

EMC Test Report

Project Number: 3878032

Report Number: 3878032 EMC01

Revision Level: 0

Client: ADTRAN, Inc.

Equipment Under Test: 802.11ac 5G Radio Module

Model Number: PCE4551AH-BS

FCC ID: HDCWLAN203XF1

IC ID: 2250A-WLAN203XF1

Applicable Standards: FCC Part 15 Subpart C, § 15.407

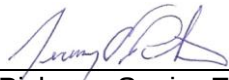
RSS-247, Issue 1

ANSI C63.10: 2013

Report issued on: 11 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.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or Testing done by SGS International Electrical Approvals in connection with distribution or use of the product described in this report must be approved by SGS international Electrical Approvals in writing.

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1 Summary of Test Results

Test Description	Test Specification		Test Result
	FCC Part 15	RSS-247	
Bandwidth	15.407	RSS-Gen / 6.2.4(1)	NS(1)
Spectral Density	15.407(a)(1) / 15.407(5)	6.2.1(1) / 6.2.4(1)	NS(1)
Peak Power Output	15.407(a)(1) / 15.407(3)	6.2.1(1) / 6.2.4(1)	NS(1)(2)
Radiated Spurious Emissions	15.407(b)(1) / 15.407(b)(4)	6.2.1(2) / 6.2.4(2)	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: 802.11ac 5G Radio Module
Model: PCE4551AH-BS

Frequency Range: 5150 to 5250 MHz and 5725 to 5825MHz
Data Modes: 802.11a, 802.11n (HT20), 802.11n (HT40), 802.11ac (VHT20), 802.11ac (VHT40), 802.11ac (VHT80)
Antenna: TerraWave, 2.4/5 GHz, 13/7 dBi High Density MIMO Patch Array (P/N: M6013070P30006I)

Rated Voltage: 48Vdc (PoE) Delivered to Host Device

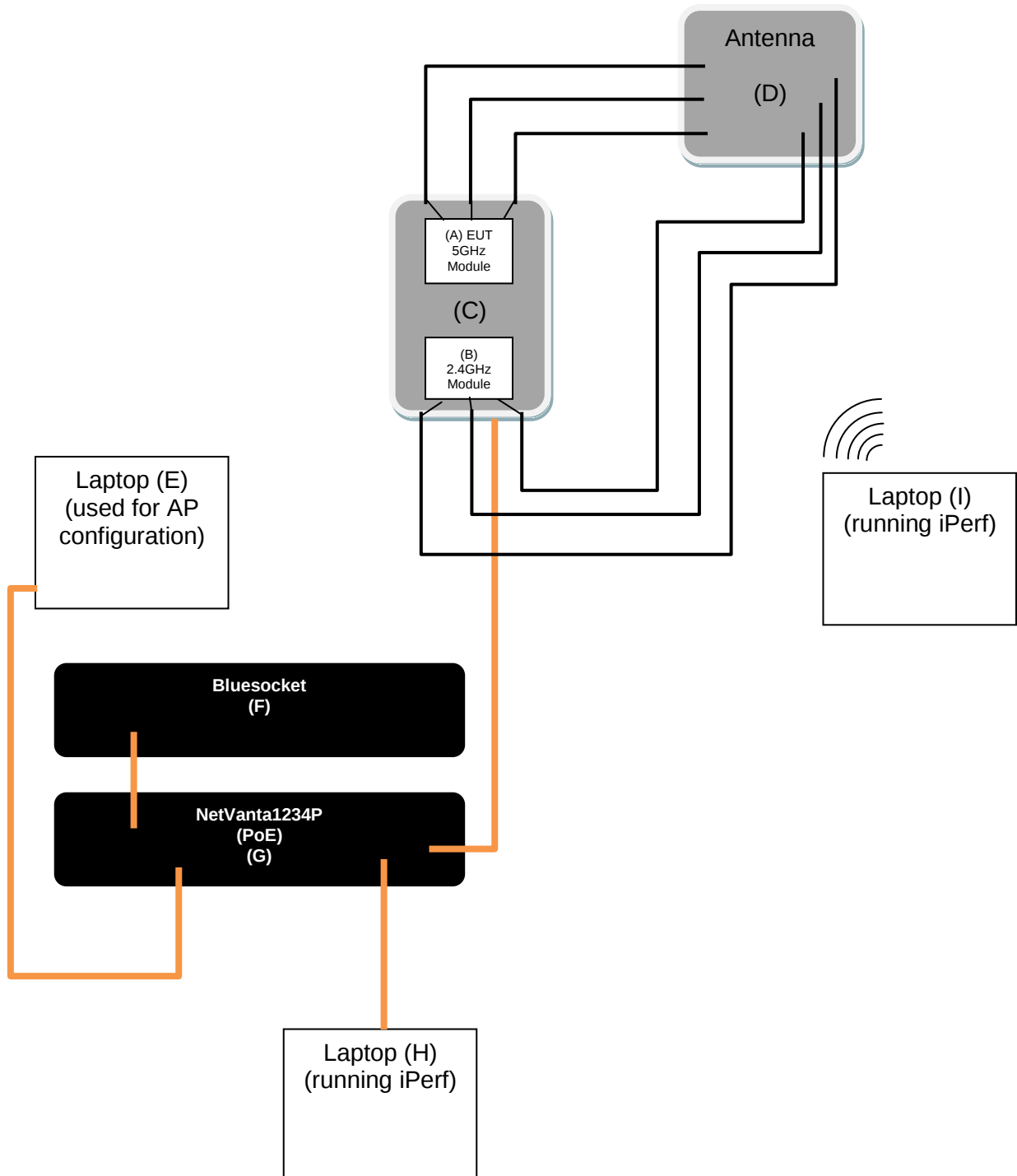
Sample Received Date: 16 September 2015
Dates of testing: 05 – 27 October 2015

Operating Modes and Conditions

For spurious emissions measurements, only the worst-case mode with respect to peak power from the original filing was investigated: 802.11a, 6Mbps. The low, middle, and high channels in each the 5150-5250MHz band and the 5725-5825MHz band were tested.

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.	5GHz Radio Module	PCE4551AH-BS	Not Labeled
B	ADTRAN, Inc.	2.4GHz Radio Module	BSAP-1930	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 Undesirable Emissions

3.1 Test Result

Test Description	Test Specification		Test Result
Spurious Emissions	15.407(b)(1) / 15.407(b)(4)	6.2.1(2) / 6.2.4(2)	Compliant
	ANSI C63.10: 2013		

3.2 Test Method

Testing was performed using the radiated methods defined in ANSI C63.10: 2013 and KDB 789033 D02 General UNII Test Procedures New Rules v01

Limit:

The limit is -27dBm/MHz or 68.2 dBuV/m @3m (applying 95.2dB correction)

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

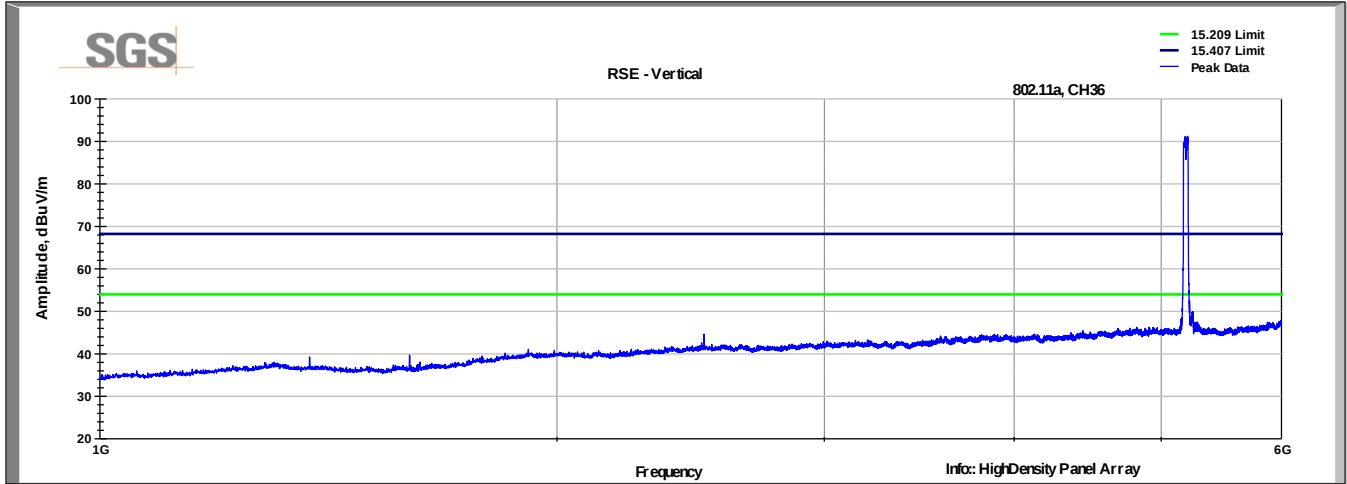
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	9-Jul-2016
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
SMALL HORN ANTENNA	LB-180400-20-C-KF	A-INFOMW	15007	11-Mar-2016
DESKTOP AMPLIFIER 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.

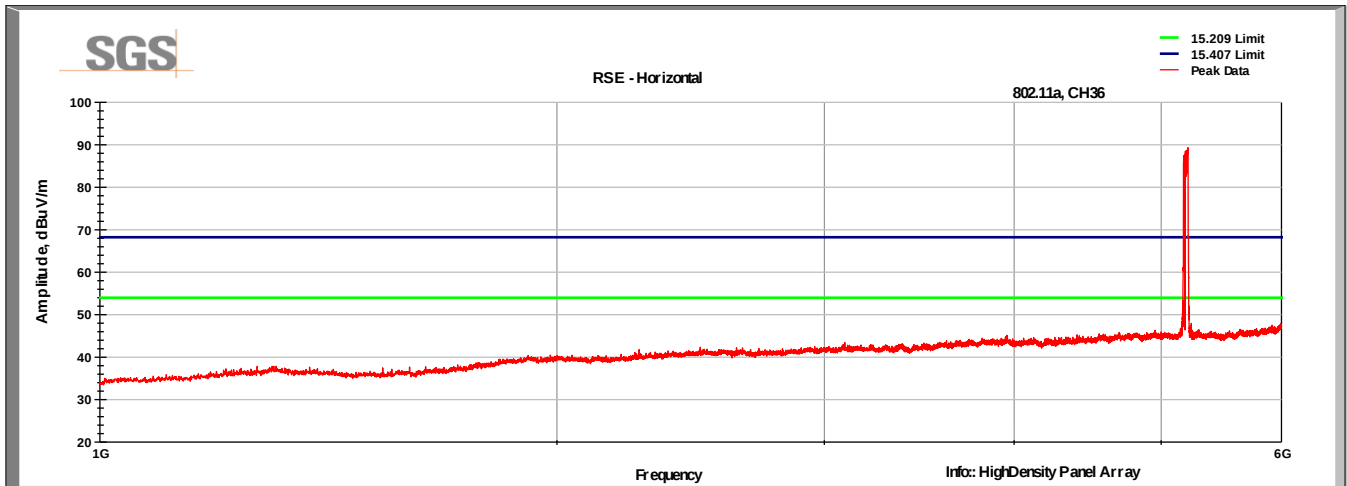
3.5 Test Data – Peak Plots (1-6GHz)

CH 36 6MB/s

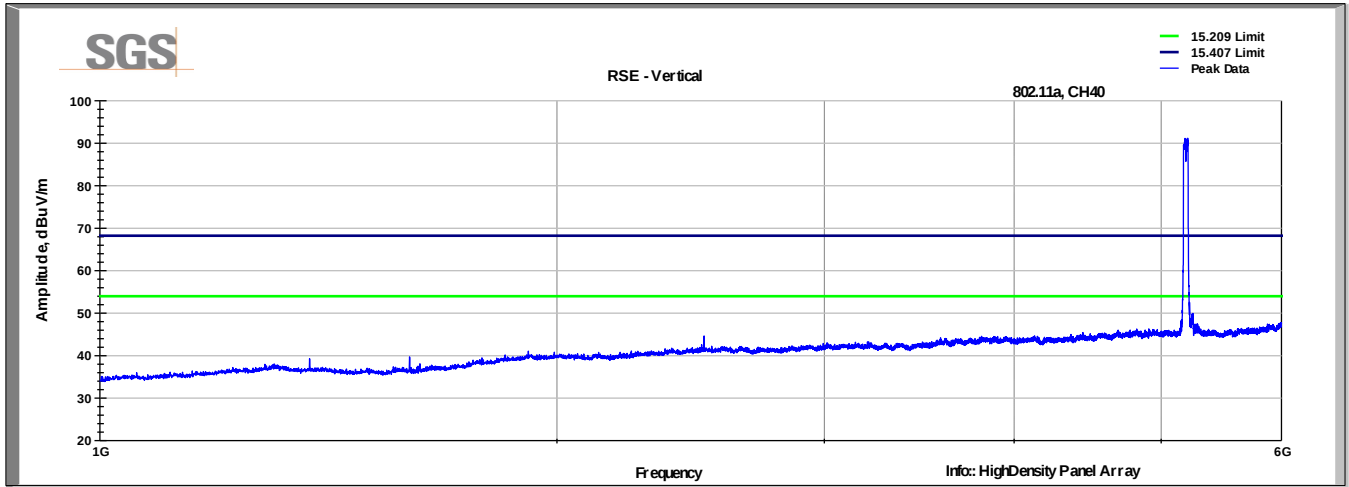
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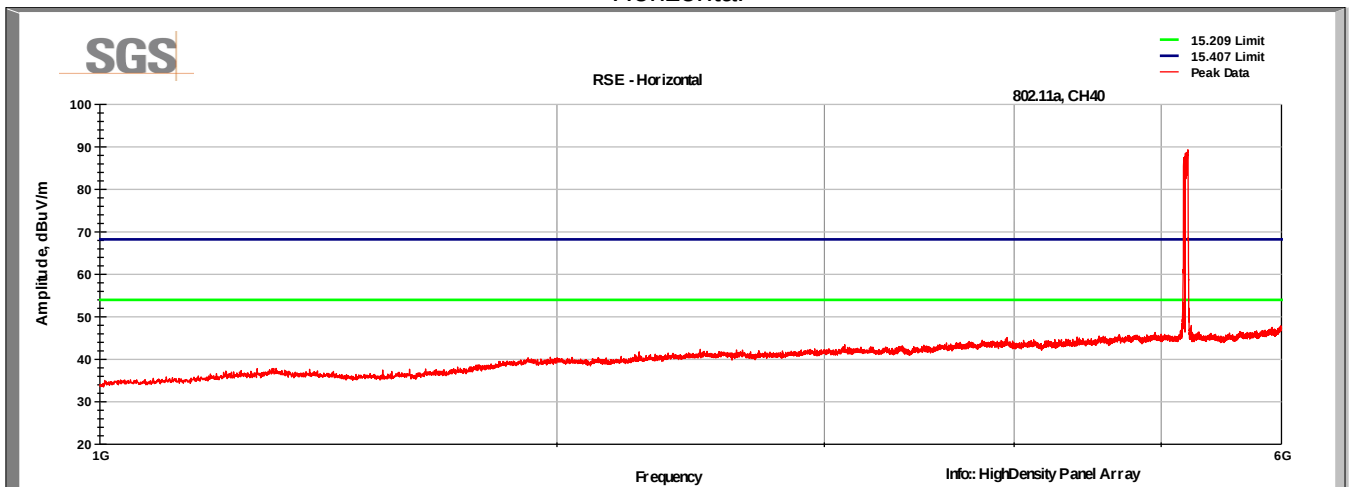
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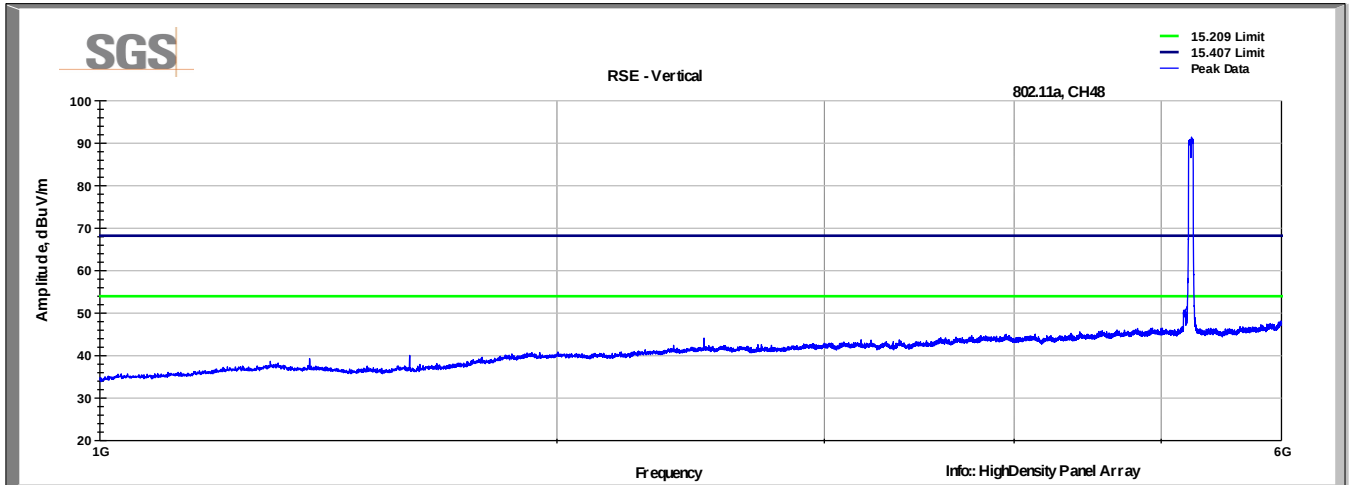
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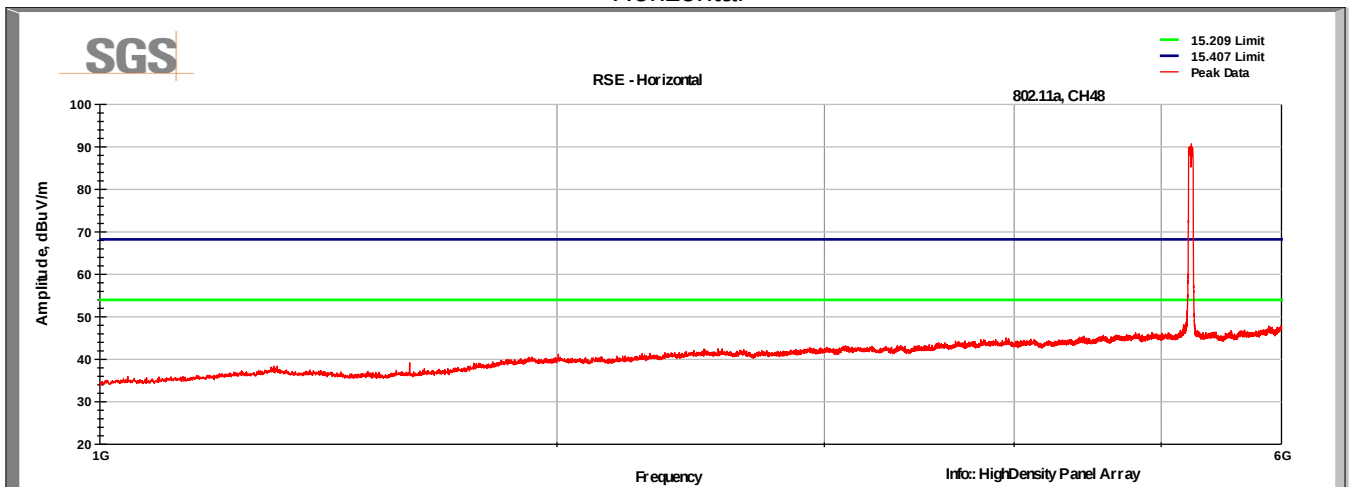
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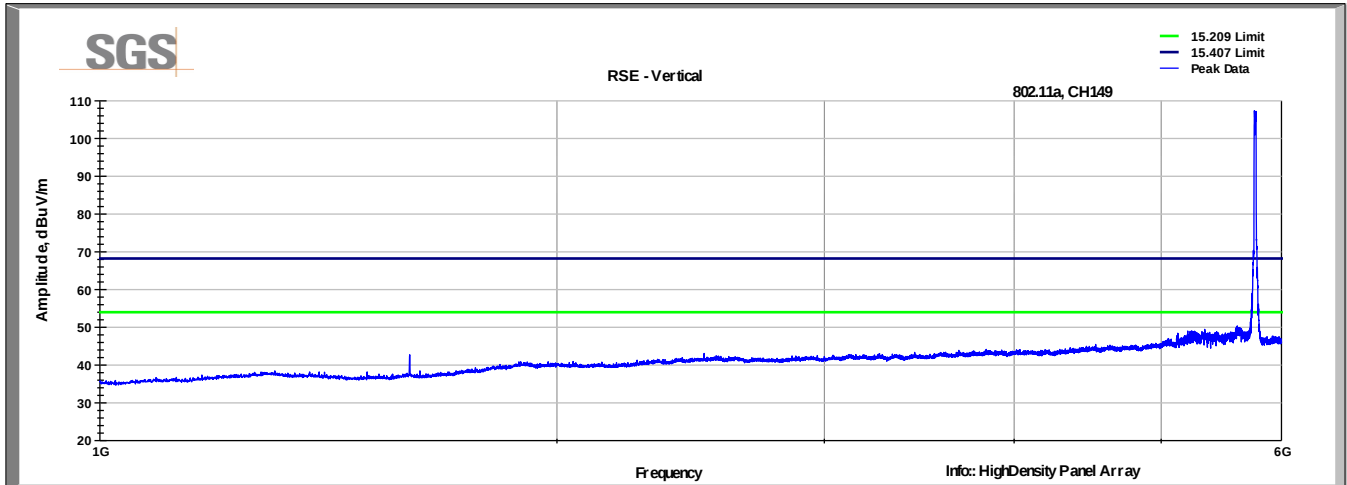
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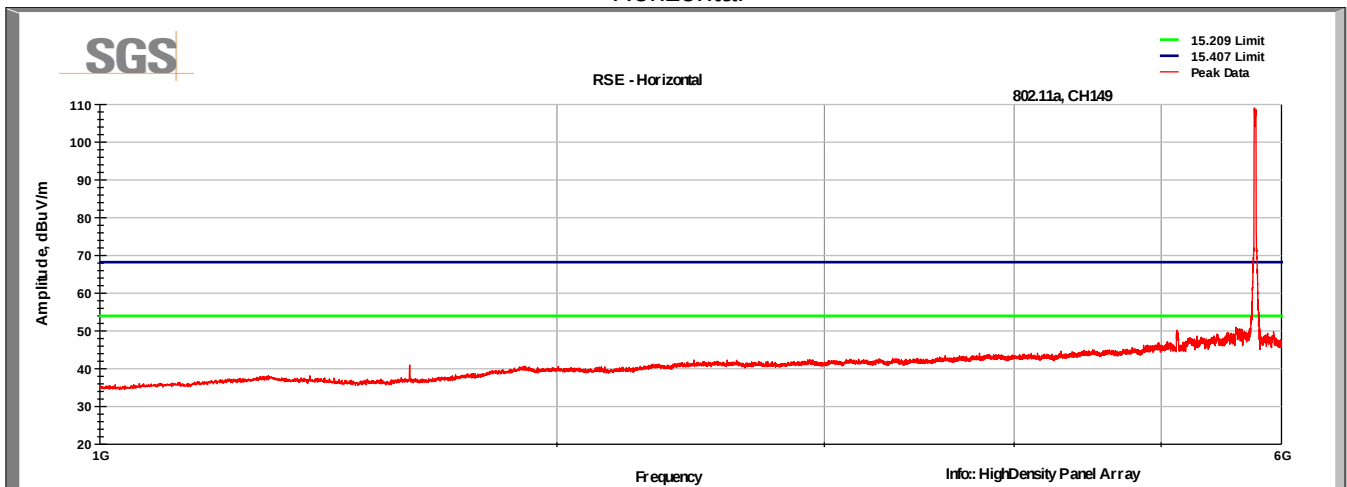
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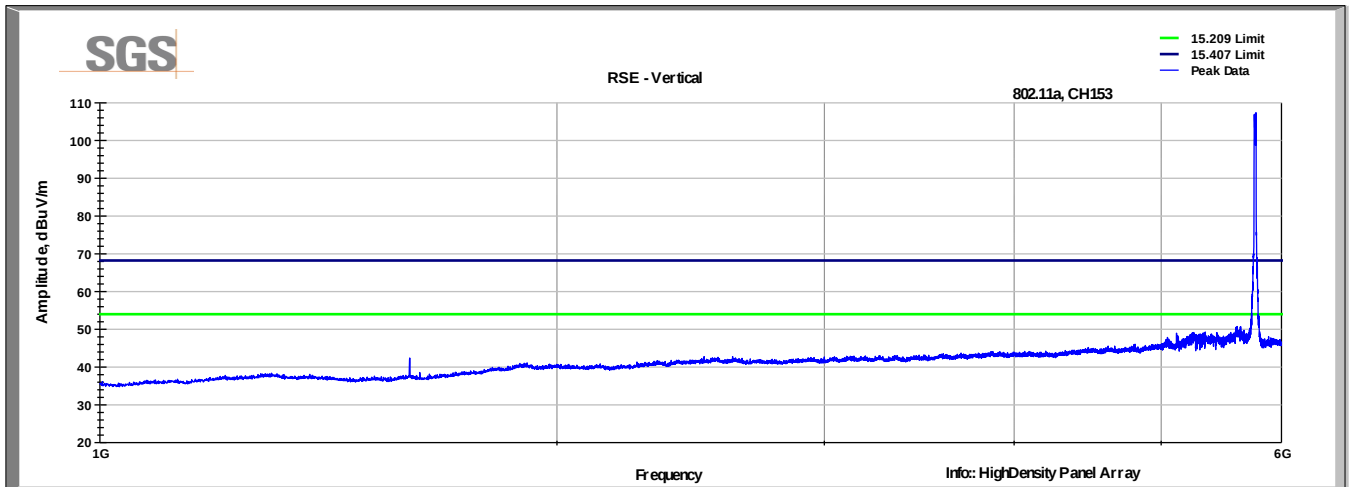
CH 149 6MB/s
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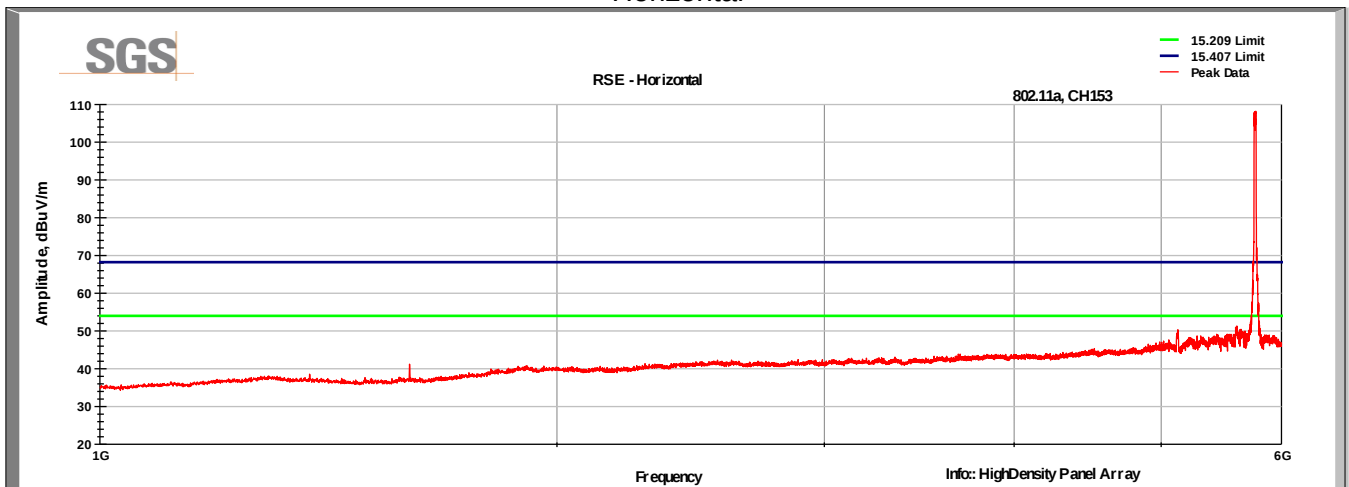
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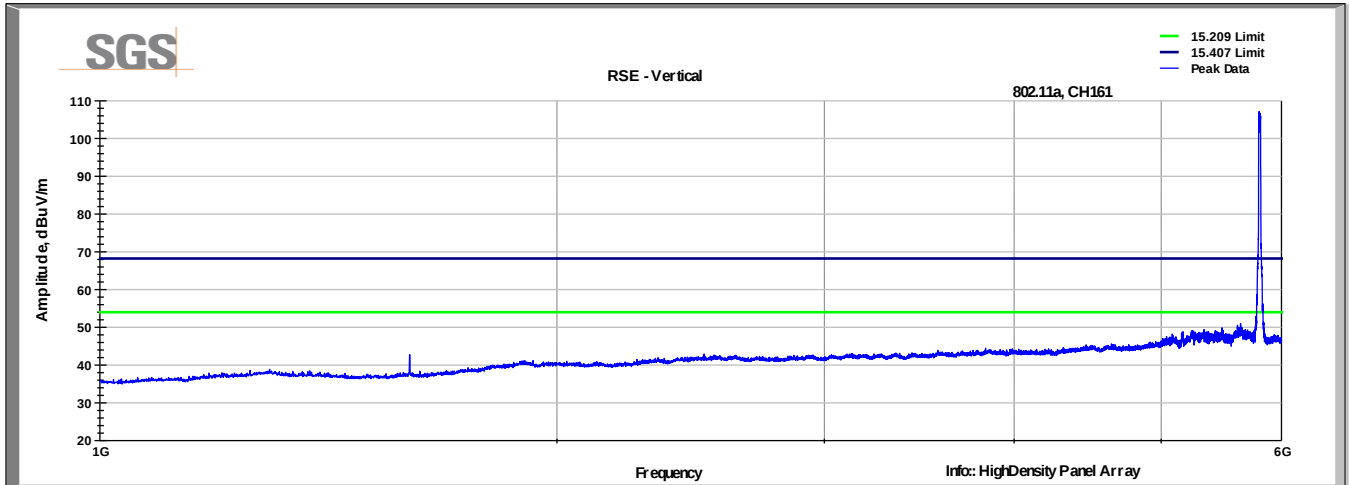
CH 153 6MB/s Vertical



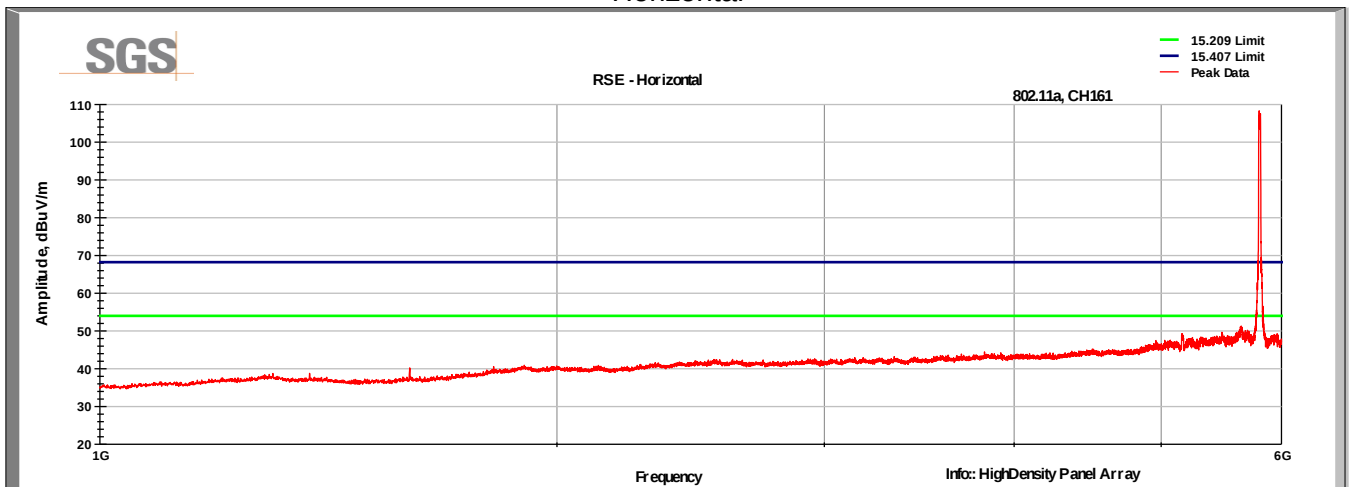
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CH 161 6MB/s Vertical



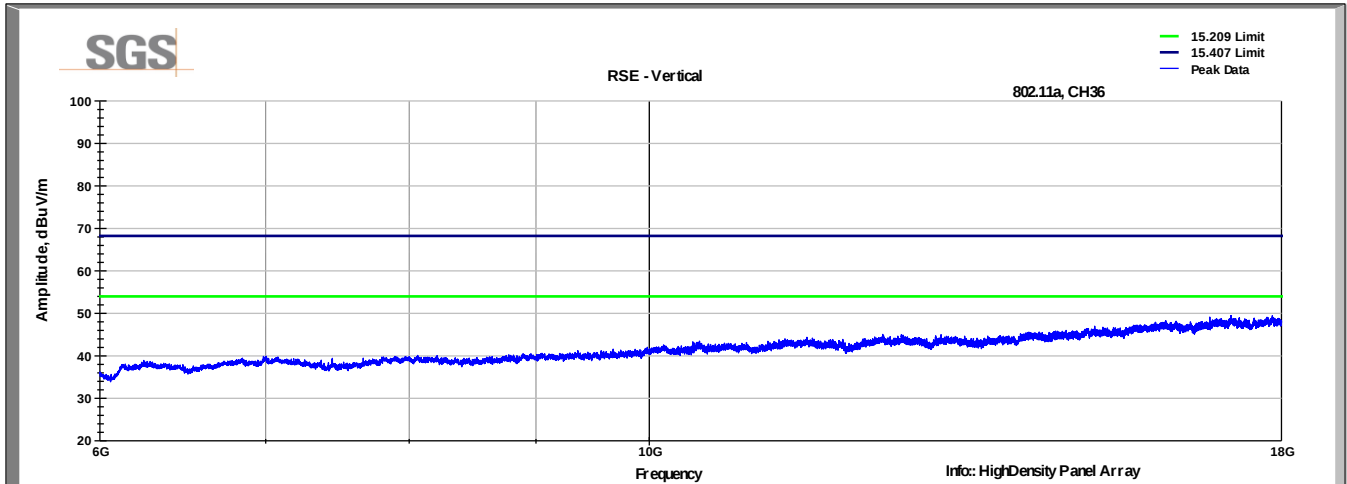
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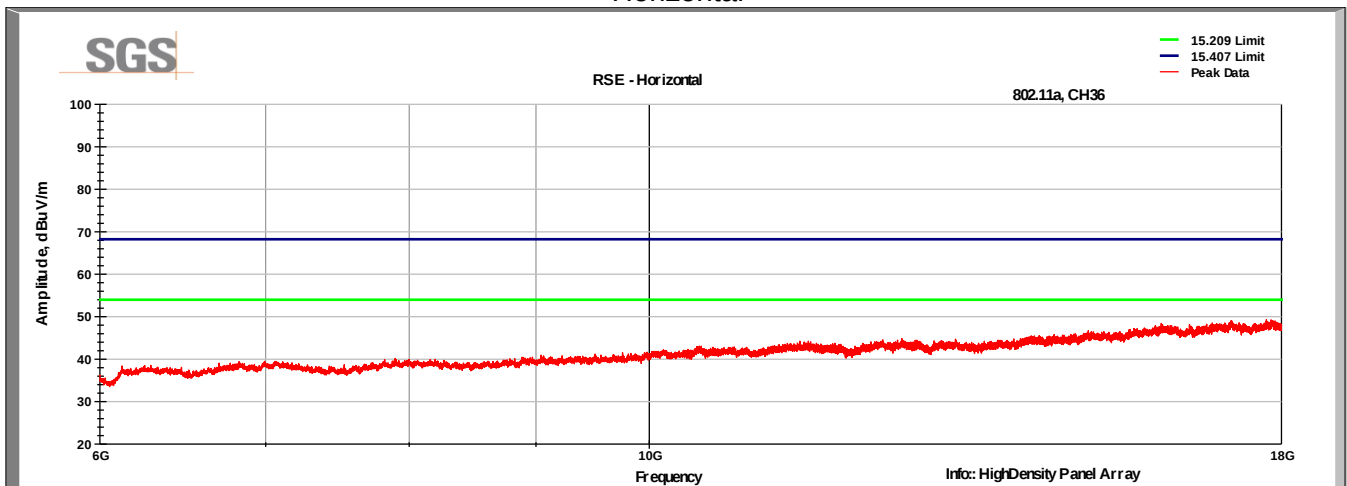
3.6 Test Data – Peak Plots (6-18GHz)

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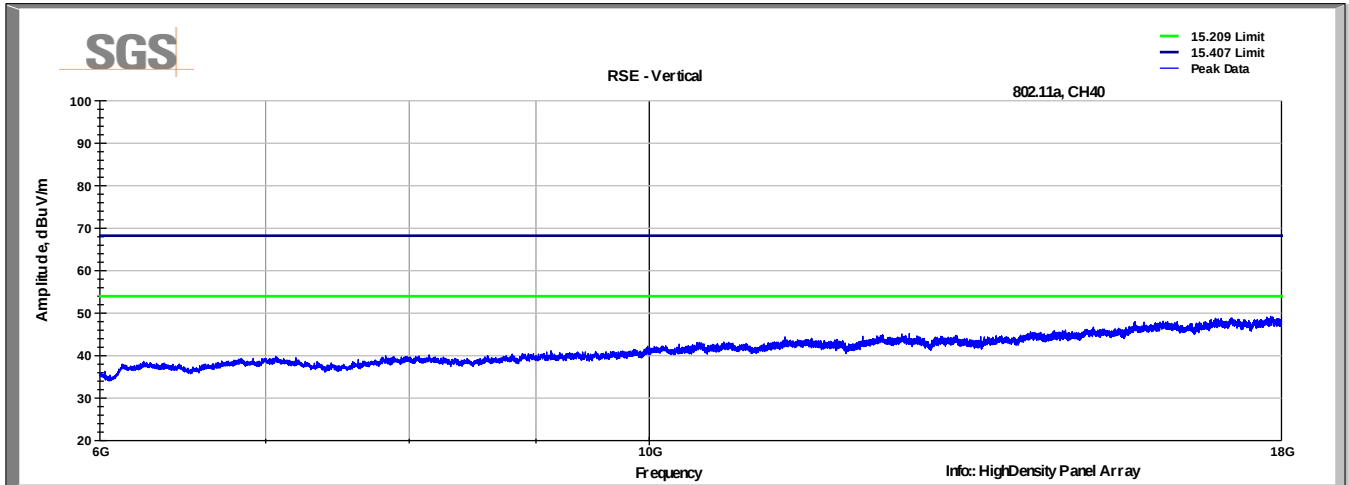
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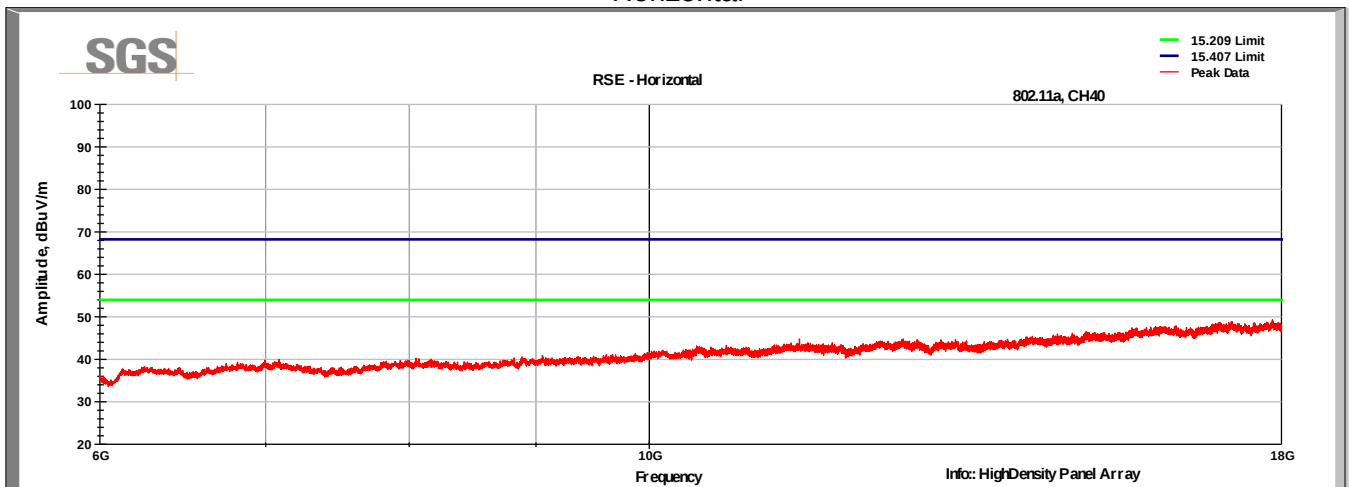
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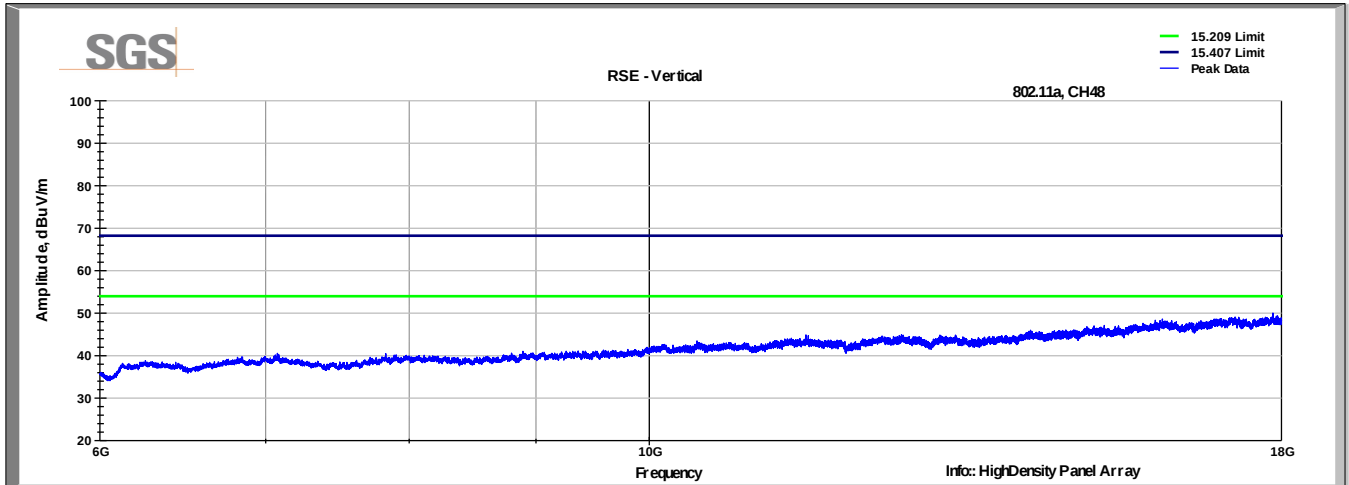
CH 40 6MB/s Vertical



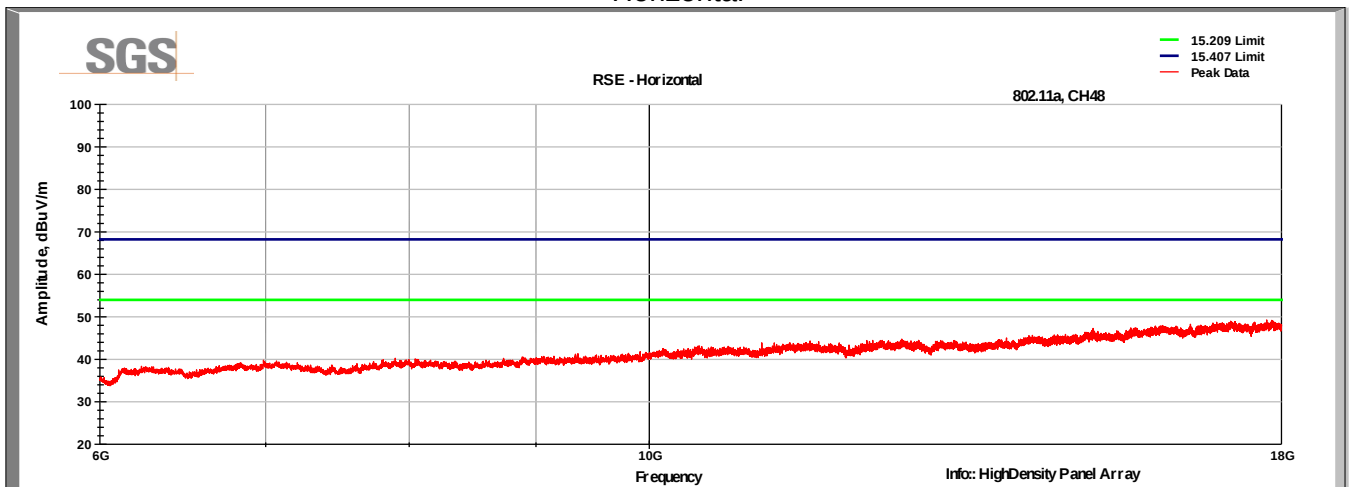
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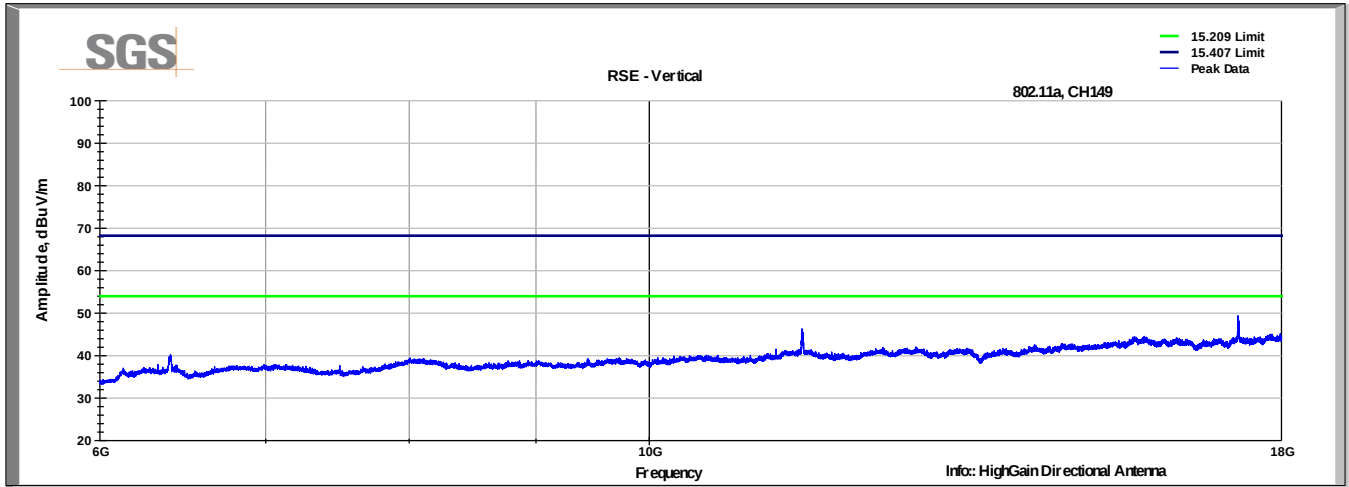
CH 48 6MB/s Vertical



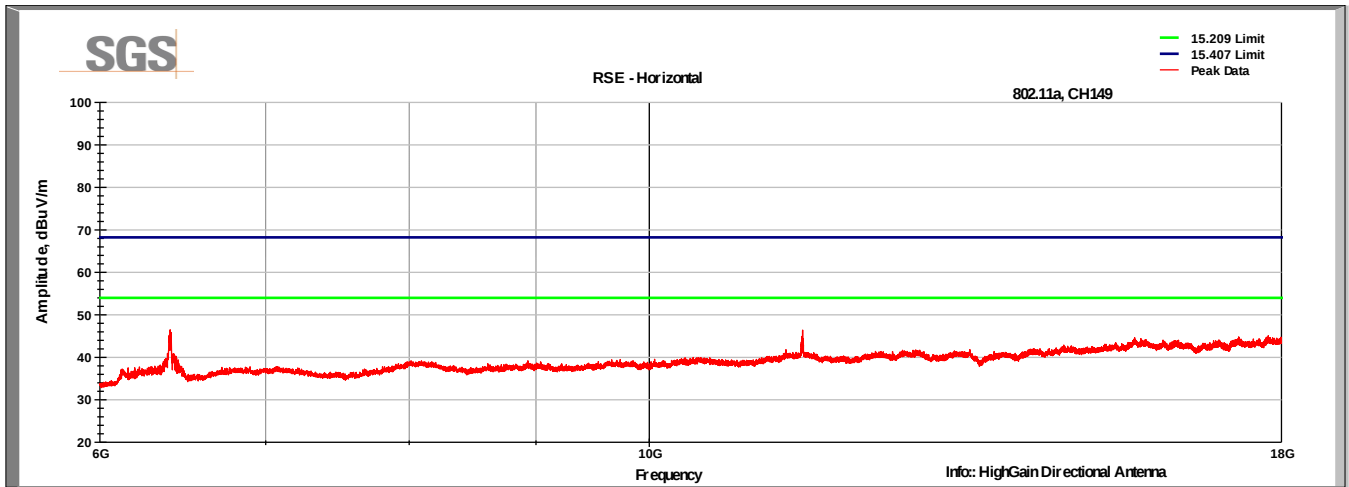
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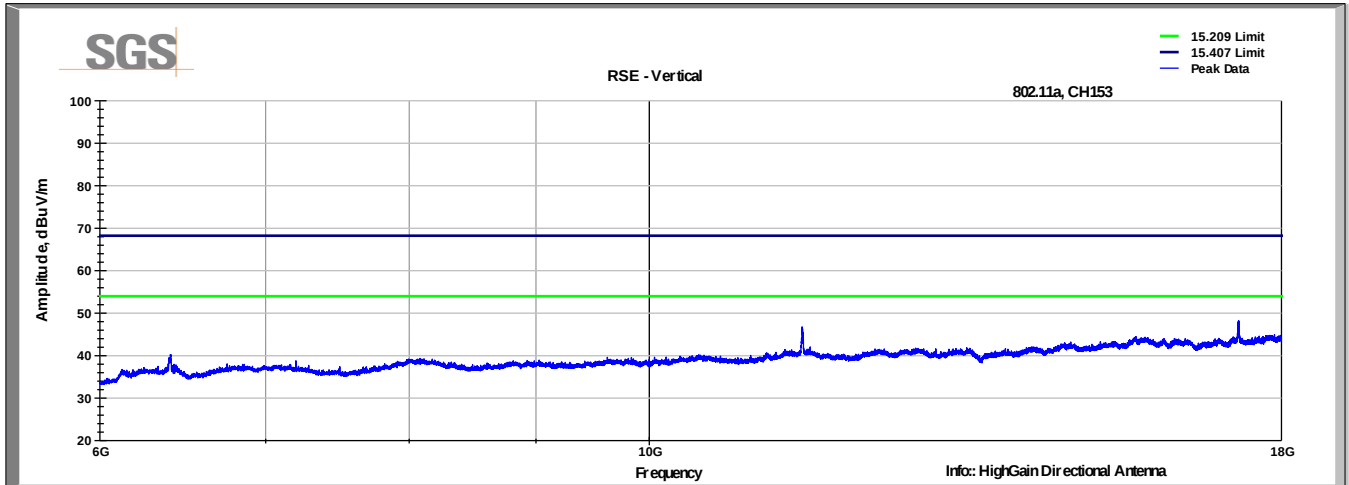
CH 149 6MB/s
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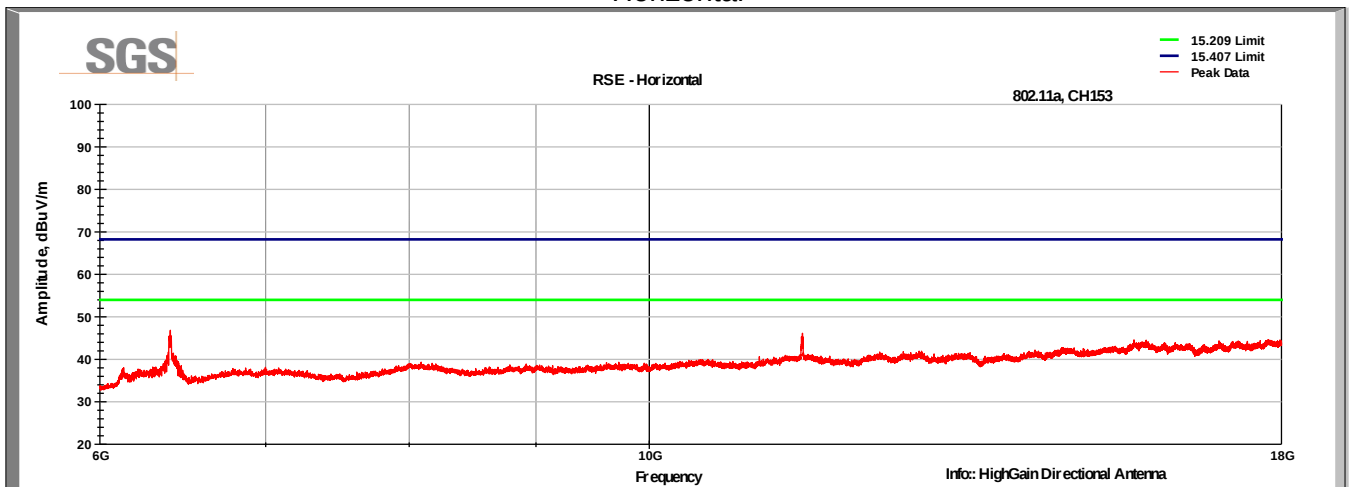
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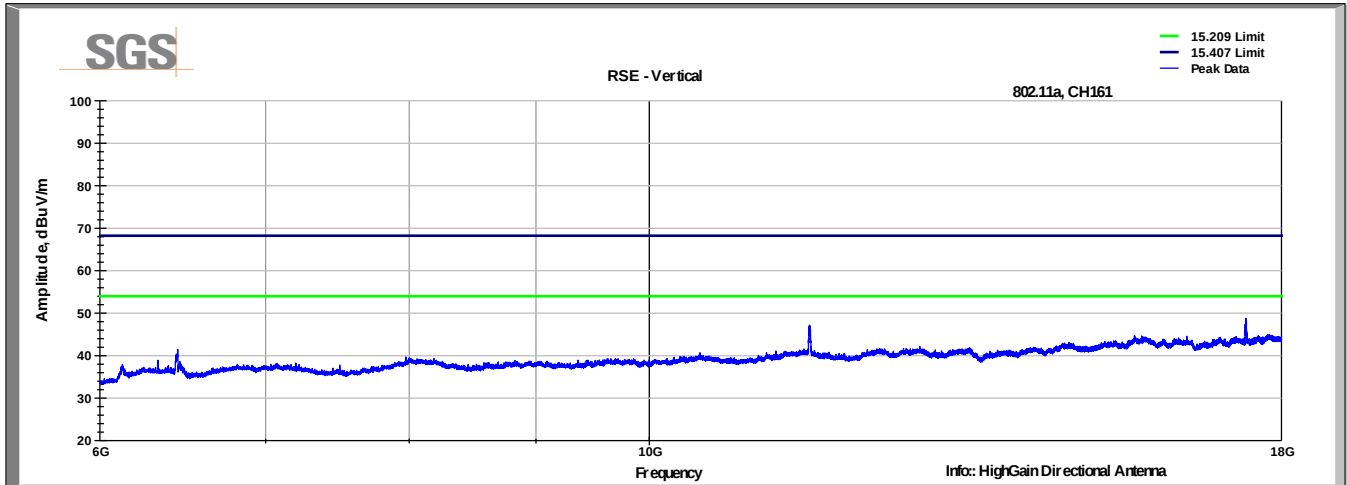
CH 153 6MB/s Vertical



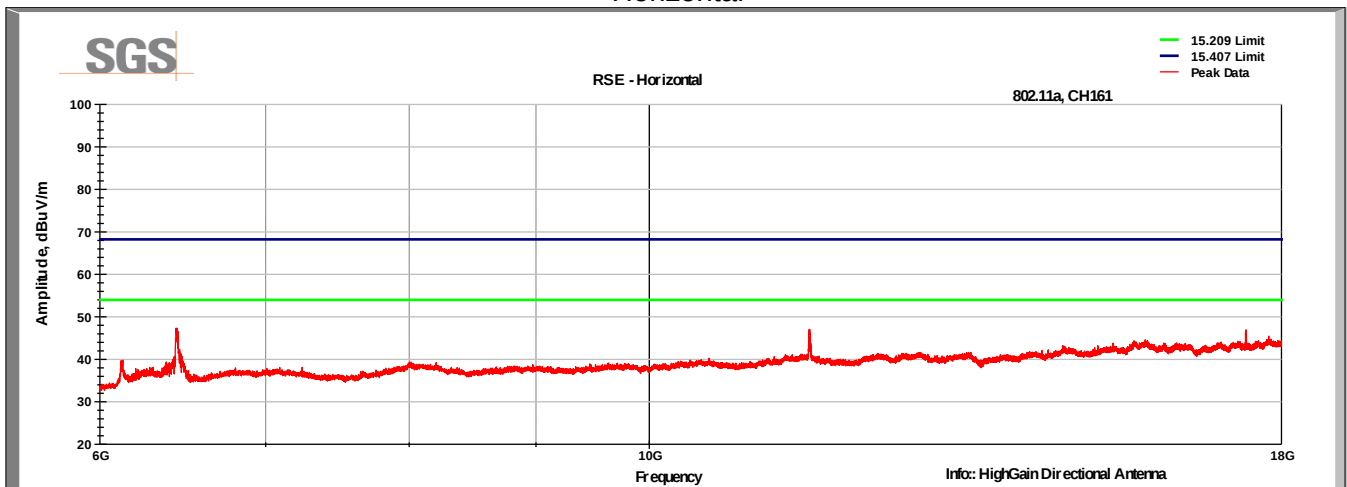
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CH 161 6MB/s Vertical



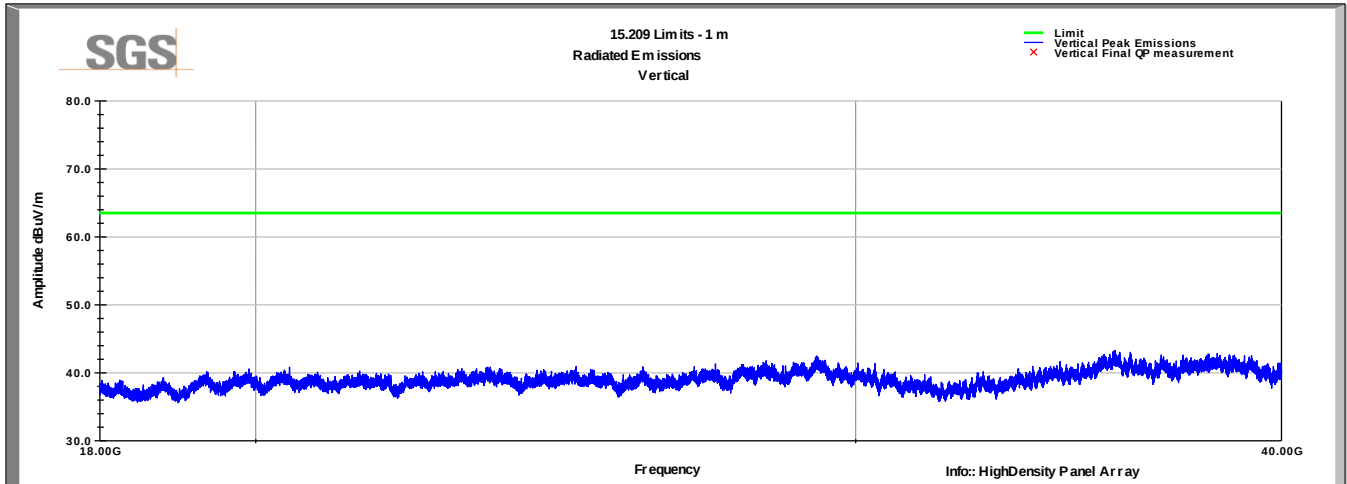
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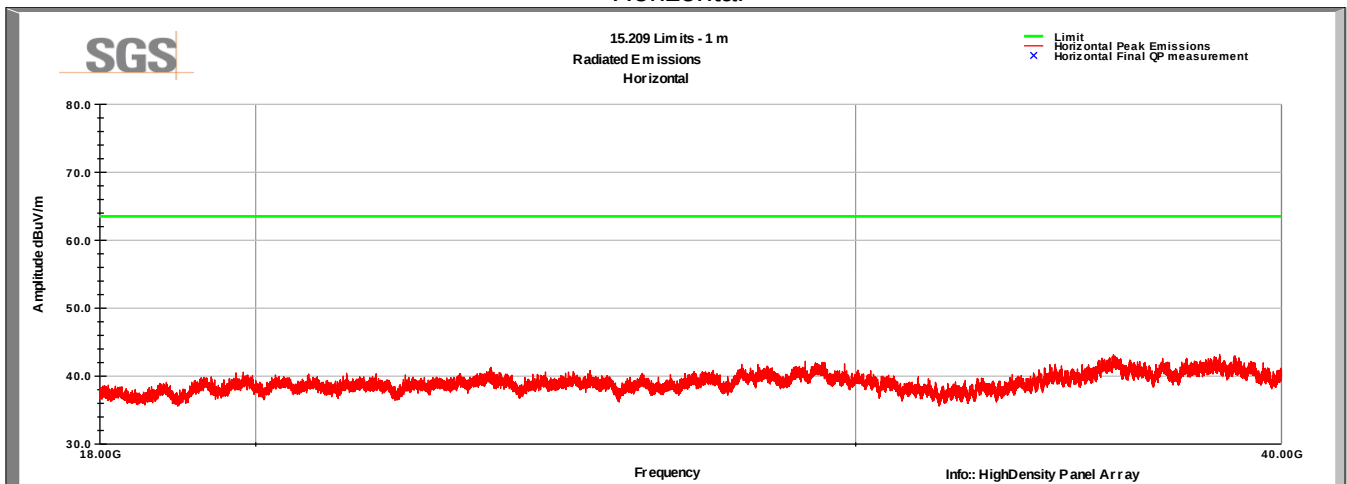
3.7 Test Data – Peak Plots (18-40GHz)

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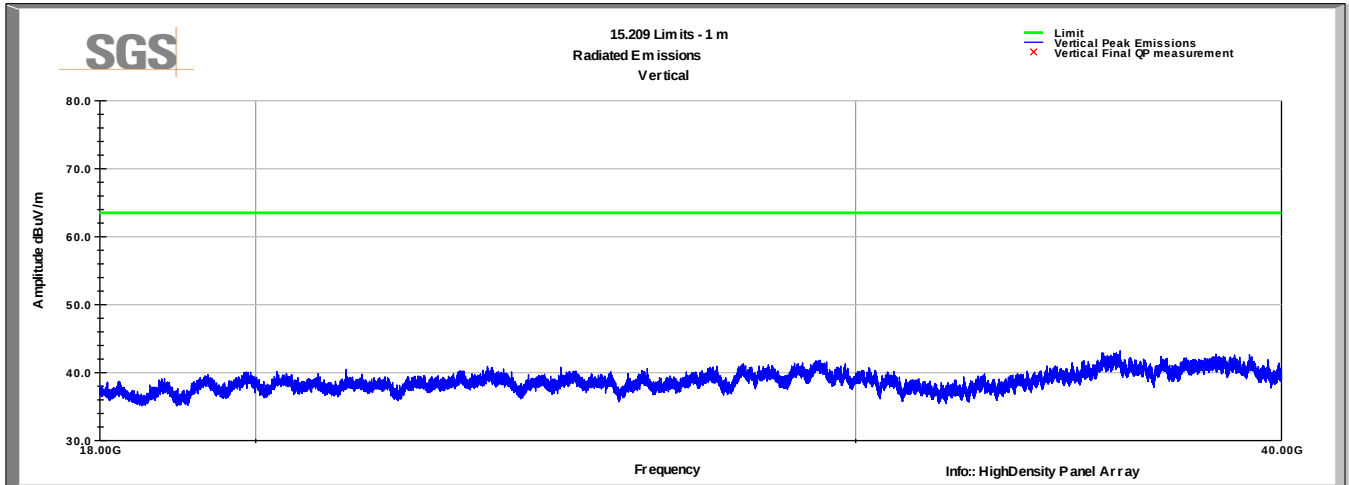
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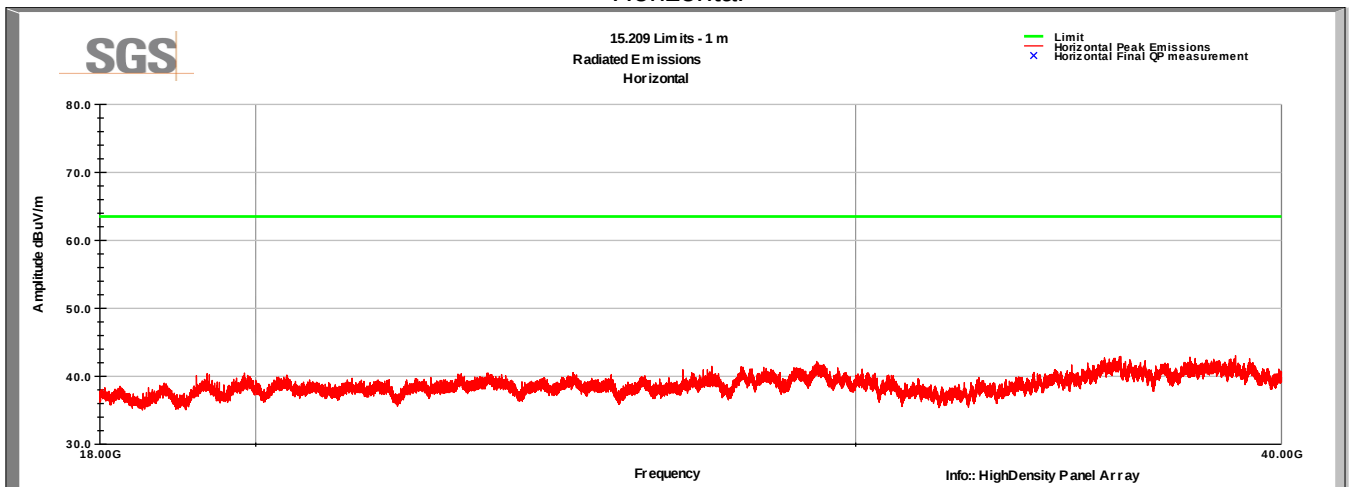
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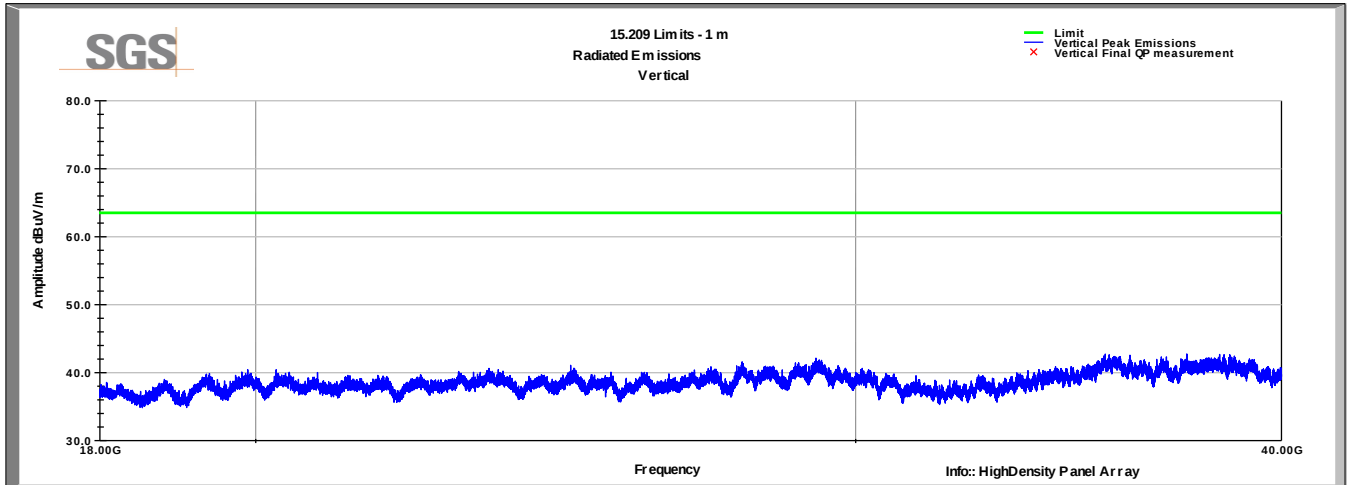
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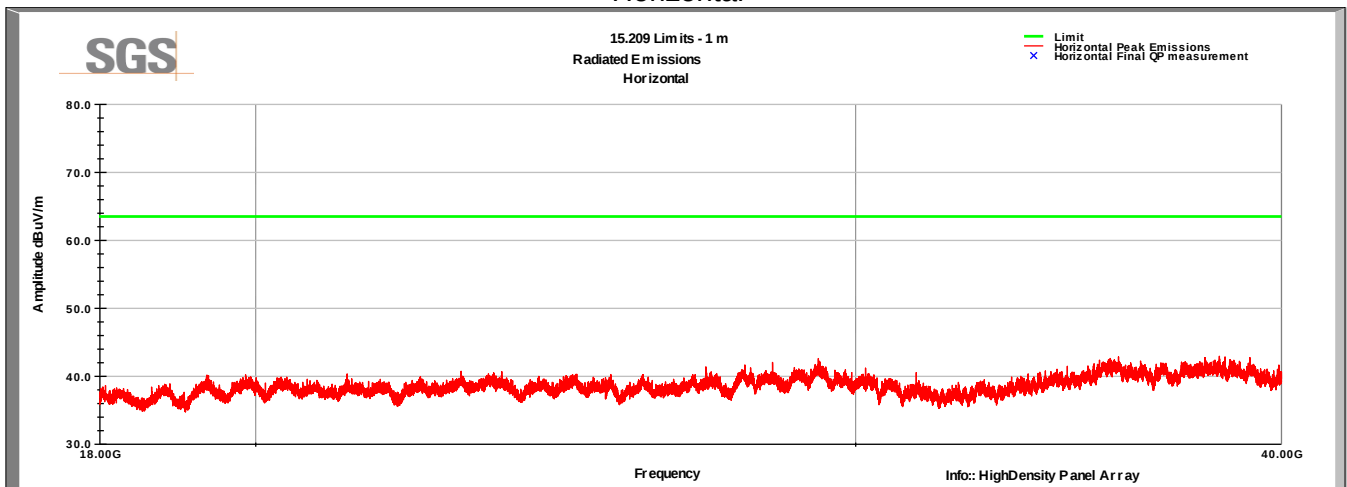
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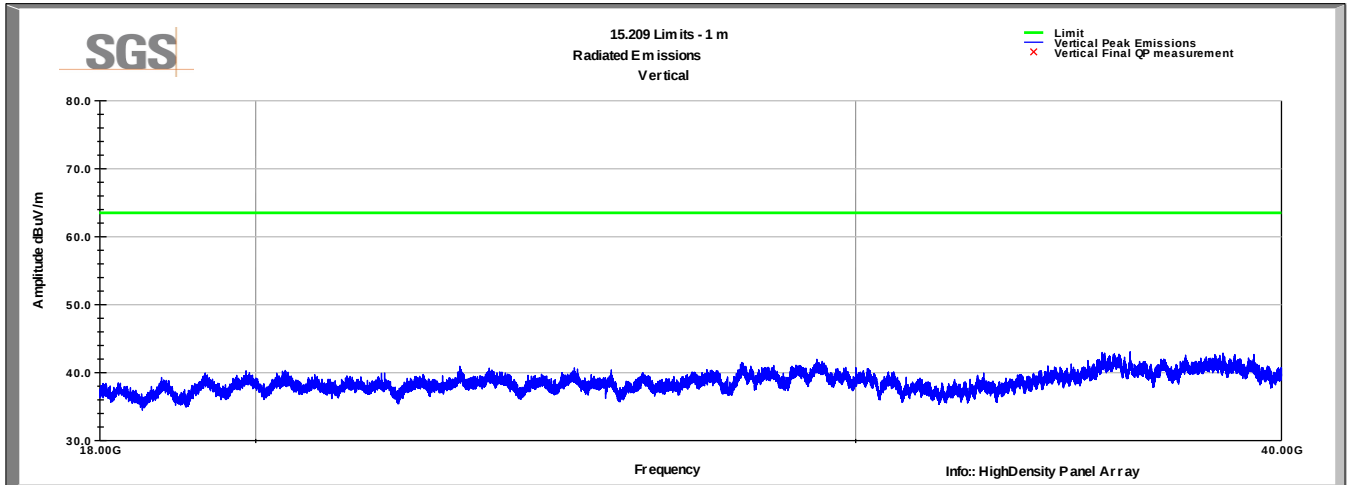
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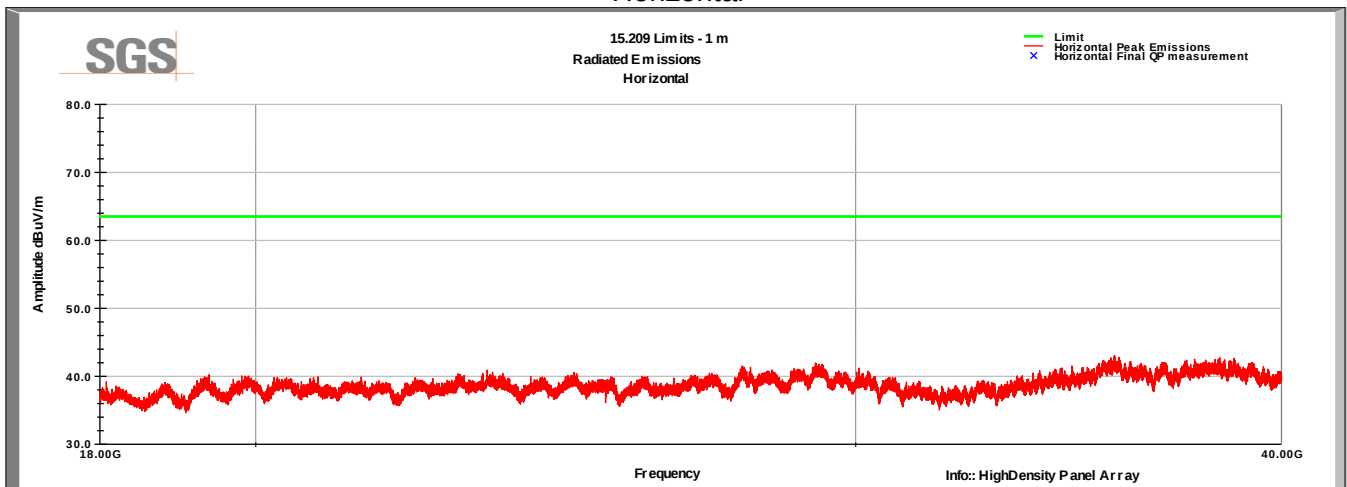
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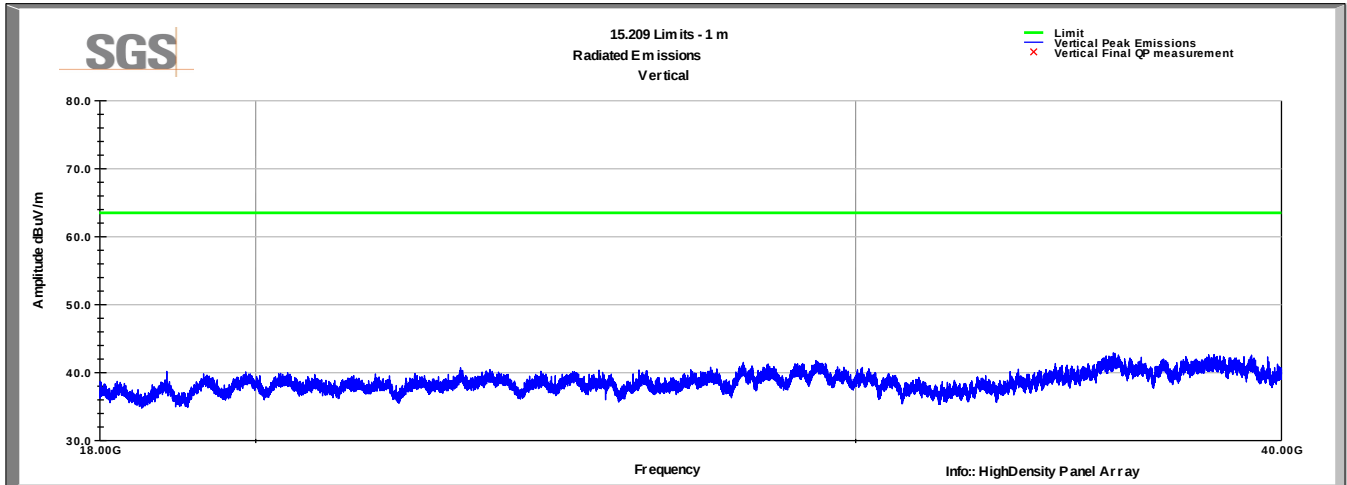
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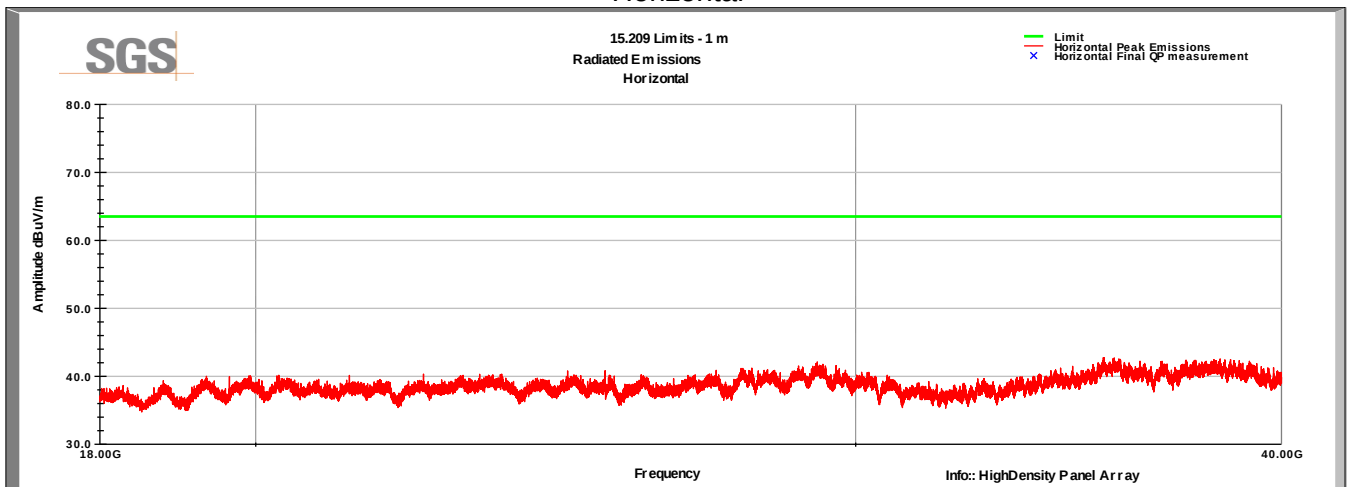
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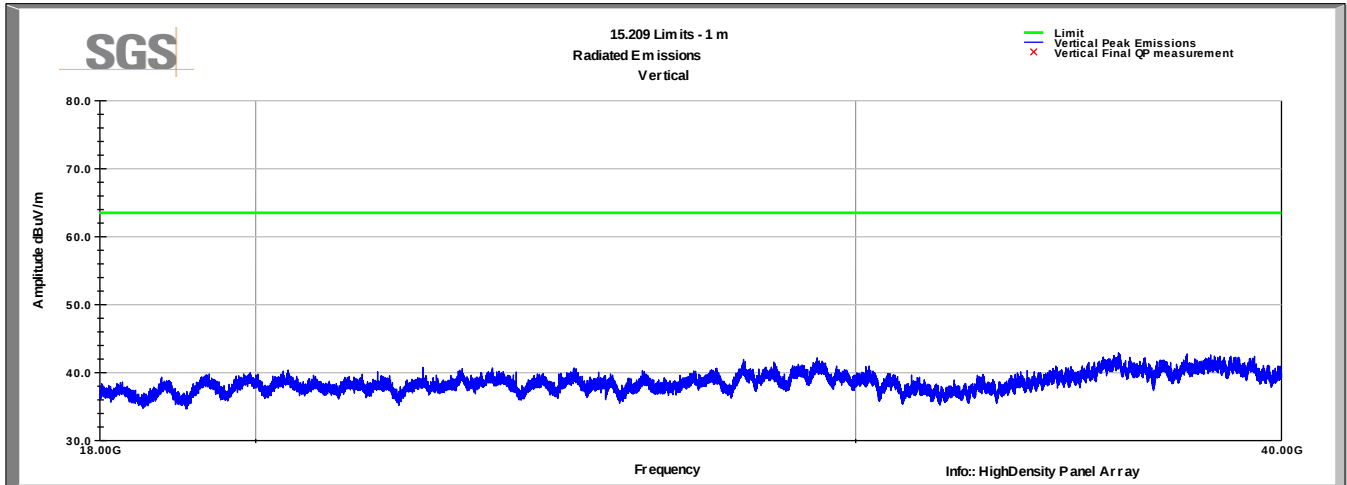
CH 153 6MB/s Vertical



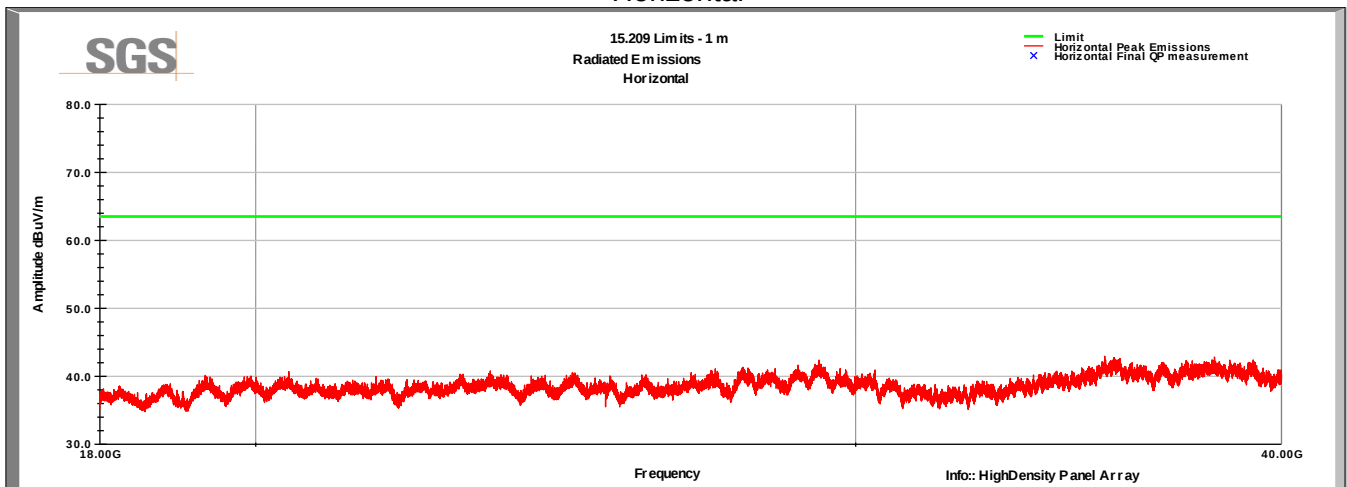
Horizontal



CH 161 6MB/s Vertical



Horizontal



3.8 Test Data – Tabular Results

Frequency MHz	Raw Meas (dBuV)	Polarity (V/H)	AF (dB/m)	CL (dB)	Amp (dB)	Corr Value dBuV/m	Limit (dBuV/m)	Margin (dB)	Detector
Channel 36									
5150.00	43.8	V	34.1	3.3	33.1	48.1	54.0	-5.9	Peak
5150.00	41.6	H	34.1	3.3	33.1	45.9	54.0	-8.1	Peak
Channel 149									
11490.00	35.2	V	38.2	5.1	32.2	46.3	54.0	-7.7	Peak
11490.00	35.3	H	38.2	5.1	32.2	46.4	54.0	-7.6	Peak
17235.00	35.3	V	41.0	6.5	33.4	49.4	68.2	-18.8	Peak
Channel 153									
11530.00	35.7	V	38.2	5.1	32.2	46.8	54.0	-7.2	Peak
11530.00	35.0	H	38.2	5.1	32.2	46.1	54.0	-7.9	Peak
17295.00	33.7	V	41.0	6.6	33.1	48.2	68.2	-20.0	Peak
Channel 161									
11610.00	36.2	V	38.3	5.1	32.4	47.2	54.0	-6.8	Peak
11610.00	36.0	H	38.3	5.1	32.4	47.0	54.0	-7.0	Peak
17415.00	34.1	V	40.9	6.8	33.0	48.8	68.2	-19.4	Peak
17415.00	32.2	H	40.9	6.8	33.0	46.9	68.2	-21.3	Peak
Avg Value = Level + AF + CL - Amp									
Margin = Avg Value - Limit									

4 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	11 January 2016

Appendix A: Power Adjustment Requirements

To maintain compliance with the power and PSD limits defined in FCC Sections 15.407(a)(1)(ii) and 15.407(a)(3) and RSS-247 Sections 6.2.1(1) and 6.2.4(1), the following guidance will be used for reducing the power settings relative to the original certification measurements.

U-NII-1 Band Conducted Power

Modulation Mode	Ntx	Freq (MHz)	Chain 1 (dBm)	Chain 2 (dBm)	Chain 3 (dBm)	Chains Summed (dBm)	Antenna Gain (dBi)	EIRP (dBm)	FCC EIRP Limit (dBm)	IC EIRP Limit (dBm)	FCC Margin (dB)	IC Margin (dB)
11a	3	5180	6.82	7.4	6.45	11.68	7	18.68	30	23	-11.32	-4.32
11a	3	5200	6.81	7.41	6.94	11.83	7	18.83	30	23	-11.17	-4.17
11a	3	5240	6.68	7.34	6.72	11.7	7	18.7	30	23	-11.3	-4.3
HT20	3	5180	6.68	7.26	6.59	11.62	7	18.62	30	23	-11.38	-4.38
HT20	3	5200	6.78	7.39	6.84	11.78	7	18.78	30	23	-11.22	-4.22
HT20	3	5240	6.62	7.3	6.61	11.63	7	18.63	30	23	-11.37	-4.37
HT40	3	5190	10.32	10.93	10.42	15.34	7	22.34	30	23	-7.66	-0.66
HT40	3	5230	10.26	10.86	10.58	15.34	7	22.34	30	23	-7.66	-0.66
VHT20	3	5180	6.73	7.3	6.62	11.66	7	18.66	30	23	-11.34	-4.34
VHT20	3	5200	6.85	7.46	6.92	11.86	7	18.86	30	23	-11.14	-4.14
VHT20	3	5240	6.62	7.32	6.67	11.65	7	18.65	30	23	-11.35	-4.35
VHT40	3	5190	10.35	11.01	10.52	15.41	7	22.41	30	23	-7.59	-0.59
VHT40	3	5230	10.34	11.03	10.62	15.44	7	22.44	30	23	-7.56	-0.56
VHT80	3	5210	11.48	11.89	11.52	16.41	7	23.41	30	23	-6.59	0.41

Power Spectral Density

Modulation Mode	Ntx	Freq (MHz)	Chains Summed (dBm)	Antenna Gain (dBi)	Corrected (dBm/MHz)	FCC PSD Limit (dBm/MHz)	IC PSD Limit (dBm/MHz)	FCC Margin (dB)	IC Margin (dB)
11a	3	5180	-1.07	7	5.93	17	10	-11.07	-4.07
11a	3	5200	-1.09	7	5.91	17	10	-11.09	-4.09
11a	3	5240	-1.18	7	5.82	17	10	-11.18	-4.18
VHT20	3	5180	-1.50	7	5.50	17	10	-11.50	-4.50
VHT20	3	5200	-1.49	7	5.51	17	10	-11.49	-4.49
VHT20	3	5240	-1.33	7	5.67	17	10	-11.33	-4.33
VHT40	3	5190	-1.15	7	5.85	17	10	-11.15	-4.15
VHT40	3	5230	-1.00	7	6.00	17	10	-11.00	-4.00
VHT80	3	5210	-3.96	7	3.04	17	10	-13.96	-6.96

No power adjustments are required for UNII-1 Band for FCC compliance. For operation in Canada, 802.11ac mode requires a 0.41dB reduction to meet the limits when operating with this 7dBi antenna.

U-NII-3 Band Conducted Power

Modulation Mode	Ntx	Freq (MHz)	Chain 1 (dBm)	Chain 2 (dBm)	Chain 3 (dBm)	Chains Summed (dBm)	Antenna Gain (dBi)	EIRP (dBm)	FCC/IC EIRP Limit (dBm)	Margin (dB)
11a	3	5745	24.69	24.8	25.1	29.64	7	36.64	36	0.64
11a	3	5785	24.71	24.81	25.25	29.7	7	36.7	36	0.7
11a	3	5825	24.78	24.89	25.26	29.75	7	36.75	36	0.75
HT20	3	5745	24.81	24.87	25.23	29.75	7	36.75	36	0.75
HT20	3	5785	24.63	24.81	25.19	29.65	7	36.65	36	0.65
HT20	3	5825	24.71	24.87	25.23	29.71	7	36.71	36	0.71
HT40	3	5745	24.52	24.81	25.08	29.58	7	36.58	36	0.58
HT40	3	5785	24.62	24.83	25.11	29.63	7	36.63	36	0.63
VHT20	3	5825	24.83	24.92	25.28	29.79	7	36.79	36	0.79
VHT20	3	5745	24.89	24.98	25.29	29.83	7	36.83	36	0.83
VHT20	3	5785	24.76	24.91	25.29	29.76	7	36.76	36	0.76
VHT40	3	5755	24.69	24.88	25.18	29.69	7	36.69	36	0.69
VHT40	3	5795	24.7	24.92	25.23	29.73	7	36.73	36	0.73
VHT80	3	5775	24.05	24.88	25.18	29.5	7	36.5	36	0.5

Power Spectral Density

Modulation Mode	Ntx	Freq (MHz)	Chains Summed (dBm/3kHz)	Chains Summed (dBm/500kHz)	Antenna Gain (dBi)	Corrected (dBm/MHz)	IC/FCC PSD Limit (dBm/500kHz)	Margin (dB)
11a	3	5745	0.24	22.46	7	29.46	30	-0.54
11a	3	5785	0.17	22.39	7	29.39	30	-0.61
11a	3	5825	0.62	22.84	7	29.84	30	-0.16
VHT20	3	5745	1.23	23.45	7	30.45	30	0.45
VHT20	3	5785	0.29	22.51	7	29.51	30	-0.49
VHT20	3	5825	0.13	22.35	7	29.35	30	-0.65
VHT40	3	5745	-2.67	19.55	7	26.55	30	-3.45
VHT40	3	5785	-2.27	19.95	7	26.95	30	-3.05
VHT80	3	5775	-11.23	10.99	7	17.99	30	-12.01

The conducted PSD measurements in the original filing were adjusted from dBm/3kHz to dBm/500kHz by using the formula $10 \cdot \log(RBW1/RBW2)$.

Summary

The power reductions in the following three tables are required to maintain compliance with all of the requirements defined in Section 15.407(a)(1)(i) when using the 7dBi gain antenna:

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

Band	Modulation	Channel	Frequency (MHz)	Required Reduction (dB)	
				FCC	IC
U-NII-1	802.11a	36	5180	0	0
		40	5200	0	0
		48	5240	0	0
	802.11n (HT20)	36	5180	0	0
		40	5200	0	0
		48	5240	0	0
	802.11n (HT40)	38	5190	0	0
		46	5230	0	0
	802.11n (VHT20)	36	5180	0	0
		40	5200	0	0
		48	5240	0	0
	802.11n (VHT40)	38	5190	0	0
		46	5230	0	0
	802.11ac (VHT80)	42	5210	0	0.41
U-NII-3	802.11a	149	5745	0.64	0.64
		157	5785	0.7	0.7
		165	5825	0.75	0.75
	802.11n (HT20)	149	5745	0.75	0.75
		157	5785	0.65	0.65
		165	5825	0.71	0.71
	802.11n (HT40)	151	5755	0.58	0.58
		159	5795	0.63	0.63
	802.11n (VHT20)	149	5745	0.79	0.79
		157	5785	0.83	0.83
		165	5825	0.76	0.76
	802.11n (VHT40)	151	5755	0.69	0.69
		159	5795	0.73	0.73
	802.11ac (VHT80)	155	5775	0.5	0.5