

# **CERTIFICATION TEST REPORT**

# **Report Number :** 11882202-E1V2

Applicant : MICROSOFT CORP ONE MICROSOFT WAY REDMOND, WA 98052, U.S.A.

**Model :** 1832

- FCC ID : C3K1832
  - IC : 3048A-1832
- EUT Description : PORTABLE COMPUTING DEVICE
- Test Standard(s) : FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS - 247 ISSUE 2

Date Of Issue: September 28, 2017

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.	Issue Date	Revisions	Revised By
V1	09/05/17	Initial Release	
V2	09/28/17	<ul> <li>Replaced Chain 0 with Chain A and Replaced Chain 1 with Chain B</li> </ul>	C. Susa

UL VERIFICATION SERVICES INC. 47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888 This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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### 1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	MICROSOFT CORP
	ONE MICROSOFT WAY
	REDMOND, WA 98052, U.S.A.

**EUT DESCRIPTION:** PORTABLE COMPUTING DEVICE

**MODEL:** 1832

#### SERIAL NUMBER: Radiated: 012813672657 Conducted: 009698372657

#### **DATE TESTED:** AUGUST 11 – SEPTEMBER 6, 2017

APPLICABLE STANDARDS				
STANDARD	TEST RESULTS			
CFR 47 Part 15 Subpart C	Pass			
INDUSTRY CANADA RSS-247 Issue 2	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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ERIC YU WISE LAB ENGINEER 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, KDB 558074 D01 v4, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 2.

# 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(IC: 2324B-1)	Chamber D(IC: 22541-1)		
Chamber B(IC: 2324B-2)	Chamber E(IC: 22541-2)		
Chamber C(IC: 2324B-3)	Chamber F(IC: 22541-3)		
	Chamber G(IC: 22541-4)		
	Chamber H(IC: 22541-5)		

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

Chambers A through C are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under Industry Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

# 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
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

# 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a portable computing device with 802.11 2x2, a/b/g/n/ac WLAN, Bluetooth, Bluetooth LE.

# 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
2412 - 2472	802.11b 2TX	19.91	97.95
2412 - 2472	802.11g 2TX	26.11	408.32
2412 - 2472	802.11n HT20 2TX CDD	25.19	330.37

The transmitter has a maximum average conducted output power as follows:

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
2412 - 2472	802.11b 2TX	16.63	46.03
2412 - 2472	802.11g 2TX	16.40	43.65
2412 - 2472	802.11n HT20 2TX	16.09	40.64

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band	Antenna Gain (dBi)		
(GHz)	Chain A	Chain B	
2.4	2.58	3.26	

# 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 14.2.201.159

The test utility software used during testing was Wifi tool v2.7.5

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### 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated bandedge, harmonics, and spurious emissions from 1 GHz to 18GHz were performed. The EUT was set to transmit at the Low/Middle/High channels.

Radiated emission below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT was set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in four orientations X/Y/Z and display tilted at 45degrees, it was determined that Y orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y orientation.

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

802.11b mode: 1 Mbps 802.11g mode: 6 Mbps 802.11n HT20mode: MCS0

For MIMO modes, the 2TX emission testing was considered as a worst case scenario and was performed at power levels, per transmit chain, greater than or equal to the maximum power in any 1TX mode.

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### 5.6. DESCRIPTION OF TEST SETUP

#### I/O CABLES

	I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks	
1	DC	1	Proprietary	Un-Shielded	1.75		
2	USB	1	USB	Un-Shielded	0.17		

#### TEST SETUP

Test software is installed on the EUT and exercises the radio. During all tests the EUT is connected to the AC adapter.

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#### SETUP DIAGRAM FOR ANTENNA PORT CONDUCTED TESTS



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#### SETUP DIAGRAM FOR RADIATED TESTS



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#### SETUP DIAGRAM FOR AC LINE CONDUCTED 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 Ca							
Spectrum Analyzer	Keysight	N9030A	T1210	07/17/18			
Spectrum Analyzer	Keysight	N9030A	T1466	04/11/18			
Antenna, Biconolog, 30-1GHz	Sunol Sciences	JB1	T130	09/23/17			
RF Preamplifier, 10kHz – 1GHz	Sonoma	310N	T300	11/10/17			
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	T862	06/09/18			
RF Preamplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	T1165	06/24/18			
RF Preamplifier, 1-8GHz	Miteq	AMF-4D-01000800-30-29P	T1573	06/24/18			
Low Pass Filter, 5GHz	Micro-Tronics	LPS17541	T481	06/24/18			
High Pass Filter, 6GHz	Micro-Tronics	HPS17542	T484	06/24/18			
Spectrum Analyzer	Keysight	N9030A	T907	01/23/18			
RF Preamplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	T493	02/15/18			
RF Preamplifier, 1-8GHz	Miteq	AMF-4D-01000800-30-29P	T1156	02/15/18			
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	T863	06/09/18			
Low Pass Filter, 5GHz	Micro-Tronics	LPS17541	T482	02/15/18			
High Pass Filter, 6GHz	Micro-Tronics	HPS17542	T483	02/15/18			
Antenna, Horn, 18-26GHz	ARA	MWH-1826/B	T449	06/12/18			
RF Preamplifier, 1-26GHz	Agilent	8499B	T404	07/23/18			
Antenna, Horn, 26-40GHz	ARA	MWH-2640	T90	08/25/18			
RF Preamplifier, 26-40GHz	Miteq	NSP4000-SP2	T88	04/29/18			
Spectrum Analyzer	Keysight	N9030A	T1454	12/15/17			
EMI Receiver	Rohde & Schwarz	ESR	T1436	01/06/18			
LISN	Fischer Custom Communications	FCC-LSN-50/250-25-2-01	T1310	06/15/18			

Test Software List						
Description Manufacturer Model Version						
Radiated Software	UL	UL EMC	9.5, 12/01/16			
Antenna Port Software	UL	UL RF	7.1, 8/6/17			
Conducted Emissions Software	UL	UL EMC	9.5, 5/26/15			

# 7. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 558074 D01 v04, Section 6.

<u>6 dB BW</u>: KDB 558074 D01 v04, Section 8.1.

<u>99% BW</u>: ANSI C63.10-2013, Section 6.9.3.

Output Power: KDB 558074 D01 v04, Section 9.2.3.2.

Power Spectral Density: KDB 558074 D01 v04, Section 10.3.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.1 (b).

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

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# 8. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
15.247 (a)(2)	Occupied Band width (6dB)	>500KHz		Pass
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-30dBc		Pass
15.247 (b) (3)	TX conducted output power	<30dBm	Conducted	Pass
15.247 (e)	PSD	<8dBm/3kHz		Pass
15.207 (a)	AC Power Line conducted emissions	Section 10		Pass
15.205, 15.209,	Radiated Spurious Emission	< 54dBuV/m	Radiated	Pass
15.247(d)		< 74dBuV/m		

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# 9. ANTENNA PORT TEST RESULTS

### 9.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

#### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

#### ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time	Period	Duty Cycle	Duty	Duty Cycle	1/T
			x	Cycle	<b>Correction Factor</b>	Minimum VBW
	(msec)	(msec)	(linear)	(%)	(dB)	(kHz)
802.11b	20.00	20.00	1.000	100.00%	0.00	0.01
802.11g	3.14	3.18	0.989	98.90%	0.00	0.01
802.11n HT20 CDD	9.89	9.94	0.995	99.50%	0.00	0.01

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#### **DUTY CYCLE PLOTS**





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enter Freq	50 Ω DC 2.437000000 0	GHz	SENSE-INT	Avg Type: Log-Pwr	06:33:07 PM Aug 15, 2017 TRACE 1 3 4 5 6 TYPE WWWWWWW	Frequency	
	NFE	IFGain:Low	Atten: 20 dB		DETPRONNE	Auto Tune	
dB/div Re	f 10.00 dBm				-12.80 dBm		
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enter 2.4370	00000 GHz	40/014/	0.000	Oursen de	Span 0 Hz	CF Step	
es BW 8 MH	Z	#VBW :	U MHZ	Sweep 15.	00 ms (1001 pts)	Auto Man	
N 1 t		3.125 ms	-12.80 dBm	RETION FUNCTION WIDTH	FUNCTION VALUE		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	(Δ) (Δ)	9.890 ms (Δ) 9.940 ms (Δ)	1.43 dB 2.23 dB		E	Freq Offsel 0 Hz	
5 7 8 9						Scale Type	
0						Log <u>Lir</u>	

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### 9.2. 11b 2TX MIMO MODE IN THE 2.4GHz BAND

#### 9.2.1. 6 dB BANDWIDTH

#### LIMITS

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (a)

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

#### **RESULTS**

Channel	Frequency (MHz)	6 dB BW Chain A (MHz)	6 dB BW Chain B (MHz)	Minimum Limit (MHz)
CH1	2412	10.08	10.08	0.5
CH6	2437	10.08	9.84	0.5
CH11	2462	9.60	10.08	0.5
CH12	2467	10.08	10.04	0.5
CH13	2472	9.64	10.08	0.5

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![](_page_22_Figure_2.jpeg)

![](_page_22_Figure_3.jpeg)

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![](_page_23_Figure_2.jpeg)

![](_page_23_Figure_3.jpeg)

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![](_page_24_Figure_2.jpeg)

![](_page_24_Figure_3.jpeg)

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#### 9.2.2. 99% BANDWIDTH

#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

Channel	Frequency (MHz)	99% Bandwidth Chain A (MHz)	99% Bandwidth Chain B (MHz)
CH1	2412	13.038	13.101
CH6	2437	13.039	13.068
CH11	2462	13.055	13.108
CH12	2467	13.141	13.186
CH13	2472	13.136	13.192

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![](_page_26_Figure_2.jpeg)

![](_page_26_Figure_3.jpeg)

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![](_page_27_Figure_2.jpeg)

![](_page_27_Figure_3.jpeg)

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![](_page_28_Figure_2.jpeg)

![](_page_28_Figure_3.jpeg)

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![](_page_29_Figure_2.jpeg)

![](_page_29_Figure_3.jpeg)

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![](_page_30_Figure_2.jpeg)

![](_page_30_Figure_3.jpeg)

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#### 9.2.3. AVERAGE POWER

#### **LIMITS**

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 10.7 dB cable) was entered as an offset in the power meter to allow for a gated reading of power.

#### **RESULTS**

ID: 37699	Date:	08/11/17
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Channel	Frequency	Chain A	Chain B	Total
		Power	Power	Power
	(MHz)	(dBm)	(dBm)	(dBm)
Low	2412	13.15	13.14	16.16
Mid	2437	13.33	13.41	16.38
High_11	2462	13.37	13.85	16.63
High_12	2467	9.12	8.52	11.84
High_13	2472	9.13	8.75	11.95

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### 9.2.4. OUTPUT POWER

#### LIMITS

FCC §15.247 (b) (3)

IC RSS-247 (5.4) (d)

For systems using digital modulation in the 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.

#### TEST PROCEDURE

KDB 558074 D01 v04 Section 9.2.3.2

#### DIRECTIONAL ANTENNA GAIN

Tx chains are uncorrelated due to the device supporting CDD in all MIMO modes. The directional gain is:

Chain A	Chain B	<b>Uncorrelated Chains</b>			
Antenna	Antenna	Directional			
Gain	Gain	Gain			
(dBi)	(dBi)	(dBi)			
2.58	3.26	2.93			

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#### **RESULTS**

ID:	37699	Date:	08/11/17
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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)
CH1	2412	2.93	30.00	30	36	30.00
CH6	2437	2.93	30.00	30	36	30.00
CH11	2462	2.93	30.00	30	36	30.00
CH12	2467	2.93	30.00	30	36	30.00
CH13	2472	2.93	30.00	30	36	30.00

#### Results

Channel	Frequency	Chain A	Chain B	Total	Power	Margin
		Meas	Meas	Corr'd	Limit	
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
CH1	2412	16.41	14.47	18.56	30.00	-11.44
CH6	2437	16.62	16.76	19.70	30.00	-10.30
CH11	2462	16.56	17.21	19.91	30.00	-10.09
CH12	2467	12.59	11.66	15.16	30.00	-14.84
CH13	2472	12.32	12.03	15.19	30.00	-14.81

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#### 9.2.5. POWER SPECTRAL DENSITY

#### **LIMITS**

FCC §15.247 (e)

IC RSS-247 (5.2) (b)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

#### **RESULTS**

PSD Results						
Channel	Frequency	Chain A	Chain B	Total Corr'd	Limit	Margin
		Meas	Meas	PSD		
	(MHz)	(dBm/3kHz)	(dBm/3kHz)	(dBm/3kHz)	(dBm/3kHz)	(dB)
CH1	2412	-10.47	-10.45	-7.45	8.0	-15.5
CH6	2437	-12.21	-11.10	-8.61	8.0	-16.6
CH11	2462	-11.49	-10.77	-8.10	8.0	-16.1
CH12	2467	-14.85	-16.04	-12.39	8.0	-20.4
CH13	2472	-14.50	-16.16	-12.24	8.0	-20.2

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![](_page_35_Figure_2.jpeg)

![](_page_35_Figure_3.jpeg)

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## 9.2.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

#### LIMITS

FCC §15.247 (d)

IC RSS-247 5.5

Output power was measured based on the use of Peak measurement, therefore the required attenuation is 20 dB.

#### **RESULTS**

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enter Freq 2.	50 9 00 483500000 GHz PNO: Fas	Trig: Free Run	#Avg Type: RMS Avg[Hold: 100/100	01:16:42 PM Aug 17, 2017 TRACE TYPE MULLINE 5 5 TYPE MULLINE 5	Frequency
Ref O Ref 1	ffset 10.72 dB 20.00 dBm	V POSSESS YE HAVE	Mi	kr1 2.465 6 GHz 0.177 dBm	Auto Tune
000 000	and the second sec	may			Center Free 2.483500000 GH
2012 2012 2010					Start Free 2.433500000 GH
90 C					Stop Fre 2.533500000 GH
enter 2.48350 Res BW 100 kl	GHz Hz #\	/BW 300 kHz	Sweep :	Span 100.0 MHz 3.733 ms (1001 pts)	CF Ste 10.000000 MH Auto Ma
1 N I f 2 N I f 3 N I f 6 6 7 8 9	2.465 5 GHz 2.516 2 GHz 2.483 5 GHz	0.177 dBm 48.867 dBm 40.661 dBm	URLINUM TORCHUR WIE	TOTUNO YALO	Freq Offse 0 H



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enter F	req 13.01500	0000 GHz PNO: Fast -	Trig: Free Run #Atten: 30 dB	#Avg Type: RMS	11:52:29 AM Aug 17, 2017 TRACE 3 4 5 5 TYPE M MANANAA DET P 1414 M	Frequency
0 dB/div	Ref Offset 10.7 Ref 20.00 dE	dB 3m		M	kr4 2.396 8 GHz -37.48 dBm	Auto Tun
00 10.0 10.0	01					Center Free 13.015000000 GH
20 3 10 12 40 0	A	Q <sup>3</sup>				Start Fre 30.000000 MH
000 000 000						Stop Fre 26.00000000 GH
Start 30 P #Res BW	/Hz 100 kHz	#VBI	N 300 kHz	Sweep 9	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Ste 2,597000000 GH
1 N 1 2 N 5 6 7 8 9	n ster f f f f	2.412 0 GHz 4.824 0 GHz 7.236 0 GHz 2.396 8 GHz	1.44 dBm 45.39 dBm 47.62 dBm -37.48 dBm	INCTION FUNCTION VAOTH	FUNCTION VALUE	Auto Ma Freq Offse 0 H



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Center F	req 13.0150	00000 GHz PNO: Fast	Trig: Free Run #Atten: 30 dB	#Avg Type: RMS	01:07:11PM Aug 17, 2017 TPACE 15.5 TYPE 104444444 DET P 11:1.01	Frequency
10 dB/div	Ref Offset 10. Ref 20.00 d	72 dB Bm		Mk	4 25.650 3 GHz -38.11 dBm	Auto Tune
000 100	01					Center Free 13,015000000 GH
20 5 30 0 40 0	0	2				Start Free 30.000000 MH
63 G 63 G 70 D						Stop Fre 26,000000000 GH
Start 30   Res BW	MHz / 100 kHz	#VBV	V 300 KHz	Sweep 9	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Stej 2.597000000 GH Auto Ma
1 N 2 N 3 N 6 6 7	1 f 1 f 1 f	2.462 0 GHz 4.924 0 GHz 7.386 0 GHz 25.650 3 GHz	1.31 dBm 43.96 dBm 50.21 dBm 38.11 dBm	arcian Trancian with	AURCHON VILUE	Freq Offse 0 H
8 9 10 11						



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enter Fi	req 13.0150	000000 GHz PNO: Fast +1 IFGain:Low	Trig: Free Run #Atten: 30 dB	#Avg Type: RMS	01:17/12 PM Aug 17, 2017 TRACE 5 5 TYRE 11 444	Frequency
0 dB/div	Ref Offset 10. Ref 20.00 d	72 dB IBm		Mkr	4 25.736 0 GHz -38.14 dBm	Auto Tun
0g 1010 1000	Q1					Center Fre 13,015000000 GH
0.0	0	2 /3				Start Fre 30.000000 MF
2 C 2 C 2 C 2 C	- North and a					Stop Fre 26,00000000 GF
tart 30 M Res BW	NHZ 100 kHz	#VBI	V 300 KHz	Sweep 95	Stop 26.00 GHz 6.0 ms (30000 pts)	CF Ste 2.597000000 GF Auto Ma
1 N 1 2 N 1 3 N 1 6 6 7 8 9 0	f f f f	2.467 0 GHz 4.934 0 GHz 7.401 0 GHz 25.736 0 GHz	-3.72 dBm -46.11 dBm -48.49 dBm -38.14 dBm	UNCTION FUNCTION WOTH	FUNCTION VALUE	Freq Offse 0 F



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enter Fr	eq 13.0150	00000 GHz PNO: Fast	Trig: Free Run #Atten: 30 dB	#Avg Type: RMS	01-20:15 PM AUG 17, 2017 TRACE TYPE DET P 111 5 10	Frequency
0 dB/div	Ref Offset 10. Ref 20.00 d	72 dB Bm		Mki	4 25.421 7 GHz -38.22 dBm	Auto Tun
09 00)	Q1					Center Fre 13.015000000 GH
20		2 ,3				Start Fre 30.000000 MH
as ne 00	and any second	WAY, RECEIPT				Stop Fre 26,00000000 GF
tart 30 M Res BW	Hz 100 kHz	#VBI	V 300 KHz	Sweep 9:	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Ste 2.597000000 GF Auto Ma
1 N 1 2 N 1 3 N 1 6 6 7 8 9	5 313 f f f f	2.472 0 GHz 4.944 0 GHz 7.416 0 GHz 25.421 7 GHz	4,64 dBm 47.72 dBm 48,68 dBm 38,22 dBm	UNCTION TOUCHON WOTH	AURCHION VALUE	Freq Offse



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# 9.3. 11g 2TX CDD MIMO MODE IN THE 2.4GHz BAND

## 9.3.1. 6 dB BANDWIDTH

#### LIMITS

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (a)

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

#### **RESULTS**

Channel	Frequency	6 dB BW Chain A (MHz)	6 dB BW Chain B (MHz)	Minimum Limit (MHz)
CH1	2412	16.48	16.32	0.5
CH2	2417	16.40	16.40	0.5
CH6	2437	16.32	16.40	0.5
CH11	2462	16.40	16.40	0.5
CH12	2467	16.40	16.40	0.5
CH13	2472	16.36	16.40	0.5

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### 9.3.2. 99% BANDWIDTH

#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

Channel	Frequency (MHz)	99% Bandwidth Chain A (MHz)	99% Bandwidth Chain B (MHz)
CH1	2412	16.651	16.598
CH2	2417	17.683	16.617
CH6	2437	16.694	16.598
CH11	2462	16.728	16.610
CH12	2467	16.672	16.595
CH13	2472	16.678	16.600

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enter Free	q 2.417000000 (	GHz #IFGain:Low	Center F Trig: Fre #Atten:	req: 2.417000 se Run 30 dB	0000 GHz Avg[Held: *	100/100	Radio Std: I Radio Devi	None Ice: BTS	Frequency
0 dB/div	Ref Offset 10.71 dE Ref 20.00 dBm	3		_			_		
00 100		June		-					Center Fre 2,417000000 GH
aa ar in fala	and white a second	4				يغ	-		
0.0									
a.)									
enter 2.41 Res BW 3	17 GHz 30 kHz		#V	BW 1 MH	z		Span Swe	140 MHz ep 1 ms	CF Ste 4.000000 MH
Occupie	ed Bandwidth 17	.683 MI	Hz	Total Po	ower	19.0	0 dBm		Auto Ma
Transmit x dB Bar	: Freq Error ndwidth	-153.68   36.34 N	kHz AHz	OBW Pa x dB	ower	91 -26	9.00 % .00 dB		01
-									



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### 9.3.3. AVERAGE POWER

#### **LIMITS**

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 10.7 dB cable) was entered as an offset in the power meter to allow for a gated reading of power.

#### **RESULTS**

ID: 37699	Date:	08/11/17
-----------	-------	----------

Channel	Frequency	Chain A	Chain B	Total
		Power	Power	Power
	(MHz)	(dBm)	(dBm)	(dBm)
Low_1	2412	9.77	10.29	13.05
Low_2	2417	13.57	13.21	16.40
Mid	2437	13.34	13.01	16.19
High_11	2462	12.46	12.07	15.28
High_12	2467	7.75	8.04	10.91
High_13	2472	7.81	8.21	11.02

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## 9.3.4. OUTPUT POWER

### <u>LIMITS</u>

FCC §15.247 (b) (3)

IC RSS-247 (5.4) (d)

For systems using digital modulation in the 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.

#### TEST PROCEDURE

KDB 558074 D01 v04Section 9.2.3.2

#### DIRECTIONAL ANTENNA GAIN

Tx chains are uncorrelated due to the device supporting CDD in all MIMO modes. The directional gain is:

Chain A	Chain B	<b>Uncorrelated Chains</b>
Antenna	Antenna	Directional
Gain	Gain	Gain
(dBi)	(dBi)	(dBi)
2.58	3.26	2.93

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#### **RESULTS**

ID:	37699	Date:	08/11/17
-----	-------	-------	----------

#### Limits

Channel	Frequency	Directional	FCC	IC	IC	Max
		Gain	Power	Power	EIRP	Power
			Limit	Limit	Limit	
	(MHz)	(dBi)	(dBm)	(dBm)	(dBm)	(dBm)
CH1	2412	2.93	30.00	30	36	30.00
CH2	2417	2.93	30.00	30	36	30.00
CH6	2437	2.93	30.00	30	36	30.00
CH11	2462	2.93	30.00	30	36	30.00
CH12	2467	2.93	30.00	30	36	30.00
CH13	2472	2.93	30.00	30	36	30.00

#### Results

Channel	Frequency	Chain A	Chain B	Total	Power	Margin
		Meas	Meas	Corr'd	Limit	
		Power	Power	Power		
	(MHz)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
CH1	2412	18.21	18.57	21.40	30.00	-8.60
CH2	2417	23.37	22.82	26.11	30.00	-3.89
CH6	2437	22.98	22.52	25.77	30.00	-4.23
CH11	2462	20.87	20.11	23.52	30.00	-6.48
CH12	2467	16.39	17.78	20.15	30.00	-9.85
CH13	2472	16.25	16.97	19.64	30.00	-10.36

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## 9.3.5. POWER SPECTRAL DENSITY

#### **LIMITS**

FCC §15.247 (e)

IC RSS-247 (5.2) (b)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

#### **RESULTS**

DSD Poculte

Channel	Frequency	Chain A	Chain B	Total Corr'd	Limit	Margin
		Meas	Meas	PSD		
	(MHz)	(dBm/3kHz)	(dBm/3kHz)	(dBm/3kHz)	(dBm/3kHz)	(dB)
CH1	2412	-15.97	-16.74	-13.32	8.0	-21.3
CH2	2417	-13.48	-13.11	-10.28	8.0	-18.3
CH6	2437	-13.03	-13.91	-10.44	8.0	-18.4
CH11	2462	-13.78	-12.86	-10.28	8.0	-18.3
CH12	2467	-19.35	-17.98	-15.60	8.0	-23.6
CH13	2472	-18.43	-17.57	-14.97	8.0	-23.0

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# 9.3.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

#### **LIMITS**

FCC §15.247 (d)

IC RSS-247 5.5

Output power was measured based on the use of peak measurement, therefore the required attenuation is 20 dB.

### **RESULTS**

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enter Freq 2.48350	DODOO GHz PNO: Fast	Trig: Free Run	#Avg Type: RMS Avg[Held: 100/100	DB:44:25 AM AUG21, 2017 TRACE	Frequency
Ref Offset 10 0 dB/div Ref 20.00	0.72 dB dBm	Prices. OF ND	M	(r1 2.464 6 GHz 1.838 dBm	Auto Tun
0g 100 200	-				Center Free 2.483500000 GH
		C.		-111 He and 1	Start Free 2.433500000 GH
25 70 B 70 D					Stop Fre 2.533500000 GH
enter 2.48350 GHz Res BW 100 kHz	#VBW \$	300 KHz	Sweep 3	Span 100.0 MHz 3.733 ms (1001 pts)	CF Ste 10.000000 MH
TE ECODE ALLE SEE N f 2 N f 3 N f 4 6 6 6 7 8 9 90	2.464 5 GHz 2.484 1 GHz 2.483 5 GHz 2.483 5 GHz	1.838 dBm 46.779 dBm 47.406 dBm	NCTION FUNCTION WIGTH	AURCHION VALUE	Freq Offse 0 H



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enter Fr	eq 13.0150	00000 GHz PN0: Fast + IFGain:Low	Trig: Free Run #Atten: 30 dB	#Avg Type: RMS	01:51:04PM Aug 17, 2017 TPACE 5 6 TYRE 104444444	Frequency
0 dB/div	Ref Offset 10. Ref 20.00 d	7 dB IBm		Mk	r4 25.482 3 GHz 38.90 dBm	Auto Tune
00 000 000	$\Diamond^1$					Center Free 13,015000000 GH
20 G 20 G 20 G	0	2 13				Start Free 30.000000 MH
	and and the second second					Stop Fre 26,000000000 GH
itart 30 N Res BW	IHz 100 kHz	#VB	W 300 KHz	Sweep 9	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Stej 2.597000000 GH Auto Ma
1 N 1 2 N 1 3 N 1 6 6 7 8 9 10	f f f	2.412 0 GHz 4.824 0 GHz 7.235 0 GHz 25.482 3 GHz	5.95 dBm 47.83 dBm 48.57 dBm -38.90 dBm		Peristan valou	Freq Offse 0 H



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enter Freq 1	3.015000000 G	Hz NO: Fast Tri	g: Free Run	#Avg Type: RMS	02-22:05 PM Aug 17, 2017 TRACE TYPE	Frequency
Ref	Offset 10.71 dB	ain:Low #At	ten: 30 dB	Mik	r4 23.798 5 GHz -38.15 dBm	Auto Tune
	20.00 (12)					Center Free 13,015000000 GH
0.0	A 4				417.20 000	Start Free 30.000000 MH
						Stop Fre 26,000000000 GH
tart 30 MHz Res BW 100	kHz	#VBW 300	) kHz	Sweep 9	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Ste 2.597000000 GH Auto Ma
Image N 1 F   1 N 1 f   2 N 1 f   3 N 1 f   6 6 7   7 8 9 10   10 11 11 1	2,437 0 4,874 0 7,311 0 23,798 5	3 GHz -2 3 GHz -48 3 GHz -49 5 GHz -36	1.33 dBm 1.49 dBm 1.45 dBm 1.15 dBm			Freq Offse 0 H



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enter Fr	eq 13.0150	00000 GHz PNO: Fast +	Trig: Free Run	#Avg Type: RMS	09:44:56 AM Aug 21, 2017 TRACE TYPE DET P 111-11	Frequency
0 dB/div	Ref Offset 10. Ref 20.00 d	72 dB	Provent, vy sta	Mik	r4 25.673 6 GHz -38.36 dBm	Auto Tune
09 00 000	Q'					Center Free 13.015000000 GH
20.2 20.0 20.0		2 13			-million	Start Free 30.000000 MH
26 706 706						Stop Fre 26,000000000 GH
itart 30 N Res BW	IHZ 100 kHz	#VBI	W 300 kHz	Sweep 9	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Stej 2.597000000 GH Auto Ma
1 N 1 2 N 1 3 N 1 6 6 7 8 9 10 11	f f f f	2.462 0 GHz 4.924 0 GHz 7.366 0 GHz 25.673 6 GHz	-3.33 dBm -47.56 dBm -49.74 dBm -38.36 dBm			Freq Offse 0 H



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enter Fr	eq 13.0150	000000 GHz PNO: Fast -	Trig: Free Run	#Avg Type: RMS	02:30:43PM Aug 17, 2017 TRACE 5 5 TYPE 000000000000000000000000000000000000	Frequency
0 dB/div	Ref Offset 10. Ref 20.00 d	72 dB	BURNELL, VY NO	Miki	r4 25.864 1 GHz -37.95 dBm	Auto Tune
09 100 000	Q1					Center Free 13.015000000 GH
30.0	0	2 13			4	Start Free 30.000000 MH
	- Marken					Stop Fre 26,00000000 GH
itart 30 M Res BW	IHz 100 kHz	#VB	W 300 kHz	Sweep 9:	Stop 26.00 GHz 56.0 ms (30000 pts)	CF Ste 2.597000000 GH Auto Ma
1 N 1 2 N 1 3 N 1 6 6 7 8 9 10 11	f f f f	2.472 0 GHz 4.944 0 GHz 7.416 0 GHz 25.864 1 GHz	8.41 dBm -46.92 dBm -49.05 dBm -37.85 dBm	UNLINK TORCHORWEYN	-UNUTION VALUE	Freq Offse 0 H



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# 9.4. 11n HT20 2TX CDD MIMO MODE IN THE 2.4GHz BAND

## 9.4.1. 6 dB BANDWIDTH

#### **LIMITS**

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (a)

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

### **RESULTS**

Channel	Frequency	6 dB BW Chain A (MHz)	6 dB BW Chain B (MHz)	Minimum Limit (MHz)
CH1	2412	17.72	17.60	0.5
CH2	2417	17.60	17.68	0.5
CH6	2437	17.68	17.68	0.5
CH11	2462	17.72	17.68	0.5
CH12	2467	17.72	17.60	0.5
CH13	2472	17.68	17.68	0.5

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### 9.4.2. 99% BANDWIDTH

#### **LIMITS**

None; for reporting purposes only.

#### **RESULTS**

Channel	Frequency (MHz)	99% Bandwidth Chain A (MHz)	99% Bandwidth Chain B (MHz)
CH1	2412	17.698	17.713
CH2	2417	17.686	17.706
CH6	2437	17.670	17.733
CH11	2462	17.686	17.671
CH12	2467	17.681	17.692
CH13	2472	17.708	17.699

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