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DASY5 Validation Report for Head TSL

Date: 08.30.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1152

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.358$ S/m; $\epsilon_r = 39.91$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.38, 8.38, 8.38) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

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

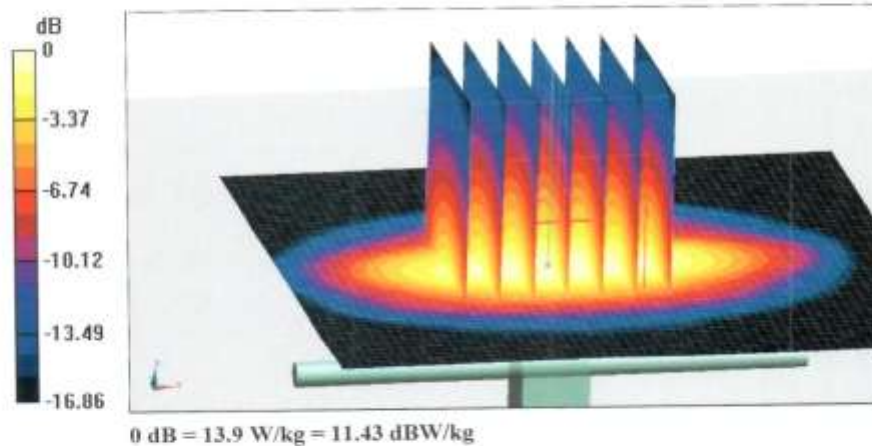
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 97.38 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.05 W/kg; SAR(10 g) = 4.8 W/kg

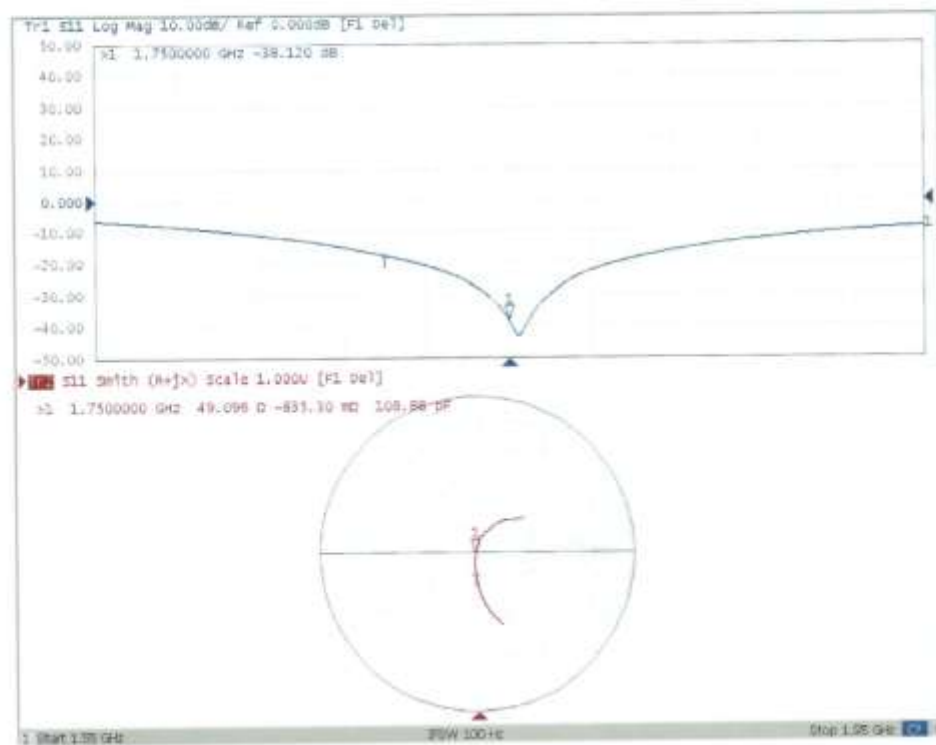
Maximum value of SAR (measured) = 13.9 W/kg





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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 08.30.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1152

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.516$ S/m; $\epsilon_r = 53.05$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.03, 8.03, 8.03) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7470)

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

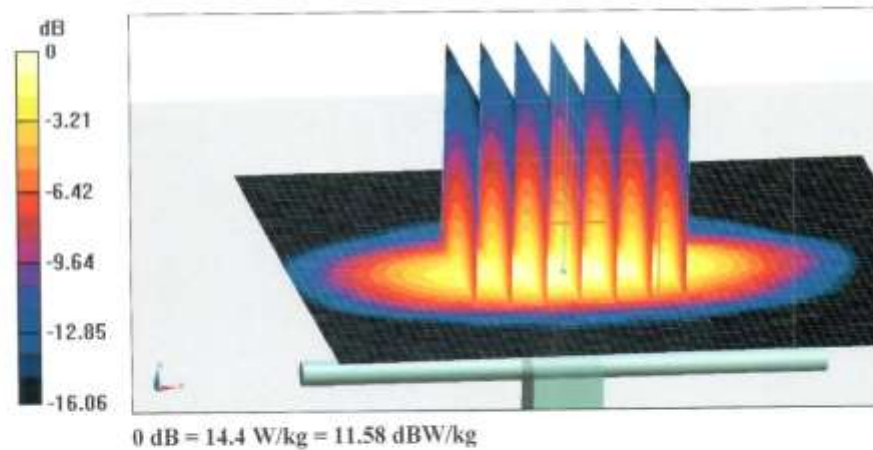
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 87.16 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.45 W/kg; SAR(10 g) = 5.05 W/kg

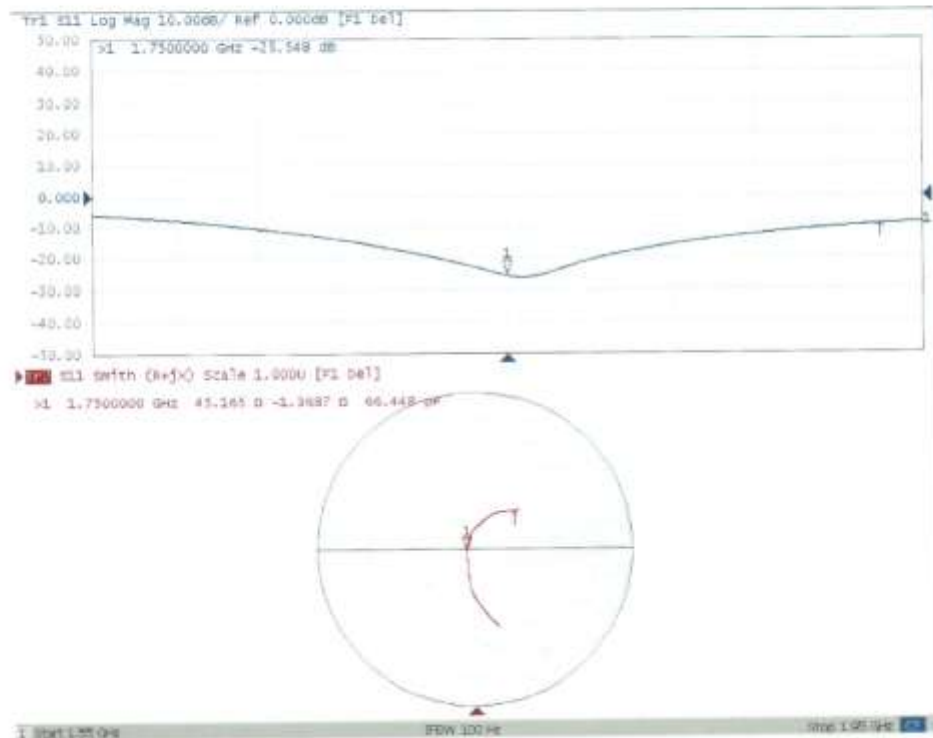
Maximum value of SAR (measured) = 14.4 W/kg





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Impedance Measurement Plot for Body TSL



1900 MHz Dipole Calibration Certificate



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CNAS L0570

Client **CTTL(South Branch)**

Certificate No: **Z18-60387**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d088**

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

Calibration date: **October 24, 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)℃ 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 7514	27-Aug-18(SPEAG, No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG, No.DAE4-1555_Aug18)	Aug-19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	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: October 28, 2018

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

Certificate No: Z18-60387

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz \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	41.1 \pm 6 %	1.37 mho/m \pm 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.92 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.5 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	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.6 \pm 6 %	1.55 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	10.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.6 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	5.41 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.4 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	$52.7\Omega + 8.63j\Omega$
Return Loss	- 23.2dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.5\Omega + 7.40j\Omega$
Return Loss	- 22.3dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.058 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: 10.24.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d088

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.367$ S/m; $\epsilon_r = 41.1$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.73, 7.73, 7.73) @ 1900 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

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

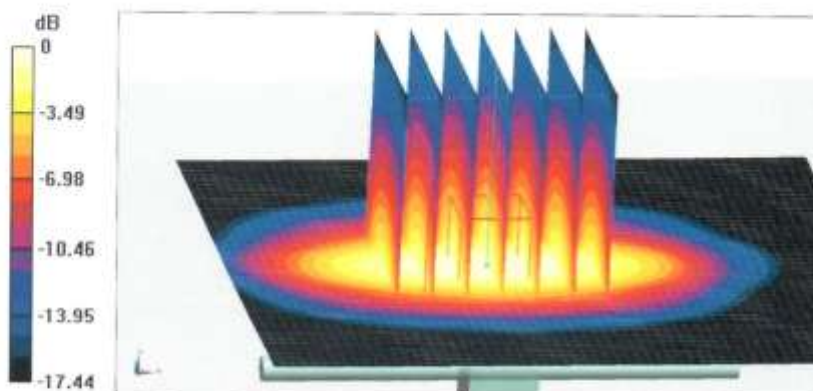
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 102.2 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 9.92 W/kg; SAR(10 g) = 5.17 W/kg

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

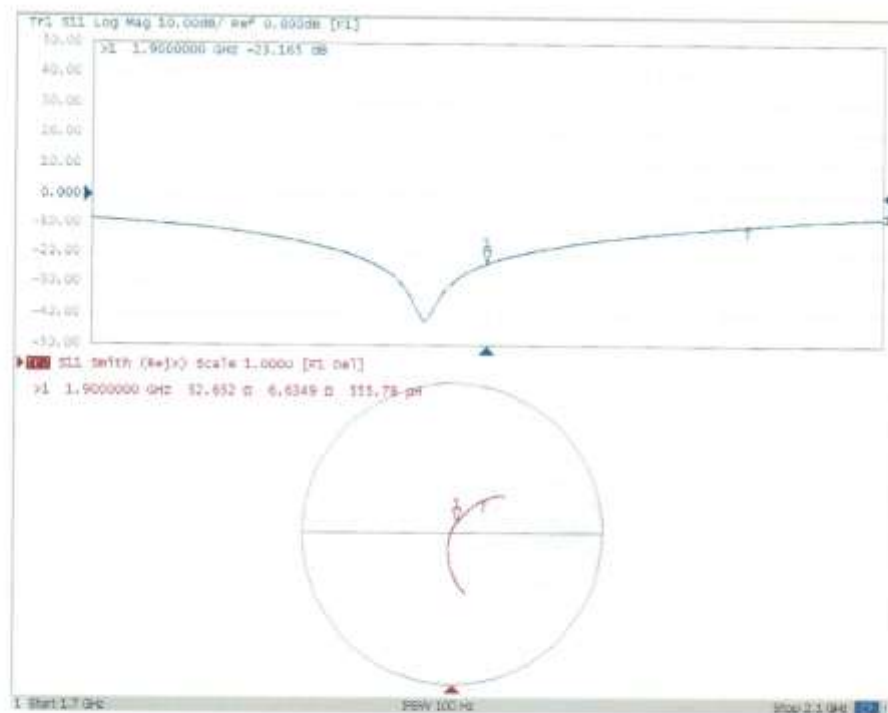


0 dB = 15.7 W/kg = 11.96 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 10.24.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d088

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.551$ S/m; $\epsilon_r = 52.63$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.53, 7.53, 7.53) @ 1900 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

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

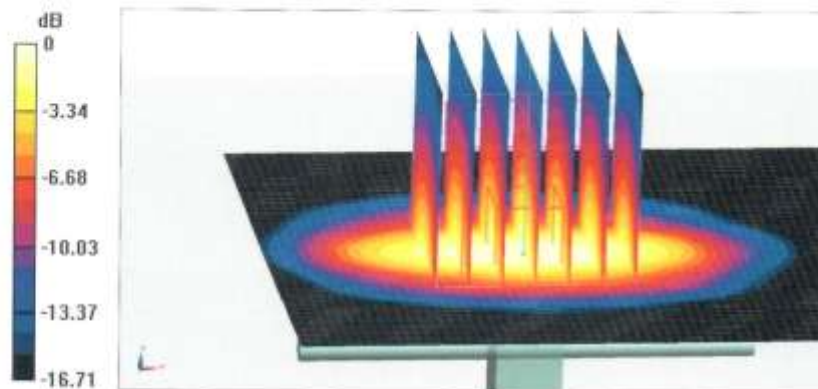
$dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 97.60 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.41 W/kg

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

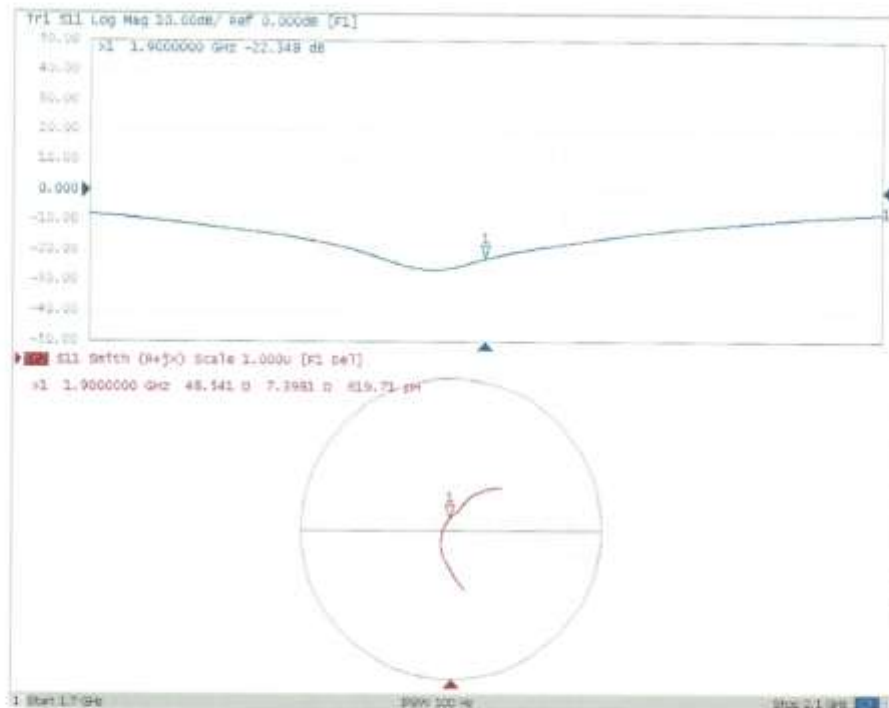


0 dB = 15.9 W/kg = 12.01 dBW/kg



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Impedance Measurement Plot for Body TSL



2450 MHz Dipole Calibration Certificate



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Client **CTTL(South Branch)**

Certificate No: **Z18-60388**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 873**

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

Calibration date: **October 26, 2018**

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(23±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 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG,No.DAE4-1555_Aug18)	Aug-19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	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: October 29, 2018

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Certificate No: Z18-60388

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Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	39.2 \pm 6 %	1.80 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	13.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.0 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	6.02 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.1 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.8 \pm 6 %	2.01 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	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.5 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	5.91 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.5 mW / g \pm 18.7 % (k=2)



Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5Ω+ 2.11 jΩ
Return Loss	- 28.0dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.3Ω+ 4.51 jΩ
Return Loss	- 26.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.024 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: 10.26.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 873

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.802$ S/m; $\epsilon_r = 39.2$; $\rho = 1000$ kg/m³

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(6.95, 6.95, 6.95) @ 2450 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

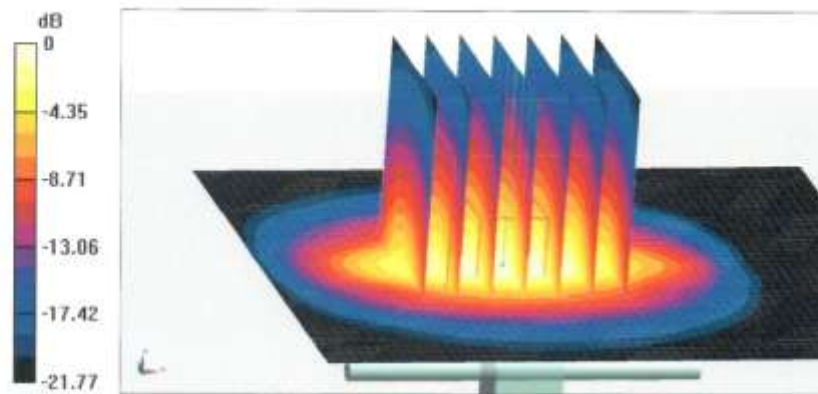
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.0 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 26.8 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.02 W/kg

Maximum value of SAR (measured) = 21.8 W/kg



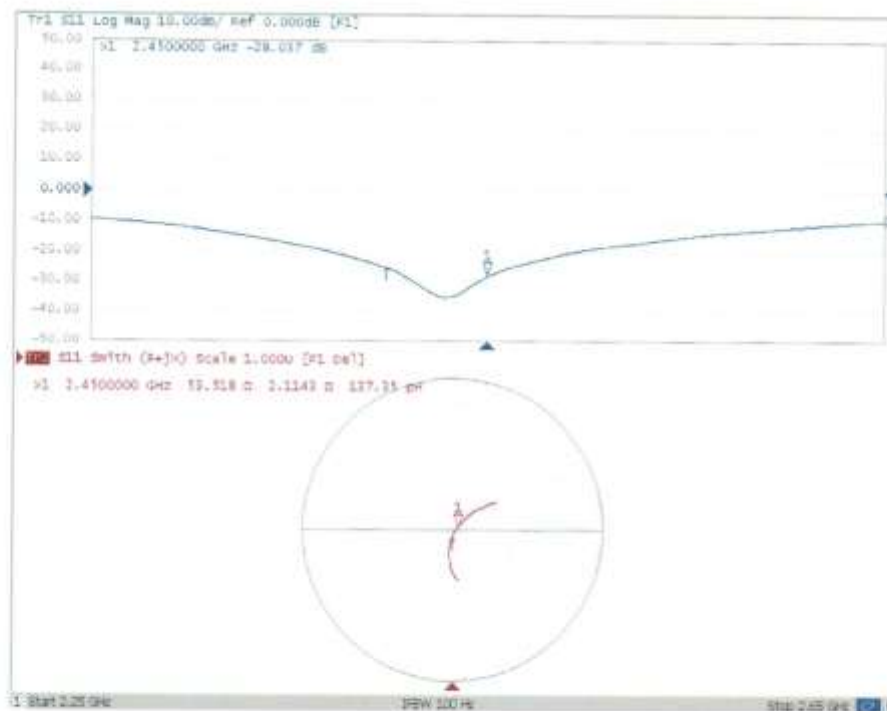
0 dB = 21.8 W/kg = 13.38 dBW/kg



In Collaboration with
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CALIBRATION LABORATORY

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E-mail: ctl@chinattl.com <http://www.chinattl.cn>

Impedance Measurement Plot for Head TSL





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E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL

Date: 10.26.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 873

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.008$ S/m; $\epsilon_r = 52.76$; $\rho = 1000$ kg/m³

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(7.13, 7.13, 7.13) @ 2450 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

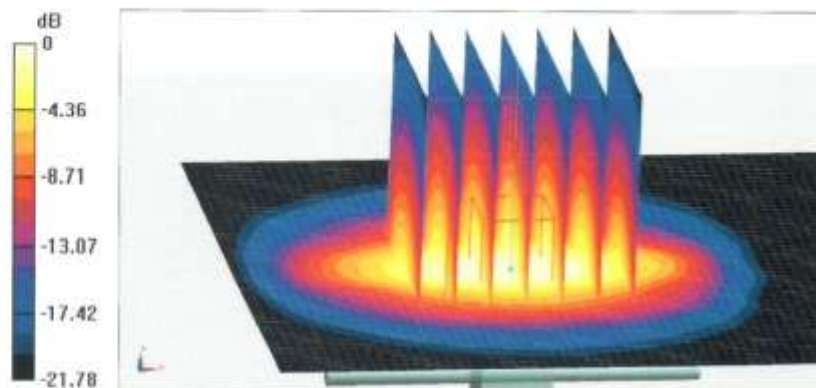
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.89 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.4 W/kg

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

Maximum value of SAR (measured) = 21.3 W/kg



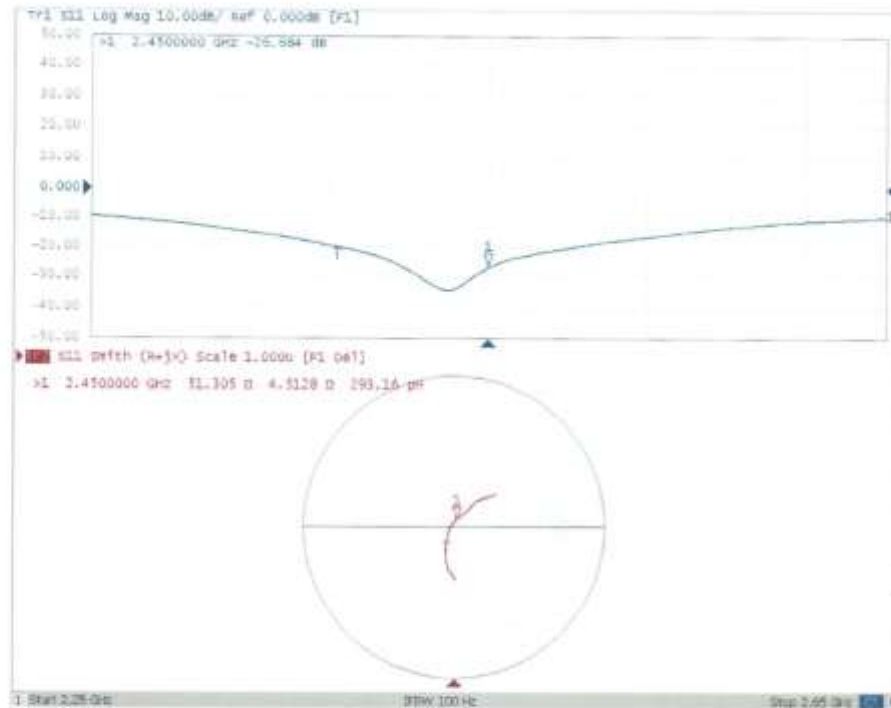
0 dB = 21.3 W/kg = 13.28 dBW/kg



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Impedance Measurement Plot for Body TSL



2550 MHz Dipole Calibration Certificate

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



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

Accredited by the Swiss Accreditation Service (SA5)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **CTTL (Auden)**

Certificate No: **D2550V2-1010_Aug18**

CALIBRATION CERTIFICATE			
Object	D2550V2 - SN:1010		
Calibration procedure(s)	QA CAL-05.v10 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	August 24, 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 (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02673/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: G837480704	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18
Calibrated by:	Name Marius Seitz	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Technical Manager	Signature
Issued: August 24, 2018			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: D2550V2-1010_Aug18

Page 1 of 8

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



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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2550 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.1	1.91 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	37.3 \pm 6 %	1.97 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	57.8 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	26.5 W/kg \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.6	2.09 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	51.5 \pm 6 %	2.14 mho/m \pm 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	54.0 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.7 W/kg \pm 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.9 Ω - 2.3 j Ω
Return Loss	- 25.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 2.0 j Ω
Return Loss	- 33.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.151 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 03, 2012

DASY5 Validation Report for Head TSL

Date: 24.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2550 MHz; Type: D2550V2; Serial: D2550V2 - SN:1010

Communication System: UID 0 - CW; Frequency: 2550 MHz

Medium parameters used: $f = 2550 \text{ MHz}$; $\sigma = 1.97 \text{ S/m}$; $\epsilon_r = 37.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.43, 7.43, 7.43) @ 2550 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

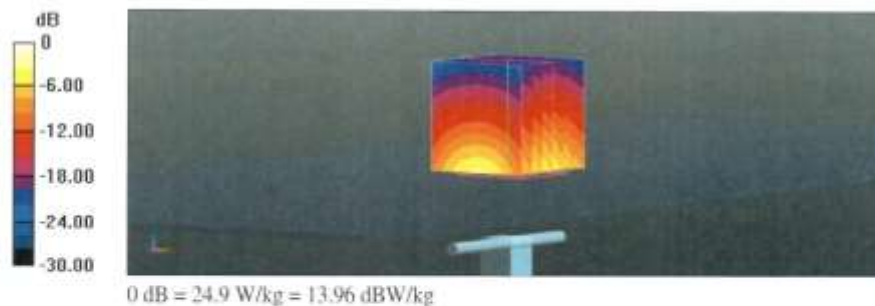
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 119.6 V/m; Power Drift = -0.07 dB

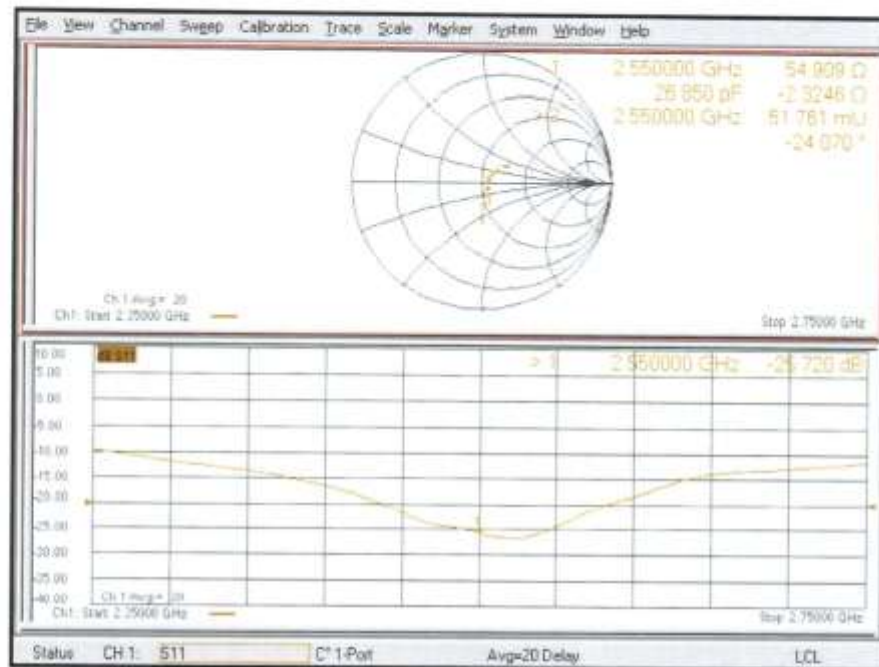
Peak SAR (extrapolated) = 30.5 W/kg

SAR(1 g) = 14.8 W/kg; SAR(10 g) = 6.73 W/kg

Maximum value of SAR (measured) = 24.9 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.08.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2550 MHz; Type: D2550V2; Serial: D2550V2 - SN:1010

Communication System: UID 0 - CW; Frequency: 2550 MHz

Medium parameters used: $f = 2550$ MHz; $\sigma = 2.14$ S/m; $\epsilon_r = 51.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.68, 7.68, 7.68) @ 2550 MHz; Calibrated: 30.12.2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 26.10.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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

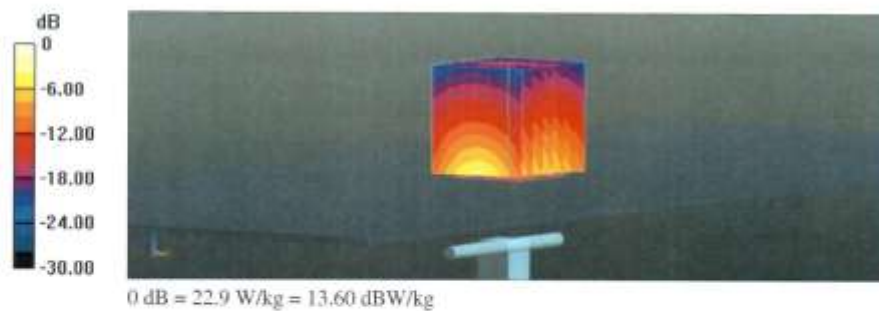
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 109.2 V/m; Power Drift = -0.03 dB

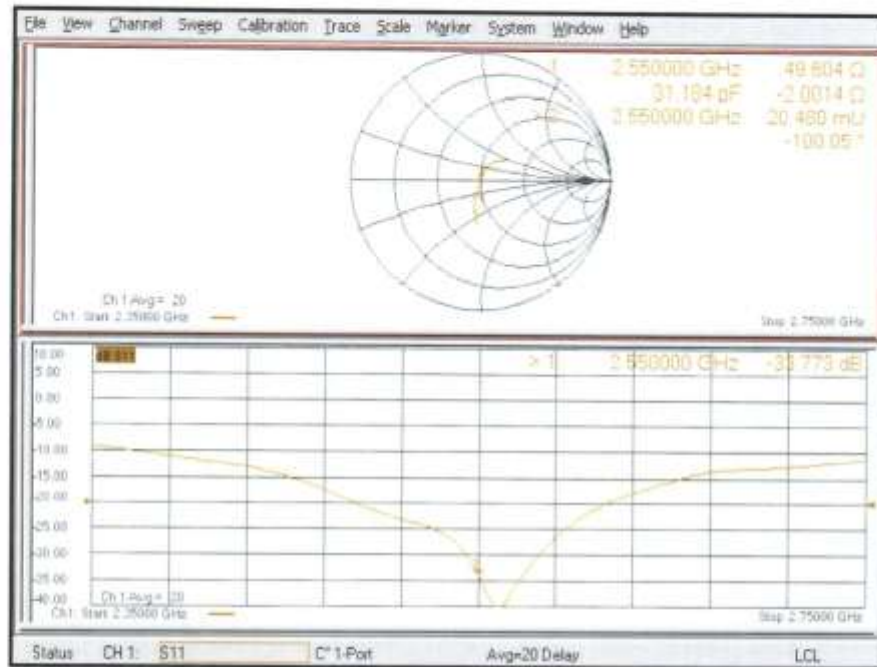
Peak SAR (extrapolated) = 27.9 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.22 W/kg

Maximum value of SAR (measured) = 22.9 W/kg



Impedance Measurement Plot for Body TSL



ANNEX J Extended Calibration SAR Dipole

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

Justification of Extended Calibration SAR Dipole D750V3– serial no.1163 (2016)

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2016-09-19	-29.0	/	49.8	/	-3.5	/
2017-09-17	-25.2	13.1	46.9	2.9	-2.8	0.7
2018-09-15	-24.4	15.9	45.5	4.3	-3.0	0.5

Justification of Extended Calibration SAR Dipole D1750V2– serial no.1152 (2016)

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2016-09-09	-27.6	/	46.3	/	-1.6	/
2017-09-08	-25.8	6.5	45.4	0.9	-1.4	0.2
2018-09-06	-24.6	10.9	44.7	1.6	-1.2	0.4

Justification of Extended Calibration SAR Dipole D835V2– serial no.4d057 (2018)

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2018-10-09	-24.3	/	46.8	/	-4.96	/
2019-10-08	-23.5	3.29	45.6	1.2	-4.75	0.21

Justification of Extended Calibration SAR Dipole D1900V2– serial no.5d088 (2018)

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2018-10-24	-22.3	/	48.5	/	7.4	/
2019-10-20	-21.4	4.04	46.3	2.2	7.9	0.5

Justification of Extended Calibration SAR Dipole D2450V2– serial no.873 (2018)

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2018-10-26	-26.7	/	51.3	/	4.51	/
2019-10-20	-24.8	7.12	49.4	1.9	4.78	0.27

Justification of Extended Calibration SAR Dipole D2550V2– serial no.1058 (2018)

Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (johm)	Delta (johm)
2018-08-24	-33.8	/	49.6	/	-2.0	/
2019-08-22	-31.2	7.69	47.4	2.2	-1.7	0.3

ANNEX K Spot Check Test

As the test lab for cp332A from Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd, we, Shenzhen Academy of Information and Communications Technology, declare on our sole responsibility that, according to “Justification Letter” provided by applicant, only the Spot check test should be performed. The test results are as below.

K.1 Internal Identification of EUT used during the spot check test

EUT ID*	IMEI	HW Version	SW Version
EUT3	867695041078378	P1	2.0.255.P0.190919.cp332A

K.2 Measurement results

LTE Band 2 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
1900	19100	Rear	21.75	22.5	0.967	1.15	1.18

LTE Band 4 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
1720	20050	Rear	20.95	21.5	1.02	1.16	1.23

LTE Band 5 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
829	20450	Rear	23.20	23.5	1.03	1.10	1.05

LTE Band 12 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
707.5	23095	Rear	23.33	24	0.766	0.89	0.81

LTE Band 13 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
782	23230	Rear	23.52	24	0.444	0.50	0.42

LTE Band 25 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
1905	26590	Rear	23.52	21.75	0.943	1.02	1.14

LTE Band 26 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
822.5	26775	Rear	23.52	23.21	0.856	0.92	1.06

LTE Band 41 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
2593	40620	Rear	23.11	24	0.690	0.85	0.59

LTE Band 66 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
1720	132072	Rear	23.11	21.75	1.16	1.23	1.19

LTE Band 71 - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
680.5	133297	Rear	23.22	24	0.454	0.54	0.30

WLAN 2.4G - Body

Frequency		Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	SAR(10g) (W/kg)		
MHz	Ch.				Spot check data		Original data
					Measured SAR	Reported SAR	
2462	11	Rear	17.80	18	0.330	0.35	0.36

K.3 Graph Results for Spot Check

LTE Band 2 Body

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 1900MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.556 \text{ S/m}$; $\epsilon_r = 52.388$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

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

Probe: EX3DV4 – SN3633 ConvF (7.67, 7.67, 7.67);

Rear Side High 1RB_Mid/Area Scan (61x101x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$
Maximum value of SAR (interpolated) = 1.35 W/kg

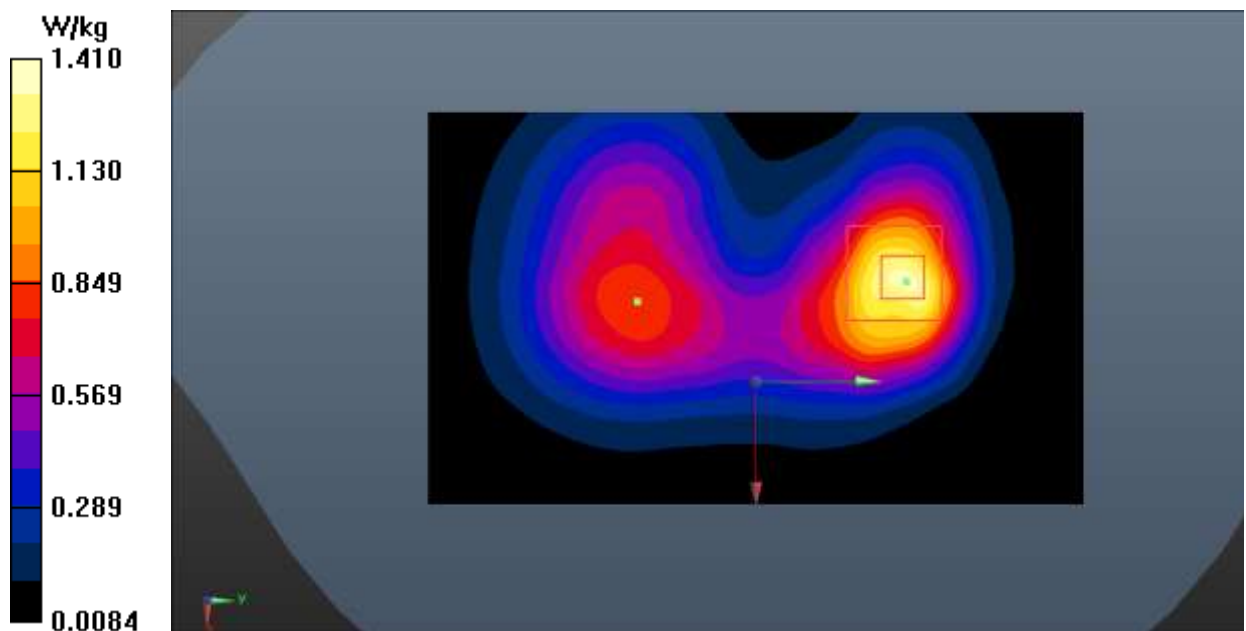
Rear Side High 1RB_Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$

Reference Value = 18.29 V/m ; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.86 W/kg

SAR(1 g) = 0.967 W/kg ; SAR(10 g) = 0.503 W/kg

Maximum value of SAR (measured) = 1.41 W/kg



LTE Band 4 Body

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 1750MHz

Medium parameters used: $f = 1720$ MHz; $\sigma = 1.434$ S/m; $\epsilon_r = 52.912$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 1720 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (7.93, 7.93, 7.93);

Rear Side Low 1RB_Middle/Area Scan (61x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.51 W/kg

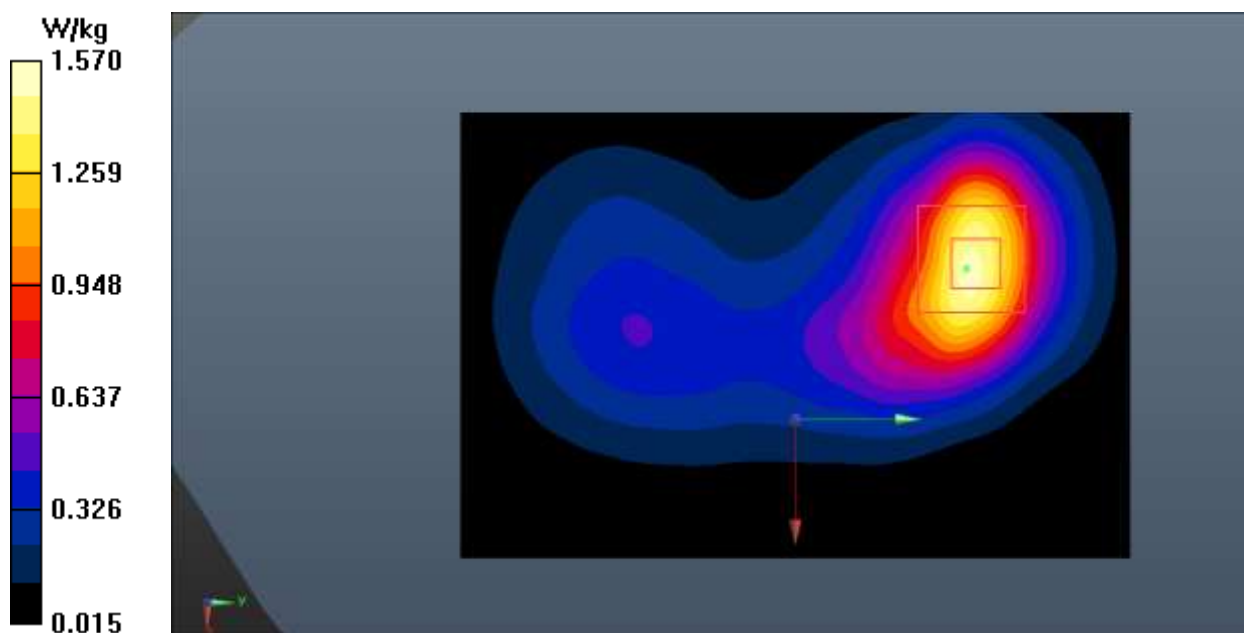
Rear Side Low 1RB_Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 15.35 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.00 W/kg

SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.565 W/kg

Maximum value of SAR (measured) = 1.57 W/kg



LTE Band 5 Body

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body 835MHz

Medium parameters used (interpolated): $f = 829$ MHz; $\sigma = 0.981$ S/m; $\epsilon_r = 53.702$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 829 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

Rear Side Low 1RB_Middle/Area Scan (61x91x1): Interpolated grid: $dx=1.500$ mm, $dy=1.500$ mm

Maximum value of SAR (interpolated) = 1.27 W/kg

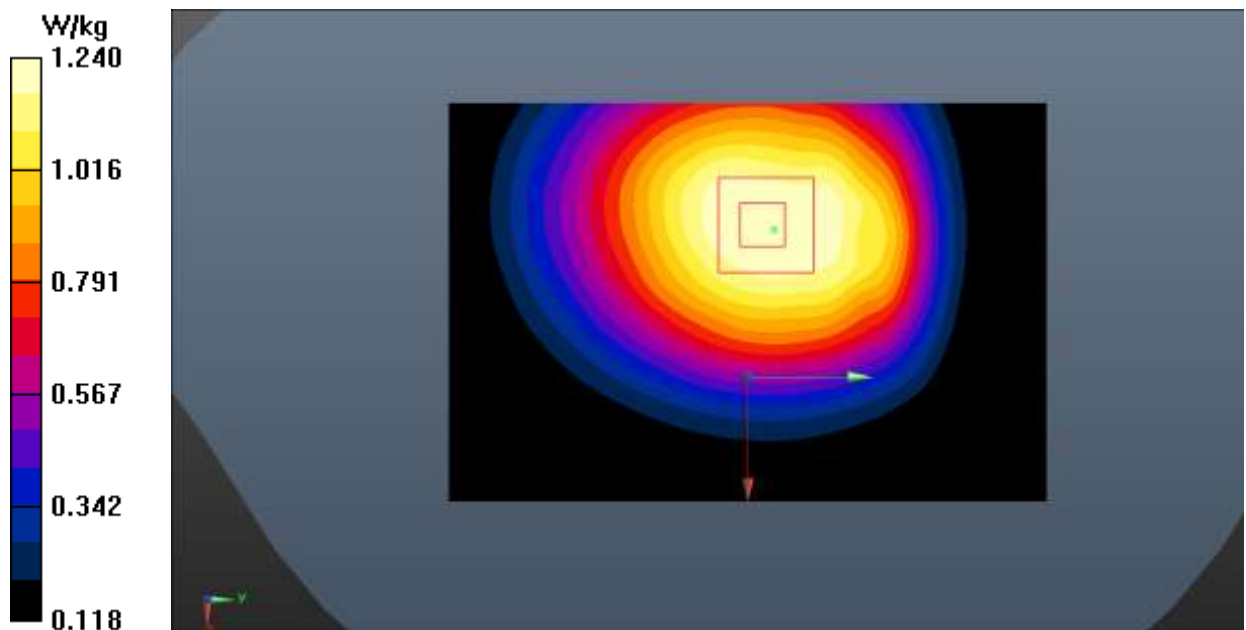
Rear Side Low 1RB_Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8$ mm, $dy=8$ mm, $dz=5$ mm

Reference Value = 31.58 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.40 W/kg

SAR(1 g) = 1.03 W/kg; SAR(10 g) = 0.744 W/kg

Maximum value of SAR (measured) = 1.24 W/kg



LTE Band 12 Body

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body 750MHz

Medium parameters used (interpolated): $f = 707.5$ MHz; $\sigma = 0.936$ S/m; $\epsilon_r = 54.464$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 707.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

Rear Side Middle 1RB_Middle/Area Scan (61x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.925 W/kg

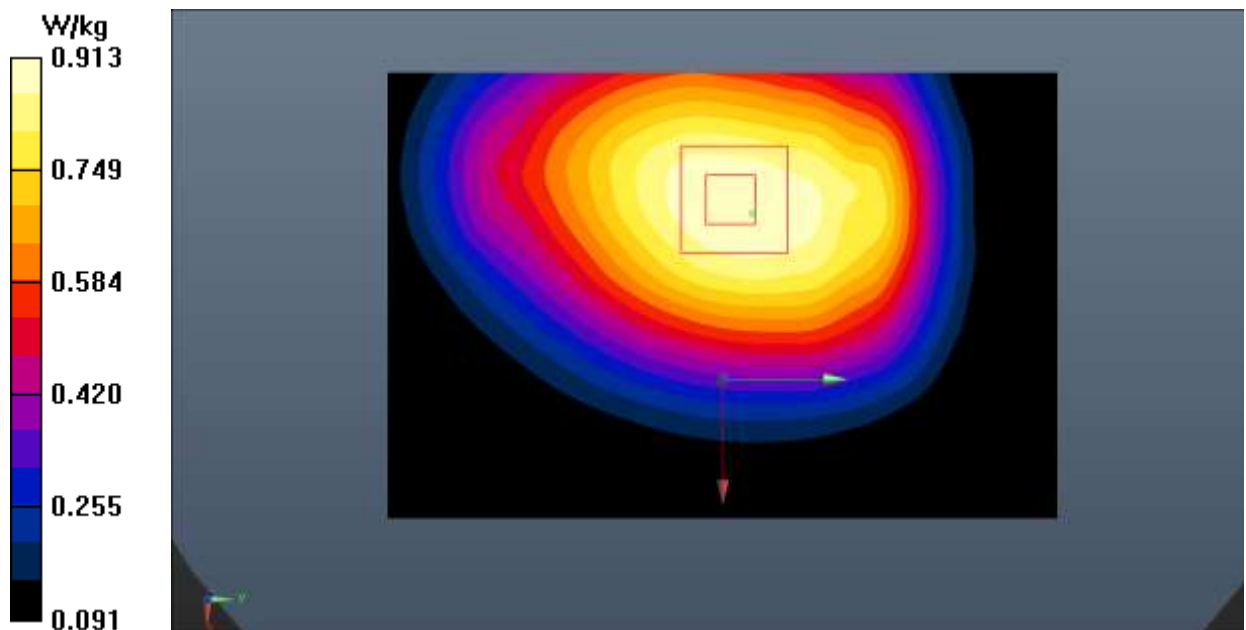
Rear Side Middle 1RB_Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 25.98 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 1.04 W/kg

SAR(1 g) = 0.766 W/kg; SAR(10 g) = 0.555 W/kg

Maximum value of SAR (measured) = 0.913 W/kg



LTE Band 13 Body

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body 750MHz

Medium parameters used: $f = 782 \text{ MHz}$; $\sigma = 0.983 \text{ S/m}$; $\epsilon_r = 53.915$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 782 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

Rear Side Middle 1RB_Middle/Area Scan (61x91x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$

Maximum value of SAR (interpolated) = 0.543 W/kg

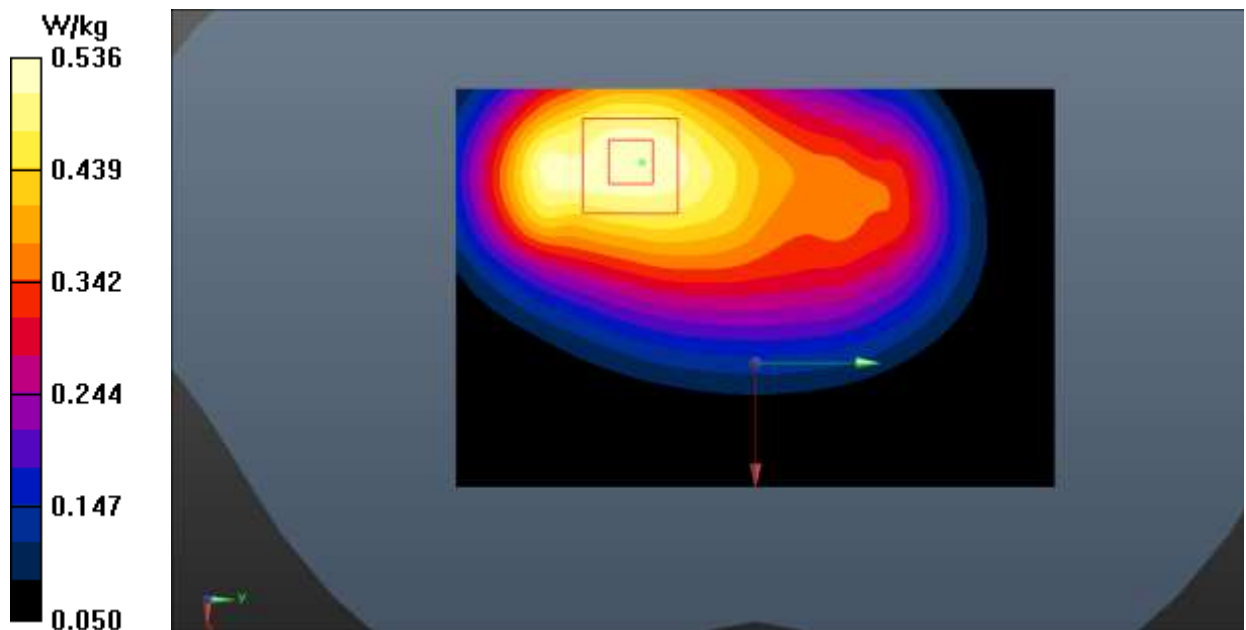
Rear Side Middle 1RB_Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 16.36 V/m ; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.619 W/kg

SAR(1 g) = 0.444 W/kg ; SAR(10 g) = 0.316 W/kg

Maximum value of SAR (measured) = 0.536 W/kg



LTE Band 25 Body

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 1900MHz

Medium parameters used (interpolated): $f = 1905$ MHz; $\sigma = 1.561$ S/m; $\epsilon_r = 52.383$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 1905 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (7.67, 7.67, 7.67);

Rear Side High 1RB_Middle/Area Scan (61x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.48 W/kg

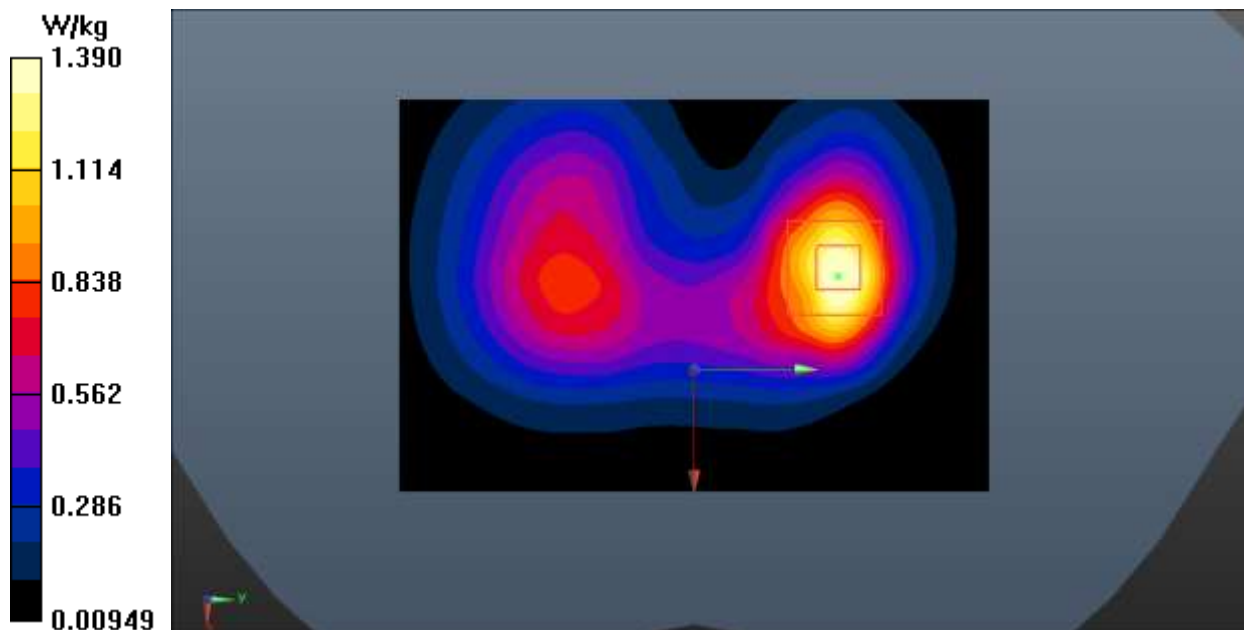
Rear Side High 1RB_Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.06 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.81 W/kg

SAR(1 g) = 0.943 W/kg; SAR(10 g) = 0.498 W/kg

Maximum value of SAR (measured) = 1.39 W/kg



LTE Band 26 Body

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body 835MHz

Medium parameters used (interpolated): $f = 822.5$ MHz; $\sigma = 0.981$ S/m; $\epsilon_r = 53.765$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 822.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

Rear Side Low 1RB_Low/Area Scan (61x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.33 W/kg

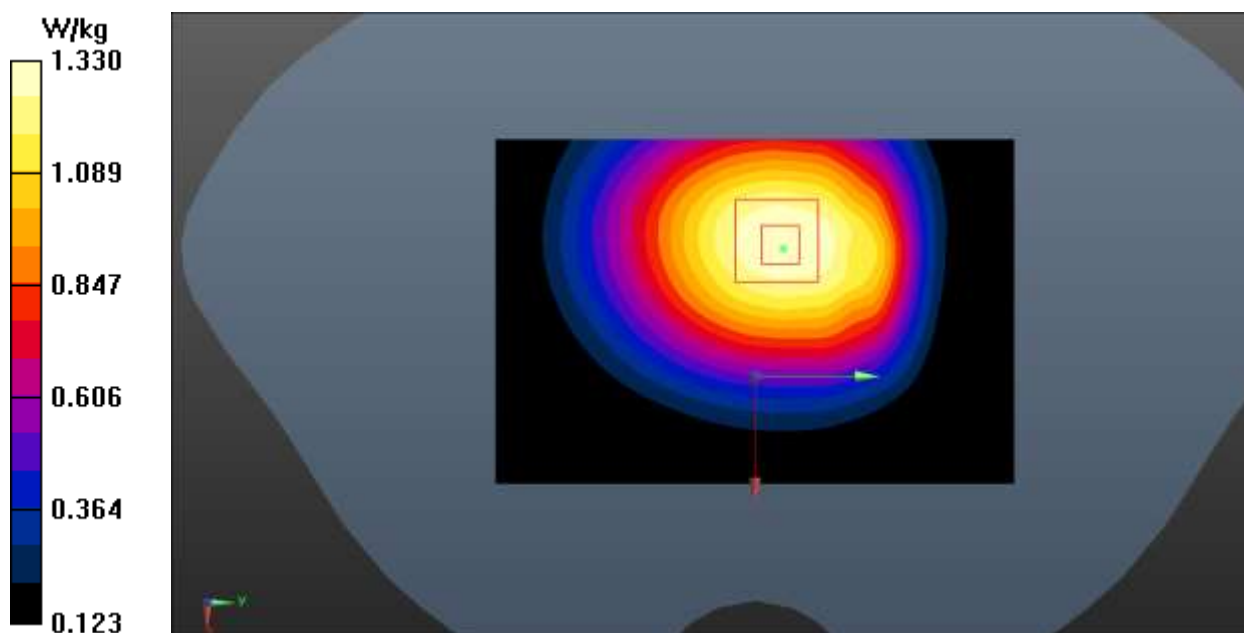
Rear Side Low 1RB_Low/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 31.83 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 1.51 W/kg

SAR(1 g) = 0.856 W/kg; SAR(10 g) = 0.613 W/kg

Maximum value of SAR (measured) = 1.33 W/kg



LTE Band 41 Body

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 2550MHz

Medium parameters used (interpolated): $f = 2593$ MHz; $\sigma = 2.102$ S/m; $\epsilon_r = 51.326$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_TDD (0) Frequency: 2593 MHz Duty Cycle: 1:1.58

Probe: EX3DV4 – SN3633 ConvF (7.21, 7.21, 7.21);

Rear Side Middle 1RB_Mid/Area Scan (101x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.25 W/kg

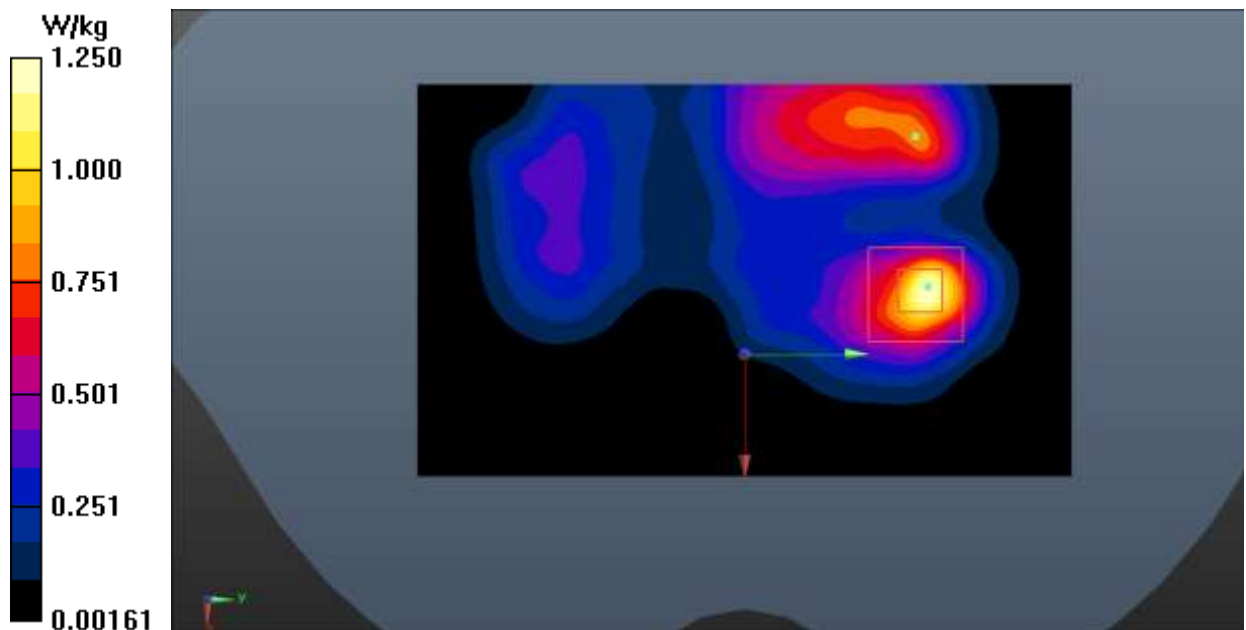
Rear Side Middle 1RB_Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.18 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 1.73 W/kg

SAR(1 g) = 0.690 W/kg; SAR(10 g) = 0.308 W/kg

Maximum value of SAR (measured) = 1.25 W/kg



LTE Band 66 Body

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 1750MHz

Medium parameters used: $f = 1720$ MHz; $\sigma = 1.434$ S/m; $\epsilon_r = 52.912$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 1720 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (7.93, 7.93, 7.93);

Rear Side Low 1RB_Middle/Area Scan (61x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.62 W/kg

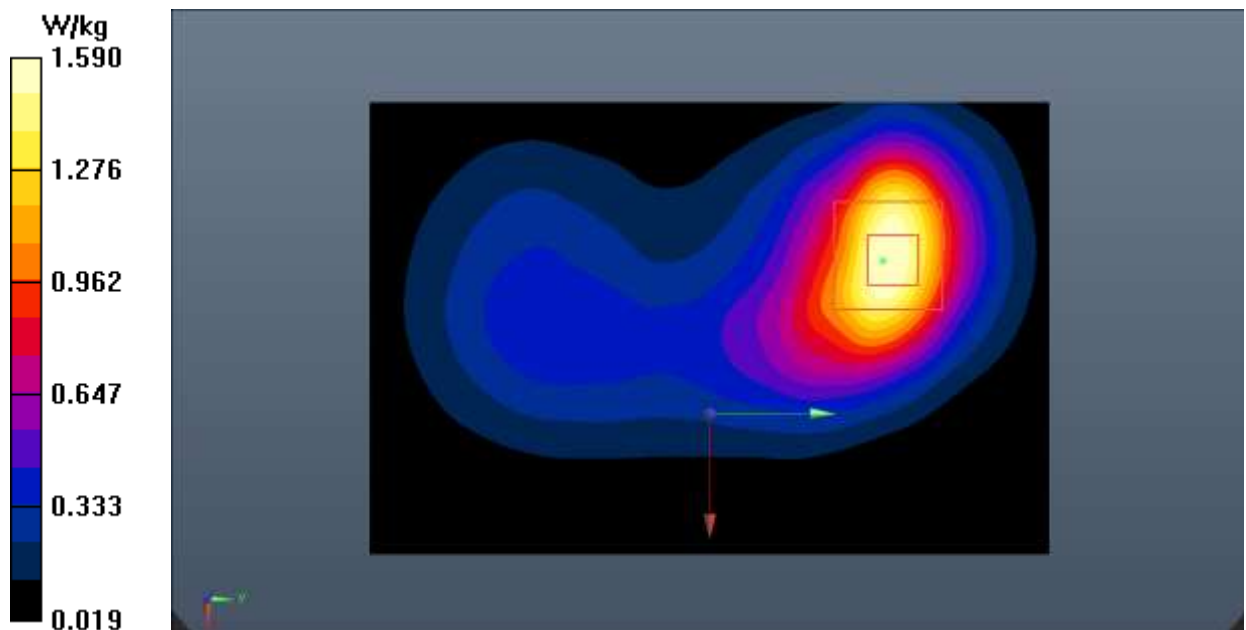
Rear Side Low 1RB_Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.40 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 2.07 W/kg

SAR(1 g) = 1.16 W/kg; SAR(10 g) = 0.643 W/kg

Maximum value of SAR (measured) = 1.59 W/kg



LTE Band 71 Body

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body 750MHz

Medium parameters used (extrapolated): $f = 680.5$ MHz; $\sigma = 0.909$ S/m; $\epsilon_r = 54.977$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: UID 0, LTE_FDD (0) Frequency: 680.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

Rear Side Middle 1RB_Middle/Area Scan (61x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.541 W/kg

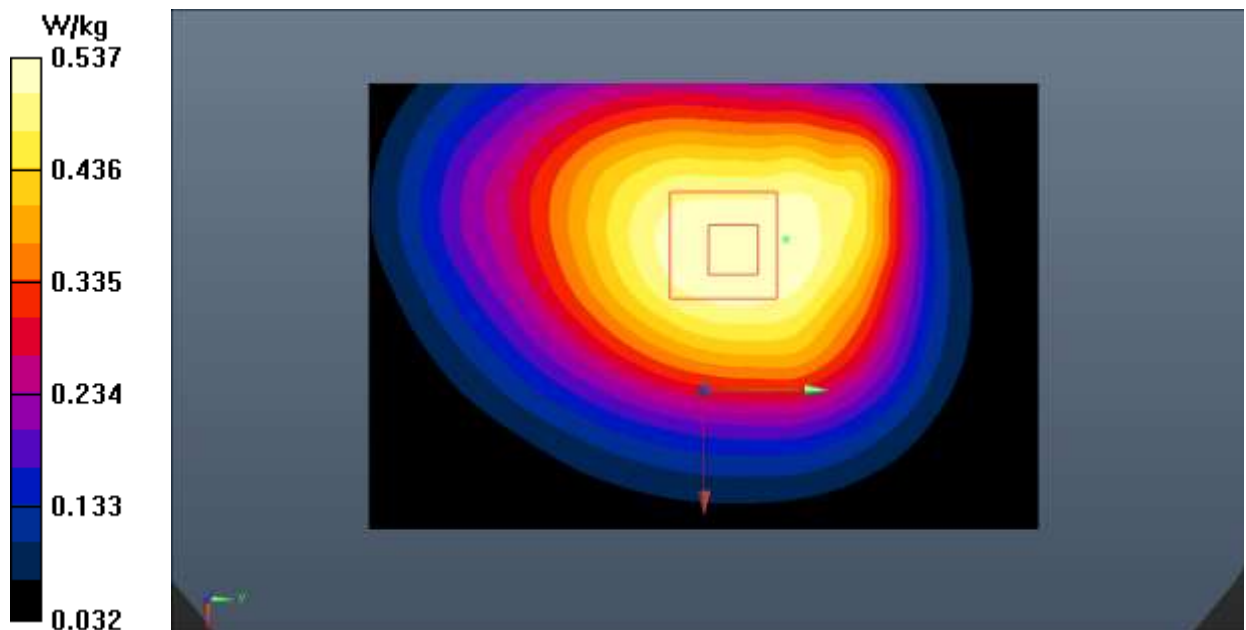
Rear Side Middle 1RB_Middle/Zoom Scan (6x7x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.85 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.617 W/kg

SAR(1 g) = 0.454 W/kg; SAR(10 g) = 0.329 W/kg

Maximum value of SAR (measured) = 0.537 W/kg



WIFI 2.4G Body

Date: 2019-12-5

Electronics: DAE4 Sn1527

Medium: Body 2450MHz

Medium parameters used: $f = 2462$ MHz; $\sigma = 1.944$ S/m; $\epsilon_r = 51.983$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

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

Probe: EX3DV4 – SN3633 ConvF (7.4, 7.4, 7.4);

Rear Side High/Area Scan (101x151x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.388 W/kg

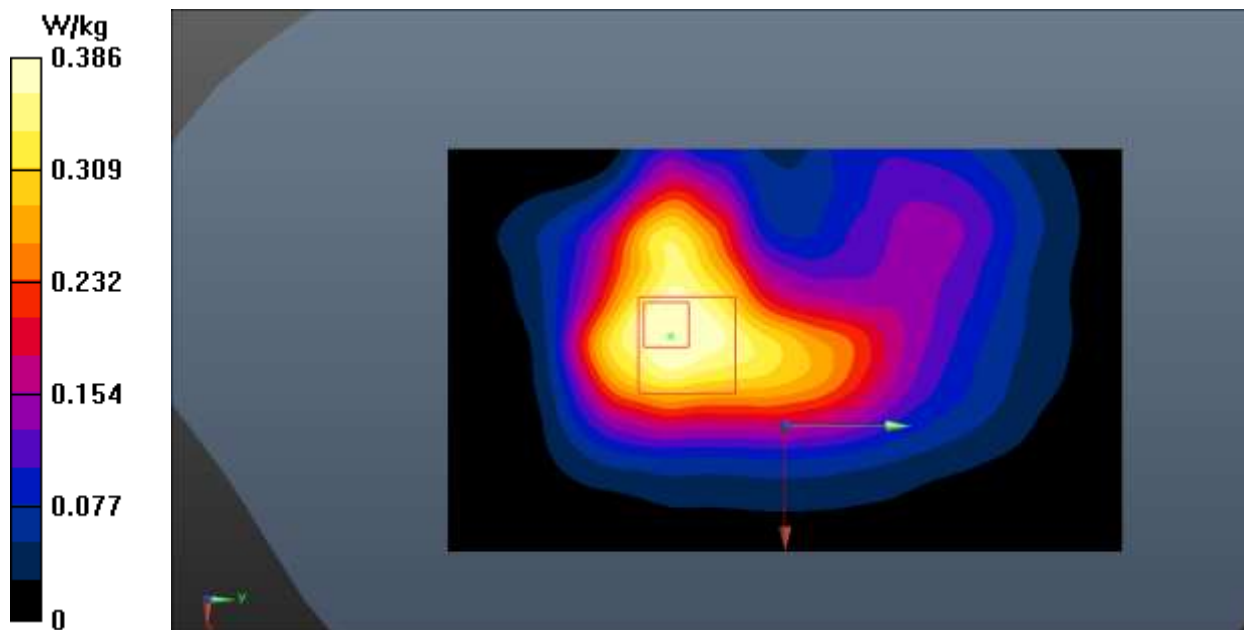
Rear Side High /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.776 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.964 W/kg

SAR(1 g) = 0.330 W/kg; SAR(10 g) = 0.145 W/kg

Maximum value of SAR (measured) = 0.386 W/kg



ANNEX L System Verification Results for Spot Check Test

750MHz

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body750MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.949 \text{ S/m}$; $\epsilon_r = 54.282$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

System Validation /Area Scan (81x191x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 59.101 V/m ; Power Drift = -0.02 dB

SAR(1 g) = 2.15 W/kg ; SAR(10 g) = 1.45 W/kg

Maximum value of SAR (interpolated) = 2.45 W/kg

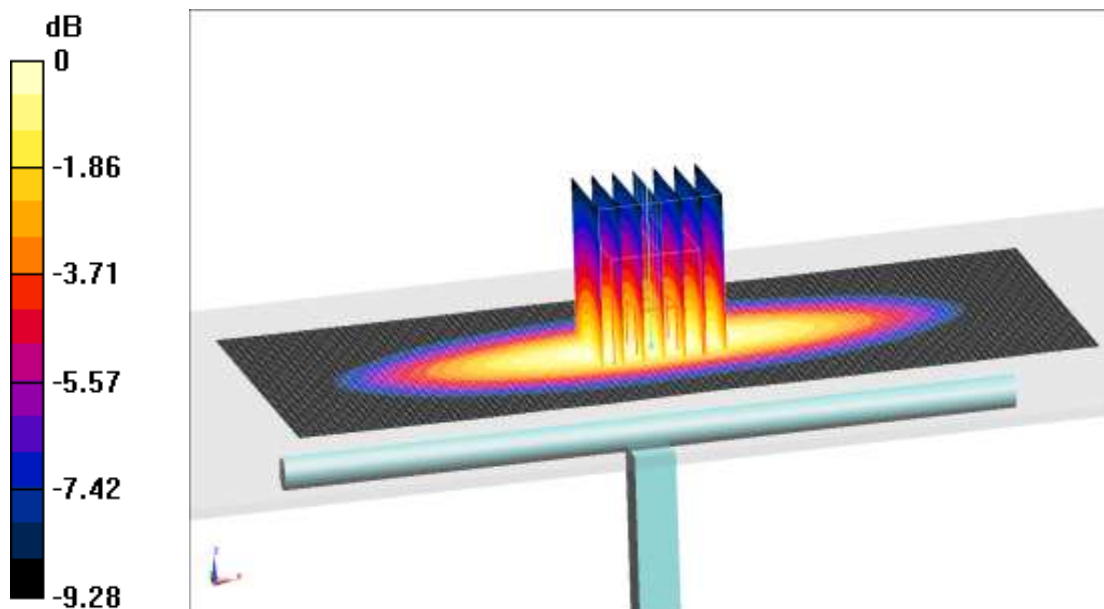
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 59.101 V/m ; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 2.81 W/kg

SAR(1 g) = 2.12 W/kg ; SAR(10 g) = 1.44 W/kg

Maximum value of SAR (measured) = 2.42 W/kg



$0 \text{ dB} = 2.42 \text{ W/kg} = 3.84 \text{ dB W/kg}$

Fig.L.1 Validation 750MHz 250mW

835MHz

Date: 2019-11-20

Electronics: DAE4 Sn1527

Medium: Body 835MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.988 \text{ S/m}$; $\epsilon_r = 53.636$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (9.56, 9.56, 9.56);

System Validation /Area Scan (81x171x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 62.315 V/m ; Power Drift = 0.06 dB

SAR(1 g) = 2.51 W/kg ; SAR(10 g) = 1.65 W/kg

Maximum value of SAR (interpolated) = 2.75 W/kg

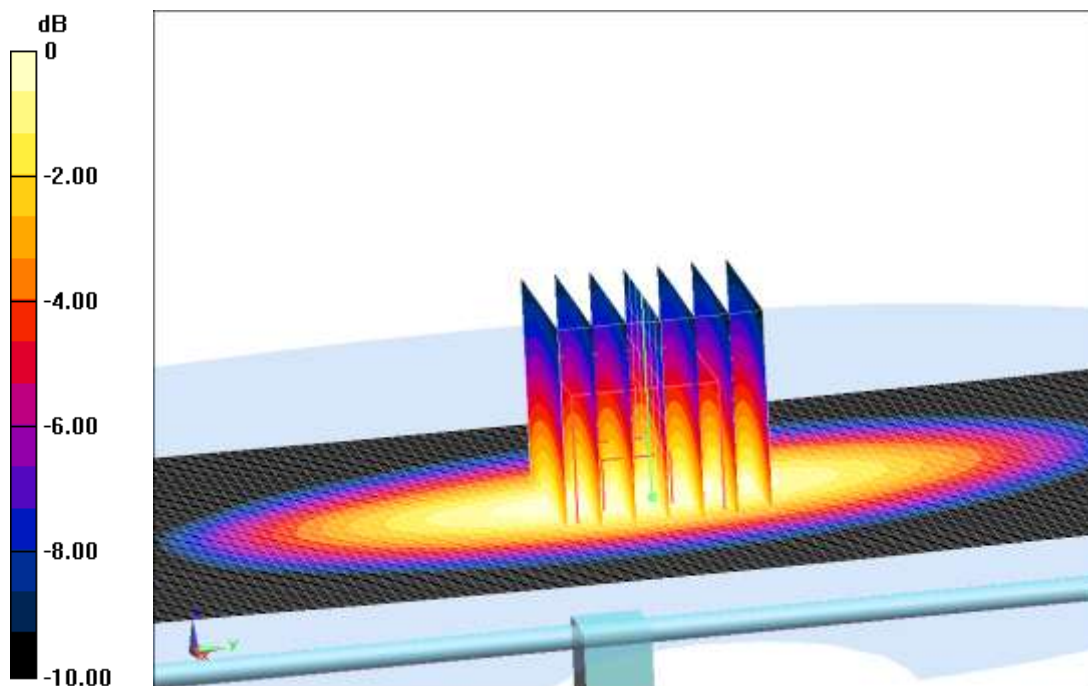
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 62.315 V/m ; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 3.63 W/kg

SAR(1 g) = 2.55 W/kg ; SAR(10 g) = 1.67 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



0 dB = 2.79 W/kg = 4.46 dB W/kg

Fig.L.2 Validation 835MHz 250mW

1750MHz

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 1750MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.463$ S/m; $\epsilon_r = 52.853$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C

Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (7.93, 7.93, 7.93);

System Validation/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 76.2263 V/m; Power Drift = -0.05 dB

SAR(1 g) = 9.03 W/kg; SAR(10 g) = 4.91 W/kg

Maximum value of SAR (interpolated) = 11.3 W/kg

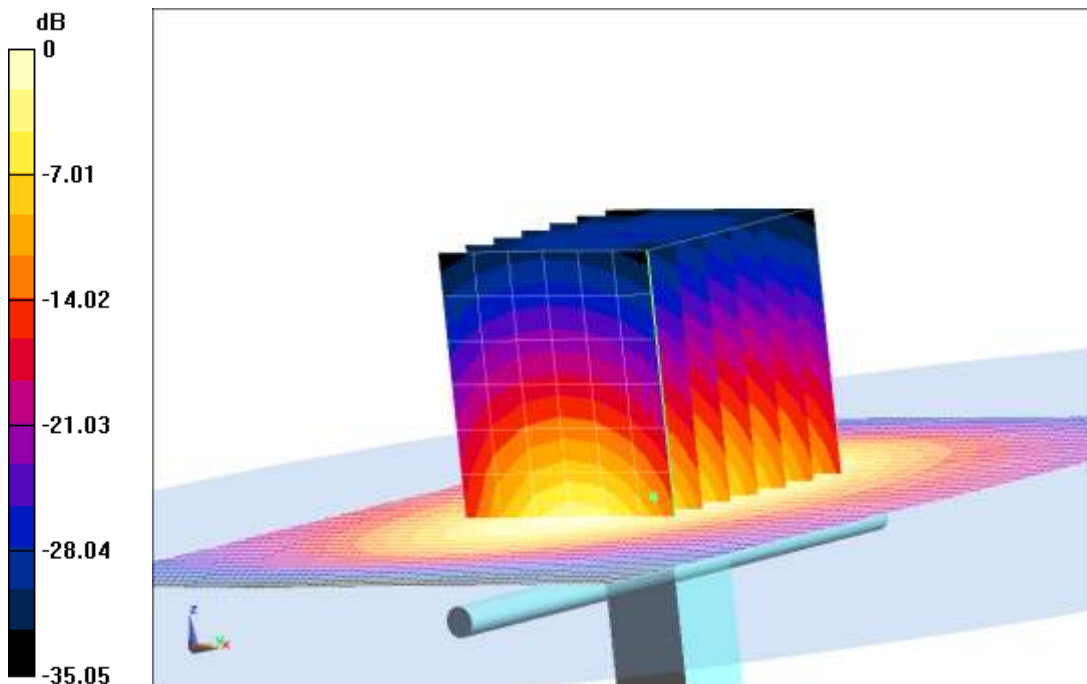
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 76.2263 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 17.9 W/kg

SAR(1 g) = 8.87 W/kg; SAR(10 g) = 4.85 W/kg

Maximum value of SAR (measured) = 11.1 W/kg



0 dB = 11.1 W/kg = 10.45 dB W/kg

Fig.L.3 Validation 1750MHz 250mW

1900MHz

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 1900MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.556 \text{ S/m}$; $\epsilon_r = 52.388$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.9°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (7.67, 7.67, 7.67);

System validation /Area Scan (81x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 89.116 V/m ; Power Drift = 0.02 dB

SAR(1 g) = 10.3 W/kg ; SAR(10 g) = 5.47 W/kg

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

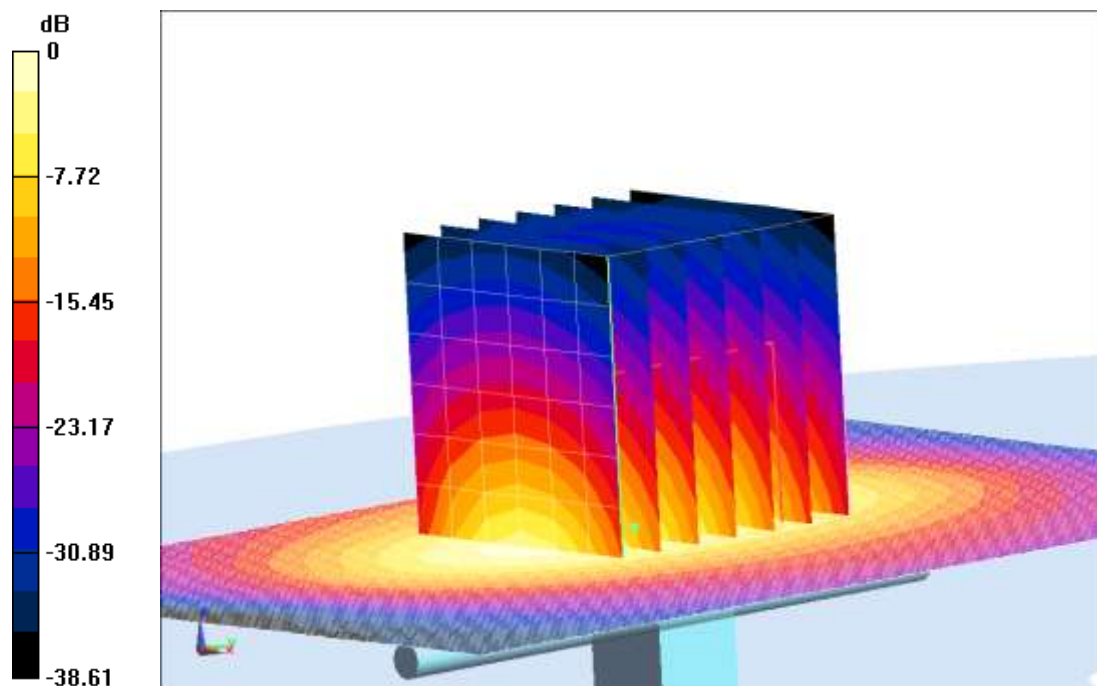
System validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 89.116 V/m ; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 23.4 W/kg

SAR(1 g) = 10.6 W/kg ; SAR(10 g) = 5.51 W/kg

Maximum value of SAR (measured) = 13.8 W/kg



$0 \text{ dB} = 13.8 \text{ W/kg} = 11.40 \text{ dB W/kg}$

Fig.L.4 Validation 1900MHz 250mW

2450MHz

Date: 2019-12-05

Electronics: DAE4 Sn1527

Medium: Body 2450MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.929 \text{ S/m}$; $\epsilon_r = 52.02$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C

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

Probe: EX3DV4 – SN3633 ConvF (7.4, 7.4, 7.4);

System Validation/Area Scan (81x101x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 90.438 V/m ; Power Drift = -0.10 dB

SAR(1 g) = 12.4 W/kg ; SAR(10 g) = 5.92 W/kg

Maximum value of SAR (interpolated) = 14.5 W/kg

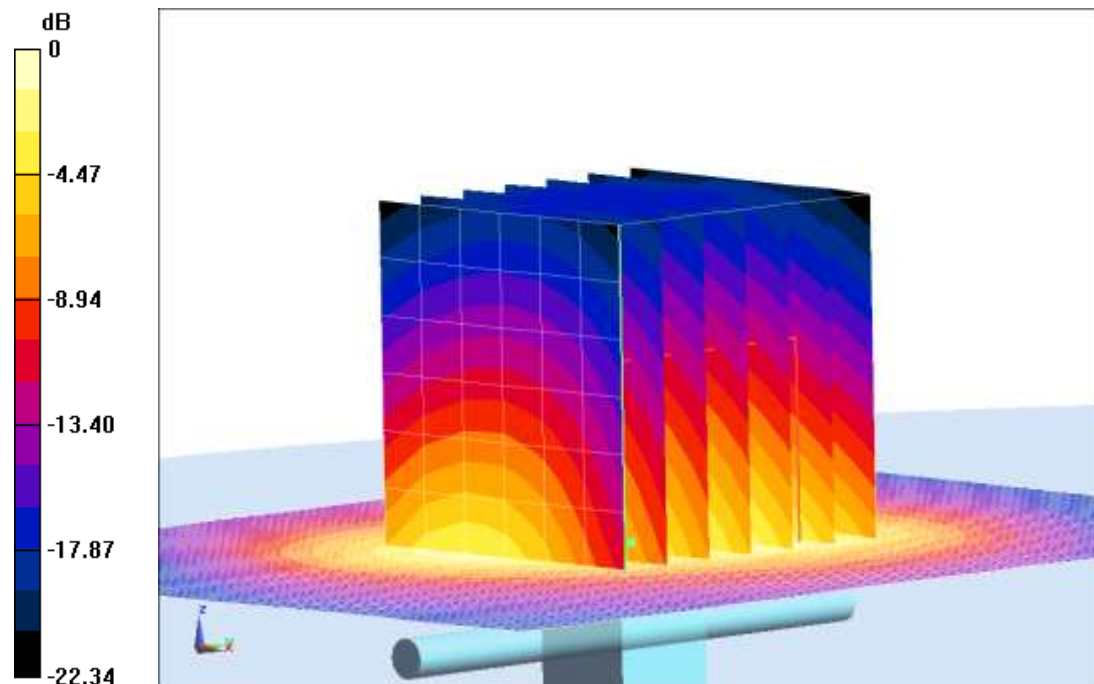
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 90.438 V/m ; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 25.5 W/kg

SAR(1 g) = 12.2 W/kg ; SAR(10 g) = 5.79 W/kg

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



$0\text{dB} = 14.2 \text{ W/kg} = 11.52 \text{ dB W/kg}$

Fig.L.5 Validation 2450MHz 250mW

2550MHz

Date: 2019-11-22

Electronics: DAE4 Sn1527

Medium: Body 2550MHz

Medium parameters used: $f = 2550 \text{ MHz}$; $\sigma = 2.061 \text{ S/m}$; $\epsilon_r = 51.464$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C

Communication System: CW Frequency: 2550 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN3633 ConvF (7.21, 7.21, 7.21);

System Validation/Area Scan (81x101x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 91.862 V/m ; Power Drift = -0.03 dB

SAR(1 g) = 13.3 W/kg ; SAR(10 g) = 6.11 W/kg

Maximum value of SAR (interpolated) = 15.5 W/kg

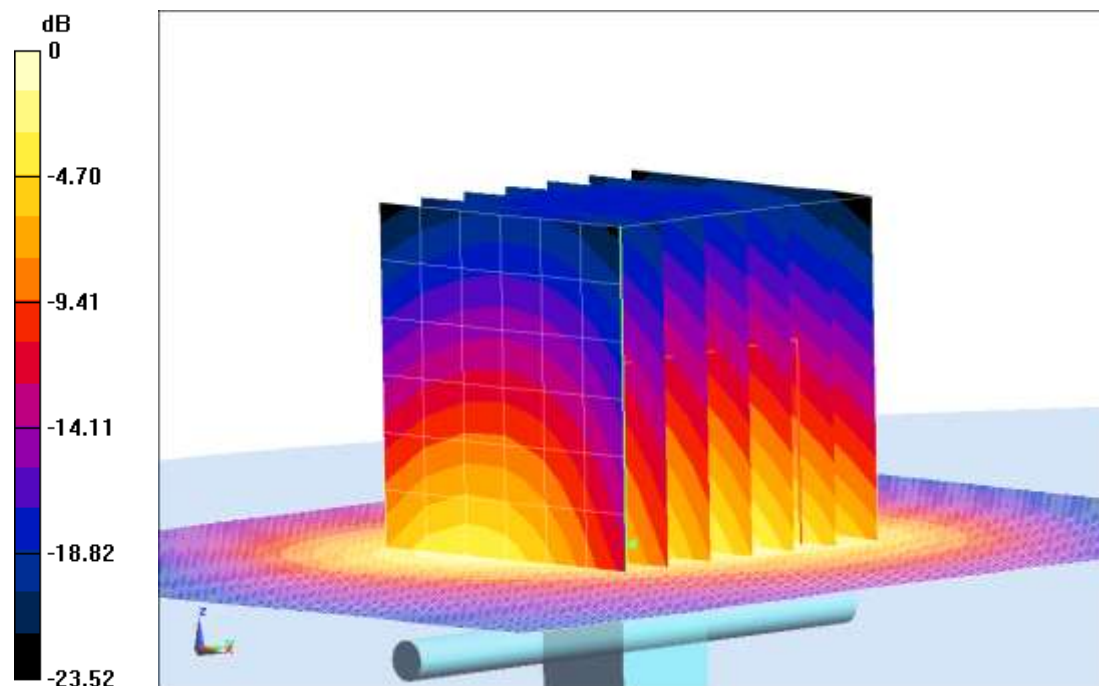
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 91.862 V/m ; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 13.1 W/kg ; SAR(10 g) = 6.06 W/kg

Maximum value of SAR (measured) = 15.4 W/kg



0 dB = 15.4 W/kg = 11.88 dB W/kg

Fig.L.6 Validation 2550MHz 250mW