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CALIBRATION LABORATORY

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E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) Http://www.chinattl.cn

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5Ω+ 4.52jΩ
Return Loss	- 25.9dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1Ω+ 5.39jΩ
Return Loss	- 25.3dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.263 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: 10.12.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 928**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450 \text{ MHz}$ ;  $\sigma = 1.777 \text{ S/m}$ ;  $\epsilon_r = 39.03$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.51, 4.51, 4.51); Calibrated: 4/15/2018;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2018
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

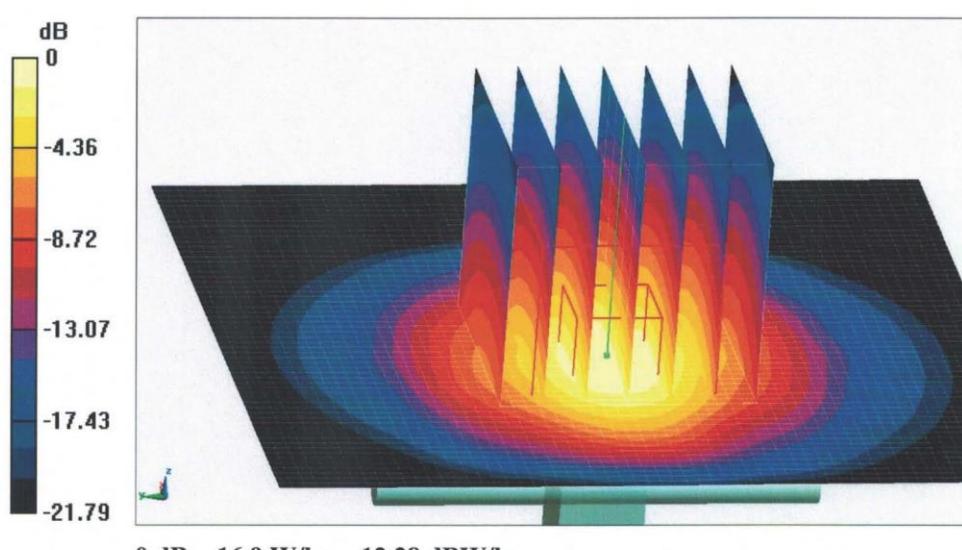
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 100.2 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.4 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.08 W/kg**

Maximum value of SAR (measured) = 16.9 W/kg

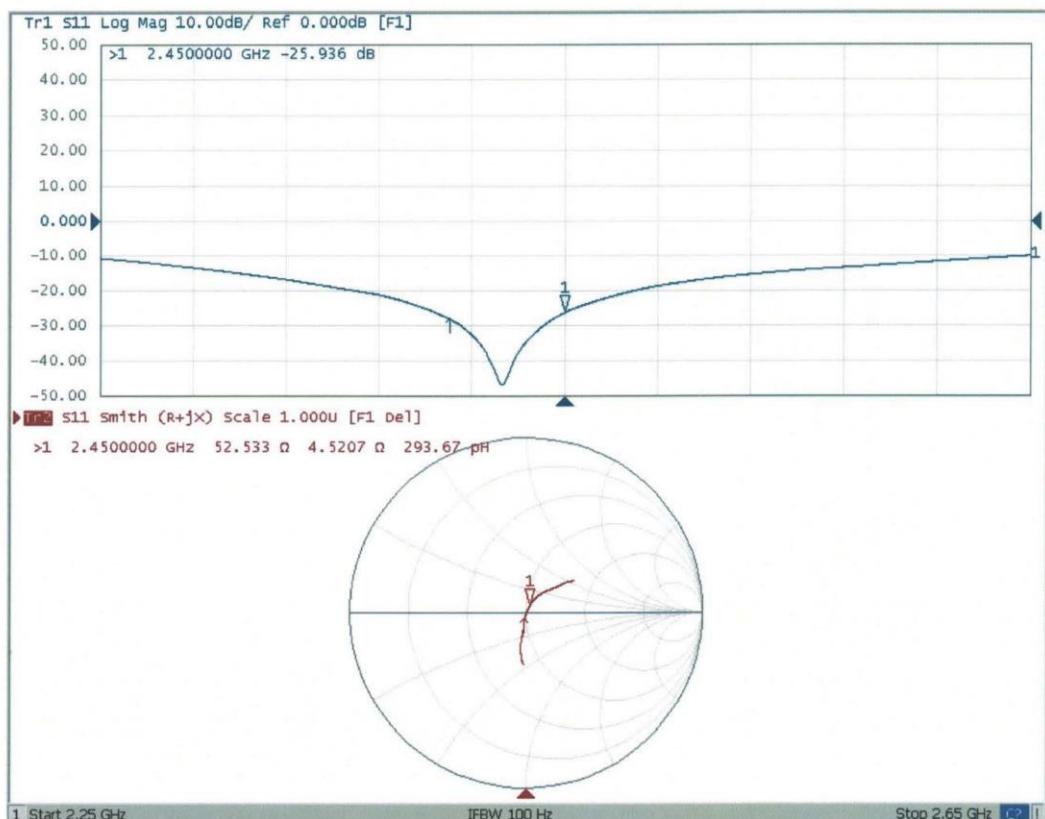




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### Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL**

Date: 10.12.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 928**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450 \text{ MHz}$ ;  $\sigma = 1.923 \text{ S/m}$ ;  $\epsilon_r = 52.91$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.23, 4.23, 4.23); Calibrated: 4/15/2018;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2018
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

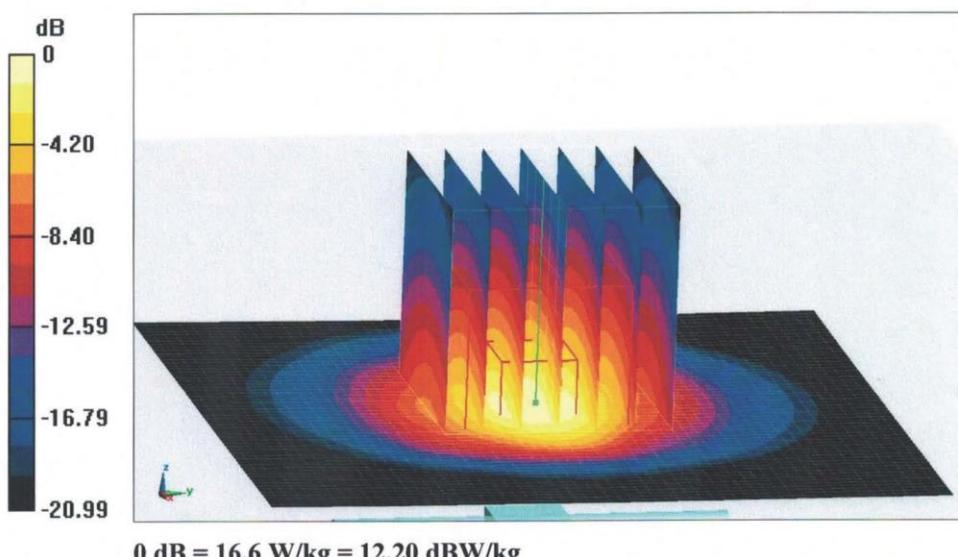
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 97.26 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 24.6 W/kg

**SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.96 W/kg**

Maximum value of SAR (measured) = 16.6 W/kg

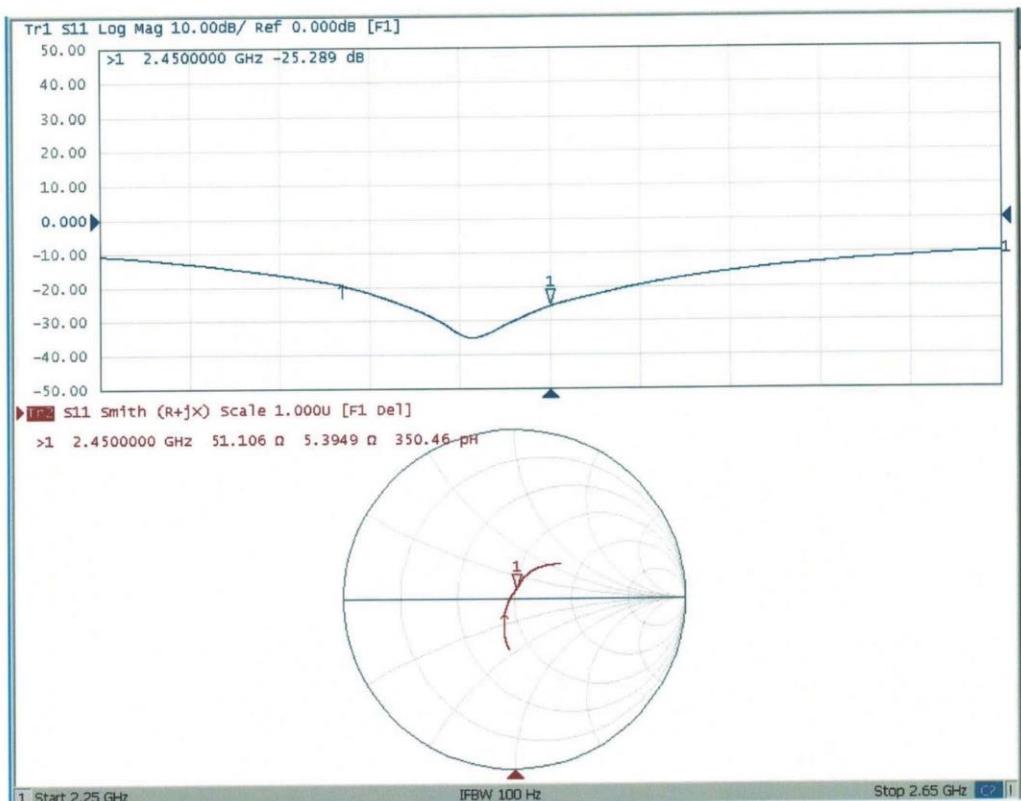




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**Impedance Measurement Plot for Body TSL**



## 1.7. D2600V2 Dipole Calibration Certificate



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CALIBRATION  
CNAS L0570

Client

GTI

Certificate No: Z18-60135

### CALIBRATION CERTIFICATE

Object D2600V2 - SN: 1126

Calibration Procedure(s) FF-Z11-003-01  
Calibration Procedures for dipole validation kits

Calibration date: August 29, 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( $22\pm3$ )°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	102083	22-Sep-17 (CTTL, No.J16X06809)	Sep-18
Power sensor NRV-Z5	100595	22-Sep-17 (CTTL, No.J16X06809)	Sep-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG, No.EX3-3617_Jan17)	Jan-18
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG, No.Z17-97015)	Jan-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

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

Issued: September 2, 2018

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



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**Glossary:**

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

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

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "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	52.10.1.1476
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	2600 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.97 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	57.4 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.51 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	26.0 mW /g ± 18.7 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.9 ± 6 %	2.17 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	13.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	53.8 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.9 mW /g ± 18.7 % (k=2)



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.3Ω- 5.20jΩ
Return Loss	- 25.1dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.6Ω- 4.12jΩ
Return Loss	- 24.0dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.256 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.

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#### Additional EUT Data

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**DASY5 Validation Report for Head TSL**

Date: 08.29.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1126**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.968$  S/m;  $\epsilon_r = 38.68$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.3, 7.3, 7.3); Calibrated: 1/23/2018;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2018
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

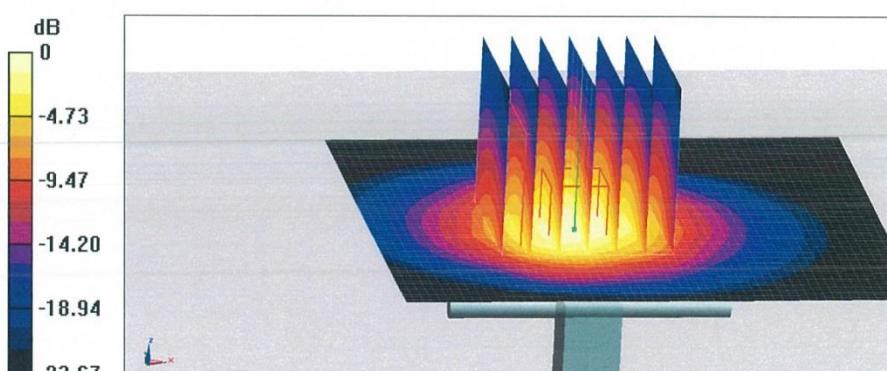
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.4 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.51 W/kg

Maximum value of SAR (measured) = 24.6 W/kg



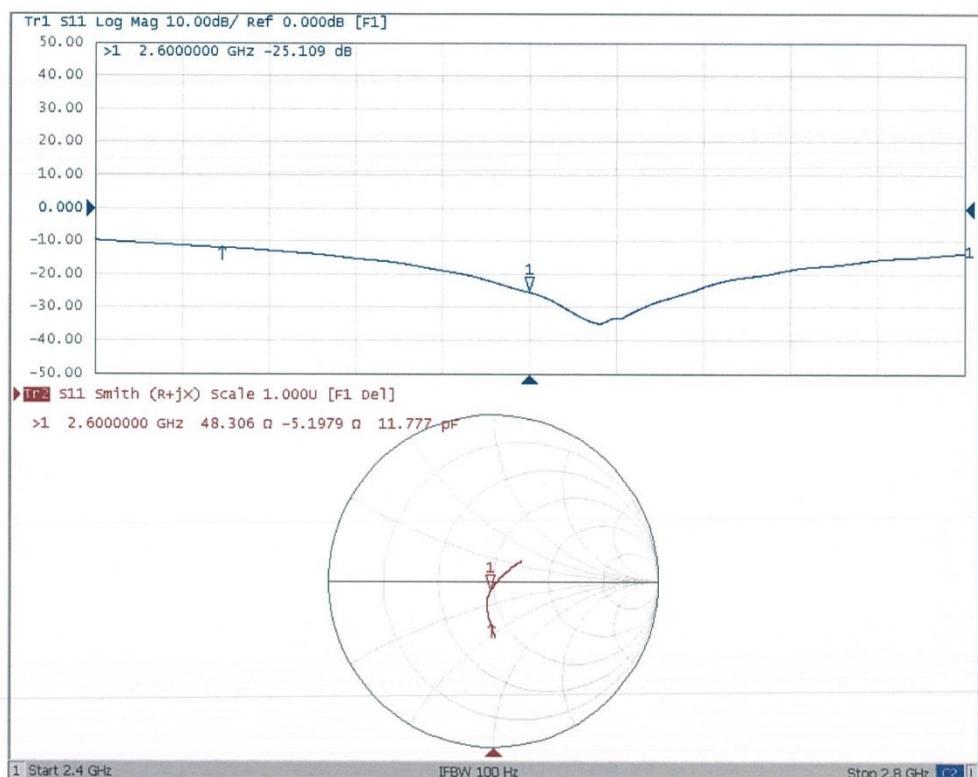
0 dB = 24.6 W/kg = 13.91 dBW/kg



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### Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL**

Date: 08.29.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1126**

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2600 \text{ MHz}$ ;  $\sigma = 2.166 \text{ S/m}$ ;  $\epsilon_r = 51.94$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.48, 7.48, 7.48); Calibrated: 1/23/2018;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2018
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

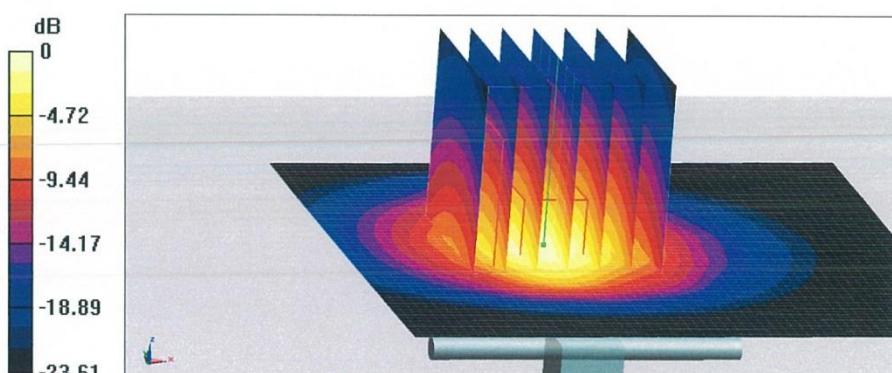
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 76.81 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 29.6 W/kg

**SAR(1 g) = 13.5 W/kg; SAR(10 g) = 5.99 W/kg**

Maximum value of SAR (measured) = 23.5 W/kg



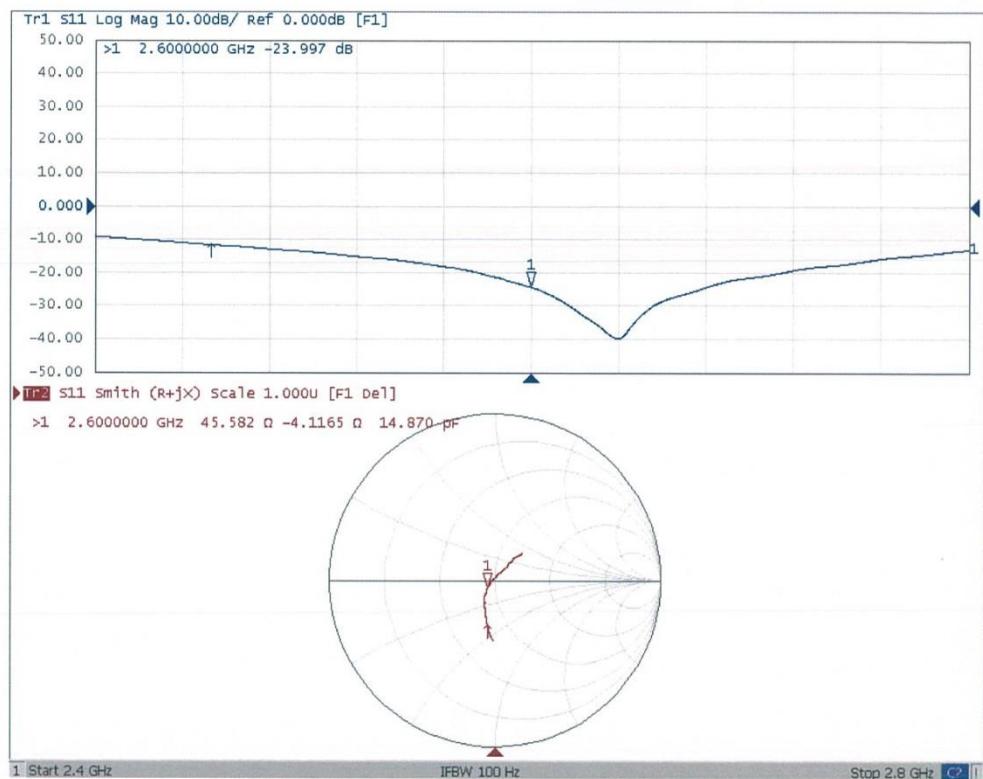
**0 dB = 23.5 W/kg = 13.71 dBW/kg**



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### Impedance Measurement Plot for Body TSL



## 1.8. sD5GHzV2 Dipole Calibration Certificate



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中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Client GTI

Certificate No: Z18-60199

### CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1171

Calibration Procedure(s) FD-Z11-003-01  
 Calibration Procedures for dipole validation kits

Calibration date: October 13, 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( $22\pm3$ )°C and humidity<70%.

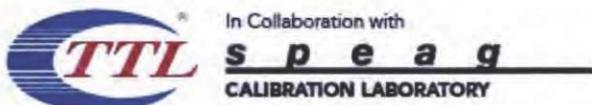
#### Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-17 (CTTL, No.J16X04777)	Jun-18
Power sensor NRP-Z91	101547	27-Jun-17 (CTTL, No.J16X04777)	Jun-18
ReferenceProbe EX3DV4	SN 7307	19-Feb-17(SPEAG, No.EX3-7307_Feb16)	Feb-18
DAE4	SN 771	02-Feb-17(CTTL-SPEAG, No.Z16-97011)	Feb-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-17 (CTTL, No.J16X00893)	Jan-18
NetworkAnalyzer E5071C	MY46110673	26-Jan-17 (CTTL, No.J16X00894)	Jan-18

Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: October 15, 2018

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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

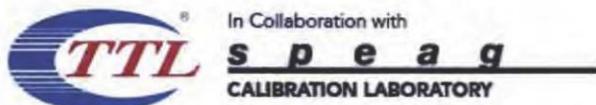
**Additional Documentation:**

- 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.

<b>DASY Version</b>	DASY52	52.10.1.1476
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Triple Flat Phantom 5.1C	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	$dx, dy = 4 \text{ mm}, dz = 1.4 \text{ mm}$	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	5250 MHz $\pm 1 \text{ MHz}$ 5600 MHz $\pm 1 \text{ MHz}$ 5750 MHz $\pm 1 \text{ MHz}$	

### Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	35.9	4.71 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm 0.2$ ) °C	36.3 $\pm 6$ %	4.72 mho/m $\pm 6$ %
<b>Head TSL temperature change during test</b>	<1.0 °C	---	---

### SAR result with Head TSL at 5250 MHz

<b>SAR averaged over 1 <math>\text{cm}^3</math> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	7.64 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	76.6 mW / g $\pm 23.0$ % (k=2)
<b>SAR averaged over 10 <math>\text{cm}^3</math> (10 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	2.18 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.9 mW / g $\pm 22.2$ % (k=2)



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### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.17 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

### SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.4 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.28 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.8 mW /g ± 22.2 % (k=2)

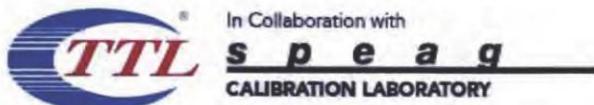
### Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	5.37 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.00 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.0 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.27 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.7 mW /g ± 22.2 % (k=2)



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### Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.9 ± 6 %	5.44 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

### SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.58 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	75.6 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.14 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.3 mW /g ± 22.2 % (k=2)

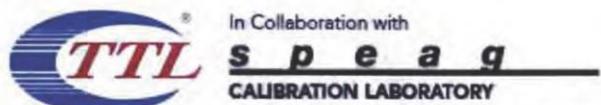
### Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.9 ± 6 %	5.74 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

### SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	81.1 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.28 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	22.9 mW /g ± 22.2 % (k=2)



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### Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.7 ± 6 %	5.91 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

### SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	74.8 mW /g ± 23.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.0 mW /g ± 22.2 % (k=2)



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## Appendix

### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	$49.1\Omega - 6.49j\Omega$
Return Loss	- 23.6dB

### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$54.1\Omega + 1.72j\Omega$
Return Loss	- 27.5dB

### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	$52.4\Omega - 3.51j\Omega$
Return Loss	- 27.6dB

### Antenna Parameters with Body TSL at 5250 MHz

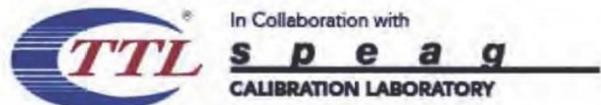
Impedance, transformed to feed point	$45.7\Omega - 4.04j\Omega$
Return Loss	- 24.2dB

### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	$54.9\Omega + 0.69j\Omega$
Return Loss	- 26.5dB

### Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	$53.3\Omega - 3.65j\Omega$
Return Loss	- 26.4dB



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### General Antenna Parameters and Design

Electrical Delay (one direction)	1.313 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

### Additional EUT Data

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**DASY5 Validation Report for Head TSL**

Date: 12.12.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1171**

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

Medium parameters used:  $f = 5250 \text{ MHz}$ ;  $\sigma = 4.724 \text{ mho/m}$ ;  $\epsilon_r = 36.26$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5600 \text{ MHz}$ ;  $\sigma = 5.172 \text{ mho/m}$ ;  $\epsilon_r = 35.54$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5750 \text{ MHz}$ ;  $\sigma = 5.371 \text{ mho/m}$ ;  $\epsilon_r = 35.17$ ;  $\rho = 1000 \text{ kg/m}^3$ ,

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(5.32,5.32,5.32); Calibrated: 2018/2/19, ConvF(4.52,4.52,4.52); Calibrated: 2018/2/19, ConvF(4.45,4.45,4.45); Calibrated: 2018/2/19,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2018/2/2
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

**Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.25 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.2 W/kg

**SAR(1 g) = 7.64 W/kg; SAR(10 g) = 2.18 W/kg**

Maximum value of SAR (measured) = 18.1 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.92 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 35.1 W/kg

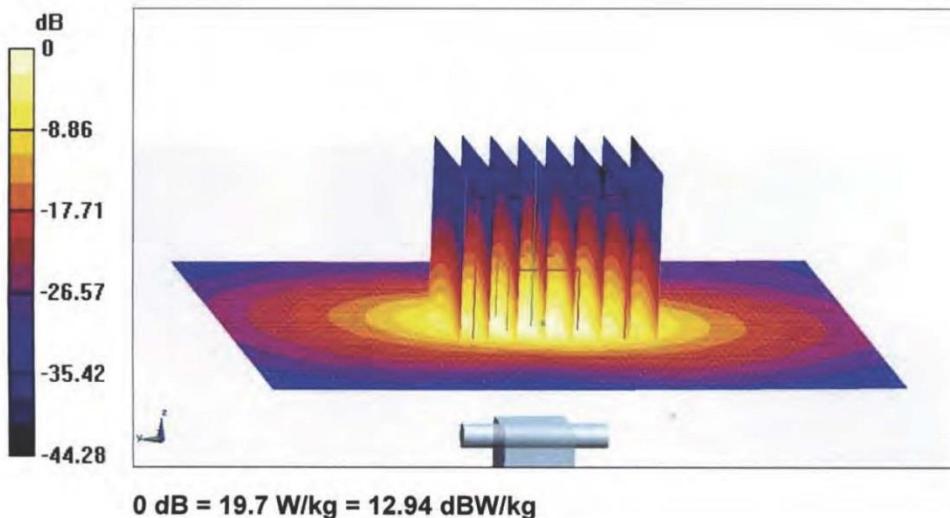
**SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.28 W/kg**

Maximum value of SAR (measured) = 19.7 W/kg



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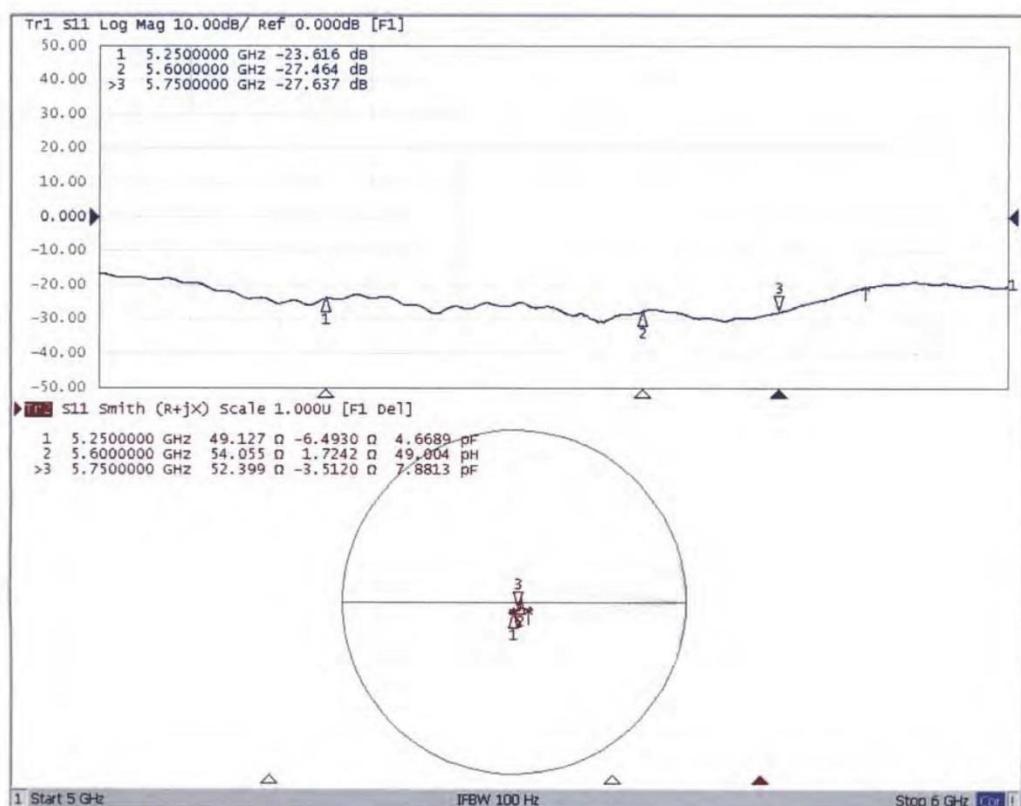
**Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan,  
dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 70.79 V/m; Power Drift = 0.02 dB  
Peak SAR (extrapolated) = 34.1 W/kg  
**SAR(1 g) = 8 W/kg; SAR(10 g) = 2.27 W/kg**  
Maximum value of SAR (measured) = 19.7 W/kg





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**Impedance Measurement Plot for Head TSL**





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**DASY5 Validation Report for Body TSL**

Date: 12.13.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1171**

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

Medium parameters used:  $f = 5250 \text{ MHz}$ ;  $\sigma = 5.442 \text{ mho/m}$ ;  $\epsilon_r = 47.93$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5600 \text{ MHz}$ ;  $\sigma = 5.74 \text{ mho/m}$ ;  $\epsilon_r = 48.92$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5750 \text{ MHz}$ ;  $\sigma = 5.91 \text{ mho/m}$ ;  $\epsilon_r = 48.73$ ;  $\rho = 1000 \text{ kg/m}^3$ ,

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(4.48,4.48,4.48); Calibrated: 2018/2/19, ConvF(3.72,3.72,3.72); Calibrated: 2018/2/19, ConvF(3.91,3.91,3.91); Calibrated: 2018/2/19,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2018/2/2
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

**Dipole Calibration /Pin=100mW, d=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 50.01 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 29.2 W/kg

**SAR(1 g) = 7.58 W/kg; SAR(10 g) = 2.14 W/kg**

Maximum value of SAR (measured) = 17.8 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 59.54 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 31.5 W/kg

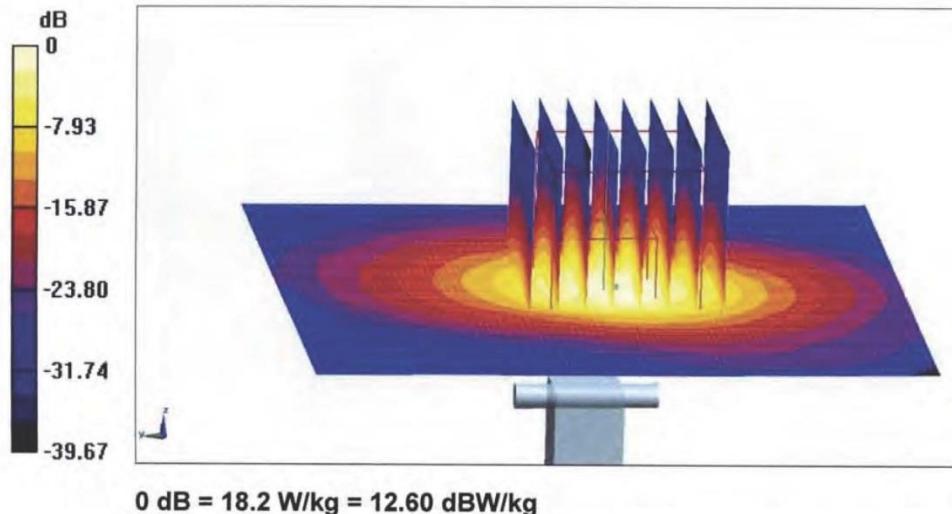
**SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.28 W/kg**

Maximum value of SAR (measured) = 18.8 W/kg



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**Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan,  
dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 61.53 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 30.9 W/kg  
**SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.1 W/kg**  
Maximum value of SAR (measured) = 18.2 W/kg





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### Impedance Measurement Plot for Body TSL

