

**31\_LTE Band 66\_20M\_QPSK\_1RB\_0Offset\_Back\_5mm\_Ch132322**

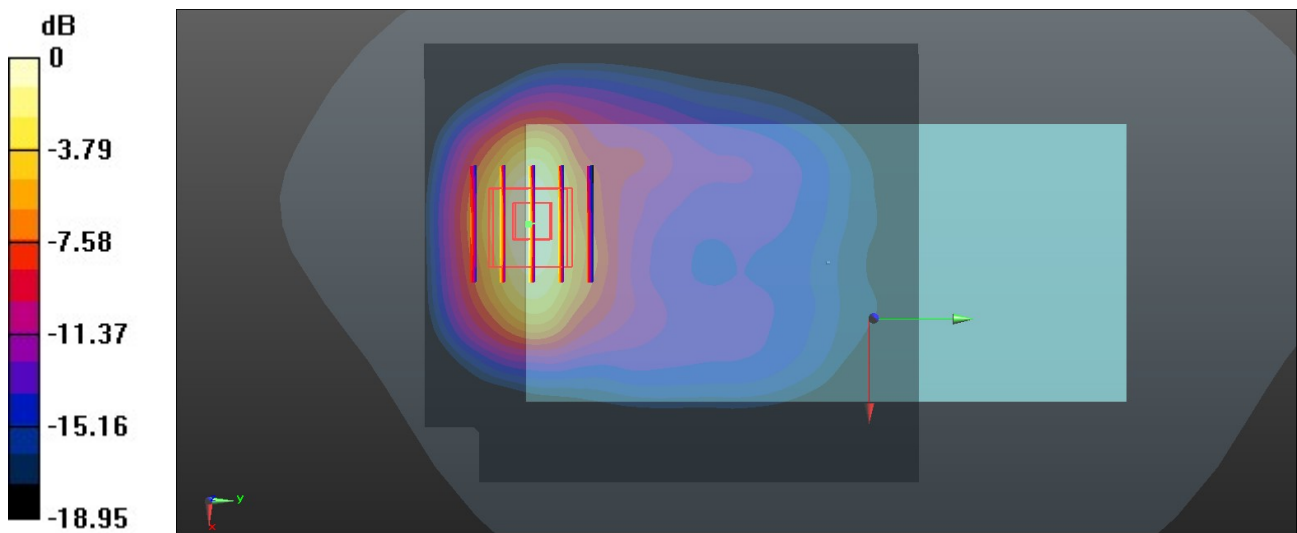
Communication System: UID 0, LTE-FDD (0); Frequency: 1745 MHz; Duty Cycle: 1:1  
 Medium: HSL\_1750 Medium parameters used:  $f = 1745$  MHz;  $\sigma = 1.345$  S/m;  $\epsilon_r = 40.397$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.9 °C

**DASY5 Configuration:**

- Probe: ES3DV3 - SN3293; ConvF(5.37, 5.37, 5.37); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (81x91x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 1.64 W/kg

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 5.644 V/m; Power Drift = -0.09 dB  
 Peak SAR (extrapolated) = 2.12 W/kg  
**SAR(1 g) = 1.19 W/kg; SAR(10 g) = 0.620 W/kg**  
 Maximum value of SAR (measured) = 1.48 W/kg



0 dB = 1.48 W/kg = 1.70 dBW/kg

### 32\_WLAN2.4GHz\_802.11b 1Mbps\_Back\_5mm\_Ch6

Communication System: UID 0, 802.11b (0); Frequency: 2437 MHz; Duty Cycle: 1:1  
Medium: HSL\_2450 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.8$  S/m;  $\epsilon_r = 38.63$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.9 °C

#### DASY5 Configuration:

- Probe: ES3DV3 - SN3293; ConvF(4.51, 4.51, 4.51); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (101x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.92 W/kg

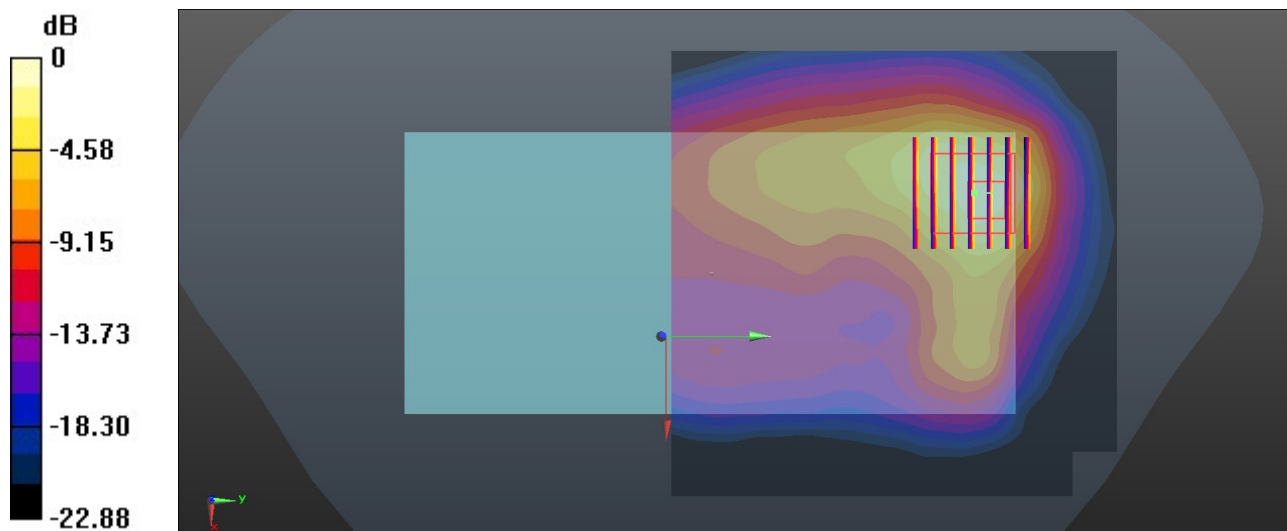
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.760 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.89 W/kg

**SAR(1 g) = 0.756 W/kg; SAR(10 g) = 0.341 W/kg**

Maximum value of SAR (measured) = 1.04 W/kg



0 dB = 1.04 W/kg = 0.17 dBW/kg

### 33\_Bluetooth\_1Mbps\_Back\_5mm\_Ch39

Communication System: UID 0, Bluetooth (0); Frequency: 2441 MHz; Duty Cycle: 1:1.304  
Medium: HSL\_2450 Medium parameters used:  $f = 2441$  MHz;  $\sigma = 1.786$  S/m;  $\epsilon_r = 38.622$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.9 °C

#### DASY5 Configuration:

- Probe: ES3DV3 - SN3293; ConvF(4.51, 4.51, 4.51); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (91x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.0271 W/kg

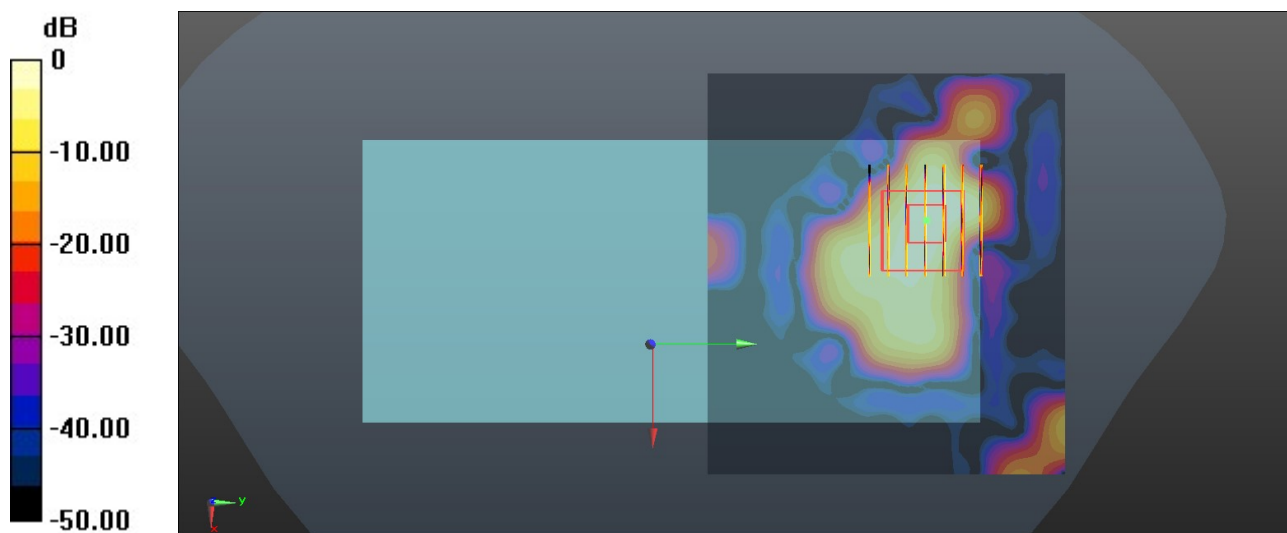
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.160 W/kg

**SAR(1 g) = 0.050 W/kg; SAR(10 g) = 0.012 W/kg**

Maximum value of SAR (measured) = 0.110 W/kg



0 dB = 0.110 W/kg = -9.72 dBW/kg

**34\_GSM 1900\_GPRS 4 Tx slot\_Bottom Side\_0mm\_Ch661**

Communication System: UID 0, PCS (0); Frequency: 1880 MHz; Duty Cycle: 1:2.08

Medium: HSL\_1900 Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.429$  S/m;  $\epsilon_r = 39.329$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: ES3DV3 - SN3293; ConvF(5.14, 5.14, 5.14); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 5.69 W/kg

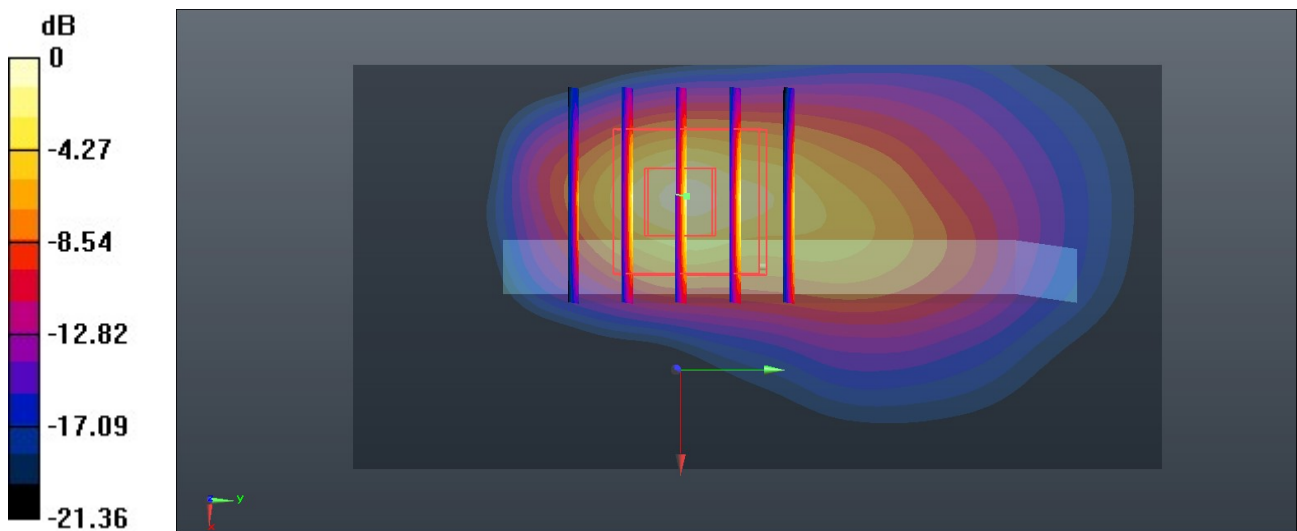
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 33.96 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 10.1 W/kg

**SAR(1 g) = 4.71 W/kg; SAR(10 g) = 1.97 W/kg**

Maximum value of SAR (measured) = 6.88 W/kg



0 dB = 6.88 W/kg = 8.38 dBW/kg

**35\_WCDMA II\_RMC 12.2Kbps\_Back\_0mm\_Ch9400**

Communication System: UID 0, WCDMA (0); Frequency: 1880 MHz; Duty Cycle: 1:1  
 Medium: HSL\_1900 Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.429$  S/m;  $\epsilon_r = 39.329$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.3 °C; Liquid Temperature : 22.8 °C

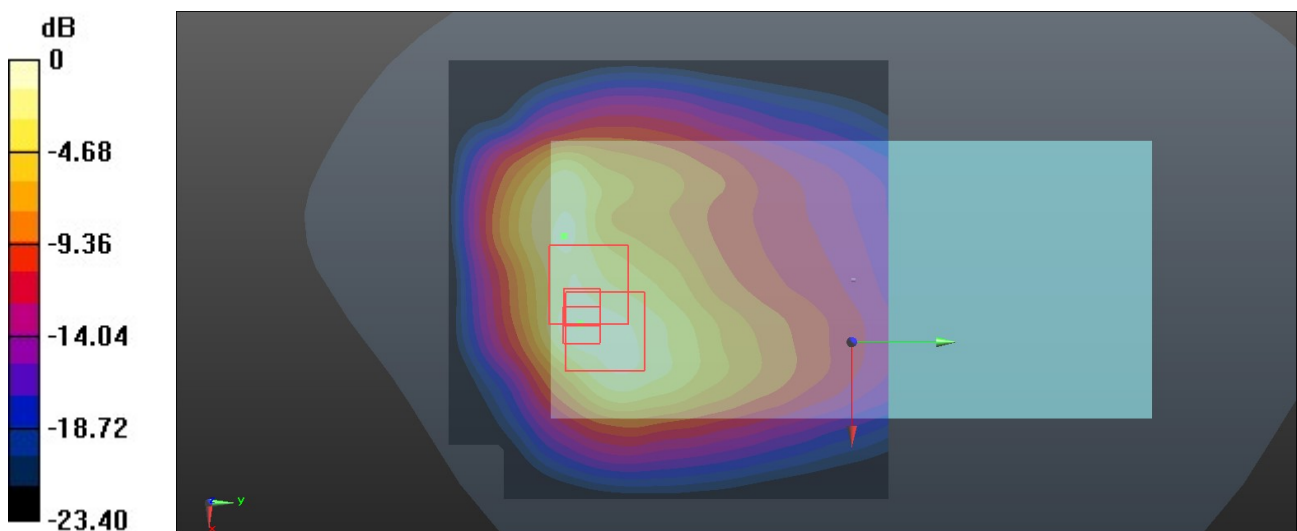
**DASY5 Configuration:**

- Probe: ES3DV3 - SN3293; ConvF(5.14, 5.14, 5.14); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (81x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 4.31 W/kg

**Zoom Scan (6x6x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 13.16 V/m; Power Drift = -0.01 dB  
 Peak SAR (extrapolated) = 8.85 W/kg  
**SAR(1 g) = 3.68 W/kg; SAR(10 g) = 1.87 W/kg**  
 Maximum value of SAR (measured) = 5.24 W/kg

**Zoom Scan (6x6x7)/Cube 1:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 13.16 V/m; Power Drift = -0.01 dB  
 Peak SAR (extrapolated) = 7.87 W/kg  
**SAR(1 g) = 3.33 W/kg; SAR(10 g) = 1.51 W/kg**  
 Maximum value of SAR (measured) = 4.75 W/kg



0 dB = 4.75 W/kg = 6.77 dBW/kg

**36\_WCDMA IV\_RMC 12.2Kbps\_Bottom Side\_0mm\_Ch1413**

Communication System: UID 0, WCDMA (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1  
 Medium: HSL\_1750 Medium parameters used:  $f = 1733 \text{ MHz}$ ;  $\sigma = 1.333 \text{ S/m}$ ;  $\epsilon_r = 40.452$ ;  $\rho = 1000 \text{ kg/m}^3$

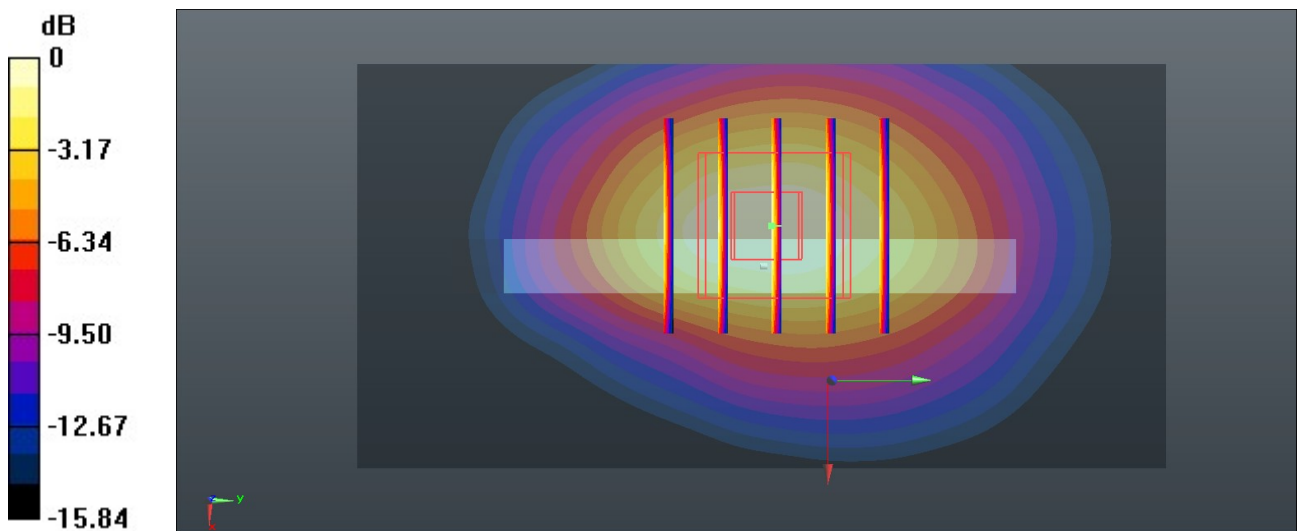
Ambient Temperature : 23.1 °C; Liquid Temperature : 22.9 °C

**DASY5 Configuration:**

- Probe: ES3DV3 - SN3293; ConvF(5.37, 5.37, 5.37); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (41x81x1):** Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$   
 Maximum value of SAR (interpolated) = 2.05 W/kg

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 36.94 V/m; Power Drift = 0.01 dB  
 Peak SAR (extrapolated) = 2.71 W/kg  
**SAR(1 g) = 1.65 W/kg; SAR(10 g) = 0.944 W/kg**  
 Maximum value of SAR (measured) = 2.01 W/kg



0 dB = 2.01 W/kg = 3.03 dBW/kg

### 37\_LTE Band 2\_20M\_QPSK\_1RB\_0Offset\_Bottom Side\_0mm\_Ch19100

Communication System: UID 0, LTE-FDD (0); Frequency: 1900 MHz; Duty Cycle: 1:1  
Medium: HSL\_1900 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.44$  S/m;  $\epsilon_r = 39.304$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.8 °C

#### DASY5 Configuration:

- Probe: ES3DV3 - SN3293; ConvF(5.14, 5.14, 5.14); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 7.28 W/kg

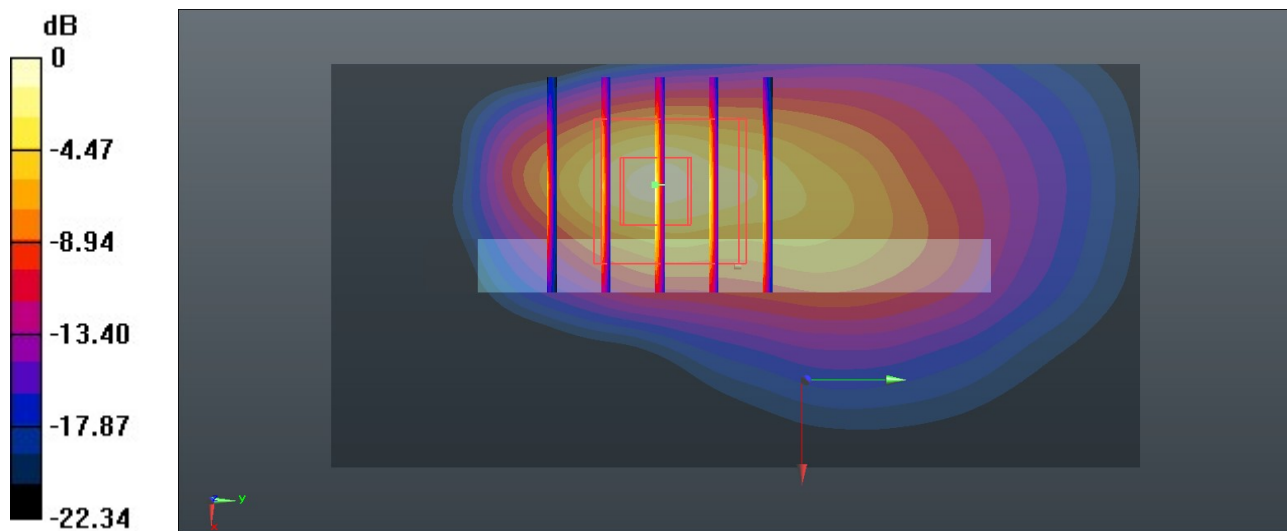
**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 31.82 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 12.3 W/kg

**SAR(1 g) = 5.74 W/kg; SAR(10 g) = 2.38 W/kg**

Maximum value of SAR (measured) = 8.55 W/kg



0 dB = 8.55 W/kg = 9.32 dBW/kg



### 38\_LTE Band 7\_20M\_QPSK\_1RB\_0Offset\_Back\_0mm\_Ch21100

Communication System: UID 0, LTE-FDD (0); Frequency: 2535 MHz; Duty Cycle: 1:1  
Medium: HSL\_2600 Medium parameters used:  $f = 2535$  MHz;  $\sigma = 1.87$  S/m;  $\epsilon_r = 38.505$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.7 °C

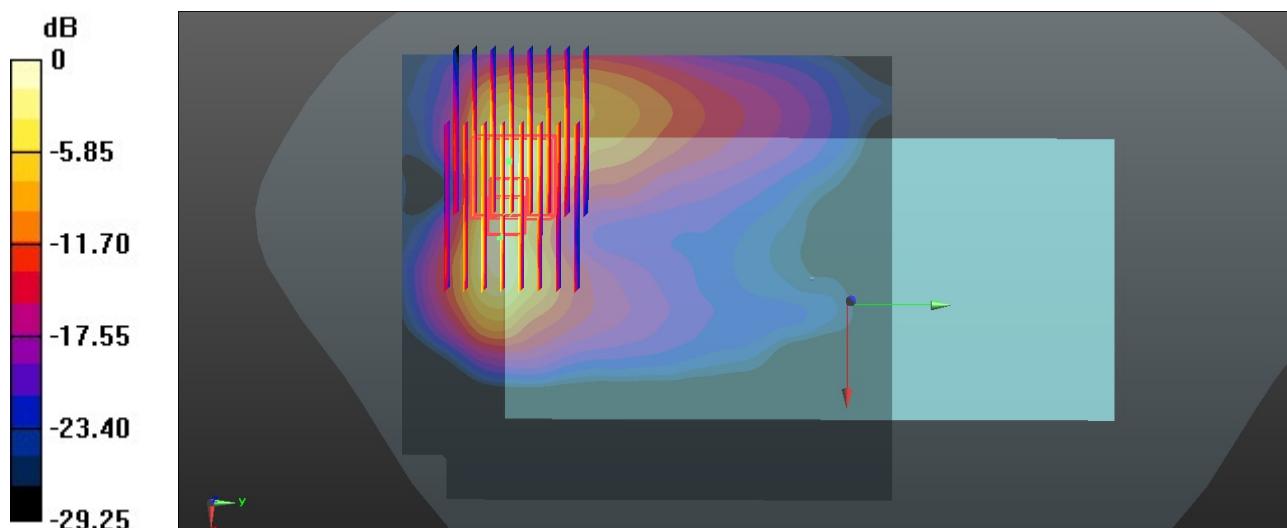
#### DASY5 Configuration:

- Probe: ES3DV3 - SN3293; ConvF(4.38, 4.38, 4.38); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (101x111x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm  
Maximum value of SAR (interpolated) = 3.20 W/kg

**Zoom Scan (10x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 2.586 V/m; Power Drift = 0.04 dB  
Peak SAR (extrapolated) = 7.41 W/kg  
**SAR(1 g) = 2.68 W/kg; SAR(10 g) = 1.06 W/kg**  
Maximum value of SAR (measured) = 3.83 W/kg

**Zoom Scan (10x8x7)/Cube 1:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 2.586 V/m; Power Drift = 0.04 dB  
Peak SAR (extrapolated) = 7.33 W/kg  
**SAR(1 g) = 2.6 W/kg; SAR(10 g) = 1.04 W/kg**  
Maximum value of SAR (measured) = 4.04 W/kg



0 dB = 4.04 W/kg = 6.06 dBW/kg



**39\_LTE Band 66\_20M\_QPSK\_1RB\_0Offset\_Bottom Side\_0mm\_Ch132322**

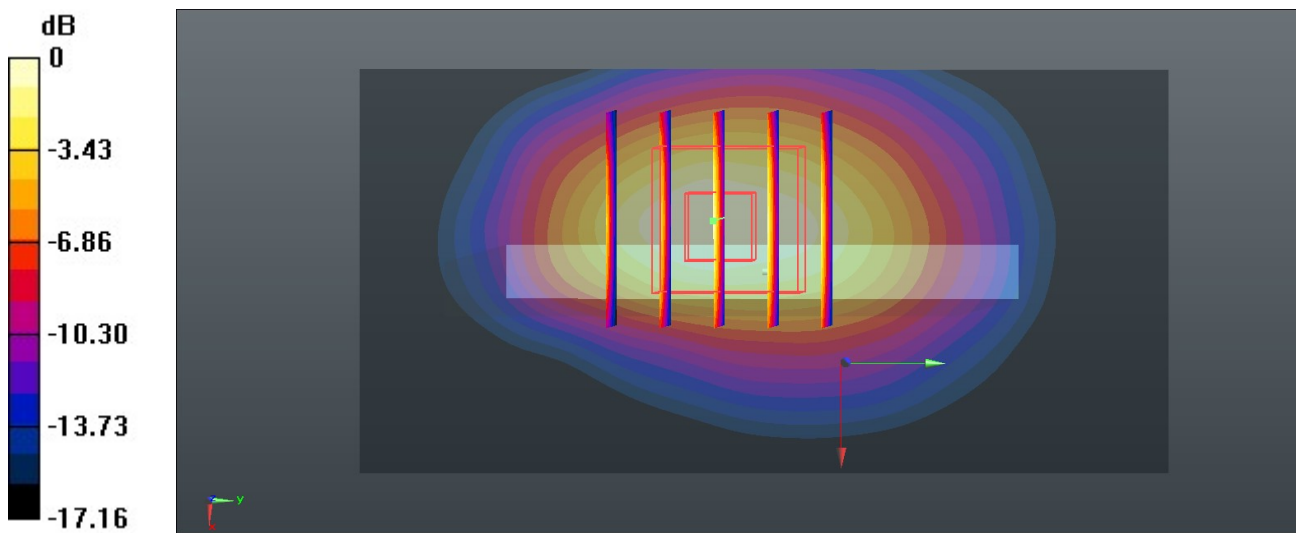
Communication System: UID 0, LTE-FDD (0); Frequency: 1745 MHz; Duty Cycle: 1:1  
 Medium: HSL\_1750 Medium parameters used:  $f = 1745$  MHz;  $\sigma = 1.345$  S/m;  $\epsilon_r = 40.397$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.1 °C; Liquid Temperature : 22.9 °C

**DASY5 Configuration:**

- Probe: ES3DV3 - SN3293; ConvF(5.37, 5.37, 5.37); Calibrated: 2020.9.23
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2020.7.7
- Phantom: SAM2; Type: SAM; Serial: TP-1503
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
 Maximum value of SAR (interpolated) = 3.01 W/kg

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 38.56 V/m; Power Drift = 0.08 dB  
 Peak SAR (extrapolated) = 3.59 W/kg  
**SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.19 W/kg**  
 Maximum value of SAR (measured) = 2.69 W/kg



0 dB = 2.69 W/kg = 4.30 dBW/kg



## **Appendix C. DAS Y Calibration Certificate**

The DAS Y calibration certificates are shown as follows.



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 CALIBRATION LABORATORY



中国认可  
 国际互认  
 校准  
 CALIBRATION  
 CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: cttl@chinattl.com http://www.chinattl.cn

Client **Sporton**

Certificate No: **Z19-60082**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d151**

Calibration Procedure(s) **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**

Calibration date: **March 27, 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±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: March 30, 2019

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





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CALIBRATION LABORATORY

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E-mail: [entl@chinattl.com](mailto:entl@chinattl.com) <http://www.chinattl.cn>

### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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%.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

### Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 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 $\pm$ 0.2) °C	42.7 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	---	---

### SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.30 W/kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.16 W/kg $\pm$ 18.7 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	56.7 $\pm$ 6 %	0.94 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	---	---

### SAR result with Body TSL

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.32 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.53 W /kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.20 W/kg $\pm$ 18.7 % (k=2)





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Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8Ω- 3.28jΩ
Return Loss	- 29.5dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7Ω- 3.98jΩ
Return Loss	- 25.5dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.253 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
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Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

### DASY5 Validation Report for Head TSL

Date: 03.26.2019

Test Laboratory: CCTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.925$  S/m;  $\epsilon_r = 42.68$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(9.75, 9.75, 9.75) @ 835 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

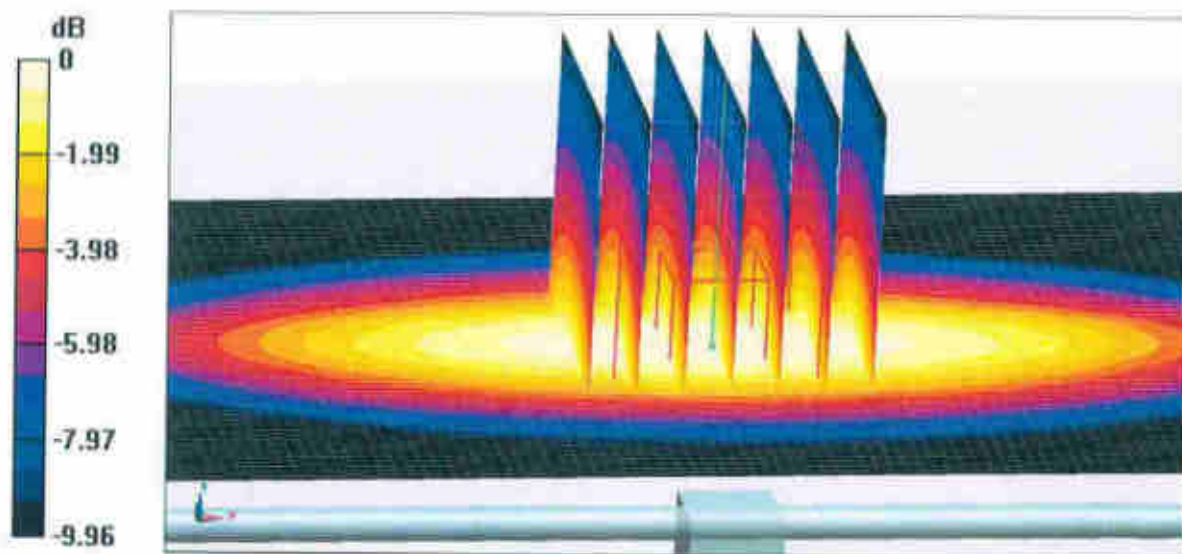
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.34 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.55 W/kg

**SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.56 W/kg**

Maximum value of SAR (measured) = 3.14 W/kg



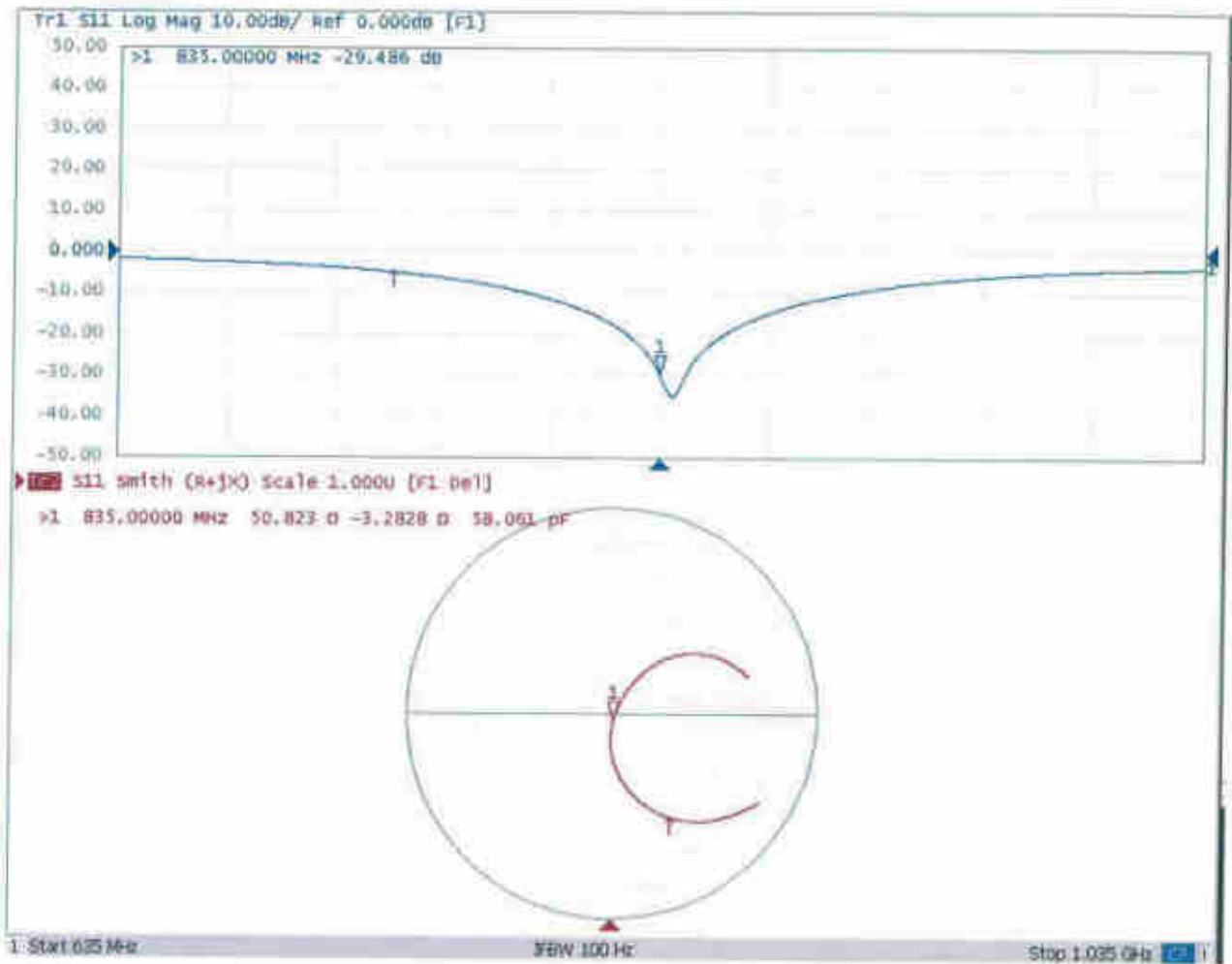
**0 dB = 3.14 W/kg = 4.97 dBW/kg**





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### Impedance Measurement Plot for Head TSL





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### DASY5 Validation Report for Body TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.944$  S/m;  $\epsilon_r = 56.66$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(9.61, 9.61, 9.61) @ 835 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

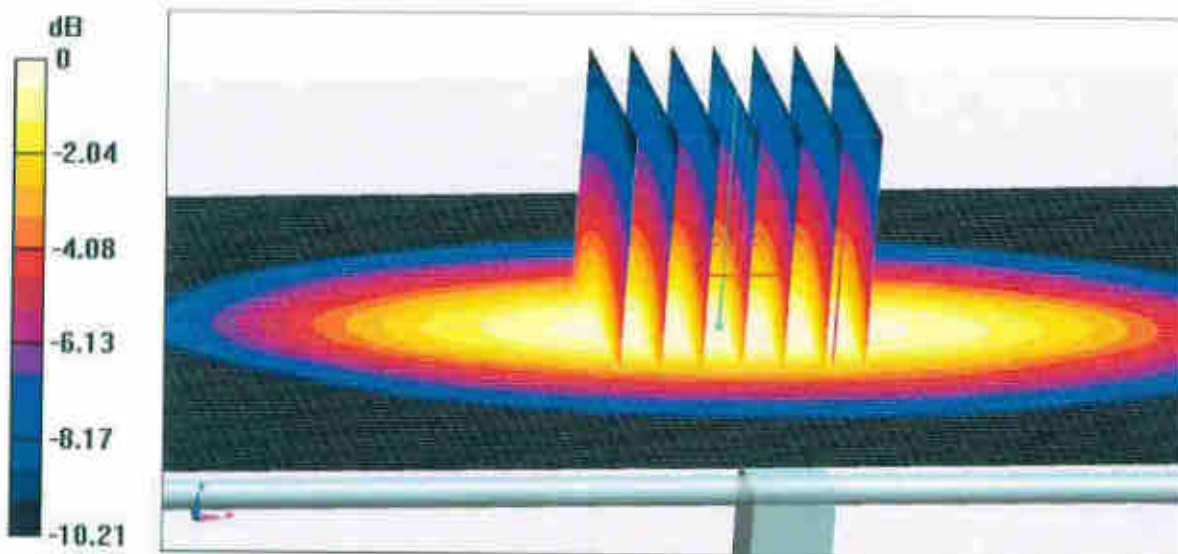
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.03 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.53 W/kg

SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 3.12 W/kg

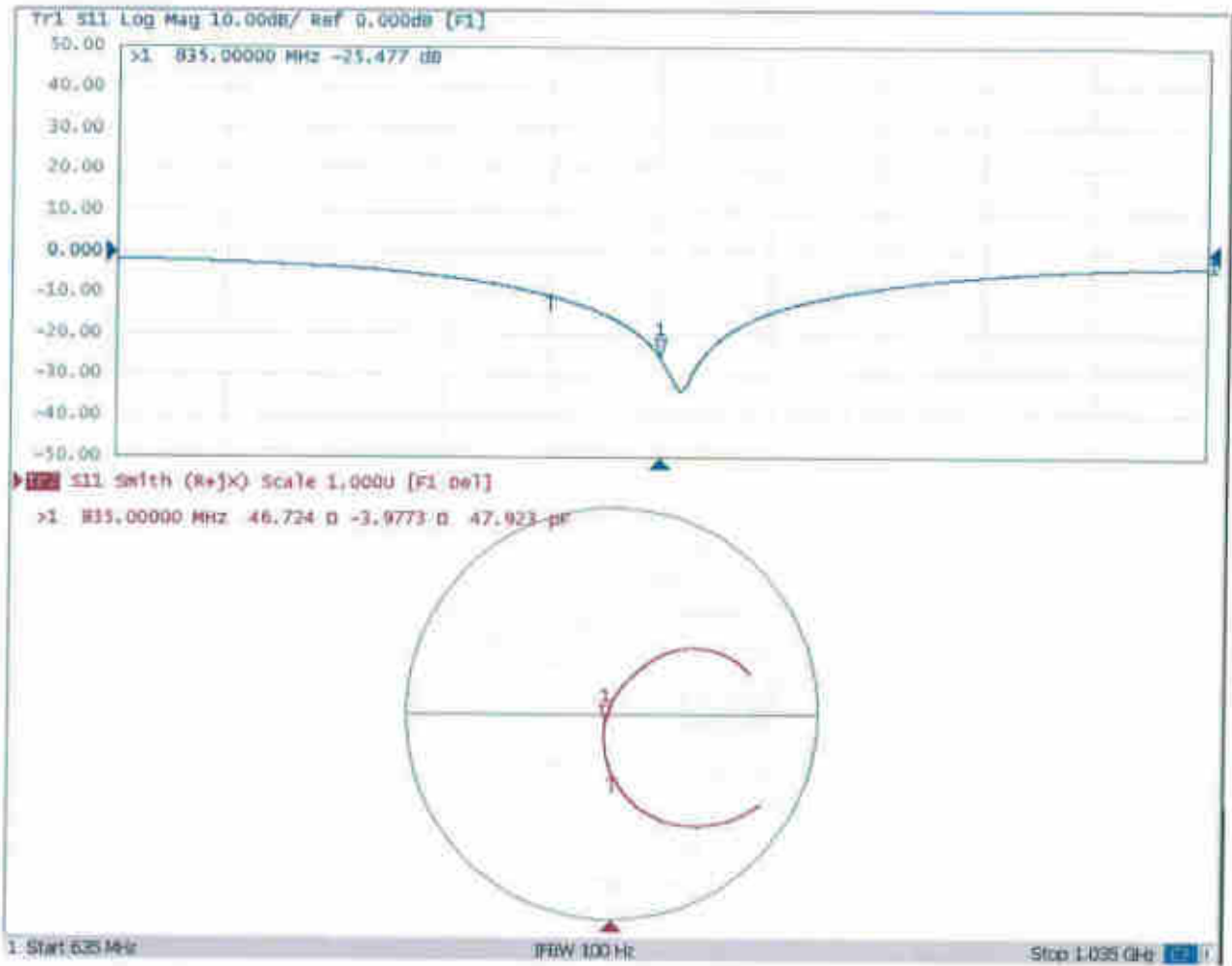


0 dB = 3.12 W/kg = 4.94 dBW/kg



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### Impedance Measurement Plot for Body TSL





## D835V2, Serial No. 4d151 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ( $< -20\text{dB}$ , 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.

835V2 – serial no. 4d151

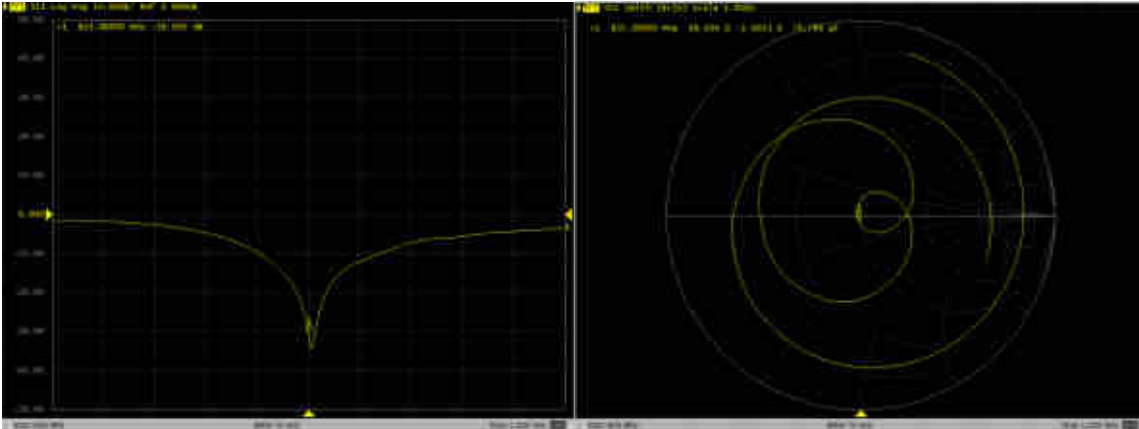
835V2 – serial no. 4d151												
	835 Head						835 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.27	-29.3		52.4		-2.6		-27.7		51.6		-3.9	
2020.3.26	-30.7	-0.05	49.0	3.44	-2.7	0.10	-24.9	0.10	50.6	0.94	-5.7	1.84

### <Justification of the extended calibration>

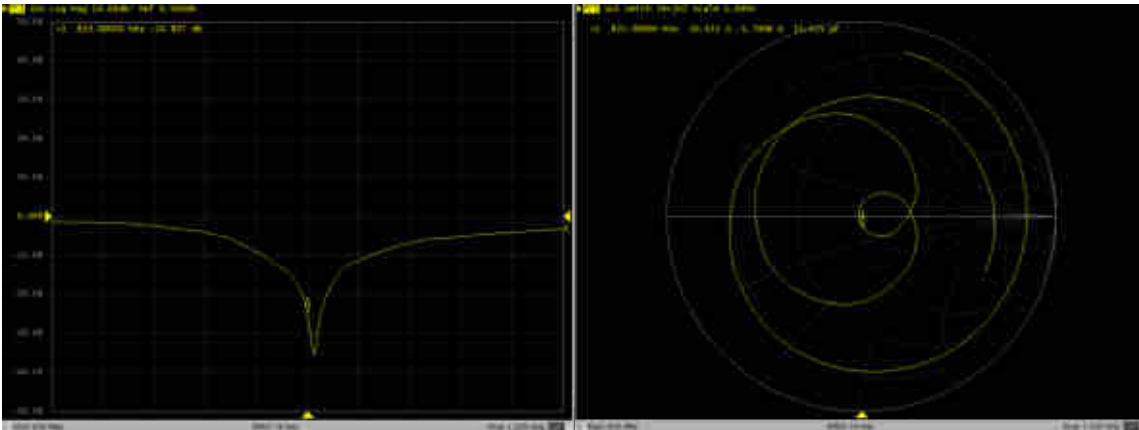
The return loss is  $< -20\text{dB}$ , within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D835V2, serial no. 4d151

835MHz – Head



835MHz – Body







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Client **Sporton**

Certificate No: **Z19-60084**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1090**

Calibration Procedure(s) **FF-Z11-003-01  
 Calibration Procedures for dipole validation kits**

Calibration date: **March 27, 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±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: March 29, 2019

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#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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%.





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## Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.3 $\pm$ 6 %	1.37 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	---	---

## SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.4 W/kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg $\pm$ 18.7 % (k=2)

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	55.0 $\pm$ 6 %	1.45 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	---	---

## SAR result with Body TSL

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.7 W/kg $\pm$ 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.9 W/kg $\pm$ 18.7 % (k=2)



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.5Ω- 2.34 jΩ
Return Loss	- 29.2 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.9Ω- 2.19 jΩ
Return Loss	- 23.2 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.085 ns
----------------------------------	----------

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

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

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

### Additional EUT Data

Manufactured by	SPEAG
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### DASY5 Validation Report for Head TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 41.27$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.38, 8.38, 8.38) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

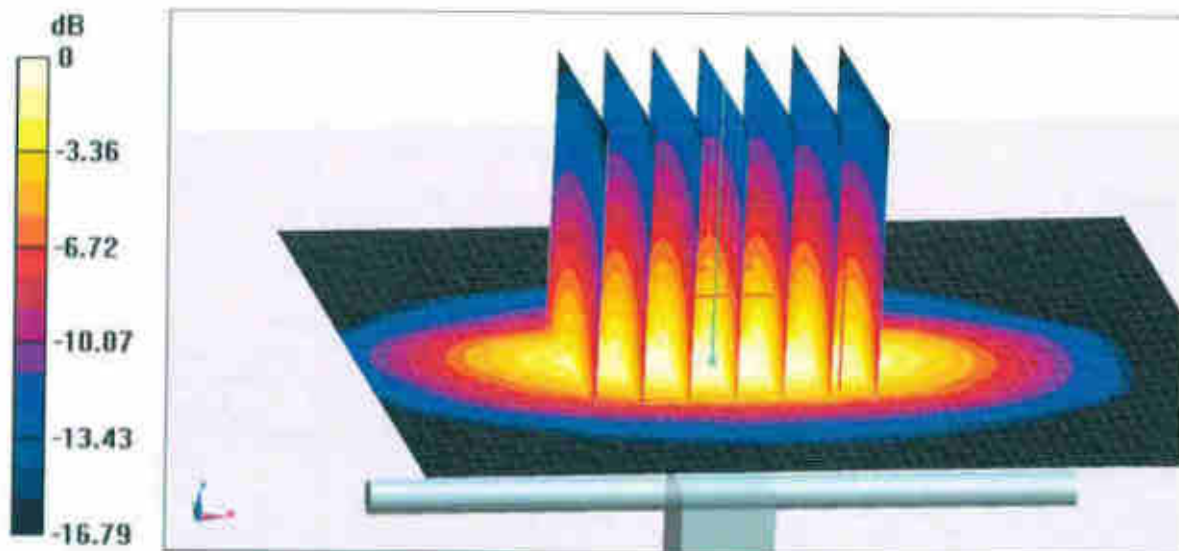
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 89.03 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 17.1 W/kg

**SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.79 W/kg**

Maximum value of SAR (measured) = 14.2 W/kg

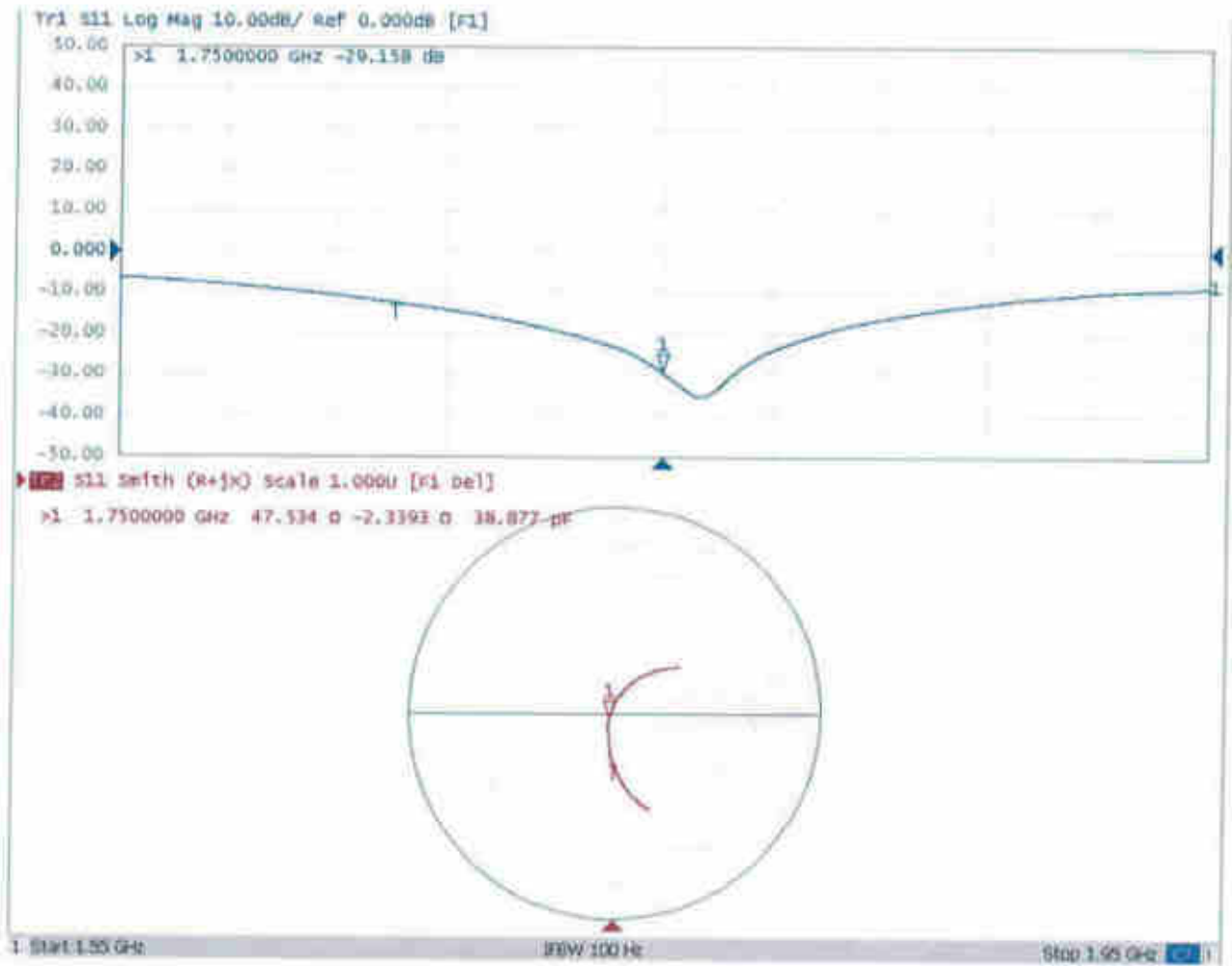


0 dB = 14.2 W/kg = 11.52 dBW/kg



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### Impedance Measurement Plot for Head TSL







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## DASY5 Validation Report for Body TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090**

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.449$  S/m;  $\epsilon_r = 54.97$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.03, 8.03, 8.03) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

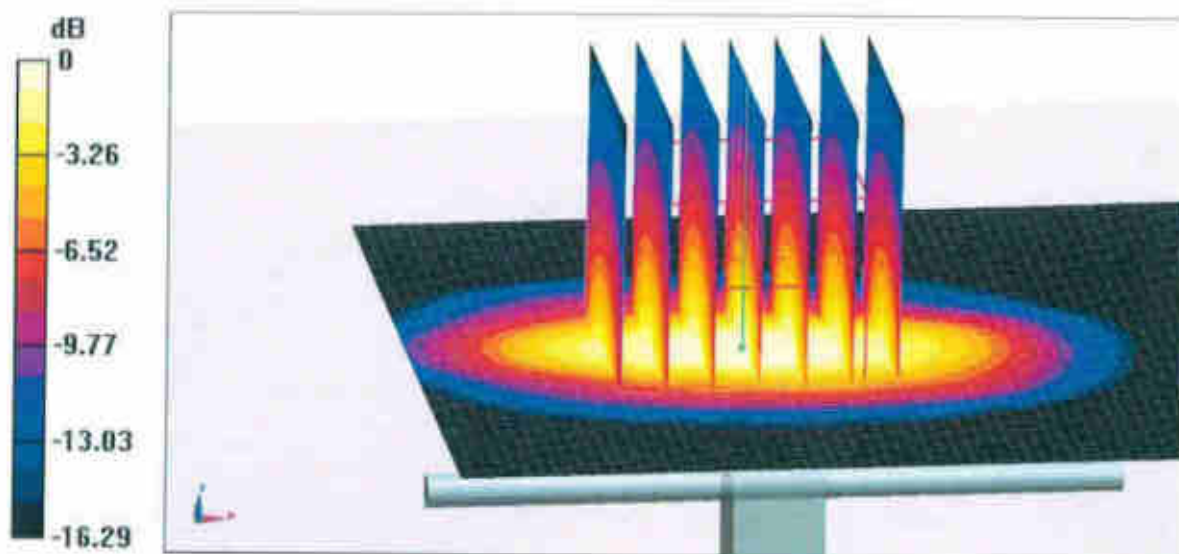
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 93.13 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.8 W/kg

**SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.89 W/kg**

Maximum value of SAR (measured) = 14.2 W/kg

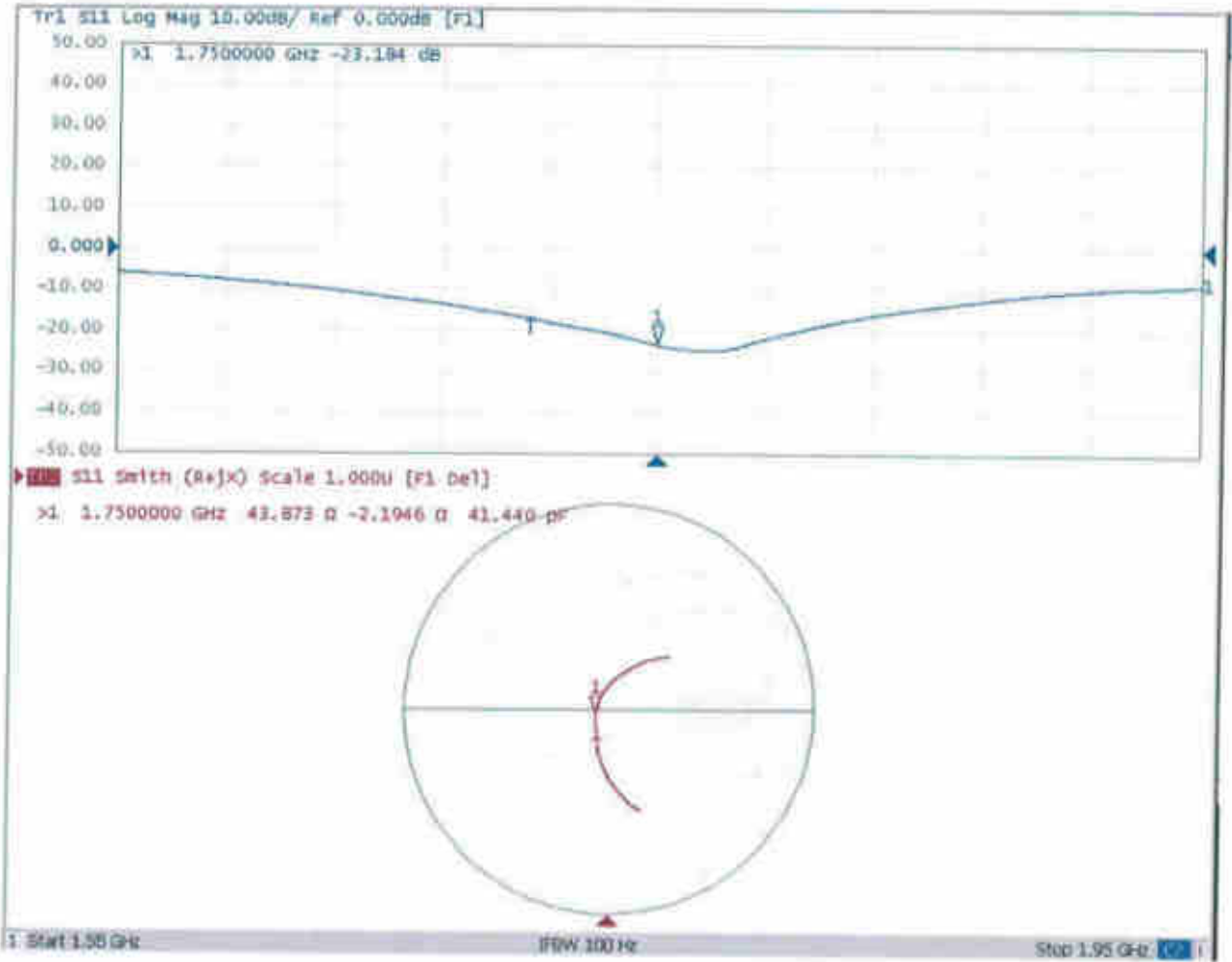


0 dB = 14.2 W/kg = 11.52 dBW/kg



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### Impedance Measurement Plot for Body TSL





## D1750V2, Serial No. 1090 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ( $< -20\text{dB}$ , 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.

1750V2 – serial no. 1090

1750V2 – serial no. 1090												
	1750 Head						1750 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.27	-29.2		47.5		-2.3		-23.2		43.9		-2.2	
2020.3.26	-29.8	-0.02	51.2	-3.66	-3.0	0.70	-25.0	-0.08	45.1	-1.22	-2.17	-0.02

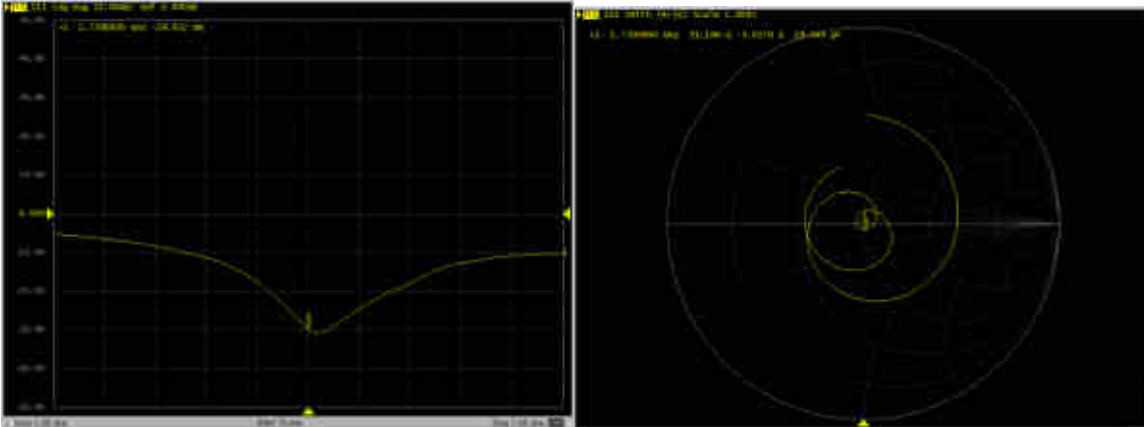
### <Justification of the extended calibration>

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

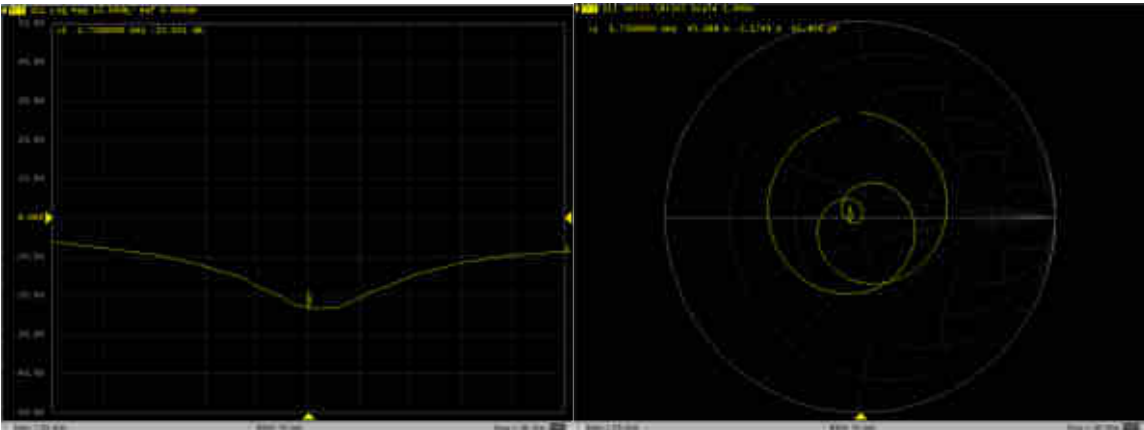


Dipole Verification Data> D1750V2, serial no. 1090

1750MHz – Head



1750MHz – Body





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Client **Sporton**

Certificate No: **Z19-60085**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d170**

Calibration Procedure(s) **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**

Calibration date: **March 26, 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±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: March 29, 2019

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#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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%.





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### Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 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	40.5 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	9.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.0 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 18.7 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.5 ± 6 %	1.56 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °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	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.0 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.0 W/kg ± 18.7 % (k=2)



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7Ω+ 6.73jΩ
Return Loss	- 23.3dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.8Ω+ 6.72jΩ
Return Loss	- 22.8dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.066 ns
----------------------------------	----------

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

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

### Additional EUT Data

Manufactured by	SPEAG
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### DASY5 Validation Report for Head TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.441$  S/m;  $\epsilon_r = 40.48$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.14, 8.14, 8.14) @ 1900 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

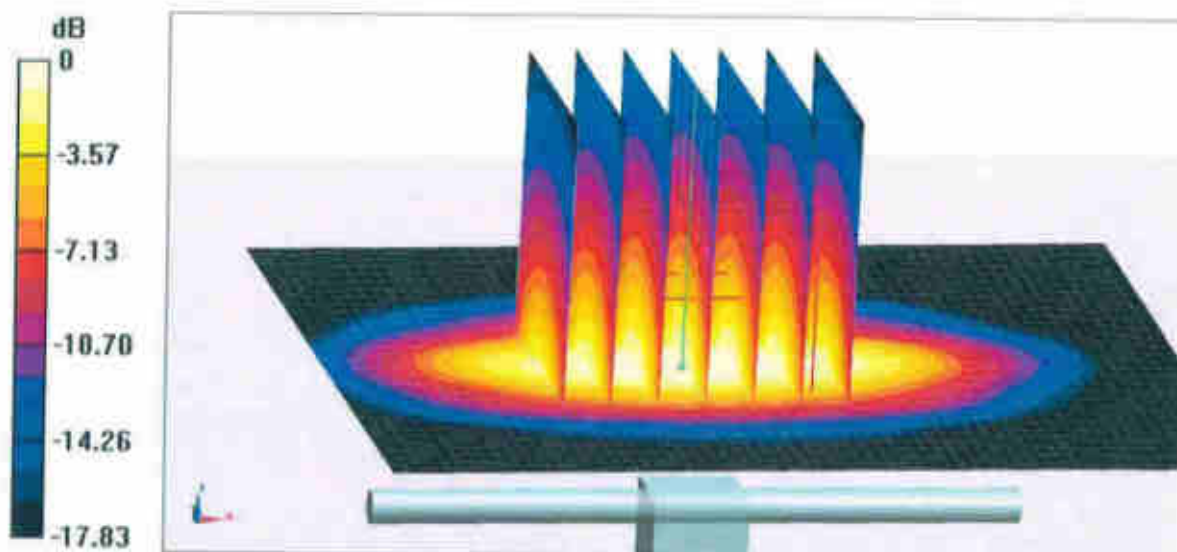
**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  
 $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 97.54 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 18.9 W/kg

**SAR(1 g) = 9.9 W/kg; SAR(10 g) = 5.12 W/kg**

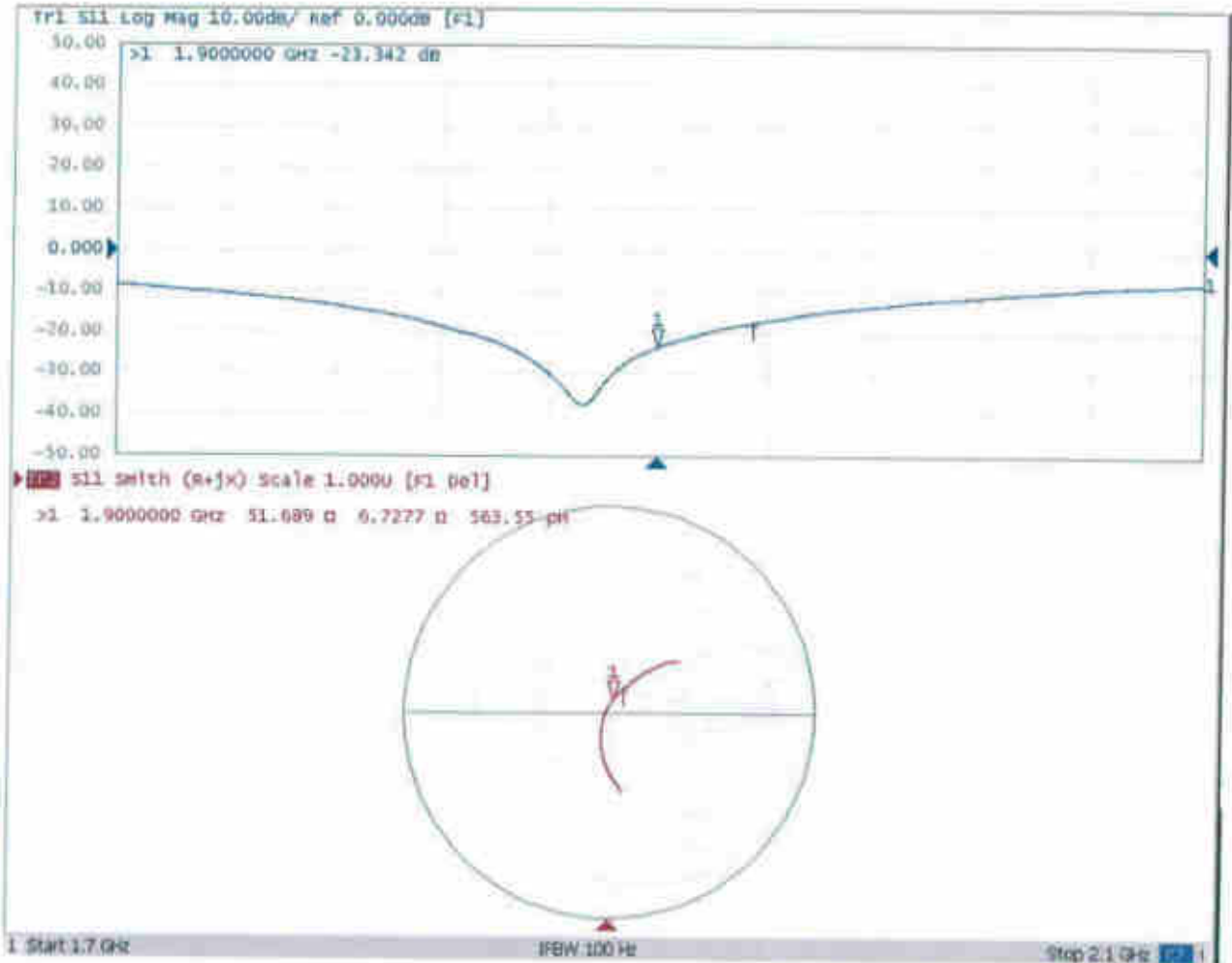
Maximum value of SAR (measured) = 15.6 W/kg





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### Impedance Measurement Plot for Head TSL







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### DASY5 Validation Report for Body TSL

Date: 03.26.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.56$  S/m;  $\epsilon_r = 54.52$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.78, 7.78, 7.78) @ 1900 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

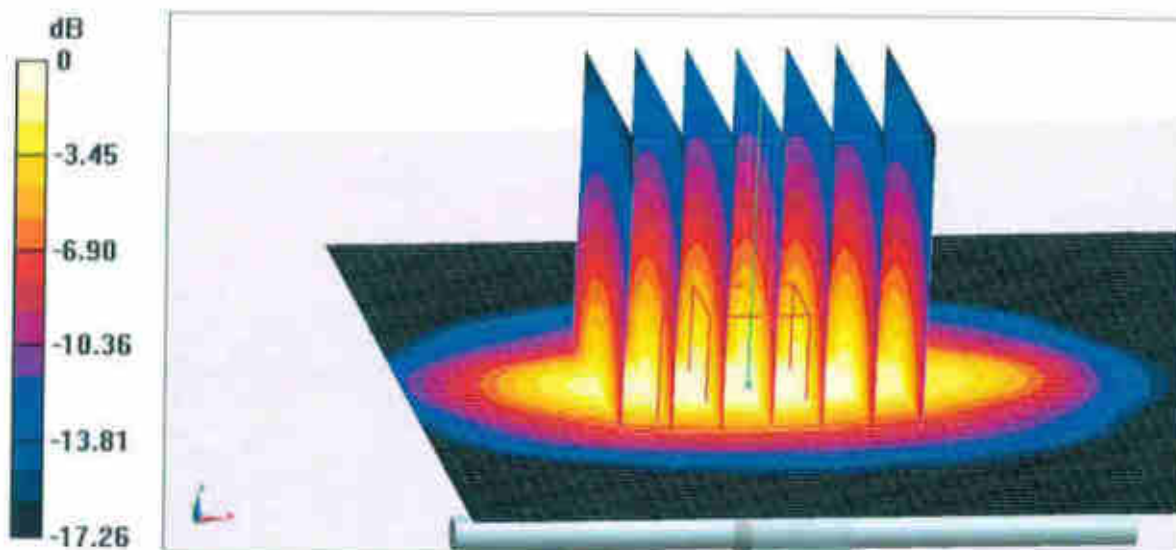
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 95.48 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.6 W/kg

**SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg**

Maximum value of SAR (measured) = 15.7 W/kg

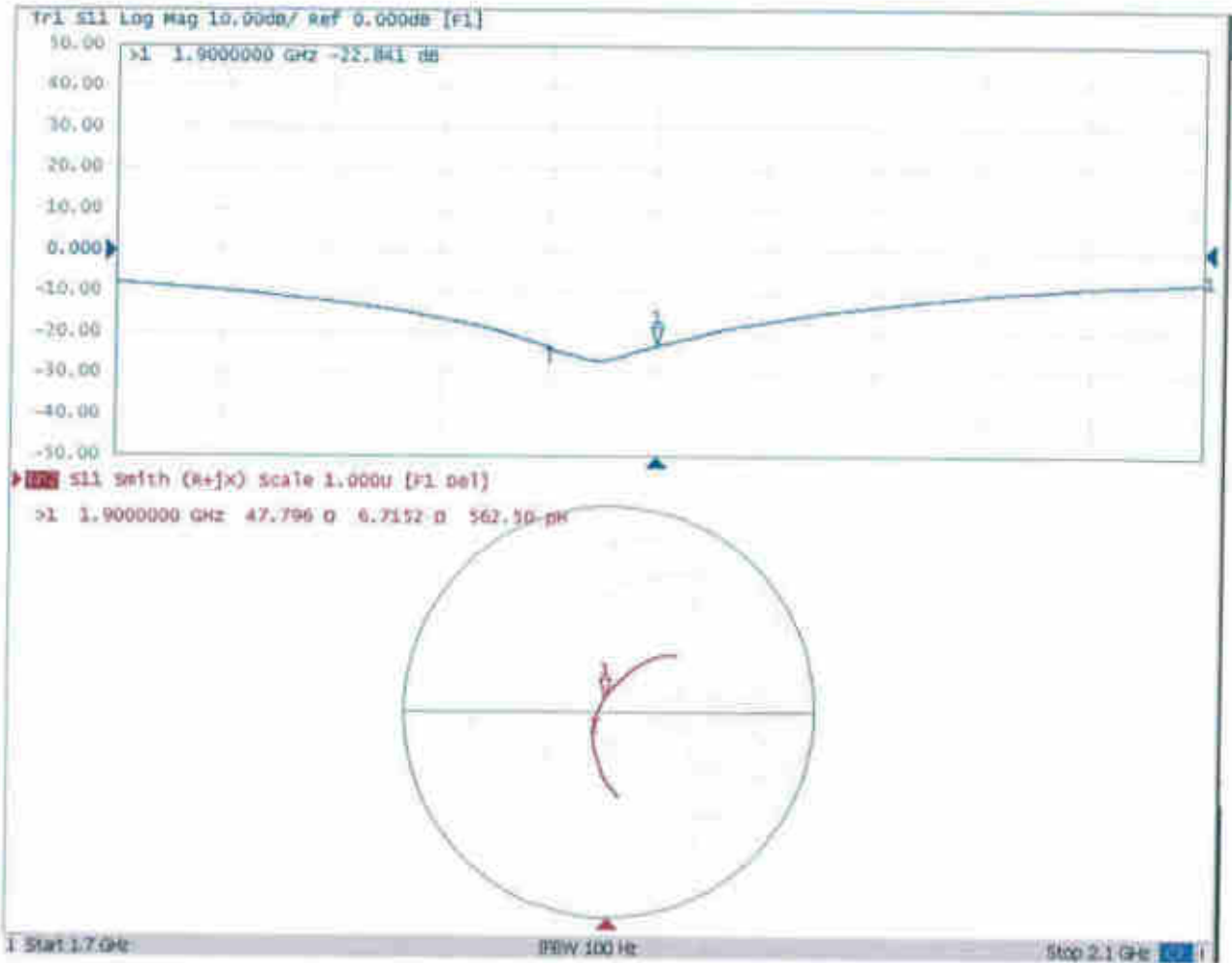


0 dB = 15.7 W/kg = 11.96 dBW/kg



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### Impedance Measurement Plot for Body TSL





## D1900V2, Serial No. 5d170 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ( $<-20\text{dB}$ , 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.

1900V2 – serial no. 5d170

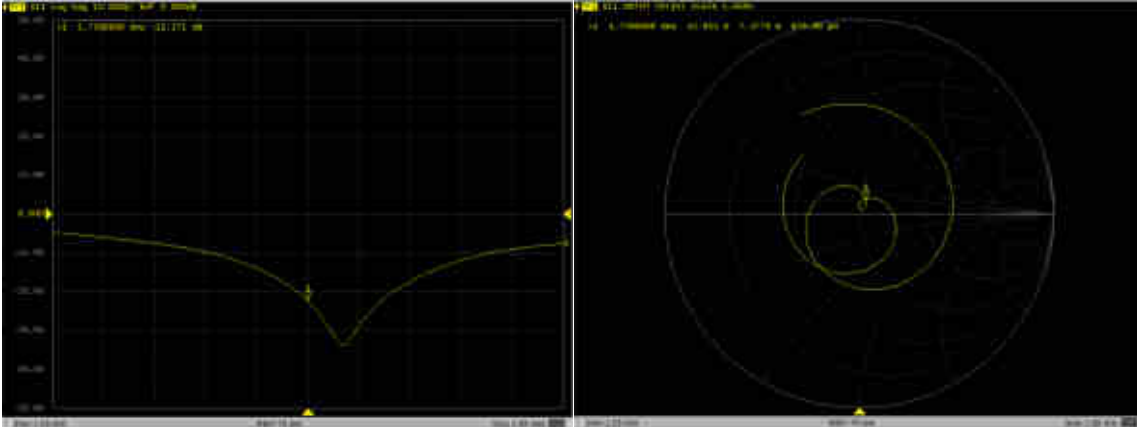
1900V2 – serial no. 5d170												
	1900 Head						1900 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.26	-23.3		51.7		6.7		-22.8		47.8		6.7	
2020.3.25	-22.3	0.05	53.0	-1.26	7.4	-0.64	-22.5	0.01	49.2	-1.37	7.41	-0.69

### <Justification of the extended calibration>

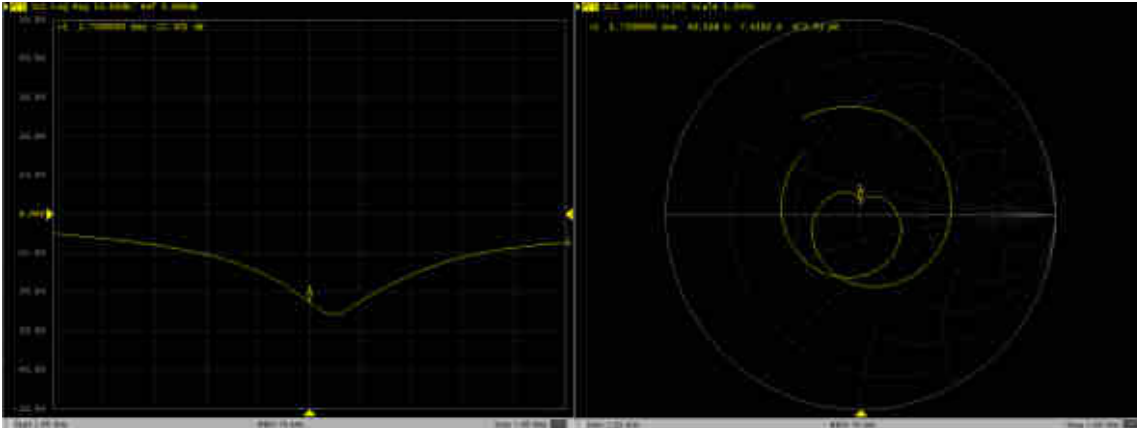
The return loss is  $<-20\text{dB}$ , within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D1900V2, serial no. 5d170

1900MHz – Head



1900MHz – Body







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Client **Sporton**

Certificate No: **Z19-60087**

## CALIBRATION CERTIFICATE

Object: **D2450V2 - SN: 908**

Calibration Procedure(s): **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**

Calibration date: **March 25, 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±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: March 28, 2019

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



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#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
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 assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	39.6 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °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	13.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.8 W/kg ± 18.6 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 18.7 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.8 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °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	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.8 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.6 W/kg ± 18.7 % (k=2)



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$57.3\Omega + 5.18 j\Omega$
Return Loss	- 21.6dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$52.6\Omega + 5.81 j\Omega$
Return Loss	- 24.1dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.020 ns
----------------------------------	----------

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

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

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

### Additional EUT Data

Manufactured by	SPEAG
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### DASY5 Validation Report for Head TSL

Date: 03.25.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.841$  S/m;  $\epsilon_r = 39.63$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.62, 7.62, 7.62) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

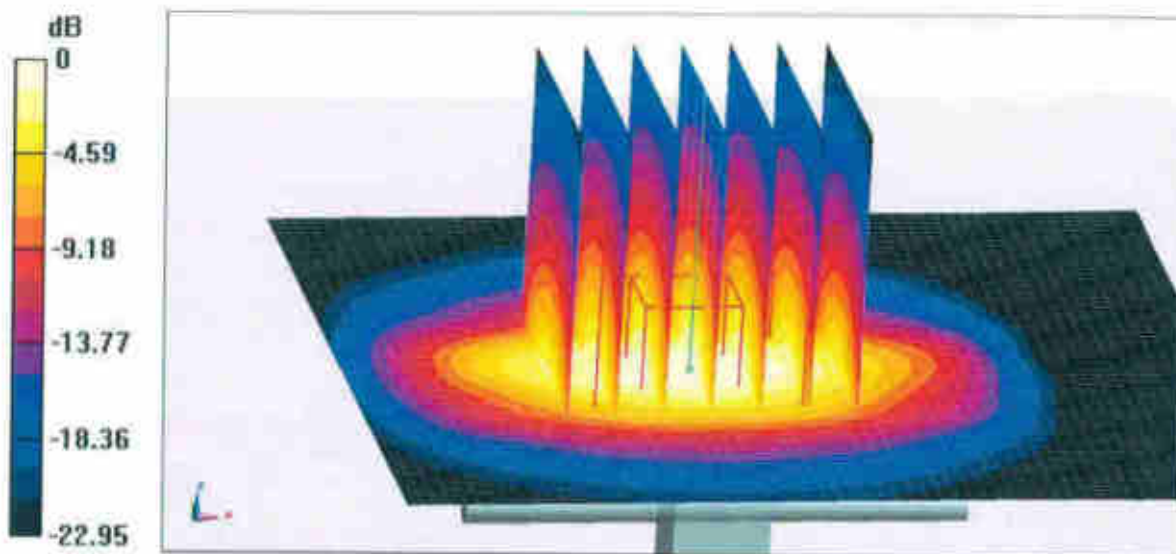
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.04 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 28.3 W/kg

**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.07 W/kg**

Maximum value of SAR (measured) = 22.4 W/kg

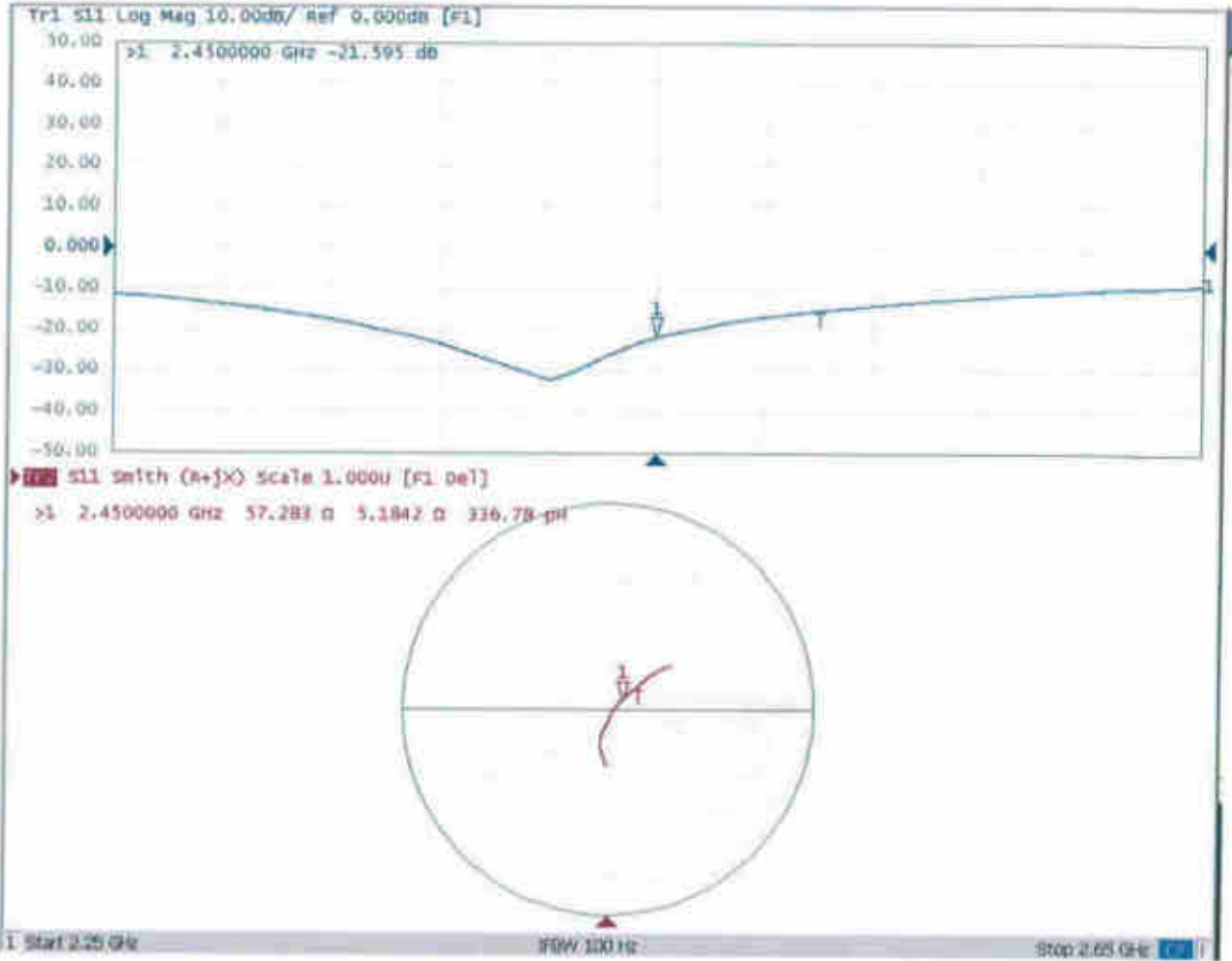


0 dB = 22.4 W/kg = 13.50 dBW/kg



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### Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL**

Date: 03.25.2019

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.003$  S/m;  $\epsilon_r = 53.78$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3617; ConvF(7.79, 7.79, 7.79) @ 2450 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

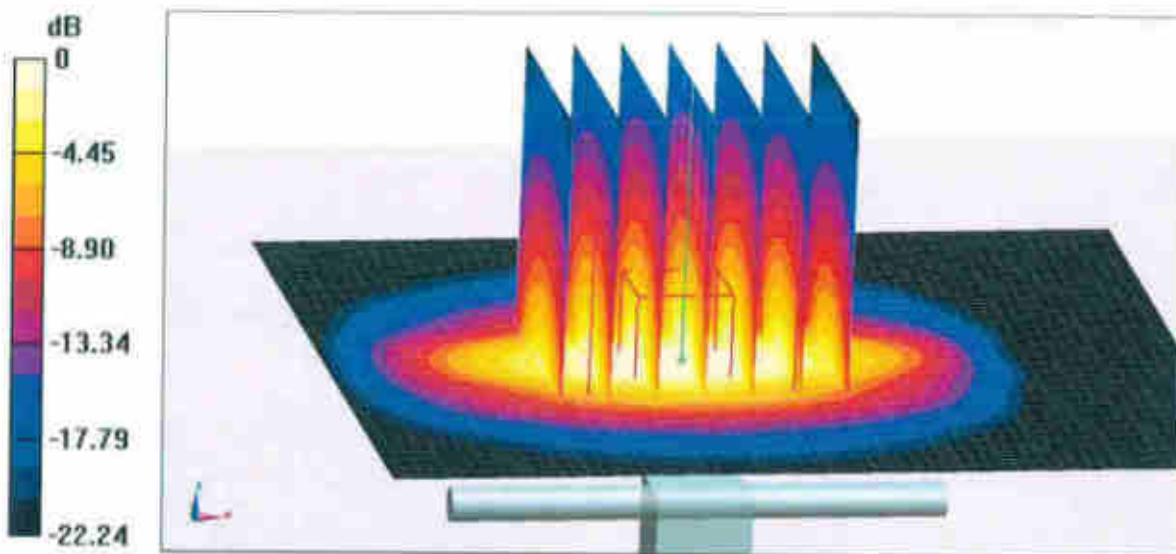
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.51 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.1 W/kg

**SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.91 W/kg**

Maximum value of SAR (measured) = 21.4 W/kg

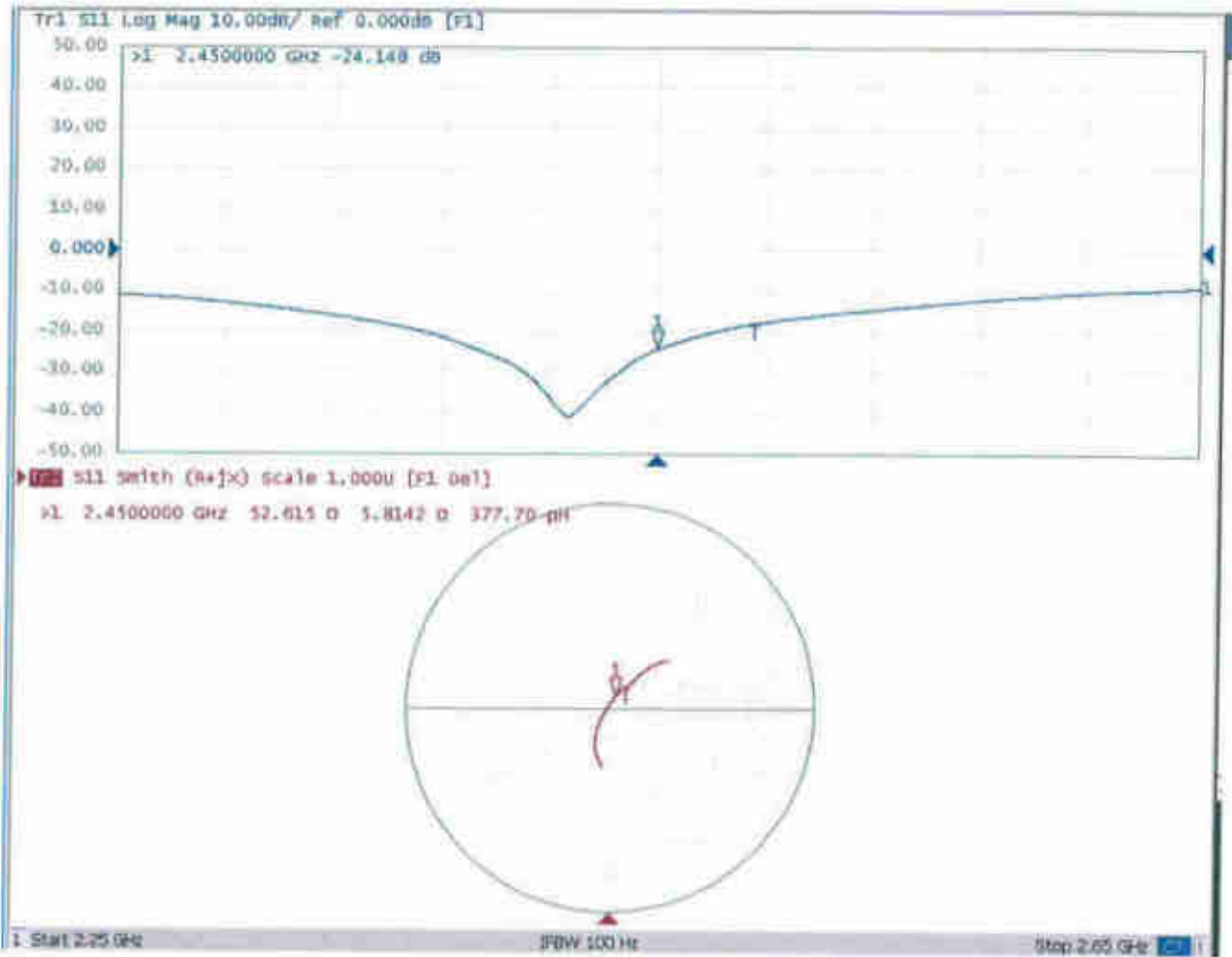


0 dB = 21.4 W/kg = 13.30 dBW/kg



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### Impedance Measurement Plot for Body TSL







## D2450V2, Serial No. 908 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss ( $< -20\text{dB}$ , 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.

2450V2 – serial no. 908

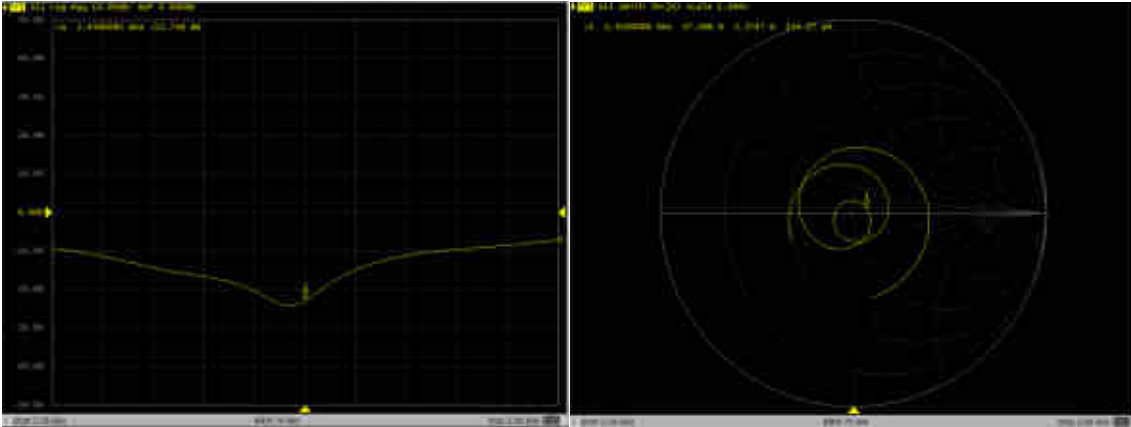
2450V2 – serial no. 908												
	2450 Head						2450 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2019.3.25	-21.6		57.3		5.2		-24.1		52.6		5.8	
2020.3.24	-22.7	-0.05	57.5	-0.18	2.4	2.81	-26.1	-0.08	55.01	-2.40	1.493	4.32

### <Justification of the extended calibration>

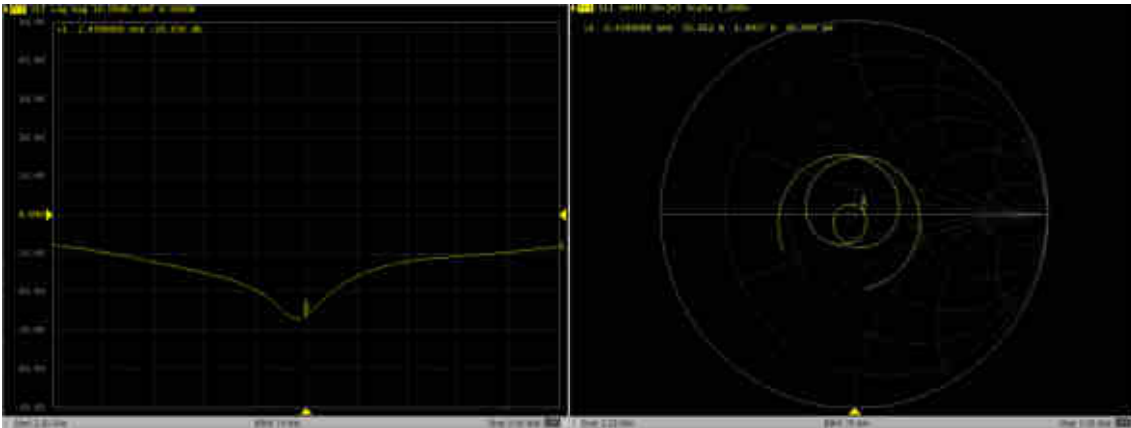
The return loss is  $< -20\text{dB}$ , within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data> D2450V2, serial no. 908

2450MHz – Head



2450MHz – Body





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

Accreditation No.: **SCS 0108**

Client **Sporton**

Certificate No: **D2600V2-1061\_Nov20**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1061**

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

Calibration date: **November 26, 2020**

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	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7405	29-Jun-20 (No. EX3-7405_Jun20)	Jun-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
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: MY41092317	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-21

Calibrated by: **Claudio Leubler**      **Laboratory Technician**

Approved by: **Katja Pokovic**      **Technical Manager**

Signature

Issued: November 26, 2020

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