

Report No. : FA9N2025-02

# Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.





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Sporton

**Certificate No:** Z18-60532

# CALIBRATION CERTIFICATE

Object

D750V3 - SN: 1099

FF-Z11-003-01

In Collaboration with

CALIBRATION LABORATORY

http://www.chinattl.cn

Fax: +86-10-62304633-2504

Calibration Procedure(s)

Client

Calibration Procedures for dipole validation kits

Calibration date:

December 6, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Power sensor NRV-Z5	100596	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG,No.DAE4-1555_Aug18)	Aug-19
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430		Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19
		$\gamma$ ,	

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	A HE
Approved by:	Qi Dianyuan	SAR Project Leader	
		lssi	ued: December 9, 2018

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



In Colleboration with



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, ChinaTel: +86-10-62304633-2079Fax: +86-10-62304633-2504E-mail: cttl@chinattl.comhttp://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

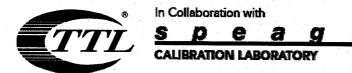
## Additional Documentation:

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%.



#### **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	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	43.1 ± 6 %	0.87 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	2.07 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.52 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.38 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.64 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	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.0 ± 6 %	0.95 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

## SAR result with Body TSL

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.15 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	8.61 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.44 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	5.77 mW /g ±18.7 % (k=2)



# Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.2Ω- 1.12jΩ
Return Loss	- 27.7dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.8Ω- 3.37jΩ		
Return Loss	- 29.4dB		

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

1.	Electrical Delay (one direction)			0.900 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	



In Collaboration with

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

Date: 12.05.2018

# DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1099

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz;  $\sigma = 0.865$  S/m;  $\varepsilon_r = 43.13$ ;  $\rho = 1000$  kg/m3 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(9.47, 9.47, 9.47) @ 750 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP\_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

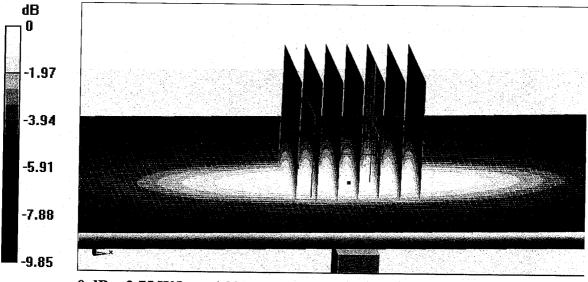
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.37 V/m; Power Drift = 0.00 dB

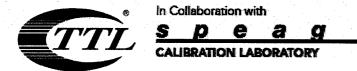
Peak SAR (extrapolated) = 3.12 W/kg

SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.38 W/kg

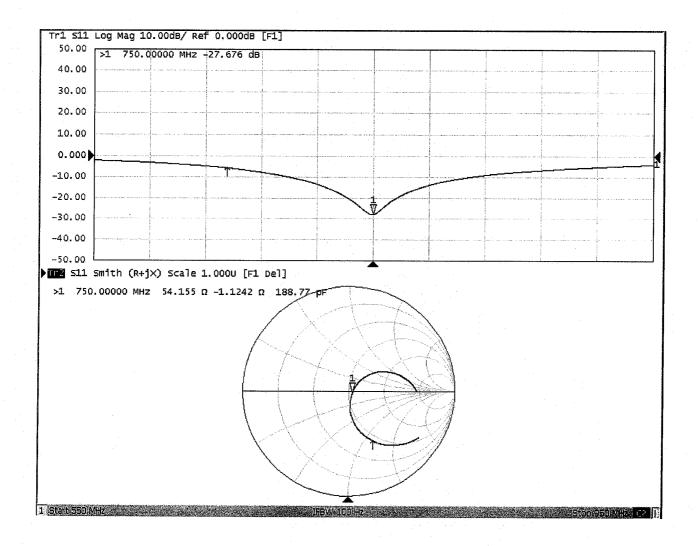
Maximum value of SAR (measured) = 2.75 W/kg



0 dB = 2.75 W/kg = 4.39 dBW/kg



## Impedance Measurement Plot for Head TSL





## **DASY5 Validation Report for Body TSL**

Date: 12.05.2018

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1099

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz;  $\sigma = 0.951$  S/m;  $\varepsilon_r = 54.02$ ;  $\rho = 1000$  kg/m3

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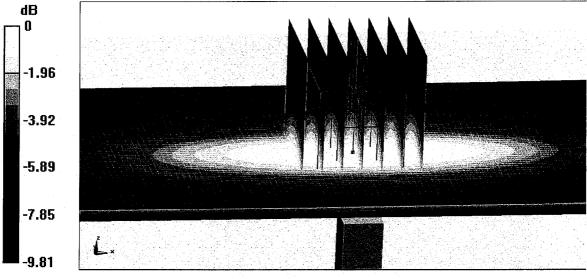
Phantom section: Center Section

**DASY5** Configuration:

- Probe: EX3DV4 SN7514; ConvF(9.68, 9.68, 9.68) @ 750 MHz; Calibrated: • 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 • (7450)

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

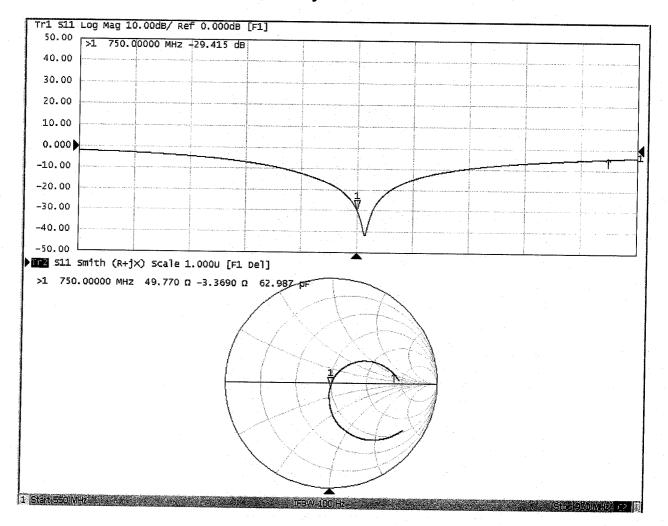
Reference Value = 51.51 V/m; Power Drift = -0.07 dBPeak SAR (extrapolated) = 3.29 W/kg SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.44 W/kgMaximum value of SAR (measured) = 2.88 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg



## Impedance Measurement Plot for Body TSL





# D750V3, Serial No. 1099 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

	D750V3 – serial no. 1099											
		750 Head			750 Body							
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.12.6	-27.7		54.2		-1.12		-29.4		49.8		-3.37	
2019.11.25	-27.9	-0.7	53.0	-1.2	-1.46	-0.34	-29.2	0.7	48.7	-1.1	-3.17	0.2

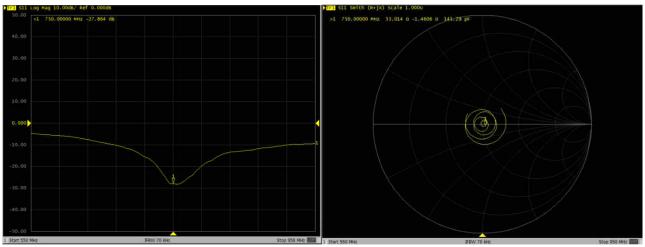
#### <Justification of the extended calibration>

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

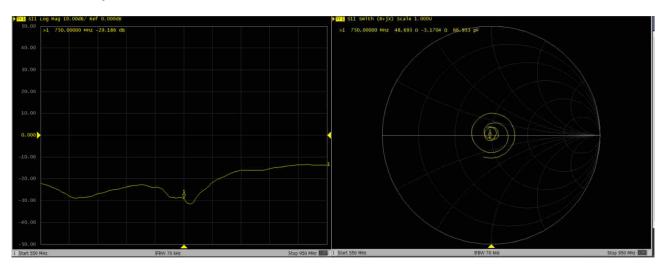


## Dipole Verification Data> D750V3, serial no. 1099

#### 750MHz - Head



750MHz – Body





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

> **Certificate No:** Z19-60054

# **CALIBRATION CERTIFICATE**

Object

D750V3 - SN: 1107

Calibration Procedure(s)

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

Calibration date:

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

March 8, 2019

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-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	- HAL
Reviewed by:	Yu Zongying	SAR Test Engineer	-the-
Approved by:	Qi Dianyuan	SAR Project Leader	Dati
		Issued: March	10, 2019

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



#### 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%.



#### **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	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	43.1 ± 6 %	0.86 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	2.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.32 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.61 W/kg ± 18.7 % (k=2)

#### **Body TSL parameters**

The following parameters and calculations were applied.

Kalana and a	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	54.8 ± 6 %	0.94 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	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.45 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.65 W/kg ±18.7 % (k=2)



#### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.2Ω- 1.55jΩ
Return Loss	- 25.7dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4Ω- 3.30jΩ
Return Loss	- 28.6dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	0.980 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

#### Additional EUT Data

Manufactured by	SPEAG
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In Collaboration with

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DASY5 Validation Report for Head TSLDaTest Laboratory: CTTL, Beijing, ChinaDUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1107Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz;  $\sigma = 0.864 \text{ S/m}$ ;  $\varepsilon_r = 43.14$ ;  $\rho = 1000 \text{ kg/m3}$ Phantom section: Right Section

DASY5 Configuration:

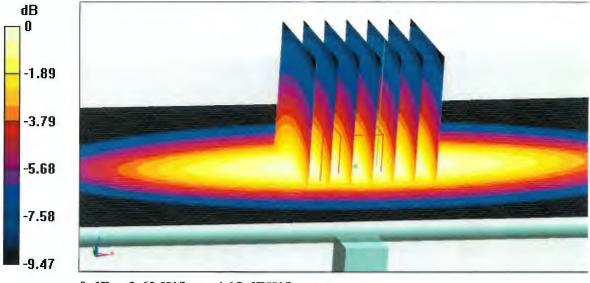
Probe: EX3DV4 - SN3617; ConvF(10.03, 10.03, 10.03) @ 750 MHz; Calibrated: 1/31/2019

Date: 03.07.2019

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

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

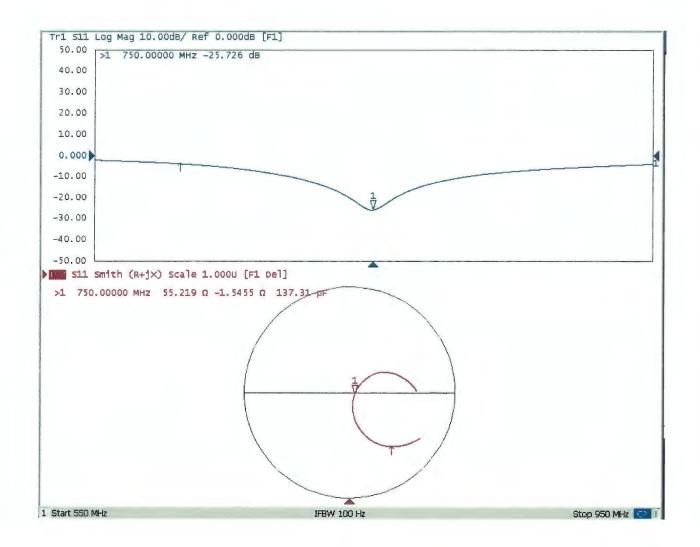
dy=5mm, dz=5mm Reference Value = 54.80 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 2.90 W/kg SAR(1 g) = 2.02 W/kg; SAR(10 g) = 1.37 W/kg Maximum value of SAR (measured) = 2.62 W/kg



0 dB = 2.62 W/kg = 4.18 dBW/kg



#### Impedance Measurement Plot for Head TSL





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CALIBRATION LABORATORY

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**DASY5 Validation Report for Body TSL** Test Laboratory: CTTL, Beijing, China DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1107 Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz;  $\sigma = 0.943$  S/m;  $\varepsilon_r = 54.78$ ;  $\rho = 1000$  kg/m3 Phantom section: Center Section DASY5 Configuration:

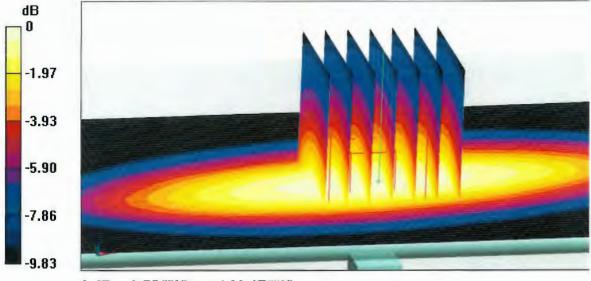
- Probe: EX3DV4 SN3617; ConvF(9.85, 9.85, 9.85) @ 750 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

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

Reference Value = 52.31 V/m; Power Drift = 0.00 dBPeak SAR (extrapolated) = 3.09 W/kg

SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.4 W/kg

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



0 dB = 2.75 W/kg = 4.39 dBW/kg

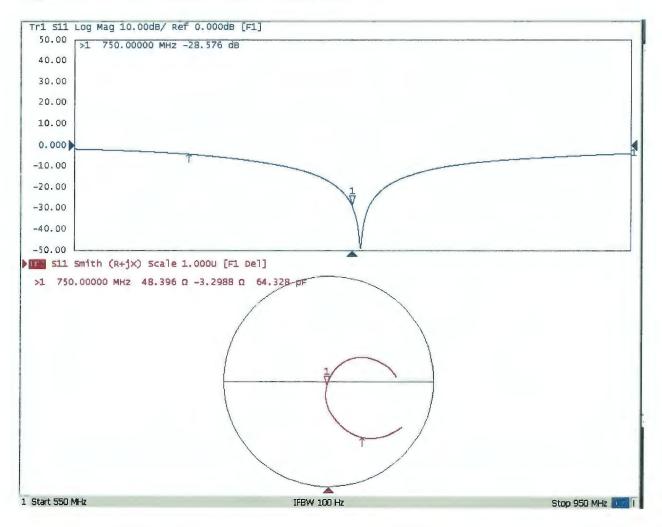
Certificate No: Z19-60054

Date: 03.07.2019

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## Impedance Measurement Plot for Body TSL





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中国认可 国际互认 MRA CNA 校准 CALIBRATION **CNAS L0570** 

Sporton Client

Z18-60533 **Certificate No:** 

ALIBRATION CERTIFICATE

Object

D835V2 - SN: 4d162

Calibration Procedure(s)

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

Calibration date:

December 5, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
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Power sensor NRV-Z5	100596	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG, No.DAE4-1555_Aug18)	Aug-19
Secondary Standards	ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	A A A
Approved by:	Qi Dianyuan	SAR Project Leader	- And

Issued: December 8, 2018

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#### Glossary:

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

# Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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

## **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495			
Extrapolation	Advanced Extrapolation				
Phantom	Triple Flat Phantom 5.1C				
Distance Dipole Center - TSL	15 mm	with Spacer			
Zoom Scan Resolution	dx, dy, dz = 5 mm				
Frequency	835 MHz ± 1 MHz				

#### **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.7 ± 6 %	0.88 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	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.61 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.56 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.35 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	53.7 ± 6 %	0.99 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	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.70 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.64 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.47 mW /g ± 18.7 % (k=2)



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# Appendix (Additional assessments outside the scope of CNAS L0570)

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# Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6Ω- 2.56jΩ
Return Loss	- 28.9dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.2Ω- 6.92jΩ		
Return Loss	- 22.3dB		

# General Antenna Parameters and Design

[	Electrical Delay (one direction)	1.306 ns	

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

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

#### **Additional EUT Data**

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	a desta de la construcción de	SPEAG
	Manufactured by	

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# **DASY5** Validation Report for Head TSL

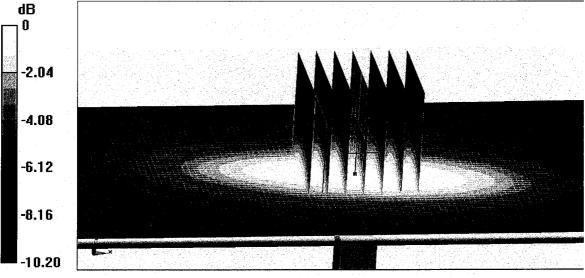
Date: 12.04.2018

Test Laboratory: CTTL, Beijing, China DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz;  $\sigma = 0.881$  S/m;  $\varepsilon_r = 42.71$ ;  $\rho = 1000$  kg/m3 Phantom section: Right Section **DASY5** Configuration:

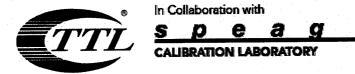
- Probe: EX3DV4 SN7514; ConvF(9.09, 9.09, 9.09) @ 835 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP V5.1C; Type: QD 000 P51CA; Serial: 1062 ٠
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 • (7450)

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

Reference Value = 57.75 V/m; Power Drift = 0.03 dBPeak SAR (extrapolated) = 3.50 W/kgSAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.56 W/kg Maximum value of SAR (measured) = 3.11 W/kg



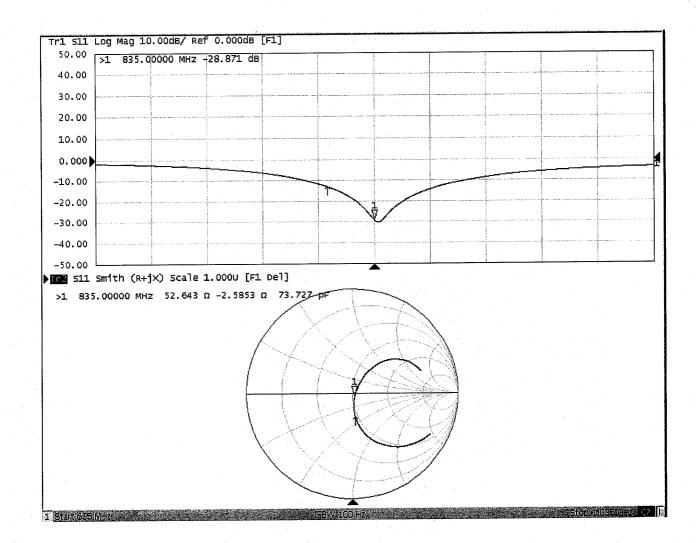
0 dB = 3.11 W/kg = 4.93 dBW/kg



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# Impedance Measurement Plot for Head TSL





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

Date: 12.04.2018

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: f = 835 MHz;  $\sigma = 0.986$  S/m;  $\varepsilon_r = 53.72$ ;  $\rho = 1000$  kg/m3

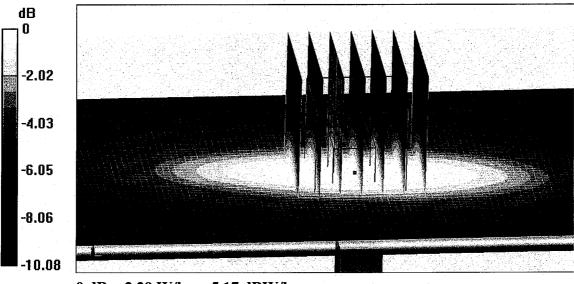
Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(9.47, 9.47, 9.47) @ 835 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

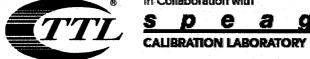
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 55.24 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.72 W/kg

SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.64 W/kg Maximum value of SAR (measured) = 3.29 W/kg



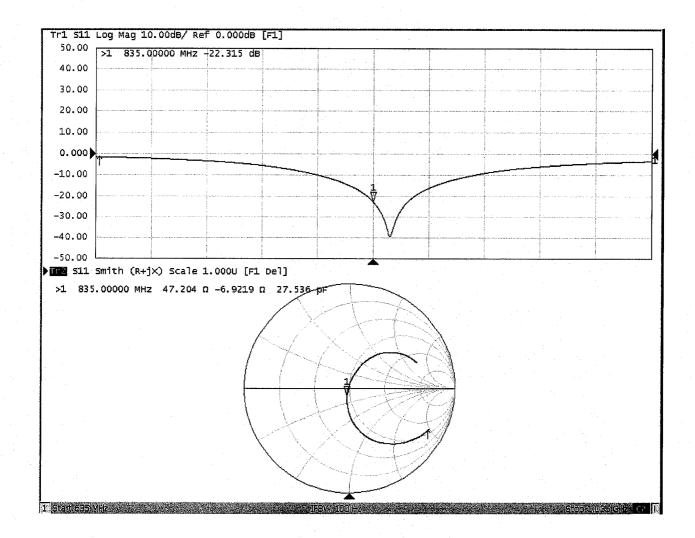
0 dB = 3.29 W/kg = 5.17 dBW/kg

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#### Impedance Measurement Plot for Body TSL





# D835V2, Serial No. 4d162 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

	D835V2 – serial no. 4d162											
	835 Head							835 Body				
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.12.5	-28.9		52.6		-2.56		-22.3		47.2		-6.92	
2019.11.25	-29.2	1.0	53.4	0.8	-1.48	1.08	-21.1	5.4	46.6	-0.6	-7.81	-0.89

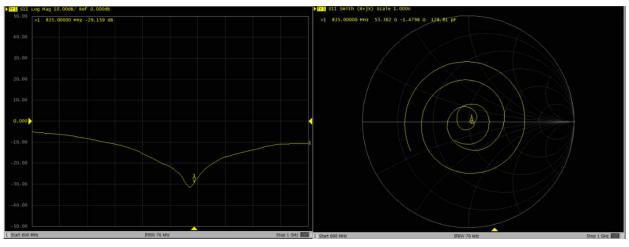
#### <Justification of the extended calibration>

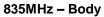
The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

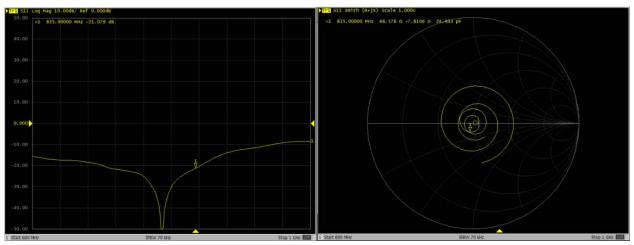


## Dipole Verification Data> 835V2, serial no. 4d162

#### 835MHz - Head







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



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#### Client Sporton

Certificate No:	D835\	/2-4d1	67	Nov19
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# CALIBRATION CERTIFICATE

Object	D835V2 - SN:4d	167	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	November 25, 20	019	
		ional standards, which realize the physical un robability are given on the following pages ar	
All calibrations have been conducte		ry facility: environment temperature (22 $\pm$ 3)°	C and humidity < 70%.
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
ower sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
ype-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	in house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20
	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	2202
Approved by:	Katja Pokovic	Technical Manager	leng
	he reproduced succession	full without written approval of the laboratory	Issued: November 25, 2019

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## **Glossarv:**

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

# **Calibration is Performed According to the Following Standards:**

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

# **Additional Documentation:**

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

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

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

Accreditation No.: SCS 0108

## **Measurement Conditions**

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

DASY Version	DASY5	V52.10.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.55 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
	050 14/2 1	
SAR measured	250 mW input power	1.56 W/kg

# Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 3.8 jΩ
Return Loss	- 28.2 dB

## **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.390 ns

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

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

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

## Additional EUT Data

Manufactured by SPEAG
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# **DASY5 Validation Report for Head TSL**

Date: 25.11.2019

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d167

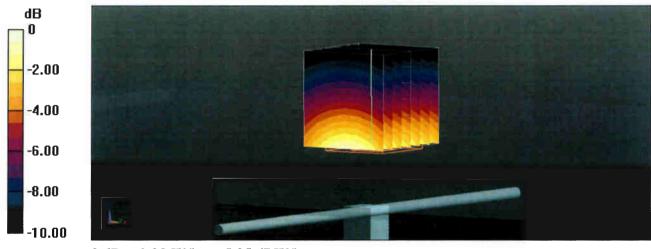
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma = 0.91$  S/m;  $\epsilon_r = 42$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.3(1513); SEMCAD X 14.6.13(7474)

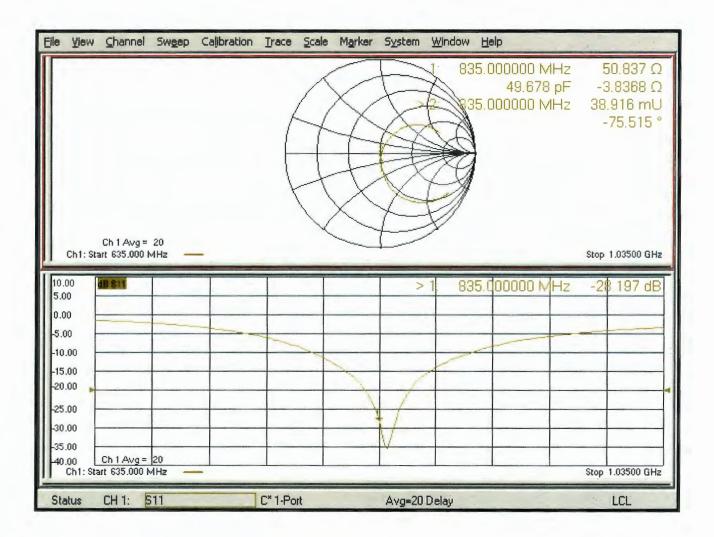
## Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 63.15 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.59 W/kg **SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.56 W/kg Smallest distance from peaks to all points 3 dB below = 16 mm Ratio of SAR at M2 to SAR at M1 = 66.8\% Maximum value of SAR (measured) = 3.20 W/kg** 



0 dB = 3.20 W/kg = 5.05 dBW/kg

# Impedance Measurement Plot for Head TSL



# Appendix: Transfer Calibration at Four Validation Locations on SAM Head<sup>1</sup>

## **Evaluation Condition**

	Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L
L 1			

## SAR result with SAM Head (Top $\cong$ C0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.24 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Mouth $\cong$ F90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.70 W/kg ± 17.5 % (k=2)
2		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
		the second secon

## SAR result with SAM Head (Neck $\cong$ H0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.22 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
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# SAR result with SAM Head (Ear $\cong$ D90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	7.93 W/kg ± 17.5 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	5.33 W/kg ± 16.9 % (k=2)

 $<sup>^{\</sup>rm I}$  Additional assessments outside the current scope of SCS 0108

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<b>O</b>			rtificate No: Z18-60	)258
Client Sporton	TIFICATE			
Object	D1750V2	- SN: 1137		
Calibration Procedure(s)	FF-Z11-0 Calibratic	03-01 on Procedures for di	oole validation kits	
Calibration date: This calibration Certificate do	July 30, 2	The product of the second s		
This calibration Certificate do measurements(SI). The meas pages and are part of the cert All calibrations have been o humidity<70%. Calibration Equipment used (	urements and th ificate. conducted in th	ne uncertainties with		- 0
Calibration Equipment used (				Scheduled Calibration
Primary Standards	<u>ID #</u>	Cal Date(Calibrate	d by, Certificate No.)	Oct-18
Power Meter NRVD	102083	01-Nov-17 (CTTL, 01-Nov-17 (CTTL,	N0.317X08756)	Oct-18
Power sensor NRV-Z5	100542	01-NOV-17 (CTTL,	No.EX3-7464_Sep17)	Sep-18
Reference Probe EX3DV4 DAE4	SN 7464 SN 1524	12-Sep-17(SPEAG	,No.DAE4-1524_Sep17)	Sep-18
	ID#	Cal Date(Calibrate	d by, Certificate No.)	Scheduled Calibration
Secondary Standards	MY49071430	23-Jan-18 (CTTL,	No.J18X00560)	Jan-19
Signal Generator E4438C NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL,	No.J18X00561)	Jan-19
	Name	Function		Signature
Calibrated by:	Zhao Jing	SAR Test Er	ngineer	An CON
Reviewed by:	Lin Hao	SAR Test E	ngineer	三林北京
Approved by:	Qi Dianyuan	SAR Projec	y glade Algebrasi	
			Issued: Augu	IST 3, 2018
This calibration certificate s	hall not be repro	oduced except in full	without written approval	of the laboratory.

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## **Glossary:**

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

# Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless

. . ...

- Communications Devices: Measurement Techniques", June 2013 b) IEC 62209-1, "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:

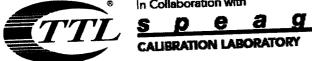
e) DASY4/5 System Handbook

# 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
- 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%.

In Collaboration with



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## **Measurement Conditions**

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

ASY system configuration, as far as	not given on page 1.	52.10.1.1476		
DASY Version	DASY52	52.10.1.1470		
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			
	1750 MHz ± 1 MHz			
Frequency				

## Head TSL parameters

ters and calculations were applied.

The following parameters and calculations mere	Temperature	Permittivity	Conductivity	
and the attended tell parameters	22.0 °C	40.1	1.37 mho/m	
Nominal Head TSL parameters Measured Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	1.33 mho/m ± 6 %	
Head TSL temperature change during test	<1.0 °C			

#### sult with Head TSI SA

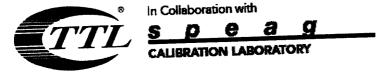
R result with Head 13L	Condition	
SAR averaged over 1 $-cm^3$ (1 g) of Head TSL		8.91 mW / g
SAR measured	250 mW input power	
SAR for nominal Head TSL parameters	normalized to 1W	36.5 mW /g ± 18.8 % (k=2)
	Condition	
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	250 mW input power	4.81 mW / g
SAR measured		19.5 mW /g ± 18.7 % (k=2)
SAR for nominal Head TSL parameters	normalized to 1W	19.5 mw/g 1 10.7 /3 (K-2/

## **Body TSL parameters**

ne following parameters and calculations were a	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	53.8 ± 6 %	1.48 mho/m ± 6 %	
Body TSL temperature change during test	<1.0 °C			

## SAR result with Body TSL

(result with body rol	Condition	
SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	250 mW input power	9.17 mW / g
SAR measured		
SAR for nominal Body TSL parameters	normalized to 1W	37.0 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
	250 mW input power	5.05 mW / g
SAR measured		20.3 mW /g ± 18.7 % (k=2)
SAR for nominal Body TSL parameters	normalized to 1W	20.3 1107 /g 2 1017 /c ( =/



# Appendix (Additional assessments outside the scope of CNAS L0570)

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.3- 0.87 jΩ
	- 40.7 dB
Return Loss	

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.8Ω- 2.59 jΩ
Return Loss	- 24.3 dB

# General Antenna Parameters and Design

	1.087 ns
Electrical 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
Manufactured by	



Date: 07.30.2018

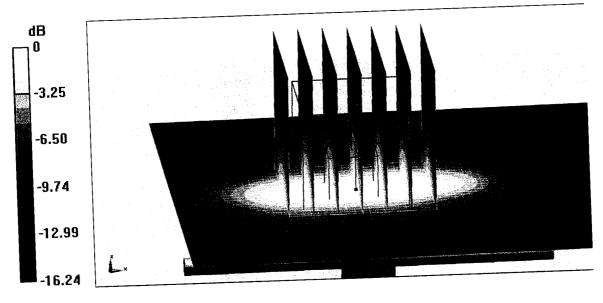
**DASY5 Validation Report for Head TSL** Test Laboratory: CTTL, Beijing, China **DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1137** Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz;  $\sigma = 1.332$  S/m;  $\epsilon r = 41.17$ ;  $\rho = 1000$  kg/m3 Phantom section: Center Section DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(8.7, 8.7, 8.7) @ 1750 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
- Pnanton: MFF\_V5.1C, Type: QD 00011101
  Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11
- Measurement Sw: DAS 132, Version 22.10 (1); (7439)

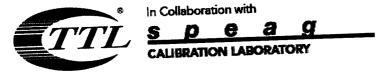
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.50 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 16.1 W/kg SAR(1 g) = 8.91 W/kg; SAR(10 g) = 4.81 W/kg

SAR(1 g) = 8.91 W/kg, SAR(10 g) Maximum value of SAR (measured) = 13.5 W/kg



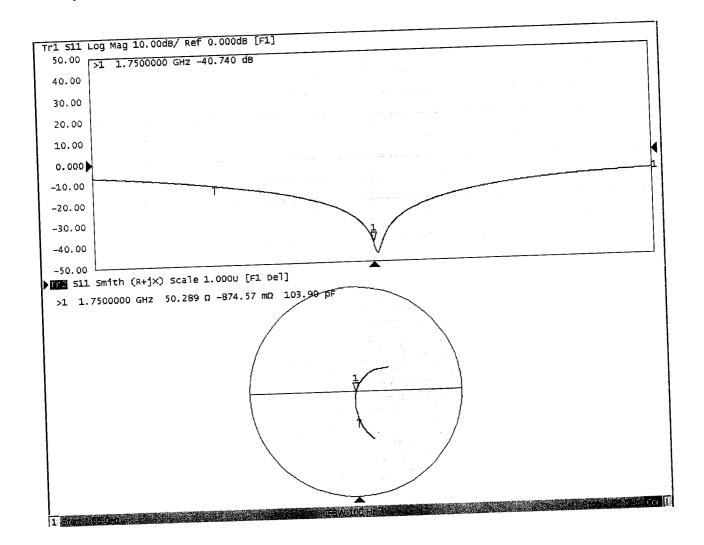
0 dB = 13.5 W/kg = 11.30 dBW/kg

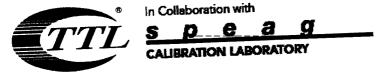


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# Impedance Measurement Plot for Head TSL





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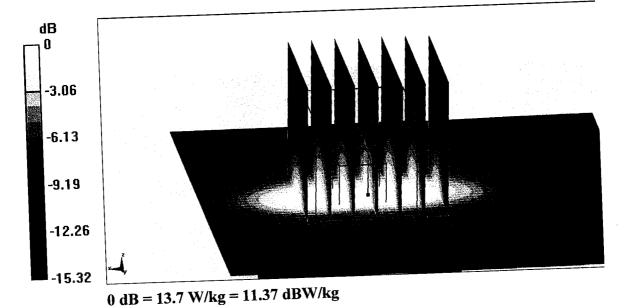
## **DASY5 Validation Report for Body TSL**

Date: 07.30.2018

Test Laboratory: CTTL, Beijing, China DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1137 Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.477 S/m;  $\epsilon$ r = 53.84;  $\rho$  = 1000 kg/m3 Phantom section: Left Section DASY5 Configuration:

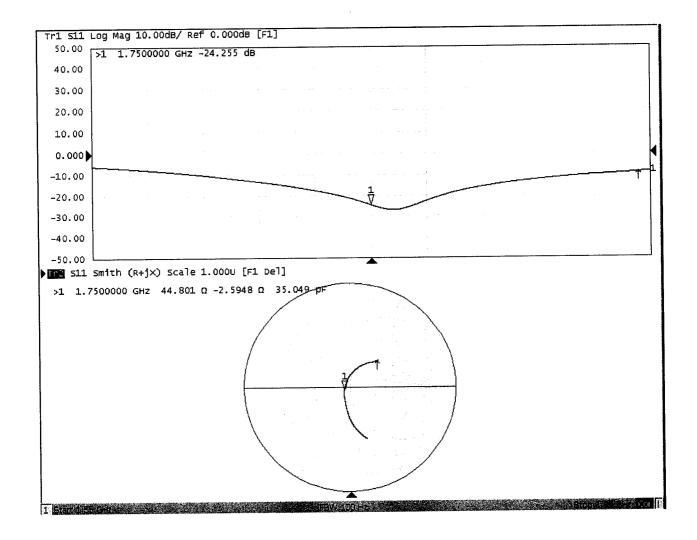
- Probe: EX3DV4 SN7464; ConvF(8.6, 8.6, 8.6) @ 1750 MHz; Calibrated: • 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 ٠ • (7439)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 77.55 V/m; Power Drift = 0.06 dB Peak SAR (extrapolated) = 16.0 W/kg SAR(1 g) = 9.17 W/kg; SAR(10 g) = 5.05 W/kg Maximum value of SAR (measured) = 13.7 W/kg





## Impedance Measurement Plot for Body TSL





# D1750V2, Serial No. 1137 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

	D1750V2 – serial no. 1137											
1750 Head					1750 Body							
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.07.30	-40.7		50.3		-0.87		-24.3		44.8		-2.59	
2019.10.23	-40.4	0.7	51	0.7	-0.15	0.72	-24.7	-1.6	46.1	1.3	-2.1	0.49

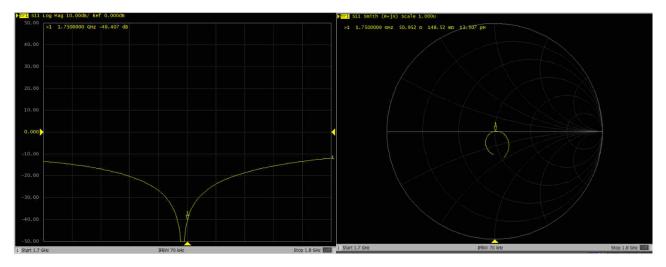
## <Justification of the extended calibration>

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

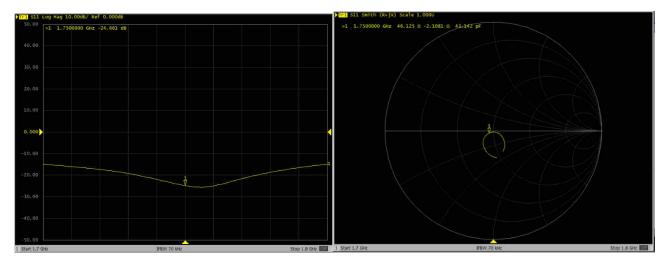


## Dipole Verification Data> D1750V2, serial no. 1137

## 1750MHz - Head



## 1750MHz – Body









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#### Sporton Client

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Z19-60057 **Certificate No:** 

## **CALIBRATION CERTIFICATE**

Object

D1750V2 - SN: 1112

Calibration Procedure(s)

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

Calibration date:

March 7, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-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	凌光
Reviewed by:	Lin Hao	SAR Test Engineer	新松
Approved by:	Qi Dianyuan	SAR Project Leader	Store
		Issued: March	
This calibration certificate sh	all not be reproc	luced except in full without written approval of	f the laboratory.



## 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%.



#### **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	41.1 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

## SAR result with Head TSL

SAR averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.7 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.4 W/kg ± 18.7 % (k=2)

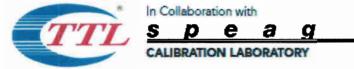
#### **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5 ± 6 %	1.47 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	9.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.4 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg ± 18.7 % (k=2)



## Appendix (Additional assessments outside the scope of CNAS L0570)

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.8Ω- 1.87 jΩ
Return Loss	- 33.0 dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.4Ω- 1.07 jΩ
Return Loss	- 28.3 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.080 ns

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

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

#### Additional EUT Data

Manufactured by	SPEAG
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## **DASY5 Validation Report for Head TSL**

Date: 03.06.2019

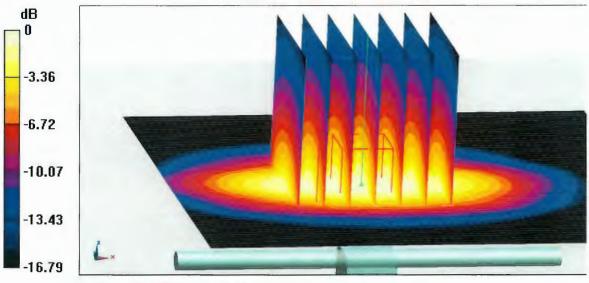
Test Laboratory: CTTL, Beijing, China DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1112 Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz;  $\sigma = 1.389 \text{ S/m}$ ;  $\varepsilon_r = 41.13$ ;  $\rho = 1000 \text{ kg/m3}$ Phantom section: Right Section **DASY5** Configuration:

а

- 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 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

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

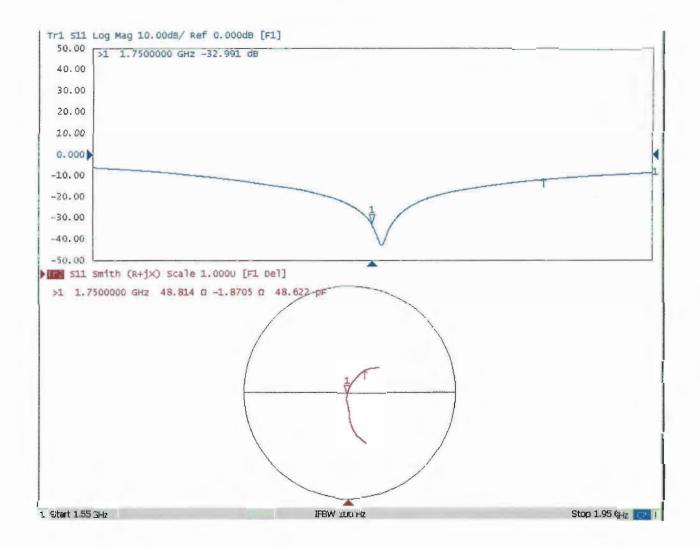
dx=5mm, dy=5mm, dz=5mm Reference Value = 93.87 V/m; Power Drift = 0.00 dBPeak SAR (extrapolated) = 17.3 W/kgSAR(1 g) = 9.2 W/kg; SAR(10 g) = 4.87 W/kg Maximum value of SAR (measured) = 14.4 W/kg



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



## Impedance Measurement Plot for Head TSL





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## DASY5 Validation Report for Body TSL

Date: 03.06.2019

Test Laboratory: CTTL, Beijing, China

## DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1112

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.465 \text{ S/m}$ ;  $\varepsilon_r = 53.49$ ;  $\rho = 1000 \text{ kg/m3}$ 

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 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

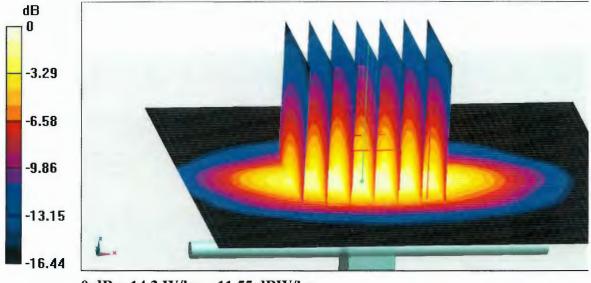
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.64 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.25 W/kg; SAR(10 g) = 4.92 W/kg

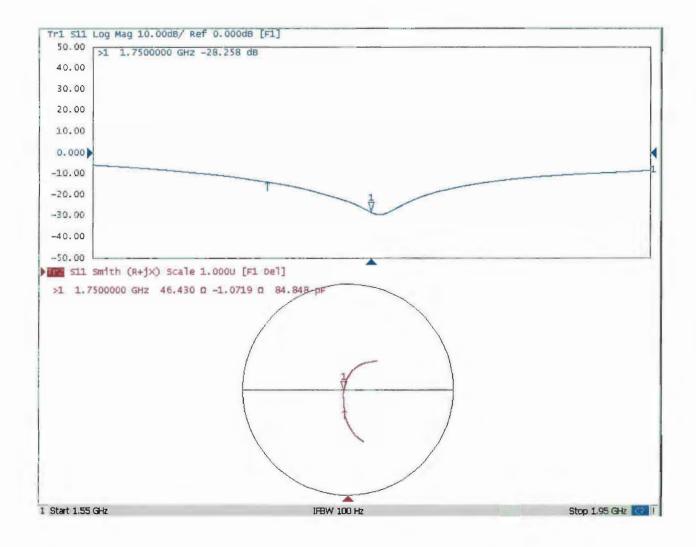
Maximum value of SAR (measured) = 14.3 W/kg



0 dB = 14.3 W/kg = 11.55 dBW/kg



## Impedance Measurement Plot for Body TSL







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#### Z18-60536 **Certificate No:**

Client

CALIBRATION GERTIFICATE

Sporton

Object

D1900V2 - SN: 5d182

December 7, 2018

Calibration Procedure(s)

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

Calibration date:

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

pages and are part of the certificate.

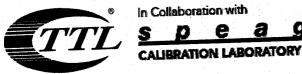
All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

		Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Primary Standards Power Meter NRVD Power sensor NRV-Z5 Reference Probe EX3DV4 DAE4	100596	Cal Date (Calibrated Dy, Containing of Calibrated Dy, Containing of Calibr	Mar-19 Mar-19 Aug-19 Aug-19
Secondary Standards Signal Generator E4438C NetworkAnalyzer E5071C	ID # MY49071430 MY46110673		Scheduled Calibration Jan-19 Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	Martin
Approved by:	Qi Dianyuan	SAR Project Leader	
	t . I . et he reprod	luced except in full without writ	Issued: December 10, 2018 ten approval of the laboratory.

This calibration certificate shall not be reproduced exc



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#### lossary:

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

# 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

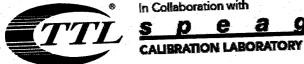
## Additional Documentation:

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
- . 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%.



In Collaboration with

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## **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

## Head TSL parameters

s and calculations were applied.

The following parameters and calculations were	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.6 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

#### P result with Head TSL SA

Condition	
250 mW input power	10.1 mW / g
normalized to 1W	39.6 mW /g ± 18.8 % (k=2)
Condition	
250 mW input power	5.25 mW / g
normalized to 1W	20.7 mW /g ± 18.7 % (k=2)
	normalized to 1W Condition 250 mW input power

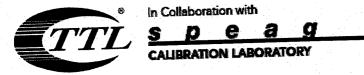
## **Body TSL parameters**

ne following parameters and calculations were a	Temperature	Permittivity	Conductivity
	22.0 °C	53.3	1.52 mho/m
Nominal Body TSL parameters	(22.0 ± 0.2) °C	51.8 ± 6 %	1.56 mho/m ± 6 %
Measured Body TSL parameters Body TSL temperature change during test			

## SAR result with Body TSL

SAR averaged over 1 $cm^3$ (1 g) of Body TSL	Condition	
	250 mW input power	10.2 mW / g
SAR measured		39.9 mW /g ± 18.8 % (k=2)
SAR for nominal Body TSL parameters	normalized to 1W	39.9 mw /g 1 10.0 // (* =/
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
	250 mW input power	5.31 mW / g
SAR measured		20.9 mW /g ± 18.7 % (k=2)
SAR for nominal Body TSL parameters	normalized to 1W	20.3 may /g 1 10.1 /6 (K 2/

Certificate No: Z18-60536



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# Appendix (Additional assessments outside the scope of CNAS L0570)

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1Ω+ 5.35jΩ
Return Loss	- 25.0dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9Ω+ 6.19ϳΩ
Return Loss	- 24.0dB

## General Antenna Parameters and Design

	1.067 ns
Electrical 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
Manufactured by	



In Collaboration with 1e CALIBRATION LABORATORY

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**DASY5 Validation Report for Head TSL** 

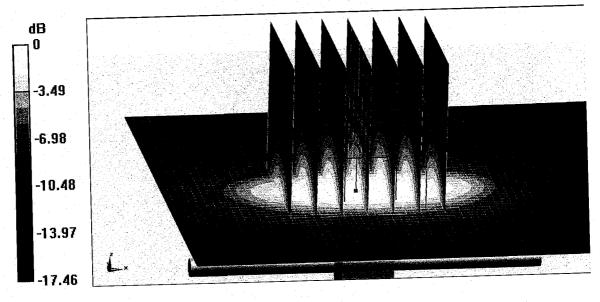
Date: 12.06.2018

Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182 Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.441 S/m;  $\epsilon_r$  = 39.59;  $\rho$  = 1000 kg/m3 Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 SN7514; ConvF(7.73, 7.73, 7.73) @ 1900 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) •
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.91 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 19.3 W/kg SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.25 W/kg Maximum value of SAR (measured) = 15.8 W/kg



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

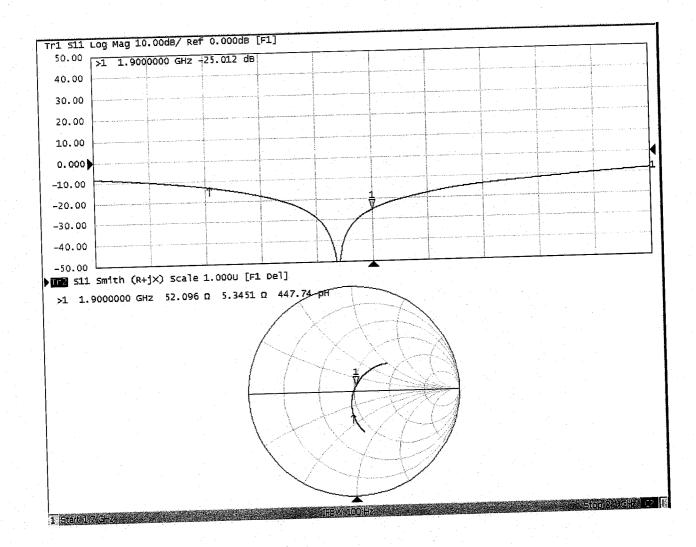


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# Impedance Measurement Plot for Head TSL





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## **DASY5 Validation Report for Body TSL**

Date: 12.05.2018

Test Laboratory: CTTL, Beijing, China DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182

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

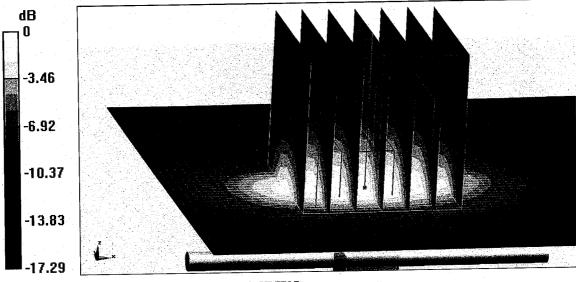
Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.564 S/m;  $\epsilon_r$  = 51.82;  $\rho$  = 1000 kg/m3

Phantom section: Right Section

**DASY5** Configuration:

- Probe: EX3DV4 SN7514; ConvF(7.53, 7.53, 7.53) @ 1900 MHz; Calibrated: • 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018 •
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062 • •
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 ٠ (7450)

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 84.07 V/m; Power Drift = -0.04 dB Peak SAR (extrapolated) = 18.9 W/kg SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.31 W/kg Maximum value of SAR (measured) = 15.7 W/kg

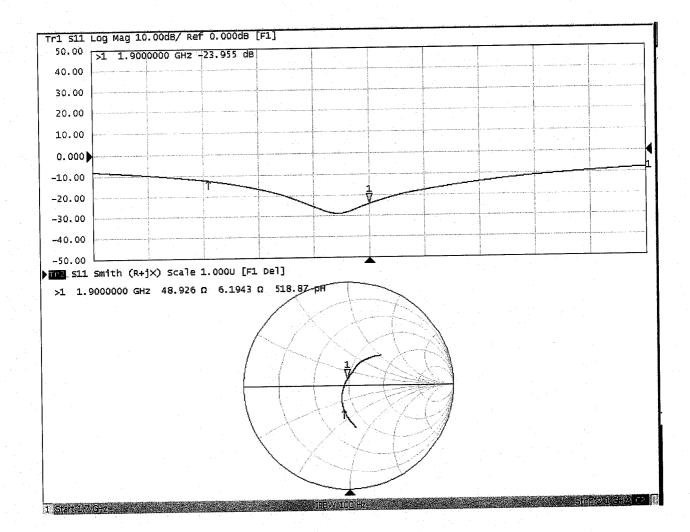


0 dB = 15.7 W/kg = 11.96 dBW/kg



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## Impedance Measurement Plot for Body TSL





# D1900V2, Serial No. 5d182 Extended Dipole Calibrations

Referring to KDB 865664 D01 v01r02, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

	D1900V2 – serial no. 5d182											
1900 Head			1900 Body									
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018.12.7	-25		52.1		5.35		-24		48.9		6.19	
2019.11.25	-25.2	-0.8	53.9	1.8	5.15	-0.2	-24.2	-0.8	48.7	-0.2	5.93	-0.26

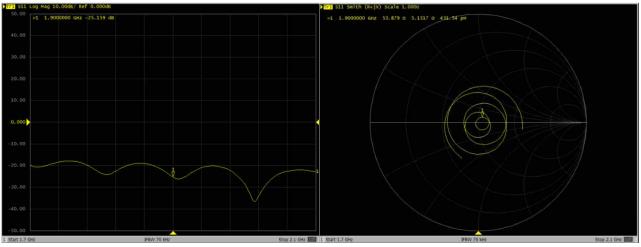
#### <Justification of the extended calibration>

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

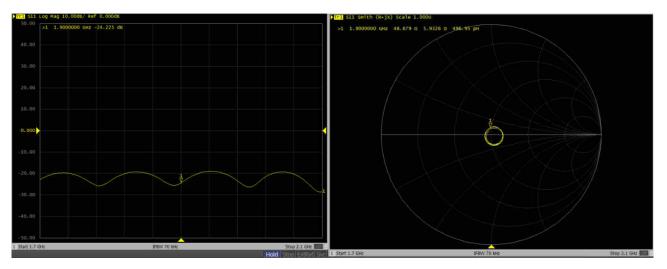


## Dipole Verification Data> D1900V2, serial no. 5d182

#### 1900MHz - Head



#### 1900MHz – Body





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Certificate No: Z18-60324

**CNAS L0570** 

# CALIBRATION CERTIFICATE Object D1900V2 - SN: 5d041 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits Calibration date: September 11, 2018 This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.</td> Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRV-Z5	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Reference Probe EX3DV4	SN 7464	12-Sep-17(SPEAG,No.EX3-7464_Sep17)	Sep-18
DAE4	SN 1524	13-Sep-17(SPEAG,No.DAE4-1524_Sep17)	Sep-18
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	1 Star
Reviewed by:	Lin Jun	SAR Test Engineer	-49
Approved by:	Qi Dianyuan	SAR Project Leader	202
		Issued: Septer	mber 15, 2018



## 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%.



## **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 averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.2 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.2 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	53.3 ± 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	9.94 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.2 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.35 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.5 mW /g ± 18.7 % (k=2)



## Appendix (Additional assessments outside the scope of CNAS L0570)

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9Ω+ 7.43jΩ
Return Loss	- 22.3dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6Ω+ 6.80jΩ
Return Loss	- 22.7dB

## 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
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DASY5 Validation Report for Head TSL

Date: 09.10.2018

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d041** Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz;  $\sigma = 1.438$  S/m;  $\varepsilon_r = 40.37$ ;  $\rho = 1000$  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)

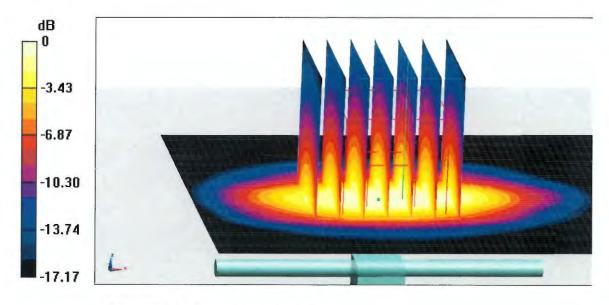
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.66 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 19.1 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.35 W/kg

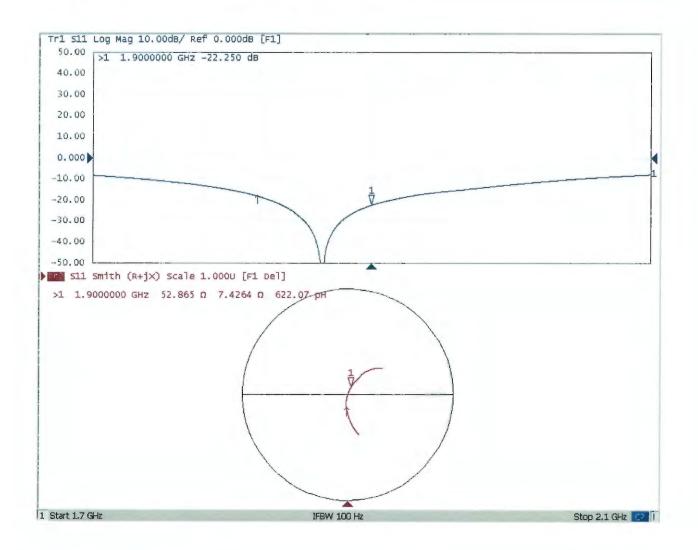
Maximum value of SAR (measured) = 15.7 W/kg



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



## Impedance Measurement Plot for Head TSL





## DASY5 Validation Report for Body TSL

Test Laboratory: CTTL, Beijing, China

Date: 09.10.2018

## DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d041

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

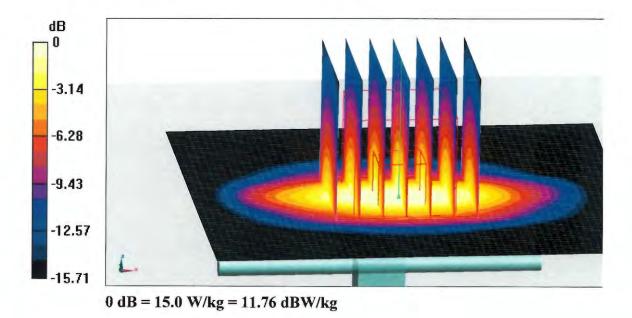
Medium parameters used: f = 1900 MHz;  $\sigma = 1.493 \text{ S/m}$ ;  $\varepsilon_r = 53.34$ ;  $\rho = 1000 \text{ kg/m3}$ 

Phantom section: Right Section

DASY5 Configuration:

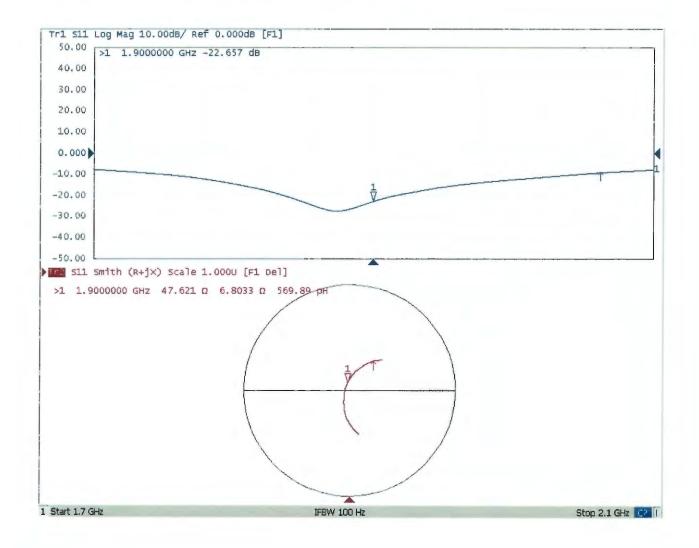
- Probe: EX3DV4 SN7464; ConvF(8.32, 8.32, 8.32) @ 1900 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1524; Calibrated: 9/13/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439))

System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 94.03 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 17.5 W/kg SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.35 W/kg Maximum value of SAR (measured) = 15.0 W/kg





## Impedance Measurement Plot for Body TSL





#### D1900V2, serial no. 5D041 Extended Dipole Calibrations

Referring to KDB 450824, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

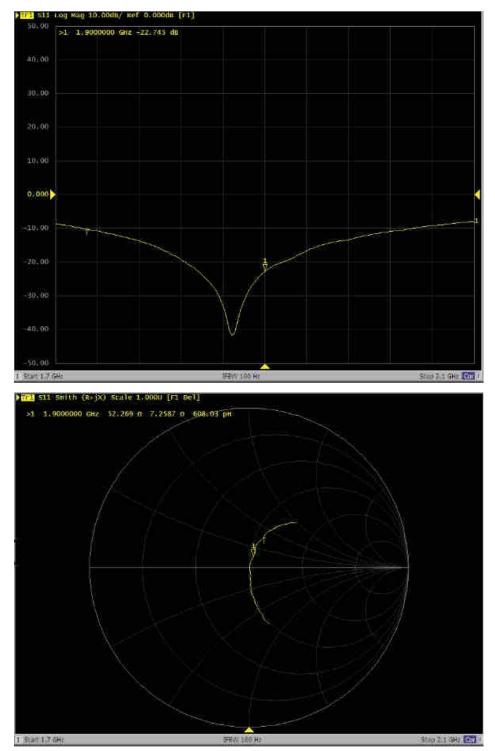
#### <Justification of the extended calibration>

D <b>1900</b> V2 – serial no. <b>5D041</b>						
	<b>1900</b> Head					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
09.11.2018	-22.25		52.865		7.4264	
09.10.2019	-22.745	2.176	52.269	-0.596	7.2587	-0.1677

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.



<Dipole Verification Data> - D1900 V2, serial no. 5D041 (Data of Measurement : 9.10.2019) 1900 MHz - Head





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**Certificate No:** Z19-60058

# CALIBRATION CERTIFICATE

Object

D1900V2 - SN: 5d185

March 7, 2019

Calibration Procedure(s)

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

Calibration date:

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

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

Calibration Equipment used (M&TE critical for calibration)

ID # 106277 104291 SN 3617	Cal Date(Calibrated by, Certificate No.) 20-Aug-18 (CTTL, No.J18X06862) 20-Aug-18 (CTTL, No.J18X06862)	Scheduled Calibration Aug-19
104291		
	20-Aug-18 (CTTL, No.J18X06862)	A 10
SN 3617		Aug-19
	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
SN 1331	06-Feb-19(SPEAG,No.DAE4-1331_Feb19)	Feb-20
ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan-20
Name	Function	Signature
Zhao Jing	SAR Test Engineer	AN
Lin Hao	SAR Test Engineer	The the
Qi Dianyuan	SAR Project Leader	- Alter
	Issued: March	9, 2019
-	MY49071430 MY46110673 Name Zhao Jing Lin Hao Qi Dianyuan	MY4907143023-Jan-19 (CTTL, No.J19X00336)MY4611067324-Jan-19 (CTTL, No.J19X00547)NameFunctionZhao JingSAR Test EngineerLin HaoSAR Test Engineer

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



#### 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%.



#### **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 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 averaged over 1 $cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.4 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.5 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.0±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	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.1 W/kg ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 W/kg ± 18.7 % (k=2)



#### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2Ω+ 6.37jΩ
Return Loss	- 23.2dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.0Ω+ 7.57jΩ
Return Loss	- 22.3dB

#### General Antenna Parameters and Design

Electrical Delay (one direction) 1.067 ns	Electrical Delay (one direction)	1.067 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

#### **Additional EUT Data**

Manufactured by	SPEAG
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#### DASY5 Validation Report for Head TSL

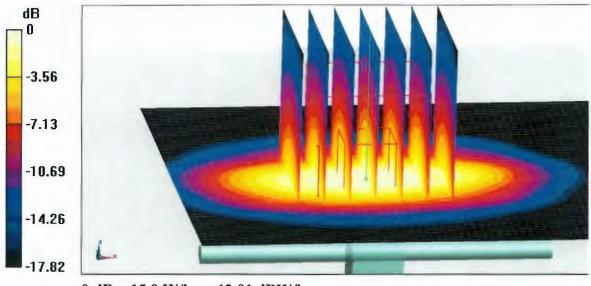
Date: 03.06.2019

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d185** Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz;  $\sigma = 1.44$  S/m;  $\varepsilon_r = 40.43$ ;  $\rho = 1000$  kg/m3 Phantom section: Center Section DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.14, 8.14, 8.14) @ 1900 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

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

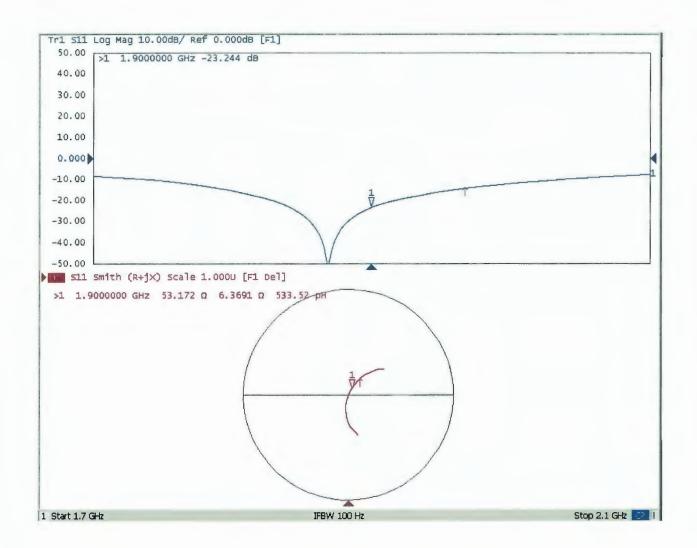
dx=5mm, dy=5mm, dz=5mm Reference Value = 96.22 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 19.3 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.17 W/kg Maximum value of SAR (measured) = 15.9 W/kg



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



#### Impedance Measurement Plot for Head TSL





Date: 03.06.2019

#### Test Laboratory: CTTL, Beijing, China **DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d185** Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz; σ = 1.564 S/m; ε<sub>r</sub> = 53.01; ρ = 1000 kg/m3

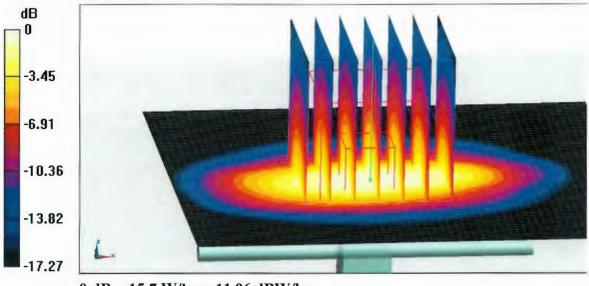
Phantom section: Right Section

**DASY5 Validation Report for Body TSL** 

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.78, 7.78, 7.78) @ 1900 MHz; Calibrated: 1/31/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2/6/2019
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

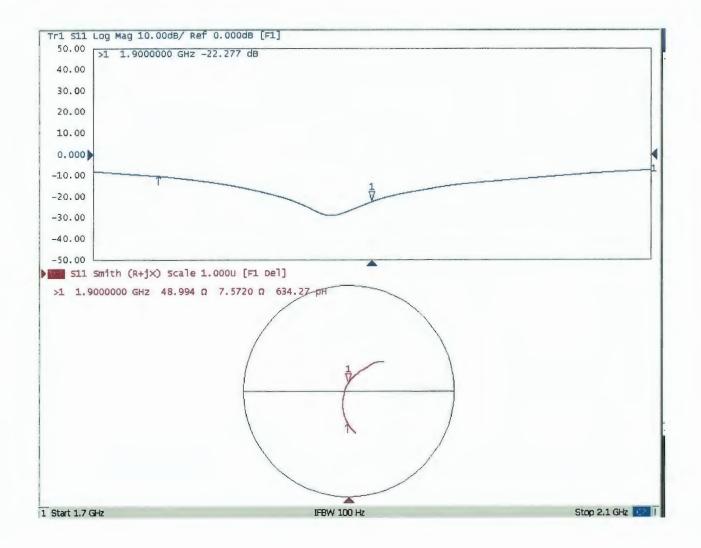
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 92.42 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 18.8 W/kg SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.28 W/kg Maximum value of SAR (measured) = 15.7 W/kg



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



#### Impedance Measurement Plot for Body TSL



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Object	D2300	DV2 - SN: 1056		
Calibration Procedure(s)		n an	n en	·
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Calibration Equipment use	d (M&TE critical f	for calibration)		
			· ·	
Primary Standards	ID #		ed by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	07-Mar-18 (CTTL,	,	Mar-19
Power sensor NRV-Z5 Reference Probe EX3DV4	100596	07-Mar-18 (CTTL,	'	Mar-19
DAE4	1		,No.EX3-7514_Aug18)	Aug-19
DAC4	SN 1555	20-Aug-18(SPEAG	No.DAE4-1555_Aug18	3) Aug-19
Secondary Standards	ID#	Cal Date(Calibrate	d by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL,		Jan-19
NetworkAnalyzer E5071C		24-Jan-18 (CTTL,		Jan-19
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	Name	Function		Signature
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	Qi Dianyuan	SAR Project	Leader	
			Issued: Nove	ember 5, 2018
This calibration certificate sl	nall not be reproc	duced except in full w	vithout written approval of	of the laboratory.
		,		
Certificate No: Z18-6039	1	Page 1 of 8		



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#### **Glossary:**

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

## Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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



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#### **Measurement Conditions**

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	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	39.4 ± 6 %	1.70 mho/m ± 6 %	
Head TSL temperature change during test	<1.0 °C			
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#### SAR result with Head TSL

SAR averaged over $1 - cm^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	49.9 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.97 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.8 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	52.9	1.81 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.0 ± 6 %	1.86 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

#### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	48.1 mW /g ± 18.8 % (k=2)
SAR averaged over 10 $cm^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.82 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.1 mW /g ± 18.7 % (k=2)



# Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.5Ω- 3.86jΩ	
Return Loss	- 25.3dB	

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.9Ω- 2.30jΩ
Return Loss	- 23.1dB

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

Electrical Delay (one direction)	1 000
	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

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Manufactured by	SPEAC
	SPEAG



**DASY5 Validation Report for Head TSL** 

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Date: 11.01.2018

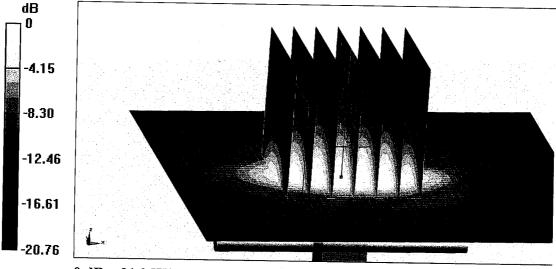
Test Laboratory: CTTL, Beijing, China DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1056 Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2300 MHz;  $\sigma$  = 1.7 S/m;  $\epsilon_r$  = 39.42;  $\rho$  = 1000 kg/m3 Phantom section: Center Section **DASY5** Configuration:

- Probe: EX3DV4 SN7514; ConvF(7.42, 7.42, 7.42) @ 2300 MHz; Calibrated: • 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection) •
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062 ٠
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 • (7450)

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

Reference Value = 106.4 V/m; Power Drift = -0.02 dBPeak SAR (extrapolated) = 26.1 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.97 W/kg Maximum value of SAR (measured) = 21.0 W/kg



0 dB = 21.0 W/kg = 13.22 dBW/kg

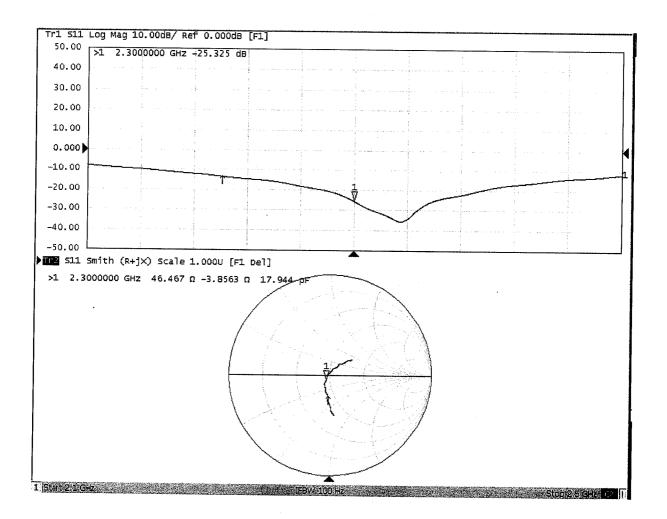


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#### Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL** Date: 11.01.2018 Test Laboratory: CTTL, Beijing, China DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1056 Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2300 MHz;  $\sigma = 1.864$  S/m;  $\varepsilon_r = 52.96$ ;  $\rho = 1000$  kg/m3 Phantom section: Right Section **DASY5** Configuration:

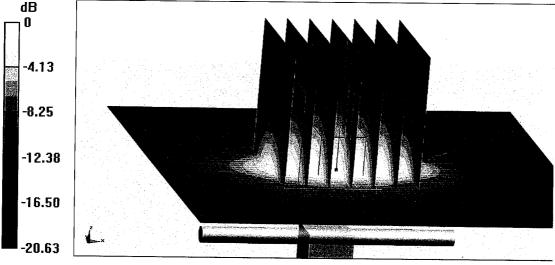
- Probe: EX3DV4 SN7514; ConvF(7.25, 7.25, 7.25) @ 2300 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1555; Calibrated: 8/20/2018
- Phantom: MFP V5.1C; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 • (7450)

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

Reference Value = 99.95 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 24.5 W/kg

SAR(1 g) = 12.2 W/kg; SAR(10 g) = 5.82 W/kg Maximum value of SAR (measured) = 20.0 W/kg



0 dB = 20.0 W/kg = 13.01 dBW/kg



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### Impedance Measurement Plot for Body TSL

