# 6.2. D835V2 Dipole Calibration Certificate

T	<u>T s p</u>	ration with C A G TION LABORATORY	Iac-MRA	CNAS
Tel: +86-10-62304 E-mail: cttl@china	533-2079 Fax: + tfLcom <u>Http://</u>	rict, Beijing, 100191, China 86-10-62304633-2504 www.chinattl.en Certificate No:	Z15-97116	CALIBRATION No. L0570
CALIBRATION C			210-9/110	
Object	D835V2	2 - SN: 4d141	anta mainta an	
Calibration Procedure(s)	FD-Z11	-2-003-01		
Calibration date:		ion Procedures for dipole validation kits		
Jampianon date.	Septem	ber 24, 2015		
	asurements and	raceability to national standards, which the uncertainties with confidence probat	-	-
humidity<70%.		he closed laboratory facility: environn	nent temperatu	re(22±3)℃ an
Calibration Equipment used	(M&TE critical fo		) Orbedet	d Collinguian
Primary Standards Power Meter NRP2	101919	Cal Date(Calibrated by, Certificate No. 01-Jul-15 (CTTL, No.J15X04256)		d Calibration
Power sensor NRP-Z91	101547	01-Jul-15 (CTTL, No.J15X04256)	-	un-16
Reference Probe EX3DV4		24-Sep-14(SPEAG,No.EX3-3846_Sep	-	ep-15
DAE4	SN 910	16-Jun-15(SPEAG,No.DAE4-910_Jun	,	un-16
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No	.) Schedule	ed Calibration
Signal Generator E4438C	MY49071430	02-Feb-15 (CTTL, No.J15X00729)	F	eb-16
Network Analyzer E5071C	MY46110673	03-Feb-15 (CTTL, No.J15X00728)	F	eb-16
	Name	Function	Siar	ature
Calibrated by:	Zhao Jing	SAR Test Engineer	f.	Ž1
Reviewed by:	Qi Dianyuan	SAR Project Leader	àro	e_
Approved by:	Lu Bingsong	Deputy Director of the laboratory	12.00	1.52
This calibration certificate st	all not be reprod	Issued: S uced except in full without written approv	eptember 29, 2 val of the labora	

Certificate No: Z15-97116

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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) 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%.

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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			

#### SAR result with Head TSL

SAR averaged over 1 $cm^3$ (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 $cm^3$ (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)

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#### 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

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: 09.18.2015

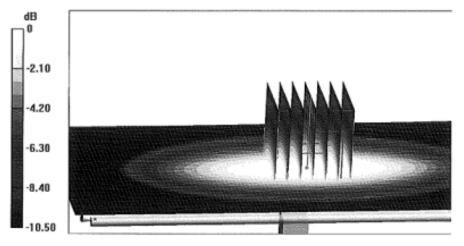
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz;  $\sigma = 0.886$  S/m;  $\varepsilon_r = 41.95$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Left Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(9.18, 9.18, 9.18); Calibrated: 9/24/2014; ٠
- Sensor-Surface: 2mm (Mechanical Surface Detection) ٠
- 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) ٠

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



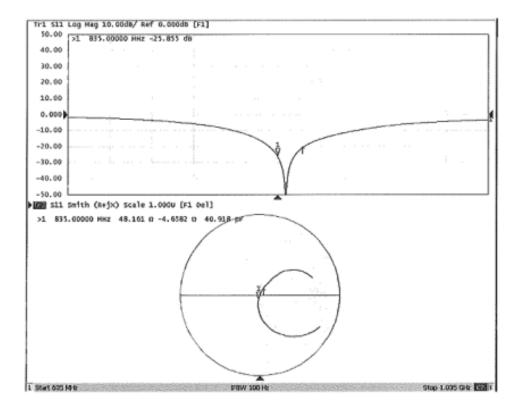
0 dB = 2.95 W/kg = 4.70 dBW/kg

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# Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

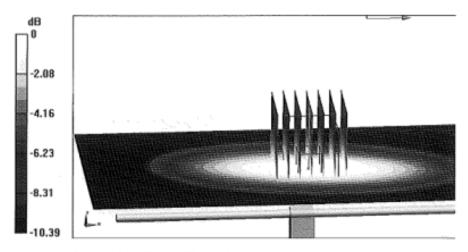
Date: 09.18.2015

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;  $\varepsilon_r = 55.99$ ;  $\rho = 1000$  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

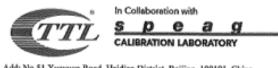
Peak SAR (extrapolated) = 3.58 W/kg SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.57 W/kg Maximum value of SAR (measured) = 3.04 W/kg



0 dB = 3.04 W/kg = 4.83 dBW/kg

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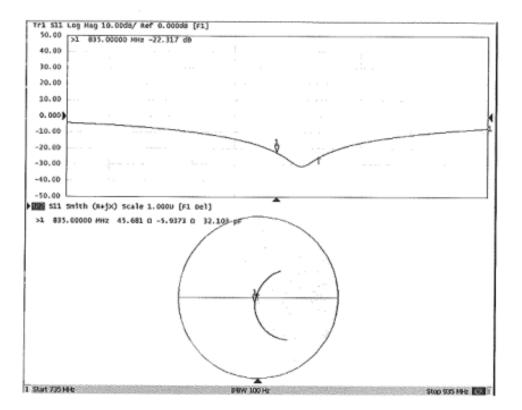


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Impedance Measurement Plot for Body TSL



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# 6.3. D190V2 Dipole Calibration Certificate

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Client SM			Z15-97117	
CALIBRATION C	ERTIFICAT	E		
Object	D1900	V2 - SN: 5d162		
Calibration Procedure(s)	50 744			
		-2-003-01 tion Procedures for dipole validation kits		
Calibration date:				
somoration date.	Septen	nber 16, 2015	iter enclaned	
measurements(SI). The me pages and are part of the ce	asurements and ertificate.	traceability to national standards, which the uncertainties with confidence probabil the closed laboratory facility: environme	lity are given o	n the following
humidity<70%. Calibration Equipment used	(M&TE critical fo	or calibration)		
Calibration Equipment used	(M&TE critical fo		Schedule	d Calibration
Calibration Equipment used	-	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256)		d Calibration
Calibration Equipment used	ID#	Cal Date(Calibrated by, Certificate No.)	Ju	
Calibration Equipment used Primary Standards Power Meter NRP2	ID# 101919 101547	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256)	Ju Ju	in-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91	ID# 101919 101547	Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04256) 01-Jul-15 (CTTL, No.J15X04256)	Ju Ju 4) Se	in-16 in-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4	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	Ju Ju 4) Se 5) Ju	in-16 in-16 ip-15
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4	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	Ju Ju 4) Se i) Ju Schedule	in-16 in-16 ip-15 in-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards	ID # 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.)	Ju Ju 4) Se 5) Ju Schedule Fe	n-16 in-16 xp-15 in-16 d Calibration
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 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)	Ju Ju 5) Se 5) Ju Schedule Fe Fe	n-16 n-16 p-15 n-16 d Calibration b-16 b-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	ID # 101919 101547 SN 3846 SN 910 ID # MY49071430 MY46110673 Name	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) Function	Ju Ju 5) Se 5) Ju Schedule Fe Fe	n-16 in-16 sp-15 in-16 d Calibration b-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	ID # 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)	Ju Ju 5) Se 5) Ju Schedule Fe Fe	n-16 n-16 p-15 n-16 d Calibration b-16 b-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C Calibrated by:	ID # 101919 101547 SN 3846 SN 910 ID # MY49071430 MY46110673 Name	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) Function	Ju Ju 5) Se 5) Ju Schedule Fe Fe	n-16 n-16 p-15 n-16 d Calibration b-16 b-16
Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 101919 101547 SN 3846 SN 910 ID # MY49071430 MY46110673 Name Zhao Jing	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) Function SAR Test Engineer	Ju Ju 5) Se 5) Ju Schedule Fe Fe	nn-16 inn-16 inp-15 inn-16 d Califoration b-16 b-16

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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) 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%.

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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
22.0 °C	40.0	1.40 mho/m
(22.0 ± 0.2) °C	40.9 ± 6 %	1.38 mho/m ± 6 %
<1.0 *C		
	22.0 °C (22.0 ± 0.2) °C	22.0 °C 40.0 (22.0 ± 0.2) °C 40.9 ± 6 %

### 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	9.96 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.4 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	5.20 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 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	54.6±6%	1.51 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	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)

Certificate No: Z15-97117

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# Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0Ω+2.72jΩ
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

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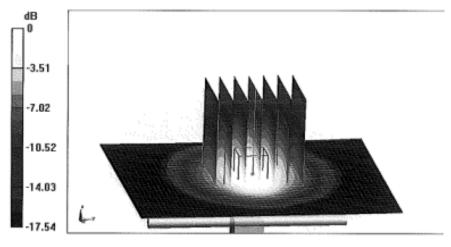
DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China

Date: 09.16.2015

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; εr = 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) ٠

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

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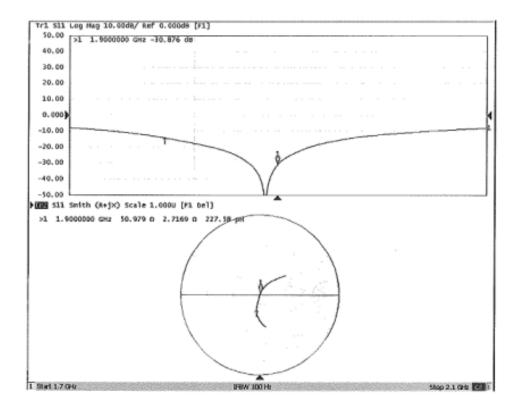


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#### Impedance Measurement Plot for Head TSL



Certificate No: Z15-97117

Page 6 of 8

Statement of Statement Statements	In Collaboration with	
TTL	<u>speag</u>	
	CALIBRATION LABORATORY	

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DASY5 Validation Report for Body TSL

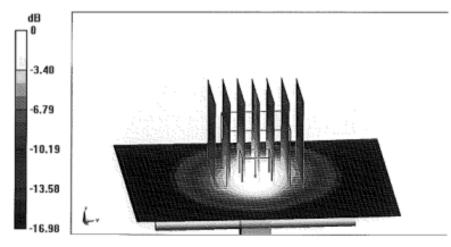
Test Laboratory: CTTL, Beijing, China

Date: 09.16.2015

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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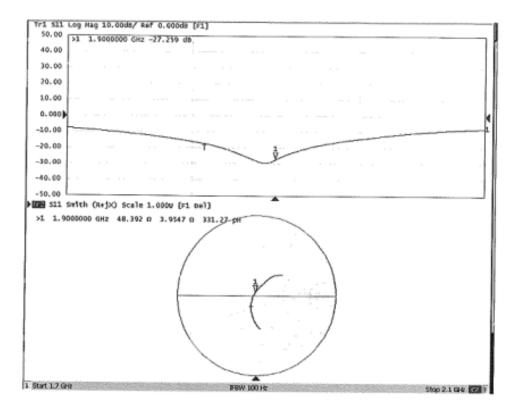


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Impedance Measurement Plot for Body TSL



Certificate No: Z15-97117

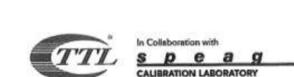
Page 8 of 8

# 6.4. D2450V2 Dipole Calibration Certificate

		ION LABORATORY	ac-MRA	
Add: No.51 Xueyunn Tel: +86-10-6230463 E-mail: ettl@chinattl	3-2079 Fax: +6	rict, Beijing, 100191, China 86-10-62304633-2504 www.chimuttl.cn	Staladalahaha	CALIBRATION No. L0570
Client SMQ		Certificate No: Z	215-97122	an left
CALIBRATION CE	RTIFICAT	E		
Object	D2450V	/2 - SN: 818		
Calibration Procedure(s)		-2-003-01 ion Procedures for dipole validation kits		
Calibration date:	Septem	ber 14, 2015		
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pages and are part of the cer All calibrations have been	rtificate.	the closed laboratory facility: environme	nt temperatu	ire(22±3)℃ ar
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All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	rtificate. conducted in 1 (M&TE critical for ID # 101919 101547 SN 3846 SN 910 ID # MY49071430	the closed laboratory facility: environme or calibration) Cal Date(Calibrated by, Certificate No.) 01-Jul-15 (CTTL, No.J15X04258) 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 J ) S ) J Schedule F F	ed Calibration un-16 un-16 ep-15 un-16 ed Calibration eb-16
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP-Z91 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	rtificate. conducted in 1 (M&TE critical for 101919 101547 SN 3846 SN 910 ID # MY49071430 MY46110673	the closed laboratory facility: environme or calibration) 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 J ) S ) J Schedule F F	ed Calibration un-16 un-16 ep-15 un-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	rtificate. conducted in 1 (M&TE critical fx 101919 101547 SN 3846 SN 910 1D # MY49071430 MY46110673 Name	the closed laboratory facility: environme or calibration) 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) Function	Schedul J J ) S ) J Schedule F F	ed Calibration un-16 un-16 ep-15 un-16 ed Calibration eb-16 eb-16

Certificate No: Z15-97122

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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) 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. ٠ 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	52.8.8.1222
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

	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		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.7 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	6.19 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.

<b>E</b> .	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 cm3 (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 cm3 (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: 215-97122



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#### 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**

1.271 ns	
	1.271 ns

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

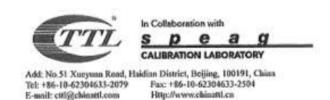
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching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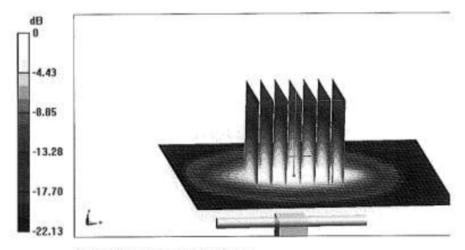


DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China Date: 09.14.2015

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:

- 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)

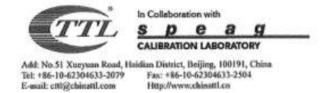
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 108.4 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 27.0 W/kg SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.19 W/kg Maximum value of SAR (measured) = 20.3 W/kg



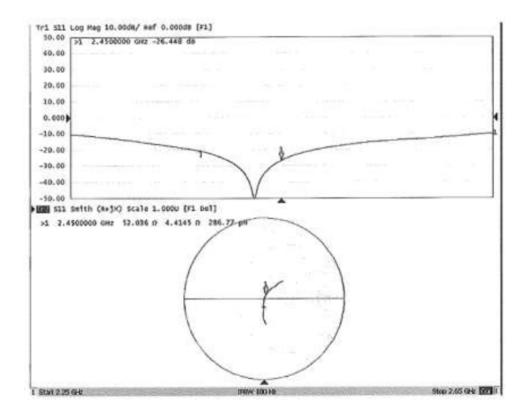
0 dB = 20.3 W/kg = 13.07 dBW/kg

Certificate No: Z15-97122

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Impedance Measurement Plot for Head TSL



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 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;  $v_r = 51.85$ ;  $\rho = 1000$  kg/m<sup>3</sup>

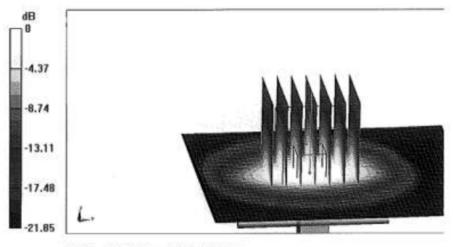
 Phantom section: Left Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

 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

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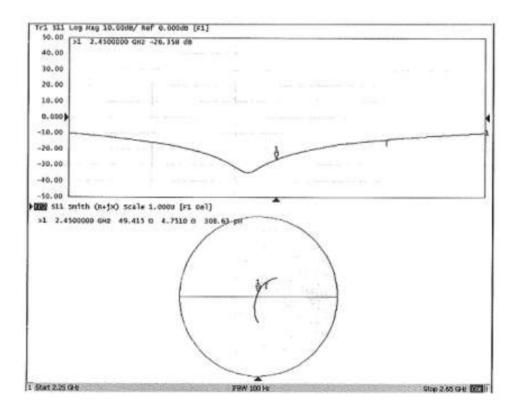


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Impedance Measurement Plot for Body TSL



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# 6.5. DAE4 Calibration Certificate

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eneme :	Q(Shenzhen)		tificate No: Z16-97120	7 7 8
CALIBRATION	CERTIFICA	TE	al - al	- and a faith
Object	DAE	4-SN: 1315 JP462		
Calibration Procedure(s)	FD-Z	11-2-002-01 ration Procedure for the Data x)	Acquisition Electronics	
Calibration date:	July 2	26, 2016		
measurements(SI). The pages and are part of the All calibrations have be humidity<70%. Calibration Equipment us	measurements an e certificate. een conducted ir sed (M&TE critical	•	nce probability are given on	the followin e(22±3)℃ an
Primary Standards	ID# C	al Date(Calibrated by, Certificate	e No.) Scheduled Calil	oration
Process Calibrator 753	1971018	27-June-16 (CTTL, No:J16X0-	4778) June-	17
	Name	Function	Signature	
Calibrated by:	Yu Zongying	SAR Test Engineer	A-TR.	
Reviewed by:	Qi Dianyuan	SAR Project Leader	-202	
Approved by:	Lu Bingsong	Deputy Director of the lal	boratory The 2950	100
			Issued: July 27, 201	6
This calibration certificate	shall not be repr	oduced except in full without wri	tten approval of the laborate	ory.

Certificate No: Z16-97120

Page 1 of 3



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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: Z16-97120

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# **DC Voltage Measurement**

A/D - Converter Resolution nominal

-100...+300 mV

<b>Calibration Factors</b>	x	Y	z
High Range	$405.179 \pm 0.15\%$ (k=2)	405.018 ± 0.15% (k=2)	404.98 ± 0.15% (k=2)
Low Range		3.98549 ± 0.7% (k=2)	3.98861 ± 0.7% (k=2)

# **Connector Angle**

Connector Angle to be used in DASY system	20.5° ± 1 °

Certificate No: Z16-97120

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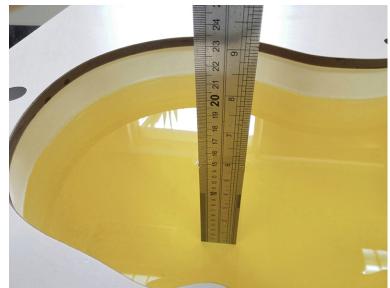
February 24, 2015

Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-CTTL Dual-Logo Calibration Program to Support FCC Equipment Certification

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by CTTL (*China Telecommunication Technology Labs*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and CTTL, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following. The conditions in this KDB are valid until December 31, 2015.

- The agreement established between SPEAG and CTTL is only applicable to calibration services performed by CTTL where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. CTTL shall inform the FCC of any changes or early termination to the agreement.
- Only a subset of the calibration services specified in the SPEAG-CTTL agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
  - Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
    - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by CTTL, are excluded and cannot be used for measurements to support FCC equipment certification.
    - Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics or probe sensor model based linearization methods that are not fully described in SAR standards are excluded and cannot be used for measurements to support FCC equipment certification.
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the CTTL QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by CTTL. Equivalent test equipment and measurement configurations may be considered only when agreed by both SPEAG and the FCC.
  - The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 systems or higher version systems that satisfy the requirements of this KDB.
- The SPEAG-CTTL agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by CTTL under this SPEAG-

# 7. Test Setup Photos



Photograph of the depth in the Head Phantom (835MHz, 15.2cm depth)



Photograph of the depth in the Body Phantom (835MHz, 15.3cm depth)



Photograph of the depth in the Head Phantom (1900MHz, 15.1cm depth)



Photograph of the depth in the Body Phantom (1900MHz, 15.3cm depth)



Photograph of the depth in the Head Phantom (2450MHz, 15.2cm depth)



Photograph of the depth in the Body Phantom (2450MHz, 15.4cm depth)



Left Hand Cheek Position



Left Hand Tilt 15 Degree Position



**Right Hand Cheek Position** 



Right Hand Tilt 15 Degree Position



Test Position 1 - Body-worn, the rear side of the EUT towards phantom (The distance was 0mm)



Test Position 2 - Body-worn, the left side of the EUT towards ground (The distance was 0mm)



Test Position 3 - Body-worn, the right side of the EUT towards ground (The distance was 0mm)



Test Position 4 - Body-worn, the top side of the EUT towards ground (The distance was 0mm)



Test Position 5 - Body-worn, the bottom side of the EUT towards ground (The distance was 0mm)

# 8. External Photos of the EUT





.....End of Report.....