

RF Exposure Evaluation

FCC ID; 2AVG2-G60

1 Measuring Standard

KDB 680106 D01 RF Exposure Wireless Charging Apps v03

2 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

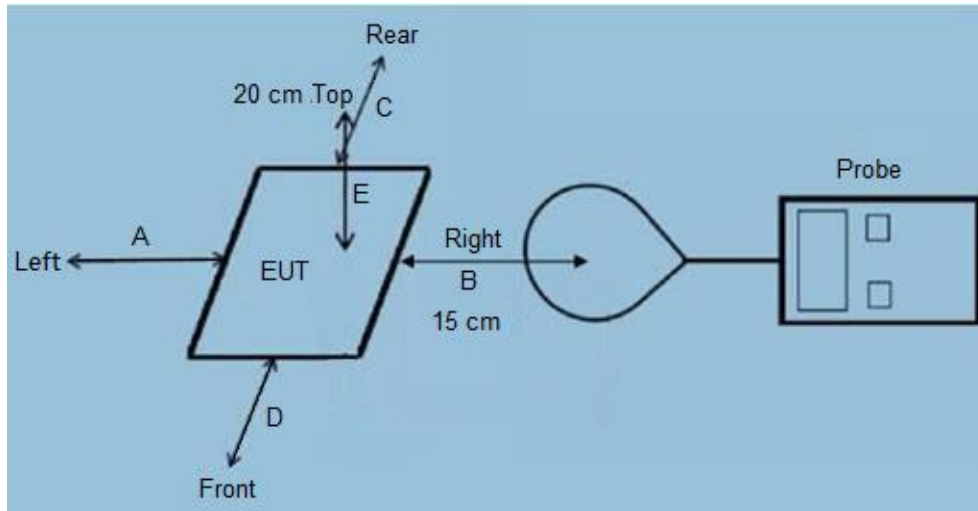
The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

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).

3 Test Setup



4 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.

5 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 for each 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. | No | The transfer system includes two charging circuit part and each part include one pair of primary and secondary coils. |
| 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 | 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. | | 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. |
|--|--|--|

6 Description of the test mode

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

☒ Charging and communication mode

| Test Modes: | | |
|---|--|------------|
| Mode 1 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 + Mobile Phone2 (Battery Status: <1%) | Record |
| Mode 2 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 + Mobile Phone2 (Battery Status: <50%) | Record |
| Mode 3 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 + Mobile Phone2 (Battery Status: 100%) | Record |
| Mode 4 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 (Battery Status: <1%) | Pre-tested |
| Mode 5 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 (Battery Status: <50%) | Pre-tested |
| Mode 6 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 (Battery Status: 100%) | Pre-tested |
| Mode 7 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone2 (Battery Status: <1%) | Pre-tested |
| Mode 8 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone2 (Battery Status: <50%) | Pre-tested |
| Mode 9 | AC/DC Adapter (5V/2A) + EUT + Mobile Phone2 (Battery Status: 100%) | Pre-tested |
| Mode 10 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone1 + Mobile Phone2 (Battery Status: <1%) | Pre-tested |
| Mode 11 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone1 + Mobile Phone2 (Battery Status: <50%) | Pre-tested |
| Mode 12 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone1 + Mobile Phone2 (Battery Status: 100%) | Pre-tested |
| Mode 13 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone1 (Battery Status: <1%) | Pre-tested |
| Mode 14 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone1 (Battery Status: <50%) | Pre-tested |
| Mode 15 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone1 (Battery Status: 100%) | Pre-tested |
| Mode 16 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone2 (Battery Status: <1%) | Pre-tested |
| Mode 17 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone2 (Battery Status: <50%) | Pre-tested |
| Mode 18 | AC/DC Adapter (9V/1.8A) + EUT + Mobile Phone2 (Battery Status: 100%) | Pre-tested |
| Note: All test modes were pre-tested, but we only recorded the worst case in this report. | | |

7 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 | CHENYANG ELECTRONICS | CD107 | Input: 100-240V~, 50/60Hz, 0.5A Output: 5V---2A / 9V---1.8A | CE/FCC | laboratory |
| / | / | / | / | / | / |
| / | / | / | / | / | / |
| / | / | / | / | / | / |

8 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 | June 29 2019 | June 28 2020 |
| Magnetic field probe 100cm ² | Narda | ELT probe 100cm ² | M0675 | June 29 2019 | June 28 2020 |

9 Test Result

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

| Test port | 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 | | |
| Phone port 1 | 1% | 0.136 | 2.33 | 2.57 | 1.98 | 2.05 | 3.47 | 307.0 | 614.0 |
| | 50% | 0.136 | 1.94 | 1.88 | 1.21 | 1.39 | 2.65 | 307.0 | 614.0 |
| | 99% | 0.136 | 1.34 | 1.16 | 1.04 | 1.15 | 1.93 | 307.0 | 614.0 |
| Phone port 2 | 1% | 0.136 | 2.40 | 2.52 | 2.05 | 2.10 | 3.54 | 307.0 | 614.0 |
| | 50% | 0.136 | 1.62 | 2.09 | 1.30 | 1.73 | 2.87 | 307.0 | 614.0 |
| | 99% | 0.136 | 1.26 | 1.29 | 1.15 | 1.22 | 2.20 | 307.0 | 614.0 |

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

| Test port | Charging Battery Level | Frequency Range (MHz) | 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 1 | 1% | 0.136 | 0.345 | 0.355 | 0.304 | 0.312 | 0.407 | 0.815 | 1.63 |
| | 50% | 0.136 | 0.289 | 0.308 | 0.222 | 0.240 | 0.366 | 0.815 | 1.63 |
| | 99% | 0.136 | 0.206 | 0.260 | 0.171 | 0.197 | 0.294 | 0.815 | 1.63 |
| Phone port 2 | 1% | 0.136 | 0.351 | 0.365 | 0.311 | 0.315 | 0.412 | 0.815 | 1.63 |
| | 50% | 0.136 | 0.272 | 0.322 | 0.246 | 0.273 | 0.354 | 0.815 | 1.63 |
| | 99% | 0.136 | 0.188 | 0.253 | 0.202 | 0.213 | 0.283 | 0.815 | 1.63 |

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

| Test port | Charging Battery Level | Frequency Range (MHz) | 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 1 | 1% | 0.136 | 0.367 | 0.815 | 1.63 |
| | 50% | 0.136 | 0.298 | 0.815 | 1.63 |
| | 99% | 0.136 | 0.224 | 0.815 | 1.63 |
| Phone port 2 | 1% | 0.136 | 0.359 | 0.815 | 1.63 |
| | 50% | 0.136 | 0.301 | 0.815 | 1.63 |
| | 99% | 0.136 | 0.239 | 0.815 | 1.63 |

10 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

| Spatial Average | 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 | | |
| E_{AVG} | 1% | 0.136 | 2.37 | 2.55 | 2.02 | 2.08 | 3.51 | 307.0 | 614.0 |
| | 50% | 0.136 | 1.78 | 1.99 | 1.26 | 1.56 | 2.76 | 307.0 | 614.0 |
| | 99% | 0.136 | 1.30 | 1.23 | 1.10 | 1.19 | 2.07 | 307.0 | 614.0 |

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

| Spatial Average | 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 | | |
| H_{AVG} | 1% | 0.136 | 0.348 | 0.360 | 0.308 | 0.314 | 0.410 | 0.815 | 1.63 |
| | 50% | 0.136 | 0.281 | 0.315 | 0.234 | 0.257 | 0.360 | 0.815 | 1.63 |
| | 99% | 0.136 | 0.197 | 0.257 | 0.187 | 0.205 | 0.289 | 0.815 | 1.63 |


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

| Charge Port | 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 E | | |
| H_{AVG} | 1% | 0.136 | 0.363 | 0.815 | 1.63 |
| | 50% | 0.136 | 0.300 | 0.815 | 1.63 |
| | 99% | 0.136 | 0.232 | 0.815 | 1.63 |

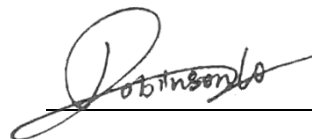
11 Conclusion

A minimum safety distance of 20 cm to the antenna is required when the device is charging a smart phone for mobile exposure. The detected emissions are below the limitations according FCC KDB 680106 and confirmed by the FCC according to KDB Inquire.

Test Engineer:



Reviewer:



12 Test Set-up Photo





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