MPE TEST REPORT

For

MODEL NO.: 1843
FCC ID: C3K1843
IC ID: 3048A-1843

Test Report No. S-156-FCCISED-MPE-2
Issue Date: May 6, 2019

FCC 47CFR Parts 1.1307, 1.1310, 2.1091
Innovation, Science and Economic Development
Canada RSS-102 Issue 5

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ACCREDITED
TESTING CERT #3472.01

1 Record of Revisions

Revision	Date	Section	Page(s)	Summary of Changes	Author/Revised By:
1.0	04/30/2019	All	All	Version 1.0	Z. Gray
2.0	05/06/2019	4	6	Added 160 MHz BW to radio description, extended WLAN frequency range to 2472 MHz.	Z. Gray

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Test Report Attestation

Microsoft Corporation
Model: 1843
FCC ID: C3K1843
ISED ID: 3048A-1843

Applicable Standards

Specification	Test Result
FCC CFR47 Rule Parts 1.1307, 1.1310, 2.1091	Pass
ISED RSS-102 Issue 5	Pass

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertains to the specific sample tested, under the conditions and operating modes as provided by the customer.

This test report replaces the previously issued report #S-156-FCCISED-MPE-1 issued by Microsoft EMC Labs.

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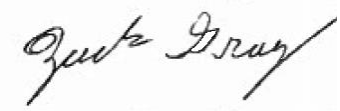

Written By: Zack Gray

SAR Test Lead

Reviewed/ Issued By: Daniel Salinas

Radio Test Lead

2 Deviations from Standards

None.

3 Facilities and Accreditations

3.1 Test Facility

All test facilities used to collect the test data are located at
Microsoft EMC Laboratory,
17760 NE 67th Ct,
Redmond WA, 98052, USA

3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.
A2LA Accredited Testing Certificate Number: 3472.01
FCC Registration Number: US1141
IC Site Registration Numbers: 3048A-3, 3048A-4

4 Product Description

Company Name:	Microsoft Corporation			
Address:	One Microsoft Way			
City, State, Zip:	Redmond, WA 98052-6399			
Customer Contact:	Choon Ooi			
Functional Description of the EUT:	Smart Display			
RF Exposure Conditions:	Mobile Exposure Conditions (Separation distance of ≥ 20 cm)			
Model:	1843			
FCC ID:	C3K1843			
IC ID:	3048A-1843			
Radio Descriptions:	WLAN Main 2.4 GHz: 802.11 b/g/n - 20/40 MHz BW's WLAN Main 5 GHz: 802.11 a/n/ac - 20, 40, 80, 160 MHz Bluetooth™ (Basic and Enhanced Data Rates) / Bluetooth LE Doppler Radar			
Frequency Range of Operation:	WLAN:	2412 – 2472 MHz		
		5180 – 5825 MHz		
	BT / BTLE:	2402 – 2480 MHz		
	Doppler:	24.15 – 24.25 GHz		
Modulations:	WLAN: CCK, BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM Bluetooth: GFSK, $\frac{\pi}{4}$DQPSK, and 8 DPSK			
Antenna Peak Gains:	**Radio**	**Band**	**Chain 1**	**Chain 2**
	WLAN	2412 – 2472 MHz	7 dBi	5.3 dBi
		5180 – 5240 MHz	4.7 dBi	4.2 dBi
		5260 – 5320 MHz	5 dBi	4.7 dBi
		5500 – 5700 MHz	4.9 dBi	4.5 dBi
		5745 – 5825 MHz	4.3 dBi	3.6 dBi
	BT / BTLE:	2402 – 2480 MHz	3.6 dBi	
	Doppler Radar:	24.15 – 24.25 GHz	4 dBi	
EUT Classification:	UNII, DTS, FHSS			
Equipment Design State:	Prototype/Production Equivalent			
Equipment Condition:	Good			

5 MPE Requirements

5.1 FCC MPE Requirements

The FCC MPE limits from CFR 47 Part 1.1310 are shown in the table below.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

5.1.1 FCC RF Exposure Exemption Criteria

The exemption criteria for RF exposure evaluation from CFR 47 Part 2.1091(c) are as follows:

(c)(1) Mobile devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; and the Citizens Broadband Radio Service pursuant to part 96 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if:

(i) They operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or

(ii) They operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.

(2) Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under §§15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in §2.1093(b) requiring evaluation under the provisions of that section.

(3) All other mobile and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§1.1307(c) and 1.1307(d) of this chapter.

5.2 ISED MPE Requirements

The ISED MPE limits from RSS-102 Issue 5 are shown in the table below.

RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

5.2.1 ISED MPE Exemption Requirements from RSS-102 Section 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 22.48/f0.5 W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31 x 10-2 f0.6834 W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

6 Maximum Device EIRP and ERP

The declared maximum output powers including tune-up tolerances are used in conjunction with the maximum antenna gains to find the maximum EIRP and ERP values.

For transmitters with multiple transmit chains, total EIRP and total ERP are calculated as:

$$EIRP_{TOT} = EIRP_1 + EIRP_2 + \cdots EIRP_n$$

$$ERP_{TOT}\ (dBm) = EIRP_{TOT}\ (dBm) - 2.15\ dB$$

Maximum EIRP and ERP of all Device Radios									
Radio	Band (GHz)	Chain A Max Power (dBm)	Chain A Max Gain (dBi)	Chain A Max EIRP (dBm)	Chain B Max Power (dBm)	Chain B Max Gain (dBi)	Chain B Max EIRP (dBm)	Max Total EIRP (dBm)	Max Total ERP (dBm)
WLAN	2.4	17.5	7	24.5	17.5	5.3	22.8	26.74	24.59
WLAN	5.2	17.5	4.7	22.2	17.5	4.2	21.7	24.97	22.82
	5.3	17.5	5	22.5	17.5	4.7	22.2	25.36	23.21
	5.6	17.5	4.9	22.4	17.5	4.5	22	25.21	23.06
	5.8	17.5	4.3	21.8	17.5	3.6	21.1	24.47	22.32
BT / BLE	2.4	5	3.6	8.6				8.6	6.45
Doppler Radar	24.25	6	4	10				10.0	7.85

7 Evaluation Against Exemption Criteria for RF Exposure Evaluation

Evaluation of Device Radios Against FCC and ISED Exemption Criteria							
Radio / Rulepart	Band (GHz)	Max Total ERP (mW)	FCC Exemption ERP Limits (mW)	FCC Exempt?	Max Total EIRP (mW)	ISED Exemption EIRP Limits (mW)	ISED Exempt?
WLAN 15.247	2.4	287.94	NA	Yes[1]	472.38	2702.91	Yes
WLAN 15.407	5.2	191.32	3000	Yes	313.87	4560.23	Yes
	5.3	209.55	3000	Yes	343.79	4608.31	Yes
	5.6	202.53	3000	Yes	332.27	4751.18	Yes
	5.8	170.78	3000	Yes	280.18	4895.01	Yes
BT / BLE 15.247	2.4	4.42	NA	Yes[1]	7.24	4560.23	Yes
Doppler Radar 15.249	24.25	6.10	NA	Yes[1]	10.00	2702.91	Yes

[1]Since 2.1091(c) does not reference Part 15.247 or 15.249, Bluetooth, WLAN 2.4 GHz and Doppler radios are categorically exempted from routine RF exposure evaluation by Part 1.1091(c)(3).

All Radios are exempt from routine RF Exposure Evaluation for both FCC and ISED.

8 MPE Calculations and Evaluation

Power densities are calculated for all radios, and the sum totals are compared to the FCC and ISED limits to support the 20 cm minimum device-user separation distance.

Power density is calculated as:

$$S = \frac{EIRP}{\pi R^2}$$

For FCC, the power densities of all radios are calculated and summed to show that the worst case is less than the corresponding power density limits.

MPE Power Density Evaluation at 20cm										
Antenna	Band (GHz)	Max EIRP (dBm)	Max EIRP (mW)	S $(\frac{mW}{cm^2})$	FCC Limit $(\frac{mW}{cm^2})$	FCC Result	S $(\frac{W}{m^2})$	ISED Limit $(\frac{W}{m^2})$	$\frac{S}{Limit}$	ISED Result
WLAN	2.4	26.74	472.38	0.38	1.0	Pass	3.76	5.37	0.70	Pass
WLAN	5.2	24.97	313.87	0.25	1.0	Pass	2.50	9.05	0.28	Pass
	5.3	25.36	343.79	0.27	1.0	Pass	2.74	9.14	0.30	Pass
	5.6	25.21	332.27	0.26	1.0	Pass	2.64	9.43	0.28	Pass
	5.8	24.47	280.18	0.22	1.0	Pass	2.23	9.71	0.23	Pass
BT / BLE	2.4	8.60	7.24	0.01	1.0	Pass	0.06	5.37	0.01	Pass
Doppler Radar	24.25	10.00	10.00	0.01	1.0	Pass	0.08	10	0.01	Pass
Total			489.62	0.40	1.0	Pass			0.72	Pass

- Since all FCC Bands have the same limit, Max EIRP and power densities are summed and the sum is compared to the FCC MPE limit.
- For FCC evaluation, the WLAN band with the highest EIRP is chosen for the worst-case total since the device can only transmit in one WLAN band at a time.

- ISED limits for 300 – 6000 MHz are calculated as (from table in section 5.2):

  $$ISED\ Limit = 0.02619 * f^{0.6834}\ \frac{W}{m^2}$$

- For ISED in accordance with RSS-102 Section 3.2, the fractions of the applicable limits are summed and the sum shown to be below 1 since the limits differ by band.
- For ISED evaluation, The WLAN band with the highest fraction of the applicable limit is chosen for the worst-case total since the device can only transmit in one WLAN band at a time.

End of Report