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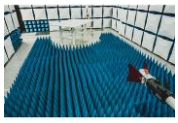

RF EXPOSURE EVALUATION
Maximal Permissible Exposure [MPE]

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
07/24/2020 – 09/11/2020
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C2008270049-11 .BCG

FCC ID:	**BCG-A2374**
IC:	**579C-A2374**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
EUT Type:	Smart Speaker
FCC Rule Part:	FCC Part 1 (§1.1310) and Part 2 (§2.1091)
ISED Specification:	RSS-102 Issue 5
Test Procedure(s):	KDB 447498 D01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in FCC KDB 447498 D01. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

ACCREDITED
CERT #2041.02

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1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Introduction

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations and RSS-102 of Industry Canada.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310 is listed in Table 1-1, and specified in RSS-102 is listed in Table 1-2. According to FCC §1.1310 and RSS-102: the criteria listed in the following tables shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	…	…	f/300	6
1500-100,000	…	…	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	…	…	f/1500	30
1500-100,000	…	…	1.0	30

Table 1-1. FCC Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (W/m^2)	Reference Period (Minutes)
(A) RF Field Strength Limits For Controlled Use Devices (Controlled Environment) (f = frequency)				
20-48	$129.8/ f^{0.25}$	$0.3444/ f^{0.25}$	$44.72/ f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
600-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/ f^{1.2}$
150000-300000	$0.354 f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	$616000/ f^{1.2}$
(B) RF Field Strength Limits For Devices Used by the General Public (Uncontrolled Environment) (f = frequency)				
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	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/ f^{1.2}$

Table 1-2. ISED Limits for Maximum Permissible Exposure (MPE)

1.2 EUT Description

The Equipment Under Test (EUT) is the **Apple Smart Speaker FCC ID: BCG-A2374 and IC: 579C-A2374** with touch display, microphone and captive USB-C power cable. It incorporates Thread, WiFi, Bluetooth and ultra-wideband radios.

1.3 MPE Requirements Overview

Three different categories of transmitters are defined by the FCC KDB 447498 D01. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.

- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.

- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.

- **General Population/Uncontrolled Exposure:** The general population / uncontrolled exposure limits are applicable to 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 made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The **Apple Smart Speaker FCC ID: BCG-A2374 and IC: 579C-A2374** is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by each transmitter used in this product was initially measured by a power meter and the powers were recorded. Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at a distance of 20cm.

Friis Transmission Formula

Friis transmission formula: $P_d = (P_{out}*G) / (4\pi r^2)$

Where,

P_d = Power Density (mW/cm^2) $\pi = 3.1416$
P_{out} = output power to antenna (mW) r = distance between observation point and center of the radiator (cm)
G = gain of antenna in linear scale

Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

	FCC		ISED	
Frequency	2432	MHz	2432	MHz
Limit	1.000	mW/cm^2	5.396	W/m^2
Distance (cm), R =	20	cm	0.2	m
Power (dBm), P =	25.10	dBm	25.10	dBm
Power (mW), P =	323.59	mW	0.324	W
TX Ant Gain (dBi), G =	2.7	dBi	2.7	dBi
Power Density (S) @ 20cm =	**0.120**	mW/cm^2	**1.199**	W/m^2
Minimum Distance =	**6.9**	cm	**0.094**	m

Table 1-3. Calculated MPE for WLAN

	FCC		ISED	
Frequency	2402	MHz	2402	MHz
Limit	1.000	mW/cm^2	5.351	W/m^2
Distance (cm), R =	20	cm	0.2	m
Power (dBm), P =	17.77	dBm	17.77	dBm
Power (mW), P =	59.84	mW	0.060	W
TX Ant Gain (dBi), G =	2.7	dBi	2.7	dBi
Power Density (S) @ 20cm =	**0.022**	mW/cm^2	**0.222**	W/m^2
Minimum Distance =	**3.0**	cm	**0.041**	m

Table 1-4. Calculated MPE for Bluetooth

	FCC		ISED	
Frequency	2404	MHz	2404	MHz
Limit	1.000	mW/cm^2	5.354	W/m^2
Distance (cm), R =	20	cm	0.2	m
Power (dBm), P =	17.27	dBm	17.27	dBm
Power (mW), P =	53.33	mW	0.053	W
TX Ant Gain (dBi), G =	2.7	dBi	2.7	dBi
Power Density (S) @ 20cm =	**0.020**	mW/cm^2	**0.198**	W/m^2
Minimum Distance =	**2.8**	cm	**0.038**	m

Table 1-5. Calculated MPE for Bluetooth HDR

	FCC		ISED	
Frequency	2402	MHz	2402	MHz
Limit	1.000	mW/cm^2	5.351	W/m^2
Distance (cm), R =	20	cm	0.2	m
Power (dBm), P =	7.48	dBm	7.48	dBm
Power (mW), P =	5.60	mW	0.006	W
TX Ant Gain (dBi), G =	2.7	dBi	2.7	dBi
Power Density (S) @ 20cm =	**0.002**	mW/cm^2	**0.021**	W/m^2
Minimum Distance =	**0.9**	cm	**0.012**	m

Table 1-6. Calculated MPE for Bluetooth LE

	FCC		ISED	
Frequency	5300	MHz	5300	MHz
Limit	1.000	mW/cm^2	9.190	W/m^2
Distance (cm), R =	20	cm	0.2	m
Power (dBm), P =	16.5	dBm	16.50	dBm
Power (mW), P =	44.67	mW	0.045	W
TX Ant Gain (dBi), G =	3.9	dBi	3.9	dBi
Power Density (S) @ 20cm =	**0.022**	mW/cm^2	**0.218**	W/m^2
Minimum Distance =	**3.0**	cm	**0.031**	m

Table 1-7. Calculated MPE for UNII

	FCC		ISED	
Frequency	2405	MHz	2405	MHz
Limit	1.000	mW/cm^2	5.355	W/m^2
Distance (cm), R =	20	cm	0.2	m
Power (dBm), P =	16.85	dBm	16.85	dBm
Power (mW), P =	48.42	mW	0.048	W
TX Ant Gain (dBi), G =	2.3	dBi	2.3	dBi
Power Density (S) @ 20cm =	**0.016**	mW/cm^2	**0.164**	W/m^2
Minimum Distance =	**2.6**	cm	**0.035**	m

Table 1-8. Calculated MPE for Thread

	FCC		ISED	
	UNII	BT	UNII	BT
Frequency	5300 MHz	2402 MHz	5300 MHz	2402 MHz
Limit	1.000 mW/cm^2	1.000 mW/cm^2	9.190 W/m^2	5.351 W/m^2
Distance (cm), R =	20 cm	20 cm	0.2 m	0.2 m
Power (dBm), P =	16.50 dBm	17.77 dBm	16.50 dBm	17.77 dBm
Power (mW), P =	44.67 mW	59.84 mW	0.045 W	0.060 W
TX Ant Gain (dBi), G =	3.9 dBi	2.7 dBi	3.9 dBi	2.7 dBi
Power Density (S) @ 20cm =	0.022 mW/cm^2	0.022 mW/cm^2	0.218 W/m^2	0.222 W/m^2
Power Density (S) / Limit =	0.022	0.022	0.024	0.041
Total =	**0.044**	<1	**0.065**	<1

Table 1-9. Calculated MPE for Simultaneous Transmission on Same Antenna

1.5 Summary of Results

	Power Density (mW/cm^2)	Limit (mW/cm^2)	Percent MPE Used (%)
Transmitter #1 WLAN	0.120	1.000	12.00
Transmitter #2 Bluetooth	0.022	1.000	2.20
Transmitter #3 Bluetooth HDR	0.020	1.000	2.00
Transmitter #4 Bluetooth LE	0.002	1.000	0.20
Transmitter #5 UNII	0.022	1.000	2.20
Transmitter #6 Thread	0.016	1.000	1.60
Total			20.20

Table 1-10. FCC Cumulative Results for Multiple Transmitters

	Power Density (W/m^2)	Limit (W/m^2)	Percent MPE Used (%)
Transmitter #1 WLAN	1.199	5.396	22.22
Transmitter #2 Bluetooth	0.222	5.351	4.15
Transmitter #3 Bluetooth HDR	0.198	5.354	3.70
Transmitter #4 Bluetooth LE	0.021	5.351	0.39
Transmitter #5 UNII	0.218	9.190	2.37
Transmitter #6 Thread	0.164	5.355	3.06
Total			35.89

Table 1-11. ISED Cumulative Results for Multiple Transmitters

2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations and Health Canada Safety Code 6. An appropriate RF exposure compliance statement will be placed in the user's manual.