RF Exposure Exemption Report

Apple Inc
Model: A3143 and A3389

In accordance with FCC CFR 47 Pt 1.1307

Prepared for: Apple Inc
One Apple Park Way
Cupertino, California
95014, USA

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SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Matthew Russell	Chief Engineer	Authorised Signatory	28 October 2024

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

FCC Accreditation
492497/UK2010 Octagon House, Fareham Test Laboratory

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 47 Part 1.1307.

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Contents

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	28-October-2024

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A3143 and A3389
Hardware Version(s)	REV1.0
Software Version(s)	N/A
Specification/Issue/Date	FCC 47 CFR Part 1.1307: 2022
Related Document(s)	KDB 447498 D04 v01

1.3 Brief Summary of Results

The mobile 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 greater than 20 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 equipment under test (EUT) was a desktop computer.

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 (SISO) Core 0	2400-2483.5	2402	16.5	100
Bluetooth (SISO) Core 1	2400-2483.5	2402	16.5	100
Bluetooth (SISO) Core 2	2400-2483.5	2402	13	100
Bluetooth (2x2 MIMO) Core 0 and Core 1	2400-2483.5	2402	18	100
Thread (SISO) Core 0	2400-2483.5	2405	20.5	100
Thread (SISO) Core 1	2400-2483.5	2405	20.5	100
Thread (SISO) Core 2	2400-2483.5	2405	12.5	100
2.4 GHz WLAN (SISO) Core 0	2400-2483.5	2412	23	100
2.4 GHz WLAN (SISO) Core 1	2400-2483.5	2412	23	100
2.4 GHz WLAN (2x2 MIMO) Core 0 and Core 1	2400-2483.5	2412	26	100
5 GHz WLAN (SISO) Core 0	5150-5850	5180	21.5	100
5 GHz WLAN (SISO) Core 1	5150-5850	5180	21.5	100
5 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5150-5850	5180	24.5	100
6 GHz WLAN (SISO) Core 0	5925-7125	5955	21.5	100
6 GHz WLAN (SISO) Core 1	5925-7125	5955	21.5	100
6 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5925-7125	5955	24.5	100
NB Core 0	UNII-1	5162	13.5	100
NB Core 1	UNII-1	5162	13.5	100
NB Core 0 and Core 1	UNII-1	5162	14	100
NB Core 0	UNII-3	5733	15	100
NB Core 1	UNII-3	5733	15	100
NB Core 0 and Core 1	UNII-3	5733	18	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 Model	Frequency Band (MHz)	Gain (dBi)	Antenna length (cm)	Minimum Separation Distance (cm)
Bluetooth / Thread / 2.4 GHz WLAN – Core 0	Not Specified	2400-2483.5	0.07	6.82	20.1
Bluetooth / Thread / 2.4 GHz WLAN – Core 1	Not Specified	2400-2483.5	1.55	6.82	20.1
Bluetooth / Thread / 2.4 GHz WLAN – Core 2	Not Specified	2400-2483.5	1.07	6.82	20.1
5 GHz WLAN – Core 0	Not Specified	5150-5850	1.85	6.82	20.1
5 GHz WLAN – Core 1	Not Specified	5150-5850	2.67	6.82	20.1
6 GHz WLAN – Core 0	Not Specified	5925-7125	0.88	6.82	20.1
6 GHz WLAN – Core 1	Not Specified	5925-7125	1.85	6.82	20.1
NB UNII-1 Core 0	Not Specified	5150-5250	0.69	6.82	20.1
NB UNII-1 Core 1	Not Specified	5150-5250	2.67	6.82	20.1
NB UNII-3 Core 0	Not Specified	5725-5850	0.48	6.82	20.1
NB UNII-3 Core 1	Not Specified	5725-5850	0.79	6.82	20.1

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

The device supports the following modes:-

- Bluetooth can operate in SISO modes on Core 0, 1, 2 & MIMO modes on Core 0 & 1
- Thread can operate in SISO modes on Core 0, 1, 2
- WLAN can operate in SISO modes on Core 0, 1 & MIMO modes on Core 0 & 1
- NB can operate in SISO modes on Core 0, 1 & MIMO modes on Core 0 & 1

The device supports simultaneous operation in the following modes:

- Bluetooth or Thread and 5 GHz / 6 GHz WLAN
- NB (Core 0) and 2.4 GHz WLAN (Core 1)
- NB (Core 1) and 2.4 GHz WLAN (Core 0)

Worst case configurations for simultaneous transmission were identified as;

- Combination 1 - Thread Core 1 + 6 GHz WLAN (2x2 MIMO on Core 0 & 1)

- Combination 2 - 2.4 GHz WLAN (SISO) Core 0 + NB Core 1

2 Assessment Details

2.1 Single RF Source options for determination of exemption.

<table>
<tr><th>Option</th><th>Reference</th><th>RF Exposure Test Exemptions for Single Source</th></tr>
<tr><td>A
(1-mW Test Exemption)</td><td>FCC
1.1307(b)(3)(i)(A)</td><td>The available maximum time averaged power is no more than 1 mW, regardless of separation distance.</td></tr>
<tr><td>B
(SAR-Based Exemption)</td><td>FCC
1.1307(b)(3)(i)(B)</td><td>The available maximum timeaveraged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (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). Pth is given by:
$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$
Where
$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right)$$ and f is in GHz;
and
$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$
d = the separation distance (cm);</td></tr>
<tr><td>C
(MPE-Based Exemption)</td><td>FCC
1.1307(b)(3)(i)(C)</td><td>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>
</td></tr>
</table>

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 Calculation of Exposure at Specified Separation Distance

The frequencies shown in the tables below have been chosen based on the lowest possible frequency that the EUT can transmit.

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? mW	1.1307(b)(3)(i)(B) Exemption (Yes/No) (300 MHz to 6 GHz, 0.5 cm to 40 cm)
Bluetooth (SISO) Core 0	2402	44.668	100	44.668	1.016	45.394	27.679	201	3060	44.668	Yes
Bluetooth (SISO) Core 1	2402	44.668	100	44.668	1.429	63.826	38.919	201	3060	44.668	Yes
Bluetooth (SISO) Core 2	2402	19.953	100	19.953	1.279	25.527	15.565	201	3060	19.953	Yes
Bluetooth (2x2 (MIMO) Core 0 and Core 1	2402	63.096	100	63.096	1.429	90.157	54.974	201	3060	63.096	Yes
Thread (SISO) Core 0	2405	112.202	100	112.202	1.016	114.025	69.527	201	3060	112.202	Yes
Thread (SISO) Core 1	2405	112.202	100	112.202	1.429	160.325	97.759	201	3060	112.202	Yes
Thread (SISO) Core 2	2405	17.783	100	17.783	1.279	22.751	13.873	201	3060	17.783	Yes
2.4 GHz WLAN (SISO) Core 0	2412	199.526	100	199.526	1.016	202.768	123.639	201	3060	199.526	Yes
2.4 GHz WLAN (SISO) Core 1	2412	199.526	100	199.526	1.429	285.102	173.843	201	3060	199.526	Yes
2.4 GHz WLAN (2x2 MIMO) Core 0 and Core 1	2412	398.107	100	398.107	1.429	568.853	346.862	201	3060	398.107	Yes
5 GHz WLAN (SISO) Core 0	5180	141.254	100	141.254	1.531	216.272	131.873	201	3060	141.254	Yes
5 GHz WLAN (SISO) Core 1	5180	141.254	100	141.254	1.849	261.216	159.278	201	3060	159.278	Yes
5 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5180	281.838	100	281.838	1.849	521.195	317.802	201	3060	317.802	Yes
NB Core 0	5162	22.387	100	22.387	1.172	26.242	16.001	201	3060	22.387	Yes
NB Core 1	5162	22.387	100	22.387	1.849	41.400	25.244	201	3060	25.244	Yes
NB Core 0 and Core 1	5162	25.119	100	25.119	1.849	46.452	28.324	201	3060	28.324	Yes

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? mW	1.1307(b)(3)(i)(B) Exemption (Yes/No) (300 MHz to 6 GHz, 0.5 cm to 40 cm)
NB Core 0	5733	31.623	100	31.623	1.117	35.318	21.536	201	3060	31.623	Yes
NB Core 1	5733	31.623	100	31.623	1.199	37.931	23.129	201	3060	31.623	Yes
NB Core 0 and Core 1	5733	63.096	100	63.096	1.199	75.683	46.148	201	3060	63.096	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 0.201 m.

2.4 Single Source Calculation of Exposure at Specified Separation Distance FCC 1.1307(b)(3)(i)(C) 'Option C' (MPE Based 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 separation distance for MPE evaluation λ/2 π mm	Actual Distance (mm)	Threshold ERP (mW)	1.1307(b)(3)(i)(C) Exemption (Yes/No) (300 kHz to 100 GHz)
6 GHz WLAN (SISO) Core 0	5955	141.254	100	141.254	1.225	172.982	105.477	8.02	201	776	Yes
6 GHz WLAN (SISO) Core 1	5955	141.254	100	141.254	1.531	216.272	131.873	8.02	201	776	Yes
6 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5955	281.838	100	281.838	1.531	431.519	263.121	8.02	201	776	Yes

Table 5 – 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 0.201 m.

2.5 Combined Antenna Port RF Exposure Results using "1.1307(b)(3)(i)(B) SAR / MPE Exemption"

2.5.1 Combination 1 - 6 GHz WLAN (2x2 MIMO on Core 0 & 1) + Thread Core 1

RAT Core	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 (mm)	ERPj / Max of time averaged conducted power or ERPth
Thread Core 1	2405	112.202	100	112.202	1.429	160.325	97.759	201	0.0367
6 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5955	281.838	100	281.838	1.531	431.519	263.121	201	0.3392
Calculated RF exposure level at minimum compliance boundary of 0.201 m as a fraction of the limit									0.3759

Table 6 – Transmitter Result

2.5.2 Combination 2 – 2.4 GHz WLAN (Core 0) + NB (Core 1)

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	Test Separation Distance (mm)	ERPj / Max of time averaged conducted power or ERPth
2.4 GHz WLAN (SISO) Core 0	2412	199.526	100	199.526	1.016	202.768	123.639	201	0.0652
NB Core 1	5733	31.623	100	31.623	1.199	37.931	23.129	201	0.0103
Calculated RF exposure level at minimum compliance boundary of 0.201 m as a fraction of the limit									0.0755

Table 7 – Transmitter Result