FCC RF Test Report

For

Shenzhen Yuzehang Industrial Co., Ltd

Test Standards:	Part 15C Subpart C §15.247
Product Description:	WiFi Smart Converter
Tested Model:	XS-A27
Additional Model No.:	N/A
Brand Name:	N/A
FCC ID:	2ARRR-A27
Classification	(DTS) Digital Transmission System
Report No.:	EC1904004F01
Tested Date:	2019-04-16 to 2019-05-20
Issued Date:	2019-05-20
Prepared By:	Jerry Wang / Engineer
Approved By:	Bacon Wu / RF Manager

Hunan Ecloud Testing Technology Co., Ltd.

Building A1, Changsha E Center, No. 18 Xiangtai Avenue, Liuyang Economic and Technological Development Zone, Hunan, P.R.C

Tel.: +86-731-89634887 Fax.: +86-731-89634887

www.hn-ecloud.com

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2019.05.20	Valid	Original Report

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Summary Of Test Result

FCC Rule	Description	Limit	Result	Remark
15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
-	99% Bandwidth	-	Pass	-
15.247(b)(3)	Peak Output Power	≤ 30dBm	Pass	-
15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
15.247(d)	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	-
15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 1.81 dB at 4874 MHz
15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 11.43 dB at 0.33 MHz
15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

1 Test Laboratory

1.1 Test facility

CNAS (accreditation number: L11138)

Hunan Ecloud TWesting Technology Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1244 , Test Firm Registration Number: 793308)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

ISED(CAB identifier: CN0012, ISED#: 24347)

Hunan Ecloud Testing Technology Co., Ltd. has been listed on the Wireless Device Testing Laboratories list of innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.

A2LA (Certificate Code : 4895.01)

Hunan Ecloud Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

2 General Description

2.1 Applicant

Shenzhen Yuzehang Industrial Co., Ltd
Floor 3, Unit 3, Building 2, Guijing Garden, Songgang Avenue, Songgang Street,Baoan District, Shenzhen

2.2 Manufacturer

Shenzhen Yuzehang Industrial Co., Ltd
Floor 3, Unit 3, Building 2, Guijing Garden, Songgang Avenue, Songgang Street, Baoan District, Shenzhen

2.3 General Description Of EUT

Product	WiFi Smart Converter
Model No.	XS-A27
Additional No.	N/A
Difference Description	N/A
FCC ID	2ARRR-A27
Power Supply	AC120/60Hz
Modulation Technology	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Type	802.11b : DSSS 802.11g/n : OFDM
Operating Frequency	2412-2462MHz
Number Of Channel	11
Max. Output Power	802.11b : 11.84 dBm (0.015 W) 802.11g : 11.89 dBm (0.015 W) 802.11n HT20 : 11.90 dBm (0.015 W)
Antenna Type	PCB Antenna type with 1.0dBi gain
I/O Ports	Refer to user's manual

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. EUT is tested at full load

2.4 Modification of EUT

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

2.5 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- ANSI C63.10-2013
- KDB 558074 D01 15.247 Meas Guidance v05r02

3 Test Configuration of Equipment Under Test

3.1 Descriptions of Test Mode

11 channels are provided for 802.11b, 802.11g and 802.11n(HT20):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	2412 MHz	7	2442 MHz
2	2417 MHz	8	2447 MHz
3	2422 MHz	9	2452 MHz
4	2427 MHz	10	2457 MHz
5	2432 MHz	11	2462 MHz
6	2437 MHz		

The transmitter has a maximum peak conducted output power as follows:

Frequency Range(MHz)	Mode	Output Power(dBm)	Output Power(mW)
2412~2462	802.11b	11.84	15.28
2412~2462	802.11g	11.89	15.45
2412~2462	802.11n HT20	11.90	15.49

a. Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

b. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z it was determined that Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y orientation.

c. Based on the baseline scan, the worst-case data rates were:

802.11b mode: 1 Mbps

802.11g mode: 6 Mbps

802.11n HT20 mode: MCS0

3.2 Test Mode

3.2.1 Antenna Port Conducted Measurement

Summary table of Test Cases			
Test Item	**Modulation**		
	802.11 b	**802.11 g**	**802.11n HT20**
Conducted Test Cases	Mode 1: CH01 Mode 2: CH06 Mode 3: CH11	Mode 1: CH01 Mode 2: CH06 Mode 3: CH11	Mode 1: CH01 Mode 2: CH06 Mode 3: CH11

3.2.2 Radiated Emission Test (Below 1GHz)

Radiated Test Cases	**802.11 g**
	Mode 1: CH01

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. Following channel(s) was (were) selected for the final test as listed above

3.2.3 Radiated Emission Test (Above 1GHz)

Test Item	**Modulation**		
	802.11 b	**802.11 g**	**802.11n HT20**
Radiated Test Cases	Mode 1: CH01 Mode 2: CH06 Mode 3: CH11	Mode 1: CH01 Mode 2: CH06 Mode 3: CH11	Mode 1: CH01 Mode 2: CH06 Mode 3: CH11

Note : 1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.

2. Following channel(s) was (were) selected for the final test as listed above

3. The high frequency, which started from 18GHz to 26GHz, was pre-scanned and the result which was lower than the limit line per 15.31(o) was not reported.

3.2.4 Power Line Conducted Emission Test:

AC Conducted Emission	Mode 1 : Power Supply + WLAN Link + Lamp

3.3 Support Equipment

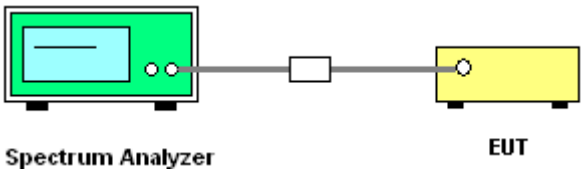
Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	TP-Link	TL-WR842N	FCC DoC	N/A	N/A
2.	Notebook	Lenovo	E540	FCC DoC	N/A	shielded cable DC O/P 1.8 m unshielded AC I/P cable1.2 m
3.	LED filament lamp	BOFA	A60-LED-WBNW	N/A	N/A	N/A
4.	Huawei	Huawei	ELE-AL00	FCC DoC	N/A	N/A

3.4 Test Setup

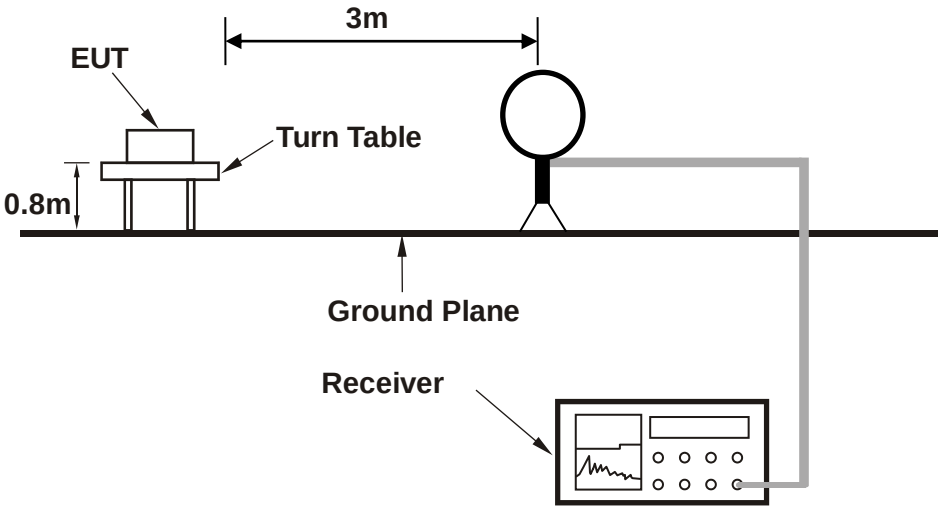
The EUT is continuously communicating to the WiFi tester during the tests.

EUT was set in WiFi communications.

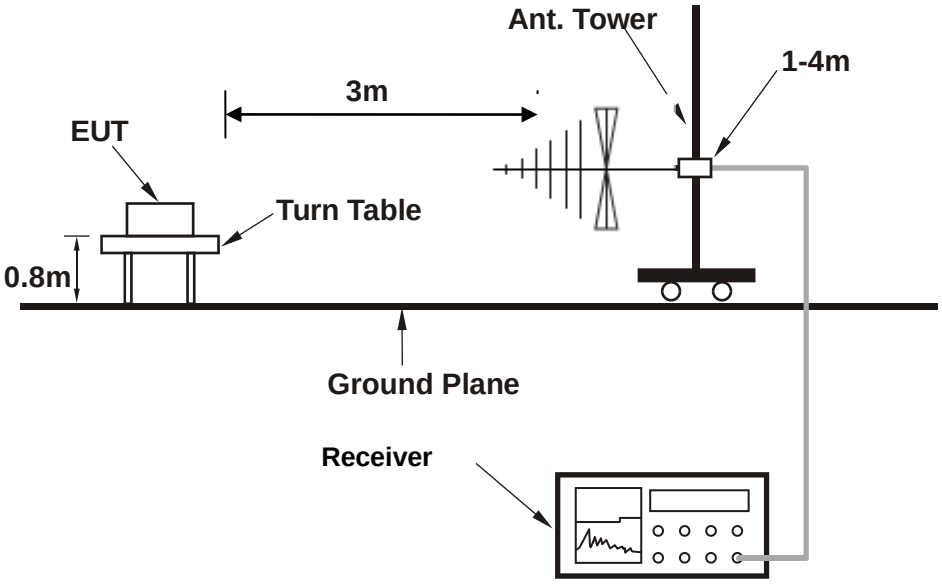
Setup diagram for Conducted Test



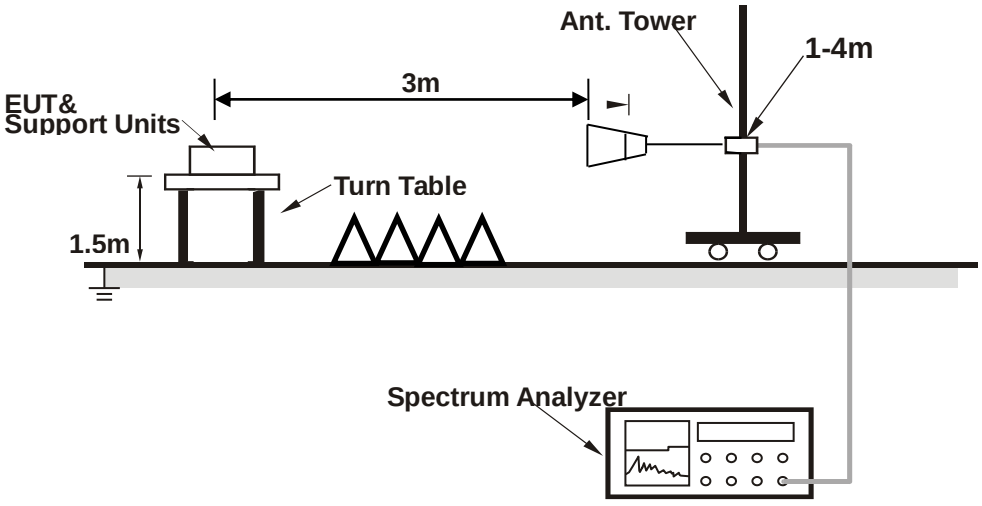
Setup diagram for Raidation(9KHz~30MHz) Test



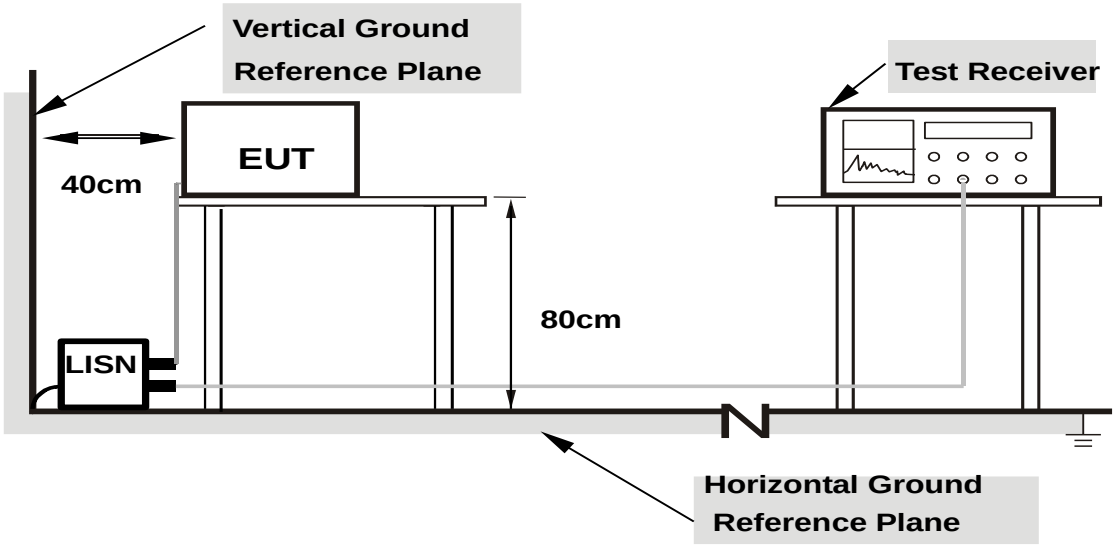
Setup diagram for Raidation(Below 1G) Test



Setup diagram for Raidation(Above1G) Test



Setup diagram for AC Conducted Emission Test



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 5 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 5 + 10 = 15 (dB)

4 Test Result

4.1 6dB and 99% Bandwidth Measurement

4.1.1 Limit of 6dB and 99% Bandwidth

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

4.1.2 Test Procedures

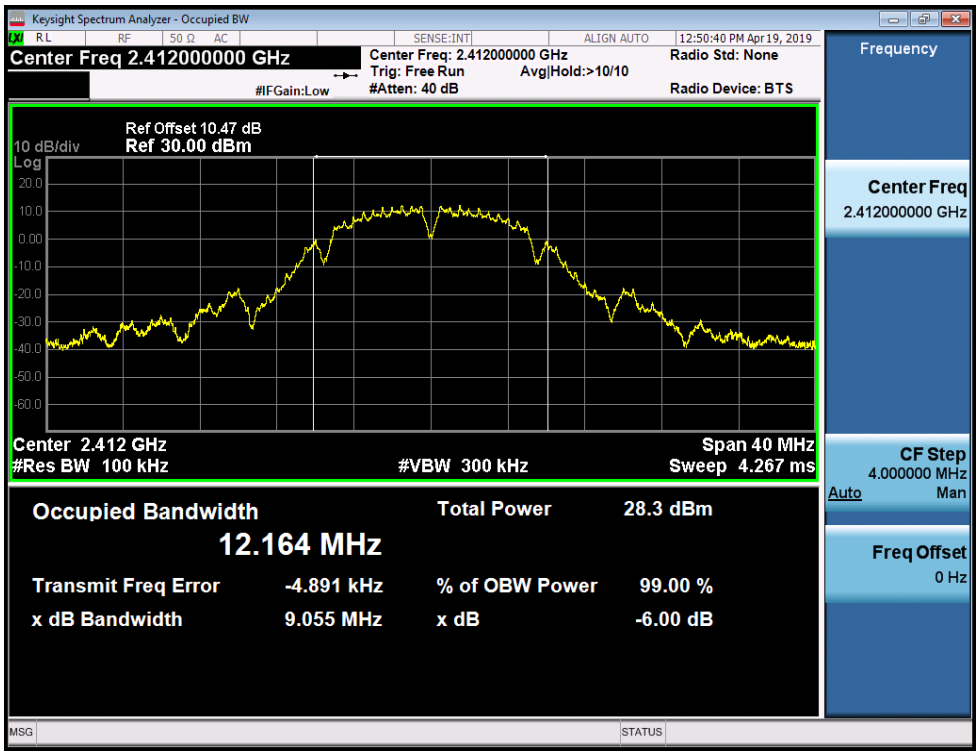
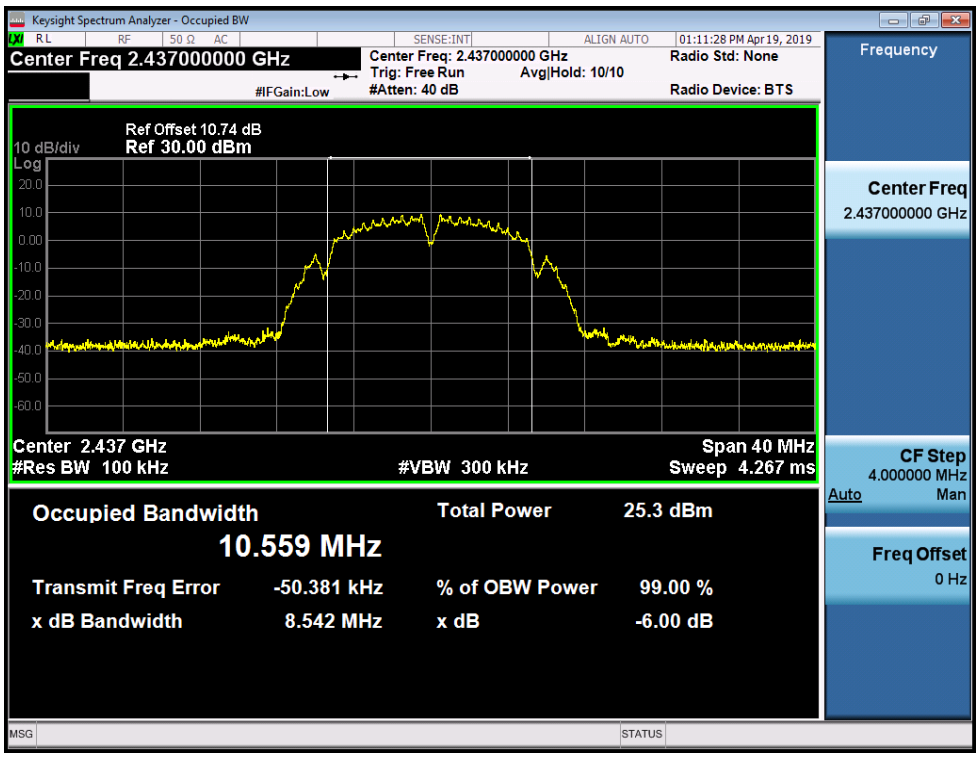
1. The testing follows FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v05r02.
2. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
3. Turn on the EUT and connect it to measurement instrument.
4. Set to the maximum power setting and enable Transmitting the EUT transmit continuously
5. 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.
6. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 100KHz and set the Video bandwidth (VBW) = 300KHz.

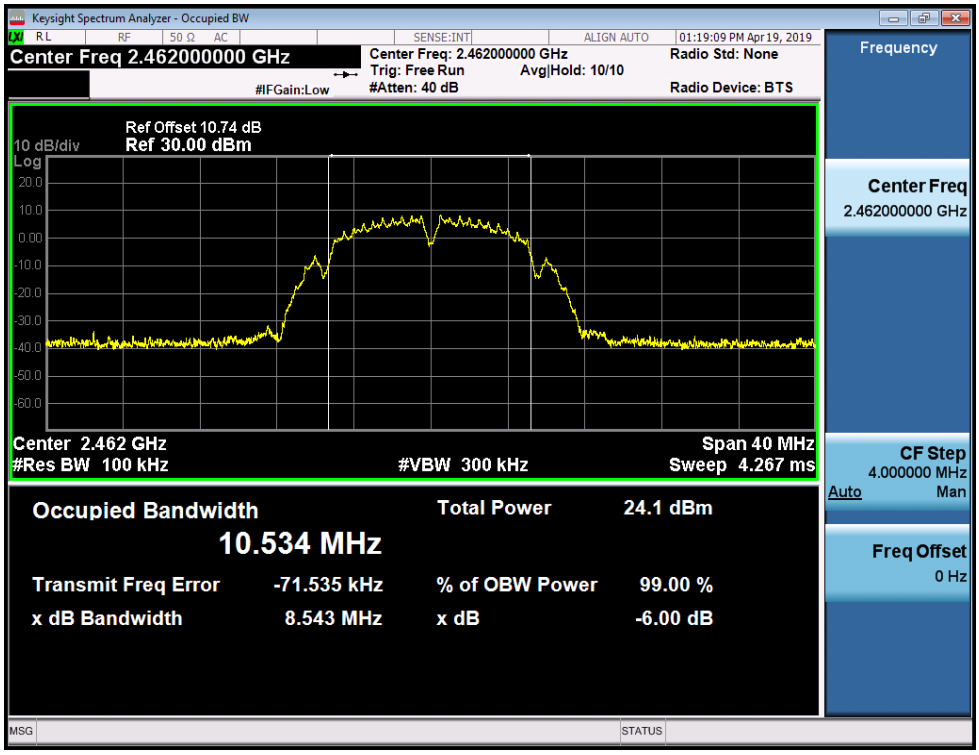
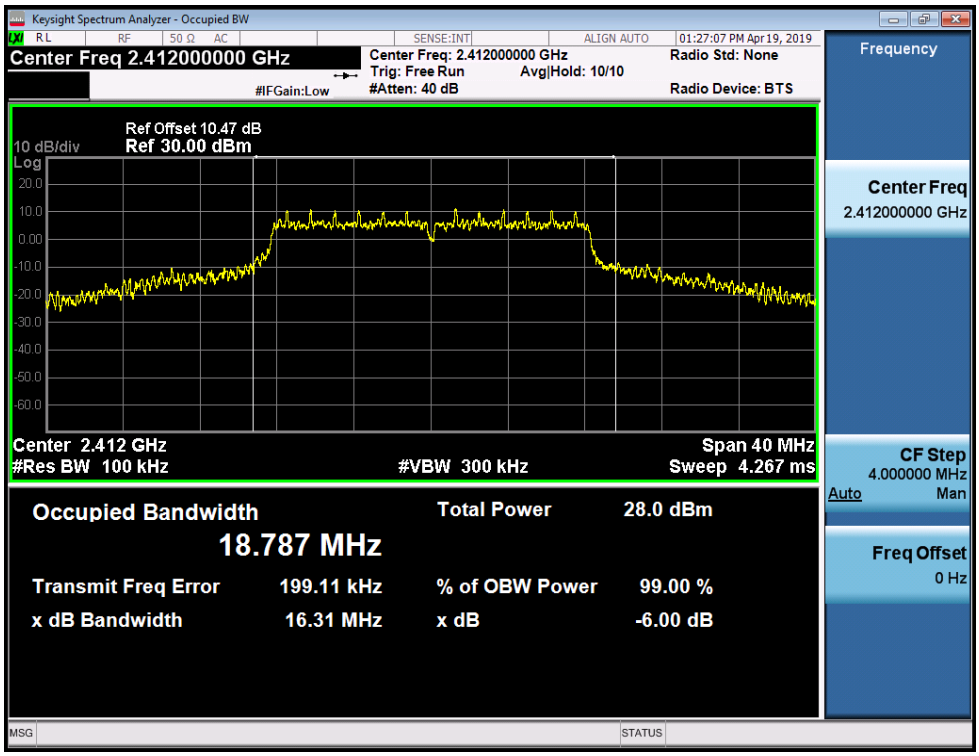
4.1.3 Test Result of 6dB and 99% Bandwidth

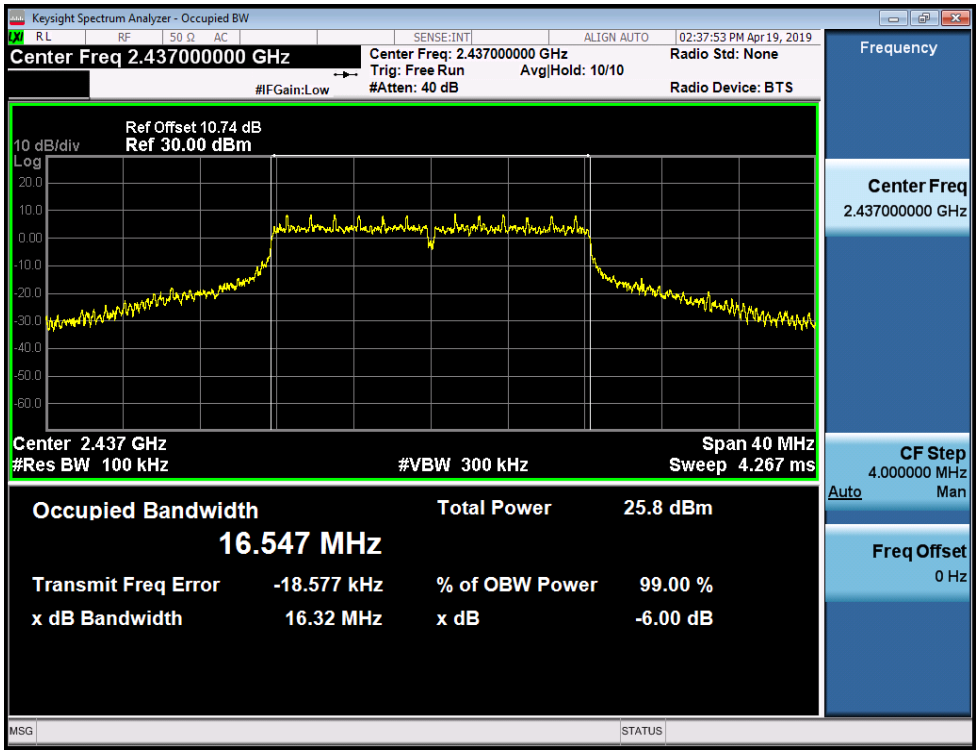
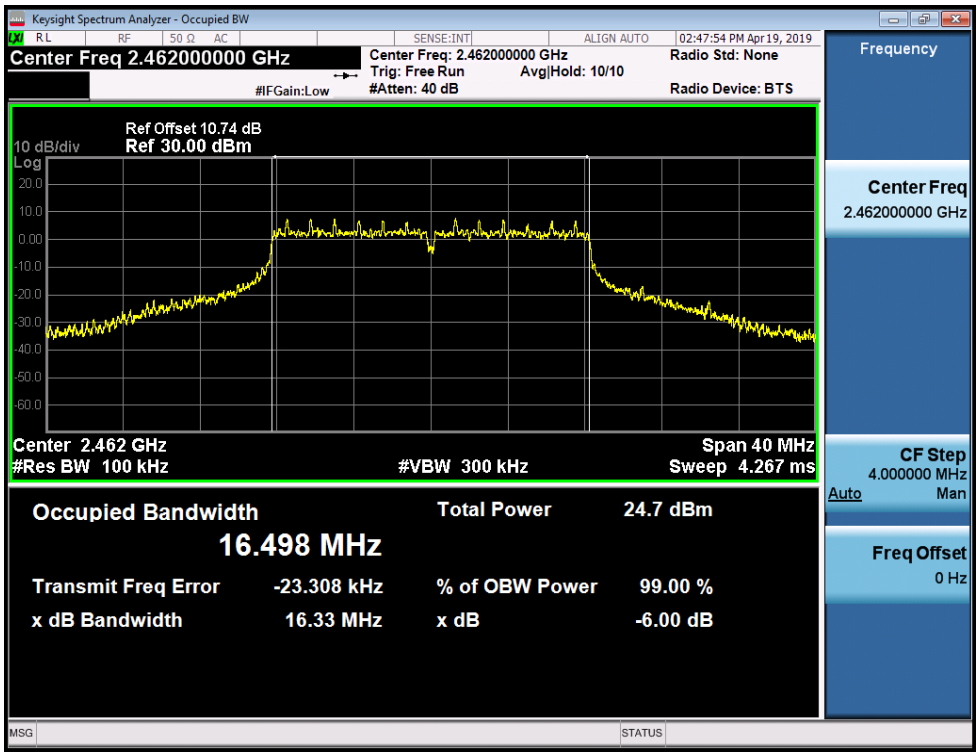
Test Mode :	TX	**Temperature :**	24~26℃
Test Engineer :	Jerry Wang	**Relative Humidity :**	50~53%

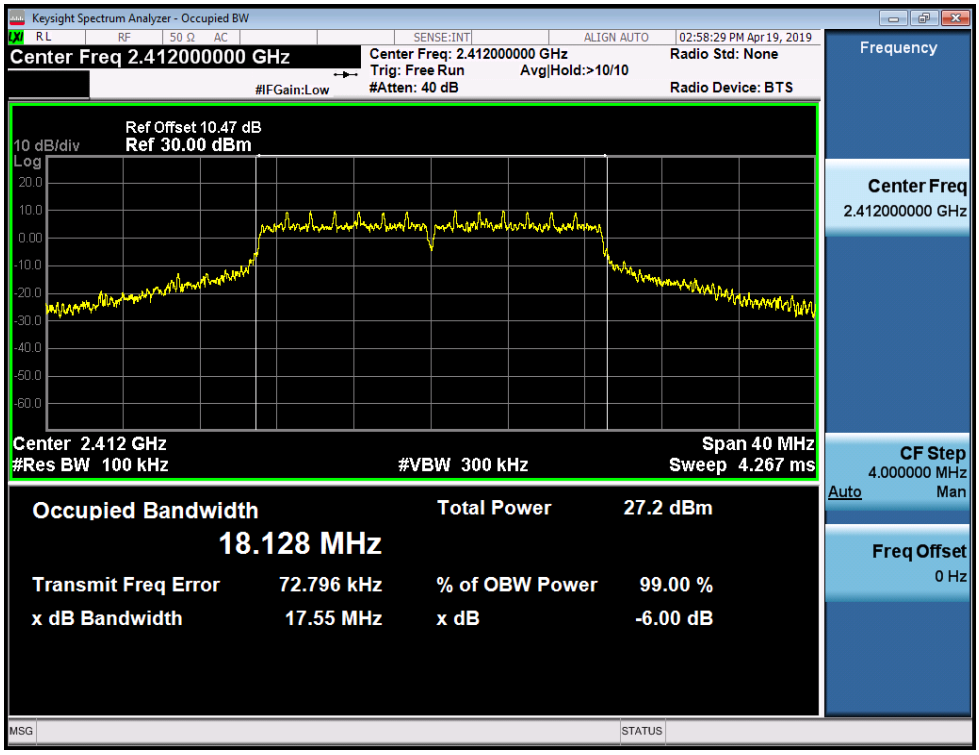
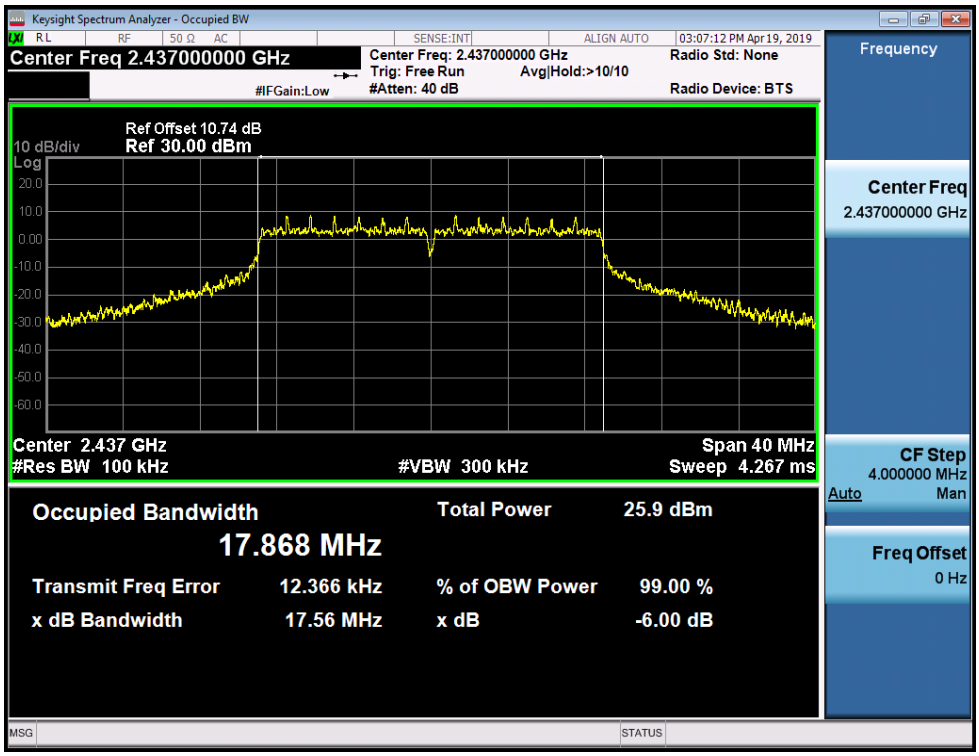
Mode	Channel	6dB Bandwidth [MHz]	99% OBW [MHz]	Verdict
11B	LCH	9.050	12.164	PASS
11B	MCH	8.092	10.559	PASS
11B	HCH	8.069	10.534	PASS
11G	LCH	16.33	18.787	PASS
11G	MCH	16.33	16.547	PASS
11G	HCH	16.33	16.498	PASS
11N20	LCH	17.56	18.128	PASS
11N20	MCH	17.55	17.868	PASS
11N20	HCH	17.58	17.798	PASS

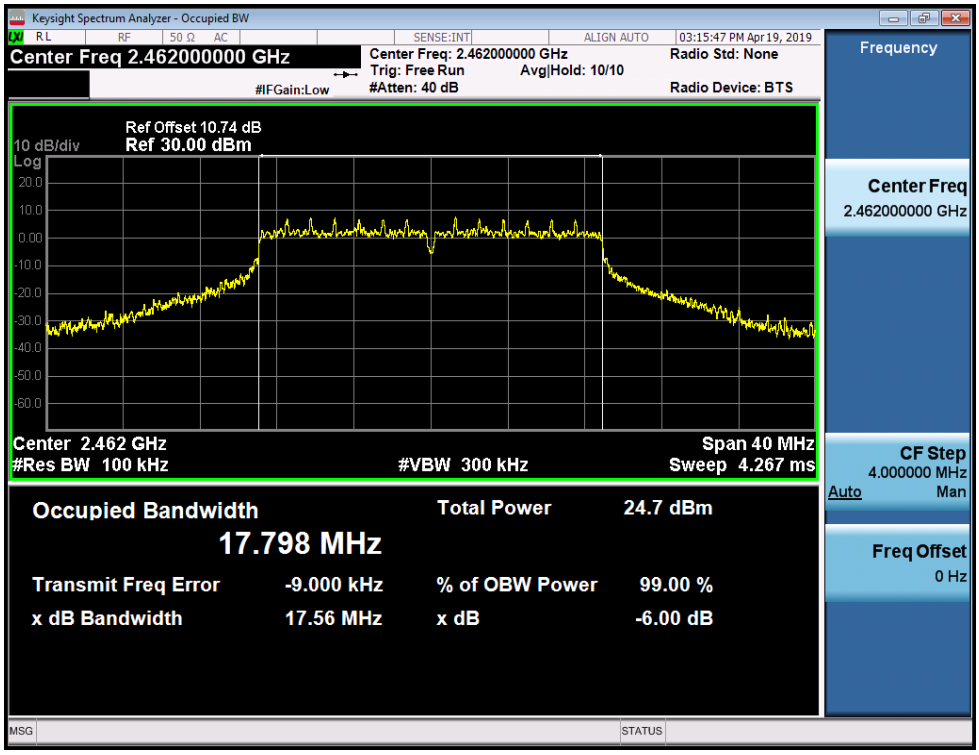
6dB and 99% Bandwidth Plot

Graphs	
11B/LCH	
11B/MCH	

11B/HCH	
11G/LCH	

11G/MCH	
11G/HCH	

11N20/LCH	
11N20/MCH	

11N20/HCH	

Keysight Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
03:15:47 PM Apr 19, 2019
Center Freq 2.462000000 GHz
Center Freq: 2.462000000 GHz
Trig: Free Run
Avg|Hold: 10/10
#IFGain:Low
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 10.74 dB
10 dB/div
Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center Freq
2.462000000 GHz
Center 2.462 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 40 MHz
Sweep 4.267 ms
CF Step
4.000000 MHz
Auto
Man
Occupied Bandwidth
17.798 MHz
Total Power
24.7 dBm
Transmit Freq Error
-9.000 kHz
% of OBW Power
99.00 %
x dB Bandwidth
17.56 MHz
x dB
-6.00 dB
Freq Offset
0 Hz
MSG
STATUS

4.2 Output Power Measurement

4.2.1 Limit of Output Power

FCC §15.247 (b)(3)

For systems using digital modulation in the 2400-2483.5 MHz bands: 30dBm.

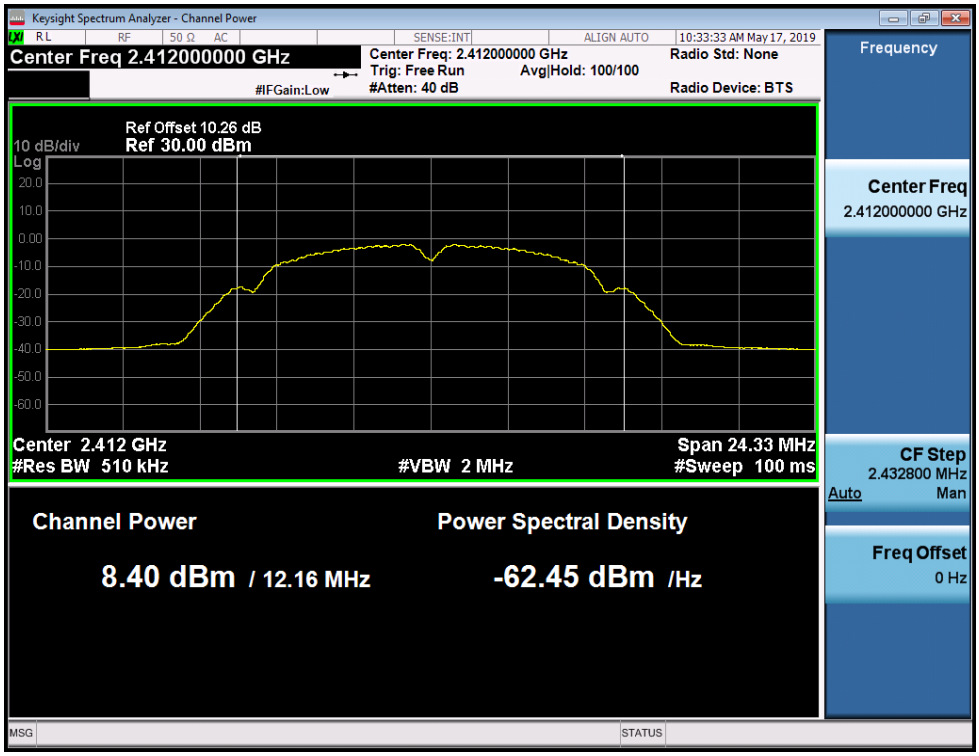
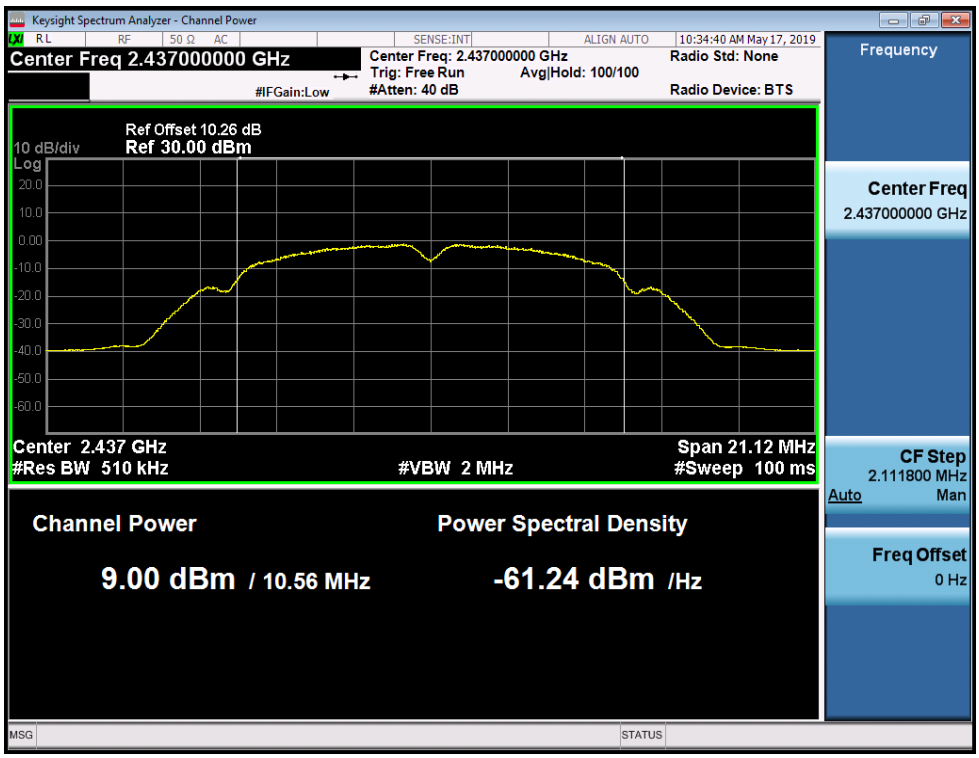
4.2.2 Test Procedures

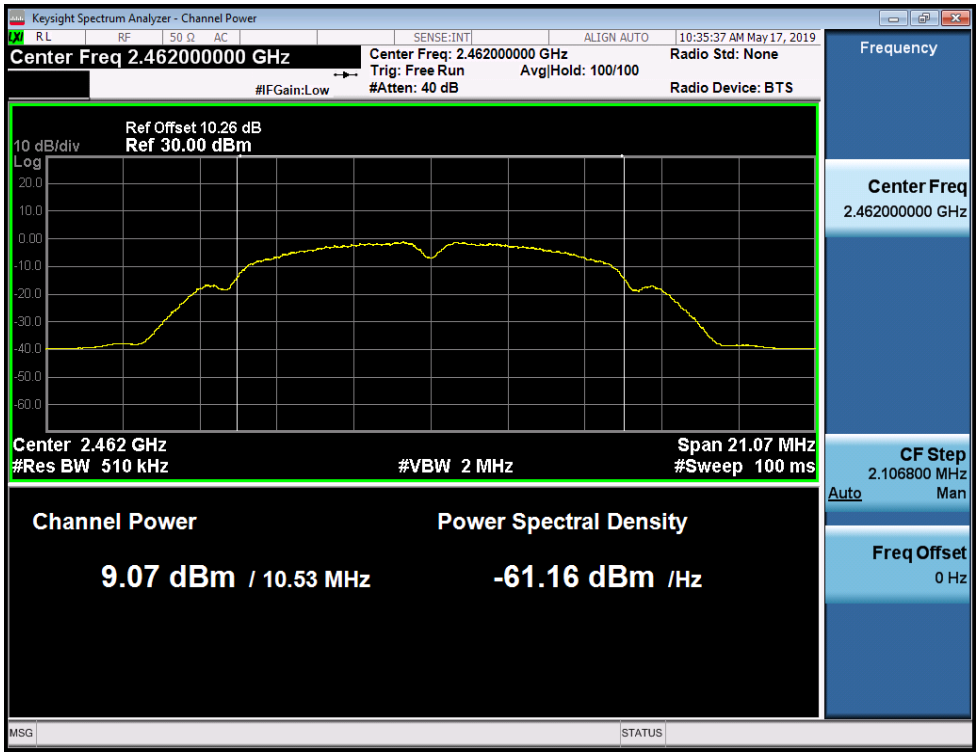
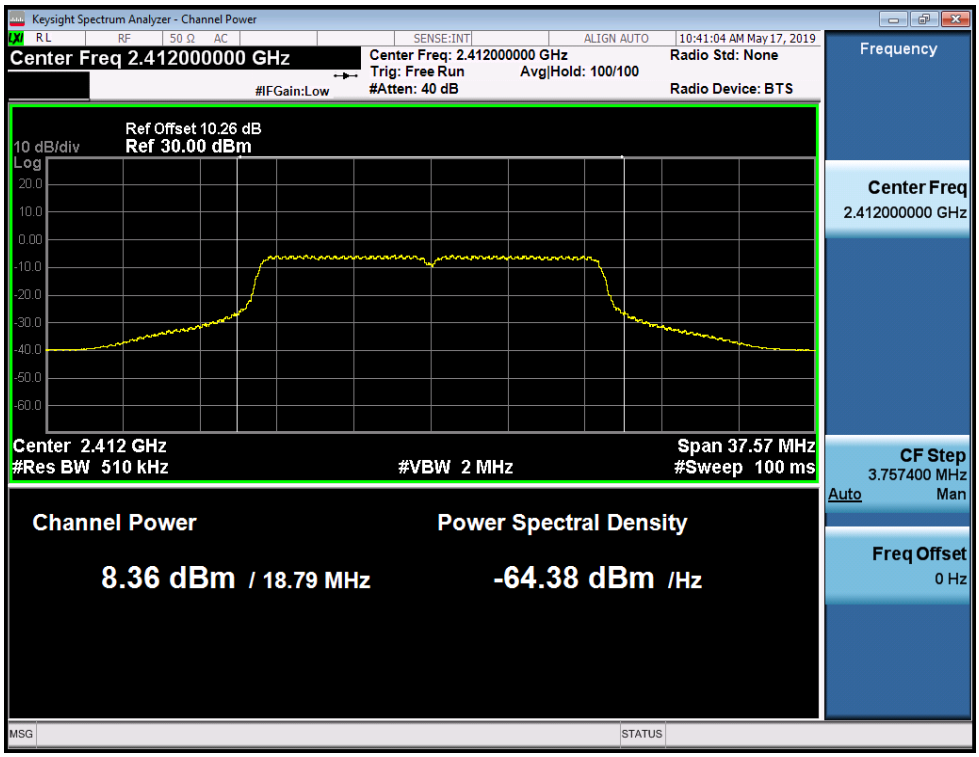
1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v05r02 section 8.3.2.2 Measurement using a spectrum analyzer.
2. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
3. Turn on the EUT and connect it to spectrum analyzer.
4. Set to the maximum power setting and enaBle Transmitting the EUT transmit continuously
5. Measure the duty cycle, x, of the transmitter output signal as described in below:
   a. Set the center frequency of the instrument to the center frequency of the transmission.
   b. Set RBW to the largest availaBle Transmitting value.
   c. Set detector = peak
6. Set span to at least 1.5*OBW.Set RBW=510KHz,VBW=2MHz, Number of points in sweep ≥ 2/3* span, Sweep time = auto. Detector = RMS
7. Allow the sweep to “free run”. Trace average 100 traces in RMS mode
8. Compute power by integrating the spectrum across the OBW of the signal using the instrument’s Channel power measurement function with band limits set equal to the OBW band edges.
9. Add 10 log (1/x), where x is the duty cycle.

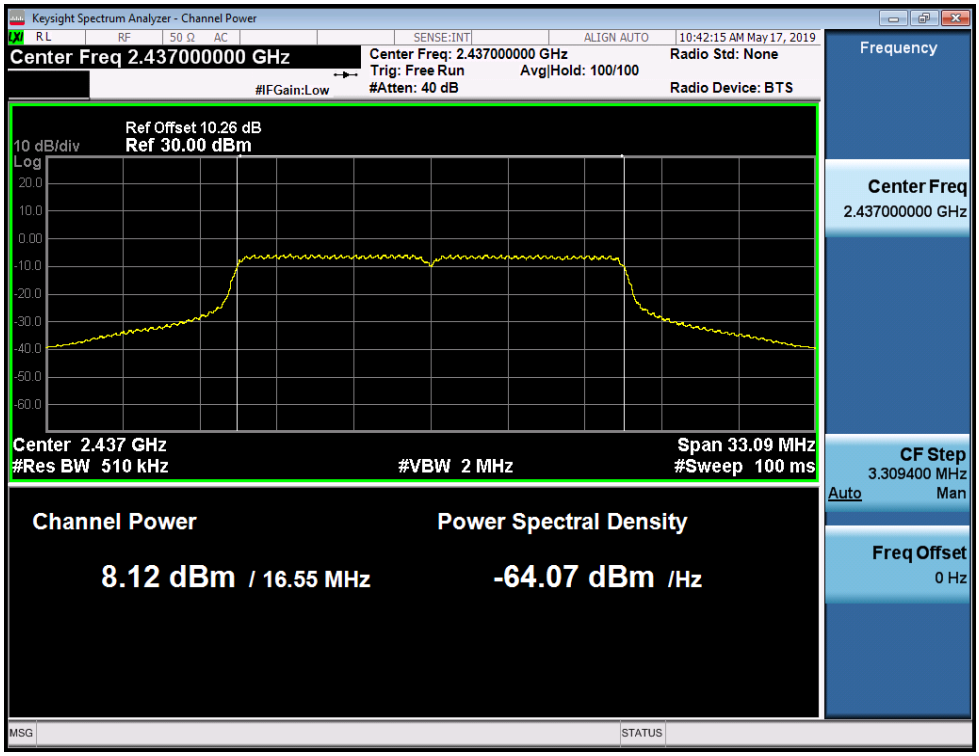
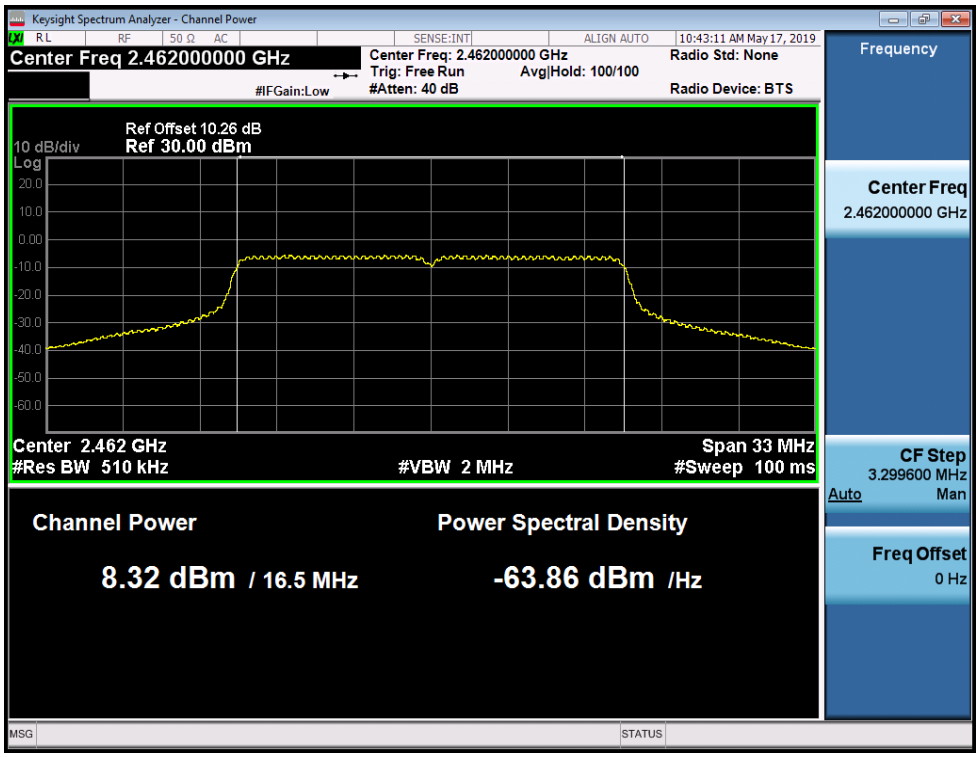
4.2.3 Test Result of Output Power

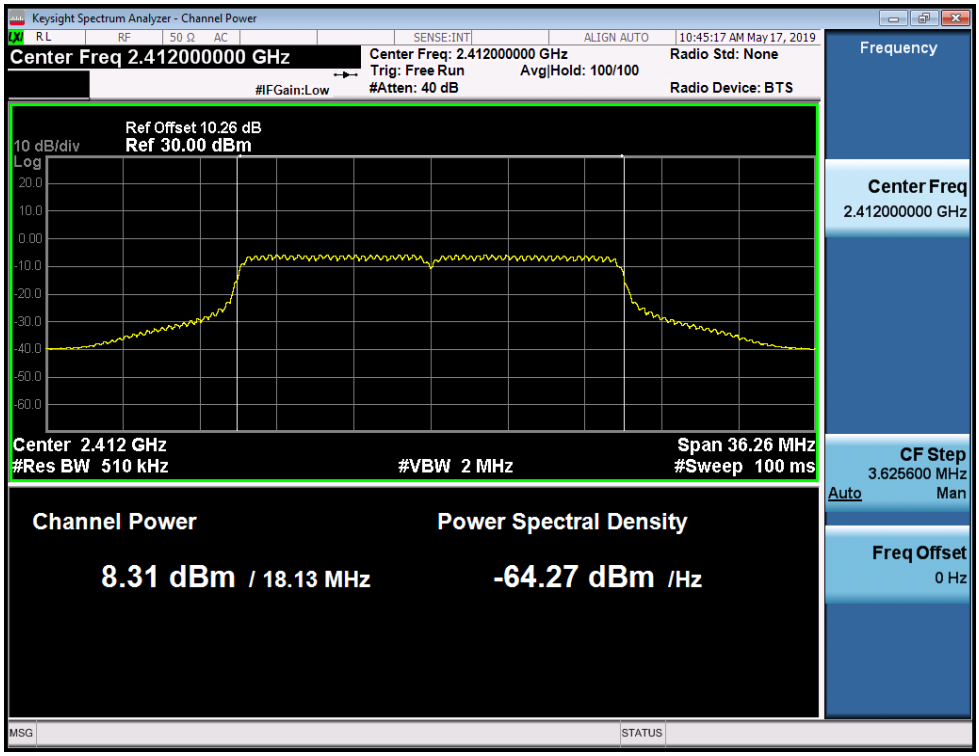
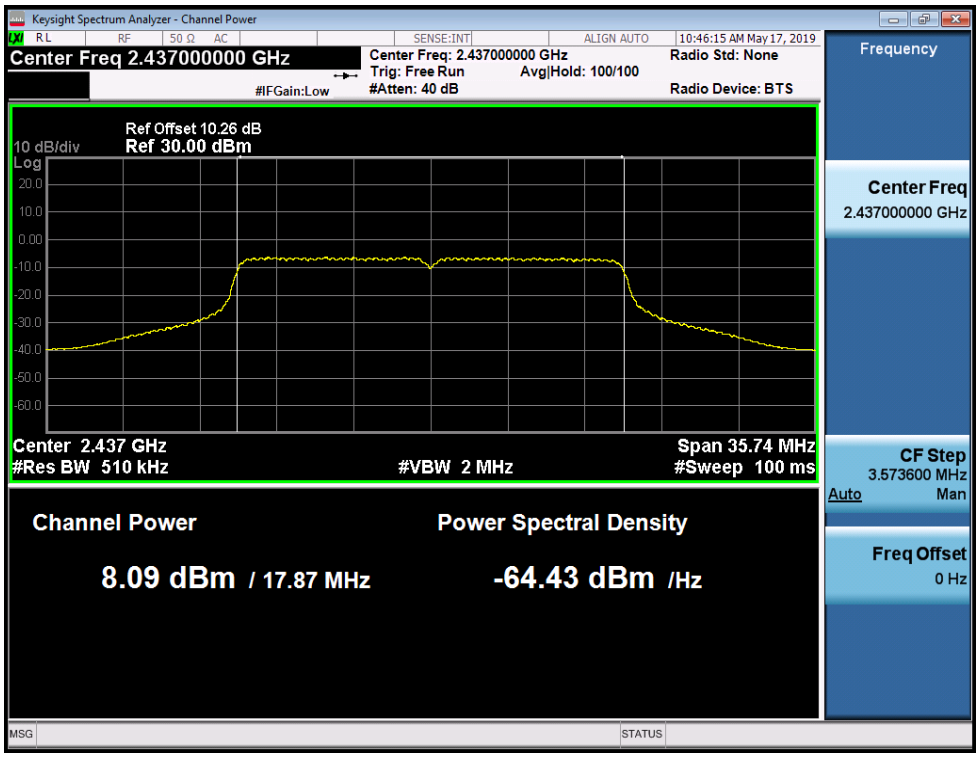
Test Mode :		TX	Temperature :		24~26℃	
Test Engineer :		Jerry Wang	Relative Humidity :		50~53%	
Mode	**Channel**	**Meas.Level [dBm]**	**DT**	**10 log (1/x)**	**AV.Power [dBm]**	**Verdict**
11B	LCH	8.40	52.85 %	2.77	11.17	PASS
11B	MCH	9.00	52.74 %	2.78	11.78	PASS
11B	HCH	9.07	52.85 %	2.77	11.84	PASS
11G	LCH	8.36	44.35 %	3.53	11.89	PASS
11G	MCH	8.12	44.35 %	3.53	11.65	PASS
11G	HCH	8.32	44.35 %	3.53	11.85	PASS
11N20	LCH	8.31	43.75 %	3.59	11.90	PASS
11N20	MCH	8.09	43.6 %	3.61	11.70	PASS
11N20	HCH	8.19	43.75 %	3.59	11.78	PASS

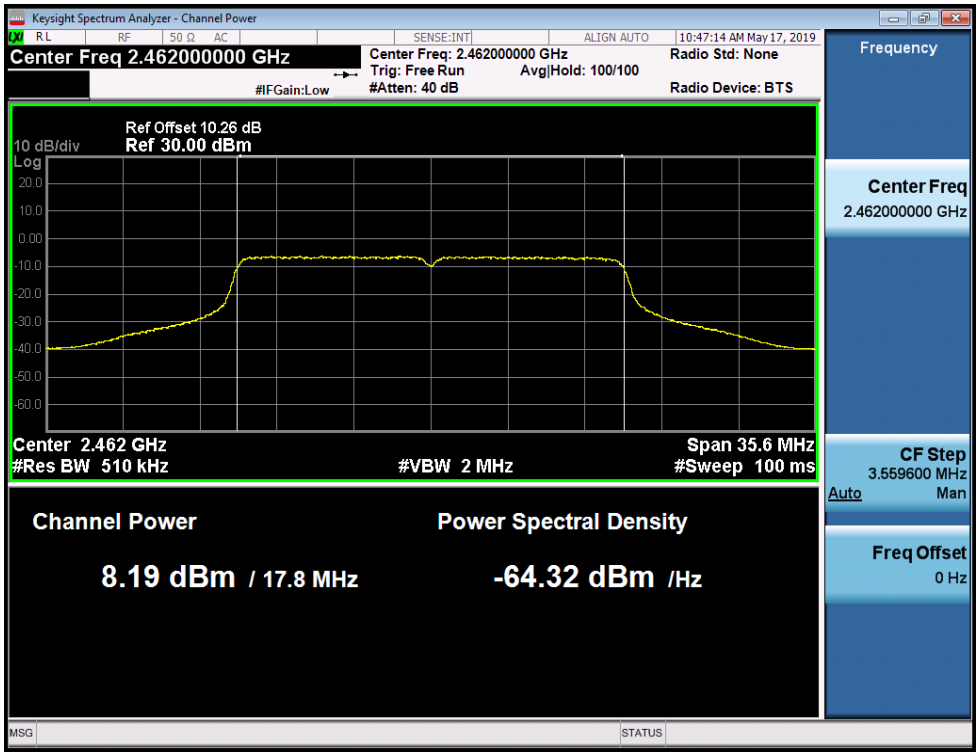
Meas.Level Plot

Graphs	
11B/LCH	
11B/MCH	

11B/HCH	
11G/LCH	

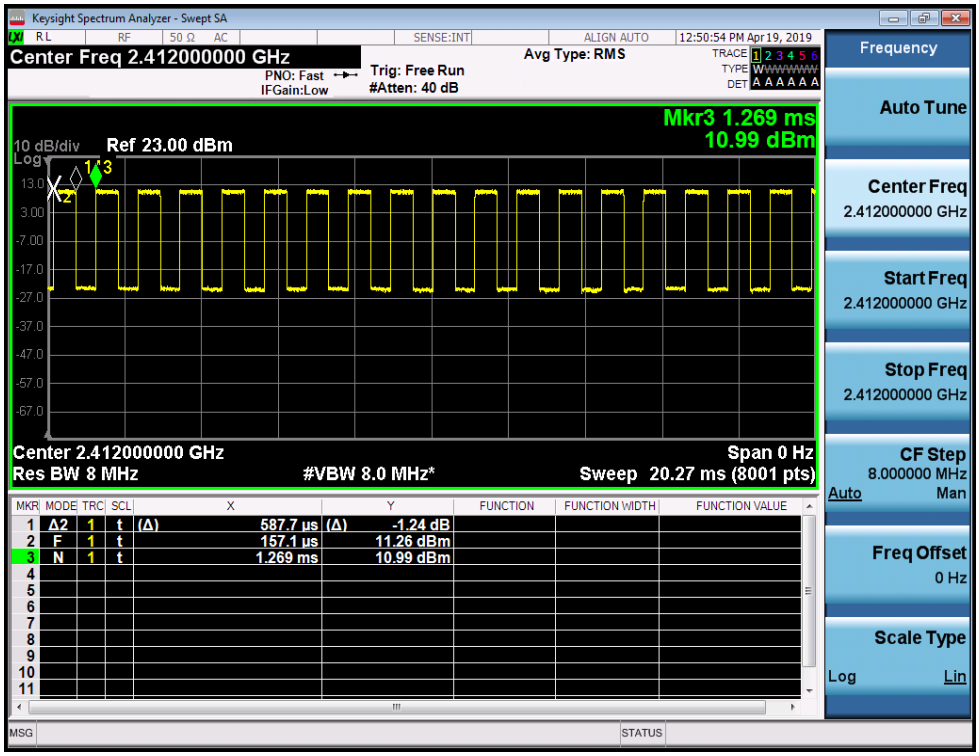
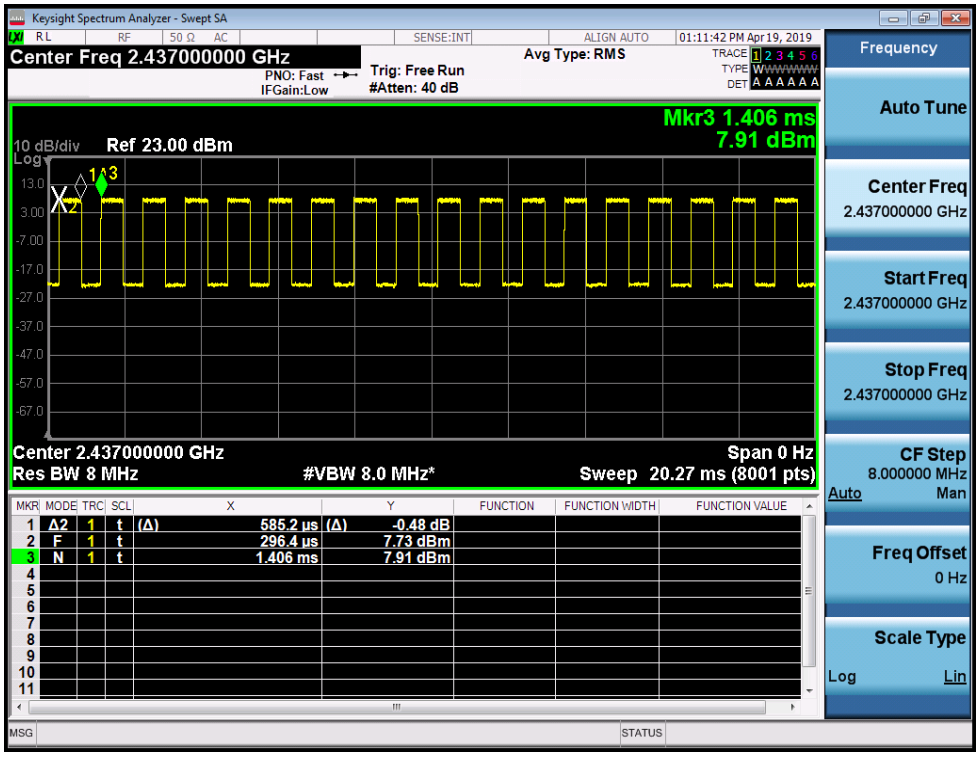
11G/MCH	
11G/HCH	

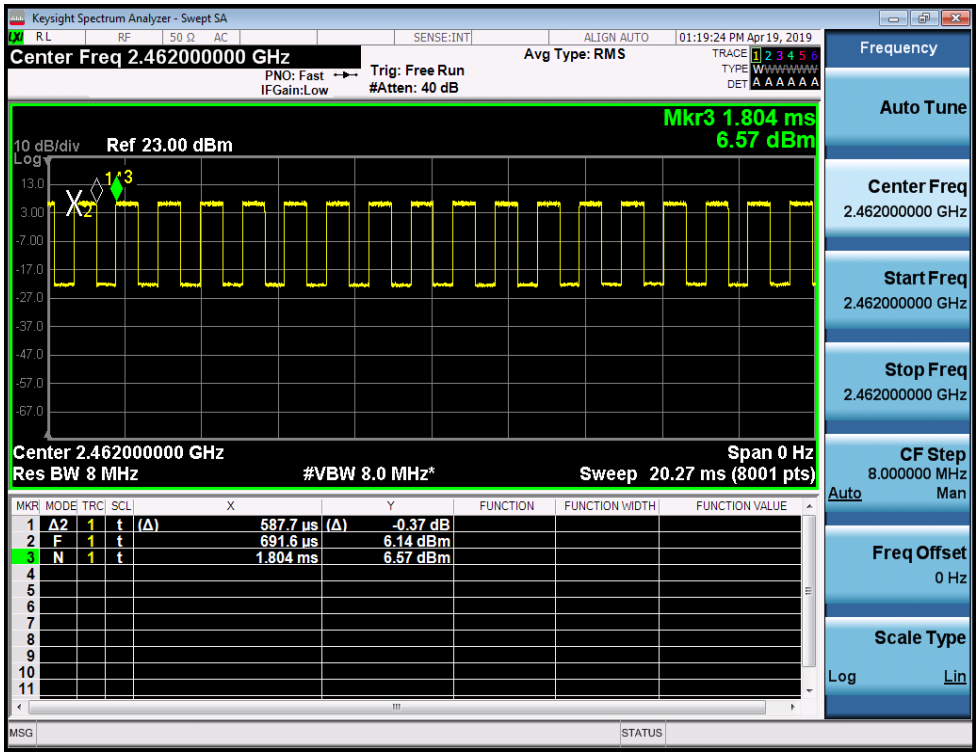
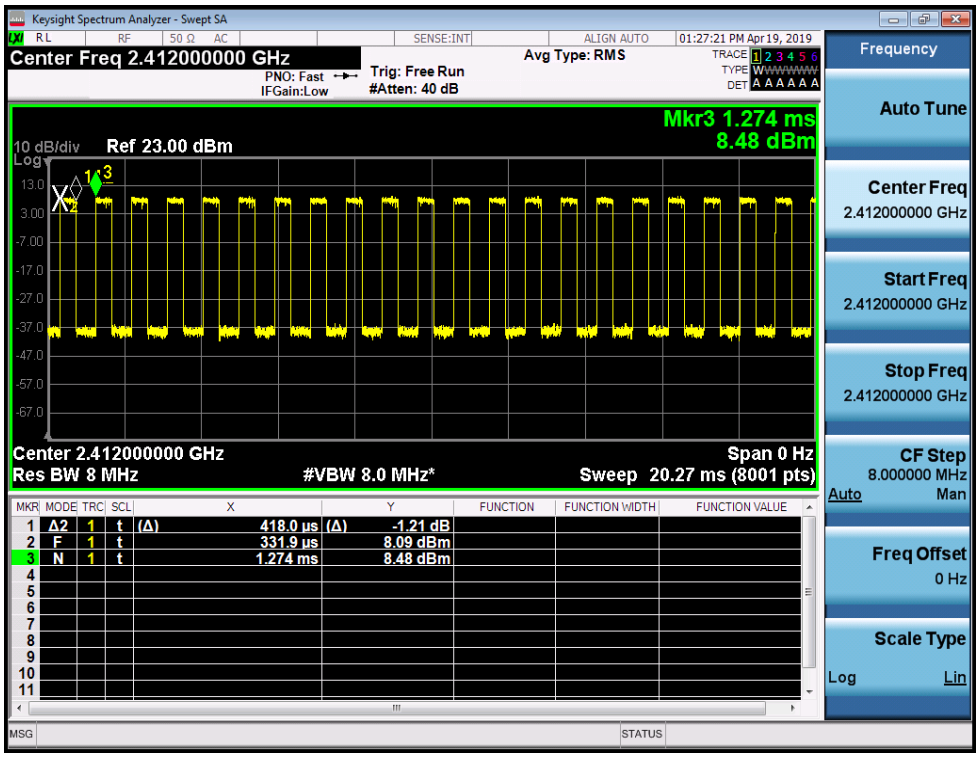
11N20/LCH	
11N20/MCH	

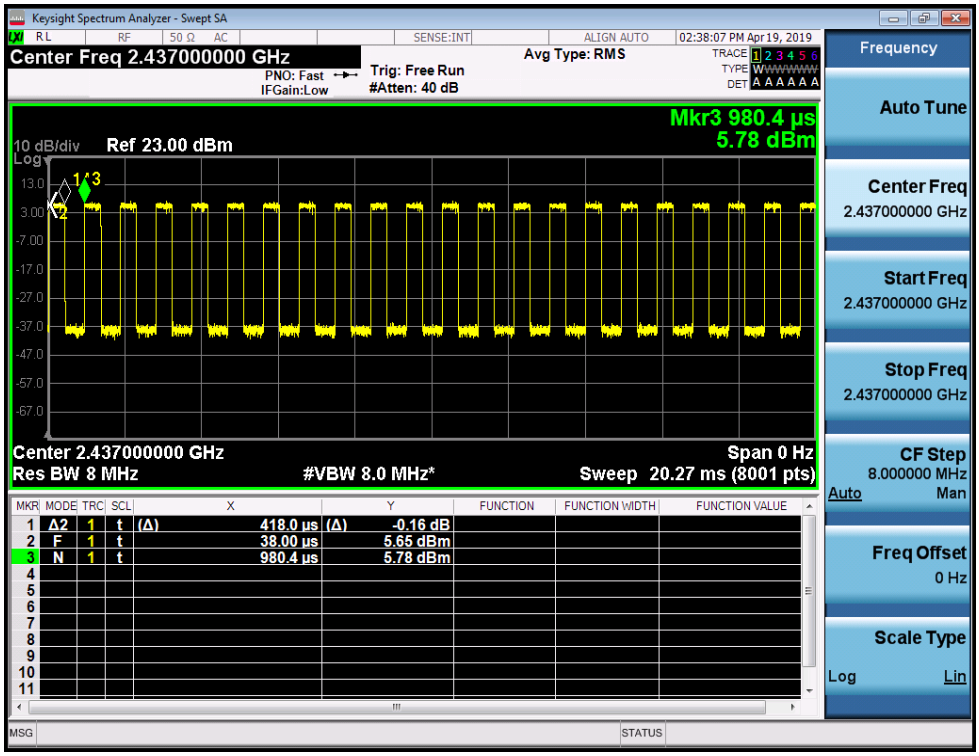
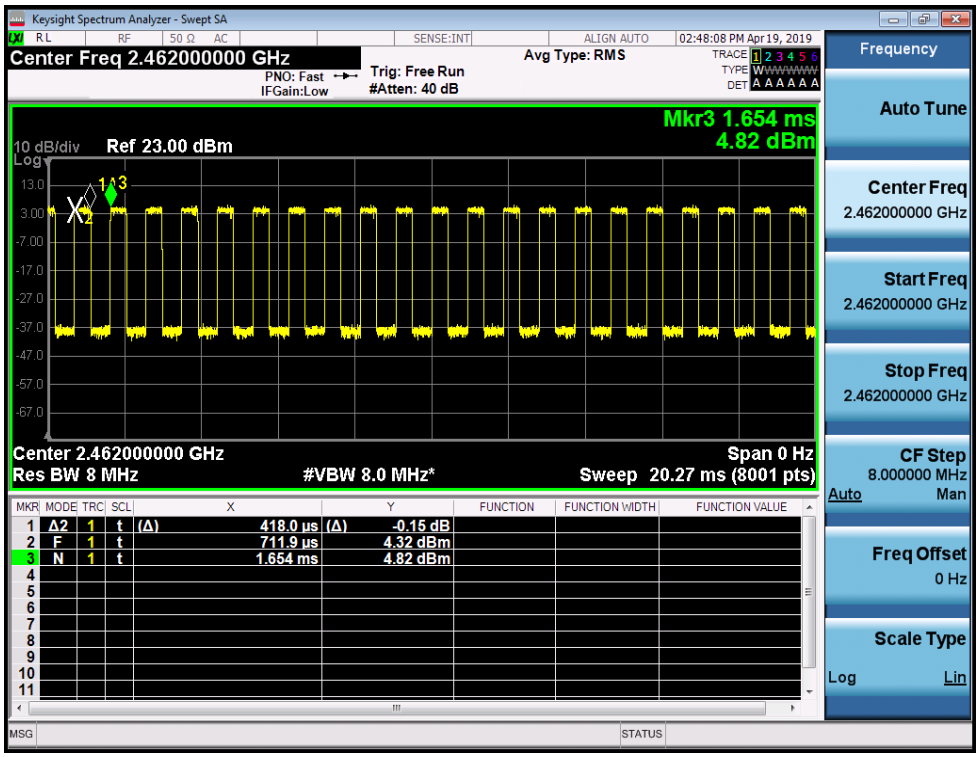
11N20/HCH	

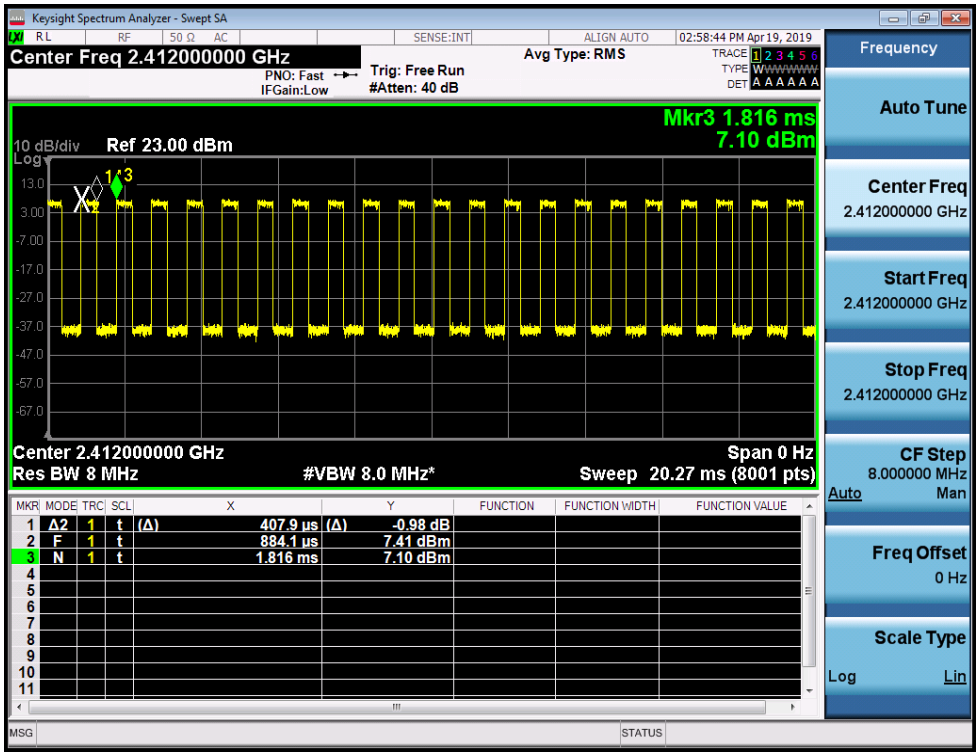
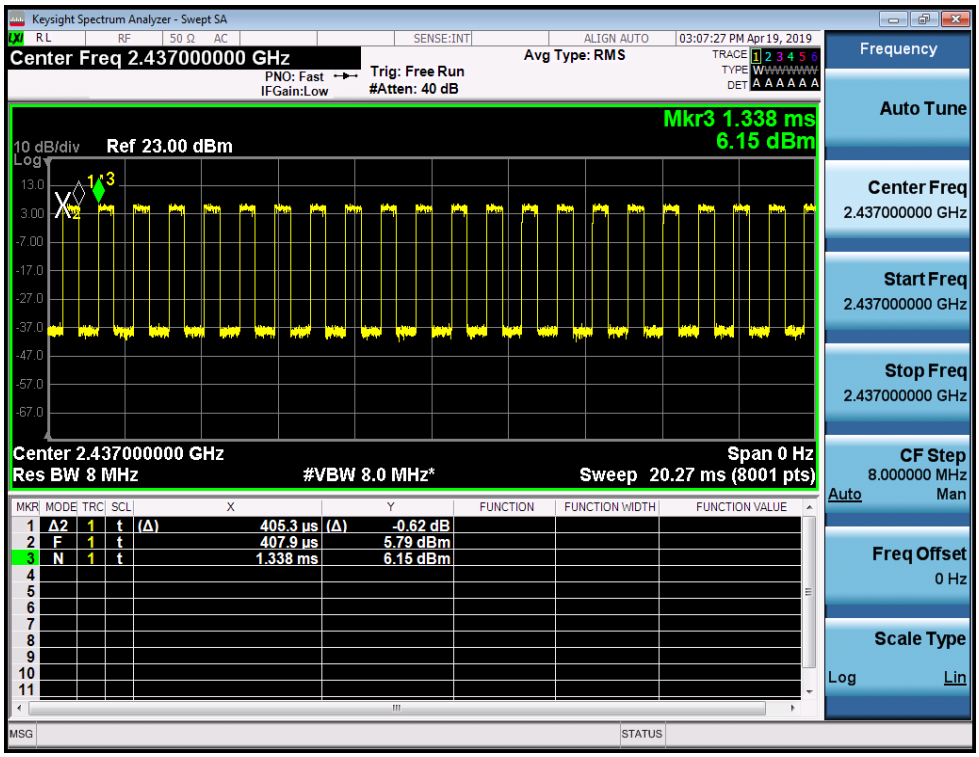
Keysight Spectrum Analyzer - Channel Power
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
10:47:14 AM May 17, 2019
Center Freq 2.462000000 GHz
Center Freq: 2.462000000 GHz
Trig: Free Run
Avg|Hold: 100/100
#IFGain:Low
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 10.26 dB
10 dB/div
Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center Freq
2.462000000 GHz
Center 2.462 GHz
#Res BW 510 kHz
#VBW 2 MHz
Span 35.6 MHz
#Sweep 100 ms
CF Step
3.559600 MHz
Auto
Man
Channel Power
8.19 dBm / 17.8 MHz
Power Spectral Density
-64.32 dBm /Hz
Freq Offset
0 Hz
MSG
STATUS

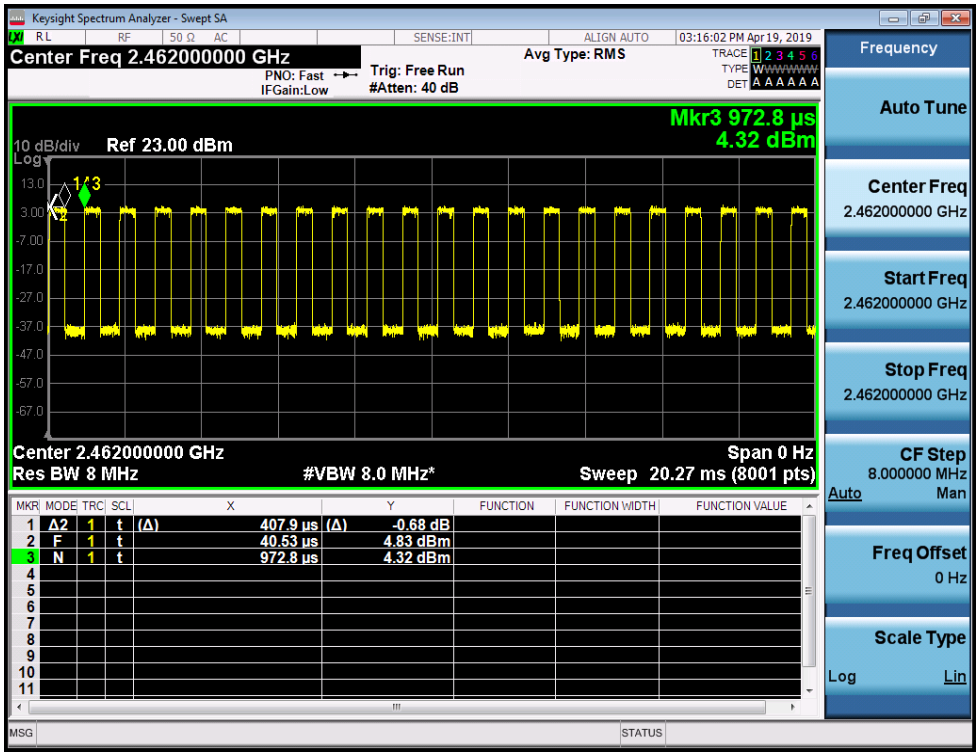
Duty cycle Plot

Graphs	
11B/LCH	
11B/MCH	

11B/HCH	
11G/LCH	

11G/MCH	
11G/HCH	

11N20/LCH	
11N20/MCH	

11N20/HCH	

Keysight Spectrum Analyzer - Swept SA
Center Freq 2.462000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
03:16:02 PM Apr 19, 2019
Mkr3 972.8 µs
4.32 dBm
10 dB/div
Log
Ref 23.00 dBm
Center 2.462000000 GHz
Res BW 8 MHz
#VBW 8.0 MHz*
Span 0 Hz
Sweep 20.27 ms (8001 pts)
1 Δ2 1 t (Δ) 407.9 µs (Δ) -0.68 dB
2 F 1 t 40.53 µs 4.83 dBm
3 N 1 t 972.8 µs 4.32 dBm
Frequency
Auto Tune
Center Freq
2.462000000 GHz
Start Freq
2.462000000 GHz
Stop Freq
2.462000000 GHz
CF Step
8.000000 MHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

4.3 Power Spectral Density Measurement

4.3.1 Limits of Power Spectral Density

FCC § 15.247(e)

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

4.3.2 Test Procedure

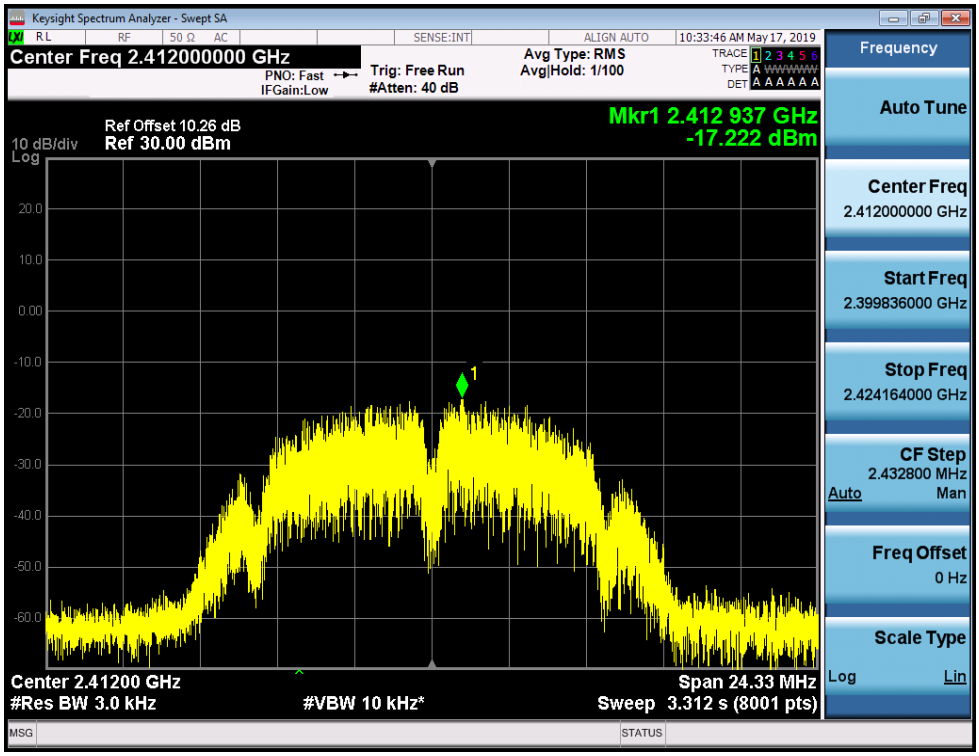
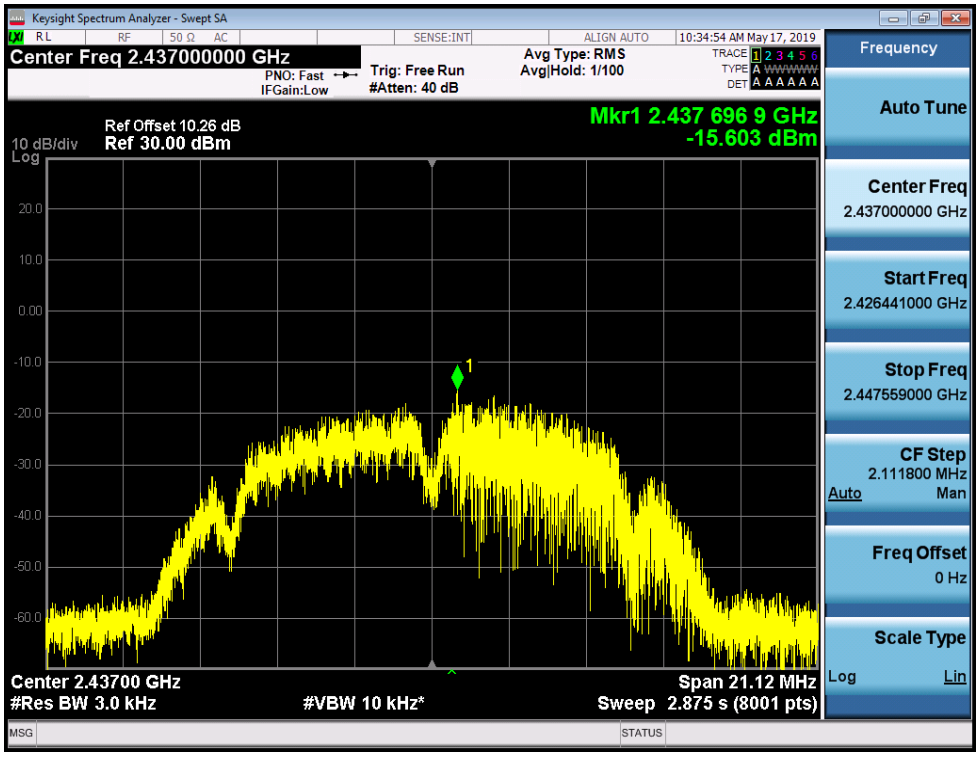
1. The testing follows Measurement Procedure 8.4 DTS maximum power spectral density level in the fundamental emission of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
2. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
3. Turn on the EUT and connect it to measurement instrument.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 30 kHz. Video bandwidth VBW = 100 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = power averaging (rms), Sweep time = auto couple, Trace mode = averaging (rms) mode over a minimum of 100 traces. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.
8. Compute power spectral density by add 10 log (1/x), where x is the duty cycle.

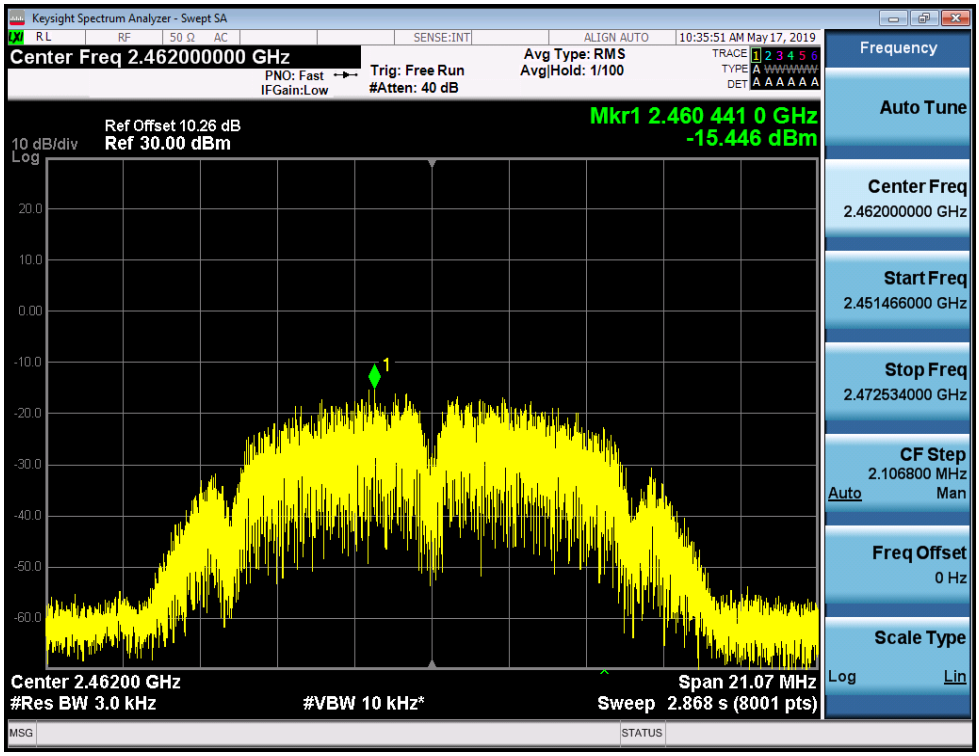
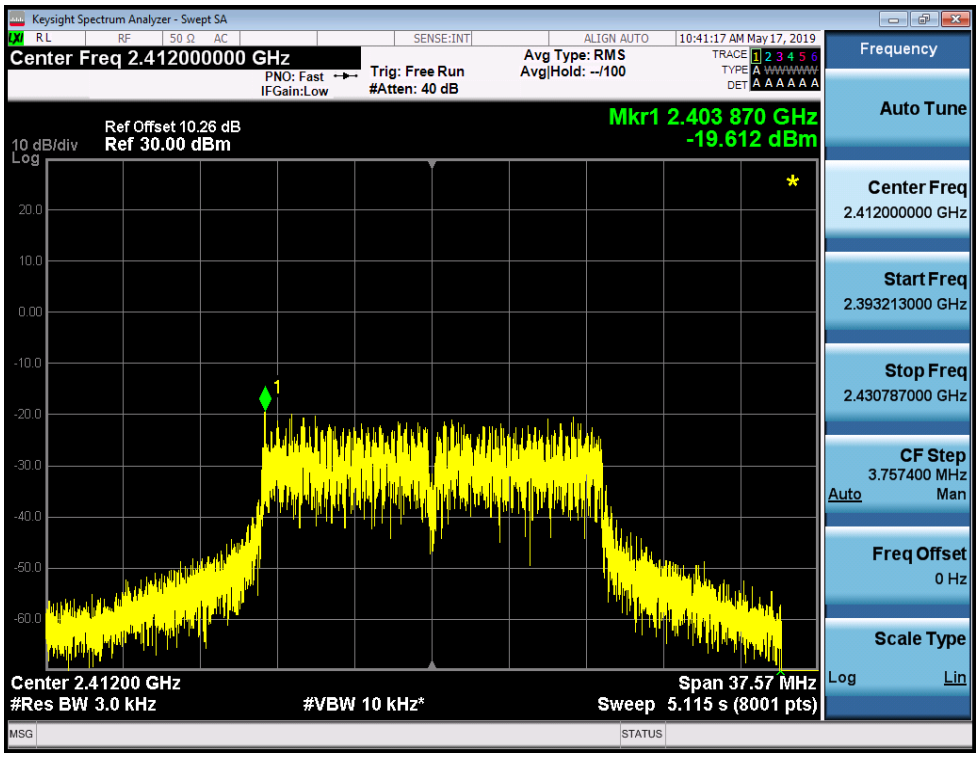
4.3.3 Test Result of Power Spectral Density

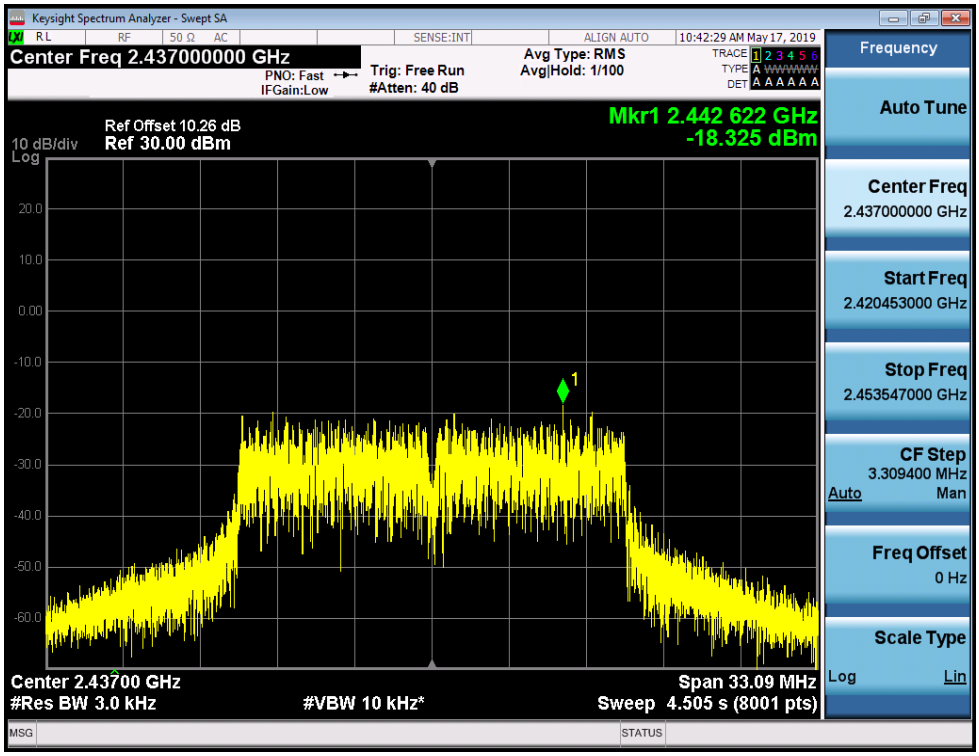
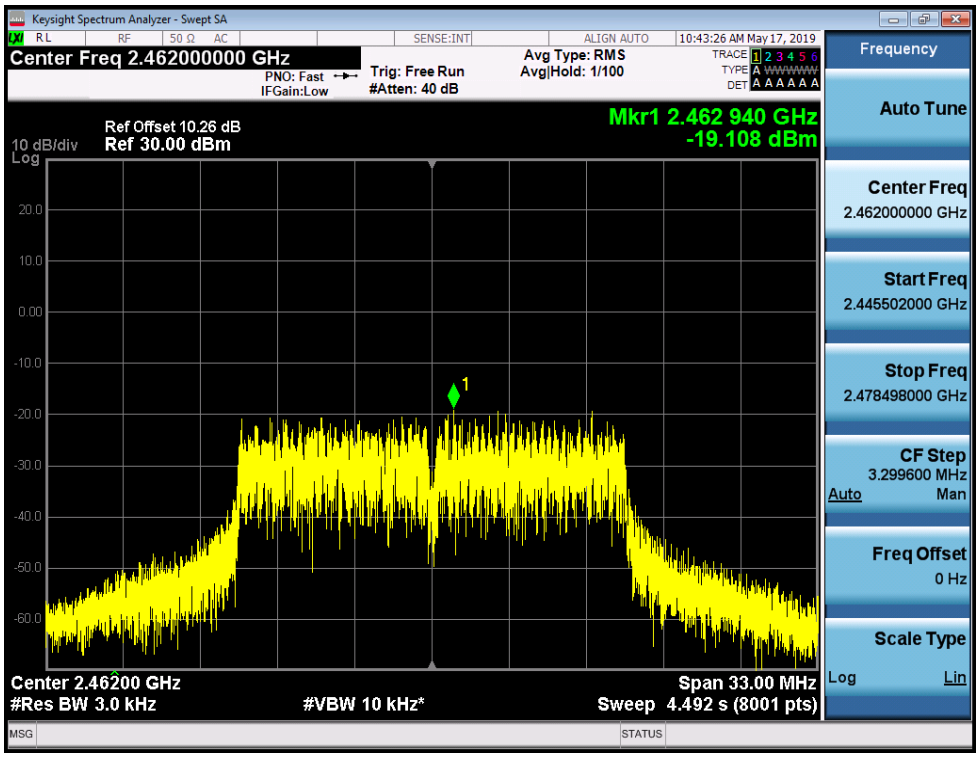
Test Mode :	TX	Temperature :	24~26℃
Test Engineer :	Jerry Wang	Relative Humidity :	50~53%

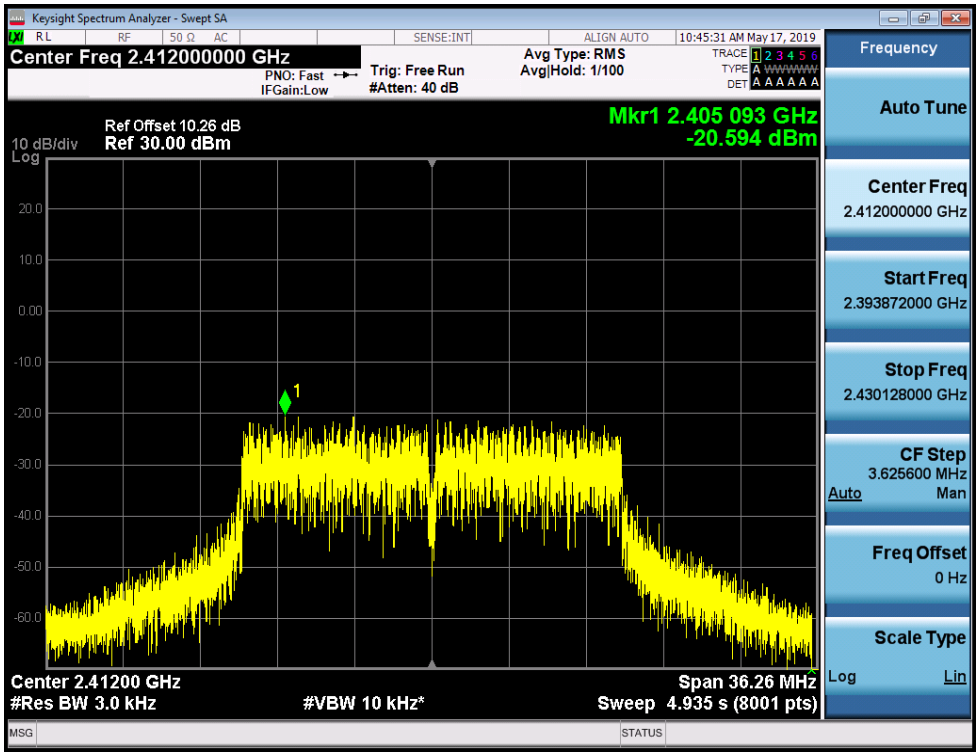
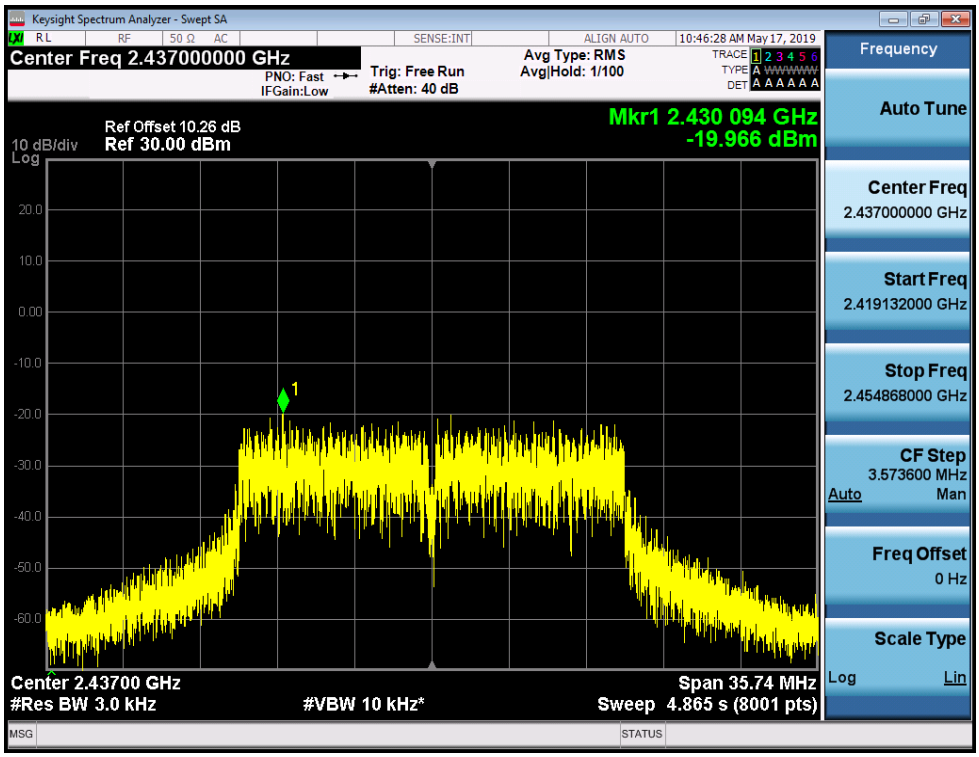
Mode	Channel	Meas.Level [dBm]	DT	10 log (1/x)	Av.PSD [dBm]	Verdict
11B	LCH	-17.222	52.85 %	2.77	-14.452	PASS
11B	MCH	-18.414	52.74 %	2.78	-15.634	PASS
11B	HCH	-15.446	52.85 %	2.77	-12.676	PASS
11G	LCH	-19.612	44.35 %	3.53	-16.082	PASS
11G	MCH	-18.325	44.35 %	3.53	-14.795	PASS
11G	HCH	-19.108	44.35 %	3.53	-15.578	PASS
11N20	LCH	-20.594	43.75 %	3.59	-17.004	PASS
11N20	MCH	-19.966	43.6 %	3.61	-16.356	PASS
11N20	HCH	-20.605	43.75 %	3.59	-17.015	PASS

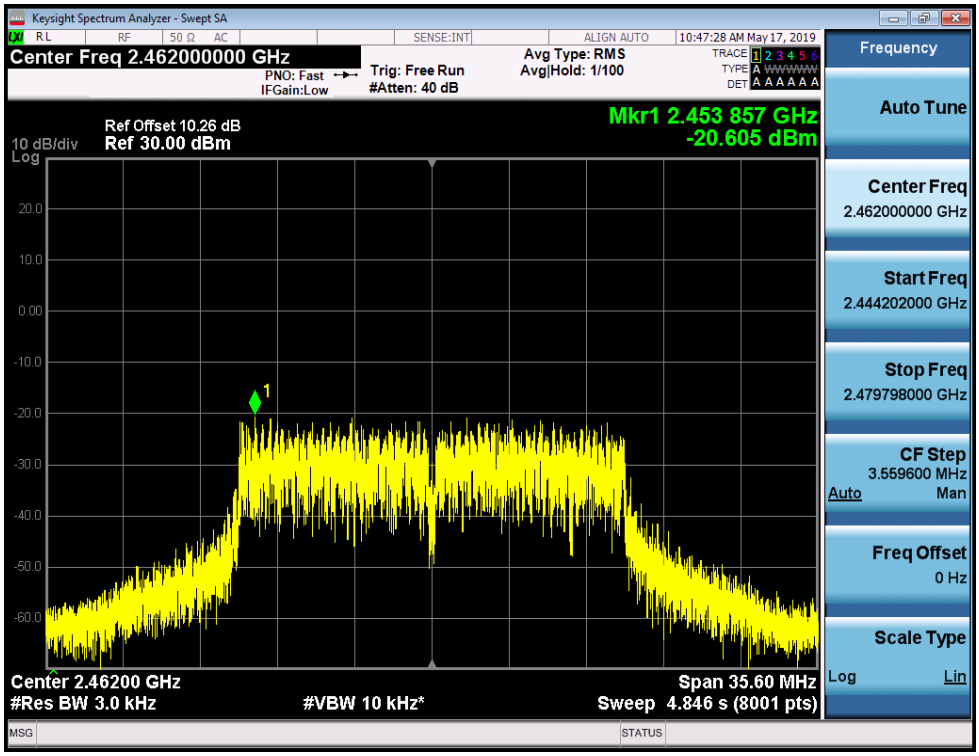
Power Spectral Density Plot

Graphs	
11B/LCH	
11B/MCH	

11B/HCH	
11G/LCH	

11G/MCH	
11G/HCH	

11N20/LCH	
11N20/MCH	

11N20/HCH	

Keysight Spectrum Analyzer - Swept SA
Center Freq 2.462000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold: 1/100
10:47:28 AM May 17, 2019
Ref Offset 10.26 dB
10 dB/div
Log
Ref 30.00 dBm
Mkr1 2.453 857 GHz
-20.605 dBm
Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz*
Span 35.60 MHz
Sweep 4.846 s (8001 pts)
Frequency
Auto Tune
Center Freq
2.462000000 GHz
Start Freq
2.444202000 GHz
Stop Freq
2.479798000 GHz
CF Step
3.559600 MHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

4.4 Conducted Band Edges and Spurious Emission Measurement

4.4.1 Limit of Conducted Band Edges and Spurious Emission

FCC §15.247 (d)

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

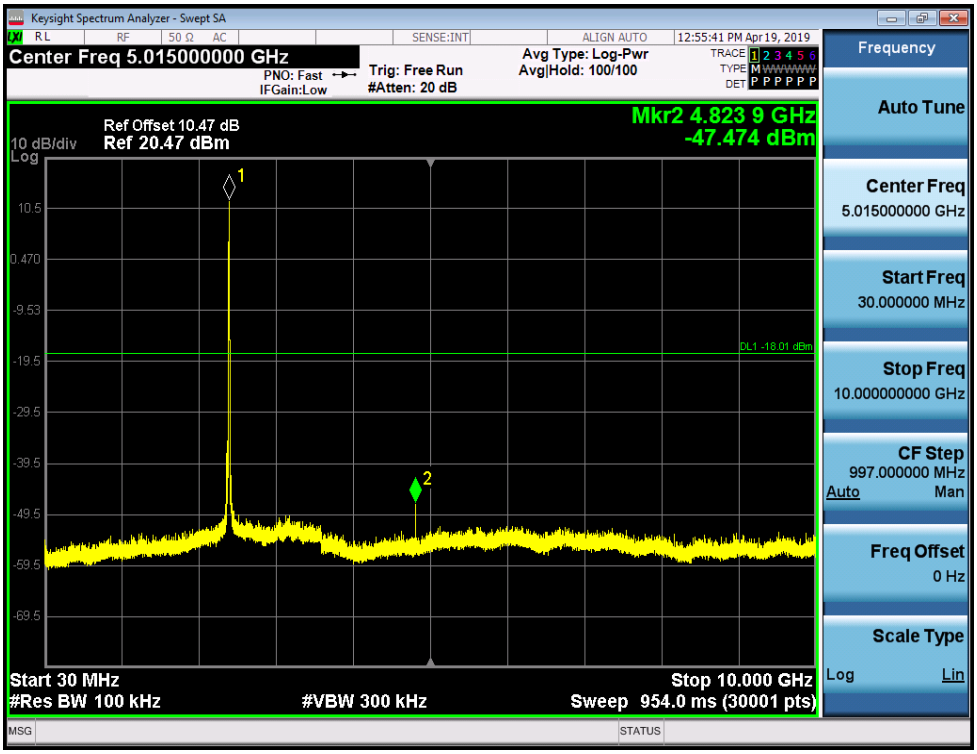
4.4.2 Test Procedures

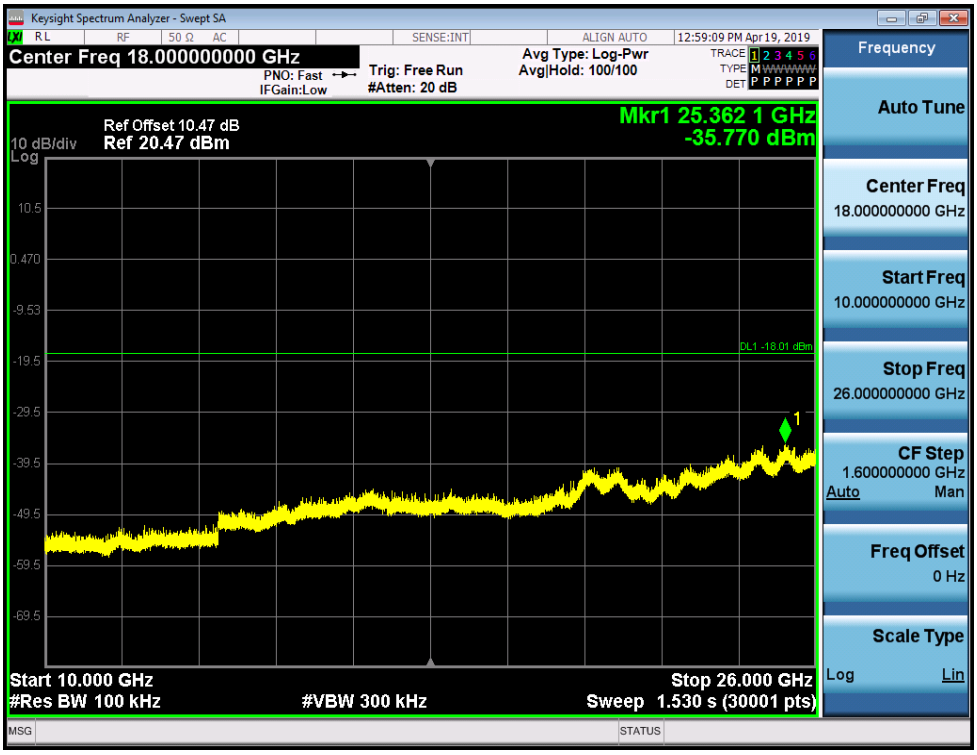
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside 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).
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

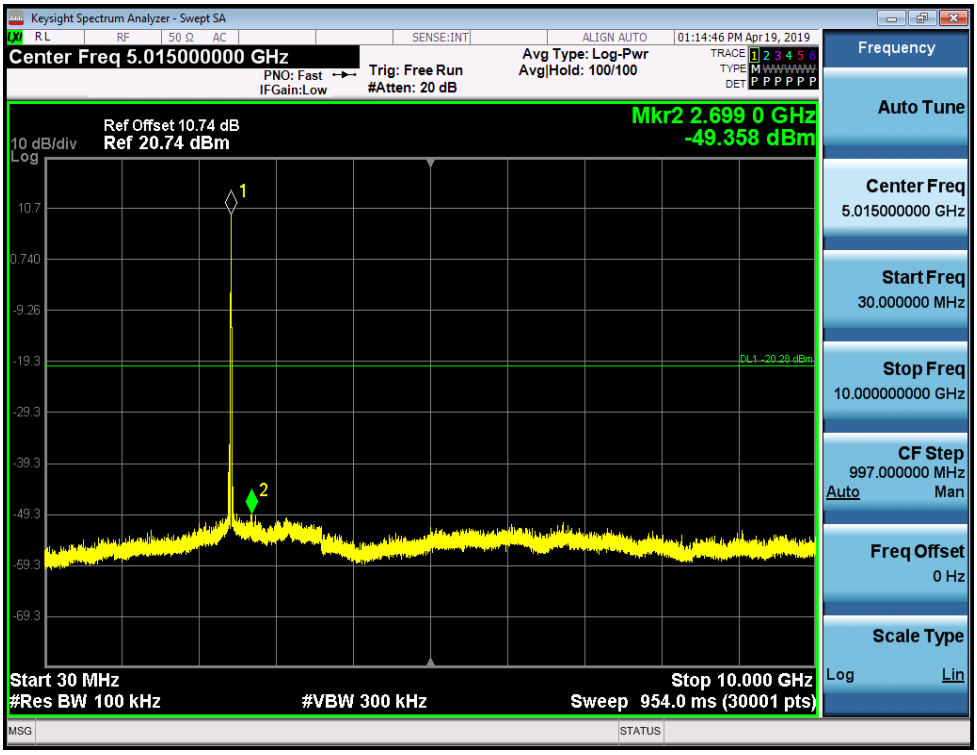
4.4.3 Test Result of Conducted Band Edges and Spurious Emission

Test Mode :		TX	Temperature :	24~26℃	
Test Engineer :		Jerry Wang	Relative Humidity :	50~53%	
Mode	Channel	Carrier Power[dBm]	Max.Spurious Level [dBm]	Limit [dBm]	Verdict
11B	LCH	11.566	-27.811	-18.43	PASS
11B	HCH	8.517	-34.963	-21.48	PASS
11G	LCH	4.654	-26.234	-25.35	PASS
11G	HCH	7.699	-32.890	-22.3	PASS
11N20	LCH	-1.174	-31.185	-31.17	PASS
11N20	HCH	7.609	-31.865	-22.39	PASS

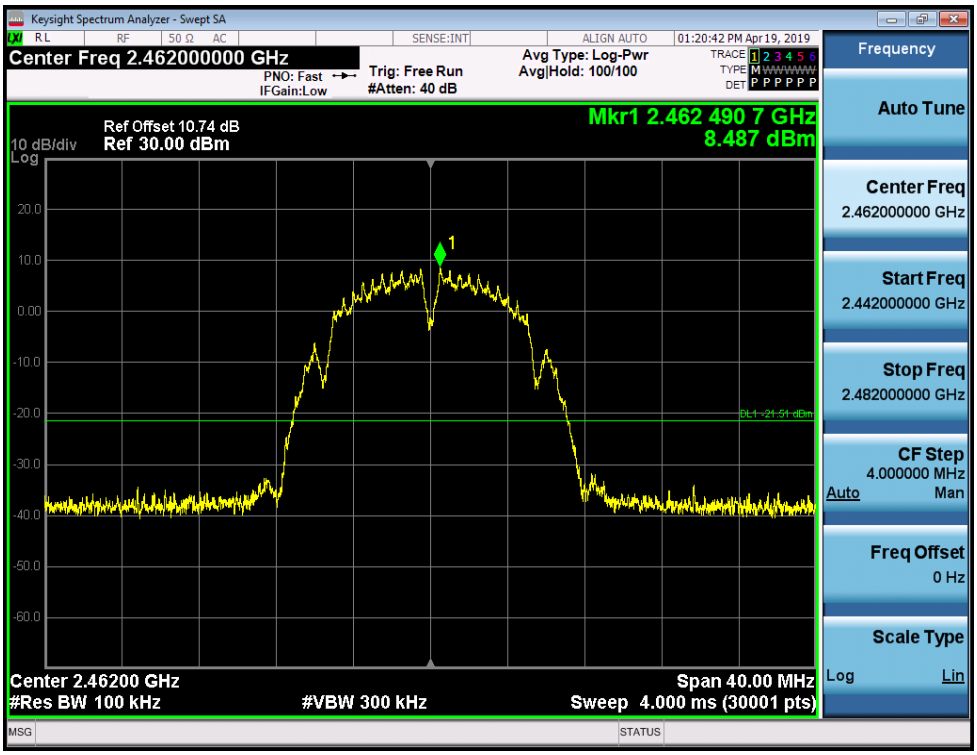
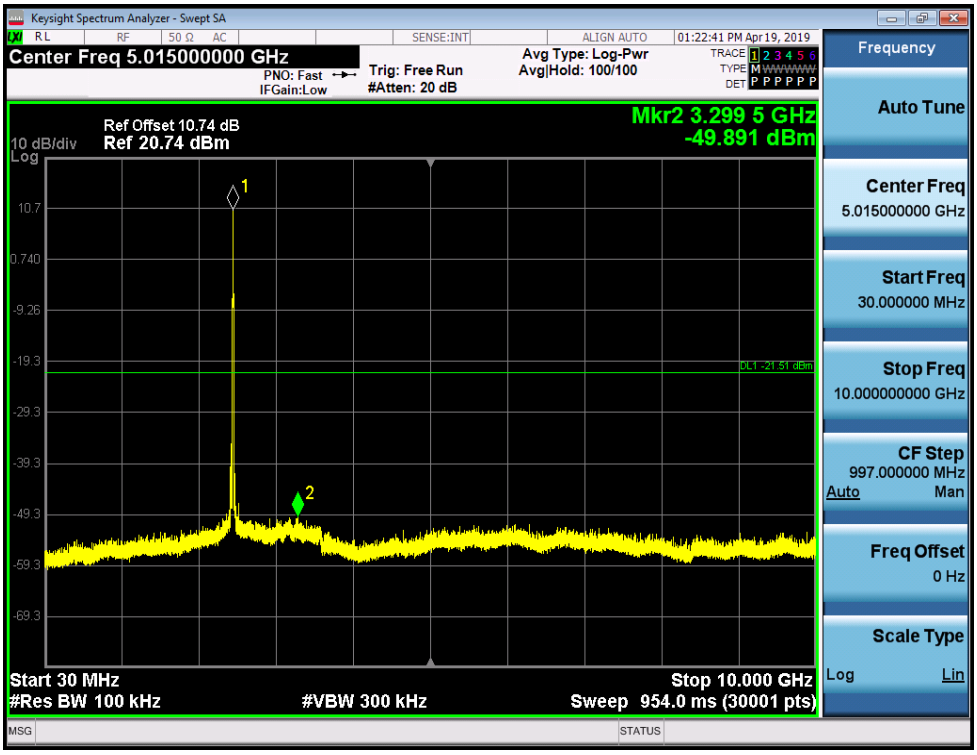
Conducted Band Edges and Spurious Emission Plot

11B_LCH_Graphs	
Pref/11B/LCH	
Puw/11B/LCH	

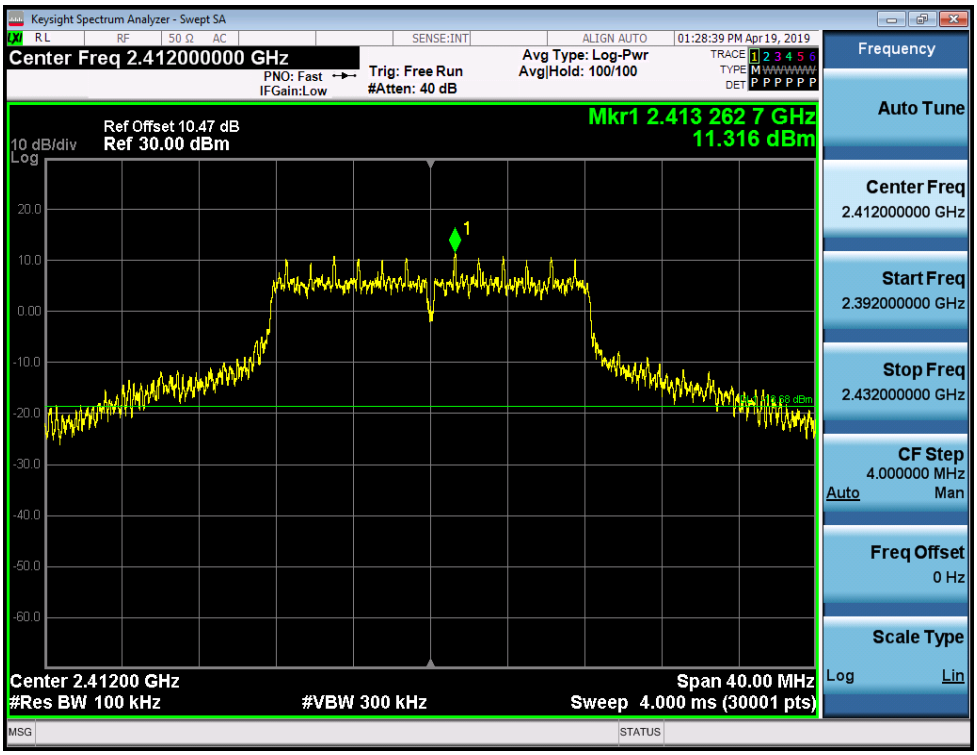
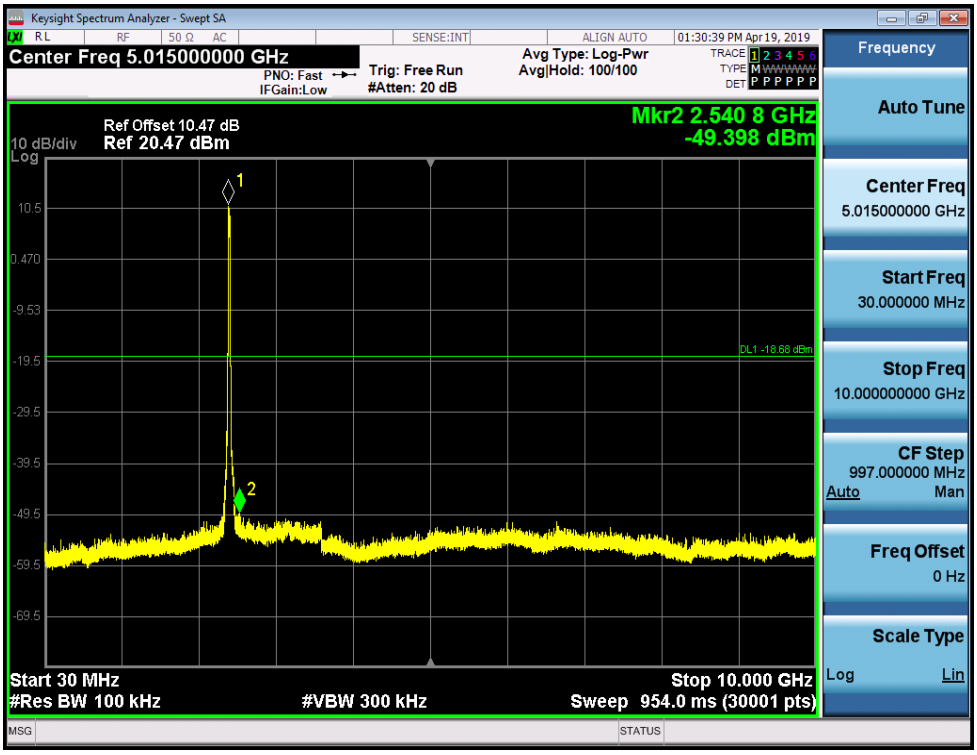

Keysight Spectrum Analyzer - Swept SA
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
12:59:09 PM Apr 19, 2019
Ref Offset 10.47 dB
10 dB/div
Log
Ref 20.47 dBm
Mkr1 25.362 1 GHz
-35.770 dBm
DL1 -18.01 dBm
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

11B_MCH_Graphs	
Pref/11B/MCH	
Puw/11B/MCH	

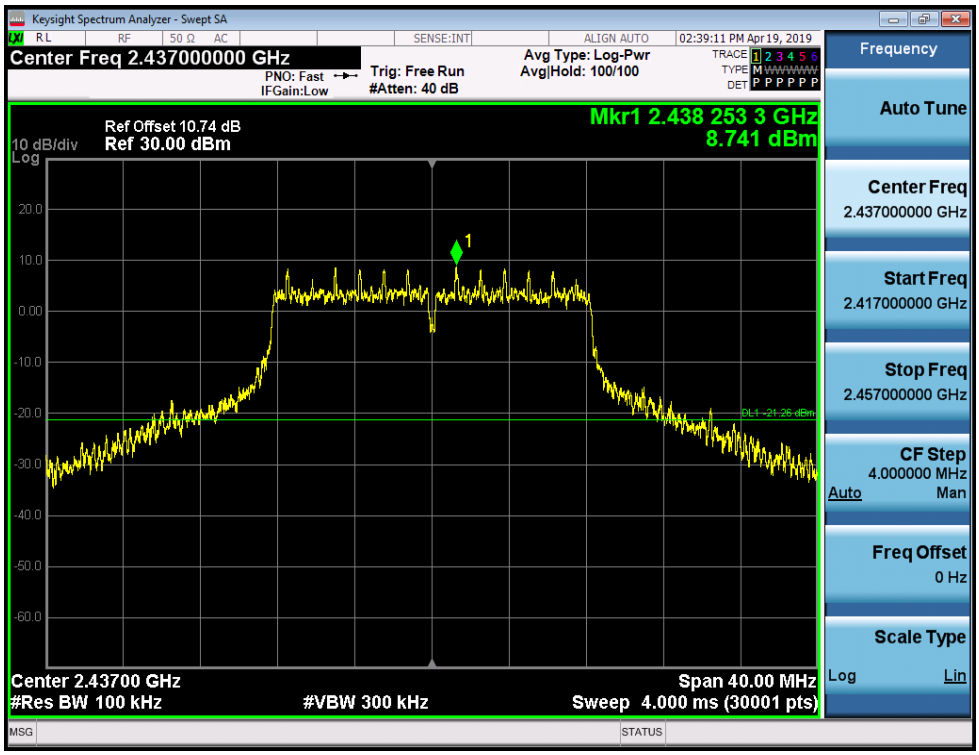
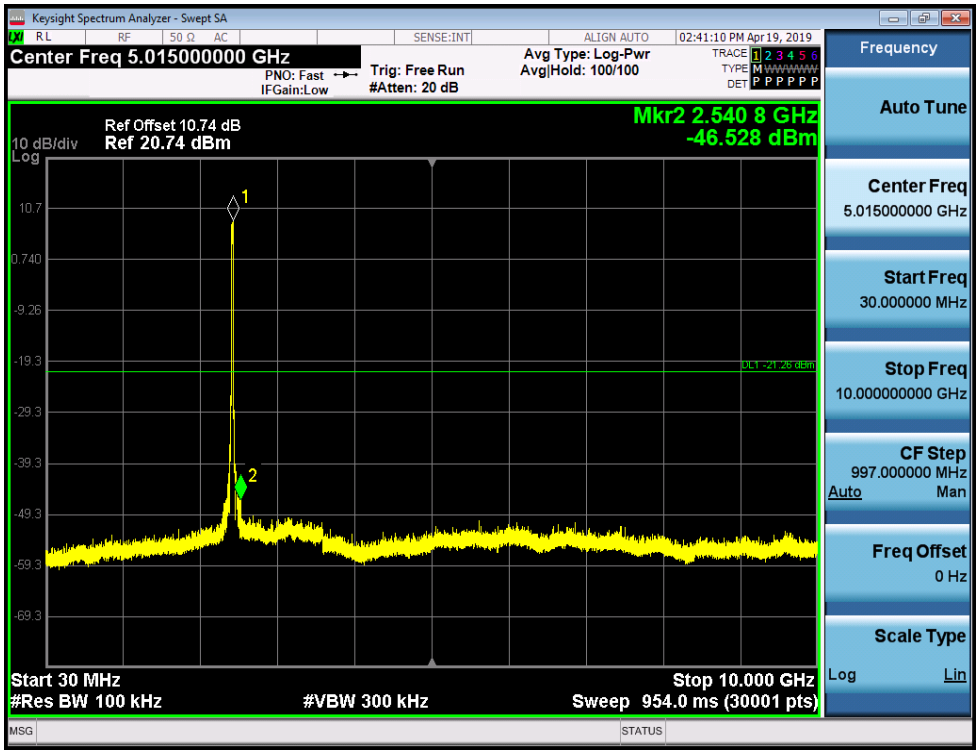

Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
01:18:14 PM Apr 19, 2019
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P P P P P
Ref Offset 10.74 dB
10 dB/div
Log
Ref 20.74 dBm
Mkr1 25.398 4 GHz
-35.081 dBm
10.7
0.740
-9.26
-19.3
-29.3
-39.3
-49.3
-59.3
-69.3
DL1 -20.28 dBm
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
MSG
STATUS
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

11B_HCH_Graphs	
Pref/11B/HCH	
Puw/11B/HCH	

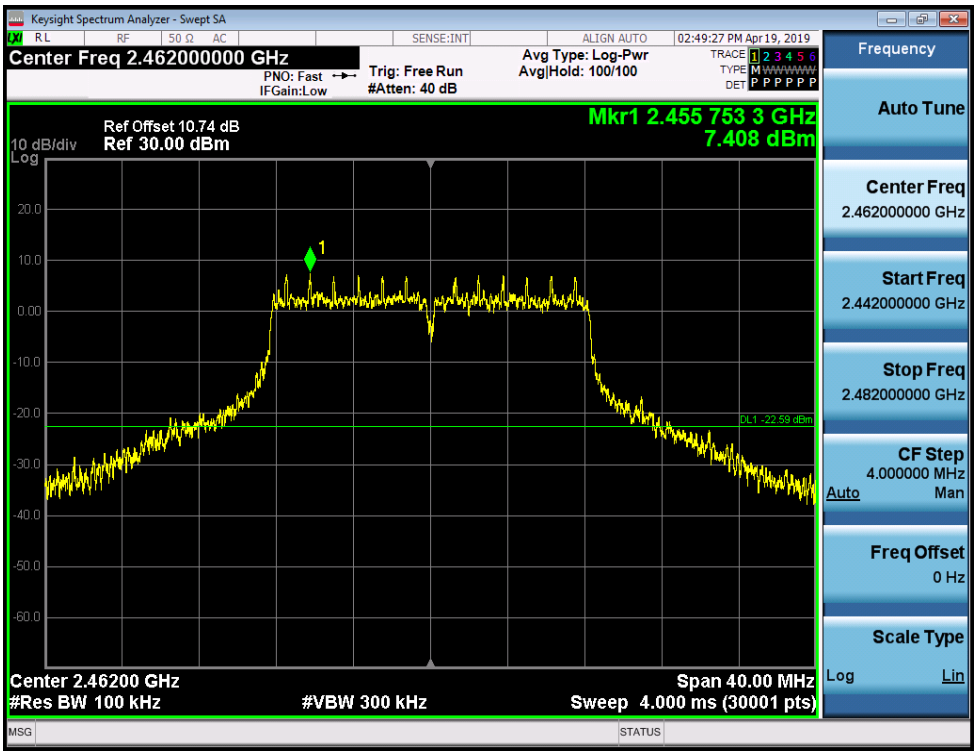
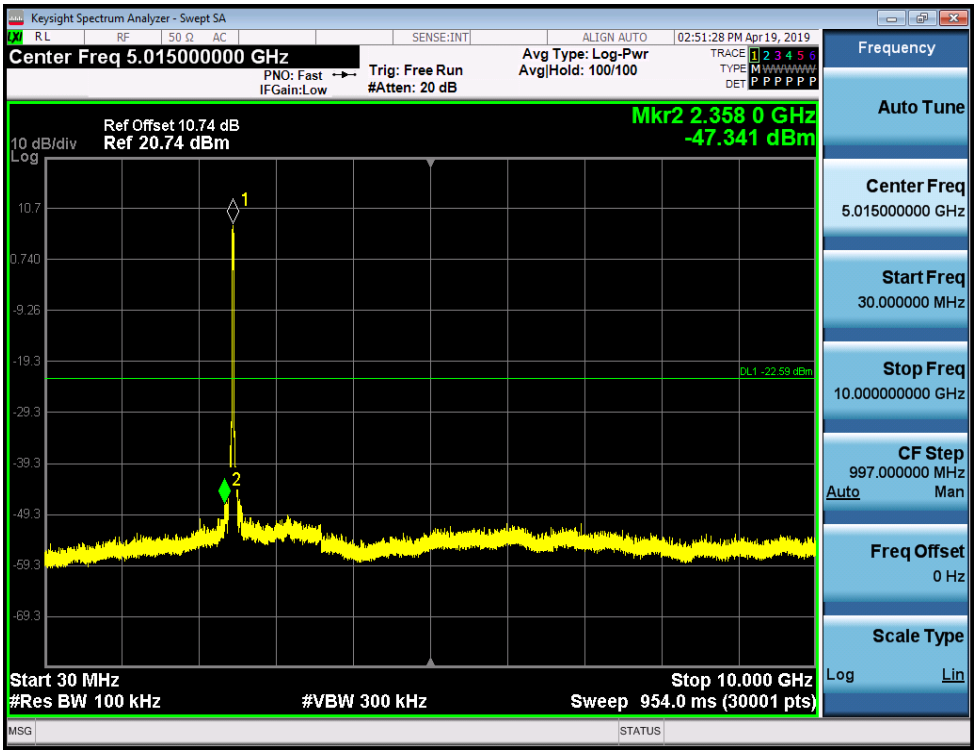

Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
01:26:10 PM Apr 19, 2019
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P P P P P
Ref Offset 10.74 dB
10 dB/div
Log
Ref 20.74 dBm
Mkr1 25.429 9 GHz
-35.402 dBm
10.7
0.740
-9.26
-19.3
-29.3
-39.3
-49.3
-59.3
-69.3
DL1 -21.51 dBm
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

11G_LCH_Graphs	
Pref/11G/LCH	
Puw/11G/LCH	

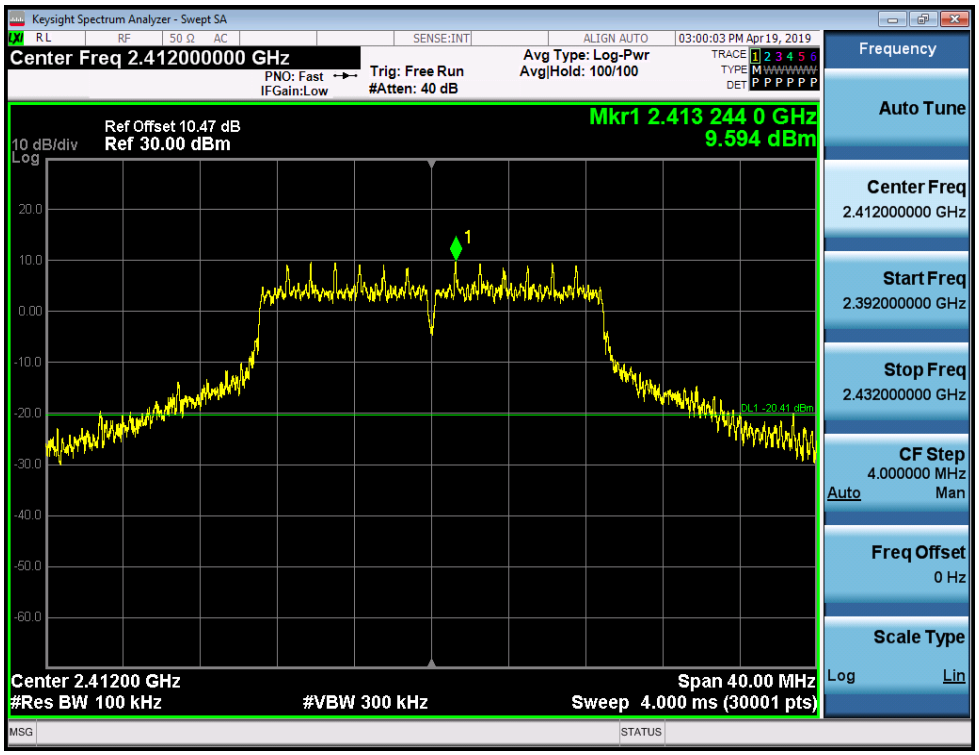

Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
01:34:08 PM Apr 19, 2019
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P P P P P
Ref Offset 10.47 dB
10 dB/div
Log
Ref 20.47 dBm
Mkr1 25.422 9 GHz
-35.035 dBm
10.5
0.470
-9.53
-19.5
-29.5
-39.5
-49.5
-59.5
-69.5
DL1 -18.68 dBm
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
MSG
STATUS
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

11G_MCH_Graphs	
Pref/11G/MCH	
Puw/11G/MCH	

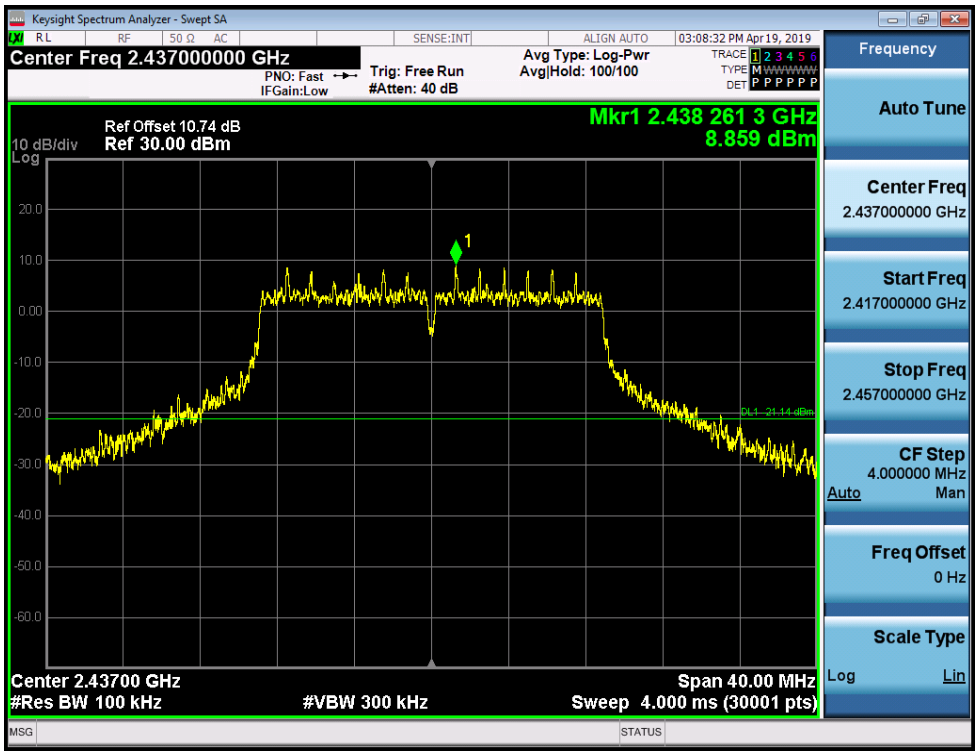
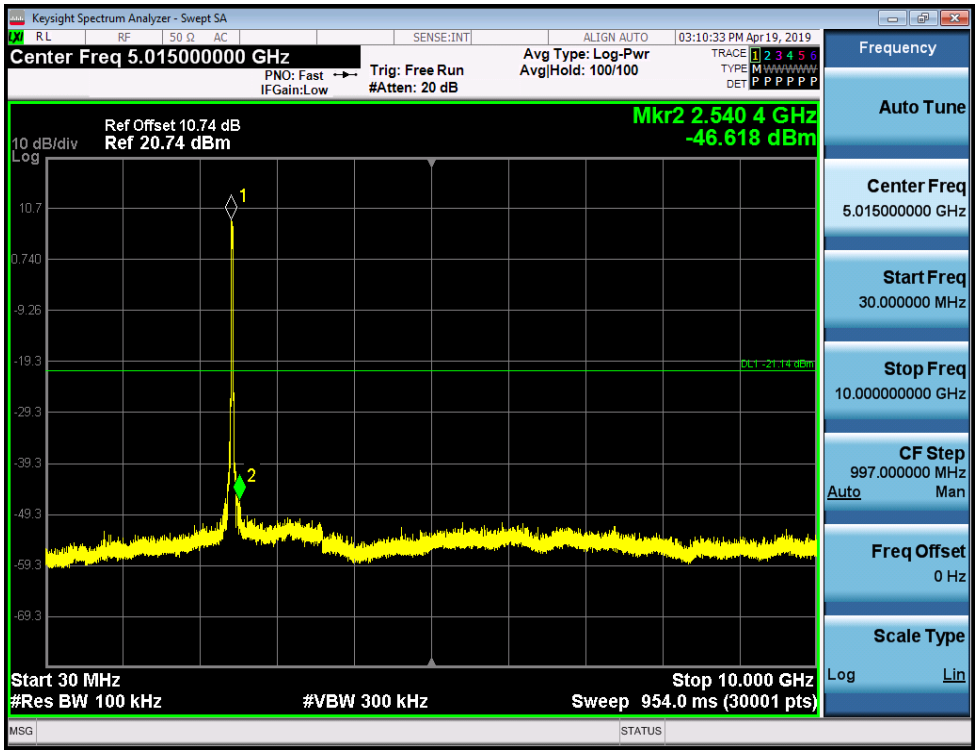

Keysight Spectrum Analyzer - Swept SA
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
02:44:39 PM Apr 19, 2019
Ref Offset 10.74 dB
10 dB/div
Log
Ref 20.74 dBm
Mkr1 25.359 5 GHz
-34.956 dBm
10.7
0.740
-9.26
-19.3
-29.3
-39.3
-49.3
-59.3
-69.3
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

11G_HCH_Graphs	
Pref/11G/HCH	
Puw/11G/HCH	

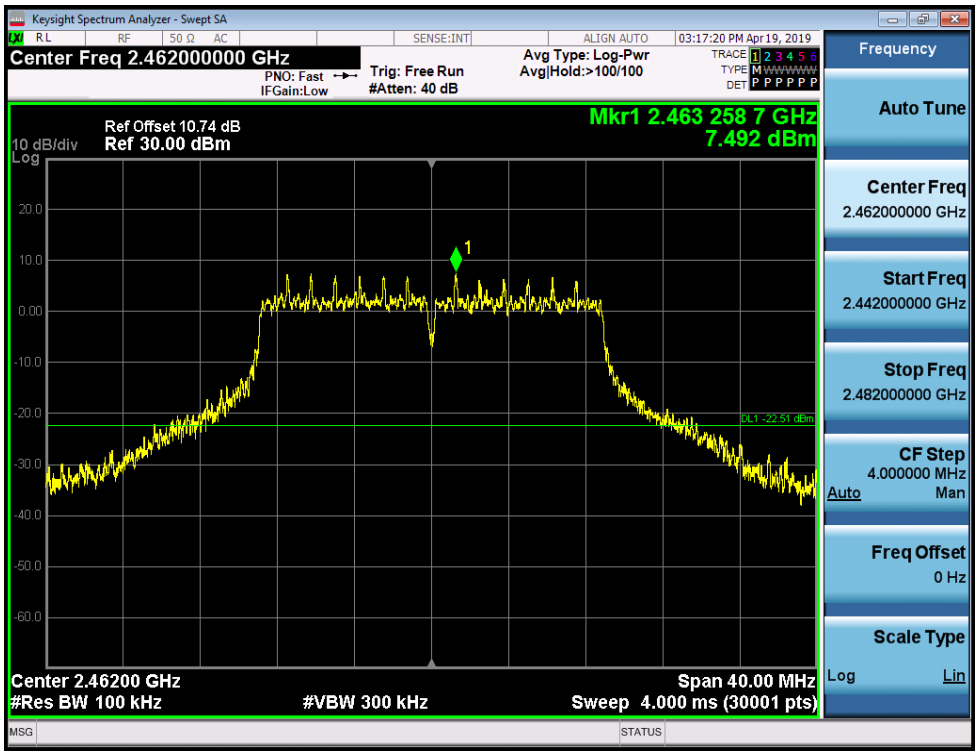
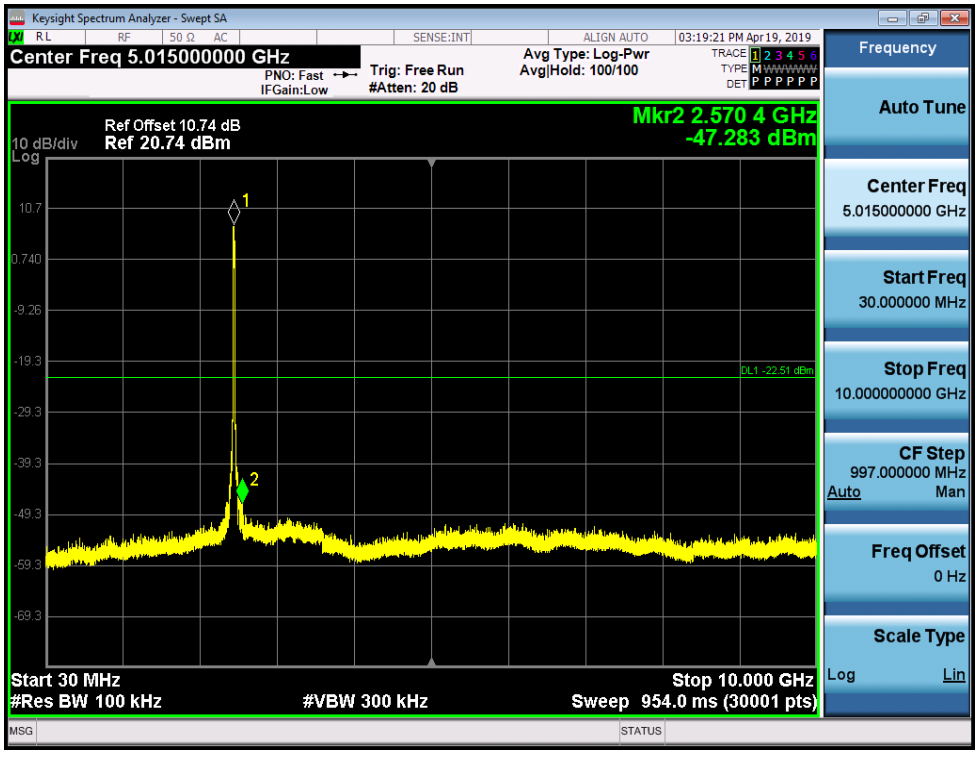

Keysight Spectrum Analyzer - Swept SA
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
02:54:56 PM Apr 19, 2019
Ref Offset 10.74 dB
10 dB/div
Log
Ref 20.74 dBm
Mkr1 25.381 9 GHz
-35.113 dBm
DL1 -22.59 dBm
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

11N20_LCH_Graphs	
Pref/11N20/LCH	
Puw/11N20/LCH	


Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
03:05:33 PM Apr 19, 2019
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 10.47 dB
10 dB/div
Log
Ref 20.47 dBm
Mkr1 24.789 3 GHz
-35.784 dBm
10.5
0.470
-9.53
-19.5
-29.5
-39.5
-49.5
-59.5
-69.5
DL1 -20.41 dBm
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
MSG
STATUS
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

11N20_MCH_Graphs	
Pref/11N20/MCH	
Puw/11N20/MCH	


Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
03:14:01 PM Apr 19, 2019
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 10.74 dB
10 dB/div
Log
Ref 20.74 dBm
Mkr1 25.346 1 GHz
-35.053 dBm
10.7
0.740
-9.26
-19.3
-29.3
-39.3
-49.3
-59.3
-69.3
D1 -21.14 dBm
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
MSG
STATUS
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin

11N20_HCH_Graphs	
Pref/11N20/HCH	
Puw/11N20/HCH	


Keysight Spectrum Analyzer - Swept SA
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
03:22:49 PM Apr 19, 2019
Ref Offset 10.74 dB
10 dB/div
Log
Ref 20.74 dBm
Mkr1 25.396 8 GHz
-34.923 dBm
10.7
0.740
-9.26
-19.3
-29.3
-39.3
-49.3
-59.3
-69.3
DL1 -22.51 dBm
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (30001 pts)
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

4.5 Radiated Band Edges and Spurious Emission Measurement

4.5.1 Limit of Radiated Band Edges and Spurious Emission

FCC §15.247 (d)

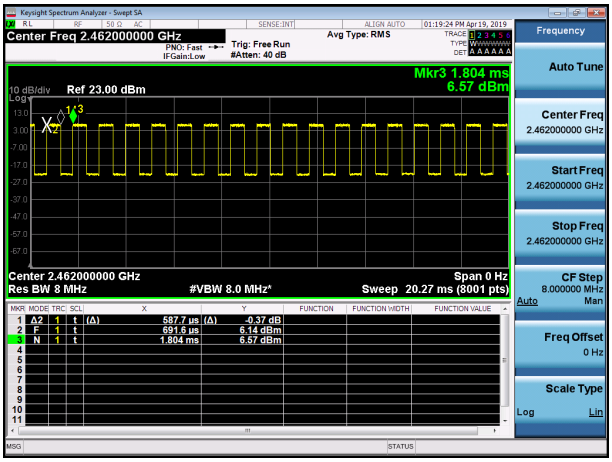
In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

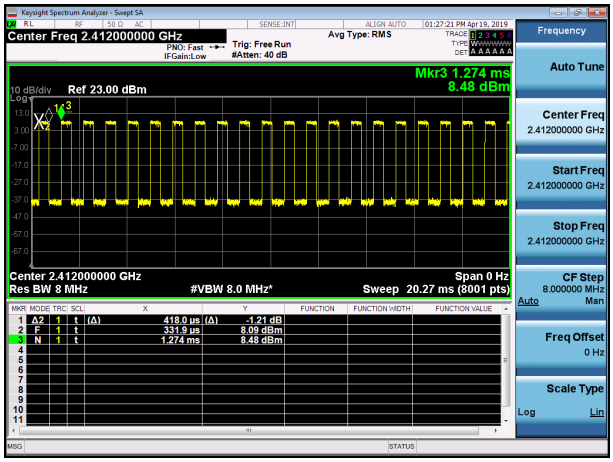
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

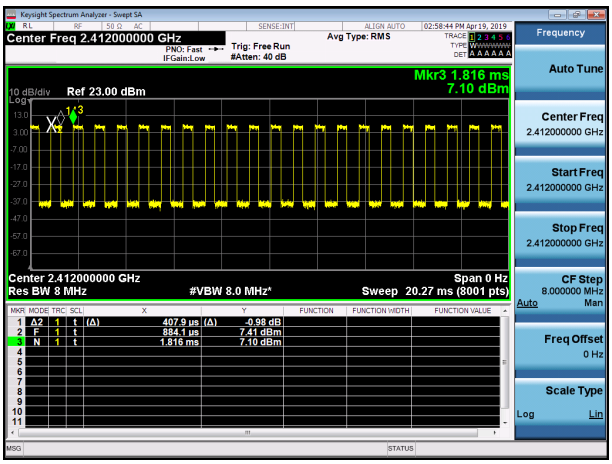
4.5.2 Test Procedures

1. 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.
2. The measurement distance is 3 meter.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) 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.

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
802.11b	52.85	0.588	1.7	3kHz
802.11g	44.35	0.418	2.4	3kHz
2.4GHz 802.11n HT20	43.75	0.408	2.5	3kHz







-

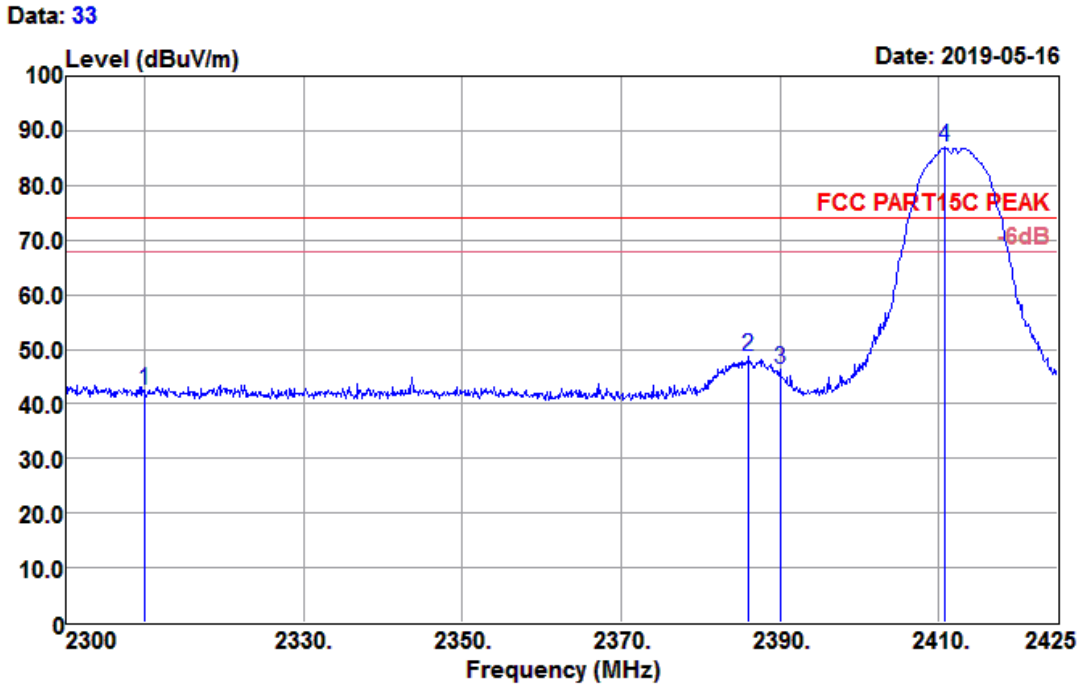
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

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

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

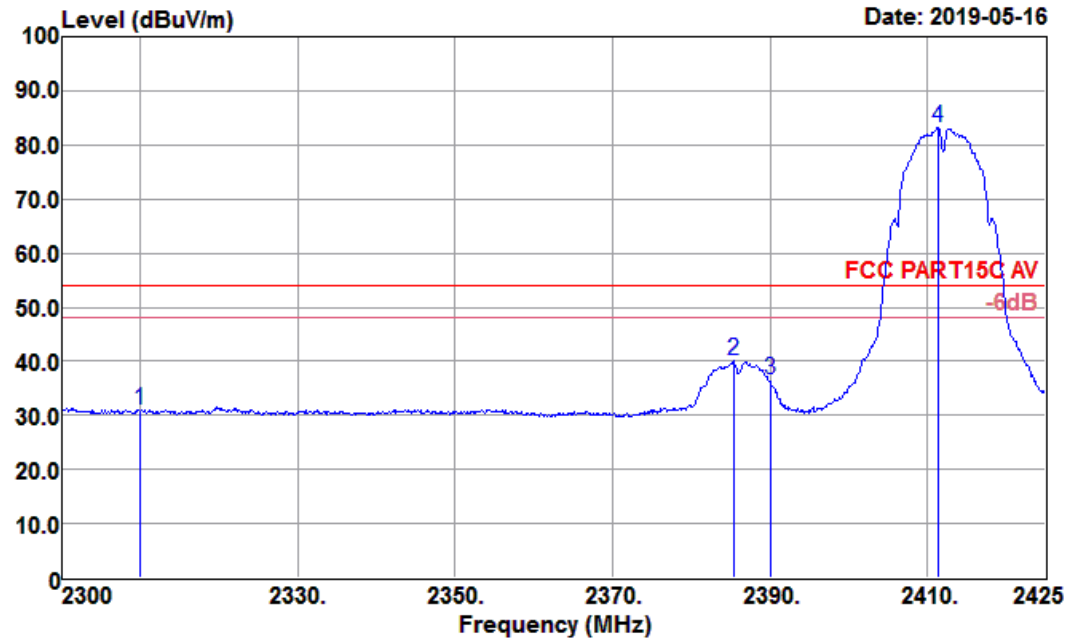
4.5.4 Test Result of Radiated Spurious at Band Edges

Test Mode :	802.11b CH01(2412MHz)	Temperature :	21°C
Test Engineer :	Julie Deng	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Horizontal



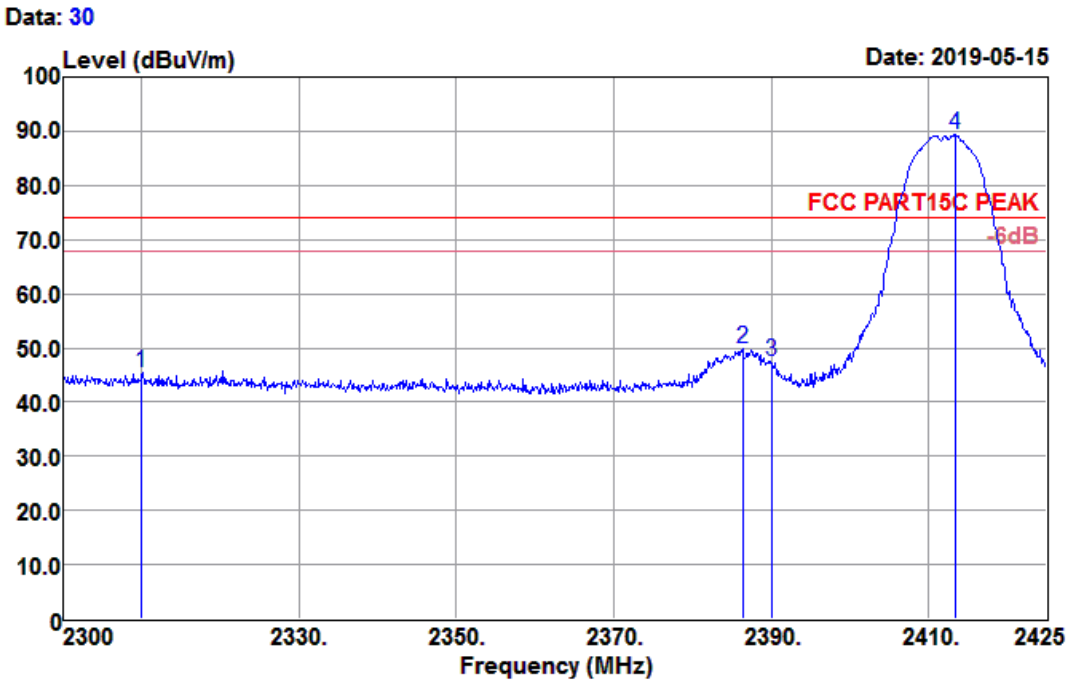
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	Level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	47.98	26.91	3.56	35.87	42.58	74.00	-31.42	Peak
2386.125	53.90	27.10	3.64	36.07	48.57	74.00	-25.43	Peak
2390.000	51.55	27.11	3.64	36.08	46.22	74.00	-27.78	Peak
2410.875	92.21	27.17	3.65	36.13	86.90	74.00	12.90	Peak

Data: 32



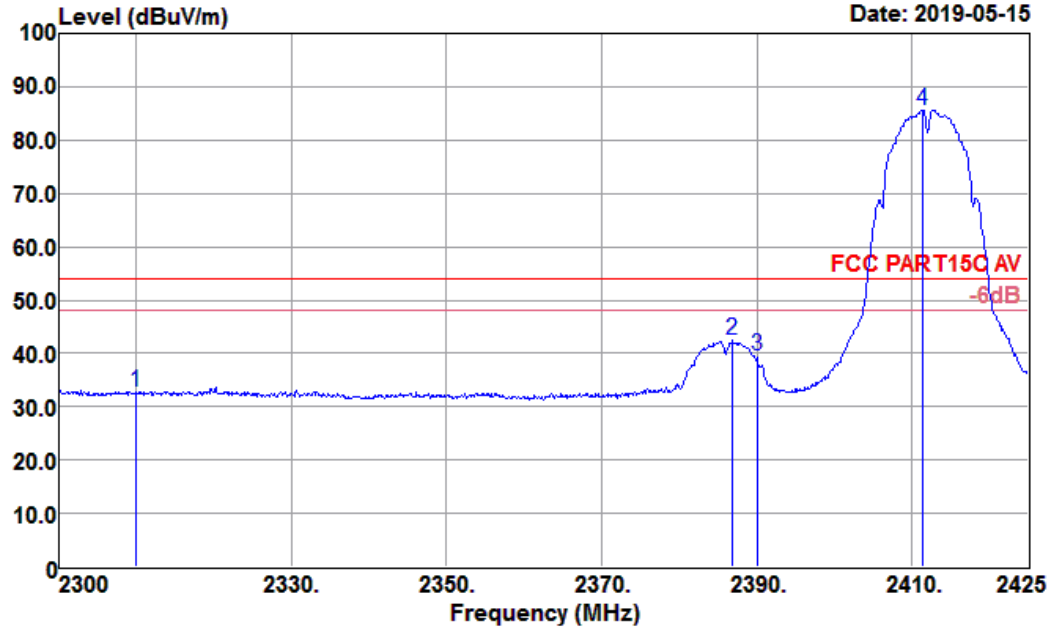
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	36.39	26.91	3.56	35.87	30.99	54.00	-23.01	Average
2385.375	45.36	27.10	3.63	36.07	40.02	54.00	-13.98	Average
2390.000	41.95	27.11	3.64	36.08	36.62	54.00	-17.38	Average
2411.375	88.41	27.17	3.65	36.14	83.09	54.00	29.09	Average

Test Mode :	802.11b CH01(2412MHz)	Temperature :	21°C
Test Engineer :	Julie Deng	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Vertical



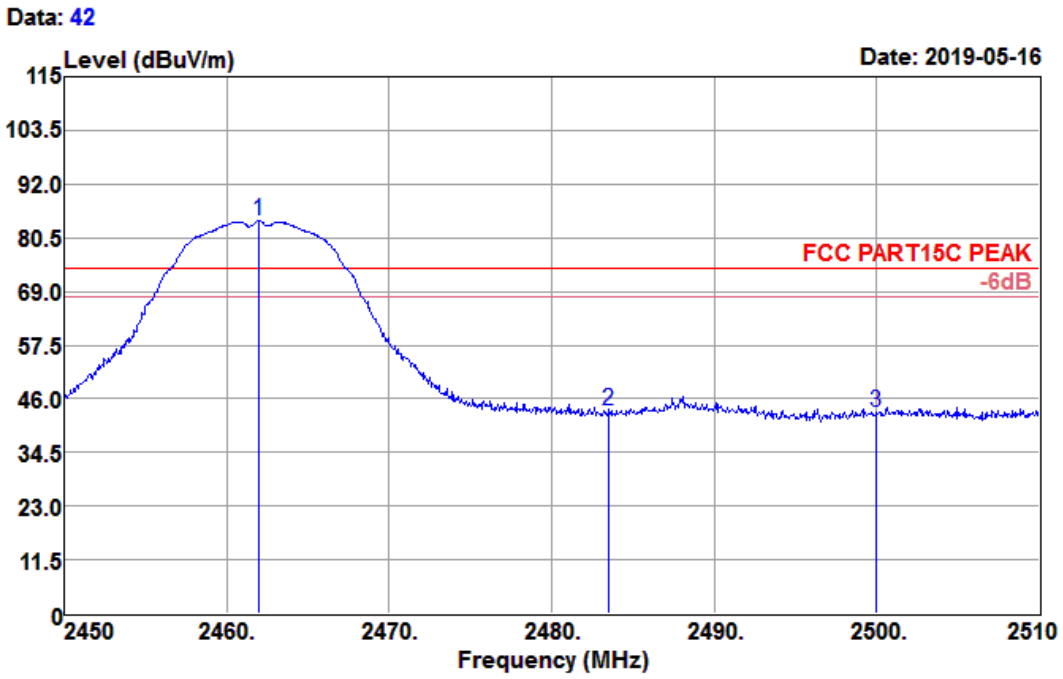
Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	50.76	26.91	3.56	35.87	45.36	74.00	-28.64	Peak
2386.375	55.33	27.10	3.64	36.07	50.00	74.00	-24.00	Peak
2390.000	52.98	27.11	3.64	36.08	47.65	74.00	-26.35	Peak
2413.375	94.60	27.17	3.65	36.14	89.28	74.00	15.28	Peak

Data: 31

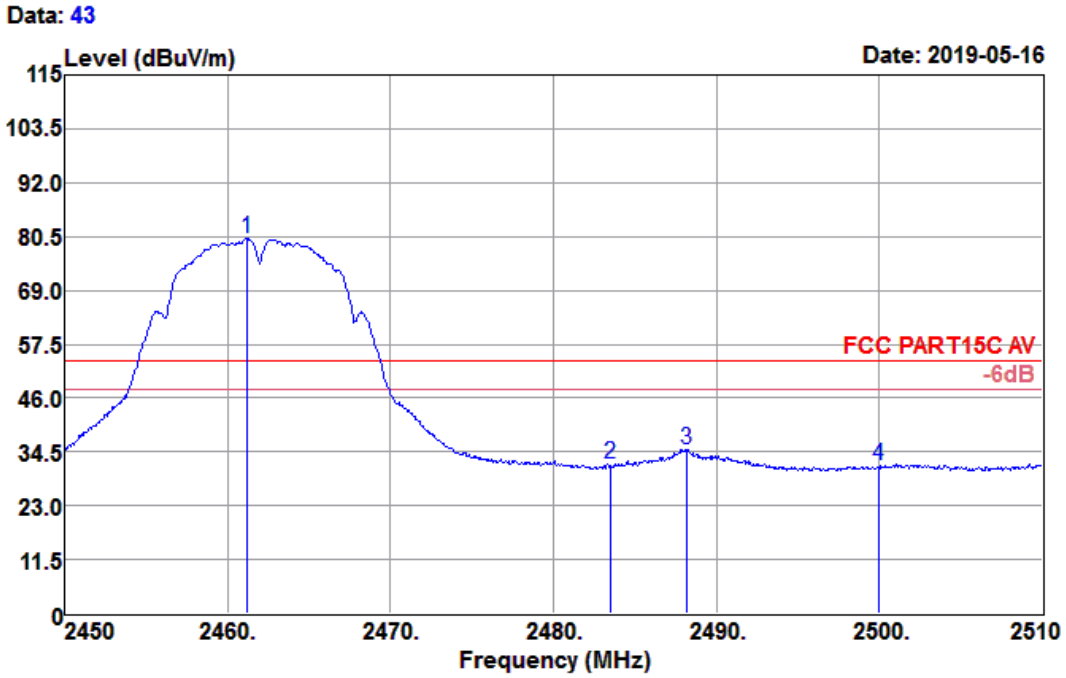


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	38.12	26.91	3.56	35.87	32.72	54.00	-21.28	Average
2386.875	47.68	27.11	3.64	36.07	42.36	54.00	-11.64	Average
2390.000	44.83	27.11	3.64	36.08	39.50	54.00	-14.50	Average
2411.375	91.00	27.17	3.65	36.14	85.68	54.00	31.68	Average

Test Mode :	802.11b CH11(2462MHz)	Temperature :	21°C
Test Engineer :	Julie Deng	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Horizontal

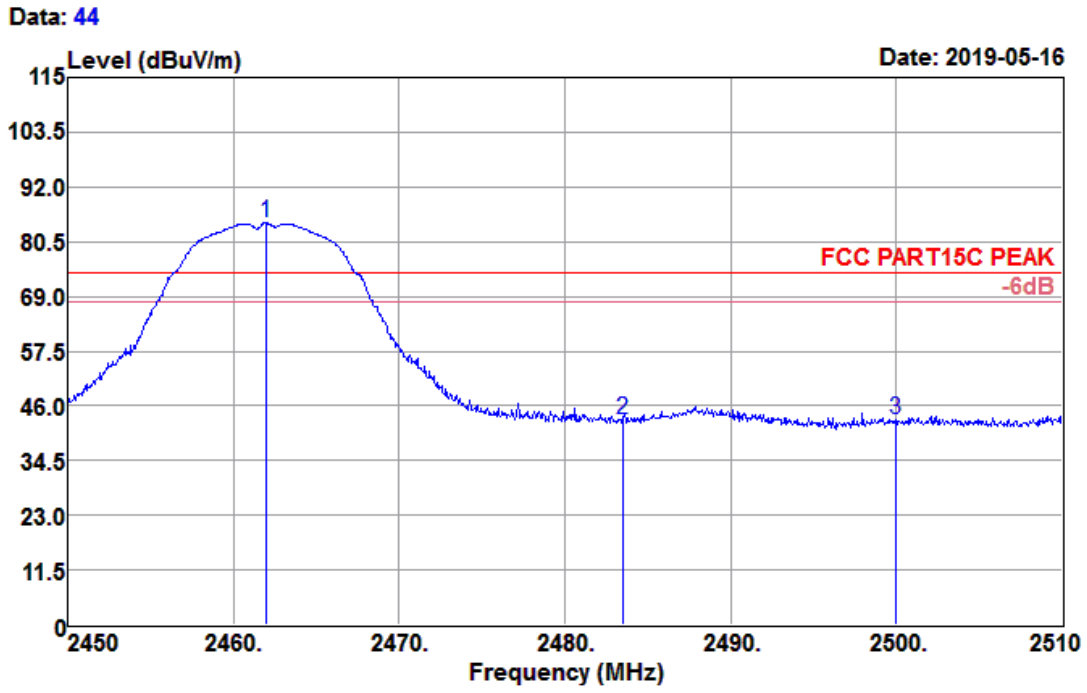


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2461.940	89.41	27.30	3.67	36.27	84.11	74.00	10.11	Peak
2483.500	48.70	27.36	3.68	36.33	43.41	74.00	-30.59	Peak
2500.000	48.47	27.40	3.68	36.37	43.18	74.00	-30.82	Peak

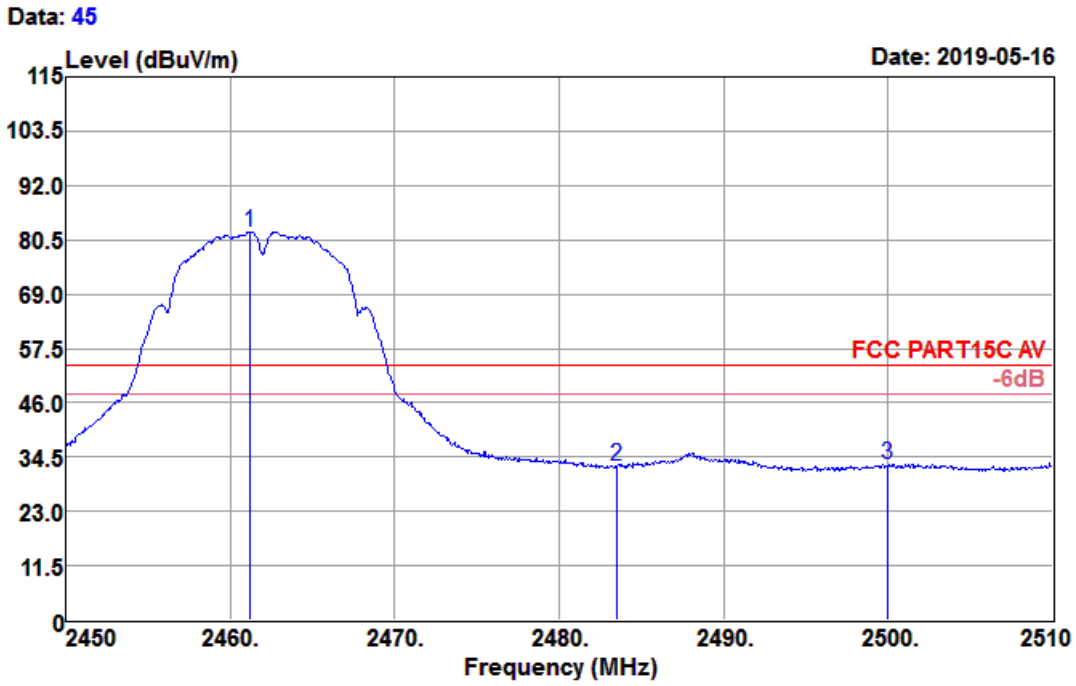


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2461.220	85.28	27.30	3.67	36.27	79.98	54.00	25.98	Average
2483.500	37.04	27.36	3.68	36.33	31.75	54.00	-22.25	Average
2488.220	40.22	27.37	3.68	36.34	34.93	54.00	-19.07	Average
2500.000	36.81	27.40	3.68	36.37	31.52	54.00	-22.48	Average

Test Mode :	802.11b CH11(2462MHz)	Temperature :	21°C
Test Engineer :	Julie Deng	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Vertical

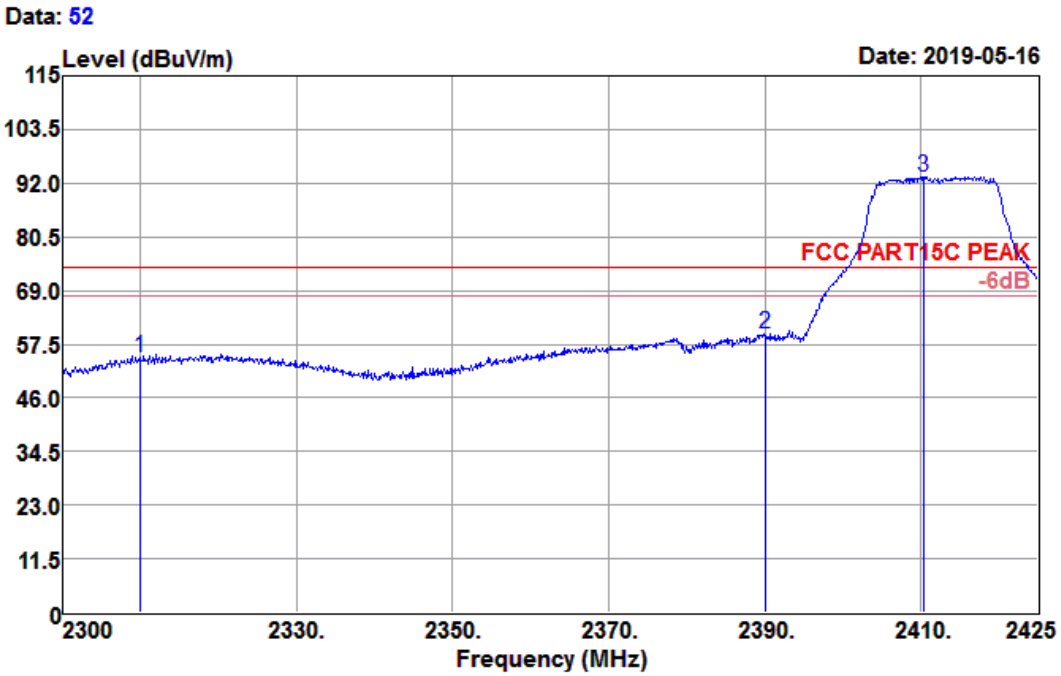


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2462.000	89.75	27.30	3.67	36.27	84.45	74.00	10.45	Peak
2483.500	48.54	27.36	3.68	36.33	43.25	74.00	-30.75	Peak
2500.000	48.53	27.40	3.68	36.37	43.24	74.00	-30.76	Peak

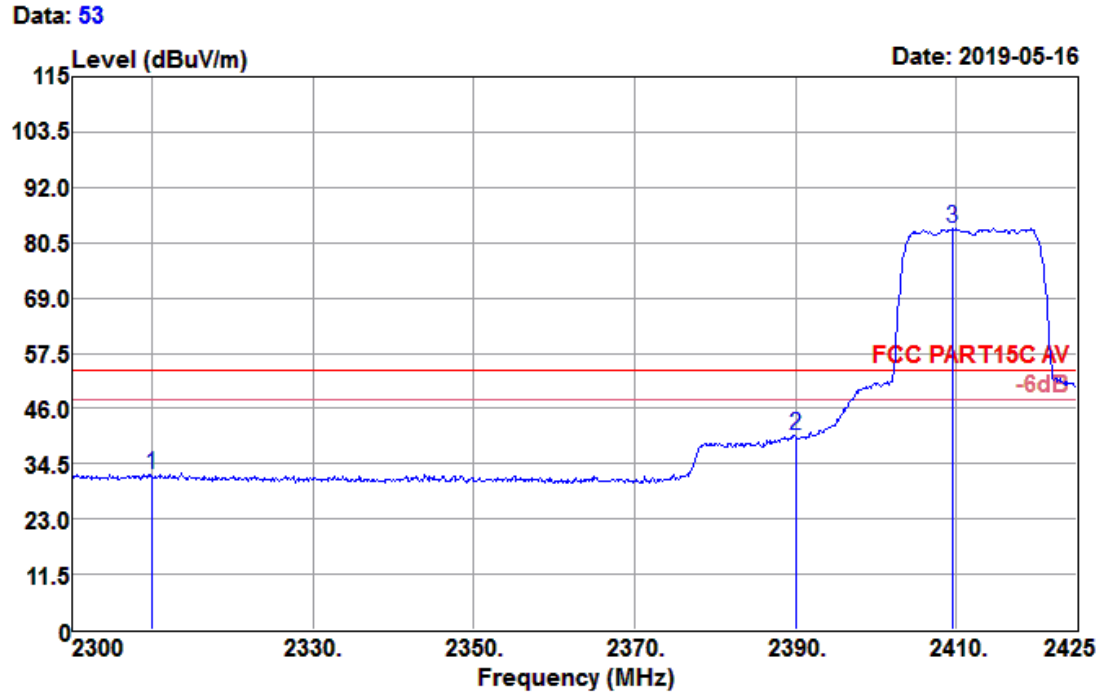


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2461.220	87.58	27.30	3.67	36.27	82.28	54.00	28.28	Average
2483.500	37.92	27.36	3.68	36.33	32.63	54.00	-21.37	Average
2500.000	38.32	27.40	3.68	36.37	33.03	54.00	-20.97	Average

Test Mode :	802.11g CH01(2412MHz)	Temperature :	21°C
Test Engineer :	Julie Deng	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Horizontal

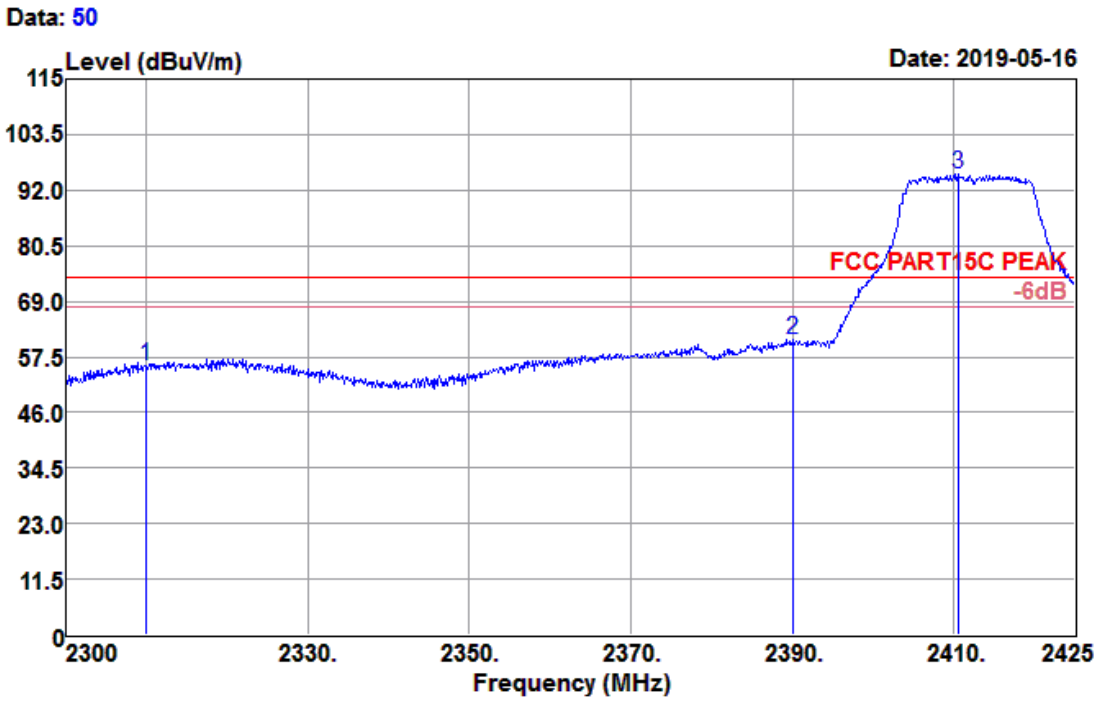


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	60.09	26.91	3.56	35.87	54.69	74.00	-19.31	Peak
2390.000	65.13	27.11	3.64	36.08	59.80	74.00	-14.20	Peak
2410.375	98.67	27.17	3.65	36.13	93.36	74.00	19.36	Peak

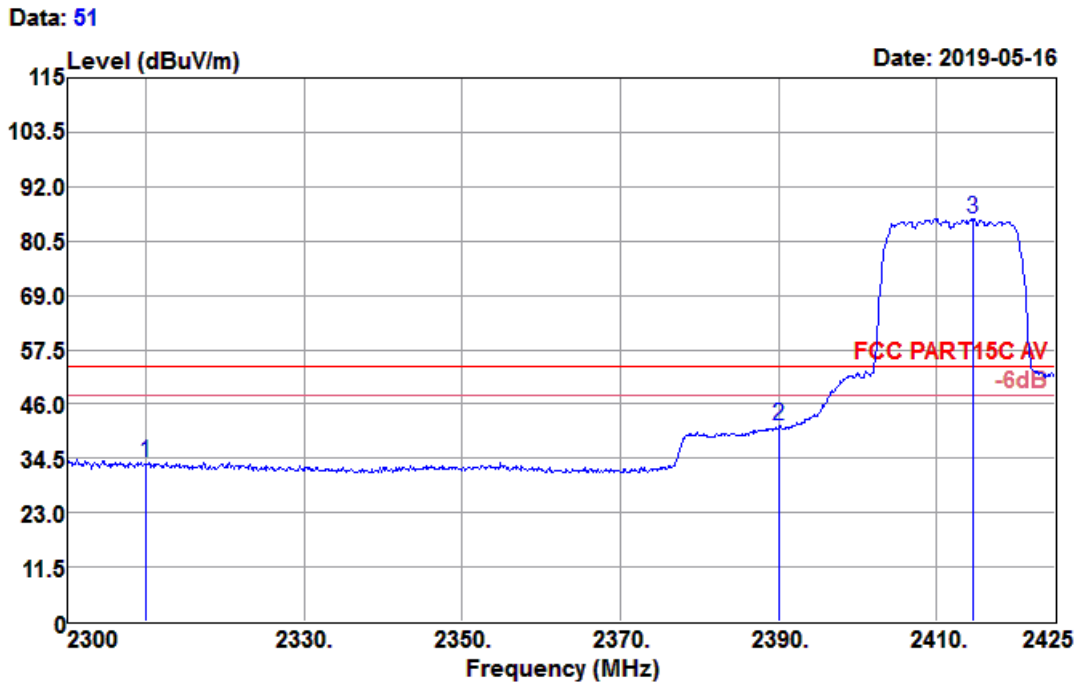


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	Level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
2310.000	37.66	26.91	3.56	35.87	32.26	54.00	-21.74	Average
2390.000	45.58	27.11	3.64	36.08	40.25	54.00	-13.75	Average
2409.625	88.79	27.17	3.65	36.13	83.48	54.00	29.48	Average

Test Mode :	802.11g CH01(2412MHz)	Temperature :	21°C
Test Engineer :	Julie Deng	Relative Humidity :	63%
Test Distance :	3m	Polarization :	Vertical



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	61.09	26.91	3.56	35.87	55.69	74.00	-18.31	Peak
2390.000	66.24	27.11	3.64	36.08	60.91	74.00	-13.09	Peak
2410.500	100.48	27.17	3.65	36.13	95.17	74.00	21.17	Peak



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	Level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2310.000	38.90	26.91	3.56	35.87	33.50	54.00	-20.50	Average
2390.000	46.87	27.11	3.64	36.08	41.54	54.00	-12.46	Average
2414.625	90.55	27.18	3.66	36.14	85.25	54.00	31.25	Average