

Exposure Calculation Report

Dyson Technology Limited
Air Purifying Headphones, Model: WP01

In accordance with FCC CFR 47 Pt 2.1091

Prepared for: Dyson Technology Limited
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SIGNATURE

A handwritten signature in black ink, appearing to read 'S Marshall'.

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	17 January 2023

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

EXECUTIVE SUMMARY

The calculation of exposure for this product was found to be compliant at a minimum distance of 2.6 cm with FCC CFR 47 Pt.2.1091 assuming continuous exposure of 6 minutes or more. If alternative antennas are used with greater gains, the distance must be recalculated.

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Contents

- 1.1 Report Modification Record.....2
- 1.2 Introduction.....2
- 1.3 Brief Summary of Results3
- 1.4 Product Information4
- 2 Assessment Details6**
- 2.1 Single RF Source options for determination of exemption.....6
- 2.2 Multiple RF Sources options for determination of exemption.7
- 2.3 Individual Antenna Port Exposure Results.....8



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	17-January-2023

Table 1

1.2 Introduction

Applicant	Dyson Technology Limited
Manufacturer	Dyson Technology Limited
Model Number(s)	WP01
Hardware Version(s)	OR1
Software Version(s)	10.3
Specification/Issue/Date	FCC 47 CFR Part 2.1091: 2021
Order Number	6000091736
Date	05-November-2020
Related Document(s)	• KDB 447498 D04 v01 • FCC 47 CFR Part 1.1307: 2021 • FCC 47 CFR Part 1.1310: 2021



1.3 Brief Summary of Results

The wireless device described within this report was compliant with the restrictions related to human exposure to electromagnetic fields for both general public and worker/occupational exposures for a separation distance of 2.6 cm.

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

The EUT is an audio headset and air purifier with Bluetooth BR/EDR and Low Energy (BLE) technology

1.4.2 Emitter 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 (%)
2.4 GHz Bluetooth BR/EDR	2402 - 2480	2402	11.5	78
2.4 GHz BLE	2402 - 2480	2402	10	32

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 Model	Gain (dBi)	Antenna length (cm)	Minimum Separation Distance (cm)
2.4 GHz Bluetooth BR/EDR	FPC+Coax	2.25	4	2.6
2.4 GHz BLE	FPC+Coax	2.25	4	2.6

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.

1.4.4 Equipment Configuration

Simultaneous transmission of Bluetooth and Bluetooth Low Energy is not supported.



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)	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: $P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$ Where $x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$ and $ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$ <i>d</i> = the separation distance (cm);												
C (MPE-Based Exemption)	FCC 1.1307(b)(3)(i)(C)	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 λ/2π, 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 λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value). TABLE 1 TO § 1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION <table><tr><th>RF Source frequency (MHz)</th><th>Threshold ERP (watts)</th></tr><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></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 .
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0.3–1.34	1,920 R ² .													
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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 in 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 using option B (SAR Based Test Exemption)

RAT	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 Antenna to User Separation Distance (mm)	Pth (mW) 1.1307 (b)(3)(i)(B)	Greater of Max time averaged conducted power or ERP?	Portable devices: 1.1307(b)(3)(i)(B) Exemption (Yes/No) (300 MHz to 6 GHz, 0.5 cm to 20 cm)
2.4 GHz Bluetooth BR/EDR	2402	14.13	78	11.02	1.68	18.52	11.29	26	63.7	11.29 mW	Yes
2.4 GHz BLE	2402	10	32	3.2	1.68	5.38	3.28	26	63.7	3.28 mW	Yes

Table 4 –Transmitter Result

The calculations show that the individual transmitters comply with FCC 1.1307(b)(3)(i)(B) SAR-based exemption at a minimum distance of 2.6cm.