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TEST REPORT

Report Number: 19080625HKG-001

Application for Original Grant of 47 CFR Part 15 Certification

FCC ID: 2AUBO43014

Prepared and Checked by:	**Approved by:**
Kelvin Liang Assistant Manager Shenzhen UnionTrust Quality and Technology Co., Ltd. Date: August 20, 2019	Digitally signed by Tim Lee Location: Intertek Testing Services Hong Kong Ltd. Lee Shui Tim, Tim Senior Lead Engineer Intertek Testing Services Hong Kong Date: August 23, 2019

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TEST REPORT

GENERAL INFORMATION

Applicant Name:	Funko LLC
Applicant Address:	2802 Wetmore Avenue, Everett WA 98201, United States
FCC Specification Standard:	FCC Part 15, October 1, 2017 Edition
FCC ID:	2AUBO43014
FCC Model(s):	43014
Type of EUT:	Spread Spectrum Transmitter
Description of EUT:	N4S Paka Paka: Machine
Serial Number:	N/A
Sample Receipt Date:	August 13, 2019
Date of Test:	August 13, 2019 to August 19, 2019
Place of Testing:	Shenzhen UnionTrust Quality and Technology Co., Ltd. 16/F., Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China.
Report Date:	August 23, 2019
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample after modification complied with the 47 CFR Part 15 Certification.

TEST REPORT

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1.0 TEST RESULTS SUMMARY & STATEMENT OF COMPLIANCE

1.1 Summary of Test Results

Test Items	FCC Part 15 Section	Results	Details See Section
Antenna Requirement	15.203	Pass	2.1
Max. Conducted Output Power (Peak)	15.247(b)(3)&(4)	Pass	4.1
Min. 6dB RF Bandwidth	15.247(a)(2)	Pass	4.2
Max. Power Density (average)	15.247(e)	Pass	4.3
Out of Band Antenna Conducted Emission	15.247(d)	Pass	4.4
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d), 15.209 & 15.109	Pass	4.6
AC Power Line Conducted Emission	15.207 & 15.107	Pass	4.7

Note: Pursuant to FCC Part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over expected variations in temperature and supply voltage were considered.

1.2 Statement of Compliance

The equipment under test is found to be complying with the following standard:

FCC Part 15, October 1, 2017 Edition

TEST REPORT

2.0 GENERAL DESCRIPTION

2.1 Product Description

The 43014 is a N4S Paka Paka: Machine.

The Equipment Under Test (EUT) operates at frequency range of 2412MHz to 2462MHz with 11 channels.

For 802.11b mode, it operates at frequency range of 2412.000MHz to 2462.000MHz with 11 channels. It transmits via Direct-sequence spread spectrum (DSSS) modulation. Maximum bit rate can be up to 11Mbps.

For 802.11g mode, it operates at frequency range of 2412.000MHz to 2462.000MHz with 11 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can be up to 54Mbps.

For 802.11n (with 20MHz bandwidth) mode, it operates at frequency range of 2412.000MHz to 2462.000MHz with 11 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 72.2Mbps.

For 802.11n (with 40MHz bandwidth) mode, it operates at frequency range of 2422.000MHz to 2452.000MHz with 7 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can support up to 150Mbps.

The EUT is power by 120VAC 60Hz .

The antenna(s) used in the EUT is integral, and the test sample is a prototype.

The circuit description is saved with filename: descri.pdf.

TEST REPORT

2.2 Test Methodology

Both AC power line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Preliminary radiated scans and all radiated measurements were performed in radiated emission test sites. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. Antenna port conducted measurements were performed according to ANSI C63.10 (2013) and KDB Publication No.558074 D01 v05r02 (02-April-2019) All other measurements were made in accordance with the procedures in 47 CFR Part 2.

2.3 Test Facility

The radiated emission test site and antenna port conducted measurement facility used to collect the radiated data and conductive data are at Shenzhen UnionTrust Quality and Technology Co., Ltd (Address: 16/F., Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China). This test facility and site measurement data have been fully placed on file with the FCC.

2.4 Related Submittal(s) Grants

This is a single application for certification of a transceiver

TEST REPORT

3.0 SYSTEM TEST CONFIGURATION

3.1 Justification

For radiated emissions testing, the equipment under test (EUT) was setup to transmit / receive continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables (if any) were manipulated to produce worst case emissions.

The EUT was powered by 120VAC 60Hz.

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable. If the base unit attached to peripherals, they were connected and operational (as typical as possible).

The signal was maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization were varied during the search for maximum signal level. The antenna height was varied from 1 to 4 meters. Radiated emissions were taken at three meters unless the signal level was too low for measurement at that distance. If necessary, a pre-amplifier was used and/or the test was conducted at a closer distance.

For any intentional radiator powered by AC power line, measurements of the radiated signal level of the fundamental frequency component of the emission was performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Radiated emission measurement for transmitter were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Emission that are directly caused by digital circuits in the transmit path and transmitter portion were measured, and the limit are according to FCC Part 15 Section 15.209. Digital circuitries used to control additional functions other than the operation of the transmitter are subject to FCC Part 15 Section 15.109 Limits.

TEST REPORT

3.1 Justification – Cont'd

Detector function for radiated emissions was in peak mode. Average readings, when required, were taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in section 4.8.3.

Determination of pulse desensitization was made according to *Hewlett Packard Application Note 150-2, Spectrum Analysis... Pulsed RF.* The effective period (Teff) was referred to Exhibit 4.8.3. With the resolution bandwidth 1MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

For AC line conducted emission test, the EUT along with its peripherals were placed on floor and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50ohm coupling impedance for measuring instrument. The LISN housing, measuring instrument case, reference ground plane, and vertical ground plane were bounded together. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were manipulated to find the maximum emission.

Different data rates have been tested. Worst case is reported only.

All relevant operation modes have been tested, and the worst case data is included in this report.

All data rates were tested under normal mode of WiFi. Only the worst-case data is shown in the report for DSSS and OFDM

3.2 EUT Exercising Software

The EUT exercise program (if any) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

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3.3 Details of EUT and Description of Accessories

Details of EUT:

None

Description of Accessories:

There are no accessories for compliance of this product.

3.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test at a level of confidence of 95% has been considered. The values of the Measurement uncertainty:

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.8 dB
2	Conducted emission 150KHz-30MHz	±3.4 dB
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

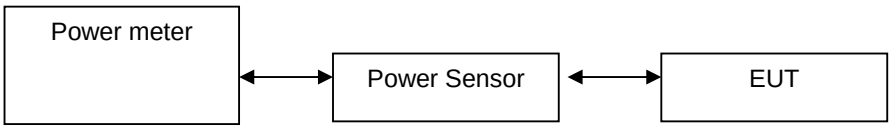
TEST REPORT

4.0 TEST RESULTS

4.1 Maximum Conducted (peak) Output Power at Antenna Terminals

RF Conduct Measurement Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



The antenna port of the EUT was connected to the input of a spectrum analyzer.

☒ The antenna power of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to the obtain power at the EUT antenna terminals. The measurement procedure 11.9.1.3 was used.

☐ The EUT should be configured to transmit continuously (at a minimum duty cycle of 98%) at full power over the measurement duration. The measurement procedure AVG1 was used.

IEEE 802.11b (DSSS, 1 Mbps) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm (PEAK)	Output in dBm (AVG)	Output in mWatt (PEAK)
Low Channel:	2412	15.86	13.71	38.55
Middle Channel:	2437	15.88	13.79	38.73
High Channel:	2462	15.95	13.83	39.36

IEEE 802.11g (OFDM, 6 Mbps) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm (PEAK)	Output in dBm (AVG)	Output in mWatt (PEAK)
Low Channel:	2412	23.34	13.22	215.77
Middle Channel:	2437	23.11	13.18	204.64
High Channel:	2462	22.75	13.13	188.36

IEEE 802.11n (20MHz) (OFDM, MCS0) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm (PEAK)	Output in dBm (AVG)	Output in mWatt (PEAK)
Low Channel:	2412	21.89	12.63	154.53
Middle Channel:	2437	22.03	12.74	159.59
High Channel:	2462	22.11	12.81	162.55

TEST REPORT

4.1 Maximum Conducted Output Power at Antenna Terminals – Cont'd

IEEE 802.11n (40MHz) (OFDM, MCS0) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm (PEAK)	Output in dBm (AVG)	Output in mWatt (PEAK)
Low Channel:	2422	21.34	12.29	136.14
Middle Channel:	2437	21.59	12.35	144.21
High Channel:	2452	21.66	12.37	146.55

For Maximum e.i.r.p.(PEAK)

IEEE 802.11b (DSSS, 1 Mbps) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt (PEAK)
Low Channel:	2412	17.86	61.09
Middle Channel:	2437	17.88	61.38
High Channel:	2462	17.95	62.37

IEEE 802.11g (OFDM, 6 Mbps) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt (PEAK)
Low Channel:	2412	25.34	341.98
Middle Channel:	2437	25.11	324.34
High Channel:	2462	24.75	298.54

IEEE 802.11n (20MHz) (OFDM, MCS0) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt (PEAK)
Low Channel:	2412	23.89	244.91
Middle Channel:	2437	24.03	252.93
High Channel:	2462	24.11	257.63

TEST REPORT

4.1 Maximum Conducted Output Power at Antenna Terminals – Cont'd

IEEE 802.11n (40MHz) (OFDM, MCS0) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt (PEAK)
Low Channel:	2422	23.34	215.77
Middle Channel:	2437	23.59	228.56
High Channel:	2452	23.66	232.27

Cable loss : 0.5 dB External Attenuation : 10 dB

Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

IEEE 802.11b (DSSS, 1 Mbps)
max. conducted (peak) output level = 15.95 dBm

IEEE 802.11g (OFDM, 9 Mbps)
max. conducted (peak) output level = 23.34 dBm

IEEE 802.11n (20MHz) (OFDM, MCS0)
max. conducted (peak) output level = 22.11 dBm

IEEE 802.11n (40MHz) (OFDM, MCS0)
max. conducted (peak) output level = 21.66 dBm

Limits:
☒ 1W (30dBm) for antennas with gains of 6dBi or less

☐ ___W (___dBm) for antennas with gains more than 6dBi

TEST REPORT

4.2 Minimum 6dB RF Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. The EBW measurement procedure was used. A PEAK output reading was taken, a DISPLAY line was drawn 6dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

IEEE 802.11b (DSSS, 1 Mbps)

	Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel:	2412	9.559
Middle Channel:	2437	10.06
High Channel:	2462	10.04

IEEE 802.11g (OFDM, 6 Mbps)

	Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel:	2412	16.40
Middle Channel:	2437	16.39
High Channel:	2462	16.40

IEEE 802.11n (20MHz) (OFDM, MCS0)

	Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel:	2412	17.58
Middle Channel:	2437	17.61
High Channel:	2462	17.64

IEEE 802.11n (40MHz) (OFDM, MCS0)

	Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel:	2422	36.03
Middle Channel:	2437	36.30
High Channel:	2452	36.27

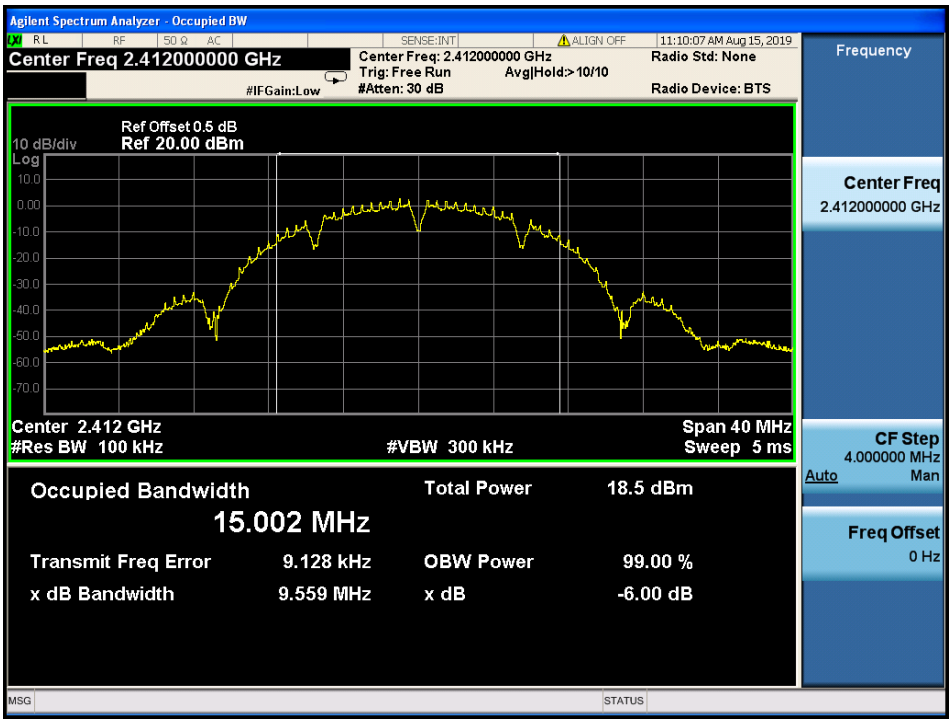
Limits
6 dB bandwidth shall be at least 500kHz

The plots of 6dB RF bandwidth are saved as below.

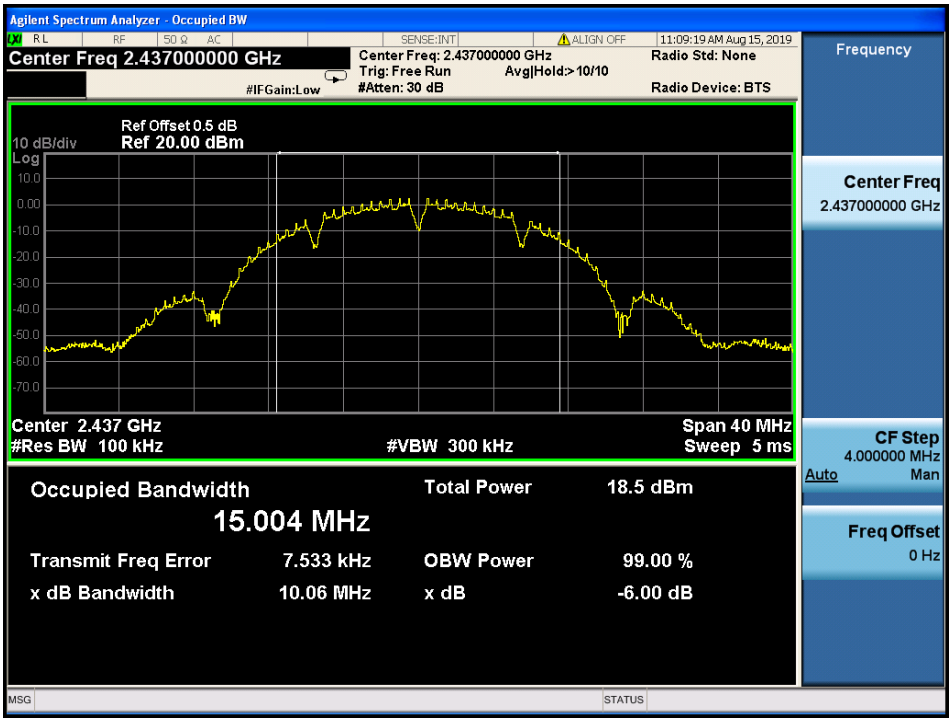
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11b, Lowest Channel



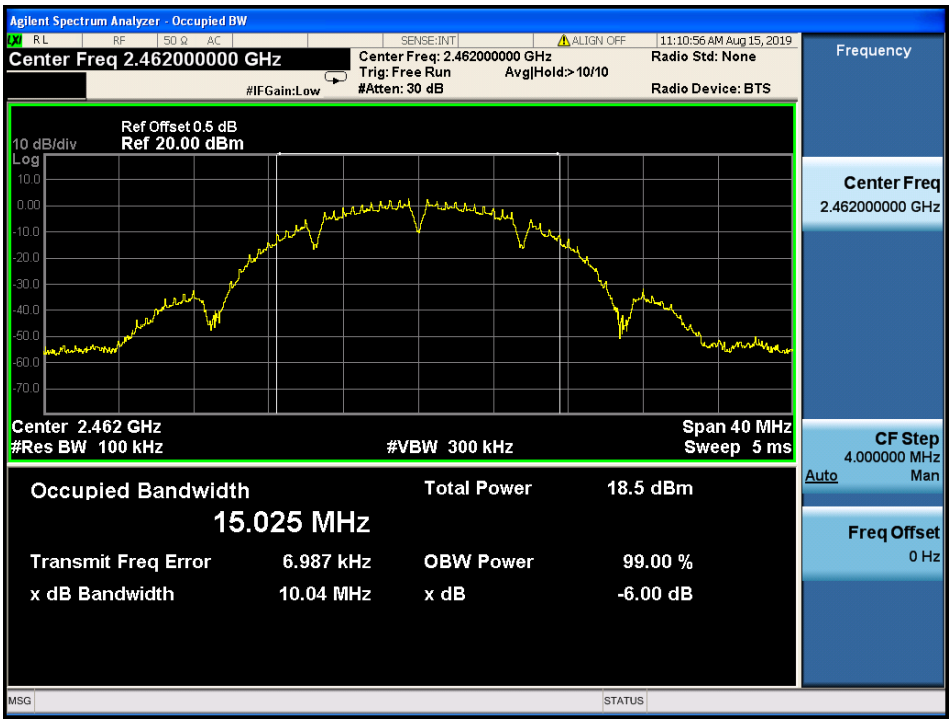
802.11b, Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

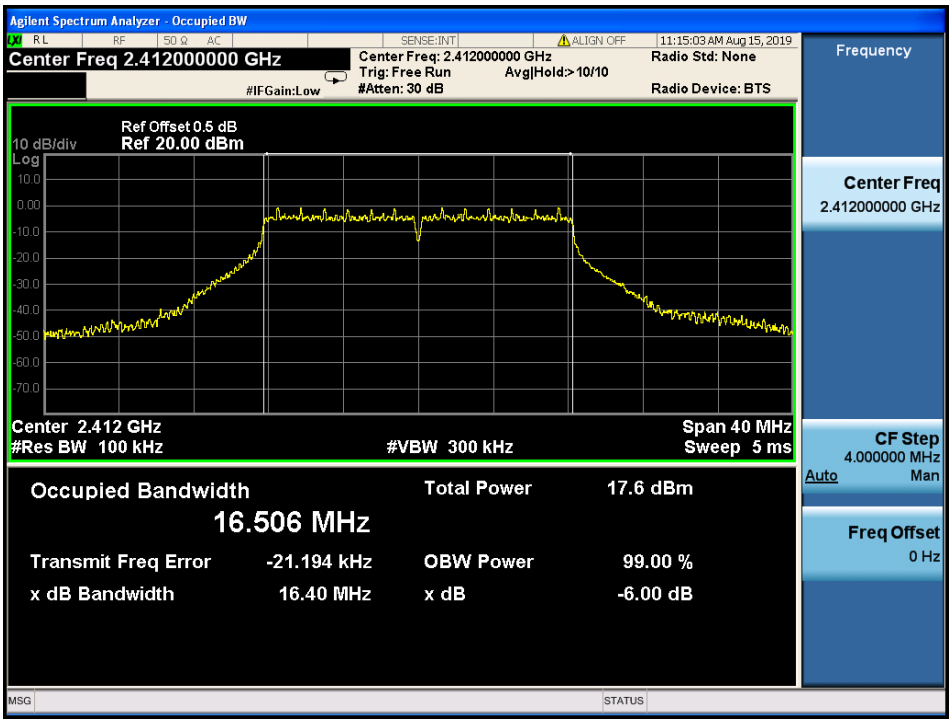
802.11b, Highest Channel



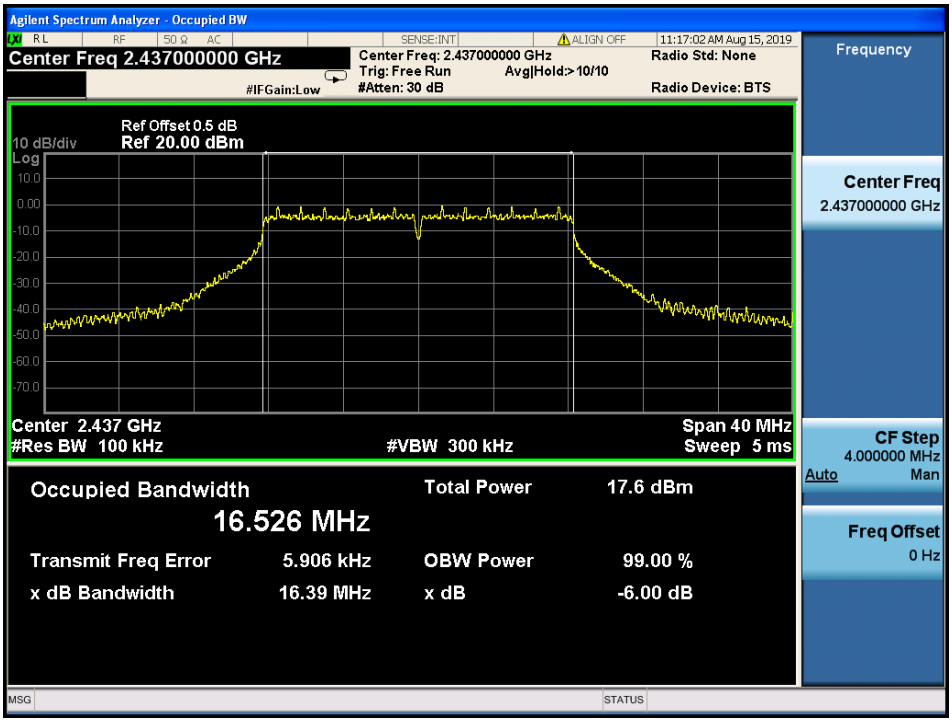
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11g, Lowest Channel



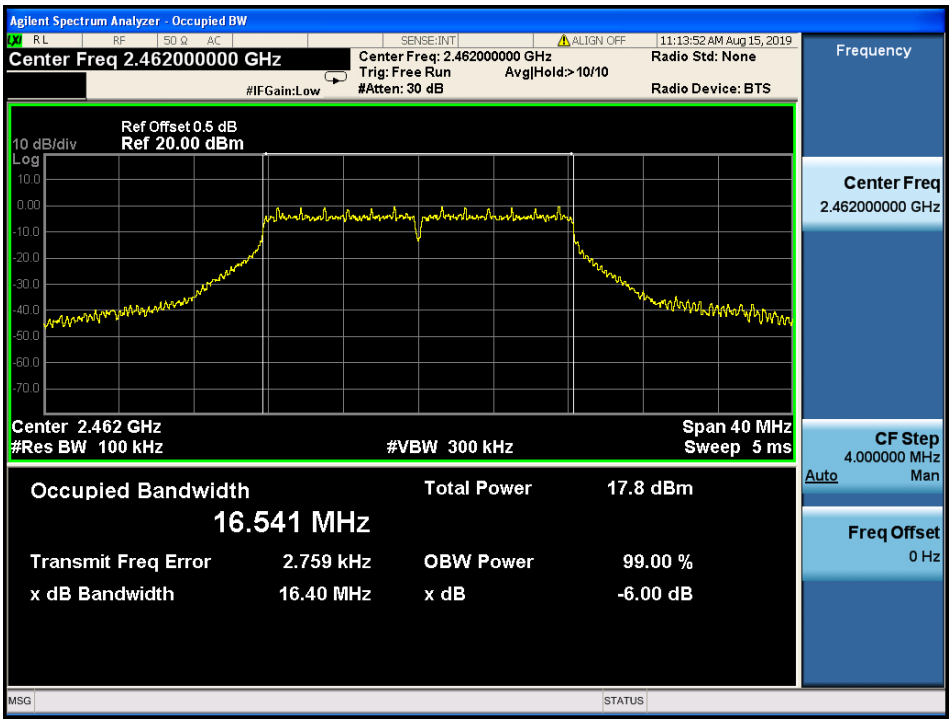
802.11g, Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

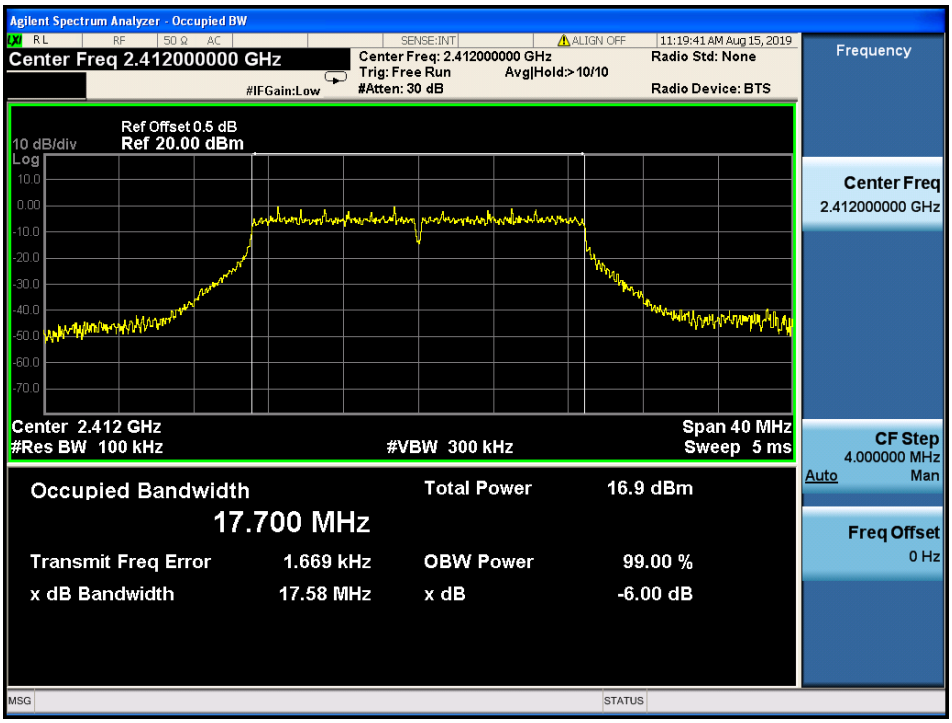
802.11g, Highest Channel



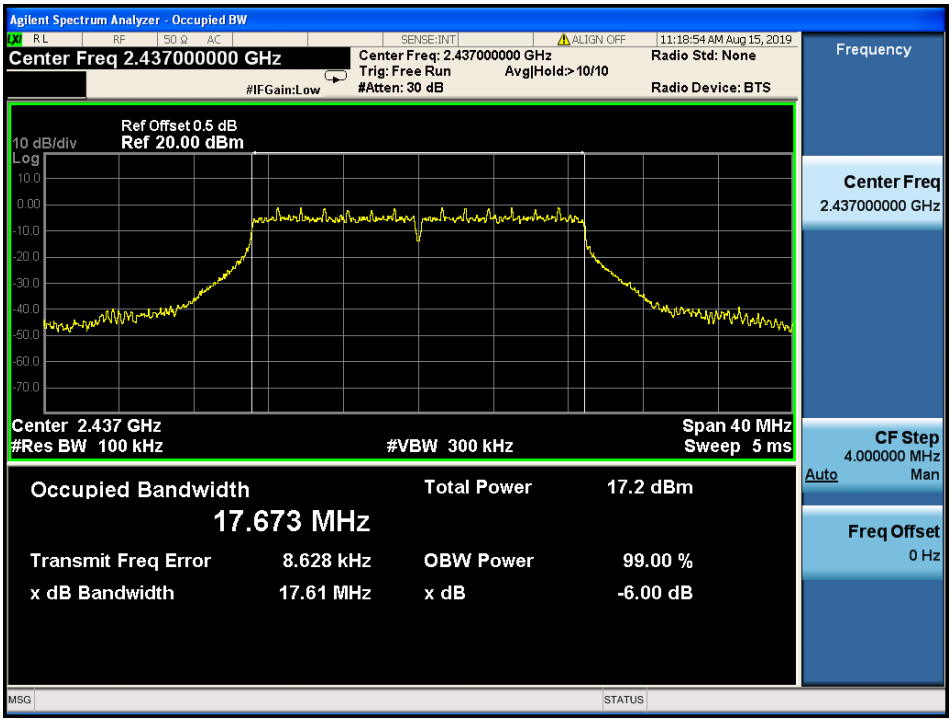
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11n (20MHz), Lowest Channel



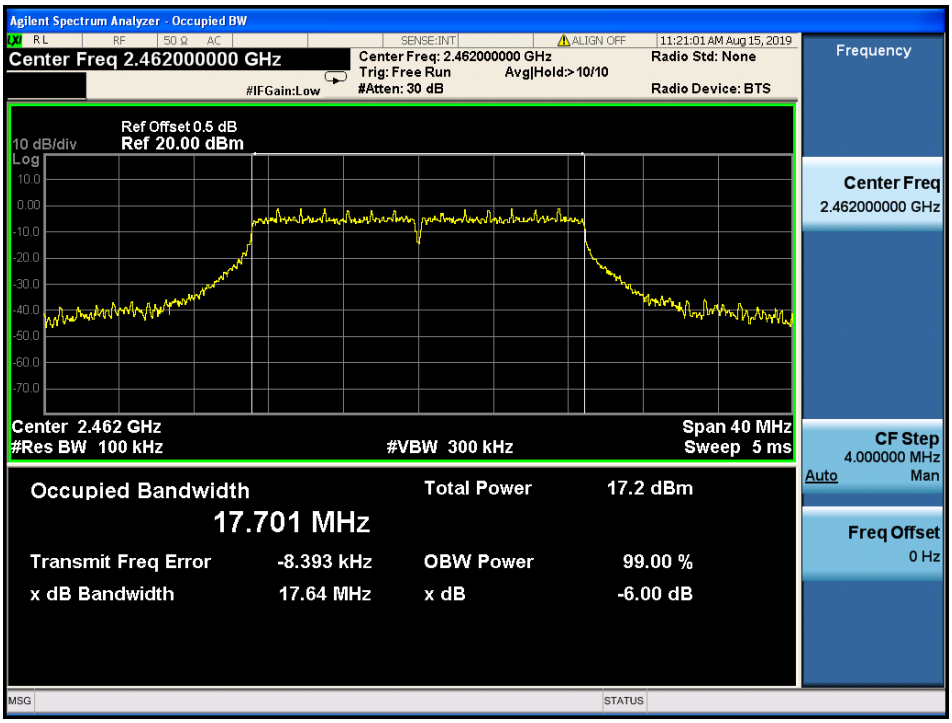
802.11n (20MHz), Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

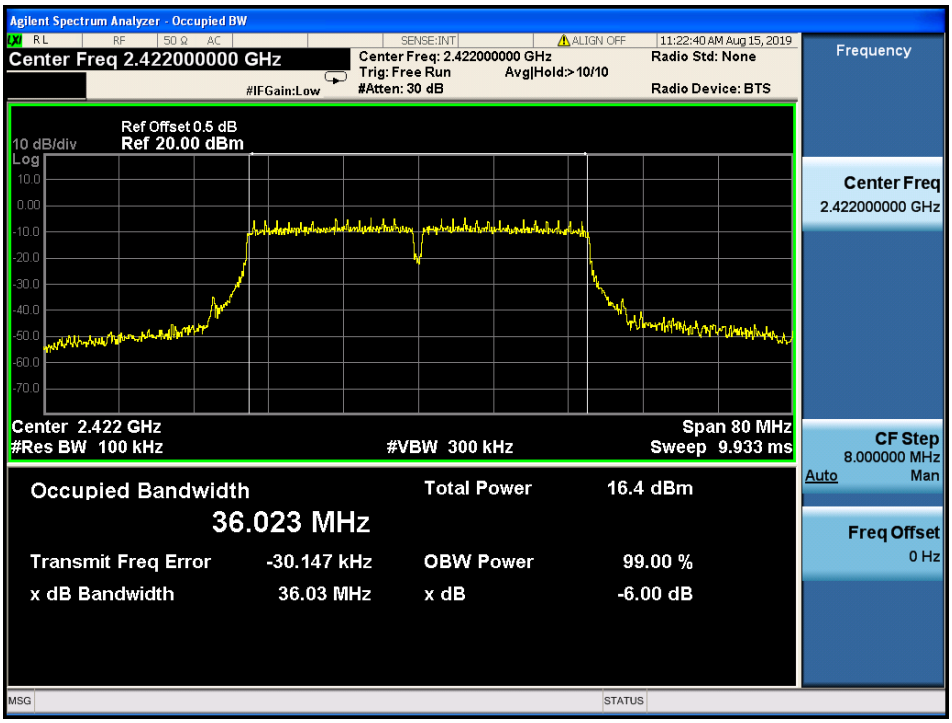
802.11n (20MHz), Highest Channel



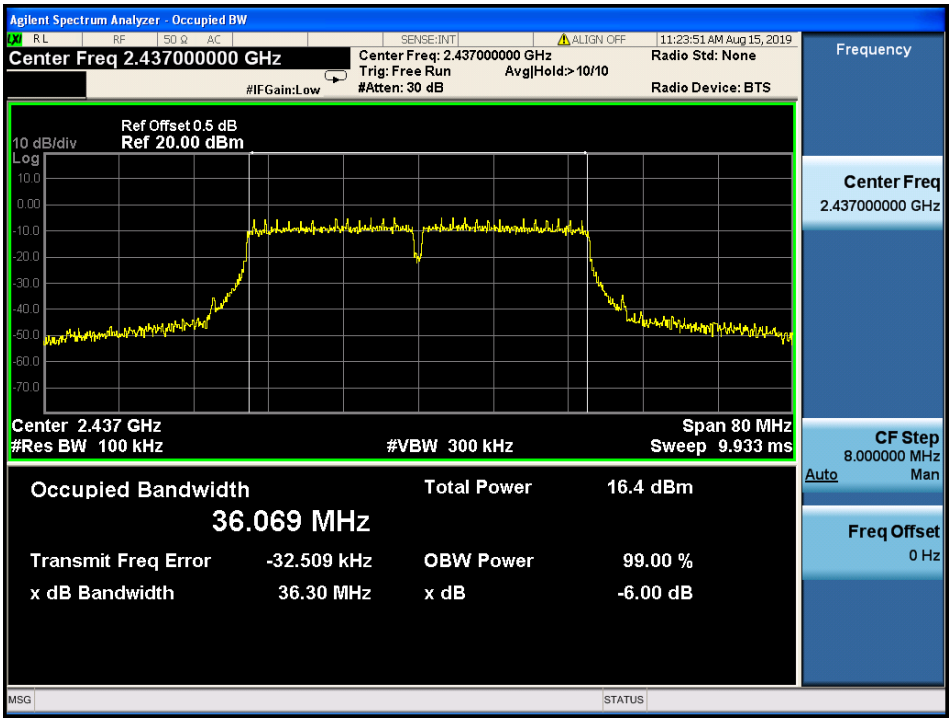
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11n (40MHz), Lowest Channel



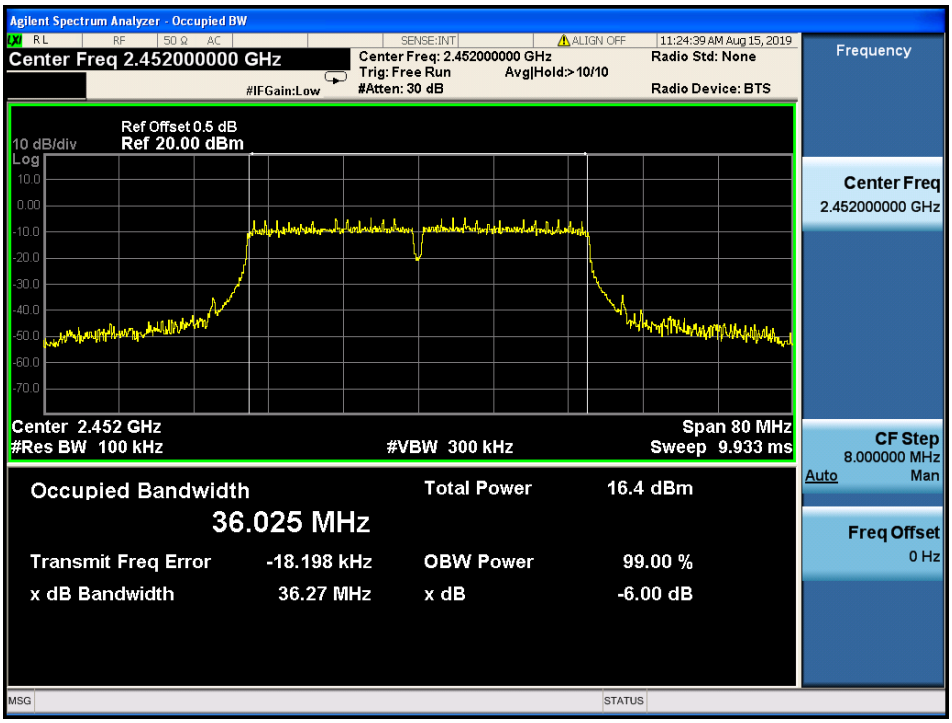
802.11n (40MHz), Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11n (40MHz), Highest Channel



TEST REPORT

4.3 Maximum Power Spectral Density

Antenna output of the EUT was coupled directly to spectrum analyzer. The measurement procedure 11.10 PKPSD was used. If an external attenuator and/or cable was used, these losses are compensated for using the OFFSET function of the analyser.

IEEE 802.11b (DSSS, 1 Mbps)

Frequency (MHz)		PSD in 3kHz (dBm)
Low Channel:	2412	-10.010
Middle Channel:	2437	-9.960
High Channel:	2462	-9.776

IEEE 802.11g (OFDM, 6 Mbps)

Frequency (MHz)		PSD in 3kHz (dBm)
Low Channel:	2412	-13.785
Middle Channel:	2437	-14.071
High Channel:	2462	-12.328

IEEE 802.11n (20MHz) (OFDM, MCS0)

Frequency (MHz)		PSD in 3kHz (dBm)
Low Channel:	2412	-13.788
Middle Channel:	2437	-14.219
High Channel:	2462	-13.866

IEEE 802.11n (40MHz) (OFDM, MCS0)

Frequency (MHz)		PSD in 3kHz (dBm)
Low Channel:	2422	-14.312
Middle Channel:	2437	-16.635
High Channel:	2452	-17.214

Cable Loss: 0.75 dB

Limit:
8 dBm

The plots of power spectral density are as below.

TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11b, Lowest channel

802.11b, Middle channel

TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

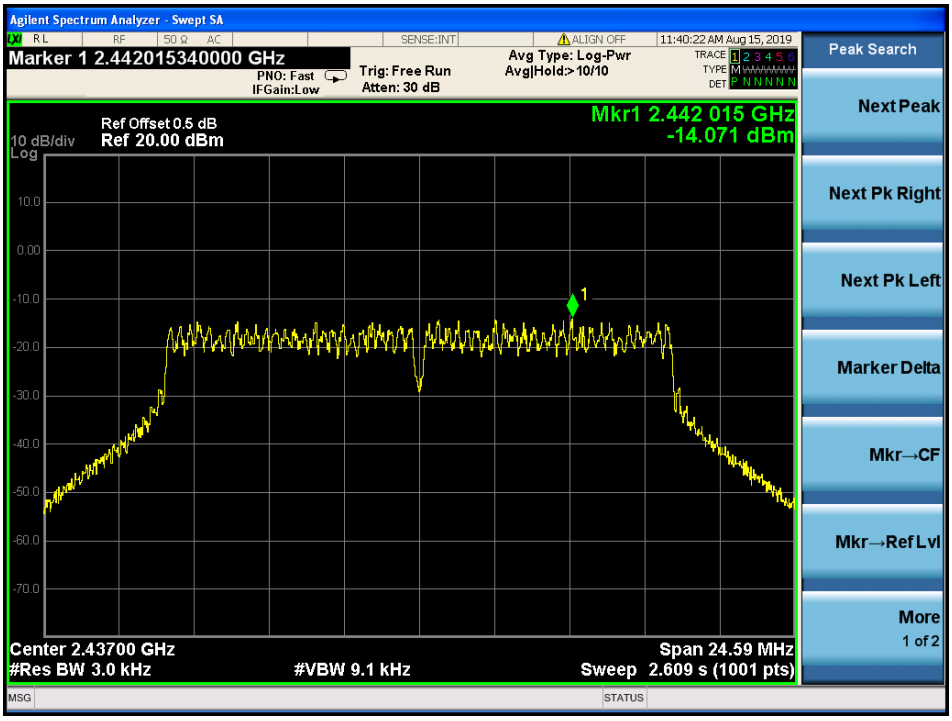
802.11b, Highest channel

TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11g, Lowest channel

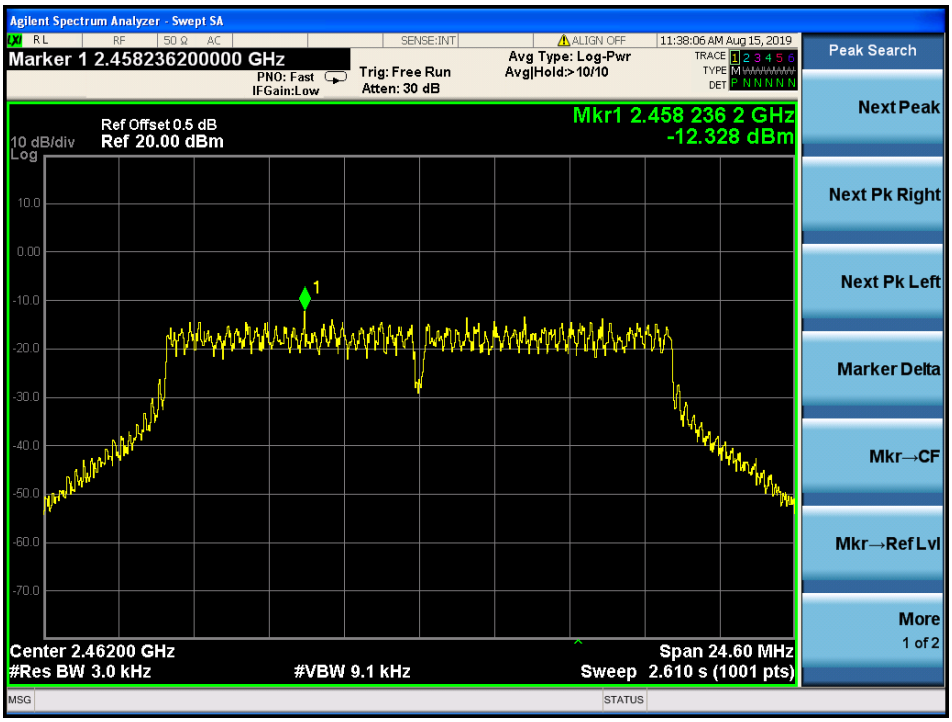
802.11g, Middle channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

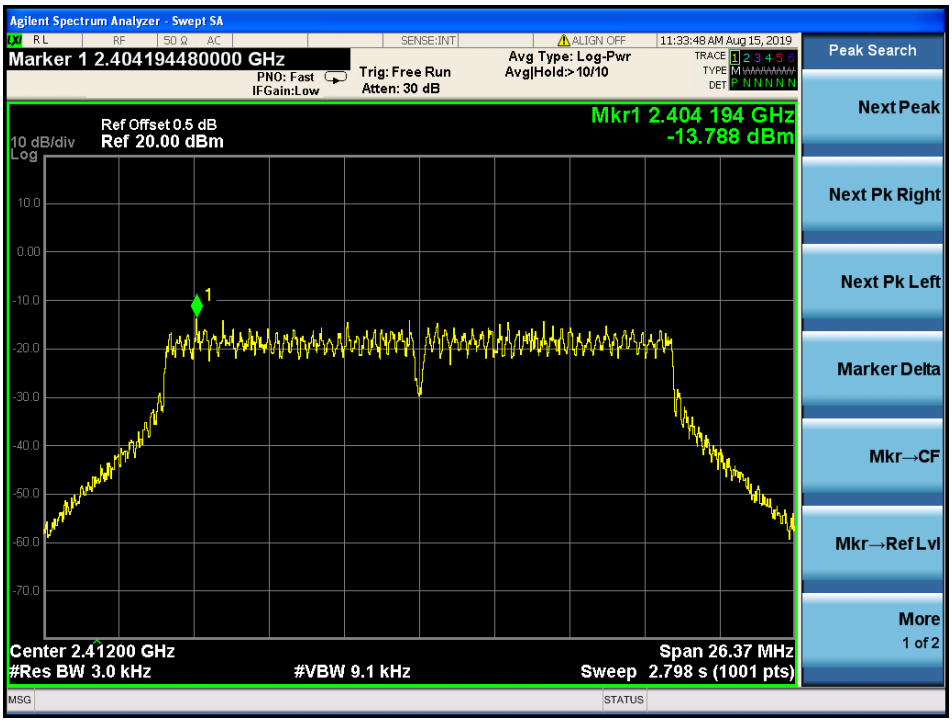
802.11g, Highest channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11n (20MHz), Lowest channel



802.11n (20MHz), Middle channel

TEST REPORT

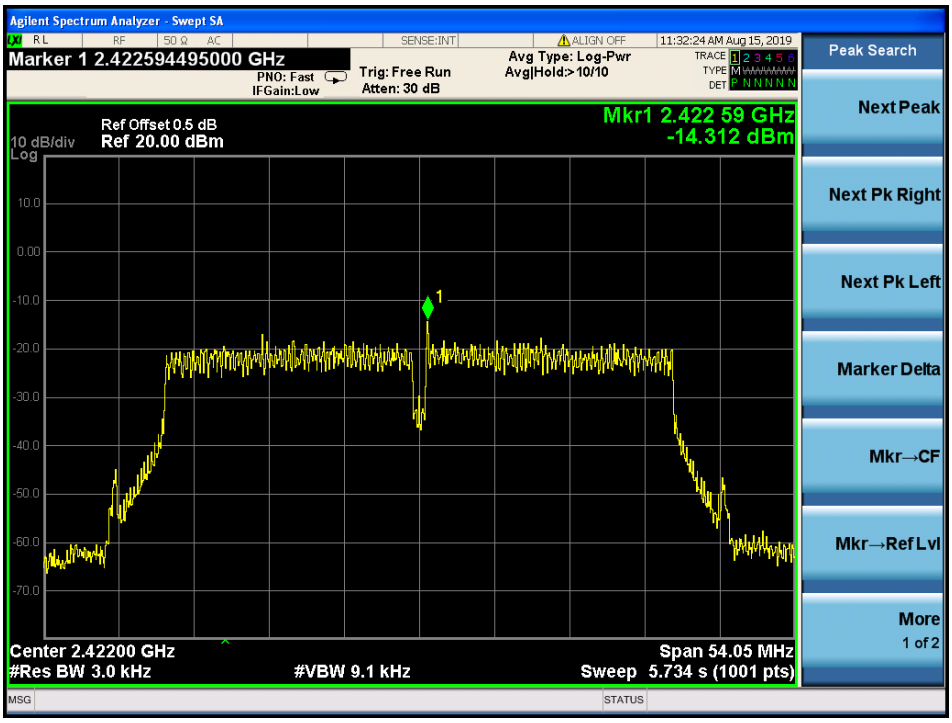
PLOTS OF POWER SPECTRAL DENSITY

802.11n (20MHz), Highest channel

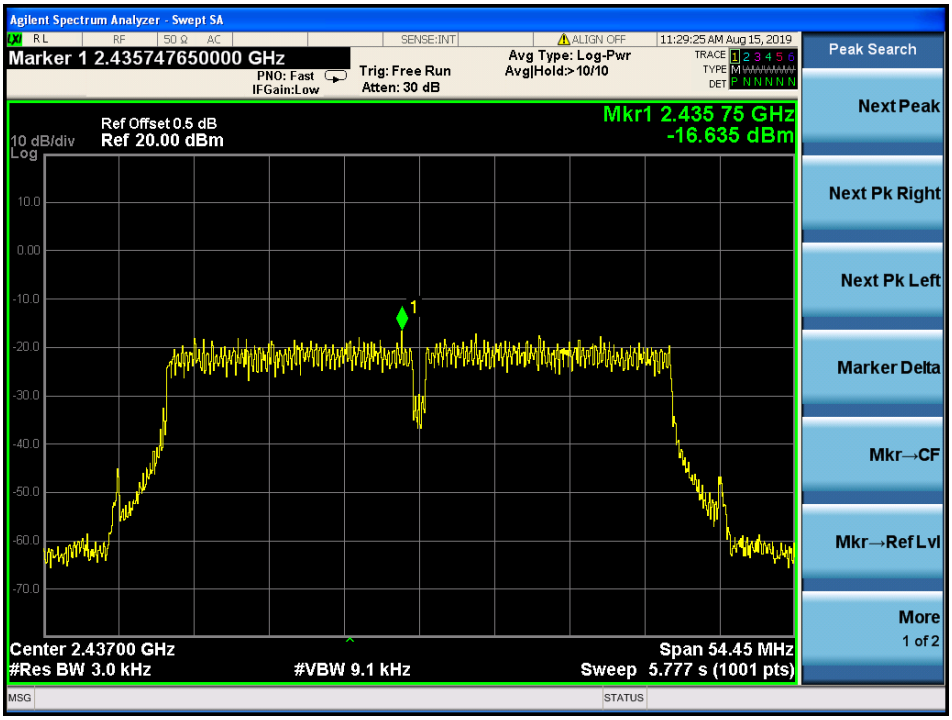
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11n (40MHz), Lowest channel



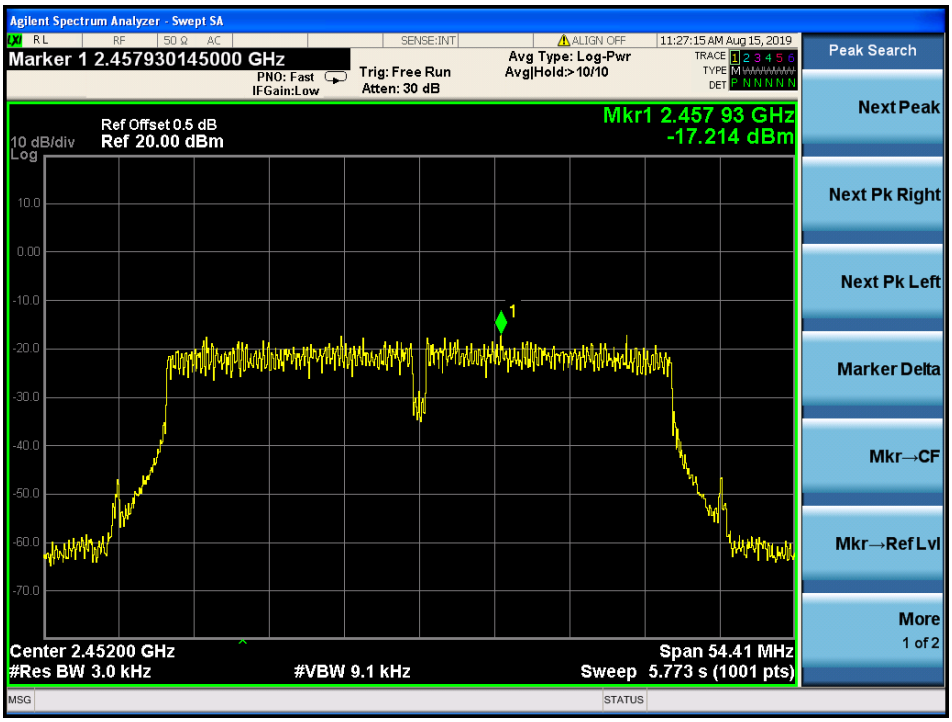
802.11n (40MHz), Middle channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11n (20MHz), Highest channel



TEST REPORT

4.4 Out of Band Conducted Emissions

For 802.11b/g/n20/n40MHz, the maximum conducted (peak) output power was used to demonstrate compliance as described in 9.1. Then the display line (in red) shown in the following plots denotes the limit at 20dB below maximum measured in-band peak PSD level in 100 KHz bandwidth for 802.11b/g/n20/n40MHz.

The measurement procedures under sections 11 of ANSI C63.10-2013 were used.

Furthermore, delta measurement technique for measuring bandedge emissions was incorporated in the test of the edge at 2483.5MHz.

Limits:
All spurious emission and up to the tenth harmonic was measured and they were found to be at least for 802.11b,g,n20MHz, n40MHz below the maximum measured in-band peak PSD level.

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Lowest Channel, Plot A

802.11b, Lowest Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Middle Channel, Plot A

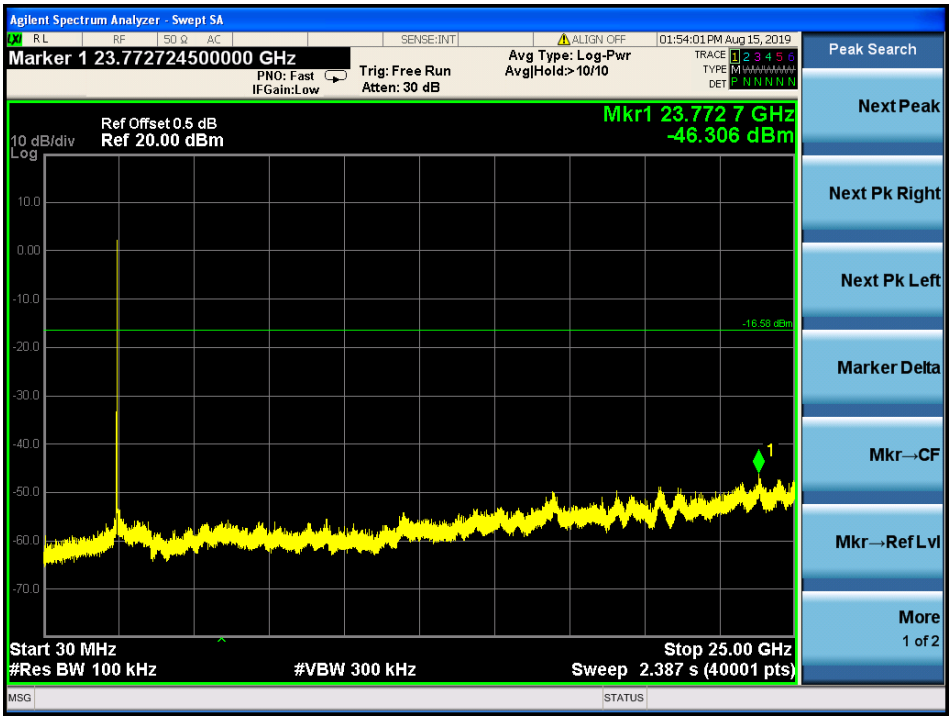
802.11b, Middle Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Highest Channel, Plot A

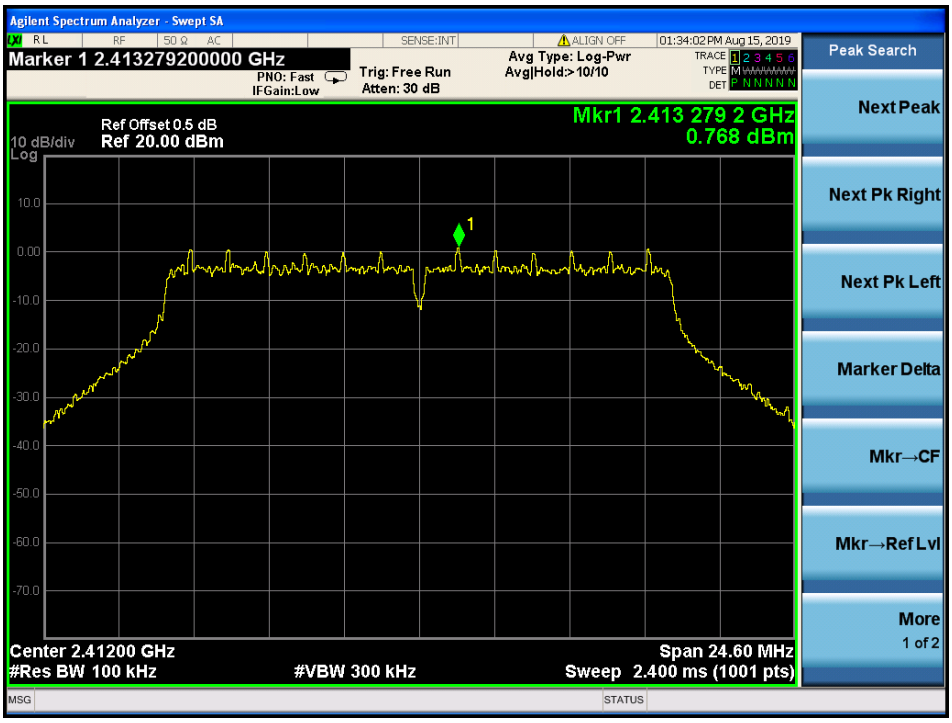
802.11b, Highest Channel, Plot B



TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11g, Lowest Channel, Plot A



802.11g, Lowest Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

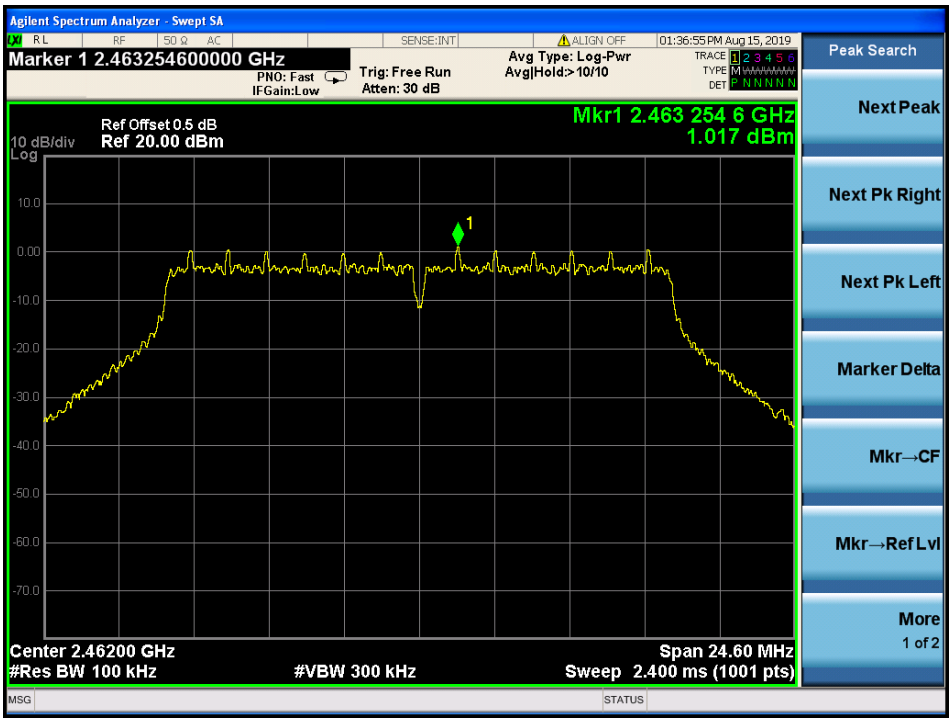
802.11g, Middle Channel, Plot A

802.11g, Middle Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11g, Highest Channel, Plot A

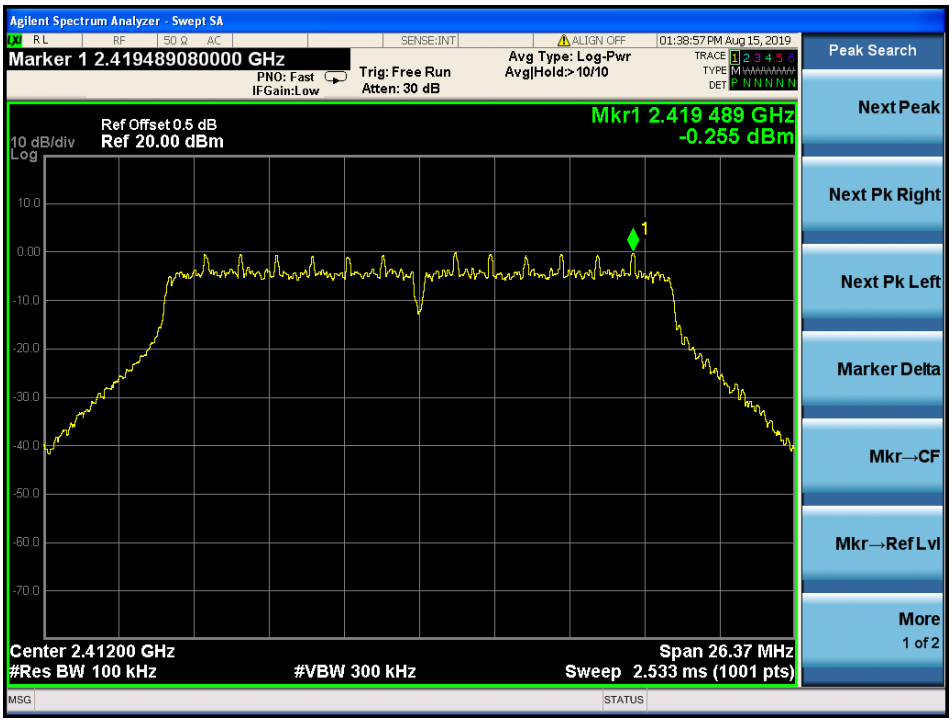


802.11g, Highest Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (20MHz), Lowest Channel, Plot A

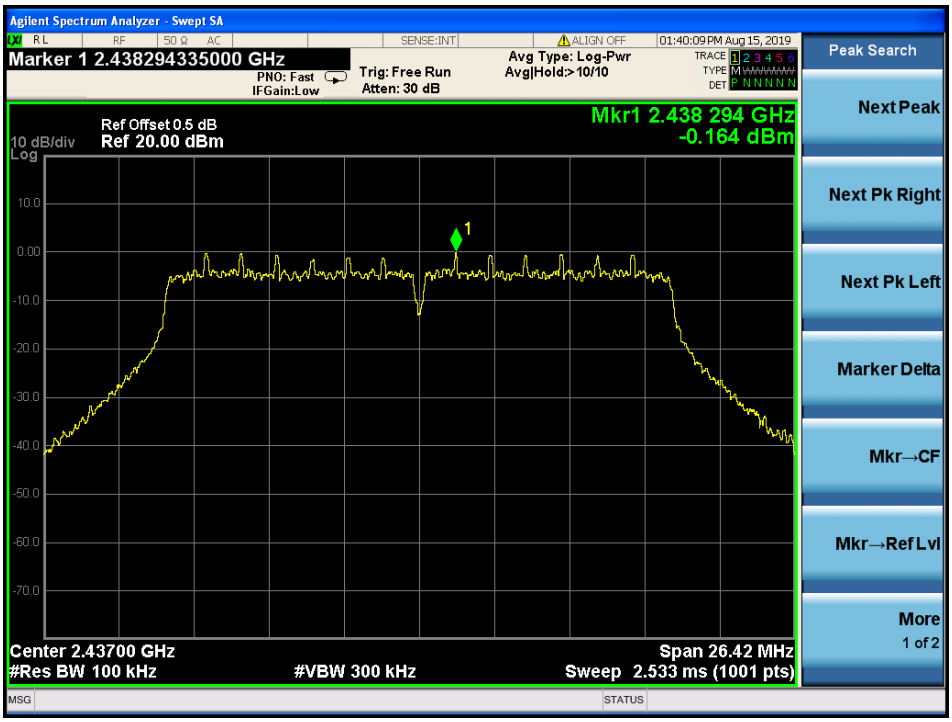


802.11n (20MHz), Lowest Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (20MHz), Middle Channel, Plot A

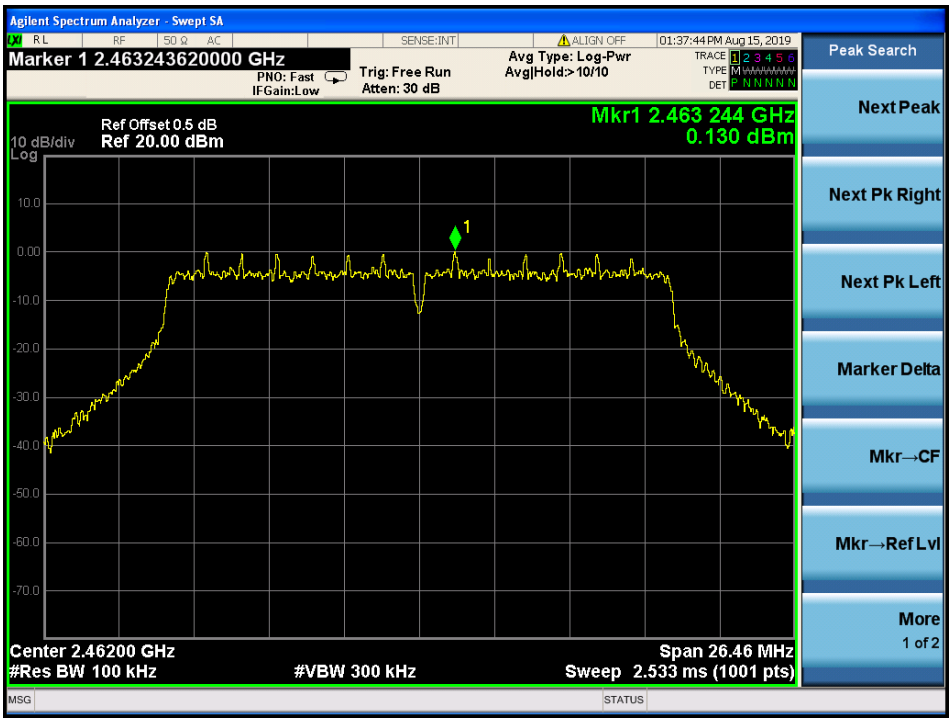


802.11n (20MHz), Middle Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (20MHz), Highest Channel, Plot A



802.11n (20MHz), Highest Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (40MHz), Lowest Channel, Plot A

802.11n (40MHz), Lowest Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (40MHz), Middle Channel, Plot A

802.11n (40MHz), Middle Channel, Plot B

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (40MHz), Highest Channel, Plot A

802.11n (40MHz), Highest Channel, Plot B

TEST REPORT

4.5 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

<u>Example</u>
Assume a receiver reading of 62.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29.0 dB is subtracted. The pulse desensitization factor of the spectrum analyzer is 0.0 dB, and the resultant average factor is -10.0 dB. The net field strength for comparison to the appropriate emission limit is 32.0 dBμV/m. This value in dBμV/m is converted to its corresponding level in μV/m.

RA = 62.0 dBμV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0.0 dB
AV = -10 dB

FS = 62.0 + 7.4 + 1.6 – 29.0 + 0.0 + (-10.0) = 32.0 dBμV/m

Level in μV/m = Common Antilogarithm [(32.0 dBμV/m)/20] = 39.8 μV/m

TEST REPORT

4.6 Transmitter Radiated Emissions in Restricted Bands and Spurious Emissions

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

4.6.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission
at

141.769 MHz

The worst case radiated emission configuration photographs are saved with filename: config photos.pdf

4.6.2 Radiated Emission Data

The data in tables 1-5 list the significant emission frequencies, the limit and the margin of compliance.

Judgement -

Passed by 4.01 dB margin

TEST REPORT

RADIATED EMISSION DATA

Table 1
IEEE 802.11b (DSSS, 1 Mbps)

Radiated Emission Test Data (Above 1GHz):

IEEE 802.11b_Lowest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4824.00	54.55	74.00	-19.45	Peak	Horizontal
2	4824.00	38.09	54.00	-15.91	Average	Horizontal
3	7236.00	49.65	74.00	-24.35	Peak	Horizontal
4	7236.00	37.60	54.00	-16.40	Average	Horizontal
5	4824.00	46.06	74.00	-27.94	Peak	Vertical
6	4824.00	34.55	54.00	-19.45	Average	Vertical
7	7236.00	48.47	74.00	-25.53	Peak	Vertical
8	7236.00	37.40	54.00	-16.60	Average	Vertical

IEEE 802.11b_Middle Channel:

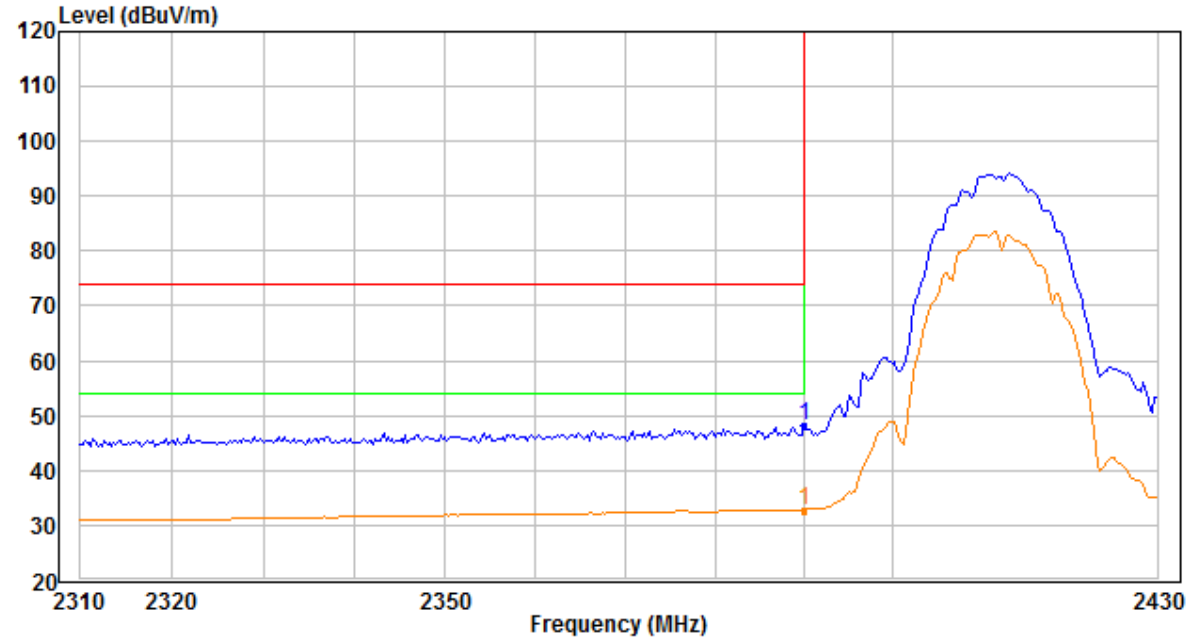
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4874.00	43.06	74.00	-30.94	Peak	Horizontal
2	4874.00	31.88	54.00	-22.12	Average	Horizontal
3	7311.00	48.05	74.00	-25.95	Peak	Horizontal
4	7311.00	37.88	54.00	-16.12	Average	Horizontal
5	4874.00	45.71	74.00	-28.29	Peak	Vertical
6	4874.00	34.32	54.00	-19.68	Average	Vertical
7	7311.00	49.40	74.00	-24.60	Peak	Vertical
8	7311.00	37.73	54.00	-16.27	Average	Vertical

IEEE 802.11b_Highest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4924.00	42.56	74.00	-31.44	Peak	Horizontal
2	4924.00	32.26	54.00	-21.74	Average	Horizontal
3	7386.00	49.26	74.00	-24.74	Peak	Horizontal
4	7386.00	37.83	54.00	-16.17	Average	Horizontal
5	4924.00	45.66	74.00	-28.34	Peak	Vertical
6	4924.00	34.37	54.00	-19.63	Average	Vertical
7	7386.00	49.45	74.00	-24.55	Peak	Vertical
8	7386.00	37.51	54.00	-16.49	Average	Vertical

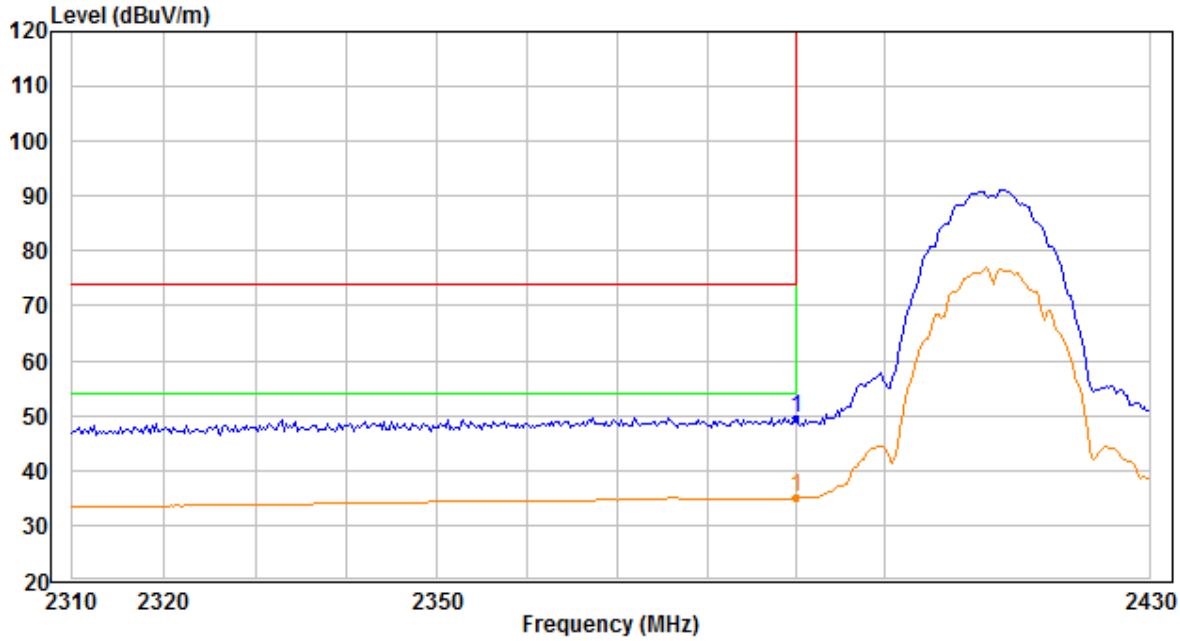
TEST REPORT

Test Channel:	Lowest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	48.29	74.00	32.85	54.00	Pass

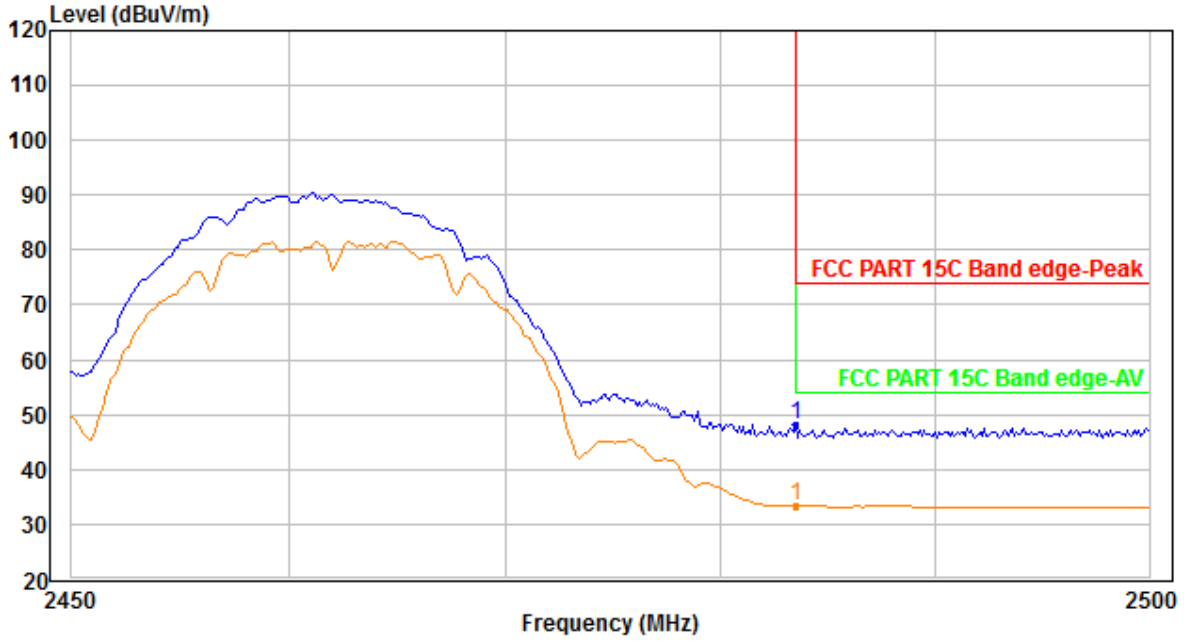
Test Channel:	Lowest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	49.59	74.00	34.96	54.00	Pass

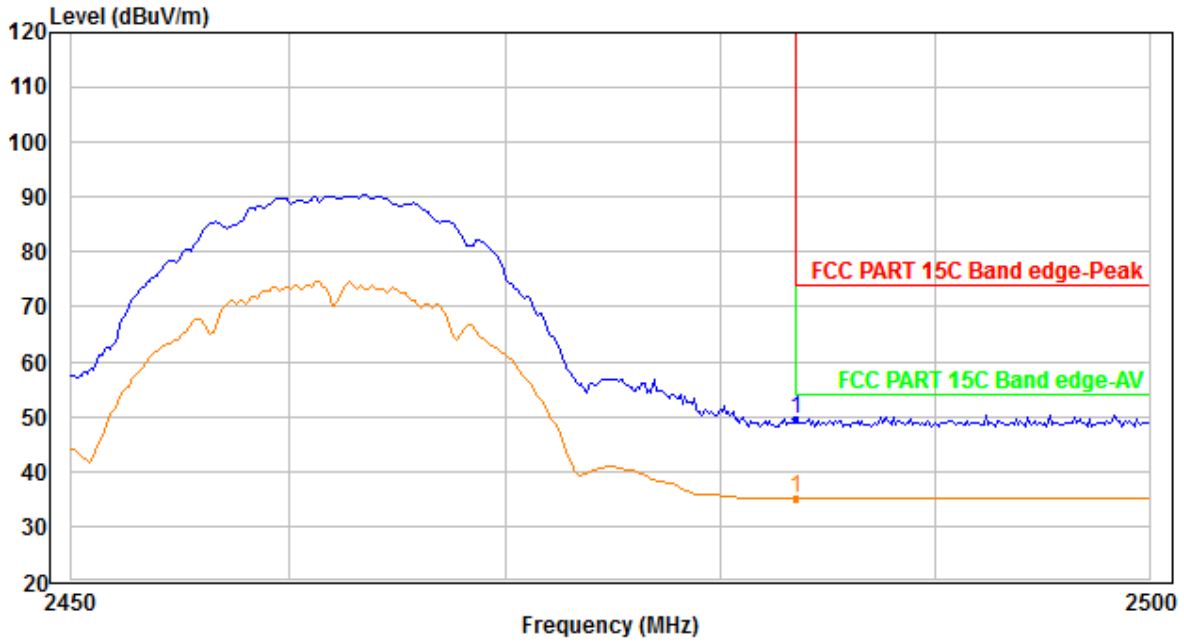
TEST REPORT

Test Channel:	Highest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	48.17	74.00	33.37	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	49.43	74.00	35.05	54.00	Pass

TEST REPORT

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement.
3. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

Table 2
IEEE 802.11g (OFDM, 6 Mbps)

Radiated Emission Test Data (Above 1GHz):

IEEE 802.11g_Lowest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4824.00	45.62	74.00	-28.38	Peak	Horizontal
2	4824.00	32.85	54.00	-21.15	Average	Horizontal
3	7236.00	49.02	74.00	-24.98	Peak	Horizontal
4	7236.00	36.86	54.00	-17.14	Average	Horizontal
5	4824.00	44.75	74.00	-29.25	Peak	Vertical
6	4824.00	33.95	54.00	-20.05	Average	Vertical
7	7236.00	48.05	74.00	-25.95	Peak	Vertical
8	7236.00	36.85	54.00	-17.15	Average	Vertical

IEEE 802.11g_Middle Channel:

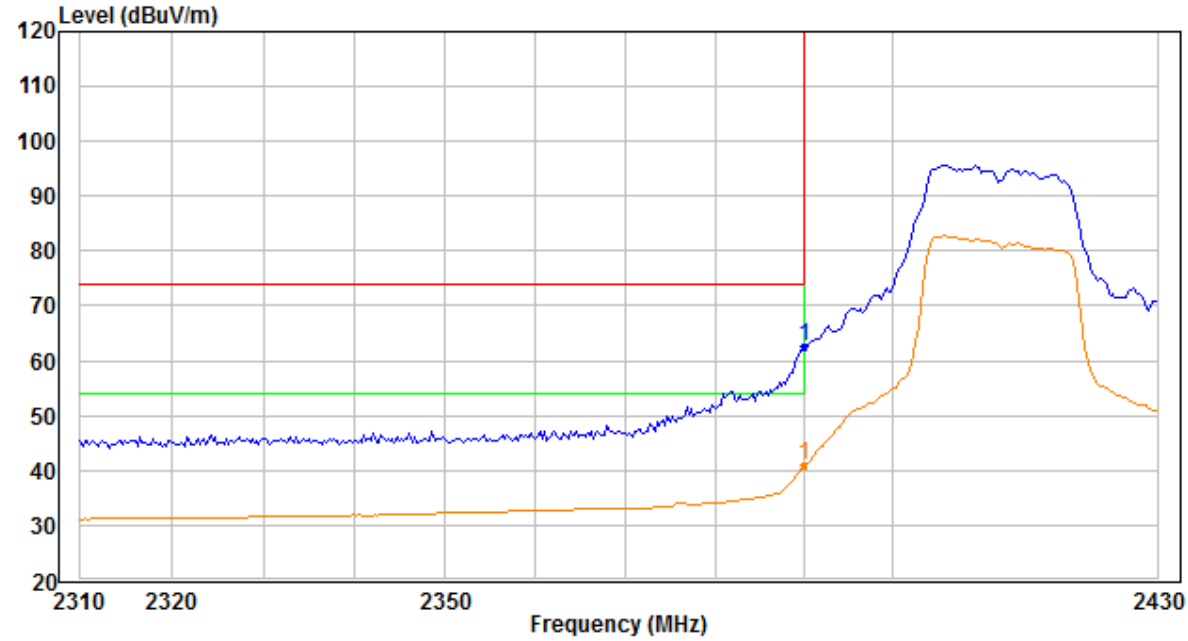
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4874.00	42.08	74.00	-31.92	Peak	Horizontal
2	4874.00	31.52	54.00	-22.48	Average	Horizontal
3	7311.00	49.44	74.00	-24.56	Peak	Horizontal
4	7311.00	37.68	54.00	-16.32	Average	Horizontal
5	4874.00	44.06	74.00	-29.94	Peak	Vertical
6	4874.00	34.02	54.00	-19.98	Average	Vertical
7	7311.00	48.50	74.00	-25.50	Peak	Vertical
8	7311.00	37.20	54.00	-16.80	Average	Vertical

IEEE 802.11g_Highest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4924.00	43.45	74.00	-30.55	Peak	Horizontal
2	4924.00	31.86	54.00	-22.14	Average	Horizontal
3	7386.00	48.92	74.00	-25.08	Peak	Horizontal
4	7386.00	37.58	54.00	-16.42	Average	Horizontal
5	4924.00	44.50	74.00	-29.50	Peak	Vertical
6	4924.00	34.12	54.00	-19.88	Average	Vertical
7	7386.00	48.05	74.00	-25.95	Peak	Vertical
8	7386.00	37.60	54.00	-16.40	Average	Vertical

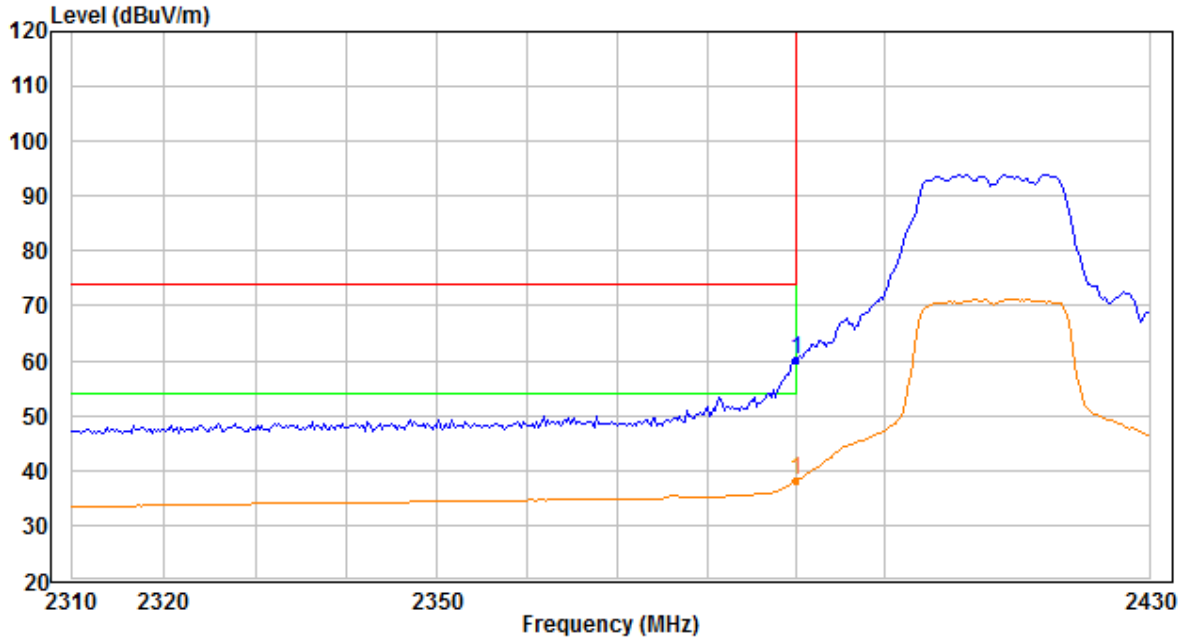
TEST REPORT

Test Channel:	Lowest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	62.62	74.00	41.04	54.00	Pass

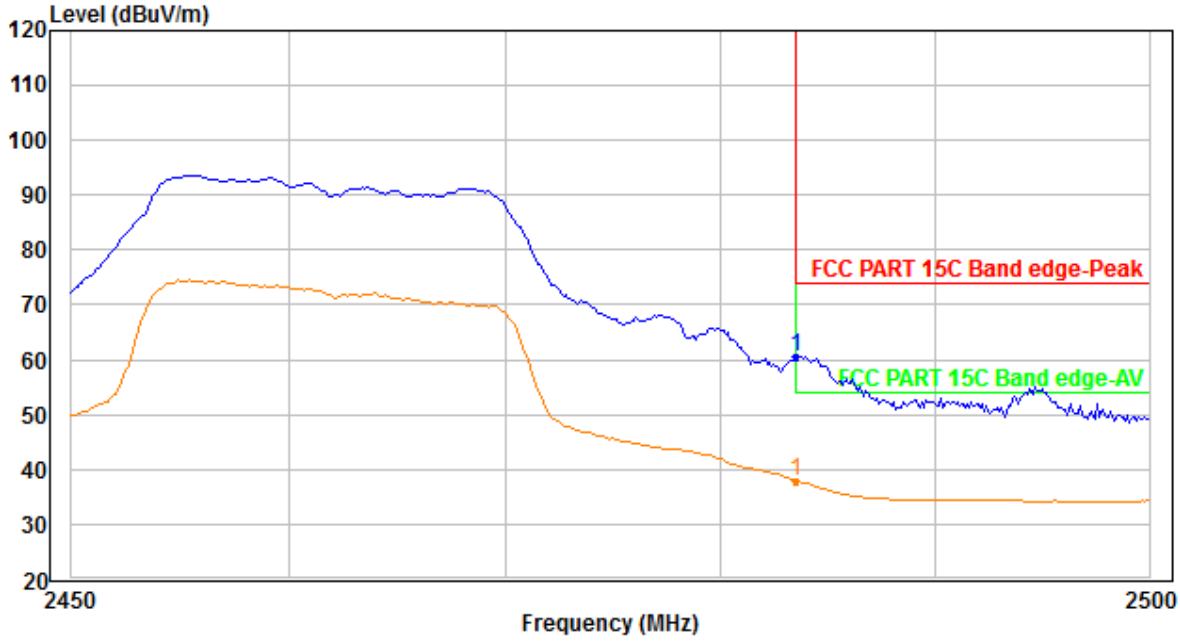
Test Channel:	Lowest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	60.25	74.00	38.21	54.00	Pass

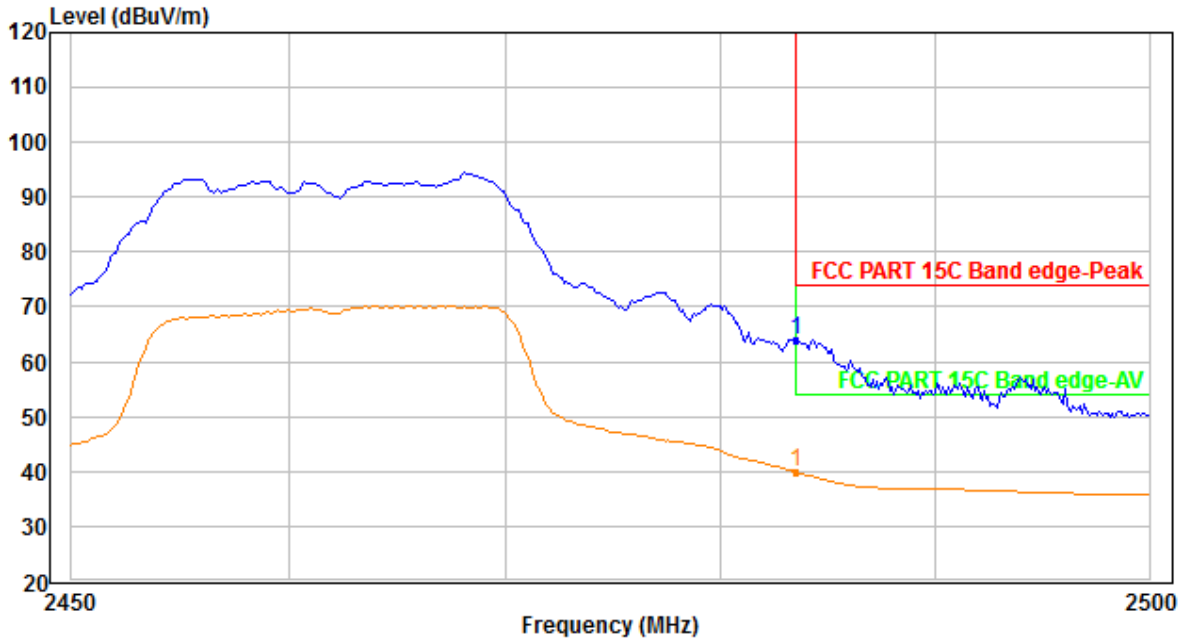
TEST REPORT

Test Channel:	Highest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	60.50	74.00	38.01	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	63.83	74.00	39.86	54.00	Pass

TEST REPORT

NOTES:

1. Peak detector is used for the emission measurement.

2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

4. Negative value in the margin column shows emission below limit.

5. Horn antenna is used for the emission over 1000MHz.

6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

Table 3
IEEE 802.11n (20MHz) (OFDM, MCS0)

Radiated Emission Test Data (Above 1GHz):

IEEE 802.11n20_Lowest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4824.00	43.79	74.00	-30.21	Peak	Horizontal
2	4824.00	32.53	54.00	-21.47	Average	Horizontal
3	7236.00	47.89	74.00	-26.11	Peak	Horizontal
4	7236.00	36.86	54.00	-17.14	Average	Horizontal
5	4824.00	44.81	74.00	-29.19	Peak	Vertical
6	4824.00	33.64	54.00	-20.36	Average	Vertical
7	7236.00	47.79	74.00	-26.21	Peak	Vertical
8	7236.00	36.54	54.00	-17.46	Average	Vertical

IEEE 802.11n20_Middle Channel:

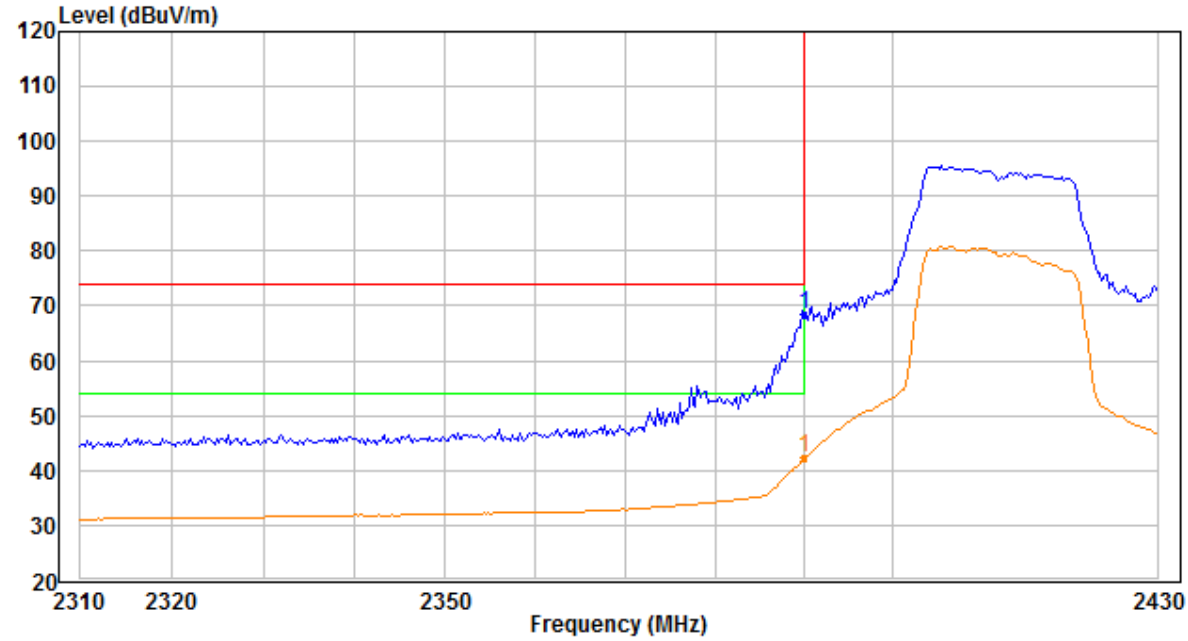
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4874.00	43.90	74.00	-30.10	Peak	Horizontal
2	4874.00	32.33	54.00	-21.67	Average	Horizontal
3	7311.00	49.60	74.00	-24.40	Peak	Horizontal
4	7311.00	37.07	54.00	-16.93	Average	Horizontal
5	4874.00	44.92	74.00	-29.08	Peak	Vertical
6	4874.00	33.50	54.00	-20.50	Average	Vertical
7	7311.00	47.91	74.00	-26.09	Peak	Vertical
8	7311.00	36.86	54.00	-17.14	Average	Vertical

IEEE 802.11n20_Highest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4924.00	44.16	74.00	-29.84	Peak	Horizontal
2	4924.00	32.43	54.00	-21.57	Average	Horizontal
3	7386.00	49.47	74.00	-24.53	Peak	Horizontal
4	7386.00	36.95	54.00	-17.05	Average	Horizontal
5	4924.00	44.74	74.00	-29.26	Peak	Vertical
6	4924.00	33.70	54.00	-20.30	Average	Vertical
7	7386.00	48.89	74.00	-25.11	Peak	Vertical
8	7386.00	36.74	54.00	-17.26	Average	Vertical

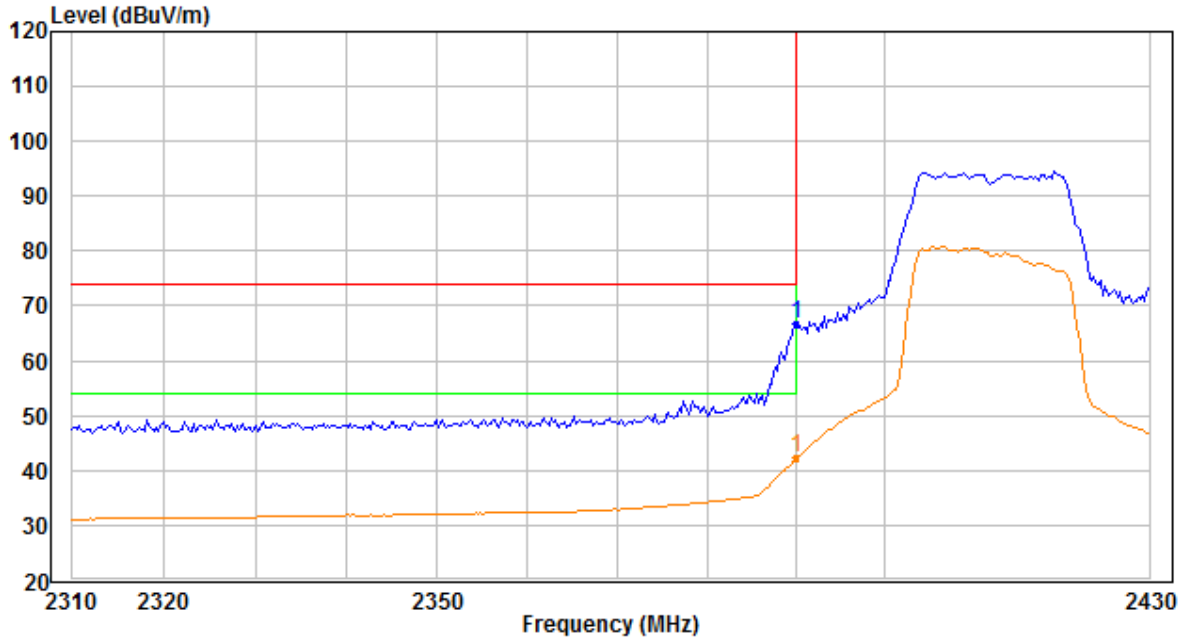
TEST REPORT

Test Channel:	Lowest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	68.58	74.00	42.24	54.00	Pass

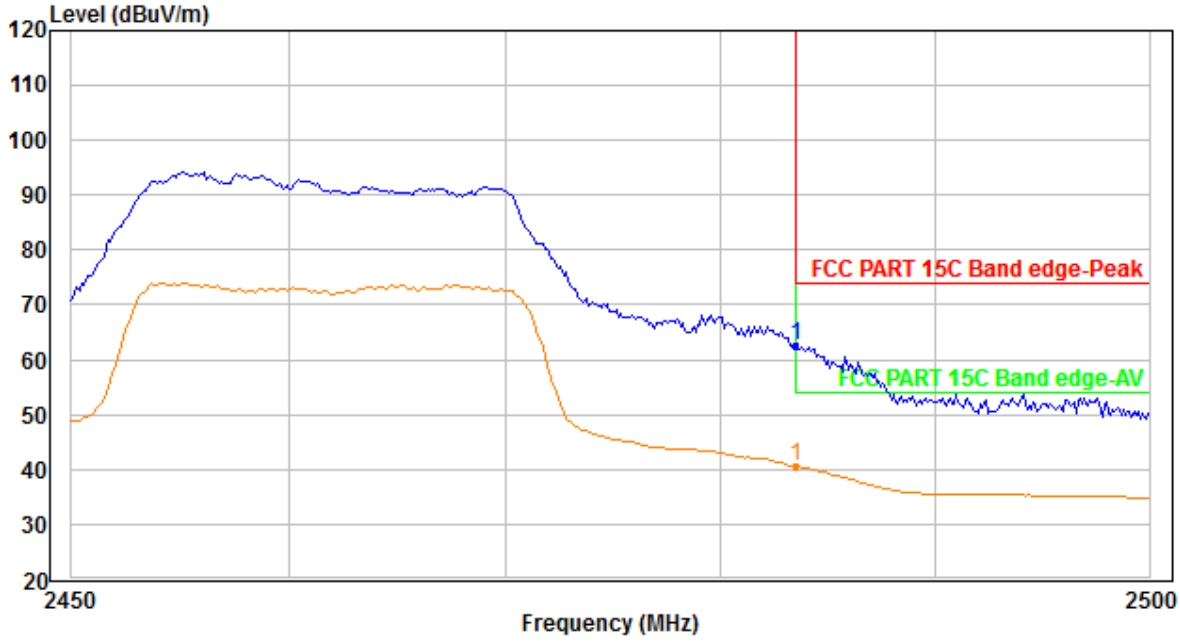
Test Channel:	Lowest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	66.69	74.00	40.19	54.00	Pass

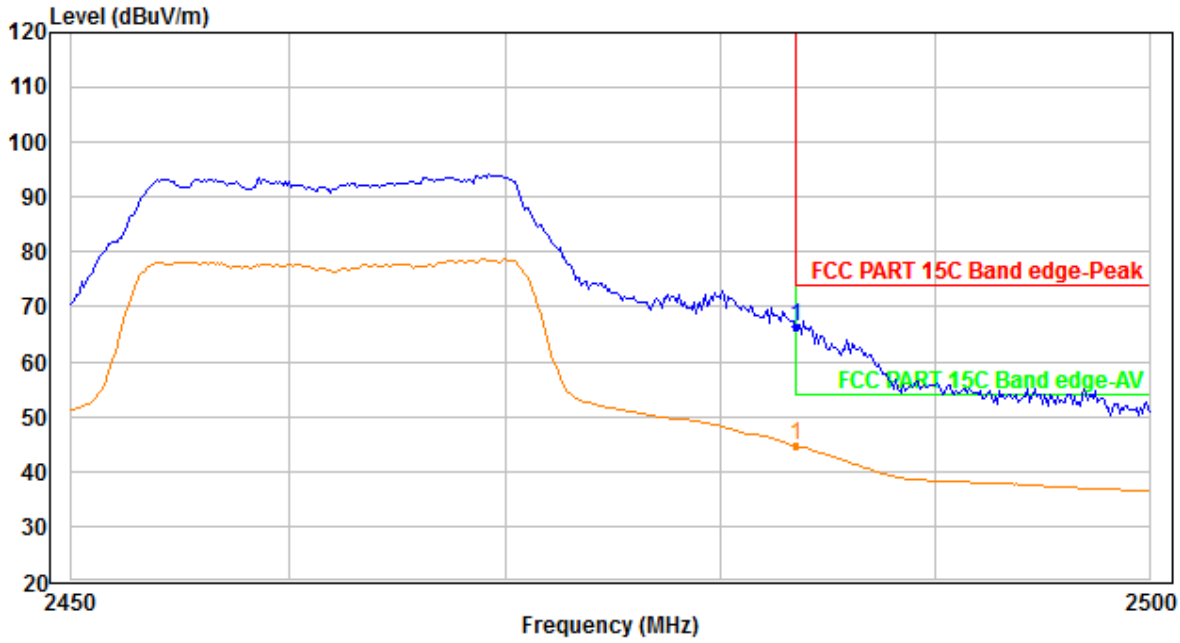
TEST REPORT

Test Channel:	Highest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	62.50	74.00	40.57	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	66.53	74.00	44.74	54.00	Pass

TEST REPORT

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

Table 4
IEEE 802.11n (40MHz) (OFDM, MCS0)

Radiated Emission Test Data (Above 1GHz):

IEEE 802.11n40_Lowest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4844.00	43.42	74.00	-30.58	Peak	Horizontal
2	4844.00	31.91	54.00	-22.09	Average	Horizontal
3	7266.00	48.01	74.00	-25.99	Peak	Horizontal
4	7266.00	36.39	54.00	-17.61	Average	Horizontal
5	4844.00	43.96	74.00	-30.04	Peak	Vertical
6	4844.00	32.62	54.00	-21.38	Average	Vertical
7	7266.00	46.80	74.00	-27.20	Peak	Vertical
8	7266.00	35.64	54.00	-18.36	Average	Vertical

IEEE 802.11n40_Middle Channel:

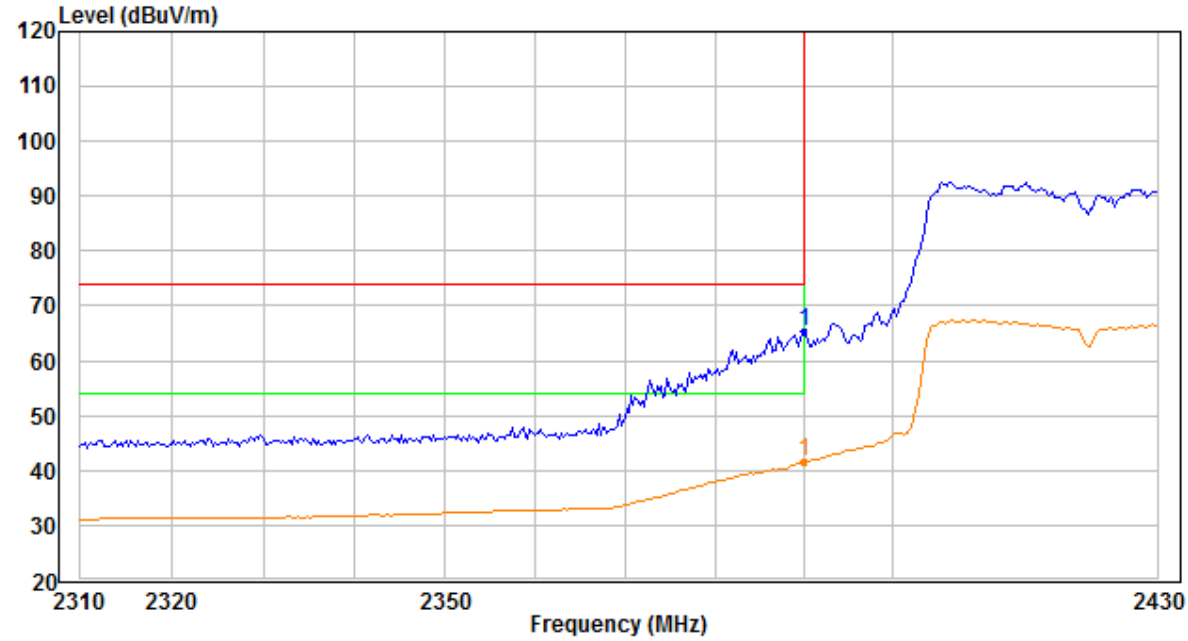
No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4874.00	43.22	74.00	-30.78	Peak	Horizontal
2	4874.00	31.70	54.00	-22.30	Average	Horizontal
3	7311.00	48.66	74.00	-25.34	Peak	Horizontal
4	7311.00	36.84	54.00	-17.16	Average	Horizontal
5	4874.00	44.14	74.00	-29.86	Peak	Vertical
6	4874.00	32.88	54.00	-21.12	Average	Vertical
7	7311.00	48.11	74.00	-25.89	Peak	Vertical
8	7311.00	36.04	54.00	-17.96	Average	Vertical

IEEE 802.11n40_Highest Channel:

No.	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4904.00	42.68	74.00	-31.32	Peak	Horizontal
2	4904.00	31.80	54.00	-22.20	Average	Horizontal
3	7356.00	47.56	74.00	-26.44	Peak	Horizontal
4	7356.00	36.57	54.00	-17.43	Average	Horizontal
5	4904.00	43.59	74.00	-30.41	Peak	Vertical
6	4904.00	33.15	54.00	-20.85	Average	Vertical
7	7356.00	46.54	74.00	-27.46	Peak	Vertical
8	7356.00	36.79	54.00	-17.21	Average	Vertical

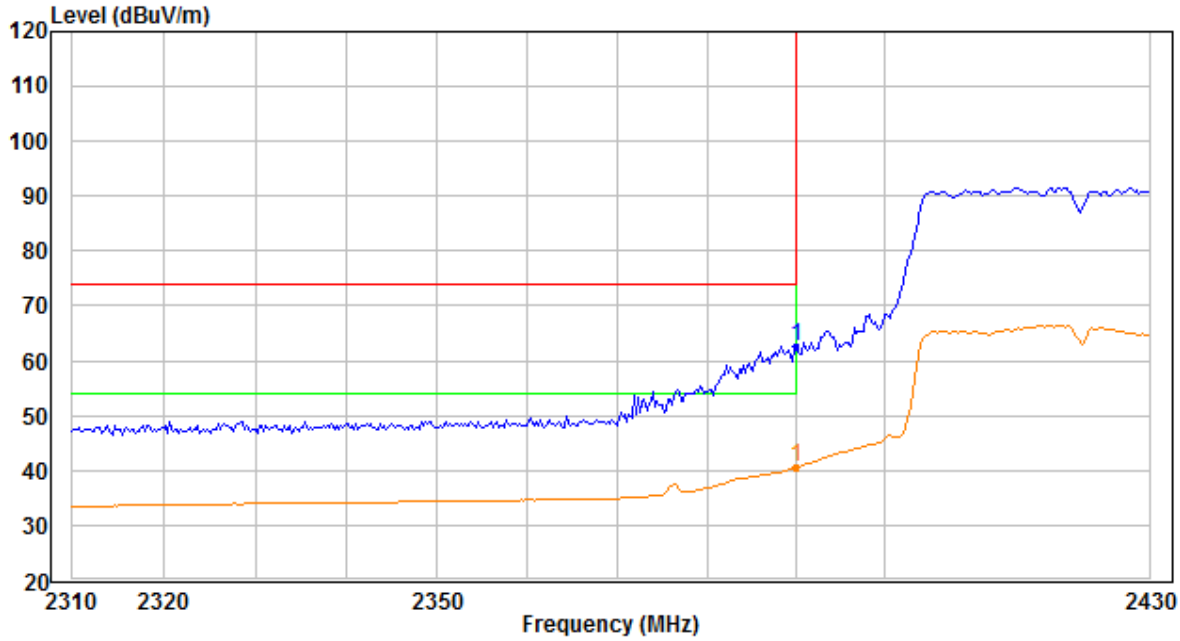
TEST REPORT

Test Channel:	Lowest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	65.26	74.00	41.58	54.00	Pass

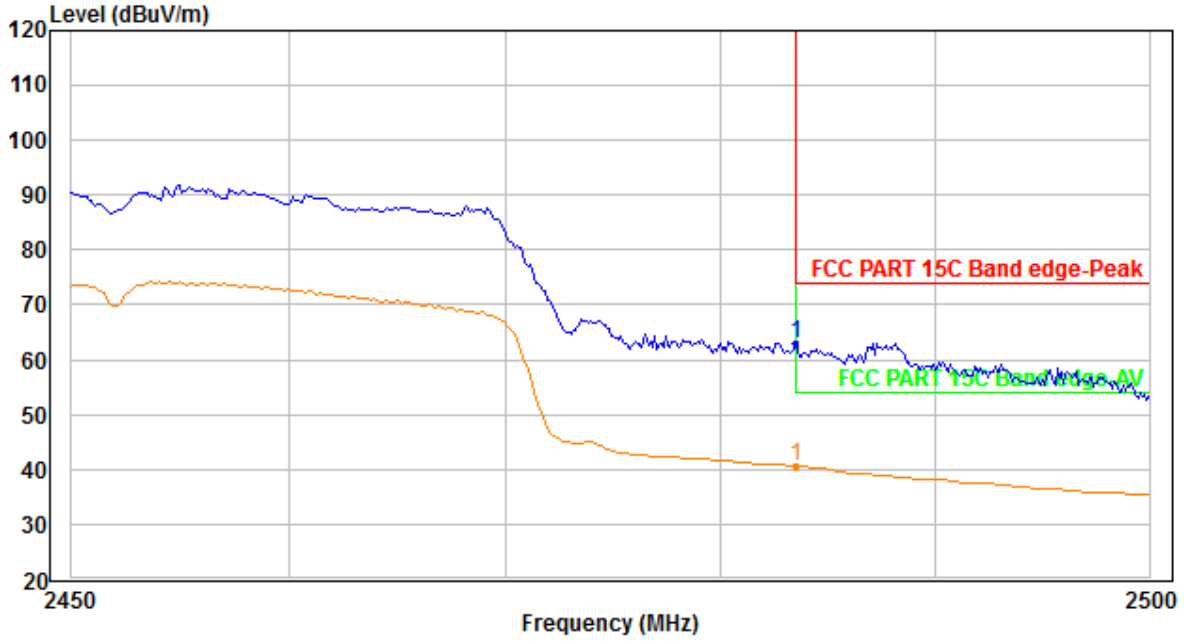
Test Channel:	Lowest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2390.0000	62.73	74.00	40.60	54.00	Pass

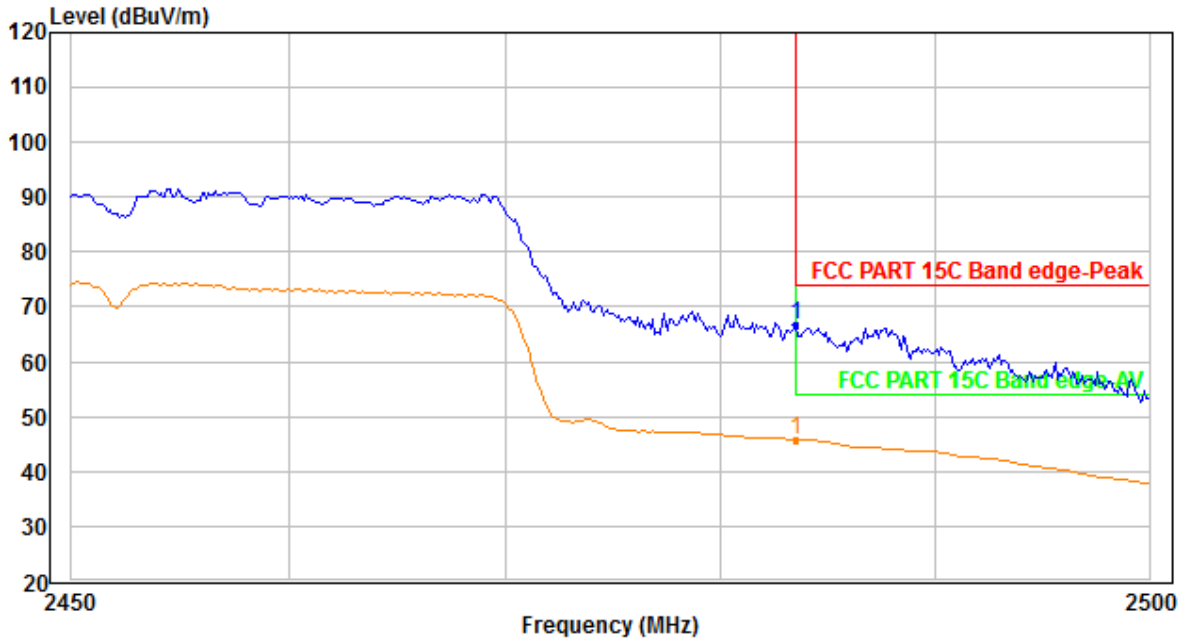
TEST REPORT

Test Channel:	Highest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	62.96	74.00	40.61	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5000	66.62	74.00	45.83	54.00	Pass

TEST REPORT

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

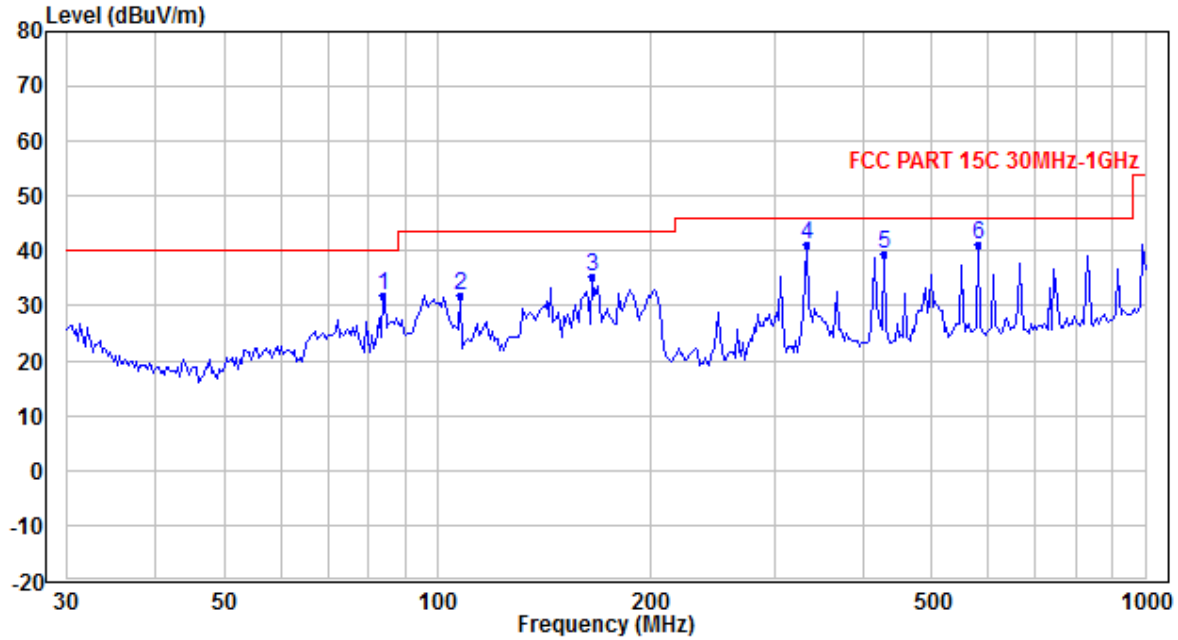
TEST REPORT

Mode: WIFI Connected

Table 5

Radiated Emission Test Data (30 MHz ~ 1 GHz):
Worst-Case Configuration

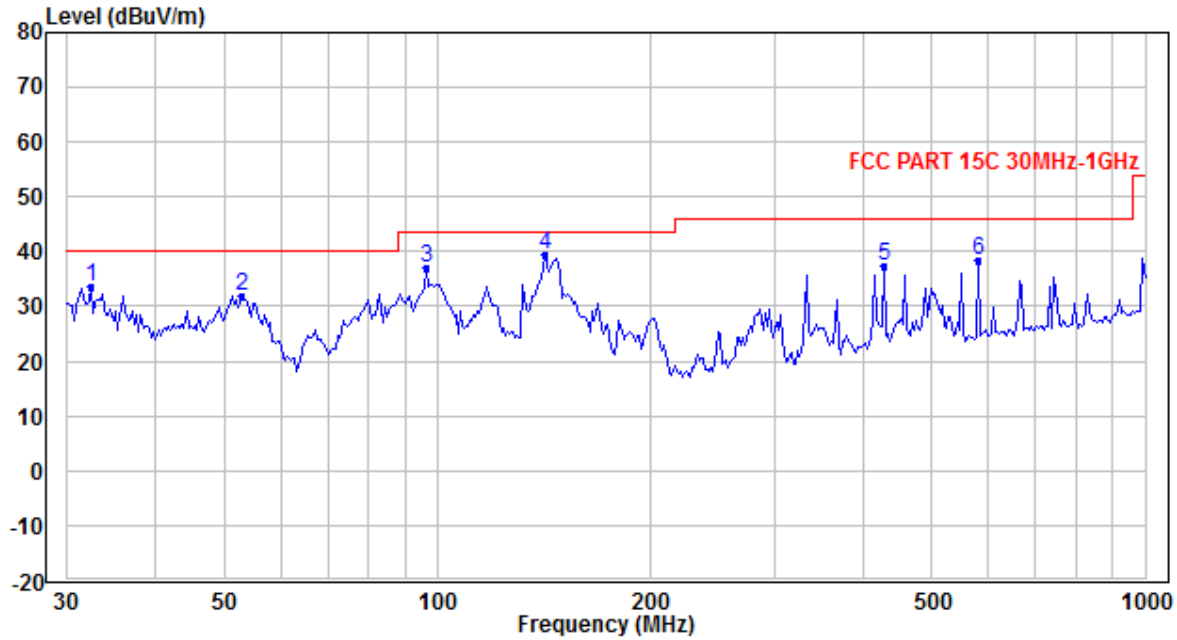
Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	83.694	45.14	-13.22	31.92	40.00	-8.08	Peak
2	107.785	43.70	-11.76	31.94	43.50	-11.56	Peak
3	165.472	45.85	-10.52	35.33	43.50	-8.17	Peak
4	331.786	47.90	-6.59	41.31	46.00	-4.69	Peak
5	427.292	43.89	-4.54	39.35	46.00	-6.65	Peak
6	582.112	43.07	-2.02	41.05	46.00	-4.95	Peak

TEST REPORT

Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correction factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	32.411	39.45	-5.73	33.72	40.00	-6.28	Peak
2	53.006	45.59	-13.55	32.04	40.00	-7.96	Peak
3	96.323	48.88	-11.91	36.97	43.50	-6.53	Peak
4	141.769	50.57	-11.08	39.49	43.50	-4.01	Peak
5	427.292	41.77	-4.54	37.23	46.00	-8.77	Peak
6	582.112	40.58	-2.02	38.56	46.00	-7.44	Peak

NOTES:

1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

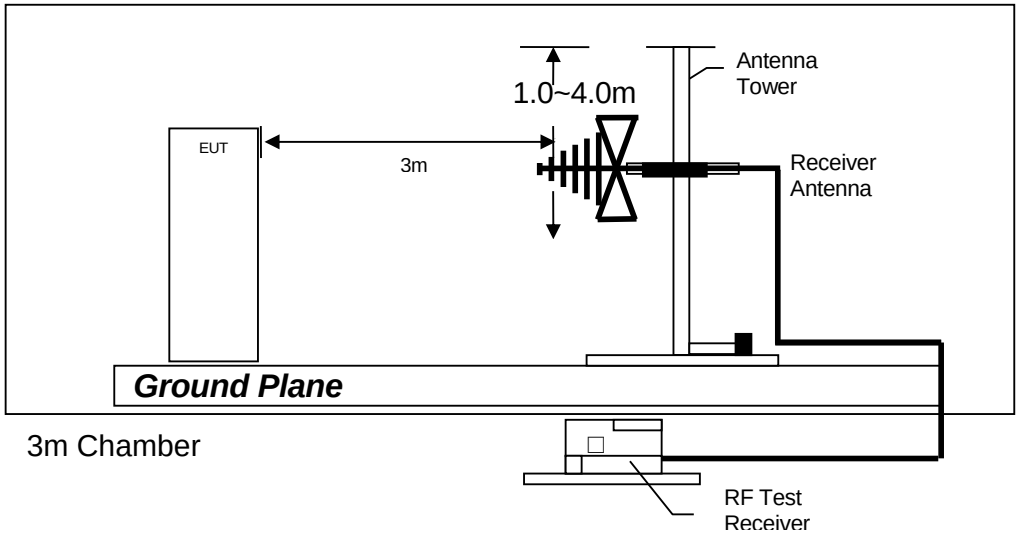
3. Negative value in the margin column shows emission below limit.

4. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

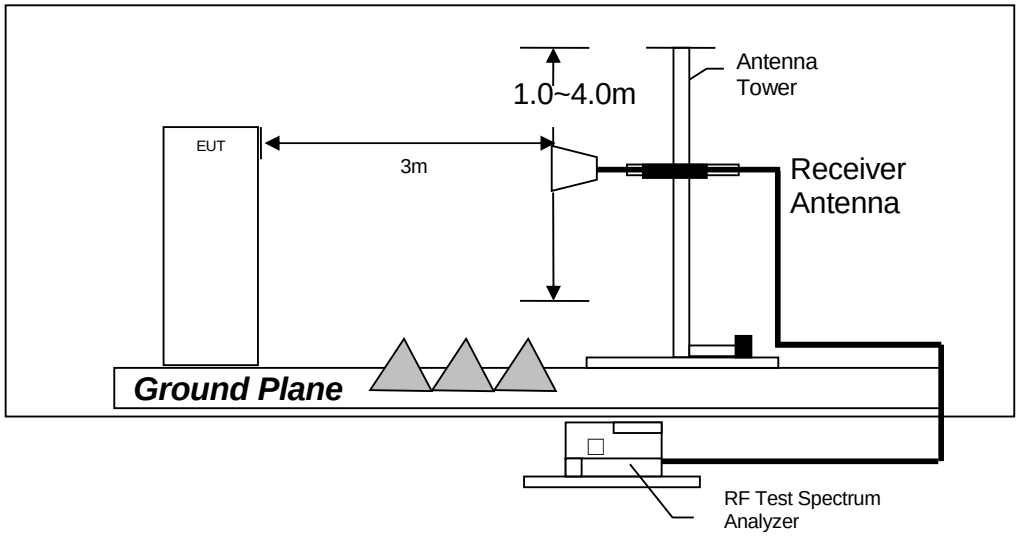
TEST REPORT

4.6.3 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

TEST REPORT

4.6.4 Transmitter Duty Cycle Calculation

Not applicable – No average factor is required.

TEST REPORT

4.7 AC Power Line Conducted Emission

☐ Not applicable – EUT is only powered by battery for operation.

☒ EUT connects to AC power line. Emission Data is listed in following pages.

☐ Base Unit connects to AC power line and has transmission. Handset connects to AC power line but has no transmission. Emission Data of Base Unit is listed in following pages.

4.7.1 AC Power Line Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration
at

0.462 kHz

The worst case line conducted configuration photographs are attached in the Appendix and saved with filename: config photos.pdf

4.7.2 AC Power Line Conducted Emission Data

The plot(s) and data in the following pages list the significant emission frequencies, the limit and the margin of compliance.

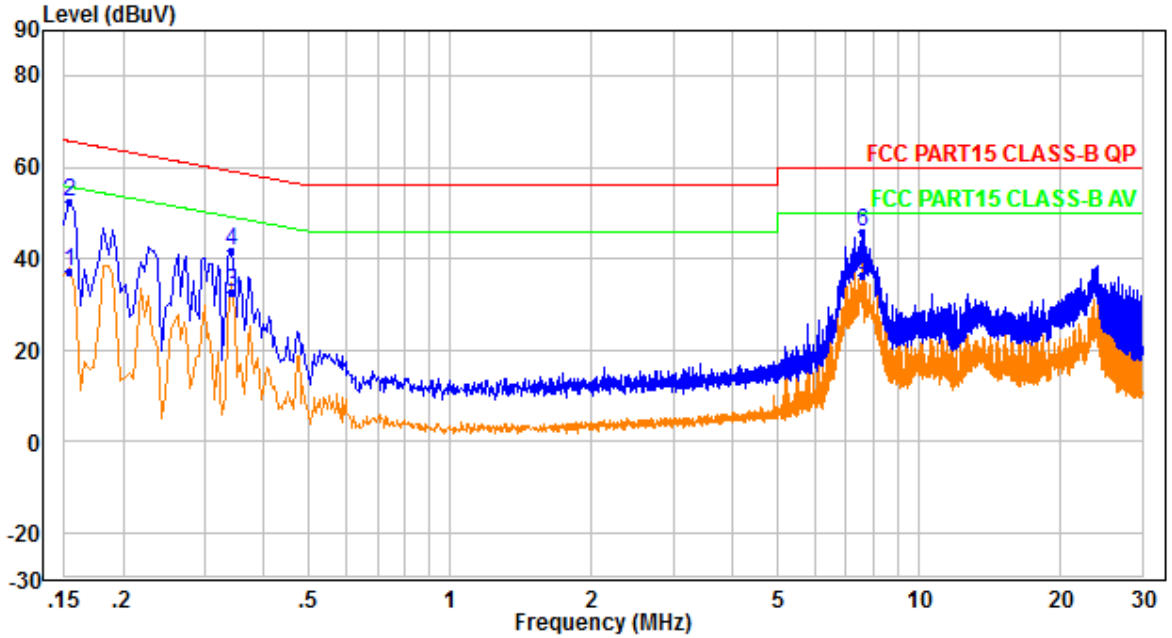
Passed by 13.48 dB margin compare with Quasi-peak limit

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

Worst Case: WiFi Operating

Live Line

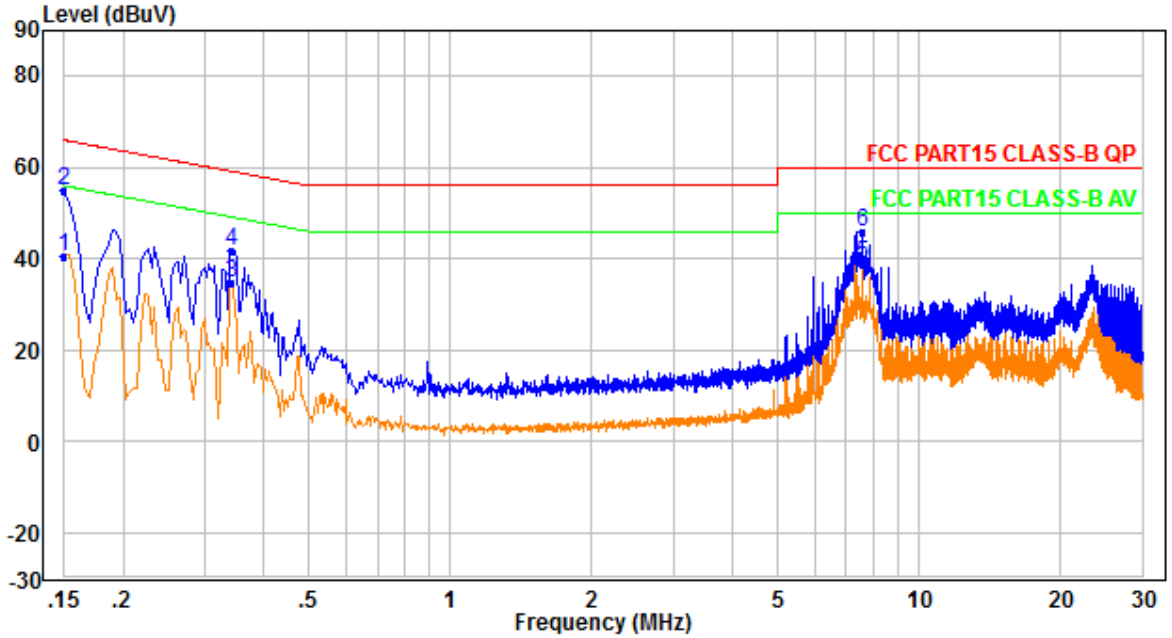


No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.154	27.35	10.03	37.38	55.78	-18.40	Average
2	0.154	42.48	10.03	52.51	65.78	-13.27	QP
3	0.342	22.86	9.99	32.85	49.15	-16.30	Average
4	0.342	31.95	9.99	41.94	59.15	-17.21	QP
5*	7.590	25.66	10.90	36.56	50.00	-13.44	Average
6	7.590	34.77	10.90	45.67	60.00	-14.33	QP

TEST REPORT

Worst Case: WiFi Operating

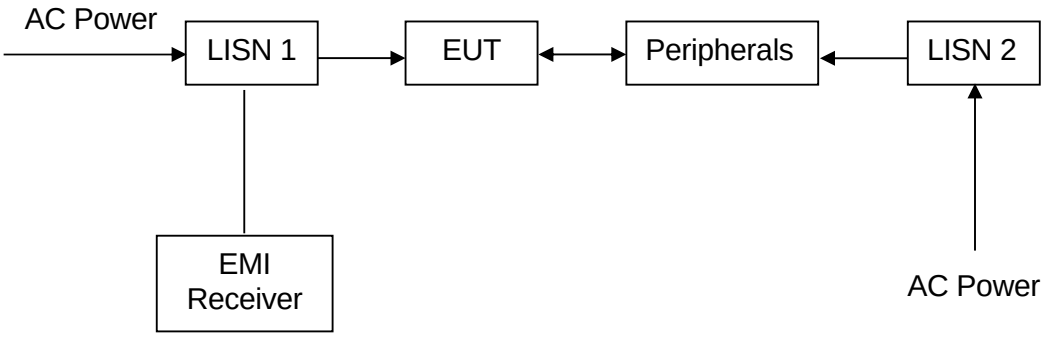
Neutral Line



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.150	30.65	10.01	40.66	56.00	-15.34	Average
2	0.150	44.74	10.01	54.75	66.00	-11.25	QP
3	0.342	24.66	9.97	34.63	49.15	-14.52	Average
4	0.342	31.75	9.97	41.72	59.15	-17.43	QP
5	7.586	27.99	10.85	38.84	50.00	-11.16	Average
6	7.586	34.99	10.85	45.84	60.00	-14.16	QP

TEST REPORT

4.7.3 Conducted Emission Test Setup



TEST REPORT

5.0 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	3M Chamber & Accessory Equipment	Receiver	Loop Antenna
Equipment No..	UTTL—E010	UTTL—E026	UTTL—E013
Manufacturer	ETS-LINDGREN	R&S	ETS-LINDGREN
Model No.	3M	ESIB26	6502
Calibration Date	December 03, 2018	November 24, 2018	December 03, 2018
Calibration Due Date	December 03, 2021	November 24, 2019	December 03, 2019

Equipment	Broadband Antenna	6dB Attenuator	Preamplifier
Equipment No..	UTTL—E014	UTTL—E056	UTTL—E043
Manufacturer	ETS-LINDGREN	Talent	HP
Model No.	3142E	RA6A5-N-18	8447F
Calibration Date	December 08, 2018	December 08, 2018	November 24, 2018
Calibration Due Date	December 08, 2019	December 08, 2019	November 24, 2019

Equipment	Horn Antenna (Pre-amplifier)	Multi device Controller	Band Rejection Filter (2400MHz~2500MHz)
Equipment No..	UTTL—E017	UTTL—EN002	UTTL—E044
Manufacturer	ETS-LINDGREN	ETS-LINDGREN	Micro-Tronics
Model No.	3117-PA	7006-001	BRM50702
Calibration Date	May 18, 2019	N/A	June 06, 2019
Calibration Due Date	May 18, 2020	N/A	June 06, 2020

Equipment	Test Software
Equipment No..	N/A
Manufacturer	Audix
Model No.	E3
Calibration Date	Software Version:
Calibration Due Date	9.160333

2) Conducted Emissions Test

Equipment	Receiver	Pulse Limiter	LISN
Equipment No..	UTTL—E005	UTTL—E007	UTTL—E003
Manufacturer	R&S	R&S	R&S
Model No.	ESR7	ESH3-Z2	ESH2-Z5
Calibration Date	November 24, 2018	November 24, 2018	November 24, 2018
Calibration Due Date	November 24, 2019	November 24, 2019	November 24, 2019

Equipment	Test Software
Equipment No..	N/A
Manufacturer	Audix
Model No.	E3
Calibration Date	Software Version:
Calibration Due Date	9.160333

TEST REPORT

3) Conductive Measurement Test

Equipment	EXA Spectrum Analyzer	USB Wideband Power Sensor
Equipment No.	UTTL－E032	UTTL－E033
Manufacturer	KEYSIGHT	KEYSIGHT
Model No.	N9010A	U2021XA
Calibration Date	November 24, 2018	November 24, 2018
Calibration Due Date	November 24, 2019	November 24, 2019

END OF TEST REPORT