

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

FOR

802.11 3X3 A/B/G/N MINI PCIE CARD. 20MHZ BW.PCB ANTENNA DFS CLIENT DEVICE

**MODEL NUMBER: PLAY3** 

FCC ID: SBVRM004 IC: 5373A-RM004

REPORT NUMBER: 13U16719-2, REVISION B ISSUE DATE: MAY 7, 2014

Prepared for SONOS, INC. 223 E. DE LA GUERRA SANTA BARBARA, CA 93101, U.S.A.

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NVLAP LAB CODE 200065-0

### **Revision History**

Rev.	lssue Date	Revisions	Revised By
	02/13/14	Initial Issue	G. Quizon
A	04/28/14	Added FCC KDB 662911 D01	M. Mekuria
В	05/07/14	Revised Output Power and PSD Data	T. Chu

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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:	802.11 3X3 A/B/G/N MINI PCIE CARD ANTENNA DFS CLIENT DEVICE	. 20MHZ BW.PCB			
MODEL:	PLAY3				
SERIAL NUMBER:	1308000E58FD280E4 (Radiated), 1308 (Conducted)	3000E58FD280A0			
DATE TESTED:	JANUARY 06 - FEBRUARY 06, 2014				
	APPLICABLE STANDARDS				
SI	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:

22 Lungar

George Quizon PROJECT LEADER UL Verification Services Inc.

Tony Wang Lab 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, FCC KDB 662911 D01 v02r01, 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

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# 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 is an 802.11 3x3 abgn Mini PCIe Card. 20MHz BW.PCB antenna. DFS client device that is embedded inside the Sonos Play3 wireless sound system.

The radio module is manufactured by Sonos, Inc.

# 5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

This is a Class II permissive change project. The change is to add a higher gain antennas on all 5GHz frequencies. The EUT tested did not support legacy mode. The original report, RF110223E04-1 R1 was issued by Bureau Veritas Consumer Products Services (H.K.) Ltd.

Note: Since the original report issued more than two years ago and some changes have made on FCC standards, this Class II permissive change report has a complete set of test data.

## 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)
5745 - 5825	802.11n HT20	27.07	509.33

# 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT is using 3 antennas as follow:

Antenna	Frequency	Peak gain with cable loss (dBi)		
Antenna (1)	5.8G (5745-5825)	2.2		
Antenna (2)	5.8G (5745-5825)	5.5		
Antenna (3)	5.8G (5745-5825)	3.7		

# 5.5. SOFTWARE AND FIRMWARE

The Sonos software version is V3.6 17.1-48020.

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## 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.

Based on the baseline scan, the worst-case data rates were:

802.11n HT20 mode: MCS0

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

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# 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List						
Description Manufacturer Model Serial Number						
Laptop	Lenovo	W510	R9-BK0RH 11/02	DOC		
Laptop AC adapter	Lenovo	45N0058	11S45N0058Z1ZJA40C1GZXP	DOC		
Router	Netgear	FS105	1D52163D0AADA	DOC		
Router AC adapter	Netgear	MU08A9075100-A1	2411201651023902JT	N/A		

### I/O CABLES

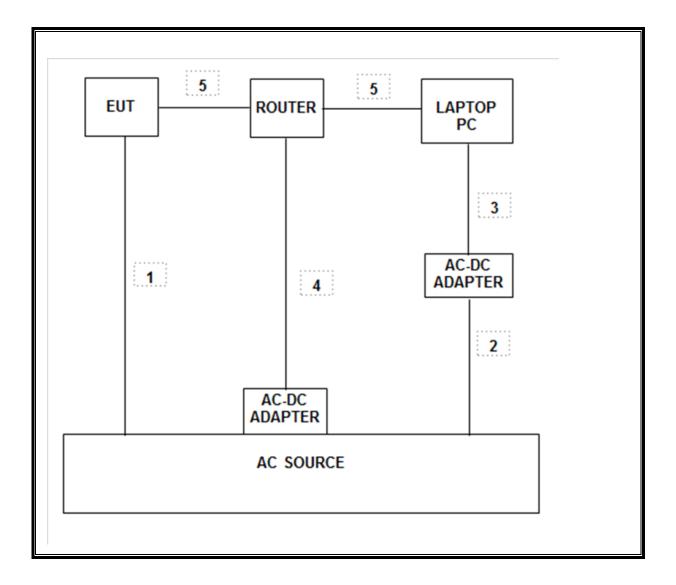
	I/O Cable List						
Cable	Cable Port # of identical Connector Cable Type Cable Re					Remarks	
No		ports	Туре		Length (m)		
1	AC	1	US 115V	Un-shielded	1.8m	N/A	
2	AC	1	US 115V	Un-shielded	1m	N/A	
3	DC	1	DC	Un-shielded	1.8m	N/A	
4	DC	1	DC	Un-shielded	1.8m	N/A	
5	Ethernet	2	RJ45	Un-shielded	2m	N/A	

### 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	02/19/14		
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	05/08/14		
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	05/06/14		
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	F00027	03/07/14		
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, 3Hz-44GHz	Agilent	N9030A	F00127	02/22/14		
Spectrum Analyzer, 40 GHz	Agilent / HP	8564E	C00951	07/29/14		
PreApmplifier, 1-26.5GHz	Agilent	8449B	F10067	03/23/14		
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	F00194	05/14/14		
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/15/14		
LISN 30MHz	FCC	50/250-25-2	C00626	01/14/14		
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/20/14		

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# 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

### <u>LIMITS</u>

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)
5.8GHz Band						
802.11n HT20 CH 0	1.296	1.479	0.876	87.63%	0.57	0.772

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## 7.2. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r01, Section 8.1.

Output Power: KDB 558074 D01 v03r01, Section 9.1.2.

Power Spectral Density: KDB 558074 D01 v03r01, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r01, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r01, Section 12.2.

KDB 662911 D01 is referred for transmitters with Multiple Outputs in the Same Band.

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# 7.3. DUTY CYCLE PLOTS

### 5.8GHz BANDS

DUTY CYCLE 802.11n HT20 5785MHz CH 0 09:39:29 AM Jan 13, 2014 TRACE 1 2 3 4 5 6 TYPE WWWWWW DET P N N N N N #Avg Type: RMS Frequency PNO: Fast +++ IFGain:Low Trig: Free Run #Atten: 30 dB Auto Tune ΔMkr3 1.479 ms -0.19 dB Ref Offset 19 dB Ref 30.00 dBm 10 dB/div Log 3∆4 **Center Freq** 10. 5.785000000 GHz Start Freq 5.785000000 GHz helper MANA 40 Stop Freq 5.785000000 GHz -60. Center 5.785000000 GHz Res BW 8 MHz Span 0 Hz Sweep 3.000 ms (1001 pts) CF Step 8.000000 MHz #VBW 50 MHz Mar MKR MODE TRC SCL ۱uto t (Δ) t t (Δ) t 1.296 ms (Δ) 1.194 ms 1.479 ms (Δ) 1.194 ms -2.25 dB 24.82 dBm -0.19 dB 24.82 dBm 1 Δ2 2 F 3 Δ4 4 F 5 Freq Offset 0 Hz 10 11 STATUS

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# 8. ANTENNA PORT TEST RESULTS

### 8.1. 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.

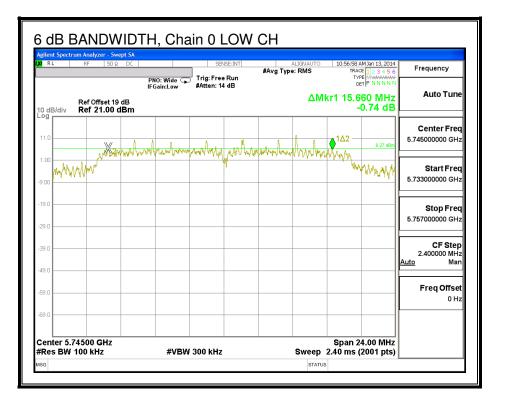
#### **RESULTS**

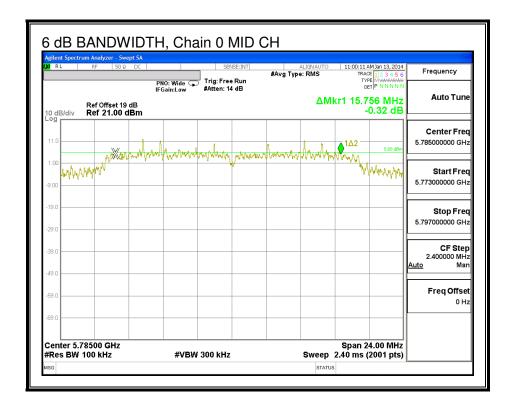
Channel	Frequency	6 dB BW	6 dB BW 6 dB BW		Minimum
		Chain 0	Chain 1	Chain 2	Limit
	(MHz)	(MHz)	(MHz)	(MHz)	(MHz)
Low	5745	15.660	15.139	15.096	0.5
Mid	5785	15.756	15.912	15.720	0.5
High	5825	15.936	15.960	15.996	0.5

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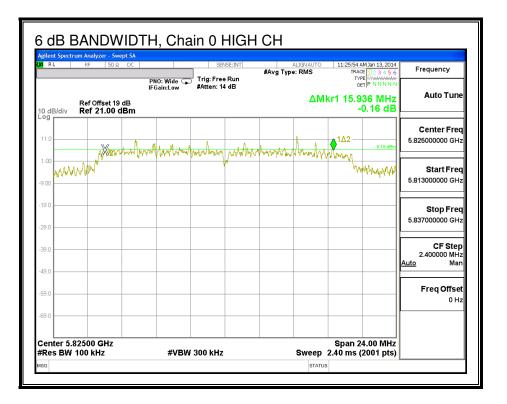
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### 6 dB BANDWIDTH, Chain 0

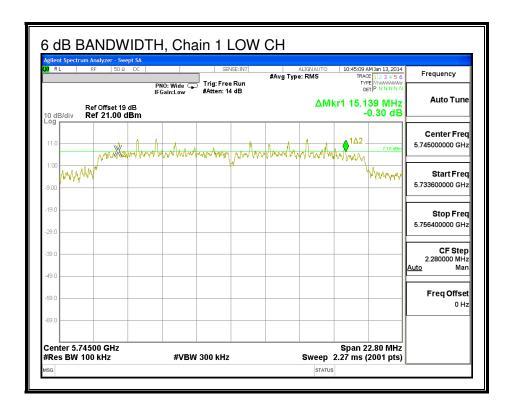




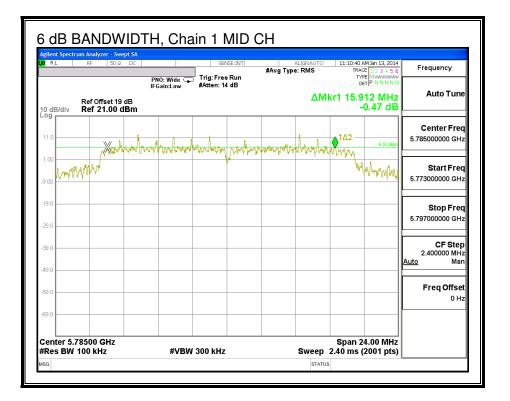
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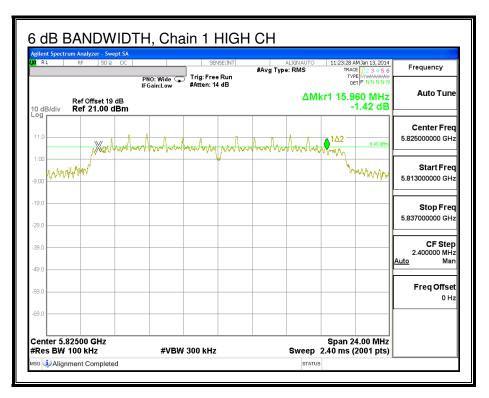


### 6 dB BANDWIDTH, Chain 1



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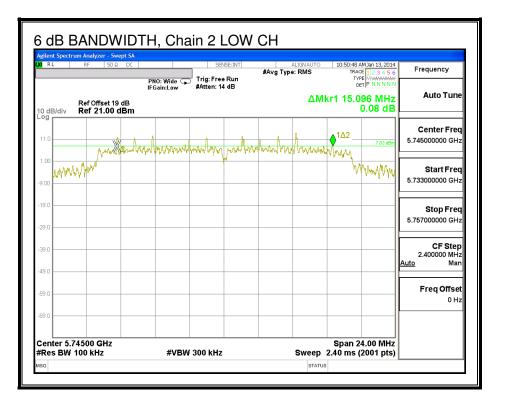


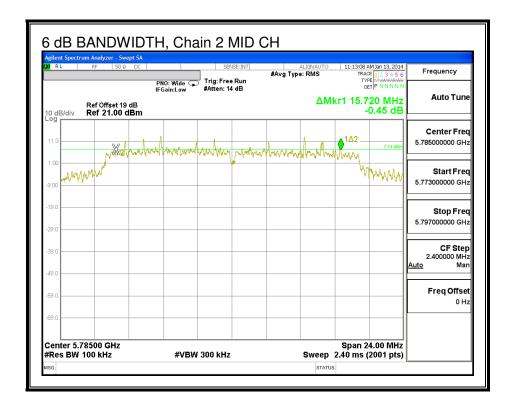


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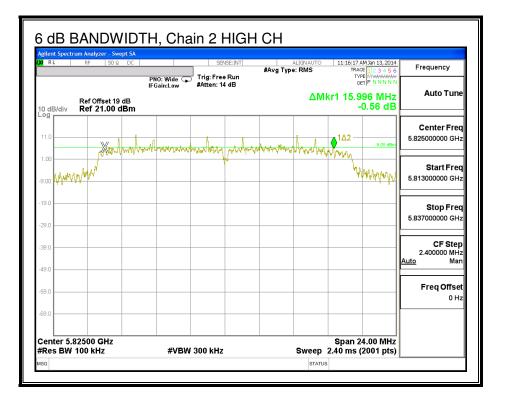
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### 6 dB BANDWIDTH, Chain 2





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### 8.2. 99% **BANDWIDTH**

### **LIMITS**

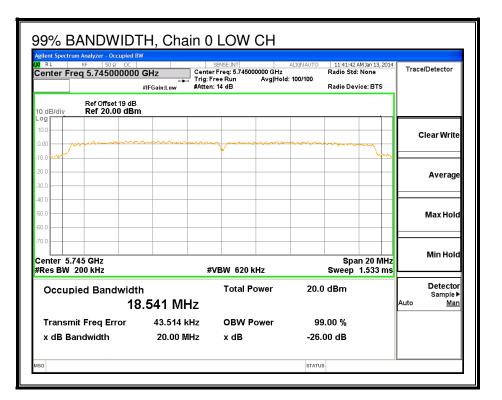
None; for reporting purposes only.

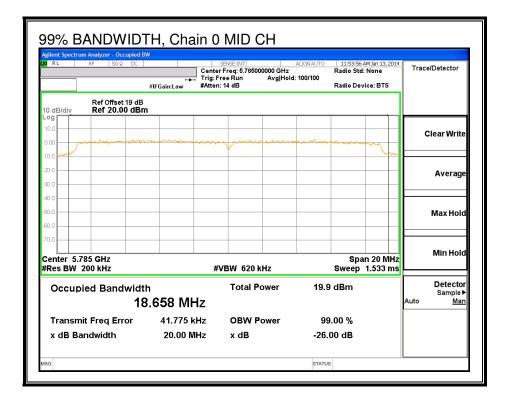
### **RESULTS**

Channel	Frequency	99% BW	99% BW	99% BW
		Chain 0	Chain 1	Chain 2
	(MHz)	(MHz)	(MHz)	(MHz)
Low	5745	18.541	18.080	18.208
Mid	5785	18.658	18.036	17.853
High	5825	18.600	17.824	17.772

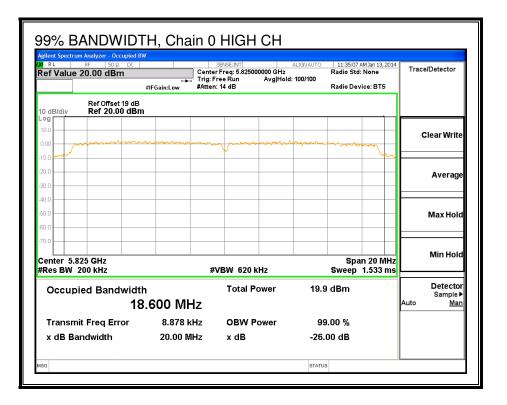
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#### 99% BANDWIDTH, Chain 0

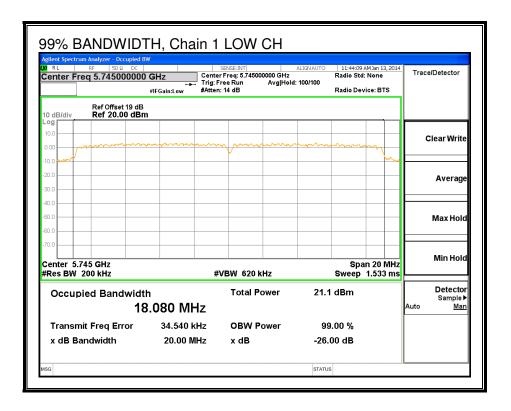




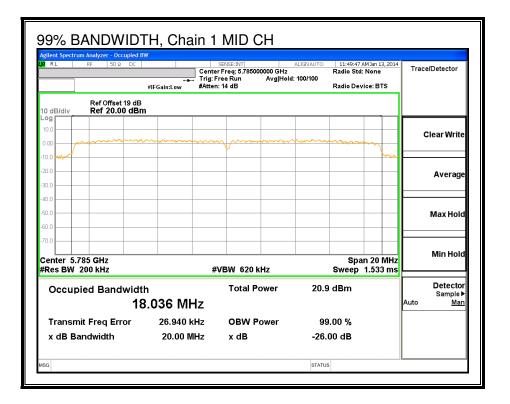
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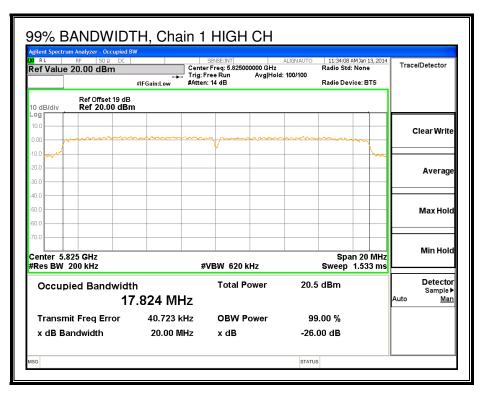


### 99% BANDWIDTH, Chain 1



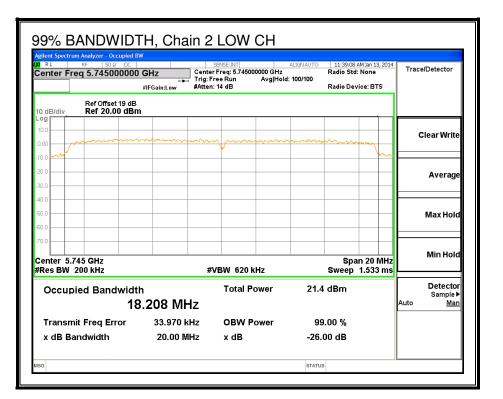
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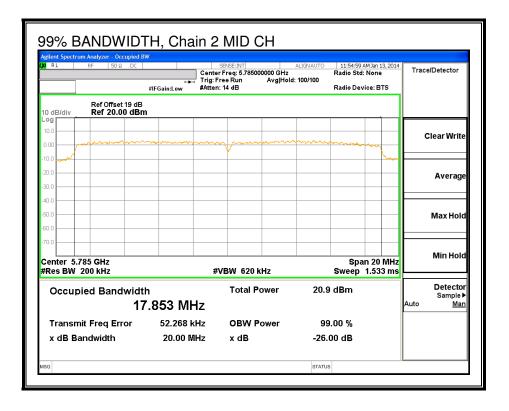




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### 99% BANDWIDTH, Chain 2





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RL Ref Value	RF 50 Ω DC ue 20.00 dBm #IFGain:Low		Center F			ALIGNAUTO : 100/100	Radio Std		Trace/Detector		
0 dB/div	Ref Offset Ref 20.0										
10.0	www.weiterington				~~~~	-	m			с	lear Write
0.0					Ý				w		
0.0											Average
0.0											
0.0											Max Hold
0.0											
enter 5.3 Res BW				#VE	3W 620 K	(Hz			n 20 MHz 1.533 ms		Min Hold
Occup	ied Band		72 MF	Ηz	Total P	ower	20.5	dBm		Auto	Detector Sample ► <u>Man</u>
Transm	nit Freq Err	or	37.190 k	Hz	OBW P	ower	99	.00 %			
x dB Ba	andwidth		20.00 N	IHz	x dB		-26.	00 dB			

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### 8.3. AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### **RESULTS**

Channel	Frequency	Power	Chain 0	Chain 1	Chain 2
		Setting	Power	Power	Power
	(MHz)		(dBm)	(dBm)	(dBm)
Low	5745	15	16.13	15.79	17.99
Mid	5785	15	17.23	16.78	18.13
High	5825	15	16.84	16.18	17.29

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## 8.4. 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)
2.20	5.50	3.70	4.01

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

Chain 0	Chain 1	Chain 2	<b>Correlated Chains</b>
Antenna	Antenna	Antenna	Directional
Gain	Gain	Gain	Gain
(dBi)	(dBi)	(dBi)	(dBi)
2.20	5.50	3.70	8.68

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#### Limits

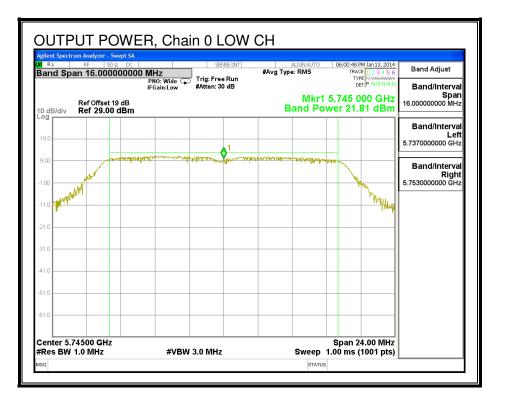
Channel	Frequency	Directional	FCC	IC	IC	Max
		Gain	Power	Power	EIRP	Power
			Limit	Limit	Limit	
	(MHz)	(dBi)	(dBm)	(dBm)	(dBm)	(dBm)
Low	5745	4.01	30.00	30	36	30.00
Mid	5785	4.01	30.00	30	36	30.00
High	5825	4.01	30.00	30	36	30.00

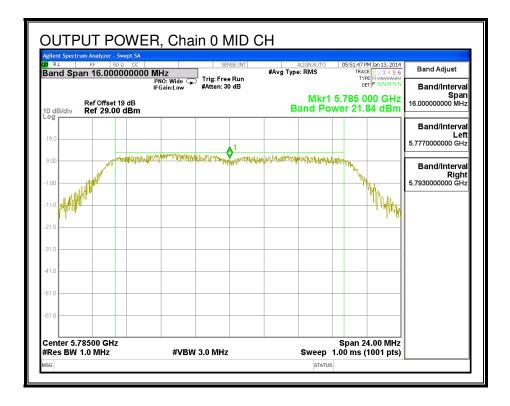
#### Results

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	5745	21.81	21.31	23.47	27.07	30.00	-2.93
Mid	5785	21.84	21.54	23.13	27.00	30.00	-3.00
High	5825	22.03	21.05	23.10	26.91	30.00	-3.09

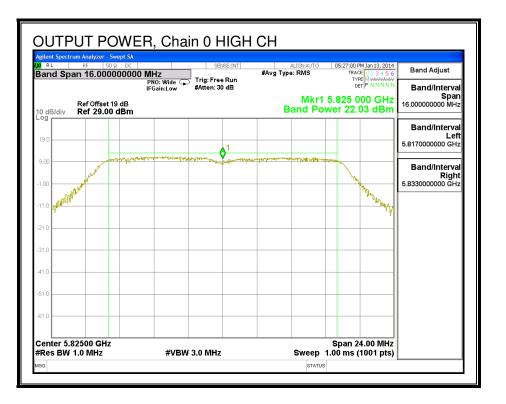
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### OUTPUT POWER, Chain 0

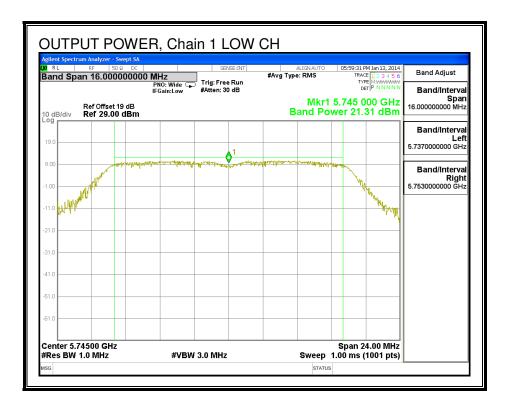




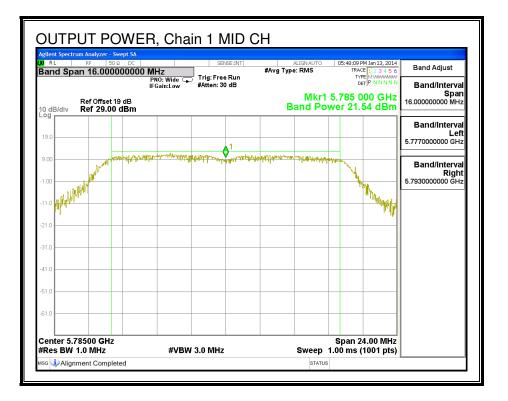
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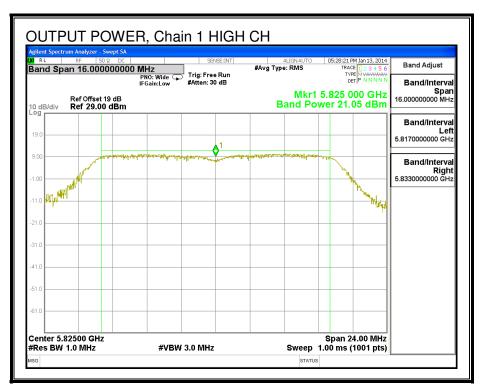


### **OUTPUT POWER, Chain 1**



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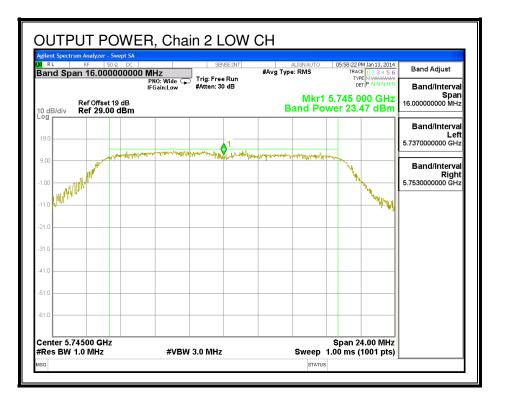


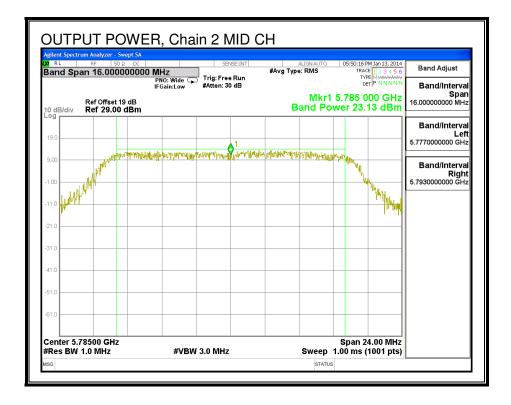


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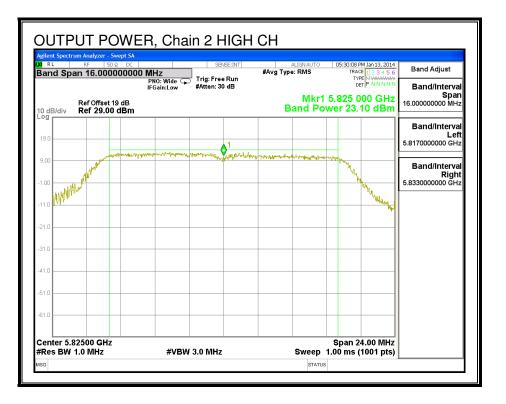
Page 33 of 76

### OUTPUT POWER, Chain 2





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### 8.5. PSD

### **LIMITS**

FCC §15.247

IC RSS-210 A8.2

### **RESULTS**

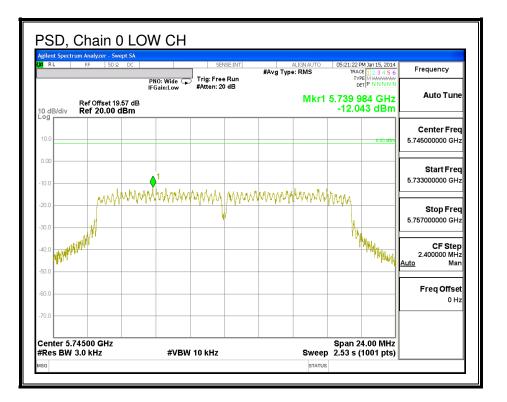
#### **PSD Results**

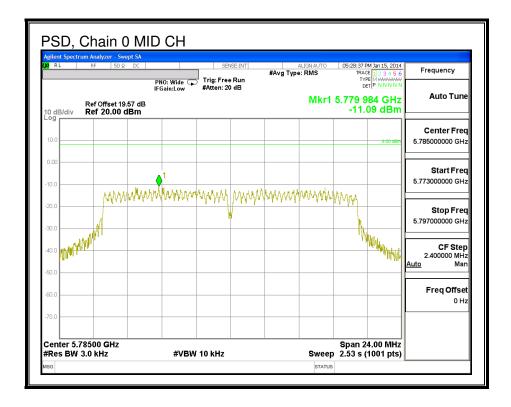
Channel	Frequency	Chain 0	Chain 1	Chain 2	Total	Limit	Margin
		Meas	Meas	Meas	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5745	-11.04	-12.14	-9.66	-6.06	8.0	-14.1
Mid	5785	-11.09	-11.02	-8.70	-5.35	8.0	-13.4
High	5825	-11.94	-10.29	-10.01	-5.89	8.0	-13.9

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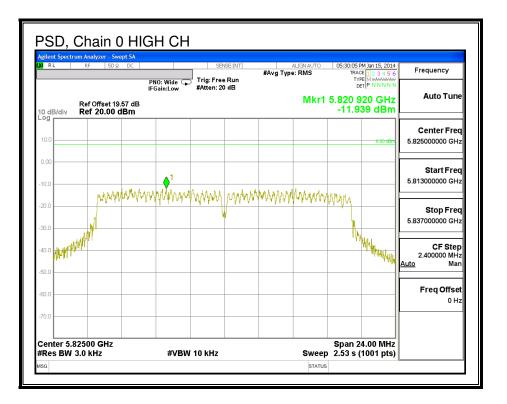
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## PSD, Chain 0

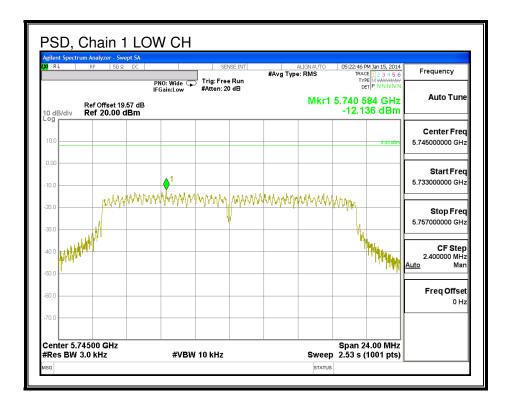




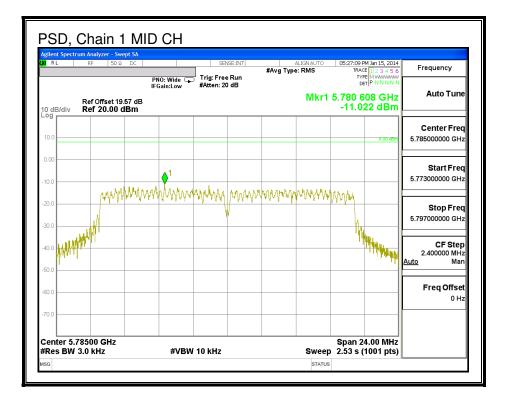
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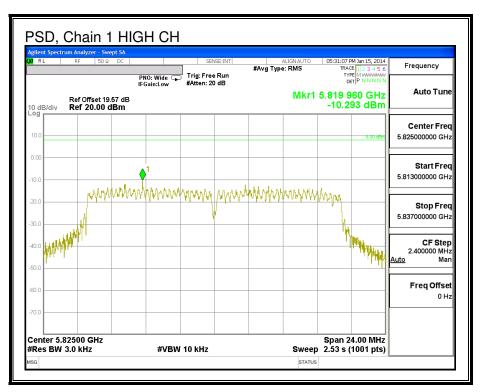


### PSD, Chain 1



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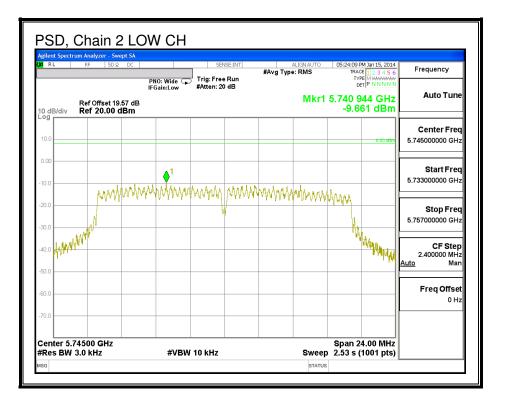


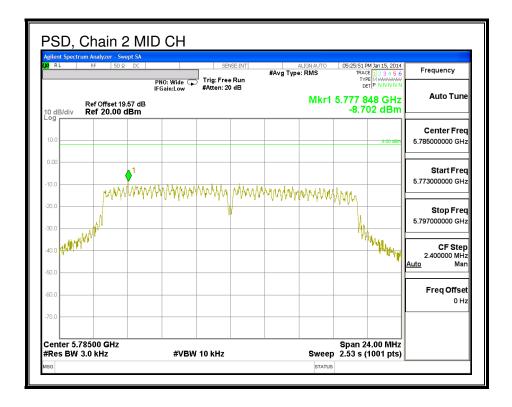


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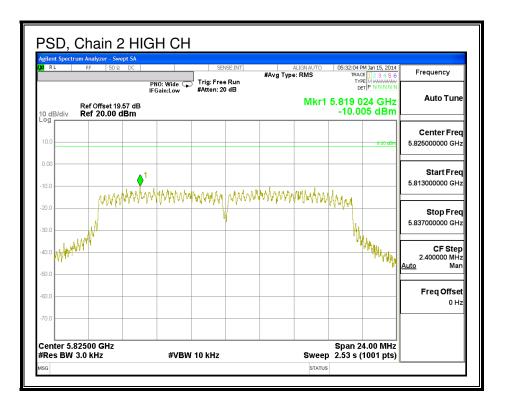
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## PSD, Chain 2





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# 8.6. OUT-OF-BAND EMISSIONS

## **LIMITS**

FCC §15.247 (d)

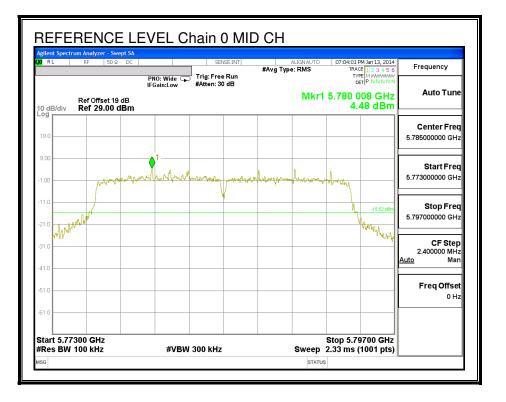
IC RSS-210 A8.5

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**

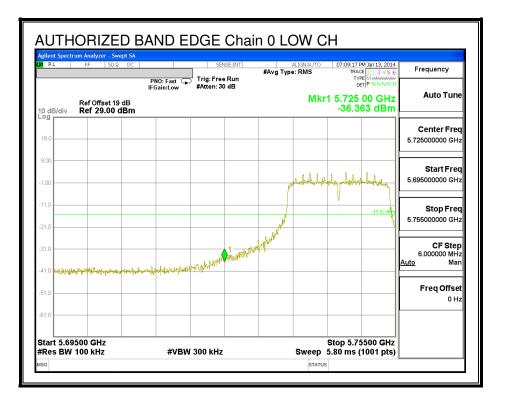
#### **IN-BAND REFERENCE LEVEL, Chain 0**



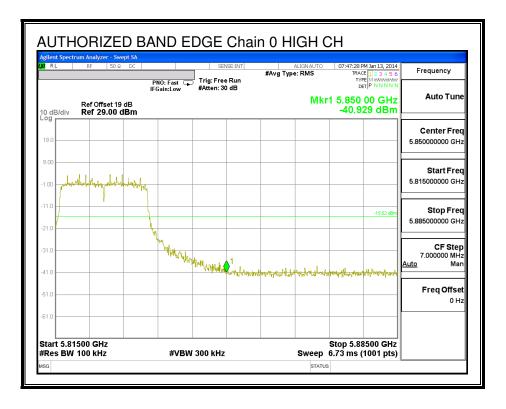
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#### LOW CHANNEL BANDEDGE, Chain 0

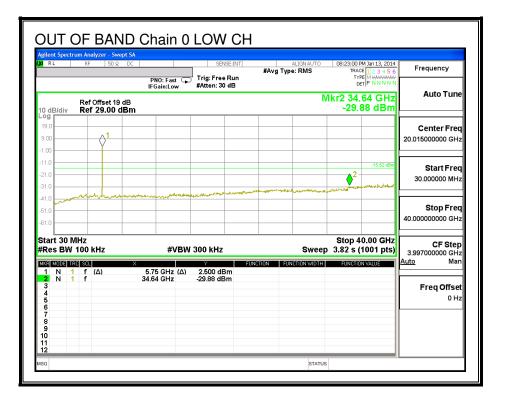


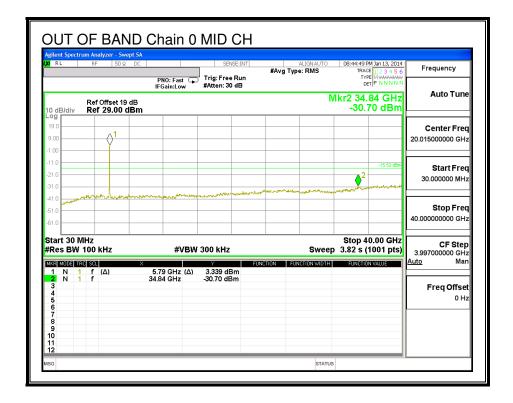
#### HIGH CHANNEL BANDEDGE, Chain 0



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



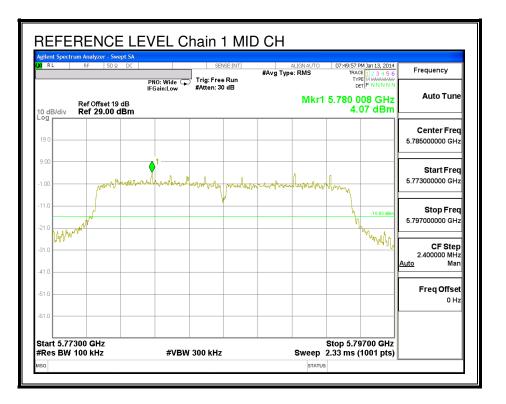


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ilent R L		ctrur	n Ana RF		- <mark>Swe</mark> 50 Ω	DC				SI	ENSE:IN	T			LIGN AUTO	)	08:46:5				Frequency
								10: Fas Sain:Lo		Trig: Fre #Atten: 3			#Avg	Туре	RMS			TYPE 🕅	2345 NNNN	w	Frequency
) dB	Vdiv				et 19 ( 00 d											MI	(r2 34 -30		) GH dBr		Auto Tune
9.0	7411			23.		0															Center Free
.00				$\neg$	1															20	.015000000 GH:
1.0																			-15.52 dB	m	Start Free
1.0 1.0														ala ka	1.000			2	wyb.		30.000000 MH:
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1.0 1.0																				40.	Stop Fred 000000000 GH
	t 30 s B\			кНz				#\	/BW	/ 300 kH:	z				Swe	ер	Stop 3.82 s		00 GH 01 pts		CF Step 997000000 GH
	<u>100e</u> N	TRC 1		(Δ)		×	5.8	3 GHz	(A)	Y 2.385 c	Bm	FUNC	TION	FUNC	TION WIDT	IH I	FUNC	FION W	ALUE	Aut	
2 3	Ň	1	ŕ					GHz		-30.52 d											Freq Offse
4 5																					0 H:
6 7																					
8 9 0																					
0 1 2																					

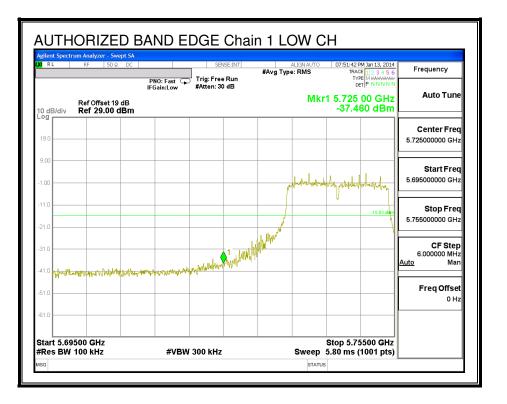
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### **IN-BAND REFERENCE LEVEL, Chain 1**

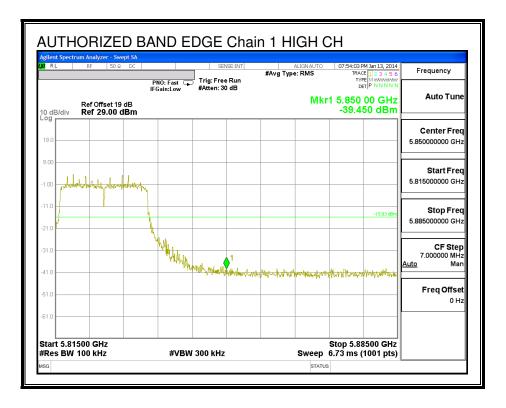


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#### LOW CHANNEL BANDEDGE, Chain 1



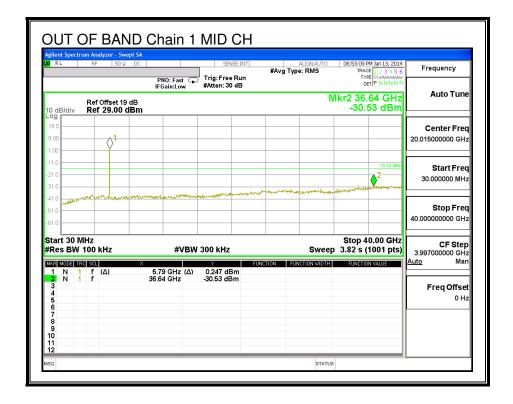
#### HIGH CHANNEL BANDEDGE, Chain 1



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

	- Swept SA 50 Ω DC PNO: F	st 🕞 Trig: Free	Run	ALIGNAUTO J Type: RMS	08:54:54 PM Jan 13, 2014 TRACE 1 2 3 4 5 ( TYPE MWWWW DET P N N N N	Frequency
Ref Offse 0 dB/div Ref 29.0		ow #Atten: 30	ab	N	1kr2 36.92 GHz -29.85 dBm	Auto Tune
.09 19.0 1.00						Center Freq 20.015000000 GHz
11.0 21.0 31.0		Wind Westman and and and and and and and and and a	and the second street and	مريسوار مريون المريس	-15.93 dBr 2-	Start Freq 30.000000 MHz
41.0	ware harded the set of the set					<b>Stop Freq</b> 40.000000000 GHz
Start 30 MHz Res BW 100 kHz	# *	¢VBW 300 kHz	FUNCTION	Sweep	Stop 40.00 GHz 3.82 s (1001 pts)	
1         N         1         Γ         (Δ)           2         N         1         Γ         (Δ)           3         -         Γ         -         -           4         -         -         -         -           5         -         -         -         -           6         -         -         -         -           7         -         -         -         -           9         -         -         -         -           11         -         -         -         -	5.75 GH 36.92 GH		m			Freq Offset

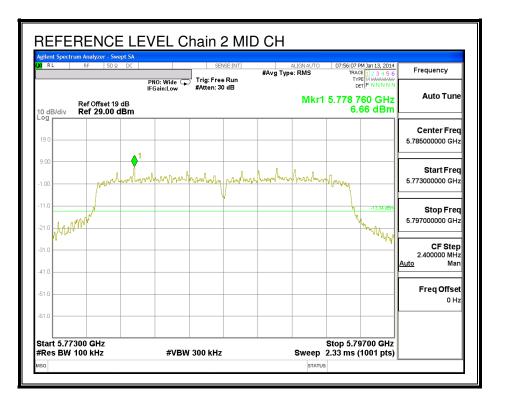


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RL	RF	50 Ω	DC DC		SENS	E:INT		ALIGN AUTO Type: RMS		PM Jan 13, 2014	Frequency
				l0: Fast G ain:Low	Trig: Free #Atten: 30		#Avg	Type. Kivis	T		
) dB/div	Ref Ref	Offset 19 d	dB Bm					P		.64 GHz .06 dBm	Auto Tune
og 19.0											Center Fred
.00		$\uparrow^1$									20.015000000 GH;
1.0	_									-15.93 dBm	Start Fred
1.0							human	New Jones	and the second second	and the second	30.000000 MH;
1.0	and the	المسرين المعامة	where the harrow	net, salantingen	and the second						Stop Fred
1.0											40.000000000 GH
tart 30 M Res BW		kHz		#VB\	V 300 kHz			Sweet		40.00 GHz (1001 pts)	CF Step 3.997000000 GH
Krimode ti 1 n 1	f	(Δ)		3 GHz (Δ)		m	CTION	FUNCTION WIDTH	FUNCTI	ON VALUE	<u>Auto</u> Mar
<mark>2</mark> N 1 3 4	f		38.64	GHz	-28.06 dB	m					Freq Offse
4 5 6											0 H:
7 B											
9											

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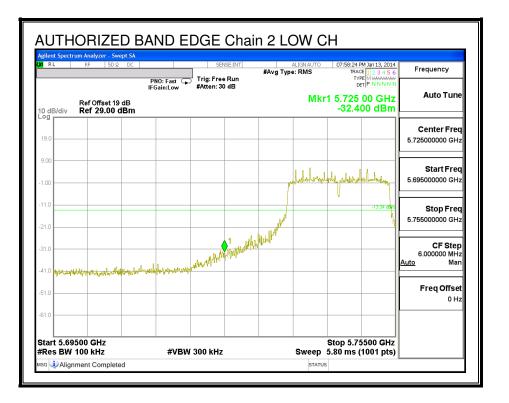
### **IN-BAND REFERENCE LEVEL, Chain 2**



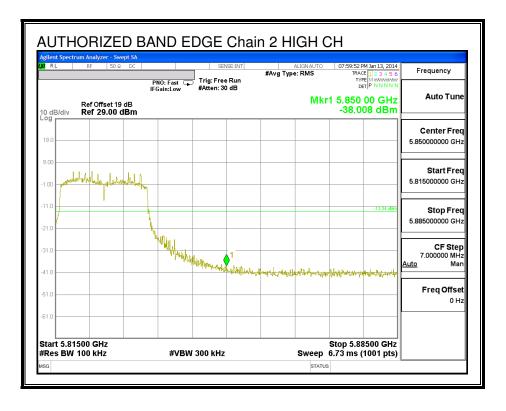
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#### LOW CHANNEL BANDEDGE, Chain 2

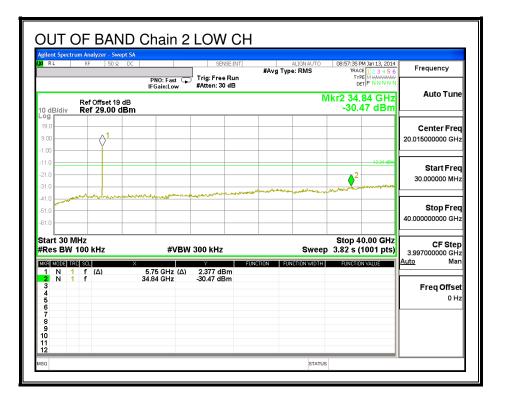


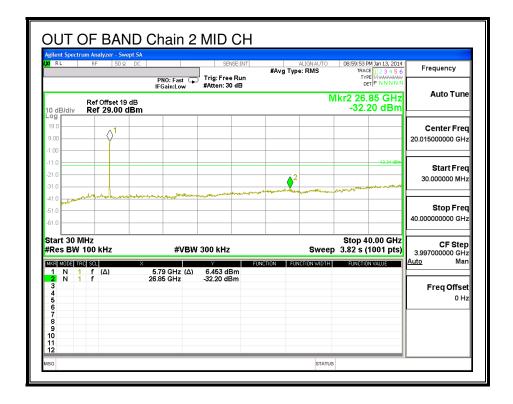
## HIGH CHANNEL BANDEDGE, Chain 2



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





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R			RF		50 Ω	DC					SE:INT	#Avg	Al Type:	.IGN AUTO RMS	т	RACE 1 2	13, 2014 3 4 5 6	Frequency
							PN IFG	0: Fast ain:Low	$\Box$	Trig: Free #Atten: 30	dB					DET P	INNNN	L.
) dl	3/div				et 19 00 d									Ν	/lkr2 3 -3	4.64 0.79		
9.0																		Center Freq
.00					1													20.015000000 GHz
1.0				_			_		_			_					13.34 dBm	Start Fred
1.0 1.0																2	المومال مير. المومال مير.	30.000000 MHz
1.0	ww	North State	n	rmul,	-	ala (geogle)	And	mon	404.000	advance	-sengen di terde	propo di provinci			-			
1.0 1.0																		Stop Freq 40.000000000 GHz
	t 30 s B1			kHz				#V	вw	300 kHz				Sweet	Stop 3.82 9		0 GHz 1 pts)	
K⊟ 1	MODE N	TRC 1		(Δ)		Х	E 02	GHz (	(A)	Y 3.357 dB		NCTION	FUNC	TION WIDTH	FUNC	TION VAL	UE	Auto Mar
2		1	f	(Δ)			34.64		Δ)	-30.79 dB								Freq Offset
4 5																		0 Hz
6 7																		
8 9																		
0 1																		

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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)

IC RSS-GEN Clause 6 (Receiver)

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.

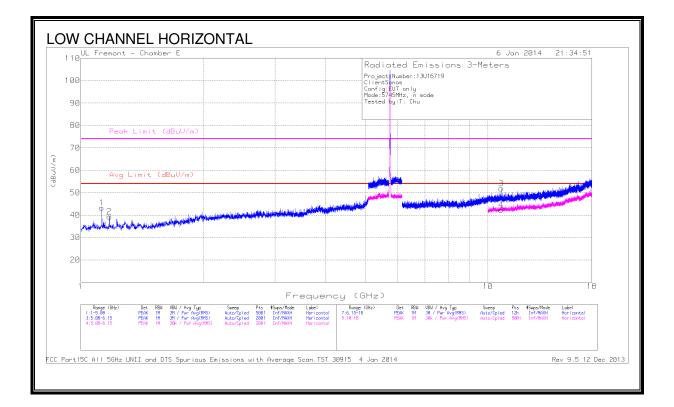
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

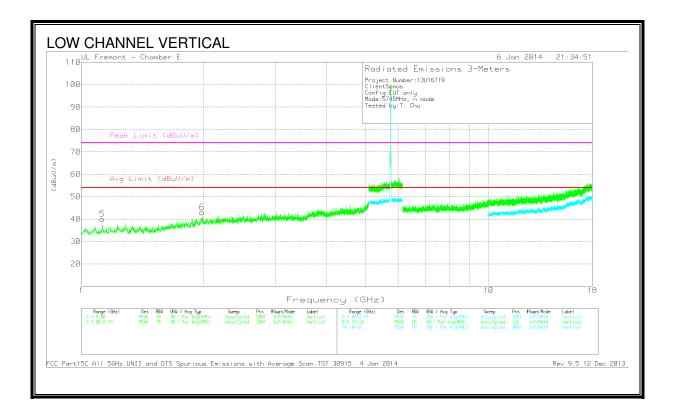
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# 9.2. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.8 GHz BAND

## HARMONICS AND SPURIOUS EMISSIONS



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# Trace Markers

Marker	Frequency	Meter	Det	AF T346 (dB/m)	Amp/Cbl/5 GHz LPF	Corrected	Avg Limit (dBuV/m)	Margin	Peak Limit (dBuV/m)	Margin	Azimuth	Height	Polarity
	(GHz)	Reading				Reading		(dB)		(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)							
1	* 1.126	49.53	РК	28.7	-35	43.23	-	-	74	-30.77	0-360	99	н
2	* 1.176	45.6	РК	28.9	-35.2	39.3	-	-	74	-34.7	0-360	199	н
3	* 10.78	37.68	РК	38.5	-24.3	51.88	-	-	74	-22.12	0-360	199	н
4	* 10.78	28.1	Avg	38.5	-24.3	42.3	54	-11.7	-	-	0-360	199	н
5	* 1.126	46.26	РК	28.7	-35	39.96	-	-	74	-34.04	0-360	101	V
6	1.978	43.75	РК	32	-32.7	43.05	-	-	68.2	-25.15	0-360	101	V

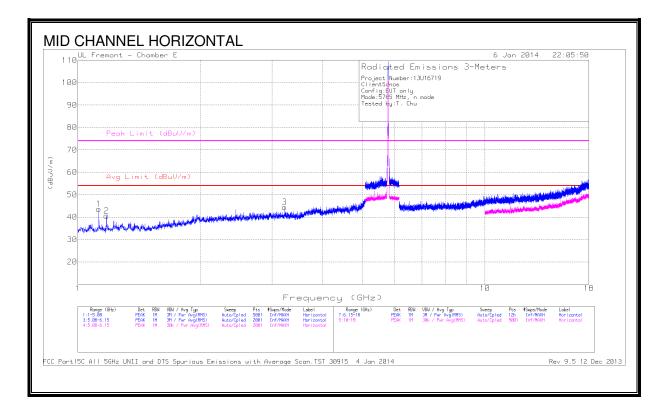
\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

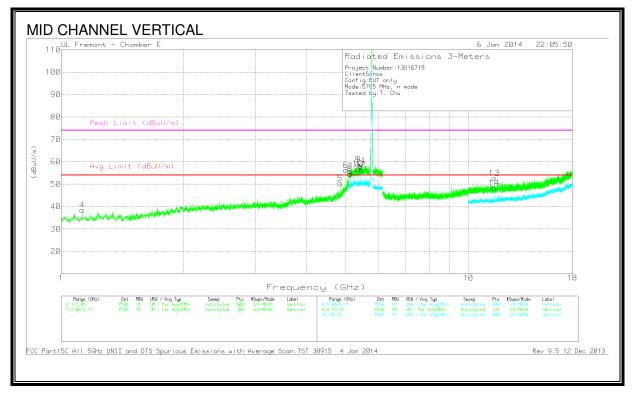
PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

FCC Part15C All 5GHz UNII and DTS Spurious Emissions with Average Scan.TST 30915 4 Jan 2014 Rev 9.5 12 Dec 2013

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## REPORT NO: 13U16719-2B FCC ID: SBVRM004

#### **Trace Markers**

Marker	Frequency	Meter	Det	AF T346 (dB/m)	Amp/Cbl/5 GHz LPF	Corrected	Avg Limit (dBuV/m)	Margin	Peak Limit (dBuV/m)	Margin	Azimuth	Height	Polarity
	(GHz)	Reading				Reading		(dB)		(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)							
1	* 1.126	49.9	РК	28.7	-35	43.6	-	-	74	-30.4	0-360	101	н
2	* 1.176	46.88	РК	28.9	-35.2	40.58	-	-	74	-33.42	0-360	101	н
3	3.22	43.1	РК	33.4	-32.1	44.4	-		68.2	-23.8	0-360	199	н
4	* 1.126	44.82	РК	28.7	-35	38.52	-	-	74	-35.48	0-360	200	v
5	* 4.841	46.29	РК	34.4	-30.3	50.39	-	-	74	-23.61	0-360	200	V
	* 4.84	34.8	AD1	34.4	-30.3	38.9	54	-15.1	-	-	8	111	v
6	* 5.001	51.02	РК	34.4	-29.1	56.32	-	-	74	-17.68	0-360	101	V
	*5.001	43.01	AD1	34.4	-29.1	48.31	54	-5.69	-	-	193	277	V
7	* 5.12	42.9	РК	34.5	-21.6	55.8	-	-	74	-18.2	0-360	101	v
8	* 5.12	36.62	AD1	34.5	-21.6	49.52	54	-4.48	-	-	339	206	v
9	* 5.361	45.77	РК	34.7	-21.7	58.77	-	-	74	-15.23	0-360	199	V
10	* 5.36	36.2	AD1	34.7	-21.7	49.2	54	-4.8	-	-	4	218	V
11	* 5.441	44.85	РК	34.8	-21.4	58.25	-	-	74	-15.75	0-360	199	V
12	* 5.44	35.65	AD1	34.8	-21.4	49.05	54	-4.95	-	-	4	232	V
13	* 11.57	39.27	РК	38.7	-25.3	52.67	-	-	74	-21.33	0-360	101	V
14	*11.570	31.14	AD1	38.7	-25.3	44.54	54	-9.46	-	-	271	315	v

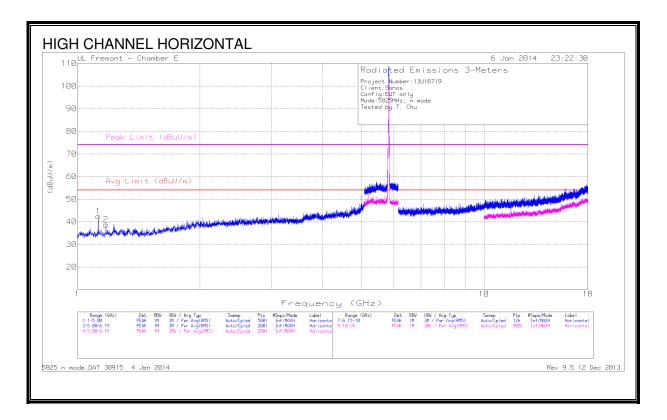
\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

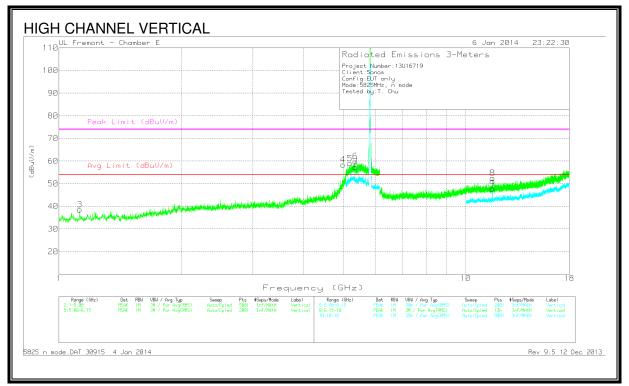
PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

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# Trace Markers

Marker	Frequency	Meter	Det	AF T346 (dB/m)	Amp/Cbl/5 GHz LPF	Corrected	Avg Limit (dBuV/m)	Margin	Peak Limit (dBuV/m)	Margin	Azimuth	Height	Polarity
	(GHz)	Reading				Reading		(dB)		(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)							
1	* 1.126	48.81	РК	28.7	-35	42.51	-	-	74	-31.49	0-360	199	н
2	* 1.176	45.04	РК	28.9	-35.2	38.74	-	-	74	-35.26	0-360	101	н
3	* 1.126	44.9	РК	28.7	-35	38.6	-	-	74	-35.4	0-360	101	v
4	* 5.001	53.09	РК	34.4	-29.1	58.39	-	-	74	-15.61	0-360	101	v
5	5.2	45.68	РК	34.6	-21.3	58.98	-	-	68.2	-9.22	0-360	101	v
6	* 5.361	46.81	РК	34.7	-21.7	59.81	-	-	74	-14.19	0-360	199	v
7	*5.36	37.03	AD1	34.7	-21.7	50.03	54	-3.97	-	-	137	200	v
8	* 11.65	38.62	РК	38.8	-24.9	52.52	-	-	74	-21.48	0-360	200	V
	*11.65	32.77	AD1	38.8	-24.9	46.67	54	-7.33	-	-	179	150	V

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

PK - Peak detector

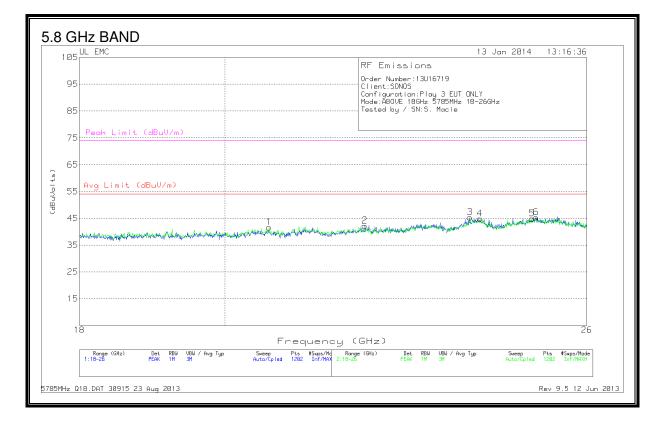
Avg - Video bandwidth < Resolution bandwidth

FCC Part15C All 5GHz UNII and DTS Spurious Emissions with Average Scan.TST 30915 4 Jan 2014 Rev 9.5 12 Dec 2013

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# 9.3. WORST-CASE ABOVE 18 GHz

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

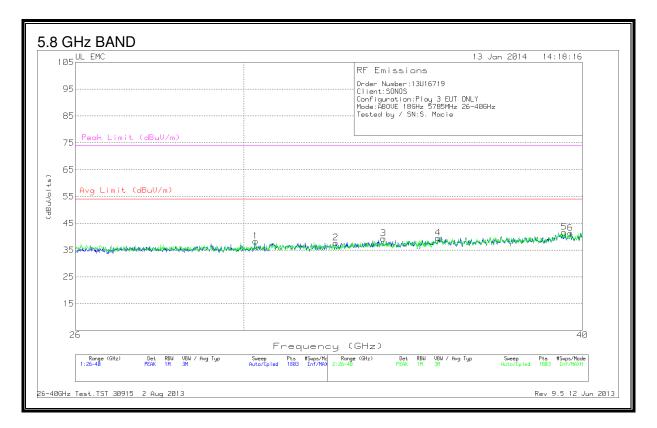


# **DATA**

Marker	Frequency	Meter	Det	AF T89 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
	(GHz)	Reading					Reading				
		(dBuV)					(dBuVolts)				
1	20.651	41.67	РК	32.9	-23.4	-9.5	41. 7	54	-12.3	74	-32.3
2	22.137	41.77	РК	33.3	-23.4	-9.5	42.2	54	-11.8	74	-31.8
3	23.888	43.93	РК	33.6	-22.7	-9.5	45.3	54	-8. 7	74	-28.7
4	24.062	43.33	РК	33.6	-22.6	-9.5	44.8	54	-9.2	74	-29.2
5	24.988	43.23	РК	34	-22.9	-9.5	44.8	54	-9.2	74	-29.2
6	25.061	43.43	РК	34	-22.6	-9.5	45.3	54	-8. 7	74	-28.7

PK - Peak detector

# SPURIOUS EMISSIONS 26 TO 40 GHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)



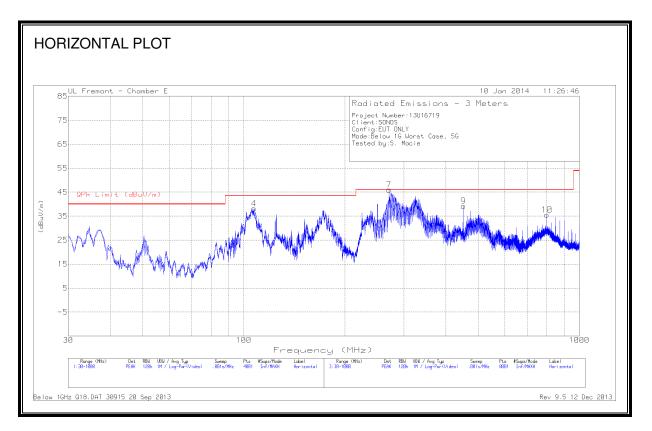
# <u>DATA</u>

Marker	Frequency	Meter	Det	T90 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
	(GHz)	Reading					Reading				
		(dBuV)					(dBuVolts)				
1	30.304	47.83	РК	35.9	-35.9	-9.5	38.3	54	-15. 7	74	-35.7
2	32.441	46.97	РК	36.2	-36	-9.5	37. 7	54	-16.3	74	-36.3
3	33.777	48.53	РК	36.8	-36.5	-9.5	39.3	54	-14. 7	74	-34.7
4	35.385	49.1	РК	37.8	-37.9	-9.5	39.5	54	-14.5	74	-34.5
5	39.386	49.07	РК	37.9	-35.8	-9.5	41.7	54	-12.3	74	-32.3
6	39.596	49.13	РК	37.3	-35.6	-9.5	41.3	54	-12. 7	74	-32. 7

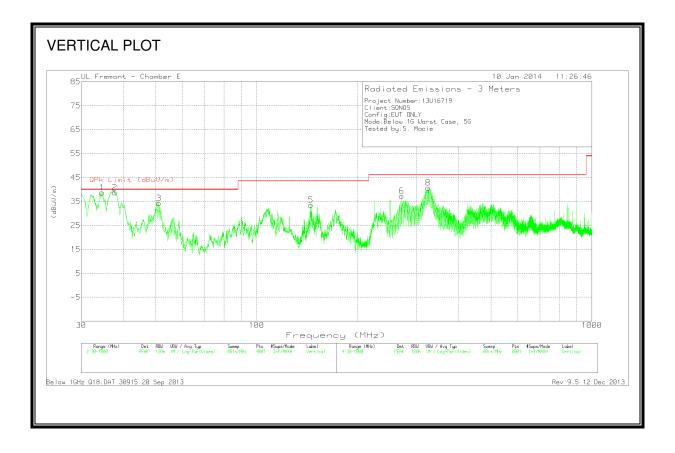
PK - Peak detector

# 9.4. WORST-CASE BELOW 1 GHz

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



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#### REPORT NO: 13U16719-2B FCC ID: SBVRM004

# Trace Markers

Marker	Frequency	Meter	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Corrected	QPk Limit (dBuV/m)	Margin	Azimuth	Height	Polarity
	(MHz)	Reading				Reading		(dB)	(Degs)	(cm)	
		(dBuV)				(dBuV/m)					
1	34.6075	48.38	РК	17.8	-27.5	38.68	-	-	0-360	100	V
	34.6075	43.76	QP	17.8	-27.5	34.06	40	-5.94	109	156	V
2	* 37.7600	51.31	PK	15.6	-27.5	39.41	-	-	0-360	100	V
	37.7600	47.77	QP	15.6	-27.5	35.87	40	-4.13	122	102	V
3	51.0975	54.51	PK	7.6	-27.6	34.51	-	-	0-360	100	v
	51.0975	49.93	QP	7.6	-27.6	29.93	40	-10.07	147	110	V
4	107.3575	54.27	PK	12	-28.1	38.17	-	-	0-360	300	Н
	107.3575	50.46	QP	12	-28.1	34.36	43.52	-9.16	55	280	н
5	145.1875	48.78	РК	12.5	-27.1	34.18	43.52	-9.34	0-360	100	V
6	* 270.9238	50.87	PK	13.1	-26.7	37.27	46.02	-8.75	0-360	200	V
7	* 271.0450	59.5	РК	13.1	-26.6	46.00	-	-	0-360	101	Н
	271.0450	54.42	QP	13.3	-26.4	41.32	46.02	-4.70	133	115	Н
8	* 324.8800	53.9	РК	14	-27.2	40.7	-	-	0-360	100	V
	324.8800	49.2	QP	14	-27.2	36.00	46.02	-10.02	6	107	V
9	451.7075	49.63	РК	16.8	-27.5	38.93	46.02	-7.09	0-360	201	Н
10	800.0588	39.73	РК	21.5	-25.7	35.53	46.02	-10.49	0-360	100	Н

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

PK - Peak detector

QP - Quasi-Peak detector

# **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

## 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	.15	59.39	РК	.1	0	59.49	66	-6.51	-	-
2	.15	40.26	Av	.1	0	40.36	-	-	56	-15.64
3	.1905	55.28	РК	.1	0	55.38	64	-8.62		-
4	.1905	41.15	Av	.1	0	41.25	-	-	54	-12.75
5	.618	37.67	РК	.1	0	37.77	56	-18.23	-	-
6	.618	31.76	Av	.1	0	31.86	-	-	46	-14.14
7	5.7075	37.13	РК	.1	.1	37.33	60	-22.67	-	-
8	5.7075	33.33	Av	.1	.1	33.53	-	-	50	-16.47
9	29.643	38.57	РК	.5	.3	39.37	60	-20.63	-	-
10	29.643	35.18	Av	.5	.3	35.98	-	-	50	-14.02

PK - Peak detector

Av - average detection

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# REPORT NO: 13U16719-2B FCC ID: SBVRM004

#### **Trace Markers**

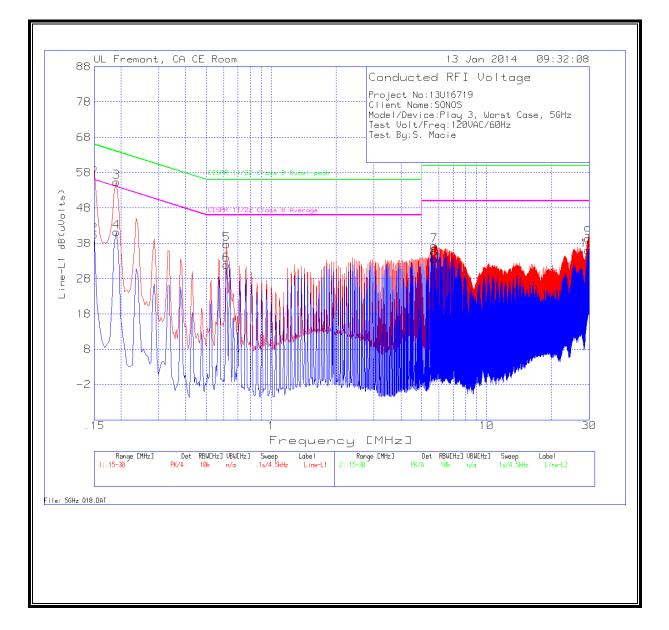
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dB(uVolts)	CISPR 11/22 Class B Quasi- peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
11	.15	56.26	РК	.1	0	56.36	66	-9.64	-	-
12	.15	36.95	Av	.1	0	37.05	-		56	-18.95
13	.1905	53.43	РК	.1	0	53.53	64	-10.47	-	
14	.1905	39.65	Av	.1	0	39.75	-	-	54	-14.25
15	.618	35.72	РК	.1	0	35.82	56	-20.18	-	
16	.618	31.99	Av	.1	0	32.09	-	-	46	-13.91
17	5.604	36.42	РК	.1	.1	36.62	60	-23.38	-	
18	5.604	33.2	Av	.1	.1	33.4	-		50	-16.6
19	29.4765	35.62	РК	.5	.3	36.42	60	-23.58	-	-
20	29.4765	28.43	Av	.5	.3	29.23		-	50	-20.77

PK - Peak detector

Av - average detection

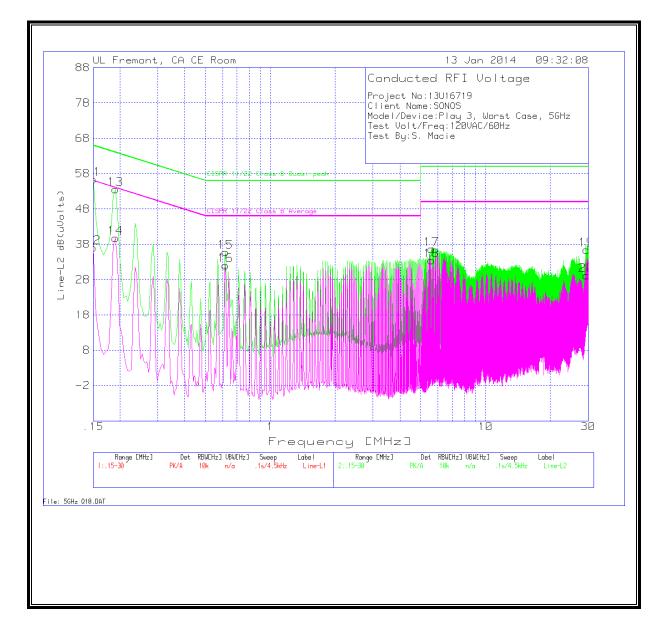
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#### LINE 1 RESULTS



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## LINE 2 RESULTS



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