FCC CFR47 Part 15 Subpart E Certification Test Report

For the

Product	**: S-DAQ**
Model	**: SRC-BAMVC2**
FCC ID	**: 2AN5BSRC-BAMVC2**
Applicant	**: SEMES CO., LTD.**
FCC Rule	**: CFR 47 Part 15 Subpart E**

We hereby certify that the above product has been tested by us with the listed rules and found in compliance with the regulation. The test data and results are issued on the test report no. **TR-W1712-002**

Signature

Choi, Yeong-min / Technical Manager

Date: 2017-12-01

Test Laboratory: ENG Co., Ltd.

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FCC CERTIFICATION TEST REPORT

Project Number	**: EA1710C-008**
Test Report Number	**: TR-W1712-002**
Type of Equipment	**: S-DAQ**
Model Name	**: SRC-BAMVC2**
FCC ID	**: 2AN5BSRC-BAMVC2**
Multiple Model Name	**: SRC-BAMVE2**
Applicant	**: SEMES CO., LTD.**
Address	**: 77, 4sandan 5-gil, Jiksan-eup Seobuk-gu, Cheonan-si, Chungcheongnam-do, Korea**
Manufacturer	**: SEMES CO., LTD.**
Address	**: 77, 4sandan 5-gil, Jiksan-eup Seobuk-gu, Cheonan-si, Chungcheongnam-do, Korea**
Regulation	**: FCC Part 15 Subpart E Section 15.407**
Total page of Report	**: 55 Pages**
Date of Receipt	**: 2017-10-13**
Date of Issue	**: 2017-12-01**
Test Result	**: PASS**

This test report only contains the result of a single test of the sample supplied for the examination.
It is not a generally valid assessment of the features of the respective products of the mass-production.

Prepared by Song, In-young / Senior Engineer _____ 2017-12-01
Signature Date

Reviewed by Choi, Yeong-min / Technical Manager _____ 2017-12-01
Signature Date

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Release Control Record

Issue Report No.	Issued Date	Revisions	Effect Section
TR-W1712-002	2017-12-01	Initial Release	All

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1. TEST SUMMARY

1.1 Regulations and results

The sample submitted for evaluation(Referred to below as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference Section	Description	P (Pass)	F (Fail)	N.T. (Not Tested)	Note
15.203	Antenna Requirement	P			
15.205, 15.209,15.407(b)(5), (6), (7)	Radiated Unwanted Emissions	P			
15.407 (a)	26 dB Bandwidth	P			
15.407 (a)(1)(ii),(3)	Maximum Conducted Output Power	P			
15.407 (a)(1)(ii),(3),(5)	Power Spectral Density	P			
15.407 (b)(1),(4)	Undesirable Emissions	P			
15.407 (e)	6 dB Occupied Bandwidth	P			
15.407(g)	Frequency Satiability	P			
15.207, 15.407(b)(6)	AC-Line Conducted Emission	P			

1.2 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart E Section 15.407.

1.3 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15 and ANSI C63.10-2013.

KDB 789033 D02 General U-NII Test Procedures New Rules v02

1.4 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

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1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjiam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Description details of test facilities were submitted to the FCC and IC, designated by the RRA (Radio Research Agency), and accredited by Korea and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea according to the requirement of ISO 17025.

Agency Name	Registration No.	Mark
FCC	KR0160	
Industry Canada (IC)	IC 12721A-1	
RRA	KR0160	
Korean Agency for Technology and Standards	KT733	

2. EUT (Equipment Under Test) INFORMATION

2.1 General Description

The SEMES CO., LTD., Model SRC-BAMVC2 (referred to as the EUT in this report) is a S-DAQ. The EUT is a device for transferring voltage signal and equipment information to an agent PC through wired/wireless communication. For wireless communication, the EUT has WLAN module has function for 802.11a/b/g, so this report covers 802.11 a only and another report covers function for 802.11b/g.

Operating Frequency	U-NII Band1: 5 180 ~ 5 240 MHz U-NII Band3: 5 745 ~ 5 805 MHz
Max. RF Output Power	15.48 dBm (Measured)
Modulation Types	OFDM(802.11 a)
Number of Channels	U-NII Band1 (5 180 ~ 5 240 MHz): 4 CH U-NII Band3 (5 745 ~ 5 805 MHz): 4 CH
Channel Bandwidth	20 MHz
Generated or used Freq. in EUT	32.768 kHz, 12 MHz, 24 MHz, 25 MHz, 33 MHz, 37.4 MHz
Type of Antenna	☐ Integrated Type ■ Dedicated Type
Antenna Gain	3.92 dBi
Operating Temperature	5 °C ~ + 50 °C
Normal Test Voltage	DC 24 V
Electrical Rating	DC 21.6 V - DC 26.4 V
Test SW Version	Tera Term ver.4.91
RF power setting in TEST SW	U-NII Band1:76, U-NII Band3: 68

2.2 Available channel number and frequency

Operating Mode: 802.11 a (U-NII Band 1)		Operating Mode: 802.11 a (U-NII Band 3)	
Channel	Frequency(MHz)	Channel	Frequency(MHz)
36	5 180	149	5 745
40	5 200	153	5 765
44	5 220	157	5 785
48	5 240	161	5 805

2.3 Additional Model

Model Name	Model Difference
SRC-BAMVC2	Basic Model
SRC-BAMVE2	SRC-BAMVE2 is identical to SRC-BAMVC2 except for model designation and without RS232 Board
NOTE: The Manufacturer has declared to all the additional model names into basic model name without any further evaluation by ENG Co., Ltd.	

3. TEST CONDITION

3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement

Description	Model No.	Serial No.	Manufacturer.
S-DAQ (EUT)	SRC-BAMVC2	N/A	SEMES CO., LTD.
Notebook PC	LGR48	MEZ62016801	LG Electronics
Adapter for Notebook PC	PA-1900-08	0Y00719207	Dongguang Lite Power 2nd Plant

3.2 Mode of operation during the test

For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission were performed with the EUT set to transmit at the channel with the highest output power as worst case scenario. All spurious emission tests were performed in X, Y and Z axis direction. And only the worst Z-axis test condition was recorded in this test report.

Based on preliminary testing following operating modes were selected for the final test as listed below.

3.2.1 Radiated Emission Test Mode Above 1 GHz

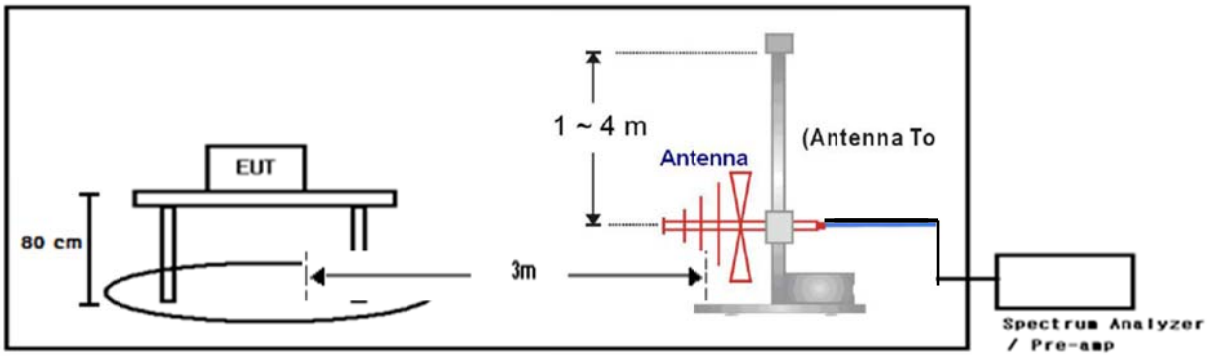
Operating Mode	Channel	Frequency (MHz)	Data rate(Mbps)	Output Power(dBm)
802.11a (U-NII Band1)	36	5 180	54	15.13
	44	5 220	54	15.39
	48	5 240	54	15.48
802.11a (U-NII Band3)	149	5 745	54	10.75
	157	5 785	54	10.41
	161	5 805	54	10.17

3.2.2 Radiated Emission Test Mode below 1 GHz and AC Power Line Conducted Emission

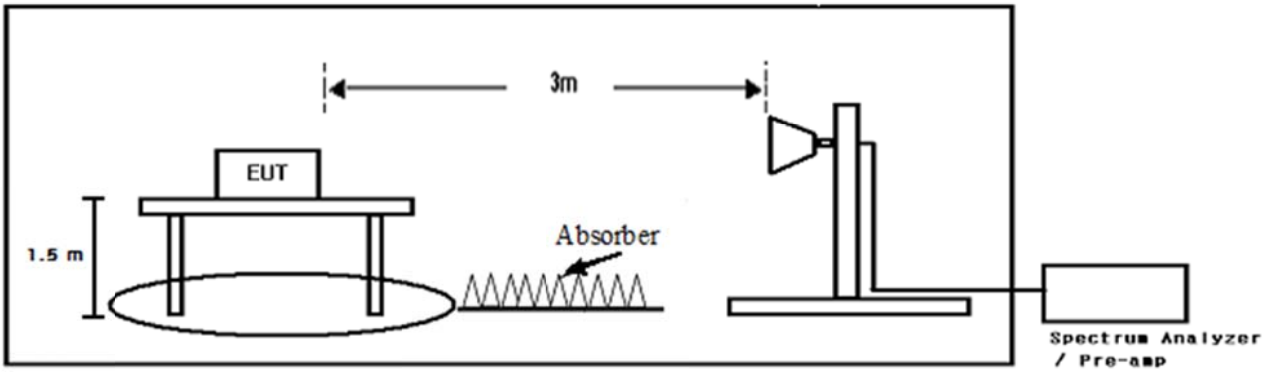
Operating Mode	Channel	Frequency (MHz)	Output Power (dBm)
802.11a (U-NII Band1)	48	5 240	15.48

3.3 Test Setup Drawing

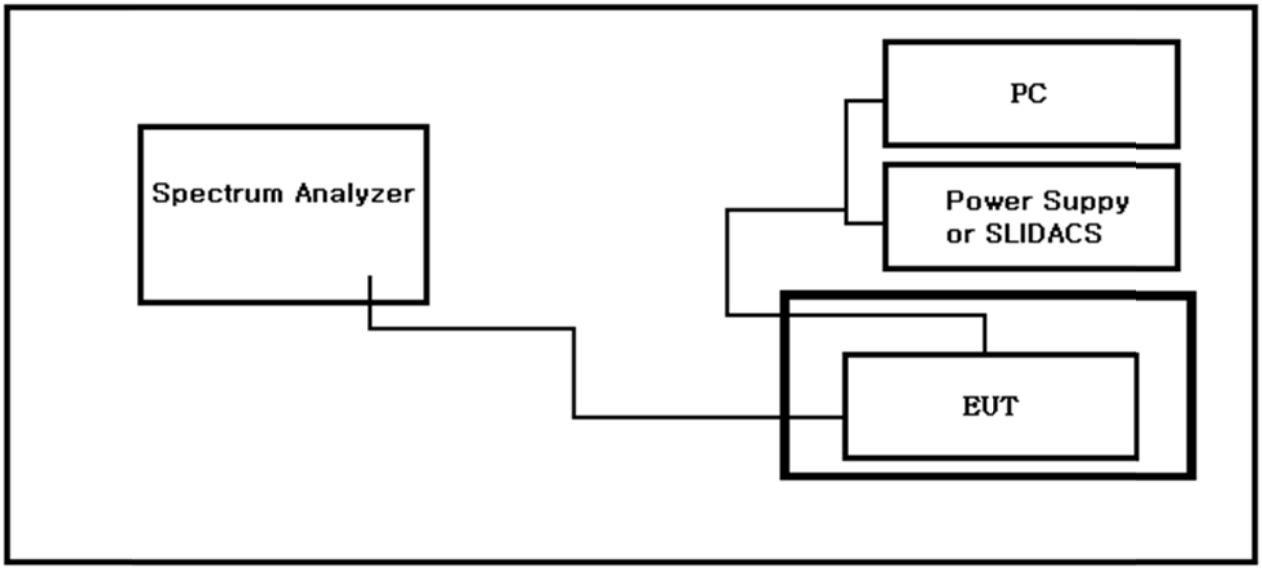
(Radiated Test below 1 GHz)



(Radiated Test above 1 GHz)



(Conducted Test)



3.4 EUT Modifications

Following modifications were implemented on the EUT for fixing the problem caused by EMC testing and the product will have all of the modifications incorporated into the product when manufactured and placed on the market.

- None.

4. ANTENNA REQUIREMENT

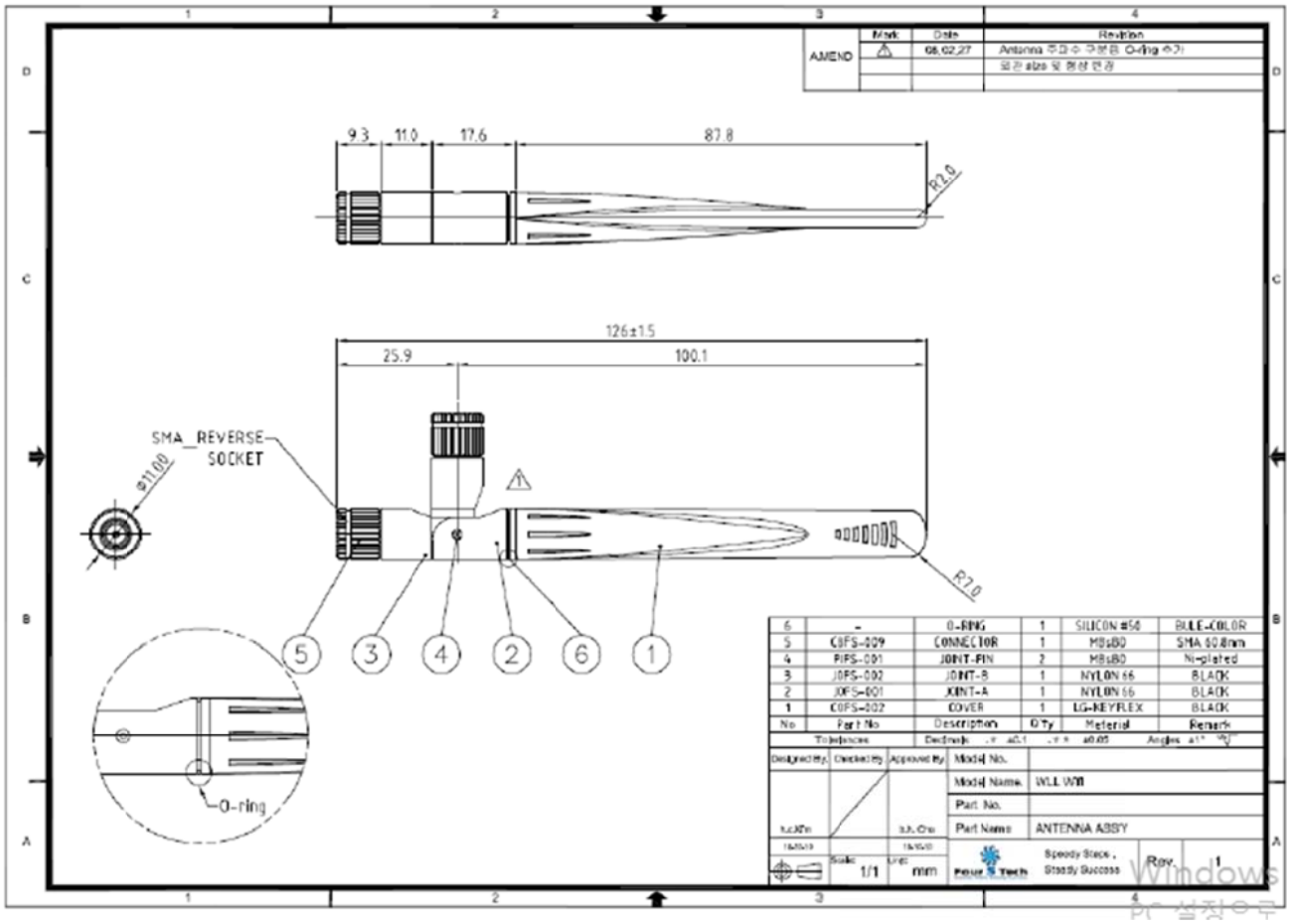
According to FCC CFR 47 Part 15 section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provision of this section.

4.1 Antenna Description

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
2.4	Dipole Antenna	4.16	Reverse polarity SMA
5	Dipole Antenna	3.92	Reverse polarity SMA

4.2 Conclusion

The antenna of the EUT is used a dedicate antenna, so the EUT met the requirement.



5. TEST RESULT

5.1 26 dB Bandwidth

5.1.1 Limit

NONE

5.1.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02 Section C.1 EBW

The transmitter output is connected to a spectrum analyzer with the RBW set to approximately 1 % of the EBW, VBW > RBW, peak detector and max hold.

5.1.3 Test Data

Date of Test	2017-11-06	Temperature	(25.7 ± 1.0) °C
		Relative humidity	(43.2 ± 3.0) % R.H.
Test Result	***PASS***	Tested by	In-yong Song

Operating Mode: 802.11a (U-NII Band 1)				
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result
Low	5 180	25.43	17.43	PASS
Middle	5 220	25.52	17.48	
High	5 240	25.43	17.43	
Operating Mode: 802.11a (U-NII Band 3)				
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result
Low	5 745	22.18	16.86	PASS
Middle	5 785	22.18	16.86	
High	5 805	22.38	16.90	

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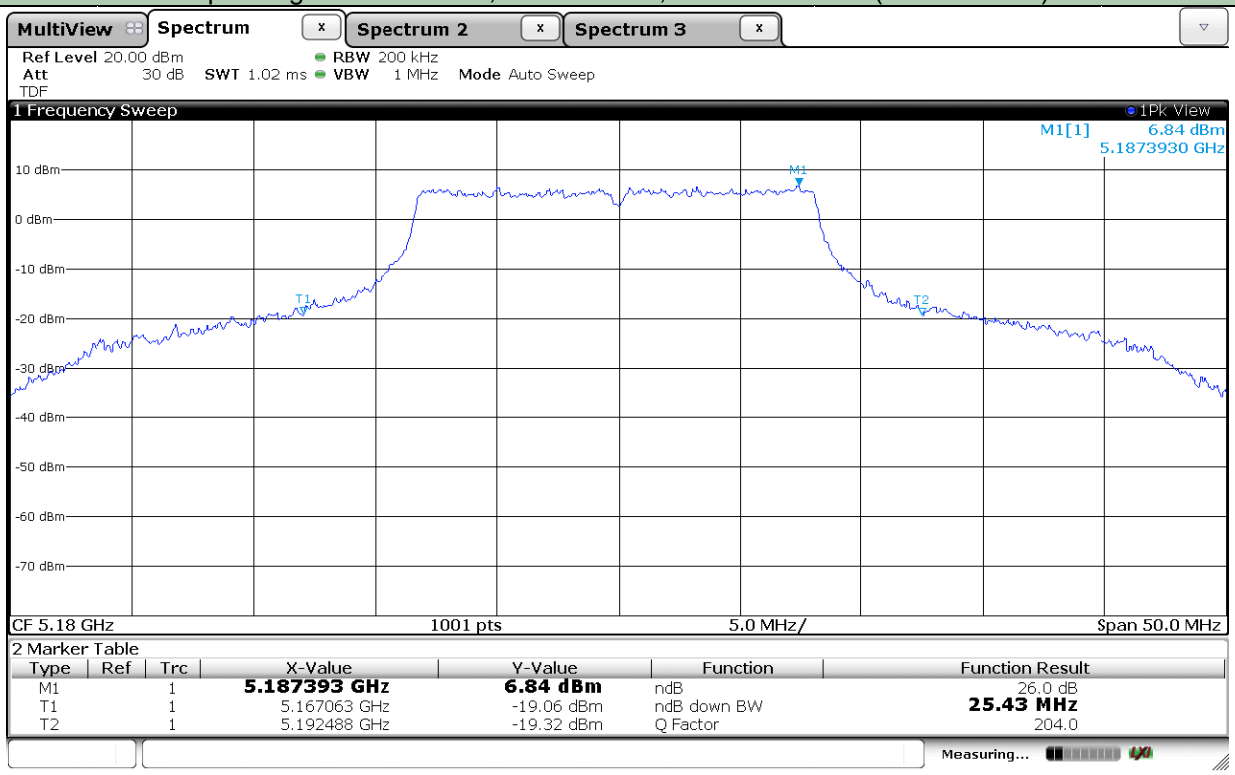
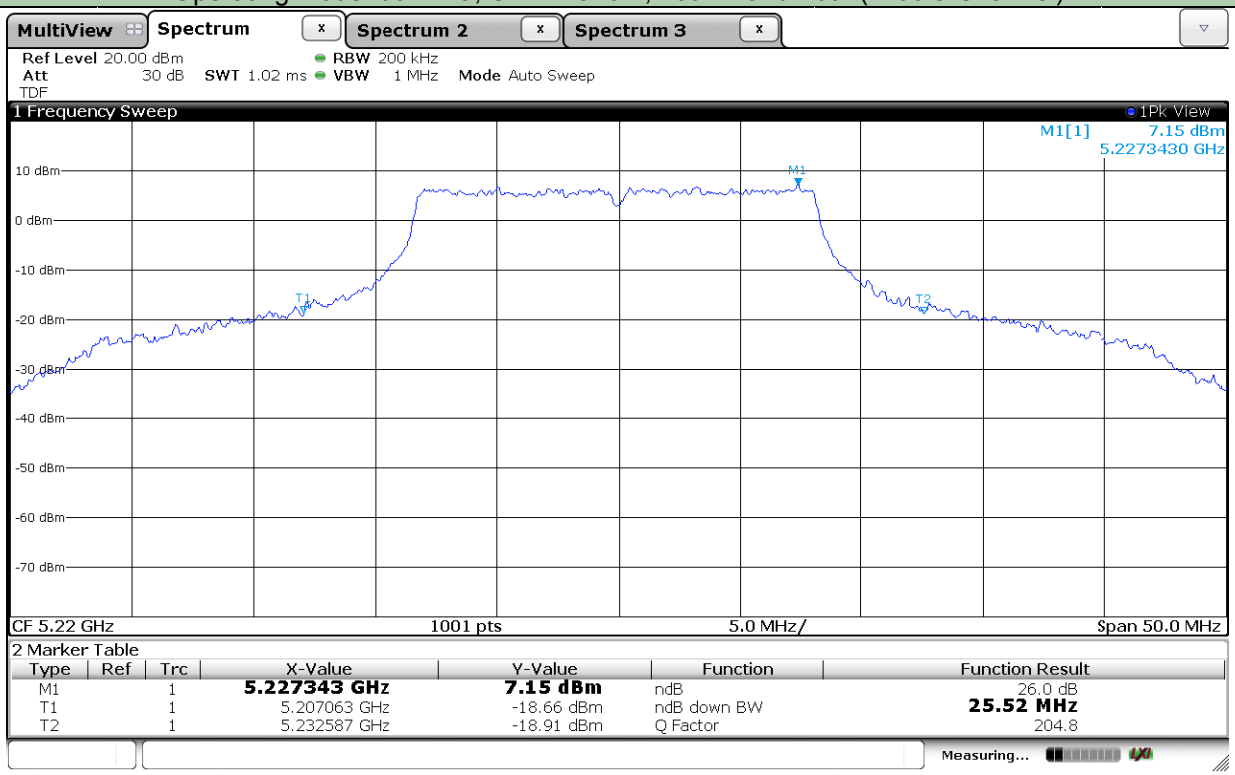
5.1.4 Test Plots

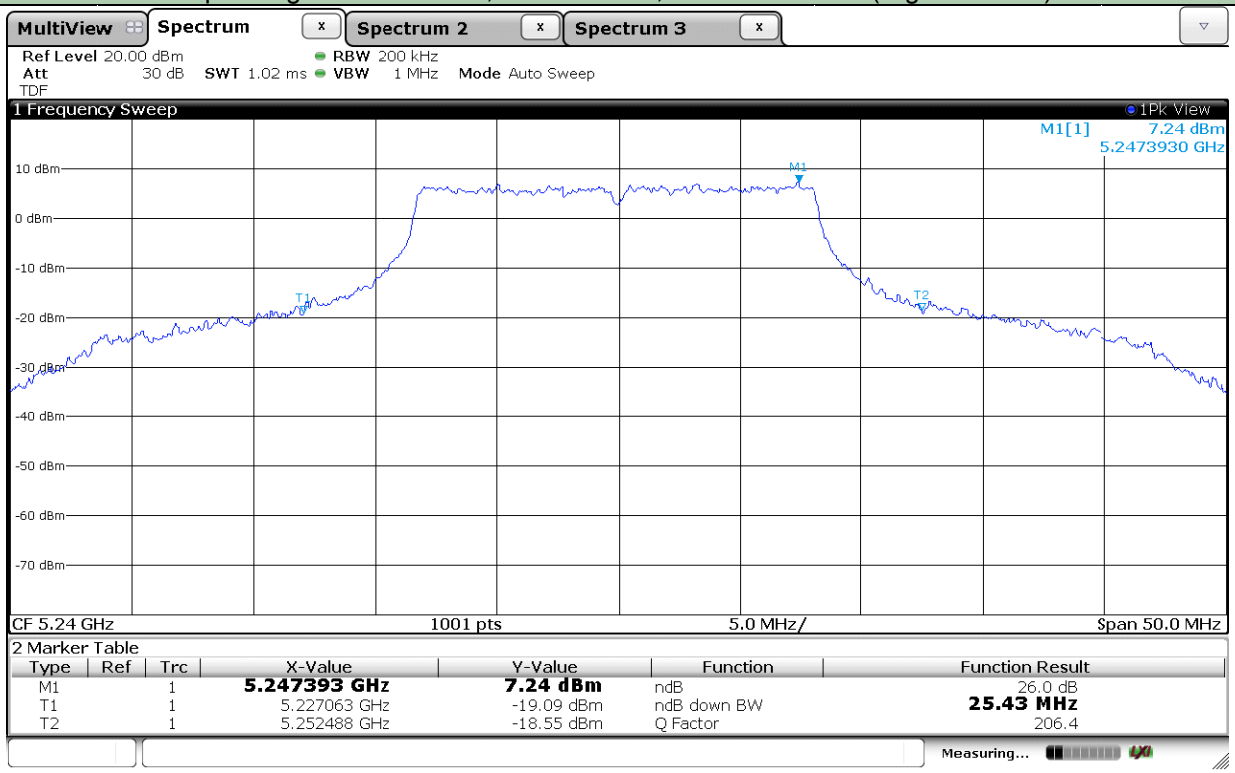
Operating Mode: 802.11a, U-NII Band 1, 26dB Bandwidth (Low Channel)



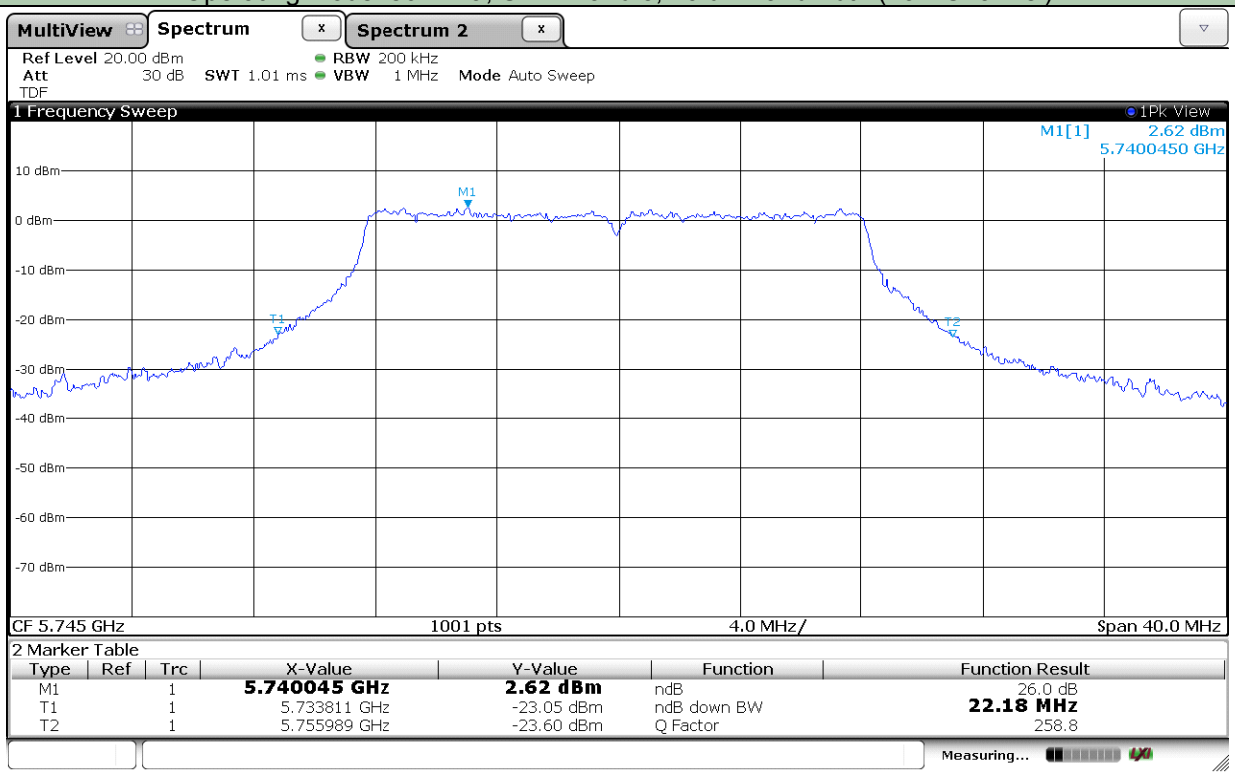
Operating Mode: 802.11a, U-NII Band 1, 26dB Bandwidth (Middle Channel)



Operating Mode: 802.11a, U-NII Band 1, 26dB Bandwidth (High Channel)



Operating Mode: 802.11a, U-NII Band 3, 26 dB Bandwidth (Low Channel)



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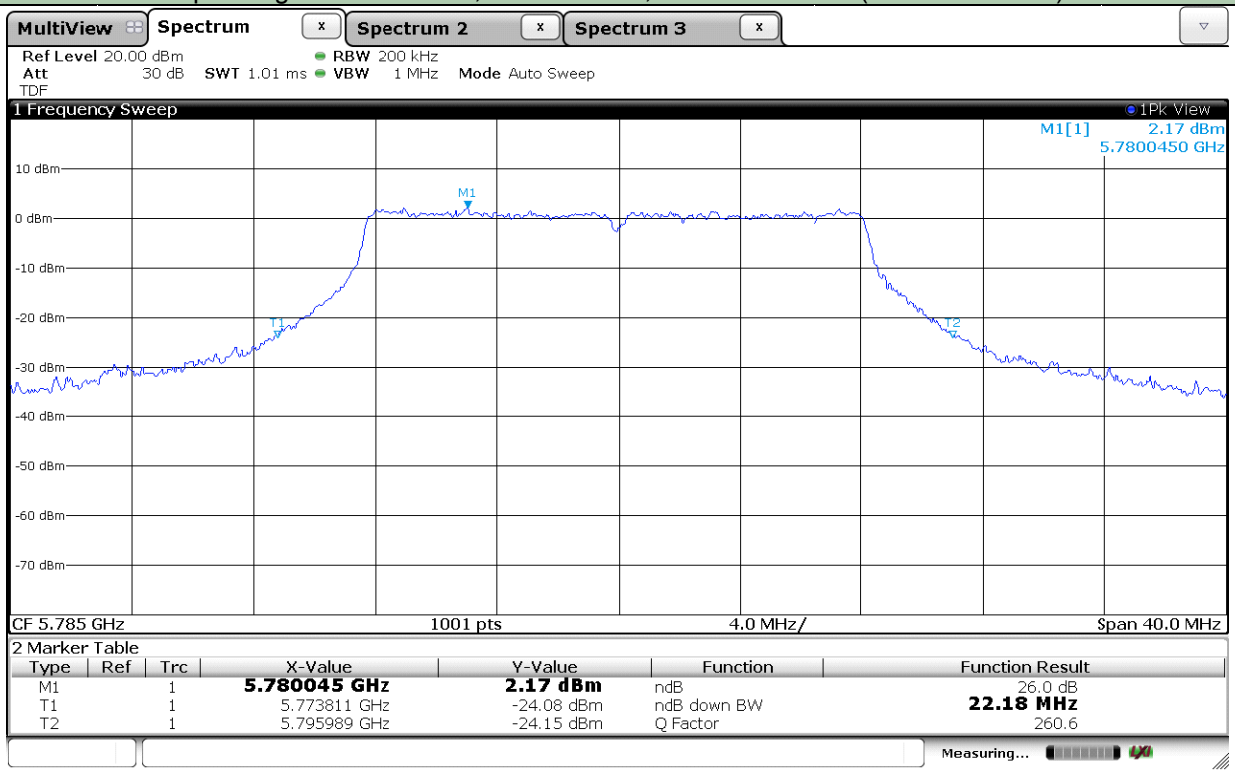
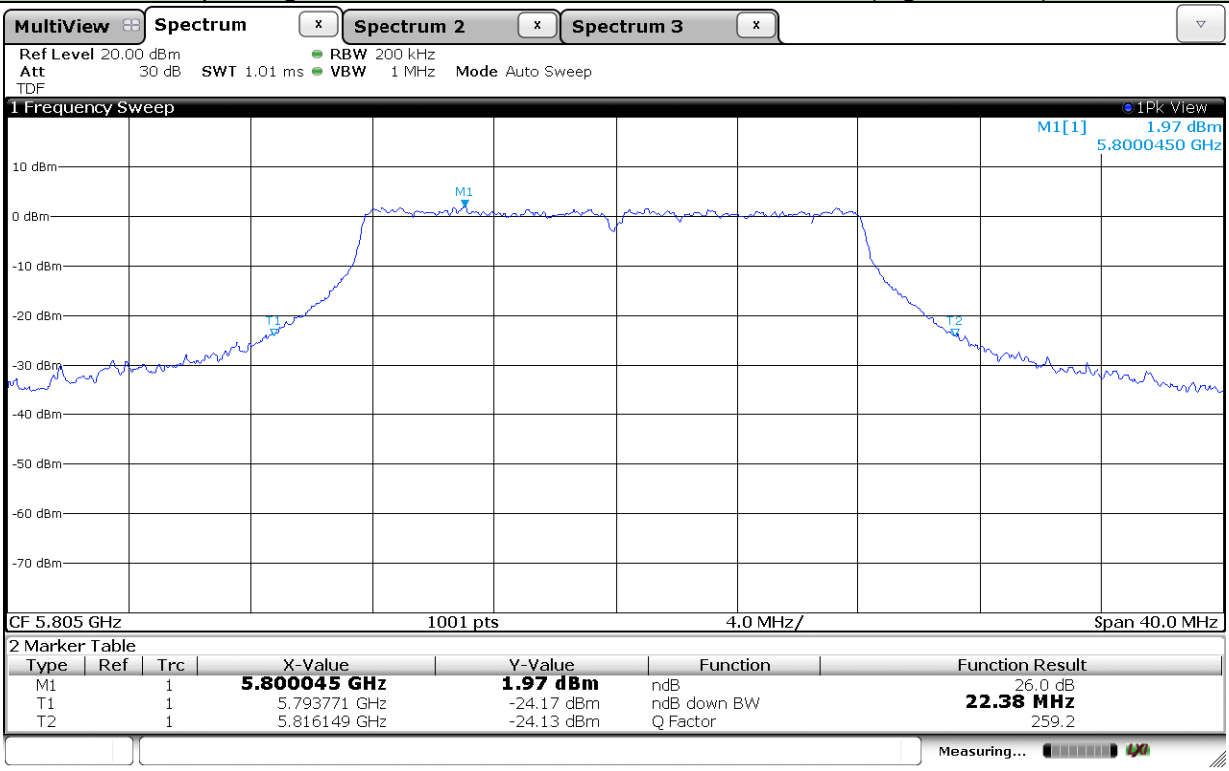
Operating Mode: 802.11a, U-NII Band 3, 26dB Bandwidth (Middle Channel)



Operating Mode: 802.11a, U-NII Band 3, 26dB Bandwidth (High Channel)



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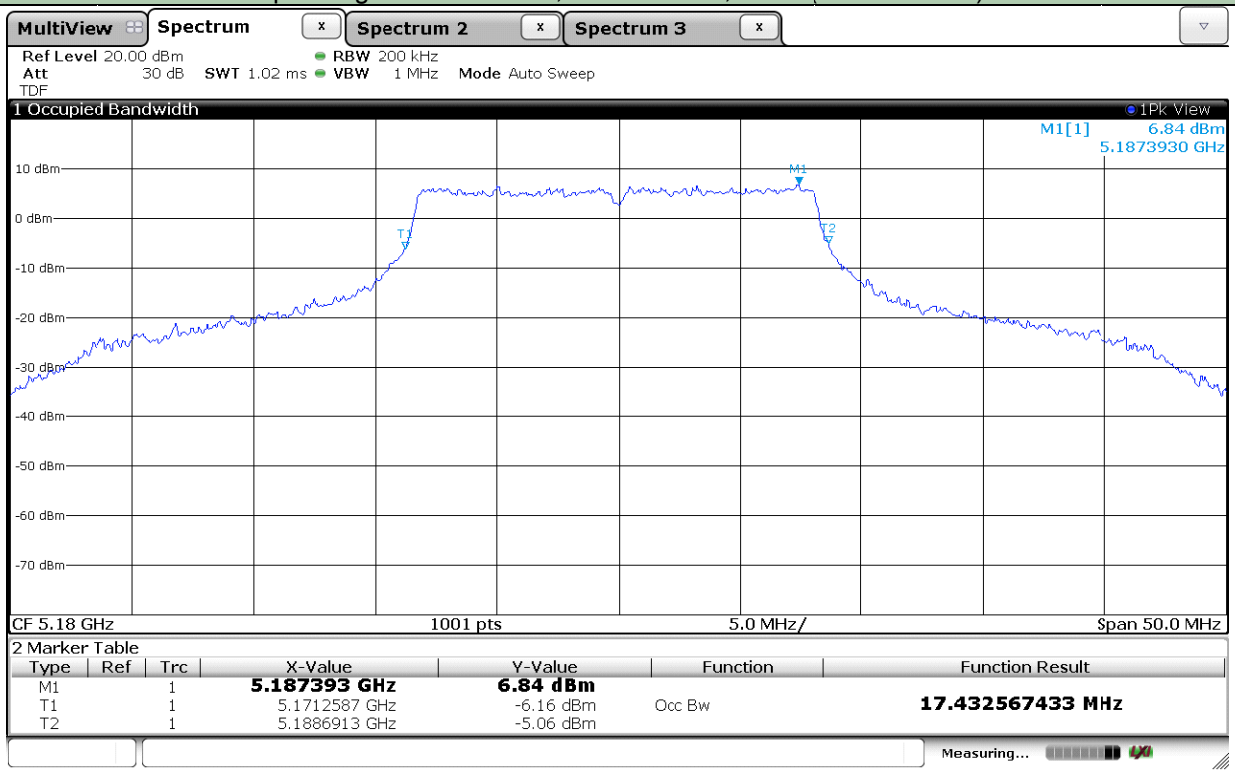
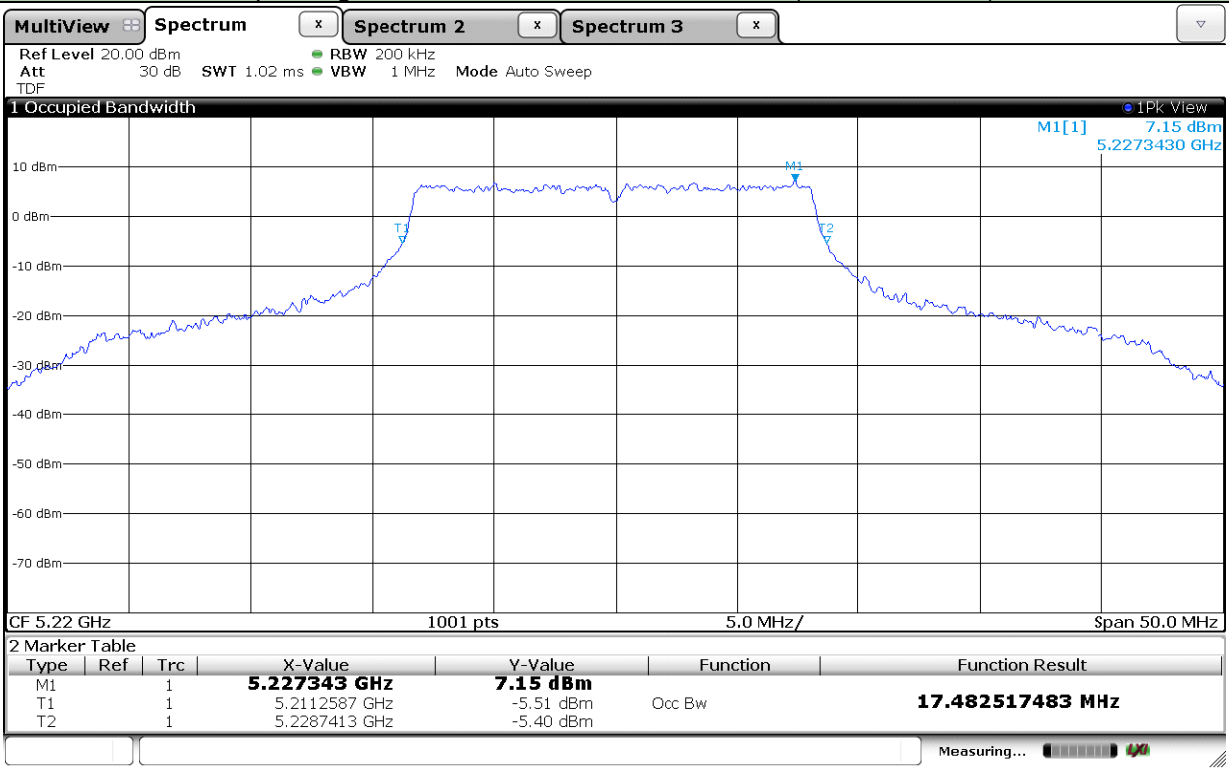
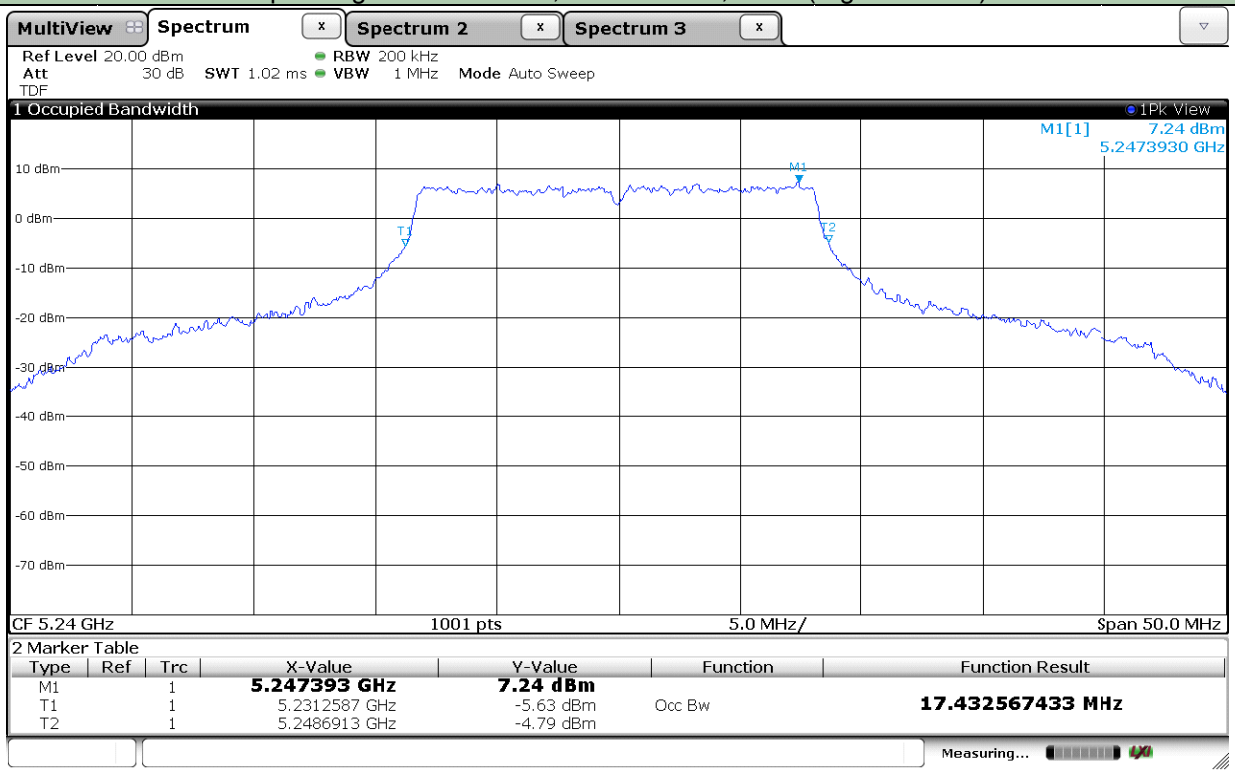
Operating Mode: 802.11a, U-NII Band 1, OBW (Low Channel)



Operating Mode: 802.11a, U-NII Band 1, OBW (Middle Channel)



Operating Mode: 802.11a, U-NII Band 1, OBW (High Channel)



Operating Mode: 802.11a, U-NII Band 3, OBW (Low Channel)

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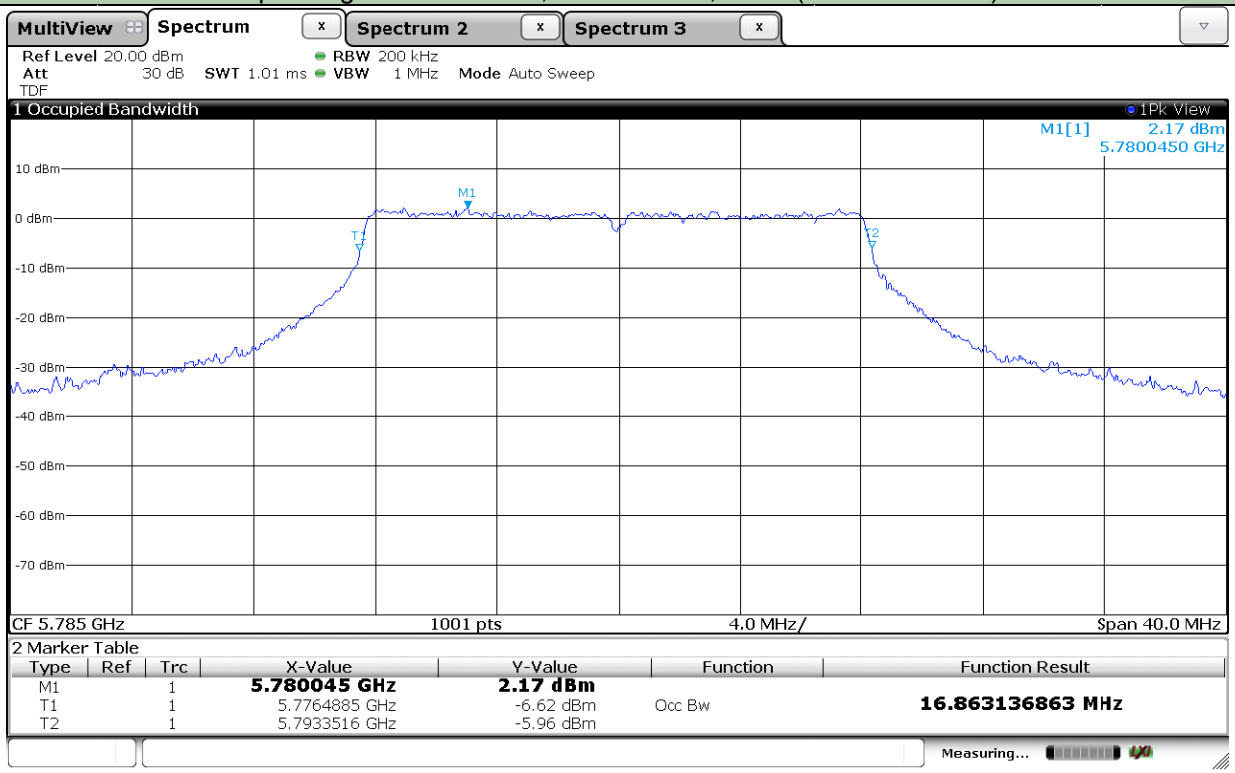
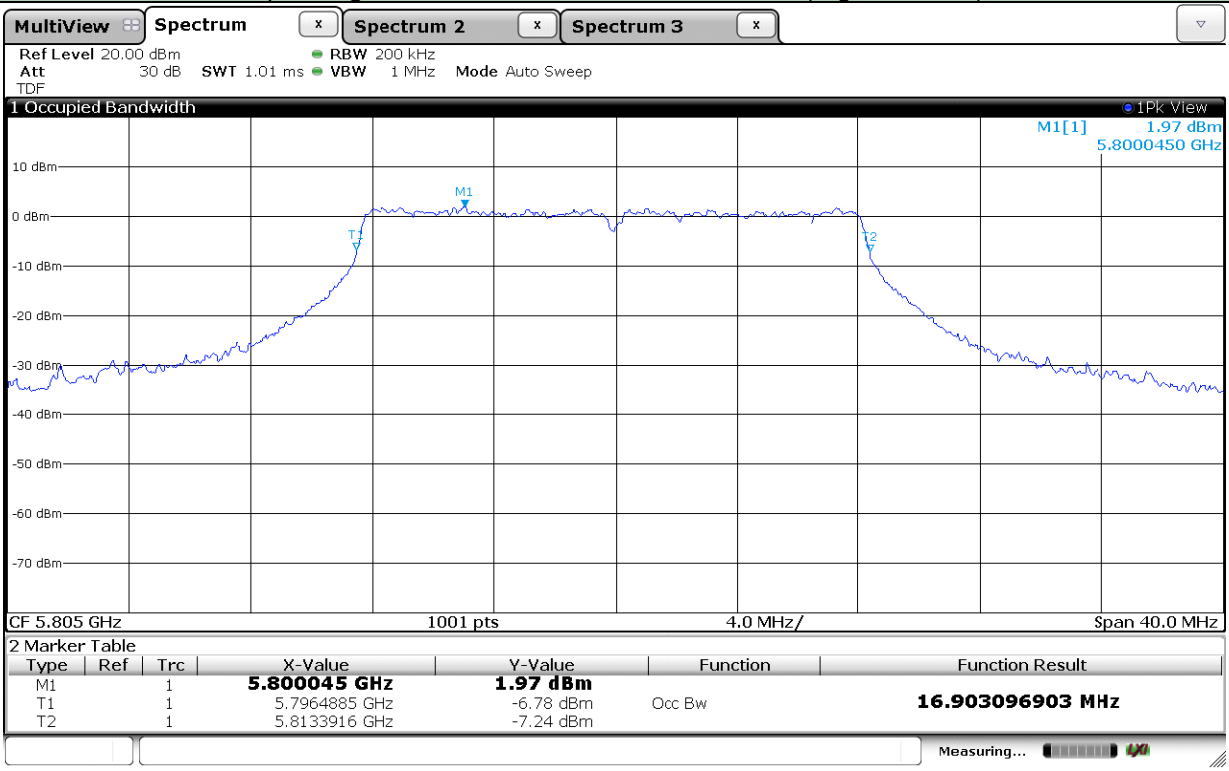
Operating Mode: 802.11a, U-NII Band 3, OBW (Middle Channel)



Operating Mode: 802.11a, U-NII Band 3, OBW (High Channel)



5.2 6 dB Bandwidth

5.2. 1 Limit

The minimum 6 dB bandwidth shall be at least 500 kHz within the (5.725 ~ 5.825) GHz band..

5.2.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02 Section C.2

The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW ≥ 3 X RBW, peak detector and max hold.

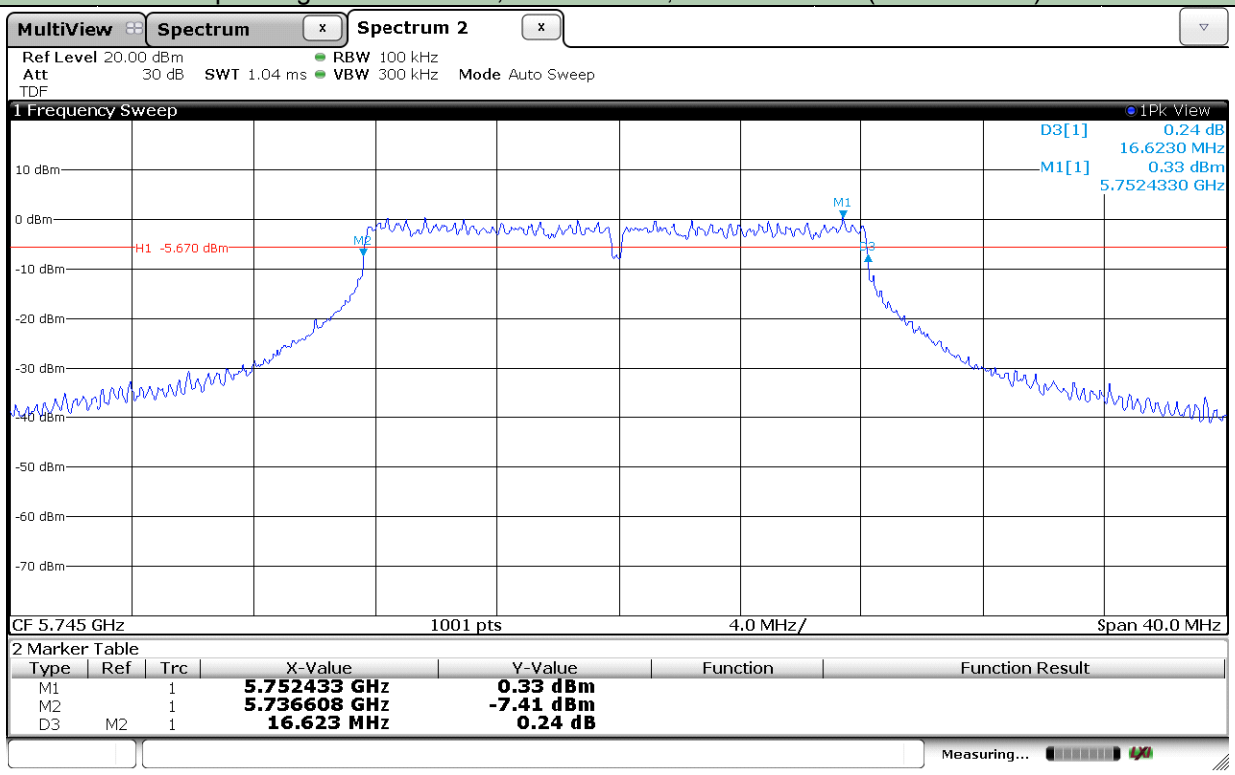
5.2.3 Test Data

Date of Test	2017-11-06	Temperature	(25.7 ± 1.0) °C
		Relative humidity	(43.2 ± 3.0) % R.H.
Test Result	***PASS***	Tested by	In-yong Song

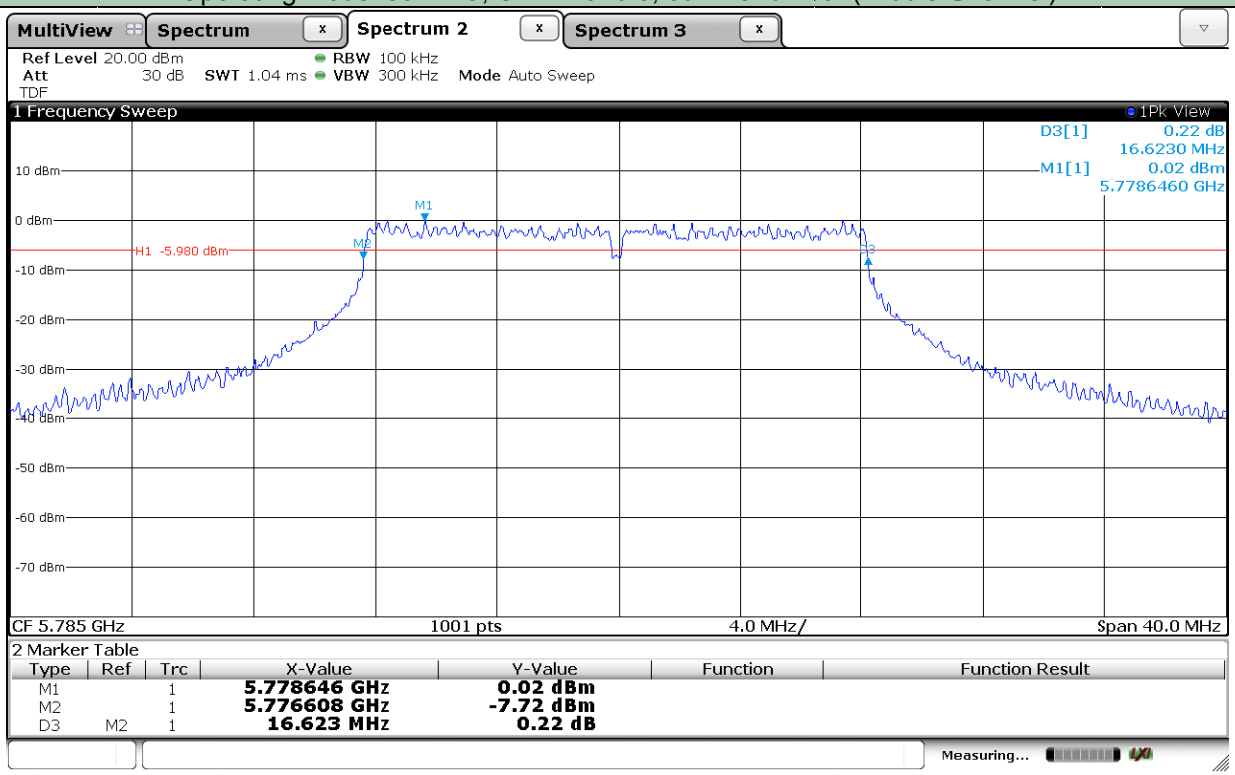
Operating Mode: 802.11a (U-NII Band 3)				
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result
Low	5 745	16.62	≥ 0.5	PASS
Middle	5 785	16.62		PASS
High	5 805	16.62		PASS

5.2.4 Test Plots

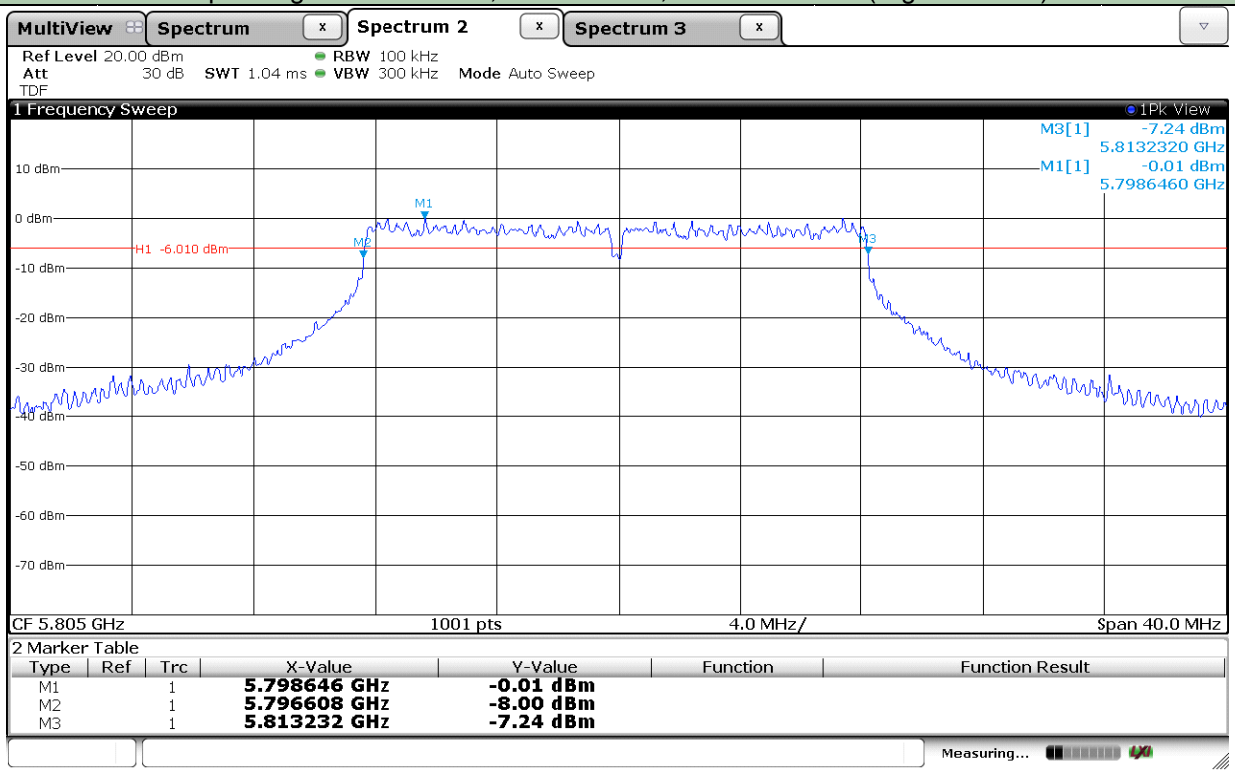
Operating Mode: 802.11a, U-NII Band 3, 6dB Bandwidth (Low Channel)



Operating Mode: 802.11a, U-NII Band 3, 6dB Bandwidth (Middle Channel)



Operating Mode: 802.11a, U-NII Band 1, 6 dB Bandwidth (High Channel)



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5.3 OUTPUT POWER MEASUREMEENT

5.3.1 Limit

For an indoor access point operating in the band (5.15 ~ 5.25) GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30 dBm).

For the band (5.725 ~ 5.85) GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30 dBm).

If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02: Section E.3.a) Method PM(Measurement using an RF average power meter)

5.3.3 Test Data for Output Power

Date of Test	2017-11-06	Temperature	(25.7 ± 1.0) °C
		Relative humidity	(43.2 ± 3.0) % R.H.
Test Result	***PASS***	Tested by	In-yong Song

Operating Mode: 802.11a (U-NII Band 1)						
Channel	Frequency (MHz)	Measured Value (dBm)	Duty Factor	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5 180	13.68	1.45	15.13	30.00	14.87
Middle	5 220	13.94	1.45	15.39	30.00	14.61
High	5 240	14.03	1.45	15.48	30.00	14.52

NOTE. 1. Margin = Limit - Total Power
2. Total Power = Measured value + Duty factor
3. Duty cycle(X) : 0.7155
4. Duty factor(10log/x) : 1.45

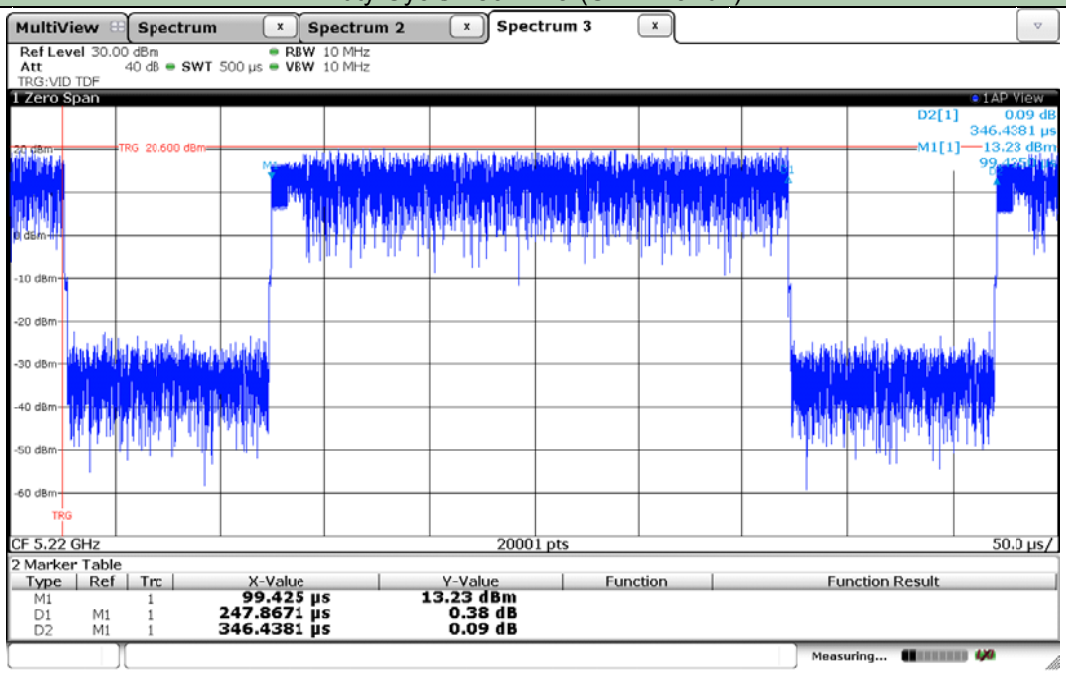
Operating Mode: 802.11a (U-NII Band 3)						
Channel	Frequency (MHz)	Measured Value (dBm)	Duty Factor	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5 745	9.30	1.45	10.75	30.00	19.25
Middle	5 785	8.96	1.45	10.41	30.00	19.59
High	5 805	8.72	1.45	10.17	30.00	19.83

NOTE. 1. Margin = Limit - Total Power
2. Total Power = Measured value + Duty factor
3. Duty cycle(X) : 0.7159
4. Duty factor(10log/x) : 1.45

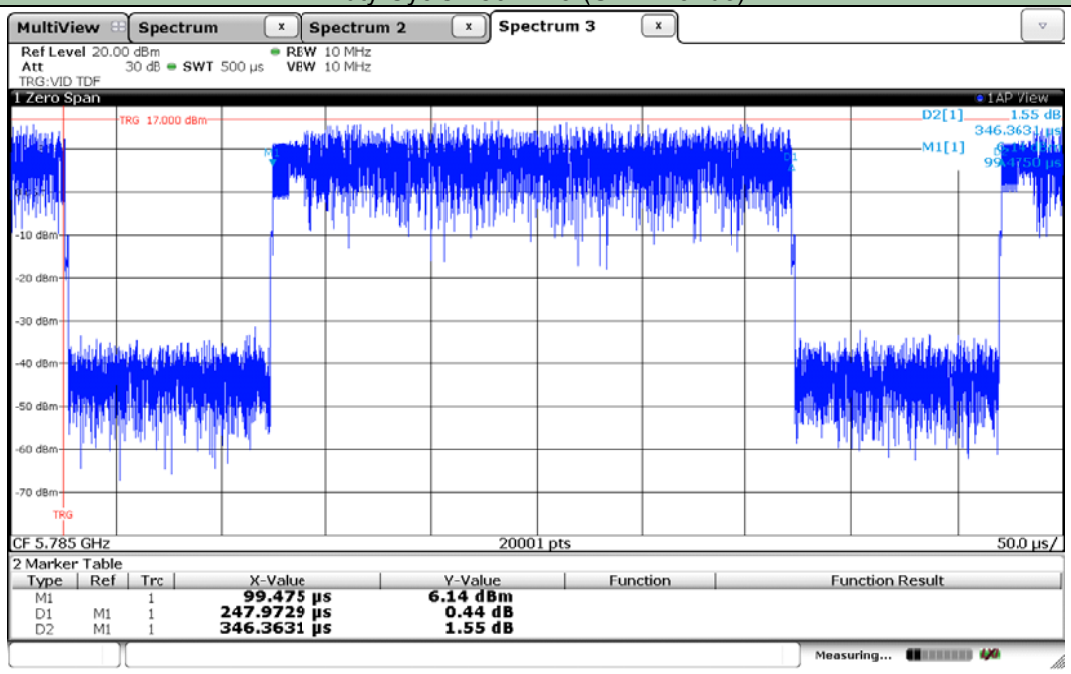
5.3.4 Test Data for Duty Cycle

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor
802.11a (U-NII Band1)	0.248	0.346	71.55	1.45
802.11a (U-NII Band3)	0.248	0.346	71.59	1.45

Duty Cycle - 802.11a (U-NII Band1)



Duty Cycle - 802.11a (U-NII Band3)



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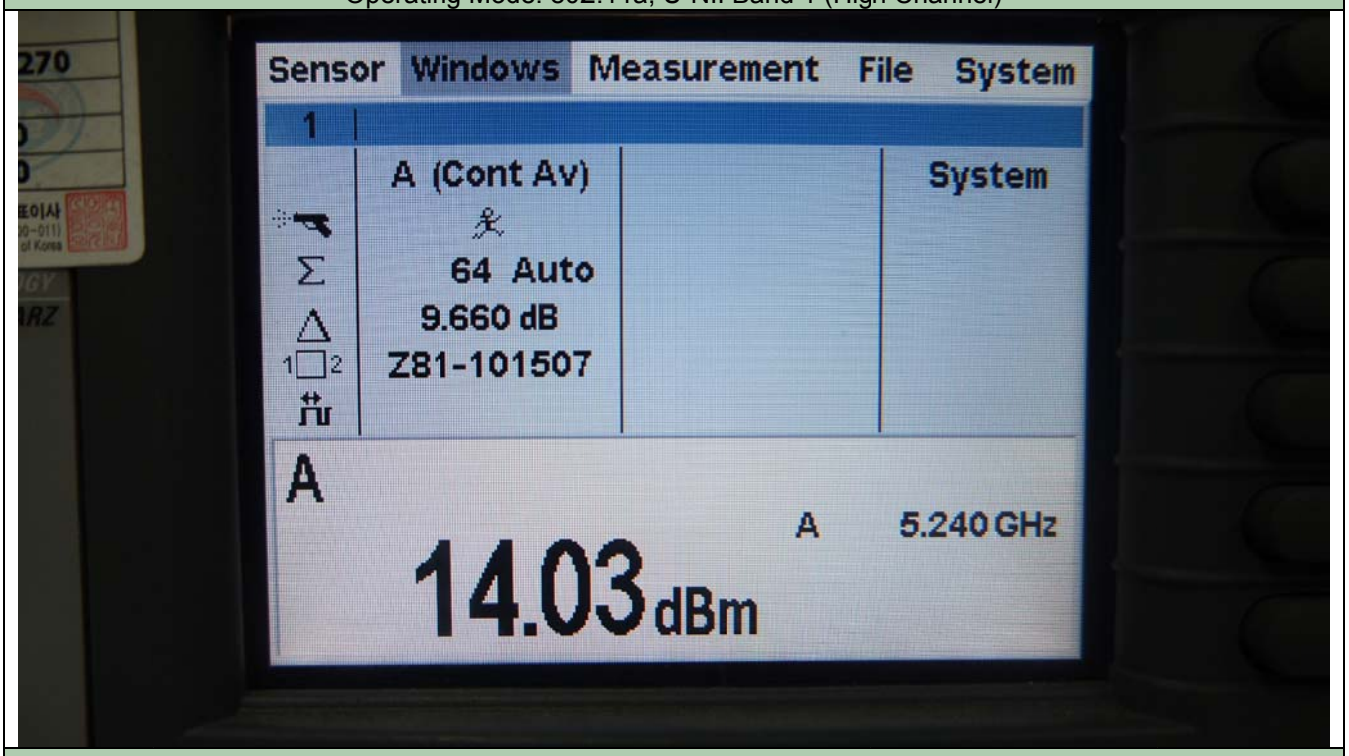
5.4.5 Test Plots

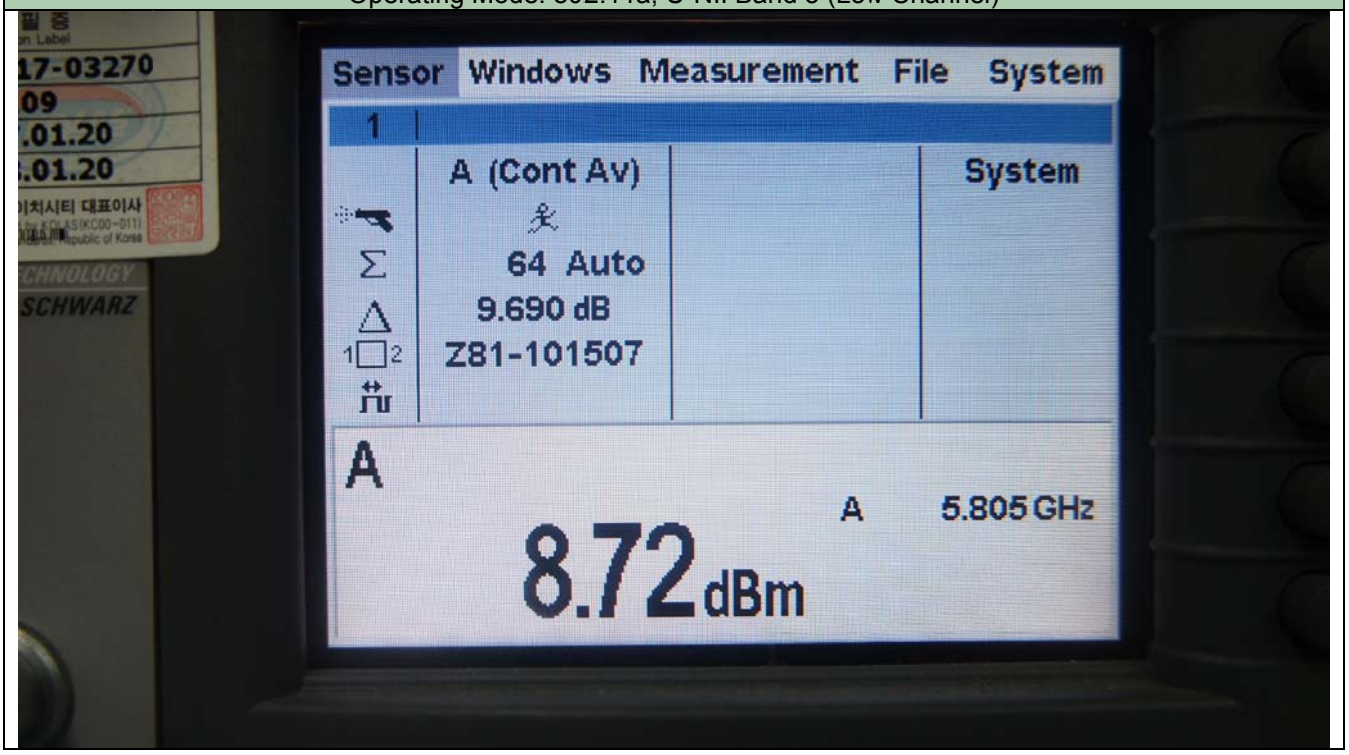
Operating Mode: 802.11a, U-NII Band 1 (Low Channel)

Operating Mode: 802.11a, U-NII Band 1 (Middle Channel)

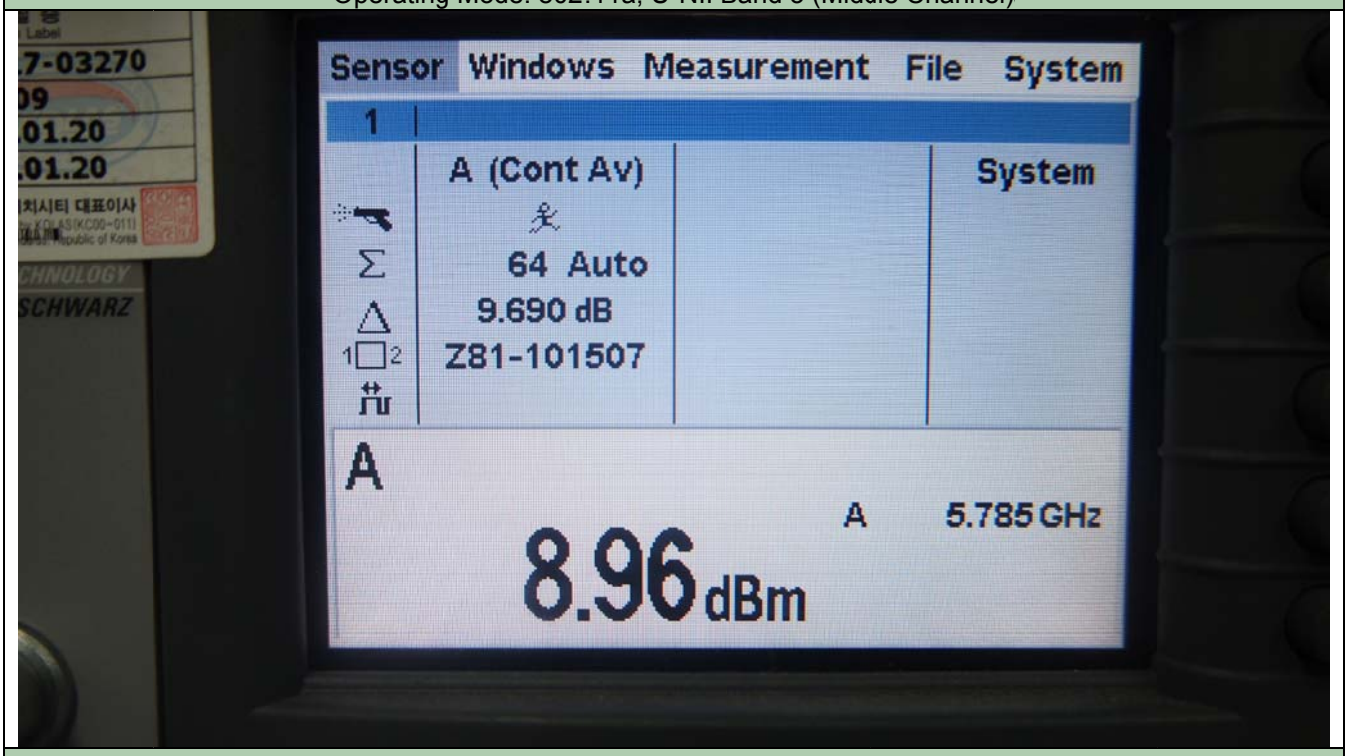
Operating Mode: 802.11a, U-NII Band 1 (High Channel)



Operating Mode: 802.11a, U-NII Band 3 (Low Channel)



Operating Mode: 802.11a, U-NII Band 3 (Middle Channel)



Operating Mode: 802.11a, U-NII Band 3 (High Channel)

5.4 POWER SPECTRAL DENSITY

5.4.1 Limit

For an indoor access point operating in the band (5.15 ~ 5.25) GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band..

For the band (5.725 ~ 5.85) GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.4.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02: Section F Maximum Power Spectral Density.

5.4.3 Test Data

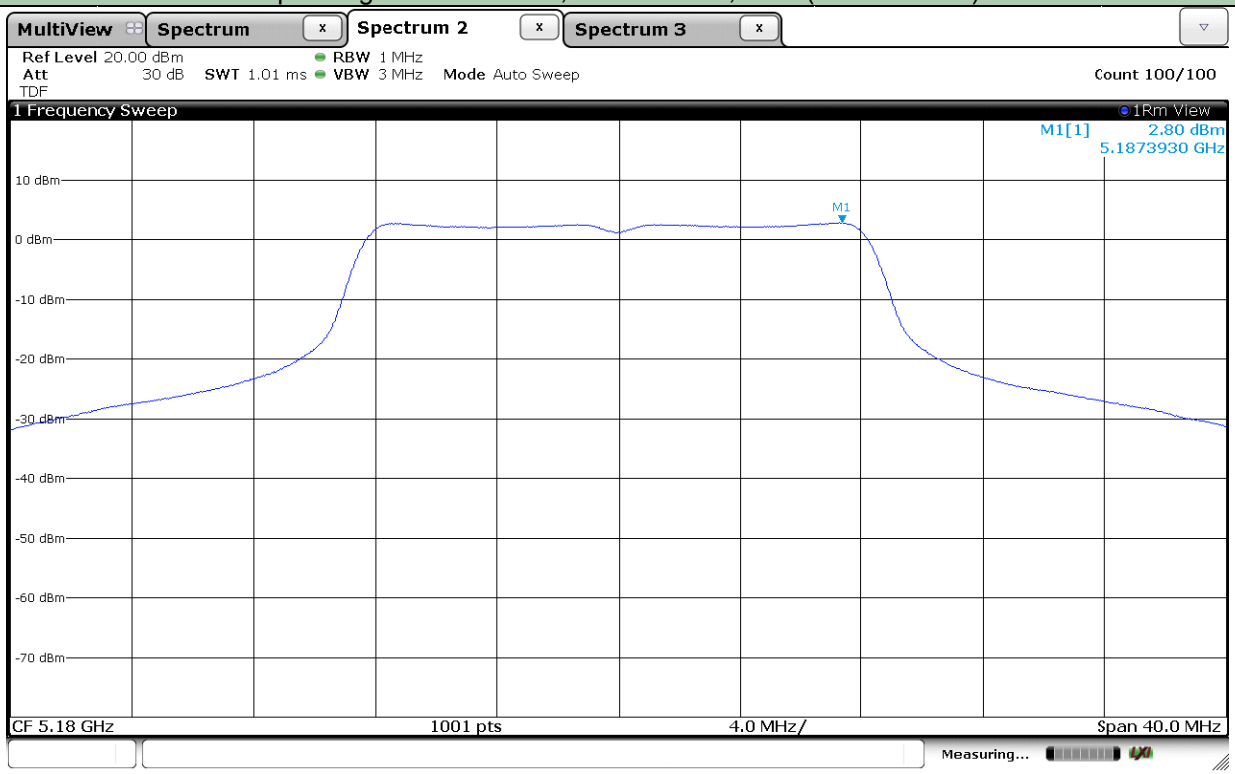
Date of Test	2017-11-06	Temperature	(25.7 ± 1.0) °C
		Relative humidity	(43.2 ± 3.0) % R.H.
Test Result	***PASS***	Tested by	In-yong Song

Operating Mode: 802.11a (U-NII Band 1)						
Channel	Frequency (MHz)	Measured Value (dBm/MHz)	Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
Low	5 180	2.80	1.45	4.25	≤17	12.75
Middle	5 220	2.95	1.45	4.40		12.60
High	5 240	3.09	1.45	4.54		12.46
Operating Mode: 802.11a (U-NII Band 3)						
Channel	Frequency (MHz)	Measured Value (dBm/MHz)	Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/500 kHz)	Margin (dB)
Low	5 745	-4.13	1.45	-2.68	≤30	32.67
Middle	5 785	-4.49	1.45	-3.04		33.03
High	5 805	-4.64	1.45	-3.19		33.18

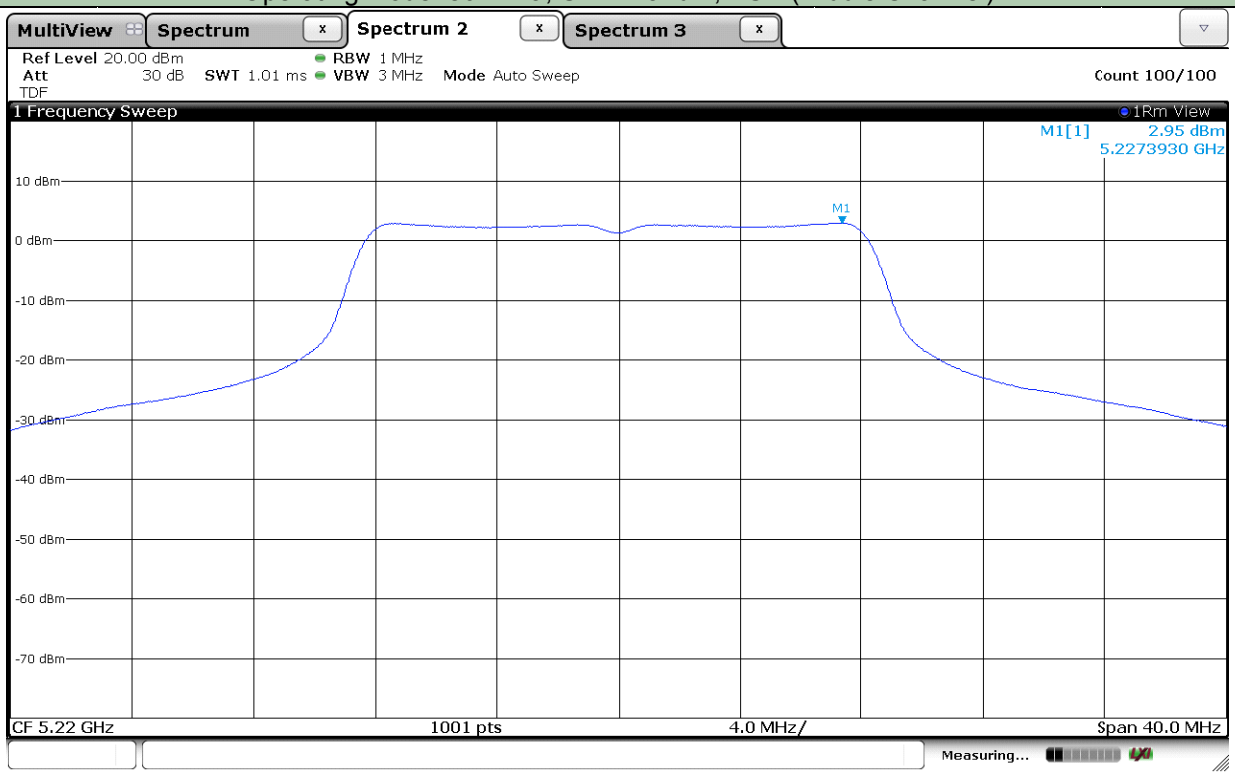
NOTE. 1. Margin = Limit - Total PSD
2. Total PSD = Measured value + Duty factor
3. Duty cycle(X) : 0.71
4. Duty factor(10log/x) : 1.45

5.4.4 Test Plots

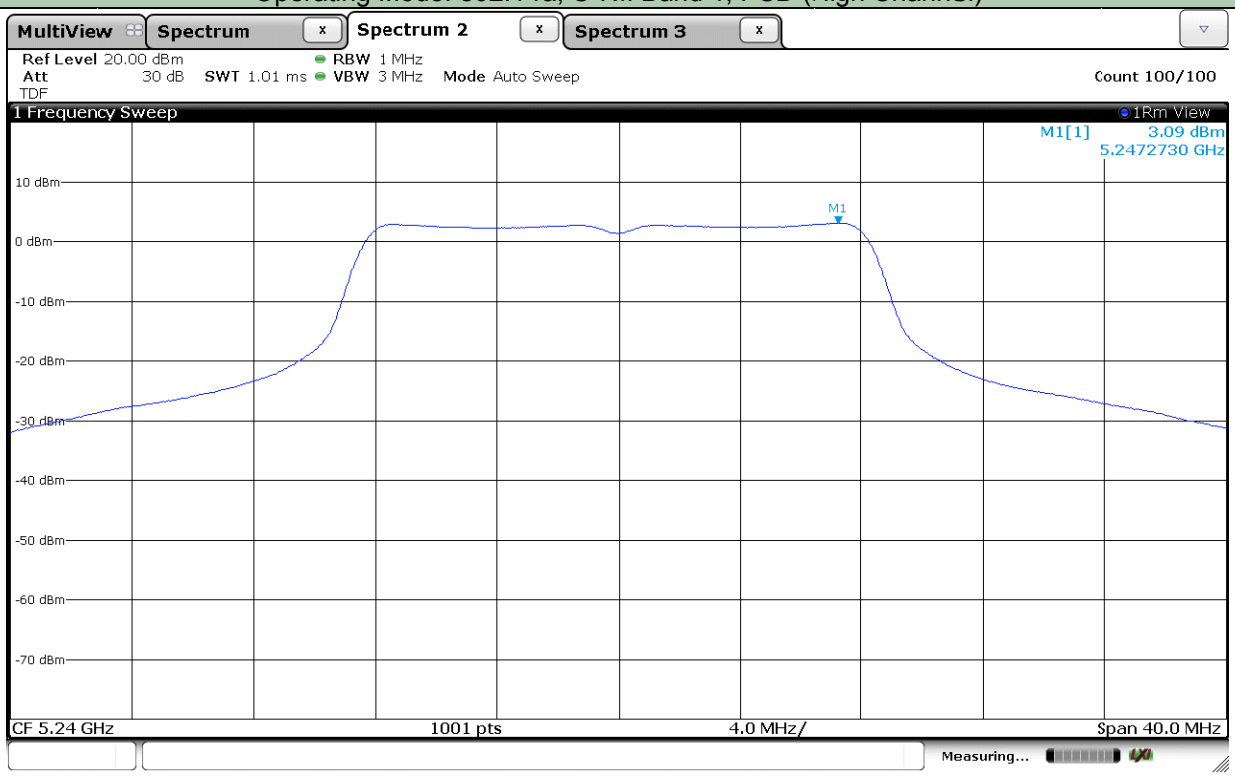
Operating Mode: 802.11a, U-NII Band 1, PSD (Low Channel)



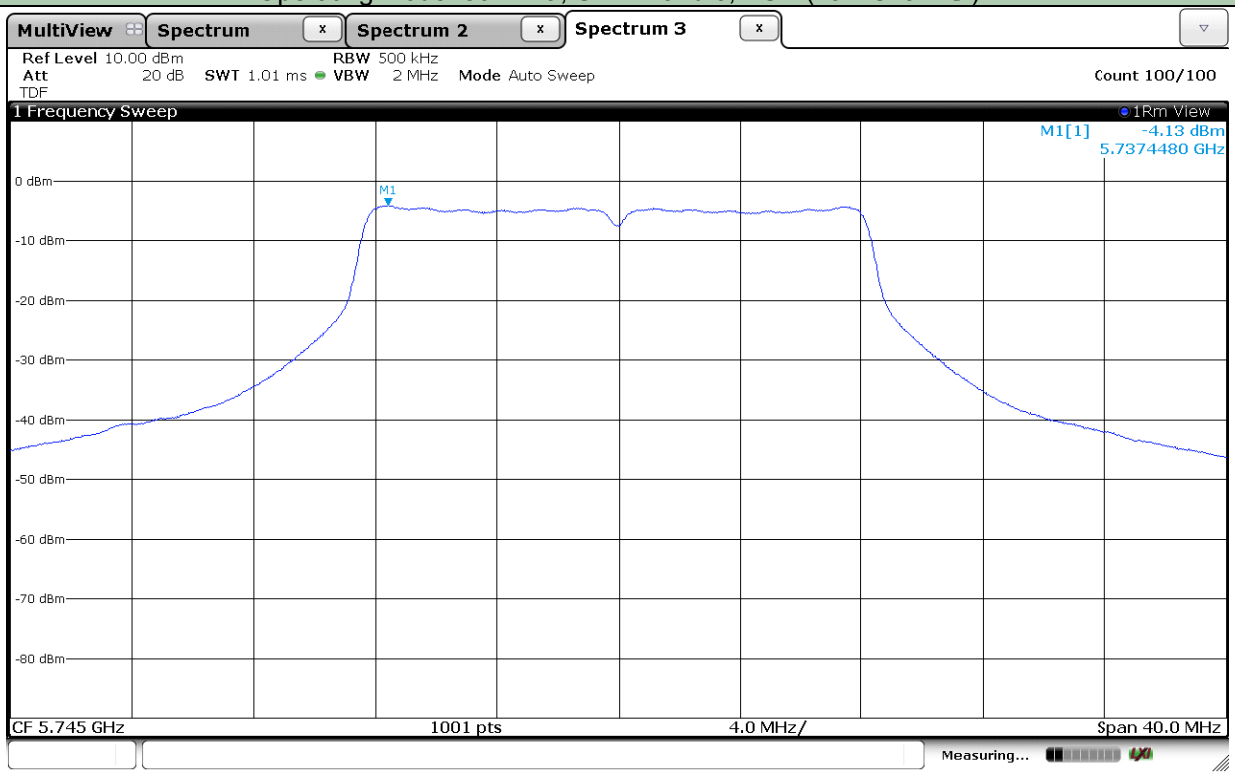
Operating Mode: 802.11a, U-NII Band 1, PSD (Middle Channel)



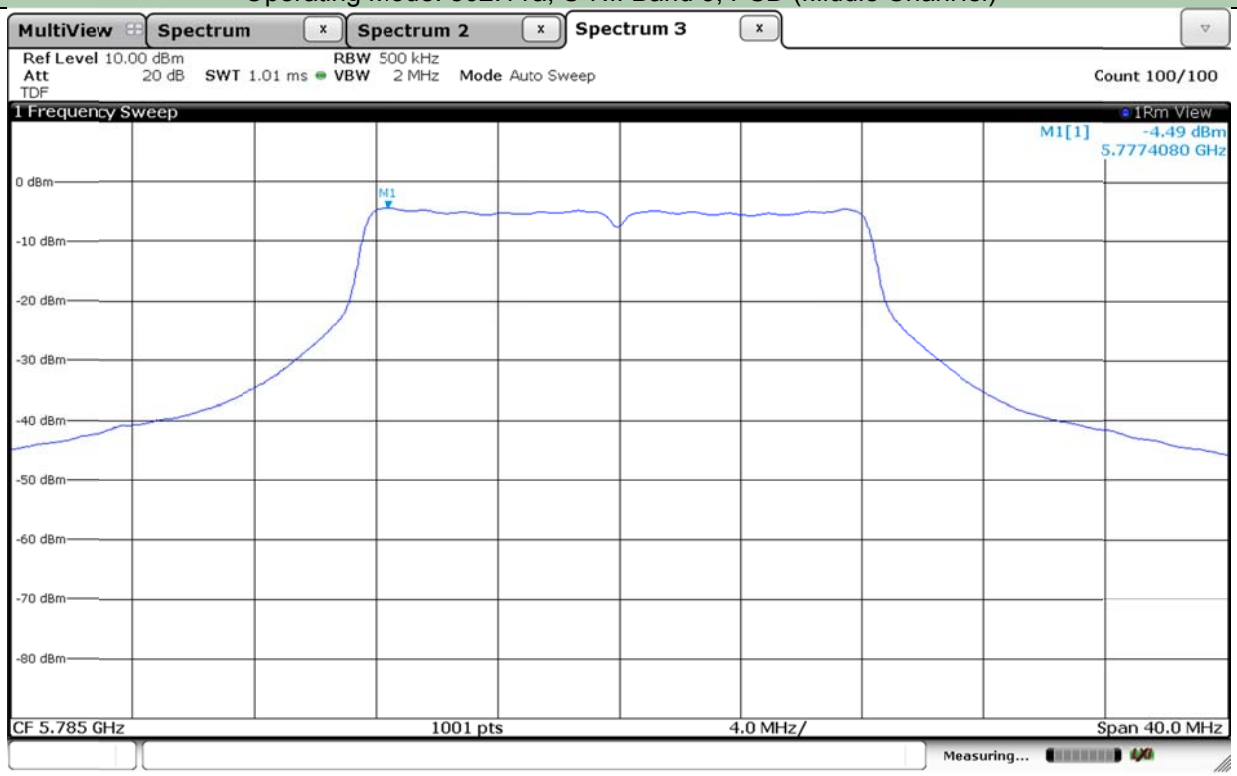
Operating Mode: 802.11a, U-NII Band 1, PSD (High Channel)



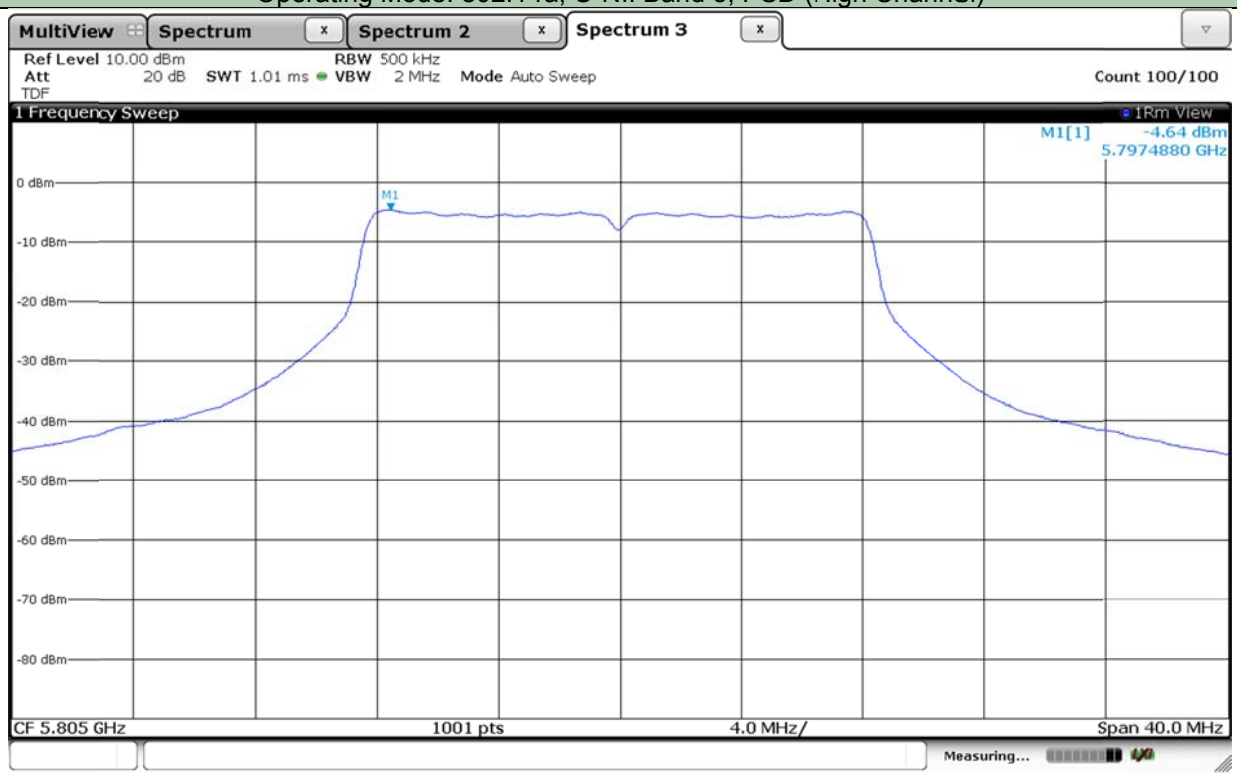
Operating Mode: 802.11a, U-NII Band 3, PSD (Low Channel)



Operating Mode: 802.11a, U-NII Band 3, PSD (Middle Channel)



Operating Mode: 802.11a, U-NII Band 3, PSD (High Channel)



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5.5 FREQUENCY STABILITY

5.5.1 Limit

Acc. to section 15.407(g),

Measurements of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

5.5.2 Method of Measurement

5.5.2.1 Frequency Stability Under Temperature Variation.

The EUT was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a spectrum analyzer. the EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency deviation and measure the frequency from the EUT at 20 ℃ operating frequency as reference frequency

Turn the EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes record the frequency. Repeat step measure with 10 ℃ decreased per stage until the lowest temperature reached.

5.5.2.2 Frequency Stability Under Voltage Variations.

Set chamber temperature to 20 ℃. Use a variable AC or DC power supply to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer low enough to obtain the desired frequency resolution and record the frequency.

Reduce the input voltage to specify extreme voltage variation ± 15 % and end point and record the maximum frequency variation.

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5.5.3 Test Data

Date of Test	2017-11-06	Temperature	(25.7 ± 1.0) °C
		Relative humidity	(43.2 ± 3.0) % R.H.
Test Result	***PASS***	Tested by	In-yong Song

Operating Mode: 802.11a, U-NII Band 1					
Voltage (%)	Input Voltage (DC)	Temperature (℃)	Frequency (Hz)	Freq. Devi. (Hz)	Deviation (%)
100	24 V	0	5 219.975 818	-24.182	-0.0005
		10	5 219.972 359	-27 641	-0.0005
		20	5 219.959 805	-40 195	-0.0008
		30	5 219.948 377	-51 623	-0.0010
		40	5 219.940 408	-59 592	-0.0011
		50	5 219.940 038	-59 962	-0.0011
115	27.6 V	20	5 219.960 123	-39 877	-0.0008
85	20.4 V	20	5 219.960 141	-39 859	-0.0008

Operating Mode: 802.11a, U-NII Band 3					
Voltage (%)	Input Voltage (DC)	Temperature (℃)	Frequency (Hz)	Freq. Devi. (Hz)	Deviation (%)
100	24 V	0	5 784.978 933	-21 067	-0.0004
		10	5 784.966 904	-33 096	-0.0006
		20	5 784.953 647	-46 353	-0.0008
		30	5 784.941 563	-58 437	-0.0010
		40	5 784.933 722	-66 278	-0.0011
		50	5 784.933 833	-66 167	-0.0011
115	27.6 V	20	5 784.953 561	-46 439	-0.0008
85	20.4 V	20	5 784.954 158	-45 842	-0.0008

5.6 Undesirable Emission

5.6.1 Limit

Acc. to section 15.205, 15.209, following table shall be applied.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

Acc. To section 15.407(b)(1) and (b)(4)(i):

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

NOTE: Emission Level (dBuV/m) = EIRP Level (dBm) - 95.2 @ 3 m measurement distance

Ex) 68.2 dBuV/m = -27 dBm/MHz and 105.2 dBuV/m = 10 dBm/MHz and 110.8 dBuV/m = 15.6 dBm/MHz, 122.2 dBuV/m = 27 dBm/MHz

5.6.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02 Section G.3 General Requirement for Unwanted Emissions Measurements.

The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm above for below 1 GHz and 1.5 m for above 1 GHz above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 40 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

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For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to ≥ 1/T, 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.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

5.6.3 Test Site Requirement for KDB 937606

Acc. to KDB 937606, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 937606.

5.6.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	± 2.1 dB	30 MHz ~ 1 GHz	± 4.7 dB
1 GHz ~ 18 GHz	± 5.0 dB	18 GHz ~ 40 GHz	± 5.7 dB

5.6.5 Sample Calculated Example

At 80 MHz Limit = 40.0 dBuV/m

Result =Receiver reading value + Antenna Factor + Cable Loss - Pre-amplifier gain = 30 dBuV/m

Margin = Limit - Result = 40 - 30 = 10 so the EUT has 10.0 dB margin at 80 MHz

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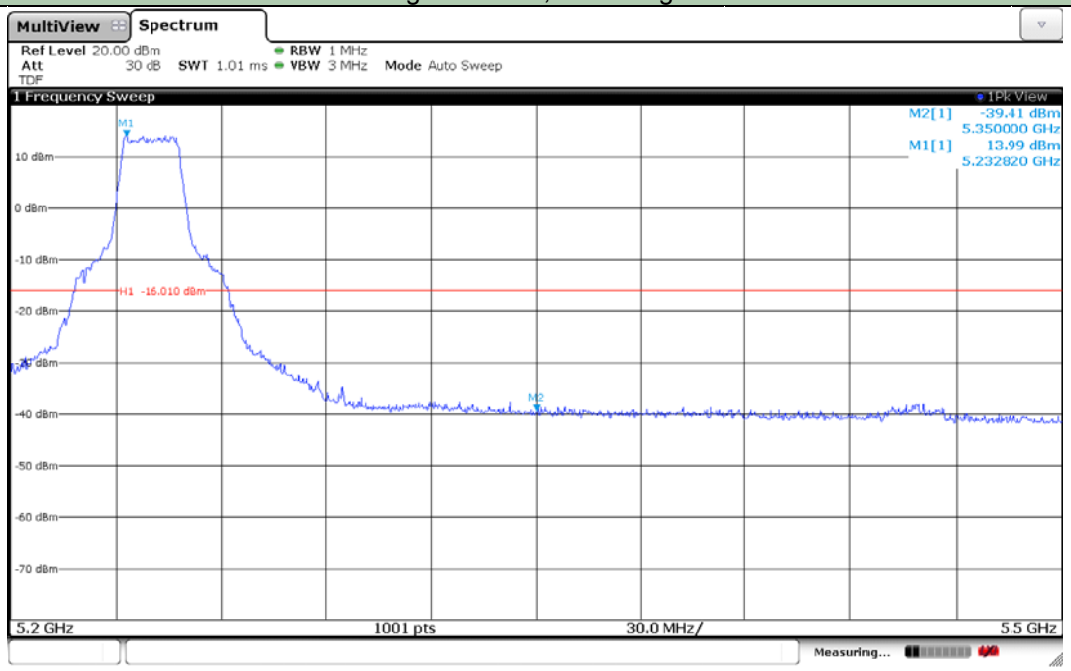
5.6.6 Test Data for Conducted spurious emission

Date of Test	2017-11-06 to 2017-11-16	Temperature	(25.7 ± 1.0) °C
		Relative humidity	(43.2 ± 3.0) % R.H.
Measurement Frequency Range		30 MHz ~ 40 GHz	
Test Result	***PASS***	Tested By	In-yong Song

Operating Mode: 802.11a, Out of Band Emission, U-NII Band 1

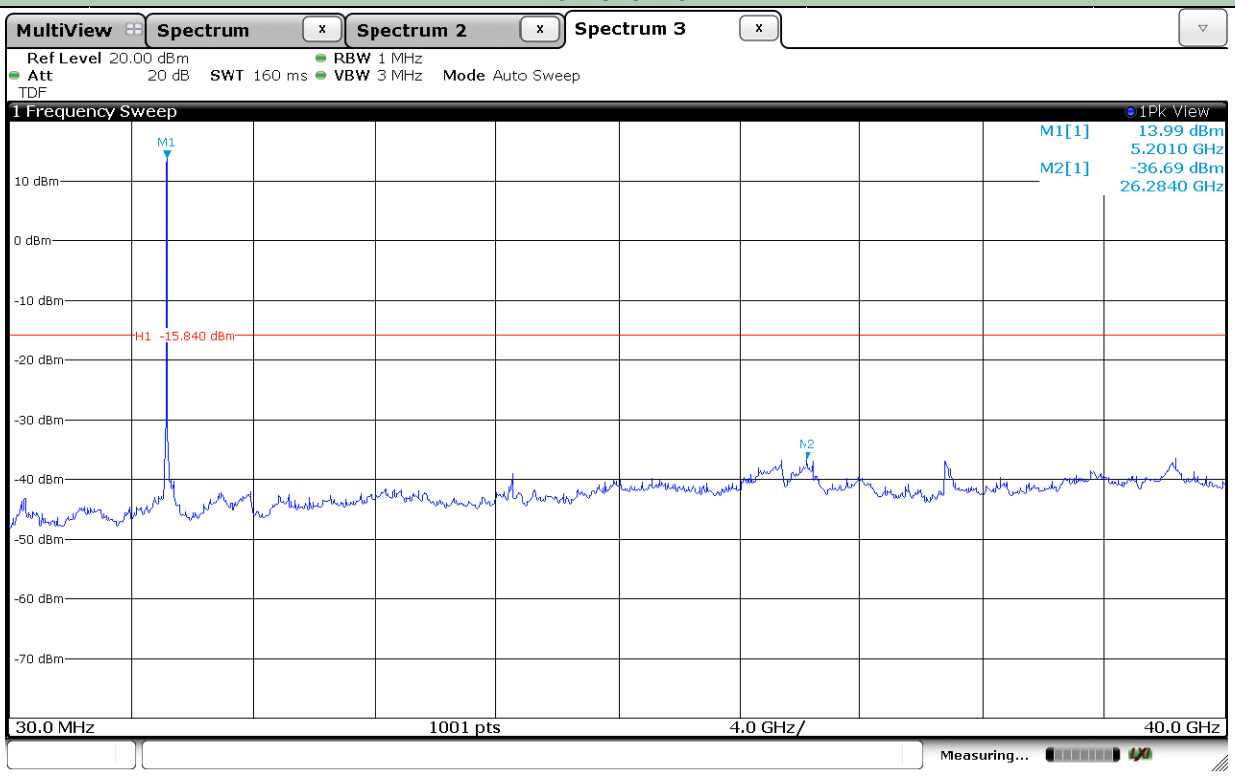
Low Channel, Band-edge

High Channel, Band-edge

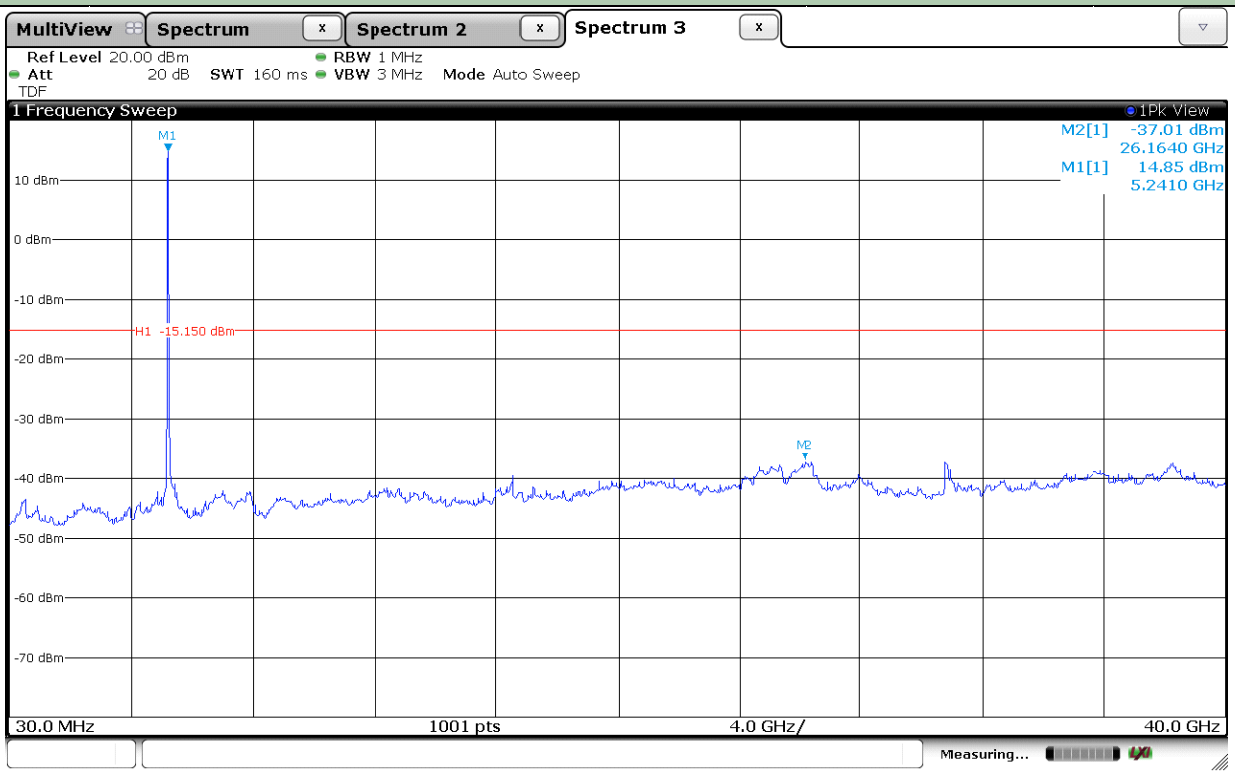


Operating Mode: 802.11a, Out of Band Emission, U-NII Band 1

Low Channel

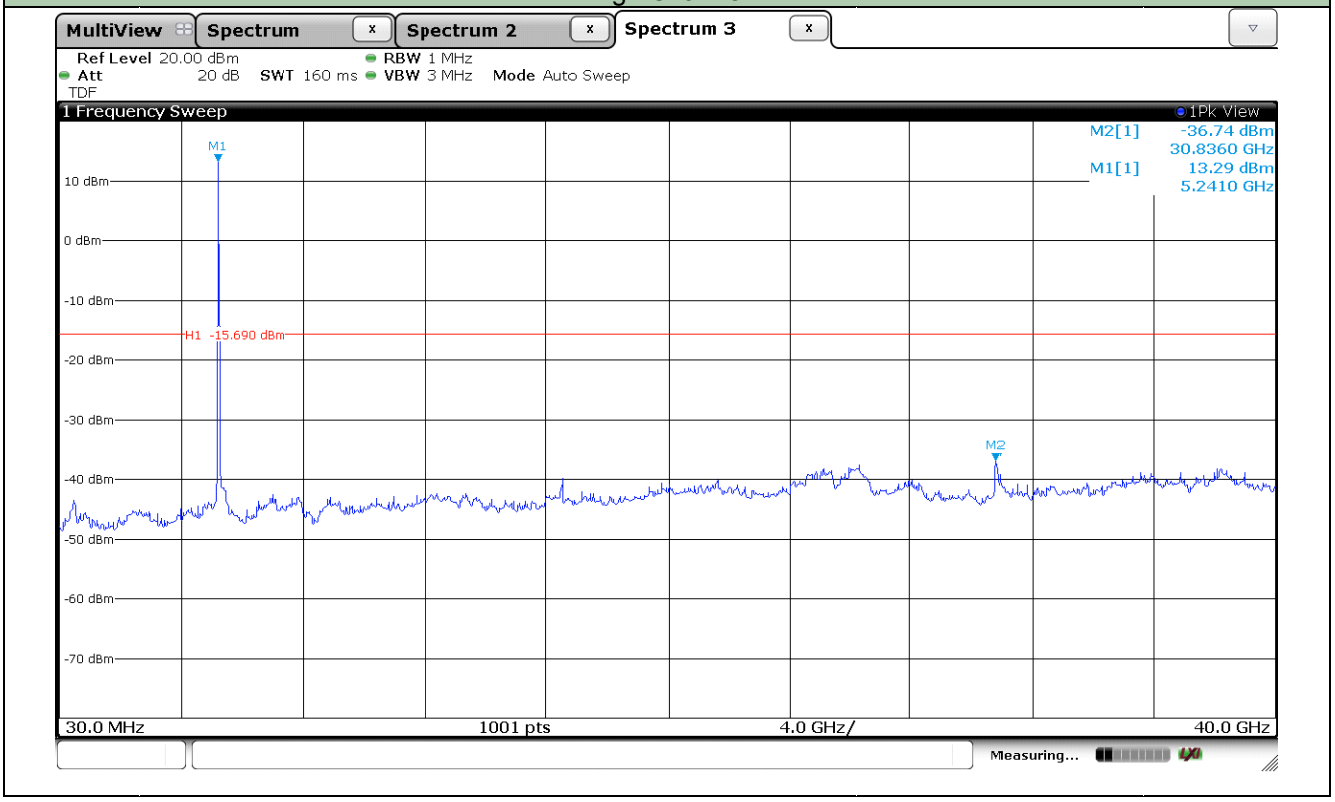


Middle Channel



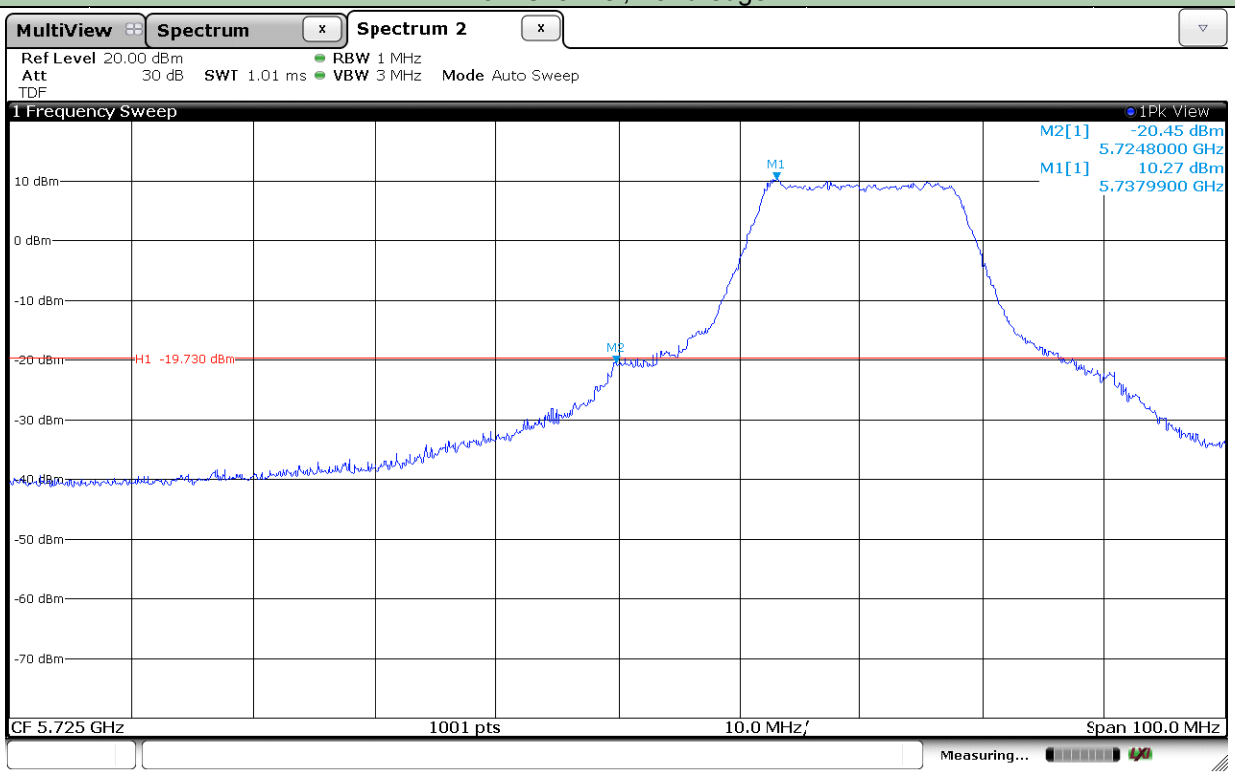
Out of Band Emission, U-NII Band 1

High Channel

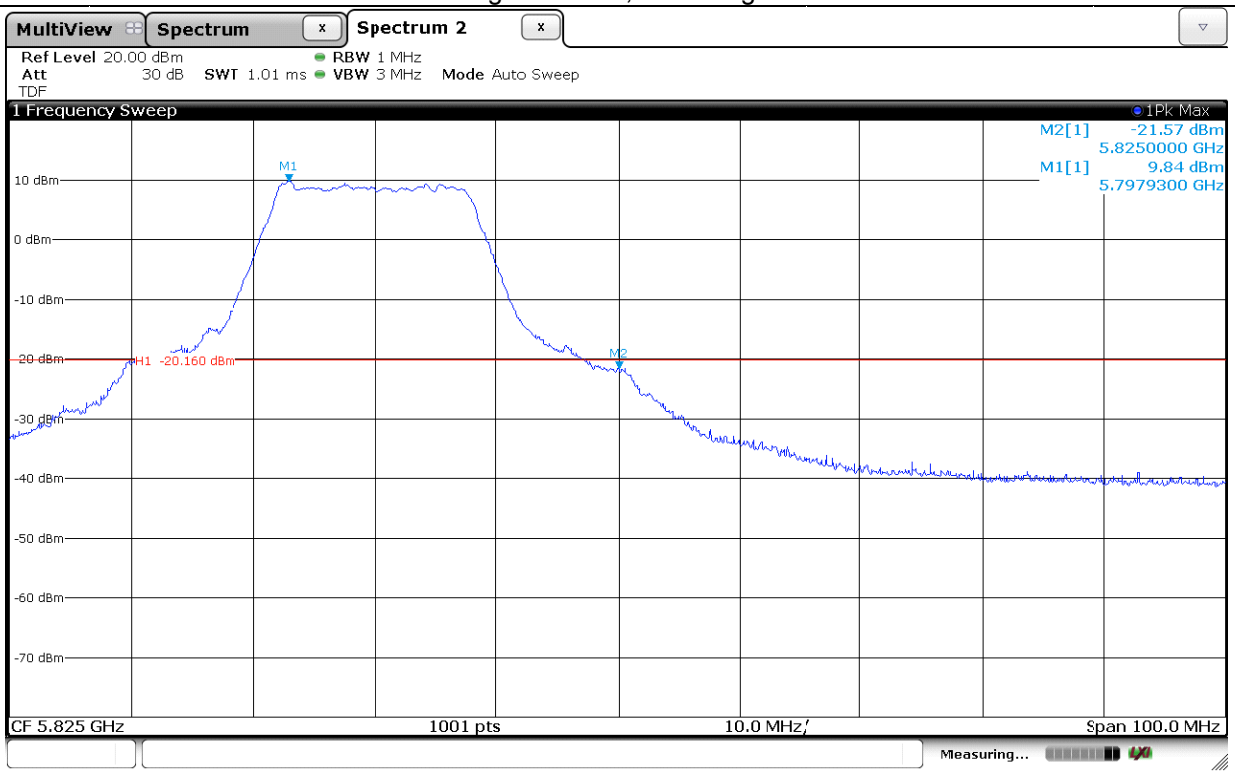


Operating Mode: 802.11a, Out of Band Emission, U-NII Band 3

Low Channel, Band-edge

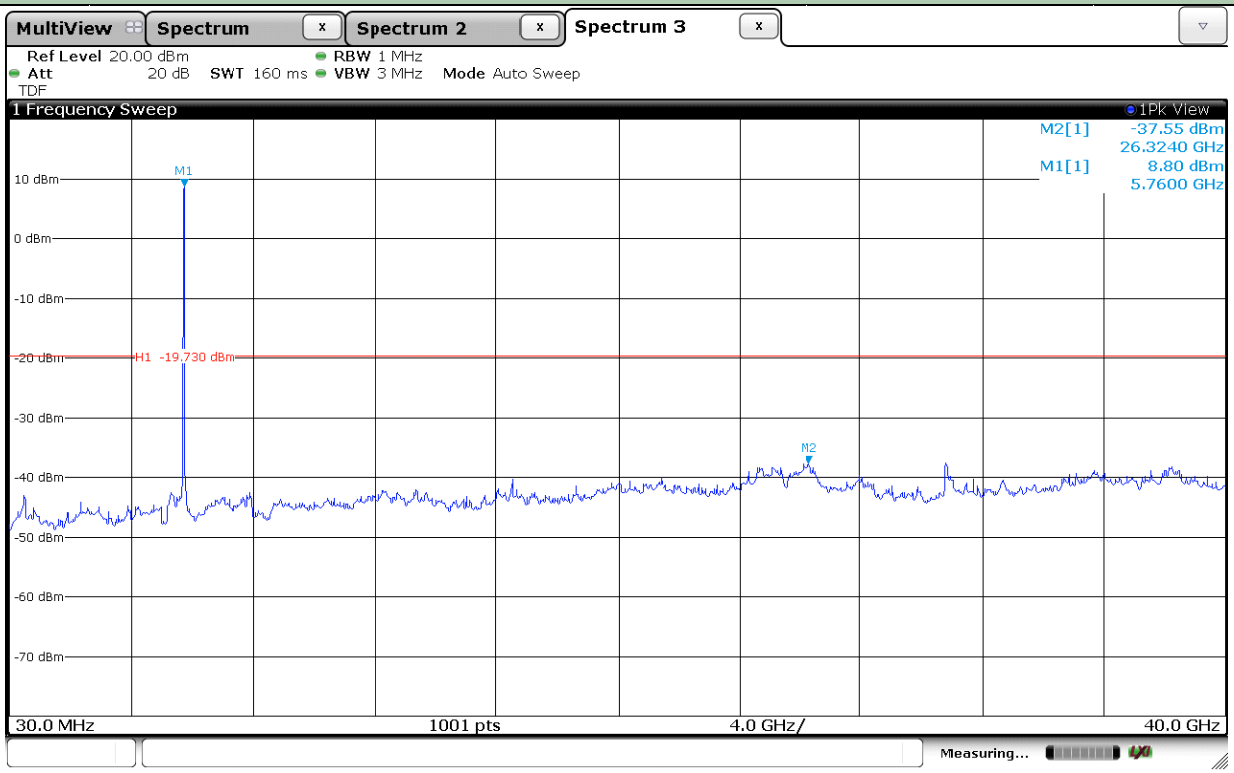


High Channel, Band-edge

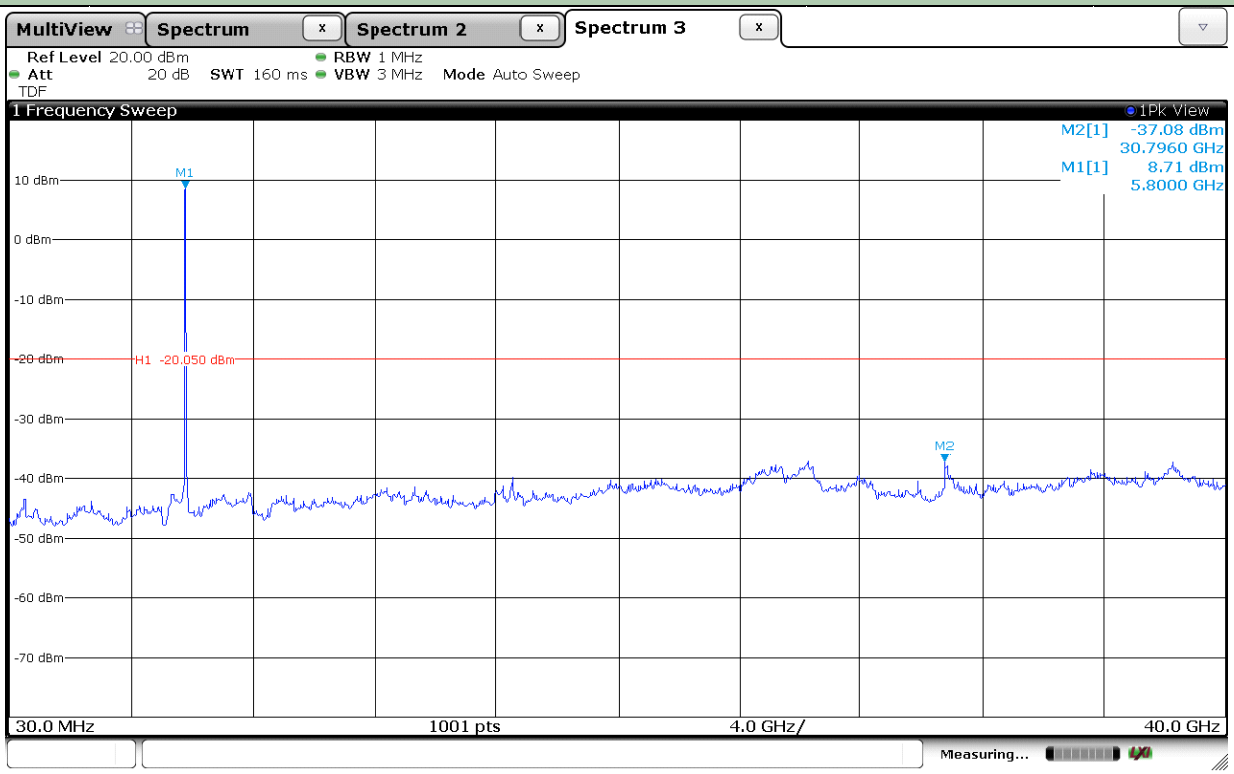


Operating Mode: 802.11a, Out of Band Emission, U-NII Band 3

Low Channel

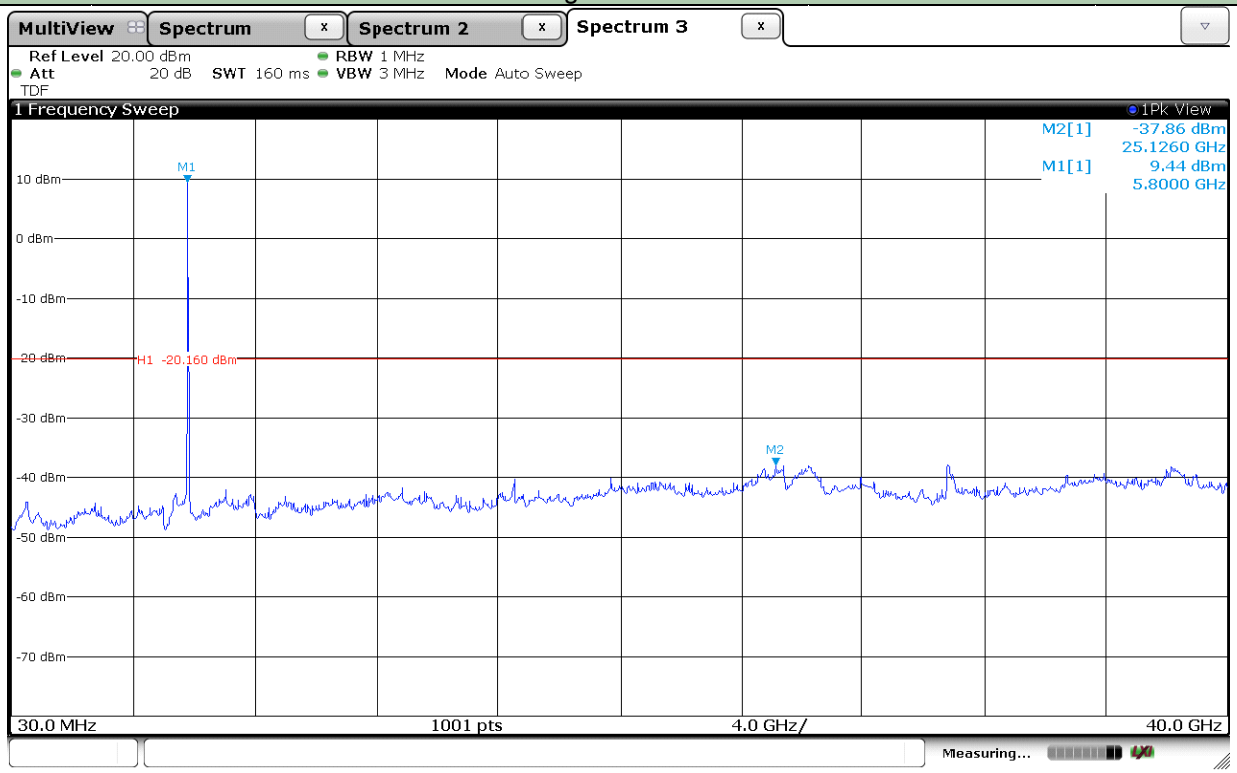


Middle Channel



Out of Band Emission, U-NII Band 3

High Channel



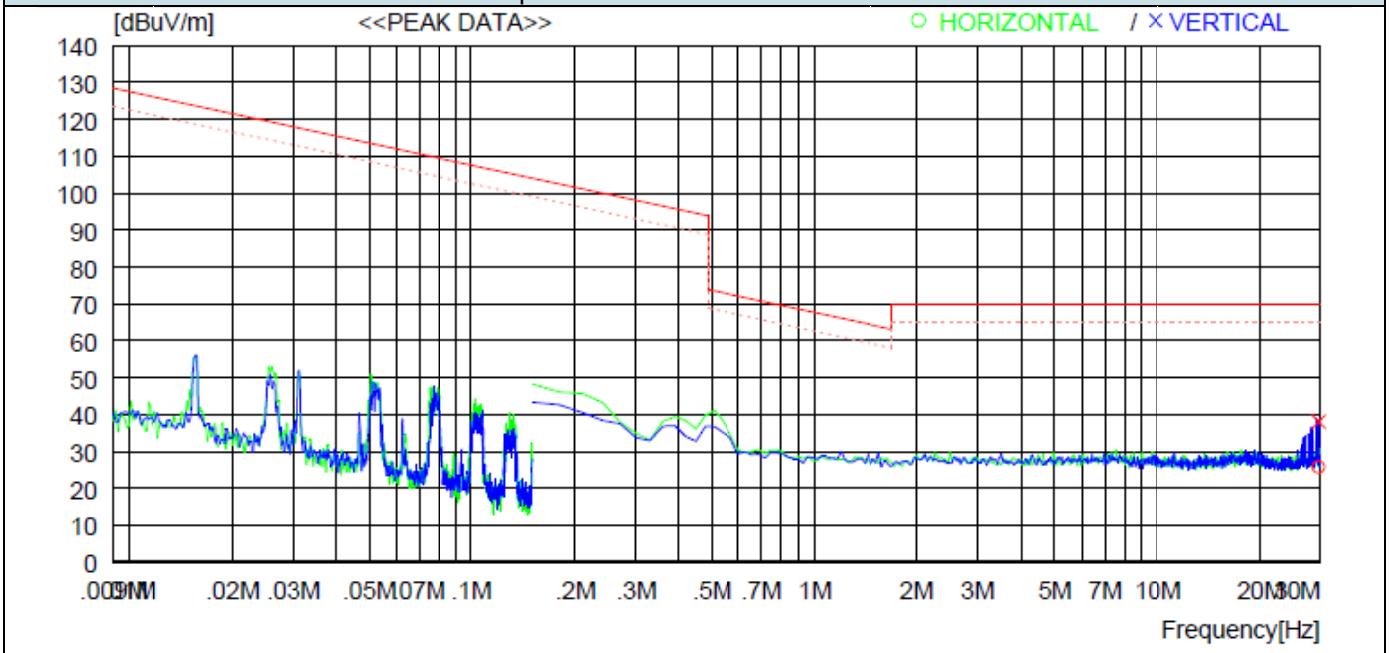
5.6.7 Test Data for Radiated spurious emission

Date of Test	2017-11-14 and 2017-11-16	Temperature	(21.2 ± 2.7) °C
		Relative humidity	(41.4 ± 5.9) % R.H.
Measurement Frequency Range		9 kHz ~ 40 GHz	
Test Result	***PASS***	Tested By	In-yong Song

Frequency range	Detector Mode	Resolution BW	Video BW	Video Filtering	Measurement distance
Below 30 MHz	Peak or Q.P.	9 kHz	100 kHz	-	3 m
30 MHz ~ 1 000 MHz	Peak or Q.P.	100 kHz	300 kHz	-	3 m

5.6.7.1 Test Data below 30 MHz

Graphical Test Data – Below 30 MHz



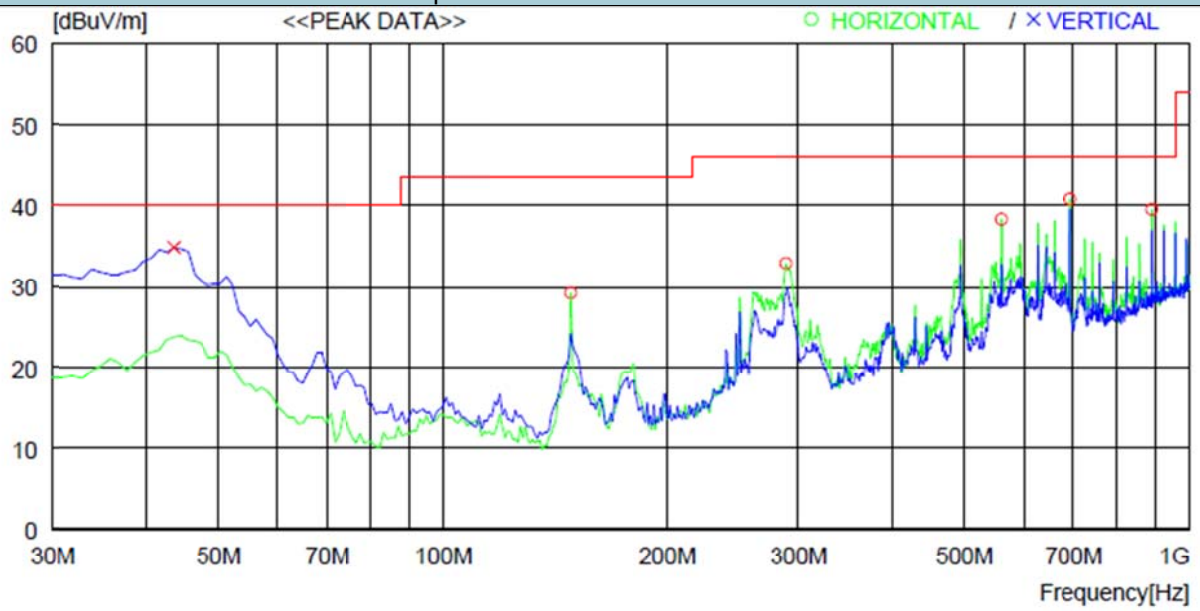
Tabulated Test Data – Low / Middle / High Channel

Frequency (MHz)	Receiver Reading (dBuV)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Degree)
* Spurious emissions that 20 dB below the limits didn't be recorded										

NOTE: The test results below 30 MHz in our SAC (Semi Anechoic Chamber) was compared with other OATS (Open Area Test Site) and found the result was almost same with OATS.

5.6.7.2 Test Data from 30 MHz to 1 GHz

Graphical Test Data – Low Channel



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	148.340	45.7	7.9	8.4	32.7	29.3	43.5	14.2	200	0
2	288.990	42.7	13.3	9.5	32.7	32.8	46.0	13.2	100	264
3	560.589	41.6	18.8	10.9	33.0	38.3	46.0	7.7	150	359
4	693.475	42.2	20.0	11.7	33.1	40.8	46.0	5.2	100	172
5	891.349	36.8	22.8	12.4	32.5	39.5	46.0	6.5	100	0
----- Vertical ------										
6	43.580	46.9	13.4	7.2	32.7	34.8	40.0	5.2	100	219

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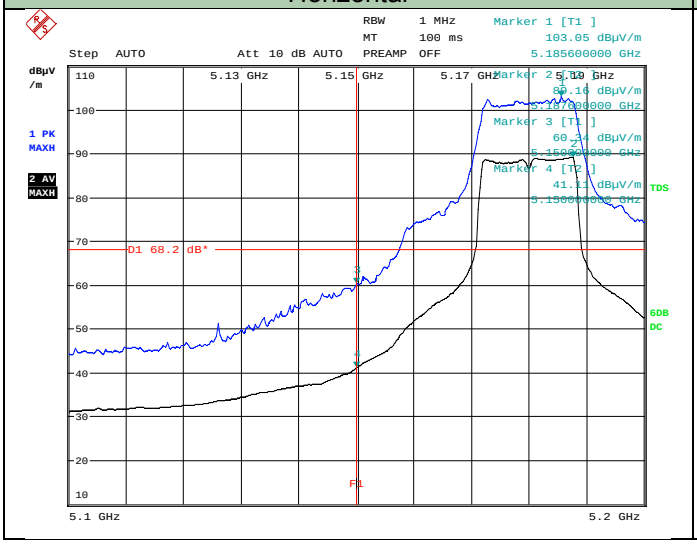
5.6.7.3 Test Data for Radiated spurious emission above 1 GHz

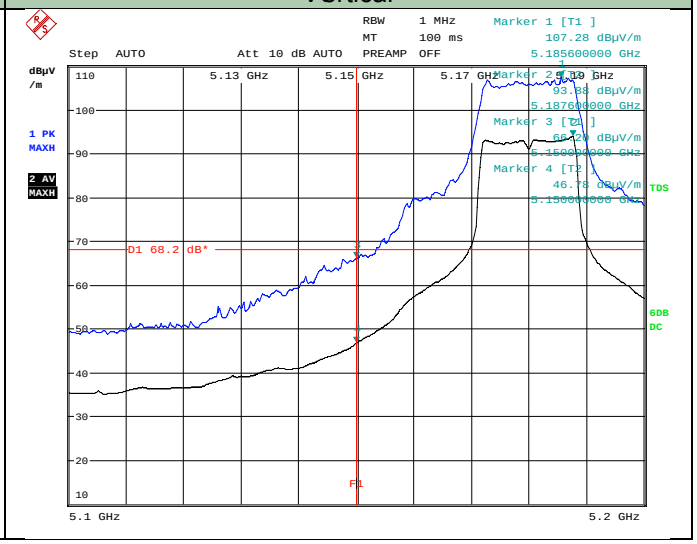
5.6.7.3.1 Test Data for Band edge(Restricted band) @ 3 m - U-NII Band 1

Graphical Test Data _ Low Channel

Horizontal



Vertical



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
5 150.0*	Peak	H	65.28	32.90	37.84	-	60.34	68.2	7.86	100	160
5 150.0*	Average	H	46.05	32.90	37.84	1.45	42.56	54.0	11.44	100	160
5 150.0*	Peak	V	71.13	32.91	37.84	-	66.20	68.2	2.00	100	144
5 150.0*	Average	V	51.71	32.91	37.84	1.45	48.23	54.0	5.77	100	144

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

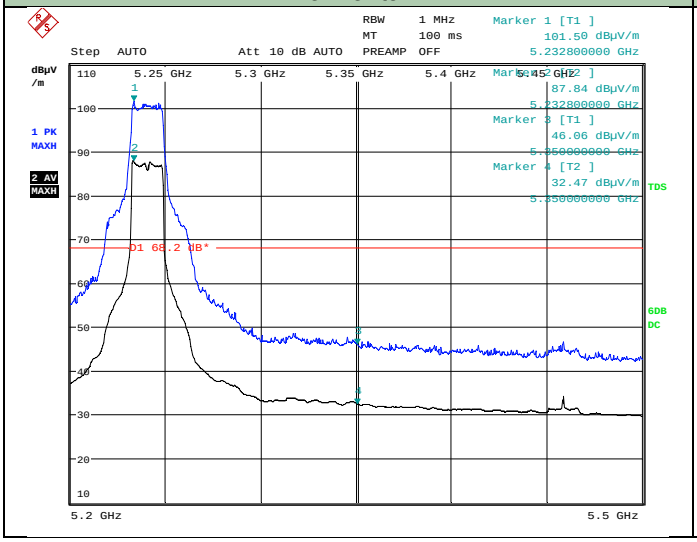
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

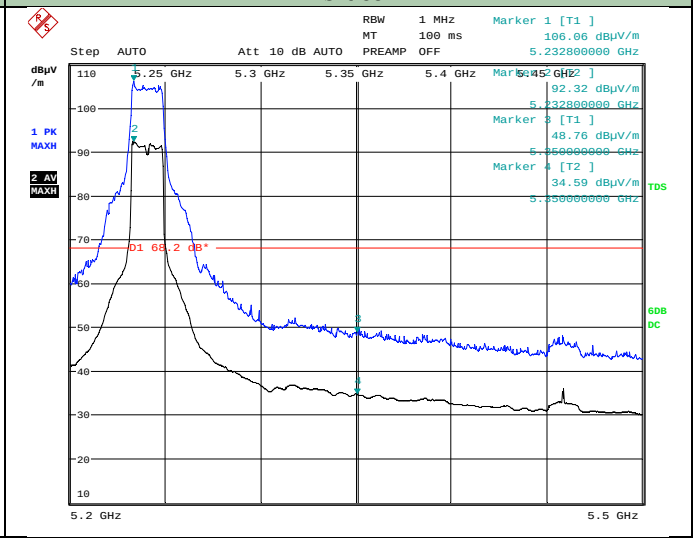
"*" indicates frequency in Restricted band.

Graphical Test Data _ High Channel

Horizontal



Vertical



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
5 350.0	Peak	H	50.64	33.16	37.74	-	46.06	68.2	22.14	100	160
5 350.0	Average	H	37.05	33.16	37.74	1.45	33.92	54.0	20.08	100	160
5 350.0	Peak	V	53.34	33.16	37.74	-	48.76	68.2	19.44	100	144
5 350.0	Average	V	39.17	33.16	37.74	1.45	36.04	54.0	17.96	100	144

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

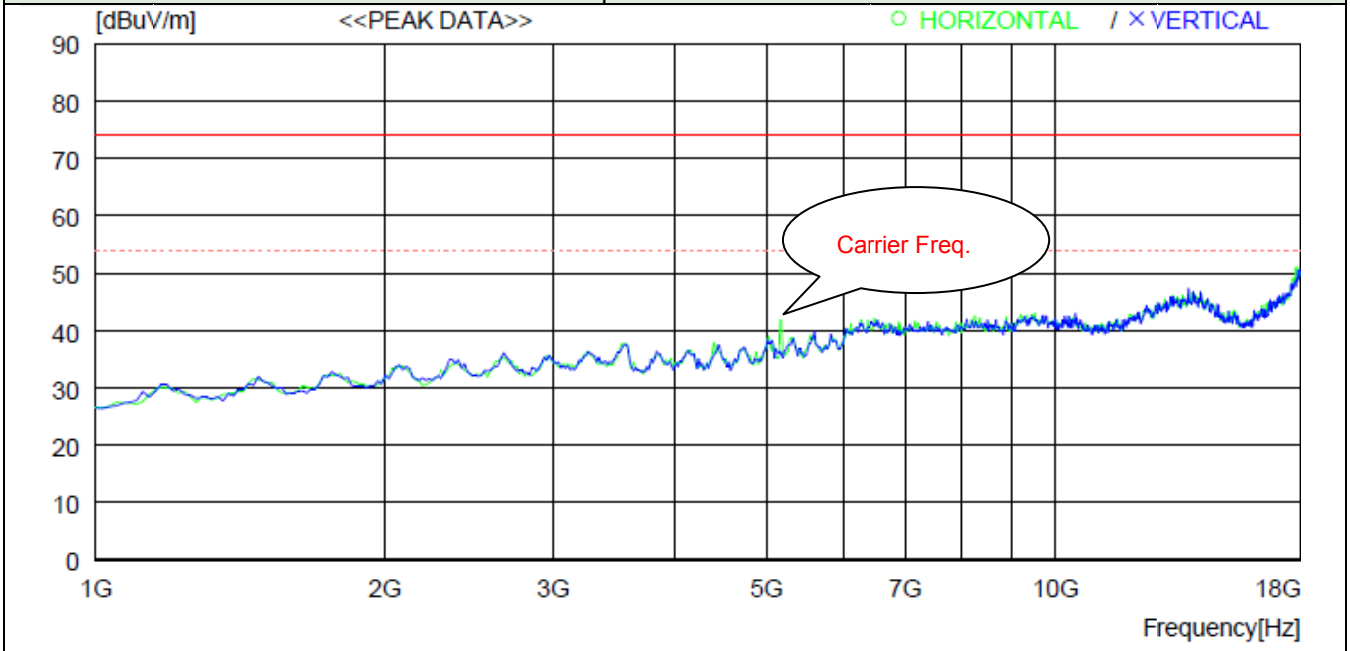
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

5.6.7.3.2 Test Data for Harmonic & Spurious Emission - U-NII Band 1

5.6.7.3.2.1 Low Channel

Graphical Test Data



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)
* Spurious emissions that 20 dB below the limits didn't be recorded										

Emission was scanned up to 40 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

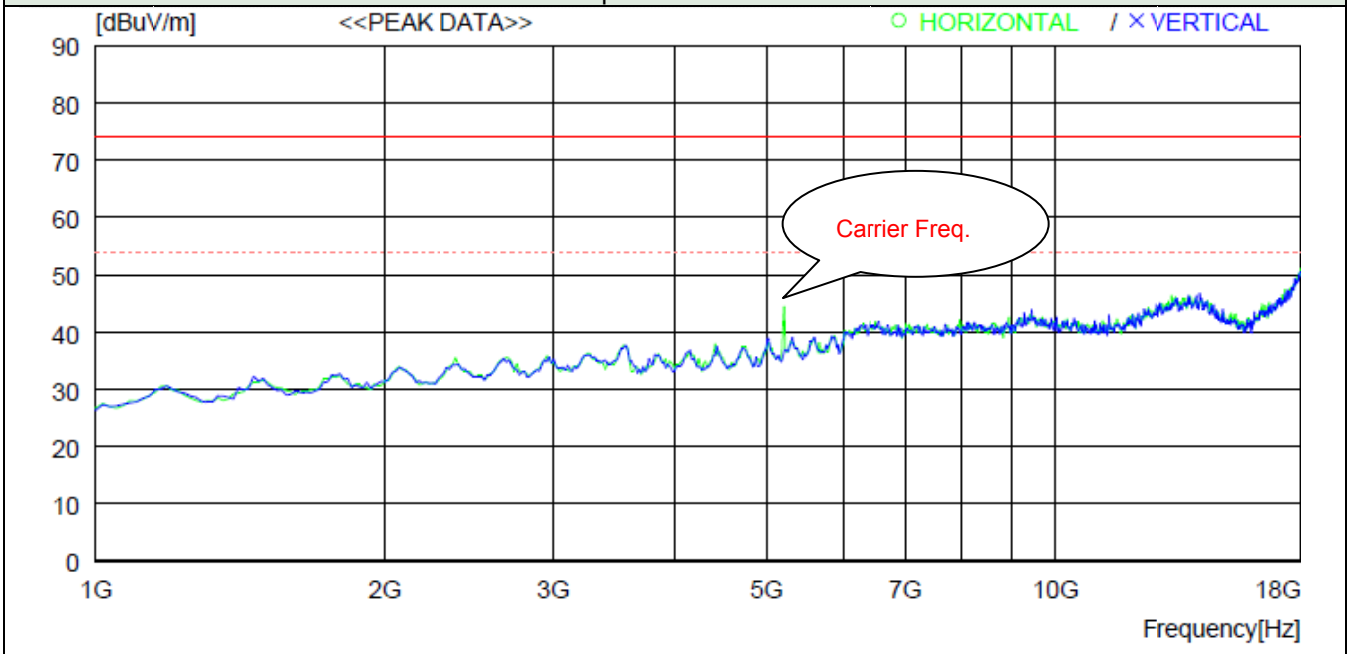
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

"*" indicates frequency in Restricted band.

5.6.7.3.2.2 Middle Channel

Graphical Test Data



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)
* Spurious emissions that 20 dB below the limits didn't be recorded										

Emission was scanned up to 40 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

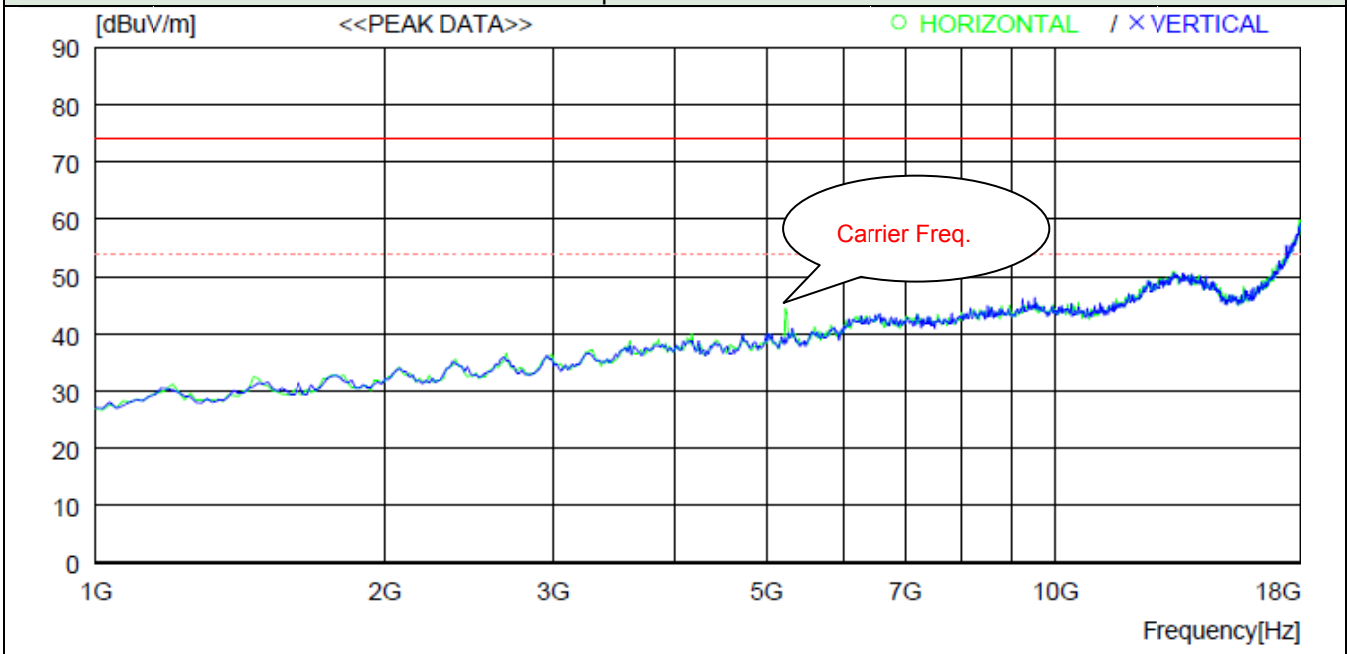
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

"*" indicates frequency in Restricted band.

5.6.7.3.2.3 High Channel

Graphical Test Data



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)
* Spurious emissions that 20 dB below the limits didn't be recorded										

Emission was scanned up to 40 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

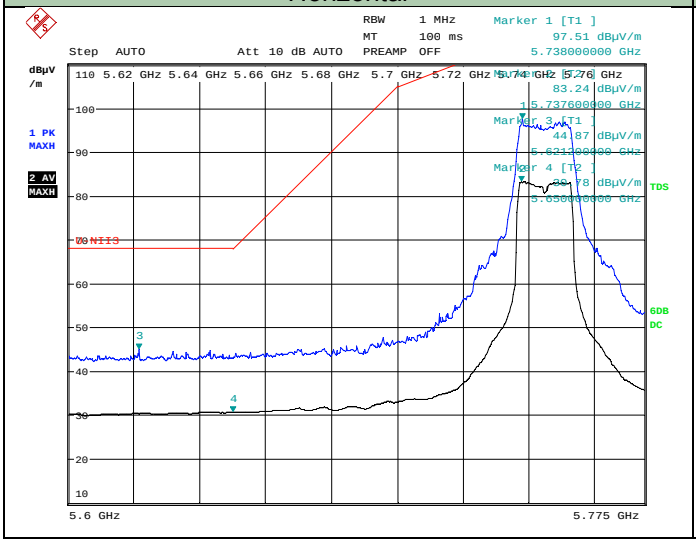
Margin = Limit – Result

"*" indicates frequency in Restricted band.

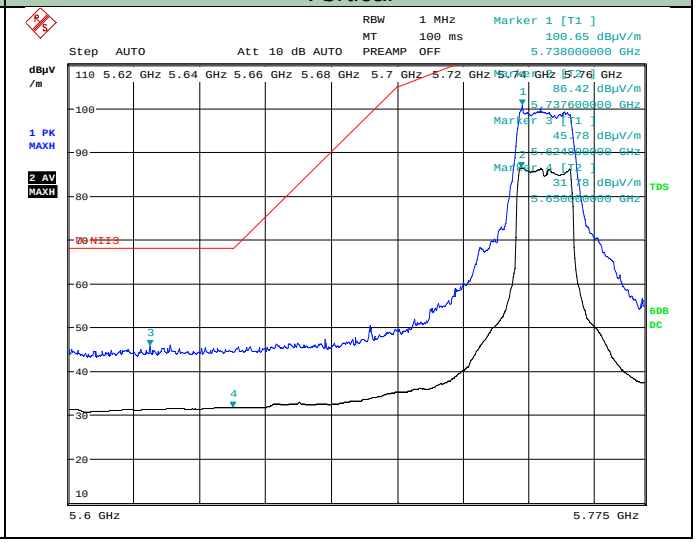
5.6.7.3.3 Test Data for Band edge(Restricted band) @ 3 m - U-NII Band 3

Graphical Test Data _ Low Channel

Horizontal



Vertical



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
5 621.2	Peak	H	48.77	33.72	37.62	-	44.87	68.2	23.33	125	155
5 650.0	Average	H	34.57	33.81	37.60	1.46	32.24	48.2	15.96	125	155
5 624.8	Peak	V	49.67	33.73	37.62	-	45.78	68.2	22.42	100	235
5 650.0	Average	V	35.57	33.81	37.60	1.46	33.24	48.2	14.96	100	235

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

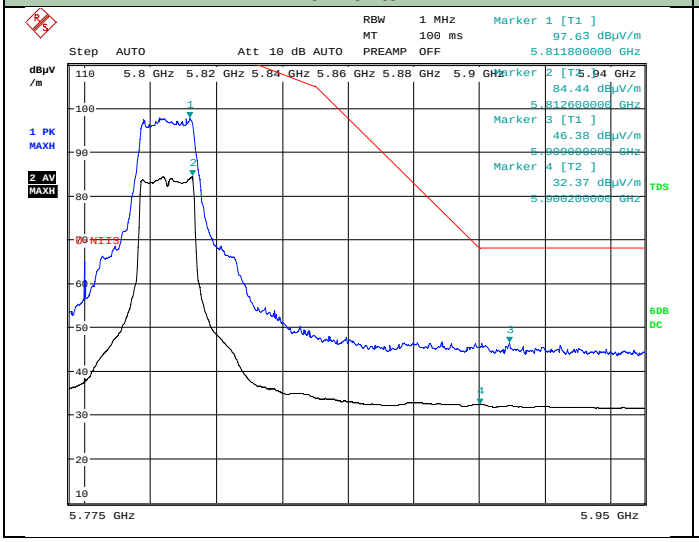
Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

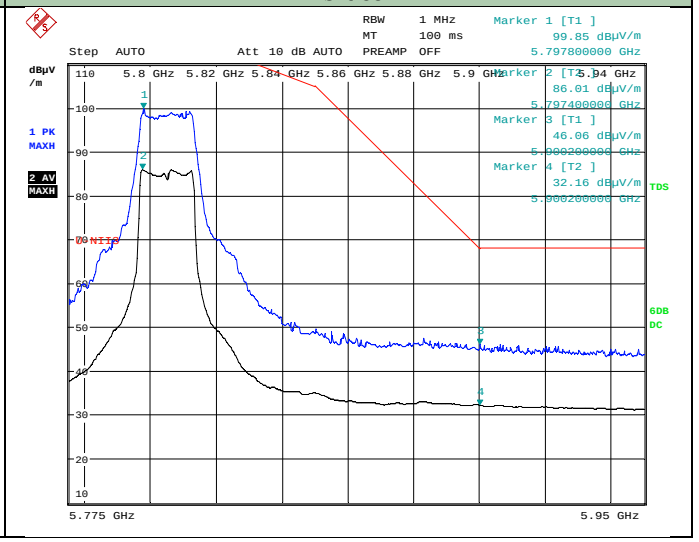
Margin = Limit – Result

Graphical Test Data _ High Channel

Horizontal



Vertical



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
5 909.0	Peak	H	49.28	34.60	37.50	-	46.38	68.2	21.82	125	155
5 900.2	Average	H	35.31	34.57	37.51	1.46	33.83	48.2	14.37	125	155
5 900.2	Peak	V	49.00	34.57	37.51	-	46.06	68.2	22.14	100	235
5 900.2	Average	V	35.10	34.57	37.51	1.46	33.62	48.2	14.58	100	235

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

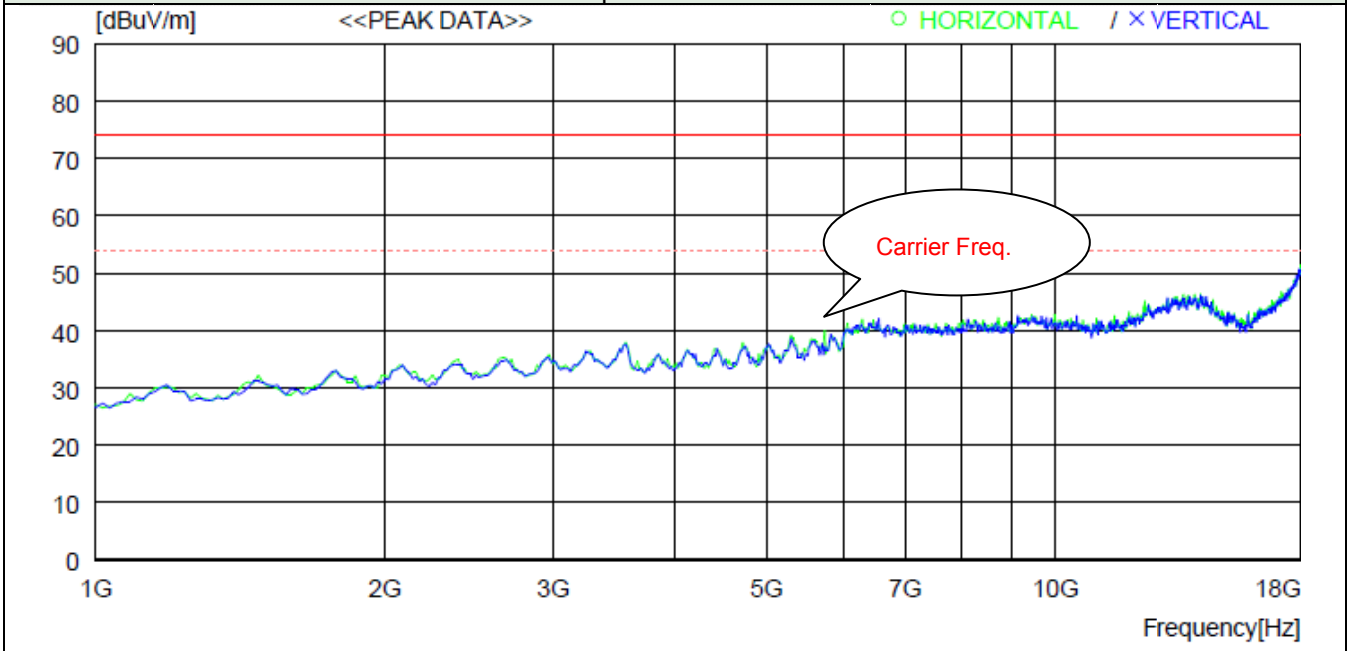
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

5.6.7.3.4 Test Data for Harmonic & Spurious Emission - U-NII Band 3

5.6.7.3.4.1 Low Channel

Graphical Test Data



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)
* Spurious emissions that 20 dB below the limits didn't be recorded										

Emission was scanned up to 40 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

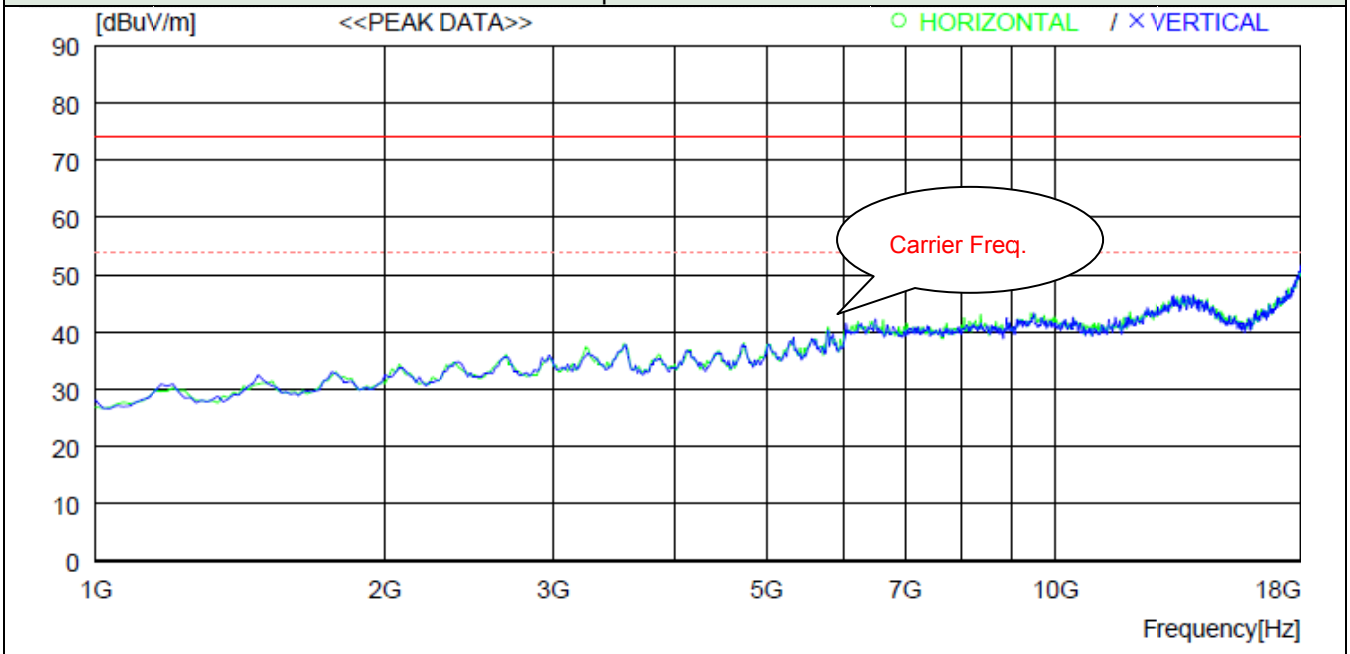
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

"*" indicates frequency in Restricted band.

5.6.7.3.4.2 Middle Channel

Graphical Test Data



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)
* Spurious emissions that 20 dB below the limits didn't be recorded										

Emission was scanned up to 40 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

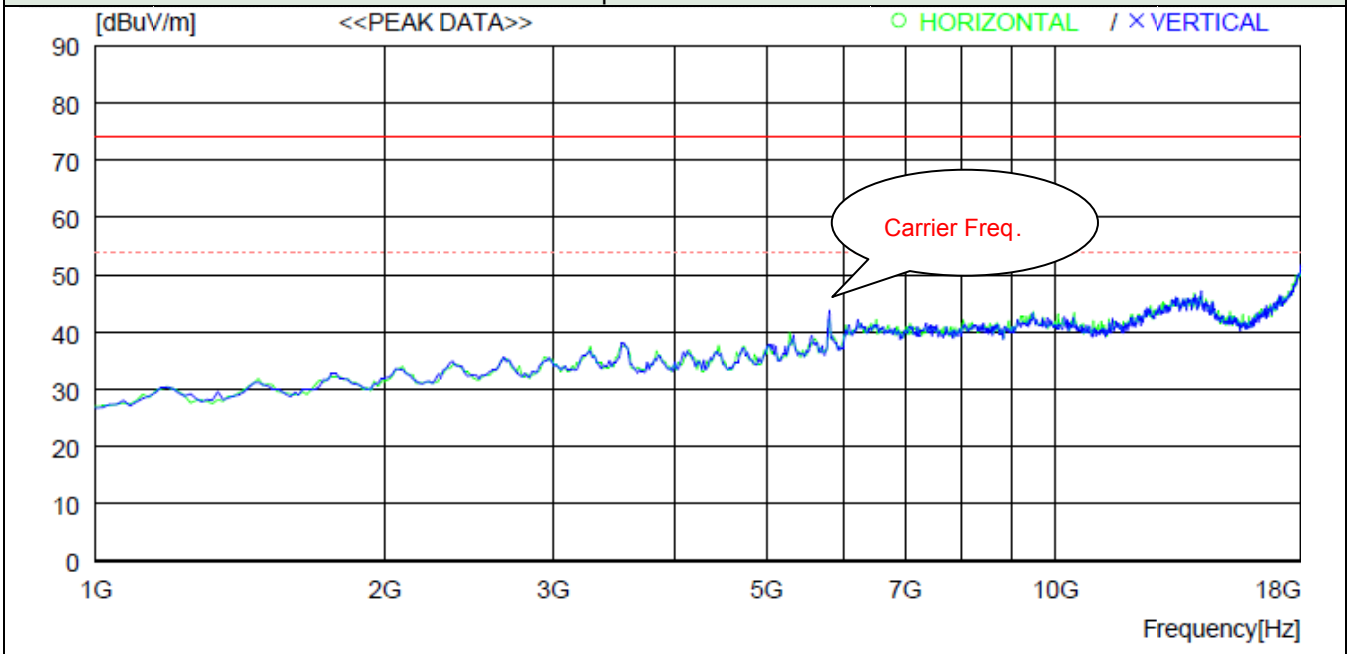
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

"*" indicates frequency in Restricted band.

5.6.7.3.4.3 High Channel

Graphical Test Data



Tabulated Test Data

Freq. (MHz)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor (dB)	Receiver Reading (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)
* Spurious emissions that 20 dB below the limits didn't be recorded										

Emission was scanned up to 40 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

"*" indicates frequency in Restricted band.

5.7 AC Power Line Conducted Emission

5.7.1 Limit

Acc. to section 15.207 (a), following table shall be applied.

Frequency Range (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 -30	60	50

5.7.2 Method of Measurement

The EUT was placed on a wooden table, 0.8 m height above the horizontal ground plane and 40 cm from the vertical ground plane. Power was fed to the EUT through a 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

The test was performed for both Neutral and Hot lines.

5.7.3 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 150 kHz	± 2.00 dB	150 kHz ~ 30 MHz	± 2.00 dB

5.7.4 Sample Calculated Example

At 5.31 MHz QP Limit = 60.0 dBuV

Correction Factor (C. Factor) of LISN, Pulse Limiter and cable loss at 5.31 MHz = 9.7 dB

Q.P Reading from the Test receiver = 20.8 dBuV

(Calculated value for system losses by software EMC32 manufactured by Rohde & Schwarz)

Therefore Q.P Margin = 60 - 20.8 = 39.2 so the EUT has 39.2 dB margin at 5.31 MHz

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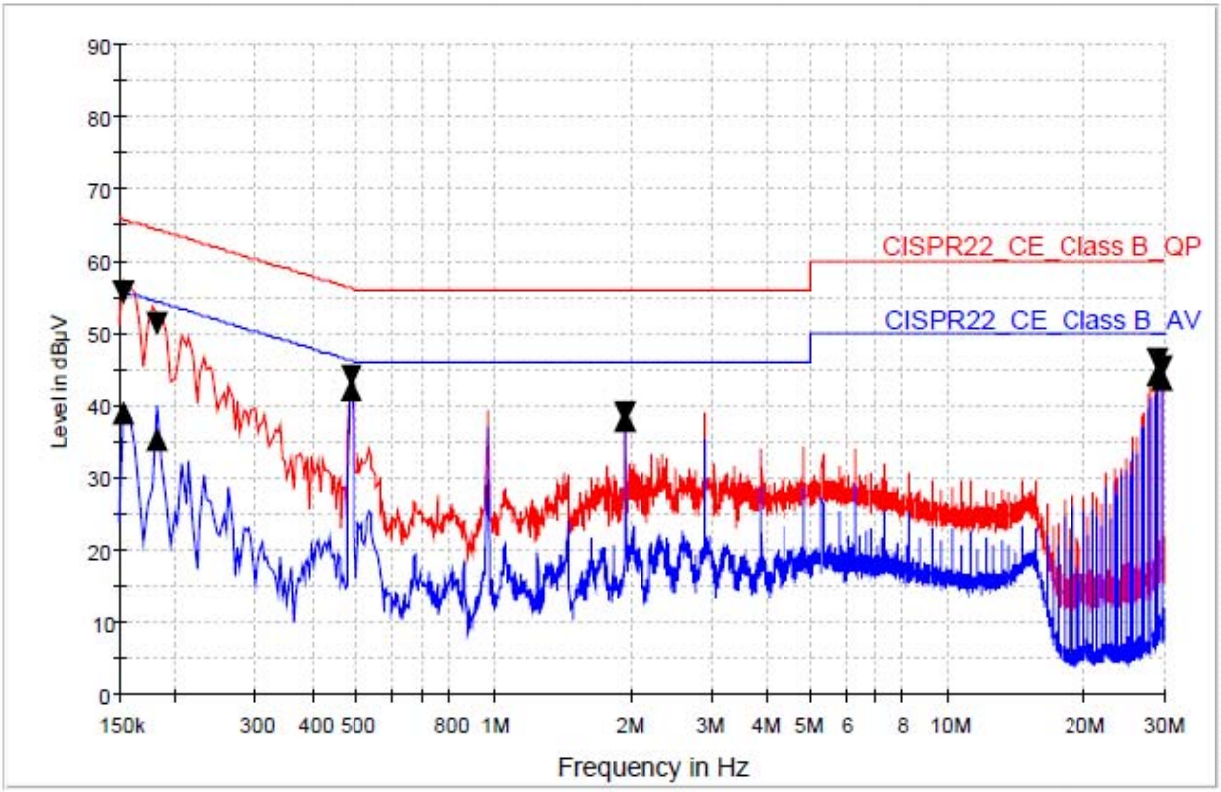
5.7.5 Worst Case Test Data

Date of Test	2017-11-08	Temperature	(23.0 ± 1.0) °C
		Relative humidity	(45.2 ± 1.5) % R.H.
Measurement Frequency Range		9 kHz ~ 30 MHz	
Test Result	***PASS***	Tested By	In-yong Song

Hot Line



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.154000	55.6	39.2	9.000	L1	9.6	10.1	65.8	16.6	55.8
0.182000	51.3	35.4	9.000	L1	9.6	13.1	64.4	19.0	54.4
0.486000	43.9	42.4	9.000	L1	9.6	12.3	56.2	3.8	46.2
1.942000	39.1	37.9	9.000	L1	9.6	16.9	56.0	8.1	46.0
29.102000	46.3	44.3	9.000	L1	10.0	13.7	60.0	5.7	50.0
29.586000	45.3	43.6	9.000	L1	10.0	14.7	60.0	6.4	50.0

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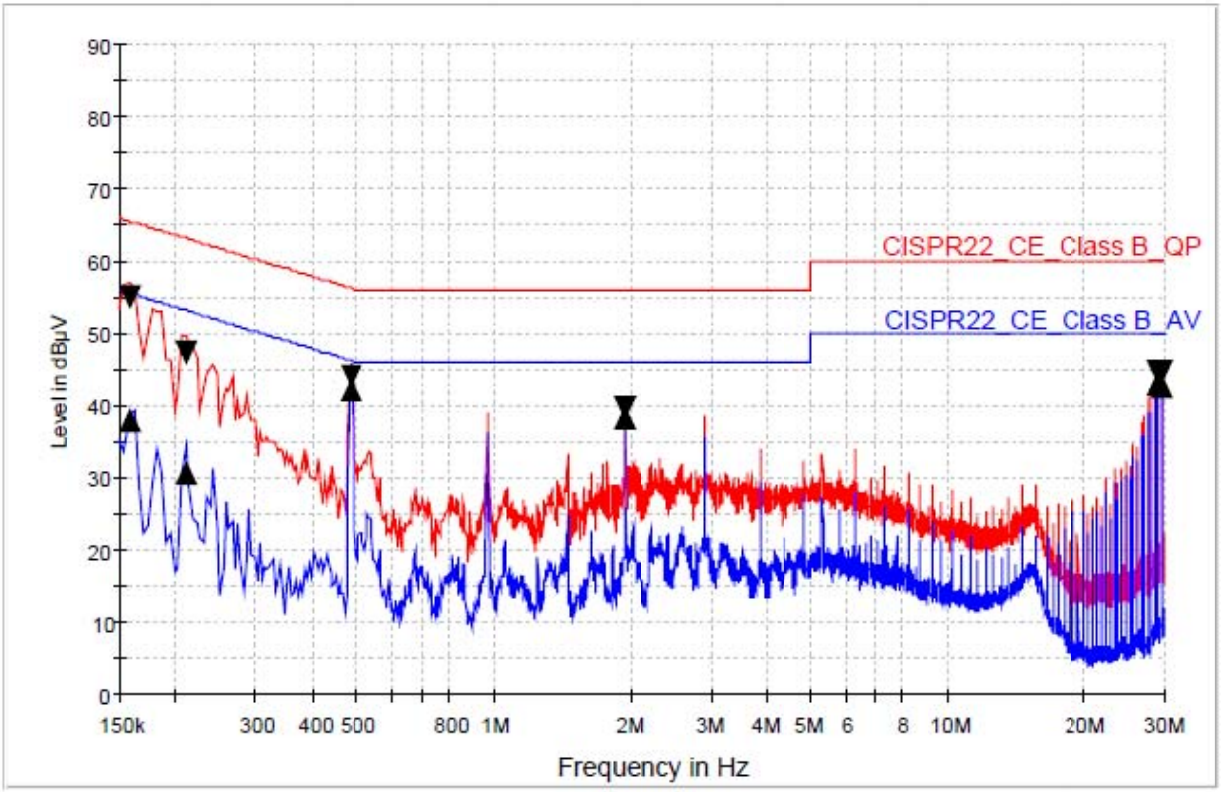
Neutral Line



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - CAV (dB)	Limit - CAV (dBµV)
0.158000	55.1	38.0	9.000	N	9.6	10.5	65.6	17.6	55.6
0.210000	47.5	30.8	9.000	N	9.6	15.7	63.2	22.4	53.2
0.486000	43.9	42.4	9.000	N	9.6	12.4	56.2	3.9	46.2
1.938000	39.6	38.4	9.000	N	9.6	16.4	56.0	7.6	46.0
29.094000	44.6	43.1	9.000	N	10.0	15.4	60.0	6.9	50.0
29.578000	44.6	42.7	9.000	N	10.0	15.4	60.0	7.3	50.0

Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal Date
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2018-05-04
Power Meter	NRP2	104109	Rohde & Schwarz	2018-01-19
Power Sensor	NRP-Z81	101507	Rohde & Schwarz	2018-07-28
DC Power Supply	U8001A	MY51080019	Agilent	2018-07-28
Attenuator	56-10	58769	WEINSCHEL	2018-01-19
Temperature & Humidity Chamber	PR-3KP	14004209	Espec	2018-08-01
Test Receiver	ESU 26	100303	Rohde & Schwarz	2018-01-19
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2019-06-05
TRILOG Broadband Antenna	VULB9163	9163.770	Schwarzbeck	2019-02-13
Band Stop Filter	HPS17542	019	MICRO-TRONICS	2018-07-28
Horn Antenna	HF 907	102426	Rohde & Schwarz	2019-01-06
DOPPEL STEG Horn Antenna	HF 906	100332	Rohde & Schwarz	2019-02-13
Horn Antenna	BBHA 9170	783	Schwarzbeck	2019-11-28
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2018-01-19
Pre-Amplifier	310N	344015	Sonoma Instrument	2018-01-19
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2018-04-24
Pre-Amplifier	CBL18265035	28706	CERNEX	2018-03-29
Pre-Amplifier	CBL26405040	28707	CERNEX	2018-03-29
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/ 34130814/L	INNCO SYSTEM	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/ 34130814/L	INNCO SYSTEM	N/A
EMI Test Receiver	ESCI 7	100722	Rohde & Schwarz	2018-01-19
LISN	ENV216	100110	Rohde & Schwarz	2018-07-28

The measuring equipment utilized to perform the tests documented in this test report has been calibrated in accordance with manufacturer's recommendations, and is traceable to recognized national standards.