

FCC UNII REPORT

FCC Certification

Applicant Name:
KAONMEDIA Co., Ltd.

Date of Issue:
May 14, 2018

Test Site/Location:

HCT CO., LTD., 74,Seoicheon-ro 578beon-gil,Majang-myeo,Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Address:
KAONMEDIA Building, 884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea

Report No.: HCT-RF-1804-FC050-R3

FCC ID : WQTVM3000G

APPLICANT : KAONMEDIA Co., Ltd.

Model: VM3000G

EUT Type: Layer3 TV

Modulation type OFDM

FCC Classification: Unlicensed National Information Infrastructure(UNII)

FCC Rule Part(s): Part 15.407

Band	Mode	Channel Bandwidth (MHz)	Frequency Range (MHz)	Ant.0 Power (dBm)	Ant.1 Power (dBm)	Ant.2 Power (dBm)	Ant.3 Power (dBm)	Ant. 0 & 1 & 2 & 3 Power (dBm)
UNII1	802.11a	20	5180 – 5240	17.04	16.80	16.62	18.16	23.19
	802.11n	20	5180 – 5240	16.88	16.53	17.37	17.98	23.23
	802.11n	40	5190 - 5230	8.78	8.89	9.13	11.06	15.54
	802.11ac	20	5180 – 5240	16.63	16.06	17.04	17.72	22.90
	802.11ac	40	5190 - 5230	8.92	9.34	9.60	11.16	15.82
	802.11ac	80	5210	9.82	8.77	9.87	12.23	16.28
UNII2A	802.11a	20	5260 – 5320	14.96	15.01	14.69	15.62	21.10
	802.11n	20	5260 – 5320	15.00	14.91	15.25	15.75	21.15
	802.11n	40	5270 – 5310	9.79	10.57	10.42	12.11	16.72
	802.11ac	20	5260 – 5320	15.27	14.82	15.58	16.17	21.49
	802.11ac	40	5270 – 5310	10.46	10.76	10.66	12.05	17.00
	802.11ac	80	5290	10.30	9.81	10.60	12.71	16.95
UNII2C	802.11a	20	5500 – 5720	13.33	15.21	13.59	14.11	20.04
	802.11n	20	5500 – 5720	13.20	15.10	13.95	13.88	20.07
	802.11n	40	5510 – 5710	13.71	15.58	14.18	14.69	20.52
	802.11ac	20	5500 – 5720	13.03	15.10	13.98	14.03	20.09
	802.11ac	40	5510 – 5710	14.55	15.81	14.70	14.71	20.87
	802.11ac	80	5530 – 5690	13.15	14.51	14.06	14.43	20.07
UNII3	802.11a	20	5745 – 5825	15.34	15.08	14.98	15.44	21.23
	802.11n	20	5745 – 5825	15.73	15.65	15.42	15.72	21.65
	802.11n	40	5755 – 5795	13.67	13.84	13.22	13.84	19.66
	802.11ac	20	5745 – 5825	15.19	15.47	15.59	15.60	21.48
	802.11ac	40	5755 – 5795	13.99	14.25	13.70	14.24	20.07
	802.11ac	80	5775	13.44	13.54	13.50	13.55	19.53

Mode	Channel Bandwidth (MHz)	Frequency Range (MHz)	Ant.0 + Ant.2 Power (dBm)	Ant.1 + Ant.3 Power (dBm)	Ant. 0 & 1 & 2 & 3 Power (dBm)
802.11ac	160	5210 + 5290	9.39	11.16	15.39
802.11ac	160	5530 + 5610	9.41	11.02	15.88

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C.853(a)



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Approved by : Jong Seok Lee
Manager of Telecommunication testing center

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1804-FC050	April 24, 2018	- First Approval Report
HCT-RF-1804-FC050-R1	May 02, 2018	- Added the PSD Antenna Gain calculations on Page 9 - Revised the limit calculations Output Power and PSD of straddle
HCT-RF-1804-FC050-R2	May 11, 2018	- Revised the Transmit Power Control section. - Revised the Directional Gain on page 9. - Revised the Output Power Limit on page 102.
HCT-RF-1804-FC050-R3	May 14, 2018	- Revised the Directional Gain on page 9 and 10

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1. GENERAL INFORMATION

Applicant: KAONMEDIA Co., Ltd.
Address: KAONMEDIA Building, 884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
FCC ID: WQTVM3000G
EUT Type: Layer3 TV
Model: VM3000G
Date(s) of Tests: February 22, 2018 ~ April 18, 2018
Place of Tests: HCT Co., Ltd.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea

2. EUT DESCRIPTION

Model	VM3000G	
EUT Type	Layer3 TV	
Power Supply	DC 12 V	
Frequency Range	TX_20 MHz BW:	5180 MHz - 5240 MHz (UNII 1) / 5260 MHz - 5320 MHz (UNII 2A) / 5500 MHz - 5720 MHz (UNII 2C) / 5745 MHz - 5825 MHz (UNII 3)
	40 MHz BW:	5190 MHz - 5230 MHz (UNII 1) / 5270 MHz - 5310 MHz (UNII 2A) / 5510 MHz - 5710 MHz (UNII 2C) / 5755 MHz - 5795 MHz (UNII 3)
	80 MHz BW:	5210 MHz (UNII 1) / 5290 MHz (UNII 2A) / 5530 - 5690 MHz (UNII 2C) / 5775 MHz (UNII 3)
	160 MHz BW:	5210MHz + 5290MHz / 5530MHz + 5610MHz
	RX_20 MHz BW:	5180 MHz - 5240 MHz (UNII 1) / 5260 MHz - 5320 MHz (UNII 2A) / 5500 MHz - 5720 MHz (UNII 2C) / 5745 MHz - 5825 MHz (UNII 3)
	40 MHz BW:	5190 MHz - 5230 MHz (UNII 1) / 5270 MHz - 5310 MHz (UNII 2A) / 5510 MHz - 5710 MHz (UNII 2C) / 5755 MHz - 5795 MHz (UNII 3)
	80 MHz BW:	5210 MHz (UNII 1) / 5290 MHz (UNII 2A) / 5530 - 5690 MHz (UNII 2C) / 5775 MHz (UNII 3)
	160 MHz BW:	5210MHz + 5290MHz / 5530MHz + 5610MHz
Modulation Type	OFDM(802.11a, 802.11n, 802.11ac)	
Antenna Specification	Antenna type: PCB Antenna	
	Peak Gain : cf. Section 6	

2.1 EUT OPERATING MODE

■ Operating mode

Mode	Operating Mode	Operating Ant.
802.11a/n/ac	SISO	Ant 0
		Ant 1
		Ant 2
		Ant 3
	MIMO(CDD)	Ant 0 & 1 & 2 & 3

Note : In case of radiation test, we have done all test case. Worst case is MIMO (Ant 0 & 1 & 2 & 3).

3. TEST METHODOLOGY

The measurement procedure described in FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled “ Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part15, Subpart E” and ANSI C63.10 (Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’ were used in the measurement.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 8.1 to 8.4.(KDB 789033 D02 v02r01)

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2006).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203, §15.407

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- * The antennas of this E.U.T are permanently attached.
- * The E.U.T Complies with the requirement of §15.203, §15.407

▣ Directional Gain Calculations

- According to KDB662911 D01 Multiple Transmitter Output v02r01;

Cyclic Delay Diversity ($N_{ANT}=2, 3, 4$ / $N_{ss}=1$)

If all antennas have the same gain, G_{ANT}

- Directional gain(dBi) = G_{ANT} + Array Gain
- Array Gain(PSD) = $10 \log(N_{ANT}/N_{ss})$ dB.
- Array Gain(Power) = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$ (Without Beamforming)
- Array Gain(Power) = $10 \log(N_{ANT}/N_{ss})$ dB (Include Beamforming).

Spatial Multiplexing ($N_{ANT}=2, 3, 4$ / $N_{ss}=2, 3, 4$)

If all antennas have the same gain, G_{ANT}

- Directional gain(dBi) = G_{ANT} + Array Gain
- Array Gain = $10 \log(N_{ANT}/N_{ss})$ dB.

■ **Directional Gain**

Mode	Test Description	N_{ANT}/N_{SS}	Array Gain Calculation (dB)	Directional Gain (= $G_{ANT} + \text{Array Gain}$) (dBi)
Cyclic Delay Diversity	Power (Include Beamforming)	2 / 1	$10 \log(N_{ANT}/N_{SS})$	5.01
	Power (Without Beamforming)	2 / 1	0	2.00
	PSD	2 / 1	$10 \log(N_{ANT}/N_{SS})$	5.01
	Power (Include Beamforming)	3 / 1	$10 \log(N_{ANT}/N_{SS})$	6.77
	Power (Without Beamforming)	3 / 1	0	2.00
	PSD	3 / 1	$10 \log(N_{ANT}/N_{SS})$	6.77
	Power (Include Beamforming)	4 / 1	$10 \log(N_{ANT}/N_{SS})$	8.02
	Power (Without Beamforming)	4 / 1	0	2.00
	PSD	4 / 1	$10 \log(N_{ANT}/N_{SS})$	8.02
Spatial Multiplexing	Power, PSD	2 / 2	$10 \log(N_{ANT}/N_{SS})$	2.00
	Power, PSD	3 / 2	$10 \log(N_{ANT}/N_{SS})$	3.76
	Power, PSD	3 / 3	$10 \log(N_{ANT}/N_{SS})$	2.00
	Power, PSD	4 / 2	$10 \log(N_{ANT}/N_{SS})$	5.01
	Power, PSD	4 / 3	$10 \log(N_{ANT}/N_{SS})$	3.25
	Power, PSD	4 / 4	$10 \log(N_{ANT}/N_{SS})$	2.00

Note:

1. Antenna Gain(dBi) = 2 dBi.
2. All antennas have the same gain.
3. Beamforming is only supported 802.11ac.
4. All modes of operation were investigated and the worst case configuration results are reported in report.
(Worst case : Cyclic Delay Diversity($N_{ANT}=4$, $N_{SS}=1$, Include Beamforming))

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Parameter	Expanded Uncertainty ($\pm$ dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70

8. SUMMARY OF TEST RESULTS

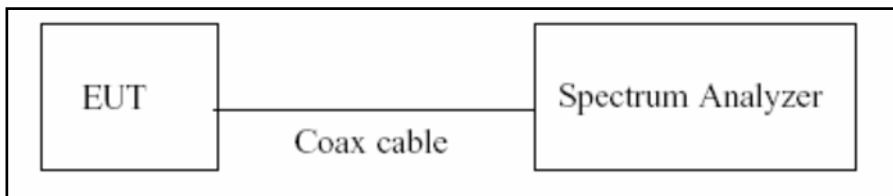
Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
26dB Bandwidth	§15.407 (for Power Measurement)	N/A	CONDUCTED	PASS
6 dB Bandwidth	§15.407(e)	>500 kHz (5725-5850 MHz)		PASS
Maximum Conducted Output Power	§15.407(a)	< 1 W (5150-5250 MHz) < 250 mW or 11+10 log log ₁₀ (BW) dBm (5250-5350 MHz) < 250 mW or 11+10 log log ₁₀ (BW) dBm (5470-5725 MHz) <1 W (5725-5850 MHz)		PASS
Peak Power Spectral Density	§15.407(a)	<17 dBm/ MHz (5150-5250 MHz) <11 dBm/ MHz (5250-5350 MHz) <11 dBm/ MHz (5470-5725 MHz) <30 dBm/500 kHz(5725-5850 MHz)		PASS
Frequency Stability	§15.407(g)	NA		PASS
AC Conducted Emissions 150 kHz-30 MHz	15.207	<FCC 15.207 limits		PASS
Undesirable Emissions	§15.407(b)	<-27 dBm/MHz EIRP (UNII1, 2A, 2C) <-17 dBm/MHz EIRP within 5715-5725 MHz and 5850-5860 MHz (UNII3) <-27 dBm/MHz EIRP outside 5715-5860 MHz (UNII 3)	RADIATED	PASS
General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	15.205, 15.407(b)(5), (6)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		PASS

9. TEST RESULT

9.1 DUTY CYCLE

The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set $RBW \geq EBW$ if possible; otherwise, set RBW to the largest available value. Set $VBW \geq RBW$. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$, where T is defined in section B)1)a), and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

■ TEST CONFIGURATION



■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, (B.2 in KDB 789033 D02 v02r01)

The largest available value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if $T \leq 6.25$ microseconds. ($50/6.25 = 8$)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are $> 50/T$.

1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz ($\geq$ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10 \cdot \log(1/\text{Duty Cycle})$

■ **Duty Cycle Factor**

Mode	Data Rate (Mbps)	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11a	6	2.064	0.108	95.028	0.222
	9	1.385	0.071	95.124	0.217
	12	1.044	0.052	95.255	0.211
	18	0.705	0.035	95.270	0.210
	24	0.533	0.027	95.179	0.215
	36	0.364	0.024	93.814	0.277
	48	0.277	0.024	92.027	0.361
	54	0.249	0.024	91.209	0.400
Mode	MCS INDEX	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11n_HT20	MCS 0	1.921	0.099	95.099	0.218
	MCS 1	0.981	0.049	95.243	0.212
	MCS 2	0.664	0.034	95.129	0.217
	MCS 3	0.508	0.025	95.310	0.209
	MCS 4	0.352	0.025	93.369	0.298
	MCS 5	0.272	0.025	91.582	0.382
	MCS 6	0.248	0.024	91.176	0.401
	MCS 7	0.229	0.024	90.514	0.433
802.11n_HT40	MCS 0	0.945	0.099	90.517	0.433
	MCS 1	0.492	0.049	90.943	0.412
	MCS 2	0.340	0.034	90.909	0.414
	MCS 3	0.264	0.025	91.349	0.393
	MCS 4	0.188	0.024	88.679	0.522
	MCS 5	0.153	0.024	86.441	0.633
	MCS 6	0.140	0.024	85.366	0.687
	MCS 7	0.128	0.025	83.660	0.775

Mode	MCS INDEX	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11ac_VHT20	MCS 0	1.928	0.029	98.518	0.065
	MCS 1	0.985	0.029	97.140	0.126
	MCS 2	0.672	0.029	95.863	0.183
	MCS 3	0.512	0.029	94.640	0.239
	MCS 4	0.356	0.029	92.468	0.340
	MCS 5	0.277	0.029	90.523	0.432
	MCS 6	0.252	0.029	89.680	0.473
	MCS 7	0.233	0.029	88.931	0.509
	MCS 8	0.200	0.029	87.336	0.588
802.11ac_VHT40	MCS 0	0.952	0.029	97.044	0.130
	MCS 1	0.497	0.029	94.487	0.246
	MCS 2	0.344	0.029	92.225	0.352
	MCS 3	0.268	0.029	90.236	0.446
	MCS 4	0.192	0.029	86.878	0.611
	MCS 5	0.157	0.029	84.409	0.736
	MCS 6	0.144	0.029	83.237	0.797
	MCS 7	0.133	0.029	82.099	0.857
	MCS 8	0.116	0.029	80.000	0.969
	MCS 9	0.113	0.029	79.577	0.992
802.11ac_VHT80	MCS 0	0.461	0.029	94.082	0.265
	MCS 1	0.252	0.029	89.680	0.473
	MCS 2	0.181	0.029	86.190	0.645
	MCS 3	0.149	0.029	83.708	0.772
	MCS 4	0.113	0.029	79.577	0.992
	MCS 5	0.097	0.029	76.984	1.136
	MCS 6	0.088	0.029	75.214	1.237
	MCS 7	0.084	0.029	74.336	1.288
	MCS 8	0.077	0.029	72.642	1.388
	MCS 9	0.072	0.029	71.287	1.470

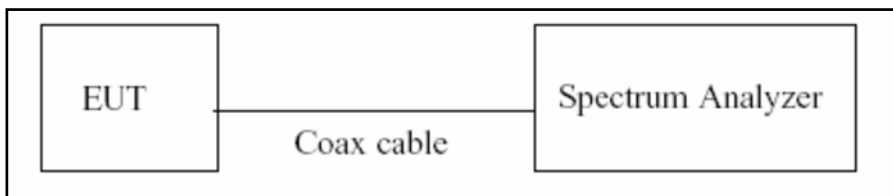
Mode	MCS INDEX	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11ac_ VHT160	MCS 0	0.253	0.029	89.716	0.471
	MCS 1	0.149	0.029	83.708	0.772
	MCS 2	0.113	0.029	79.577	0.992
	MCS 3	0.096	0.029	76.800	1.146
	MCS 4	0.076	0.029	72.381	1.404
	MCS 5	0.069	0.029	70.408	1.524
	MCS 6	0.064	0.029	68.817	1.623
	MCS 7	0.064	0.029	68.817	1.623
	MCS 8	0.061	0.029	67.778	1.689
	MCS 9	0.056	0.029	65.882	1.812

9.2 EMISSION BANDWIDTH AND MINIMUM EMISSION BANDWIDTH MEASUREMENT

The bandwidth at 26 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum power control level, as defined in KDB 789033 D02 v02r01, at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26 dB bandwidth.

The 26 dB bandwidth is used to determine the conducted power limits.

■ TEST CONFIGURATION



■ TEST PROCEDURE (26dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (C.1 in KDB 789033 D02 v02r01)

1. RBW = approximately 1 % of the emission bandwidth
2. VBW > RBW
3. Detector = Peak
4. Trace mode = max hold
5. Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

Note : We tested 26 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 26 dB.

■ **TEST PROCEDURE (for the band 5.725-5.85 GHz, 6 dB Bandwidth)**

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to(C.2 in KDB 789033 D02 v02r01)

1. RBW = 100 kHz
2. VBW $\geq$ 3*RBW
3. Detector = Peak
4. Trace mode = max hold
5. Allow the trace to stabilize
6. 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 : We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

■ **TEST RESULTS for Ant.0_802.11a**

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.11	N/A	Pass
5200	40	21.19	N/A	Pass
5240	48	21.30	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.13	N/A	Pass
5300	60	21.22	N/A	Pass
5320	64	21.38	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

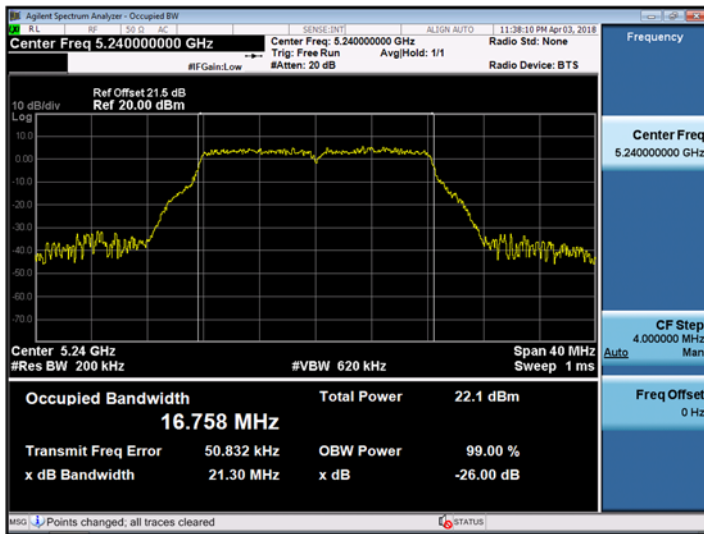
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.18	N/A	Pass
5600	120	21.28	N/A	Pass
5720	144	21.20	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

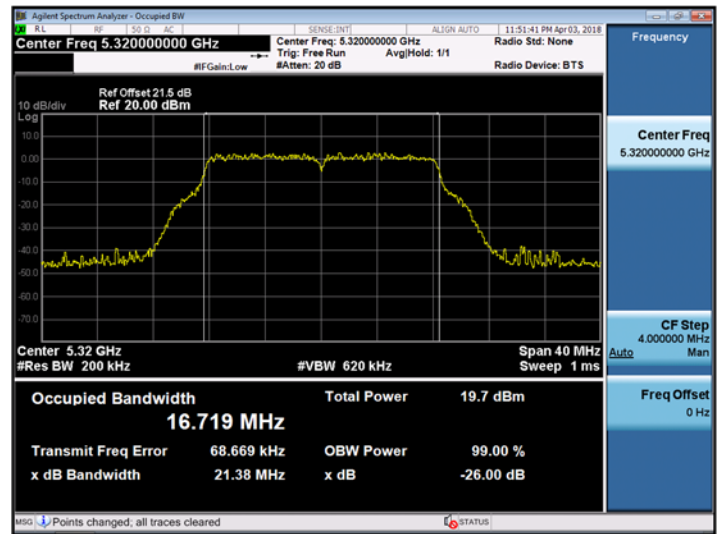
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.20	N/A	Pass
5785	157	21.20	N/A	Pass
5825	165	21.05	N/A	Pass

■ TEST Plot for Ant.0_802.11a

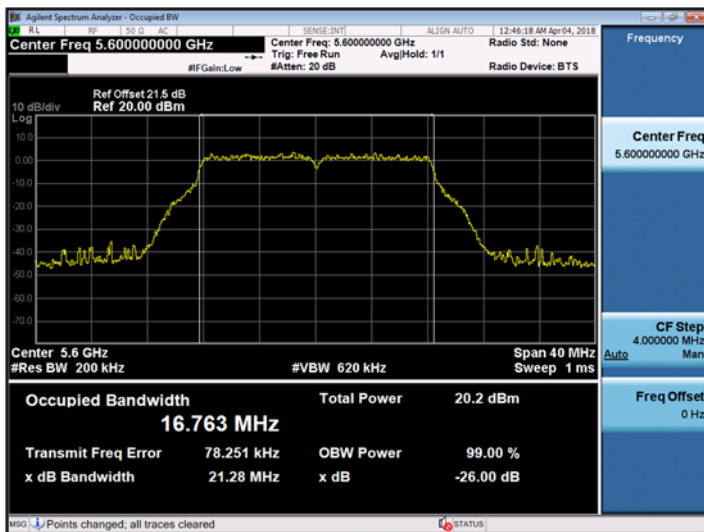
802.11a UNII 1 BAND 26dB Bandwidth (CH 48)



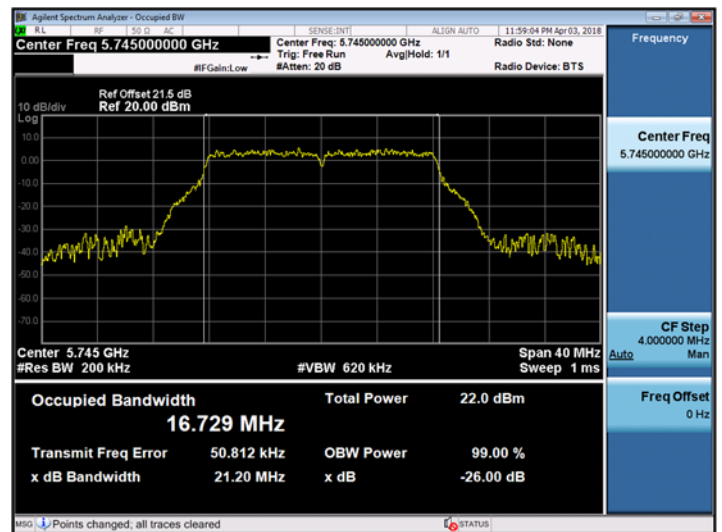
802.11a UNII 2A BAND 26dB Bandwidth (CH 64)



802.11a UNII 2C BAND 26dB Bandwidth (CH 120)



802.11a UNII 3 BAND 26dB Bandwidth (CH 149)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ **TEST RESULTS for Ant.1_802.11a**

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.29	N/A	Pass
5200	40	21.10	N/A	Pass
5240	48	21.18	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.21	N/A	Pass
5300	60	21.23	N/A	Pass
5320	64	21.37	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

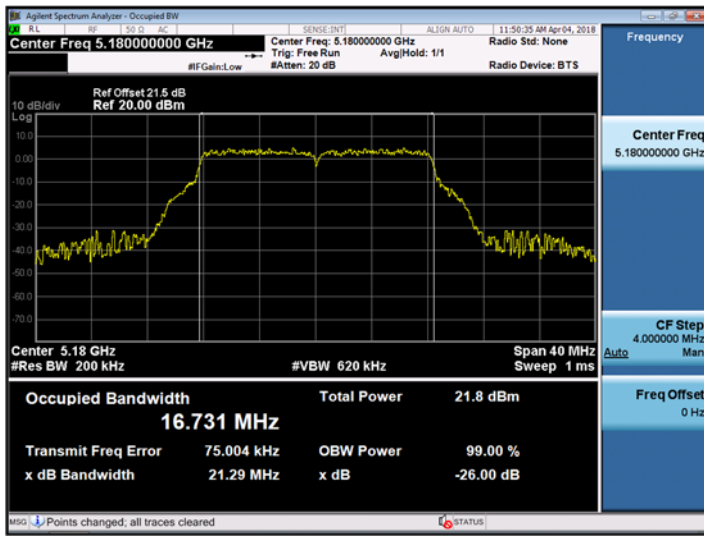
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.05	N/A	Pass
5600	120	21.21	N/A	Pass
5720	144	21.30	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

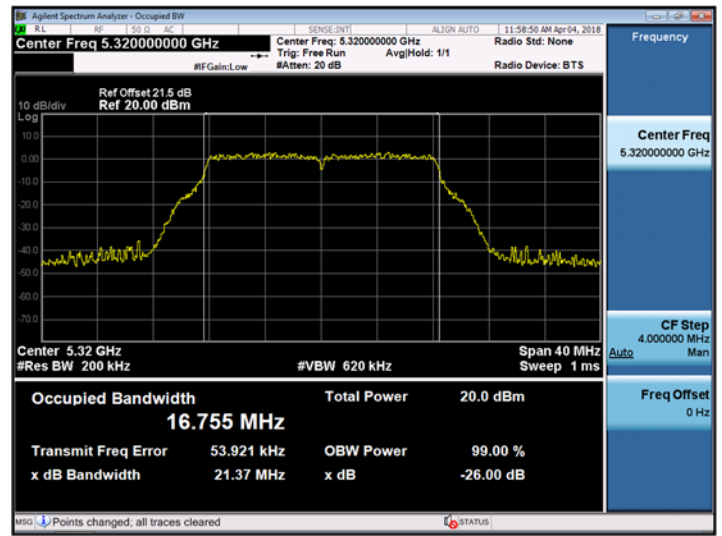
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	20.98	N/A	Pass
5785	157	21.01	N/A	Pass
5825	165	21.21	N/A	Pass

■ TEST Plot for Ant.1_802.11a

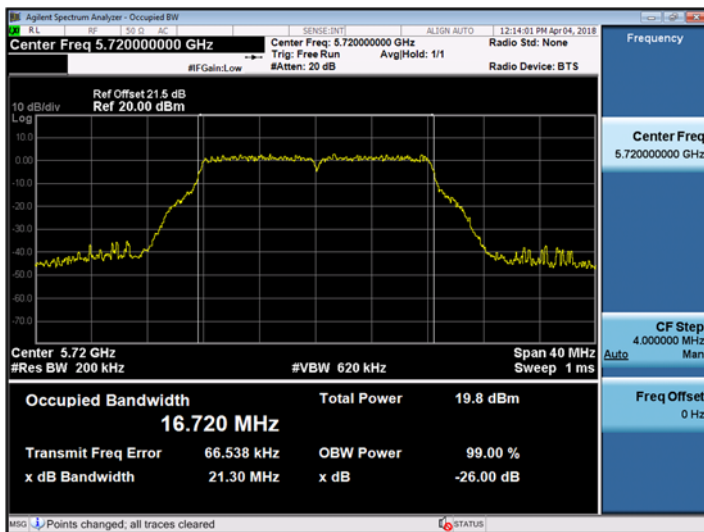
802.11a UNII 1 BAND 26dB Bandwidth (CH 36)



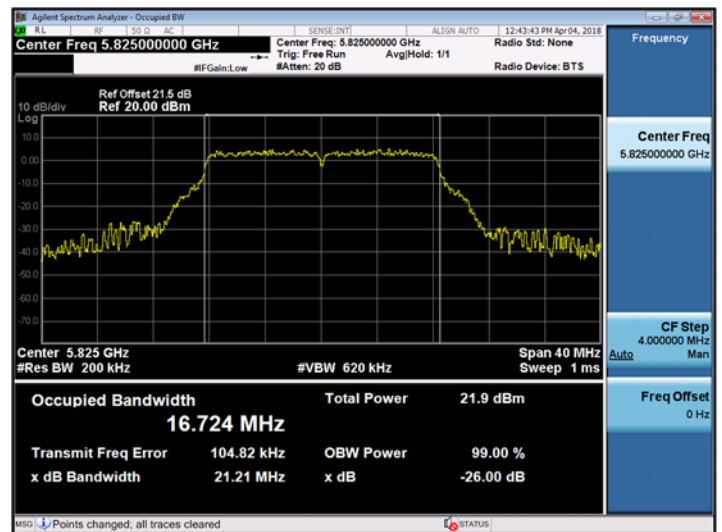
802.11a UNII 2A BAND 26dB Bandwidth (CH 64)



802.11a UNII 2C BAND 26dB Bandwidth (CH144)



802.11a UNII 3 BAND 26dB Bandwidth (CH 165)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ **TEST RESULTS for Ant.2_802.11a**

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.18	N/A	Pass
5200	40	21.22	N/A	Pass
5240	48	21.13	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.28	N/A	Pass
5300	60	21.22	N/A	Pass
5320	64	21.35	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

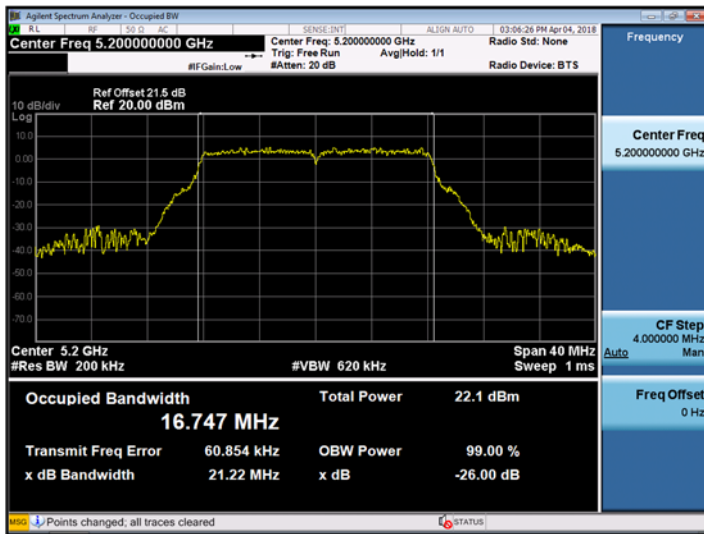
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.25	N/A	Pass
5600	120	21.22	N/A	Pass
5720	144	21.10	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

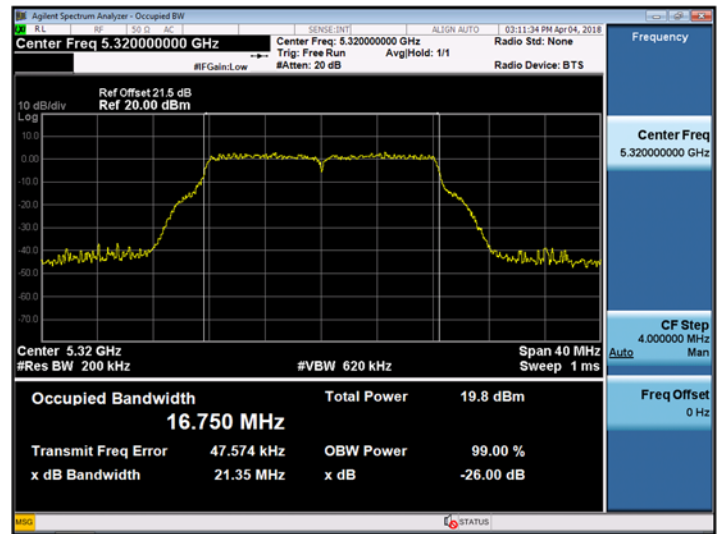
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.16	N/A	Pass
5785	157	21.06	N/A	Pass
5825	165	21.23	N/A	Pass

■ TEST Plot for Ant.2_802.11a

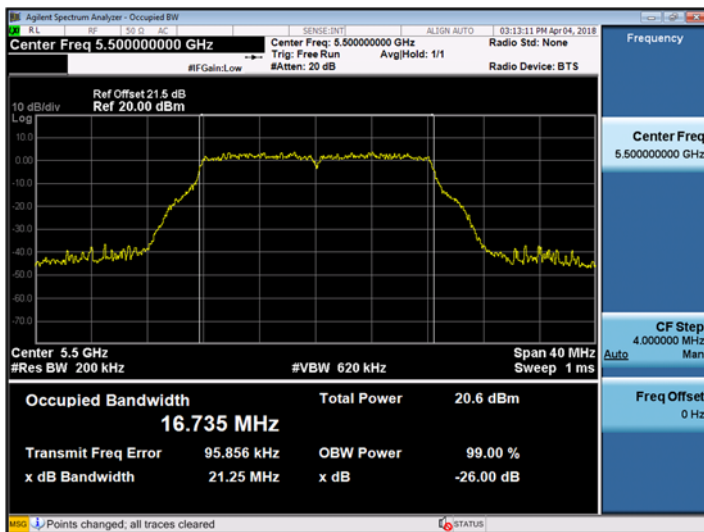
802.11a UNII 1 BAND 26dB Bandwidth (CH 40)



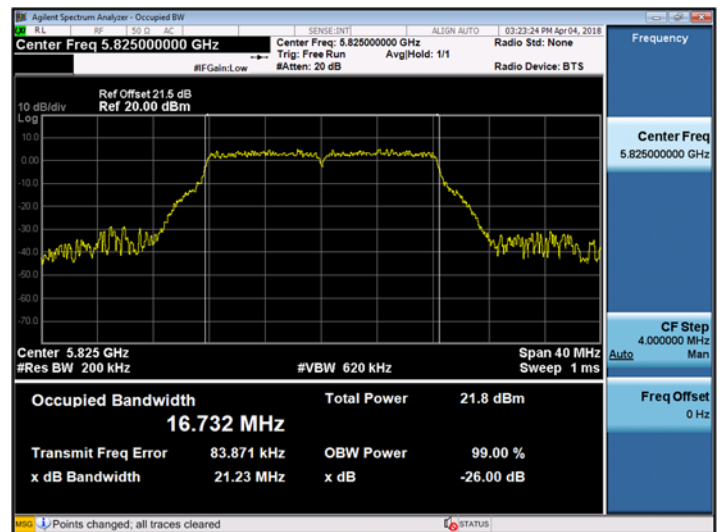
802.11a UNII 2A BAND 26dB Bandwidth (CH 64)



802.11a UNII 2C BAND 26dB Bandwidth (CH 100)



802.11a UNII 3 BAND 26dB Bandwidth (CH 165)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ TEST RESULTS for Ant.3_802.11a

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.23	N/A	Pass
5200	40	21.28	N/A	Pass
5240	48	21.32	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.41	N/A	Pass
5300	60	21.09	N/A	Pass
5320	64	21.26	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

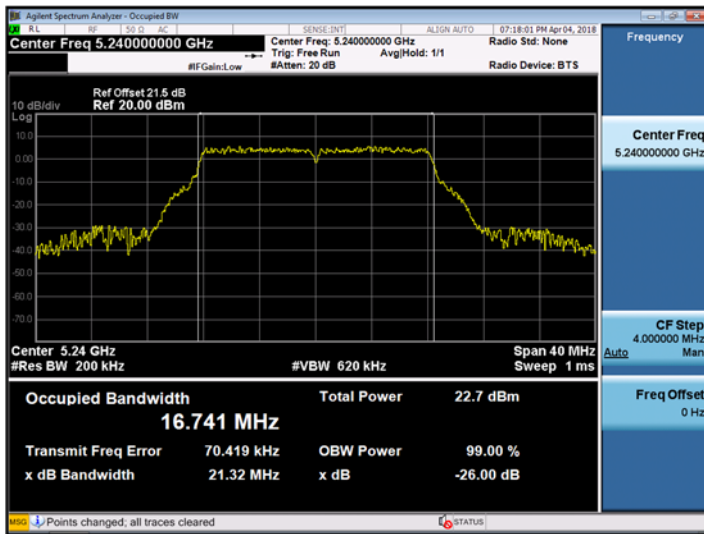
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.14	N/A	Pass
5600	120	21.17	N/A	Pass
5720	144	21.24	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11a

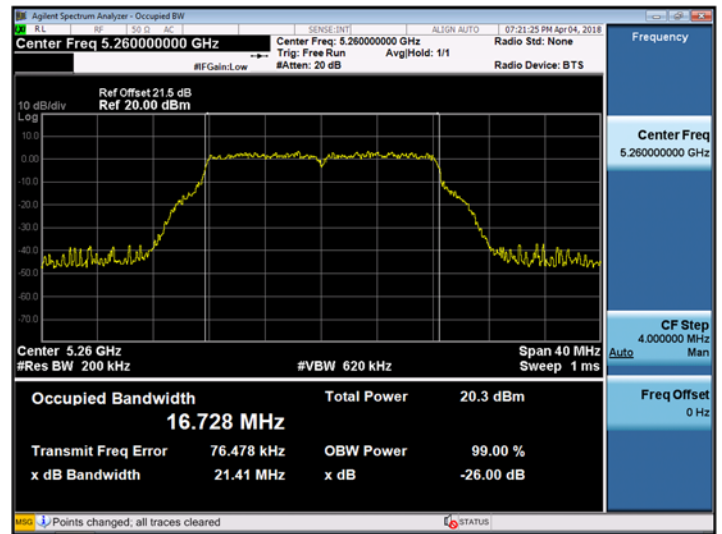
802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.32	N/A	Pass
5785	157	21.35	N/A	Pass
5825	165	21.19	N/A	Pass

■ TEST Plot for Ant.3_802.11a

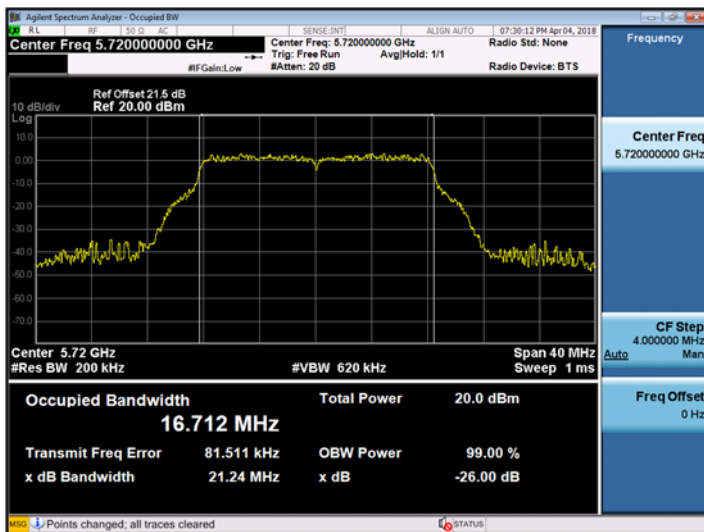
802.11a UNII 1 BAND 26dB Bandwidth (CH 48)



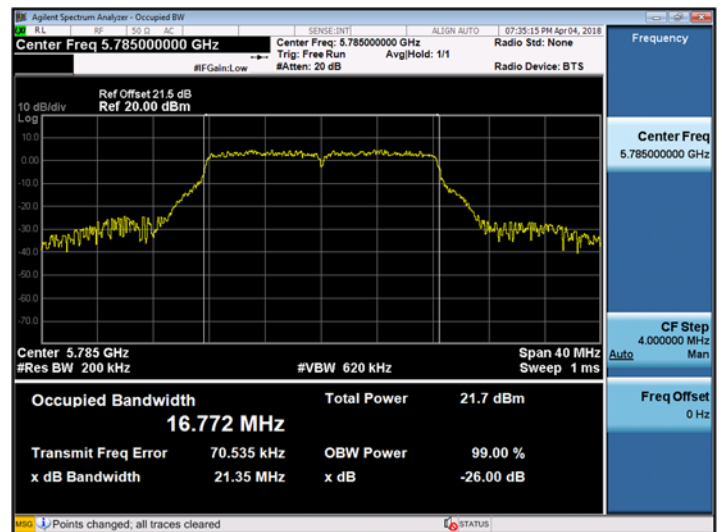
802.11a UNII 2A BAND 26dB Bandwidth (CH 52)



802.11a UNII 2C BAND 26dB Bandwidth (CH 144)



802.11a UNII 3 BAND 26dB Bandwidth (CH 157)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ **TEST RESULTS for Ant.0_802.11n_HT20**

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.57	N/A	Pass
5200	40	21.45	N/A	Pass
5240	48	21.26	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.52	N/A	Pass
5300	60	21.49	N/A	Pass
5320	64	21.67	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

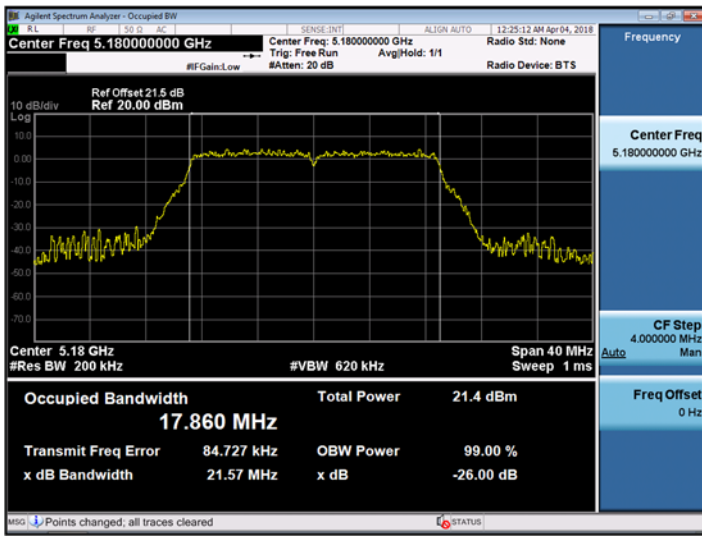
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.51	N/A	Pass
5600	120	21.54	N/A	Pass
5720	144	21.56	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

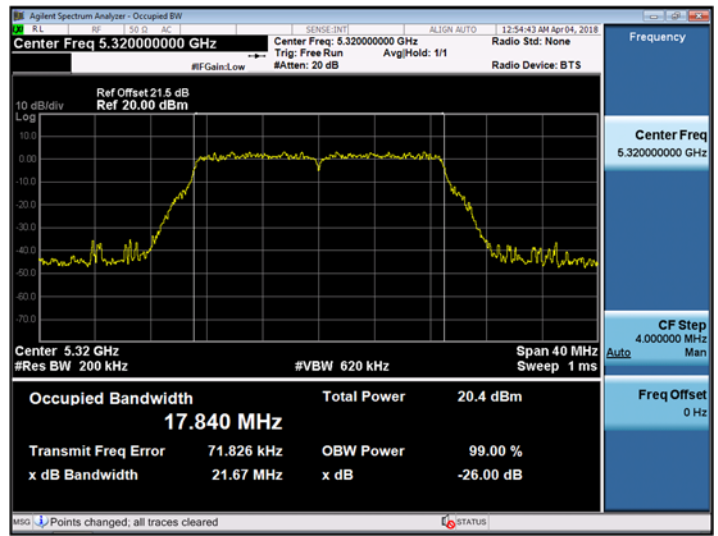
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.44	N/A	Pass
5785	157	21.57	N/A	Pass
5825	165	21.38	N/A	Pass

■ TEST Plot for Ant.0_802.11n_HT20

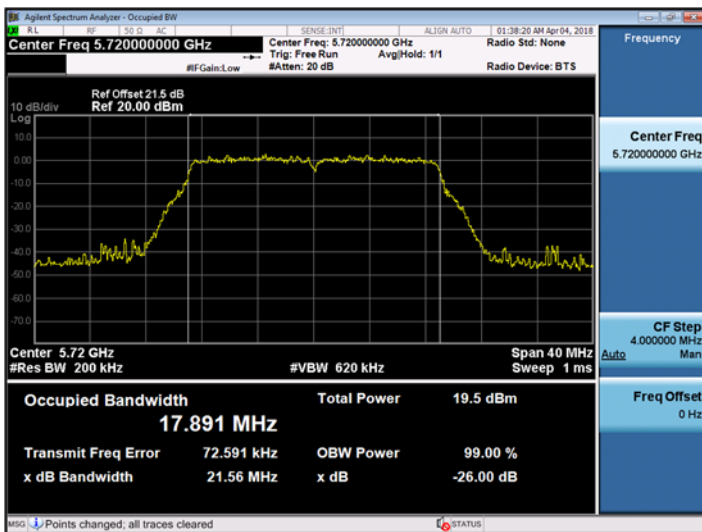
802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 36)



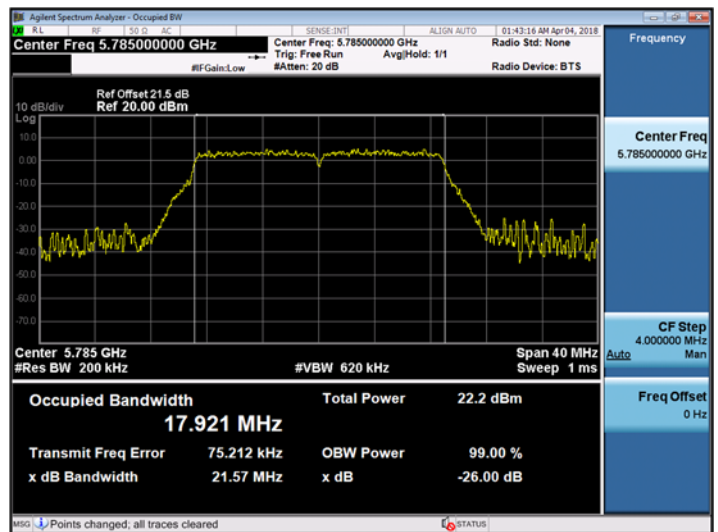
802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 64)



802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 144)



802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 157)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ TEST RESULTS for Ant.1_802.11n_HT20

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.96	N/A	Pass
5200	40	21.60	N/A	Pass
5240	48	21.64	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.41	N/A	Pass
5300	60	21.43	N/A	Pass
5320	64	21.48	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

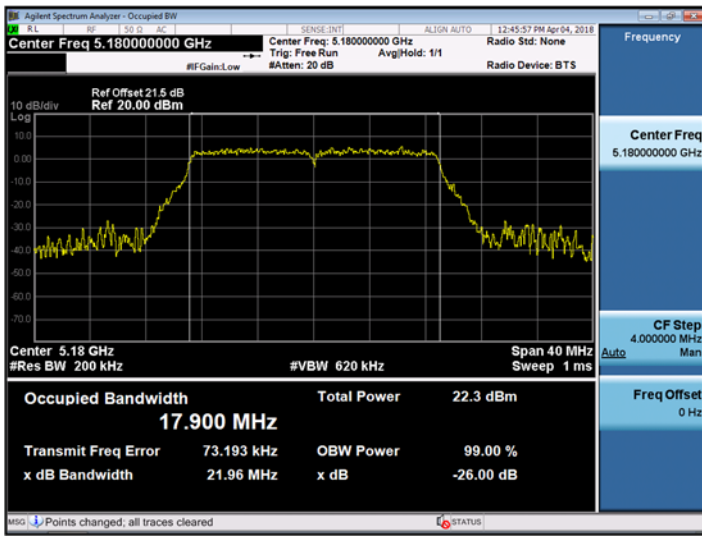
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.52	N/A	Pass
5600	120	21.46	N/A	Pass
5720	144	21.67	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

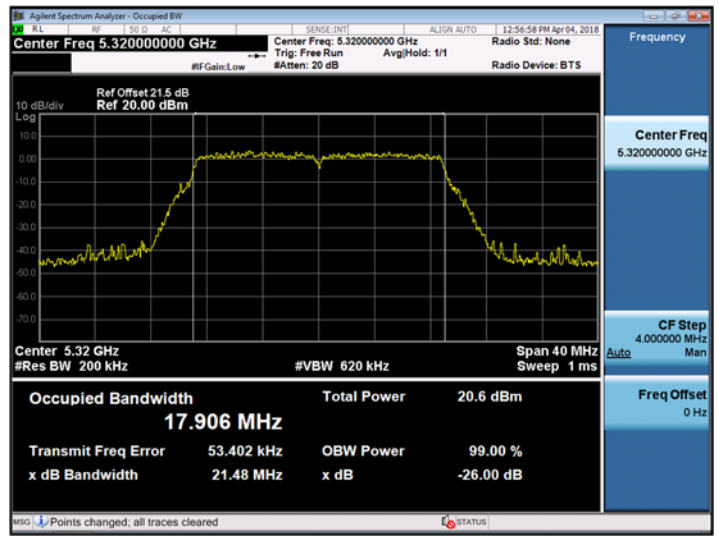
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.43	N/A	Pass
5785	157	21.42	N/A	Pass
5825	165	21.57	N/A	Pass

■ TEST Plot for Ant.1_802.11n_HT20

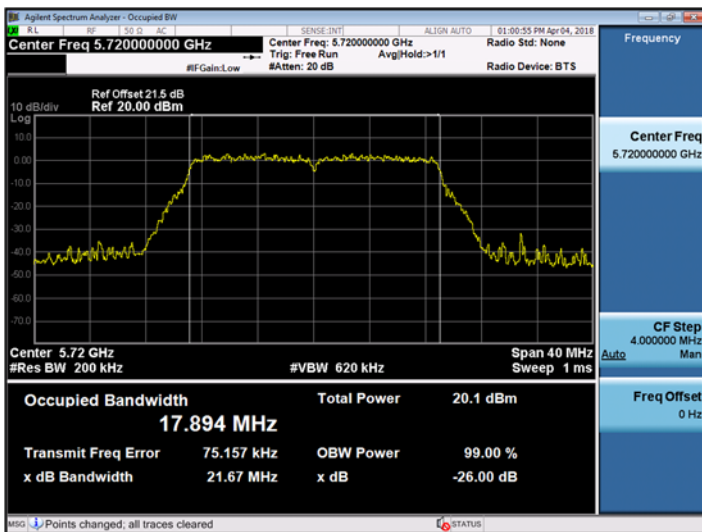
802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 36)



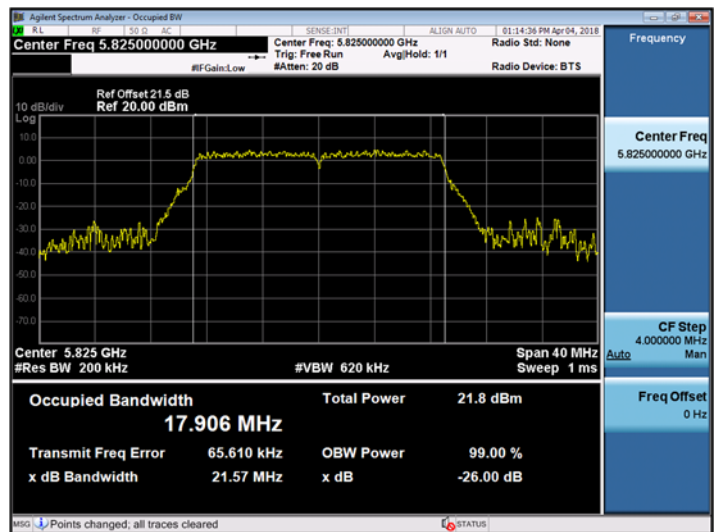
802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 64)



802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 144)



802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 165)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ **TEST RESULTS for Ant.2_802.11n_HT20**

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.31	N/A	Pass
5200	40	21.51	N/A	Pass
5240	48	21.74	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.63	N/A	Pass
5300	60	21.65	N/A	Pass
5320	64	21.40	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

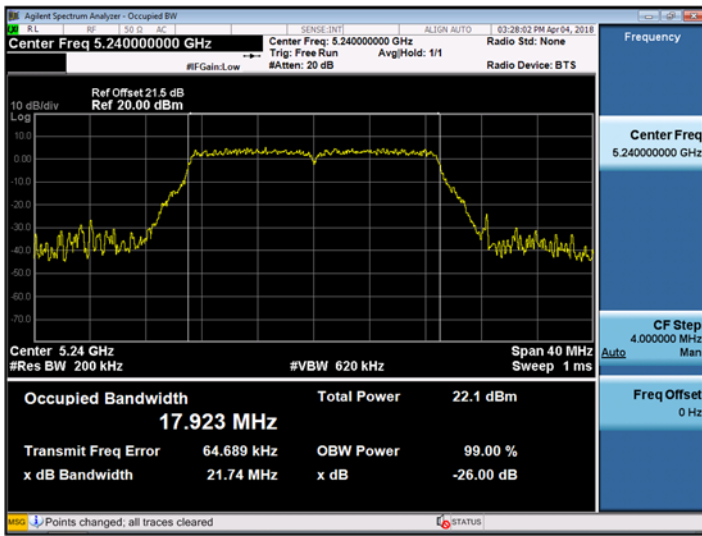
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.42	N/A	Pass
5600	120	21.58	N/A	Pass
5720	144	21.48	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

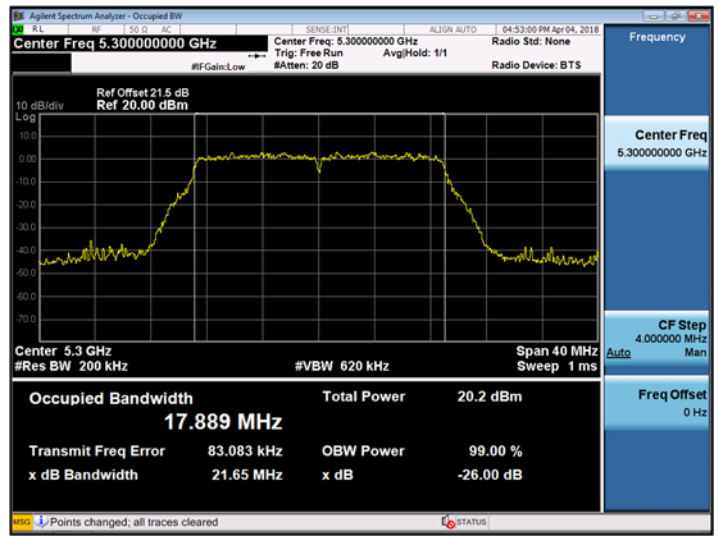
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.52	N/A	Pass
5785	157	21.67	N/A	Pass
5825	165	21.47	N/A	Pass

■ TEST Plot for Ant.2_802.11n_HT20

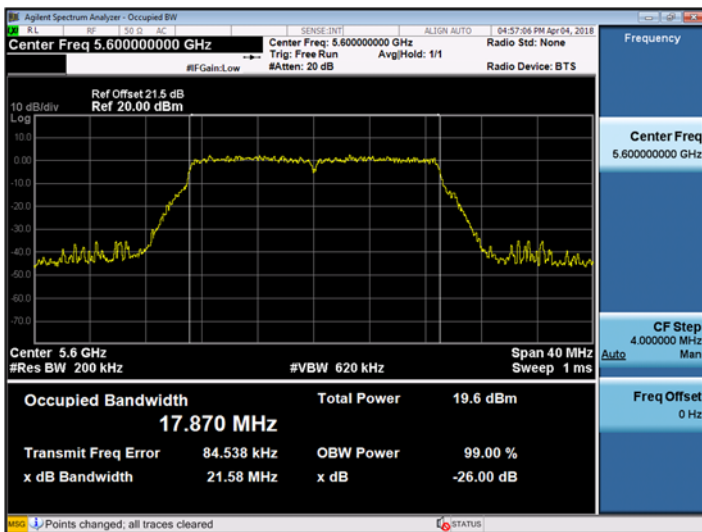
802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 48)



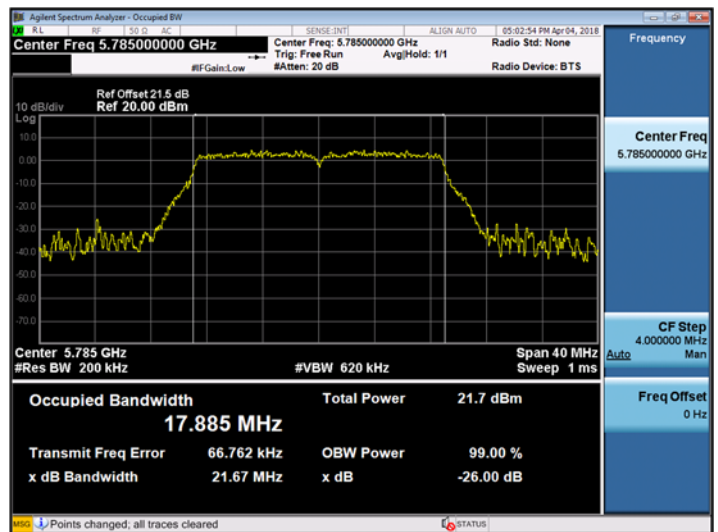
802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 60)



802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 120)



802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 157)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ **TEST RESULTS for Ant.3_802.11n_HT20**

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.59	N/A	Pass
5200	40	21.45	N/A	Pass
5240	48	21.50	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.64	N/A	Pass
5300	60	21.62	N/A	Pass
5320	64	21.55	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

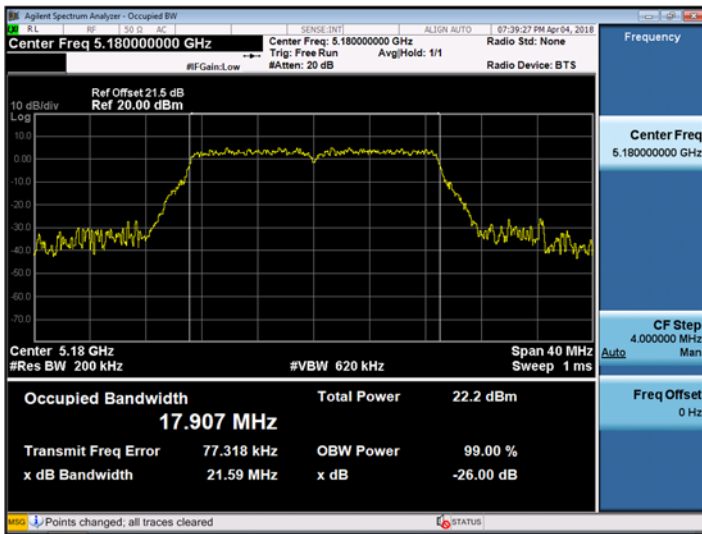
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.78	N/A	Pass
5600	120	21.56	N/A	Pass
5720	144	21.57	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

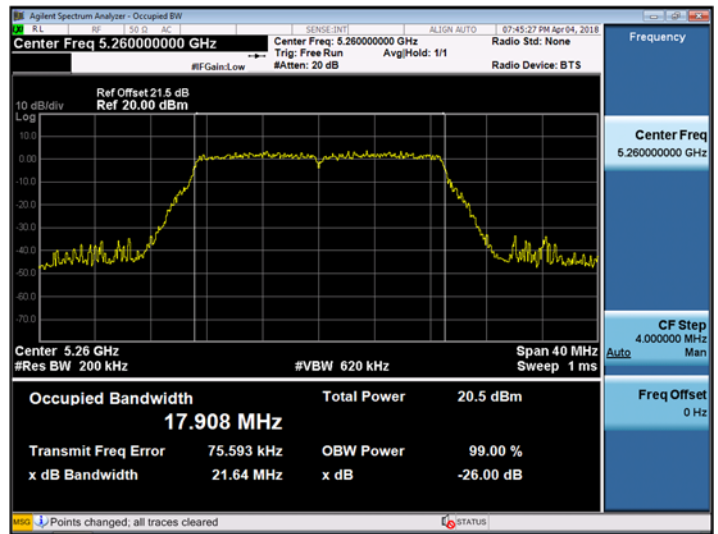
802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	23.66	N/A	Pass
5785	157	26.80	N/A	Pass
5825	165	25.54	N/A	Pass

■ TEST Plot for Ant.3_802.11n_HT20

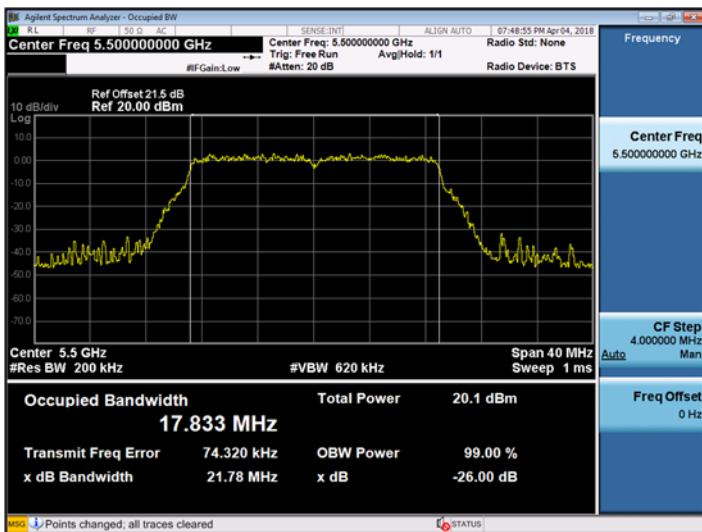
802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 36)



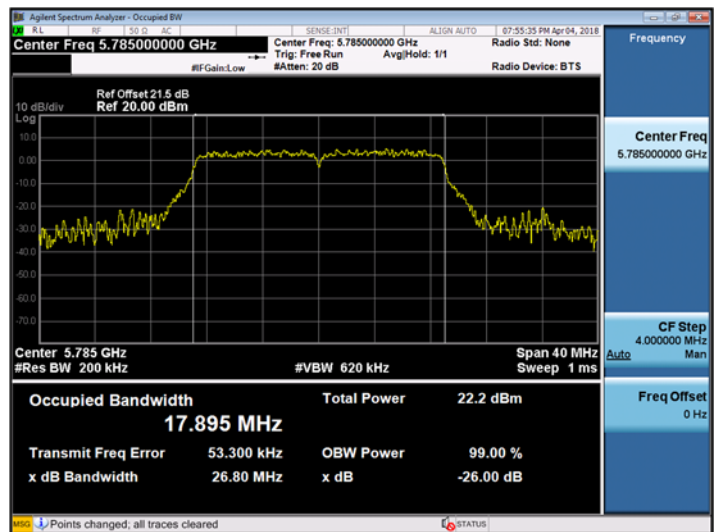
802.11n_HT20 UNII 2A BAND 26dB Bandwidth(CH 52)



802.11n_HT20 UNII 2C BAND 26dB Bandwidth(CH 100)



802.11n_HT20 UNII 3 BAND 26dB Bandwidth(CH 157)



Note : In order to simplify the report, attached plots were only the most wide channel.

■ **TEST RESULTS for Ant.0_ 802.11ac_VHT20**

Conducted 26 dB Bandwidth Measurements for 802.11ac_VHT20

802.11ac_VHT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	21.54	N/A	Pass
5200	40	21.45	N/A	Pass
5240	48	21.44	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11ac_VHT20

802.11ac_VHT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5260	52	21.59	N/A	Pass
5300	60	21.55	N/A	Pass
5320	64	21.70	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11ac_VHT20

802.11ac_VHT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5500	100	21.45	N/A	Pass
5600	120	21.37	N/A	Pass
5720	144	21.73	N/A	Pass

Conducted 26 dB Bandwidth Measurements for 802.11ac_VHT20

802.11ac_VHT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5745	149	21.42	N/A	Pass
5785	157	21.50	N/A	Pass
5825	165	21.44	N/A	Pass