



**FCC 47 CFR PART 15 SUBPART E
INDUSTRY CANADA RSS-247 ISSUE 1**

CLASS II PERMISSIVE CHANGE

TEST REPORT

FOR

802.11a/b/g/n 2x2 (HT20) CLIENT DEVICE

MODEL NUMBER: PLAY: 1 (Type 2)

FCC ID: SBVRM009

IC: 5373A-RM009

REPORT NUMBER: 15U21732- E2V2

ISSUE DATE: FEBRUARY 26, 2016

Prepared for

Sonos, Inc.

614 Chapala Street

Santa Barbara, CA, 93101, U.S.A.

Prepared by

UL VERIFICATION SERVICES INC.

47173 BENICIA STREET

FREMONT, CA 94538, U.S.A.

TEL: (510) 771-1000

FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	1/8/16	Initial Issue	H. Mustapha
V2	2/26/16	Updated PSD results table on page 26	H. Mustapha

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	4
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>7</i>
4.3. <i>MEASUREMENT UNCERTAINTY.....</i>	<i>7</i>
5. EQUIPMENT UNDER TEST	8
5.1. <i>DESCRIPTION OF EUT</i>	<i>8</i>
5.2. <i>DESCRIPTION OF CLASS II PERMISSIVE CHANGE</i>	<i>8</i>
5.3. <i>MAXIMUM OUTPUT POWER.....</i>	<i>8</i>
5.4. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>8</i>
5.5. <i>SOFTWARE AND FIRMWARE.....</i>	<i>8</i>
5.6. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>9</i>
5.7. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>10</i>
6. TEST AND MEASUREMENT EQUIPMENT	12
7. MEASUREMENT METHODS	13
8. ANTENNA PORT TEST RESULTS	14
8.1. <i>ON TIME AND DUTY CYCLE.....</i>	<i>14</i>
8.2. <i>802.11n HT20 CDD 2Tx MODE IN THE 5.8 GHz BAND.....</i>	<i>15</i>
8.2.1. <i>6 dB BANDWIDTH.....</i>	<i>15</i>
8.2.1. <i>99% BANDWIDTH.....</i>	<i>19</i>
8.2.2. <i>OUTPUT POWER</i>	<i>23</i>
8.2.3. <i>MAXIMUM POWER SPECTRAL DENSITY (PSD)</i>	<i>25</i>
9. RADIATED TEST RESULTS.....	30
9.1. <i>LIMITS AND PROCEDURE.....</i>	<i>30</i>
9.2. <i>TX ABOVE 1 GHz 802.11n HT20 CDD 2TX MODE IN THE 5.8 GHz BAND.....</i>	<i>31</i>
9.3. <i>WORST-CASE ABOVE 18GHz</i>	<i>41</i>
9.4. <i>WORST-CASE BELOW 1 GHz.....</i>	<i>45</i>
10. AC POWER LINE CONDUCTED EMISSIONS	47
11. SETUP PHOTOS	51
12. ART POWER SETTINGS TABLE	55

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Sonos, Inc.
614 Chapala Street
Santa Barbara, CA, 93101, U.S.A.

EUT DESCRIPTION: 802.11a/b/g/n 2x2 Client Device

MODEL: PLAY: 1 (Type 2)

SERIAL NUMBER: B8-E9-37-E7-83-AE (Type2).

DATE TESTED: OCTOBER 20, 2015 to NOVEMBER 05, 2015
FEBRUARY 27, 2014 to MARCH 7, 2014

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. And all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

Tested By:

Huda Mustapha



HUDA MUSTAPHA
PROJECT LEAD
UL Verification Services Inc.

DANNY VU
EMC ENGINEER
UL Verification Services Inc.



FRANK IBRAHIM
PROGRAM MANAGER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033 D02 v01, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
<input type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input checked="" type="checkbox"/> Chamber B	<input type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F
	<input type="checkbox"/> Chamber G
	<input type="checkbox"/> Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	± 3.52 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.94 dB
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT is an 802.11a/b/g/n (2x2, 20 MHz channel bandwidth only) DFS client device.

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The purpose of this C2PC is to upgrade the device described under section 5.1 of this report to the new rules per KDB 789033 D02 v01 and RSS-247.

For UNII-1, UNII-2 and UNII-2C bands, we have also reviewed the original test report (report no. 14U17203-2A) and are hereby attesting that all the current technical requirements are still met and all applicable test procedures remain the same. Therefore, the original test report is still applicable and no additional testing is done.

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5745 - 5825	802.11n HT20	18.45	69.98

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes right and left dipole PCB antennas with a maximum gain of 2.85 dBi and 3.09 dBi respectively.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Atheros Radio Test 2 (ART2-GUI).

5.6. WORST-CASE CONFIGURATION AND MODE

For Radiated Emissions below 1 GHz and Power line Conducted Emissions, the channel with the highest conducted output power was selected as worst-case scenario.

Worst-case data rate as provided by the manufacturer was:
11n HT20 (5.8 GHz band): MCS9

The EUT is for desktop applications; all radiated testing was performed with EUT laid out in desktop configuration.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	X201	R9-6KTFV	N/A
Laptop AC Adapter	Lenovo	ADLX65NCT2A	11S45N0323Z1ZH3B4HPD	N/A

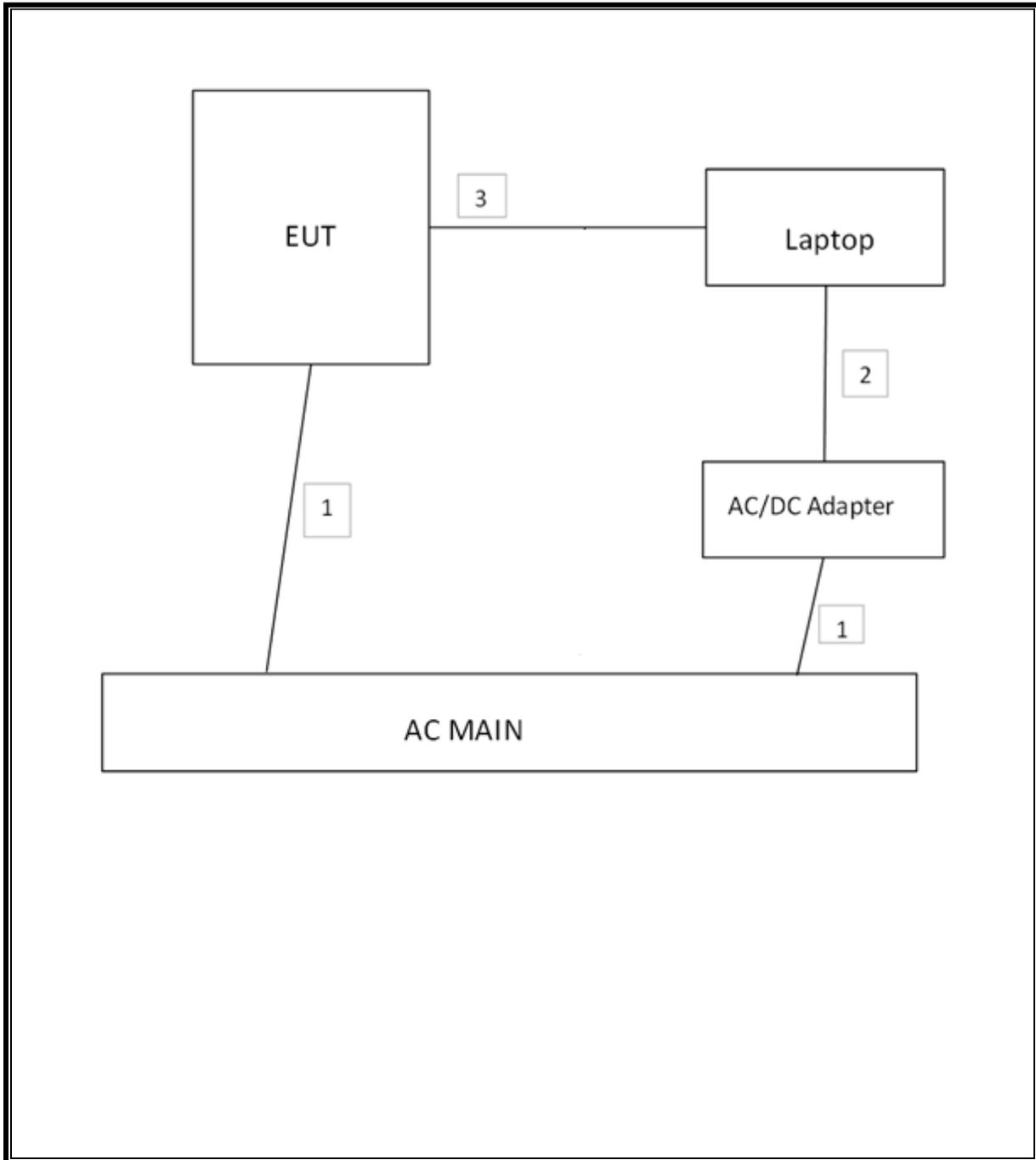
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	2	US 115V	Unshielded	1.8m	N/A
2	DC	1	DC	Unshielded	1.8m	N/A
3	Ethernet	1	RJ45	Unshielded	1.5m	N/A

TEST SETUP

The EUT is connected to a laptop via an Ethernet cable during the tests and software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	Manufacturer	Model	T No.	Cal Date	Cal Due
Radiated Software	UL	UL EMC	Ver 9.5, June 6, 2015		
Conducted Software	UL	UL EMC	Ver 9.5, May 17 2012		
Bilog Antenna 30-1000MHz	Sunol	JB1	130	09/01/15	09/01/16
Horn Antenna 1-18GHz	ETS	3117	136	03/03/15	03/03/16
Horn Antenna 18-26GHz	ARA	SWH-28	98	12/17/14	12/17/15
Horn Antenna 26.5- 40GHz	ARA	MWH-2640/B	90	07/28/15	07/28/16
Preamp 10kHz- 1000MHz	HP	8447D	10	01/16/15	01/16/16
Preamp 1-8GHz	Miteq	AMF-4D-01000800-30-29P	782	10/22/15	10/22/16
Preamp 1-26.5GHz	Agilent	8449B	404	04/13/15	04/13/16
Amplifier, 26-40GHz	Miteq	NSP4000-SP2	88	04/07/15	04/07/16
Spectrum Analyzer 3kHz - 44GHz	Agilent	N9030A	907	05/15/15	05/15/16
Spectrum Analyzer 9kHz - 40GHz	HP	8564E	106	08/14/15	08/14/16
Coaxial Switchbox	Agilent	SP6T	927	03/03/15	03/03/16
3GHz HPF	Micro-Tronics	HPM17543	487	01/31/15	01/31/16
5GHz LPF	Micro-Tronics	LPS17541	482	01/16/15	01/16/16
6GHz HPF	Micro-Tronics	HPS17542	483	01/16/15	01/16/16
EMI Test Receiver	Rohde & Schwarz	ECSI 7	212	08/07/15	08/07/16
Power Meter	Agilent	N1911A	T1268	06/07/15	06/07/16
Power Sensor	Agilent	N1921A	1223	06/07/15	02/06/16

7. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 789033 D02 v01, Section B.

6 dB Emission BW: KDB 789033 D02 v01, Section C.2.

99% Occupied BW: KDB 789033 D02 v01, Section D.

Conducted Output Power: KDB 789033 D02 v01, Section E.3.a (Method PM), and KDB 662911 D01 v02r01.

Power Spectral Density: KDB 789033 D02 v01, Section F.

Unwanted emissions in restricted bands: KDB 789033 D02 v01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01, Sections G.3, G.4, and G.5.

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

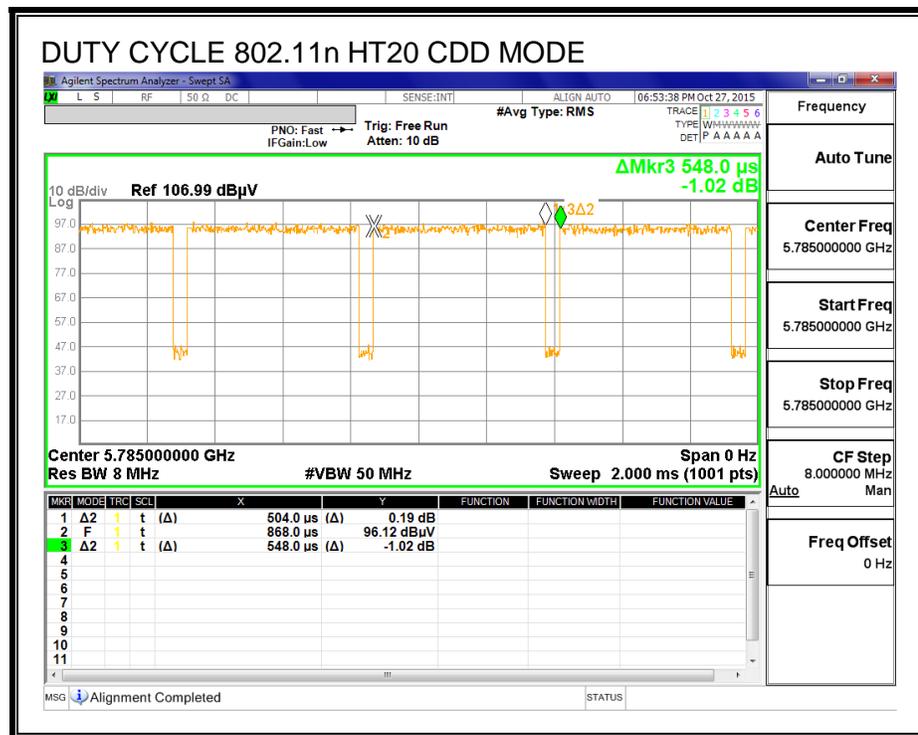
LIMITS

None; for reporting purposes only.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11n HT20 CDD	0.504	0.548	0.920	91.97%	0.36	1.984

DUTY CYCLE PLOTS



8.2. 802.11n HT20 CDD 2Tx MODE IN THE 5.8 GHz BAND

8.2.1. 6 dB BANDWIDTH

LIMITS

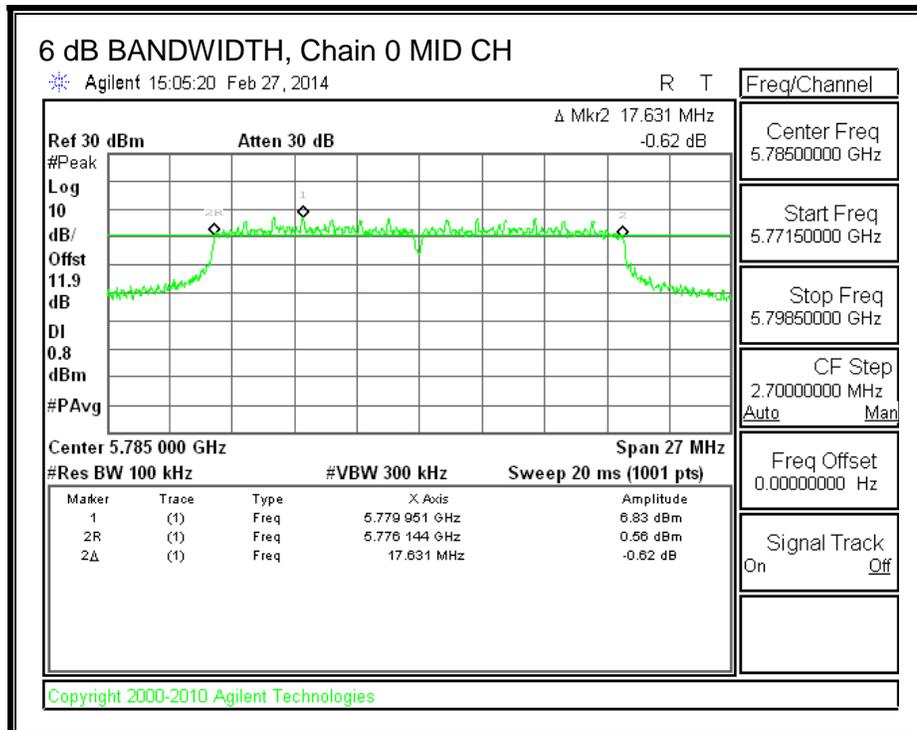
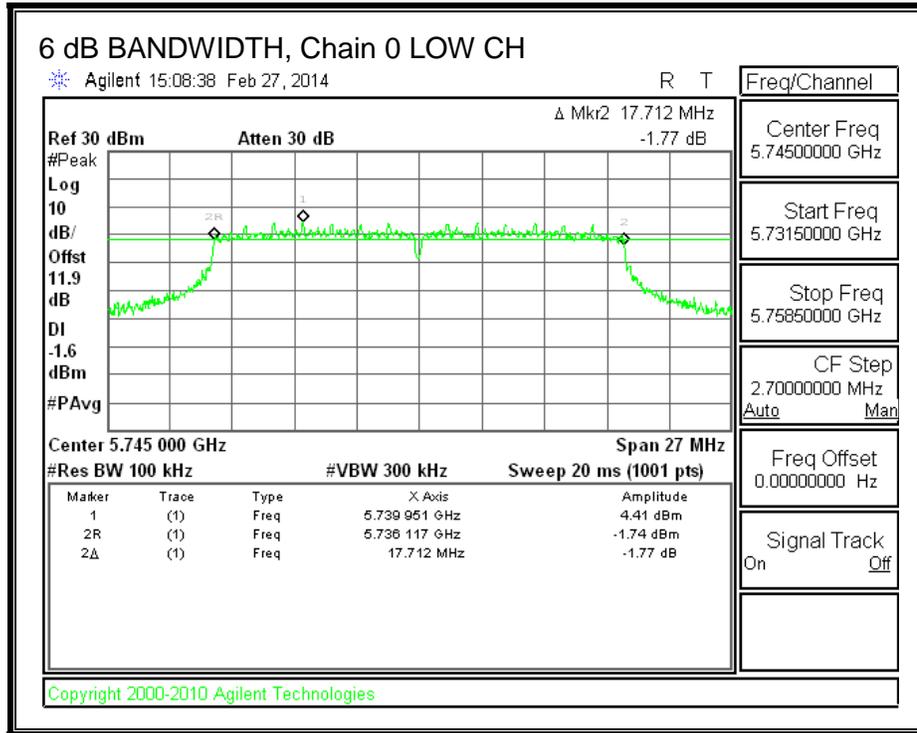
FCC §15.247 (a) (2)

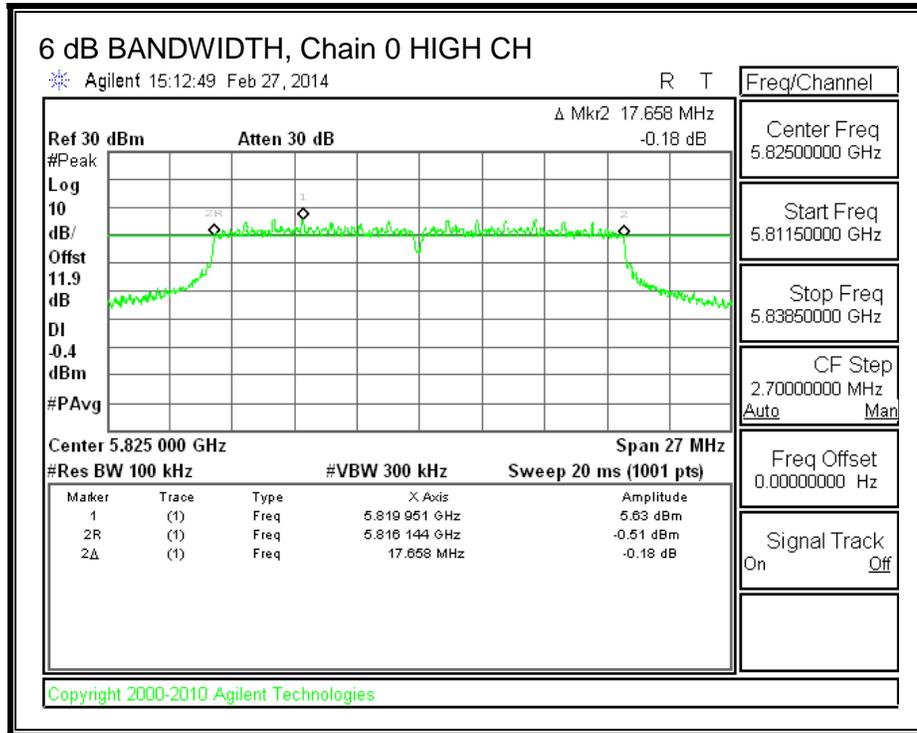
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

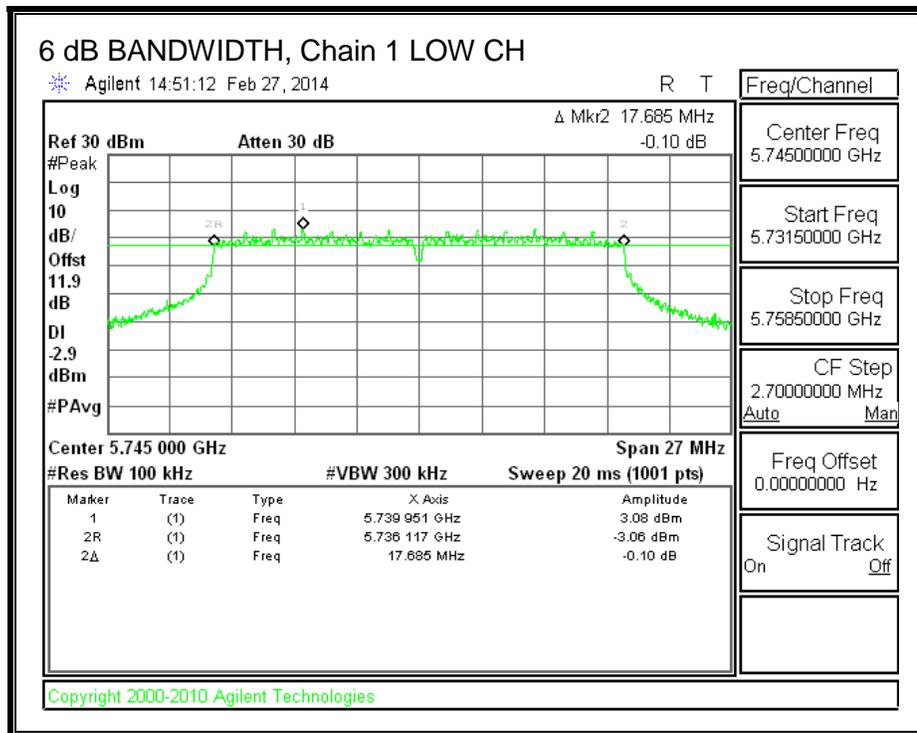
Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	5745	17.712	17.685	0.5
Mid	5785	17.631	16.929	0.5
High	5825	17.658	17.631	0.5

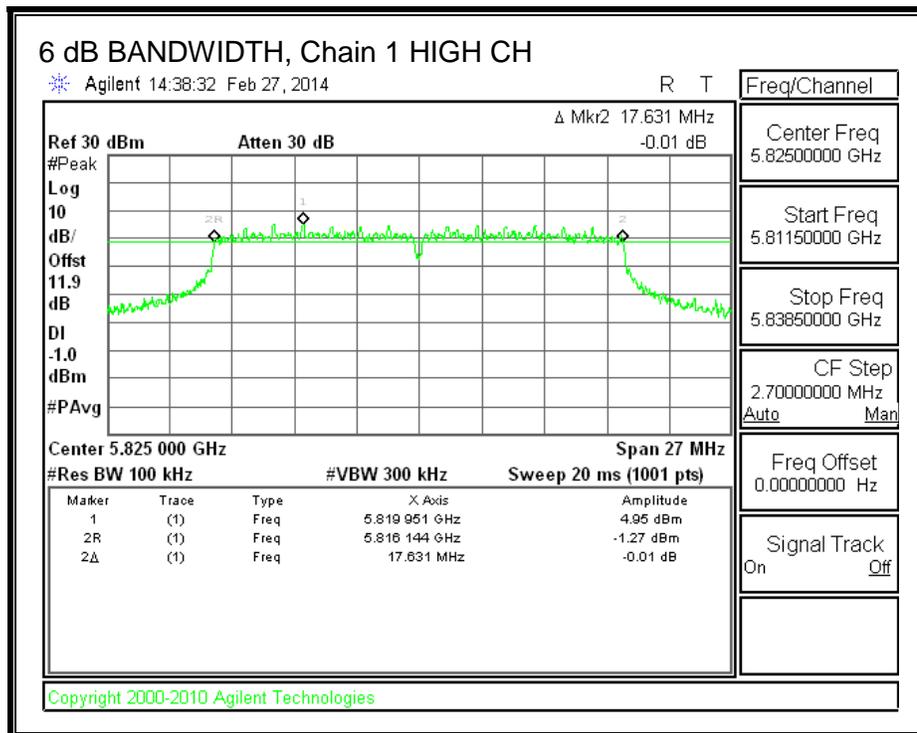
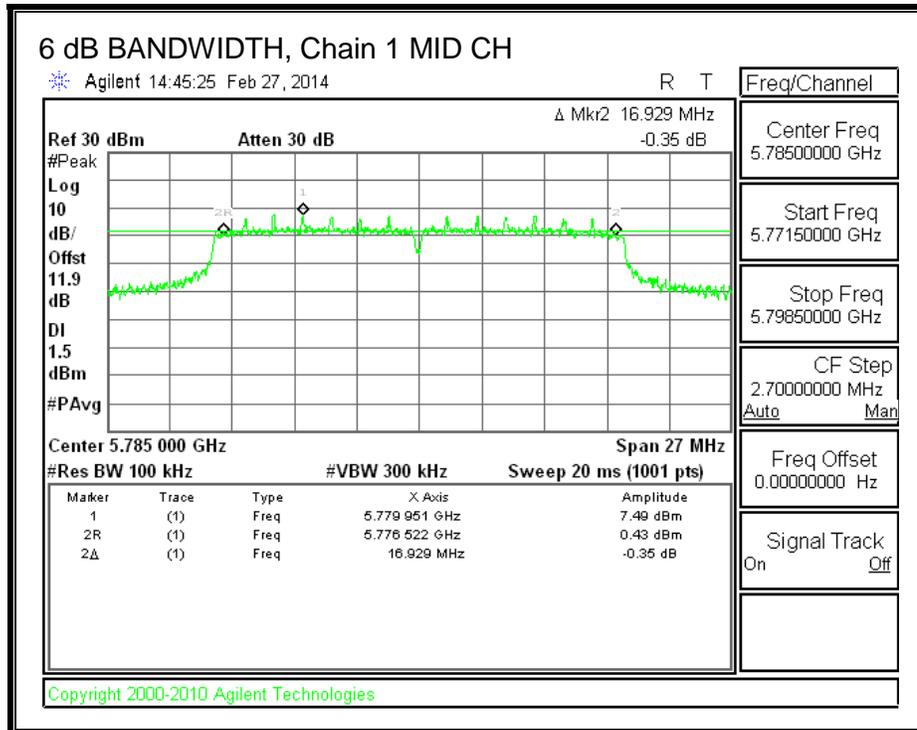
6 dB BANDWIDTH, Chain 0





6 dB BANDWIDTH, Chain 1





8.2.1. 99% BANDWIDTH

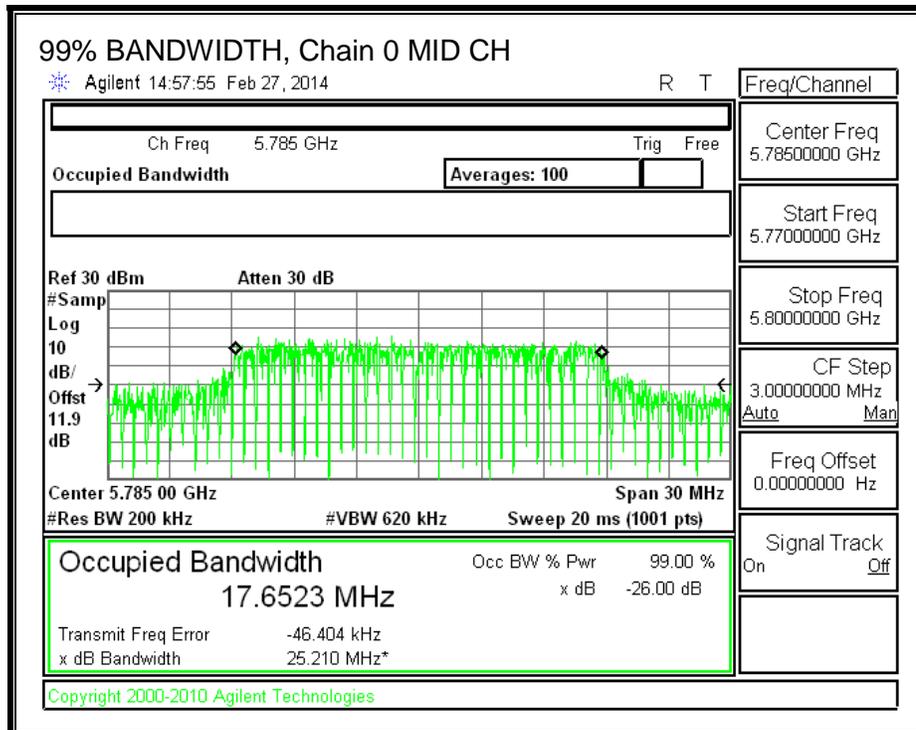
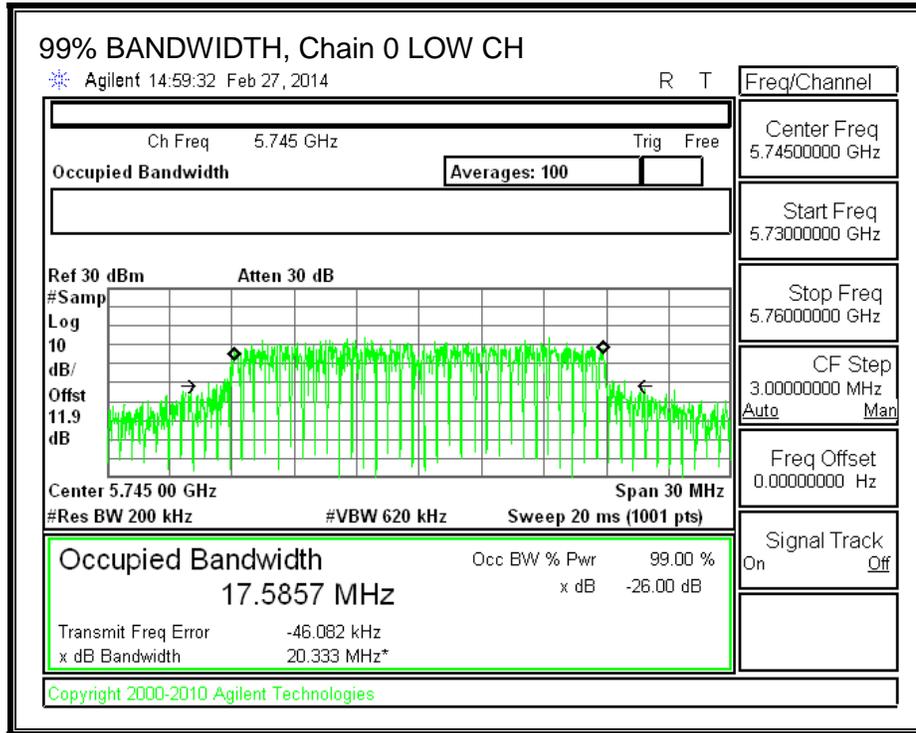
LIMITS

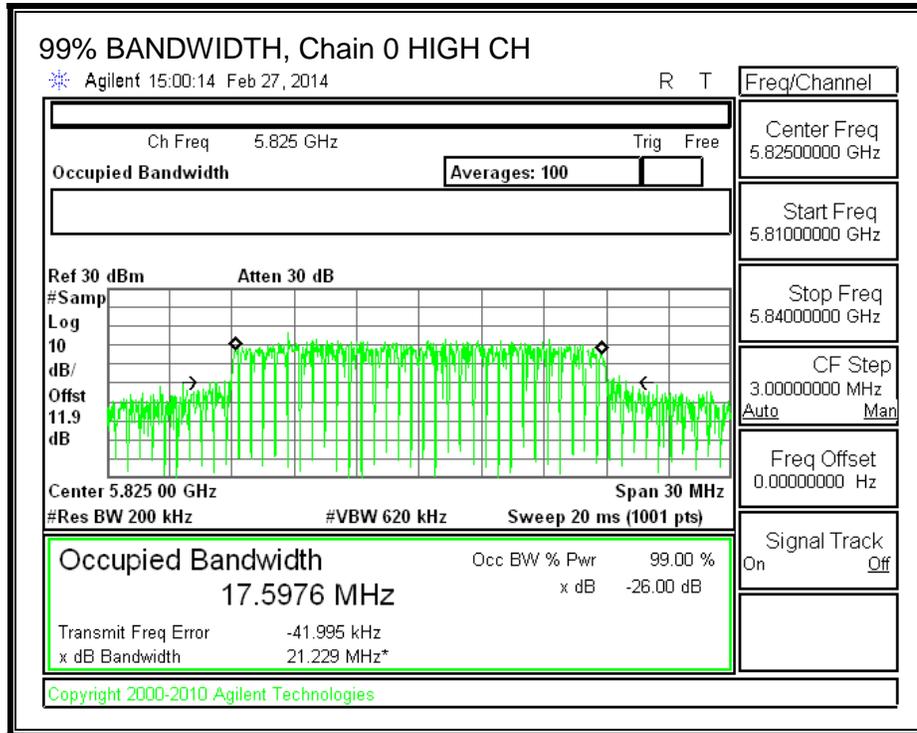
None; for reporting purposes only.

RESULTS

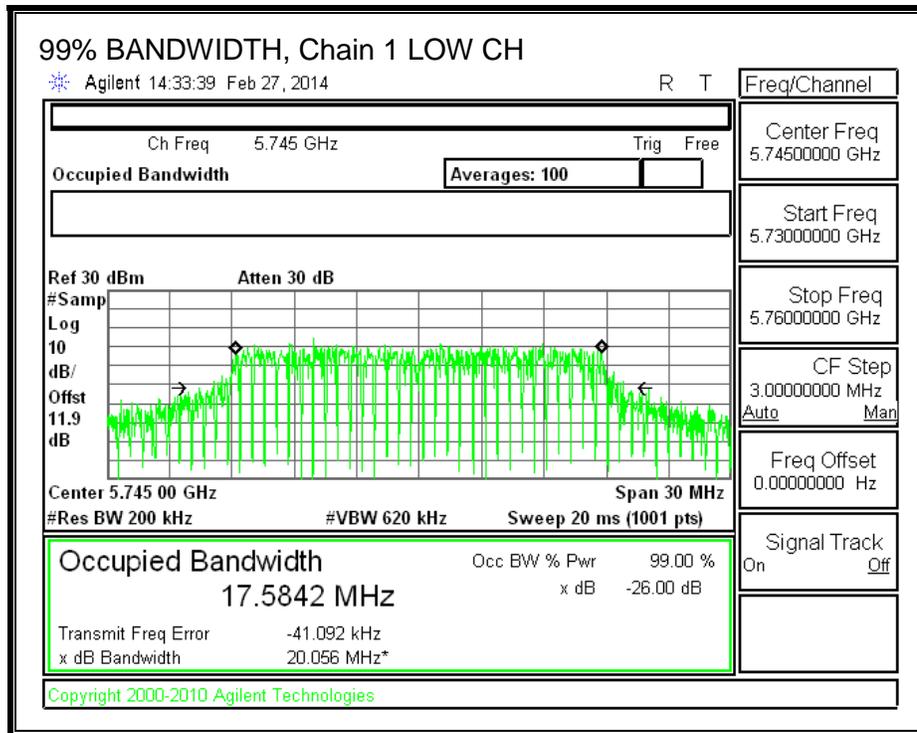
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5745	17.59	17.58
Mid	5785	17.65	17.68
High	5825	17.60	17.63

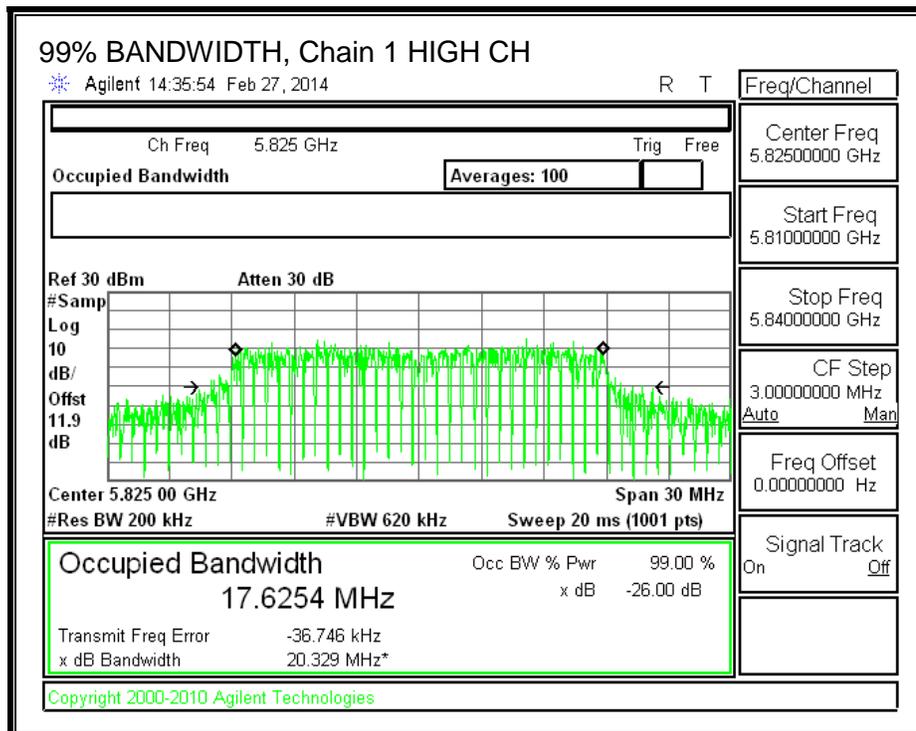
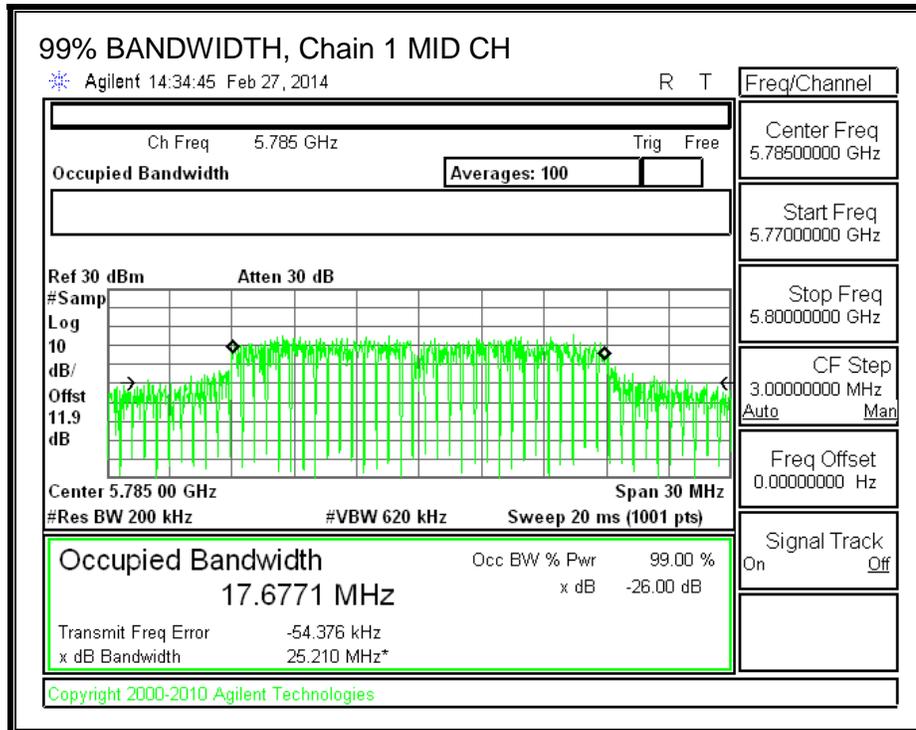
99% BANDWIDTH, Chain 0





99% BANDWIDTH, Chain 1





8.2.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (3)

IC RSS-247 6.2.4 (1)

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.85	3.09	2.97

RESULTS

Antenna Gain and Limit

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Power Limit (dBm)
Low	5745	2.97	30.00
Mid	5785	2.97	30.00
High	5825	2.97	30.00

Duty Cycle CF (dB)	0.36	Included in Calculations of Corr'd Power
---------------------------	------	---

Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5745	15.00	14.70	18.22	30.00	-11.78
Mid	5785	15.00	15.15	18.45	30.00	-11.55
High	5825	14.05	13.80	17.30	30.00	-12.70

8.2.3. MAXIMUM POWER SPECTRAL DENSITY (PSD)

LIMITS

FCC §15.407 (a) (3)

IC RSS-247 6.2.4 (1)

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
2.85	3.09	5.98

RESULTS

Antenna Gain and Limits

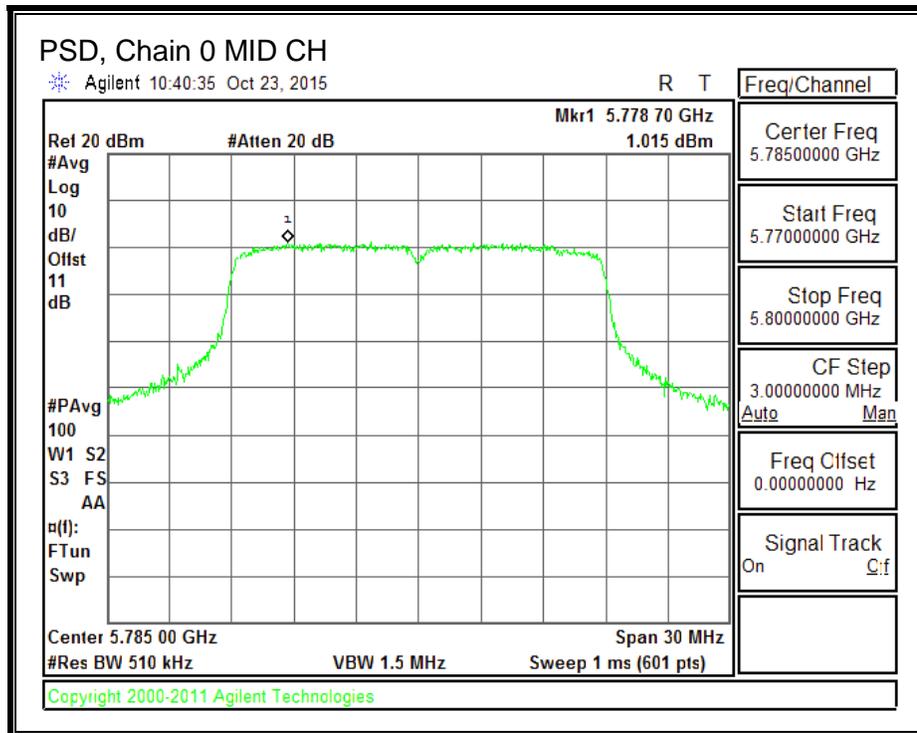
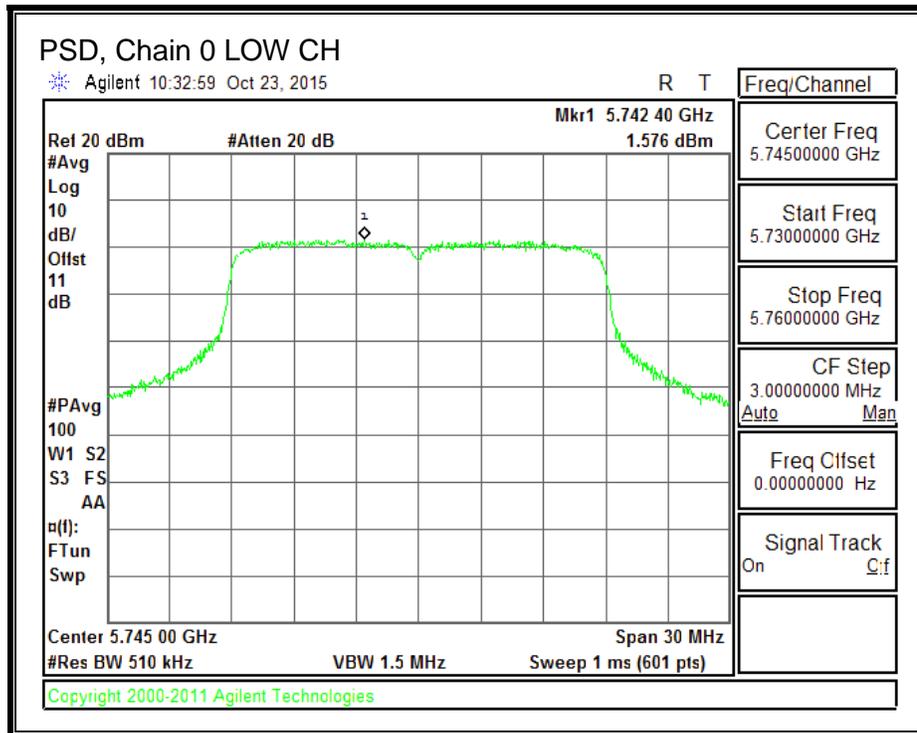
Channel	Frequency (MHz)	Directional Gain (dBi)	PSD Limit (dBm)
Low	5745	5.98	30.00
Mid	5785	5.98	30.00
High	5825	5.98	30.00

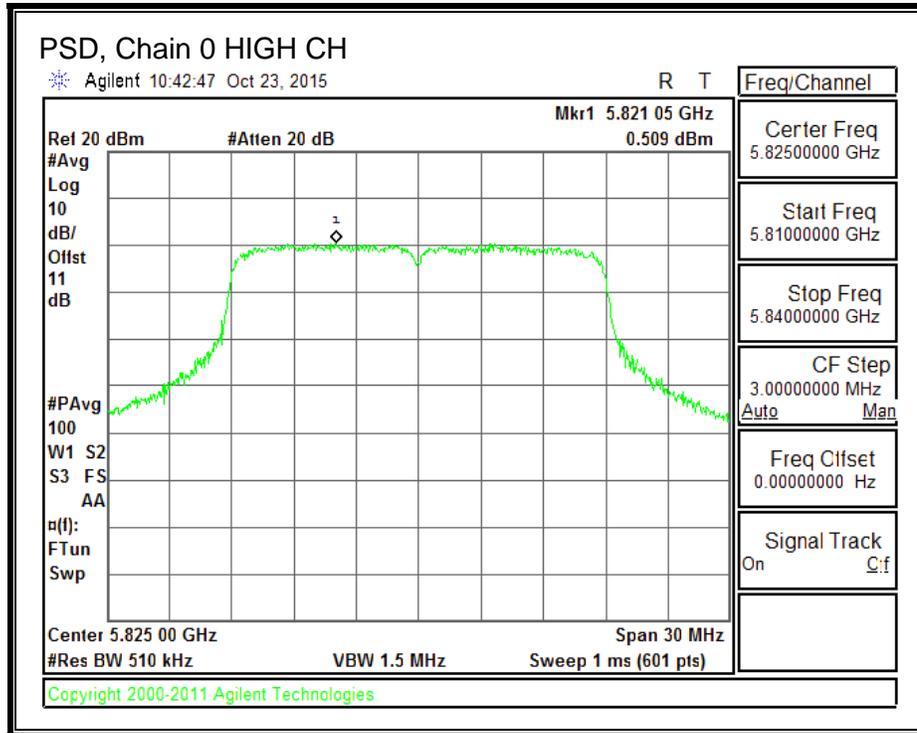
Duty Cycle CF (dB)	0.36	Included in Calculations of Corr'd PSD
---------------------------	------	---

PSD Results

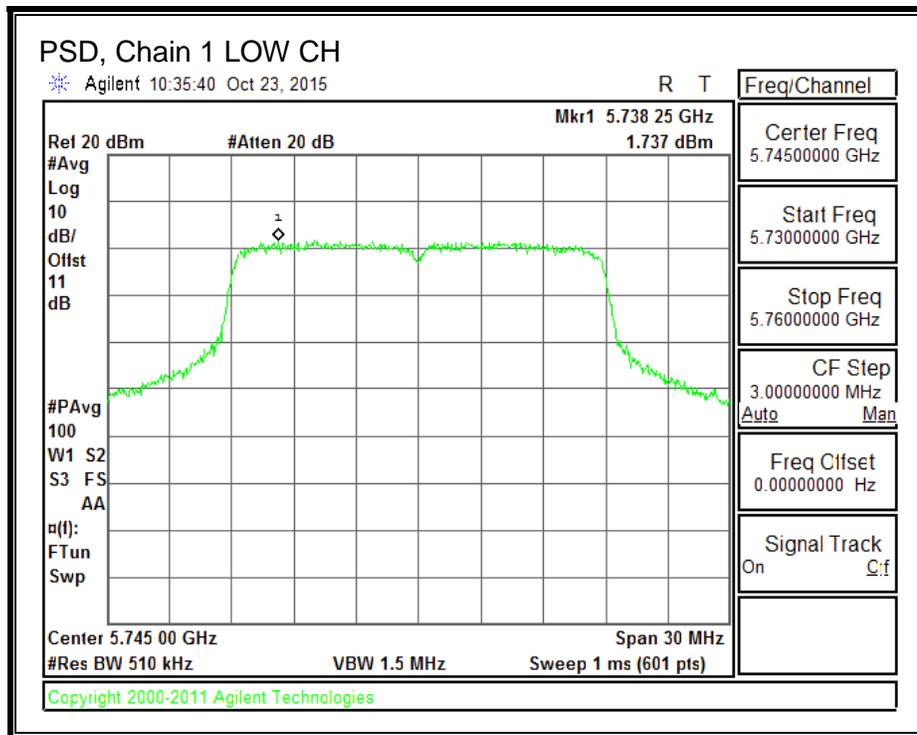
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5745	1.576	1.737	5.028	30.000	-24.972
Mid	5785	1.015	0.713	4.237	30.000	-25.763
High	5825	0.509	0.722	3.987	30.000	-26.013

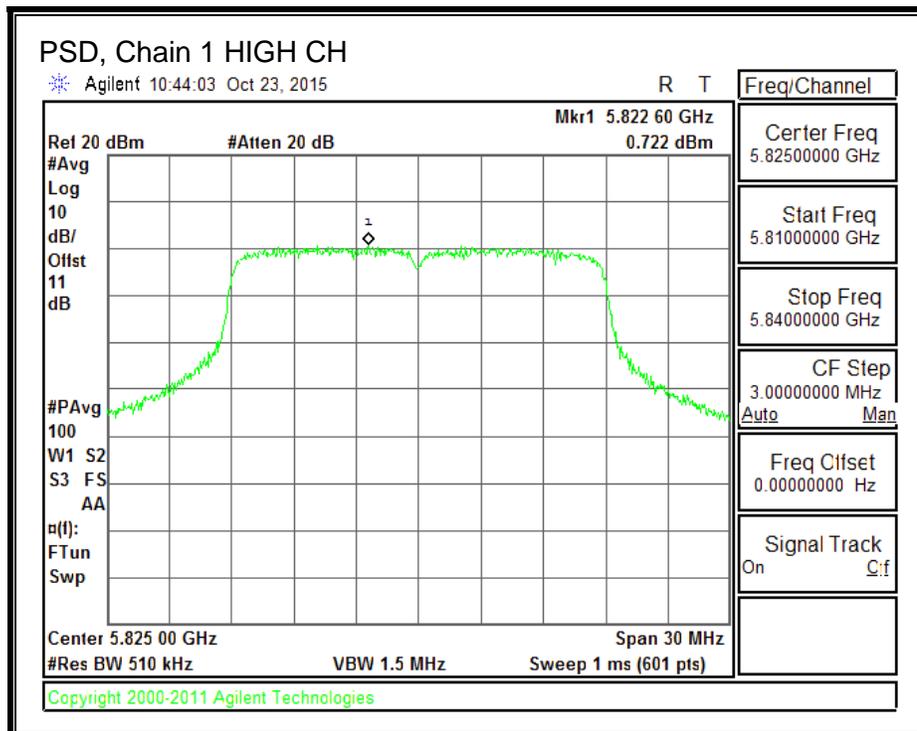
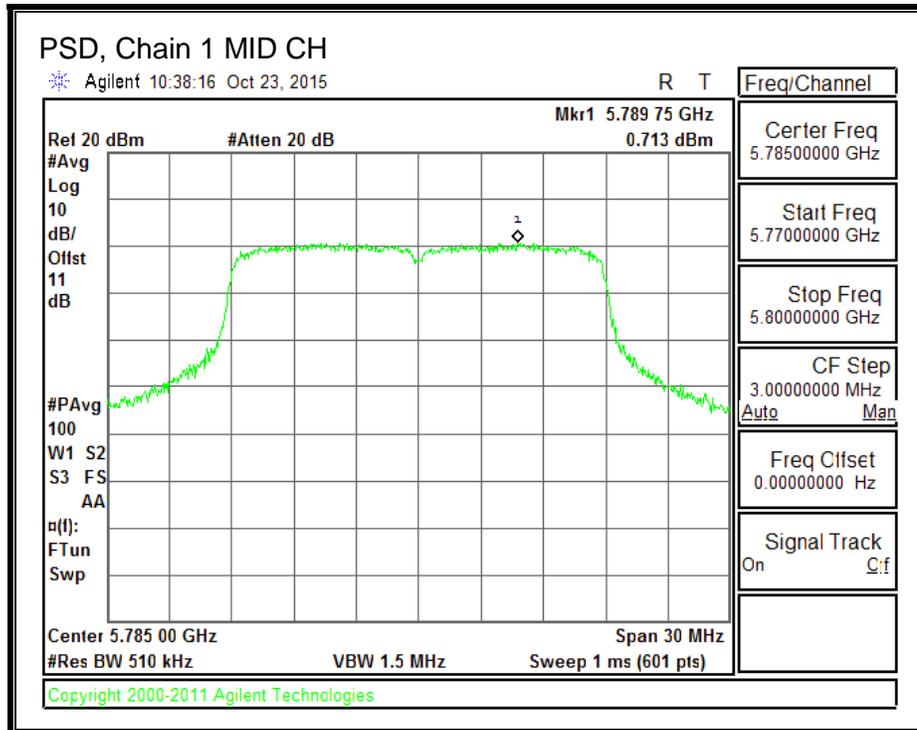
PSD, Chain 0





PSD, Chain 1





9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

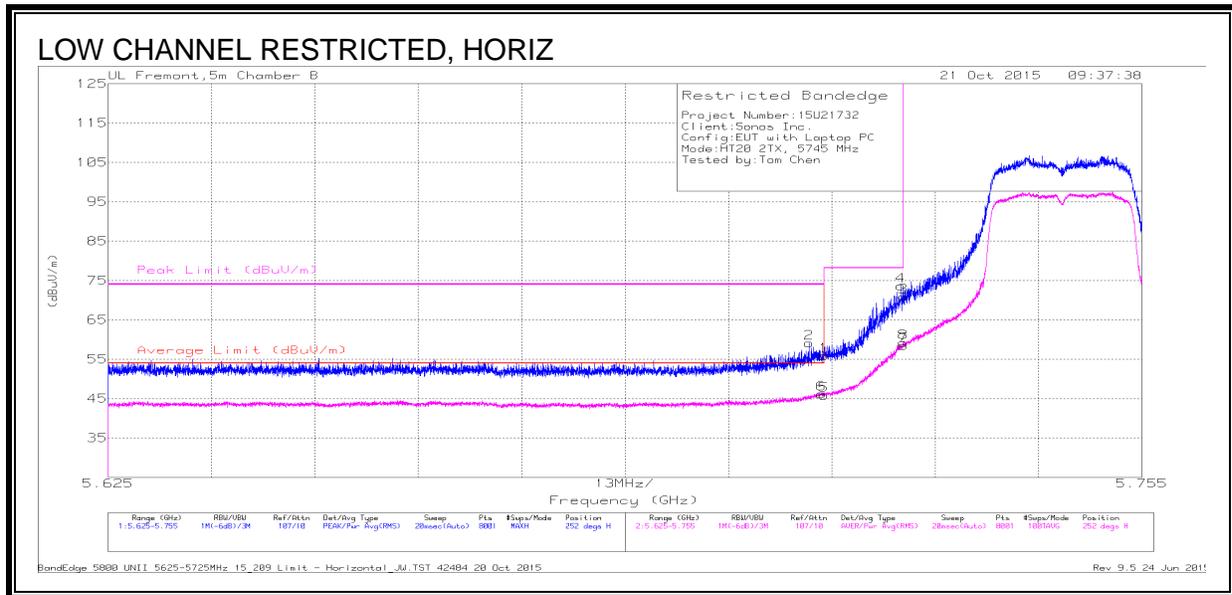
FCC §15.205 and §15.209

IC RSS-GEN Clause 8.9 (Transmitter)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

9.2. TX ABOVE 1 GHz 802.11n HT20 CDD 2TX MODE IN THE 5.8 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)



Trace Markers

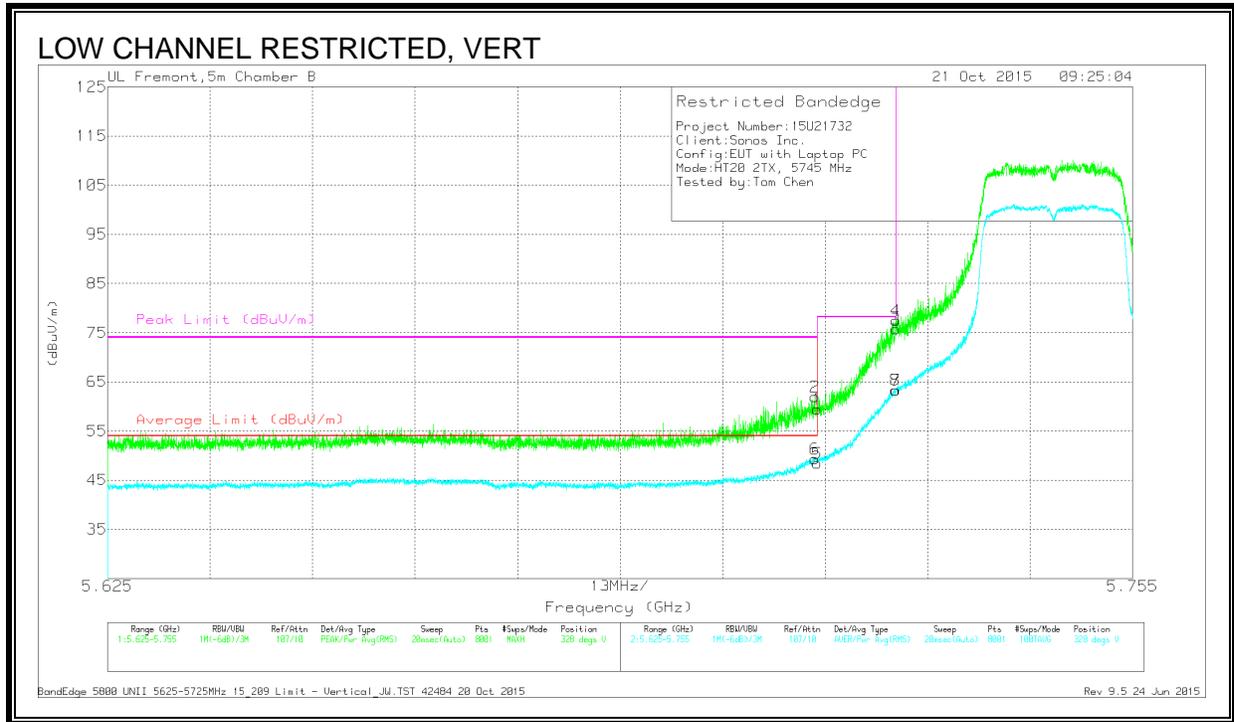
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fit r/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	5.713	45.15	Pk	35	-21	0	59.15	-	-	74	-14.85	252	396	H
1	5.715	41.89	Pk	35	-21	0	55.89	-	-	74	-18.11	252	396	H
5	5.715	31.87	RMS	35	-21	.36	46.23	54	-7.77	-	-	252	396	H
6	5.715	32.05	RMS	35	-20.9	.36	46.51	54	-7.49	-	-	252	396	H
3	5.725	56.67	Pk	35	-20.8	0	70.87	-	-	78.2	-7.33	252	396	H
4	5.725	59.51	Pk	35	-20.9	0	73.61	-	-	78.2	-4.59	252	396	H

Pk - Peak detector

RMS - RMS detection

BandEdge 5800 UNII 5625-5725MHz 15_209 Limit - Horizontal_JW.TST 42484 20 Oct 2015

Rev 9.5 24 Jun 2015



Trace Markers

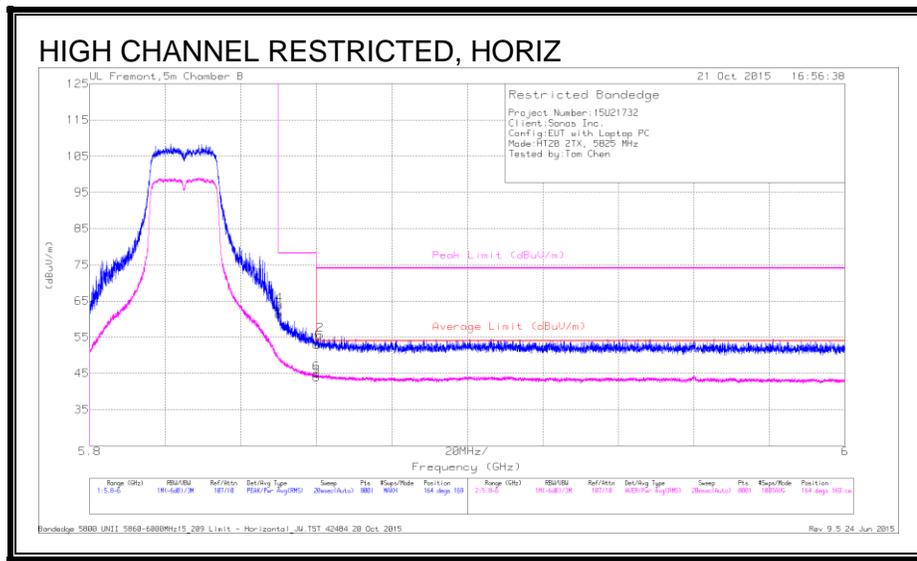
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dBm)	Amp/Cb/Fitr/P ad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	5.715	45.47	Pk	35	-21	0	59.47	-	-	74	-14.53	328	291	V
2	5.715	47.89	Pk	35	-20.9	0	61.99	-	-	74	-12.01	328	291	V
5	5.715	34.45	RMS	35	-21	.36	48.81	54	-5.19	-	-	328	291	V
6	5.715	35.23	RMS	35	-20.9	.36	49.69	54	-4.31	-	-	328	291	V
3	5.725	61.55	Pk	35	-20.8	0	75.75	-	-	78.2	-2.45	328	291	V
4	5.725	63.38	Pk	35	-20.9	0	77.48	-	-	78.2	-72	328	291	V

Pk - Peak detector

RMS - RMS detection

BandEdge 5800 UNII 5625-5725MHz 15_209 Limit - Vertical_JW.TST 42484 20 Oct 2015
 Rev 9.5 24 Jun 2015

RESTRICTED BANDEDGE (HIGH CHANNEL)



Trace Markers

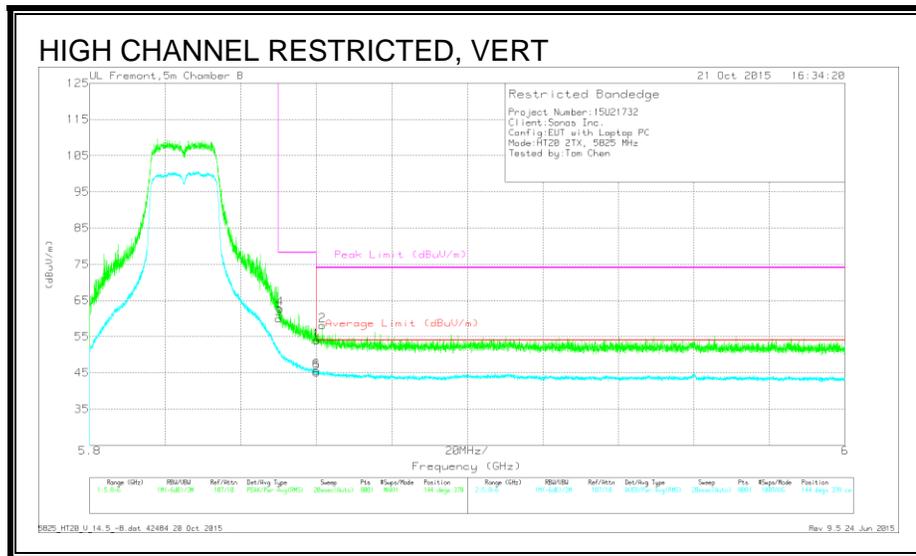
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dBm)	Amp/Cb/Fltr/P ad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	5.85	47	Pk	35.4	-20.9	0	61.5	-	-	78.2	-16.7	164	169	H
4	5.85	49.48	Pk	35.4	-20.9	0	63.98	-	-	78.2	-14.22	164	169	H
1	5.86	38.37	Pk	35.4	-20.9	0	52.87	-	-	74	-21.13	164	169	H
5	5.86	29.15	RMS	35.4	-20.9	.36	44.01	54	-9.99	-	-	164	169	H
6	5.86	30.05	RMS	35.4	-20.9	.36	44.89	54	-9.11	-	-	164	169	H
2	5.861	41.28	Pk	35.4	-21	0	55.68	-	-	74	-18.32	164	169	H

Pk - Peak detector

RMS - RMS detection

Bandedge 5800 UNII 5860-6000MHz15_209 Limit - Horizontal_JW.TST 42484 20 Oct 2015

Rev 9.5 24 Jun 2015



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dBm)	Amp/Cb/Filt/P ad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	5.85	45.46	Pk	35.4	-20.9	0	59.96	-	-	78.2	-18.24	144	378	V
4	5.85	48.24	Pk	35.4	-20.9	0	62.74	-	-	78.2	-15.46	144	378	V
1	5.86	39.35	Pk	35.4	-20.9	0	53.85	-	-	74	-20.15	144	378	V
5	5.86	30.22	RMS	35.4	-20.9	.36	45.08	54	-8.92	-	-	144	378	V
6	5.86	30.73	RMS	35.4	-20.9	.36	45.59	54	-8.41	-	-	144	378	V
2	5.862	43.49	Pk	35.4	-20.8	0	58.09	-	-	74	-15.91	144	378	V

Pk - Peak detector

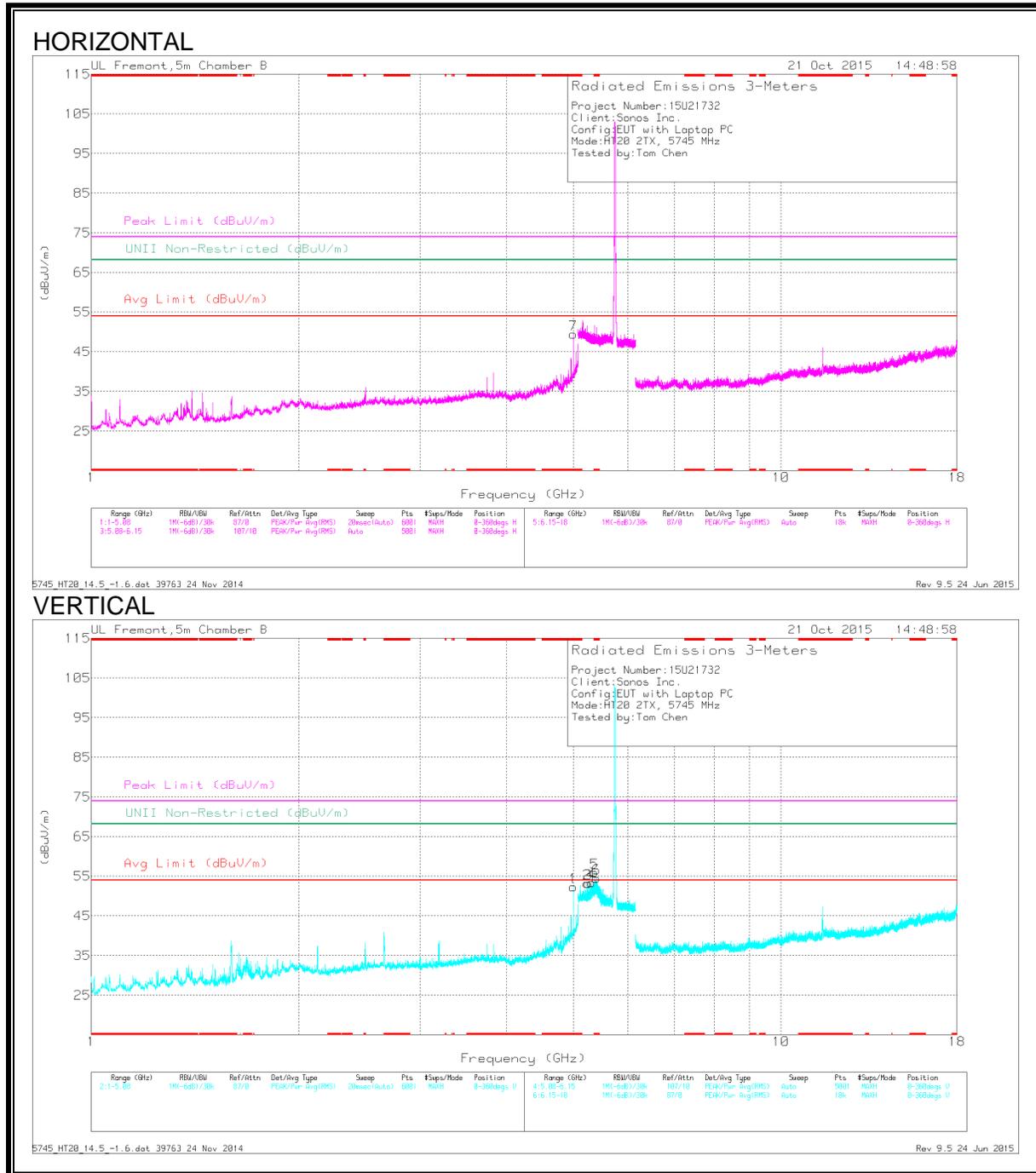
RMS - RMS detection

5825_HT20_V_14.5_-8.dat 42484 20 Oct 2015

Rev 9.5 24 Jun 2015

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL



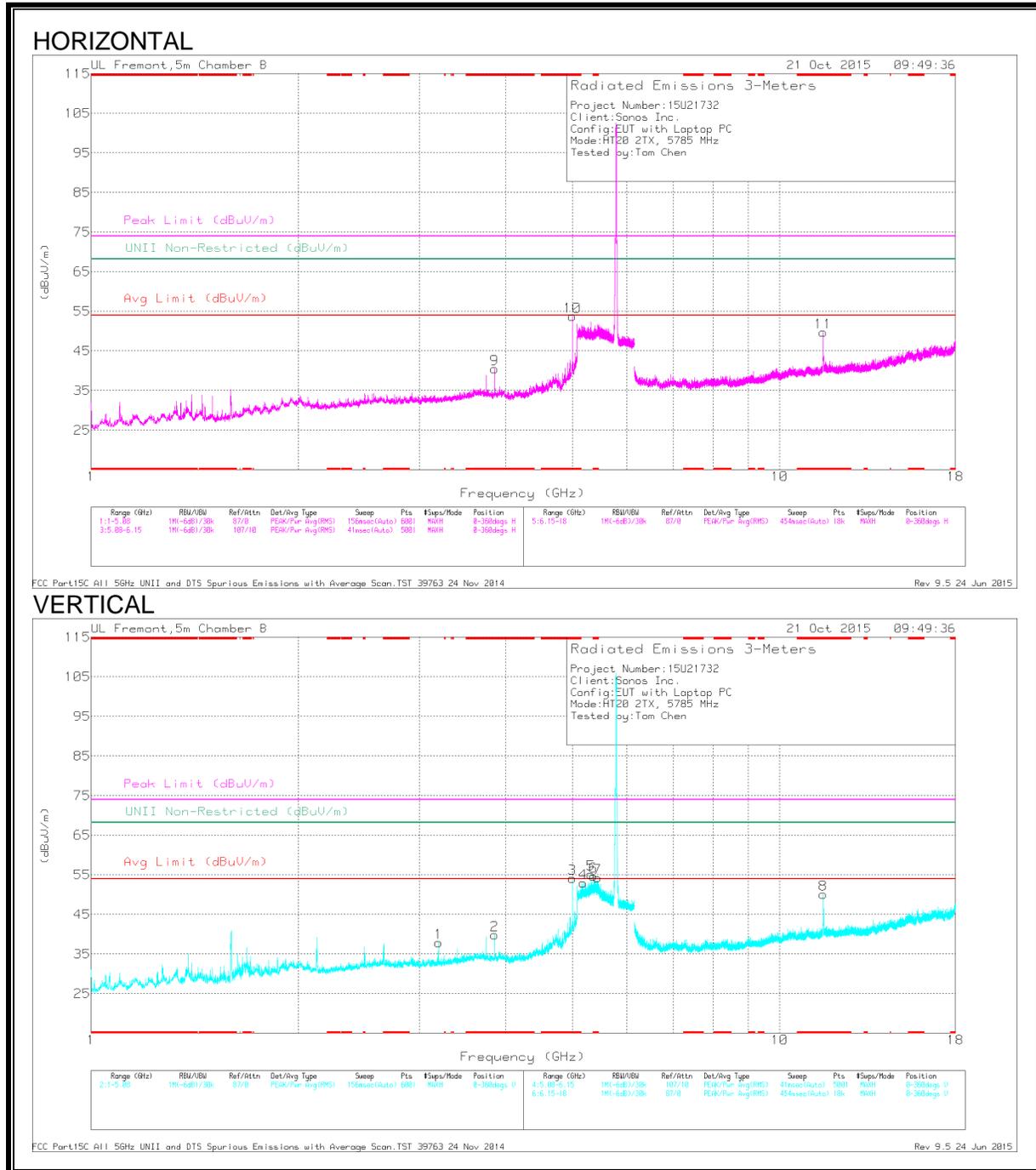
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dBm)	Amp/Cbl/ Filt/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7	* 5	50.66	PK-U	34	-29.9	0	54.76	-	-	74	-19.24	68.2	-13.44	124	116	H
	* 5	44.49	ADR	34	-29.9	.36	48.95	54	-5.06	-	-	-	-	124	116	H
1	* 5	53.34	PK-U	34	-29.9	0	57.44	-	-	74	-16.56	68.2	-10.76	236	176	V
	* 5	48.03	ADR	34	-29.9	.36	52.49	54	-1.51	-	-	-	-	236	176	V
5	* 5.36	46.82	PK-U	34.4	-19.9	0	61.32	-	-	74	-12.68	68.2	-6.88	312	203	V
	* 5.36	37.61	ADR	34.4	-20	.36	52.37	54	-1.63	-	-	-	-	312	203	V
6	* 5.4	48.51	PK-U	34.5	-19.8	0	63.21	-	-	74	-10.79	68.2	-4.99	309	274	V
	* 5.4	37.98	ADR	34.5	-19.9	.36	52.94	54	-1.06	-	-	-	-	309	274	V
2	5.24	46.49	PK-U	34.3	-19.3	0	61.49	-	-	-	-	68.2	-6.71	312	290	V
3	5.253	46.33	PK-U	34.3	-19.5	0	61.13	-	-	-	-	68.2	-7.07	315	286	V
4	5.304	47.04	PK-U	34.4	-19.5	0	61.94	-	-	-	-	68.2	-6.26	315	276	V

* - indicates frequency in CFR15.205 Restricted Band.

PK - Peak detector
 PK-U - U-NII: Maximum Peak
 ADR - U-NII AD primary method, RMS average

MID CHANNEL

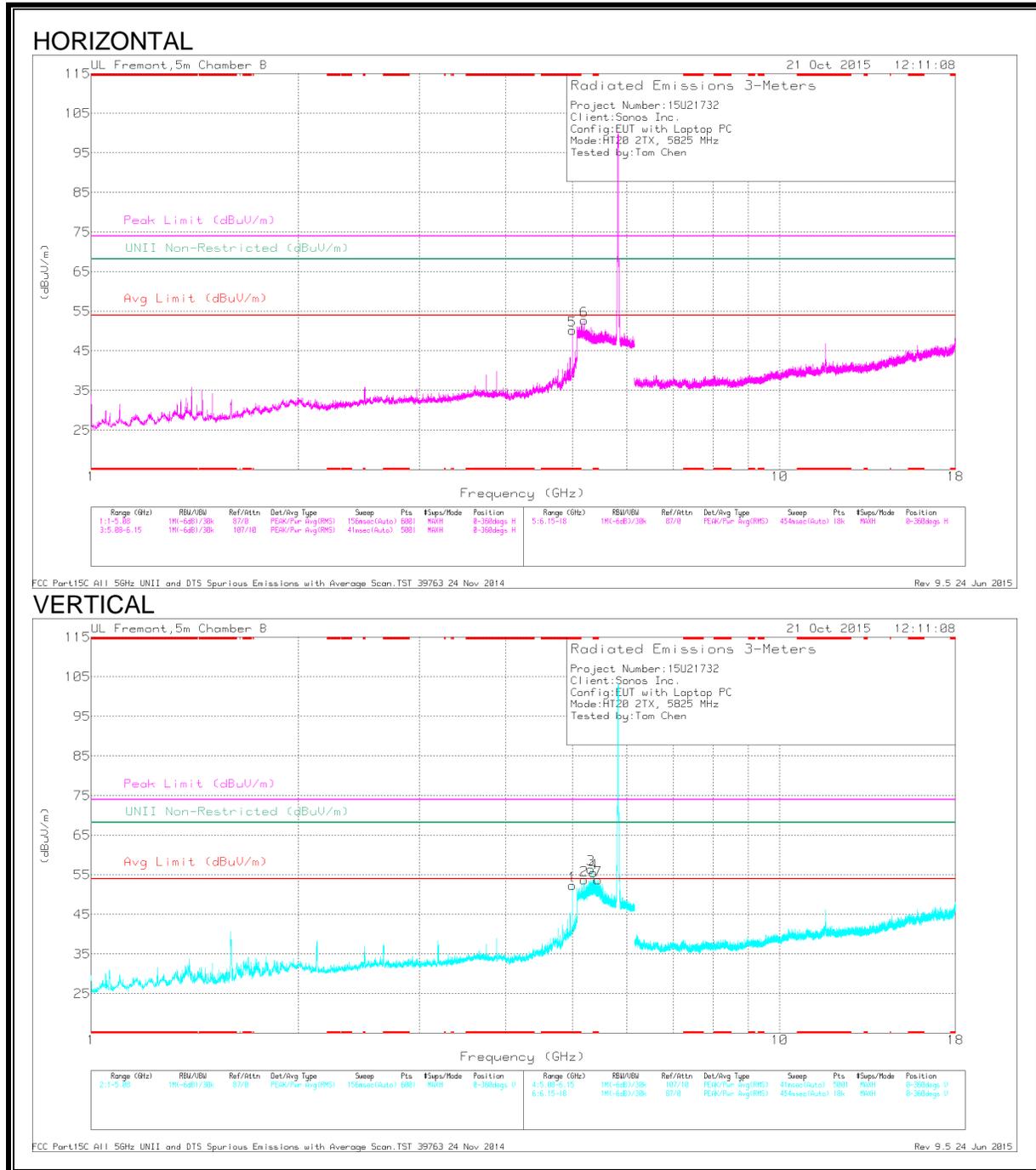


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dBm)	Amp/Cbl/ Filt/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
9	* 3.857	45.9	PK-U	33.4	-32.9	0	46.4	-	-	74	-27.6	68.2	-21.8	260	210	H
	3.857	38.43	ADR	33.4	-32.9	.36	39.29	54	-14.71	-	-	-	-	260	210	H
10	* 5	53.57	PK-U	34	-29.9	0	57.67	-	-	74	-16.33	68.2	-10.53	124	103	H
	5	48.54	ADR	34	-29.9	.36	52.10	54	-1.00	-	-	-	-	124	103	H
2	* 3.856	46.14	PK-U	33.4	-32.9	0	46.64	-	-	74	-27.36	68.2	-21.56	248	246	V
	3.857	39.79	ADR	33.4	-32.9	.36	40.65	54	-13.35	-	-	-	-	248	246	V
3	* 5	52.38	PK-U	34	-29.9	0	56.48	-	-	74	-17.52	68.2	-11.72	38	250	V
	5	46.86	ADR	34	-29.9	.36	51.32	54	-2.68	-	-	-	-	38	250	V
6	* 5.362	40.08	PK-U	34.4	-19.6	0	54.88	-	-	74	-19.12	68.2	-13.32	196	163	V
	5.358	28.31	ADR	34.4	-19.6	.36	43.47	54	-10.53	-	-	-	-	196	163	V
7	* 5.442	48.7	PK-U	34.5	-20.3	0	62.9	-	-	74	-11.1	68.2	-5.3	225	171	V
	5.44	36.55	ADR	34.5	-20.4	.36	51.01	54	-2.99	-	-	-	-	225	171	V
11	* 11.57	41.74	PK-U	38.4	-24.6	0	55.54	-	-	74	-18.46	68.2	-12.66	132	240	H
	11.57	27.42	ADR	38.4	-24.6	.36	41.58	54	-12.42	-	-	-	-	132	240	H
8	* 11.57	44.84	PK-U	38.4	-24.6	0	58.64	-	-	74	-15.36	68.2	-9.56	158	306	V
	11.57	30.56	ADR	38.4	-24.6	.36	44.72	54	-9.28	-	-	-	-	158	306	V
1	3.196	48.12	PK-U	32.4	-32.8	0	47.72	-	-	-	-	68.2	-20.48	357	286	V
4	5.178	45.35	PK-U	34.2	-19.2	0	60.35	-	-	-	-	68.2	-7.85	226	167	V
5	5.321	46.72	PK-U	34.4	-19.5	0	61.62	-	-	-	-	68.2	-6.58	333	195	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
 PK-U - U-NII: Maximum Peak
 ADR - U-NII AD primary method, RMS average

HIGH CHANNEL



Trace Markers

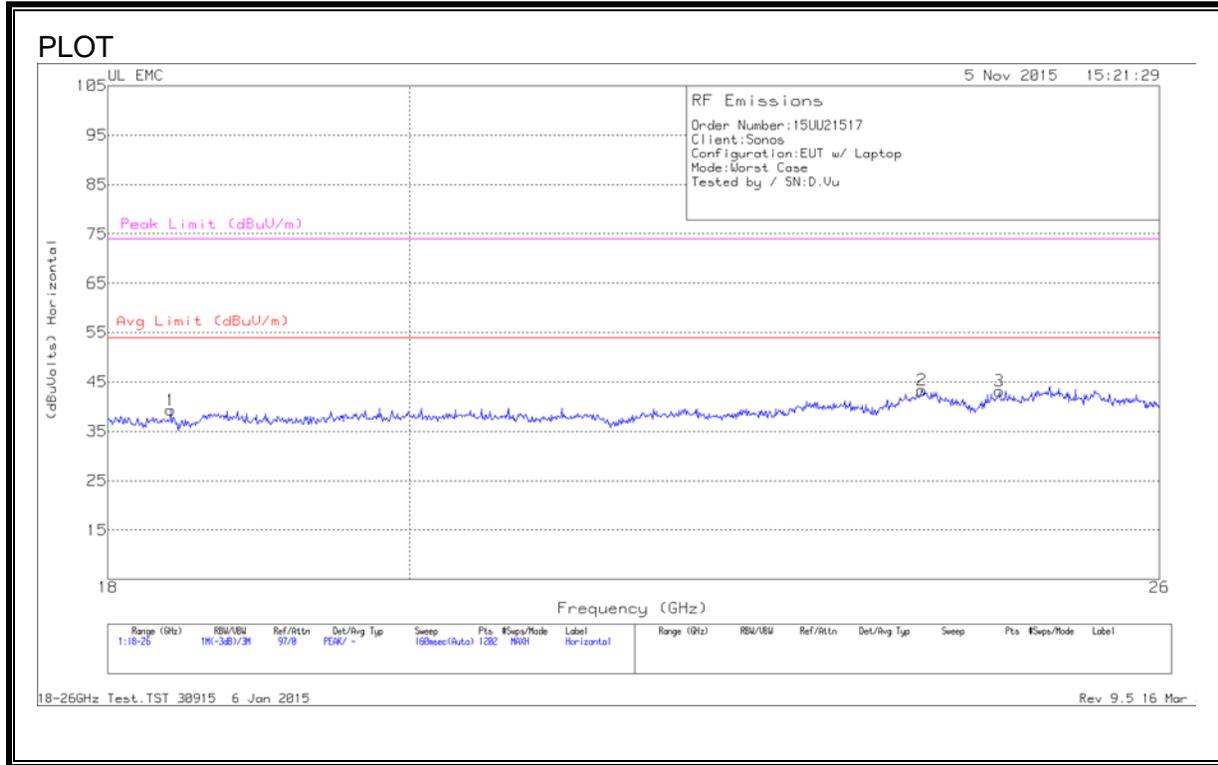
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dBm)	Amp/Cbl/ Fitr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	* 5	53.27	PK-U	34	-29.9	0	57.37	-	-	74	-16.63	68.2	-10.83	130	103	H
	* 5	48.14	ADR	34	-29.9	.36	52.60	54	-1.40	-	-	-	-	130	103	H
1	* 5	54.37	PK-U	34	-29.9	0	58.47	-	-	74	-15.53	68.2	-9.73	235	189	V
	* 5	48.68	ADR	34	-29.9	.36	53.14	54	-86	-	-	-	-	235	189	V
4	* 5.36	49.13	PK-U	34.4	-20	0	63.53	-	-	74	-10.47	68.2	-4.67	312	296	V
	* 5.36	38.95	ADR	34.4	-20	.36	53.71	54	-29	-	-	-	-	312	296	V
7	* 5.444	48.2	PK-U	34.5	-20.4	0	62.3	-	-	74	-11.7	68.2	-5.9	314	199	V
	* 5.446	36.03	ADR	34.5	-20.4	.36	50.49	54	-3.51	-	-	-	-	314	199	V
6	5.2	47.18	PK-U	34.3	-19.4	0	62.08	-	-	-	-	68.2	-6.12	323	177	H
2	5.2	44.91	PK-U	34.3	-19.5	0	59.71	-	-	-	-	68.2	-8.49	275	167	V
3	5.321	48.35	PK-U	34.4	-19.4	0	63.35	-	-	-	-	68.2	-4.85	313	293	V

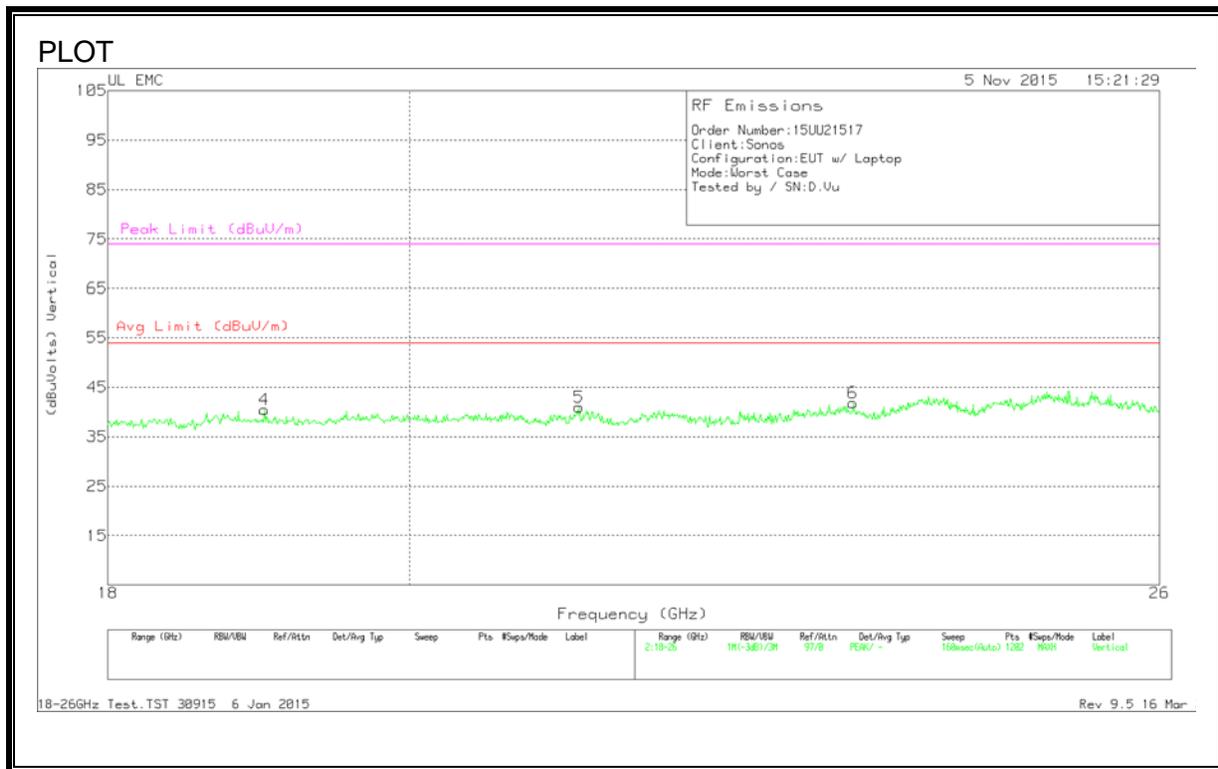
* - indicates frequency in CFR15.205 Restricted Band.

PK - Peak detector
 PK-U - U-NII: Maximum Peak
 ADR - U-NII AD primary method, RMS average

9.3. WORST-CASE ABOVE 18GHZ

SPURIOUS EMISSIONS 18 – 26 GHz





Trace Markers

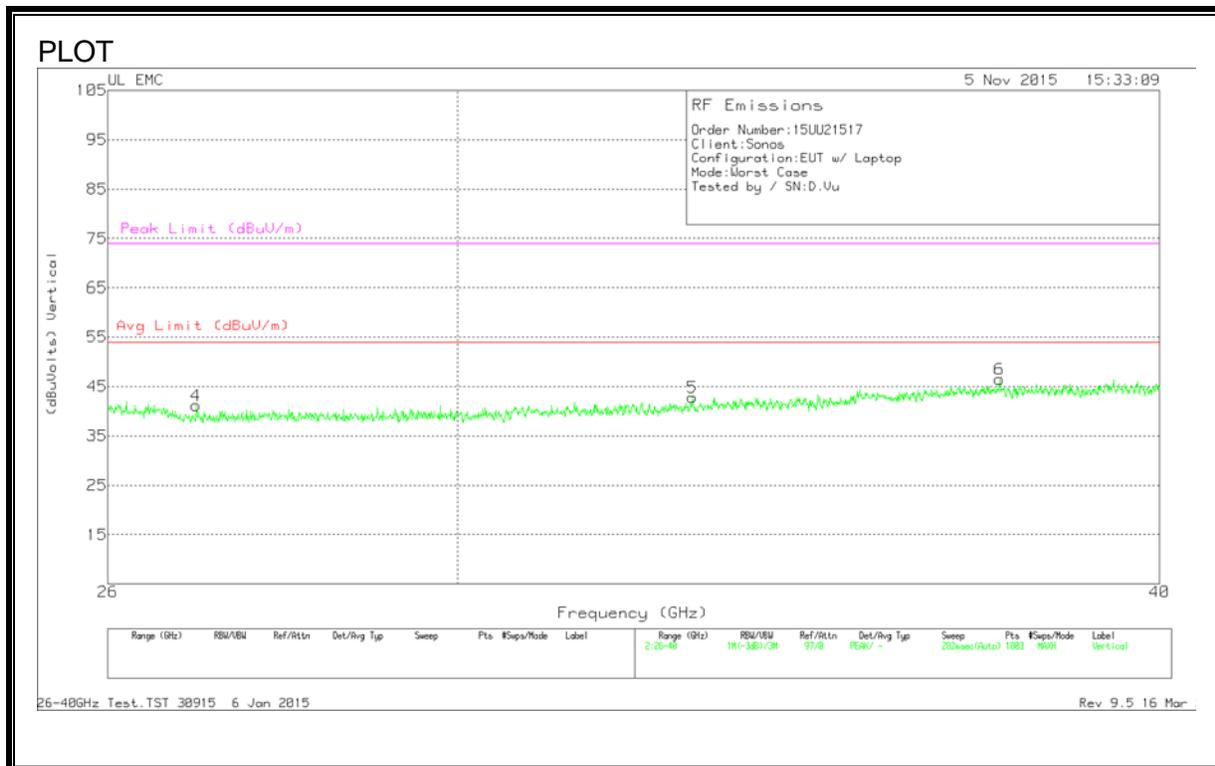
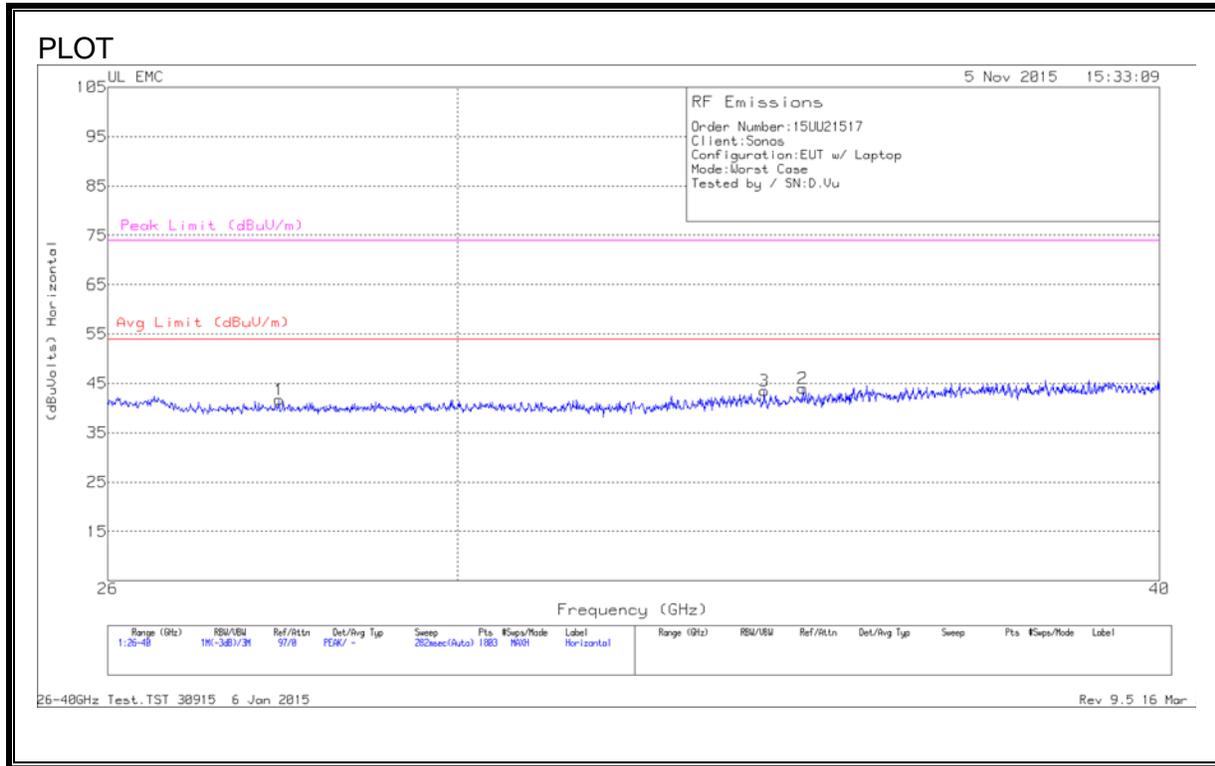
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T89 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	18.4	41.63	Pk	32.4	-25.2	-9.5	39.33	54	-14.67	74	-34.67
2	23.925	43.43	Pk	33.4	-24	-9.5	43.33	54	-10.67	74	-30.67
3	24.581	42.87	Pk	33.9	-24.1	-9.5	43.17	54	-10.80	74	-30.80
4	19.012	42.5	Pk	32.2	-24.7	-9.5	40.5	54	-13.5	74	-33.5
5	21.224	42.4	Pk	33.1	-25	-9.5	41	54	-13	74	-33
6	23.356	42.63	Pk	33.4	-24.7	-9.5	41.833	54	-12.17	74	-32.17

Pk - Peak detector

18-26GHz Test.TST 30915 6 Jan 2015

Rev 9.5 16 Mar 2015

SPURIOUS EMISSIONS 26 – 40GHz



Trace Markers

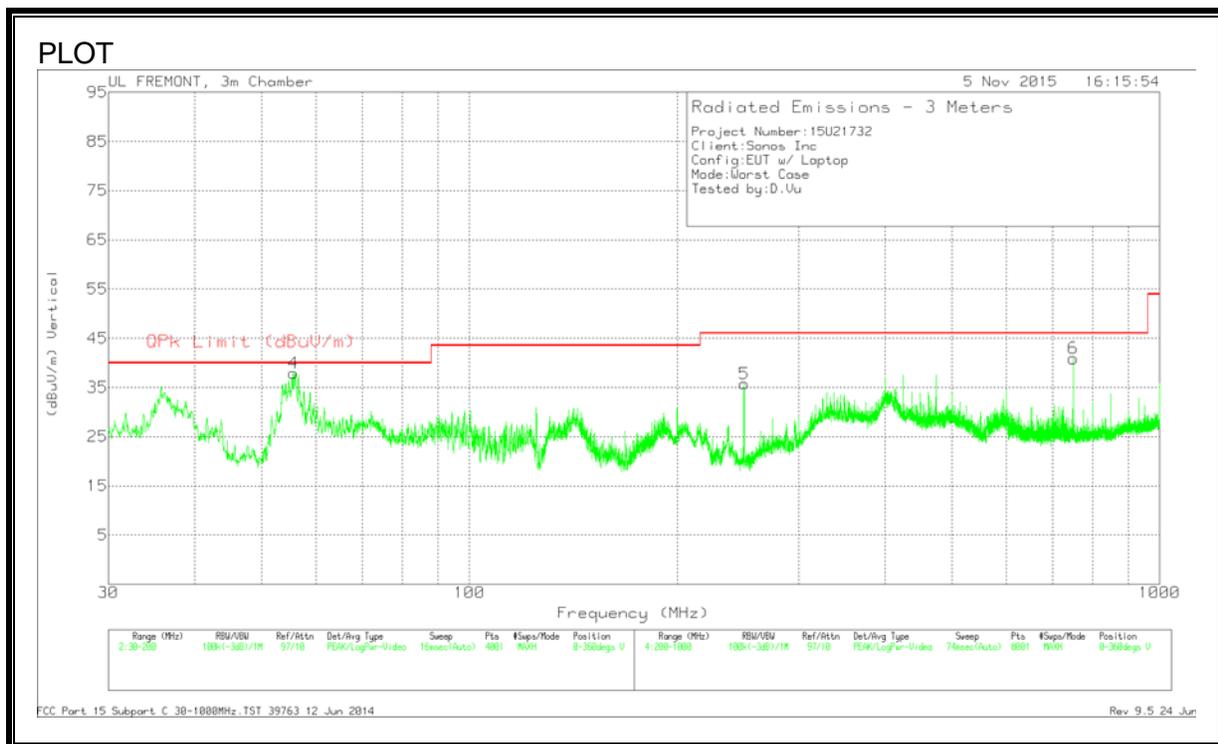
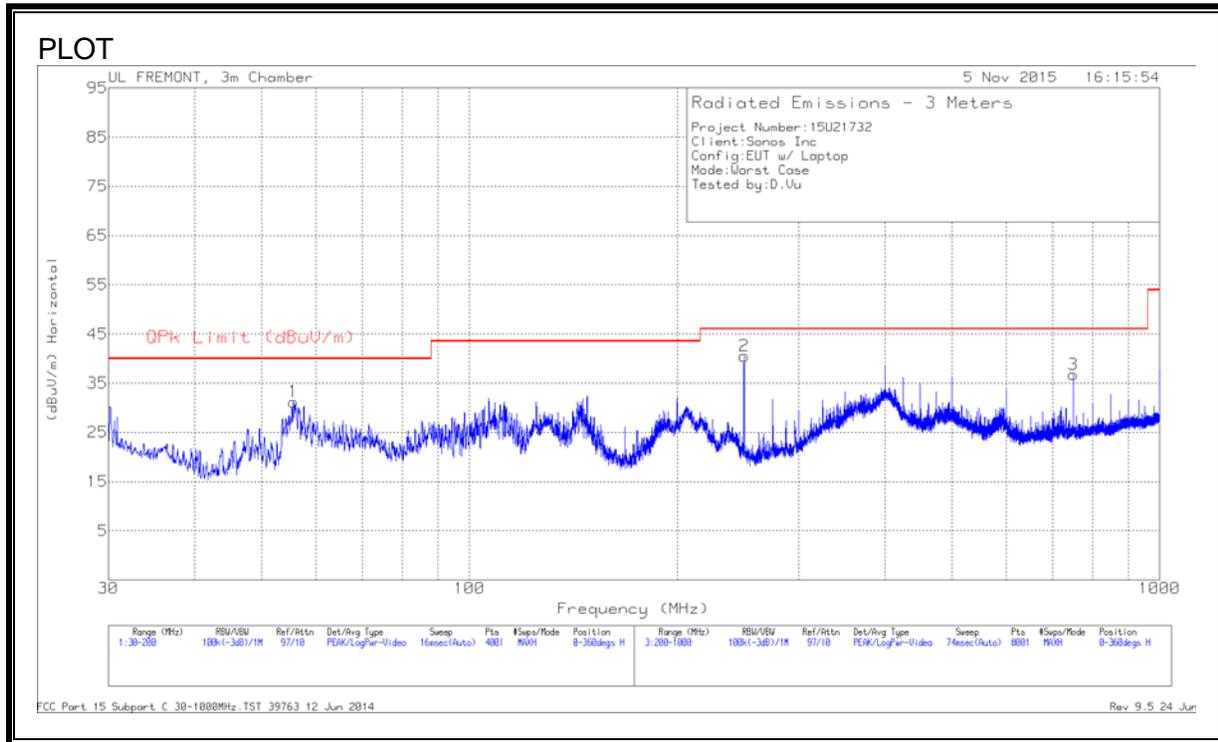
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	27.888	46.77	Pk	35.8	-31.4	-9.5	41.67	54	-12.30	74	-32.30
2	34.562	49.3	Pk	37.4	-33.2	-9.5	44	54	-10	74	-30
3	34.018	49	Pk	36.9	-32.9	-9.5	43.5	54	-10.5	74	-30.5
4	26.956	46.37	Pk	35.5	-31.2	-9.5	41.16	54	-12.83	74	-32.83
5	33.031	48.23	Pk	36.7	-32.6	-9.5	42.83	54	-11.16	74	-31.16
6	37.459	51.7	Pk	37.3	-33	-9.5	46.5	54	-7.5	74	-27.5

Pk - Peak detector

26-40GHz Test.TST 30915 6 Jan 2015
 Rev 9.5 16 Mar 2015

9.4. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	55.585	51.05	Pk	7.1	-26.9	31.25	40	-8.75	0-360	400	H
4	55.585	57.74	Pk	7.1	-26.9	37.94	40	-2.06	0-360	100	V
2	250	53.72	Pk	11.5	-24.7	40.52	46.02	-5.5	0-360	100	H
5	250	48.93	Pk	11.5	-24.7	35.73	46.02	-10.29	0-360	300	V
3	750	39.96	Pk	20.6	-23.8	36.76	46.02	-9.26	0-360	200	H
6	750	44.1	Pk	20.6	-23.8	40.9	46.02	-5.12	0-360	100	V

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
55.5919	56.45	Qp	7.1	-26.9	36.65	40	-3.35	26
249.9981	41.02	Qp	11.5	-24.7	27.82	46.02	-18.2	26
750	39.49	Qp	20.6	-23.8	36.29	46.02	-9.73	26

Pk - Peak detector

Qp - Quasi-Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-GEN Clause 8.8

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 [*]	56 to 46 [*]
0.5-5	56	46
5-30	60	50

^{*}Decreases with the logarithm of the frequency.

RESULTS

6 WORST EMISSIONS

Line-L1 .15 - 30MHz

Trace Markers

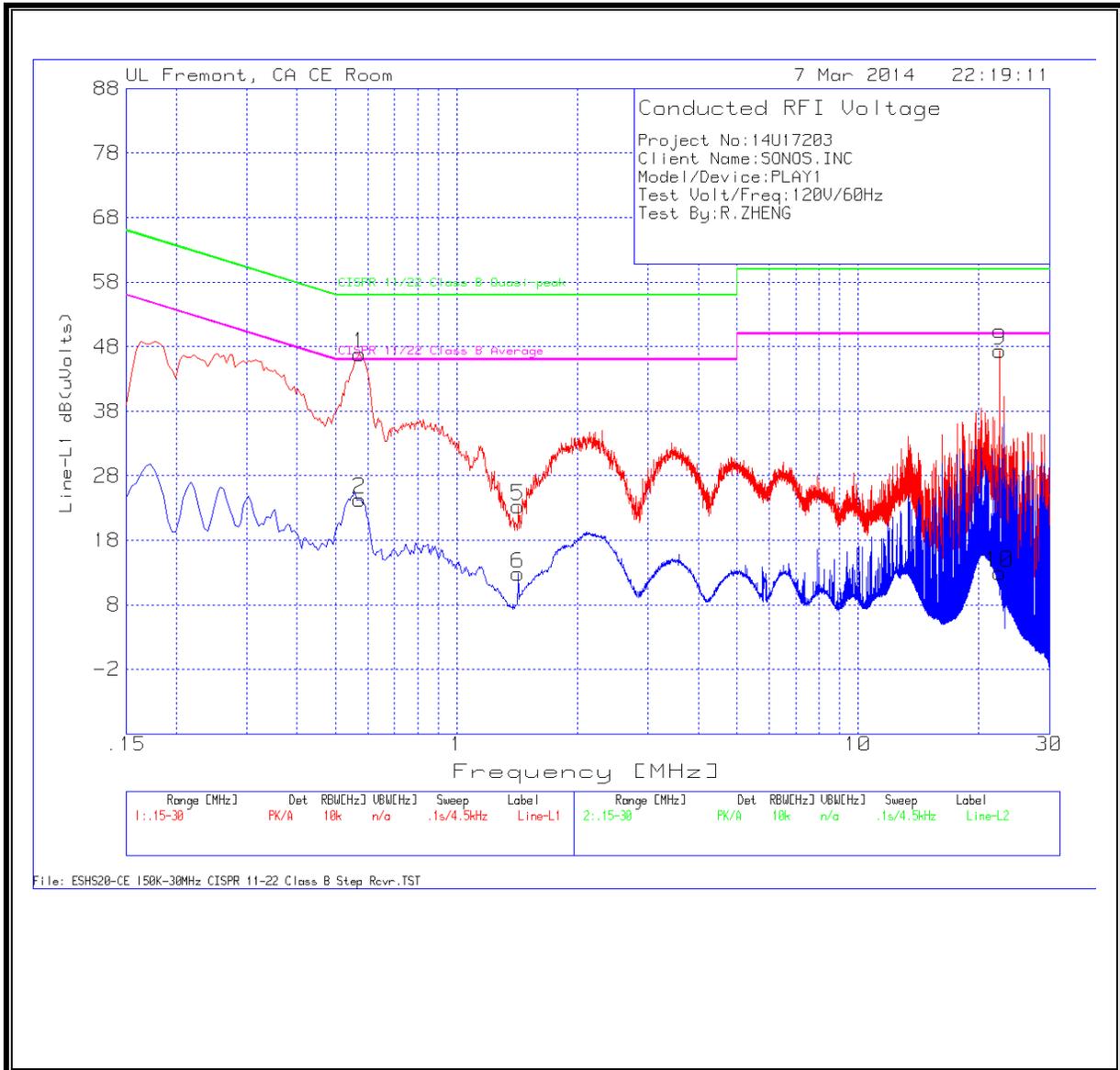
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
1	.573	46.56	PK	.3	0	46.86	56	-9.14	-	-
2	.573	24.04	Av	.3	0	24.34	-	-	46	-21.66
5	1.4235	22.97	PK	.2	.1	23.27	56	-32.73	-	-
6	1.4235	12.48	Av	.2	.1	12.78	-	-	46	-33.22
9	22.5465	46.9	PK	.3	.2	47.4	60	-12.6	-	-
10	22.5465	12.48	Av	.3	.2	12.98	-	-	50	-37.02

Line-L2 .15 - 30MHz

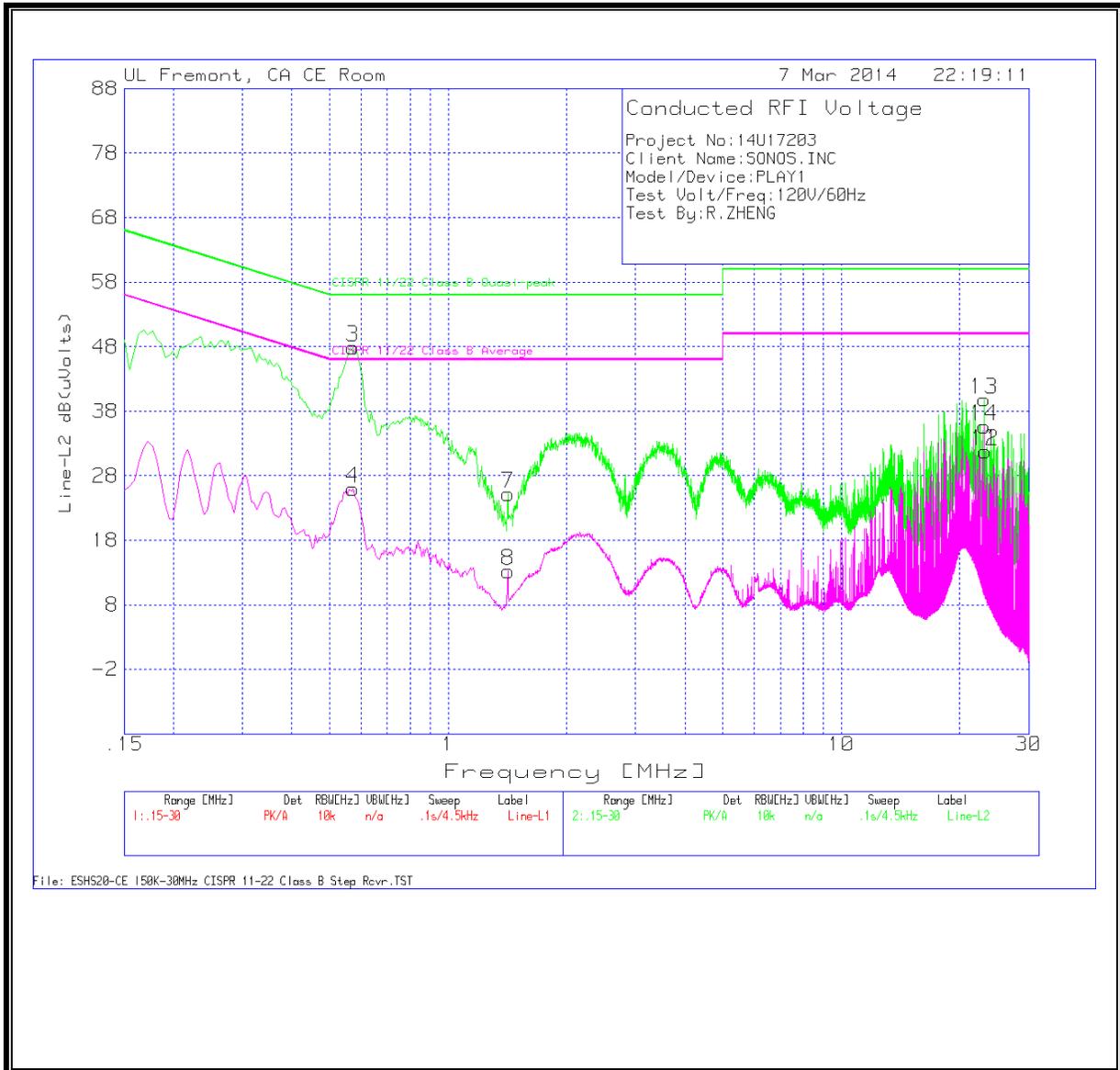
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
3	.573	47.6	PK	.3	0	47.9	56	-8.1	-	-
4	.573	25.66	Av	.3	0	25.96	-	-	46	-20.04
7	1.419	24.96	PK	.2	.1	25.26	56	-30.74	-	-
8	1.419	12.95	Av	.2	.1	13.25	-	-	46	-32.75
13	23.127	39.34	PK	.3	.2	39.84	60	-20.16	-	-
14	23.127	35.2	Av	.3	.2	35.7	-	-	50	-14.3
11	23.19	31.32	PK	.3	.2	31.82	60	-28.18	-	-
12	23.19	31.32	PK	.3	.2	31.82	60	-28.18	-	-

LINE 1 RESULTS



LINE 2 RESULTS



12. ART POWER SETTINGS TABLE

Channel	Frequency	FCC (Region 1)		
		11b	11g	11n
149	5745			14.5
157	5785			15
165	5825			14.5

END OF REPORT