

Client **UL Korea**
Gyeonggi-do, Republic of Korea

Certificate No: **V-Coil50/400-1014_Oct23**

CALIBRATION CERTIFICATE

Object **V-Coil50/400 - SN: 1014**
 Calibration procedure(s) **QA CAL-47.v1**
Calibration Procedure for MAGPy Validation Source
 Calibration date: **October 10, 2023**

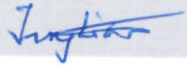

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|--------------------|---------------|---------------------------------|-----------------------|
| MAGPy-8H3D+E3D/DAS | SN: 3065/3056 | 06-Apr-23 (MAGPy-8H3D+E3D-3065) | Apr-24 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---------------------|------|-----------------------|-----------------|
| | | | |

| | Name | Function | Signature |
|----------------|-------------|-------------------|---|
| Calibrated by: | Jingtian Xi | Project leader |  |
| Approved by: | Sven Kühn | Technical Manager |  |

Issued: October 16, 2023

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Glossary:

V-Coil50/400 system check and validation source

Calibration is Performed According to the Following Standards:

- Internal procedure QA CAL-47-Calibration procedure for sources from 3 kHz to 10 MHz

Additional Documentation:

- a) DASY8 Module WPT Manual

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* The verification sources are switched on for at least 10 minutes. The current in time domain is measured prior and after the measurement with the oscilloscope to verify that harmonics can be neglected. Then the current is measured with the voltmeter and an FFT analysis of the time domain signal is performed to derive the amplitude of the fundamental current component (see the Appendix for the conversion).
- *Source Positioning:* The Validation Source is placed in the center of the platform such that the device surface is parallel to phantom surface. Initial probe location is the center of the coil and the distance of the probe tip to the surface of <0.1mm is verified using mechanical gauge.
- *H-field distribution:* H field is measured in the volume above the Validation Source in a rectilinear grid of 7mm x 7mm x 7mm.
- *H-field at 2mm and Induced Values at 2mm:* The H-field and the induced field and current quantities at the surface inside the infinite the virtual half space phantom ($\epsilon_r = 4.34 \times 10^3$, $\sigma = 0.75 \text{ S/m}$) at the distance of 2mm from the surface are reconstructed quantities.

Calibrated Quantity

- The calibration quantities are induced peak E-field (2mm cube average), induced peak E-field (5mm line average), induced peak current density (1cm² area average), induced peak spatial SAR (1g and 10g averaged) at 2mm (+/-0.1) from the surface or 4.7 mm from the physical coil (PCB thickness = 1.7 mm, surface film thickness = 1.0 mm).

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

| | | |
|------------------|-------------------|------------------------------------|
| Object model | V-Coil50/400 | 1014 |
| | Frequency | 400 kHz |
| Probe model | MAGPy-8H3D+E3D | 3065 |
| | MAGPy-DAS | 3056 |
| | MAGPy FPGA Board | WP000030 |
| Software version | cDASY6 Module WPT | 2.0.0 |
| | Notebook GUI | 2.0.5.7 |
| | Sim4Life | 7.2.3 |
| Scan setup | Grid dimensions | X: 169 mm, Y: 169 mm, Z: 36.7 mm |
| | Grid resolutions | X: 7.33 mm, Y: 7.33 mm, Z: 7.33 mm |

Calibrated Parameters: 400 kHz

| Distance of the Virtual Phantom from the Surface | Peak H-field (A/m) | Unc. (k=2) (dB) | Induced peak current density, 1cm ² area avg. (A/m ²) | Induced peak E-field(V/m) | | peak spatial SAR (mW/kg) | | Unc. (k=2) (dB) |
|--|--------------------|-----------------|--|---------------------------|---------------|--------------------------|----------|-----------------|
| | | | | 2mm cube avg. | 5mm line avg. | 1g avg. | 10g avg. | |
| 2.00 mm | 245 | 1.23 | 2.74 | 4.37 | 4.49 | 7.34 | 3.63 | 1.59 |

Appendix (Additional assessments outside the scope of SCS 0108)

Total current measurement

| | | |
|---------------------|--------|--------------|
| | U (V) | I (A, = 2×U) |
| Total current (RMS) | 0.4009 | 0.8018 |

Current spectrum measurement

| Frequency (kHz) | Measured power (dBm) | Power covered (W) | U (V) (R = 50 Ω) | I (A) | I _{normalized} (A) |
|-----------------|----------------------|-------------------|------------------|--------|-----------------------------|
| 400 | 5.08 | 3.22E-03 | 0.4013 | 0.8026 | 0.7697 |
| 800 | -28.29 | 1.48E-06 | 0.0086 | 0.0172 | 0.0165 |
| 1200 | -28.81 | 1.32E-06 | 0.0081 | 0.0162 | 0.0156 |

Measurement report

cDASY6 Module WPT Measurement Report

Device under test

Info:
V-Coil50/400

Serial number:
1014

Scenario:
source calibration

Tool info

DASY software version:
cDASY6 Module WPT 2.0.0.2607

Probe model, serial and calibration date:
MAGPy-8H3D+E3Dv2, WP000030, 2023/06/16

Software version:
2.0.31, backend: 0.9.2

Scan info

Center location:
x: -750.00 μm , y: -26.64 mm, z: 85.24 mm

Dimensions:
x: 169.0 mm, y: 169.0 mm, z: 36.7 mm

Resolution:
x: 7.33 mm, y: 7.33 mm, z: 7.33 mm

Completed on:
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Measurement results

Maximum H-field [RMS]:

MAGNITUDE: 139.13 A/m

x: 25.23 A/m, y: 21.18 A/m, z: 135.18 A/m

Maximum H-field location relative to DUT:

x: 3.67 mm, y: 3.67 mm, z: 8.00 mm

Maximum E-field [RMS]:

MAGNITUDE: 66.53 V/m

x: 25.32 V/m, y: 11.85 V/m, z: 60.37 V/m

Maximum E-field location relative to DUT:

x: 7.33 mm, y: -29.33 mm, z: 500.00 μm

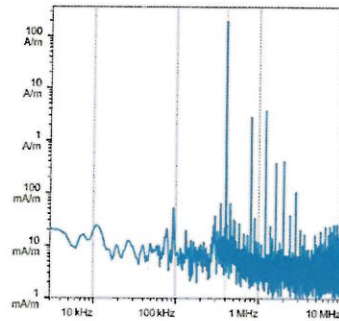
Distance to -20.0 dB boundary:

36.67 mm

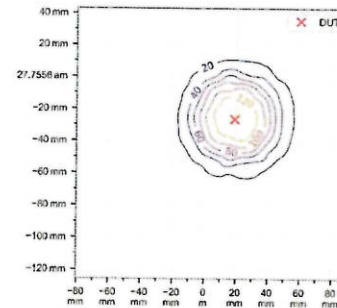
Offset relative to DUT:

x: 0.00 m, y: 0.00 m, z: 500.00 μm

H-field magnitude [RMS] at maximum location



H-field magnitude [RMS] at lowest plane



Incident fields, and induced quantities in the anatomical model ($f = 400.00 \text{ kHz}$, $\sigma = 0.750 \text{ S/m}$, tissue density = $1,000 \text{ kg/m}^3$)

| Distance [mm] | Peak incident fields | | Peak E_{ind} [V/m, RMS] | | | Peak J_{ind} [A/m^2 , RMS] | | psSAR [mW/kg] | | H-field extent -20 dB radius [mm] | Errors | | |
|---------------|-----------------------------|-----------------------------|----------------------------------|-------|-----------|---|---------|---------------|------|-----------------------------------|------------------|-----------------|--|
| | H_{inc} [A/m, RMS] | E_{inc} [V/m, RMS] | Cube avg. | Local | Line avg. | Surface avg. | 1g avg. | 10g avg. | Sign | | Vector potential | Boundary effect | |
| 2.0 | 245.0 | 58.2 | 4.37 | 4.51 | 4.49 | 2.74 | 7.34 | 3.63 | 38.6 | 7% | 9% | 17% | |

Standard compliance evaluation (with multi-frequency enhancement, total field evaluation)

| Distance [mm] | ICNIRP 2010/2020 [dB] | | | | ICNIRP 1998 [dB] | | | | IEEE 2019 [dB] | | | | FCC [dB] | | | | HC Code 6 [dB] | | | |
|---------------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|
| | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak J_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR |
| 2.0 | 26.0 | 36.8 | -20.8 | -27.4 | 42.5 | 36.3 | 12.0 | -27.4 | 8.6 | 18.3 | -24.4 | -27.4 | 43.5 | 23.1 | -20.8 | -23.4 | 42.5 | 36.8 | -20.5 | -23.4 |

Standard compliance evaluation (coverage factor-adjusted) (with multi-frequency enhancement, total field evaluation)

| Distance [mm] | ICNIRP 2010/2020 [dB] | | | | ICNIRP 1998 [dB] | | | | IEEE 2019 [dB] | | | | FCC [dB] | | | | HC Code 6 [dB] | | | |
|---------------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-----------------------|-------|
| | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak J_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR | Peak H_{inc} | Peak E_{inc} | Peak E_{ind} | psSAR |
| 2.0 | 26.0 | 36.8 | -7.0 | -27.4 | 42.5 | 36.3 | 12.0 | -27.4 | 8.6 | 18.3 | -15.7 | -27.4 | 43.5 | 23.1 | -7.0 | -23.4 | 42.5 | 36.8 | -3.8 | -23.4 |

Coverage factors: $w_{\text{red, cube avg}} = [3.379]$, $w_{\text{red, line avg}} = [2.949]$

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