APPENDIX D: RELEVANT PAGES FROM DAE& DIPOLE VALIDATION KIT REPORT(S)

Add: No.51 Xneyus Tel: +86-10-623046 E-mail: cttl@chinat	33-2079 Fax	District, Beijing, 100191, Chin c: +86-10-62304633-2504 p://www.chinattl.cn	a Mandalaha	CALIBRAT CNAS LOS	0.00
Client SMC	2	(Certificate No:	Z20-60037	
CALIBRATION CI	RTIFICA	ATE	STATE SA		
Object	D750	0V3 - SN: 1103			
Calibration Procedure(s)	FF-Z	11-003-01			
	Calib	pration Procedures for d	ipole validation kits	1	
Calibration date:	January 6, 2020				
	asurements a		and the state of the state of the state	h realize the physical units bility are given on the follow	
All calibrations have been humidity<70%.	conducted i	n the closed laborator	ry facility: environ	ment temperature(22±3)で a	and
Calibration Equipment used	(M&TE critica	al for calibration)			
Primary Standards	ID #	Cal Date(Calibrate	d by, Certificate No	o.) Scheduled Calibratic	'n
Power Meter NRP2	106276	11-Apr-19 (CTTL, N	lo.J19X02605)	Apr-20	
Power sensor NRP6A	101369	11-Apr-19 (CTTL, N	lo.J19X02605)	Apr-20	
Deferre Debe EVODUA	ON ODAT	DE LOS ED/CDEAC	V- EVO DOLT IN	101	

In Collaboration with

e

CALIBRATION LABORATORY

а

p

s

TTL

Fower meter INRF2	100270	11-Abi-19 (0111, NO.018A02000)	Abt-20
Power sensor NRP6A	101369	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1555	22-Aug-19(CTTL-SPEAG,No.Z19-60295)	Aug-20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No. J19X00547)	Jan-20
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	St.
Reviewed by:	Lin Hao	SAR Test Engineer	#35
Approved by:	Qi Dianyuan	SAR Project Leader	Thors
		그는 아파는 그는 그는 것 같은 것은 것은 것을 하는 것을 하는 것을 하는 것 같은 것을 가지 않는 것을 했다. 것을 것 같은 것을 하는 것을 했다.	uary 9, 2020
This calibration certificate sl	hall not be repro-	duced except in full without written approva	l of the laboratory.

Certificate No: Z20-60037

Page 1 of 8

中国认可国际互认

炒准



Add: No.51 Xueyunn Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / 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%.

Certificate No: Z20-60037

Page 2 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: =86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.en

Measurement Conditions

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

DASY Version	DASY52	V52.10.3
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	41.6±6%	0.90 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	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.66 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.83 W/kg ± 18.7 % (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 %	0.97 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		2

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.64 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.82 W/kg ±18.7 % (k=2)

Certificate No: Z20-60037

Page 3 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9Ω- 2.67jΩ
Return Loss	- 26.8dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5Ω- 3.66jΩ	
Return Loss	- 28.6dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	0.896 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	

Certificate No: Z20-60037

Page 4 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Date: 01.06.2020

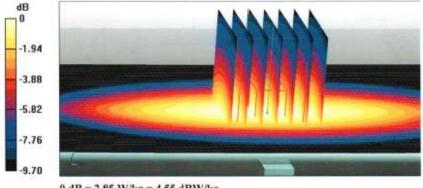
Test Laboratory: CTTL, Beijing, China **DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1103** Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; σ = 0.902 S/m; ε_r = 41.63; ρ = 1000 kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(10.03, 10.03, 10.03) @ 750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 57.43 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 3.16 W/kg SAR(1 g) = 2.19 W/kg; SAR(10 g) = 1.47 W/kg Smallest distance from peaks to all points 3 dB below = 23.3 mm Ratio of SAR at M2 to SAR at M1 = 69.4% Maximum value of SAR (measured) = 2.85 W/kg



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

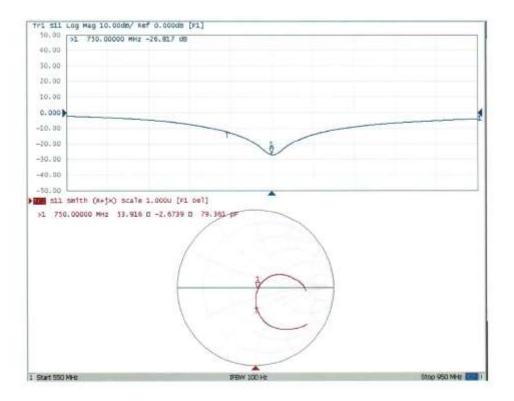
Certificate No: Z20-60037

Page 5 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z20-60037

Page 6 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1103

Date: 01.03.2020

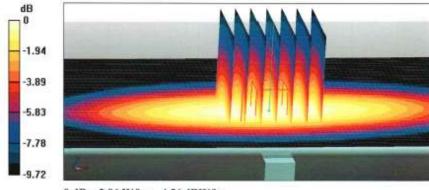
DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1103 Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; σ = 0.965 S/m; ε_r = 55.21; ρ = 1000 kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(9.85, 9.85, 9.85) @ 750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 49.46 V/m; Power Drift = 0.08 dB Peak SAR (extrapolated) = 3.20 W/kg SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.46 W/kg Smallest distance from peaks to all points 3 dB below = 19.2 mm Ratio of SAR at M2 to SAR at M1 = 68.3% Maximum value of SAR (measured) = 2.86 W/kg



0 dB = 2.86 W/kg = 4.56 dBW/kg

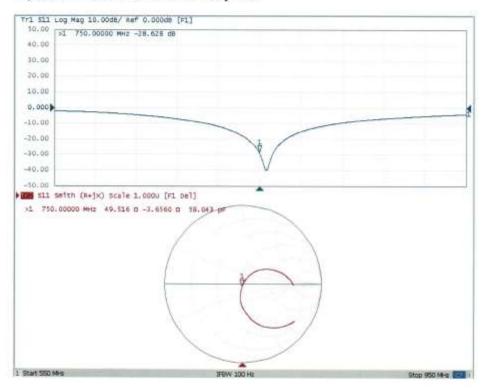
Certificate No: Z20-60037

Page 7 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



Certificate No: Z20-60037

Page 8 of 8

	m Road, Haidian Dis	trion Laboratory trion Laboratory	CALIBRATION
Tel: +86-10-623046 E-mail: cttl@chinat		*86-10-62304633-2504 "44/14/14/14	CNAS L0570
Client SMQ		Certificate No: Z1	8-60333
CALIBRATION CI	ERTIFICAT	'E	
Object	D835V	2 - SN: 4d141	
Calibration Procedure(s)	43.666666	-003-01 tion Procedures for dipole validation kits	
Calibration date:	Septer	nber 6, 2018	
	asurements and	traceability to national standards, which rea the uncertainties with confidence probability	
All calibrations have been humidity<70%.	conducted in	the closed laboratory facility: environment	temperature(22±3) ¹ C and
Calibration Equipment used	(M&TE critical f	or calibration)	
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	「
Reviewed by:	Lin Hao	SAR Test Engineer	林光
Approved by:	Qi Dianyuan	SAR Project Leader	200g/
		Issued: Sente	mber 9, 2018
This calibration certificate sh	all not be reproc	luced except in full without written approval o	

Certificate No: Z18-60333

Page 1 of 8



Add: No.51 Xuoyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ethlig-chinant.com http://www.chinasti.cu

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%.

Certificate No: Z18-60333

Page 2 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
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	

 \boldsymbol{g}

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	42.7 ± 6 %	0.90 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	2.32 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.31 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.13 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	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	56.0 ± 6 %	1.00 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	2.48 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.74 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.66 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.54 mW /g ± 18.7 % (k=2)

Certificate No: Z18-60333

Page 3 of 8



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

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.3Ω- 5.68jΩ	
Return Loss	- 24.9dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8Ω- 7.52jΩ		
Return Loss	- 21.5dB		

General Antenna Parameters and Design

	Electrical Delay (one direction)	1.255 ns
l	crossing four anadimy	naoo ne

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: Z18-60333

Page 4 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-muil: ettl@chinattl.com
 http://www.chinattl.en

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

Date: 09.04.2018

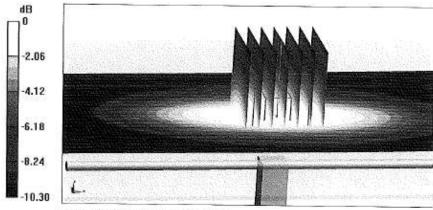
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; $\sigma = 0.904$ S/m; $\varepsilon_f = 42.71$; $\rho = 1000$ kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(10.28, 10.28, 10.28) @ 835 MHz; Calibrated: 9/12/2017
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 57.01 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.49 W/kg SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.53 W/kg Maximum value of SAR (measured) = 3.10 W/kg



0 dB = 3.10 W/kg = 4.91 dBW/kg

Certificate No: Z18-60333

Page 5 of 8

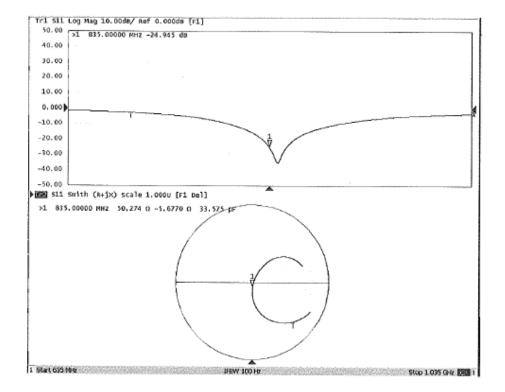


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tek: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

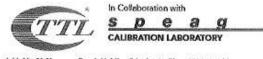
 E-mail: cttl@chinattl.com
 http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z18-60333

Page 6 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

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

Date: 09.06.2018

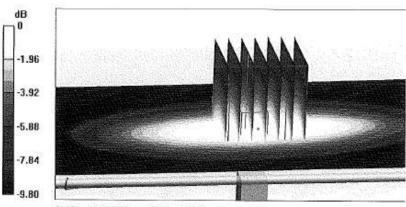
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d141 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; σ = 0.998 S/m; ε_r = 56.04; ρ = 1000 kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(10.21, 10.21, 10.21) @ 835 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

```
Reference Value = 55.80 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.73 W/kg
SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.66 W/kg
Maximum value of SAR (measured) = 3.27 W/kg
```



0 dB = 3.27 W/kg = 5.15 dBW/kg

Certificate No: Z18-60333

Page 7 of 8

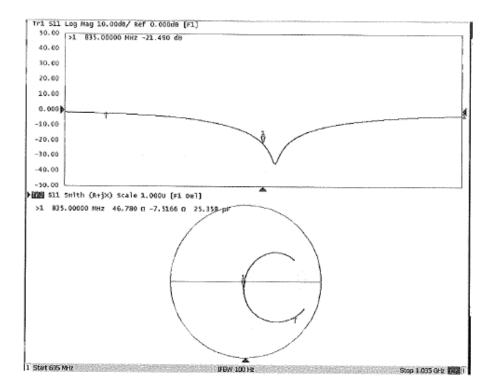


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Body TSL



Certificate No: Z18-60333

Page 8 of 8

Add: No.51 Xueyuar Tel: +86-10-6230463 E-mail: ctt@chinatt	n Road, Haidian Dist 3-2079 Fax: +4	ration with C 2 9 TION LABORATORY rict, Beijing, 100191, China 86-10-62304633-2504 www.chinatl.cn	AC-MRA	CNAS	中国认可 国际互认 校准 CALIBRATION CNAS L0570
Client SMQ	and a start of the Second		ertificate No:	Z18-60334	
Olon					
CALIBRATION CE	RIFICAL	E			
Object	D900V2	2 - SN:1d077			
Calibration Procedure(s)	FF-Z11- Calibrat	-003-01 lion Procedures for di	pole validation kits		
Calibration date:	Septem	ber 7, 2018			
This calibration Certificate of measurements(SI). The mea pages and are part of the ce	surements and				
All calibrations have been humidity<70%.	conducted in t	the closed laborator	y facility: environr	ment temperatur	e(22±3) [°] C and
Calibration Equipment used	(M&TE critical fo	or calibration)			
Primary Standards	ID#	Cal Date(Calibrated	d by, Certificate No	.) Schedule	d Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, N	lo.J17X08756)		Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, N	lo.J17X08756)		Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG	No.EX3-7464_Sep	17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG	No.DAE4-1524_Se	ep17)	Sep-18
Secondary Standards	ID#	Cal Date(Calibrated	by. Certificate No.) Schedule	d Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, N			Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, N	,		Jan-19
	Nama	P		0	ohuro
O Photo A have	Name	Function	Shile South a sub-t	Sign	ature
Calibrated by:	Zhao Jing	SAR Test Eng	ineer	1	2
Reviewed by:	Lin Hao	SAR Test Eng	ineer	₩ 11	ЖD
Approved by:	Qi Dianyuan	SAR Project I	.eader	Sill	AZ
			Issued:	September 10, 2	018
This calibration certificate sh	all not be repro-	duced except in full w	ithout written appro	oval of the labora	tory.

Certificate No: Z18-60334

Page 1 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: ettl@chinattl.com
 http://www.chinattl.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, "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%.

Certificate No: Z18-60334

Page 2 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Measurement Conditions

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

DASY Version	DASY52	52.10.1.1446
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	900 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	0.97 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.7 ± 6 %	0.97 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	2.69 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	10.9 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.74 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	7.01 mW /g ± 18.7 % (k=2)

Body TSL parameters The following parameters and calculations were applied.

	-	Conductivity
22.0 °C	55.0	1.05 mho/m
(22.0 ± 0.2) °C	55.5 ± 6 %	1.07 mho/m ± 6 %
<1.0 °C		
	(22.0 ± 0.2) °C	(22.0 ± 0.2) °C 55.5 ± 6 %

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.85 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	11.3 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.87 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	7.40 mW /g ± 18.7 % (k=2)

Certificate No: Z18-60334

Page 3 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: ett@chinattl.com
 http://www.chinattl.en

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.6Ω- 5.66jΩ	
Return Loss	- 24.6dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.5Ω- 7.00jΩ
Return Loss	- 21.2dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.274 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

- 1		
	Manufactured by	SPEAG
- 1		

Certificate No: Z18-60334

Page 4 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: cttl@chinattLcom
 http://www.chinattLca

Date: 09.07.2018

Test Laboratory: CTTL, Beijing, China

DASY5 Validation Report for Head TSL

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d077 Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 900 MHz; $\sigma = 0.966$ S/m; $\epsilon_r = 42.67$; $\rho = 1000$ kg/m3 Phantom section: Right Section

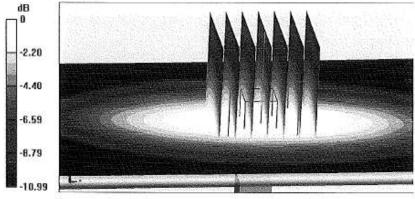
DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(10.03, 10.03, 10.03) @ 900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 59.93 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 4.14 W/kg SAR(1 g) = 2.69 W/kg; SAR(10 g) = 1.74 W/kg

Maximum value of SAR (measured) = 3.65 W/kg



0 dB = 3.65 W/kg = 5.62 dBW/kg

Certificate No: Z18-60334

Page 5 of 8

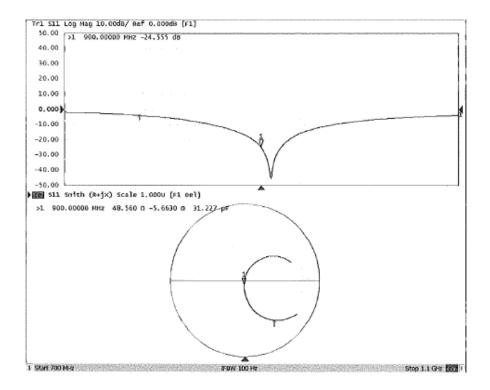


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Head TSL



Certificate No: Z18-60334

Page 6 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

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

Date: 09.06.2018

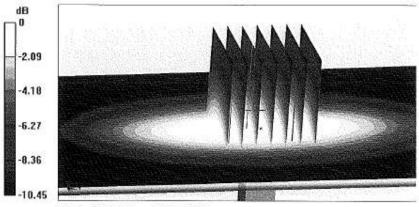
DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d077 Communication System: UID 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 900 MHz; $\sigma = 1.071$ S/m; $\varepsilon_t = 55.51$; $\rho = 1000$ kg/m3 Phantom section: Left Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(10.17, 10.17, 10.17) @ 900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

Reference Value = 58.25 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 4.35 W/kg SAR(1 g) = 2.85 W/kg; SAR(10 g) = 1.87 W/kg Maximum value of SAR (measured) = 3.82 W/kg



0 dB = 3.82 W/kg = 5.82 dBW/kg

Certificate No: Z18-60334

Page 7 of 8

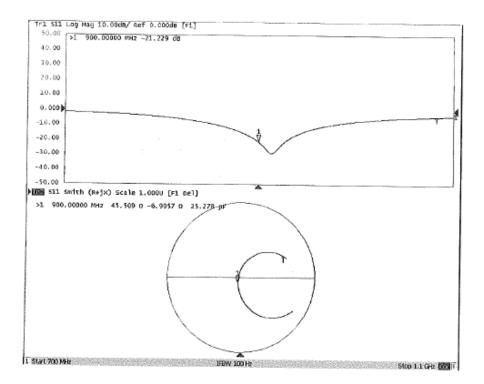


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Body TSL



Certificate No: Z18-60334

Page 8 of 8

TI	<u>L</u> sp	TON LABORATORY	中国认可国际互认
Add: No.51 Xueyua Tel: +86-10-623046 E-mail: cttl@chinat	n Road, Haidian Dist 33-2079 Fax: +	rict, Beijing, 100191, China 86-10-62304633-2504 www.chinattl.co	大人名 CALIBRATION CNAS L0570
Client SMQ		Certificate No: Z2	20-60038
CALIBRATION CE	ERTIFICAT	E	
Object	D1750	/2 - SN: 1108	
Calibration Procedure(s)			
A.9	FF-Z11	-003-01 tion Procedures for dipole validation kits	
	Ganora	ton Procedures for upple validation kits	
Calibration date:	January	/ 3, 2020	
pages and are part of the ce	rtificate. conducted in	the uncertainties with confidence probability the closed laboratory facility: environmer or calibration)	
Primary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106276	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
Power sensor NRP6A	101369	11-Apr-19 (CTTL, No.J19X02605)	Apr-20
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1555	22-Aug-19(CTTL-SPEAG,No.Z19-60295)	Aug-20
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20
	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	A. A.
Reviewed by:	Lin Hao	SAR Test Engineer	134
Approved by:	Qi Dianyuan	SAR Project Leader	Stop J
This calibration certificate sh	nall not be reproc	Issued: Jan duced except in full without written approval	nuary 8, 2020 I of the laboratory.

Certificate No: Z20-60038

Page 1 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / 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%.

Certificate No: Z20-60038

Page 2 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: ettl@chinattl.com
 http://www.chinattl.en

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

DASY Version	DASY52	V52.10.3
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 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	1.000	

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	35.7 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.8 W/kg ± 18.7 % (k=2)

Body TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	1.50 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		-

SAR result with Body TSL

SAR for nominal Body TSL parameters	normalized to 1W	19.5 W/kg ± 18.7 % (k=2)
SAR measured	250 mW input power	4.89 W/kg
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR for nominal Body TSL parameters	normalized to 1W	36.8 W/kg ± 18.8 % (k=2)
SAR measured	250 mW input power	9.23 W/kg
SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	

Certificate No: Z20-60038

Page 3 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.2Ω- 0.65 jΩ	
Return Loss	- 39.7 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8Ω- 1.02 jΩ	
Return Loss	- 26.8 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.084 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

Page 4 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

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

Date: 01.03.2020

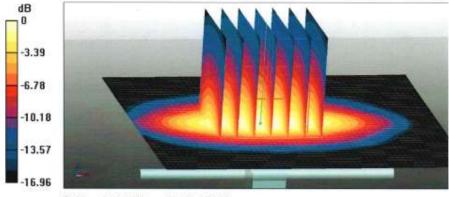
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1108 Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz; σ = 1.365 S/m; ε_r = 40.52; ρ = 1000 kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.38, 8.38, 8.38) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 97.57 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 16.7 W/kg SAR(1 g) = 8.89 W/kg; SAR(10 g) = 4.69 W/kg Smallest distance from peaks to all points 3 dB below = 10 mm Ratio of SAR at M2 to SAR at M1 = 54% Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

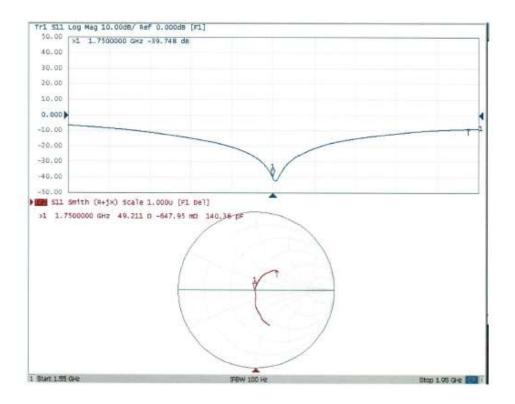
Certificate No: Z20-60038

Page 5 of 8



Add: No.51 Xueyuaa Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z20-60038

Page 6 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Test Laboratory: CTTL, Beijing, China DUT: Dipole 1750 MHz; Type: D1750V2; Seria

Date: 01.03.2020

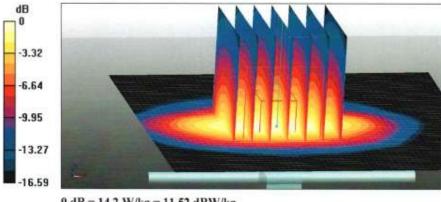
DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1108 Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz; σ = 1.499 S/m; ε_r = 53.62; ρ = 1000 kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.03, 8.03, 8.03) @ 1750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 89.57 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 16.8 W/kg SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.89 W/kg Smallest distance from peaks to all points 3 dB below = 9.2 mm Ratio of SAR at M2 to SAR at M1 = 55.7% Maximum value of SAR (measured) = 14.2 W/kg



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

Certificate No: Z20-60038

Page 7 of 8

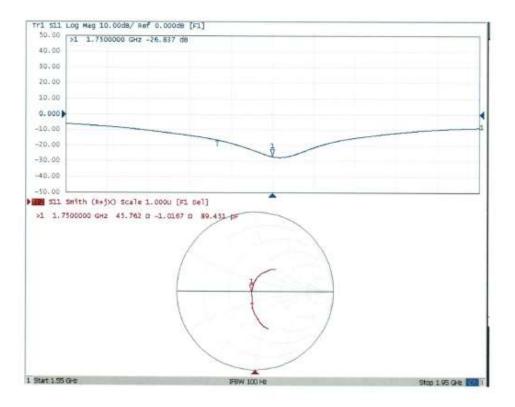


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Body TSL



Page 8 of 8

	T sp		中国认可国际互认
Add: No.51 Xueyun Tel: +86-10-623046 E-mail: ett/@chinat Client SMC	33-2079 Fax: # 1.com http://	rict, Beijing, 100191, China 86-10-62304633-2504 www.chinattLen	CALIBRATIO CNAS L0570 18-60335
CALIBRATION CE	RTIFICAT	E	
Object	D1800\	/2 - SN: 2d171	
Calibration Procedure(s)	FF-Z11- Calibrat	-003-01 tion Procedures for dipole validation kits	
Calibration date:	Septem	ber 12, 2018	
pages and are part of the ce	rtificate.	the uncertainties with confidence probability	
All calibrations have been humidity<70%. Calibration Equipment used		the closed laboratory facility: environment	t temperature(22±3) C and
humidity<70%. Calibration Equipment used		or calibration)	
humidity<70%. Calibration Equipment used	(M&TE critical fo		Scheduled Calibration Oct-18 Oct-18 Jan-19 Dec-18
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4	(M&TE critical fo ID # 102083 100542 SN 3846	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 25-Jan-18(SPEAG,No.EX3-3846_Jan18)	Scheduled Calibration Oct-18 Oct-18 Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4	(M&TE critical fo ID # 102083 100542 SN 3846 SN 777	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 25-Jan-18(SPEAG,No.EX3-3846_Jan18) 15-Dec-17(SPEAG,No.DAE4-777_Dec17	Scheduled Calibration Oct-18 Oct-18 Jan-19 Dec-18
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 102083 100542 SN 3846 SN 777 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 25-Jan-18(SPEAG,No.EX3-3846_Jan18) 15-Dec-17(SPEAG,No.DAE4-777_Dec17 Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560)	Scheduled Calibration Oct-18 Oct-18 Jan-19 Dec-18 Scheduled Calibration Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 102083 100542 SN 3846 SN 777 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 25-Jan-18(SPEAG,No.EX3-3846_Jan18) 15-Dec-17(SPEAG,No.DAE4-777_Dec17 Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Jan-19 Dec-18 Scheduled Calibration Jan-19 Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	(M&TE critical fe ID # 102083 100542 SN 3846 SN 777 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 25-Jan-18(SPEAG,No.EX3-3846_Jan18) 15-Dec-17(SPEAG,No.DAE4-777_Dec17 Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function	Scheduled Calibration Oct-18 Oct-18 Jan-19 Dec-18 Scheduled Calibration Jan-19 Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	(M&TE critical fe ID # 102083 100542 SN 3846 SN 777 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 25-Jan-18(SPEAG,No.EX3-3846_Jan18) 15-Dec-17(SPEAG,No.DAE4-777_Dec17 Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer	Scheduled Calibration Oct-18 Oct-18 Jan-19 Dec-18 Scheduled Calibration Jan-19 Jan-19

Certificate No: Z18-60335

Page 1 of 8



Add: No.51 Xueyunn Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / 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%.

Certificate No: Z18-60335

Page 2 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Measurement Conditions

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

DASY Version	DASY52	52.10.1.1446
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	1800 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	40.6 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	1000	

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	9.77 mW / g	
SAR for nominal Head TSL parameters	normalized to 1W	39.4 mW /g ± 18.8 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.19 mW / g	
SAR for nominal Head TSL parameters	normalized to 1W	20.9 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	1.56 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	10.0 mW / g	
SAR for nominal Body TSL parameters	normalized to 1W	39.3 mW /g ± 18.8 % (k=2	
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition		
SAR measured	250 mW input power 5.38 mW / g		
SAR for nominal Body TSL parameters	normalized to 1W	21.3 mW /g ± 18.7 % (k=2)	

Certificate No: Z18-60335



Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.0Ω- 2.88jΩ		
Return Loss	- 30.3dB		

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.8Ω- 2.77jΩ	
Return Loss	- 24.1dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.075 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

Certificate No: Z18-60335

Page 4 of 8



Add: No.51 Xuoyuan Road, Haidian District, Ileijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

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

Date: 09.12.2018

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d171 Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1800 MHz; σ = 1.39 S/m; ε_r = 40.63; ρ = 1000 kg/m3 Phantom section: Center Section

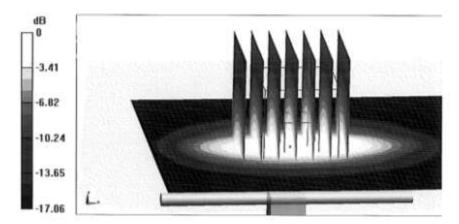
DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(8.22, 8.22, 8.22) @ 1800 MHz; Calibrated: 1/25/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 12/15/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

Reference Value = 99.67 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 18.2 W/kg

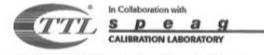
SAR(1 g) = 9.77 W/kg; SAR(10 g) = 5.19 W/kg Maximum value of SAR (measured) = 15.1 W/kg



0 dB = 15.1 W/kg = 11.79 dBW/kg

Certificate No: Z18-60335

Page 5 of 8

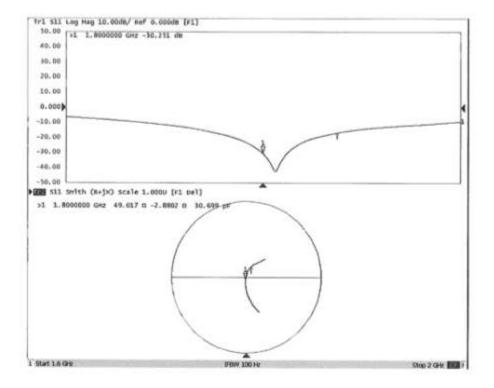


 Add: No.51 Xueyuan Road, Haidinn District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Head TSL



Certificate No: Z18-60335

Page 6 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

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

Date: 09.12.2018

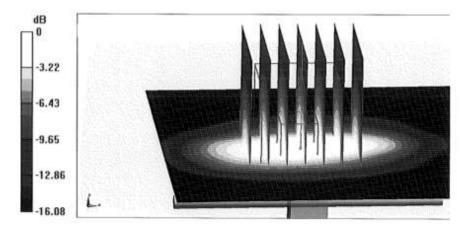
DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d171 Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1800 MHz; $\sigma = 1.56$ S/m; $\varepsilon_r = 53.15$; $\rho = 1000$ kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(7.73, 7.73, 7.73) @ 1800 MHz; Calibrated: 1/25/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 12/15/2017
- Phantom: MFP_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 92.91 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 17.9 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.38 W/kg

Maximum value of SAR (measured) = 15.2 W/kg



0 dB = 15.2 W/kg = 11.82 dBW/kg

Certificate No: Z18-60335

Page 7 of 8

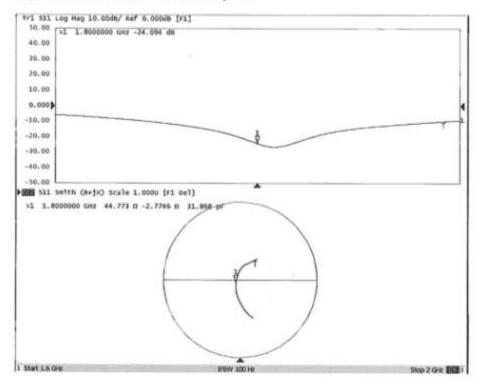


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, Chinn

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Body TSL



Certificate No: Z18-60335

Page 8 of 8

	S D	e a g	中国认可国际互认
	Allowed Management Const	TION LABORATORY	NASta
Add: No.51 Xueyu Tel: +86-10-623046 E-mail: cttl@chinat	533-2079 Fax: 4	trict, Beijing, 100191, China 86-10-62304633-2504 www.chinattl.cn	CALIBRATION CNAS L0570
Client SMC	2	Certificate No: Z1	8-60336
CALIBRATION CI	ERTIFICAT	E	
Object	D1900	V2 - SN: 5d162	
Calibration Procedure(s)			
	0.0.000000	-003-01	
	Calibra	tion Procedures for dipole validation kits	
Calibration date:	Septen	nber 11, 2018	
pages and are part of the ce	artificate.	the uncertainties with confidence probability the closed laboratory facility: environment	
Calibration Equipment used	(M&TE critical for	or calibration)	
	(M&TE critical fo		Scheduled Calibration
Calibration Equipment used		Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18
Calibration Equipment used Primary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	
Calibration Equipment used Primary Standards Power Meter NRVD	ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25	ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756)	Oct-18 Oct-18 Sep-18
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4	ID # 102083 100542 SN 7464	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Oct-18 Oct-18 Sep-18 Sep-18
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4	ID # 102083 100542 SN 7464 SN 1524	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Oct-18 Oct-18 Sep-18
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards	ID # 102083 100542 SN 7464 SN 1524 ID #	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.)	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560)	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C Calibrated by:	ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration Jan-19 Jan-19
Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C Calibrated by: Reviewed by:	ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY46110673 Name Zhao Jing Lin Jun	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17 (SPEAG,No.EX3-7464_Sep17) 13-Sep-17 (SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer SAR Test Engineer SAR Test Engineer	Oct-18 Oct-18 Sep-18 Sep-18 Scheduled Calibration Jan-19 Jan-19

Certificate No: Z18-60336

Page 1 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: etti@chinattl.com http://www.chinattl.cn

lossary:

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%.

Certificate No: Z18-60336

Page 2 of #



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
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	40.4 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature change during test	<1.0 *C		

SAR result with Head TSL

SAR measured SAR for nominal Head TSL parameters	250 mW input power normalized to 1W	5.33 mW / g 21.1 mW /g ± 18.7 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	39.8 mW /g ± 18.8 % (k=2)
SAR measured	250 mW input power	10.1 mW / g
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	

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	53.3 ± 6 %	1.49 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	9.97 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.3 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.38 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.7 mW /g ± 18.7 % (k=2)

Certificate No: Z18-60336



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattLcom http://www.chinattLcn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0Ω+ 5.00jΩ	
Return Loss	- 24.2dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4Ω+ 5.03jΩ	
Return Loss	- 25.4dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.061 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
-----------------	-------

Page 4 of 8



Add: No.51 Xueyum Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

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

Date: 09.10.2018

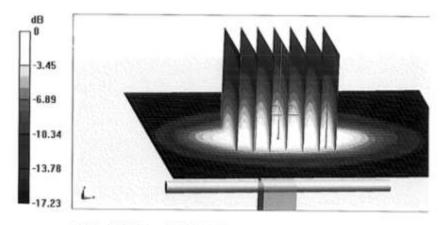
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.438 S/m; e_z = 40.37; ρ = 1000 kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(8.39, 8.39, 8.39) @ 1900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

System Performance Check/Zoom Sean (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 97.60 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.33 W/kg Maximum value of SAR (measured) = 15.8 W/kg



0 dB = 15.8 W/kg = 11.99 dBW/kg

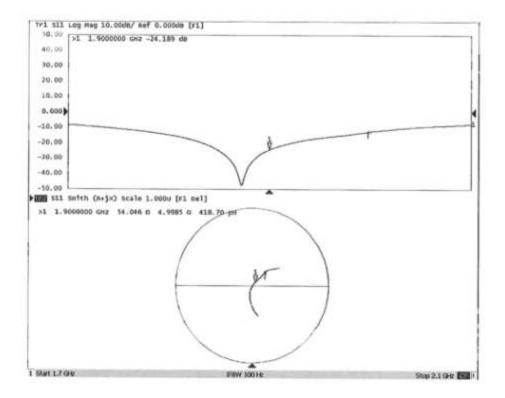
Certificate No: Z18-60336

Page 5 of 8



Add: No.51 Xueyuan Road, Haidinn District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z18-60336

Page 6 of 8



Add: No.51 Xueyunn Road, Haidian District, Beijing, 100191, Chinn Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattLcom http://www.chinattLcn

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

Date: 09.10.2018

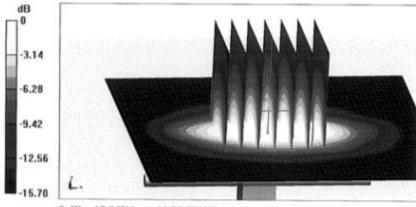
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.493 S/m; ε_e = 53.34; ρ = 1000 kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(8.32, 8.32, 8.32) @ 1900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439))

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.26 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 17.5 W/kg SAR(1 g) = 9.97 W/kg; SAR(10 g) = 5.38 W/kg

Maximum value of SAR (measured) = 15.0 W/kg



0 dB = 15.0 W/kg = 11.76 dBW/kg

Certificate No: Z18-60336

Page 7 of 8

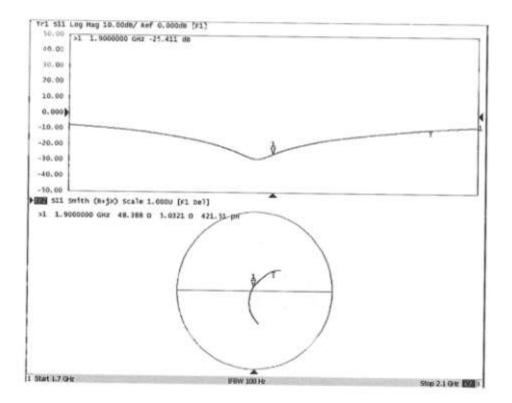


 Add: No.51 Xucyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Body TSL



Certificate No: Z18-60336

Page 8 of 8

	Road, Haidian Dist		CALIBRATION
Tel: +86-10-623046 E-mail: cttlijichinatt		66-10-62304633-2504	CNAS L0570
Client SMQ		Certificate No: Z	20-60039
CALIBRATION CE	RTIFICAT	E	
Object	D2300V	/2 - SN: 1034	
Calibration Procedure(s)	FE 744	000.04	
	FF-Z11- Calibrat	ion Procedures for dipole validation kits	
Calibration date:			
valioration date:	January	2, 2020	
pages and are part of the ce	rtificate.		
All calibrations have been humidity<70%. Calibration Equipment used Primary Standards		the closed laboratory facility: environmen or calibration) Cal Date(Calibrated by, Certificate No.)	t temperature(22±3)10 and Scheduled Calibration
humidity<70%. Calibration Equipment used	(M&TE critical fo	or calibration)	\$2
humidity<70%. Calibration Equipment used Primary Standards	(M&TE critical fo	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	(M&TE critical fc ID # 106276	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605)	Scheduled Calibration Apr-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	(M&TE critical fc ID # 106276 101369	Calibration) Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605)	Scheduled Calibration Apr-20 Apr-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	(M&TE critical fc ID # 106276 101369 SN 3617	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG, No.EX3-3617_Jan19)	Scheduled Calibration Apr-20 Apr-20 Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG, No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG, No.Z19-60295)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID #	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG, No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG, No.Z19-60295) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fc ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 32-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20

Certificate No: Z20-60039

Page 1 of 8



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

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

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%.

Certificate No: Z20-60039

Page 2 of 8



In Collaboration with



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Measurement Conditions

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

DASY Version	DASY52	V52.10.3
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	2300 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.3±6%	1,64 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	11.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	47.5 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

· · · · · · · · · · · · · · · · · · ·	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3±6%	1.83 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	12.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	47.6 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.70 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.7 W/kg ± 18.7 % (k=2)

Certificate No: Z20-60039

Page 3 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.4Ω- 3.16jΩ	
Return Loss	- 28.8dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.4Ω- 2.69jΩ	
Return Loss	- 25.1dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 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
-----------------	-------

Page 4 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

Date: 01.02.2020

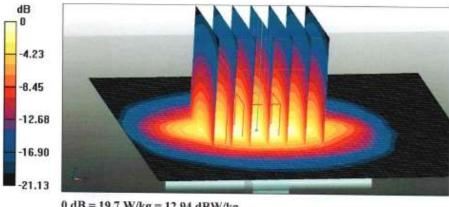
DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1034 Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2300 MHz; $\sigma = 1.644 \text{ S/m}$; $\varepsilon_r = 39.26$; $\rho = 1000 \text{ kg/m3}$ Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.74, 7.74, 7.74) @ 2300 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 101.4 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 24.4 W/kg SAR(1 g) = 11.8 W/kg; SAR(10 g) = 5.57 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 48.7% Maximum value of SAR (measured) = 19.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

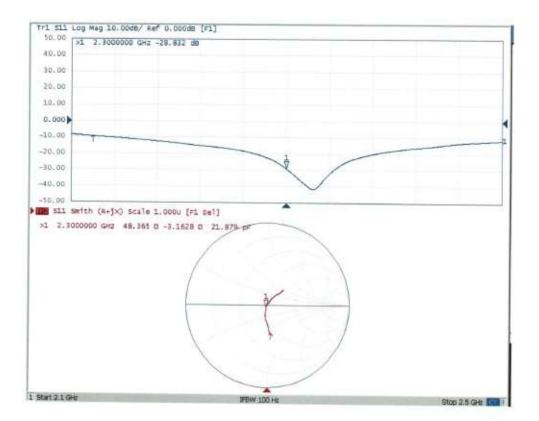
Certificate No: Z20-60039

Page 5 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z20-60039

Page 6 of 8



Add: No.51 Xaryuan Koad, Haddan District, Beijing, 100191, U Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL

Date: 01.02.2020

Test Laboratory: CTTL, Beijing, China DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1034

Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2300 MHz; $\sigma = 1.828$ S/m; $\epsilon_r = 52.26$; $\rho = 1000$ kg/m3 Phantom section: Right Section

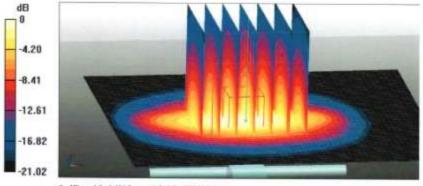
DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.84, 7.84, 7.84) @ 2300 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 98.06 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 23.9 W/kg

SAR(1 g) = 12 W/kg; SAR(10 g) = 5.7 W/kg Smallest distance from peaks to all points 3 dB below = 8.2 mm Ratio of SAR at M2 to SAR at M1 = 51.1% Maximum value of SAR (measured) = 19.6 W/kg



0 dB = 19.6 W/kg = 12.92 dBW/kg

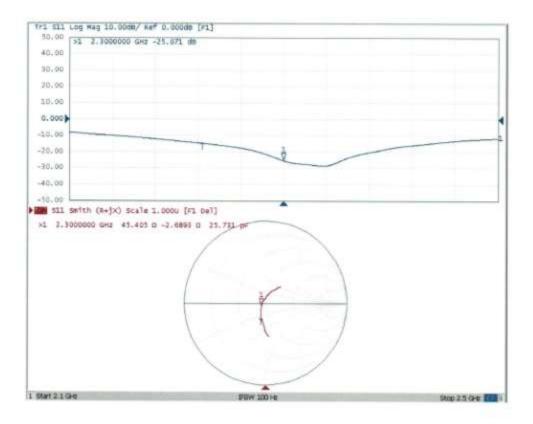
Certificate No: Z20-60039

Page 7 of 8



Add: No.51 Xueyuan Roud, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattLcom http://www.chinattLcn

Impedance Measurement Plot for Body TSL



Certificate No: Z20-60039

Page 8 of 8

Statement M. M.	<u>s</u> p	e a g	国际互认
	CALIBRAT	NON LABORATORY	NAStat
Add: No.51 Xuryuz Tel: +86-10-623046 E-mail: cttl@chinat	33-2079 Fax: +	rict, Beijing, 100191, China 86-10-62304633-2504 www.chinattl.cn	CALIBRATION CNAS L0570
Client SMQ		Certificate No: Z	18-60338
CALIBRATION CI	ERTIFICAT	E	
Object	D2450\	/2 - SN: 818	
Calibration Procedure(s)	FF 744	002.04	
	FF-Z11 Calibra	-003-01 tion Procedures for dipole validation kits	
0.10.11.11			
Calibration date:	August	31, 2018	
measurements(SI). The me pages and are part of the ce	asurements and intificate.	traceability to national standards, which re the uncertainties with confidence probability	are given on the following
All calibrations have been humidity<70%. Calibration Equipment used		the closed laboratory facility: environmen or calibration)	t temperature(22±3)°C and
humidity<70%.			t temperature(22±3)°C and Scheduled Calibration
humidity<70%. Calibration Equipment used	(M&TE critical fo	or calibration)	
humidity<70%. Calibration Equipment used Primary Standards	(M&TE critical fo	or calibration) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD	(M&TE critical fo ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-25	(M&TE critical fo ID # 102083 100542	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756)	Scheduled Calibration Oct-18 Oct-18 Sep-18
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4	(M&TE critical fo ID # 102083 100542 SN 7464	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Scheduled Calibration Oct-18 Oct-18 Sep-18
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4	(M&TE critical fo ID # 102083 100542 SN 7464 SN 1524	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards	(M&TE critical fo ID # 102083 100542 SN 7464 SN 1524 ID #	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18 Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560)	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18 Scheduled Calibration Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	(M&TE critical fe ID # 102083 100542 SN 7484 SN 1524 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17 Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561)	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18 Scheduled Calibration Jan-19 Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fe ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY4910673 Name	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18 Scheduled Calibration Jan-19 Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	(M&TE critical fe ID # 102083 100542 SN 7464 SN 1524 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18 Scheduled Calibration Jan-19 Jan-19
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C Calibrated by: Reviewed by:	(M&TE critical fe ID # 102083 100542 SN 7484 SN 1524 ID # MY49071430 MY46110673 Name Zhao Jing Lin Hao	Cal Date(Calibrated by, Certificate No.) 01-Nov-17 (CTTL, No.J17X08756) 01-Nov-17 (CTTL, No.J17X08756) 12-Sep-17(SPEAG,No.EX3-7464_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) 13-Sep-17(SPEAG,No.DAE4-1524_Sep17) Cal Date(Calibrated by, Certificate No.) 23-Jan-18 (CTTL, No.J18X00560) 24-Jan-18 (CTTL, No.J18X00561) Function SAR Test Engineer SAR Test Engineer	Scheduled Calibration Oct-18 Oct-18 Sep-18) Sep-18 Scheduled Calibration Jan-19 Jan-19

Certificate No: Z18-60338

Page 1 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / 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%.

Certificate No: Z18-60338

Page 2 of 8



In Collaboration with

<u>spea</u> g CALIBRATION LABORATORY

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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Measurement Conditions

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

DASY Version	DASY52	52.10.1.1476
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	38.8 ± 6 %	1.80 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	13.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	53.1 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.19 mW/g
SAR for nominal Head TSL parameters	normalized to 1W	24.7 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	1.98 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL

Condition	
250 mW input power	13.0 mW / g
normalized to 1W	51.5 mW /g ± 18.8 % (k=2)
Condition	
250 mW input power	6.13 mW/g
normalized to 1W	24.4 mW /g ± 18.7 % (k=2)
	250 mW input power normalized to 1W Condition 250 mW input power

Certificate No: Z18-60338



Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chimattl.com http://www.chimattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.4Ω+ 3.63jΩ	
Return Loss	- 26.4dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6Ω+ 5.36jΩ	
Return Loss	- 25.4dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.027 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
manufactured by	SPEAG

Certificate No: Z18-60338

Page 4 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

 E-mail: cttl@chinattLeom
 http://www.chinattLeo

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

Date: 08.31.2018

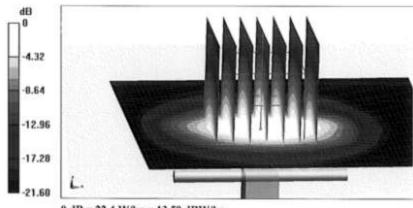
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; σ = 1.802 S/m; ε_e = 38.84; ρ = 1000 kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(7.89, 7.89, 7.89) @ 2450 MHz; Calibrated: 9/12/2017
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

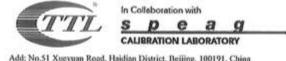
Reference Value = 100.2 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 27.7 W/kg SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.19 W/kg Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 dBW/kg

Certificate No: Z18-60338

Page 5 of 8

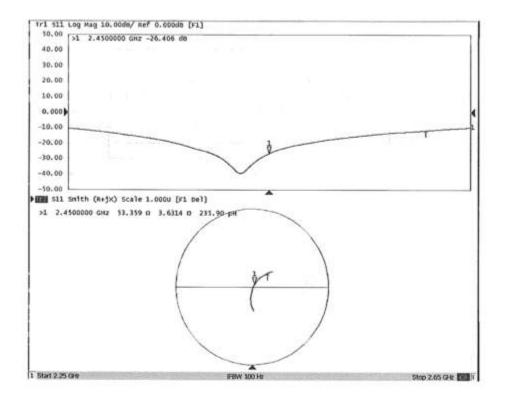


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

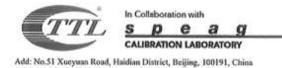
 E-mail: cttl@chinattl.com
 http://www.chinattLcn

Impedance Measurement Plot for Head TSL



Certificate No: Z18-60338

Page 6 of 8



Add: No.51 Xueyuan Road, Haldian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattLcom http://www.chinattLen

DASY5 Validation Report for Body TSL

Date: 08.30.2018

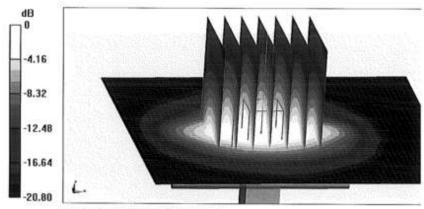
Test Laboratory: CTTL, Beijing, China **DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818** Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; σ = 1.982 S/m; ε_r = 52.34; ρ = 1000 kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(8.09, 8.09, 8.09) @ 2450 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

Reference Value = 98.69 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 26.4 W/kg SAR(1 g) = 13 W/kg; SAR(10 g) = 6.13 W/kg Maximum value of SAR (measured) = 21.4 W/kg



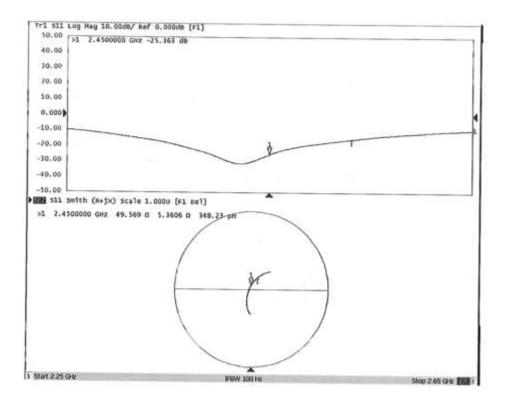
0 dB = 21.4 W/kg = 13.30 dBW/kg

Certificate No: Z18-60338

Page 7 of 8



Impedance Measurement Plot for Body TSL



Page 8 of 8

TT	TSP	e a g	中国认可国际互认
	CALIBRAT	TION LABORATORY	NAS
Add: No.51 Xueyuar Tel: +86-10-6230463 E-mail: ettl@chinattl	3-2079 Fax: +1	rict, Beijing, 100191, China 86-10-62304633-2504 www.chinatti.cn	CALIBRATION CNAS L0570
Client SMQ		Certificate No: Z	20-60040
CALIBRATION CE	RTIFICAT	E	
Object	D2600V	/2 - SN: 1074	5-61
Calibration Procedure(s)	FF-Z11-	003.01	
		tion Procedures for dipole validation kits	
Calibration date:	January	2. 2020	
	and the second second		
measurements(SI). The mea pages and are part of the cer	surements and trificate.	traceability to national standards, which re the uncertainties with confidence probability the closed laboratory facility: environment	y are given on the following
	conducted in i	the closed laboratory lacency, environment	
humidity<70%. Calibration Equipment used	(M&TE critical fo	or calibration)	
humidity<70%. Calibration Equipment used Primary Standards	(M&TE critical fo	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2	(M&TE critical fo ID # 106276	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No J19X02605)	Scheduled Calibration Apr-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A	(M&TE critical fo ID # 106276 101369	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605)	Scheduled Calibration Apr-20 Apr-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4	(M&TE critical fo ID # 106276 101369 SN 3617	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Scheduled Calibration Apr-20 Apr-20 Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID #	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 32-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547)	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan19) 22-Aug-19 (CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20
humidity<70%. Calibration Equipment used Primary Standards Power Meter NRP2 Power sensor NRP6A Reference Probe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C Network Analyzer E5071C	(M&TE critical fo ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date(Calibrated by, Certificate No.) 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan19) 22-Aug-19(CTTL-SPEAG,No.Z19-60295) Cal Date(Calibrated by, Certificate No.) 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function SAR Test Engineer	Scheduled Calibration Apr-20 Apr-20 Jan-20 Aug-20 Scheduled Calibration Jan-20 Jan-20

Certificate No: Z20-60040

Page 1 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

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%.

Certificate No: Z20-60040

Page 2 of 8



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

 Te1. *86-10-62304633-2079
 Fax: *86-10-62304633-2504

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

Measurement Conditions

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

DASY Version	DASY52	V52.10.3
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
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.5±6%	1.94 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL

Condition	
250 mW input power	14.2 W/kg
normalized to 1W	56.9 W/kg ± 18.8 % (k=2)
Condition	
250 mW input power	6.29 W/kg
normalized to 1W	25.2 W/kg ± 18.7 % (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	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	-	1

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.6 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	54.6 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.1 W/kg ± 18.7 % (k=2)

Certificate No: Z20-60040



Tel: +86-10-62304633-2079 Fax: +86-10-62304633-250 E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix(Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.1Ω- 6.89jΩ
Return Loss	- 23.1dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2Ω- 5.65jΩ	
Return Loss	- 23.0dB	

General Antenna Parameters and Design

lectrical Delay (one direction) 1.012 ns	trical Delay (one direction)
ectrical Delay (one direction) 1.012 hs	trical Delay (one direction)

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

SPEAG

Page 4 of 8



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

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

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

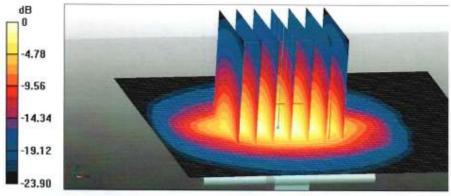
Date: 01.02.2020

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1074 Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2600 MHz; $\sigma = 1.943$ S/m; $\varepsilon_r = 38.52$; $\rho = 1000$ kg/m3 Phantom section: Center Section DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.19, 7.19, 7.19) @ 2600 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 103.8 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 30.9 W/kg SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.29 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 46.4% Maximum value of SAR (measured) = 24.4 W/kg



0 dB = 24.4 W/kg = 13.87 dBW/kg

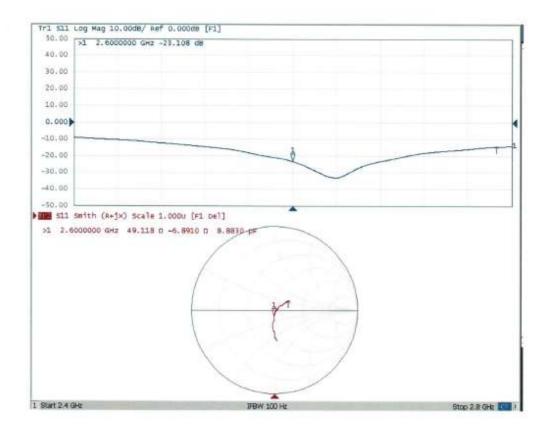
Certificate No: Z20-60040

Page 5 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z20-60040

Page 6 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: ettl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL

Date: 01.02.2020

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1074 Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

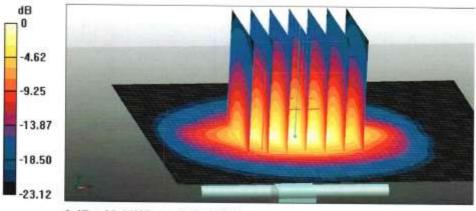
Medium parameters used: f = 2600 MHz; $\sigma = 2.145 \text{ S/m}$; $\epsilon_r = 52.74$; $\rho = 1000 \text{ kg/m3}$ Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.49, 7.49, 7.49) @ 2600 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

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

Reference Value = 95.00 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 29.4 W/kg SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.02 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 47.2% Maximum value of SAR (measured) = 23.4 W/kg



0 dB = 23.4 W/kg = 13.69 dBW/kg

Certificate No: Z20-60040

Page 7 of 8

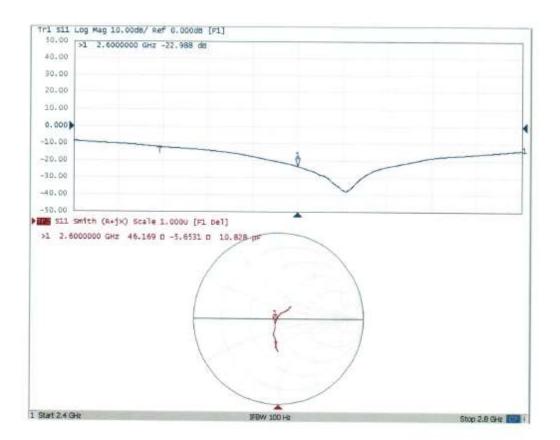


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2079
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Body TSL



Certificate No: Z20-60040

Page 8 of 8

	S P	e a g	でNAS 関係互认
	n Road, Haidian Dist	trict, Beijing, 100191, China	CALIBRATIO
Tel: +86-10-623046 E-mail: cttl@chinat		\$6-10-62304633-2504 "Multidialite"	CNAS L0570
Client SMC	2	Certificate No:	Z20-60041
CALIBRATION CE	ERTIFICAT	E	
Object	D5GHz	V2 - SN: 1185	
Calibration Procedure(s)	EE.711	-003-01	
		tion Procedures for dipole validation kits	5
Calibration date:	Decem	ber 31, 2019	
numidity<70%.		the closed laboratory facility; environ	nment temperature(22±3) 12 an
Calibration Equipment used	(M&TE critical f	or calibration)	
	(M&TE critical f	or calibration) Cal Date(Calibrated by, Certificate N	o.) Scheduled Calibration
Primary Standards			o.) Scheduled Calibration Apr-20
Primary Standards	ID#	Cal Date(Calibrated by, Certificate N	
Primary Standards Power Meter NRP2	ID# 106276	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605)	Apr-20 Apr-20
Primary Standards Power Meter NRP2 Power sensor NRP6A	ID# 106276 101369	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605)	Apr-20 Apr-20 19) Jan-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4	ID # 106276 101369 SN 3617	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan	Apr-20 Apr-20 (19) Jan-20 (295) Aug-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4	ID # 106276 101369 SN 3617 SN 1555	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan 22-Aug-19 (CTTL-SPEAG,No.Z19-602	Apr-20 Apr-20 (19) Jan-20 (295) Aug-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards	ID # 106276 101369 SN 3617 SN 1555 ID #	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan 22-Aug-19 (CTTL-SPEAG,No.Z19-602 Cal Date(Calibrated by, Certificate No	Apr-20 Apr-20 (19) Jan-20 (95) Aug-20 (.) Scheduled Calibration
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan 22-Aug-19(CTTL-SPEAG,No.Z19-602 Cal Date(Calibrated by, Certificate No 23-Jan-19 (CTTL, No.J19X00336)	Apr-20 Apr-20 (19) Jan-20 (295) Aug-20 (2) Scheduled Calibration Jan-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzerE5071C	ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19(SPEAG,No.EX3-3617_Jan 22-Aug-19(CTTL-SPEAG,No.Z19-602 Cal Date(Calibrated by, Certificate No 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547)	Apr-20 Apr-20 (19) Jan-20 (295) Aug-20 (2.) Scheduled Calibration Jan-20 Jan-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C	ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan 22-Aug-19(CTTL-SPEAG,No.Z19-602 Cal Date(Calibrated by, Certificate No 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function	Apr-20 Apr-20 (19) Jan-20 (295) Aug-20 (2.) Scheduled Calibration Jan-20 Jan-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzerE5071C	ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name Zhao Jing	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan 22-Aug-19 (CTTL-SPEAG,No.Z19-602 Cal Date(Calibrated by, Certificate No 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function SAR Test Engineer	Apr-20 Apr-20 19) Jan-20 295) Aug-20 2.) Scheduled Calibration Jan-20 Jan-20
Primary Standards Power Meter NRP2 Power sensor NRP6A ReferenceProbe EX3DV4 DAE4 Secondary Standards Signal Generator E4438C NetworkAnalyzerE5071C Calibrated by: Reviewed by:	ID # 106276 101369 SN 3617 SN 1555 ID # MY49071430 MY46110673 Name Zhao Jing Lin Hao	Cal Date(Calibrated by, Certificate N 11-Apr-19 (CTTL, No.J19X02605) 11-Apr-19 (CTTL, No.J19X02605) 31-Jan-19 (SPEAG,No.EX3-3617_Jan 22-Aug-19(CTTL-SPEAG,No.Z19-602 Cal Date(Calibrated by, Certificate No 23-Jan-19 (CTTL, No.J19X00336) 24-Jan-19 (CTTL, No.J19X00547) Function SAR Test Engineer SAR Test Engineer SAR Project Leader	Apr-20 Apr-20 (19) Jan-20 (295) Aug-20 (2.) Scheduled Calibration Jan-20 Jan-20

Certificate No: Z20-60041

Page 1 of 14



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%.

Certificate No: Z20-60041

Page 2 of 14



Measurement Conditions

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

DASY Version	DASY52	V52.10.3
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

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	36.8 ± 6 %	4.65 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	1105	

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	7.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.5 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.8 W/kg ± 24.2 % (k=2)

Certificate No: Z20-60041

Page 3 of 14



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	36.2 ± 6 %	5.03 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	1	

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	7.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 24.2 % (k=2)

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	36.0 ± 6 %	5.19 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.2 W/kg ± 24.2 % (k=2)

Certificate No: Z20-60041

Page 4 of 14



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

 Tel: +86-10-62304633-2512
 Fax: +86-10-62304633-2504

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

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 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.7 ± 6 %	5.32 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	1000	

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	7.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	74.2 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.08 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.8 W/kg ± 24.2 % (k=2)

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	48.0 ± 6 %	5.79 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		1

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	7.70 W/kg	
SAR for nominal Body TSL parameters	normalized to 1W	76.9 W/kg ± 24.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition		
SAR measured	100 mW input power	2.17 W/kg	
SAR for nominal Body TSL parameters	normalized to 1W	21.7 W/kg ± 24.2 % (k=2)	

Certificate No: Z20-60041

Page 5 of 14



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

 Tel: +86-10-62304633-2512
 Fax: +86-10-62304633-2504

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

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	47.7 ± 6 %	6.02 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.30 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.9 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.2 W/kg ± 24.2 % (k=2)

Certificate No: Z20-60041

Page 6 of 14



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

 Tel: +86-10-62304633-2512
 Fax: +86-10-62304633-2504

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

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	49.3Ω - 5.08jΩ		
Return Loss	- 25.8dB		

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.2Ω - 2.17jΩ		
Return Loss	- 25.5dB		

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	55.6Ω - 0.52jΩ		
Return Loss	- 25.5dB		

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	49.3Ω - 3.89jΩ		
Return Loss	- 28.0dB		

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.9Ω - 2.71jΩ		
Return Loss	- 26.7dB		

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	55.8Ω - 2.17jΩ		
Return Loss	- 24.7dB		

Page 7 of 14



General Antenna Parameters and Design

Electrical Delay (one direction)	1.066 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
- 12		

Page 8 of 14



DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

Date: 12.31.2019

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1185

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 4.652 S/m; ϵ_r = 36.81; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.027 S/m; ϵ_r = 36.19; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 5.19 S/m; ϵ_r = 35.96; ρ = 1000 kg/m3,

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(5.39, 5.39, 5.39) @ 5250 MHz; ConvF(5.06, 5.06, 5.06) @ 5600 MHz; ConvF(5.07, 5.07, 5.07) @ 5750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.41 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 31.5 W/kg SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.17 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.3% Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.02 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 36.2 W/kg SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.27 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 62.7%

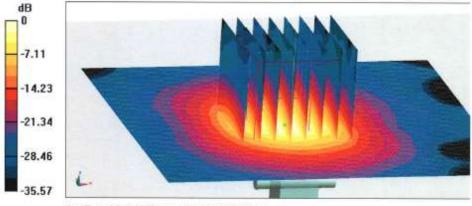
Maximum value of SAR (measured) = 19.5 W/kg

Certificate No: Z20-60041

Page 9 of 14



Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.14 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 36.9 W/kg SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.21 W/kg Smallest distance from peaks to all points 3 dB below = 7.5 mm Ratio of SAR at M2 to SAR at M1 = 59.5% Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

Page 10 of 14

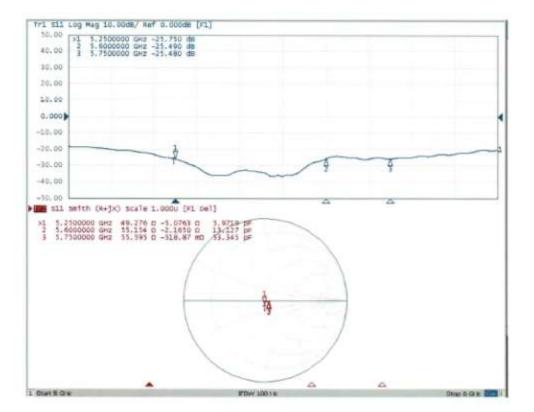


 Add: No.51 Xuoyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2512
 Fax: +86-10-62304633-2504

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

Impedance Measurement Plot for Head TSL



Certificate No: Z20-60041

Page 11 of 14



DASY5 Validation Report for Body TSL

Date: 12.30.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1185

Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz,

Medium parameters used: f = 5250 MHz; σ = 5.317 S/m; ϵ_r = 48.69; ρ = 1000 kg/m3, Medium parameters used: f = 5600 MHz; σ = 5.79 S/m; ϵ_r = 48.02; ρ = 1000 kg/m3, Medium parameters used: f = 5750 MHz; σ = 6.019 S/m; ϵ_r = 47.69; ρ = 1000 kg/m3,

Phantom section: Right Section

DASY5 Configuration:

- Probe: SN3617; ConvF(4.76, 4.76, 4.76) @ 5250 MHz; ConvF(4.23, 4.23, 4.23)
 @ 5600 MHz; ConvF(4.36, 4.36, 4.36) @ 5750 MHz; Calibrated: 1/31/2019,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/22/2019
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (3); SEMCAD X Version 14.6.13 (7474)

Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 66.27 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 29.5 W/kg SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.08 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.1% Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 66.02 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 34.0 W/kg SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.17 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 61.7% Maximum value of SAR (measured) = 18.8 W/kg

Certificate No: Z20-60041

Page 12 of 14

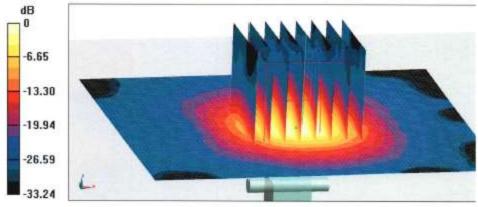


 Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China

 Tel: +86-10-62304633-2512
 Fax: +86-10-62304633-2504

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

Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.40 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 34.0 W/kg SAR(1 g) = 7.3 W/kg; SAR(10 g) = 2.03 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 59.9% Maximum value of SAR (measured) = 18.1 W/kg



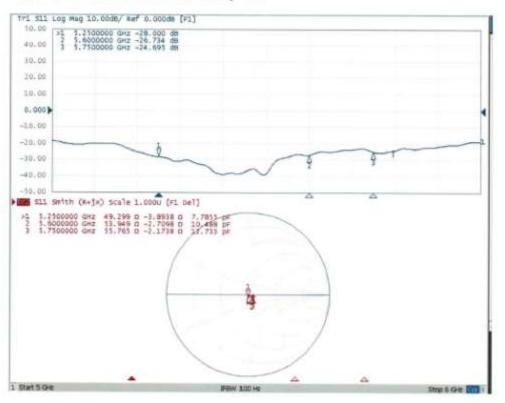
0 dB = 18.1 W/kg = 12.58 dBW/kg

Certificate No: Z20-60041

Page 13 of 14



Impedance Measurement Plot for Body TSL



Certificate No: Z20-60041

Page 14 of 14

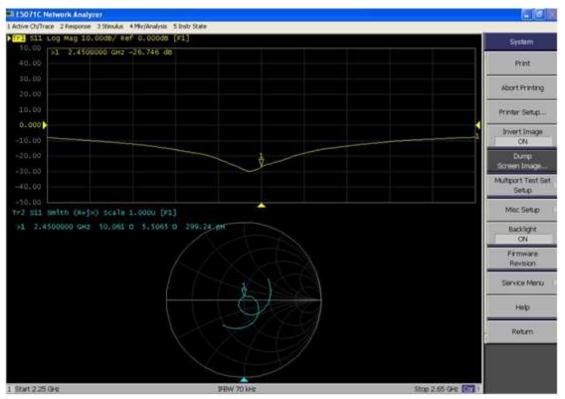
Note:

1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix D.

a) There is no physical damage on the dipole;

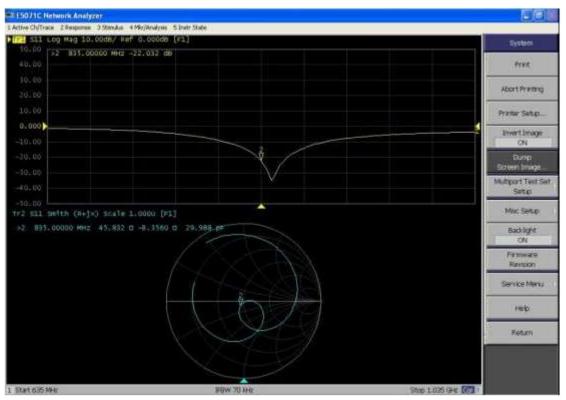
- b) System check with specific dipole is within 10% of calibrated value;
- c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
- d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.

D2450MHz



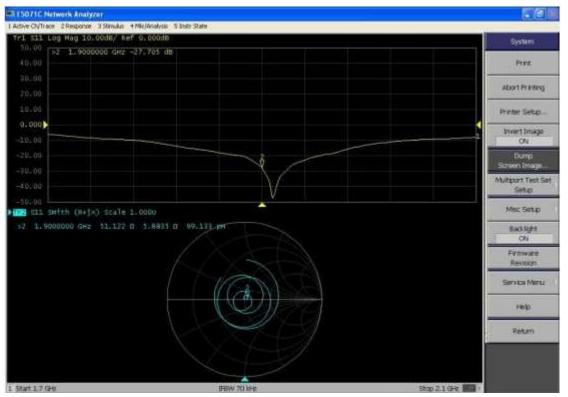
D2450V2, serial No. 818 Extended Dipole Calibrations

	2450					
Date of Return-Loss Delta			Real	Delta	Imaginary	Delta
Measurement	(dB)		Impedance(ohm)	(ohm)	Impedance(ohm)	(ohm)
2018-08-31	-25.36		49.569		5.36	
2019-08-31	-26.74	5.44	50.061	0.646	5.50	2.61





	835MHz Body							
Date of	Return-Loss	Delta(%)	Real	Delta	Imaginary	Delta		
Measurement	(dB)		Impedance(ohm)	(ohm)	Impedance(ohm)	(ohm)		
2018-09-06	-22.49		46.780		-7.52			
2019-09-06	-22.03	-2.04	45.832	-0.151	-8.35	-0.83		





	1900MHz							
Date of	Return-Loss	Delta(%)	Real	Delta	Imaginary	Delta		
Measurement	(dB)		Impedance(ohm)	(ohm)	Impedance(ohm)	(ohm)		
2018-09-12	-25.411		48.388		5.032			
2019-09-11	-27.705	9.03	51.122	2.73	5.884	0.852		