



RF Exposure Evaluation

FCC ID: 2AVG2-AK03

Test Sample: CTA211109002-1#

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 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.
- (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 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.

Remark: Meet all the above requirements.

Limits

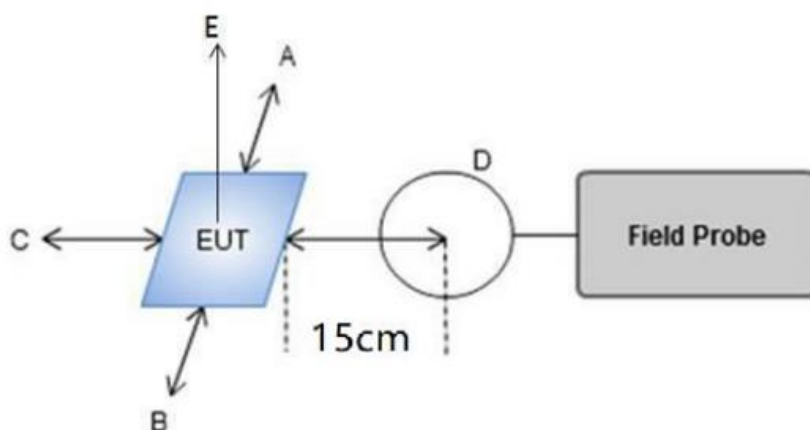
The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

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:

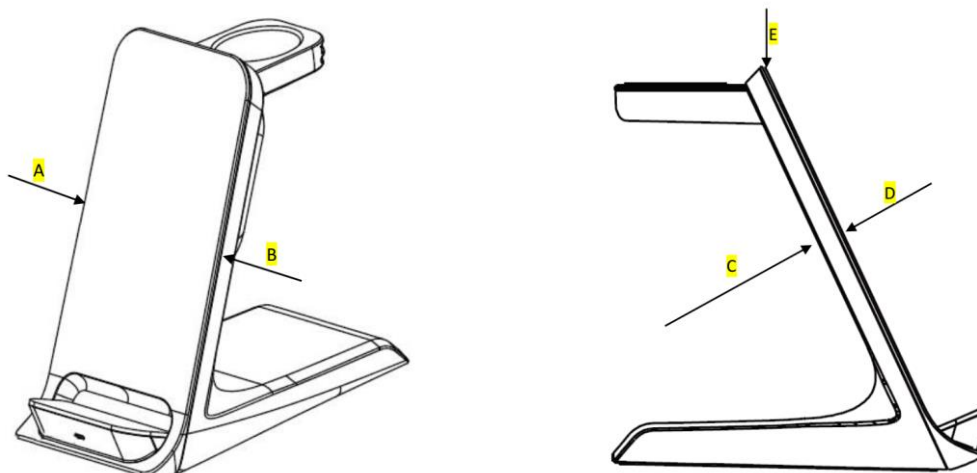


Figure1: surface define for phone charger port during the test

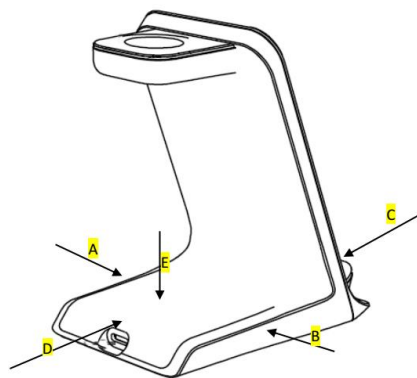


Figure 2: surface define for AirPods charger port during the test.

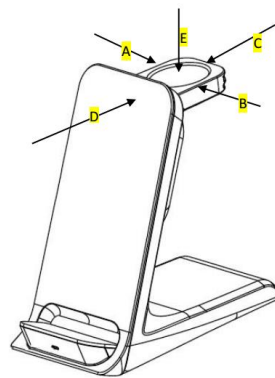


Figure 3:surface define for iWatch charger port during the test

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 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.	No	The transfer system includes three coil 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 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.



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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/2.2A) + EUT + Mobile Phone	Record
TM2	AC/DC Adapter (9V/2.2A) + EUT + Earbuds	Record
TM3	AC/DC Adapter (9V/2.2A) + EUT + Smart Watch	Record
TM4	AC/DC Adapter (9V/2.2A) + EUT + Mobile Phone+ Smart Watch	Record
TM5	AC/DC Adapter (9V/2.2A) + EUT + Mobile Phone + Earbuds	Record
TM6	AC/DC Adapter (9V/2.2A) + EUT + Smart Watch + Earbuds	Record
TM7	AC/DC Adapter (9V/2.2A) + 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	UGREEN	CD101	/	FCC/IC	laboratory
Phone	Apple	iPhone12	/	FCC/IC	laboratory
Smart Watch	/	T3	/	FCC/IC	laboratory
Earbuds	Huawei	T0003	/	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	0.131	144.391	142.883	126.295	123.279	148.538	307.0	614.0
TM2	0.131	54.288	56.173	55.419	53.157	53.911	307.0	614.0
TM3	0.131	35.061	34.684	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	0.131	95.381	105.183	88.595	85.579	103.298	307.0	614.0
iWatch port	0.131	35.438	36.569	35.438	34.684	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	0.131	84.071	86.333	81.055	77.662	91.611	307.0	614.0
AirPods port	0.131	53.911	55.419	53.157	52.026	51.649	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	0.131	54.665	55.042	53.911	50.518	51.272	307.0	614.0
iWatch port	0.131	34.684	36.192	35.061	35.438	35.815	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	0.131	68.991	71.253	73.515	66.352	76.531	307.0	614.0
AirPods port	0.131	53.534	53.157	55.419	49.387	52.403	307.0	614.0
iWatch port	0.131	34.684	36.192	35.061	35.438	35.815	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	0.131	uT	0.479	0.474	0.419	0.409	0.493	--	--
		A/m	0.383	0.379	0.335	0.327	0.394	0.815	1.63
TM2	0.131	uT	0.180	0.186	0.184	0.176	0.179	--	--
		A/m	0.144	0.149	0.147	0.141	0.143	0.815	1.63
TM3	0.131	uT	0.116	0.115	0.116	0.121	0.120	--	--
		A/m	0.093	0.092	0.093	0.097	0.096	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	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	0.131	uT	0.316	0.349	0.294	0.284	0.343	--	--
		A/m	0.253	0.279	0.235	0.227	0.274	0.815	1.63
iWatch port	0.131	uT	0.118	0.121	0.118	0.115	0.120	--	--
		A/m	0.094	0.097	0.094	0.092	0.096	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 A	Test Position B	Test Position C	Test Position D	Test Position E		
Phone port	0.131	uT	0.279	0.286	0.269	0.258	0.304	--	--
		A/m	0.223	0.229	0.215	0.206	0.243	0.815	1.63
AirPods port	0.131	uT	0.179	0.184	0.176	0.173	0.171	--	--
		A/m	0.143	0.147	0.141	0.138	0.137	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 A	Test Position B	Test Position C	Test Position D	Test Position E		
AirPods port	0.131	uT	0.181	0.183	0.179	0.168	0.170	--	--
		A/m	0.145	0.146	0.143	0.134	0.136	0.815	1.63
iWatch port	0.131	uT	0.115	0.120	0.116	0.118	0.119	--	--
		A/m	0.092	0.096	0.093	0.094	0.095	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	0.131	uT	0.229	0.236	0.244	0.220	0.254	--	--
		A/m	0.183	0.189	0.195	0.176	0.203	0.815	1.63
AirPods port	0.131	uT	0.178	0.176	0.184	0.164	0.174	--	--
		A/m	0.142	0.141	0.147	0.131	0.139	0.815	1.63
iWatch port	0.131	uT	0.115	0.120	0.116	0.118	0.119	--	--
		A/m	0.092	0.096	0.093	0.094	0.095	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	0.131	uT	0.390	--	--
		A/m	0.312	0.815	1.63
TM2	0.131	uT	0.145	--	--
		A/m	0.116	0.815	1.63
TM3	0.131	uT	0.085	--	--
		A/m	0.068	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	0.131	uT	0.334	--	--
		A/m	0.267	0.815	1.63
iWatch port	0.131	uT	0.081	--	--
		A/m	0.065	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	0.131	uT	0.323	--	--
		A/m	0.258	0.815	1.63
AirPods port	0.131	uT	0.084	--	--
		A/m	0.067	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	0.131	uT	0.148	--	--
		A/m	0.118	0.815	1.63
iWatch port	0.131	uT	0.090	--	--
		A/m	0.072	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	0.131	uT	0.178	--	--
		A/m	0.142	0.815	1.63
iWatch port	0.131	uT	0.133	--	--
		A/m	0.106	0.815	1.63
AirPods port	0.131	uT	0.094	--	--
		A/m	0.075	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	0.131	91.611	55.419	--	73.515	307.0	614.0
Phone+ iWatch TM4	0.131	105.183	--	36.569	70.876	307.0	614.0
AirPods+iWatch TM6	0.131	--	55.042	36.192	45.617	307.0	614.0
Phone+AirPods +iWatch TM7	0.131	76.531	55.419	35.815	55.922	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	0.131	0.243	0.147	--	0.195	0.815	1.63
Phone+ iWatch TM4	0.131	0.279	--	0.097	0.188	0.815	1.63
AirPods+iWatch TM6	0.131	--	0.146	0.096	0.121	0.815	1.63
Phone+AirPods +iWatch TM7	0.131	0.203	0.147	0.096	0.149	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	iWatch port	AirPods port			
Phone+ AirPods TM5	0.131	0.258	0.067	--	0.163	0.815	1.63
Phone+ iWatch TM4	0.131	0.267	--	0.065	0.166	0.815	1.63
AirPods+iWatch TM6	0.131	--	0.118	0.072	0.095	0.815	1.63
Phone+AirPods +iWatch TM7	0.131	0.142	0.106	0.075	0.108	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	Jan. 25, 2022	Initial Issue	Eric Wang

-----End-----