

#17_WCDMA Band V_RMC 12.2Kbps_Right Side_10mm_Ch4182

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.983$ S/m; $\epsilon_r = 54.957$; $\rho = 1000$ kg/m³

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(10.32, 10.32, 10.32); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch4182/Area Scan (41x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.591 W/kg

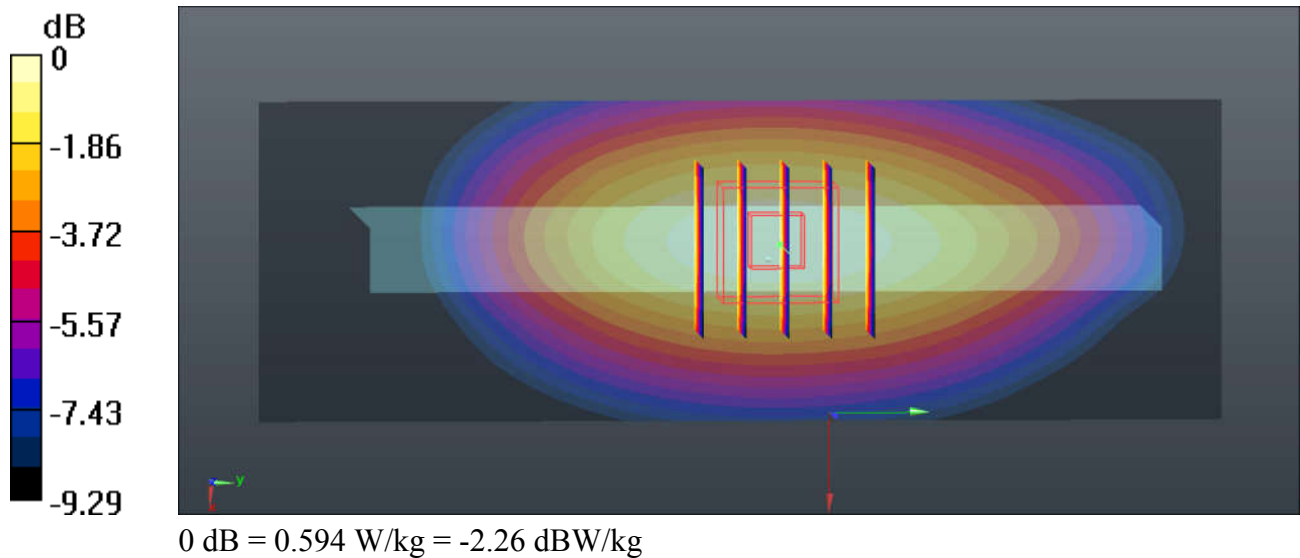
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 24.57 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.683 W/kg

SAR(1 g) = 0.484 W/kg; SAR(10 g) = 0.335 W/kg

Maximum value of SAR (measured) = 0.594 W/kg



#18_WCDMA Band IV_RMC12.2Kbps_Back_10mm_Ch1513

Communication System: UID 0, UMTS (0); Frequency: 1752.6 MHz; Duty Cycle: 1:1

Medium: 1750MSL Medium parameters used: $f = 1752.6$ MHz; $\sigma = 1.511$ S/m; $\epsilon_r = 52.764$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.81, 7.81, 7.81); Calibrated: 2016.5.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2016.5.18
- Phantom: SAM1; Type: SAM; Serial: TP-1479
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1513/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.05 W/kg

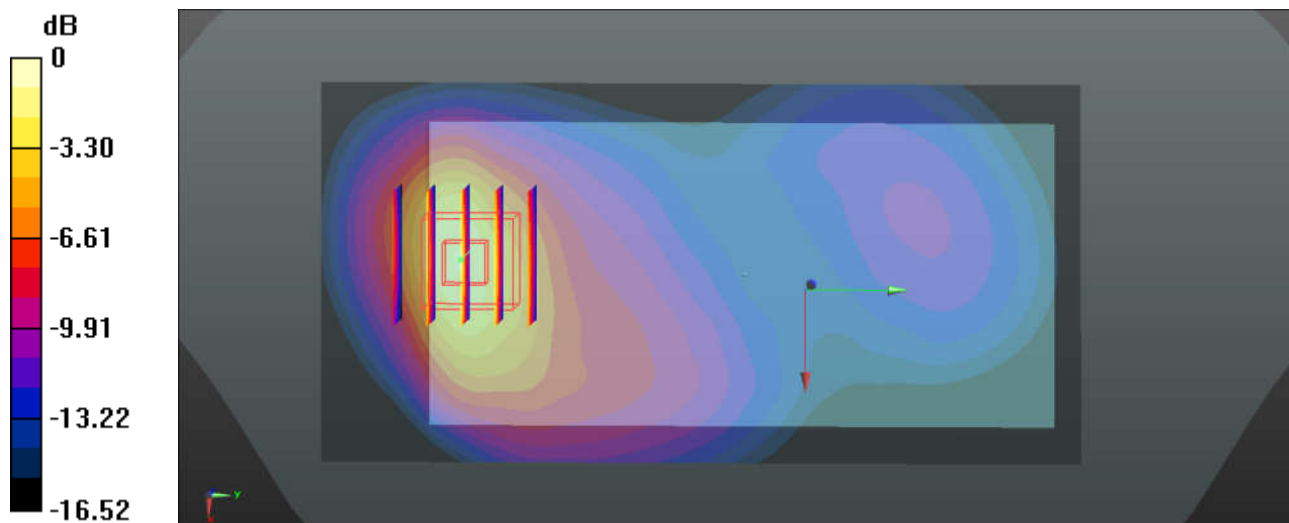
Ch1513/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.417 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 1.61 W/kg

SAR(1 g) = 0.971 W/kg; SAR(10 g) = 0.551 W/kg

Maximum value of SAR (measured) = 1.32 W/kg



0 dB = 1.32 W/kg = 1.21 dBW/kg

#19_WCDMA Band II_RMC12.2Kbps_Back_10mm_Ch9400

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

Medium: MSL_1900 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.494$ S/m; $\epsilon_r = 52.661$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.55, 7.55, 7.55); Calibrated: 2016.5.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2016.5.18
- Phantom: SAM1; Type: SAM; Serial: TP-1479
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch9400/Area Scan (61x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.29 W/kg

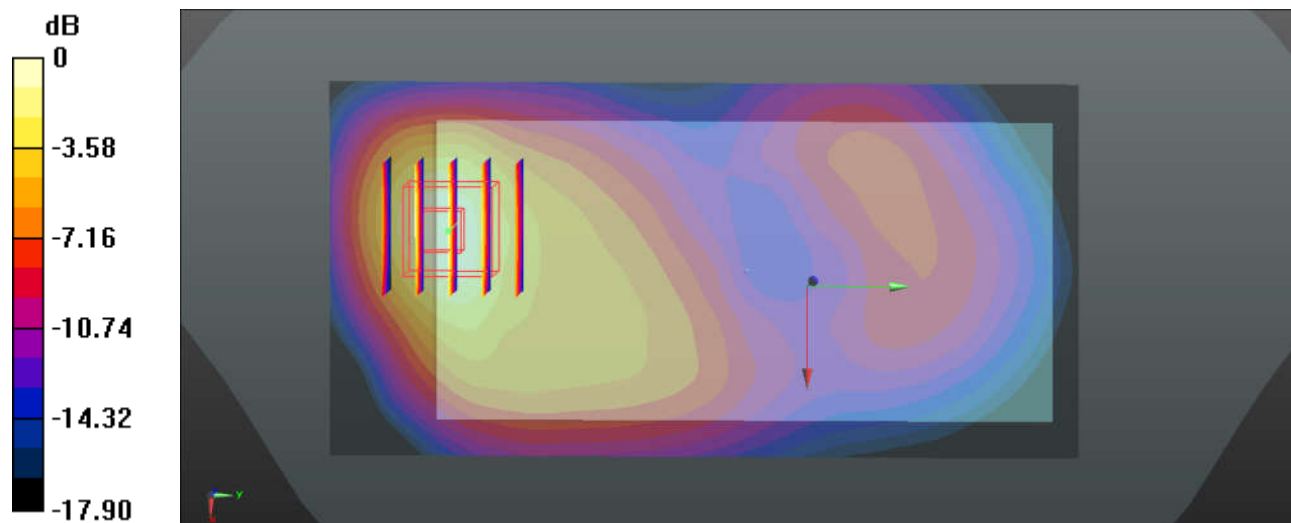
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.941 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.69 W/kg

SAR(1 g) = 0.970 W/kg; SAR(10 g) = 0.535 W/kg

Maximum value of SAR (measured) = 1.32 W/kg



0 dB = 1.32 W/kg = 1.21 dBW/kg

#20_LTE Band 12_10M_QPSK_1RB_25Offset_Back_10mm_Ch23095

Communication System: UID 0, FDD_LTE (0); Frequency: 707.5 MHz; Duty Cycle: 1:1
Medium: MSL_750 Medium parameters used: $f = 707.5$ MHz; $\sigma = 0.925$ S/m; $\epsilon_r = 56.348$; $\rho = 1000$

kg/m³

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(10.54, 10.54, 10.54); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch23095/Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.400 W/kg

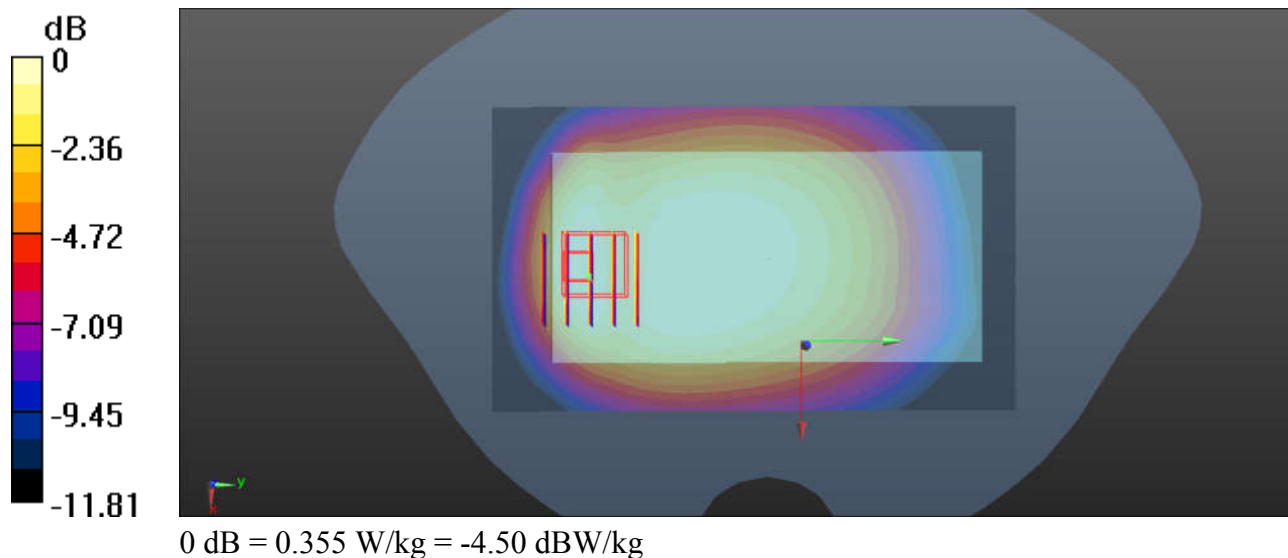
Ch23095/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.03 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.468 W/kg

SAR(1 g) = 0.284 W/kg; SAR(10 g) = 0.182 W/kg

Maximum value of SAR (measured) = 0.355 W/kg



#21_LTE Band 5_10M_QPSK_1RB_25Offset_Back_10mm_Ch20525

Communication System: UID 0, FDD_LTE (0); Frequency: 836.5 MHz; Duty Cycle: 1:1
Medium: MSL_850 Medium parameters used: $f = 836.5$ MHz; $\sigma = 0.984$ S/m; $\epsilon_r = 54.956$; $\rho = 1000$

kg/m³

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(10.32, 10.32, 10.32); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch20525/Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.495 W/kg

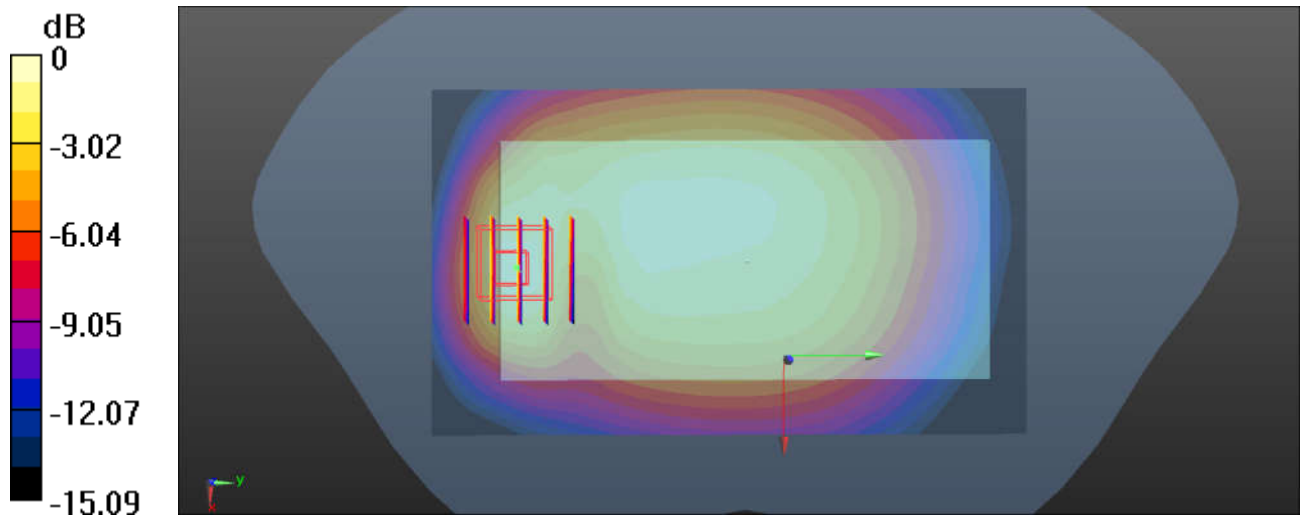
Ch20525/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.72 V/m; Power Drift = -0.19 dB

Peak SAR (extrapolated) = 0.679 W/kg

SAR(1 g) = 0.397 W/kg; SAR(10 g) = 0.226 W/kg

Maximum value of SAR (measured) = 0.554 W/kg



0 dB = 0.554 W/kg = -2.56 dBW/kg

#22_LTE Band4_20M_QPSK_1RB_49Offset_Back_10mm_Ch20175

Communication System: UID 0, FDD_LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: 1750MSL Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.489$ S/m; $\epsilon_r = 52.825$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.81, 7.81, 7.81); Calibrated: 2016.5.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2016.5.18
- Phantom: SAM1; Type: SAM; Serial: TP-1479
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch20175/Area Scan (61x121x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 0.860 W/kg

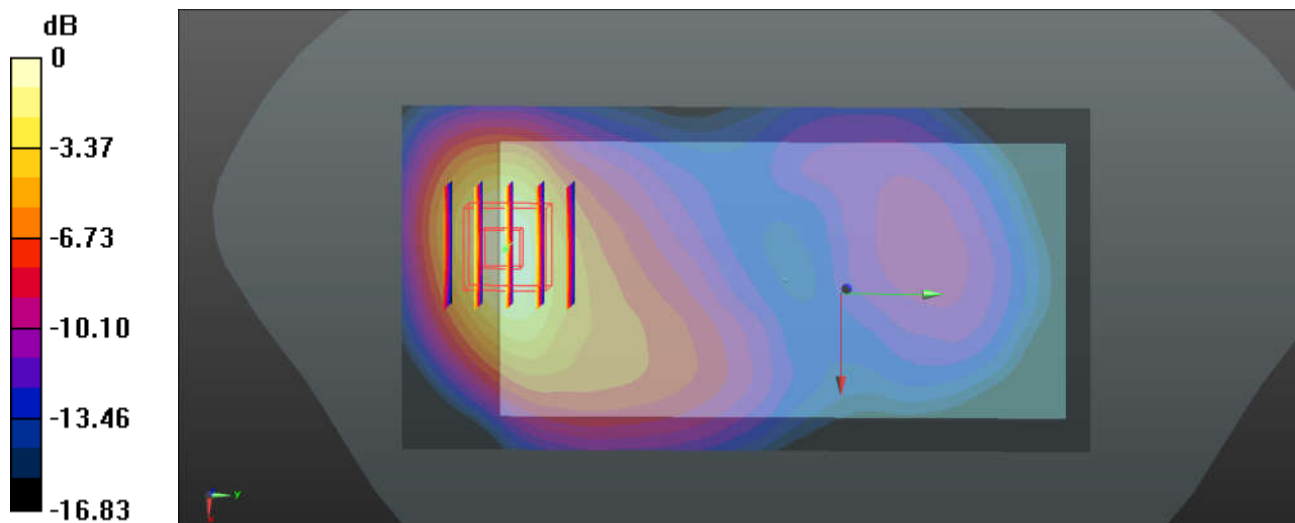
Ch20175/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 5.155 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 1.07 W/kg

SAR(1 g) = 0.643 W/kg; SAR(10 g) = 0.366 W/kg

Maximum value of SAR (measured) = 0.875 W/kg



0 dB = 0.875 W/kg = -0.58 dBW/kg

#23_LTE Band2_20M_QPSK_1RB_49Offset_Back_10mm_Ch19100

Communication System: UID 0, FDD_LTE (0); Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL_1900 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.516$ S/m; $\epsilon_r = 52.596$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.3 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.55, 7.55, 7.55); Calibrated: 2016.5.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2016.5.18
- Phantom: SAM1; Type: SAM; Serial: TP-1479
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch19100/Area Scan (61x121x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 1.29 W/kg

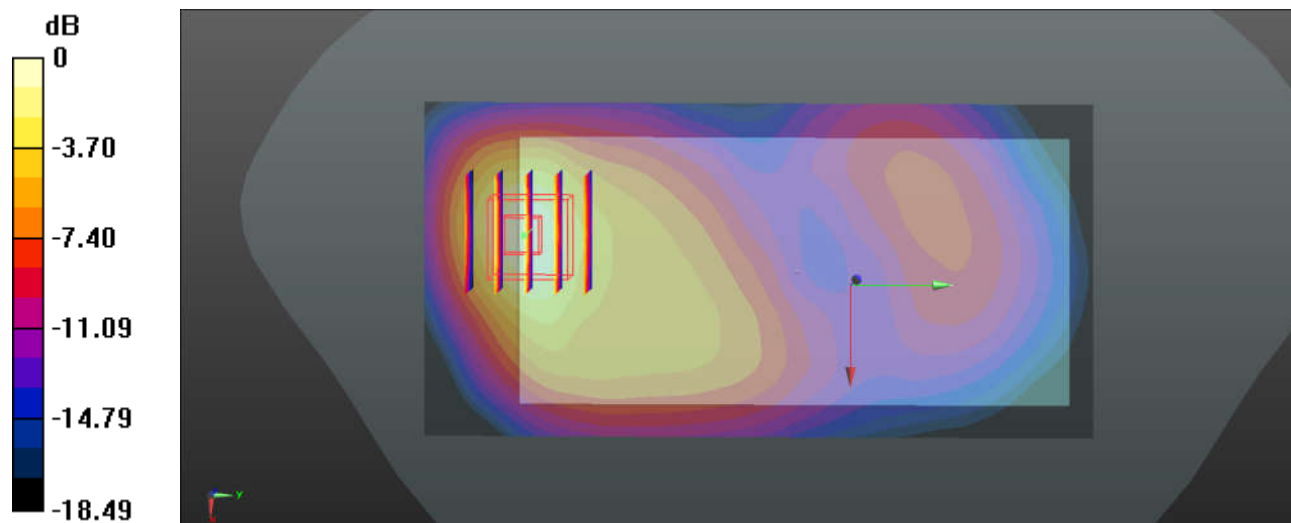
Ch19100/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 8.336 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 1.69 W/kg

SAR(1 g) = 0.958 W/kg; SAR(10 g) = 0.523 W/kg

Maximum value of SAR (measured) = 1.35 W/kg



0 dB = 1.35 W/kg = 1.30 dBW/kg

#24_LTE Band7_20M_QPSK_1RB_49Offset_Back_10mm_Ch20850

Communication System: UID 0, FDD_LTE (0); Frequency: 2510 MHz; Duty Cycle: 1:1
Medium: MSL_2600 Medium parameters used: $f = 2510$ MHz; $\sigma = 2.107$ S/m; $\epsilon_r = 51.484$; $\rho = 1000$ kg/m³
Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(7.05, 7.05, 7.05); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch20850/Area Scan (81x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 1.60 W/kg

Ch20850/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.304 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 2.04 W/kg

SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.425 W/kg

Maximum value of SAR (measured) = 1.58 W/kg

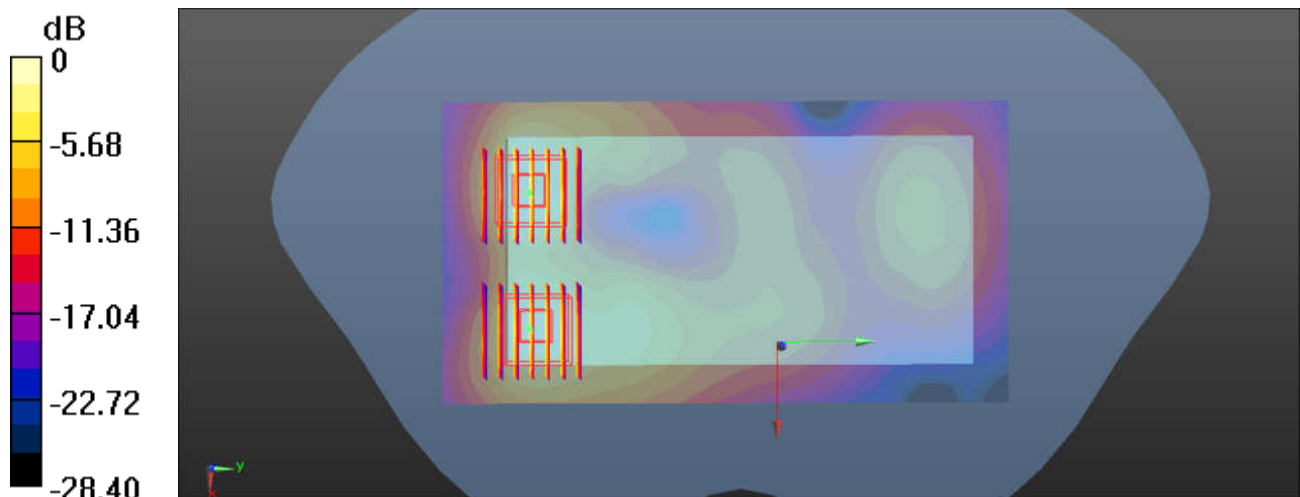
Ch20850/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.304 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.39 W/kg

SAR(1 g) = 0.684 W/kg; SAR(10 g) = 0.294 W/kg

Maximum value of SAR (measured) = 1.01 W/kg



0 dB = 1.01 W/kg = 0.04 dBW/kg

#25_WLAN2.4GHz_802.11b 1Mbps_Back_10mm_Ch11

Communication System: UID 0, WIFI (0); Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: MSL_2450 Medium parameters used: $f = 2462$ MHz; $\sigma = 2.014$ S/m; $\epsilon_r = 52.069$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.23, 7.23, 7.23); Calibrated: 2016.5.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2016.5.18
- Phantom: SAM2; Type: SAM; Serial: TP-1477
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch11/Area Scan (81x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.117 W/kg

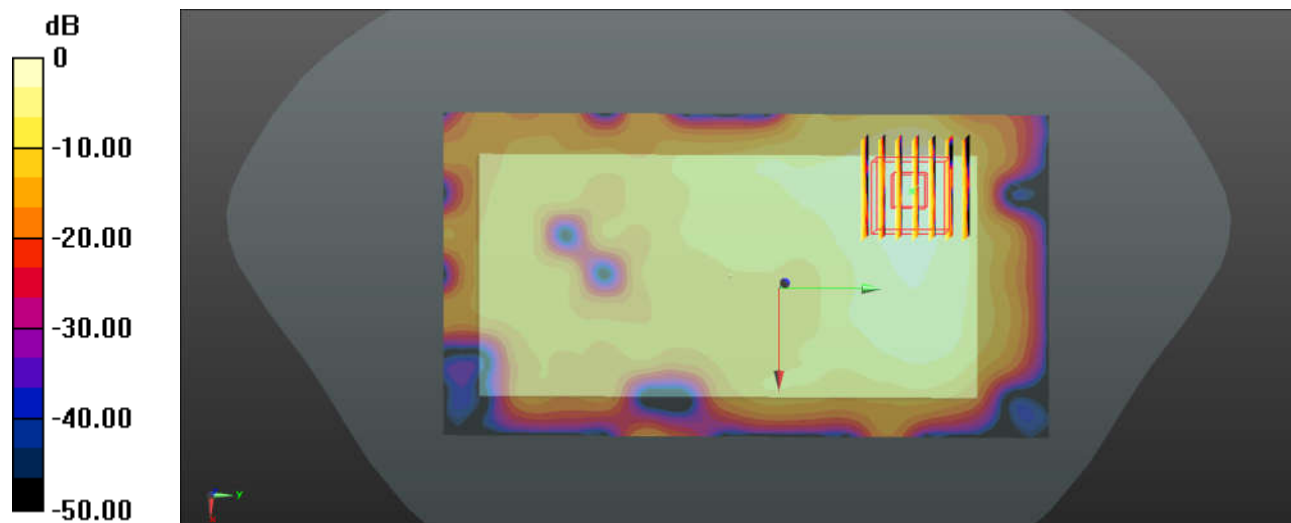
Ch11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.272 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 0.174 W/kg

SAR(1 g) = 0.076 W/kg; SAR(10 g) = 0.034 W/kg

Maximum value of SAR (measured) = 0.120 W/kg



0 dB = 0.120 W/kg = -9.21 dBW/kg

#26_WLAN5.2GHz_802.11a 6Mbps_Back_10mm_Ch44

Communication System: UID 0, WIFI (0); Frequency: 5220 MHz; Duty Cycle: 1:1.026

Medium: MSL_5000 Medium parameters used: $f = 5220$ MHz; $\sigma = 5.33$ S/m; $\epsilon_r = 49.157$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(4.5, 4.5, 4.5); Calibrated: 2016.11.28;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1437; Calibrated: 2016.7.12
- Phantom: SAM1; Type: SAM; Serial: TP-1164
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch44/Area Scan (181x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.245 W/kg

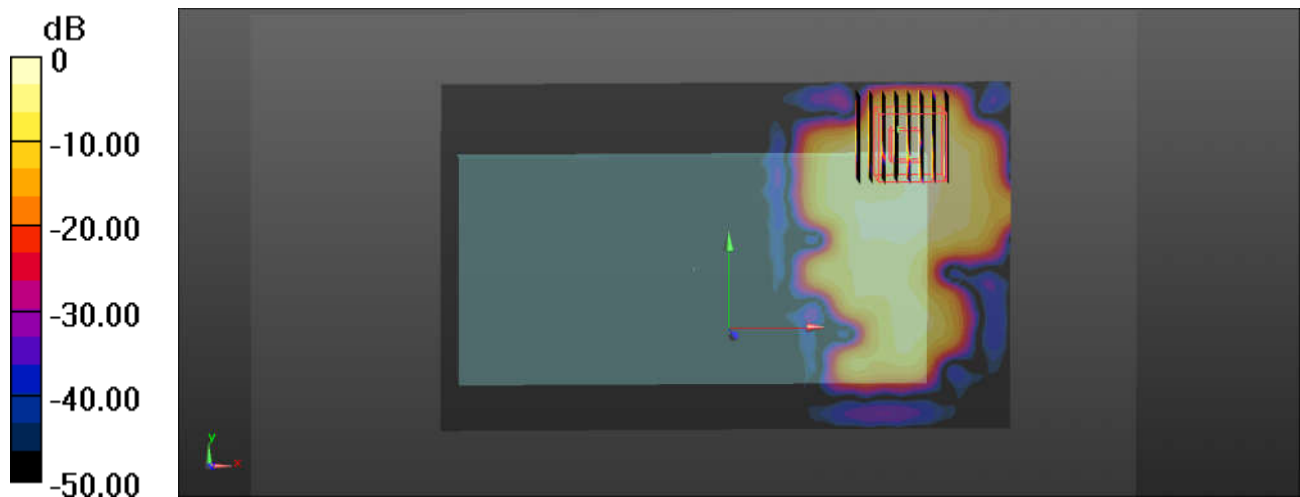
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.272 W/kg

SAR(1 g) = 0.066 W/kg; SAR(10 g) = 0.021 W/kg

Maximum value of SAR (measured) = 0.187 W/kg



0 dB = 0.187 W/kg = -7.28 dBW/kg

#27_WLAN5.8GHz_802.11a 6Mbps_Back_10mm_Ch149

Communication System: UID 0, WIFI (0); Frequency: 5745 MHz; Duty Cycle: 1:1.026

Medium: MSL_5000 Medium parameters used: $f = 5745$ MHz; $\sigma = 6.065$ S/m; $\epsilon_r = 47.996$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(4.05, 4.05, 4.05); Calibrated: 2016.11.28;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1437; Calibrated: 2016.7.12
- Phantom: SAM1; Type: SAM; Serial: TP-1164
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch149/Area Scan (181x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.457 W/kg

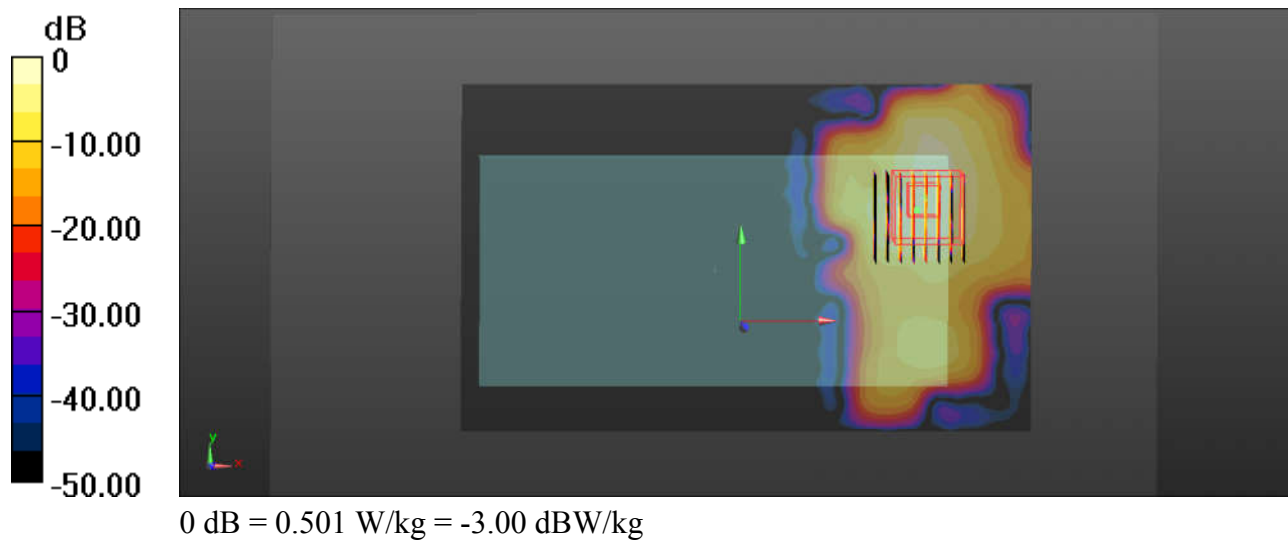
Ch149/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.758 W/kg

SAR(1 g) = 0.208 W/kg; SAR(10 g) = 0.072 W/kg

Maximum value of SAR (measured) = 0.501 W/kg



#28_WCDMA Band V_RMC 12.2Kbps_Back_10mm_Ch4182

Communication System: UID 0, UMTS (0); Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.983$ S/m; $\epsilon_r = 54.957$; $\rho = 1000$ kg/m³

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(10.32, 10.32, 10.32); Calibrated: 2016.11.28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2016.4.4
- Phantom: SAM1; Type: SAM; Serial: TP-1644
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch4182/Area Scan (71x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.616 W/kg

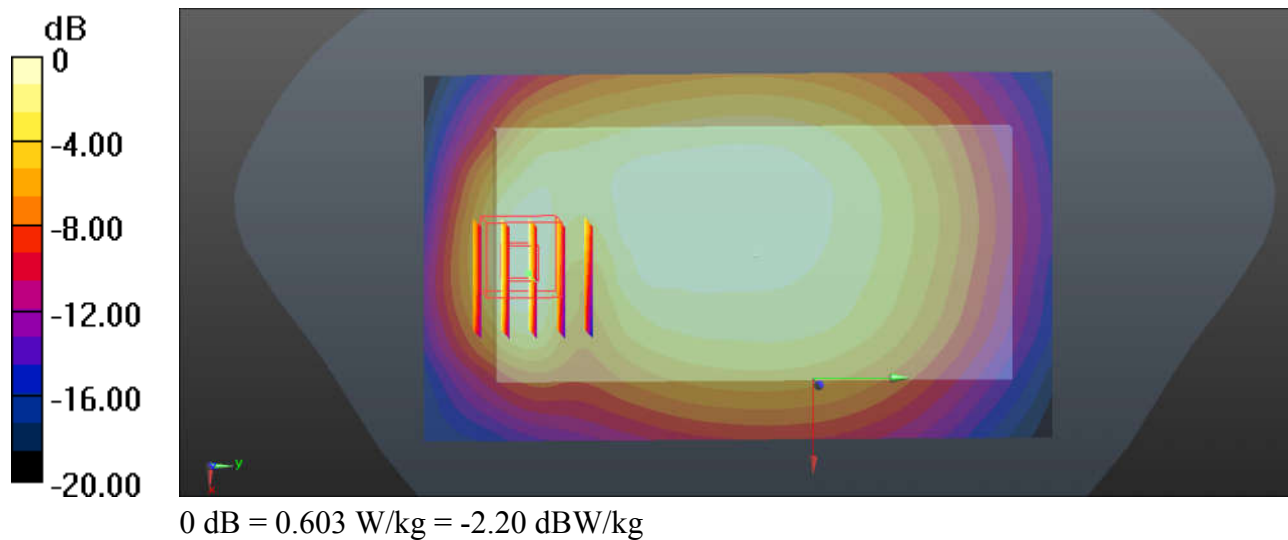
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.86 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.781 W/kg

SAR(1 g) = 0.453 W/kg; SAR(10 g) = 0.256 W/kg

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



#29_WLAN5.3GHz_802.11a 6Mbps_Back_10mm_Ch56

Communication System: UID 0, WIFI (0); Frequency: 5280 MHz; Duty Cycle: 1:1.026

Medium: MSL_5000 Medium parameters used: $f = 5280$ MHz; $\sigma = 5.415$ S/m; $\epsilon_r = 49.041$; $\rho = 1000$

kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(4.5, 4.5, 4.5); Calibrated: 2016.11.28;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1437; Calibrated: 2016.7.12
- Phantom: SAM1; Type: SAM; Serial: TP-1164
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch56/Area Scan (181x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.167 W/kg

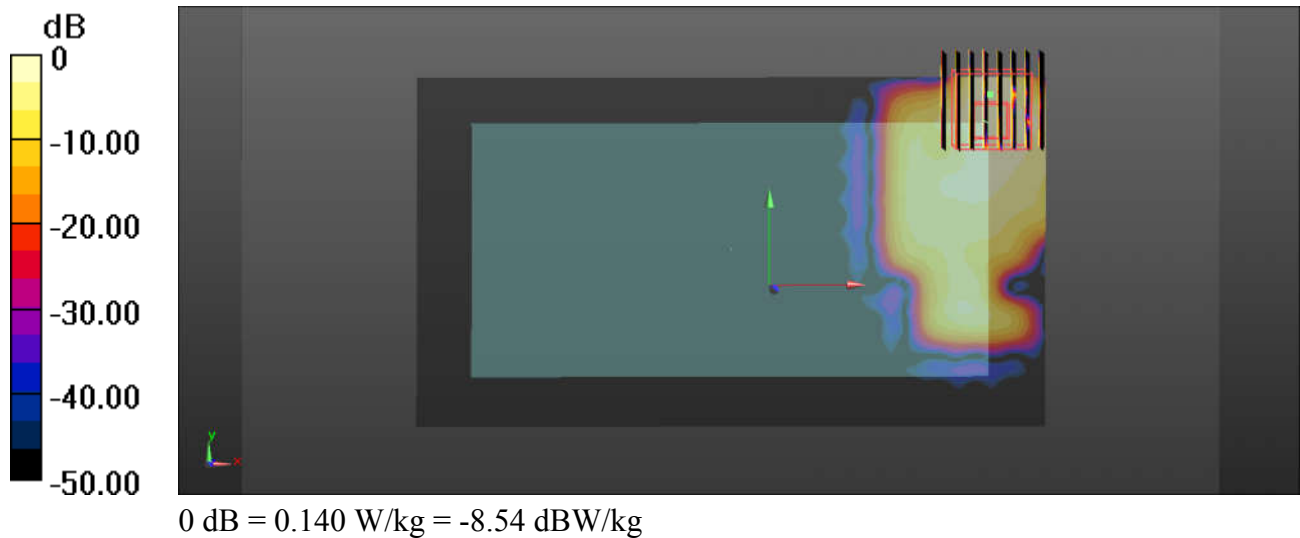
Ch56/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

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

Peak SAR (extrapolated) = 0.289 W/kg

SAR(1 g) = 0.067 W/kg; SAR(10 g) = 0.022 W/kg

Maximum value of SAR (measured) = 0.140 W/kg



#30_WLAN5.5GHz_802.11a 6Mbps_Back_10mm_Ch144

Communication System: UID 0, WIFI (0); Frequency: 5720 MHz; Duty Cycle: 1:1.026

Medium: MSL_5000 Medium parameters used: $f = 5720$ MHz; $\sigma = 6.041$ S/m; $\epsilon_r = 48.052$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3954; ConvF(3.92, 3.92, 3.92); Calibrated: 2016.11.28;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1437; Calibrated: 2016.7.12
- Phantom: SAM1; Type: SAM; Serial: TP-1164
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch144/Area Scan (181x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.290 W/kg

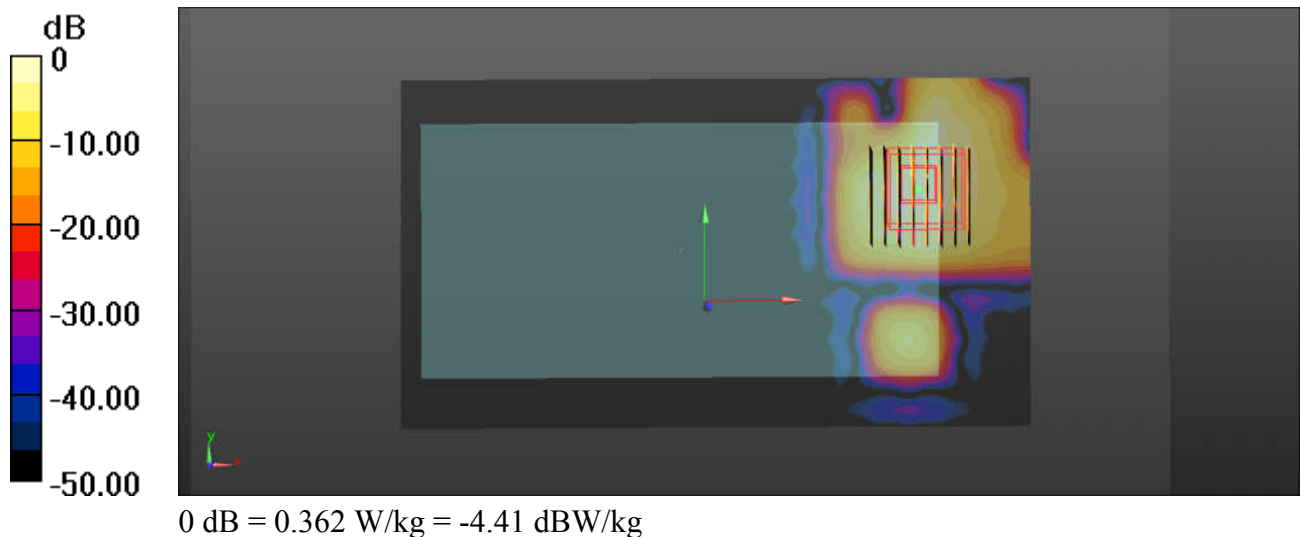
Ch144/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.579 W/kg

SAR(1 g) = 0.153 W/kg; SAR(10 g) = 0.053 W/kg

Maximum value of SAR (measured) = 0.362 W/kg





Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.



In Collaboration with
s p e a g
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](http://www.chinattl.cn)

Client

Sporton-CN

Certificate No: **Z16-97221**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1065**

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

Calibration date: **November 21, 2016**

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	101919	27-Jun-16 (CTTL, No.J16X04771)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04771)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 26, 2016

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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](http://www.chinattl.cn)

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- c) 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
- d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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	52.8.8.1258
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	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.8 $\pm$ 6 %	0.91 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	2.11 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.32 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.41 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.58 mW / g $\pm$ 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.5 $\pm$ 6 %	0.95 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	2.16 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	8.71 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	5.88 mW / g $\pm$ 20.4 % (k=2)



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7Ω- 3.08jΩ
Return Loss	- 29.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9Ω- 2.07jΩ
Return Loss	- 32.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.021 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
-----------------	-------

DASY5 Validation Report for Head TSL

Date: 11.21.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1065

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.906 \text{ S/m}$; $\epsilon_r = 41.82$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(10.01, 10.01, 10.01); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

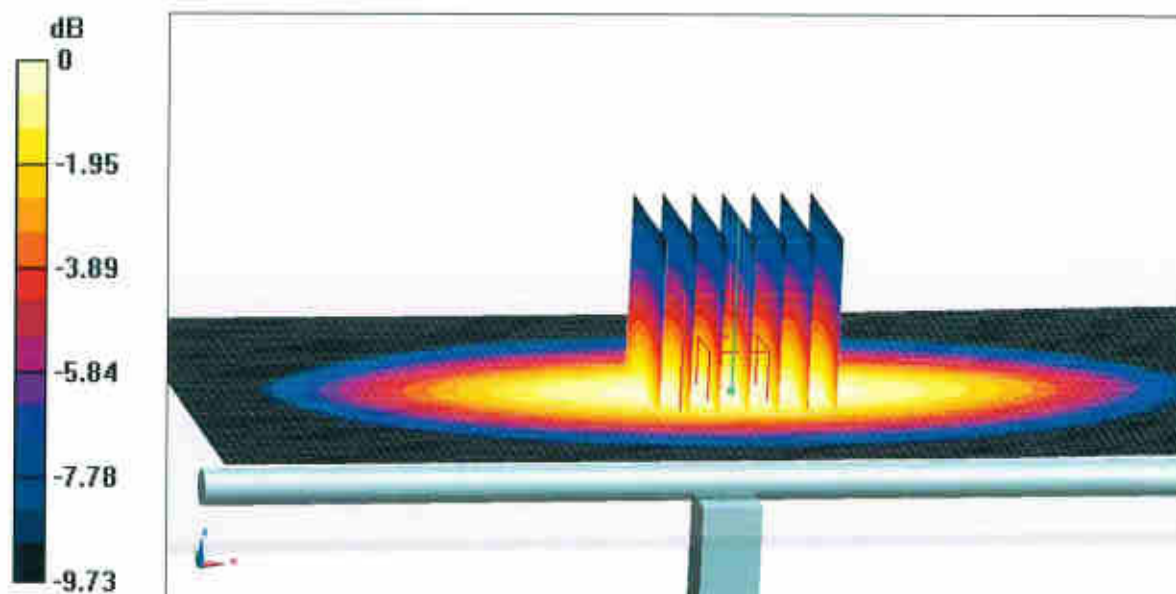
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.09 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.09 W/kg

SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.41 W/kg

Maximum value of SAR (measured) = 2.65 W/kg


0 dB = 2.65 W/kg = 4.23 dBW/kg

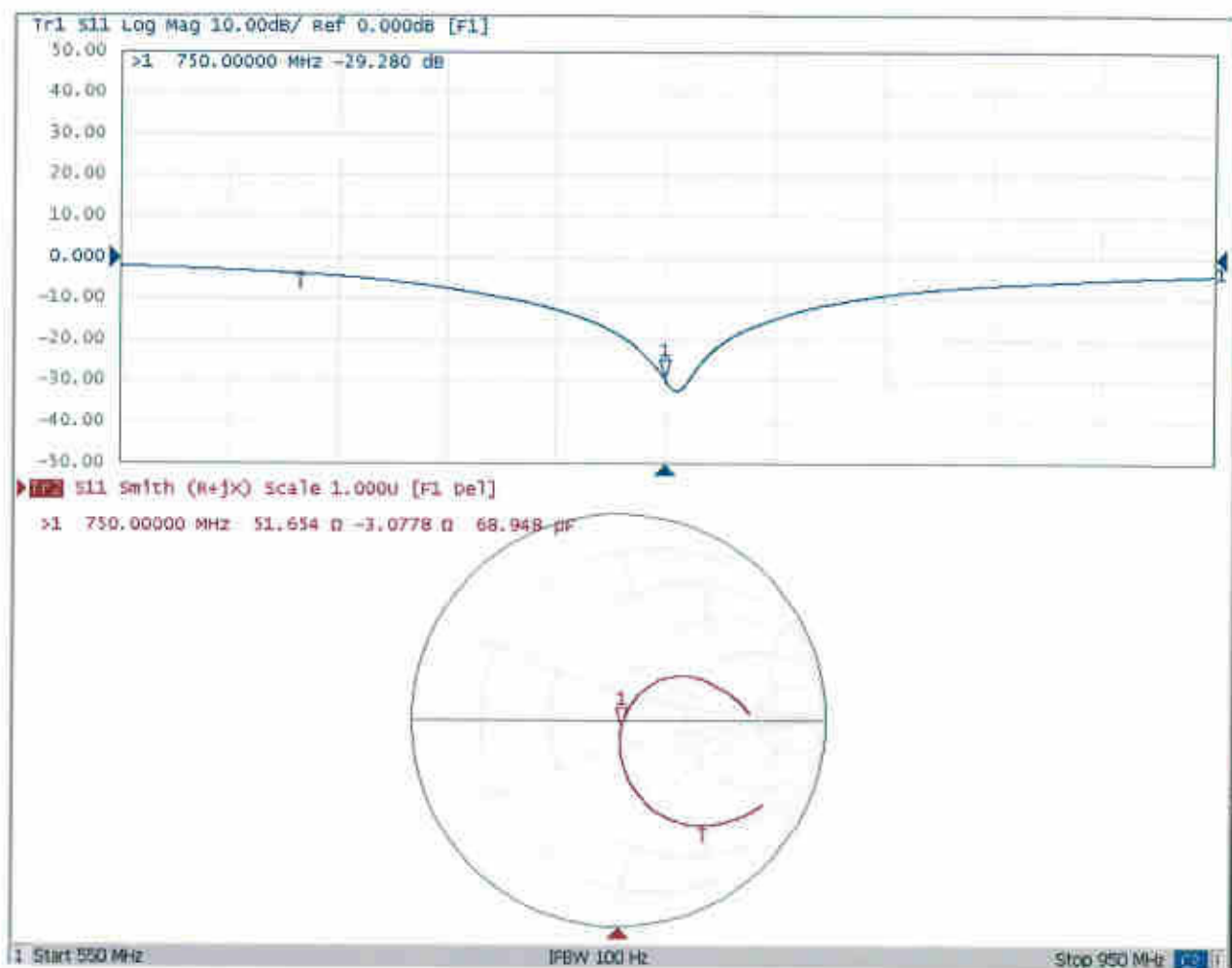


In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Impedance Measurement Plot for Head TSL





In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

DASY5 Validation Report for Body TSL

Date: 11.21.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1065

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 750$ MHz; $\sigma = 0.945$ S/m; $\epsilon_r = 54.47$; $\rho = 1000$ kg/m³

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.83, 9.83, 9.83); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

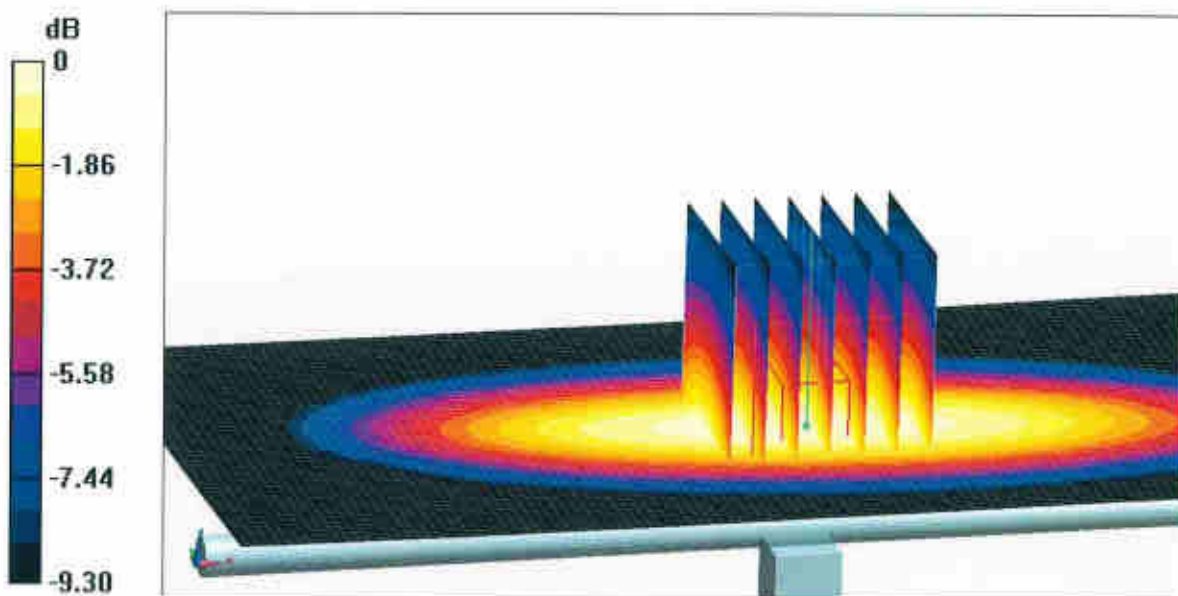
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.84 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.09 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.46 W/kg

Maximum value of SAR (measured) = 2.68 W/kg



0 dB = 2.68 W/kg = 4.28 dBW/kg



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

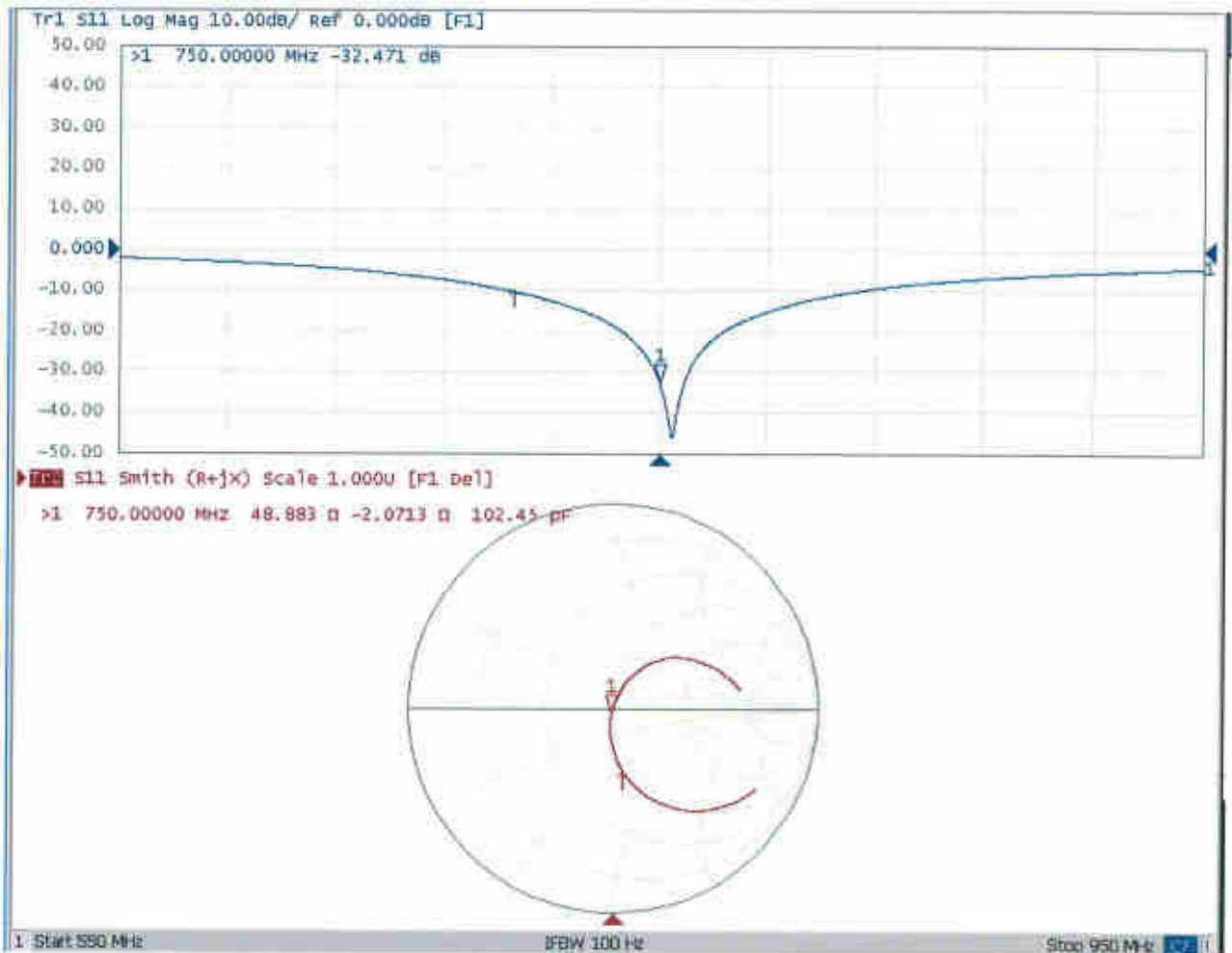
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Impedance Measurement Plot for Body TSL





In Collaboration with
s p e a g
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](http://www.chinattl.cn)

Client

Sporton-CN

Certificate No: Z16-97223

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d091**

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

Calibration date: **November 22, 2016**

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) $^{\circ}\text{C}$ 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	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 26, 2016

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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%.



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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	52.8.8.1258
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	41.4 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.31 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm³ (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	6.09 mW / g $\pm$ 20.4 % (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	54.2 $\pm$ 6 %	0.95 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.40 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.68 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.60 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.45 mW / g $\pm$ 20.4 % (k=2)



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: ctl@chinattl.com

[Http://www.chinattl.cn](http://www.chinattl.cn)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.0Ω- 3.20jΩ
Return Loss	- 29.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8Ω- 1.59jΩ
Return Loss	- 28.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.282 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
-----------------	-------



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

DASY5 Validation Report for Head TSL

Date: 11.21.2016

Test Laboratory: CCTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d091

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.916 \text{ S/m}$; $\epsilon_r = 41.41$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.82, 9.82, 9.82); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

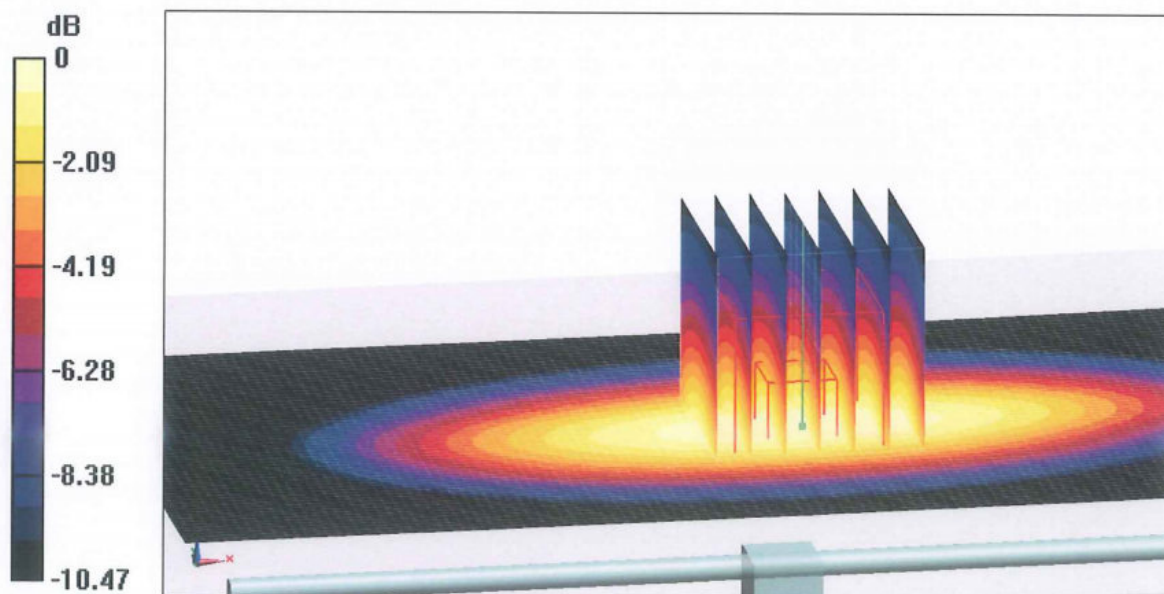
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.29V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.54 W/kg

SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.54 W/kg

Maximum value of SAR (measured) = 3.01 W/kg



0 dB = 3.01 W/kg = 4.79 dBW/kg

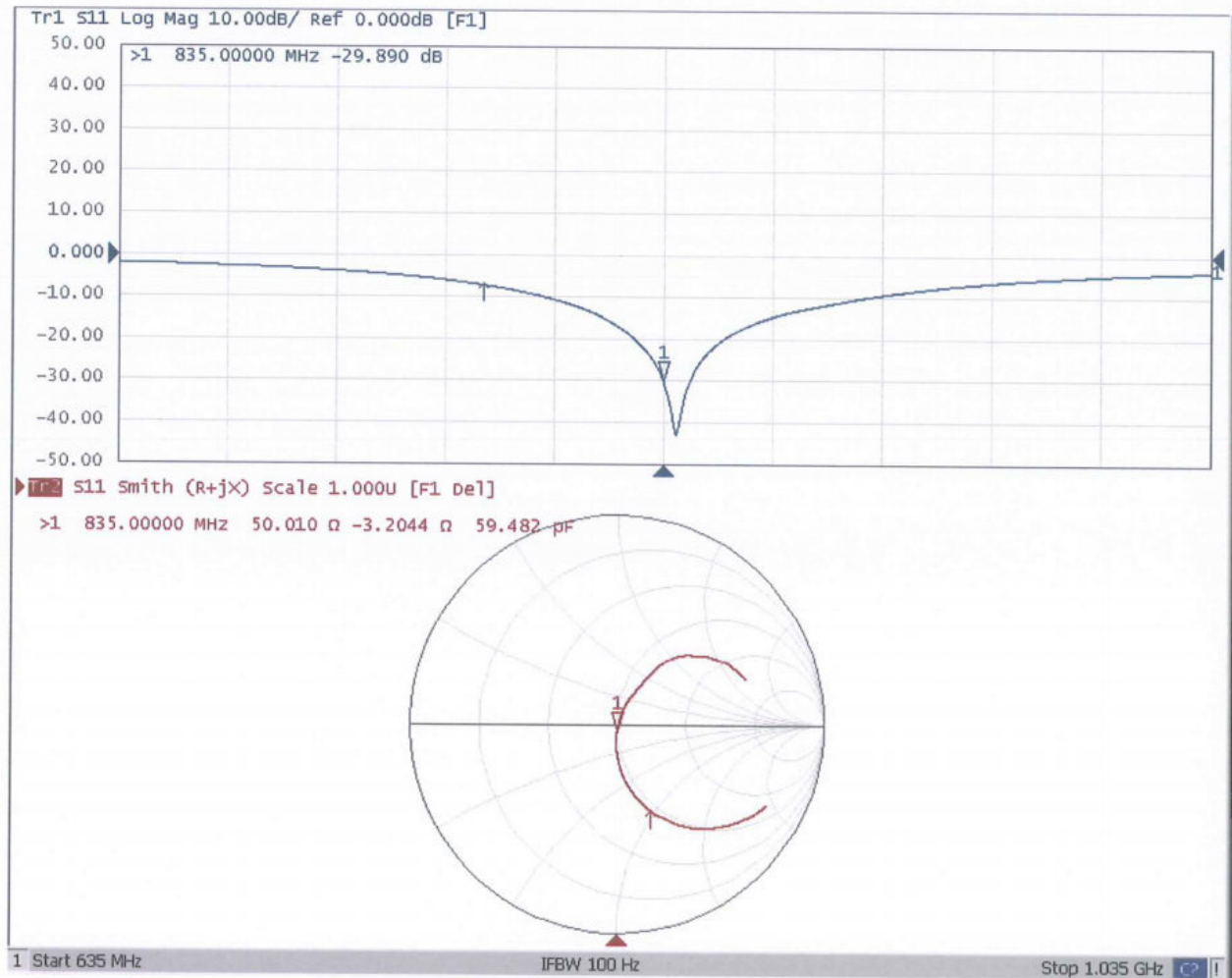


In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Impedance Measurement Plot for Head TSL





In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

DASY5 Validation Report for Body TSL

Date: 11.22.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d091

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.954 \text{ S/m}$; $\epsilon_r = 54.22$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.5,9.5, 9.5); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

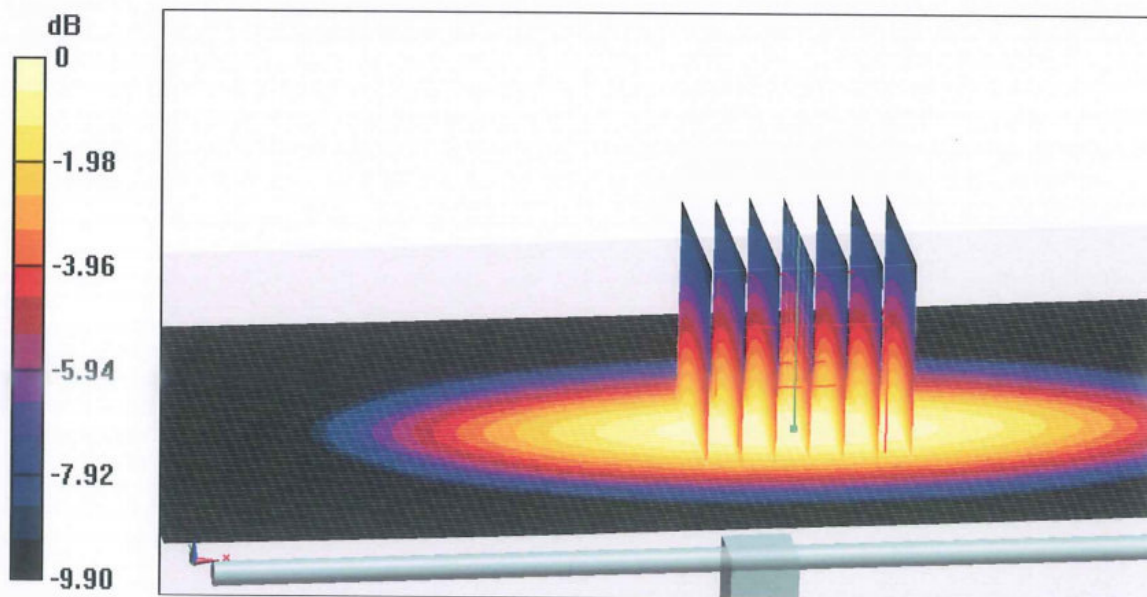
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 55.98 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 3.49 W/kg

SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.01 W/kg



0 dB = 3.01 W/kg = 4.79 dBW/kg



In Collaboration with

s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

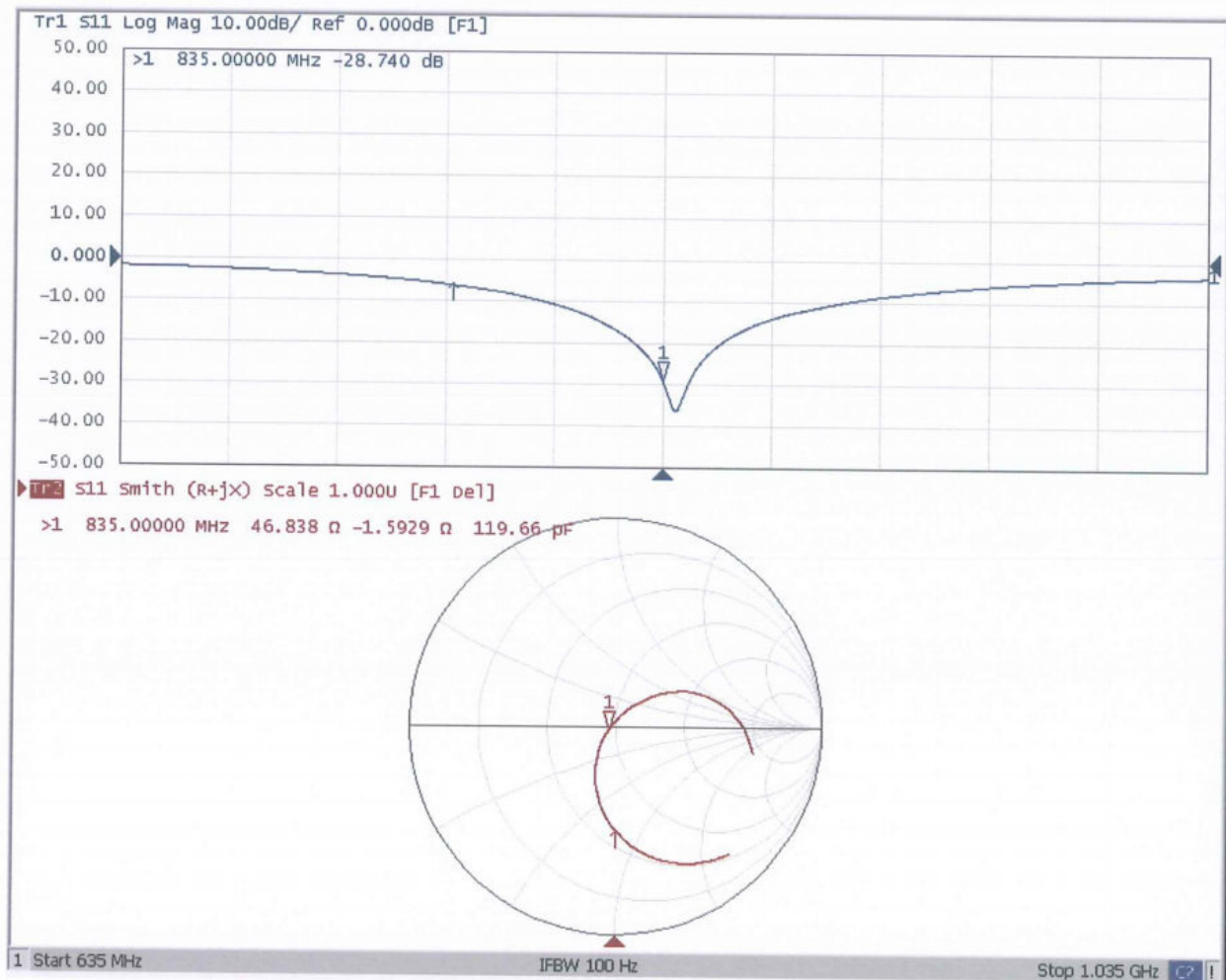
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Impedance Measurement Plot for Body TSL





In Collaboration with
s p e a g
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](http://www.chinattl.cn)

Client

Sporton-CN

Certificate No: Z16-97226

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1069**

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

Calibration date: **November 23, 2016**

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) $^{\circ}\text{C}$ 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	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 27, 2016

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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%.



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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	52.8.8.1258
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	39.8 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.34 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	37.5 mW /g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.01 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.1 mW /g $\pm$ 20.4 % (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	52.5 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.55 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	37.7 mW /g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.13 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.3 mW /g $\pm$ 20.4 % (k=2)



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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$49.1\Omega + 0.48j\Omega$
Return Loss	- 39.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$45.5\Omega + 0.42j\Omega$
Return Loss	- 26.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.101 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
-----------------	-------



In Collaboration with

s p e a k
CALIBRATION LABORATORY

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

DASY5 Validation Report for Head TSL

Date: 11.23.2016

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; $\sigma = 1.357$ S/m; $\epsilon_r = 39.79$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(8.25, 8.25, 8.25); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

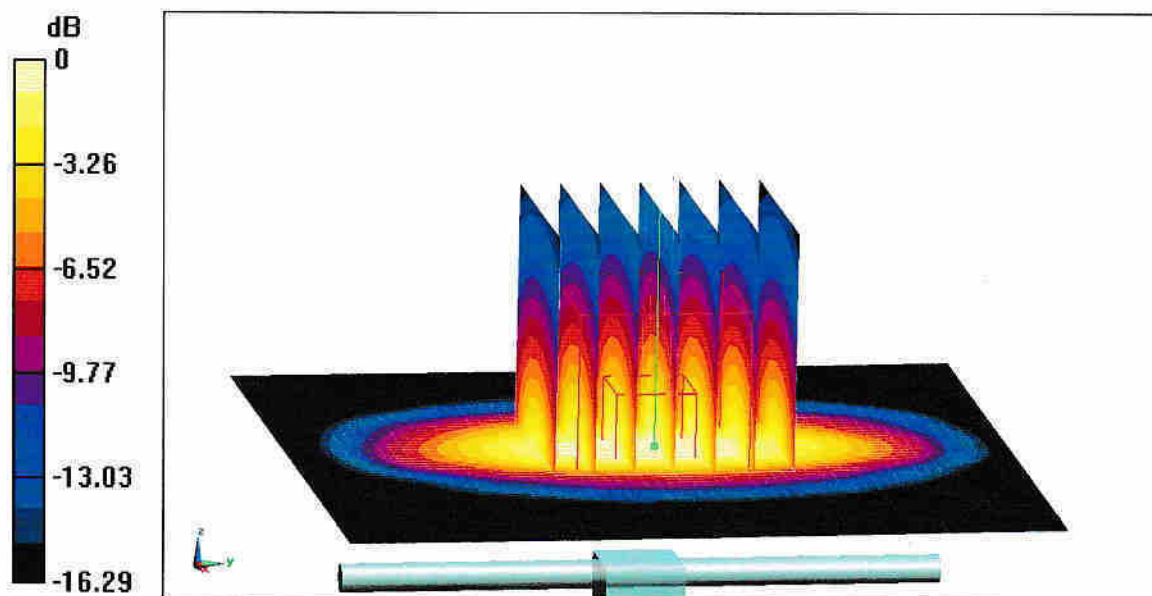
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 100.3V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 16.7W/kg

SAR(1 g) = 9.34 W/kg; SAR(10 g) = 5.01 W/kg

Maximum value of SAR (measured) = 13.2 W/kg

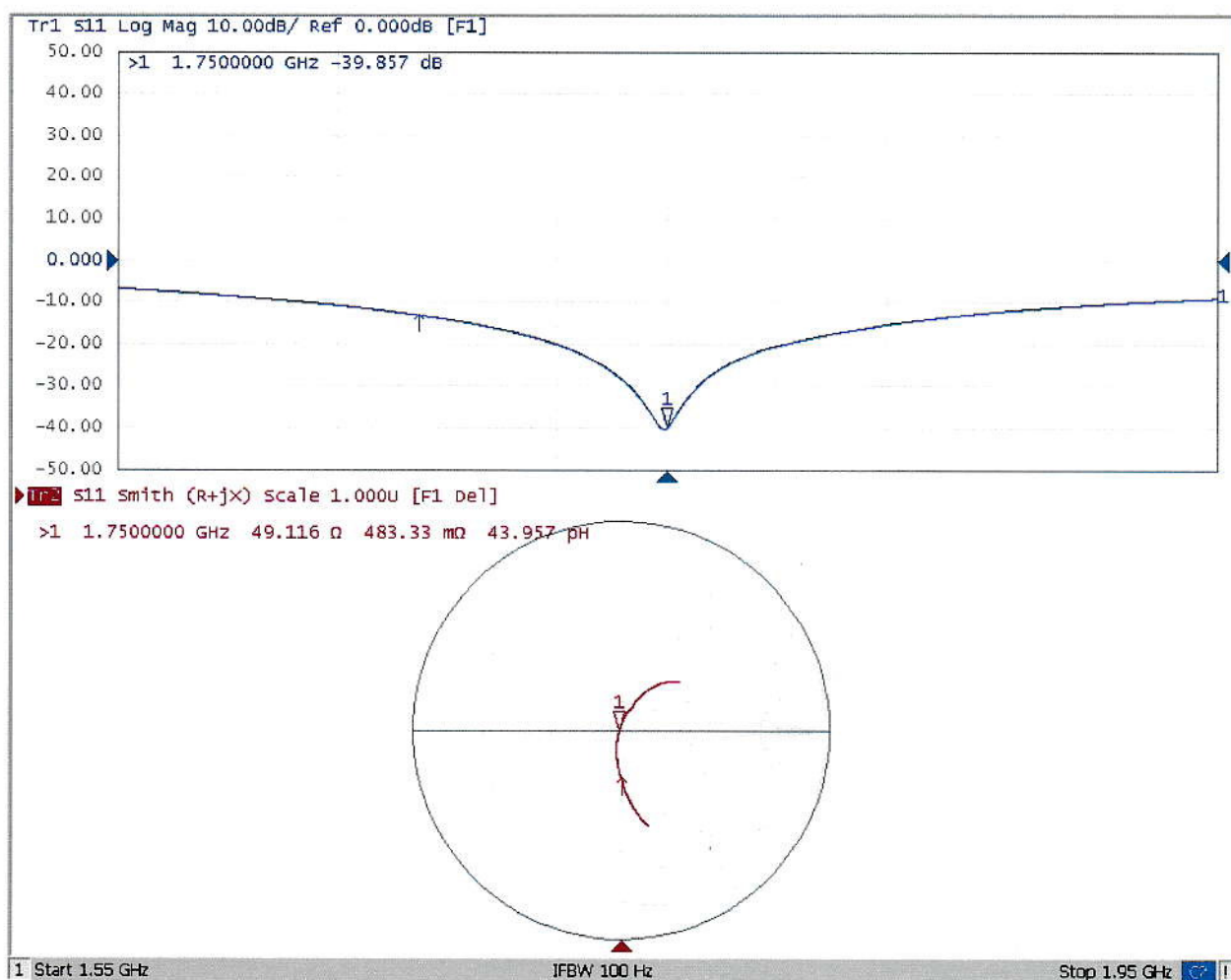


0 dB = 13.2 W/kg = 11.21 dBW/kg



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

Impedance Measurement Plot for Head TSL





In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

DASY5 Validation Report for Body TSL

Date: 11.23.2016

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; $\sigma = 1.514$ S/m; $\epsilon_r = 52.45$; $\rho = 1000$ kg/m³

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.92, 7.92, 7.92); Calibrated: 9/26/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

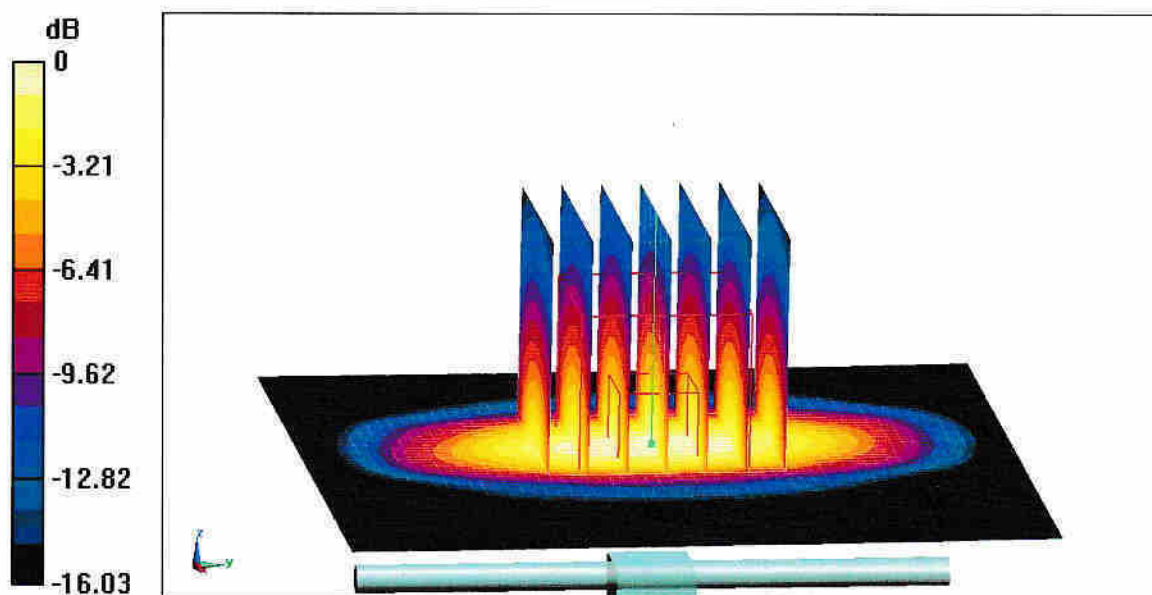
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 94.60 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.55 W/kg; SAR(10 g) = 5.13 W/kg

Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 13.4 W/kg = 11.27 dBW/kg



In Collaboration with

s p e a g

CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

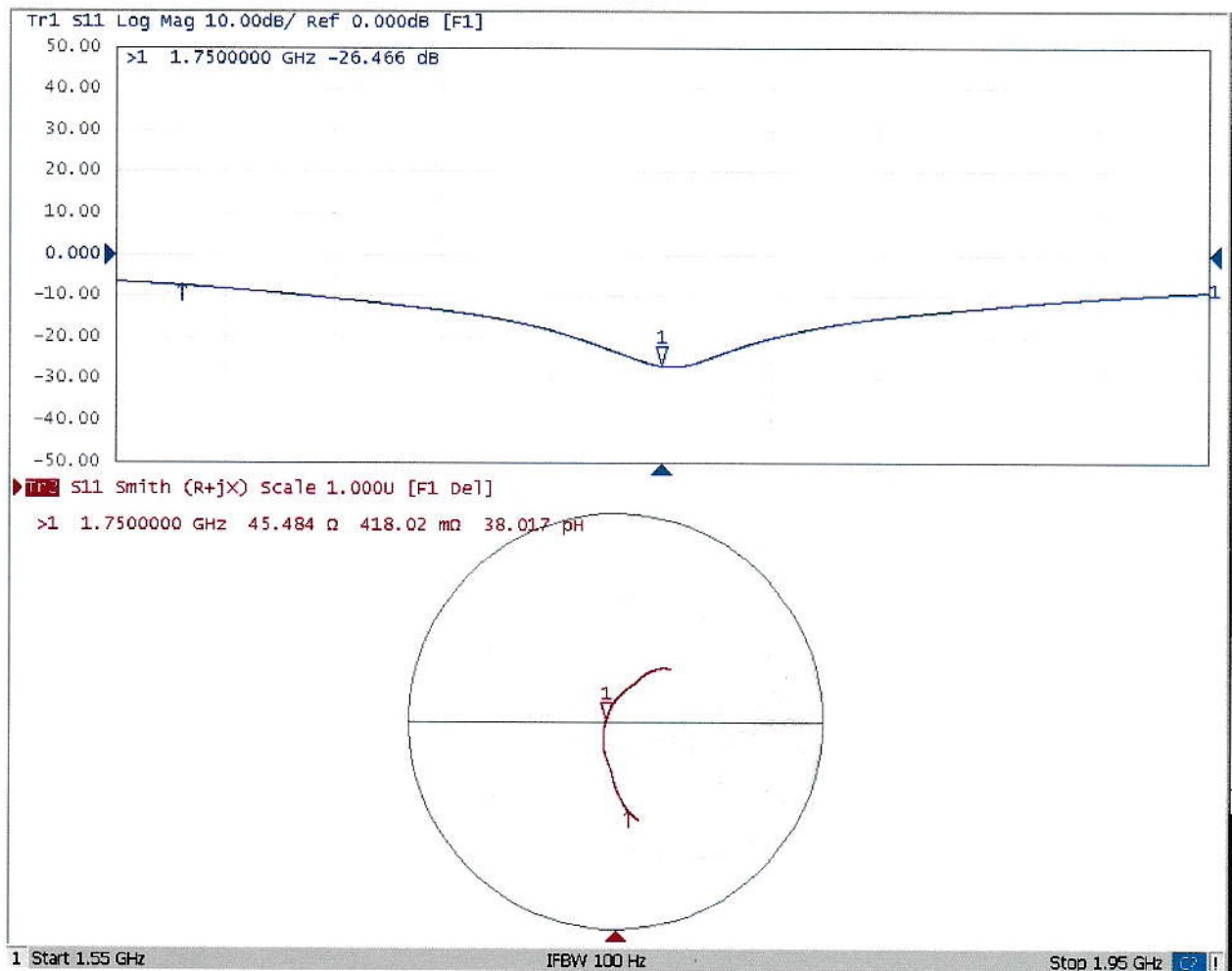
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

Http://www.chinattl.cn

Impedance Measurement Plot for Body TSL





In Collaboration with
s p e a g
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](http://www.chinattl.cn)

Client

Sporton-CN

Certificate No: **Z16-97229**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d118**

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

Calibration date: **November 24, 2016**

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	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 27, 2016

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



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM _{x,y,z}
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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%.



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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	52.8.8.1258
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 $\pm$ 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 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	1.43 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	10.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.4 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.29 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW / g $\pm$ 20.4 % (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 $\pm$ 0.2) °C	54.6 $\pm$ 6 %	1.53 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	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.8 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.32 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.3 mW / g $\pm$ 20.4 % (k=2)



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.4\Omega + 6.22j\Omega$
Return Loss	- 24.2dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$47.5\Omega + 7.79j\Omega$
Return Loss	- 21.6dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.086 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
-----------------	-------



In Collaboration with

s p e a g
CALIBRATION LABORATORY

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

DASY5 Validation Report for Head TSL

Date: 11.24.2016

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d118

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.426$ S/m; $\epsilon_r = 40.35$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.98, 7.98, 7.98); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

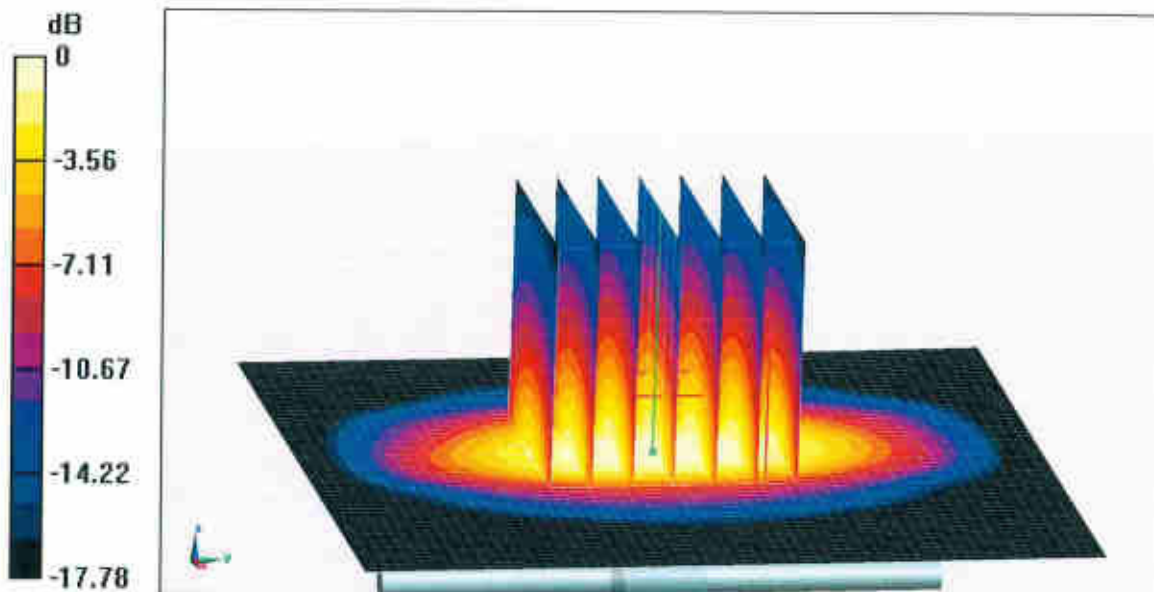
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 103.5 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 18.9 W/kg

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

Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg