

## DASY5 Validation Report for Body TSL

Date: 24.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:920**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 51.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(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:

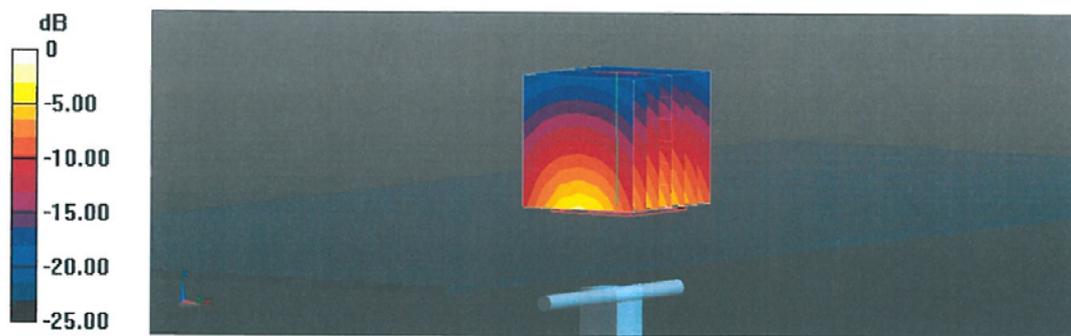
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.0 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 26.2 W/kg

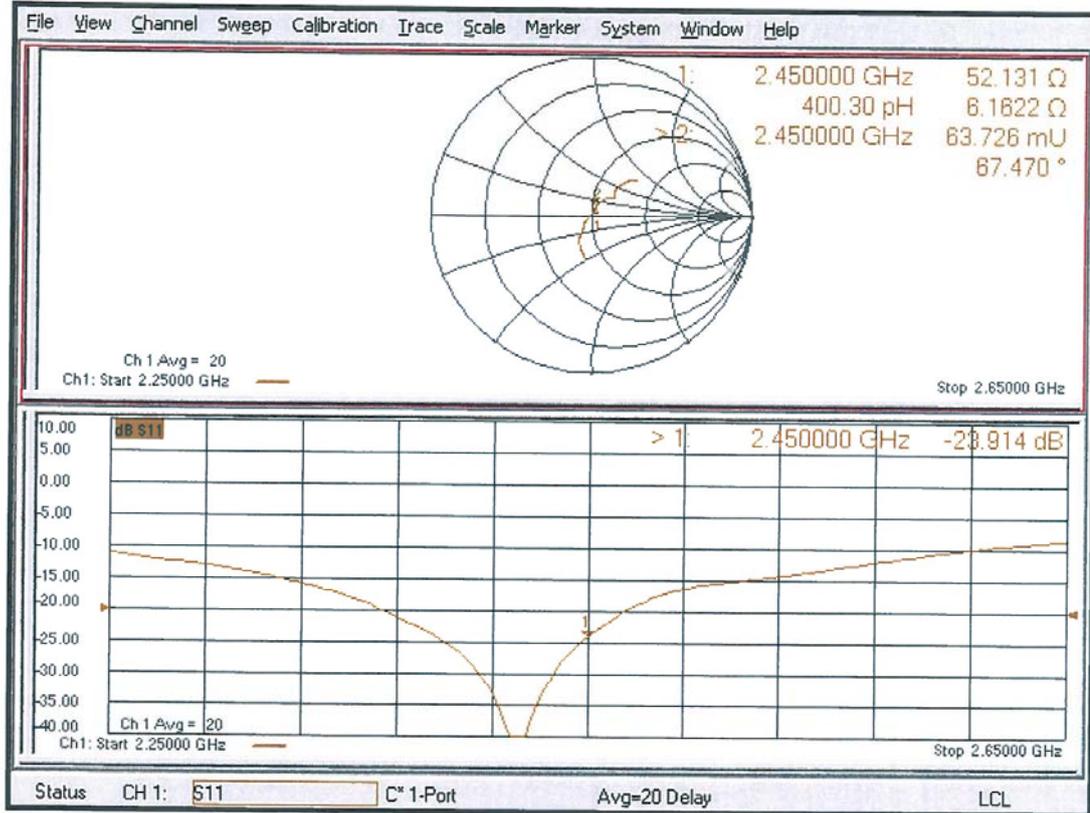
**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.22 W/kg**

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



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

Impedance Measurement Plot for Body TSL



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



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **D5GHzV2-1212\_Feb18**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1212**

Calibration procedure(s) **QA CAL-22.v2**  
 Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **February 15, 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-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3503	30-Dec-17 (No. EX3-3503_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 HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	

Approved by:	Katja Pokovic	Technical Manager	
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Issued: February 15, 2018

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

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



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

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for 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
- c) 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
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

- e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

**Measurement Conditions**

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

**Head TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.4 ± 6 %	4.53 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL at 5200 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>79.6 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.6 W/kg ± 19.5 % (k=2)</b>

**Head TSL parameters at 5300 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.64 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL at 5300 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>81.1 W / kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.1 W/kg ± 19.5 % (k=2)</b>

**Head TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.0 ± 6 %	4.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL at 5500 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>85.4 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.0 W/kg ± 19.5 % (k=2)</b>

**Head TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL at 5600 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>83.6 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.8 W/kg ± 19.5 % (k=2)</b>

**Head TSL parameters at 5800 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.16 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL at 5800 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>79.5 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.4 W/kg ± 19.5 % (k=2)</b>

**Body TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.5 ± 6 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Body TSL at 5200 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.31 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>72.7 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>20.2 W/kg ± 19.5 % (k=2)</b>

**Body TSL parameters at 5300 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.3 ± 6 %	5.54 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Body TSL at 5300 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>75.2 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>20.9 W/kg ± 19.5 % (k=2)</b>

**Body TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.80 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Body TSL at 5500 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>79.9 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>22.0 W/kg ± 19.5 % (k=2)</b>

**Body TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.95 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Body TSL at 5600 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>78.9 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>21.8 W/kg ± 19.5 % (k=2)</b>

**Body TSL parameters at 5800 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	6.23 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Body TSL at 5800 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.62 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>75.7 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>20.8 W/kg ± 19.5 % (k=2)</b>

**Appendix (Additional assessments outside the scope of SCS 0108)**
**Antenna Parameters with Head TSL at 5200 MHz**

Impedance, transformed to feed point	48.3 $\Omega$ - 3.7 j $\Omega$
Return Loss	- 27.8 dB

**Antenna Parameters with Head TSL at 5300 MHz**

Impedance, transformed to feed point	47.8 $\Omega$ - 0.1 j $\Omega$
Return Loss	- 33.0 dB

**Antenna Parameters with Head TSL at 5500 MHz**

Impedance, transformed to feed point	46.8 $\Omega$ + 1.4 j $\Omega$
Return Loss	- 28.8 dB

**Antenna Parameters with Head TSL at 5600 MHz**

Impedance, transformed to feed point	50.4 $\Omega$ + 3.1 j $\Omega$
Return Loss	- 30.2 dB

**Antenna Parameters with Head TSL at 5800 MHz**

Impedance, transformed to feed point	52.3 $\Omega$ + 3.2 j $\Omega$
Return Loss	- 28.2 dB

**Antenna Parameters with Body TSL at 5200 MHz**

Impedance, transformed to feed point	47.9 $\Omega$ - 3.7 j $\Omega$
Return Loss	- 27.3 dB

**Antenna Parameters with Body TSL at 5300 MHz**

Impedance, transformed to feed point	48.6 $\Omega$ + 2.0 j $\Omega$
Return Loss	- 32.0 dB

**Antenna Parameters with Body TSL at 5500 MHz**

Impedance, transformed to feed point	47.4 $\Omega$ + 3.1 j $\Omega$
Return Loss	- 27.5 dB

**Antenna Parameters with Body TSL at 5600 MHz**

Impedance, transformed to feed point	50.5 $\Omega$ + 4.0 j $\Omega$
Return Loss	- 28.0 dB

**Antenna Parameters with Body TSL at 5800 MHz**

Impedance, transformed to feed point	52.5 $\Omega$ + 4.4 j $\Omega$
Return Loss	- 26.2 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.191 ns
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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 14, 2014

**DASY5 Validation Report for Head TSL**

Date: 14.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1212**Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHzMedium parameters used:  $f = 5200$  MHz;  $\sigma = 4.53$  S/m;  $\epsilon_r = 36.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.64$  S/m;  $\epsilon_r = 36.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.84$  S/m;  $\epsilon_r = 36$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.95$  S/m;  $\epsilon_r = 35.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.16$  S/m;  $\epsilon_r = 35.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

## DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.75, 5.75, 5.75); Calibrated: 30.12.2017, ConvF(5.5, 5.5, 5.5);  
Calibrated: 30.12.2017, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2017, ConvF(5.05, 5.05, 5.05);  
Calibrated: 30.12.2017, ConvF(4.96, 4.96, 4.96); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.98 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 28.5 W/kg

**SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.26 W/kg**

Maximum value of SAR (measured) = 18.0 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.21 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 29.9 W/kg

**SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.31 W/kg**

Maximum value of SAR (measured) = 18.8 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:**

Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 73.15 V/m; Power Drift = -0.08 dB

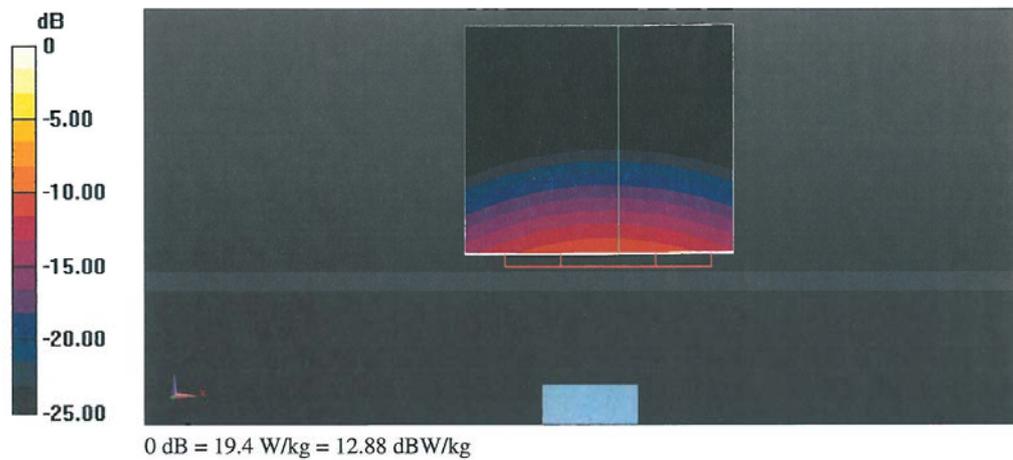
Peak SAR (extrapolated) = 33.3 W/kg

**SAR(1 g) = 8.53 W/kg; SAR(10 g) = 2.4 W/kg**

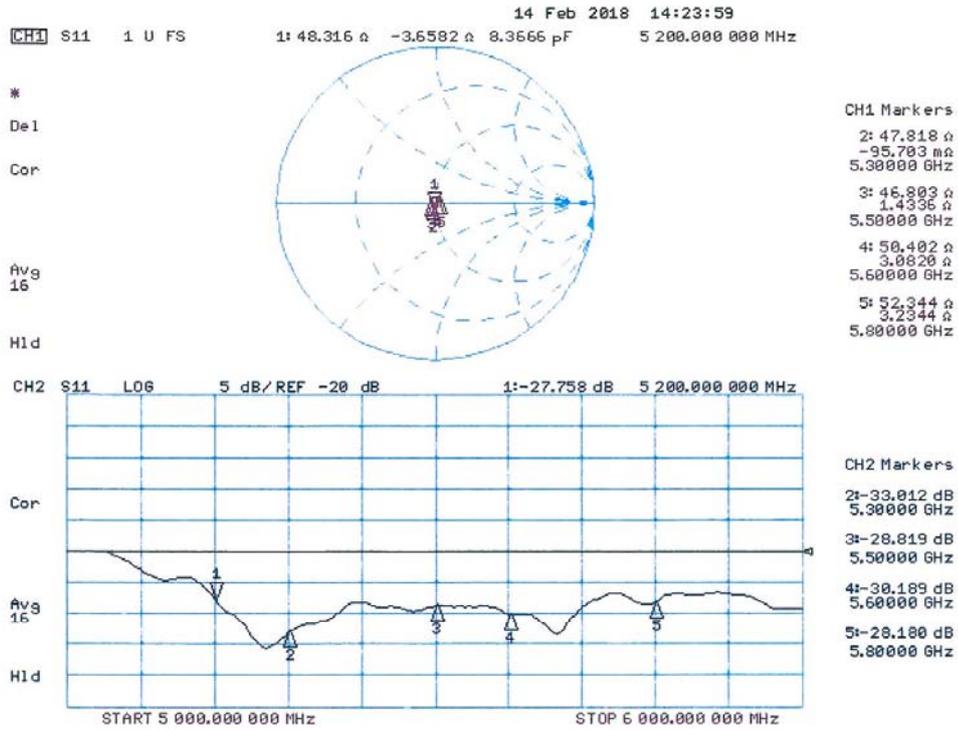
Maximum value of SAR (measured) = 20.1 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 72.01 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 32.2 W/kg  
**SAR(1 g) = 8.36 W/kg; SAR(10 g) = 2.38 W/kg**  
Maximum value of SAR (measured) = 20.0 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 70.08 V/m; Power Drift = -0.03 dB  
Peak SAR (extrapolated) = 31.9 W/kg  
**SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.24 W/kg**  
Maximum value of SAR (measured) = 19.4 W/kg



Impedance Measurement Plot for Head TSL



**DASY5 Validation Report for Body TSL**

Date: 15.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1212**Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHzMedium parameters used:  $f = 5200$  MHz;  $\sigma = 5.41$  S/m;  $\epsilon_r = 47.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.54$  S/m;  $\epsilon_r = 47.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.8$  S/m;  $\epsilon_r = 47$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.95$  S/m;  $\epsilon_r = 46.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>,Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.23$  S/m;  $\epsilon_r = 46.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

## DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.35, 5.35, 5.35); Calibrated: 30.12.2017, ConvF(5.15, 5.15, 5.15);  
Calibrated: 30.12.2017, ConvF(4.7, 4.7, 4.7); Calibrated: 30.12.2017, ConvF(4.65, 4.65, 4.65);  
Calibrated: 30.12.2017, ConvF(4.53, 4.53, 4.53); 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 52.10.0(1446); SEMCAD X 14.6.10(7417)

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.59 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.2 W/kg

**SAR(1 g) = 7.31 W/kg; SAR(10 g) = 2.03 W/kg**

Maximum value of SAR (measured) = 16.9 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.99 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 29.6 W/kg

**SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.11 W/kg**

Maximum value of SAR (measured) = 17.7 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,****dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.88 V/m; Power Drift = -0.07 dB

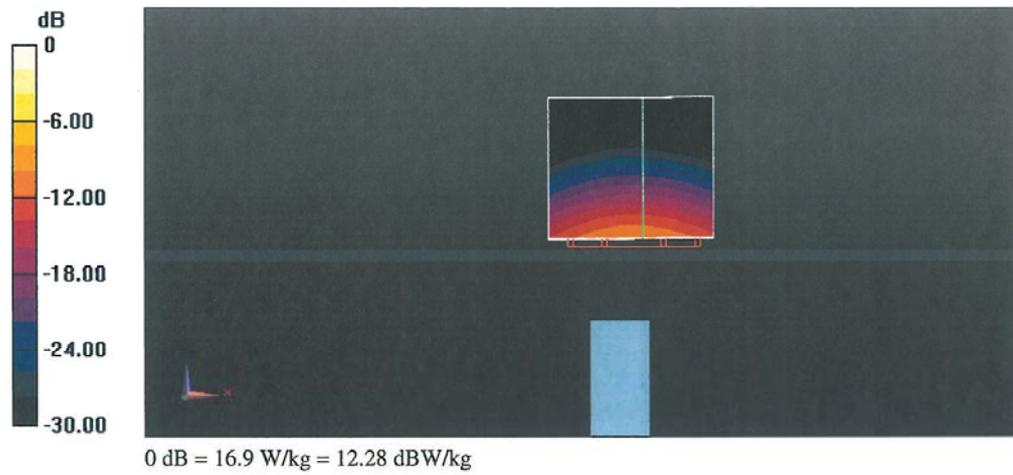
Peak SAR (extrapolated) = 33.3 W/kg

**SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.22 W/kg**

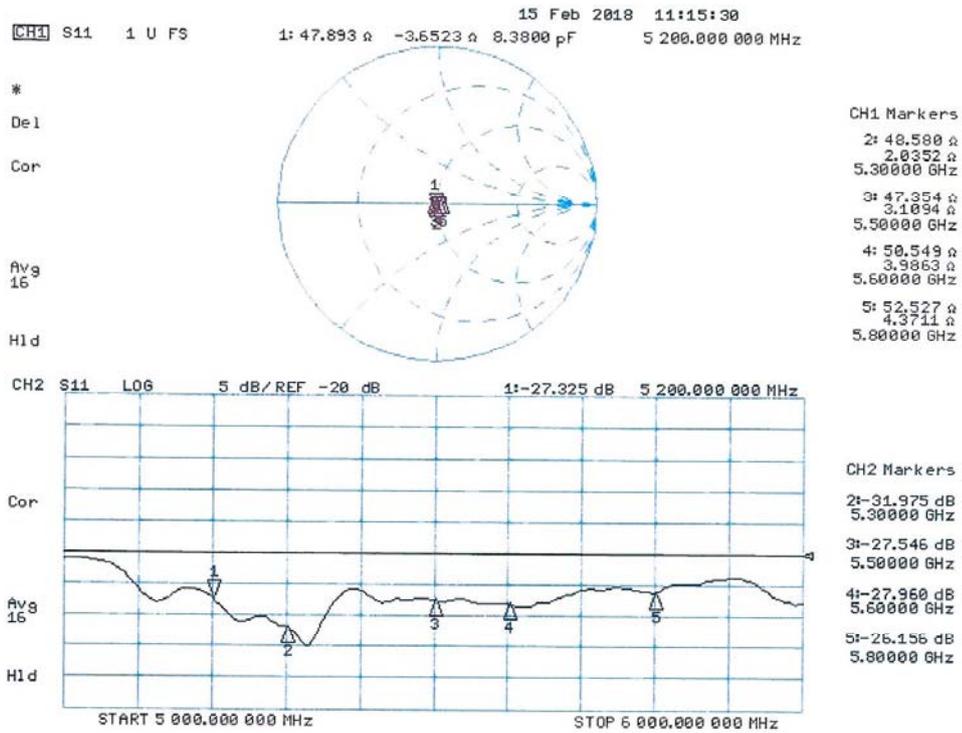
Maximum value of SAR (measured) = 19.3 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
 Reference Value = 64.59 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 33.4 W/kg  
**SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.2 W/kg**  
 Maximum value of SAR (measured) = 19.0 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
 Reference Value = 63.42 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 33.2 W/kg  
**SAR(1 g) = 7.62 W/kg; SAR(10 g) = 2.1 W/kg**  
 Maximum value of SAR (measured) = 18.7 W/kg



**Impedance Measurement Plot for Body TSL**



## Attachment 3. – SAR SYSTEM VALIDATION

### SAR System Validation

Per FCC KDB 865664 D02v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01v01r04 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

**Table Attachment 3.1 SAR System Validation Summary**

SAR System	Freq. [MHz]	Date	Probe SN	Probe Type	Probe CAL. Point		PERM.	COND.	CW Validation			MOD. Validation		
							( $\epsilon_r$ )	( $\sigma$ )	Sensitivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
D	2450	2018-05-10	3916	EX3DV4	2450	Head	38.995	1.822	PASS	PASS	PASS	OFDM	N/A	PASS
D	5200	2018-05-14	3916	EX3DV4	5200	Head	34.856	4.725	PASS	PASS	PASS	OFDM	N/A	PASS
D	5300	2018-05-15	3916	EX3DV4	5300	Head	34.854	4.856	PASS	PASS	PASS	OFDM	N/A	PASS
D	5600	2018-05-17	3916	EX3DV4	5600	Head	34.265	5.221	PASS	PASS	PASS	OFDM	N/A	PASS
D	5800	2018-05-18	3916	EX3DV4	5800	Head	34.113	5.414	PASS	PASS	PASS	OFDM	N/A	PASS
D	2450	2018-05-10	3916	EX3DV4	2450	Body	51.454	2.011	PASS	PASS	PASS	OFDM	N/A	PASS
D	5200	2018-05-14	3916	EX3DV4	5200	Body	48.156	5.467	PASS	PASS	PASS	OFDM	N/A	PASS
D	5300	2018-05-15	3916	EX3DV4	5300	Body	48.111	5.488	PASS	PASS	PASS	OFDM	N/A	PASS
D	5600	2018-05-17	3916	EX3DV4	5600	Body	47.116	5.911	PASS	PASS	PASS	OFDM	N/A	PASS
D	5800	2018-05-18	3916	EX3DV4	5800	Body	46.774	6.223	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.