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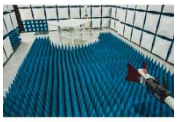

RF EXPOSURE EVALUATION
Maximal Permissible Exposure [MPE]

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

Date of Testing:
6/7/2022 – 8/14/2022
Test Site/Location:
Element Washington DC LLC, Morgan Hill, CA, USA
Test Report Serial No.:
1C2205090038-15.BCG

FCC ID:	**BCG-A2772**
IC:	**579C-A2772**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2772
EUT Type:	Watch
FCC Rule Part:	FCC Part 1 (§1.1310) and Part 2 (§2.1091)
ISED Specification:	RSS-102 Issue 5

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.

RJ Ortanez
Executive Vice 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 Watch FCC ID: BCG-A2772 and IC: 579C-A2772**. The device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-Band LTE, 802.11b/g/n WLAN, 802.11a/n UNII, Bluetooth (1x, EDR, HDR4, HDR8, LE1M, LE2M), NFC, UWB, 60.5GHz Transmitter

EUT consists of a Apple Watch handheld device containing a 60.5GHz unlicensed/license-exempt data communications transmitter module. A proprietary Wireless Serial Dock with a corresponding 60.5GHz module is needed to activate transmission on the Apple Watch. A magnetic alignment fixture locks the Apple Watch in place on top of the Wireless Serial Dock, thus allowing communication between the Dock and Apple Watch. The Wireless Serial Dock is powered by a USB-C port.

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 Watch FCC ID: BCG-A2772 and IC: 579C-A2772** is evaluated to the General Population/Uncontrolled Exposure requirements.

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 the 60.5GHz transmitter used in this product was initially calculated using radiated measurement techniques as outlined in the RF Part 15.255 report (1C2205090038-14.BCG). 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.

All different frequencies per technology have been investigated and only the worst power density ratios have been reported.

Friis Transmission Formula

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

Where,

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

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	2462	MHz	2462	MHz
Limit	1.000	mW/cm^2	5.442	W/m^2
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	23.37	dBm	23.37	dBm
Power (mW), P =	217.270	mW	0.217	W
Tx Ant Gain (dBi), G =	-7.4	dBi	-7.4	dBi
Power Density (S) at 20cm =	0.00787	mW/cm^2	0.07866	W/m^2
Minimum Distance =	1.77376	cm	0.02404	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
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	16.09	dBm	16.09	dBm
Power (mW), P =	40.644	mW	0.041	W
Tx Ant Gain (dBi), G =	-7.4	dBi	-7.4	dBi
Power Density (S) at 20cm =	0.00147	mW/cm^2	0.01471	W/m^2
Minimum Distance =	0.76718	cm	0.01049	m

Table 1-4. Calculated MPE for Bluetooth

	FCC		ISED	
Frequency	2441	MHz	2441	MHz
Limit	1.000	mW/cm^2	5.410	W/m^2
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	15.72	dBm	15.72	dBm
Power (mW), P =	37.325	mW	0.037	W
Tx Ant Gain (dBi), G =	-7.4	dBi	-7.4	dBi
Power Density (S) at 20cm =	0.00135	mW/cm^2	0.01351	W/m^2
Minimum Distance =	0.73518	cm	0.01000	m

Table 1-5. Calculated MPE for Bluetooth HDR

	FCC		ISED	
Frequency	2480	MHz	2480	MHz
Limit	1.000	mW/cm^2	5.469	W/m^2
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	13.21	dBm	13.21	dBm
Power (mW), P =	20.941	mW	0.021	W
Tx Ant Gain (dBi), G =	-7.4	dBi	-7.4	dBi
Power Density (S) at 20cm =	0.00076	mW/cm^2	0.00758	W/m^2
Minimum Distance =	0.55067	cm	0.00745	m

Table 1-6. Calculated MPE for Bluetooth LE

	FCC		ISED	
Frequency	5785	MHz	5785	MHz
Limit	1.000	mW/cm^2	9.756	W/m^2
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	17.00	dBm	17.00	dBm
Power (mW), P =	50.119	mW	0.050	W
Tx Ant Gain (dBi), G =	-4.7	dBi	-4.7	dBi
Power Density (S) at 20cm =	0.00338	mW/cm^2	0.03379	W/m^2
Minimum Distance =	1.16250	cm	0.01177	m

Table 1-7. Calculated MPE for UNII

	FCC		ISED	
Frequency	7987.2	MHz	7987.2	MHz
Limit	1.000	mW/cm^2	10.000	W/m^2
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	-2.56	dBm	-2.56	dBm
Power (mW), P =	0.555	mW	0.001	W
Tx Ant Gain (dBi), G =	-6.2	dBi	-6.2	dBi
Power Density (S) at 20cm =	0.00003	mW/cm^2	0.00026	W/m^2
Minimum Distance =	0.10290	cm	0.00103	m

Table 1-8. Calculated MPE for UWB

	FCC		ISED	
Frequency	60500	MHz	60500	MHz
Limit	1.000	mW/cm^2	10.000	W/m^2
Limit Distance (cm), R =	20.00	cm	0.20	m
Power (dBm), P =	6.18	dBm	6.18	dBm
Power (mW), P =	4.150	mW	0.004	W
Tx Ant Gain (dBi), G =	4.0	dBi	4.0	dBi
Power Density (S) at 20cm =	0.00207	mW/cm^2	0.02074	W/m^2
Minimum Distance =	0.91074	cm	0.00911	m

Table 1-9. Calculated MPE for 60.5GHz

	FCC		ISED	
Frequency	836.500	MHz	836.500	MHz
Limit	0.558	mW/cm^2	2.602	W/m^2
Limit Distance (cm), R =	20.000	cm	0.200	m
Power (dBm), P =	25.50	dBm	25.50	dBm
Power (mW), P =	354.813	mW	0.355	W
Tx Ant Gain (dBi), G =	-29.2	dBi	-29.2	dBi
Power Density (S) at 20cm =	0.00008	mW/cm^2	0.00085	W/m^2
Minimum Distance =	0.247	cm	0.004	m

Table 1-10. Calculated MPE for LTE (Low Band – B26)

	FCC		ISED	
Frequency	1860.0	MHz	1860.0	MHz
Limit	1.000	mW/cm^2	4.493	W/m^2
Limit Distance (cm), R =	20.000	cm	0.200	m
Power (dBm), P =	24.38	dBm	24.38	dBm
Power (mW), P =	274.157	mW	0.274	W
Tx Ant Gain (dBi), G =	-10.8	dBi	-10.8	dBi
Power Density (S) at 20cm =	0.00454	mW/cm^2	0.04537	W/m^2
Minimum Distance =	1.34708	cm	0.02010	m

Table 1-11. Calculated MPE for LTE (Mid Band – B2)

	FCC		ISED	
Frequency	2498.5	MHz	2498.5	MHz
Limit	1.000	mW/cm^2	5.497	W/m^2
Limit Distance (cm), R =	20.000	cm	0.200	m
Power (dBm), P =	24.00	dBm	24.00	dBm
Power (mW), P =	251.189	mW	0.251	W
Tx Ant Gain (dBi), G =	-7.0	dBi	-7.0	dBi
Power Density (S) at 20cm =	0.00997	mW/cm^2	0.09971	W/m^2
Minimum Distance =	1.99708	cm	0.02694	m

Table 1-12. Calculated MPE for LTE (High Band – B41)

1.5 Summary of Results

	Power Density (mW/cm^2)	Limit (mW/cm^2)	Percent MPE Used (%)
Transmitter #1 WLAN	0.00787	1.00000	0.78656
Transmitter #2 Bluetooth	0.00147	1.00000	0.14714
Transmitter #3 Bluetooth HDR	0.00135	1.00000	0.13512
Transmitter #4 Bluetooth LE	0.00076	1.00000	0.07581
Transmitter #5 UNII	0.00338	1.00000	0.33785
Transmitter #6 UWB	0.00003	1.00000	0.00265
Transmitter #7 60.5GHz	0.00207	1.00000	0.20736
Transmitter #8 LTE - Low Band	0.00008	0.56	0.01522
Transmitter #9 LTE - Mid Band	0.00454	1.00	0.45366
Transmitter #10 LTE - High Band	0.00997	1.00	0.99708
Total			3.15845

Table 1-13. FCC Cumulative Results for Multiple Transmitters

	Power Density (W/m^2)	Limit (W/m^2)	Percent MPE Used (%)
Transmitter #1 WLAN	0.07866	5.44179	1.44540
Transmitter #2 Bluetooth	0.01471	5.35080	0.27499
Transmitter #3 Bluetooth HDR	0.01351	5.41003	0.24976
Transmitter #4 Bluetooth LE	0.00758	5.46895	0.13862
Transmitter #5 UNII	0.03379	9.75649	0.34629
Transmitter #6 UWB	0.00026	10.00000	0.00265
Transmitter #7 60.5GHz	0.02074	10.00000	0.20736
Transmitter #8 LTE - Low Band	0.00085	2.60225	0.03261
Transmitter #9 LTE - Mid Band	0.04537	4.49284	1.00974
Transmitter #10 LTE - High Band	0.09971	5.49680	1.81393
Total			5.52134

Table 1-14. ISED Cumulative Results for Multiple Transmitters

2.0 CONCLUSION

The device's 60.5GHz transmitter 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.