RF Exposure Evaluation Report

1. Product Information

Report Reference No.	LCSA09274055EB
Applicant's Name	Ugreen Group Limited
Address	Ugreen Building, Longcheng Industrial Park, Longguanxi Road, Longhua, ShenZhen, China
FCC ID:	2AQI5-W702A
Product Name	2-in-1 Magnetic Wireless Charger
Model Number	W702
P/N code	35316, 35316P, 35316X, 35316A, 35316B, 35316U, 35316JP, 35316ZD, 35316GI
P/N code Declaration	For marketing purpose, will be marked on the marking plate
Power Supply	USB-C1(IN)Input: 5.0V⎓3.0A/9.0V⎓3.0A/12.0V⎓2.5A Wireless Charging Output:20.0W Max (iPhone:15.0W, AirPods:5.0W) USB-C2(OUT) Output:5.0V⎓1.0A 5.0W Max Total Output Power:25.0W Max
Modulation Type	ASK
Frequency Range	Coil1: For Phone: 127.8kHz, 360kHz Coil2: For Earphone: 110.2-148.5kHz
Antenna Type	Coil Antenna
Hardware version	W526-35278-A-V2
Software version	W526-35278-A
Accessories	/
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

2. Evaluation Method

Per KDB 680106 D01 Section 3. RF Exposure Requirements;

1) Wireless power transfer devices must comply with RF exposure requirements for all design configurations in which they can operate. At a minimum, RF exposure must be evaluated for the worst-case scenario, typically when the transmitter, while delivering energy to a client device, is operating at maximum output power. RF exposure compliance for equipment authorization must be determined following the guidance of KDB447498, which includes consideration of the different test requirements for *Mobile Device* and *Portable Device* exposure categories, as defined in §§ 2.1091 and 2.1093 of the Rules.
2) The RF exposure limits, as set forth in § 1.1310, do not cover the frequency range below 100 kHz for Specific Absorption Rate (SAR) and below 300 kHz for Maximum Permitted Exposure (MPE). In addition, present limitations of RF exposure evaluation systems prevent an accurate evaluation of SAR below 4 MHz. For these reasons, a specific MPE-based RF Exposure compliance procedure for devices operating in the

aforementioned low-frequency ranges has been set in place. This procedure is applicable to Equipment Authorization of all RF devices, thus including, but not limited to, Part 18 and WPT devices. Accordingly, for § 2.1091-*Mobile* devices, the MPE limits between 100 kHz to 300 kHz are to be considered the same as those at 300 kHz in Table 1 of § 1.1310, that is, 614 V/m and 1.63 A/m, for the electric field and magnetic field, respectively. For § 2.1093-*Portable* devices below 4 MHz and down to 100 kHz, the MPE limits in § 1.1310 (with the 300 kHz limit applicable all the way down to 100 kHz) can be used for the purpose of equipment authorization in lieu of SAR evaluations.

Furthermore, consistent with FCC's equipment authorization RF exposure guidance, any device (both portable and mobile) operating at frequencies below 100 kHz is considered compliant for the purpose of equipment authorization when the external (unperturbed) temporal peak field strengths do not exceed the following reference levels:

83 V/m for the electric field strength (*E*)

and 90 A/m for the magnetic field strength (*H*)

These data may be provided through measurements and/or numerical simulations, and for all the positions in space relevant for any possible body exposure.

3) "Large size" probes may prevent the measurement of E- and/or H-fields near the surface of the radiating structure (e.g., a WPT source coil), as in the example shown in Figure 1.

If the center of the probe sensing element is located more than 5 mm from the probe outer surface, the field strengths need to be estimated through modeling for those positions that are not reachable. The estimates may be done either via numerical calculation, or via analytic model: e.g., approximated formulas for circular coils, dipoles, etc., may be acceptable if it is shown that the model is applicable for the design parameters considered. A typical example is the use of a quasi-static approximation formula for a low-frequency magnetic field source. These estimates shall include points spaced no more than 2 cm from each other. Thus, in the example of

Figure 1, at least the estimates at 0 cm2 and 2 cm are required, while only one point would not be sufficient. In addition, the model needs to be validated through the probe measurements for the two closest points to the device surface, and with 2-cm increments, as indicated in Figure 1. In that example, the same model must also be applied to the 4 cm and 6 cm positions, and then compared with the measured data, for validation purposes. The validation is considered sufficient if a 30% agreement between the model and the (E- and/or H-field) probe measurements is demonstrated. If such a level of agreement cannot be shown, a more accurate model (and/or a smaller probe) shall be used.

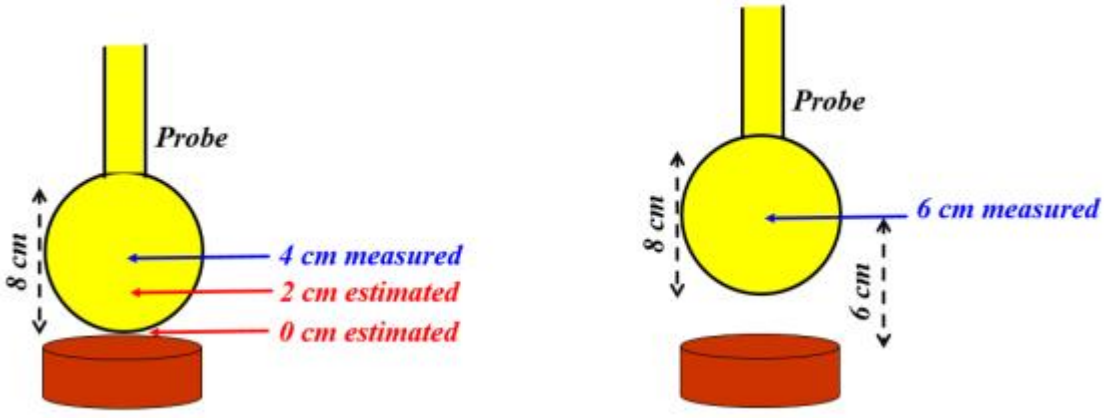
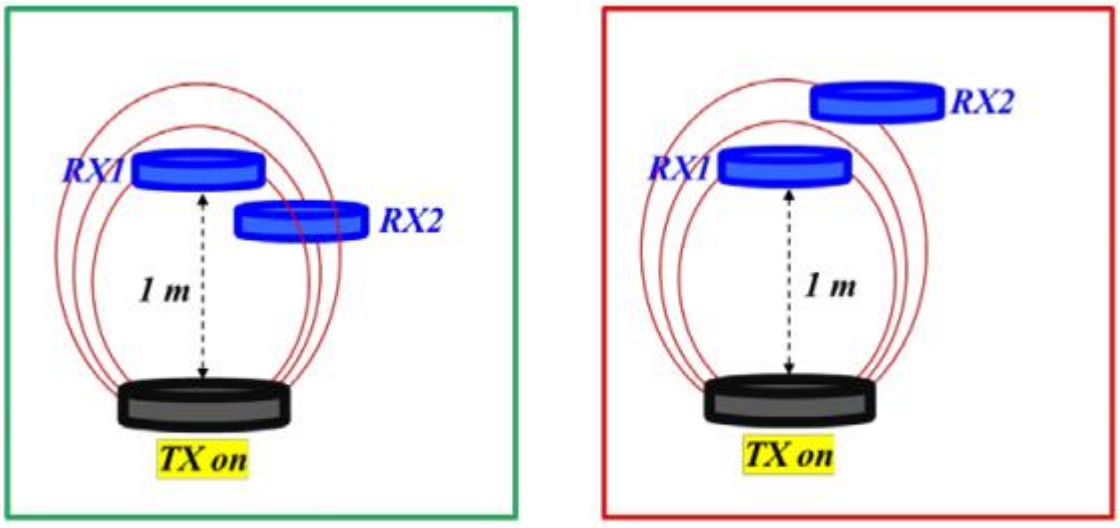


Figure 1. Example of probe (in yellow) measurements in points close to the WPT device (in red/brown). The probe radius is 4 cm, thus the closest point to the device where the field can be measured is at 4 cm from the surface (this example assumes that the probe calibration refers to the center of the sensing element structure, in this case a sphere of 4 cm radius). Data at 0 cm and 2 cm must be estimated through a model, and then the same model must be validated via comparison with the actual measurements at 4 cm and 6 cm, where the probe center can be positioned and collect valid data.

4) Part 18 Wireless Power Transfer up to One-Meter Distance. This section applies only to WPT transmitters that, by design, can provide power to a load located at a distance no greater than one meter. This distance shall be measured between the closest points between the transmitter and the receiver enclosure surfaces. For instance, two coils positioned as in Figure 2-a may be operated and considered under the provisions of this section, because both receivers are within one-meter distance from the transmitter. However, the case in Figure 2-b cannot be considered in the same way, and it is treated according to the prescription of Section 5.3.

For WPT designs with more than one radiating structure the distance to the load shall be considered as in Figure 3, thus measured between the receiver and the closest transmitting structure.



a) Not considered as WPT "at-a-distance"

b) WPT "at-a-distance" because RX2 position

Figure 2-a) For multiple-receiver systems (here shown with two receivers, indicated with RX1 and RX2) the one-meter distance limit must apply for all the receivers that are engaged in the charging process. b) The WPT system is considered "at-a-distance" because it can function when the RX2 is further away than one meter from the transmitter.

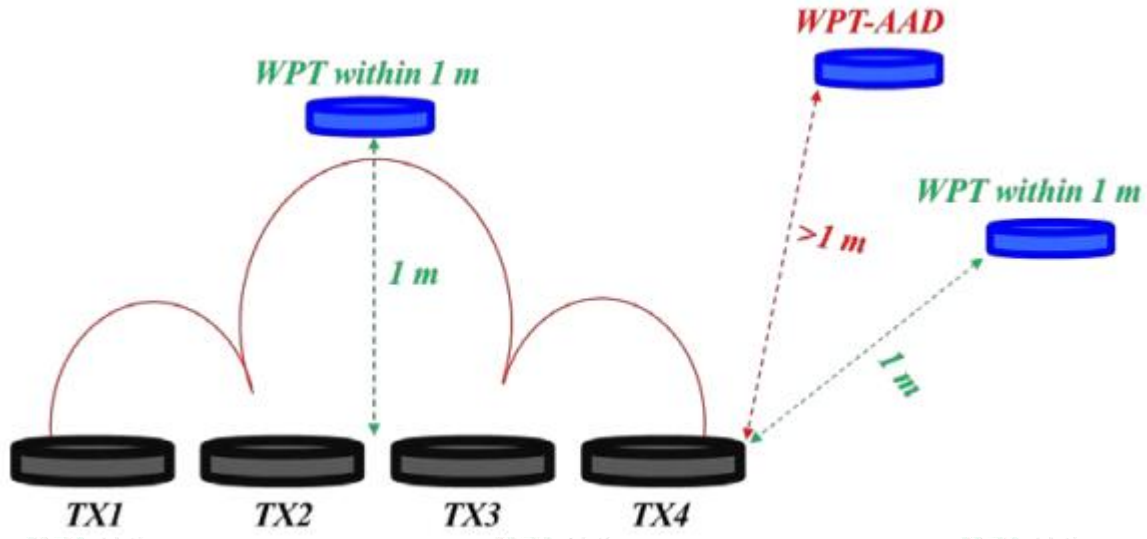


Figure 3. For multiple-coil transmitter systems, the one-meter distance limit is measured from the closest coil edge. A WPT within one meter operates with loads configured as those labeled in green font, if a load can be powered beyond one meter (in red), then it shall be considered "at-a-distance"

There might be situations where the WPT RF emissions are limited enough that even operations in a "crowded" environment, where many similar WPT devices are present, do not pose significant EMC and RF exposure concerns. In this scenario, and for devices operating within a one-meter distance from the receiver, as defined above, a manufacturer will not have to submit an "Equipment Compliance Review" KDB, and receive FCC concurrence before proceeding with equipment authorization. This exception to the requirement of submitting the ECR to obtain FCC concurrence only applies when all the following criteria (1) through (6) are met:

(1) The power transfer frequency is below 1 MHz.

(2) The output power from each transmitting element (e.g., coil) is less than or equal to 15 watts.

(3) A client device providing the maximum permitted load is placed in physical contact with the transmitter (i.e., the surfaces of the transmitter and client device enclosures need to be in physical contact)

(4) Only § 2.1091- Mobile exposure conditions apply (i.e., this provision does not cover § 2.1093 – Portable exposure conditions).

(5) The E-field and H-field strengths, at and beyond 20 cm surrounding the device surface, are demonstrated to be less than 50% of the applicable MPE limit, per KDB 447498, Table 1. These measurements shall be taken along the principal axes of the device, with one axis oriented along the direction of the estimated maximum field strength, and for three points per axis or until a 1/d (inverse distance from the emitter structure) field strength decay is observed. Symmetry considerations may be used for test reduction purposes. The device shall be operated in documented worst-case compliance scenarios (i.e., the ones that lead to the maximum field components), and while all the radiating structures (e.g., coils or antennas) that by design can simultaneously transmit are energized at their nominal maximum power.

5) For systems with more than one radiating structure, the conditions specified in (5) must be met when the system is fully loaded (i.e., clients absorbing maximum power available), and with all the radiating structures operating at maximum power at the same time, as per design conditions. If the design allows one or more radiating structures to be powered at a higher level while other radiating structures are not powered, then those cases must be tested as well. For instance, a device may use three RF coils powered at 5 W, or one coil powered at 15 W: in this case, both scenarios shall be tested

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/cm^2)	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/f^2	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/cm^2)	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

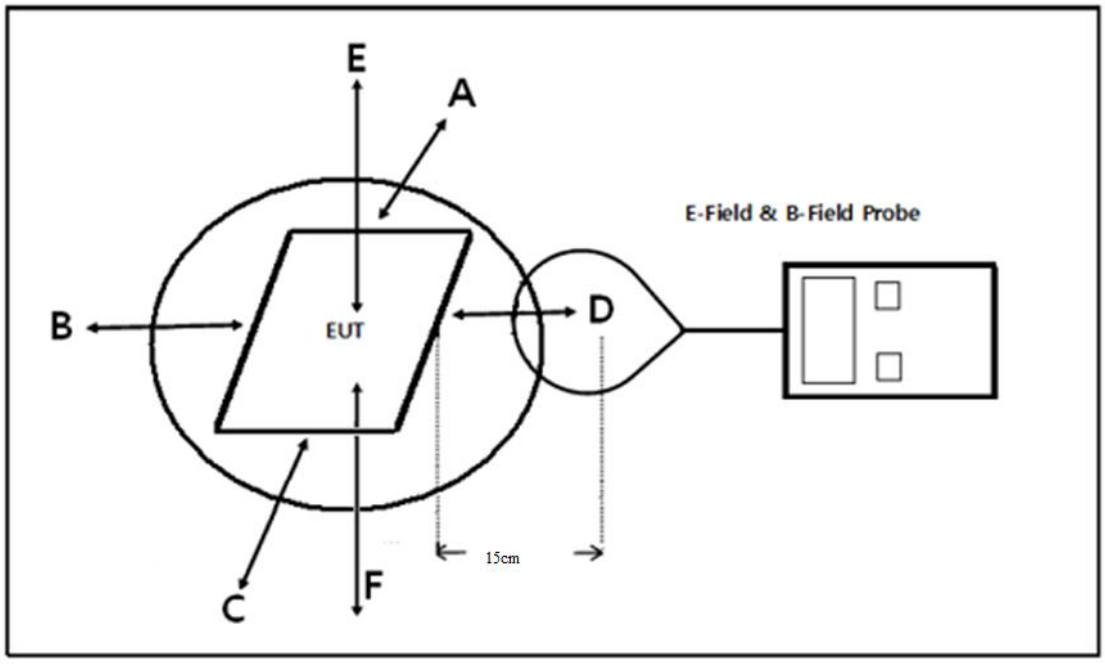
*=Plane-wave equivalent power density

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



5. Test Equipment

Equipment	Manufacturer	Model	Serial no.	Calibrated date	Calibrated Due
Exposure Level Tester	Narda	ELT-400	N-0713	2023-10-28	2024-10-27
B-Field Probe	Narda	ELT-400	M-1154	2023-10-28	2024-10-27
Electric field probe	Narda	EP601	611WX70332	N/A	N/A

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 edges 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 D01v04 as follows table;

Requirements of KDB 680106 D01	Yes / No	Description
Power transfer frequency is less than 1 MHz	Yes	The device operates in the frequency range 110.2kHz - 148.5 kHz, 360kHz
The output power from each transmitting element (e.g., coil) is less than or equal to 15 watts.	Yes	The maximum output power of the primary coil is 15W.
A client device providing the maximum permitted load is placed in physical contact with the transmitter (i.e., the surfaces of the transmitter and client device enclosures need to be in physical contact)	Yes	Client device is placed directly in contact with the transmitter.
Only § 2.1091- Mobile exposure conditions apply (i.e., this provision does not cover § 2.1093-Portable exposure conditions).	Yes	Mobile exposure conditions only
The E-field and H-field strengths, at and beyond 20 cm surrounding the device surface, are demonstrated to be less than 50% of the applicable MPE limit, per KDB 447498, Table 1. These measurements shall be taken along the principal axes of the device, with one axis oriented along the direction of the estimated maximum field strength, and for three points per axis or until a 1/d (inverse distance from the emitter structure) field strength decay is observed. Symmetry considerations may be used for test reduction purposes. The device shall be operated in documented worst-case compliance scenarios (i.e., the ones that lead to the maximum field components), and while all the radiating structures (e.g., coils or antennas) that by design can simultaneously transmit are energized at their nominal maximum power.	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.
For systems with more than one radiating structure, the conditions specified in (5) must be met when the system is fully loaded (i.e., clients absorbing maximum power available), and with all the radiating structures operating at maximum power at the same time, as per design conditions. If the design allows one or more radiating structures to be powered at a higher level while other radiating structures are not powered, then those cases must be tested as well.	Yes	Only one radiating structure and tested at maximum Output Power

For instance, a device may use three RF coils powered at 5 W, or one coil powered at 15 W: in this case, both scenarios shall be tested		

There might be situations where the WPT RF emissions are limited enough that even operations in a “crowded” environment, where many similar WPT devices are present, do not pose significant EMC and RF exposure concerns. In this scenario, and for devices operating within a one-meter distance from the receiver, as defined above, a manufacturer will not have to submit an “Equipment Compliance Review” KDB, and receive FCC concurrence before proceeding with equipment authorization. This exception to the requirement of submitting the ECR to obtain FCC concurrence only applies when all the following criteria (1) through (6) are met.

8. E and H field Strength

Test Modes		
Mode 1	AC/DC Adapter(12V/2.5A) + EUT + Phone + TWS Earphone (Battery Status: <1%)	Record
Mode 2	AC/DC Adapter (12V/2.5A)+ EUT + Phone + TWS Earphone Battery Status: <50%)	Record
Mode 3	AC/DC Adapter (12V/2.5A) + EUT + Phone + TWS Earphone (Battery Status: 100%)	Record
Mode 4	AC/DC Adapter (9V/3A) + EUT + Phone + TWS Earphone (Battery Status: <1%)	Pre-tested
Mode 5	AC/DC Adapter (9V/3A) + EUT + Phone + TWS Earphone (Battery Status: <50%)	Pre-tested
Mode 6	AC/DC Adapter (9V/3A) + EUT + Phone + TWS Earphone (Battery Status: 100%)	Pre-tested
Mode 7	AC/DC Adapter (5V/3A) + EUT + Phone + TWS Earphone (Battery Status: <1%)	Pre-tested
Mode 8	AC/DC Adapter (5V/3A) + EUT + Phone + TWS Earphone (Battery Status: <50%)	Pre-tested
Mode 9	AC/DC Adapter (5V/3A) + EUT + Phone + TWS Earphone (Battery Status: 100%)	Pre-tested
Mode 10	AC/DC Adapter (5V/3A) + EUT + Phone (Battery Status: <1%)	Pre-tested
Mode 11	AC/DC Adapter (5V/3A) + EUT + Phone (Battery Status: <50%)	Pre-tested
Mode 12	AC/DC Adapter (5V/3A) + EUT + Phone (Battery Status: 100%)	Pre-tested
Mode 13	AC/DC Adapter (5V/3A) + TWS Earphone (Battery Status: <1%)	Pre-tested
Mode 14	AC/DC Adapter (5V/3A) + TWS Earphone (Battery Status: <50%)	Pre-tested
Mode 15	AC/DC Adapter (5V/3A) + TWS Earphone (Battery Status: 100%)	Pre-tested
Mode 16	AC/DC Adapter (9V/3A) + EUT + Phone (Battery Status: <1%)	Pre-tested
Mode 17	AC/DC Adapter (9V/3A) + EUT + Phone (Battery Status: <50%)	Pre-tested
Mode 18	AC/DC Adapter (9V/3A) + EUT + Phone (Battery Status: 100%)	Pre-tested
Mode 19	AC/DC Adapter (9V/3A) + EUT + TWS Earphone (Battery Status: <1%)	Pre-tested
Mode 20	AC/DC Adapter (9V/3A) + EUT + TWS Earphone (Battery Status: <50%)	Pre-tested
Mode 22	AC/DC Adapter (9V/3A) + EUT + TWS Earphone (Battery Status: 100%)	Pre-tested
Mode 23	AC/DC Adapter (12V/2.5A) + EUT + Phone (Battery Status: <1%)	Pre-tested
Mode 24	AC/DC Adapter (12V/2.5A) + EUT + Phone (Battery Status: <50%)	Pre-tested
Mode 25	AC/DC Adapter (12V/2.5A) + EUT + Phon (Battery Status: 100%)	Pre-tested
Mode 26	AC/DC Adapter (12V/2.5A) + EUT + TWS Earphone (Battery Status: <1%)	Pre-tested
Mode 27	AC/DC Adapter (12V/2.5A) + EUT + TWS Earphone (Battery Status: <50%)	Pre-tested
Mode 28	AC/DC Adapter (12V/2.5A) + EUT + TWS Earphone (Battery Status: 100%)	Pre-tested
Note: All test modes were pre-tested, but we only recorded the worst case in this report.		

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

Load mode	Frequency Range (kHz)	Field Strength	Measured Field Strength Values					50% Limits	Limits
			Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
Mode 1	110.2-148.5	uT	0.122	0.135	0.144	0.127	0.149	--	--
Mode 1	110.2-148.5	A/m	0.098	0.108	0.115	0.102	0.119	0.815	1.63
Mode 1	110.2-148.5	V/m	36.828	40.729	43.164	38.273	44.775	307.0	614.0
Mode 2	110.2-148.5	uT	0.124	0.138	0.136	0.131	0.144	--	--
Mode 2	110.2-148.5	A/m	0.099	0.110	0.108	0.105	0.115	0.815	1.63
Mode 2	110.2-148.5	V/m	37.140	41.502	40.754	39.471	43.390	307.0	614.0
Mode 3	110.2-148.5	uT	0.123	0.138	0.135	0.124	0.140	--	--
Mode 3	110.2-148.5	A/m	0.098	0.110	0.108	0.100	0.112	0.815	1.63
Mode 3	110.2-148.5	V/m	36.878	41.491	40.626	37.404	42.054	307.0	614.0

Load mode	Frequency Range (kHz)	Field Strength	Measured Field Strength Values					50% Limits	Limits
			Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
Mode 1	127.6	uT	0.119	0.140	0.142	0.126	0.145	--	--
Mode 1	127.6	A/m	0.095	0.112	0.114	0.101	0.116	0.815	1.63
Mode 1	127.6	V/m	35.802	41.987	42.734	37.969	43.528	307	614
Mode 2	127.6	uT	0.123	0.135	0.141	0.134	0.141	--	--
Mode 2	127.6	A/m	0.098	0.108	0.112	0.107	0.112	0.815	1.63
Mode 2	127.6	V/m	36.957	40.575	42.259	40.348	42.282	307	614
Mode 3	127.6	uT	0.116	0.122	0.133	0.117	0.132	--	--
Mode 3	127.6	A/m	0.093	0.097	0.106	0.094	0.106	0.815	1.63
Mode 3	127.6	V/m	35.001	36.600	39.933	35.152	39.683	307	614

Load mode	Frequency Range (kHz)	Field Strength	Measured Field Strength Values					50% Limits	Limits
			Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
Mode 1	360.0	uT	0.120	0.134	0.138	0.132	0.147	--	--
Mode 1	360.0	A/m	0.096	0.107	0.110	0.105	0.117	0.815	1.63
Mode 1	360.0	V/m	35.933	40.167	41.483	39.562	44.124	307	614
Mode 2	360.0	uT	0.120	0.131	0.143	0.130	0.140	--	--
Mode 2	360.0	A/m	0.096	0.105	0.114	0.104	0.112	0.815	1.63
Mode 2	360.0	V/m	36.080	39.533	42.860	39.187	42.038	307	614
Mode 3	360.0	uT	0.116	0.127	0.134	0.122	0.138	--	--

Mode 3	360.0	A/m	0.093	0.102	0.108	0.098	0.111	0.815	1.63
Mode 3	360.0	V/m	34.938	38.172	40.430	36.806	41.626	307	614

Field Strength at 20 cm from the edges surrounding the EUT and 20cm from the top surface of the EUT

Load mode	Frequency Range (kHz)	Field Strength	Measured Field Strength Values	50% Limits	Limits
			Test Position E		
Mode 1	110.2-148.5	uT	0.145	--	--
Mode 1	110.2-148.5	A/m	0.116	0.815	1.63
Mode 1	110.2-148.5	V/m	43.683	307	614
Mode 2	110.2-148.5	uT	0.143	--	--
Mode 2	110.2-148.5	A/m	0.114	0.815	1.63
Mode 2	110.2-148.5	V/m	42.952	307	614
Mode 3	110.2-148.5	uT	0.130	--	--
Mode 3	110.2-148.5	A/m	0.104	0.815	1.63
Mode 3	110.2-148.5	V/m	39.052	307	614

Load mode	Frequency Range (kHz)	Field Strength	Measured Field Strength Values	50% Limits	Limits
			Test Position E		
Mode 1	127.6	uT	0.145	--	--
Mode 1	127.6	A/m	0.116	0.815	1.63
Mode 1	127.6	V/m	43.574	307	614
Mode 2	127.6	uT	0.134	--	--
Mode 2	127.6	A/m	0.108	0.815	1.63
Mode 2	127.6	V/m	40.422	307	614
Mode 3	127.6	uT	0.130	--	--
Mode 3	127.6	A/m	0.104	0.815	1.63
Mode 3	127.6	V/m	39.063	307	614

Load mode	Frequency Range (kHz)	Field Strength	Measured Field Strength Values	50% Limits	Limits
			Test Position E		
Mode 1	360.0	uT	0.135	--	--
Mode 1	360.0	A/m	0.108	0.815	1.63

Mode 1	360.0	V/m	40.669	307	614
Mode 2	360.0	uT	0.129	--	--
Mode 2	360.0	A/m	0.103	0.815	1.63
Mode 2	360.0	V/m	38.781	307	614
Mode 3	360.0	uT	0.125	--	--
Mode 3	360.0	A/m	0.100	0.815	1.63
Mode 3	360.0	V/m	37.727	307	614

Note:V/m=10(((20lg(A/m*10^6)+51.5)-120)/20)

Note:A/m=uT/1.25

9 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

Report Version	Issue Date	Revision Content	Revised By
000	October 16, 2024	Initial Issue	--

10 Photographs OF Test Setup

Please refer to separated files for RF Exposure test Setup Photos.

11 Description of Test Lab

NVLAP Accreditation Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.
CNAS Registration Number is L4595.
ISED Designation Number is 9642A.

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