# RF Exposure Evaluation

## Client Information:

| | |
|---|---|
| Applicant: | Otter Products, LLC. |
| Applicant add.: | 209 South Meldrum, Fort Collins, Colorado 80521, United States |
| Manufacturer: | Hamedata Technology Co.,Limited |
| Manufacturer add.: | 1-3F & 6-8F, BLDG#A,Changfang Industrial Park, No.2 Guihua 5th Road, Pingshan District, Shenzhen |

## Product Information:

| | |
|---|---|
| Product Name: | Power Bank |
| Model No.: | OBFTC-0178-A |
| Brand Name: | N/A |
| FCC ID: | 2AEEV-OBFTC-0178-A |
| Applicable standards: | FCC CFR 47 PART 1, § 1.1310<br>KDB 680106 D01 Wireless Power Transfer v04 |

## Prepared By:

**Guangdong Asia Hongke Test Technology Limited**

B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Tel.: +86 0755-230967639 Fax.: +86 0755-230967639

Date of Receipt: Jul. 12, 2024 Date of Test: Jul. 12, 2024 ~ Jul. 23, 2024

Date of Issue: Jul. 23, 2024 Test Result: Pass

This device described above has been tested by Guangdong Asia Hongke Test Technology Limited and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.



**Reviewed by:** Leon Yi Leon.yi

**Approved by:** Sean She Sean She

# TABLE OF CONTENTS

**Revision History**

| Revision | Issue Date | Revisions | Revised By |
|---|---|---|---|
| 00 | Jul. 23, 2024 | Initial Issue | Sean She |
| | | | |
| | | | |

# 1 TEST FACILITY

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

**FCC-Registration No.: 251906 Designation Number: CN1376**

Guangdong Asia Hongke Test Technology Limited has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

**IC —Registration No.: 31737 CAB identifier: CN0165**

The 3m Semi-anechoic chamber of Guangdong Asia Hongke Test Technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 31737

**A2LA-Lab Cert. No.: 7133.01**

Guangdong Asia Hongke Test Technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

## 1.1 Deviation from standard

None

## 1.2 Abnormalities from standard conditions

None

## 1.3 Test Location

**Guangdong Asia Hongke Test Technology Limited**
Address: B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Tel.: +86 0755-230967639 Fax.: +86 0755-230967639

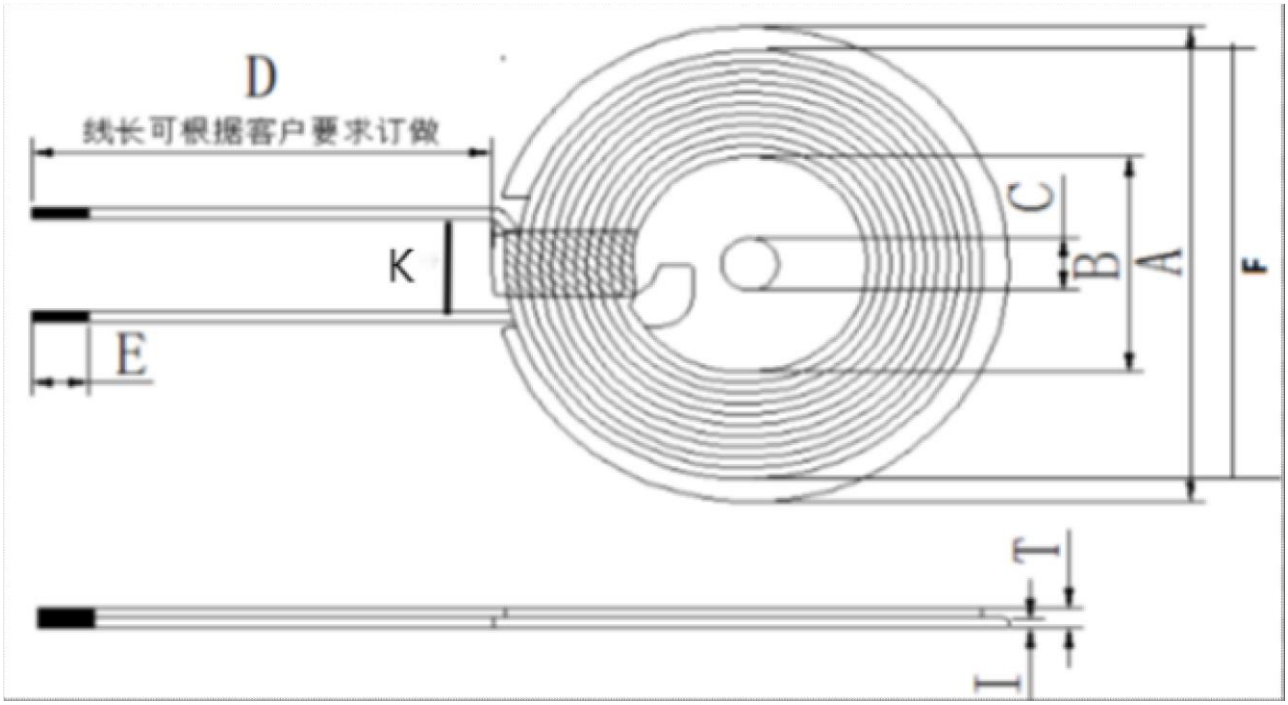
# 2 GENERAL INFORMATION

| | |
|---|---|
| EUT Name: | Power Bank |
| Model No: | OBFTC-0178-A |
| Serial Model: | N/A |
| Test sample(s) ID: | AiTDG-240712013-1 |
| Sample(s) Status: | Engineer sample |
| Operation frequency: | 111kHz-205kHz |
| Modulation Technology: | ASK |
| Antenna Type: | loop coil Antenna |
| Antenna gain: | 0dBi |
| Hardware version.: | N/A |
| Software version.: | N/A |
| Power supply: | Battery Capacity: 5000mAh/3.7V/18.5Wh<br>Type-C Input: 5V⎓3A 9V⎓2A<br>Output: Wireless charging 7.5W<br>Type-C Output: 5V⎓2.4A<br>Output: 12W(Max) |
| Model different: | N/A |
| Note: | For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. |

## 2.1 Coil Specifications

| Item | Parameter |
|---|---|
| Input inductance: | L0A（Individual coils）=3.8uH±20%<br>L0A(Coil + magnetic sheet)=6.8uH±10% |
| Material of enclosure(s): | Hot Air stranded Wire |
| Number of turns: | Transmitter 1: 11 turns |

## 2.2 Coil Size



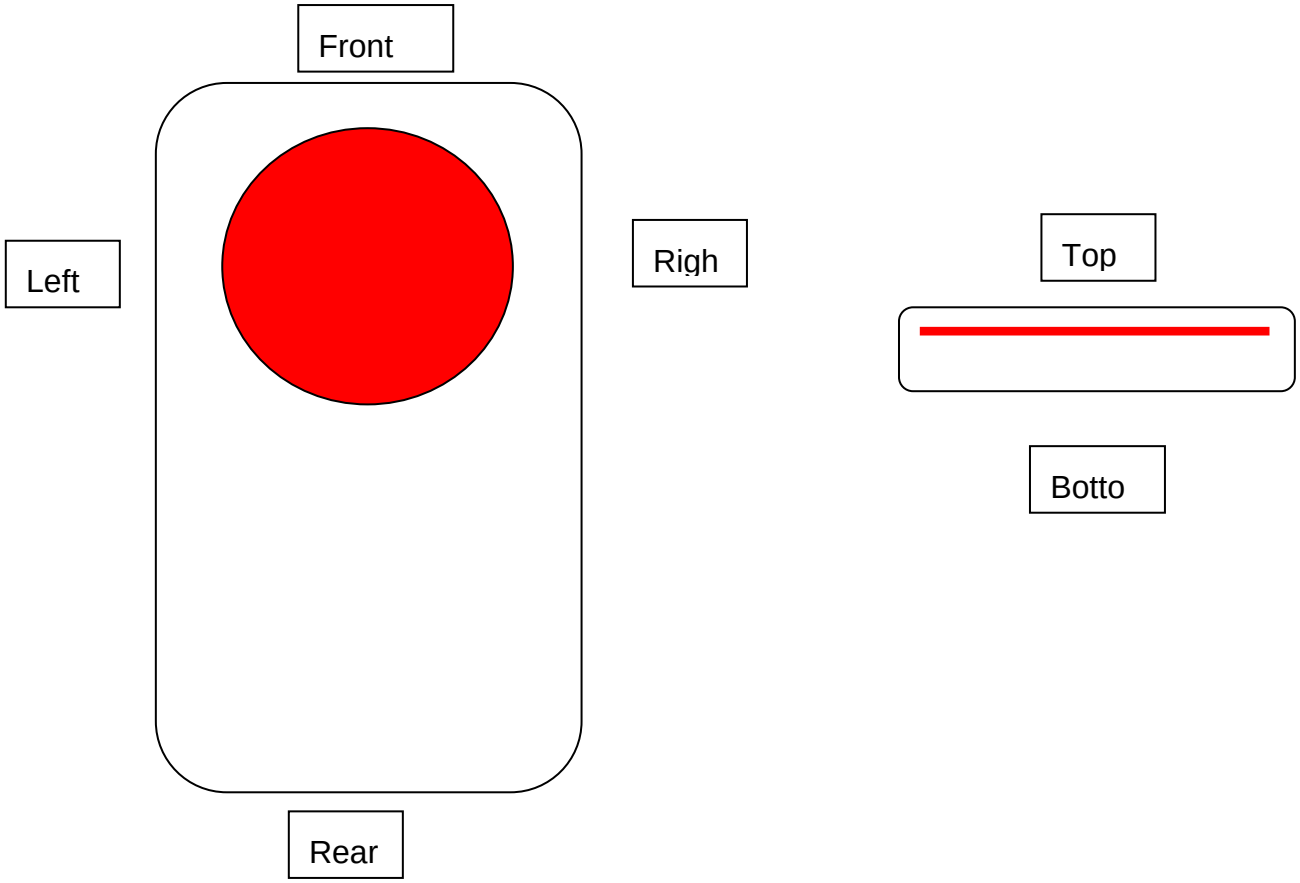

Unit: mm

| A | B | C | D | E | F | I | T | K |
|---|---|---|---|---|---|---|---|---|
| 43.5±0.5 | 18±0.5 | 5.3±0.5 | 35±2 | 2-5 | 39.5±1.2 | 0.6±0.1 | 1.5Max | ≤5 |

## 2.3 Location(s) – Coil to the outer surface of the enclosure(s)

Unit: mm

| Front A | Rear B | Left C | Right D | Top E | Bottom F |
|---|---|---|---|---|---|
| 45 | 8 | 10 | 10 | 3 | 7 |



# 3 TEST METHODOLOGY

## 3.1 Measuring Standard

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Cocmission's guidelines. According to §1.1310 and §2.1091 RF exposure is calculated. According KDB680106 D01: KDB 680106 D01 Wireless Power Transfer v04.

## 3.2 Requirements

According to the item 3 of KDB 680106 D01v04:

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

(1) Mobile Device and Portable Device Configurations

(2) Equipment Authorization Procedures for Devices Operating at Frequencies Below 4 MHz

(3) The aggregate H-field strengths anywhere at or beyond 15 cm surrounding the device, and 20 cm away from the top surface.

### 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 |

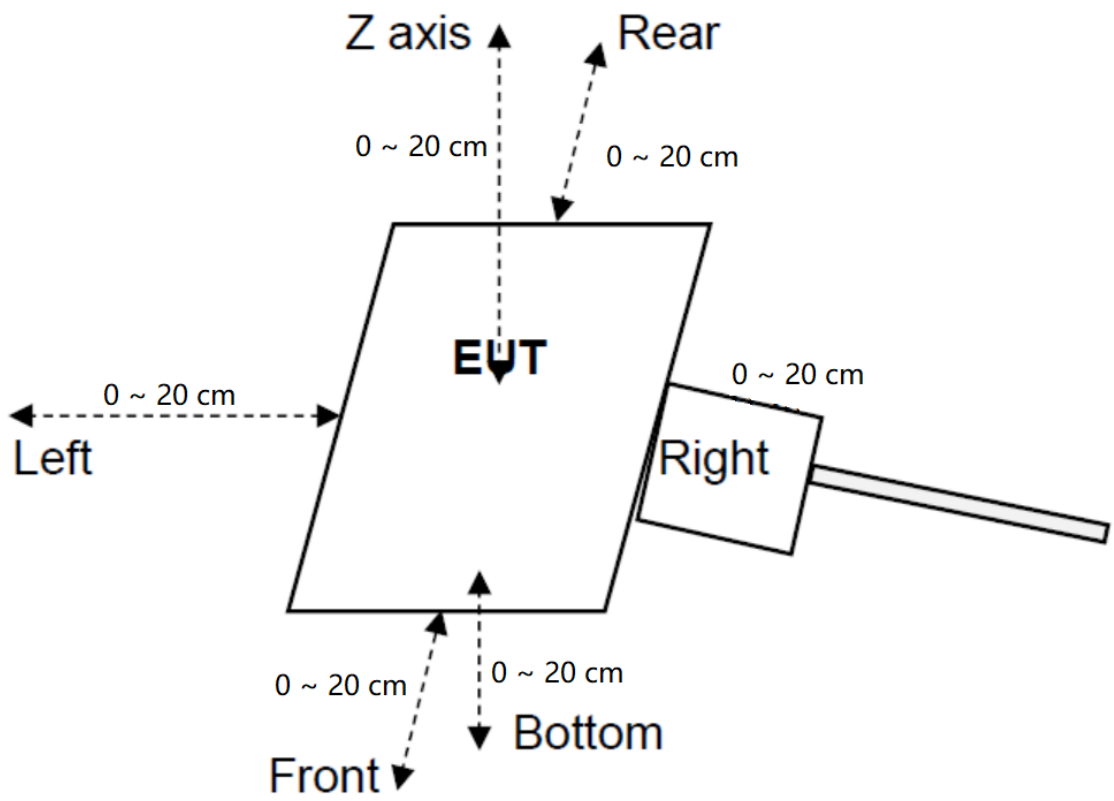
F=frequency in MHz
*=Plane-wave equivalent power density
RF exposure compliance will need to be determined with respect to 1.1307(c) and (d) of the FCC rules. The emissions should be within the limits at 300kHz in Table 1 of 1.1310(use the 300kHz limits for 150kHz:614V/m,1.63A/m).

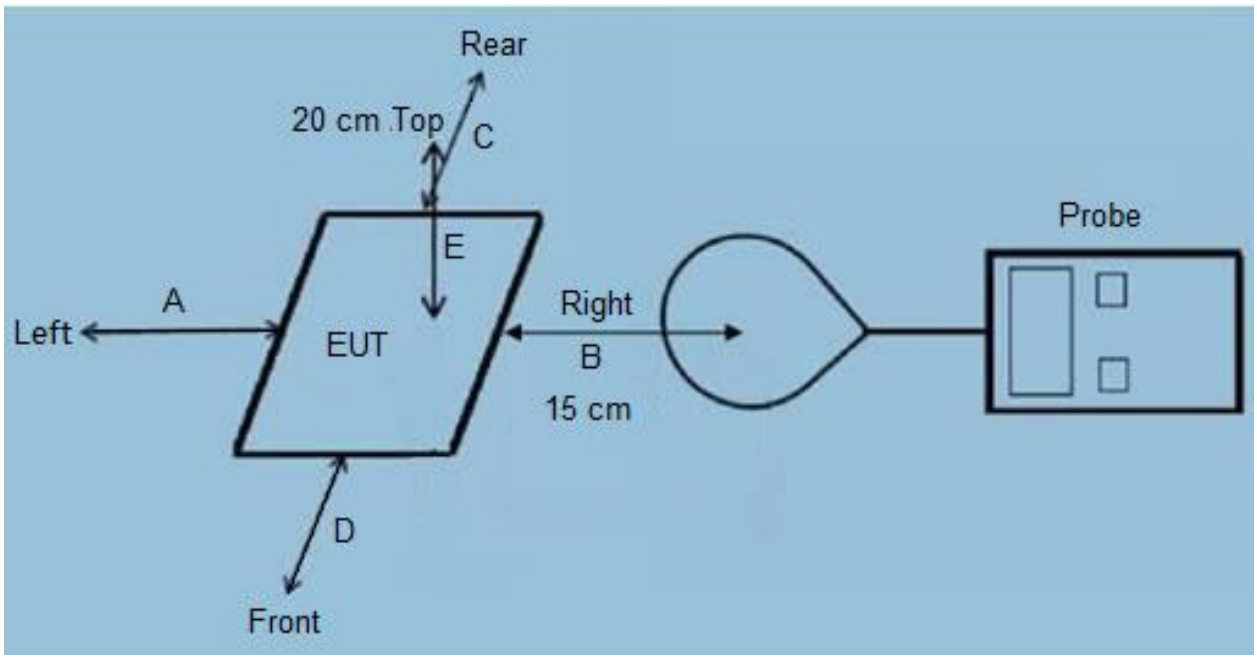
Note 1: f = frequency in MHz; *Plane-wave equivalent power density

Note 2: For the applicable limit, see FCC 1.1310, 680106 D01 RF Exposure Wireless Charging Apps v03

Note 3: 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.

### 3.3 Test Setup

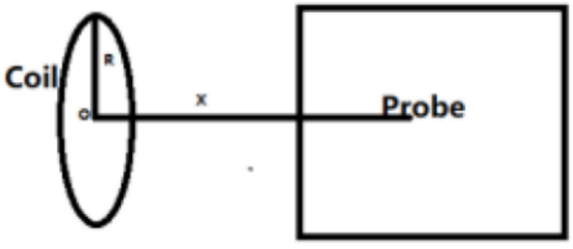


## 3.4 Test Procedure

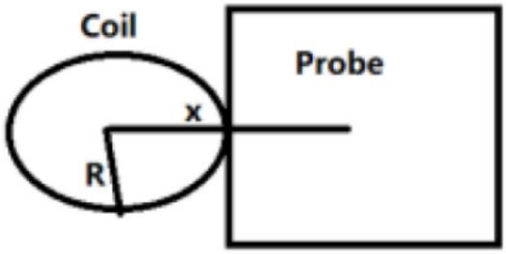
1) The RF exposure test was performed in anechoic chamber.
2) The measurement probe was placed at test distance (2cm increments from 0 ~ 20 cm for all sides for portable mode, 15 cm from all sides and 20 cm from the top for mobile mode) which is between the edge of the charger and the geometric edge 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, F) were completed.
4) The EUT was measured according to the dictates of KDB 680106 D01 Wireless Power Transfer v04.
5) According to the reguirements if KDB 680106 D01 v04, If the center of the probe sensing element is located more than 5mm from the probe outer surface, the field strengths need to be estimated through modeling for those positions that are not reachable. (The sensitive elements are located approximately 18.5 mm below the external surface specified in user manual of MAGPy-8H3D+E3D)
6) Use Biot-Savart Law, the value of 0 cm can be estimated through the results of 2 cm, according to the formula:

**Top & Bottom Side:**




$$B = \frac{\mu_0 * I * N * R^2}{2 * (R^2 + x^2)^{3/2}}$$

**Front, left, right & rear Side:**




$$B = \frac{\mu_0 * I * N}{2 * x}$$

Remark:

B: H-field (Unit:T)

$u_0$: Space permeability = $4*pi*10^{-7}$

I (Unit: A):The current element passing through a radiated coil

R: Radius of radiated coil, according to the coil specification: R=0.01975m

X: The distance from the sensing elements of the probe to the edge of the radiated coil (the dimensions of EUT and load are take into account), (Unit: m)

N: Turns of the radiated coil, according to the coil specification: N=11.

# 4 Equipment Approval Considerations

The EUT does comply with KDB 680106 D01 as follow table.

| Requirements of section 5 of KDB 680106 D01 | Yes / No | Description |
|---|---|---|
| Mobile Device and Portable Device Configurations | Yes | Mobile Device or Portable Device |
| Equipment Authorization Procedures for Devices Operating at Frequencies Below 4 MHz | Yes | The device operates in the frequency range 111kHz-205kHz |
| RF Exposure compliance may be ensured only for a minimum separation distance that is greater than 20 cm, while use conditions at smaller distances can still be considered unlikely. | Yes | Mobile mode:<br>The EUT H-field strengths at 15 cm surrounding the device and 20 cm above the top surface.<br>Portable mode:<br>H-field and E-field measurement taken every 2 cm (starting as close to 20 cm as possible) on each edge/top surface of the host/client pair were also evaluated for portable use conditions. |

## 4.1 Description of the test mode

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

| Test Mode | Description | |
|---|---|---|
| Mode 1 | AC Adapter + EUT + phone (Battery Status: < 1%) | Record |
| Mode 2 | AC Adapter + EUT + phone (Battery Status: < 50%) | Record |
| Mode 3 | AC Adapter + EUT + phone (Battery Status: < 99%) | Record |
| Mode 4 | EUT + phone (Battery Status: < 1%) | Record |
| Mode 5 | EUT + phone (Battery Status: < 50%) | Pre-tested |
| Mode 6 | EUT + phone (Battery Status: < 99%) | Pre-tested |
| Mode 7 | Test the EUT in idle mode. | Pre-tested |
| Note: All test modes were pre-tested, but we only recorded the worst case in this report. | | |

## 4.2 Peripheral List

| No. | Equipment | Manufacturer | Model No. | Serial No. | Power cord | signal cable |
|---|---|---|---|---|---|---|
| 1 | Phone | Apple | iPhone 14 | N/A | N/A | N/A |
| 2 | Adapter | HNT | HNT-QC530 | N/A | N/A | N/A |

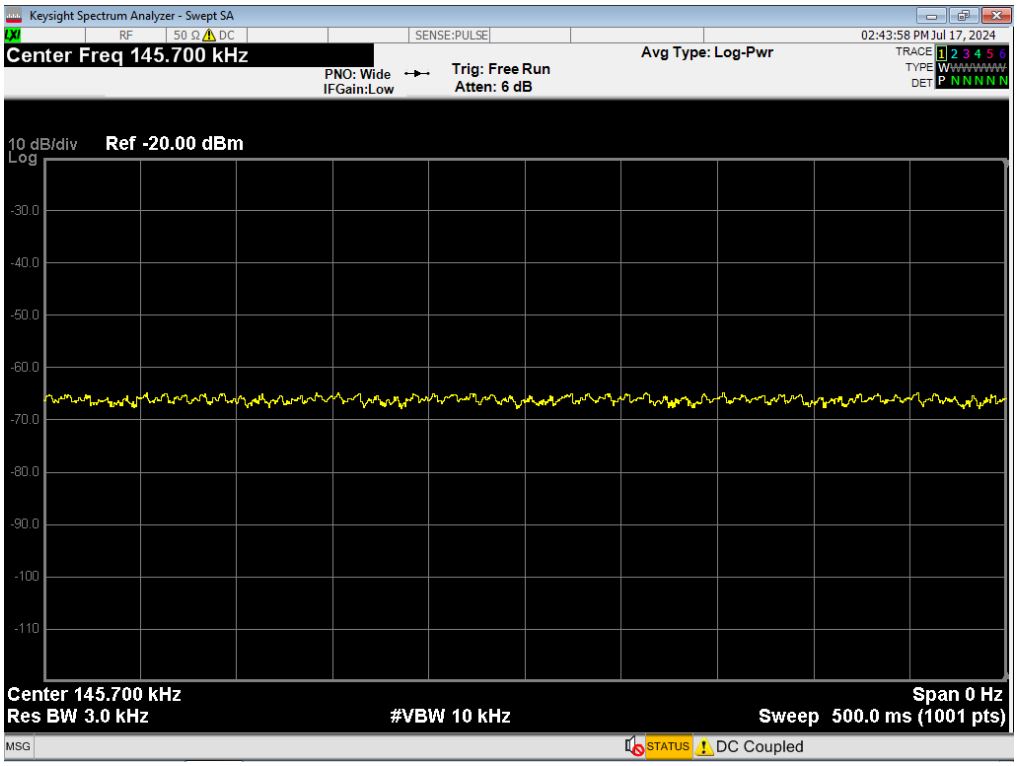
## 4.3 Test Instruments list

| Test Equipment | Manufacturer | Model No. | SN. | Cal. Date (mm-dd-yy) | Cal. Due date (mm-dd-yy) |
|---|---|---|---|---|---|
| Magnetic Amplitude and Gradient Probe System | SPEAG | MAGPy-8H3D+E3D V2.6 & MAGPy-DAS V2.6 | 3107 & 3097 | 03.15.2024 | 03.14.2025 |

| Parameter | Specs |
|---|---|
| PROBE DESIGN | |
| Diameter | 60 mm |
| 8 isotropic $H$-field sensors | concentric loops of 1 $cm^2$ arranged at the corner of a cube of 22 mm side length |
| 1 isotropic $E$-field sensor | orthogonal dipole/monopole (arm length: 50 mm) |
| Measurement center | 18.5 mm from the probe tip |
| Temperature range | 0–40 °C |
| Dimensions | 110 × 635 × 35 mm (MAGPy-8H3D+E3D V2 & MAGPy-DAS V2) |
| $H$-FIELD SPECIFICATION | |
| Frequency range | 3 kHz–10 MHz |
| Measurement range | 0.1–3200 A/m, 0.12 µT–4 mT |
| Gradient range | 0–80 T/m/T |
| $E$-FIELD SPECIFICATION | |
| Frequency range | 3 kHz–10 MHz |
| Measurement range | 0.08–2000 V/m |

## 4.4 Duty Cycle

| Mode | ON Time(ms) | Period(ms) | Duty Cycle(%) |
|---|---|---|---|
| Operating(113kHz-205kHz) | / | / | 100 |



## 4.5 Compliance Location: Center vs Tip-Surface of the Probe

The following information is from the equipment manual:

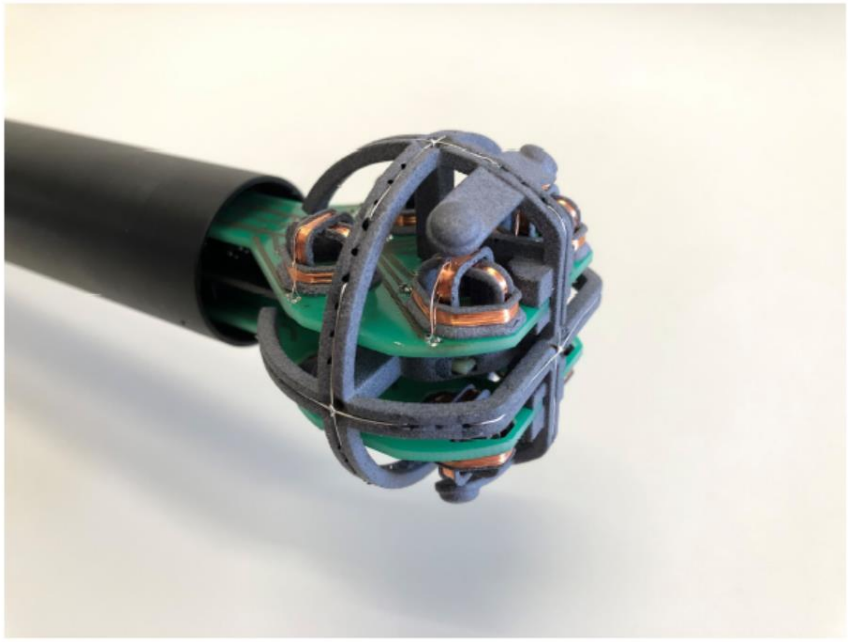


Figure 2.1: MAGPy-8H3D+E3D V2 probe, without the casing

In the MAGPy V2.0 implementation, the H-field is evaluated at the center of the probe (which is 18.5mm above the surface of its tip) and also at the surface of its tip.

In the MAGPy V2.0 implementation, the $H$-field is evaluated at the center of the probe (which is 18.5 mm above the surface of its tip) and also at the surface of its tip.

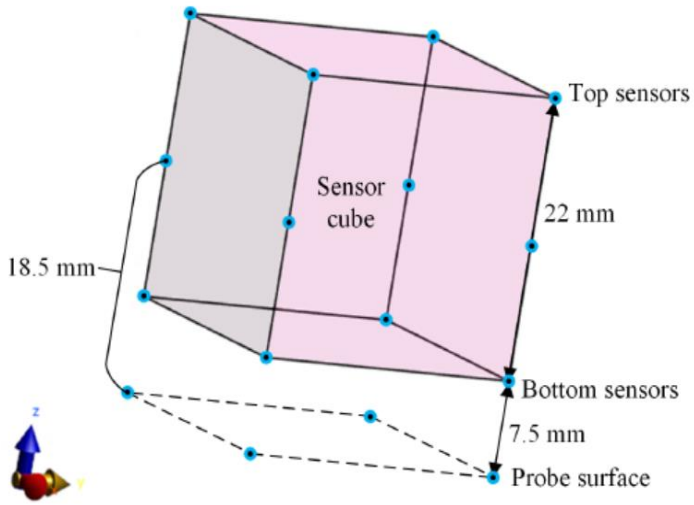



Figure 2.5: Extrapolation of the total H-field at the probe surface is made at each pair of sensors (i.e., bottom and top sensors) around the sensor cube

The total $H$-field at the tip-surface $H_{tip-surface}$ can be extrapolated using the total $H$-field measured at the top and bottom sensors (Figure 2.5), $H_{top}$ and $H_{bottom}$, as well as the normalized $H$-field gradient $G_n$. The field extrapolation formula is a polynomial function of $G_n$ ($\Delta d = 18.5$ mm) [7].

$$H_{tip-surface} = \frac{H_{bottom} + H_{top}}{2} \sum_{i=0}^{7} c_i \left(G_n \Delta d\right)^i \tag{1.6}$$

The polynomial coefficients $c_i$ are given in Table 2.2. They have been determined from simulations of 70 coils covering normalized gradients up to 80 for the 97.5$^{\text{th}}$ percentile (Figure 2.6). This provides a conservative estimate of the total $H$-field at the tip-surface without large overestimation.

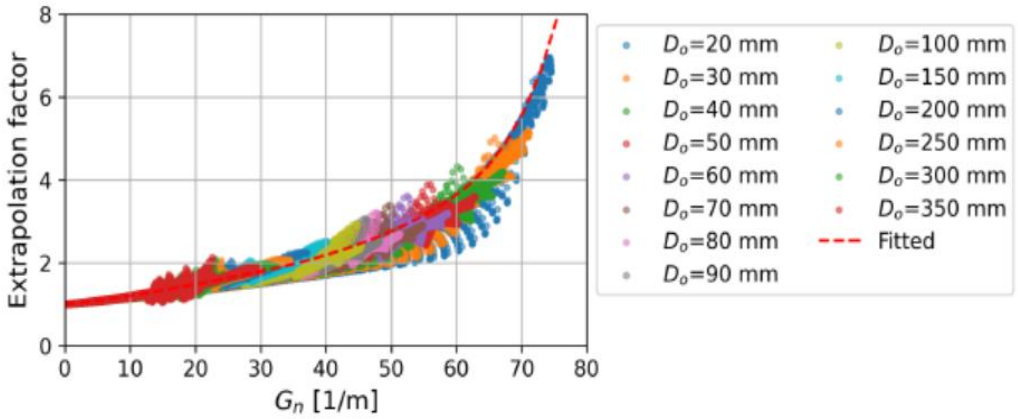



Figure 2.6: Extrapolation factors (i.e., ratios between the simulated results of $H_{tip-surface}$ and $\frac{H_{bottom}+H_{top}}{2}$) plotted as a function of the normalized $H$-field gradient. The data are from simulations of 70 coils with varying outer diameters $D_o$ and filling ratios (0.1–0.9). The predication of the polynomial function $\sum_{i=0}^{7} c_i \left(G_n \Delta d\right)^i$ with coefficients fitted for 97.5$^{th}$ percentile (i.e., the red dashed line) is also shown.

| Coefficient | Value |
|---|---|
| $c_0$ | 1.00 |
| $c_1$ | 1.00 |
| $c_2$ | -1.01 |
| $c_3$ | 15.9 |
| $c_4$ | -50.8 |
| $c_5$ | 74.7 |
| $c_6$ | -51.4 |
| $c_7$ | 13.7 |

Table 2.2: Coefficients of the polynomial function for the H-field extrapolation to the tip-surface of the probe, determined with 0.975 quantile regression (i.e., the 97.5$^{\text{th}}$ percentile)

## 4.6 Test Result

Mode 1

| MPE | | | | |
|---|---|---|---|---|
| Test distance | Battery levels | Probe from EUT Side | E-field (V/m) | H-field (A/m) |
| 20cm | ＜ 1% | Top | 1.281 | 0.337 |
| 15cm | ＜ 1% | Top | 1.396 | 0.452 |
| 15cm | ＜ 1% | Left | 0.969 | 0.314 |
| 15cm | ＜ 1% | Right | 0.957 | 0.408 |
| 15cm | ＜ 1% | Front | 1.114 | 0.361 |
| 15cm | ＜ 1% | Rear | 1.036 | 0.342 |
| Limit | | | 614 | 1.63 |

Mode 2

| MPE | | | | |
|---|---|---|---|---|
| Test distance | Battery levels | Probe from EUT Side | E-field (V/m) | H-field (A/m) |
| 20cm | ＜ 50% | Top | 1.190 | 0.307 |
| 15cm | ＜ 50% | Top | 1.351 | 0.447 |
| 15cm | ＜ 50% | Left | 0.939 | 0.294 |
| 15cm | ＜ 50% | Right | 0.887 | 0.385 |
| 15cm | ＜ 50% | Front | 1.103 | 0.359 |
| 15cm | ＜ 50% | Rear | 0.988 | 0.338 |
| Limit | | | 614 | 1.63 |

Mode 3

| MPE | | | | |
|---|---|---|---|---|
| Test distance | Battery levels | Probe from EUT Side | E-field (V/m) | H-field (A/m) |
| 20cm | ＜ 99% | Top | 1.072 | 0.301 |
| 15cm | ＜ 99% | Top | 1.236 | 0.440 |
| 15cm | ＜ 99% | Left | 0.861 | 0.280 |
| 15cm | ＜ 99% | Right | 0.875 | 0.349 |
| 15cm | ＜ 99% | Front | 1.046 | 0.340 |
| 15cm | ＜ 99% | Rear | 0.942 | 0.305 |
| Limit | | | 614 | 1.63 |

Note: All test modes were pre-tested, but we only recorded the worst case in this report.

Mode 4

Note: <1%, 50%, >95% load all have been tested, only worse case Max load (<1%) is reported.
H-Filed Strength at (distance 0cm to 20cm at 2cm iteration, i.e. at a distance of 20cm, 18cm, 16cm, … 0cm, Which is between the edge of the charger and the edge of probe,) surrounding the EUT (A/m)

| Test Distance (cm) | Test Position A (A/m) | Test Position B (A/m) | Test Position C (A/m) | Test Position D (A/m) | Test Position E (A/m) | Test Position F (A/m) | Limit (A/m) |
|---|---|---|---|---|---|---|---|
| 2 | 0.515 | 0.372 | 0.152 | 0.145 | 0.336 | 0.381 | 1.63 |
| 4 | 0.349 | 0.227 | 0.101 | 0.093 | 0.106 | 0.124 | |
| 6 | 0.327 | 0.209 | 0.099 | 0.084 | 0.097 | 0.121 | |
| 8 | 0.312 | 0.188 | 0.098 | 0.084 | 0.089 | 0.120 | |
| 10 | 0.293 | 0.180 | 0.094 | 0.079 | 0.085 | 0.119 | |
| 12 | 0.288 | 0.169 | 0.090 | 0.072 | 0.082 | 0.109 | |
| 14 | 0.271 | 0.167 | 0.085 | 0.068 | 0.079 | 0.103 | |
| 16 | 0.263 | 0.151 | 0.082 | 0.063 | 0.076 | 0.100 | |
| 18 | 0.238 | 0.145 | 0.075 | 0.062 | 0.073 | 0.099 | |
| 20 | 0.217 | 0.144 | 0.068 | 0.060 | 0.073 | 0.090 | |

Use the Biot-Sacart Law to estimated the results of 2cm through 4cm

| Test position | Measure Value (A/m) | Estimated Value (A/m) | Agreement Ratio | Limits |
|---|---|---|---|---|
| A | 0.515 | 0.431 | -16.24% | 30% |
| B | 0.372 | 0.322 | -13.42% | 30% |
| C | 0.152 | 0.142 | -6.84% | 30% |
| D | 0.145 | 0.130 | -10.08% | 30% |
| E | 0.336 | 0.403 | 19.96% | 30% |
| F | 0.381 | 0.439 | 15.20% | 30% |

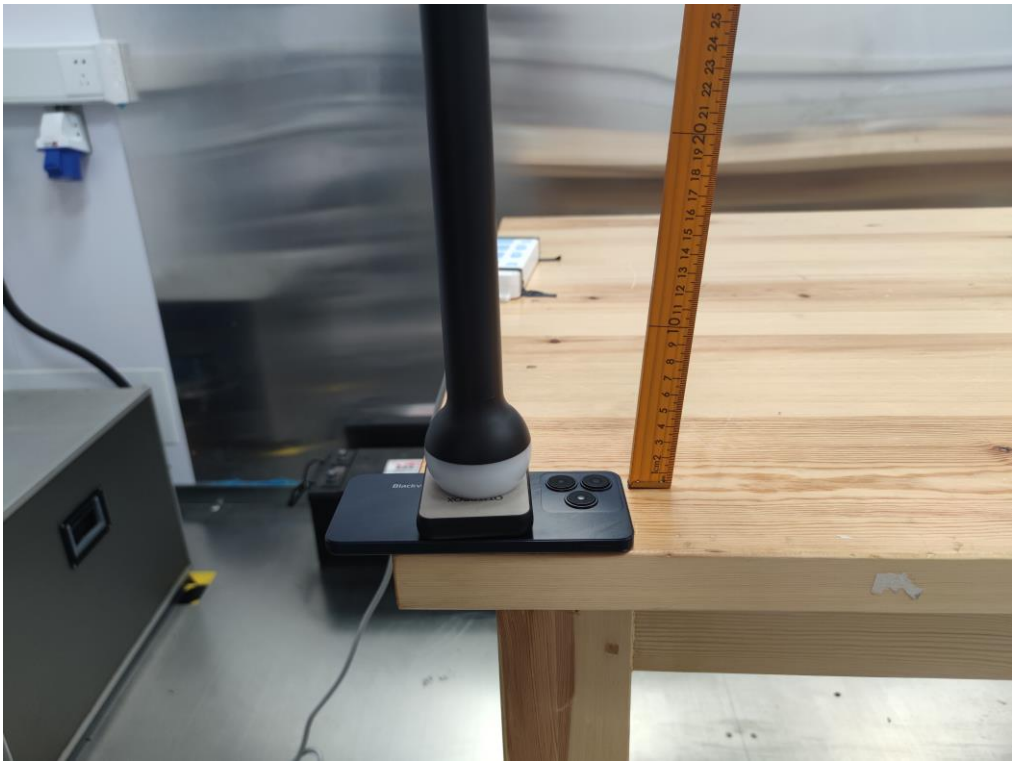
As the model is sufficient, the calue of 0cm can be estimated through the results of 2 cm

| Test position | Estimated Value (A/m) | Limits (A/m) |
|---|---|---|
| A | 0.674 | 1.63 |
| B | 0.640 | |
| C | 0.254 | |
| D | 0.242 | |
| E | 1.174 | |
| F | 1.550 | |

# 5 Test Setup photo

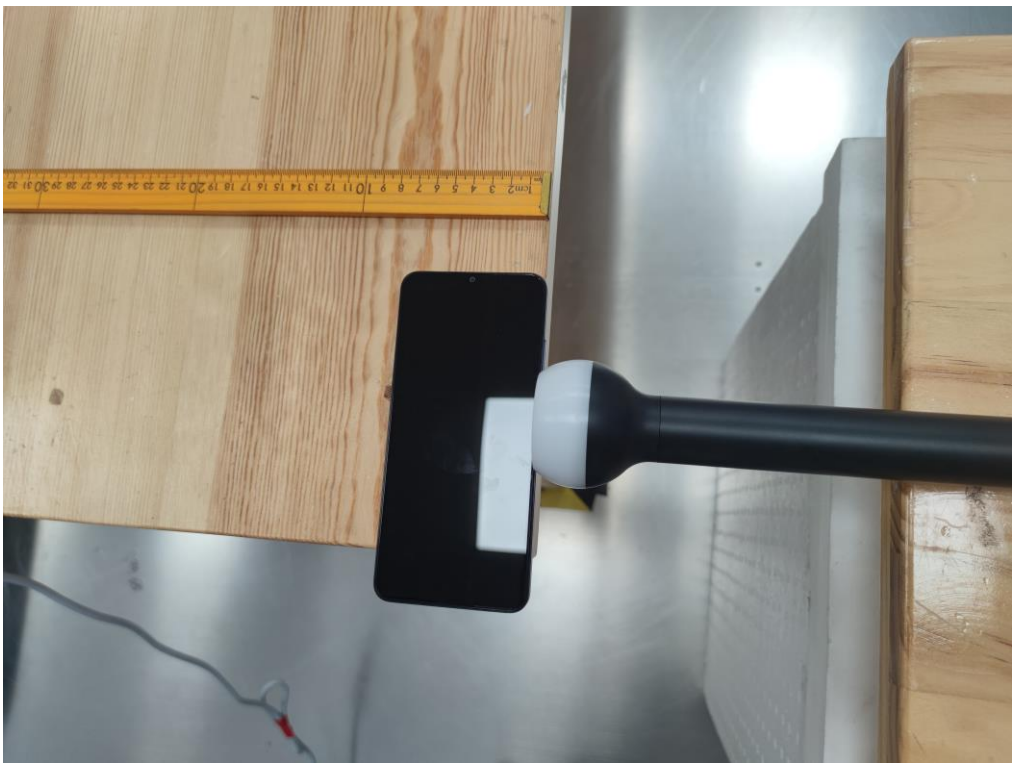
Portable mode:

0cm-Bottom



0cm-Front

0cm-Left



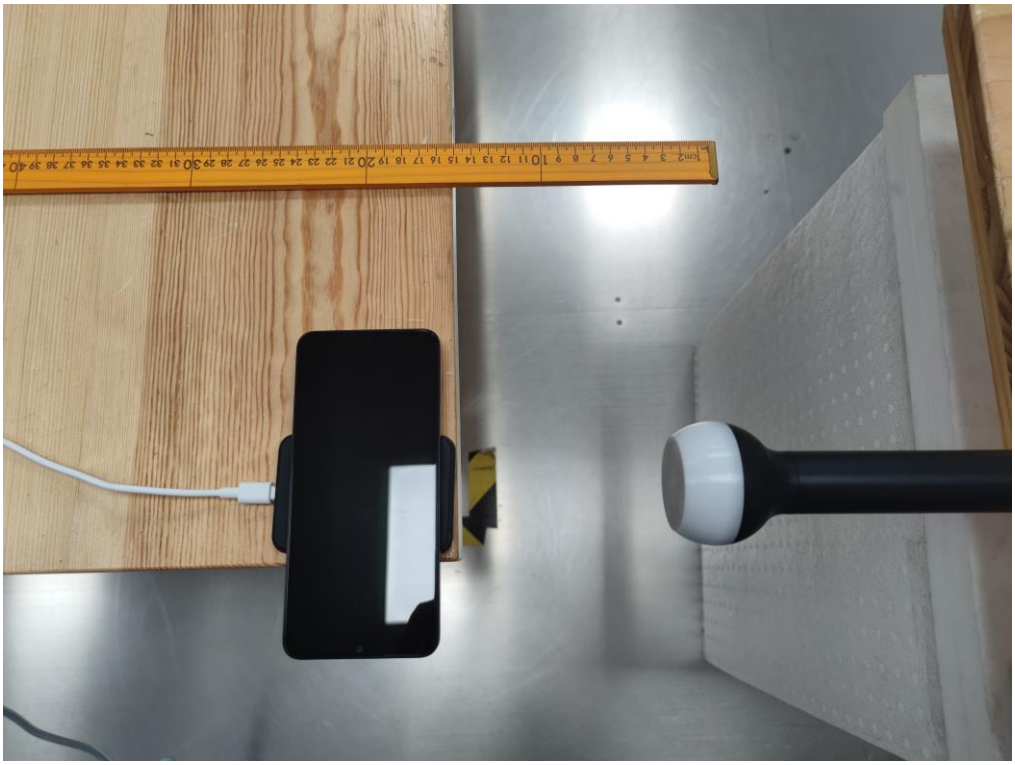
0cm-Rear

0cm-Right

0cm-Top

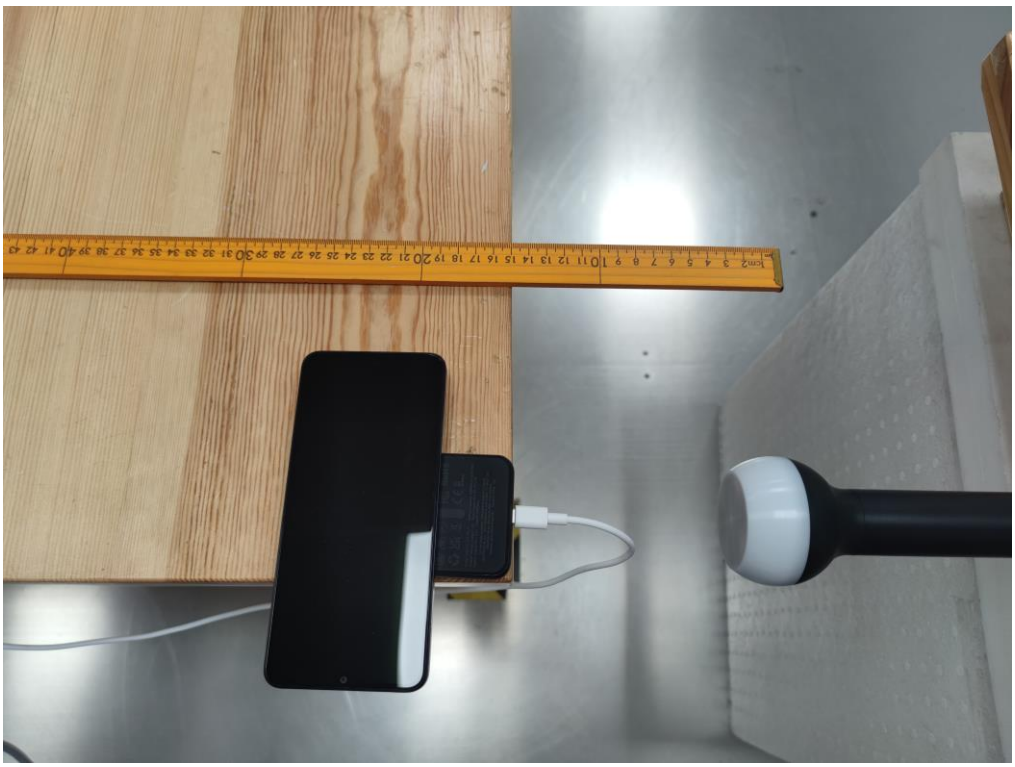
Mobile mode:

15cm-Front

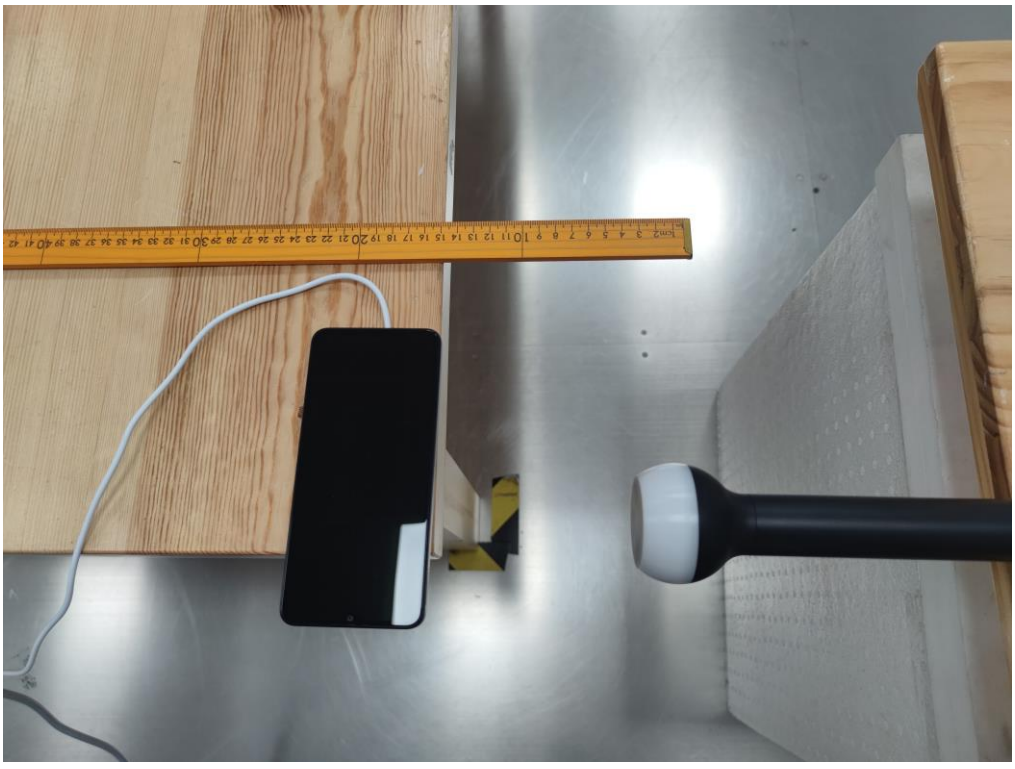


15cm-Left

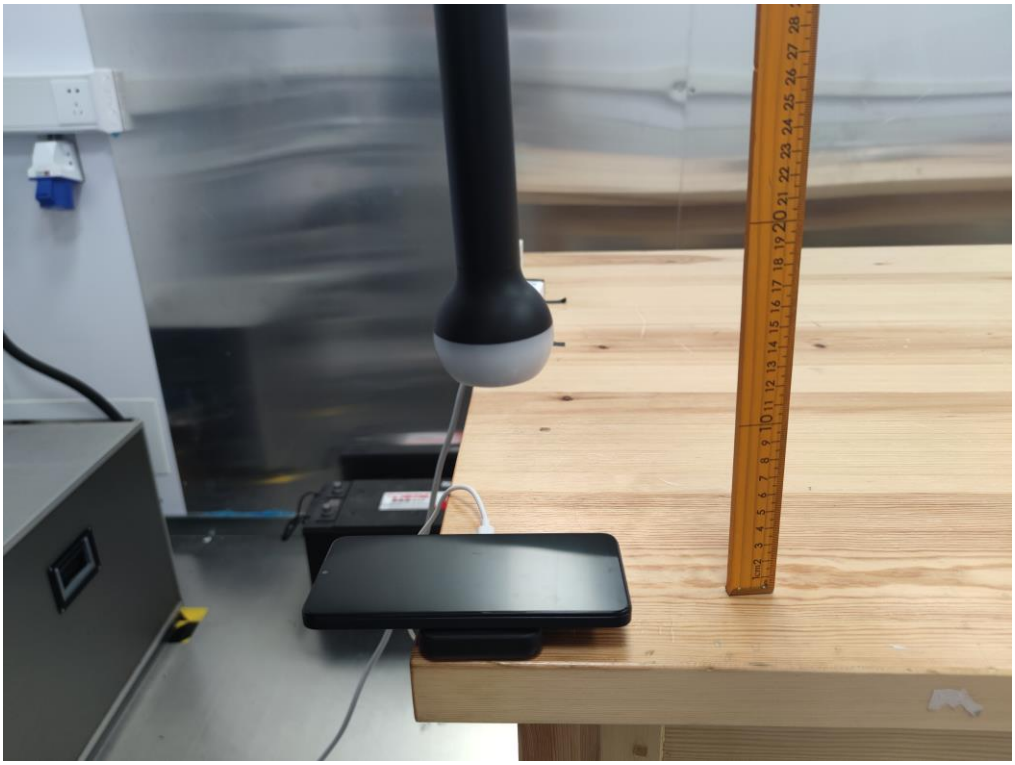
15cm-Rear



15cm-Right



15cm-Top



***End of report***