# RF Exposure Evaluation Report

## 1. Product Information

| | |
|---|---|
| FCC ID: | 2AIPA-AT1200 |
| Product Name | 3 Port Wireless Charger |
| Model Number | AT1200 |
| Power Supply | DC 9V/3500mA by POWER SUPPLY |
| Modulation Type | Continuous Wave |
| Frequency Range | 105.0 KHz – 189.0 KHz |
| Operation Frequency | 161.0 KHz |
| Antenna Type | Coil Antenna |
| Hardware version | MXN-3XQWXKC003-10W-V03H |
| Software version | V92 |
| Accessories | Mobile Phone (With Wireless Charging Receiver Module) |
| 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) Consumer wireless power transfer devices approved under Part 15 and 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 10 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 10 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 KDB inquiry 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

## 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 v02: 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

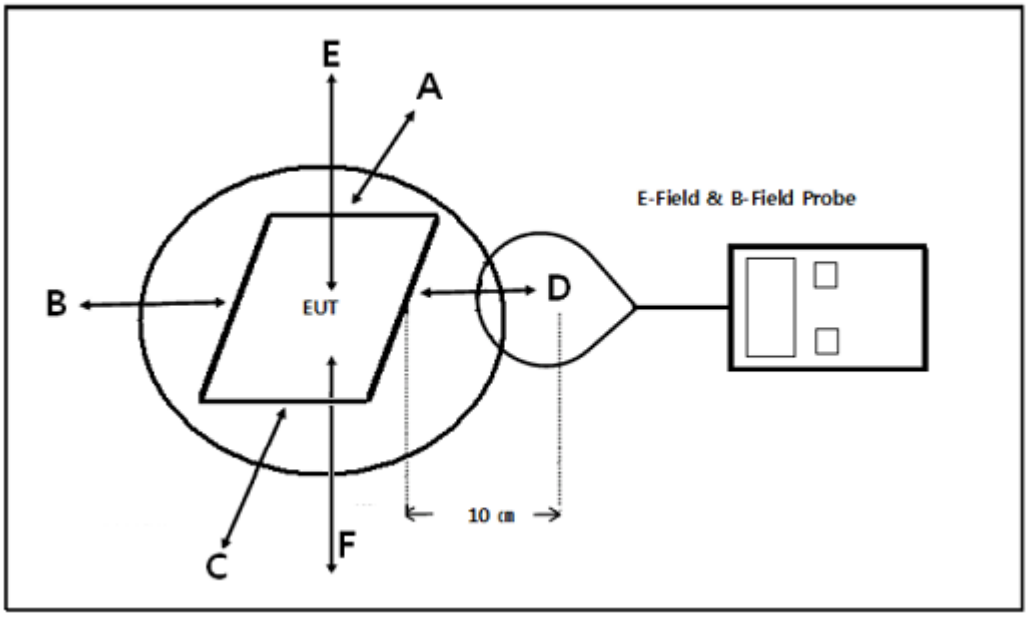
*=Plane-wave equivalent power density

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 10cm from the center of the probe to the edge of the device):

| | E-filed | H-filed | B-filed |
|---|---|---|---|
| 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




Due to installation limitations no tests from the underside of the charging device (Test Position F) are required.

## 5. Test Equipment

| Equipment | Manufacturer | Model | Serial no. | Calibrated date | Calibrated Due |
|---|---|---|---|---|---|
| Exposure Level Tester | Narda | ELT-400 | N-0713 | 2017-04-03 | 2018-04-02 |
| B-Field Probe | Narda | ELT-400 | M-1154 | 2017-04-11 | 2018-04-10 |

## 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 (10cm) 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 680106D01v02.

## 7. Equipment Approval Considerations

The EUT does comply with item 5.2 of KDB 680106 D01v02 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 105.0 KHz - 189.0 KHz |
| Output power from each primary coil is less than 5 watts | No | 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 | No | The transfer system includes three same charging circuit part and each part include only single primary and secondary coils. |
| Client device is inserted in or placed directly in contact with the transmitter | Yes | Client device is placed directly in contact with the transmitter. |
| The maximum coupling surface area of the transmit (charging) device is between 60 $cm^2$ and 400 $cm^2$ | No | The maximum coupling surface area for each port of the EUT was 23 $cm^2$<60$cm^2$ |
| Aggregate leakage fields at 10 cm surrounding the device from all simultaneous transmitting coils are demonstrated to be less than 30% of the MPE limit. | Yes | The EUT E-field strength levels at 10cm and H- field strength levels at 10cm are less than 30% 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

## 8.1 Symbols

For the purpose of the present document, the following symbols apply;

E: Filed strength
H: Magnetic field strength
$E_{AVG}$ = Spatial average of Filed strength
$H_{AVG}$ = Spatial average of Magnetic field strength
$E_1$: Filed Strength of wireless charge port 1
$H_1$: Magnetic field strength of wireless charge port 1
$E_{1A}$: Filed strength of wireless charge port 1 at test position A
$H_{1A}$: Magnetic field strength of wireless charge port 1 at test position A

## 8.2 Standalone E-Filed Strength and H-Filed Strength

The three charge ports are same for rated power, tested at charge together and measure each five points;

Test mode: Normal Operation (Charging mode)

E-Filed Strength at 10 cm from the edges surrounding the EUT

| Charge Port | Charging Battery Level | Frequency Range (MHz) | Measured E-Field Strength Values (V/m) | | | | | FCC E-Field Strength Limits (V/m) |
|---|---|---|---|---|---|---|---|---|
| | | | Test Position A | Test Position B | Test Position C | Test Position D | Test Position E | |
| $E_1$ | 1% | 0.1610 | 6.01 | 5.72 | 6.11 | 6.06 | 5.89 | 614.0 |
| | 50% | 0.1610 | 5.66 | 5.39 | 5.80 | 5.72 | 5.48 | 614.0 |
| | 99% | 0.1610 | 5.23 | 5.02 | 5.49 | 5.29 | 5.33 | 614.0 |
| $E_2$ | 1% | 0.1610 | 6.25 | 5.77 | 6.29 | 6.08 | 5.95 | 614.0 |
| | 50% | 0.1610 | 5.81 | 5.43 | 5.85 | 5.73 | 5.53 | 614.0 |
| | 99% | 0.1610 | 5.56 | 5.05 | 5.59 | 5.32 | 5.27 | 614.0 |
| $E_3$ | 1% | 0.1610 | 5.88 | 5.68 | 5.93 | 6.01 | 5.71 | 614.0 |
| | 50% | 0.1610 | 5.57 | 5.31 | 5.84 | 5.68 | 5.36 | 614.0 |
| | 99% | 0.1610 | 5.43 | 4.97 | 5.47 | 5.25 | 5.02 | 614.0 |

H-Filed Strength at 10 cm from the edges surrounding the EUT

| Charge Port | Charging Battery Level | Frequency Range (MHz) | Measured H-Field Strength Values (A/m) | | | | | FCC H-Field Strength Limits (A/m) |
|---|---|---|---|---|---|---|---|---|
| | | | Test Position A | Test Position B | Test Position C | Test Position D | Test Position E | |
| $H_1$ | 1% | 0.1610 | 0.106 | 0.094 | 0.109 | 0.107 | 0.099 | 1.63 |
| | 50% | 0.1610 | 0.098 | 0.089 | 0.100 | 0.098 | 0.092 | 1.63 |
| | 99% | 0.1610 | 0.071 | 0.066 | 0.077 | 0.075 | 0.067 | 1.63 |
| $H_2$ | 1% | 0.1610 | 0.112 | 0.099 | 0.116 | 0.113 | 0.105 | 1.63 |
| | 50% | 0.1610 | 0.105 | 0.094 | 0.108 | 0.107 | 0.100 | 1.63 |
| | 99% | 0.1610 | 0.077 | 0.068 | 0.081 | 0.080 | 0.071 | 1.63 |
| $H_3$ | 1% | 0.1610 | 0.101 | 0.090 | 0.103 | 0.102 | 0.096 | 1.63 |
| | 50% | 0.1610 | 0.094 | 0.083 | 0.098 | 0.094 | 0.086 | 1.63 |
| | 99% | 0.1610 | 0.070 | 0.059 | 0.077 | 0.072 | 0.061 | 1.63 |

## 8.3 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 10 cm surrounding the device from all simultaneous transmitting coils are demonstrated to be less than 30% 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 § 1.310 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 10 cm from the edges surrounding the EUT

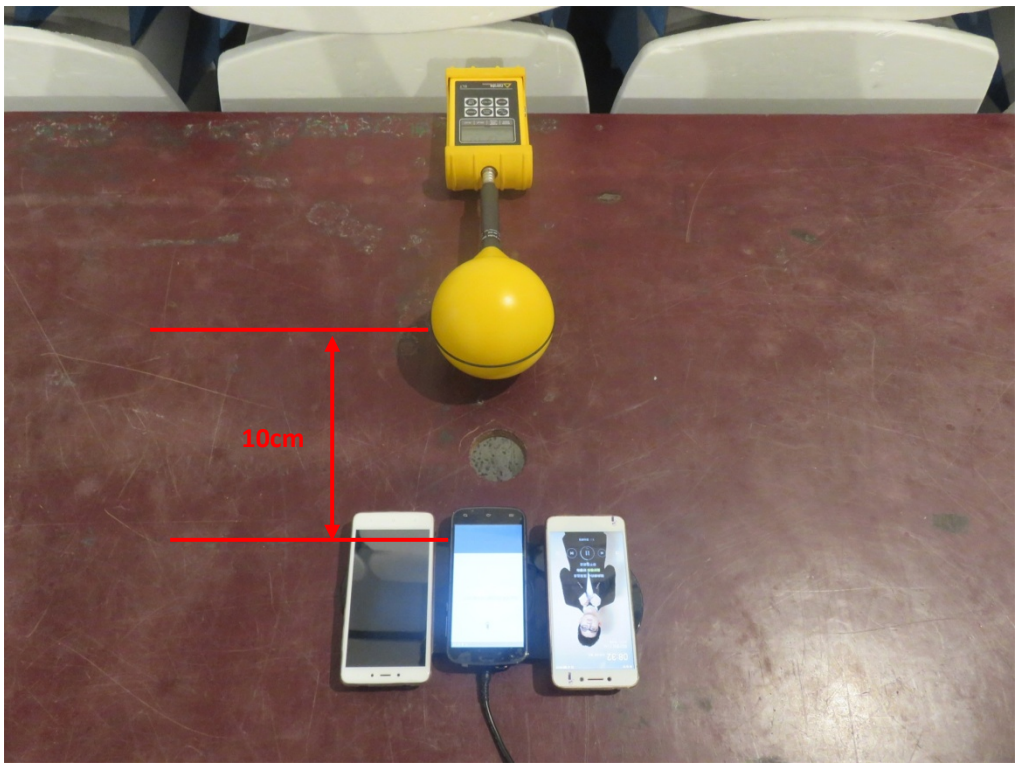
| Spatial Average | Charging Battery Level | Frequency Range (MHz) | Measured E-Field Strength Values (V/m) | | | | | FCC E-Field Strength Limits (V/m) |
|---|---|---|---|---|---|---|---|---|
| | | | Test Position A | Test Position B | Test Position C | Test Position D | Test Position E | |
| $E_{AVG}$ | 1% | 0.1610 | 6.047 | 5.723 | 6.110 | 6.050 | 5.850 | 614.0 |
| | 50% | 0.1610 | 5.680 | 5.377 | 5.830 | 5.710 | 5.457 | 614.0 |
| | 99% | 0.1610 | 5.407 | 5.013 | 5.517 | 5.287 | 5.207 | 614.0 |

H-Filed Strength at 10 cm from the edges surrounding the EUT

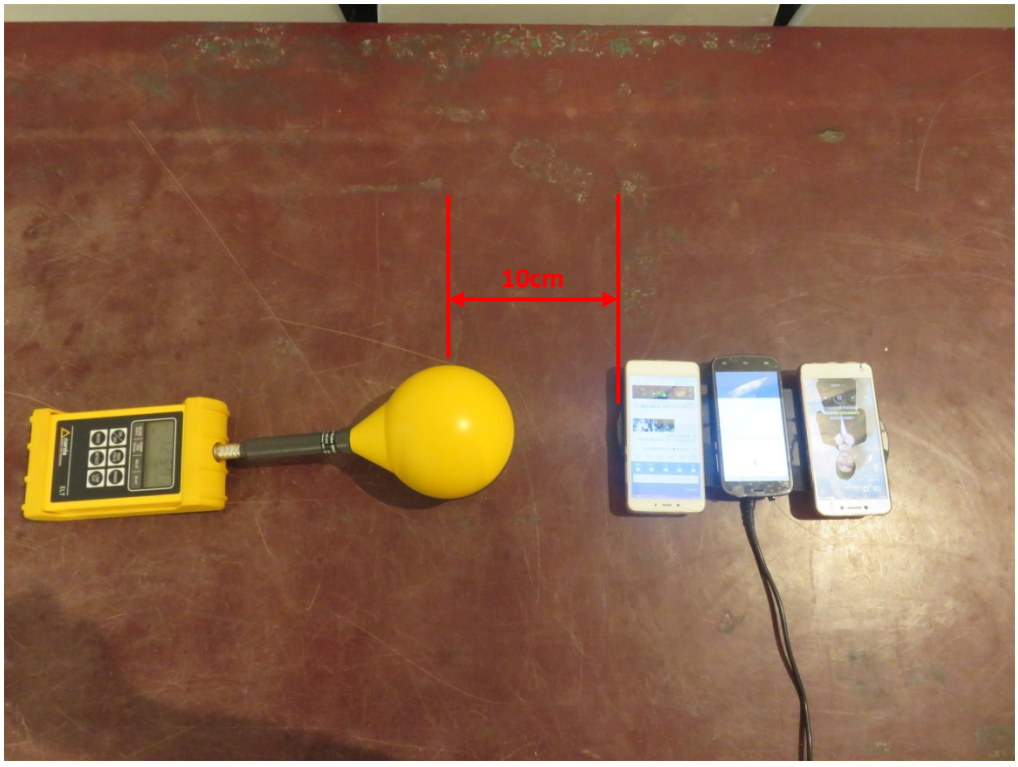
| Spatial Average | Charging Battery Level | Frequency Range (MHz) | Measured H-Field Strength Values (A/m) | | | | | FCC H-Field Strength Limits (A/m) |
|---|---|---|---|---|---|---|---|---|
| | | | Test Position A | Test Position B | Test Position C | Test Position D | Test Position E | |
| $H_{AVG}$ | 1% | 0.1610 | 0.106 | 0.094 | 0.109 | 0.107 | 0.100 | 1.63 |
| | 50% | 0.1610 | 0.099 | 0.089 | 0.102 | 0.100 | 0.093 | 1.63 |
| | 99% | 0.1610 | 0.073 | 0.064 | 0.078 | 0.076 | 0.066 | 1.63 |

## 9. Test Setup Photos

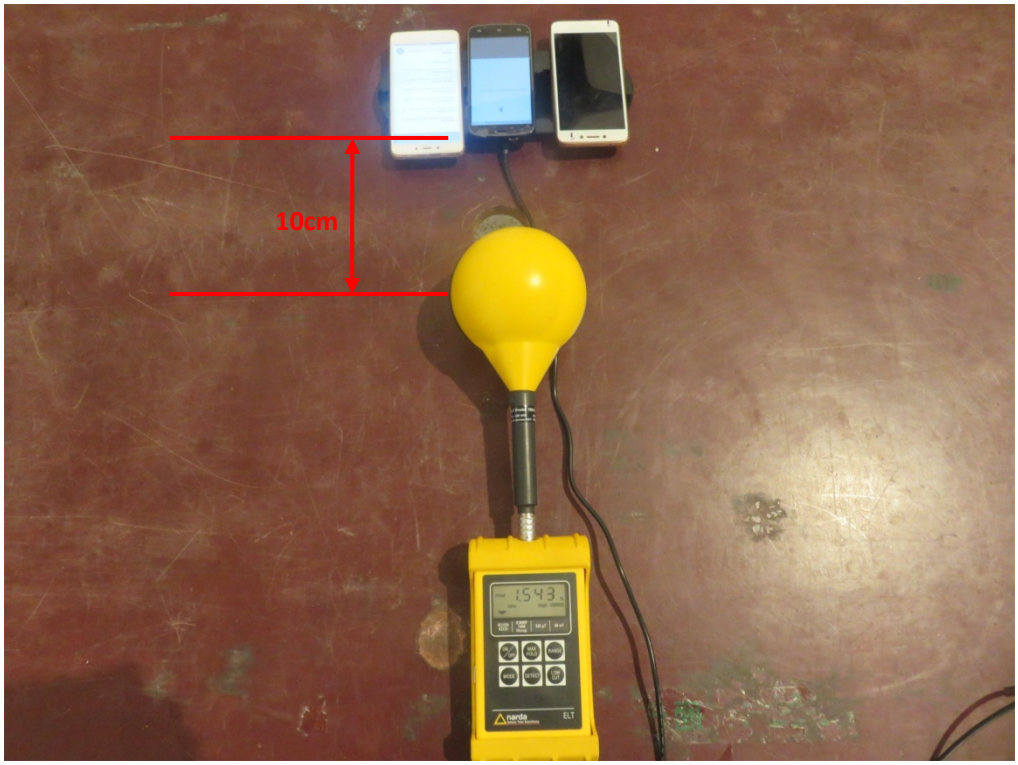
DUT – measurement position A – top side with 10 cm distance charging three smartphones



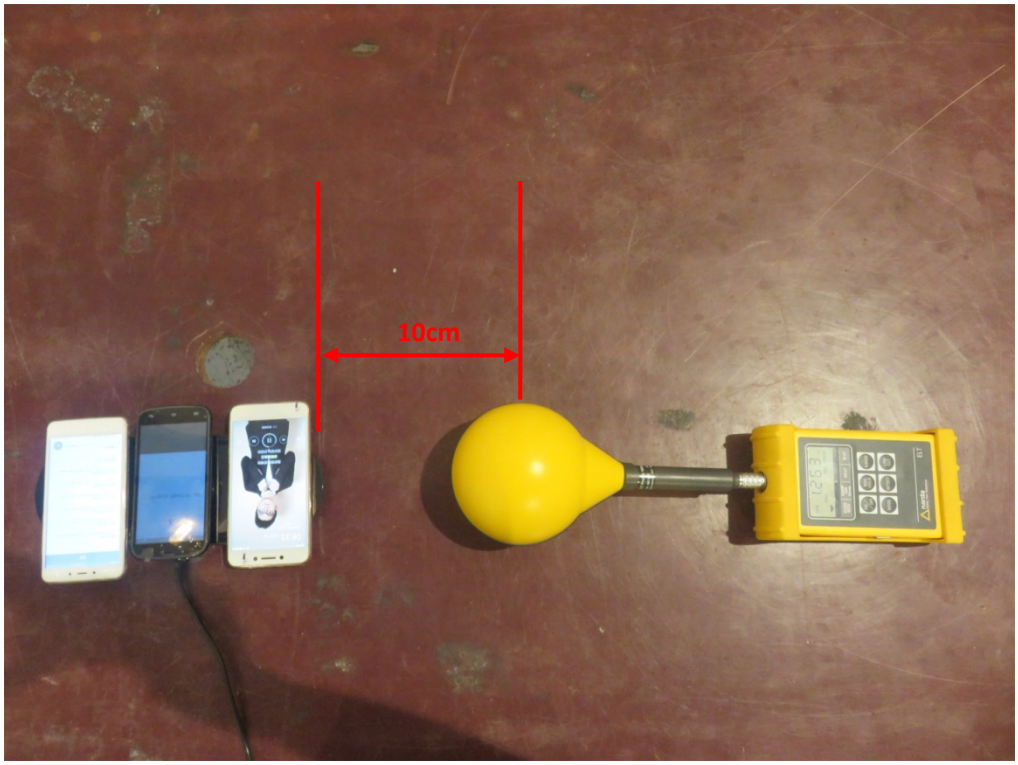

DUT – measurement position B – left side with 10 cm distance charging three smartphones



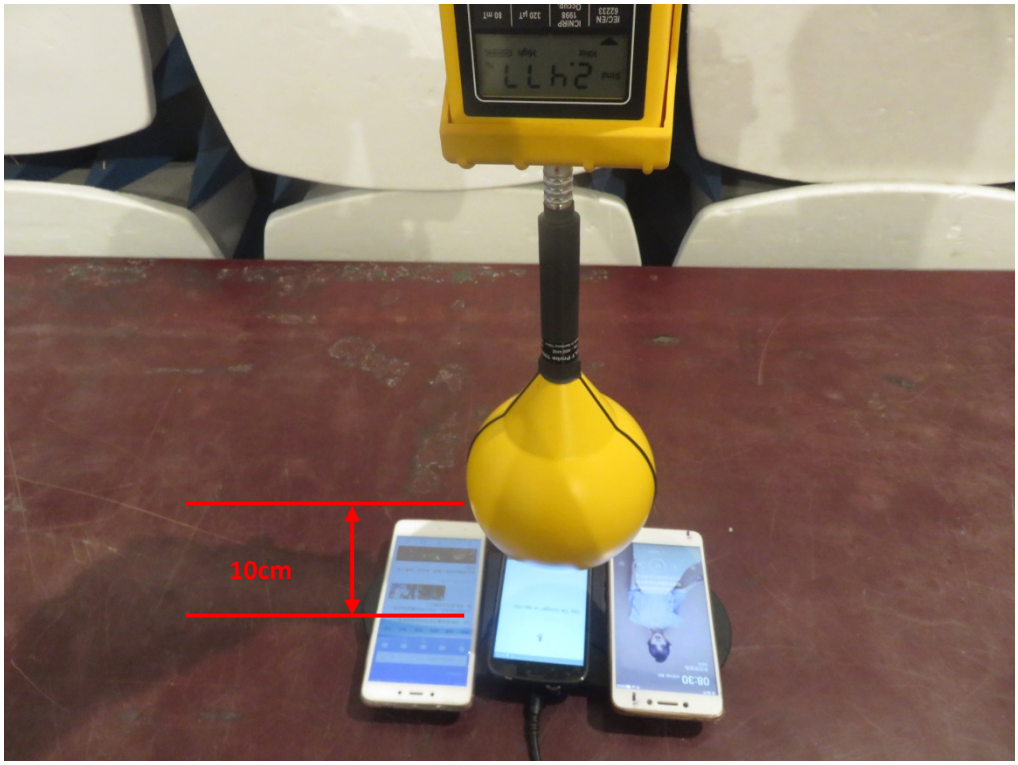
DUT – measurement position C – bottom side with 10 cm distance charging three smartphones




DUT – measurement position D – right side with 10 cm distance charging three smartphones



DUT – measurement position E – front side with 10 cm distance charging three smartphones




## 10. Conclusion

A minimum safety distance of 10 cm to the antenna is required when the device is charging a smart phone. The detected emissions with a distance of 10 cm 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 | January 17, 2018 | Initial Issue | Gavin Liang |
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.....END OF REPORT.....