RF Exposure Evaluation Report

1. Product Information

EUT	:	axiom
Test Model	:	CS01
Additional Model No.	:	CS02, CS03, CS04, CS05
Model Declaration	:	PCB board, structure and internal of these model(s) are the same, So no additional models were tested.
Hardware Version	:	V01
Software Version	:	004A7C5A
Operating Frequency	:	110.0~205.0KHz
Modulation Type	:	Continuous Wave
Antenna Type	:	Coil Antenna
Ratings	:	Input: 5V ⎓ 2A, 9V ⎓ 2A, 12V ⎓ 1.5A Output: 5W, 7.5W, 10W, 15W Max

2. Evaluation Method

Per KDB 680106 D01 Section 3. RF Exposure Requirements;

1) Consumer wireless power transfer devices approved under Part 18 in some cases have to demonstrate compliance with RF exposure requirements. The potential for exposure must be assessed according to the operating configurations of the wireless system and the exposure conditions of users and bystanders. RF exposure must be evaluated with the client device(s) being charged by the primary at maximum output power. The RF exposure requirements must be determined in conjunction with the device operating characteristics, according to the mobile and portable exposure requirements in Section 2.1091 and Section 2.1093 of the rules. SAR and MPE limits do not cover the frequency range for wireless power transfer applications which operate below 100 kHz and 300 kHz respectively; therefore, RF exposure compliance needs to be determined with respect to 1.1307 (c) and (d) of the FCC rules.
2) Based on the design and implementation of the power transfer application, it must be clearly identified if mobile or portable RF exposure conditions apply. Devices that are installed to provide separation of at least 20 cm from users and bystanders may qualify for mobile exposure conditions. For some conditions where users and bystanders may be exposed at closer than 20 cm, section 2.1091(d) (4) of the rules may apply.
3) For devices designed for typical desktop applications, such a wireless charging pads, RF exposure evaluation should be conducted assuming a user separation distance of 15 cm. E and H field strength measurements or numerical modeling may be used to demonstrate compliance. Measurements should be made from all sides and the top of the primary/client pair, with the 15 cm measured from the center of the probe(s) to the edge of the device. Emissions between 100 kHz to 300 kHz should be assessed versus the limits at 300 kHz in Table 1 of Section 1.1310: 614 V/m and 1.63 A/m. A KDBinquiry is required to determine the applicable exposure limits below 100 kHz.
4) Portable exposure conditions from 100 kHz to 6 GHz are determined with respect to SAR requirements.

Existing SAR systems and test procedures are generally intended for measurements above 100 MHz. While numerical modeling can be an alternative, the constraints of substantial computational resources at low frequencies could introduce further limitations. Under these circumstances, including operations below 100 kHz, the Commission may consider a combination of analytical analysis, field strength, radiated and conducted power measurements, in conjunction with some limited numerical modeling to assess compliance.

5) Depending on the operating frequency, existing SAR and MPE measurement procedures may be adapted to evaluate wireless power transfer devices for compliance with respect to mobile or portable exposure conditions. If the grantee or its test lab have any questions regarding RF exposure evaluation they should contact the FCC Laboratory with sufficient system operating configuration details to determine if RF exposure evaluation is necessary and, if required, how to apply specific test procedures. Below 100 MHz, when SAR testing is required and the device is operating at close proximity to persons, information on device design, implementation, operating configurations, exposure conditions of users and bystanders are needed to determine the evaluation and testing requirements. In addition, the influence of nearby objects may also need consideration according to the wireless power transfer system implementation; for example, the effects of placing the device, its coils or radiating elements on or near metallic surfaces

6) According to April 2018 TCB Workshop, No need to report E-field measurements. Only H-field required.

3. Evaluation Limit

3.1 Refer Evaluation Method

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 680106 D01 RF Exposure Wireless Charging Apps v03: RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications

FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

FCC CFR 47 part 18.107:Indusial, Scientific, and Medical Equipment

3.2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f²	6
30-300	61.4	0.163	1.0	6
300-1,500	/	/	f/300	6
1,500-100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm²)	Averaging Time (minute)
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
30-300	27.5	0.073	0.2	30
300-1,500	/	/	f/1500	30
1,500-100,000	/	/	1.0	30

F=frequency in MHz

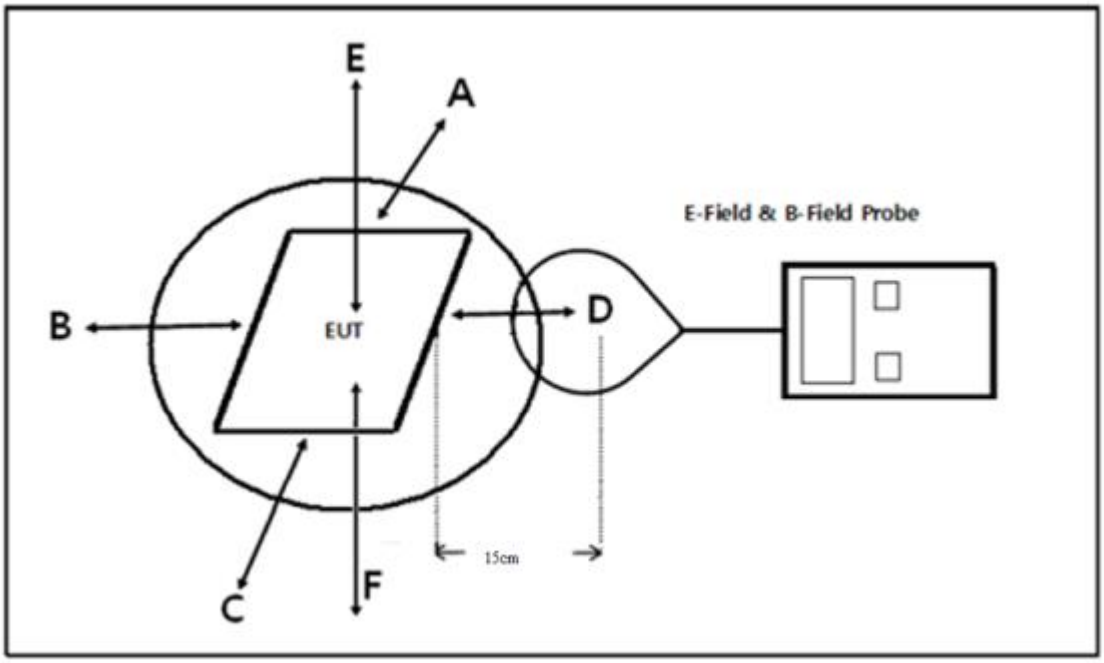
*=Plane-wave equivalent power density

According to FCC KDB 680106 D01 Section 3. RF Exposure Requirements clause 3 the Emission-Limits in the frequency range from 100 KHz to 300 KHz should be assessed versus the limits at 300 KHz in Table 1 of CFR 47 – Section1.310 as following (measured distance shall be 15cm from the center of the probe to the edge of the device):

	E-Field	*/*	B-Field
Frequency	V/m	A/m	uT
0.3 MHz – 3.0 MHz	614	1.613	2.0
3.0 MHz – 30 MHz	824/f (=27.5_{30MHz})	2.19/f (=0.073_{30MHz})	--

A KDB inquire was required to determine/confirm the applicable limits below 100 KHz.

4. Test Setup Diagram



For mobile RF exposure condition, due to installation limitations no tests from the underside of the charging device are required.

5. Test Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Exposure Level Tester	Narda	ELT-400	N-0713	2019-06-17	2020-06-16
2	B-Field Probe	Narda	ELT-400	M-1154	2019-06-17	2020-06-16
Note: All equipment is calibrated through CHINA CEPREI LABORATORY.						

6. Measurement Procedure

a) The RF exposure test was performed on 360 degree turn table in anechoic chamber.

b) The measurement probe was placed at test distance (15cm and 20cm) which is between the edge of the charger and the geometric center of probe.

c) The turn table was rotated 360d degree to search of highest strength.

d) The highest emission level was recorded and compared with limit as soon as measurement of each points (A, B, C, D, E) were completed.

e) The EUT were measured according to the dictates of KDB 680106D01v03.

7. Equipment Approval Considerations

The EUT does comply with item 5.2 of KDB 680106 D01v03 as follows table;

Requirements of KDB 680106 D01	Yes / No	Description
Power transfer frequency is less than 1 MHz	Yes	The device operate in the frequency range 110.0 KHz - 205 KHz
Output power from each primary coil is less than 15 watts	Yes	The maximum output power of the primary coil is 10W.
The transfer system includes only single primary and secondary coils. This includes charging systems that may have multiple primary coils and clients that are able to detect and allow coupling only between individual pairs of coils.	Yes	The transfer system includes onlysinglecoil.
Client device is placed directly in contact with the transmitter.	Yes	Client device is placed directly in contact with the transmitter.
Mobile exposure conditions only (portable exposure conditions are not covered by this exclusion).	Yes	Mobile exposure conditions only
The aggregate H-field strengths at 15 cm surrounding the device and 20 cm above the top surface from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit.	Yes	The EUT H-field strengths at 15 cm surrounding the device and 20 cm above the top surface from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit.

In all other cases, unless excluded above, an RF exposure evaluation report must be reviewed and accepted through a KDB or PBA inquiry to enable authorization of the equipment. When evaluation is required to show compliance; for example, using field strength, power density, SAR measurements or computational modeling etc., the specific authorization requirements will be determined based on the results of the RF exposure evaluation

8. E and H field Strength

Test Modes:		
Mode 1	AC/DC Adapter (9V/2A) + EUT+ Mobile Phone (Battery Status: <1%)	Record
Mode 2	AC/DC Adapter (9V/2A) + EUT+ Mobile Phone (Battery Status: <50%)	Pre-tested
Mode 3	AC/DC Adapter (9V/2A) + EUT+ Mobile Phone (Battery Status: 100%)	Pre-tested
Mode 4	AC/DC Adapter (5V/2A) + EUT+ Mobile Phone (Battery Status: <1%)	Pre-tested
Mode 5	AC/DC Adapter (5V/2A) + EUT+ Mobile Phone (Battery Status: <50%)	Pre-tested
Mode 6	AC/DC Adapter (5V/2A) + EUT+ Mobile Phone (Battery Status: 100%)	Pre-tested
Mode 7	PC Charger + EUT+ Mobile Phone (Battery Status: <1%)	Pre-tested
Mode 8	PC Charger + EUT+ Mobile Phone (Battery Status: <50%)	Pre-tested
Mode 9	PC Charger + EUT+ Mobile Phone (Battery Status: 100%)	Pre-tested
Note: All test modes were pre-tested, but we only recorded the worst case in this report.		

E-Field Strength at 15 cm from the edges surrounding the EUT and 15cm from the top surface of the EUT

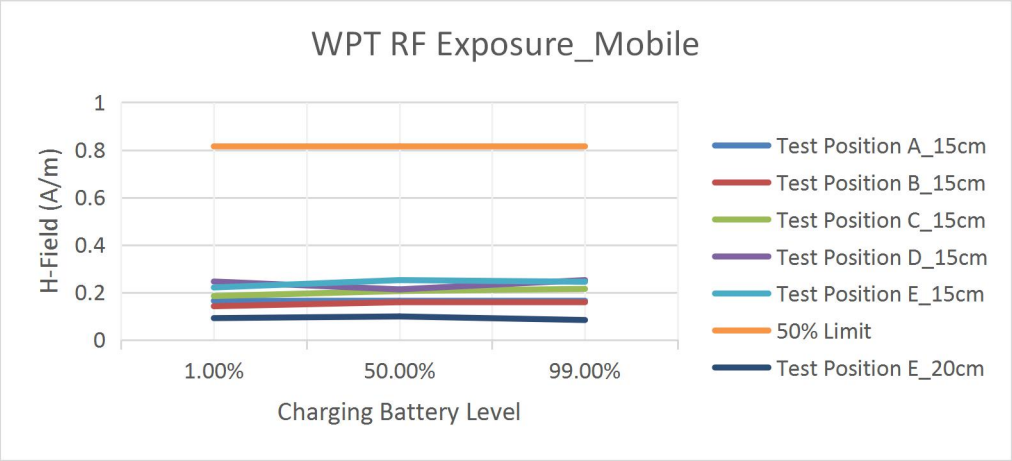
Charging Battery Level	Frequency Range (MHz)	Measured E-Field Strength Values (V/m)					FCC E-Field Strength 50% Limits (V/m)	FCC E-Field Strength Limits (V/m)
		Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
1%	0.1650	5.448	5.559	5.915	5.768	6.125	307.0	614.0
50%	0.1650	5.368	5.632	6.028	5.896	6.238	307.0	614.0
99%	0.1650	5.285	5.774	6.115	5.884	6.225	307.0	614.0

H-Field Strength at 15 cm from the edges surrounding the EUTand 15cm from the top surface of the EUT

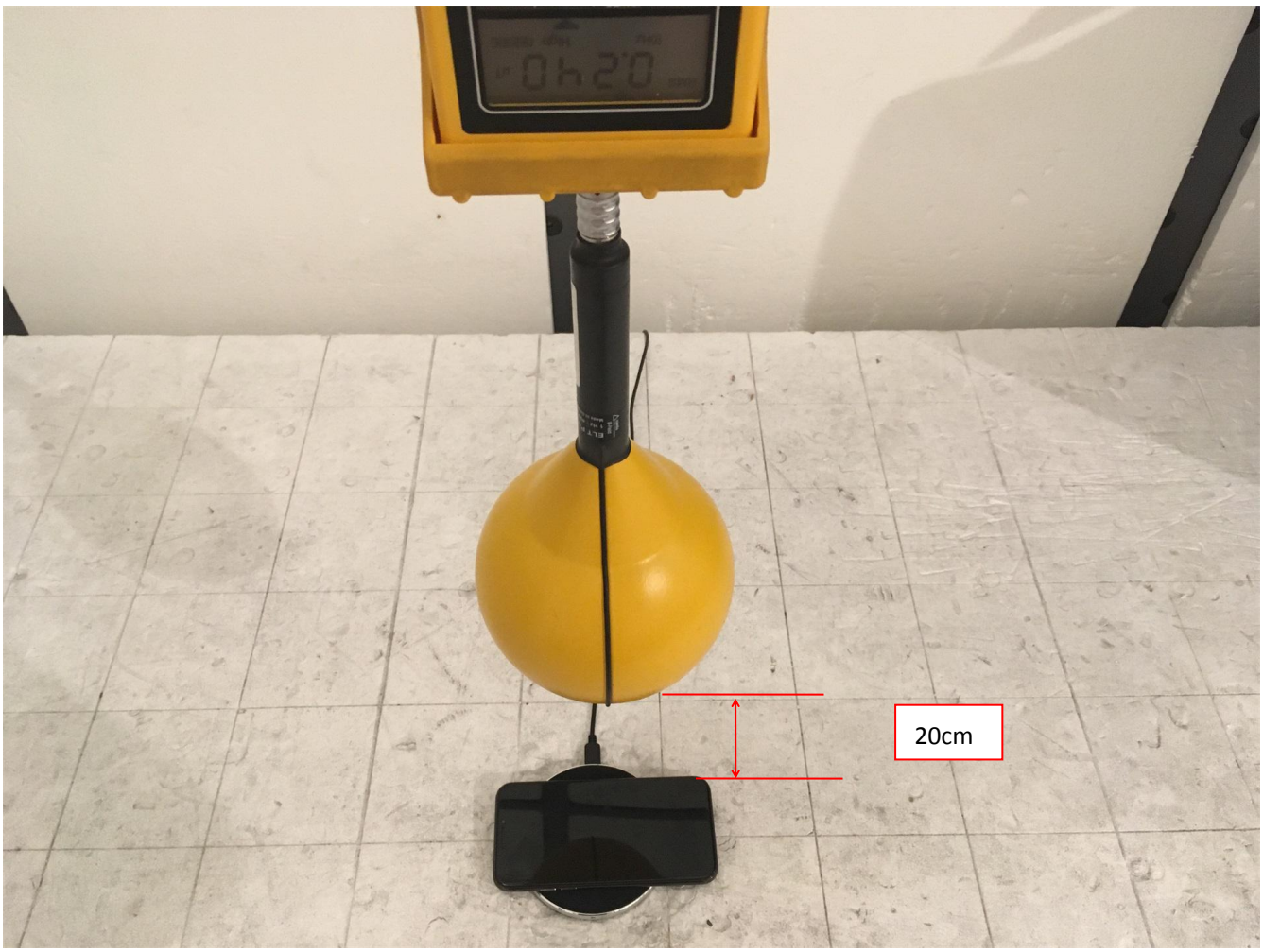
Charging Battery Level	Frequency Range (MHz)	Measured H-Field Strength Values (A/m)					FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
		Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
1%	0.1650	0.143	0.186	0.246	0.221	0.291	0.815	1.63
50%	0.1650	0.158	0.207	0.213	0.252	0.268	0.815	1.63
99%	0.1650	0.157	0.216	0.252	0.245	0.257	0.815	1.63

H-Field Strength at 20cm from the top surface of the EUT

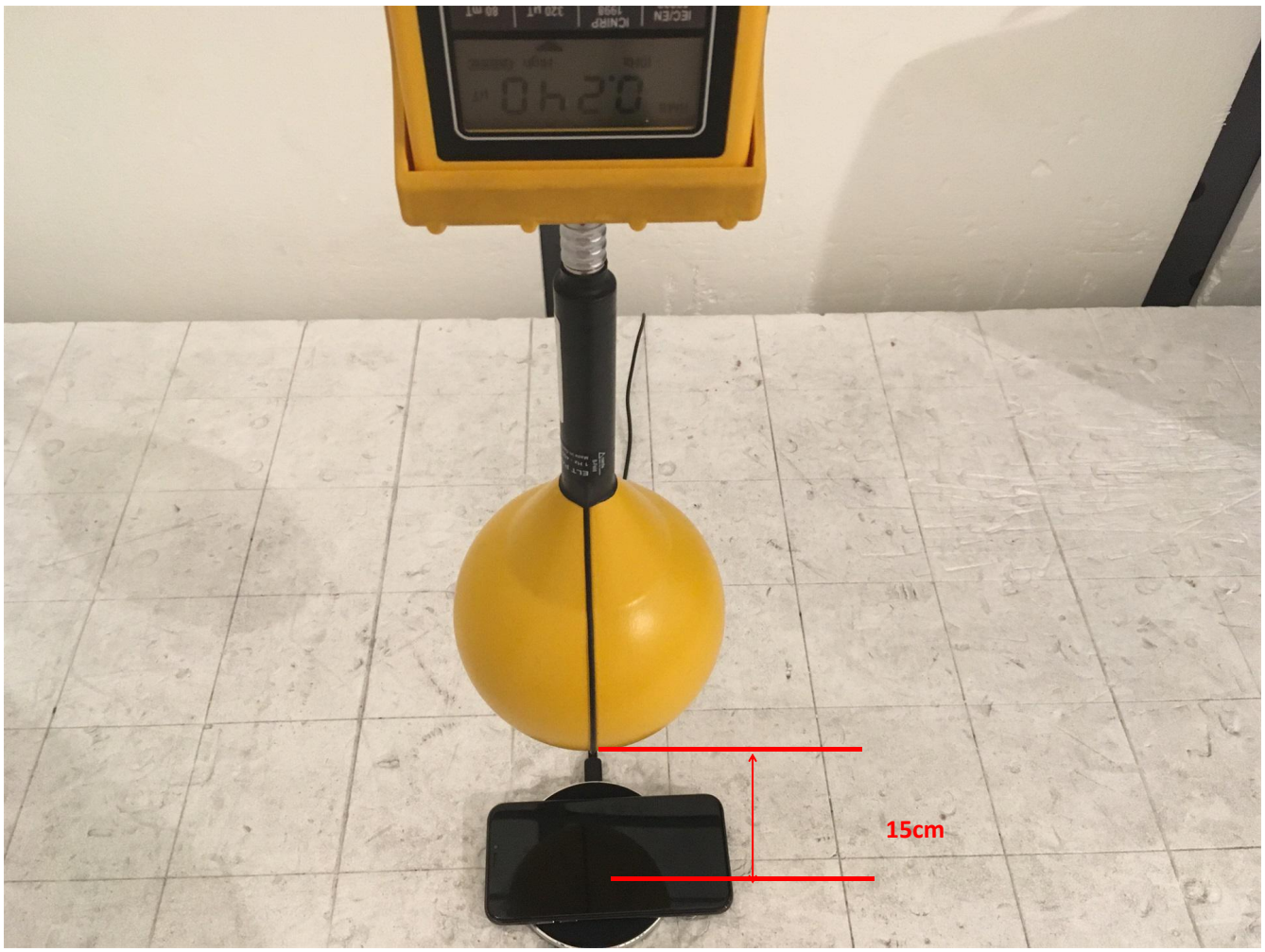
Charging Battery Level	Frequency Range (MHz)	Measured H-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
		TestPosition E		
1%	0.1650	0.162	0.815	1.63
50%	0.1650	0.168	0.815	1.63
99%	0.1650	0.157	0.815	1.63


WPT RF Exposure_Mobile
H-Field (A/m)
1
0.8
0.6
0.4
0.2
0
1.00%
50.00%
99.00%
Charging Battery Level
Test Position A_15cm
Test Position B_15cm
Test Position C_15cm
Test Position D_15cm
Test Position E_15cm
50% Limit
Test Position E_20cm

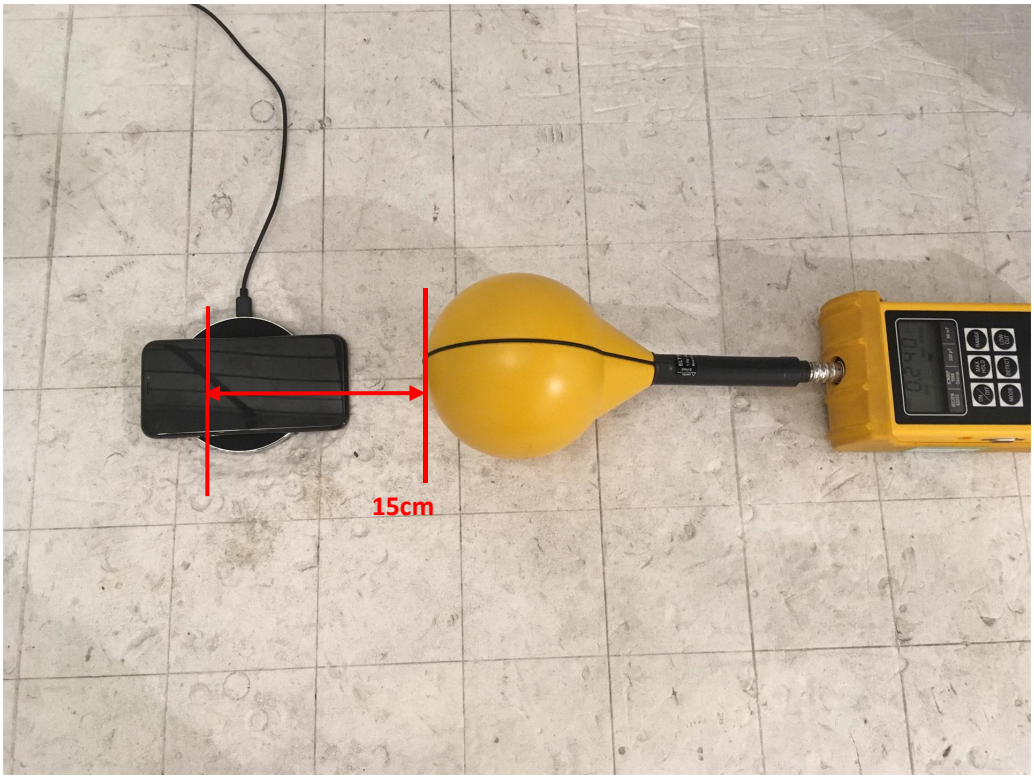
9. Test Setup Photos



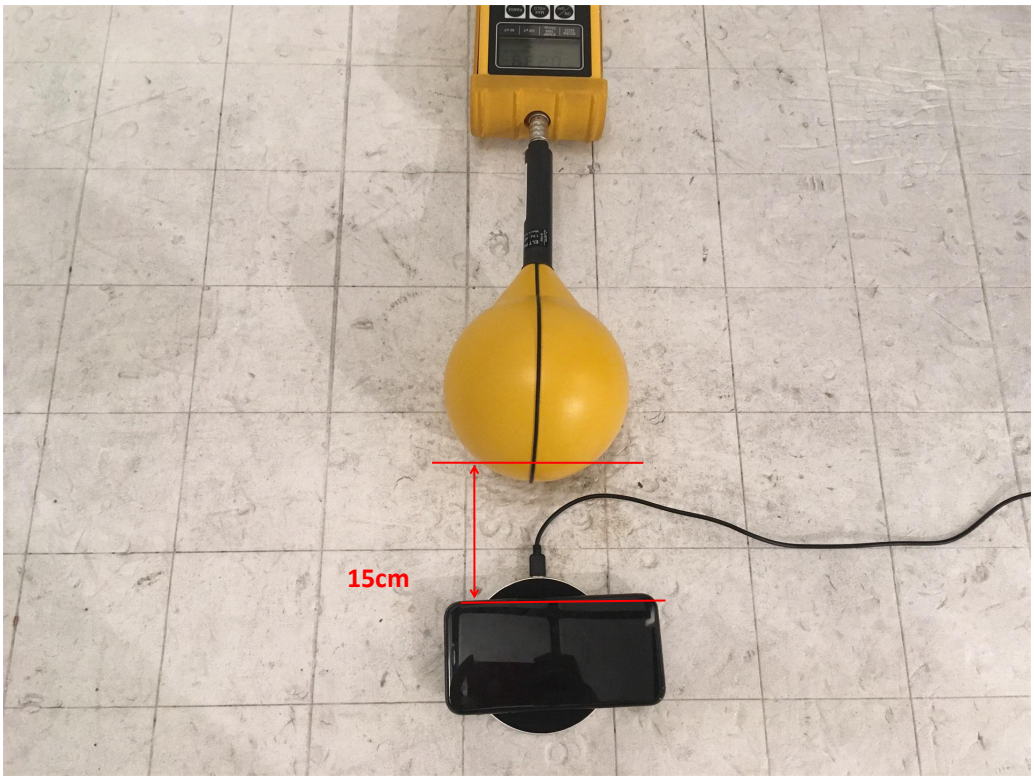
TestPosition E-Exposure photo from top surface (20cm)
(TM1)



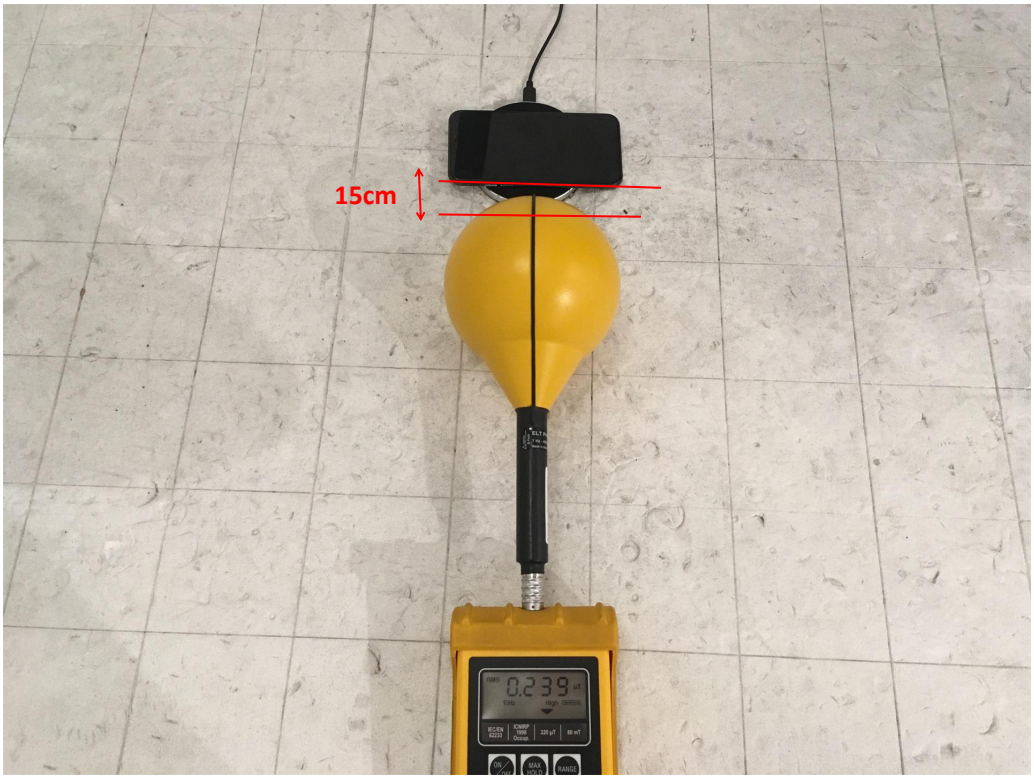
TestPosition E-Exposure photo from top surface (15cm)
(TM1)



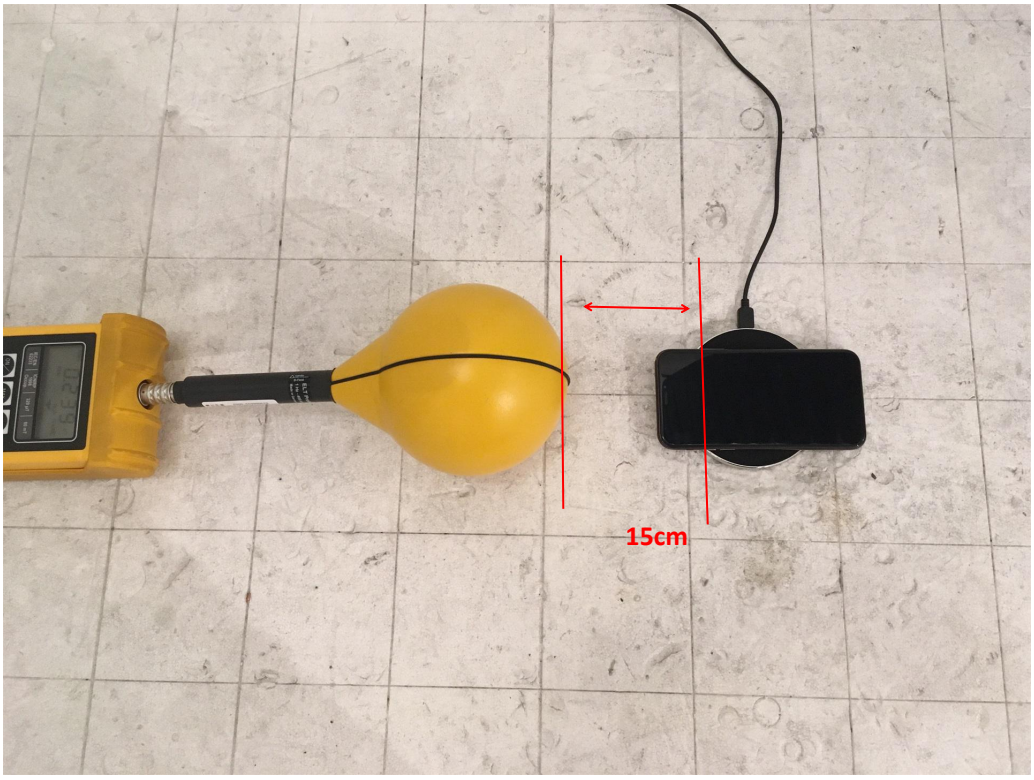
TestPosition A-Exposure photo from side edge surface-Rear (TM1)



TestPosition B-Exposure photo from side edge surface-Left (TM1)



TestPosition C-Exposure photo from side edge surface-Front (TM1)



TestPosition D-Exposure photo from side edge surface-Right (TM1)

10. Conclusion

A minimum safety distance of at 15 cm surrounding the device and 20 cm above the top surface of the device is required when the device is charging a smart phone. The detected emissions with a distance of 15 cm surrounding the device and 20 cm above the top surface of the device are below the limitations according to FCC KDB 680106 D01 Section 3. RF Exposure Requirement Clause 3.

Revision History

Revision	Issue Date	Revisions	Revised By
000	November 18, 2019	Initial Issue	Gavin Liang

.....END OF REPORT.....