

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

**CLASS II PERMISSIVE CHANGE** 

**TEST REPORT** 

FOR

802.11 3x3 a/b/g/n MINI PCIE CARD

**MODEL NUMBER: PLAY3** 

FCC ID: SBVRM004 IC: 5373A-RM004

REPORT NUMBER: 15U21734- E1

**ISSUE DATE: JANUARY 8, 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

(R)

NVLAP LAB CODE 200065-0

## **Revision History**

Rev.	lssue Date	Revisions	Revised By
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# **1. ATTESTATION OF TEST RESULTS**

COMPANY NAME:	Sonos, Inc. 614 Chapala Street Santa Barbara, CA 93101, U.S.A.
EUT DESCRIPTION:	802.11 3x3 a/b/g/n MINI PCIE CARD
MODEL:	PLAY3
SERIAL NUMBER:	80-E9-37-DA-46-B6-F
DATE TESTED:	OCTOBER 20, 2015 to NOVEMBER 02, 2015 JANUARY 13, 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.

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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, 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
Chamber A	🗌 Chamber D
Chamber B	🗌 Chamber E
Chamber C	Chamber F
	🗌 Chamber G
	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 <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
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%.

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# 5. EQUIPMENT UNDER TEST

# 5.1. DESCRIPTION OF EUT

The EUT is an 802.11 3x3 abgn Mini PCIe Card, 20 MHz BW, PCB antenna.

The radio module is manufactured by Sonos, Inc.

# 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 reviewed the original test report (report no. 13U16719-1B) 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

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
5745 - 5825	802.11n HT20	22.91	195.43

The transmitter has a maximum conducted output power as follows:

# 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

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

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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.

Worst-case data rate as provided by the manufacturer was 11n HT20 (5.8 GHz band): 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 FCC ID									
Laptop	Lenovo	X201	R9-6KTFV	N/A					
Laptop AC Adapter	aptop AC Adapter Lenovo ADLX65NCT2A 11S45N0323Z1ZH3B4HPD N/A								

#### I/O CABLES

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

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## 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	Description         Manufacturer         Model         T No.         Cal Date         Cal Due										
Radiated Software UL UL EMC Ver 9.5, June 6, 202					2015						
Conducted Software	UL	ULEMC	V	′er 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						

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# 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.

<u>99% Occupied BW</u>: 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.

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

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# 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	<b>ON Time</b>	Period	<b>Duty Cycle</b>	Duty	Duty Cycle	1/B
	В		x	x Cycle Correction Factor		Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
802.11n HT20 CDD	0.503	0.548	0.918	91.79%	0.37	1.988

## **DUTY CYCLE PLOTS**



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# 8.2. 6 dB BANDWIDTH

## LIMITS

FCC §15.247 (a) (2)

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 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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### 6 dB BANDWIDTH, Chain 0





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## 6 dB BANDWIDTH, Chain 1



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## 6 dB BANDWIDTH, Chain 2





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## 8.3. 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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ef Value	RF 50 Ω DC 20.00 dBm	U #IFGain:Low ##	SENSE:INT enter Freq: 5.825000 ig: Free Run tten: 14 dB	ALIGN AUTO 000 GHz Avg Hold: 100/100	Radio Std: None Radio Device: BT	S
0 dB/div	Ref Offset 19 di Ref 20.00 dB	3 m				
og 0.0		man manana		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Clear Write
0.0			· · · · · · · · · · · · · · · · · · ·			m
0.0						Average
0.0						
0.0						Max Hold
0.0						
enter 5.8 Res BW 2	25 GHz 200 kHz		#VBW 620 kł	lz	Span 20 F Sweep 1.533	Min Hold MHz ms
Occupi	ed Bandwid 1	<sup>th</sup> 8.600 MHz	Total Po	wer 19	.9 dBm	Detector Sample ► Auto <u>Mar</u>
Transmi	it Freq Error	8.878 kHz	OBW Po	wer 9	9.00 %	
x dB Ba	ndwidth	20.00 MHz	x dB	-26	5.00 dB	

## 99% BANDWIDTH, Chain 1

gilent Spectru RL Center Fro	m Analyzer - Occ RF 50 Ω eq 5.74500	DC   00000 GH #IF	Hz Gain:Low	Ser Center Fr Trig: Free #Atten: 14	NSE:INT req: 5.74500 e Run 4 dB	0000 GHz Avg Hold:	ALIGN AUTO : <b>100/100</b>	11:44:09 A Radio Std: Radio Devi	M Jan 13, 2014 None ice: BTS	Trace/Detector
0 dB/div	Ref Offset Ref 20.0	19 dB 0 dBm								
.og 10.0	gun	ana		<b>~</b> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	,		m		~~~~	ClearWrite
										Average
40.0 50.0										Max Hold
70.0 Center 5.7	745 GHz							Spa	n 20 MHz	Min Hold
Res BW Occup	200 kHz ied Band	width 18.0	)80 MI	#VE Hz	3W 620 k Total Pe	Hz ower	21.1	Sweep dBm	1.533 ms	Detecto Sample J Auto <u>Mar</u>
Transm x dB Ba	iit Freq Err andwidth	or	34.540   20.00 N	кHz ЛHz	OBW P x dB	ower	99 -26.0	.00 % 00 d <b>B</b>		

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#### 99% BANDWIDTH, Chain 2





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# 8.4. 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**

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

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## **RESULTS**

#### Antenna Gain and Limit

Channel	Frequency	Directional	Power
		Gain	Limit
	(MHz)	(dBi)	(dBm)
Low	5745	4.01	30.00
Mid	5785	4.01	30.00
High	5825	4.01	30.00

Duty Cycle CF (dB)

0.37 Included in Calculations of Corr'd Power

#### **Output Power Results**

Channel	Frequency	Chain 0	Chain 1	Chain 2	Total	Power	Power
		Meas	Meas	Meas	Corr'd	Limit	Margin
		Power	Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5745	14.00	14.05	14.10	19.19	30.00	-10.81
Mid	5785	17.50	17.82	17.98	22.91	30.00	-7.09
High	5825	16.02	16.88	16.75	21.71	30.00	-8.29

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# 8.5. 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	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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#### **RESULTS**

#### Antenna Gain and Limits

Channel	Frequency	Directional	PSD
		Gain	Limit
	(MHz)	(dBi)	(dBm)
Low	5745	8.68	27.32
Mid	5785	8.68	27.32
High	5825	8.68	27.32

Duty Cycle CF (dB) 0.37 Included in Calculations of Corr'd PSD

#### **PSD Results**

Channel	Frequency	Chain 0	Chain 1	Chain 2	Total	PSD	PSD
		Meas	Meas	Meas	Corr'd	Limit	Margin
		PSD	PSD	PSD	PSD		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5745	0.264	0.377	0.075	3.701	27.320	-23.619
Mid	5785	3.881	3.650	4.237	7.147	27.320	-20.173
High	5825	2.239	3.228	3.068	6.142	27.320	-21.178

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## PSD, Chain 0

Agilent 13:38:15	; Nov 2, 2015			L	Measure
Pv3.6(102315),TC, ef 15 dBm Avg	. Conducted B Atten 20 dB		Mkr2 5.740 0.26	25 GHz 34 dBm	Meas Off
og 0 B/	2				Channel Power
B					Occupied Bk
PAvg					ACF
1 S2					Multi Carrier Power
(f): Tun Wp					Power Stat CCDF
enter 5.745 00 GH Res BW 510 kHz	 Iz #VBW 1.	5 MHz Sweer	Span ! 20 ms (100	50 MHz	<b>More</b> 1 of 2



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#### PSD, Chain 1



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### PSD, Chain 3





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PSD, Chain 1	HIGH CH					
🔆 Agilent 13:47:10	Nov 2, 2015				L	Measure
APv3.6(102315),TC, Ref 15 dBm #Ava	Conducted B Atten 20 dB		Mkr2	5.821 3 3.068	30 GHz 3 dBm	Meas Off
Log 10 dB/		2				Channel Power
11.5 dB						Occupied BW
#PAvg						ACP
W1 S2 S3 FS AA						Multi Carrier Power
£(f): FTun Swp						Power Stat CCDF
Center 5.825 00 GH #Res BW 510 kHz Copyright 2000-20	z #VE 011 Agilent T	W 1.5 MHz echnologies	Sweep 20	 Span 5 ms (1001	0 MHz L pts)	More 1 of 2

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# 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

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# 9.2. TX RADIATED EMISSIONS (1 GHz – 18 GHz)

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



### Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/ Fltr/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
6	5.714	33.17	RMS	35	-20.8	.37	47.74	54	-6.26	-	-	284	325	Н
1	5.715	45.36	Pk	35	-21	0	59.36	-	-	74	-14.64	284	325	Н
2	5.715	47.17	Pk	35	-21	0	61.17	-	-	74	-12.83	284	325	Н
5	5.715	32.67	RMS	35	-21	.37	47.04	54	-6.96	-	-	284	325	Н
4	5.724	60.08	Pk	35	-21	0	74.08	-	-	78.2	-4.12	284	325	Н
3	5.725	55.86	Pk	35	-20.8	0	70.06	-	-	78.2	-8.14	284	325	Н

Pk - Peak detector RMS - RMS detection BandEdge 5800 UNII 5625-5725MHz 15\_209 Limit - Horizonta\_JW.TST 42484 20 Oct 2015 Rev 9.5 24 Jun 2015

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#### Trace Markers

Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fl tr/Pad (dB)	DC Corr (dB)	Correcte d Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	5.714	35.62	RMS	35	-20.8	.37	50.19	54	-3.81	-	-	253	151	V
1	5.715	49.46	Pk	35	-21	0	63.46	-	-	74	-10.54	253	151	V
2	5.715	52.14	Pk	35	-20.9	0	66.24	-	-	74	-7.76	253	151	V
5	5.715	34.29	RMS	35	-21	.37	48.66	54	-5.34	-	-	253	151	V
4	5.724	63.92	Pk	35	-21	0	77.92	-	-	78.2	28	253	151	V
3	5.725	61.6	Pk	35	-20.8	0	75.8		-	78.2	-2.4	253	151	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

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### **RESTRICTED BANDEDGE (HIGH CHANNEL)**



## Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Fl tr/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
3	5.85	53.26	Pk	35.1	-20.3	0	68.06	-	-	78.2	-10.14	230	143	Н
4	5.85	57.09	Pk	35.1	-20.3	0	71.89	-	-	78.2	-6.31	230	143	Н
1	5.86	44.59	Pk	35.1	-20.3	0	59.39	-	-	74	-14.61	230	143	Н
5	5.86	33.87	RMS	35.1	-20.3	.37	49.04	54	-4.96	-	-	230	143	Н
6	5.86	34.03	RMS	35.1	-20.3	.37	49.2	54	-4.8	-	-	230	143	Н
2	5.866	48.39	Pk	35.1	-20.2	0	63.29	-	-	74	-10.71	230	143	Н

Pk - Peak detector RMS - RMS detection Bandedge 5800 UNII 5860-6000MHz15\_209 Limit - Horizontal.TST 42484 20 Oct 2015 Rev 9.5 24 Jun 2015

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## Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Fl tr/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
3	5.85	58.72	Pk	35.1	-20.3	0	73.52	-	-	78.2	-4.68	229	100	V
4	5.85	61.58	Pk	35.1	-20.3	0	76.38	-	-	78.2	-1.82	229	100	V
1	5.86	50.98	Pk	35.1	-20.3	0	65.78	-	-	74	-8.22	229	100	V
5	5.86	38.32	RMS	35.1	-20.3	.37	53.49	54	51	-	-	229	100	V
2	5.862	55.58	Pk	35.1	-20.3	0	70.38	-	-	74	-3.62	229	100	V
6	5.862	38.72	RMS	35.1	-20.3	.37	53.89	54	11	-	-	229	100	V

#### Pk - Peak detector

RMS - RMS detection Bandedge 5800 UNII 5825-5850MHz15\_209 Limit - Vertical.TST 42484 20 Oct 2015 Rev 9.5 24 Jun 2015

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#### HARMONICS AND SPURIOUS EMISSIONS

#### LOW CHANNEL



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#### REPORT NO: 15U21734-E1 FCC ID: SBVRM004

#### **Radiated Emissions**

Marker	Frequency	Meter	Det	AF T345	Amp/Cbl/Fl	DC Corr (dB)	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	UNII Non-	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	tr/Pad (dB)		Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	Restricted	(dB)	(Degs)	(cm)	
		(dBuV)					(dBuV/m)					(dBuV/m)				
1	* 1.594	61.38	PK-U	28.8	-35.3	0	54.88	-	-	74	-19.12	-	-	112	213	V
	* 1.594	37.4	ADR	28.8	-35.3	.37	31.27	54	-22.73	-	-	-	-	112	213	V
2	* 2.664	53.18	PK-U	32.7	-33.7	0	52.18	-	-	74	-21.82	-	-	334	234	V
	* 2.662	32.7	ADR	32.7	-33.7	.37	32.07	54	-21.93	-	-	-	-	334	234	V
3	* 5	48.73	PK-U	34	-29.9	0	52.83	-	-	74	-21.17	-	-	157	110	V
	* 5	42.4	ADR	34	-29.9	.37	46.87	54	-7.13	-	-	-	-	157	110	V
6	* 11.49	45.58	PK-U	38.3	-25.4	0	58.48	-	-	74	-15.52	-	-	275	240	V
	* 11.49	32.46	ADR	38.3	-25.4	.37	45.73	54	-8.27	-	-	-	-	275	240	V
4	5.24	44.57	PK-U	34.3	-19.2	0	59.67	-	-	-	-	68.2	-8.53	137	203	V
5	5.48	44.22	PK-U	34.5	-20.2	0	58.52	-	-	-	-	68.2	-9.68	251	115	V

\* - indicates frequency in CFR15.205.

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

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### **MID CHANNEL**



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#### **Radiated Emissions**

Marker	Frequency	Meter	Det	AF T136	Amp/Cbl/Fl	DC Corr (dB)	Corrected	Avg Limit	Margin	Peak Limit	PK Margin	UNII Non-	PK Margin	Azimuth	Height	Polarity
	(GHz)	Reading		(dB/m)	tr/Pad (dB)		Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)	Restricted	(dB)	(Degs)	(cm)	
		(dBuV)					(dBuV/m)					(dBuV/m)				
2	* 5	53.4	PK-U	34	-28.9	0	58.5	-	-	74	-15.5	-	-	91	167	V
	* 5	46.7	ADR	34	-28.9	.37	52.17	54	-1.83	-	-	-	-	91	167	V
6	* 11.57	45.17	PK-U	38.1	-22.8	0	60.47	-	-	74	-13.53	-	-	263	266	V
	* 11.57	32.06	ADR	38.1	-22.8	.37	47.73	54	-6.27	-	-	-	-	263	266	V
1	2.5	46.78	PK-U	32.1	-34.4	0	44.48	-	-	-	•	68.2	-23.72	122	254	V
3	5.24	47	PK-U	34.4	-20.9	0	60.5	-	-	-	-	68.2	-7.7	128	194	V
4	5.24	47.05	PK-U	34.4	-20.9	0	60.55	-	-	-	-	68.2	-7.65	132	195	V
5	5.6	48.08	PK-U	34.5	-21.1	0	61.48	-	-	-	-	68.2	-6.72	257	114	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

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### **HIGH CHANNEL**



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#### REPORT NO: 15U21734-E1 FCC ID: SBVRM004

#### **Radiated Emissions**

Marker	Frequency	Meter	Det	AF T136	Amp/Cbl/Fl	DC Corr (dB)	Corrected	Avg Limit	Margin (dB)	Peak Limit	PK Margin	UNII Non-	PK Margin	Azimuth (Dogs)	Height (cm)	Polarity
	(GHZ)	(dBuV)		(00/11)	u/rau (ub)		(dBuV/m)	(0004711)	(05)	(0004/11)	(00)	(dBuV/m)	(00)	(Degs)	(ciii)	
2	* 5.44	47.24	PK-U	34.5	-20.8	0	60.94	-	-	74	-13.06	-	-	238	154	V
	* 5.44	35.28	ADR	34.5	-20.8	.37	49.35	54	-4.65	-	-	-	-	238	154	V
9	* 11.651	42.6	PK-U	38.2	-22.4	0	58.4	-	-	74	-15.6	-	•	263	276	V
	* 11.65	30.52	ADR	38.2	-22.4	.37	46.69	54	-7.31	-	-	-	-	263	276	V
1	2.5	46.81	PK-U	32.1	-34.4	0	44.51	-	-	-	-	68.2	-23.69	122	225	V
3	5.2	48	PK-U	34.4	-20.9	0	61.5	-	-	-	-	68.2	-6.7	133	197	V
4	5.28	48.56	PK-U	34.5	-20.9	0	62.16	-	-	-	•	68.2	-6.04	157	185	V
5	5.32	47.86	PK-U	34.5	-21	0	61.36	-	-	-	-	68.2	-6.84	160	197	V
7	5.56	51.45	PK-U	34.5	-21	0	64.95	-	-	-	-	68.2	-3.25	243	123	V
8	5.641	47.71	PK-U	34.5	-21	0	61.21	-	-	-	-	68.2	-6.99	215	100	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

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# 9.3. WORST-CASE TX RADIATED EMISSIONS (18 GHz – 40 GHz)

## SPURIOUS EMISSIONS 18 – 26 GHz

R5c	2 Nov 2015 15:09:0
	RF Emissions
95	Order Number:15U21734 Client:SDNOS
	Configuration:EUT with Laptop PC Mode:TX worst case
85	Tested by / SN:Tom Chen
75 Peak Limit (dBuU/m)	
65	
55 Avg Limit (dBuU/m)	
45	
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45 35	ware have a marting for land of maring all marine marine and
45 35	www.hue.au.m. Marca har harden har and a star
45 35 25	www.eu.eu.eu.eu.eu.eu.eu.eu.eu.eu.eu.eu.eu.
45 35 25	ware have a prove for and for a second second and the second
45 35 25	2 www.hul.al.a.m.
45 35 25 15 18	2 under have been from the second of the sec
45 35 25 15 18	Frequency (GHz)
45 35 25 15 18 Range (Rtz) REM/RM Ref/Atta Dut/Arg Tup 118-28 19-	Frequency (GHz)
45 35 25 15 18 Range (Rtz) Ref/Rt/n Det/Ref Typ 118-26 196-29 196 207.0 PCR/- 1 Typ	Frequency (GHz) Seete 102 102 1001 Herizotal Range (912) REV/RU Ref/Rtin Det/Ring Typ Seete Pts #Sept/fode Label

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PL: 31-	JL EMC			2 Nov 2015	15:09:0
			RF Emissions		
95			Order Number:15U21734 Client:SONOS Configuration:EUT with Laptop PC		
85-			Tested by / SN:Tom Chen		
75	Peak Limit (dBuU/m)				
65.					
55.	Avg Limit (dBuV/m)				
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45. 35. 25.	www.and		a mouse more and and a second		
45. 35. 25. 15.	men and a second and a second and a second and a second a		an marting and a second and a		
45. 35. 25. 15. 18	nun den en e				
45. 35. 25. 15. 18	Barras (Bt.) 854/184 54//841 Det/Reg Tap	Frequency Same Pts Kiscy/fode Label	y (GHz) Rome (Rt) REV/REU Ref/Ret.n Det/Reg Typ See		· Lober

## 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	19.499	41.93	Pk	32.5	-25.1	-9.5	39.83	54	-14.17	74	-34.17
2	21.277	41.27	Pk	33.2	-25.3	-9.5	39.67	54	-14.33	74	-34.33
3	23.009	41.93	Pk	33.6	-25.2	-9.5	40.83	54	-13.167	74	-33.17
4	19.545	40.77	Pk	32.5	-25.1	-9.5	38.67	54	-15.33	74	-35.33
5	21.311	40.83	Pk	33.2	-25.2	-9.5	39.33	54	-14.67	74	-34.67
6	22.936	42.17	Pk	33.5	-25	-9.5	41.17	54	-12.83	74	-32.83

Pk - Peak detector 18-26GHz Test.TST 30915 6 Jan 2015 Rev 9.5 16 Mar 2015

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## **SPURIOUS EMISSIONS 26 – 40GHz**

	UL EMC	2 Nov 2015 15:27:2
		RF Emissions
95		Order Number:15U21734 Client:5DNDS Configuration:EUT with Laptop PC
85		Tested by / SN:Tom Chen
75	Peak Limit (dBuU/m)	
65		
55	Avg Limit (dBuU/m)	
45	1 4 minutes and the second	and a second second and a second s
35		
25		
15		
15	6	Frequency (GHz)

P	IL EMC								2 Nov 2015	15:27:2
						RF Emiss	sions			
95						Order Number Client:SDN	er:15U21734 35			
						Configurat Mode:TX wor	ion:EUT with	Loptop PC	2	
85						Tested by A	/ SN:Tom Chen	1		
75	Peak Limit (dBuU/r	m)								0.00.00.00.000.000
/5										
65										
	Qualimit (dBull/-)									
55	HVg LIMIT (dbd0/m)									
15										
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45 35 25 15 26		94.html								*
45 35 25 15 26	Sum (20) 20180 0				Frequenc	адаана ала ала ала ала ала ала ала ала ала				
45 35 25 15 26	Range (Rtz) RSW/BN Ref	Web	Sweep F	rts #Sups/Made	Frequenc		La Ref Webs De	t/Prg Typ	Seep Pts Kapolici	de Lubel

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#### **Trace Markers**

Marker	Frequency	Meter	Det	T90 AF	Amp/Cbl	Dist Corr	Corrected	Avg Limit	Margin	Peak Limit	PK Margin
	(GHz)	Reading		(dB/m)	(dB)	(dB)	Reading	(dBuV/m)	(dB)	(dBuV/m)	(dB)
		(dBuV)					(dBuVolts)				
1	27.686	45.4	Pk	35.8	-31.2	-9.5	40.5	54	-13.5	74	-33.5
2	30.933	47.57	Pk	35.9	-32.8	-9.5	41.17	54	-12.83	74	-32.83
3	34.538	48.03	Pk	37.4	-33.1	-9.5	42.83	54	-11.17	74	-31.17
4	28.191	46.13	Pk	35.9	-31.7	-9.5	40.83	54	-13.17	74	-33.17
5	31.407	47.97	Pk	36.1	-32.9	-9.5	41.67	54	-12.33	74	-32.33
6	34.243	47.83	Pk	36.9	-32.9	-9.5	42.33	54	-11.67	74	-31.67

Pk - Peak detector

26-40GHz Test.TST 30915 6 Jan 2015

Rev 9.5 16 Mar 2015

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# 9.4. WORST-CASE TX RADIATED EMISSIONS (30 MHz – 1000 MHz)



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

**Trace Markers** 

Marker	Frequency (MHz)	Meter Reading	Det	AF T477 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
		(dBuV)				(dBuV/m)					
2	* 250	47.42	Pk	15.4	-29.6	33.22	46.02	-12.8	0-360	101	Н
6	* 250	44.44	Pk	15.4	-29.6	30.24	46.02	-15.78	0-360	199	V
3	42.92	58.56	Pk	15.8	-31.1	43.26	-	-	0-360	101	V
1	43.8125	44.94	Pk	15.1	-31.1	28.94	40	-11.06	0-360	399	Н
4	43.8125	58.77	Pk	15.1	-31.1	42.77	-	-	0-360	101	V
5	47.8075	54.38	Pk	12.7	-31.1	35.98	40	-4.02	0-360	101	V

## **Radiated Emissions**

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
42.9439	55.04	Qp	15.7	-31.1	39.64	40	36	36	105	V
43.8012	55.94	Qp	15.1	-31.1	39.94	40	06	316	104	V
47.7982	51.96	Qp	12.7	-31.1	33.56	40	-6.44	146	101	V

\* - indicates frequency in CFR15.205 Restricted Band

Pk - Peak detector

**Qp** - Quasi-Peak detector

FCC Part 15 Subpart C 30-1000MHz.TST 30915 15 Jul 2014

Rev 9.5 24 Jun 2015

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# 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.

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#### **<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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## 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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# 12. ART POWER SETTINGS TABLE

Channel	Frequency	FCC (Region 1)					
Ghannei	Frequency	11b	11g	11n			
149	5745			14			
157	5785			15			
165	5825			15			

# **END OF REPORT**

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