

RF Exposure Exemption Report

Dyson Technology Limited
Robot Vacuum Cleaner, Model: RB03

In accordance with FCC CFR 47 Pt 1.1307

Prepared for: Dyson Technology Limited
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EXECUTIVE SUMMARY

The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR Title 47 Part 1.1307.



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Contents

1	Report Summary	2
1.1	Report Modification Record.....	2
1.2	Introduction.....	2
1.3	Brief Summary of Results	3
1.4	Product Information	3
2	Assessment Details	5
2.1	Single RF Source options for determination of exemption.....	5
2.2	Multiple RF Sources options for determination of exemption.	6
2.3	Individual Antenna Port Exposure Results.....	7
2.4	Combined Antenna Port RF Exposure Results FCC 1.1307(b)(3)(ii)(B)	8



1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	24-Aug-2023

Table 1

1.2 Introduction

Applicant	Dyson Technology Limited
Manufacturer	Dyson Technology Limited
Model Number	RB03
Hardware Version(s)	OR2.0
HLP Version	2
PCBA Version	289439-01
Software Version(s)	RB03PR.01.06.014.1085
Specification/Issue/Date	FCC 47 CFR Part 1.1307: 2021
Order Number	6000112314
Date	25-February-2021
Related Document(s)	<ul style="list-style-type: none">• KDB 447498 D04 v01• FCC 47 CFR Part 2.1091: 2021



1.3 Brief Summary of Results

The wireless devices described within this report are compliant with the exemption criteria related to human exposure to electromagnetic fields laid out in FCC CFR Title 47 Part 1.1307.

The calculations shown in this report were made in accordance with the procedures specified in the applied test specification(s).

1.4 Product Information

1.4.1 Technical Description

Robotic Vacuum Cleaner with 2.4 GHz, 5 GHz Wi-Fi and Bluetooth Low Energy wireless technologies.

1.4.2 Transmitter Description

The following radio access technologies and frequency bands are supported by the equipment under test.

Radio Access Technology	Frequency Band (MHz)	Minimum Frequency (MHz)	Output Power (dBm)	Duty Cycle (%)
Bluetooth Low Energy	2402 - 2480	2402	4	100
2.4 GHz WLAN	2412 - 2472	2412	15	100
5 GHz WLAN	5180 - 5825	5180	15	100

Table 2 – Transmitter Description- FCC

Note: Transmitter power includes upper bounds of uncertainty therefore maximum values are used.



1.4.3 Antenna Description

The following antennas are supported by the equipment under test.

Radio Access Technology	Antenna Port	Antenna Model	Gain (dBi)	Antenna length (cm)	Minimum Separation Distance (cm)
Bluetooth Low Energy	B	X277-AZW-WIFI_ANT_B/BT	4.1	2.758	> 20
2.4 GHz WLAN	A	X277-AZW-WIFI_ANT_A	4.1	2.668	> 20
2.4 GHz WLAN	B	X277-AZW-WIFI_ANT_B/BT	4.1	2.758	> 20
5 GHz WLAN	A	X277-AZW-WIFI_ANT_A	6.3	2.668	> 20
5 GHz WLAN	B	X277-AZW-WIFI_ANT_B/BT	6.3	2.758	> 20

Table 3 – Antenna description

In the case of more than one type of antenna being supported by the equipment, the calculation is based on the maximum of the antenna gains. If other antennas can be used that have greater gains, the minimum separation distances will need to be recalculated.

Note: Antenna gain includes upper bounds of uncertainty therefore maximum values are used in accordance with Section **Error! Reference source not found..**

1.4.4 Equipment Configuration

The device supports the following modes:-

- Bluetooth Low Energy via Ant B
- 2.4 GHz WLAN via Ant A
- 2.4 GHz WLAN via Ant B
- 5 GHz WLAN via Ant A
- 5 GHz WLAN via Ant B
- 2.4 GHz WLAN MIMO operation via Ant A and Ant B
- 5 GHz WLAN MIMO operation via Ant A and Ant B



2 Assessment Details

2.1 Single RF Source options for determination of exemption.

Option	Reference	RF Exposure Test Exemptions for Single Source												
A (1-mW Test Exemption)	FCC 1.1307(b)(3)(i)(A)	The available maximum time averaged power is no more than 1 mW, regardless of separation distance.												
B (SAR-Based Exemption)	FCC 1.1307(b)(3)(i)(B)	<p>The available maximum timeaveraged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:</p> $P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$ <p>Where</p> $x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$ <p>and</p> $ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$ <p><i>d</i> = the separation distance (cm);</p>												
C (MPE-Based Exemption)	FCC 1.1307(b)(3)(i)(C)	<p>Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).</p> <p>TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION</p> <table border="1"> <thead> <tr> <th>RF Source frequency (MHz)</th> <th>Threshold ERP (watts)</th> </tr> </thead> <tbody> <tr> <td>0.3–1.34</td> <td>1,920 R².</td> </tr> <tr> <td>1.34–30</td> <td>3,450 R²/f².</td> </tr> <tr> <td>30–300</td> <td>3.83 R².</td> </tr> <tr> <td>300–1,500</td> <td>0.0128 R²f.</td> </tr> <tr> <td>1,500–100,000</td> <td>19.2R².</td> </tr> </tbody> </table>	RF Source frequency (MHz)	Threshold ERP (watts)	0.3–1.34	1,920 R ² .	1.34–30	3,450 R ² /f ² .	30–300	3.83 R ² .	300–1,500	0.0128 R ² f.	1,500–100,000	19.2R ² .
RF Source frequency (MHz)	Threshold ERP (watts)													
0.3–1.34	1,920 R ² .													
1.34–30	3,450 R ² /f ² .													
30–300	3.83 R ² .													
300–1,500	0.0128 R ² f.													
1,500–100,000	19.2R ² .													



2.2 Multiple RF Sources options for determination of exemption.

Option	Reference	
A 1-mW Test Exemption for Multiple Sources	FCC 1.1307(b)(3)(ii)(A)	The available maximum time averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
B Simultaneous Transmission with both SAR-based and MPE- Based Test Exemptions	FCC 1.1307(b)(3)(ii)(B)	in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation. $\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$



2.3 Individual Antenna Port Exposure Results

2.3.1 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307(b)(3)(i)(C) 'Option C' (MPE Based Exemption)

RAT	Antenna	Frequency (MHz)	Conducted Power Output (mW)	Duty Cycle %	Time Average Conducted Power Output (mW)	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Minimum separation distance for MPE evaluation $\lambda/2$ π mm	Actual Distance (mm)	Threshold ERP (mW)	1.1307(b)(3)(i)(C) Exemption (Yes/No) (300 kHz to 100 GHz)
Bluetooth Low Energy	B	2402	2.512	100	2.512	2.570	6.456	3.94	19.9	200	768	Yes
2.4 GHz WLAN	A	2412	31.623	100	31.623	2.570	81.283	49.56	19.8	200	768	Yes
2.4 GHz WLAN	B	2412	31.623	100	31.623	2.570	81.283	49.56	19.8	200	768	Yes
5 GHz WLAN	A	5180	31.623	100	31.623	4.266	134.896	82.25	9.2	200	768	Yes
5 GHz WLAN	B	5180	31.623	100	31.623	4.266	134.896	82.25	9.2	200	768	Yes

Table 4 –Transmitter Result

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(C) MPE-based exception at a minimum distance of 20 cm.



2.4 Combined Antenna Port RF Exposure Results FCC 1.1307(b)(3)(ii)(B)

2.4.1 Combination 1 – Option B or Option C Summation

RAT	Antenna	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Test Separation Distance (cm)	ERP _j / ERP _{th,j} <or> P _i / P _{th}	Sum of the fractional contributions to the applicable thresholds is less than or equal to 1. Compliant? (Yes/No)
2.4 GHz WLAN	A	2412	31.623	100	31.623	2.570	81.283	49.56	20	0.06453	
2.4 GHz WLAN	B	2412	31.623	100	31.623	2.570	81.283	49.56	20	0.06453	
Calculated RF exposure level at minimum compliance boundary of 0.2 m as a fraction of the limit										0.12906	Yes

Table 5 –Transmitter Result

The calculations show that the multiple transmitters comply with FCC 1.1307(b)(3)(ii)(B) summation-based exemption.

2.4.2 Combination 2 - Option B or Option C Summation

RAT	Antenna	Frequency (MHz)	Conducted Power Output mW	Duty Cycle %	Time Average Conducted Power Output mW	Antenna Gain Ratio	Maximum Power (EIRP) mW	Maximum Power (ERP) mW	Test Separation Distance (cm)	ERP _j / ERP _{th,j} <or> P _i / P _{th}	Sum of the fractional contributions to the applicable thresholds is less than or equal to 1. Compliant? (Yes/No)
5 GHz WLAN	A	5180	31.623	100	31.623	4.266	134.896	82.25	20	0.10710	
5 GHz WLAN	B	5180	31.623	100	31.623	4.266	134.896	82.25	20	0.10710	
Calculated RF exposure level at minimum compliance boundary of 0.2 m as a fraction of the limit										0.21420	Yes

The calculations show that the multiple transmitters comply with FCC 1.1307(b)(3)(ii)(B) summation-based exemption