

**Appendix (Additional assessments outside the scope of SCS 0108)****Antenna Parameters with Head TSL**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $54.1 \Omega + 3.9 j\Omega$ |
| Return Loss                          | - 25,2 dB                   |

**Antenna Parameters with Body TSL**

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $48.5 \Omega + 6.0 j\Omega$ |
| Return Loss                          | - 24.1 dB                   |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.161 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | November 10, 2009 |

## DASY5 Validation Report for Head TSL

Date: 24.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:853**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

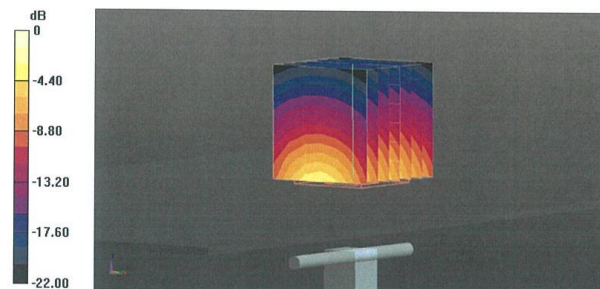
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 115.3 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 26.1 W/kg

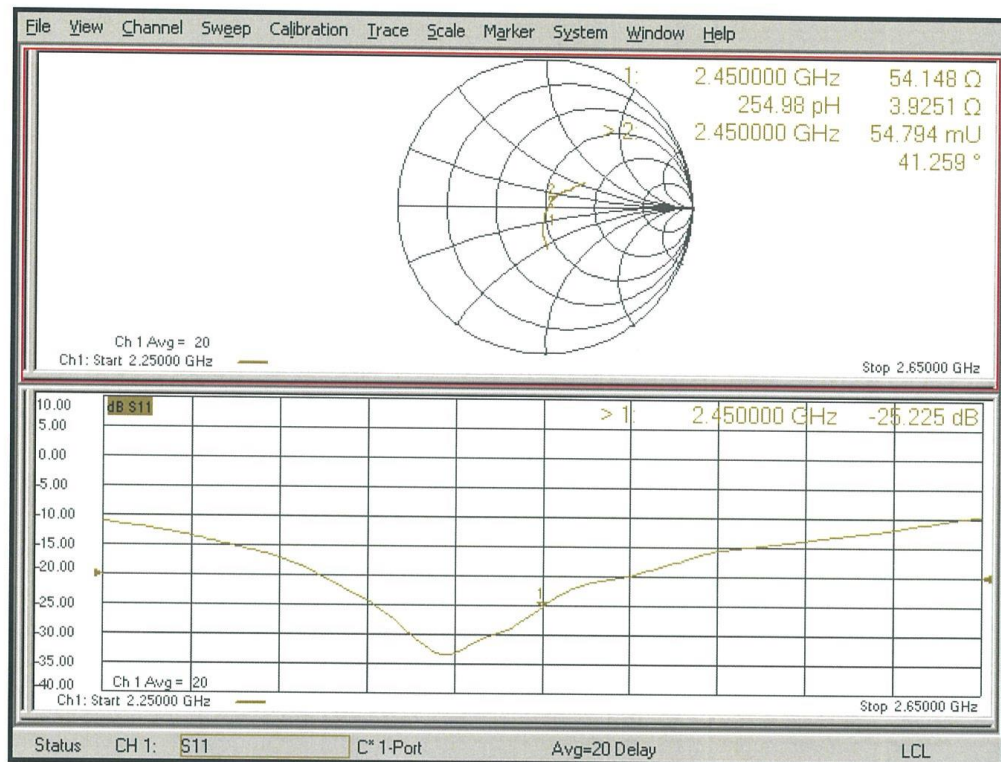
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg**

Maximum value of SAR (measured) = 21.6 W/kg



0 dB = 21.6 W/kg = 13.34 dBW/kg

### Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 16.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:853**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.01, 8.01, 8.01) @ 2450 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

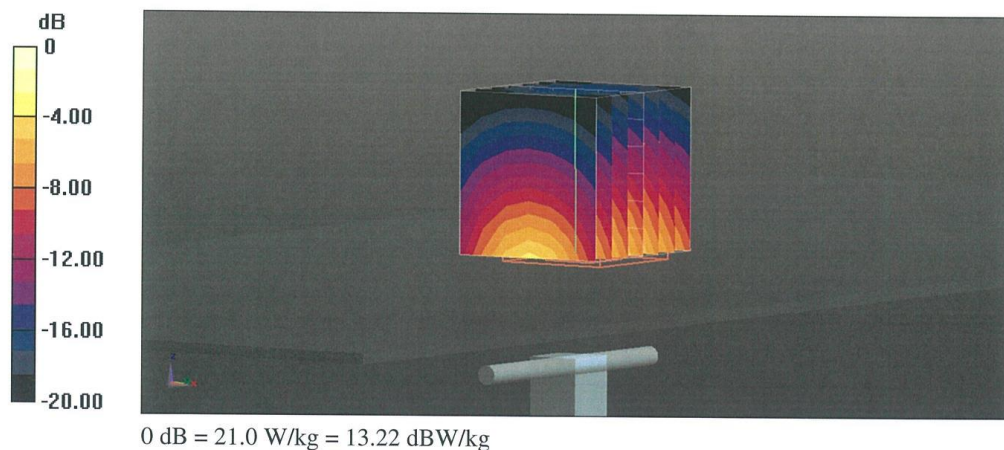
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.0 V/m; Power Drift = -0.03 dB

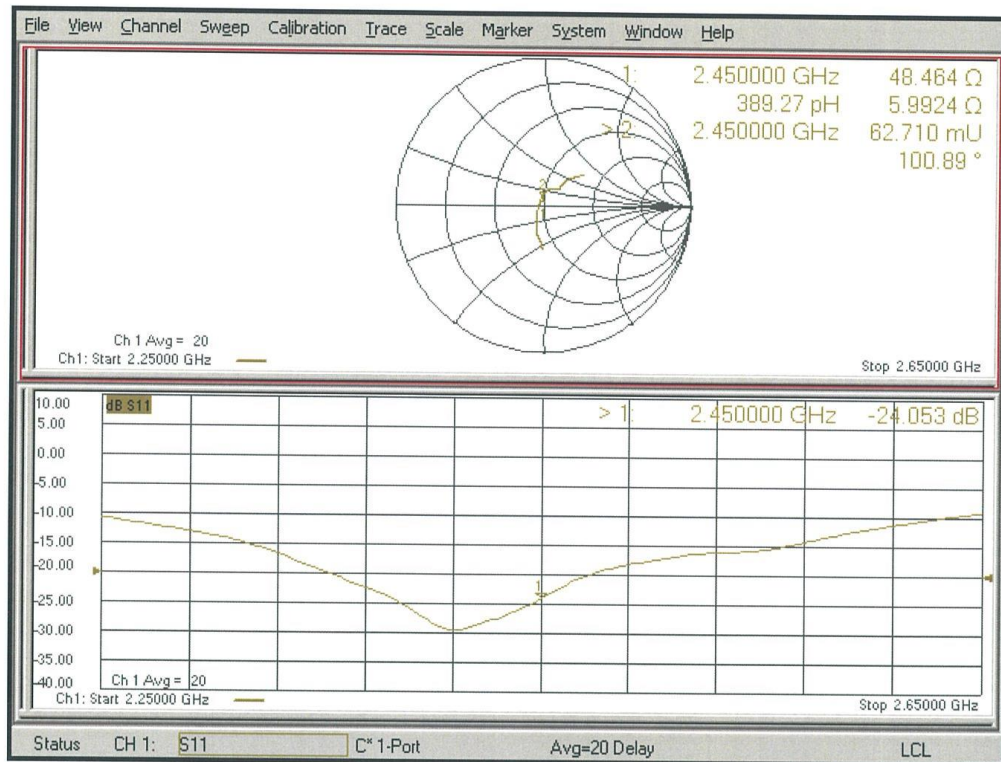
Peak SAR (extrapolated) = 25.6 W/kg

**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.1 W/kg**

Maximum value of SAR (measured) = 21.0 W/kg



### Impedance Measurement Plot for Body TSL





## 2600 MHz Dipole Calibration Certificate

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**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 **CTTL (Auden)**

Certificate No: **D2600V2-1012\_Jul18**

### CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1012**

Calibration procedure(s) **QA CAL-05.v10**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **July 26, 2018**

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 ( $22 \pm 3$ )°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-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103244         | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91            | SN: 103245         | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator      | SN: 5058 (20k)     | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| Type-N mismatch combination     | SN: 5047.2 / 06327 | 04-Apr-18 (No. 217-02683)         | Apr-19                 |
| Reference Probe EX3DV4          | SN: 7349           | 30-Dec-17 (No. EX3-7349_Dec17)    | Dec-18                 |
| DAE4                            | SN: 601            | 26-Oct-17 (No. DAE4-601_Oct17)    | Oct-18                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter EPM-442A            | SN: GB37480704     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-16) | In house check: Oct-18 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-16) | In house check: Oct-18 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-17) | In house check: Oct-18 |

|                |               |                       |                                                                                       |
|----------------|---------------|-----------------------|---------------------------------------------------------------------------------------|
|                | Name          | Function              | Signature                                                                             |
| Calibrated by: | Michael Weber | Laboratory Technician |  |
| Approved by:   | Katja Pokovic | Technical Manager     |  |

Issued: July 26, 2018

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

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



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

**Glossary:**

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

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

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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

### Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.10.1    |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2600 MHz $\pm$ 1 MHz   |             |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.0           | 1.96 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 37.2 $\pm$ 6 % | 2.02 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Head TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 14.2 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 55.4 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.33 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.9 W/kg $\pm$ 16.5 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.5           | 2.16 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.5 $\pm$ 6 % | 2.20 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Body TSL

|                                                       |                    |                              |
|-------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured                                          | 250 mW input power | 13.7 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 54.1 W/kg $\pm$ 17.0 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured                                            | 250 mW input power | 6.17 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.5 W/kg $\pm$ 16.5 % (k=2) |



**Appendix (Additional assessments outside the scope of SCS 0108)****Antenna Parameters with Head TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.4 $\Omega$ - 7.4 j $\Omega$ |
| Return Loss                          | - 21.9 dB                      |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 44.1 $\Omega$ - 4.9 j $\Omega$ |
| Return Loss                          | - 21.8 dB                      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.154 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

**Additional EUT Data**

|                 |                  |
|-----------------|------------------|
| Manufactured by | SPEAG            |
| Manufactured on | October 30, 2007 |

## DASY5 Validation Report for Head TSL

Date: 26.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1012**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 37.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.7, 7.7, 7.7) @ 2600 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

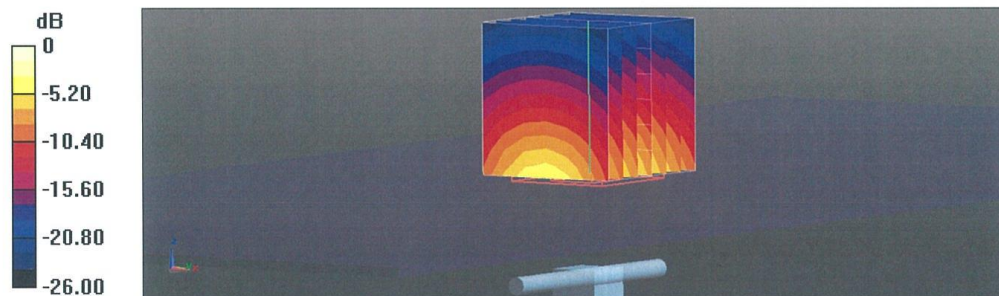
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 118.3 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.3 W/kg

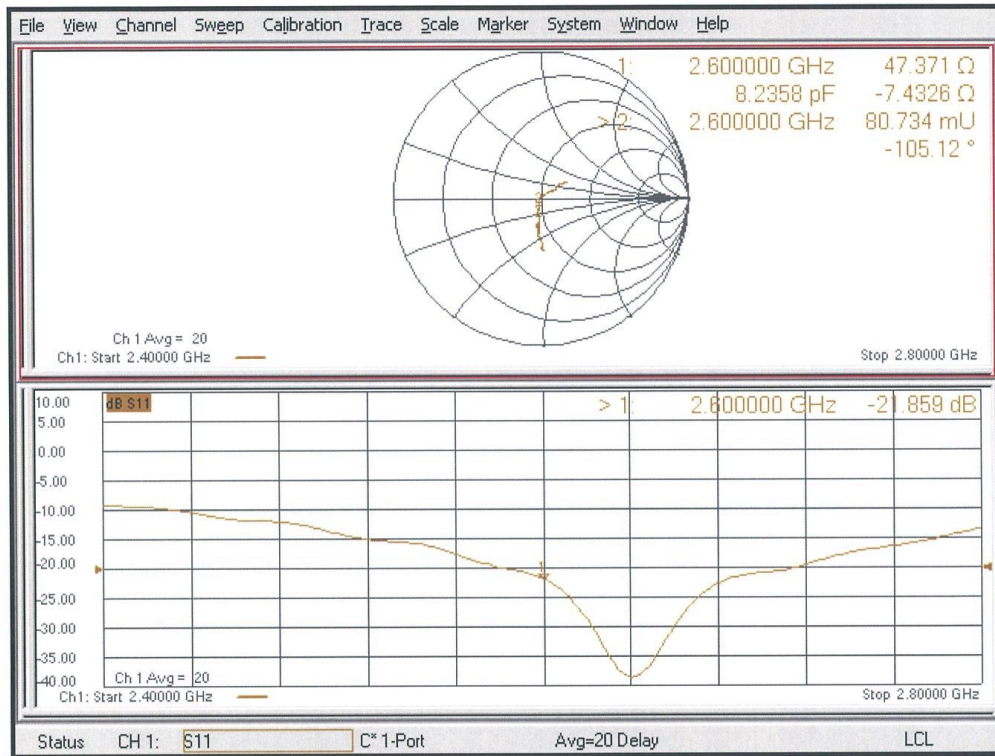
**SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.33 W/kg**

Maximum value of SAR (measured) = 23.7 W/kg



0 dB = 23.7 W/kg = 13.75 dBW/kg

### Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 26.07.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1012**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.2$  S/m;  $\epsilon_r = 51.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.81, 7.81, 7.81) @ 2600 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

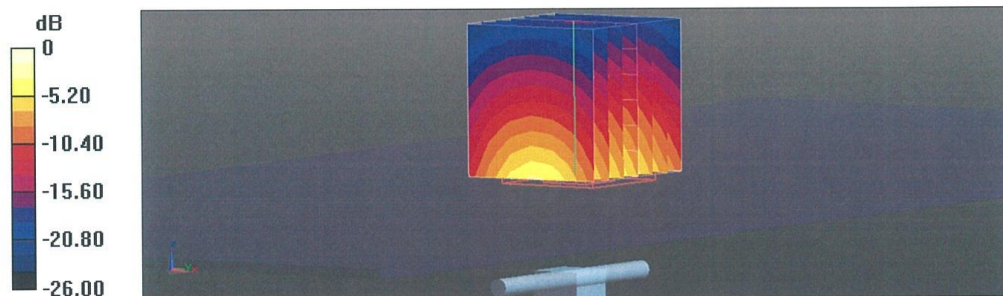
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 27.7 W/kg

**SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.17 W/kg**

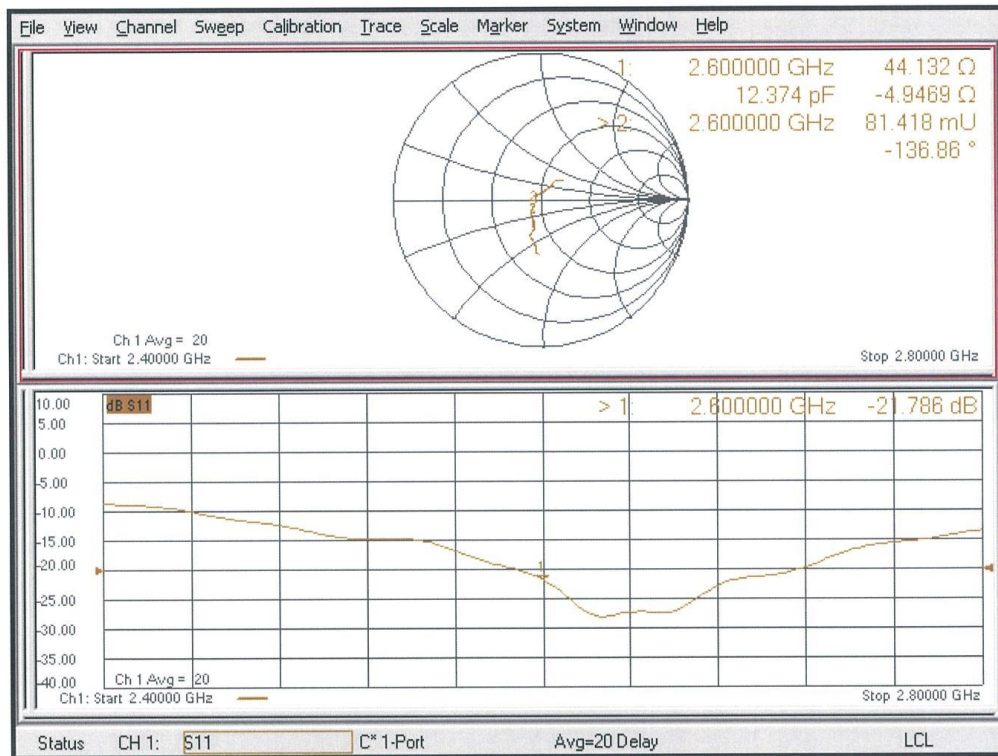
Maximum value of SAR (measured) = 22.6 W/kg



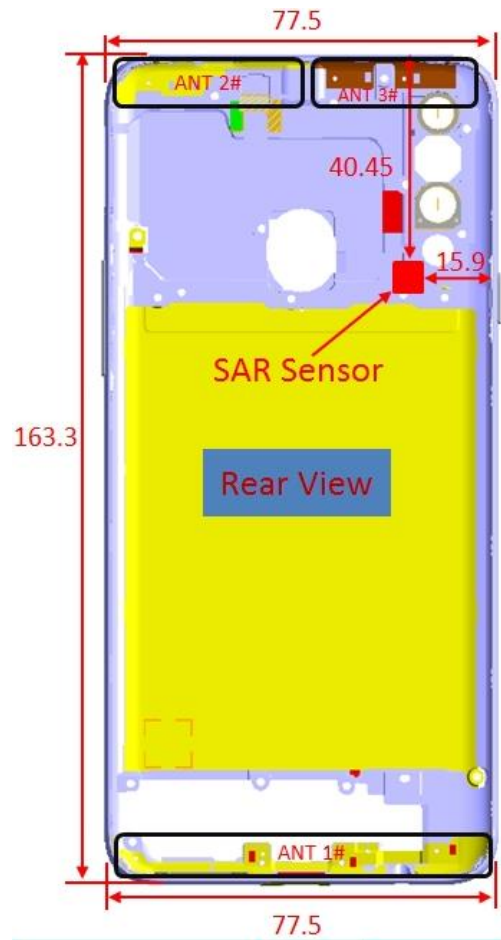
0 dB = 22.6 W/kg = 13.54 dBW/kg



### Impedance Measurement Plot for Body TSL



## ANNEX I Sensor Triggering Data Summary



| Antenna            | Trigger Position | Trigger Distance (mm) |
|--------------------|------------------|-----------------------|
| 1#<br>Main Antenna | Rear             | 16                    |
|                    | Bottom           | 16                    |
|                    | Front            | 11                    |

Note: According to customer requirements, Front edge is tested with normal power of 10mm.

According to the above description, this device was tested by the manufacturer to determine the SAR sensor triggering distances for the rear and bottom edge of the device. The measured power state within  $\pm 5\text{mm}$  of the triggering points (or until touching the phantom) is included for rear and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1mm less than the smallest distance from the device and SAR phantom with the device at maximum output power without power reduction.

We tested the power and got the different proximity sensor triggering distances for rear and bottom edge. But the manufacturer has declared 16mm is the most conservative triggering distance for main antenna. So base on the most conservative triggering distance of 16mm, additional SAR measurements were required at 15mm from the highest SAR position between rear and bottom edge of main antenna.

#### Rear

Moving device toward the phantom:

| The power state |        |        |        |        |        |     |     |     |     |     |     |
|-----------------|--------|--------|--------|--------|--------|-----|-----|-----|-----|-----|-----|
| Distance [mm]   | 21     | 20     | 19     | 18     | 17     | 16  | 15  | 14  | 13  | 12  | 11  |
| Main antenna    | Normal | Normal | Normal | Normal | Normal | Low | Low | Low | Low | Low | Low |

Moving device away from the phantom:

| The power state |     |     |     |     |     |     |        |        |        |        |        |
|-----------------|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|--------|
| Distance [mm]   | 11  | 12  | 13  | 14  | 15  | 16  | 17     | 18     | 19     | 20     | 21     |
| Main antenna    | Low | Low | Low | Low | Low | Low | Normal | Normal | Normal | Normal | Normal |

#### Bottom Edge

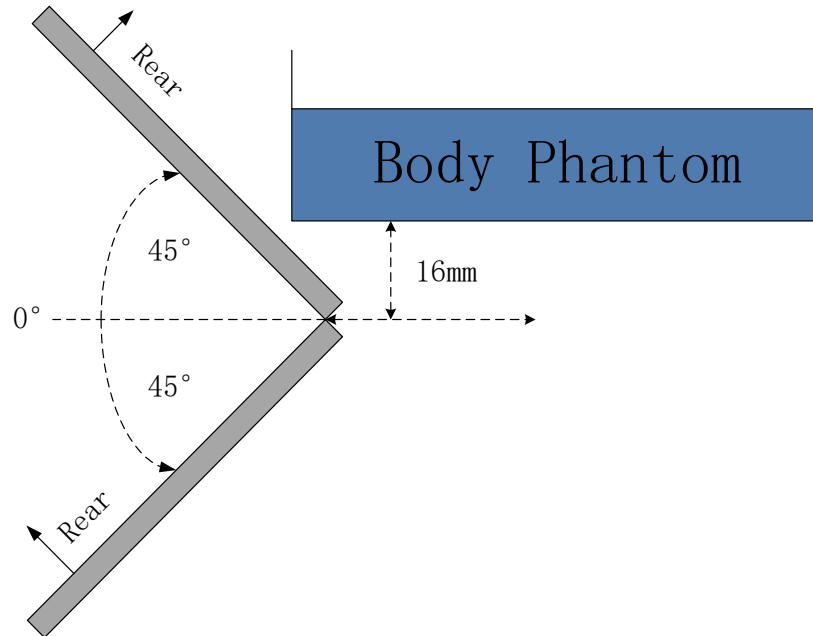
Moving device toward the phantom:

| The power state |     |     |     |     |     |     |     |     |     |     |     |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Distance [mm]   | 21  | 20  | 19  | 18  | 17  | 16  | 15  | 14  | 13  | 12  | 11  |
| Main antenna    | Low | Low | Low | Low | Low | Low | Low | Low | Low | Low | Low |

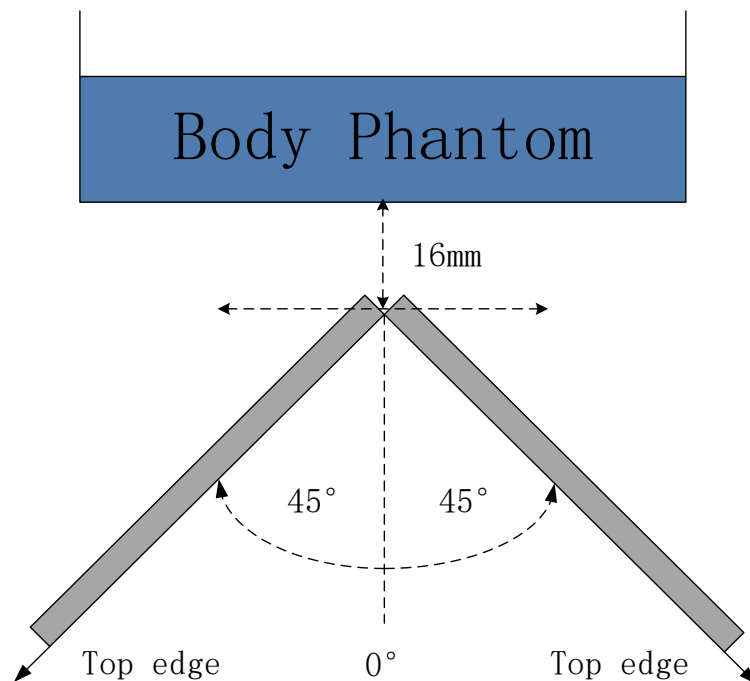
Moving device away from the phantom:

| The power state |     |     |     |     |     |     |     |     |     |     |     |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Distance [mm]   | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  |
| Main antenna    | Low | Low | Low | Low | Low | Low | Low | Low | Low | Low | Low |

The influence of table tilt angles to proximity sensor triggering is determined by positioning each edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance by rotating the device around the edge next to the phantom in  $\leq 10^\circ$  increments until the tablet is  $\pm 45^\circ$  or more from the vertical position at  $0^\circ$ .



**The rear evaluation for main antenna**



**The bottom edge evaluation for main antenna**

Based on the above evaluation, we come to the conclusion that the sensor triggering is not released and normal maximum output power is not restored within the  $\pm 45^\circ$  range at the smallest sensor triggering test distance declared by manufacturer.



## ANNEX J Extended Calibration SAR Dipole

Referring to KDB865664 D01, if dipoles are verified in return loss ( <-20dBm, within 20% of prior calibration), and in impedance ( within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

### Justification of Extended Calibration SAR Dipole D835V2– serial no.4d069

| Head                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-23           | -33.0            |           | 50.8                 |             | -2.1                       |              |
| 2019-7-21           | -30.3            | 8.1       | 53.0                 | 2.2         | -1.0                       | 1.1          |

| Body                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-23           | -23.4            |           | 46.1                 |             | -5.2                       |              |
| 2019-7-21           | -25.5            | 9.0       | 48.5                 | 2.4         | -5.0                       | 0.2          |

### Justification of Extended Calibration SAR Dipole D1900V2– serial no.5d101

| Head                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-24           | -25.6            |           | 50.7                 |             | 5.3                        |              |
| 2019-7-22           | -22.9            | 10.5      | 50.6                 | -0.1        | 7.2                        | 1.9          |

| Body                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2017-7-26           | -21.2            |           | 44.9                 |             | 6.5                        |              |
| 2018-7-24           | -21.4            | 0.9       | 46.4                 | 1.5         | 7.4                        | 0.9          |

## Justification of Extended Calibration SAR Dipole D2450V2– serial no.853

| Head                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-24           | -25.2            |           | 54.1                 |             | 3.9                        |              |
| 2019-7-22           | -23.1            | 9.5       | 53.6                 | -0.5        | 6.3                        | 2.4          |

| Body                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-24           | -24.1            |           | 48.5                 |             | 6.0                        |              |
| 2019-7-22           | -22.0            | 8.7       | 50.4                 | 1.9         | 8.0                        | 2            |

## Justification of Extended Calibration SAR Dipole D2600V2– serial no.1012

| Head                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-26           | -21.9            |           | 47.4                 |             | -7.4                       |              |
| 2019-7-24           | -23.7            | 8.2       | 47.7                 | 0.3         | -5.9                       | 1.5          |

| Body                |                  |           |                      |             |                            |              |
|---------------------|------------------|-----------|----------------------|-------------|----------------------------|--------------|
| Date of Measurement | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (johm) | Delta (johm) |
| 2018-7-26           | -21.8            |           | 44.1                 |             | -4.9                       |              |
| 2019-7-24           | -22.4            | 2.7       | 44.4                 | 0.3         | -4.5                       | 0.4          |

## ANNEX K SPOT CHECK

### K.1 Dielectric Performance and System Validation

**Table K.1-1: Dielectric Performance of Head Tissue Simulating Liquid**

| Measurement Date (yyyy-mm-dd) | Type | Frequency | Permittivity $\epsilon$ | Drift (%) | Conductivity $\sigma$ (S/m) | Drift (%) |
|-------------------------------|------|-----------|-------------------------|-----------|-----------------------------|-----------|
| 2019/9/23                     | Head | 2450 MHz  | 38.54                   | -1.68     | 1.777                       | -1.28     |
|                               | Body | 2450 MHz  | 52.61                   | -0.17     | 1.957                       | 0.36      |

**Table K.1-2: System Validation of Head**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) |             | Measured value(W/kg) |             | Deviation    |             |
|-------------------------------|-----------|---------------------|-------------|----------------------|-------------|--------------|-------------|
|                               |           | 10 g Average        | 1 g Average | 10 g Average         | 1 g Average | 10 g Average | 1 g Average |
| 2019/9/23                     | 2450 MHz  | 24.2                | 51.6        | 24.6                 | 51.72       | 1.65%        | 0.23%       |

**Table K.1-3: System Validation of Body**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) |             | Measured value(W/kg) |             | Deviation    |             |
|-------------------------------|-----------|---------------------|-------------|----------------------|-------------|--------------|-------------|
|                               |           | 10 g Average        | 1 g Average | 10 g Average         | 1 g Average | 10 g Average | 1 g Average |
| 2019/9/23                     | 2450 MHz  | 24.5                | 52.3        | 24.84                | 52.72       | 1.39%        | 0.80%       |

### K.2 Conducted power of selected case

**Table K.2-1: The conducted Power for WLAN-Normal Power**

| Mode / data rate | Channel | Measured Power (dBm) |
|------------------|---------|----------------------|
| 802.11b – 1Mbps  | 1       | 17.91                |

**Table K.2-2: The conducted Power for WLAN-Low Power**

| Mode / data rate | Channel | Measured Power (dBm) |
|------------------|---------|----------------------|
| 802.11b – 1Mbps  | 1       | 14.82                |

### K.3 SAR results for Main antenna

| Frequency Band | Channel Number | Frequency (MHz) | Tune up (dBm) | EUT Measured Power (dBm) | Test setup | Measured SAR 10g (W/kg) | Measured SAR 1g (W/kg) | Calculated SAR 10g (W/kg) | Calculated SAR 1g (W/kg) | Power Drift |
|----------------|----------------|-----------------|---------------|--------------------------|------------|-------------------------|------------------------|---------------------------|--------------------------|-------------|
| WLAN           | 1              | 2412            | 16.00         | 14.82                    | Left Tilt  | 0.160                   | 0.407                  | 0.21                      | 0.53                     | 0.03        |
| WLAN           | 1              | 2412            | 19.00         | 17.91                    | Top 10mm   | 0.113                   | 0.263                  | 0.15                      | 0.34                     | 0.16        |

#### K.4 Reported SAR Comparison

**Table K.4-1: Highest Reported SAR (1g)**

| Exposure Configuration | Technology Band | Highest Reported SAR 1g(W/kg) original | Highest Reported SAR 1g(W/kg) spot check | Equipment Class |
|------------------------|-----------------|----------------------------------------|------------------------------------------|-----------------|
| Head                   | GSM 850         | 0.26                                   | \                                        | PCE             |
|                        | PCS 1900        | 0.14                                   | \                                        |                 |
|                        | UMTS FDD 2      | 0.14                                   | \                                        |                 |
|                        | UMTS FDD 5      | 0.29                                   | \                                        |                 |
|                        | CDMA BC0        | 0.31                                   | \                                        |                 |
|                        | LTE Band 2      | 0.28                                   | \                                        |                 |
|                        | LTE Band 5      | 0.21                                   | \                                        |                 |
|                        | LTE Band 7      | 0.24                                   | \                                        |                 |
|                        | LTE Band 41     | 0.07                                   | \                                        |                 |
|                        | WLAN 2.4        | <b>1.20</b>                            | 0.53                                     | DTS             |
| Hotspot                | GSM 850         | 0.54                                   | \                                        | PCE             |
|                        | PCS 1900        | 0.46                                   | \                                        |                 |
|                        | UMTS FDD 2      | 0.39                                   | \                                        |                 |
|                        | UMTS FDD 5      | 0.32                                   | \                                        |                 |
|                        | CDMA BC0        | 0.40                                   | \                                        |                 |
|                        | LTE Band 2      | 0.40                                   | \                                        |                 |
|                        | LTE Band 5      | 0.24                                   | \                                        |                 |
|                        | LTE Band 7      | 0.20                                   | \                                        |                 |
|                        | LTE Band 41     | 0.18                                   | \                                        |                 |
|                        | WLAN 2.4        | 0.74                                   | 0.34                                     | DTS             |

**Note: The spot check results marked blue are larger than the original result.**

**K.5 MAIN TEST INSTRUMENTS****Table K.5-1: List of Main Instruments**

| No. | Name                  | Type          | Serial Number | Calibration Date         | Valid Period |
|-----|-----------------------|---------------|---------------|--------------------------|--------------|
| 01  | Network analyzer      | E5071C        | MY46110673    | January 24, 2019         | One year     |
| 02  | Power meter           | NRVD          | 102083        | October 24, 2018         | One year     |
| 03  | Power sensor          | NRV-Z5        | 100542        |                          |              |
| 04  | Power sensor          | NRP6A         | 101369        | April 11, 2019           | One Year     |
| 05  | Signal Generator      | E4438C        | MY49070393    | January 4, 2019          | One Year     |
| 06  | Amplifier             | 60S1G4        | 0331848       | No Calibration Requested |              |
| 07  | Directional Coupler   | 778D          | MY48220584    | No Calibration Requested |              |
| 08  | Directional Coupler   | 772D          | MY46151265    | No Calibration Requested |              |
| 09  | E-field Probe         | SPEAG EX3DV4  | 3617          | January 31, 2019         | One year     |
| 10  | DAE                   | SPEAG DAE4    | 771           | January 11,2019          | One year     |
| 11  | Dipole Validation Kit | SPEAG D2450V2 | 853           | July 17, 2019            | One year     |



## K.6 GRAPH RESULTS

### WLAN2450\_CH1 Left Tilt

Date: 9/23/2019

Electronics: DAE4 Sn771

Medium: head 2450 MHz

Medium parameters used:  $f = 2412$ ;  $\sigma = 1.741$  mho/m;  $\epsilon_r = 38.59$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C

Communication System: WLAN2450 2412 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3617 ConvF(7.62,7.62,7.62)

**Area Scan (71x121x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 0.908 W/kg

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

Reference Value = 4.624 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.08 W/kg

**SAR(1 g) = 0.407 W/kg; SAR(10 g) = 0.16 W/kg**

Maximum value of SAR (measured) = 0.603 W/kg

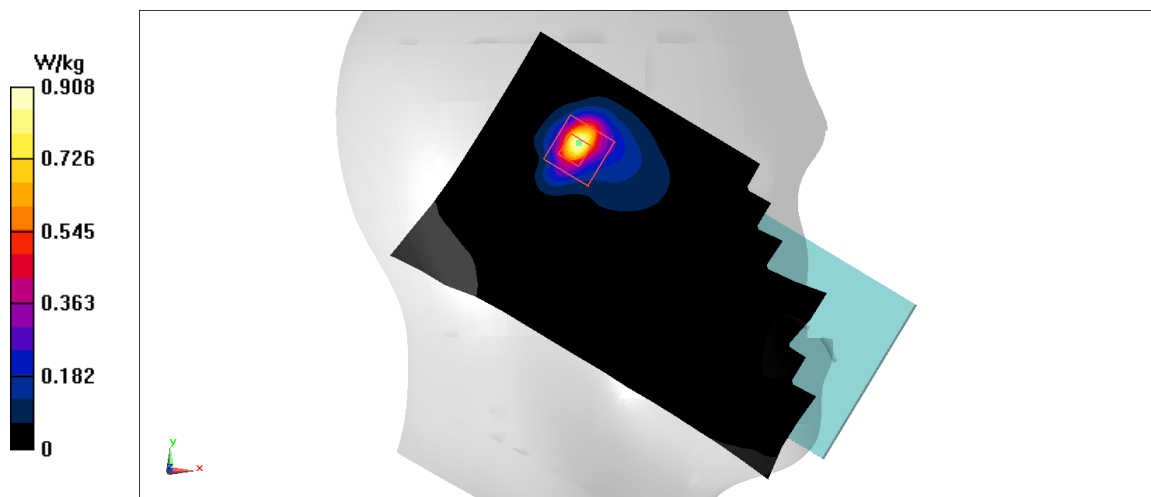


Fig K.6-1

### WLAN2450\_CH1 Top

Date: 9/23/2019

Electronics: DAE4 Sn771

Medium: body 2450 MHz

Medium parameters used:  $f = 2412$ ;  $\sigma = 1.921$  mho/m;  $\epsilon_r = 52.66$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C, Liquid Temperature: 22.3°C

Communication System: WLAN2450 2412 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3617 ConvF(7.79,7.79,7.79)

**Area Scan (71x121x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 0.466 W/kg

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

Reference Value = 4.518 V/m; Power Drift = 0.16 dB

Peak SAR (extrapolated) = 0.586 W/kg

**SAR(1 g) = 0.263 W/kg; SAR(10 g) = 0.113 W/kg**

Maximum value of SAR (measured) = 0.465 W/kg

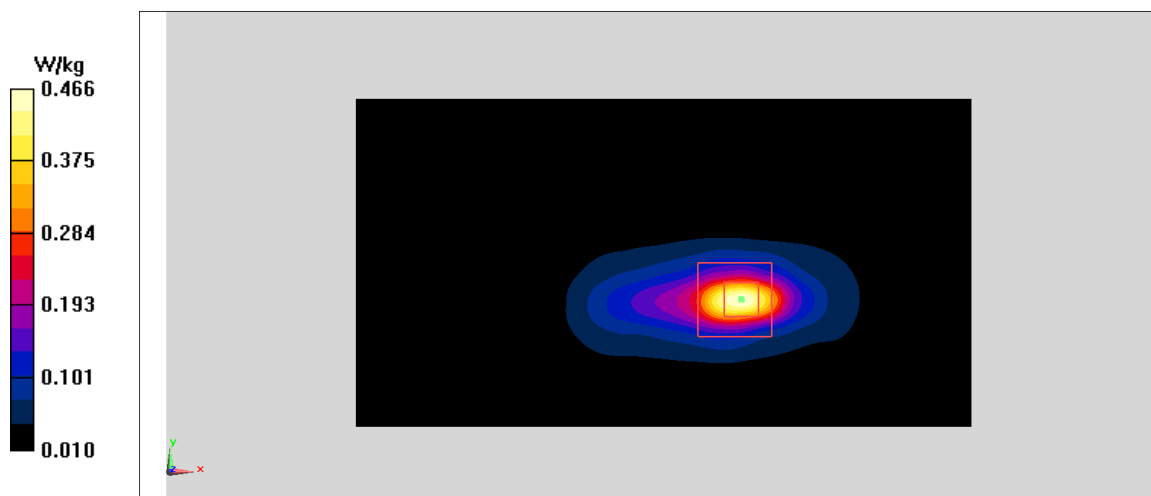


Fig K.6-2

## K.7 ANNEX SYSTEM VALIDATION RESULTS

### 2450 MHz

Date: 9/23/2019

Electronics: DAE4 Sn771

Medium: Head 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.777$  mho/m;  $\epsilon_r = 38.54$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C Liquid Temperature: 22.3°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3617 ConvF(7.62,7.62,7.62)

**System Validation /Area Scan (81x191x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 117.48 V/m; Power Drift = 0.06

**Fast SAR: SAR(1 g) = 12.97 W/kg; SAR(10 g) = 6.03 W/kg**

Maximum value of SAR (interpolated) = 22.26 W/kg

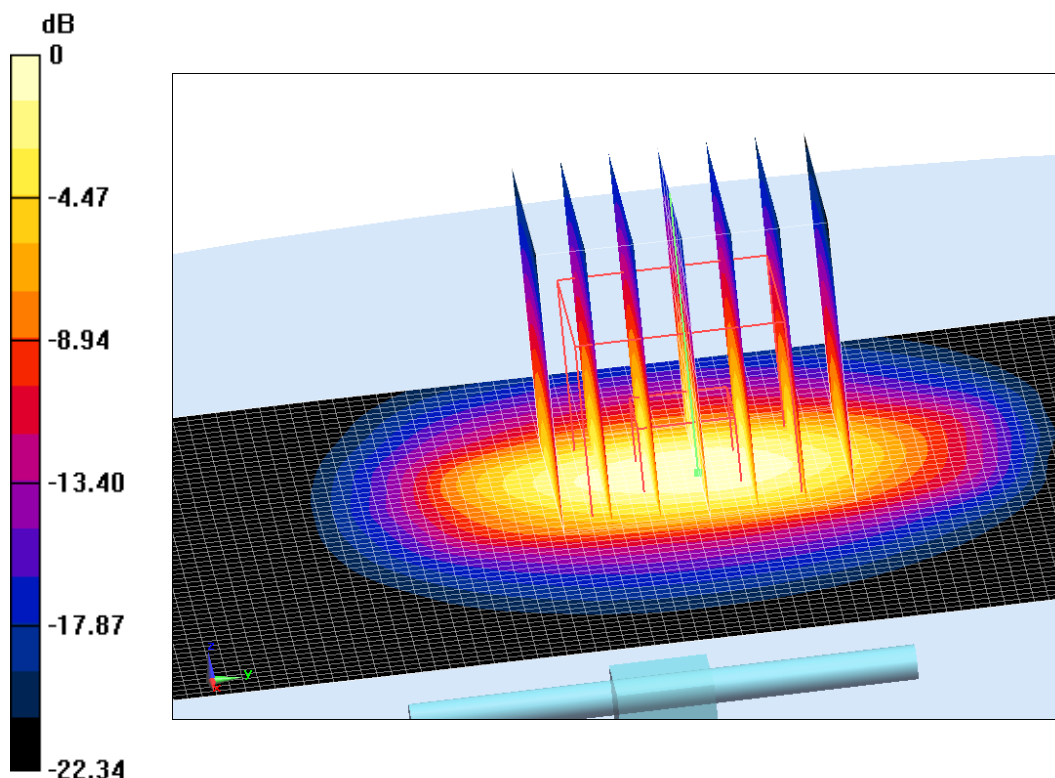
**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 117.48 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 25.48 W/kg

**SAR(1 g) = 12.93 W/kg; SAR(10 g) = 6.15 W/kg**

Maximum value of SAR (measured) = 21.09 W/kg



0 dB = 21.09 W/kg = 13.24 dB W/kg

**Fig K.7-1 validation 2450 MHz 250mW**

## 2450 MHz

Date: 9/23/2019

Electronics: DAE4 Sn771

Medium: Body 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.957$  mho/m;  $\epsilon_r = 52.61$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature: 22.5°C Liquid Temperature: 22.3°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3617 ConvF(7.79,7.79,7.79)

**System Validation /Area Scan (81x191x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 109.15 V/m; Power Drift = -0.02

**Fast SAR: SAR(1 g) = 13.14 W/kg; SAR(10 g) = 6.03 W/kg**

Maximum value of SAR (interpolated) = 21.04 W/kg

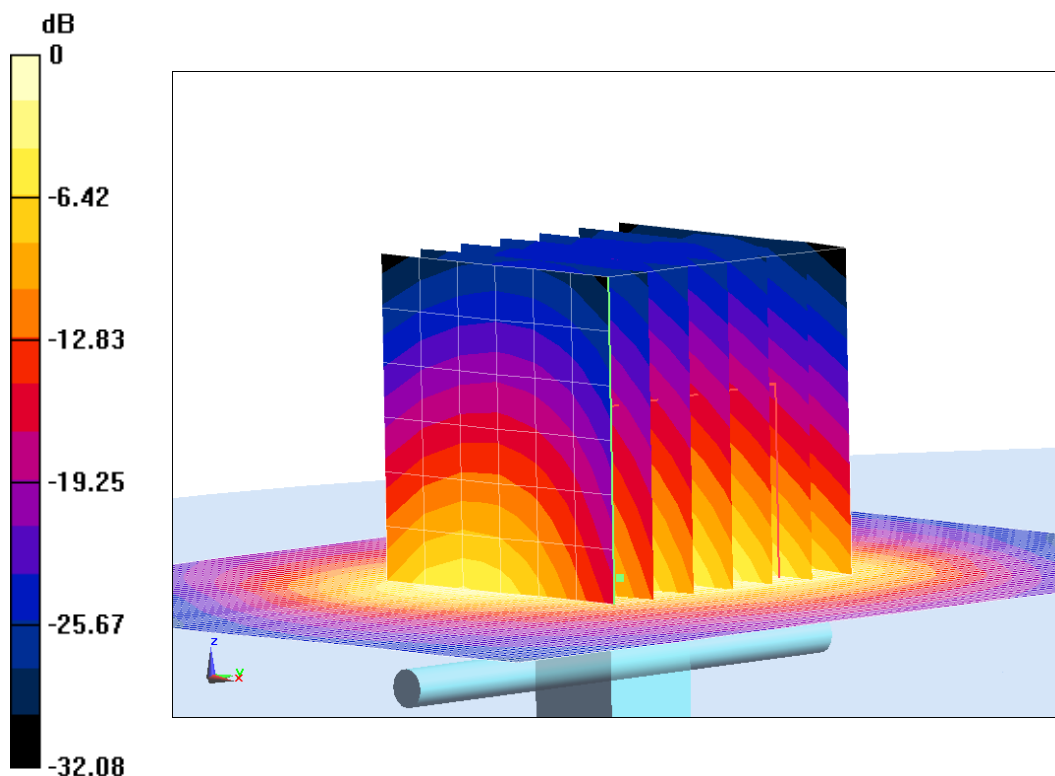
**System Validation /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value =109.15 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 26.74 W/kg

**SAR(1 g) = 13.18 W/kg; SAR(10 g) = 6.21 W/kg**

Maximum value of SAR (measured) = 21.84 W/kg



0 dB = 21.84 W/kg = 13.39 dB W/kg

**Fig K.7-2 validation 2450 MHz 250mW**

## K.8 System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

**Table F.1: System Validation for 3617**

| Probe SN. | Liquid name  | Validation date | Frequency point | Status (OK or Not) |
|-----------|--------------|-----------------|-----------------|--------------------|
| 3617      | Head 750MHz  | Feb.14,2019     | 750 MHz         | OK                 |
| 3617      | Head 850MHz  | Feb.14,2019     | 835 MHz         | OK                 |
| 3617      | Head 900MHz  | Feb.14,2019     | 900 MHz         | OK                 |
| 3617      | Head 1750MHz | Feb.14,2019     | 1750 MHz        | OK                 |
| 3617      | Head 1810MHz | Feb.14,2019     | 1810 MHz        | OK                 |
| 3617      | Head 1900MHz | Feb.15,2019     | 1900 MHz        | OK                 |
| 3617      | Head 2000MHz | Feb.15,2019     | 2000 MHz        | OK                 |
| 3617      | Head 2100MHz | Feb.15,2019     | 2100 MHz        | OK                 |
| 3617      | Head 2300MHz | Feb.15,2019     | 2300 MHz        | OK                 |
| 3617      | Head 2450MHz | Feb.15,2019     | 2450 MHz        | OK                 |
| 3617      | Head 2600MHz | Feb.16,2019     | 2600 MHz        | OK                 |
| 3617      | Head 3500MHz | Feb.16,2019     | 3500 MHz        | OK                 |
| 3617      | Head 3700MHz | Feb.16,2019     | 3700 MHz        | OK                 |
| 3617      | Head 5200MHz | Feb.16,2019     | 5250 MHz        | OK                 |
| 3617      | Head 5500MHz | Feb.16,2019     | 5600 MHz        | OK                 |
| 3617      | Head 5800MHz | Feb.16,2019     | 5800 MHz        | OK                 |
| 3617      | Body 750MHz  | Feb.16,2019     | 750 MHz         | OK                 |
| 3617      | Body 850MHz  | Feb.13,2019     | 835 MHz         | OK                 |
| 3617      | Body 900MHz  | Feb.13,2019     | 900 MHz         | OK                 |
| 3617      | Body 1750MHz | Feb.13,2019     | 1750 MHz        | OK                 |
| 3617      | Body 1810MHz | Feb.13,2019     | 1810 MHz        | OK                 |
| 3617      | Body 1900MHz | Feb.13,2019     | 1900 MHz        | OK                 |
| 3617      | Body 2000MHz | Feb.17,2019     | 2000 MHz        | OK                 |
| 3617      | Body 2100MHz | Feb.17,2019     | 2100 MHz        | OK                 |
| 3617      | Body 2300MHz | Feb.17,2019     | 2300 MHz        | OK                 |
| 3617      | Body 2450MHz | Feb.17,2019     | 2450 MHz        | OK                 |
| 3617      | Body 2600MHz | Feb.17,2019     | 2600 MHz        | OK                 |
| 3617      | Body 3500MHz | Feb.12,2019     | 3500 MHz        | OK                 |
| 3617      | Body 3700MHz | Feb.12,2019     | 3700 MHz        | OK                 |
| 3617      | Body 5200MHz | Feb.12,2019     | 5250 MHz        | OK                 |
| 3617      | Body 5500MHz | Feb.12,2019     | 5600 MHz        | OK                 |
| 3617      | Body 5800MHz | Feb.12,2019     | 5800 MHz        | OK                 |



## K.9 Probe Calibration Certificate

### Probe 3617 Calibration Certificate

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**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 **CTTL (Auden)**

Certificate No: **EX3-3617\_Jan19**

### CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3617**

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

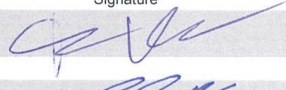
Calibration date: **January 31, 2019**

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  $(22 \pm 3)^{\circ}\text{C}$  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-18 (No. 217-02672/02673)   | Apr-19                 |
| Power sensor NRP-Z91       | SN: 103244       | 04-Apr-18 (No. 217-02672)         | Apr-19                 |
| Power sensor NRP-Z91       | SN: 103245       | 04-Apr-18 (No. 217-02673)         | Apr-19                 |
| Reference 20 dB Attenuator | SN: S5277 (20x)  | 04-Apr-18 (No. 217-02682)         | Apr-19                 |
| DAE4                       | SN: 660          | 19-Dec-18 (No. DAE4-660_Dec18)    | Dec-19                 |
| Reference Probe ES3DV2     | SN: 3013         | 31-Dec-18 (No. ES3-3013_Dec18)    | Dec-19                 |
| Secondary Standards        | ID               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B         | SN: GB41293874   | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: MY41498087   | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A        | SN: 000110210    | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| RF generator HP 8648C      | SN: US3642U01700 | 04-Aug-99 (in house check Jun-18) | In house check: Jun-20 |
| Network Analyzer E8358A    | SN: US41080477   | 31-Mar-14 (in house check Oct-18) | In house check: Oct-19 |

|                                                                                                                 | Name           | Function              | Signature                                                                             |
|-----------------------------------------------------------------------------------------------------------------|----------------|-----------------------|---------------------------------------------------------------------------------------|
| Calibrated by:                                                                                                  | Jeton Kastrati | Laboratory Technician |   |
| Approved by:                                                                                                    | Katja Pokovic  | Technical Manager     |  |
|                                                                                                                 |                |                       | Issued: February 2, 2019                                                              |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. |                |                       |                                                                                       |