KDB 680106 D01 RF Exposure Wireless Charging Apps v03

RF EXPOSURE EVALUATION REPORT

For

PROTECHT CHARGING CASE for Mouthguard
Model: Rev3

FCC ID: 2AT9A-CC0002NA

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REVISION HISTORY

Ver.	Issue Date	Revisions	Revised By
1.0	03 April 2020	Initial Issue	--
2.0	21 October 2021	Updated in accordance with TCB Reviewer feedback.	Naseer Mirza

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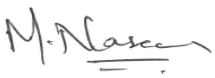
1. Attestation of Test Results

Applicant Name:	Sports & Wellbeing Analytics Limited		
Model:	REV3		
Test Device is	A representative test sample		
Device category	Mouthguard charging case		
Date Tested	12 December 2019 to 20 December 2019		
Highest Reported Field Strength Values	**Separation Distance**	**Magnetic Field**	**Electric Field**
	5 cm	1.57 A/m	1.84 V/m
	10 cm	0.42 A/m	0.44 V/m
	15 cm	0.06 A/m	0.19 V/m
Applicable Standards	Title 47 CFR (Part 1.1310) KDB publication		
Test Results	Pass		

UL International (UK) Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL International (UK) Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties are in accordance with the above standard and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample(s), under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL International (UK) Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL International (UK) Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by UKAS. This report is written to support regulatory compliance of the applicable standards stated above.

Issued By:	Prepared By:
	
Naseer Mirza Operations Leader UL	Masood Khan Test Engineer UL

2. Test Specification, Methods and Procedures

2.1. Test Specification

Reference Standard:	KDB 680106 D01 RF Exposure Wireless Charging App v03
Title:	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz)
Purpose of Test:	This International Standard applies to electronic and electrical equipment for Wireless Power transfer where inductive coupling techniques are commonly used. This method requires one or more primary inductive coils with operating frequency and power level determined by the specific application requirements. The object of this generic standard is to provide assessment methods and criteria to evaluate such equipment against basic restrictions or reference levels on exposure of the general public related to electric, magnetic and electromagnetic fields and induced and contact current.

2.1. FCC Applicable Limits

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

2.2. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods and procedures in the section above. 'Section 4.1' contains the list of the test equipment used.

3. Facilities and Accreditation

The measurement facilities used to collect data are located at:

Unit 1-3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, UK

Test Sites	Facility Type
SAR Lab 63	Controlled Environment Chamber

4. Test Description

The following conditions were met prior to perform the measurements:

- Test environment was an open area free of metal objects that could influence the measurements and was also free of ambient signals and background noise.
- Measurement instrumentation was placed on a non-conductive support.
- Measurements were taken distancing the body of the operator from the DUT and the measuring probe in order to mitigate any effects the body of the operator could cause to the field and the instrumentation.
- A 3-dimension coordinate system was established to position the probe in order to keep traceability of the measured field strengths.

4.1. Measurement Procedure

According to KDB 680106 v03 for any device designed for typical desktop applications, RF exposure evaluation should be conducted assuming a user separation distance of 15 cm.

The following procedure was followed to measure the incident electric and magnetic field strengths for each of the configurations under test:

a) Independent field evaluation was performed for each of the defined edges under test.

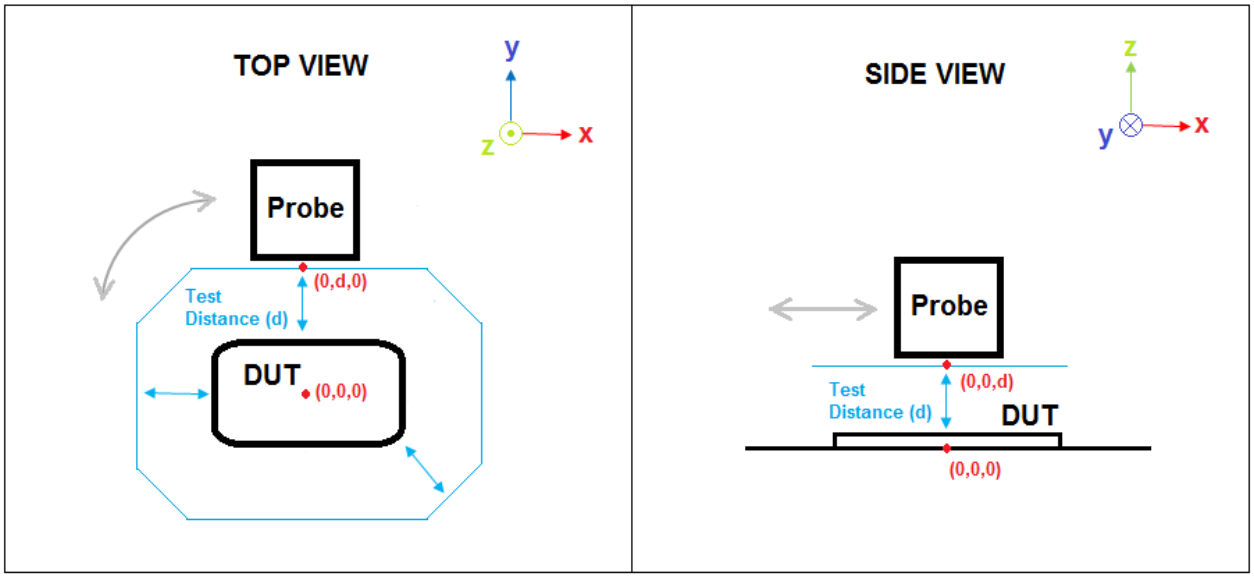
b) Closest separation distance was used as distance from the edge of the device to the edge of the sensor of the probe. In case separation distance was not provided, a logical distance based on normal usage condition was defined.

c) For each edge under test:

   a. A preliminary scan was performed to determine the position(s) of maximum electric and magnetic field at the closest separation distance.

   b. Electric and magnetic field strengths were recorded at the maximum field position. Measurements were taken as RMS average over a 6-minute period. Coordinates of the maximum field position were also recorded.

The following diagram describes the test setup:



4.2. Test Equipment

Measuring equipment used to perform the tests is documented in this report and has been calibrated in accordance with UKAS' recommendations and is traceable to recognized national standards.

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
PRE0195826	EMF Probe Analyzer	NARDA	EHP-200	170WX90304	15 Nov 2019	12

5. Equipment Under Test (EUT)

5.1. Identification of Equipment Under Test (EUT)

Sample 1 Serial Number:	None Stated (charging case), 2490106 (mouthguard), FCC1, FCC2 (circuit boards)
Hardware Version Number:	4.1M
Software Version Number:	20f2dc7
Baseband Firmware Version:	805
Country of Manufacture:	UK
Date of Receipt:	05 December 2020
Device Description:	The equipment under test (EUT) was a 'charging case'. The EUT is used to wirelessly charge the instrumented mouthguards singly or in groups of up to 24.
Device Dimension	EUT (charging case): 210 x 530 x 450 mm

5.2. Wireless Technologies

Wireless Technologies	Operating Frequency	Operating Mode	Duty Cycle
WPT	140 kHz	Device continuously charging	Automatically adjusted

5.3. Antenna Information

	Antenna Type	Antenna Description
Antenna Information	Inductive Coil Antenna	Antenna consisting of 24 coils organized in 3 rows

6. Measurements and Derived Results

The EUT consists of 24 inductive charging points divided in 3 rows. It was tested together with auxiliary equipment receivers (load devices) on charging state mode. It was on continuous charging mode only with no battery display option.

The configurations under test were all sides (Edge 1, Edge 2, Edge 3 and Edge 4) and Top of the EUT.

The following operation modes were established in order to achieve the maximum exposure.

1. All 3 Row Charging at 5 cm
2. Only Top Row Charging at 5 cm
3. Only Middle Row Charging at 5 cm
4. Only Bottom Row Charging at 5 cm
5. Top + Middle Row Charging at 5 cm
6. Top + Bottom Row Charging at 5 cm
7. Middle + Bottom Row Charging at 5 cm
8. Standby (No Mouth Guards charging) at 5 cm
9. All 3 Row Charging at 10 cm
10. All 3 Row Charging at 15 cm

Operating Modes Considered:

Operating Modes	Separation Distance (cm)	Load Setup		
		Top Row	Middle Row	Bottom Row
1	5	✓	✓	✓
2	5	✓		
3	5		✓	
4	5			✓
5	5	✓	✓	
6	5	✓		✓
7	5		✓	✓
8	5			
9	10	✓	✓	✓
10	15	✓	✓	✓

✓ = Active Row

Customer declared 15 cm as minimum separation distance. Measurements at the declared distance were found negligible. Further due diligence testing with final assessment was done at 5 cm. Worst case was re-evaluated at 10 and 15 cm.

6.1. Test Results for H-Field Measurements

The table below shows the field strength limits to demonstrate compliance for the operating frequency of the device.

Type of Exposure	Frequency	Magnetic Field Strength (A/m)
Occupational Exposure	140 kHz	1.63
General Public Exposure		1.63

H – Field Measurement at 5 cm – Operating Modes for Worst Case

Cases	Operating Mode	Separation Distance (cm)	Measurement Time	H-Field Measurement (A/m)	Plot No.
				Top	
1	All 3 Rows Charging	5	6 mins	1.57[1]	001
2	Top Row Charging	5	6 mins	0.81	-
3	Middle Row Charging	5	6 mins	0.88	-
4	Bottom Row Charging	5	6 mins	1.15	-
5	Top + Middle Row Charging	5	6 mins	1.44	-
6	Top + Bottom Row Charging	5	6 mins	1.45	-
7	Middle + Bottom Row Charging	5	6 mins	1.49	-
8	Standby (No MouthGuards charging)	5	6 mins	0.03	-

Note[1]: Worst-case operating mode

H – Field Measurement at 5 cm

Cases	Configuration	Separation Distance (cm)	Measurement Time	H-Field Measurement (A/m)	Plot No.
				All 3 Rows Charging	
1	Top	5	6 mins	1.57[1]	001
1	Edge 1	5	6 mins	0.12	-
2	Edge 2	5	6 mins	0.12	-
3	Edge 3	5	6 mins	0.03	-
4	Edge 4	5	6 mins	0.03	-

Note[1]: Worst-case configuration

H – Field Measurement at 10 cm

Cases	Configuration	Separation Distance (cm)	Measurement Time	H-Field Measurement (A/m)	Plot No.
				All 3 Rows Charging	
1	Top[1]	10	6 mins	0.42	002

Note[1]: The worst-case configuration was evaluated

H – Field Measurement at 15 cm

Cases	Configuration	Separation Distance (cm)	Measurement Time	H-Field Measurement (A/m)	Plot No.
				All 3 Rows Charging	
1	Top[1]	15	6 mins	0.06	003

Note[1]: The worst-case configuration was evaluated

6.2. Test Results for E-Field Measurements

The table below shows the field strength limits to demonstrate compliance for the operating frequency of the device.

Type of Exposure	Frequency	Electric Field Strength (V/m)
Occupational Exposure	140 kHz	614
General Public Exposure		614

E – Field Measurement at 5 cm - Operating Modes for Worst Case

Cases	Operating Mode	Separation Distance (cm)	Measurement Time	E-Field Measurement (V/m)	Plot No.
				Top	
1	All 3 Rows Charging	5	6 mins	1.84[1]	004
2	Top Row Charging	5	6 mins	1.64	-
3	Middle Row Charging	5	6 mins	1.67	-
4	Bottom Row Charging	5	6 mins	1.61	-
5	Top + Middle Row Charging	5	6 mins	1.60	-
6	Top + Bottom Row Charging	5	6 mins	1.65	-
7	Middle + Bottom Row Charging	5	6 mins	1.45	-
8	Standby (No MouthGuards charging)	5	6 mins	0.19	-

Note[1]: Worst-case operating mode

E – Field Measurement at 5 cm

Cases	Configuration	Separation Distance (cm)	Measurement Time	E-Field Measurement (V/m)	Plot No.
				All 3 Rows Charging	
1	Top	5	6 mins	1.84[1]	004
2	Edge 1	5	6 mins	0.23	-
3	Edge 2	5	6 mins	0.27	-
4	Edge 3	5	6 mins	0.19	-
5	Edge 4	5	6 mins	0.18	-

Note[1]: Worst-case configuration

E – Field Measurement at 10 cm

Cases	Configuration	Separation Distance (cm)	Measurement Time	E-Field Measurement (V/m)	Plot No.
				All 3 Rows Charging	
1	Top[1]	10	6 mins	0.44	005

Note[1]: The worst-case configuration was evaluated

E – Field Measurement at 15 cm

Cases	Configuration	Separation Distance (cm)	Measurement Time	E-Field Measurement (V/m)	Plot No.
				All 3 Rows Charging	
1	Top[1]	15	6 mins	0.19	006

Note[1]: The worst-case configuration was evaluated