FCC Test Report

Report No.: AGC04216180601TE05

FCC ID	:	2AQAT-COLORFULL
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	Smart Wi-Fi LED Bulb
BRAND NAME	:	OTOT
MODEL NAME	:	Colorful L, D1
CLIENT	:	Shenzhen Huazhi IoT Technology Co.,Ltd.
DATE OF ISSUE	:	July 23, 2018
STANDARD(S) **TEST PROCEDURE(S)**	:	FCC Part 15.247
REPORT VERSION	:	V1.0

Attestation of ***G***lobal ***C***ompliance (Shenzhen) Co., Ltd

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REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Jul. 23, 2018	Valid	Initial Release

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1. VERIFICATION OF CONFORMITY

Applicant	Shenzhen Huazhi IoT Technology Co., Ltd.
Address	9F, Tower B, Unicenter, Xinhu Road, Xin'an Subdistrict, Bao'an District, Shenzhen, China
Manufacturer	Shenzhen Huazhi IoT Technology Co., Ltd.
Address	9F, Tower B, Unicenter, Xinhu Road, Xin'an Subdistrict, Bao'an District, Shenzhen, China
Product Designation	Smart Wi-Fi LED Bulb
Brand Name	OTOT
Test Model	Colorful L
Series Model	D1
Declaration of Difference	The products are the same. There are two models.
Date of test	July 11, 2018~July 23, 2018
Deviation	None
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-US-BGN/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.247.

Tested By	Dojon Huang(HuangDongyang)	July. 23, 2018
Reviewed By	Bart Xie(Xie Xiaobin)	July. 23, 2018
Approved By	Forrest Lei(Lei Yonggang) Authorized Officer	July. 23, 2018

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is designed as “Smart Wi-Fi LED Bulb" it is designed by way of utilizing the DSSS and OFDM technology to achieve the system operation.

A major technical description of EUT is described as following

Operation Frequency	2.412 GHz～2.462GHz
Output Power(Average)	IEEE 802.11b:14.28dBm; IEEE 802.11g:13.96dBm; IEEE 802.11n(20):13.87dBm
Modulation	DSSS(DBPSK/DQPSK/CCK);OFDM(BPSK/QPSK/16-QAM/64-QAM)
Number of channels	11
Hardware Version	V1.2
Software Version	V1.7
Antenna Designation	Internal antenna
Antenna Gain	2.0dBi
Power Supply	AC 120V/60Hz

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
2400~2483.5MHZ	1	2412 MHZ
	2	2417 MHZ
	3	2422 MHZ
	4	2427 MHZ
	5	2432 MHZ
	6	2437 MHZ
	7	2442 MHZ
	8	2447 MHZ
	9	2452 MHZ
	10	2457 MHZ
	11	2462 MHZ

Note: For 20MHZ bandwidth system use Channel 1 to Channel 11.

2.3. IEEE 802.11N MODULATION SCHEME

MCS Index	Nss	Modulation	R	NBPSC	NCBPS		NDBPS		Data rate(Mbps) 800nsGI	
					20MHz	40MHz	20MHz	40MHz	20MHz	40MHz
0	1	BPSK	1/2	1	52	108	26	54	6.5	13.5
1	1	QPSK	1/2	2	104	216	52	108	13.0	27.0
2	1	QPSK	3/4	2	104	216	78	162	19.5	40.5
3	1	16-QAM	1/2	4	208	432	104	216	26.0	54.0
4	1	16-QAM	3/4	4	208	432	156	324	39.0	81.0
5	1	64-QAM	2/3	6	312	648	208	432	52.0	108.0
6	1	64-QAM	3/4	6	312	648	234	489	58.5	121.5
7	1	64-QAM	5/6	6	312	648	260	540	65.0	135.0

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPSC	Number of coded bits per single carrier
NCBPS	Number of coded bits per symbol
NDBPS	Number of data bits per symbol
GI	Guard interval

2.4. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: 2AQAT-COLORFULL** filing to comply with the FCC Part 15 requirements.

2.5. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

2.6. SPECIAL ACCESSORIES

Refer to section 5.2.

2.7. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

3. MEASUREMENT UNCERTAINTY

The uncertainty is calculated using the methods suggested in the “Guide to the Expression of Uncertainty in measurement” (GUM) published by CISPR and ANSI.

- Uncertainty of Conducted Emission, Uc = ±3.2 dB
- Uncertainty of Radiated Emission below 1GHz, Uc = ±3.9 dB
- Uncertainty of Radiated Emission above 1GHz, Uc = ±4.8 dB

4. DESCRIPTION OF TEST MODES

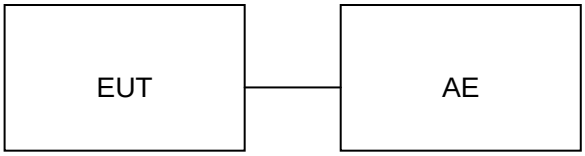
NO.	TEST MODE DESCRIPTION
1	Low channel TX
2	Middle channel TX
3	High channel TX
4	Normal operating
Note: Transmit by 802.11b with Date rate (1/2/5.5/11) Transmit by 802.11g with Date rate (6/9/12/18/24/36/48/54) Transmit by 802.11n (20MHz) with Date rate (6.5/13/19.5/26/39/52/58.5/65)	

Note:

1. The EUT has been set to operate continuously on the lowest, middle and highest operation frequency Individually, and the eut is operating at its maximum duty cycle>or equal 98%
2. All modes under which configure applicable have been tested and the worst mode test data recording in the test report, if no other mode data.
3. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM



5.2. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.247	Output Power	Compliant
§15.247	6 dB Bandwidth	Compliant
§15.247	Conducted Spurious Emission	Compliant
§15.247	Maximum Conducted Output Power SPECTRAL Density	Compliant
§15.209	Radiated Emission	Compliant
§15.247	Band Edges	Compliant
§15.207	Line Conduction Emission	Compliant

6. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2F., Bldg.2, No.1-4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang, Bao'an District B112-B113, Bldg.12, Baoan Bldg Materials Center, No.1 of Xixiang Inner Ring Road, Baoan District, Shenzhen 518012
NVLAP LAB CODE	600153-0
Designation Number	CN5028
FCC Test Firm Registration Number	682566
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by National Voluntary Laboratory Accreditation program, NVLAP Code 600153-0

TEST EQUIPMENT OF CONDUCTED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	Jun. 12, 2018	Jun. 11, 2019
LISN	R&S	ESH2-Z5	100086	Aug.21, 2017	Aug.20, 2018

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	Jun. 12, 2018	Jun. 11, 2019
EXA Signal Analyzer	Aglient	N9010A	MY53470504	Dec.08, 2017	Dec.07, 2018
Power sensor	Aglient	U2021XA	MY54110007	Sep.21, 2017	Sep.20, 2018
2.4GHz Fliter	Micro-tronics	087	N/A	Jun. 12, 2018	Jun. 11, 2019
Horn antenna	SCHWARZBECK	BBHA 9170	#768	Sep.20, 2017	Sep.19, 2018
preamplifier	ChengYi	EMC184045SE	980508	Sep.15, 2017	Sep.14, 2018
Active loop antenna (9K-30MHz)	A.H.	SAS-562B	N/A	Mar.01, 2018	Feb.28, 2019
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	May.18, 2017	May.17, 2019
Broadband Preamplifier	SCHWARZBECK	BBV 9718	9718-205	Jun. 12, 2018	Jun. 11, 2019
ANTENNA	SCHWARZBECK	VULB9168	D69250	Sep.28, 2017	Sep.27, 2018

7. OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

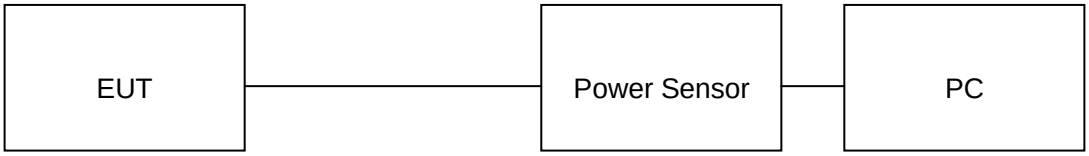
For average power test:

1. Connect EUT RF output port to power sensor through an RF attenuator.
2. Connect the power sensor to the PC.
3. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
4. Record the maximum power from the software.

Note：The EUT was tested according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

AVERAGE POWER SETUP



7.3. LIMITS AND MEASUREMENT RESULT

TEST ITEM	OUTPUT POWER
TEST MODE	802.11b with data rate 1

Frequency (GHz)	Average Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2.412	13.10	30	Pass
2.437	14.28	30	Pass
2.462	13.42	30	Pass

TEST ITEM	OUTPUT POWER
TEST MODE	802.11g with data rate 6

Frequency (GHz)	Average Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2.412	12.29	30	Pass
2.437	13.96	30	Pass
2.462	13.25	30	Pass

TEST ITEM	OUTPUT POWER
TEST MODE	802.11n 20 with data rate 6.5

Frequency (GHz)	Average Power (dBm)	Applicable Limits (dBm)	Pass or Fail
2.412	12.24	30	Pass
2.437	13.87	30	Pass
2.462	13.19	30	Pass

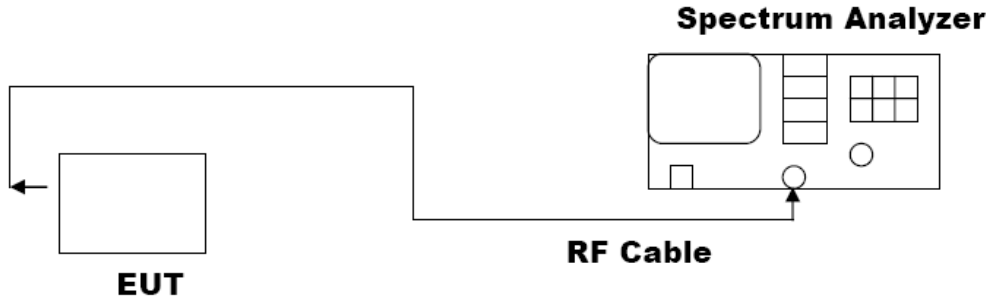
8. 6 DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set SPA Centre Frequency = Operation Frequency, RBW= 100 KHz, VBW⩾3×RBW.
4. Set SPA Trace 1 Max hold, then View.

Note: The EUT was tested according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements.

8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



8.3. LIMITS AND MEASUREMENT RESULTS

TEST ITEM	6DB BANDWIDTH
TEST MODE	802.11b with data rate 11

LIMITS AND MEASUREMENT RESULT			
Applicable Limits	**Applicable Limits**		
	Test Data (MHz)		**Criteria**
>500KHZ	Low Channel	8.182	PASS
	Middle Channel	8.191	PASS
	High Channel	8.185	PASS

TEST ITEM	6DB BANDWIDTH
TEST MODE	802.11g with data rate 54

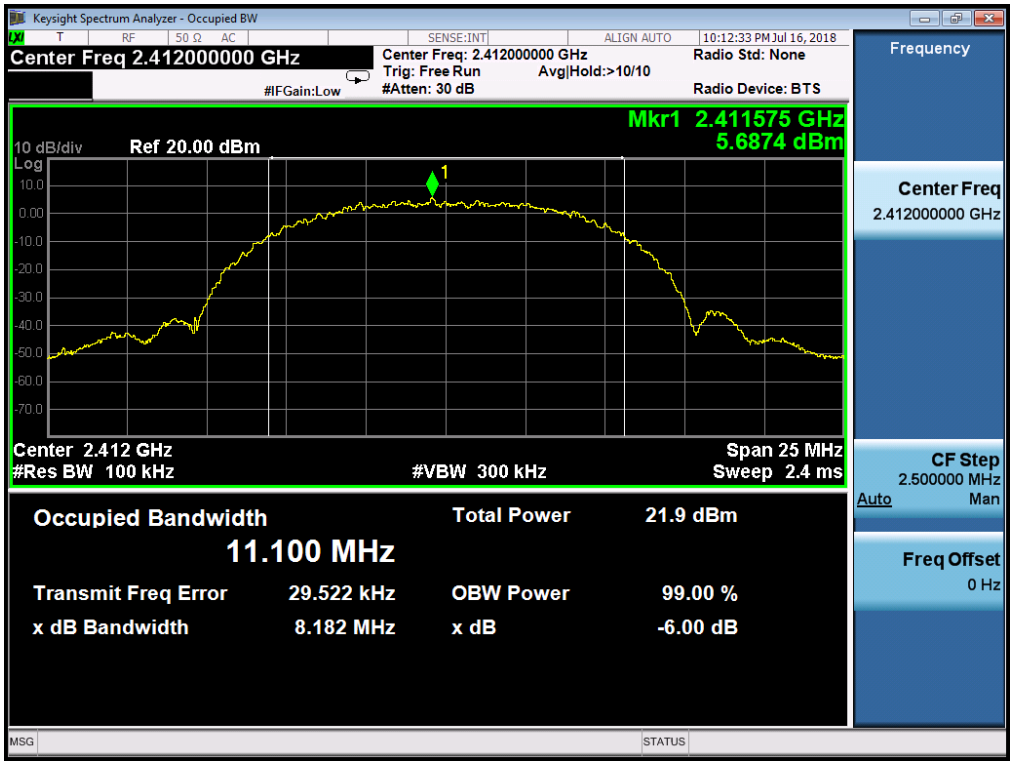
LIMITS AND MEASUREMENT RESULT			
Applicable Limits	**Applicable Limits**		
	Test Data (MHz)		**Criteria**
>500KHZ	Low Channel	16.35	PASS
	Middle Channel	16.35	PASS
	High Channel	16.35	PASS

TEST ITEM	6DB BANDWIDTH
TEST MODE	802.11n 20 with data rate 65

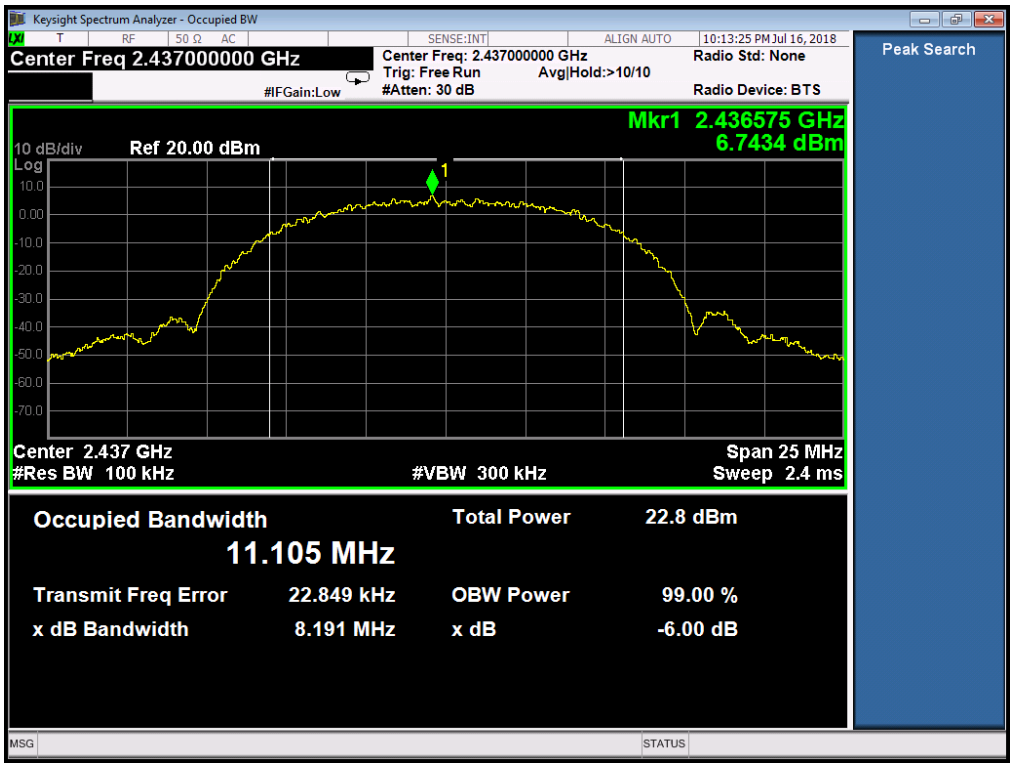
LIMITS AND MEASUREMENT RESULT			
Applicable Limits	**Applicable Limits**		
	Test Data (MHz)		**Criteria**
>500KHZ	Low Channel	17.10	PASS
	Middle Channel	17.08	PASS
	High Channel	17.08	PASS

802.11b TEST RESULT

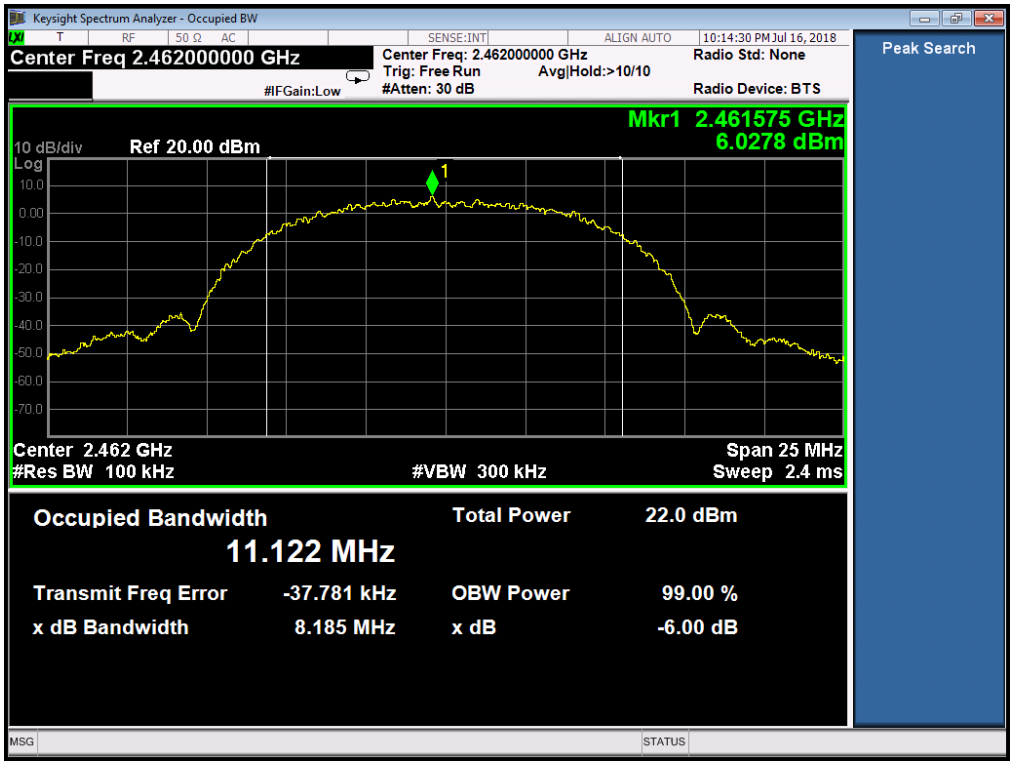
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

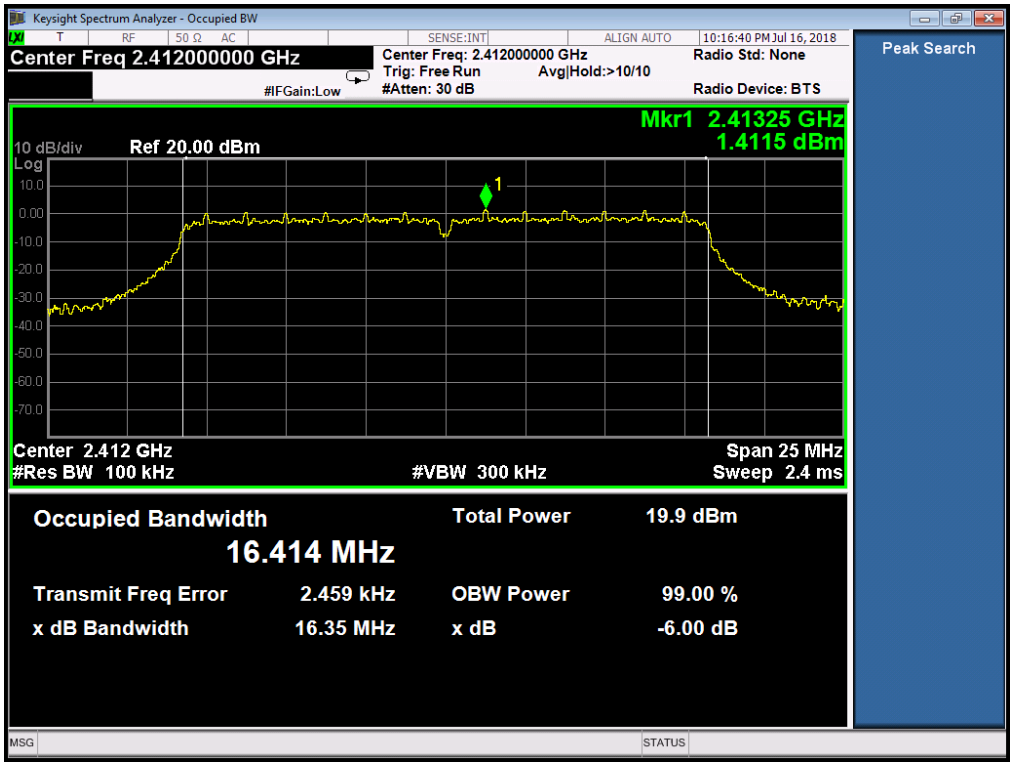


TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

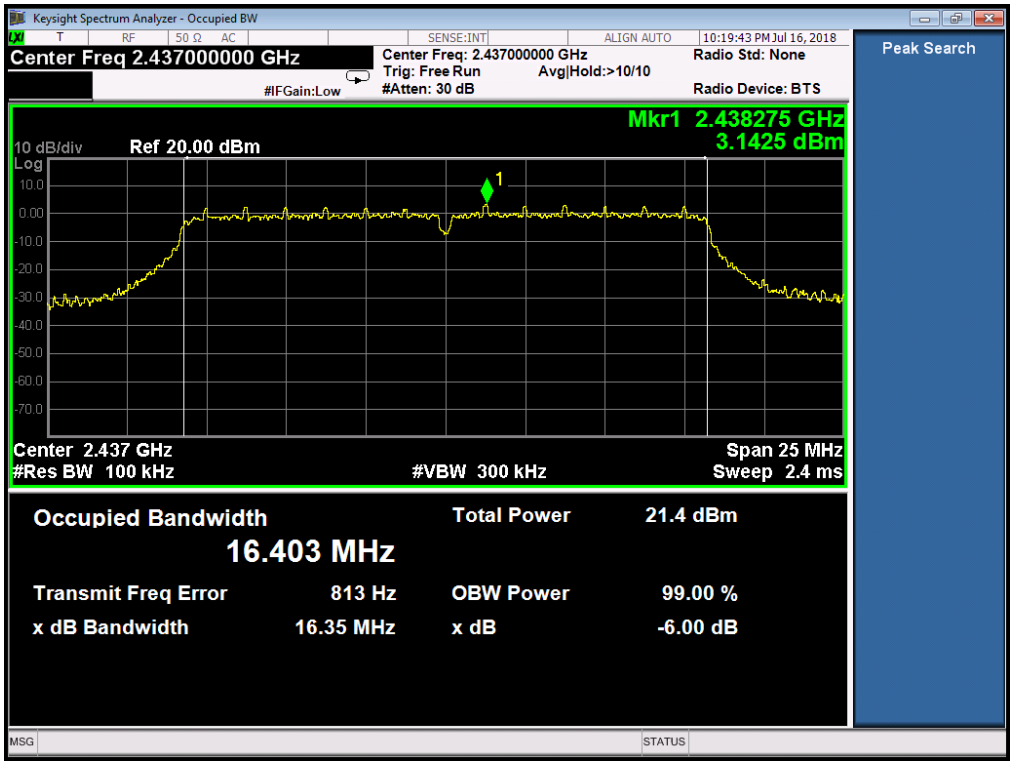


802.11g TEST RESULT

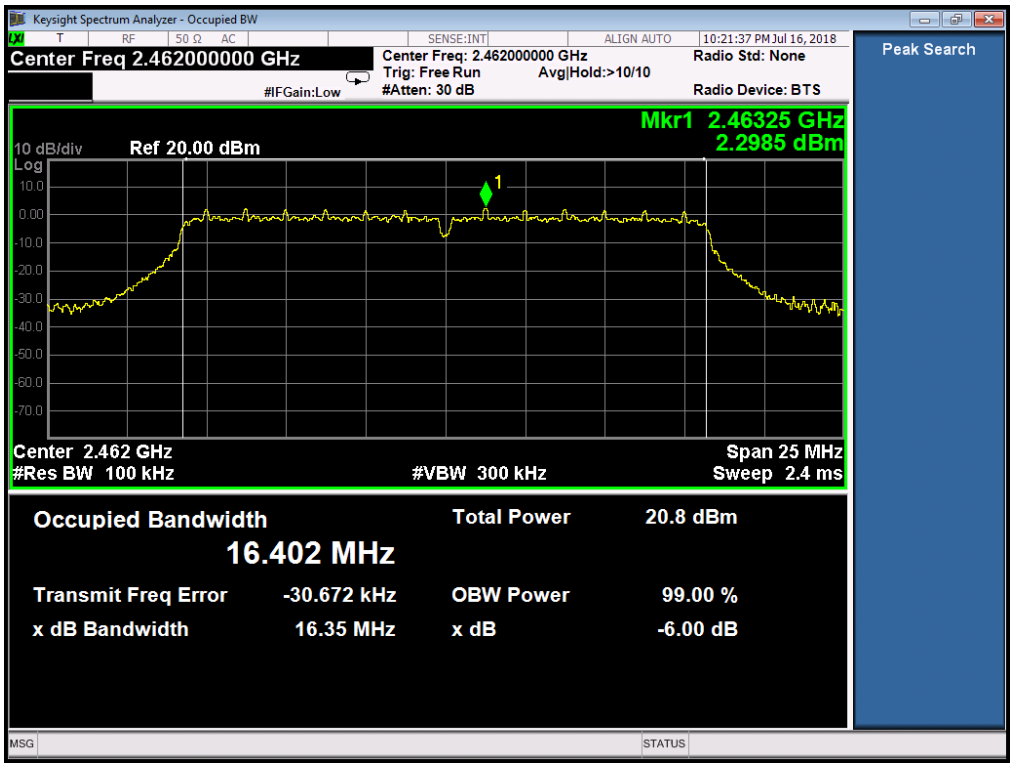
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

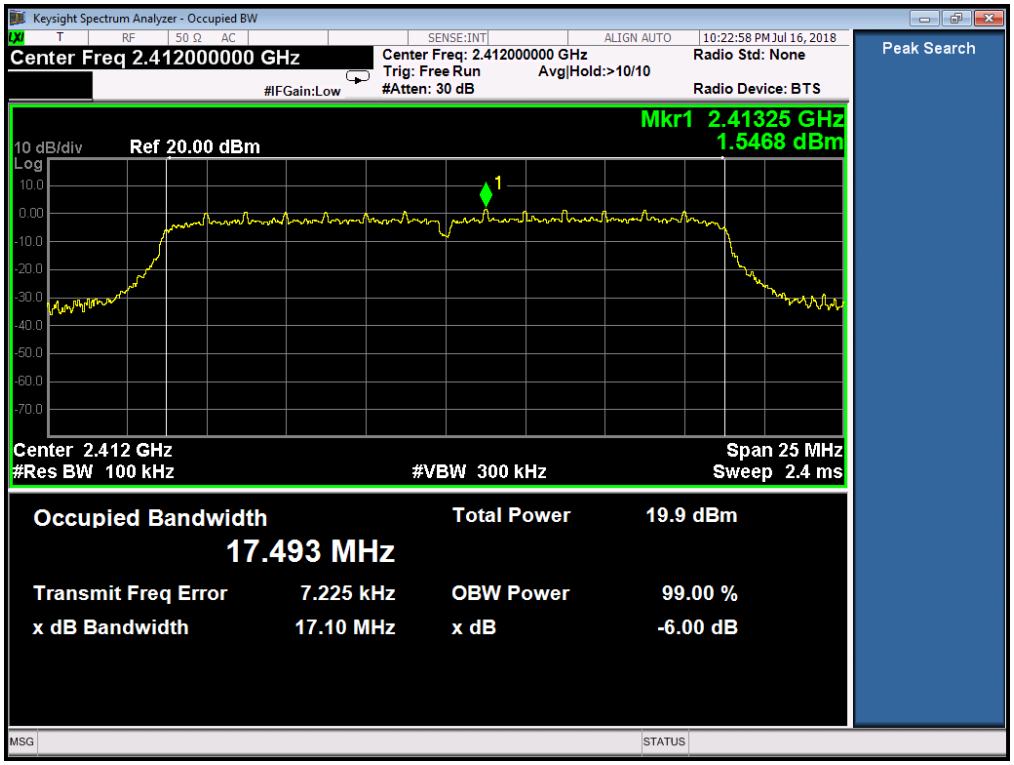


TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

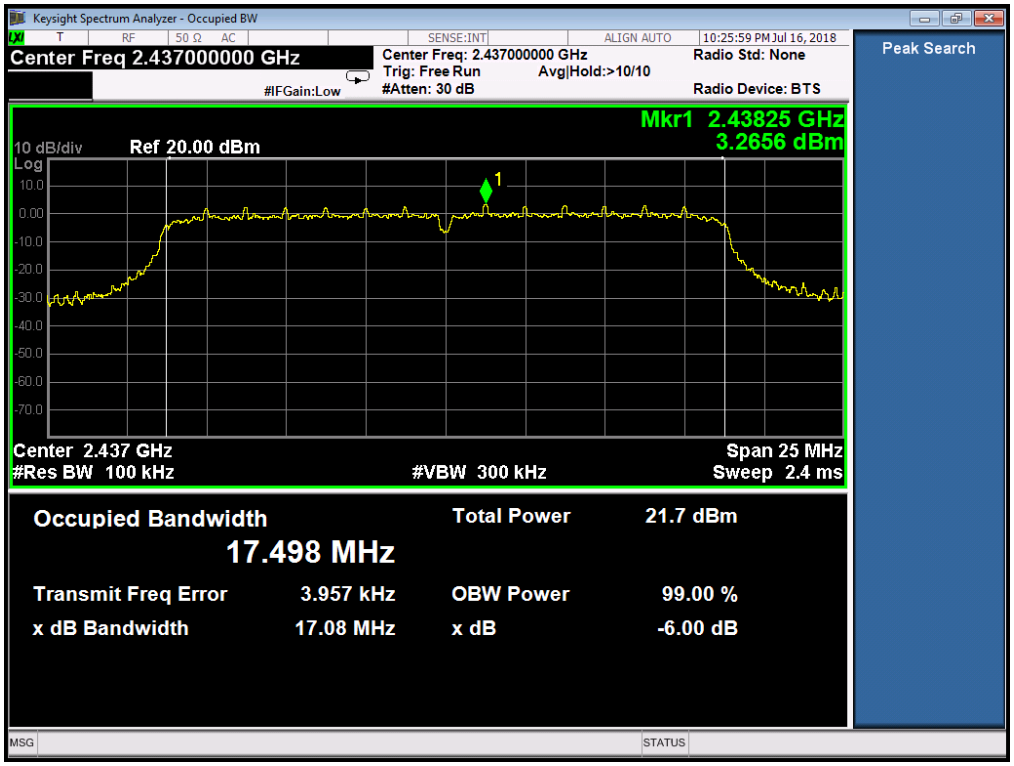


802.11n (20) TEST RESULT

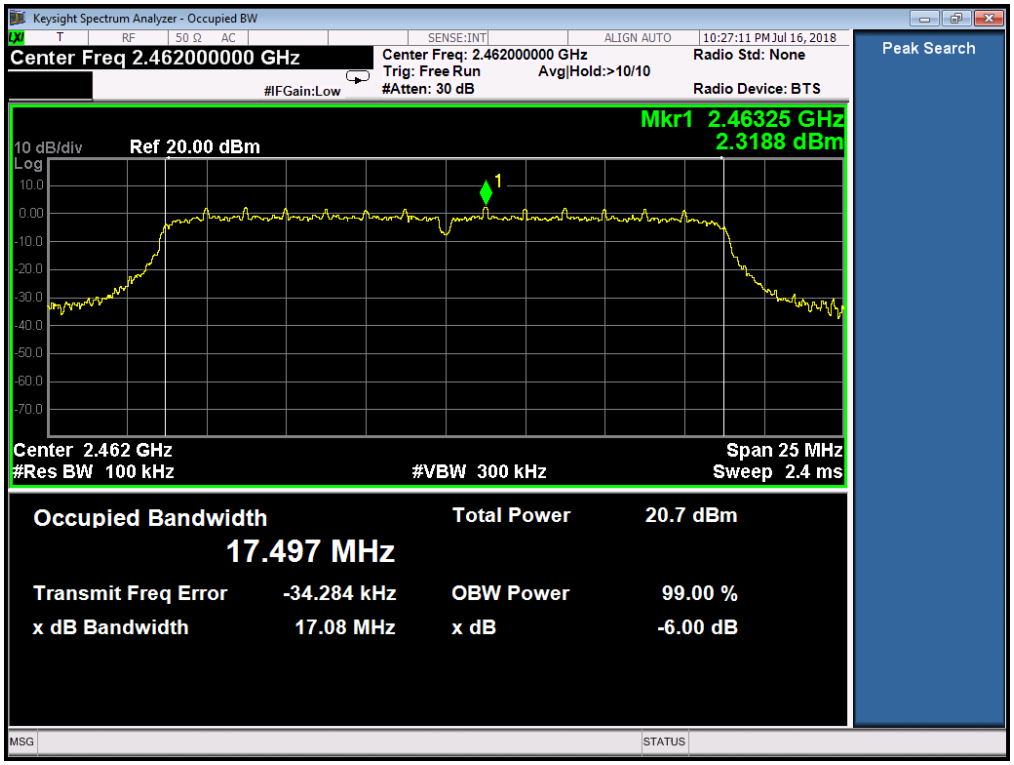
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL



TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL



9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set SPA Trace 1 Max hold, then View.

Note: The EUT was tested according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements. Owing to satisfy the requirements of the number of measurement points, we set the RBW=1MHz, VBW＞RBW, scan up through 10th harmonic, and consider the tested results as the worst case, if the tested results conform to the requirement, we can deem that the real tested results(set the RBW=100KHz, VBW＞RBW) are conform to the requirement.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2.

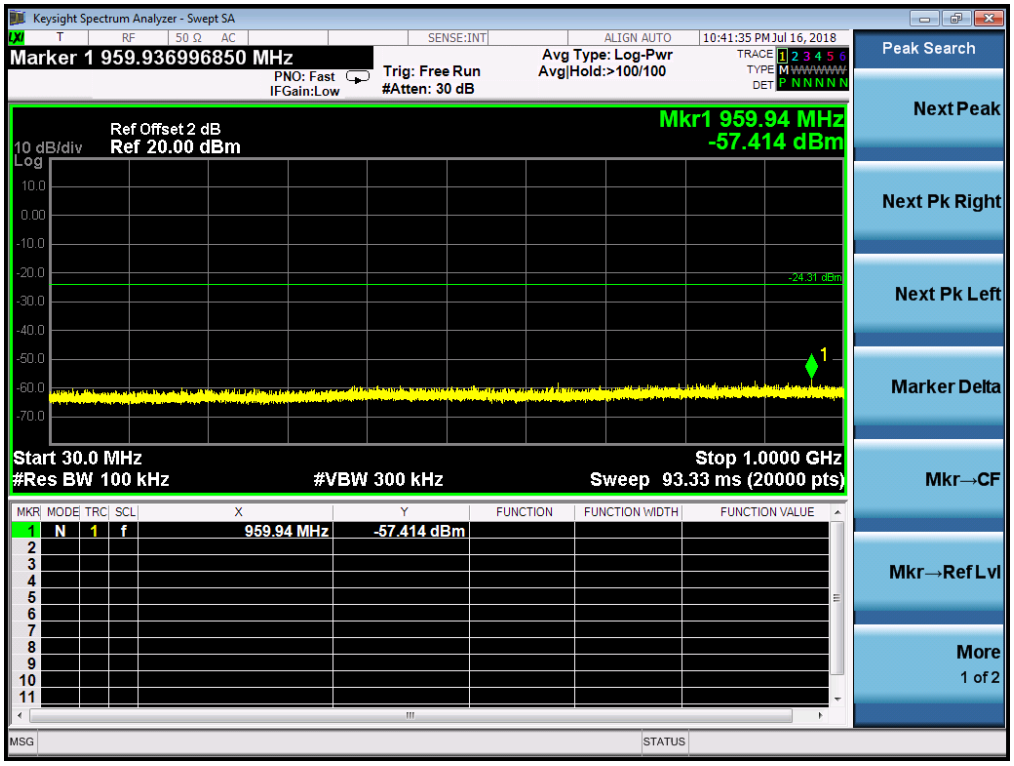
9.3. MEASUREMENT EQUIPMENT USED

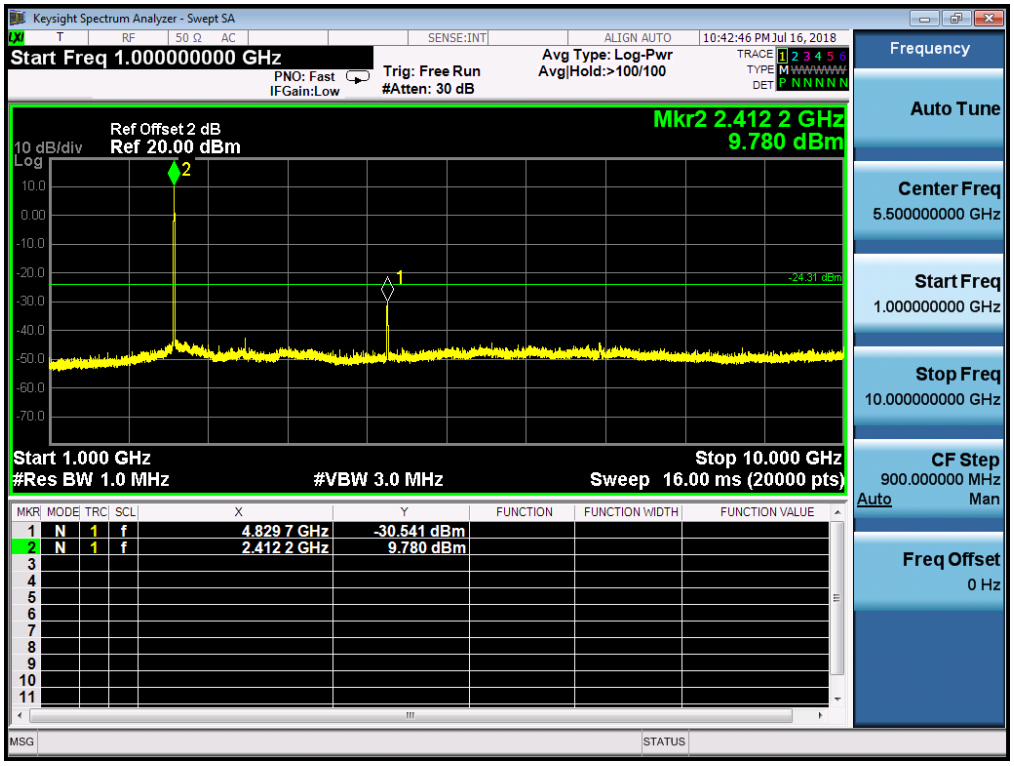
The same as described in section 6.

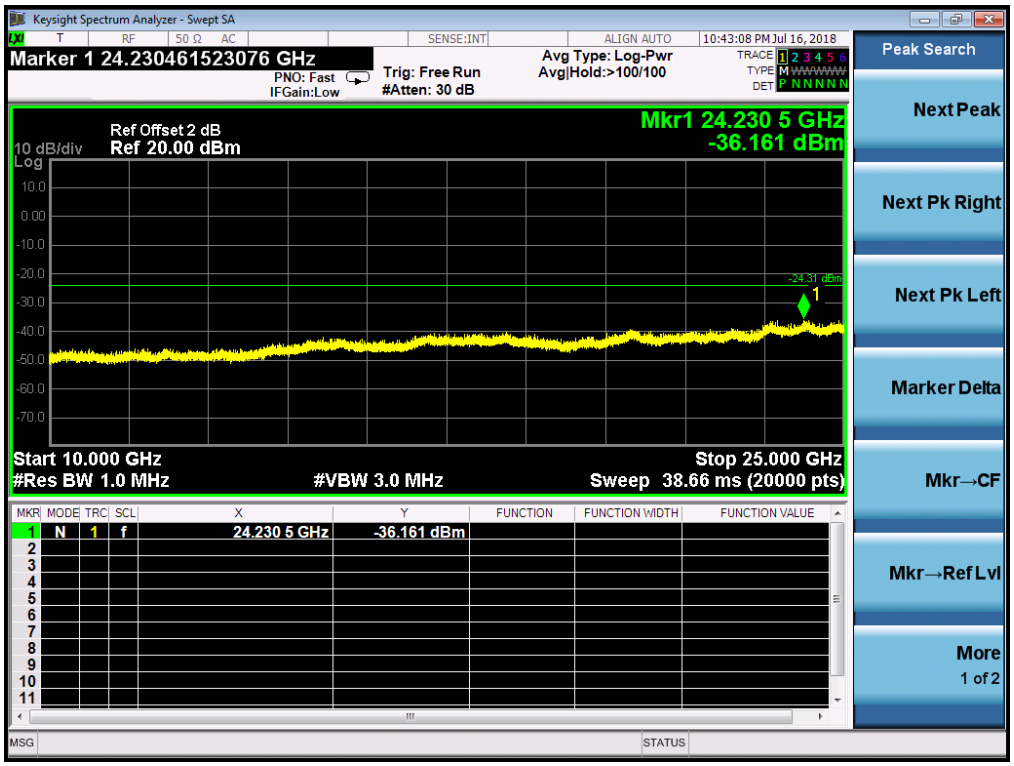
9.4. LIMITS AND MEASUREMENT RESULT

LIMITS AND MEASUREMENT RESULT		
Applicable Limits	**Measurement Result**	
	Test Data	**Criteria**
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 30 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -30dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -30dBc than the limit Specified on the TOP Channel	PASS

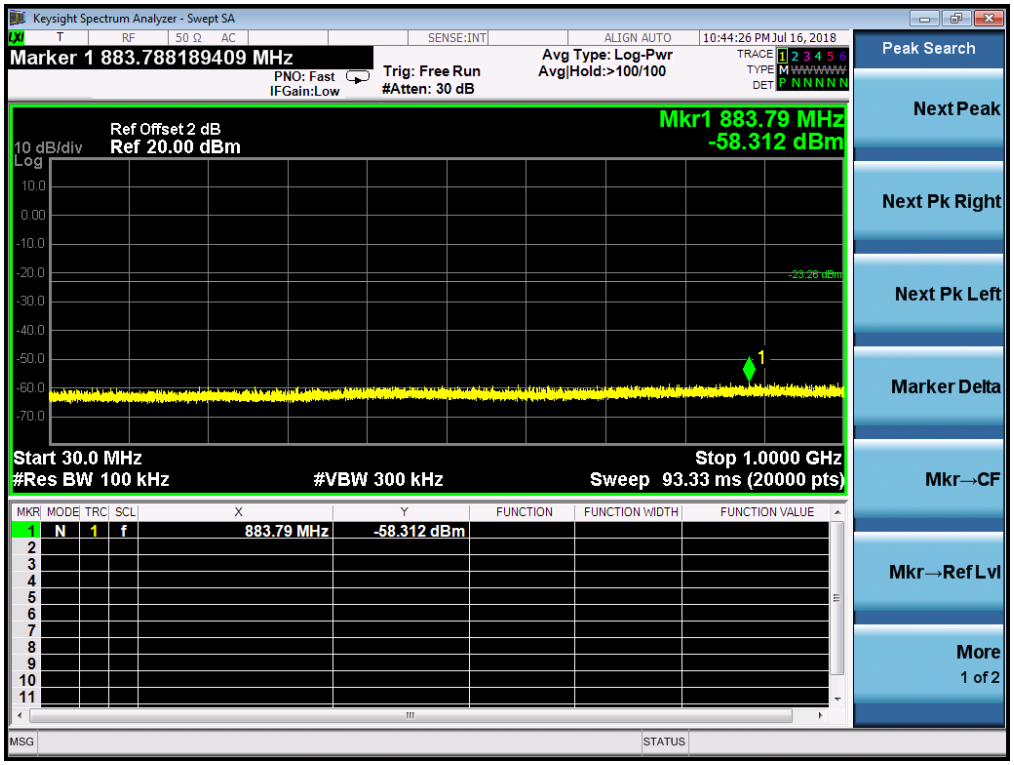
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF 802.11b FOR MODULATION IN LOW CHANNEL

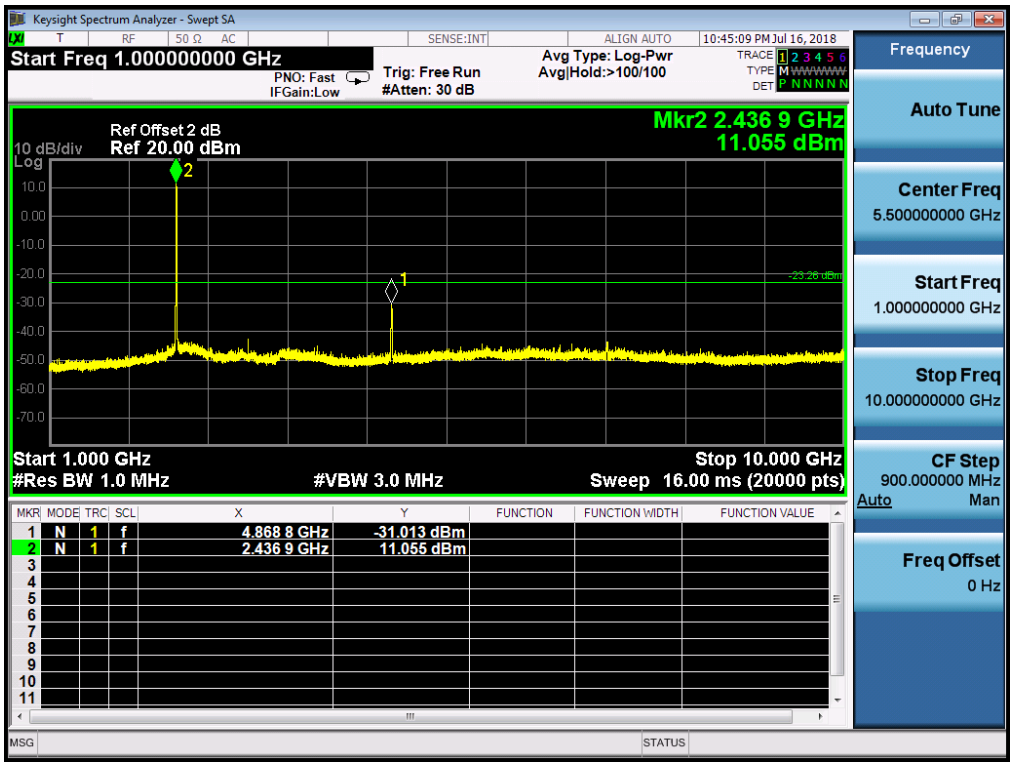


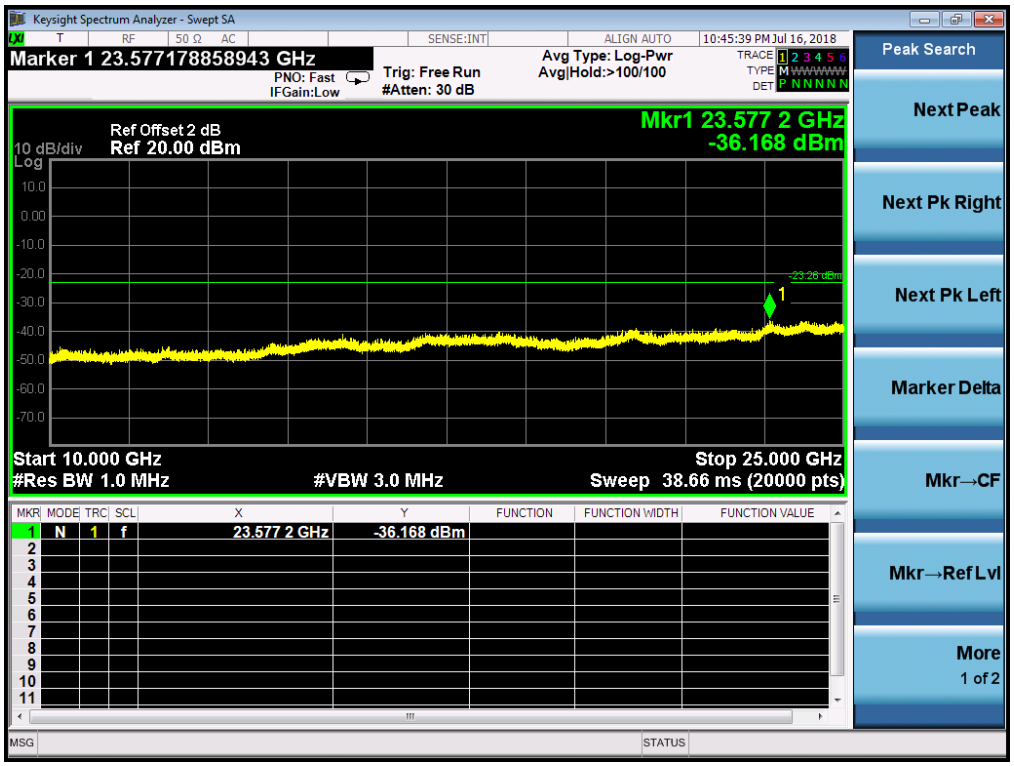




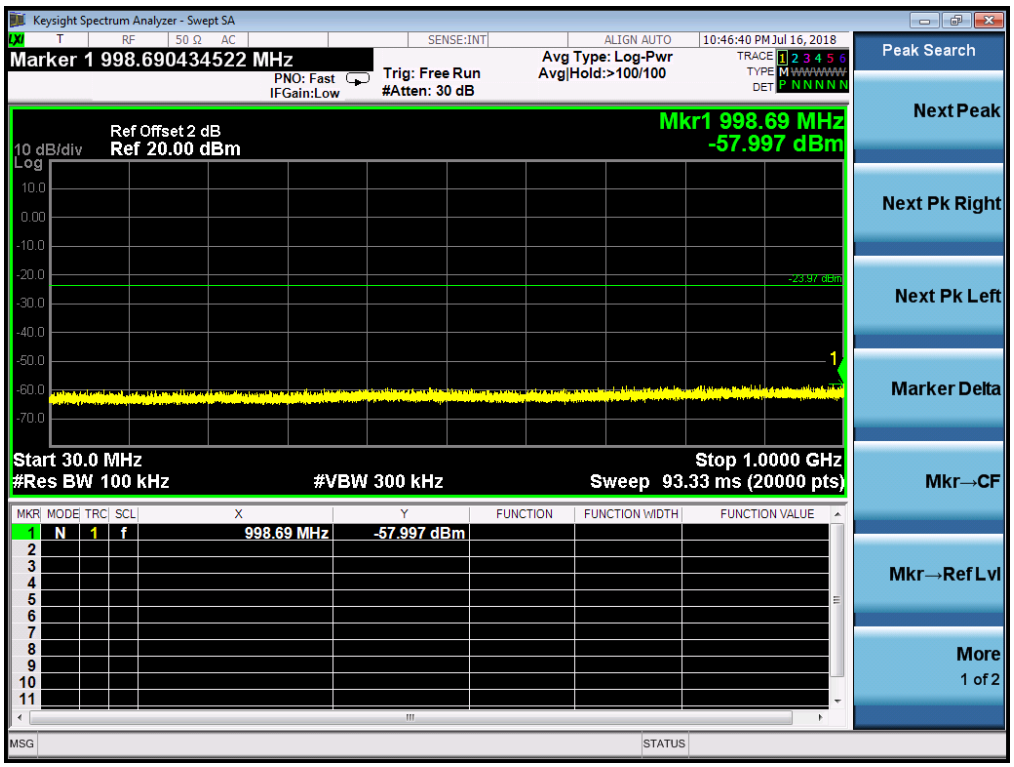
TEST PLOT OF OUT OF BAND EMISSIONS THE WORST CASE OF 802.11b FOR MODULATION IN MIDDLE CHANNEL

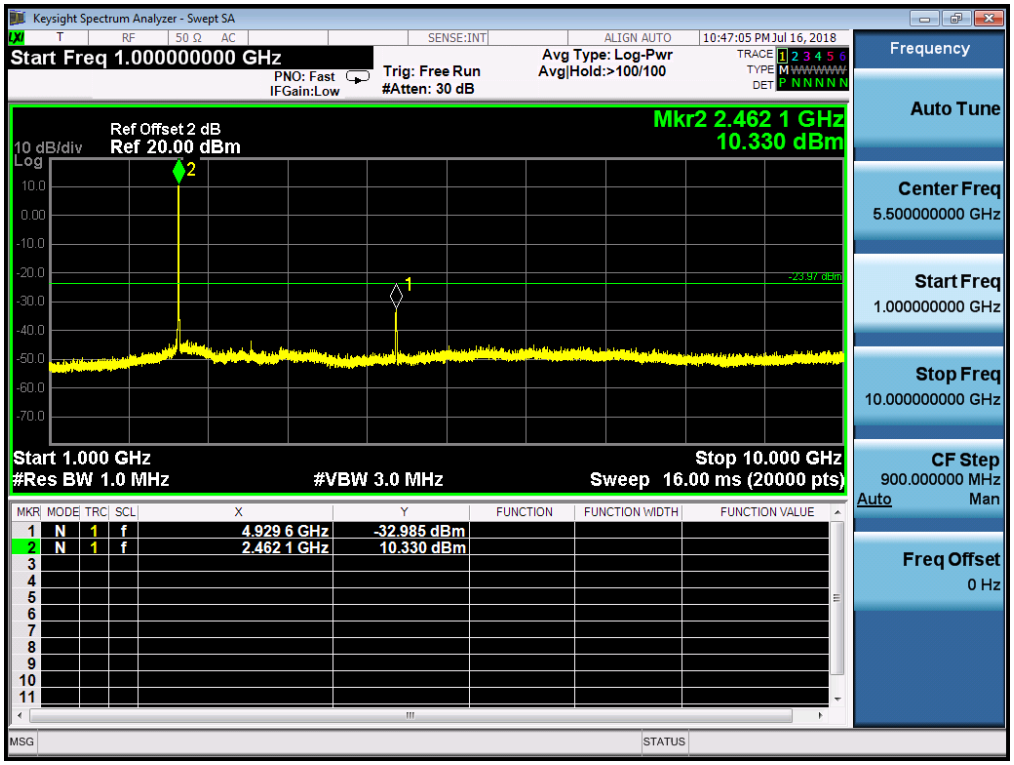


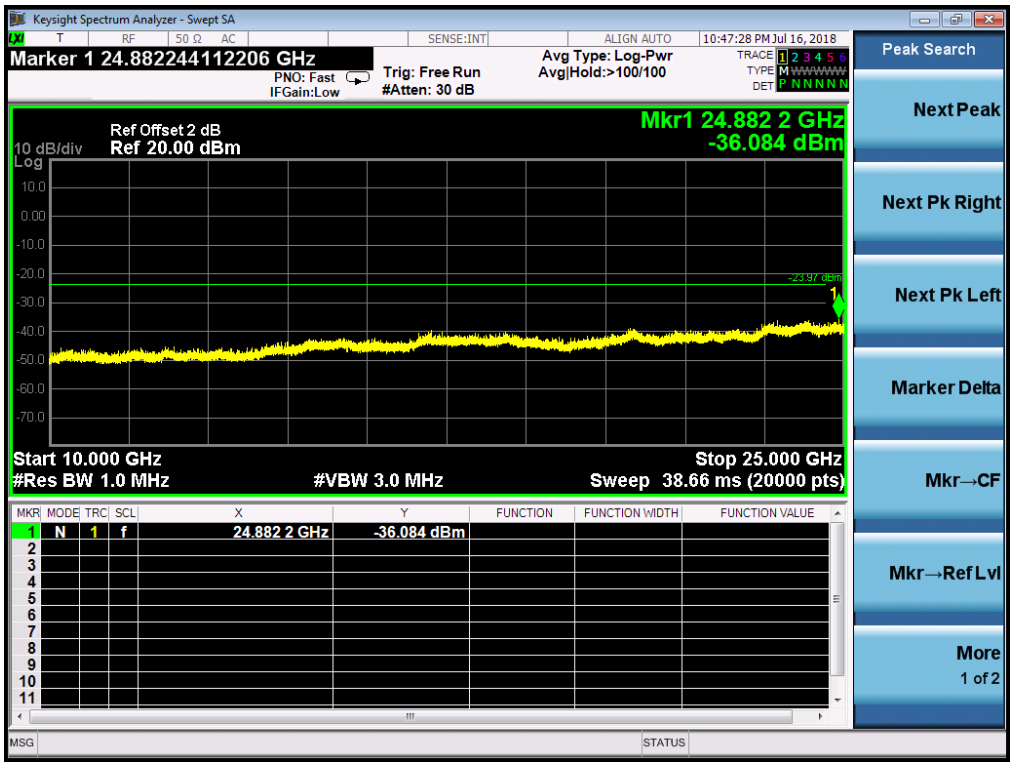

Keysight Spectrum Analyzer - Swept SA
Start Freq 1.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
10:45:09 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Mkr2 2.436 9 GHz
11.055 dBm
-23.26 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 10.000 GHz
Sweep 16.00 ms (20000 pts)
1 N 1 f 4.868 8 GHz -31.013 dBm
2 N 1 f 2.436 9 GHz 11.055 dBm
Frequency
Auto Tune
Center Freq
5.500000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
10.000000000 GHz
CF Step
900.000000 MHz
Auto
Man
Freq Offset
0 Hz


Keysight Spectrum Analyzer - Swept SA
Marker 1 23.577178858943 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
10:45:39 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Mkr1 23.577 2 GHz
-36.168 dBm
-23.26 dBm
Start 10.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.000 GHz
Sweep 38.66 ms (20000 pts)
1 N 1 f 23.577 2 GHz -36.168 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

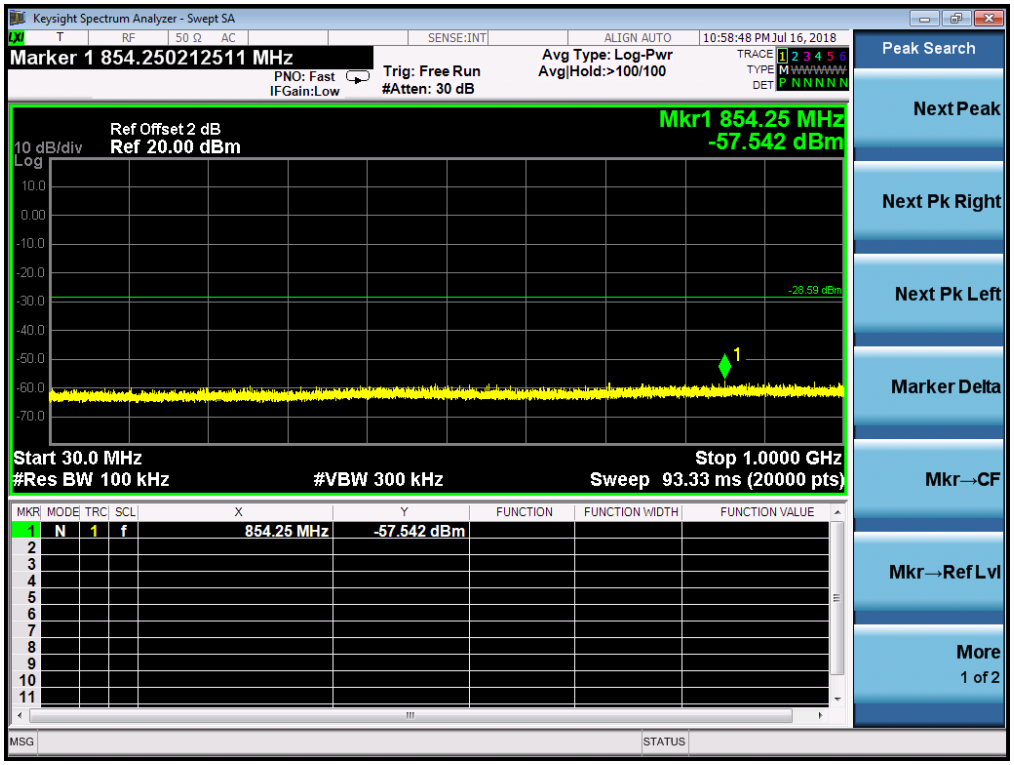
TEST PLOT OF OUT OF BAND EMISSIONS THE WORST CASE
OF 802.11b FOR MODULATION IN HIGH CHANNEL

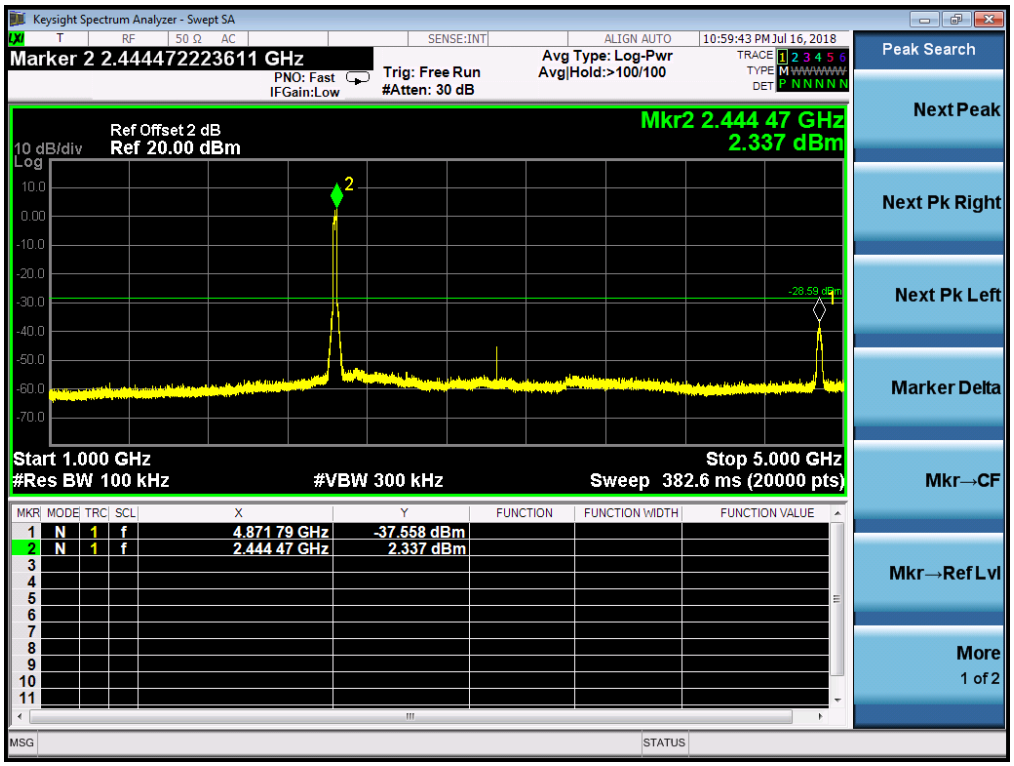


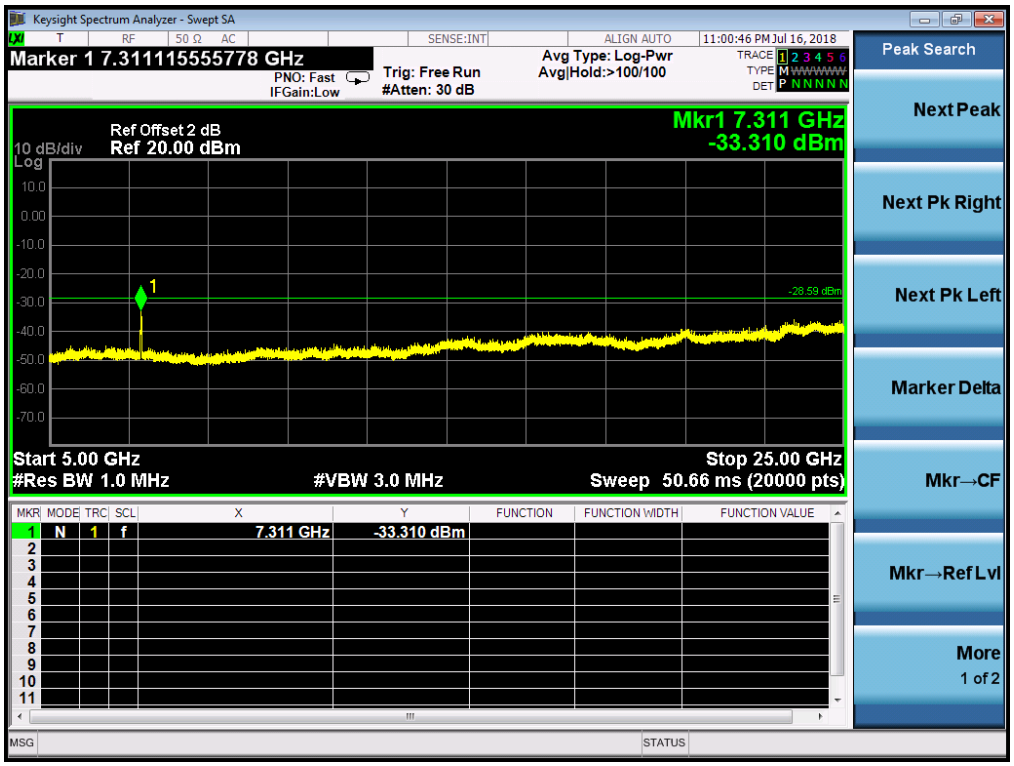




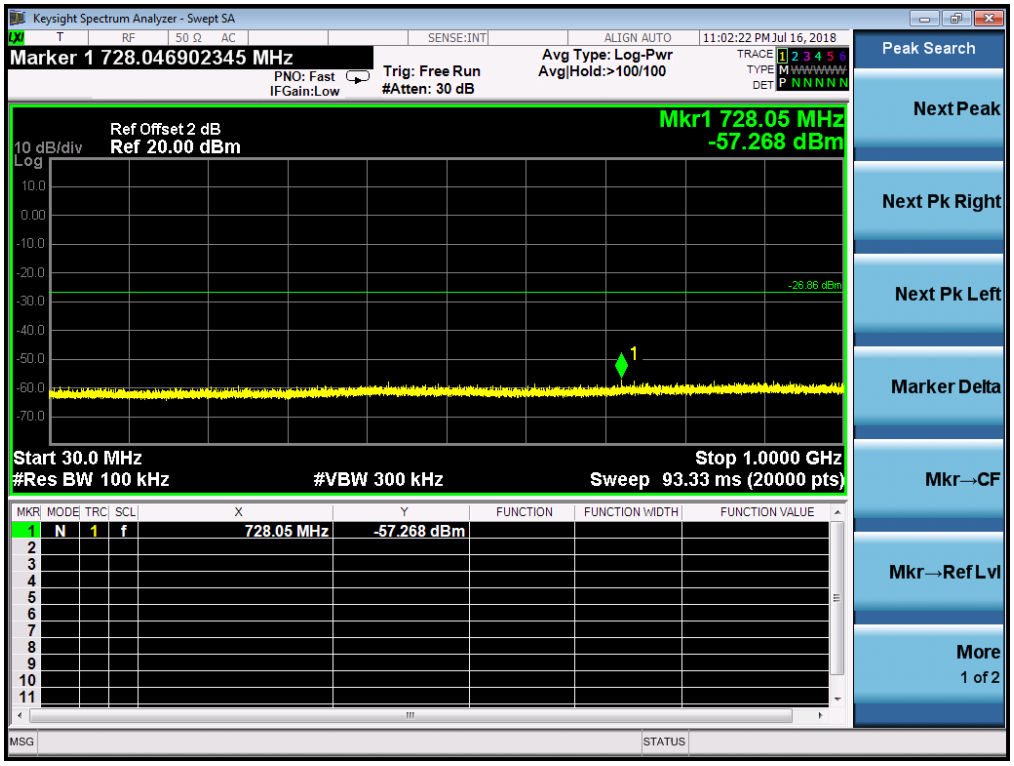
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF 802.11g FOR MODULATION IN LOW CHANNEL

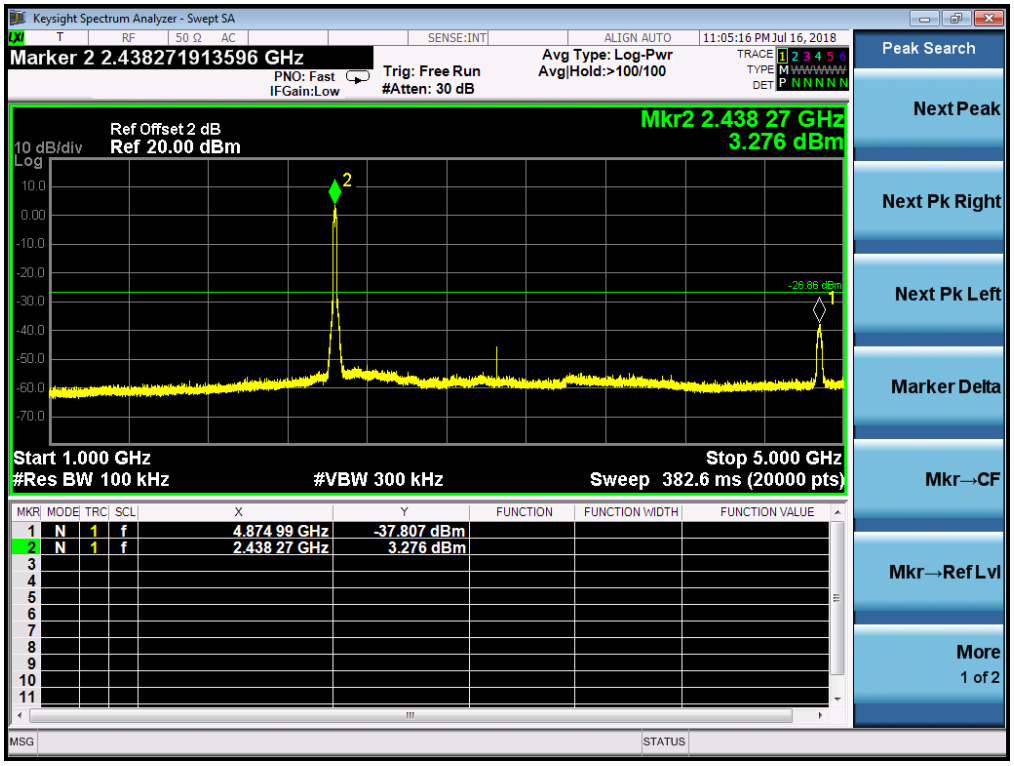


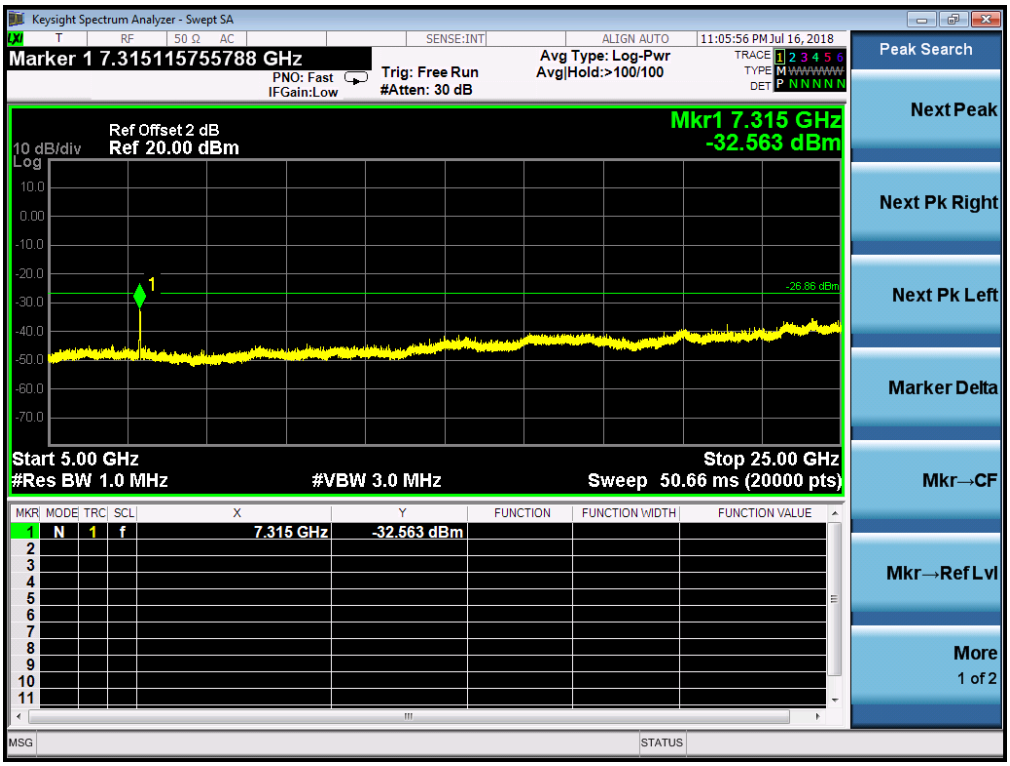

Keysight Spectrum Analyzer - Swept SA
Marker 2 2.444472223611 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
10:59:43 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr2 2.444 47 GHz
2.337 dBm
-28.59 dBm
Start 1.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 5.000 GHz
Sweep 382.6 ms (20000 pts)
1 N 1 f 4.871 79 GHz -37.558 dBm
2 N 1 f 2.444 47 GHz 2.337 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Marker 1 7.311115555778 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:00:46 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 7.311 GHz
-33.310 dBm
-28.59 dBm
Start 5.00 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 50.66 ms (20000 pts)
1 N 1 f 7.311 GHz -33.310 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

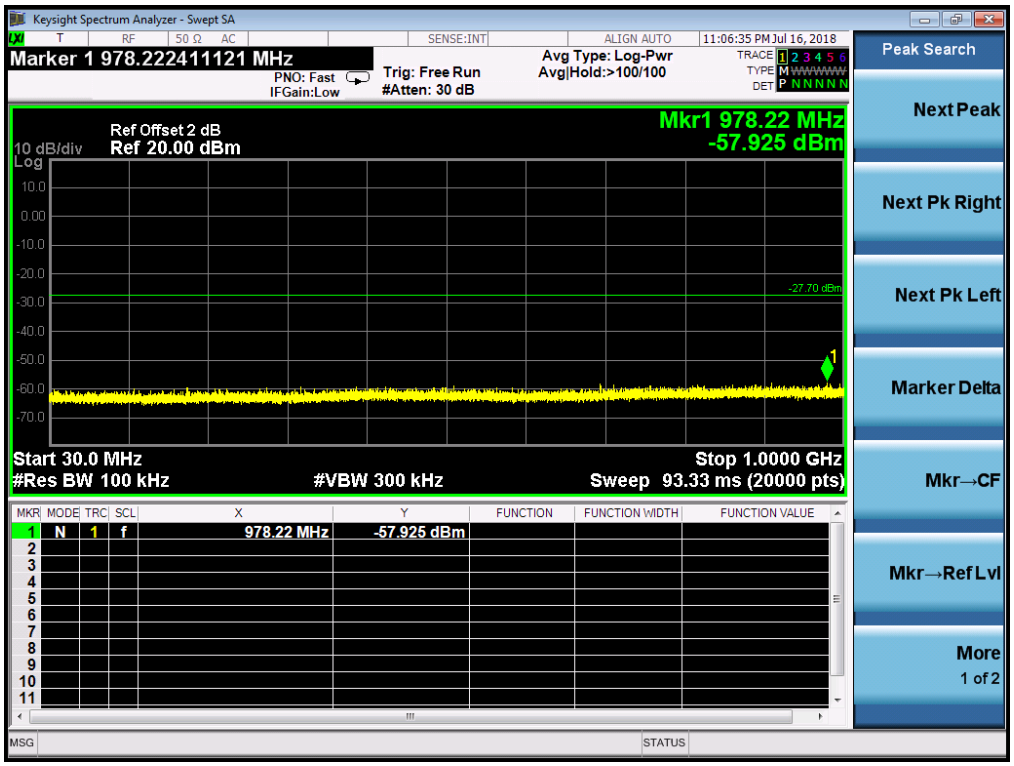
TEST PLOT OF OUT OF BAND EMISSIONS THE WORST CASE
OF 802.11g FOR MODULATION IN MIDDLE CHANNEL

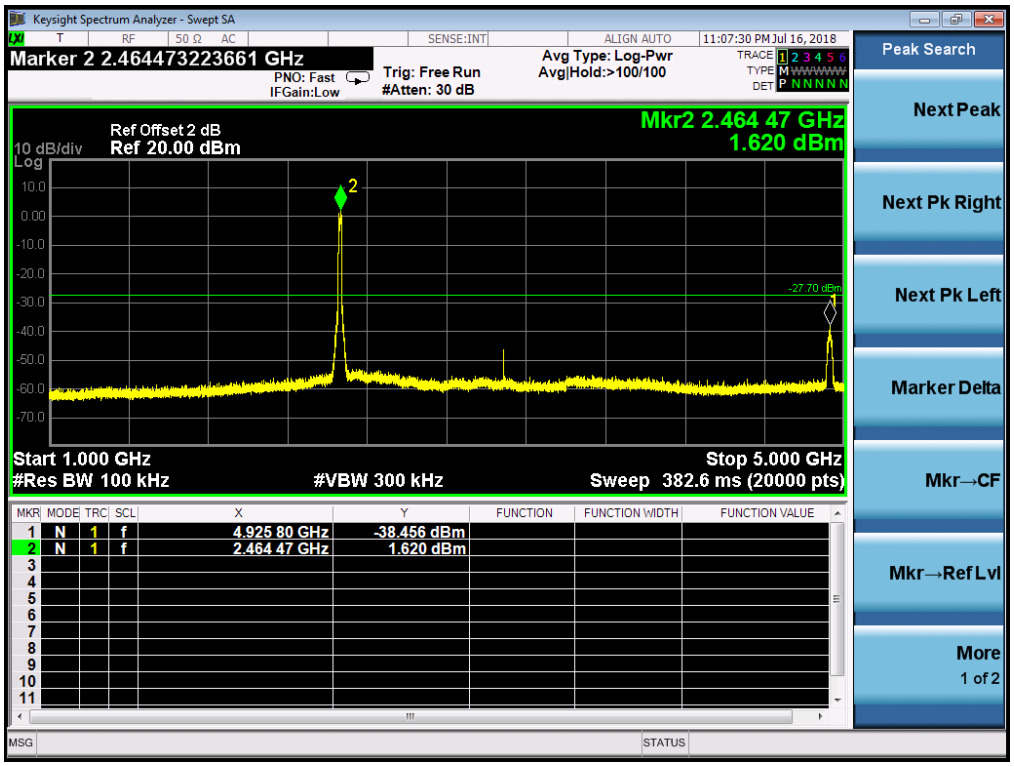


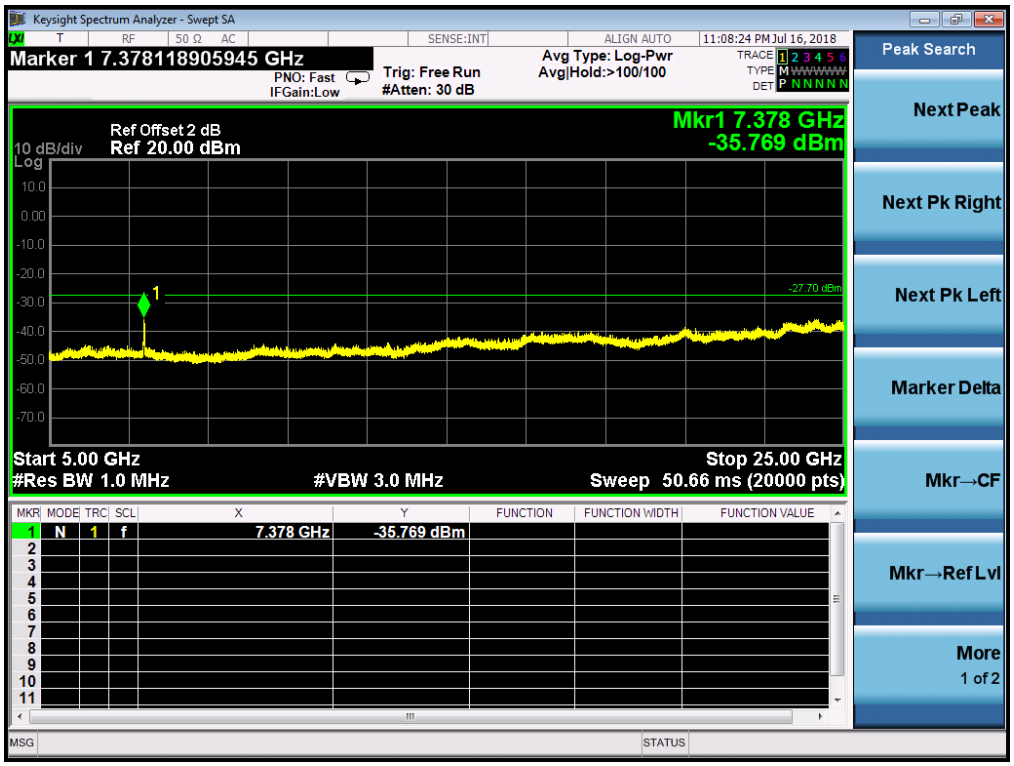




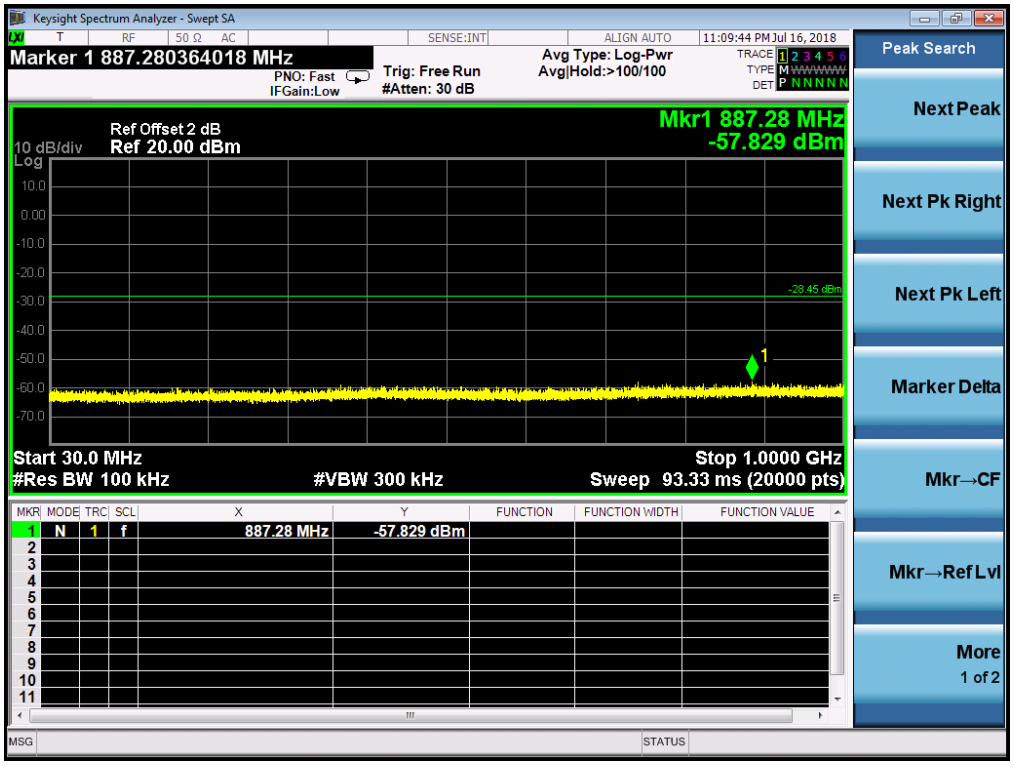
TEST PLOT OF OUT OF BAND EMISSIONS THE WORST CASE OF 802.11g FOR MODULATION IN HIGH CHANNEL

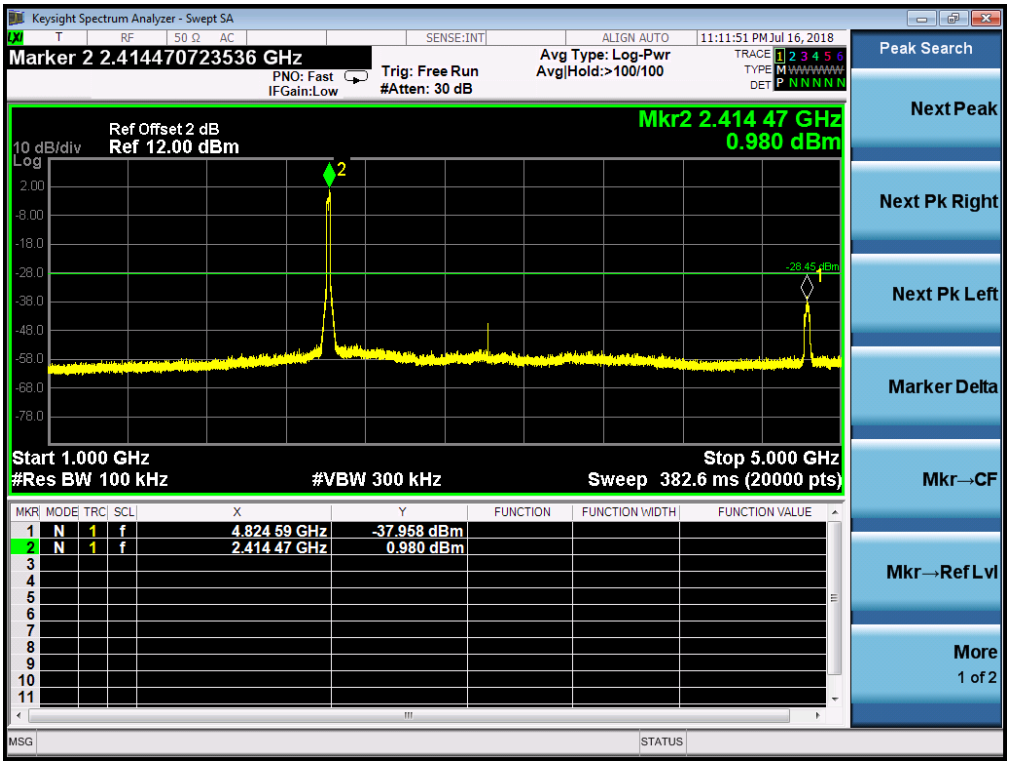


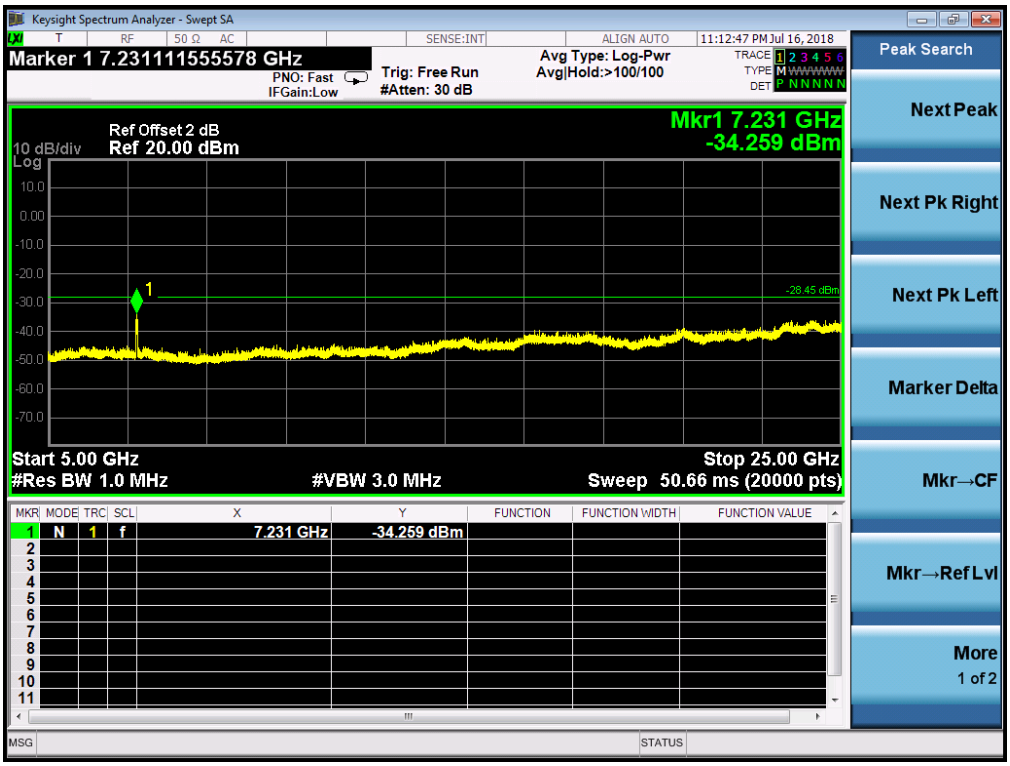

Keysight Spectrum Analyzer - Swept SA
Marker 2 2.464473223661 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:07:30 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr2 2.464 47 GHz
1.620 dBm
-27.70 dBm
Start 1.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 5.000 GHz
Sweep 382.6 ms (20000 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 4.925 80 GHz -38.456 dBm
2 N 1 f 2.464 47 GHz 1.620 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS


Keysight Spectrum Analyzer - Swept SA
Marker 1 7.378118905945 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:08:24 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 7.378 GHz
-35.769 dBm
-27.70 dBm
Start 5.00 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 50.66 ms (20000 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 7.378 GHz -35.769 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

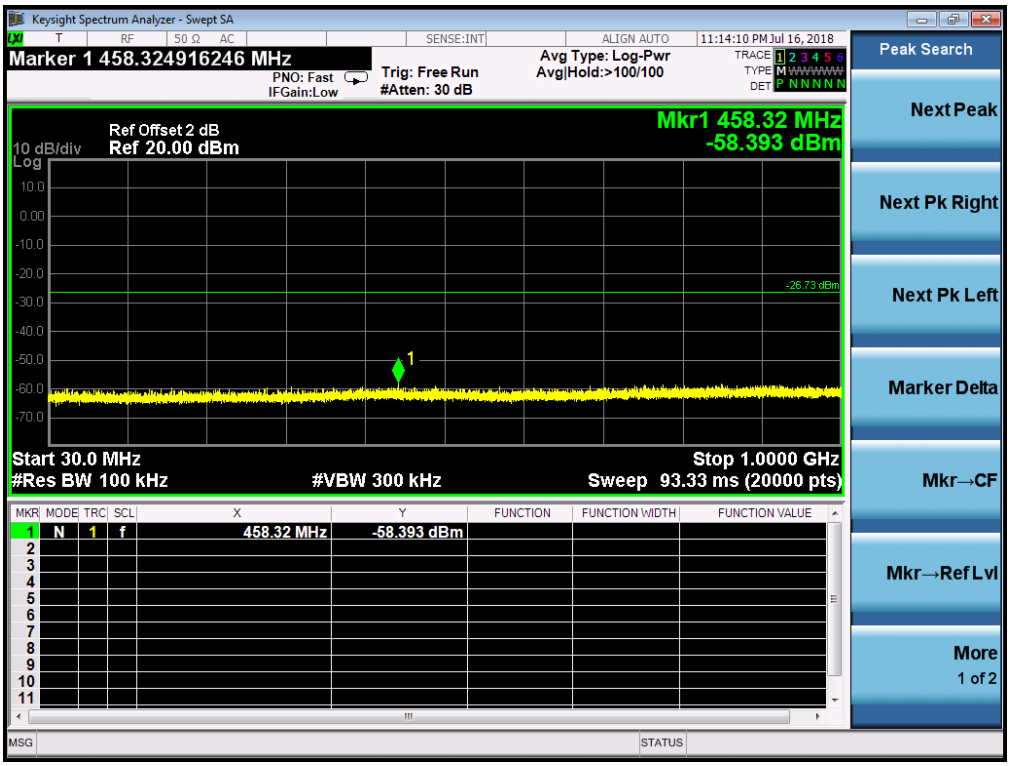
TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF 802.11n20 FOR MODULATION IN LOW CHANNEL

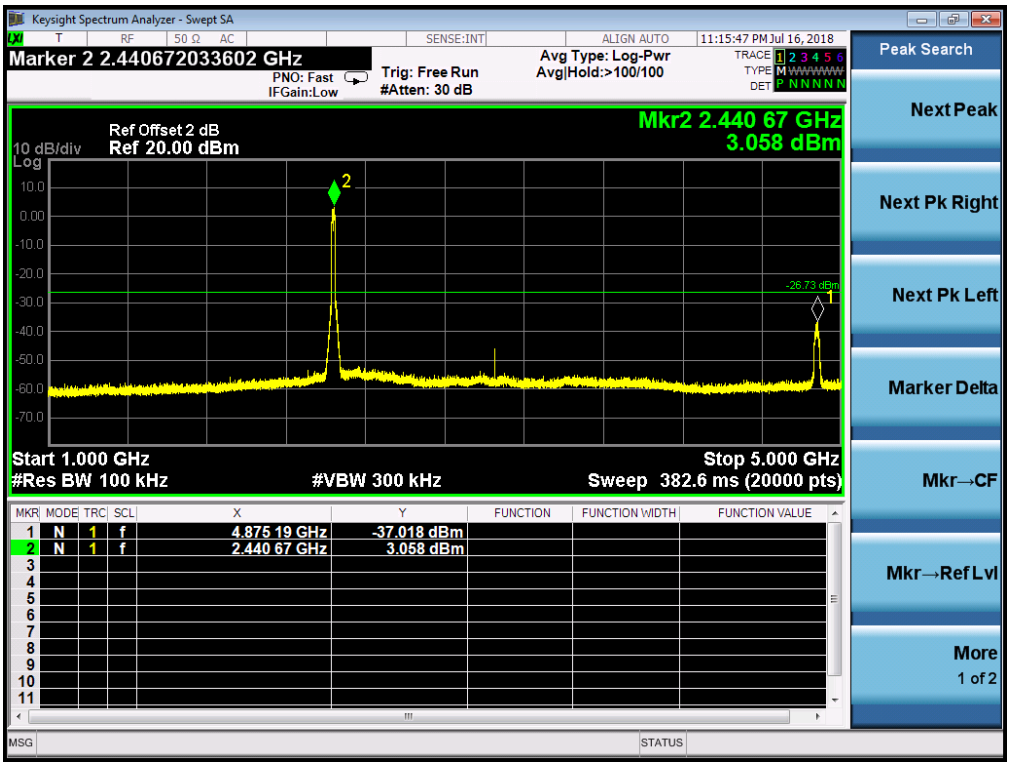


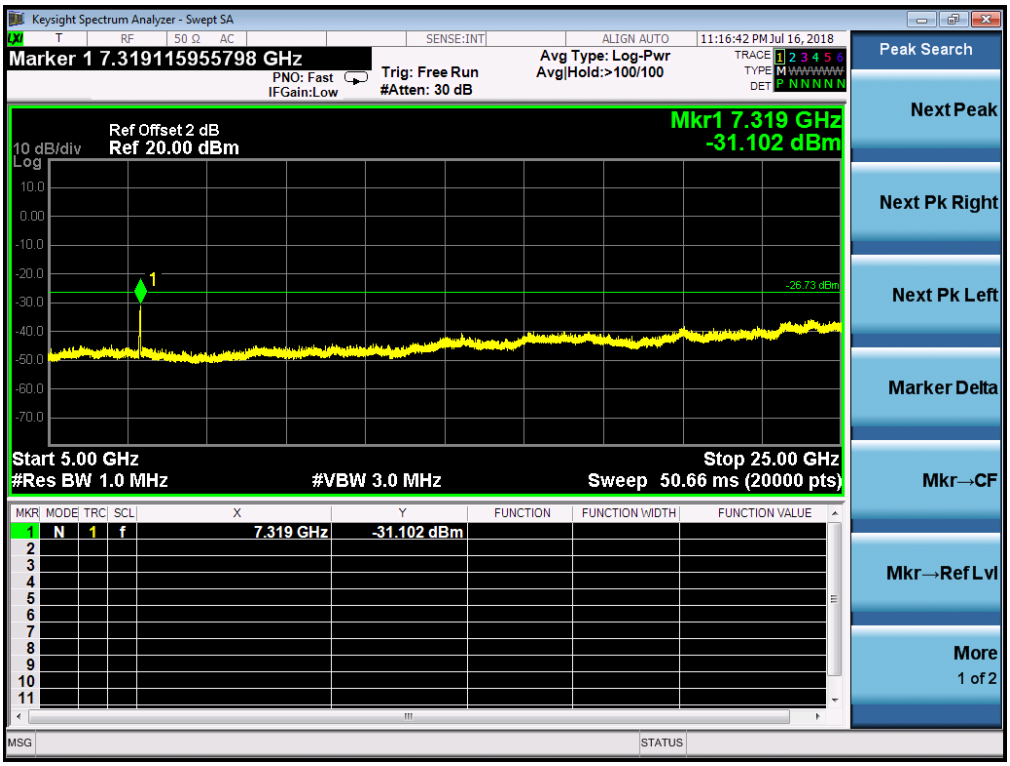




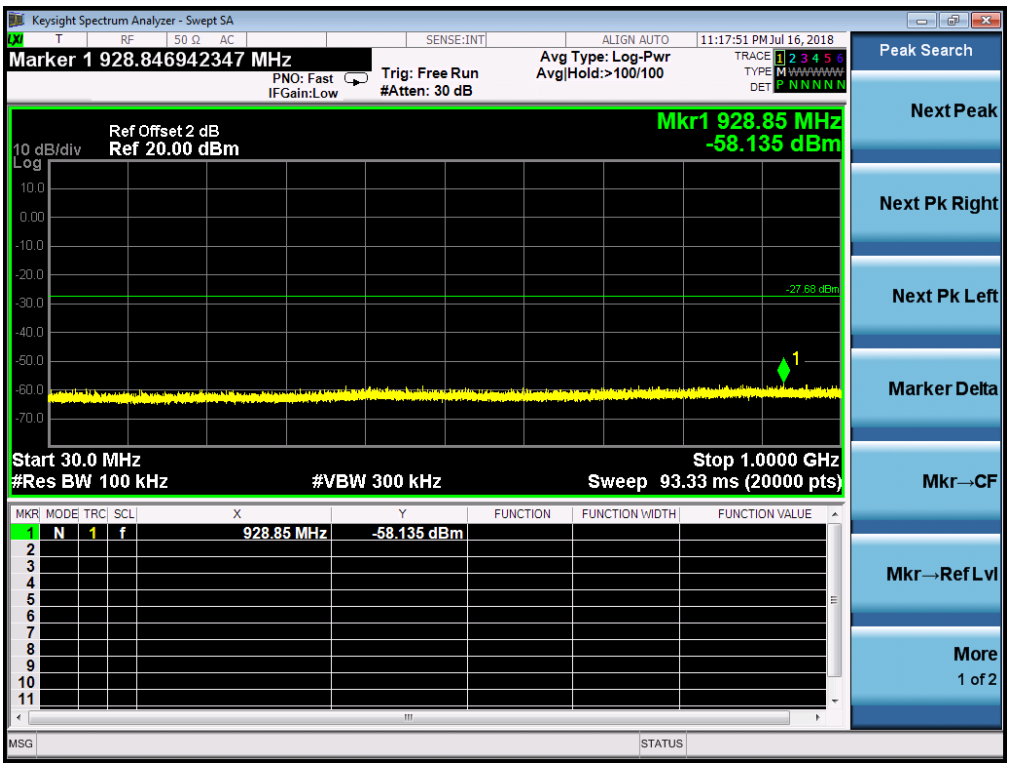
TEST PLOT OF OUT OF BAND EMISSIONS THE WORST CASE OF 802.11n20 FOR MODULATION IN MIDDLE CHANNEL

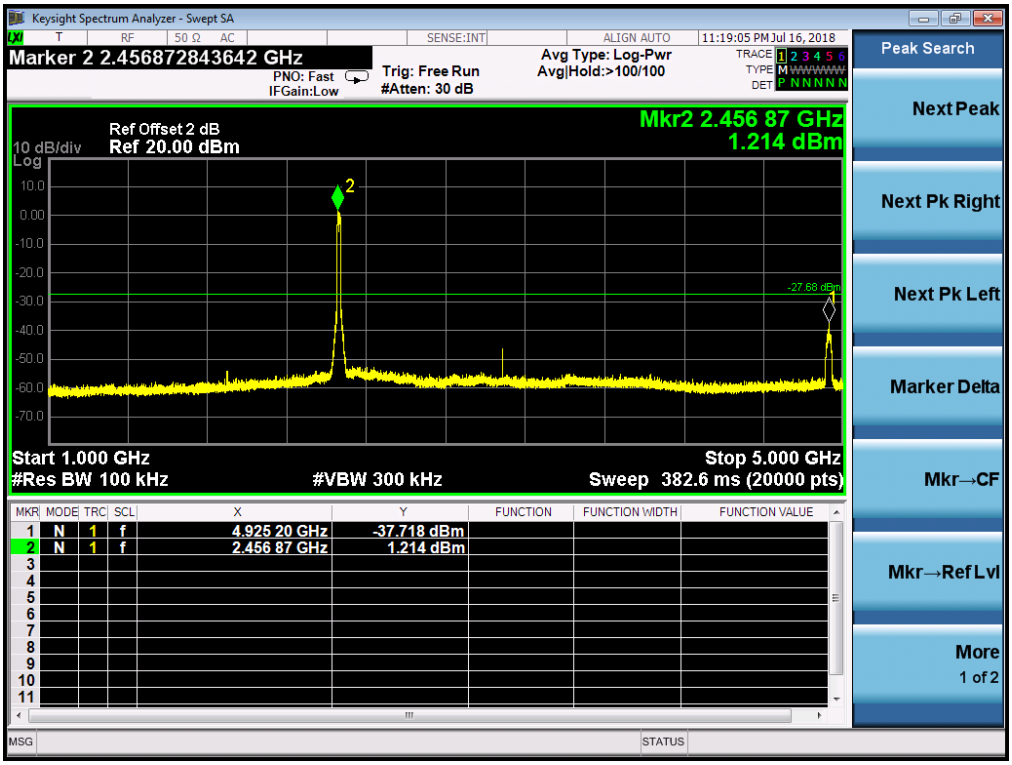


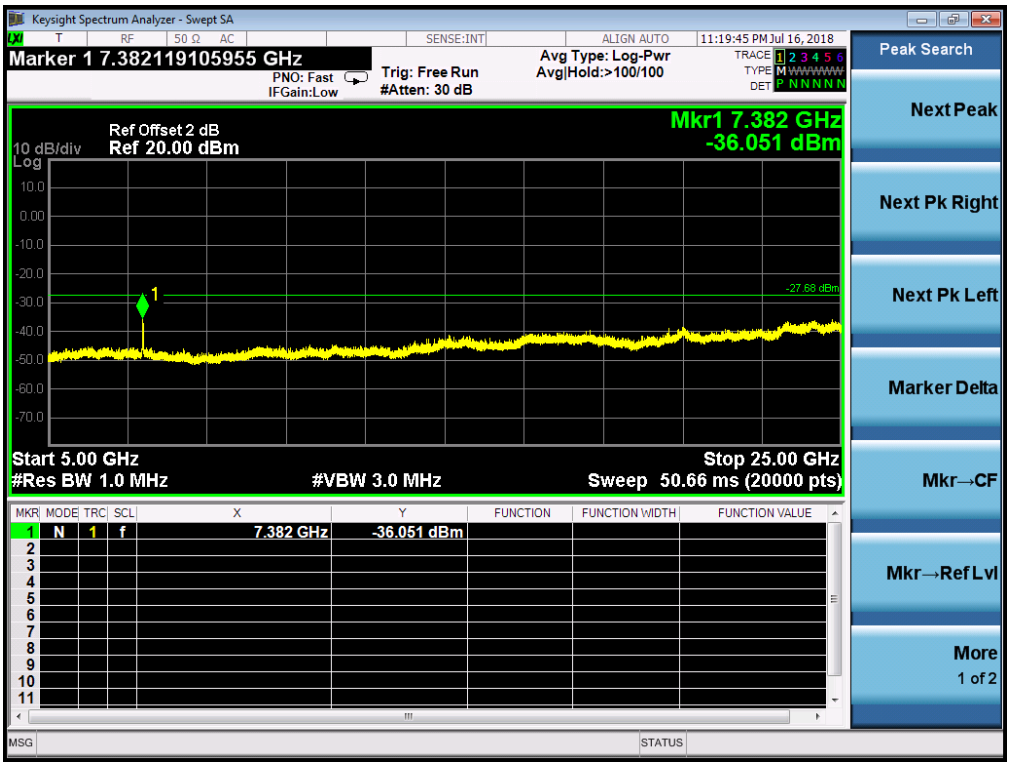

Keysight Spectrum Analyzer - Swept SA
Marker 2 2.440672033602 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:15:47 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr2 2.440 67 GHz
3.058 dBm
-26.73 dBm
Start 1.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 5.000 GHz
Sweep 382.6 ms (20000 pts)
1 N 1 f 4.875 19 GHz -37.018 dBm
2 N 1 f 2.440 67 GHz 3.058 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Marker 1 7.319115955798 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:16:42 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 7.319 GHz
-31.102 dBm
-26.73 dBm
Start 5.00 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 50.66 ms (20000 pts)
1 N 1 f 7.319 GHz -31.102 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

TEST PLOT OF OUT OF BAND EMISSIONS THE WORST CASE
OF 802.11n20 FOR MODULATION IN HIGH CHANNEL






Keysight Spectrum Analyzer - Swept SA
Marker 1 7.382119105955 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:19:45 PM Jul 16, 2018
Ref Offset 2 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 7.382 GHz
-36.051 dBm
-27.68 dBm
Start 5.00 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 50.66 ms (20000 pts)
1 N 1 f 7.382 GHz -36.051 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

10. MAXIMUM CONDUCTED OUTPUT POWER SPECTRAL DENSITY

10.1 MEASUREMENT PROCEDURE

(1). Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
(2). Set the EUT Work on the top, the middle and the bottom operation frequency individually.
(3). Set SPA Trace 1 Max hold, then View.

Note: The method of AVGPSD-1 in the ANSI C63.10 (2013) item 11.10 was used in this testing.

10.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

Refer To Section 8.2.

10.3 MEASUREMENT EQUIPMENT USED

Refer To Section 6.

10.4 LIMITS AND MEASUREMENT RESULT

TEST ITEM	POWER SPECTRAL DENSITY
TEST MODE	802.11b with data rate 1

Channel No.	**Power density (dBm/20kHz)**	**Limit (dBm/3kHz)**	**Result**
Low Channel	-1.055	8	Pass
Middle Channel	0.081	8	Pass
High Channel	-0.689	8	Pass

TEST ITEM	POWER SPECTRAL DENSITY
TEST MODE	802.11g with data rate 6

Channel No.	**Power density (dBm/20kHz)**	**Limit (dBm/3kHz)**	**Result**
Low Channel	-4.038	8	Pass
Middle Channel	-2.646	8	Pass
High Channel	-3.748	8	Pass

TEST ITEM	POWER SPECTRAL DENSITY
TEST MODE	802.11n 20 with data rate 6.5

Channel No.	**Power density (dBm/20kHz)**	**Limit (dBm/3kHz)**	**Result**
Low Channel	-4.508	8	Pass
Middle Channel	-2.923	8	Pass
High Channel	-3.800	8	Pass

802.11b TEST RESULT

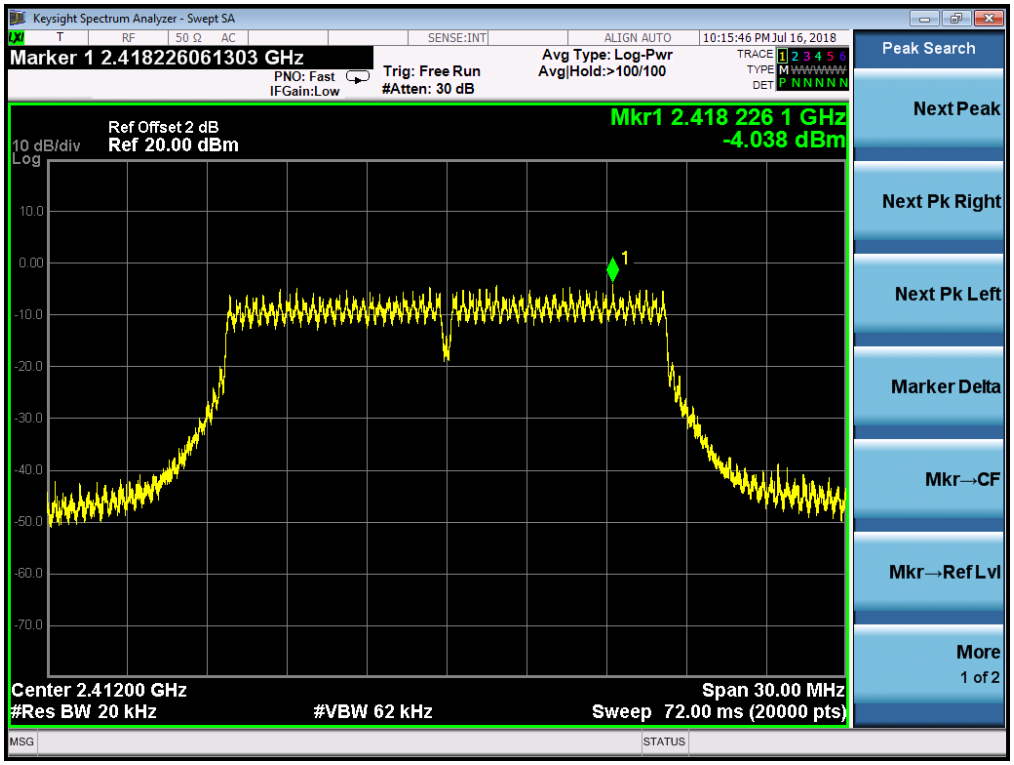
TEST PLOT OF SPECTRAL DENSITY FOR LOW CHANNEL

TEST PLOT OF SPECTRAL DENSITY FOR MIDDLE CHANNEL

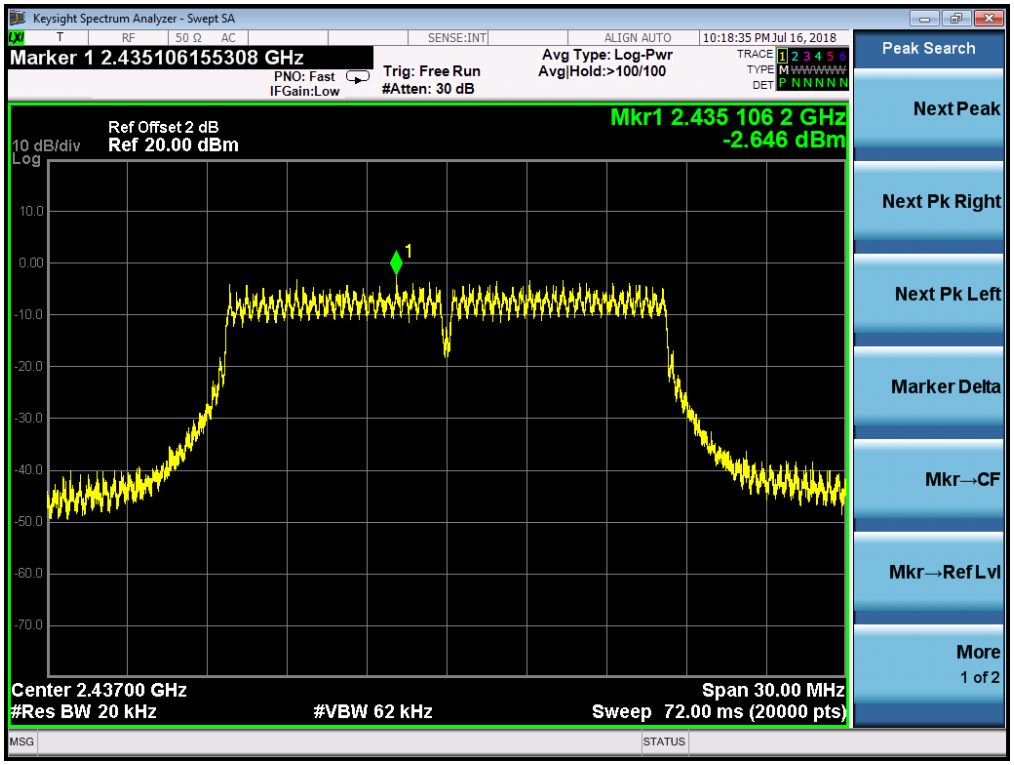
TEST PLOT OF SPECTRAL DENSITY FOR HIGH CHANNEL

802.11g TEST RESULT

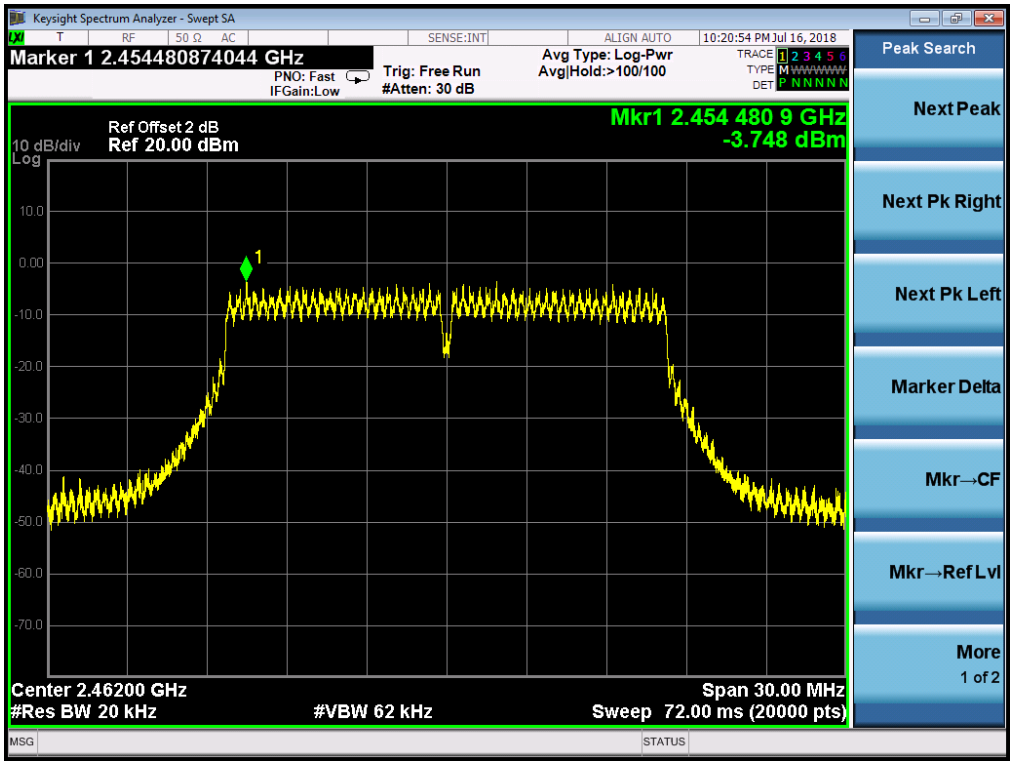
TEST PLOT OF SPECTRAL DENSITY FOR LOW CHANNEL



TEST PLOT OF SPECTRAL DENSITY FOR MIDDLE CHANNEL

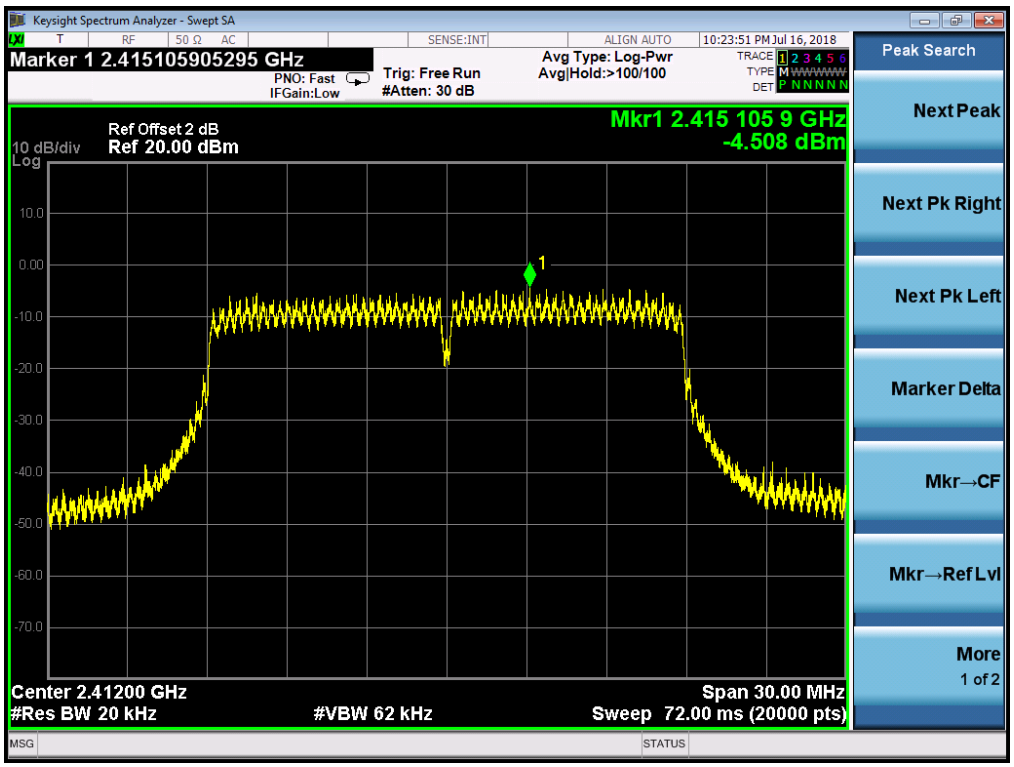


TEST PLOT OF SPECTRAL DENSITY FOR HIGH CHANNEL

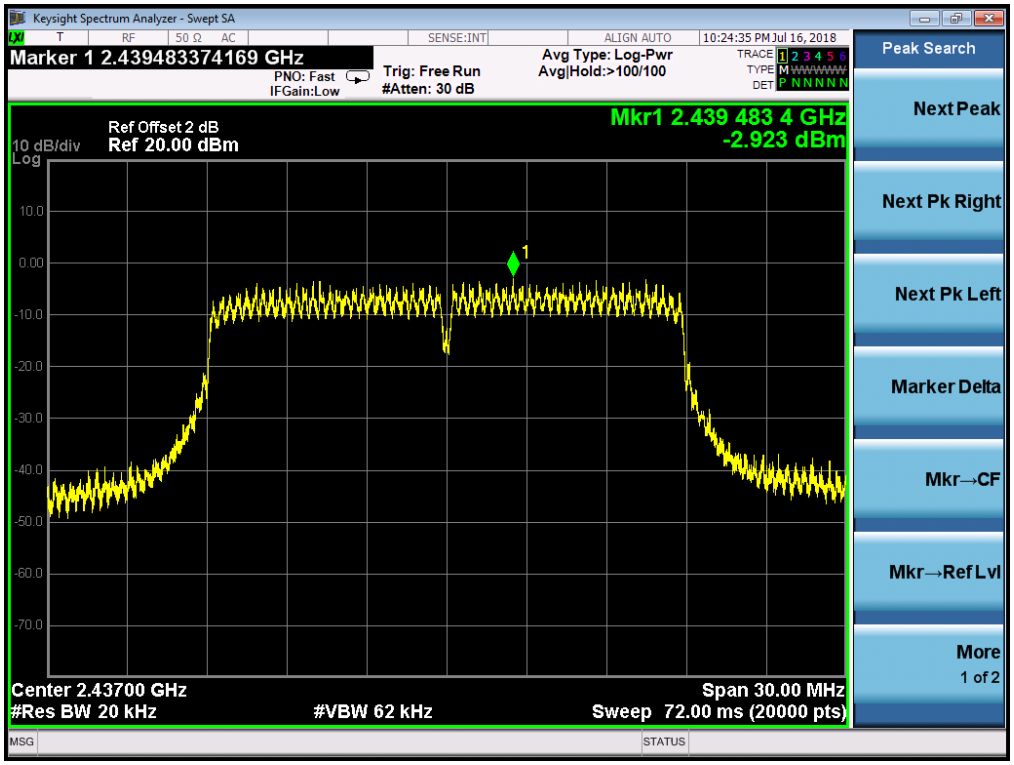


802.11n 20 TEST RESULT

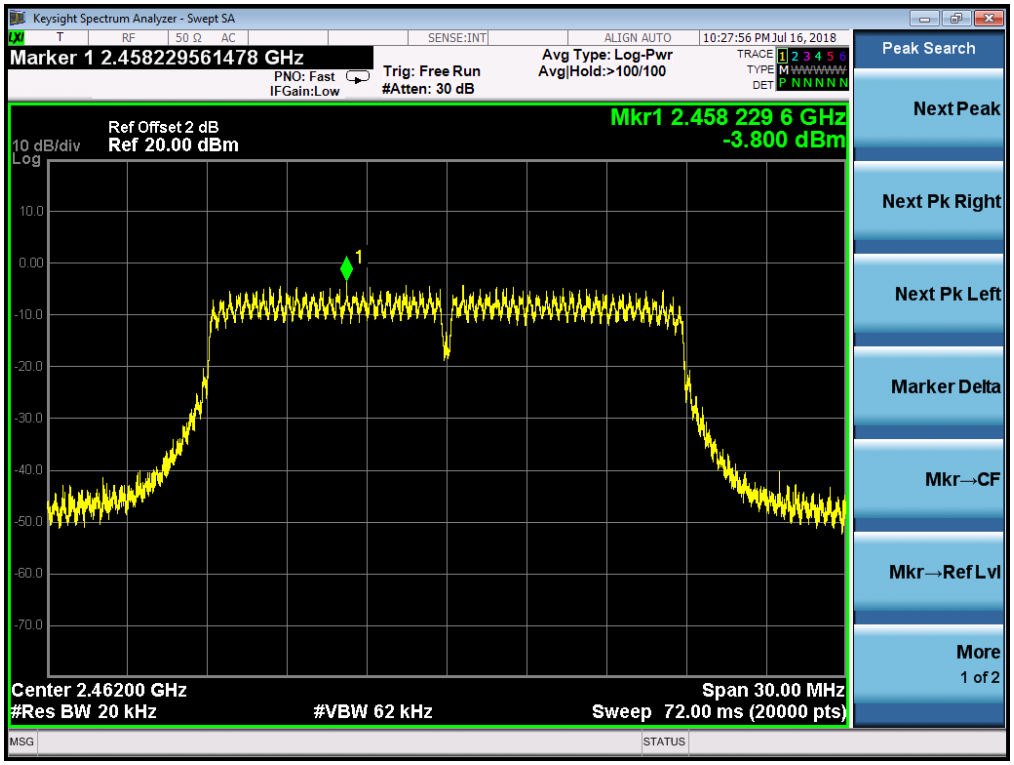
TEST PLOT OF SPECTRAL DENSITY FOR LOW CHANNEL



TEST PLOT OF SPECTRAL DENSITY FOR MIDDLE CHANNEL



TEST PLOT OF SPECTRAL DENSITY FOR HIGH CHANNEL



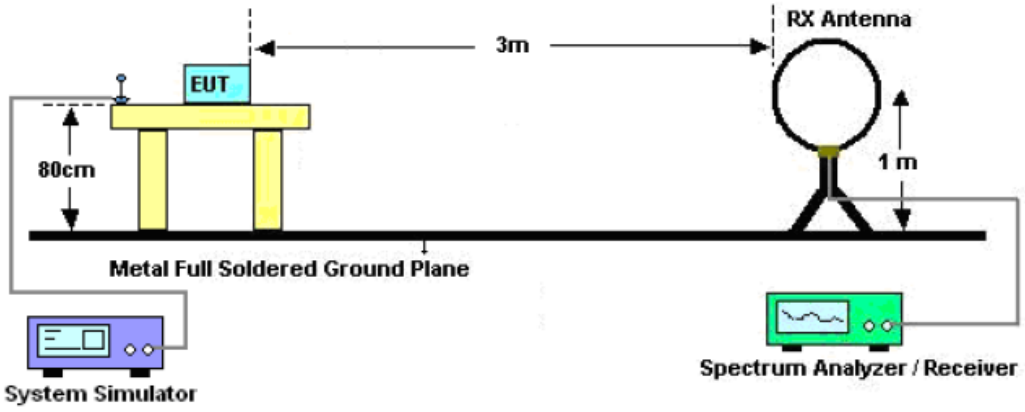
11. RADIATED EMISSION

11.1. MEASUREMENT PROCEDURE

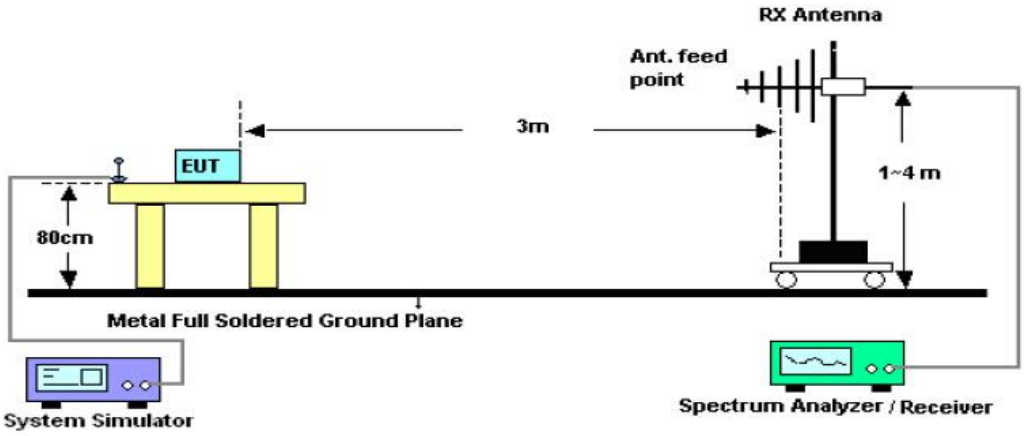
1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

11.2. TEST SETUP

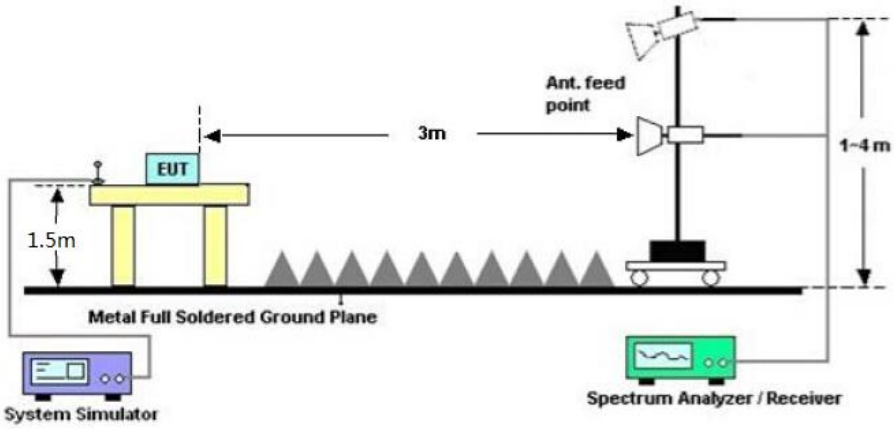
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



11.3. LIMITS AND MEASUREMENT RESULT

15.209(a) Limit in the below table has to be followed

Frequencies (MHz)	Field Strength (micorvolts/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

Note: All modes were tested For restricted band radiated emission,
the test records reported below are the worst result compared to other modes.

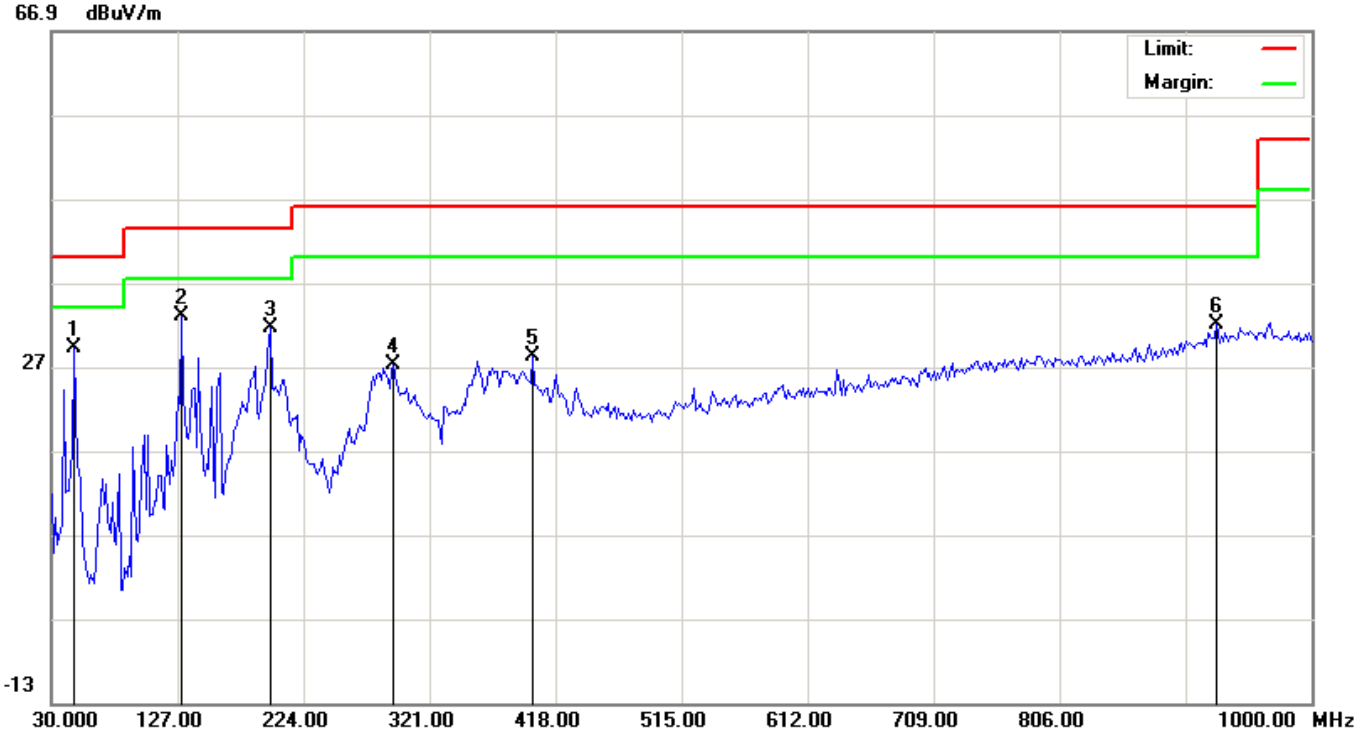
11.4. TEST RESULT

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

RADIATED EMISSION BELOW 1GHZ

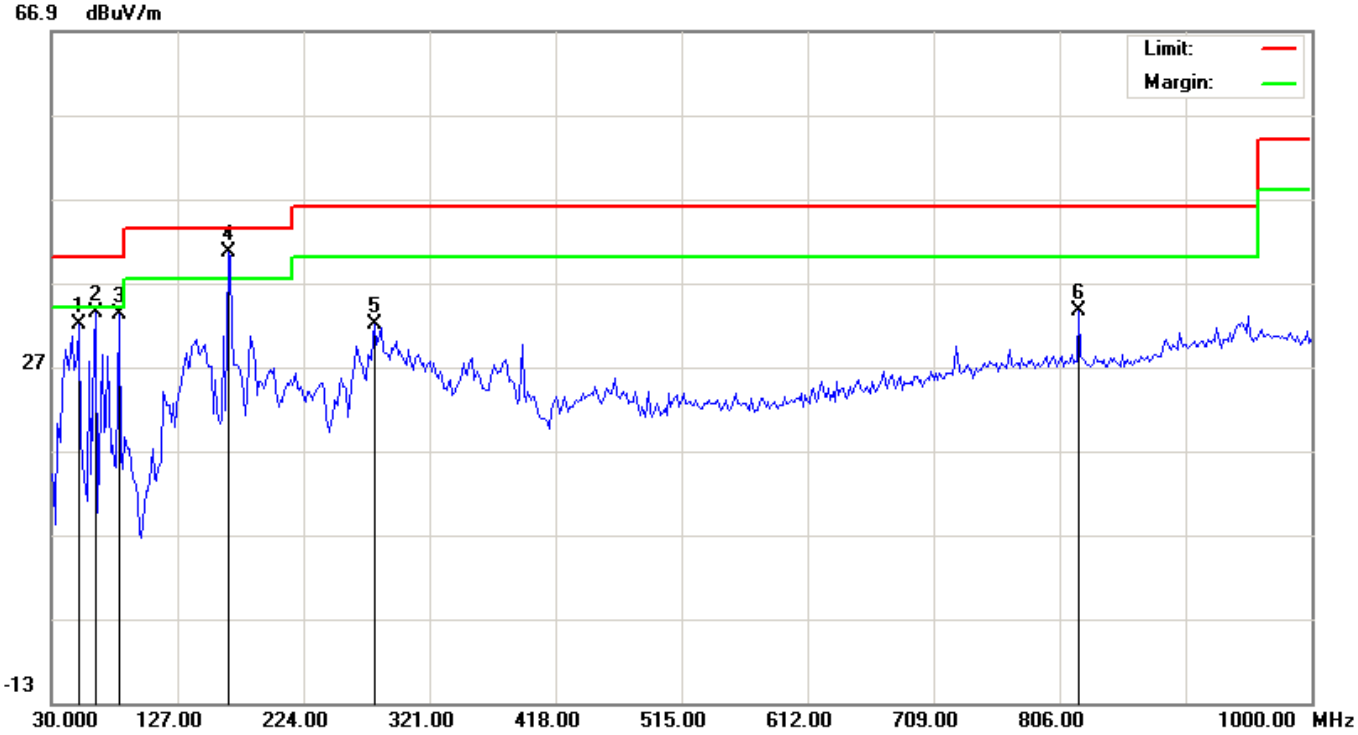
RADIATED EMISSION TEST- (30MHZ-1GHZ) -HORIZONTAL



No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	-	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		47.7833	17.79	11.39	29.18	40.00	-10.82	peak			
2	*	130.2332	22.28	10.64	32.92	43.50	-10.58	peak			
3		198.1333	19.71	11.91	31.62	43.50	-11.88	peak			
4		293.5167	12.87	14.31	27.18	46.00	-18.82	peak			
5		400.2167	9.04	19.08	28.12	46.00	-17.88	peak			
6		927.2500	2.69	29.37	32.06	46.00	-13.94	peak			

RESULT: PASS

RADIATED EMISSION TEST- (30MHZ-1GHZ) -VERTICAL



No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
	.	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		51.0167	23.71	8.23	31.94	40.00	-8.06	peak			
2		63.9500	26.71	6.61	33.32	40.00	-6.68	peak			
3		81.7333	30.73	2.42	33.15	40.00	-6.85	peak			
4	*	165.8000	25.61	14.96	40.57	43.50	-2.93	peak			
5		278.9667	17.14	14.77	31.91	46.00	-14.09	peak			
6		820.5500	6.35	27.32	33.67	46.00	-12.33	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

3. All test modes had been pre-tested. The 802.11b at low channel is the worst case and recorded in the report.

RADIATED EMISSION ABOVE 1GHZ

Frequency	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	Type	
TX 11b 2412MHz					
4824	49.85	74	-24.15	Pk	Horizontal
4824	35.69	54	-18.31	AV	Horizontal
7236	50.22	74	-23.78	pk	Horizontal
7236	34.44	54	-19.56	AV	Horizontal
4824	50.31	74	-23.69	Pk	Vertical
4824	34.21	54	-19.79	AV	Vertical
7236	50.11	74	-23.89	Pk	Vertical
7236	39.09	54	-14.91	AV	Vertical
TX 11b 2437MHz					
4874	48.25	74	-25.75	Pk	Horizontal
4874	32.33	54	-21.67	AV	Horizontal
7311	45.78	74	-28.22	Pk	Horizontal
7311	35.13	54	-18.87	AV	Horizontal
4874	49.25	74	-24.75	Pk	Vertical
4874	40.64	54	-13.36	AV	Vertical
7311	48.22	74	-25.78	Pk	Vertical
7311	38.12	54	-15.88	AV	Vertical
TX 11b 2462MHz					
4924	50.05	74	-23.95	Pk	Horizontal
4924	34.11	54	-19.89	AV	Horizontal
7386	48.42	74	-25.58	Pk	Horizontal
7386	39.33	54	-14.67	AV	Horizontal
4924	50.42	74	-23.58	Pk	Vertical
4924	38.25	54	-15.75	AV	Vertical
7386	49.18	74	-24.82	Pk	Vertical
7386	37.44	54	-16.56	AV	Vertical

RESULT: PASS

Note:

1. Margin = Emission Leve - Limit

2.1GHz-25GHz(All test modes had been pre-tested. The 802.11b mode is the worst case and recorded in the report. No recording in the test report at least have 20dB margin).

12. BAND EDGE EMISSION

12.1. MEASUREMENT PROCEDURE

1)Radiated restricted band edge measurements

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting

2)Conducted Emissions at the bang edge

a)The transmitter output was connected to the spectrum analyzer

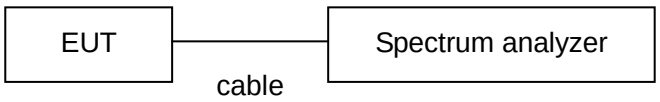
b)Set RBW=100kHz,VBW=300kHz

c)Suitable frequency span including 100kHz bandwidth from band edge

12.2. TEST SET-UP

Radiated same as 11.2

Conducted set up



12.3. RADIATED TEST RESULT

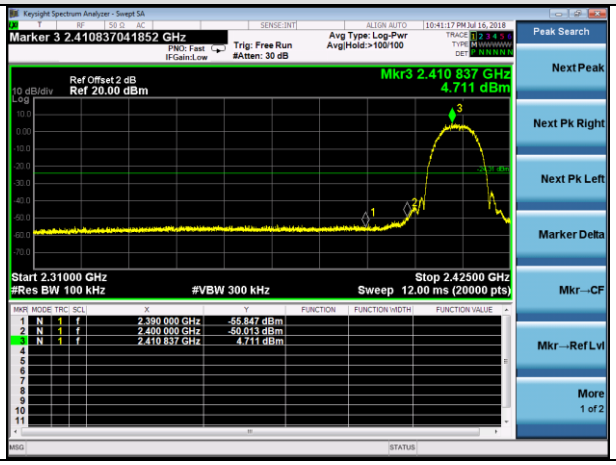
Frequency	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	Type	
TX 11b 2412MHz					
2399.9	47.44	74	-26.56	pk	Horizontal
2399.9	41.36	54	-12.64	AV	Horizontal
2400	50.74	74	-23.26	pk	Horizontal
2400	35.20	54	-18.80	AV	Horizontal
2399.9	53.36	74	-20.64	pk	Vertical
2399.9	38.52	54	-15.48	AV	Vertical
2400	49.44	74	-24.56	pk	Vertical
2400	38.36	54	-15.64	AV	Vertical
TX 11b 2462MHz					
2483.5	47.11	74	-26.89	pk	Horizontal
2483.5	38.25	54	-15.75	AV	Horizontal
2483.6	48.11	74	-25.89	pk	Horizontal
2483.6	39.31	54	-14.69	AV	Horizontal
2483.5	48.85	74	-25.15	pk	Vertical
2483.5	34.46	54	-19.54	AV	Vertical
2483.6	53.31	74	-20.69	pk	Vertical
2483.6	39.28	54	-14.72	AV	Vertical

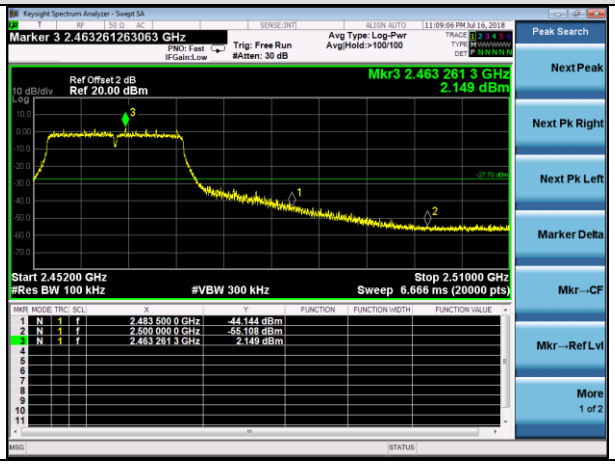
RESULT: PASS

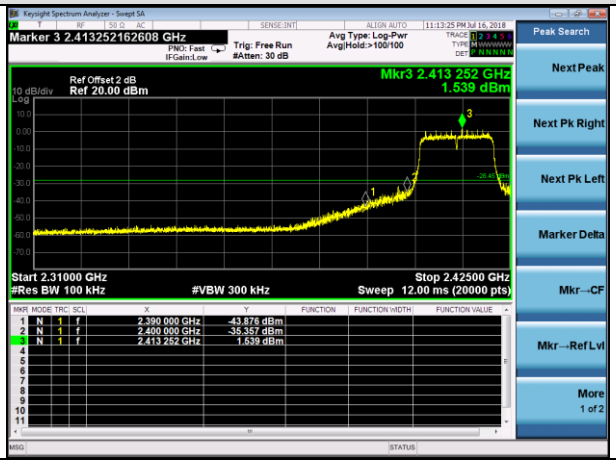
Note: Scan with 11b,11g,11n, the worst case is 11b Mode
Margin= Emission Level -Limit.

12.4. CONDUCTED TEST RESULT

Test Graph

11b-LCH	11b-HCH
	

11g-LCH	11g-HCH
	

11n20-LCH	11n20-HCH
	

RESULT: PASS

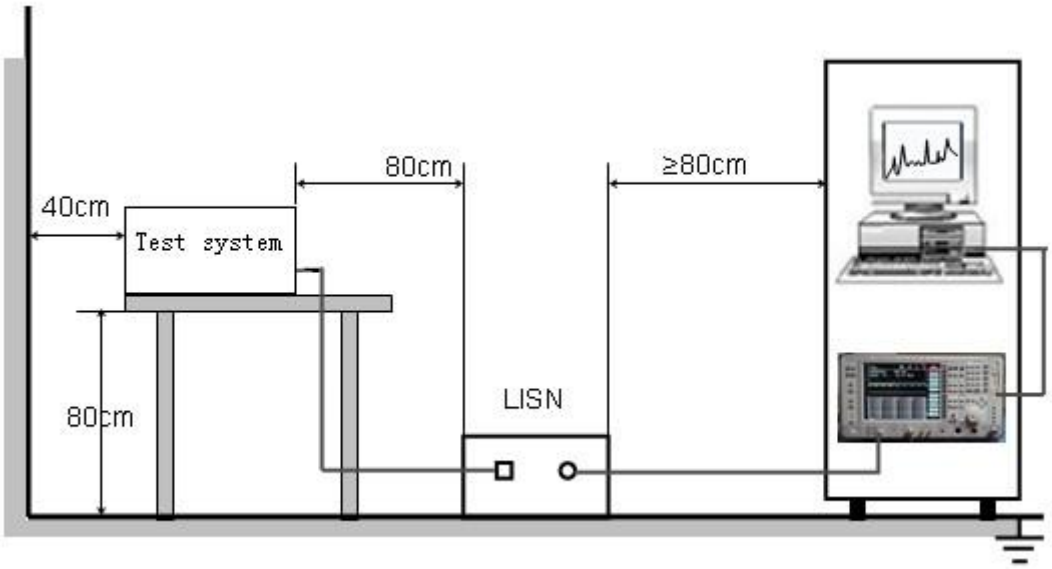
13. FCC LINE CONDUCTED EMISSION TEST

13.1. LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz-500kHz	66-56	56-46
500kHz-5MHz	56	46
5MHz-30MHz	60	50

Note:
1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50MHz.

13.2. BLOCK DIAGRAM OF TEST SETUP



13.3. PROCEDURE OF LINE CONDUCTED EMISSION TEST

(1) The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When the EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.

(2) Support equipment, if needed, was placed as per ANSI C63.10.

(3) All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.

(4) The EUT received AC120V/60Hz power from a LISN.

(5) The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.

(6) Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.

(7) During the above scans, the emissions were maximized by cable manipulation.

(8) A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions.

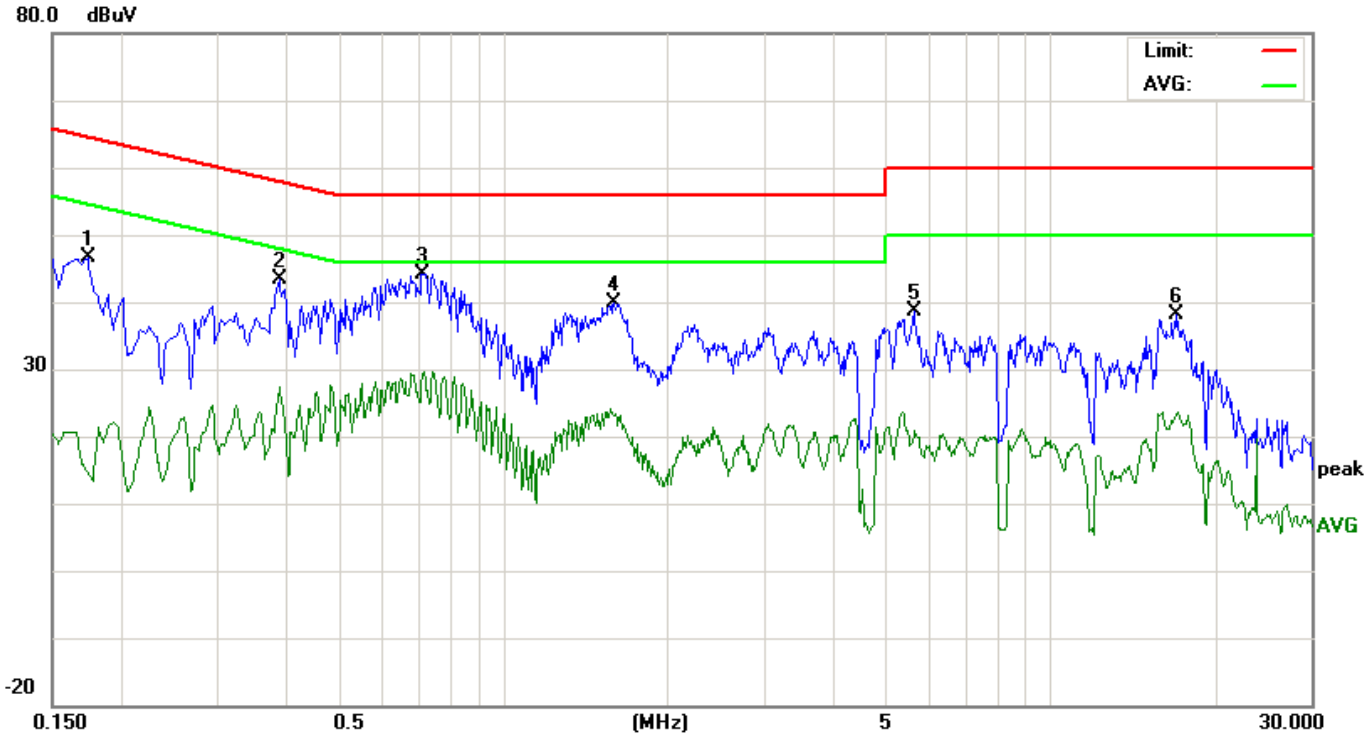
(9) Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.

13.4. TEST RESULT OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

13.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

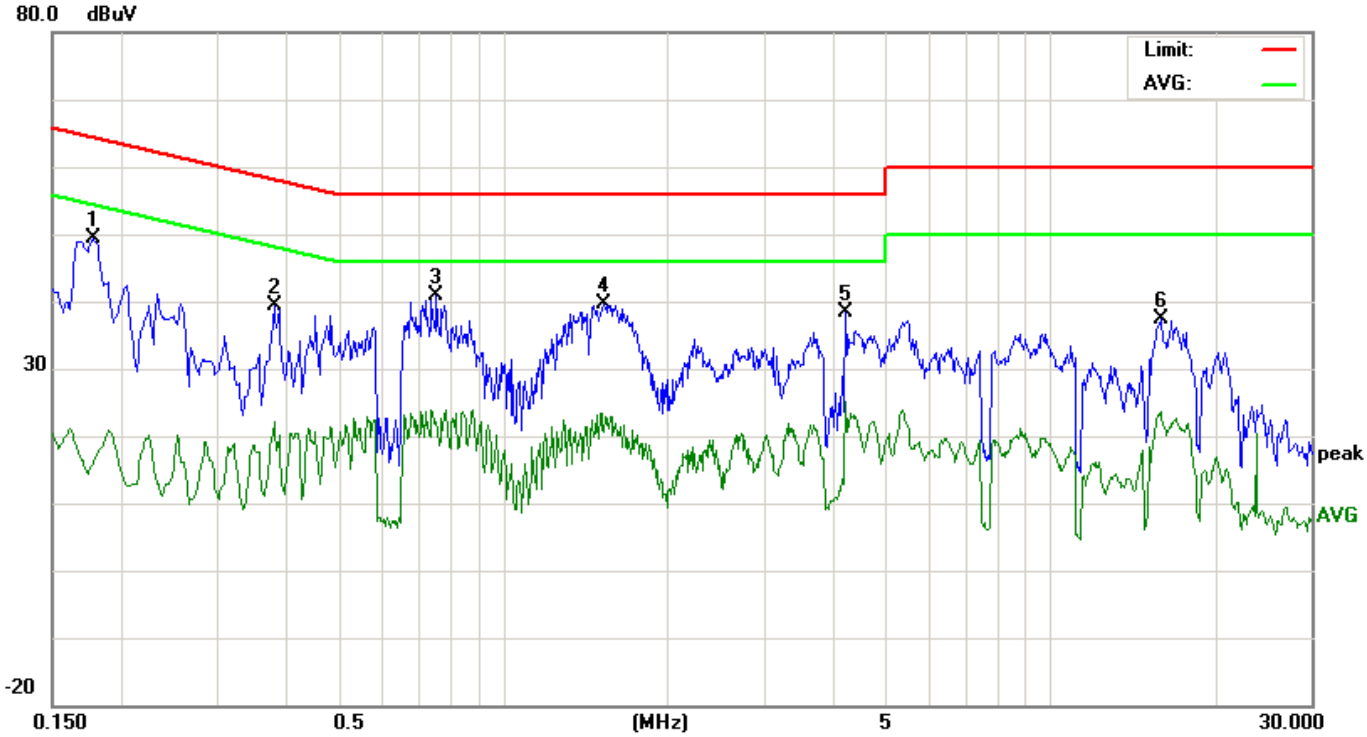
LINE CONDUCTED EMISSION TEST-L1



No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG	dB	Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.1740	36.42		4.51	10.19	46.61		14.70	64.76	54.76	-18.15	-40.06	P	
2	0.3899	33.03		16.93	10.33	43.36		27.26	58.06	48.06	-14.70	-20.80	P	
3	0.7140	33.86		18.78	10.34	44.20		29.12	56.00	46.00	-11.80	-16.88	P	
4	1.5940	29.59		12.80	10.35	39.94		23.15	56.00	46.00	-16.06	-22.85	P	
5	5.6460	28.37		10.08	10.26	38.63		20.34	60.00	50.00	-21.37	-29.66	P	
6	17.0780	27.93		13.05	10.13	38.06		23.18	60.00	50.00	-21.94	-26.82	P	

RESULT: PASS

LINE CONDUCTED EMISSION TEST-N

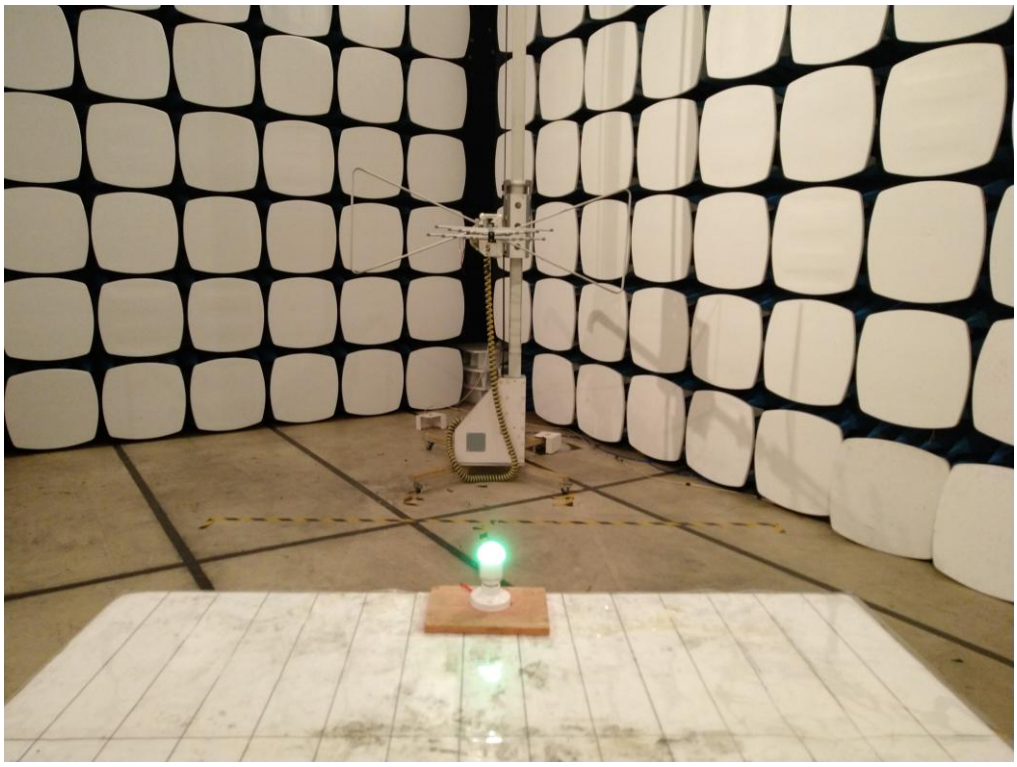


No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG	dB	Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.1780	39.15		5.78	10.19	49.34		15.97	64.57	54.57	-15.23	-38.60	P	
2	0.3820	28.98		11.76	10.32	39.30		22.08	58.23	48.23	-18.93	-26.15	P	
3	0.7580	30.65		11.80	10.31	40.96		22.11	56.00	46.00	-15.04	-23.89	P	
4	1.5300	29.20		10.29	10.37	39.57		20.66	56.00	46.00	-16.43	-25.34	P	
5	4.2380	27.96		14.81	10.33	38.29		25.14	56.00	46.00	-17.71	-20.86	P	
6	16.0220	27.33		12.84	10.11	37.44		22.95	60.00	50.00	-22.56	-27.05	P	

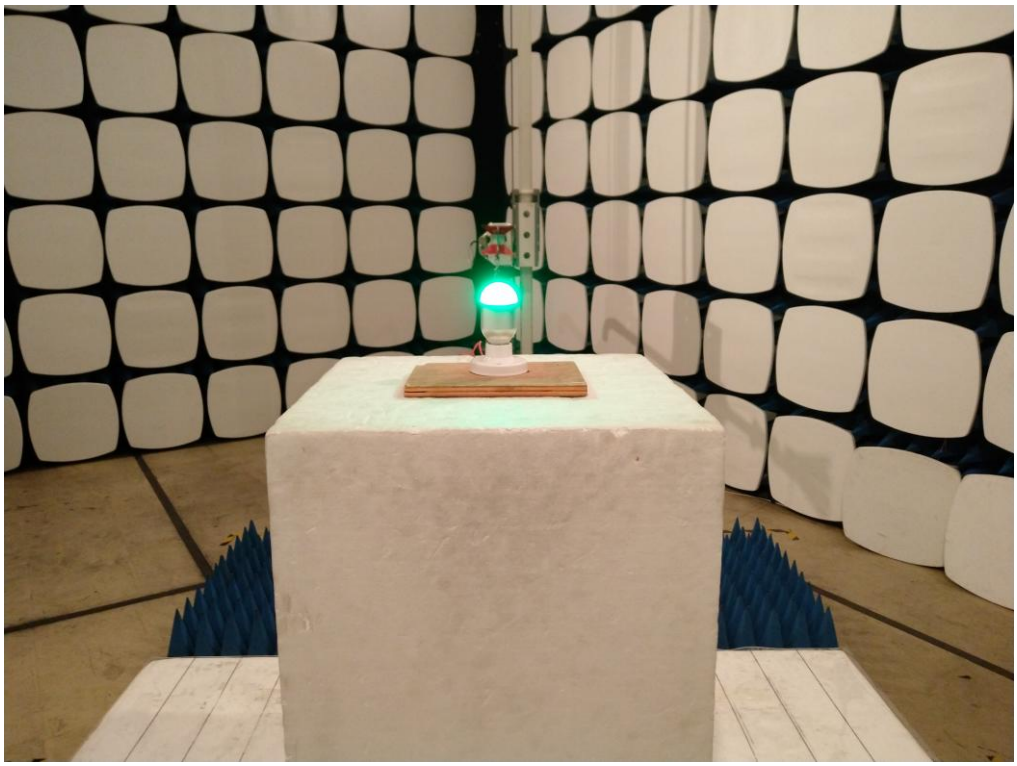
RESULT: PASS

APPENDIX A: PHOTOGRAPHS OF TEST SETUP

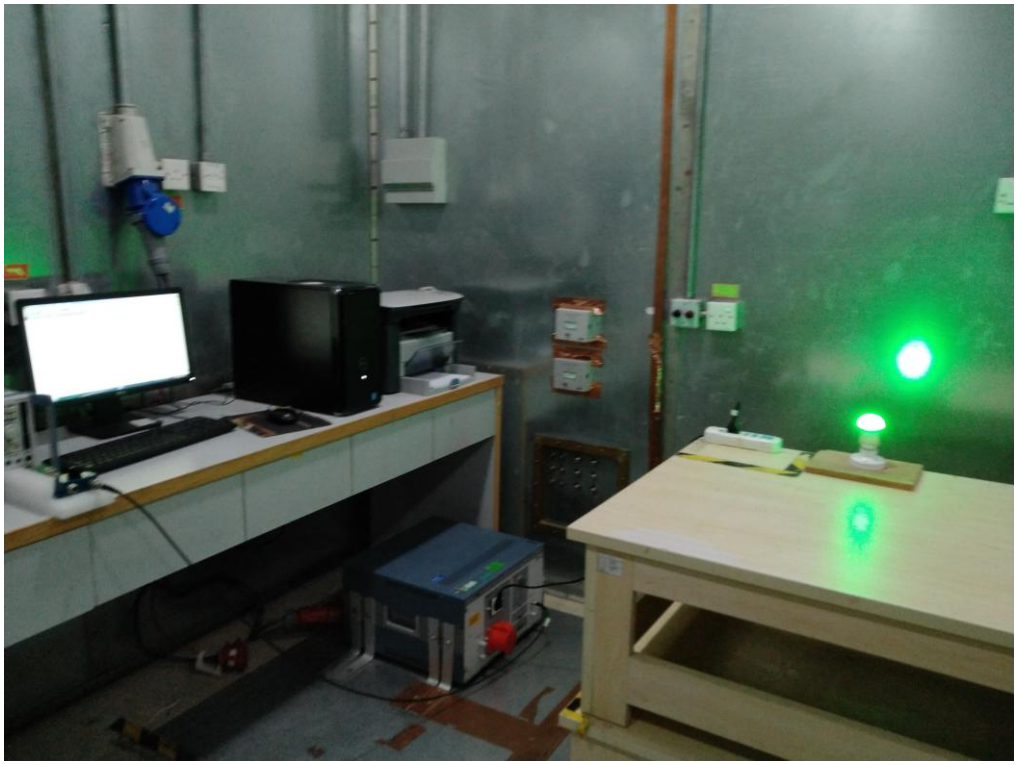
FCC RADIATED EMISSION TEST SETUP BELOW 1GHZ



FCC RADIATED EMISSION TEST SETUP ABOVE 1GHZ



FCC CONDUCTED EMISSION TEST SETUP



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