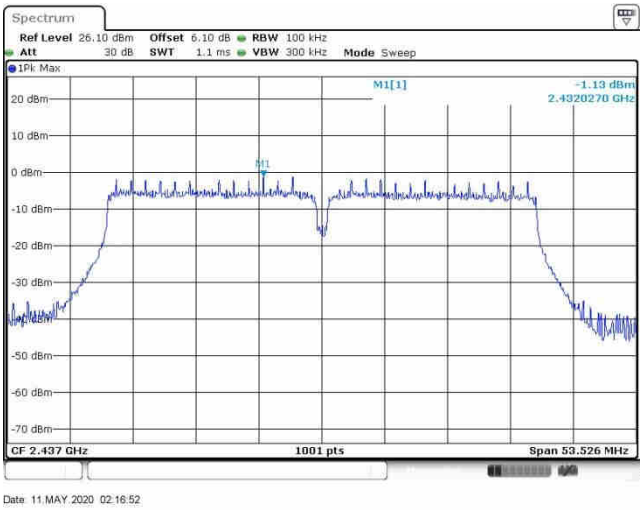
Test Mode :	802.11n HT20	Test Channel :	11

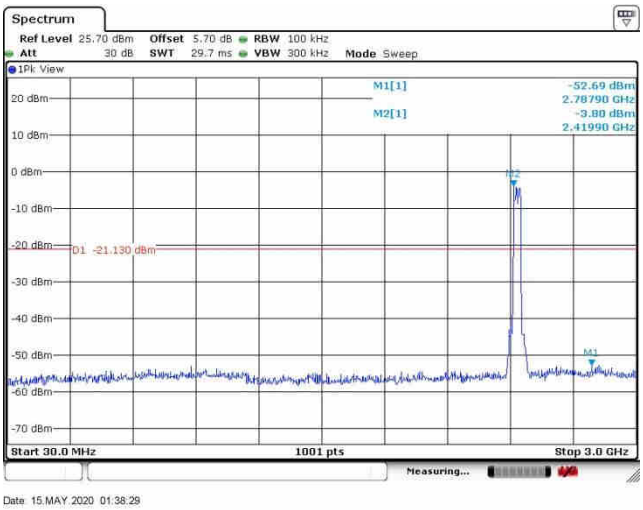
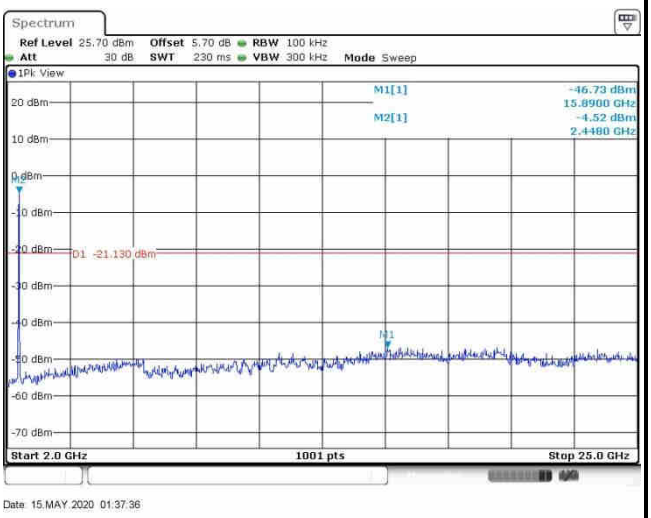
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	03

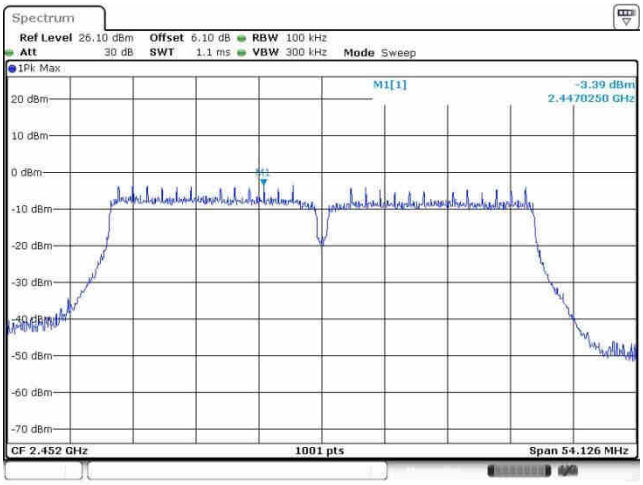
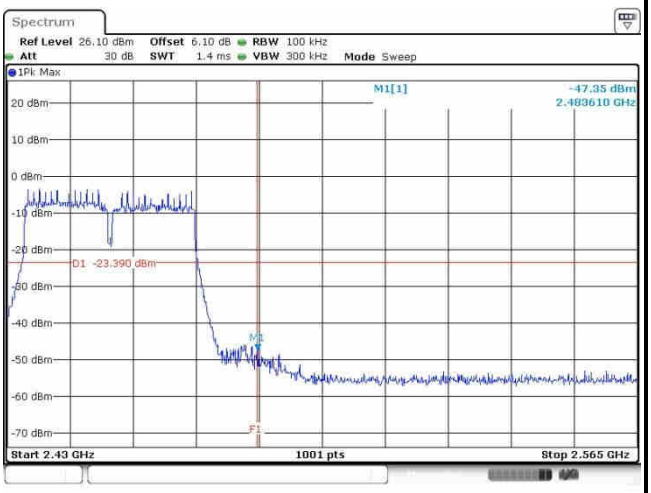
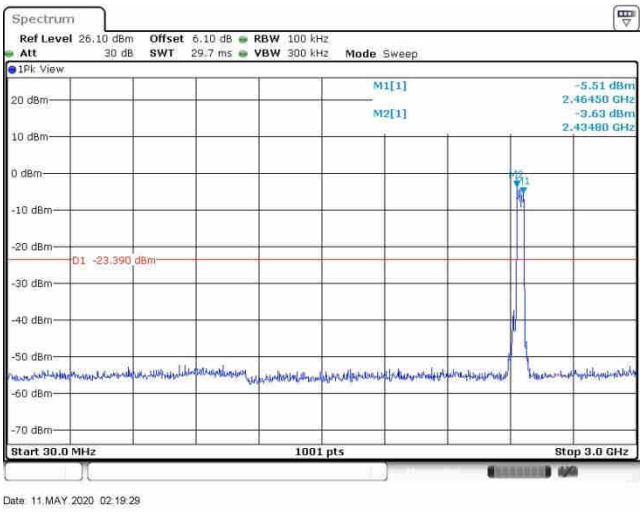
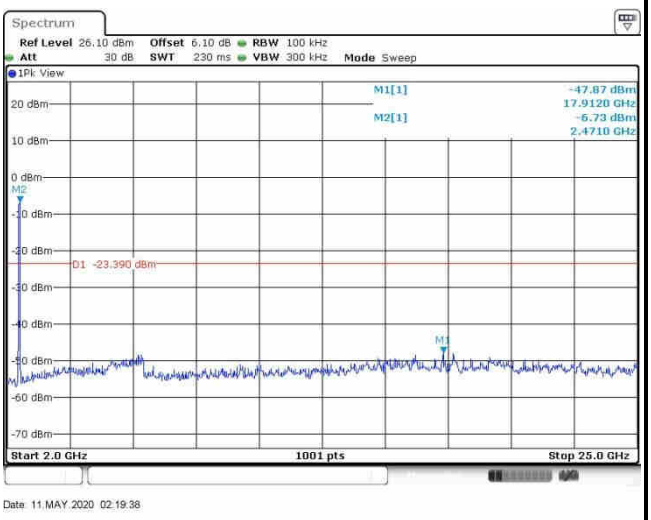
100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

Test Mode :	802.11n HT40	Test Channel :	06

100kHz PSD reference Level	Channel Plot
	

Spurious Emission 30MHz~3GHz	Spurious Emission 2GHz~25GHz
	

Test Mode :	802.11n HT40	Test Channel :	09

100kHz PSD reference Level	Channel Plot
	
Spurious Emission 30MHz~3GHz	**Spurious Emission 2GHz~25GHz**
	

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

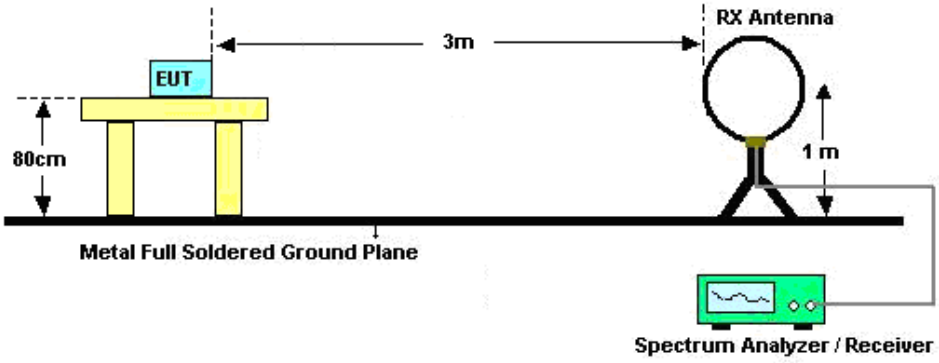
The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

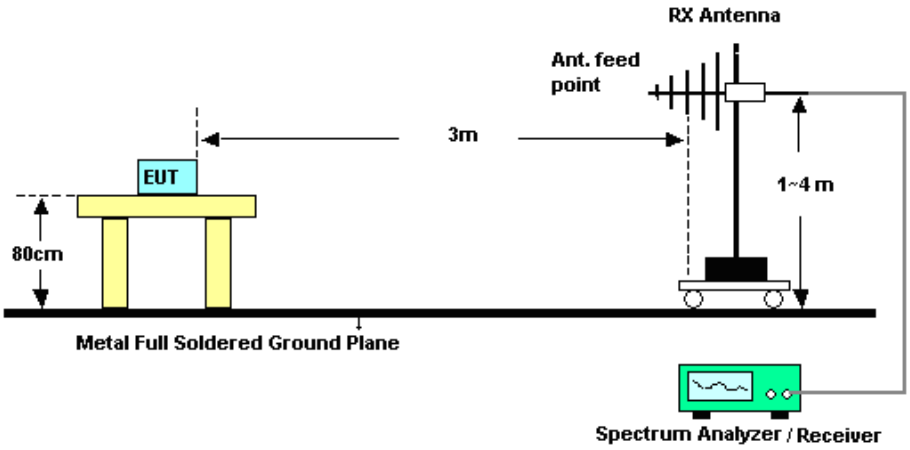
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better 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 ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 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

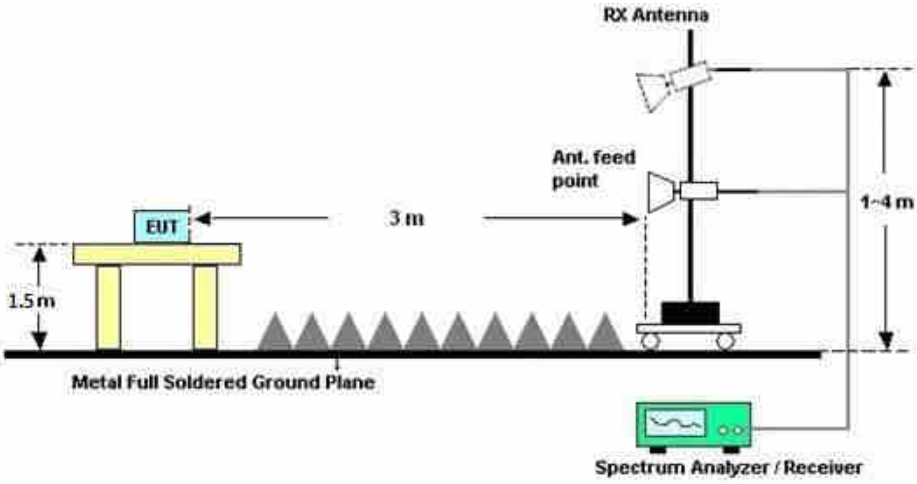
For radiated emissions below 30MHz



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 (dBµV)	
	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.

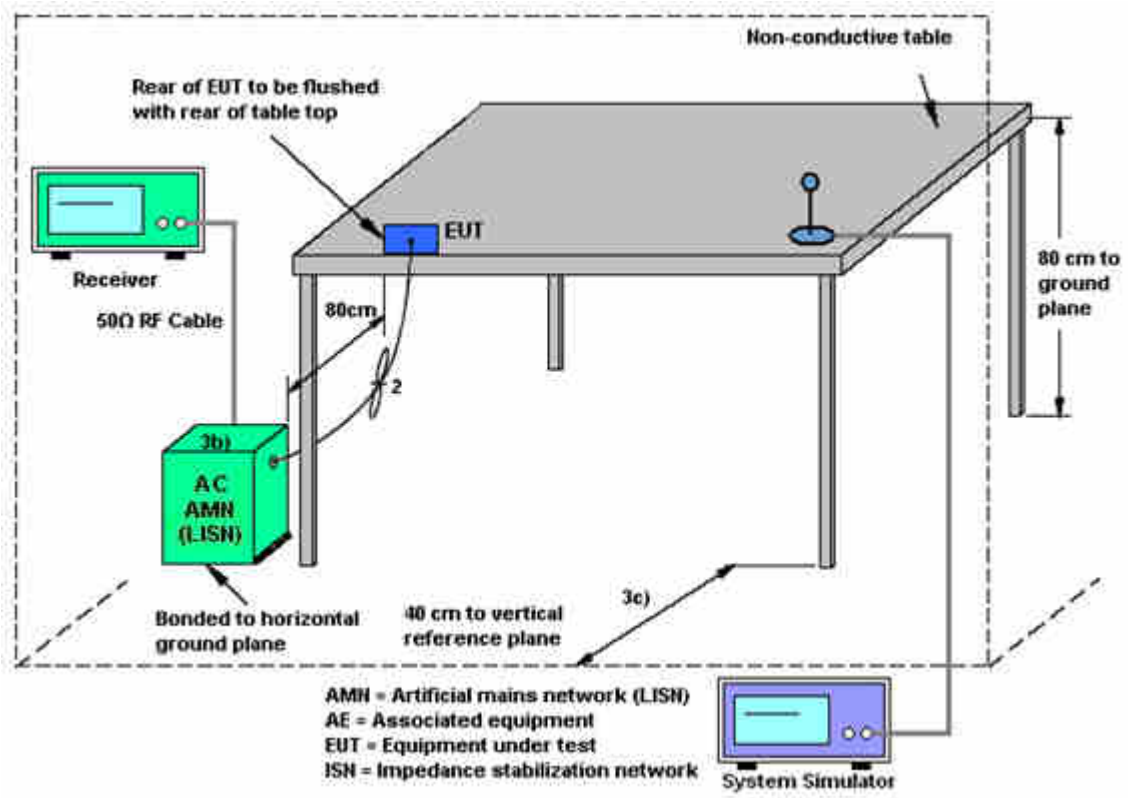
3.6.2 Measuring Instruments

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

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

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 (dBi)	Ant. 2 (dBi)	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
2.4 GHz	0.62	2.20	2.20	4.46	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	Nov. 02, 2019	May 10, 2020~ May 15, 2020	Nov. 01, 2020	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 15, 2020	May 10, 2020~ May 15, 2020	Jan. 14, 2021	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 08, 2020	May 10, 2020~ May 15, 2020	Jan. 07, 2021	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY57290157	3Hz~8.5GHz;Max 30dBm	Jul. 18, 2019	May 04, 2020	Jul. 17, 2020	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz-44GHz	Apr. 15, 2020	May 04, 2020	Apr. 16, 2021	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 10, 2019	May 04, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz-1GHz	May 30, 2020	May 04, 2020	May 29, 2021	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 27, 2020	May 04, 2020	Apr. 26, 2021	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101115	18GHz~40GHz	Nov. 10, 2019	May 04, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Aug. 06, 2019	May 04, 2020	Aug. 05, 2020	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 08, 2020	May 04, 2020	Jan. 07, 2021	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Aug. 16, 2019	May 04, 2020	Aug. 15, 2020	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 15, 2020	May 04, 2020	Apr. 14, 2021	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	May 04, 2020	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	May 04, 2020	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	May 04, 2020	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 14, 2020	May 09, 2020	Apr. 13, 2021	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 18, 2019	May 09, 2020	Oct. 17, 2020	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Oct. 28, 2019	May 09, 2020	Oct. 27, 2020	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 18, 2019	May 09, 2020	Oct. 17, 2020	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 (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.9dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

Appendix A. Conducted Test Results

Report Number : FR042407A

Test Engineer:	Weller Liu	Temperature:	0~40	°C
Test Date:	2020/5/10~2020/5/15	Relative Humidity:	51~54	%

Report Number : FR042407A

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	12.64	12.99	7.55	7.57	0.50	Pass
11b	1Mbps	2	6	2437	12.94	12.89	7.55	7.53	0.50	Pass
11b	1Mbps	2	11	2462	13.09	12.99	7.53	7.03	0.50	Pass
11g	6Mbps	2	1	2412	18.13	17.83	16.32	16.34	0.50	Pass
11g	6Mbps	2	6	2437	18.28	17.78	16.32	16.36	0.50	Pass
11g	6Mbps	2	11	2462	18.18	17.88	16.34	16.32	0.50	Pass
HT20	MCS0	2	1	2412	18.28	17.78	16.34	16.34	0.50	Pass
HT20	MCS0	2	6	2437	18.13	17.83	16.32	13.36	0.50	Pass
HT20	MCS0	2	11	2462	18.33	17.83	16.32	16.36	0.50	Pass
HT40	MCS0	2	3	2422	37.06	36.76	36.28	36.28	0.50	Pass
HT40	MCS0	2	6	2437	37.06	36.96	36.00	35.68	0.50	Pass
HT40	MCS0	2	9	2452	37.06	37.26	36.04	36.08	0.50	Pass

Report Number : FR042407A

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	2	1	2412	18.46	18.18	21.33	30.00		2.20		23.53		36.00		Pass
11b	1Mbps	2	6	2437	18.38	18.08	21.24	30.00		2.20		23.44		36.00		Pass
11b	1Mbps	2	11	2462	18.53	17.94	21.26	30.00		2.20		23.46		36.00		Pass
11g	6Mbps	2	1	2412	22.32	21.69	25.03	30.00		2.20		27.23		36.00		Pass
11g	6Mbps	2	6	2437	22.45	22.15	25.31	30.00		2.20		27.51		36.00		Pass
11g	6Mbps	2	11	2462	22.44	21.95	25.21	30.00		2.20		27.41		36.00		Pass
HT20	MCS0	2	1	2412	21.80	21.21	24.53	30.00		2.20		26.73		36.00		Pass
HT20	MCS0	2	6	2437	22.40	21.96	25.20	30.00		2.20		27.40		36.00		Pass
HT20	MCS0	2	11	2462	21.64	21.37	24.52	30.00		2.20		26.72		36.00		Pass
HT40	MCS0	2	3	2422	19.12	18.91	22.03	30.00		2.20		24.23		36.00		Pass
HT40	MCS0	2	6	2437	22.65	21.90	25.30	30.00		2.20		27.50		36.00		Pass
HT40	MCS0	2	9	2452	21.22	20.40	23.84	30.00		2.20		26.04		36.00		Pass
VHT20	MCS0	2	1	2412	21.69	21.34	24.53	30.00		2.20		26.73		36.00		Pass
VHT20	MCS0	2	6	2437	22.38	21.93	25.17	30.00		2.20		27.37		36.00		Pass
VHT20	MCS0	2	11	2462	21.73	21.20	24.48	30.00		2.20		26.68		36.00		Pass
VHT40	MCS0	2	3	2422	19.04	18.87	21.97	30.00		2.20		24.17		36.00		Pass
VHT40	MCS0	2	6	2437	22.43	21.85	25.16	30.00		2.20		27.36		36.00		Pass
VHT40	MCS0	2	9	2452	21.19	20.38	23.81	30.00		2.20		26.01		36.00		Pass

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

Report Number : FR042407A

TEST RESULTS DATA
Average Output Power

2.4GHz Band									
Mod.	Data Rate	N_{TX}	CH.	Freq. (MHz)	Duty Factor (dB)		Average Conducted Power (dBm)		
					Ant 1	Ant 2	Ant 1	Ant 2	SUM
11b	1Mbps	2	1	2412	0.00	0.00	15.31	15.18	18.26
11b	1Mbps	2	6	2437	0.00	0.00	15.42	15.04	18.24
11b	1Mbps	2	11	2462	0.00	0.00	15.68	15.13	18.42
11g	6Mbps	2	1	2412	0.08	0.11	12.38	11.79	15.10
11g	6Mbps	2	6	2437	0.08	0.11	13.00	12.15	15.60
11g	6Mbps	2	11	2462	0.08	0.11	12.63	11.80	15.24
HT20	MCS0	2	1	2412	0.23	0.21	11.91	11.26	14.61
HT20	MCS0	2	6	2437	0.23	0.21	13.12	12.17	15.68
HT20	MCS0	2	11	2462	0.23	0.21	11.59	10.72	14.19
HT40	MCS0	2	3	2422	0.23	0.23	9.22	8.40	11.84
HT40	MCS0	2	6	2437	0.23	0.23	13.01	12.45	15.75
HT40	MCS0	2	9	2452	0.23	0.23	11.04	10.48	13.78
VHT20	MCS0	2	1	2412	0.21	0.19	11.85	11.22	14.56
VHT20	MCS0	2	6	2437	0.21	0.19	12.89	12.10	15.53
VHT20	MCS0	2	11	2462	0.21	0.19	11.54	10.68	14.14
VHT40	MCS0	2	3	2422	0.23	0.23	9.23	8.33	11.81
VHT40	MCS0	2	6	2437	0.23	0.23	12.95	12.38	15.68
VHT40	MCS0	2	9	2452	0.23	0.23	11.03	10.41	13.74

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

Report Number : FR042407A

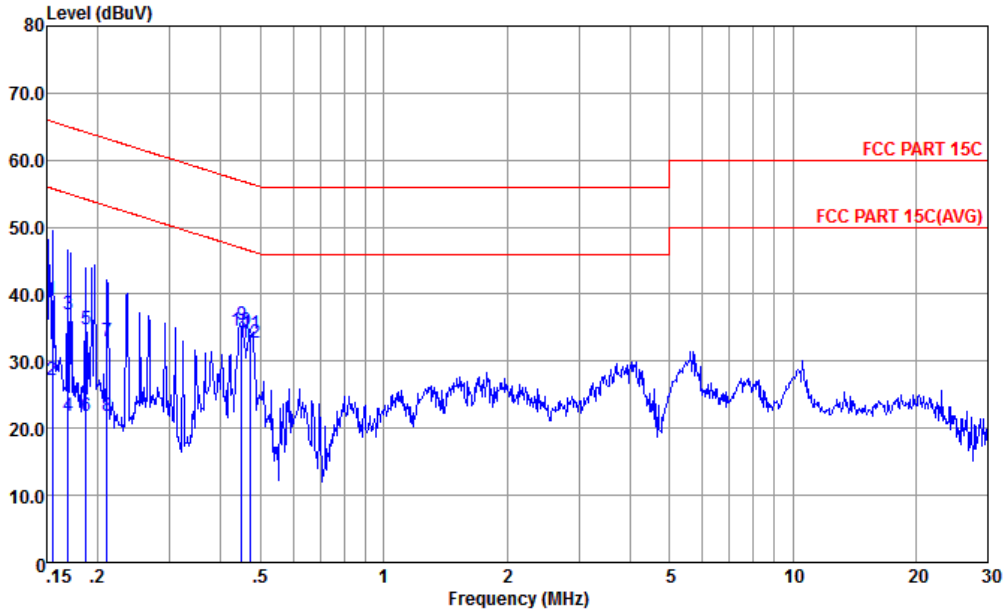
TEST RESULTS DATA
Peak Power Spectral Density

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	-8.52	-6.50	-3.49	4.46		8.00		Pass
11b	1Mbps	2	6	2437	-6.13	-7.16	-3.12	4.46		8.00		Pass
11b	1Mbps	2	11	2462	-6.57	-6.79	-3.56	4.46		8.00		Pass
11g	6Mbps	2	1	2412	-10.85	-13.72	-7.84	4.46		8.00		Pass
11g	6Mbps	2	6	2437	-14.44	-13.21	-10.20	4.46		8.00		Pass
11g	6Mbps	2	11	2462	-12.38	-14.37	-9.37	4.46		8.00		Pass
HT20	MCS0	2	1	2412	-14.68	-13.41	-10.40	4.46		8.00		Pass
HT20	MCS0	2	6	2437	-13.07	-14.43	-10.06	4.46		8.00		Pass
HT20	MCS0	2	11	2462	-15.13	-15.63	-12.12	4.46		8.00		Pass
HT40	MCS0	2	3	2422	-19.94	-21.03	-16.93	4.46		8.00		Pass
HT40	MCS0	2	6	2437	-16.63	-15.28	-12.27	4.46		8.00		Pass
HT40	MCS0	2	9	2452	-17.84	-17.71	-14.70	4.46		8.00		Pass

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

Appendix B. AC Conducted Emission Test Results

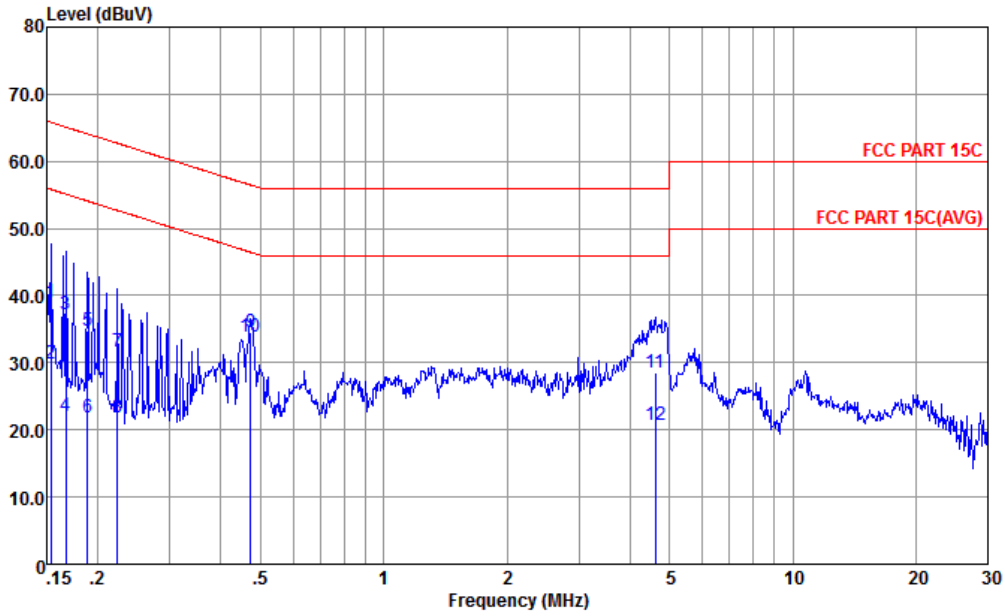
Test Engineer :	Amos Zhang	**Temperature :**	24.2~25.6℃
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : FCC PART 15C LISN-L-191028-060105 LINE

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.155	39.30	-26.44	65.74	28.80	0.03	10.47	QP
2	0.155	27.10	-28.64	55.74	16.60	0.03	10.47	Average
3	0.169	37.06	-27.93	64.99	26.60	0.03	10.43	QP
4	0.169	21.76	-33.23	54.99	11.30	0.03	10.43	Average
5	0.187	34.73	-29.42	64.15	24.30	0.04	10.39	QP
6	0.187	21.73	-32.42	54.15	11.30	0.04	10.39	Average
7	0.211	33.00	-30.18	63.18	22.60	0.04	10.36	QP
8	0.211	21.90	-31.28	53.18	11.50	0.04	10.36	Average
9	0.449	35.41	-21.48	56.89	25.10	0.06	10.25	QP
10 *	0.449	34.51	-12.38	46.89	24.20	0.06	10.25	Average
11	0.474	34.10	-22.35	56.45	23.80	0.06	10.24	QP
12	0.474	32.80	-13.65	46.45	22.50	0.06	10.24	Average

Test Engineer :	Amos Zhang	**Temperature :**	24.2~25.6℃
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : FCC PART 15C LISN-N-191028-060105 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.153	39.05	-26.77	65.82	28.50	0.08	10.47	QP
2	0.153	29.85	-25.97	55.82	19.30	0.08	10.47	Average
3	0.167	37.12	-28.00	65.12	26.60	0.08	10.44	QP
4	0.167	22.12	-33.00	55.12	11.60	0.08	10.44	Average
5	0.188	34.67	-29.44	64.11	24.20	0.08	10.39	QP
6	0.188	21.77	-32.34	54.11	11.30	0.08	10.39	Average
7	0.223	31.63	-31.07	62.70	21.20	0.08	10.35	QP
8	0.223	21.73	-30.97	52.70	11.30	0.08	10.35	Average
9	0.474	34.64	-21.81	56.45	24.30	0.10	10.24	QP
10 *	0.474	33.84	-12.61	46.45	23.50	0.10	10.24	Average
11	4.622	28.62	-27.38	56.00	18.20	0.16	10.26	QP
12	4.622	20.72	-25.28	46.00	10.30	0.16	10.26	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

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		2345.75	55.16	-18.84	74	49.43	32.1	10.15	36.52	173	303	P	H
		2389.56	44.29	-9.71	54	38.44	32.1	10.28	36.53	173	303	A	H
	*	2412	105.37	-	-	99.36	32.23	10.31	36.53	173	303	P	H
	*	2410	101.8	-	-	95.79	32.23	10.31	36.53	173	303	A	H
		2388.65	58.84	-15.16	74	52.99	32.1	10.28	36.53	317	266	P	V
		2389.95	44.54	-9.46	54	38.69	32.1	10.28	36.53	317	266	A	V
	*	2412	110.81	-	-	104.8	32.23	10.31	36.53	317	266	P	V
	*	2414	107.64	-	-	101.63	32.23	10.31	36.53	317	266	A	V
802.11b CH 11 2462MHz	*	2462	106.38	-	-	100.06	32.43	10.43	36.54	298	302	P	H
	*	2460	103.03	-	-	96.71	32.43	10.43	36.54	298	302	A	H
		2485.66	55.65	-18.35	74	49.36	32.37	10.46	36.54	298	302	P	H
		2485.66	44.68	-9.32	54	38.39	32.37	10.46	36.54	298	302	A	H
	*	2462	110.52	-	-	104.2	32.43	10.43	36.54	235	261	P	V
	*	2460	107.24	-	-	100.92	32.43	10.43	36.54	235	261	A	V
		2485	61.64	-12.36	74	55.35	32.37	10.46	36.54	235	261	P	V
		2485.6	44.91	-9.09	54	38.62	32.37	10.46	36.54	235	261	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	41.56	-32.44	74	54.65	34.15	14.76	62	300	0	P	H
		4824	41.87	-32.13	74	54.96	34.15	14.76	62	300	360	P	V
802.11b CH 06 2437MHz		4872	42.56	-31.44	74	55.62	34.03	14.83	61.92	300	0	P	H
		7308	42.43	-31.57	74	50.14	35.7	18.46	61.87	300	0	P	H
		4872	40.92	-33.08	74	53.98	34.03	14.83	61.92	300	360	P	V
		7308	42.51	-31.49	74	50.22	35.7	18.46	61.87	300	360	P	V
802.11b CH 11 2462MHz		4926	43.44	-30.56	74	56.39	34	14.9	61.85	300	0	P	H
		7386	42.36	-31.64	74	49.81	35.7	18.71	61.86	300	0	P	H
		4926	42.5	-31.5	74	55.45	34	14.9	61.85	300	360	P	V
		7386	42.67	-31.33	74	50.12	35.7	18.71	61.86	300	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+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		2389.95	61.2	-12.8	74	55.35	32.1	10.28	36.53	264	323	P	H
		2389.95	47.39	-6.61	54	41.54	32.1	10.28	36.53	264	323	A	H
	*	2408	107.49	-	-	101.48	32.23	10.31	36.53	264	323	P	H
	*	2408	99.56	-	-	93.55	32.23	10.31	36.53	264	323	A	H
		2387.87	61.75	-12.25	74	55.9	32.1	10.28	36.53	100	272	P	V
		2389.17	45.99	-8.01	54	39.4	31.2	7.04	31.65	100	272	A	V
	*	2408	107.01	-	-	101	32.23	10.31	36.53	100	272	P	V
	*	2408	99.79	-	-	93.07	31.31	7.06	31.65	100	272	A	V
802.11g CH 11 2462MHz	*	2470	106.79	-	-	100.47	32.43	10.43	36.54	143	317	P	H
	*	2470	99.07	-	-	92.75	32.43	10.43	36.54	143	317	A	H
		2485.12	61.93	-12.07	74	55.64	32.37	10.46	36.54	143	317	P	H
		2483.5	47.68	-6.32	54	41.39	32.37	10.46	36.54	143	317	A	H
	*	2456	108.3	-	-	101.98	32.43	10.43	36.54	100	271	P	V
	*	2456	100.87	-	-	93.68	31.66	7.13	31.6	100	271	A	V
		2485.6	62.31	-11.69	74	56.02	32.37	10.46	36.54	100	271	P	V
		2485.18	47.53	-6.47	54	40.18	31.77	7.16	31.58	100	271	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	42.27	-31.73	74	55.36	34.15	14.76	62	300	0	P	H
		4824	41.41	-32.59	74	54.5	34.15	14.76	62	300	360	P	V
802.11g CH 06 2437MHz		4872	41.47	-32.53	74	54.53	34.03	14.83	61.92	300	0	P	H
		7308	42.85	-31.15	74	50.56	35.7	18.46	61.87	300	0	P	H
		4872	41.09	-32.91	74	54.15	34.03	14.83	61.92	300	360	P	V
		7308	42.05	-31.95	74	49.76	35.7	18.46	61.87	300	360	P	V
802.11g CH 11 2462MHz		4926	42.2	-31.8	74	55.15	34	14.9	61.85	100	360	P	H
		7386	41.56	-32.44	74	49.01	35.7	18.71	61.86	100	360	P	H
		4926	41.53	-32.47	74	54.48	34	14.9	61.85	100	0	P	V
		7386	41.77	-32.23	74	49.22	35.7	18.71	61.86	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		2389.43	67.01	-6.99	74	60.42	31.2	7.04	31.65	264	327	P	H
		2389.69	50.14	-3.86	54	43.55	31.2	7.04	31.65	264	327	A	H
	*	2420	109.44	-	-	102.56	31.43	7.08	31.63	264	327	P	H
	*	2420	101.55	-	-	94.67	31.43	7.08	31.63	264	327	A	H
		2388.26	67.95	-6.05	74	61.36	31.2	7.04	31.65	100	279	P	V
		2389.95	51.72	-2.28	54	45.13	31.2	7.04	31.65	100	279	A	V
	*	2406	109.74	-	-	103.02	31.31	7.06	31.65	100	279	P	V
	*	2406	101.71	-	-	94.99	31.31	7.06	31.65	100	279	A	V
802.11n HT20 CH 11 2462MHz	*	2484.76	69.92	-4.08	74	62.57	31.77	7.16	31.58	253	327	P	H
	*	2483.5	50.79	-3.21	54	43.44	31.77	7.16	31.58	253	327	A	H
		2466	108.46	-	-	101.27	31.66	7.13	31.6	253	327	P	H
		2468	100.52	-	-	93.33	31.66	7.13	31.6	253	327	A	H
	*	2483.68	68.74	-5.26	74	61.39	31.77	7.16	31.58	116	271	P	V
	*	2483.5	51.76	-2.24	54	44.41	31.77	7.16	31.58	116	271	A	V
		2456	111.55	-	-	104.36	31.66	7.13	31.6	116	271	P	V
		2456	103.21	-	-	96.02	31.66	7.13	31.6	116	271	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	41.8	-32.2	74	54.89	34.15	14.76	62	100	0	P	H
		4824	41.11	-32.89	74	54.2	34.15	14.76	62	100	360	P	V
802.11n HT20 CH 06 2437MHz		4872	39.23	-34.77	74	52.29	34.03	14.83	61.92	100	65	P	H
		7308	41.09	-32.91	74	48.8	35.7	18.46	61.87	100	65	P	H
		4872	40.35	-33.65	74	53.41	34.03	14.83	61.92	100	186	P	V
		7308	41.37	-32.63	74	49.08	35.7	18.46	61.87	100	186	P	V
802.11n HT20 CH 11 2462MHz		4926	40.44	-33.56	74	53.39	34	14.9	61.85	100	223	P	H
		7386	41.4	-32.6	74	48.85	35.7	18.71	61.86	100	223	P	H
		4926	41.58	-32.42	74	54.53	34	14.9	61.85	100	360	P	V
		7386	41.9	-32.1	74	49.35	35.7	18.71	61.86	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

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		2389.95	63	-11	74	56.41	31.2	7.04	31.65	302	328	P	H
	!	2389.95	49.51	-4.49	54	42.92	31.2	7.04	31.65	302	328	A	H
	*	2410	102.52	-	-	95.8	31.31	7.06	31.65	302	328	P	H
	*	2412	94.43	-	-	87.71	31.31	7.06	31.65	302	328	A	H
		2490.7	55.35	-18.65	74	47.86	31.89	7.18	31.58	302	328	P	H
		2488.24	44.99	-9.01	54	37.5	31.89	7.18	31.58	302	328	A	H
		2389.82	67.96	-6.04	74	61.37	31.2	7.04	31.65	100	275	P	V
		2389.95	51.7	-2.3	54	45.11	31.2	7.04	31.65	100	275	A	V
	*	2436	105.15	-	-	98.25	31.43	7.08	31.61	100	275	P	V
	*	2434	96.22	-	-	89.34	31.43	7.08	31.63	100	275	A	V
		2483.8	57.39	-16.61	74	50.04	31.77	7.16	31.58	100	275	P	V
		2487.1	45.4	-8.6	54	38.05	31.77	7.16	31.58	100	275	A	V

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 06 2437MHz		2388.78	58.14	-15.86	74	51.55	31.2	7.04	31.65	180	135	P	H
	!	2389.95	46.19	-7.81	54	39.6	31.2	7.04	31.65	180	135	A	H
	*	2448	104.08	-	-	97.04	31.54	7.11	31.61	180	135	P	H
	*	2446	96.3	-	-	89.26	31.54	7.11	31.61	180	135	A	H
		2483.56	64.65	-9.35	74	57.3	31.77	7.16	31.58	180	135	P	H
		2483.5	48.82	-5.18	54	41.47	31.77	7.16	31.58	180	135	A	H
		2389.69	60.76	-13.24	74	54.17	31.2	7.04	31.65	257	98	P	V
		2389.95	46.31	-7.69	54	39.72	31.2	7.04	31.65	257	98	A	V
	*	2434	106.08	-	-	99.2	31.43	7.08	31.63	257	98	P	V
	*	2434	98.39	-	-	91.51	31.43	7.08	31.63	257	98	A	V
		2487.1	62.87	-11.13	74	55.52	31.77	7.16	31.58	257	98	P	V
		2483.5	47.7	-6.3	54	40.35	31.77	7.16	31.58	257	98	A	V
802.11n HT40 CH 09 2452MHz		2389.56	57.17	-16.83	74	50.58	31.2	7.04	31.65	160	323	P	H
		2389.95	44.49	-9.51	54	37.9	31.2	7.04	31.65	160	323	A	H
	*	2446	104.32	-	-	97.28	31.54	7.11	31.61	160	323	P	H
	*	2448	96.52	-	-	89.48	31.54	7.11	31.61	160	323	A	H
		2483.62	65.57	-8.43	74	58.22	31.77	7.16	31.58	160	323	P	H
	!	2483.8	51.35	-2.65	54	44	31.77	7.16	31.58	160	323	A	H
		2387.61	57.32	-16.68	74	50.73	31.2	7.04	31.65	256	287	P	V
		2389.82	44.8	-9.2	54	38.21	31.2	7.04	31.65	256	287	A	V
	*	2442	106.45	-	-	99.41	31.54	7.11	31.61	256	287	P	V
	*	2442	97.84	-	-	90.8	31.54	7.11	31.61	256	287	A	V
		2484.4	67.88	-6.12	74	60.53	31.77	7.16	31.58	256	287	P	V
	!	2484.04	50.75	-3.25	54	43.4	31.77	7.16	31.58	256	287	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		4844	40.27	-33.73	74	56.69	33.73	9.88	60.03	100	360	P	H
HT40		7266	40.27	-33.73	74	52.46	35.8	12.52	60.51	100	360	P	H
CH 03		4844	38.81	-35.19	74	55.23	33.73	9.88	60.03	100	140	P	V
2422MHz		7266	39.21	-34.79	74	51.4	35.8	12.52	60.51	100	140	P	V
802.11n		4872	41.29	-32.71	74	54.35	34.03	14.83	61.92	300	0	P	H
HT40		7308	43.45	-30.55	74	51.16	35.7	18.46	61.87	300	0	P	H
CH 06		4872	41.22	-32.78	74	54.28	34.03	14.83	61.92	300	360	P	V
2437MH		7308	42.12	-31.88	74	49.83	35.7	18.46	61.87	300	360	P	V
802.11n		4902	41.32	-32.68	74	54.31	34	14.88	61.87	300	0	P	H
HT40		7356	43.74	-30.26	74	51.29	35.7	18.61	61.86	300	0	P	H
CH 09		4902	42.07	-31.93	74	55.06	34	14.88	61.87	300	360	P	V
2452MHz		7356	42.37	-31.63	74	49.92	35.7	18.61	61.86	300	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 802.11n HT40 (LF)

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)
2.4GHz 802.11n HT40 LF		37.76	17.66	-22.34	40	35.6	20.8	1.14	39.88	-	-	P	H
		217.21	21.11	-24.89	46	41.84	15.17	2.6	38.5	-	-	P	H
		320.03	21.16	-24.84	46	36.32	19.69	3.13	37.98	-	-	P	H
		459.71	21.22	-24.78	46	31.41	22.91	3.78	36.88	-	-	P	H
		748.77	27.01	-18.99	46	29.05	27.32	4.8	34.16	100	0	P	H
		967.02	29.49	-24.51	54	26.09	29.74	5.39	31.73	-	-	P	H
		46.49	22.71	-17.29	40	37.59	16.27	0.79	31.94	100	0	P	V
		100.81	18.94	-24.56	43.5	33.49	16.22	1.16	31.93	-	-	P	V
		242.43	17.82	-28.18	46	29.79	18.15	1.83	31.95	-	-	P	V
		347.19	18.01	-27.99	46	27.47	20.52	2.1	32.08	-	-	P	V
		671.17	24.74	-21.26	46	27.49	26.64	2.96	32.35	-	-	P	V
		967.02	28.77	-25.23	54	25.28	30.76	3.56	30.83	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Co-Location

WIFI 802.11n HT40 CH09 + LTE B41 BW20M (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 09 2452MHz		2380.72	55.14	-18.86	74	50.95	32.1	8.62	36.53	260	333	P	H
	!	2389.43	44.74	-9.26	54	40.52	32.1	8.65	36.53	260	333	A	H
		2483.98	62.51	-11.49	74	57.87	32.37	8.81	36.54	260	333	P	H
		2483.86	50.54	-3.46	54	45.9	32.37	8.81	36.54	260	333	A	H
	*	2452	97.88	-	-	93.16	32.5	8.75	36.53	260	333	P	H
	*	2452	90.68	-	-	85.96	32.5	8.75	36.53	260	333	A	H
		2387.61	55.19	-18.81	74	50.97	32.1	8.65	36.53	116	291	P	V
		2388.78	44.73	-9.27	54	40.51	32.1	8.65	36.53	116	291	A	V
		2484.7	65.61	-8.39	74	60.97	32.37	8.81	36.54	116	291	P	V
		2483.5	50.11	-3.89	54	45.47	32.37	8.81	36.54	116	291	A	V
	*	2452	101.05	-	-	96.33	32.5	8.75	36.53	116	291	P	V
	*	2452	93.02	-	-	88.3	32.5	8.75	36.53	116	291	A	V

WIFI 802.11n HT40 CH09 + LTE B41 BW20M (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 HT40 CH 09 2452MHz		4902	39.6	-34.4	74	57.88	34	12.2	64.48	300	100	P	H
		4992	45.35	-28.65	74	63.4	34	12.43	64.48	300	100	P	H
		7356	42.14	-31.86	74	55.73	35.7	15.49	64.78	300	100	P	H
		7494	56.25	-17.75	74	69.64	35.8	15.64	64.83	300	100	P	H
		4904	39.31	-34.69	74	28.53	34.1	12.8	36.12	200	360	P	V
		4992	42.3	-31.7	74	31.18	34.1	13.12	36.1	200	360	P	V
		7356	42.38	-31.62	74	26.48	36.6	15.85	36.55	200	360	P	V
		7494	52.27	-21.73	74	36.51	36.3	15.97	36.51	200	360	P	V

Note symbol

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

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

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

1. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

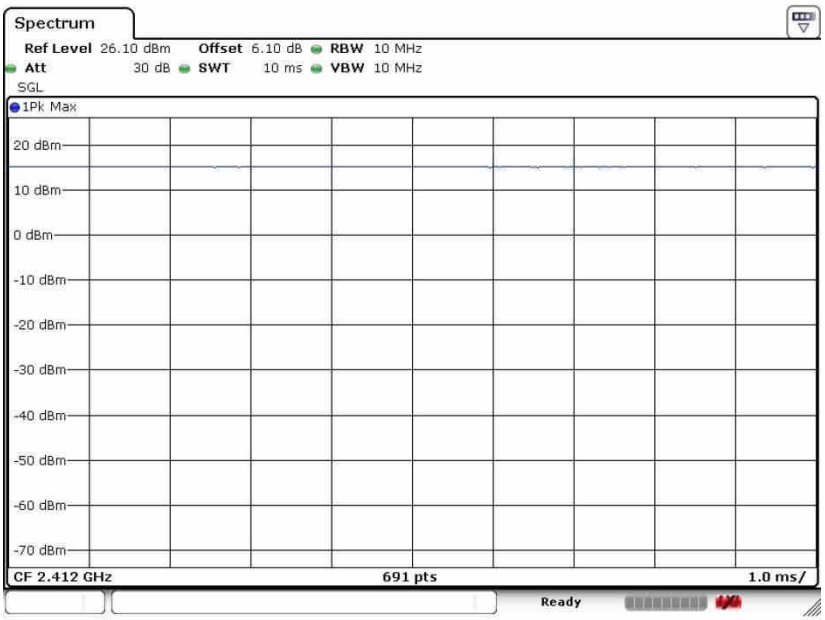
Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix D. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1+2	802.11b	100	-	-	10Hz
1+2	802.11g	95.24	2.029	0.493	0.51kHz
1+2	2.4GHz 802.11n HT20	94.91	1.891	0.529	0.56kHz
1+2	2.4GHz 802.11n HT40	90.78	0.928	1.078	1.1kHz

<MIMO Ant. 1+2>

802.11b



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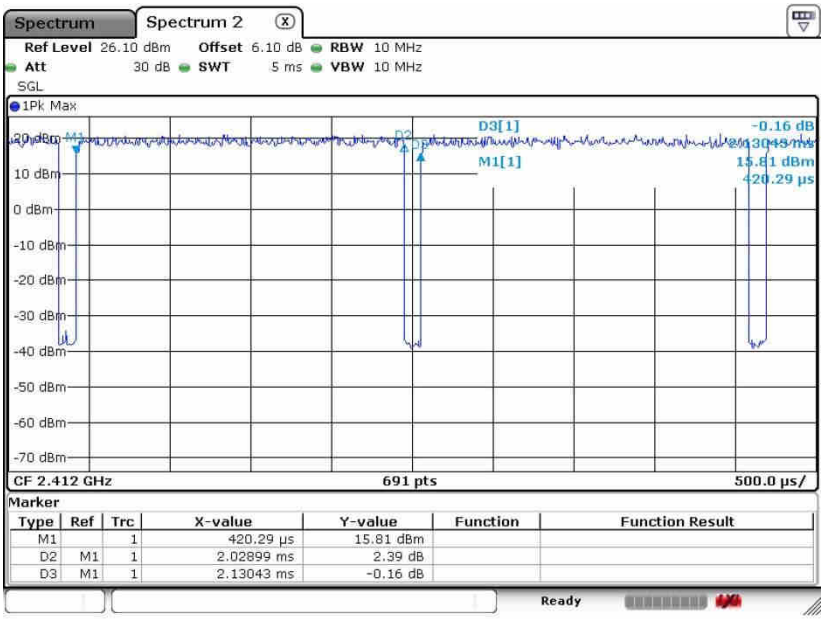
802.11g



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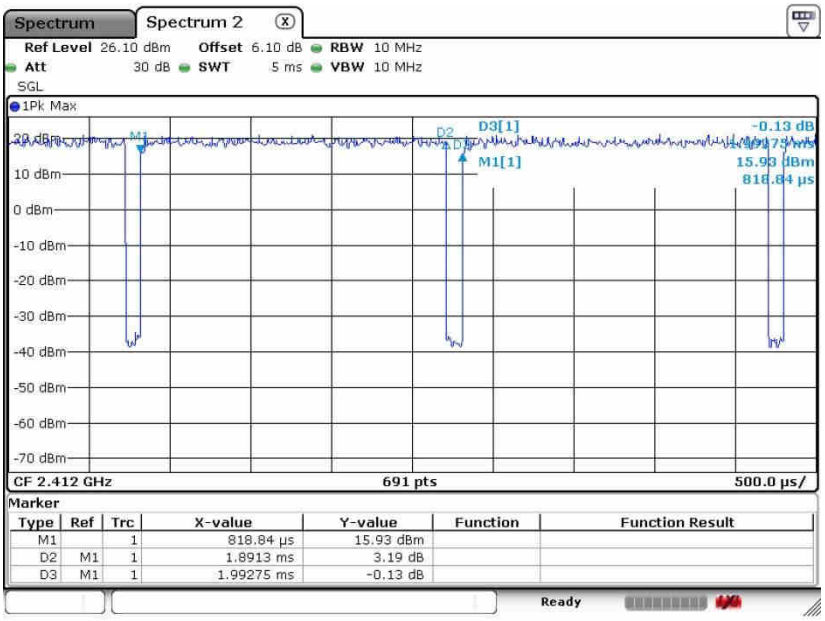
802.11n HT20



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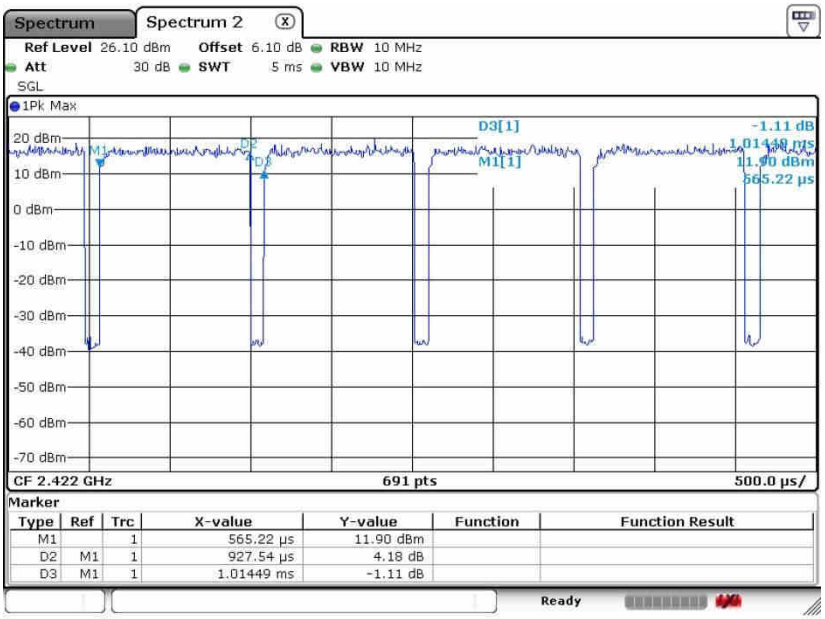
802.11n HT40



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