



# RF TEST REPORT

**Applicant** Alcatel-Lucent Shanghai Bell CO. Ltd.  
**FCC ID** 2ADZRHA030WB  
**Product** 7368 Intelligent Services Access Manager CPE  
**Brand** NOKIA  
**Model** HA-030W-B  
**Report No.** RBA1712-0148RF04R1  
**Issue Date** January 25, 2018

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15E (2017)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

*Performed by: Xianqing Li*

*Approved by: Kai Xu*

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## TA Technology (Shanghai) Co., Ltd.

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## 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: December 18, 2017 ~ January 15, 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.  
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City: Shanghai  
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## 2. General Description of Equipment under Test

### Client Information

<b>Applicant</b>	Alcatel-Lucent Shanghai Bell CO. Ltd.
<b>Applicant address</b>	388-389#, Ningqiao Road, Pudong Jinqiao, Shanghai, P.R. China
<b>Manufacturer</b>	TAICANG T&W ELECTRONICS CO.,LTD
<b>Manufacturer address</b>	89# Jiang Nan RD, Lu Du, Taicang, Jiangsu, China

### General information

EUT Description	
Model	HA-030W-B
SN	/
Hardware Version	PEM2
Software Version	Null
Power Supply	AC adapter
Antenna Type	Internal Antenna
Antenna Gain	Antenna 1: 4.0 dBi Antenna 2: 4.0 dBi Antenna 3: 4.0 dBi Antenna 4: 4.0 dBi
Directional Gain	10.02 dBi
additional beamforming gain	6 dB
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	28.24dBm
Operating Frequency Range(s)	U-NII-1: 5150-5250MHz U-NII-3: 5725-5850MHz
EUT Accessory	
Adapter 1	Manufacturer: Dongguan Shilong Fuhua Electronic Co., Ltd Model: UES36WA-120300SPAU
Adapter 2	Manufacturer:RUIDE Model: RD1202000-C55-80MG
<p>Note: The information of the EUT is declared by the manufacturer.</p> <p>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 for Radiated Emission, Adapter 2 for Conducted Emission) will be recorded in this report.</p>	

**EUT Configuration**

No.	Name	Model/Code No.	Edition	Serial No. or Quantity
1	EMA-HA-030W-B	3FE47429AA	PEM2	PEM 1
2	Power adapter	UES36WA-120300SPAU	A/0	PEM 1
3	Power adapter	RD1202000-C55-80MG	A/0	PEM 1

ONT Mnemonic	Kit Code	EMA Code	Part Description
HA-030W-B	3FE47357AA	3FE47429AA	Wi-Fi Access Point and range extender, 3xGE UNI, 3x3 11n+4x4 11ac, US plug

**Auxiliary Equipment**

No.	Name	Brand name	Model	ASB code	Valid Until
1	SmartBits 600B	Sprint	DE7853	-	No Cal. Required
2	PC	HP	N.A	-	No Cal. Required
3	PC	DELL	N.A	-	No Cal. Required
4	PC	Thinkpad	N.A	-	No Cal. Required

**Ports**

No.	Port name	Number	Shielded or unshielded	Cable type (optic, twisted pair, etc.)	Max. Cable length
1	Power	1	unshielded	-	-
2	GE	4	unshielded	-	-



### 3. Applied Standards

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

**FCC CFR47 Part 15E (2017)** Unlicensed National Information Infrastructure Devices

**ANSI C63.10 (2013)**

**KDB 789033 D02 General UNII Test Procedures New Rules v02**

**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	Antenna 3	Antenna 4
802.11a	6	6	6	6
802.11n HT20	MCS0	MCS0	MCS0	MCS0
802.11n HT40	MCS0	MCS0	MCS0	MCS0
802.11ac HT20	MCS0	MCS0	MCS0	MCS0
802.11ac HT40	MCS0	MCS0	MCS0	MCS0
802.11ac HT80	MCS0	MCS0	MCS0	MCS0

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

Test Cases	MIMO Antenna 1	MIMO Antenna 2	MIMO Antenna 3	MIMO Antenna 4
Average conducted output power	O	O	O	O
Occupied bandwidth	O	O	O	O
Frequency stability	O	O	O	O
Power Spectral Density	O	O	O	O
Unwanted Emissions	O	O	O	O
Conducted Emissions	O	O	O	O
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
	U-NII-3	20 MHz	42	5210MHz
			149	5745MHz
			157	5785MHz
		40 MHz	165	5825MHz
			151	5755MHz
			159	5795MHz
80 MHz	155	5775MHz		
Does this device support TPC Function? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				
Does this device support TDWR Band? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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.

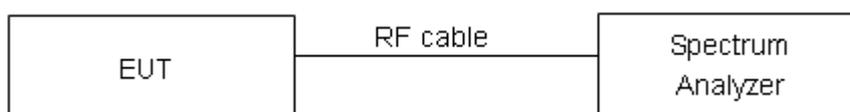
For U-NII-1, set RBW  $\approx$ 1% OCB kHz, VBW  $\geq$  3  $\times$  RBW, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 26 dB relative to the maximum level measured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

For U-NII-3, Set RBW = 100 kHz, VBW  $\geq$  3  $\times$  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.

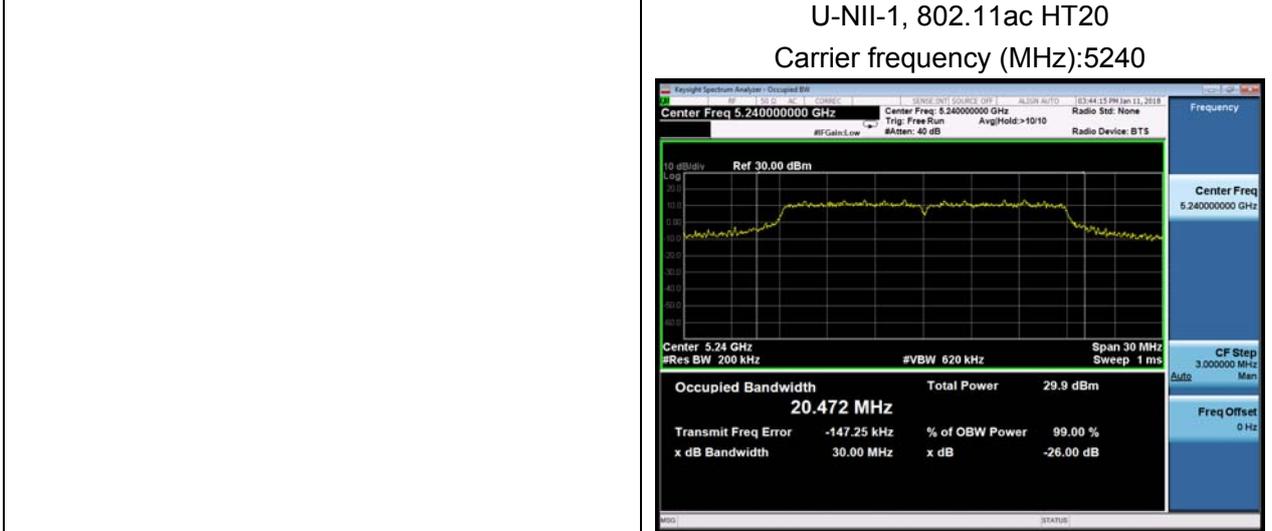
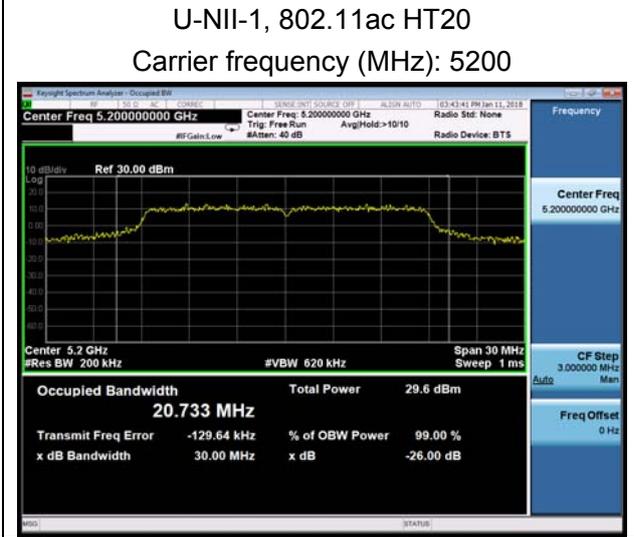
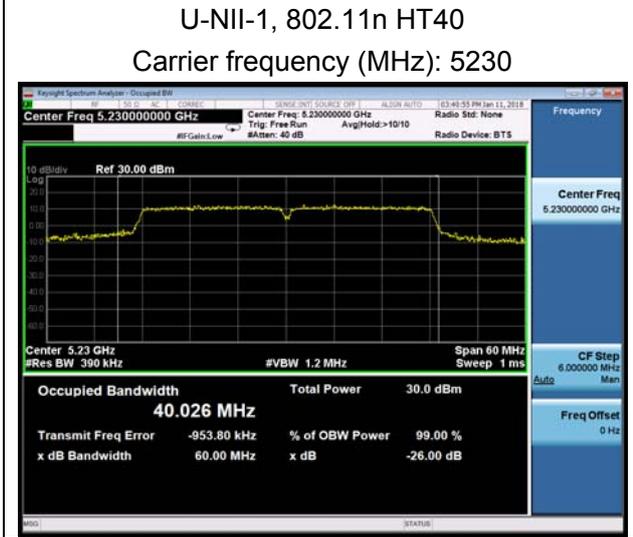
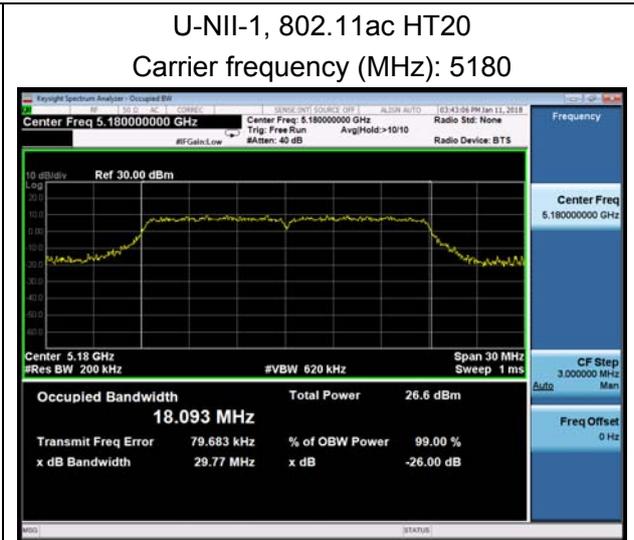
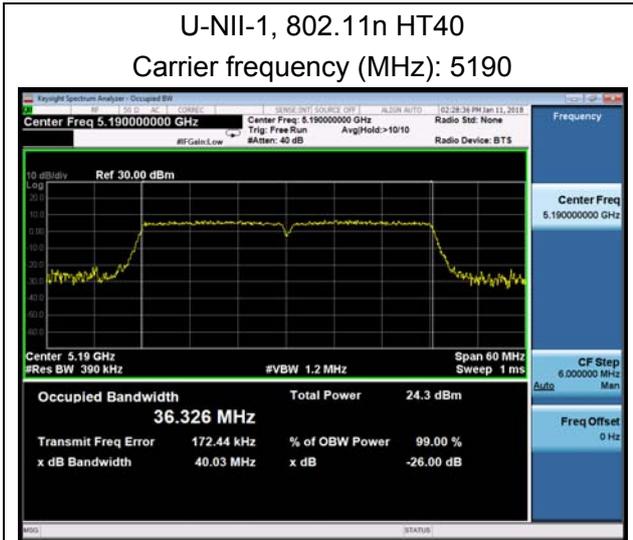
**Test Results:****U-NII-1**

Network Standards	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5180	16.779	21.38	PASS
	5200	16.768	21.25	PASS
	5240	16.728	21.22	PASS
802.11n HT20	5180	18.067	28.90	PASS
	5200	19.959	30.00	PASS
	5240	21.182	30.00	PASS
802.11n HT40	5190	36.326	40.03	PASS
	5230	40.026	60.00	PASS
802.11ac HT20	5180	18.093	29.77	PASS
	5200	20.733	30.00	PASS
	5240	20.472	30.00	PASS
802.11ac HT40	5190	36.306	39.95	PASS
	5230	39.271	60.00	PASS
802.11ac HT80	5210	74.997	81.27	PASS

**U-NII-3**

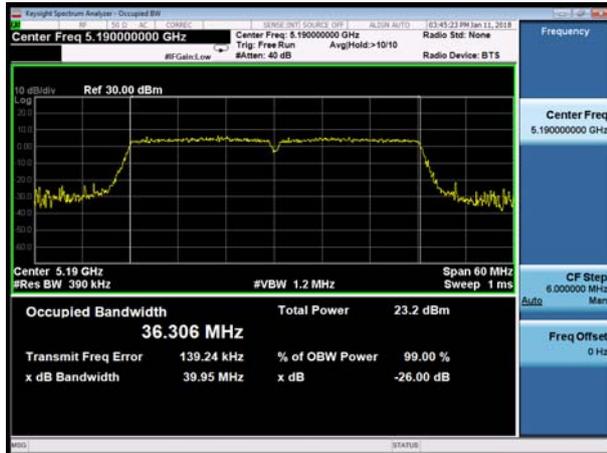
Network Standards	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11a	5745	18.135	16.39	500	PASS
	5785	19.371	16.36	500	PASS
	5825	21.662	16.32	500	PASS
802.11n HT20	5745	18.291	17.62	500	PASS
	5785	18.197	17.60	500	PASS
	5825	19.334	17.63	500	PASS
802.11n HT40	5755	36.732	36.35	500	PASS
	5795	37.221	36.42	500	PASS
802.11ac HT20	5745	18.356	17.64	500	PASS
	5785	18.643	17.59	500	PASS
	5825	20.040	17.59	500	PASS
802.11ac HT40	5755	36.811	36.38	500	PASS
	5795	37.378	36.41	500	PASS
802.11ac HT80	5775	76.054	75.83	500	PASS







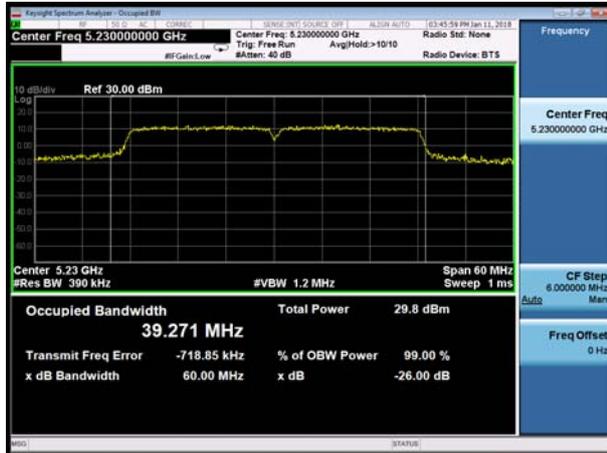
U-NII-1, 802.11ac HT40  
Carrier frequency (MHz): 5190



U-NII-1, 802.11ac HT80  
Carrier frequency (MHz): 5210



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

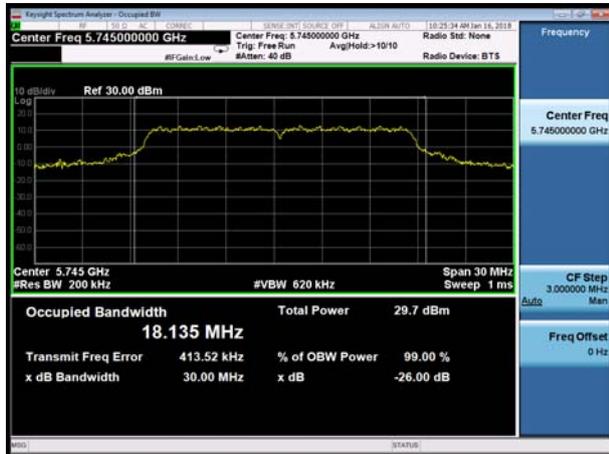




U-NII-3 99% bandwidth

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

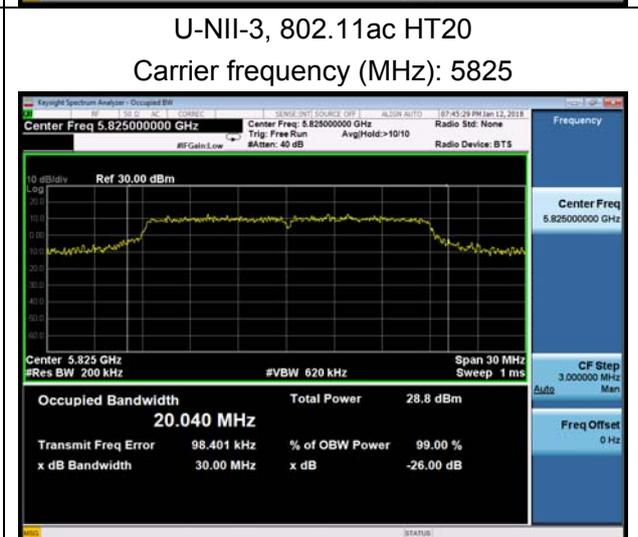
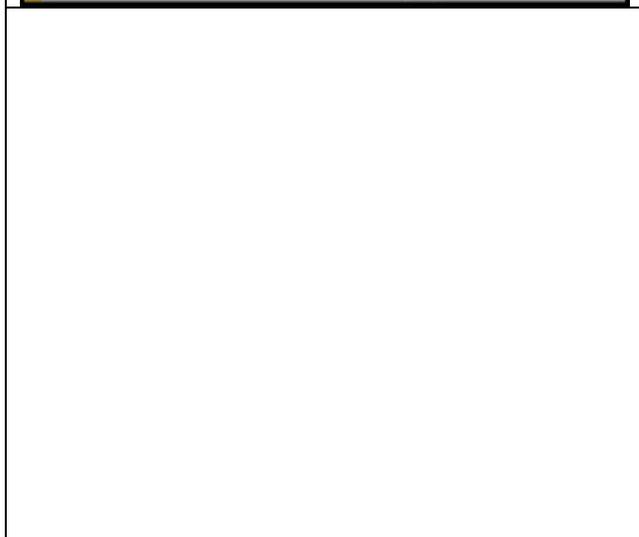
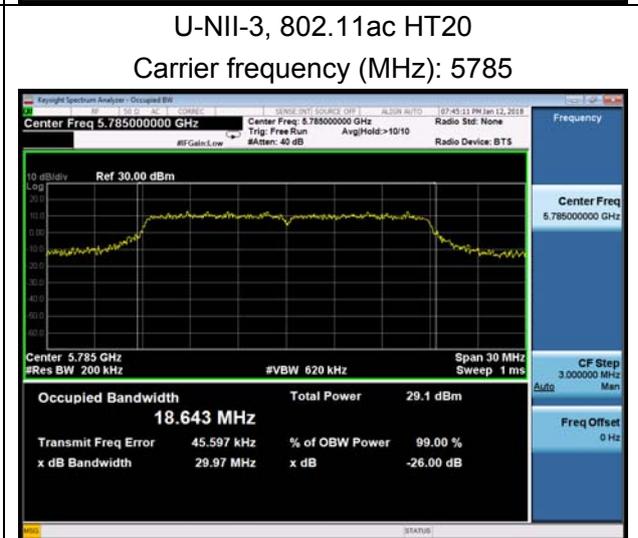
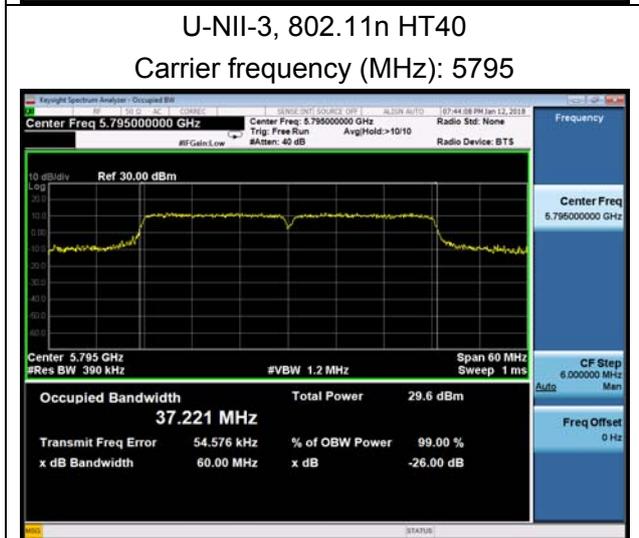
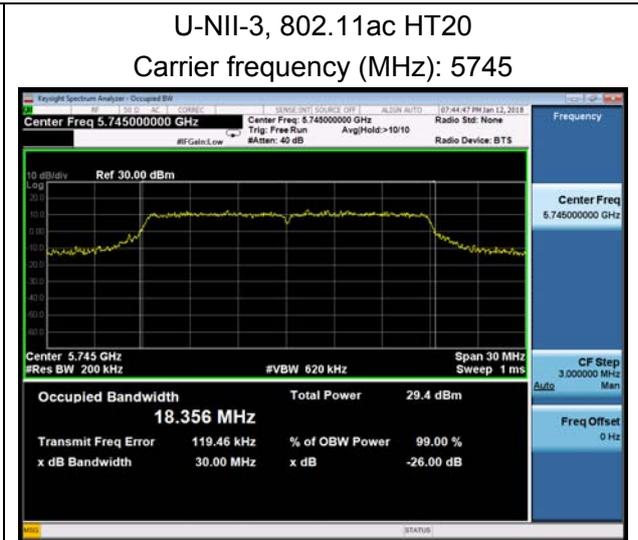
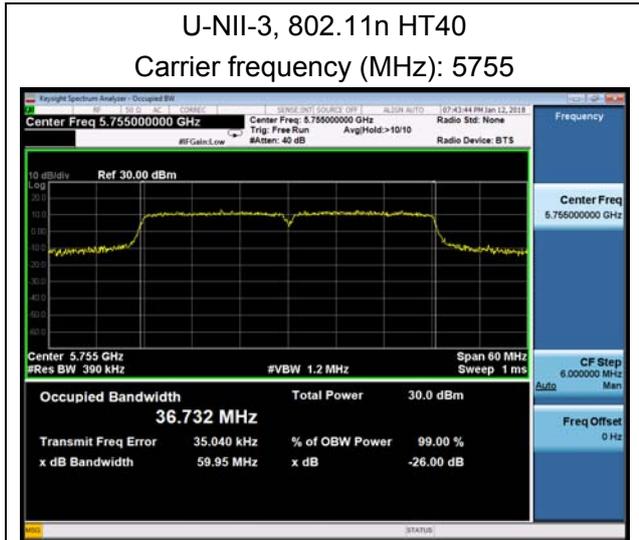
Carrier frequency (MHz): 5825



U-NII-3, 802.11n HT20

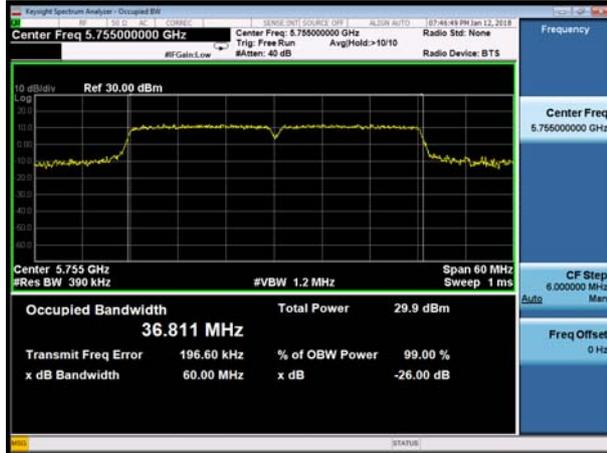
Carrier frequency (MHz): 5825







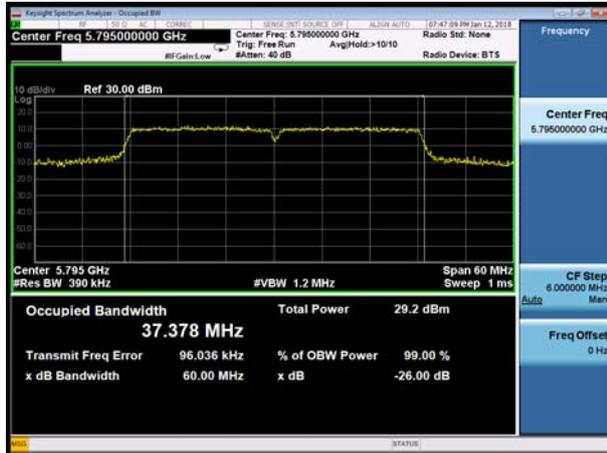
U-NII-3, 802.11ac HT40  
Carrier frequency (MHz): 5755



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



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



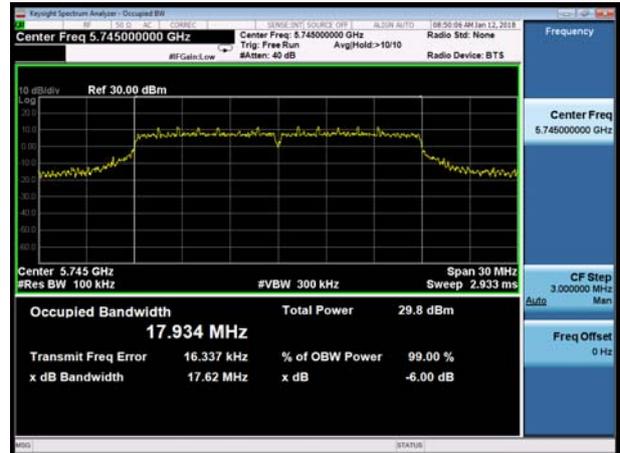


U-NII-3 Minimum 6 dB bandwidth

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



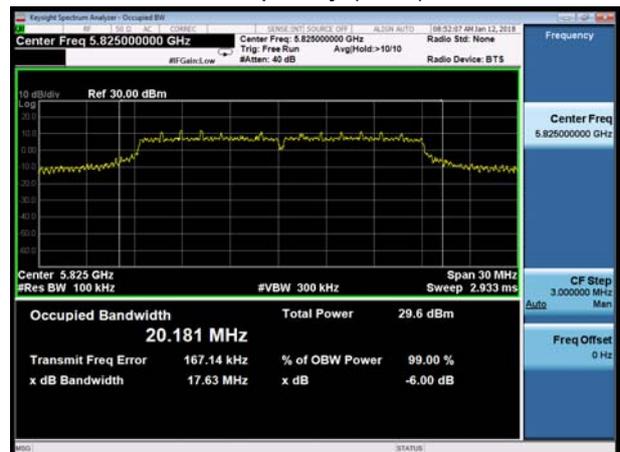
U-NII-3, 802.11n HT20  
Carrier frequency (MHz): 5785



U-NII-3, 802.11a  
Carrier frequency (MHz): 5825



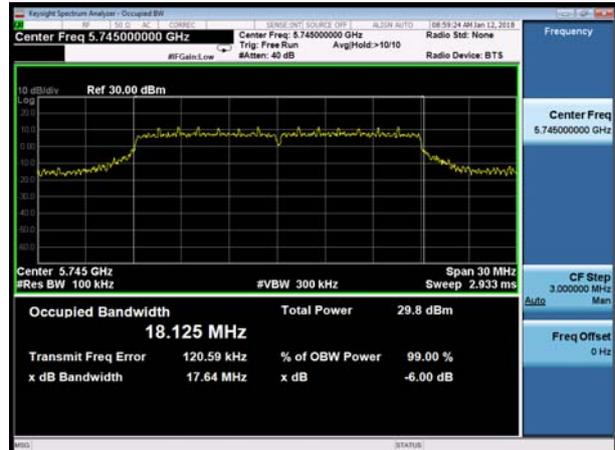
U-NII-3, 802.11n HT20  
Carrier frequency (MHz): 5825



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



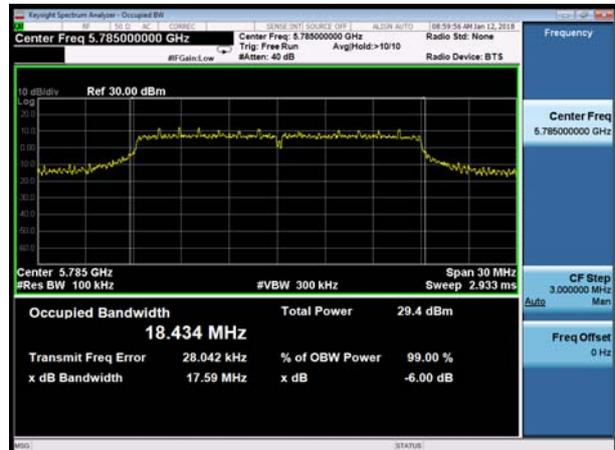
U-NII-3, 802.11ac HT20  
Carrier frequency (MHz): 5745



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



U-NII-3, 802.11ac HT20  
Carrier frequency (MHz): 5785

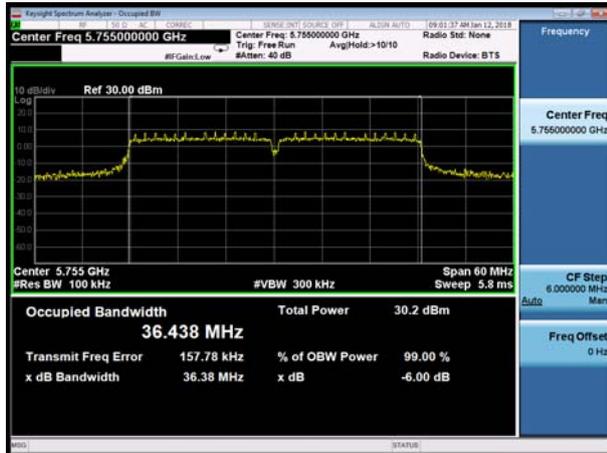


U-NII-3, 802.11ac HT20  
Carrier frequency (MHz): 5825





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



## 5.2. Average Power Output –Conducted

### Ambient condition

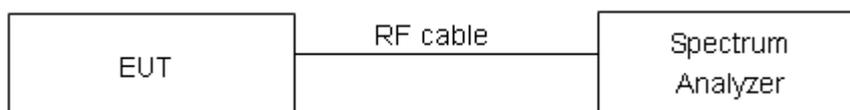
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

### Methods of Measurement

During the process of the testing, The EUT was connected to spectrum analyzer through an external attenuator and a known loss cable. The EUT is max power transmission with proper modulation. We use Maximum average Conducted Output Power Level Method in KDB789033 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 <sub>on</sub> (ms)	T <sub>(on+off)</sub> (ms)	Duty cycle	Duty cycle correction Factor(dB)
802.11a	2.06	2.17	0.95	0.21
802.11n HT20	1.92	2.02	0.95	0.23
802.11n HT40	0.94	1.04	0.90	0.44
802.11ac HT20	1.93	1.97	0.98	NA
802.11ac HT40	0.95	0.98	0.97	0.13
802.11ac HT80	0.95	0.98	0.97	0.14

Note: when Duty cycle>0.98, Duty cycle correction Factor not required.

Antenna 1/2/3/4 Power Index						
Packet Type	CH36	CH40	CH48	CH149	CH157	CH165
802.11a	80	80	80	94	94	94
802.11n HT20	81	83	83	94	94	94
802.11ac HT20	85	77	78	94	94	94
Packet Type	CH38	CH46	CH151	CH159	/	/
802.11n HT40	71	94	94	94	/	/
802.11ac HT40	70	87	94	94	/	/
Packet Type	CH42	CH155	/	/	/	/
802.11ac HT80	70	94	/	/	/	/

**Test results****U-NII-1****MIMO without Beamforming**

Network Standards	Channel/ Frequency (MHz)	Output Power									Limit (dBm)	Conclusion
		Antenna 1		Antenna 2		Antenna 3		Antenna 4		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11a	36/5180	19.55	19.76	17.45	17.66	18.32	18.53	15.92	16.13	24.24	30.00	PASS
	40/5200	18.71	18.92	17.69	17.90	18.49	18.70	16.17	16.38	24.11	30.00	PASS
	48/5240	18.81	19.02	18.21	18.42	18.86	19.07	16.40	16.61	24.41	30.00	PASS
802.11n HT20	36/5180	18.83	19.06	18.29	18.52	18.46	18.69	17.65	17.88	24.58	30.00	PASS
	40/5200	19.27	19.50	18.53	18.76	18.36	18.59	18.48	18.71	24.92	30.00	PASS
	48/5240	19.37	19.60	18.77	19.00	19.04	19.27	17.56	17.79	24.99	30.00	PASS
802.11n HT40	38/5190	16.74	17.18	14.15	14.59	14.55	14.99	14.05	14.49	21.48	30.00	PASS
	46/5230	20.62	21.06	20.35	20.79	20.62	21.06	20.48	20.92	26.98	30.00	PASS
802.11ac HT20	36/5180	20.27	20.27	18.11	18.11	18.72	18.72	18.01	18.01	24.90	30.00	PASS
	40/5200	17.88	17.88	16.96	16.96	17.74	17.74	15.35	15.35	23.11	30.00	PASS
	48/5240	18.01	18.01	17.78	17.78	17.42	17.42	16.25	16.25	23.44	30.00	PASS
802.11ac HT40	38/5190	16.80	16.93	14.12	14.25	14.81	14.94	13.61	13.74	21.16	30.00	PASS
	46/5230	18.44	18.57	20.60	20.73	20.89	21.02	20.82	20.95	26.44	30.00	PASS
802.11ac HT80	42/5210	16.58	16.72	13.97	14.11	14.74	14.88	14.39	14.53	21.21	30.00	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),  
The Total Power =  $10\log(10^{(\text{Power antenna1 in dBm}/10)} + 10^{(\text{Power antenna2 in dBm}/10)} + 10^{(\text{Power antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$ .

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 =  $G_{ANT} + \text{Array Gain}$ ,  
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  $\geq 40$  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 =  $G_{ANT} + \text{Array Gain} = 4 + 0 = 4$  dBi  $< 6$  dBi. So the power limit is 30dBm.

**MIMO with Beamforming**

Network Standards	Channel/ Frequency (MHz)	Output Power									Limit (dBm)	Conclusion
		Antenna 1		Antenna 2		Antenna 3		Antenna 4		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11n HT20	36/5180	18.88	19.11	18.28	18.51	18.54	18.77	17.56	17.79	24.59	25.98	PASS
	40/5200	19.22	19.45	19.14	19.37	19.14	19.37	19.31	19.54	25.45	25.98	PASS
	48/5240	19.40	19.63	19.43	19.66	19.46	19.69	19.30	19.53	25.65	25.98	PASS
802.11n HT40	38/5190	16.82	17.28	16.78	17.24	16.74	17.20	16.77	17.22	23.25	25.98	PASS
	46/5230	20.61	19.49	19.64	20.09	19.35	19.80	19.58	20.03	25.88	25.98	PASS
802.11ac HT20	36/5180	20.17	20.17	18.09	18.09	18.79	18.79	18.06	18.06	24.89	25.98	PASS
	40/5200	17.84	17.84	17.90	17.90	17.94	17.94	17.77	17.77	23.88	25.98	PASS
	48/5240	17.95	17.95	17.95	17.95	17.97	17.97	17.94	17.94	23.97	25.98	PASS
802.11ac HT40	38/5190	16.88	17.02	16.89	17.03	16.84	16.99	16.90	17.04	23.04	25.98	PASS
	46/5230	18.36	18.50	18.38	18.52	18.29	18.43	18.37	18.51	24.51	25.98	PASS
802.11ac HT80	42/5210	16.48	16.63	16.54	16.68	16.57	16.71	16.54	16.68	22.70	25.98	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),  
The Total Power =  $10\log(10^{(\text{Power antenna1 in dBm}/10)} + 10^{(\text{Power antenna2 in dBm}/10)} + 10^{(\text{Power antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$ .

2. The manufacturer declared the transmitter output signals is CDD mode And  $N_{ss}=1$ . according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e) (i), if all antennas have the same gain, directional gain = GANT + 10  $\log(NANT/NSS)=4+10\log(4/1)=10.02>6$  dBi. So the power limit =  $30 - (\text{directional gain} - 6 \text{ dBi}) = 30 - (10.02 - 6) = 25.98$  dBm.



## U-NII-3

## MIMO without Beamforming

Network Standards	Channel/ Frequency (MHz)	Output Power									Limit (dBm)	Conclusion
		Antenna 1		Antenna 2		Antenna 3		Antenna 4		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11a	149/5745	22.48	22.69	21.96	22.17	22.46	22.67	20.53	20.74	28.16	30.00	PASS
	157/5785	22.67	22.88	22.27	22.48	22.30	22.51	20.46	20.67	28.24	30.00	PASS
	165/5825	22.31	22.52	22.04	22.25	22.18	22.39	20.68	20.89	28.08	30.00	PASS
802.11n HT20	149/5745	22.10	22.33	20.72	20.95	21.54	21.77	20.56	20.79	27.53	30.00	PASS
	157/5785	21.67	21.90	20.59	20.82	21.04	21.27	20.43	20.66	27.21	30.00	PASS
	165/5825	21.00	21.23	20.26	20.49	20.96	21.19	20.72	20.95	26.99	30.00	PASS
802.11n HT40	151/5755	21.68	22.12	20.44	20.88	20.60	21.04	20.62	21.06	27.32	30.00	PASS
	159/5795	21.14	21.58	20.15	20.59	20.34	20.78	20.19	20.63	26.93	30.00	PASS
802.11ac HT20	149/5745	21.83	21.83	20.43	20.43	20.97	20.97	20.78	20.78	27.05	30.00	PASS
	157/5785	22.06	22.06	20.55	20.55	20.90	20.90	20.77	20.77	27.13	30.00	PASS
	165/5825	22.06	22.06	20.29	20.29	20.62	20.62	20.90	20.90	27.04	30.00	PASS
802.11ac HT40	151/5755	22.27	22.40	20.40	20.53	20.60	20.73	20.63	20.76	27.19	30.00	PASS
	159/5795	21.52	21.65	19.96	20.09	20.40	20.53	20.42	20.55	26.76	30.00	PASS
802.11ac HT80	155/5775	21.83	21.97	19.84	19.98	20.13	20.27	20.49	20.63	26.81	30.00	PASS

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

The Total Power =  $10\log(10^{(\text{Power antenna1 in dBm}/10)} + 10^{(\text{Power antenna2 in dBm}/10)} + 10^{(\text{Power antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$ .

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 =  $G_{ANT} + \text{Array Gain}$ ,

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  $\geq 40$  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 =  $G_{ANT} + \text{Array Gain} = 4 + 0 = 4 \text{ dBi} < 6 \text{ dBi}$ . So the power limit is 30dBm.

**MIMO with Beamforming**

Network Standards	Channel/ Frequency (MHz)	Output Power									Limit (dBm)	Conclusion
		Antenna 1		Antenna 2		Antenna 3		Antenna 4		Total Power (dBm)		
		Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)	Read Value (dBm)	Output Power (dBm)			
802.11n HT20	149/5745	17.25	17.48	17.98	18.21	18.10	18.33	16.67	16.90	23.79	25.98	PASS
	157/5785	16.95	17.18	17.95	18.18	17.85	18.08	16.55	16.78	23.62	25.98	PASS
	165/5825	17.06	17.29	17.68	17.91	17.42	17.65	16.41	16.64	23.42	25.98	PASS
802.11n HT40	151/5755	17.70	18.16	17.67	18.13	16.98	17.44	16.39	16.84	23.69	25.98	PASS
	159/5795	17.28	17.74	17.48	17.93	16.88	17.33	16.11	16.56	23.44	25.98	PASS
802.11ac HT20	149/5745	17.42	17.42	17.91	17.91	17.82	17.82	17.26	17.26	23.63	25.98	PASS
	157/5785	16.80	16.80	17.86	17.86	17.71	17.71	16.75	16.75	23.33	25.98	PASS
	165/5825	17.08	17.08	17.47	17.47	17.55	17.55	16.65	16.65	23.22	25.98	PASS
802.11ac HT40	151/5755	17.66	17.80	17.93	18.07	17.42	17.57	16.51	16.65	23.58	25.98	PASS
	159/5795	17.41	17.56	17.67	17.81	17.07	17.22	16.46	16.60	23.34	25.98	PASS
802.11ac HT80	155/5775	17.10	17.25	17.81	17.95	17.27	17.41	16.34	16.48	23.32	25.98	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),  
The Total Power =  $10\log(10^{(\text{Power antenna1 in dBm}/10)} + 10^{(\text{Power antenna2 in dBm}/10)} + 10^{(\text{Power antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$ .

2. The manufacturer declared the transmitter output signals is CDD mode And  $N_{ss}=1$ . according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e) (i), if all antennas have the same gain, directional gain =  $G_{ANT} + 10\log(N_{ANT}/N_{SS}) = 4 + 10\log(4/1) = 10.02 > 6$  dBi. So the power limit =  $30 - (\text{directional gain} - 6 \text{ dBi}) = 30 - (10.02 - 6) = 25.98$  dBm.

### 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 than 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  $k = 2$ ,  $U = 936\text{Hz}$

**Test Results**

Voltage (V)	Temperature (°C)	U-NII-1 Test Results			
		5200MHz			
		1min	2min	5min	10min
12	-20	5199.997502	5199.993261	5199.985059	5199.982938
12	-10	5200.001106	5199.987446	5199.980274	5199.976304
12	0	5200.000095	5199.985562	5199.970942	5199.968559
12	10	5199.996109	5199.983594	5199.965812	5199.959597
12	20	5199.990647	5199.97896	5199.956915	5199.950832
12	30	5199.989139	5199.973689	5199.952134	5199.949671
12	40	5199.984635	5199.966926	5199.947932	5199.948853
12	50	5199.975293	5199.962228	5199.941996	5199.947692
10.2	20	5199.969414	5199.956608	5199.940632	5199.943189
13.8	20	5199.968863	5199.955670	5199.939728	5199.938771
MHz		-0.031137219	-0.044329818	-0.060271583	-0.061228703
PPM		-5.987926693	-8.52496506	-11.59068908	-11.77475052

Voltage (V)	Temperature (°C)	U-NII-3 Test Results			
		5785MHz			
		1min	2min	5min	10min
12	-20	5784.996670	5784.990456	5784.981587	5784.976913
12	-10	5784.990582	5784.986245	5784.979691	5784.976098
12	0	5784.985479	5784.984671	5784.976149	5784.972778
12	10	5784.975511	5784.977206	5784.970385	5784.971088
12	20	5784.966127	5784.97056	5784.969733	5784.961242
12	30	5784.959831	5784.960746	5784.963615	5784.957180
12	40	5784.956327	5784.951477	5784.962077	5784.949226
12	50	5784.949497	5784.950640	5784.955850	5784.943344
10.2	20	5784.942953	5784.945890	5784.948871	5784.933513
13.8	20	5784.937890	5784.945689	5784.946467	5784.933238
MHz		-0.062110064	-0.054310829	-0.053533372	-0.066762293
PPM		-10.73639823	-9.388215892	-9.253823981	-11.54058654

### 5.4. Power Spectral Density

#### Ambient condition

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

#### Method of Measurement

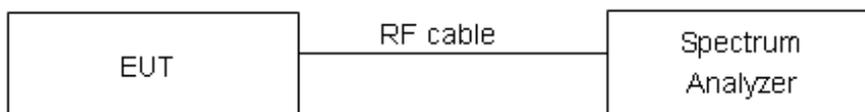
The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable.

Set RBW = 510 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.

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 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.

Frequency Bands/MHz	Limits
5150-5250	17MHz
5725-5850	30dBm/500kHz



## Measurement Uncertainty

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

**Test Results:****U-NII-1****MIMO without Beamforming**

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density									Limit (dBm/ MHz)	Conclusion
		Antenna 1		Antenna 2		Antenna 3		Antenna 4		Total Power (dBm /MHz)		
		Read Value (dBm/ MHz)	PSD (dBm/ MHz)	Read Value (dBm/ MHz)	PSD (dBm/ MHz)	Read Value (dBm/ MHz)	PSD (dBm/ MHz)	Read Value (dBm/ MHz)	PSD (dBm/ MHz)			
802.11a	36/5180	7.84	8.05	6.28	6.50	6.68	6.89	5.02	5.23	12.80	12.98	PASS
	40/5200	7.31	7.52	6.42	6.63	6.77	6.98	4.95	5.16	12.68	12.98	PASS
	48/5240	6.96	7.17	6.85	7.07	6.90	7.12	5.54	5.75	12.83	12.98	PASS
802.11n HT20	36/5180	7.36	7.58	6.24	6.47	6.76	6.98	5.95	6.18	12.86	12.98	PASS
	40/5200	6.13	6.36	5.08	5.31	5.34	5.57	4.21	4.44	11.49	12.98	PASS
	48/5240	5.96	6.19	5.66	5.89	5.87	6.10	6.16	6.39	12.16	12.98	PASS
802.11n HT40	38/5190	2.05	2.49	-0.91	-0.47	0.14	0.58	-0.40	0.04	6.83	12.98	PASS
	46/5230	5.21	5.65	5.39	5.83	6.28	6.72	5.90	6.34	12.17	12.98	PASS
802.11ac HT20	36/5180	6.17	6.17	6.26	6.26	7.16	7.16	6.55	6.55	12.57	12.98	PASS
	40/5200	5.97	5.97	5.40	5.40	5.03	5.03	3.71	3.71	11.13	12.98	PASS
	48/5240	6.17	6.17	6.32	6.32	6.46	6.46	4.64	4.64	11.97	12.98	PASS
802.11ac HT40	38/5190	2.01	2.14	-0.88	-0.76	-0.10	0.03	-0.41	-0.29	6.45	12.98	PASS
	46/5230	6.64	6.76	5.77	5.90	6.28	6.41	6.11	6.24	12.36	12.98	PASS
802.11ac HT80	42/5210	-0.194	-0.05	-2.64	-2.49	-2.34	-2.20	-2.61	-2.47	4.35	12.98	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= $10\log(10^{(\text{PSD antenna1 in dBm}/10)} + 10^{(\text{PSD antenna2 in dBm}/10)} + 10^{(\text{PSD antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$

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= $10\log(\text{Nant}/\text{Nss})\text{dB}$ ,so directional gain= $\text{GANT} + \text{Array Gain} = 4 + 10\log(4/1) = 10.02 > 6 \text{ dBi}$ . So the PSD limit is  $17 - (\text{directional gain} - 6 \text{ dBi}) = 17 - (10.02 - 6) = 12.98 \text{ dBm}$ .

**MIMO with Beamforming**

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density									Limit (dBm /MHz)	Conclusion
		ANT1		ANT2		ANT3		ANT 4		Total Power (dBm /MHz)		
		Read Value (dBm /MHz)	PSD (dBm /MHz)	Read Value (dBm /MHz)	PSD (dBm /MHz)	Read Value (dBm /MHz)	PSD (dBm /MHz)	Read Value (dBm /MHz)	PSD (dBm /MHz)			
802.11n HT20	36/5180	5.15	5.38	7.46	7.69	5.28	5.51	7.09	7.32	12.62	12.98	PASS
	40/5200	6.11	6.34	7.64	7.87	6.02	6.25	6.91	7.14	12.97	12.98	PASS
	48/5240	5.83	6.06	6.96	7.19	6.56	6.79	6.74	6.97	12.79	12.98	PASS
802.11n HT40	38/5190	-0.38	0.08	1.27	1.72	0.94	1.39	2.53	2.98	7.69	12.98	PASS
	46/5230	1.22	1.67	2.72	3.18	2.42	2.88	3.89	4.35	9.14	12.98	PASS
802.11ac HT20	36/5180	6.72	6.72	7.09	7.09	6.78	6.78	6.79	6.79	12.87	12.98	PASS
	40/5200	4.45	4.45	6.15	6.15	5.34	5.34	6.56	6.56	11.72	12.98	PASS
	48/5240	4.93	4.93	6.62	6.62	6.19	6.19	6.61	6.61	12.16	12.98	PASS
802.11ac HT40	38/5190	-0.27	-0.13	1.94	2.08	0.90	1.04	2.45	2.60	7.54	12.98	PASS
	46/5230	1.27	1.42	3.39	3.53	2.74	2.88	3.13	3.28	8.87	12.98	PASS
802.11ac HT80	42/5210	-2.311	-2.17	-0.24	-0.10	-0.78	-0.63	0.45	0.59	5.56	12.98	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= $10\log(10^{(PSD\ antenna1\ in\ dBm/10)}+10^{(PSD\ antenna2\ in\ dBm/10)}+10^{(PSD\ antenna3\ in\ dBm/10)}+10^{(PSD\ antenna4\ in\ dBm/10)})$

3. The manufacturer declared the transmitter output signals is CDD mode And  $N_{ss}=1$ . according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e) (i),if all antennas have the same gain, directional gain =  $G_{ANT} + 10\log(N_{ANT}/N_{SS})=4+10\log(4/1)=10.02>6\text{ dBi}$ . So the PSD limit is  $17-(\text{directional gain}-6\text{ dBi})=17-(10.02-6)=12.98\text{ dBm}$ .



## U-NII-3

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density									Limit (dBm/ 500kHz)	Conclusion
		Antenna 1		Antenna 2		Antenna 3		Antenna 4		Total Power (dBm/ 500kHz)		
		Read Value (dBm/ 500kHz)	PSD (dBm/ 500kHz)	Read Value (dBm/ 500kHz)	PSD (dBm/ 500kHz)	Read Value (dBm/ 500kHz)	PSD (dBm/ 500kHz)	Read Value (dBm/ 500kHz)	PSD (dBm/ 500kHz)			
802.11a	149/5745	8.34	8.55	7.40	7.61	7.51	7.73	6.36	6.57	13.69	25.98	PASS
	157/5785	8.03	8.25	7.44	7.65	7.62	7.83	6.83	7.04	13.73	25.98	PASS
	165/5825	7.30	7.51	7.07	7.28	8.07	8.28	6.58	6.80	13.52	25.98	PASS
802.11n HT20	149/5745	8.43	8.66	5.56	5.79	6.80	7.03	6.32	6.55	13.16	25.98	PASS
	157/5785	7.80	8.03	5.50	5.72	6.64	6.87	6.24	6.47	12.87	25.98	PASS
	165/5825	6.79	7.01	6.28	6.51	5.77	6.00	6.47	6.70	12.59	25.98	PASS
802.11n HT40	151/5755	4.42	4.86	2.79	3.22	3.21	3.65	3.10	3.54	9.88	25.98	PASS
	159/5795	3.88	4.31	2.70	3.14	2.37	2.81	3.18	3.62	9.53	25.98	PASS
802.11ac HT20	149/5745	7.71	7.71	6.10	6.10	6.62	6.62	6.76	6.76	12.86	25.98	PASS
	157/5785	7.59	7.59	5.86	5.86	6.51	6.51	6.90	6.90	12.78	25.98	PASS
	165/5825	6.63	6.63	5.76	5.76	5.92	5.92	6.28	6.28	12.18	25.98	PASS
802.11ac HT40	151/5755	5.20	5.32	2.63	2.75	3.21	3.33	3.32	3.44	9.85	25.98	PASS
	159/5795	3.97	4.10	2.15	2.27	2.72	2.84	2.83	2.96	9.12	25.98	PASS
802.11ac HT80	155/5775	1.43	1.57	-0.52	-0.38	0.24	0.39	0.06	0.20	6.53	25.98	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),  
The Total Power =  $10\log(10^{(\text{Power antenna1 in dBm}/10)} + 10^{(\text{Power antenna2 in dBm}/10)} + 10^{(\text{Power antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$ .

2. 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 =  $10\log(\text{Nant}/\text{Nss})\text{dB}$ , so directional gain = GANT + Array Gain =  $4 + 10\log(4/1) = 10.02 > 6\text{ dBi}$ . So the PSD limit is  $17 - (\text{directional gain} - 6\text{ dBi}) = 30 - (10.02 - 6) = 25.98\text{ dBm}$ .



**MIMO with Beamforming**

Network Standards	Channel/ Frequency (MHz)	Power Spectral Density										Limit (dBm/500kHz)	Conclusion
		ANT1		ANT2		ANT3		ANT 4		Total Power (dBm/500kHz)			
		Read Value (dBm/500kHz)	PSD (dBm/500kHz)										
U-NII-3	802.11n HT20	149/5745	1.06	1.29	2.27	2.50	2.02	2.25	1.25	1.48	7.93	25.98	PASS
		157/5785	1.99	2.22	3.15	3.38	2.98	3.21	2.53	2.76	8.94	25.98	PASS
		165/5825	1.75	1.98	3.12	3.35	2.79	3.02	3.04	3.27	8.96	25.98	PASS
	802.11n HT40	151/5755	-2.34	-1.89	-0.18	0.27	-0.81	-0.36	-0.17	0.28	5.68	25.98	PASS
		159/5795	-1.63	-1.17	-0.17	0.29	-1.12	-0.66	0.47	0.92	5.94	25.98	PASS
	802.11ac HT20	149/5745	0.41	0.41	2.34	2.34	2.37	2.37	1.95	1.95	7.86	25.98	PASS
		157/5785	1.83	1.83	3.38	3.38	2.88	2.88	2.78	2.78	8.77	25.98	PASS
		165/5825	2.22	2.22	3.33	3.33	2.61	2.61	2.65	2.65	8.74	25.98	PASS
	802.11ac HT40	151/5755	-1.27	-1.12	-0.08	0.06	-0.08	0.06	0.43	0.58	5.96	25.98	PASS
		159/5795	-1.05	-0.91	0.35	0.49	-0.56	-0.42	0.15	0.29	5.92	25.98	PASS
	802.11ac HT80	155/5775	-4.16	-4.01	-4.35	-4.20	-3.70	-3.55	-3.25	-3.10	2.32	25.98	PASS

Note: 1. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),  
The Total Power =  $10\log(10^{(\text{Power antenna1 in dBm}/10)} + 10^{(\text{Power antenna2 in dBm}/10)} + 10^{(\text{Power antenna3 in dBm}/10)} + 10^{(\text{PSD antenna4 in dBm}/10)})$ .

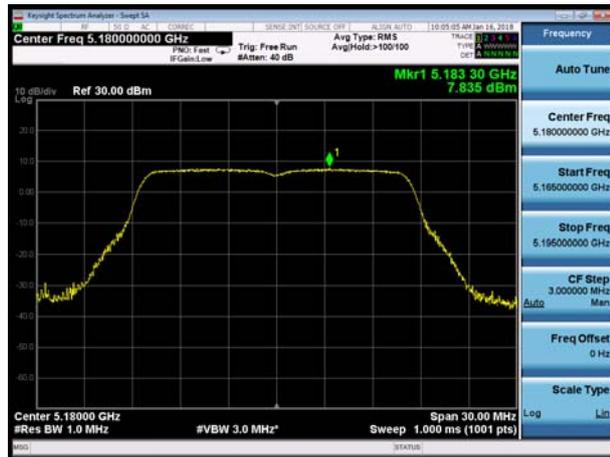
2. The manufacturer declared the transmitter output signals is CDD mode And  $N_{ss}=1$ . according to KDB662911 D01 Multiple Transmitter Output v02r01 F) 2) e) (i), If all antennas have the same gain, directional gain =  $G_{ANT} + 10\log(N_{ANT}/N_{SS}) = 4 + 10\log(4/1) = 10.02 > 6$  dBi. So the PSD limit is  $17 - (\text{directional gain} - 6 \text{ dBi}) = 30 - (10.02 - 6) = 25.98$  dBm.



# MIMO without Beamforming

## Antenna 1

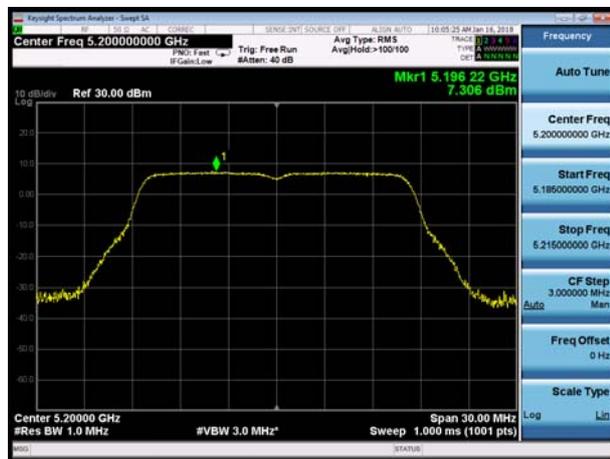
U-NII-1, 802.11a, Channel No.: 36



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



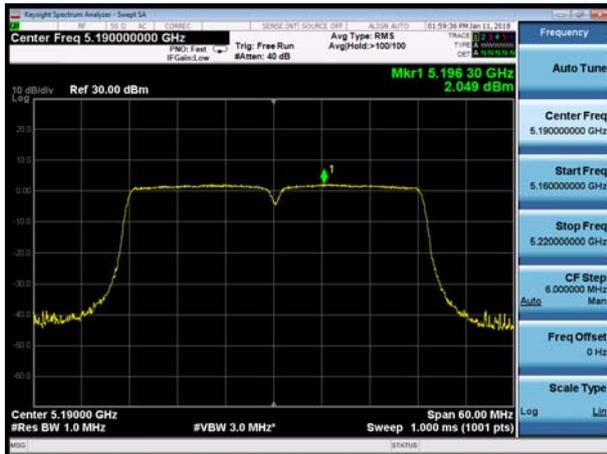
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U-NII-1, 802.11n HT20, Channel No.: 48



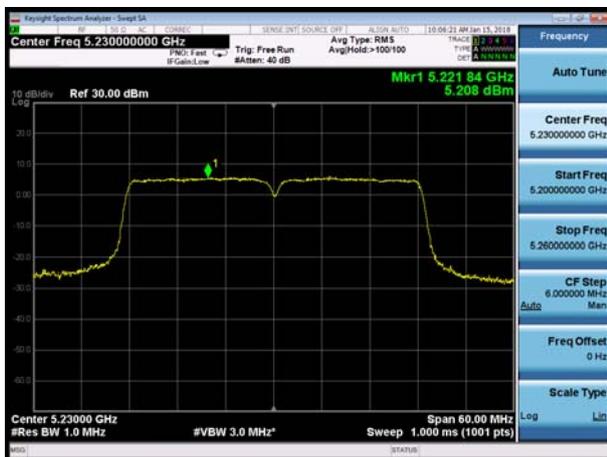
U-NII-1, 802.11n HT40, Channel No.: 38



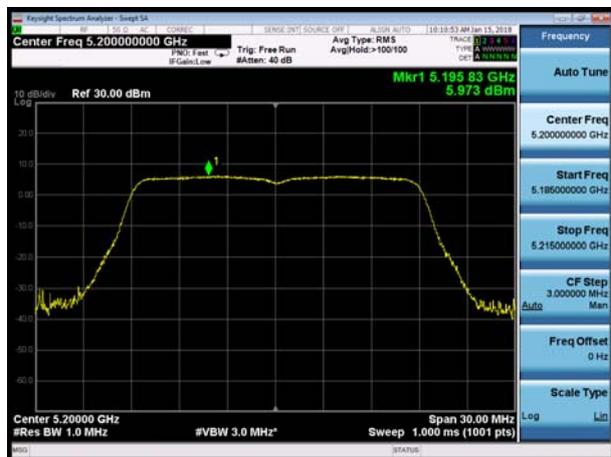
U-NII-1, 802.11ac HT20, Channel No.: 36



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



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



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

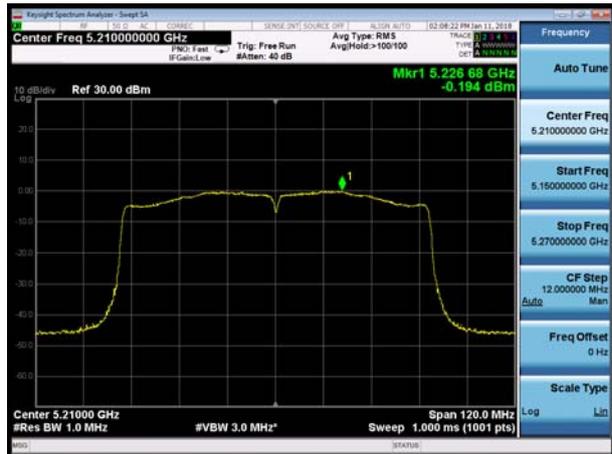




U-NII-1, 802.11ac HT40, Channel No.: 38



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



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





Antenna 2

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



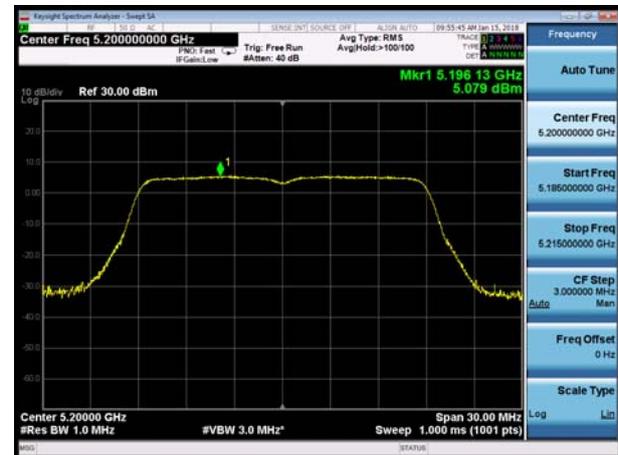
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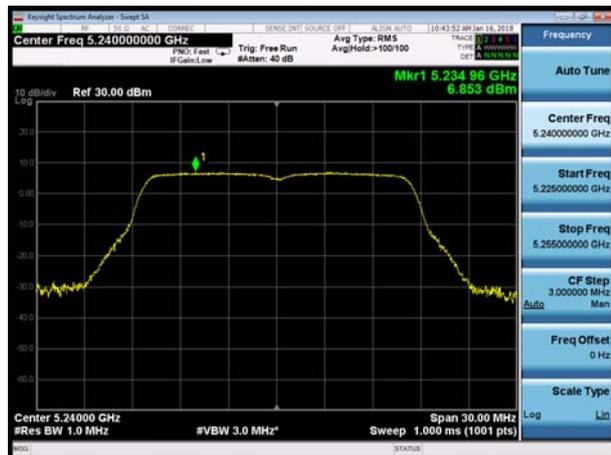
U-NII-1, 802.11a, Channel No.: 40



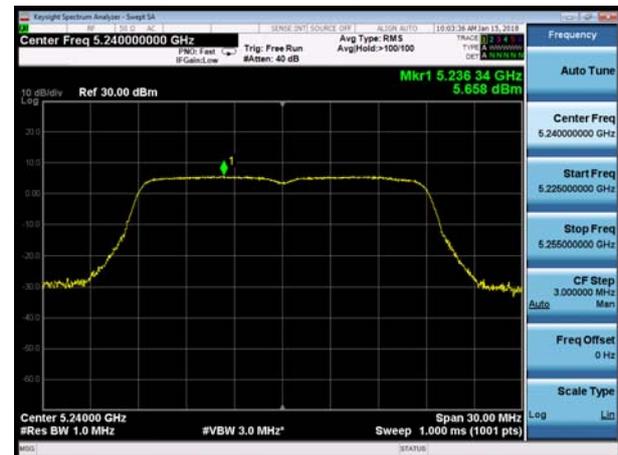
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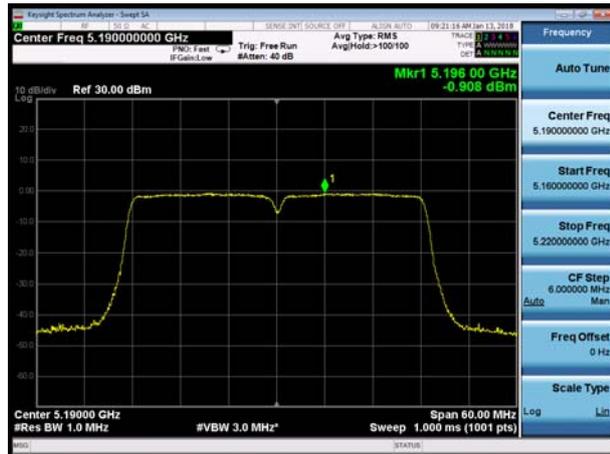
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U-NII-1, 802.11n HT20, Channel No.: 48



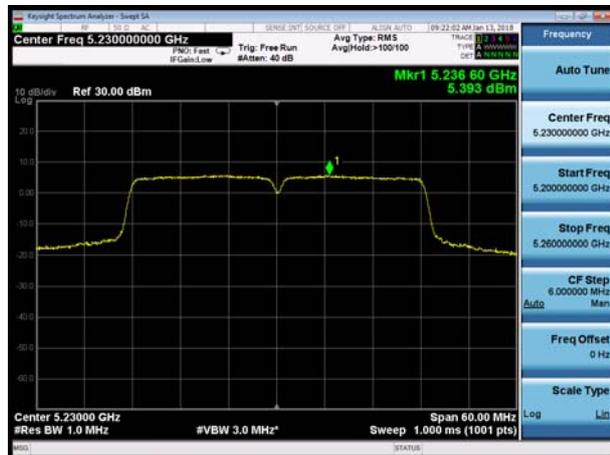
U-NII-1, 802.11n HT40, Channel No.: 38



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

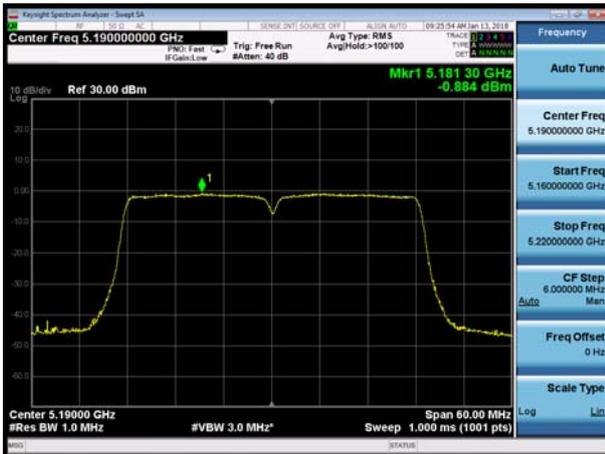


U-NII-1, 802.11ac HT20, Channel No.: 48





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



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



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



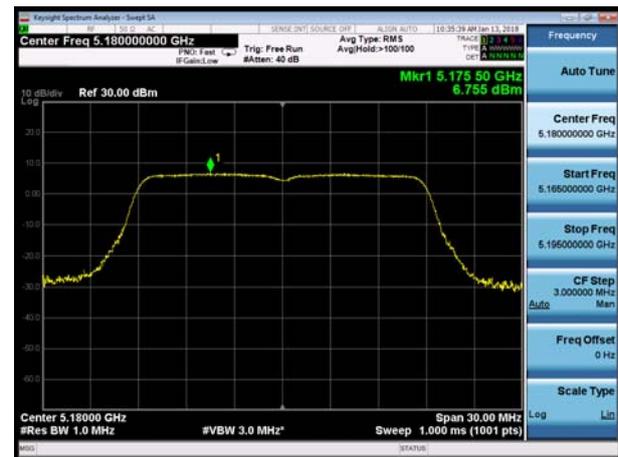


Antenna 3

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



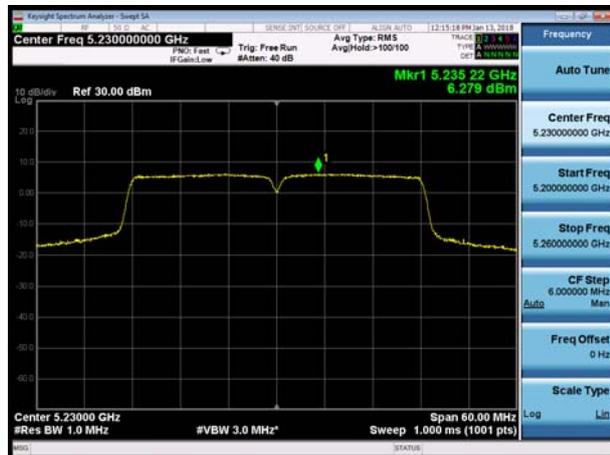
U-NII-1, 802.11n HT40, Channel No.: 38



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



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



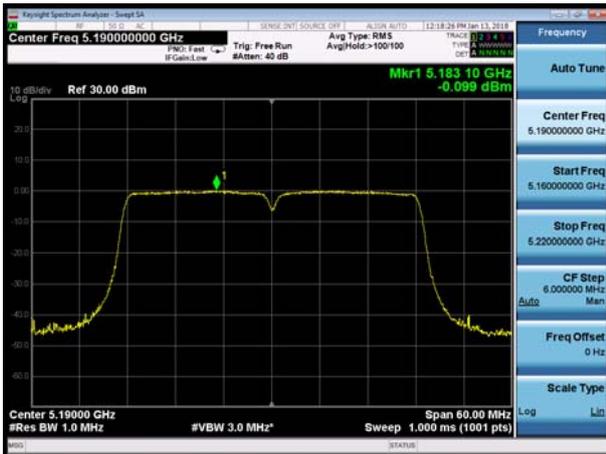
U-NII-1, 802.11ac HT20, Channel No.: 40



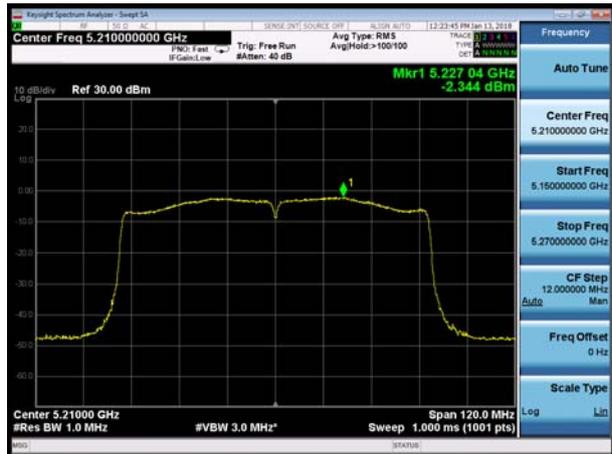
U-NII-1, 802.11ac HT20, Channel No.: 48



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



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



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





Antenna 4

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



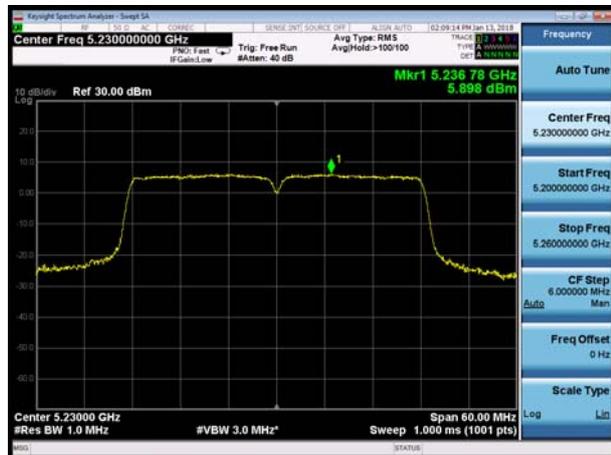
U-NII-1, 802.11n HT40, Channel No.: 38



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



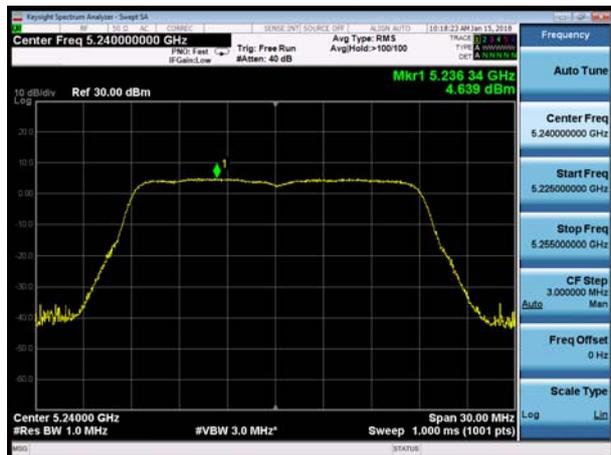
U-NII-1, 802.11n HT40, Channel No.: 46



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

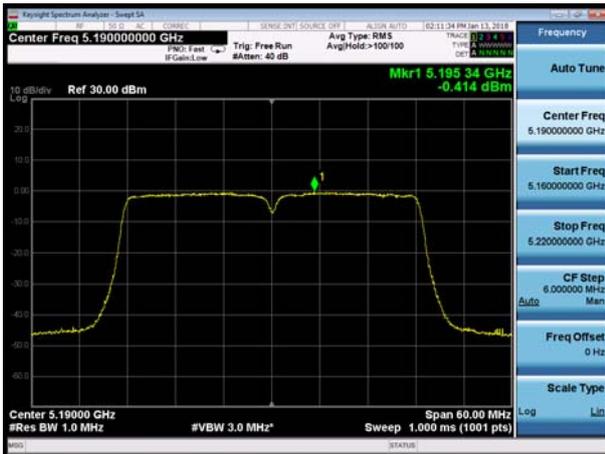


U-NII-1, 802.11ac HT20, Channel No.: 48





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



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



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

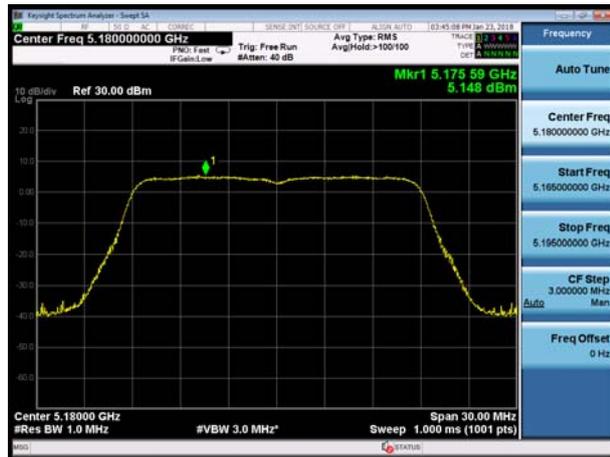




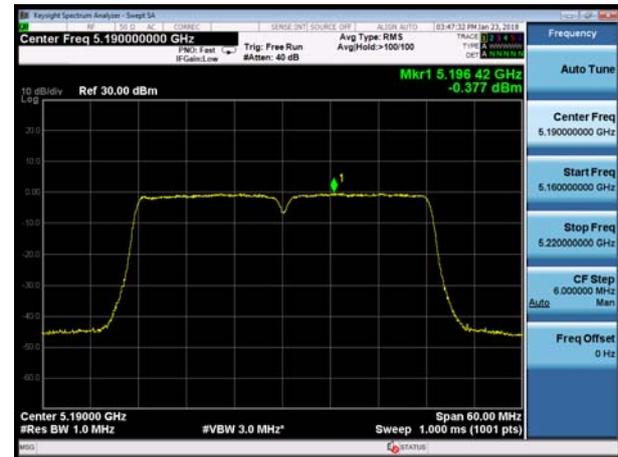
# MIMO with Beamforming

## Antenna 1

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



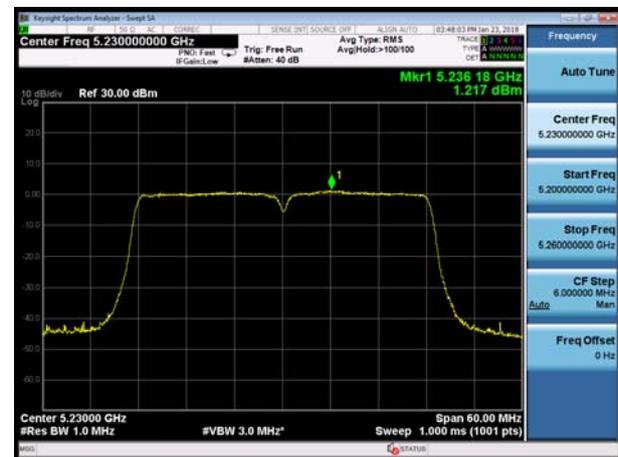
U-NII-1, 802.11n HT40, Channel No.: 38



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



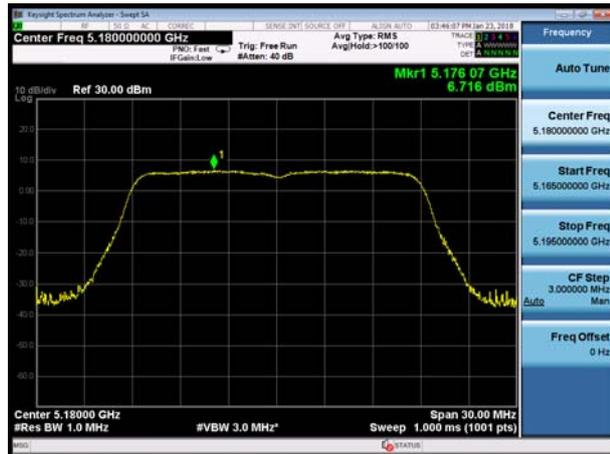
U-NII-1, 802.11n HT40, Channel No.: 46



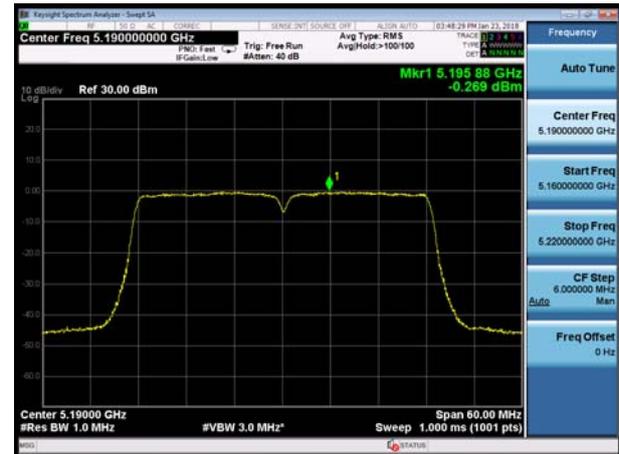
U-NII-1, 802.11n HT20, Channel No.: 48



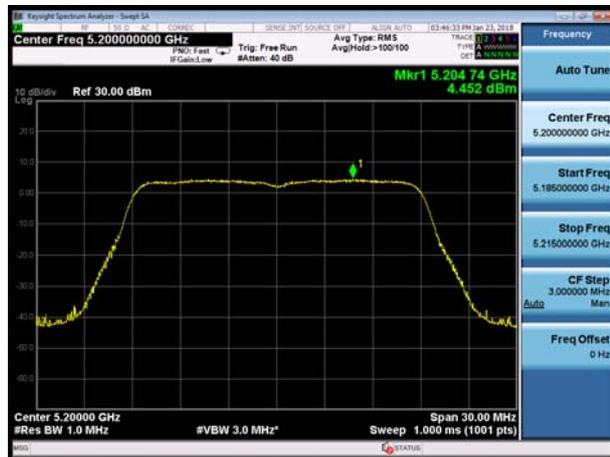
U-NII-1, 802.11ac HT20, Channel No.: 36



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



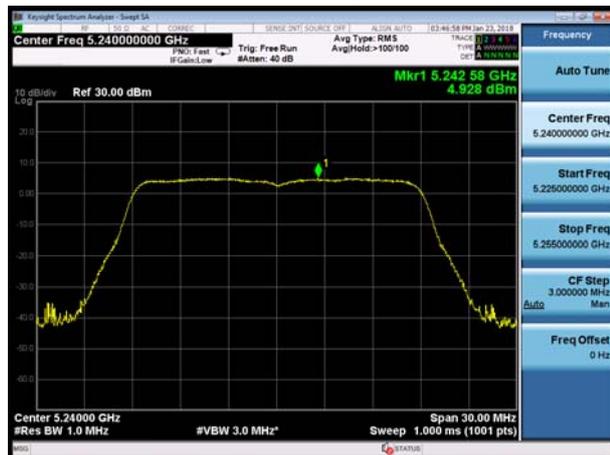
U-NII-1, 802.11ac HT20, Channel No.: 40



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



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



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

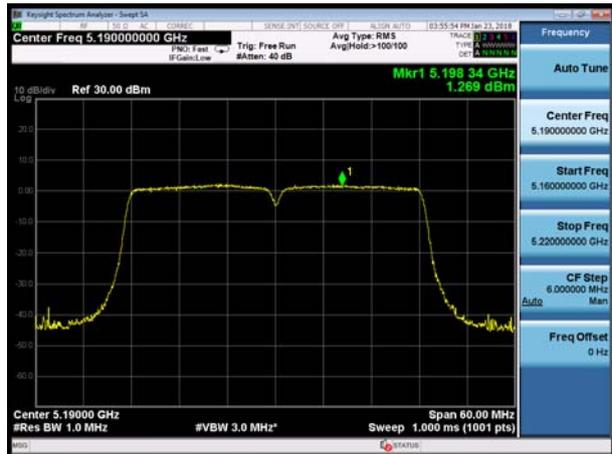


Antenna 2

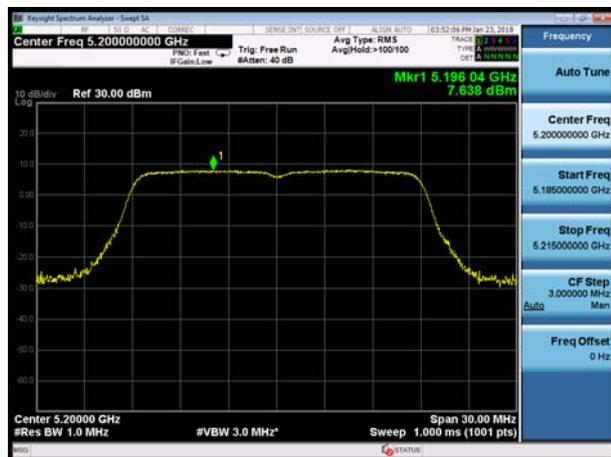
U-NII-1, 802.11n HT20, Channel No.: 36



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



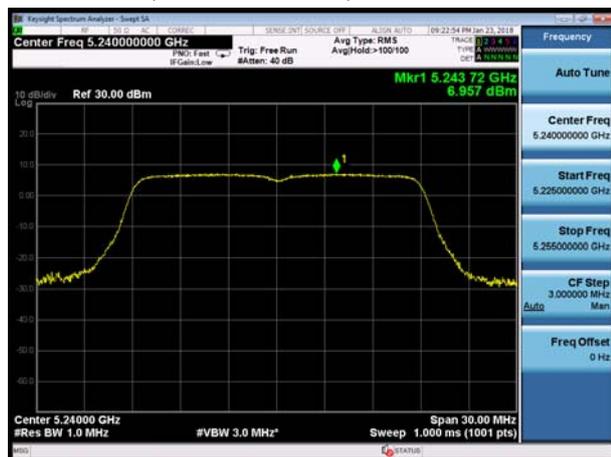
U-NII-1, 802.11n HT20, Channel No.: 40



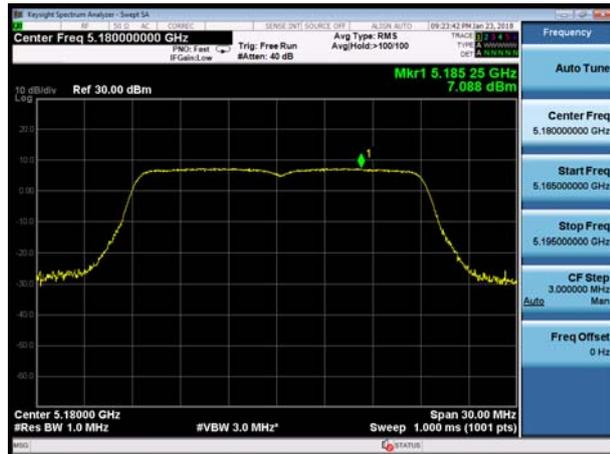
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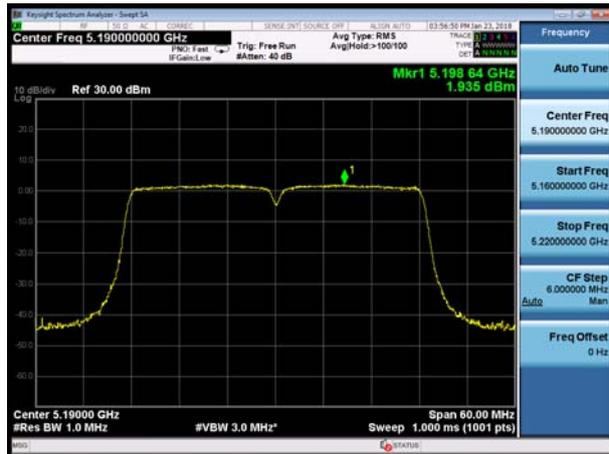
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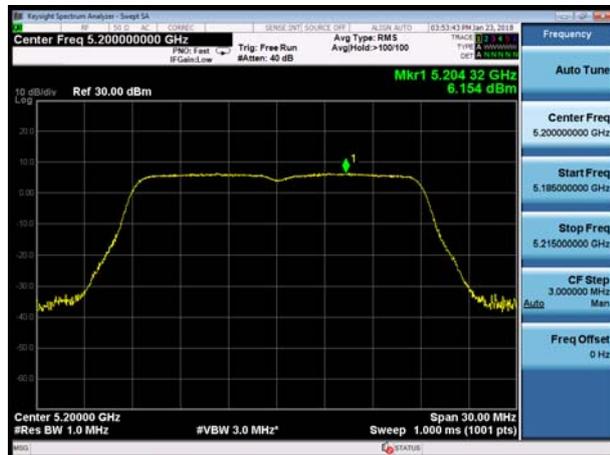
U-NII-1, 802.11ac HT20, Channel No.: 36



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



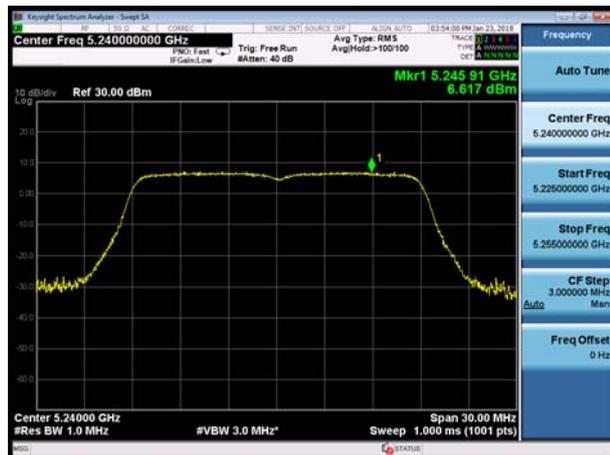
U-NII-1, 802.11ac HT20, Channel No.: 40



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



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



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

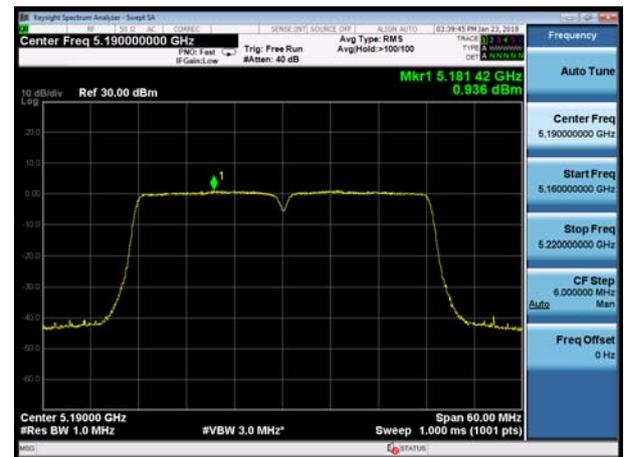


Antenna 3

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



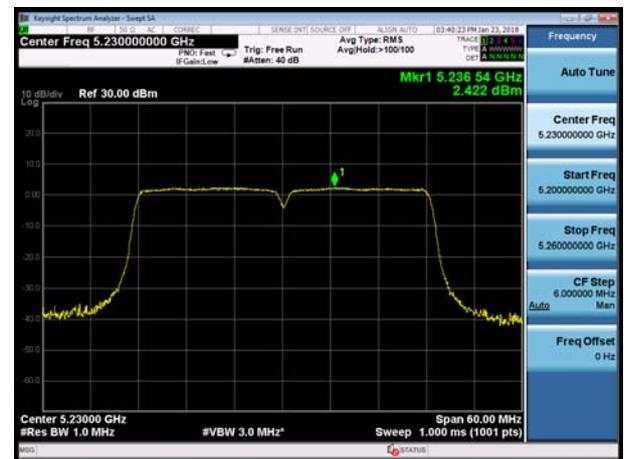
U-NII-1, 802.11n HT40, Channel No.: 38



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



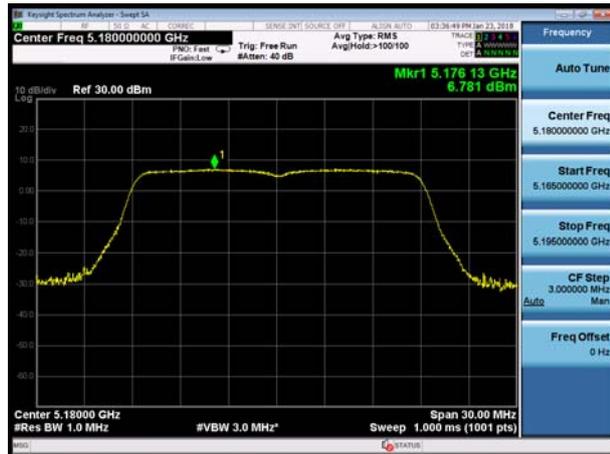
U-NII-1, 802.11n HT40, Channel No.: 46



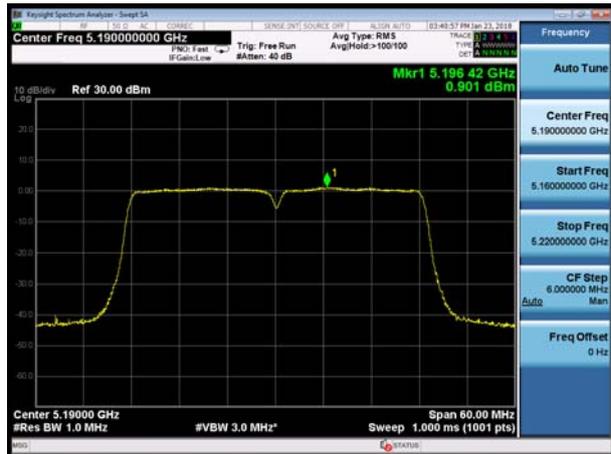
U-NII-1, 802.11n HT20, Channel No.: 48



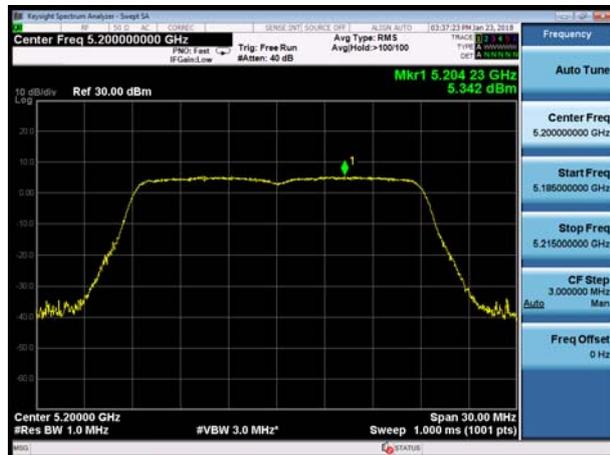
U-NII-1, 802.11ac HT20, Channel No.: 36



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



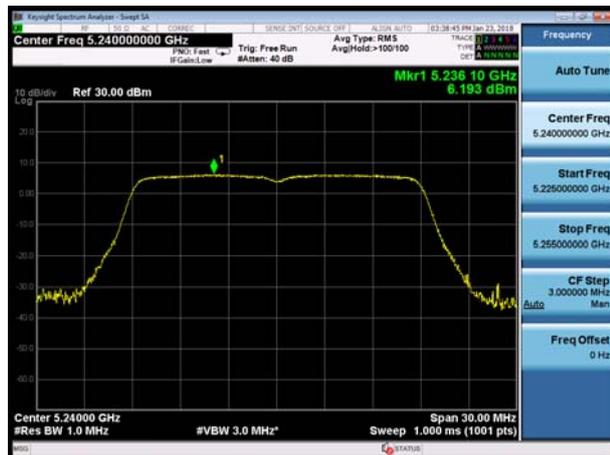
U-NII-1, 802.11ac HT20, Channel No.: 40



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



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



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



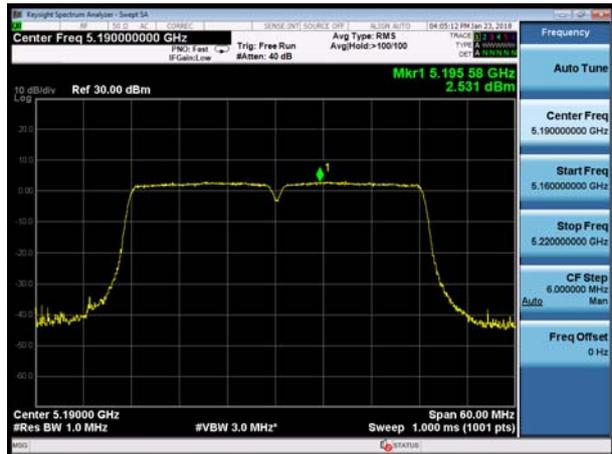


Antenna 4

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



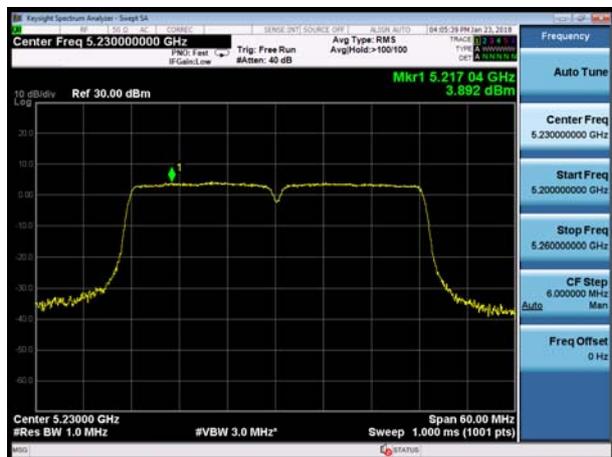
U-NII-1, 802.11n HT40, Channel No.: 38



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



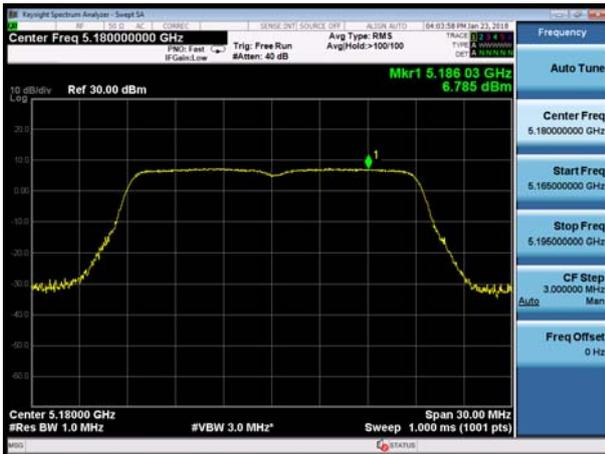
U-NII-1, 802.11n HT40, Channel No.: 46



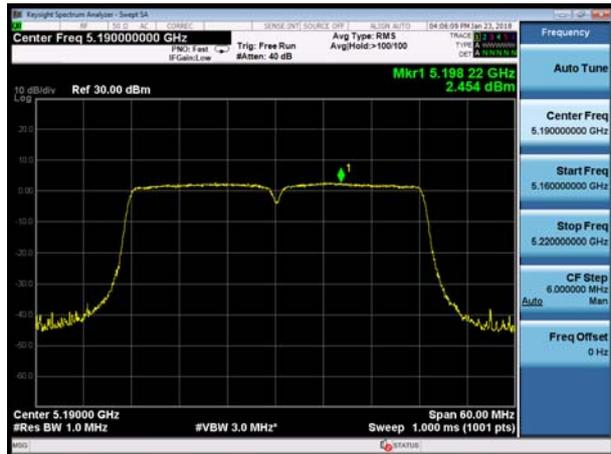
U-NII-1, 802.11n HT20, Channel No.: 48



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



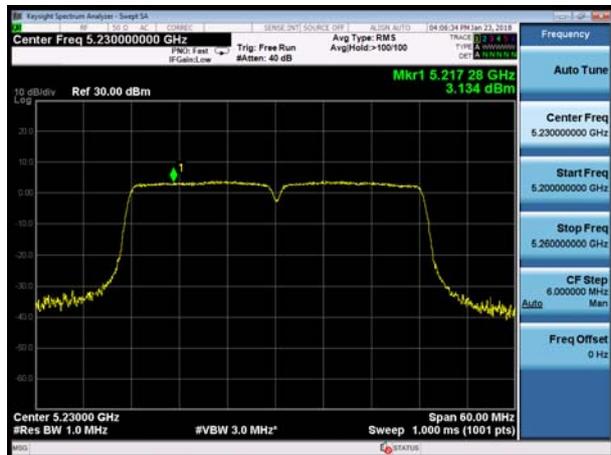
U-NII-1, 802.11ac HT40, Channel No.: 38



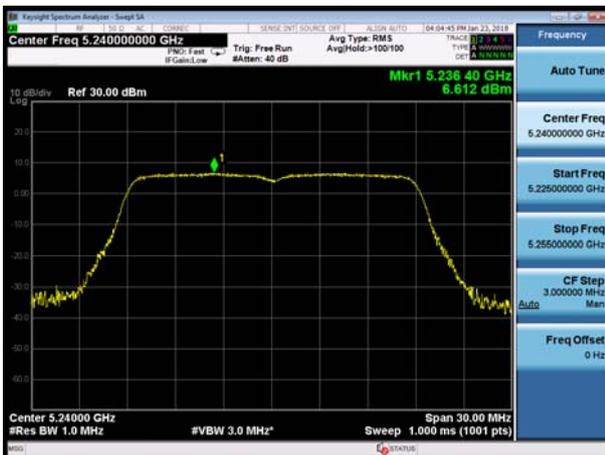
U-NII-1, 802.11ac HT20, Channel No.: 40



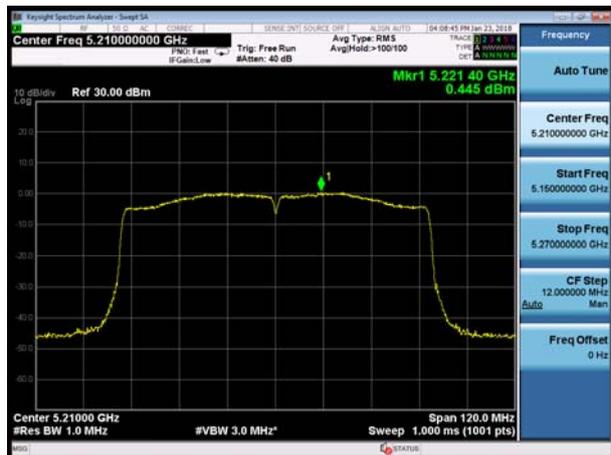
U-NII-1, 802.11ac HT40, Channel No.: 46



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



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





### MIMO without Beamforming

### Antenna 1

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

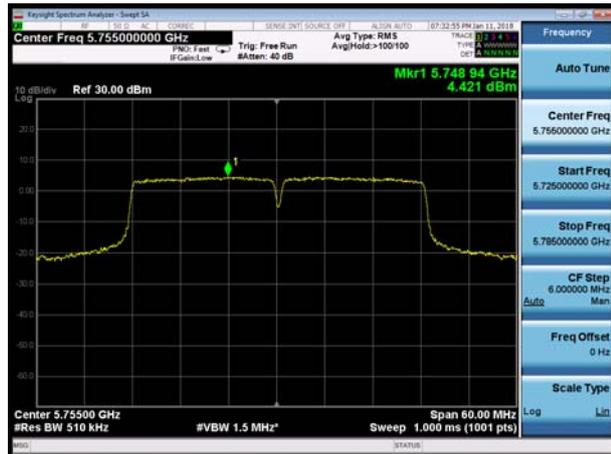


U-NII-3, 802.11n HT20, Channel No.: 165

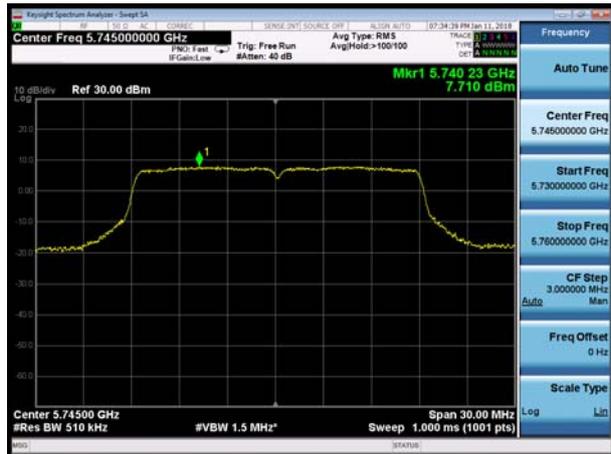




U-NII-3, 802.11n HT40, Channel No.: 151



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

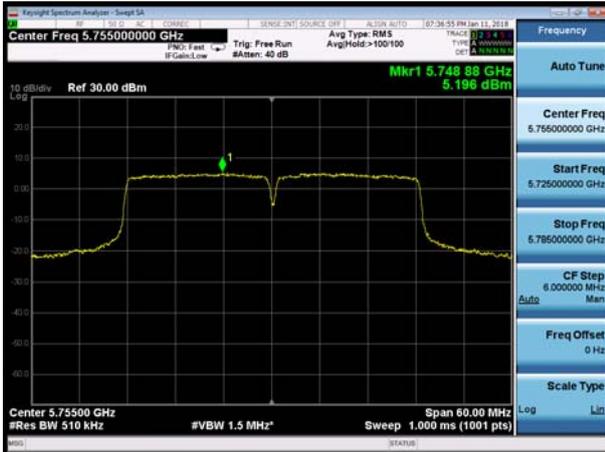


U-NII-3, 802.11ac HT20, Channel No.: 165





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



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



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





Antenna 2

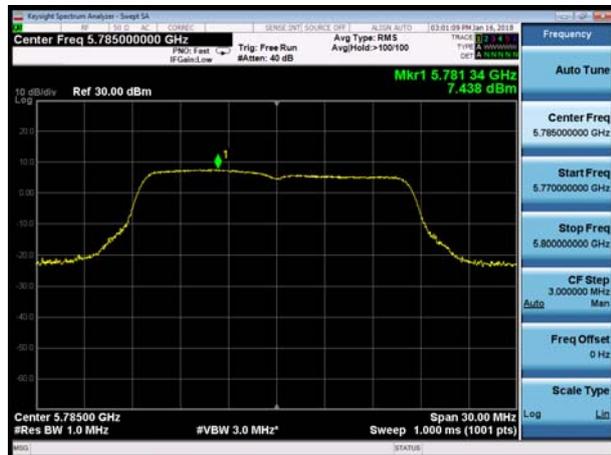
U-NII-3, 802.11a, Channel No.: 149



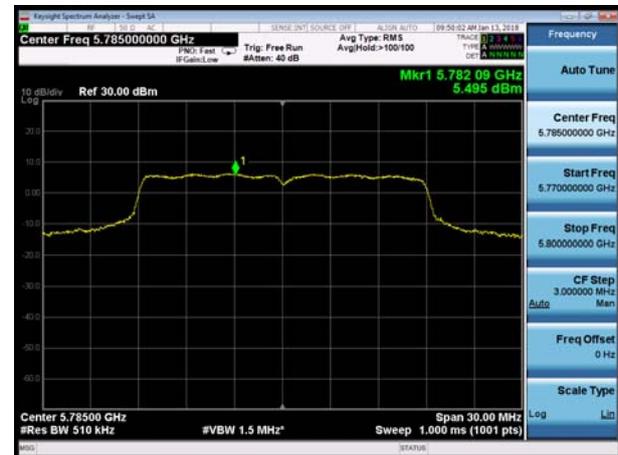
U-NII-3, 802.11n HT20, Channel No.: 149



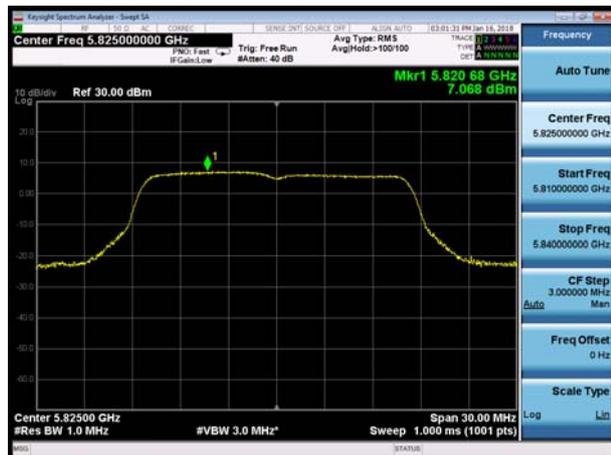
U-NII-3, 802.11a, Channel No.: 157



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

