

FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS-210 ISSUE 8 CLASS II PERMISSIVE CHANGE CERTIFICATION TEST REPORT

FOR

WIRELESS SPEAKER

MODEL NUMBER: PLAYBAR

FCC ID: SBVRM006 IC: 5373A-RM006

REPORT NUMBER: 13U16285-1

**ISSUE DATE: MARCH 12, 2014** 

Prepared for SONOS, INC. 223 E. DE LA GUERRA 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**

Rev.	lssue Date	Revisions	Revised By
	03/12/14	Initial Issue	G. Quizon

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REPO	ORT NO: 13U16285-1	DATE: MARCH 12, 2014
FCC	ID: SBVRM006	IC: 5373A-RM006
11.	POWER SETTINGS	
12.	SETUP PHOTOS	

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## **1. ATTESTATION OF TEST RESULTS**

COMPANY NAME:	SONOS, INC. 223 E. DE LA GUERRA ST. SANTA BARBARA, CA 93101, U.S.A.
EUT DESCRIPTION:	WIRELESS SPEAKER
MODEL:	PLAYBAR
SERIAL NUMBER:	1205000E58800046B (RAD)/ 1205000E58800016E (CON)

DATE TESTED: DECEMBER 05, 2013- FEBRUARY 11, 2014

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	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:

2 Lungar

George Quizon WiSE PROJECT LEADER UL Verification Services Inc.

Tina Chu WiSE LABORATORY TECHNICIAN UL Verification Services Inc.

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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2009, RSS-GEN Issue 3, and RSS-210 Issue 8.

# 3. FACILITIES AND ACCREDITATION

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
Chamber A	🛛 Chamber D
Chamber B	🖂 Chamber E
Chamber C	Chamber F

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

# 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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB - 26.9 dB = 28.9 dBuV/m

## 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

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

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## 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT possesses an 802.11 b/g/n wireless card. It is a 2.4/5GHz dual band concurrent module based on two Atheros' Osprey chipsets, AR9381 for 2GHz radio and AR9382 for 5GHz radio. The wireless card supports 802.11b/g/n functionality for 2.4GHz, and 802.11n for 5GHz. The 2.4GHz radio supports (3x3) MIMO, the 5GHz radio support (2x2) MIMO.

## 5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

This is a Class II permissive change project, change of scope is to add 802.11b 3x3.

## 5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
2412 - 2462	802.11b	26.41	437.52

## 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following antenna arrangement. The maximum antenna gains as a function of frequency band operation are given in the following table.

Frequencies	Antenna A	Antenna B	Antenna D			
2412-2462MHz	2.9dBi	4.4dBi	3.7dBi			
Antenna A: Monopole, Antenna B: Monopole, Antenna D: Dipole						

# 5.5. SOFTWARE AND FIRMWARE

The Sonos software version is V4.6

Atheros Radio Test 2(ART2-GUI) V 2.3

# 5.6. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in two orthogonal orientations X and Y, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Worst-case data rates as provided by the manufacturer were:

802.11b mode: 24 Mbps

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## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List							
Description	Manufacturer	Model	Serial Number	FCC ID			
Laptop	Dell	P05G	3535214077	DoC			
Laptop AC Adapter	Dell	LA65NS2-01	72438-084	DoC			

## I/O CABLES

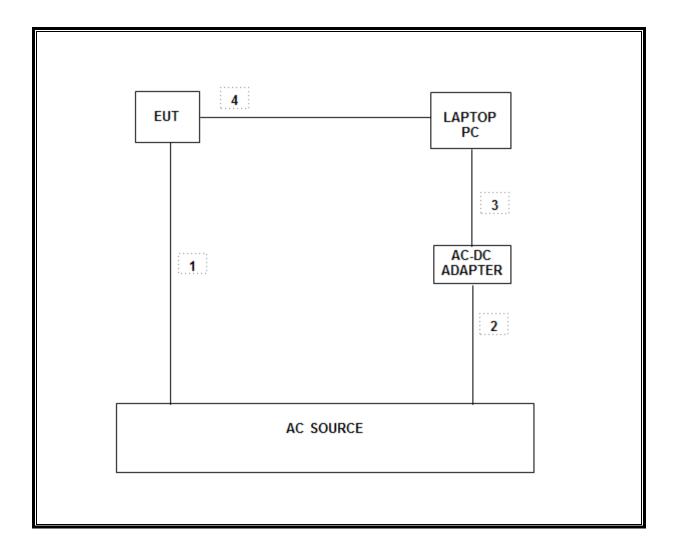
	I/O Cable List							
Cable	Port	# of identical	Connector	Cable Type	Cable	Remarks		
No		ports	Туре		Length (m)			
1	AC	1	US 115V	Un-shielded	1.8m	N/A		
2	AC	1	US 115V	Un-shielded	1m	N/A		
3	DC	1	DC	Un-shielded	1.8m	N/A		
4	Ethernet	2	RJ45	Un-shielded	2m	N/A		

#### TEST SETUP

Test software exercised the radio card.

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### SETUP DIAGRAM FOR TESTS



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# 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	Asset	Cal Due			
Horn Antenna 1-18GHz	ETS Lindgren	3117	F00131	02/18/15			
Horn Antenna 1-18GHz	ETS Lindgren	3117	F00133	02/25/15			
Preamplifier, 1300 MHz	Sonoma	310	F00008	05/27/14			
Preamplifier, 1300 MHz	Sonoma	310	F00009	05/08/14			
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	F00027	03/07/14			
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	F00168	03/07/14			
RF PreAmplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	F00350	06/26/14			
RF PreAmplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	F00351	06/27/14			
Spectrum Analyzer	Agilent	N9030A	F00128	02/12/15			
Spectrum Analyzer, 3Hz-44GHz	Agilent	N9030A	F00127	02/21/14			
Peak / Average Power Sensor	Agilent / HP	E9323A	F00163	04/03/14			
P-Series single channel Power Meter	Agilent / HP	N1911A	F00164	04/03/14			
Spectrum Analyzer, 44GHz	Agilent	E4446A	C01012	10/21/14			
Spectrum Analyzer, 40GHz	HP	8564E	C00951	07/29/14			
Antenna, Horn, 26GHz	ARA	MWH-1826/B	81140	05/17/14			
Preamplifier, 26.5 GHz	Agilent	8449B	F100167	03/23/14			

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# 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

## LIMITS

None; for reporting purposes only.

## PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

## 7.1. ON TIME AND DUTY CYCLE RESULTS

Mode	<b>ON Time</b>	Period	<b>Duty Cycle</b>	Duty	Duty Cycle	1/B
	В		x	Cycle	<b>Correction Factor</b>	Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
2.4GHz Band						
802.11b 3TX	0.916	0.962	0.952	95.18%	0.21	1.092

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## 7.2. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01

Output Power: KDB 558074 D0.

Power Spectral Density: KDB 558074 D01

Out-of-band emissions in non-restricted bands: KDB 558074 D01

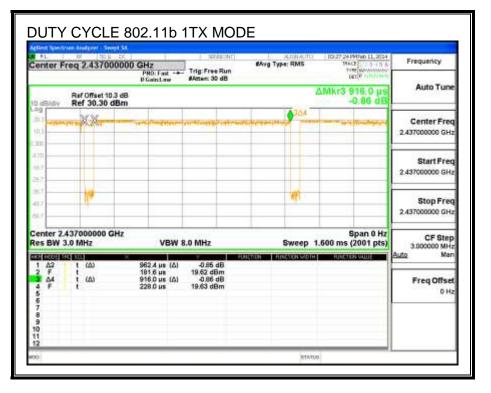
Out-of-band emissions in restricted bands: KDB 558074 D01

Band-edge: KDB 558074 D01 v03r01

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## 7.3. DUTY CYCLE PLOTS

### 2.4 GHz BAND



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## 8. ANTENNA PORT TEST RESULTS

## 8.1. 802.11b MODE IN THE 2.4 GHz BAND

## 8.1.1. 6 dB BANDWIDTH

### **LIMITS**

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

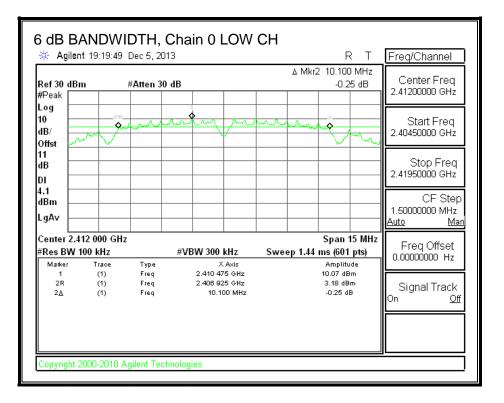
The minimum 6 dB bandwidth shall be at least 500 kHz.

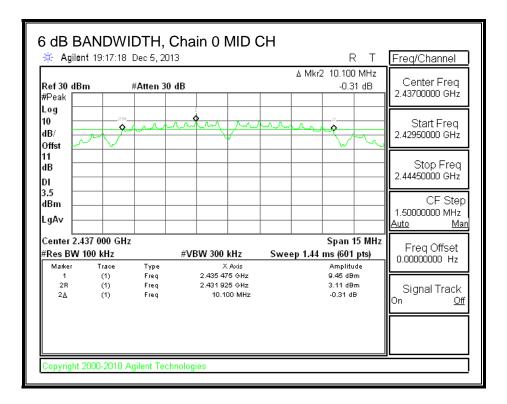
### **RESULTS**

Channel	hannel Frequency		6 dB BW	6 dB BW	Minimum
		Chain 0	Chain 1	Chain 2	Limit
	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
Low	2412	10.100	10.125	10.125	0.5
Mid	2437	10.100	10.150	10.150	0.5
High	2462	10.075	10.125	10.150	0.5

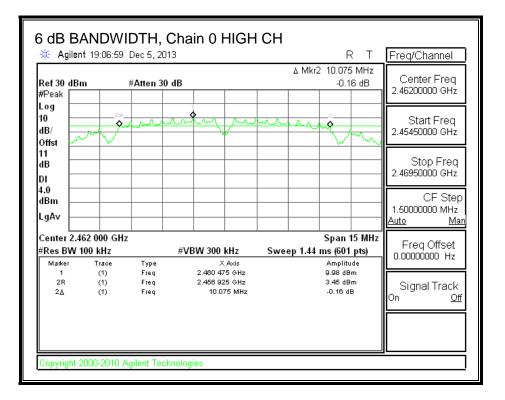
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### 6 dB BANDWIDTH, Chain 0

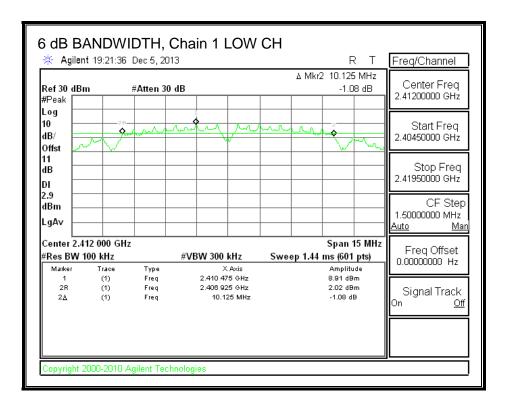




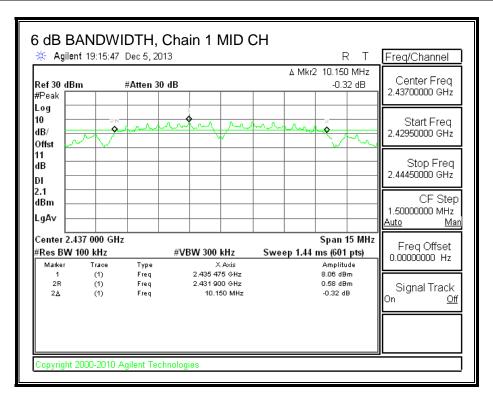
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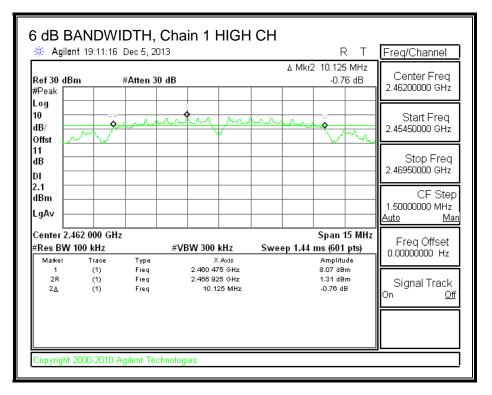


#### 6 dB BANDWIDTH, Chain 1

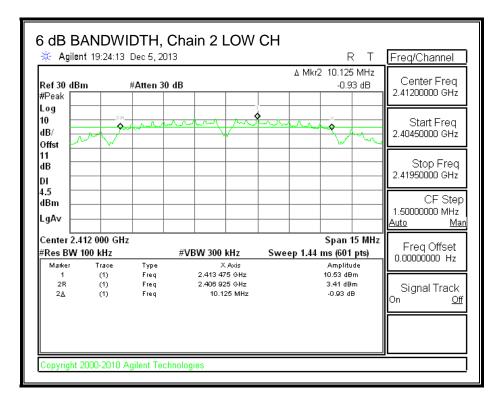


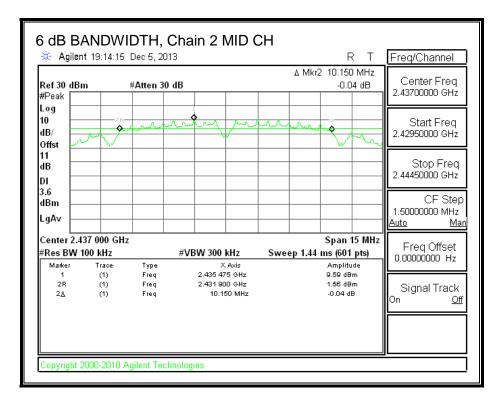
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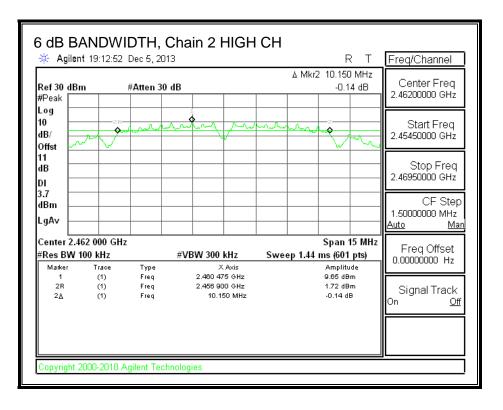
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## 8.1.2. 99% BANDWIDTH

### **LIMITS**

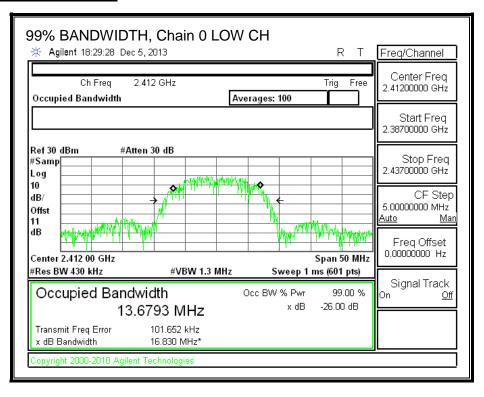
None; for reporting purposes only.

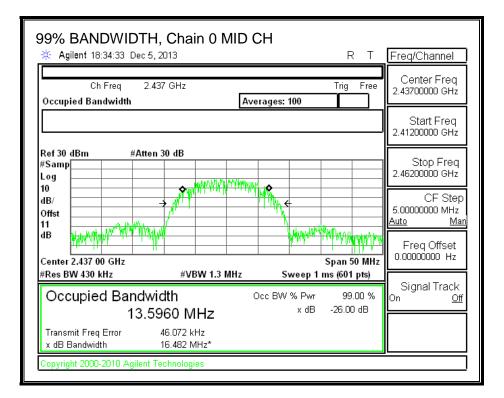
## **RESULTS**

Channel	Frequency	99% BW	99% BW	99% BW
		Chain 0	Chain 1	Chain 2
	(MHz)	(MHz)	(MHz)	(MHz)
Low	2412	13.6793	13.9838	13.5198
Mid	2437	13.5960	13.6365	14.2646
High	2462	14.2436	14.0006	14.8235

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#### REPORT NO: 13U16285-1 FCC ID: SBVRM006 99% BANDWIDTH, Chain 0



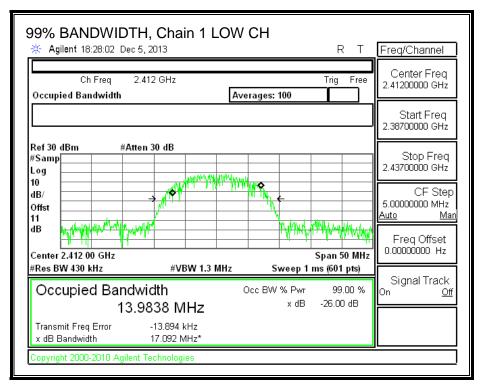


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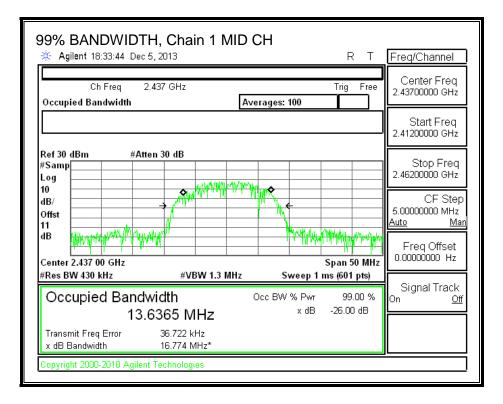
Agilent 18:38:37 Dec 5	, 2013		RT	Freq/Channel
Ch Freq 2 Occupied Bandwidth	462 GHz	Averages: 100	Trig Free	Center Freq 2.46200000 GHz
				Start Freq 2.43700000 GHz
≠Samp _og	n 30 dB	Million -		Stop Freq 2.48700000 GHz
10 18/	→ ( <sup>1</sup> · · · · · · · · · · · · · · · · · · ·			CF Step 5.0000000 MHz <u>Auto Ma</u>
IB		<b>1</b>	Span 50 MHz	Freq Offset 0.00000000 Hz
∜Res BW 430 kHz	#VBW 1.3 MHz	Sweep 1 i	ns (601 pts)	
Occupied Bandw 14.2	/idth 2436 MHz	Occ BW % Pwr x dB	99.00 % -26.00 dB	Signal Track On <u>Of</u>
Transmit Freq Error x dB Bandwidth	-47.845 kHz 17.283 MHz*			

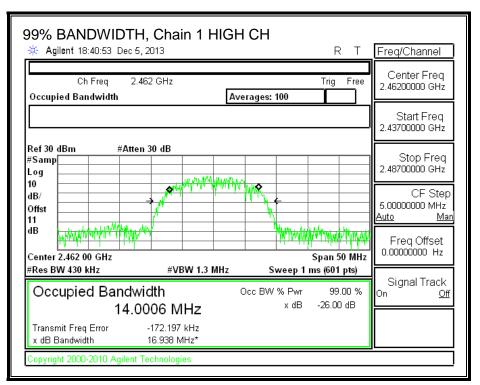
## 99% BANDWIDTH, Chain 1



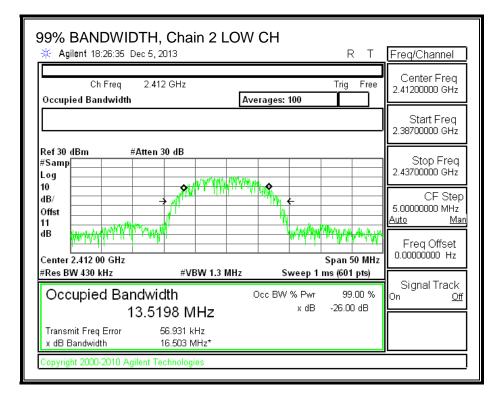
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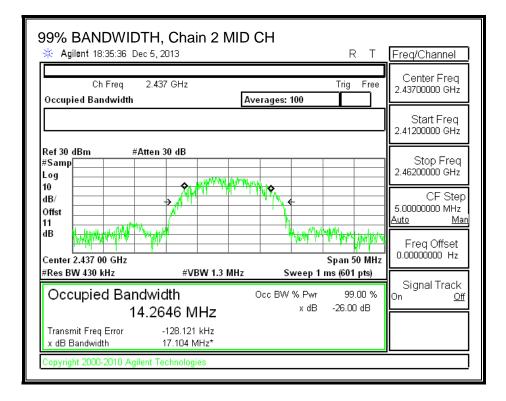
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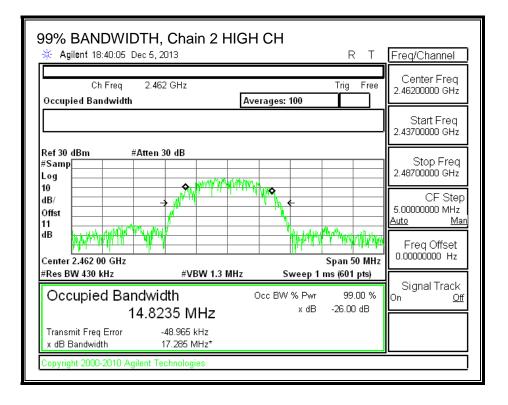


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## 8.1.3. AVERAGE POWER

#### **LIMITS**

None; for reporting purposes only.

### **RESULTS**

Channel	Frequency	Chain 0	Chain 1	Chain 2	Total
		Power	Power	Power	Power
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)
Low	2412	18.24	15.57	18.17	22.26
Mid	2437	18.54	15.79	18.24	22.46
High	2462	16.88	14.72	18.09	21.55

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## 8.1.4. OUTPUT POWER

### LIMITS

FCC §15.247

IC RSS-210 A8.4

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator 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 uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0	Chain 1	Chain 2	<b>Uncorrelated Chains</b>
Antenna	Antenna	Antenna	Directional
Gain	Gain	Gain	Gain
(dBi)	(dBi)	(dBi)	(dBi)
4.40	2.90	3.70	3.71

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## **RESULTS**

Limits

Channel	Frequency	Directional	FCC	IC	IC	Max
		Gain	Power	Power	EIRP	Power
			Limit	Limit	Limit	
	(MHz)	(dBi)	(dBm)	(dBm)	(dBm)	(dBm)
Low	2412	3.71	30.00	30	36	30.00
Mid	2437	3.71	30.00	30	36	30.00
High	2462	3.71	30.00	30	36	30.00

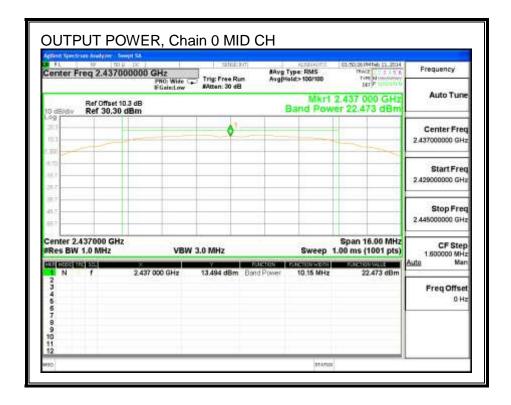
#### Results

Channel	Frequency	Chain 0	Chain 1	Chain 2	Total	Power	Margin
		Meas	Meas	Meas	Corr'd	Limit	
		Power	Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	2412	21.82	20.03	22.12	26.19	30.00	-3.81
Mid	2437	22.47	19.98	22.07	26.41	30.00	-3.59
High	2462	21.33	18.64	21.87	25.60	30.00	-4.40

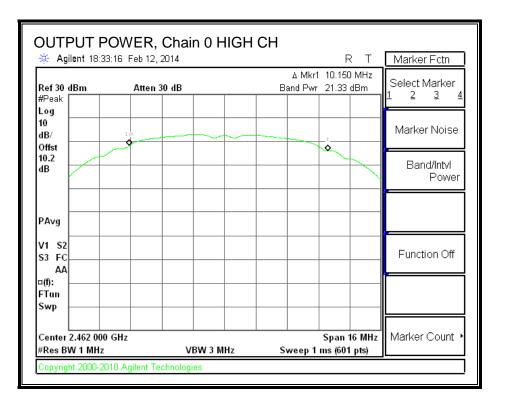
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### OUTPUT POWER, Chain 0

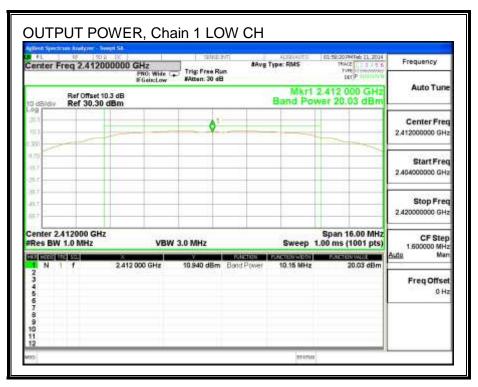
Center Freq 2.41	PNO: Write 1	Trig: Free Ru	đAvg m	Type: RMS	01:46:13 PM Reb 11,2004 TRACE 1, 2, 2, 4, 5, 6 TVRE 2, 2, 2, 4, 5, 6 TVRE 2, 2, 2, 4, 5, 6	Frequency
o derdiv Ref 30.	FGein:Low et 10.3 dB 30 dBm	#Atten: 30 dE		Mkrt Band Po	2.412 000 GHz wer 21.82 dBm	Auto Tune
09 313 003		0'	_	-		Center Freq 2.412000000 GHz
87 87						Start Freq 2.404000000 GHz
87 87						Stop Freq 2.420000000 GHz
enter 2.412000 C Res BW 1.0 MHz		3.0 MHz		Sweep	Span 16.00 MHz 1.00 ms (1001 pts)	CF Step 1.600000 MHz
N 1 T	2.412 000 GHz	12.55 dBm	Band Power	10.15 MHz	21.82 dBm	<u>Auto</u> Man
2 3 4 5 5 7 7 8 9 9 10						Freq Offset 0 Hz



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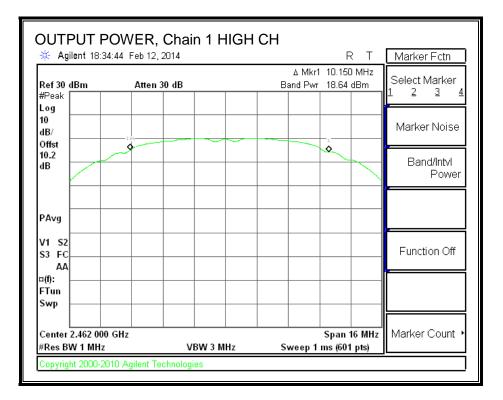


## OUTPUT POWER, Chain 1



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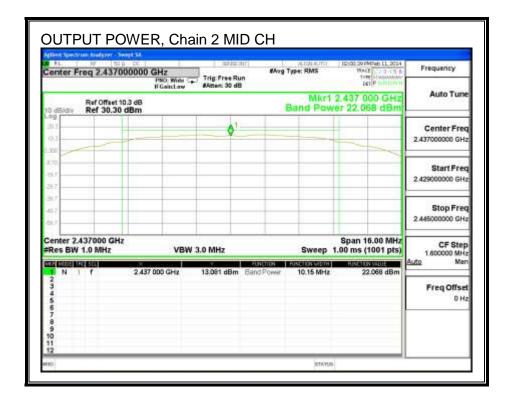
inter Freq 2.43		Trig: Free Run #Atten: 30 dB	AAvg Type: RMS	01:52:30 PM Reb 11, 2004 19402 1, 2, 3, 4, 5, 6 19402 1, 2004	Frequency
Ref Offse dBidly Ref 30.3				2.437 000 GHz ver 19.976 dBm	Auto Tune
03 03 98		01			Center Free 2.437000000 GH:
					Start Free 2.429000000 GHz
17 NT 17					Stop Free 2.445000000 GH:
enter 2,437000 G Res BW 1.0 MHz		/ 3.0 MHz	Sweep	Span 16.00 MHz 1.00 ms (1001 pts)	
N 1 f 23 4 5 5 7 8 9 9 0 1 1 2	2.437 000 GHz	10,863 dBm Ean			Freq Offset 0 Hz



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## OUTPUT POWER, Chain 2

	req 2.412000		Trig Free R	#Avg	Type: RMS	THESE OF PAPer IL 2014 THACE IL 2 0 4 5 5 THE IL WARDON OF PAPER	Frequency
0 dB/div	Ref Offset 10.3 Ref 30.30 dB	dB		-	Micr1 Band Por	2.412 000 GHz wer 22.12 dBm	Auto Tun
0.2	-		0'		_		Center Free 2.412000000 GH
um 9.7							Start Free 2.404000000 GH
8.7 8.7 8.7							Stop Free 2.420000000 GH
	412000 GHz 1.0 MHz	VBN	V 3.0 MHz	-	Sweep	Span 16.00 MHz 1.00 ms (1001 pts)	CF Step 1.800000 MH
		2,412,000 GHz	13.083 dBm	n Band Powar	10.15 MHz	22.12 dBm	Auto Mar
34567							Freq Offse 0 H
8 9 10 11							
100					STATUS	1	



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	OWER, Chain 2 1:56 Feb 12, 2014	HIGH CH	R	T Marker Fctn
Ref 30 dBm #Peak	Atten 30 dB	В	∆ Mkr1 10.150 M and Pwr 21.87 dB	Coloot Morkor
Log 10 dB/ Offst	18		1	Marker Noise
10.2 dB				Band/Intvl Power
PAvg				_
V1 S2 S3 FC AA				Function Off
¤(f): FTun Swp				
Center 2.462 000 #Res BW 1 MHz	GHz VBW 1 110 Agilent Technologies	3 MHz S	Span 16 weep 1 ms (601 p	

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#### 8.1.5. PSD

#### **LIMITS**

FCC §15.247

IC RSS-210 A8.2

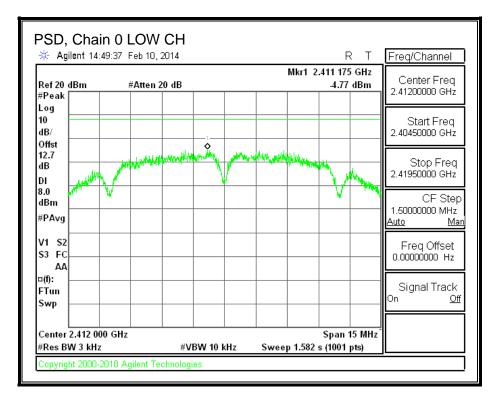
#### **RESULTS**

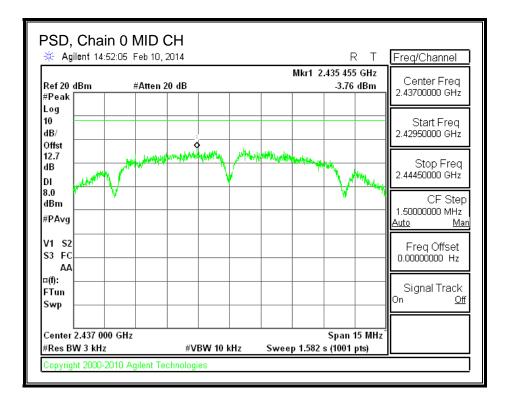
#### **PSD** Results

Channel	Frequency	Chain 0	Chain 1	Chain 2	Total	Limit	Margin
		Meas	Meas	Meas	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	2412	-4.77	-5.77	-4.28	-0.13	8.0	-8.1
Mid	2437	-3.76	-7.01	-4.33	-0.05	8.0	-8.0
High	2462	-4.79	-7.43	-4.02	-0.41	8.0	-8.4

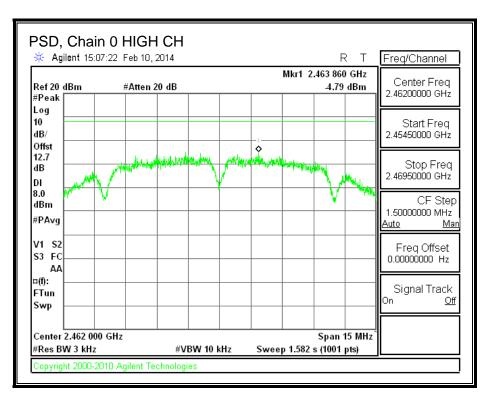
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### PSD, Chain 0

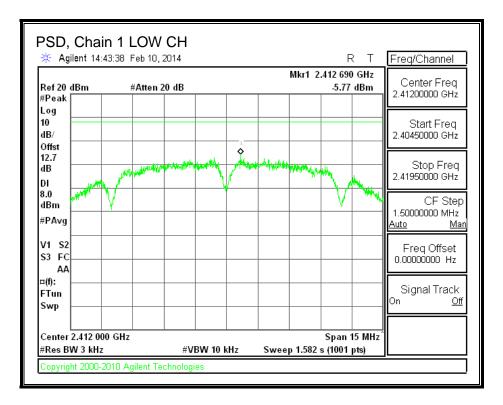




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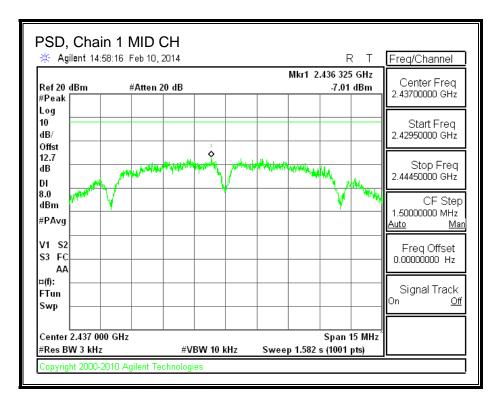


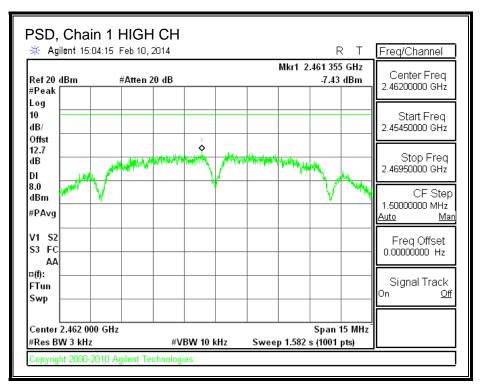
## PSD, Chain 1



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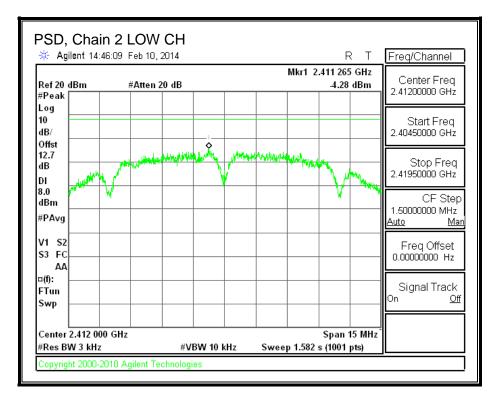


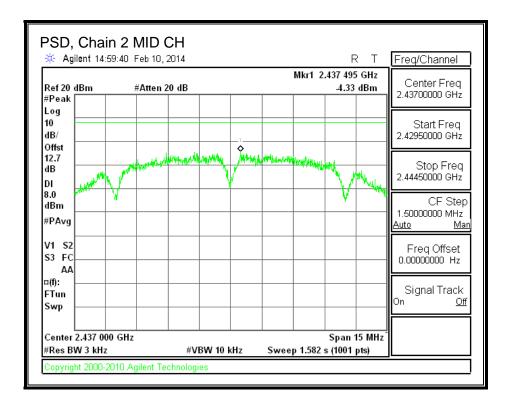


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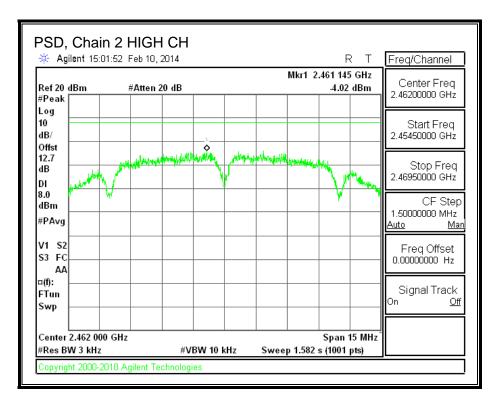
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#### PSD, Chain 2





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## 8.1.6. OUT-OF-BAND EMISSIONS

#### **LIMITS**

FCC §15.247 (d)

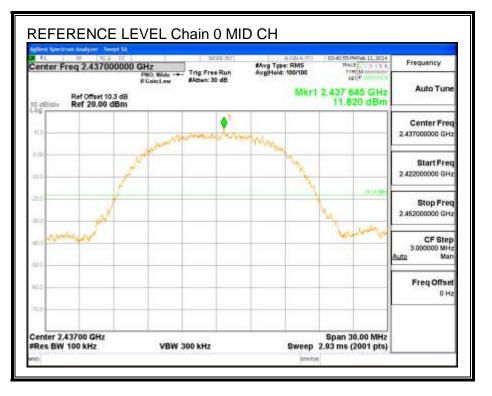
IC RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

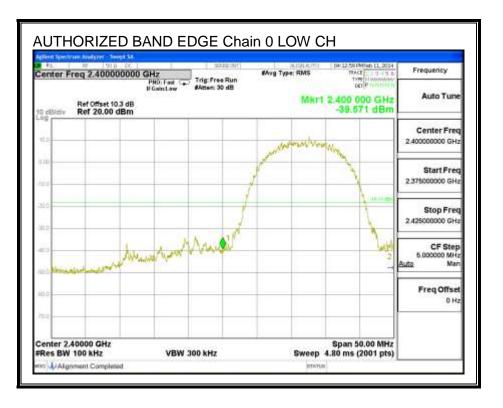
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#### **RESULTS**

#### **IN-BAND REFERENCE LEVEL, Chain 0**

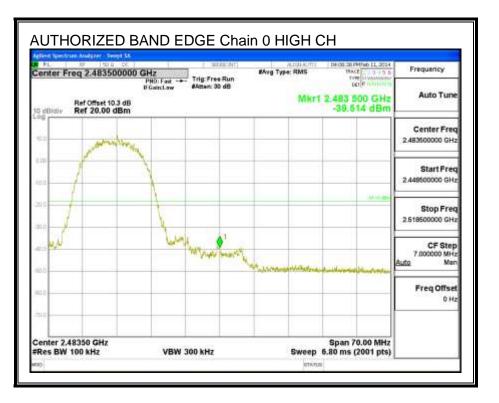


#### LOW CHANNEL BANDEDGE, Chain 0

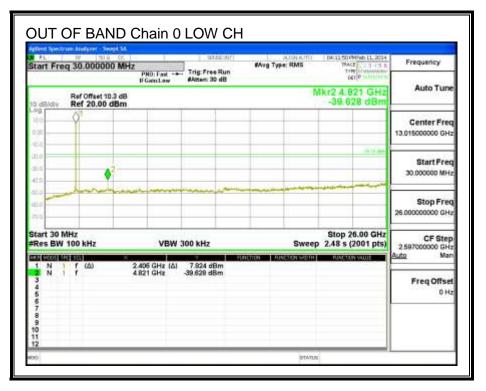


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#### HIGH CHANNEL BANDEDGE, Chain 0

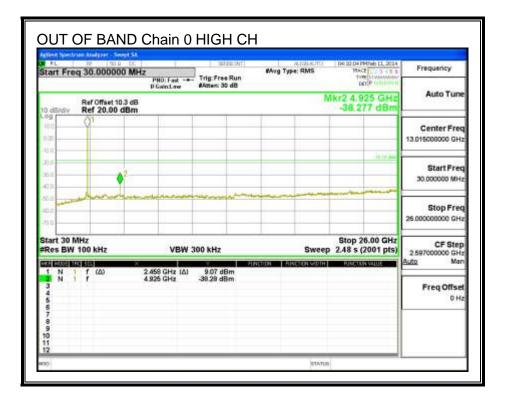


#### **OUT-OF-BAND EMISSIONS, Chain 0**



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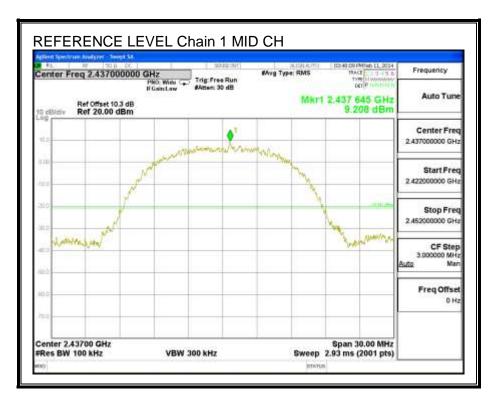
	nq 30.0		/Hz	0: Fast :	Trig Free P	393 - N	BAvg Type	RMS	TUA	MPab 11, 2004	Frequency
-	212/2007		IF G	with the second second	#Atten: 30 d			N	kr3 7.3	15 GHZ	Auto Tune
VIDIBD 0		set 10.3 d 0.00 dB								34 dBm	
0.0	01										Center Free 13.015000000 GH
0.0		QF	<b>6</b> <sup>3</sup>							10.12.000	Start Free 30.000000 MH
0.0	- Harry	- Ha	au antos					442 MA	iner de d'Andre de d		Stop Free 26.00000000 GH
	100 kH	z		VBW	300 kHz			Sweep	2.48 5 (	6.00 GHz 2001 pts)	CF Step 2 59700000 GH Auto Mar
1 N 2 N 4 5 5 7 8 9 0		2	2,438 4,873 7,315		9.30 dBn -40.96 dBn -43.34 dBn	1	94 PUN		HINCLE		Freq Offse 0 H



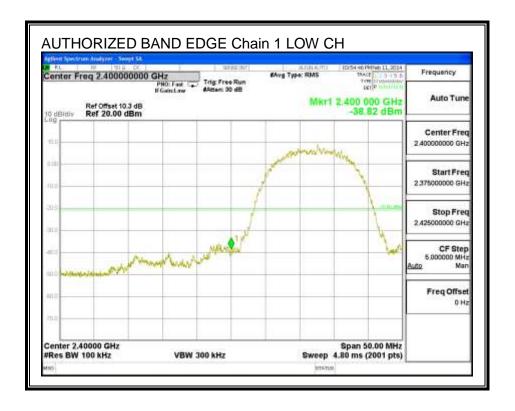
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#### **IN-BAND REFERENCE LEVEL, Chain 1**

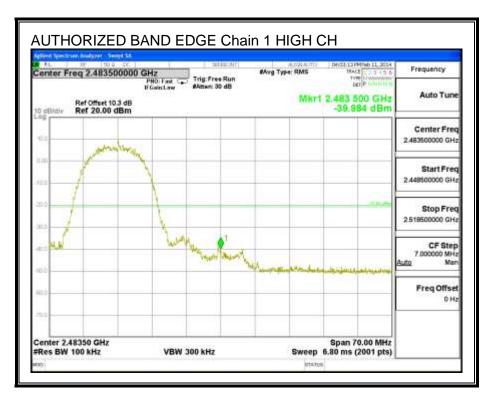


#### LOW CHANNEL BANDEDGE, Chain 1

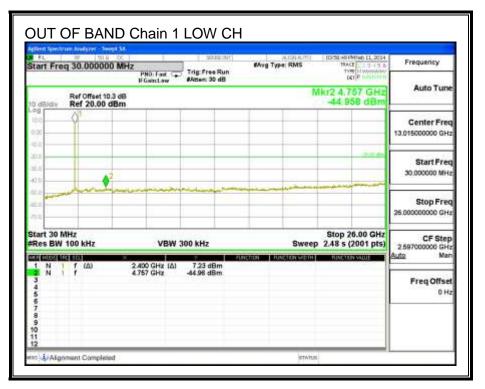


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#### HIGH CHANNEL BANDEDGE, Chain 1

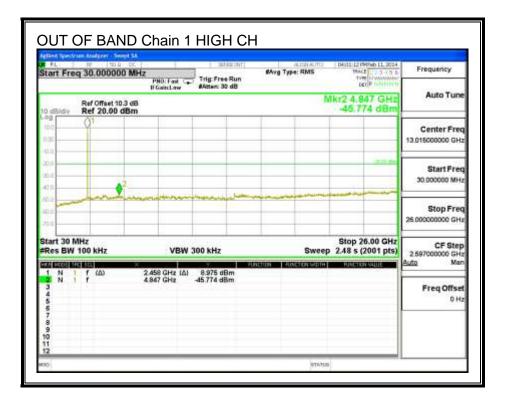


#### **OUT-OF-BAND EMISSIONS, Chain 1**



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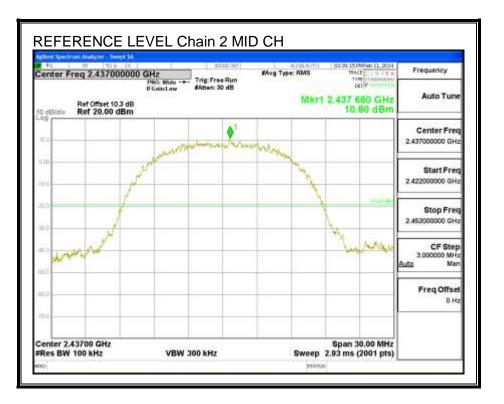
RL.	W	and the second se	Trig Free Run	#Avg Type: RMS	TDPS0-25 PMPeb 11, 2014 TNACE 12: 0: 4:5: 5 TVME 14 WestWest	Frequency
_		PND: Fast C If Gain:Low	Atten: 30 dB		Der[P mininimm	Auto Tun
vib/Bb d	Ref Offset 10. Ref 20.00 d				44.87 dBm	Auto Tun
00	1					
	Y					Center Free 13.015000000 GH
0.0	-				2.0.6	Start Free
0.0						30.000000 MH
0.0						Stop Free 26.00000000 GH
tart 30 f Res BW	WHz 100 kHz	VBW	300 kHz	Swee	Stop 26.00 GHz p 2.48 s (2001 pts)	CF Ster 2 597000000 GH
	τ (Δ)	2.438 GHz (A		UNCTION AND ADDRESS OF WEATH		Auto Ma
2 N 3 4 5	,	3.796 GHz	-44.97 dBm			Freq Offse 0 H
6 7 8 9 0						



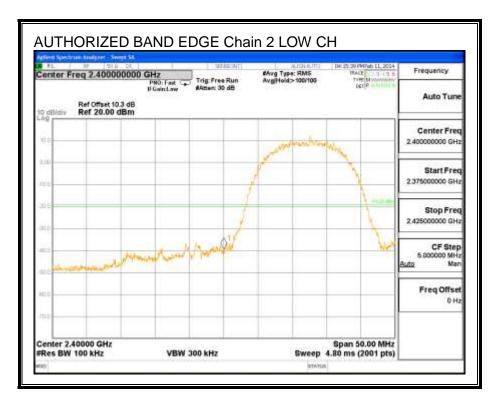
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#### **IN-BAND REFERENCE LEVEL, Chain 2**

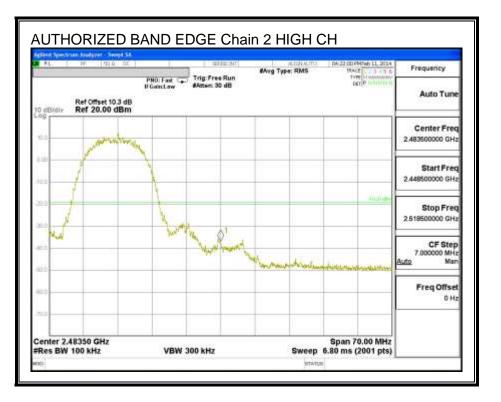


#### LOW CHANNEL BANDEDGE, Chain 2

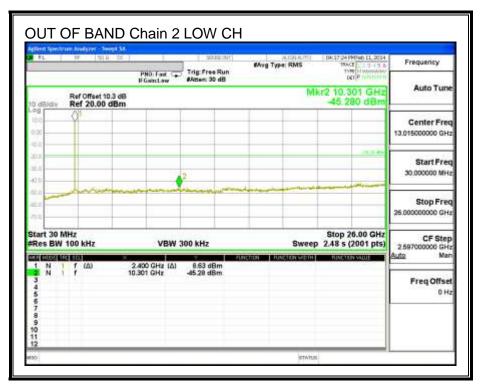


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#### HIGH CHANNEL BANDEDGE, Chain 2

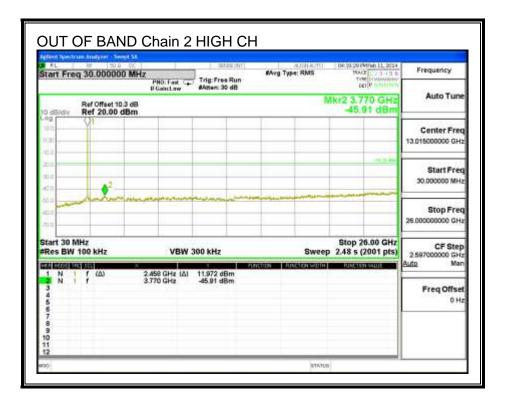


#### **OUT-OF-BAND EMISSIONS, Chain 2**



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RL.	W 1919.5	and the second second	Trig Free Run	#Avg Type: RMS	104:23:50 PMPeb 11, 2014 TRACE 12:2:3:4:5 5 TVM: 14 VALUE	Frequency
		PND: Fast C IF Gain:Low	#Atten: 30 dB		DET P INTERNE	Auto Tune
U dB/div	Ref Offset 10.3 d Ref 20.00 dBr				44.865 dBm	Auto Turk
00	01	8 p				10202020
0.00						Center Free 13.01500000 GH
0.0					21.0.00	Start Free
0.0	A2					30.000000 MH
0.0	Anna					Stop Free 26.00000000 GH
tart 30 / Res BW	MHz 100 kHz	VBW	/ 300 kHz	Swee	Stop 26.00 GHz 2.48 s (2001 pts)	CF Step 2 59700000 GH
	τα 100 ματο	2.432 GHz (A		RETEN AUNCTION METH		<u>Auto</u> Mar
2 N 3 4 5	, -	3.874 GHz	-44.885 dBm			Freq Offse 0 H
6 7 8 9 0						



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# 9. RADIATED TEST RESULTS

## 9.1. LIMITS AND PROCEDURE

#### <u>LIMITS</u>

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (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

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

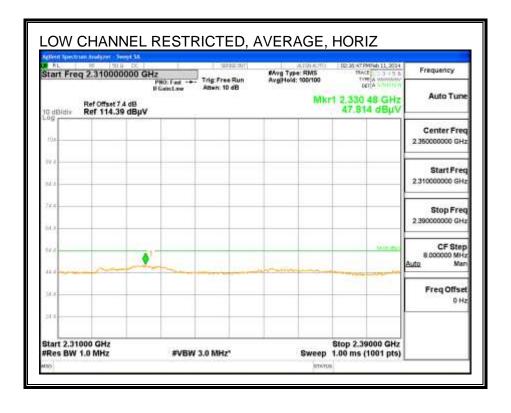
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

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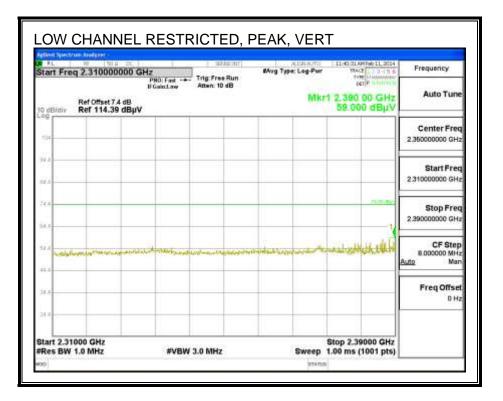
## 9.2. TX ABOVE 1 GHz 802.11b MODE IN THE 2.4 GHz BAND

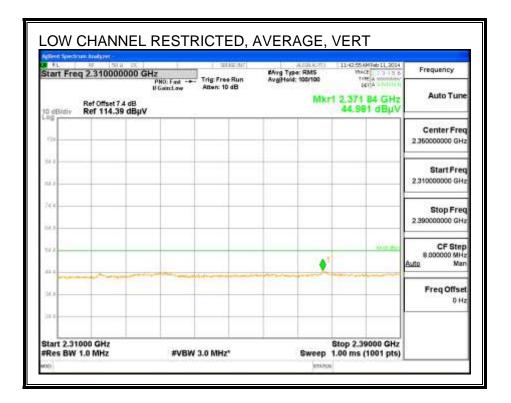
#### **RESTRICTED BANDEDGE (LOW CHANNEL)**

LOW CHANNEL RESTRICTED, PEAK, HORIZ Start Freq 2.310000000 GHz Freq 2.310000000 GHz Figure America 10 dB 10:17:56 PMPeb 11, 2014 TRACE 11:20:45 6 Frequency Myg Type: Log-Pur DETR Mkr1 2.328 08 GHz 57.054 dBµV Auto Tune Ref Offset 7.4 dB Ref 114.39 dBµV Center Freq 2.35000000 GHz Start Freq 2.310000000 GHz Stop Freq 2.39000000 GHz 01 CF Step 8 000000 MHz Man uto Freq Offset D Hz Start 2.31000 GHz Stop 2.39000 GHz #VBW 3.0 MHz Res BW 1.0 MHz Sweep 1.00 ms (1001 pts)



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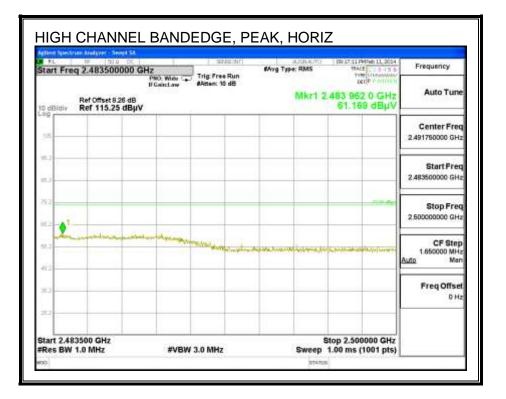


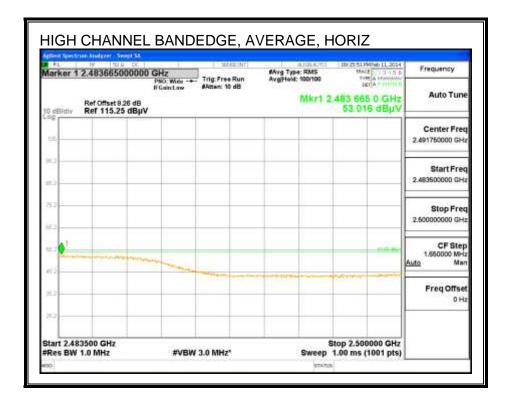


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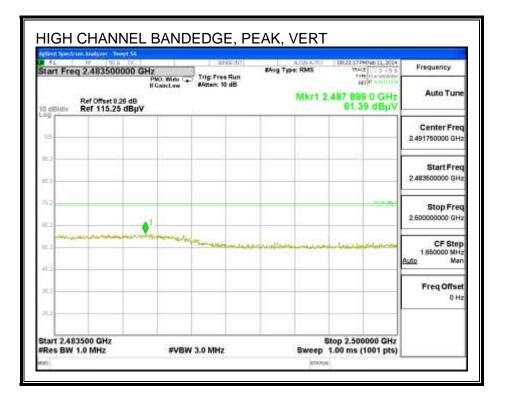
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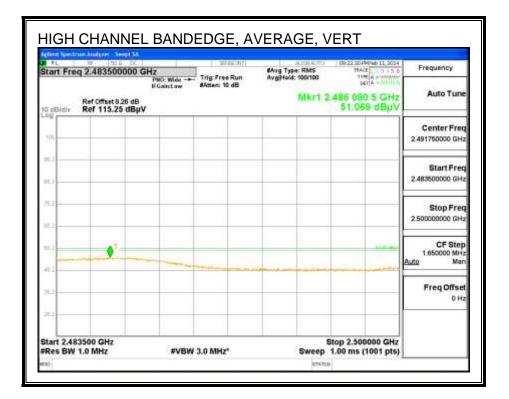
#### AUTHORIZED BANDEDGE (HIGH CHANNEL)





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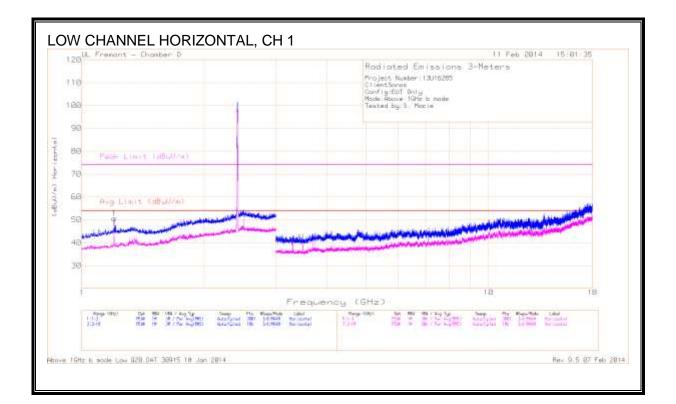


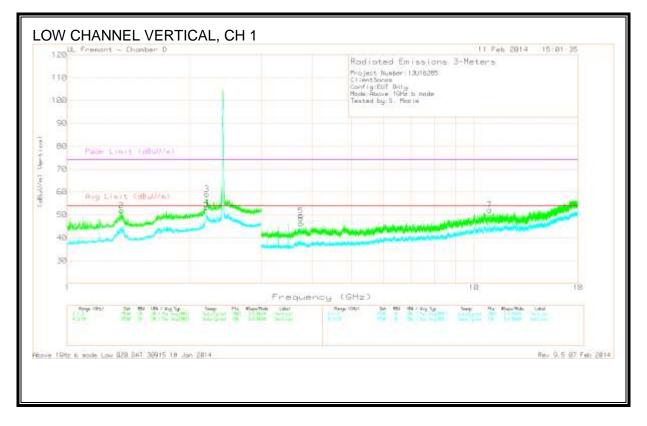


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#### HARMONICS AND SPURIOUS EMISSIONS





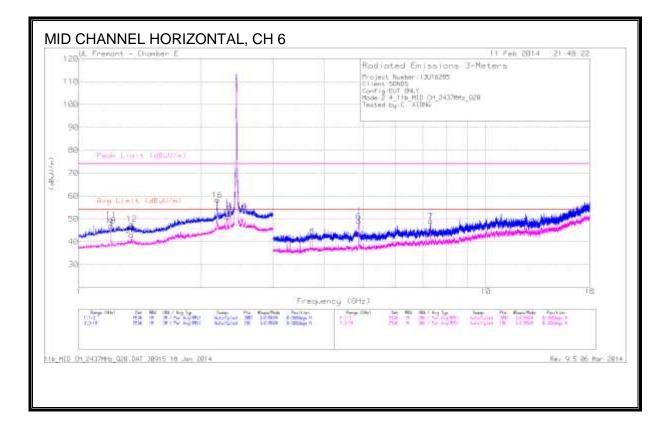
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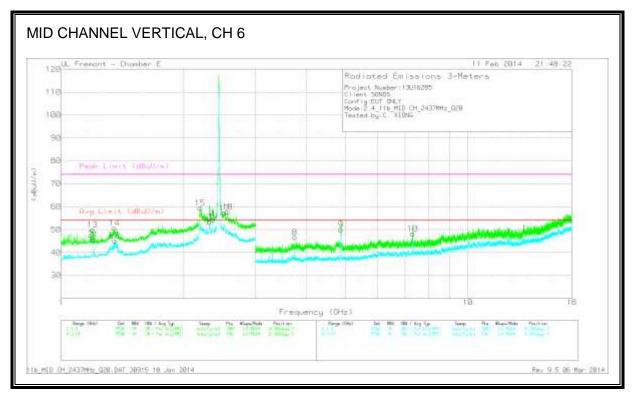
### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/F ltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.205	40.68	PK2	29	-27.6	42.08	-	-	74	-31.92	140	393	Н
	* 1.209	30.31	MAv1	29	-27.6	31.71	53.97	-22.26	-	-	140	393	н
2	* 1.355	43.33	PK2	29	-26.8	45.53	-	-	74	-28.47	350	212	V
	* 1.351	32.83	MAv1	29	-26.8	35.03	53.97	-18.94	-	-	350	212	V
3	*2.198	50.4	PK2	32.3	-25.3	57.4	-	-	74	-16.6	246	125	V
4	*2.200	40.98	MAv1	32.3	-25.3	47.98	53.97	-5.99	-	-	246	125	V
5	* 3.749	40.62	PK2	33.7	-31.2	43.12	-	-	74	-30.88	20	318	V
6	* 3.750	33.77	MAv1	33.7	-31.2	36.27	53.97	-17.7	-	-	20	318	V
7	* 10.91	34.07	PK2	38.5	-23.9	48.67	-	-	74	-25.33	77	273	V
	* 10.913	23.6	MAv1	38.5	-23.8	38.3	53.97	-15.67	-	-	77	273	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band PK2 - KDB558074 Method: Maximum Peak MAv1 - KDB558074 Option 1 Maximum RMS Average

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#### **Trace Markers**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/F ltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.313	48.16	PK2	32.5	-25.3	55.36	-	-	74	-18.64	250	104	н
	* 2.314	37.27	MAv1	32.5	-25.3	44.47	53.97	-9.5	-	-	250	104	н
2	* 2.35	50.38	PK2	32.5	-24.9	57.98	-	-	74	-16.02	264	132	н
	* 2.348	41.4	MAv1	32.5	-25	48.9	53.97	-5.07	-	-	264	132	н
3	* 2.314	54.61	PK2	32.5	-25.3	61.81	-	-	74	-12.19	247	121	V
	* 2.313	39.93	MAv1	32.5	-25.3	47.13	53.97	-6.84	-	-	247	121	V
4	* 2.356	52.82	PK2	32.5	-24.8	60.52	-	-	74	-13.48	246	135	V
	* 2.358	43.59	MAv1	32.5	-24.8	51.29	53.97	-2.68	-	-	246	135	V
5	* 3.75	39.68	Avg	33.7	-31.2	42.18	53.97	-11.79	-	-	0-360	199	н
6	* 4.874	53.13	PK2	34.4	-31	56.53	-	-	74	-17.47	300	217	н
	* 4.874	43.82	MAv1	34.4	-31	47.22	53.97	-6.75	-	-	300	217	н
7	* 7.309	48.67	PK2	36	-28.1	56.57	-	-	74	-17.43	294	160	н
	* 7.31	39.52	MAv1	36	-28.1	47.42	53.97	-6.55	-	-	294	160	н
8	* 3.75	44.2	Avg	33.7	-31.2	46.7	53.97	-7.27	-	-	0-360	200	V
9	* 4.874	53.26	PK2	34.4	-31	56.66	-	-	74	-17.34	4	200	V
	* 4.873	44.77	MAv1	34.4	-31	48.17	53.97	-5.8	-	-	4	200	V
10	* 7.309	48.47	PK2	36	-28.1	56.37	-	-	74	-17.63	338	259	V
	* 7.309	38.73	MAv1	36	-28.1	46.63	53.97	-7.34	-	-	338	259	V
11	* 1.201	48.28	PK	29	-27.6	49.68	-	-	74	-24.32	0-360	199	н
	* 1.2	45.69	Avg	29	-27.6	47.09	53.97	-6.88	-	-	0-360	199	н
12	* 1.348	45.61	PK	29	-26.8	47.81	-	-	74	-26.19	0-360	101	н
	* 1.347	40.58	Avg	29	-26.8	42.78	53.97	-11.19	-	-	0-360	101	н
13	* 1.194	48.55	PK	29	-27.6	49.95	-	-	74	-24.05	0-360	200	V
	* 1.2	44.32	Avg	29	-27.6	45.72	53.97	-8.25	-	-	0-360	101	V
14	* 1.351	48.49	РК	29	-26.8	50.69	-	-	74	-23.31	0-360	101	V
	* 1.354	43.07	Avg	29	-26.8	45.27	53.97	-8.7	-	-	0-360	101	v
15	2.192	52.49	PK	32.3	-25.3	59.49	-	-	68.2	-8.71	0-360	101	v
16	2.188	51.23	PK	32.3	-25.3	58.23	-	-	68.2	-9.97	0-360	101	н
17	2.516	48.98	PK	32.7	-24.4	57.28	-	-	68.2	-10.92	0-360	101	V
18	2.565	49.45	PK	32.8	-24.5	57.75	-	-	68.2	-10.45	0-360	101	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

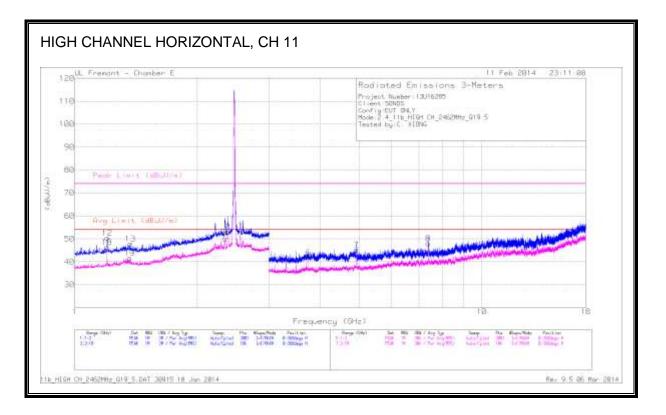
PK – Peak Detector

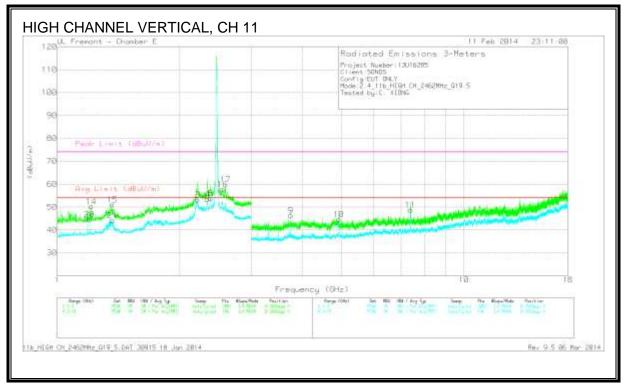
Avg - Video bandwidth < Resolution bandwidth

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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#### **Trace Markers**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Fl tr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.338	53.19	PK2	32.5	-25.1	0	60.59	-	-	74	-13.41	239	102	н
	* 2.337	38.95	MAv1	32.5	-25.1	0	46.35	53.97	-7.62	-	-	239	102	Н
2	* 2.376	52.13	PK2	32.6	-25	0	59.73	-	-	74	-14.27	46	135	Н
	* 2.375	43.05	MAv1	32.5	-24.9	0	50.65	53.97	-3.32	-	-	46	135	н
3	* 2.21	55	PK2	32.4	-25.2	0	62.2	-	-	74	-11.8	230	104	V
	* 2.2	43.38	MAv1	32.3	-25.3	0	50.38	53.97	-3.59	-	-	230	104	V
4	* 2.336	55.47	PK2	32.5	-25.1	0	62.87	-	-	74	-11.13	182	156	V
	* 2.337	40.91	MAv1	32.5	-25.1	0	48.31	53.97	-5.66	-	-	182	156	V
5	* 2.379	51.89	PK2	32.6	-25	0	59.49	-	-	74	-14.51	178	216	V
	* 2.379	41.86	MAv1	32.6	-25	0	49.46	53.97	-4.51	-	-	178	216	V
6	* 3.75	39.36	Avg	33.7	-31.2	0	41.86	53.97	-12.11	-	-	0-360	199	н
7	* 4.923	41.43	Avg	34.4	-30.6	0	45.23	53.97	-8.74	-	-	0-360	199	н
8	* 7.388	46.26	PK2	36.1	-27.3	0	55.06	-	-	74	-18.94	284	253	н
	* 7.388	37.7	MAv1	36.1	-27.3	0	46.5	53.97	-7.47	-	-	284	253	н
9	* 3.75	43.85	Avg	33.7	-31.2	0	46.35	53.97	-7.62	-	-	0-360	200	V
10	* 4.924	40.84	Avg	34.4	-30.6	0	44.64	53.97	-9.33	-	-	0-360	200	V
11	* 7.387	46.16	PK2	36.1	-27.3	0	54.96	-	-	74	-19.04	360	268	V
	* 7.388	37.4	MAv1	36.1	-27.3	0	46.2	53.97	-7.77	-	-	360	268	V
12	* 1.201	49	PK	29	-27.6	0	50.4	-	-	74	-23.6	0-360	101	н
	* 1.2	44.86	Avg	29	-27.6	0	46.26	53.97	-7.71	-	-	0-360	200	н
13	* 1.37	45.63	PK	29	-26.7	0	47.93	-	-	74	-26.07	0-360	101	н
	* 1.365	39.44	Avg	29	-26.8	0	41.64	53.97	-12.33	-	-	0-360	101	н
14	* 1.211	48.86	PK	29	-27.6	0	50.26	-	-	74	-23.74	0-360	200	V
	* 1.199	43.18	Avg	29	-27.6	0	44.58	53.97	-9.39	-	-	0-360	200	V
15	* 1.365	48.83	PK	29	-26.8	0	51.03	-	-	74	-22.97	0-360	101	V
	* 1.367	41.91	Avg	29	-26.7	0	44.21	53.97	-9.76	-	-	0-360	101	V
16	2.551	49.35	PK	32.8	-24.4	0	57.75	-	-	68.2	-10.45	0-360	101	V
17	2.591	51.18	PK	32.9	-24.2	0	59.88	-	-	68.2	-8.32	0-360	101	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK – Peak Detector

Avg - Video bandwidth < Resolution bandwidth

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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# 9.3. WORST-CASE ABOVE 18 GHz

# SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)

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## <u>DATA</u>

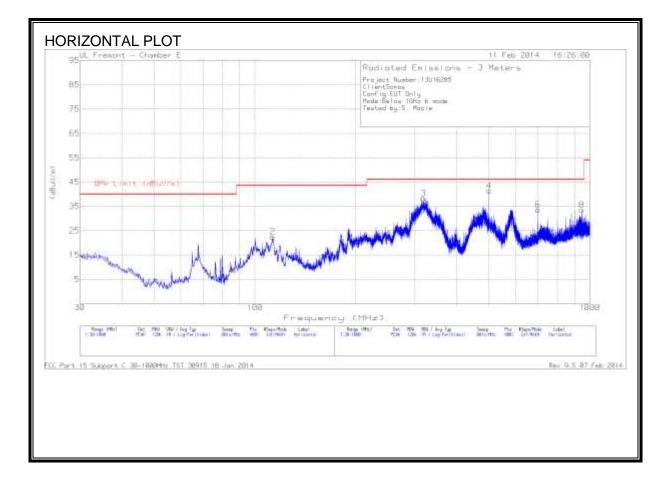
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T89 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	25.474	44.37	PK	34.1	-22.8	-9.5	46.17	54	-7.83	74	-27.83
2	25.307	44.43	PK	33.9	-22.5	-9.5	46.33	54	-7.67	74	-27.67

PK - Peak detector DTS 2.DAT 30915 23 Aug 2013 Rev 9.5 19 Jan 2014

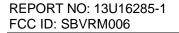
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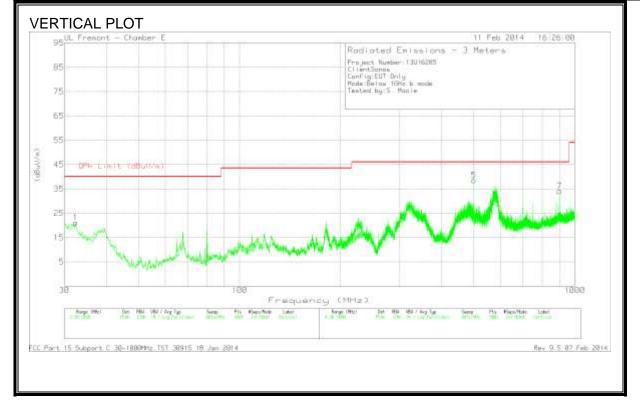
# 9.4. WORST-CASE BELOW 1 GHz

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



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## **Trace Markers**

Marker	Frequenc y (MHz)	Meter Reading (dBuV)	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Correcte d Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	32.425	33.64	PK	19.3	-31.9	21.04	40	-18.96	0-360	100	V
2	112.935	40.82	PK	12.9	-31.2	22.52	43.52	-21.00	0-360	301	Н
3	318.575	54.83	PK	13.8	-30.3	38.33	46.02	-7.69	0-360	100	Н
4	499.9637	52.76	QP	17.8	-29.7	40.86	46.02	-5.16	230	156	Н
5	499.965	50.49	PK	17.8	-29.7	38.59	46.02	-7.43	0-360	201	V
6	699.9063	43.17	PK	19.7	-29.3	33.57	46.02	-12.45	0-360	100	Н
7	899.9688	39.96	PK	22.5	-28.4	34.06	46.02	-11.96	0-360	100	V
8	946.5288	39.1	PK	22.2	-27.8	33.5	46.02	-12.52	0-360	100	Н

PK - Peak detector

QP - Quasi-Peak detector

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# **10. AC POWER LINE CONDUCTED EMISSIONS**

#### **LIMITS**

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted I	.imit (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.

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

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#### **RESULTS**

#### **<u>6 WORST EMISSIONS</u>**

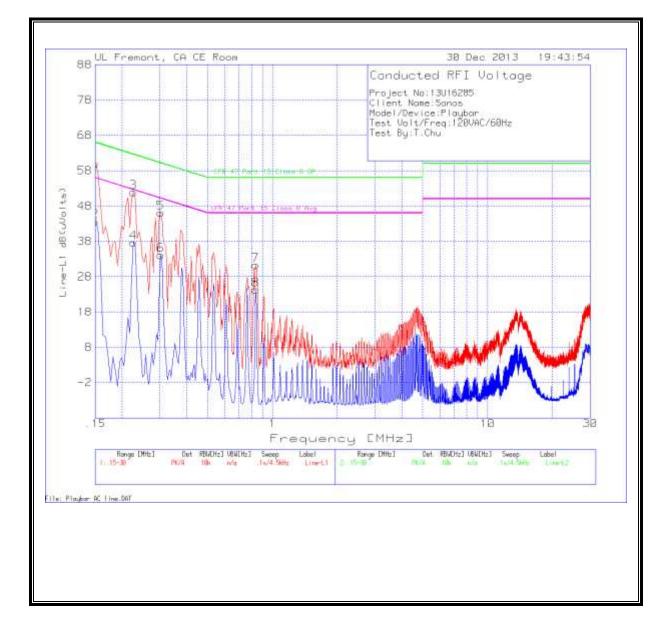
## Line-L1 .15 - 30MHz

Marker	Frequency	Meter	Det	T24 IL L1	LC Cables	Corrected	CFR 47 Part	Margin to	CFR 47 Part	Margin to
	(MHz)	Reading (dBuV)		(dB)	1&3 (dB)	Reading dB(uVolts)	15 Class B QP	Limit (dB)	15 Class B Avg	Limit (dB)
1	.15	59.78	PK	.1	0	59.88	66	-6.12	-	-
2	.15	43.55	Av	.1	0	43.65	-	-	56	-12.35
3	.2265	51.77	PK	.1	0	51.87	62.6	-10.73	-	-
4	.2265	37.55	Av	.1	0	37.65	-	-	52.6	-14.95
5	.303	46	PK	.1	0	46.1	60.2	-14.1	-	-
6	.303	34.04	Av	.1	0	34.14	-	-	50.2	-16.06
7	.8385	31.18	PK	.1	0	31.28	56	-24.72	-	-
8	.8385	24.21	Av	.1	0	24.31	-	-	46	-21.69
Line	-L2 .15 -	30MHz								
Trace	e Markers									
Markor	Eroquonov	Motor	Dot	T24 II 1 2		Corrected	CEP 47 Port	Margin to	CEP 47 Port	Margin to

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dB(uVolts)	CFR 47 Part 15 Class B QP	Margin to Limit (dB)	CFR 47 Part 15 Class B Avg	Margin to Limit (dB)
9	.213	50.1	PK	.1	0	50.2	63.1	-12.9	-	-
10	.213	31.27	Av	.1	0	31.37	-	-	53.1	-21.73
11	.3615	40.71	PK	.1	0	40.81	58.7	-17.89	-	-
12	.3615	30.09	Av	.1	0	30.19	-	-	48.7	-18.51
13	1.446	15.81	PK	.1	.1	16.01	56	-39.99	-	-
14	1.446	4.18	Av	.1	.1	4.38	-	-	46	-41.62
15	25.3995	11.83	PK	.5	.3	12.63	60	-47.37	-	-
16	25.3995	5.02	Av	.5	.3	5.82	-	-	50	-44.18

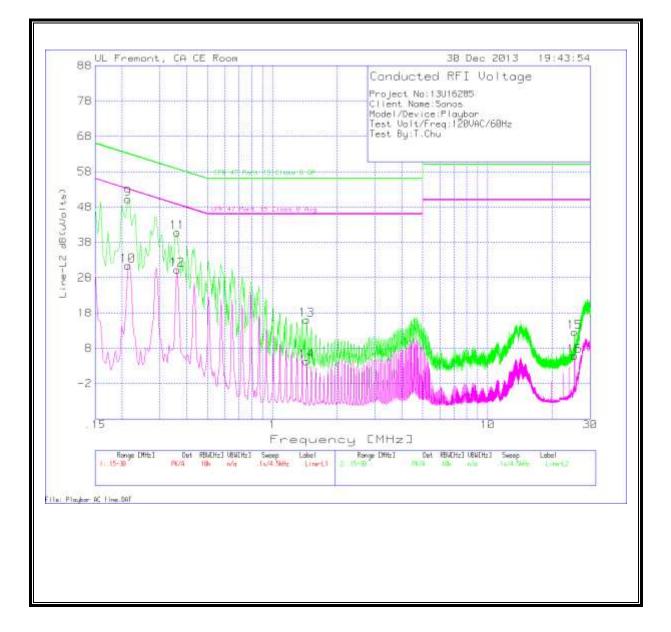
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#### LINE 1 RESULTS



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#### LINE 2 RESULTS



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# 11. POWER SETTINGS

Frequency(MHz)	Power setting (Q)
2412	20
2437	20
2462	19.5

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