FCC / IC DTS REPORT

Certification

Applicant Name:
Safetrust Inc

Address:
8116 Mill Creek Rd.

Fremont, CA 94539, U.S.A.

Date of Issue:
July 24, 2019

Test Site/Location:
EMCE Engineering

1726 Ringwood Avenue San Jose, California USA

Report No.: EMCE-R-1907-F003-1

FCC ID:	**2ANI5SA200**
IC:	**23133-SA200**
APPLICANT:	**Safetrust Inc**

Model:	SA200
EUT Type:	SABRE Module
Peak Output Power:	802.11b : 9.19 dBm 802.11g : 18.75 dBm 802.11n(HT20) : 18.59 dBm
Frequency Range:	2412 MHz - 2462 MHz
Modulation type:	CCK/DSSS/OFDM
FCC Classification:	Digital Transmission System(DTS)
FCC Rule Part(s):	Part 15.247
ISED Rule Part(s):	RSS-247 Issue 2 (February 2017), RSS-Gen Issue 5(April 2018)

Engineering Statement:
The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC / IC Rules under normal use and maintenance

Steve In
Test Engineer
Certification Division

Billy Kim
Technical Manager
Certification Division

Version

TEST REPORT NO.	DATE	DESCRIPTION
EMCE-R-1907-F003	July 12, 2019	- First Approval Report
EMCE-R-1907-F003-1	July 24, 2019	Revised Test Procedure of Radiated spurious emissions

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EMCE Engineering, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA
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1. EUT DESCRIPTION

Model	SA200	
EUT Type	SABRE Module	
Power Supply	DC 5.0 V	
Frequency Range	2412 MHz - 2462 MHz	
Max. RF Output Power	Peak Power	802.11b : 9.19 dBm 802.11g : 18.75 dBm 802.11n(HT20) : 18.59 dBm
	Average Power	802.11b : 3.49 dBm 802.11g : 11.05 dBm 802.11n(HT20) : 11.19 dBm
Modulation Type	DSSS/CCK : 802.11b OFDM : 802.11g, 802.11n	
Number of Channels	11 Channels	
Antenna Specification	Antenna type: Chip antenna Peak Gain :2.0 dBi	
Firmware Version	N/A	
Haedware Version	SA200	
Date(s) of Tests	June 10, 2019 ~ July 11, 2019	

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2. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05r01 dated February 11, 2019 entitled "guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

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.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpse of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C / RSS-Gen issue 5, RSS-247 issue 2.

GENERAL TEST PROCEDURES

Conducted Emissions

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

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 8.3.(KDB 558074 v05r01)

DESCRIPTION OF TEST MODES

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

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3. 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's, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, California 95131, USA.

The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

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

5. 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 antennas of this E.U.T are permanently attached.

* The E.U.T Complies with the requirement of §15.203

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6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

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

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	2.55
Radiated Disturbance (9 kHz ~ 30 MHz)	3.20
Radiated Disturbance (30 MHz ~ 1 GHz)	4.73
Radiated Disturbance (1 GHz ~ 18 GHz)	5.21
Radiated Disturbance (18 GHz ~ 40 GHz)	5.18

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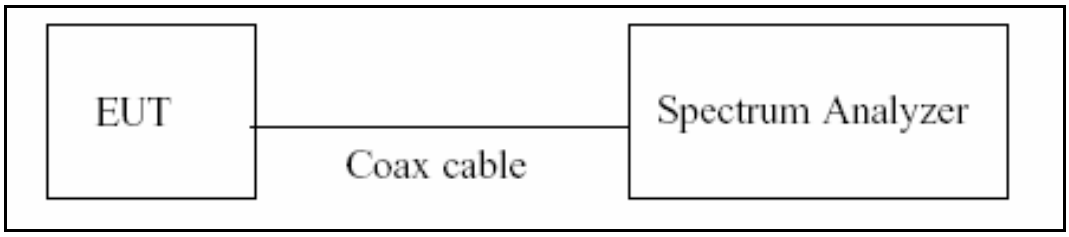
7. DESCRIPTION OF TESTS

7.1. Duty Cycle

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T 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.)

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to the zero-span measurement method.

The largest availble value of RBW is 8 MHz and VBW is 50 MHz.

The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)

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

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

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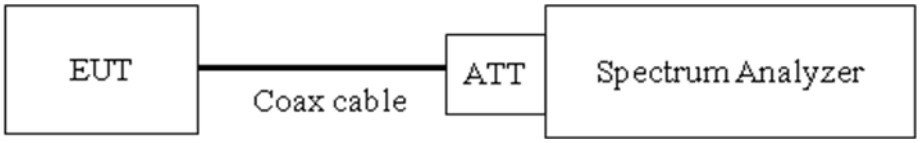
7.2. 6dB Bandwidth & 99 % Bandwidth

Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 8.2 in KDB 558074 v05r01,

Procedure 11.8.1 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Detector = Peak
4) Trace mode = max hold
5) Sweep = auto couple
6) Allow the trace to stabilize
7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

Test Procedure (99 % Bandwidth for IC)

The transmitter output is connected to the spectrum analyzer.

RBW = 1% ~ 5% of the occupied bandwidth

VBW ≒ 3 x RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

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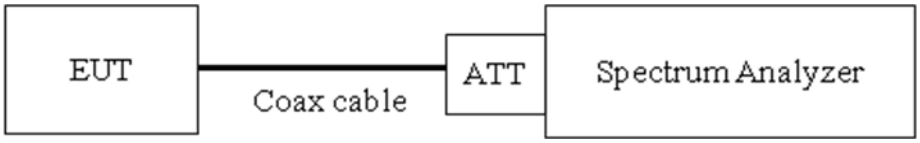
7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer. We use the spectrum analyzer's integrated band power measurement function

The Spectrum Analyzer is set to

- Peak Power (Procedure 8.3.1.1 in KDB 558074 v05r02)

  RBW ≥ Bandwidth

  VBW ≥ 3 x RBW

  SPAN ≥ 3 x RBW

  Detector Mode = Peak

  Sweep = auto couple

  Trace Mode = max hold

  Allow trace to fully stabilize.

  Use peak marker function to determine the peak amplitude level

- Average Power (Procedure 8.3.2.2 in KDB 558074 v05r02)

  Measure the duty cycle

  Set span to at least 1.5 times the OBW

  RBW = 1-5 % of the OBW, not to exceed 1 MHz

  VBW ≥ 3 x RBW.

  Number of points in sweep ≥ 2 x span / RBW. (This gives bin-to-bin spacing ≤ RBW/2,

  so that narrowband signals are not lost between frequency bins.)

  Sweep time = auto.

  Detector = RMS (i.e., power averaging)

  Do not use sweep triggering. Allow the sweep to "free run".

  Trace average at least 100 traces in power averaging (RMS) mode.

  Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power

measurement function with band limits set equal to the OBW band edges.

Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

- Conducted Output Power(Peak) = Reading Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Reading Value + ATT loss + Cable loss + Duty Cycle Factor

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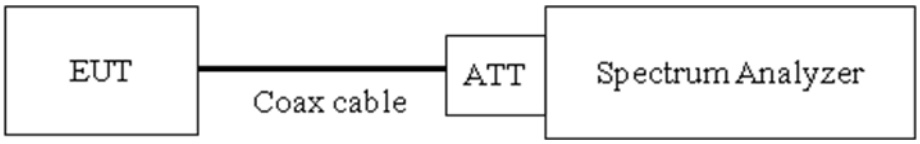
7.4. Power Spectral Density

Limit

The transmitter power density average over 1-second interval shall not be greater than 8dBm in any 3kHz BW.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure 8.4 in KDB 558074 v05r01, Procedure 11.10 in ANSI 63.10-2013.

The spectrum analyzer is set to :

1) Set analyzer center frequency to DTS channel center frequency.
2) Set span to at least 1.5 times the OBW.
3) RBW = 3 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x RBW.
5) Sweep = auto couple
6) Detector = power averaging (rms) or sample detector (when rms not available).
7) Ensure that the number of measurement points in the sweep ≥[2 ×span / RBW].
8) Employ trace averaging (rms) modeover a minimum of 100 traces
9) Use the peak marker function to determine the maximum amplitude level.
10) Use the peak marker function to determine the maximum amplitude level within the RBW.
    If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Sample Calculation

▪ Power Spectral Density = Reading Value + ATT loss + Cable loss

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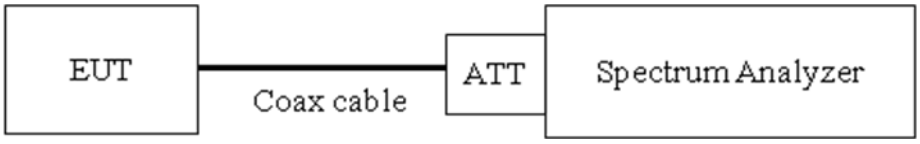
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Peak) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least
30 dB relative to the maximum in-band peak PSD level in 100 kHz.
[Conducted > 20 dBc]

Test Configuration



Test Procedure

The transmitter output is connected to the spectrum analyzer.
(Procedure 11.11 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Set span to encompass the spectrum to be examined
4) Detector = Peak
5) Trace Mode = max hold
6) Sweep time = auto couple
7) Ensure that the number of measurement points ≥ 2*Span/RBW
8) Allow trace to fully stabilize.
9) Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

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Factors for frequency

Freq [MHz]	Factor [dB]	Freq [MHz]	Factor [dB]
30	20.13	11000	21.19
100	20.31	12000	21.32
200	20.21	13000	21.44
300	20.16	14000	21.39
400	20.22	15000	21.51
500	20.15	16000	21.66
600	20.26	17000	21.72
700	20.17	18000	21.88
800	20.23	19000	21.92
900	20.21	20000	22.04
1000	20.19	21000	22.17
2000	20.38	22000	22.31
2400*	20.42	23000	22.57
2500*	20.51	24000	22.41
3000	20.53	25000	22.53
4000	20.61		
5000	20.97		
6000	20.73		
7000	21.01		
8000	20.88		
9000	21.11		
10000	21.21		

Note : 1. '*' is fundamental frequency range.

2. Factor = Attenuator loss + Cable loss + EUT Cable loss

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7.6. Radiated Test

Limit

FCC

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30

IC

Frequency (MHz)	Field Strength (uA/m)	Measurement Distance (m)
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30

FCC&IC

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

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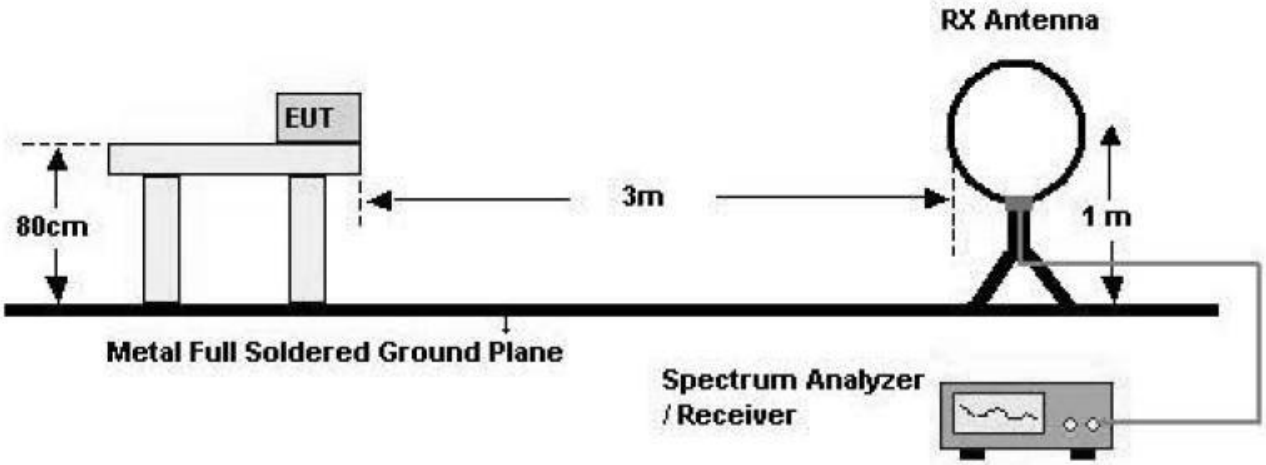
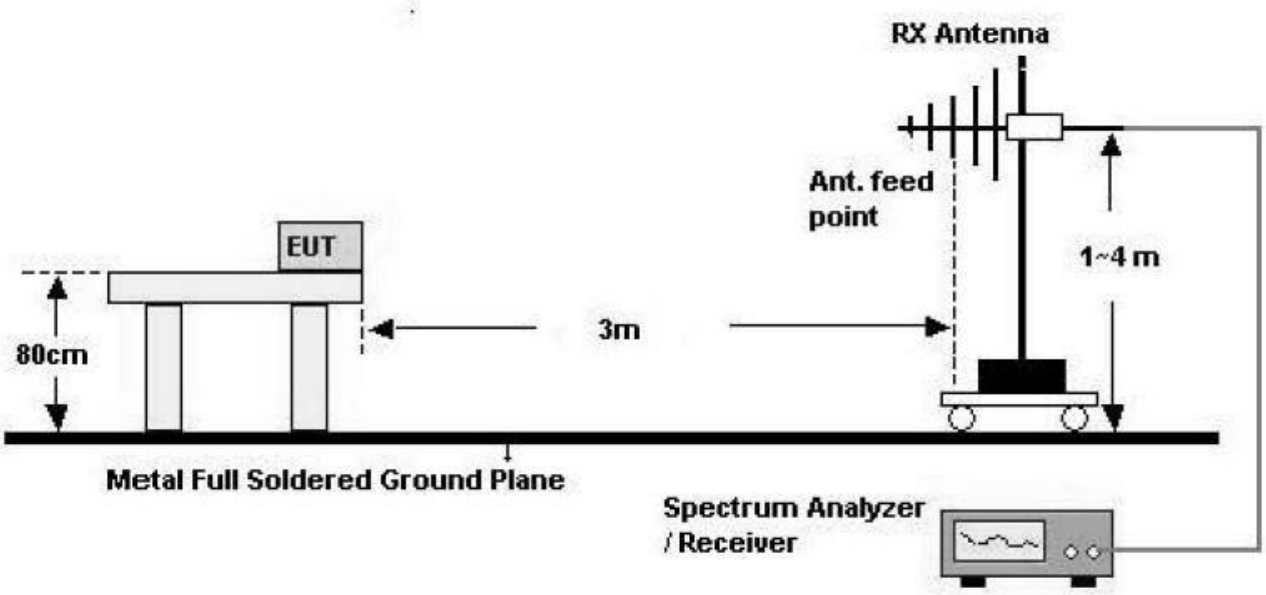
Test Configuration

Below 30 MHz



30 MHz - 1 GHz



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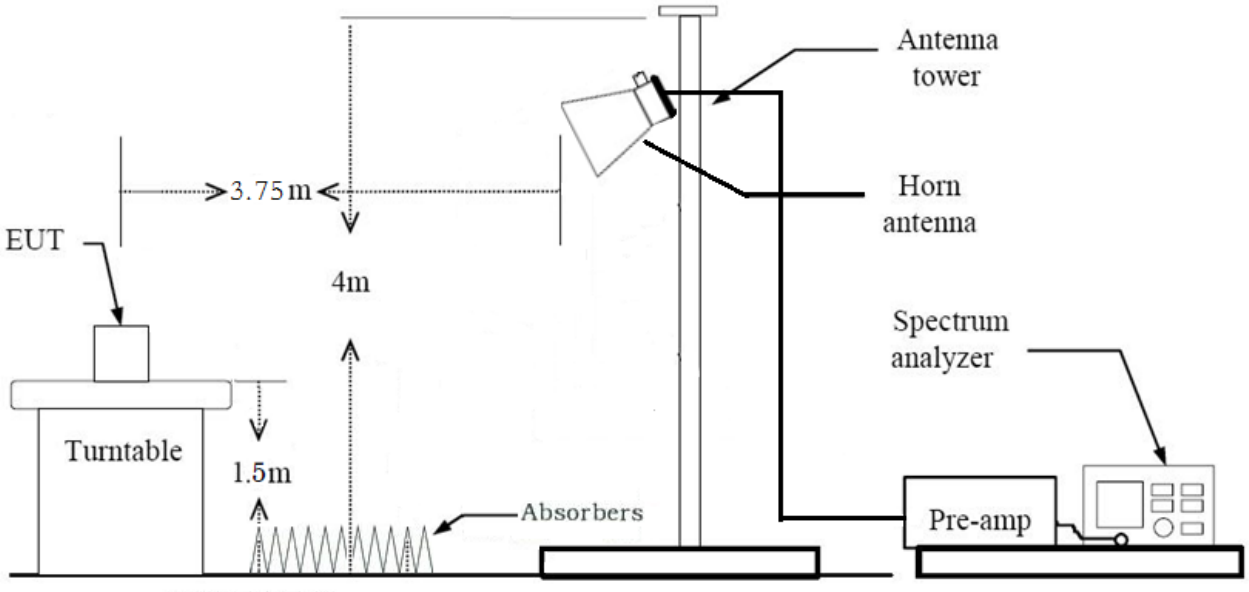
Above 1 GHz



Test Procedure of Radiated spurious emissions(Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40*log(3 m/300 m) = - 80 dB

   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40*log(3 m/30 m) = - 40 dB

   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3*RBW
9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

10. Although these tests were performed at a test site other than an open field site, adequate comparison measurements were confirmed against an open field site. Therefore, sufficient test were made to demonstrate that the alternative site produces Result that correlate with the one of test made in an open field site based on KDB 414788

Sample validation

Reference-signal Frequency [kHz]	Reading [dBuV]	Measurement Distance [m]	Extrapolation Factor	Total [dBuV/m]
135	70.1	3	80.0	-9.9
135	47.4	10	59.1	-11.7

Test Procedure of Radiated spurious emissions(Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3*RBW
   (2) Measurement Type(Quasi-peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Quasi-Peak
      - RBW = 120 kHz
   *In general, (1) is used mainly
6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from

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center of turn table. So, we applied the distance factor(reference distance : 3 m).

*Distance extrapolation factor = 20*log (test distance / specific distance) (dB)

6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting (Method 8.6 in KDB 558074 v05r01, Procedure 11.12 in ANSI 63.10-2013)

(1) Measurement Type(Peak):

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = Peak
- Trace = Maxhold
- RBW = 1 MHz
- VBW ≥ 3*RBW

(2) Measurement Type(Average): Duty cycle ≥ 98%

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3*RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).

(3) Measurement Type(Average): Duty cycle < 98%, duty cycle variations are less than ±2％

- Measured Frequency Range : 1 GHz – 25 GHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3*RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).
- 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.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

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11. Total(Measurement Type : Peak)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle ≥ 98%)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle < 98%)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)
+ Duty Cycle Factor

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
   *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3*RBW
   (2) Measurement Type(Average): Duty cycle ≥ 98%,
      - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
      - Detector = RMS
      - Averaging type = power (*i.e.*, RMS)
      - RBW = 1 MHz
      - VBW ≥ 3*RBW
      - Sweep time = auto.
      - Trace mode = average (at least 100 traces).

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(3) Measurement Type(Average): Duty cycle < 98%, duty cycle variations are less than ±2%

- Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
- Detector = RMS
- Averaging type = power (*i.e.*, RMS)
- RBW = 1 MHz
- VBW ≥ 3*RBW
- Sweep time = auto.
- Trace mode = average (at least 100 traces).
- 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.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.

10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

11. Total(Measurement Type : Peak)
= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle ≥ 98%)
= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle < 98%)
= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)
+ Duty Cycle Factor

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7.7. AC Power line Conducted Emissions

Limit

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)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 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 attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

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7.8. Receiver Spurious Emissions

Limit

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

Measurements for compliance with the limits in table may be performed at distances other than 3 metres.

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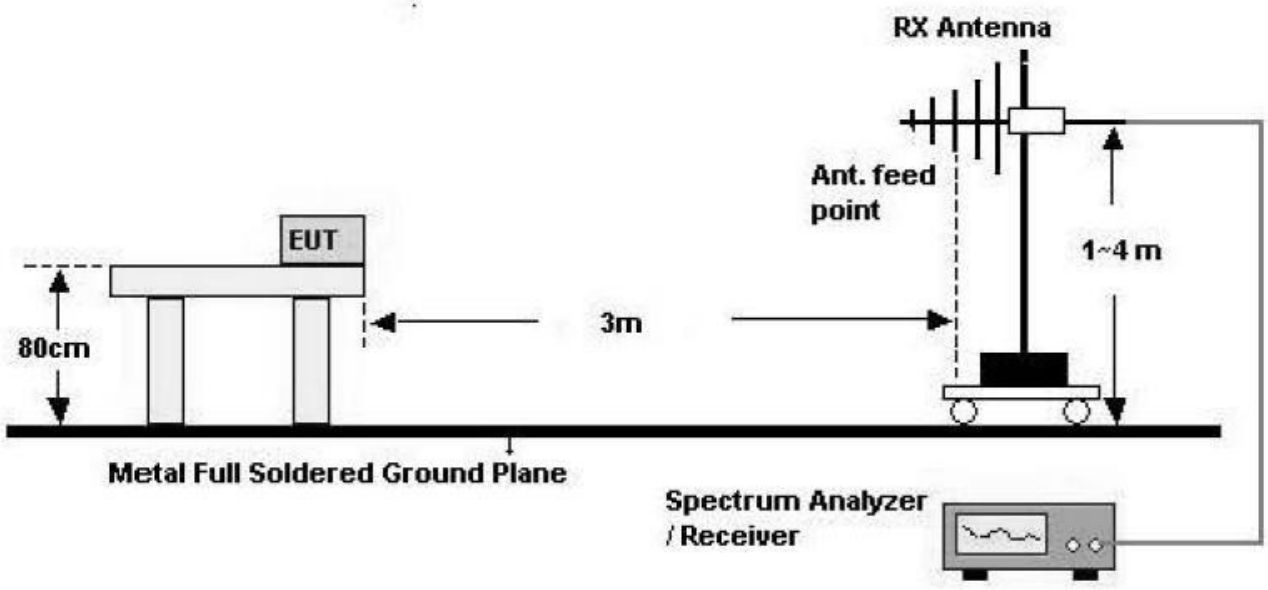
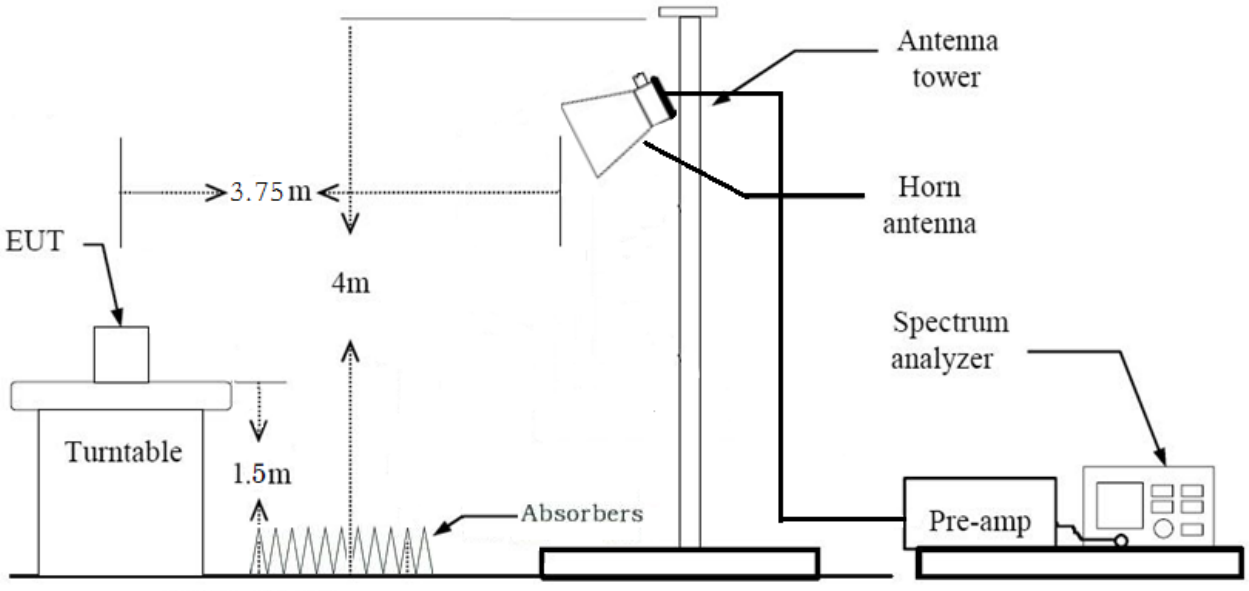
Test Configuration

30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
5. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
   *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3*RBW
   (2) Measurement Type(Average):
      - We performed using a reduced video BW method was done with the analyzer in linear mode
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 1/τ Hz, where τ = pulse width in seconds
        The actual setting value of VBW = 1 kHz
10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
11. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

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7.9. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
2. EUT Axis
   - Radiated Spurious Emissions : Y
   - Radiated Restricted Band Edge : Y
3. Duty cycle factor applies only 802.11g/n (Duty cycle < 98%).
4. All datarate of operation were investigated and the worst case datarate results are reported
   - 802.11b : 1Mbps
   - 802.11g : 6Mbps
   - 802.11n : MCS0

Conducted test

1. All datarate of operation were investigated and the worst case datarate results are reported.

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8. SUMMARY TEST OF RESULTS

FCC Part

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	Conducted	PASS
Conducted Maximum Peak Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§15.247(d)	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 7.7		PASS
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 7.6		PASS

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IC Part

Test Description	IC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	RSS-247, 5.2	> 500 kHz	Conducted	PASS
99% Bandwidth	RSS-GEN, 6.7	N/A		N/A
Conducted Maximum Peak Output Power And e.i.r.p.	RSS-247, 5.4.	< 1 Watt <4 Watt(e.i.r.p.)		PASS
Power Spectral Density	RSS-247, 5.2	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	RSS-247, 5.5	Conducted > 30 dBc		PASS
AC Power line Conducted Emissions	RSS-GEN, 8.8	cf. Section 7.7		PASS
Radiated Spurious Emissions	RSS-GEN, 8.9	cf. Section 7.6	Radiated	PASS
Receiver Spurious Emissions	RSS-GEN, 7	cf. Section 7.8		PASS
Radiated Restricted Band Edge	RSS-GEN, 8.10	cf. Section 7.6		PASS

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9. TEST RESULT

9.1 DUTY CYCLE

Mode	Data Rate (Mbps)	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11b	1	0.594	1.221	0.487	3.126
	2	0.592	1.221	0.485	3.144
	5.5	0.557	1.184	0.471	3.271
	11	0.594	1.221	0.487	3.126
802.11g	6	0.587	1.216	0.483	3.163
	9	0.587	1.216	0.483	3.163
	12	0.587	1.214	0.484	3.154
	18	0.587	1.216	0.483	3.163
	24	0.186	0.415	0.449	3.479
	36	0.187	0.415	0.451	3.459
	48	0.187	0.415	0.451	3.459
	54	0.186	0.414	0.450	3.470
802.11n (HT20)	6.5 (MCS0)	0.562	1.191	0.472	3.260
	13 (MCS1)	0.562	1.191	0.472	3.260
	19.5 (MCS2)	0.587	1.216	0.483	3.163
	26 (MCS3)	0.203	0.432	0.471	3.271
	39 (MCS4)	0.203	0.431	0.470	3.282
	52 (MCS5)	0.203	0.432	0.469	3.291
	58.5 (MCS6)	0.200	0.428	0.466	3.314
	65 (MCS7)	0.203	0.432	0.471	3.271

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9.2 6dB BANDWIDTH & 99 % BANDWIDTH

FCC

802.11b Mode		6dB Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	10.07	> 0.5
2437	6	10.05	> 0.5
2462	11	10.06	> 0.5

802.11g Mode		6dB Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	16.07	> 0.5
2437	6	16.34	> 0.5
2462	11	16.07	> 0.5

802.11n(HT20) Mode		6dB Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	17.28	> 0.5
2437	6	17.27	> 0.5
2462	11	17.25	> 0.5

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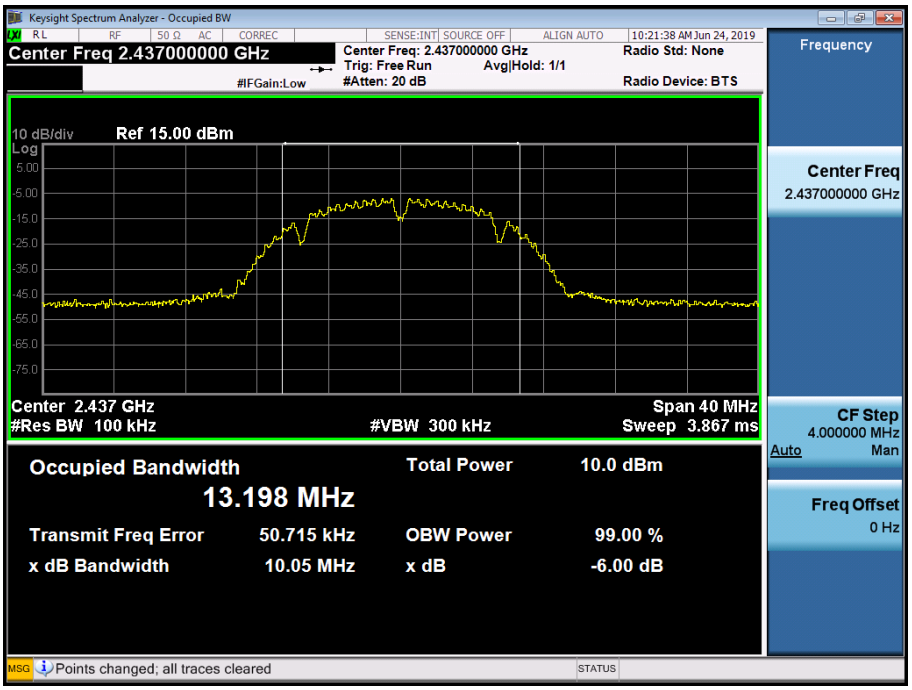
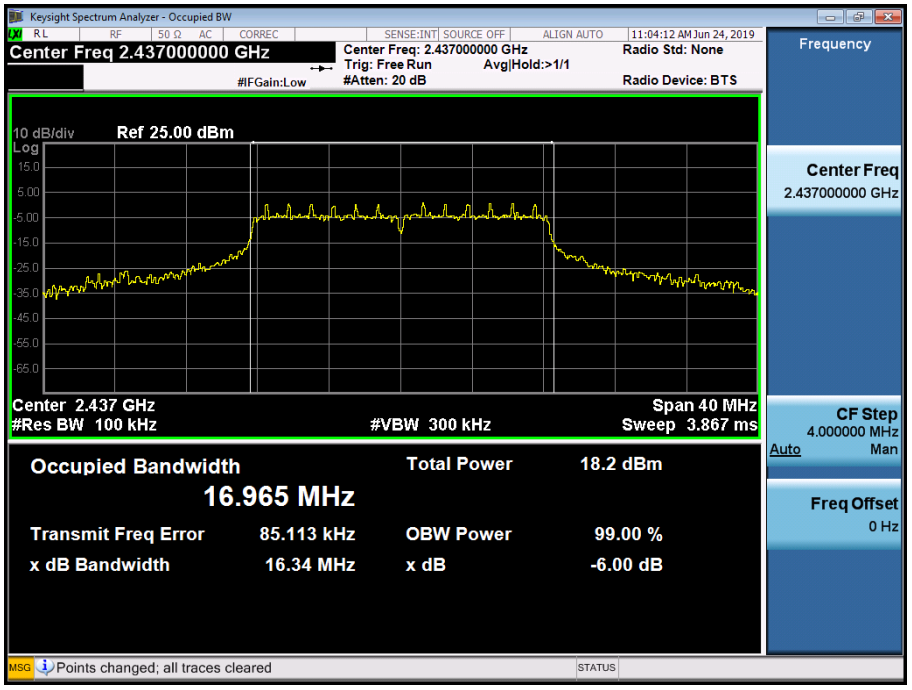
▣ Test Plots

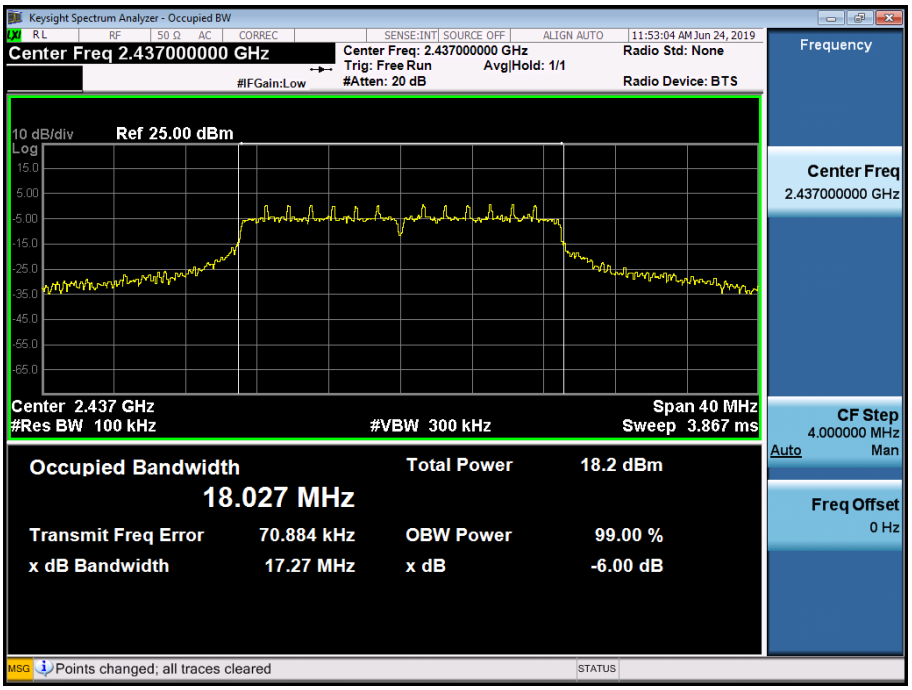
6dB Bandwidth plot (802.11b-CH 6)



6dB Bandwidth plot (802.11g-CH 6)



6dB Bandwidth plot (802.11n_HT20-CH 6)



Note:

In order to simplify the report, attached plots were only the most narrow 6 dB BW channel.

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IC

802.11b Mode		OBW Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	13.39	N/A
2437	6	13.41	N/A
2462	11	13.40	N/A

802.11g Mode		OBW Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	18.89	N/A
2437	6	18.96	N/A
2462	11	18.90	N/A

802.11n(HT20) Mode		OBW Bandwidth [MHz]	Limit [MHz]
Frequency [MHz]	Channel No.		
2412	1	19.55	N/A
2437	6	19.60	N/A
2462	11	19.48	N/A

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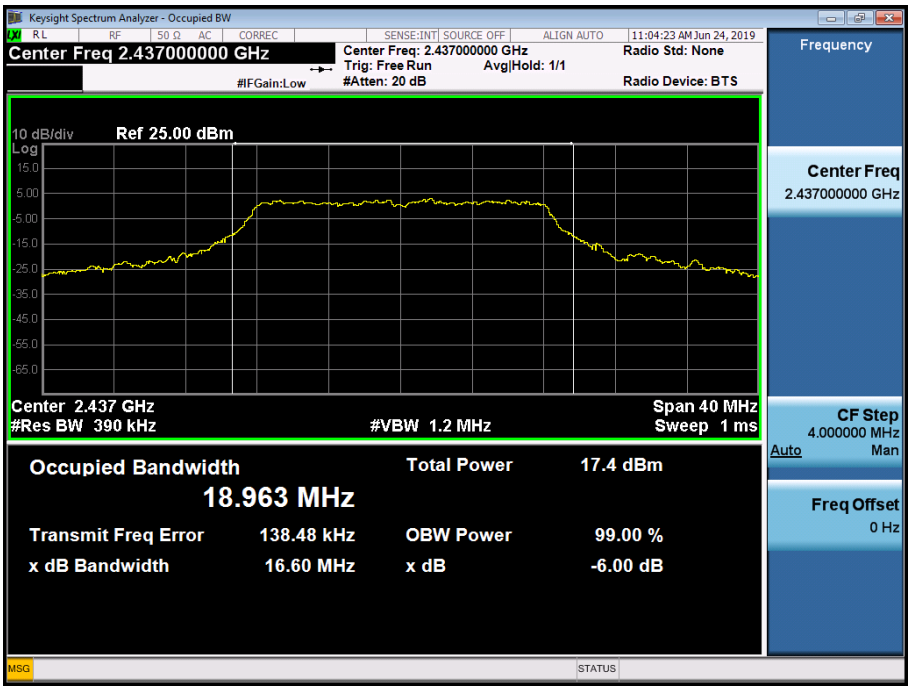
[Ant1]

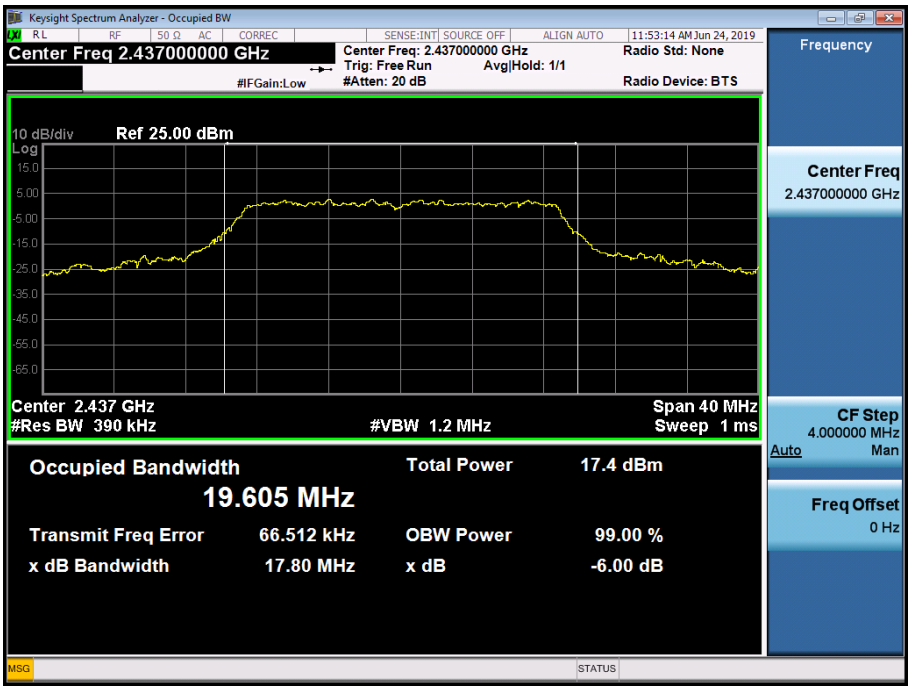
▣ Test Plots

99% Bandwidth plot (802.11b-CH 6)

99% Bandwidth plot (802.11g-CH 6)



99% Bandwidth plot (802.11n_HT20-CH 6)



Note:

In order to simplify the report, attached plots were only the most wide 99% Bandwidth channel.

9.3 OUTPUT POWER

1.Sample Calculation

▪ Conducted Output Power(Peak) = Reading Value + ATT loss + Cable loss

2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest twentieth dB.

So, 20.42 dB is offset for 2.4 GHz Band.

802.11b Mode		Data Rate (Mbps)	Measured Power(dBm)	Limit (dBm)	Power Level Setting
Frequency [MHz]	Channel No.				
2412	1	1	6.18	30	-48
		2	6.46	30	
		5.5	7.90	30	
		11	9.10	30	
2437	6	1	5.87	30	
		2	6.49	30	
		5.5	7.82	30	
		11	9.19	30	
2462	11	1	5.98	30	
		2	6.40	30	
		5.5	7.85	30	
		11	9.19	30	

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802.11g Mode		Data Rate (Mbps)	Measured Power(dBm)	Limit (dBm)	Power Level Setting
Frequency [MHz]	Channel No.				
2412	1	6	18.40	30	0
		9	18.75	30	
		12	18.32	30	
		18	18.15	30	
		24	17.03	30	
		36	17.14	30	
		48	16.01	30	
		54	15.45	30	
2437	6	6	18.16	30	
		9	18.42	30	
		12	18.32	30	
		18	18.19	30	
		24	17.16	30	
		36	17.29	30	
		48	16.05	30	
		54	15.25	30	
2462	11	6	18.35	30	
		9	18.70	30	
		12	18.51	30	
		18	18.40	30	
		24	17.43	30	
		36	17.65	30	
		48	16.32	30	
		54	15.64	30	

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802.11n Mode		MCS Index	Measured Power(dBm)	Limit (dBm)	Power Level Setting
Frequency [MHz]	Channel No.				
2412	1	0	18.26	30	0
		1	18.21	30	
		2	18.58	30	
		3	17.01	30	
		4	17.08	30	
		5	16.41	30	
		6	15.50	30	
		7	14.35	30	
2437	6	0	18.15	30	
		1	17.99	30	
		2	18.17	30	
		3	17.25	30	
		4	17.12	30	
		5	16.19	30	
		6	15.21	30	
		7	14.30	30	
2462	11	0	18.59	30	
		1	18.38	30	
		2	18.50	30	
		3	17.38	30	
		4	17.52	30	
		5	16.82	30	
		6	15.73	30	
		7	14.75	30	

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Average Power

1.Sample Calculation

▪ Conducted Output Power(Average) = Reading Value + ATT loss + Cable loss + Duty Cycle Factor

2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest twentieth dB.

So, 20.42 dB is offset for 2.4 GHz Band.

802.11b Mode		Data Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)	Power Level Setting
Frequency [MHz]	Channel No.						
2412	1	1	0.36	3.13	3.49	30	-48
		2	-0.10	3.14	3.04	30	
		5.5	0.01	3.27	3.28	30	
		11	0.00	3.13	3.13	30	
2437	6	1	-0.24	3.13	2.88	30	
		2	-0.08	3.14	3.06	30	
		5.5	-0.09	3.27	3.18	30	
		11	-0.03	3.13	3.10	30	
2462	11	1	-0.12	3.13	3.01	30	
		2	-0.06	3.14	3.08	30	
		5.5	0.03	3.27	3.30	30	
		11	-0.08	3.13	3.04	30	

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802.11g Mode		Data Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)	Power Level Setting
Frequency [MHz]	Channel No.						
2412	1	6	7.65	3.16	10.82	30	0
		9	7.56	3.16	10.72	30	
		12	7.68	3.15	10.84	30	
		18	7.41	3.16	10.57	30	
		24	6.06	3.48	9.53	30	
		36	6.05	3.46	9.51	30	
		48	4.89	3.46	8.35	30	
		54	4.22	3.47	7.69	30	
2437	6	6	7.36	3.16	10.52	30	
		9	7.29	3.16	10.45	30	
		12	7.29	3.15	10.45	30	
		18	7.41	3.16	10.58	30	
		24	5.97	3.48	9.45	30	
		36	6.03	3.46	9.49	30	
		48	4.96	3.46	8.42	30	
		54	3.97	3.47	7.44	30	
2462	11	6	7.69	3.16	10.86	30	
		9	7.48	3.16	10.64	30	
		12	7.90	3.15	11.05	30	
		18	7.62	3.16	10.78	30	
		24	6.39	3.48	9.87	30	
		36	6.48	3.46	9.94	30	
		48	5.23	3.46	8.69	30	
		54	4.37	3.47	7.84	30	

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802.11n Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)	Power Level Setting
Frequency [MHz]	Channel No.						
2412	1	0	7.16	3.26	10.42	30	0
		1	7.19	3.26	10.45	30	
		2	7.89	3.16	11.05	30	
		3	6.19	3.27	9.46	30	
		4	6.21	3.28	9.49	30	
		5	5.26	3.29	8.55	30	
		6	4.33	3.31	7.64	30	
		7	3.51	3.27	6.78	30	
2437	6	0	7.08	3.26	10.34	30	
		1	7.51	3.26	10.77	30	
		2	7.32	3.16	10.49	30	
		3	6.30	3.27	9.57	30	
		4	6.11	3.28	9.39	30	
		5	5.01	3.29	8.30	30	
		6	4.13	3.31	7.45	30	
		7	3.40	3.27	6.67	30	
2462	11	0	7.69	3.26	10.95	30	
		1	7.93	3.26	11.19	30	
		2	7.76	3.16	10.92	30	
		3	6.60	3.27	9.87	30	
		4	6.56	3.28	9.84	30	
		5	5.57	3.29	8.86	30	
		6	4.66	3.31	7.97	30	
		7	3.93	3.27	7.20	30	

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9.4 POWER SPECTRAL DENSITY

Mode	Frequency (MHz)	Channel No.	Test Result			
			Measured PSD (dBm)	Duty Cycle Factor	Measured PSD(dBm) + Duty Cycle Factor	Limit (dBm)
802.11b	2412	1	-18.92	3.13	-15.79	8
	2437	6	-18.10	3.27	-14.83	8
	2462	11	-16.65	3.27	-13.38	8
802.11g	2412	1	-14.21	3.15	-11.06	8
	2437	6	-14.04	3.16	-10.88	8
	2462	11	-15.82	3.15	-12.67	8
802.11n	2412	1	-17.01	3.16	-13.85	8
	2437	6	-17.38	3.26	-14.12	8
	2462	11	-17.84	3.26	-14.58	8

Note :

1.Sample Calculation

▪ Conducted POWER SPECTRAL DENSITY = Reading Value + Duty Cycle +ATT loss + Cable loss

2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest twentieth dB.

So, 20.42 dB is offset for 2.4 GHz Band.

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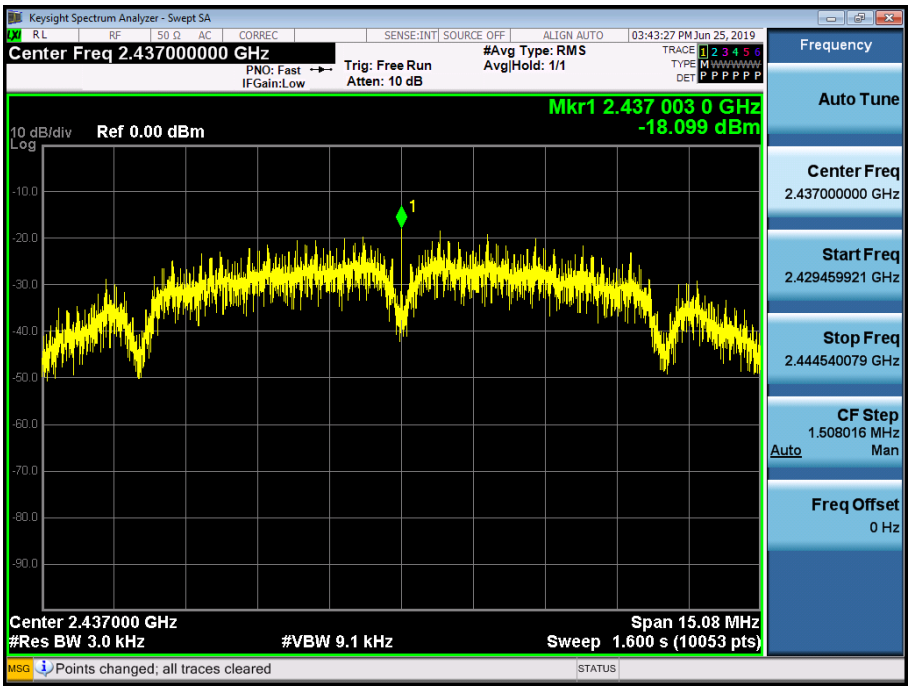
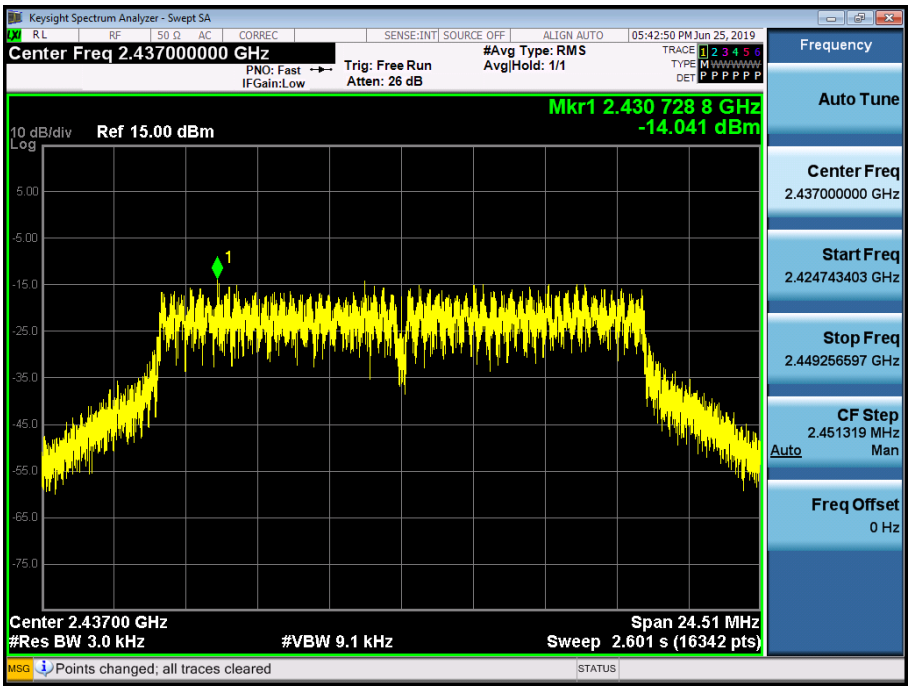
[Ant1]

▣ Test Plots

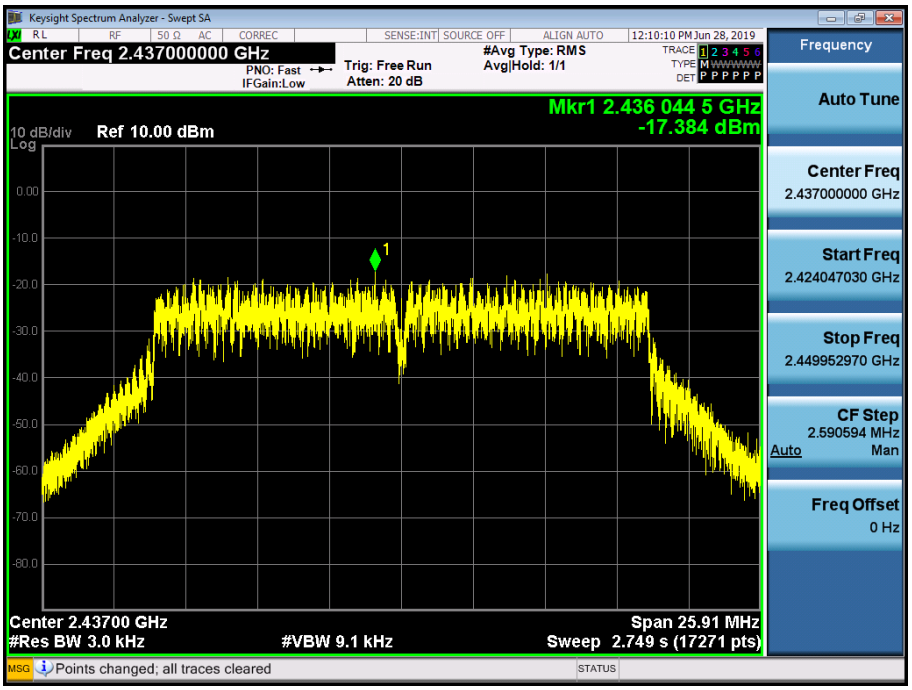
Power Spectral Density (802.11b-CH 6)



Power Spectral Density (802.11g-CH 6)



Power Spectral Density (802.11n_HT20 -CH 6)



Note :

In order to simplify the report, attached plots were only the worstcase PSD channel.

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9.5 BAND EDGE / CONDUCTED SPURIOUS EMISSIONS

▣ TEST RESULTS

Out of Band Emissions at the Band Edge

802.11 b

Frequency [MHz]	Channel No.	Position	Test Result		
			Measured Level [dB]	Limit [dBc]	Pass/Fail
2402	0	Lower	45.79	20	Pass
2480	39	Upper	48.78	20	Pass

802.11 g

Frequency [MHz]	Channel No.	Position	Test Result		
			Measured Level [dB]	Limit [dBc]	Pass/Fail
2402	0	Lower	35.12	20	Pass
2480	39	Upper	47.45	20	Pass

802.11 n

Frequency [MHz]	Channel No.	Position	Test Result		
			Measured Level [dB]	Limit [dBc]	Pass/Fail
2402	0	Lower	34.11	20	Pass
2480	39	Upper	47.08	20	Pass

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Conducted Spurious Emissions

802.11 b

Frequency [MHz]	Channel No.	Test Result		
		Measured Level [dB]	Limit [dBc]	Pass/Fail
2412	1	40.37	20	Pass
2437	6	47.37	20	Pass
2462	11	47.70	20	Pass

802.11 g

Frequency [MHz]	Channel No.	Test Result		
		Measured Level [dB]	Limit [dBc]	Pass/Fail
2412	1	48.35	20	Pass
2437	6	43.27	20	Pass
2462	11	44.50	20	Pass

802.11 n

Frequency [MHz]	Channel No.	Test Result		
		Measured Level [dB]	Limit [dBc]	Pass/Fail
2412	1	43.10	20	Pass
2437	6	44.47	20	Pass
2462	11	46.14	20	Pass

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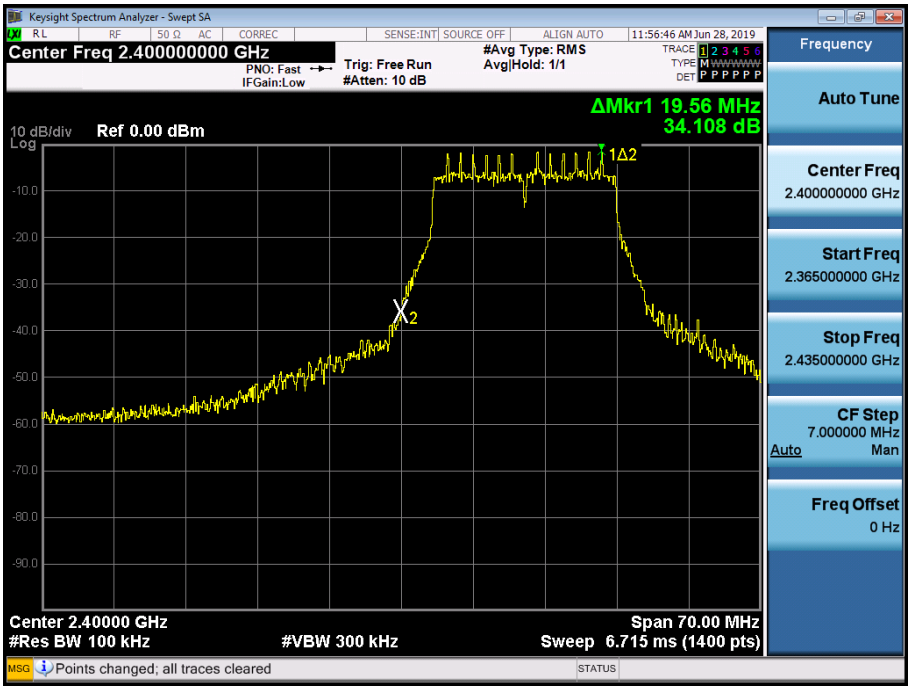
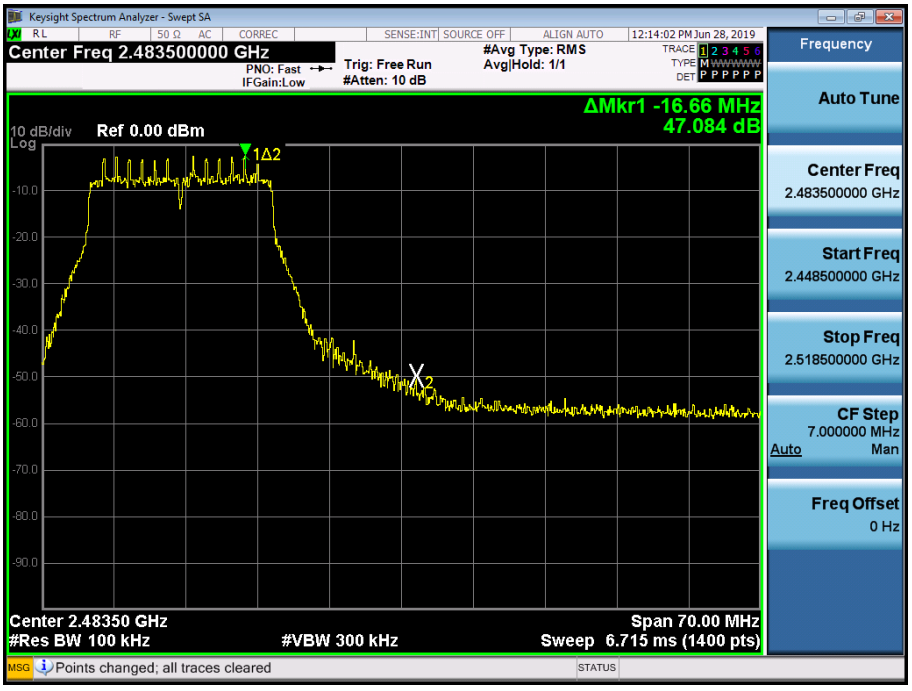
▣ Test Plots(BandEdge)

Band Edge (802.11n-CH1)



Band Edge (802.11n-CH11)



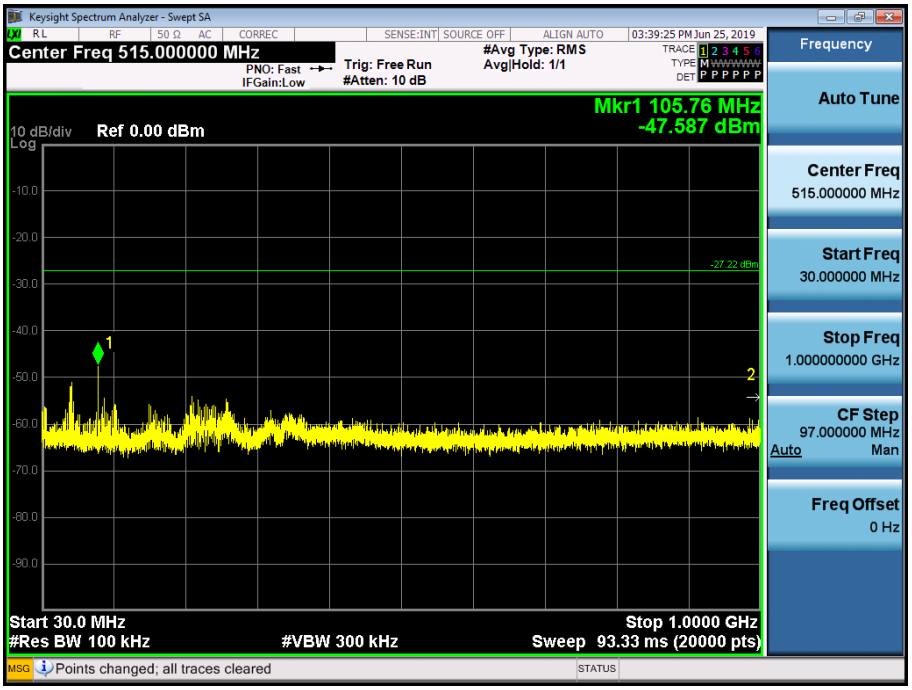
Note:

Plot of worst case are only reported.

▣ Test Plots(Conducted Spurious Emission)

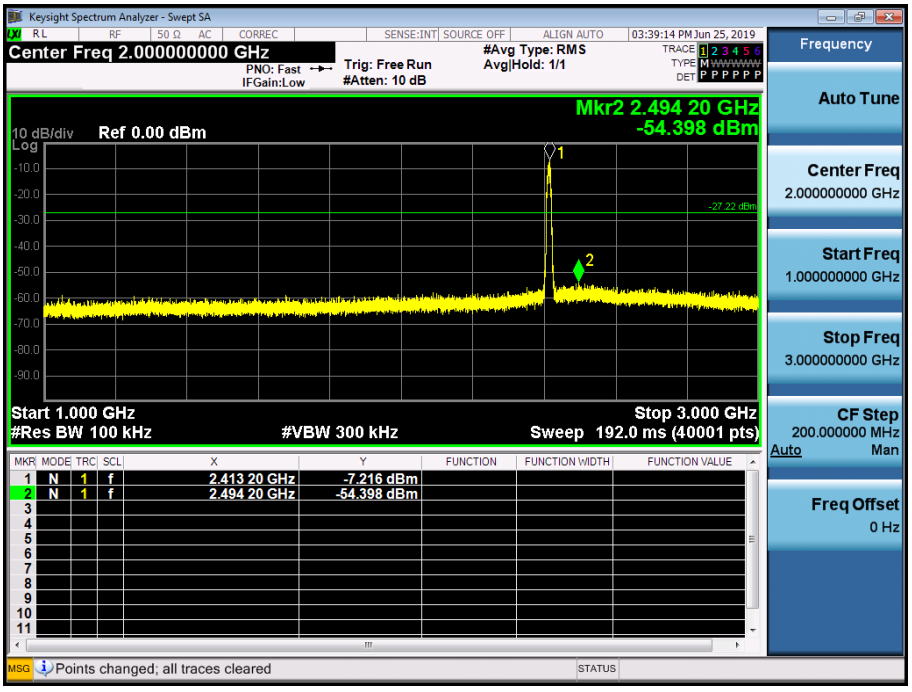
30 MHz ~ 1 GHz

Conducted Spurious Emission (802.11b_Ch.1)



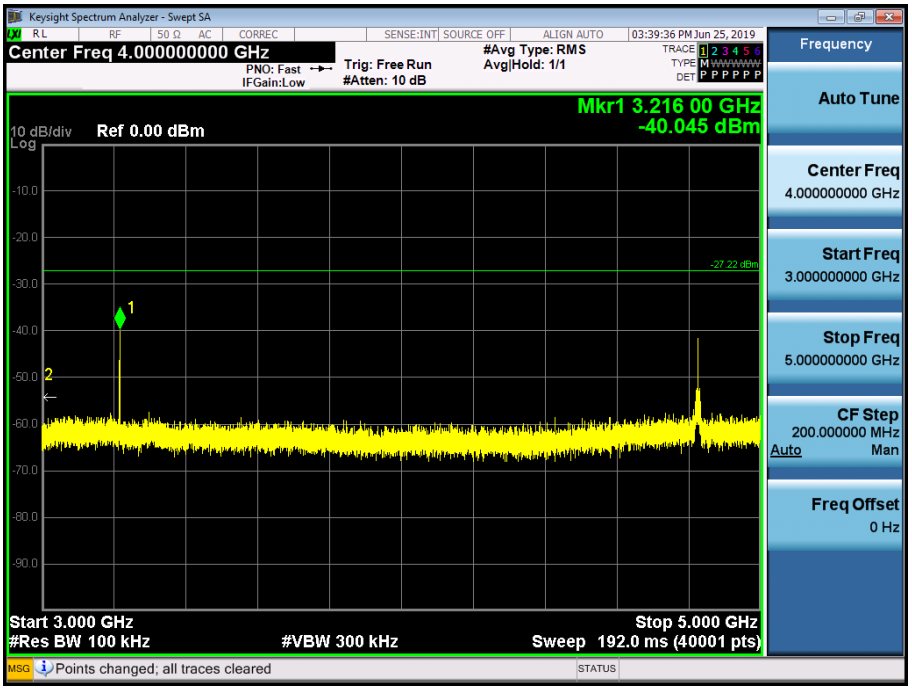
1 GHz ~ 3 GHz

Conducted Spurious Emission (802.11b_Ch.1)



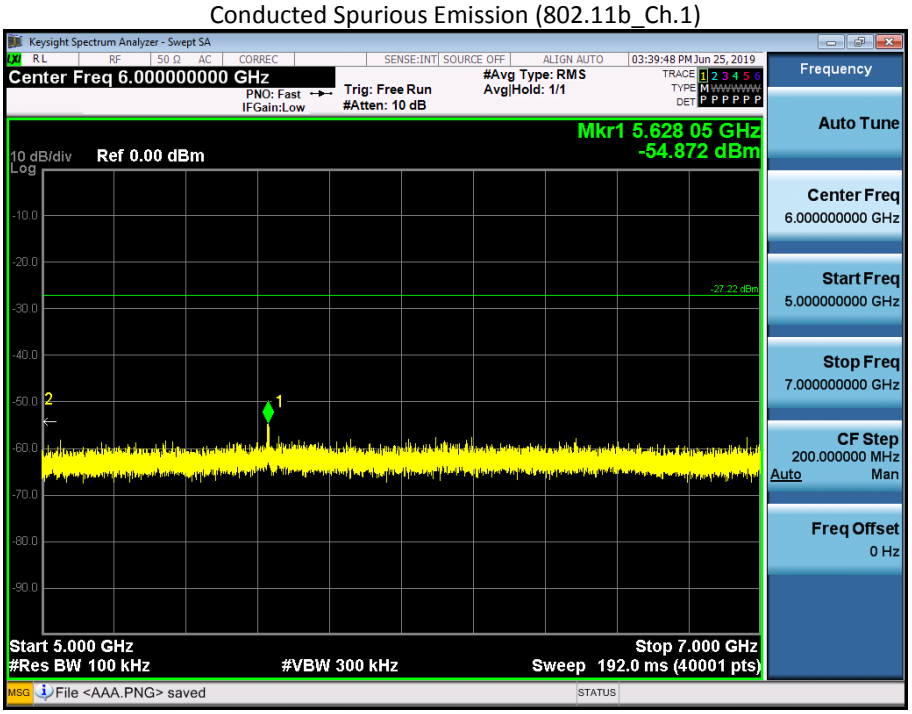
3 GHz ~ 5 GHz

Conducted Spurious Emission (802.11b_Ch.1)



5 GHz ~ 7 GHz

Conducted Spurious Emission (802.11b_Ch.1)



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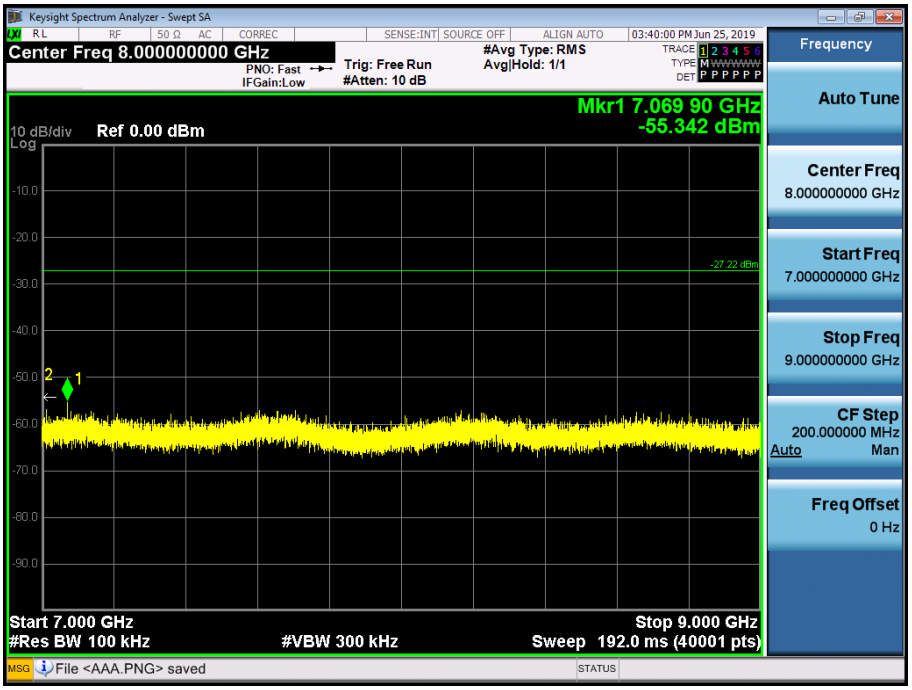
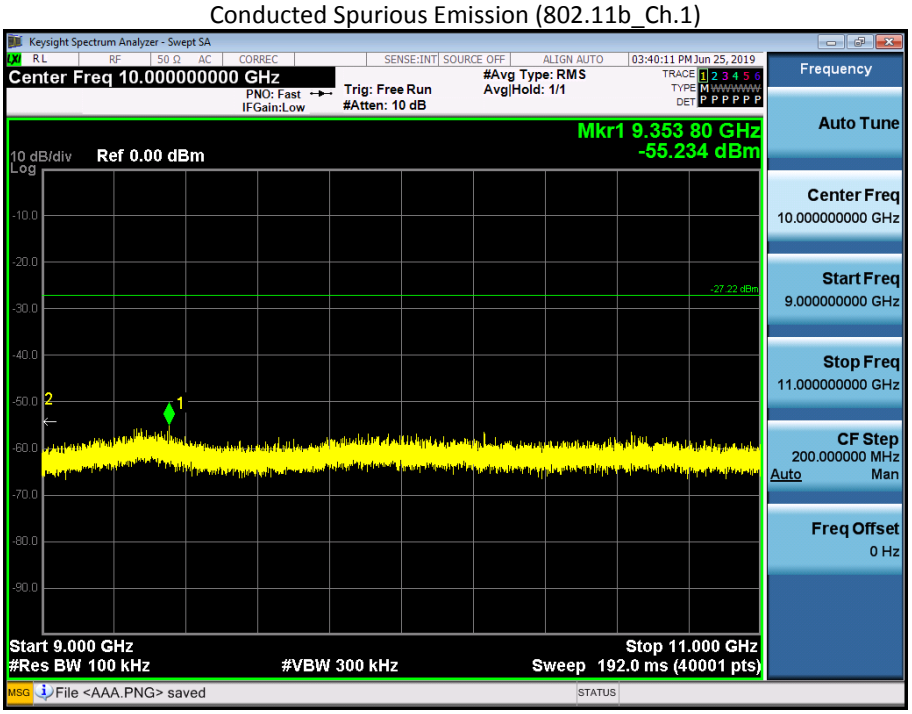
7 GHz ~ 9 GHz

Conducted Spurious Emission (802.11b_Ch.1)



9 GHz ~ 11 GHz

Conducted Spurious Emission (802.11b_Ch.1)



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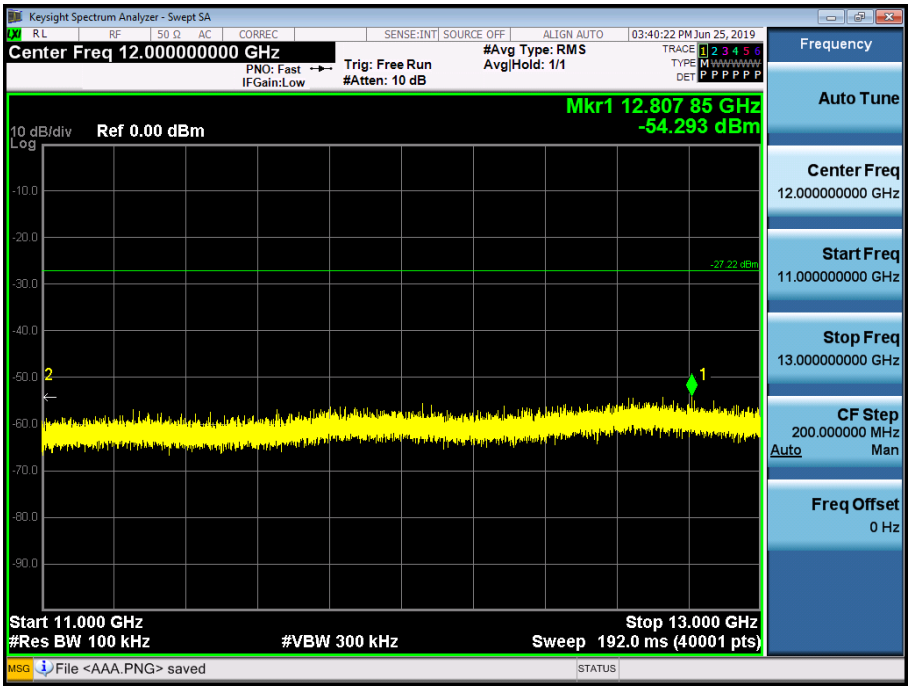
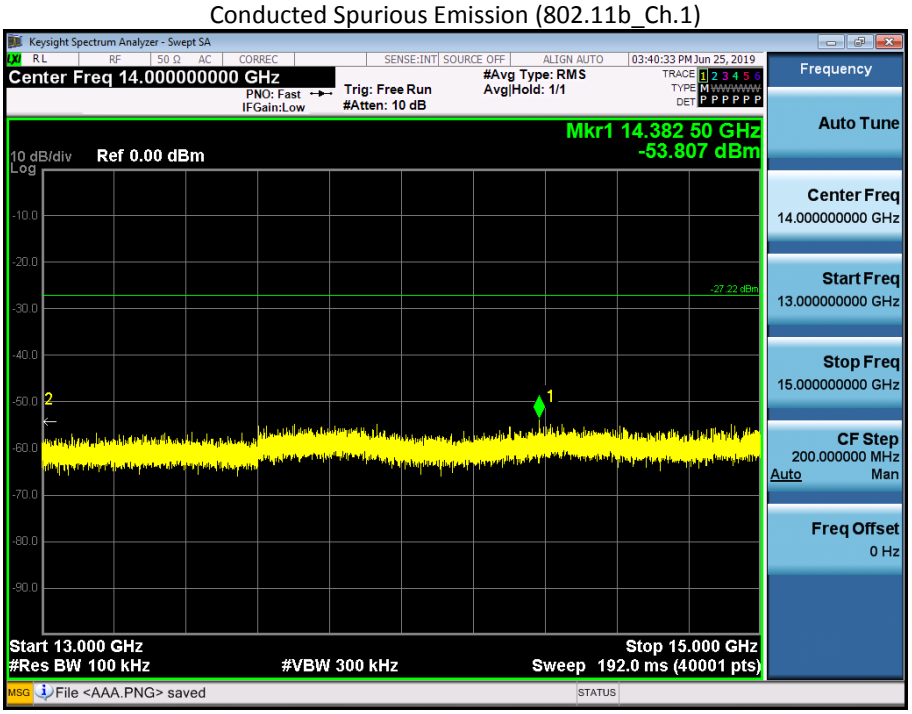
11 GHz ~ 13 GHz

Conducted Spurious Emission (802.11b_Ch.1)



13 GHz ~ 15 GHz

Conducted Spurious Emission (802.11b_Ch.1)



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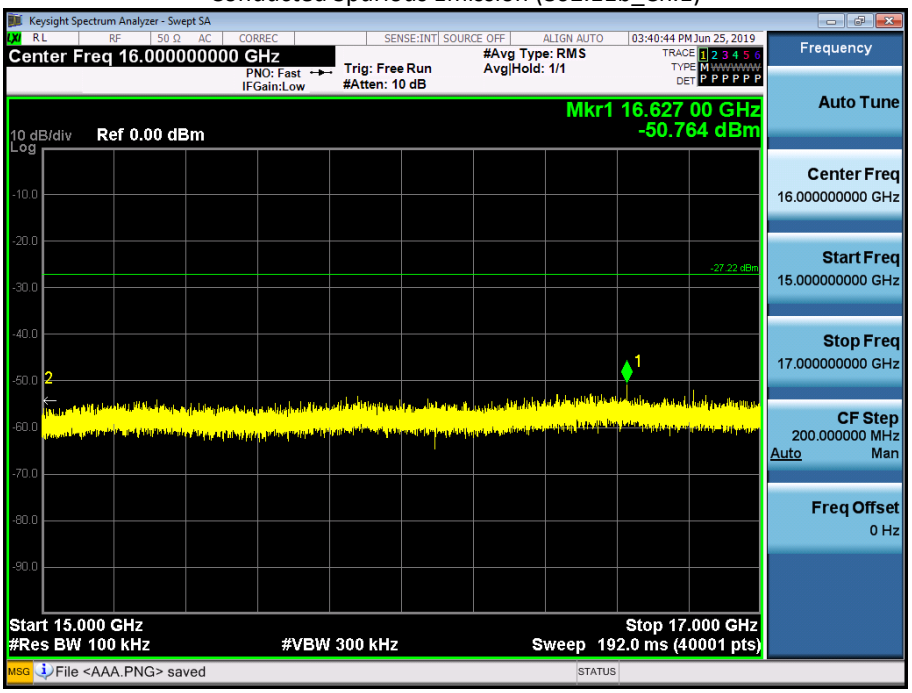
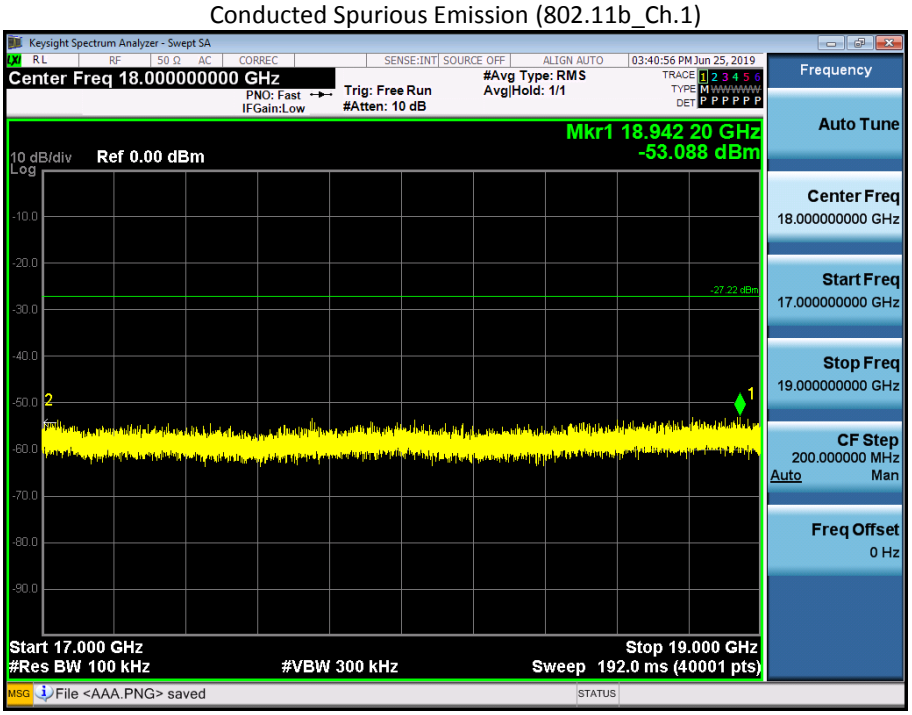
15 GHz ~ 17 GHz

Conducted Spurious Emission (802.11b_Ch.1)



17 GHz ~ 19 GHz

Conducted Spurious Emission (802.11b_Ch.1)



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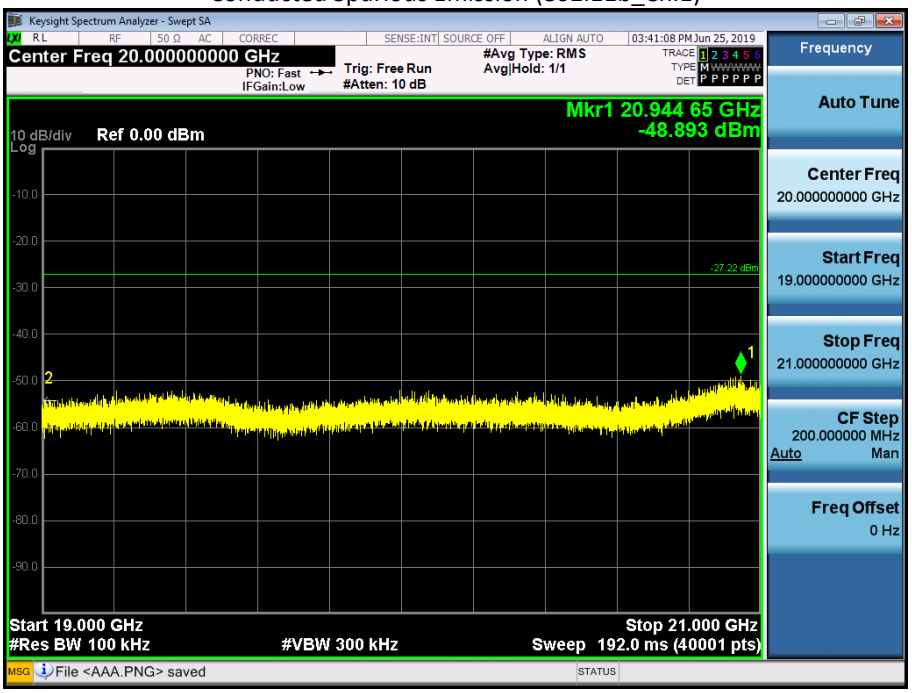
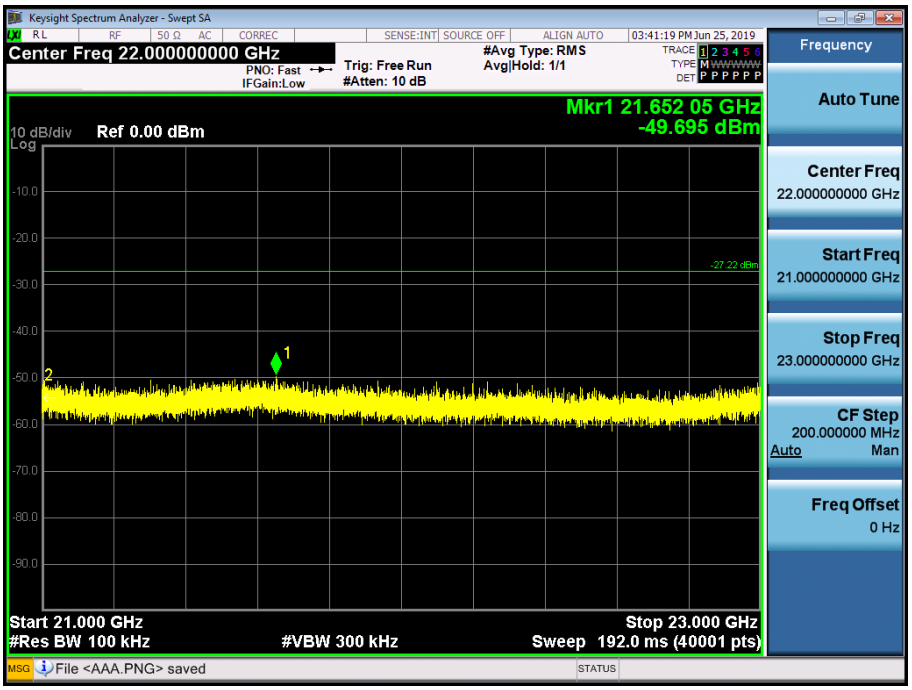
19 GHz ~ 21 GHz

Conducted Spurious Emission (802.11b_Ch.1)



21 GHz ~ 23 GHz

Conducted Spurious Emission (802.11b_Ch.1)



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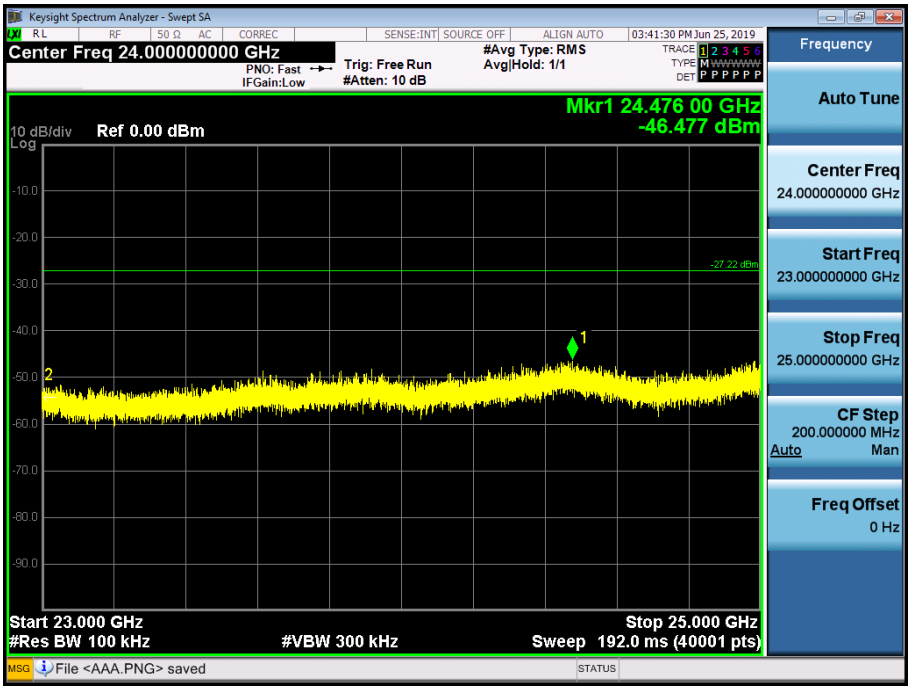
23 GHz ~ 25 GHz

Conducted Spurious Emission (802.11b_Ch.1)



Note:

Plot of worst case are only reported.

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9.6 RADIATED SPURIOUS EMISSIONS

9 kHz – 30MHz

CH 1

Frequency [kHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
12	H	29.2	20.7	49.9	126.02	76.12	QP
12	V	27.6	20.7	48.3	126.02	77.72	QP
20	H	27.9	19.9	47.8	121.58	73.78	QP
20	V	23.0	19.9	42.9	121.58	78.68	QP
36	H	24.0	20.8	44.8	116.39	71.59	QP

CH 6

Frequency [kHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
36	H	26.2	20.8	47	116.39	69.39	QP
36	V	25.3	20.8	46.1	116.39	70.29	QP

CH 11

Frequency [kHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
36	H	27.1	20.8	47.9	116.39	68.49	QP
36	V	26.3	20.8	47.1	116.39	69.29	QP

1. The measurement distance is 3 meters.
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. Corrected reading: Antenna Factor + Cable loss + Read Level
5. The other operating Modes are attenuated more than 20 dB below the permissible limits.

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Frequency Range : Below 1 GHz

CH 1

Frequency [MHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
72.01	V	55.7	-21.8	33.9	40	6.1	QP
84.01	V	59.6	-22.9	36.7	40	3.3	QP
120.01	V	56.9	-16.0	40.9	43.5	2.6	QP
155.986	V	52.4	-17.4	35.0	43.5	8.5	QP
584.813	H	43.9	-9.3	34.6	46	11.4	QP

CH 6

Frequency [MHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
84.02	V	59.0	-22.9	36.1	40	3.9	QP
120.01	V	57.1	-16.0	41.1	43.5	2.4	QP
120.01	V	56.9	-16.0	40.9	43.5	2.6	QP
586.259	H	43.1	-9.3	33.8	46	12.2	QP
587.789	V	41.3	-9.4	31.9	46	14.1	QP

CH 11

Frequency [MHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
84.03	V	58.4	-22.9	35.5	40	4.5	QP
120.01	V	56.9	-16.0	40.9	43.5	2.6	QP
156.01	V	52.2	-17.4	34.8	43.5	8.7	QP
587.876	H	43.1	-9.4	33.7	46	12.3	QP
588.003	V	41.5	-9.4	32.1	46	13.9	QP

1. The measurement distance is 3 meters.

2. Corrected reading: Antenna Factor + Cable loss + Read Level

3. The other operating Modes are attenuated more than 20 dB below the permissible limits.

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Frequency Range : Above 1 GHz

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2412
Channel No.	01 Ch

Frequency MHz	Polarization	Reading			Level		Limit		Margin	
		dB(uV)		dB	dB(uV/m)		dB(uV/m)		dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3216	V	51.0	58.2	-7.9	43.1	50.3	54	74	10.9	23.7
3216	H	59.0	62.8	-7.9	51.1	54.9	54	74	2.9	19.1
4824	V	53.9	64.3	-3.3	50.6	61.0	54	74	3.4	13.0
4824	H	48.2	60.2	-3.3	44.9	56.9	54	74	9.1	17.1
12555	V	35.0	48.1	9.3	44.3	57.4	54	74	9.7	16.6
12555	H	35.1	47.9	9.3	44.4	57.2	54	74	9.6	16.8

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2412
Channel No.	01 Ch

Frequency MHz	Polarization	Reading			Level		Limit		Margin	
		dB(uV)		dB	dB(uV/m)		dB(uV/m)		dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3208	H	58.0	62.2	-8.0	50.0	54.2	54	74	4.0	19.8
3208	V	55.0	60.4	-8.0	47.0	52.4	54	74	7.0	21.6
4824	H	50.9	63.6	-3.3	47.6	60.3	54	74	6.4	13.7
4824	V	52.7	65.2	-3.3	49.4	61.9	54	74	4.6	12.1
12566	V	34.9	48.2	9.4	44.3	57.6	54	74	9.7	16.4
12566	H	34.9	48.8	9.4	44.3	58.2	54	74	9.7	15.8

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Operation Mode:	802.11n (HT20)
Transfer MCS Index:	0
Operating Frequency	2412
Channel No.	01 Ch

Frequency MHz	Polarization	Reading			Level		Limit		Margin	
		dB(uV)		dB	dB(uV/m)		dB(uV/m)		dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3216	H	56.9	61.4	-7.9	49.0	53.5	54	74	5.0	20.5
3216	V	57.9	62.0	-7.9	50.0	54.1	54	74	4.0	19.9
4824	V	53.2	66.0	-3.3	49.9	62.7	54	74	4.1	11.3
4824	H	51.5	64.3	-3.3	48.2	61.0	54	74	5.8	13.0
12726	V	33.3	46.8	9.6	42.9	56.4	54	74	11.1	17.6
12726	H	33.3	46.3	9.6	42.9	55.9	54	74	11.1	18.1

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Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2437
Channel No.	06 Ch

Frequency MHz	Polarization	Reading			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		dB(uV)		dB						
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3249	H	59.0	62.4	-7.8	51.2	54.6	54	74	2.8	19.4
3249	V	50.7	58.3	-7.8	42.9	50.5	54	74	11.1	23.5
4874	V	55.4	65.5	-3.4	52.0	62.1	54	74	2.0	11.9
4874	H	52.1	62.1	-3.4	48.7	58.7	54	74	5.3	15.3
5992	V	41.3	56.9	-0.5	40.8	56.4	54	74	13.2	17.6
5995	H	41.3	56.4	-0.5	40.8	55.9	54	74	13.2	18.1
12555	H	35.0	48.1	9.3	44.3	57.4	54	74	9.7	16.6
12560	V	34.9	48.4	9.3	44.2	57.7	54	74	9.8	16.3

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2437
Channel No.	06 Ch

Frequency MHz	Polarization	Reading			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		dB(uV)		dB						
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3249	V	53.0	59.1	-7.8	45.2	51.3	54	74	8.8	22.7
3249	H	57.4	61.5	-7.8	49.6	53.7	54	74	4.4	20.3
4874	V	54.6	66.7	-3.4	51.2	63.3	54	74	2.8	10.7
4874	H	49.4	62.8	-3.4	46.0	59.4	54	74	8.0	14.6
12605	V	34.7	47.6	9.4	44.1	57.0	54	74	9.9	17.0
12605	H	34.7	47.9	9.4	44.1	57.3	54	74	9.9	16.7

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Operation Mode:	802.11n (HT20)
Transfer MCS Index:	0
Operating Frequency	2437
Channel No.	06 Ch

Frequency MHz	Polarization	Reading			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		dB(uV)		dB						
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3249	V	53.6	59.6	-7.8	45.8	51.8	54	74	8.2	22.2
3249	H	55.9	60.6	-7.8	48.1	52.8	54	74	5.9	21.2
4874	H	49.6	63.7	-3.4	46.2	60.3	54	74	7.8	13.7
4874	V	53.7	67.4	-3.4	50.3	64.0	54	74	3.7	10.0
12541	V	34.8	47.9	9.2	44.0	57.1	54	74	10.0	16.9
12541	H	34.8	47.9	9.2	44.0	57.1	54	74	10.0	16.9

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Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2462
Channel No.	11 Ch

Frequency MHz	Polarization	Reading			Level		Limit		Margin	
		dB(uV)		dB	dB(uV/m)		dB(uV/m)		dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3282	V	51.1	58.7	-7.7	43.4	51.0	54	74	10.6	23.0
3282	H	58.1	62.1	-7.7	50.4	54.4	54	74	3.6	19.6
4924	V	54.9	65.1	-3.3	51.6	61.8	54	74	2.4	12.2
4924	H	51.3	61.7	-3.3	48.0	58.4	54	74	6.0	15.6
5995	V	43.2	59.3	-0.5	42.7	58.8	54	74	11.3	15.2
5997	H	40.7	55.4	-0.5	40.2	54.9	54	74	13.8	19.1
12511	H	34.8	48.5	9.1	43.9	57.6	54	74	10.1	16.4
12510	V	34.8	48.8	9.1	43.9	57.9	54	74	10.1	16.1

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2462
Channel No.	11 Ch

Frequency MHz	Polarization	Reading			Level		Limit		Margin	
		dB(uV)		dB	dB(uV/m)		dB(uV/m)		dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3282	H	58.6	62.4	-7.7	50.9	54.7	54	74	3.1	19.3
3282	V	56.2	61.4	-7.7	48.5	53.7	54	74	5.5	20.3
4924	V	55.4	67.0	-3.3	52.1	63.7	54	74	1.9	10.3
4924	H	51.1	63.2	-3.3	47.8	59.9	54	74	6.2	14.1
12480	V	34.9	48.7	8.9	43.8	57.6	54	74	10.2	16.4
12480	H	34.9	48.4	8.9	43.8	57.3	54	74	10.2	16.7

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Operation Mode:	802.11n (HT20)
Transfer Rate:	6.5 Mbps
Operating Frequency	2462
Channel No.	11 Ch

Frequency MHz	Polarization	Reading			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		dB(uV)		dB						
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
3282	V	54.2	60.1	-7.7	46.5	52.4	54	74	7.5	21.6
3282	H	56.9	61.6	-7.7	49.2	53.9	54	74	4.8	20.1
4924	H	51.4	63.7	-3.3	48.1	60.4	54	74	5.9	13.6
4924	V	55.4	68.9	-3.3	52.1	65.6	54	74	1.9	8.4
12633	V	33.8	47.0	9.4	43.2	56.4	54	74	10.8	17.6
12633	H	33.8	47.1	9.4	43.2	56.5	54	74	10.8	17.5

Note

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Sample Calculation

   Total(Measurement Type : Peak)

   = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

   Total(Measurement Type : Average, Duty cycle ≥ 98%)

   = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

   Total(Measurement Type : Average, Duty cycle < 98%)

   = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

   + Duty Cycle Factor

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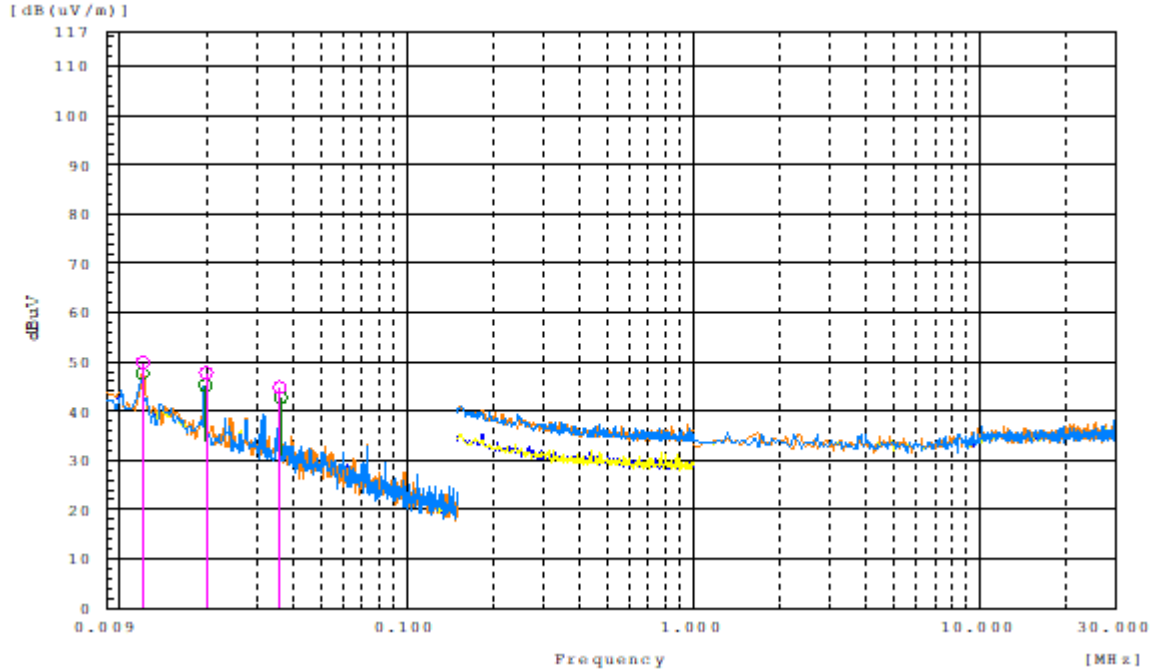
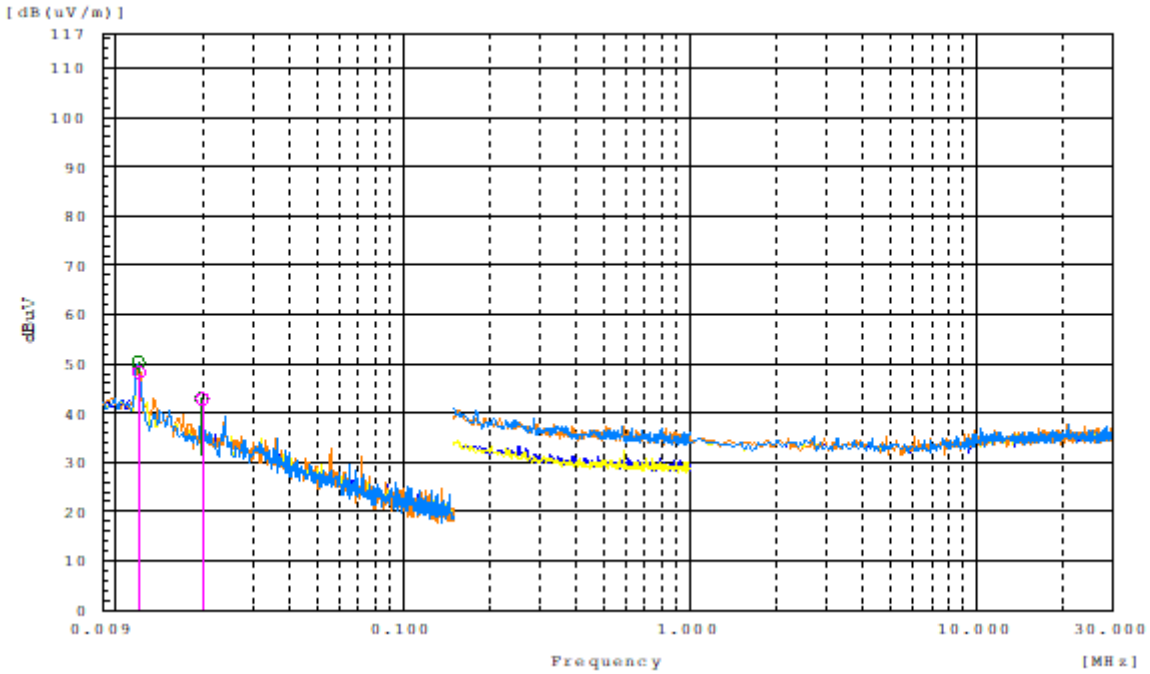
▣ Test Plots

9 kHz – 30MHz

Radiated Spurious Emissions plot – Vertical



Radiated Spurious Emissions plot – Horizontal



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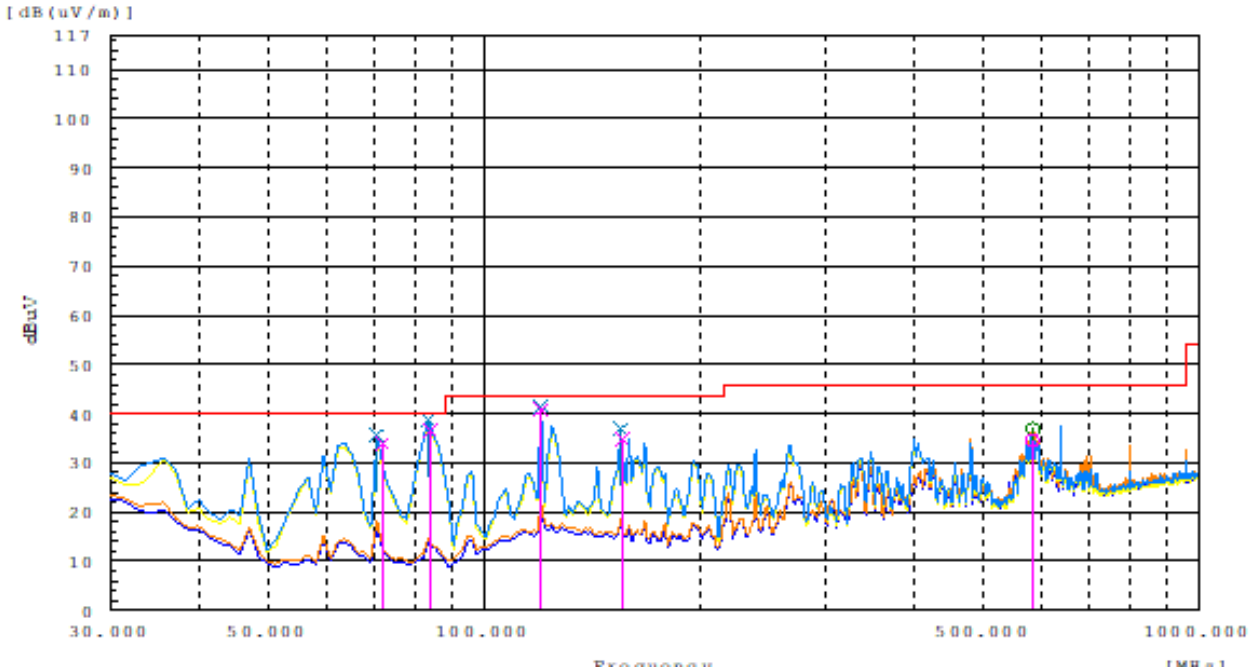
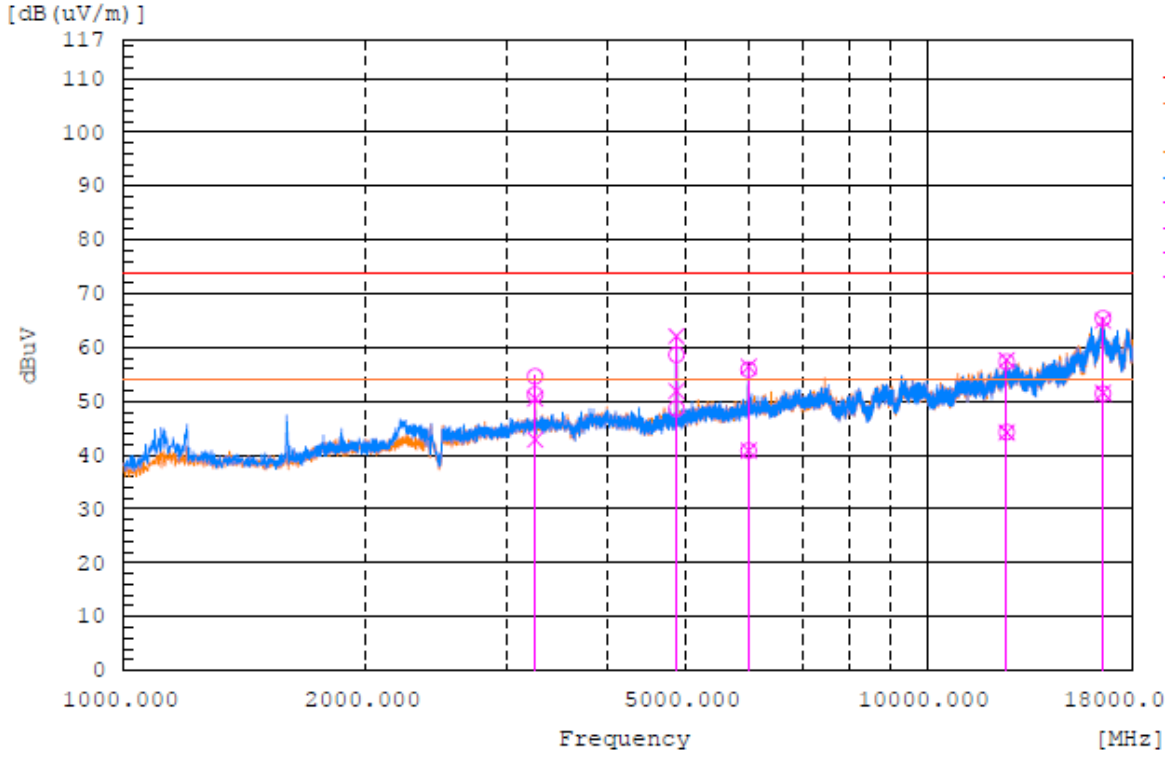
Below 1 GHz

Radiated Spurious Emissions plot – (802.11b)



Above 1 GHz

Radiated Spurious Emissions plot – (802.11b)



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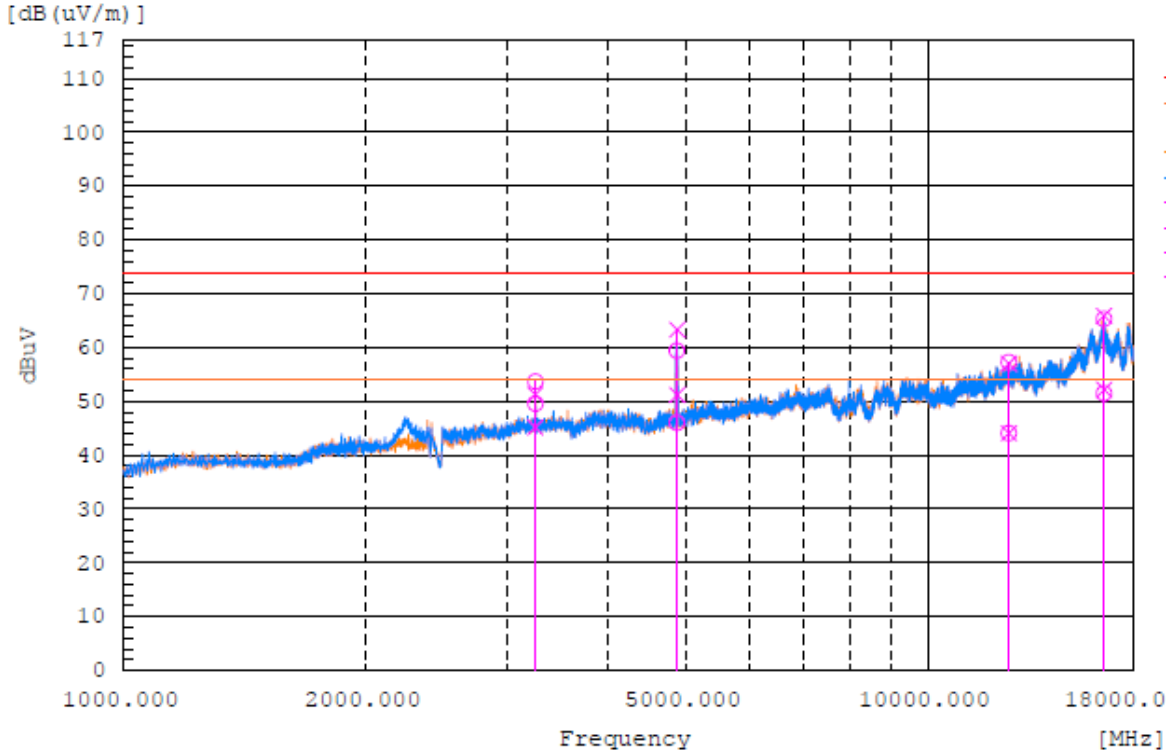
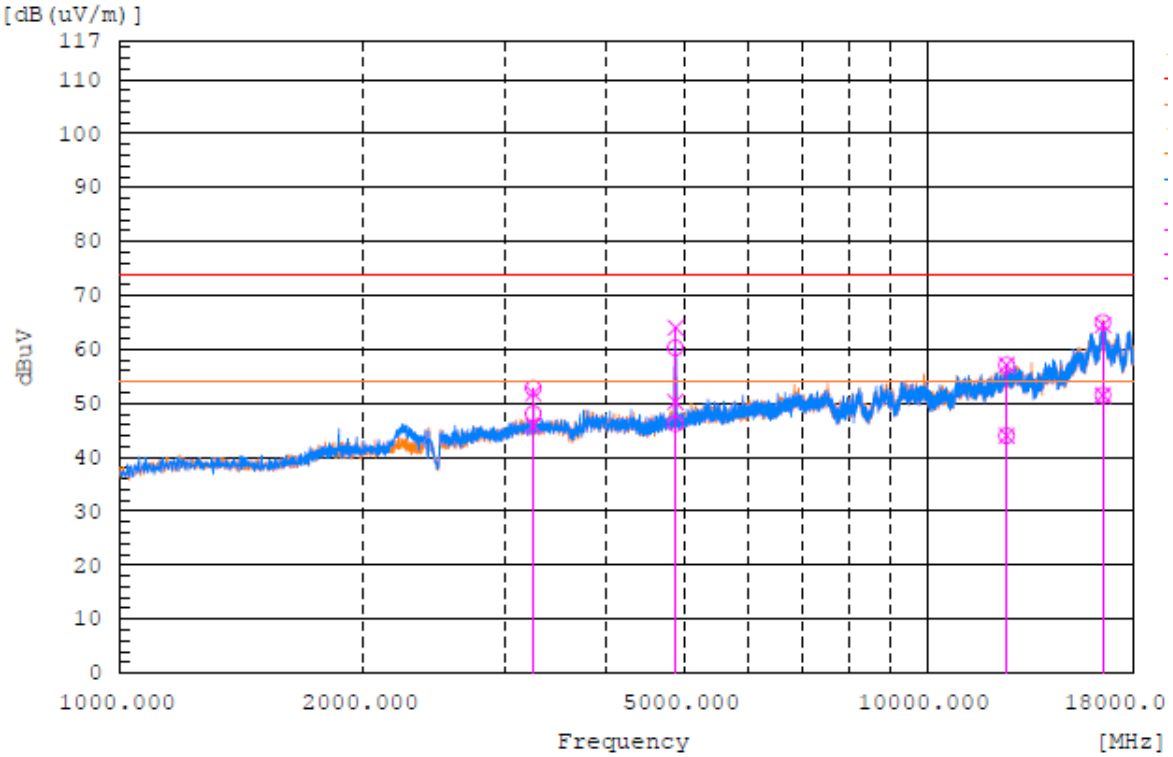
Radiated Spurious Emissions plot – (802.11g)



Radiated Spurious Emissions plot – (802.11n)



Note:

Plot of worst case are only reported.

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9.7 RADIATED RESTRICTED BAND EDGES

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	01 Ch, 11 Ch

Frequency MHz	Polarization	Reading dB(uV)			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
2390	V	4.3	17.8	35.9	40.2	53.7	54	74	13.8	20.3
2390	H	3.6	16.9	35.9	39.5	52.8	54	74	14.5	21.2
2483.5	V	9.1	22.0	36.1	45.2	58.1	54	74	8.8	15.9
2483.5	H	4.0	18.0	36.1	40.1	54.1	54	74	13.9	19.9

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	01 Ch, 11 Ch

Frequency MHz	Polarization	Reading dB(uV)			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
2390	H	6.5	21.6	35.9	42.4	57.5	54	74	11.6	16.5
2390	V	11.4	26.9	35.9	47.3	62.8	54	74	6.7	11.2
2483.5	V	8.6	22.1	36.1	44.7	58.2	54	74	9.3	15.8
2483.5	H	4.8	18.1	36.1	40.9	54.2	54	74	13.1	19.8

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Operation Mode:	802.11n (HT20)
Transfer MCS Index:	0
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	01 Ch, 11 Ch

Frequency MHz	Polarization	Reading dB(uV)			Level dB(uV/m)		Limit dB(uV/m)		Margin dB	
		AV	PK	Factor	AV	PK	AV	PK	AV	PK
2390	V	11.8	25.3	35.9	47.7	61.2	54	74	6.3	12.8
2390	H	6.7	20.4	35.9	42.6	56.3	54	74	11.4	17.7
2483.5	V	10.1	24.9	36.1	46.2	61.0	54	74	7.8	13.0
2483.5	H	5.2	18.9	36.1	41.3	55.0	54	74	12.7	19.0

Note

1. Frequency range of measurement = 2300 MHz ~ 2390MHz / 2483.5 MHz ~ 2500 MHz
2. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
3. Sample Calculation

Total(Measurement Type : Peak)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle ≥ 98%)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Total(Measurement Type : Average, Duty cycle < 98%)

= Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

+ Duty Cycle Factor

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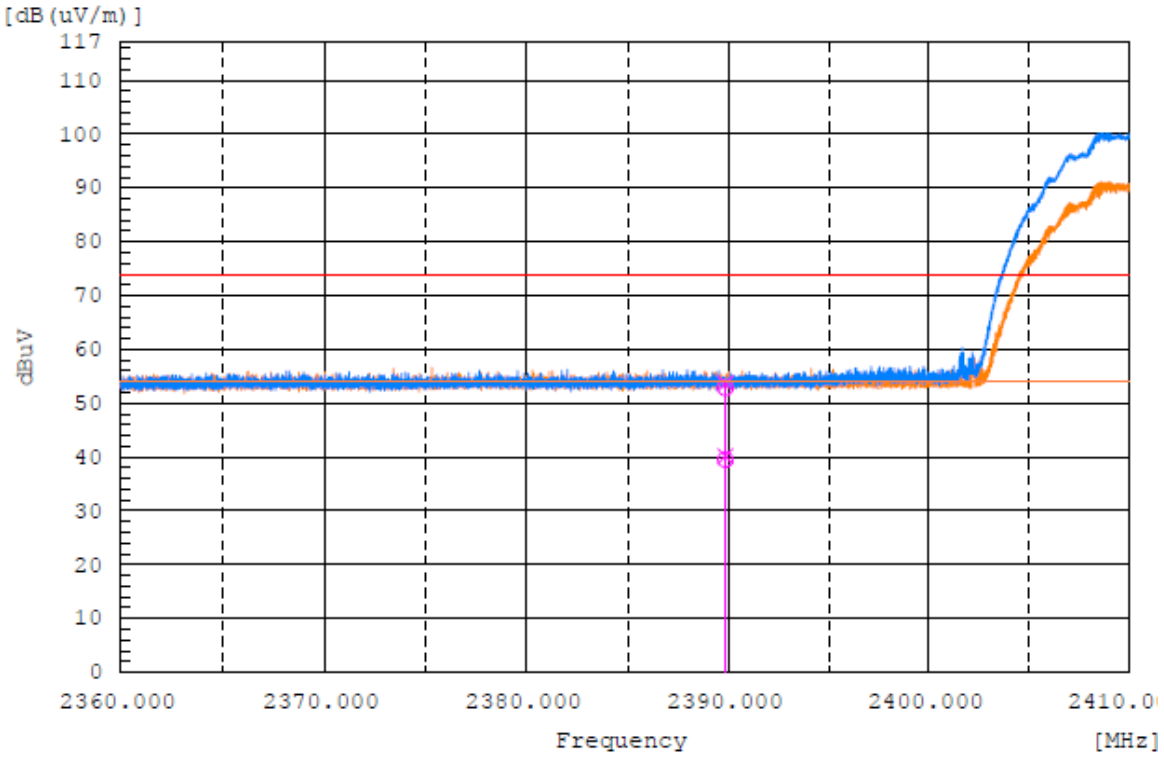
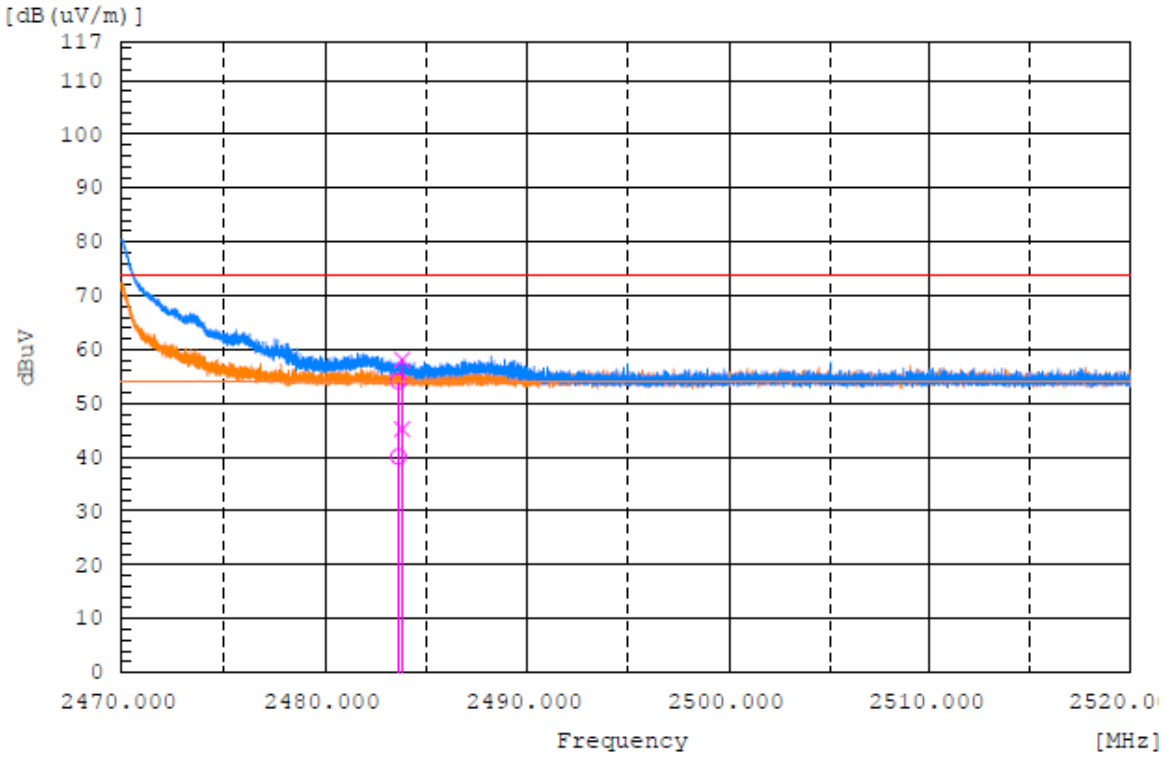
▣ Test Plots

Radiated Restricted Band Edges plot – (802.11b)



Radiated Restricted Band Edges plot – (802.11b)



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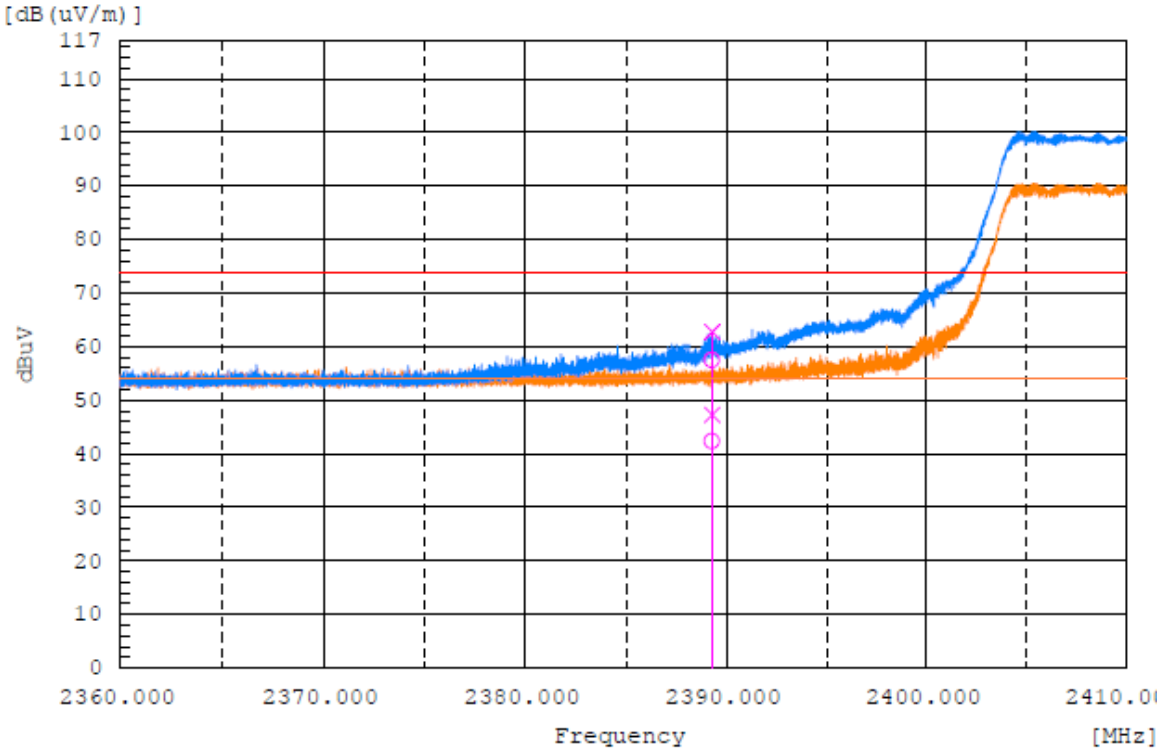
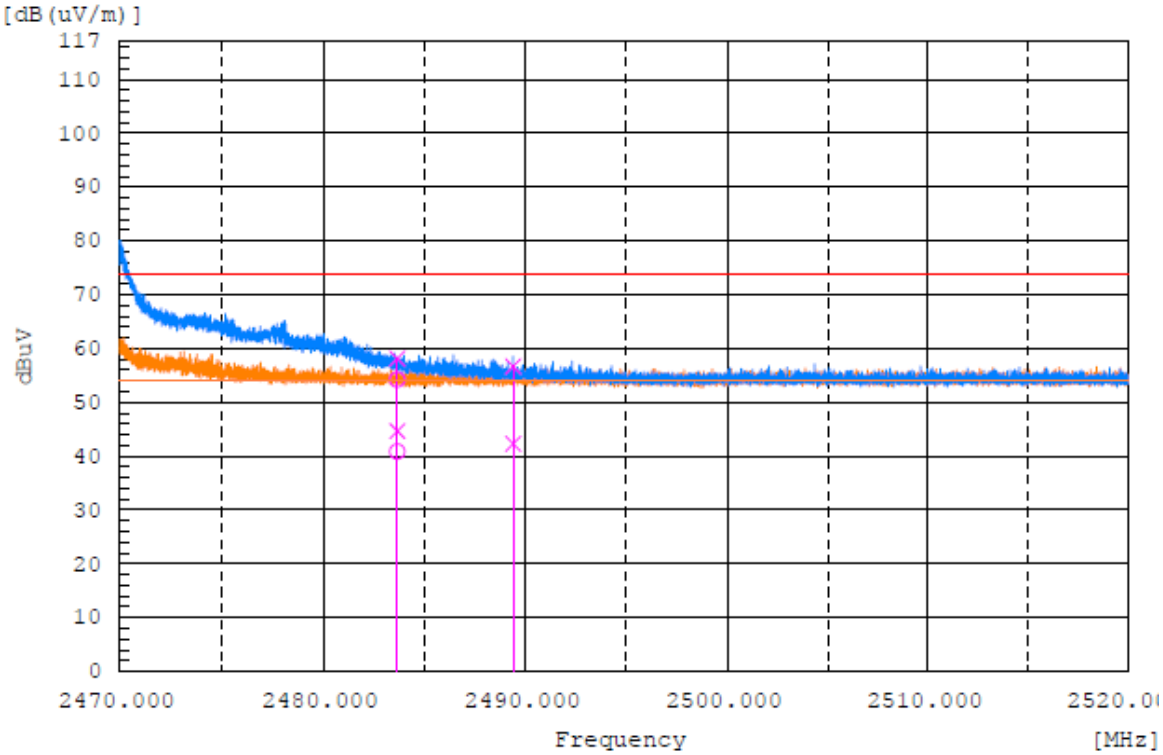
Radiated Restricted Band Edges plot – (802.11g)



Radiated Restricted Band Edges plot – (802.11g)



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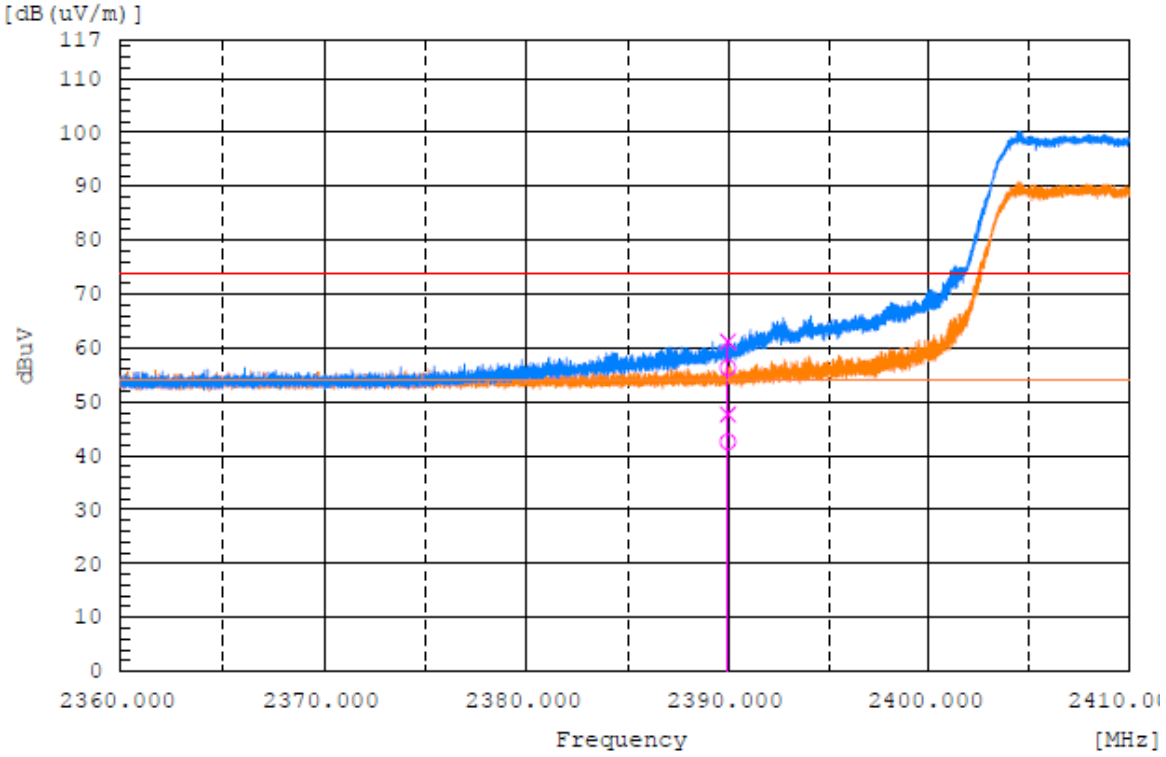
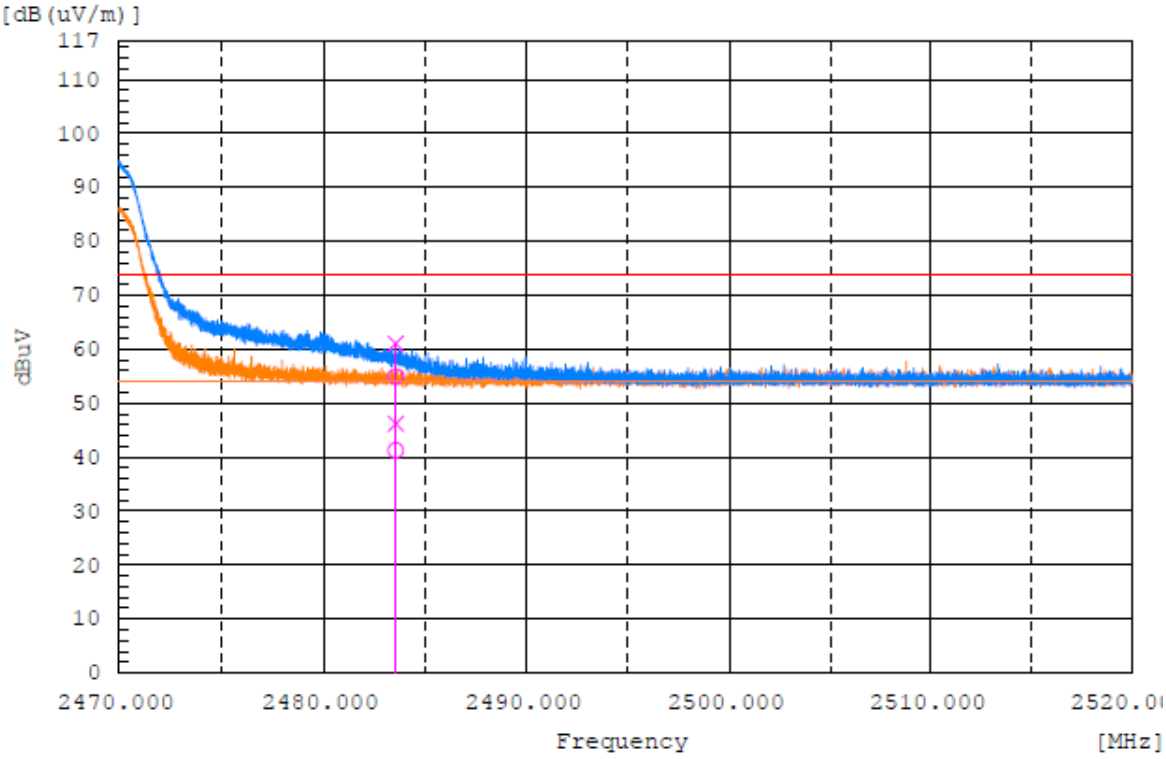
Radiated Restricted Band Edges plot – (802.11n)



Radiated Restricted Band Edges plot – (802.11n)



Note:

Plot of worst case are only reported.

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9.8 RECEIVER SPURIOUS EMISSIONS

Frequency Range : Below 1 GHz

Frequency [MHz]	ANT. POL [H/V]	Reading [dBuV]	※A.F.+C.L. [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
84.04	V	58.7	-22.9	35.8	40	4.2	QP
120.01	V	57.4	-16.0	41.4	43.5	2.1	QP
156.00	V	52.5	-17.4	35.1	43.5	8.4	QP
586.54	H	43.6	-9.3	34.3	46	11.7	QP

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

Frequency Range : Above 1 GHz

Frequency MHz	Polarization	Reading dB(uV)		Level dB(uV/m)	Limit dB(uV/m)	Margin dB
		AV	Factor	AV	AV	AV
2416.66	H	41.8	-12.6	29.2	54	24.8
5985.57	H	38.7	-1.4	37.3	54	16.7
5985.57	V	38.5	-1.4	37.1	54	16.9
16583.3	V	34.4	15.6	50.0	54	4.0
16583.3	H	34.8	15.6	50.4	54	3.6

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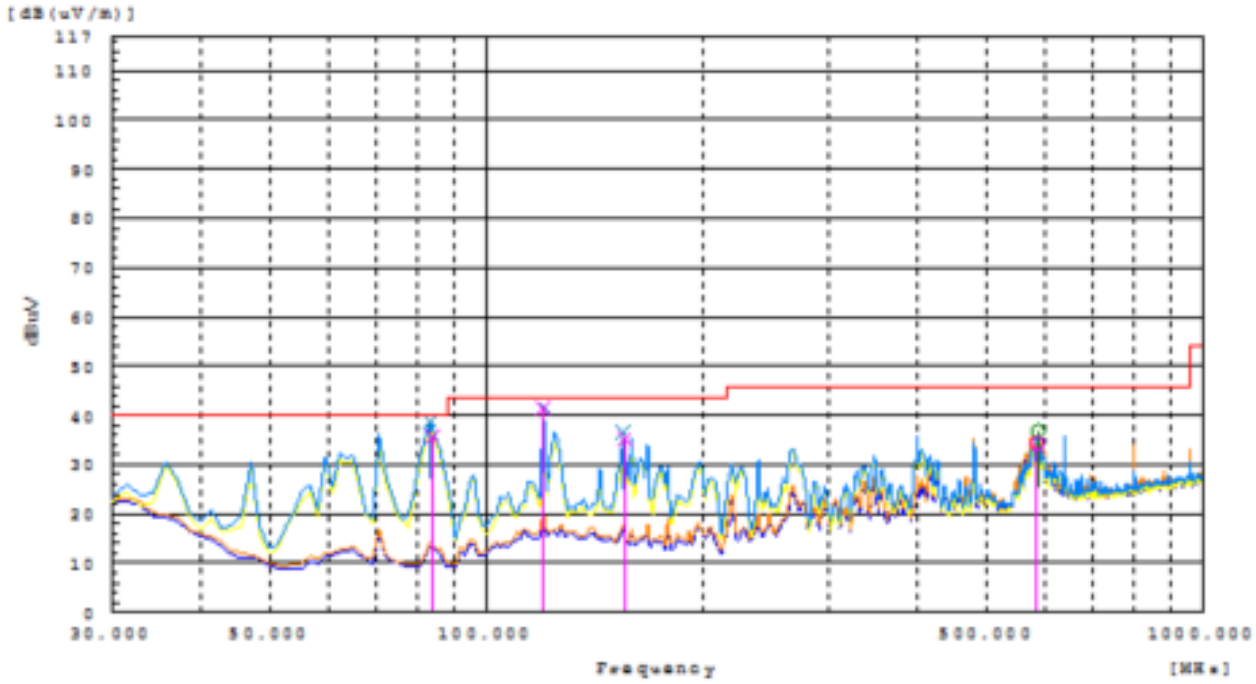
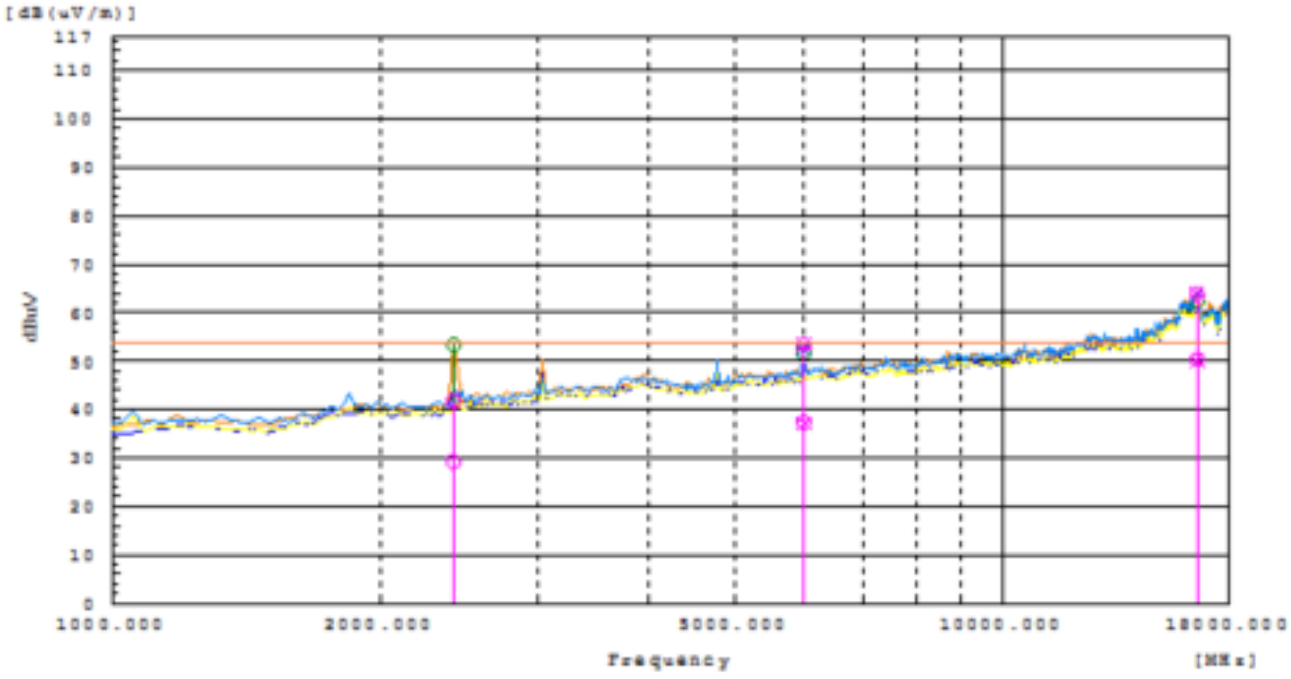
▣ Test Plots

Below 1 GHz



Above 1 GHz



Note:

Plot of worst case are only reported.

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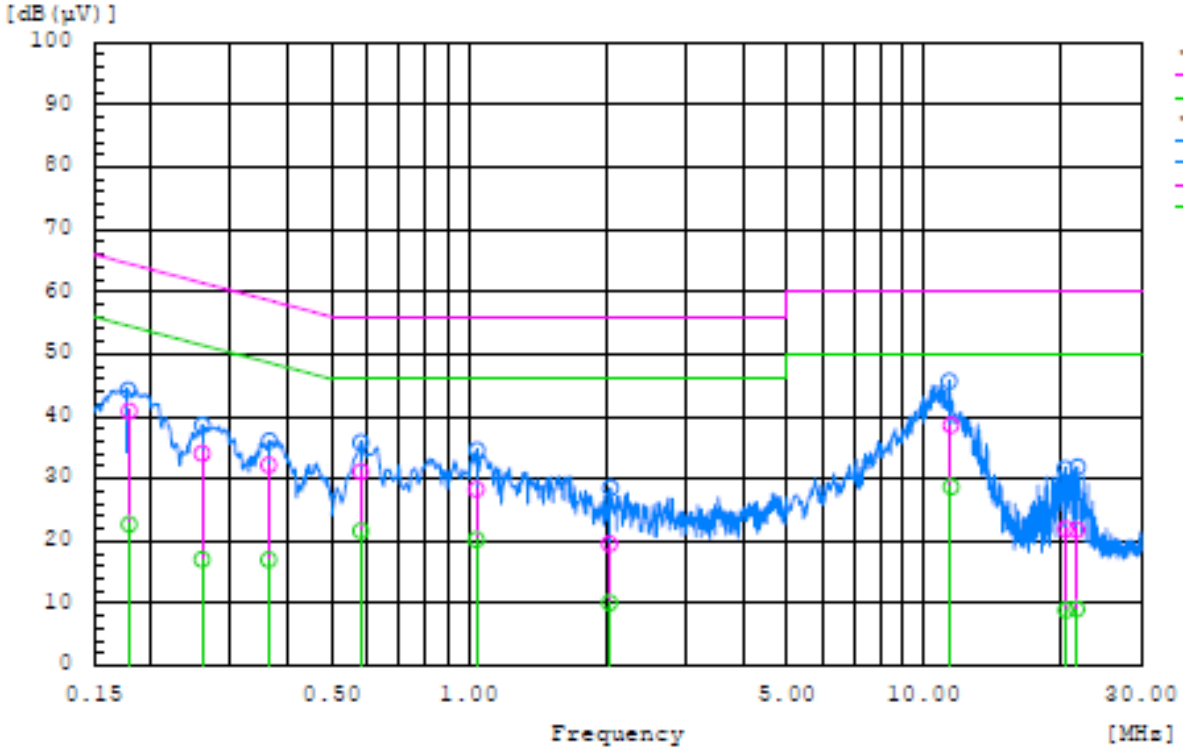
9.9 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)



Frequency	Line	Reading		Factor	Level		Limit		Margin	
MHz		dB(µV)		dB	dB(µV)		dB(µV)		dB	
		QP	AV		QP	AV	QP	AV	QP	AV
0.179	L1	31.3	13.1	9.6	40.9	22.7	64.5	54.5	23.6	31.8
0.363	L1	22.7	7.4	9.6	32.3	17	58.7	48.7	26.4	31.7
0.259	L1	24.5	7.5	9.6	34.1	17.1	61.5	51.5	27.4	34.4
0.578	L1	21.6	12.1	9.6	31.2	21.7	56	46	24.8	24.3
1.038	L1	18.7	10.6	9.7	28.4	20.3	56	46	27.6	25.7
2.037	L1	10	0.6	9.6	19.6	10.2	56	46	36.4	35.8
11.447	L1	28.6	18.7	10	38.6	28.7	60	50	21.4	21.3
21.616	L1	11.7	-1	10.1	21.8	9.1	60	50	38.2	40.9
20.497	L1	11.9	-1.1	10.1	22	9	60	50	38	41

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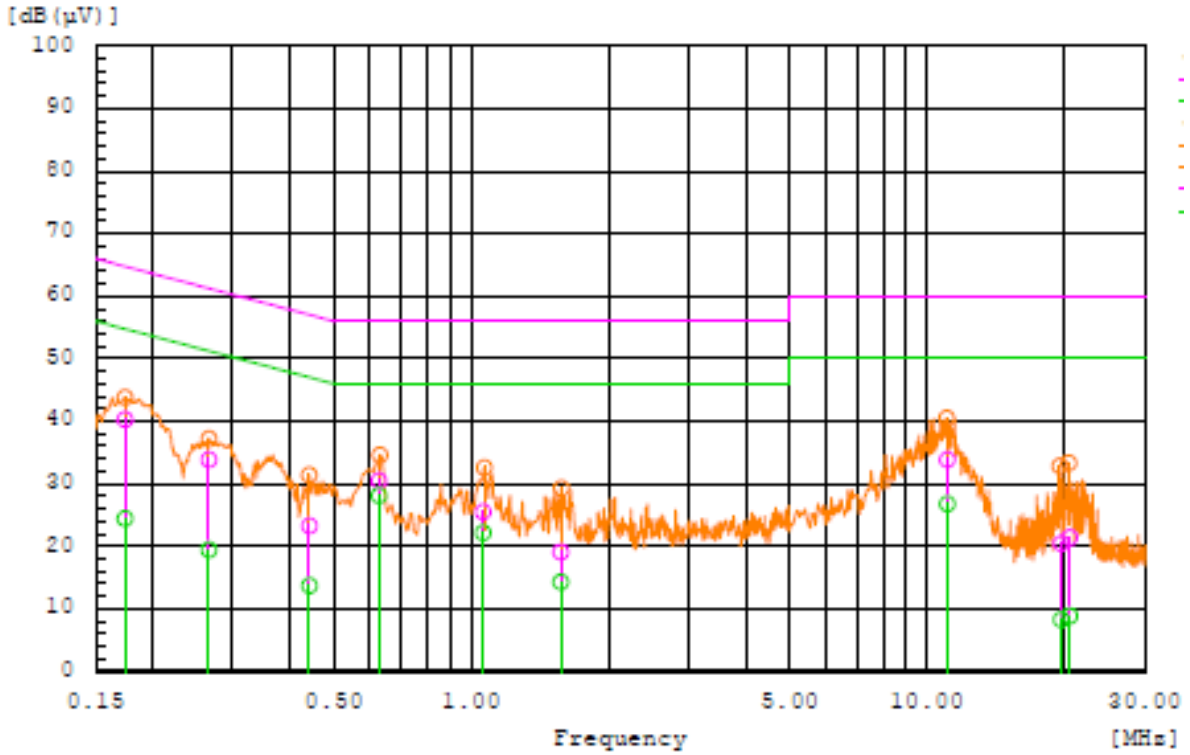
Conducted Emissions (Line 2)



Frequency	Line	Reading		Factor	Level		Limit		Margin	
MHz		dB(µV)		dB	dB(µV)		dB(µV)		dB	
		QP	AV		QP	AV	QP	AV	QP	AV
0.174	N	30.7	14.9	9.6	40.3	24.5	64.8	54.8	24.5	30.3
0.266	N	24.3	9.9	9.6	33.9	19.5	61.2	51.2	27.3	31.7
0.442	N	13.7	4.1	9.6	23.3	13.7	57	47	33.7	33.3
0.627	N	20.9	18.5	9.6	30.5	28.1	56	46	25.5	17.9
1.062	N	15.8	12.5	9.7	25.5	22.2	56	46	30.5	23.8
1.57	N	9.4	4.7	9.7	19.1	14.4	56	46	36.9	31.6
11.062	N	23.9	16.8	10	33.9	26.8	60	50	26.1	23.2
20.541	N	11.4	-1.2	10.1	21.5	8.9	60	50	38.5	41.1
19.638	N	10.3	-1.9	10.2	20.5	8.3	60	50	39.5	41.7

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10. LIST OF TEST EQUIPMENT

No.	Instrument	Model No.	Due to Calibration	Manufacture	Serial No.
☒	Signal Analyzer (20 Hz ~ 40.0 GHz)	ESU40	2019-12-20	ROHDE & SCHWARZ	100529
☒	Signal Analyzer (3 ㎐ ~ 40 ㎓)	N9020A	2019-11-09	AGILENT	MY52091291
☒	BI-LOG Antenna (30 MHz ~ 1 GHz)	JB6	2020-11-29	Sunol	A071116
☒	Attenuator (20 dB, DC ~ 26.5 GHz)	8493C	2019-12-20	HP	09072
☒	DC power supply	6655A	2020-01-23	HP	KR94907553
☒	POWER AMP (1 GHz ~ 18 GHz)	CBLU1183540B-01	2020-01-18	CERNEX	27974
☒	POWER AMP (0.3GHz ~ 1GHz)	PAM-103A	2020-01-18	Com-Power Corporation	18020005
☒	Horn Antenna (1 GHz ~ 18 GHz)	DRH-118	2020-05-24	Sunol	A070516
☒	Loop Antenna (0.009 ~ 30 MHz)	HLA 6121	2020-08-27	Teseq	43964
☒	Horn Antenna (18 GHz ~ 40 GHz)	DRH-1840	2020-02-20	Sunol	17120
☒	POWER AMP (18 GHz ~ 40 GHz)	CBL184050-45-01	2020-02-20	CERNEX,Inc.	43964

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

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11. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	EMCE-R-1907-F003-P

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