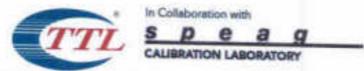
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Page 1 of 8



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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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%.

Certificate No: Z17-97037

Page 2 of 8



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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 ± 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 ± 0.2) °C	41.4±8%	0.91 mho/m ± 6 %
Head TSL temperature change during test.	<1.0 °C		

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.13 mW/g
SAR for nominal Head TSL parameters	normalized to 1VV	8.37 mW /g ± 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	5.56 mW /g ± 20.4 % (k=2)

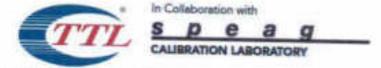
Body TSL parameters

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 ± 0.2) *C	55.2 ± 6 %	0.95 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		-

SAR result with Body TSL

SAR averaged over 1 cm ¹ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.17 mW/g
SAR for nominal Body TSL parameters	normalized to 1W	8.73 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm3 (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	5.87 mW /g ± 20.4 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.00-3.15jD
Return Loss	- 29.7dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.7Ω- 2.50 <u>Ι</u> Ω	
Return Loss	- 32.0dB	-

General Antenna Parameters and Design

Electrical Delay (one direction)	1.115 ns
Electrical Delay (one direction)	1.115 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 semingid 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	
manufactured by	SPEAG



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DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

Date: 03.20.2017

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1087 Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; σ = 0.908 S/m; ε_r = 41.38; ρ = 1000 kg/m³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

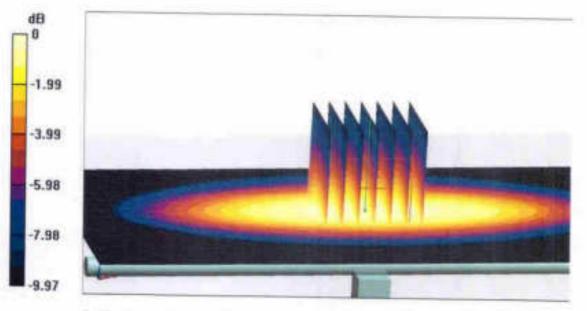
DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(10.05, 10.05, 10.05); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- 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 = 52.61 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.22 W/kg

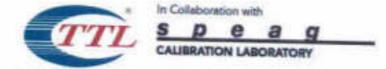
SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.41 W/kg Maximum value of SAR (measured) = 2.84 W/kg



0 dB = 2.84 W/kg = 4.53 dBW/kg

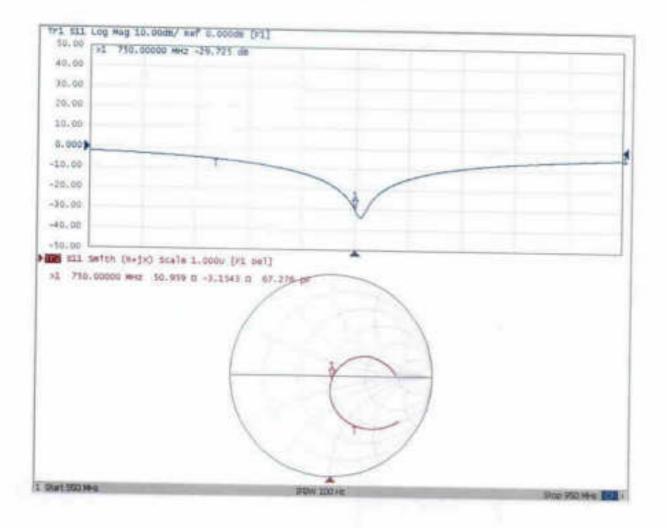
Certificate No: Z17-97037

Page 5 of 8



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Impedance Measurement Plot for Head TSL





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 DASY5 Validation Report for Body TSL.
 Date: 03.20.2017

 Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1087

 Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
 Medium parameters used: f = 750 MHz; $\sigma = 0.952$ S/m; $\epsilon_r = 55.23$; $\rho = 1000$ kg/m³

 Phantom section: Center Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

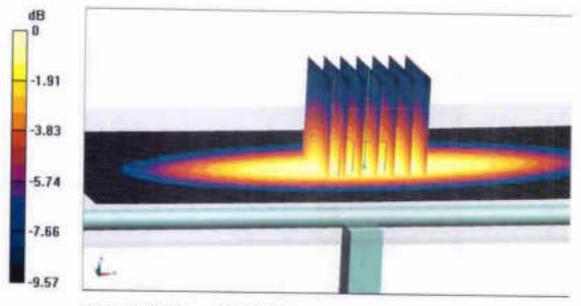
 DASY5 Configuration:
 Dasystem: D

- Probe: EX3DV4 SN3617; ConvF(9.8, 9.8, 9.8); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

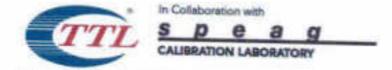
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 54,49 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.18 W/kg

SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.46 W/kg

Maximum value of SAR (measured) = 2.85 W/kg

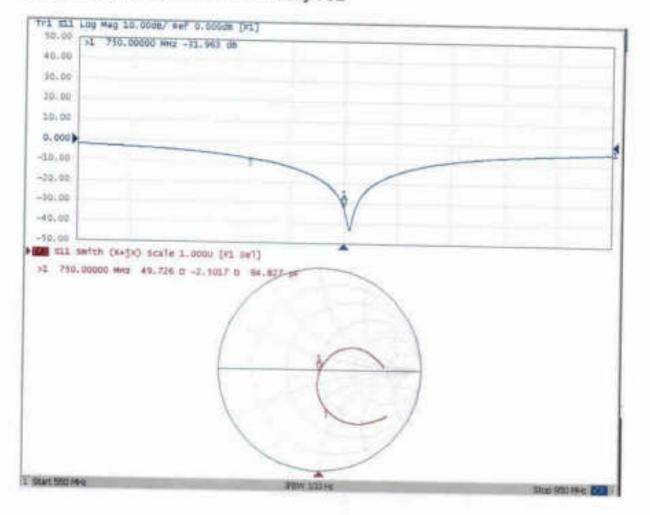


0 dB = 2.85 W/kg = 4.55 dBW/kg



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Impedance Measurement Plot for Body TSL



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Page # of #

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Il calibrations have been umidity<70%. Calibration Equipment used trimary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4	I conducted in I (M&TE critical fo ID # 101919 101547 SN 3617	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 23-Jan-17 (SPEAG, No.EX3-3617_Jan17)	temperature(22±3)10 and Scheduled Calibration Jun-17
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VII calibrations have been pumidity<70%. Calibration Equipment used Inimary Standards Power Meter NRP2 Power sensor NRP-291 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	I conducted in 1 I (M&TE critical fo ID # 101919 101547 SN 3617 SN 777 ID # MY49071430	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 23-Jan-17(SPEAG,No.EX3-3617_Jan17) 22-Aug-16(CTTL-SPEAG,No.Z16-97138)	temperature(22±3)℃ and Scheduled Calibration Jun-17 Jun-17 Jan-18 Aug-17
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-291 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	I conducted in 1 (M&TE critical fo I (M&TE critical fo ID # 101919 101547 SN 3617 SN 3617 SN 777 ID # MY49071430	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 23-Jan-17 (SPEAG,No.EX3-3617_Jan17) 22-Aug-16(CTTL-SPEAG,No.Z16-97138) Cal Date(Calibrated by, Certificate No.) 13-Jan-17 (CTTL, No.J17X00286)	temperature(22±3)℃ and Scheduled Calibration Jun-17 Jun-17 Jan-18 Aug-17 Scheduled Calibration Jan-18 Jan-18
All calibrations have been sumidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-291 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	I conducted in (M&TE critical fc ID# 101919 101547 SN 3617 SN 777 ID# MY49071430 MY46110673	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 23-Jan-17 (CTTL, No.J16X04777) 23-Jan-17 (SPEAG,No.EX3-3617_Jan17) 22-Aug-16(CTTL-SPEAG,No.Z16-97138) Cal Date(Calibrated by, Certificate No.) 13-Jan-17 (CTTL, No.J17X00286) 13-Jan-17 (CTTL, No.J17X00285)	temperature(22±3)© and Scheduled Calibration Jun-17 Jun-17 Jan-18 Aug-17 Scheduled Calibration Jan-18
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-291 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	I conducted in 1 (M&TE critical fo ID# 101919 101547 SN 3617 SN 3617 SN 777 ID# MY49071430 MY46110673 Name	the closed laboratory facility: environment or calibration) Cal Date(Calibrated by, Certificate No.) 27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 23-Jan-17 (SPEAG,No.EX3-3617_Jan17) 22-Aug-16(CTTL-SPEAG,No.Z16-97138) Cal Date(Calibrated by, Certificate No.) 13-Jan-17 (CTTL, No.J17X00286) 13-Jan-17 (CTTL, No.J17X00285) Function	temperature(22±3)℃ and Scheduled Calibration Jun-17 Jun-17 Jan-18 Aug-17 Scheduled Calibration Jan-18 Jan-18



In Collaboration with ALIBRATION LABORATOR

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured
	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
- 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%.



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Measurement Conditions

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

DASY Version	DASY52	
Extrapolation	2.00 - 2.	52.8.8.1258
	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	Contraction of the Contraction
Zoom Scan Resolution	SHEWITY.	with Spacer
and the second se	dx, dy, dz ≈ 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied

	·	I server and server	
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0±0.2) °C	41.0 ± 6 %	The state of the second second
Head TSL temperature change during test		110 2 0 76	0.89 mho/m ± 6 %
R result with Head TO	410 0		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.41 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.73 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm3 (10 g) of Head TSL	Condition	(in the second of the second section and the second s
SAR measured	250 mW input power	1.57 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.33 mW /g ± 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 ± 0.2) *C	55.6±6%	0.96 mho/m ± 8 %
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	2.41 mW/g
SAR for nominal Body TSL parameters	normalized to 1W	9.72 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (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	6.44 mW /g ± 20.4 % (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			
	48.2Ω- 3.30jΩ		
Return Loss	- 28 3dB		

Antenna Parameters with Body TSL

Impedance, transformed to feed point		
	46.0Q- 3.06jQ	
Return Loss	- 25.6dB	

General Antenna Parameters and Design

Electrical Dalay (and discussion)	
Electrical Delay (one direction)	1.474 ns

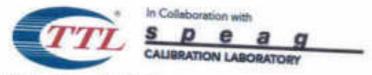
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

Additional EUT Data

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Manufactured by	SPEAG





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DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

Date: 03.20.2017

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; $\sigma = 0.886$ S/m; $v_t = 40.96$; $\rho = 1000$ kg/m³ Phantom section: Right Section

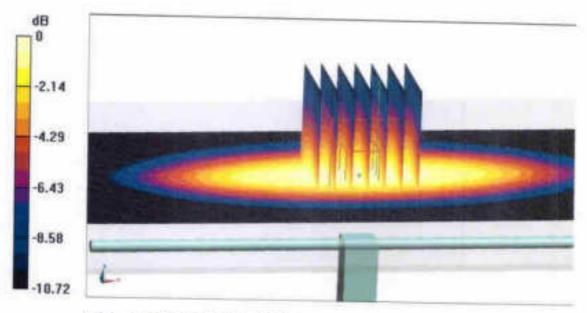
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(9.73, 9.73, 9.73); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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 = 59.22 V/m; Power Drift == 0.03 dB Peak SAR (extrapolated) = 3.68 W/kg SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.57 W/kg

Maximum value of SAR (measured) = 3.24 W/kg



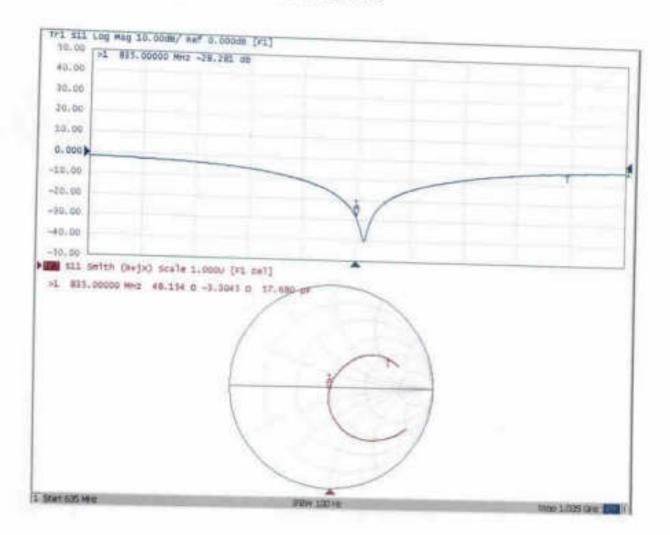
0 dB = 3.24 W/kg = 5.11 dBW/kg



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Impedance Measurement Plot for Head TSL





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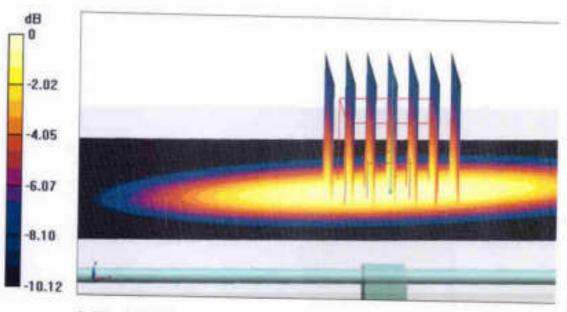
DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China Date: 03.20.2017 DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; $\sigma = 0.962$ S/m; $\epsilon_r = 55.58$; $\rho = 1000$ kg/m³ Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(9.64,9.64, 9.64); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1 ٠
- 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 = 57.67 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.50 W/kg SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.6 W/kg

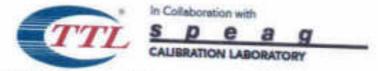
Maximum value of SAR (measured) = 3.03 W/kg



0 dB = 3.03 W/kg = 4.81 dBW/kg

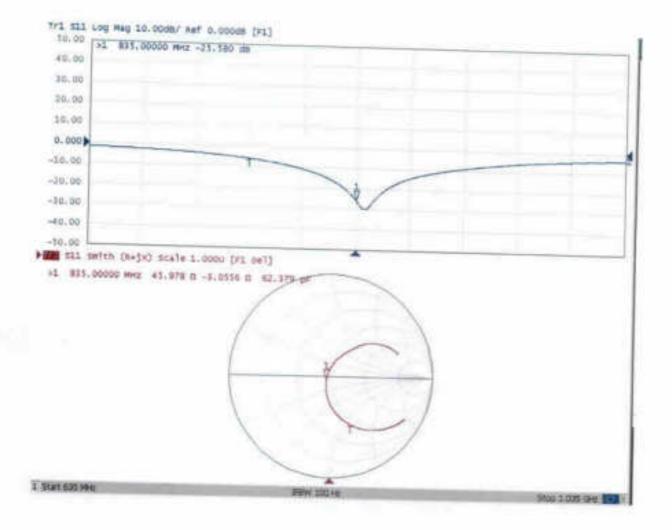
Certificate No: Z17-97038

Page 7 of #



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Impedance Measurement Plot for Body TSL



Certificate No: Z17-97038

Page 8 of 8

Tel: +8	0.51 Xueyuan Road, Hai 6-10-62304633-2079	Fax: +86-10-62304	100191, China 1633-2504	ACC MRA	CNAS	中国认可 国际互认 校准 CALIBRATION CNAS L0570
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CALIBRATI	ON CERTIF	CATE			- Party I	1
Object	9	01750V2 - SN: 1	090			

FD-Z11-003-01 Calibration Procedures for dipole validation kits

March 23, 2017

Calibration date:

Calibration Procedure(s)

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	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 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE4	SN 777	22-Aug-16(CTTL-SPEAG,No.Z16-97138)	Aug-17
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	44-
Reviewed by:	Qi Dianyuan	SAR Project Leader	da
Approved by:	Lu Bingsong	Deputy Director of the laboratory	加州野
		Issued: Marc	ch 25, 2017

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



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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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%.



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Measurement Conditions

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

DASY Version	DASY52	52.8.B.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 ± 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 mhorm
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0±6%	1.36 mho/m ± 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	9.22 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	37.0 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.97 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.9 mW /g ± 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 ± 0.2) °C	53.1±6 %	1,48 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

SAR averaged over 1 cm ² (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.49 mW / g
SAR for nominal Body TSL parameters	normalized to TW	38.1 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (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	20.6 mW /g ± 20.4 % (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	48.0Ω- 1.53jΩ
Return Loss	- 31.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.5Ω- 1.69jΩ
Return Loss	- 24.3dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1,326 ns
----------------------------------	----------

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

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

Additional EUT Data

Manufactured by	SPEAG
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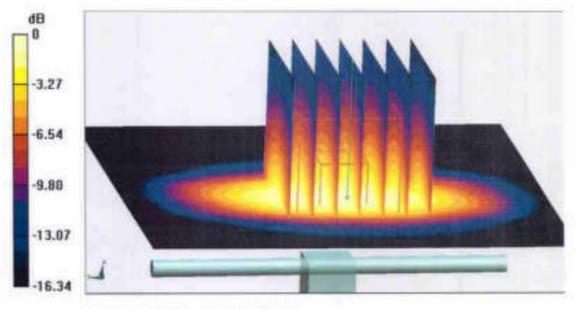
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DASY5 Validation Report for Head TSL Dute: 03.23.2017 Test Laboratory: CTTL, Beijing, China DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090 Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz; α = 1.364 S/m; εr = 40.01; ρ = 1000 kg/m3 Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.49, 8.49, 8.49); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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=5mm, dy=5mm, dz=5mm

Reference Value = 95.51V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 16.8W/kg SAR(1 g) = 9.22 W/kg; SAR(10 g) = 4.97 W/kg Maximum value of SAR (measured) = 14.1 W/kg

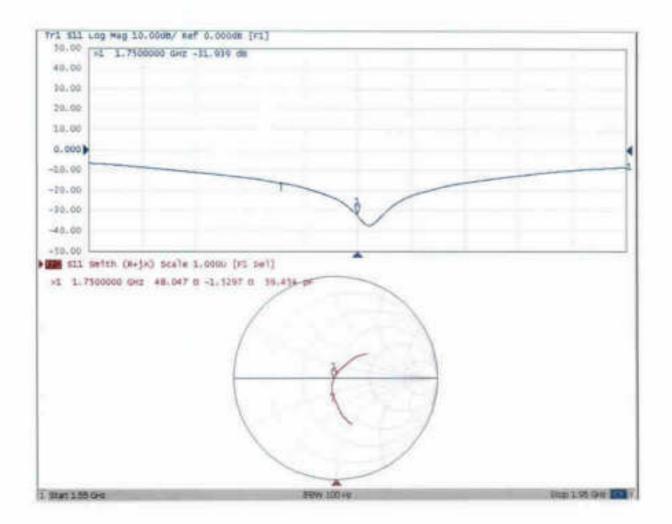


0 dB = 14.1 W/kg = 11.49 dBW/kg



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Impedance Measurement Plot for Head TSL



Page 6 of 8.

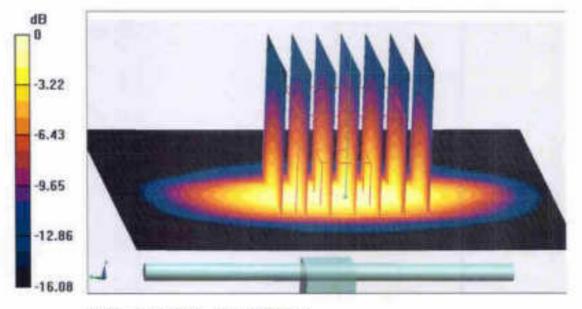


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DASY5 Validation Report for Body TSL Date: 03.23.2017 Test Laboratory: CTTL, Beijing, China DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1090 Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz; σ = 1.481 S/m; ϵ_r = 53.11; ρ = 1000 kg/m³ Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.21, 8.21, 8.21); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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=5mm, dy=5mm, dz=5mm Reference Value = 96.45 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 17.0 W/kg SAR(1 g) = 9.49 W/kg; SAR(10 g) = 5.13 W/kg Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 11.58 dBW/kg

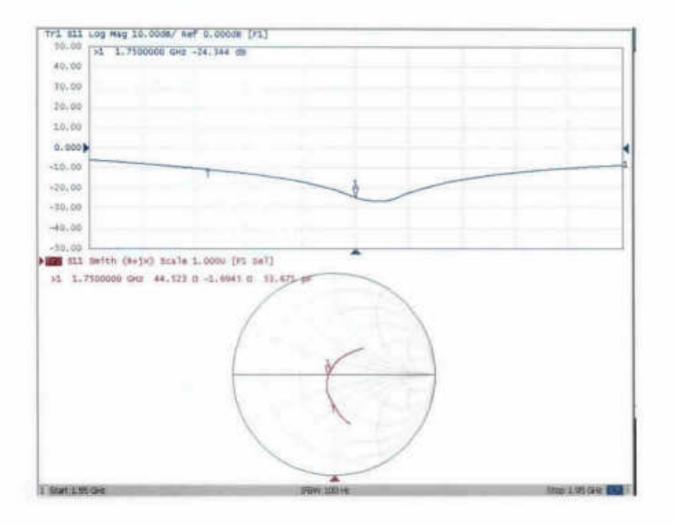
Certificate No: Z17-97040

Page 7 of #



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Impedance Measurement Plot for Body TSL



Certificate No: Z17-97040

Page 8 of 8

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Add: No.51 Xueyua Tel: +86-10-623046		trict, Beijing, 100191, China	CALIBRATION CNAS L0570
E-mail: etth@chinat	theoren hettpol/	www.chinattl.cn	Sentimetric (Service)
	rton_XA		17-97041
CALIBRATION CI	ERTIFICAT	E	The table in
Object	D1900	/2 - SN: 5d170	
Calibration Procedure(s)	FD-211	-003-01	-
	Calibra	tion Procedures for dipole validation kits	
Calibration date:	March ;	22, 2017	
pages and are part of the ce	conducted in	the uncertainties with confidence probabilit the closed laboratory facility: environment or 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 DAE4	SN 3617 SN 777	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
UNCA	SNITT	22-Aug-16(CTTL-SPEAG,No.Z16-97138)	Aug-17
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No. J17X00285)	Jan-18
	Name		-
Calibrated by:		Function	Signature
	Zhao Jing	SAR Test Engineer	8.4
Reviewed by:	Qi Dianyuan	SAR Project Leader	abr
Approved by:	Lu Bingsong	Deputy Director of the laboratory	32 13357

Issued March 25, 2017

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

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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-heid 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%.



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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 ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9±6%	1.38 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	112	-

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.89mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.0 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.15 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.7 mW /g ± 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±0.2) *C	53.6 ± 6 %	1.53 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		-

SAR result with Body TSL

SAR averaged over 1 cm ¹ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1VV	40.7 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.37 mW / g
SAR for nominal Body TSL parameters	normalized to 1VV	21.4 mW /g ± 20.4 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.5Q+ 5.31jQ
Return Loss	- 25.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.20+ 5.61jD	
Return Loss	- 24.9dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.307 ns
----------------------------------	----------

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

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

Additional EUT Data

Manufactured by	SPEAG



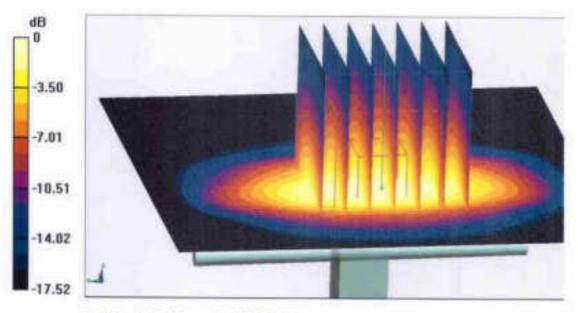
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DASY5 Validation Report for Head TSL Date: 03.22.2017 Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.376 S/m; tr = 39.92; ρ = 1000 kg/m3 Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.26, 8.26, 8.26); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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=5mm, dy=5mm, dz=5mm Reference Value = 90.60 V/m: Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.7 W/kg SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.15 W/kg Maximum value of SAR (measured) = 15.5 W/kg

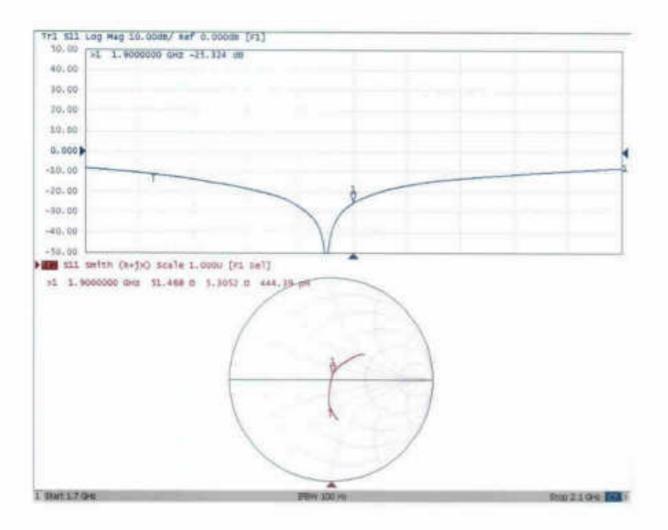


0 dB = 15.5 W/kg = 11.90 dBW/kg



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Impedance Measurement Plot for Head TSL



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Page 5 of 8

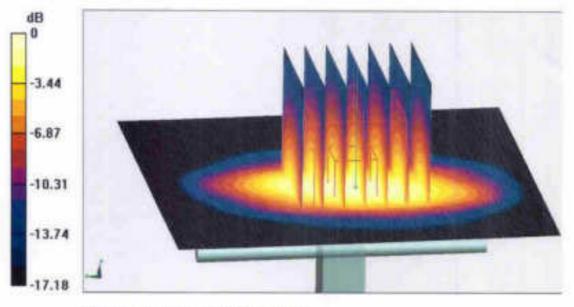


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DASY5 Validation Report for Body TSL Date: 03.22.2017 Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.532 S/m; ε_r = 53.62; ρ = 1000 kg/m³ Phantom section: Center Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.95, 7.95, 7.95); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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)

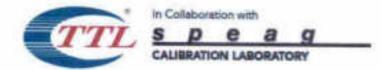
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 97.75 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 18.3 W/kg SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.37 W/kg Maximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

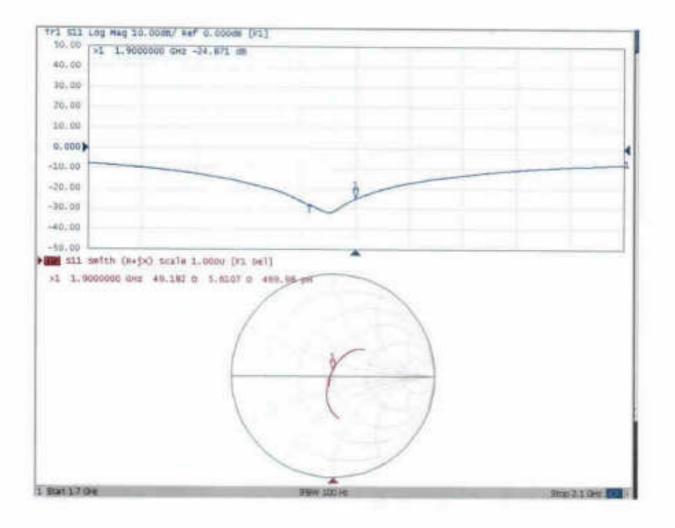
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Page 7 of 8



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Impedance Measurement Plot for Body TSL



Page 8 of 8

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Object	D2450	V2 - SN: 908		-	and a	1
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Glossary:

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

Calibration is Performed According to the Following Standards:

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- 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%.

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Page 2 of 8



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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	ALCONTRACTORY OF
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) *C	39.0 ± 6 %	1.77 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		_

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	53.2 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSE	Condition	
SAR measured	250 mW input power	6.13 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	24.6 mW /g ± 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3±6%	1.93 mho/m ± 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	12.7 mW/g
SAR for nominal Body TSL parameters	normalized to 1W	50.9 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.88 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.6 mW /g ± 20.4 % (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	55.5Q+ 2.35jQ	
Return Loss	- 24.9dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.5Q+ 2.12jQ		
Return Loss	- 30.0dB		

General Antenna Parameters and Design

Electrical Delay (one direction)	1.261 ns
The state of the s	1.201 16

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		
ificate No: Z17-97043	Page 4 of #		



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DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

Date: 03.21.2017

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; σ = 1.768 S/m; ar = 39.02; ρ = 1000 kg/m3 Phantom section: Right Section

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

Probe: EX3DV4 - SN3617; ConvF(7.74, 7.74, 7.74); Calibrated: 1/23/2017;

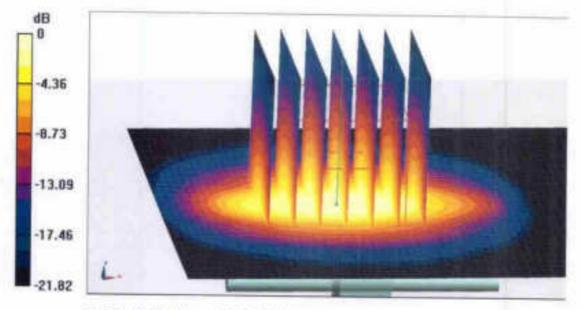
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

Reference Value = 104.7 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.13 W/kg

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



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

Certificate No: 7.17-97043

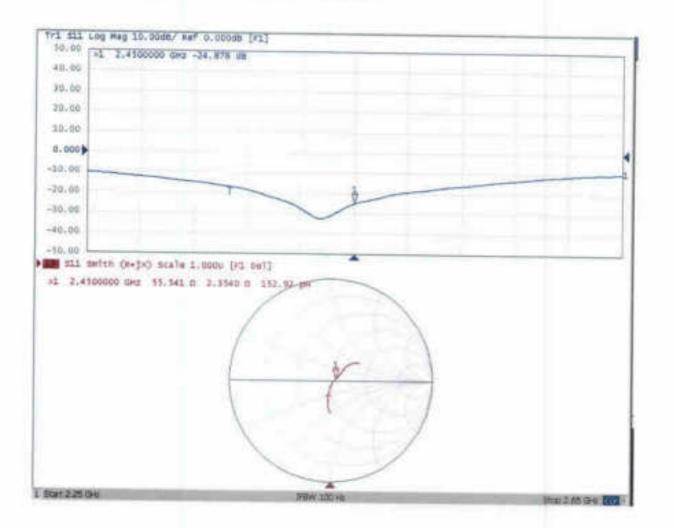
Page 5 of 8



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Impedance Measurement Plot for Head TSL



Certificate No: Z17-97043

Page 6 of #



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DASY5 Validation Report for Body TSL

Test Laboratory; CTTL, Beijing, China

Date: 03.21.2017

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908 Communication System: UID 0, CW: Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; $\sigma = 1.931$ S/m; $\varepsilon_r = 52.27$; $\rho = 1000$ kg/m³ Phantom section: Center Section

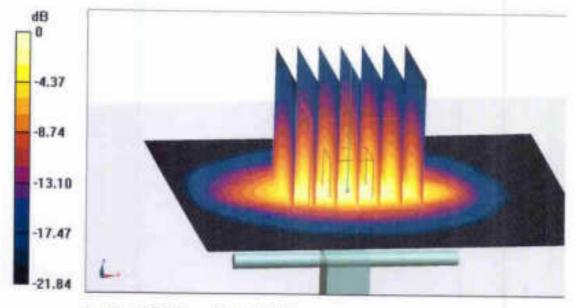
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.8, 7.8, 7.8); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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 = 97.13 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 27.0 W/kg SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.88 W/kg

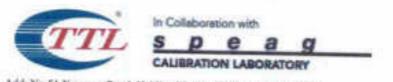
Maximum value of SAR (measured) = 21.7 W/kg



0 dB = 21.7 W/kg = 13.36 dBW/kg

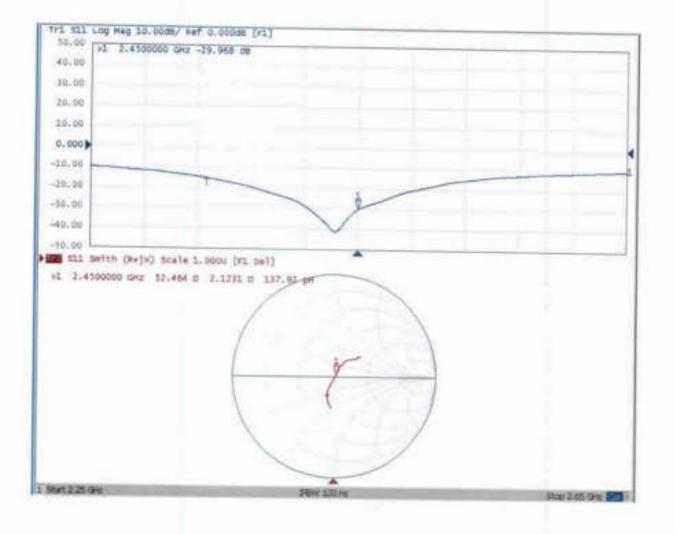
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Impedance Measurement Plot for Body TSL



Certificate No: Z17-97043

Page 8 of 8

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CALIBRATION C			Z17-97044	
Object	D2450	V2 - SN: 924	1 T 1	
		FD-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	March	21, 2017	-	
measurements(SI). The me pages and are part of the ce	asurements and intificate.	traceability to national standards, whi the uncertainties with confidence prob the closed laboratory facility: enviror or calibration)	ability are given on the following	
Primary Standards	ID#	Cal Date(Calibrated by, Certificate N	o.) Scheduled Calibration	
Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4	101919 101547 SN 3617 SN 777	27-Jun-16 (CTTL, No.J16X04777) 27-Jun-16 (CTTL, No.J16X04777) 23-Jan-17 (SPEAG, No.EX3-3617_Jan 22-Aug-16 (CTTL-SPEAG, No.Z16-97)	Jun-17 Jun-17 17) Jan-18	
Secondary Standards	1D#	Cal Date(Calibrated by, Certificate No	.) Scheduled Calibration	
Signal Generator E4438C Network Analyzer E5071C	MY49071430 MY46110673	13-Jan-17 (CTTL, No.J17X00288) 13-Jan-17 (CTTL, No.J17X00285)	Jan-18 Jan-18	
Calibrated by:	Name	Function	Signature	

Zhao Jing SAR Test Engineer Reviewed by: Qi Dianyuan an SAR Project Leader Approved by: Lu Bingsong Deputy Director of the laboratory Issued: March 25, 2017

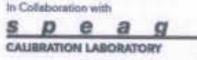
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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,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%.



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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	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39,2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) *C	39.0±6%	1.77 mho/m ± 6 %
Head TSL temperature change during test	<1.0 *C	1.0222	

SAR result with Head TSL

SAR averaged over 1 cm ² (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	52.4 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.04 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.3 mW /g ± 20.4 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) *C	52.3 ± 6 %	1.93 mho/m ± 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	12.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.5 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.86 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.5 mW /g ± 20.4 % (k=2)



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Appendix (Additional assessments outside the scope of CNAS L0570)

CALIBRATION LABORATORY

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Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9Q+ 3,77jQ		
Return Loss	- 28.3dB		

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3Ω+ 4.18jΩ		
Return Loss	- 26.8dB		

General Antenna Parameters and Design

Electrical Delay (one direction)	1.260 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

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DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China

Date: 03.21.2017

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

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; $\sigma = 1.768$ S/m; $\epsilon r = 39.02$; $\rho = 1000$ kg/m3 Phantom section: Right Section.

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

DASY5 Configuration:

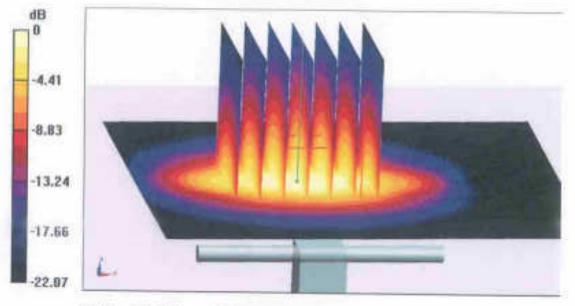
- Probe: EX3DV4 SN3617; ConvF(7.74, 7.74, 7.74); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

Reference Value = 103.8 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 27.0 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.04 W/kg

Maximum value of SAR (measured) = 21.7 W/kg

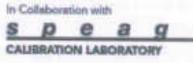


0 dB = 21.7 W/kg = 13.36 dBW/kg

Certificate No: Z17-97044

Page 5 of 8

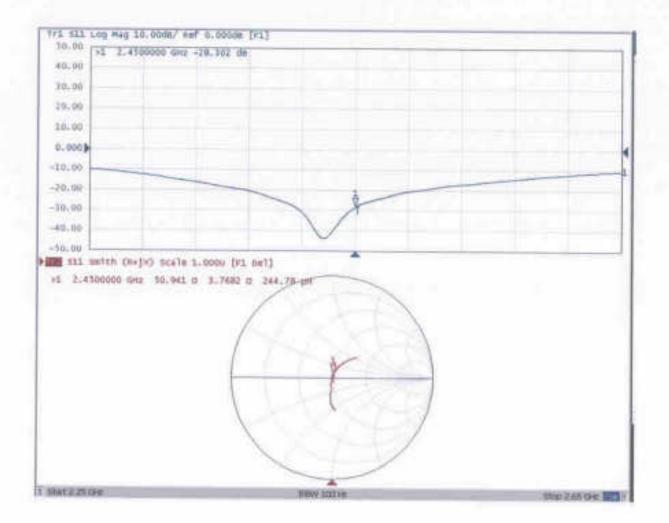




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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China

Date: 03.21.2017

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; $\sigma = 1.931$ S/m; $\epsilon_c = 52.27$; $\rho = 1000$ kg/m³ Phantom section: Center Section

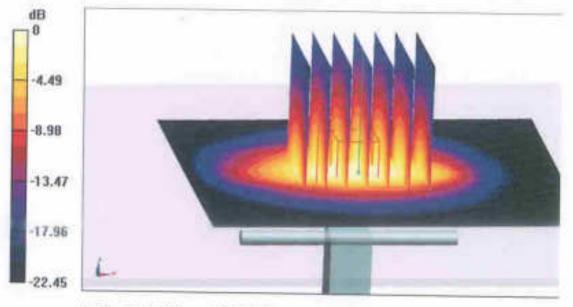
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.8, 7.8, 7.8); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- 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 = 97.48 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 26.4 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.86 W/kg Maximum value of SAR (measured) = 20.9 W/kg



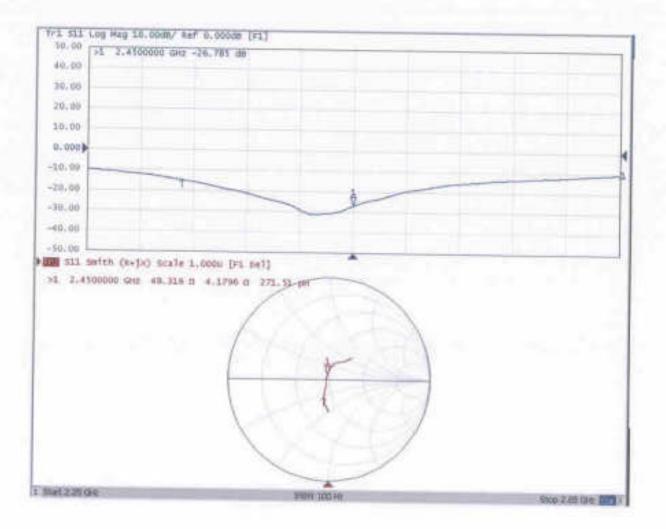
0 dB = 20.9 W/kg = 13.20 dBW/kg



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Impedance Measurement Plot for Body TSL



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Object	D2600)V2 - SN: 1112			
Calibration Procedure(s)	FF_71	1-003-01			
		ation Procedures for di	inclo validation Lite		
	Culbre		ipole validation kits		
Calibration date:	Septer	nber 18, 2017	_		
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Primary Standards	ID #				
Power Meter NRVD	102196	Cal Date(Calibrated			
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, N 02-Mar-17 (CTTL, N		Mar-	
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,N		Mar-	
DAE4	SN 1331	19-Jan-17(CTTL-SP			
		x		/ Jan-	
Secondary Standards	ID #	Cal Date(Calibrated	by, Certificate No.)	Scheduled C	alibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No	•	Jan-1	8
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No	o.J17X00285)	Jan-1	8
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Approved by:	Qi Dianyuan	SAR Project Le	eader	- Alt	
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Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for 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
- 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%.



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Measurement Conditions

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

DASY Version	DASY52	52.10.0.1446
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

Temperature	Permittivity	Conductivity
22.0 °C	39.0	1.96 mho/m
(22.0 ± 0.2) °C	39.8 ± 6 %	1.95 mho/m ± 6 %
<1.0 °C		
	22.0 °C (22.0 ± 0.2) °C	22.0 °C 39.0 (22.0 ± 0.2) °C 39.8 ± 6 %

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	56.4 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.29 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.3 mW /g ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.7 ± 6 %	2.15 mho/m ± 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	13.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	55.0 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.08 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.4 mW /g ± 18.7 % (k=2)

Certificate No: Z17-97161



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Appendix(Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.0Ω- 5.12jΩ
Return Loss	- 25.8dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8Ω- 5.40jΩ
Return Loss	- 23.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	
Ciccultar Delay (one direction)	1.258 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
	SPEAG



In Collaboration with e

CALIBRATION LABORATORY Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 E-mail: cttl@chinattl.com

Fax: +86-10-62304633-2504 http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

Date: 09.18.2017

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1112 Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2600 MHz; $\sigma = 1.947$ S/m; $\epsilon r = 39.75$; $\rho = 1000$ kg/m3 Phantom section: Left Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN7433; ConvF(7.19, 7.19, 7.19); Calibrated: 9/26/2016; •
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) •
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017 •
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

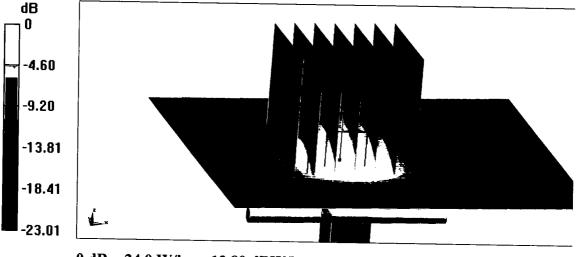
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.92 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 14 W/kg; SAR(10 g) = 6.29 W/kg

Maximum value of SAR (measured) = 24.0 W/kg



0 dB = 24.0 W/kg = 13.80 dBW/kg

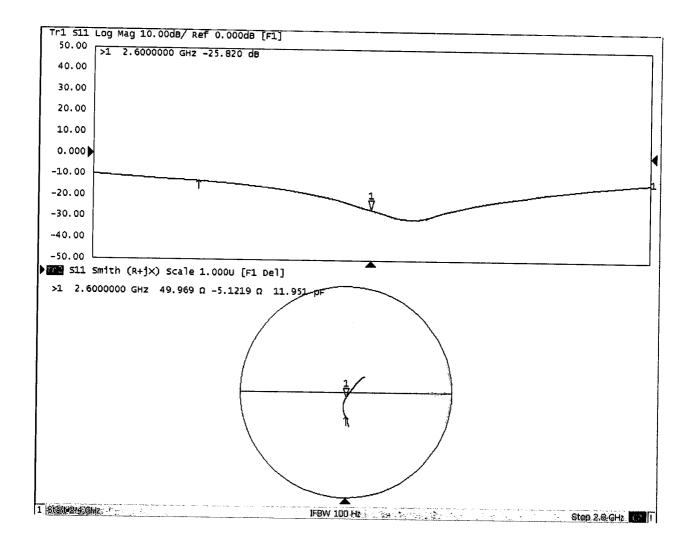


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Impedance Measurement Plot for Head TSL





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Fax: +86-10-62304633-2504 http://www.chinattl.cn

DASY5 Validation Report for Body TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1112

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2600 MHz; σ = 2.147 S/m; ϵ_r = 52.74; ρ = 1000 kg/m³ Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN7433; ConvF(7.22, 7.22, 7.22); Calibrated: 9/26/2016; •
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) •
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017 •
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

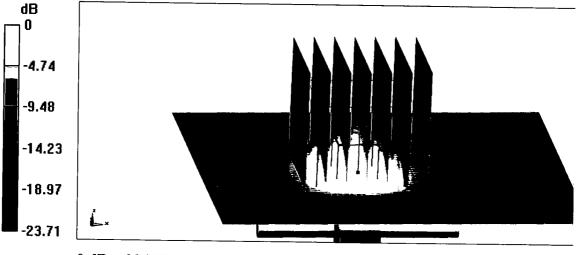
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.69 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (measured) = 23.7 W/kg



0 dB = 23.7 W/kg = 13.75 dBW/kg

Certificate No: Z17-97161

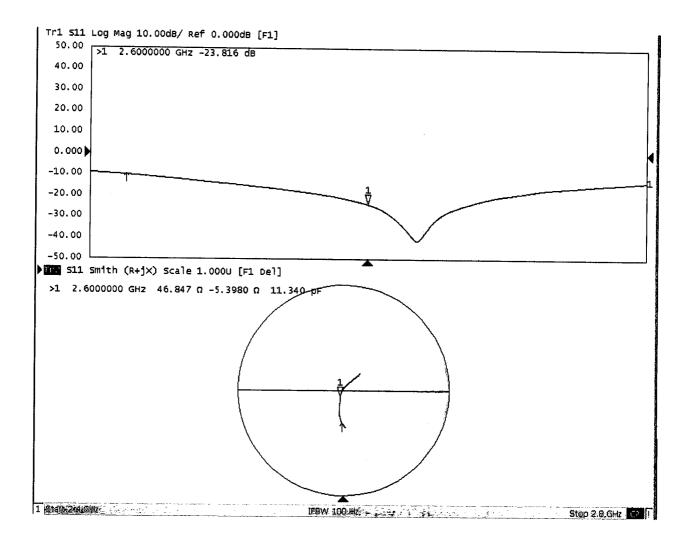
Date: 09.18.2017



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

Fax: +86-10-62304633-2504 http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



Certificate No: Z17-97161

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



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Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client Sporton (Auden) Certificate No: D5GHzV2-1167_Jul17

CALIBRATION CERTIFICATE

	D5GHzV2 - SN:1	167	
Calibration procedure(s)	QA CAL-22.v2 Calibration proce	dure for dipole validation kits bet	ween 3-6 GHz
Safbration date:	July 26, 2017		
The measurements and the unce	rtainties with confidence p ded in the closed laborato	ional standards, which realize the physical un robability are given on the following pages ar ry facility: environment temperature (22 ± 3)*)	id are part of the cartificate.
Primary Standards	lipe	Cel Date (Certificate No.)	Scheduled Galibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
	and the second se		
ower sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
	SN: 103244 SN: 103245	04-Apr-17 (No. 217-02521) 04-Apr-17 (No. 217-02522)	Apr-18 Apr-18
lower sensor NRP-Z91			
Yower sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103245	04-Apr-17 (No. 217-02522)	Api-18
ower sensor NRP-Z91 interence 20 dB Attenuator ype-N mismatch combination	SN: 103245 SN: 5058 (20k)	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528)	Apr-18 Apr-18
Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103245 SN: 5058 (209) SN: 5047.2 / 06327	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528)	Apr-18 Apr-18 Apr-18
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 DAE4	SN: 103245 SN: 5058 (20)) SN: 5047.2 / 06327 SN: 3503	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 31-Dec-16 (No. EX3-3503_Dec16)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Gecondary Standards	SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3503 SN: 601	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 31-Dec-16 (No. EX3-3503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chack
Yower sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Yower meter EPM-442A	SN: 103245 SN: 5058 (20%) SN: 5047.2 / 06327 SN: 3503 SN: 601	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 31-Dec-16 (No. 217-02528) 31-Dec-16 (No. 2K3-9503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Check In house check: Oct-18
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 103245 SN: 5058 (209) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB37480704	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02529) 31-Dec-16 (No. EX3-3503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chack
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 DAE4 Becondary Standards Power meter EPM-442A Power sensor HP 8481A Nower sensor HP 8481A	SN: 103245 SN: 5058 (200) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB37480704 SN: U537292783	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 31-Dec-16 (No. EX3-9503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chack In house check: Oct-18 In house check: Oct-18
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX30V4 DAE4 Becondary Standards Power meter EPM-442A Power meter EPM-442A Power sensor HP 8481A Tower sensor HP 8481A R generator HAS 5MT-00	SN: 103245 SN: 5058 (200) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 31-Dec-16 (No. EX3-9503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chack In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A Research RES SMT-00 Network Analyzer HP 8753E	SN: 103245 SN: 5058 (20)() SN: 5047.2 (06327 SN: 3503 SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41082317 SN: 105972	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 31-Dec-16 (No. EX3-9503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 11-Jun-15 (in house check Oct-10)	Api-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Chack In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A Nower sensor HP 8481A R generator HAS SMT-00	SN: 103245 SN: 5058 (200) SN: 5047.2 / 06327 SN: 3503 SN: 601 ID # SN: GB37480704 SN: U537292783 SN: WY41092317 SN: 105972 SN: 105972 SN: US37390585	04-Apr-17 (No. 217-02522) 07-Apr-17 (No. 217-02528) 07-Apr-17 (No. 217-02528) 31-Dec-16 (No. EX3-9503_Dec16) 28-Mar-17 (No. DAE4-601_Mar17) Check Date (in house) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 07-Oct-15 (in house check Oct-16) 15-Jun-15 (in house check Oct-16) 16-Oct-01 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Dec-17 Mar-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18

Certificate No: D5GHzV2-1167_Jul17

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





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- Service suisso d'étalonnage
- C Servizio svizzero di taratura
 - Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary: TS Ce

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASYS	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	and the second second

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35,9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.56 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	4444	1

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.9 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 100 mW input power	2.28 W/kg

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) "C	35.7±6%	4.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 *C		

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.8 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1167_Jul17

Head TSL parameters at 5750 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.08 mhp/m ± 6 %
Head TSL temperature change during test	< 0.5 "C	112	

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	Normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5250 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mha/m
Measured Body TSL parameters	(22.0 ± 0.2) *C	47.3±6%	5.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	100	

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.9 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
and the second se	Contract of the second s	HILL HANDARD
SAR measured	100 mW input power	2.17 W/kg

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.7 ± 6 %	5.99 mho/m ± 6 %
Body TSL temperature change during teat	< 0.5 °C		

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	80.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (ke2)

Body TSL parameters at 5750 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	6.20 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm ² (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.5 W/kg ± 19.9 % (k=2)

and the second s	
100 mW input power	2.18 W/kg
normalized to 1W	21.6 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

48.2 Ω - 11.7 jΩ	
- 18.4 dB	
	Second and a second

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.5 Ω - 6.7 jΩ
Return Loss	- 21.2 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	54.2 Ω - 9.2 jΩ	
Return Loss	- 20.3 dB	

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	48.0 Ω - 9.7 jΩ
Return Loss	- 20.0 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	56.6 Ω - 6.3 μΩ	
Return Losa	- 21,4 dB	

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	56.0 Ω - 8.7 jΩ
Return Loss	~ 20.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG		
Manufactured on	October 30, 2013		

DASY5 Validation Report for Head TSL

Date: 25.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1167

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz; $\sigma = 4.56$ S/m; $\epsilon_f = 36.2$; $\rho = 1000$ kg/m³. Medium parameters used: f = 5600 MHz; $\sigma = 4.92$ S/m; $\epsilon_f = 35.7$; $\rho = 1000$ kg/m³. Medium parameters used: f = 5750 MHz; $\sigma = 5.08$ S/m; $\epsilon_f = 35.5$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

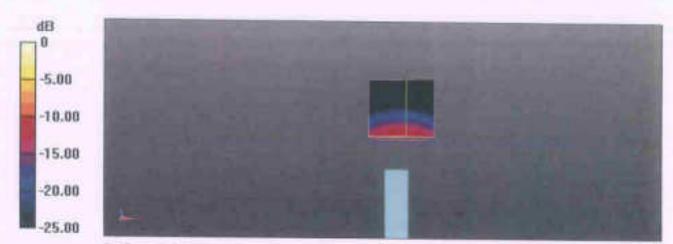
DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.85 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 29.6 W/kg SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.28 W/kg Maximum value of SAR (measured) = 17.8 W/kg

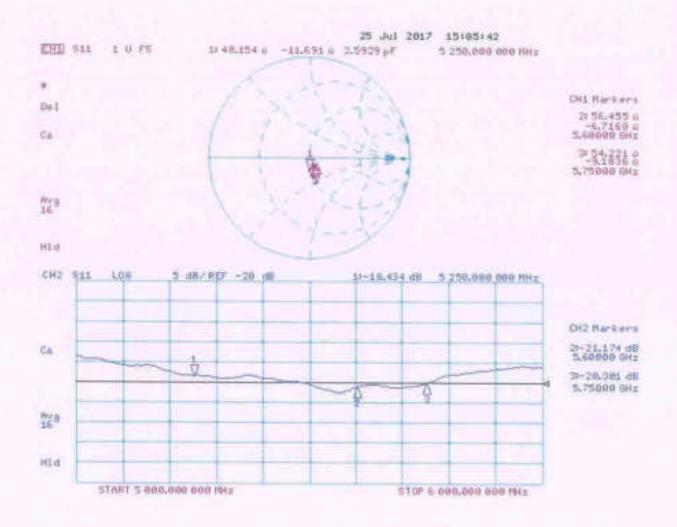
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 70.37 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 32.9 W/kg SAR(1 g) = 8.38 W/kg; SAR(10 g) = 2.39 W/kg Maximum value of SAR (measured) = 19.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 67.77 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 32.2 W/kg SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.28 W/kg Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 17.8 W/kg = 12.52 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 26.07.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1167

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Medium parameters used: f = 5250 MHz; $\sigma = 5.52$ S/m; $\varepsilon_r = 47.3$; $\rho = 1000$ kg/m³. Medium parameters used: f = 5600 MHz; $\sigma = 5.99$ S/m; $\varepsilon_r = 46.7$; $\rho = 1000$ kg/m³. Medium parameters used: f = 5750 MHz; $\sigma = 6.2$ S/m; $\varepsilon_r = 46.4$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

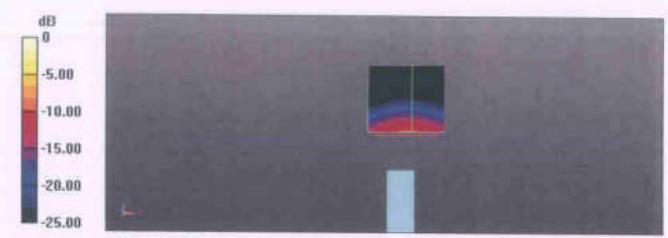
DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.51, 4.51, 4.51); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.50 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 29.6 W/kg SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.17 W/kg Maximum value of SAR (measured) = 17.7 W/kg

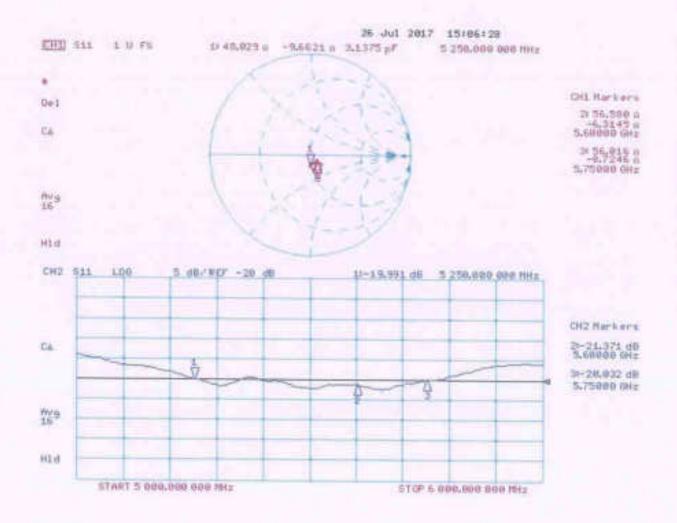
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.37 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 33.4 W/kg SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.26 W/kg Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.14 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 33.6 W/kg SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.18 W/kg Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 17.7 W/kg = 12.48 dBW/kg

Impedance Measurement Plot for Body TSL



In Collaboration with
<u>spe</u>
CALIBRATION LABO



Certificate No: Z17-97205

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Client :	Sporton	International INC	
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CALIBRATION CERTIFICATE

Object

DAE4 - SN: 1358

October 24, 2017

Calibration Procedure(s)

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

Calibration date:

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)[°]C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID # Cal Date(Calibrated by, Certificate No.)		Scheduled Calibration
Process Calibrator 753	1971018	27-Jun-17 (CTTL, No.J17X05859)	June-18
Calibrated by:	Name Yu Zongying	Function SAR Test Engineer	Signature
Reviewed by:	Lin Hao	SAR Test Engineer	the all
Approved by:	Qi Dianyuan	SAR Project Leader	A CH
Issued: October 26, 2017 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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Glossary: DAE Connector angle

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

Methods Applied and Interpretation of Parameters:

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



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DC Voltage Measurement

A/D - Converter Resolution nominal

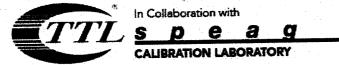
High Range: $1LSB = 6.1\mu V$,full range = -100...+300 mVLow Range:1LSB = 61nV,full range = -1.....+3mVDASY measurement parameters:Auto Zero Time: 3 sec;Measuring time: 3 sec

Calibration Factors X		Y	Z	
High Range	403.474 ± 0.15% (k=2)	403.509 ± 0.15% (k=2)	403.510 ± 0.15% (k=2)	
Low Range 3.96147 ± 0.7% (k=2)		3.98783 ± 0.7% (k=2)	3.99209 ± 0.7% (k=2)	

Connector Angle

C	Connector Angle to be used in DASY system	134°±1°

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	Lan Road, Haidian District, Beijing, 100191, China			CALIBRATI CNAS L05
Tel: +86-10-6230 E-mail: cttl@chin	attl.com <u>Http://www.chinattl.cn</u>	Certificate N	o: Z17-97269	
Client : Spor				
bject	DAE4 - SN: 1303			
alibration Procedure(s)	FF-Z11-002-01			
	Calibration Procedure for t (DAEx)	he Data Acquisiti	on Electronics	
Calibration date:	December 19, 2017			
All calibrations have be	en conducted in the closed laborator	y facility: environr	nent temperature	e(22±3)℃ an
numidity<70%. Calibration Equipment us	en conducted in the closed laborator ed (M&TE critical for calibration)		nent temperature Scheduled Cali	
numidity<70%.				
numidity<70%. Calibration Equipment us	ed (M&TE critical for calibration)	Certificate No.)		bration
numidity<70%. Calibration Equipment us Primary Standards	ed (M&TE critical for calibration) ID # Cal Date(Calibrated by,	Certificate No.)	Scheduled Cali	bration
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numidity<70%. Calibration Equipment us Primary Standards Process Calibrator 753 Calibrated by: Reviewed by: Approved by:	ed (M&TE critical for calibration) ID # Cal Date(Calibrated by, 1971018 27-Jun-17 (CTTL, Ne Name Function Zhao Jing SAR Test Engin Lin Hao SAR Test Engin	Certificate No.) o.J17X05859) neer neer sader	Scheduled Cali June-1 Signature	bration 18 22, 2017



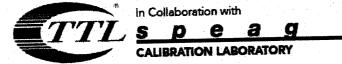
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Glossary: DAE Connector angle

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

Methods Applied and Interpretation of Parameters:

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



DC Voltage Measurement

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

Connector Angle

		36.5°±1°
•	Connector Angle to be used in DASY system	00.0 _ 1

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<u>s</u>	p	e	a	
CAL	BRATIC	ON LAP	OPAT	



_Client SI

orton International INC

Certificate No: Z17-97257

CALIBRATION CERTIFICATE

Object

EX3DV4 - SN:3935

Calibration Procedure(s)

FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes

Calibration date:

December 14, 2017

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)[°]C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Date(Calibrated by, Certificate No.)			
Power Meter NRP2	101919	27-Jun-17 (CTTL, No.J17X05857)	Scheduled Calibration		
Power sensor NRP-Z91	101547		Jun-18		
Power sensor NRP-Z91	101548	27-Jun-17 (CTTL, No.J17X05857)	Jun-18		
Reference10dBAttenuator		27-Jun-17 (CTTL, No.J17X05857)	Jun-18		
Reference20dBAttenuator	18N50W-20dB		Mar-18		
Reference Probe EX3DV4		13-Mar-16(CTTL, No.J16X01548)	Mar-18		
DAE4	SN 549	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18		
DAE4	SN 549 SN 1524	13-Dec-16(SPEAG, No.DAE4-549_Dec16)			
Secondary Standards		13-Sep-17(SPEAG, No.DAE4-1524_Sep17) Sep -18		
SignalGeneratorMG3700A	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration		
Network Analyzer E5071C		27-Jun-17 (CTTL, No.J17X05858)	Jun-18		
	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan -18		
	Name	Function	Signature		
Calibrated by:	Yu Zongying	SAR Test Engineer			
Reviewed by:	Lin Hao	SAR Test Engineer	- ALAB		
Approved by:	Qi Dianyuan	SAR Project Leader			
Issued: December 16, 2017 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.					
the callstation certificate sh	an not be reprodu	ced except in full without written approval of t	he laboratory.		



Glossary:

TSL NORMx,y,z ConvF DCP CF A,B,C,D Polarization Φ Polarization θ	tissue simulating liquid sensitivity in free space sensitivity in TSL / NORMx,y,z diode compression point crest factor (1/duty_cycle) of the RF signal modulation dependent linearization parameters Φ rotation around probe axis θ rotation around an axis that is in the sta	
	o location around an axis that is in the	

around an axis that is in the plane normal to probe axis (at measurement center) θ =0 is normal to probe axis

Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system Calibration is Performed According to the Following Standards:

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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

- Methods Applied and Interpretation of Parameters:
- *NORMx, y, z:* Assessed for E-field polarization $\theta=0$ (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z* frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx, y, z: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal
- Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z:A,B,C are numerical linearization parameters assessed based on the • data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx, y, z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx



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Probe EX3DV4

SN: 3935

Calibrated: December 14, 2017

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: Z17-97257

Page 3 of 11



DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3935

Basic Calibration Parameters

	Sensor X			
Normal Alla 2	Jensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(µV/(V/m)²) ^A	0.48	0.54		
DCP(mV) ^B	104.4		0.49	±10.0%
	104.4	104.3	106.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	С	D	VR	Unc ^E
0	CW	X	0.0	0.0	1.0	dB 0.00	mV 162.8	(k=2) ±2.2%
		Y 7	0.0	0.0	1.0		176.1	
		Z	0.0	0.0	1.0		165.6	1

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%.

^A The uncertainties of Norm X, Y, Z do not affect the E²-field uncertainty inside TSL (see Page 5 and Page 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3935

6 FRALL SC	Relative	Conductivity						
f [MHz] ^C	Permittivity ^F	(S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G	Unct.
750	41.9	0.89	10.68	10.00			(mm)	(k=2)
835	41.5	0.90		10.68	10.68	0.40	0.70	±12.19
900	41.5	0.97	10.36	10.36	10.36	0.10	1.67	±12.19
1750	40.1		10.22	10.22	10.22	0.16	1.29	±12.19
1900	40.0	1.37	8.85	8.85	8.85	0.22	1.08	±12.19
2000		1.40	8.41	8.41	8.41	0.26	0.94	
	40.0	1.40	8.41	8.41	8.41	0.28	0.90	±12.1%
2300	39.5	1.67	8.39	8.39	8.39	0.44		±12.1%
2450	39.2	1.80	7.87	7.87	7.87		0.79	±12.1%
2600	39.0	1.96	7.67	7.67		0.53	0.73	±12.1%
5200	36.0	4.66	5.91		7.67	0.60	0.68	±12.1%
5300	35.9	4.76		5.91	5.91	0.35	1.50	±13.3%
5500	35.6		5.63	5.63	5.63	0.35	1.50	±13.3%
5600	35.5	4.96	5.29	5.29	5.29	0.35	1.60	±13.3%
5800		5.07	5.08	5.08	5.08	0.35	1.60	$\pm 13.3\%$
5000	35.3	5.27	5.15	5.15	5.15	0.40	1.40	$\pm 13.3\%$ $\pm 13.3\%$

Calibration Parameter Determined in Head Tissue Simulating Media

^c Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to \pm 110 MHz.

^F At frequency below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters. ^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than \pm 1% for frequencies below 3 GHz and below \pm 2% for the frequencies

between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3935

6 FRAI 1-3C	Relative	Conductivity	vity					
f [MHz] ^C	Permittivity ^F	(S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G	Unct.
750	55.5	0.96	10.65	10.05			(mm)	(k=2)
835	55.2	0.97	· · · · · · · · · · · · · · · · · · ·	10.65	10.65	0.40	0.80	±12.19
1750	53.4		10.33	10.33	10.33	0.17	1.41	±12.1%
1900	53.3	1.49	8.71	8.71	8.71	0.26	0.99	$\pm 12.1\%$
2300		1.52	8.30	8.30	8.30	0.16	1.39	±12.1%
	52.9	1.81	8.10	8.10	8.10	0.32		
2450	52.7	1.95	7.99	7.99	7.99		1.16	±12.1%
2600	52.5	2.16	7.71	7.71		0.29	1.25	<u>±12.1%</u>
5200	49.0	5.30	5.41		7.71	0.39	0.95	±12.1%
5300	48.9	5.42		5.41	5.41	0.45	1.30	±13.3%
5500	48.6		5.20	5.20	5.20	0.40	1.30	±13.3%
5600		5.65	4.62	4.62	4.62	0.40	1.70	$\pm 13.3\%$
	48.5	5.77	4.51	4.51	4.51	0.45	1.55	
5800	48.2	6.00	4.64	4.64	4.64			±13.3%
					<u> </u>	0.58	1.07	±13.3%

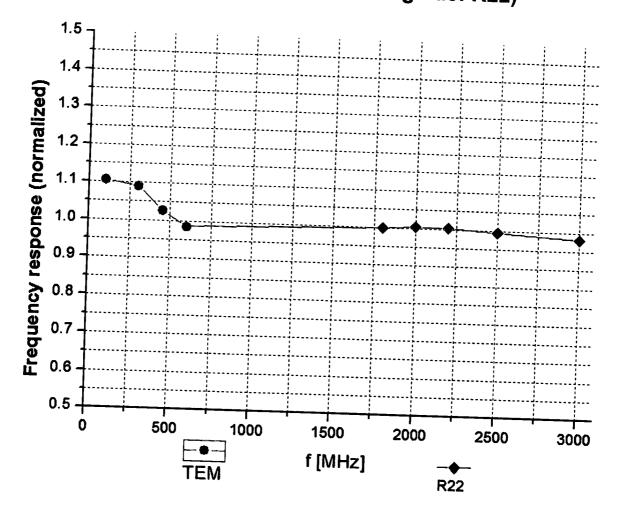
Calibration Parameter Determined in Body Tissue Simulating Media

^c Frequency validity above 300 MHz of \pm 100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to \pm 50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is \pm 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to \pm 110 MHz.

^FAt frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters. ^GAlpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

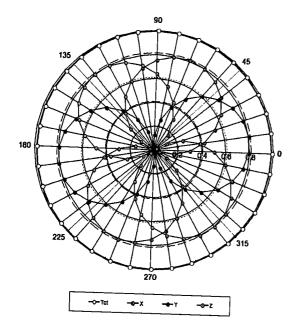


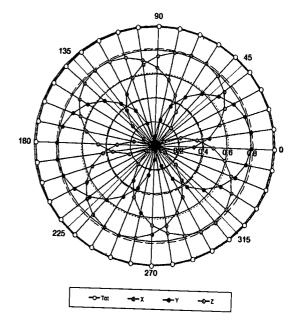
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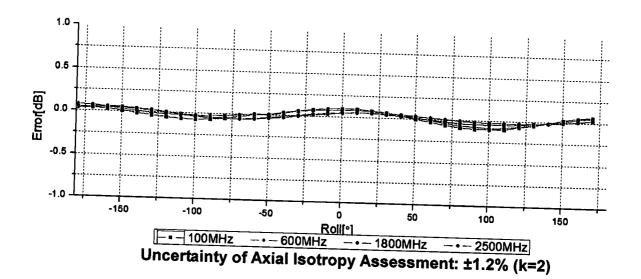
Receiving Pattern (Φ), θ =0°

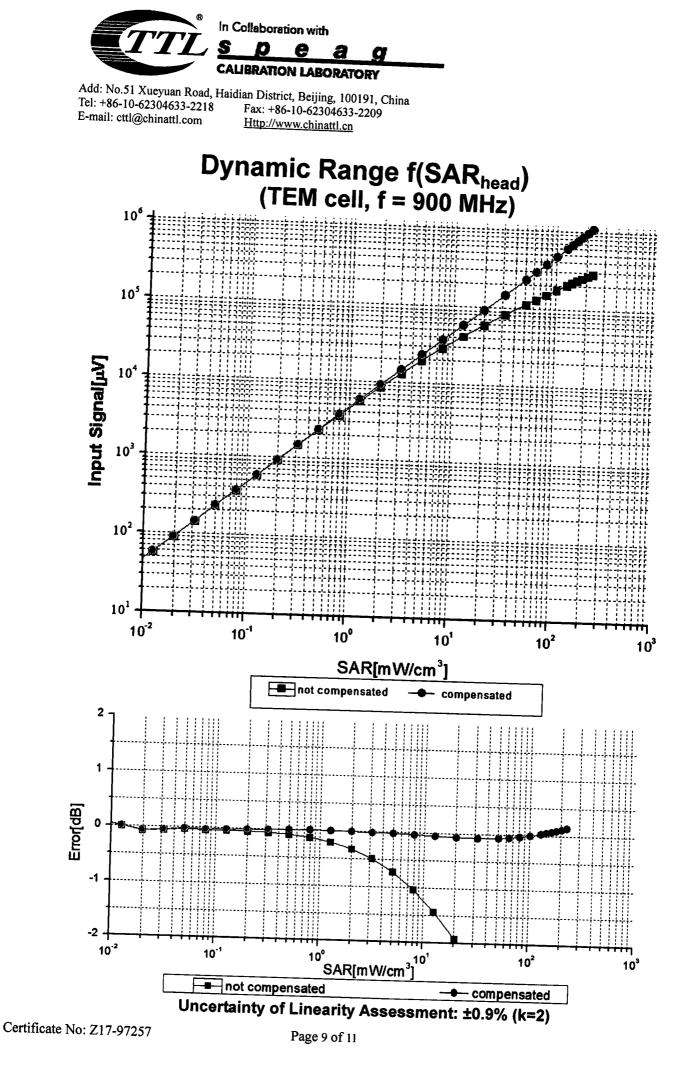
f=600 MHz, TEM

f=1800 MHz, R22





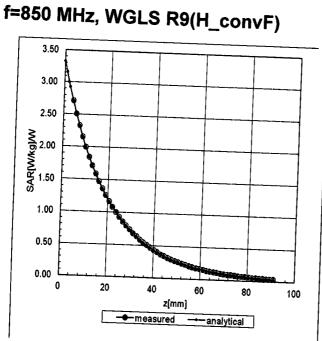


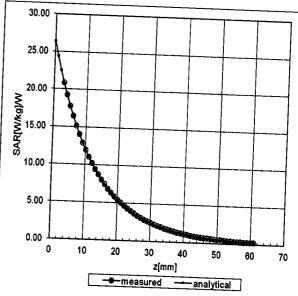




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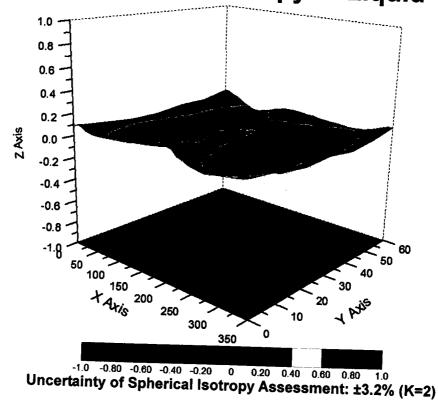
Conversion Factor Assessment





f=1750 MHz, WGLS R22(H_convF)

Deviation from Isotropy in Liquid



Certificate No: Z17-97257

Page 10 of 11



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3935

Other Probe Parameters

Γ

Sensor Arrangement	Triangular
Connector Angle (°)	
Mechanical Surface Detection Mode	42.2
Optical Surface Detection Mode	enabled
	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	
Tip Diameter	9mm
	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	
	1mm
Recommended Measurement Distance from Surface	1.4mm

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



S Schweizerischer Kalibrierdienst

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

Accreditation No.: SCS 0108

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

Client Sporton (Auden)

Certificate No: EX3-3911_Nov17

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3911
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 28, 2017
	uments the traceability to national standards, which replize the physical units of measurements (SI) scartainties with confidence probability are given on the following pages and are part of the certificate.
All calibrations have been can	ducted 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-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: \$5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DVZ	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	5N: 660	7-Dec-16 (No. DAE4-660, Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E44198	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	05-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 6648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzor HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Namo	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	Milles
Approved by:	Katja Pokovic	Technical Managar	fel af
			Issued: November 28, 2017

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

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



S Schweizerischer Kalibrierdienst

Accreditation No.: SCS 0108

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

Accredited by the Swiss Accreditation Service (SAS)

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

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization (p	(p rotation around probe axis
Polarization 9	9 rotation around an axis that is in the plane normal to probe axis (at measurement center),
	i.e., 9 = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORMx,y,z: Assessed for E-field polarization 8 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is
 implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included
 in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z; A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMx (no uncertainty required).

Probe EX3DV4

SN:3911

Manufactured: Repaired: Calibrated:

September 4, 2012 November 23, 2017 November 28, 2017

(Note: non-compatible with DASY2 systems)

Page 3 of 11

Basic Calibration Parameters

and the second sec	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) ²) ^A	0.31	0.35	0.46	± 10.1 %
DCP (mV)"	106.3	98.7	98.9	- 1901 19

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	С	D dB	VR mV	Unc [®] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	150.0	±3.3 %
		Y	0.0	0.0	1.0		151.3	
		Z	0.0	0.0	1.0		158.1	

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%.

* The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

Numerical linearization parameter: uncertainty not required.

² Uncertainty is determined using the max, deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

f (MHz) ^C	Relative Permittivity*	Conductivity (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ⁰	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	11.04	11.04	11.04	0.48	0.87	± 12.0 %
835	41.5	0.90	10.30	10.30	10.30	0.41	0.88	± 12.0 %
900	41.5	0.97	9.91	9.91	9.91	0.43	0.85	± 12.0 %
1750	40.1	1.37	8.61	8.61	8.61	0.38	0.80	± 12.0 %
1900	40.0	1.40	8,31	8.31	8.31	0.40	0.80	± 12.0 %
2000	40.0	1.40	8.23	8.23	8.23	0.39	0.80	± 12.0 %
2300	39.5	1.67	7.86	7.86	7.86	0.30	0.85	± 12.0 %
2450	39.2	1.80	7.53	7.53	7,53	0.35	0.80	± 12.0 %
2600	39.0	1.96	7.32	7.32	7.32	0.33	0.87	± 12.0 %
5250	35.9	4.71	5.25	5.25	5.25	0.35	1.80	± 13.1 %
5600	35.5	5.07	4,60	4.60	4.60	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.93	4.93	4.93	0.40	1.80	± 13.1 %

Calibration Parameter Determined in Head Tissue Simulating Media

⁶ Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

At frequencies below 3 GHz, the validity of tissue parameters (x and m) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ii and ii) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters. ⁹ Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is ⁹ Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is

always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

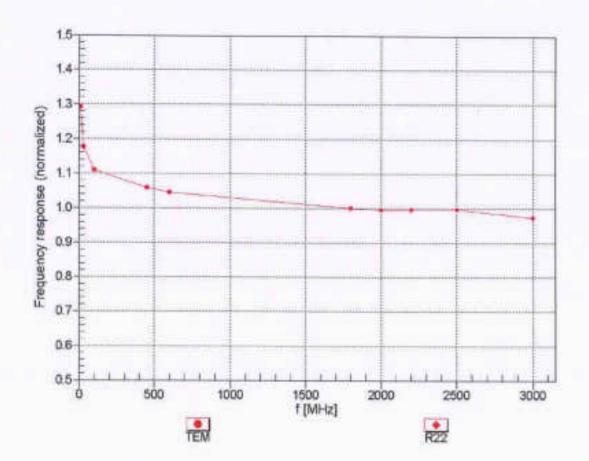
f (MHz) ^C	Relative Permittivity	Conductivity (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha	Depth [®] (mm)	Unc (k=2)
750	55.5	0.96	10.27	10.27	10.27	0.53	0.80	± 12.0 %
835	55.2	0.97	10.09	10.09	10.09	0.50	0.80	± 12.0 %
1750	53,4	1.49	8.28	8.28	8.28	0.38	0.80	± 12.0 %
1900	53.3	1.52	8.02	8.02	8.02	0.39	0.85	± 12.0 %
2300	52.9	1.81	7.78	7.78	7.78	0,41	0.80	± 12.0 %
2450	52.7	1.95	7.68	7.68	7.68	0.38	0.80	± 12.0 %
2600	52.5	2.16	7.37	7.37	7.37	0.24	0.98	± 12.0 %
5250	48.9	5.36	4.80	4.80	4.80	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.12	4.12	4.12	0.40	1.90	± 13.1 %
5750	48.3	5.94	4,23	4.23	4,23	0.45	1.90	± 13.1 %

Calibration Parameter Determined in Body Tissue Simulating Media

⁶ Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity calibration be extended to ± 110 MHz.
⁷ At frequencies below 3 GHz, the validity of tissue parameters (c and e) can be relaxed to ± 10% if liquid compensation formula is applied to

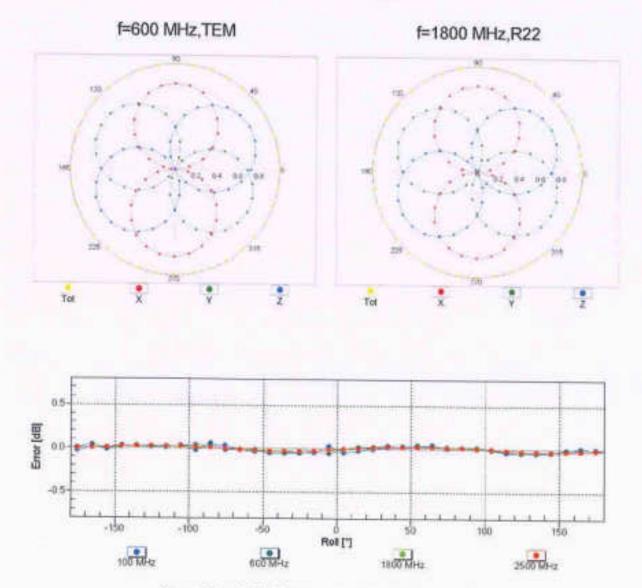
¹ At frequencies below 3 GHz, the validity of tissue parameters (c and e) can be refaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (c and e) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
¹⁰ Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is

"Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always loss than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

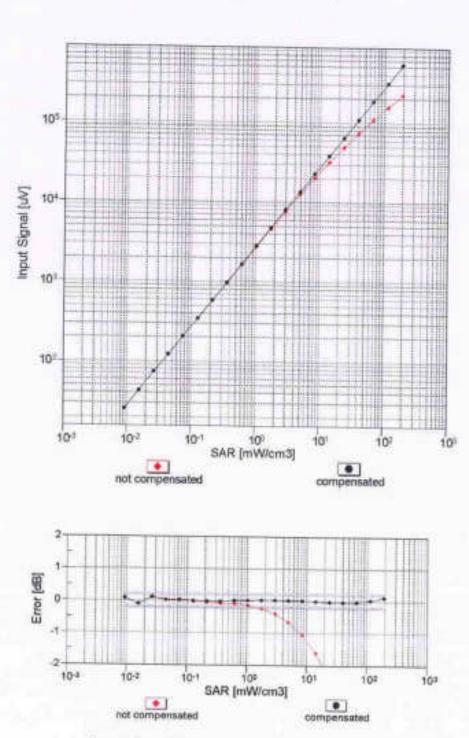


Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)

Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

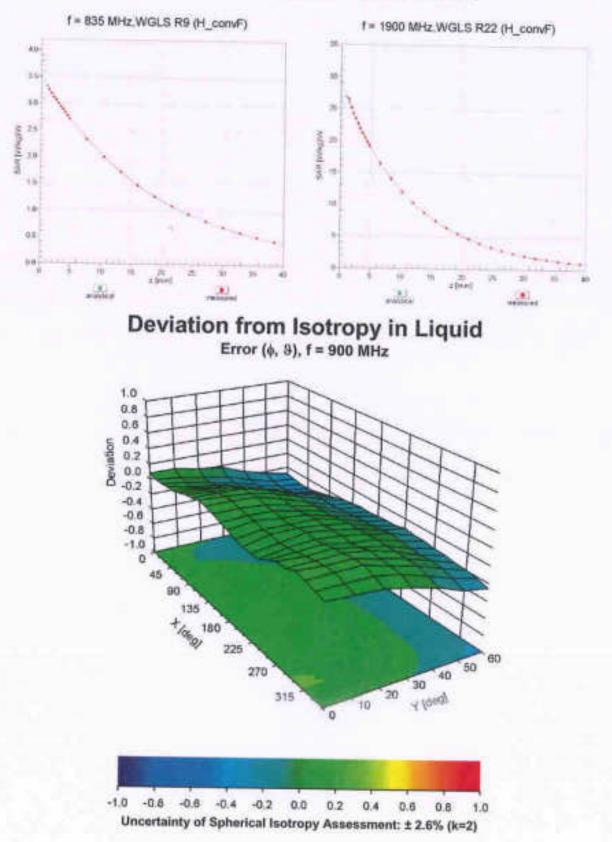


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)



Dynamic Range f(SAR_{head}) (TEM cell , f_{eval}= 1900 MHz)

Uncertainty of Linearity Assessment: ± 0.6% (k=2)



Conversion Factor Assessment

Certificate No: EX3-3911_Nov17

Page 10 of 11

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (*)	34.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1,4 mm