EMC Test Report

Project Number: 4348586

Report Number: 4348586EMC04 **Revision Level:** 5

Client: United Technologies Electronic Controls Inc.

Equipment Under Test: Micro-Link 5 Controller

Model Number: ML5

FCC ID: 2AK6N-MICROLINK5

IC: 703A-MICROLINK5

Applicable Standards: ANSI C63.10: 2013 (FCC Part 15 Subpart C, § 15.247)
RSS-247, Issue 2
RSS-GEN Issue 5

Report issued on: 20 May 2019

Test Result: Compliant

Tested by: _____
Aaron Froehlich, EMC Test Engineer

Reviewed by: _____
David Schramm, Operations Manager

Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

Table of Contents

1 Summary of Test Results

Test Description	Test Specification		Test Result
Bandwidth	15.247(d)	RSS-247 S5.2 (1) RSS-GEN S6.7	Compliant
Peak Output Power	15.247(b)(3)	RSS-247 S5.4 (D)	Compliant
Power Spectral Density	15.247(e)	RSS-247 S5.2 (B)	Compliant
Conducted Spurious Emissions / Band Edge	15.247(d)	RSS-247 S5.5	Compliant
Field Strength of Spurious Radiation	15.247(d), 15.209	RSS-247 S5.5	Compliant
Emissions in Restricted Frequency Bands	15.205, 15.209	RSS-GEN S8.9, S8.10	Compliant
Antenna Requirement	15.203	RSS-GEN S6.8	Compliant
Frequency Stability	15.215	RSS-GEN S6.11	Compliant
AC Powerline Conducted Emissions	15.107, 15.207	RSS-GEN S8.8	N/A[1]

Notes:
1. DUT is DC Powered

1.1 *Modifications Required for Compliance*

None

2 General Information

2.1 *Client Information*

Name:	United Technologies Electronic Controls Inc.
Address:	3650 W Hwy 200 N
City, State, Zip, Country:	Huntington, IN 46750 USA

2.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA
Accrediting Body:	A2LA
Type of lab:	Testing Laboratory
Certificate Number:	3212.01

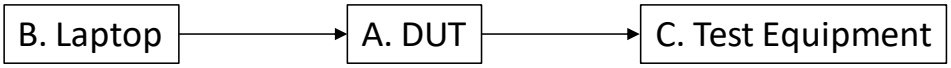
2.3 *General Information of EUT*

Product Marketing Name (PMN):	Micro-Link 5 Controller
Model Number (HVIN):	ML5
Firmware Version (FVIN):	8.9.0.0.79
Serial Number:	3318W000118
Frequency Range:	2400-2483.5 MHz
Data Modes:	802.11 b/g/n
Antenna:	PCB Trace Inverted F 4.54 dBi
Rated Voltage:	5 Vdc
Test Voltage:	5 Vdc
Sample Received Date:	8/7/2018
Dates of testing:	11/5/2018-12/17/2018

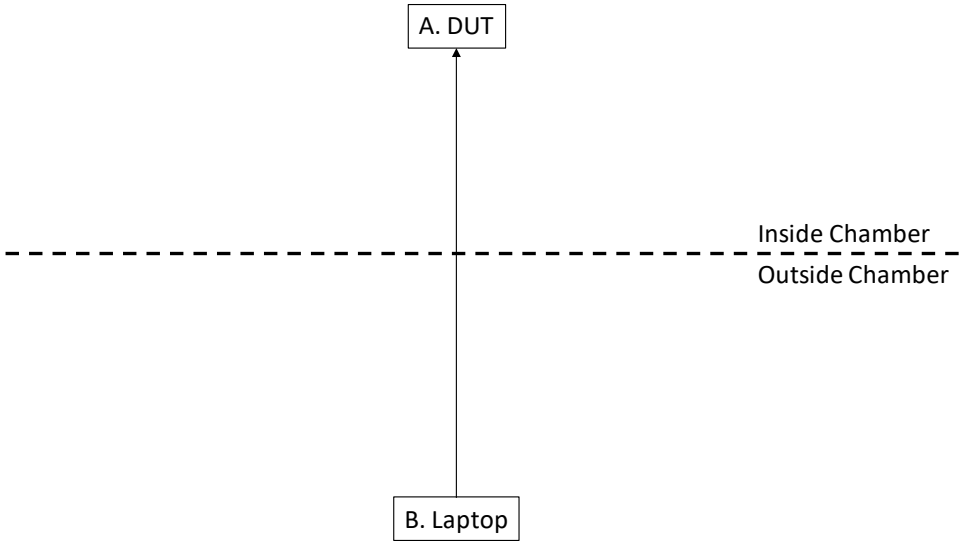
2.4 *Operating Modes and Conditions*

Test modes were utilized to control the receiver and transmit at full power, maximum duty cycle, on specified channel in the desired data mode.

2.5 *EUT Connection Block Diagram – Conducted Measurements*



2.6 *EUT Connection Block Diagram – Radiated Measurements*



2.7 *System Configurations*

Device reference	Manufacturer	Description	Model Number	Serial Number
A	UT Electronic Controls, Inc.	DUT	ML5	3318W000118
Support Equipment				
B	Lenovo	Laptop	ThinkPad T420	4236B85

3 Bandwidth

3.1 *Test Result*

Test Description	Test Specification		Test Result
6 dB bandwidth	15.247(d)	RSS-247 S5.2 (1) RSS-GEN S6.6	Compliant

3.2 *Test Method*

The procedures from ANSI C63.10: 2013 clause 11.8 and 558074 D01 DTS Meas Guidance v04 were used to determine the 6 dB bandwidth.

The 99% Occupied Bandwidth has also been reported.

3.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	22.3 °C
Relative Humidity:	53.1 %
Atmospheric Pressure:	97.1 kPa

3.4 *Test Equipment*

Test End Date: 10-Oct-2018 Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095592	25-Jul-2019
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	15-Dec-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

Note: The equipment calibration period is 1 year.

3.5 *Test Data*

6 dB Bandwidth:

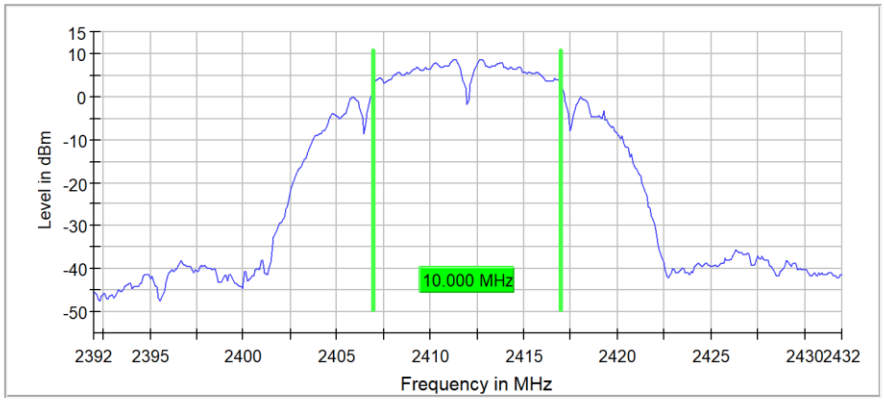
Mode 802.11	Data Rate (Mbps)	Ch (#)	DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
b	2.0	1	2412	10.0	0.5	---	2406.95	2416.95	8.6	PASS
b	2.0	6	2437	10.0	0.5	---	2431.95	2441.95	8.9	PASS
b	2.0	11	2462	10.1	0.5	---	2456.95	2467.05	9.1	PASS
g	6.0	1	2412	15.3	0.5	---	2404.35	2419.65	4.7	PASS
g	6.0	6	2437	15.3	0.5	---	2429.35	2444.65	8.0	PASS
g	6.0	11	2462	15.3	0.5	---	2454.35	2469.65	5.0	PASS
n	6.5	1	2412	15.3	0.5	---	2404.35	2419.65	4.8	PASS
n	6.5	6	2437	15.3	0.5	---	2429.35	2444.65	7.1	PASS
n	6.5	11	2462	15.3	0.5	---	2454.35	2469.65	5.3	PASS

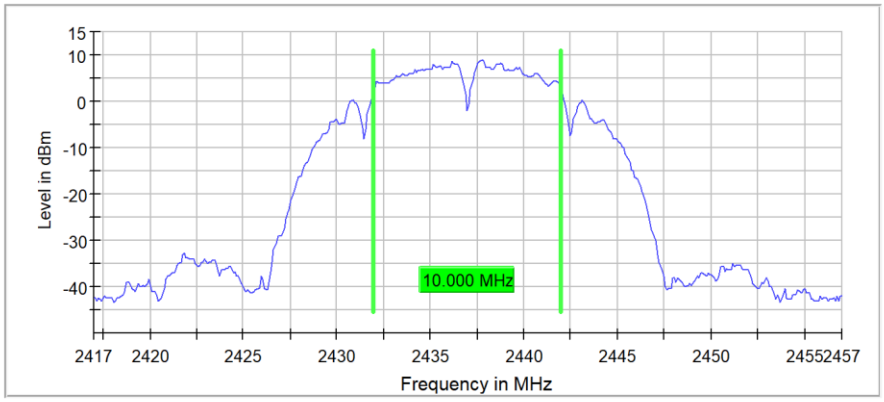
99% Occupied Bandwidth:

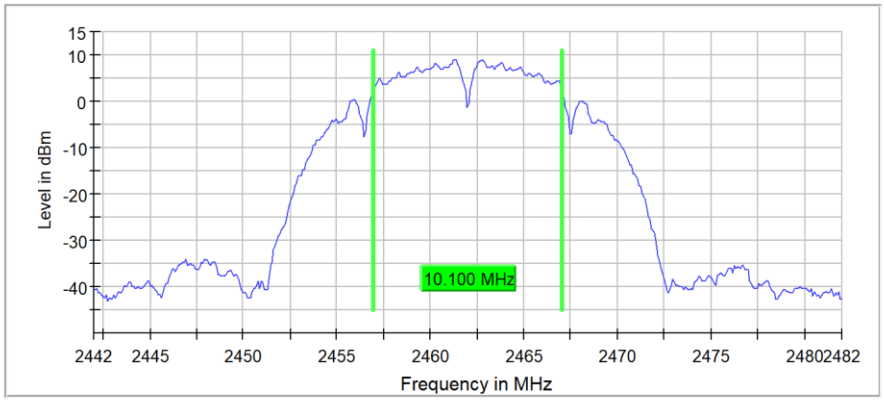
Mode 802.11	Data Rate (Mbps)	Ch (#)	DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
b	2.0	1	2412	16.9	---	---	2403.575	2420.425	8.2	PASS
b	2.0	6	2437	17.0	---	---	2428.475	2445.425	8.6	PASS
b	2.0	11	2462	16.8	---	---	2453.625	2470.375	8.8	PASS
g	6.0	1	2412	17.2	---	---	2403.425	2420.575	4.6	PASS
g	6.0	6	2437	17.9	---	---	2427.875	2445.775	8.0	PASS
g	6.0	11	2462	17.2	---	---	2453.375	2470.575	5.0	PASS
n	6.5	1	2412	18.5	---	---	2402.725	2421.225	4.8	PASS
n	6.5	6	2437	18.8	---	---	2427.725	2446.525	7.1	PASS
n	6.5	11	2462	18.5	---	---	2452.725	2471.225	5.4	PASS

3.5.1 Plots

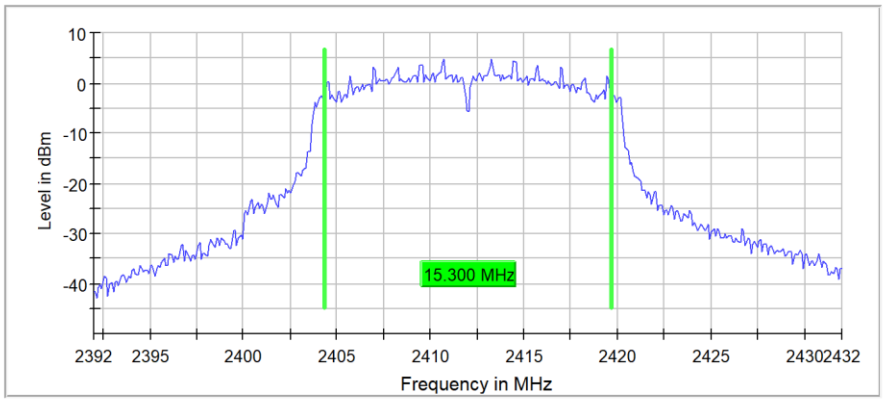
3.5.1.1 802.11b

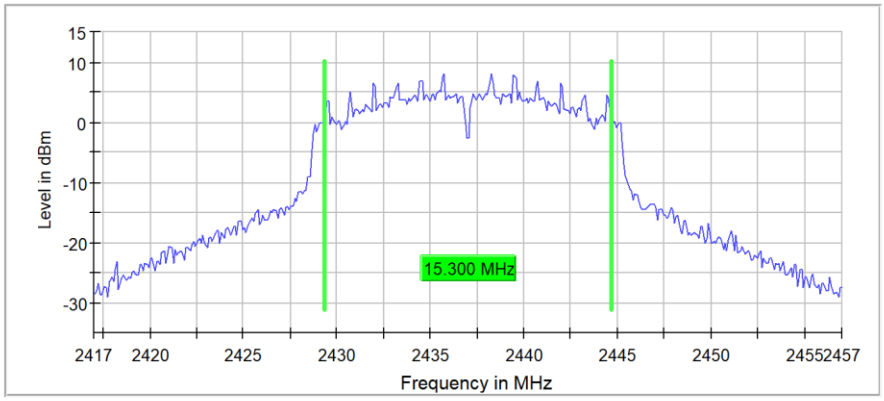


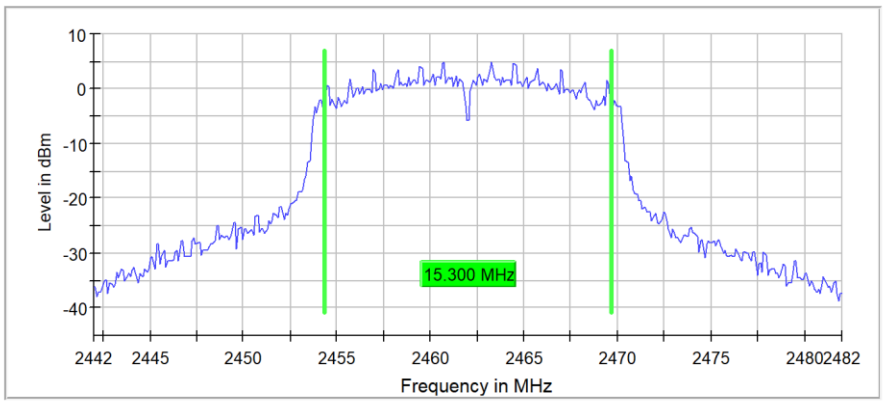




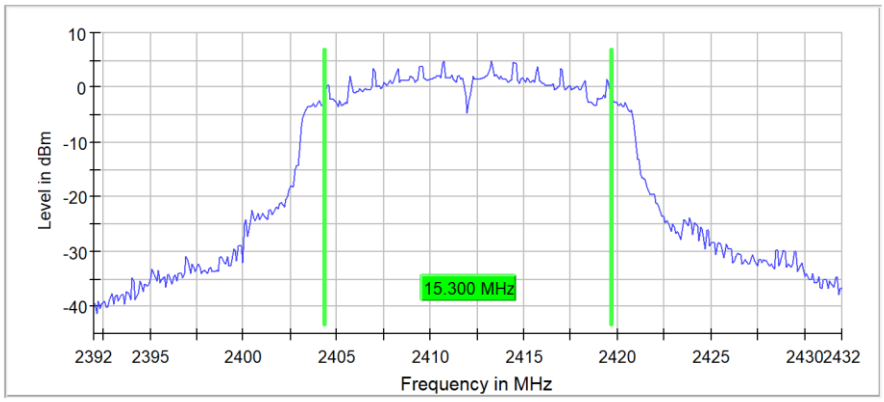
3.5.1.2 802.11g

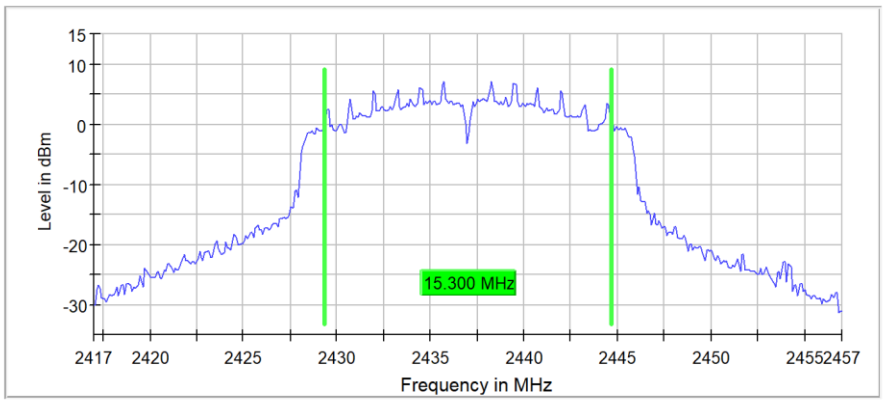

10
0
-10
-20
-30
-40
Level in dBm
15.300 MHz
2392
2395
2400
2405
2410
2415
2420
2425
24302432
Frequency in MHz

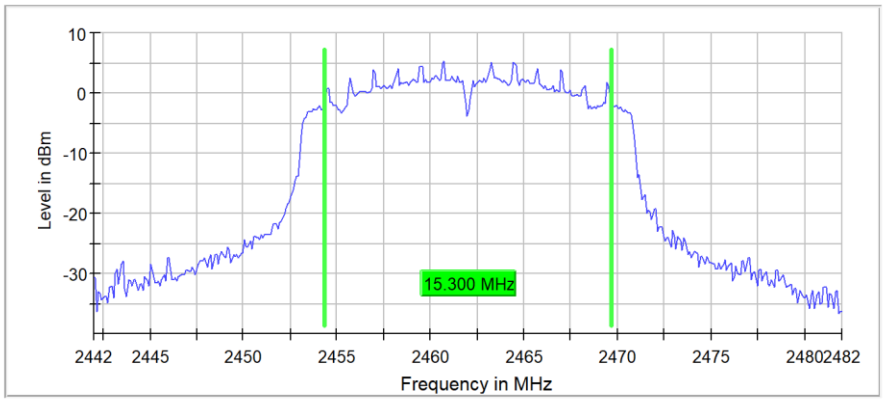

15
10
0
-10
-20
-30
Level in dBm
15.300 MHz
2417
2420
2425
2430
2435
2440
2445
2450
24552457
Frequency in MHz


10
0
-10
-20
-30
-40
Level in dBm
15.300 MHz
2442
2445
2450
2455
2460
2465
2470
2475
24802482
Frequency in MHz

3.5.1.3 802.11n


10
0
-10
-20
-30
-40
Level in dBm
15.300 MHz
2392
2395
2400
2405
2410
2415
2420
2425
24302432
Frequency in MHz


15
10
0
-10
-20
-30
Level in dBm
15.300 MHz
2417
2420
2425
2430
2435
2440
2445
2450
24552457
Frequency in MHz


10
0
-10
-20
-30
Level in dBm
15.300 MHz
2442
2445
2450
2455
2460
2465
2470
2475
24802482
Frequency in MHz

4 RF Output Power

4.1 *Test Result*

Test Description	Test Specification		Test Result
RF Output Power	15.247(b)(3)	RSS-247 S5.4 (4)	Compliant

4.2 *Test Method*

Fundamental peak power measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.9 and KDB 558074 D01 Measurement Guidance v05r02.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi (e.g. for a 7.4dBi antenna, the limit is reduced from 30dBm to 28.6dBm)

4.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	22.3 °C
Relative Humidity:	53.1 %
Atmospheric Pressure:	97.1 kPa

4.4 *Test Equipment*

Test End Date: 10-Oct-2018 Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095592	25-Jul-2019
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	15-Dec-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

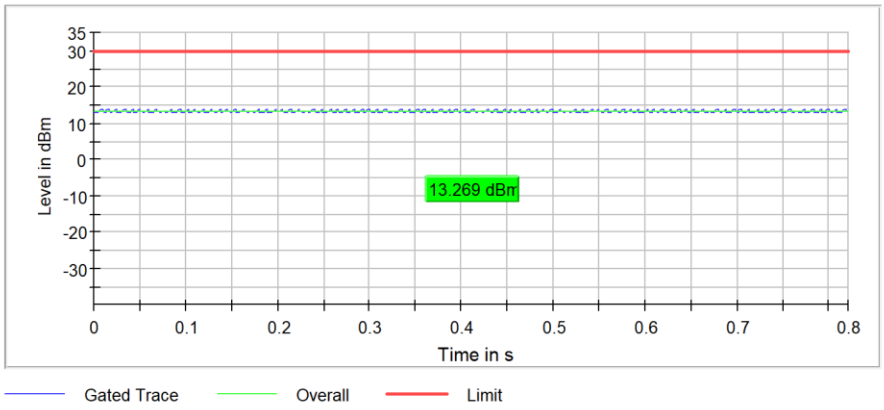
Note: The equipment calibration period is 1 year.

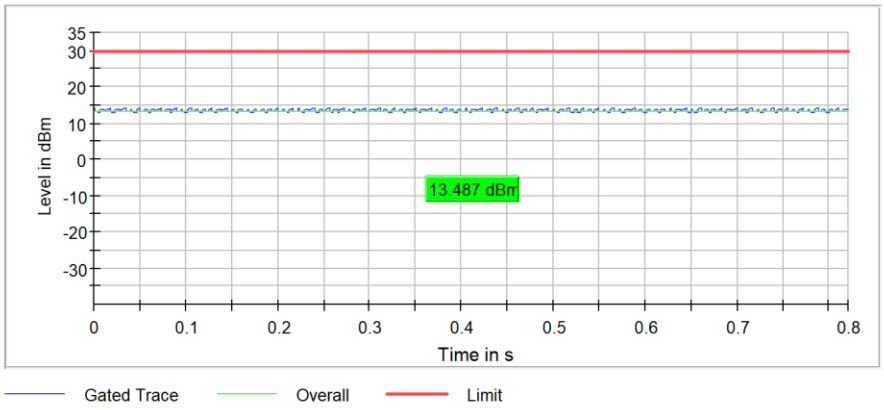
4.5 *Test Data*

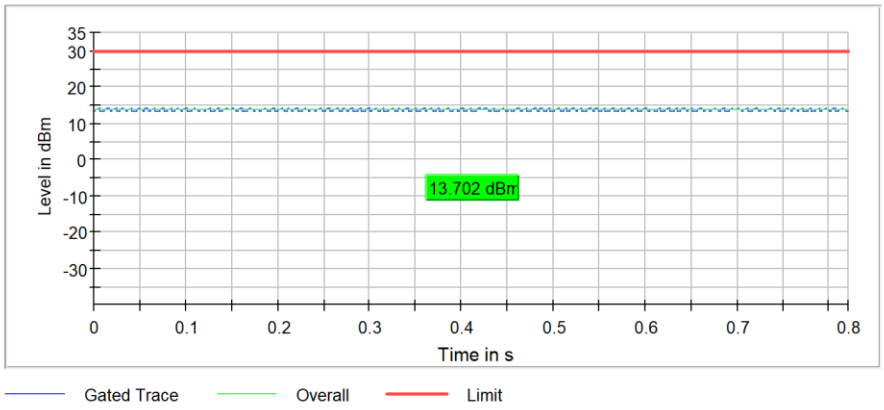
Mode 802.11	Data Rate (Mbps)	Ch (#)	DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	Duty Cycle (%)	Result
b	2.0	1	2412	13.3	30	17.8	82.41	PASS
b	2.0	6	2437	13.5	30	18	82.41	PASS
b	2.0	11	2462	13.7	30	18.2	82.41	PASS
g	6.0	1	2412	11.3	30	15.8	59.52	PASS
g	6.0	6	2437	14.1	30	18.6	59.53	PASS
g	6.0	11	2462	11.6	30	16.1	59.52	PASS
n	6.5	1	2412	11.3	30	15.8	55.75	PASS
n	6.5	6	2437	13.2	30	17.7	55.75	PASS
n	6.5	11	2462	11.7	30	16.3	55.75	PASS

4.5.1 Plots

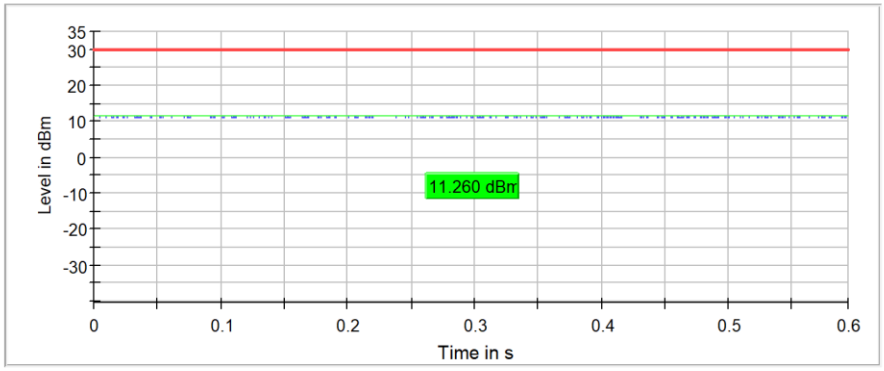
4.5.1.1 802.11b

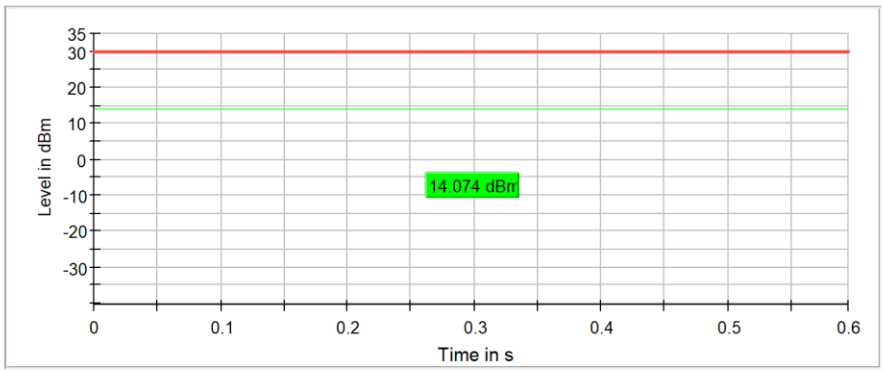


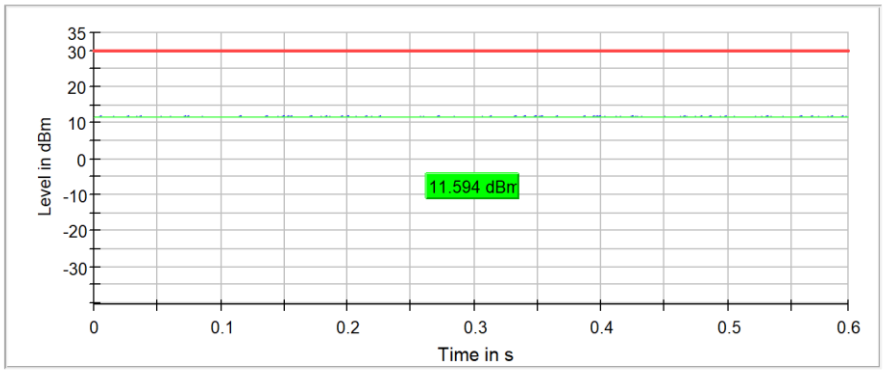




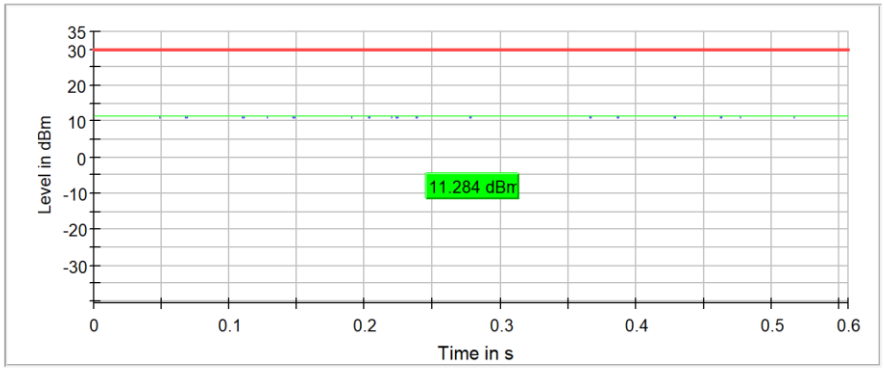
4.5.1.2 802.11g

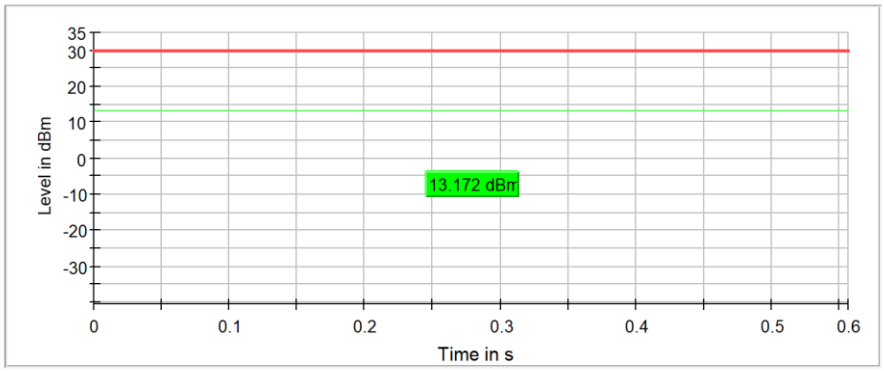

35
30
20
10
0
-10
-20
-30
Level in dBm
11.260 dBm
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in s
Gated Trace
Overall
Limit

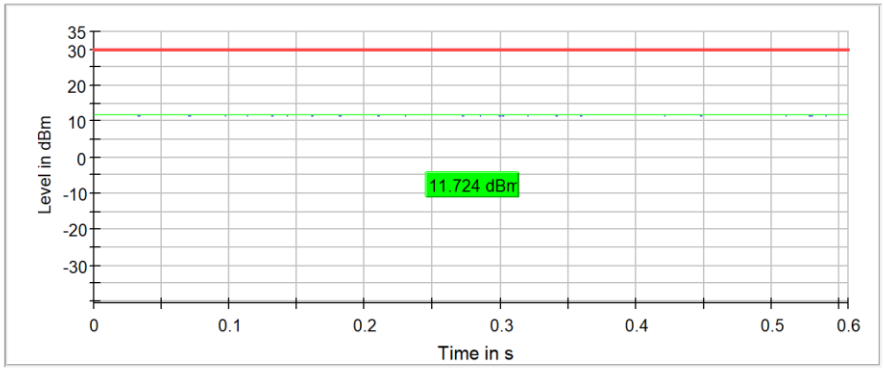

35
30
20
10
0
-10
-20
-30
Level in dBm
14.074 dBm
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in s
Gated Trace
Overall
Limit


35
30
20
10
0
-10
-20
-30
Level in dBm
11.594 dBm
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in s
Gated Trace
Overall
Limit

4.5.1.3 802.11n


Level in dBm
35
30
20
10
0
-10
-20
-30
11.284 dBm
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in s
Gated Trace
Overall
Limit


Level in dBm
35
30
20
10
0
-10
-20
-30
13.172 dBm
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in s
Gated Trace
Overall
Limit


Level in dBm
35
30
20
10
0
-10
-20
-30
11.724 dBm
0
0.1
0.2
0.3
0.4
0.5
0.6
Time in s
Gated Trace
Overall
Limit

5 Power Spectral Density

5.1 *Test Result*

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-247 S5.2 (2)	Compliant

5.2 *Test Method*

Power spectral density measurements were recorded using the procedures from ANSI C63.10: 2013 clause 11.10.7 (AVGPSD-3) and KDB 558074 D01 Measurement Guidance v05r02.

Limit
The limit is 8 dBm.

5.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	22.3 °C
Relative Humidity:	53.1 %
Atmospheric Pressure:	97.1 kPa

5.4 *Test Equipment*

Test End Date: 10-Oct-2018 Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095592	25-Jul-2019
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	15-Dec-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019

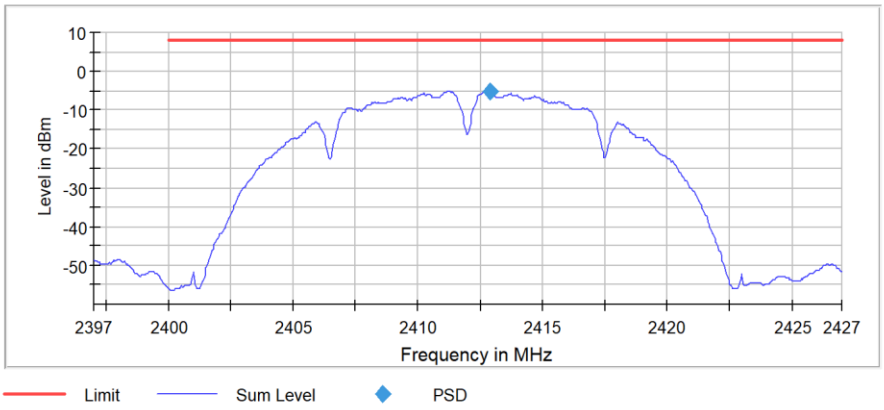
Note: The equipment calibration period is 1 year.

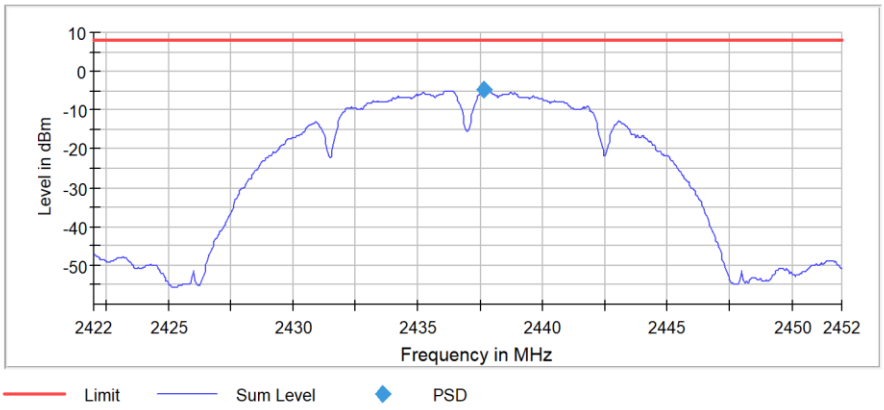
5.5 *Test Data*

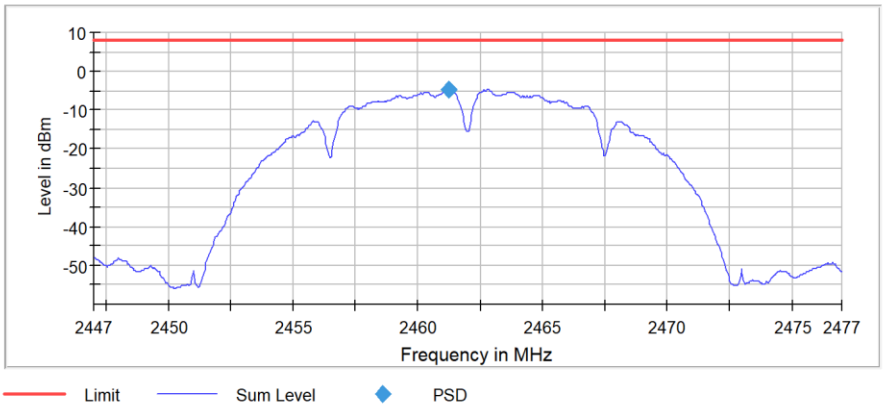
Mode 802.11	Data Rate (Mbps)	Ch (#)	DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
b	2.0	1	2412	2412.875	-5.008	8	PASS
b	2.0	6	2437	2437.675	-4.886	8	PASS
b	2.0	11	2462	2461.225	-4.656	8	PASS
g	6.0	1	2412	2410.725	-10.571	8	PASS
g	6.0	6	2437	2435.725	-7.449	8	PASS
g	6.0	11	2462	2460.725	-10.263	8	PASS
n	6.5	1	2412	2410.725	-10.785	8	PASS
n	6.5	6	2437	2435.725	-8.913	8	PASS
n	6.5	11	2462	2460.725	-10.201	8	PASS

5.5.1 Plots

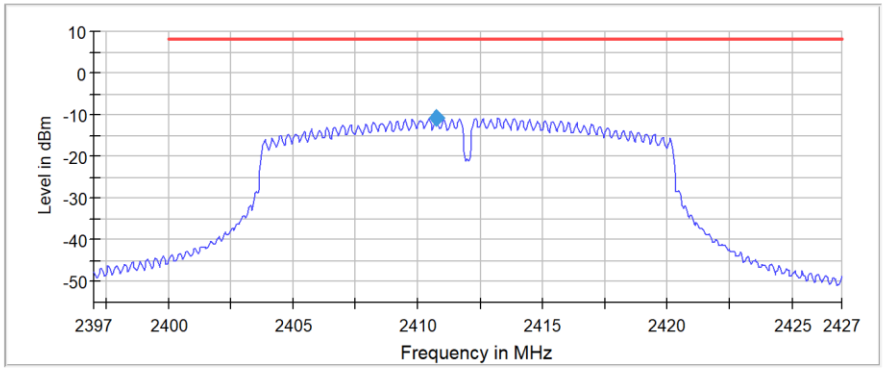
5.5.1.1 802.11b



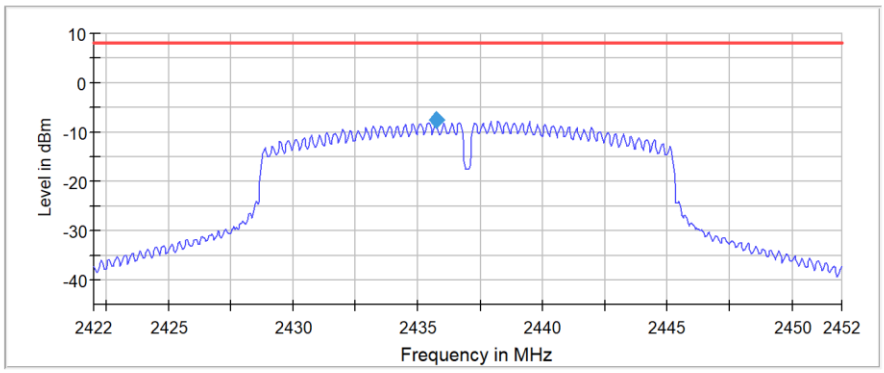




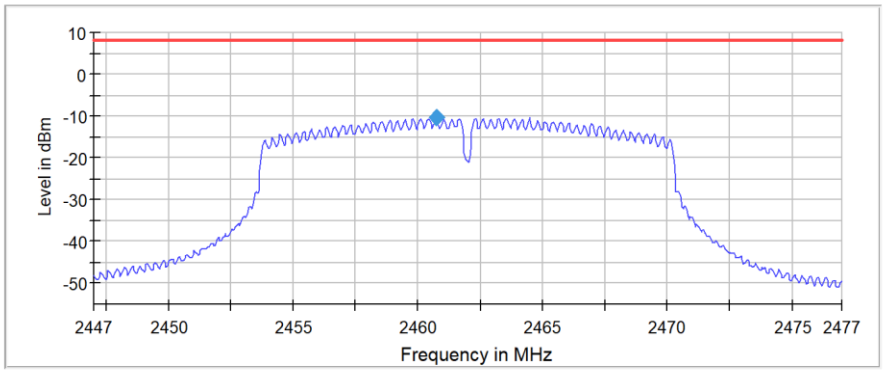
5.5.1.2 802.11g



Limit Sum Level PSD

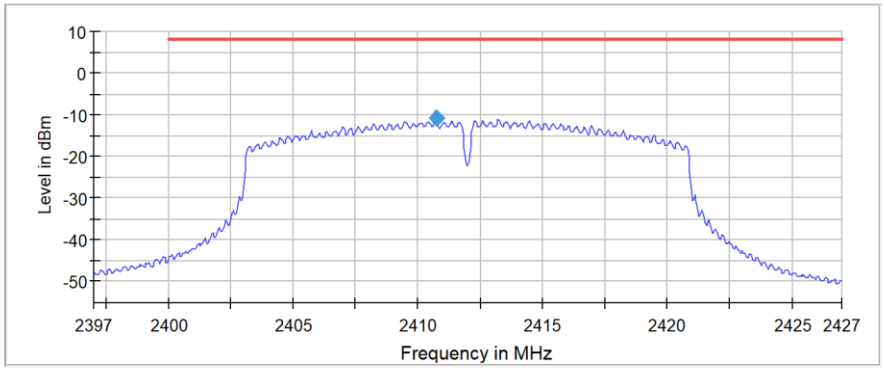


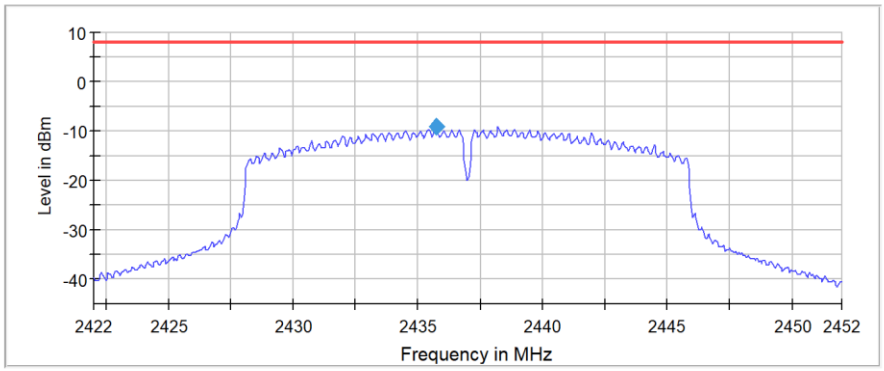
Limit Sum Level PSD

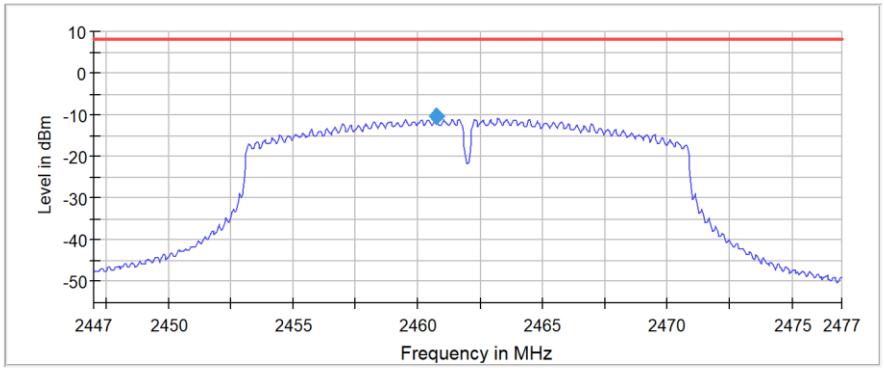


Limit Sum Level PSD

5.5.1.3 802.11n


10
0
-10
-20
-30
-40
-50
Level in dBm
2397
2400
2405
2410
2415
2420
2425
2427
Frequency in MHz
Limit
Sum Level
PSD


10
0
-10
-20
-30
-40
Level in dBm
2422
2425
2430
2435
2440
2445
2450
2452
Frequency in MHz
Limit
Sum Level
PSD


10
0
-10
-20
-30
-40
-50
Level in dBm
2447
2450
2455
2460
2465
2470
2475
2477
Frequency in MHz
Limit
Sum Level
PSD

6 Conducted Spurious Emissions / Band Edge

6.1 *Test Result*

Test Description	Test Specification		Test Result
Conducted Spurious Emissions	15.247(d)	RSS-247 S5.5	Compliant

6.2 *Test Method*

Spurious emissions in non-restricted frequency bands were recorded using the methods defined in ANSI C63.10: 2013 clause 11.11 and KDB 558074 D01 Measurement Guidance v05r02.

Lowest, middle, and highest channels were investigated.

Because the maximum conducted peak output power was used to determine compliance with the output power limits, the limit in any 100 kHz band outside of the authorized band is 20 dB below the maximum in-band peak level.

6.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	22.3 °C
Relative Humidity:	53.1 %
Atmospheric Pressure:	97.1 kPa

6.4 *Test Equipment*

Test End Date: 5-Nov-2018 Tester: ASF

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095587	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095592	25-Jul-2019
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	15-Dec-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	SF102	HUBER & SUHNER	B079823	25-Jul-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019

Note: The equipment calibration period is 1 year.

6.5 *Test Data – DTS Band Edge*

6.5.1 802.11b

802.11b 2 Mbps Low Channel				
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2396.725	-39.1	27.5	-11.6	PASS
2396.675	-39.2	27.6	-11.6	PASS
2396.625	-39.4	27.9	-11.6	PASS
2397.725	-39.8	28.2	-11.6	PASS
2396.925	-39.9	28.4	-11.6	PASS
2396.975	-40.2	28.6	-11.6	PASS
2398.175	-40.2	28.6	-11.6	PASS
2396.525	-40.2	28.6	-11.6	PASS
2397.775	-40.3	28.7	-11.6	PASS
2398.275	-40.4	28.8	-11.6	PASS
2396.575	-40.5	28.9	-11.6	PASS
2396.775	-40.6	29	-11.6	PASS
2397.025	-40.6	29	-11.6	PASS
2398.125	-40.7	29.1	-11.6	PASS
2397.075	-40.7	29.1	-11.6	PASS

802.11b 2 Mbps High Channel				
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2499.125	-46.1	34.8	-11.3	PASS
2491.025	-46.7	35.4	-11.3	PASS
2493.925	-46.7	35.5	-11.3	PASS
2499.075	-46.8	35.5	-11.3	PASS
2493.875	-46.8	35.6	-11.3	PASS
2499.175	-46.9	35.6	-11.3	PASS
2491.075	-46.9	35.6	-11.3	PASS
2495.975	-47	35.7	-11.3	PASS
2485.425	-47	35.7	-11.3	PASS
2488.525	-47	35.7	-11.3	PASS
2496.025	-47	35.7	-11.3	PASS
2495.025	-47	35.7	-11.3	PASS
2484.875	-47	35.7	-11.3	PASS
2483.725	-47	35.7	-11.3	PASS
2487.025	-47.1	35.8	-11.3	PASS

6.5.2 802.11g

802.11g 6 Mbps Low Channel				
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2398.575	-29.3	14	-15.3	PASS
2398.625	-29.7	14.4	-15.3	PASS
2398.525	-29.8	14.6	-15.3	PASS
2399.525	-30.1	14.9	-15.3	PASS
2399.825	-30.4	15.2	-15.3	PASS
2399.475	-30.5	15.3	-15.3	PASS
2398.825	-30.6	15.3	-15.3	PASS
2399.875	-30.6	15.3	-15.3	PASS
2398.875	-30.6	15.4	-15.3	PASS
2399.575	-30.8	15.5	-15.3	PASS
2399.775	-30.9	15.6	-15.3	PASS
2399.425	-30.9	15.7	-15.3	PASS
2398.775	-31.4	16.2	-15.3	PASS
2399.175	-31.7	16.5	-15.3	PASS
2399.125	-31.8	16.5	-15.3	PASS

802.11g 6 Mbps High Channel				
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2485.475	-43.9	28.9	-15	PASS
2485.525	-44.3	29.3	-15	PASS
2484.775	-44.7	29.7	-15	PASS
2483.625	-44.7	29.7	-15	PASS
2484.175	-44.7	29.7	-15	PASS
2485.425	-44.7	29.7	-15	PASS
2484.725	-44.7	29.8	-15	PASS
2484.225	-44.7	29.8	-15	PASS
2484.425	-44.9	30	-15	PASS
2483.575	-45.1	30.1	-15	PASS
2484.875	-45.1	30.1	-15	PASS
2484.375	-45.1	30.1	-15	PASS
2485.375	-45.2	30.2	-15	PASS
2484.675	-45.3	30.3	-15	PASS
2484.625	-45.3	30.3	-15	PASS

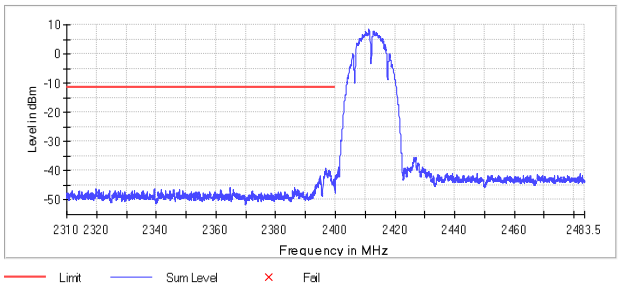
6.5.3 802.11n

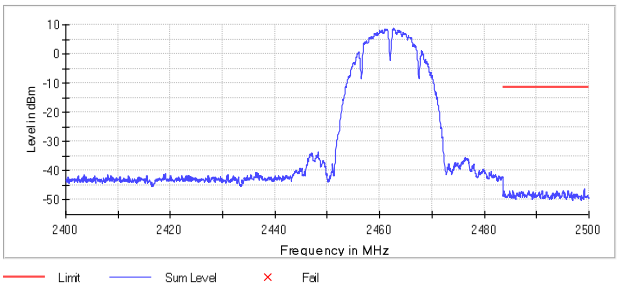
802.11n 6.5 Mbps Low Channel				
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.475	-30.6	15.4	-15.1	PASS
2398.925	-30.6	15.5	-15.1	PASS
2398.875	-30.7	15.5	-15.1	PASS
2399.775	-30.7	15.6	-15.1	PASS
2399.525	-31	15.8	-15.1	PASS
2398.225	-31	15.9	-15.1	PASS
2398.975	-31.2	16.1	-15.1	PASS
2398.275	-31.3	16.2	-15.1	PASS
2398.175	-31.3	16.2	-15.1	PASS
2398.575	-31.3	16.2	-15.1	PASS
2399.025	-31.4	16.3	-15.1	PASS
2399.825	-31.4	16.3	-15.1	PASS
2399.425	-31.5	16.4	-15.1	PASS
2398.625	-31.6	16.4	-15.1	PASS
2399.225	-31.6	16.5	-15.1	PASS

802.11n 6.5 Mbps High Channel				
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2484.775	-42.7	28.1	-14.6	PASS
2484.725	-42.7	28.1	-14.6	PASS
2483.575	-43.2	28.6	-14.6	PASS
2483.525	-43.3	28.7	-14.6	PASS
2484.825	-43.8	29.2	-14.6	PASS
2484.175	-44.1	29.5	-14.6	PASS
2484.125	-44.3	29.6	-14.6	PASS
2484.675	-44.3	29.7	-14.6	PASS
2483.625	-44.3	29.7	-14.6	PASS
2483.725	-44.3	29.7	-14.6	PASS
2484.275	-44.9	30.3	-14.6	PASS
2484.325	-44.9	30.3	-14.6	PASS
2483.825	-44.9	30.3	-14.6	PASS
2484.225	-44.9	30.3	-14.6	PASS
2483.775	-45	30.4	-14.6	PASS

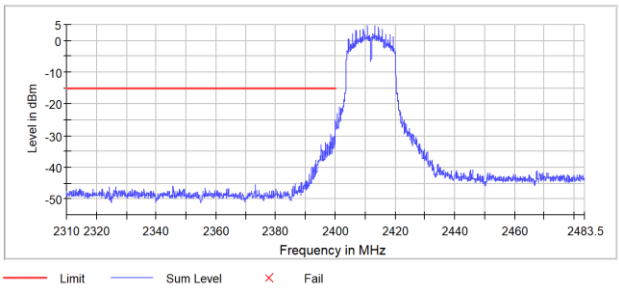
6.5.4 Plots

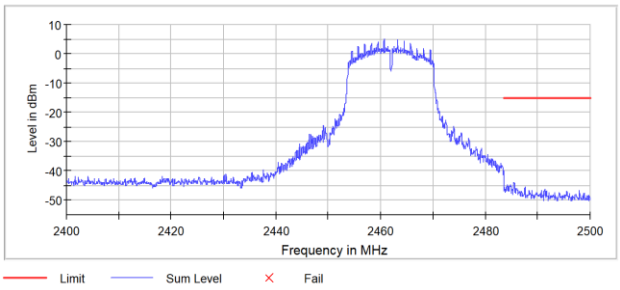
6.5.4.1 802.11b



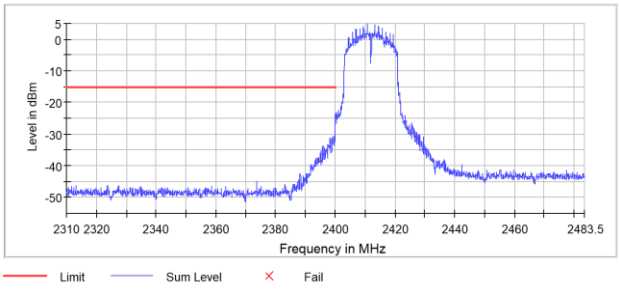


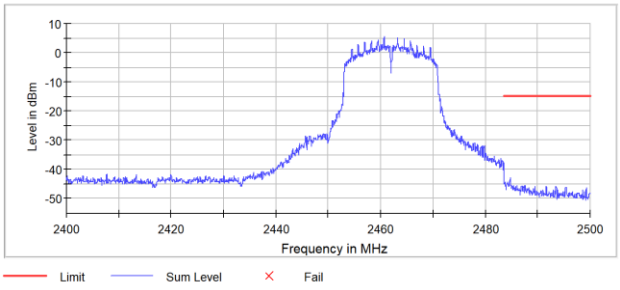
6.5.4.2 802.11g





6.5.4.3 802.11n





7 Field Strength of Spurious Radiation

7.1 *Test Result*

Test Description	Test Specification		Test Result
Radiated Spurious Emissions	15.247 (d) and 15.209	RSS-247 S5.5	Compliant

7.2 *Test Method*

The measurement methods defined in ANSI C63.10: 2013 were used.

Lowest, middle, and highest channels were investigated – the device was commanded to continuously transmit on channels low, middle, and high channels.

Test distance:

9k to 30 MHz – Near field prescan to determine if there were any emissions.
30 to 1000 MHz - The EUT to measurement antenna distance was 3 meters
1 to 18 GHz - The EUT to measurement antenna distance was 3 meters
18 to 26 GHz - The EUT to measurement antenna distance was 3 meters

Limits within restricted bands of operation:

Frequency	Limits(1)		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 (2)	--
88 - 216 MHz	150	43.5 (2)	--
216 - 960 MHz	200	46 (2)	--
960 - 1000 MHz	500	54 (2)	--
1 - 40 GHz	500	54 (3)	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.
(2) Quasi-peak limit
(3) Average limit

7.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature:	22.7 °C
Relative Humidity:	52.9 %
Atmospheric Pressure:	97.3 kPa

7.4 *Test Equipment*

Test End Date: 11-Oct-2018 Tester: ASF

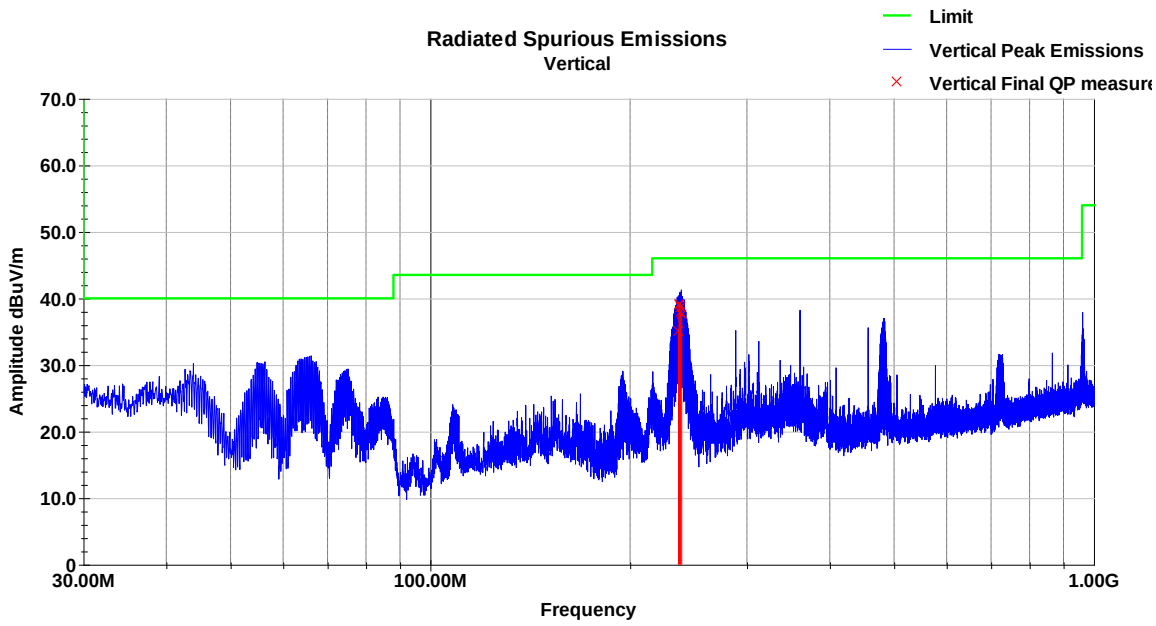
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079689	16-Oct-2018
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	23-Jul-2019
RF CABLE	NFS-290-78.7-NFS	FLORIDA RF LABS	B095019	24-Jul-2019
RF CABLE	SF106	HUBER & SUHNER	B079661	23-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	2-Jul-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	25-Jul-2019
FILTER, HIGH PASS (>2800MHZ)	HPM50111	MICRO-TRONICS	B085747	26-Jul-2019

Note: The equipment calibration period is 1 year.

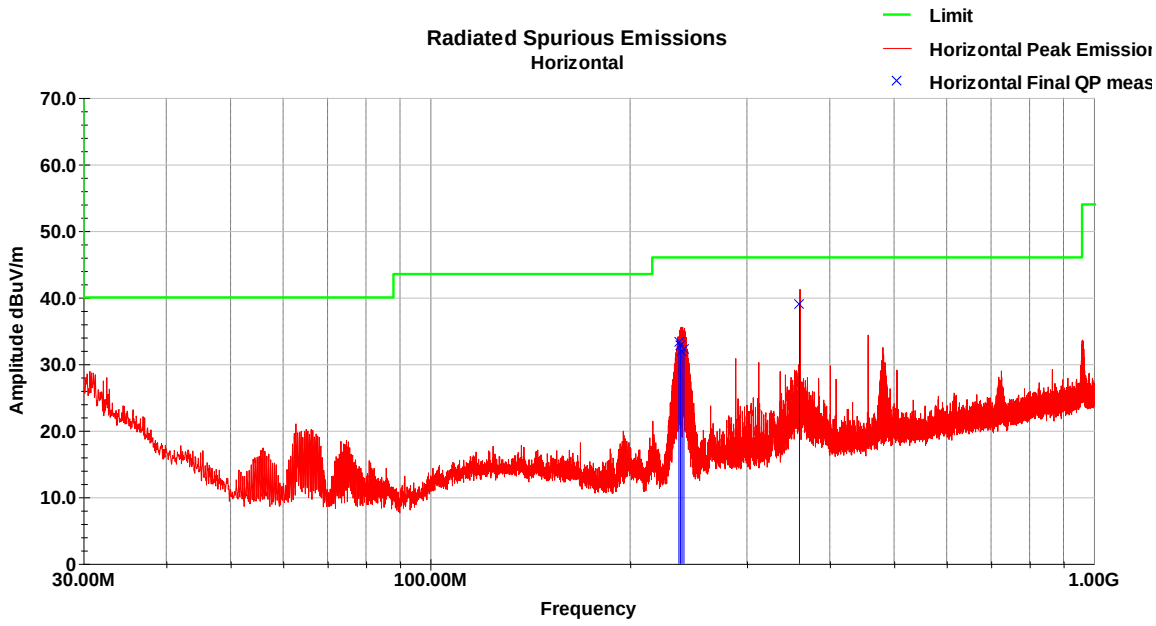
7.5 *Test Data*

7.5.1 30-1000 MHz

There was no significant difference between channel, modulation, or axis below 1 GHz

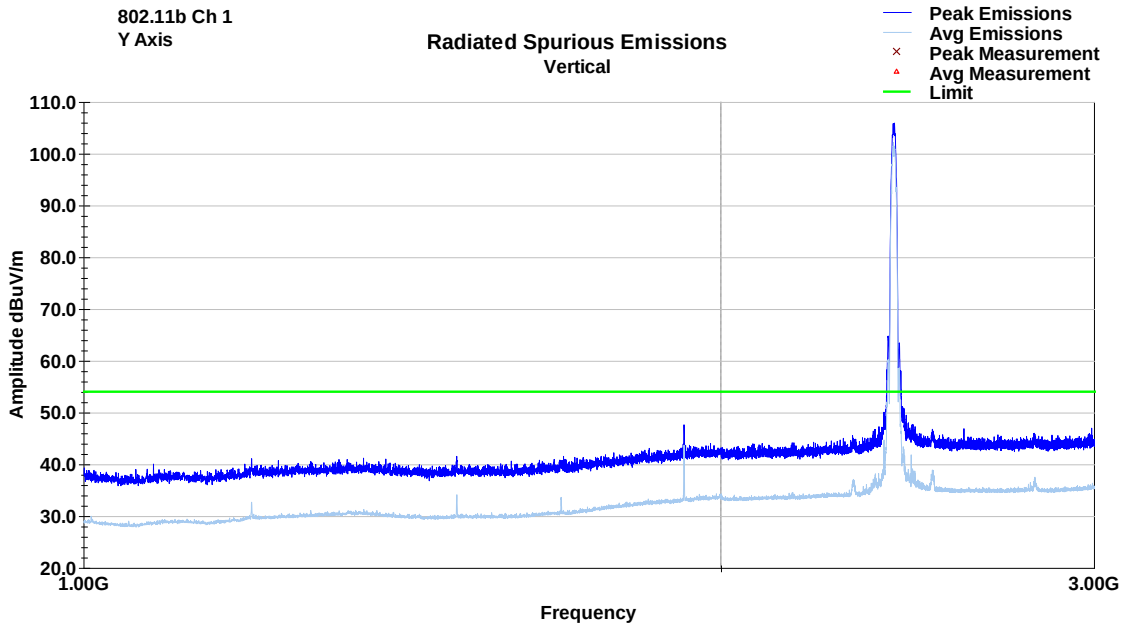


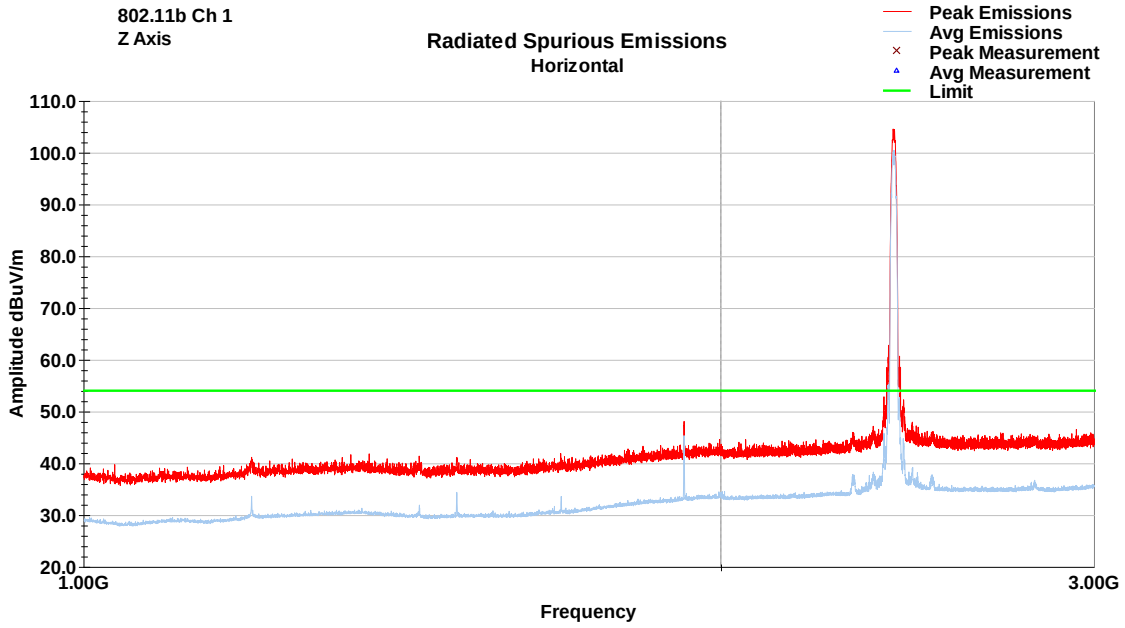
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
236.64	55.4	V	243.0	151.0	12.1	1.2	33.7	35.1	46.0	-10.9
236.98	59.5	V	237.0	100.0	12.1	1.2	33.7	39.2	46.0	-6.8
237.37	59.2	V	218.0	100.0	12.1	1.2	33.7	39.0	46.0	-7.1
238.09	58.3	V	207.0	100.0	12.2	1.2	33.6	38.0	46.0	-8.0
238.48	58.9	V	246.0	100.0	12.2	1.2	33.6	38.7	46.0	-7.4
239.26	57.8	V	234.0	114.0	12.2	1.2	33.6	37.6	46.0	-8.5
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

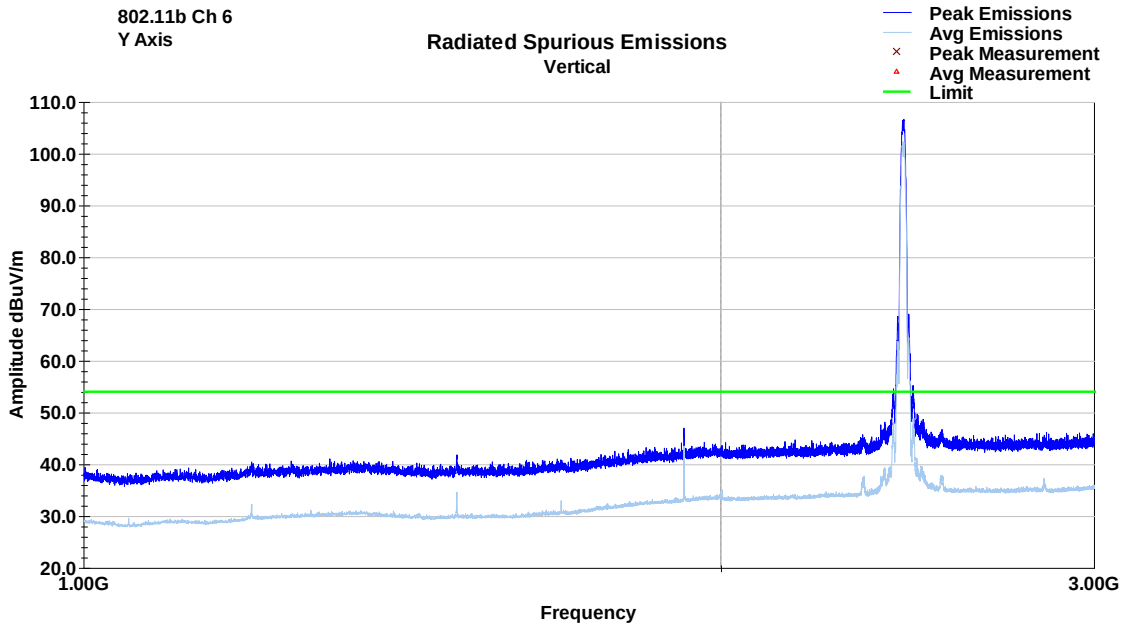


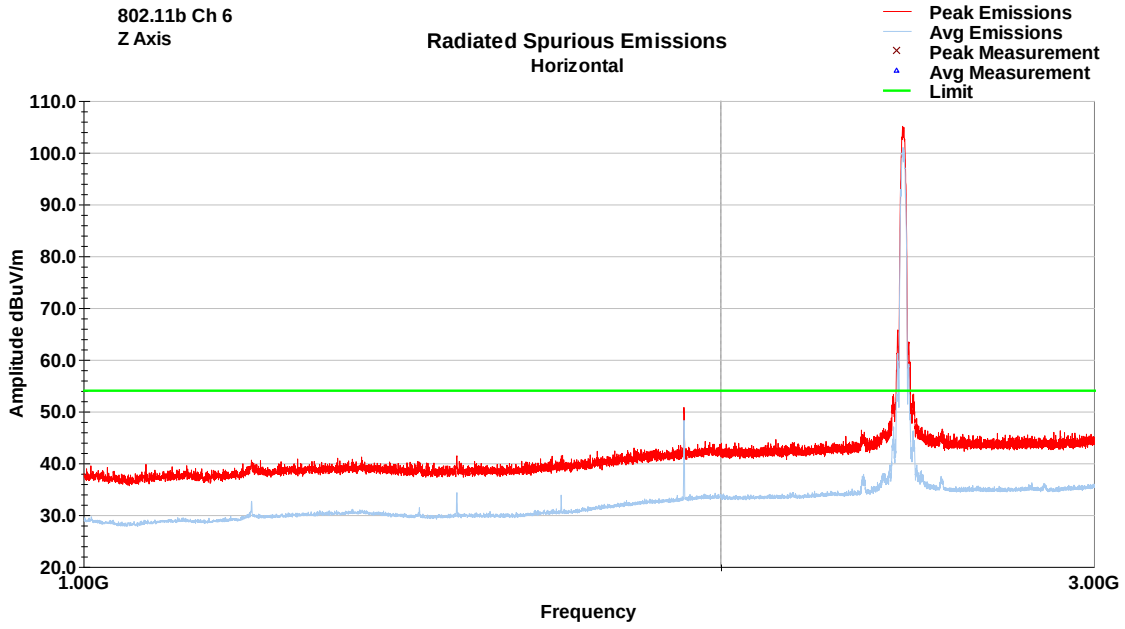
Frequency MHz	Raw QP (dBuV)	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	Loss (dB)	Amp (dB)	QP Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)
236.98	53.6	H	235.0	149.0	12.1	1.2	33.7	33.3	46.0	-12.7
238.09	53.0	H	242.0	150.0	12.2	1.2	33.6	32.7	46.0	-13.3
238.48	53.1	H	258.0	151.0	12.2	1.2	33.6	32.9	46.0	-13.2
239.60	52.2	H	258.0	149.0	12.2	1.2	33.6	32.0	46.0	-14.0
241.15	52.4	H	252.0	143.0	12.2	1.2	33.6	32.2	46.0	-13.8
360.02	55.5	H	130.0	102.0	15.5	1.5	33.5	38.9	46.0	-7.1
QP Value = Level + AF + CL - Amp										
Margin = QP Value - Limit										

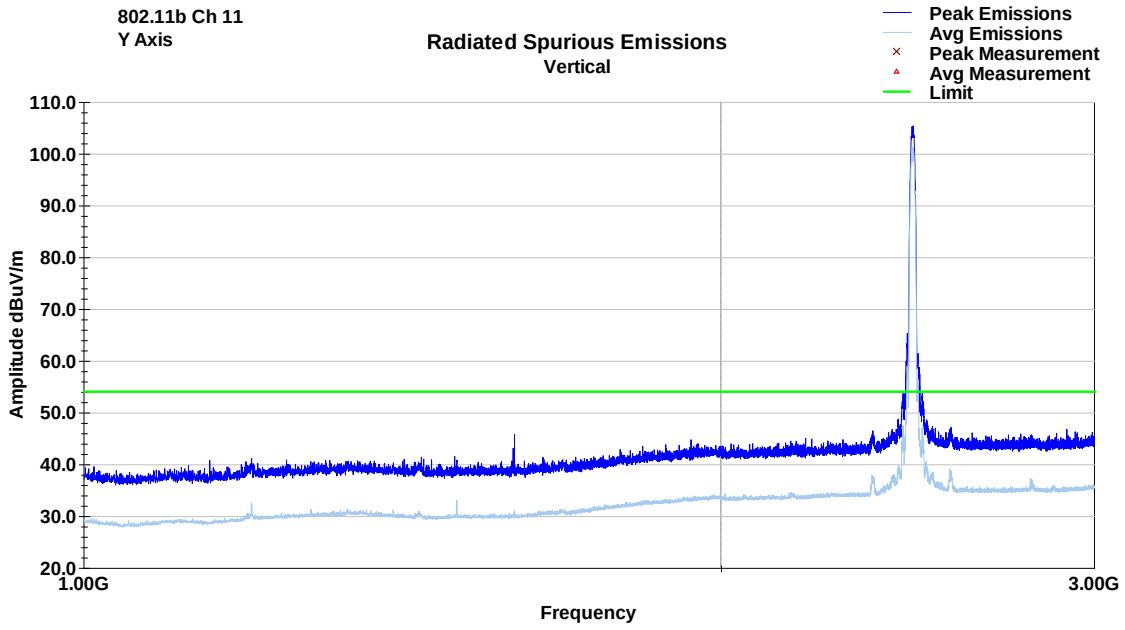
7.5.2 **1-3 GHz**

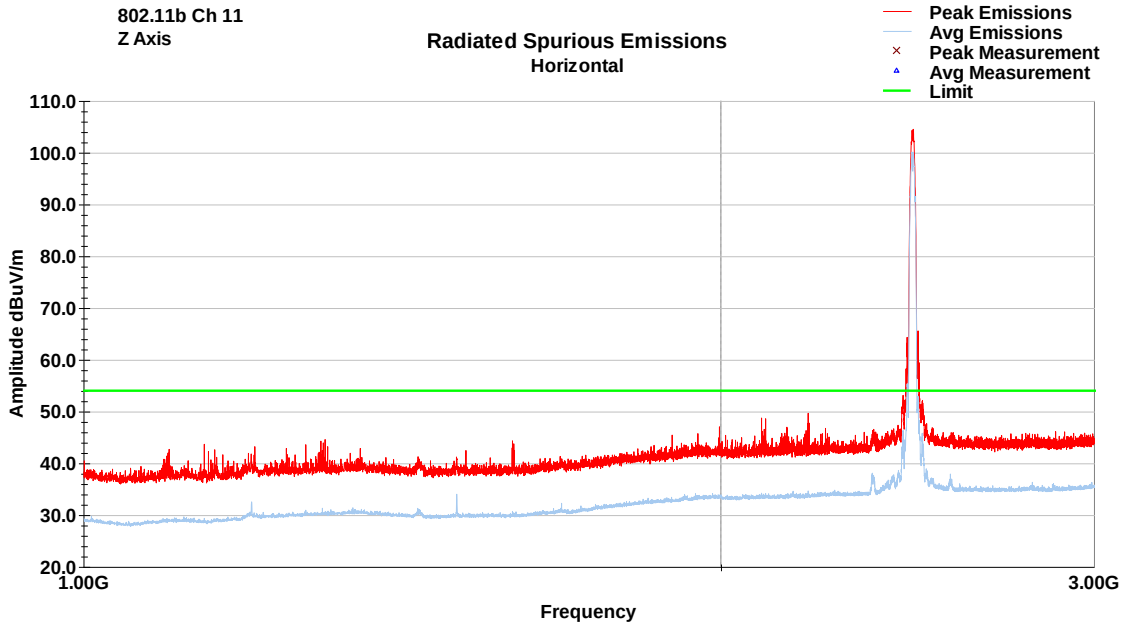

802.11b Ch 1
Y Axis
Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
Amplitude dBuV/m
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1.00G
3.00G
Frequency

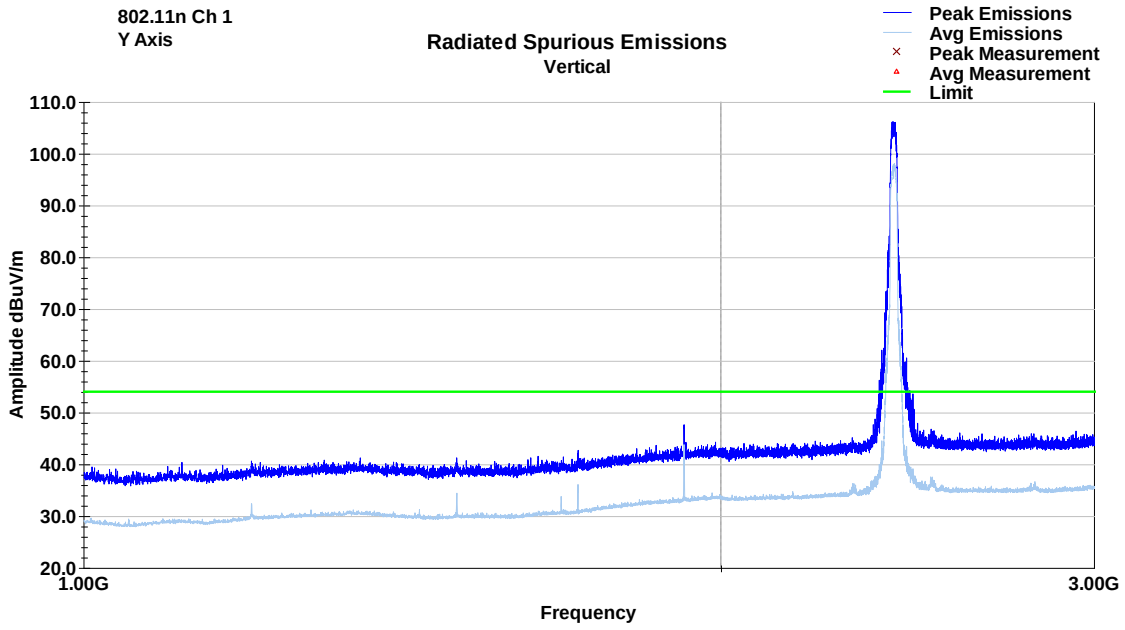

802.11b Ch 1
Z Axis
Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
Amplitude dBuV/m
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1.00G
3.00G
Frequency

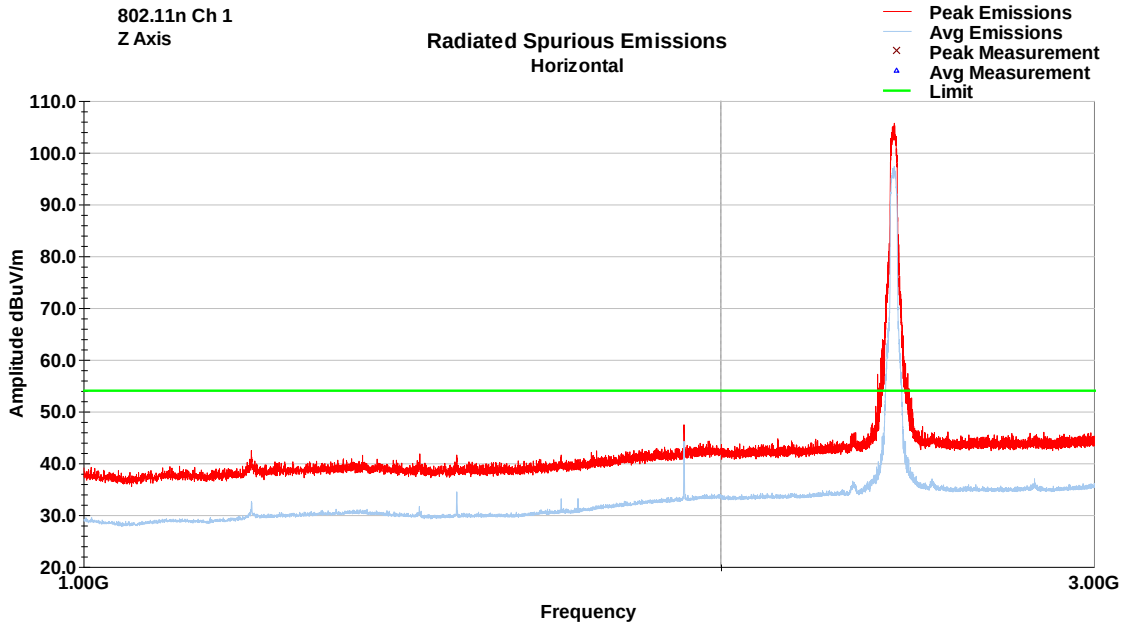

802.11b Ch 6
Y Axis
Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency

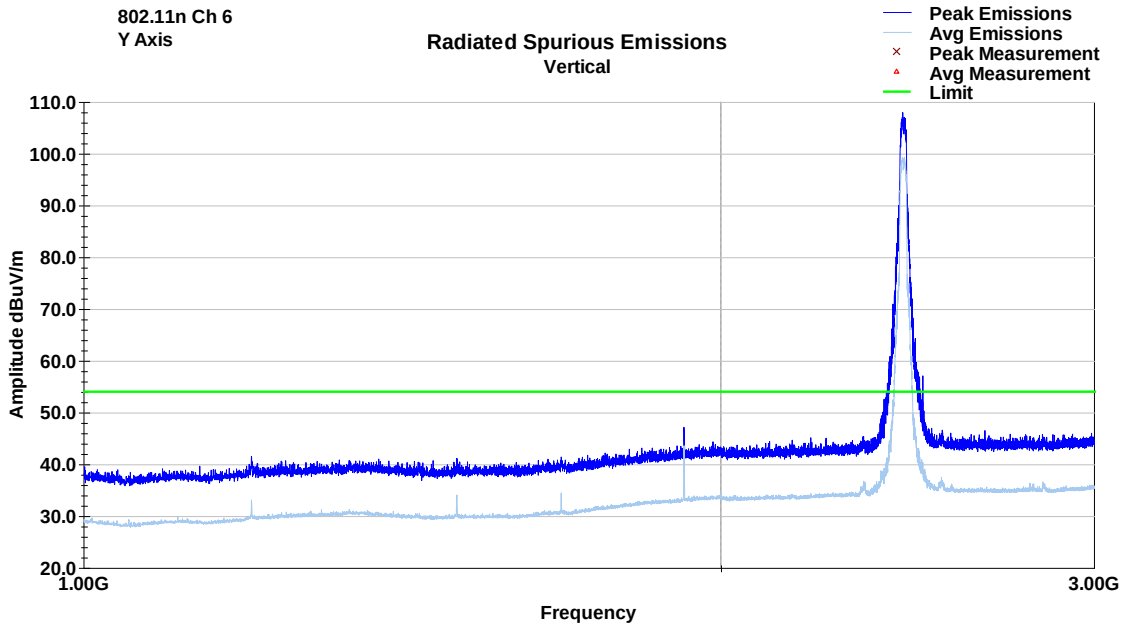

802.11b Ch 6
Z Axis
Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency

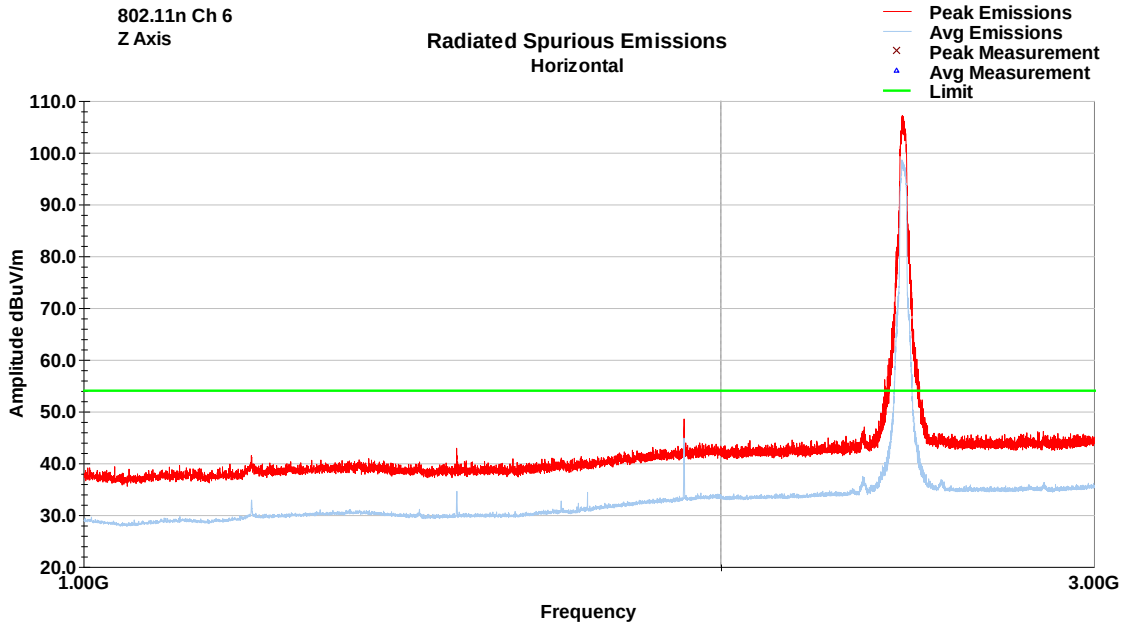

802.11b Ch 11
Y Axis
Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency

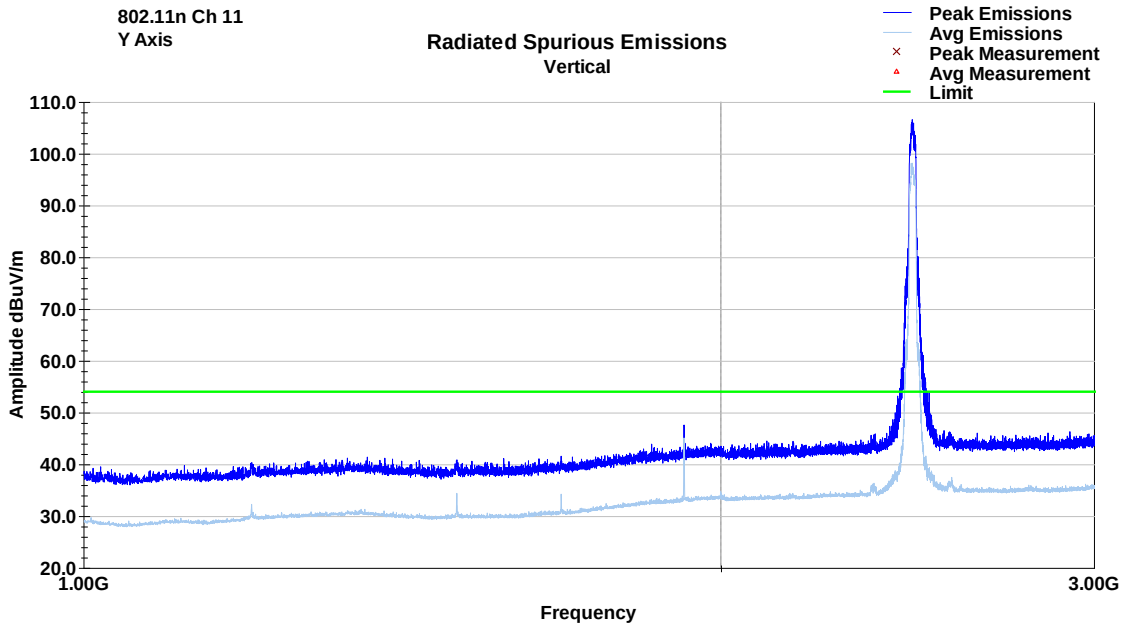

802.11b Ch 11
Z Axis
Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency

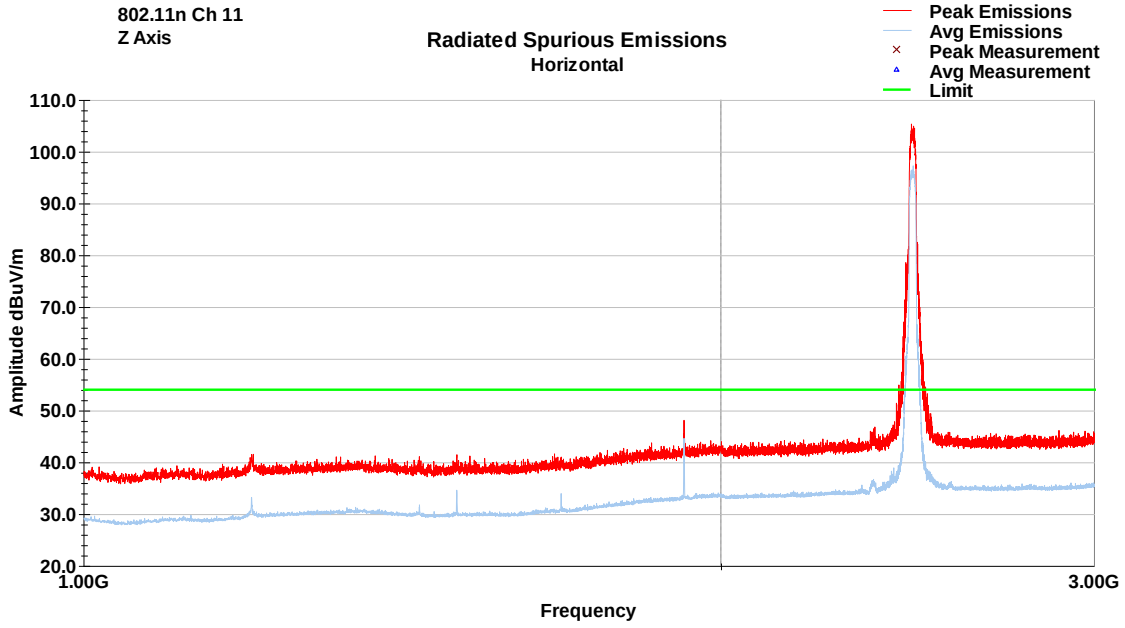

802.11n Ch 1
Y Axis
Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency


802.11n Ch 1
Z Axis
Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency


802.11n Ch 6
Y Axis
Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency

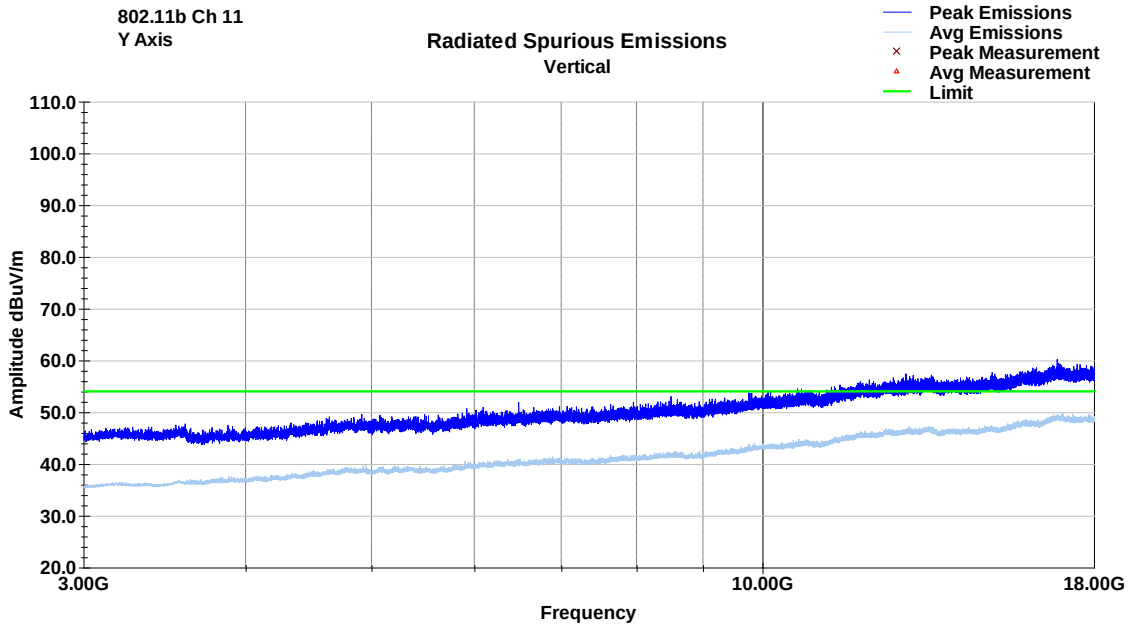

802.11n Ch 6
Z Axis
Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
Amplitude dBuV/m
1.00G
3.00G
Frequency

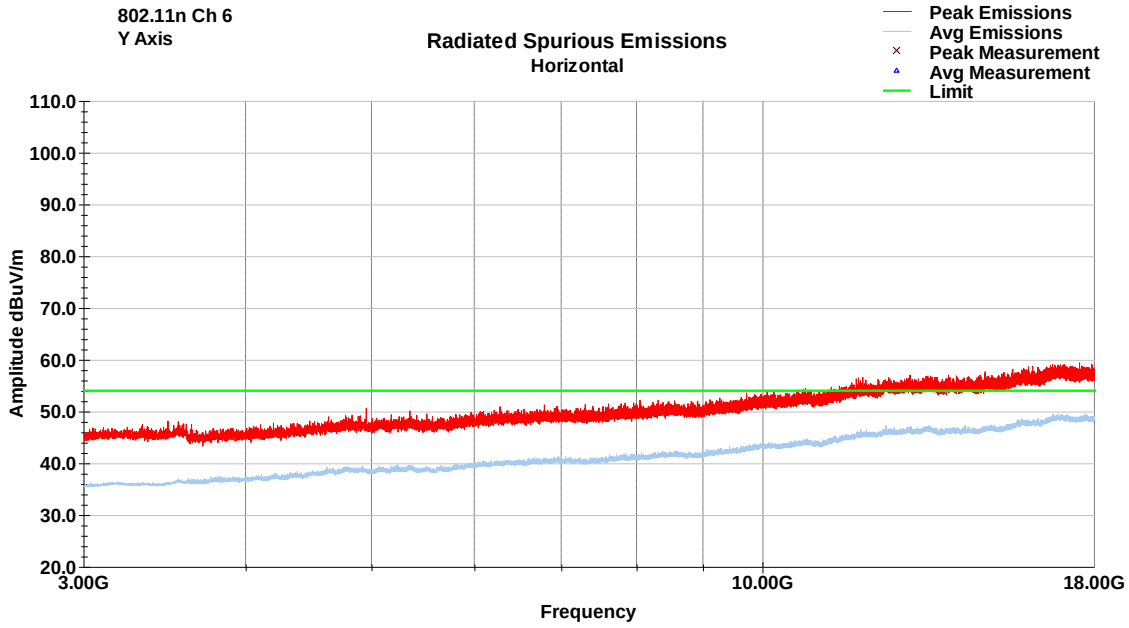

802.11n Ch 11
Y Axis
Radiated Spurious Emissions
Vertical
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
Amplitude dBuV/m
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1.00G
3.00G
Frequency


802.11n Ch 11
Z Axis
Radiated Spurious Emissions
Horizontal
Peak Emissions
Avg Emissions
Peak Measurement
Avg Measurement
Limit
Amplitude dBuV/m
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
1.00G
3.00G
Frequency

7.5.3 **Above 3 GHz**

No Cabinet Spurious Emissions regardless of Modulation Scheme, Channel, or Axis in this range





8 Emissions in Restricted Frequency Bands

8.1 *Test Result*

Test Description	Test Specification		Test Result
Restricted Band Emissions	15.205 / 15.209	RSS-GEN S8.9 / 8.10	Compliant

8.2 *Test Method*

Field strength measurements were performed at the restricted band edges of 2390MHz and 2483.5MHz for each modulation. Measurements were made using the conducted methods defined in ANSI C63.10, Section 11.12.2.

Offset Calculations:
Offset calculations so that conducted measurements on the spectrum analyzer in dBµV represent field strength measurements in dBµV/m.

Offset = -20Log(D) + 104.8 - 107 + CL + DCCF + AG
$Offset_{3m}$ = -11.7 + CL + DCCF + AG

Mode	DC	DCCF	Path Loss	Ant	Offset
802.11b	0.82	0.84	11.00	4.54	4.68
802.11g	0.60	2.25	11.00	4.54	6.09
802.11n	0.56	2.54	11.00	4.54	6.38

8.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 22.4 °C
Relative Humidity: 50.5 %
Atmospheric Pressure: 98.5 kPa

8.4 *Test Equipment*

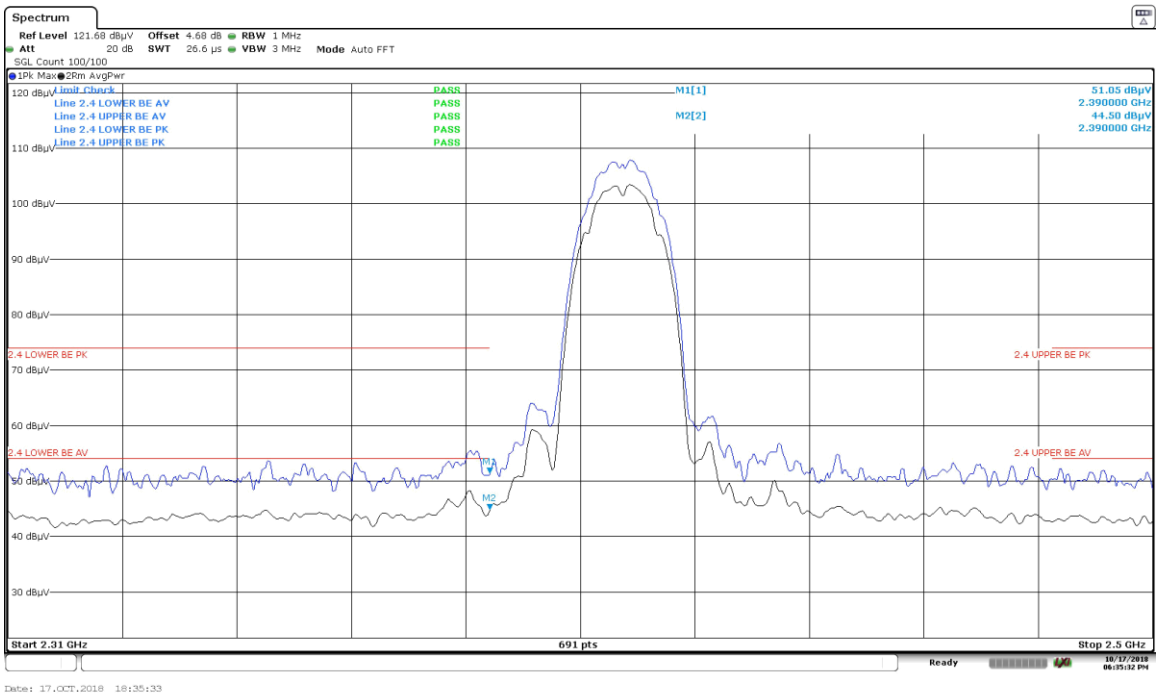
Test End Date: 5-Nov-2018 Tester: ASF

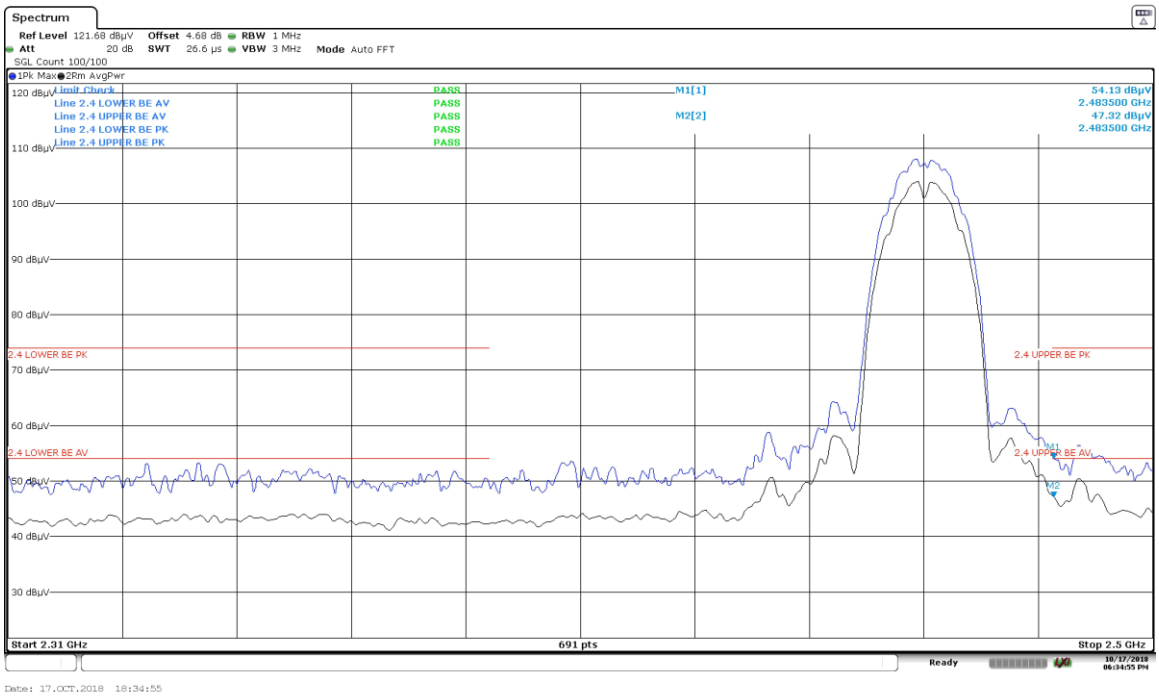
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE (TS8997)	141	HUBER & SUHNER	B095585	25-Jul-2019
ATTENUATOR, 10DB (TS8997)	10DB	ROHDE & SCHWARZ	B095591	25-Jul-2019
RF SWITCH (TS8997)	OSP	ROHDE & SCHWARZ	15039	15-Dec-2019
POWER METER (TS8997)	OSP-B157	ROHDE & SCHWARZ	15040	15-Dec-2019
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	SF102	HUBER & SUHNER	B079823	25-Jul-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019

Note: The equipment calibration period is 1 year.

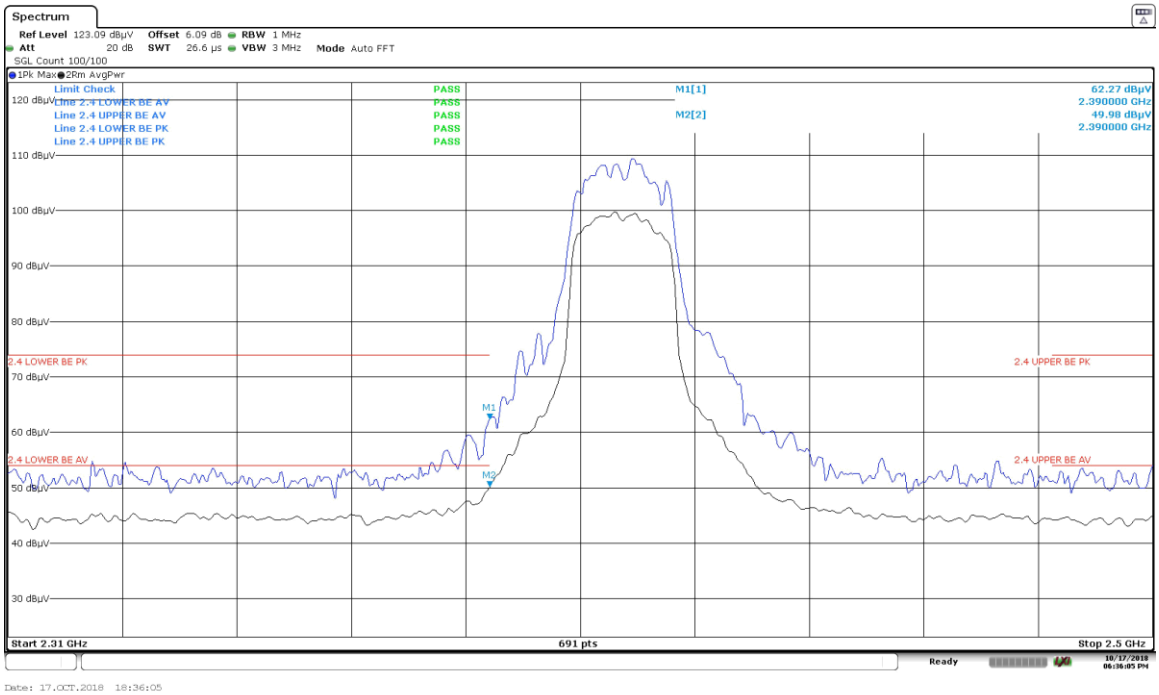
8.5 *Test Data – Restricted Band Band Edge*

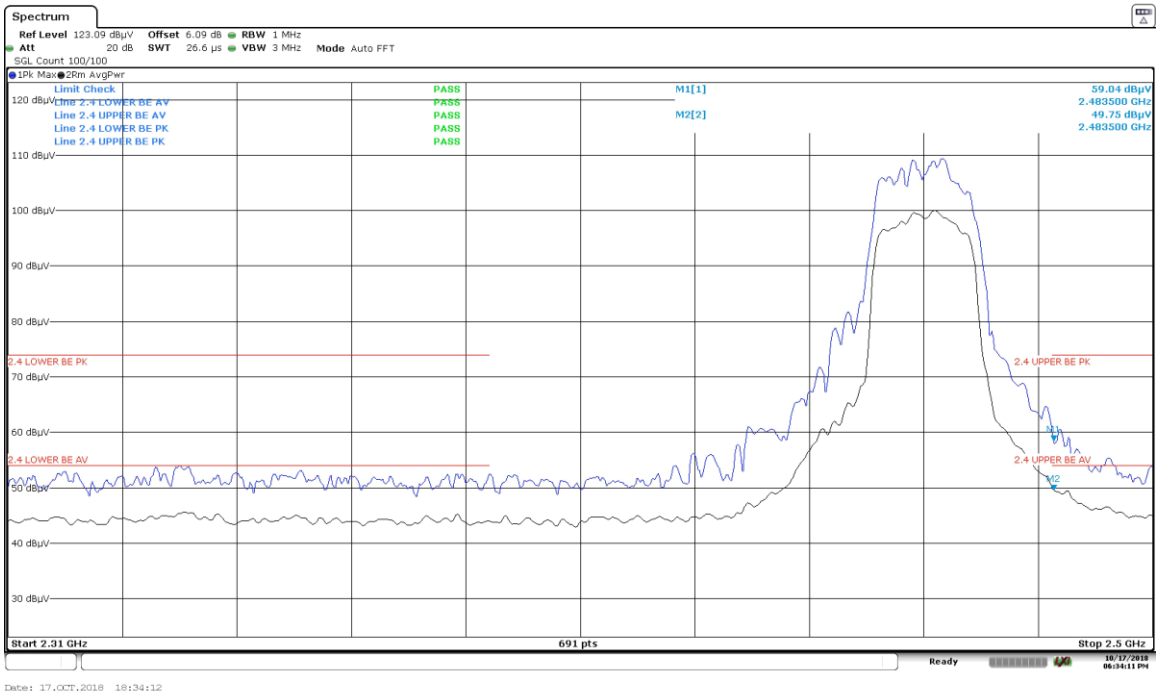
8.5.1 802.11b



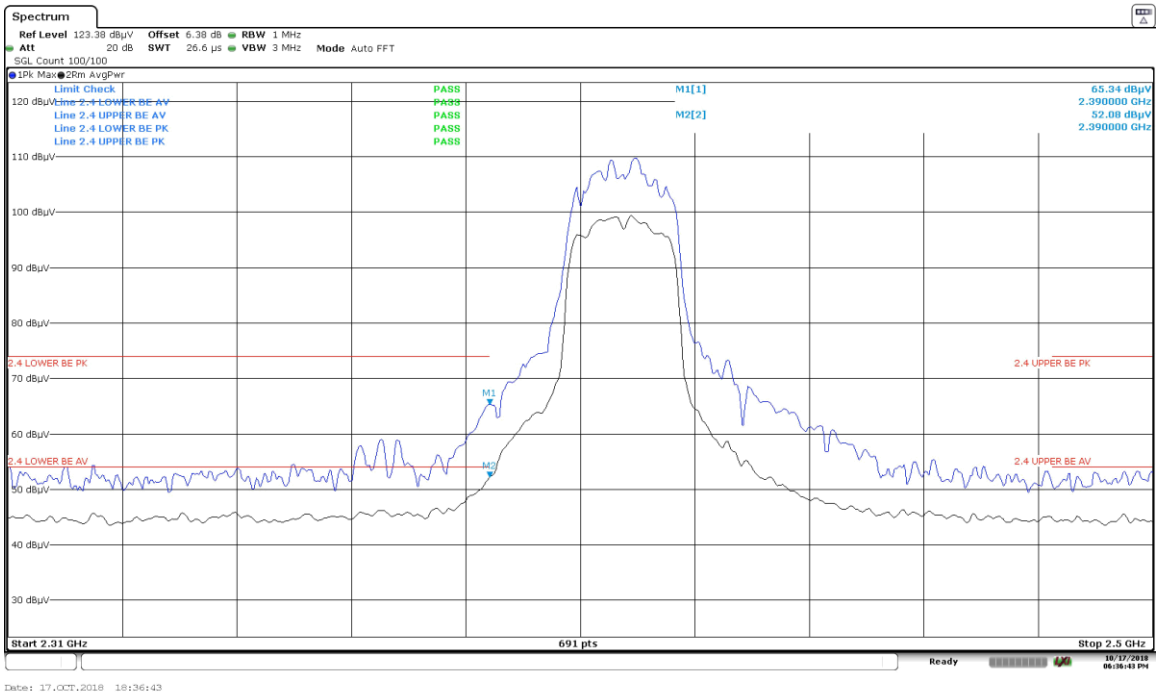


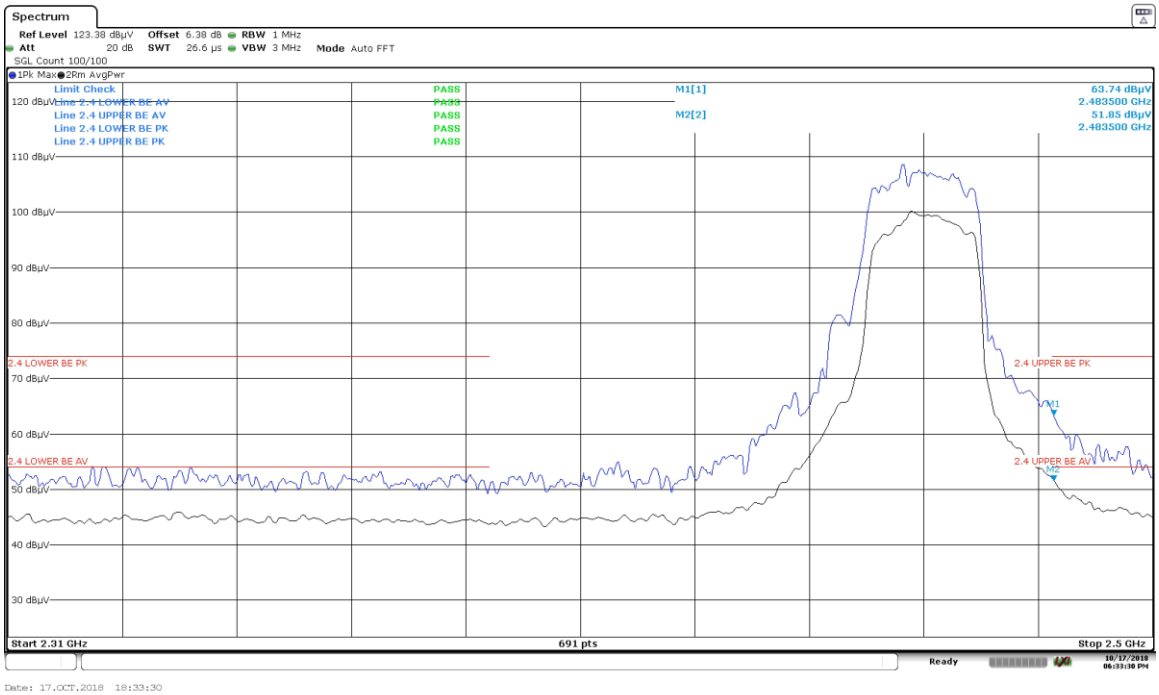
8.5.2 **802.11g**


Spectrum
Ref Level 123.09 dBµV Offset 6.09 dB RBW 1 MHz
Att 20 dB SWT 26.6 µs VBW 3 MHz Mode Auto FFT
SGL Count 100/100
1Pk Max 2Rm AvgPwr
Limit Check PASS
Line 2.4 LOWER BE AV PASS
Line 2.4 UPPER BE AV PASS
Line 2.4 LOWER BE PK PASS
Line 2.4 UPPER BE PK PASS
M1[1] 62.27 dBµV 2.390000 GHz
M2[2] 49.98 dBµV 2.390000 GHz
2.4 LOWER BE PK
2.4 UPPER BE PK
2.4 LOWER BE AV
2.4 UPPER BE AV
Start 2.31 GHz 691 pts Stop 2.5 GHz
Ready
Date: 17.OCT.2018 18:36:05


Spectrum
Ref Level 123.09 dBµV Offset 6.09 dB RBW 1 MHz
Att 20 dB SWT 26.6 µs VBW 3 MHz Mode Auto FFT
SGL Count 100/100
1Pk Max 2Rm AvgPwr
Limit Check PASS
Line 2.4 LOWER BE AV PASS
Line 2.4 UPPER BE AV PASS
Line 2.4 LOWER BE PK PASS
Line 2.4 UPPER BE PK PASS
M1[1] 59.04 dBµV 2.483500 GHz
M2[2] 49.75 dBµV 2.483500 GHz
2.4 LOWER BE PK
2.4 UPPER BE PK
2.4 LOWER BE AV
2.4 UPPER BE AV
Start 2.31 GHz 691 pts Stop 2.5 GHz
Ready
Date: 17.OCT.2018 18:34:12

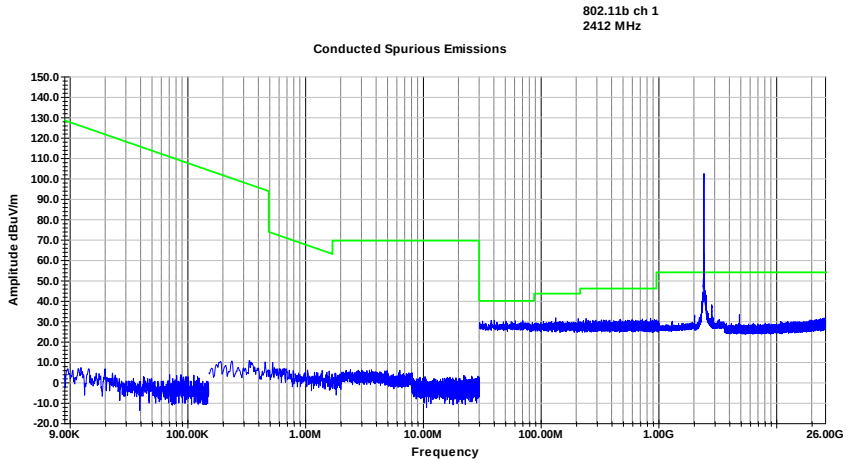
8.5.3 **802.11n**

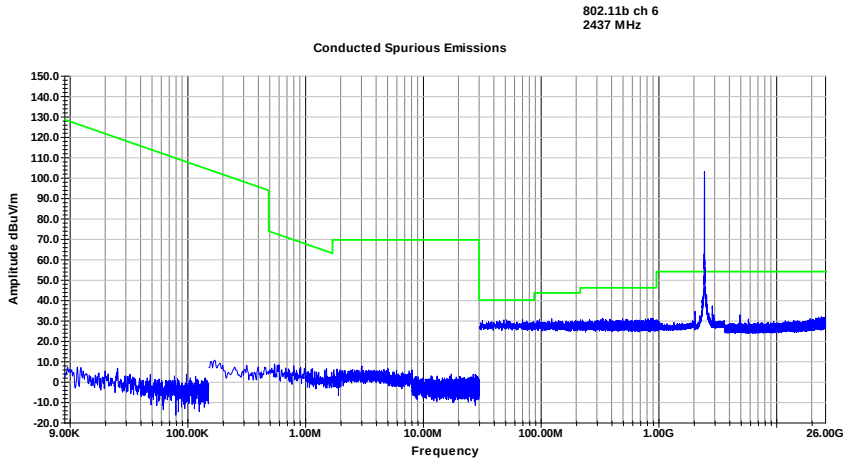

Spectrum
Ref Level 123.38 dBµV Offset 6.38 dB RBW 1 MHz
Att 20 dB SWT 26.6 µs VBW 3 MHz Mode Auto FFT
SGL Count 100/100
1Pk Max 2Rm AvgPwr
Limit Check PASS
Line 2.4 LOWER BE AV PASS
Line 2.4 UPPER BE AV PASS
Line 2.4 LOWER BE PK PASS
Line 2.4 UPPER BE PK PASS
M1[1] 65.34 dBµV 2.390000 GHz
M2[2] 52.08 dBµV 2.390000 GHz
2.4 LOWER BE PK
2.4 LOWER BE AV
2.4 UPPER BE PK
2.4 UPPER BE AV
Start 2.31 GHz 691 pts Stop 2.5 GHz
Ready
Date: 17.OCT.2018 18:36:43

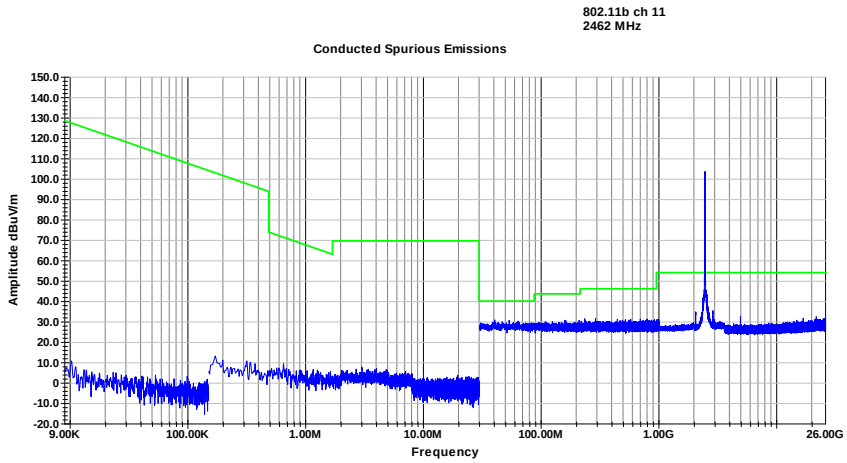

Spectrum
Ref Level 123.38 dBµV Offset 6.38 dB RBW 1 MHz
Att 20 dB SWT 26.6 µs VBW 3 MHz Mode Auto FFT
SGL Count 100/100
1Pk Max 2Rm AvgPwr
Limit Check PASS
Line 2.4 LOWER BE AV PASS
Line 2.4 UPPER BE AV PASS
Line 2.4 LOWER BE PK PASS
Line 2.4 UPPER BE PK PASS
M1[1] 63.74 dBµV 2.483500 GHz
M2[2] 51.85 dBµV 2.483500 GHz
2.4 LOWER BE PK
2.4 LOWER BE AV
2.4 UPPER BE PK
2.4 UPPER BE AV
Start 2.31 GHz 691 pts Stop 2.5 GHz
Ready
Date: 17.OCT.2018 18:33:30

8.6 *Test Data – Conducted Spurious Emissions*

8.6.1 **802.11b**



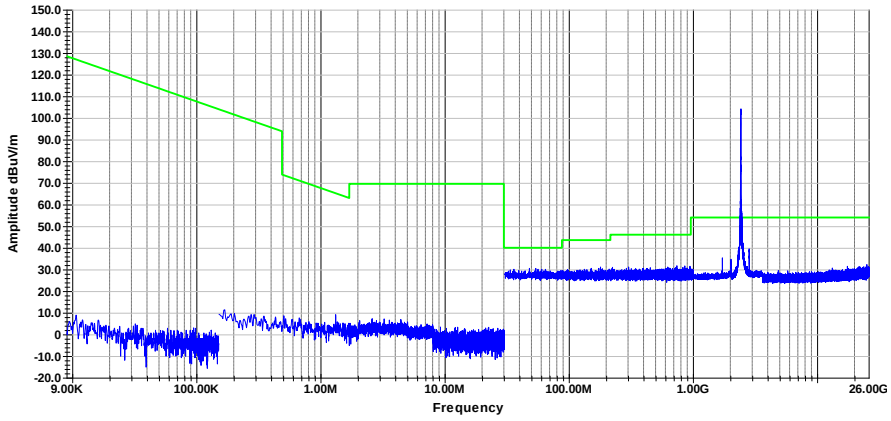




8.6.2 **802.11g**

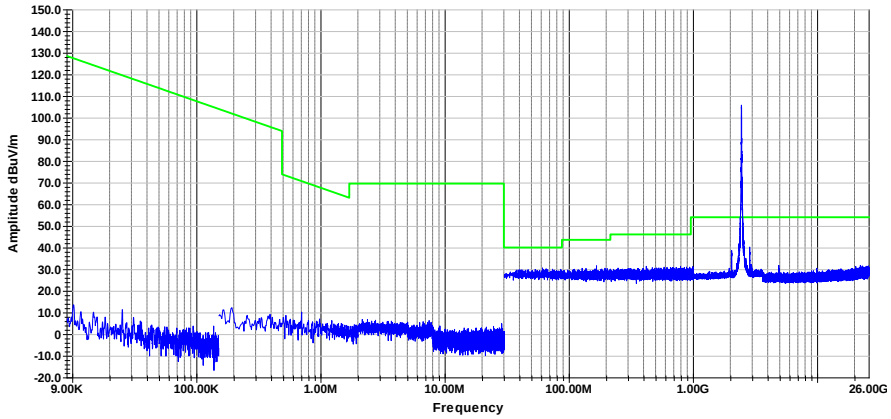
802.11g ch 1
2412 MHz

Conducted Spurious Emissions



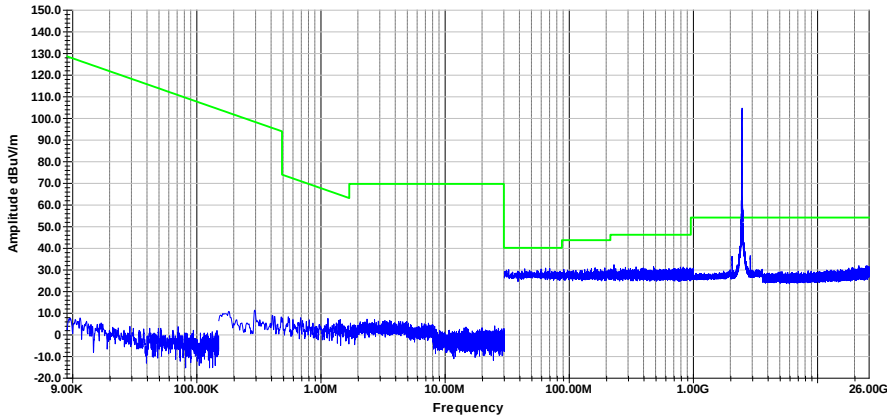
802.11g ch 6
2437 MHz

Conducted Spurious Emissions



802.11g ch 11
2462 MHz

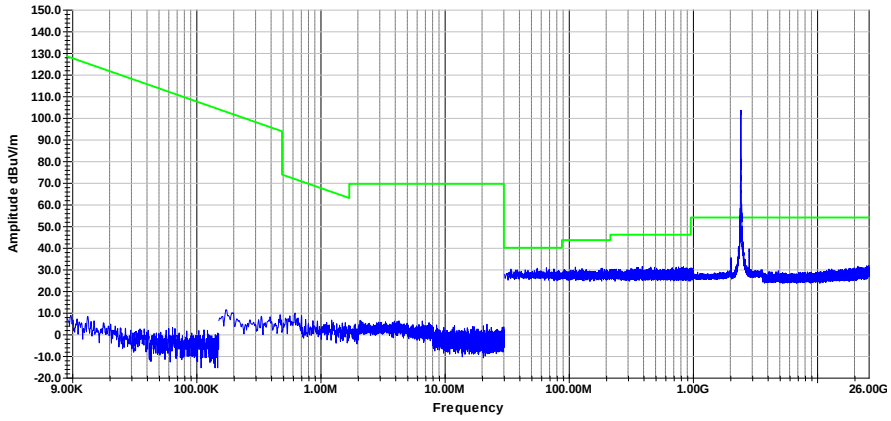
Conducted Spurious Emissions



8.6.3 **802.11n**

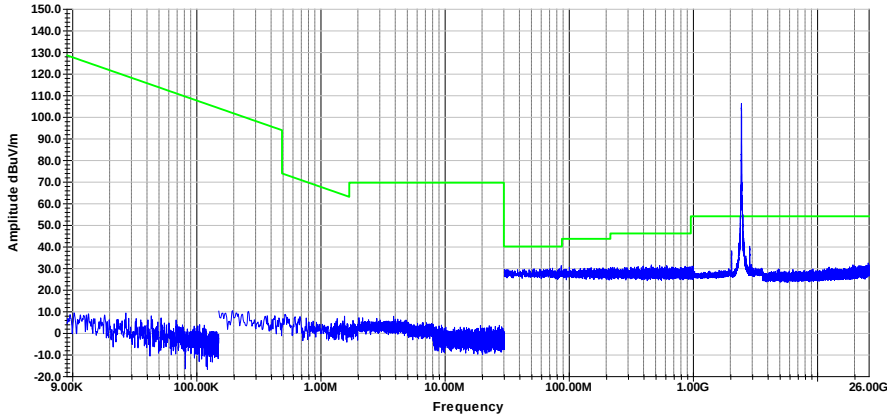
802.11n ch 1
2412 MHz

Conducted Spurious Emissions



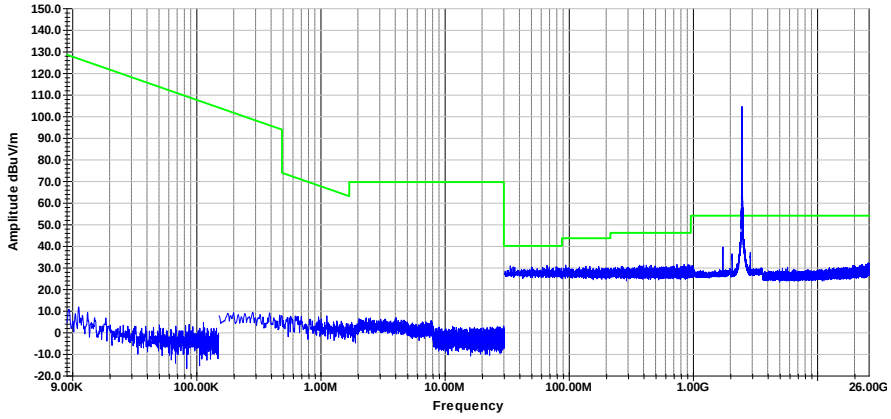
802.11n ch 6
2437 MHz

Conducted Spurious Emissions



802.11n ch 11
2462 MHz

Conducted Spurious Emissions



9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	24 JAN 2019
1	Corrected client address Section 1	22 Feb 2019
2	Client Changed to UTEC for TCB filing. All address information changed to match. Section 5.2 – Added clarification of PSD test method. Frequency Stability – Section deleted. Cover Page - RSS GEN ref updated to Issue 5 Section 3 – Added 99% OBW	2 Apr 2019
3	Revised FCC And IC IDs.	16 April 2019
4	Updated FVIN at client's request	6 May 2019
5	Updated KDB 558074 D01 ref to v05r02 in sections 4, 5, and 6	20 May 2019