

EMC Test Report

Project Number: 3878032

Report Number: 3878032EMC06

Revision Level: 1

Client: ADTRAN, Inc.

Equipment Under Test: Wireless 802.11abgn Module (2.4GHz Only)

Model Number: BSAP-1930/1935

FCC ID: HDCWLAN193XF1

IC ID: 2250A- WLAN193XF1

Applicable Standards: FCC Part 15 Subpart C, § 15.247

RSS-247, Issue 1, May 2015

RSS-GEN, Issue 4, November 2014

ANSI C63.10: 2013

Report issued on: 27 January 2016

Test Result: Compliant

Tested by:



Jeremy O. Pickens, Senior EMC Engineer

Reviewed by:



David Schramm, EMC/RF/SAR/HAC 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.

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1 Summary of Test Results

Test Description	Test Specification		Test Result
6dB Bandwidth	15.247(d)	RSS-247 S5.2 (1)	NS(1)
Power Spectral Density	15.247(e)	RSS-247 S5.2 (2)	NS(1)
Transmitter Output Power	15.247(b) (3)	RSS-247 S5.4 (4)	NS(1)(2)
Radiated Spurious Emissions / Restricted Bands	15.247(d), 15.35(b),15.209	RSS-247 S5.5	Compliant

(1) This evaluation is to support a Class II Permissive Change. Refer to original filing for results.

(2) In order to maintain compliance when using the higher gain antennas, the power must be reduced. These calculations are included in Appendix A.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: ADTRAN, Inc.
Address: 901 Explorer Blvd.
City, State, Zip, Country: Huntsville, AL 35806

2.1 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

2.2 General Information of EUT

Type of Product: Wireless 802.11abgn Module
Model: BSAP-1930/1935
Serial Number: Not Labeled

Frequency Range: 2400-2483.5MHz
Data Modes: 802.11b, 802.11g, 802.11n (HT20), 802.11n (HT40),
Antenna: TerraWave, 2.4/5 GHz, 13/7 dBi High Density MIMO Patch Array (P/N: M6013070P30006I)

Rated Voltage: 48Vdc (PoE)

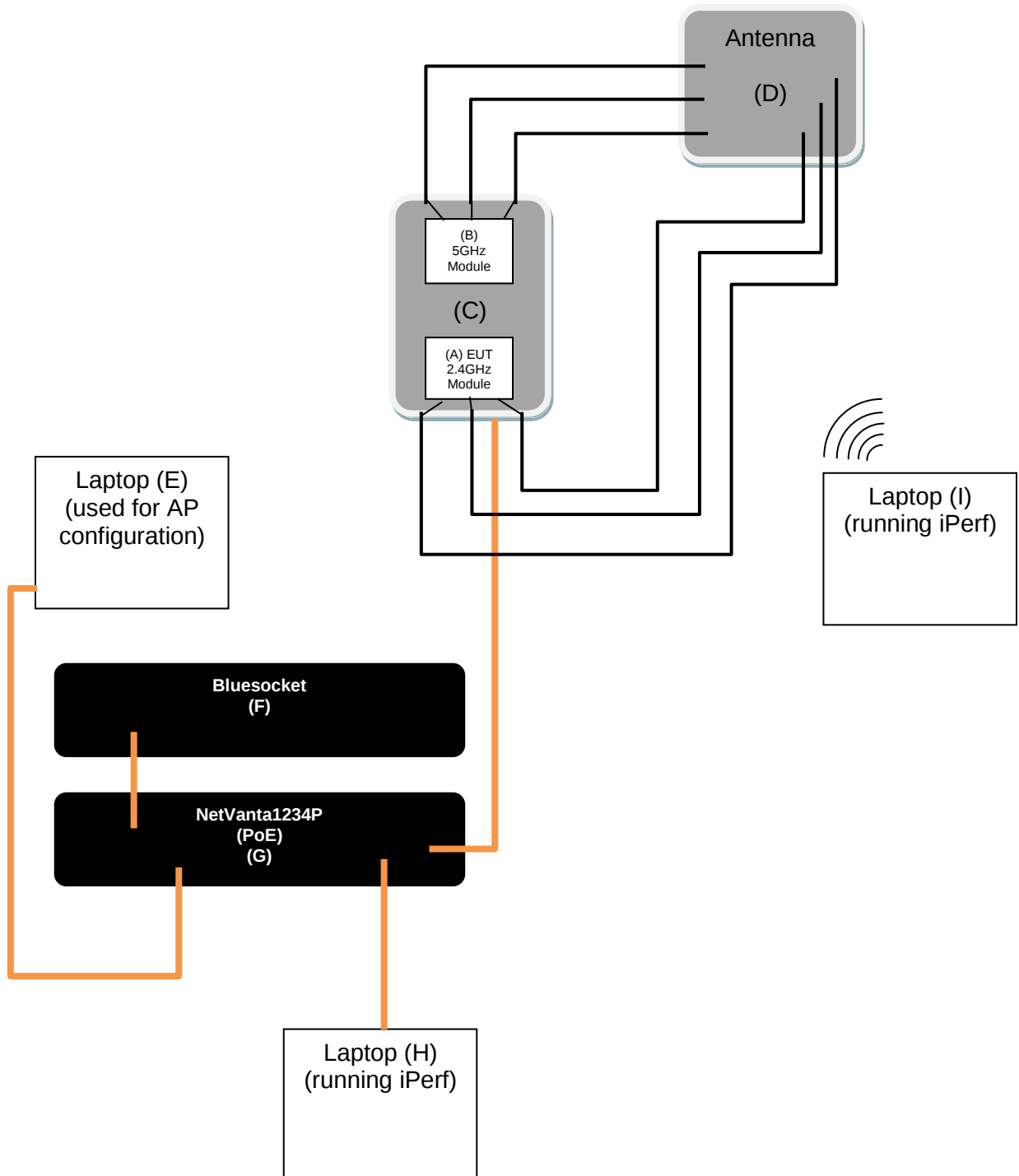
Sample Received Date: 16 September 2015
Dates of testing: 05 – 27 October 2015

Operating Modes and Conditions

For spurious emissions measurements, only the worst-case mode with respect to peak power from the original filing was investigated: 802.11b, 1Mbps. The low, middle, and high channels in the 2400-2483.5MHz band were evaluated.

Continuous traffic was generated using iPerf software which established communication between a laptop on the wired side of the access point and a second laptop connected wirelessly to the access point. Software was provided that allowed the access point to be fixed on each channel under investigation.

2.3 EUT Connection Block Diagram



2.4 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	ADTRAN, Inc.	2.4GHz Radio Module	BSAP-1930/1935	Not Labeled
B	ADTRAN, Inc.	5GHz Radio Module	PCE4551AH-BS	Not Labeled
C	ADTRAN, Inc.	Indoor Access Point	BSAP-2035	20352614050231
D	TerraWave	High Density MIMO Patch Array	M6013070P30006I	Not Labeled
E	ADTRAN, Inc.	Bluesocket	1700900F2	80031315020001
F	ADTRAN, Inc.	NetVanta 1234P	1703595G1	Not Labeled
G	Dell	Laptop	Latitude D610	CN-0XD762-48643-629-0517
H	Lenovo	Laptop	T60	L3-PV518
I	Lenovo	Laptop	T420	R8-X9XFV

3 Field Strength of Spurious Radiation

3.1 Test Result

Test Description	Test Specification	Test Result
Spurious Emissions	15.247 (d) and 15.209 RSS-247 S5.5 ANSI C63.10: 2013	Compliant

3.2 Test Method

The preliminary scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. For harmonics of the fundamental, Average measurements were made by correcting the peak value with the duty cycle correction factor. For emissions other than harmonics of the fundamental, the Average measurements were made using the Average detector. The receivers resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHz and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

There is a limit on spurious emissions produced by an intentional radiator in any 100 kHz Bandwidth outside the intentional emission band of -20dBc provided the radiator complies with the limits specified in 15.205© and 15.209(a).

Test distance:

1 to 18 GHz - The EUT to measurement antenna distance is 3 meters

18 to 40 GHz - The EUT to measurement antenna distance is 1 meter

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

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.2 – 24.1 °C

Relative Humidity: 32.4 - 42.6 %

3.4 Test Equipment

Final Test Date: 22-Oct-2015

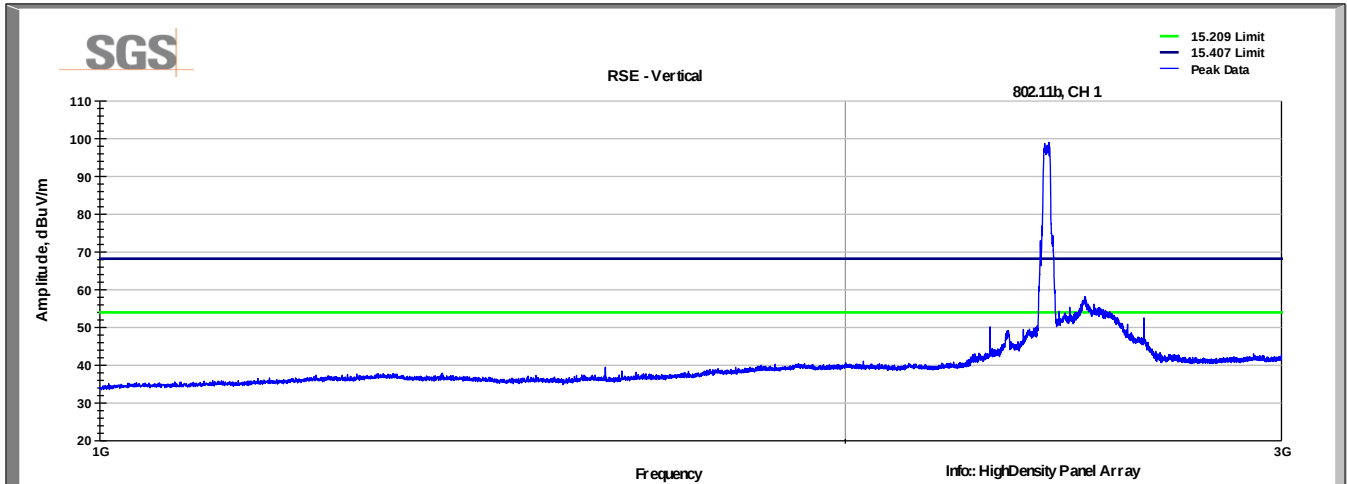
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	9-Jul-2016
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
SMALL HORN ANTENNA	LB-180400-20-C-KF	A-INFOMW	15007	11-Mar-2016
DESKTOP AMPLIFIER 1-18 GHZ	NSP1800-25-HG	MITEQ	B085930	30-Mar-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2016
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	15-Oct-2016
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	3-Aug-2016
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	3-Aug-2016
10DB ATTENUATOR	10DB	ROHDE & SCHWARZ	B095594	5-Aug-2016
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079717	3-Aug-2016
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079824	4-Aug-2016
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079823	4-Aug-2016
FILTER	HPM50112	MICRO-TRONICS	B093647	5-Aug-2016
HIGH PASS FILTER	HPM50111	MICRO-TRONICS	B085747	5-Aug-2016

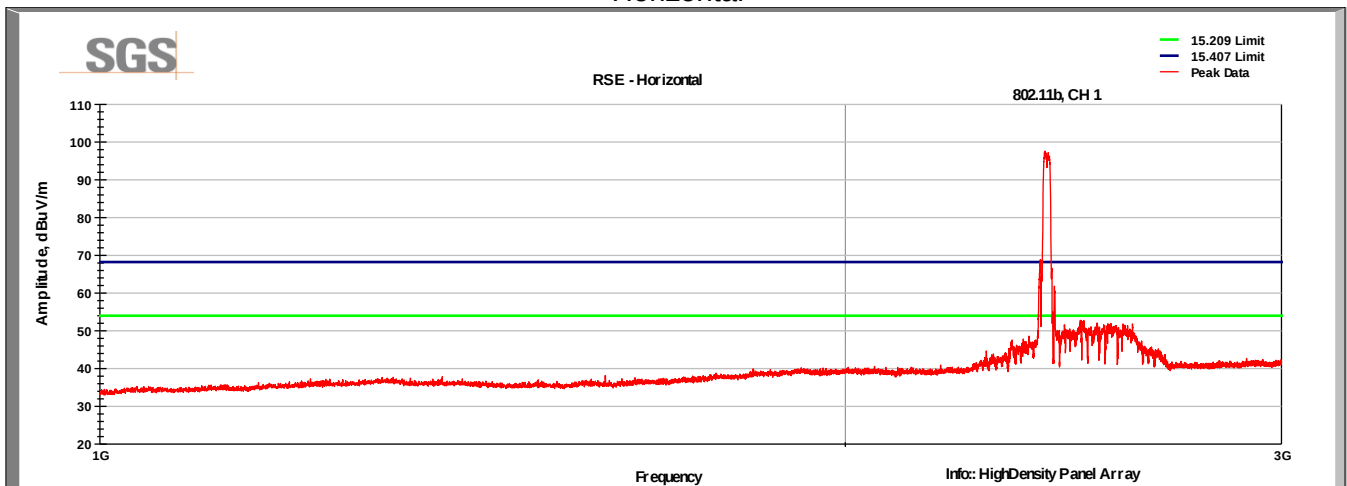
Note: The calibration period equipment is 1 year.

3.5 Test Data – (1-3GHz)

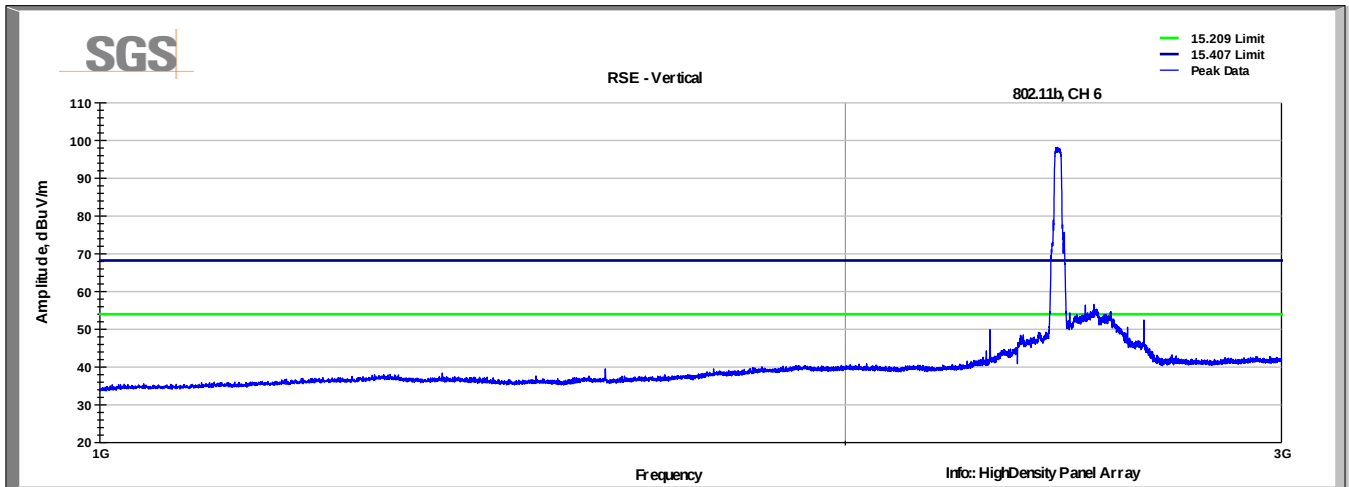
CH 1 802.11b, 1Mbps
Vertical



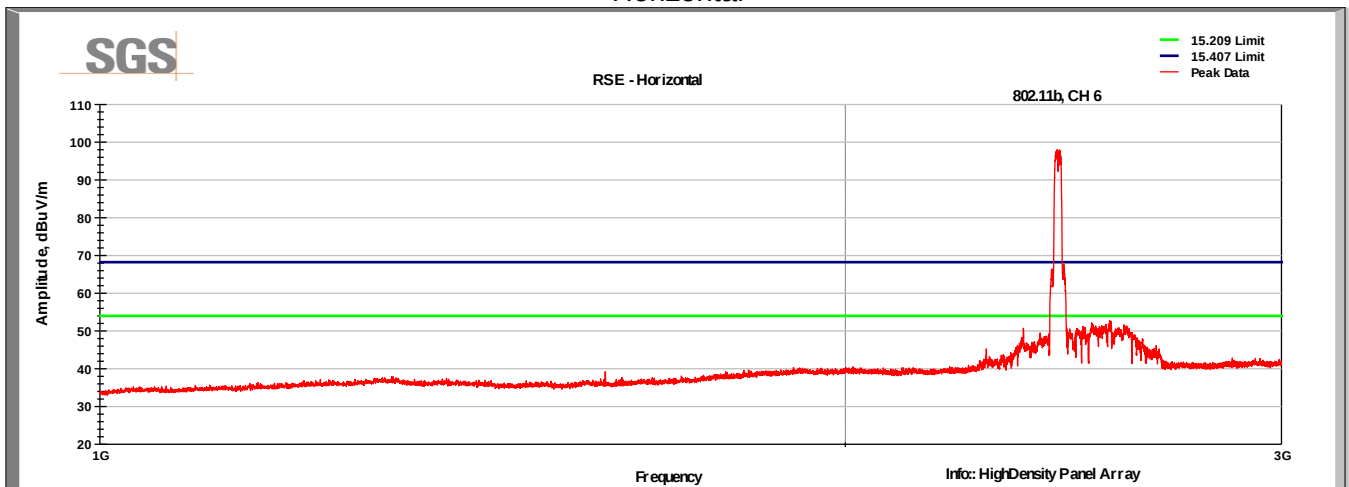
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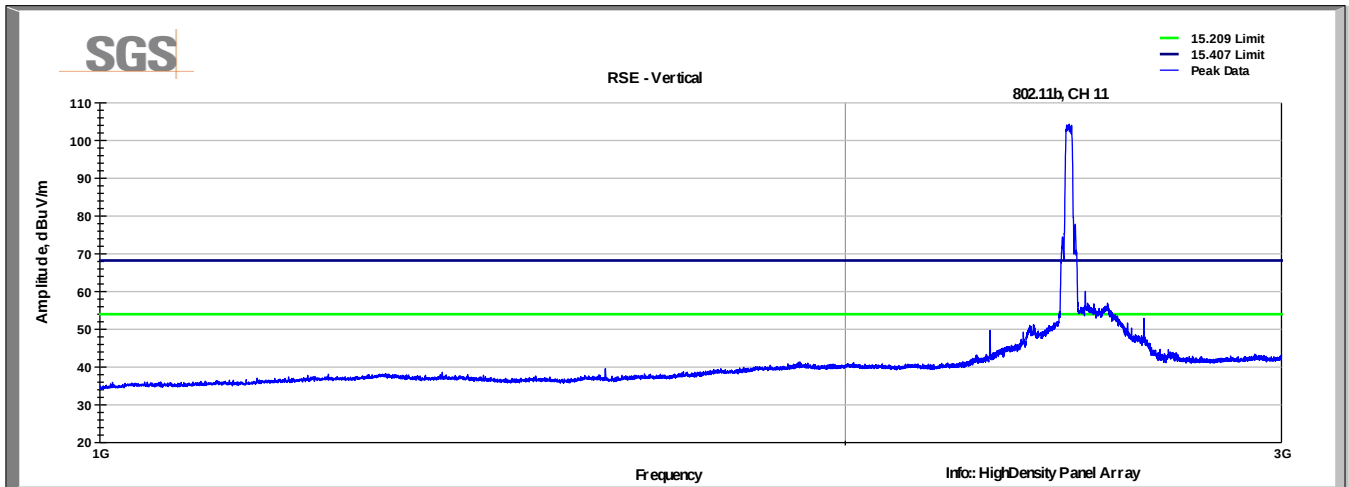
CH 6 802.11b, 1Mbps Vertical



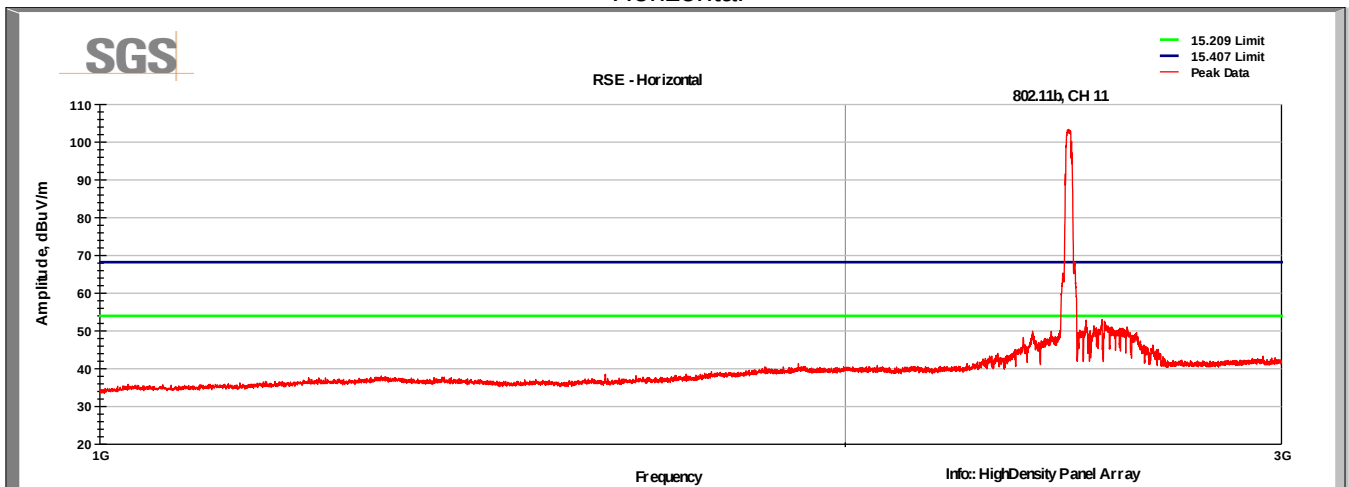
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CH 11 802.11b, 1Mbps Vertical

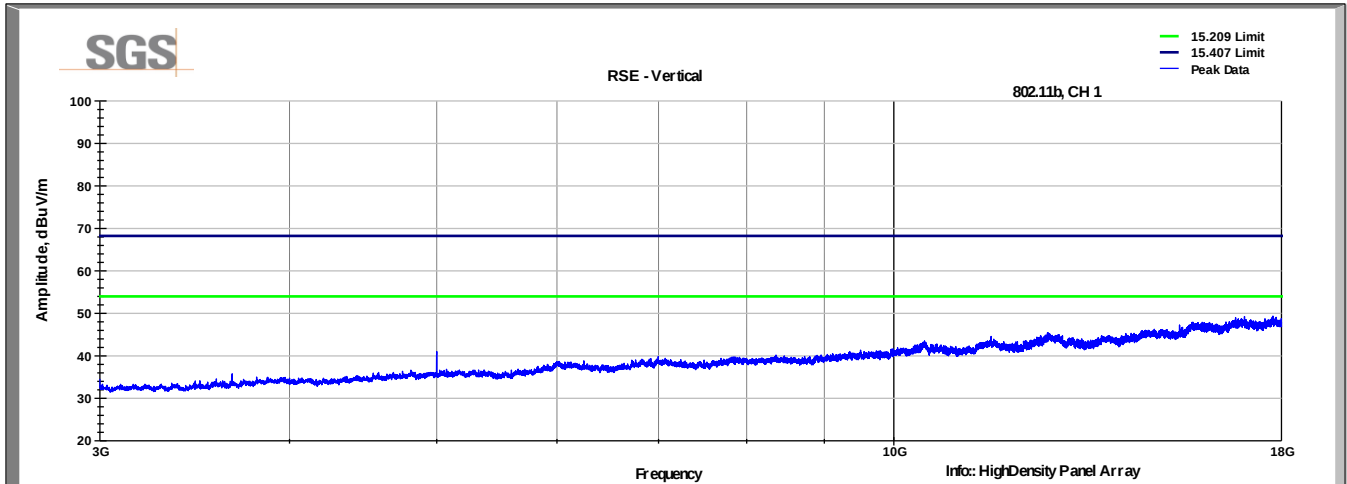


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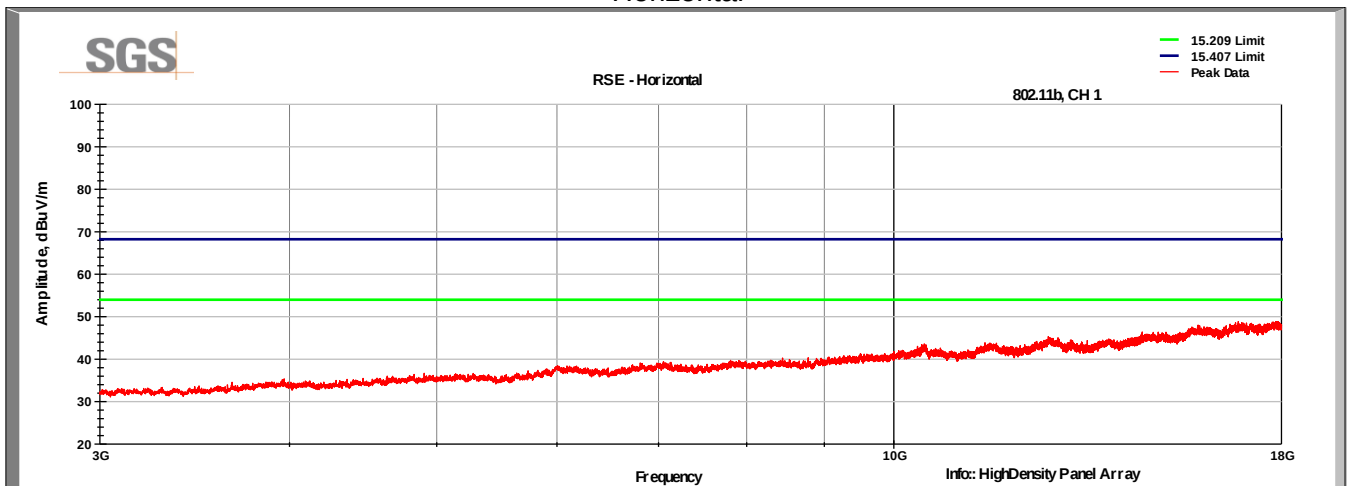


3.6 Test Data – (3-18GHz)

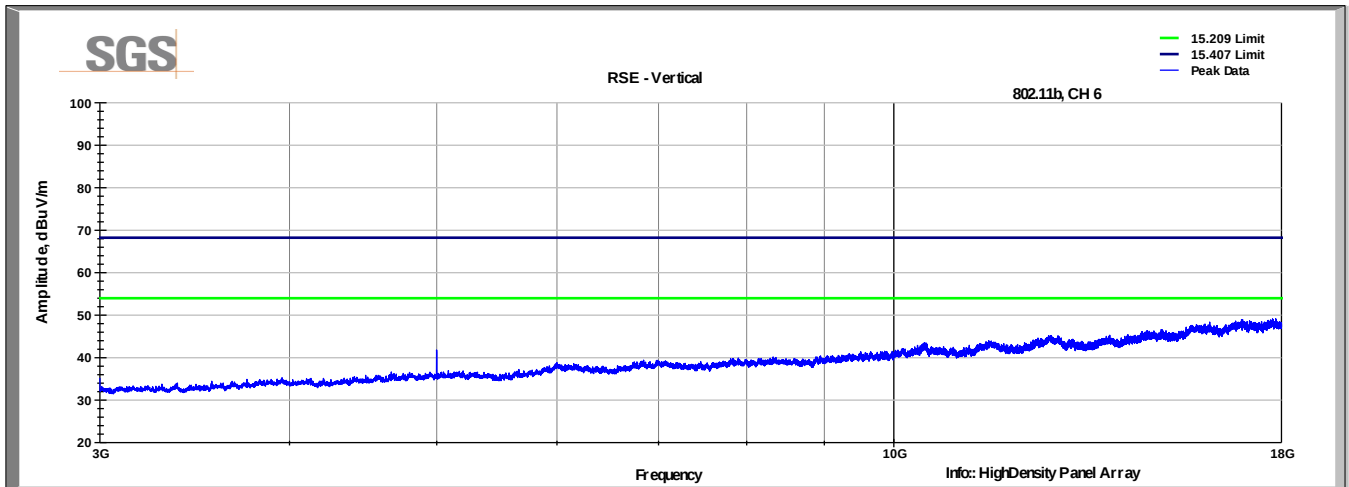
CH 1 802.11b, 1Mbps
Vertical



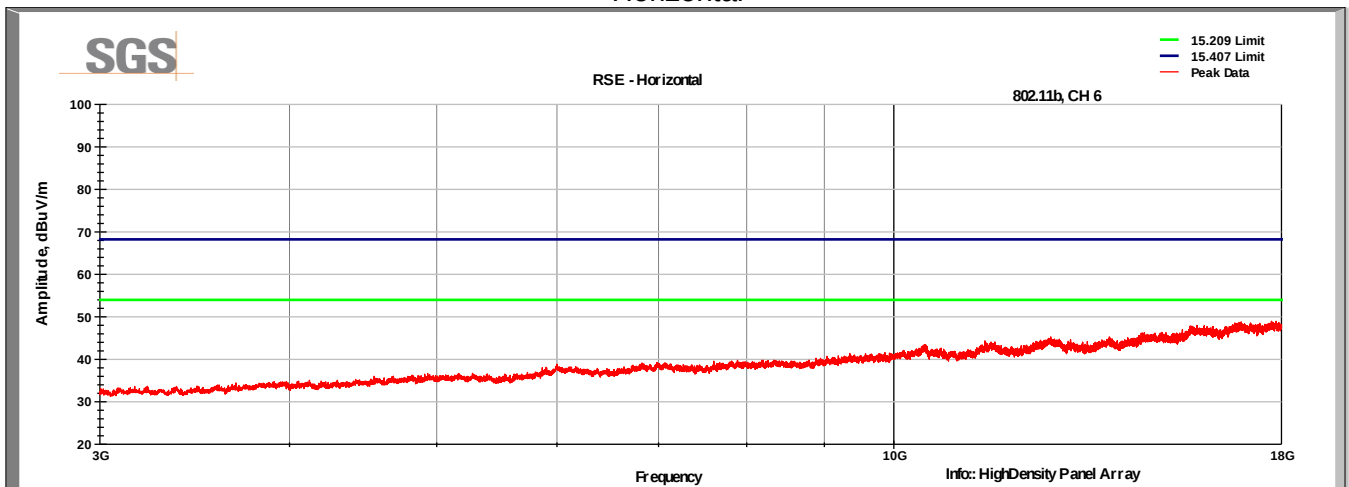
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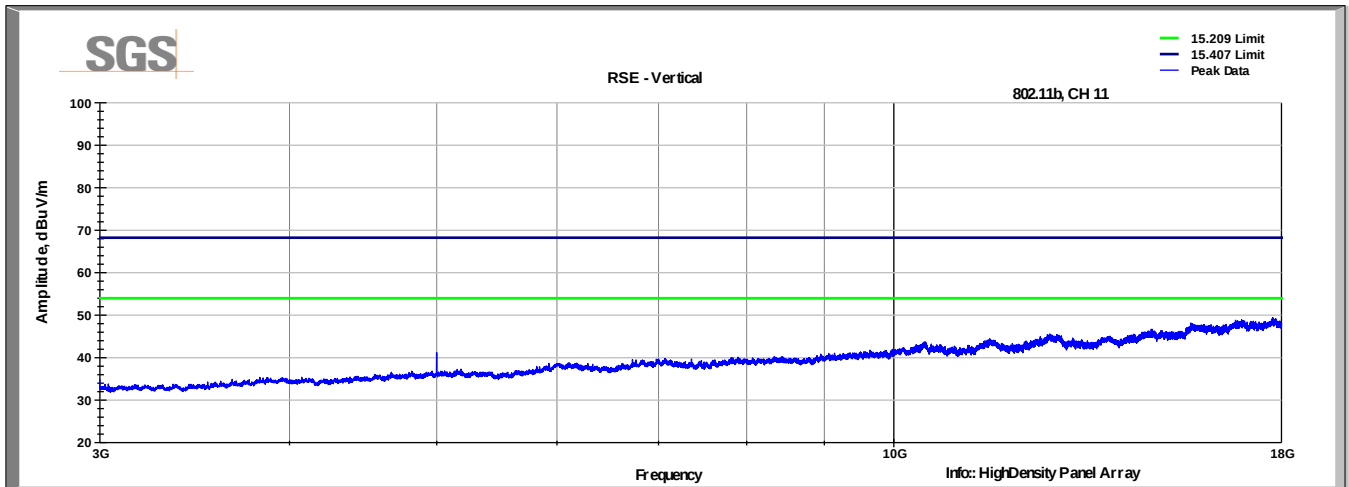
CH 6 802.11b, 1Mbps Vertical



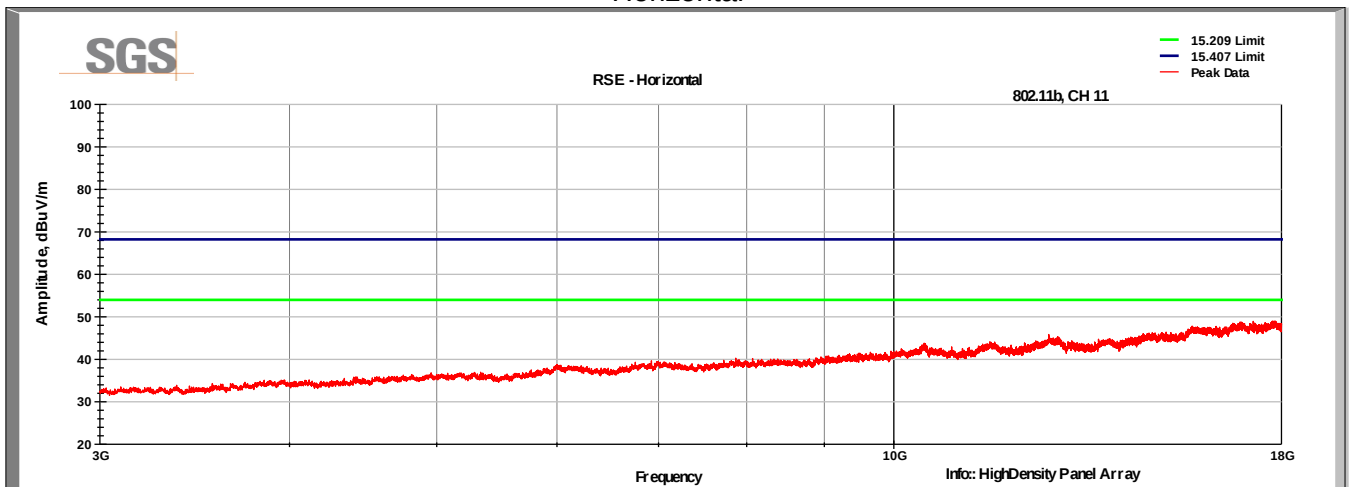
Horizontal



CH 11 802.11b, 1Mbps Vertical

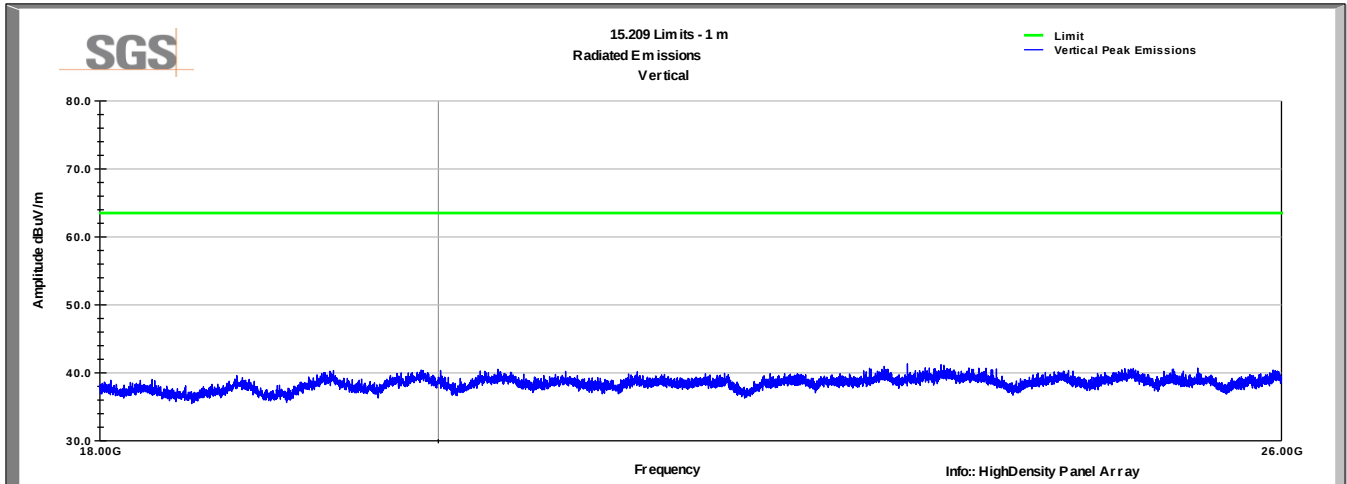


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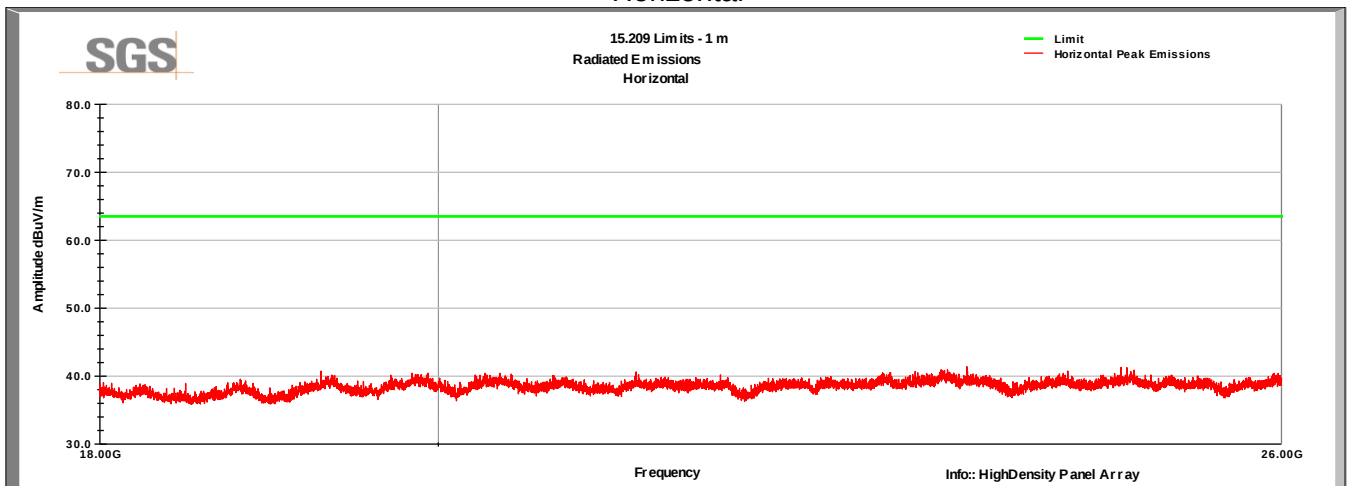


3.7 Test Data – (18-26GHz)

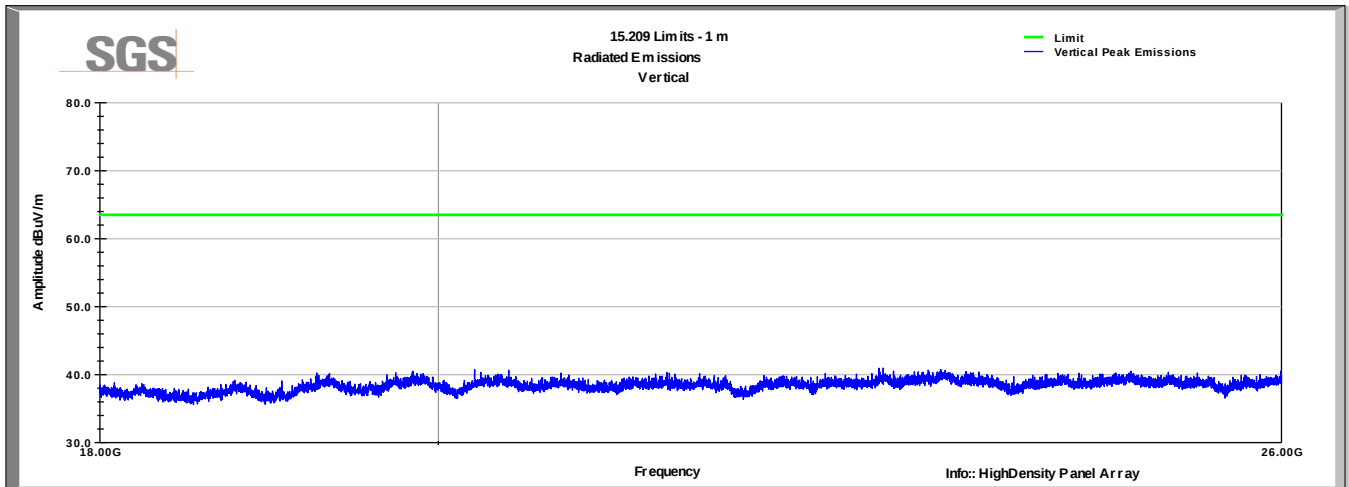
CH 1 802.11b, 1Mbps
Vertical



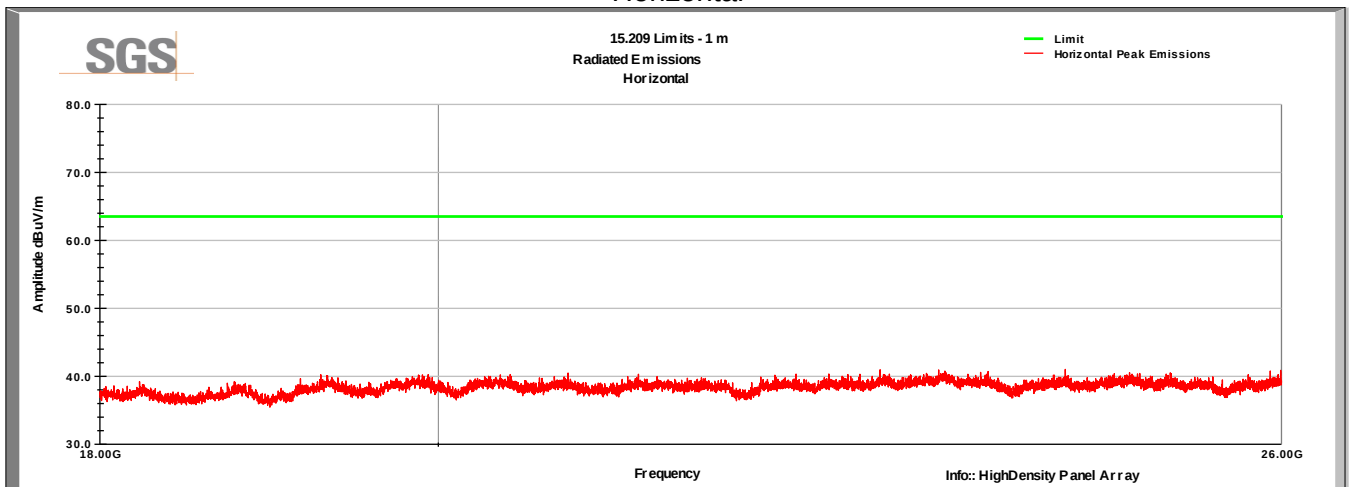
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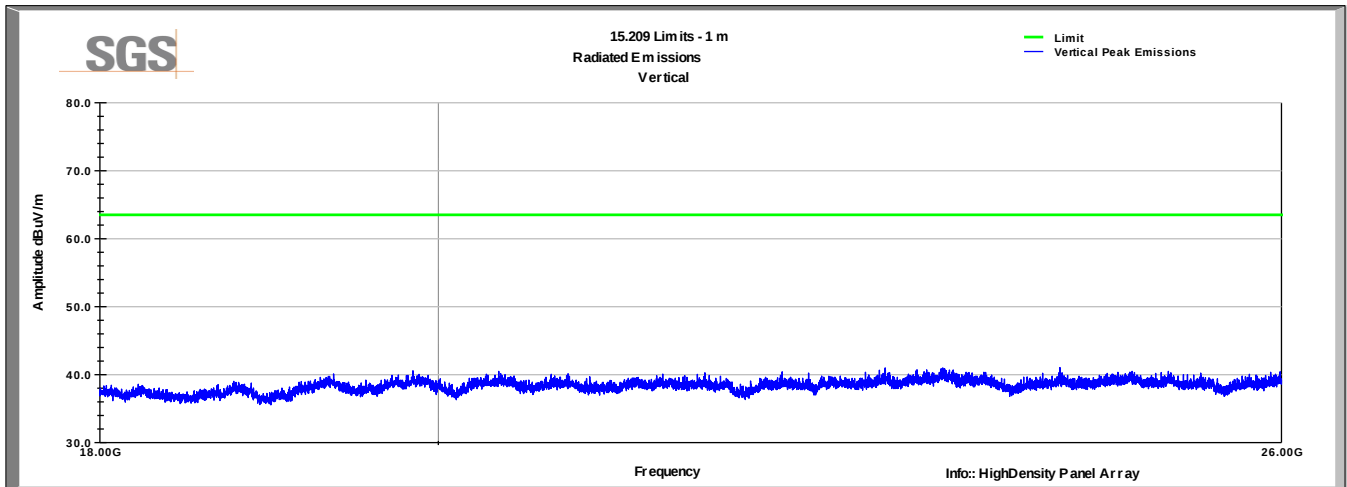
CH 6 802.11b, 1Mbps Vertical



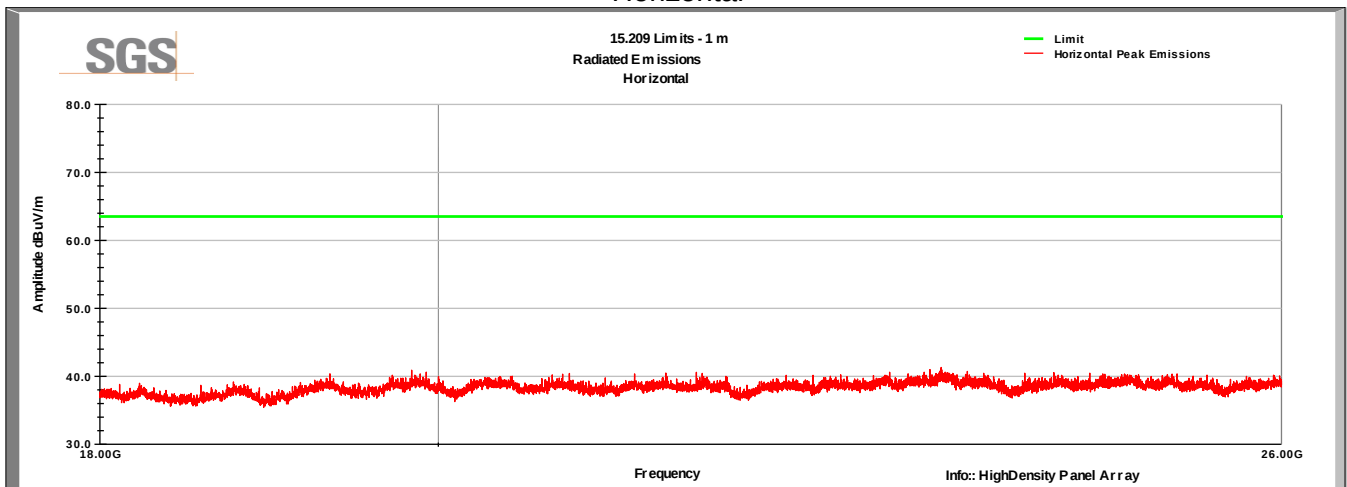
Horizontal



CH 11 802.11b, 1Mbps Vertical



Horizontal



4 Radiated Emissions at Band Edge / Restricted Band

4.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.247 (d) and 15.209	Compliant

4.2 Test Method

Peak and average field strength measurements were performed at the restricted band edges of 2390MHz and 2483.5MHz. Measurements were made using the radiated methods defined in Sections 12 and 13 of FCC publication D01 DTS Meas Guidance v03r02.

4.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.2 – 24.1 °C

Relative Humidity: 32.4 - 42.6 %

4.4 Test Equipment

Final Test Date: 22-Oct-2015

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	9-Jul-2016
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
DESKTOP AMPLIFIER 1-18 GHZ	NSP1800-25-HG	MITEQ	B085930	30-Mar-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2016
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	15-Oct-2016
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	3-Aug-2016
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079717	3-Aug-2016
10DB ATTENUATOR	10DB	ROHDE & SCHWARZ	B095594	5-Aug-2016

Note: The calibration period equipment is 1 year.

4.5 Test Data

802.11g, 6Mbps

Frequency MHz	Raw Meas (dBuV)	Polarity (V/H)	Correction (dB/m)	Corr Value dBuV/m	Limit (dBuV/m)	Margin (dB)	Detector
Channel 1							
2390.00	61.3	V	11.6	72.9	74.0	-1.1	Peak
2390.00	38.3	V	14.0	52.3	54.0	-1.7	Average
Channel 11							
2483.50	59.8	V	11.6	71.4	74.0	-2.6	Peak
2483.50	39.8	V	14.0	53.8	54.0	-0.2	Average

802.11b, 1Mbps

Frequency MHz	Raw Meas (dBuV)	Polarity (V/H)	Correction (dB/m)	Corr Value dBuV/m	Limit (dBuV/m)	Margin (dB)	Detector
Channel 1							
2390.00	59.3	V	11.6	70.9	74.0	-3.1	Peak
2390.00	35.0	V	13.8	48.8	54.0	-5.2	Average
Channel 11							
2483.50	53.6	V	11.6	65.2	74.0	-8.8	Peak
2483.50	36.4	V	13.8	50.2	54.0	-3.8	Average

To comply with the band edge requirements, the target power levels had to be adjusted as follows:

Antenna	Modulation	Channel	Target Power
M6013070P30006I	802.11g	1	18
M6013070P30006I	802.11g	11	17
M6013070P30006I	802.11b	1	20
M6013070P30006I	802.11b	11	20

There were no other spurious emissions detected.

5 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	20 January 2016
1	- Added Appendix A to provide power reductions needed to comply with the higher gain antenna. - Added note to summary referencing Appendix A	27 January 2016

Appendix A: Power Adjustment Requirements

To maintain compliance with the power limits defined in FCC 15.247 and RSS-247, the following guidance will be used for reducing the power settings relative to the original certification measurements. Adjustments for power spectral density are not taken into consideration as these conducted measurements are fixed at 8dBm/3kHz regardless of antenna gain.

Conducted Power

Modulation Mode	Freq (MHz)	Chain 1 (dBm)	Chain 2 (dBm)	Chain 3 (dBm)	Chains Summed (dBm)	Antenna Gain (dBi)	EIRP (dBm)	FCC/IC EIRP Limit (dBm)	FCC/IC Margin (dB)
11b	2412	19.09	18.84	18.98	23.74	13	36.74	30	6.74
11b	2437	19.55	18.94	18.62	23.83	13	36.83	30	6.83
11b	2462	18.34	18.28	18.68	23.21	13	36.21	30	6.21
11g	2412	14.68	14.61	14.9	19.5	13	32.5	30	2.5
11g	2437	17.04	16.3	16.1	21.27	13	34.27	30	4.27
11g	2462	13.04	13.37	13.34	18.02	13	31.02	30	1.02
11n (20MHz)	2412	13.43	13.26	13.64	18.22	13	31.22	30	1.22
11n (20MHz)	2437	16.74	16.32	16.04	21.15	13	34.15	30	4.15
11n (20MHz)	2462	12.14	12.58	13.06	17.38	13	30.38	30	0.38
11n (40MHz)	2422	7.81	7.38	7.88	12.47	13	25.47	30	-4.53
11n (40MHz)	2437	11.87	11.3	11.95	16.49	13	29.49	30	-0.51
11n (40MHz)	2452	8.66	8.42	8.26	13.22	13	26.22	30	-3.78

Summary

The power reductions in the following three tables are required to maintain compliance with the conducted power requirements defined in Section 15.247 and RSS-247 using the referenced antenna:

13/7 dBi High Density MIMO Patch Array (P/N: M6013070P30006I)

Band	Modulation	Channel	Frequency (MHz)	Required Reduction (dB)
2.4GHz	802.11b	1	2412	6.74
		6	2437	6.83
		11	2462	6.21
	802.11g	1	2412	2.5
		6	2437	4.27
		11	2462	1.02
	802.11n (HT20)	1	2412	1.22
		6	2437	4.15
		11	2462	0.38
	802.11n (HT40)	3	2422	0
		6	2437	0
		19	2452	0