



RF Exposure Evaluation

FCC ID: 2A4D7-X3

Test Sample: CTA211207011-2#

1 Measuring Standard

KDB 680106 D01 RF Exposure Wireless Charging Apps v03

2 Laboratory Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 517856 Designation Number: CN1318

Shenzhen CTA Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA-Lab Cert. No.: 6534.01

Shenzhen CTA Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3 Requirements

According to the item 5 of KDB 680106 D01v03:

Inductive wireless power transfer applications that meet all of the following requirements are excluded from submitting an RF exposure evaluation.

- (1) Power transfer frequency is less than 1MHz.
- (2) Output power from each primary coil is less than or equal to 15 watts.
- (3) The system may consist of more than one source primary coils, charging one or more clients. If more than one primary coil is present, the coil pairs may be powered on at the same time.
- (4) Client device is placed directly in contact with the transmitter.
- (5) Mobile exposure conditions only (portable exposure conditions are not covered by this exclusion).
- (6) The aggregate H-field strengths anywhere at or beyond 15 cm surrounding the device, and 20 cm away from the surface from all coils that by design can simultaneously transmit, and while those coils are simultaneously energized, are demonstrated to be less than 50% of the applicable MPE limit.

Limits

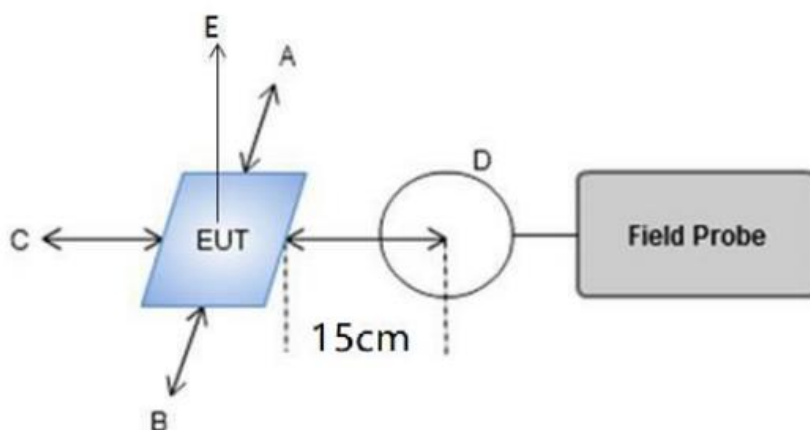
The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

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
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
 RF exposure compliance will need to be determined with respect to 1.1307(c) and (d) of the FCC rules. The emissions should be within the limits at 300kHz in Table 1 of 1.1310(use the 300kHz limits for 150kHz:614V/m,1.63A/m).

4 Test Setup



Note: A, B, C, D, E, F for six surfaces of the product.

The surfaces of each charge port is defined as figure below:

5 Test Procedure

- 1) The RF exposure test was performed in anechoic chamber.
- 2) The measurement probe was placed at test distance (15 cm from all sides and 20 cm from the top) which is between the edge of the charger and the geometric center of probe.
- 3) The highest emission level was recorded and compared with limit as soon as measurement of each points (A, B, C, D, E) were completed.
- 4) The EUT was measured according to the dictates of KDB 680106 D01v03.

Remark: The EUT's test position A, B, C, D and E is valid for the E and H field measurements.



6 Equipment Approval Considerations

The EUT does comply with KDB 680106 D01 as follow 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 110KHz~205KHz
Output power from each primary coil is less than 15 watts	Yes	The maximum output power of the primary coil is less than 15W
The system may consist of more than one source primary coils, charging one or more clients. If more than one primary coil is present, the coil pairs may be powered on at the same time.	Yes	The transfer system includes three coils that is able to detect receiver device.
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 anywhere at or beyond 15 cm surrounding the device, and 20 cm away from the surface from all coils that by design can simultaneously transmit, and while those coils are simultaneously energized, are demonstrated to be less than 50% of the applicable 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.



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7 Description of the test mode

Equipment under test was operated during the measurement under the following conditions:

☒ Charging and communication mode

Test Conditions	Description	
TM1	AC/DC Adapter (9V/3.0A) + EUT + Mobile Phone	Record
TM2	AC/DC Adapter (9V/3.0A) + EUT + Earbuds	Record
TM3	AC/DC Adapter (9V/3.0A) + EUT + Smart Watch	Record
TM4	AC/DC Adapter (9V/3.0A) + EUT + Mobile Phone+ Smart Watch	Record
TM5	AC/DC Adapter (9V/3.0A) + EUT + Mobile Phone + Earbuds	Record
TM6	AC/DC Adapter (9V/3.0A) + EUT + Smart Watch + Earbuds	Record
TM7	AC/DC Adapter (9V/3.0A) + EUT + Mobile Phone + Smart Watch + Earbuds	Record

8 Description of Support Units

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

Description	Manufacturer	Model	Technical Parameters	Certificate	Provided by
Adapter	PD	V1285	/	CE/FCC	laboratory
Phone	Apple	iPhone8 plus	/	FCC/IC	laboratory
Smart Watch	/	T3	/	FCC/IC	laboratory
Earbuds	Apple	AirPods	/	FCC/IC	laboratory

9 Test Instruments list

Test Equipment	Manufacturer	Model No.	SN.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
Exposure Level Tester	Narda	ELT-400	N-0231	2021/08/06	2022/08/05
Magnetic field probe 100cm2	Narda	ELT probe 100cm2	M0675	2021/08/06	2022/08/05



10 Test Result

E-Filed Strength at 15 cm from the edges surrounding the EUT and 15 cm above the top surface

Test port	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		
TM1	0.125	140.244	141.752	130.442	125.918	144.768	307.0	614.0
TM2	0.125	58.058	59.943	59.189	56.173	55.042	307.0	614.0
TM3	0.125	36.569	36.192	35.815	34.684	36.946	307.0	614.0

Test port	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		
Phone port	0.125	101.036	102.921	96.889	93.119	99.151	307.0	614.0
iWatch port	0.125	36.946	36.192	35.061	36.569	36.192	307.0	614.0

Test port	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		
Phone port	0.125	91.611	93.496	92.365	88.972	89.349	307.0	614.0
AirPods port	0.125	55.796	53.911	54.665	53.534	55.042	307.0	614.0

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Test port TM6	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		
AirPods port	0.125	53.157	55.796	53.911	54.288	56.173	307.0	614.0
iWatch port	0.125	36.192	34.307	36.569	36.192	35.438	307.0	614.0

Test port TM7	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		
Phone port	0.125	74.269	75.023	72.007	70.122	75.777	307.0	614.0
AirPods port	0.125	52.403	54.288	53.911	51.649	53.911	307.0	614.0
iWatch port	0.125	35.815	35.438	35.061	36.192	34.307	307.0	614.0

Note: V/m= A/m *377

Test port	Frequency Range (MHz)	Unit	Measured E-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		
TM1	0.125	uT	0.465	0.470	0.433	0.418	0.480	--	--
		A/m	0.372	0.376	0.346	0.334	0.384	0.815	1.63
TM2	0.125	uT	0.193	0.199	0.196	0.186	0.183	--	--
		A/m	0.154	0.159	0.157	0.149	0.146	0.815	1.63
TM3	0.125	uT	0.121	0.120	0.119	0.115	0.123	--	--
		A/m	0.097	0.096	0.095	0.092	0.098	0.815	1.63

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

Test port TM4	Frequency Range (MHz)	Unit	Measured E-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		
Phone port	0.125	uT	0.335	0.341	0.321	0.309	0.329	--	--
		A/m	0.268	0.273	0.257	0.247	0.263	0.815	1.63
iWatch port	0.125	uT	0.123	0.120	0.116	0.121	0.120	--	--
		A/m	0.098	0.096	0.093	0.097	0.096	0.815	1.63

Test port TM5	Frequency Range (MHz)	Unit	Measured E-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		
Phone port	0.125	uT	0.304	0.310	0.306	0.295	0.296	--	--
		A/m	0.243	0.248	0.245	0.236	0.237	0.815	1.63
AirPods port	0.125	uT	0.185	0.179	0.181	0.178	0.183	--	--
		A/m	0.148	0.143	0.145	0.142	0.146	0.815	1.63

Test port TM6	Frequency Range (MHz)	Unit	Measured E-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		
AirPods port	0.125	uT	0.176	0.185	0.179	0.180	0.186	--	--
		A/m	0.141	0.148	0.143	0.144	0.149	0.815	1.63
iWatch port	0.125	uT	0.120	0.114	0.121	0.120	0.118	--	--
		A/m	0.096	0.091	0.097	0.096	0.094	0.815	1.63

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Test port	Frequency Range (MHz)	Unit	Measured E-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		
Phone port	0.125	uT	0.246	0.249	0.239	0.233	0.251	--	--
		A/m	0.197	0.199	0.191	0.186	0.201	0.815	1.63
AirPods port	0.125	uT	0.174	0.180	0.179	0.171	0.179	--	--
		A/m	0.139	0.144	0.143	0.137	0.143	0.815	1.63
iWatch port	0.125	uT	0.119	0.118	0.116	0.120	0.114	--	--
		A/m	0.095	0.094	0.093	0.096	0.091	0.815	1.63

Note: A/m=uT/1.25

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

Test port	Frequency Range (MHz)	Unit	Measured E-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position E		
TM1	0.125	uT	0.396	--	--
		A/m	0.317	0.815	1.63
TM2	0.125	uT	0.151	--	--
		A/m	0.121	0.815	1.63
TM3	0.125	uT	0.098	--	--
		A/m	0.078	0.815	1.63

Test port	Frequency Range (MHz)	Unit	Measured E-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position E		
Phone port	0.125	uT	0.326	--	--
		A/m	0.261	0.815	1.63
iWatch port	0.125	uT	0.079	--	--
		A/m	0.063	0.815	1.63

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Test port TM5	Frequency Range (MHz)	Unit	Measured E-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position E		
Phone port	0.125	uT	0.318	--	--
		A/m	0.254	0.815	1.63
AirPods port	0.125	uT	0.080	--	--
		A/m	0.064	0.815	1.63

Test port TM6	Frequency Range (MHz)	Unit	Measured E-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position E		
AirPods port	0.125	uT	0.149	--	--
		A/m	0.119	0.815	1.63
iWatch port	0.125	uT	0.091	--	--
		A/m	0.073	0.815	1.63

Test port TM7	Frequency Range (MHz)	Unit	Measured E-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position E		
Phone port	0.125	uT	0.184	--	--
		A/m	0.147	0.815	1.63
AirPods port	0.125	uT	0.126	--	--
		A/m	0.101	0.815	1.63
iWatch port	0.125	uT	0.090	--	--
		A/m	0.072	0.815	1.63

Note:A/m=uT/1.25

11 Simultaneous E-Filed Strength and H-Filed Strength

KDB 447498 points for simultaneous transmission on far-filed measurement, while for below 30 MHz usually measured at near-filed. KDB680106 require aggregate leakage fields at 15 cm surrounding the device from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit;

KDB680106 can accept 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.

Test labs suggest use Computational modelling to calculate Nerve Stimulation BRs;

Computational modelling, such as finite-difference time-domain (FDTD) may be used to demonstrate compliance with FCC § 1.1310 limits requirement,

Basic Calculations - The following calculations may be used to evaluate systems without consideration for the effects of phase resulting from multiple frequency and/or multiple antennas co-located in the measurement space, which may overestimate the actual result. If the result exceeds the limits, the advanced calculations described in follows may be used.

$$E_{AVG} = \frac{1}{n} \sum_{i=1}^n (E_{MaxRMS})_i$$

Where:

E-field measurements

E_{AVG} = Spatial average

E_{MaxRMS} = E-field at a measurement point

N = Number of spatially averaged points

And

$$H_{AVG} = \frac{1}{n} \sum_{i=1}^n (H_{MaxRMS})_i$$

Where:

H-field levels of magnetic field strength

H_{AVG} = Spatial average

H_{MaxRMS} = H-field at a measurement point

N = Number of spatially averaged points



E-Filed Strength at 15 cm from the edges surrounding the EUT and 15 cm above the top surface

Simultaneous combination	Frequency Range (MHz)	Max.Measured E-Field Strength Values (V/m)			Spatial Average E_{AVG} (V/m)	FCC E-Field Strength 50% Limits (V/m)	FCC E-Field Strength Limits (V/m)
		Phone port	AirPods port	iWatch port			
Phone+ AirPods TM5	0.125	93.496	55.796	--	74.646	307.0	614.0
Phone+ iWatch TM4	0.125	102.921	--	36.946	69.934	307.0	614.0
AirPods+iWatch TM6	0.125	--	56.173	36.569	28.087	307.0	614.0
Phone+AirPods +iWatch TM7	0.125	75.777	54.288	36.192	55.419	307.0	614.0

H-Filed Strength at 15 cm from the edges surrounding the EUT and 15 cm above the top surface

Simultaneous combination	Frequency Range (MHz)	Max. Measured H-Field Strength Values (A/m)			Spatial Average H_{AVG} (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
		Phone port	AirPods port	iWatch port			
Phone+ AirPods TM5	0.125	0.248	0.148	--	0.198	0.815	1.63
Phone+ iWatch TM4	0.125	0.273	--	0.098	0.186	0.815	1.63
AirPods+iWatch TM6	0.125	--	0.149	0.097	0.075	0.815	1.63
Phone+AirPods +iWatch TM7	0.125	0.201	0.144	0.096	0.147	0.815	1.63



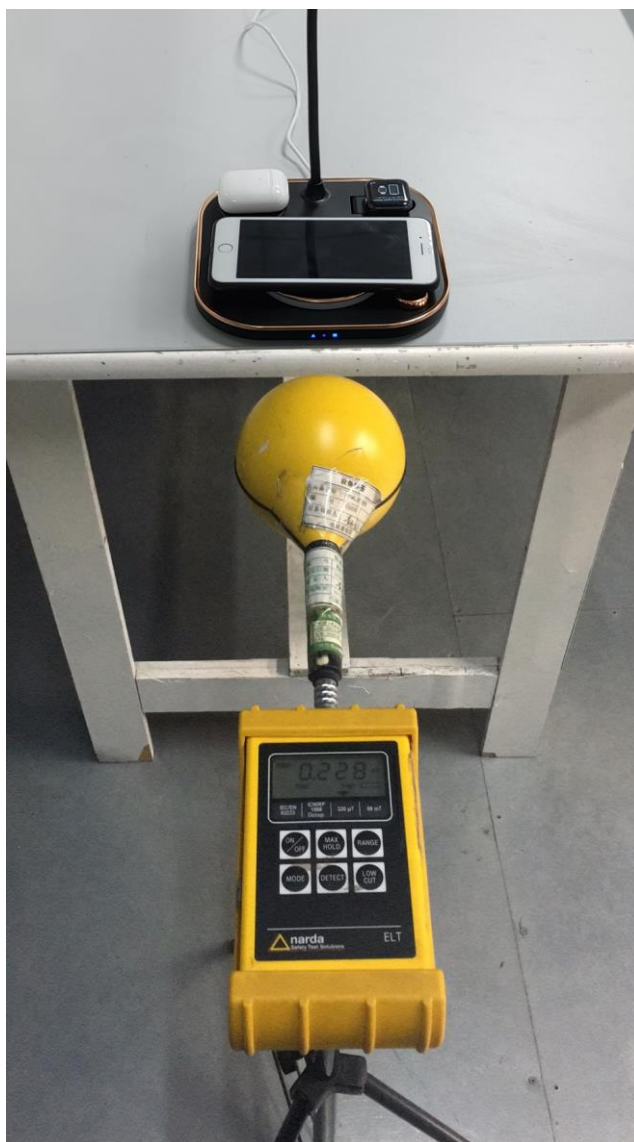
H-Field Strength at 20cm from the top surface of the EUT

Simultaneous combination	Frequency Range (MHz)	Max. Measured H-Field Strength Values (A/m)			Spatial Average H_{AVG} (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
		Phone port	AirPods port	iWatch port			
Phone+ AirPods TM5	0.125	0.254	0.064	--	0.159	0.815	1.63
Phone+ iWatch TM4	0.125	0.261	--	0.063	0.162	0.815	1.63
AirPods+iWatch TM6	0.125	--	0.119	0.073	0.060	0.815	1.63
Phone+AirPods +iWatch TM7	0.125	0.147	0.101	0.072	0.107	0.815	1.63

12 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.

13 Test Set-up Photo



Revision History

Revision	Issue Date	Revisions	Revised By
000	Dec. 12, 2021	Initial Issue	Eric Wang

-----End-----