

RF Exposure Exemption Report

Apple Inc
Model: A3137

In accordance with FCC CFR 47 Pt 1.1307

Prepared for: Apple Inc
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FCC ID: BCGA3137

Document 75960544-17 Issue: 03

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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 47 Part 1.1307.

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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-July-2024
2	6 GHz WLAN evaluated using FCC 1.1307(b)(3)(i)(C) 'Option C' (MPE Based Exemption)	08-October-2024
3	Re-evaluated based on "Mobile" device	14-October-2024

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A3137
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 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 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	18.0	100
Bluetooth (SISO) Core 1	2400-2483.5	2402	17.0	100
Bluetooth (SISO) Core 2	2400-2483.5	2402	12.0	100
Bluetooth (2x2 (MIMO) Core 0 and Core 1	2400-2483.5	2402	21.0	100
Thread (SISO) Core 0	2400-2483.5	2405	19.5	100
Thread (SISO) Core 1	2400-2483.5	2405	20.0	100
Thread (SISO) Core 2	2400-2483.5	2405	12.5	100
2.4 GHz WLAN (SISO) Core 0	2400-2483.5	2412	22.5	100
2.4 GHz WLAN (SISO) Core 1	2400-2483.5	2412	22.5	100
2.4 GHz WLAN (2x2 MIMO) Core 0 and Core 1	2400-2483.5	2412	25.5	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	14.0	100
NB Core 1	UNII-1	5162	14.0	100
NB Core 0 and Core 1	UNII-1	5162	11.5	100
NB Core 0	UNII-3	5733	14.0	100
NB Core 1	UNII-3	5733	14.0	100
NB Core 0 and Core 1	UNII-3	5733	17.0	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	2.40	5.17	20.1
Bluetooth / Thread / 2.4 GHz WLAN – Core 1	Not Specified	2400-2483.5	2.60	3.11	20.1
Bluetooth / Thread / 2.4 GHz WLAN – Core 2	Not Specified	2400-2483.5	1.10	4.82	20.1
5 GHz WLAN – Core 0	Not Specified	5150-5850	4.60	5.17	20.1
5 GHz WLAN – Core 1	Not Specified	5150-5850	6.30	3.11	20.1
6 GHz WLAN – Core 0	Not Specified	5925-7125	4.5	5.17	20.1
6 GHz WLAN – Core 1	Not Specified	5925-7125	5.7	3.11	20.1
NB UNII-1 Core 0	Not Specified	5150-5250	4.2	5.17	20.1
NB UNII-1 Core 1	Not Specified	5150-5250	5.9	3.11	20.1
NB UNII-3 Core 0	Not Specified	5725-5850	4.6	5.17	20.1
NB UNII-3 Core 1	Not Specified	5725-5850	4.4	3.11	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 Mode 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 Mode on Core 0 – 1
- NB can operate in SISO modes on Core 0, 1 & MIMO Mode on Core 0 – 1

The device supports simultaneous operation in the following modes:

- Bluetooth and 5 GHz WLAN
- 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 - Bluetooth (2x2 MIMO on Core 0 & 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.

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 .
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 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 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. A full list of the regional requirements is shown in Annex A.

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	63.096	100	63.096	1.738	109.648	66.858	201	3060	66.858	Yes
Bluetooth (SISO) Core 1	2402	50.119	100	50.119	1.820	91.201	55.610	201	3060	55.610	Yes
Bluetooth (SISO) Core 2	2402	15.849	100	15.849	1.288	20.417	12.450	201	3060	15.849	Yes
Bluetooth (2x2 MIMO) Core 0 and Core 1	2402	125.893	100	125.893	1.820	229.087	139.687	201	3060	139.687	Yes
Thread (SISO) Core 0	2405	89.125	100	89.125	1.738	154.882	94.440	201	3060	94.440	Yes
Thread (SISO) Core 1	2405	100.000	100	100.000	1.820	181.970	110.957	201	3060	110.957	Yes
Thread (SISO) Core 2	2405	17.783	100	17.783	1.288	22.909	13.969	201	3060	17.783	Yes
2.4 GHz WLAN (SISO) Core 0	2412	177.828	100	177.828	1.738	309.030	188.433	201	3060	188.433	Yes
2.4 GHz WLAN (SISO) Core 1	2412	177.828	100	177.828	1.820	323.594	197.313	201	3060	197.313	Yes
2.4 GHz WLAN (2x2 MIMO) Core 0 and Core 1	2412	354.813	100	354.813	1.820	645.654	393.692	201	3060	393.692	Yes
5 GHz WLAN (SISO) Core 0	5180	141.254	100	141.254	2.884	407.380	248.403	201	3060	248.403	Yes
5 GHz WLAN (SISO) Core 1	5180	141.254	100	141.254	4.266	602.560	367.414	201	3060	367.414	Yes
5 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5180	281.838	100	281.838	4.266	1202.264	733.088	201	3060	733.088	Yes
NB Core 0	5162	25.119	100	25.119	2.630	66.069	40.286	201	3060	40.286	Yes
NB Core 1	5162	25.119	100	25.119	3.890	97.724	59.588	201	3060	59.588	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 and Core 1	5162	14.125	100	14.125	3.890	54.954	33.509	201	3060	33.509	Yes
NB Core 0	5733	25.119	100	25.119	2.884	72.444	44.173	201	3060	44.173	Yes
NB Core 1	5733	25.119	100	25.119	2.512	63.096	38.473	201	3060	38.473	Yes
NB Core 0 and Core 1	5733	50.119	100	50.119	2.884	144.544	88.137	201	3060	88.137	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.



2.3.2 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 $\lambda/2$ 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	2.818	398.107	242.748	8.0	201	776	Yes
6 GHz WLAN (SISO) Core 1	5955	141.254	100	141.254	3.715	524.807	320.005	8.0	201	776	Yes
6 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5955	281.838	100	281.838	3.715	1047.128	638.49	8.0	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.



2.4 Combined Antenna Port RF Exposure Results using “1.1307(b)(3)(i)(B) SAR / MPE Exemption”

2.4.1 Combination 1 - Bluetooth (2x2 MIMO on Core 0 & 1) + 6 GHz WLAN (2x2 MIMO on Core 0 & 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
Bluetooth (2x2 (MIMO) Core 0 and Core 1)	2402	125.893	100	125.893	1.820	229.087	139.687	201	0.0456
6 GHz WLAN (2x2 MIMO) Core 0 and Core 1	5955	281.838	100	281.838	3.715	1047.128	638.49	201	0.8231
Calculated RF exposure level at minimum compliance boundary of 0.201 m as a fraction of the limit									0.8687

Table 6 – Transmitter Result

2.4.2 Combination 2 – 2.4 GHz WLAN (Core 0) + NB (Core 1) (UNII-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	177.828	100	177.828	1.738	309.030	188.433	201	0.0616
NB Core 1	5162	25.119	100	25.119	3.890	97.724	59.588	201	0.0195
Calculated RF exposure level at minimum compliance boundary of 0.201 m as a fraction of the limit									0.0811

Table 7 – Transmitter Result