TEST REPORT

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1. Report No : DRTFCC1904-0127
2. Customer
   - Name (FCC) : Canon Korea Business Solutions Inc.
   - Name (IC) : CANON KOREA BUSINESS SOLUTIONS INC.
   - Address (FCC) : 575, Sihwabencheo-ro, Danwon-gu, Ansan-si, Gyeonggi-do, South Korea
   - Address (IC) : 575, Sihwabencheo-ro, Danwon-gu, Ansan-si, Gyeonggi-do Korea (Republic Of)
3. Use of Report : FCC & IC Original Grant
4. Product Name / Model Name : Projector / Rayo S1
   FCC ID : 2AR9TRAYOS1 / IC : 498G-RAYOS1
5. Test Method Used : KDB789033 D02v02r01, ANSI C 63.10-2013
   Test Specification : FCC Part 15.407 Subpart E
   RSS-247 Issue 2 (2017-02), RSS-GEN Issue 5 (2018-04)
6. Date of Test : 2019.01.02 ~ 2019.03.06
7. Testing Environment : Refer to appended test report.
8. Test Result : Refer to the attached test result.

Affirmation	Tested by Name : InHee Bae (Signature)	Reviewed by Name : Geunki Son (Signature)

2019 . 04 . 22 .

DT&C Co., Ltd.

Test Report Version

Test Report No.	Date	Description
DRTFCC1904-0127	Apr. 22, 2019	Initial issue

CONTENTS

1. EUT DESCRIPTION

Equipment Class	Unlicensed National Information Infrastructure (UNII)
Product	Projector
Model Name(HVIN)	Rayo S1
Add Model Name	NA
FVIN	3.10.X
Power Supply	DC 3.7 V
Modulation type	OFDM
Antenna Specification	**Antenna type:** FPC Antenna **Antenna gain** U-NII 1: 1.34 dBi U-NII 3: 1.04 dBi

5GHz Band	Mode	Frequency range (MHz)	Max power(dBm)
U-NII 1	802.11a	5180 ~ 5240	10.03
	802.11n(HT20)	5180 ~ 5240	**10.49**
U-NII 3	802.11a	5745 ~ 5825	11.56
	802.11n(HT20)	5745 ~ 5825	**12.21**

2. Information about test items

2.1 Transmitting configuration of EUT

Mode	Data rate
802.11a	6 ~ 54 Mbps
802.11n(HT20)	MCS 0 ~ 7

2.2 Tested Channel Information

5GHz Band	802.11a/n(HT20)	
	Channel	Frequency [MHz]
U-NII 1	36	5180
	40	5200
	48	5240
U-NII 3	149	5745
	157	5785
	165	5825

2.3 Testing Environment

Temperature	:	+22 ºC ~ +25 ºC
Relative humidity content	:	43 % ~ 48 %
Details of power supply	:	DC 3.7 V

2.4 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

2.5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014 and ANSI C 63.10-2013. All measurement uncertainty values are shown with a coverage factor of *k* = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.9 dB (The confidence level is about 95 %, k = 2)
Conducted spurious emission	0.9 dB (The confidence level is about 95 %, k = 2)
AC conducted emission	2.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)

3. SUMMARY OF TESTS

FCC Part Section(s)	RSS Section(s)	Parameter	Limit	Test Condition	Status Note 1
15.407(a)	-	Emission Bandwidth (26 dB Bandwidth)	N/A	Conducted	C
15.407(e)	RSS-247[6.2.4]	Minimum Emission Bandwidth (6 dB Bandwidth)	> 500 kHz in 5725 ~ 5850 MHz		C
15.407(a)	RSS-247[6.2]	Maximum Conducted Output Power	Refer to the section 8.3		C
15.407(a)	RSS-247[6.2]	Peak Power Spectral Density	Refer to the section 8.4		C
-	RSS GEN[6.7]	Occupied Bandwidth (99%)	N/A		C
15.407(g)	-	Frequency Stability	N/A		C
15.407(h)	RSS-247[6.3]	Dynamic Frequency Selection	FCC 15.407(h)		NA Note 3
15.205 15.209 15.407(b)	RSS-247[6.2] RSS-GEN[8.9] RSS-GEN[8.10]	Undesirable Emissions	Refer to the section 8.6	Radiated	C Note 4
15.207	RSS-GEN[8.8]	AC Conducted Emissions	FCC 15.207	AC Line Conducted	C
15.203	-	Antenna Requirements	FCC 15.203	-	C

Note 1: **C** = Comply **NC** = Not Comply **NT** = Not Tested **NA** = Not Applicable

Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.

Note 3: This device does not supported DFS bands.

Note 4: These test items were performed in each axis and the worst case data was reported.

4. TEST METHODOLOGY

The measurement procedures described in the ANSI C63.10-2013 and the guidance provided in KDB 7899033 D02v02r01 were used in measurement of the EUT.

The EUT was tested per the guidance of KDB789033 D02v02r01. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

4.1 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.

4.2 EUT exercise

The EUT was operated in the test 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.

4.3 General test procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB789033 D02v02r01. So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB789033 D02v02r01. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on KDB789033 D02v02r01.

The EUT is placed on a non-conductive table, which is 0.8 m above ground plane. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 1 or 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 highest emission, the relative positions of the EUT were rotated through three orthogonal axis.

4.4 Description of test modes

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics.

A test program is used to control the EUT for staying in continuous transmitting mode with maximum fixed duty cycle.

5. 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 equipment , which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1 Facilities

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014. **- FCC MRA Accredited Test Firm No. : KR0034** **- IC Test site No. : 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

6.2 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, loop, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, 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.”

7. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

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 antenna is permanently attached. (Refer to Internal Photo file.)
Therefore this EUT complies with the requirement of §15.203.

8. TEST RESULT

8.1 Emission Bandwidth (26 dB Bandwidth)

▣ Test Requirements

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 in transmission mode at the appropriate frequencies.

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

▣ Test Configuration

Refer to the APPENDIX I.

▣ Test Procedure

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB789033 D02v02r01**.

1. Set resolution bandwidth (RBW) = approximately **1 %** of the EBW.
2. Set the video bandwidth **(VBW) > RBW**.
3. Detector = **Peak**.
4. Trace mode = **max hold**.

Measure the maximum width of the emission that is 26 dB down from the peak 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%.

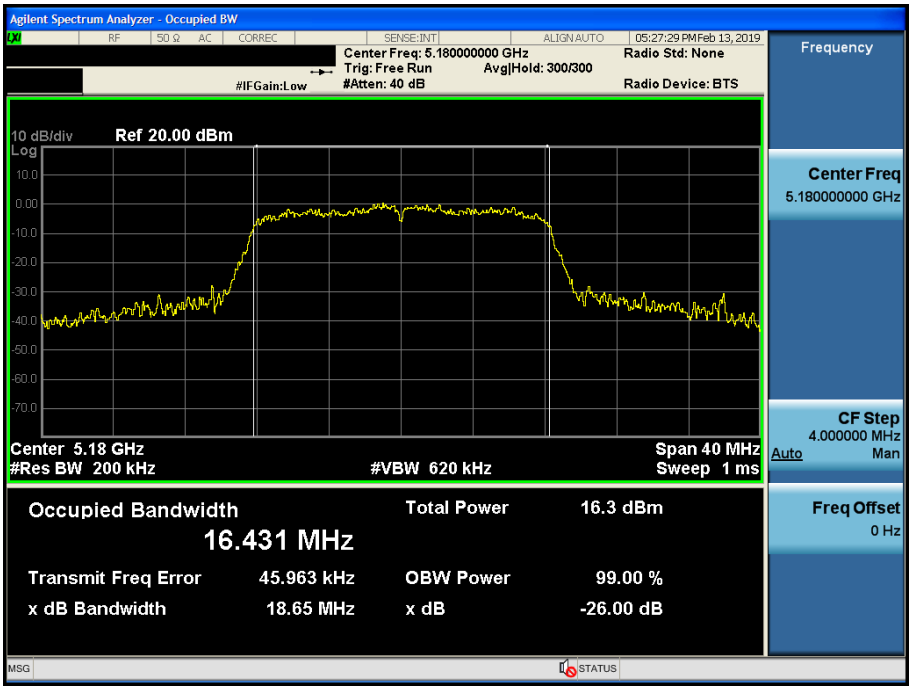
▣ TEST RESULTS: Comply

Mode	Band	Channel	Frequency [MHz]	Test Result [MHz]
802.11a	U-NII 1	36	5180	18.65
		40	5200	18.81
		48	5240	18.54
802.11n (HT20)	U-NII 1	36	5180	19.02
		40	5200	18.89
		48	5240	19.02

▣ Result Plots

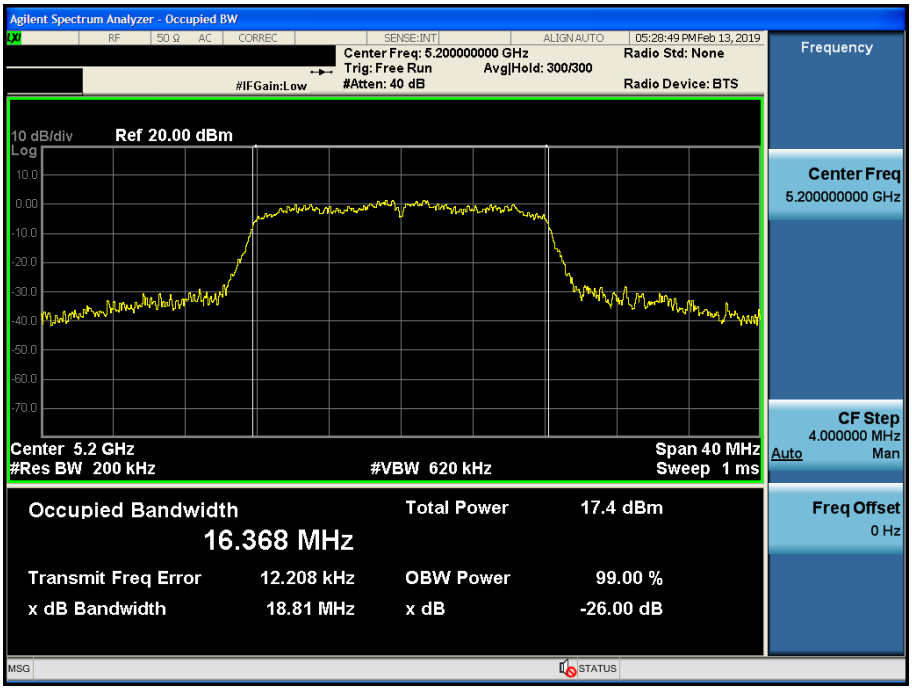
26 dB Bandwidth

Test Mode: 802.11a & Ch.36



26 dB Bandwidth

Test Mode: 802.11a & Ch.40



26 dB Bandwidth

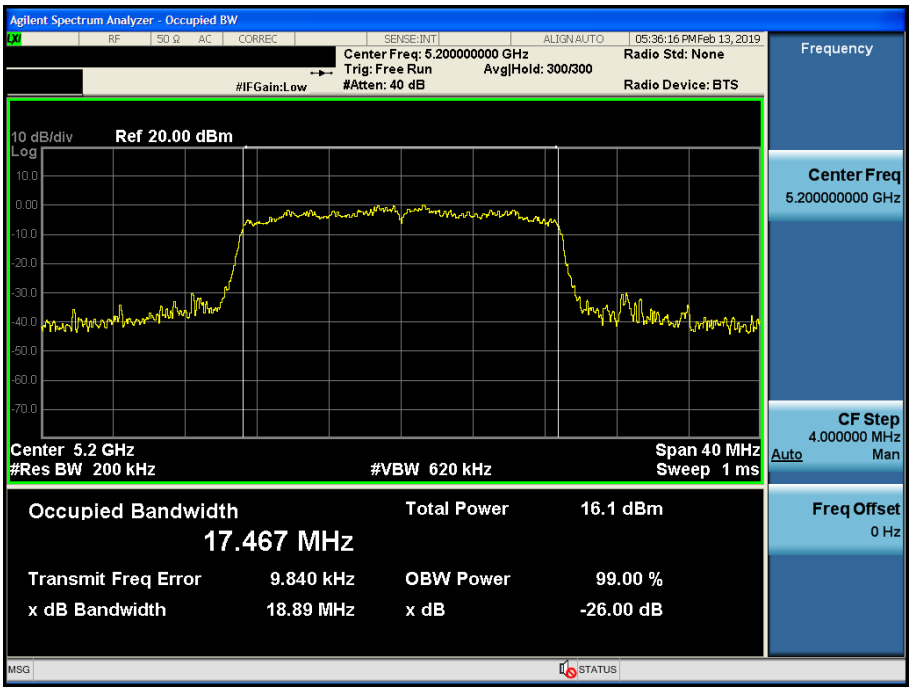
Test Mode: 802.11a & Ch.48

26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.36

26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.40



26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.48

8.2 Minimum Emission Bandwidth (6 dB Bandwidth)

▣ Test Requirements

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

▣ Test Configuration

Refer to the APPENDIX I.

▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB789033 D02v02r01**.

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth **≥ 3 x RBW**.
3. Detector = **Peak**.
4. Trace mode = **max hold**.

   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.

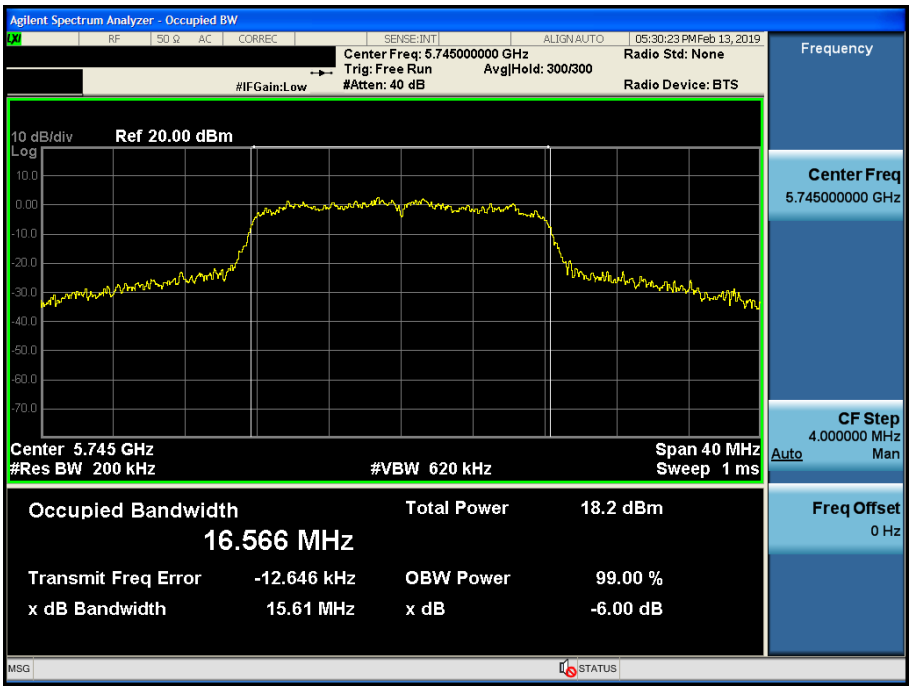
▣ TEST RESULTS: Comply

Mode	Band	Channel	Frequency [MHz]	Test Result [MHz]
802.11a	U-NII 3	149	5745	15.61
		157	5785	15.60
		165	5825	15.96
802.11n (HT20)	U-NII 3	149	5745	17.08
		157	5785	17.42
		165	5825	17.26

▣ RESULT PLOTS

6 dB Bandwidth

Test Mode: 802.11a & Ch.149



6 dB Bandwidth

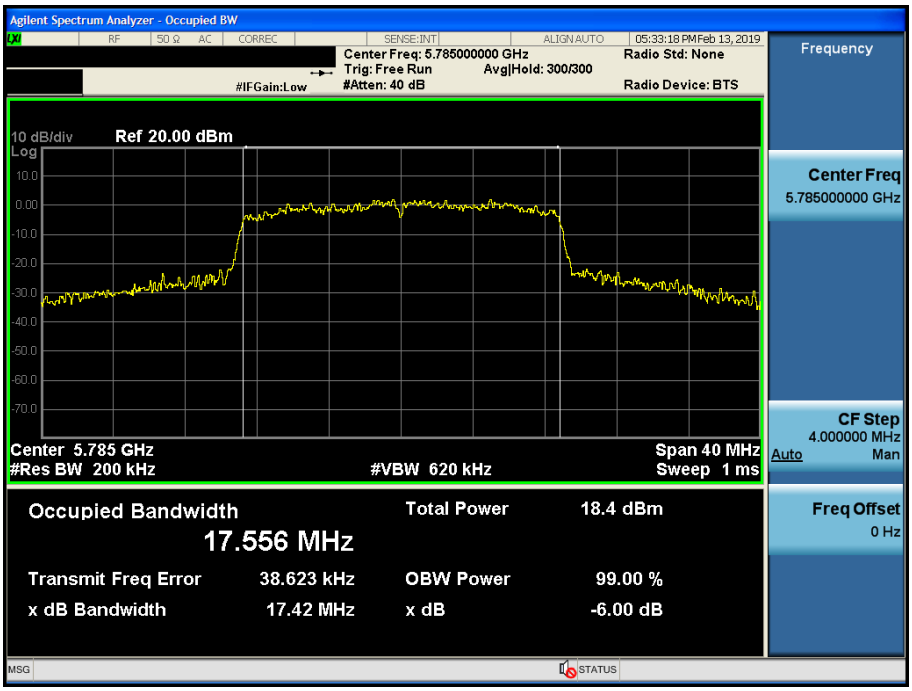
Test Mode: 802.11a & Ch.157

6 dB Bandwidth

Test Mode: 802.11a & Ch.165

6 dB Bandwidth Test Mode: 802.11n HT20 & Ch.149

6 dB Bandwidth Test Mode: 802.11n HT20 & Ch.157



6 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.165

8.3 Maximum Conducted Output Power

▣ Test Requirements

Part. 15.407(a)

(1) For the band 5.15 - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. 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.

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable 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. 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.

(2) 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. 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.

(3) For the band 5.725 - 5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

RSS-247[6.2]

(1) For band 5150 - 5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

(2) For band 5250 - 5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
Devices, other than devices installed in vehicles, shall comply with the following:
a) The maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
b) The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

(3) For band 5470 - 5600 MHz and 5650 - 5725 MHz

The maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.
The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than
500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

(4) For band 5725 - 5850 MHz

The maximum conducted output power shall not exceed 1 W. The output 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 output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

▣ Test Configuration

Method PM-G

▣ Test Procedure

Method PM-G of KDB789033 D02v02r01

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

▣ **Test Results: Comply**

- Output Power

Mode	CH	Freq.[MHz]	Conducted Output Power[dBm]	Antenna Gain[dBi]	e.i.r.p[Note1] [dBm]
802.11a	36	5180	9.97	1.34	11.31
	40	5200	10.03	1.34	11.37
	48	5240	10.02	1.34	11.36
	149	5745	10.56	1.04	11.60
	157	5785	10.96	1.04	12.00
	165	5825	11.56	1.04	12.60

Mode	CH	Freq.[MHz]	Conducted Output Power[dBm]	Antenna Gain[dBi]	e.i.r.p[Note1] [dBm]
802.11n(HT20)	36	5180	9.81	1.34	11.15
	40	5200	10.16	1.34	11.50
	48	5240	10.49	1.34	11.83
	149	5745	11.18	1.04	12.22
	157	5785	11.66	1.04	12.70
	165	5825	12.21	1.04	13.25

Note 1: e.i.r.p = Conducted Output Power + Antenna Gain

8.4 Maximum Power Spectral Density

▣ Test requirements

Part. 15.407(a)

(1) For the band 5.15 - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band. note1

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band. note1

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band. note1

(2) **For the 5.25 - 5.35 GHz and 5.47 - 5.725 GHz bands**, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. note1

(3) **For the band 5.725 - 5.85 GHz**, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.note1,note2

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

RSS-247[6.2]

(1) For band 5150 - 5250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

(2) For band 5250 - 5350 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.
Devices, other than devices installed in vehicles, shall comply with the following:
a) The maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;
b) The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

(3) For band 5470 - 5600 MHz and 5650 - 5725 MHz

The maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.
The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than
500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

(4) For band 5725 - 5850 MHz

The maximum conducted output power shall not exceed 1 W. The output 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 output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

▣ Test configuration

Refer to the APPENDIX I.

▣ Test procedure

Maximum Power Spectral Density is measured using Measurement Procedure **of KDB789033 D02v02r01**

1) Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA - 1, SA - 2, SA - 3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power…”. (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)

2) Use the peak search function on the instrument to find the peak of the spectrum and record its value.

3) Make the following adjustments to the peak value of the spectrum, if applicable:

a) If Method SA - 2 or SA - 2 Alternative was used, add 10 log(1 / x), where x is the duty cycle, to the peak of the spectrum.

b) If Method SA - 3 Alternative was used and the linear mode was used in step II.E.2.g (viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.

4) The result is the Maximum PSD over 1 MHz reference bandwidth.

5) For devices operating in the bands 5.15 - 5.25 GHz, 5.25 - 5.35 GHz, and 5.47 - 5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in §15.407(a)(5). For devices operating in the band 5.725 - 5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1 / T, where T is defined in section II.B.1.a). (Refer to Appendix II)

b) Set VBW ≥ 3 RBW.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10 log(500 kHz / RBW) to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10 log(1 MHz / RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 kHz for the sections 5.c) and 5.d) above, since RBW = 100 kHz is available on nearly all spectrum analyzers.

▣ **Test results: Comply**

- Power spectral density: Single

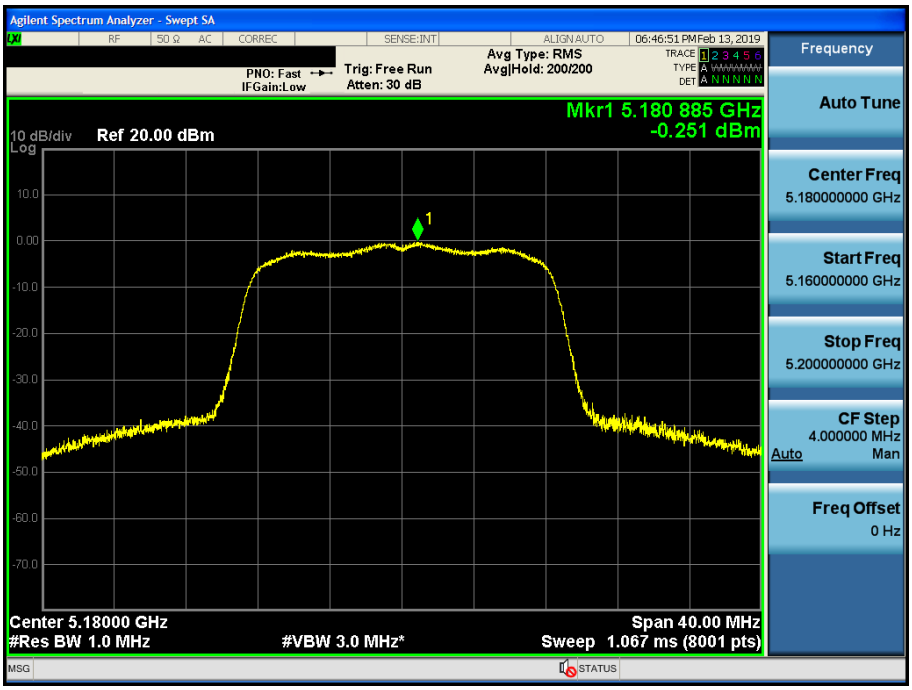
Mode	Channel	Frequency [MHz]	Reading [dBm]	T.F Note 1 [dB]	Power Spectral Density[dBm]	Antenna Gain [dBi]	e.i.r.p Spectral Density [dBm]
802.11a	36	5180	-0.25	0.13	-0.12	1.34	1.22
	40	5200	0.78		0.91	1.34	2.25
	48	5240	0.95		1.08	1.34	2.42
	149	5745	-7.21	7.12	-0.09	1.04	0.95
	157	5785	-6.13		0.99	1.04	2.03
	165	5825	-6.58		0.54	1.04	1.58
802.11n (HT20)	36	5180	-1.69	0.14	-1.55	1.34	-0.21
	40	5200	-0.62		-0.48	1.34	0.86
	48	5240	-0.52		-0.38	1.34	0.96
	149	5745	-8.15	7.13	-1.02	1.04	0.02
	157	5785	-7.18		-0.05	1.04	0.99
	165	5825	-7.36		-0.23	1.04	0.81

Note 1: "U-NII 1 [T.F] = DCCF"
"U-NII 3 [T.F] = 10*LOG(500kHz/100kHz) + DCCF"
For DCCF(Duty Cycle Correction Factor) please refer to appendix II.
Note 2: Test Result = Measurement Data + T.F
Note 3: e.i.r.p Spectral Density= Power spectral density + Antenna Gain

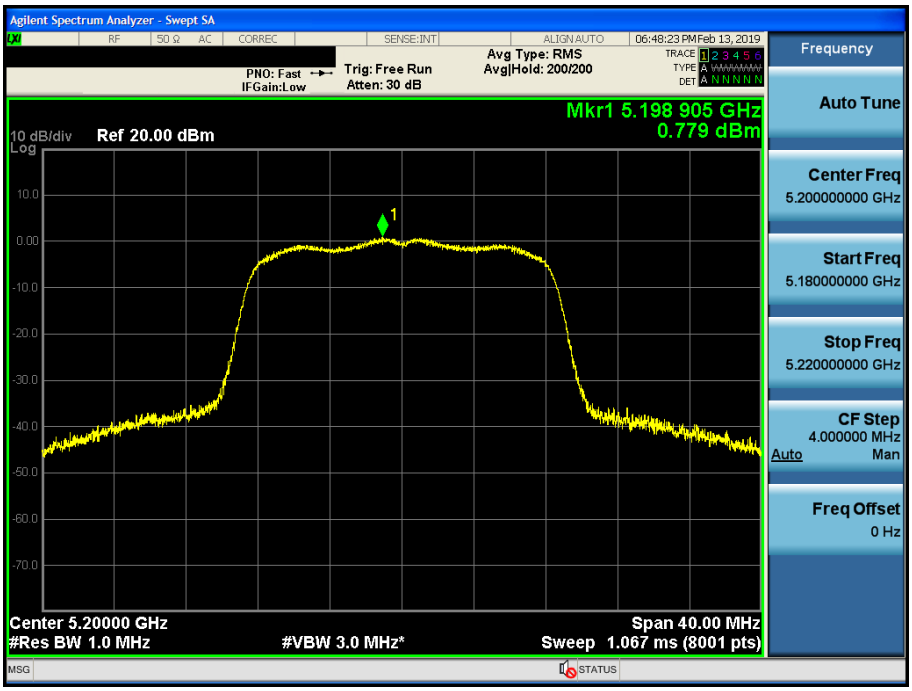
▣ RESULT PLOTS

- Power spectral density

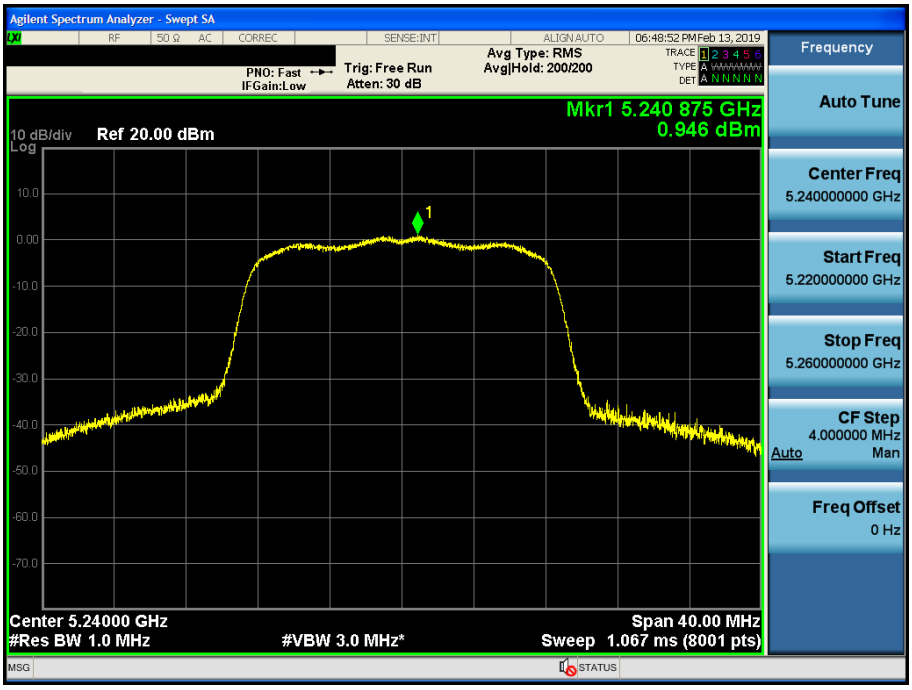
Maximum Power Spectral Density Test Mode: 802.11a & Ch.36



Maximum Power Spectral Density Test Mode: 802.11a & Ch.40



Maximum Power Spectral Density Test Mode: 802.11a & Ch.48

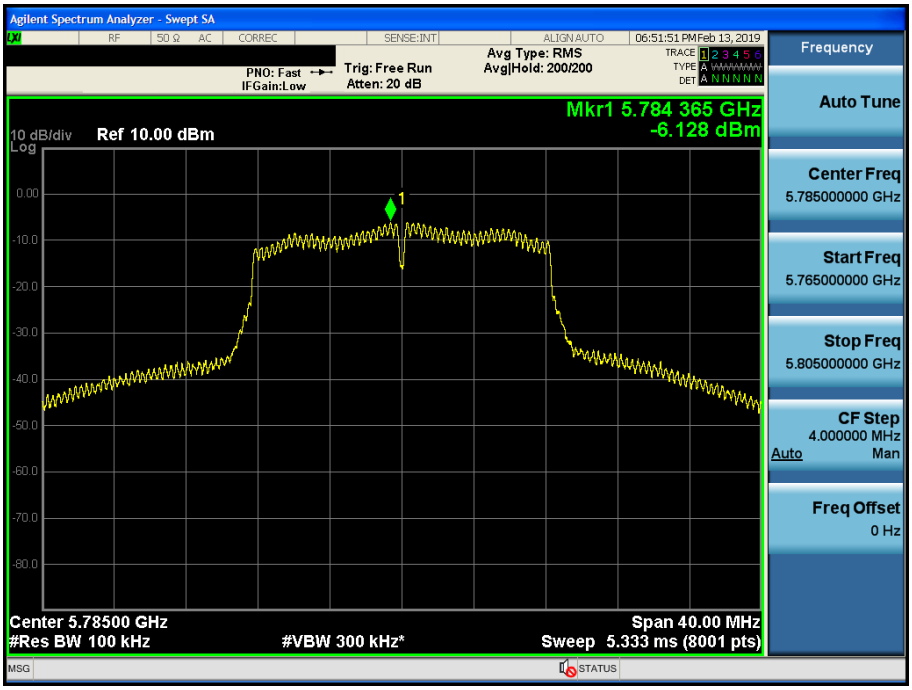


Maximum Power Spectral Density

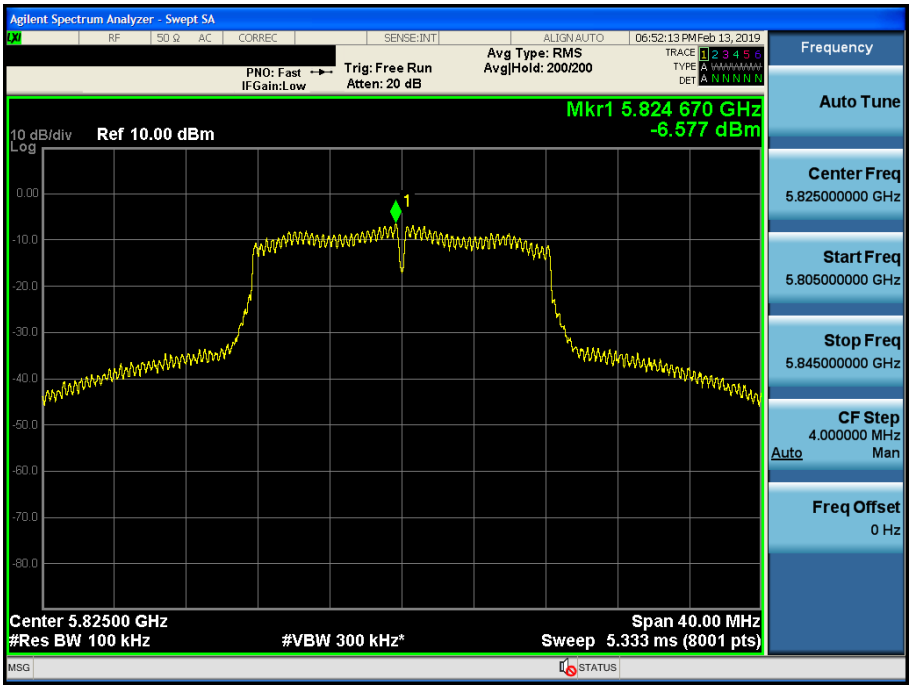
Test Mode: 802.11a & Ch.149

Maximum Power Spectral Density

Test Mode: 802.11a & Ch.157

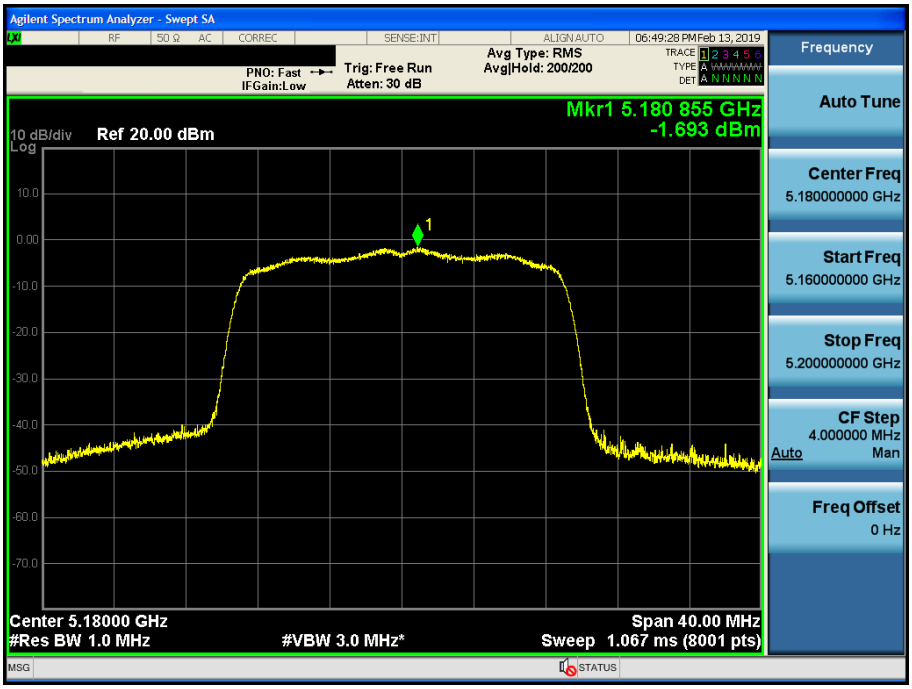


Maximum Power Spectral Density Test Mode: 802.11a & Ch.165



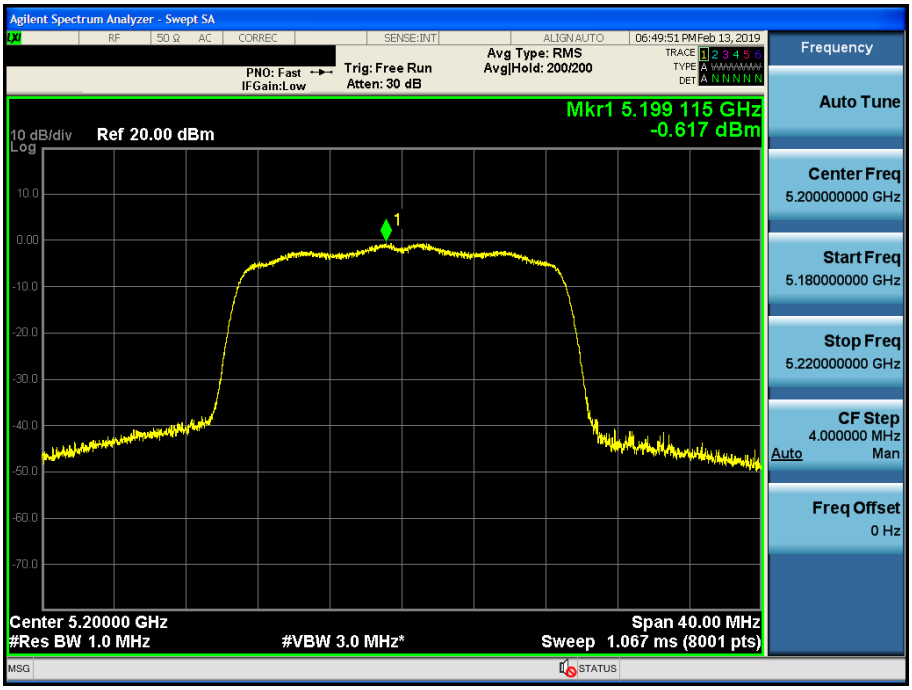
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.36

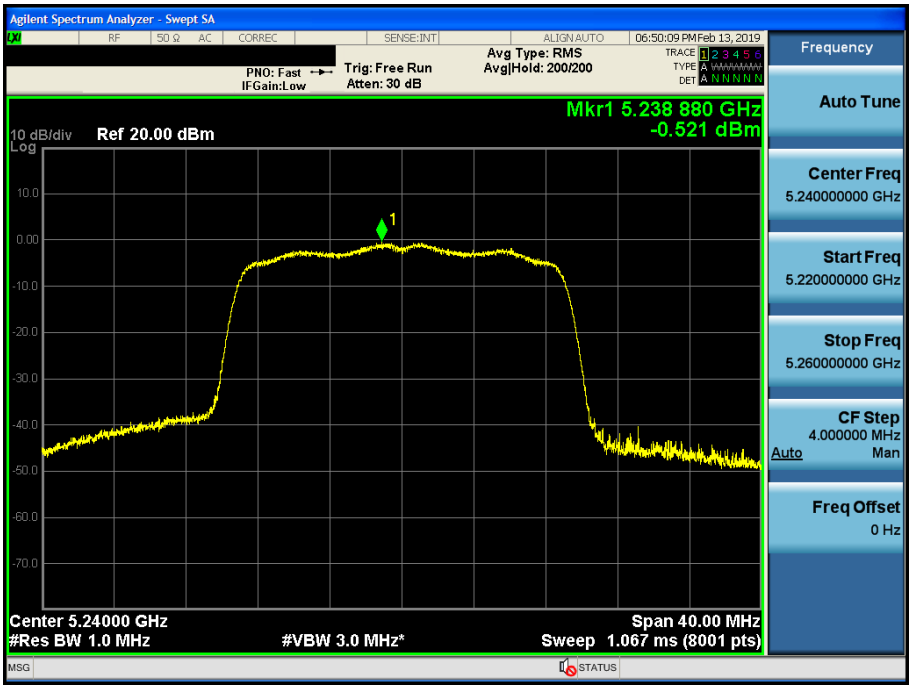


Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.40

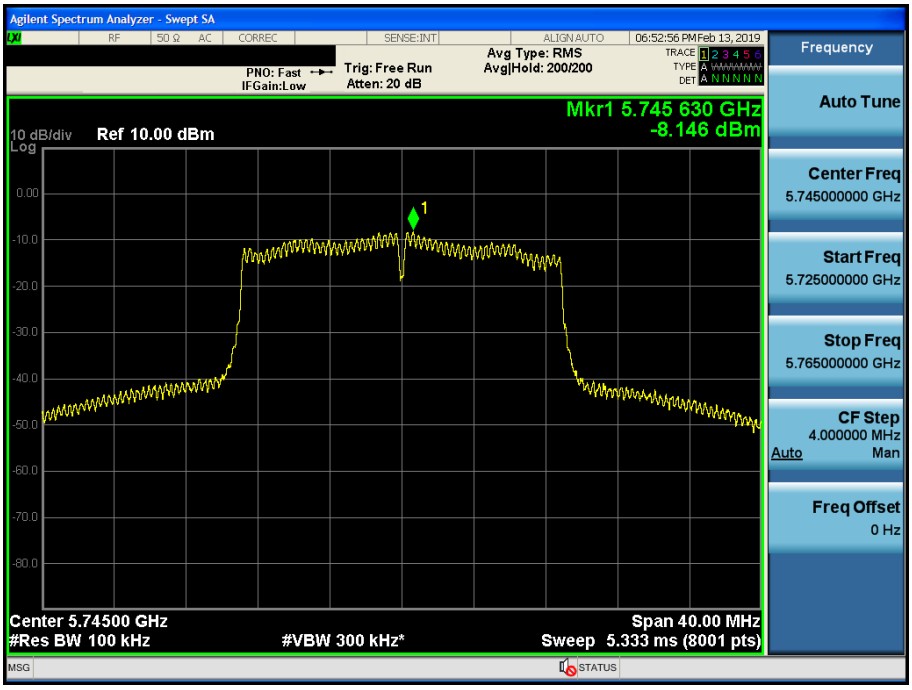


Maximum Power Spectral Density Test Mode: 802.11n HT20 & Ch.48



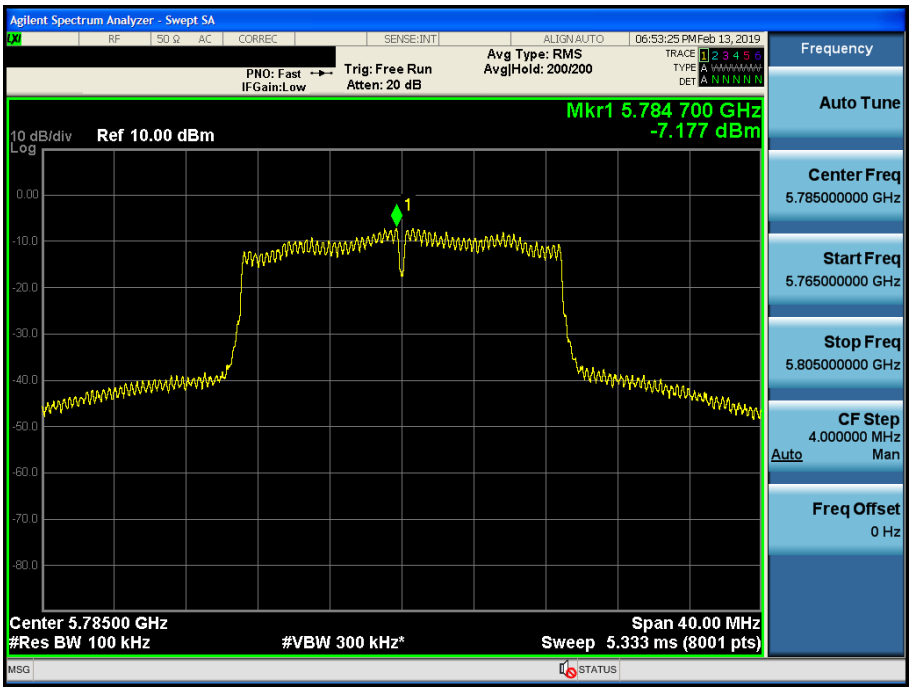
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.149

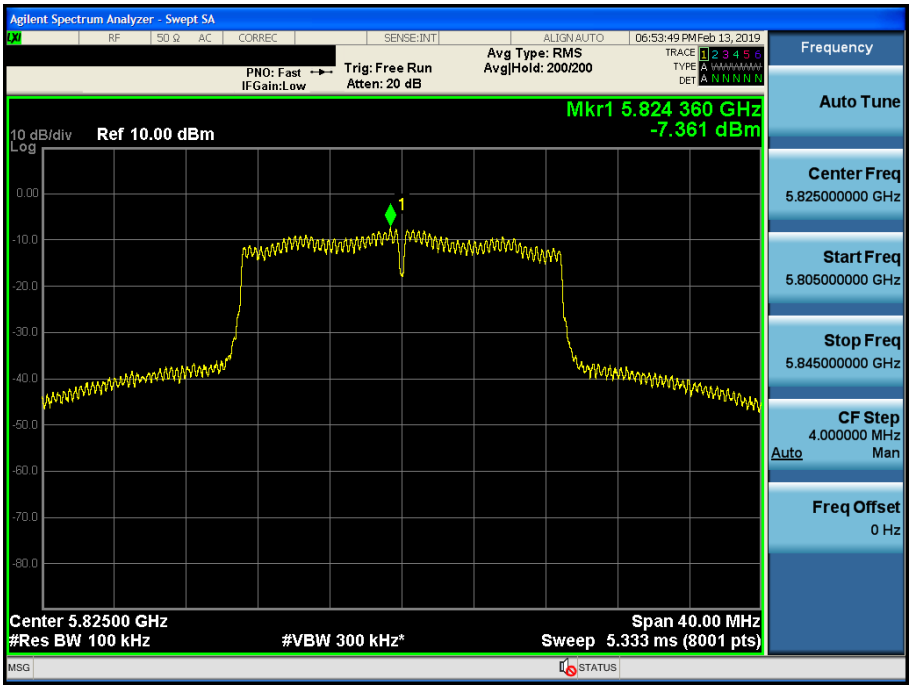


Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.157



Maximum Power Spectral Density Test Mode: 802.11n HT20 & Ch.165



8.5 Frequency Stability

▣ Test requirements

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 user's manual.

▣ Test Procedure

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -20℃ and +50℃. The temperature was incremented by 10℃ intervals and the unit was allowed to stabilize at each measurement. And the edge point of EBW (26dB or 6dB bandwidth) was reported.

▣ Test Results: Comply

U-NII 1 : (5180 MHz ~ 5240 MHz)

Supply Voltage (V DC)	TEMP (℃)	Operating Frequency	
		5180 MHz	5240 MHz
		26dBc low edge (Hz)	26dBc High edge(Hz)
3.70	+20(Ref)	5,170,721,000	5,249,163,000
	+50	5,170,753,000	5,249,185,000
	+40	5,170,742,000	5,249,179,000
	+30	5,170,725,000	5,249,167,000
	+20	5,170,721,000	5,249,163,000
	+10	5,170,719,000	5,249,158,000
	0	5,170,711,000	5,249,153,000
	-10	5,170,707,000	5,249,147,000
	-20	5,170,703,000	5,249,139,000
4.26	+20	5,170,747,000	5,249,142,000
3.55	+20	5,170,735,000	5,249,169,000

U-NII 3 : (5745 MHz ~ 5825 MHz)

Supply Voltage (V DC)	TEMP (℃)	Operating Frequency	
		5745 MHz	5825 MHz
		6dBc low edge (Hz)	6dBc low edge (Hz)
3.70	+20(Ref)	5,737,413,000	5,832,519,000
	+50	5,737,447,000	5,832,539,000
	+40	5,737,435,000	5,832,533,000
	+30	5,737,424,000	5,835,524,000
	+20	5,737,413,000	5,832,519,000
	+10	5,737,411,000	5,832,513,000
	0	5,737,407,000	5,832,503,000
	-10	5,737,395,000	5,832,497,000
	-20	5,737,381,000	5,832,493,000
4.26	+20	5,737,421,000	5,832,517,000
3.55	+20	5,737,429,000	5,832,509,000

8.6 Radiated Spurious Emission Measurements

▣ Test Procedure

▪ **FCC Part 15.209(a) and (b)**

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 – 0.490	2400/F(KHz)	300
0.490 – 1.705	24000/F(KHz)	30
1.705 – 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ **FCC Part 15.205 (a):** Only spurious emissions are permitted in any of the frequency bands listed below:

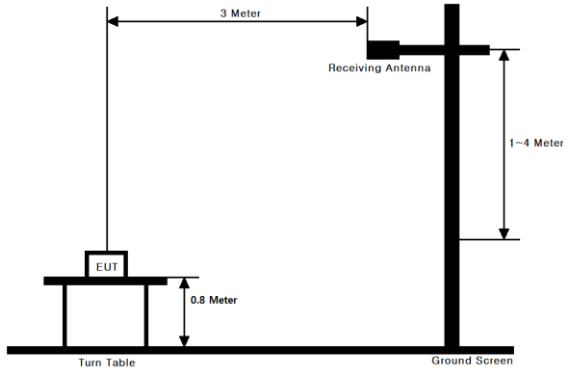
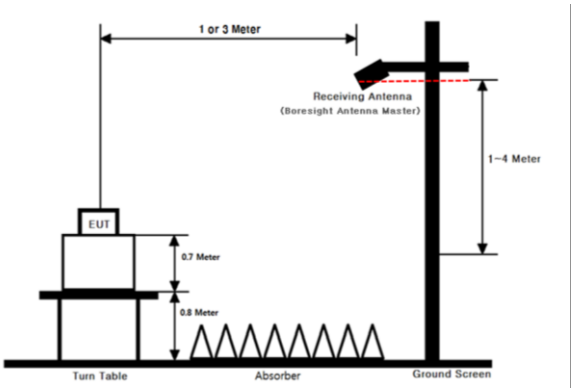
MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	160.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	160.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	160.7 ~ 160.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240	3600 ~ 4000		
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

▪ **FCC Part 15.205(b):** The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

▪ **FCC Part 15.407 (b):** Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the **5.15-5.25 GHz band**: all emissions outside of the **5.15-5.35 GHz band** shall not exceed an **EIRP of -27 dBm/MHz**.
(2) For transmitters operating in the **5.25-5.35 GHz band**: all emissions outside of the **5.15-5.35 GHz band** shall not exceed an **EIRP of -27 dBm/MHz**.
(3) For transmitters operating in the **5.47-5.725 GHz band**: all emissions outside of the **5.47-5.725 GHz band** shall not exceed an **EIRP of -27 dBm/MHz.**
(4) For transmitters operating in the **5.725-5.85 GHz band**: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
(6) Unwanted emissions **below 1 GHz** must comply with the general field strength limits set forth in **Section 15.209**. Further, any U-NII devices using an **AC power line** are required to comply also with the conducted limits set forth in **Section 15.207**.
(7) The provisions of §15.205 apply to intentional radiators operating under this section
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

▣ Test Procedure

Below 1GHz	Above 1GHz
	

▣ Test Procedure

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The turn table shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 1m or 3 m away from the receiving antenna, which is varied from 1m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

Radiated spurious emission measured using following Measurement Procedure **of KDB789033 D02v02r01**

► **General Requirements for Unwanted Emissions Measurements**

The following requirements apply to all unwanted emissions measurements, both in and outside of the restricted bands:

▪ EUT Duty Cycle

(1) The EUT shall be configured or modified to **transmit continuously** except as stated in (ii), below. The intent is to test at 100 percent duty cycle; however a small reduction in duty cycle (**to no lower than 98 percent**) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

(2) If **continuous transmission (or at least 98 percent duty cycle) cannot be achieved** due to hardware limitations of the EUT (e.g., overheating), the following additions to the measurement and reporting procedures are required:

- The EUT shall be configured to operate at the maximum achievable duty cycle.
- Measure the duty cycle, x, of the transmitter output signal.
- Adjustments to measurement procedures (e.g., increasing test time and number of traces averaged) shall be performed as described in the procedures below.
- The test report shall include the following additional information:
  - The reason for the duty cycle limitation.
  - The duty cycle achieved for testing and the associated transmit duration and interval between transmissions.
  - The sweep time and the amount of time used for trace stabilization during max-hold measurements for peak emission measurements.

(3) Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

► **Measurements below 1000 MHz**

a) Follow the requirements in section II.G.3, “General Requirements for Unwanted Emissions Measurements”.

b) Compliance shall be demonstrated using **CISPR quasi-peak detection**; however, **peak detection** is permitted as an alternative to quasi-peak detection.

► **Measurements Above 1000 MHz (Peak)**

a) Follow the requirements in section II.G.3, “General Requirements for Unwanted Emissions Measurements”.
b) Peak emission levels are measured by setting the analyzer as follows:
(i) **RBW = 1 MHz.**
(ii) **VBW ≥ 3 MHz.**
(iii) **Detector = Peak.**
(iv) Sweep time = Auto.
(v) Trace mode = Max hold.
(vi) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle. For example, at 50 percent duty cycle, the measurement time will increase by a factor of two relative to measurement time for continuous transmission.

► **Measurements Above 1000 MHz (Method AD)**

(i) **RBW = 1 MHz.**
(ii) **VBW ≥ 3 MHz.**
(iii) **Detector = RMS**, if span / (# of points in sweep) ≤ RBW / 2. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, the detector mode shall be set to peak.
(iv) Averaging type = power (i.e., RMS)
• As an alternative, the detector and averaging type may be set for linear voltage averaging. Some analyzers require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
(v) Sweep time = Auto.
(vi) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 percent duty cycle, at least 200 traces shall be averaged.
(vii) If tests are performed with the EUT transmitting at a duty cycle less than 98 percent, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
• **If power averaging (RMS) mode was used in step (iv) above, the correction factor is 10 log(1/x), where x is the duty cycle.** For example, if the transmit duty cycle was 50 percent, then 3 dB must be added to the measured emission levels.
• If linear voltage averaging mode was used in step (iv) above, the correction factor is 20 log (1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50 percent, then 6 dB must be added to the measured emission levels.
• If a specific emission is demonstrated to be continuous (100 percent duty cycle) rather than turning on and off with the transmit cycle, no duty cycle correction is required for that emission.

Please refer to Appendix II for the duty correction factor

▣ Measurement Data:

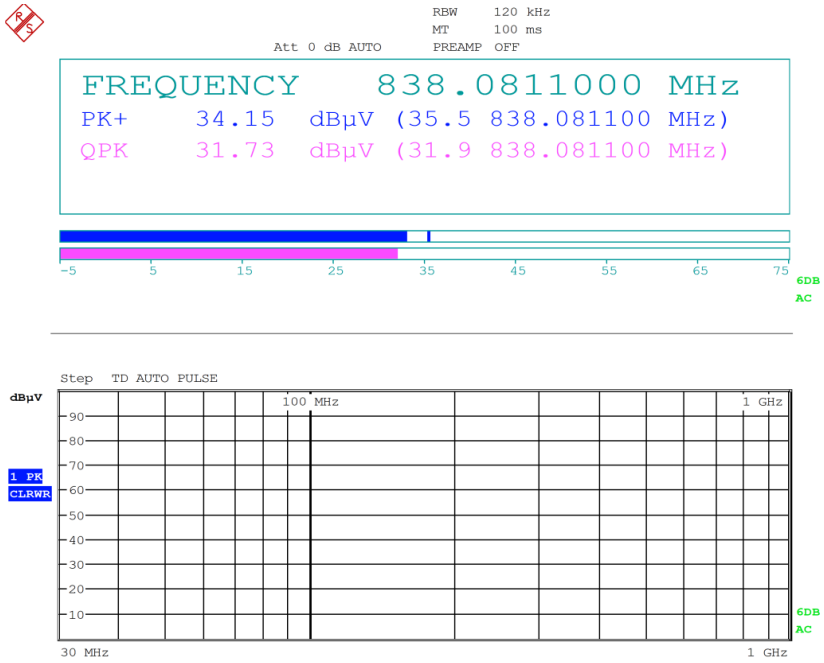
Radiated Spurious Emissions data(9 kHz ~ 1 GHz) : *802.11a*

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 3	165 (5825 MHz)	57.14	H	X	QP	33.40	-7.00	N/A	N/A	26.40	40.00	13.60
		316.03	H	X	QP	33.80	-5.40	N/A	N/A	28.40	46.00	17.60
		400.00	V	X	QP	34.90	-3.60	N/A	N/A	31.30	46.00	14.70
		838.08	H	X	QP	31.90	5.10	N/A	N/A	37.00	46.00	9.00
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-

Note.

1. Exploratory testing has been performed to determine the emissions characteristic of this EUT.
   And 5825MHz of 802.11a(TM2) was selected for final testing and reported.
2. No other unwanted emissions were found above listed frequencies.
3. Information of Distance Factor
   For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**
   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.
4. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

802.11a & 5825MHz & X axis & Hor Detector Mode : QP



Radiated Spurious Emissions data(1 ~ 40 GHz) : *802.11a*

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 1	36 (5180 MHz)	5148.33	V	Y	PK	53.57	1.80	N/A	N/A	55.37	74.00	18.63
		5148.74	V	Y	AV	42.61	1.80	0.13	N/A	44.54	54.00	9.46
		10362.14	V	Y	PK	46.21	6.04	N/A	N/A	52.25	74.00	21.75
	40 (5200 MHz)	10401.54	V	Y	PK	46.60	6.05	N/A	N/A	52.65	74.00	21.35
	48 (5240 MHz)	5391.40	V	Y	PK	51.41	2.63	N/A	N/A	54.04	74.00	19.96
		5392.11	V	Y	AV	41.85	2.63	0.13	N/A	44.61	54.00	9.39
		10477.86	V	Y	PK	44.97	6.08	N/A	N/A	51.05	74.00	22.95
U-NII 3	149 (5745 MHz)	5714.18	H	Z	PK	67.99	2.79	N/A	N/A	70.78	109.17	38.39
		5724.88	H	Z	PK	79.88	2.65	N/A	N/A	82.53	121.93	39.40
		11489.66	H	Y	PK	46.15	8.26	N/A	N/A	54.41	74.00	19.59
		11489.34	H	Y	AV	35.02	8.26	0.13	N/A	43.41	54.00	10.59
	157 (5785 MHz)	11571.78	H	Y	PK	45.86	8.34	N/A	N/A	54.20	74.00	19.80
		11569.96	H	Y	AV	35.44	8.34	0.13	N/A	43.91	54.00	10.09
	165 (5825 MHz)	5851.72	H	Z	PK	67.23	3.12	N/A	N/A	70.35	118.28	47.93
		5862.31	H	Z	PK	59.78	3.15	N/A	N/A	62.93	108.75	45.82
		11649.45	H	Y	PK	46.10	8.40	N/A	N/A	54.50	74.00	19.50
		11647.84	H	Y	AV	35.59	8.40	0.13	N/A	44.12	54.00	9.88

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Information of Distance Factor
   For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**
   When distance factor is “N/A”, the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
4. The limit is converted to field strength.
   E[dBuV/m] = EIRP[dBm] + 95.2 dB = -27 dBm + 95.2 = 68.2 dBuV/m

Radiated Spurious Emissions data(1 ~ 40 GHz)) : *802.11n(HT20)*

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 1	36 (5180 MHz)	5148.53	V	Y	PK	53.37	1.80	N/A	N/A	55.17	74.00	18.83
		5148.75	V	Y	AV	42.85	1.80	0.14	N/A	44.79	54.00	9.21
		10361.68	V	Y	PK	45.91	6.04	N/A	N/A	51.95	74.00	22.05
	40 (5200 MHz)	10398.07	V	Y	PK	46.19	6.05	N/A	N/A	52.24	74.00	21.76
	48 (5240 MHz)	5448.03	V	Y	PK	51.97	2.86	N/A	N/A	54.83	74.00	19.17
		5399.92	V	Y	AV	41.73	2.66	0.14	N/A	44.53	54.00	9.47
		10478.62	V	Y	PK	45.87	6.08	N/A	N/A	51.95	74.00	22.05
U-NII 3	149 (5745 MHz)	5714.23	H	Z	PK	66.33	2.79	N/A	N/A	69.12	109.18	40.06
		5724.10	H	Z	PK	79.69	2.66	N/A	N/A	82.35	120.15	37.80
		11487.94	H	Y	PK	45.17	8.25	N/A	N/A	53.42	74.00	20.58
		11489.52	H	Y	AV	34.97	8.26	0.14	N/A	43.37	54.00	10.63
	157 (5785 MHz)	11570.81	H	Y	PK	46.10	8.34	N/A	N/A	54.44	74.00	19.56
		11568.04	H	Y	AV	35.49	8.34	0.14	N/A	43.97	54.00	10.03
	165 (5825 MHz)	5850.90	H	Z	PK	65.67	3.11	N/A	N/A	68.78	120.15	51.37
		5861.09	H	Z	PK	58.72	3.15	N/A	N/A	61.87	109.09	47.22
		11652.04	H	Y	PK	45.37	8.41	N/A	N/A	53.78	74.00	20.22
		11647.94	H	Y	AV	35.76	8.40	0.14	N/A	44.30	54.00	9.70

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Information of Distance Factor
   For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**
   When distance factor is “N/A”, the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
4. The limit is converted to field strength.
   E[dBuV/m] = EIRP[dBm] + 95.2 dB = -27 dBm + 95.2 = 68.2 dBuV/m

8.7 AC Conducted Emissions

▣ **Test Requirements and limit, §15.207**

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

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

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

▣ **Test Configuration**

See test photographs for the actual connections between EUT and support equipment.

▣ **Test Procedure**

Conducted emissions from the EUT were measured according to the ANSI C63.10-2013.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

▣ **Measurement Data: Comply**

Note 1: See next pages for actual measured spectrum plots and data for worst case result.

AC Line Conducted Emissions (Graph)

Test Mode: U-NII 1 & 802.11a & 5180 MHz

Results of Conducted Emission

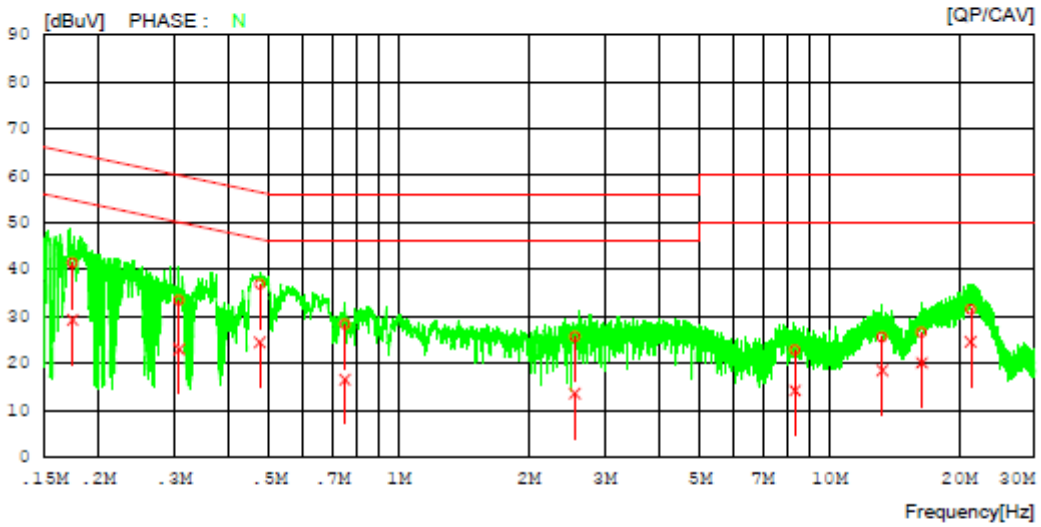
DTNC

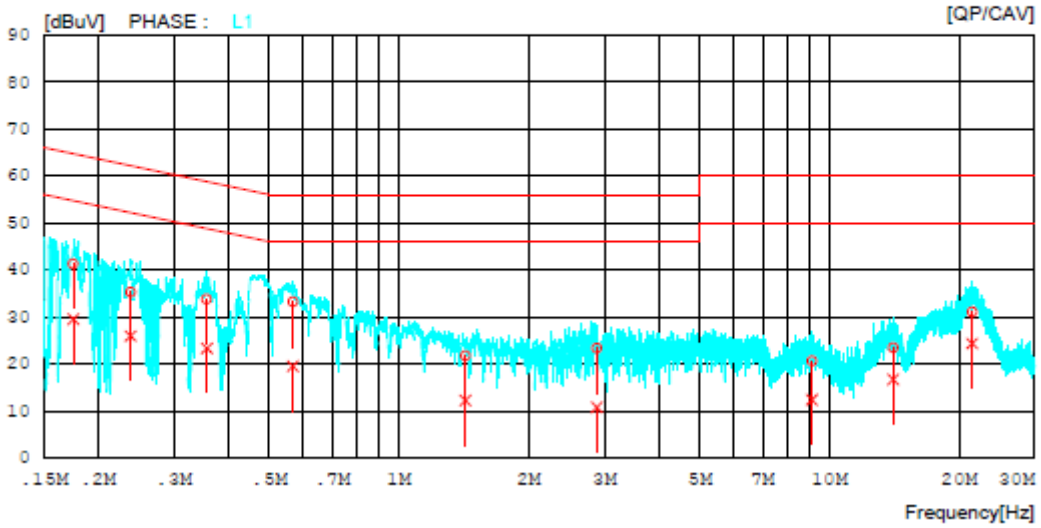
Date 2019-01-02

Order No.		Referrence No.	
Model No.	Rayo S1	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	23 'C / 45 %
Test Condition	5.1G (WLAN)	Operator	MyungHoon LEE

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV





AC Line Conducted Emissions (Data List)

Test Mode: U-NII 1 & 802.11a & 5180 MHz

Results of Conducted Emission

DTNC

Date 2019-01-02

Order No.		Referrence No.	
Model No.	Rayo S1	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	23 'C / 45 %
Test Condition	5.1G (WLAN)	Operator	MyungHoon LEE

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ	READING QP	READING CAV	C.FACTOR	RESULT QP	RESULT CAV	LIMIT QP	LIMIT CAV	MARGIN QP	MARGIN CAV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.17444	31.34	19.26	9.99	41.33	29.25	64.75	54.75	23.42	25.50	N
2	0.30834	23.47	13.01	9.99	33.46	23.00	60.02	50.02	26.56	27.02	N
3	0.47499	26.81	14.55	9.98	36.79	24.53	56.43	46.43	19.64	21.90	N
4	0.74881	18.33	6.57	10.02	28.35	16.59	56.00	46.00	27.65	29.41	N
5	2.56160	15.62	3.50	10.09	25.71	13.59	56.00	46.00	30.29	32.41	N
6	8.32320	12.52	3.91	10.31	22.83	14.22	60.00	50.00	37.17	35.78	N
7	13.27220	15.19	8.01	10.45	25.64	18.46	60.00	50.00	34.36	31.54	N
8	16.37820	16.14	9.60	10.51	26.65	20.11	60.00	50.00	33.35	29.89	N
9	21.27440	20.88	14.00	10.58	31.46	24.58	60.00	50.00	28.54	25.42	N
10	0.17519	31.27	19.51	9.96	41.23	29.47	64.71	54.71	23.48	25.24	L1
11	0.23817	25.26	15.91	9.95	35.21	25.86	62.16	52.16	26.95	26.30	L1
12	0.35786	23.72	13.30	9.96	33.68	23.26	58.78	48.78	25.10	25.52	L1
13	0.56728	23.13	9.47	9.97	33.10	19.44	56.00	46.00	22.90	26.56	L1
14	1.42620	11.66	2.14	10.00	21.66	12.14	56.00	46.00	34.34	33.86	L1
15	2.88080	13.15	0.66	10.07	23.22	10.73	56.00	46.00	32.78	35.27	L1
16	9.10960	10.19	1.99	10.29	20.48	12.28	60.00	50.00	39.52	37.72	L1
17	14.05720	12.96	6.17	10.42	23.38	16.59	60.00	50.00	36.62	33.41	L1
18	21.44360	20.41	13.75	10.52	30.93	24.27	60.00	50.00	29.07	25.73	L1

AC Line Conducted Emissions (Graph)

Test Mode: U-NII 3 & 802.11a & 5745 MHz

Results of Conducted Emission

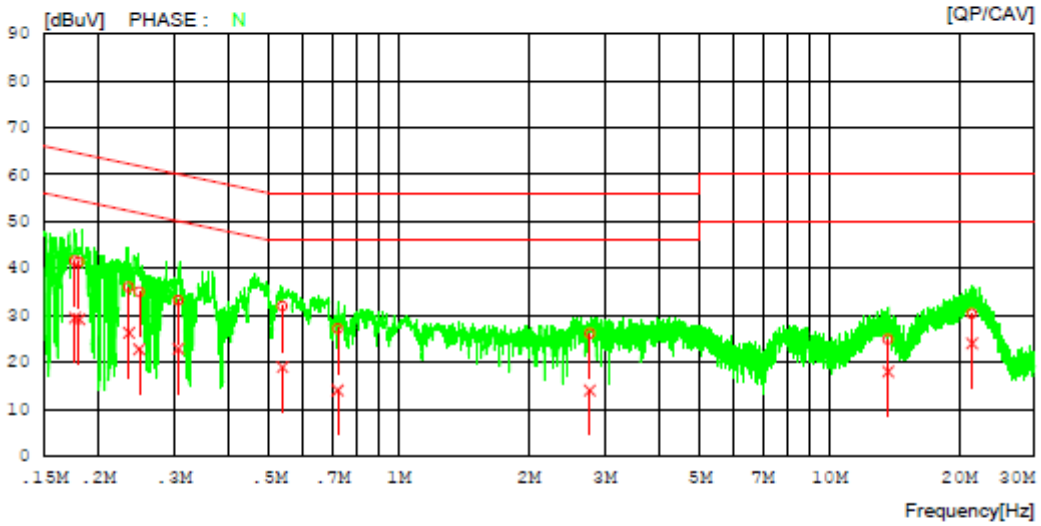
DTNC

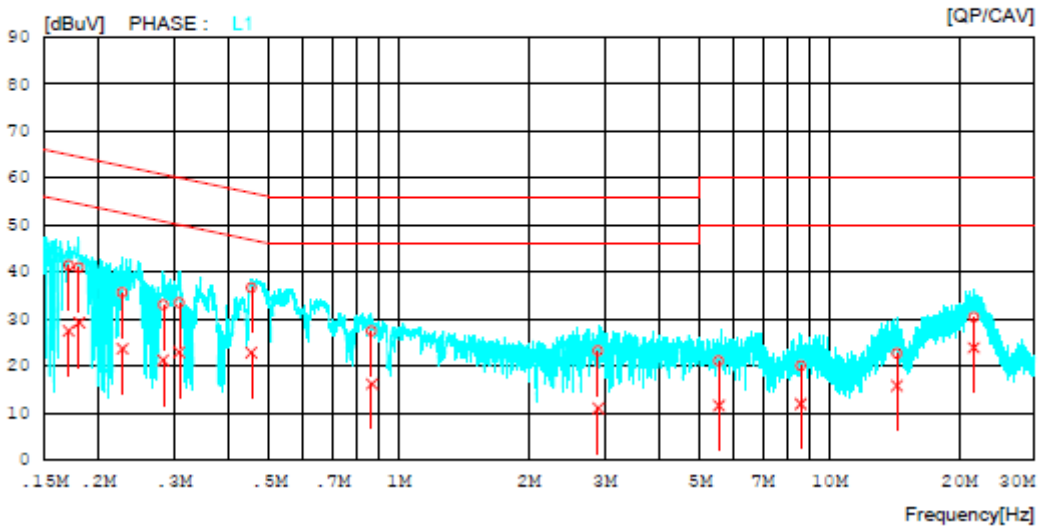
Date 2019-01-02

Order No.		Referrence No.	
Model No.	Rayo S1	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	23 'C / 45 %
Test Condition	5.7G (WLAN)	Operator	MyungHoon LEE

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV





AC Line Conducted Emissions (Data List)

Test Mode: U-NII 3 & 802.11a & 5745 MHz

Results of Conducted Emission

DTNC Date 2019-01-02

Order No.		Referrence No.	
Model No.	Rayo S1	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	23 ℃ / 45 %
Test Condition	5.7G (WLAN)	Operator	MyungHoon LEE

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ	READING QP	READING CAV	C.FACTOR	RESULT QP	RESULT CAV	LIMIT QP	LIMIT CAV	MARGIN QP	MARGIN CAV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.17664	31.63	19.52	9.99	41.62	29.51	64.64	54.64	23.02	25.13	N
2	0.18073	31.36	19.19	9.99	41.35	29.18	64.45	54.45	23.10	25.27	N
3	0.23580	26.06	16.28	9.98	36.04	26.26	62.24	52.24	26.20	25.98	N
4	0.24917	24.98	12.80	9.98	34.96	22.78	61.78	51.78	26.82	29.00	N
5	0.30726	23.24	12.88	9.99	33.23	22.87	60.04	50.04	26.81	27.17	N
6	0.53615	21.92	8.98	9.99	31.91	18.97	56.00	46.00	24.09	27.03	N
7	0.72107	17.20	4.02	10.02	27.22	14.04	56.00	46.00	28.78	31.96	N
8	2.77560	16.06	3.93	10.11	26.17	14.04	56.00	46.00	29.83	31.96	N
9	13.69420	14.40	7.53	10.45	24.85	17.98	60.00	50.00	35.15	32.02	N
10	21.42360	19.71	13.48	10.58	30.29	24.06	60.00	50.00	29.71	25.94	N
11	0.17093	31.32	17.40	9.96	41.28	27.36	64.92	54.92	23.64	27.56	L1
12	0.18081	30.94	19.19	9.96	40.90	29.15	64.45	54.45	23.55	25.30	L1
13	0.22777	25.53	13.64	9.95	35.48	23.59	62.53	52.53	27.05	28.94	L1
14	0.28323	23.01	11.19	9.95	32.96	21.14	60.72	50.72	27.76	29.58	L1
15	0.30870	23.37	12.94	9.95	33.32	22.89	60.01	50.01	26.69	27.12	L1
16	0.45364	26.58	12.79	9.96	36.54	22.75	56.81	46.81	20.27	24.06	L1
17	0.86415	17.34	6.10	9.98	27.32	16.08	56.00	46.00	28.68	29.92	L1
18	2.90320	13.01	0.86	10.07	23.08	10.93	56.00	46.00	32.92	35.07	L1
19	5.53640	10.85	1.28	10.18	21.03	11.46	60.00	50.00	38.97	38.54	L1
20	8.58360	9.66	1.51	10.28	19.94	11.79	60.00	50.00	40.06	38.21	L1
21	14.34740	12.11	5.29	10.44	22.55	15.73	60.00	50.00	37.45	34.27	L1
22	21.63920	19.81	13.30	10.52	30.33	23.82	60.00	50.00	29.67	26.18	L1

8.8 Occupied Bandwidth (99%)

▣ Test Requirements

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured

▣ Test Configuration

Refer to the APPENDIX I.

▣ TEST PROCEDURE

- Procedure: RSS-Gen[6.7]

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

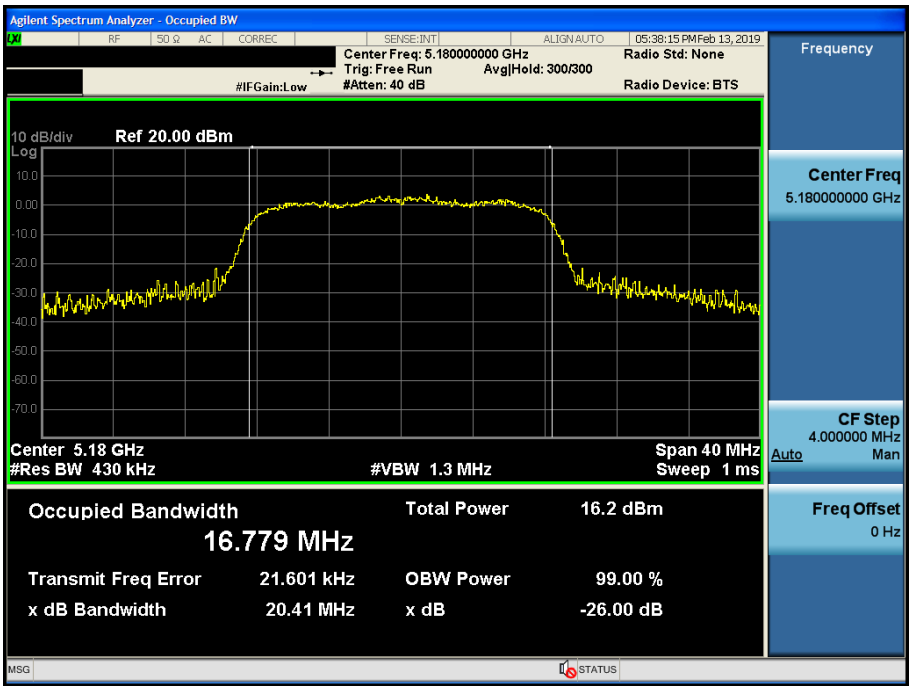
▣ Test Result : Comply

. Mode	Bands	Channel	Frequency [MHz]	Test Result [MHz]
802.11a	U-NII 1	36	5180	16.78
		40	5200	16.71
		48	5240	16.68
	U-NII 3	149	5745	17.04
		157	5785	17.13
		165	5825	17.44
802.11n(HT20)	U-NII 1	36	5180	17.58
		40	5200	17.59
		48	5240	17.59
	U-NII 3	149	5745	17.69
		157	5785	17.76
		165	5825	17.87

▣ RESULT PLOTS

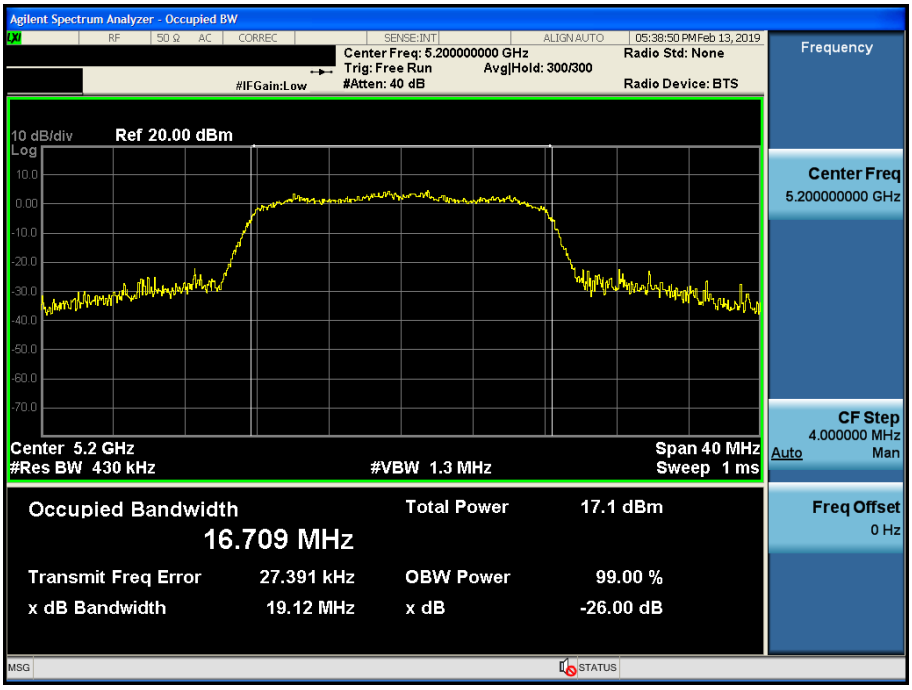
Occupied Bandwidth 99%

Test Mode: 802.11a & Ch.36

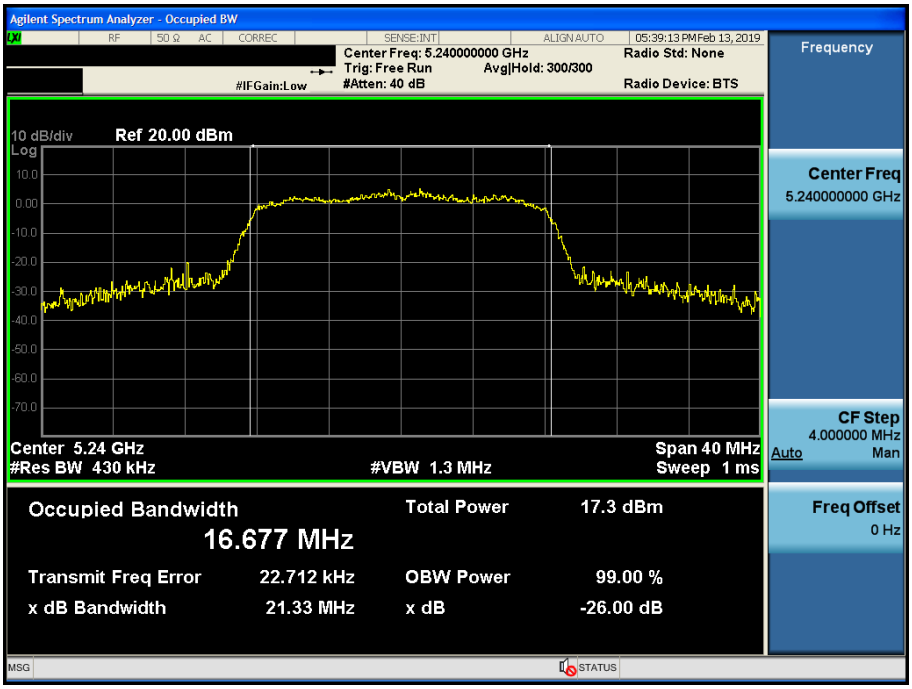


Occupied Bandwidth 99%

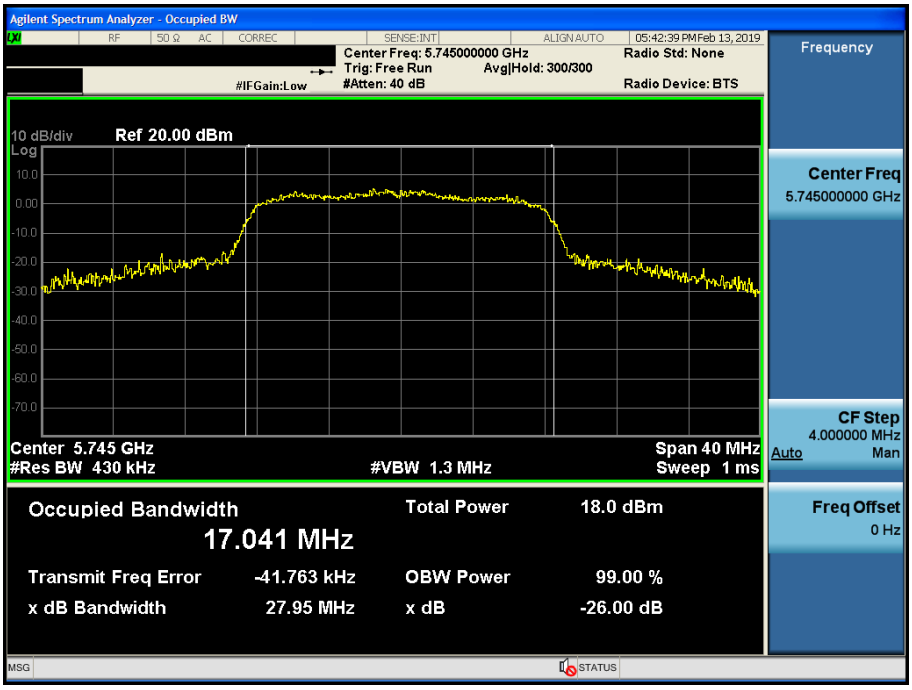
Test Mode: 802.11a & Ch.40



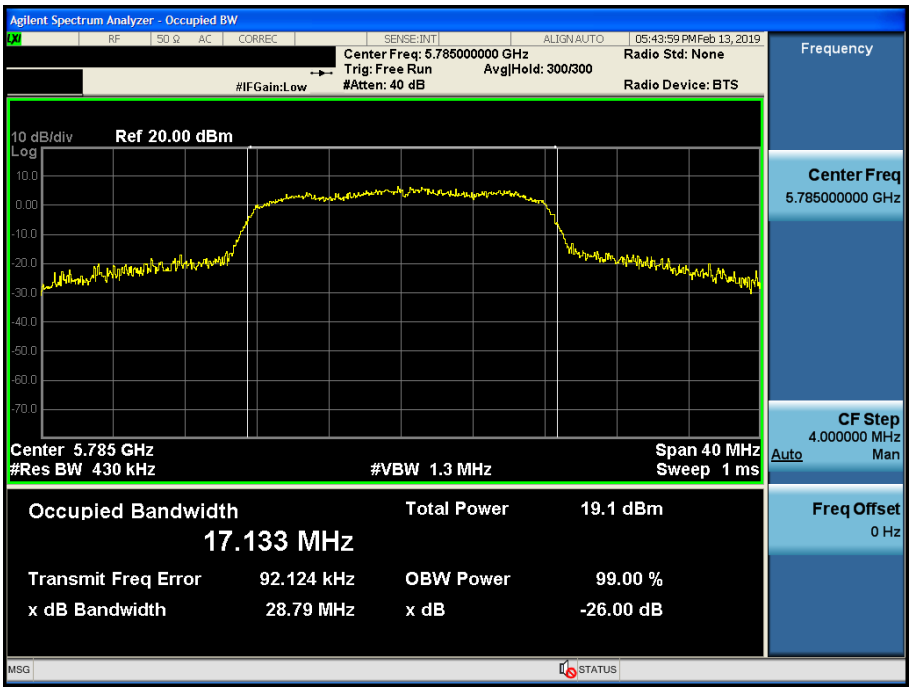
Occupied Bandwidth 99% Test Mode: 802.11a & Ch.48



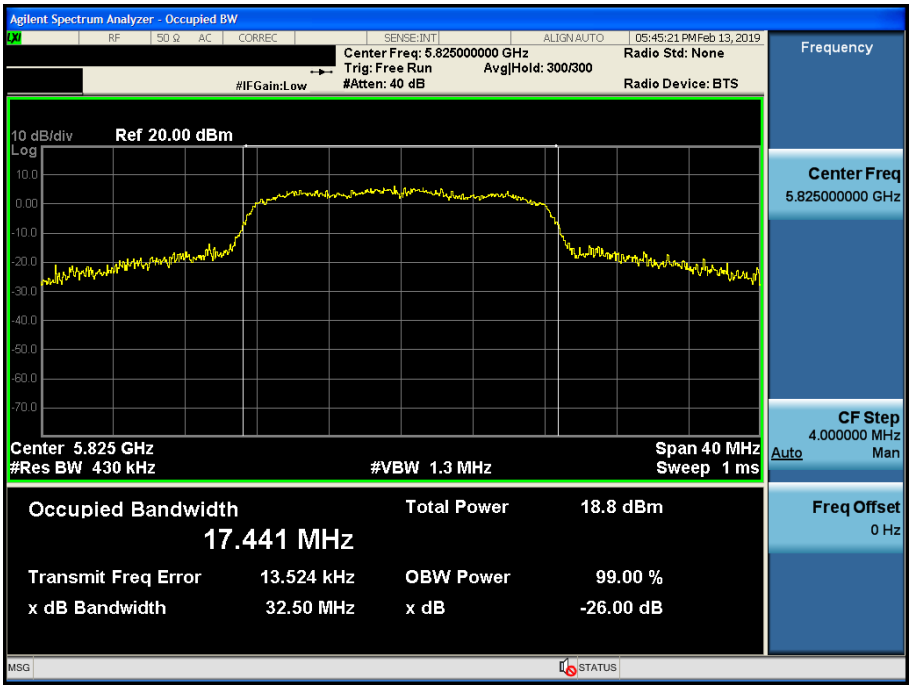
Occupied Bandwidth 99% Test Mode: 802.11a & Ch.149



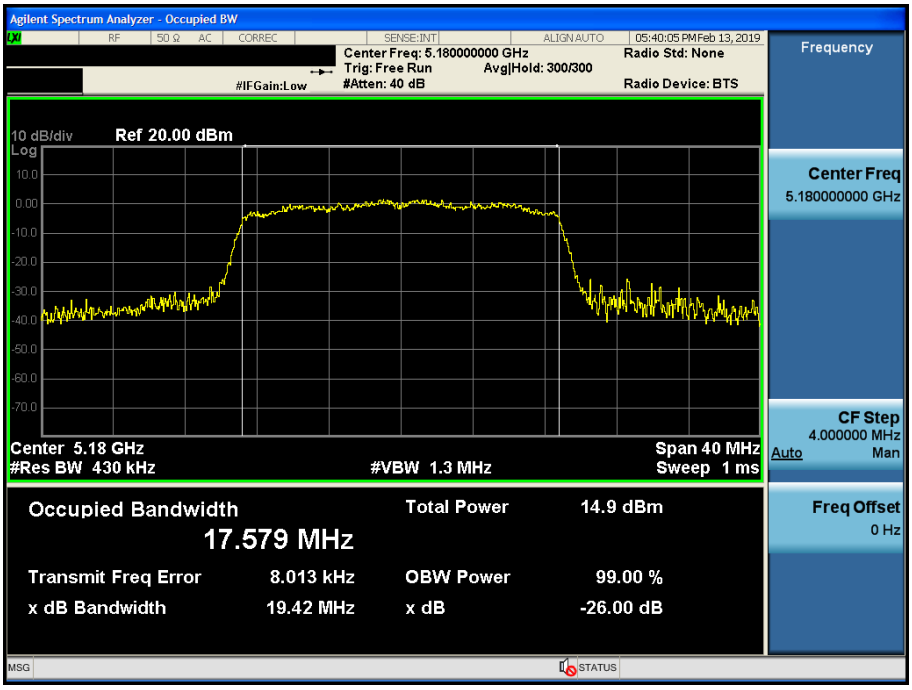
Occupied Bandwidth 99% Test Mode: 802.11a & Ch.157



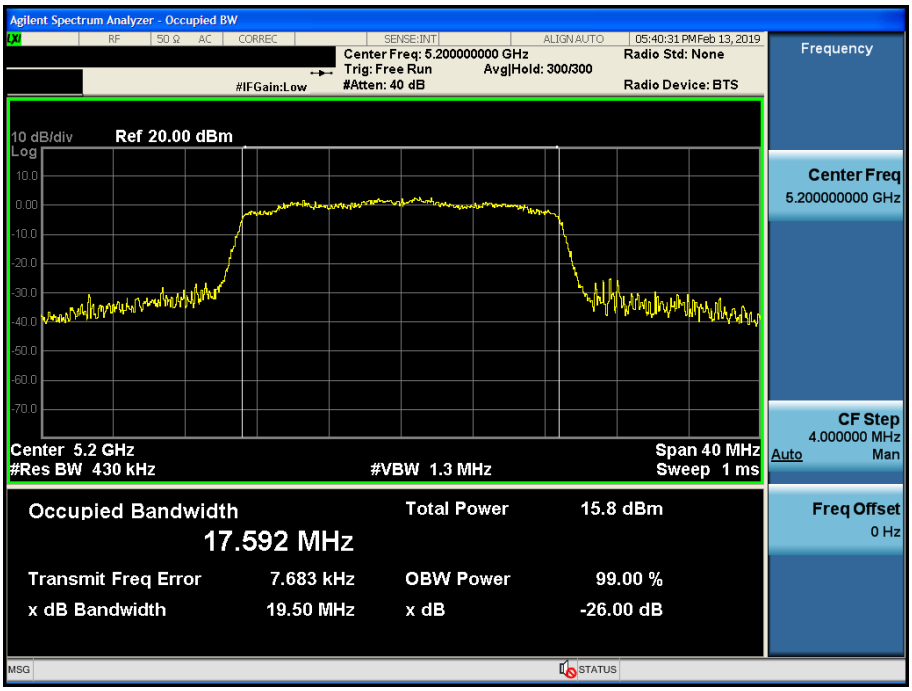
Occupied Bandwidth 99% Test Mode: 802.11a & Ch.165



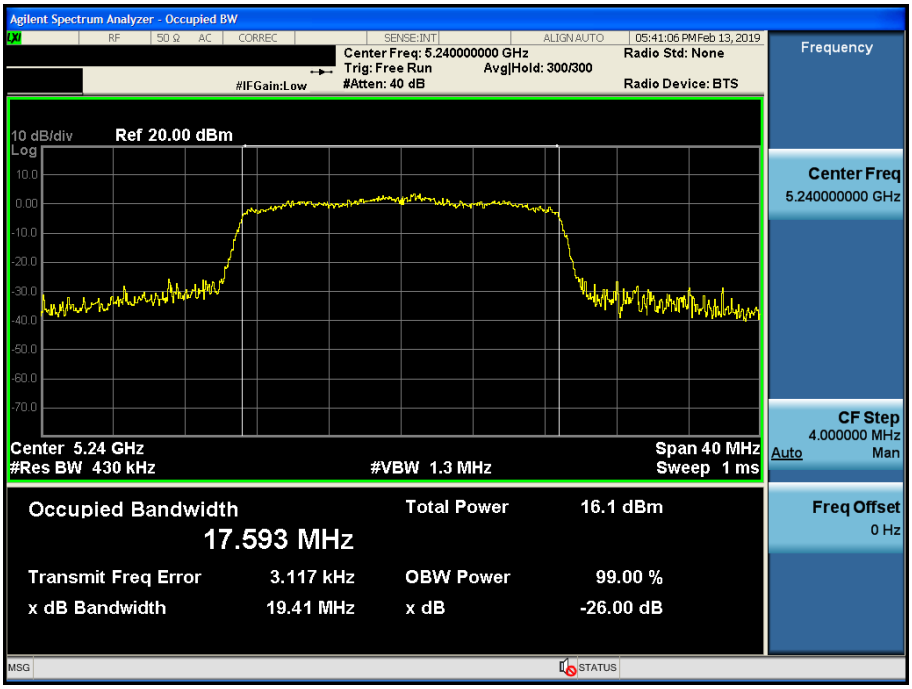
Occupied Bandwidth 99% Test Mode: 802.11n(HT20) & Ch.36



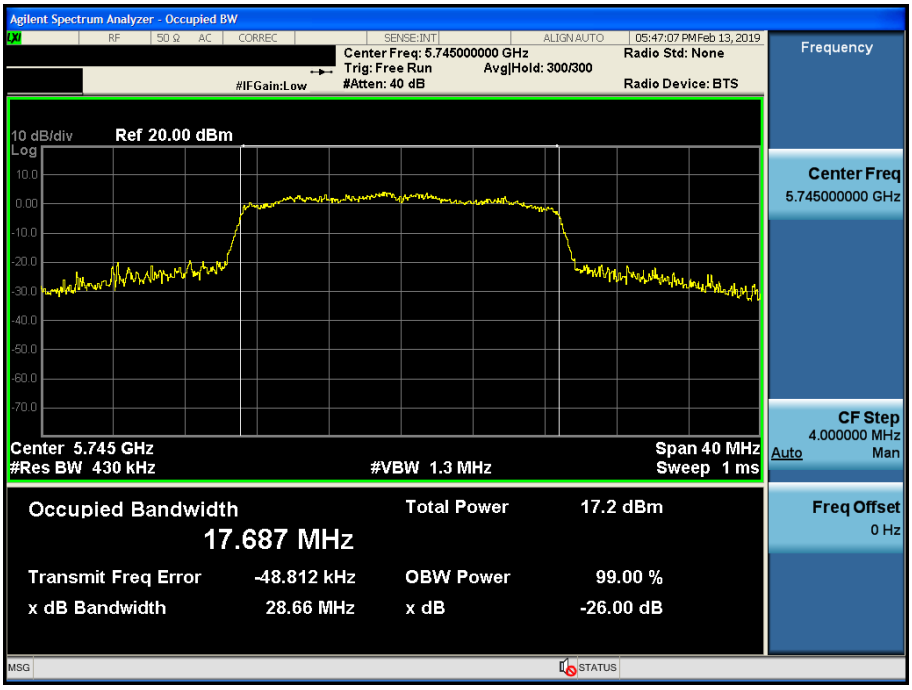
Occupied Bandwidth 99% Test Mode: 802.11n(HT20) & Ch.40



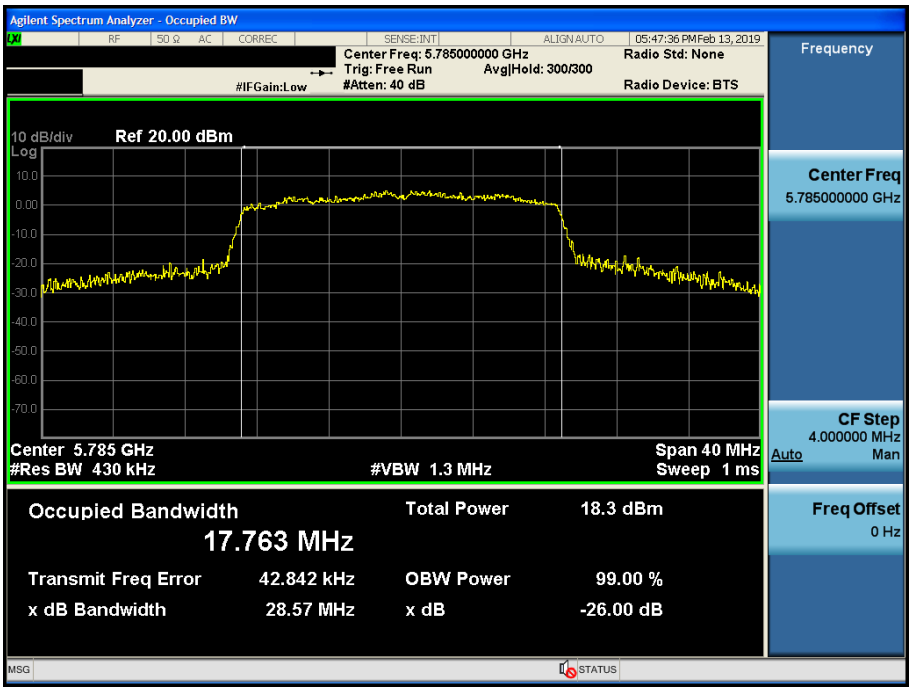
Occupied Bandwidth 99% Test Mode: 802.11n(HT20) & Ch.48



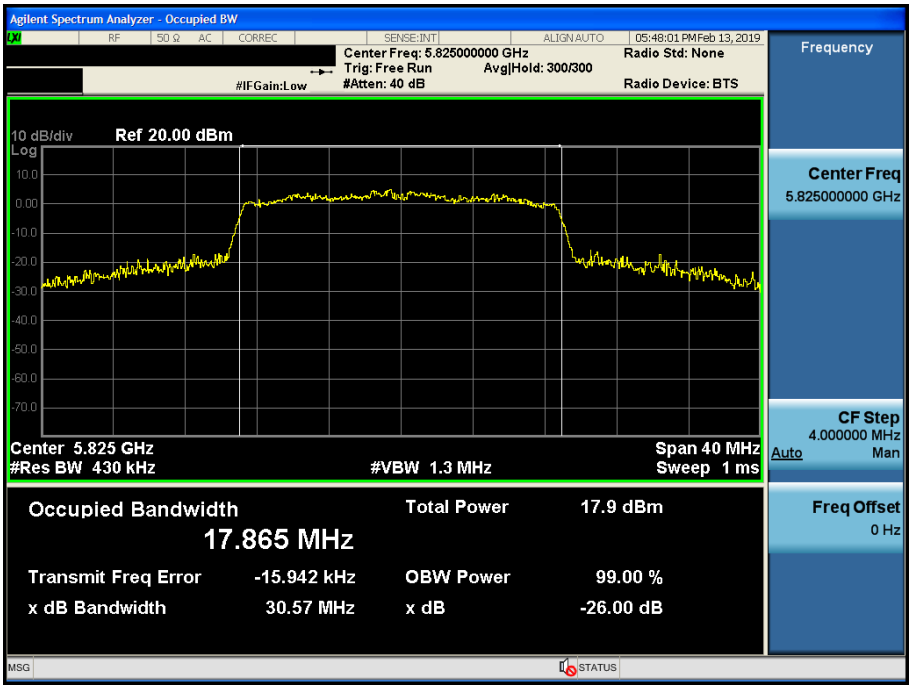
Occupied Bandwidth 99% Test Mode: 802.11n(HT20) & Ch.149



Occupied Bandwidth 99% Test Mode: 802.11n(HT20) & Ch.157



Occupied Bandwidth 99% Test Mode: 802.11n(HT20) & Ch.165



9. LIST OF TEST EQUIPMENT

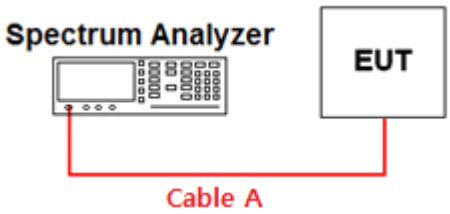
Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY50410357
Spectrum Analyzer	Agilent Technologies	N9030A	18/07/09	19/07/09	MY53310140
Horn Antenna	ETS-Lindgren	3115	18/01/30	20/01/30	6419
Horn Antenna	Schwarzbeck	BBHA 9120C	17/12/04	19/12/04	9120C-561
Horn Antenna	A.H.Systems Inc.	SAS-574	17/07/31	19/07/31	155
Loop Antenna	Schwarzbeck	FMZB1513	18/01/30	20/01/30	1513-128
Biglog Antenna	Schwarzbeck	VULB 9160	18/07/13	20/07/13	3359
EMI Test Receiver	Rohde Schwarz	ESCI7	18/03/13	19/03/13	100364
EMI Test Receiver	Rohde Schwarz	ESCI7	18/02/12 19/01/30	19/02/12 20/01/30	100910
Multimeter	FLUKE	17B	18/12/18	19/12/18	26030065WS
Thermohygrometer	BODYCOM	BJ5478	18/07/09	19/07/09	NA
Thermohygrometer	BODYCOM	BJ5478	18/01/03 18/12/27	19/01/03 19/12/27	120612-1
Thermohygrometer	BODYCOM	BJ5478	18/01/03 18/12/27	19/01/03 19/12/27	120612-2
HYGROMETER	TESTO	608-H1	18/02/10 19/01/31	19/02/10 20/01/31	34862883
Signal Generator	Rohde Schwarz	SMBV100A	18/12/19	19/12/19	255571
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	18/09/27	19/09/27	101333
LISN	SCHWARZBECK	NNLK 8121	18/03/20	19/03/20	06183
PreAmplifier	H.P	8447D	18/12/18	19/12/18	2944A07774
PreAmplifier	tsj	MLA-0118-J01-45	18/12/19	19/12/19	17138
PreAmplifier	tsj	MLA-1840-J02-45	18/07/06	19/07/06	16966-10728
Attenuator	SMAJK	SMAJK-2-3	18/07/02	19/07/02	3
Attenuator	Aeroflex/Weinschel	56-3	18/07/02	19/07/02	Y2370
Attenuator	SRTechnology	F01-B0606-01	18/07/02	19/07/02	13092403
Attenuator	Hefei Shunze	SS5T2.92-10-40	18/07/03	19/07/03	16012202
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	18/07/02	19/07/02	3
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	18/07/02	19/07/02	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	18/07/02	19/07/02	1
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	18/07/04	19/07/04	1338003 1249304
Cable	Radiall	TESTPRO3	18/07/06	19/07/06	M-01
Cable	Junkosha	MWX315	18/11/19	19/11/19	M-05
Cable	Junkosha	MWX221	18/11/19	19/11/19	M-06
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-07
Cable	DT&C	Cable	18/07/06	19/07/06	G-13
Cable	DT&C	Cable	18/07/06	19/07/06	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	18/07/06	19/07/06	G-15
Cable	DT&C	CABLE	18/06/25	19/06/25	RF-20
Cable	DT&C	Cable	18/07/05	19/07/05	RF-82

Note 1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note 2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

APPENDIX I

Conducted Test set up Diagram

▪ Conducted Measurement



APPENDIX II

Duty Cycle Information

▣ Test Procedure

Duty Cycle [X = On Time / (On + Off time)] is measured using Measurement Procedure **of KDB789033 D02v02r01**

1. Set the center frequency of the spectrum analyzer to the center frequency of the transmission.
2. Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value.
3. Set VBW ≥ RBW. Set detector = peak.
4. Note : The zero-span measurement method shall not be used unless both **RBW and VBW are > 50/*T***, where *T* is defined in section II.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* ≤ 16.7 microseconds.)

   T : The minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
   (***T* = On time** of the above table since the EUT operates with above fixed Duty Cycle and it is the minimum On time)

▣ Test Results:

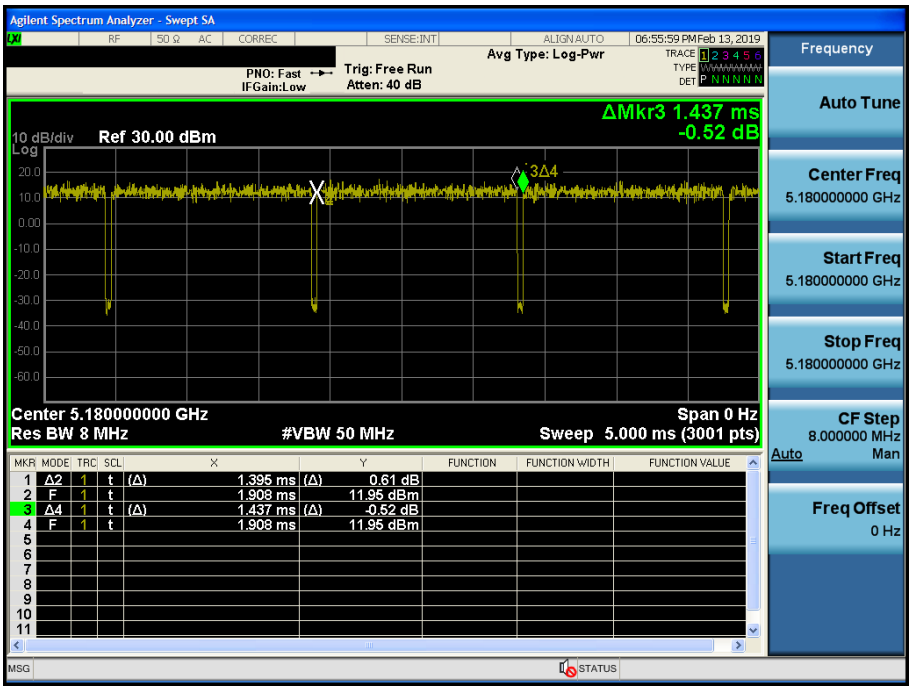
Duty cycle

Mode	Data Rate	Tested Frequency [MHz]	Maximum Achievable Duty Cycle (*x*) = On / (On+Off)			Duty Cycle Correction Factor [dB]	50/*T* [kHz]
			On Time [ms]	(On+Off) Time [ms]	*x*		
802.11a	6Mbps	5180	1.40	1.44	97.08	0.13	35.71
802.11n (HT20)	MCS0	5180	1.31	1.35	96.96	0.14	38.17

Single Transmit

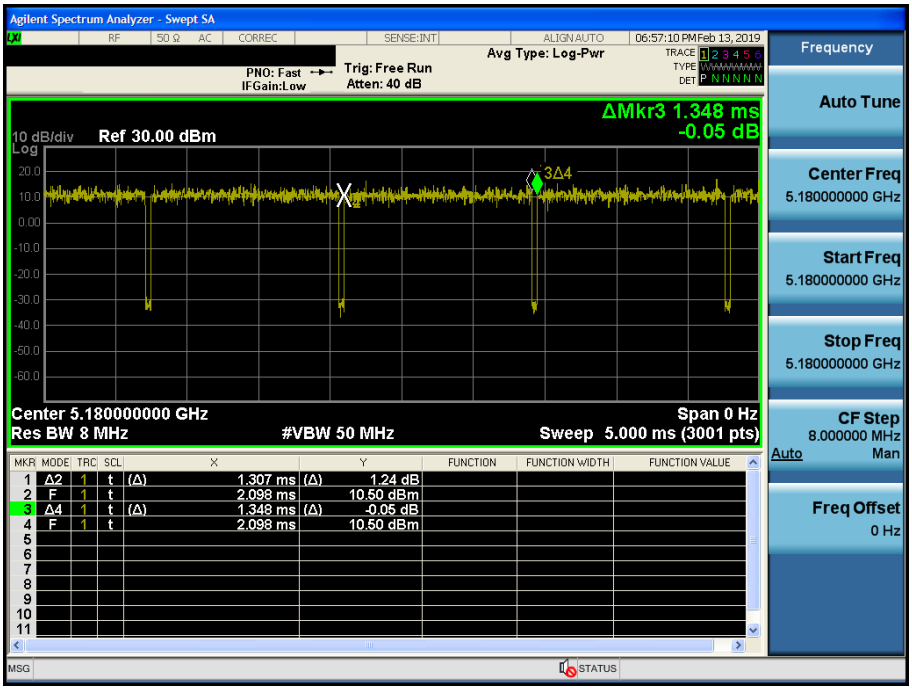
Duty Cycle

Test Mode: 802.11a & Ch.36



Duty Cycle

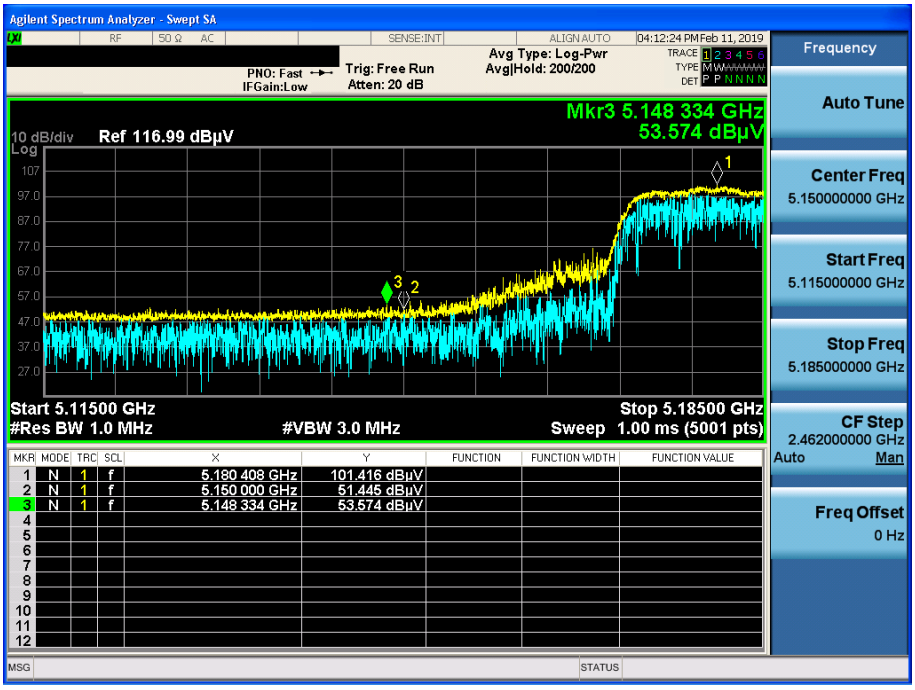
Test Mode: 802.11n HT20 & Ch.36



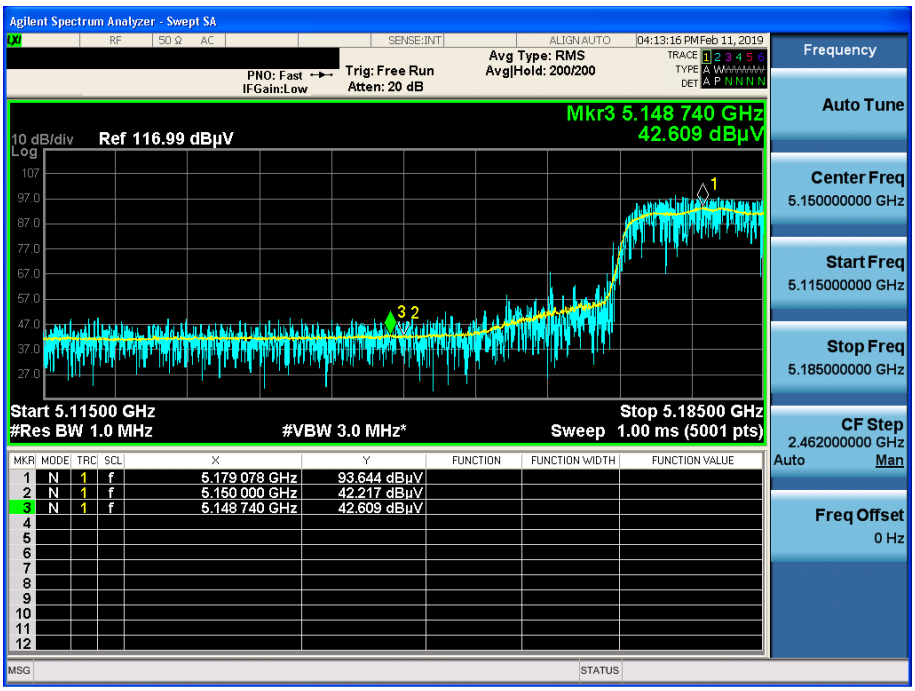
APPENDIX III

Unwanted Emissions (Radiated) Test Plot

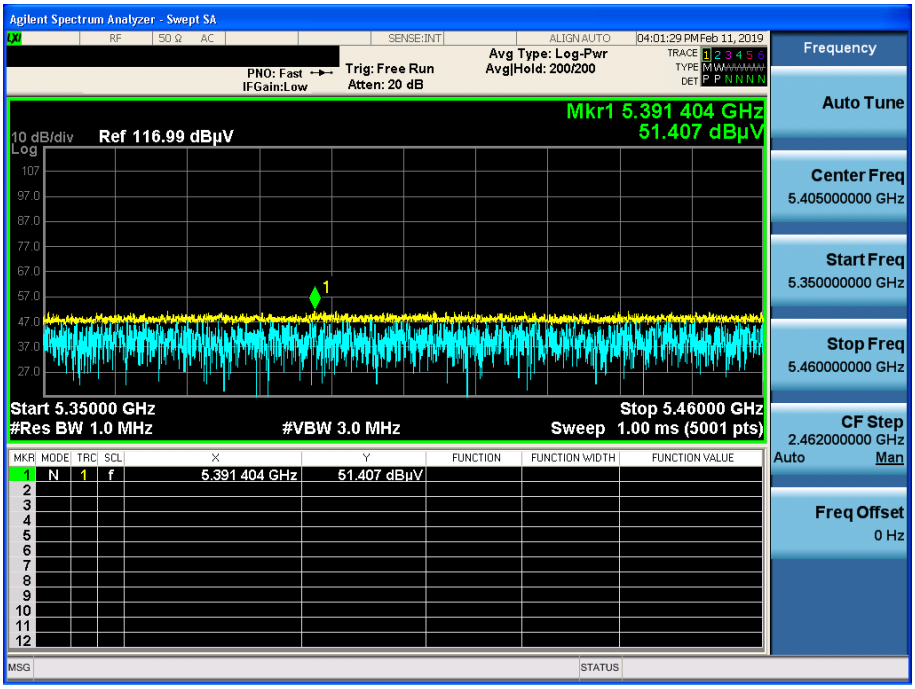
802.11a & U-NII 1 & Ch.36 & Y axis & Ver — Detector Mode : PK



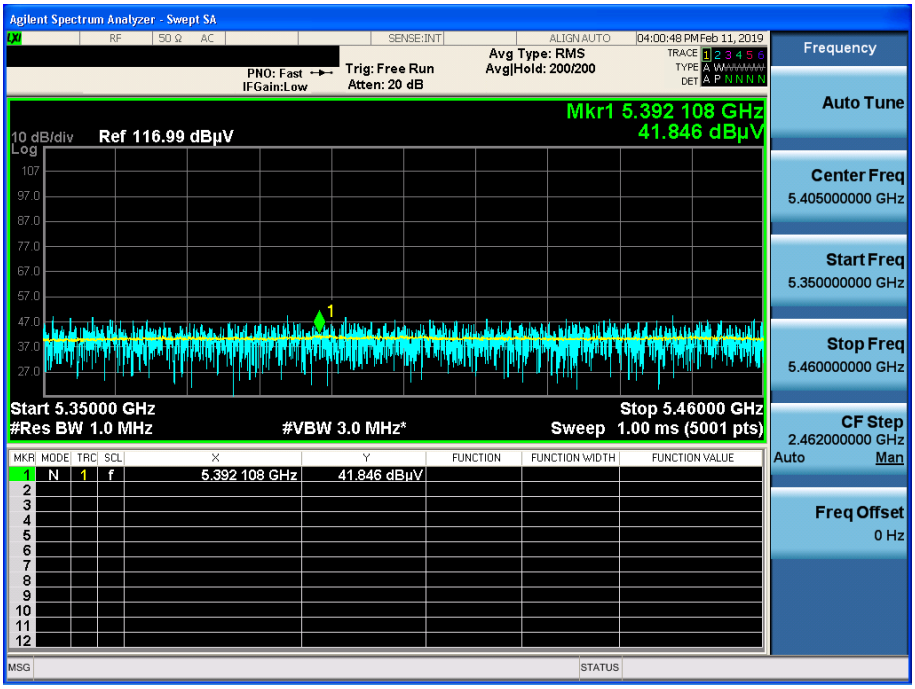
802.11a & U-NII 1 & Ch.36 & Y axis & Ver — Detector Mode : AV



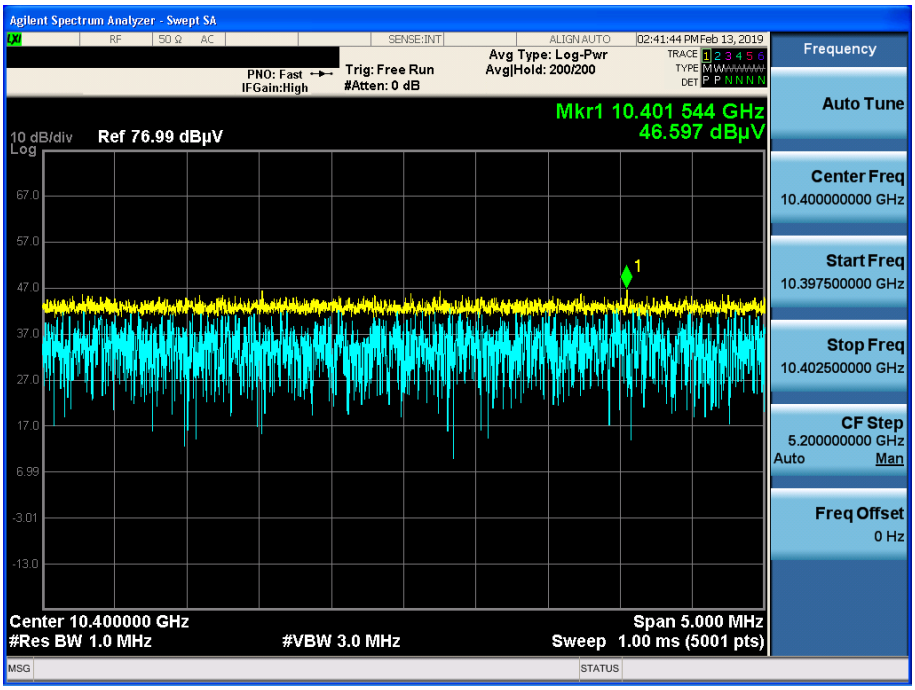
802.11a & U-NII 1 & Ch.48 & Y axis & Ver **Detector Mode : PK**



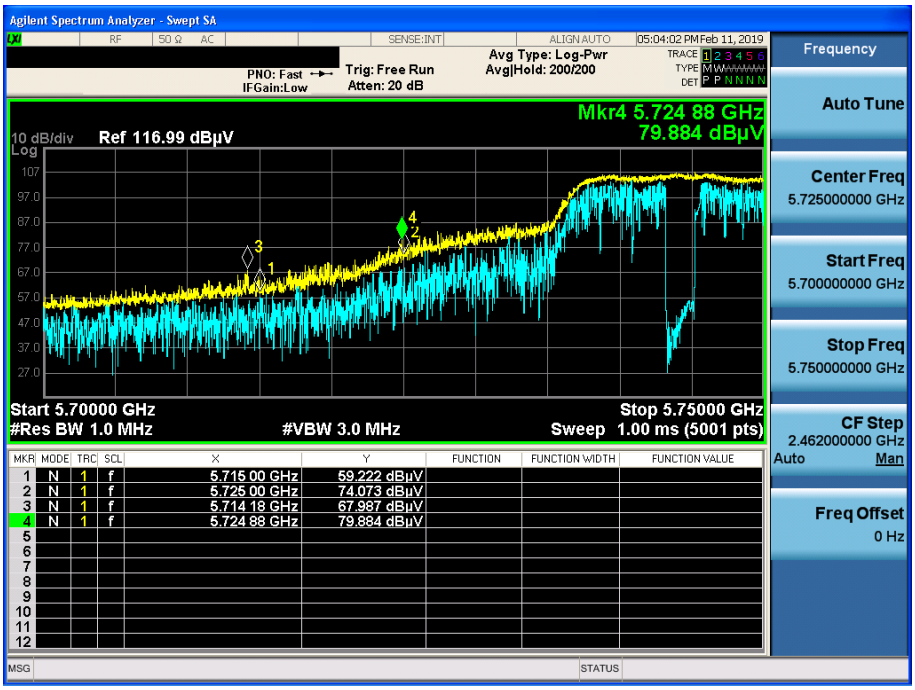
802.11a & U-NII 1 & Ch.48 & Y axis & Ver **Detector Mode : AV**



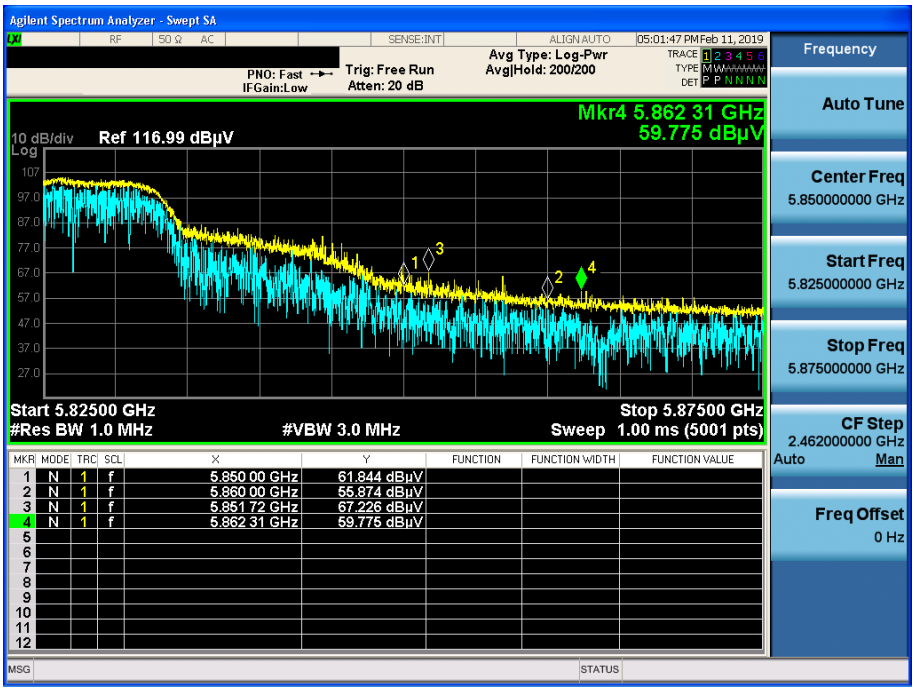
802.11a & U-NII 1 & Ch.40 & Y axis & Ver **Detector Mode : PK**



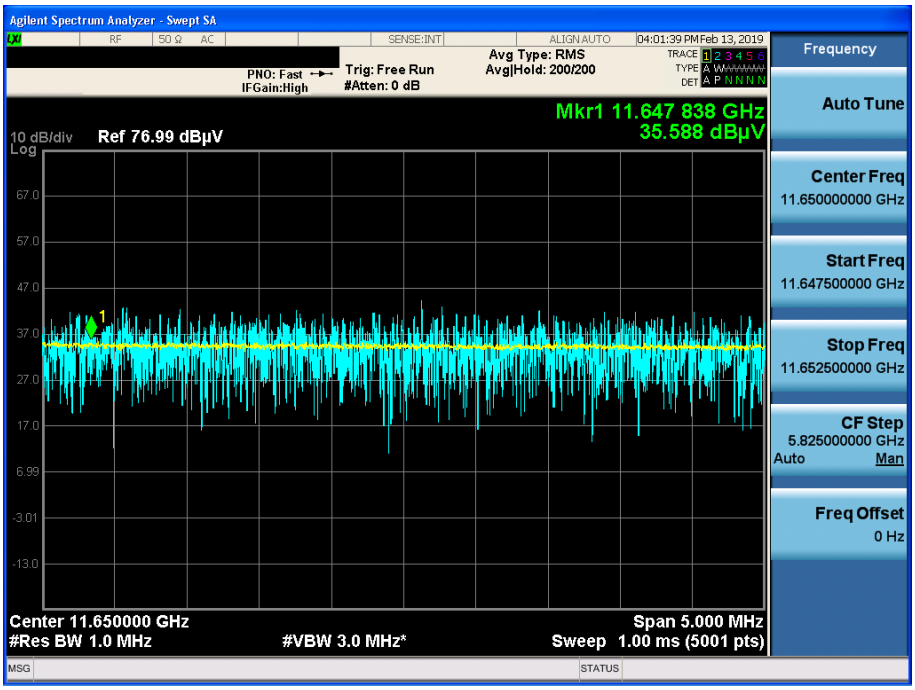
802.11a & U-NII 3 & Ch.149 & Z axis & Hor **Detector Mode : PK**



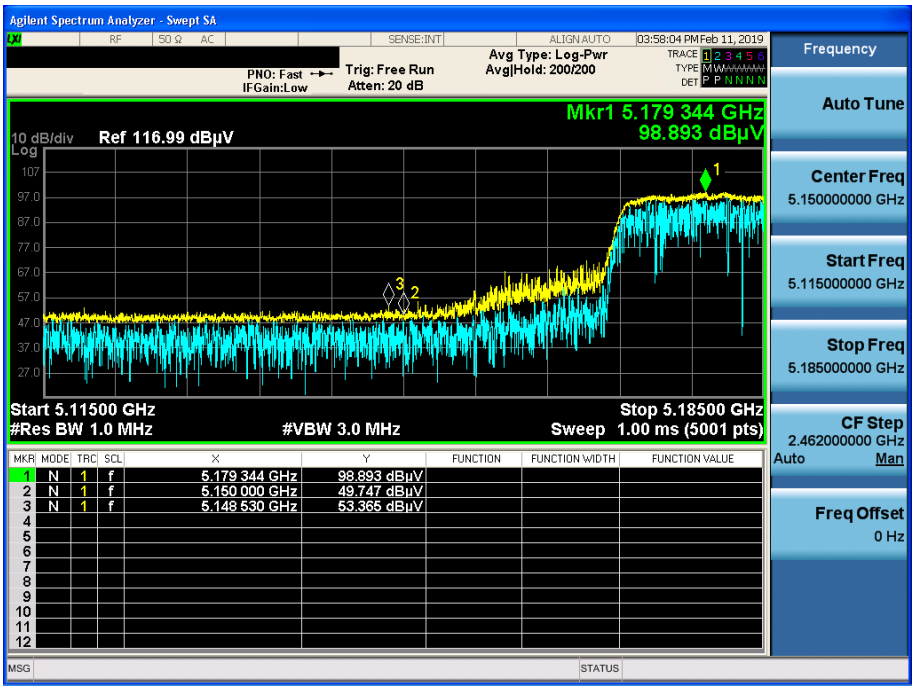
802.11a & U-NII 3 & Ch.165 & Z axis & Hor **Detector Mode : PK**



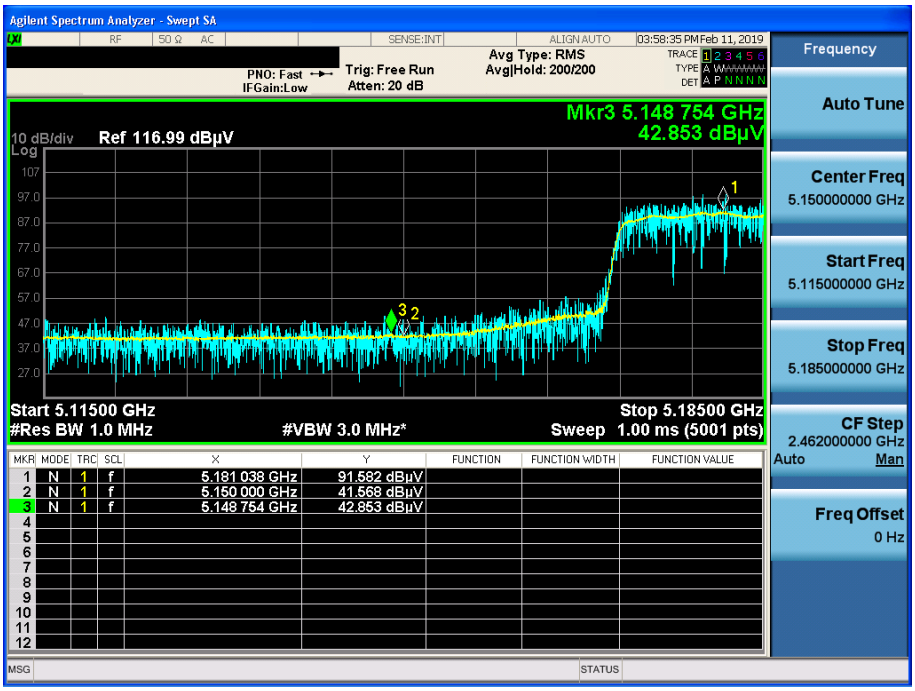
802.11a & U-NII 3 & Ch.165 & Y axis & Hor **Detector Mode : AV**



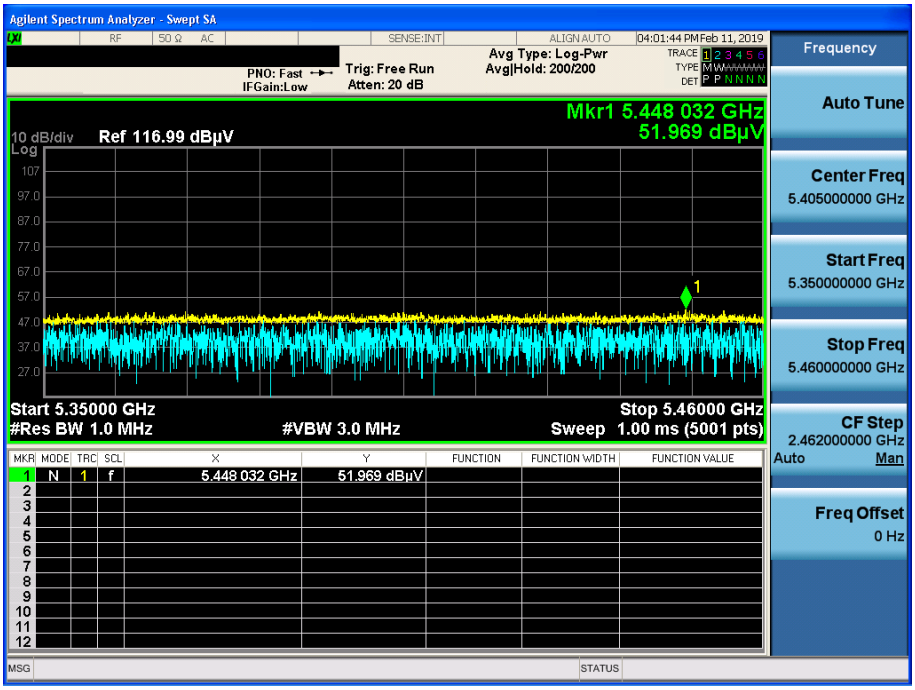
802.11n(HT20) & U-NII 1 & Ch.36 & Y axis & Ver **Detector Mode : PK**



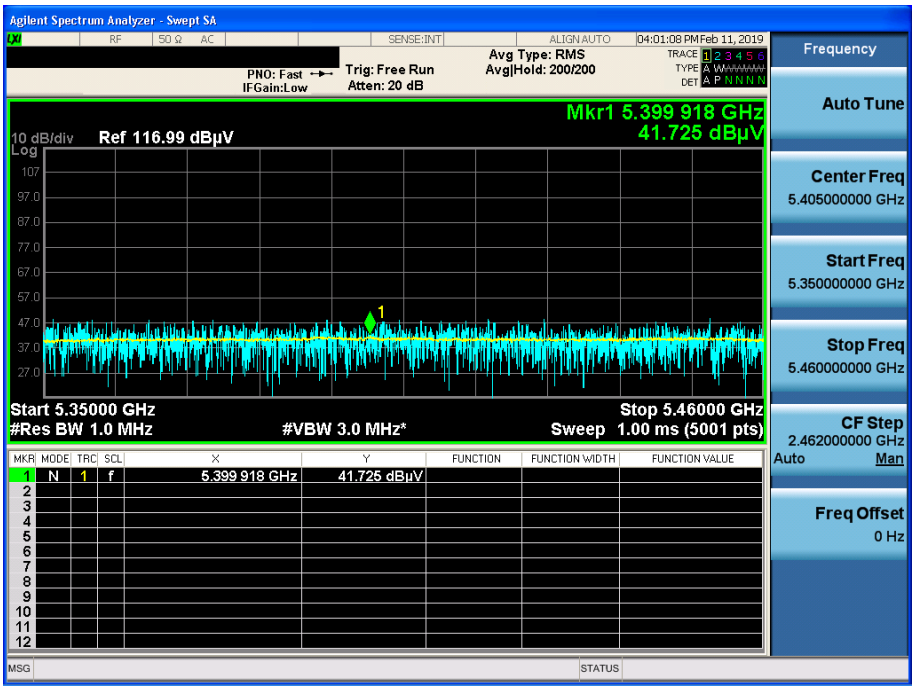
802.11n(HT20) & U-NII 1 & Ch.36 & Y axis & Ver **Detector Mode : AV**



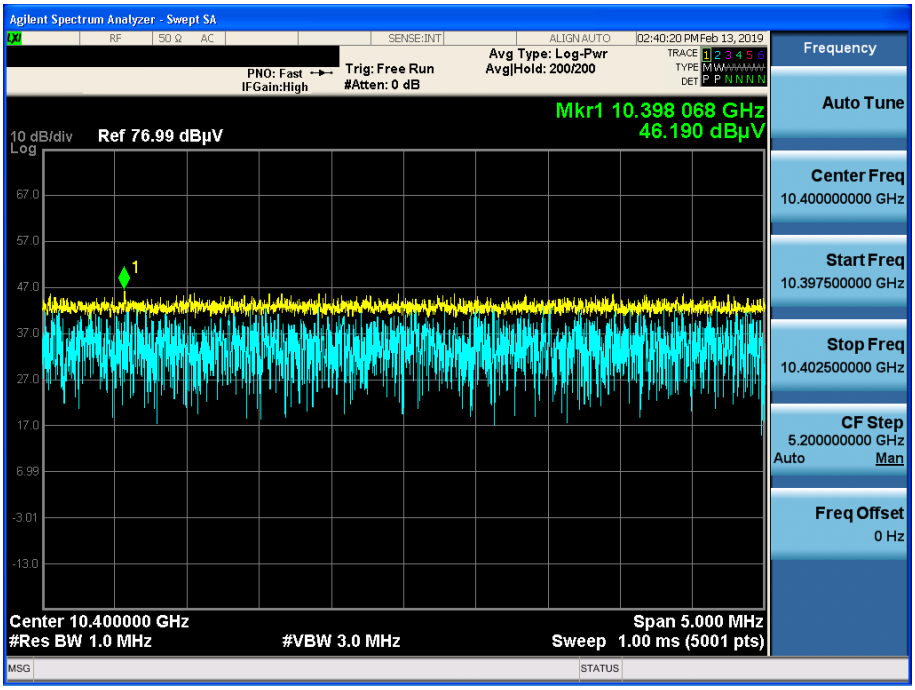
802.11n(HT20) & U-NII 1 & Ch.48 & Y axis & Ver **Detector Mode : PK**



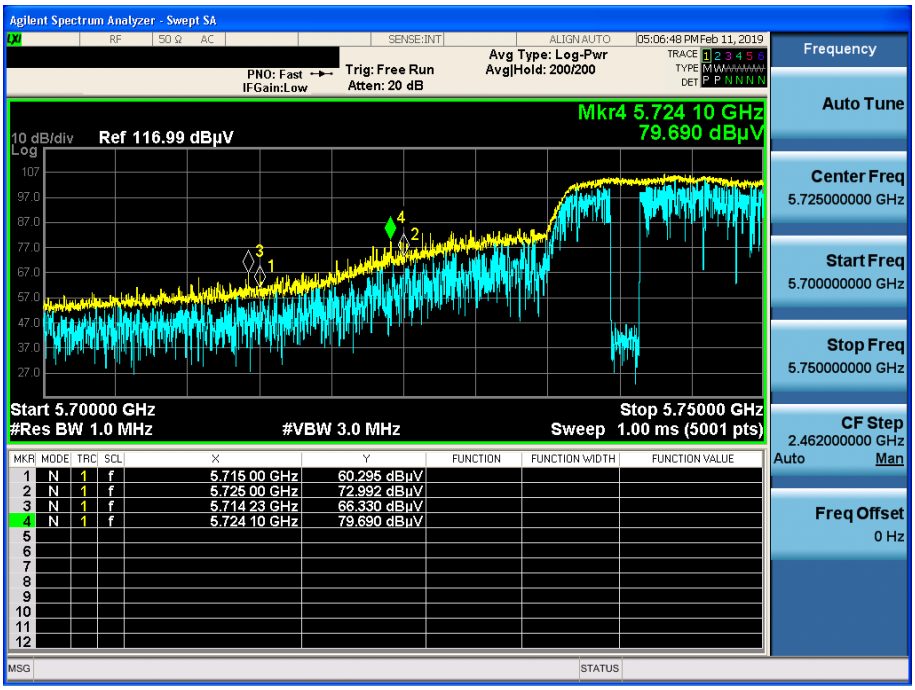
802.11n(HT20) & U-NII 1 & Ch.48 & Y axis & Ver **Detector Mode : AV**



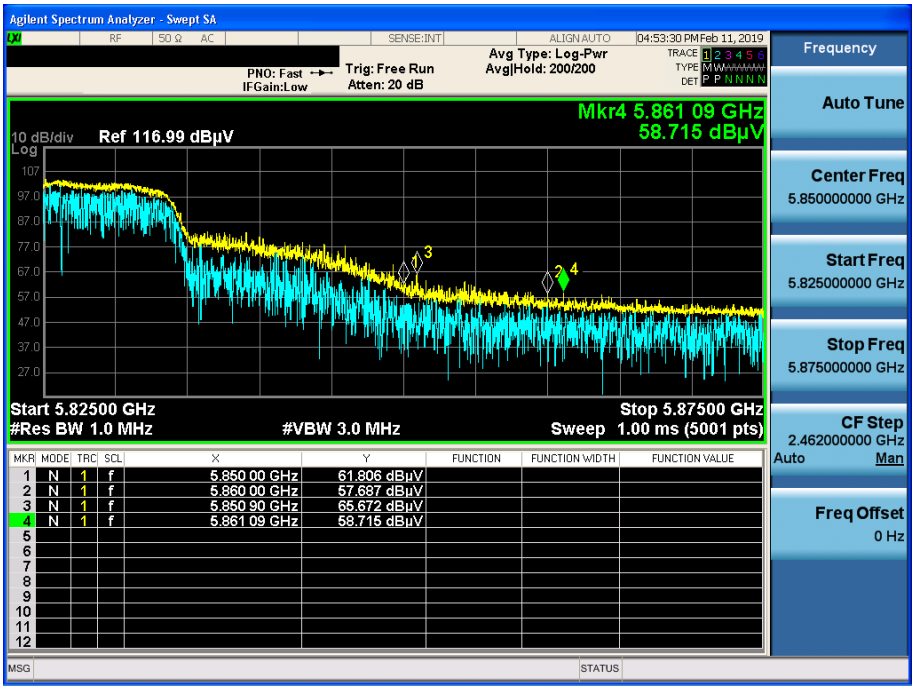
802.11n(HT20) & U-NII 1 & Ch.40 & Y axis & Ver **Detector Mode : PK**



802.11n(HT20) & U-NII 3 & Ch.149 & Z axis & Hor **Detector Mode : PK**



802.11n(HT20) & U-NII 3 & Ch.165 & Z axis & Hor **Detector Mode : PK**



802.11n(HT20) & U-NII 3 & Ch.165 & Y axis & Hor **Detector Mode : AV**