



FCC Part 1 Subpart I
FCC Part 2 Subpart J
RSS 102 ISSUE 6

RF EXPOSURE REPORT

FOR

WIRELESS MODULE

MODEL NUMBER: HWB-Q93

FCC ID: C3K00002101
IC: 3048A-00002101

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2024-12-03	Initial Issue	Charles Moody
V2	2025-01-13	Revised Section 7 to Include Notes Regarding EIRP and PD Limit Calculations	Charles Moody

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
1 Microsoft Way
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EUT DESCRIPTION: Wireless Module

MODEL: HWB-Q93

SERIAL NUMBER: 6-19, 6-25, 6-28

SAMPLE RECEIPT DATE: 2024-06-20 TO 2024-10-10

DATE TESTED: 2024-07-02 TO 2024-11-27

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 1 SUBPART I & PART 2 SUBPART J	Complies
RSS 102 ISSUE 6	Complies

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
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2. TEST METHODOLOGY

All calculations were made in accordance with FCC Parts 1.1310, 2.1091, 2.1093, KDB 447498 D01 v06, KDB 447498 D03 V01, IEEE Std C95.1-2005, IEEE Std C95.3-2002, IC Safety Code 6 and RSS 102 Issue 6.

3. REFERENCES

Antenna gain data is excerpted from product documentation provided by the applicant.

Note: Output Power is the declared maximum power across production units.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Certificate Number 0751.06.

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

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.

5.2. DECISION RULES

For all tests where the applicable $U_{LAB} \leq U_{MAX}$ the Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2, where $U_{MAX} = 30\% (0.3)$ for RF Exposure evaluations. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

For all tests where the applicable $U_{LAB} > U_{MAX}$ the Decision Rule is based on Guarded Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.3.2, with a guard band equal to $(U_{LAB} - U_{MAX})$, where $U_{MAX} = 30\% (0.3)$ for RF Exposure evaluations. (Test results are adjusted by the value of the guard band to determine conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Not applicable – calculations are based on the maximum output power and, where applicable, nominal antenna gains as declared by the manufacturer.

6. MAXIMUM PERMISSIBLE EXPOSURE (LIMITS AND EQUATIONS)

6.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

f = frequency in MHz

* = Plane-wave equivalent power density

Notes:

- (1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
- (2) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure

6.2. ISED RULES

For the purpose of this standard, Innovation, Science and Economic Development (ISED) has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.

Table 4: 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 (W/m ²)	Dentist (minutes)	Reference Period
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 $f^{0.3417}$	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 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$	

Note: f is frequency in MHz.

* Based on nerve stimulation (NS).

** Based on specific absorption rate (SAR).

6.3. EQUATIONS

POWER DENSITY

Power density is given by:

$$S = \text{EIRP} / (4 * \pi * D^2)$$

Where

S = Power density in mW/cm²

EIRP = Equivalent Isotropic Radiated Power in mW

D = Separation distance in cm

Power density in units of mW/cm² is converted to units of W/m² by multiplying by 10.

DISTANCE

Distance is given by:

$$D = \sqrt{(\text{EIRP} / (4 * \pi * S))}$$

Where

D = Separation distance in cm

EIRP = Equivalent Isotropic Radiated Power in mW

S = Power density in mW/cm²

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

$$\text{Source-based time-averaged EIRP} = (\text{DC} / 100) * \text{EIRP}$$

Where

DC = Duty Cycle in %, as applicable

EIRP = Equivalent Isotropic Radiated Power in mW

MIMO AND COLOCATED TRANSMITTERS (IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple chain devices, and colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the EIRP (in linear units) of each transmitter.

$$\text{Total EIRP} = (\text{EIRP}_1) + (\text{EIRP}_2) + \dots + (\text{EIRP}_n)$$

where

EIRP_x = Source-based time-averaged EIRP of chain x or transmitter x

The total EIRP is then used to calculate the Power Density or the Distance as applicable.

MIMO AND COLOCATED TRANSMITTERS (NON-IDENTICAL LIMIT FOR ALL TRANSMITTERS)

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply:

The Power Density at the specified separation distance is calculated for each transmitter chain or transmitter.

The fraction of the exposure limit is calculated for each chain or transmitter as $(\text{Power Density of chain or transmitter}) / (\text{Limit applicable to that chain or transmitter})$.

The fractions are summed.

Compliance is established if the sum of the fractions is less than or equal to one.

7. RF EXPOSURE RESULTS

This report contains data provided by the customer which can impact the validity of results. UL LLC is only responsible for correctly integrating customer-provided data with measurements performed by UL LLC.

Below is a list of the data provided by the customer:

1. Antenna gain and type (See section 3)
2. Maximum output power (See section 3)

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

(MIMO and/or Co-located transmitters all with same Power Density limit, 20 cm MPE distance)

Config 1:

Multiple chain or colocated transmitters												
Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)	
2.4 GHz	WLAN	0		23.00	6.10	100.0	812.83					
2.4 GHz	WLAN	1		23.00	6.10	100.0	812.83					
Combined			20				1625.66	0.32	3.24	1.00	5.35	

Config 2:

Multiple chain or colocated transmitters												
Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)	
5 GHz	WLAN	0		21.50	8.66	100.0	1037.53					
5 GHz	WLAN	1		21.50	8.66	100.0	1037.53					
Combined			20				2075.06	0.41	4.13	1.00	9.01	

Config 3:

Multiple chain or colocated transmitters												
Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)	
2.4 GHz	BT/BLE	0		20.50	6.10	100.0	457.09					
2.4 GHz	WLAN	1		23.00	6.10	100.0	812.83					
Combined			20				1269.92	0.25	2.53	1.00	5.35	

Config 4:

Multiple chain or colocated transmitters

Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)
2.4 GHz	BT/BLE	0		20.50	6.10	100.0	457.09				
5 GHz	WLAN	1		21.50	8.66	100.0	1037.53				
Combined			20				1494.62	0.30	2.97	1.00	5.35

Config 5:

Multiple chain or colocated transmitters

Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)
2.4 GHz	BT/BLE	0		20.50	6.10	100.0	457.09				
6 GHz	WLAN	1		19.00	8.66	100.0	583.45				
Combined			20				1040.53	0.21	2.07	1.00	5.35

Config 6:

Multiple chain or colocated transmitters

Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)
2.4 GHz	WLAN	0		23.00	6.10	100.0	812.83				
5 GHz	WLAN	1		21.50	8.66	100.0	1037.53				
Combined			20				1850.36	0.37	3.68	1.00	5.35

Config 7:

Multiple chain or colocated transmitters

Band	Mode	Chain for MIMO	Separ. Dist. (cm)	Output AVG Power (dBm)	Ant. Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC PD (mW/cm^2)	ISED PD (W/m^2)	FCC PD Limit (mW/cm^2)	ISED PD Limit (W/m^2)
2.4 GHz	WLAN	0		23.00	6.10	100.0	812.83				
6 GHz	WLAN	1		19.00	8.66	100.0	583.45				
Combined			20				1396.28	0.28	2.78	1.00	5.35

Notes:

- 1) For MPE, KDB 447498 D01 v6 and RSS-102, the calculations use the maximum rated power.
- 2) Declared maximum rated power was within manufacturer's tolerance requirements for all radios. The manufacturer configures output power so that the maximum power, after accounting for manufacturing tolerances, will never exceed the maximum power level measured.
- 3) The output power in the tables above is the maximum power per chain among various channels and various modes within the specific band.
- 4) The antenna gain in the tables above is the maximum antenna gain among various channels within the specified band.
- 5) A worst-case duty cycle of 100% was used for all calculations.
- 6) The following Sim-Tx modes and configurations were evaluated based on what the module supports

Configuration	Chain 0	Chain 1
1	2.4 WLAN	2.4 WLAN
2	5 WLAN	5 WLAN
3	BT/BLE	2.4 WLAN
4	BT/BLE	5 WLAN
5	BT/BLE	6 WLAN
6	2.4 WLAN	5 WLAN
7	2.4 WLAN	6 WLAN

- 7) For all ISED PD Limit calculations, the lowest supported frequency in the simultaneous combination was used in the calculation of the PD limit as a worst-case consideration
- 8) Low gain power and high gain antenna gain was used during the EIRP calculations as a worst-case testing configuration.
- 9) 2.4 WLAN MIMO transmission was included in the MPE calculation as the mode with the highest power per chain with the 6.1 dBi antenna. 5 WLAN was included in the MPE calculation as the mode with the highest power per chain with the 8.66 dBi antenna.
- 10) For the ISED PD Limit calculation, the lowest of the two frequency was used in the calculation of the limit as a worst-case scenario, where applicable.

END OF TEST REPORT