# APPENDIX D: RELEVANT PAGES FROM DAE&

DIPOLE VALIDATION KIT REPORT(S)

T	In Collabo	ration with	
	CALIBRAT	ION LABORATORY	ac-MRA
Add: No.51 Xueyu Tel: +86-10-62304 E-mail: ett@china Client SM	633-2079 Fax: + til.com <u>Http://</u>	rict, Beijing, 100191, Chinn 86-10-62304633-2304 www.chinntl.cn Certificate No:	CALIBRATION No. L0570
CALIBRATION C			
Object	D835V2	? - SN: 4d141	
Calibration Procedure(s)	ED 744	-2-003-01	
	OCTACED FOR	ion Procedures for dipole validation kits	
Calibration date:		ber 24, 2015	
	oopten	001 24, 2010	
		raceability to national standards, which r the uncertainties with confidence probabili	
pages and are part of the co			,
humidity<70%. Calibration Equipment used		r calibration)	
Primary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2 Power sensor NRP-Z91	101919	01-Jul-15 (CTTL, No.J15X04266) 01-Jul-15 (CTTL, No.J15X04256)	Jun-16 Jun-16
Reference Probe EX3DV4	0.555510	24-Sep-14(SPEAG,No.EX3-3846 Sep1	
DAE4	SN 910	16-Jun-15(SPEAG,No.DAE4-910_Jun1	
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	02-Feb-15 (CTTL, No.J15X00729)	Feb-16
Network Analyzer E5071C	MY46110673	03-Feb-15 (CTTL, No.J15X00728)	Feb-16
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	3.31
Reviewed by:	Qi Dianyuan	SAR Project Leader	and -
Approved by:	Lu Bingsong	Deputy Director of the laboratory	12.000-57
			and the second

Certificate No: Z15-97116

Page 1 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, Chinn Tel: +86-10-62304633-2079 Fax: +86-10-62301633-2504 E-mail: ett@elinattl.com Http://www.ehinattl.en

#### 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) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

#### Additional Documentation:

d) 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: Z15-97116

Page 2 of 8



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#### **Measurement Conditions**

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

DASY Version	DASY52	52.8.8.1222
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	1	

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.45 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.51 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	6.11 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	56.0 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.51 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.25 mW /g ± 20.4 % (k=2)

Certificate No: Z15-97116

Page 3 of 8



#### Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.2Ω- 4.66jΩ	
Return Loss	- 25.9dB	

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.7Ω- 5.94jΩ	
Return Loss	- 22.3dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.441 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.

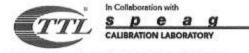
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching 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
	2

Certificate No: Z15-97116

Page 4 of 8



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**DASY5 Validation Report for Head TSL** 

Date: 09.18.2015

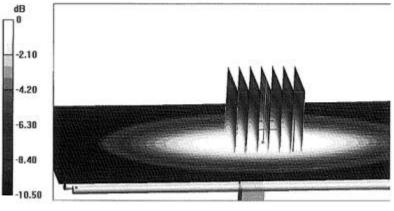
Test Laboratory: CTTL, Beijing, China DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141 Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; σ = 0.886 S/m; ε<sub>r</sub> = 41.95; ρ = 1000 kg/m<sup>3</sup> Phantom section: Left Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(9.18, 9.18, 9.18); Calibrated: 9/24/2014;
- · Sensor-Surface: 2mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- 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 (7331)

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

Reference Value = 59.07 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 3.48 W/kg SAR(1 g) = 2.33 W/kg; SAR(10 g) = 1.51 W/kg Maximum value of SAR (measured) = 2.95 W/kg



0 dB = 2.95 W/kg = 4.70 dBW/kg

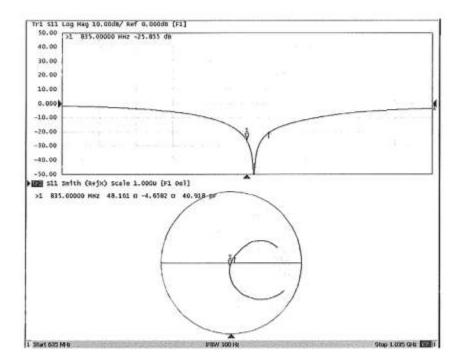
Certificate No: Z15-97116

Page 5 of 8



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# Impedance Measurement Plot for Head TSL



Certificate No: Z15-97116

Page 6 of 8



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**DASY5 Validation Report for Body TSL** 

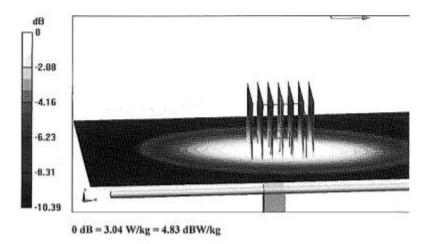
Date: 09.18.2015

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141** Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1 Medium parameters used: f = 835 MHz;  $\sigma$  = 0.981 S/m;  $\epsilon_r$  = 55.99;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(9.09,9.09, 9.09); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- · 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 (7331)

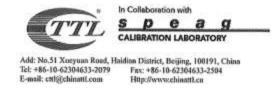
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 56.07 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.58 W/kg SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.57 W/kg Maximum value of SAR (measured) = 3.04 W/kg



Certificate No: Z15-97116

Page 7 of 8



Impedance Measurement Plot for Body TSL

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Certificate No: Z15-97116

Page 8 of 8

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Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
01-Jul-15 (CTTL, No.J15X04256)	Jun-16
01-Jul-15 (CTTL, No.J15X04256)	Jun-16
16-JUN-15(SPEAG,NO.DAE4-910_JUN15	) Jun-16
Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
430 02-Feb-15 (CTTL, No.J15X00729)	Feb-16
673 03-Feb-15 (CTTL, No.J15X00728)	Feb-16
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Certificate No: Z15-97117

Page 1 of #



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Glossary: TSL tissue simulating liquid

ussue simulating liquid
sensitivity in TSL / NORMx,y,z
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) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

#### Additional Documentation:

d) 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: Z15-97117

Page 2 of 8



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

DASY Version	DASY52	52.8.8.1222
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9±6%	1.38 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		222

# SAR result with Head TSL

Condition	
250 mW input power	9.96 mW / g
normalized to 1W	40.4 mW /g ± 20.8 % (k=2)
Condition	
250 mW input power	5.20 mW / g
normalized to 1W	21.0 mW /g ± 20.4 % (k=2)
	250 mW input power normalized to 1W Condition 250 mW input power

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.6 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	27720	

#### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	41.2 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.37 mW/g
SAR for nominal Body TSL parameters	normalized to 1W	21.6 mW /g ± 20.4 % (k=2)

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Page 3 of 8



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#### Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0Ω+2.72)Ω	
Return Loss	- 30.9dB	

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4Ω+ 3.95jΩ	
Return Loss	- 27.3dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.301 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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Page 4 of 8



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**DASY5 Validation Report for Head TSL** 

Date: 09.16.2015

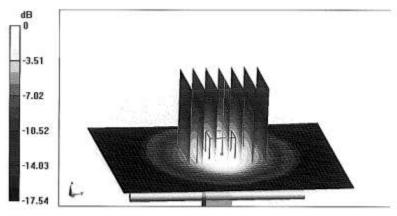
Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162 Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.378 S/m; er = 40.94; ρ = 1000 kg/m3 Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(7.26, 7.26, 7.26); Calibrated: 9/24/2014;
- · Sensor-Surface: 2mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- 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 (7331)

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

Reference Value = 104.1 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 18.0W/kg SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.2 W/kg Maximum value of SAR (measured) = 14.2 W/kg



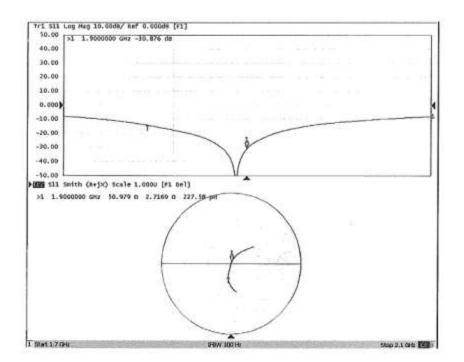
0 dB = 14.2 W/kg = 11.52 dBW/kg

Certificate No: Z15-97117

Page 5 of 8

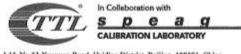


Impedance Measurement Plot for Head TSL



Certificate No: 215-97117

Page 6 of 8



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**DASY5 Validation Report for Body TSL** 

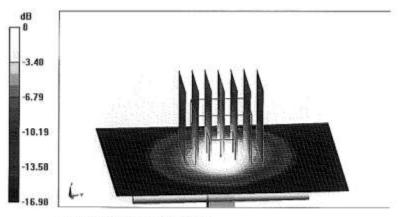
Date: 09.16.2015

Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162 Communication System: UID 0, CW; Frequency: 1900 MHz;Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.507 S/m; ε<sub>r</sub> = 54.56; ρ = 1000 kg/m<sup>3</sup> Phantom section: Left Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(7.15, 7.15, 7.15); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- 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 (7331)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 100.5 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 18.4 W/kg SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.37 W/kg Maximum value of SAR (measured) = 14.7 W/kg



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

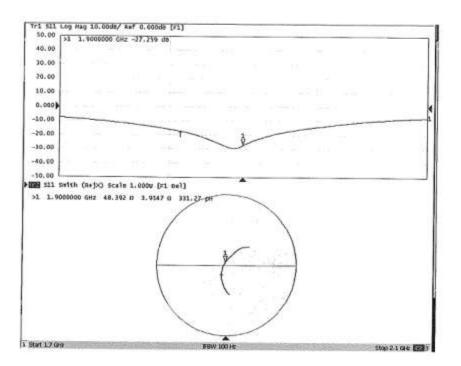
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Page 7 of 8



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# Impedance Measurement Plot for Body TSL



Certificate No: Z15-97117

Page 8 of 8

	CALIBRAT	ION LABORATORY	ac-MRA	
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Client SMG	ARAMA LUI COLORADO		Z15-97122	En la la
CALIBRATION CE	RTIFICAT	E		
Dbject	D2450V	/2 - SN: 818		
Calibration Procedure(s)	ED 711	-2-003-01		
	- A.D.27.14	tion Procedures for dipole validation kits		
Calibration date:	Septem	ber 14, 2015		
pages and are part of the ce				
	conducted in t	the closed laboratory facility: environme or calibration)	ent temperati	ure(22±3)℃ and
All calibrations have been numidity<70%. Calibration Equipment used	conducted in t	or calibration)		ure(22+3) <sup>®</sup> and ed Calibration
All calibrations have been numidity<70%. Calibration Equipment used	conducted in t		Schedul	
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards	conducted in the conduc	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04258) 01-Jul-15 (CTTL, No.J15X04256)	Schedul J J	ed Calibration un-16 un-16
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	conducted in 1 (M&TE critical fo ID # 101919 101547 SN 3846	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256) 24-Sep-14(SPEAG,No.EX3-3846_Sep14	Schedul J J I) S	ed Calibration un-16 un-16 iep-15
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-291	conducted in 1 (M&TE critical fo ID # 101919 101547	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04258) 01-Jul-15 (CTTL, No.J15X04256)	Schedul J J I) S	ed Calibration un-16 un-16
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4	conducted in 1 (M&TE critical fo ID # 101919 101547 SN 3846	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256) 24-Sep-14(SPEAG,No.EX3-3846_Sep14	Schedul J J I) S I) J	ed Calibration un-16 un-16 iep-15
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4	conducted in 1 (M&TE critical fo ID # 101919 101547 SN 3846 SN 910	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256) 24-Sep-14(SPEAG,No.EX3-3846_Sep14 16-Jun-15(SPEAG,No.DAE4-910_Jun15	Schedul J J () S () J Schedul	ed Calibration un-16 un-16 iep-15 un-16
All calibrations have been numidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards	conducted in 1 (M&TE critical fo ID # 101919 101547 SN 3846 SN 910 ID #	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256) 24-Sep-14(SPEAG,No.EX3-3846_Sep14 16-Jun-15(SPEAG,No.DAE4-910_Jun15 Cal Date(Calibrated by, Certificate No.)	Schedul J J I) S I) J Schedul F	ed Calibration un-16 un-16 lep-15 uun-16 ed Calibration
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	conducted in 1 (M&TE critical fo 101919 101547 SN 3846 SN 910 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256) 24-Sep-14 (SPEAG,No.EX3-3846_Sep14 16-Jun-15 (SPEAG,No.DAE4-910_Jun15 Cal Date(Calibrated by, Certificate No.) 02-Feb-15 (CTTL, No.J15X00729) 03-Feb-15 (CTTL, No.J15X00728)	Schedul J I) S ) J Schedul F F	ed Calibration un-16 un-16 lep-15 un-16 ed Calibration eb-16
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	conducted in 1 (M&TE critical fo 101919 101547 SN 3846 SN 910 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256) 24-Sep-14(SPEAG,No.EX3-3846_Sep14 16-Jun-15(SPEAG,No.DAE4-910_Jun15 Cal Date(Calibrated by, Certificate No.) 02-Feb-15 (CTTL, No.J15X00729)	Schedul J I) S ) J Schedul F F	ed Calibration un-16 iep-15 iun-16 ed Calibration eb-16 eb-16
All calibrations have been humidity<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	conducted in 1 (M&TE critical fo 101919 101547 SN 3846 SN 910 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04258) 01-Jul-15 (CTTL, No.J15X04258) 24-Sep-14(SPEAG,No.EX3-3848_Sep14 16-Jun-15(SPEAG,No.DAE4-910_Jun15 Cal Date(Calibrated by, Certificate No.) 02-Feb-15 (CTTL, No.J15X00729) 03-Feb-15 (CTTL, No.J15X00728) Function	Schedul J I) S ) J Schedul F F	ed Calibration un-16 iep-15 iun-16 ed Calibration eb-16 eb-16

Certificate No: Z15-97122

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) KDB8655664, SAR Measurement Requirements for 100 MHz to 6 GHz

#### Additional Documentation:

d) 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: Z15-97122

Page 2 of 8



#### In Collaboration with pe S а g

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# **Measurement Conditions**

DASY Version	DASY52	52.8.8.1222
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 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		1

# SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.7 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.19 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	24.6 mW /g ± 20.4 % (k=2)

#### **Body TSL parameters**

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mha/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.9 ± 6 %	1.94 mho/m ± 6 %
Body TSL temperature change during test	<1.0 *C		

SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.1 mW /g ± 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.9 mW /g ± 20.4 % (k=2)

Certificate No: Z15-97122

Page 3 of 8



# Appendix

# Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0Ω+ 4.41jΩ	
Return Loss	- 26.4dB	

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.4Ω+ 4.75jΩ	
Return Loss	- 26.4dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.271 ns
the second state of the se	

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

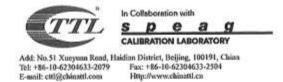
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching 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

Certificate No: Z15-97122

Page 4 of 8



Date: 09.14.2015

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818** Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; σ = 1.831 S/m; εr = 39.04; ρ = 1000 kg/m3 Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

DASY5 Validation Report for Head TSL

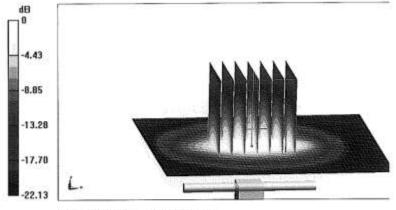
- Probe: EX3DV4 SN3846; ConvF(6.56, 6.56, 6.56); Calibrated: 9/24/2014;
- · Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 108.4 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.0 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.19 W/kg

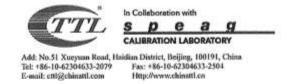
Maximum value of SAR (measured) = 20.3 W/kg



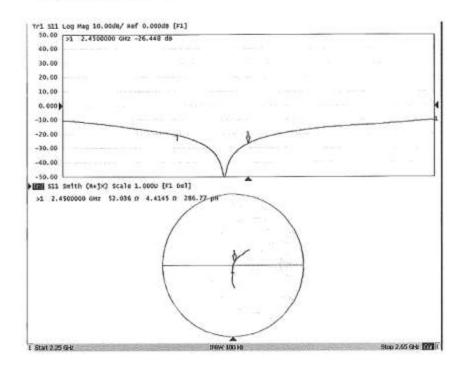
0 dB = 20.3 W/kg = 13.07 dBW/kg

Certificate No: Z15-97122

Page 5 of 8



# Impedance Measurement Plot for Head TSL



Certificate No: Z15-97122

Page 6 of 8



**DASY5 Validation Report for Body TSL** 

Date: 09.14.2015

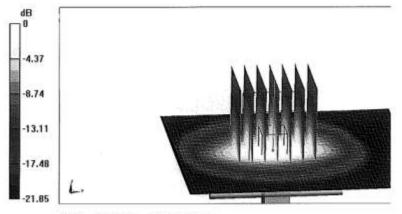
Test Laboratory: CTTL, Beijing, China DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz;  $\sigma = 1.944$  S/m;  $\epsilon_r = 51.85$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Left Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(6.9, 6.9, 6.9); Calibrated: 9/24/2014; .
- Sensor-Surface: 2mm (Mechanical Surface Detection) .
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015 .
- 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 (7331)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.30 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.7 W/kg SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.99 W/kg

Maximum value of SAR (measured) = 19.5 W/kg



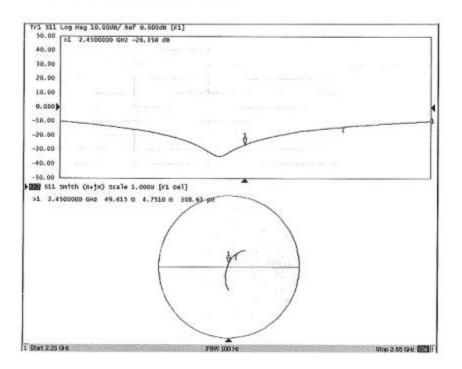
0 dB = 19.5 W/kg = 12.90 dBW/kg

Certificate No: Z15-97122

Page 7 of 8



#### Impedance Measurement Plot for Body TSL



Certificate No: Z15-97122

Page 8 of 8

Client : SM	Q	Certific	ate No: Z16-97022
CALIBRATION	CERTIFICAT	E	
Object	DAE4 -	SN: 876	
Calibration Procedure(s)	Calibra	-2-002-01 tion Procedure for the Data Ac	quisition Electronics
College data	(DAEx)		
Calibration date:	March 3	2, 2016	
Primary Standards	ID# Cal	or calibration) Date(Calibrated by, Certificate No 06-July-15 (CTTL, No:J15X04257	
Primary Standards	ID# Cal	Date(Calibrated by, Certificate No	
Calibration Equipment us Primary Standards Process Calibrator 753.	ID # Cal 1971018 Name	Date(Calibrated by, Certificate No 06-July-15 (CTTL, No:J15X04257 Function	
Primary Standards Process Calibrator 753. Calibrated by:	ID# Cal 1971018	Date(Calibrated by, Certificate No 06-July-15 (CTTL, No:J15X04257	r) July-16
Primary Standards Process Calibrator 753	ID # Cal 1971018 Name	Date(Calibrated by, Certificate No 06-July-15 (CTTL, No:J15X04257 Function	r) July-16
Primary Standards Process Calibrator 753. Calibrated by:	ID # Cal 1971018 Name Yu Zongying	Date(Calibrated by, Certificate No 06-July-15 (CTTL, No:J15X04257 Function SAR Test Engineer	) July-16 Signature
Primary Standards Process Calibrator 753 Calibrated by: Reviewed by: Approved by:	ID # Cal 1971018 Name Yu Zongying Qi Dianyuan Lu Bingsong	Date(Calibrated by, Certificate No 06-July-15 (CTTL, No:J15X04257 Function SAR Test Engineer SAR Project Leader	Signature



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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.

Certificate No: Z16-97022

Page 2 of 3



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# DC Voltage Measurement

AND - Convenser Mes	olucon nomin	1991		
High Range:	1L58 =	6.1µV ,	full range =	-100+300 mV
Low Range:	1LS8 =	61nV .	full range =	+1+3mV
DASY measurement	parameters:	Auto Zero	Time: 3 sec; Meas	uring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.489 ± 0.15% (k=2)	405 148 ± 0.15% (k=2)	405.367 ± 0.15% (k=2)
Low Range	3.98974 ± 0.7% (k=2)	3.97262 ± 0.7% (k=2)	3.99843 ± 0.7% (k=2)

# **Connector Angle**

Connector Angle to be used in DASY system	181 *±1 *
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Certificate No: Z16-97022

Page 3 of 3