# SAR Compliance Test Report

| | | | |
|---|---|---|---|
| **Date of Report** | 21/06/2023 | **Client's Contact person:** | Andreas Kroll |
| **Number of pages:** | 84 | | |
| | | **Responsible Test engineer:** | Jesper Varis |
| **Testing laboratory:** | **Verkotan Oy**<br>Elektroniikkatie 17<br>90590 Oulu<br>Finland | **Client:** | **German Bionic Systems GmbH**<br>August-Wessels Str. 23<br>86156 Augsburg<br>German |
| **Tested device** | **Apogee** | | |
| **Related reports:** | - | | |
| **Testing has been carried out in accordance with:** | **47CFR §2.1093**<br>Radiofrequency Radiation Exposure Evaluation: Portable Devices<br><br>**FCC published RF exposure KDB procedures**<br><br>**IEEE 1528:2013**<br>IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques | | |
| **Documentation:** | The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory | | |
| **Test Results:** | **The EUT complies with the requirements in respect of all parameters subject to the test.**<br>The test results relate only to devices specified in this document | | |
| **Date and signatures:** | 21.06.2023<br><br>**Laboratory Manager**<br>Miia Nurkkala<br>Digitaalinen allekirjoittaja: Miia Nurkkala<br>Päiväys: 2023.06.21 20:04:05 +03'00' | | |

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# 1. SUMMARY OF SAR TEST REPORT

## 1.1 Test Details

### Equipment under Test (DUT):

| | |
|---|---|
| **Product:** | Exoskeleton |
| **Manufacturer:** | German Bionic Systems GmbH |
| **Model:** | Apogee |
| **Serial Number:** | 99-99-00-27, 99-99-00-30 |
| **FCC ID Number:** | FCC ID: VVX-LM843, 2AJYU-8PYA007 |
| **DUT Number:** | 21355, 21366 |
| **Battery Type used in testing:** | Li-Ion Battery |
| **State of the Sample:** | Production sample |

### Testing information:

| | |
|---|---|
| **Testing performed:** | 01.03.2023 – 20.04.2023 |
| **Notes:** | Splitted FCC and ISED into own reports. |
| **Document history:** | This report replaces previous "FCC ISED_SAR report_Apogee ID5977c_23052023.pdf" report. |
| **Document ID:** | FCC_SAR report_Apogee ID5977c_21062023.docx |
| **Temperature °C** | 22±2 / Controlled |
| **Humidity RH%** | 30±20 / Controlled |
| **Measurement performed by:** | Jesper Varis, Ilari Kinnunen, Kalle Orava |
| **FCC Test Firm Designation Number:** | FI0005 |

## 1.2 Maximum Results

The maximum reported* SAR values for Body-worn for transmitting systems are shown in a table below. The device conforms to the requirements of the standards when the maximum reported SAR value is less than or equal to the limit. The SAR limit specified in FCC 47 CFR part 2 (2.1093) for Head/Body $SAR_{1g}$ is 1.6 W/kg.



### 1.2.1 Standalone SAR

| System | Highest Reported* $SAR_{1g}$(W/kg) in Body-Worn Exposure Condition, 0mm separation distance | Result |
|---|---|---|
| WCDMA 2 | 0.17 | PASS |
| WCDMA 4 | 0.36 | PASS |
| WCDMA 5 | 0.48 | PASS |
| LTE 2 | 0.25 | PASS |
| LTE 5 | 0.46 | PASS |
| LTE 7 | 0.18 | PASS |
| LTE 12 | 0.28 | PASS |
| LTE 13 | 0.40 | PASS |
| LTE 66 | 0.33 | PASS |
| 2.4 GHz WLAN | 0.047 | PASS |
| 5 GHz WLAN | 0.00021 | PASS |

* Reported SAR Values are scaled to upper limit of power tuning tolerance.

### 1.2.2 Simultaneous Transmission SAR

| Highest Simultaneous Transmission SAR | $SAR_{1g}$(W/kg) in Body-Worn Exposure Condition |
|---|---|
| WCDMA + 2.4 GHz WLAN | 0.527 |

### 1.2.3 Maximum Drift

| Maximum Drift During Measurements | 1.05 dB |
|---|---|

*Larger than 5% drifts included to scaling factors

### 1.2.4 Measurement Uncertainty

SAR 1g: 0.3 – 3 GHz:

| Expanded Uncertainty (k=2) 95 % | ±22.3 % |
|---|---|

SAR 1g: 3 – 6 GHz:

| Expanded Uncertainty (k=2) 95 % | ±24.6 % |
|---|---|



## 2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

The DUT is an exoskeleton which supports user's movements and reduces risk of workplace accidents and load-bearing injuries. Supported wireless standards are WCDMA, LTE and 2.4GHz & 5GHz WLAN.

All the modules and antennas are located behind the user. See section 5.1.1 for more details.

Figure 1. Overview of the DUT

| | |
|---|---|
| **Device Category** | Portable |
| **Exposure Environment** | General population uncontrolled |



## 2.1 Supported Frequency Bands and Operational Modes

| | Modes of Operation | Transmitter Frequency Range [MHz] |
|---|---|---|
| **TX Frequency bands** | WCDMA 2 | 1850 – 1910 |
| | WCDMA 4 | 1710 – 1755 |
| | WCDMA 5 | 824 – 849 |
| | LTE 2 | 1850 – 1910 |
| | LTE 4 | 1710 – 1755 |
| | LTE 5 | 824 – 849 |
| | LTE 7 | 2500 – 2570 |
| | LTE 12 | 698 – 716 |
| | LTE 13 | 777 – 787 |
| | LTE 66 | 1710 – 1780 |
| | 2.4GHz WLAN | 2412 – 2462 |
| | 5GHz WLAN | 5180 - 5825 |

## 2.2 Test Exclusions

According to April 2015 TCB workshop, SAR test exclusion can be applied for testing overlapping LTE bands when the specified maximum output power, including tune-up tolerance, is less or same for the smaller band as for the larger band.
The channel bandwidth and other operating parameters for the smaller band must be fully supported by the larger band.

For this product:

- LTE 4 band, 1710-1755 MHz, is excluded from the testing as it is fully covered by LTE 66 band, 1710 – 1780 MHz

## 2.3 Simultaneous transmission

The DUT supports the following combinations:
- Cellular and 2.4GHz WLAN
- Cellular and 5GHz WLAN



# 3. OUTPUT POWER

## 3.1 Maximum specified conducted output power

From the customer, including tune-up tolerances;

| WCDMA | Max Output Power [dBm] |
|---|---|
| 2 | 25 |
| 4 | 25 |
| 5 | 25 |

| LTE | Max Output Power [dBm] |
|---|---|
| 2 | 25.7 |
| 4 | 25.7 |
| 5 | 25.7 |
| 7 | 25.7 |
| 12 | 25.7 |
| 13 | 25.7 |
| 66 | 25.7 |

| 2.4GHz WLAN | Max Output Power [dBm] |
|---|---|
| 802.11b | 17 |
| 802.11g | 15 |
| 802.11n | 14 |

| 5GHz WLAN | Max Output Power [dBm] |
|---|---|
| 802.11a | 15 |
| 802.11n | 14 |
| 802.11ac | 12 |



## 3.2 Tested conducted power

Measured conducted output power at transmitting antenna connector;

WCDMA:

| Reference Channel | WCDMA 2 | | | WCDMA 4 | | | WCDMA 5 | | |
|---|---|---|---|---|---|---|---|---|---|
| | CH 9262 1852.4 MHz | CH 9400 1880.0 MHz | CH 9538 1907.6 MHz | CH 1312 1712.4 MHz | CH 1413 1732.6 MHz | CH 1513 1752.6 MHz | CH 4132 826.4 MHz | CH 4183 836.6 MHz | CH 4233 846.6 MHz |
| **RMC 12.2K** | 24.08 | 24.21 | 24.19 | 23.25 | 22.15 | 23.16 | 23.17 | 23.18 | 23.17 |
| **HSDPA Subtest-1** | 23.04 | 23.17 | 23.16 | 22.49 | 22.03 | 22.46 | 22.19 | 22.18 | 22.11 |
| **HSDPA Subtest-2** | 23.06 | 23.14 | 23.12 | 22.49 | 22.04 | 22.52 | 22.08 | 22.15 | 22.03 |
| **HSDPA Subtest-3** | 22.59 | 22.59 | 22.56 | 22.07 | 21.56 | 22.08 | 21.63 | 21.55 | 21.44 |
| **HSDPA Subtest-4** | 22.46 | 22.44 | 22.5 | 22.1 | 21.5 | 22.17 | 21.49 | 21.61 | 21.45 |
| **HSUPA Subtest-1** | 23.13 | 23.11 | 23.17 | 22.51 | 21.85 | 22.45 | 22.02 | 22.21 | 22.0 |
| **HSUPA Subtest-2** | 22.62 | 22.72 | 22.68 | 21.89 | 21.28 | 21.93 | 21.52 | 21.52 | 21.41 |
| **HSUPA Subtest-3** | 22.93 | 23.01 | 22.89 | 22.53 | 21.73 | 22.55 | 22.08 | 22.03 | 21.92 |
| **HSUPA Subtest-4** | 22.88 | 22.91 | 22.84 | 22.32 | 21.54 | 22.33 | 21.95 | 21.94 | 21.91 |
| **HSUPA Subtest-5** | 22.65 | 22.79 | 22.67 | 22.37 | 21.57 | 22.28 | 21.92 | 21.95 | 21.89 |

LTE:

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 18607 1850.7 MHz | CH 18900 1880.0 MHz | CH 19193 1909.3 MHz | 3GPP MPR [dB] | CH 18607 1850.7 MHz | CH 18900 1880.0 MHz | CH 19193 1909.3 MHz | 3GPP MPR [dB] |
| **2 / 1.4M** | 1 | 0 | 24.08 | 24.21 | 24.19 | 23.25 | 22.15 | 23.16 | 23.17 | 23.18 |
| | 1 | 2 | 23.04 | 23.17 | 23.16 | 22.49 | 22.03 | 22.46 | 22.19 | 22.18 |
| | 1 | 5 | 23.06 | 23.14 | 23.12 | 22.49 | 22.04 | 22.52 | 22.08 | 22.15 |
| | 3 | 0 | 22.59 | 22.59 | 22.56 | 22.07 | 21.56 | 22.08 | 21.63 | 21.55 |
| | 3 | 1 | 22.46 | 22.44 | 22.5 | 22.1 | 21.5 | 22.17 | 21.49 | 21.61 |
| | 3 | 3 | 23.13 | 23.11 | 23.17 | 22.51 | 21.85 | 22.45 | 22.02 | 22.21 |
| | 6 | 0 | 22.62 | 22.72 | 22.68 | 21.89 | 21.28 | 21.93 | 21.52 | 21.52 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 18615 1851.5 MHz | CH 18900 1880.0 MHz | CH 19185 1918.5 MHz | 3GPP MPR [dB] | CH 18615 1851.5 MHz | CH 18900 1880.0 MHz | CH 19185 1918.5 MHz | 3GPP MPR [dB] |
| **2 / 3M** | 1 | 0 | 22.36 | 21.91 | 22.54 | 0 | 20.66 | 20.46 | 20.93 | 1 |
| | 1 | 7 | 22.45 | 21.97 | 22.8 | 0 | 20.99 | 20.45 | 21.21 | 1 |
| | 1 | 14 | 22.23 | 21.79 | 22.41 | 0 | 20.89 | 20.5 | 20.86 | 1 |
| | 8 | 0 | 21.42 | 21.02 | 21.54 | 1 | 20.31 | 19.94 | 20.2 | 2 |
| | 8 | 3 | 21.38 | 21.0 | 21.46 | 1 | 20.26 | 19.97 | 20.21 | 2 |
| | 8 | 7 | 21.4 | 21.0 | 21.5 | 1 | 20.28 | 19.97 | 20.18 | 2 |
| | 15 | 0 | 21.35 | 20.94 | 21.55 | 1 | 20.31 | 20.16 | 20.58 | 2 |



| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 18625 1852.5 MHz | CH 18900 1880.0 MHz | CH 19175 1907.5 MHz | 3GPP MPR [dB] | CH 18625 1852.5 MHz | CH 18900 1880.0 MHz | CH 19175 1907.5 MHz | 3GPP MPR [dB] |
| 2 / 5M | 1 | 0 | 22.16 | 21.87 | 22.32 | 0 | 20.87 | 20.8 | 20.91 | 1 |
| | 1 | 12 | 22.3 | 22.04 | 22.44 | 0 | 21.04 | 20.52 | 21.21 | 1 |
| | 1 | 24 | 22.1 | 22.04 | 22.44 | 0 | 20.79 | 20.56 | 20.73 | 1 |
| | 12 | 0 | 21.37 | 21.08 | 21.65 | 1 | 20.17 | 19.82 | 20.33 | 2 |
| | 12 | 6 | 21.43 | 21.11 | 21.6 | 1 | 20.26 | 19.82 | 20.43 | 2 |
| | 12 | 13 | 21.32 | 21.0 | 21.54 | 1 | 20.16 | 19.84 | 20.26 | 2 |
| | 25 | 0 | 21.36 | 20.95 | 21.66 | 1 | 20.3 | 20.0 | 20.58 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 18650 1855 MHz | CH 18900 1880.0 | CH 19150 1905 MHz | 3GPP MPR [dB] | CH 18650 1855 MHz | CH 18900 1880.0 MHz | CH 19150 1905 MHz | 3GPP MPR [dB] |
| 2 / 10M | 1 | 0 | 22.22 | 22.05 | 22.32 | 0 | 20.92 | 20.73 | 20.58 | 1 |
| | 1 | 24 | 22.42 | 22.16 | 22.52 | 0 | 20.93 | 20.55 | 20.67 | 1 |
| | 1 | 49 | 22.07 | 22.05 | 22.44 | 0 | 20.57 | 20.42 | 20.86 | 1 |
| | 25 | 0 | 21.45 | 21.05 | 21.52 | 1 | 20.5 | 19.98 | 20.45 | 2 |
| | 25 | 12 | 21.46 | 21.08 | 21.56 | 1 | 20.44 | 20.03 | 20.86 | 2 |
| | 25 | 25 | 21.23 | 20.96 | 21.51 | 1 | 20.21 | 20.0 | 20.53 | 2 |
| | 50 | 0 | 21.44 | 21.07 | 21.65 | 1 | 20.4 | 20.17 | 20.54 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 18675 1857.5 MHz | CH 18900 1880.0 | CH 19125 1902.5 MHz | 3GPP MPR [dB] | CH 18675 1857.5 MHz | CH 18900 1880.0 MHz | CH 19125 1902.5 MHz | 3GPP MPR [dB] |
| 2 / 15M | 1 | 0 | 22.35 | 22.02 | 22.35 | 0 | 21.07 | 20.88 | 20.83 | 1 |
| | 1 | 37 | 22.37 | 22.26 | 22.76 | 0 | 21.25 | 20.91 | 21.3 | 1 |
| | 1 | 74 | 22.12 | 22.16 | 22.44 | 0 | 20.61 | 20.63 | 20.64 | 1 |
| | 36 | 0 | 21.5 | 21.11 | 21.47 | 1 | 20.27 | 20.05 | 20.42 | 2 |
| | 36 | 19 | 21.36 | 21.1 | 21.44 | 1 | 20.26 | 20.13 | 20.38 | 2 |
| | 36 | 39 | 21.25 | 21.09 | 21.55 | 1 | 20.35 | 20.12 | 20.39 | 2 |
| | 75 | 0 | 21.4 | 21.04 | 21.41 | 1 | 20.39 | 20.16 | 20.35 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 18700 1860.0 MHz | CH 18900 1880.0 | CH 19100 1900.0 MHz | 3GPP MPR [dB] | CH 18700 1860.0 MHz | CH 18900 1880.0 | CH 19100 1900.0 MHz | 3GPP MPR [dB] |
| 2 / 20M | 1 | 0 | 22.38 | 22.17 | 22.29 | 0 | 21.07 | 20.66 | 20.39 | 1 |
| | 1 | 50 | 22.3 | 22.11 | 22.57 | 0 | 21.1 | 20.87 | 21.31 | 1 |
| | 1 | 99 | 22.03 | 22.13 | 22.45 | 0 | 20.44 | 20.53 | 20.7 | 1 |
| | 50 | 0 | 21.45 | 21.18 | 21.36 | 1 | 20.5 | 20.14 | 20.41 | 2 |
| | 50 | 25 | 21.37 | 21.04 | 21.53 | 1 | 20.38 | 20.16 | 20.58 | 2 |
| | 50 | 50 | 21.15 | 21.01 | 21.59 | 1 | 20.25 | 20.22 | 20.59 | 2 |
| | 100 | 0 | 21.33 | 21.02 | 21.43 | 1 | 20.46 | 20.16 | 20.37 | 2 |



| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 19957 1710.7 MHz | CH 20175 1732.5 MHz | CH 20393 1754.3 MHz | 3GPP MPR [dB] | CH 19957 1710.7 MHz | CH 20175 1732.5 MHz | CH 20393 1754.3 MHz | 3GPP MPR [dB] |
| 4 / 1.4M | 1 | 0 | 23.05 | 23.14 | 23.11 | 0 | 21.96 | 21.85 | 21.97 | 1 |
| | 1 | 2 | 23.17 | 23.21 | 23.3 | 0 | 21.91 | 22.13 | 22.05 | 1 |
| | 1 | 5 | 23.12 | 22.89 | 23.12 | 0 | 21.88 | 21.62 | 21.93 | 1 |
| | 3 | 0 | 23.27 | 23.14 | 23.23 | 0 | 22.12 | 22.1 | 22.2 | 1 |
| | 3 | 1 | 23.22 | 23.17 | 23.33 | 0 | 22.15 | 22.24 | 22.31 | 1 |
| | 3 | 3 | 23.16 | 23.16 | 23.19 | 0 | 22.14 | 22.12 | 22.22 | 1 |
| | 6 | 0 | 22.12 | 22.16 | 22.35 | 1 | 21.14 | 21.11 | 21.51 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 19965 1711.5 MHz | CH 20175 1732.5 MHz | CH 20385 1753.5 MHz | 3GPP MPR [dB] | CH 19965 1711.5 MHz | CH 20175 1732.5 MHz | CH 20385 1753.5 MHz | 3GPP MPR [dB] |
| 4 / 3M | 1 | 0 | 23.08 | 22.98 | 22.86 | 0 | 21.8 | 21.7 | 21.71 | 1 |
| | 1 | 7 | 23.01 | 23.06 | 23.11 | 0 | 22.04 | 21.95 | 21.91 | 1 |
| | 1 | 14 | 22.79 | 23.06 | 23.12 | 0 | 21.52 | 21.41 | 21.97 | 1 |
| | 8 | 0 | 22.25 | 22.27 | 22.27 | 1 | 20.79 | 21.28 | 21.18 | 2 |
| | 8 | 3 | 22.26 | 22.27 | 22.13 | 1 | 21.21 | 21.2 | 21.22 | 2 |
| | 8 | 7 | 22.19 | 22.18 | 22.07 | 1 | 21.11 | 21.17 | 21.18 | 2 |
| | 15 | 0 | 22.11 | 22.23 | 22.09 | 1 | 21.2 | 21.28 | 21.22 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 19975 1711.5 MHz | CH 20175 1732.5 MHz | CH 20375 1753.5 MHz | 3GPP MPR [dB] | CH 19975 1711.5 MHz | CH 20175 1732.5 MHz | CH 20375 1753.5 MHz | 3GPP MPR [dB] |
| 4 / 5M | 1 | 0 | 23.16 | 23.14 | 22.98 | 0 | 21.87 | 22.13 | 22.12 | 1 |
| | 1 | 12 | 23.12 | 23.12 | 23.23 | 0 | 21.84 | 22.21 | 22.2 | 1 |
| | 1 | 24 | 23.0 | 23.09 | 23.34 | 0 | 21.75 | 21.67 | 22.08 | 1 |
| | 12 | 0 | 22.35 | 22.34 | 22.34 | 1 | 21.07 | 21.04 | 21.04 | 2 |
| | 12 | 6 | 22.31 | 22.34 | 22.37 | 1 | 21.03 | 21.1 | 21.12 | 2 |
| | 12 | 13 | 22.21 | 22.3 | 22.45 | 1 | 21.06 | 20.92 | 21.18 | 2 |
| | 25 | 0 | 22.21 | 22.31 | 22.38 | 1 | 21.14 | 21.13 | 21.31 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20000 1715.0 MHz | CH 20175 1732.5 MHz | CH 20350 1750.0 MHz | 3GPP MPR [dB] | CH 20000 1715.0 MHz | CH 20175 1732.5 MHz | CH 20350 1750.0 MHz | 3GPP MPR [dB] |
| 4 / 10M | 1 | 0 | 23.45 | 23.09 | 23.42 | 0 | 22.2 | 21.88 | 21.95 | 1 |
| | 1 | 24 | 23.41 | 23.81 | 23.44 | 0 | 21.84 | 21.95 | 22.17 | 1 |
| | 1 | 49 | 23.39 | 23.09 | 23.52 | 0 | 21.78 | 21.77 | 21.98 | 1 |
| | 25 | 0 | 22.51 | 22.66 | 22.57 | 1 | 21.46 | 21.41 | 21.35 | 2 |
| | 25 | 12 | 22.38 | 22.62 | 22.61 | 1 | 21.49 | 21.52 | 21.64 | 2 |
| | 25 | 25 | 22.33 | 22.42 | 22.48 | 1 | 21.3 | 21.22 | 21.42 | 2 |
| | 50 | 0 | 22.53 | 22.49 | 22.43 | 1 | 21.44 | 21.3 | 21.43 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20025 1717.0 MHz | CH 20175 1732.5 MHz | CH 20325 1747.5 MHz | 3GPP MPR [dB] | CH 20025 1717.0 MHz | CH 20175 1732.5 MHz | CH 20325 1747.5 MHz | 3GPP MPR [dB] |
| 4 / 15M | 1 | 0 | 23.44 | 22.47 | 23.33 | 0 | 22.16 | 21.62 | 21.84 | 1 |
| | 1 | 37 | 23.4 | 23.34 | 23.22 | 0 | 22.12 | 21.72 | 22.19 | 1 |
| | 1 | 74 | 22.56 | 23.13 | 23.3 | 0 | 21.49 | 21.61 | 22.0 | 1 |
| | 36 | 0 | 22.47 | 22.45 | 22.18 | 1 | 21.25 | 21.31 | 21.07 | 2 |
| | 36 | 19 | 22.28 | 22.35 | 22.35 | 1 | 21.22 | 21.34 | 21.33 | 2 |
| | 36 | 39 | 22.36 | 22.25 | 22.32 | 1 | 21.2 | 21.24 | 21.28 | 2 |
| | 75 | 0 | 22.33 | 22.25 | 22.23 | 1 | 21.17 | 21.32 | 21.29 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20050 1720.0 MHz | CH 20175 1732.5 MHz | CH 20300 1745.0 MHz | 3GPP MPR [dB] | CH 20050 1720.0 MHz | CH 20175 1732.5 MHz | CH 20300 1745.0 MHz | 3GPP MPR [dB] |
| 4 / 20M | 1 | 0 | 23.51 | 23.09 | 22.83 | 0 | 22.37 | 21.78 | 21.68 | 1 |
| | 1 | 50 | 23.34 | 23.45 | 23.52 | 0 | 22.4 | 22.2 | 22.36 | 1 |
| | 1 | 99 | 22.76 | 23.45 | 23.41 | 0 | 21.61 | 22.03 | 22.12 | 1 |
| | 50 | 0 | 22.56 | 22.67 | 22.52 | 1 | 21.51 | 21.52 | 21.44 | 2 |
| | 50 | 25 | 22.43 | 22.59 | 22.46 | 1 | 21.38 | 21.49 | 21.37 | 2 |
| | 50 | 50 | 22.44 | 22.38 | 22.51 | 1 | 21.4 | 21.32 | 21.48 | 2 |
| | 100 | 0 | 22.57 | 22.59 | 22.41 | 1 | 21.52 | 21.34 | 21.34 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20407 824.7 MHz | CH 20525 836.5 MHz | CH 20643 848.3 MHz | 3GPP MPR [dB] | CH 20407 824.7 MHz | CH 20525 836.5 MHz | CH 20643 848.3 MHz | 3GPP MPR [dB] |
| 5 / 1.4M | 1 | 0 | 23.06 | 22.9 | 23.01 | 0 | 21.82 | 21.68 | 21.72 | 1 |
| | 1 | 2 | 23.13 | 23.05 | 23.08 | 0 | 21.73 | 21.66 | 21.79 | 1 |
| | 1 | 5 | 22.88 | 22.62 | 23.08 | 0 | 21.53 | 21.54 | 21.38 | 1 |
| | 3 | 0 | 23.07 | 22.91 | 23.16 | 0 | 22.11 | 22.07 | 22.09 | 1 |
| | 3 | 1 | 23.11 | 22.97 | 23.12 | 0 | 22.04 | 22.09 | 22.16 | 1 |
| | 3 | 3 | 23.08 | 22.96 | 23.07 | 0 | 22.01 | 22.08 | 22.19 | 1 |
| | 6 | 0 | 21.98 | 21.98 | 22.22 | 1 | 20.88 | 21.12 | 21.01 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20415 825.5 MHz | CH 20525 836.5 MHz | CH 20635 847.5 MHz | 3GPP MPR [dB] | CH 20415 825.5 MHz | CH 20525 836.5 MHz | CH 20635 847.5 MHz | 3GPP MPR [dB] |
| 5 / 3M | 1 | 0 | 22.98 | 23.01 | 22.89 | 0 | 21.64 | 21.41 | 21.59 | 1 |
| | 1 | 7 | 22.93 | 23.16 | 23.25 | 0 | 21.56 | 21.53 | 21.89 | 1 |
| | 1 | 14 | 22.84 | 23.0 | 23.06 | 0 | 21.5 | 21.34 | 21.55 | 1 |
| | 8 | 0 | 22.06 | 22.0 | 22.0 | 1 | 20.93 | 20.88 | 20.95 | 2 |
| | 8 | 3 | 21.85 | 21.98 | 22.05 | 1 | 20.75 | 20.94 | 20.98 | 2 |
| | 8 | 7 | 21.88 | 21.98 | 22.18 | 1 | 20.82 | 20.97 | 20.74 | 2 |
| | 15 | 0 | 21.89 | 21.95 | 22.12 | 1 | 20.99 | 20.98 | 21.05 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20425 826.5 MHz | CH 20525 836.5 MHz | CH 20625 846.5 MHz | 3GPP MPR [dB] | CH 20425 826.5 MHz | CH 20525 836.5 MHz | CH 20625 846.5 MHz | 3GPP MPR [dB] |
| 5 / 5M | 1 | 0 | 22.88 | 22.71 | 22.95 | 0 | 21.59 | 21.44 | 21.46 | 1 |
| | 1 | 12 | 23.04 | 23.08 | 22.97 | 0 | 21.65 | 21.98 | 21.78 | 1 |
| | 1 | 24 | 22.91 | 22.96 | 22.93 | 0 | 21.51 | 21.47 | 21.62 | 1 |
| | 12 | 0 | 21.88 | 21.97 | 21.94 | 1 | 20.67 | 20.79 | 20.85 | 2 |
| | 12 | 6 | 21.92 | 21.94 | 21.96 | 1 | 20.7 | 20.76 | 20.8 | 2 |
| | 12 | 13 | 22.0 | 21.95 | 22.09 | 1 | 20.93 | 20.76 | 20.84 | 2 |
| | 25 | 0 | 21.86 | 22.05 | 22.01 | 1 | 20.82 | 20.88 | 20.87 | 2 |



| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20450 829.0 MHz | CH 20525 836.5 MHz | CH 20600 844 MHz | 3GPP MPR [dB] | CH 20450 829.0 MHz | CH 20525 836.5 MHz | CH 20600 844 MHz | 3GPP MPR [dB] |
| 5 / 10M | 1 | 0 | 23.13 | 22.91 | 22.81 | 0 | 21.72 | 21.52 | 21.85 | 1 |
| | 1 | 24 | 22.88 | 23.02 | 23.1 | 0 | 21.58 | 21.58 | 21.66 | 1 |
| | 1 | 49 | 22.86 | 22.94 | 22.83 | 0 | 21.45 | 21.47 | 21.31 | 1 |
| | 25 | 0 | 22.04 | 22.11 | 22.05 | 1 | 20.88 | 20.91 | 20.89 | 2 |
| | 25 | 12 | 22.11 | 21.97 | 22.03 | 1 | 21.04 | 20.91 | 20.87 | 2 |
| | 25 | 25 | 22.13 | 22.03 | 22.06 | 1 | 20.99 | 20.84 | 20.83 | 2 |
| | 50 | 0 | 22.0 | 22.08 | 21.99 | 1 | 21.07 | 21.05 | 20.97 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20775 2502.5 MHz | CH 21100 2535.0 MHz | CH 21425 2567.5 MHz | 3GPP MPR [dB] | CH 20775 2502.5 MHz | CH 21100 2535.0 MHz | CH 21425 2567.5 MHz | 3GPP MPR [dB] |
| 7 / 5M | 1 | 0 | 23.89 | 24.24 | 24.0 | 0 | 22.8 | 23.22 | 22.86 | 1 |
| | 1 | 12 | 24.21 | 24.37 | 23.0 | 0 | 23.21 | 23.41 | 23.33 | 1 |
| | 1 | 24 | 24.11 | 24.36 | 21.65 | 0 | 22.72 | 23.04 | 22.3 | 1 |
| | 12 | 0 | 23.09 | 23.09 | 23.32 | 1 | 21.95 | 22.22 | 22.07 | 2 |
| | 12 | 6 | 23.18 | 23.08 | 22.88 | 1 | 22.14 | 21.99 | 22.02 | 2 |
| | 12 | 13 | 23.21 | 23.1 | 22.11 | 1 | 22.02 | 22.16 | 21.94 | 2 |
| | 25 | 0 | 23.17 | 23.19 | 22.68 | 1 | 22.15 | 22.25 | 22.23 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20800 2505.0 MHz | CH 21100 2535.0 MHz | CH 21400 2565.0 MHz | 3GPP MPR [dB] | CH 20800 2505.0 MHz | CH 21100 2535.0 MHz | CH 21400 2565.0 MHz | 3GPP MPR [dB] |
| 7 / 10M | 1 | 0 | 24.06 | 24.32 | 24.71 | 0 | 23.03 | 22.9 | 22.67 | 1 |
| | 1 | 24 | 24.37 | 24.56 | 23.15 | 0 | 23.15 | 22.77 | 22.73 | 1 |
| | 1 | 49 | 24.32 | 24.33 | 20.37 | 0 | 22.53 | 22.97 | 21.84 | 1 |
| | 25 | 0 | 23.35 | 23.3 | 23.53 | 1 | 22.37 | 22.6 | 22.36 | 2 |
| | 25 | 12 | 23.41 | 23.57 | 23.11 | 1 | 22.36 | 22.56 | 22.44 | 2 |
| | 25 | 25 | 23.39 | 23.5 | 21.86 | 1 | 22.44 | 22.27 | 22.8 | 2 |
| | 50 | 0 | 23.38 | 23.52 | 23.37 | 1 | 22.55 | 22.41 | 22.52 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20825 2507.5 MHz | CH 21100 2535.0 MHz | CH 21375 2562.5 MHz | 3GPP MPR [dB] | CH 20825 2507.5 MHz | CH 21100 2535.0 MHz | CH 21375 2562.5 MHz | 3GPP MPR [dB] |
| 7 / 15M | 1 | 0 | 24.04 | 24.27 | 24.66 | 0 | 22.77 | 23.06 | 23.03 | 1 |
| | 1 | 37 | 24.2 | 24.4 | 24.48 | 0 | 23.25 | 23.42 | 23.15 | 1 |
| | 1 | 74 | 24.0 | 23.92 | 22.7 | 0 | 22.78 | 23.19 | 22.26 | 1 |
| | 36 | 0 | 23.02 | 23.44 | 23.2 | 1 | 22.37 | 22.61 | 22.4 | 2 |
| | 36 | 19 | 23.1 | 23.45 | 23.21 | 1 | 22.5 | 22.54 | 22.36 | 2 |
| | 36 | 39 | 23.14 | 23.43 | 23.26 | 1 | 22.39 | 22.48 | 22.34 | 2 |
| | 75 | 0 | 23.15 | 23.5 | 23.53 | 1 | 22.43 | 22.58 | 22.51 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 20850 2510.0 MHz | CH 21100 2535.0 MHz | CH 21350 2560.0 MHz | 3GPP MPR [dB] | CH 20850 2510.0 MHz | CH 21100 2535.0 MHz | CH 21350 2560.0 MHz | 3GPP MPR [dB] |
| 7 / 20M | 1 | 0 | 24.09 | 24.12 | 23.51 | 0 | 23.03 | 23.03 | 22.8 | 1 |
| | 1 | 50 | 24.2 | 24.33 | 24.52 | 0 | 23.17 | 23.26 | 23.51 | 1 |
| | 1 | 99 | 24.06 | 23.47 | 21.16 | 0 | 22.74 | 22.85 | 22.42 | 1 |
| | 50 | 0 | 23.23 | 23.4 | 23.63 | 1 | 22.37 | 22.56 | 22.43 | 2 |
| | 50 | 25 | 23.19 | 23.39 | 23.3 | 1 | 22.53 | 22.68 | 22.44 | 2 |
| | 50 | 50 | 23.31 | 23.38 | 23.48 | 1 | 22.41 | 22.68 | 22.44 | 2 |
| | 100 | 0 | 23.26 | 23.42 | 23.54 | 1 | 22.43 | 22.54 | 22.21 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 23017 699.7 MHz | CH 23095 707.5 MHz | CH 23173 715.3 MHz | 3GPP MPR [dB] | CH 23017 699.7 MHz | CH 23095 707.5 MHz | CH 23173 715.3 MHz | 3GPP MPR [dB] |
| 12 / 1.4M | 1 | 0 | 22.69 | 22.89 | 22.33 | 0 | 21.28 | 21.39 | 21.26 | 1 |
| | 1 | 2 | 22.84 | 22.93 | 22.59 | 0 | 21.28 | 21.58 | 21.38 | 1 |
| | 1 | 5 | 22.73 | 22.62 | 22.41 | 0 | 21.38 | 21.35 | 21.31 | 1 |
| | 3 | 0 | 22.95 | 22.77 | 22.58 | 0 | 21.46 | 21.61 | 21.33 | 1 |
| | 3 | 1 | 22.77 | 22.79 | 22.58 | 0 | 21.65 | 21.74 | 21.57 | 1 |
| | 3 | 3 | 22.8 | 22.67 | 22.63 | 0 | 21.54 | 21.64 | 21.7 | 1 |
| | 6 | 0 | 21.65 | 21.69 | 21.39 | 1 | 20.45 | 20.73 | 20.62 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 23025 700.5 MHz | CH 23095 707.5 MHz | CH 23165 714.5 MHz | 3GPP MPR [dB] | CH 23025 700.5 MHz | CH 23095 707.5 MHz | CH 23165 714.5 MHz | 3GPP MPR [dB] |
| 12 / 3M | 1 | 0 | 22.62 | 22.6 | 22.41 | 0 | 21.43 | 21.15 | 21.19 | 1 |
| | 1 | 7 | 22.52 | 22.64 | 22.42 | 0 | 21.27 | 21.34 | 21.25 | 1 |
| | 1 | 14 | 22.46 | 22.53 | 22.45 | 0 | 21.01 | 21.17 | 21.07 | 1 |
| | 8 | 0 | 21.45 | 21.67 | 21.22 | 1 | 20.5 | 20.6 | 20.34 | 2 |
| | 8 | 3 | 21.5 | 21.56 | 21.28 | 1 | 20.51 | 20.58 | 20.31 | 2 |
| | 8 | 7 | 21.43 | 21.57 | 21.4 | 1 | 20.54 | 20.59 | 20.49 | 2 |
| | 15 | 0 | 21.4 | 21.43 | 21.3 | 1 | 20.57 | 20.53 | 20.18 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 23035 701.5 MHz | CH 23095 707.5 MHz | CH 23155 713.5 MHz | 3GPP MPR [dB] | CH 23035 701.5 MHz | CH 23095 707.5 MHz | CH 23155 713.5 MHz | 3GPP MPR [dB] |
| 12 / 5M | 1 | 0 | 22.42 | 22.25 | 22.25 | 0 | 21.18 | 21.14 | 21.11 | 1 |
| | 1 | 12 | 22.28 | 22.32 | 22.5 | 0 | 21.12 | 21.49 | 21.04 | 1 |
| | 1 | 24 | 22.5 | 22.45 | 22.38 | 0 | 21.16 | 21.1 | 20.95 | 1 |
| | 12 | 0 | 21.44 | 21.51 | 21.3 | 1 | 20.32 | 20.39 | 20.25 | 2 |
| | 12 | 6 | 21.46 | 21.55 | 21.27 | 1 | 20.53 | 20.33 | 20.29 | 2 |
| | 12 | 13 | 21.53 | 21.54 | 21.18 | 1 | 20.51 | 20.32 | 20.23 | 2 |
| | 25 | 0 | 21.51 | 21.45 | 21.22 | 1 | 20.5 | 20.35 | 20.25 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 23060 704.0 MHz | CH 23095 707.5 MHz | CH 23130 711.0 MHz | 3GPP MPR [dB] | CH 23060 704.0 MHz | CH 23095 707.5 MHz | CH 23130 711.0 MHz | 3GPP MPR [dB] |
| 12 / 10M | 1 | 0 | 22.41 | 22.21 | 22.49 | 0 | 21.12 | 20.7 | 20.95 | 1 |
| | 1 | 24 | 22.48 | 22.67 | 22.5 | 0 | 21.01 | 21.3 | 21.13 | 1 |
| | 1 | 49 | 22.34 | 22.37 | 22.33 | 0 | 21.26 | 20.99 | 21.02 | 1 |
| | 25 | 0 | 21.3 | 21.49 | 21.35 | 1 | 20.31 | 20.43 | 20.38 | 2 |
| | 25 | 12 | 21.31 | 21.39 | 21.36 | 1 | 20.27 | 20.42 | 20.38 | 2 |
| | 25 | 25 | 21.54 | 21.32 | 21.36 | 1 | 20.45 | 20.42 | 20.36 | 2 |
| | 50 | 0 | 21.38 | 21.28 | 21.48 | 1 | 20.37 | 20.43 | 20.61 | 2 |



| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 23205 779.5 MHz | CH 23230 782.0 MHz | CH 23255 784.5 MHz | 3GPP MPR [dB] | CH 23205 779.5 MHz | CH 23230 782.0 MHz | CH 23255 784.5 MHz | 3GPP MPR [dB] |
| 13 / 5M | 1 | 0 | 21.94 | 22.22 | 22.71 | 0 | 21.18 | 21.4 | 21.49 | 1 |
| | 1 | 12 | 22.34 | 22.93 | 22.86 | 0 | 21.53 | 21.97 | 21.82 | 1 |
| | 1 | 24 | 22.66 | 22.91 | 22.09 | 0 | 21.57 | 21.47 | 21.11 | 1 |
| | 12 | 0 | 22.2 | 22.05 | 22.03 | 1 | 20.75 | 20.65 | 20.85 | 2 |
| | 12 | 6 | 22.09 | 22.04 | 22.07 | 1 | 20.86 | 20.95 | 21.17 | 2 |
| | 12 | 13 | 22.06 | 22.14 | 21.99 | 1 | 20.75 | 20.89 | 21.04 | 2 |
| | 25 | 0 | 21.96 | 22.0 | 22.07 | 1 | 20.87 | 20.98 | 21.04 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | NA | CH 23230 782.0 MHz | NA | 3GPP MPR [dB] | NA | CH 23230 782.0 MHz | NA | 3GPP MPR [dB] |
| 13 / 10M | 1 | 0 | 21.46 | 21.46 | 21.46 | 0 | 20.6 | 20.6 | 20.6 | 1 |
| | 1 | 24 | 23.08 | 23.08 | 23.08 | 0 | 21.59 | 21.59 | 21.59 | 1 |
| | 1 | 49 | 21.69 | 21.69 | 21.69 | 0 | 21.13 | 21.13 | 21.13 | 1 |
| | 25 | 0 | 21.99 | 21.99 | 21.99 | 1 | 20.87 | 20.87 | 20.87 | 2 |
| | 25 | 12 | 21.91 | 21.91 | 21.91 | 1 | 20.93 | 20.93 | 20.93 | 2 |
| | 25 | 25 | 22.05 | 22.05 | 22.05 | 1 | 20.97 | 20.97 | 20.97 | 2 |
| | 50 | 0 | 21.91 | 21.91 | 21.91 | 1 | 20.92 | 20.92 | 20.92 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 131979 1710.7 MHz | CH 132322 1745.0 MHz | CH 132665 1779.3 MHz | 3GPP MPR [dB] | CH 131979 1710.7 MHz | CH 132322 1745.0 MHz | CH 132665 1779.3 MHz | 3GPP MPR [dB] |
| 66 / 1.4M | 1 | 0 | 23.24 | 23.18 | 19.87 | 0 | 21.84 | 21.76 | 19.65 | 1 |
| | 1 | 2 | 23.37 | 23.18 | 20.38 | 0 | 21.93 | 21.75 | 19.33 | 1 |
| | 1 | 5 | 23.26 | 23.12 | 20.75 | 0 | 22.18 | 21.62 | 19.49 | 1 |
| | 3 | 0 | 23.34 | 23.26 | 18.85 | 0 | 22.06 | 22.0 | 18.88 | 1 |
| | 3 | 1 | 23.32 | 23.26 | 20.3 | 0 | 22.26 | 22.13 | 18.87 | 1 |
| | 3 | 3 | 23.19 | 23.2 | 18.8 | 0 | 22.2 | 22.08 | 18.49 | 1 |
| | 6 | 0 | 22.27 | 22.26 | 20.58 | 1 | 21.18 | 20.96 | 19.13 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 131987 1711.5 MHz | CH 132322 1745.0 MHz | CH 132657 1778.5 MHz | 3GPP MPR [dB] | CH 131987 1711.5 MHz | CH 132322 1745.0 MHz | CH 132657 1778.5 MHz | 3GPP MPR [dB] |
| 66 / 3M | 1 | 0 | 22.01 | 23.02 | 18.32 | 0 | 21.98 | 22.01 | 18.92 | 1 |
| | 1 | 7 | 23.12 | 23.09 | 18.77 | 0 | 22.06 | 22.05 | 19.99 | 1 |
| | 1 | 14 | 23.08 | 23.2 | 18.69 | 0 | 21.82 | 21.87 | 18.72 | 1 |
| | 8 | 0 | 22.58 | 22.32 | 19.4 | 1 | 21.31 | 21.25 | 19.17 | 2 |
| | 8 | 3 | 22.45 | 22.36 | 19.11 | 1 | 21.29 | 21.2 | 19.12 | 2 |
| | 8 | 7 | 22.38 | 22.26 | 18.73 | 1 | 21.74 | 21.41 | 19.0 | 2 |
| | 15 | 0 | 22.29 | 22.16 | 19.34 | 1 | 21.48 | 21.26 | 18.97 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 131997 1712.5 MHz | CH 132322 1745.0 MHz | CH 132647 1777.5 MHz | 3GPP MPR [dB] | CH 131997 1712.5 MHz | CH 132322 1745.0 MHz | CH 132647 1777.5 MHz | 3GPP MPR [dB] |
| 66 / 5M | 1 | 0 | 23.11 | 22.41 | 18.68 | 0 | 21.92 | 21.73 | 17.43 | 1 |
| | 1 | 12 | 22.95 | 22.65 | 18.28 | 0 | 21.74 | 22.0 | 18.51 | 1 |
| | 1 | 24 | 20.74 | 22.79 | 18.87 | 0 | 21.31 | 21.68 | 17.54 | 1 |
| | 12 | 0 | 22.39 | 22.37 | 19.77 | 1 | 21.18 | 20.92 | 17.65 | 2 |
| | 12 | 6 | 22.06 | 22.41 | 19.71 | 1 | 21.38 | 21.12 | 18.42 | 2 |
| | 12 | 13 | 21.82 | 22.38 | 18.46 | 1 | 21.41 | 21.48 | 18.05 | 2 |
| | 25 | 0 | 22.27 | 22.31 | 18.58 | 1 | 21.35 | 21.35 | 17.31 | 2 |



| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 132022 1715.0 MHz | CH 132322 1745.0 MHz | CH 132622 1775.0 MHz | 3GPP MPR [dB] | CH 132022 1715.0 MHz | CH 132322 1745.0 MHz | CH 132622 1775.0 MHz | 3GPP MPR [dB] |
| 66 / 10M | 1 | 0 | 22.58 | 21.18 | 17.73 | 0 | 21.3 | 20.19 | 19.57 | 1 |
| | 1 | 24 | 22.61 | 20.24 | 18.96 | 0 | 21.16 | 22.03 | 18.34 | 1 |
| | 1 | 49 | 20.7 | 22.09 | 17.43 | 0 | 18.79 | 21.78 | 17.07 | 1 |
| | 25 | 0 | 22.45 | 22.24 | 20.52 | 1 | 21.36 | 21.39 | 18.62 | 2 |
| | 25 | 12 | 21.56 | 22.41 | 19.0 | 1 | 21.02 | 21.54 | 18.94 | 2 |
| | 25 | 25 | 20.58 | 22.4 | 18.59 | 1 | 20.27 | 21.56 | 17.58 | 2 |
| | 50 | 0 | 21.2 | 22.29 | 20.43 | 1 | 20.88 | 21.35 | 18.14 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 132047 1717.5 MHz | CH 132322 1745.0 MHz | CH 132597 1772.5 MHz | 3GPP MPR [dB] | CH 132047 1717.5 MHz | CH 132322 1745.0 MHz | CH 132597 1772.5 MHz | 3GPP MPR [dB] |
| 66 / 15M | 1 | 0 | 21.88 | 20.25 | 20.48 | 0 | 21.59 | 19.78 | 20.77 | 1 |
| | 1 | 37 | 21.93 | 23.1 | 20.53 | 0 | 21.17 | 22.25 | 18.98 | 1 |
| | 1 | 74 | 19.8 | 23.01 | 17.17 | 0 | 18.69 | 21.97 | 17.22 | 1 |
| | 36 | 0 | 22.37 | 22.26 | 20.78 | 1 | 21.51 | 21.19 | 19.43 | 2 |
| | 36 | 19 | 22.22 | 22.26 | 20.43 | 1 | 21.27 | 21.35 | 19.7 | 2 |
| | 36 | 39 | 21.6 | 22.29 | 20.15 | 1 | 20.33 | 21.54 | 17.62 | 2 |
| | 75 | 0 | 21.9 | 22.09 | 20.04 | 1 | 21.32 | 21.3 | 19.0 | 2 |

| LTE Band / BW | RBs | RB Start | QPSK | | | | 16QAM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CH 132072 1720.0 MHz | CH 132322 1745.0 MHz | CH 132572 1770.0 MHz | 3GPP MPR [dB] | CH 132072 1720.0 MHz | CH 132322 1745.0 MHz | CH 132572 1770.0 MHz | 3GPP MPR [dB] |
| 66 / 20M | 1 | 0 | 22.29 | 19.82 | 21.36 | 0 | 21.92 | 18.99 | 21.37 | 1 |
| | 1 | 50 | 21.2 | 23.17 | 20.97 | 0 | 21.61 | 22.23 | 19.79 | 1 |
| | 1 | 99 | 19.22 | 22.65 | 18.33 | 0 | 19.16 | 22.08 | 17.4 | 1 |
| | 50 | 0 | 22.37 | 22.1 | 21.36 | 1 | 21.43 | 21.29 | 21.03 | 2 |
| | 50 | 25 | 22.07 | 22.27 | 20.86 | 1 | 21.34 | 21.34 | 20.34 | 2 |
| | 50 | 50 | 20.56 | 22.27 | 19.97 | 1 | 20.4 | 21.41 | 19.75 | 2 |
| | 100 | 0 | 21.44 | 22.12 | 20.71 | 1 | 21.21 | 21.21 | 20.44 | 2 |

2.4 GHz WLAN:

| Standard | Transmission mode | Data rate [Mbps] | Output power [dBm] | | |
|---|---|---|---|---|---|
| | | | CH 1 2412 MHz | CH 6 2437 MHz | CH 11 2462 MHz |
| 802.11b | DSSS | 1 | 18.58 | 18.36 | 17.7 |

WLAN 5 GHz:

| Standard | Channel | Frequency [MHz] | Transmission mode | Data rate [Mbps] | Output power [dBm] |
|---|---|---|---|---|---|
| 802.11a | 52 | 5260 | OFDM | 6 | 15.51 |
| 802.11a | 56 | 5280 | OFDM | 6 | 15.69 |
| 802.11a | 60 | 5300 | OFDM | 6 | 15.63 |
| 802.11a | 64 | 5320 | OFDM | 6 | 15.5 |
| 802.11a | 100 | 5500 | OFDM | 6 | 15.69 |
| 802.11a | 112 | 5560 | OFDM | 6 | 16.98 |
| 802.11a | 116 | 5580 | OFDM | 6 | 17.02 |
| 802.11a | 128 | 5640 | OFDM | 6 | 16.29 |
| 802.11a | 132 | 5660 | OFDM | 6 | 15.51 |
| 802.11a | 149 | 5745 | OFDM | 6 | 13.3 |
| 802.11a | 165 | 5825 | OFDM | 6 | 12.41 |
| 802.11a | 52 | 5260 | OFDM | 54 | 15.48 |
| 802.11a | 56 | 5280 | OFDM | 54 | 15.68 |
| 802.11a | 60 | 5300 | OFDM | 54 | 15.58 |
| 802.11a | 64 | 5320 | OFDM | 54 | 15.33 |
| 802.11a | 100 | 5500 | OFDM | 54 | 15.64 |
| 802.11a | 112 | 5560 | OFDM | 54 | 16.9 |
| 802.11a | 116 | 5580 | OFDM | 54 | 17.01 |
| 802.11a | 128 | 5640 | OFDM | 54 | 16.22 |
| 802.11a | 132 | 5660 | OFDM | 54 | 15.42 |
| 802.11a | 149 | 5745 | OFDM | 54 | 13.25 |
| 802.11a | 165 | 5825 | OFDM | 54 | 12.37 |



## 4. TEST EQUIPMENT

Dasy52 near field scanning system, manufactured by SPEAG was used for SAR testing. The test system consists of high precision robotics system (Staubli), robot controller, computer, near-field probe, probe alignment sensor, and a phantom containing the tissue equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location of maximum electromagnetic field.

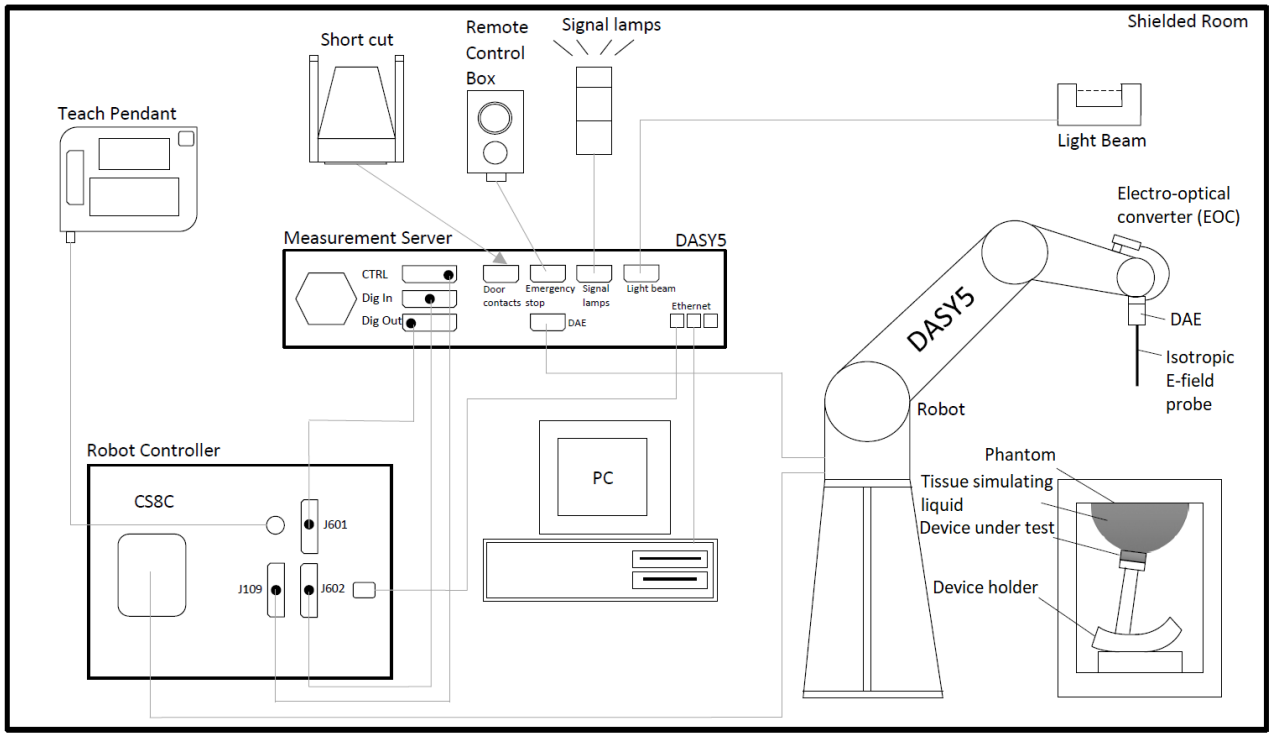



Figure 2 Schematic Laboratory Picture



## 4.1 Test Equipment List

Main used test system components are listed below. For full equipment list and calibration intervals, please contact the testing laboratory.

| Test Equipment | Model | Serial Number | Calibration Date |
|---|---|---|---|
| DASY5 Software | 52.8.8.1258 | - | NA |
| DAE4, converter | DAE4 | 710 | 10/2022 |
| DAE4, converter | DAE4 | 1332 | 02/2023 |
| Radio Communication Analyzer | MT8820C | 6200930942 | 12/2022 |
| Radio Communication Analyzer | MT8820C | 6200883099 | 10/2022 |
| Isotropic DOS probe | EX3DV4 | 7447 | 02/2023 |
| Isotropic DOS probe | EX3DV4 | 3892 | 04/2022 |
| Isotropic DOS probe | EX3DV4 | 3852 | 10/2022 |
| System validation dipole | D750V3 | 1154 | 07/2022 |
| System validation dipole | D835V2 | 455 | 07/2022 |
| System validation dipole | D1800V2 | 249 | 07/2022 |
| System validation dipole | D1900V2 | 511 | 03/2020 |
| System validation dipole | D2450V2 | 729 | 07/2022 |
| System validation dipole | SID2600 | 49/21 DIP2G600-637 | 12/2021 |
| System validation dipole | D5GHzV2 | 1045 | 03/2023 |
| Vector Signal Generator | MG3710A | 6261911026 | NA |
| Vector Signal Generator | MG3710E | 6262028676 | NA |
| Network Analyzer | E5071B | MY42301191 | 03/2023 |
| Network Analyzer | E5071C | MY46102812 | 05/2022 |
| Vector Network Analyzer | P5008A | MY58100258 | 01/2023 |
| Amplifier, 800MHz-4200MHz, 10W | 10S1G4A | 320421 | NA |
| Amplifier, 800-4200MHz, 50W | 5163F | 1022 | NA |
| Inline Peak Power Sensor | MA24105A | 2102058 | 11/2022 |

Dipole calibration period supporting data:

| | | Measured on 10/2022 | | | Calibrated | | |
|---|---|---|---|---|---|---|---|
| Dipole and serial number | Frequency (MHz) | Return loss (dB) | Impedance [Ω] | | Return loss [dB] | Impedance [Ω] | |
| D1900V2-SN:511 | 1900 | -23.8 | 48.5 | 6.2 | -21.37 | 52.9 | 8 |
| 49/21 DIP 2G600-637 | 2600 | -28.3 | 46.4 | -0.9 | -31.57 | 51.4 | 2.3 |



### 4.1.1 Isotropic E-field Probe Type EX3DV4

| | |
|---|---|
| **Construction** | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| **Calibration** | Calibration certificate in Appendix D |
| **Frequency** | 10 MHz to >6 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 6 GHz) |
| **Directivity** | ± 0.3 dB in HSL (rotation around probe axis)<br>± 0.5 dB in tissue material (rotation normal to probe axis) |
| **Dynamic Range** | 10 µW/g to > 100 mW/g, Linearity: ± 0.2 dB |
| **Dimensions** | Overall length: 330 mm<br>Tip length: 10 mm<br>Body diameter: 12 mm |
| **Application** | General dosimetry up to 6 GHz<br>Compliance tests of mobile phones<br>Fast automatic scanning in arbitrary phantoms |

## 4.2 Phantoms

Eli Phantom:

The phantom used in SAR tests was an ELI phantom, manufactured by SPEAG. ELI phantom is used for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. The phantom conforms to the requirements of IEEE 1528 and FCC published RF Exposure KDB Procedures.

## 4.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 and FCC published RF Exposure KDB Procedures. The dielectric parameters of the used tissue simulants were within ±10% of the recommended values at frequencies under 3GHz and ±5% at frequencies above 3GHz. A liquid compensation algorithm was used in DASY5 with which measured peak average SAR values were corrected for the deviation of used liquid. Depth of the tissue simulant was at least 15.0 cm from the inner surface of the flat phantom.

| Tissue simulant liquid Ingredients |
|---|
| Deionized Water, oil, salt, emulsifiers |



## 4.4 System Validation Status

| Frequency [MHz] | Dipole Type / SN | Probe Type / SN | Calibrated Signal Type | DAE Unit / SN | Dielectric Constant [ε'] | Conductivity σ [S/m] | Head tissue simulant |
|---|---|---|---|---|---|---|---|
| 750 | D750V3 - SN: 635 | EX3DV4 - SN: 3892 | CW | DAE 4 / 705 | 42.71 | 0.91 | 04/2022 |
| 2450 | D2450V2 - SN: 758 | EX3DV4 - SN: 3852 | CW | DAE 4 / 710 | 40.46 | 1.75 | 11/2022 |
| 750 | D750V3 - SN: 635 | EX3DV4 - SN: 7447 | CW | DAE 4 / 1332 | 45.44 | 0.86 | 03/2023 |
| 835 | D835V2- SN:455 | EX3DV4 - SN: 7447 | CW | DAE 4 / 1332 | 45.03 | 0.88 | 03/2023 |
| 1800 | D1800V2- SN:249 | EX3DV4 - SN: 7447 | CW | DAE 4 / 1332 | 43.51 | 1.35 | 02/2023 |
| 1900 | D1900V2- SN:511 | EX3DV4 - SN: 7447 | CW | DAE 4 / 1332 | 43.33 | 1.4 | 02/2023 |
| 2600 | 51/18 DIP 2G600-637 | EX3DV4 - SN: 7447 | CW | DAE 4 / 710 | 41.46 | 1.82 | 03/2023 |
| 5250 | D5GHzV2 - SN: 1014 | EX3DV4 - SN: 3852 | CW | DAE 4 / 710 | 37.44 | 4.66 | 11/2022 |
| 5600 | D5GHzV2 - SN: 1014 | EX3DV4 - SN: 3852 | CW | DAE 4 / 710 | 36.79 | 5.07 | 11/2022 |
| 5750 | D5GHzV2 - SN: 1014 | EX3DV4 - SN: 3852 | CW | DAE 4 / 710 | 36.62 | 5.19 | 11/2022 |

## 4.5 System Check

| Date | Tissue Type | Tissue Temp. [°C] | Frequency [MHz] | Input Power [mW] | Measured $SAR_{1g}$ [W/kg] | 1 W Target $SAR_{1g}$ [W/kg] | 1 W Normalized $SAR_{1g}$ [W/kg] | Deviation [%] | Plot # |
|---|---|---|---|---|---|---|---|---|---|
| 02.03.2023 | WB Head | 22 | 750 | 250 | 2.1 | 8.54 | 8.4 | -1.64 | 1 |
| 02.03.2023 | WB Head | 22 | 835 | 250 | 2.51 | 9.69 | 10.04 | 3.61 | 2 |
| 06.03.2023 | WB Head | 22 | 750 | 250 | 2.12 | 8.54 | 8.48 | -0.70 | 3 |
| 08.03.2023 | WB Head | 22 | 1800 | 250 | 9 | 38.9 | 35.6 | -8.5 | 4 |
| 08.03.2023 | WB Head | 22 | 2600 | 250 | 12.9 | 56.47 | 51.6 | -8.62 | 5 |
| 09.03.2023 | WB Head | 22 | 1900 | 250 | 9.2 | 39.3 | 36.8 | -6.4 | 6 |
| 13.03.2023 | WB Head | 22 | 750 | 250 | 1.99 | 8.54 | 7.96 | -6.79 | 7 |
| 13.03.2023 | WB Head | 22 | 1900 | 250 | 9.46 | 39.3 | 37.84 | -3.7 | 8 |
| 18.04.2023 | WB Head | 22 | 2450 | 250 | 12 | 52.3 | 48 | -8.22 | 9 |
| 19.04.2023 | WB Head | 22 | 5250 | 100 | 7.53 | 73.09 | 75.3 | 3.02 | 10 |
| 19.04.2023 | WB Head | 22 | 5600 | 100 | 7.6 | 72.92 | 76 | 4.22 | 11 |
| 19.04.2023 | WB Head | 22 | 5750 | 100 | 6.98 | 69.05 | 69.8 | 1.09 | 12 |



### 4.5.1 Tissue Simulant Verification

| | | | | Target | | Measured | | Deviation | |
|---|---|---|---|---|---|---|---|---|---|
| **Date** | **Tissue Type** | **Tissue Temp [°C]** | **Frequency [MHz]** | **Dielectric Constant [ε] Target** | **Conductivity σ [S/m] Target** | **Dielectric Constant [ε]** | **Conductivity σ [S/m]** | **ε [%]** | **σ [%]** |
| 03.03.2023 | WB Head | 22 | 750.0 | 41.9 | 0.89 | 42.43 | 0.84 | 1.3 | -5.6 |
| 03.03.2023 | WB Head | 22 | 782.0 | 41.75 | 0.89 | 42.34 | 0.85 | 1.4 | -4.8 |
| 03.03.2023 | WB Head | 22 | 829.0 | 41.53 | 0.9 | 42.21 | 0.87 | 1.6 | -3.7 |
| 03.03.2023 | WB Head | 22 | 836.5 | 41.5 | 0.9 | 42.19 | 0.87 | 1.7 | -3.4 |
| 03.03.2023 | WB Head | 22 | 844.0 | 41.5 | 0.91 | 42.17 | 0.87 | 1.6 | -4.1 |
| 06.03.2023 | WB Head | 22 | 704.0 | 42.15 | 0.89 | 45.81 | 0.82 | 8.7 | -8.0 |
| 06.03.2023 | WB Head | 22 | 750.0 | 41.9 | 0.89 | 45.56 | 0.83 | 8.7 | -6.5 |
| 06.03.2023 | WB Head | 22 | 836.5 | 41.5 | 0.9 | 45.16 | 0.86 | 8.8 | -4.2 |
| 06.03.2023 | WB Head | 22 | 844.0 | 41.5 | 0.91 | 45.12 | 0.87 | 8.7 | -4.8 |
| 08.03.2023 | WB Head | 22 | 1712.4 | 0.54 | 40.14 | 0.53 | 42.91 | -7.9 | 6.9 |
| 08.03.2023 | WB Head | 22 | 1720.0 | 0.54 | 40.13 | 0.53 | 42.89 | -7.9 | 6.9 |
| 08.03.2023 | WB Head | 22 | 1732.6 | 0.54 | 40.11 | 0.52 | 42.87 | -7.9 | 6.9 |
| 08.03.2023 | WB Head | 22 | 1745.0 | 0.54 | 40.09 | 0.52 | 42.84 | -8.0 | 6.9 |
| 08.03.2023 | WB Head | 22 | 1770.0 | 0.53 | 40.05 | 0.51 | 42.79 | -8.0 | 6.8 |
| 08.03.2023 | WB Head | 22 | 1800.0 | 0.52 | 40.0 | 0.5 | 42.74 | -8.0 | 6.9 |
| 08.03.2023 | WB Head | 22 | 1860.0 | 0.51 | 40.0 | 0.49 | 42.65 | -5.8 | 6.6 |
| 08.03.2023 | WB Head | 22 | 1880.0 | 0.5 | 40.0 | 0.48 | 42.62 | -5.0 | 6.5 |
| 08.03.2023 | WB Head | 22 | 1900.0 | 0.5 | 40.0 | 0.48 | 42.59 | -4.2 | 6.5 |
| 08.03.2023 | WB Head | 22 | 2510.0 | 0.33 | 39.12 | 0.3 | 41.72 | -7.5 | 6.6 |
| 08.03.2023 | WB Head | 22 | 2535.0 | 0.32 | 39.09 | 0.3 | 41.69 | -7.9 | 6.6 |
| 08.03.2023 | WB Head | 22 | 2560.0 | 0.31 | 39.06 | 0.29 | 41.64 | -8.3 | 6.6 |
| 08.03.2023 | WB Head | 22 | 2600.0 | 0.3 | 39.01 | 0.28 | 41.58 | -8.8 | 6.6 |
| 09.03.2023 | WB Head | 22 | 1752.6 | 40.07 | 1.37 | 42.58 | 1.28 | 6.3 | -6.4 |
| 09.03.2023 | WB Head | 22 | 1800.0 | 40.0 | 1.4 | 42.5 | 1.31 | 6.3 | -6.4 |
| 09.03.2023 | WB Head | 22 | 1852.4 | 40.0 | 1.4 | 42.42 | 1.34 | 6.0 | -4.5 |
| 13.03.2023 | WB Head | 22 | 707.5 | 42.16 | 0.89 | 41.54 | 0.8 | -1.5 | -9.7 |
| 13.03.2023 | WB Head | 22 | 750.0 | 41.94 | 0.89 | 41.45 | 0.82 | -1.2 | -8.5 |
| 13.03.2023 | WB Head | 22 | 1880.0 | 40.0 | 1.4 | 39.25 | 1.33 | -1.9 | -5.1 |
| 13.03.2023 | WB Head | 22 | 1900.0 | 40.0 | 1.4 | 39.25 | 1.34 | -1.9 | -4.1 |
| 13.03.2023 | WB Head | 22 | 1907.6 | 40.0 | 1.4 | 39.25 | 1.35 | -1.9 | -3.7 |
| 18.04.2023 | WB Head | 22.2 | 2412.0 | 39.27 | 1.77 | 40.79 | 1.69 | 3.9 | -4.5 |
| 18.04.2023 | WB Head | 22.2 | 2437.0 | 39.22 | 1.79 | 40.74 | 1.7 | 3.9 | -4.8 |
| 18.04.2023 | WB Head | 22.2 | 2450.0 | 39.2 | 1.8 | 40.73 | 1.71 | 3.9 | -4.9 |
| 18.04.2023 | WB Head | 22.2 | 2462.0 | 39.18 | 1.81 | 40.71 | 1.72 | 3.9 | -5.1 |
| 19.04.2023 | WB Head | 21.2 | 5250.0 | 35.95 | 4.71 | 34.79 | 4.93 | -3.2 | 4.7 |
| 19.04.2023 | WB Head | 21.2 | 5260.0 | 35.94 | 4.72 | 34.77 | 4.94 | -3.2 | 4.7 |
| 19.04.2023 | WB Head | 21.2 | 5280.0 | 35.92 | 4.74 | 34.75 | 4.96 | -3.3 | 4.6 |
| 19.04.2023 | WB Head | 21.2 | 5320.0 | 35.88 | 4.78 | 34.69 | 4.99 | -3.3 | 4.5 |
| 19.04.2023 | WB Head | 21.2 | 5500.0 | 35.65 | 4.96 | 34.42 | 5.15 | -3.5 | 3.7 |
| 19.04.2023 | WB Head | 21.2 | 5580.0 | 35.53 | 5.05 | 34.3 | 5.22 | -3.5 | 3.4 |
| 19.04.2023 | WB Head | 21.2 | 5600.0 | 35.5 | 5.07 | 34.27 | 5.25 | -3.5 | 3.5 |
| 19.04.2023 | WB Head | 21.2 | 5640.0 | 35.46 | 5.11 | 34.21 | 5.28 | -3.5 | 3.3 |
| 19.04.2023 | WB Head | 21.2 | 5660.0 | 35.44 | 5.13 | 34.19 | 5.3 | -3.5 | 3.4 |
| 19.04.2023 | WB Head | 21.2 | 5745.0 | 35.35 | 5.22 | 34.06 | 5.38 | -3.7 | 3.1 |
| 19.04.2023 | WB Head | 21.2 | 5750.0 | 35.35 | 5.22 | 34.05 | 5.38 | -3.7 | 3.1 |
| 19.04.2023 | WB Head | 21.2 | 5825.0 | 35.28 | 5.3 | 33.95 | 5.45 | -3.8 | 2.9 |



## 5. TEST PROCEDURE

Testing was carried out in accordance with FCC KDB Publications 447498 D04 Interim General RF Exposure Guidance v01, 248227 D01 802.11 Wi-Fi SAR.

For the cellular technologies, the device was set to transmit using maximum power with a communication tester.

A control software for WLAN was used to set the DUT to transmit at maximum power. Due to the control SW, output power was higher than specified for the 802.11a mode, thus measured SAR is conservative over-estimation.

The WLAN transmission modes for testing were selected according to largest channel bandwidth configuration, lowest order modulation and lowest data rate.

2.4GHz WLAN was tested with 802.11b standard with data rate of 1Mbit/s. 5GHz WLAN was tested with 802.11a standard with data rate of 6Mbit/s.

### 5.1 Test Positions

#### 5.1.1 Body-worn Configuration, 0mm separation distance

Body SAR was tested from the user's side, which would be pressed against the user's back. The device was placed on the top of a Rohacell and lifted towards the phantom until the distance between phantom and the device was 0mm.

Figure 3. Location of the antennas

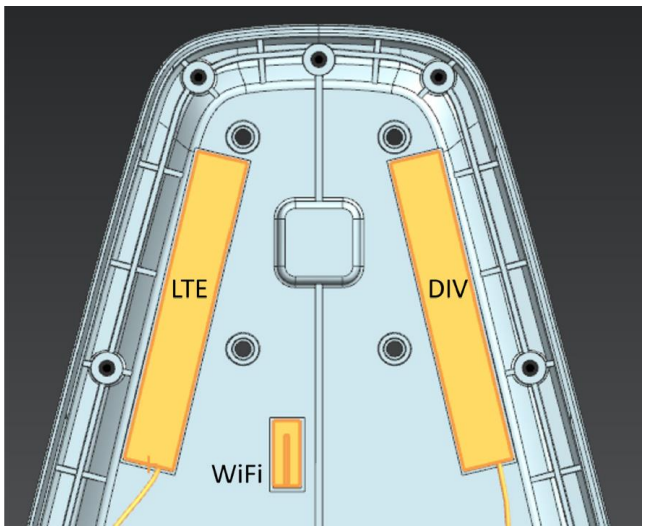



Figure 4. Schematic of the antennas

Photos of the test positions are presented in appendix A



### 5.2 Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

### 5.3 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy52 are all based on the modified Quadratic Shepard's method (Robert J. Renka," Multivariate Interpolation of Large Sets of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).
The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighboring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.



## 6. MEASUREMENT UNCERTAINTY

**Uncertainty Budget**
**According to IEEE 1528-2013 and IEC 62209-1/201x**
**(0.3 - 3 GHz range)**

| Error Description | Uncert. value | Prob. Dist. | Div. | ($c_i$) 1g | ($c_i$) 10g | Std. Unc. (1g) | Std. Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±6.0 % | N | 1 | 1 | 1 | ±6.0 % | ±6.0 % | ∞ |
| Axial Isotropy | ±4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±1.9 % | ±1.9 % | ∞ |
| Hemispherical Isotropy | ±9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±3.9 % | ±3.9 % | ∞ |
| Boundary Effects | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Linearity | ±4.7 % | R | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| System Detection Limits | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Modulation Response[M] | ±2.4 % | R | $\sqrt{3}$ | 1 | 1 | ±1.4 % | ±1.4 % | ∞ |
| Readout Electronics | ±0.3 % | N | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| Response Time | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Integration Time | ±2.6 % | R | $\sqrt{3}$ | 1 | 1 | ±1.5 % | ±1.5 % | ∞ |
| RF Ambient Noise | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| RF Ambient Reflections | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Probe Positioner | ±0.4 % | R | $\sqrt{3}$ | 1 | 1 | ±0.2 % | ±0.2 % | ∞ |
| Probe Positioning | ±2.9 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Max. SAR Eval. | ±2.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ±2.9 % | N | 1 | 1 | 1 | ±2.9 % | ±2.9 % | 145 |
| Device Holder | ±3.6 % | N | 1 | 1 | 1 | ±3.6 % | ±3.6 % | 5 |
| Power Drift | ±5.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.9 % | ±2.9 % | ∞ |
| Power Scaling[P] | ±0% | R | $\sqrt{3}$ | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±6.1 % | R | $\sqrt{3}$ | 1 | 1 | ±3.5 % | ±3.5 % | ∞ |
| SAR correction | ±1.9 % | R | $\sqrt{3}$ | 1 | 0.84 | ±1.1 % | ±0.9 % | ∞ |
| Liquid Conductivity (mea.)[DAK] | ±2.5 % | R | $\sqrt{3}$ | 0.78 | 0.71 | ±1.1 % | ±1.0 % | ∞ |
| Liquid Permittivity (mea.)[DAK] | ±2.5 % | R | $\sqrt{3}$ | 0.26 | 0.26 | ±0.3 % | ±0.4 % | ∞ |
| Temp. unc. - Conductivity[BB] | ±3.4 % | R | $\sqrt{3}$ | 0.78 | 0.71 | ±1.5 % | ±1.4 % | ∞ |
| Temp. unc. - Permittivity[BB] | ±0.4 % | R | $\sqrt{3}$ | 0.23 | 0.26 | ±0.1 % | ±0.1 % | ∞ |
| Combined Std. Uncertainty | | | | | | ±11.2 % | ±11.1 % | 361 |
| **Expanded STD Uncertainty** | | | | | | **±22.3 %** | **±22.2 %** | |



## Uncertainty Budget
**According to IEEE 1528-2013 and IEC 62209-1/2016**
**(3 - 6 GHz range)**

| Error Description | Uncert. value | Prob. Dist. | Div. | ($c_i$) 1g | ($c_i$) 10g | Std. Unc. (1g) | Std. Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±6.55 % | N | 1 | 1 | 1 | ±6.55 % | ±6.55 % | ∞ |
| Axial Isotropy | ±4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±1.9 % | ±1.9 % | ∞ |
| Hemispherical Isotropy | ±9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±3.9 % | ±3.9 % | ∞ |
| Boundary Effects | ±2.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| Linearity | ±4.7 % | R | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| System Detection Limits | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Modulation Response[m] | ±2.4 % | R | $\sqrt{3}$ | 1 | 1 | ±1.4 % | ±1.4 % | ∞ |
| Readout Electronics | ±0.3 % | N | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| Response Time | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Integration Time | ±2.6 % | R | $\sqrt{3}$ | 1 | 1 | ±1.5 % | ±1.5 % | ∞ |
| RF Ambient Noise | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| RF Ambient Reflections | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Probe Positioner | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Probe Positioning | ±6.7 % | R | $\sqrt{3}$ | 1 | 1 | ±3.9 % | ±3.9 % | ∞ |
| Max. SAR Eval. | ±4.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ±2.9 % | N | 1 | 1 | 1 | ±2.9 % | ±2.9 % | 145 |
| Device Holder | ±3.6 % | N | 1 | 1 | 1 | ±3.6 % | ±3.6 % | 5 |
| Power Drift | ±5.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.9 % | ±2.9 % | ∞ |
| Power Scaling[p] | ±0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.0 % | ±0.0 % | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±6.6 % | R | $\sqrt{3}$ | 1 | 1 | ±3.8 % | ±3.8 % | ∞ |
| SAR correction | ±1.9 % | R | $\sqrt{3}$ | 1 | 0.84 | ±1.1 % | ±0.9 % | ∞ |
| Liquid Conductivity (mea.)[DAK] | ±2.5 % | R | $\sqrt{3}$ | 0.78 | 0.71 | ±1.1 % | ±1.0 % | ∞ |
| Liquid Permittivity (mea.) [DAK] | ±2.5 % | R | $\sqrt{3}$ | 0.26 | 0.26 | ±0.3 % | ±0.4 % | ∞ |
| Temp. unc. - Conductivity [BB] | ±3.4 % | R | $\sqrt{3}$ | 0.78 | 0.71 | ±1.5 % | ±1.4 % | ∞ |
| Temp. unc. - Permittivity [BB] | ±0.4 % | R | $\sqrt{3}$ | 0.23 | 0.26 | ±0.1 % | ±0.1 % | ∞ |
| Combined Std. Uncertainty | | | | | | ±12.3 % | ±12.2 % | 748 |
| **Expanded STD Uncertainty** | | | | | | **±24.6 %** | **±24.5 %** | |



# 7. TEST RESULTS

## 7.1 SAR Results for Body Exposure Condition with 0mm separation

WCDMA:

| Band | Channel | Frequency [MHz] | Mode | Maximum Power [dBm] | Conducted Power [dBm] | Test Position | Measured SAR1g [W/kg] | Power Drift* [dB] | Duty Cycle | Scaling Factor | Reported SAR1g [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WCDMA 2 | 9262 | 1852.4 | RMC 12.2K | 25 | 24.08 | Front, 0mm | 0.13 | -0.25 | 1:1 | 1.31 | 0.17 | 13 |
| WCDMA 2 | 9400 | 1880 | RMC 12.2K | 25 | 24.21 | Front, 0mm | 0.12 | -0.21 | 1:1 | 1.20 | 0.14 | |
| WCDMA 2 | 9538 | 1907.6 | RMC 12.2K | 25 | 24.19 | Front, 0mm | 0.11 | 0.12 | 1:1 | 1.21 | 0.13 | |

*Larger than 5% drifts included to scaling factors

| Band | Channel | Frequency [MHz] | Mode | Maximum Power [dBm] | Conducted Power [dBm] | Test Position | Measured SAR1g [W/kg] | Power Drift* [dB] | Duty Cycle | Scaling Factor | Reported SAR1g [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WCDMA 4 | 1312 | 1712.4 | RMC 12.2K | 25 | 23.25 | Front, 0mm | 0.22 | -0.3 | 1:1 | 1.60 | 0.36 | 14 |
| WCDMA 4 | 1413 | 1732.6 | RMC 12.2K | 25 | 22.15 | Front, 0mm | 0.12 | 0.47 | 1:1 | 2.15 | 0.25 | |
| WCDMA 4 | 1513 | 1752.6 | RMC 12.2K | 25 | 23.16 | Front, 0mm | 0.20 | -0.57 | 1:1 | 1.74 | 0.34 | |

*Larger than 5% drifts included to scaling factors

| Band | Channel | Frequency [MHz] | Mode | Maximum Power [dBm] | Conducted Power [dBm] | Test Position | Measured SAR1g [W/kg] | Power Drift [dB] | Duty Cycle | Scaling Factor | Reported SAR1g [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WCDMA 5 | 4132 | 826.4 | RMC 12.2K | 25 | 23.17 | Front, 0mm | 0.31 | -0.06 | 1:1 | 1.52 | 0.48 | |
| WCDMA 5 | 4183 | 835 | RMC 12.2K | 25 | 23.18 | Front, 0mm | 0.31 | 0.01 | 1:1 | 1.52 | 0.48 | 15 |
| WCDMA 5 | 4233 | 846.6 | RMC 12.2K | 25 | 23.17 | Front, 0mm | 0.27 | -0.09 | 1:1 | 1.52 | 0.40 | |

LTE:

| Band | Channel | Frequency [MHz] | Modulation / BW [MHz] | RB Size | RB Offset | Maximum Power [dBm] | Conducted Power [dBm] | Test position | Measure $SAR_{1g}$ [W/kg] | Power Drift [dB] | Scaling Factor | Duty Cycle | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE 2 | 19100 | 1900 | QPSK / 20 | 1 | 50 | 25.7 | 22.57 | Front, 0mm | 0.073 | -0.7 | 2.42 | 1:1 | 0.18 | |
| LTE 2 | 18900 | 1880 | QPSK / 20 | 1 | 0 | 25.7 | 22.17 | Front, 0mm | 0.065 | 0.06 | 2.25 | 1:1 | 0.15 | |
| LTE 2 | 18700 | 1860 | QPSK / 20 | 1 | 0 | 25.7 | 22.38 | Front, 0mm | 0.12 | -0.04 | 2.15 | 1:1 | 0.25 | 16 |
| LTE 2 | 19100 | 1900 | QPSK / 20 | 50 | 50 | 25.7 | 21.59 | Front, 0mm | 0.080 | 0.04 | 2.58 | 1:1 | 0.21 | |

| Band | Channel | Frequency [MHz] | Modulation / BW [MHz] | RB Size | RB Offset | Maximum Power [dBm] | Conducted Power [dBm] | Test position | Measure $SAR_{1g}$ [W/kg] | Power Drift [dB] | Scaling Factor | Duty Cycle | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE 5 | 20450 | 829 | QPSK / 10 | 1 | 0 | 25.7 | 23.13 | Front, 0mm | 0.20 | 0.03 | 1.81 | 1:1 | 0.37 | |
| LTE 5 | 20600 | 844 | QPSK / 10 | 1 | 24 | 25.7 | 23.10 | Front, 0mm | 0.20 | 0.19 | 1.82 | 1:1 | 0.37 | |
| LTE 5 | 20525 | 836.5 | QPSK / 10 | 1 | 24 | 25.7 | 23.02 | Front, 0mm | 0.25 | 0.09 | 1.85 | 1:1 | 0.46 | 17 |
| LTE 5 | 20450 | 829 | QPSK / 10 | 25 | 25 | 25.7 | 22.13 | Front, 0mm | 0.19 | -0.1 | 2.28 | 1:1 | 0.42 | |



| Band | Channel | Frequency [MHz] | Modulation / BW [MHz] | RB Size | RB Offset | Maximum Power [dBm] | Conducted Power [dBm] | Test position | Measure $SAR_{1g}$ [W/kg] | Power Drift* [dB] | Scaling Factor | Duty Cycle | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE 7 | 21350 | 2560 | QPSK / 20 | 1 | 50 | 25.7 | 24.52 | Front, 0mm | 0.13 | 0.32 | 1.41 | 1:1 | 0.18 | 18 |
| LTE 7 | 21100 | 2535 | QPSK / 20 | 1 | 50 | 25.7 | 24.33 | Front, 0mm | 0.10 | 0.35 | 1.49 | 1:1 | 0.15 | |
| LTE 7 | 20850 | 2510 | QPSK / 20 | 1 | 50 | 25.7 | 24.2 | Front, 0mm | 0.10 | 0.06 | 1.41 | 1:1 | 0.14 | |
| LTE 7 | 21350 | 2560 | QPSK / 20 | 50 | 0 | 25.7 | 23.63 | Front, 0mm | 0.10 | 0.32 | 1.73 | 1:1 | 0.17 | |

*Larger than 5% drifts included to scaling factors

| Band | Channel | Frequency [MHz] | Modulation / BW [MHz] | RB Size | RB Offset | Maximum Power [dBm] | Conducted Power [dBm] | Test position | Measure $SAR_{1g}$ [W/kg] | Power Drift* [dB] | Scaling Factor | Duty Cycle | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE 12 | 23095 | 707.5 | QPSK / 10 | 1 | 24 | 25.7 | 22.67 | Front, 0mm | 0.13 | -0.07 | 2.01 | 1:1 | 0.27 | |
| LTE 12 | 23130 | 711 | QPSK / 10 | 1 | 24 | 25.7 | 22.5 | Front, 0mm | 0.13 | 0.11 | 2.09 | 1:1 | 0.28 | 19 |
| LTE 12 | 23060 | 704 | QPSK / 10 | 1 | 24 | 25.7 | 22.48 | Front, 0mm | 0.11 | -0.92 | 2.59 | 1:1 | 0.27 | |
| LTE 12 | 23095 | 707.5 | QPSK / 10 | 25 | 0 | 25.7 | 21.49 | Front, 0mm | 0.12 | 0.16 | 2.64 | 1:1 | 0.31 | |

*Larger than 5% drifts included to scaling factors

| Band | Channel | Frequency [MHz] | Modulation / BW [MHz] | RB Size | RB Offset | Maximum Power [dBm] | Conducted Power [dBm] | Test position | Measure $SAR_{1g}$ [W/kg] | Power Drift* [dB] | Scaling Factor | Duty Cycle | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE 13 | 23230 | 782 | QPSK / 10 | 1 | 24 | 25.7 | 23.08 | Front, 0mm | 0.15 | 0 | 1.83 | 1:1 | 0.28 | |
| LTE 13 | 23205 | 779.5 | QPSK / 5 | 1 | 24 | 25.7 | 22.66 | Front, 0mm | 0.17 | -0.67 | 2.35 | 1:1 | 0.40 | 20 |
| LTE 13 | 23255 | 784.5 | QPSK / 5 | 1 | 12 | 25.7 | 22.86 | Front, 0mm | 0.11 | -0.33 | 2.07 | 1:1 | 0.23 | |
| LTE 13 | 23230 | 782 | QPSK / 10 | 25 | 25 | 25.7 | 22.05 | Front, 0mm | 0.11 | 0.21 | 2.32 | 1:1 | 0.26 | |

*Larger than 5% drifts included to scaling factors

| Band | Channel | Frequency [MHz] | Modulation / BW [MHz] | RB Size | RB Offset | Maximum Power [dBm] | Conducted Power [dBm] | Test position | Measure $SAR_{1g}$ [W/kg] | Power Drift* [dB] | Scaling Factor | Duty Cycle | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LTE 66 | 132322 | 1745 | QPSK / 20 | 1 | 50 | 25.7 | 23.17 | Front, 0mm | 0.11 | -0.59 | 2.05 | 1:1 | 0.22 | |
| LTE 66 | 132572 | 1770 | QPSK / 20 | 1 | 0 | 25.7 | 21.36 | Front, 0mm | 0.11 | 0.42 | 2.99 | 1:1 | 0.33 | 21 |
| LTE 66 | 132072 | 1720 | QPSK / 20 | 1 | 0 | 25.7 | 22.29 | Front, 0mm | 0.11 | -1.05 | 2.79 | 1:1 | 0.30 | |
| LTE 66 | 132322 | 1745 | QPSK / 20 | 50 | 25 | 25.7 | 22.27 | Front, 0mm | 0.10 | -0.69 | 2.58 | 1:1 | 0.26 | |

*Larger than 5% drifts included to scaling factors



2.4GHz WLAN:

| Mode | Data Rate [Mbps] | Frequency [MHz] | Channel | Test position | Maximum Power [dBm] | Conducted Power [dBm] | Measured $SAR_{1g}$ [W/kg] | Power Drift [dB]* | Scaling Factor | Duty Cycle [%] | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11b | 1 | 2412 | 1 | Front, 0mm | 17 | 18.58 | 0.0407 | -0.64 | 1.16 | 100 | 0.047 | 22 |
| 802.11b | 1 | 2437 | 6 | Front, 0mm | 17 | 18.36 | 0.0347 | 0.43 | 1.10 | 100 | 0.038 | |
| 802.11b | 1 | 2462 | 11 | Front, 0mm | 17 | 17.7 | 0.0231 | 0.47 | 1.11 | 100 | 0.026 | |

*Due to low e-field generated by DUT, the measurements are not applicable
**Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable.

5GHz WLAN:

| Mode | Data Rate [Mbps] | Frequency [MHz] | Channel | Test position | Maximum Power [dBm] | Conducted Power [dBm] | Measured $SAR_{1g}$ [W/kg] | Power Drift [dB]** | Scaling Factor | Duty Cycle [%] | Reported $SAR_{1g}$ [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11a | 6 | 5260 | 52 | Front, 0mm | 15 | 15.51 | 0.00021 | N/A | 1.00 | 100 | 0.00021 | 23 |
| 802.11a | 6 | 5280 | 56 | Front, 0mm | 15 | 15.69 | N/A* | N/A | 1.00 | 100 | N/A | |
| 802.11a | 6 | 5320 | 64 | Front, 0mm | 15 | 15.5 | N/A* | N/A | 1.00 | 100 | N/A | |
| 802.11a | 6 | 5500 | 100 | Front, 0mm | 15 | 15.69 | N/A* | N/A | 1.00 | 100 | N/A | |
| 802.11a | 6 | 5580 | 116 | Front, 0mm | 15 | 17.02 | N/A* | N/A | 1.00 | 100 | N/A | |
| 802.11a | 6 | 5640 | 128 | Front, 0mm | 15 | 16.29 | N/A* | N/A | 1.00 | 100 | N/A | |
| 802.11a | 6 | 5660 | 132 | Front, 0mm | 15 | 15.51 | N/A* | N/A | 1.00 | 100 | N/A | |
| 802.11a | 6 | 5745 | 149 | Front, 0mm | 15 | 13.3 | N/A* | N/A | 1.48 | 100 | N/A | |
| 802.11a | 6 | 5825 | 165 | Front, 0mm | 15 | 12.41 | N/A* | N/A | 1.82 | 100 | N/A | |

*Due to low e-field generated by DUT, the measurements are not applicable
**Due to low e-field generated by DUT at the location of drift measurement, the measurements are not applicable.



### 7.2 IEC 62209-2 AMD1:2019

According to IEC 62209-2 AMD1:2019, the zoom scan complies if the peak spatial-average SAR is below 0.1 W/kg, or if the following criteria is met:

1. The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak is larger than the horizontal grid step.

2. Ratio of SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum is at least 30%.

Zoom scan compliance according to IEC 62209-2 AMD1:2019 is automatically verified by DASY5 software and all zoom scans in this test report do pass the criteria. The smallest horizontal distance and Ratio between measurement points M2 and M1 of the highest SAR results is available in Appendix C.



### 7.3 Simultaneous Transmission Analysis

Simultaneous transmission analysis for the maximum Cellular SAR and the maximum WLAN SAR is in the table below. Direct summation of SAR results was performed.

Body SAR:

| | Exposure Condition | Body $SAR_{1g}$ [W/kg] |
|---|---|---|
| | **Test Position** | **Front** |
| **Cellular** | WCDMA 2 | 0.17 |
| | WCDMA 4 | 0.36 |
| | WCDMA 5 | 0.48 |
| | LTE 2 | 0.25 |
| | LTE 5 | 0.46 |
| | LTE 7 | 0.18 |
| | LTE 12 | 0.28 |
| | LTE 13 | 0.40 |
| | LTE 66 | 0.33 |
| **Maximum Cellular SAR** | | 0.48 |
| **Maximum 2.4 GHz WLAN SAR** | | 0.047 |
| **Maximum 5 GHz WLAN SAR** | | 0.00021 |
| **SAR Summation:** | | 0.527 |



## APPENDIX A: PHOTOS OF THE DUT

Figure 5. Front side, 0mm



## APPENDIX B: SYSTEM CHECK SCAN

Plot 1

Date/Time: 02/03/2023 11.47.18

Test Laboratory: Verkotan Oy

**DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN:1154**

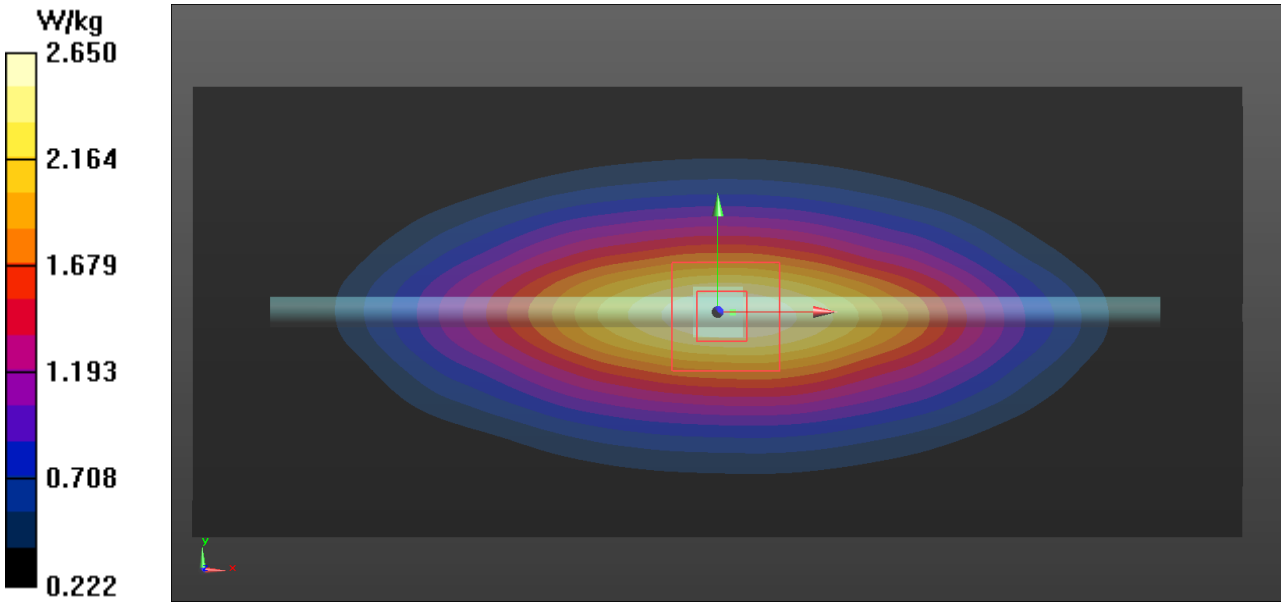
Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 750 MHz; $\sigma$ = 0.855 S/m; $\varepsilon_r$ = 45.438; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.91, 8.74, 9.52) @ 750 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 750MHz/Area Scan (141x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.65 W/kg

**Configuration/ System Check 750MHz/Zoom Scan (7x9x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.66 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.96 W/kg
**SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.38 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 2.65 W/kg





Plot 2

Date/Time: 02/03/2023 8.42.58

Test Laboratory: Verkotan Oy

**DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:455**

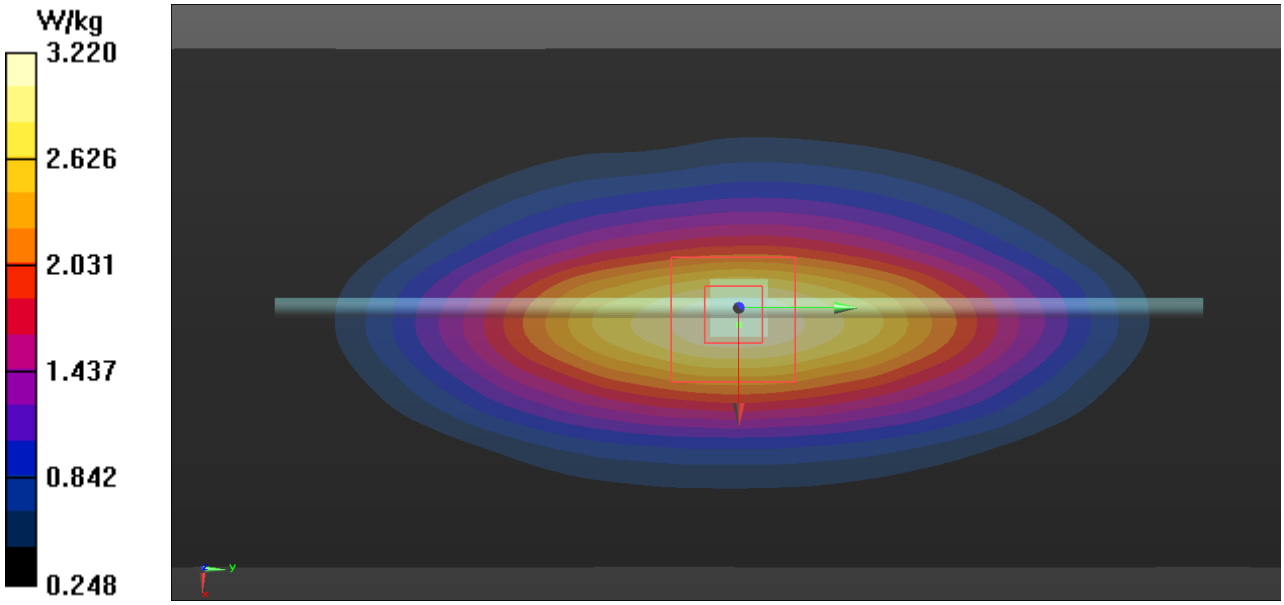
Communication System: UID 0, CW (0); Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 835 MHz; $\sigma$ = 0.885 S/m; $\varepsilon_r$ = 45.028; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.37, 8.45, 8.89) @ 835 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 835MHz/Area Scan (61x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.20 W/kg

**Configuration/ System Check 835MHz/Zoom Scan (9x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.03 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 3.61 W/kg
**SAR(1 g) = 2.51 W/kg; SAR(10 g) = 1.63 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 3.22 W/kg





Plot 3

Date/Time: 06/03/2023 9.21.06

Test Laboratory: Verkotan Oy

**DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN:1154**

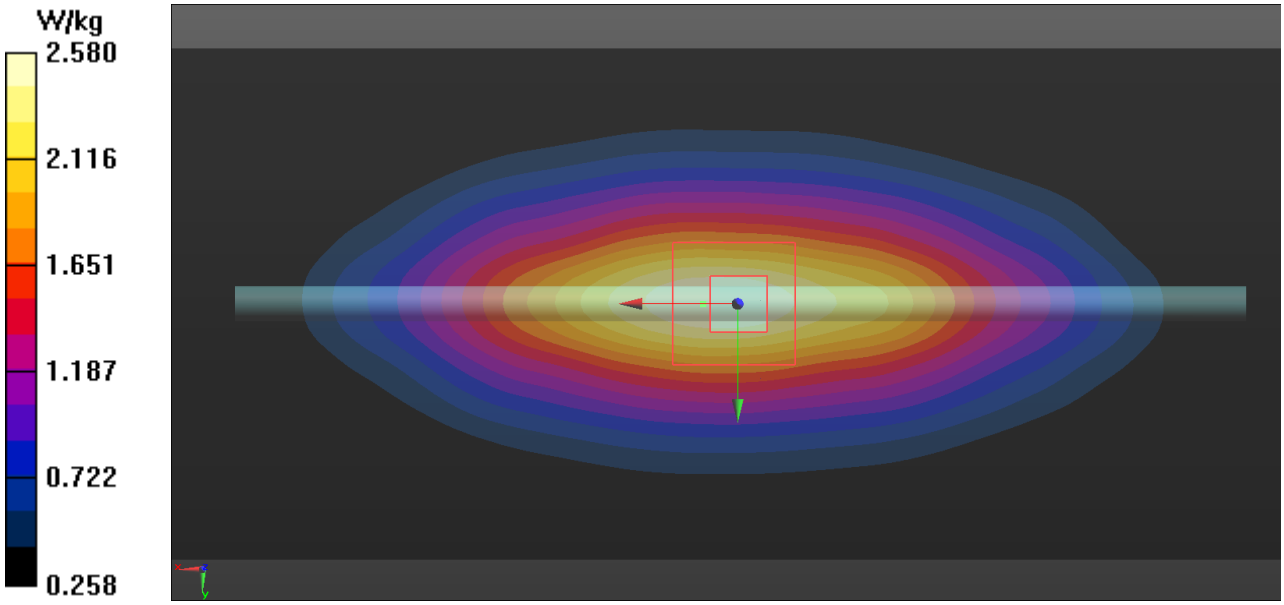
Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 750 MHz; $\sigma$ = 0.832 S/m; $\varepsilon_r$ = 45.559; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.91, 8.74, 9.52) @ 750 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 750MHz/Area Scan (141x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.58 W/kg

**Configuration/System Check 750MHz/Zoom Scan (8x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.17 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.88 W/kg
**SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.39 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 2.58 W/kg





Plot 4

Date/Time: 08/03/2023 9.33.50

Test Laboratory: Verkotan Oy

**DUT: Dipole 1800 MHz D1800V2; Type: D1800V2; Serial: D1800V2 - SN:249**

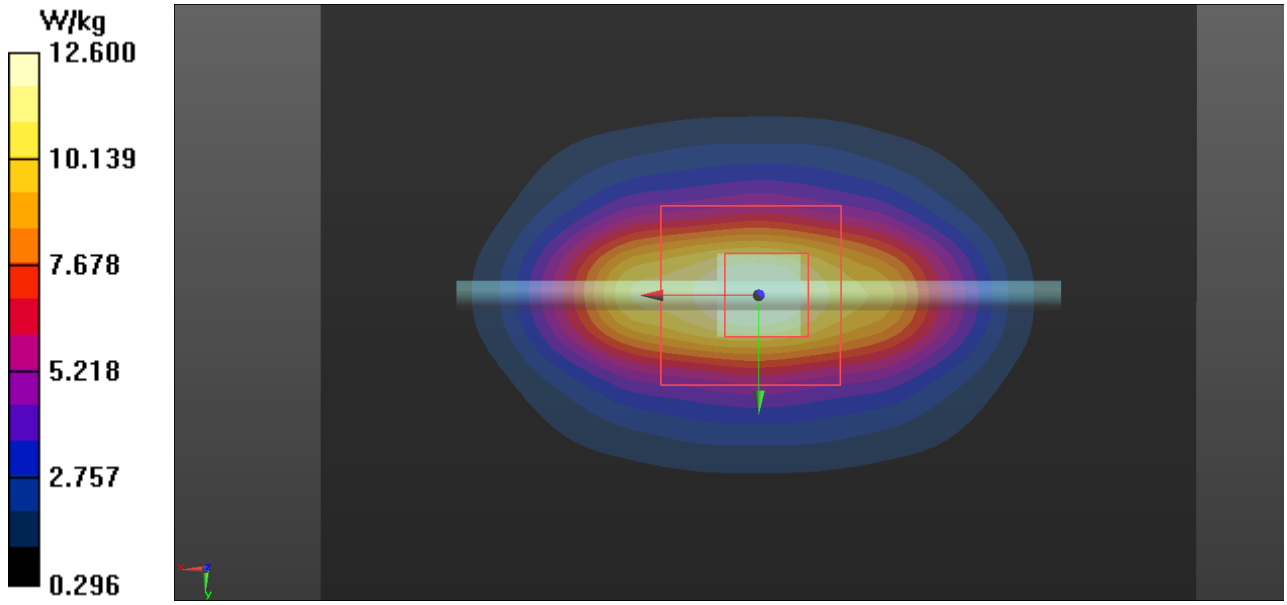
Communication System: UID 0, CW (0); Communication System Band: D1800 (1800.0 MHz); Frequency: 1800 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 1800 MHz; $\sigma$ = 1.288 S/m; $\varepsilon_r$ = 42.745; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.45, 7.97, 8.4) @ 1800 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 1800MHz/Area Scan (71x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 13.3 W/kg

**Configuration/System Check 1800MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 106.0 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 14.6 W/kg
**SAR(1 g) = 8.9 W/kg; SAR(10 g) = 4.64 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 12.6 W/kg





Plot 5

Date/Time: 08/03/2023 9.55.40

Test Laboratory: Verkotan Oy

**DUT: Dipole 2600 MHz D2600V2; Type: D2600V2; Serial: D2600V2 - SN:637**

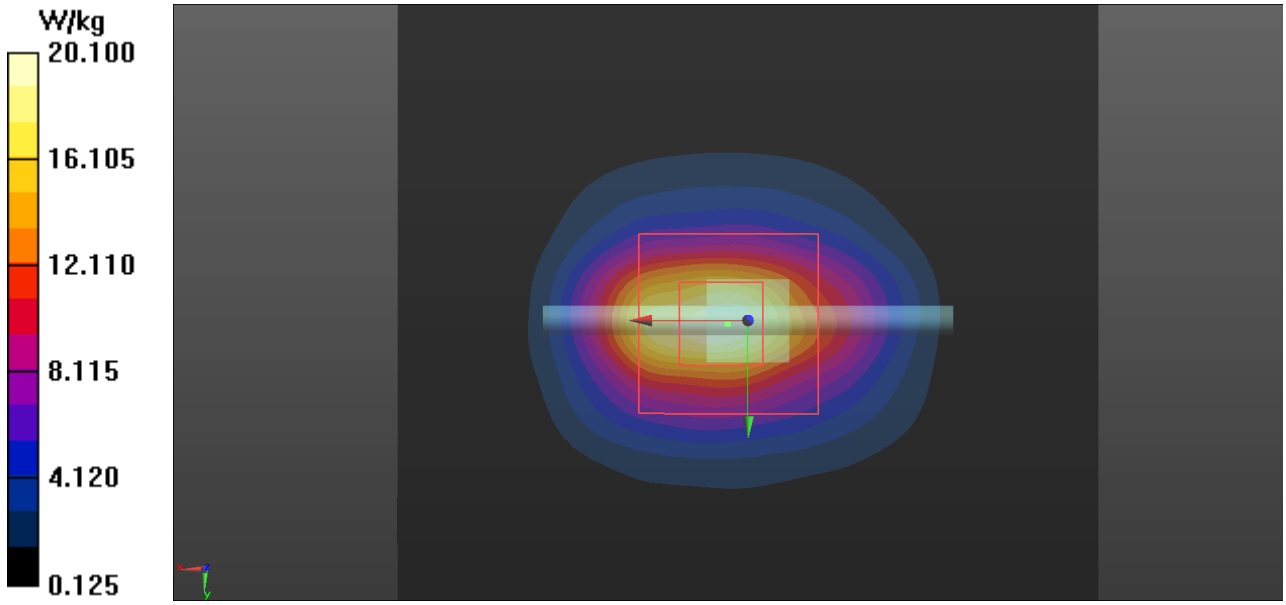
Communication System: UID 0, CW (0); Communication System Band: D2600 (2600.0 MHz); Frequency: 2600 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 2600 MHz; $\sigma$ = 1.791 S/m; $\varepsilon_r$ = 41.579; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.55, 7.37, 7.73) @ 2600 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 2600 MHz/Area Scan (71x61x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 20.0 W/kg

**Configuration/System Check 2600 MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 109.9 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 24.9 W/kg
**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.74 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 20.1 W/kg





Plot 6

Date/Time: 09/03/2023 14.43.08

Test Laboratory: Verkotan Oy

**DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:511**

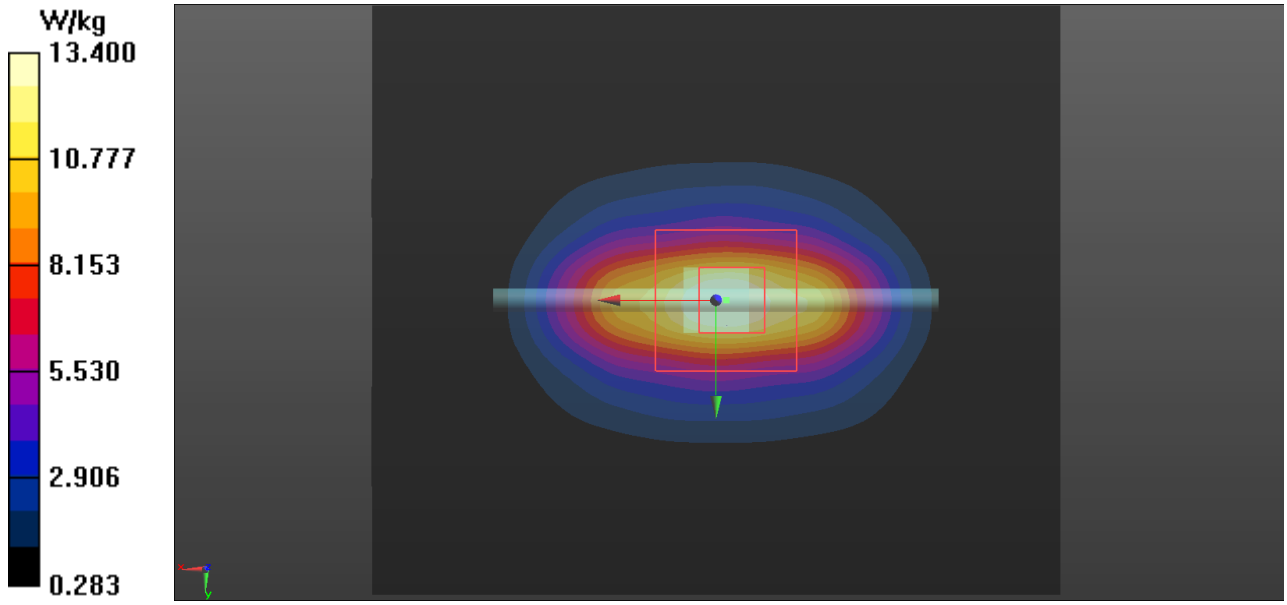
Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.364 S/m; $\varepsilon_r$ = 42.345; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.05, 7.59, 7.97) @ 1900 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 1900MHz/Area Scan (71x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.1 W/kg

**Configuration/System Check 1900MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 105.6 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 15.7 W/kg
**SAR(1 g) = 9.2 W/kg; SAR(10 g) = 4.83 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 13.4 W/kg





Plot 7

Date/Time: 13/03/2023 12.12.03

Test Laboratory: Verkotan Oy

**DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN:1154**

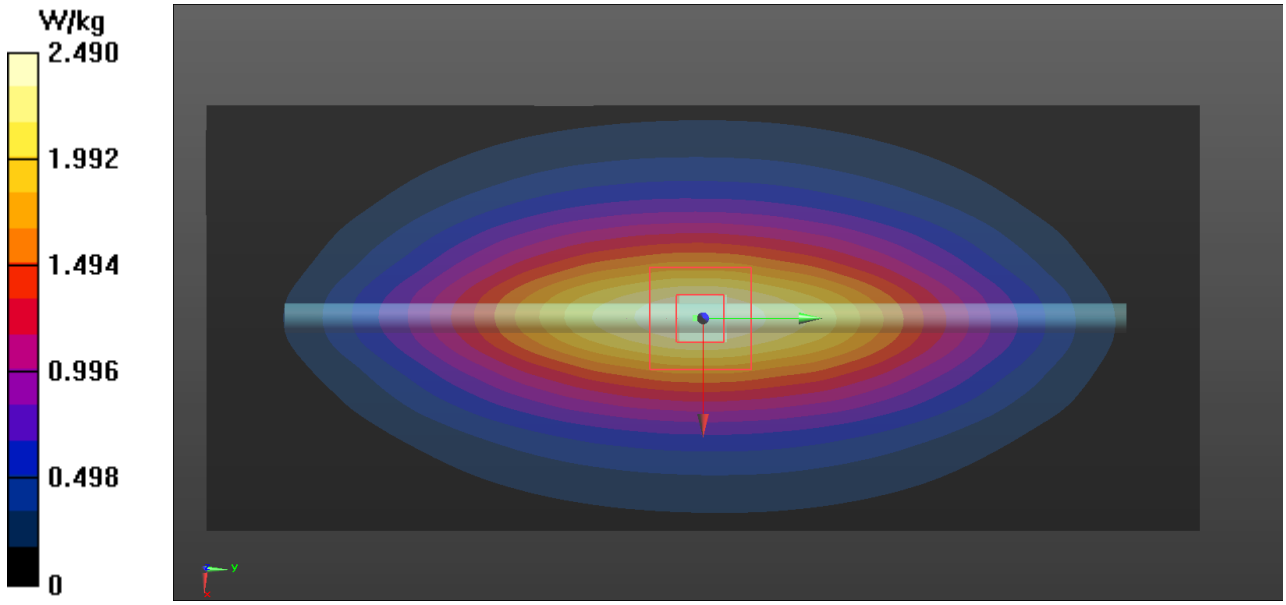
Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 750 MHz; $\sigma$ = 0.817 S/m; $\varepsilon_r$ = 41.447; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(10.26, 10.26, 10.26) @ 750 MHz; Calibrated: 12/04/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
  - Phantom: SAR1_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/System Check 750 MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.93 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 2.72 W/kg
**SAR(1 g) = 1.99 W/kg; SAR(10 g) = 1.32 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 2.44 W/kg

**Configuration/System Check 750 MHz/Area Scan (61x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.49 W/kg





Plot 8

Date/Time: 13/03/2023 12.46.29

Test Laboratory: Verkotan Oy

**DUT: D1900V2 - SN5d004; Type: D1900V2; Serial: SN5d004**

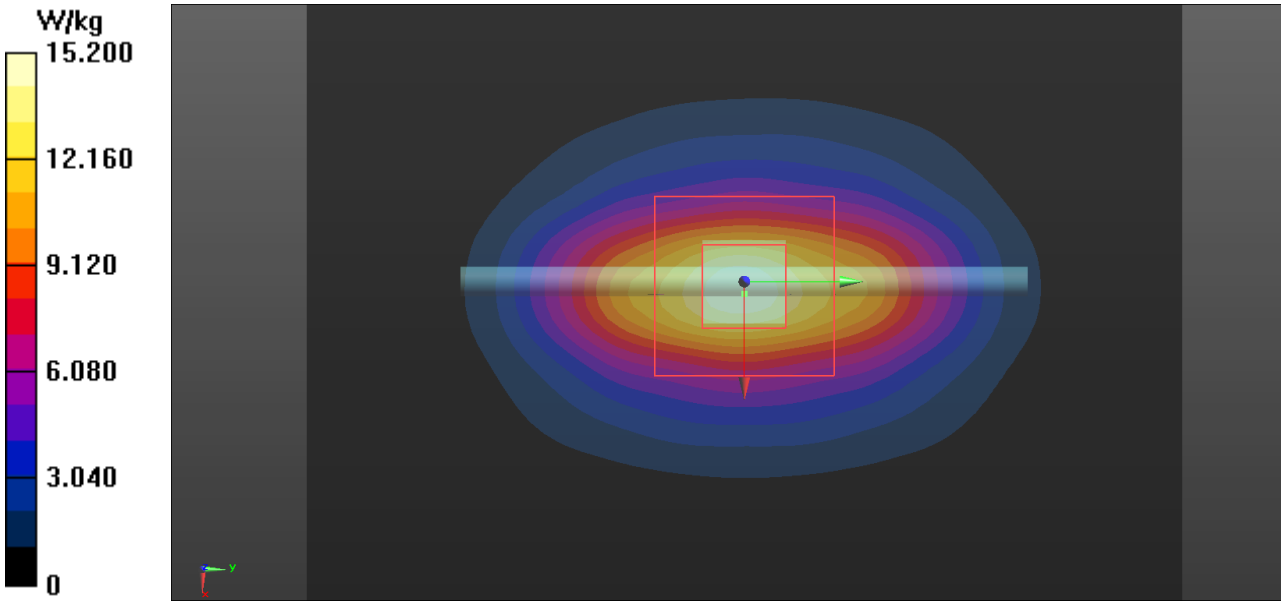
Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.343 S/m; $\varepsilon_r$ = 39.249; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3892; ConvF(8.31, 8.31, 8.31) @ 1900 MHz; Calibrated: 12/04/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
  - Phantom: SAR1_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/system check/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 106.4 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 16.6 W/kg
**SAR(1 g) = 9.46 W/kg; SAR(10 g) = 4.97 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 14.1 W/kg

**Configuration/system check/Area Scan (61x71x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 15.2 W/kg





Plot 9

Date/Time: 18/04/2023 09:54:40

Test Laboratory: Verkotan Oy

**DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:729**

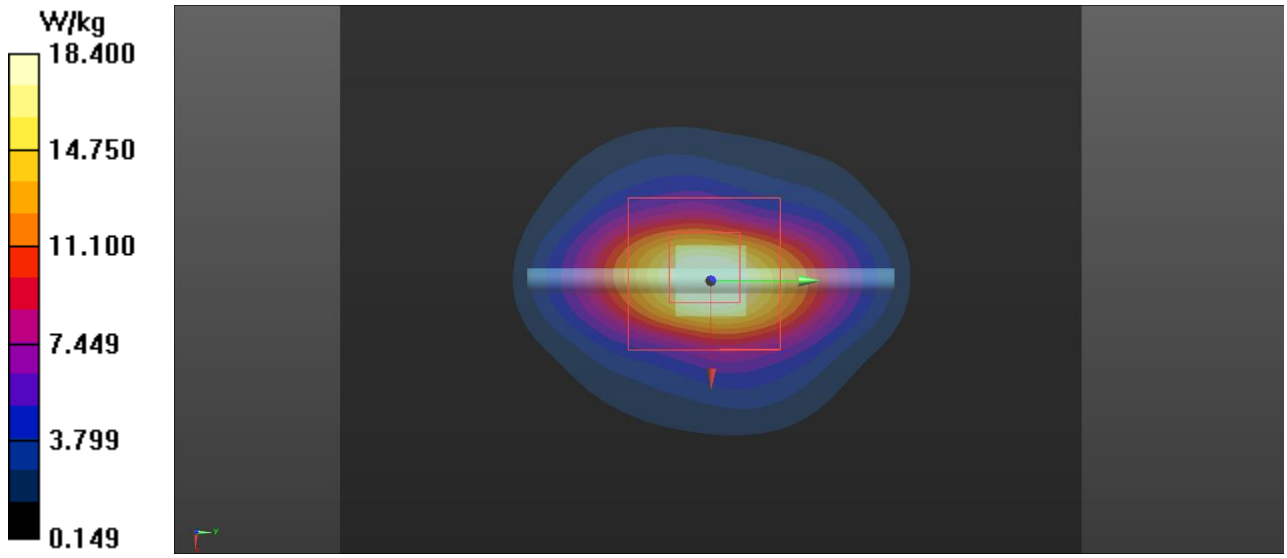
Communication System: UID 0, CW (0); Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 2450 MHz; $\sigma$ = 1.712 S/m; $\varepsilon_r$ = 40.732; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.48, 7.48, 7.48) @ 2450 MHz; Calibrated: 27/10/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/System check 2450MHz/Area Scan (71x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 19.9 W/kg

**Configuration/System check 2450MHz/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 107.5 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 22.6 W/kg
**SAR(1 g) = 12 W/kg; SAR(10 g) = 5.56 W/kg** (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 51.8%
Maximum value of SAR (measured) = 18.4 W/kg





Plot 10

Date/Time: 19.4.2023 12.02.48

Test Laboratory: Verkotan Oy

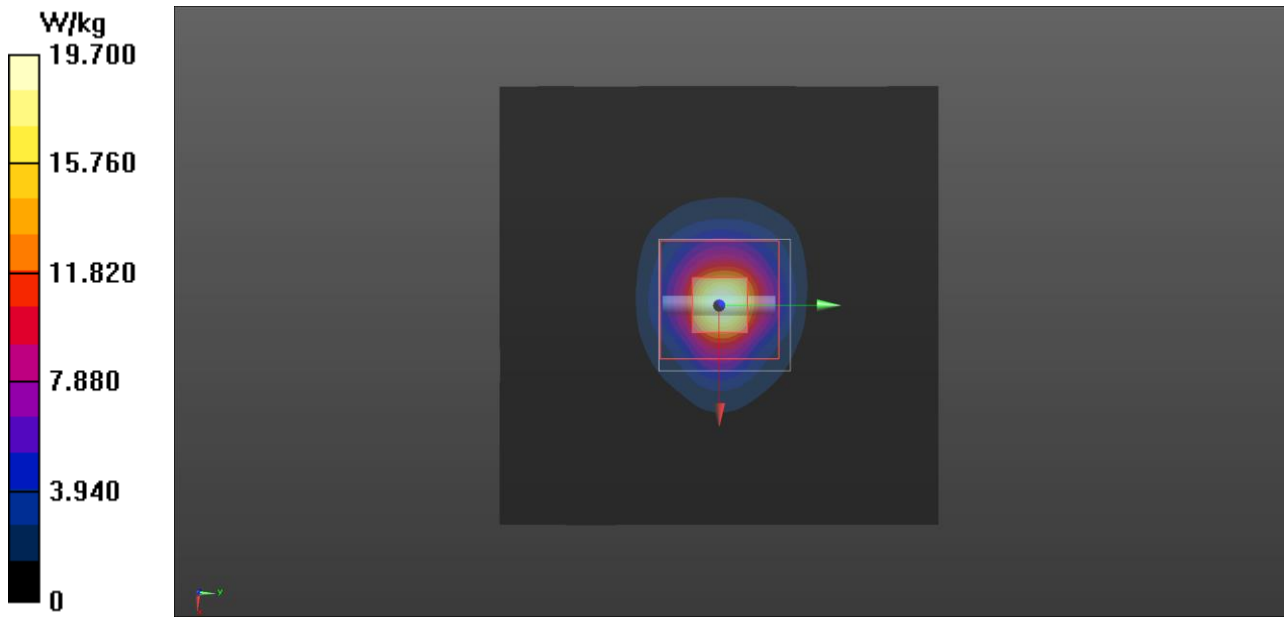
**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1045**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5250 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 5250 MHz; $\sigma$ = 4.932 S/m; $\varepsilon_r$ = 34.789; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.9, 4.9, 4.9) @ 5250 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 25.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/system check 5250MHz/Zoom Scan (7x7x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.86 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 31.2 W/kg
**SAR(1 g) = 7.53 W/kg; SAR(10 g) = 2.16 W/kg** (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 5.7 mm
Ratio of SAR at M2 to SAR at M1 = 64.1%
Maximum value of SAR (measured) = 19.4 W/kg
**Configuration/system check 5250MHz/Area Scan (81x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 19.7 W/kg





Plot 11

Date/Time: 19.4.2023 12.18.26

Test Laboratory: Verkotan Oy

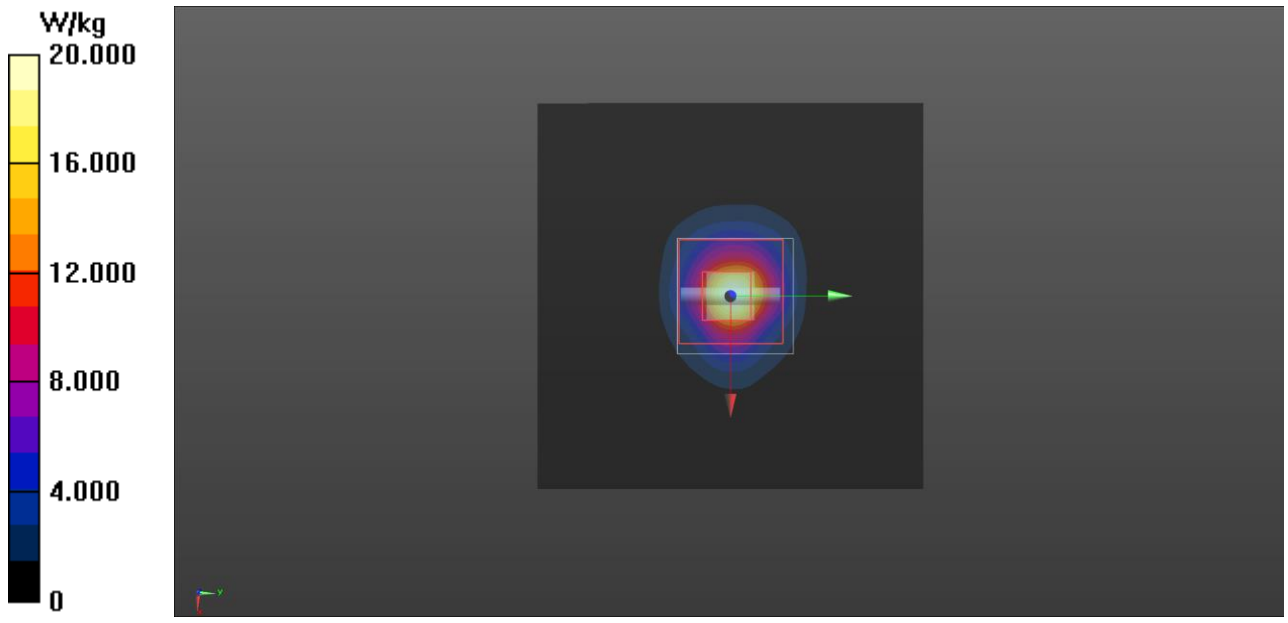
**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1045**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5600 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5600 MHz; $\sigma$ = 5.246 S/m; $\varepsilon_r$ = 34.271; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.61, 4.61, 4.61) @ 5600 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 25.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/system check 5600MHz/Area Scan (81x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.0 W/kg
**Configuration/system check 5600MHz/Zoom Scan (7x7x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.66 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 33.1 W/kg
**SAR(1 g) = 7.6 W/kg; SAR(10 g) = 2.15 W/kg** (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 5.1 mm
Ratio of SAR at M2 to SAR at M1 = 62.1%
Maximum value of SAR (measured) = 18.9 W/kg





Plot 12

Date/Time: 19.4.2023 12.50.29

Test Laboratory: Verkotan Oy

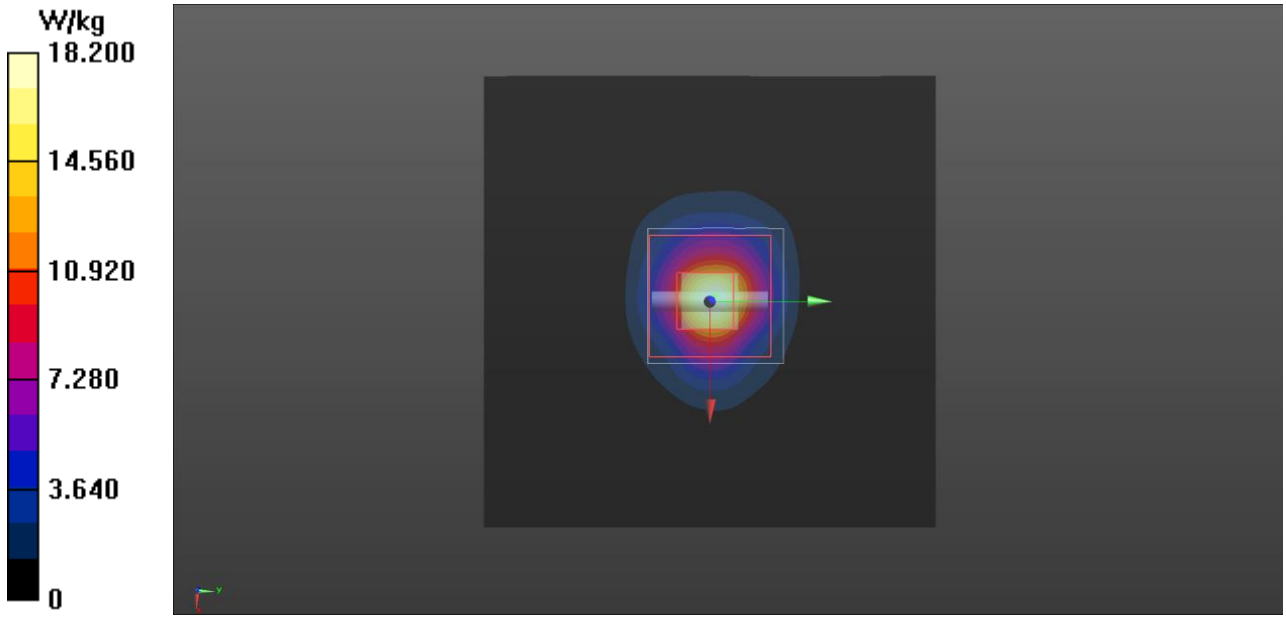
**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1045**

Communication System: UID 0, CW (0); Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5750 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5750 MHz; $\sigma$ = 5.384 S/m; $\varepsilon_r$ = 34.053; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.65, 4.65, 4.65) @ 5750 MHz; Calibrated: 27.10.2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 25.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19.10.2022
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/system check 5750MHz/Zoom Scan (7x7x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.53 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 33.2 W/kg
**SAR(1 g) = 6.98 W/kg; SAR(10 g) = 1.94 W/kg** (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below = 5.6 mm
Ratio of SAR at M2 to SAR at M1 = 61.1%
Maximum value of SAR (measured) = 17.8 W/kg
**Configuration/system check 5750MHz/Area Scan (81x81x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.2 W/kg





## APPENDIX C: MEASUREMENT SCANS

Plot 13

Date/Time: 09/03/2023 17.17.31

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

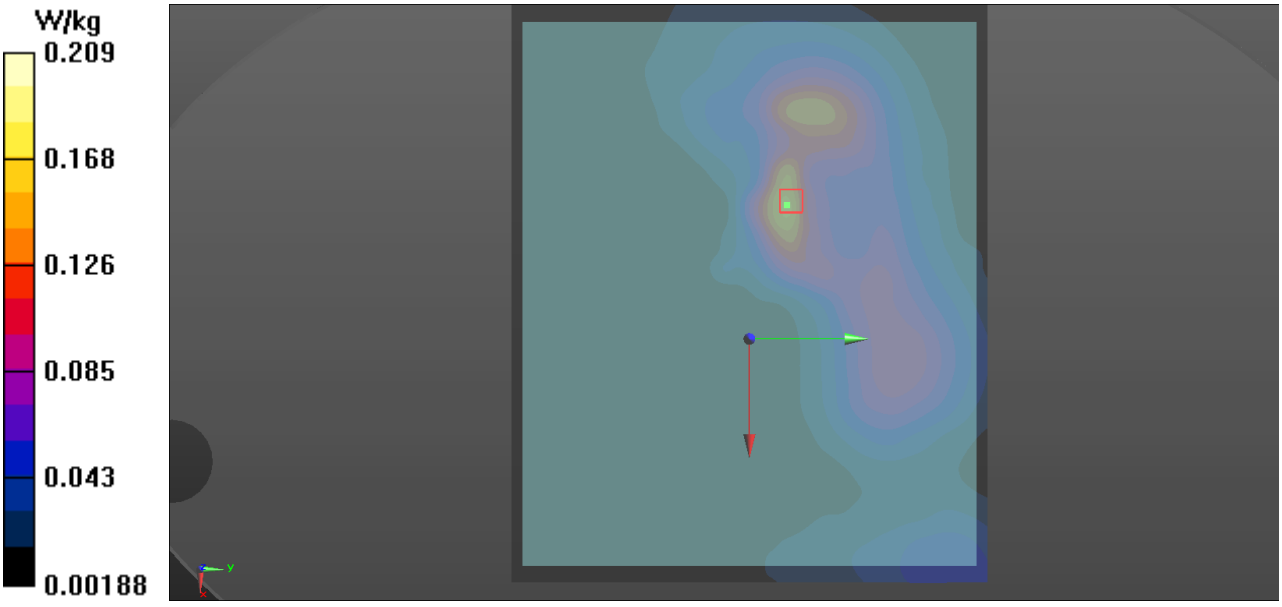
Communication System: UID 0, WCDMA (0); Communication System Band: Band 2; Frequency: 1852.4 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 1852.4 MHz; $\sigma$ = 1.338 S/m; $\varepsilon_r$ = 42.416; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.05, 7.59, 7.97) @ 1852.4 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, WCDMA 2, low/Area Scan (171x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.158 W/kg

**Configuration/Apogee, WCDMA 2, low/Zoom Scan (11x11x8)/Cube 0:** Measurement grid: dx=3mm, dy=3mm, dz=1.4mm
Reference Value = 8.983 V/m; Power Drift = -0.25 dB
Peak SAR (extrapolated) = 0.457 W/kg
**SAR(1 g) = 0.131 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.237 W/kg





Plot 14

Date/Time: 09/03/2023 14.03.16

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

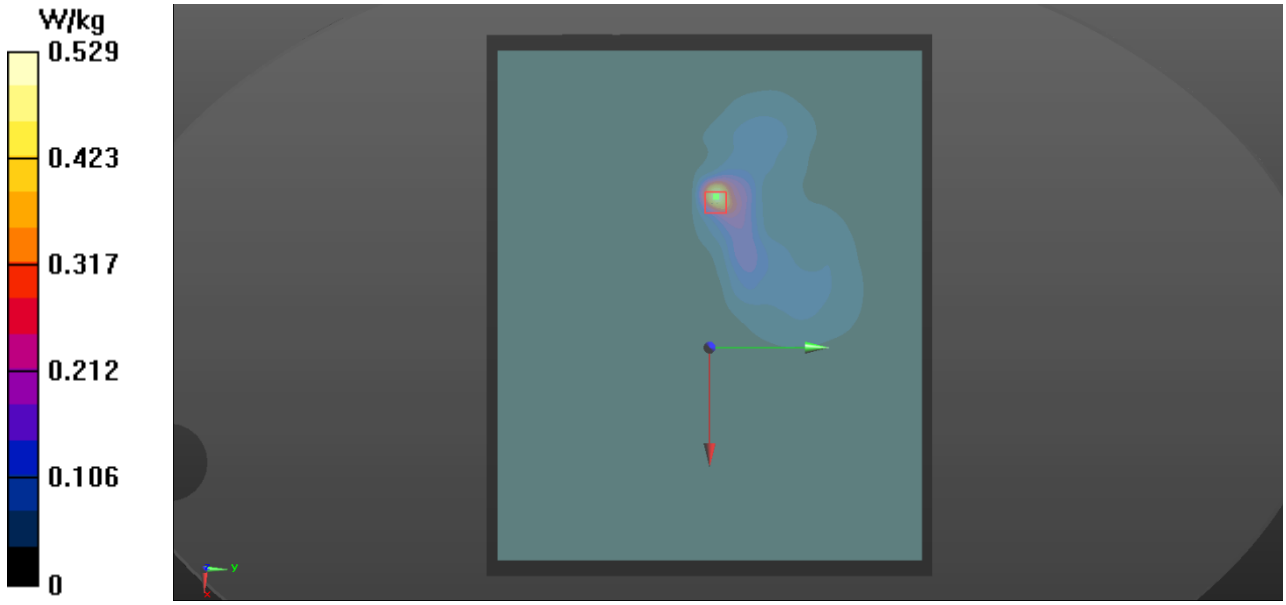
Communication System: UID 0, WCDMA (0); Communication System Band: Band 4; Frequency: 1712.4 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 1712.4 MHz; $\sigma$ = 1.243 S/m; $\varepsilon_r$ = 42.906; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.45, 7.97, 8.4) @ 1712.4 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = 31.0, -4.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, WCDMA 4, Low/Zoom Scan (11x11x8)/Cube 0:** Measurement grid: dx=3mm, dy=3mm, dz=1.4mm
Reference Value = 8.548 V/m; Power Drift = -0.30 dB
Peak SAR (extrapolated) = 2.73 W/kg
**SAR(1 g) = 0.224 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.766 W/kg

**Configuration/Apogee, WCDMA 4, Low/Area Scan (171x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.529 W/kg





Plot 15

Date/Time: 07/03/2023 10.11.06

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

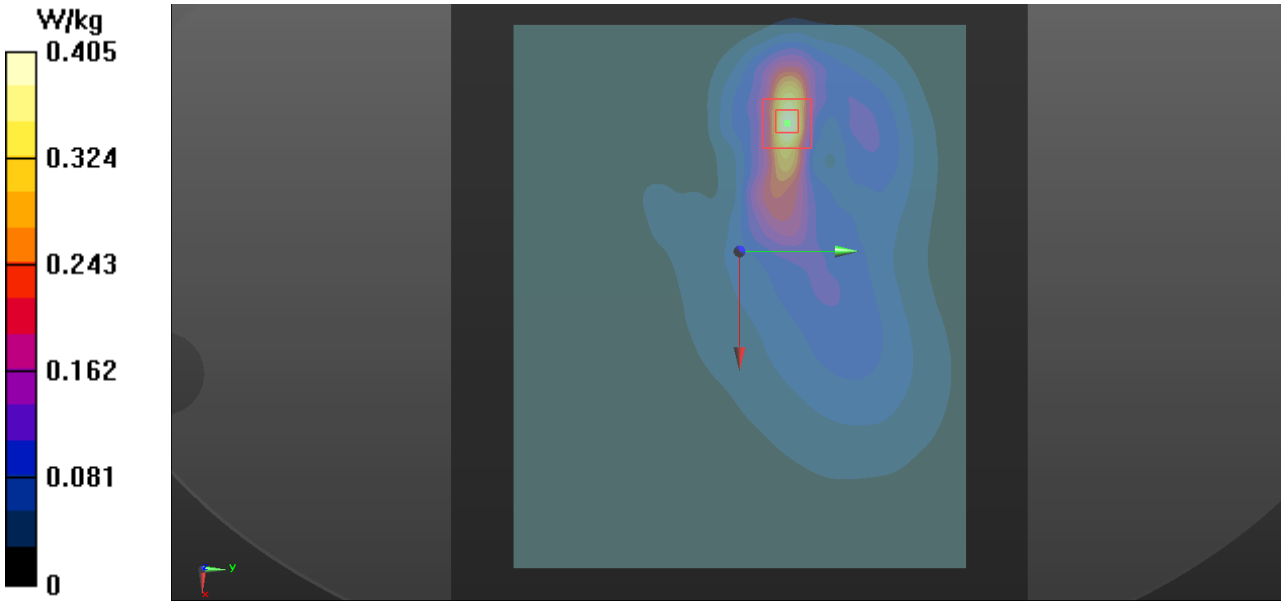
Communication System: UID 0, WCDMA (0); Communication System Band: Band 5; Frequency: 836.6 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 837 MHz; $\sigma$ = 0.863 S/m; $\varepsilon_r$ = 45.152; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.37, 8.45, 8.89) @ 836.6 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, WCDMA 5, Mid/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.78 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.506 W/kg
**SAR(1 g) = 0.314 W/kg; SAR(10 g) = 0.172 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.425 W/kg

**Configuration/Apogee, WCDMA 5, Mid/Area Scan (201x171x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.405 W/kg





Plot 16

Date/Time: 08/03/2023 14.24.51

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

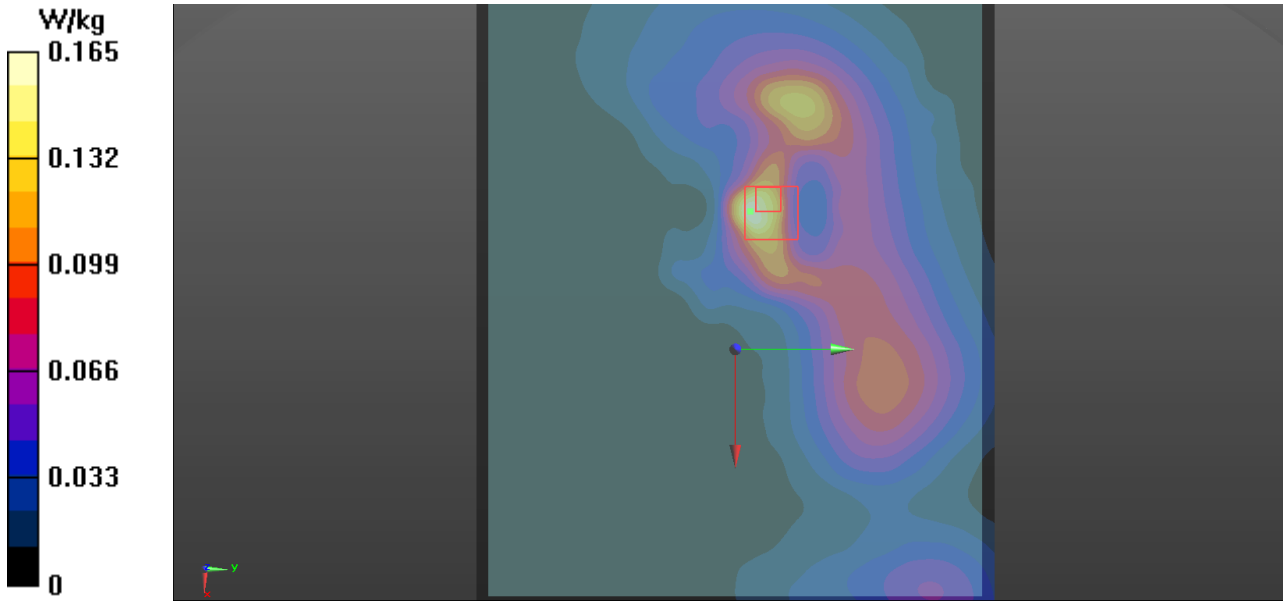
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 2, E-UTRA/FDD (1850.0 - 1910.0 MHz); Frequency: 1860 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 1860 MHz; $\sigma$ = 1.319 S/m; $\varepsilon_r$ = 42.65; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.05, 7.59, 7.97) @ 1860 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 33.0, -4.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, LTE2, BW20, Low, RBs 1, Offset 0/Zoom Scan (10x10x9)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=4mm
Reference Value = 13.98 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.312 W/kg
**SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.070 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.194 W/kg

**Configuration/Apogee, LTE2, BW20, Low, RBs 1, Offset 0/Area Scan (171x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.165 W/kg





Plot 17

Date/Time: 07/03/2023 15.01.27

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

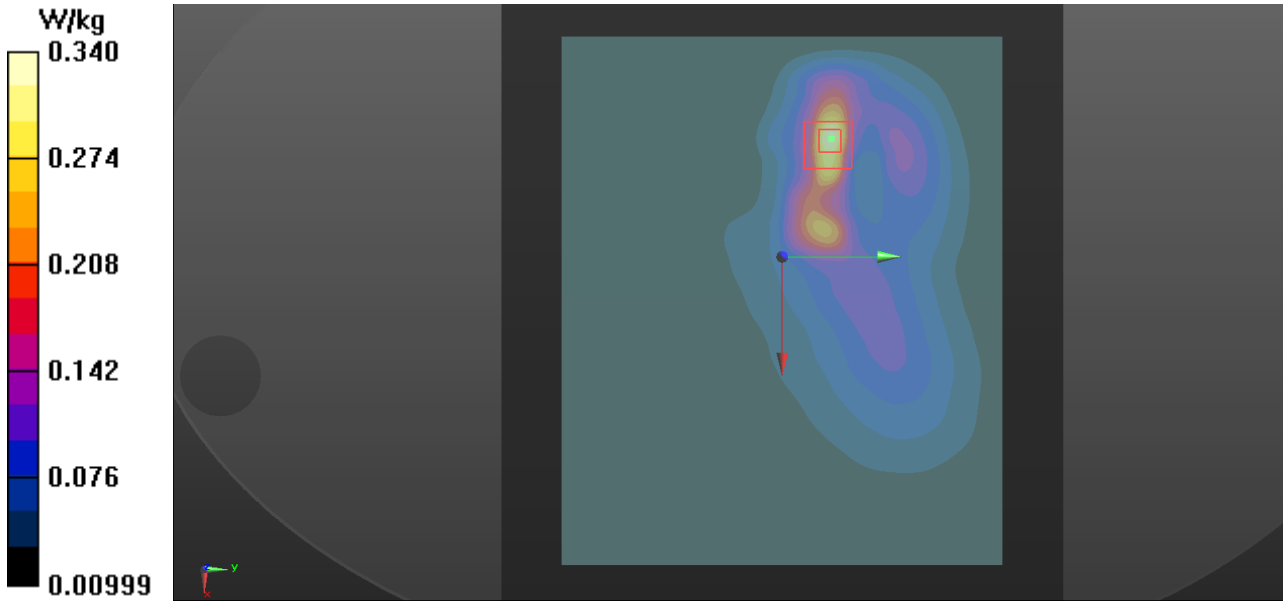
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 5, E-UTRA/FDD (824.0 - 849.0 MHz); Frequency: 836.5 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 836.5 MHz; $\sigma$ = 0.863 S/m; $\varepsilon_r$ = 45.157; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.37, 8.45, 8.89) @ 836.5 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, LTE5, BW10, Mid, RBs 1, Offset 24/Area Scan (201x171x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.327 W/kg

**Configuration/Apogee, LTE5, BW10, Mid, RBs 1, Offset 24/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.44 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.404 W/kg
**SAR(1 g) = 0.248 W/kg; SAR(10 g) = 0.136 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.340 W/kg





Plot 18

Date/Time: 08/03/2023 18.01.52

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

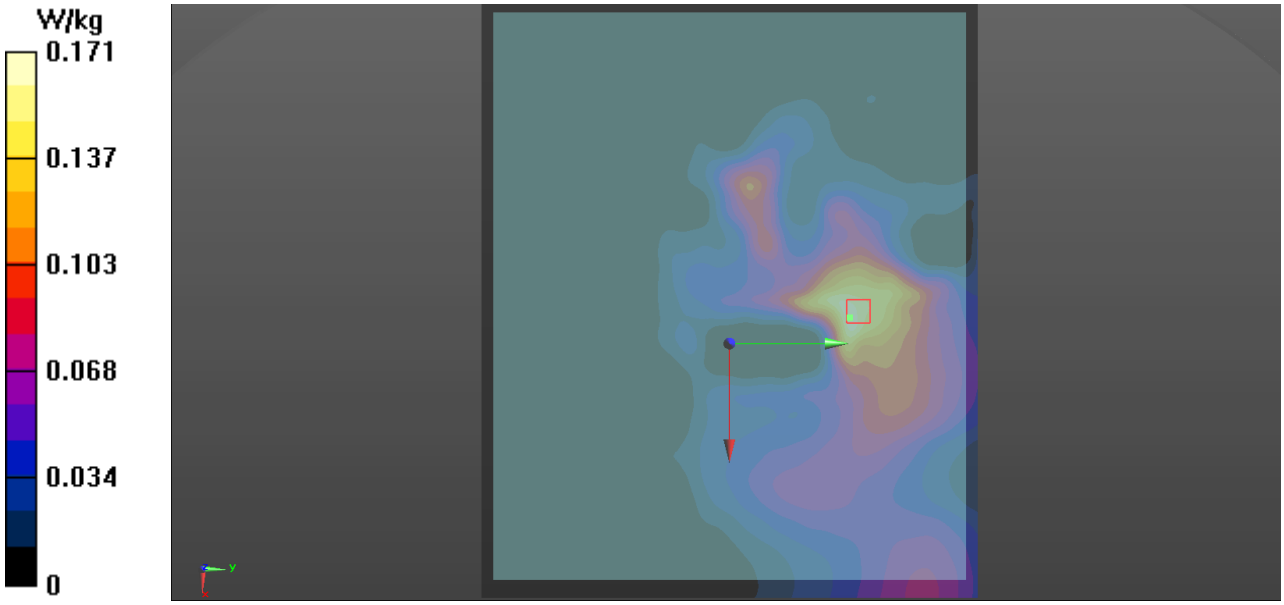
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 7, E-UTRA/FDD (2500.0 - 2570.0 MHz); Frequency: 2560 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 2560 MHz; $\sigma$ = 1.761 S/m; $\varepsilon_r$ = 41.641; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(7.55, 7.37, 7.73) @ 2560 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, LTE 7 BW20, high, RBs 1, Offset 50/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.493 V/m; Power Drift = 0.32 dB
Peak SAR (extrapolated) = 0.209 W/kg
**SAR(1 g) = 0.129 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.177 W/kg

**Configuration/Apogee, LTE 7 BW20, high, RBs 1, Offset 50/Area Scan (171x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.171 W/kg





Plot 19

Date/Time: 07/03/2023 12.10.27

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

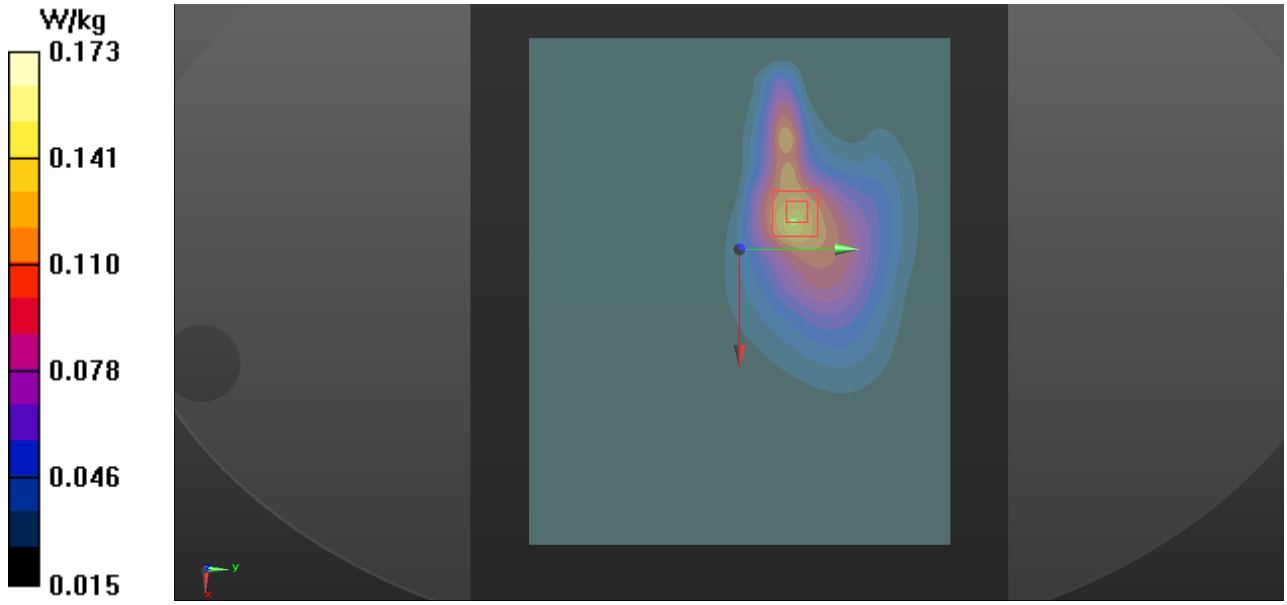
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 12, E-UTRA/FDD (698.0 - 716.0 MHz); Frequency: 711 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 711 MHz; $\sigma$ = 0.818 S/m; $\varepsilon_r$ = 45.771; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.91, 8.74, 9.52) @ 711 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, LTE12, BW10, High, RBs 1, Offset 24/Area Scan (201x171x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.139 W/kg

**Configuration/Apogee, LTE12, BW10, High, RBs 1, Offset 24/Zoom Scan (8x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.52 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.204 W/kg
**SAR(1 g) = 0.134 W/kg; SAR(10 g) = 0.087 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.173 W/kg





Plot 20

Date/Time: 06/03/2023 12.38.55

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

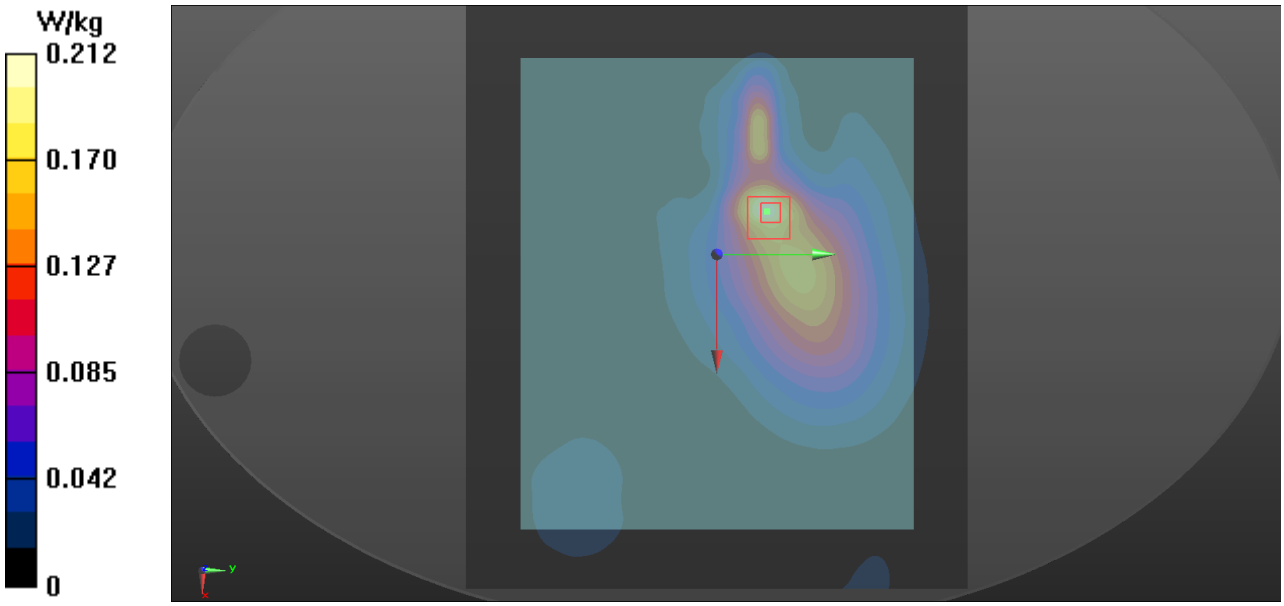
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 13, E-UTRA/FDD (777.0 - 787.0 MHz); Frequency: 779.5 MHz;
Communication System PAR: 0 dB;
Medium parameters used (interpolated): f = 779.5 MHz; $\sigma$ = 0.842 S/m; $\varepsilon_r$ = 45.404; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(9.91, 8.74, 9.52) @ 779.5 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, LTE13, RBs 1, Offset 24, CH23205/Zoom Scan (8x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.03 V/m; Power Drift = -0.67 dB
Peak SAR (extrapolated) = 0.299 W/kg
**SAR(1 g) = 0.169 W/kg; SAR(10 g) = 0.103 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.247 W/kg

**Configuration/Apogee, LTE13, RBs 1, Offset 24, CH23205/Area Scan (201x171x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.212 W/kg





Plot 21

Date/Time: 09/03/2023 8.43.24

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

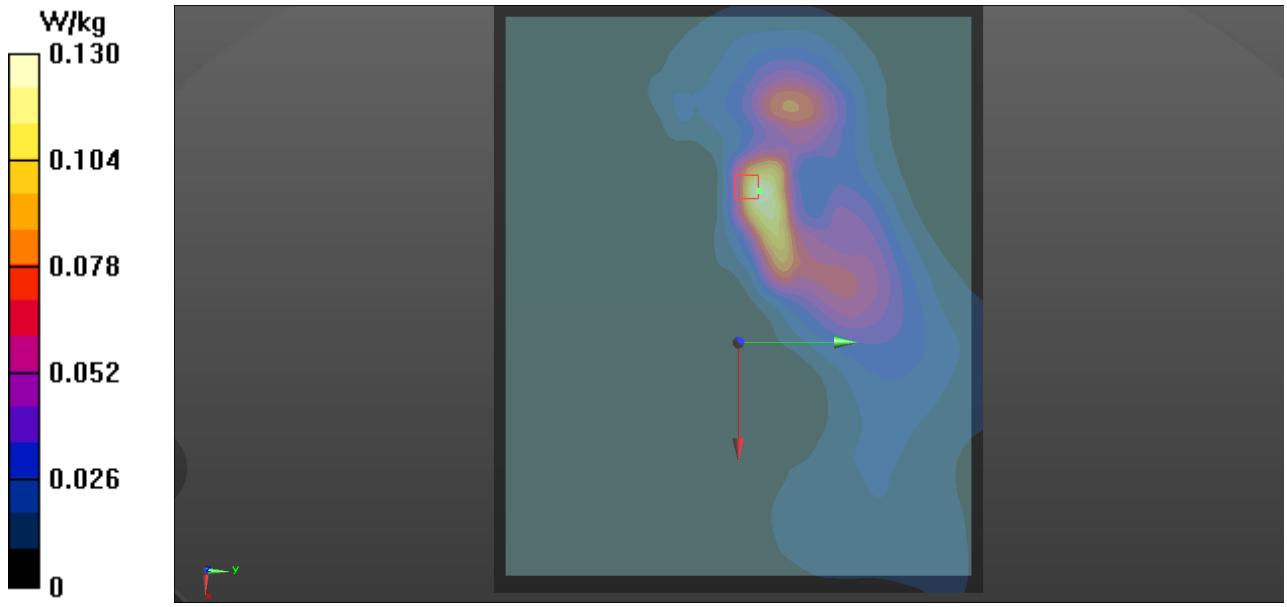
Communication System: UID 0, Generic LTE (0); Communication System Band: Band 66; Frequency: 1770 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 1770 MHz; $\sigma$ = 1.272 S/m; $\varepsilon_r$ = 42.789; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN7447; ConvF(8.45, 7.97, 8.4) @ 1770 MHz; Calibrated: 17/02/2023
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection (Locations From Previous Scan Used)), z = 31.0, -4.0
  - Electronics: DAE4 Sn1332; Calibrated: 15/02/2023
  - Phantom: SAR2_Phantom1_ELI; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.12(7450)

**Configuration/Apogee, LTE 66, BW20, High, RBs 1, Offset 0/Zoom Scan (11x11x8)/Cube 0:** Measurement grid: dx=3mm, dy=3mm, dz=1.4mm
Reference Value = 15.63 V/m; Power Drift = 0.42 dB
Peak SAR (extrapolated) = 0.735 W/kg
**SAR(1 g) = 0.109 W/kg** (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.304 W/kg

**Configuration/Apogee, LTE 66, BW20, High, RBs 1, Offset 0/Area Scan (171x141x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.130 W/kg





Plot 22

Date/Time: 18/04/2023 10:46:20

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

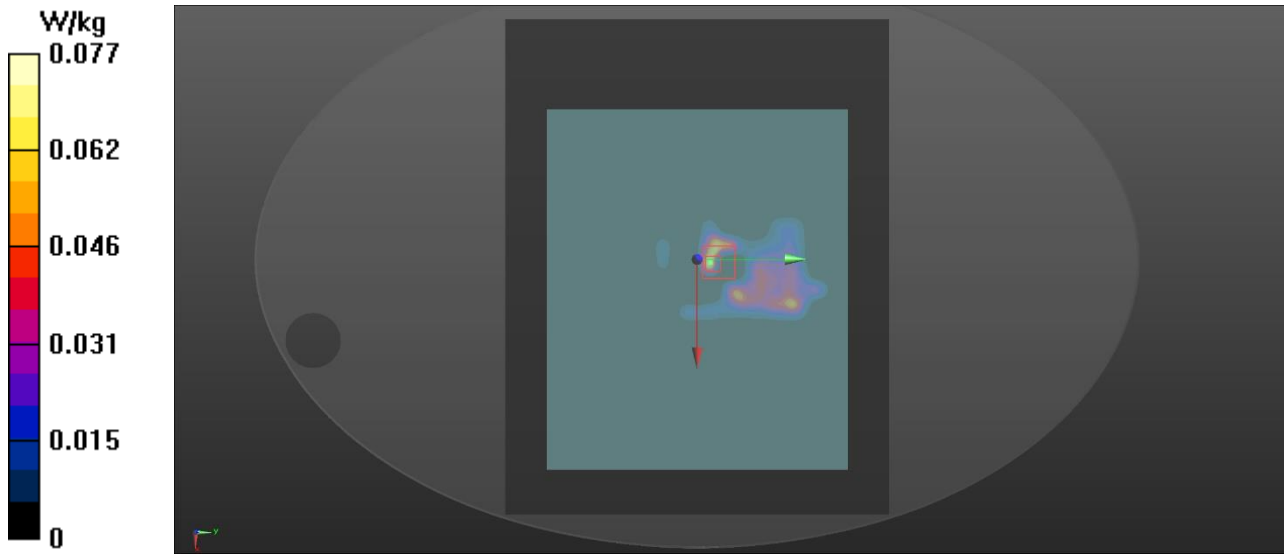
Communication System: UID 0, WLAN 2.4 (0); Communication System Band: WLAN2.4GHz; Frequency: 2412 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 2412 MHz; $\sigma$ = 1.688 S/m; $\varepsilon_r$ = 40.787; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(7.48, 7.48, 7.48) @ 2412 MHz; Calibrated: 27/10/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -4.0, 31.0
  - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/Apogee, WLAN CH1, BW20, 1 Mbps/Zoom Scan (7x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.675 V/m; Power Drift = -0.64 dB
Peak SAR (extrapolated) = 0.198 W/kg
**SAR(1 g) = 0.041 W/kg; SAR(10 g) = 0.016 W/kg** (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 44.1%
Maximum value of SAR (measured) = 0.0628 W/kg

**Configuration/Apogee, WLAN CH1, BW20, 1 Mbps/Area Scan (221x171x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0769 W/kg





Plot 23

Date/Time: 19/04/2023 13:34:03

Test Laboratory: Verkotan Oy

**DUT: German Bionics Exoskeleton, Apogee;**

Communication System: UID 0, WLAN5GHz (0); Communication System Band: 5GHz; Frequency: 5260 MHz;
Communication System PAR: 0 dB;
Medium parameters used: f = 5260 MHz; $\sigma$ = 4.942 S/m; $\varepsilon_r$ = 34.772; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

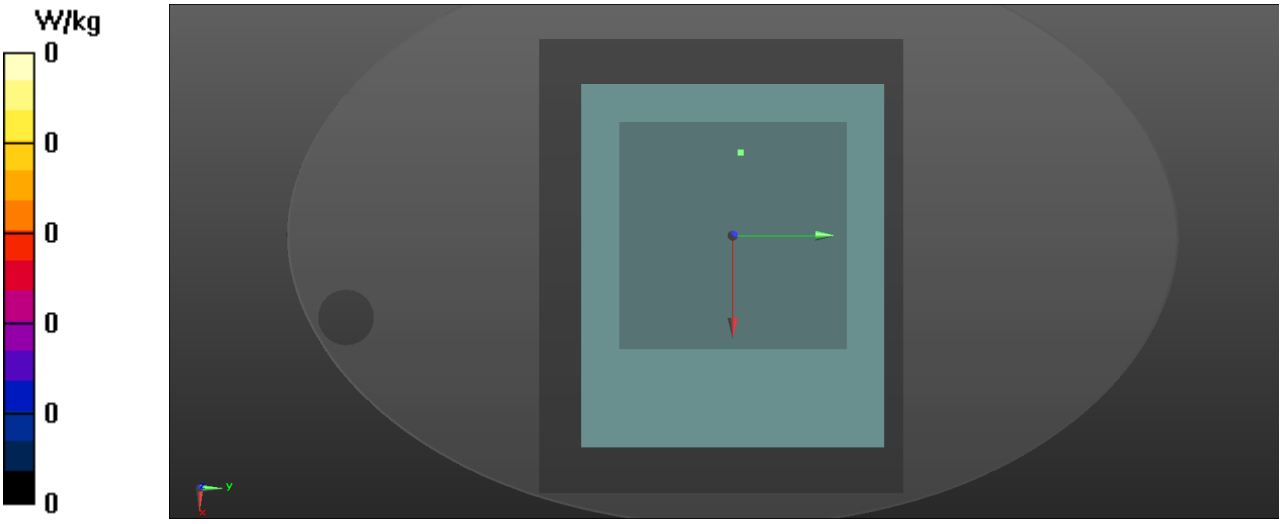
DASY Configuration:

- Probe: EX3DV4 - SN3852; ConvF(4.9, 4.9, 4.9) @ 5260 MHz; Calibrated: 27/10/2022
  - Sensor-Surface: 1.4mm (Mechanical Surface Detection), z = -14.0, 25.0, -4.0
  - Electronics: DAE4 Sn710; Calibrated: 19/10/2022
  - Phantom: SAR2_Phantom1_ELl; Type: QD OVA 002 AA;
  - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

**Configuration/Apogee, 802.11a, WLAN CH52, BW20, 6 Mbps/Area Scan (151x151x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.00243 W/kg

**Configuration/Apogee, 802.11a, WLAN CH52, BW20, 6 Mbps/Zoom Scan (10x10x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.373 V/m; Power Drift = N/A
Peak SAR (extrapolated) = 0 W/kg
**SAR(1 g) = n.a. ; SAR(10 g) = n.a.** (SAR corrected for target medium)
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 54.5%
Maximum value of SAR (measured) = 0.0180 W/kg

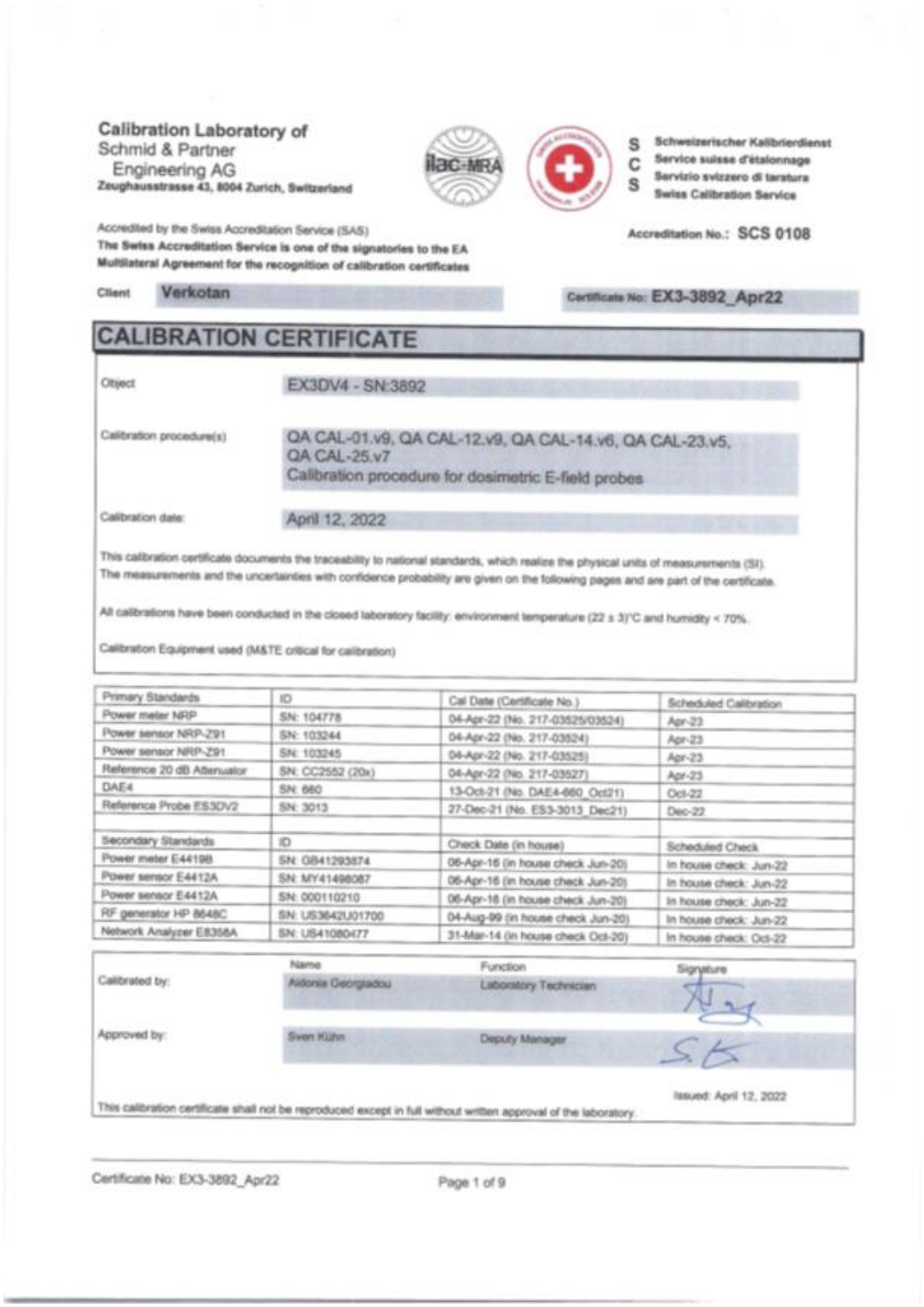
**Configuration/Apogee, 802.11a, WLAN CH52, BW20, 6 Mbps/Area Scan 2 (51x41x1):** Interpolated grid: dx=6.000 mm, dy=6.000 mm
Maximum value of SAR (interpolated) = 0 W/kg





## APPENDIX D: RELEVANT PAGES FROM PROBE CALIBRATION REPORTS



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Accreditation No.: SCS 0108

Client: Verkotan

Certificate No: EX3-3892_Apr22

# CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3892

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes

Calibration date: April 12, 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: CC2552 (20x) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| DAE4 | SN: 660 | 13-Oct-21 (No. DAE4-660_Oct21) | Oct-22 |
| Reference Probe ES3DV2 | SN: 3013 | 27-Dec-21 (No. ES3-3013_Dec21) | Dec-22 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-20) | In house check: Jun-22 |
| Network Analyzer E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-20) | In house check: Oct-22 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Aidonia Georgiadou | Laboratory Technician | |
| Approved by: | Sven Kühn | Deputy Manager | |

Issued: April 12, 2022

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

Certificate No: EX3-3892_Apr22 Page 1 of 9



 

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3892

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm (μV/(V/m)²)[A] | 0.47 | 0.38 | 0.47 | ± 10.1 % |
| DCP (mV)[B] | 102.0 | 105.5 | 101.6 | |

## Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Max dev. | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 154.3 | ± 3.0 % | ± 4.7 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 165.8 | | |
| | | Z | 0.0 | 0.0 | 1.0 | | 158.8 | | |

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%.

[A] The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 5).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.





 

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3892

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | -148.5 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |

**Note**: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.



 

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3892

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha [G] | Depth [G] (mm) | Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 600 | 42.7 | 0.88 | 10.43 | 10.43 | 10.43 | 0.10 | 1.25 | ± 13.3 % |
| 750 | 41.9 | 0.89 | 10.26 | 10.26 | 10.26 | 0.48 | 0.80 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.95 | 9.95 | 9.95 | 0.36 | 0.91 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.31 | 8.31 | 8.31 | 0.29 | 0.86 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.66 | 7.66 | 7.66 | 0.33 | 0.90 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.55 | 7.55 | 7.55 | 0.39 | 0.90 | ± 12.0 % |
| 4400 | 36.9 | 3.84 | 6.08 | 6.08 | 6.08 | 0.40 | 1.60 | ± 13.1 % |
| 4800 | 36.4 | 4.25 | 5.65 | 5.65 | 5.65 | 0.40 | 1.80 | ± 13.1 % |

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters ($\varepsilon$ and $\sigma$) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ($\varepsilon$ and $\sigma$) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.





 

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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 | Verkotan | Certificate No | EX-7447_Feb23 |
|---|---|---|---|

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:7447 |
| 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 | February 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 |
|---|---|---|---|
| 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 |
| 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) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| DAE4 | SN: 660 | 10-Oct-22 (No. DAE4-660_Oct22) | Oct-23 |
| 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 | Joanna Lleshaj | Laboratory Technician | |
| Approved by | Niels Kuster | Quality Manager | |

Issued: February 21, 2023





 

## Parameters of Probe: EX3DV4 - SN:7447

### Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc ($k = 2$) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$) [A] | 0.43 | 0.43 | 0.43 | ±10.1% |
| DCP (mV) [B] | 90.0 | 91.0 | 96.0 | ±4.7% |

### Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B $dB\sqrt{\mu V}$ | C | D dB | VR mV | Max dev. | Max Unc[E] $k = 2$ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.00 | 0.00 | 1.00 | 0.00 | 130.7 | ±2.3% | ±4.7% |
| | | Y | 0.00 | 0.00 | 1.00 | | 130.1 | | |
| | | Z | 0.00 | 0.00 | 1.00 | | 134.6 | | |

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%.

[A] The uncertainties of Norm X,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Page 5).
[B] Linearization parameter uncertainty for maximum specified field strength.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.





 

## Parameters of Probe: EX3DV4 - SN:7447

### Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle | -139.3° |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |

**Note:** Measurement distance from surface can be increased to 3–4 mm for an *Area Scan* job.



 

## Parameters of Probe: EX3DV4 - SN:7447

### Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz)[C] | Relative Permittivity[F] | Conductivity[F] (S/m) | ConvF X | ConvF Y | ConvF Z | Alpha[G] | Depth[G] (mm) | Unc ($k$ = 2) |
|---|---|---|---|---|---|---|---|---|
| 13 | 55.0 | 0.75 | 17.42 | 17.42 | 17.42 | 0.00 | 1.25 | ±13.3% |
| 750 | 41.9 | 0.89 | 9.91 | 8.74 | 9.52 | 0.31 | 1.27 | ±12.0% |
| 900 | 41.5 | 0.97 | 9.37 | 8.45 | 8.89 | 0.32 | 1.27 | ±12.0% |
| 1750 | 40.1 | 1.37 | 8.45 | 7.97 | 8.40 | 0.25 | 1.27 | ±12.0% |
| 1950 | 40.0 | 1.40 | 8.05 | 7.59 | 7.97 | 0.29 | 1.27 | ±12.0% |
| 2150 | 39.7 | 1.53 | 8.01 | 7.58 | 7.90 | 0.28 | 1.27 | ±12.0% |
| 2300 | 39.5 | 1.67 | 7.85 | 7.46 | 7.80 | 0.28 | 1.27 | ±12.0% |
| 2450 | 39.2 | 1.80 | 7.70 | 7.50 | 7.63 | 0.28 | 1.27 | ±12.0% |
| 2600 | 39.0 | 1.96 | 7.55 | 7.37 | 7.73 | 0.28 | 1.27 | ±12.0% |
| 3300 | 38.2 | 2.71 | 7.02 | 6.71 | 7.02 | 0.34 | 1.27 | ±14.0% |
| 5250 | 35.9 | 4.71 | 5.18 | 4.99 | 5.17 | 0.39 | 1.53 | ±14.0% |
| 5600 | 35.5 | 5.07 | 4.40 | 4.29 | 4.43 | 0.38 | 1.77 | ±14.0% |
| 5750 | 35.4 | 5.22 | 4.47 | 4.33 | 4.53 | 0.38 | 1.85 | ±14.0% |

[C] Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

[F] The probes are calibrated using tissue simulating liquids (TSL) that deviate for $\varepsilon$ and $\sigma$ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10%. If TSL with deviations from the target of less than ±5% are used, the calibration uncertainties are 11.1% for 0.7 - 3 GHz and 13.1% for 3 - 6 GHz.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe tip diameter from the boundary.





 

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**Accreditation No.: SCS 0108**

**Client** Verkotan **Certificate No** EX-3852_Oct22

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3852 |
| Calibration procedure(s) | QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7<br>Calibration procedure for dosimetric E-field probes |
| Calibration date | October 27, 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 |
| 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) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| DAE4 | SN: 660 | 10-Oct-22 (No. DAE4-660_Oct22) | Oct-23 |
| Reference Probe ES3DV2 | SN: 3013 | 27-Dec-21 (No. ES3-3013_Dec21) | Dec-22 |

| 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 | |
| Approved by | Sven Kühn | Technical Manager | |

Issued: October 27, 2022





## Parameters of Probe: EX3DV4 - SN:3852

### Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc ($k = 2$) |
|---|---|---|---|---|
| Norm ($\mu$V/(V/m)$^2$) [A] | 0.41 | 0.39 | 0.46 | ±10.1% |
| DCP (mV) [B] | 99.8 | 98.2 | 99.9 | ±4.7% |

### Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B dB$\sqrt{\mu V}$ | C | D dB | VR mV | Max dev. | Max Unc[E] $k = 2$ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.00 | 0.00 | 1.00 | 0.00 | 147.5 | ±2.5% | ±4.7% |
| | | Y | 0.00 | 0.00 | 1.00 | | 138.0 | | |
| | | Z | 0.00 | 0.00 | 1.00 | | 137.1 | | |

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%.

[A] The uncertainties of Norm X,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Page 5).
[B] Linearization parameter uncertainty for maximum specified field strength.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



## Parameters of Probe: EX3DV4 - SN:3852

### Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle | 126.7° |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 1.4 mm |

**Note:** Measurement distance from surface can be increased to 3–4 mm for an *Area Scan* job.



## Parameters of Probe: EX3DV4 - SN:3852

### Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz)[C] | Relative Permittivity[F] | Conductivity[F] (S/m) | ConvF X | ConvF Y | ConvF Z | Alpha[G] | Depth[G] (mm) | Unc ($k = 2$) |
|---|---|---|---|---|---|---|---|---|
| 6 | 55.0 | 0.75 | 15.18 | 15.18 | 15.18 | 0.00 | 1.00 | ±13.3% |
| 30 | 55.0 | 0.75 | 13.34 | 13.34 | 13.34 | 0.00 | 1.00 | ±13.3% |
| 64 | 54.2 | 0.75 | 11.88 | 11.88 | 11.88 | 0.00 | 1.00 | ±13.3% |
| 128 | 52.8 | 0.76 | 11.57 | 11.57 | 11.57 | 0.00 | 1.00 | ±13.3% |
| 220 | 49.0 | 0.81 | 10.92 | 10.92 | 10.92 | 0.00 | 1.00 | ±13.3% |
| 450 | 43.5 | 0.87 | 10.20 | 10.20 | 10.20 | 0.16 | 1.30 | ±13.3% |
| 900 | 41.5 | 0.97 | 8.82 | 8.82 | 8.82 | 0.44 | 0.94 | ±12.0% |
| 1300 | 40.8 | 1.14 | 8.54 | 8.54 | 8.54 | 0.27 | 1.22 | ±12.0% |
| 1450 | 40.5 | 1.20 | 8.63 | 8.63 | 8.63 | 0.39 | 0.80 | ±12.0% |
| 1640 | 40.2 | 1.31 | 8.33 | 8.33 | 8.33 | 0.34 | 0.90 | ±12.0% |
| 1810 | 40.0 | 1.40 | 7.90 | 7.90 | 7.90 | 0.38 | 0.90 | ±12.0% |
| 1900 | 40.0 | 1.40 | 7.72 | 7.72 | 7.72 | 0.36 | 0.90 | ±12.0% |
| 2450 | 39.2 | 1.80 | 7.48 | 7.48 | 7.48 | 0.41 | 0.90 | ±12.0% |
| 3300 | 38.2 | 2.71 | 6.85 | 6.85 | 6.85 | 0.30 | 1.30 | ±13.1% |
| 3500 | 37.9 | 2.91 | 6.83 | 6.83 | 6.83 | 0.30 | 1.35 | ±13.1% |
| 3700 | 37.7 | 3.12 | 6.65 | 6.65 | 6.65 | 0.30 | 1.35 | ±13.1% |
| 3900 | 37.5 | 3.32 | 6.38 | 6.38 | 6.38 | 0.40 | 1.60 | ±13.1% |
| 4100 | 37.2 | 3.53 | 6.19 | 6.19 | 6.19 | 0.40 | 1.60 | ±13.1% |
| 5250 | 35.9 | 4.71 | 4.90 | 4.90 | 4.90 | 0.40 | 1.80 | ±13.1% |
| 5600 | 35.5 | 5.07 | 4.61 | 4.61 | 4.61 | 0.40 | 1.80 | ±13.1% |
| 5750 | 35.4 | 5.22 | 4.65 | 4.65 | 4.65 | 0.40 | 1.80 | ±13.1% |

[C] Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

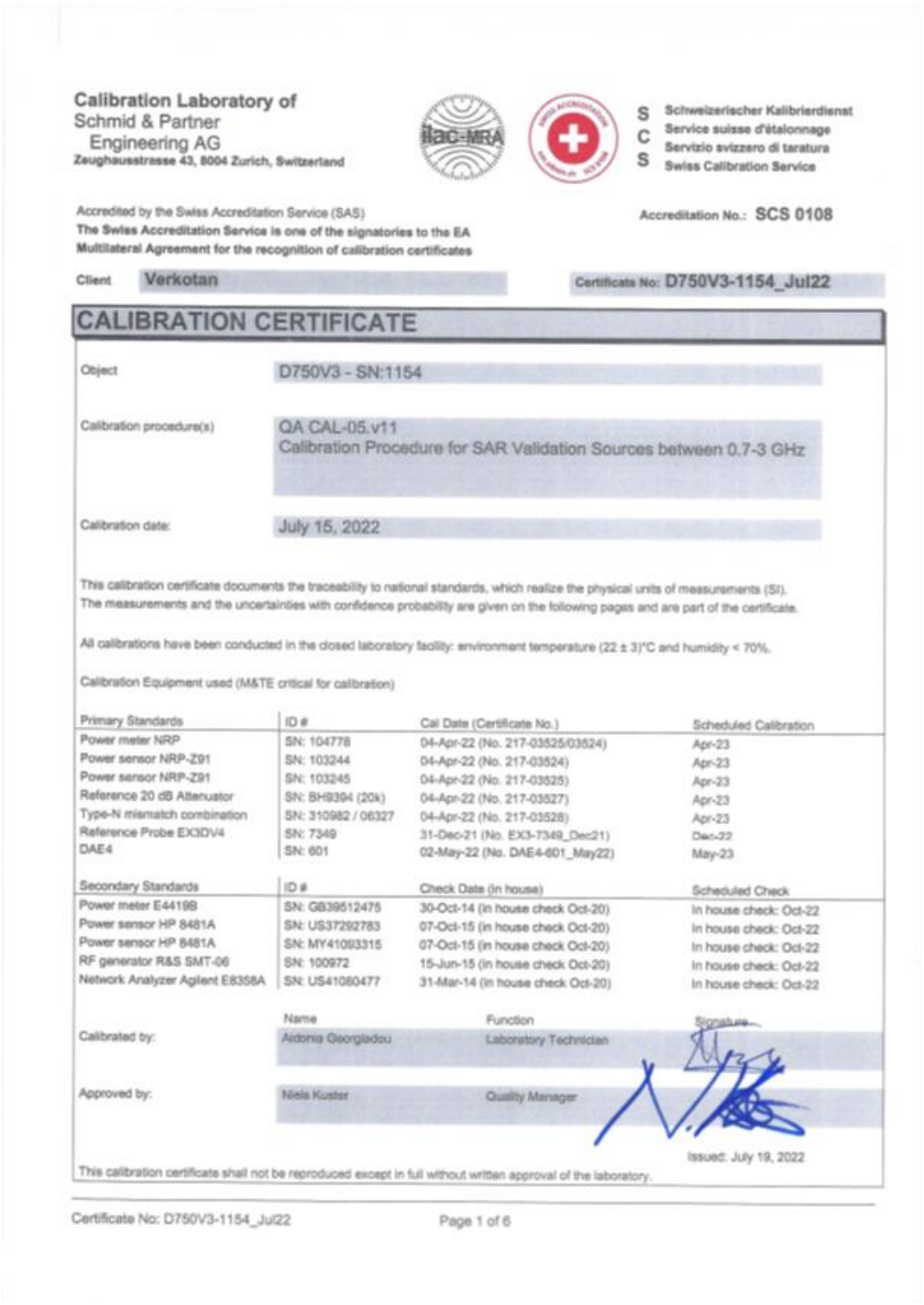
[F] At frequencies below 3 GHz, the validity of tissue parameters ($\varepsilon$ and $\sigma$) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ($\varepsilon$ and $\sigma$) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe tip diameter from the boundary.



## APPENDIX E: RELEVANT PAGES FROM DIPOLE CALIBRATION REPORTS



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Accreditation No.: SCS 0108

Client: Verkotan

Certificate No: D750V3-1154_Jul22

# CALIBRATION CERTIFICATE

Object: D750V3 - SN:1154

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: July 15, 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 | 02-May-22 (No. DAE4-601_May22) | May-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: | Aidonia Georgiadou | Laboratory Technician | |
| Approved by: | Niels Kuster | Quality Manager | |

Issued: July 19, 2022

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

Certificate No: D750V3-1154_Jul22 Page 1 of 6



 

## 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** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 750 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.9 | 0.89 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.5 ± 6 % | 0.90 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | --- | --- |

## SAR result with Head TSL

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.17 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **8.54 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **5.57 W/kg ± 16.5 % (k=2)** |



 

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Accreditation No.: **SCS 0108**

Client **Verkotan** Certificate No: **D835V2-455_Jul22**

# CALIBRATION CERTIFICATE

Object: D835V2 - SN:455

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: July 15, 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 | 02-May-22 (No. DAE4-601_May22) | May-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: | Aidonia Georgiadou | Laboratory Technician | |
| Approved by: | Niels Kuster | Quality Manager | |

Issued: July 19, 2022





## 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** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 835 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.90 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.3 ± 6 % | 0.93 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | --- | --- |

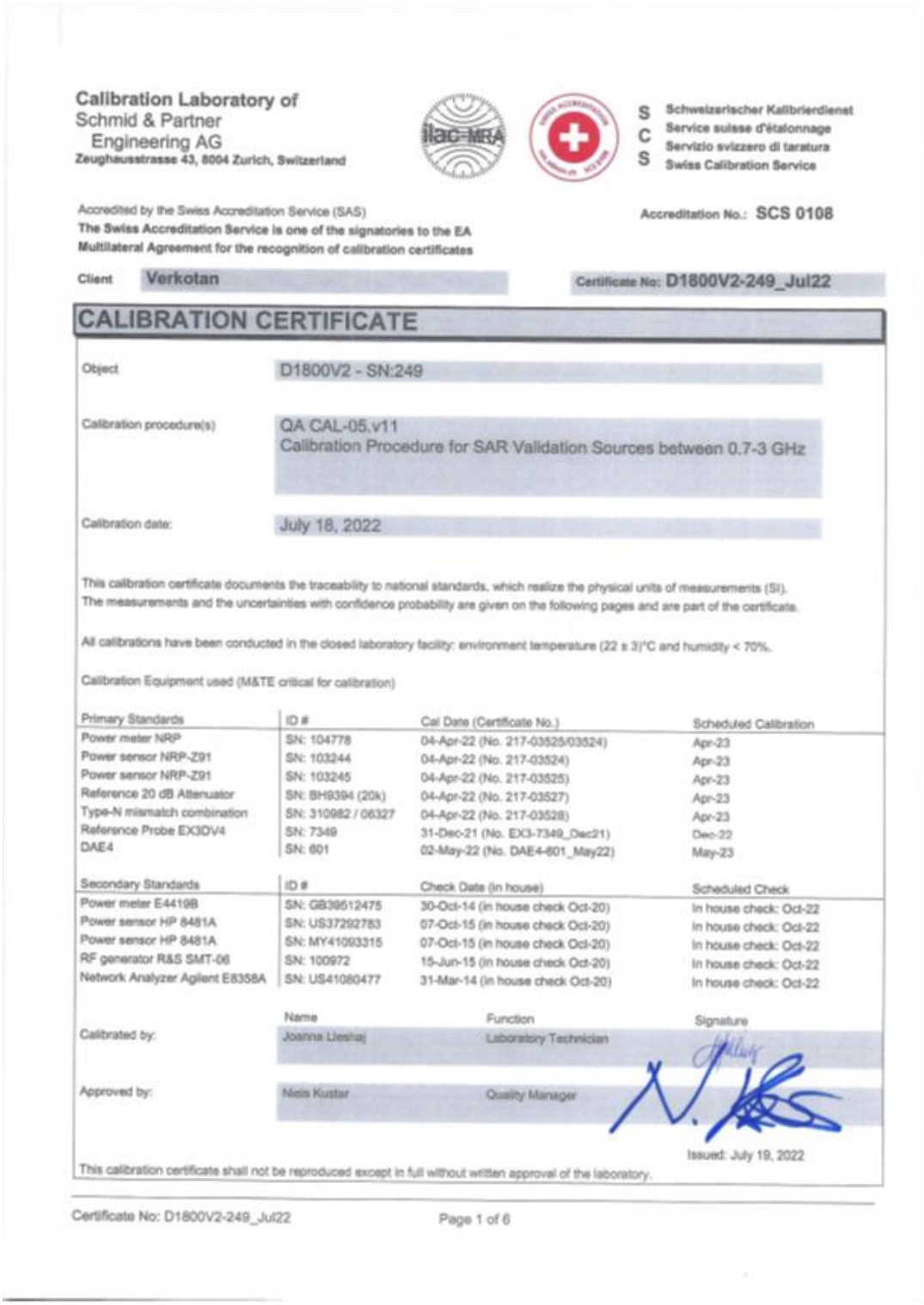
## SAR result with Head TSL

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.50 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.69 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.61 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **6.29 W/kg ± 16.5 % (k=2)** |





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Accreditation No.: SCS 0108

Client: Verkotan

Certificate No: D1800V2-249_Jul22

# CALIBRATION CERTIFICATE

Object: D1800V2 - SN:249

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: July 18, 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 | 02-May-22 (No. DAE4-601_May22) | May-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: | Joanna Lleshaj | Laboratory Technician | |
| Approved by: | Niels Kuster | Quality Manager | |

Issued: July 19, 2022

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

Certificate No: D1800V2-249_Jul22 Page 1 of 6



 

## 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** | 1800 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 | 38.4 ± 6 % | 1.38 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | --- | --- |

## SAR result with Head TSL

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.74 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **38.9 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.07 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **20.3 W/kg ± 16.5 % (k=2)** |



 

mvg

# SAR Reference Dipole Calibration Report

Ref : ACR.84.5.20.MVGB.A

**VERKOTAN LTD.**
**ELEKTRONIIKKATIE 17**
**90590, OULU, FINLAND**
**SAR REFERENCE DIPOLE**
**FREQUENCY: 1900 MHZ**
**SERIAL NO.: SN 511**

**Calibrated at MVG**
**Z.I. de la pointe du diable**
**Technopôle Brest Iroise – 295 avenue Alexis de Rochon**
**29280 PLOUZANE - FRANCE**

**Calibration date: 03/23/2020**

ilac-MRA cofrac ETALONNAGE

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

*Summary:*

This document presents the method and results from an accredited SAR reference dipole calibration performed at MVG, using the COMOSAR test bench. The test results covered by accreditation are traceable to the International System of Units (SI).



 

| | | | | | | |
|---|---|---|---|---|---|---|
| 3000 | 41.5 ±1 %. | | 25.0 ±1 %. | | 3.6 ±1 %. | |
| 3500 | 37.0±1 %. | | 26.4 ±1 %. | | 3.6 ±1 %. | |
| 3700 | 34.7±1 %. | | 26.4 ±1 %. | | 3.6 ±1 %. | |

## 7 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

### 7.1 MEASUREMENT CONDITION

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | SN 41/18 EPGO333 |
| Liquid | Head Liquid Values: eps' : 38.5 sigma : 1.45 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=8mm/dy=8mm/dz=5mm |
| Frequency | 1900 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-80 % |

### 7.2 HEAD LIQUID MEASUREMENT

| Frequency MHz | Relative permittivity (ε') | | Conductivity (σ) S/m | |
|---|---|---|---|---|
| | required | measured | required | measured |
| 300 | 45.3 ±10 % | | 0.87 ±10 % | |
| 450 | 43.5 ±10 % | | 0.87 ±10 % | |
| 750 | 41.9 ±10 % | | 0.89 ±10 % | |
| 835 | 41.5 ±10 % | | 0.90 ±10 % | |
| 900 | 41.5 ±10 % | | 0.97 ±10 % | |
| 1450 | 40.5 ±10 % | | 1.20 ±10 % | |
| 1500 | 40.4 ±10 % | | 1.23 ±10 % | |
| 1640 | 40.2 ±10 % | | 1.31 ±10 % | |
| 1750 | 40.1 ±10 % | | 1.37 ±10 % | |
| 1800 | 40.0 ±10 % | | 1.40 ±10 % | |
| 1900 | 40.0 ±10 % | 38.5 | 1.40 ±10 % | 1.45 |
| 1950 | 40.0 ±10 % | | 1.40 ±10 % | |
| 2000 | 40.0 ±10 % | | 1.40 ±10 % | |
| 2100 | 39.8 ±10 % | | 1.49 ±10 % | |







 

| | | | | |
|---|---|---|---|---|
| 2300 | 39.5 ±10 % | | 1.67 ±10 % | |
| 2450 | 39.2 ±10 % | | 1.80 ±10 % | |
| 2600 | 39.0 ±10 % | | 1.96 ±10 % | |
| 3000 | 38.5 ±10 % | | 2.40 ±10 % | |
| 3500 | 37.9 ±10 % | | 2.91 ±10 % | |

## 7.3 MEASUREMENT RESULT

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

| Frequency MHz | 1 g SAR (W/kg/W) | | 10 g SAR (W/kg/W) | |
|---|---|---|---|---|
| | required | measured | required | measured |
| 300 | 2.85 | | 1.94 | |
| 450 | 4.58 | | 3.06 | |
| 750 | 8.49 | | 5.55 | |
| 835 | 9.56 | | 6.22 | |
| 900 | 10.9 | | 6.99 | |
| 1450 | 29 | | 16 | |
| 1500 | 30.5 | | 16.8 | |
| 1640 | 34.2 | | 18.4 | |
| 1750 | 36.4 | | 19.3 | |
| 1800 | 38.4 | | 20.1 | |
| 1900 | 39.7 | 37.10 (3.71) | 20.5 | 19.14 (1.91) |
| 1950 | 40.5 | | 20.9 | |
| 2000 | 41.1 | | 21.1 | |
| 2100 | 43.6 | | 21.9 | |
| 2300 | 48.7 | | 23.3 | |
| 2450 | 52.4 | | 24 | |
| 2600 | 55.3 | | 24.6 | |
| 3000 | 63.8 | | 25.7 | |
| 3500 | 67.1 | | 25 | |







 

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

ilac-MRA

S C S Schweizerischer Kalibrierdienst
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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: Verkotan

Certificate No: D2450V2-729_Jul22

# CALIBRATION CERTIFICATE

Object: D2450V2 - SN:729

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: July 15, 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 | 02-May-22 (No. DAE4-601_May22) | May-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: | Aldonia Georgiadou | Laboratory Technician | |
| Approved by: | Niels Kuster | Quality Manager | |

Issued: July 19, 2022

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

Certificate No: D2450V2-729_Jul22 Page 1 of 6



## 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** | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 37.9 ± 6 % | 1.85 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | --- | --- |

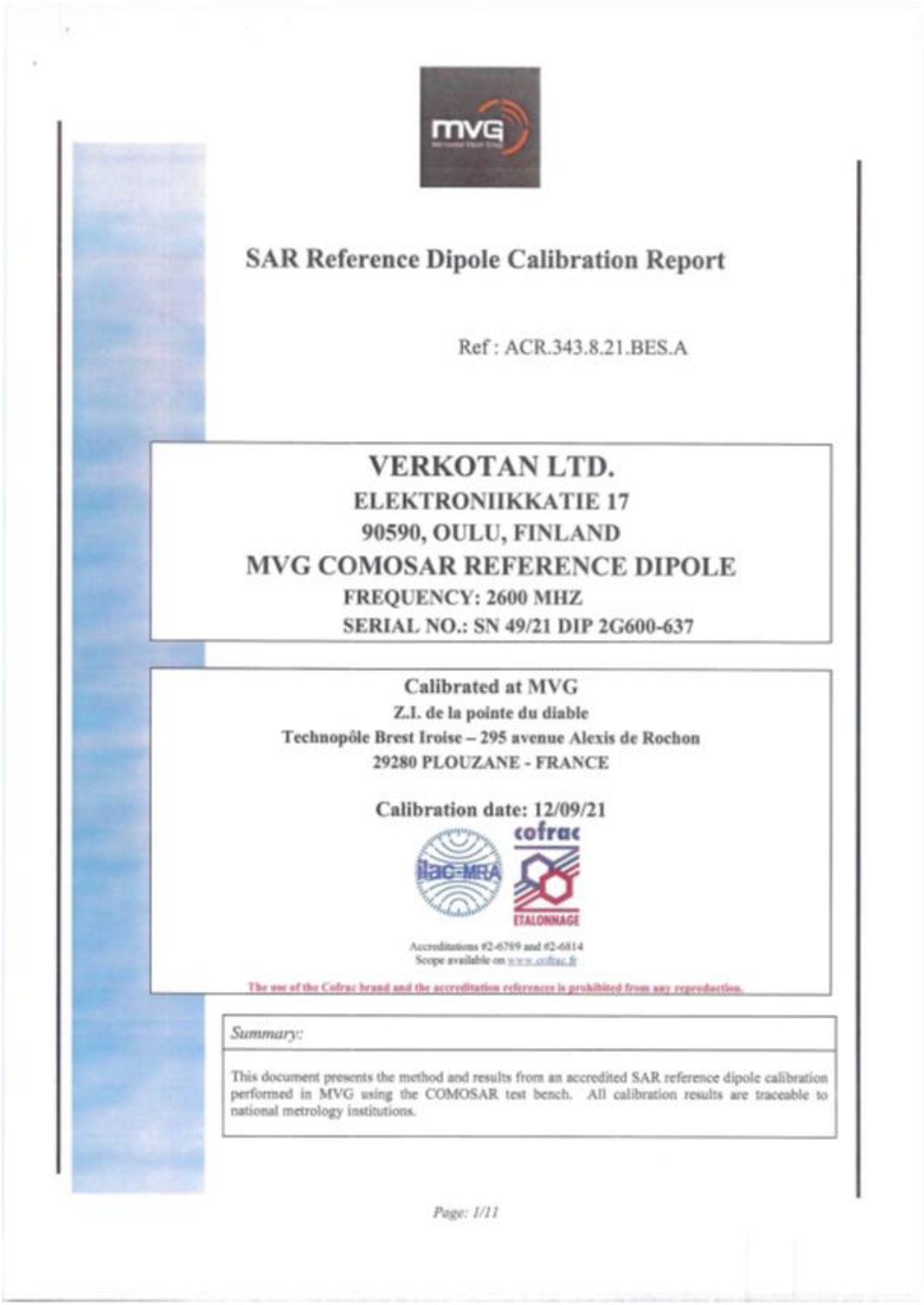
## SAR result with Head TSL

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.4 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **52.3 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.21 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.5 W/kg ± 16.5 % (k=2)** |





SAR Reference Dipole Calibration Report

Ref : ACR.343.8.21.BES.A

**VERKOTAN LTD.**
**ELEKTRONIIKKATIE 17**
**90590, OULU, FINLAND**
**MVG COMOSAR REFERENCE DIPOLE**
**FREQUENCY: 2600 MHZ**
**SERIAL NO.: SN 49/21 DIP 2G600-637**

**Calibrated at MVG**
**Z.I. de la pointe du diable**
**Technopôle Brest Iroise – 295 avenue Alexis de Rochon**
**29280 PLOUZANE - FRANCE**

**Calibration date: 12/09/21**

ilac-MRA cofrac ETALONNAGE

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr

The use of the Cofrac brand and the accreditation references is prohibited from any reproduction.

*Summary:*

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

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7.1 HEAD LIQUID MEASUREMENT

| Frequency MHz | Relative permittivity (ε,') | | Conductivity (σ) S/m | |
|---|---|---|---|---|
| | required | measured | required | measured |
| 300 | 45.3 ±10 % | | 0.87 ±10 % | |
| 450 | 43.5 ±10 % | | 0.87 ±10 % | |
| 750 | 41.9 ±10 % | | 0.89 ±10 % | |
| 835 | 41.5 ±10 % | | 0.90 ±10 % | |
| 900 | 41.5 ±10 % | | 0.97 ±10 % | |
| 1450 | 40.5 ±10 % | | 1.20 ±10 % | |
| 1500 | 40.4 ±10 % | | 1.23 ±10 % | |
| 1640 | 40.2 ±10 % | | 1.31 ±10 % | |
| 1750 | 40.1 ±10 % | | 1.37 ±10 % | |
| 1800 | 40.0 ±10 % | | 1.40 ±10 % | |
| 1900 | 40.0 ±10 % | | 1.40 ±10 % | |
| 1950 | 40.0 ±10 % | | 1.40 ±10 % | |
| 2000 | 40.0 ±10 % | | 1.40 ±10 % | |
| 2100 | 39.8 ±10 % | | 1.49 ±10 % | |
| 2300 | 39.5 ±10 % | | 1.67 ±10 % | |
| 2450 | 39.2 ±10 % | | 1.80 ±10 % | |
| 2600 | 39.0 ±10 % | 35.7 | 1.96 ±10 % | 2.12 |
| 3000 | 38.5 ±10 % | | 2.40 ±10 % | |
| 3300 | 38.2 ±10 % | | 2.71 ±10 % | |
| 3500 | 37.9 ±10 % | | 2.91 ±10 % | |
| 3700 | 37.7 ±10 % | | 3.12 ±10 % | |
| 3900 | 37.5 ±10 % | | 3.32 ±10 % | |
| 4200 | 37.1 ±10 % | | 3.63 ±10 % | |
| 4600 | 36.7 ±10 % | | 4.04 ±10 % | |
| 4900 | 36.3 ±10 % | | 4.35 ±10 % | |

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.







 

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.343.8.21.IBES.A

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | SN 41/18 EPGO333 |
| Liquid | Head Liquid Values: eps' : 35.7 sigma : 2.12 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=5mm/dy=5mm/dz=5mm |
| Frequency | 2600 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency MHz | 1 g SAR (W/kg/W) | | 10 g SAR (W/kg/W) | |
|---|---|---|---|---|
| | required | measured | required | measured |
| 300 | 2.85 | | 1.94 | |
| 450 | 4.58 | | 3.06 | |
| 750 | 8.49 | | 5.55 | |
| 835 | 9.56 | | 6.22 | |
| 900 | 10.9 | | 6.99 | |
| 1450 | 29 | | 16 | |
| 1500 | 30.5 | | 16.8 | |
| 1640 | 34.2 | | 18.4 | |
| 1750 | 36.4 | | 19.3 | |
| 1800 | 38.4 | | 20.1 | |
| 1900 | 39.7 | | 20.5 | |
| 1950 | 40.5 | | 20.9 | |
| 2000 | 41.1 | | 21.1 | |
| 2100 | 43.6 | | 21.9 | |
| 2300 | 48.7 | | 23.3 | |
| 2450 | 52.4 | | 24 | |
| 2600 | 55.3 | 56.47 (5.65) | 24.6 | 24.22 (2.42) |
| 3000 | 63.8 | | 25.7 | |
| 3300 | - | | - | |
| 3500 | 67.1 | | 25 | |
| 3700 | 67.4 | | 24.2 | |
| 3900 | - | | - | |
| 4200 | - | | - | |
| 4600 | - | | - | |
| 4900 | - | | - | |







 

# SAR Reference Dipole Calibration Report

Ref : ACR.68.8.23.BES.A

**VERKOTAN OY**
**ELEKTRONIIKKATIE 17**
**90590, OULU, FINLAND**
**SAR REFERENCE DIPOLE**
**FREQUENCY: 5200-5800 MHZ**
**SERIAL NO.: 1045**

**Calibrated at MVG**
**Z.I. de la pointe du diable**
**Technopôle Brest Iroise – 295 avenue Alexis de Rochon**
**29280 PLOUZANE - FRANCE**

**Calibration date: 03/09/2023**

Accreditations #2-6789 and #2-6814
Scope available on www.cofrac.fr



*Summary:*

This document presents the method and results from an accredited SAR reference dipole calibration performed in MVG using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

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mvg

**SAR REFERENCE DIPOLE CALIBRATION REPORT** Ref: ACR.60.8.23.BES.A

| | Name | Function | Date | Signature |
|---|---|---|---|---|
| *Prepared by :* | Cyrille ONNEE | Measurement Responsible | 3/9/2023 | |
| *Checked & approved by:* | Jérôme Luc | Technical Manager | 3/9/2023 | |
| *Authorized by:* | Yann Toutain | Laboratory Director | 3/9/2023 | |

Yann Toutain ID
Signature numérique de Yann Toutain ID
Date : 2023.03.09 15:05:03 +01'00'

| | Customer Name |
|---|---|
| *Distribution :* | Verkotan Oy |

| Issue | Name | Date | Modifications |
|---|---|---|---|
| A | Cyrille ONNEE | 3/9/2023 | Initial release |
| | | | |
| | | | |
| | | | |

*Page: 2/9*





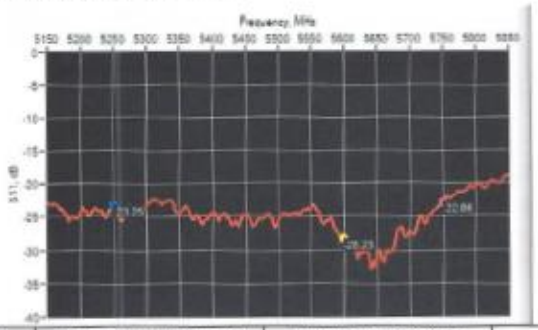
## 6 CALIBRATION RESULTS

### 6.1 MECHANICAL DIMENSIONS

| L mm | | h mm | | d mm | |
|---|---|---|---|---|---|
| Measured | Required | Measured | Required | Measured | Required |
| - | 20.60 +/- 2% | - | 40.30 +/- 2% | - | 3.60 +/- 2% |

### 6.2 S11 PARAMETER

#### 6.2.1 S11 parameter in Head Liquid



| Frequency (MHz) | S11 parameter (dB) | Requirement (dB) | Impedance |
|---|---|---|---|
| 5250 | -23.25 | -20 | 47.8Ω + 6.4jΩ |
| 5600 | -28.23 | -20 | 48.5Ω - 3.5jΩ |
| 5750 | -22.86 | -20 | 46.7Ω + 6.1jΩ |

### 6.3 SAR

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

#### 6.3.1 SAR with Head Liquid

The IEC/IEEE 62209-1528 and FCC KDB865664 D01 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.







SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.68.8.23.BES.A

| | |
|---|---|
| Software | OPENSAR V5 |
| Phantom | SN 13/09 SAM68 |
| Probe | SN 41/18 EPGO333 |
| Liquid | Head Liquid Values @ 5250 MHz: eps' : 34.3 sigma : 4.67<br>Head Liquid Values @ 5600 MHz: eps' : 33.6 sigma : 5.05<br>Head Liquid Values @ 5750 MHz: eps' : 32.9 sigma : 5.46 |
| Distance between dipole center and liquid | 10.0 mm |
| Area scan resolution | dx=8mm/dy=8mm |
| Zoon Scan Resolution | dx=4mm/dy=4mm/dz=2mm |
| Frequency | 5250 MHz<br>5600 MHz<br>5750 MHz |
| Input power | 20 dBm |
| Liquid Temperature | 20 +/- 1 °C |
| Lab Temperature | 20 +/- 1 °C |
| Lab Humidity | 30-70 % |

| Frequency | 1g SAR (W/kg) | | | 10g SAR (W/kg) | | |
|---|---|---|---|---|---|---|
| | Measured | Measured normalized to 1W | Target normalized to 1W | Measured | Measured normalized to 1W | Target normalized to 1W |
| 5250 MHz | 7.31 | 73.09 | - | 2.11 | 21.12 | - |
| 5600 MHz | 7.29 | 72.92 | 78.30 | 2.13 | 21.29 | 23.20 |
| 5750 MHz | 6.91 | 69.05 | - | 2.03 | 20.27 | - |

SAR MEASUREMENT PLOTS @ 5250 MHz