RF TEST REPORT

Applicant	Nokia Shanghai Bell CO., Ltd.
FCC ID	2ADZRA020WA
Product	WIFI Mesh
Brand	Nokia
Model	HA-020W-A, A-020W-A
Report No.	R1806B0067-R2
Issue Date	June 28, 2018

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15E (2018)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Zhengqiang Zhou

Performed by: Zhengqiang Zhou

Kai Xu

Approved by: Kai Xu

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TABLE OF CONTENT

Summary of measurement results

Number	Summary of measurements of results	Clause in FCC rules	Verdict
1	Average conducted output power	15.407(a)	PASS
2	Occupied bandwidth	15.407(e)	PASS
3	Frequency stability	15.407(g)	PASS
4	Maximum power spectral density	15.407(a)	PASS
5	Unwanted Emissions	15.407(b)	PASS
6	Conducted Emissions	15.207	PASS
Date of Testing: Date of Testing: January 31, 2018~ March 13, 2018			

1. Test Laboratory

1.1. Notes of the test report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

CNAS (accreditation number: L2264)

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

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

IC (recognition number is 8510A)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement.

VCCI (recognition number is C-4595, T-2154, R-4113, G-10766)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Japan to perform electromagnetic emission measurement.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3. Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City:	Shanghai
Post code:	201201
Country:	P. R. China
Contact:	Xu Kai
Telephone:	+86-021-50791141/2/3
Fax:	+86-021-50791141/2/3-8000
Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

2. General Description of Equipment under Test

Client Information

Applicant	Nokia Shanghai Bell CO., Ltd.
Applicant address	388#, Ningqiao Road, China (Shanghai) Pilot Free Trade Zone, Shanghai 201206, China
Manufacturer	Nokia Shanghai Bell CO., Ltd.
Manufacturer address	388#, Ningqiao Road, China (Shanghai) Pilot Free Trade Zone, Shanghai 201206, China

General information

EUT Description	
Model	HA-020W-A, A-020W-A
IMEI	/
Hardware Version	PEM4
Software Version	3FE473360.00
Power Supply	Battery/AC adapter
Antenna Type	Internal Antenna
Antenna Gain	Antenna 1: 4dBi Antenna 2: 4dBi
Test Mode(s)	U-NII-1(5150MHz-5250MHz) U-NII-3(5725MHz-5850MHz)
Modulation Type	802.11a/n (HT20/HT40) : OFDM 802.11ac (HT20.HT40/HT80): OFDM
Max. Conducted Power	27.69 dBm
Operating Frequency Range(s)	U-NII-1: 5150-5250MHz U-NII-3: 5725-5850MHz
EUT Accessory	
Adapter 1	Manufacturer: Shenzhen Ruide Electronical Industrial CO., LTD Model: RD1201000- C55-26MG
Adapter 2	Manufacturer: Dongguan Shilong Fuhua Electronic CO., LTD Model: UES12W8-120100SPAU
Note: The information of the EUT is declared by the manufacturer. 2. There is more than one Adapter, each one should be applied throughout the compliance test respectively, and however, only the worst case (Adapter 1) will be recorded in this report.	

Item	HA-020W-A	A-020W-A
Software	The same	The same
Hardware	The same	The same
Mechanical Shell	Black	White
Mechanical push button	Plastic handle reduced 2mm	Plastic handle increase 2mm
Other	The same	The same
Note: Customer declaration, two models is the same, except for Mechanical. There are more than one model, each one should be applied throughout the compliance test respectively, however, only the worst case (HA-020W-A) will be recorded in this report.		

3. Applied Standards

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

FCC CFR47 Part 15E (2018) Unlicensed National Information Infrastructure Devices

ANSI C63.10 (2013)

KDB 789033 D02 General UNII Test Procedures New Rules v02r01

KDB 662911 D01 Multiple Transmitter Output v02r01

4. Test Configuration

Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

Band	Data Rate	
	Antenna 1	**Antenna 2**
802.11a	6 Mbps	6 Mbps
802.11n HT20	MCS8	MCS8
802.11n HT40	MCS8	MCS8
802.11ac HT20	MCS0	MCS0
802.11ac HT40	MCS0	MCS0
802.11ac HT80	MCS0	MCS0

The worst case Antenna mode for each of the following tests for Wi-Fi:

Test Cases	MIMO Antenna 1	MIMO Antenna 2
Average conducted output power	O	O
Occupied bandwidth	O	--
Frequency stability	802.11a	--
Power Spectral Density	O	O
Unwanted Emissions	O	--
Conducted Emissions	802.11a	--
Note：“O”: test all bands		

Wireless Technology and Frequency Range

Wireless Technology		Bandwidth	Channel	Frequency
Wi-Fi	U-NII-1	20 MHz	36	5180MHz
			40	5200MHz
			44	5220MHz
			48	5240MHz
		40 MHz	38	5190MHz
			46	5230MHz
		80 MHz	42	5210MHz
	U-NII-3	20 MHz	149	5745MHz
			157	5785MHz
			165	5825MHz
		40 MHz	151	5755MHz
			159	5795MHz
		80 MHz	155	5775MHz
Does this device support TPC Function? ☐Yes ☒No				
Does this device support TDWR Band? ☐Yes ☒No				

5. Test Case Results

5.1. Occupied Bandwidth

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable.

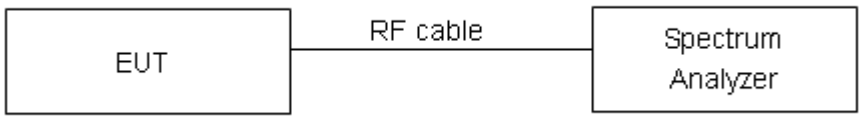
For U-NII-1, set RBW ≈1% OCB kHz, VBW ≥ 3 × RBW, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 26 dB relative to the maximum level measured in the fundamental emission.

For U-NII-3, Set RBW = 100 kHz, VBW ≥ 3 × RBW, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

Use the 99 % power bandwidth function of the instrument

Test Setup



Limits

Rule FCC Part §15.407(e)

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936 Hz.

Test Results:

MIMO Antenna 2

U-NII-1

Network Standards	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5180	16.456	22.75	PASS
	5200	16.421	22.00	PASS
	5240	16.452	21.66	PASS
802.11n HT20	5180	17.586	20.10	PASS
	5200	17.576	20.19	PASS
	5240	17.601	20.01	PASS
802.11n HT40	5190	35.934	39.83	PASS
	5230	35.929	39.56	PASS
802.11ac HT20	5180	17.584	20.24	PASS
	5200	17.600	19.94	PASS
	5240	17.617	21.31	PASS
802.11ac HT40	5190	35.929	39.76	PASS
	5230	35.960	39.86	PASS
802.11ac HT80	5210	74.975	79.67	PASS

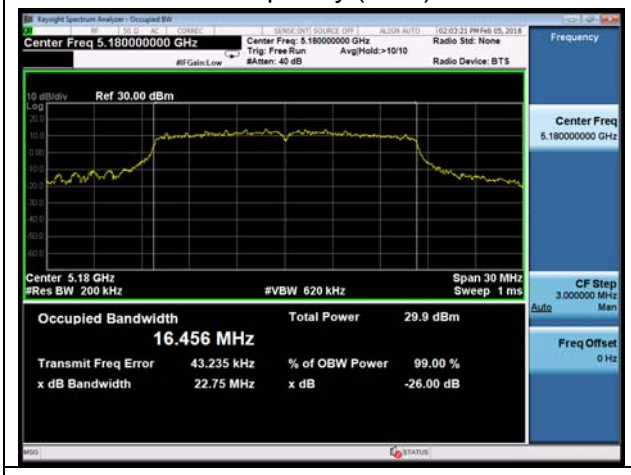
U-NII-3

Network Standards	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11a	5745	16.552	13.84	500	PASS
	5785	16.414	15.13	500	PASS
	5825	16.401	16.06	500	PASS
802.11n HT20	5745	17.626	14.42	500	PASS
	5785	17.605	15.71	500	PASS
	5825	17.572	15.13	500	PASS
802.11n HT40	5755	36.006	35.15	500	PASS
	5795	36.008	35.14	500	PASS
802.11ac HT20	5745	17.658	15.15	500	PASS
	5785	17.587	15.70	500	PASS
	5825	17.570	14.48	500	PASS
802.11ac HT40	5755	35.987	33.91	500	PASS
	5795	35.929	35.15	500	PASS
802.11ac HT80	5775	74.948	65.22	500	PASS

MIMO Antenna 2

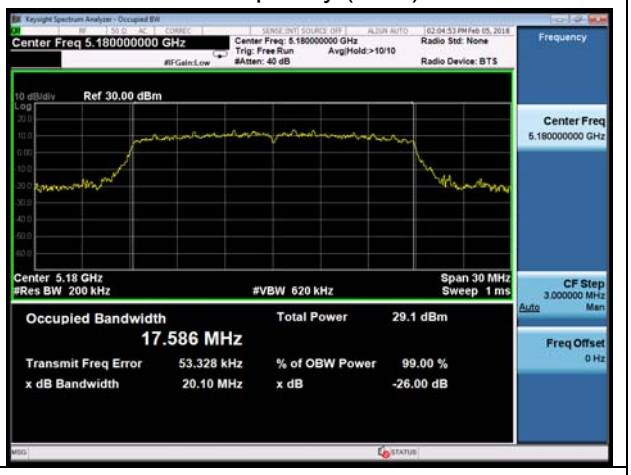
U-NII-1, 802.11a

Carrier frequency (MHz): 5180



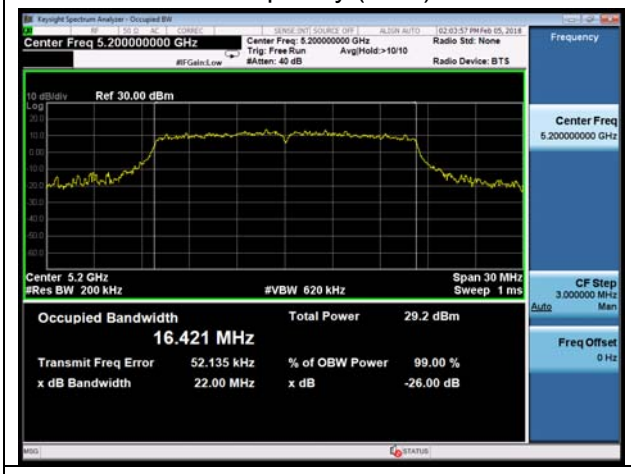
U-NII-1, 802.11n HT20

Carrier frequency (MHz): 5180



U-NII-1, 802.11a

Carrier frequency (MHz): 5200

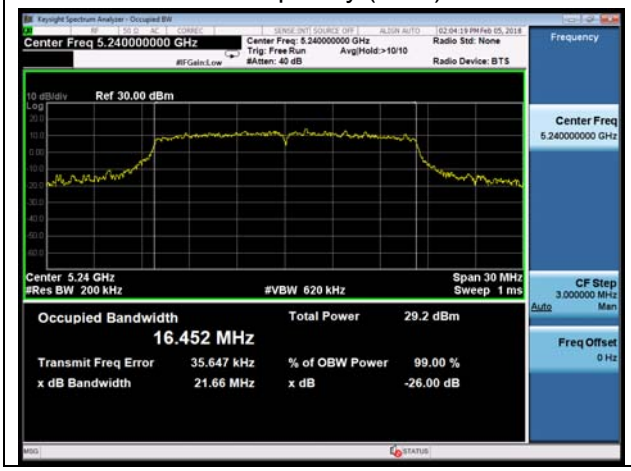


U-NII-1, 802.11n HT20

Carrier frequency (MHz): 5200

U-NII-1, 802.11a

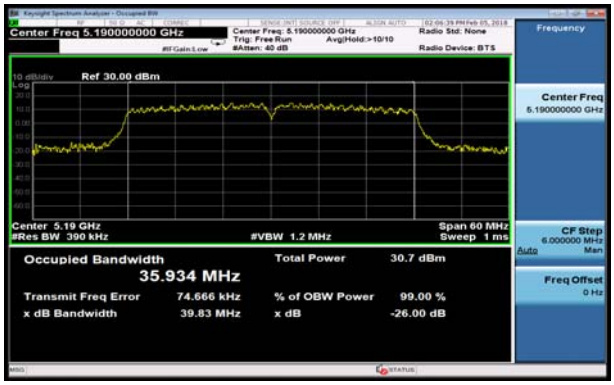
Carrier frequency (MHz):5240



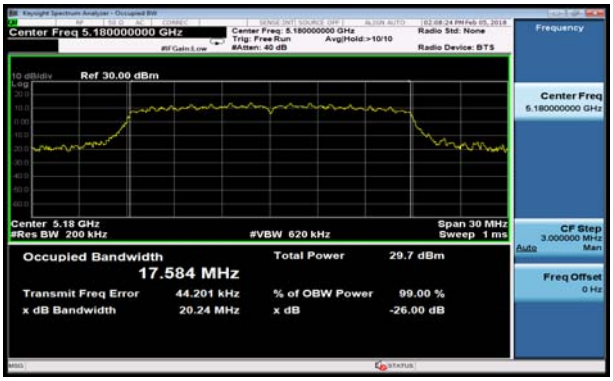
U-NII-1, 802.11n HT20

Carrier frequency (MHz):5240

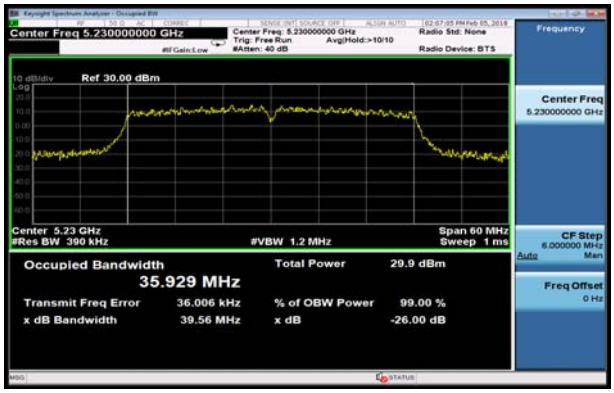
U-NII-1, 802.11n HT40
Carrier frequency (MHz): 5190



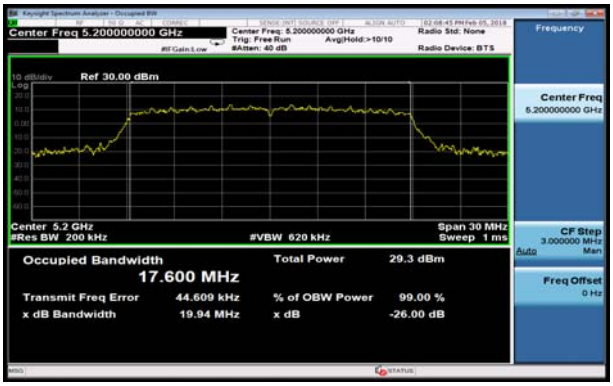
U-NII-1, 802.11ac HT20
Carrier frequency (MHz): 5180



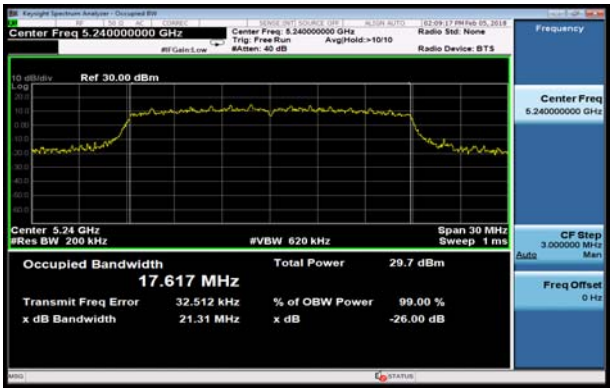
U-NII-1, 802.11n HT40
Carrier frequency (MHz): 5230



U-NII-1, 802.11ac HT20
Carrier frequency (MHz): 5200

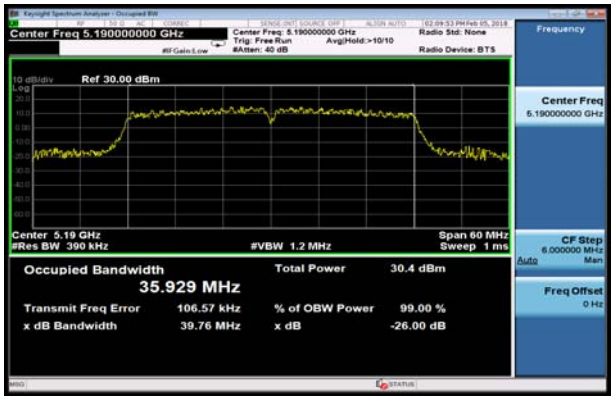


U-NII-1, 802.11ac HT20
Carrier frequency (MHz):5240



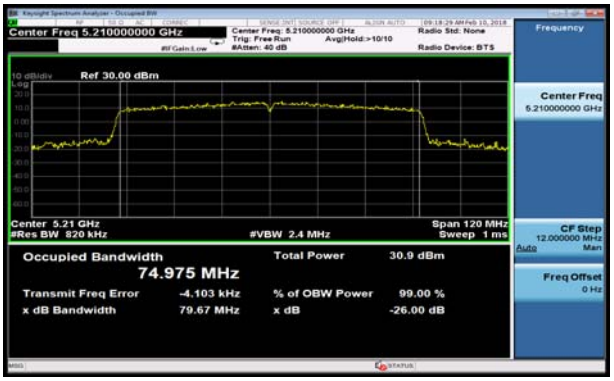
U-NII-1, 802.11ac HT40

Carrier frequency (MHz): 5190



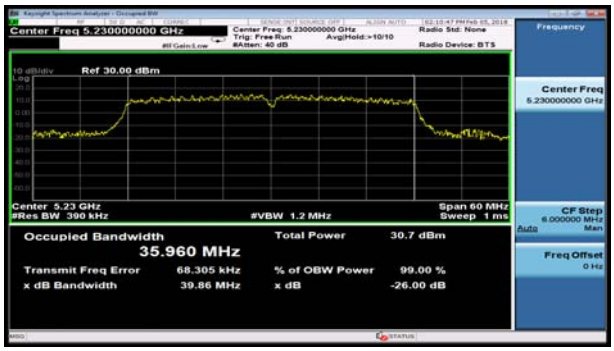
U-NII-1, 802.11ac HT80

Carrier frequency (MHz): 5210



U-NII-1, 802.11ac HT40

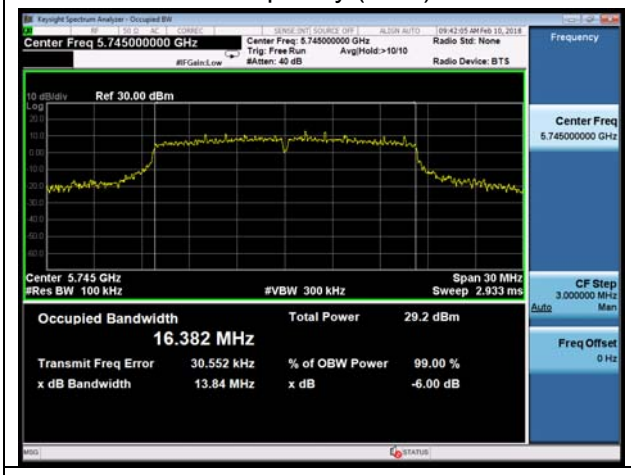
Carrier frequency (MHz): 5230



Minimum 6 dB bandwidth

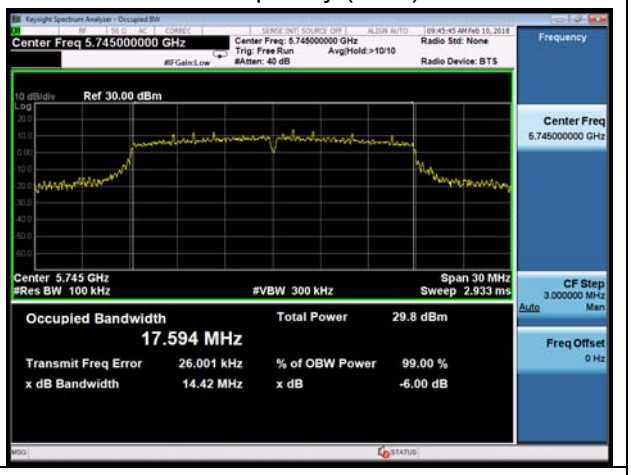
U-NII-3, 802.11a

Carrier frequency (MHz): 5745



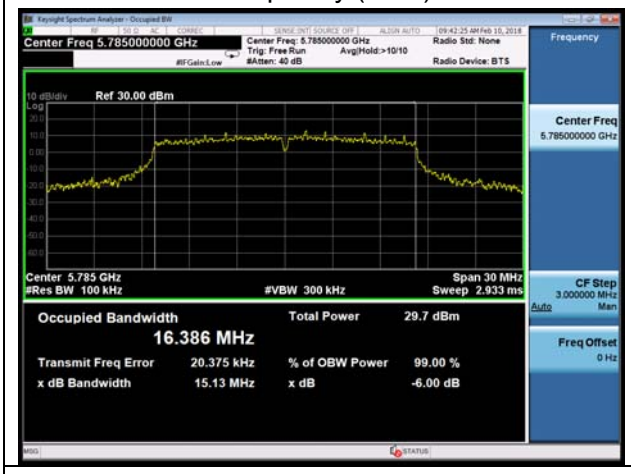
U-NII-3, 802.11n HT20

Carrier frequency (MHz): 5745



U-NII-3, 802.11a

Carrier frequency (MHz): 5785

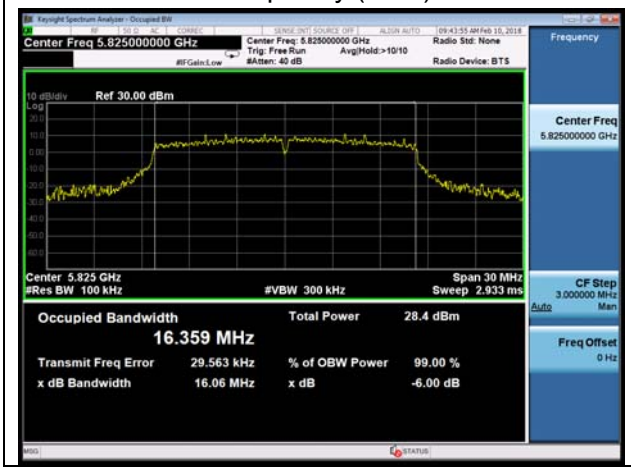


U-NII-3, 802.11n HT20

Carrier frequency (MHz): 5785

U-NII-3, 802.11a

Carrier frequency (MHz): 5825

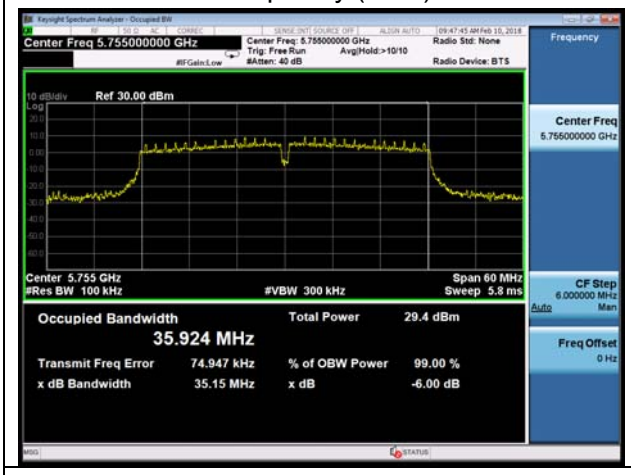


U-NII-3, 802.11n HT20

Carrier frequency (MHz): 5825

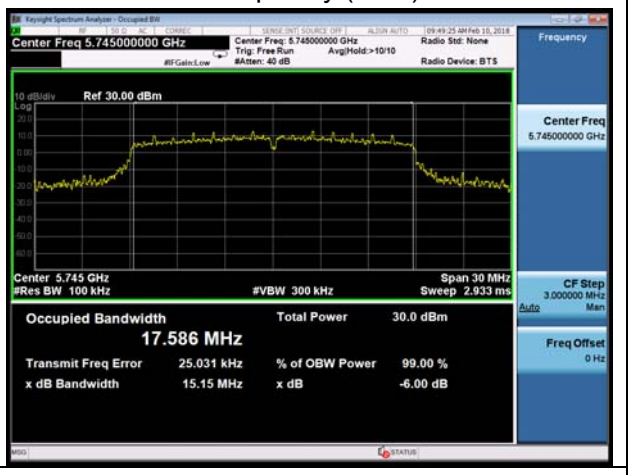
U-NII-3, 802.11n HT40

Carrier frequency (MHz): 5755



U-NII-3, 802.11ac HT20

Carrier frequency (MHz): 5745



U-NII-3, 802.11n HT40

Carrier frequency (MHz): 5795

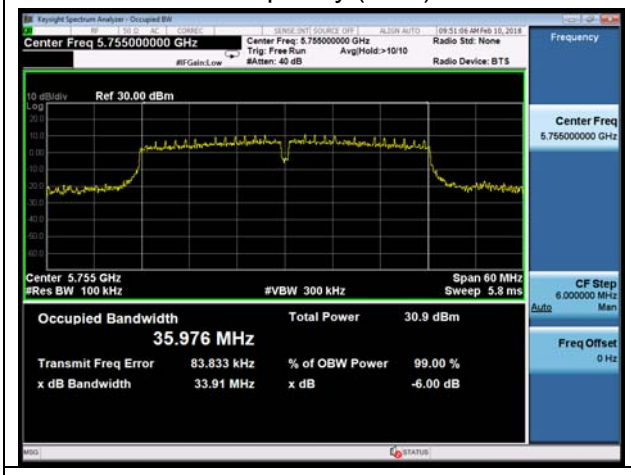
U-NII-3, 802.11ac HT20

Carrier frequency (MHz): 5785

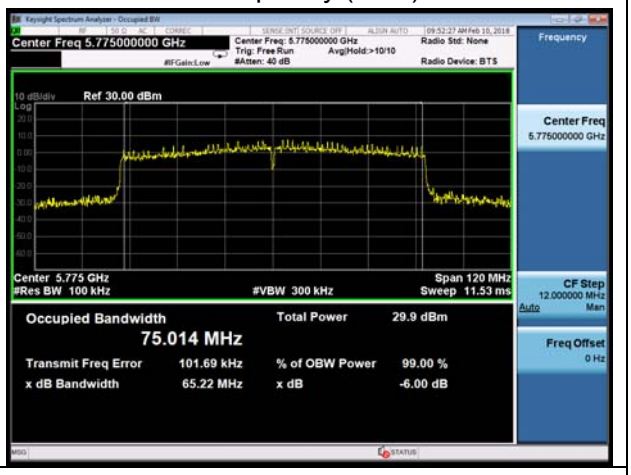
U-NII-3, 802.11ac HT20

Carrier frequency (MHz): 5825

U-NII-3, 802.11ac HT40
Carrier frequency (MHz): 5755



U-NII-3, 802.11ac HT80
Carrier frequency (MHz): 5775



U-NII-3, 802.11ac HT40
Carrier frequency (MHz): 5795

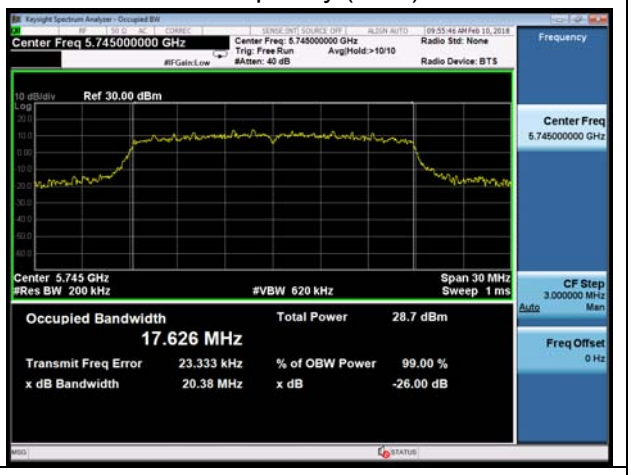
99% bandwidth

U-NII-3, 802.11a

Carrier frequency (MHz): 5745

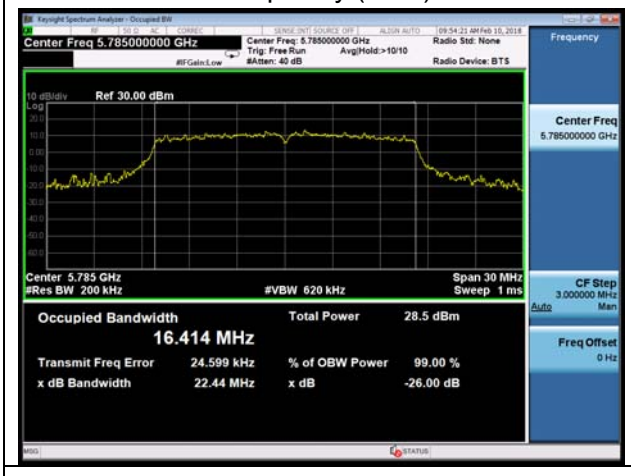
U-NII-3, 802.11n HT20

Carrier frequency (MHz): 5745



U-NII-3, 802.11a

Carrier frequency (MHz): 5785

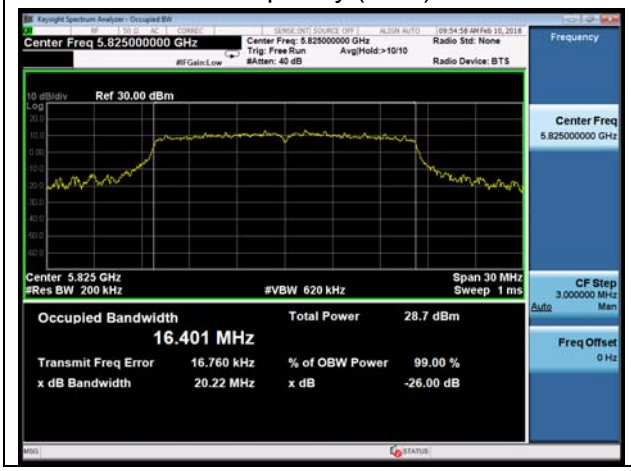


U-NII-3, 802.11n HT20

Carrier frequency (MHz): 5785

U-NII-3, 802.11a

Carrier frequency (MHz): 5825

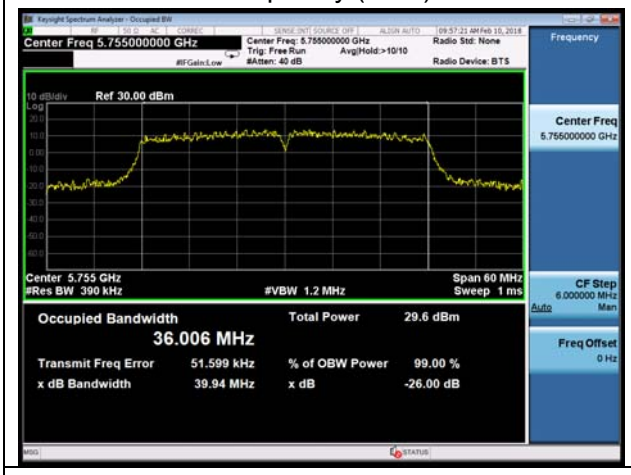


U-NII-3, 802.11n HT20

Carrier frequency (MHz): 5825

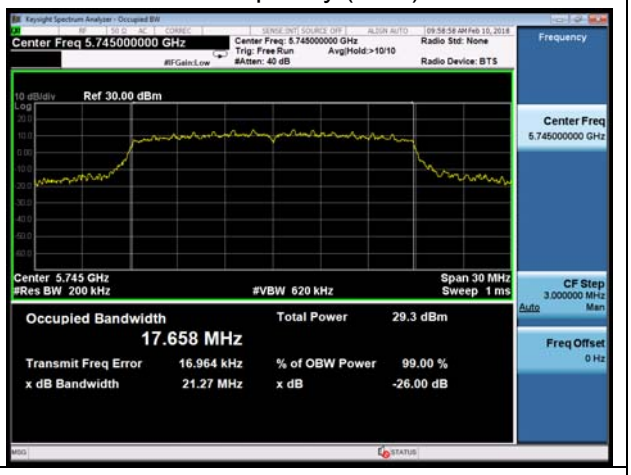
U-NII-3, 802.11n HT40

Carrier frequency (MHz): 5755



U-NII-3, 802.11ac HT20

Carrier frequency (MHz): 5745

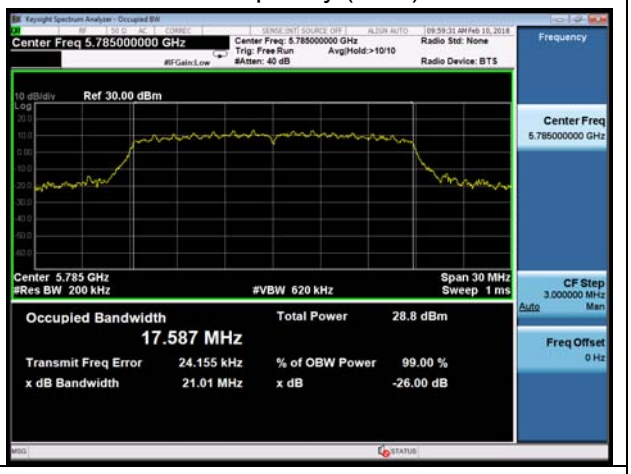


U-NII-3, 802.11n HT40

Carrier frequency (MHz): 5795

U-NII-3, 802.11ac HT20

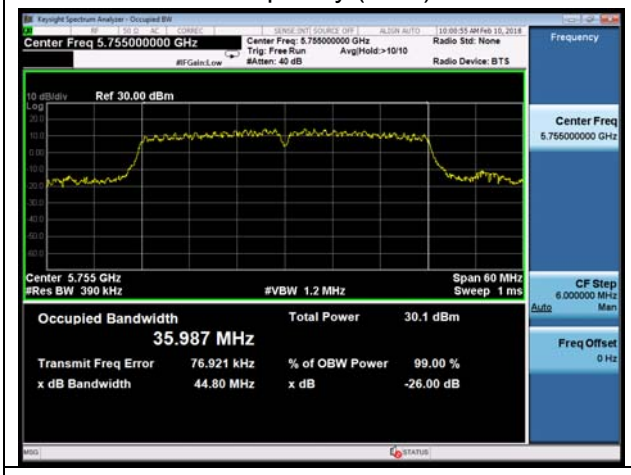
Carrier frequency (MHz): 5785



U-NII-3, 802.11ac HT20

Carrier frequency (MHz): 5825

U-NII-3, 802.11ac HT40
Carrier frequency (MHz): 5755



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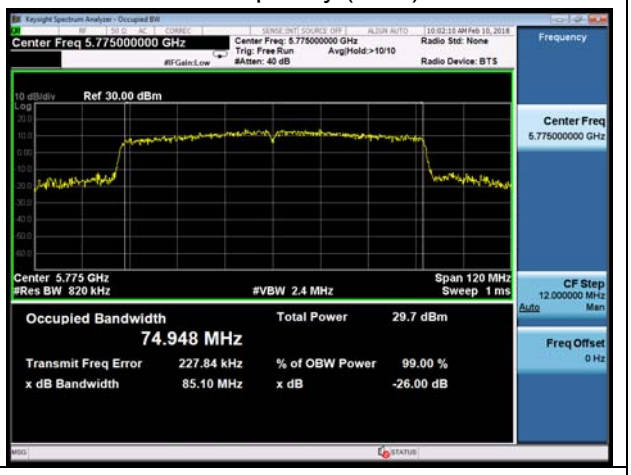
Carrier frequency (MHz): 5775



U-NII-3, 802.11ac HT40
Carrier frequency (MHz): 5795

5.2. Maximum Conducted Output Power

Ambient condition

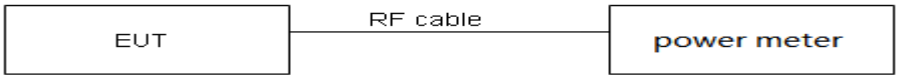
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT was connected to the average power meter through an external attenuator and a known loss cable. The EUT is max power transmission with proper modulation. Method PM in KDB789033 D02 was used for this test

The conducted Power is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test Setup



Limits

Rule FCC Part 15.407(a)(1)(2)(3)

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, 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, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.44 dB.

Test Results

Band	T_{on} (ms)	$T_{(on+off)}$ (ms)	Duty cycle	Duty cycle correction Factor(dB)
802.11a	1.39	1.45	0.96	0.17
802.11n HT20	1.28	1.35	0.95	0.24
802.11n HT40	0.63	0.69	0.91	0.40
802.11ac HT20	0.68	0.73	0.93	0.29
802.11ac HT40	0.35	0.40	0.87	0.60
802.11ac HT80	0.19	0.52	0.36	4.40
Note: when Duty cycle>0.98, Duty cycle correction Factor not required.				

Test results

Note: Output Power=Read Value+Duty cycle correction factor.

With beamforming U-NII-1

Network Standards	Channel/ Frequency (MHz)	Output Power					Limit (dBm)	Conclusion
		Antenna 1		Antenna 2		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11a	36/5180	22.63	22.80	22.64	22.81	25.82	28.99	PASS
	40/5200	22.57	22.74	22.33	22.50	25.63	28.99	PASS
	48/5240	23.38	23.55	22.80	22.97	26.28	28.99	PASS
802.11n HT20	36/5180	22.54	22.78	22.88	23.12	25.96	28.99	PASS
	40/5200	22.54	22.78	22.75	22.99	25.89	28.99	PASS
	48/5240	22.83	23.07	22.71	22.95	26.02	28.99	PASS
802.11n HT40	38/5190	22.55	22.95	21.87	22.27	25.63	28.99	PASS
	46/5230	23.50	23.90	23.12	23.52	26.72	28.99	PASS
802.11ac HT20	36/5180	22.96	23.25	22.96	23.25	26.26	28.99	PASS
	40/5200	23.36	23.65	23.04	23.33	26.51	28.99	PASS
	48/5240	23.42	23.71	23.10	23.39	26.57	28.99	PASS
802.11ac HT40	38/5190	22.01	22.61	22.13	22.73	25.68	28.99	PASS
	46/5230	22.91	23.51	22.99	23.59	26.56	28.99	PASS
802.11ac HT80	42/5210	19.14	23.54	19.50	23.90	26.74	28.99	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),
The Total Power =$10\log(10^{(\text{Power antenna1 in dBm}/10)}+10^{(\text{Power antenna2 in dBm}/10)}+10^{(\text{Power antenna3 in dBm}/10)})$.

2. Direction gain calculation according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e）(i),If all antennas have the same gain, directional gain = GANT + 10 log(NANT/NSS)=4+10log（2/1）=7.01 dBi＞6dBi. So the limt is 30-7.01+6=28.99dBm.

With beamforming U-NII-3

Network Standards	Channel/ Frequency (MHz)	Output Power					Limit (dBm)	Conclusion
		Antenna 1		Antenna 2		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11a	149/5745	25.65	25.82	22.93	23.10	27.68	28.99	PASS
	157/5785	23.73	23.90	22.88	23.05	26.51	28.99	PASS
	165/5825	23.29	23.46	22.63	22.80	26.15	28.99	PASS
802.11n HT20	149/5745	25.20	25.44	22.24	22.48	27.22	28.99	PASS
	157/5785	23.94	24.18	22.70	22.94	26.61	28.99	PASS
	165/5825	23.63	23.87	22.65	22.89	26.42	28.99	PASS
802.11n HT40	151/5755	24.29	24.69	22.03	22.43	26.71	28.99	PASS
	159/5795	23.82	24.22	22.61	23.01	26.66	28.99	PASS
802.11ac HT20	149/5745	25.60	25.89	22.45	22.74	27.61	28.99	PASS
	157/5785	23.84	24.13	22.80	23.09	26.66	28.99	PASS
	165/5825	23.07	23.36	22.23	22.52	25.98	28.99	PASS
802.11ac HT40	151/5755	24.97	25.57	22.95	23.55	27.69	28.99	PASS
	159/5795	23.82	24.42	23.11	23.71	27.09	28.99	PASS
802.11ac HT80	155/5775	20.04	24.44	17.98	22.38	26.54	28.99	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),
The Total Power =$10\log(10^{(\text{Power antenna1 in dBm}/10)}+10^{(\text{Power antenna2 in dBm}/10)}+10^{(\text{Power antenna3 in dBm}/10)})$.

2. Direction gain calculation according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e）(i),If all antennas have the same gain, directional gain = GANT + 10 log(NANT/NSS)= 4+10log（2/1）=7.01 dBi＞ 6dBi. So the limt is 30-7.01+6=28.99dBm.

Without beamforming U-NII-1

Network Standards	Channel/ Frequency (MHz)	Output Power					Limit (dBm)	Conclusion
		ANT1		ANT2		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11a	36/5180	22.74	22.91	22.63	22.80	25.87	30.00	PASS
	40/5200	22.10	22.27	22.46	22.63	25.47	30.00	PASS
	48/5240	23.13	23.30	22.38	22.55	25.95	30.00	PASS
802.11n HT20	36/5180	22.54	22.78	22.58	22.82	25.81	30.00	PASS
	40/5200	22.35	22.59	22.39	22.63	25.62	30.00	PASS
	48/5240	22.90	23.14	22.47	22.71	25.94	30.00	PASS
802.11n HT40	38/5190	21.40	21.80	21.61	22.01	24.91	30.00	PASS
	46/5230	23.06	23.46	22.93	23.33	26.40	30.00	PASS
802.11ac HT20	36/5180	22.61	22.90	22.70	22.99	25.96	30.00	PASS
	40/5200	22.88	23.17	23.09	23.38	26.29	30.00	PASS
	48/5240	23.82	24.11	23.14	23.43	26.80	30.00	PASS
802.11ac HT40	38/5190	21.58	22.18	21.48	22.08	25.14	30.00	PASS
	46/5230	22.77	23.37	22.90	23.50	26.44	30.00	PASS
802.11ac HT80	42/5210	18.82	23.22	17.64	22.04	25.68	30.00	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),

The Total Power $=10\log(10^{(\text{Power antenna1 in dBm}/10)}+10^{(\text{Power antenna2 in dBm}/10)}+10^{(\text{Power antenna3 in dBm}/10)})$.

2. The manufacturer declared the transmitter output signals is CDD mode And $N_{ss}=1$. According to KDB 662911 D01 Multiple Transmitter Output v02r01 2)f)(i): If all antennas have the same gain, Directional gain = G_{ANT} + Array Gain,

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};

Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

So directional gain = G_{ANT} + Array Gain =4+0=4 dBi<6dBi. So the power limt is 30dBm.

Without beamforming U-NII-3

Network Standards	Channel/ Frequency (MHz)	Output Power					Limit (dBm)	Conclusion
		ANT1		ANT2		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11a	149/5745	25.29	25.46	22.76	22.93	27.39	30.00	PASS
	157/5785	23.93	24.10	22.81	22.98	26.59	30.00	PASS
	165/5825	23.89	24.06	22.14	22.31	26.28	30.00	PASS
802.11n HT20	149/5745	25.11	25.35	22.82	23.06	27.36	30.00	PASS
	157/5785	23.98	24.22	22.50	22.74	26.55	30.00	PASS
	165/5825	23.70	23.94	22.34	22.58	26.32	30.00	PASS
802.11n HT40	151/5755	24.00	24.40	22.45	22.85	26.70	30.00	PASS
	159/5795	23.89	24.29	23.01	23.41	26.88	30.00	PASS
802.11ac HT20	149/5745	25.46	25.75	22.48	22.77	27.53	30.00	PASS
	157/5785	23.99	24.28	22.85	23.14	26.76	30.00	PASS
	165/5825	22.98	23.27	22.39	22.68	26.00	30.00	PASS
802.11ac HT40	151/5755	24.86	25.46	22.88	23.48	27.59	30.00	PASS
	159/5795	23.54	24.14	22.83	23.43	26.81	30.00	PASS
802.11ac HT80	155/5775	19.92	24.32	18.17	22.57	26.54	30.00	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),

The Total Power $=10\log(10^{(\text{Power antenna1 in dBm}/10)}+10^{(\text{Power antenna2 in dBm}/10)}+10^{(\text{Power antenna3 in dBm}/10)})$.

2. The manufacturer declared the transmitter output signals is CDD mode And $N_{ss}=1$. According to KDB 662911 D01 Multiple Transmitter Output v02r01 2)f)(i): If all antennas have the same gain, Directional gain = G_{ANT} + Array Gain,

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};

Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

So directional gain = G_{ANT} + Array Gain =4+0=4 dBi<6dBi. So the power limt is 30dBm.

5.3. Frequency Stability

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

1. Frequency stability with respect to ambient temperature

a) Supply the EUT with a nominal ac voltage or install a new or fully charged battery in the EUT. If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.

b) Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring instrument, through an attenuator if necessary.

c) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

d) Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

e) Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.

f) While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

g) Measure the frequency at each of frequencies specified in 5.6.

h) Switch OFF the EUT but do not switch OFF the oscillator heater.

i) Lower the chamber temperature by not more that 10 C, and allow the temperature inside the chamber to stabilize.

j) Repeat step f) through step i) down to the lowest specified temperature.

2. Frequency stability when varying supply voltage

Unless otherwise specified, these tests shall be made at ambient room temperature (+15 C to +25 C). An antenna shall be connected to the antenna output terminals of the EUT if possible. If the EUT is equipped with or uses an adjustable-length antenna, then it shall be fully extended.

a) Supply the EUT with nominal voltage or install a new or fully charged battery in the EUT. Turn ON the EUT and couple its output to a frequency counter or other frequency-measuring instrument.

b) Tune the EUT to one of the number of frequencies required in 5.6. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).
c) Measure the frequency at each of the frequencies specified in 5.6.
d) Repeat the above procedure at 85% and 115% of the nominal supply voltage.

Limit

Manufacturers 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 users manual.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936Hz

Test Results

Voltage (V)	Temperature (°C)	U-NII-1 Test Results			
		5200MHz			
		1min	2min	5min	10min
120	-5	5199.992803	5199.987630	5199.980295	5199.971330
120	0	5199.996602	5199.981327	5199.975815	5199.969281
120	5	5199.991490	5199.978528	5199.971014	5199.964938
120	10	5199.985944	5199.973061	5199.969696	5199.957082
120	15	5199.984955	5199.964437	5199.960787	5199.954159
120	25	5199.982637	5199.956803	5199.952784	5199.944675
120	35	5199.973698	5199.954729	5199.947154	5199.935801
120	45	5199.967534	5199.953005	5199.938018	5199.933948
90	25	5199.957745	5199.950476	5199.933270	5199.926502
264	25	5199.956509	5199.945575	5199.928041	5199.919924
MHz		-0.043491	-0.054425	-0.071959	-0.080076
PPM		-8.363587	-10.466318	-13.838302	-15.399203

Voltage (V)	Temperature (°C)	U-NII-3 Test Results			
		5785MHz			
		1min	2min	5min	10min
120	-5	5784.992457	5784.982567	5784.973066	5784.964226
120	0	5784.989754	5784.979784	5784.970830	5784.960323
120	5	5784.985529	5784.970155	5784.969020	5784.955040
120	10	5784.985361	5784.961393	5784.965420	5784.948973
120	20	5784.979518	5784.956986	5784.962508	5784.941555
120	28	5784.971681	5784.949704	5784.952677	5784.937655
120	32	5784.963214	5784.942444	5784.944111	5784.934588
120	45	5784.955444	5784.938604	5784.938902	5784.930537
90	25	5784.946206	5784.931524	5784.934216	5784.925124
264	25	5784.936629	5784.929085	5784.931567	5784.921406
MHz		-0.063371	-0.070915	-0.068433	-0.078594
PPM		-10.954323	-12.258462	-11.829346	-13.585854

5.4. Power Spectral Density

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

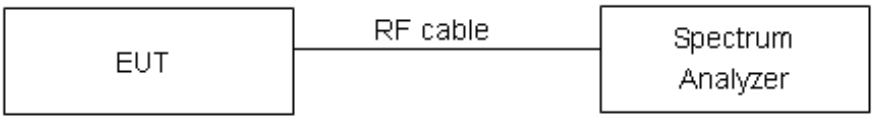
The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable.

Set RBW = 500 kHz, VBW =1.5MHz for the band 5.725-5.85 GHz

Set RBW = 1 MHz, VBW =3MHz for the band 5.150-5.250 GHz

The conducted PSD is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test setup



Limits

Rule FCC Part 15.407(a)(1)/ Part 15.407(a)(2) / Part 15.407(a)(3)
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 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmittingantennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the

amount in dB that the directional gain of the antenna exceeds 6 dBi.

Frequency Bands/MHz	Limits
5150-5250	17/MHz
5.25-5.35 GHz and 5.47-5.725 GHz	11dBm/MHz
5725-5850	30dBm/500kHz

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.75dB.

Test Results:

Note: Power Spectral Density =Read Value+Duty cycle correction factor

With Beamforming U-NII-1

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density					Limit (dBm /MHz)	Conclusion
		Antenna 1		Antenna 2		Total Power (dBm /MHz)		
		Read Value (dBm/MHz)	PSD (dBm /MHz)	Read Value (dBm/MHz)	PSD (dBm /MHz)			
802.11a	36/5180	12.24	12.41	12.61	12.78	15.61	15.99	PASS
	40/5200	12.98	13.15	11.63	11.80	15.54	15.99	PASS
	48/5240	12.81	12.98	12.47	12.64	15.83	15.99	PASS
802.11n HT20	36/5180	12.07	12.31	12.27	12.51	15.42	15.99	PASS
	40/5200	11.96	12.20	11.81	12.05	15.13	15.99	PASS
	48/5240	12.65	12.89	11.50	11.74	15.36	15.99	PASS
802.11n HT40	38/5190	9.47	9.87	9.38	9.78	12.83	15.99	PASS
	46/5230	10.00	10.39	10.00	10.40	13.41	15.99	PASS
802.11ac HT20	36/5180	12.24	12.54	12.02	12.32	15.44	15.99	PASS
	40/5200	12.55	12.84	12.19	12.48	15.68	15.99	PASS
	48/5240	12.90	13.19	12.40	12.69	15.96	15.99	PASS
802.11ac HT40	38/5190	9.37	9.97	9.89	10.48	13.24	15.99	PASS
	46/5230	9.55	10.15	9.85	10.45	13.31	15.99	PASS
802.11ac HT80	42/5210	3.27	7.67	3.77	8.17	10.94	15.99	PASS

Note: 1. Power Spectral Density =Read Value+Duty cycle correction factor

2. For Total PSD, according to KDB 662911 D01 Multiple Transmitter Output v02r01 2)a),the power spectral density=$10\log(10^{(\text{PSD antenna1 in dBm/10})}+10^{(\text{PSD antenna2 in dBm/10})})$

3. Direction gain calculation according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e)(i),If all antennas have the same gain, directional gain = GANT + 10 log(NANT/NSS)=4+10log(2/1) =7.01 dBi＞ 6dBi. So the limt is 17-7.01+6=15.99dBm.

With Beamforming U-NII-3

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density					Limit (dBm /kHz)	Conclusion
		Antenna 1		Antenna 2		Total Power (dBm/ 500kHz)		
		Read Value (dBm /500kHz)	PSD (dBm /500kHz)	Read Value (dBm/ 500kHz)	PSD (dBm/ 500kHz)			
802.11a	149/5745	12.74	12.91	9.50	9.67	14.60	28.99	PASS
	157/5785	10.75	10.92	9.70	9.87	13.44	28.99	PASS
	165/5825	9.78	9.96	8.70	8.87	12.46	28.99	PASS
802.11n HT20	149/5745	11.88	12.12	9.65	9.88	14.16	28.99	PASS
	157/5785	10.44	10.68	9.46	9.70	13.23	28.99	PASS
	165/5825	9.59	9.83	8.73	8.97	12.43	28.99	PASS
802.11n HT40	151/5755	7.84	8.23	4.83	5.23	9.99	28.99	PASS
	159/5795	7.49	7.89	6.27	6.67	10.33	28.99	PASS
802.11ac HT20	149/5745	11.83	12.13	8.77	9.06	13.87	28.99	PASS
	157/5785	10.52	10.82	9.04	9.33	13.15	28.99	PASS
	165/5825	9.43	9.73	8.37	8.66	12.24	28.99	PASS
802.11ac HT40	151/5755	8.45	9.04	6.36	6.95	11.13	28.99	PASS
	159/5795	7.52	8.12	6.47	7.07	10.64	28.99	PASS
802.11ac HT80	155/5775	1.50	5.90	-0.01	4.39	8.22	28.99	PASS

Note: 1. Power Spectral Density =Read Value+Duty cycle correction factor

2. For Total PSD, according to KDB 662911 D01 Multiple Transmitter Output v02r01 2)a),the power spectral density=$10\log(10^{(\text{PSD antenna1 in dBm/10})}+10^{(\text{PSD antenna2 in dBm/10})})$

3. Direction gain calculation according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e）(i),If all antennas have the same gain, directional gain = GANT + 10 log(NANT/NSS)= 4+10log（2/1）=7.01 dBi＞ 6dBi. So the limt is 30-7.01+6=28.99dBm.

Without Beamforming U-NII-1

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density					Limit (dBm /MHz)	Conclusion
		Antenna 1		Antenna 2		Total Power (dBm /MHz)		
		Read Value (dBm/MHz)	PSD (dBm /MHz)	Read Value (dBm/MHz)	PSD (dBm /MHz)			
802.11a	36/5180	12.73	12.90	12.48	12.65	15.79	15.99	PASS
	40/5200	12.30	12.47	12.04	12.21	15.35	15.99	PASS
	48/5240	12.94	13.11	11.91	12.09	15.64	15.99	PASS
802.11n HT20	36/5180	11.97	12.21	12.03	12.26	15.25	15.99	PASS
	40/5200	11.48	11.71	11.89	12.12	14.93	15.99	PASS
	48/5240	12.53	12.76	11.87	12.11	15.46	15.99	PASS
802.11n HT40	38/5190	9.29	9.68	9.13	9.53	12.62	15.99	PASS
	46/5230	8.95	9.34	9.71	10.11	12.75	15.99	PASS
802.11ac HT20	36/5180	12.08	12.38	12.23	12.52	15.46	15.99	PASS
	40/5200	12.23	12.53	12.13	12.43	15.49	15.99	PASS
	48/5240	12.16	12.45	12.47	12.76	15.62	15.99	PASS
802.11ac HT40	38/5190	8.73	9.33	8.94	9.54	12.45	15.99	PASS
	46/5230	9.98	10.58	8.80	9.40	13.04	15.99	PASS
802.11ac HT80	42/5210	3.59	7.99	2.96	7.36	10.70	15.99	PASS

Note: 1. Power Spectral Density =Read Value+Duty cycle correction factor

2. For Total PSD, according to KDB 662911 D01 Multiple Transmitter Output v02r01 2)a),the power spectral density=$10\log(10^{(\text{PSD antenna1 in dBm/10})}+10^{(\text{PSD antenna2 in dBm/10})})$

3. The manufacturer declared the transmitter output signals is CDD mode And Nss=1. According to KDB 662911 D01 Multiple Transmitter Output v02r01 2)f)(i): If all antennas have the same gain, Directional gain = GANT + Array Gain, For PSD measurements on all devices,Array Gain=10log(Nant/Nss)dB,so directional gain=GANT+Array Gain=4+10log(2/1)=7.01＞6 dBi. So the PSD limt is 17-7.01+6=15.99dBm.

Without Beamforming U-NII-3

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density					Limit (dBm /kHz)	Conclusion
		Antenna 1		Antenna 2		Total Power (dBm /MHz)		
		Read Value (dBm/MHz)	PSD (dBm /MHz)	Read Value (dBm/MHz)	PSD (dBm /MHz)			
802.11a	149/5745	12.25	12.42	9.25	9.42	14.18	28.99	PASS
	157/5785	11.16	11.33	10.06	10.23	13.82	28.99	PASS
	165/5825	10.72	10.89	8.95	9.12	13.11	28.99	PASS
802.11n HT20	149/5745	12.59	12.83	8.64	8.88	14.30	28.99	PASS
	157/5785	10.91	11.15	9.75	9.98	13.61	28.99	PASS
	165/5825	10.14	10.38	9.24	9.48	12.96	28.99	PASS
802.11n HT40	151/5755	7.69	8.08	5.54	5.93	10.15	28.99	PASS
	159/5795	7.31	7.70	5.88	6.27	10.06	28.99	PASS
802.11ac HT20	149/5745	11.70	11.99	8.92	9.21	13.83	28.99	PASS
	157/5785	10.39	10.68	8.92	9.21	13.02	28.99	PASS
	165/5825	9.42	9.71	8.55	8.85	12.31	28.99	PASS
802.11ac HT40	151/5755	8.62	9.22	6.47	7.07	11.29	28.99	PASS
	159/5795	7.93	8.53	6.80	7.40	11.01	28.99	PASS
802.11ac HT80	155/5775	0.91	5.31	-0.02	4.38	7.88	28.99	PASS

Note: 1. Power Spectral Density =Read Value+Duty cycle correction factor

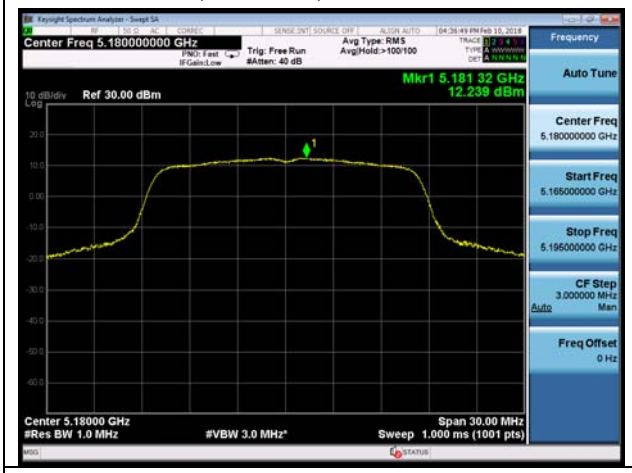
2. For Total PSD, according to KDB 662911 D01 Multiple Transmitter Output v02r01 2)a),the power spectral density=$10\log(10^{(\text{PSD antenna1 in dBm/10})}+10^{(\text{PSD antenna2 in dBm/10})})$

3. The manufacturer declared the transmitter output signals is CDD mode And Nss=1. According to KDB 662911 D01 Multiple Transmitter Output v02r01 2)f)(i): If all antennas have the same gain, Directional gain = GANT + Array Gain, For PSD measurements on all devices,Array Gain=10log(Nant/Nss)dB,so directional gain=GANT+Array Gain=4+10log(2/1)=7.01＞6 dBi. So the PSD limt is 30-7.01+6=28.99dBm.

With Beamforming

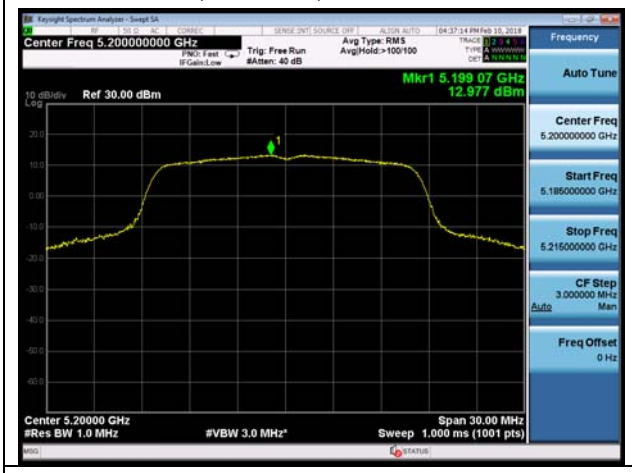
Antenna 1

U-NII-1, 802.11a, Channel No.: 36



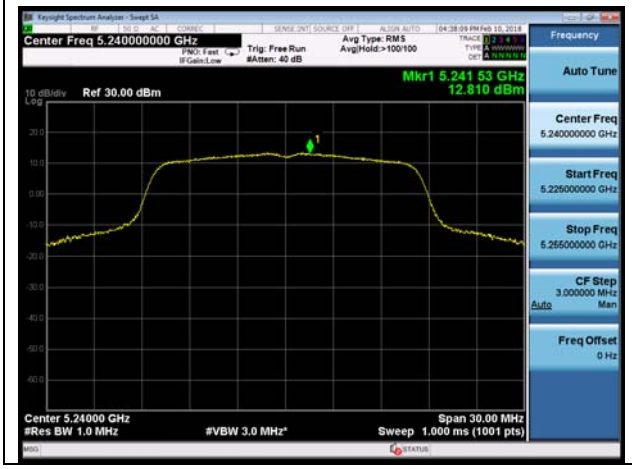
U-NII-1, 802.11n HT20, Channel No.: 36

U-NII-1, 802.11a, Channel No.: 40



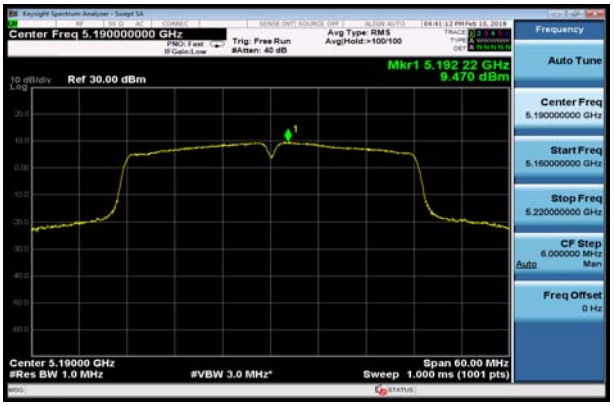
U-NII-1, 802.11n HT20, Channel No.: 40

U-NII-1, 802.11a, Channel No.: 48



U-NII-1, 802.11n HT20, Channel No.: 48

U-NII-1, 802.11n HT40, Channel No.: 38

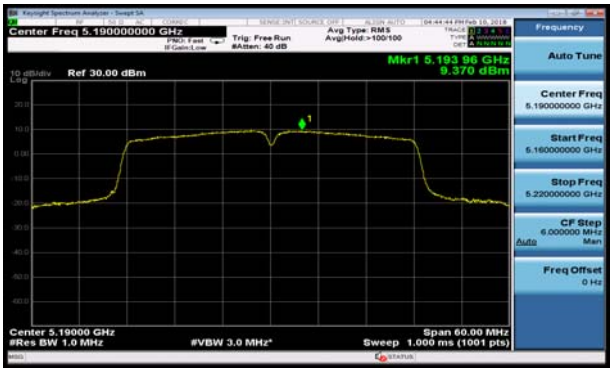


U-NII-1, 802.11ac HT20, Channel No.: 36

U-NII-1, 802.11n HT40, Channel No.: 46

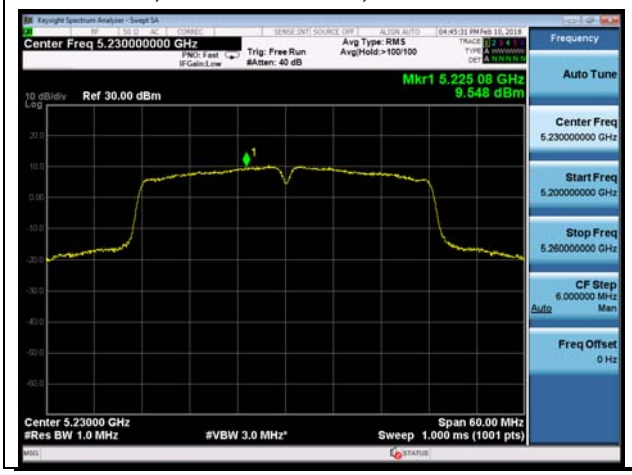
U-NII-1, 802.11ac HT20, Channel No.: 40

U-NII-1, 802.11ac HT40, Channel No.: 38



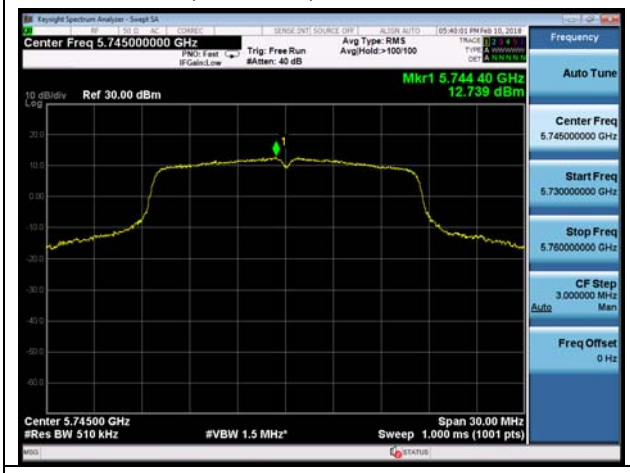
U-NII-1, 802.11ac HT20, Channel No.: 48

U-NII-1, 802.11ac HT40, Channel No.: 46

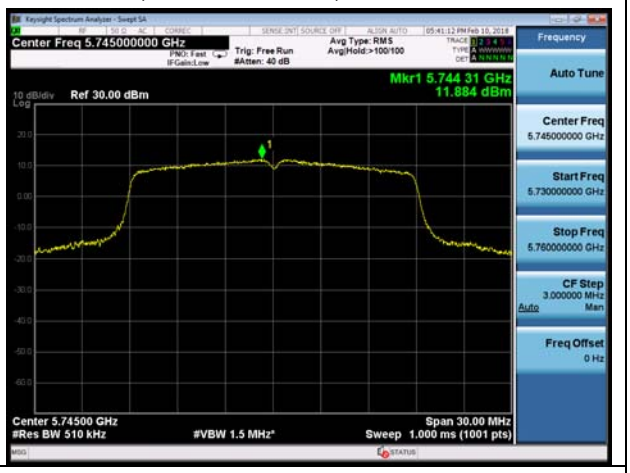


U-NII-1, 802.11ac HT80, Channel No.: 42

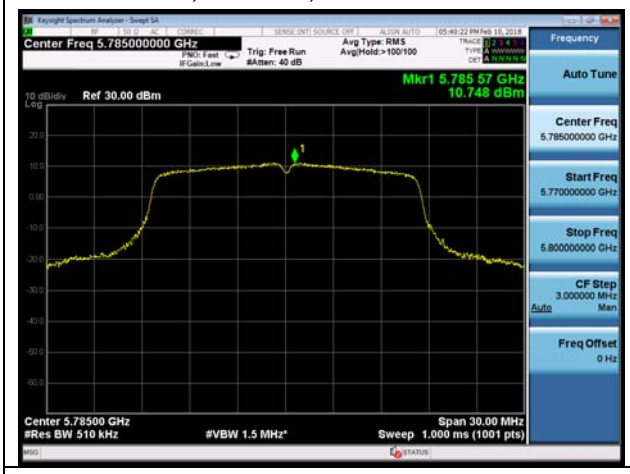
U-NII-3, 802.11a, Channel No.: 149



U-NII-3, 802.11n HT20, Channel No.: 149

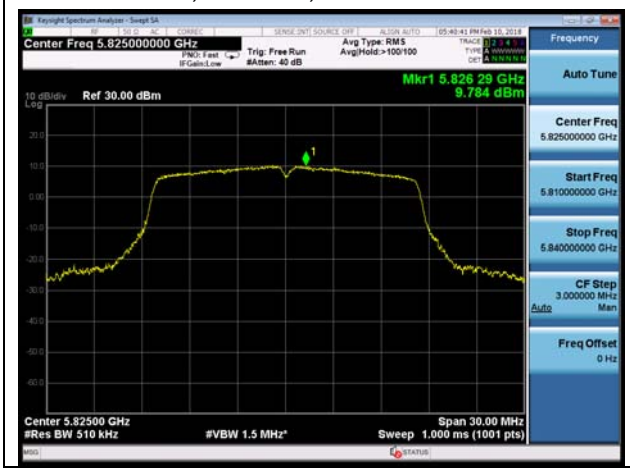


U-NII-3, 802.11a, Channel No.: 157



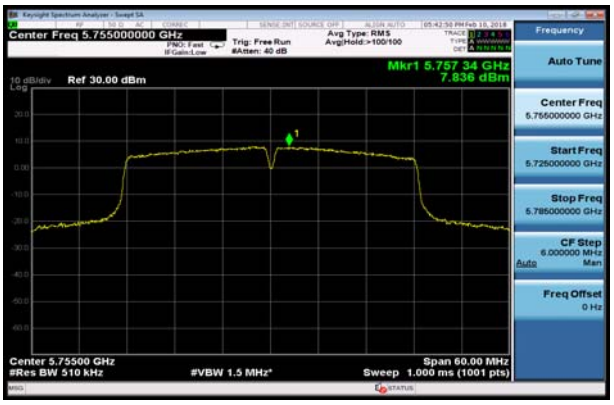
U-NII-3, 802.11n HT20, Channel No.: 157

U-NII-3, 802.11a, Channel No.: 165



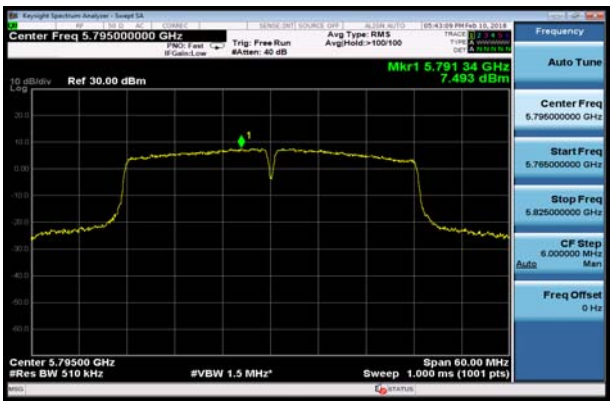
U-NII-3, 802.11n HT20, Channel No.: 165

U-NII-3, 802.11n HT40, Channel No.: 151



U-NII-3, 802.11ac HT20, Channel No.: 149

U-NII-3, 802.11n HT40, Channel No.: 159



U-NII-3, 802.11ac HT20, Channel No.: 157

U-NII-3, 802.11ac HT40, Channel No.: 151

U-NII-3, 802.11ac HT20, Channel No.: 165

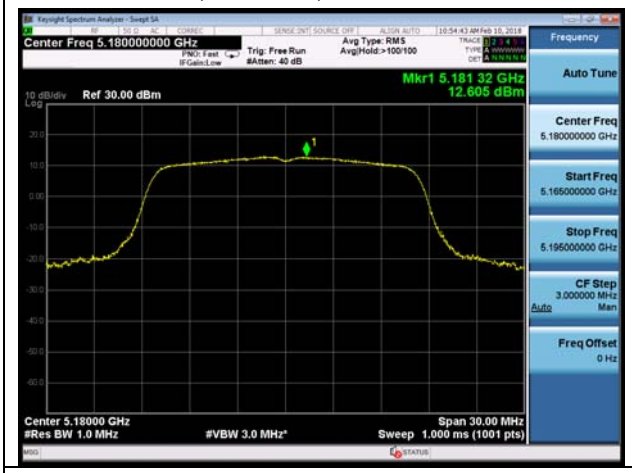
U-NII-3, 802.11ac HT40, Channel No.: 159

U-NII-3, 802.11ac HT80, Channel No.: 155

With Beamforming

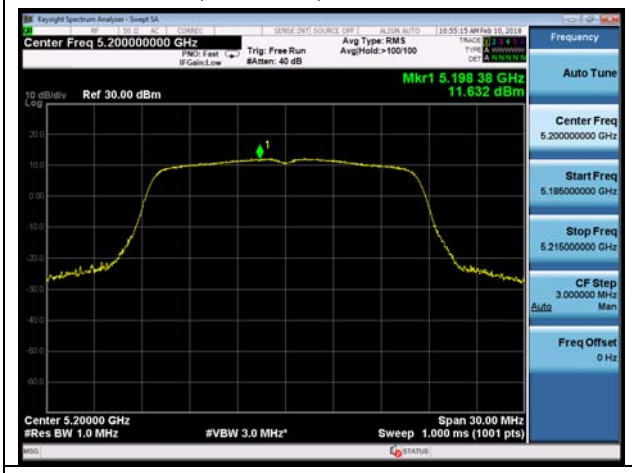
Antenna 2

U-NII-1, 802.11a, Channel No.: 36



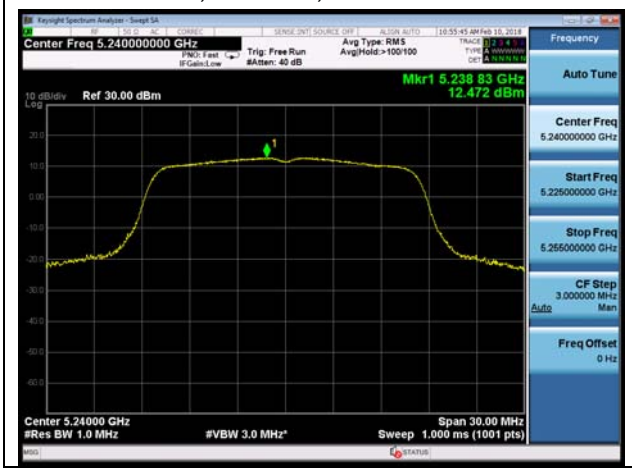
U-NII-1, 802.11n HT20, Channel No.: 36

U-NII-1, 802.11a, Channel No.: 40



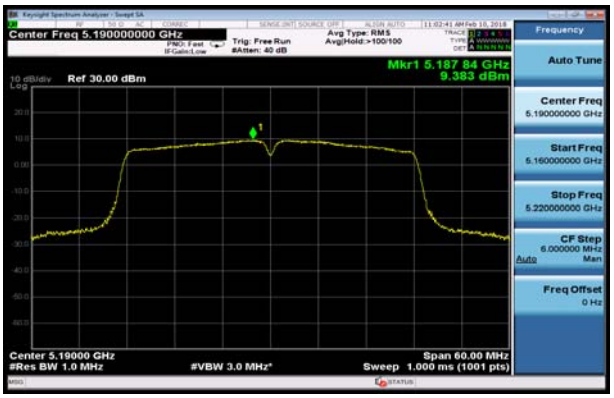
U-NII-1, 802.11n HT20, Channel No.: 40

U-NII-1, 802.11a, Channel No.: 48



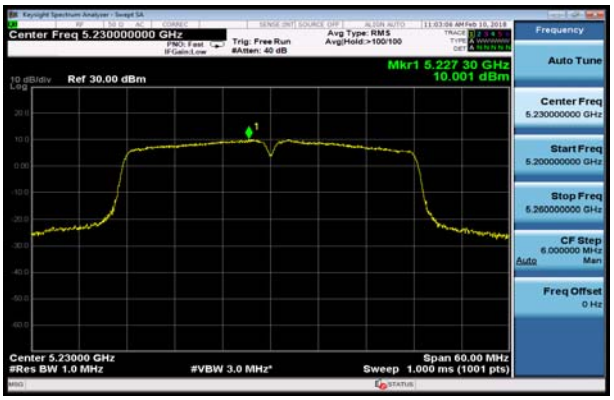
U-NII-1, 802.11n HT20, Channel No.: 48

U-NII-1, 802.11n HT40, Channel No.: 38

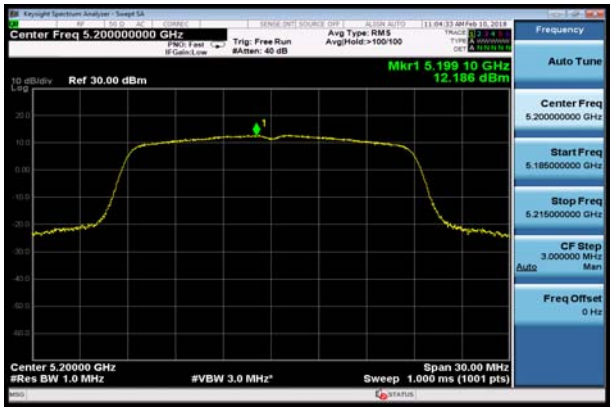


U-NII-1, 802.11ac HT20, Channel No.: 36

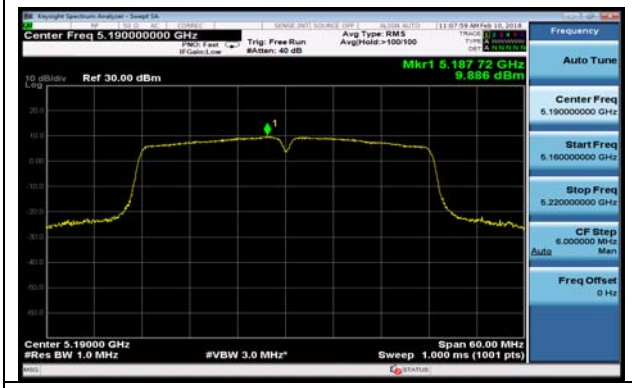
U-NII-1, 802.11n HT40, Channel No.: 46



U-NII-1, 802.11ac HT20, Channel No.: 40

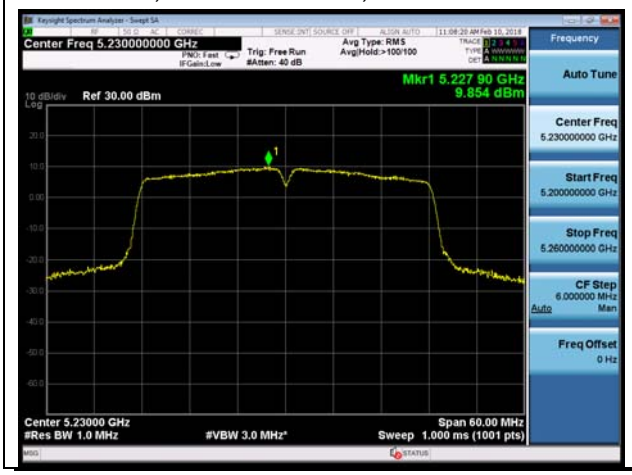


U-NII-1, 802.11ac HT40, Channel No.: 38



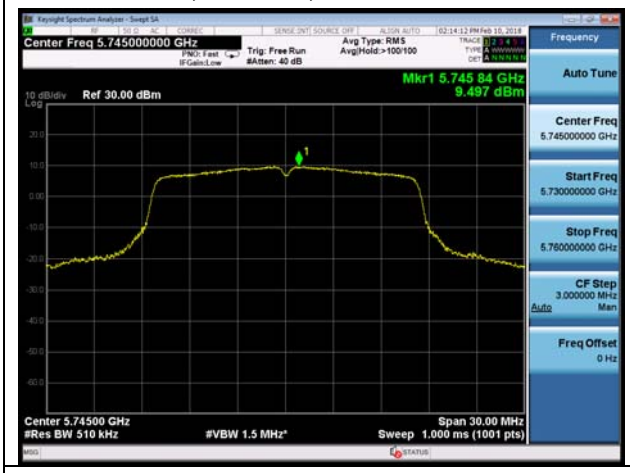
U-NII-1, 802.11ac HT20, Channel No.: 48

U-NII-1, 802.11ac HT40, Channel No.: 46



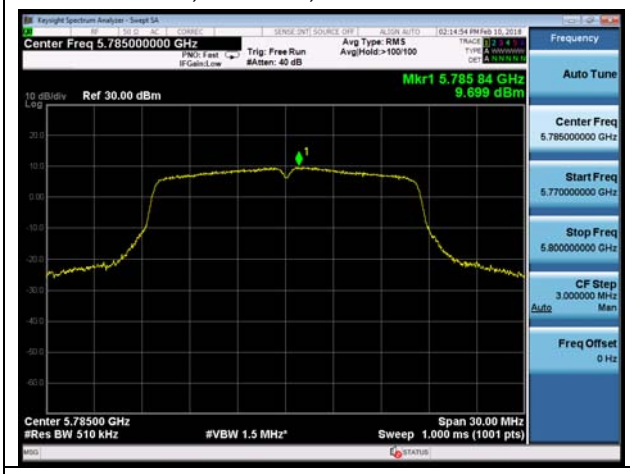
U-NII-1, 802.11ac HT80, Channel No.: 42

U-NII-3, 802.11a, Channel No.: 149



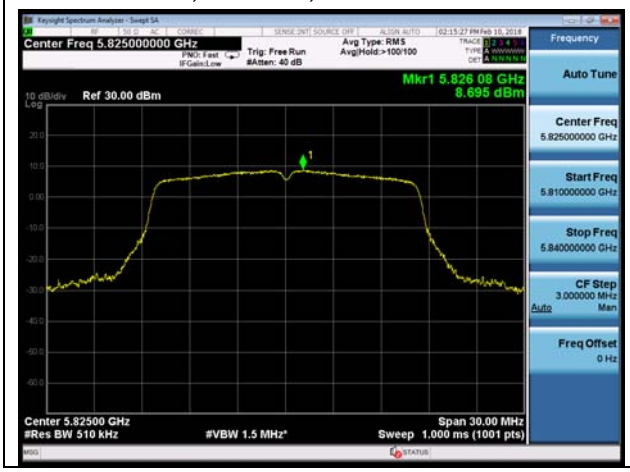
U-NII-3, 802.11n HT20, Channel No.: 149

U-NII-3, 802.11a, Channel No.: 157



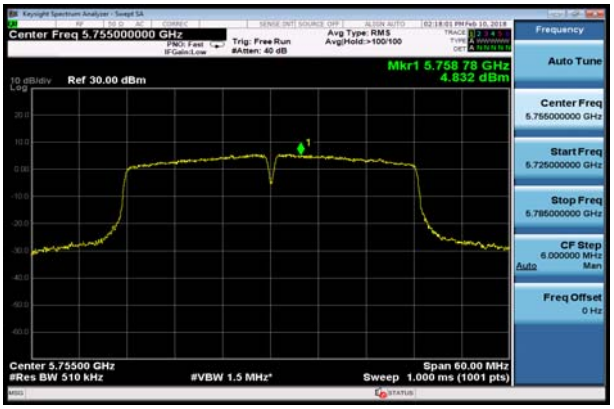
U-NII-3, 802.11n HT20, Channel No.: 157

U-NII-3, 802.11a, Channel No.: 165



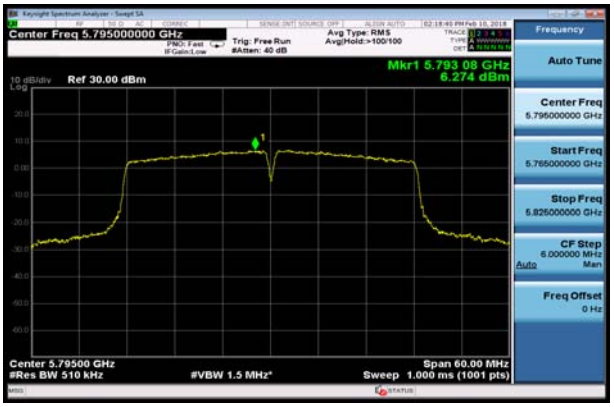
U-NII-3, 802.11n HT20, Channel No.: 165

U-NII-3, 802.11n HT40, Channel No.: 151

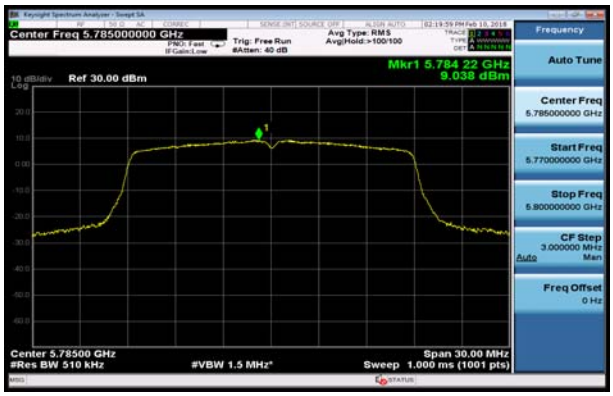


U-NII-3, 802.11ac HT20, Channel No.: 149

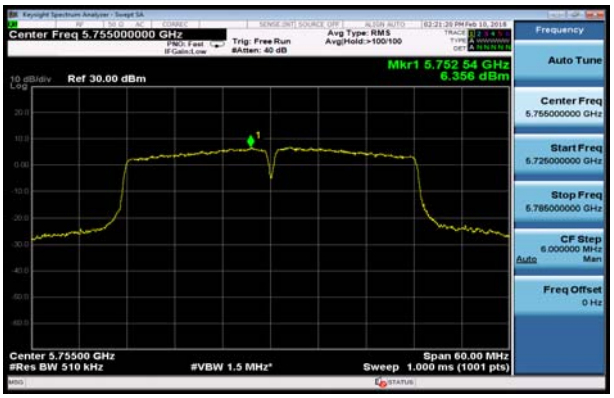
U-NII-3, 802.11n HT40, Channel No.: 159



U-NII-3, 802.11ac HT20, Channel No.: 157



U-NII-3, 802.11ac HT40, Channel No.: 151



U-NII-3, 802.11ac HT20, Channel No.: 165

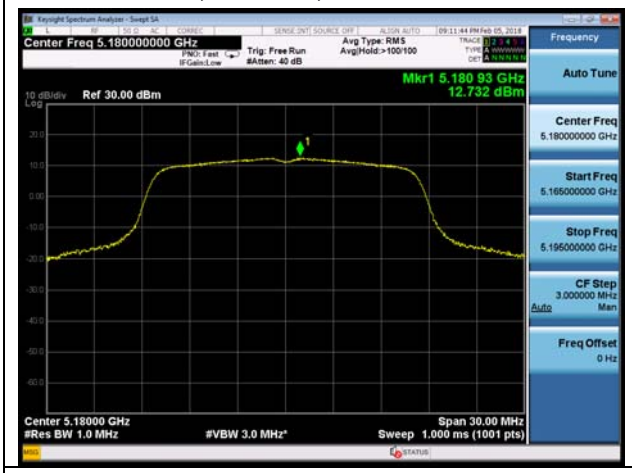
U-NII-3, 802.11ac HT40, Channel No.: 159

U-NII-3, 802.11ac HT80, Channel No.: 155

Without Beamforming

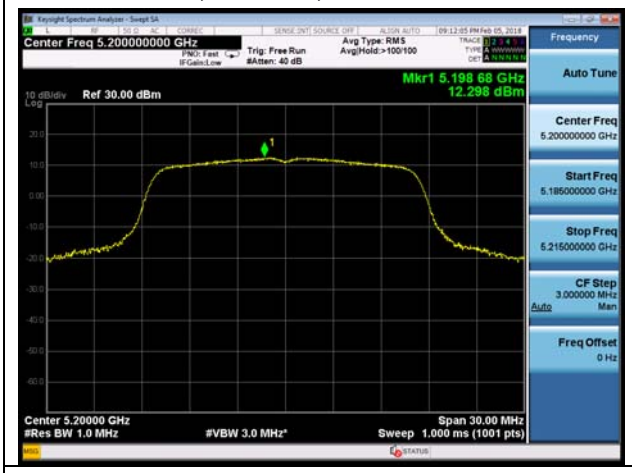
Antenna 1

U-NII-1, 802.11a, Channel No.: 36



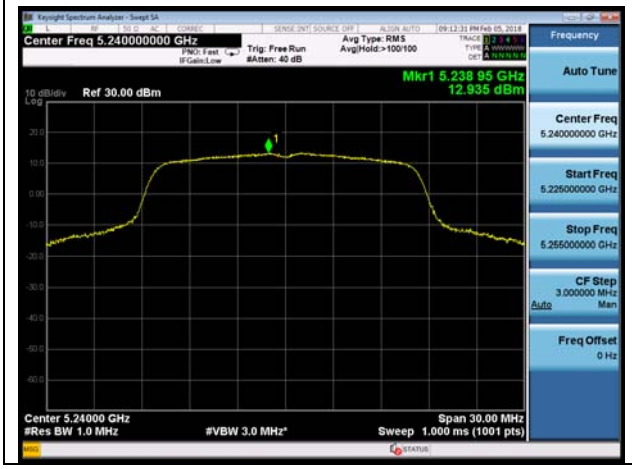
U-NII-1, 802.11n HT20, Channel No.: 36

U-NII-1, 802.11a, Channel No.: 40



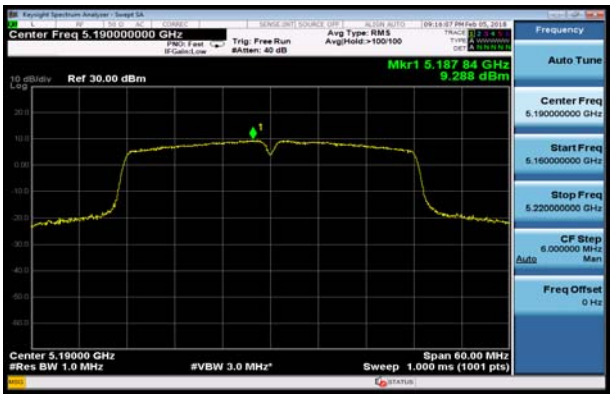
U-NII-1, 802.11n HT20, Channel No.: 40

U-NII-1, 802.11a, Channel No.: 48



U-NII-1, 802.11n HT20, Channel No.: 48

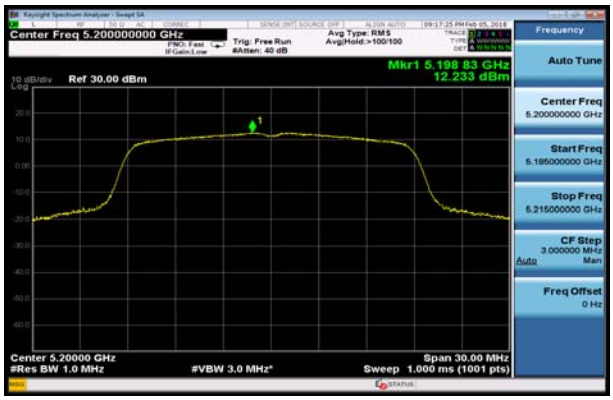
U-NII-1, 802.11n HT40, Channel No.: 38



U-NII-1, 802.11ac HT20, Channel No.: 36

U-NII-1, 802.11n HT40, Channel No.: 46

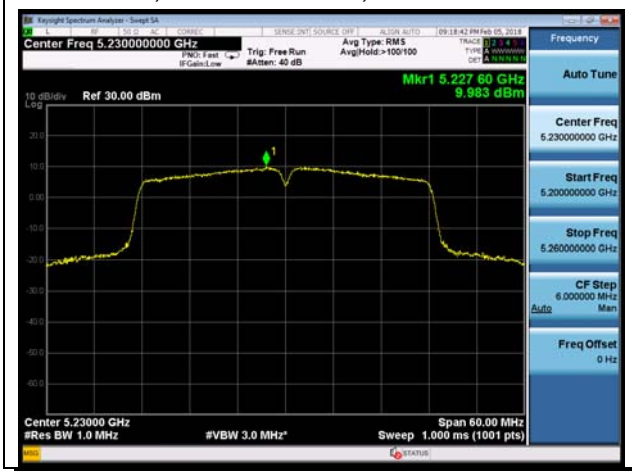
U-NII-1, 802.11ac HT20, Channel No.: 40



U-NII-1, 802.11ac HT40, Channel No.: 38

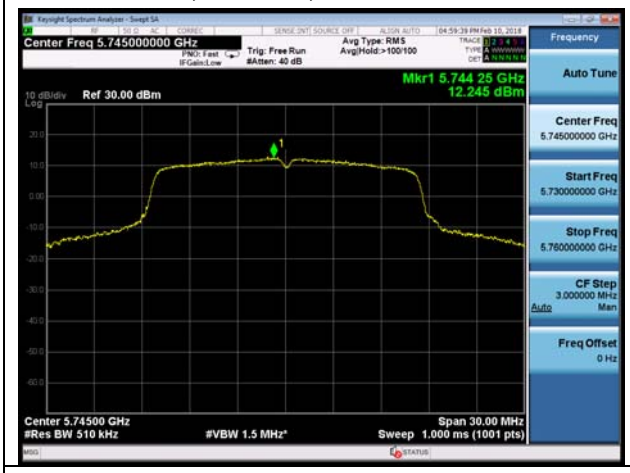
U-NII-1, 802.11ac HT20, Channel No.: 48

U-NII-1, 802.11ac HT40, Channel No.: 46



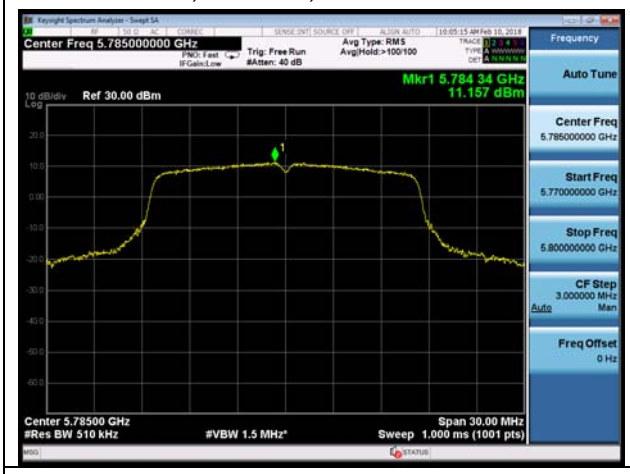
U-NII-1, 802.11ac HT80, Channel No.: 42

U-NII-3, 802.11a, Channel No.: 149



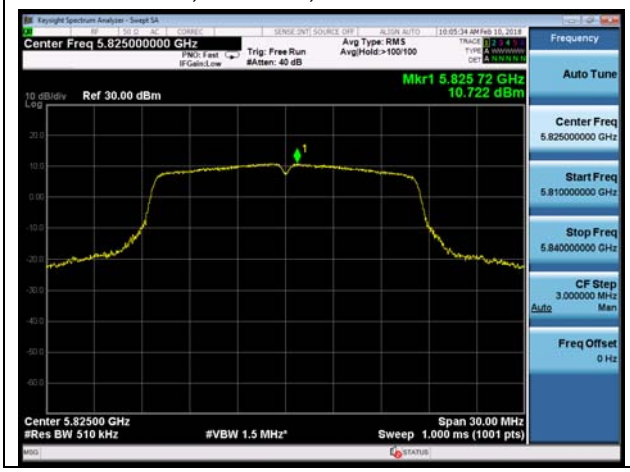
U-NII-3, 802.11n HT20, Channel No.: 149

U-NII-3, 802.11a, Channel No.: 157



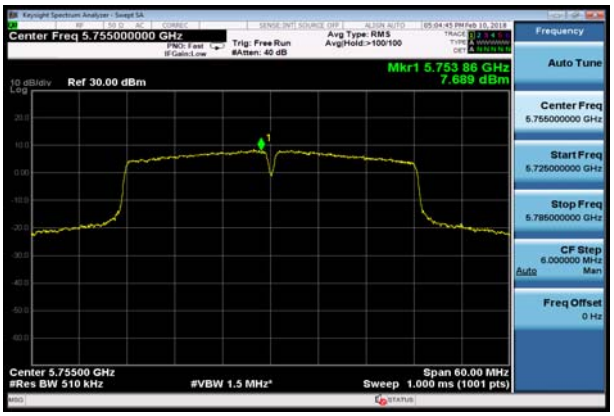
U-NII-3, 802.11n HT20, Channel No.: 157

U-NII-3, 802.11a, Channel No.: 165

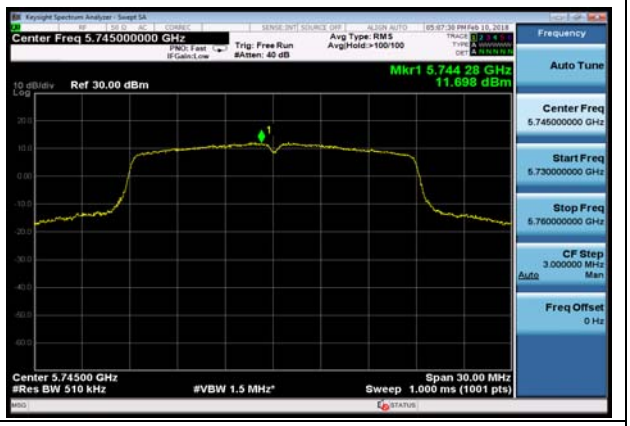


U-NII-3, 802.11n HT20, Channel No.: 165

U-NII-3, 802.11n HT40, Channel No.: 151



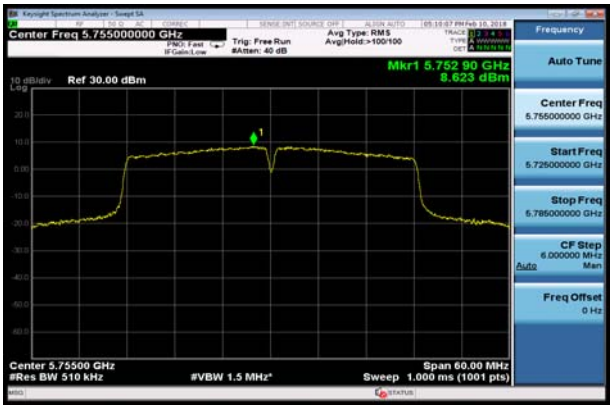
U-NII-3, 802.11ac HT20, Channel No.: 149



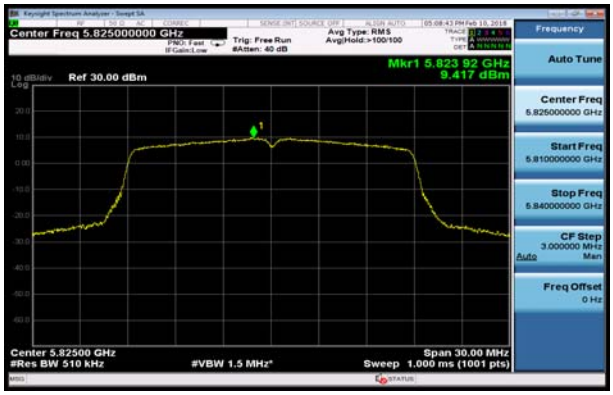
U-NII-3, 802.11n HT40, Channel No.: 159

U-NII-3, 802.11ac HT20, Channel No.: 157

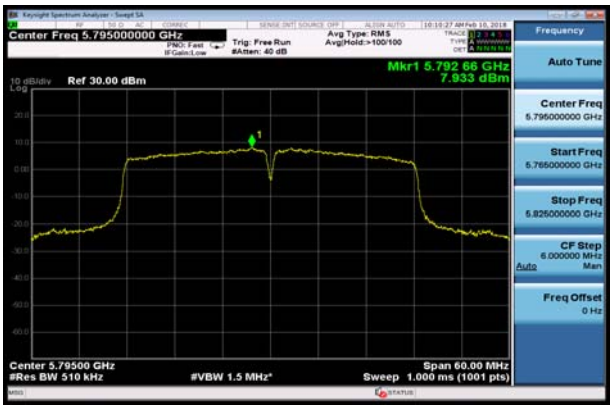
U-NII-3, 802.11ac HT40, Channel No.: 151



U-NII-3, 802.11ac HT20, Channel No.: 165



U-NII-3, 802.11ac HT40, Channel No.: 159



U-NII-3, 802.11ac HT80, Channel No.: 155

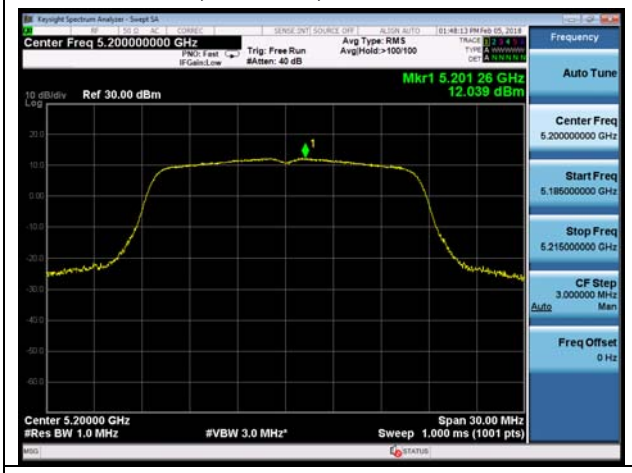
Without Beamforming

Antenna 2

U-NII-1, 802.11a, Channel No.: 36

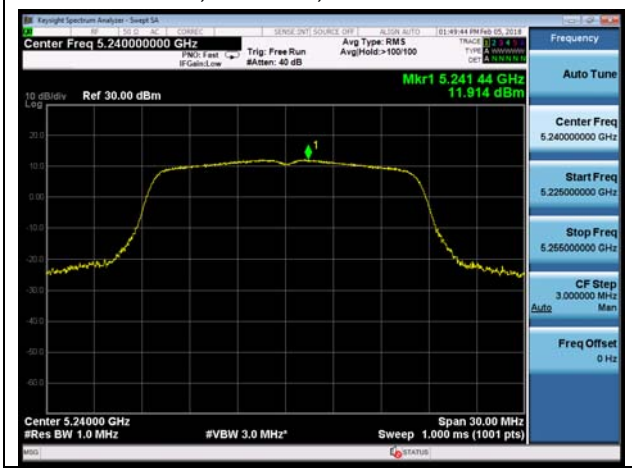
U-NII-1, 802.11n HT20, Channel No.: 36

U-NII-1, 802.11a, Channel No.: 40



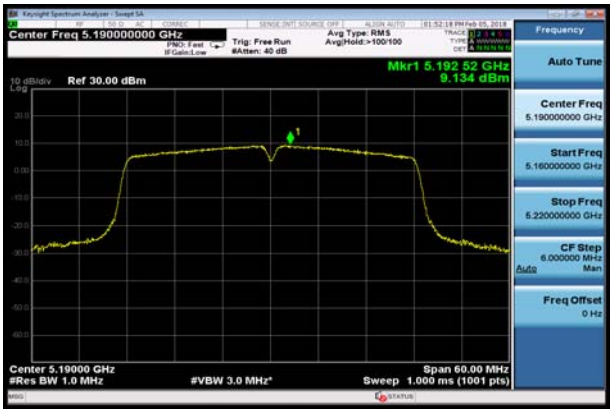
U-NII-1, 802.11n HT20, Channel No.: 40

U-NII-1, 802.11a, Channel No.: 48



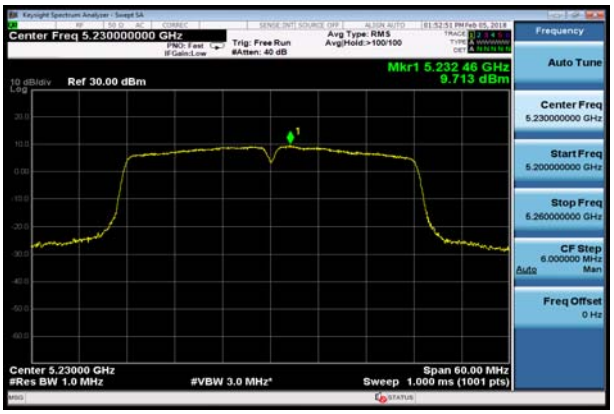
U-NII-1, 802.11n HT20, Channel No.: 48

U-NII-1, 802.11n HT40, Channel No.: 38



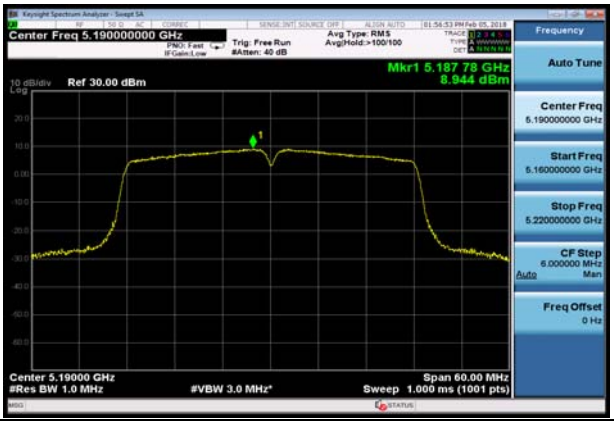
U-NII-1, 802.11ac HT20, Channel No.: 36

U-NII-1, 802.11n HT40, Channel No.: 46



U-NII-1, 802.11ac HT20, Channel No.: 40

U-NII-1, 802.11ac HT40, Channel No.: 38

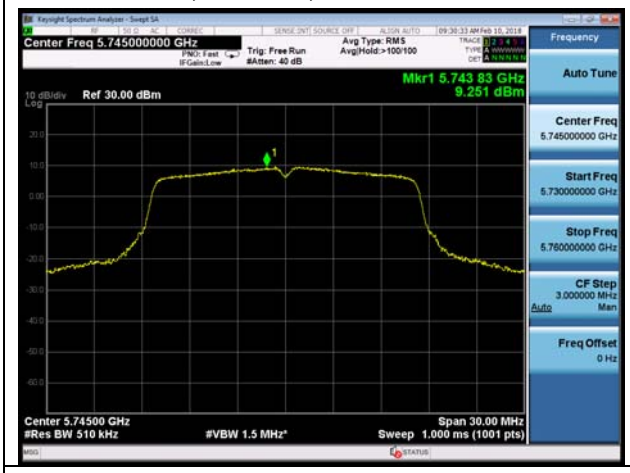


U-NII-1, 802.11ac HT20, Channel No.: 48

U-NII-1, 802.11ac HT40, Channel No.: 46

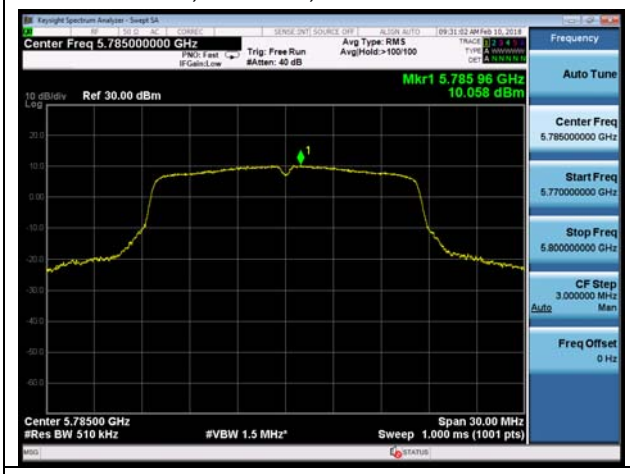
U-NII-1, 802.11ac HT80, Channel No.: 42

U-NII-3, 802.11a, Channel No.: 149



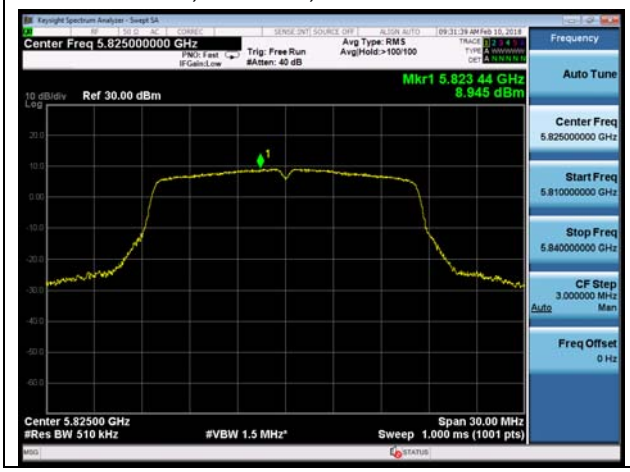
U-NII-3, 802.11n HT20, Channel No.: 149

U-NII-3, 802.11a, Channel No.: 157



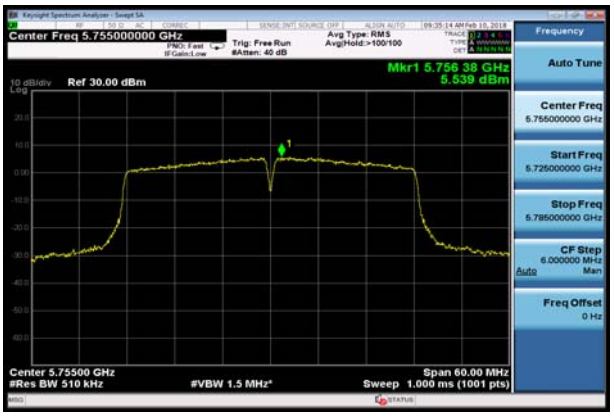
U-NII-3, 802.11n HT20, Channel No.: 157

U-NII-3, 802.11a, Channel No.: 165



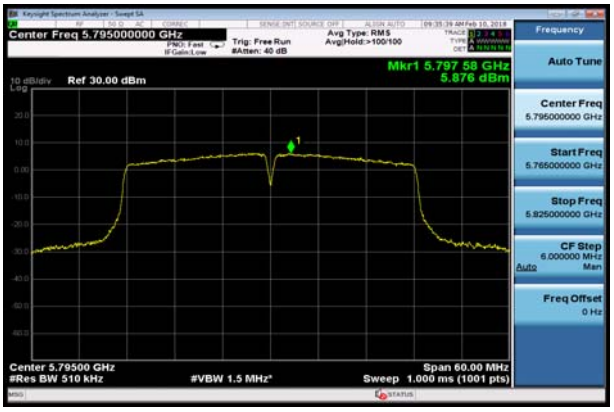
U-NII-3, 802.11n HT20, Channel No.: 165

U-NII-3, 802.11n HT40, Channel No.: 151



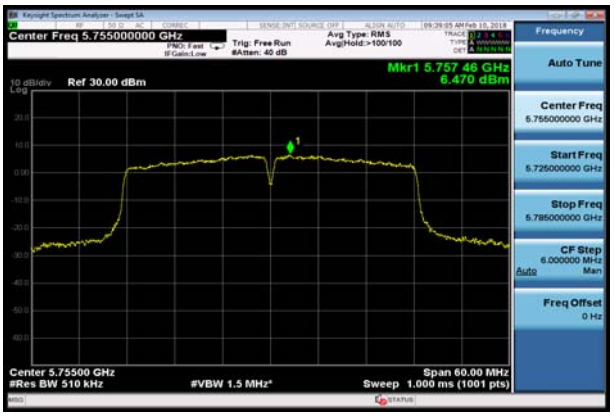
U-NII-3, 802.11ac HT20, Channel No.: 149

U-NII-3, 802.11n HT40, Channel No.: 159

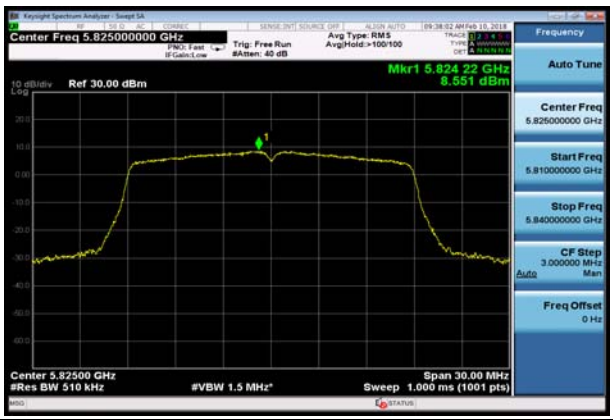


U-NII-3, 802.11ac HT20, Channel No.: 157

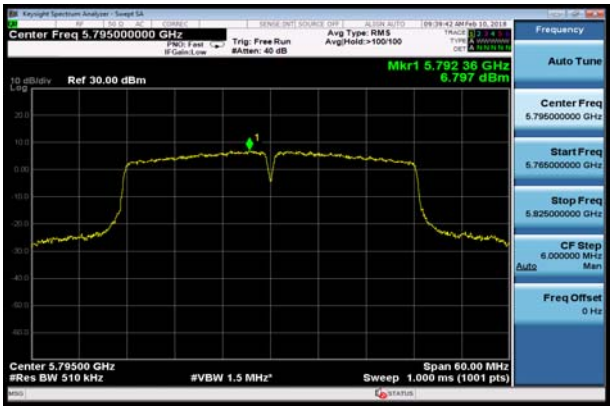
U-NII-3, 802.11ac HT40, Channel No.: 151



U-NII-3, 802.11ac HT20, Channel No.: 165



U-NII-3, 802.11ac HT40, Channel No.: 159



U-NII-3, 802.11ac HT80, Channel No.: 155

5.5. Unwanted Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

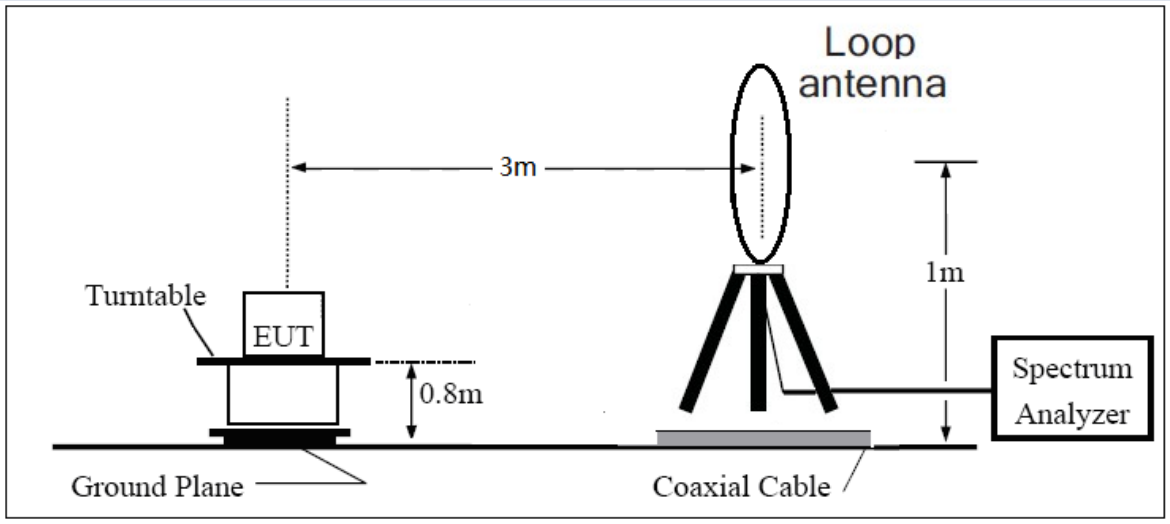
The test set-up was made in accordance to the general provisions of ANSI C63.10-2013. The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna. The radiated emissions measurements were made in a typical installation configuration.
Sweep the whole frequency band range from 9kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

During the test, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing.
Set the spectrum analyzer in the following:
Below 1GHz (detector: Peak and Quasi-Peak)
RBW=100kHz / VBW=300kHz / Sweep=AUTO
Above 1GHz (detector: Peak):
(a) PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO
(b) AVERAGE: RBW=1MHz /VBW=10Hz, when duty cycle is no less than 98%
VBW≥1/T when duty cycle is less than 98%,where T is transmit on time
Sweep=AUTO

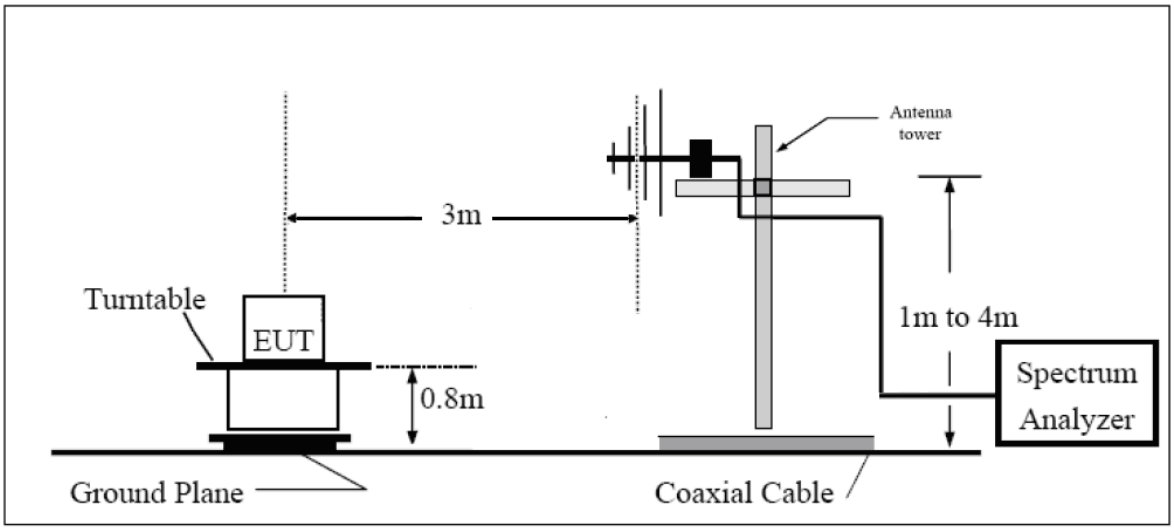
The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded.

The test is in transmitting mode.

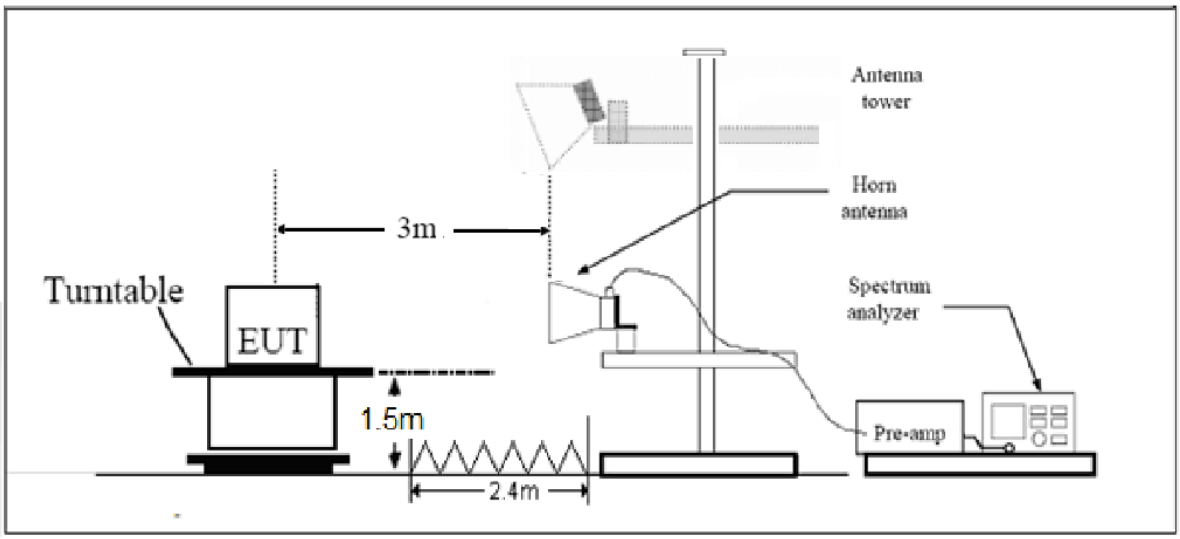
9KHz~~~30MHz



30MHz~~~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

(1) For transmitters operating in the 5725-5850 MHz band: 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.

(2) 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(68.2dBμV/m).

(3) For transmitters operating in the 5.25-5.35 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(68.2dBμV/m).

(4) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz(68.2dBμV/m).

Note: the following formula is used to convert the EIRP to field strength

§1、E[dBμV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and

d = distance at which field strength limit is specified in the rules;

§2、E[dBμV/m] = EIRP[dBm] + 95.2, for d = 3 meters

(5) Unwanted spurious emissions fallen in restricted bands per FCC Part15.205 shall comply with the general field strength limits set forth in § 15.209 as below table.

Frequency of emission (MHz)	Field strength(uV/m)	Field strength(dBuV/m)
0.009–0.490	2400/F(kHz)	/
0.490–1.705	24000/F(kHz)	/
1.705–30.0	30	/
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960	500	54

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor *k* = 1.96.

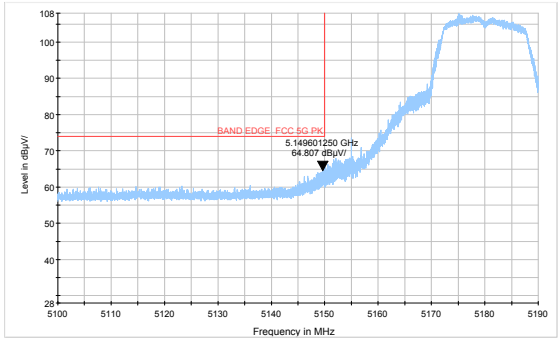
Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.19 dB
200MHz-1GHz	3.63 dB
1GHz-26.5G	3.68 dB
26.5G-40GHz	4.76dB

Test Results:

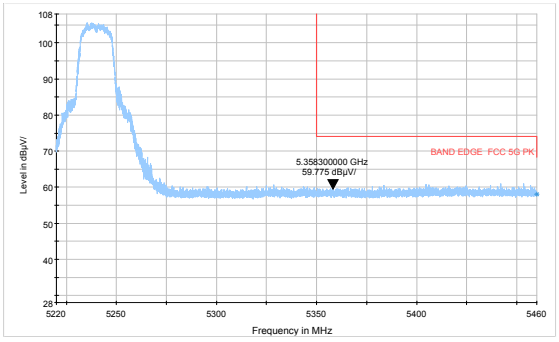
The signal beyond the limit is carrier.

U-NII-1

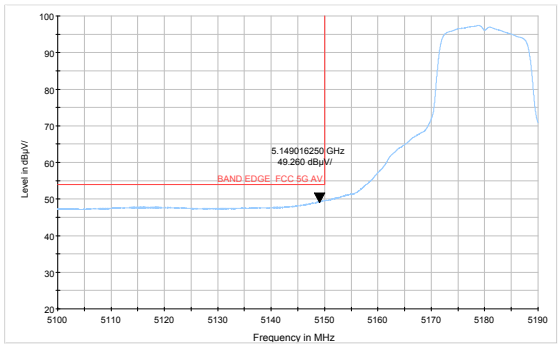
802.11a-Channel 36: Peak



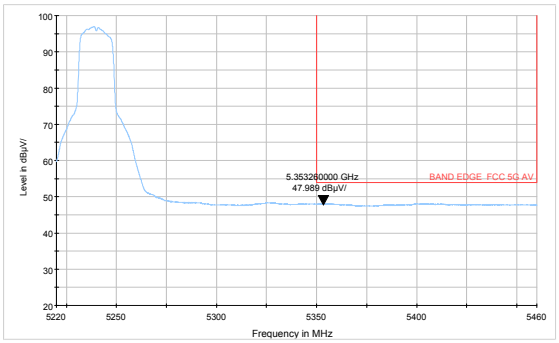
802.11a-Channel 48: Peak



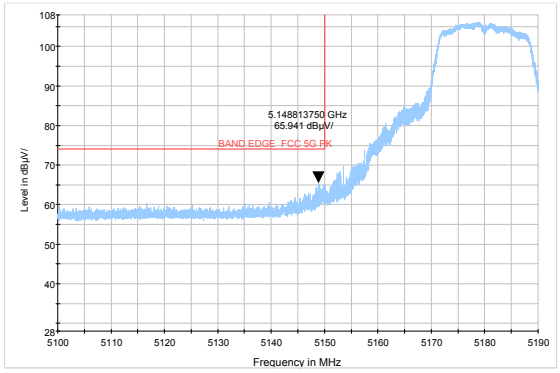
802.11a-Channel 36: Average



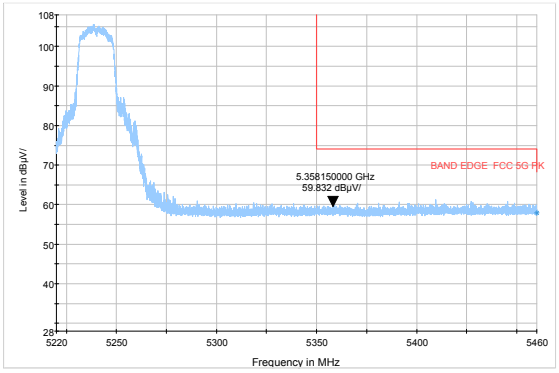
802.11a-Channel 48: Average



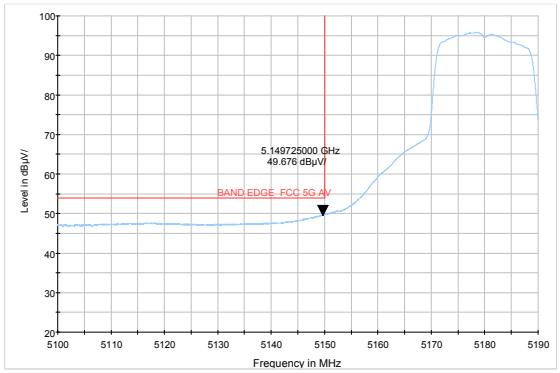
802.11n HT20-Channel 36: Peak



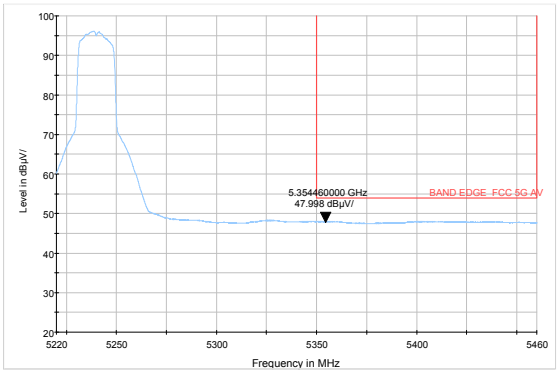
802.11n HT20-Channel 48: Peak



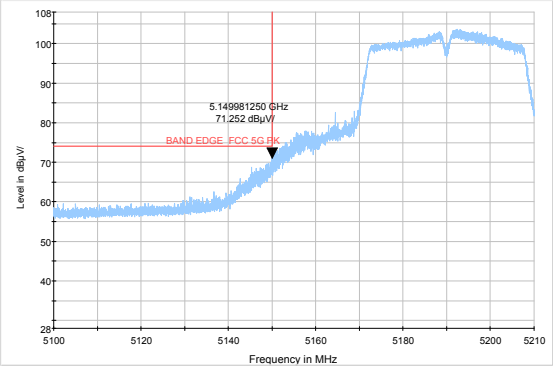
802.11n HT20-Channel 36: Average



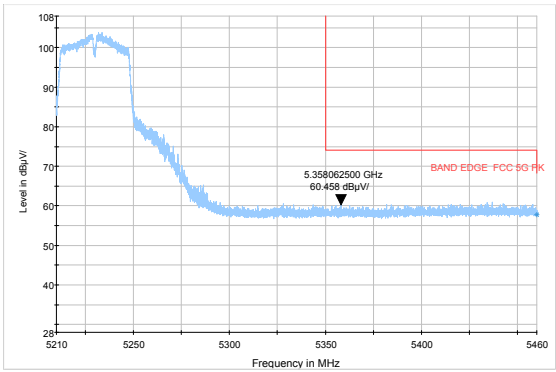
802.11n HT20-Channel 48: Average



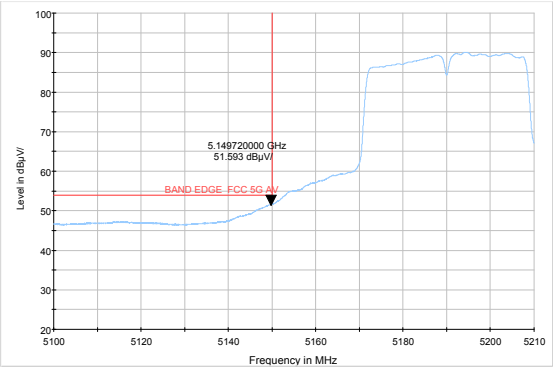
802.11n HT40-Channel 38: Peak



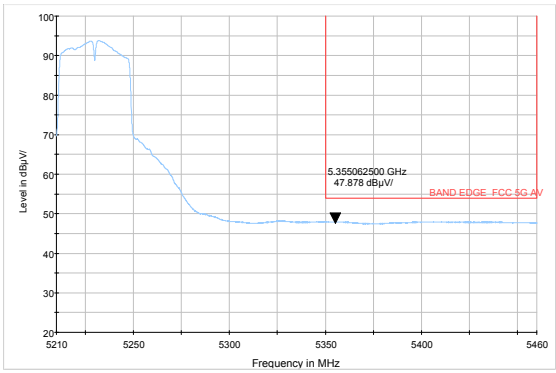
802.11n HT46-Channel 46: Peak



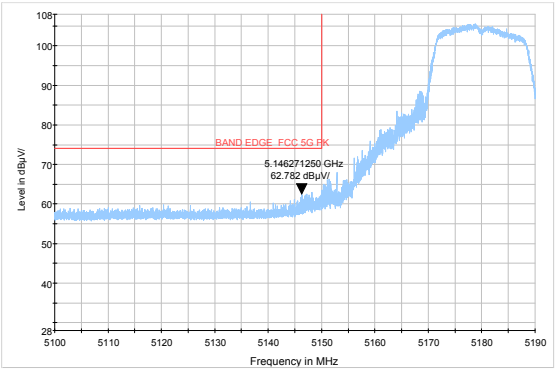
802.11n HT40-Channel 38: Average



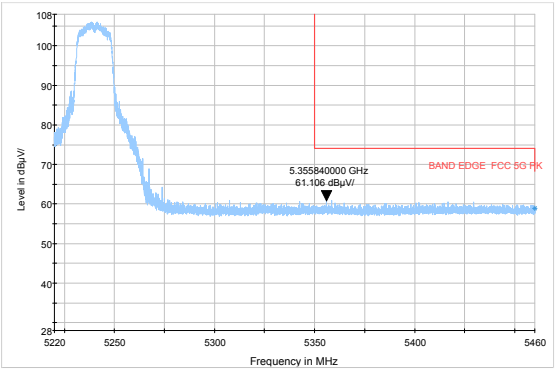
802.11n HT46-Channel 46: Average



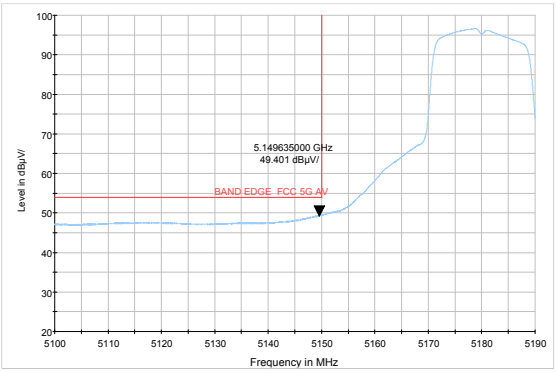
802.11ac HT20 -Channel 36: Peak



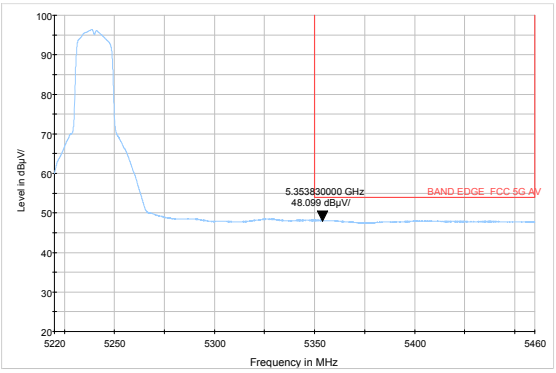
802.11ac HT20 -Channel 48: Peak



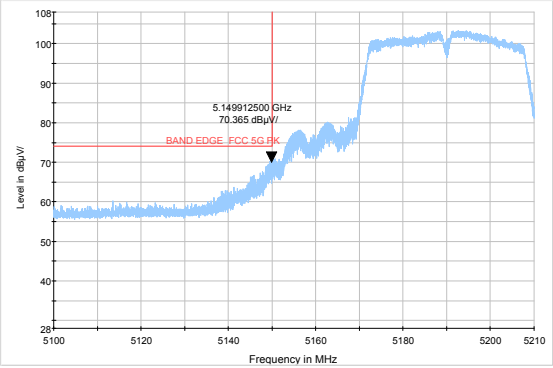
802.11ac HT20-Channel 36: Average



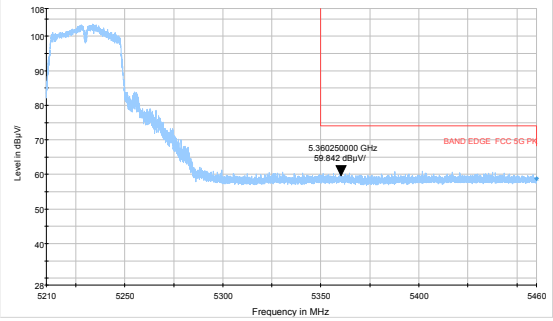
802.11ac HT20 -Channel 48: Average



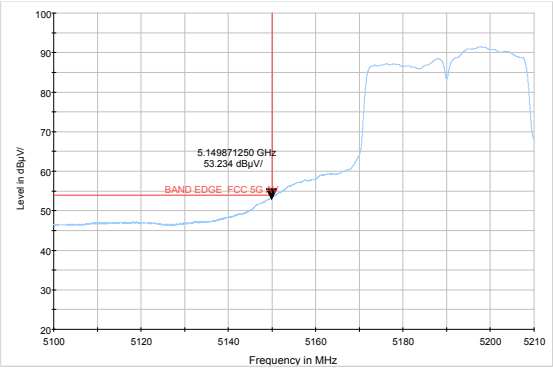
802.11ac HT40-Channel 38: Peak



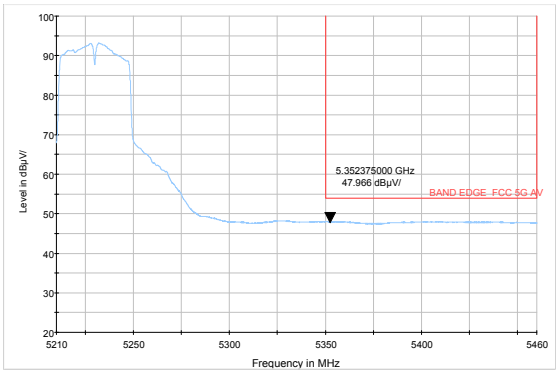
802.11ac HT40-Channel 46: Peak



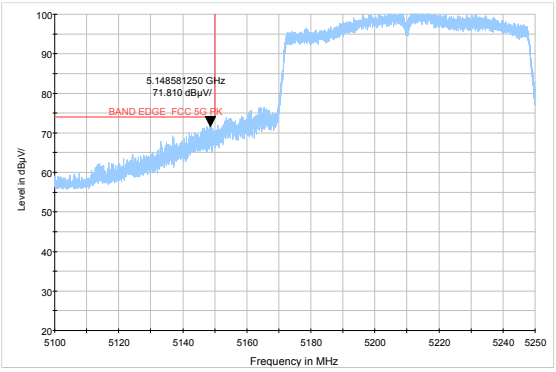
802.11ac HT40-Channel 38: Average



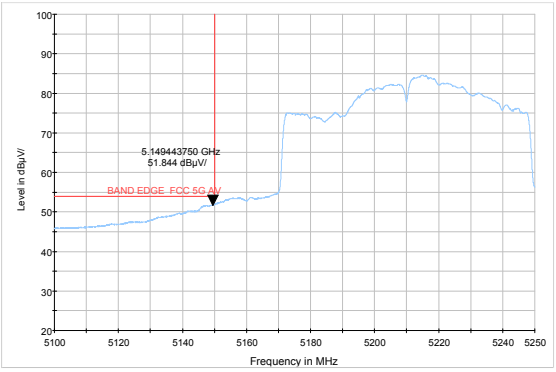
802.11ac HT40-Channel 46: Average



802.11ac HT80 –Channel 42: Peak

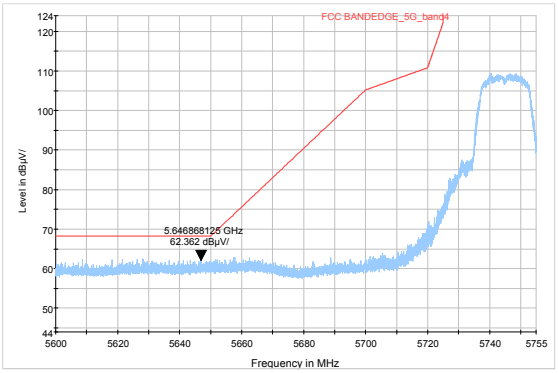


802.11ac HT80- Channel 42: Average

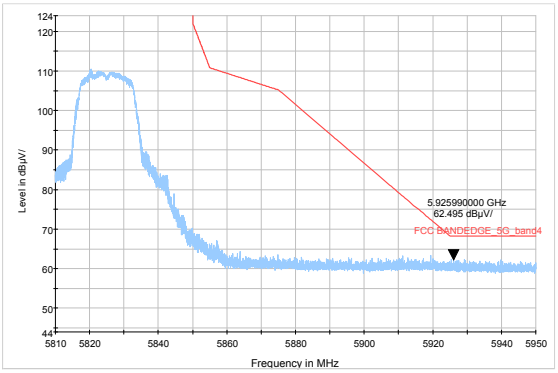


U-NII-3

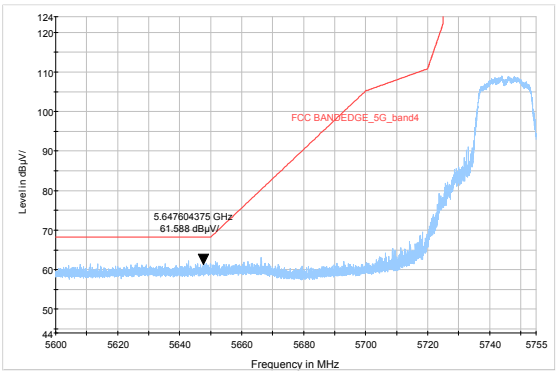
802.11a-Channel 149: Peak



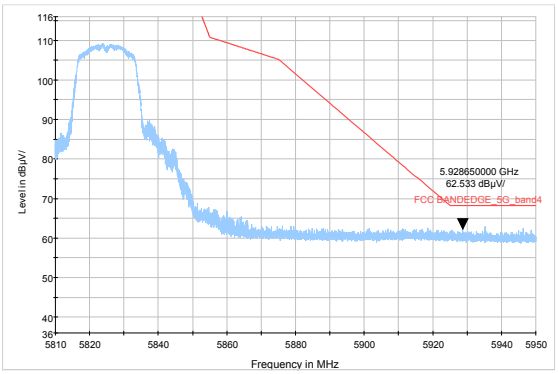
802.11a-Channel 165: Peak



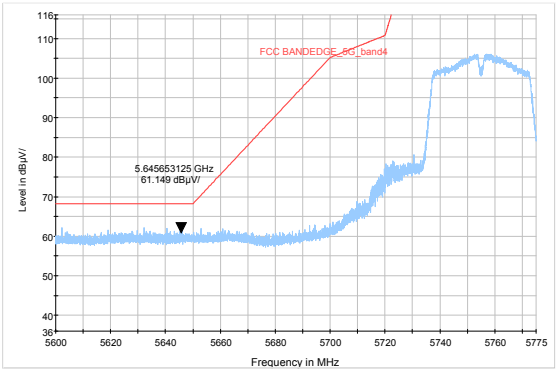
802.11n HT20-Channel 149: Peak



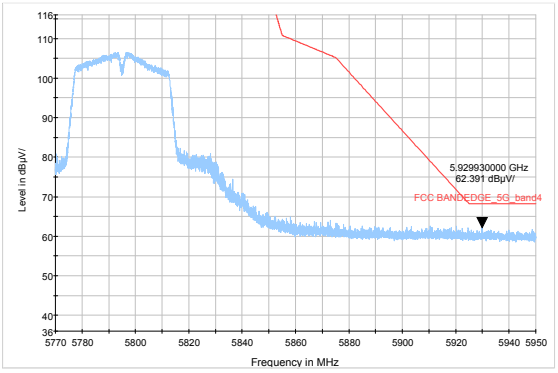
802.11n HT20-Channel 165: Peak



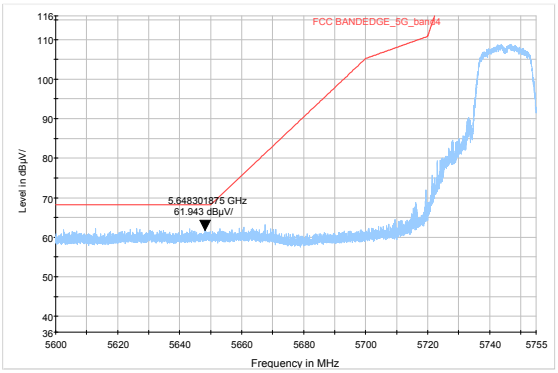
802.11n HT40-Channel 151: Peak



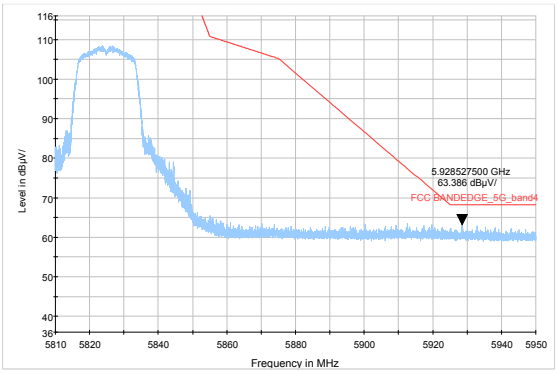
802.11n HT40-Channel 159: Peak



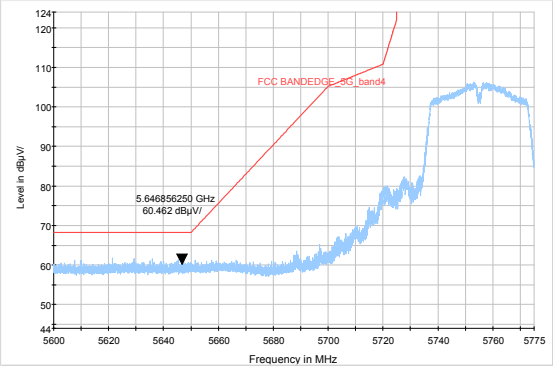
802.11ac HT20-Channel 149: Peak



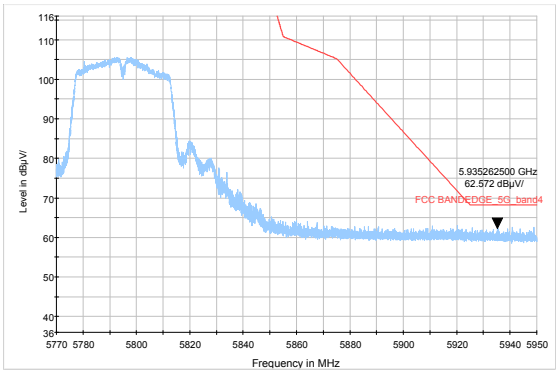
802.11ac HT20-Channel 165: Peak



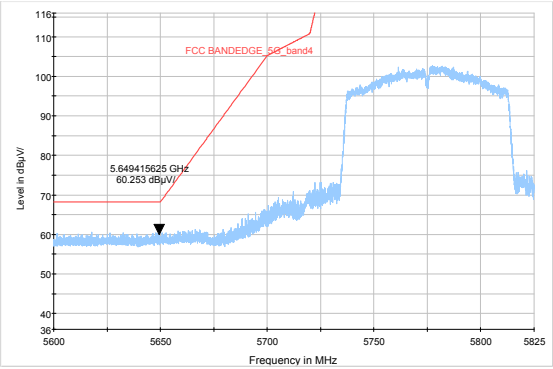
802.11ac HT40-Channel 151: Peak



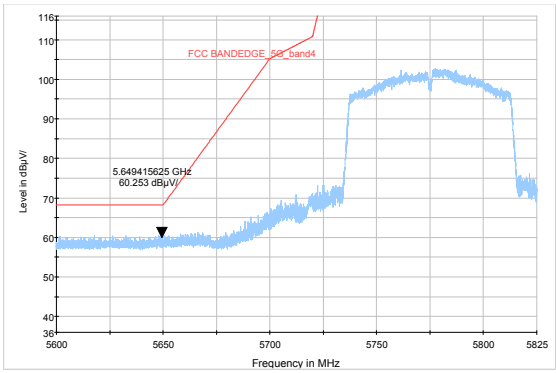
802.11ac HT40-Channel 159: Peak



802.11ac HT80- Channel 155: Peak



802.11ac HT80- Channel 155: Peak



Result of RE

Test result

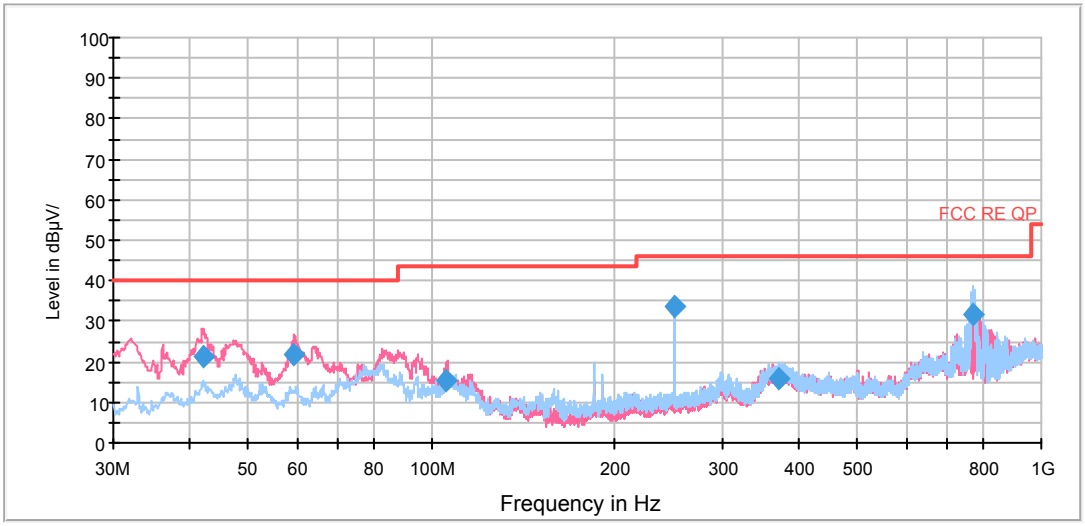
Sweep the whole frequency band through the range from 9kHz to the 10th harmonic of the carrier, and 9KHz-30MHz, the emissions more than 20 dB below the permissible value are not reported.

After the pre test, Antenna 1 was selected as the worst antenna.

During the test, the Radiates Emission from 30MHz to 1GHz was performed in all modes with all channels, 802.11ac(HT20), Channel 165 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

Continuous TX mode:

RE 30M-1GHz QP



Radiates Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBuV/m)	Reading value (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
42.108760	21.5	39.6	100.0	V	306.0	-18.1	18.5	40.0
59.475090	21.6	43.2	100.0	V	220.0	-21.6	18.4	40.0
105.797744	15.1	39.8	121.0	V	7.0	-24.7	28.4	43.5
250.003750	33.5	58.5	119.0	H	82.0	-25.0	12.5	46.0
370.860750	15.7	34.9	100.0	H	263.0	-19.2	30.3	46.0
774.252250	31.5	47.5	100.0	H	107.0	-16.0	14.5	46.0

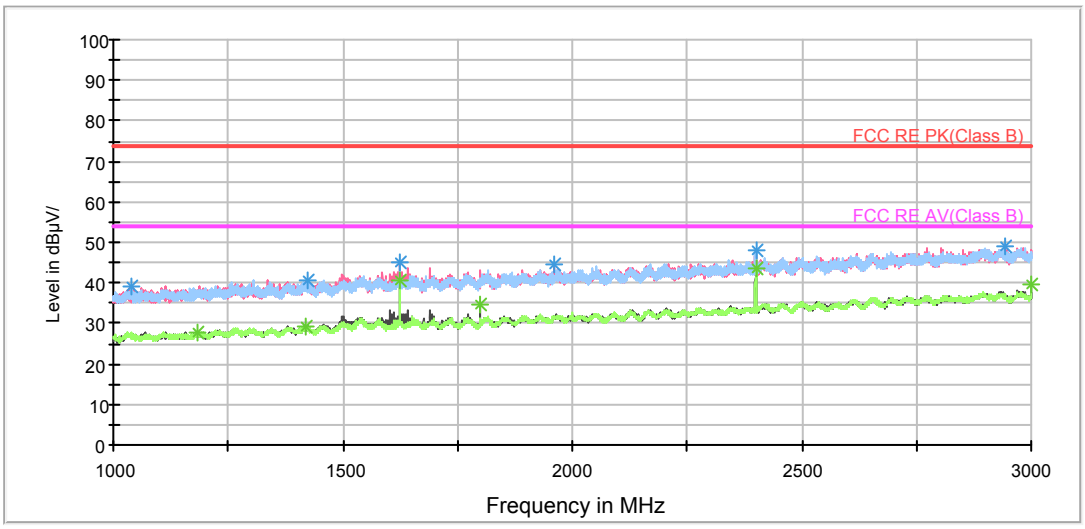
Remark: 1. Quasi-Peak = Reading value + Correction factor

2. Correction Factor = Antenna factor+ Insertion loss(cable loss+amplifier gain)

3. Margin = Limit – Quasi-Peak

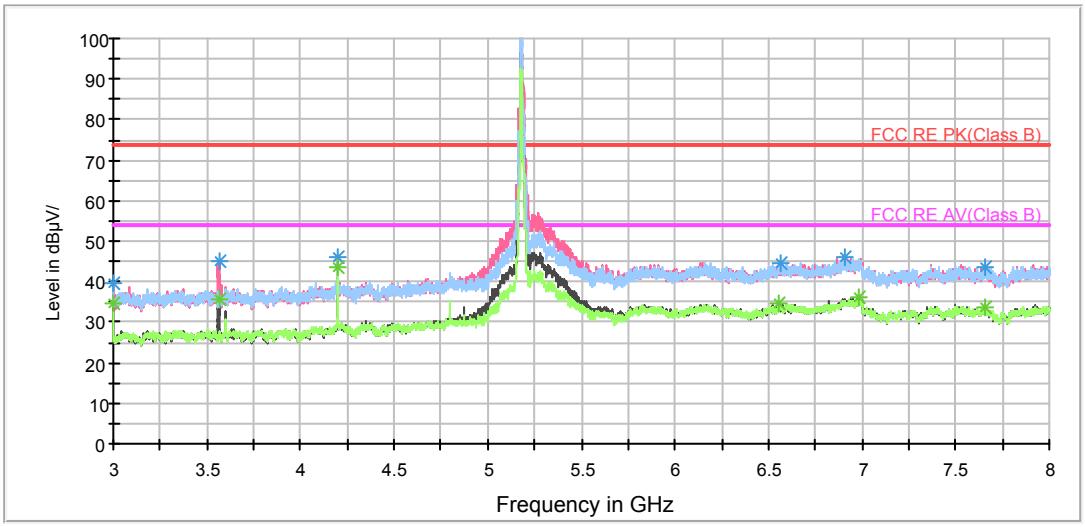
802.11a CH36

RE 1G-3GHz PK+AV



Radiates Emission from 1GHz to 3GHz

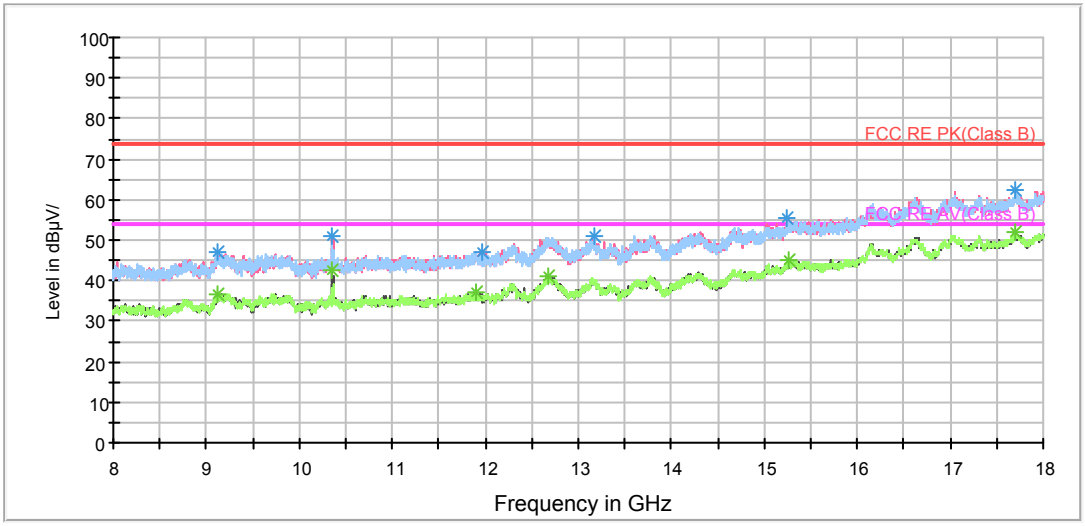
RE 3-18GHz PK+AV



Note: The signal beyond the limit is carrier.

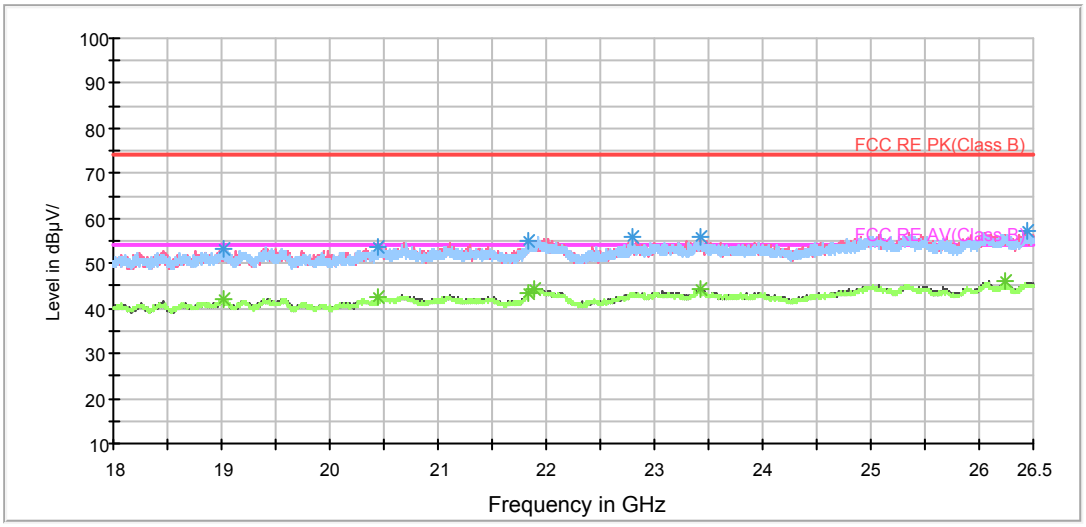
Radiates Emission from 3GHz to 8GHz

RE 3-18GHz PK+AV



Radiates Emission from 8GHz to 18GHz

BELL_RE 18-26.5GHz PK+AV



Radiates Emission from 18GHz to 26.5GHz

BELL RE 26.5-40GHz PK+AV

Radiates Emission from 26.5GHz to 40GHz

Frequency (MHz)	Peak (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
3000.000000	39.8	100.0	V	287.0	43.0	-3.2	34.2	74
3562.500000	45.1	100.0	V	184.0	47.2	-2.1	28.9	74
4200.000000	45.8	100.0	H	47.0	45.4	0.4	28.2	74
6560.625000	44.8	100.0	H	31.0	39.0	5.8	29.2	74
6905.625000	46.1	100.0	V	0.0	39.8	6.3	27.9	74
7656.250000	43.6	100.0	V	176.0	36.8	6.8	30.4	74

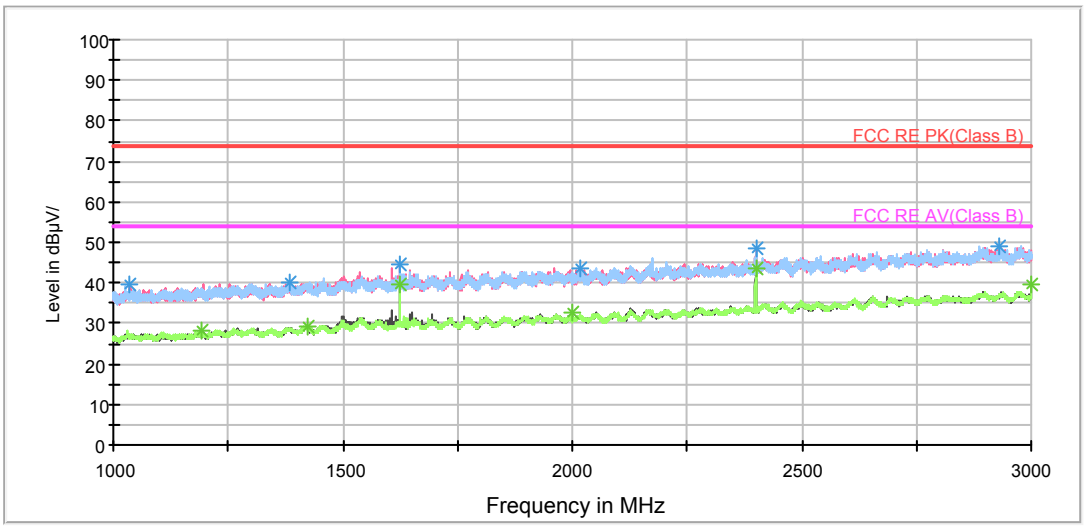
Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
3000.000000	34.7	100.0	V	287.0	37.9	-3.2	19.3	54
3563.125000	35.7	100.0	V	192.0	37.8	-2.1	18.3	54
4200.000000	43.4	100.0	H	47.0	43.0	0.4	10.6	54
6559.375000	34.5	100.0	H	111.0	28.7	5.8	19.5	54
6979.375000	36.0	100.0	V	60.0	29.7	6.3	18.0	54
7657.500000	33.8	100.0	H	135.0	27.0	6.8	20.2	54

Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

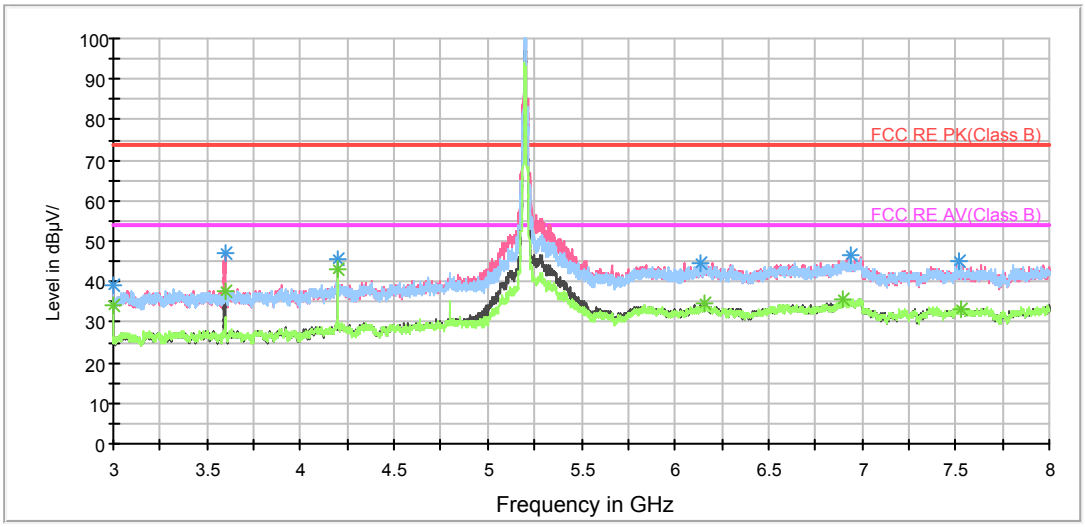
802.11a CH40

RE 1G-3GHz PK+AV



Radiates Emission from 1GHz to 3GHz

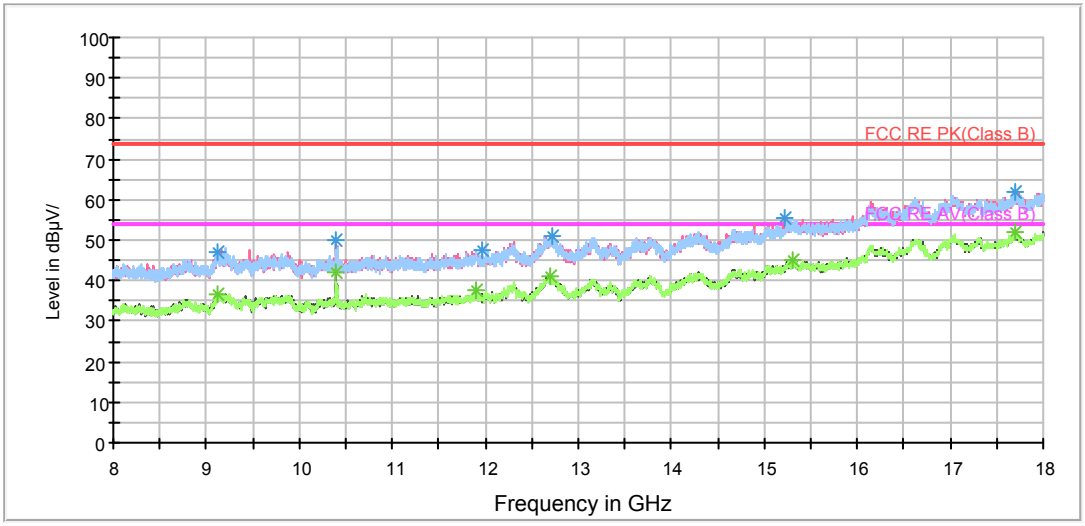
RE 3-18GHz PK+AV



Note: The signal beyond the limit is carrier.

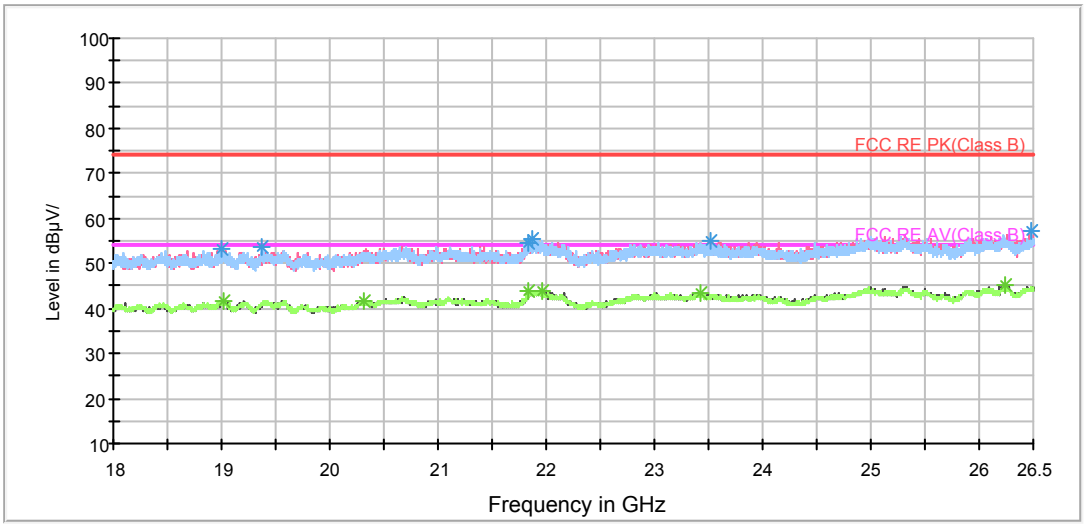
Radiates Emission from 3GHz to 8GHz

RE 3-18GHz PK+AV



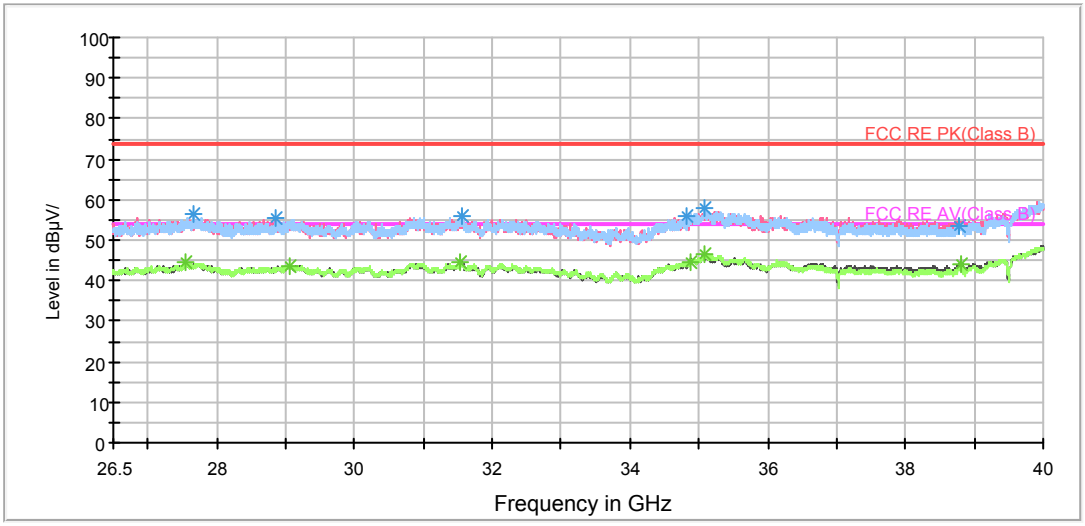
Radiates Emission from 8GHz to 18GHz

BELL_RE 18-26.5GHz PK+AV



Radiates Emission from 18GHz to 26.5GHz

BELL RE 26.5-40GHz PK+AV



Radiates Emission from 26.5GHz to 40GHz

Frequency (MHz)	Peak (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
3000.000000	39.3	100.0	V	291.0	42.5	-3.2	34.7	74
3595.625000	47.1	100.0	V	188.0	49.4	-2.3	26.9	74
4200.000000	45.5	100.0	H	52.0	45.1	0.4	28.5	74
6135.625000	44.7	100.0	V	80.0	39.3	5.4	29.3	74
6935.000000	46.3	100.0	H	76.0	40.2	6.1	27.7	74
7513.125000	44.9	100.0	H	278.0	37.9	7.0	29.1	74

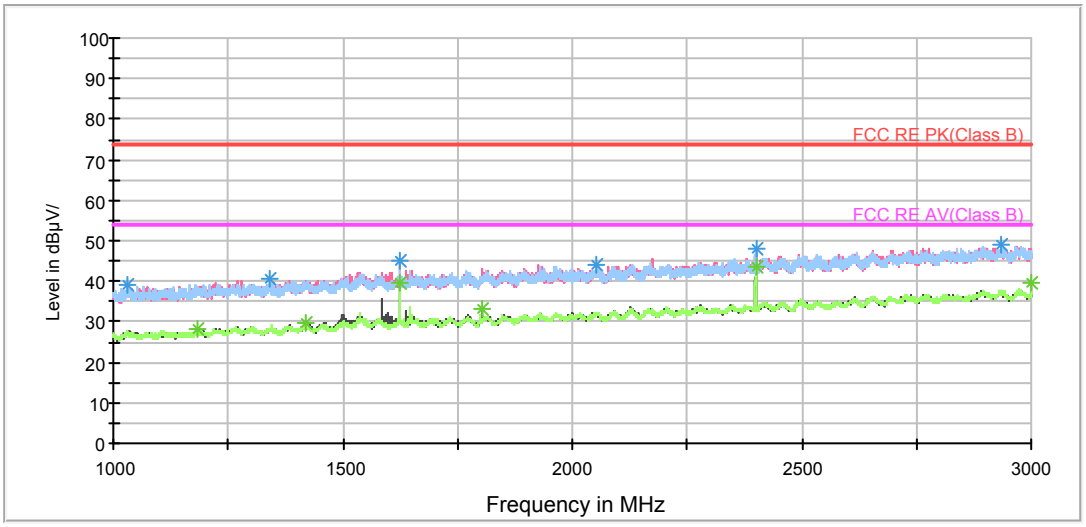
Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

Frequency (MHz)	Average (dBuV/m)	Height (cm)	Polarization	Azimuth (deg)	Reading value (dBuV/m)	Correct Factor (dB)	Margin (dB)	Limit (dBuV/m)
3000.000000	34.3	100.0	V	291.0	37.5	-3.2	19.7	54
3595.625000	37.4	100.0	V	188.0	39.7	-2.3	16.6	54
4200.000000	43.2	100.0	H	52.0	42.8	0.4	10.8	54
6161.875000	34.6	100.0	V	275.0	29.0	5.6	19.4	54
6898.125000	35.8	100.0	V	0.0	29.6	6.2	18.2	54
7533.125000	33.1	100.0	V	0.0	26.1	7.0	20.9	54

Remark: 1. Correction Factor = Antenna factor+ Insertion loss (cable loss + amplifier gain)

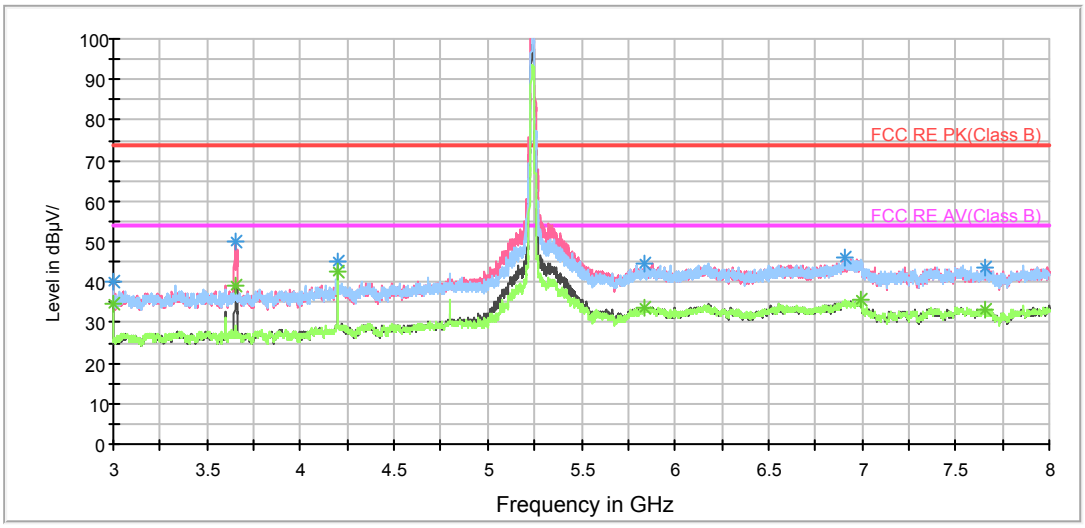
802.11a CH48

RE 1G-3GHz PK+AV



Radiates Emission from 1GHz to 3GHz

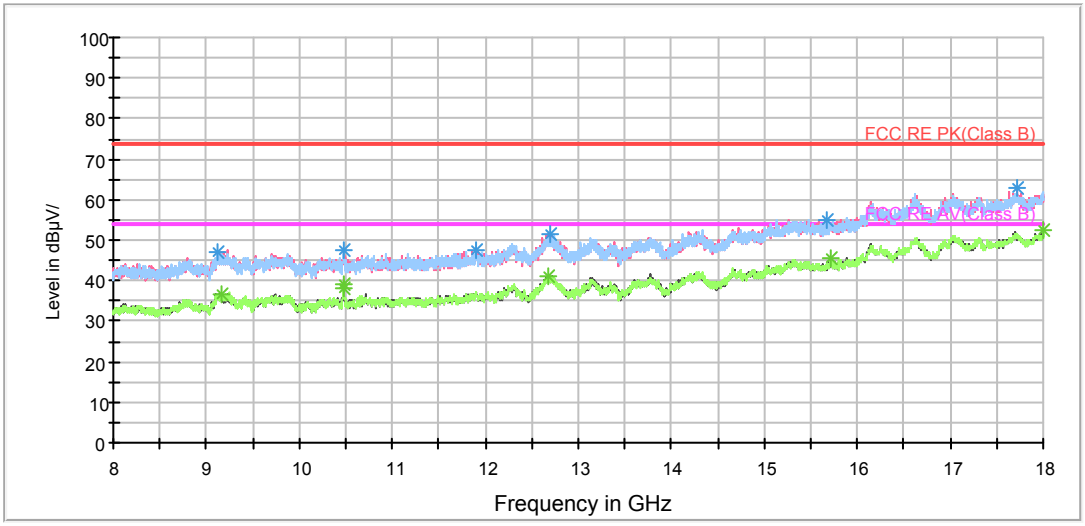
RE 3-18GHz PK+AV



Note: The signal beyond the limit is carrier.

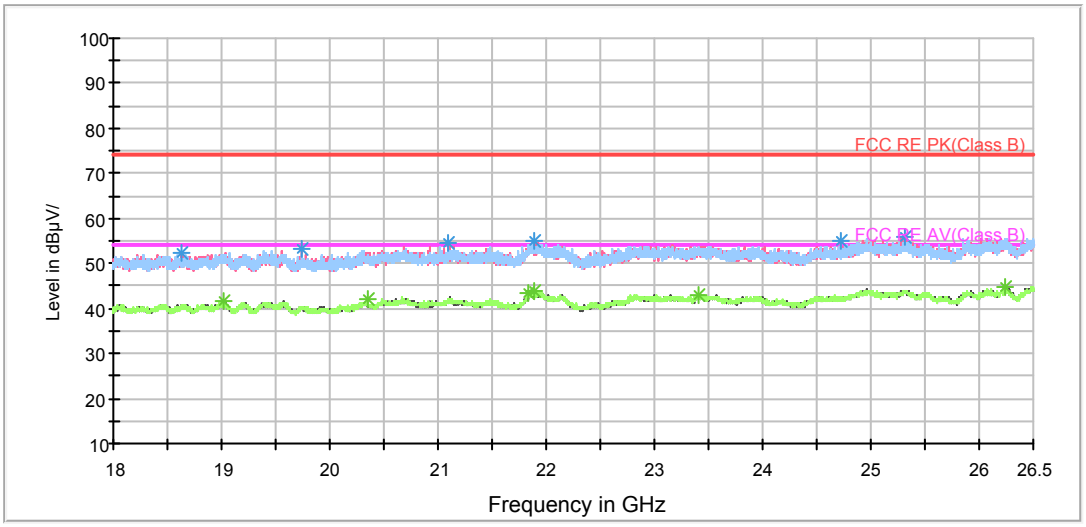
Radiates Emission from 3GHz to 8GHz

RE 3-18GHz PK+AV



Radiates Emission from 8GHz to 18GHz

BELL_RE 18-26.5GHz PK+AV



Radiates Emission from 18GHz to 26.5GHz