

### 23\_GSM1900\_GPRS(4 Tx slots)\_Front\_10mm\_Ch512

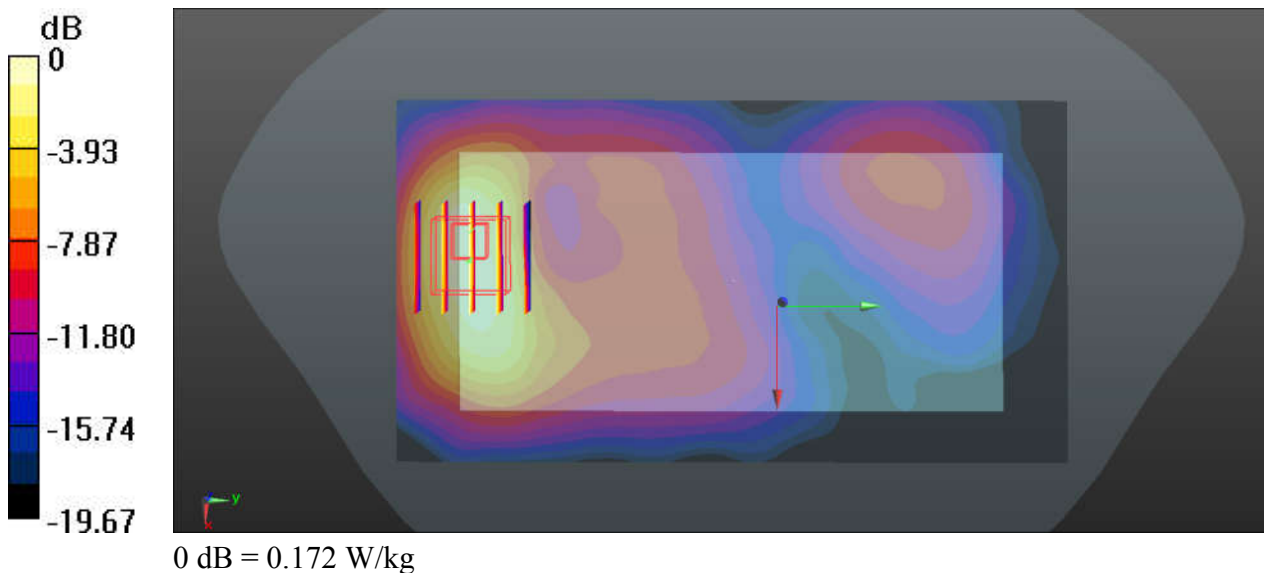
Communication System: UID 0, GPRS/EDGE12 (0); Frequency: 1850.2 MHz; Duty Cycle: 1:2.08  
Medium: MSL\_1900\_180720 Medium parameters used:  $f = 1850.2$  MHz;  $\sigma = 1.521$  S/m;  $\epsilon_r = 54.39$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C; Liquid Temperature : 22.9 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(8.27, 8.27, 8.27); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch512/Area Scan (71x131x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.172 W/kg

**Ch512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 1.301 V/m; Power Drift = -0.03 dB  
Peak SAR (extrapolated) = 0.259 W/kg  
**SAR(1 g) = 0.148 W/kg; SAR(10 g) = 0.078 W/kg**  
Maximum value of SAR (measured) = 0.207 W/kg



## 24\_WCDMA V\_RMC 12.2Kbps\_Back\_10mm\_Ch4182

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1  
Medium: MSL\_835\_180723 Medium parameters used:  $f = 836.4$  MHz;  $\sigma = 0.979$  S/m;  $\epsilon_r = 54.429$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.8 °C; Liquid Temperature : 22.8 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(10.19, 10.19, 10.19); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch4182/Area Scan (71x131x1):** Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.134 W/kg

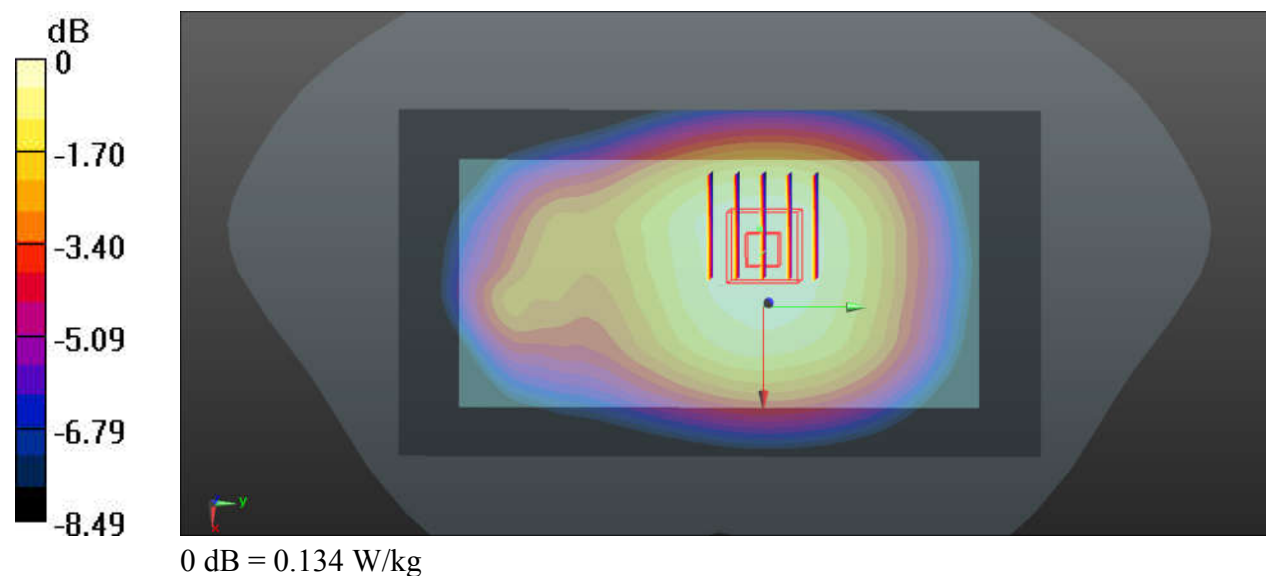
**Ch4182/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 0.9050 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.144 W/kg

**SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.090 W/kg**

Maximum value of SAR (measured) = 0.132 W/kg



## 25\_WCDMA IV\_RMC 12.2Kbps\_Back\_10mm\_Ch1413

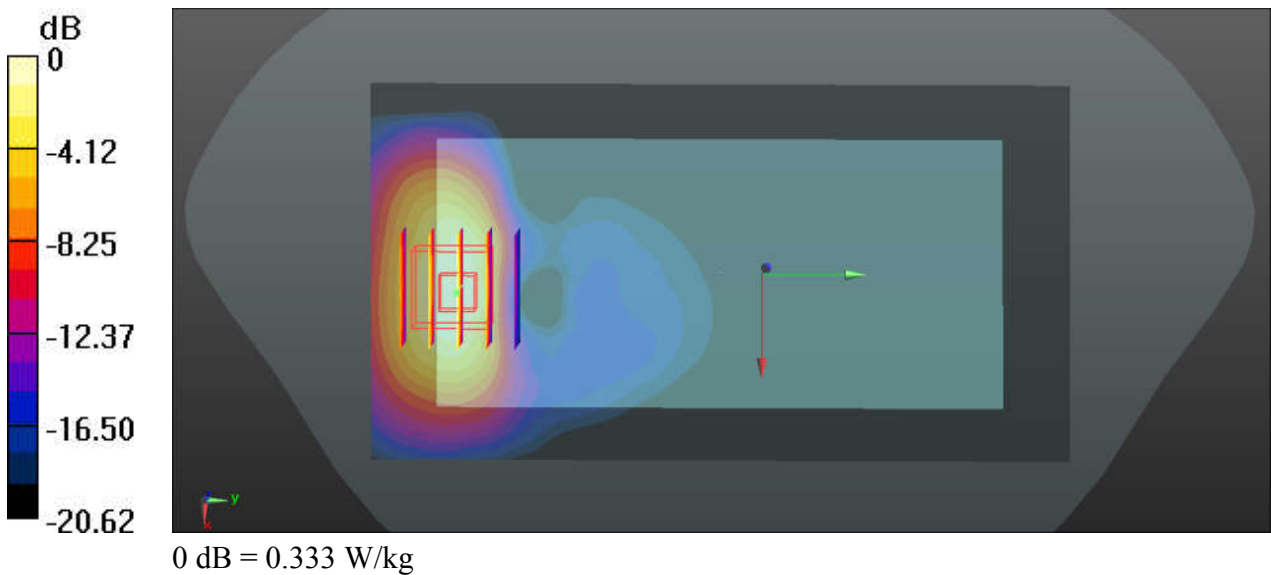
Communication System: UID 0, UMTS (0); Frequency: 1732.6 MHz; Duty Cycle: 1:1  
 Medium: MSL\_1750\_180720 Medium parameters used:  $f = 1732.6 \text{ MHz}$ ;  $\sigma = 1.503 \text{ S/m}$ ;  $\epsilon_r = 52.551$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Ambient Temperature :  $23.5 \text{ }^\circ\text{C}$ ; Liquid Temperature :  $22.7 \text{ }^\circ\text{C}$

### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(8.61, 8.61, 8.61); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch1413/Area Scan (71x131x1):** Interpolated grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$   
 Maximum value of SAR (interpolated) =  $0.380 \text{ W/kg}$

**Ch1413/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value =  $1.061 \text{ V/m}$ ; Power Drift =  $0.07 \text{ dB}$   
 Peak SAR (extrapolated) =  $0.409 \text{ W/kg}$   
**SAR(1 g) =  $0.245 \text{ W/kg}$ ; SAR(10 g) =  $0.133 \text{ W/kg}$**   
 Maximum value of SAR (measured) =  $0.333 \text{ W/kg}$



## 26\_WCDMA II\_RMC 12.2Kbps\_Front\_10mm\_Ch9262

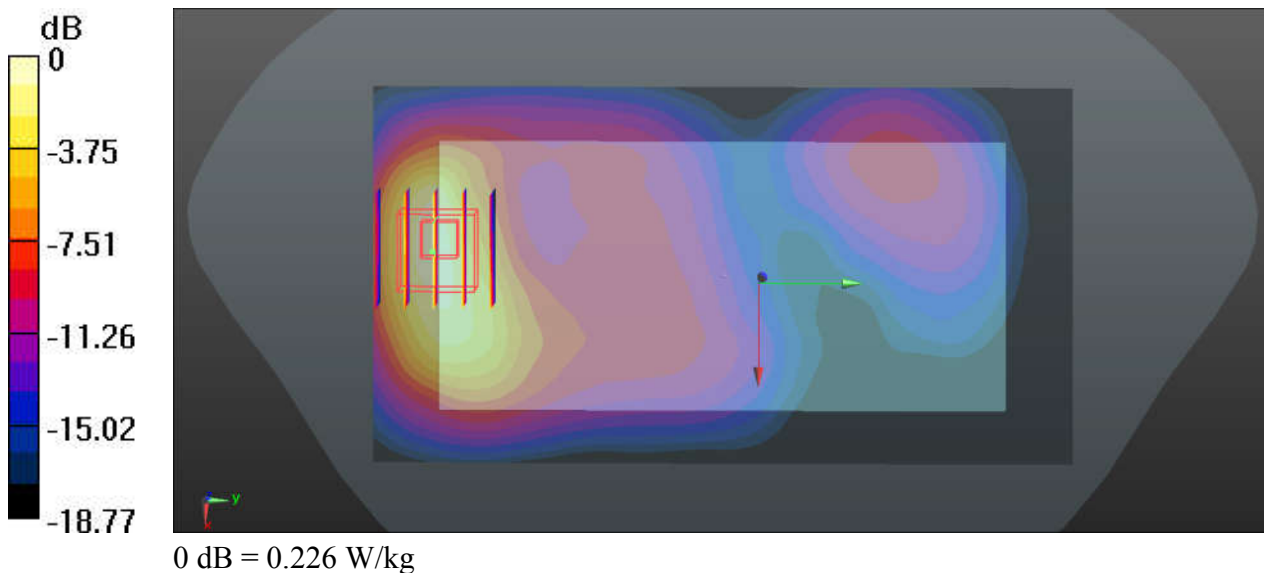
Communication System: UID 0, UMTS (0); Frequency: 1852.4 MHz; Duty Cycle: 1:1  
Medium: MSL\_1900\_180720 Medium parameters used:  $f = 1852.4$  MHz;  $\sigma = 1.523$  S/m;  $\epsilon_r = 54.384$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C; Liquid Temperature : 22.9 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(8.27, 8.27, 8.27); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch9262/Area Scan (71x131x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.215 W/kg

**Ch9262/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 1.470 V/m; Power Drift = -0.09 dB  
Peak SAR (extrapolated) = 0.308 W/kg  
**SAR(1 g) = 0.174 W/kg; SAR(10 g) = 0.091 W/kg**  
Maximum value of SAR (measured) = 0.226 W/kg



## 27\_LTE Band 5\_10M\_QPSK\_1RB\_25Offset\_Front\_10mm\_Ch20525

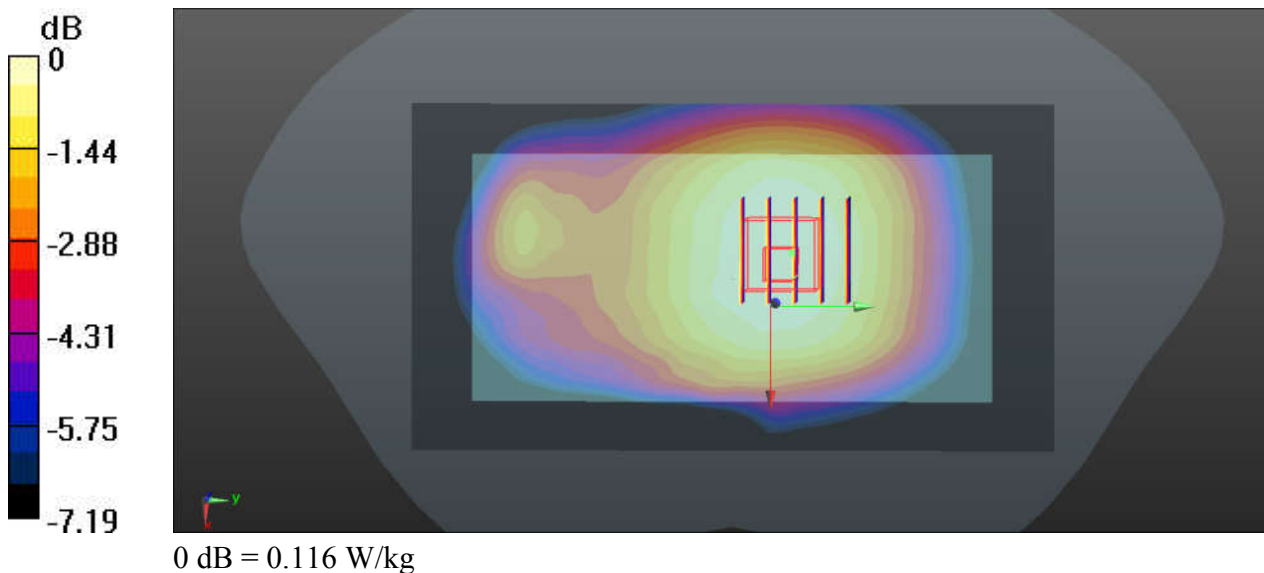
Communication System: UID 0, LTE (0); Frequency: 836.5 MHz; Duty Cycle: 1:1  
Medium: MSL\_835\_180723 Medium parameters used:  $f = 836.5$  MHz;  $\sigma = 0.979$  S/m;  $\epsilon_r = 54.428$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.8 °C; Liquid Temperature : 22.8 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(10.19, 10.19, 10.19); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch20525/Area Scan (71x131x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.116 W/kg

**Ch20525/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 1.193 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 0.126 W/kg  
**SAR(1 g) = 0.102 W/kg; SAR(10 g) = 0.080 W/kg**  
Maximum value of SAR (measured) = 0.115 W/kg



## 28\_LTE Band 4\_20M\_QPSK\_1RB\_49Offset\_Back\_10mm\_Ch21750

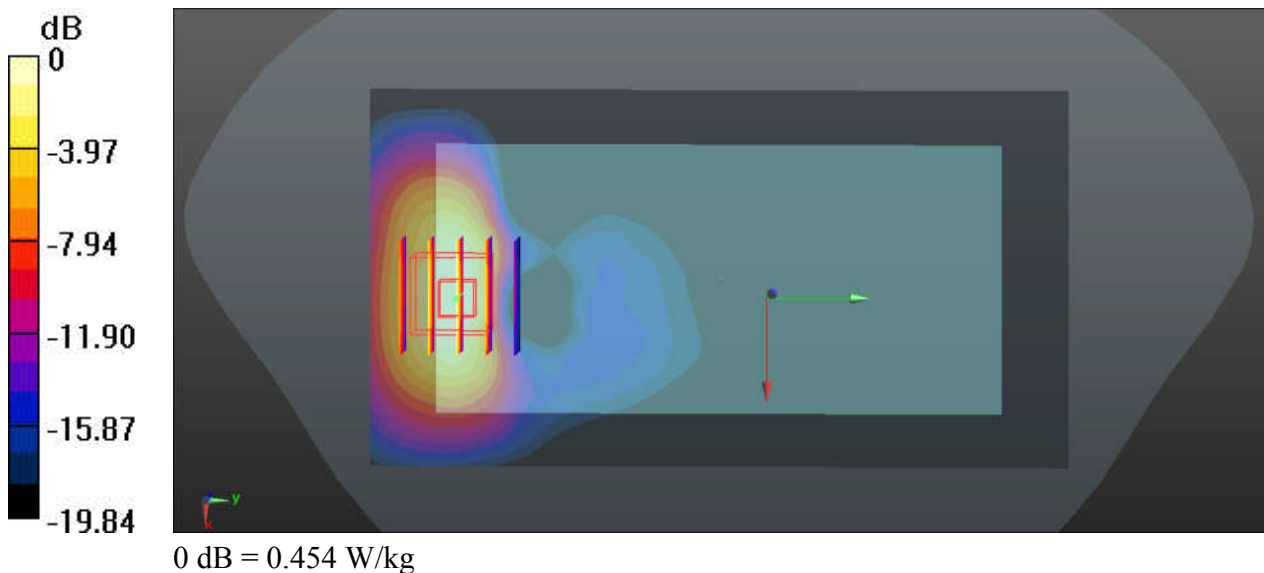
Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1  
Medium: MSL\_1750\_180720 Medium parameters used:  $f = 1732.5$  MHz;  $\sigma = 1.502$  S/m;  $\epsilon_r = 52.553$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C; Liquid Temperature : 22.7 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(8.61, 8.61, 8.61); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch21750/Area Scan (71x131x1):** Interpolated grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 0.553 W/kg

**Ch21750/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 1.233 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 0.556 W/kg  
**SAR(1 g) = 0.338 W/kg; SAR(10 g) = 0.180 W/kg**  
Maximum value of SAR (measured) = 0.454 W/kg



## 29\_LTE Band 2\_20M\_QPSK\_1RB\_49Offset\_Front\_10mm\_Ch19100

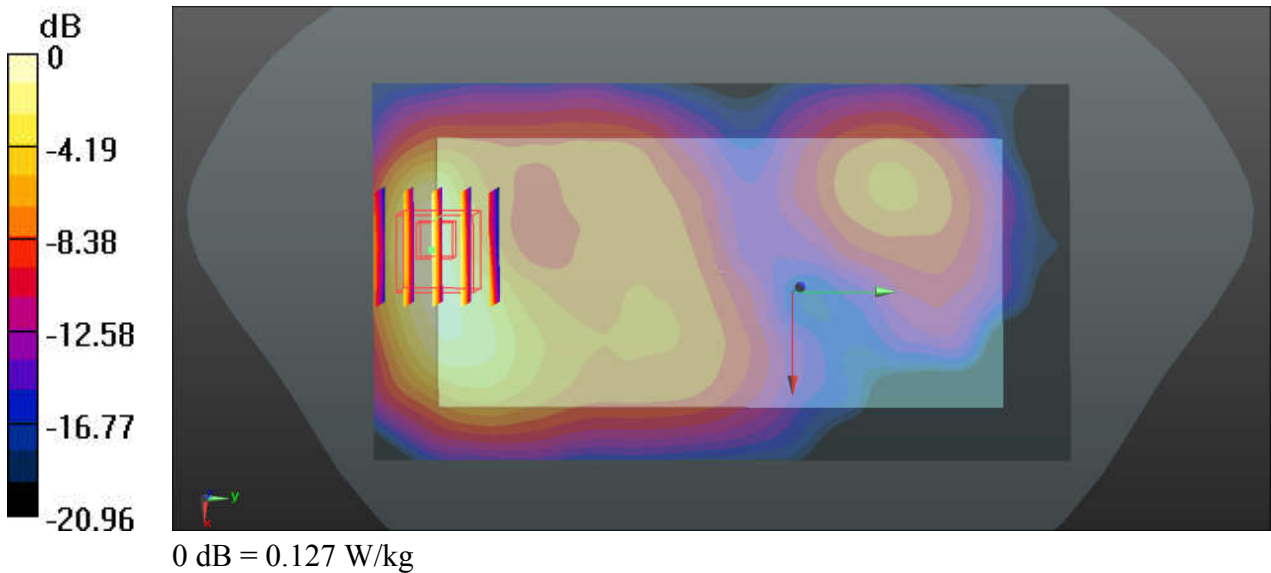
Communication System: UID 0, LTE (0); Frequency: 1900 MHz; Duty Cycle: 1:1  
 Medium: MSL\_1900\_180720 Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.577$  S/m;  $\epsilon_r = 54.209$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
 Ambient Temperature : 23.5 °C; Liquid Temperature : 22.9 °C

### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(8.27, 8.27, 8.27); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch19100/Area Scan (71x131x1):** Interpolated grid: dx=15mm, dy=15mm  
 Maximum value of SAR (interpolated) = 0.127 W/kg

**Ch19100/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 0.9080 V/m; Power Drift = 0.04 dB  
 Peak SAR (extrapolated) = 0.176 W/kg  
**SAR(1 g) = 0.101 W/kg; SAR(10 g) = 0.052 W/kg**  
 Maximum value of SAR (measured) = 0.135 W/kg



### 30\_LTE Band 7\_20M\_QPSK\_1RB\_49Offset\_Back\_10mm\_Ch21350

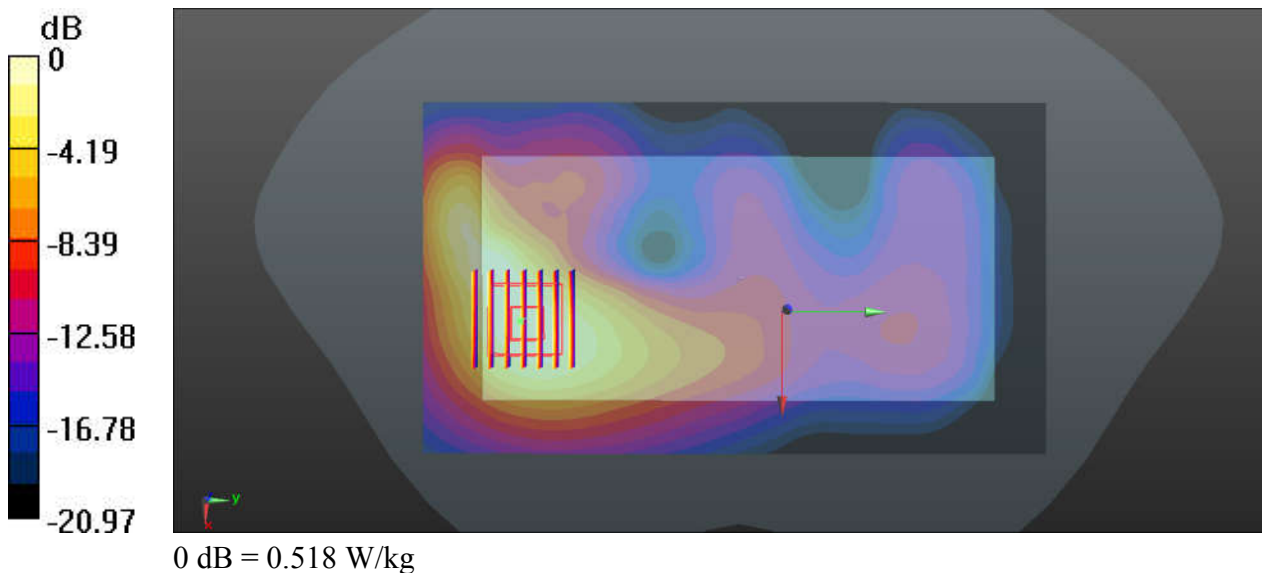
Communication System: UID 0, LTE (0); Frequency: 2560 MHz; Duty Cycle: 1:1  
Medium: MSL\_2600\_180721 Medium parameters used:  $f = 2560$  MHz;  $\sigma = 2.137$  S/m;  $\epsilon_r = 51.063$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.6 °C; Liquid Temperature : 22.5 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(7.84, 7.84, 7.84); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch21350/Area Scan (91x161x1):** Interpolated grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 0.518 W/kg

**Ch21350/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 1.592 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 0.632 W/kg  
**SAR(1 g) = 0.355 W/kg; SAR(10 g) = 0.197 W/kg**  
Maximum value of SAR (measured) = 0.492 W/kg





### 31\_WLAN2.4GHz\_802.11b 1Mbps\_Front\_10mm\_Ch6

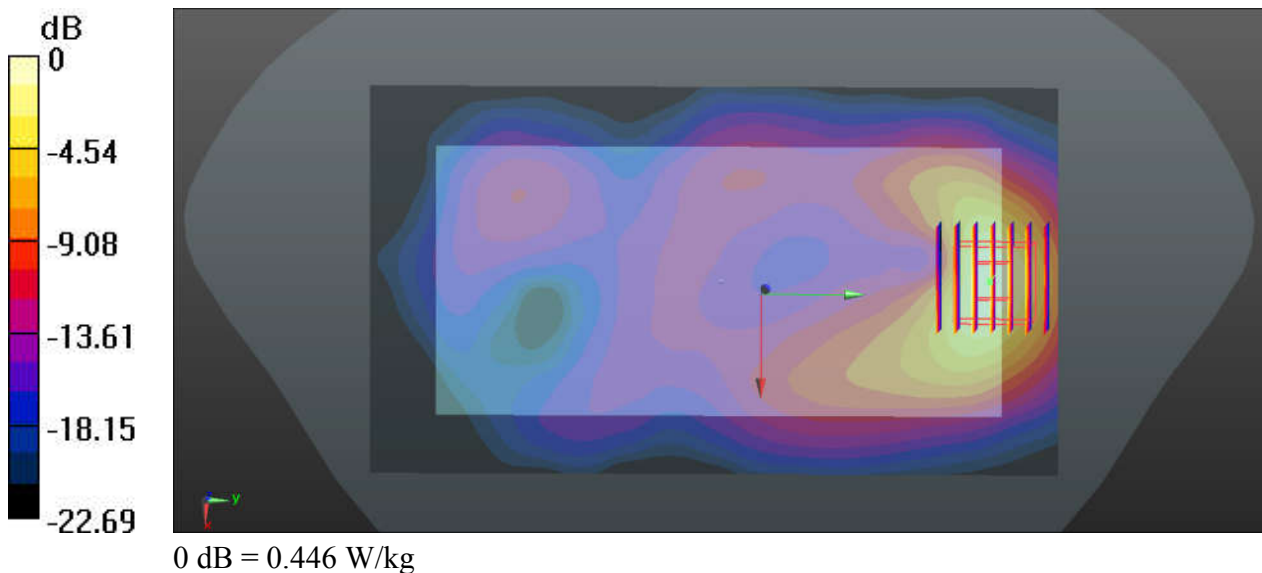
Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1.026  
Medium: MSL\_2450\_180721 Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.931$  S/m;  $\epsilon_r = 51.715$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.5 °C; Liquid Temperature : 22.5 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3958; ConvF(8, 8, 8); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM (Front) with CRP v5.0; Type: QD000P40CD; Serial: TP:1795
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch6/Area Scan (91x161x1):** Interpolated grid: dx=12mm, dy=12mm  
Maximum value of SAR (interpolated) = 0.428 W/kg

**Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 0.5980 V/m; Power Drift = -0.07 dB  
Peak SAR (extrapolated) = 0.568 W/kg  
**SAR(1 g) = 0.297 W/kg; SAR(10 g) = 0.138 W/kg**  
Maximum value of SAR (measured) = 0.446 W/kg





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**Appendix C. DAS Y Calibration Certificate**

The DAS Y calibration certificates are shown as follows.



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Client Sporton

Certificate No: **Z17-97247**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d162**

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

Calibration date: **December 5, 2017**

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 NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	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: December 9, 2017

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%.



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### Measurement Conditions

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

DASY Version	DASY52	52.10.0.1446
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 ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.7 ± 6 %	0.88 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	2.34 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.56 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.54 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.26 mW / g ± 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 ± 0.2) °C	54.7 ± 6 %	0.96 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	2.38 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.56 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.58 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.34 mW / g ± 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	50.3 $\Omega$ - 2.96j $\Omega$
Return Loss	- 30.5dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6 $\Omega$ - 3.92j $\Omega$
Return Loss	- 26.6dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.264 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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**DASY5 Validation Report for Head TSL**

Date: 12.04.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.876 \text{ S/m}$ ;  $\epsilon_r = 41.67$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3617; ConvF(9.73, 9.73, 9.73); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

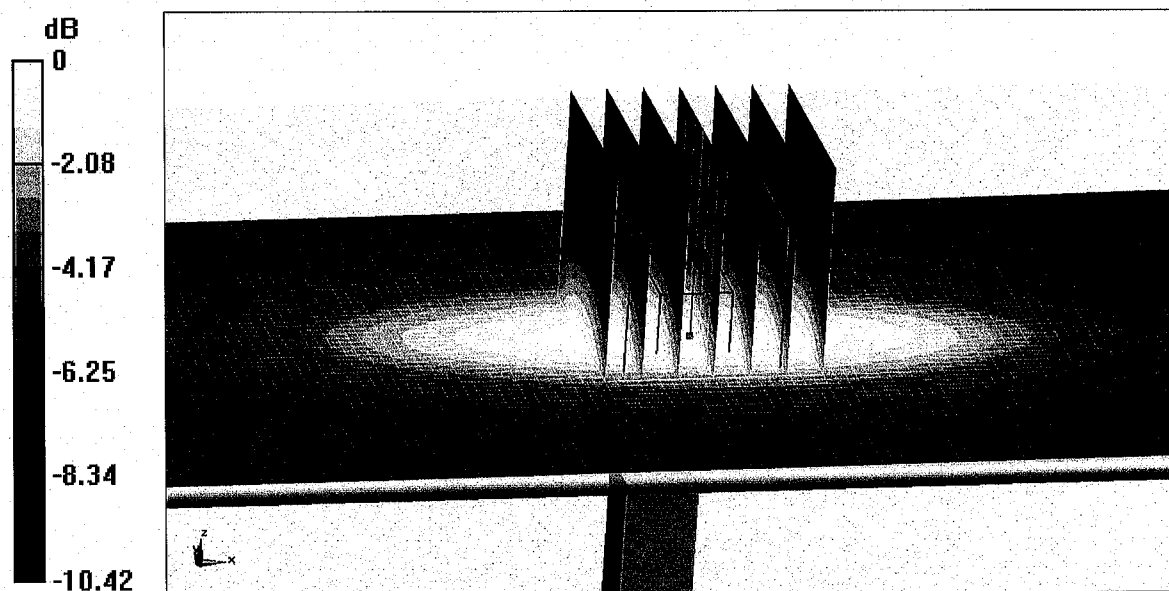
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.70V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.53 W/kg

**SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.54 W/kg**

Maximum value of SAR (measured) = 3.13 W/kg

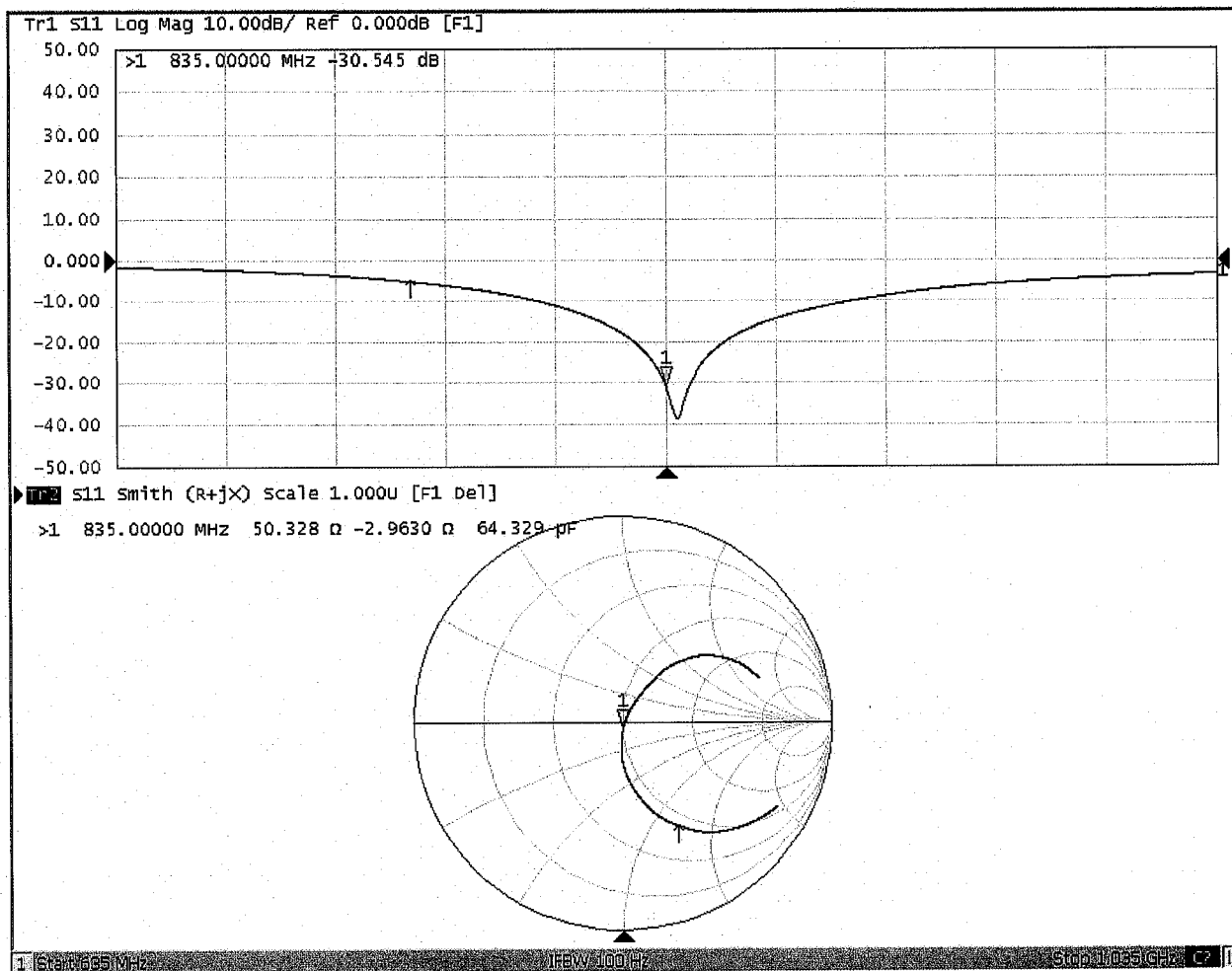


**0 dB = 3.13 W/kg = 4.96 dBW/kg**



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### Impedance Measurement Plot for Head TSL







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**DASY5 Validation Report for Body TSL**

Date: 12.05.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162**

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

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.962 \text{ S/m}$ ;  $\epsilon_r = 54.65$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3617; ConvF(9.64, 9.64, 9.64); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

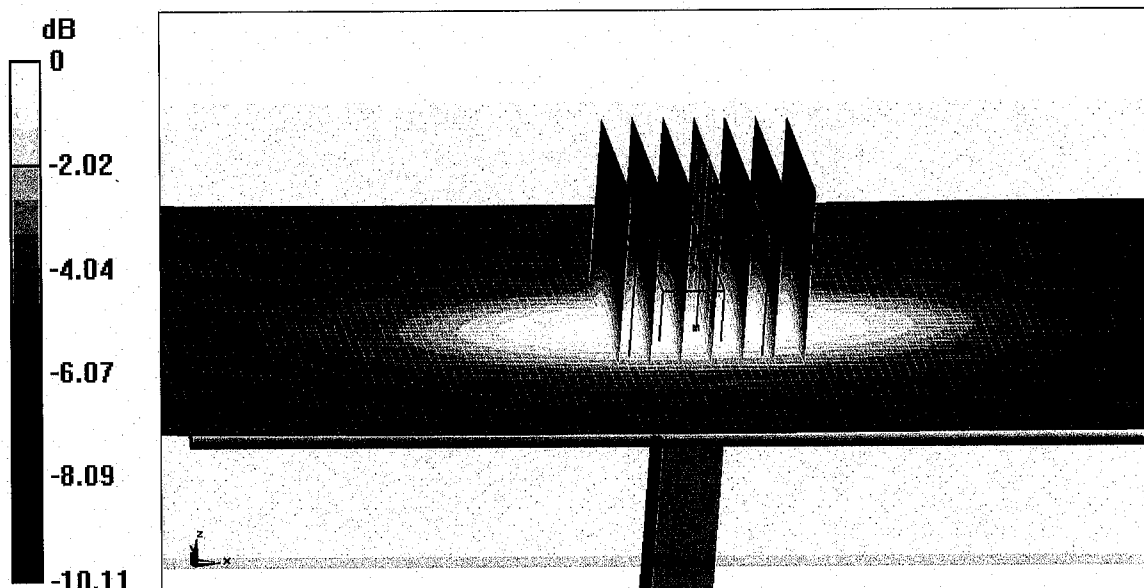
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 55.91 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.53 W/kg

**SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.58 W/kg**

Maximum value of SAR (measured) = 3.15 W/kg

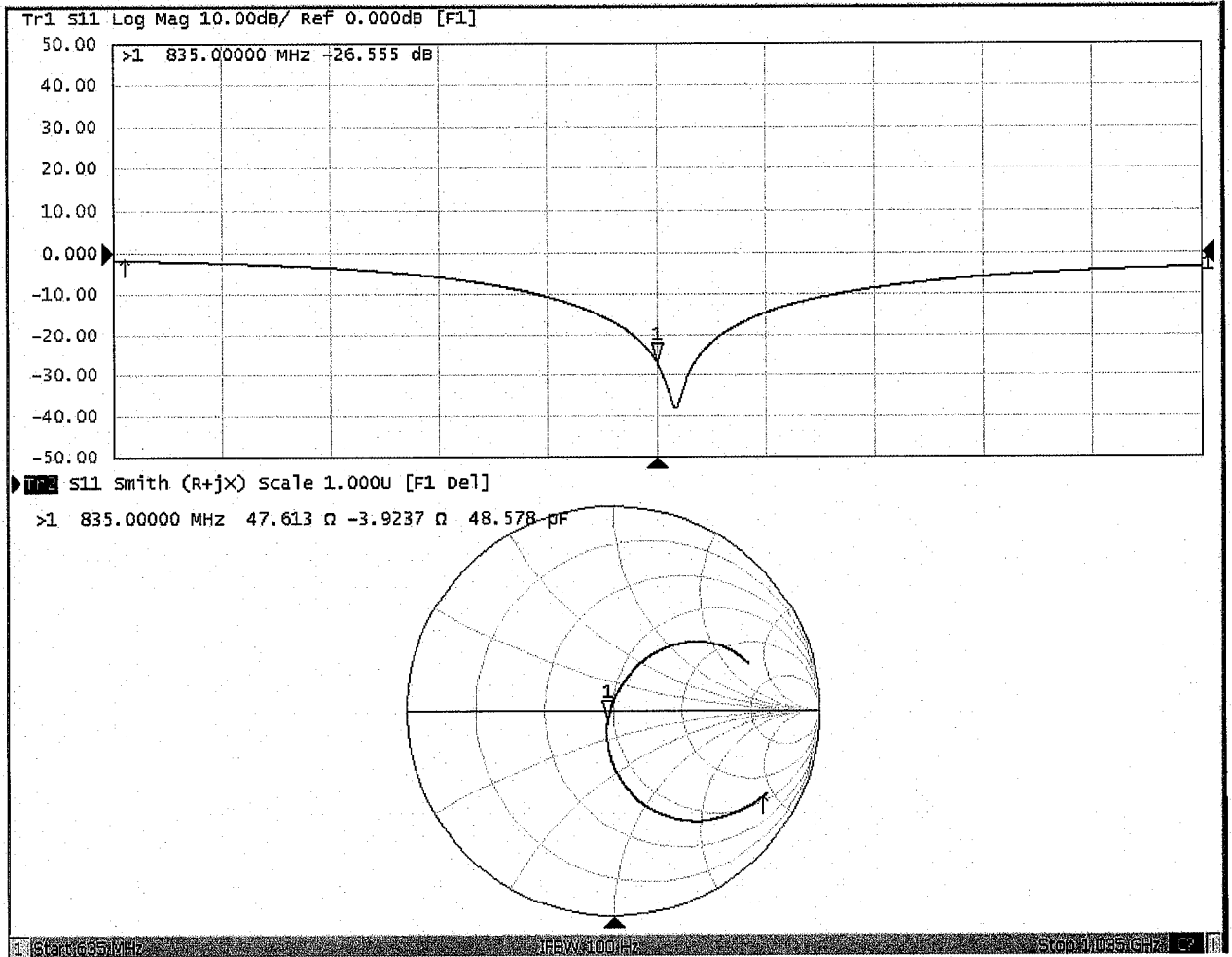


**0 dB = 3.15 W/kg = 4.98 dBW/kg**



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### Impedance Measurement Plot for Body TSL





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Client

**Sporton**

Certificate No:

**Z17-97260**

## CALIBRATION CERTIFICATE

Object: D1750V2 - SN: 1069

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

Calibration date: December 5, 2017

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 NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	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: December 9, 2017

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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	52.10.0.1446
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	39.5 $\pm$ 6 %	1.38 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	9.31 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	37.0 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.96 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.8 mW / g $\pm$ 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	53.8 $\pm$ 6 %	1.47 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	9.40 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	38.0 mW / g $\pm$ 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.03 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.3 mW / g $\pm$ 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	49.3Ω+ 1.19 jΩ
Return Loss	- 37.2 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.3Ω+ 0.51 jΩ
Return Loss	- 26.0 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.084 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: 12.05.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1069**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.378$  S/m;  $\epsilon_r = 39.46$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3617; ConvF(8.49, 8.49, 8.49); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

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

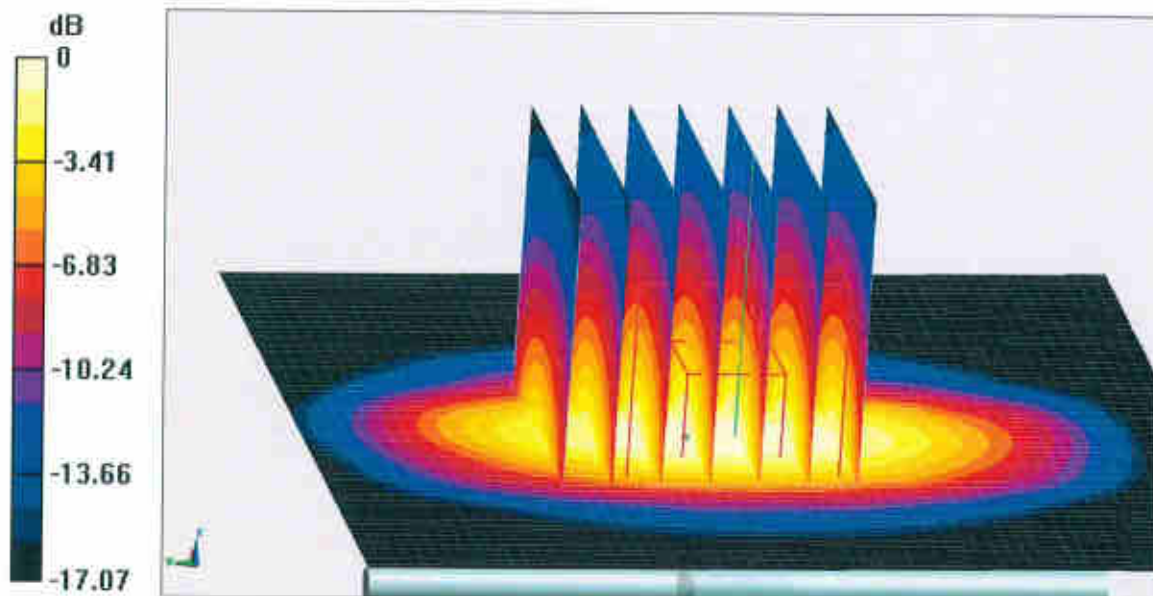
dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.28 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 17.2 W/kg

**SAR(1 g) = 9.31 W/kg; SAR(10 g) = 4.96 W/kg**

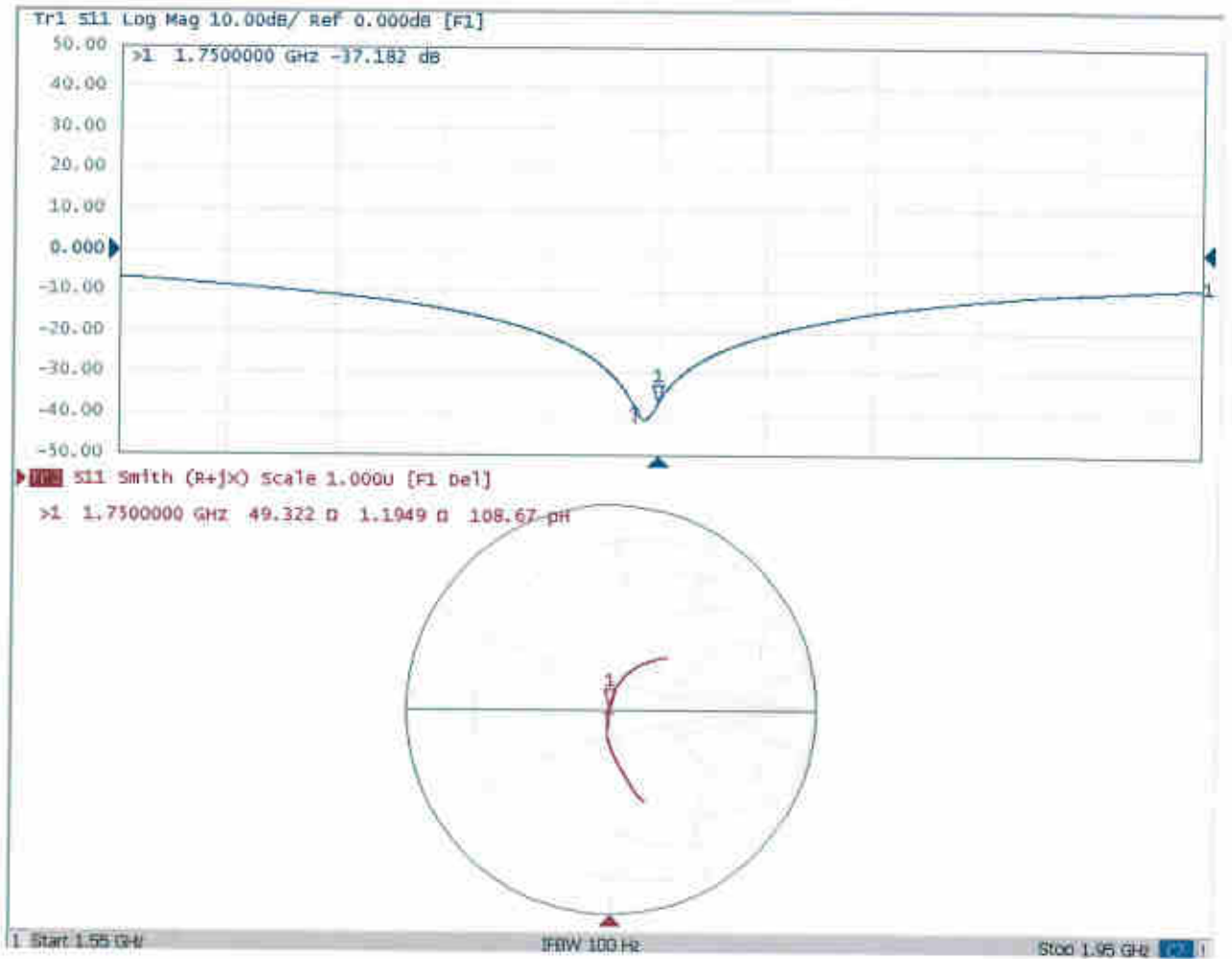
Maximum value of SAR (measured) = 14.3 W/kg

**0 dB = 14.3 W/kg = 11.55 dBW/kg**



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### Impedance Measurement Plot for Head TSL







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### DASY5 Validation Report for Body TSL

Date: 12.05.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1069**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.469$  S/m;  $\epsilon_r = 53.75$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.21, 8.21, 8.21); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

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

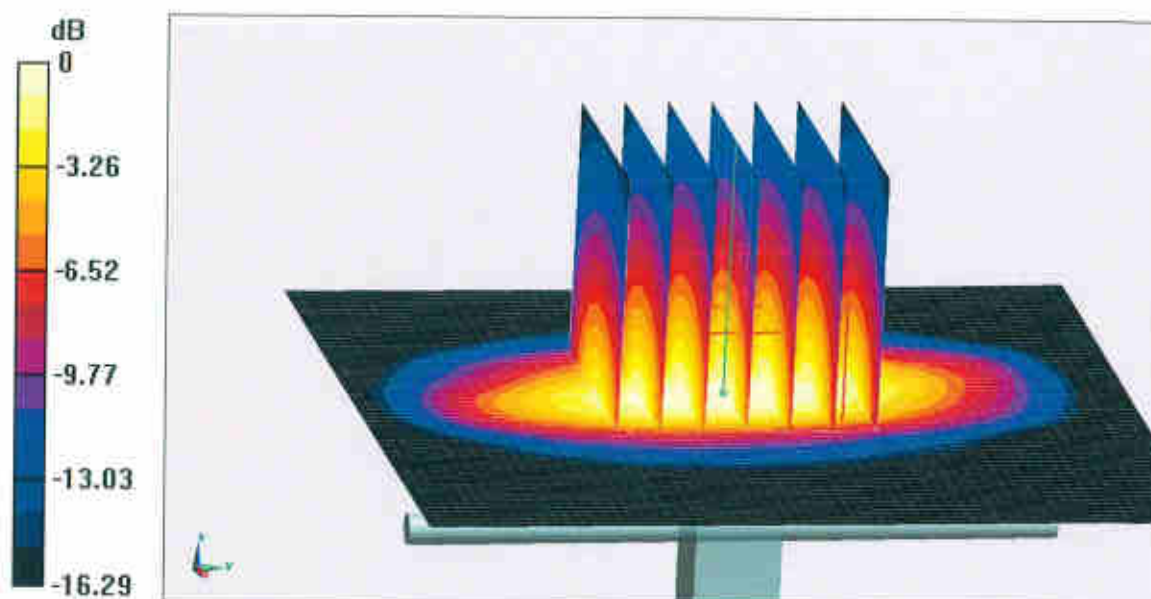
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 96.22 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.8 W/kg

**SAR(1 g) = 9.4 W/kg; SAR(10 g) = 5.03 W/kg**

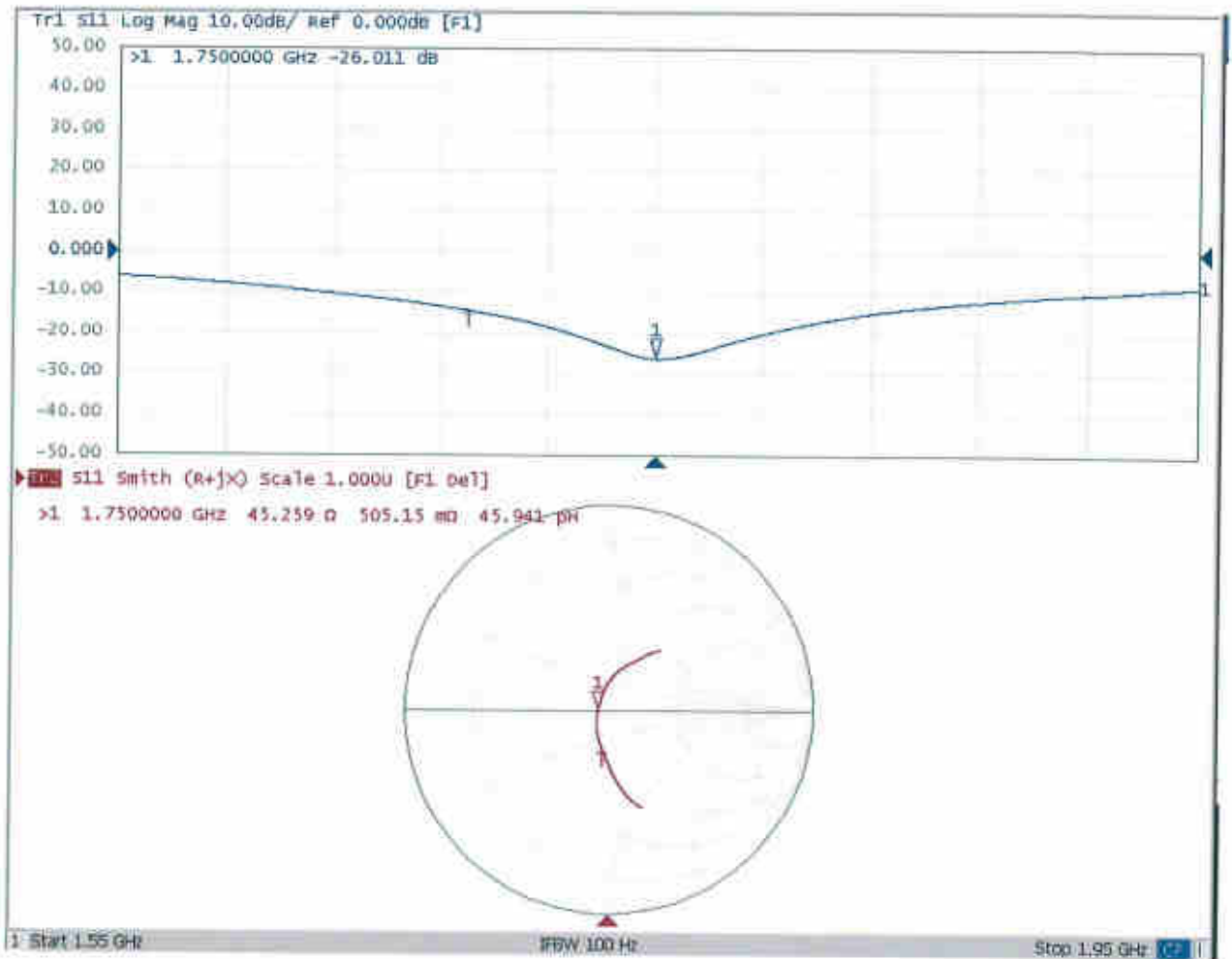
Maximum value of SAR (measured) = 14.3 W/kg





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### Impedance Measurement Plot for Body TSL





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Client **Sporton**

Certificate No: **Z17-97250**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d182**

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

Calibration date: **December 6, 2017**

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 NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	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: December 10, 2017

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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	52.10.0.1446
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	39.4 ± 6 %	1.41 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	10.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.1 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW / g ± 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	52.9 ± 6 %	1.54 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	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.4 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.29 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.0 mW / g ± 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	52.2Ω+ 5.30jΩ
Return Loss	- 25.0dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8Ω+ 5.25jΩ
Return Loss	- 25.3dB

### 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: 12.06.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.409$  S/m;  $\epsilon_r = 39.36$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.26, 8.26, 8.26); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

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

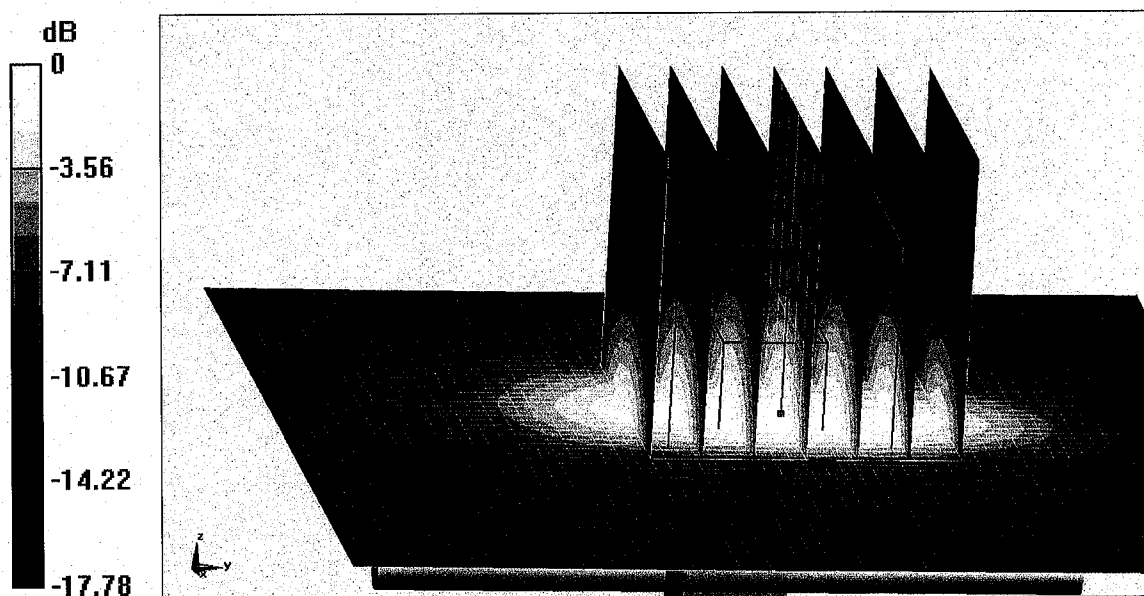
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 101.7 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 19.3 W/kg

**SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.27 W/kg**

Maximum value of SAR (measured) = 15.9 W/kg

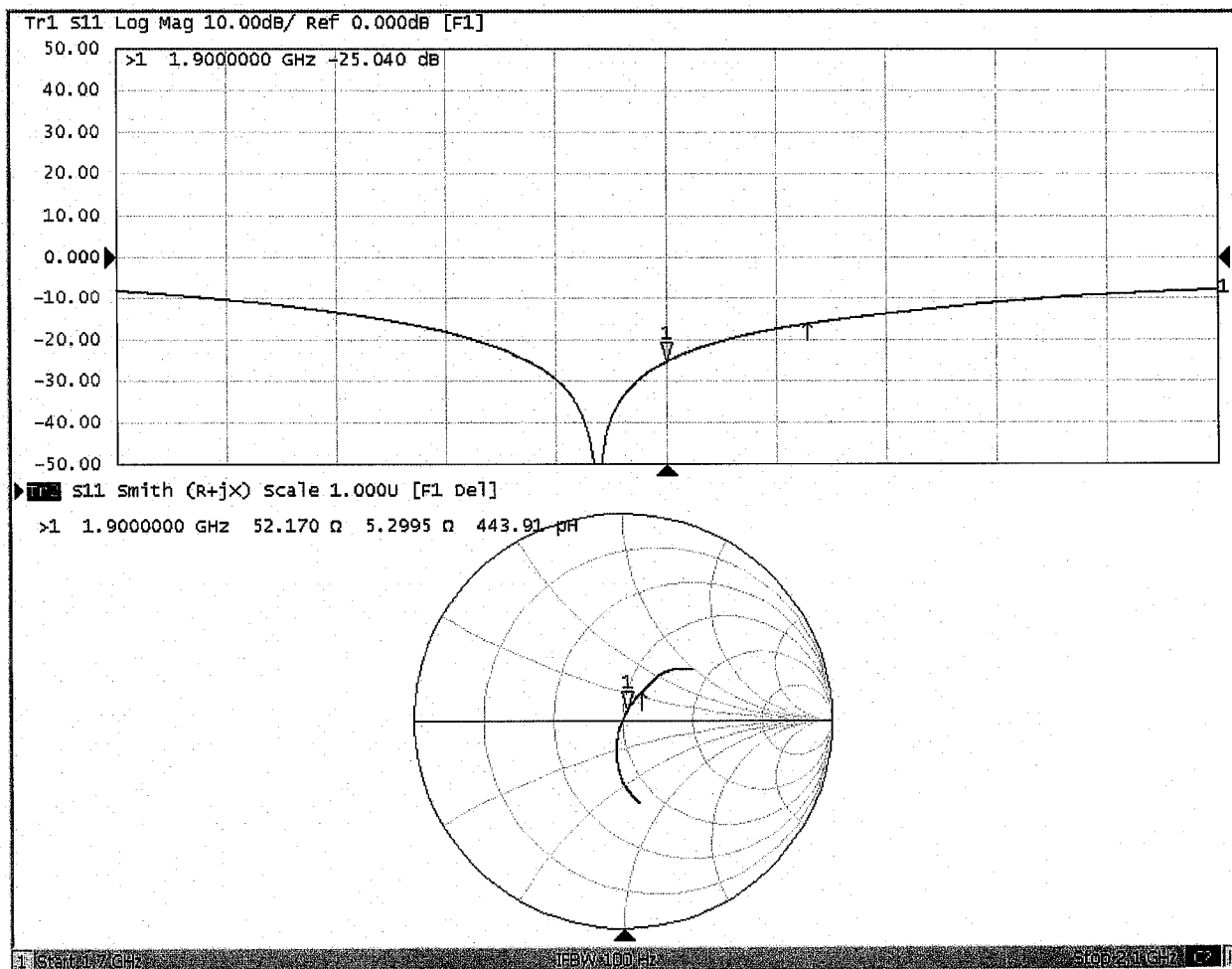


**0 dB = 15.9 W/kg = 12.01 dBW/kg**



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### Impedance Measurement Plot for Head TSL







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### DASY5 Validation Report for Body TSL

Date: 12.06.2017

Test Laboratory: CCTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.542$  S/m;  $\epsilon_r = 52.89$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.95, 7.95, 7.95); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

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

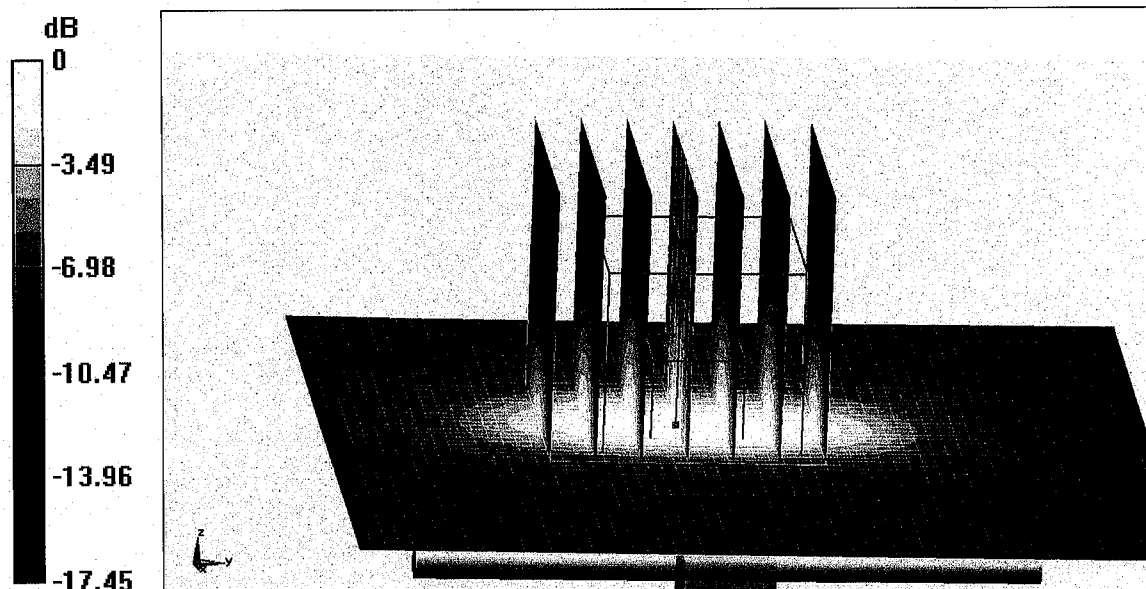
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 96.89 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.6 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.29 W/kg**

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

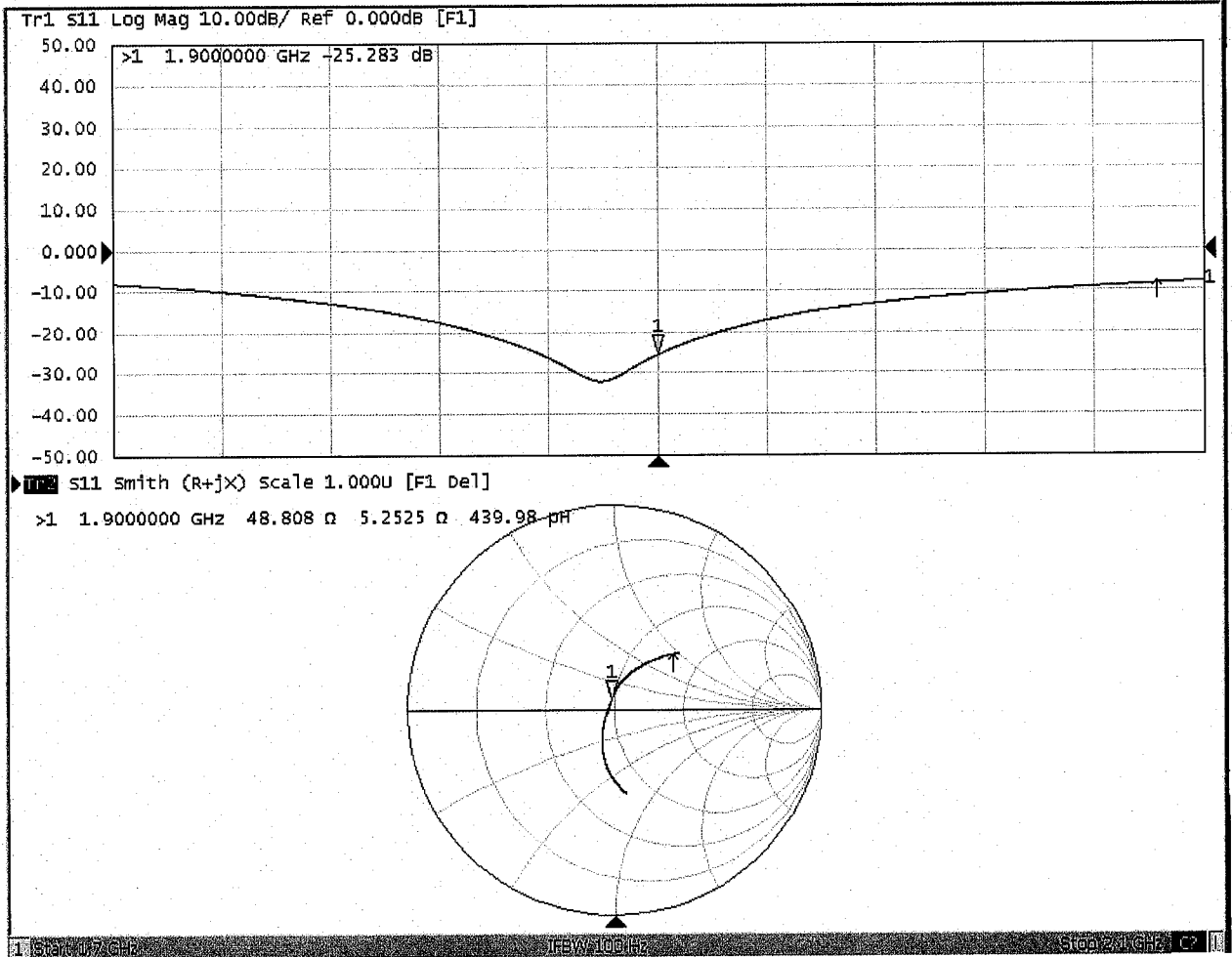


**0 dB = 15.7 W/kg = 11.96 dBW/kg**



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### Impedance Measurement Plot for Body TSL





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Client **Sporton**

Certificate No: **Z18-60051**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 924**

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

Calibration date: **March 22, 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±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 NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5239A	MY55491241	29-Jun-17 (CTTL, No.J18X00561)	Jun-18

	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 25, 2018

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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	52.10.0.1446
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	40.3 ± 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	13.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>51.8 mW / g ± 18.8 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.98 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.9 mW / g ± 18.7 % (k=2)</b>

### 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	51.3 ± 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	12.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>50.7 mW / g ± 18.8 % (k=2)</b>
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.88 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>23.3 mW / g ± 18.7 % (k=2)</b>



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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9Ω+ 4.08jΩ
Return Loss	- 27.7dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.8Ω+ 4.69jΩ
Return Loss	- 26.5dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.060 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

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**DASY5 Validation Report for Head TSL**

Date: 03.22.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.841$  S/m;  $\epsilon_r = 40.32$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7464; ConvF(7.89, 7.89, 7.89); Calibrated: 9/12/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

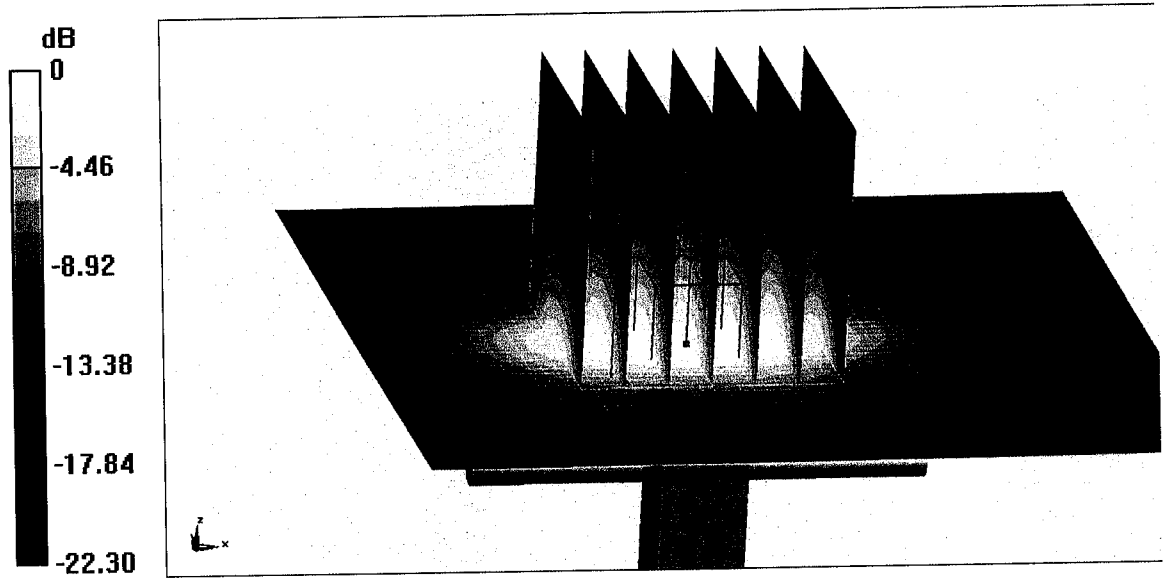
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 101.2 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.2 W/kg

**SAR(1 g) = 13 W/kg; SAR(10 g) = 5.98 W/kg**

Maximum value of SAR (measured) = 22.0 W/kg

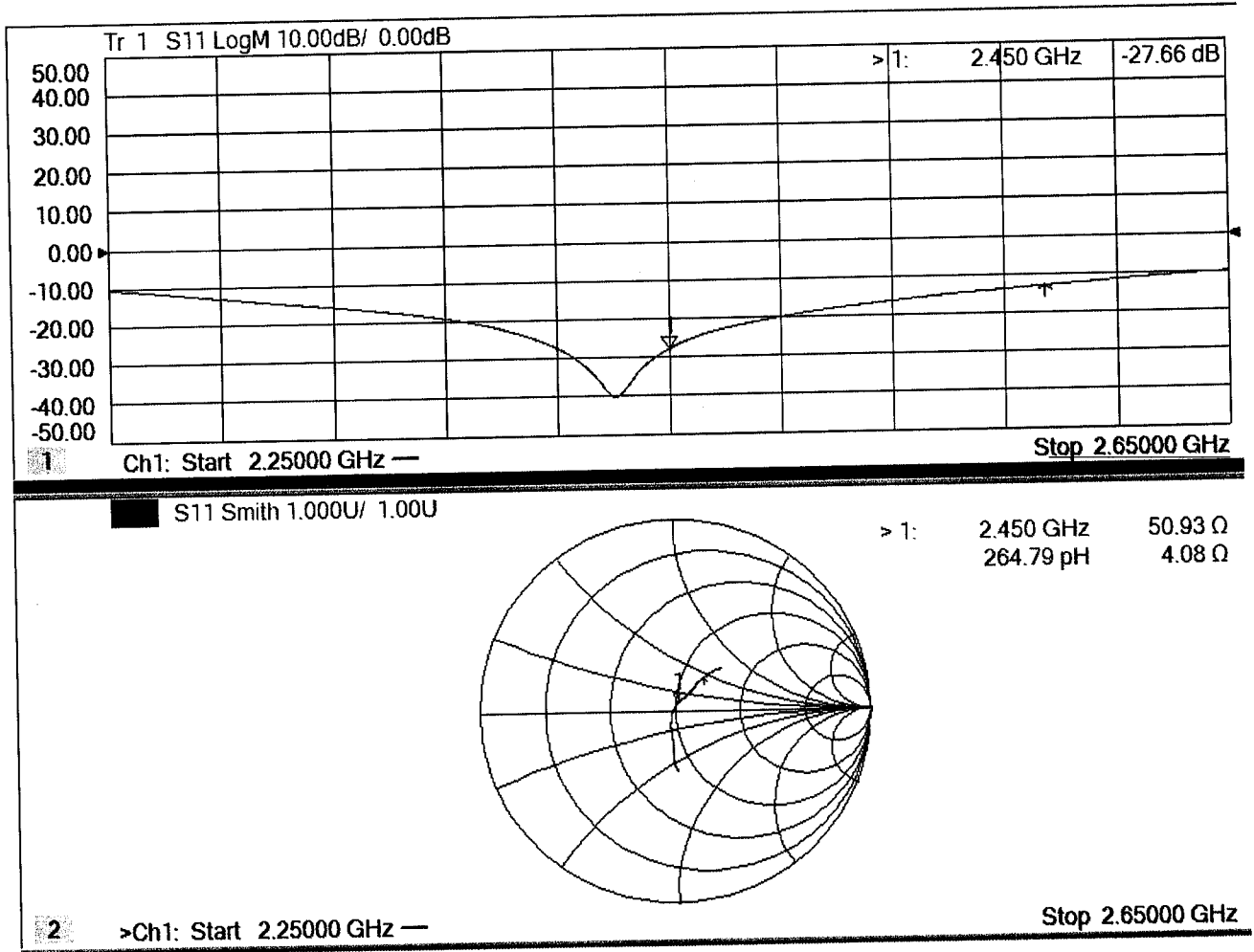


**0 dB = 22.0 W/kg = 13.42 dBW/kg**



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### Impedance Measurement Plot for Head TSL







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Date: 03.22.2018

**DASY5 Validation Report for Body TSL**

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.998$  S/m;  $\epsilon_r = 51.28$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7464; ConvF(8.09, 8.09, 8.09); Calibrated: 9/12/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

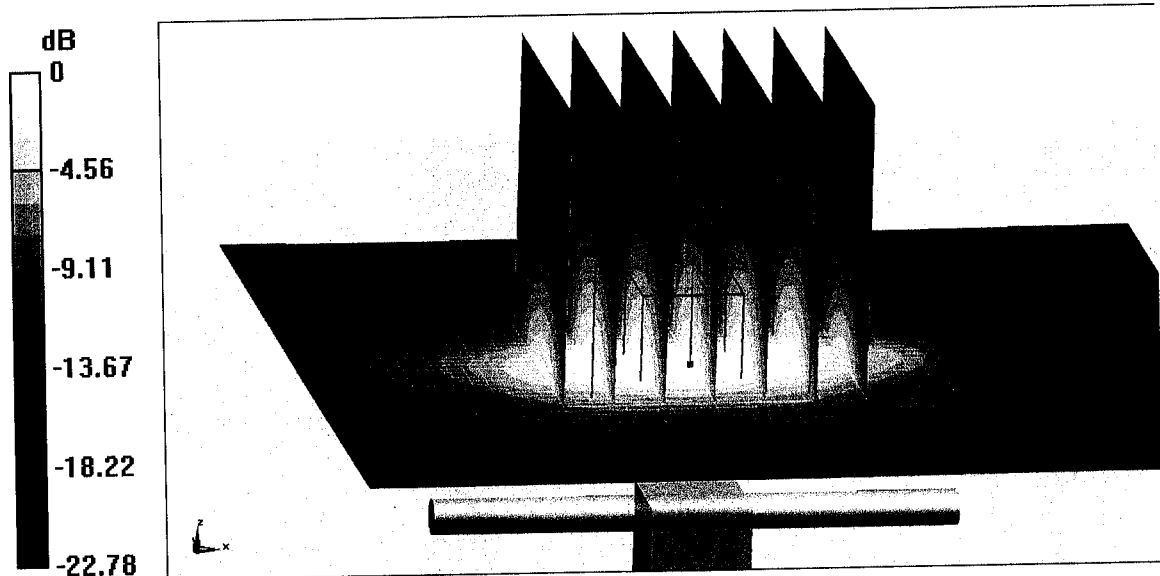
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 98.09 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.1 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.88 W/kg**

Maximum value of SAR (measured) = 21.5 W/kg

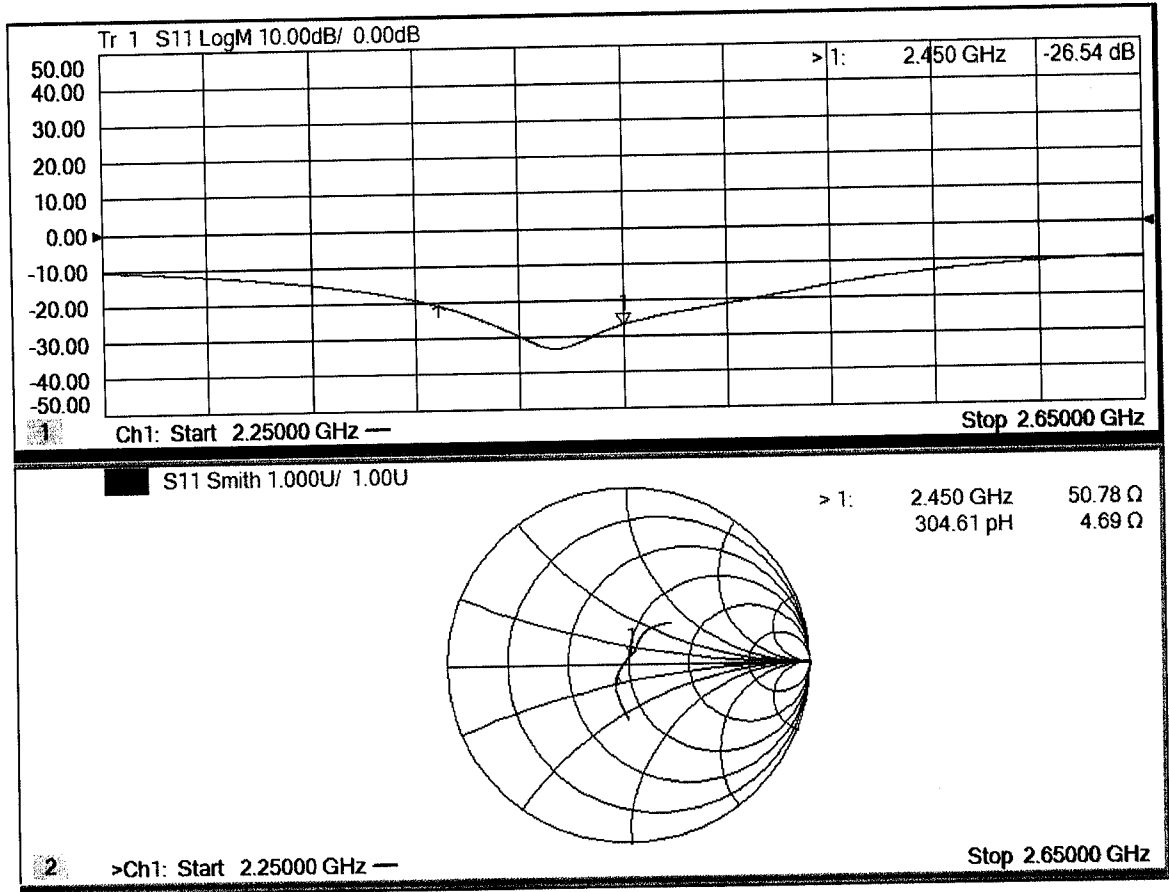


**0 dB = 21.5 W/kg = 13.32 dBW/kg**



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### Impedance Measurement Plot for Body TSL





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Certificate No: **Z17-97251**

Client **Sporton**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN: 1070**

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

Calibration date: **December 7, 2017**

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 NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	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: December 10, 2017

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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	52.10.0.1446
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	2600 MHz ± 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 ± 0.2) °C	39.4 ± 6 %	1.99 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	14.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	58.2 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.51 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	26.0 mW / g ± 18.7 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	2.13 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	13.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	55.2 mW / g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.5 mW / g ± 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	47.3Ω- 5.52jΩ
Return Loss	- 24.0dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.5Ω- 4.72jΩ
Return Loss	- 23.3dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.011 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: 12.07.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.985$  S/m;  $\epsilon_r = 39.42$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.3, 7.3, 7.3); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

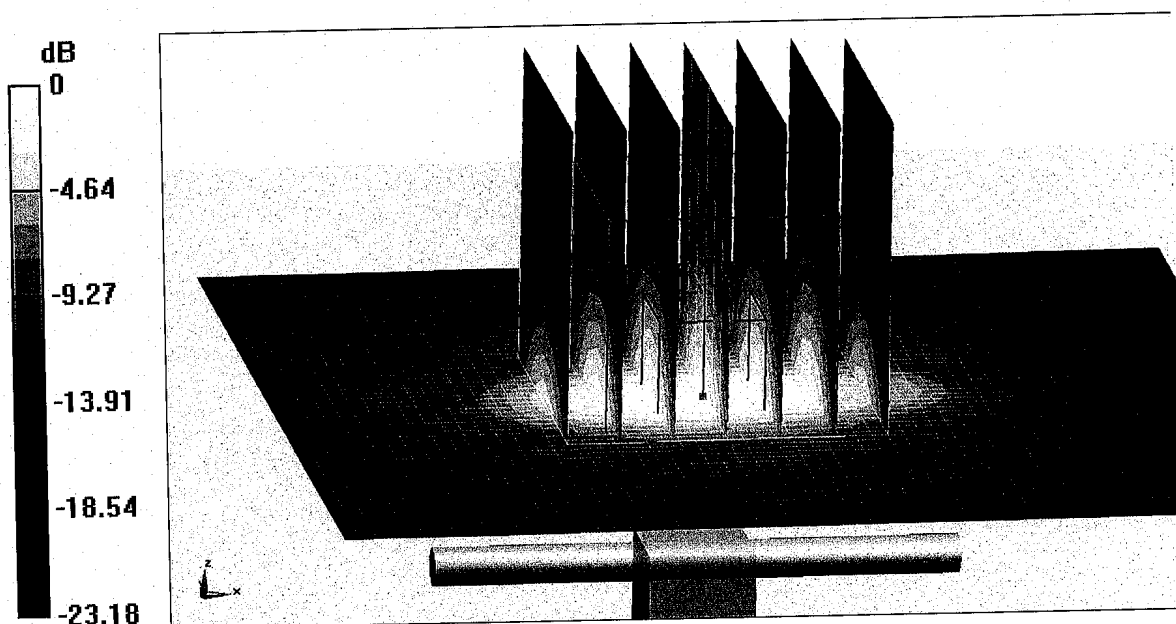
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.8 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.6 W/kg

**SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.51 W/kg**

Maximum value of SAR (measured) = 25.2 W/kg

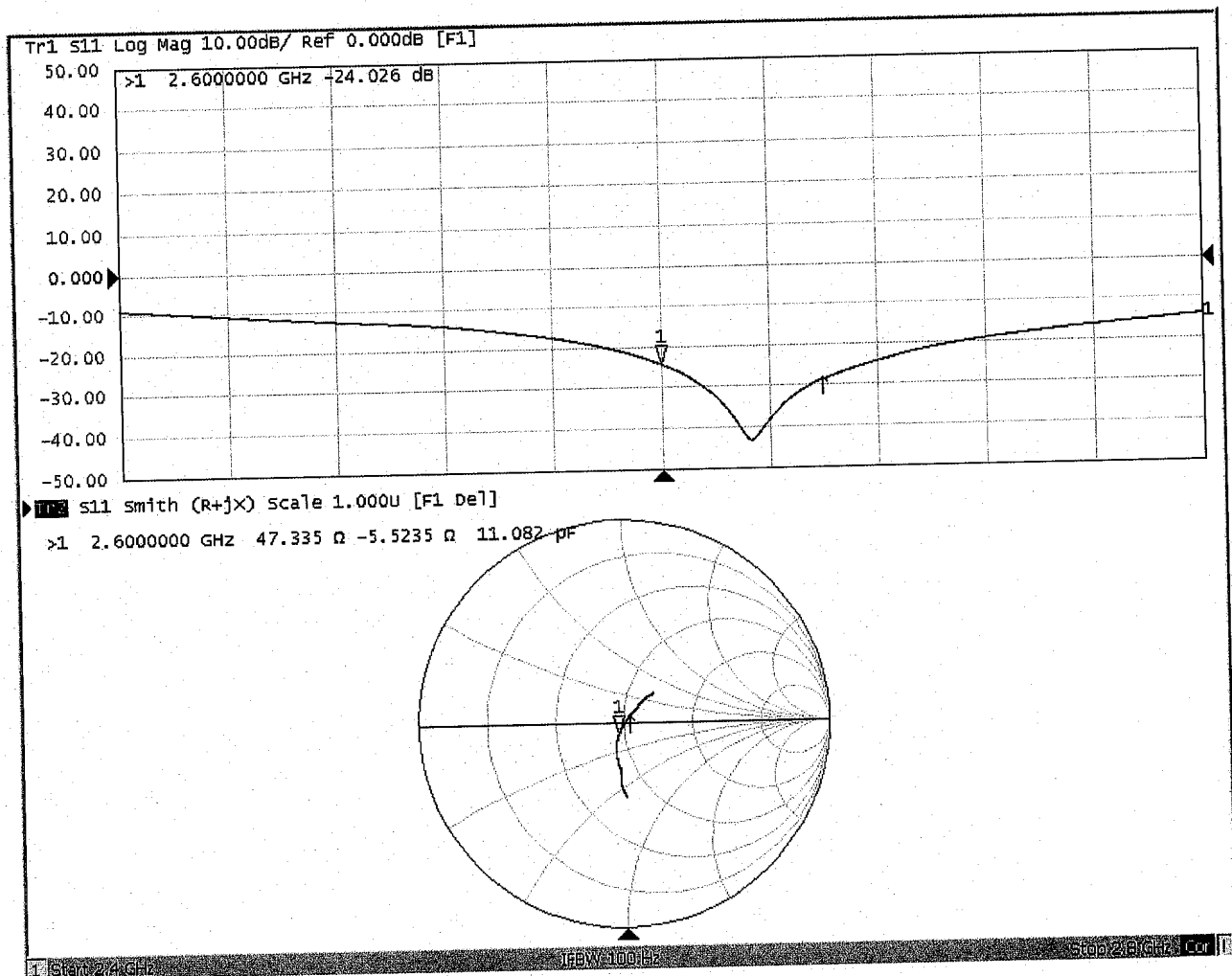


**0 dB = 25.2 W/kg = 14.01 dBW/kg**



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### Impedance Measurement Plot for Head TSL







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### DASY5 Validation Report for Body TSL

Date: 12.07.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.127$  S/m;  $\epsilon_r = 52.63$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.48, 7.48, 7.48); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

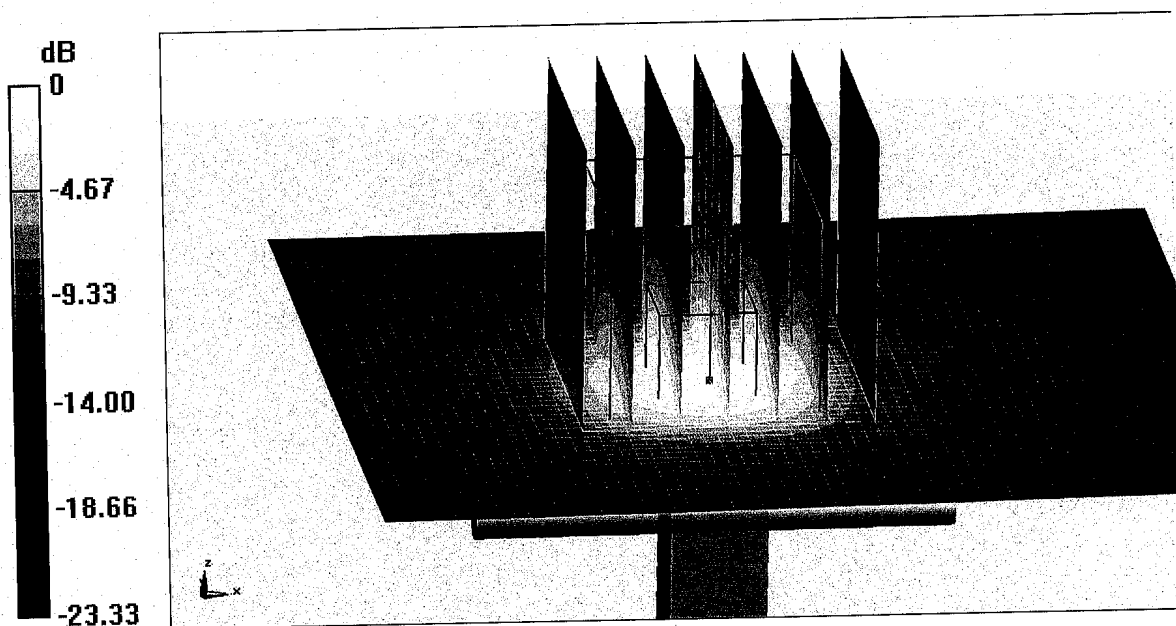
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.1 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 29.4 W/kg

**SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.11 W/kg**

Maximum value of SAR (measured) = 23.6 W/kg

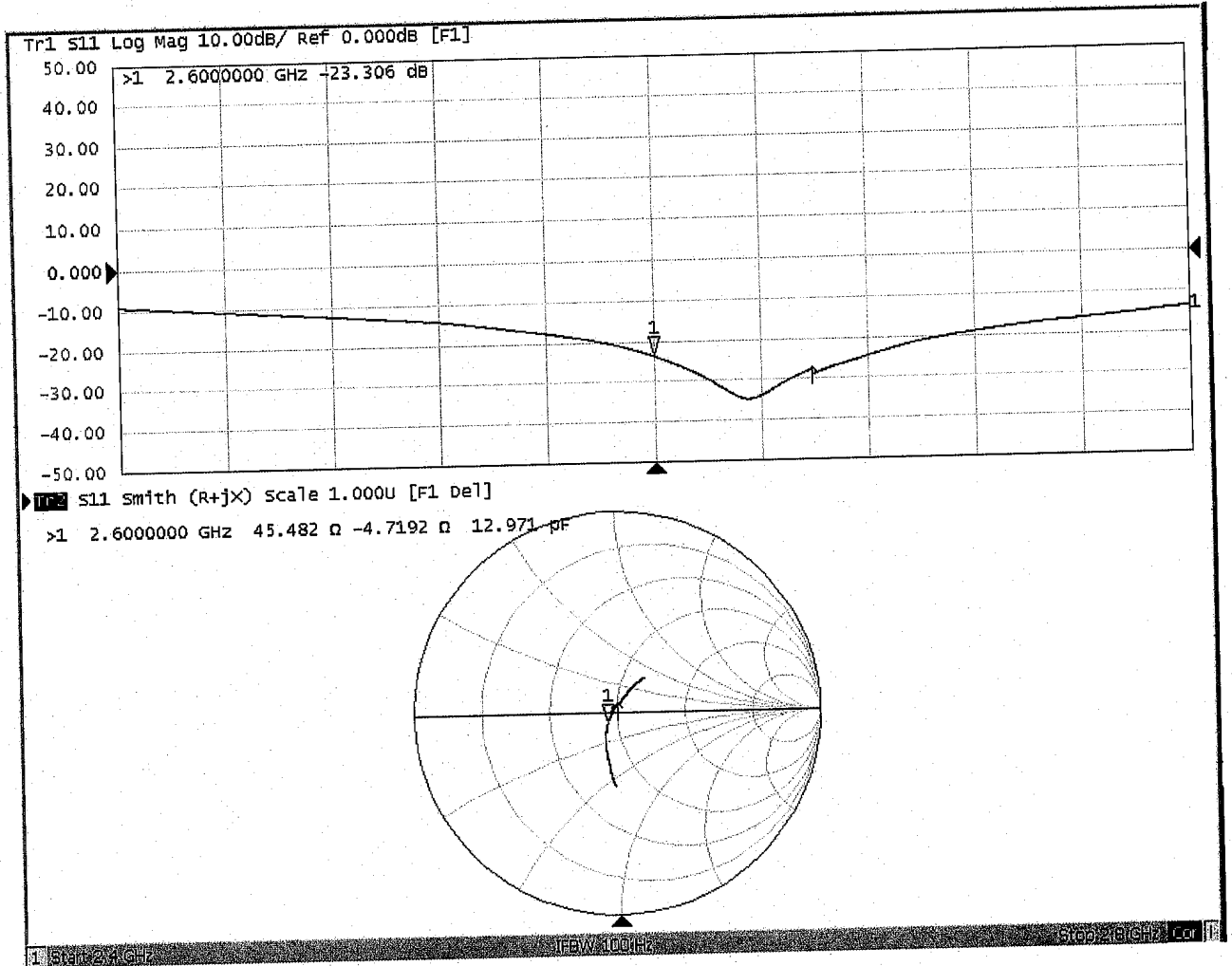


**0 dB = 23.6 W/kg = 13.73 dBW/kg**



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### Impedance Measurement Plot for Body TSL





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Client : **Sporton**

Certificate No: **Z17-97269**

## CALIBRATION CERTIFICATE

Object: DAE4 - SN: 1303

Calibration Procedure(s): FF-Z11-002-01  
Calibration Procedure for the Data Acquisition Electronics (DAEx)

Calibration date: December 19, 2017

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
Process Calibrator 753	1971018	27-Jun-17 (CTTL, No.J17X05859)	June-18

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

Signature

Issued: December 22, 2017

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



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### **Glossary:**

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

### **Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



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### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

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

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

Calibration Factors	X	Y	Z
High Range	405.569 $\pm$ 0.15% (k=2)	403.452 $\pm$ 0.15% (k=2)	404.893 $\pm$ 0.15% (k=2)
Low Range	3.96471 $\pm$ 0.7% (k=2)	3.99229 $\pm$ 0.7% (k=2)	4.01287 $\pm$ 0.7% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	36.5° $\pm$ 1°
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