# FCC SAR Test Report

| | | |
|---|---|---|
| APPLICANT | : | Shenzhen Gotron Electronic CO.,LTD. |
| EQUIPMENT | : | Mobile Phone |
| BRAND NAME | : | ulefone |
| MODEL NAME | : | Armor 23 Ultra, GQ5005, Armor 23, Armor 23E, Armor 23S, Armor 23 Lite, Armor 23 Pro, Armor 23 Pro+, Armor 23s, Armor 23s Pro |
| FCC ID | : | 2AOWK-5005AF1 |
| STANDARD | : | FCC 47 CFR Part 2 (2.1093) |

**We, Sporton International Inc. (Shenzhen), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Shenzhen), the test report shall not be reproduced except in full.**

Si Zhang

**Approved by: Si Zhang**

ilac-MRA

ACCREDITED Cert #5145.01

***Sporton International Inc. (Shenzhen)***
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***People's Republic of China***

# Table of Contents

# Revision History

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FA391513 | Rev. 01 | Initial issue of report. | Dec. 13, 2023 |
| FA391513 | Rev. 02 | Added the model name. | Jan. 03, 2024 |
| FA391513 | Rev. 03 | Corrected the report typo for note 4 on page 6. | Jan. 11, 2024 |
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# 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Shenzhen Gotron Electronic CO.,LTD., Mobile Phone, Armor 23 Ultra, GQ5005, Armor 23, Armor 23E, Armor 23S, Armor 23 Lite, Armor 23 Pro, Armor 23 Pro+, Armor 23s, Armor 23s Pro,** are as follows.

| **Highest 1g SAR Summary** | | |
|---|---|---|
| Equipment Class | Frequency Band | Body-worn (Separation 15mm) |
| Licensed | Band 23 | 0.28 |
| | Band 255/24 | **0.31** |
| Date of Testing: | | 2023/11/21 |

| **Highest 10g SAR Summary** | | |
|---|---|---|
| Equipment Class | Frequency Band | Product Specific 10g SAR (W/kg) (Separation 0mm) |
| Licensed | Band 23 | **0.85** |
| | Band 255/24 | 0.70 |
| Date of Testing: | | 2023/11/21 |
| **Remark:** This device supports Band24 and Band255. Since the supported frequency span for Band24 falls completely within the supports frequency span for Band255, both MES bands have the same target power, and both MES bands share the same transmission path; therefore, SAR was only assessed for Band255. | | |

| Declaration of Conformity: |
|---|
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| Comments and Explanations: |
| The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

## 2. Administration Data

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

| Testing Laboratory | | | |
|---|---|---|---|
| Test Firm | Sporton International Inc. (Shenzhen) | | |
| Test Site Location | 1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China<br>TEL: +86-755-86379589<br>FAX: +86-755-86379595 | | |
| Test Site No. | Sporton Site No. | FCC Designation No. | FCC Test Firm Registration No. |
| | SAR01-SZ | CN1256 | 421272 |

| Applicant | |
|---|---|
| Company Name | Shenzhen Gotron Electronic CO.,LTD. |
| Address | 7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China |

| Manufacturer | |
|---|---|
| Company Name | Shenzhen Gotron Electronic CO.,LTD. |
| Address | 7B01, Building A, Block 1, Anhongji Tianyao Plaza, Longhua District, Shenzhen City, Guangdong Province China |

## 3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02
- FCC KDB 941225 D05 SAR for LTE Devices v02r05

# 4. Equipment Under Test (EUT) Information

## 4.1 General Information

| Product Feature & Specification | |
|---|---|
| **Equipment Name** | Mobile Phone |
| **Brand Name** | ulefone |
| **Model Name** | Armor 23 Ultra, GQ5005, Armor 23, Armor 23E, Armor 23S, Armor 23 Lite, Armor 23 Pro, Armor 23 Pro+, Armor 23s, Armor 23s Pro |
| **FCC ID** | 2AOWK-5005AF1 |
| **IMEI Code** | IMEI1: 351525100813709<br>IMEI2: 351525100813717 |
| **Wireless Technology and Frequency Range** | Band 23 : 2000 MHz ~ 2020 MHz<br>Band 24 : 1626.5 MHz ~ 1660.5 MHz<br>Band 255 : 1626.5 MHz ~ 1660.5 MHz |
| **Mode** | MES: BPSK/QPSK |
| **HW Version** | A500_02 |
| **SW Version** | Armor 23 Ultra_AF1_V10 |
| **EUT Stage** | Identical Prototype |

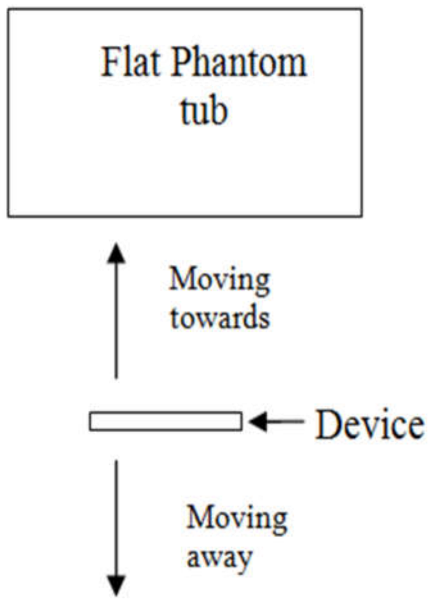
**Remark:**

1. The device implements Proximity sensors trigger reduced power for the power management for SAR compliance at different exposure conditions (body). The device will invoke corresponding work scenarios power level, which are provided in the operational description. And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at appendix E.
2. For Band 23/24/255 test, using FTM to perform SAR testing with default 100% transmission.
3. For Band 23/24/255 supports SCS 3.75 kHz and SCS 15 kHz, chose higher power which is SCS 15 kHz to perform SAR testing.
4. The device supports MES of Band 23/24/255. When these bands are enabled, the device will only operate at the body exposure condition due to MES operation does not support voice calling.
5. For dual SIM card mobile has single SIM slots + eSIM (electronic SIM) and supports dual SIM dual standby. The WWAN radio transmission will be enabled by either one SIM at a time (single active).
6. The differences between model names are the model naming and appearance color.

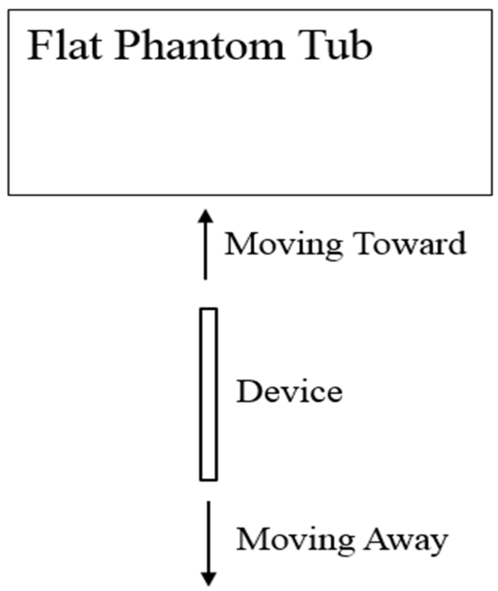
# 5. Proximity Sensor Triggering Test

## 5.1 Proximity sensor triggering distances(Per KDB616217§6.2)

1. Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed.
2. Proximity sensor triggering distance testing was performed according and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed and the tissue-equivalent medium for highest frequency (2000MHz) and lowest (1600MHz) frequency was used for proximity sensor triggering testing.
3. Capacitive proximity sensor placed coincident with antenna elements at the top left corners of the Top ends of the EUT are utilized to determine when the device comes in proximity of the user's body or finger or hand at the front or back or left or top side of the device.
4. The sensors can use to detect the proximity of the user's body states at the front or back or left or top side of the device use a detection threshold distance. When front/back/ left / top sides of body condition is detected reduced power will be active. The trigger distance shown in the sections below. The verification test and more details please refer to sensor operation description.
5. For verification of compliance of power reduction scheme, additional SAR testing with EUT transmitting at full RF power at a conservative trigger distance -1mm was performed.



Sensor/Handheld detection test set-up, Front and Back sides



Handheld detection test set-up, Left, Top Side

**<P-Sensor>**

| Proximity Sensor Triggering Distance (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Position | Front | | Back | | Left Side | | Top Side | |
| | Moving towards | Moving away | Moving towards | Moving away | Moving towards | Moving away | Moving towards | Moving away |
| Minimum | 11 | 11 | 12 | 12 | 11 | 11 | 12 | 12 |

# 6. RF Exposure Limits

## 6.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

## 6.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Limits for Occupational/Controlled Exposure (W/kg)**

| Whole-Body | Partial-Body | Hands, Wrists, Feet and Ankles |
|---|---|---|
| 0.4 | 8.0 | 20.0 |

**Limits for General Population/Uncontrolled Exposure (W/kg)**

| Whole-Body | Partial-Body | Hands, Wrists, Feet and Ankles |
|---|---|---|
| 0.08 | 1.6 | 4.0 |

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

# 7. Specific Absorption Rate (SAR)

## 7.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

## 7.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

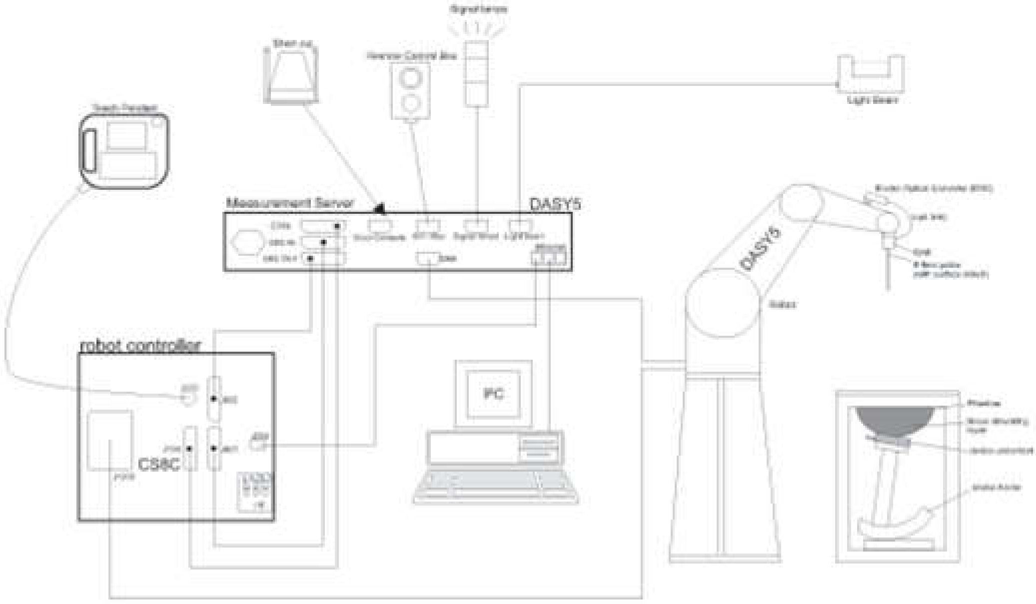
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

# 8. System Description and Setup

**The DASY system used for performing compliance tests consists of the following items:**




- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## 8.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

**<EX3DV4 Probe>**

| | |
|---|---|
| **Construction** | Symmetric design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| **Frequency** | 10 MHz – >6 GHz<br>Linearity: ±0.2 dB (30 MHz – 6 GHz) |
| **Directivity** | ±0.3 dB in TSL (rotation around probe axis)<br>±0.5 dB in TSL (rotation normal to probe axis) |
| **Dynamic Range** | 10 μW/g – >100 mW/g<br>Linearity: ±0.2 dB (noise: typically <1 μW/g) |
| **Dimensions** | Overall length: 337 mm (tip: 20 mm)<br>Tip diameter: 2.5 mm (body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm |

## 8.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

**Photo of DAE**

## 8.3 Phantom

**<SAM Twin Phantom>**

| | |
|---|---|
| **Shell Thickness** | 2 ± 0.2 mm;<br>Center ear point: 6 ± 0.2 mm |
| **Filling Volume** | Approx. 25 liters |
| **Dimensions** | Length: 1000 mm; Width: 500 mm; Height: adjustable feet |
| **Measurement Areas** | Left Hand, Right Hand, Flat Phantom |

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

**<ELI Phantom>**

| | |
|---|---|
| **Shell Thickness** | 2 ± 0.2 mm (sagging: <1%) |
| **Filling Volume** | Approx. 30 liters |
| **Dimensions** | Major ellipse axis: 600 mm<br>Minor axis: 400 mm |

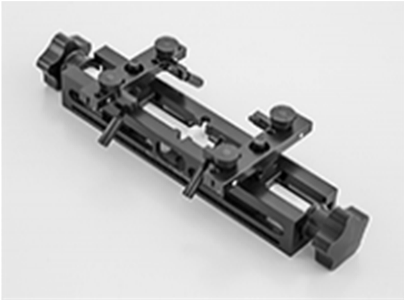
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices or for evaluating transmitters operating at low frequencies. ELI is fully compatible with standard and all known tissue simulating liquids.

## 8.4 Device Holder

**<Mounting Device for Hand-Held Transmitter>**

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

**<Mounting Device for Laptops and other Body-Worn Transmitters>**

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

# 9. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

## 9.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

## 9.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

## 9.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

| | ≤ 3 GHz | > 3 GHz |
|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | 5 ± 1 mm | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm |
| | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |

## 9.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>$\leq$ 2 GHz: $\leq$ 8 mm<br>2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*<br>4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm<br>4 – 5 GHz: $\leq$ 3 mm<br>5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm<br>4 – 5 GHz: $\leq$ 2.5 mm<br>5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm<br>4 – 5 GHz: $\geq$ 25 mm<br>5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.<br>* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

## 9.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 9.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

# 10. Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | 1640MHz System Validation Kit | D1640V2 | 347 | Sep. 01, 2022 | Aug. 31, 2025 |
| SPEAG | 2000MHz System Validation Kit | D2000V2 | 1083 | Oct. 14, 2021 | Oct. 12, 2024 |
| SPEAG | Data Acquisition Electronics | DAE4 | 1386 | Jul. 17, 2023 | Jul. 16, 2024 |
| SPEAG | Dosimetric E-Field Probe | EX3DV4 | 7576 | Aug. 23, 2023 | Aug. 22, 2024 |
| SPEAG | SAM Twin Phantom | QD 000 P40 CD | 1671 | NCR | NCR |
| SPEAG | Phone Positioner | N/A | N/A | NCR | NCR |
| Keysight | Network Analyzer | E5071C | MY46523671 | Oct. 16, 2023 | Oct. 15, 2024 |
| Speag | Dielectric Assessment KIT | DAK-3.5 | 1071 | Feb. 20, 2023 | Feb. 19, 2024 |
| Agilent | Signal Generator | N5181A | MY50145381 | Dec. 27, 2022 | Dec. 26, 2023 |
| Anritsu | Power Senor | MA2411B | 1306099 | Oct. 16, 2023 | Oct. 15, 2024 |
| Anritsu | Power Meter | ML2495A | 1349001 | Oct. 16, 2023 | Oct. 15, 2024 |
| Anritsu | Power Sensor | MA2411B | 1542004 | Dec. 27, 2022 | Dec. 26, 2023 |
| Anritsu | Power Meter | ML2495A | 1339473 | Dec. 27, 2022 | Dec. 26, 2023 |
| R&S | Spectrum Analyzer | FSP7 | 100818 | Jul. 05, 2023 | Jul. 04, 2024 |
| TES | Hygrometer | 1310 | 200505600 | Jul. 08, 2023 | Jul. 07, 2024 |
| Anymetre | Thermo-Hygrometer | JR593 | 2015030904 | Jul. 08, 2023 | Jul. 07, 2024 |
| SPEAG | Device Holder | N/A | N/A | N/A | N/A |
| AR | Amplifier | 5S1G4 | 0333096 | Note 1 | |
| ARRA | Power Divider | A3200-2 | N/A | Note 1 | |
| ET Industries | Dual Directional Coupler | C-058-10 | N/A | Note 1 | |
| Weinschel | Attenuator 1 | 3M-10 | N/A | Note 1 | |
| Weinschel | Attenuator 2 | 3M-20 | N/A | Note 1 | |

**Note:**
1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

# 11. System Verification

## 11.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 11.1.

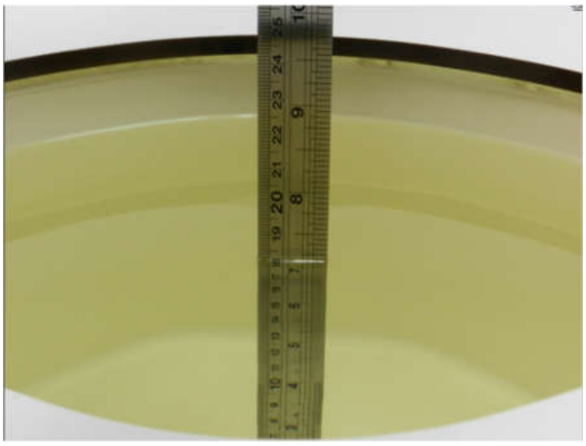


**Fig 11.1 Photo of Liquid Height for Body SAR**

## 11.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

| Frequency (MHz) | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGBE (%) | Conductivity (σ) | Permittivity (εr) |
|---|---|---|---|---|---|---|---|---|
| For Head | | | | | | | | |
| 1640 | 54.3 | 0 | 0 | 0.4 | 0 | 45.3 | 1.31 | 40.2 |
| 2000 | 55.2 | 0 | 0 | 0.3 | 0 | 44.5 | 1.40 | 40.0 |

**<Tissue Dielectric Parameter Check Results>**

| Frequency (MHz) | Tissue Type | Liquid Temp. (℃) | Conductivity (σ) | Permittivity ($\varepsilon_r$) | Conductivity Target (σ) | Permittivity Target ($\varepsilon_r$) | Delta (σ) (%) | Delta ($\varepsilon_r$) (%) | Limit (%) | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 1640 | Head | 22.2 | 1.343 | 41.918 | 1.31 | 40.20 | 2.52 | 4.27 | ±5 | 2023/11/21 |
| 2000 | Head | 22.2 | 1.444 | 41.015 | 1.40 | 40.00 | 3.14 | 2.54 | ±5 | 2023/11/21 |

## 11.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

**<1g SAR>**

| Date | Frequency (MHz) | Tissue Type | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured 1g SAR (W/kg) | Targeted 1g SAR (W/kg) | Normalized 1g SAR (W/kg) | Deviation (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2023/11/21 | 1640 | Head | 250 | 347 | 7576 | 1386 | 8.360 | 34.600 | 33.44 | -3.35 |
| 2023/11/21 | 2000 | Head | 250 | 1083 | 7576 | 1386 | 10.500 | 40.900 | 42 | 2.69 |

**<10g SAR>**

| Date | Frequency (MHz) | Tissue Type | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured 10g SAR (W/kg) | Targeted 10g SAR (W/kg) | Normalized 10g SAR (W/kg) | Deviation (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2023/11/21 | 1640 | Head | 250 | 347 | 7576 | 1386 | 4.640 | 18.600 | 18.56 | -0.22 |
| 2023/11/21 | 2000 | Head | 250 | 1083 | 7576 | 1386 | 5.260 | 20.400 | 21.04 | 3.14 |

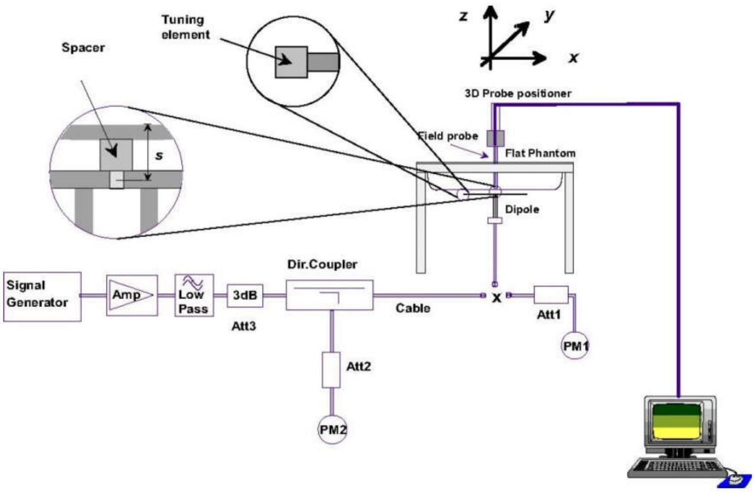



**Fig 11.3.1System Performance Check Setup**

**Fig 11.3.2 Setup Photo**

# 12. RF Exposure Positions

## 12.1 Body Worn Accessory

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 11.4). Per KDB648474 D04v01r03, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

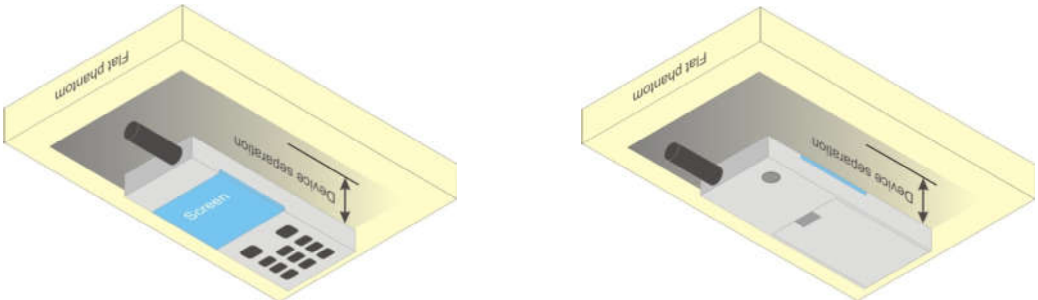



**Fig 11.4 Body Worn Position**

## 12.2 Product Specific 10g SAR Exposure

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, that can provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets and support voice calls next to the ear, according to KDB648474 D04v01r03, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.

2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.6 The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

# 13. Conducted RF Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

**<MES Conducted Power>**

1. Due to test setup limitations, SAR testing for MES was performed using Factory Test Mode software to establish the connection and perform SAR with 100% transmission.
2. For MES bands test procedure was following step similar FCC KDB 941225 D05, only choose the highest output power channel among all configurations of bandwidths, RBs, modulations to test SAR.

# 14. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos.

# 15. SAR Test Results

**General Note:**

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg.
4. The device implements Proximity sensors trigger reduced power for the power management for SAR compliance at different exposure conditions (body). The device will invoke corresponding work scenarios power level, which are provided in the operational description. And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at appendix E.
5. For Band 23/255 supports SCS 3.75 kHz and SCS 15 kHz, chose higher power which is SCS 15 kHz to perform SAR testing.
6. The following table “n/a” in the result means the SAR cube is too small to be detected.

## 15.1 Body Worn SAR

| Plot No. | Band | Sub-carrier Speacing (KHz) | Modulation | RB Size | RB offset | Test Position | Gap (mm) | Power Reduction | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | Band 255 | 15 | QPSK | 1 | 0 | Front | 15mm | Full | 261843 | 1660.4 | 23.83 | 25.00 | 1.309 | 0.01 | 0.236 | **0.309** |
| | Band 255 | 15 | QPSK | 1 | 0 | Back | 15mm | Full | 261843 | 1660.4 | 23.83 | 25.00 | 1.309 | -0.06 | 0.215 | 0.281 |
| 02 | Band 23 | 15 | QPSK | 1 | 0 | Front | 15mm | Full | 25501 | 2000.1 | 23.69 | 25.00 | 1.352 | 0.17 | 0.208 | **0.281** |
| | Band 23 | 15 | QPSK | 1 | 0 | Back | 15mm | Full | 25501 | 2000.1 | 23.69 | 25.00 | 1.352 | -0.18 | 0.199 | 0.269 |

## 15.2 Product specific 10g SAR

| Plot No. | Band | Sub-carrier Speacing (KHz) | Modulation | RB Size | RB offset | Test Position | Gap (mm) | Power Reduction | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 10g SAR (W/kg) | Reported 10g SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Band 255 | 15 | QPSK | 1 | 0 | Front | 0mm | Reduced | 261505 | 1626.6 | 20.60 | 21.00 | 1.096 | -0.11 | 0.632 | 0.693 |
| | Band 255 | 15 | QPSK | 1 | 0 | Back | 0mm | Reduced | 261505 | 1626.6 | 20.60 | 21.00 | 1.096 | 0.14 | 0.292 | 0.320 |
| | Band 255 | 15 | QPSK | 1 | 0 | Left Side | 0mm | Reduced | 261505 | 1626.6 | 20.60 | 21.00 | 1.096 | 0.15 | 0.087 | 0.095 |
| | Band 255 | 15 | QPSK | 1 | 0 | Right Side | 0mm | Full | 261843 | 1660.4 | 23.83 | 25.00 | 1.309 | 0.08 | 0.123 | 0.161 |
| 03 | Band 255 | 15 | QPSK | 1 | 0 | Top Side | 0mm | Reduced | 261505 | 1626.6 | 20.60 | 21.00 | 1.096 | 0.02 | 0.639 | **0.701** |
| | Band 255 | 15 | QPSK | 1 | 0 | Bottom Side | 0mm | Full | 261843 | 1660.4 | 23.83 | 25.00 | 1.309 | - | n/a | n/a |
| | Band 255 | 15 | QPSK | 1 | 0 | Front | 10mm | Full | 261505 | 1626.6 | 23.28 | 25.00 | 1.486 | 0.07 | 0.188 | 0.279 |
| | Band 255 | 15 | QPSK | 1 | 0 | Back | 11mm | Full | 261505 | 1626.6 | 23.28 | 25.00 | 1.486 | 0.12 | 0.160 | 0.237 |
| | Band 255 | 15 | QPSK | 1 | 0 | Left Side | 10mm | Full | 261505 | 1626.6 | 23.28 | 25.00 | 1.486 | -0.19 | 0.030 | 0.045 |
| | Band 255 | 15 | QPSK | 1 | 0 | Top Side | 11mm | Full | 261505 | 1626.6 | 23.28 | 25.00 | 1.486 | -0.05 | 0.281 | 0.418 |
| | Band 23 | 15 | QPSK | 1 | 0 | Front | 0mm | Reduced | 25600 | 2010 | 19.79 | 21.00 | 1.321 | -0.01 | 0.465 | 0.614 |
| | Band 23 | 15 | QPSK | 1 | 0 | Back | 0mm | Reduced | 25600 | 2010 | 19.79 | 21.00 | 1.321 | 0.05 | 0.213 | 0.281 |
| | Band 23 | 15 | QPSK | 1 | 0 | Left Side | 0mm | Reduced | 25600 | 2010 | 19.79 | 21.00 | 1.321 | 0 | 0.048 | 0.063 |
| | Band 23 | 15 | QPSK | 1 | 0 | Right Side | 0mm | Full | 25501 | 2000.1 | 23.69 | 25.00 | 1.352 | 0.03 | 0.110 | 0.149 |
| 04 | Band 23 | 15 | QPSK | 1 | 0 | Top Side | 0mm | Reduced | 25600 | 2010 | 19.79 | 21.00 | 1.321 | 0.01 | 0.646 | **0.854** |
| | Band 23 | 15 | QPSK | 1 | 0 | Bottom Side | 0mm | Full | 25501 | 2000.1 | 23.69 | 25.00 | 1.352 | - | n/a | n/a |
| | Band 23 | 15 | QPSK | 1 | 0 | Front | 10mm | Full | 25600 | 2010 | 23.31 | 25.00 | 1.476 | -0.16 | 0.257 | 0.379 |
| | Band 23 | 15 | QPSK | 1 | 0 | Back | 11mm | Full | 25600 | 2010 | 23.31 | 25.00 | 1.476 | 0.04 | 0.223 | 0.329 |
| | Band 23 | 15 | QPSK | 1 | 0 | Left Side | 10mm | Full | 25600 | 2010 | 23.31 | 25.00 | 1.476 | 0.03 | 0.034 | 0.050 |
| | Band 23 | 15 | QPSK | 1 | 0 | Top Side | 11mm | Full | 25600 | 2010 | 23.31 | 25.00 | 1.476 | 0.17 | 0.334 | 0.493 |

**Test Engineer**：Hank Huang, Kevin Xu, David Dai, Bin He

# 16. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

# 17. References


[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[8] FCC KDB 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.

[9] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015

[10] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015


------THE END------

# Appendix A. Plots of System Performance Check

The plots are shown as follows.

## System Check_1640MHz

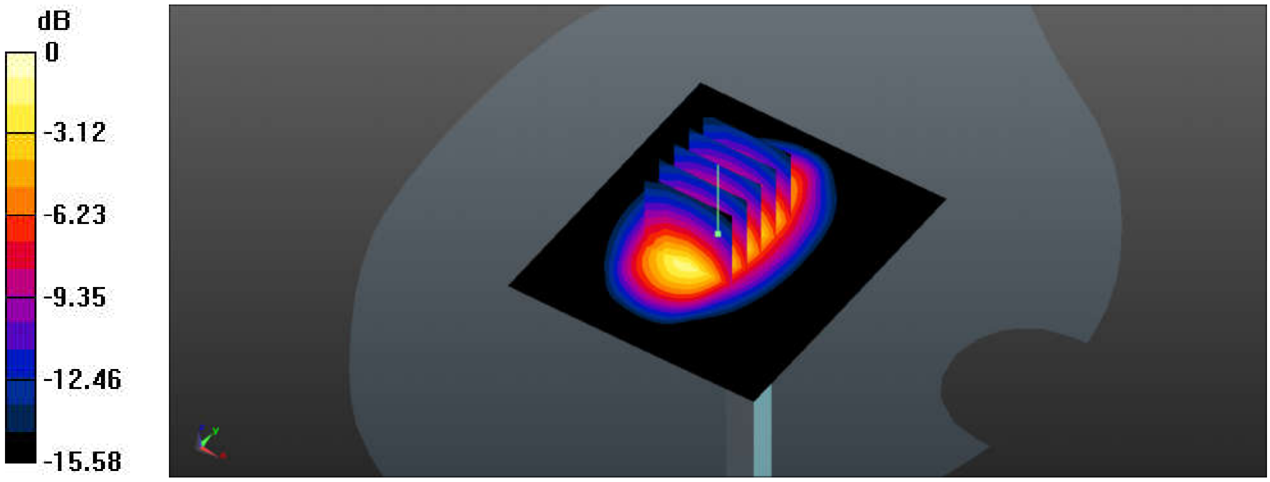
**DUT: D1640V2-SN:347**

Communication System: UID 0, CW (0); Frequency: 1640 MHz;Duty Cycle: 1:1
Medium: HSL_1640_231121 Medium parameters used: f = 1640 MHz; $\sigma$ = 1.343 S/m; $\varepsilon_r$ = 41.918; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7576; ConvF(9.17, 9.17, 9.17); Calibrated: 2023/8/23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1386; Calibrated: 2023/7/17
- Phantom: SAM with CRP v5.0(Front); Type: QD000P40CD; Serial: 1671
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**Pin=250mW/Area Scan (61x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 13.2 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 92.55 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 14.4 W/kg
**SAR(1 g) = 8.36 W/kg; SAR(10 g) = 4.64 W/kg**
Maximum value of SAR (measured) = 12.4 W/kg




0 dB = 12.4 W/kg

## System Check_2000MHz

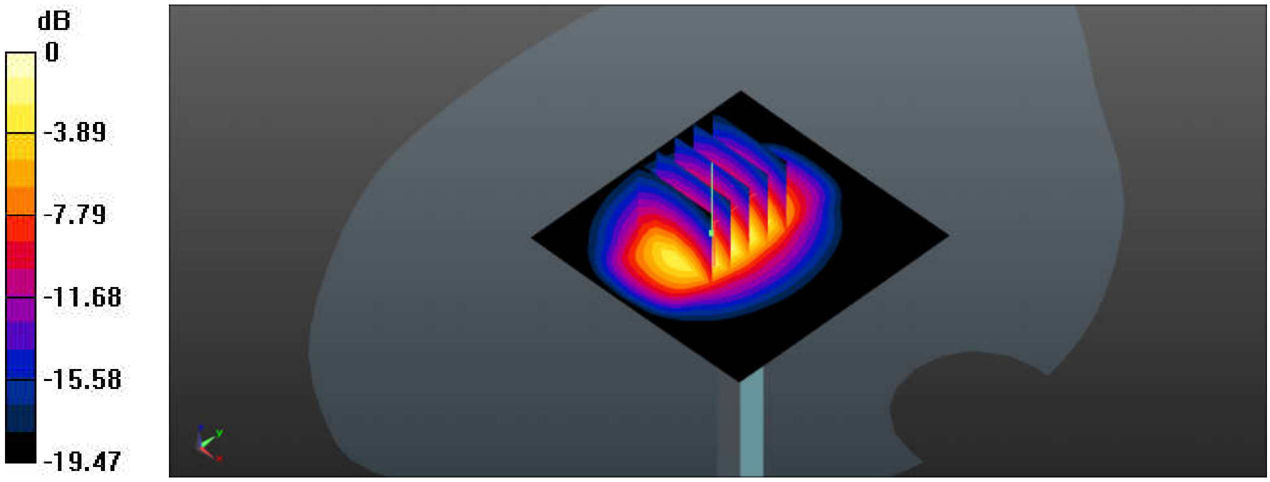
**DUT: D2000V2-SN:1083**

Communication System: UID 0, CW (0); Frequency: 2000 MHz;Duty Cycle: 1:1
Medium: HSL_2000_231121 Medium parameters used: f = 2000 MHz; $\sigma$ = 1.444 S/m; $\varepsilon_r$ = 41.015; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7576; ConvF(8.55, 8.55, 8.55); Calibrated: 2023/8/23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1386; Calibrated: 2023/7/17
- Phantom: SAM with CRP v5.0(Front); Type: QD000P40CD; Serial: 1671
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.0 W/kg

**Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 81.76 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 19.5 W/kg
**SAR(1 g) = 10.5 W/kg; SAR(10 g) = 5.26 W/kg**
Maximum value of SAR (measured) = 13.5 W/kg




0 dB = 13.5 W/kg

# Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2023/11/21

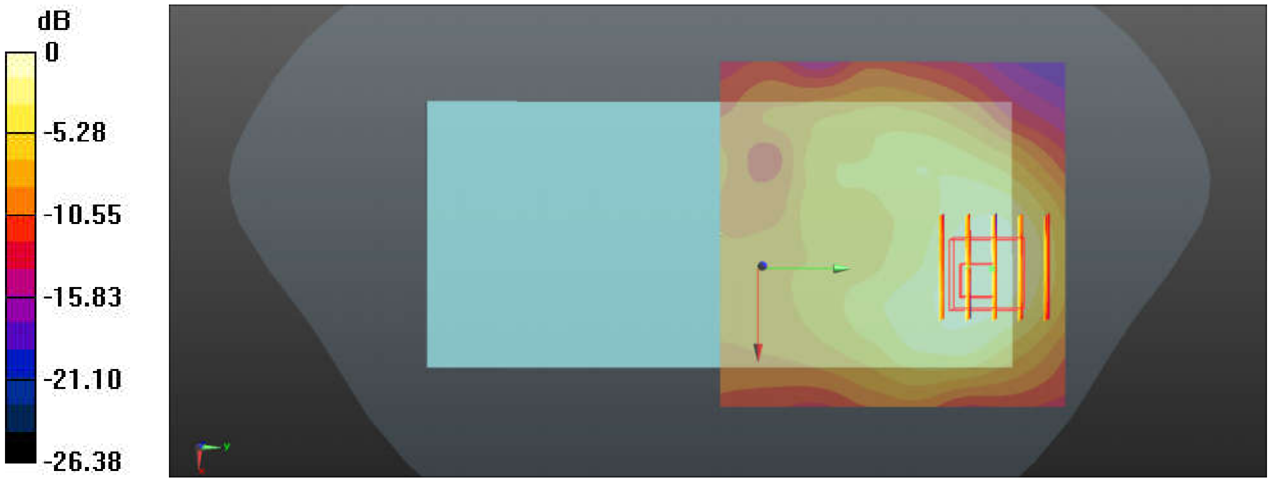
## 01_Band 255_15KHz_QPSK_1RB_0Offset_Front_15mm_Ch261843

Communication System: UID 0, LTE (0); Frequency: 1660.4 MHz;Duty Cycle: 1:1
Medium: HSL_1640_231121 Medium parameters used: f = 1660.4 MHz; $\sigma$ = 1.356 S/m; $\varepsilon_r$ = 41.884; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7576; ConvF(9.17, 9.17, 9.17); Calibrated: 2023/8/23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1386; Calibrated: 2023/7/17
- Phantom: SAM with CRP v5.0(Front); Type: QD000P40CD; Serial: 1671
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**Ch261843/Area Scan (71x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.338 W/kg

**Ch261843/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.979 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.425 W/kg
**SAR(1 g) = 0.236 W/kg; SAR(10 g) = 0.142 W/kg**
Maximum value of SAR (measured) = 0.343 W/kg




0 dB = 0.343 W/kg

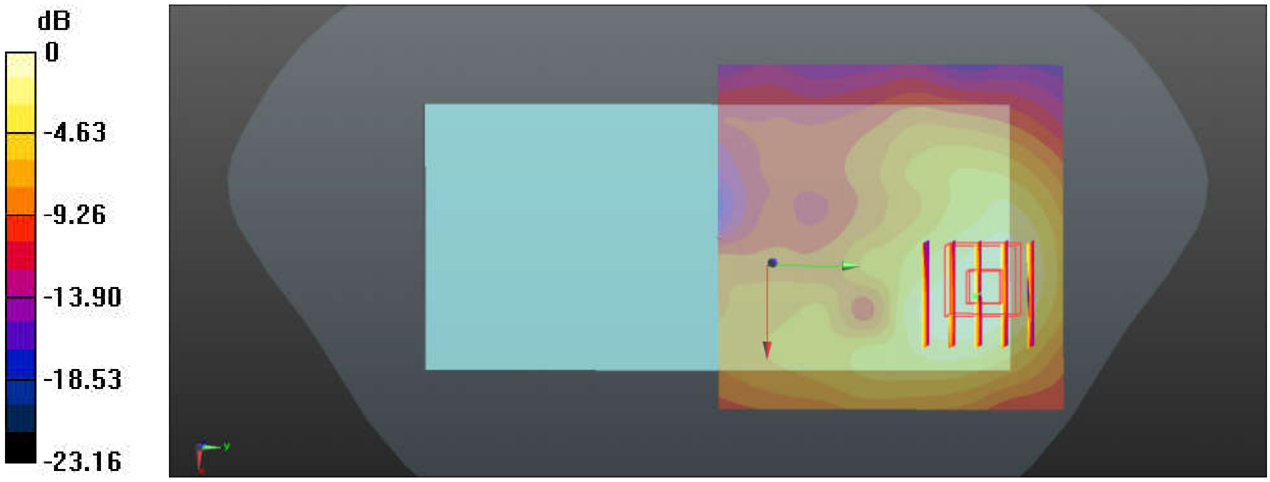
# 02_Band 23_15KHz_QPSK_1RB_0Offset_Front_15mm_Ch25501

Communication System: UID 0, LTE (0); Frequency: 2000.1 MHz;Duty Cycle: 1:1
Medium: HSL_2000_231121 Medium parameters used: f = 2000.1 MHz; $\sigma$ = 1.444 S/m; $\varepsilon_r$ = 41.015; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7576; ConvF(8.55, 8.55, 8.55); Calibrated: 2023/8/23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1386; Calibrated: 2023/7/17
- Phantom: SAM with CRP v5.0(Front); Type: QD000P40CD; Serial: 1671
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**Ch25501/Area Scan (71x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.303 W/kg

**Ch25501/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.679 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 0.888 W/kg
**SAR(1 g) = 0.208 W/kg; SAR(10 g) = 0.111 W/kg**
Maximum value of SAR (measured) = 0.298 W/kg




0 dB = 0.298 W/kg

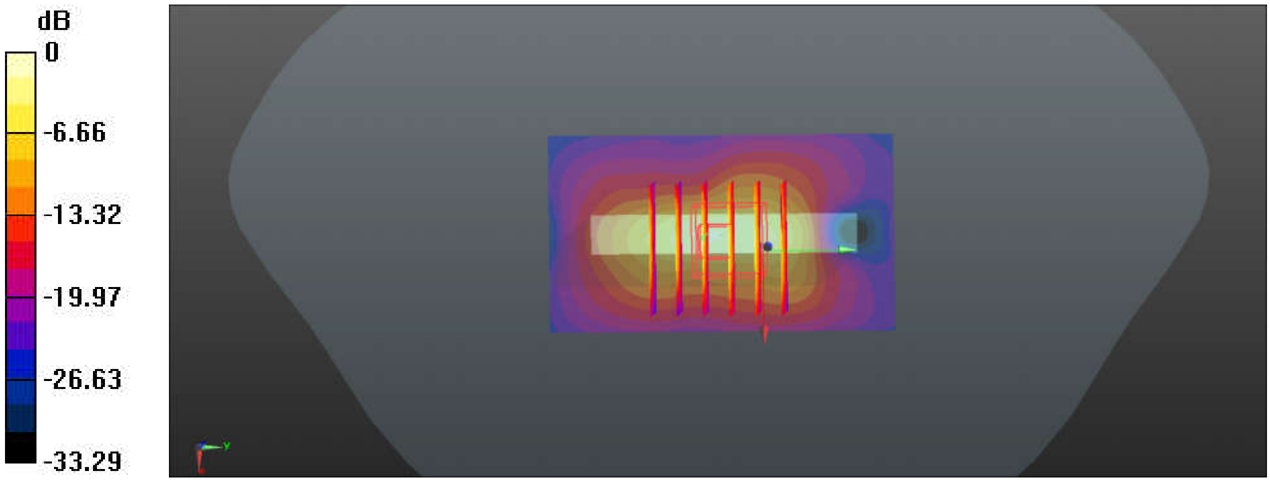
# 03_Band 255_15KHz_QPSK_1RB_0Offset_Top Side_0mm_Ch261505

Communication System: UID 0, LTE (0); Frequency: 1626.6 MHz;Duty Cycle: 1:1
Medium: HSL_1640_231121 Medium parameters used: f = 1627 MHz; $\sigma$ = 1.336 S/m; $\varepsilon_r$ = 41.945; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7576; ConvF(9.17, 9.17, 9.17); Calibrated: 2023/8/23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1386; Calibrated: 2023/7/17
- Phantom: SAM with CRP v5.0(Front); Type: QD000P40CD; Serial: 1671
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**Ch261505/Area Scan (41x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.25 W/kg

**Ch261505/Zoom Scan (6x6x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 40.73 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 4.79 W/kg
**SAR(1 g) = 1.58 W/kg; SAR(10 g) = 0.639 W/kg**
Maximum value of SAR (measured) = 3.41 W/kg




0 dB = 3.41 W/kg

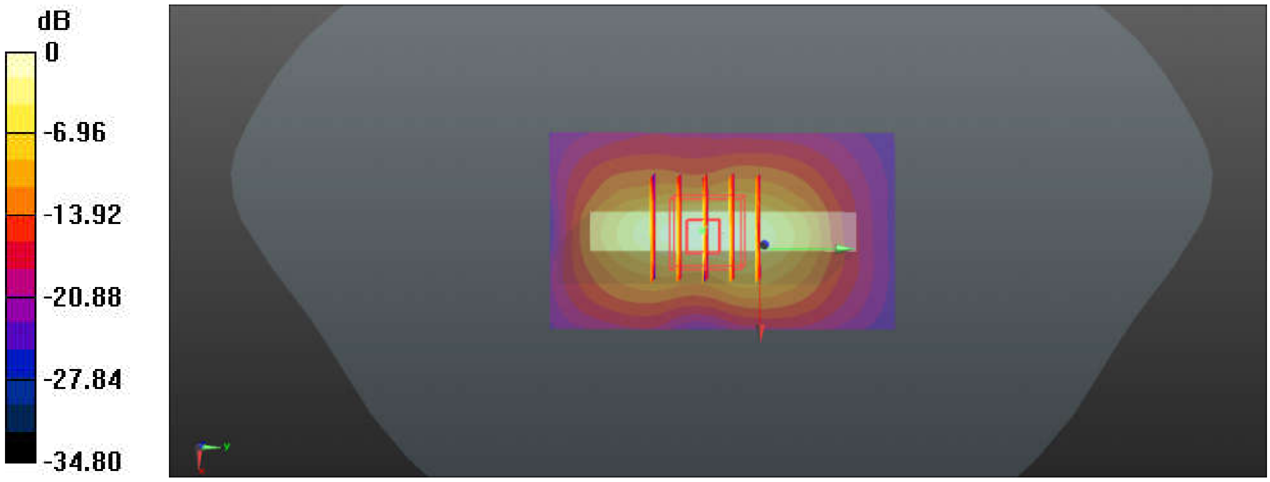
## 04_Band 23_15KHz_QPSK_1RB_0Offset_Top Side_0mm_Ch25600

Communication System: UID 0, LTE (0); Frequency: 2010 MHz;Duty Cycle: 1:1
Medium: HSL_2000_231121 Medium parameters used: f = 2010 MHz; σ = 1.454 S/m; $\varepsilon_r$ = 40.975; ρ = 1000 kg/m$^3$
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7576; ConvF(8.55, 8.55, 8.55); Calibrated: 2023/8/23
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1386; Calibrated: 2023/7/17
- Phantom: SAM with CRP v5.0(Front); Type: QD000P40CD; Serial: 1671
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

**Ch25600/Area Scan (41x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.76 W/kg

**Ch25600/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.911 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.74 W/kg
**SAR(1 g) = 1.54 W/kg; SAR(10 g) = 0.646 W/kg**
Maximum value of SAR (measured) = 2.91 W/kg




0 dB = 2.91 W/kg

# Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
**S** Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 0108**

**Client** Sporton

Certificate No: **D1640V2-347_Sep22**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1640V2 - SN:347 |
| Calibration procedure(s) | QA CAL-05.v11<br>Calibration Procedure for SAR Validation Sources between 0.7-3 GHz |
| Calibration date: | September 01, 2022 |

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 |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 04-Apr-22 (No. 217-03525/03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-22 (No. 217-03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-22 (No. 217-03525) | Apr-23 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528) | Apr-23 |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-21 (No. EX3-7349_Dec21) | Dec-22 |
| DAE4 | SN: 601 | 31-Aug-22 (No. DAE4-601_Aug22) | Aug-23 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A | SN: MY41093315 | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-20) | In house check: Oct-22 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-20) | In house check: Oct-22 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeffrey Katzman | Laboratory Technician | |
| Approved by: | Sven Kühn | Technical Manager | |

Issued: September 1, 2022

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

## Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

c) DASY System Handbook

## Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY52 | V52.10.4 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 1640 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.2 | 1.31 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 38.6 ± 6 % | 1.30 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 8.68 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **34.6 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 4.67 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **18.6 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.3 Ω + 6.4 jΩ |
| Return Loss | - 23.9 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.224 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |

**DASY5 Validation Report for Head TSL**

Date: 01.09.2022

Test Laboratory: SPEAG, Zurich, Switzerland

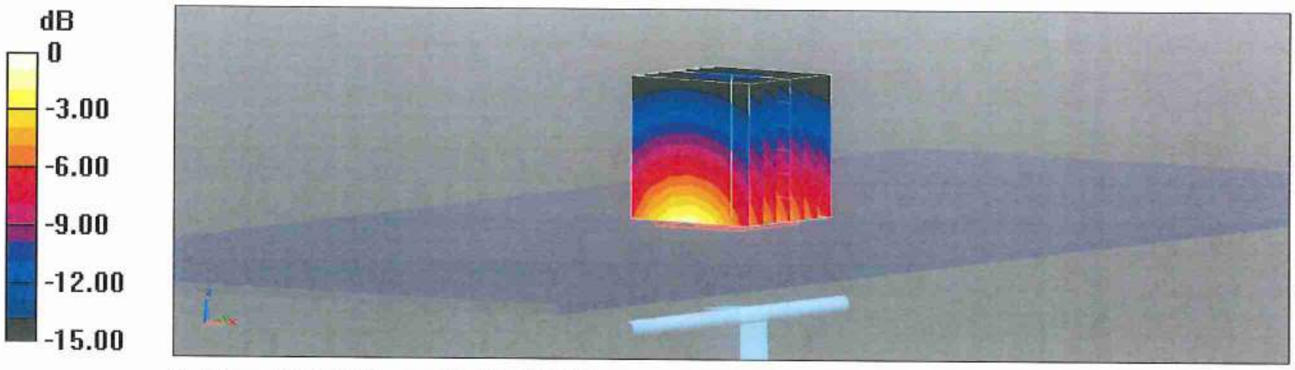
**DUT: Dipole 1640 MHz; Type: D1640V2; Serial: D1640V2 - SN: 347**

Communication System: UID 0 - CW; Frequency: 1640 MHz
Medium parameters used: f = 1640 MHz; $\sigma$ = 1.3 S/m; $\varepsilon_r$ = 38.6; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

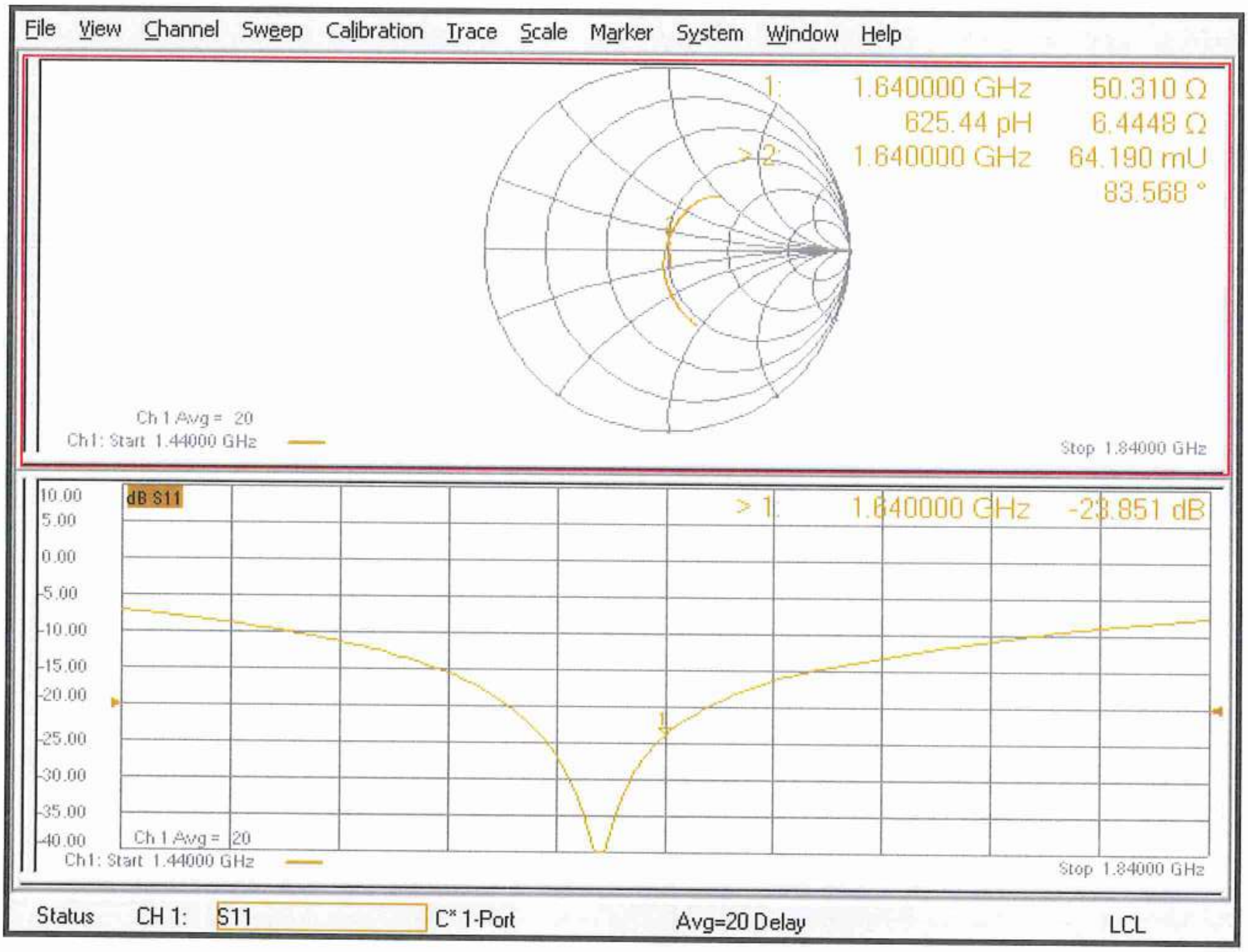
- Probe: EX3DV4 - SN7349; ConvF(8.68, 8.68, 8.68) @ 1640 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.8 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 16.0 W/kg
**SAR(1 g) = 8.68 W/kg; SAR(10 g) = 4.67 W/kg**
Smallest distance from peaks to all points 3 dB below = 10.8 mm
Ratio of SAR at M2 to SAR at M1 = 54.8%
Maximum value of SAR (measured) = 13.3 W/kg




0 dB = 13.3 W/kg = 11.24 dBW/kg

## Impedance Measurement Plot for Head TSL



# D1640V2, Serial No. 347 Extended Dipole Calibrations

if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

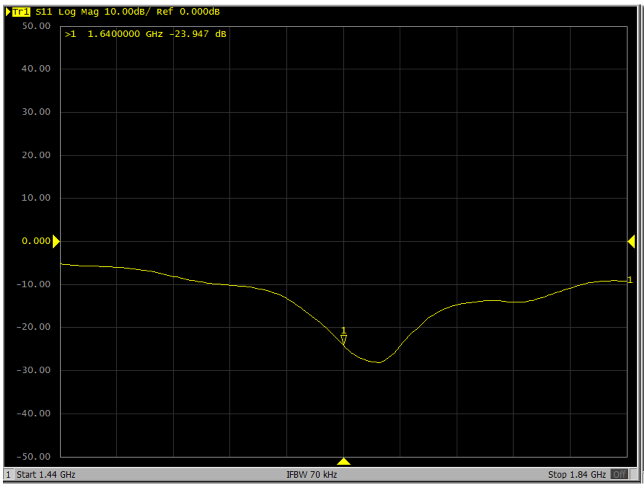
| D1640V2 – serial no. 347 | | | | | | |
|---|---|---|---|---|---|---|
| | 1640 Head | | | | | |
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 2022.9.1 | -23.9 | | 50.3 | | 6.4 | |
| 2023.8.31 | -24.9 | 4.4% | 49 | 1.3 | 6.2 | 0.2 |

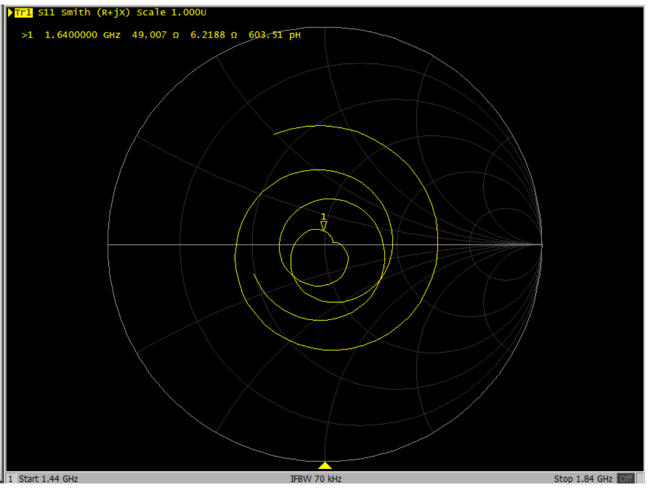
**<Justification of the extended calibration>**

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

### Dipole Verification Data> 1640V2, serial no. 347

### 1640MHz – Head----2023.8.31



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CALIBRATION
CNAS L0570

Client **sporton** **Certificate No: Z21-60375**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2000V2 - SN: 1083 |
| Calibration Procedure(s) | FF-Z11-003-01<br>Calibration Procedures for dipole validation kits |
| Calibration date: | October 14, 2021 |

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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power Meter NRP2 | 106277 | 24-Sep-21 (CTTL, No.J21X08326) | Sep-22 |
| Power sensor NRP8S | 104291 | 24-Sep-21 (CTTL, No.J21X08326) | Sep-22 |
| Reference Probe EX3DV4 | SN 7517 | 03-Feb-21(CTTL-SPEAG,No.Z21-60001) | Feb-22 |
| DAE4 | SN 1556 | 15-Jan-21(SPEAG,No.DAE4-1556_Jan21) | Jan-22 |
| | | | |
| Secondary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-21 (CTTL, No.J21X00593) | Jan-22 |
| NetworkAnalyzer E5071C | MY46110673 | 14-Jan-21 (CTTL, No.J21X00232) | Jan-22 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Zhao Jing | SAR Test Engineer | |
| Reviewed by: | Lin Hao | SAR Test Engineer | |
| Approved by: | Qi Dianyuan | SAR Project Leader | |

Issued: October 21 2021

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**lossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORMx,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

e) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

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## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY52 | V52.10.4 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Triple Flat Phantom 5.1C | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 2000 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.0 | 1.40 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.8 ± 6 % | 1.39 mho/m ± 6 % |
| **Head TSL temperature change during test** | <1.0 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.2 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **40.9 W/kg ± 18.8 % (*k*=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
| SAR measured | 250 mW input power | 5.09 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **20.4 W/kg ± 18.7 % (*k*=2)** |

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## Appendix (Additional assessments outside the scope of CNAS L0570)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 55.2Ω- 1.00jΩ |
| Return Loss | - 26.0dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.103 ns |

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |

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**DASY5 Validation Report for Head TSL** Date: 10.14.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2000 MHz; Type: D2000V2; Serial: D2000V2 - SN: 1083**

Communication System: UID 0, CW; Frequency: 2000 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2000 MHz; $\sigma$ = 1.391 S/m; $\varepsilon_r$ = 39.78; $\rho$ = 1000 kg/m$^3$

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(7.9, 7.9, 7.9) @ 2000 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2021-01-15
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7501)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 104.9 V/m; Power Drift = -0.02 dB

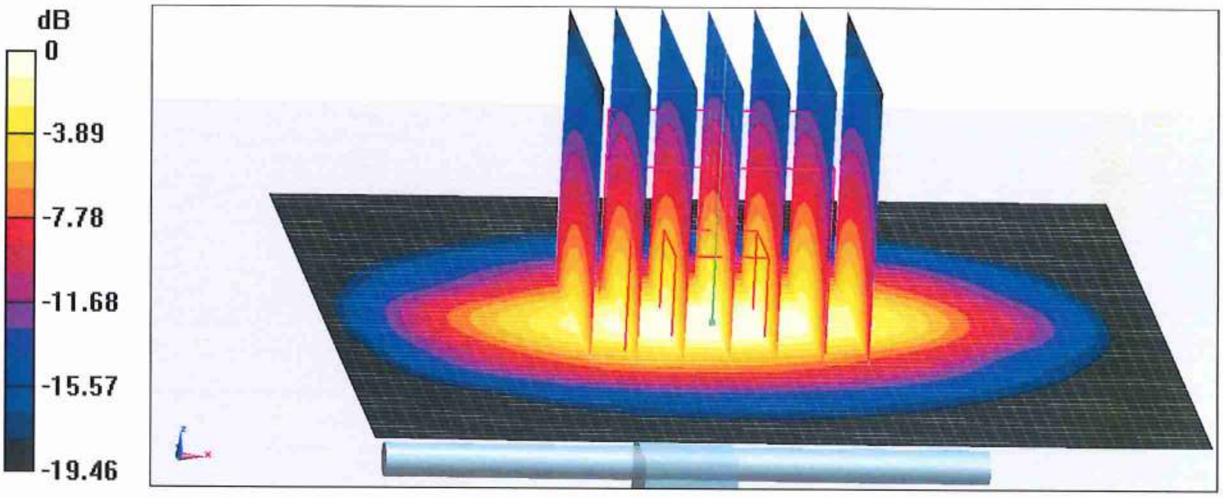
Peak SAR (extrapolated) = 20.4 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.09 W/kg**

Smallest distance from peaks to all points 3 dB below = 9.8 mm

Ratio of SAR at M2 to SAR at M1 = 50.2%

Maximum value of SAR (measured) = 16.6 W/kg




**0 dB = 16.6 W/kg = 12.20 dBW/kg**

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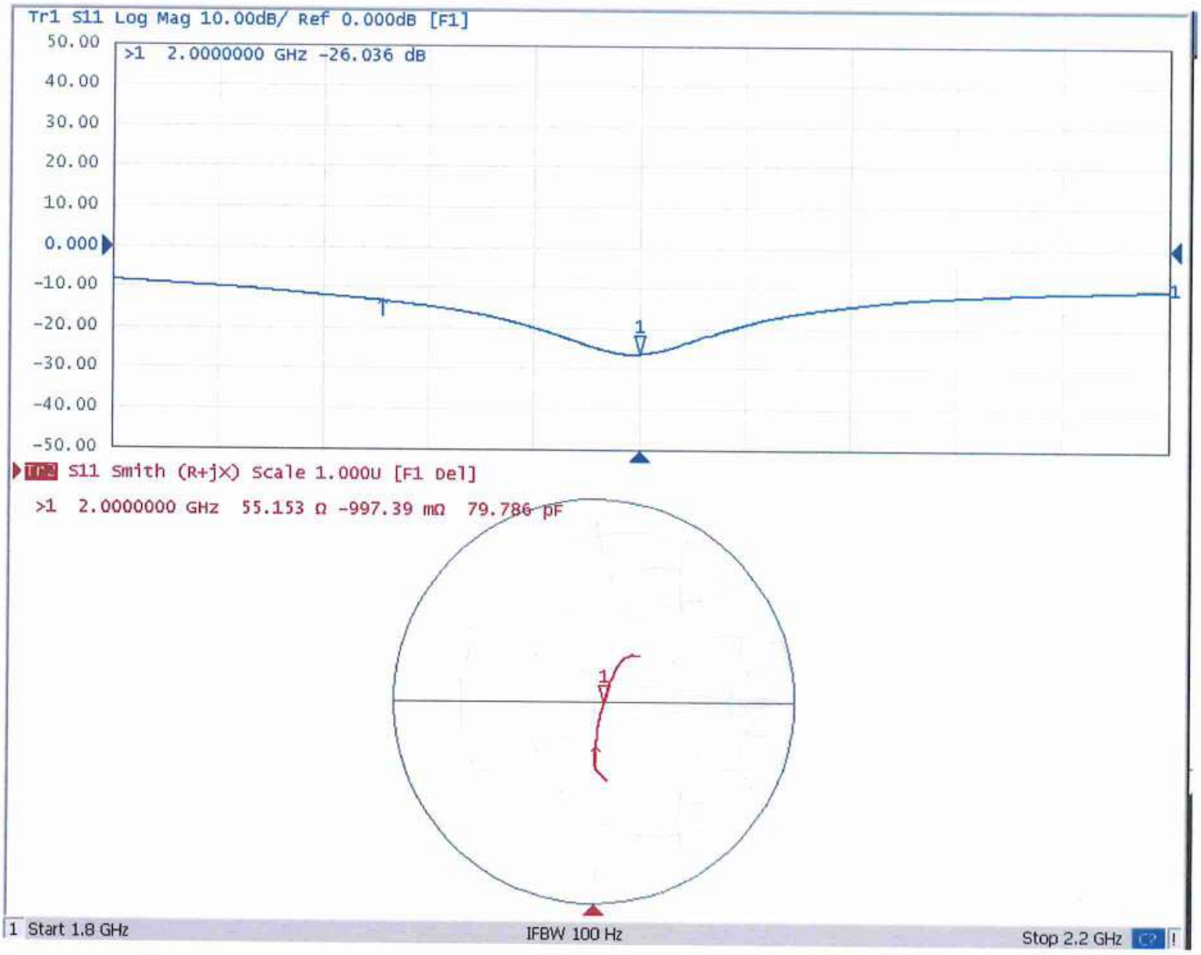
## Impedance Measurement Plot for Head TSL



# D2000V2, Serial No. 1083 Extended Dipole Calibrations

if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

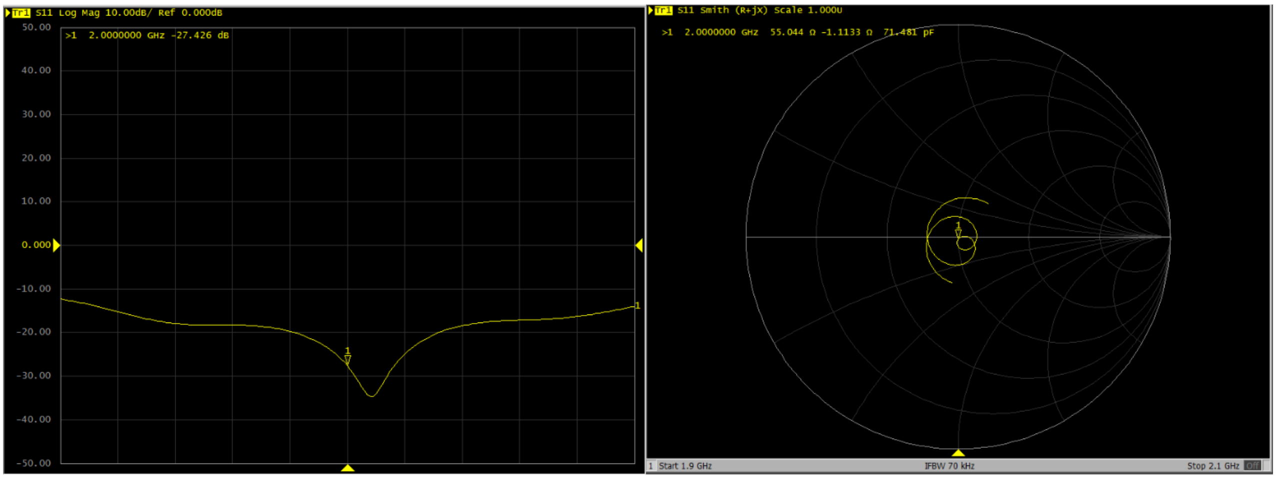
| D2000V2 – serial no. 1083 | | | | | | |
|---|---|---|---|---|---|---|
| | 2000 Head | | | | | |
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 2021.10.14 | -26 | | 55.2 | | -1 | |
| 2022.10.13 | -27.4 | 5.4% | 55 | 0.2 | -1.1 | 0.1 |
| 2023.10.13 | -26.1 | 0.4% | 57.3 | -2.1 | -1.5 | 0.5 |

**<Justification of the extended calibration>**

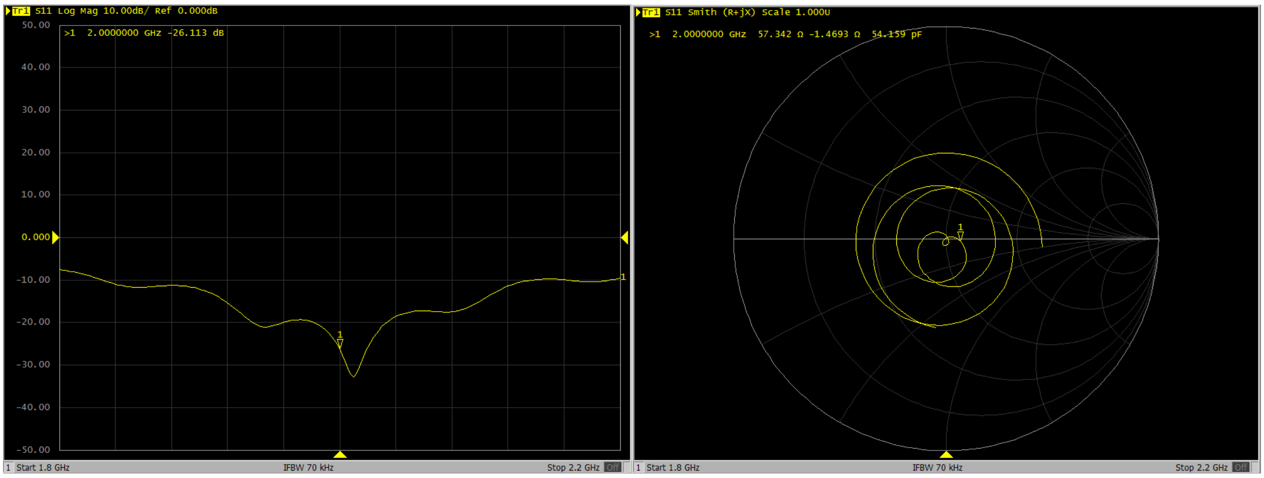
The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

## Dipole Verification Data> D2000V2, serial no. 1083

### 2000MHz – Head—2022.10.13




### 2000MHz – Head—2023.10.13



**Calibration Laboratory of**
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Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
Servizio svizzero di taratura
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 0108**

**Client** **Sporton**
**Shenzhen City**

**Certificate No: DAE4-1386_Jul23**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BM - SN: 1386 |
| Calibration procedure(s) | QA CAL-06.v30<br>Calibration procedure for the data acquisition electronics (DAE) |
| Calibration date: | July 17, 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 |
|---|---|---|---|
| Keithley Multimeter Type 2001 | SN: 0810278 | 29-Aug-22 (No:34389) | Aug-23 |
| **Secondary Standards** | **ID #** | **Check Date (in house)** | **Scheduled Check** |
| Auto DAE Calibration Unit | SE UWS 053 AA 1001 | 27-Jan-23 (in house check) | In house check: Jan-24 |
| Calibrator Box V2.1 | SE UMS 006 AA 1002 | 27-Jan-23 (in house check) | In house check: Jan-24 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Adrian Gehring | Laboratory Technician | |
| Approved by: | Sven Kühn | Technical Manager | i.V. |

Issued: July 17, 2023

## Glossary

| | |
|---|---|
| DAE | data acquisition electronics |
| Connector angle | information used in DASY system to align probe sensor X to the robot coordinate system. |

## Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| **High Range** | 404.538 ± 0.02% (k=2) | 404.631 ± 0.02% (k=2) | 404.147 ± 0.02% (k=2) |
| **Low Range** | 4.02032 ± 1.50% (k=2) | 4.01467 ± 1.50% (k=2) | 4.01239 ± 1.50% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 150.5 ° ± 1 ° |

## Appendix (Additional assessments outside the scope of SCS0108)

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199998.26 | 2.92 | 0.00 |
| Channel X | + Input | 20002.53 | 0.37 | 0.00 |
| Channel X | - Input | -20001.05 | 1.19 | -0.01 |
| Channel Y | + Input | 199996.32 | 1.35 | 0.00 |
| Channel Y | + Input | 20000.21 | -1.92 | -0.01 |
| Channel Y | - Input | -20003.93 | -1.59 | 0.01 |
| Channel Z | + Input | 199996.80 | 1.67 | 0.00 |
| Channel Z | + Input | 19999.03 | -2.98 | -0.01 |
| Channel Z | - Input | -20004.13 | -1.81 | 0.01 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2001.06 | 0.07 | 0.00 |
| Channel X | + Input | 201.18 | -0.07 | -0.03 |
| Channel X | - Input | -198.83 | -0.17 | 0.09 |
| Channel Y | + Input | 2001.13 | 0.13 | 0.01 |
| Channel Y | + Input | 200.06 | -1.17 | -0.58 |
| Channel Y | - Input | -199.86 | -1.05 | 0.53 |
| Channel Z | + Input | 2001.13 | 0.21 | 0.01 |
| Channel Z | + Input | 200.63 | -0.47 | -0.23 |
| Channel Z | - Input | -199.56 | -0.77 | 0.39 |

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | -14.86 | -16.96 |
| | - 200 | 18.57 | 16.65 |
| Channel Y | 200 | -9.13 | -10.04 |
| | - 200 | 7.83 | 7.46 |
| Channel Z | 200 | -5.73 | -5.48 |
| | - 200 | 4.10 | 4.22 |

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | 4.53 | -2.66 |
| Channel Y | 200 | 8.83 | - | 6.35 |
| Channel Z | 200 | 8.37 | 6.18 | - |

## 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | High Range (LSB) | Low Range (LSB) |
|---|---|---|
| Channel X | 16012 | 14821 |
| Channel Y | 16075 | 17443 |
| Channel Z | 16061 | 13144 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

| | Average (μV) | min. Offset (μV) | max. Offset (μV) | Std. Deviation (μV) |
|---|---|---|---|---|
| Channel X | 0.33 | -0.71 | 1.31 | 0.34 |
| Channel Y | -1.48 | -3.09 | -0.07 | 0.43 |
| Channel Z | 0.03 | -1.43 | 0.93 | 0.36 |

## 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

## 7. Input Resistance (Typical values for information)

| | Zeroing (kOhm) | Measuring (MOhm) |
|---|---|---|
| Channel X | 200 | 200 |
| Channel Y | 200 | 200 |
| Channel Z | 200 | 200 |

## 8. Low Battery Alarm Voltage (Typical values for information)

| Typical values | Alarm Level (VDC) |
|---|---|
| Supply (+ Vcc) | +7.9 |
| Supply (- Vcc) | -7.6 |

## 9. Power Consumption (Typical values for information)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|---|---|---|---|
| Supply (+ Vcc) | +0.01 | +6 | +14 |
| Supply (- Vcc) | –0.01 | -8 | -9 |

**Calibration Laboratory of**
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**S** **Schweizerischer Kalibrierdienst**
**C** **Service suisse d'étalonnage**
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**Accreditation No.: SCS 0108**

**Client** **Sporton**
**Shenzhen City**

**Certificate No.** **EX-7576_Aug23**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:7576 |
| Calibration procedure(s) | QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6, QA CAL-25.v8<br>Calibration procedure for dosimetric E-field probes |
| Calibration date | August 23, 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 |
|---|---|---|---|
| Power meter NRP2 | SN: 104778 | 30-Mar-23 (No. 217-03804/03805) | Mar-24 |
| Power sensor NRP-Z91 | SN: 103244 | 30-Mar-23 (No. 217-03804) | Mar-24 |
| OCP DAK-3.5 (weighted) | SN: 1249 | 20-Oct-22 (OCP-DAK3.5-1249_Oct22) | Oct-23 |
| OCP DAK-12 | SN: 1016 | 20-Oct-22 (OCP-DAK12-1016_Oct22) | Oct-23 |
| Reference 20 dB Attenuator | SN: CC2552 (20x) | 30-Mar-23 (No. 217-03809) | Mar-24 |
| DAE4 | SN: 660 | 16-Mar-23 (No. DAE4-660_Mar23) | Mar-24 |
| Reference Probe ES3DV2 | SN: 3013 | 06-Jan-23 (No. ES3-3013_Jan23) | Jan-24 |

| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-22) | In house check: Jun-24 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-22) | In house check: Jun-24 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-22) | In house check: Jun-24 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-22) | In house check: Jun-24 |
| Network Analyzer E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by | Michael Weber | Laboratory Technician | M.Weber |
| Approved by | Sven Kühn | Technical Manager | S. Kühn |

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