



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

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

Client **BTL Inc .**

Certificate No: **Z18-60176**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1095**

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

Calibration date: **June 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
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 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 11, 2018

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



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

### Glossary:

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

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

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

### Additional Documentation:

- 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%.



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

**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>	15 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	750 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	41.9	0.89 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	42.9 $\pm$ 6 %	0.86 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	2.06 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>8.47 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	1.38 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>5.64 mW / g <math>\pm</math> 18.7 % (k=2)</b>

**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	55.5	0.96 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	55.8 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Body TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	2.08 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>8.51 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	1.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>5.66 mW / g <math>\pm</math> 18.7 % (k=2)</b>



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9Ω- 1.15jΩ
Return Loss	- 30.4dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.9Ω- 2.43jΩ
Return Loss	- 29.6dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	0.897 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

**s p e a g**  
**CALIBRATION LABORATORY**

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

## DASY5 Validation Report for Head TSL

Date: 06.04.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1095**

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.864$  S/m;  $\epsilon_r = 42.91$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.57, 10.57, 10.57) @ 750 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.IC ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

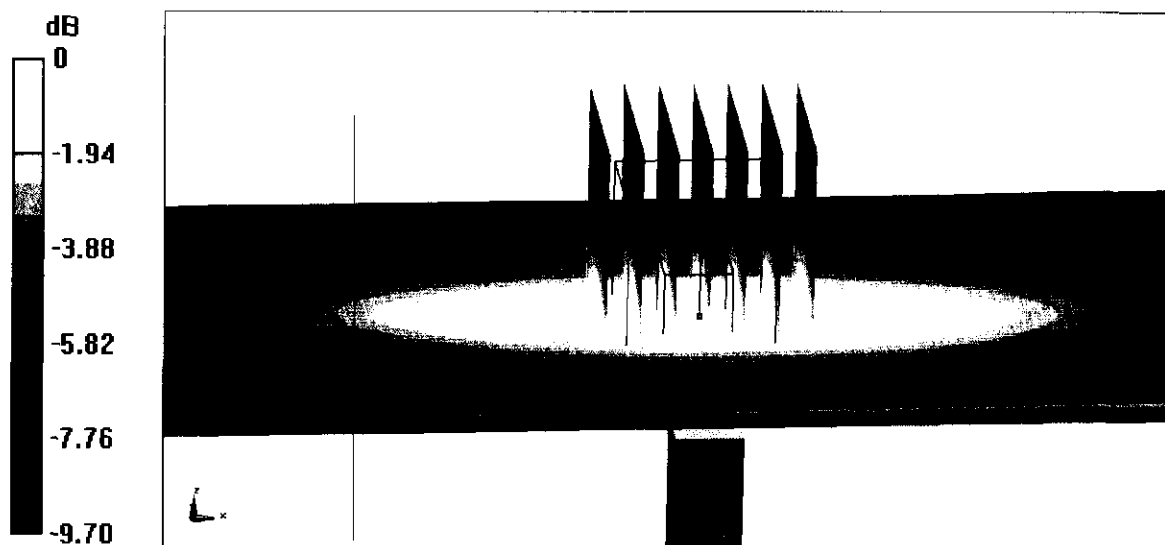
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.80 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.05 W/kg

**SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.38 W/kg**

Maximum value of SAR (measured) = 2.70 W/kg



0 dB = 2.70 W/kg = 4.31 dBW/kg



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

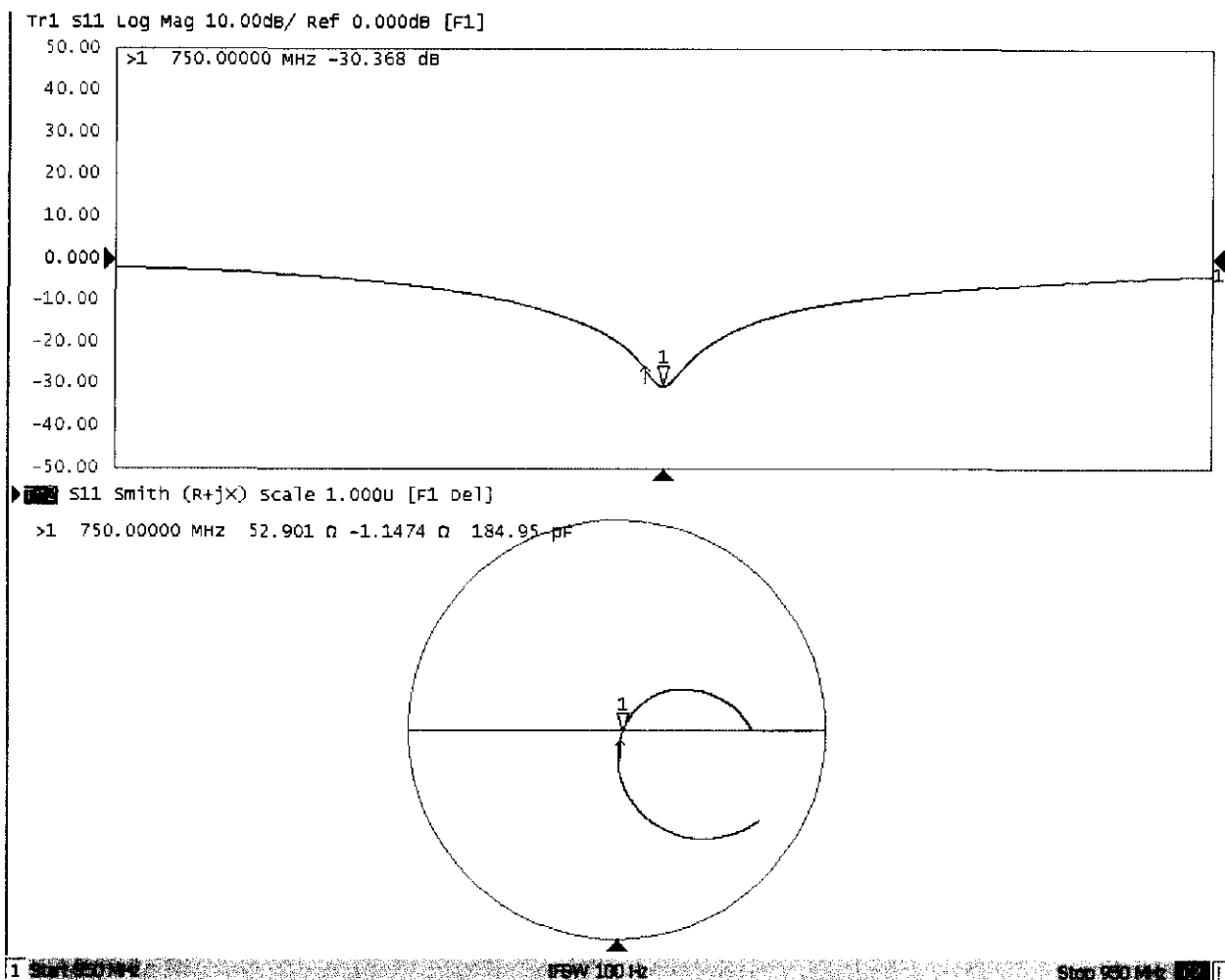
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL





In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

## DASY5 Validation Report for Body TSL

Date: 06.04.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1095**

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

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.933$  S/m;  $\epsilon_r = 55.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.63, 10.63, 10.63) @ 750 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

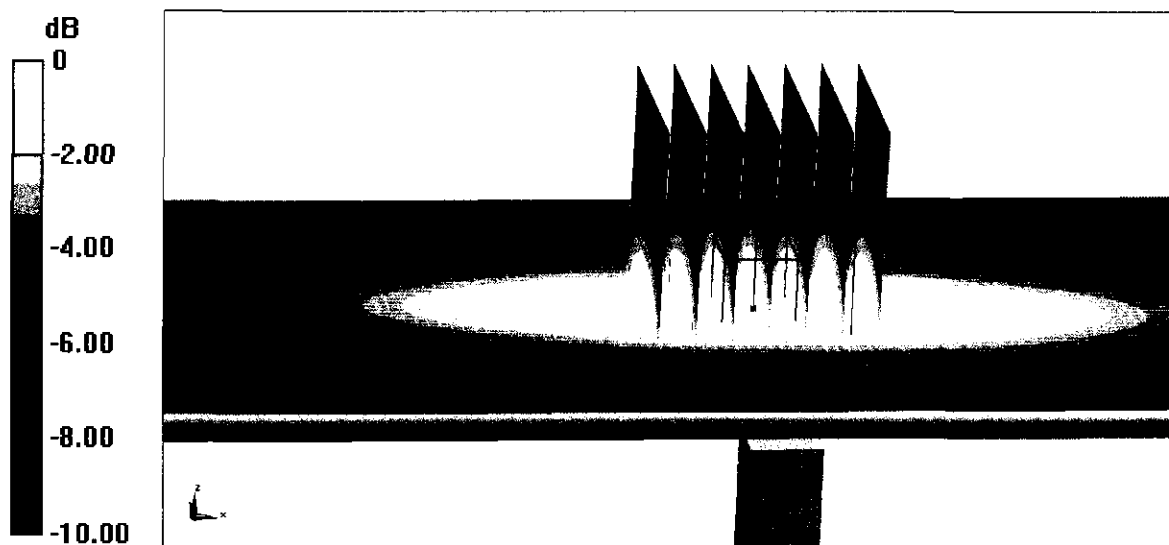
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.27 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.09 W/kg

**SAR(1 g) = 2.08 W/kg; SAR(10 g) = 1.39 W/kg**

Maximum value of SAR (measured) = 2.76 W/kg



0 dB = 2.76 W/kg = 4.41 dBW/kg



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

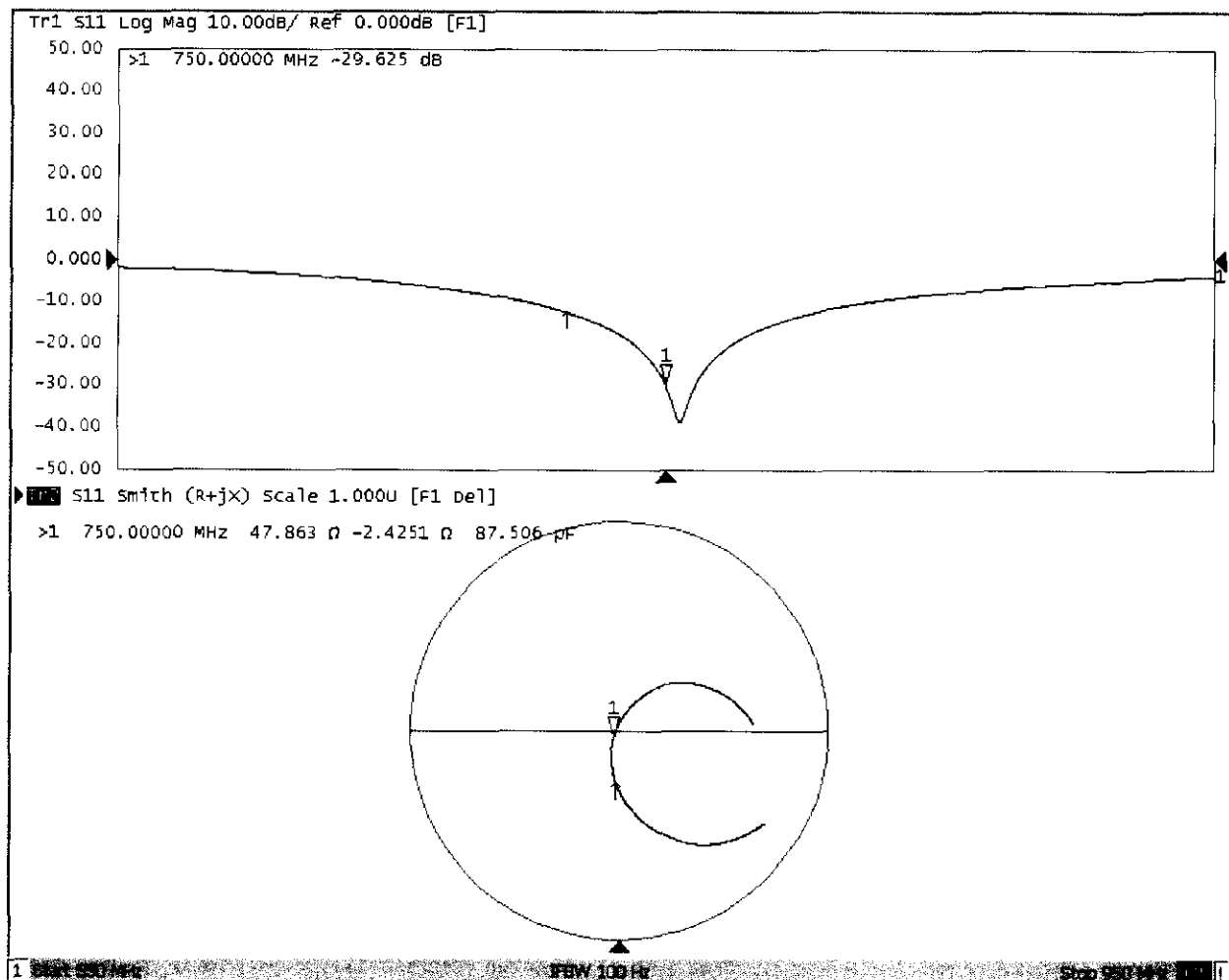
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL







## Dipole Internal Calibration Record

Asset No. :	E-429	Model No. :	D750V3	Serial No. :	1095
Environmental	22.4°C, 53 %	Original Cal. Date :	June 5, 2018	Next Cal. Date :	June 5, 2021

### Standard List

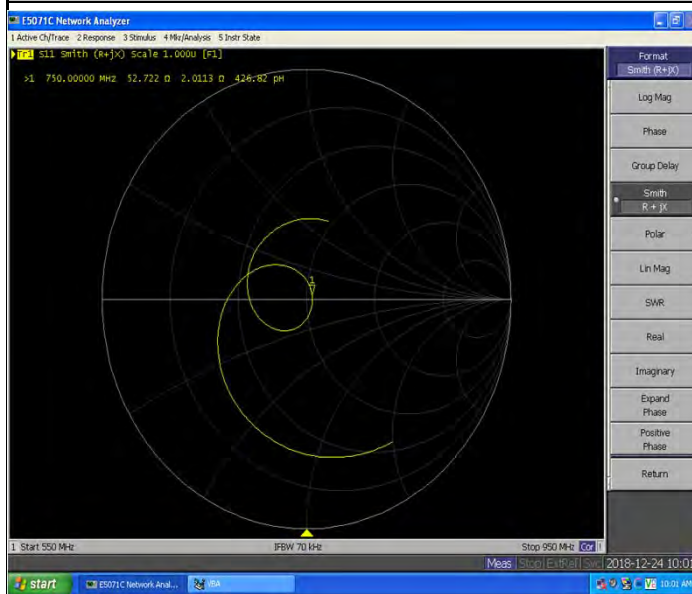
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

### Equipment Information

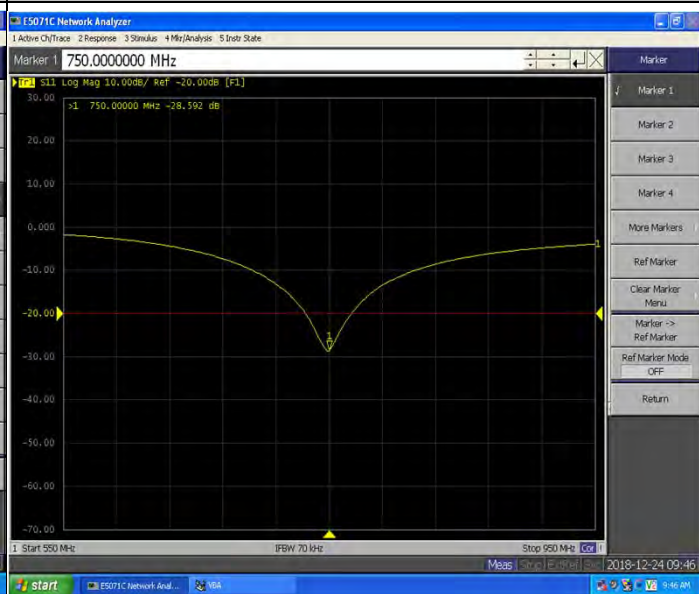
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

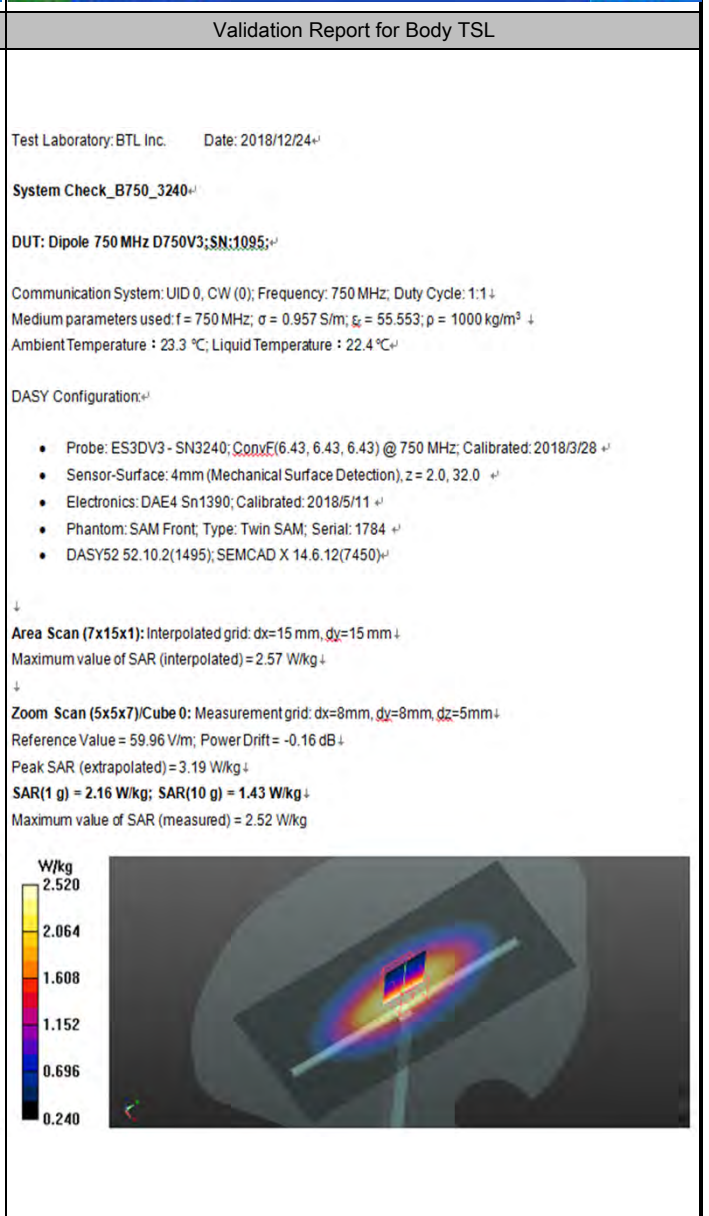
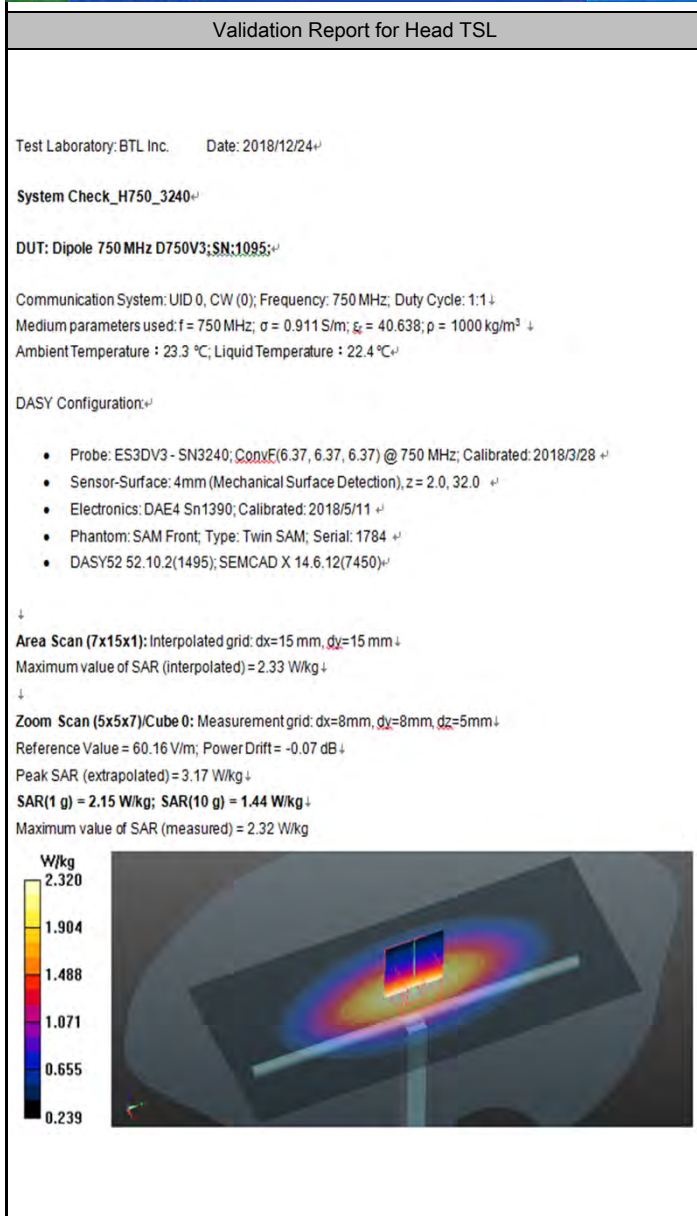
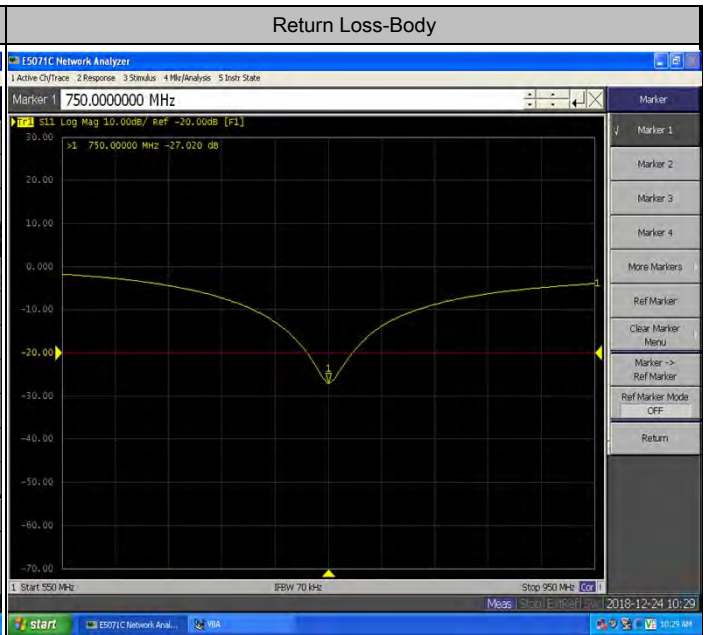
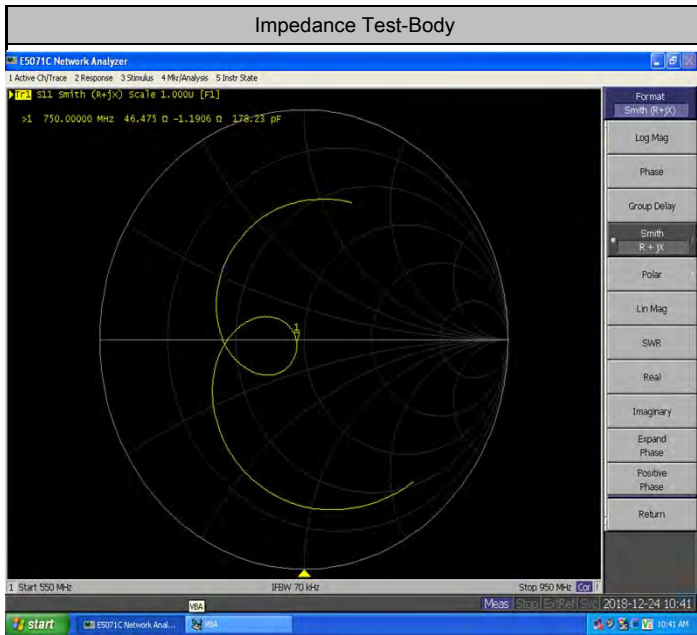
Model No	For Head Tissue				
D750V3	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	52.9Ω-1.15jΩ	52.7Ω+2.01jΩ	<5Ω	Pass
	Return Loss(dB)	-30.4	-28.6	-5.9%	Pass
	SAR Value for 1g(mW/g)	2.06	2.15	4.4%	Pass
	SAR Value for 10g(mW/g)	1.38	1.44	4.3%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	47.9Ω-2.43jΩ	46.5Ω-1.19jΩ	<5Ω	Pass
	Return Loss(dB)	-29.6	-27	-8.8%	Pass
	SAR Value for 1g(mW/g)	2.08	2.16	3.8%	Pass
	SAR Value for 10g(mW/g)	1.39	1.43	2.9%	Pass

### Impedance Test-Head



### Return Loss-Head





Calibrator:

Rot - Liang

Approver:

Herbert Lin



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

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

Client **BTL Inc .**

Certificate No: **Z18-60177**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d160**

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

Calibration date: **June 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
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 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-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
Calibrated by:	Zhao Jing	SAR Test Engineer
Reviewed by:	Lin Hao	SAR Test Engineer
Approved by:	Qi Dianyuan	SAR Project Leader

Signature

Issued: June 11, 2018

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



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

### Glossary:

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

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

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

### Additional Documentation:

- 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%.



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

**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>	15 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	835 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	41.5	0.90 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	42.1 $\pm$ 6 %	0.87 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	2.25 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>9.23 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	1.47 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>6.00 mW / g <math>\pm</math> 18.7 % (k=2)</b>

**Body TSL parameters**

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Body TSL parameters</b>	22.0 °C	55.2	0.97 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	55.2 $\pm$ 6 %	0.99 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Body TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	2.42 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>9.53 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	1.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>6.20 mW / g <math>\pm</math> 18.7 % (k=2)</b>



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0Ω- 3.97jΩ
Return Loss	- 27.9dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.4Ω- 4.96jΩ
Return Loss	- 23.9dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.308 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

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## DASY5 Validation Report for Head TSL

Date: 06.04.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d160**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.874 \text{ S/m}$ ;  $\epsilon_r = 42.13$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.28, 10.28, 10.28) @ 835 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

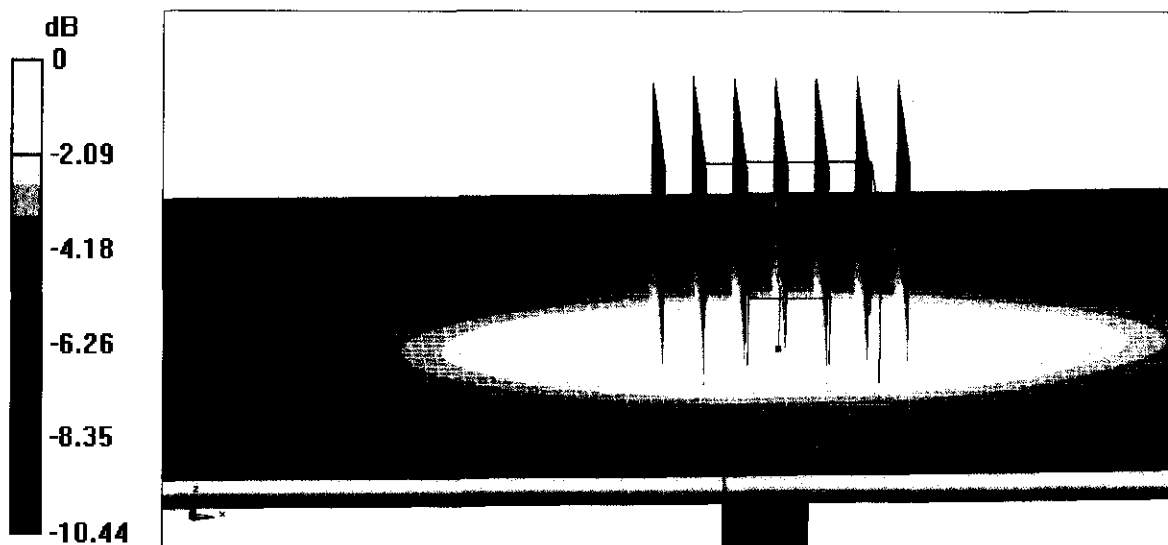
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.53 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.44 W/kg

**SAR(1 g) = 2.25 W/kg; SAR(10 g) = 1.47 W/kg**

Maximum value of SAR (measured) = 3.03 W/kg



0 dB = 3.03 W/kg = 4.81 dBW/kg



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

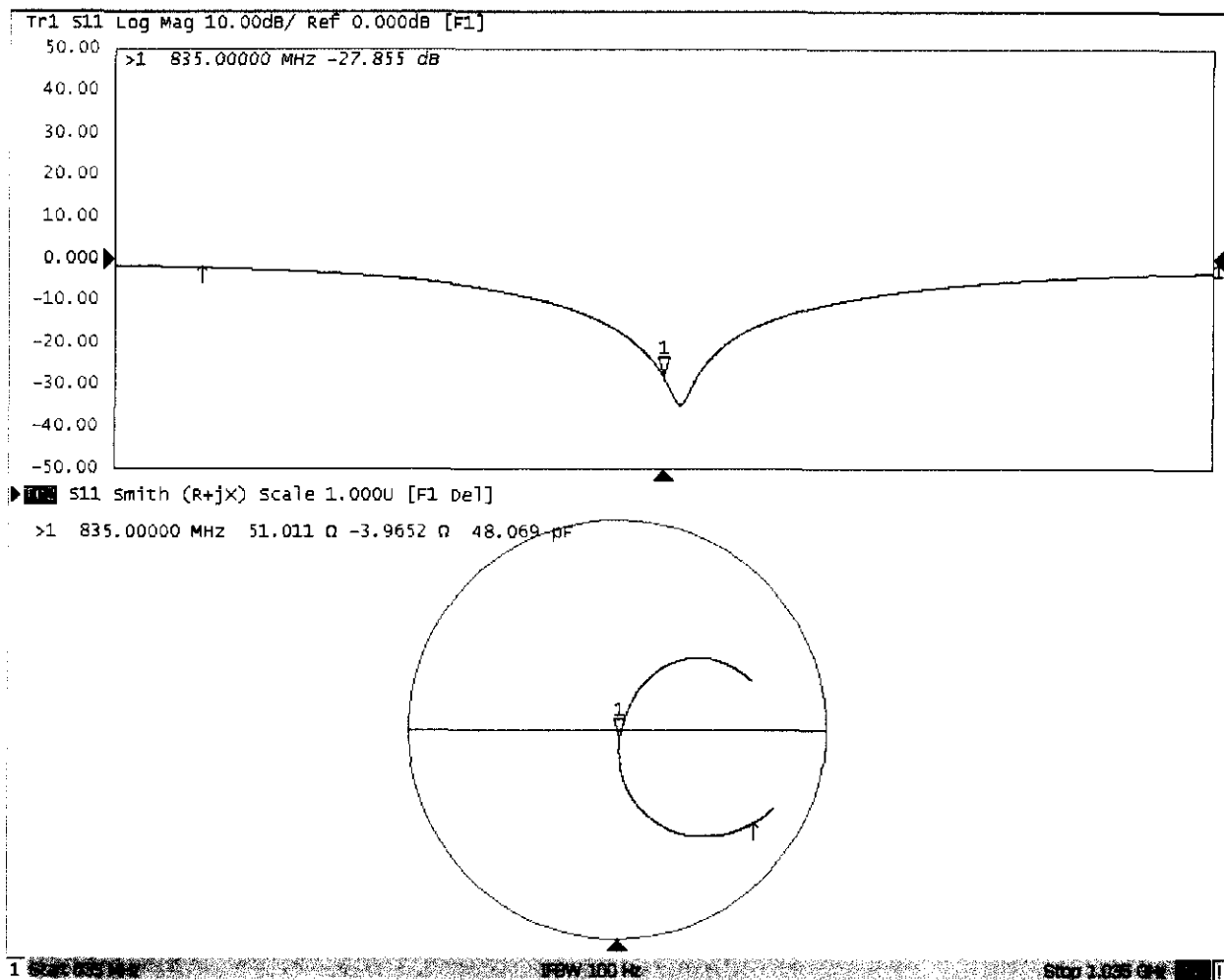
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL







In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

## DASY5 Validation Report for Body TSL

Date: 06.04.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d160**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.99 \text{ S/m}$ ;  $\epsilon_r = 55.15$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(10.21, 10.21, 10.21) @ 835 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

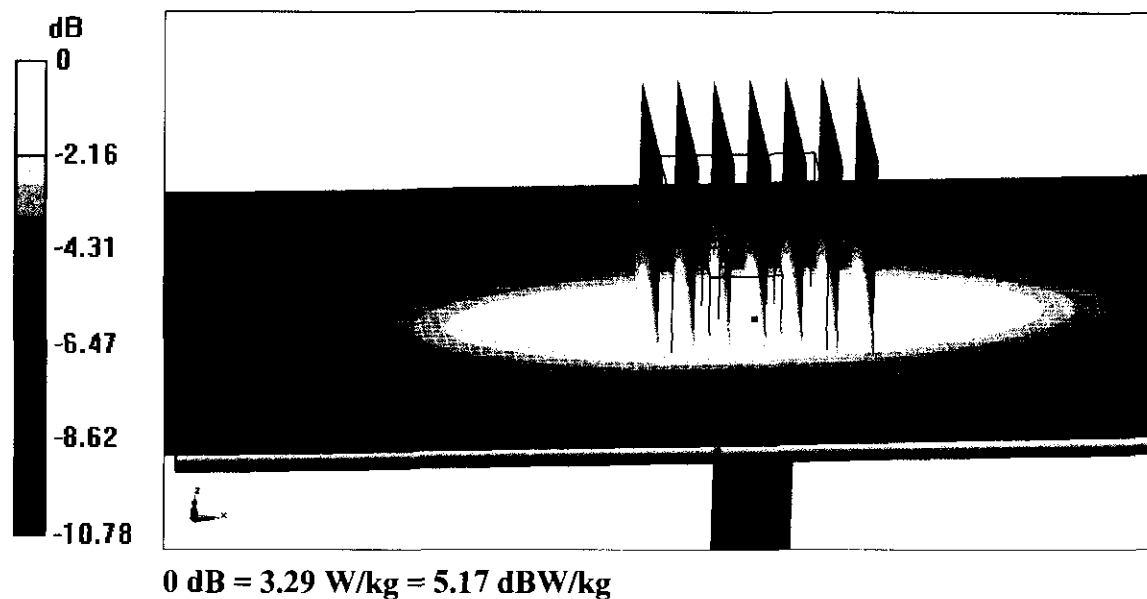
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 55.82 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 3.76 W/kg

**SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.57 W/kg**

Maximum value of SAR (measured) = 3.29 W/kg





In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

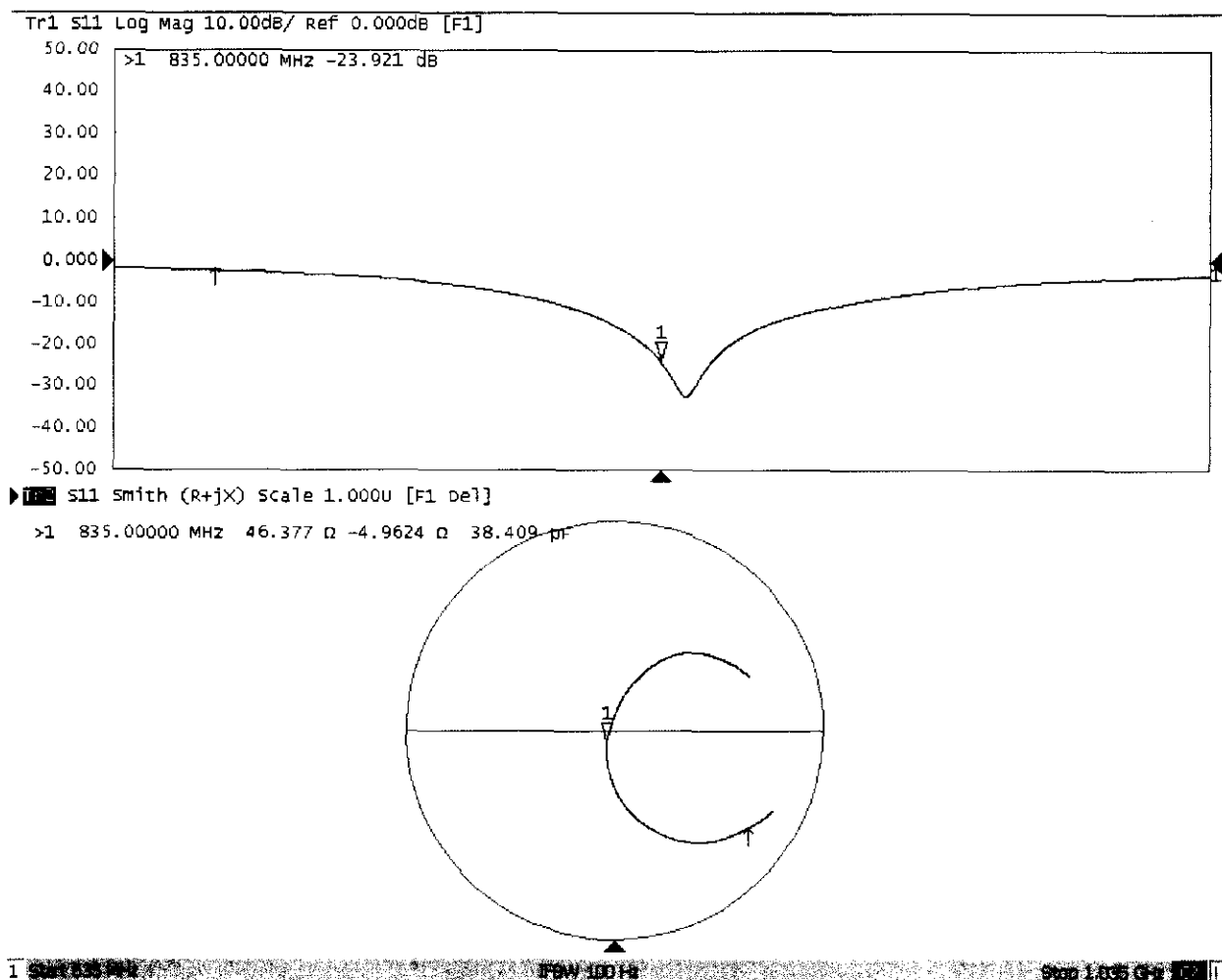
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL





## Dipole Internal Calibration Record

Asset No. :	E-437	Model No. :	D835V2	Serial No. :	4d160
Environmental	21.8°C, 57 %	Original Cal. Date :	June 5, 2018	Next Cal. Date :	June 5, 2021

### Standard List

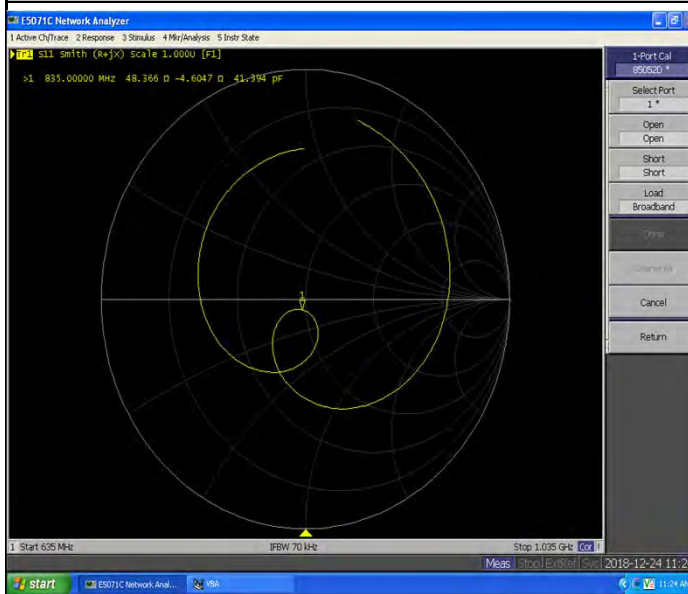
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

### Equipment Information

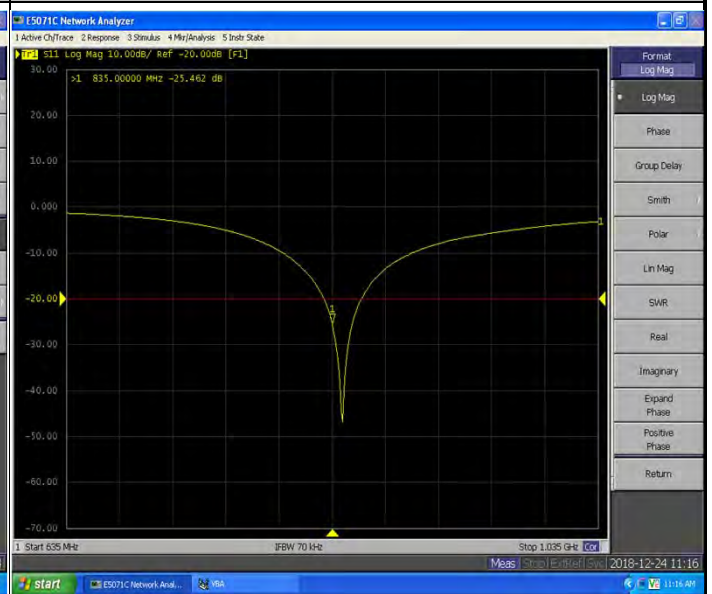
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

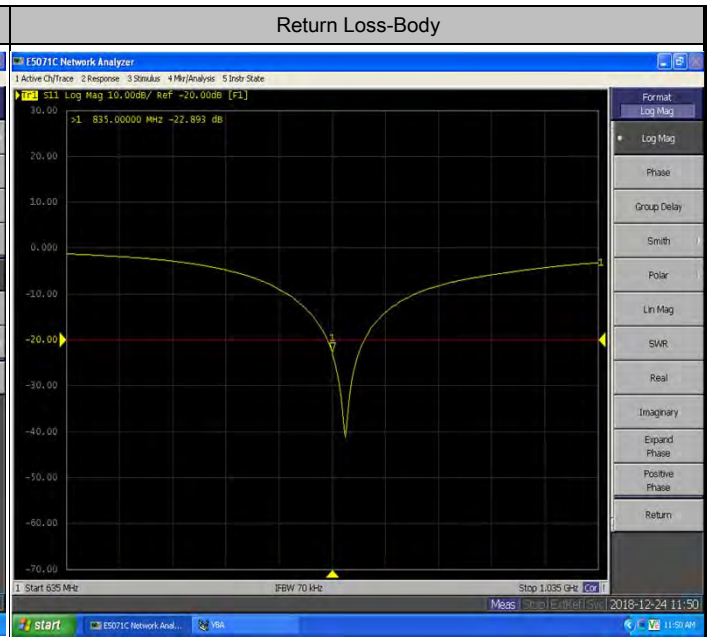
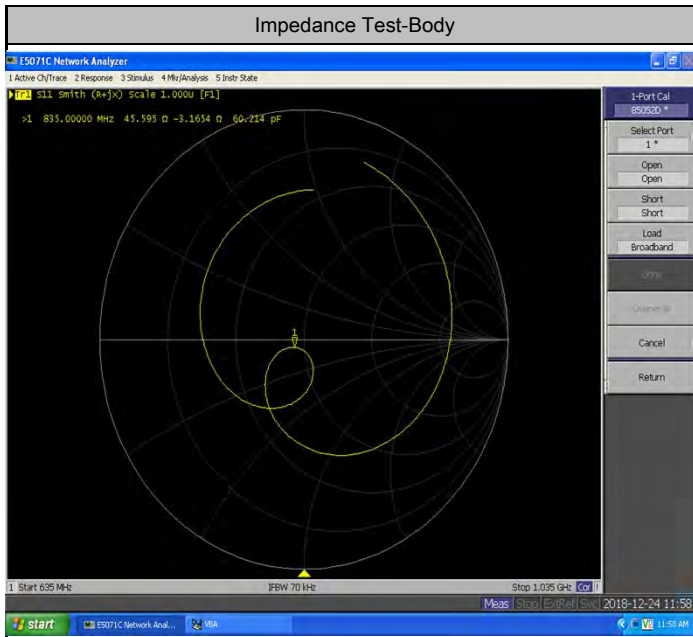
Model No	For Head Tissue				
D835V2	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	51.0Ω-3.97jΩ	48.4Ω-4.6jΩ	<5Ω	Pass
	Return Loss(dB)	-27.9	-25.5	-8.6%	Pass
	SAR Value for 1g(mW/g)	2.25	2.36	4.9%	Pass
	SAR Value for 10g(mW/g)	1.47	1.46	-0.7%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	46.4Ω-4.96jΩ	45.6Ω-3.17jΩ	<5Ω	Pass
	Return Loss(dB)	-23.9	-22.9	-4.2%	Pass
	SAR Value for 1g(mW/g)	2.42	2.38	-1.7%	Pass
	SAR Value for 10g(mW/g)	1.57	1.46	-7.0%	Pass

### Impedance Test-Head



### Return Loss-Head





### Validation Report for Head TSL

Test Laboratory: BTL Inc. Date: 2018/12/24

System Check\_H835\_3240

DUT: Dipole 835 MHz D835V2; SN: 4d160

Communication System: UID 0, CW (0); Frequency: 835 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.89$  S/m;  $\epsilon_r = 42.992$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.4 °C

DASY Configuration:

- Probe: ES3DV3 - SN3240; ConvF(6.13, 6.13, 6.13) @ 835 MHz; Calibrated: 2018/3/28
- Sensor-Surface: 4mm (Mechanical Surface Detection),  $z = 2.0, 32.0$
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11
- Phantom: SAM Front; Type: Twin SAM; Serial: 1784
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (6x13x1): Interpolated grid:  $dx=15$  mm,  $dy=15$  mm  
Maximum value of SAR (interpolated) = 2.50 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid:  $dx=8$  mm,  $dy=8$  mm,  $dz=5$  mm  
Reference Value = 65.24 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 3.76 W/kg  
SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.46 W/kg  
Maximum value of SAR (measured) = 2.59 W/kg

### Validation Report for Body TSL

Test Laboratory: BTL Inc. Date: 2018/12/24

System Check\_B835\_3240

DUT: Dipole 835 MHz D835V2; SN: 4d160

Communication System: UID 0, CW (0); Frequency: 835 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.971$  S/m;  $\epsilon_r = 53.894$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.3 °C; Liquid Temperature : 22.4 °C

DASY Configuration:

- Probe: ES3DV3 - SN3240; ConvF(6.29, 6.29, 6.29) @ 835 MHz; Calibrated: 2018/3/28
- Sensor-Surface: 4mm (Mechanical Surface Detection),  $z = 2.0, 32.0$
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11
- Phantom: SAM Front; Type: Twin SAM; Serial: 1784
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (7x13x1): Interpolated grid:  $dx=15$  mm,  $dy=15$  mm  
Maximum value of SAR (interpolated) = 2.88 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid:  $dx=8$  mm,  $dy=8$  mm,  $dz=5$  mm  
Reference Value = 63.41 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 3.82 W/kg  
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.46 W/kg  
Maximum value of SAR (measured) = 2.88 W/kg

Calibrator: *Rot - Liang*

Approver: *Herbert Lin*



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cnClient **BTL Inc .**Certificate No: **Z18-60179****CALIBRATION CERTIFICATE**Object **D1750V2 - SN: 1101**Calibration Procedure(s) **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**Calibration date: **June 7, 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&amp;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 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 11, 2018

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



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

#### **Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
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%.



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

**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, dz = 5 mm	
<b>Frequency</b>	1750 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	40.1	1.37 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	41.2 $\pm$ 6 %	1.33 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	9.04 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	37.0 mW / g $\pm$ 18.8 % (k=2)
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	4.90 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.9 mW / g $\pm$ 18.7 % (k=2)

**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	53.4	1.49 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	52.0 $\pm$ 6 %	1.53 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Body TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	9.57 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	37.4 mW / g $\pm$ 18.8 % (k=2)
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	5.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.1 mW / g $\pm$ 18.7 % (k=2)



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8Ω- 2.69 jΩ
Return Loss	- 31.4 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3Ω- 2.68 jΩ
Return Loss	- 26.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.085 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

**s p e a g**  
**CALIBRATION LABORATORY**

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

## DASY5 Validation Report for Head TSL

Date: 06.07.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1101**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.332$  S/m;  $\epsilon_r = 41.23$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right 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 Sn1525; Calibrated: 10/2/2017
- 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:**

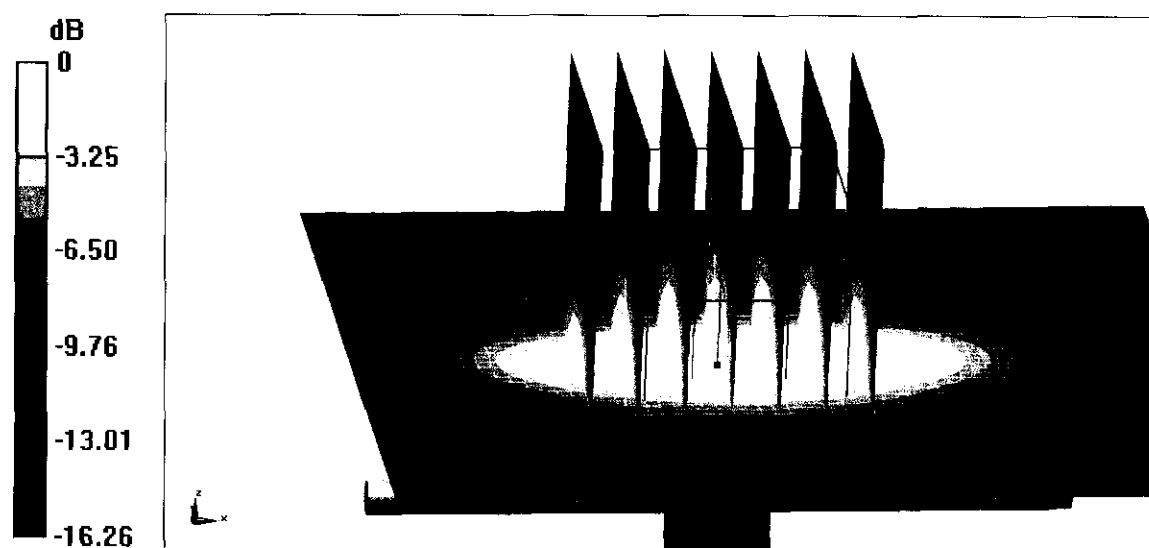
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 96.28 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 16.5 W/kg

**SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.9 W/kg**

Maximum value of SAR (measured) = 13.8 W/kg



**0 dB = 13.8 W/kg = 11.40 dBW/kg**



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

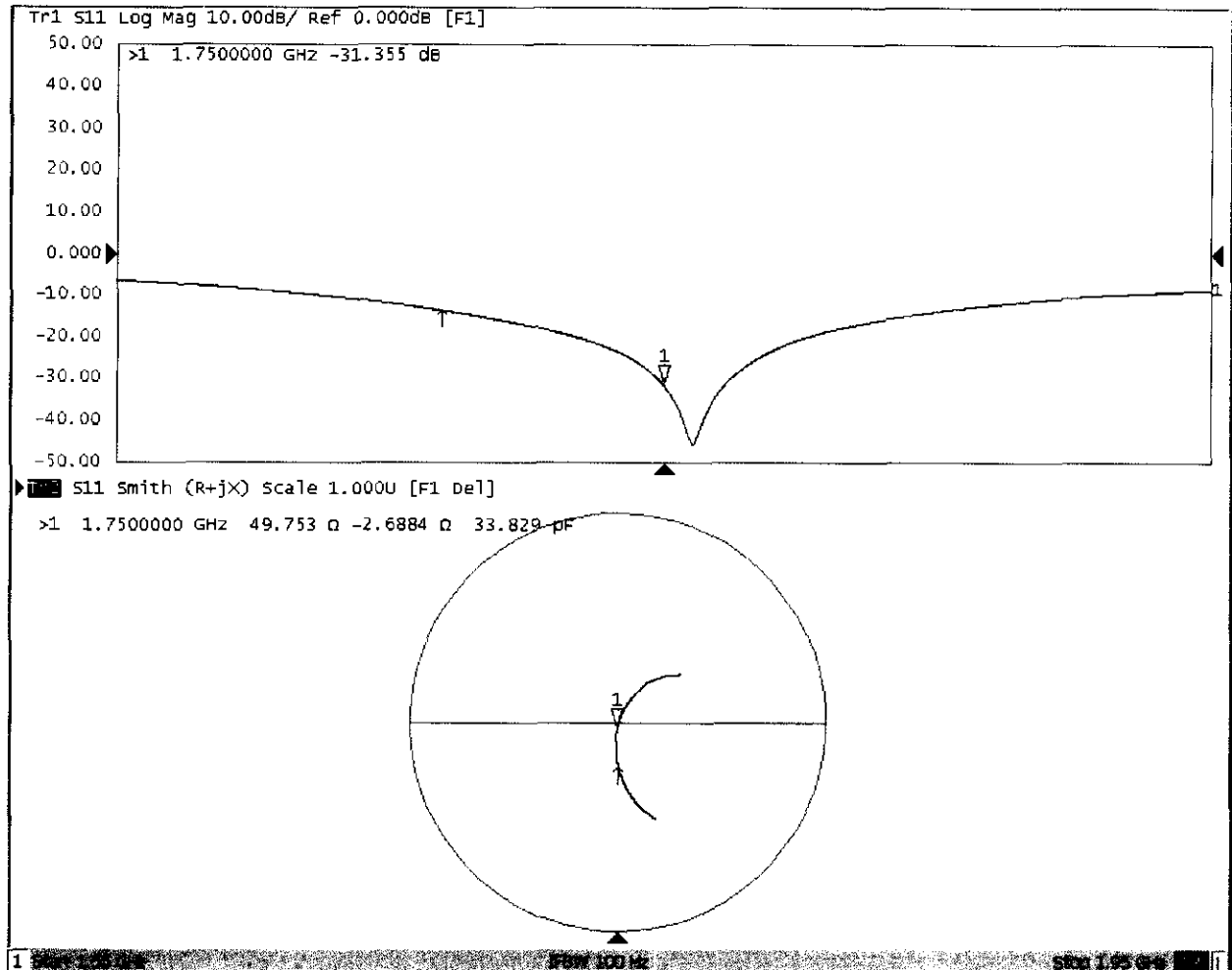
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL





In Collaboration with

**s p e a k**  
CALIBRATION LABORATORY

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

## DASY5 Validation Report for Body TSL

Date: 06.06.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1101**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.533$  S/m;  $\epsilon_r = 51.99$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center 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 Sn1525; Calibrated: 10/2/2017
- 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:**

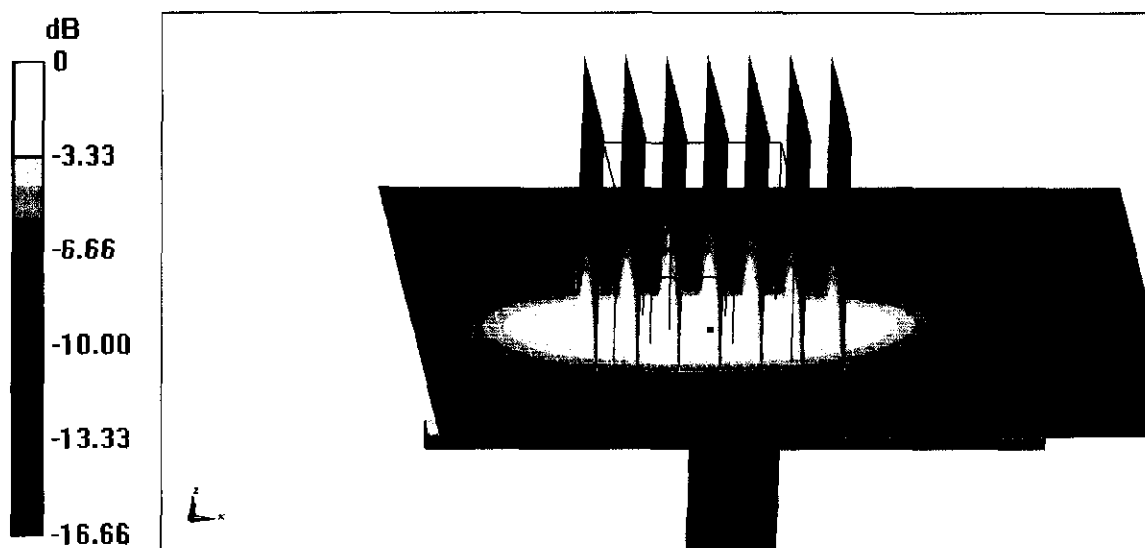
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 82.09 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 17.3 W/kg

**SAR(1 g) = 9.57 W/kg; SAR(10 g) = 5.11 W/kg**

Maximum value of SAR (measured) = 14.6 W/kg



0 dB = 14.6 W/kg = 11.64 dBW/kg



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

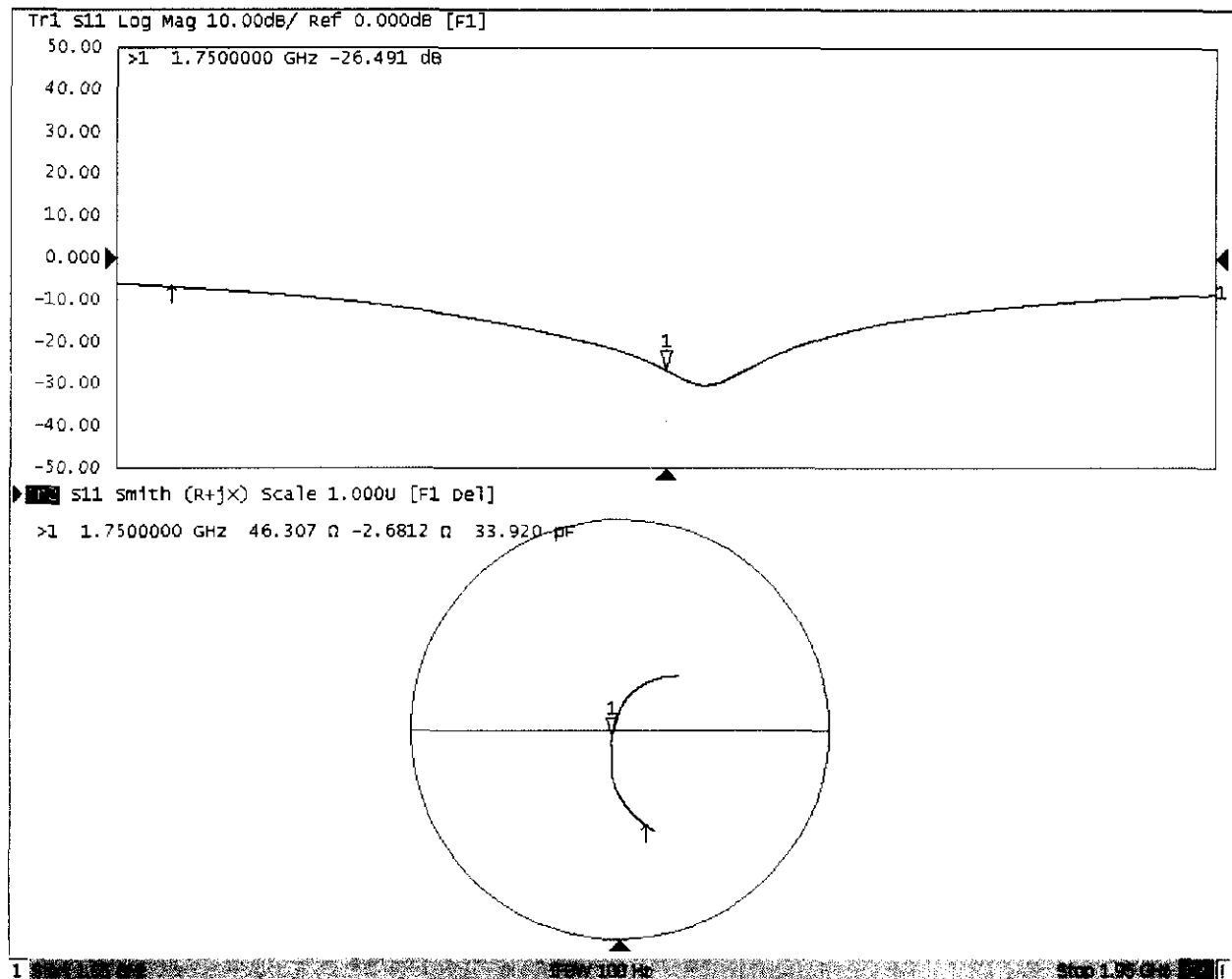
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL





## Dipole Internal Calibration Record

Asset No. :	E-438	Model No. :	D1750V2	Serial No. :	1101
Environmental	23.3°C, 51 %	Original Cal. Date :	June 7, 2018	Next Cal. Date :	June 7, 2021

### Standard List

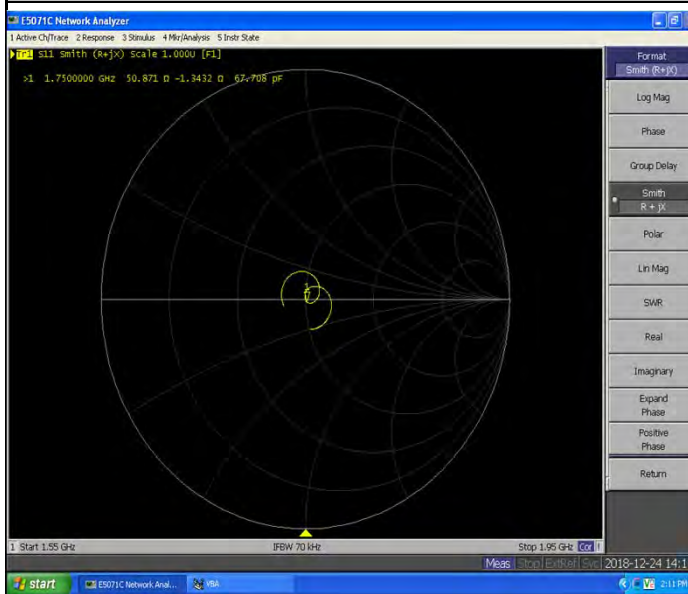
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

### Equipment Information

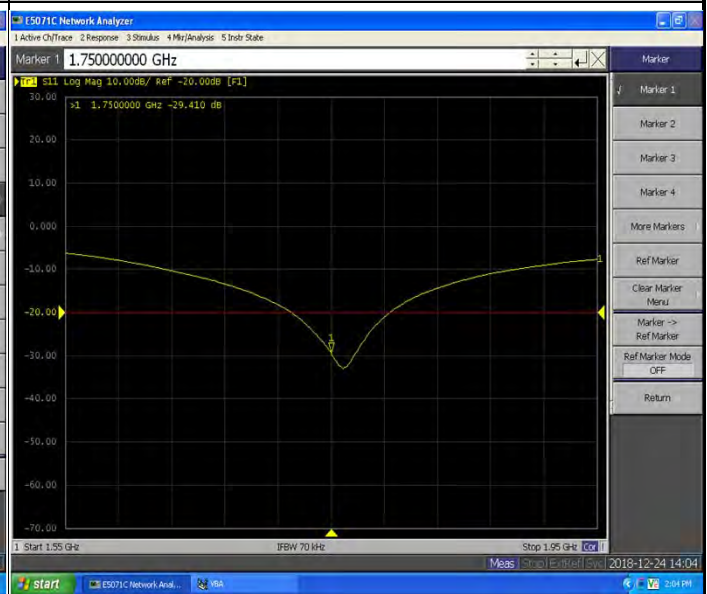
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

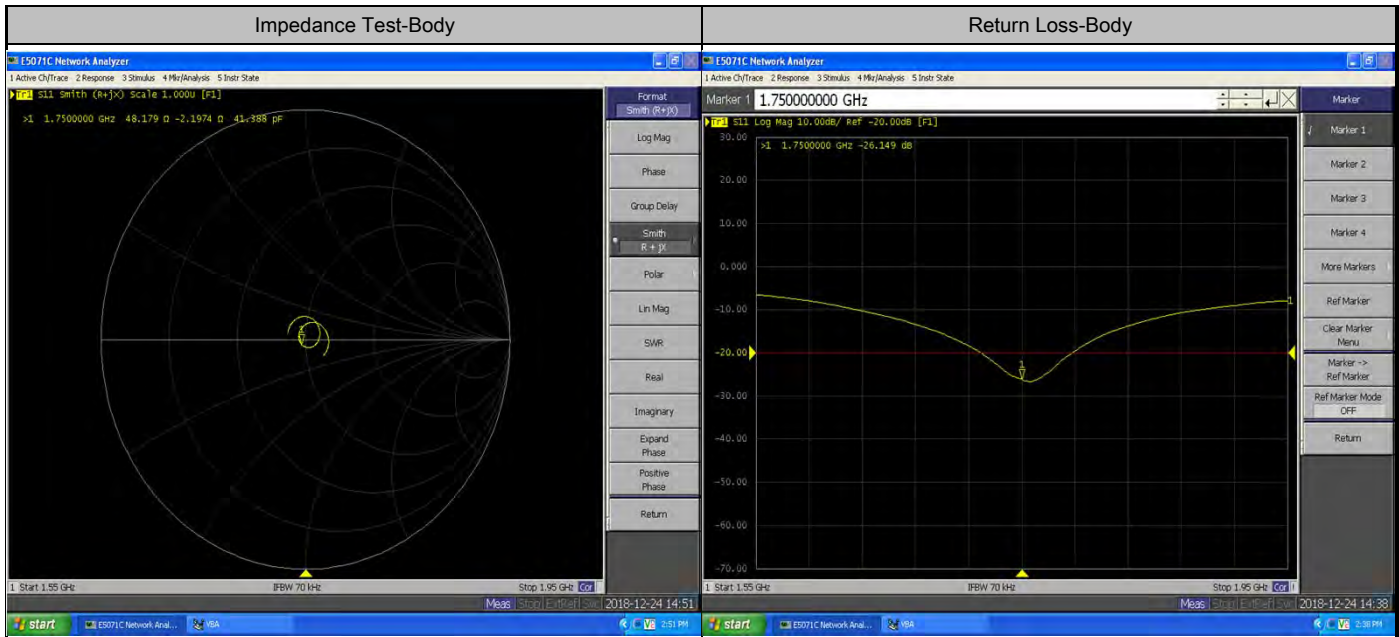
Model No	For Head Tissue				
D1750V2	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	49.8Ω-2.69jΩ	50.9Ω-1.34jΩ	<5Ω	Pass
	Return Loss(dB)	-31.4	-29.4	-6.4%	Pass
	SAR Value for 1g(mW/g)	9.04	9.2	1.8%	Pass
	SAR Value for 10g(mW/g)	4.9	4.47	-8.8%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	46.3Ω-2.68jΩ	48.2Ω-2.2jΩ	<5Ω	Pass
	Return Loss(dB)	-26.5	-26.1	-1.5%	Pass
	SAR Value for 1g(mW/g)	9.57	8.96	-6.4%	Pass
	SAR Value for 10g(mW/g)	5.11	4.74	-7.2%	Pass

### Impedance Test-Head



### Return Loss-Head





Validation Report for Head TSL	Validation Report for Body TSL
<p>Test Laboratory: BTL Inc.      Date: 2018/12/24<sup>+</sup></p> <p><b>System Check_H1750_3240<sup>+</sup></b></p> <p><b>DUT: Dipole 1750 MHz D1750V2;SN:1101<sup>+</sup></b></p> <p>Communication System: UID 0, CW (0); Frequency: 1750 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: f = 1750 MHz; <math>\sigma</math> = 1.405 S/m; <math>\epsilon_r</math> = 41.336; <math>\rho</math> = 1000 kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.3 °C; Liquid Temperature : 22.4 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"><li>Probe: ES3DV3 - SN3240; ConvE(5.33, 5.33, 5.33) @ 1750 MHz; Calibrated: 2018/3/28 <sup>+</sup></li><li>Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0 <sup>+</sup></li><li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li><li>Phantom: SAM Front; Type: Twin SAM; Serial: 1784 <sup>+</sup></li><li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li></ul> <p>↓</p> <p><b>Area Scan (6x7x1):</b> Interpolated grid: dx=15 mm, dy=15 mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 10.6 W/kg<sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (5x5x7)/Cube 0:</b> Measurement grid: dx=8mm, dy=8mm, dz=5mm<sup>+</sup></p> <p>Reference Value = 105.3 V/m; Power Drift = 0.15 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 19.2 W/kg<sup>+</sup></p> <p><b>SAR(1 g) = 9.2 W/kg; SAR(10 g) = 4.47 W/kg<sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 10.2 W/kg</p> <div><div>W/kg</div><div>10.200</div><div>8.175</div><div>6.150</div><div>4.125</div><div>2.100</div><div>0.075</div></div>	<p>Test Laboratory: BTL Inc.      Date: 2018/12/24<sup>+</sup></p> <p><b>System Check_B1750_3240<sup>+</sup></b></p> <p><b>DUT: Dipole 1750 MHz D1750V2;SN:1101<sup>+</sup></b></p> <p>Communication System: UID 0, CW (0); Frequency: 1750 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: f = 1750 MHz; <math>\sigma</math> = 1.486 S/m; <math>\epsilon_r</math> = 52.091; <math>\rho</math> = 1000 kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.3 °C; Liquid Temperature : 22.4 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"><li>Probe: ES3DV3 - SN3240; ConvE(4.99, 4.99, 4.99) @ 1750 MHz; Calibrated: 2018/3/28 <sup>+</sup></li><li>Sensor-Surface: 4mm (Mechanical Surface Detection), z = 2.0, 32.0 <sup>+</sup></li><li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li><li>Phantom: SAM Front; Type: Twin SAM; Serial: 1784 <sup>+</sup></li><li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li></ul> <p>↓</p> <p><b>Area Scan (6x7x1):</b> Interpolated grid: dx=15 mm, dy=15 mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 10.9 W/kg<sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (5x5x7)/Cube 0:</b> Measurement grid: dx=8mm, dy=8mm, dz=5mm<sup>+</sup></p> <p>Reference Value = 98.19 V/m; Power Drift = 0.15 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 16.2 W/kg<sup>+</sup></p> <p><b>SAR(1 g) = 8.96 W/kg; SAR(10 g) = 4.74 W/kg<sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 9.88 W/kg</p> <div><div>W/kg</div><div>9.880</div><div>7.939</div><div>5.999</div><div>4.058</div><div>2.118</div><div>0.177</div></div>

Calibrator: *Rot - Liang*

Approver: *Herbert Lin*



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

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

Client **BTL Inc .**

Certificate No: **Z18-60180**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d179**

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

Calibration date: **June 7, 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	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 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 11, 2018

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



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

#### **Glossary:**

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

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

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

#### **Additional Documentation:**

- 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%.





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

## Measurement Conditions

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

<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, dz = 5 mm	
<b>Frequency</b>	1900 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	40.0	1.40 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	41.2 $\pm$ 6 %	1.44 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	9.96 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>39.5 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	5.21 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>20.7 mW / g <math>\pm</math> 18.7 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	53.3	1.52 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	51.8 $\pm$ 6 %	1.57 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	<1.0 °C	----	----

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>39.8 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	5.29 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>20.8 mW / g <math>\pm</math> 18.7 % (k=2)</b>



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9Ω+ 3.19jΩ
Return Loss	- 29.7dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.2Ω+ 3.99jΩ
Return Loss	- 26.0dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.065 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

**s p e a g**  
**CALIBRATION LABORATORY**

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

Date: 06.06.2018

## DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d179**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.438$  S/m;  $\epsilon_r = 41.15$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right 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 Sn1525; Calibrated: 10/2/2017
- 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:**

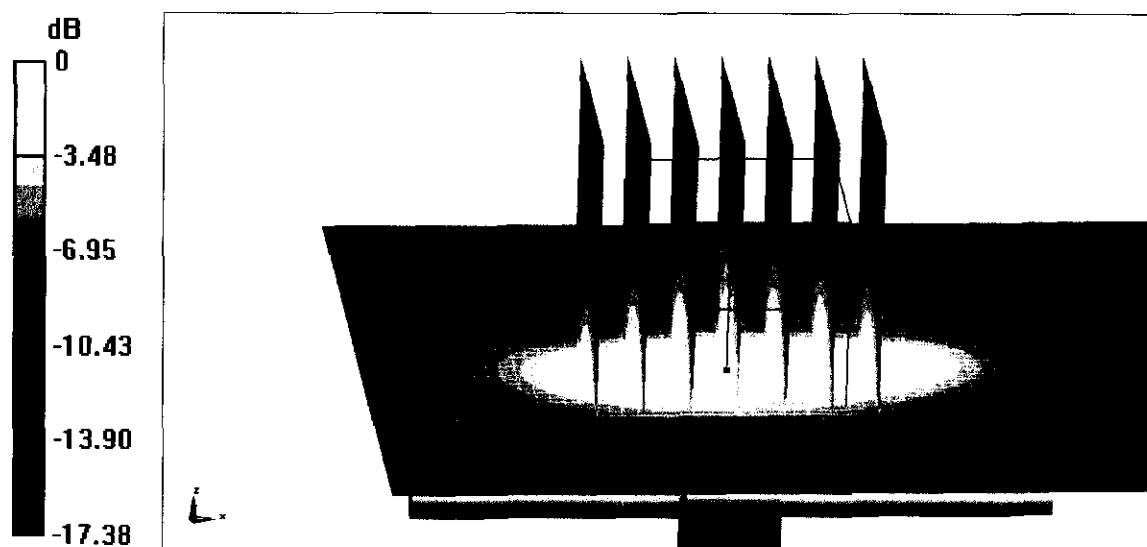
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 95.41 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.8 W/kg

**SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.21 W/kg**

Maximum value of SAR (measured) = 15.5 W/kg



**0 dB = 15.5 W/kg = 11.90 dBW/kg**



In Collaboration with

**s p e a k**  
CALIBRATION LABORATORY

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

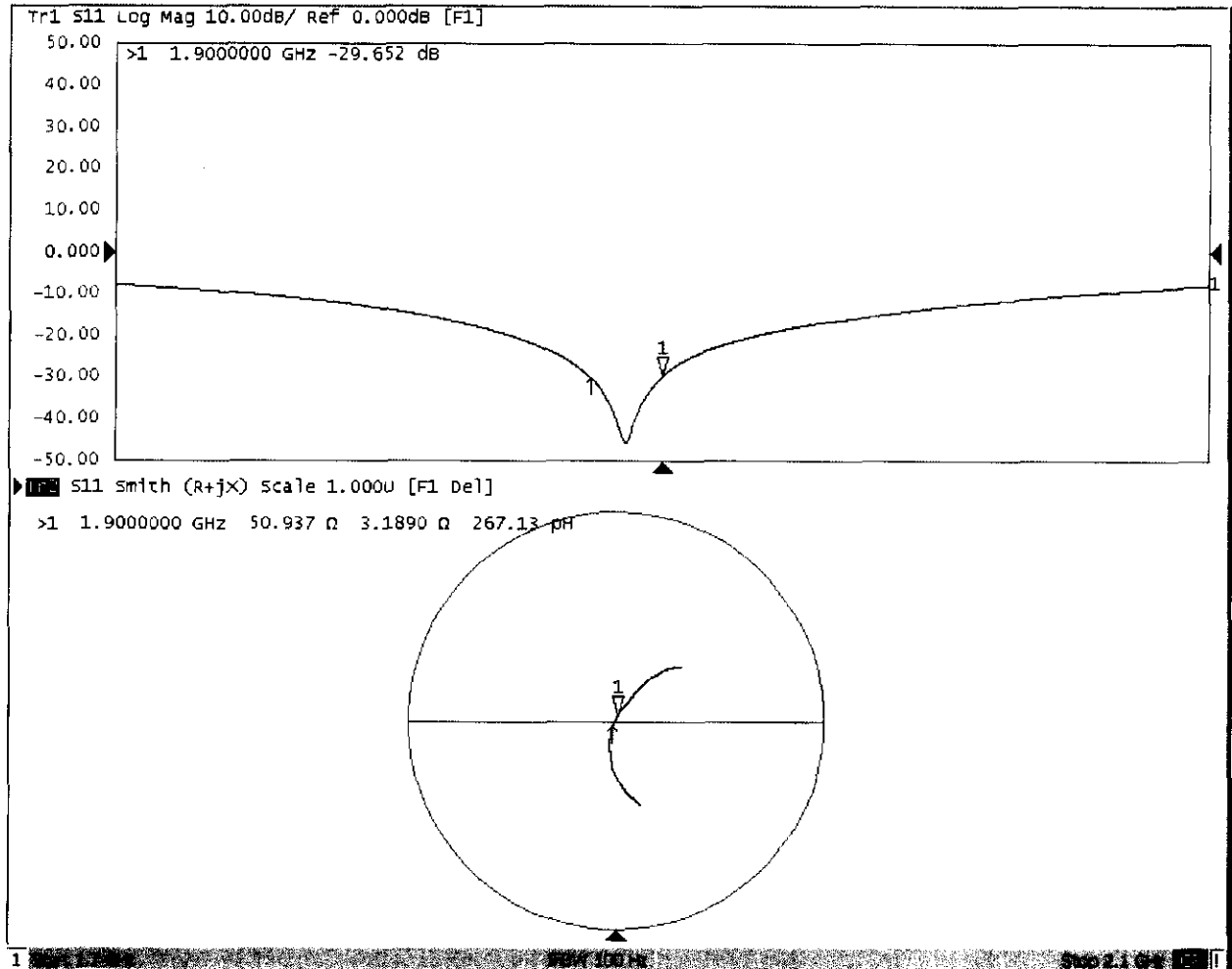
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL





In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## DASY5 Validation Report for Body TSL

Date: 06.06.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d179**

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.565$  S/m;  $\epsilon_r = 51.75$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center 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 Sn1525; Calibrated: 10/2/2017
- 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:

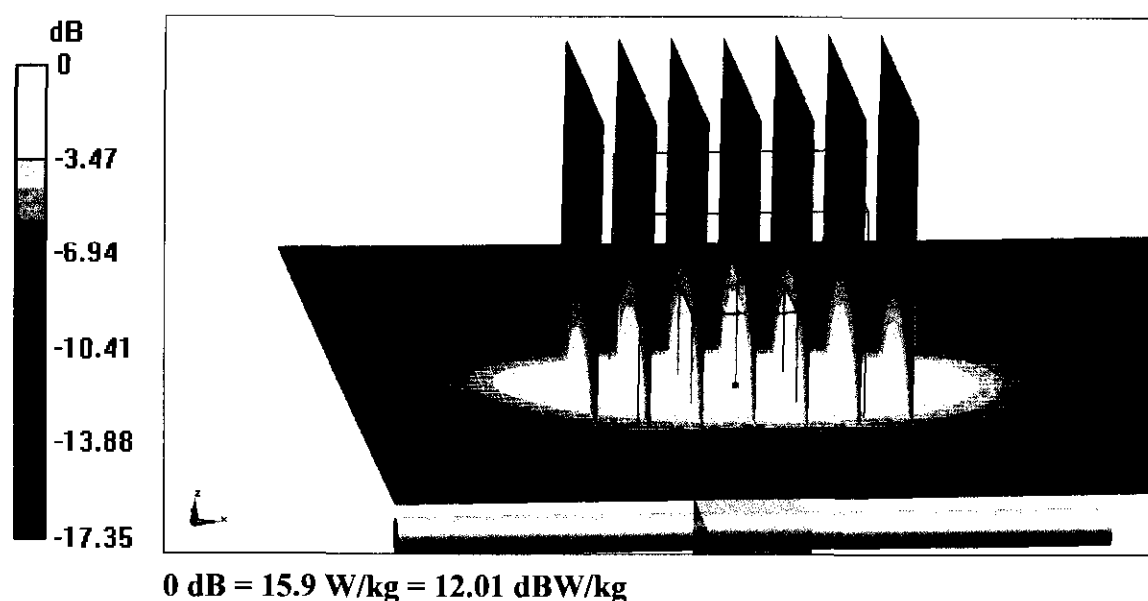
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 87.58 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 19.1 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.29 W/kg**

Maximum value of SAR (measured) = 15.9 W/kg





In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

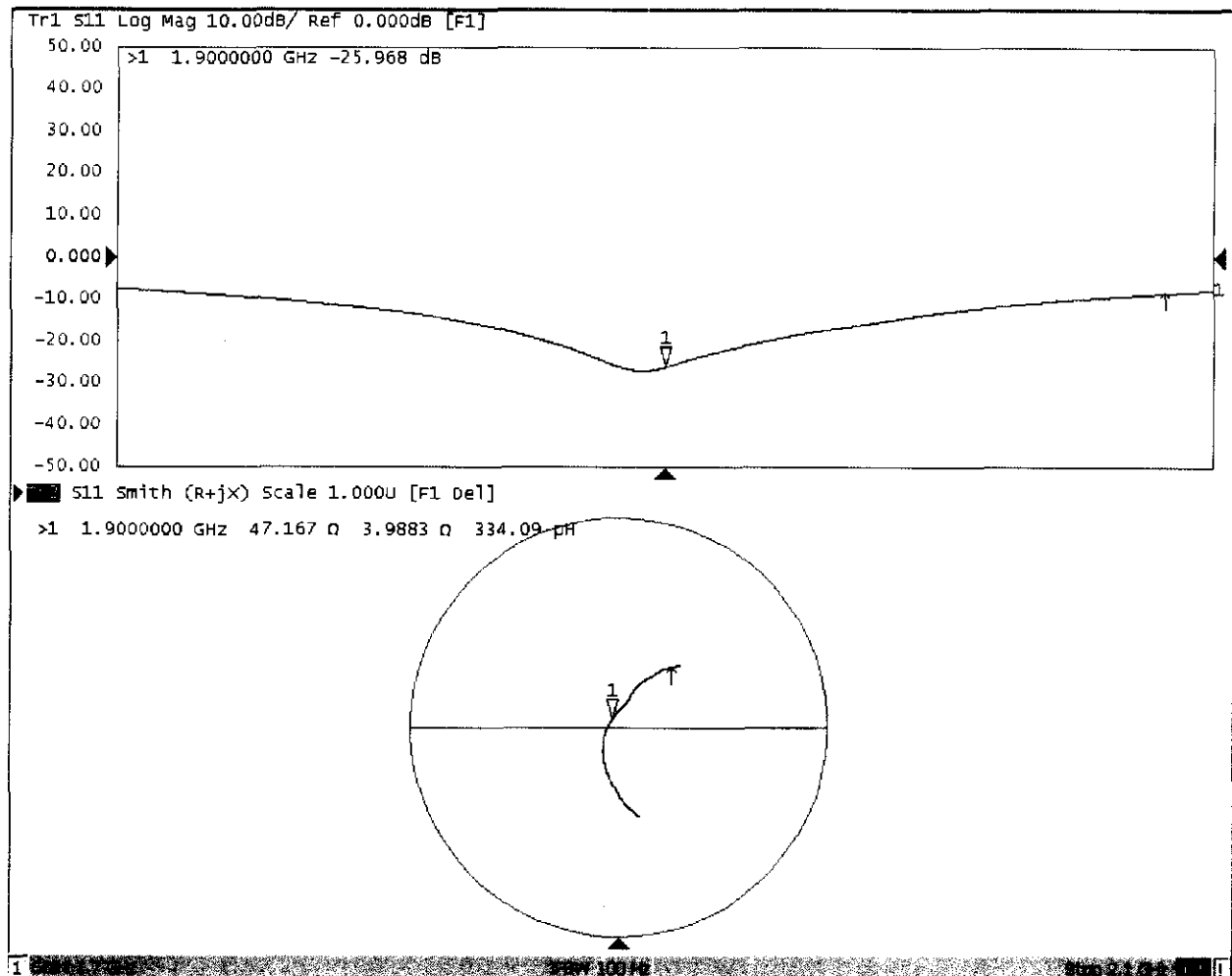
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL





## Dipole Internal Calibration Record

Asset No. :	E-431	Model No. :	D1900V2	Serial No. :	5d179
Environmental	23.4°C, 61 %	Original Cal. Date :	June 7, 2018	Next Cal. Date :	June 7, 2021

### Standard List

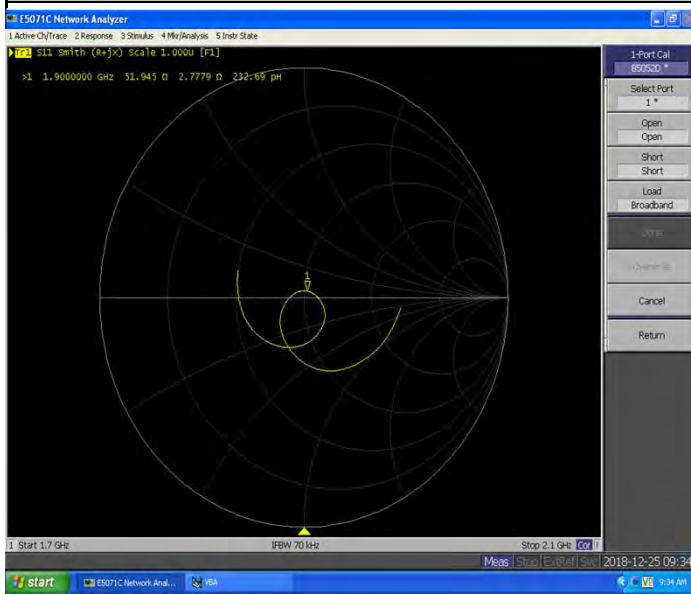
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

### Equipment Information

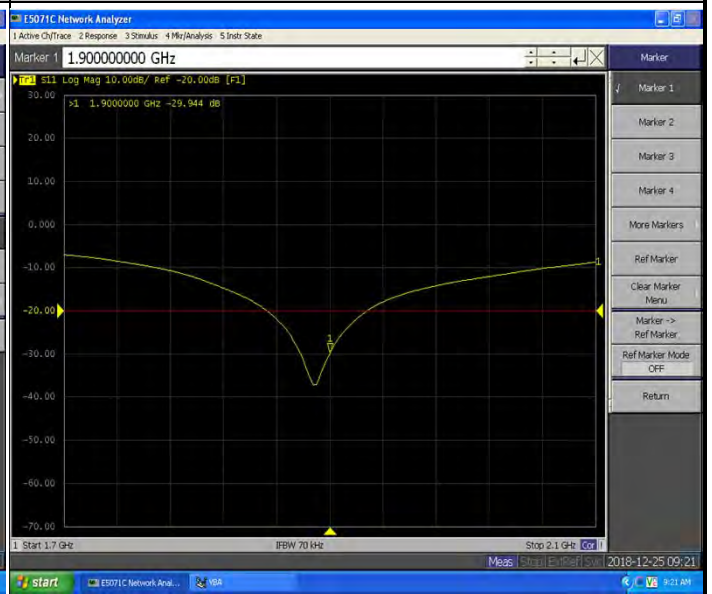
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

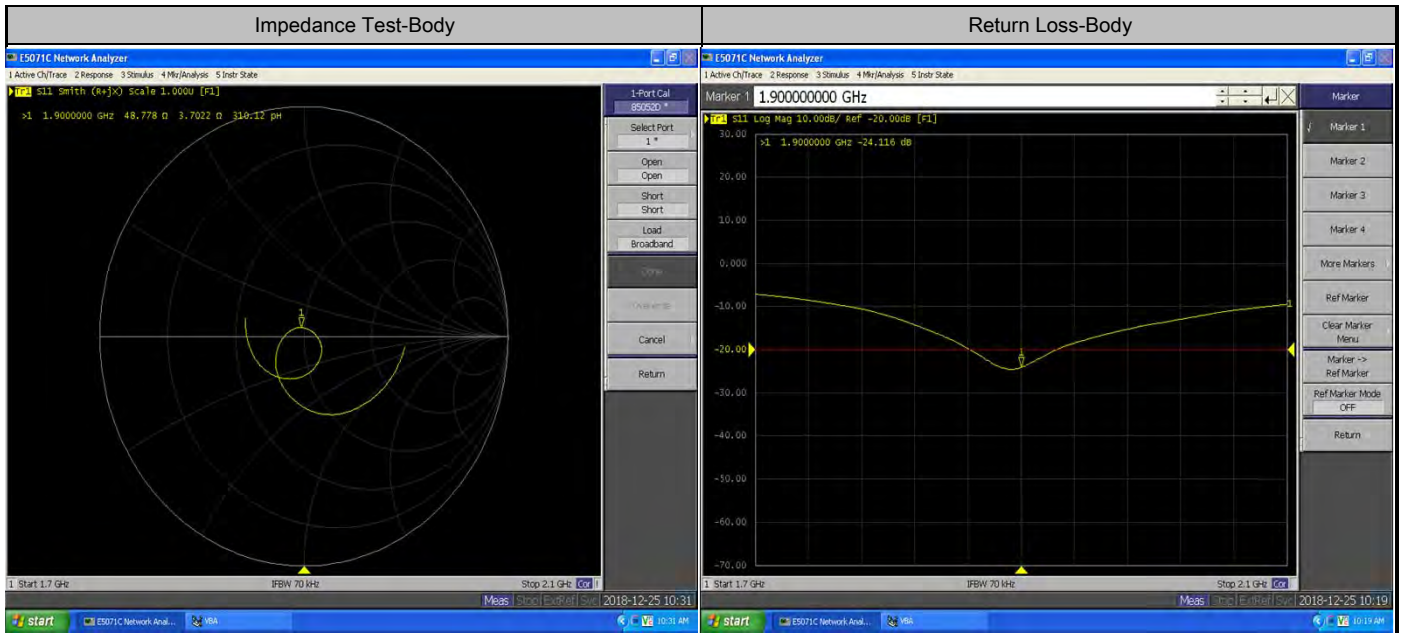
Model No	For Head Tissue				
D1900V2	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	50.9Ω+3.19jΩ	51.9Ω+2.78jΩ	<5Ω	Pass
	Return Loss(dB)	-29.7	-29.4	-1.0%	Pass
	SAR Value for 1g(mW/g)	9.96	9.73	-2.3%	Pass
	SAR Value for 10g(mW/g)	5.21	5.24	0.6%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	47.2Ω+3.99jΩ	48.8Ω+3.7jΩ	<5Ω	Pass
	Return Loss(dB)	-26	-24.1	-7.3%	Pass
	SAR Value for 1g(mW/g)	10.2	10.2	0.0%	Pass
	SAR Value for 10g(mW/g)	5.29	5.37	1.5%	Pass

### Impedance Test-Head



### Return Loss-Head





Validation Report for Head TSL	Validation Report for Body TSL
<p>Test Laboratory: BTL Inc.      Date: 2018/12/25<sup>+</sup></p> <p>System Check_H1900_7396<sup>+</sup></p> <p>DUT: Dipole 1900 MHz D1900V2; SN: 5d179<sup>+</sup></p> <p>Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: <math>f = 1900</math> MHz; <math>\sigma = 1.385</math> S/m; <math>\epsilon_r = 39.758</math>; <math>\rho = 1000</math> kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature: 23.2 °C; Liquid Temperature: 22.5 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"> <li>Probe: EX3DV4 - SN7396; ConvE(8.2, 8.2, 8.2) @ 1900 MHz; Calibrated: 2018/5/29 <sup>+</sup></li> <li>Sensor-Surface: 4mm (Mechanical Surface Detection), <math>z = 1.0, 31.0</math> <sup>+</sup></li> <li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li> <li>Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li> <li>DASY52 52.8(1258); SEMCAD X 14.6.12(7450)<sup>+</sup></li> </ul> <p>↓</p> <p><b>Area Scan (6x7x1):</b> Interpolated grid: <math>dx=15</math> mm, <math>dy=15</math> mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 16.2 W/kg<sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (5x5x7)/Cube 0:</b> Measurement grid: <math>dx=8</math> mm, <math>dy=8</math> mm, <math>dz=5</math> mm<sup>+</sup></p> <p>Reference Value = 101.9 V/m; Power Drift = -0.01 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 16.9 W/kg<sup>+</sup></p> <p><b>SAR(1 g) = 9.73 W/kg; SAR(10 g) = 5.24 W/kg<sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 14.5 W/kg</p>	<p>Test Laboratory: BTL Inc.      Date: 2018/12/25<sup>+</sup></p> <p>System Check_B1900_3240<sup>+</sup></p> <p>DUT: Dipole 1900 MHz D1900V2; SN: 5d179<sup>+</sup></p> <p>Communication System: UID 0, CW (0); Frequency: 1900 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: <math>f = 1900</math> MHz; <math>\sigma = 1.542</math> S/m; <math>\epsilon_r = 53.199</math>; <math>\rho = 1000</math> kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3240; ConvE(4.8, 4.8, 4.8) @ 1900 MHz; Calibrated: 2018/3/28 <sup>+</sup></li> <li>Sensor-Surface: 4mm (Mechanical Surface Detection), <math>z = 2.0, 32.0</math> <sup>+</sup></li> <li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li> <li>Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li> <li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li> </ul> <p>↓</p> <p><b>Area Scan (6x6x1):</b> Interpolated grid: <math>dx=15</math> mm, <math>dy=15</math> mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 12.0 W/kg<sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (5x5x7)/Cube 0:</b> Measurement grid: <math>dx=8</math> mm, <math>dy=8</math> mm, <math>dz=5</math> mm<sup>+</sup></p> <p>Reference Value = 100.8 V/m; Power Drift = 0.09 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 18.1 W/kg<sup>+</sup></p> <p><b>SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.37 W/kg<sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 11.4 W/kg</p>

Calibrator: *Rot - Liang*

Approver: *Herbert Lin*





In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

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

Client **BTL Inc.**

Certificate No: **Z18-60183**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 919**

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

Calibration date: **June 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%.

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 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 13, 2018

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



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

### Glossary:

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

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

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

### Additional Documentation:

- 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%.



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

**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, dz = 5 mm	
<b>Frequency</b>	2450 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>52.1 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	6.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.6 mW / g <math>\pm</math> 18.7 % (k=2)</b>

**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	52.7	1.95 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	54.1 $\pm$ 6 %	1.98 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Body TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	12.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>50.8 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	5.93 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>23.7 mW / g <math>\pm</math> 18.7 % (k=2)</b>



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.0\Omega + 2.85j\Omega$
Return Loss	- 27.9dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.9\Omega + 4.74j\Omega$
Return Loss	- 26.5dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.022 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

**s p e a g**

**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## DASY5 Validation Report for Head TSL

Date: 06.11.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 919**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 40.36$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(7.89, 7.89, 7.89) @ 2450 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

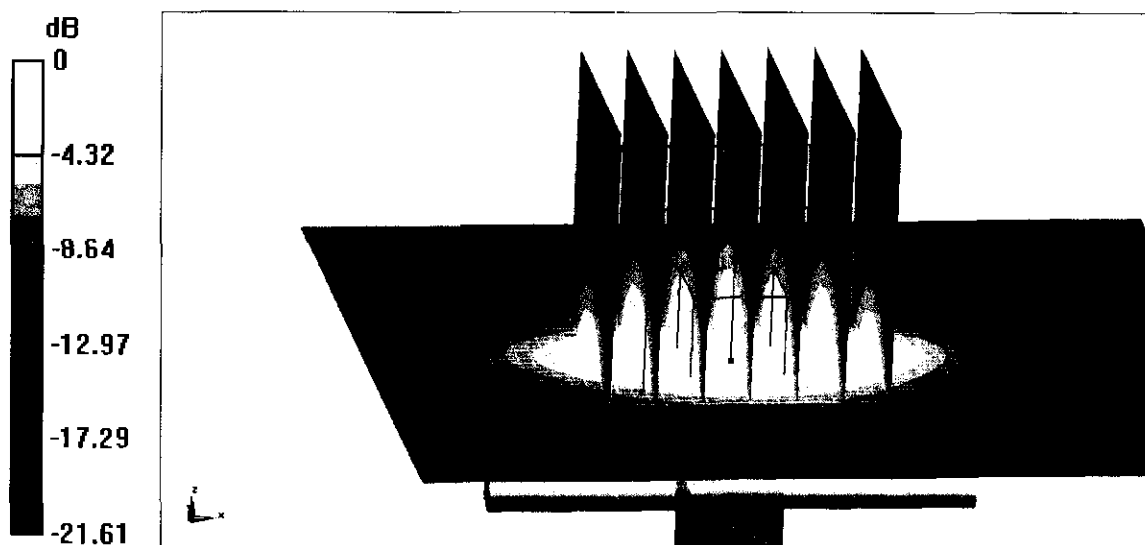
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.2 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 27.0 W/kg

**SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.17 W/kg**

Maximum value of SAR (measured) = 22.0 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg



In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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

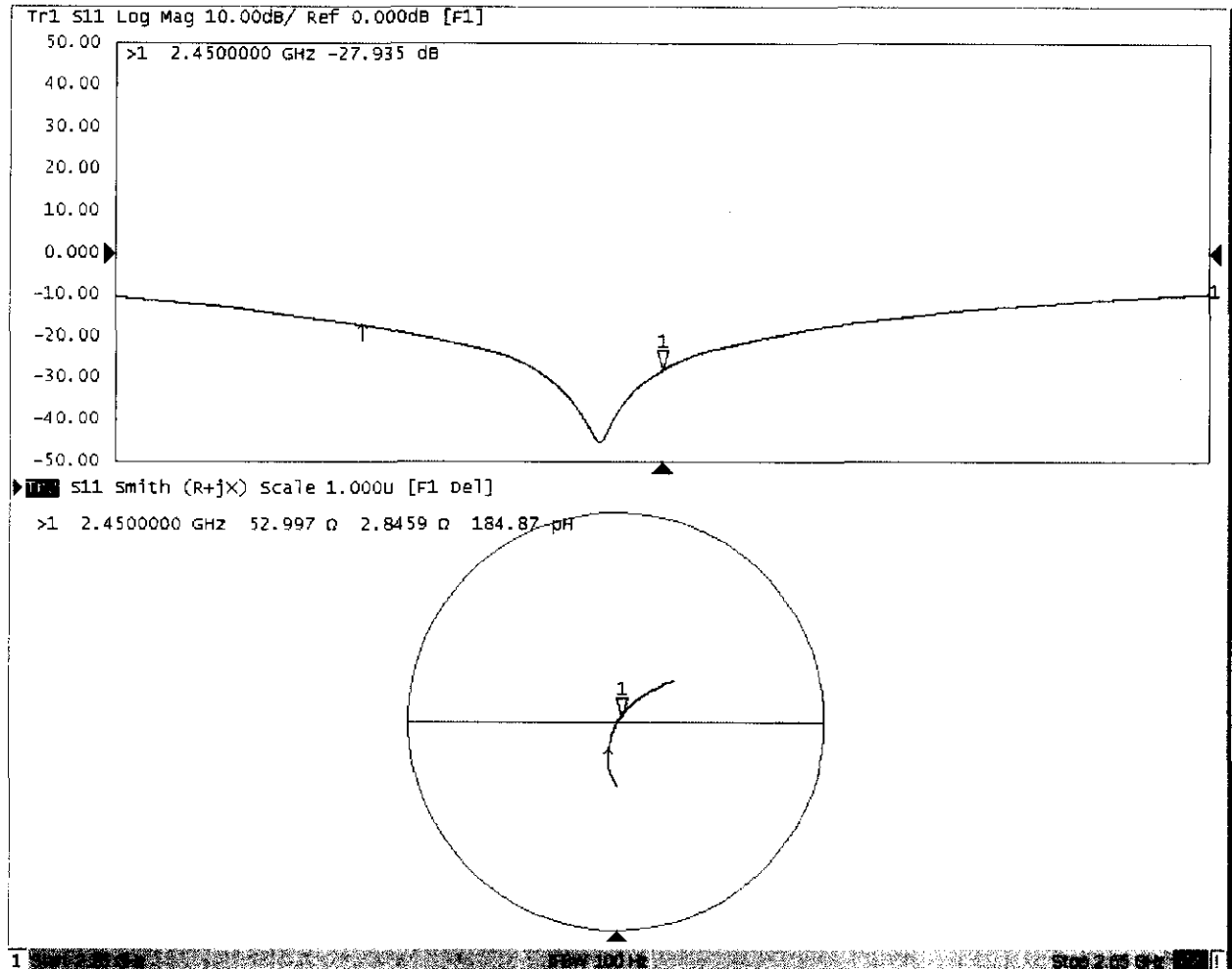
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL





In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

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

Date: 06.08.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 919**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.977$  S/m;  $\epsilon_r = 54.12$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(8.09, 8.09, 8.09) @ 2450 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

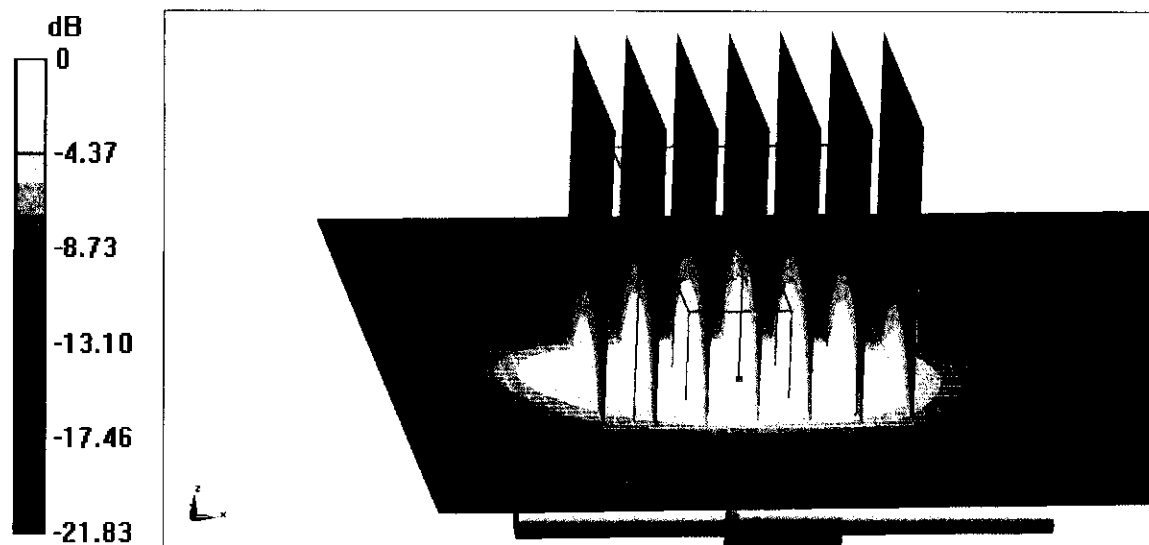
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.30 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 26.0 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.93 W/kg**

Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg = 13.18 dBW/kg



In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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

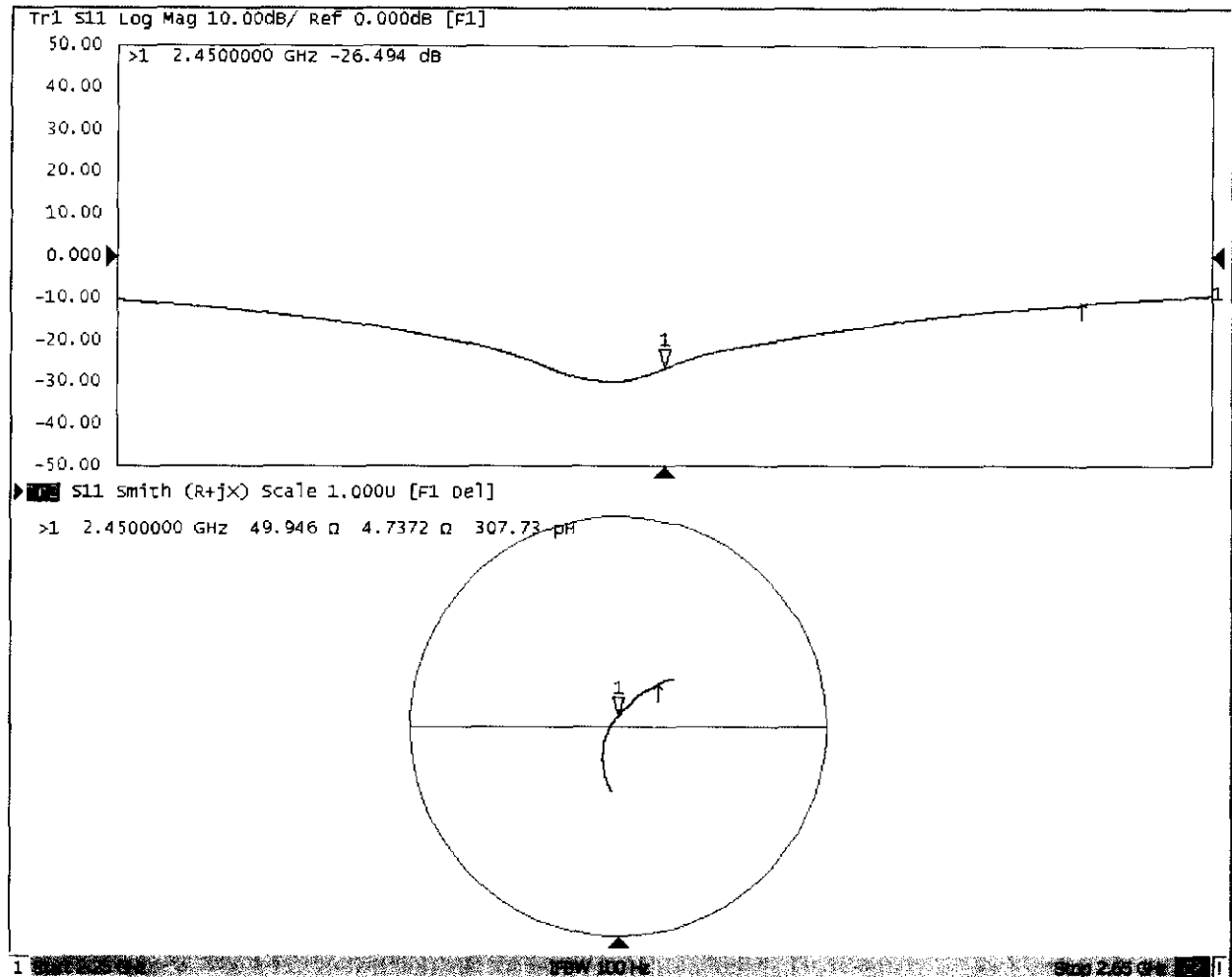
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL







## Dipole Internal Calibration Record

Asset No. :	E-434	Model No. :	D2450V2	Serial No. :	919
Environmental	23.6°C, 54 %	Original Cal. Date :	June 11, 2018	Next Cal. Date :	June 11, 2021

### Standard List

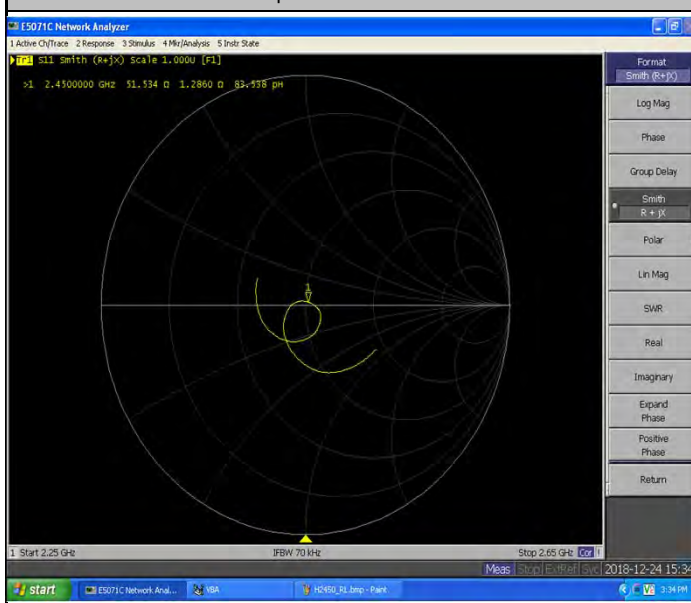
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

### Equipment Information

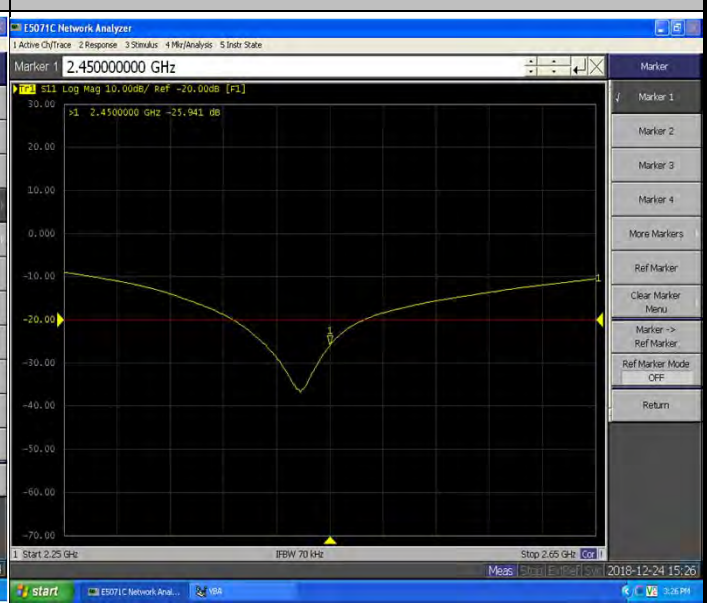
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

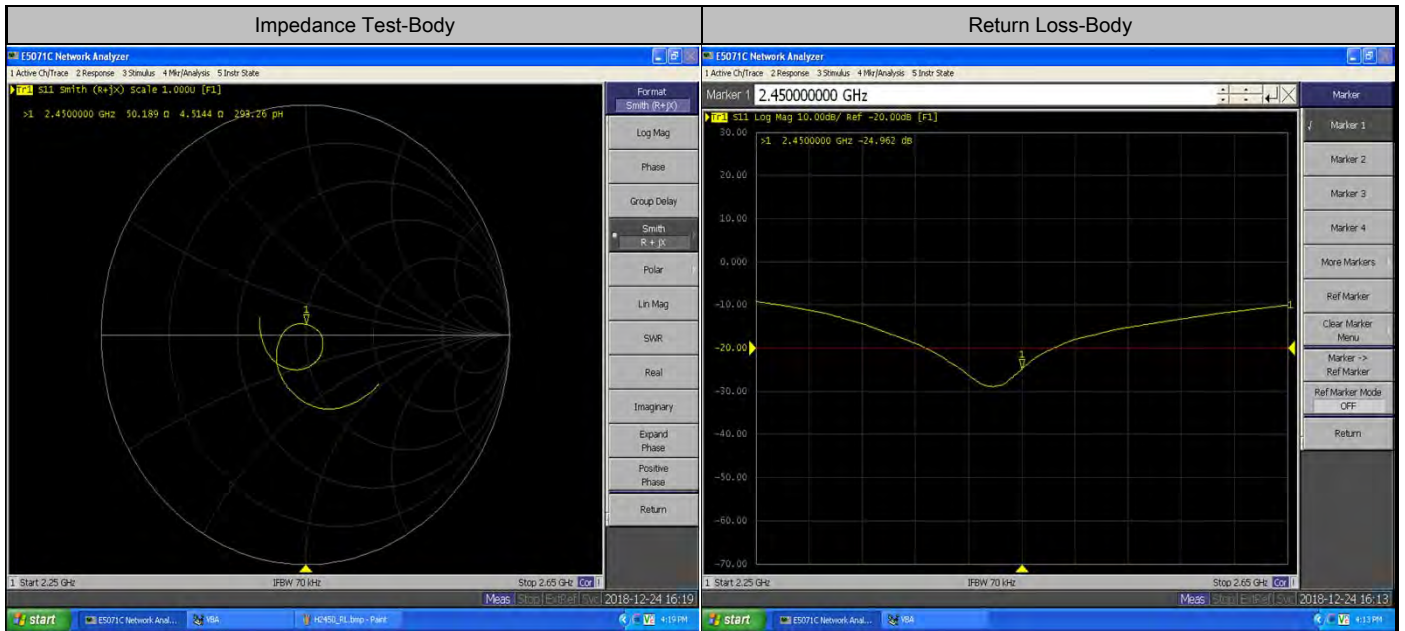
Model No	For Head Tissue				
D2450V2	Item	Originak Cal. Result	Verified on 2018/12/24	Deviation	Result
	Impedance, transformed to feed point	53Ω+2.85jΩ	51.5Ω+1.29jΩ	<5Ω	Pass
	Return Loss(dB)	-27.9	-25.941	-7.0%	Pass
	SAR Value for 1g(mW/g)	13.1	12.5	-4.6%	Pass
	SAR Value for 10g(mW/g)	6.17	5.71	-7.5%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/12/24	Deviation	Result
	Impedance, transformed to feed point	49.9Ω+4.74jΩ	50.2Ω+4.51jΩ	<5Ω	Pass
	Return Loss(dB)	-26.5	-24.962	-5.8%	Pass
	SAR Value for 1g(mW/g)	12.7	13.1	3.1%	Pass
	SAR Value for 10g(mW/g)	5.93	6.01	1.3%	Pass

### Impedance Test-Head



### Return Loss-Head





Validation Report for Head TSL	Validation Report for Body TSL
<p>Test Laboratory: BTL Inc.      Date: 2018/12/24<sup>+</sup></p> <p><b>System Check_H2450_3240<sup>+</sup></b></p> <p><b>DUT: Dipole 2450 MHz D2450V2; SN: 919<sup>+</sup></b></p> <p>Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used (interpolated): <math>f = 2450</math> MHz; <math>\sigma = 1.872</math> S/m; <math>\epsilon_r = 38.229</math>; <math>\rho = 1000</math> kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.3 °C; Liquid Temperature : 22.4 °C<sup>+</sup></p> <p>DASY Configuration<sup>+</sup></p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3240; ConvE(4.74, 4.74, 4.74) @ 2450 MHz; Calibrated: 2018/3/28 <sup>+</sup></li> <li>Sensor-Surface: 4mm (Mechanical Surface Detection), <math>z = 2.0, 32.0</math> <sup>+</sup></li> <li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li> <li>Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li> <li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li> </ul> <p>↓</p> <p><b>Area Scan (8x9x1):</b> Interpolated grid: <math>dx=12</math> mm, <math>dy=12</math> mm <sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 15.1 W/kg <sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5</math> mm, <math>dy=5</math> mm, <math>dz=5</math> mm <sup>+</sup></p> <p>Reference Value = 109.4 V/m; Power Drift = 0.00 dB <sup>+</sup></p> <p>Peak SAR (extrapolated) = 26.3 W/kg <sup>+</sup></p> <p><b>SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.71 W/kg <sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 14.1 W/kg</p>	<p>Test Laboratory: BTL Inc.      Date: 2018/12/24<sup>+</sup></p> <p><b>System Check_B2450_3240<sup>+</sup></b></p> <p><b>DUT: Dipole 2450 MHz D2450V2; SN: 919<sup>+</sup></b></p> <p>Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: <math>f = 2450</math> MHz; <math>\sigma = 2.045</math> S/m; <math>\epsilon_r = 50.242</math>; <math>\rho = 1000</math> kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.3 °C; Liquid Temperature : 22.4 °C<sup>+</sup></p> <p>DASY Configuration<sup>+</sup></p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3240; ConvE(4.57, 4.57, 4.57) @ 2450 MHz; Calibrated: 2018/3/28 <sup>+</sup></li> <li>Sensor-Surface: 4mm (Mechanical Surface Detection), <math>z = 2.0, 32.0</math> <sup>+</sup></li> <li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li> <li>Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li> <li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li> </ul> <p>↓</p> <p><b>Area Scan (8x9x1):</b> Interpolated grid: <math>dx=12</math> mm, <math>dy=12</math> mm <sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 15.8 W/kg <sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5</math> mm, <math>dy=5</math> mm, <math>dz=5</math> mm <sup>+</sup></p> <p>Reference Value = 107.1 V/m; Power Drift = -0.03 dB <sup>+</sup></p> <p>Peak SAR (extrapolated) = 28.0 W/kg <sup>+</sup></p> <p><b>SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.01 W/kg <sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 14.9 W/kg</p>

Calibrator: *Rot - Liang*

Approver: *Herbert Lin*



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cnClient **BTL Inc .**Certificate No: **Z18-60184****CALIBRATION CERTIFICATE**Object **D2600V2 - SN: 1067**Calibration Procedure(s) **FF-Z11-003-01**  
**Calibration Procedures for dipole validation kits**Calibration date: **June 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%.

Calibration Equipment used (M&amp;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 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
Network Analyzer 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	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 13, 2018

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



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

### Glossary:

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

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

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

### Additional Documentation:

- 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%.



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

**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, dz = 5 mm	
<b>Frequency</b>	2600 MHz $\pm$ 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.0	1.96 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	39.9 $\pm$ 6 %	2.01 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Head TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	14.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>56.1 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	6.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.3 mW / g <math>\pm</math> 18.7 % (k=2)</b>

**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	52.5	2.16 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	54.0 $\pm$ 6 %	2.16 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Body TSL**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	13.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>55.2 mW / g <math>\pm</math> 18.8 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	6.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>24.6 mW / g <math>\pm</math> 18.7 % (k=2)</b>



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.5Ω- 6.92jΩ
Return Loss	- 22.5dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	43.8Ω- 5.59jΩ
Return Loss	- 21.1dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.012 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

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## **DASY5 Validation Report for Head TSL**

Date: 06.11.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1067**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.01$  S/m;  $\epsilon_r = 39.93$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(7.76, 7.76, 7.76) @ 2600 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

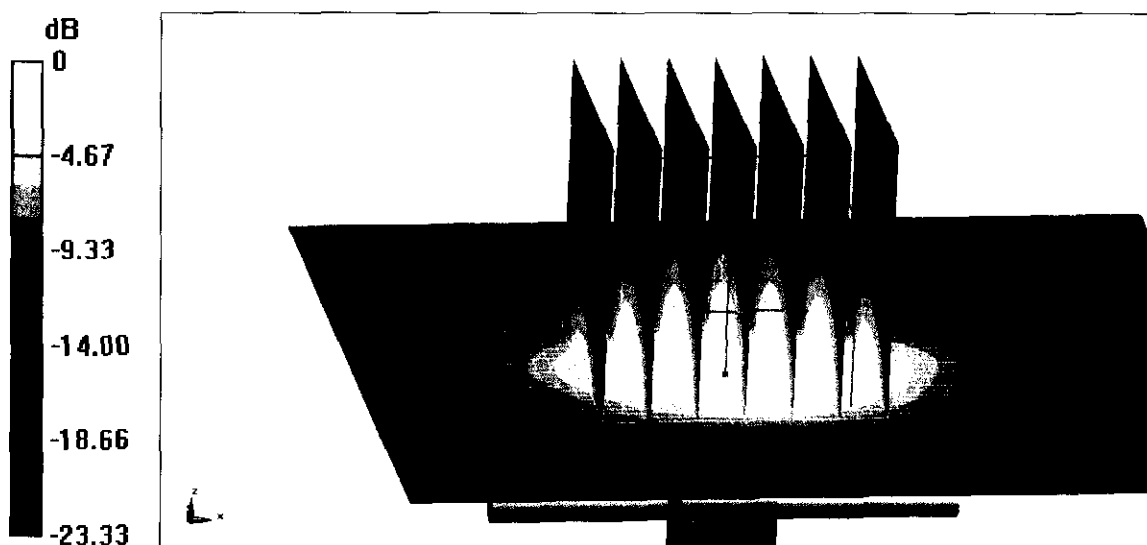
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.20 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 30.3 W/kg

**SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.33 W/kg**

Maximum value of SAR (measured) = 24.2 W/kg



0 dB = 24.2 W/kg = 13.84 dBW/kg



In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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

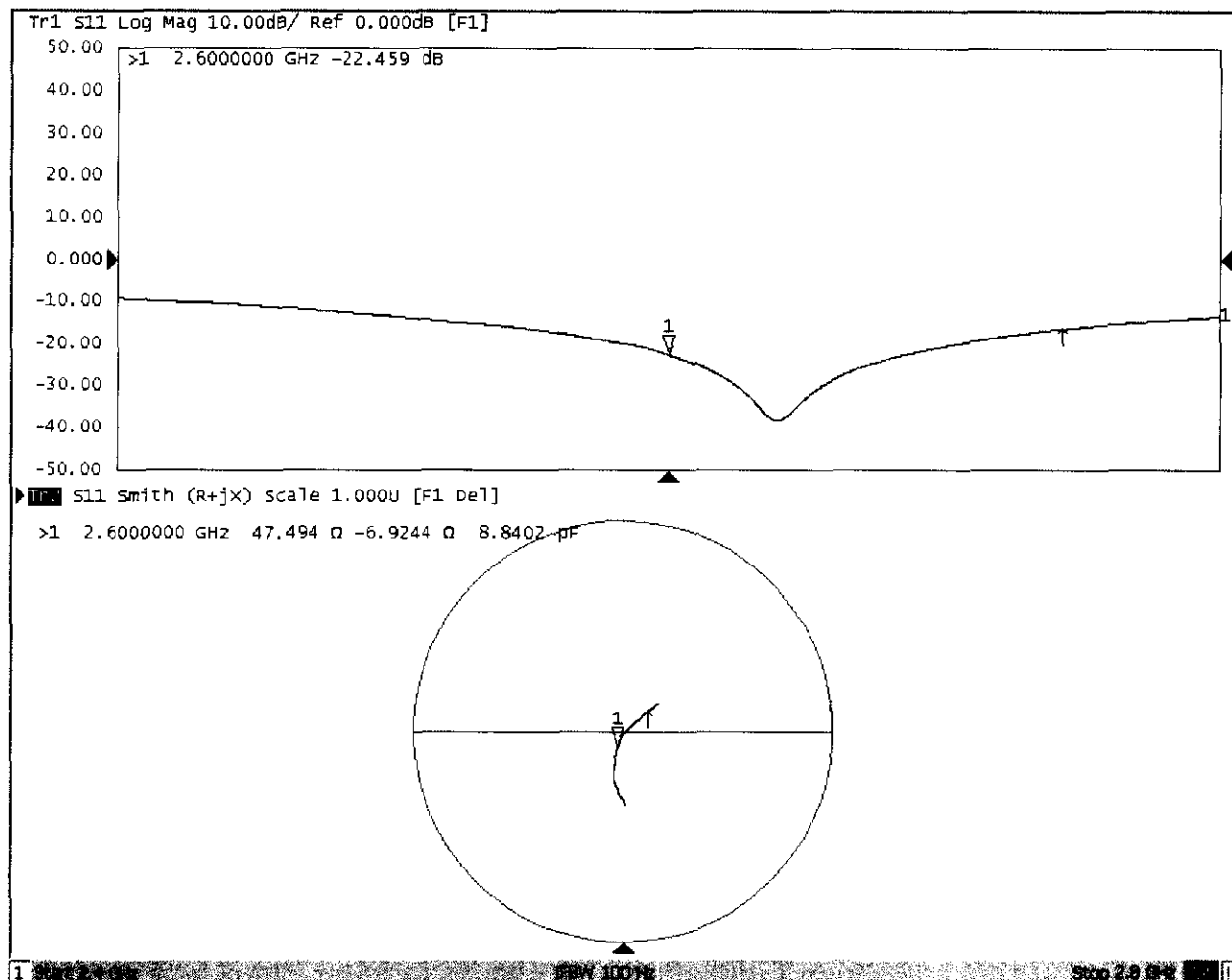
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL







In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## DASY5 Validation Report for Body TSL

Date: 06.08.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1067**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.157$  S/m;  $\epsilon_r = 54.01$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 9/12/2017
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Phantom: MFP\_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

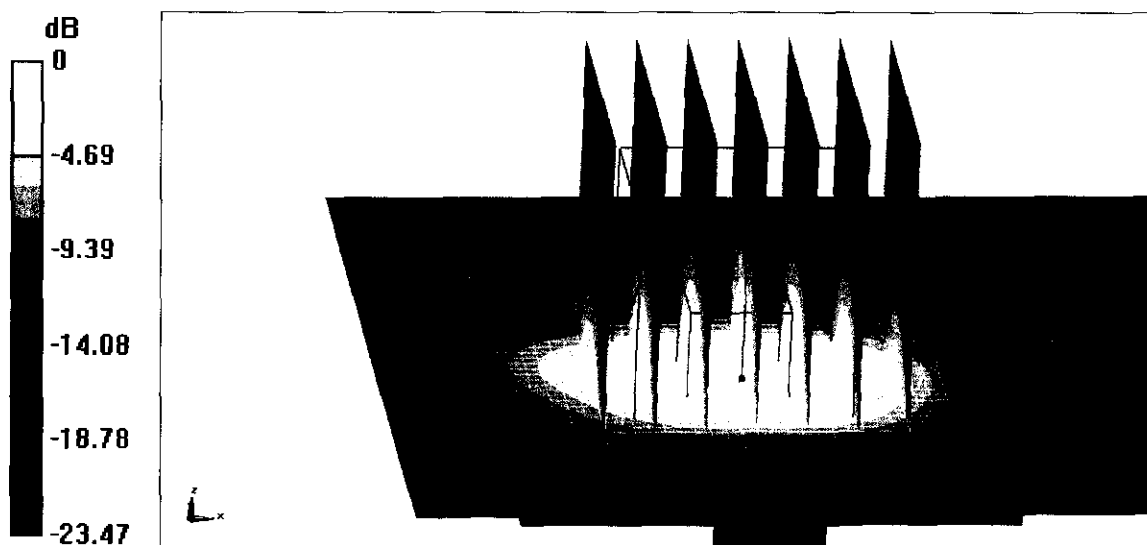
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 78.44 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29.5 W/kg

**SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.11 W/kg**

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



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



In Collaboration with

**s p e a g**

**CALIBRATION LABORATORY**

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

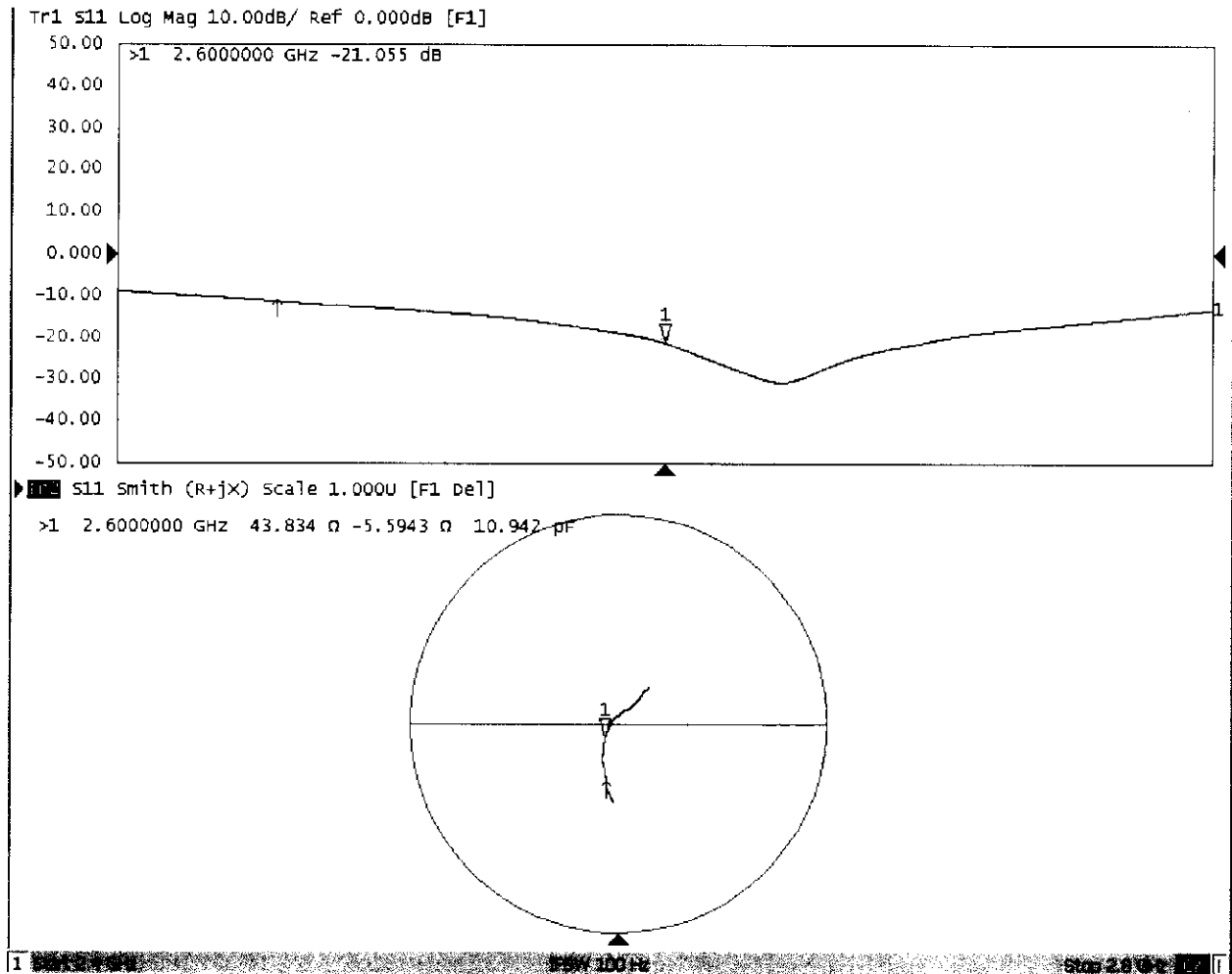
Tel: +86-10-62304633-2079

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL





## Dipole Internal Calibration Record

Asset No. :	E-435	Model No. :	D2600V2	Serial No. :	1067
Environmental	22.7°C, 62 %	Original Cal. Date :	June 11, 2018	Next Cal. Date :	June 11, 2021

### Standard List

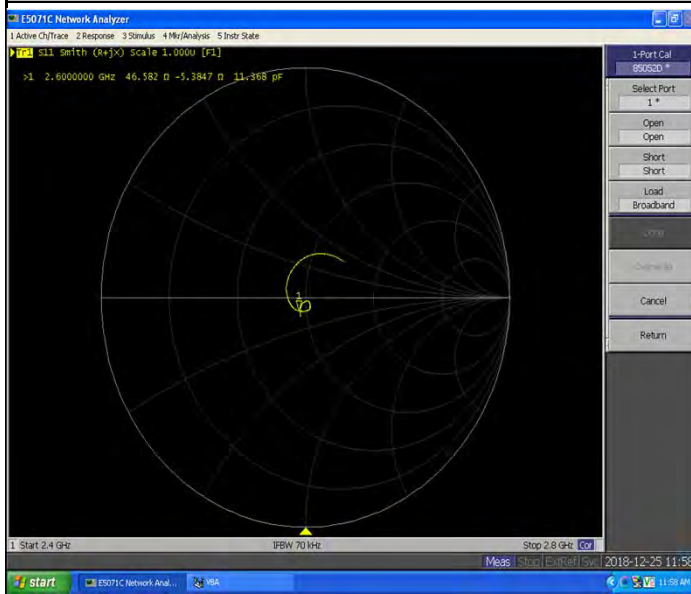
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013
2	IEC 62209-2	Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30 MHz to 6 GHz), March 2010
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz

### Equipment Information

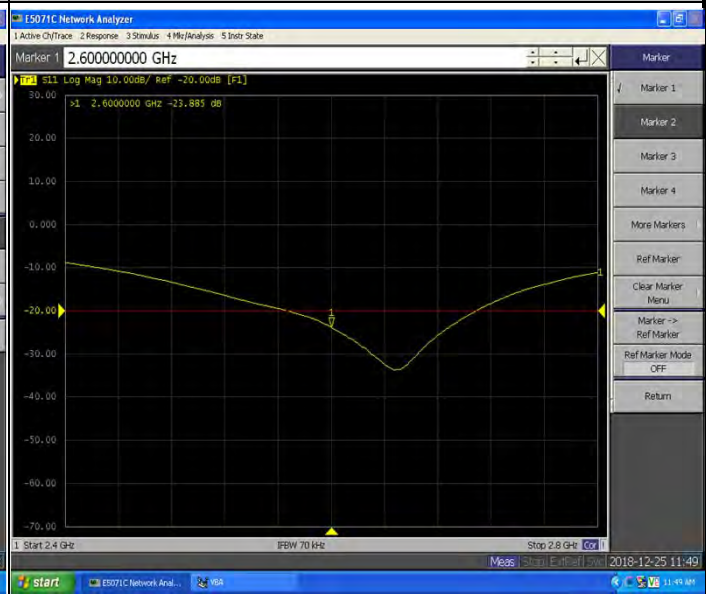
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018

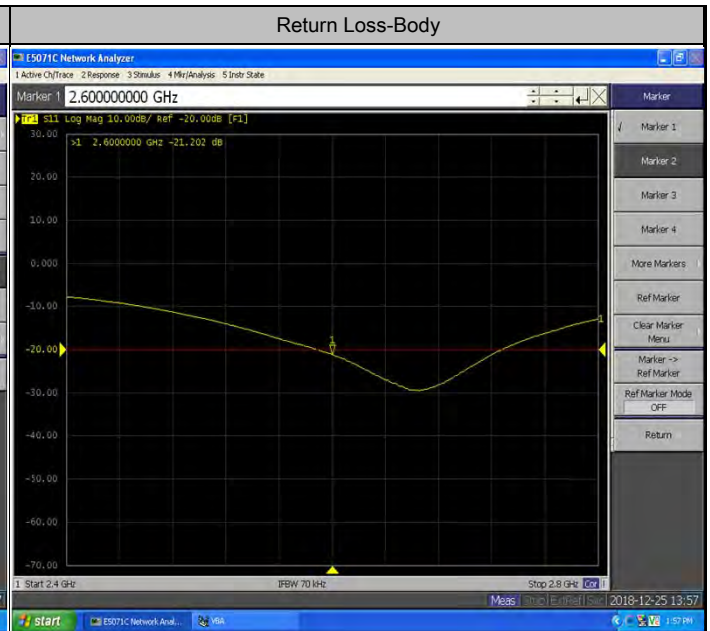
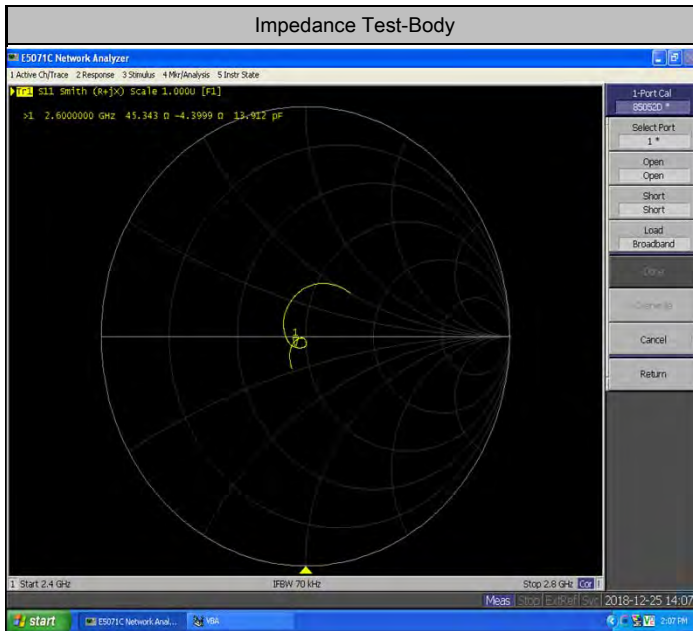
Model No	For Head Tissue				
D2600V2	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	47.5Ω-6.92jΩ	46.6Ω-5.38jΩ	<5Ω	Pass
	Return Loss(dB)	-22.5	-23.9	6.2%	Pass
	SAR Value for 1g(mW/g)	14.1	14.1	0.0%	Pass
	SAR Value for 10g(mW/g)	6.33	6.18	-2.4%	Pass
	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/X/X	Deviation	Result
	Impedance, transformed to feed point	43.8Ω-5.59jΩ	45.3Ω-4.4jΩ	<5Ω	Pass
	Return Loss(dB)	-21.1	-21.2	0.5%	Pass
	SAR Value for 1g(mW/g)	13.7	14.3	4.4%	Pass
	SAR Value for 10g(mW/g)	6.11	6.28	2.8%	Pass

### Impedance Test-Head



### Return Loss-Head





### Validation Report for Head TSL

Test Laboratory: BTL Inc. Date: 2018/12/25

System Check\_H2600\_3240

DUT: Dipole 2600 MHz D2600V2; SN:1067

Communication System: UID 0, CW (0); Frequency: 2600 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.024$  S/m;  $\epsilon_r = 38.632$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C

DASY Configuration:

- Probe: ES3DV3 - SN3240; ConvE(4.63, 4.63, 4.63) @ 2600 MHz; Calibrated: 2018/3/28
- Sensor-Surface: 4mm (Mechanical Surface Detection),  $z = 2.0, 32.0$
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (8x9x1): Interpolated grid:  $dx=12$  mm,  $dy=12$  mm  
Maximum value of SAR (interpolated) = 17.3 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid:  $dx=5$  mm,  $dy=5$  mm,  $dz=5$  mm  
Reference Value = 111.8 V/m; Power Drift = 0.02 dB  
Peak SAR (extrapolated) = 30.8 W/kg  
SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.18 W/kg  
Maximum value of SAR (measured) = 15.9 W/kg

W/kg  
15.900  
12.733  
9.566  
6.399  
3.232  
0.064

### Validation Report for Body TSL

Test Laboratory: BTL Inc. Date: 2018/12/25

System Check\_B2600\_3240

DUT: Dipole 2600 MHz D2600V2; SN:1067

Communication System: UID 0, CW (0); Frequency: 2600 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.229$  S/m;  $\epsilon_r = 50.273$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C

DASY Configuration:

- Probe: ES3DV3 - SN3240; ConvE(4.28, 4.28, 4.28) @ 2600 MHz; Calibrated: 2018/3/28
- Sensor-Surface: 4mm (Mechanical Surface Detection),  $z = 2.0, 32.0$
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Area Scan (8x9x1): Interpolated grid:  $dx=12$  mm,  $dy=12$  mm  
Maximum value of SAR (interpolated) = 17.6 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid:  $dx=5$  mm,  $dy=5$  mm,  $dz=5$  mm  
Reference Value = 107.4 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 31.4 W/kg  
SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.28 W/kg  
Maximum value of SAR (measured) = 16.2 W/kg

W/kg  
16.200  
12.973  
9.745  
6.518  
3.291  
0.064

Calibrator: *Rot - Liang*

Approver: *Herbert Lin*



In Collaboration with  
**s p e a g**  
**CALIBRATION LABORATORY**



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

Client **BTL Inc.**

Certificate No: **Z18-60185**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1160**

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

Calibration date: **June 20, 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 NRP2	102083	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
Power sensor NRP-Z91	100542	01-Nov-17 (CTTL, No.J17X08756)	Oct-18
ReferenceProbe EX3DV4	SN 3846	25-Jan-18(SPEAG,No.EX3-3846_Jan18)	Jan-19
DAE4	SN 1525	02-Oct-17(SPEAG,No.DAE4-1525_Oct17)	Oct-18
DAE4	SN 777	15-Dec-17(SPEAG,No.DAE4-777_Dec17)	Dec-18

Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzerE5071C	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	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 23, 2018

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



In Collaboration with

**s p e a k**  
**CALIBRATION LABORATORY**

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

### Glossary:

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

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

- 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
- 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
- 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
- KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

### Additional Documentation:

- 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%.



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
 E-mail: cttl@chinattl.com http://www.chinattl.cn

**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 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	5200 MHz $\pm$ 1 MHz 5300 MHz $\pm$ 1 MHz 5500 MHz $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 1 MHz	

**Head TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	36.0	4.66 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	36.6 $\pm$ 6 %	4.63 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	<1.0 °C	----	----

**SAR result with Head TSL at 5200 MHz**

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	7.50 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>75.3 mW / g <math>\pm</math> 24.4 % (k=2)</b>
<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	2.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>21.7 mW / g <math>\pm</math> 24.2 % (k=2)</b>



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

**Head TSL parameters at 5300 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	4.75 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

**SAR result with Head TSL at 5300 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	76.8 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.20 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.1 mW / g ± 24.2 % (k=2)

**Head TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.6 ± 6 %	4.94 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

**SAR result with Head TSL at 5500 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.8 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.30 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.0 mW / g ± 24.2 % (k=2)





In Collaboration with

**s p e a k**  
CALIBRATION LABORATORY

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

**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	35.8 ± 6 %	4.98 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	7.85 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	78.6 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.25 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.5 mW / g ± 24.2 % (k=2)

**Head TSL parameters at 5800 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.6 ± 6 %	5.24 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

**SAR result with Head TSL at 5800 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	77.9 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.21 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.1 mW / g ± 24.2 % (k=2)



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

**Body TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.8 ± 6 %	5.32 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5200 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	69.8 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	1.92 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	19.2 mW / g ± 24.2 % (k=2)

**Body TSL parameters at 5300 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.38 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5300 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.25 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	72.3 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.04 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.3 mW / g ± 24.2 % (k=2)



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

**Body TSL parameters at 5500 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.56 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5500 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	76.2 mW / g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.13 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.3 mW / g ± 24.2 % (k=2)

**Body TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.1 ± 6 %	5.80 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	7.78 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	77.7 mW / g ± 24.4 % (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	21.4 mW / g ± 24.2 % (k=2)



In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

<http://www.chinattl.cn>**Body TSL parameters at 5800 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.0 ± 6 %	6.07 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

**SAR result with Body TSL at 5800 MHz**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.66 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	76.6 mW /g ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	100 mW input power	2.15 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.5 mW /g ± 24.2 % (k=2)



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	53.5Ω - 8.96jΩ
Return Loss	- 20.7dB

### Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	50.1Ω - 3.00jΩ
Return Loss	- 30.5dB

### Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.4Ω - 5.39jΩ
Return Loss	- 25.2dB

### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.5Ω - 2.95jΩ
Return Loss	- 22.5dB

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.5Ω - 1.38jΩ
Return Loss	- 26.9dB

### Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.1Ω - 7.52jΩ
Return Loss	- 22.1dB

### Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	49.3Ω - 2.06jΩ
Return Loss	- 33.1dB



In Collaboration with

**s p e a g**  
CALIBRATION LABORATORY

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

### Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.9Ω - 4.94jΩ
Return Loss	- 26.1dB

### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.5Ω - 0.79jΩ
Return Loss	- 22.1dB

### Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	54.3Ω + 0.12jΩ
Return Loss	- 27.6dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.065 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

**s p e a g**  
**CALIBRATION LABORATORY**

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

## **DASY5 Validation Report for Head TSL**

Date: 06.20.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1160**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.633$  S/m;  $\epsilon_r = 36.62$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.754$  S/m;  $\epsilon_r = 36.31$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.942$  S/m;  $\epsilon_r = 35.58$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.984$  S/m;  $\epsilon_r = 35.81$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.241$  S/m;  $\epsilon_r = 35.58$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Right Section

### **DASY5 Configuration:**

- Probe: EX3DV4 - SN3846; ConvF(5.57, 5.57, 5.57) @ 5200 MHz; Calibrated: 1/25/2018, ConvF(5.34, 5.34, 5.34) @ 5300 MHz; Calibrated: 1/25/2018, ConvF(4.91, 4.91, 4.91) @ 5500 MHz; Calibrated: 1/25/2018, ConvF(4.73, 4.73, 4.73) @ 5600 MHz; Calibrated: 1/25/2018, ConvF(4.9, 4.9, 4.9) @ 5800 MHz; Calibrated: 1/25/2018,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 12/15/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

**Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 67.38 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 31.8 W/kg  
**SAR(1 g) = 7.5 W/kg; SAR(10 g) = 2.16 W/kg**  
Maximum value of SAR (measured) = 17.8 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 62.70 V/m; Power Drift = -0.02 dB  
Peak SAR (extrapolated) = 33.3 W/kg  
**SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.2 W/kg**  
Maximum value of SAR (measured) = 18.4 W/kg



In Collaboration with

**s p e a k**  
**CALIBRATION LABORATORY**

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

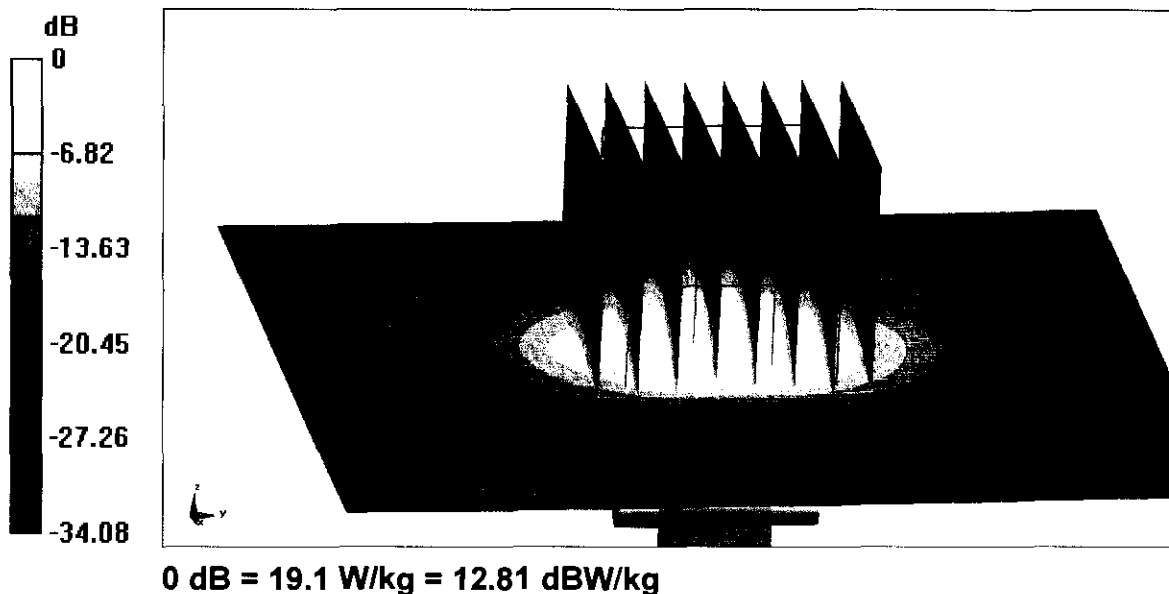
E-mail: cttl@chinattl.com

http://www.chinattl.cn

**Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 66.94 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 36.4 W/kg  
**SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.3 W/kg**  
Maximum value of SAR (measured) = 19.4 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 = 65.08 V/m; Power Drift = -0.01 dB  
Peak SAR (extrapolated) = 35.7 W/kg  
**SAR(1 g) = 7.85 W/kg; SAR(10 g) = 2.25 W/kg**  
Maximum value of SAR (measured) = 18.9 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 62.16 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 37.2 W/kg  
**SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.21 W/kg**  
Maximum value of SAR (measured) = 19.1 W/kg







In Collaboration with

**s p e a k**  
CALIBRATION LABORATORY

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

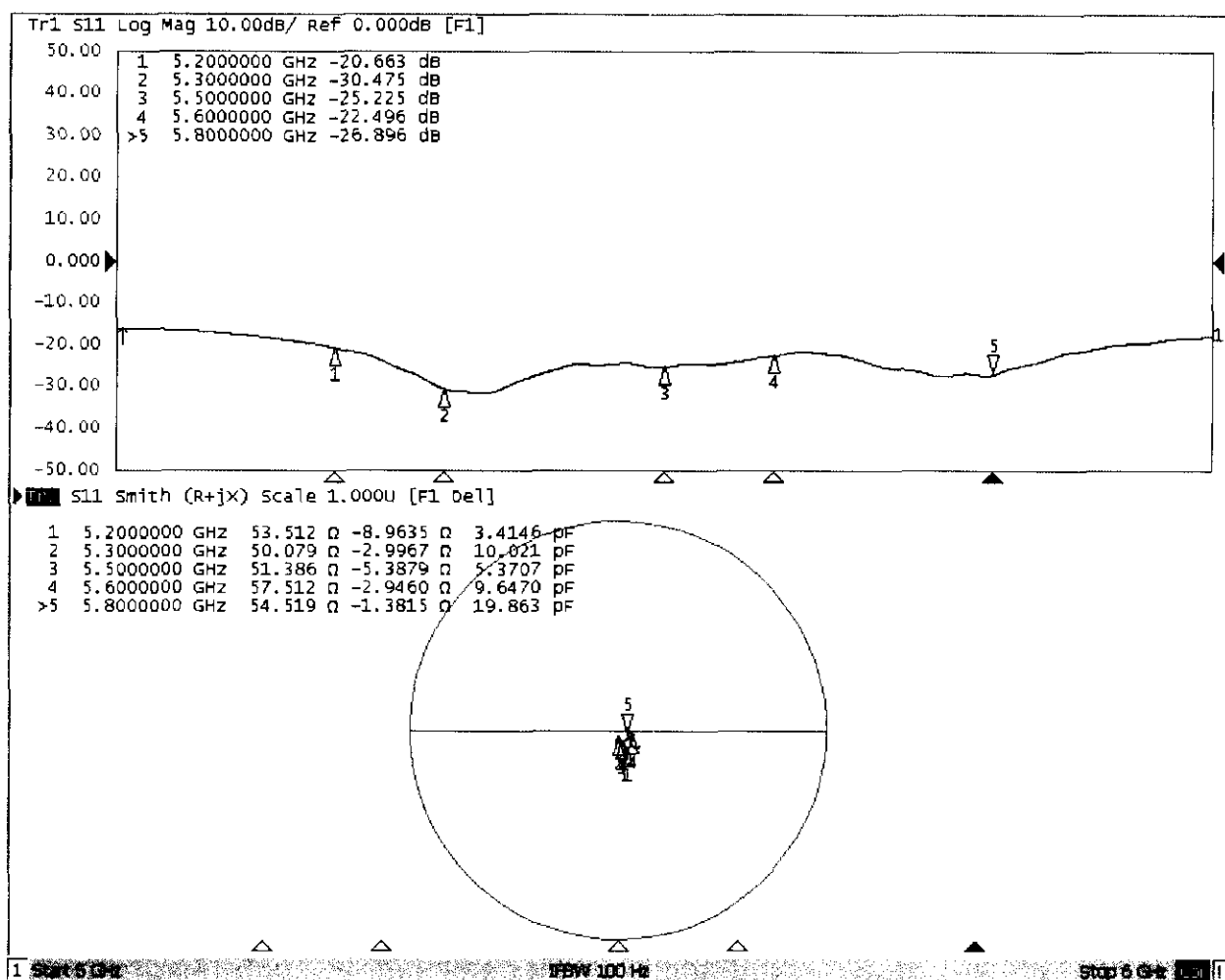
Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

E-mail: cttl@chinattl.com

http://www.chinattl.cn

## Impedance Measurement Plot for Head TSL





In Collaboration with

**s p e a g**  
**CALIBRATION LABORATORY**

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

Date: 06.19.2018

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1160**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.317$  S/m;  $\epsilon_r = 48.78$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.381$  S/m;  $\epsilon_r = 48.35$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.56$  S/m;  $\epsilon_r = 48.36$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.795$  S/m;  $\epsilon_r = 48.14$ ;  $\rho = 1000$  kg/m<sup>3</sup>,  
Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.065$  S/m;  $\epsilon_r = 48.03$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Left Section

### **DASY5 Configuration:**

- Probe: EX3DV4 - SN3846; ConvF(5.15, 5.15, 5.15) @ 5200 MHz; Calibrated: 1/25/2018, ConvF(5.04, 5.04, 5.04) @ 5300 MHz; Calibrated: 1/25/2018, ConvF(4.46, 4.46, 4.46) @ 5500 MHz; Calibrated: 1/25/2018, ConvF(4.36, 4.36, 4.36) @ 5600 MHz; Calibrated: 1/25/2018, ConvF(4.51, 4.51, 4.51) @ 5800 MHz; Calibrated: 1/25/2018,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1525; Calibrated: 10/2/2017
- Electronics: DAE4 Sn777; Calibrated: 12/15/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

**Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.32 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 31.6 W/kg

**SAR(1 g) = 6.99 W/kg; SAR(10 g) = 1.92 W/kg**

Maximum value of SAR (measured) = 16.7 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan,**

**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 56.59 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 33.3 W/kg

**SAR(1 g) = 7.25 W/kg; SAR(10 g) = 2.04 W/kg**

Maximum value of SAR (measured) = 18.2 W/kg



In Collaboration with

**s p e a k**  
CALIBRATION LABORATORY

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

Tel: +86-10-62304633-2512

Fax: +86-10-62304633-2504

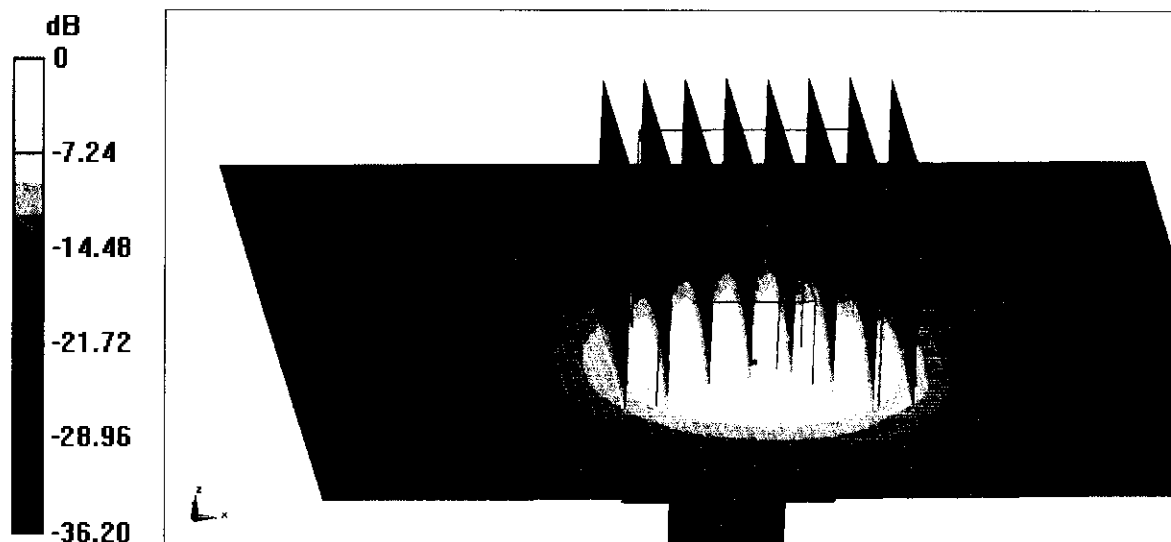
E-mail: cttl@chinattl.com

http://www.chinattl.cn

**Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 65.72 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 35.6 W/kg  
**SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.13 W/kg**  
Maximum value of SAR (measured) = 19.2 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 = 57.49 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 37.4 W/kg  
**SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.14 W/kg**  
Maximum value of SAR (measured) = 19.3 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 41.04 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 36.5 W/kg  
**SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.15 W/kg**  
Maximum value of SAR (measured) = 18.8 W/kg

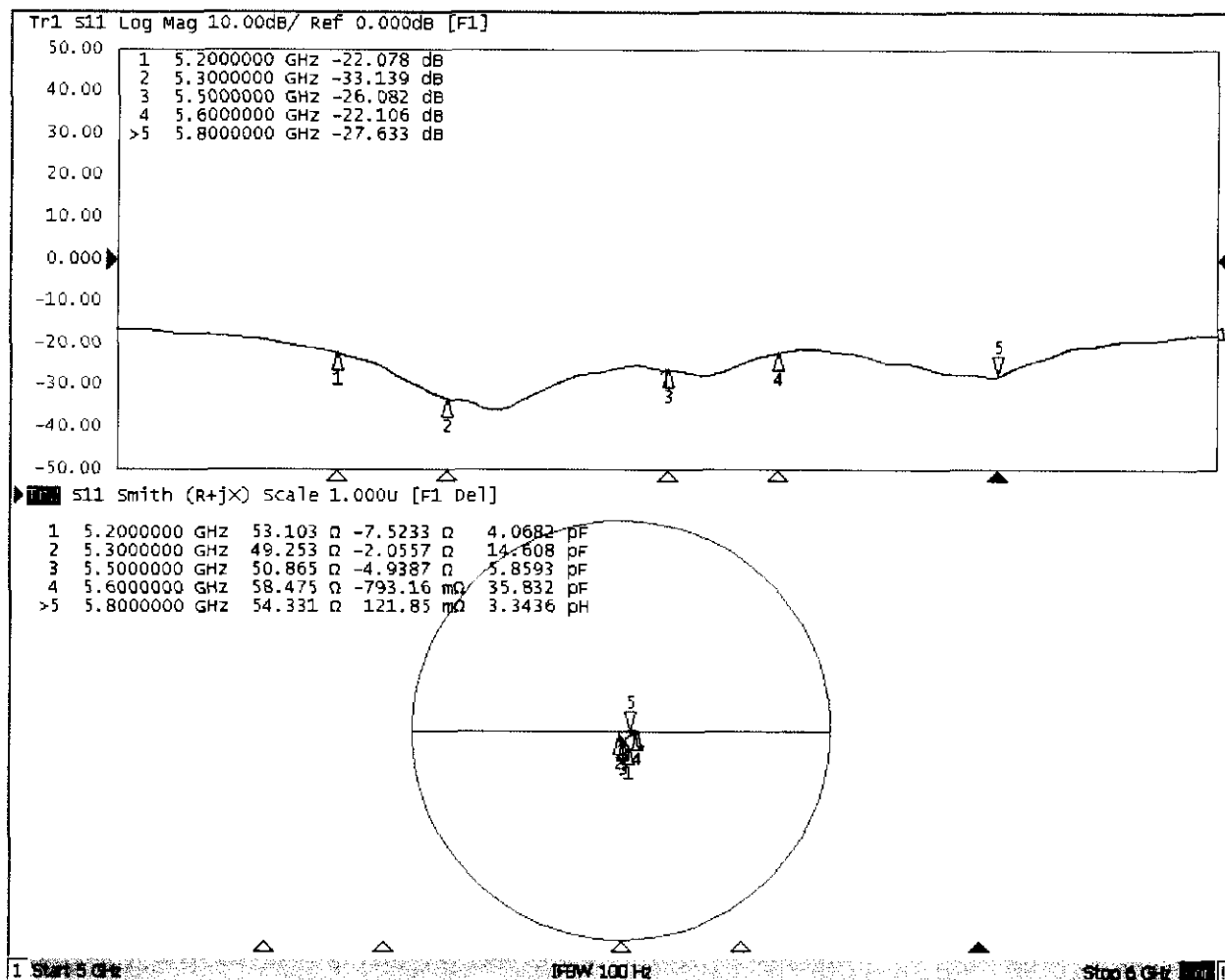


**0 dB = 18.8 W/kg = 12.74 dBW/kg**



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504  
E-mail: cttl@chinattl.com http://www.chinattl.cn

## Impedance Measurement Plot for Body TSL





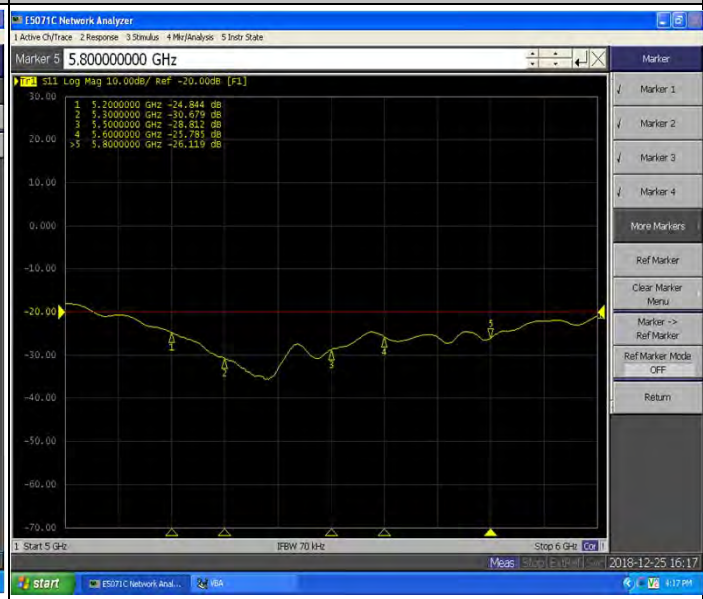
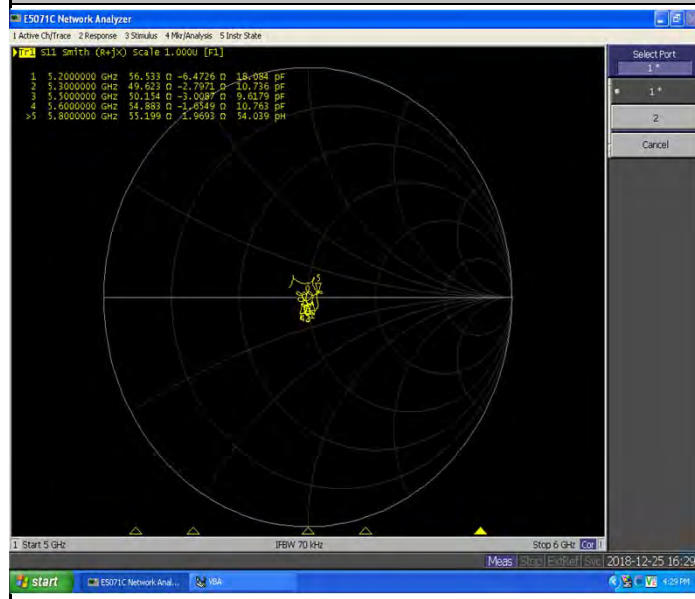
## Dipole Internal Calibration Record

Asset No. :	E-436	Model No. :	D5GHzV2	Serial No. :	1160
Environmental	22.3°C, 55 %	Original Cal. Date :	June 20, 2018	Next Cal. Date :	June 20, 2021
Standard List					
1	IEEE Std 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorpton Rate(SAR) in the Human Head from Wireless Communication Devices: Measurement Texhniques, June 2013			
2	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			
3	KDB865664	SAR Measurement Requirements for 100 MHz to 6 GHz			
Equipment Information					
Equipment :	Manufacturer :	Model No. :	Serial No. :	Cal.Organization :	Cal. Date :
Power Amplifier	Mini-Circuits	ZVE-8G+	520701341	NA	March 9, 2018
DC Source	Iteck	OT6154	M00157	NA	October 12, 2018
P-series power meter	Agilent	N1911A	MY45100473	NA	August 11, 2018
wideband power sensor	Agilent	N1921A	MY51100041	NA	August 11, 2018
power Meter	Anritsu	ML2495A	1128009	NA	Mar. 11, 2018
Pulse Power Sensor	Anritsu	MA 2411B	1027500	NA	Mar. 11, 2018
Dual directional coupler	Woken	TS-PCC0M-05	107090019	NA	Mar. 11, 2018
MXG Analog Signal Generator	Agilent	N5181A	MY49060710	NA	August 11, 2018
ENA Network Analyzer	Agilent	E5071C	MY46102965	NA	March 11, 2018
Model No	For Head Tissue				
	Item	Originak Cal. Result	Verified on 2018/12/25	Deviation	Result
D5GHzV2(5.2GHz)	Impedance, transformed to feed point	53.5Ω-8.96jΩ	56.5Ω-6.47jΩ	<5Ω	Pass
	Return Loss(dB)	-20.7	-24.8	19.8%	Pass
	SAR Value for 1g(mW/g)	7.5	7.27	-3.1%	Pass
	SAR Value for 10g(mW/g)	2.16	2.07	-4.2%	Pass
D5GHzV2(5.3GHz)	Impedance, transformed to feed point	50.1Ω-3jΩ	49.6Ω-2.8jΩ	<5Ω	Pass
	Return Loss(dB)	-30.5	-30.7	0.7%	Pass
	SAR Value for 1g(mW/g)	7.66	7.34	-4.2%	Pass
	SAR Value for 10g(mW/g)	2.2	2.07	-5.9%	Pass
D5GHzV2(5.5GHz)	Impedance, transformed to feed point	51.4Ω-5.39jΩ	50.2Ω-3.01jΩ	<5Ω	Pass
	Return Loss(dB)	-25.2	-28.8	14.3%	Pass
	SAR Value for 1g(mW/g)	8.08	8.32	3.0%	Pass
	SAR Value for 10g(mW/g)	2.3	2.33	1.3%	Pass
D5GHzV2(5.6GHz)	Impedance, transformed to feed point	57.5Ω-2.95jΩ	54.9Ω-1.65jΩ	<5Ω	Pass
	Return Loss(dB)	-22.5	-25.8	14.7%	Pass
	SAR Value for 1g(mW/g)	7.85	7.84	-0.1%	Pass
	SAR Value for 10g(mW/g)	2.25	2.2	-2.2%	Pass
D5GHzV2(5.8GHz)	Impedance, transformed to feed point	54.5Ω-1.38jΩ	55.2Ω+1.97jΩ	<5Ω	Pass
	Return Loss(dB)	-26.9	-26.1	-3.0%	Pass
	SAR Value for 1g(mW/g)	7.78	7.89	1.4%	Pass
	SAR Value for 10a(mW/a)	2.21	2.21	0.0%	Pass

Model No	For Body Tissue				
	Item	Originak Cal. Result	Verified on 2018/12/25	Deviation	Result
D5GHzV2(5.2GHz)	Impedance, transformed to feed point	53.1 $\Omega$ -7.52j $\Omega$	55.1 $\Omega$ -7.96j $\Omega$	<5 $\Omega$	Pass
	Return Loss(dB)	-22.1	-26.1	18.1%	Pass
	SAR Value for 1g(mW/g)	6.99	7.28	4.1%	Pass
	SAR Value for 10g(mW/g)	1.92	2.06	7.3%	Pass
D5GHzV2(5.3GHz)	Impedance, transformed to feed point	49.3 $\Omega$ -2.06j $\Omega$	52.7 $\Omega$ -1.73j $\Omega$	<5 $\Omega$	Pass
	Return Loss(dB)	-33.1	-30.3	-8.5%	Pass
	SAR Value for 1g(mW/g)	7.25	7.16	-1.2%	Pass
	SAR Value for 10g(mW/g)	2.04	2	-2.0%	Pass
D5GHzV2(5.5GHz)	Impedance, transformed to feed point	50.9 $\Omega$ -4.94j $\Omega$	48.2 $\Omega$ -3.03j $\Omega$	<5 $\Omega$	Pass
	Return Loss(dB)	-26.1	-24.8	-5.0%	Pass
	SAR Value for 1g(mW/g)	7.63	7.72	1.2%	Pass
	SAR Value for 10g(mW/g)	2.13	2.16	1.4%	Pass
D5GHzV2(5.6GHz)	Impedance, transformed to feed point	58.5 $\Omega$ -0.79j $\Omega$	57.6 $\Omega$ -0.43j $\Omega$	<5 $\Omega$	Pass
	Return Loss(dB)	-22.1	-23.2	5.0%	Pass
	SAR Value for 1g(mW/g)	7.78	7.92	1.8%	Pass
	SAR Value for 10g(mW/g)	2.14	2.2	2.8%	Pass
D5GHzV2(5.8GHz)	Impedance, transformed to feed point	54.3 $\Omega$ +0.12j $\Omega$	52.2 $\Omega$ +0.43j $\Omega$	<5 $\Omega$	Pass
	Return Loss(dB)	-27.6	-24.1	-12.7%	Pass
	SAR Value for 1g(mW/g)	7.66	7.79	1.7%	Pass
	SAR Value for 10g(mW/g)	2.15	2.16	0.5%	Pass

Impedance Test-Head

Return Loss-Head





Validation Report for Head TSL of 5.2GHz	Validation Report for Head TSL of 5.3GHz
<p>Test Laboratory: BTL Inc. Date: 2018/12/25<sup>+</sup></p> <p>System Check_H5200_7396<sup>+</sup></p> <p>DUT: Dipole D5GHzV2;SN:1160;<sup>+</sup></p> <p>Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: f = 5200 MHz; <math>\sigma</math> = 4.766 S/m; <math>\epsilon_r</math> = 35.64; <math>\rho</math> = 996 kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"> <li>Probe: EX3DV4 - SN7396; ConvE(5.7, 5.7, 5.7) @ 5200 MHz; Calibrated: 2018/5/29 <sup>+</sup></li> <li>Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0 <sup>+</sup></li> <li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li> <li>Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li> <li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li> </ul> <p>↓</p> <p><b>Area Scan (6x6x1):</b> Interpolated grid: dx=10 mm, dy=10 mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 15.4 W/kg<sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (7x7x12)/Cube 0:</b> Measurement grid: dx=4mm, dy=4mm, dz=2mm<sup>+</sup></p> <p>Reference Value = 41.93 V/m; Power Drift = -0.11 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 30.7 W/kg<sup>+</sup></p> <p><b>SAR(1 g) = 7.27 W/kg; SAR(10 g) = 2.07 W/kg<sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 15.4 W/kg</p>	<p>Test Laboratory: BTL Inc. Date: 2018/12/25<sup>+</sup></p> <p>System Check_H5300_7396<sup>+</sup></p> <p>DUT: Dipole D5GHzV2;SN:1160;<sup>+</sup></p> <p>Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used (interpolated): f = 5300 MHz; <math>\sigma</math> = 4.882 S/m; <math>\epsilon_r</math> = 35.392; <math>\rho</math> = 996 kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"> <li>Probe: EX3DV4 - SN7396; ConvE(5.35, 5.35, 5.35) @ 5300 MHz; Calibrated: 2018/5/29 <sup>+</sup></li> <li>Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0 <sup>+</sup></li> <li>Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li> <li>Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li> <li>DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li> </ul> <p>↓</p> <p><b>Area Scan (6x6x1):</b> Interpolated grid: dx=10 mm, dy=10 mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 16.5 W/kg<sup>+</sup></p> <p>↓</p> <p><b>Zoom Scan (7x7x12)/Cube 0:</b> Measurement grid: dx=4mm, dy=4mm, dz=2mm<sup>+</sup></p> <p>Reference Value = 41.02 V/m; Power Drift = -0.06 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 31.4 W/kg<sup>+</sup></p> <p><b>SAR(1 g) = 7.34 W/kg; SAR(10 g) = 2.07 W/kg<sup>+</sup></b></p> <p>Maximum value of SAR (measured) = 15.7 W/kg</p>



## Validation Report for Head TSL of 5.5GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>u</sup>System Check\_H5500\_7396<sup>u</sup>DUT: Dipole D5GHzV2;SN:1160;<sup>u</sup>Communication System: UID 0, CW (0); Frequency: 5500 MHz; Duty Cycle: 1:1<sup>u</sup>Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.112$  S/m;  $\epsilon_r = 34.912$ ;  $\rho = 996$  kg/m<sup>3</sup><sup>u</sup>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>u</sup>DASY Configuration<sup>u</sup>

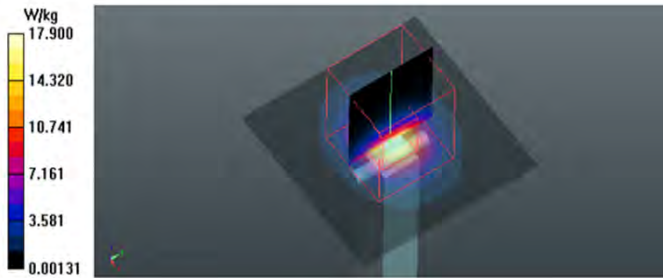
- Probe: EX3DV4 - SN7396; ConvE(4.94, 4.94, 4.94) @ 5500 MHz; Calibrated: 2018/5/29<sup>u</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 23.0$ <sup>u</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11<sup>u</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896<sup>u</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>u</sup>

↓  
**Area Scan (6x6x1):** Interpolated grid:  $dx=10$  mm,  $dy=10$  mm<sup>u</sup>  
Maximum value of SAR (interpolated) = 18.5 W/kg<sup>u</sup>

↓  
**Zoom Scan (7x7x12)/Cube 0:** Measurement grid:  $dx=4$  mm,  $dy=4$  mm,  $dz=2$  mm<sup>u</sup>  
Reference Value = 42.15 V/m; Power Drift = -0.07 dB<sup>u</sup>

Peak SAR (extrapolated) = 38.9 W/kg<sup>u</sup>SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.33 W/kg<sup>u</sup>

Maximum value of SAR (measured) = 17.9 W/kg



## Validation Report for Head TSL of 5.6GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>u</sup>System Check\_H5600\_7396<sup>u</sup>DUT: Dipole D5GHzV2;SN:1160;<sup>u</sup>Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1<sup>u</sup>Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.235$  S/m;  $\epsilon_r = 34.669$ ;  $\rho = 996$  kg/m<sup>3</sup><sup>u</sup>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>u</sup>DASY Configuration<sup>u</sup>

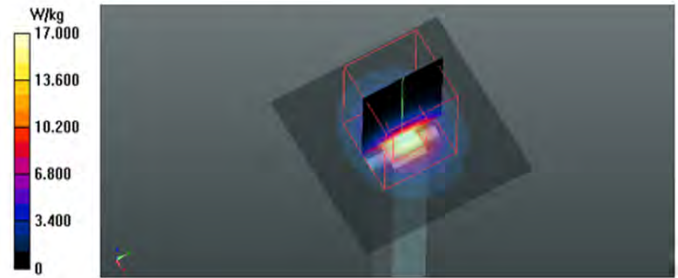
- Probe: EX3DV4 - SN7396; ConvE(4.94, 4.94, 4.94) @ 5600 MHz; Calibrated: 2018/5/29<sup>u</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 23.0$ <sup>u</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11<sup>u</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896<sup>u</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>u</sup>

↓  
**Area Scan (6x6x1):** Interpolated grid:  $dx=10$  mm,  $dy=10$  mm<sup>u</sup>  
Maximum value of SAR (interpolated) = 17.4 W/kg<sup>u</sup>

↓  
**Zoom Scan (7x7x12)/Cube 0:** Measurement grid:  $dx=4$  mm,  $dy=4$  mm,  $dz=2$  mm<sup>u</sup>  
Reference Value = 40.04 V/m; Power Drift = -0.09 dB<sup>u</sup>

Peak SAR (extrapolated) = 37.1 W/kg<sup>u</sup>SAR(1 g) = 7.84 W/kg; SAR(10 g) = 2.2 W/kg<sup>u</sup>

Maximum value of SAR (measured) = 17.0 W/kg





## Validation Report for Head TSL of 5.8GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>+</sup>System Check\_H5800\_7396<sup>+</sup>DUT: Dipole D5GHzV2;SN:1160<sup>+</sup>

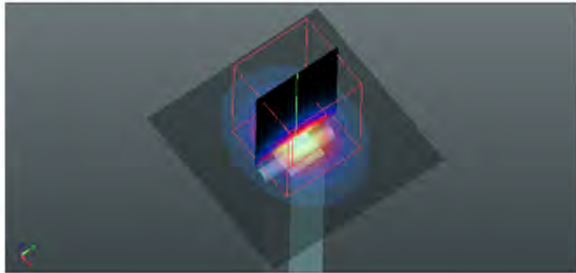
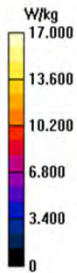
Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1<sup>+</sup>  
Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.479$  S/m;  $\epsilon_r = 34.208$ ;  $\rho = 996$  kg/m<sup>3</sup> <sup>+</sup>  
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup>

DASY Configuration:<sup>+</sup>

- Probe: EX3DV4 - SN7396; ConvE(5.05, 5.05, 5.05) @ 5800 MHz; Calibrated: 2018/5/29 <sup>+</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 23.0$  <sup>+</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup>

↓  
**Area Scan (6x6x1):** Interpolated grid:  $dx=10$  mm,  $dy=10$  mm <sup>+</sup>  
Maximum value of SAR (interpolated) = 17.5 W/kg <sup>+</sup>

↓  
**Zoom Scan (7x7x12)/Cube 0:** Measurement grid:  $dx=4$  mm,  $dy=4$  mm,  $dz=2$  mm <sup>+</sup>  
Reference Value = 39.17 V/m; Power Drift = -0.06 dB <sup>+</sup>  
Peak SAR (extrapolated) = 37.5 W/kg <sup>+</sup>  
**SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.21 W/kg** <sup>+</sup>  
Maximum value of SAR (measured) = 17.0 W/kg



## Validation Report for Body TSL of 5.2GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>+</sup>System Check\_B5200\_7396<sup>+</sup>DUT: Dipole D5GHzV2;SN:1160<sup>+</sup>

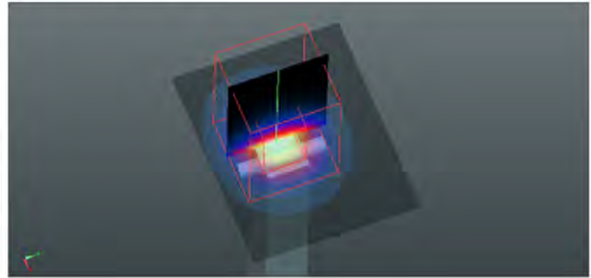
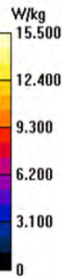
Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1<sup>+</sup>  
Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.372$  S/m;  $\epsilon_r = 47.807$ ;  $\rho = 996$  kg/m<sup>3</sup> <sup>+</sup>  
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup>

DASY Configuration:<sup>+</sup>

- Probe: EX3DV4 - SN7396; ConvE(5.3, 5.3, 5.3) @ 5200 MHz; Calibrated: 2018/5/29 <sup>+</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 23.0$  <sup>+</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup>

↓  
**Area Scan (6x5x1):** Interpolated grid:  $dx=10$  mm,  $dy=10$  mm <sup>+</sup>  
Maximum value of SAR (interpolated) = 15.9 W/kg <sup>+</sup>

↓  
**Zoom Scan (7x7x12)/Cube 0:** Measurement grid:  $dx=4$  mm,  $dy=4$  mm,  $dz=2$  mm <sup>+</sup>  
Reference Value = 35.81 V/m; Power Drift = 0.06 dB <sup>+</sup>  
Peak SAR (extrapolated) = 31.3 W/kg <sup>+</sup>  
**SAR(1 g) = 7.28 W/kg; SAR(10 g) = 2.06 W/kg** <sup>+</sup>  
Maximum value of SAR (measured) = 15.5 W/kg



## Validation Report for Body TSL of 5.3GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>4/</sup>System Check\_B5300\_7396<sup>4/</sup>DUT: Dipole D5GHzV2;SN:1160;<sup>4/</sup>

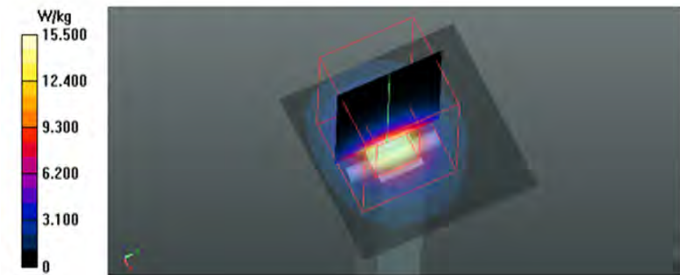
Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1<sup>4/</sup>  
Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.507$  S/m;  $\epsilon_r = 47.625$ ;  $\rho = 996$  kg/m<sup>3</sup> <sup>4/</sup>  
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>4/</sup>

DASY Configuration:<sup>4/</sup>

- Probe: EX3DV4 - SN7396; ConvF(5.05, 5.05, 5.05) @ 5300 MHz; Calibrated: 2018/5/29 <sup>4/</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 23.0$  <sup>4/</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>4/</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>4/</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>4/</sup>

↓  
**Area Scan (5x5x1):** Interpolated grid:  $dx=10$  mm,  $dy=10$  mm<sup>4/</sup>  
Maximum value of SAR (interpolated) = 14.7 W/kg<sup>4/</sup>

↓  
**Zoom Scan (7x7x12)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=2$ mm<sup>4/</sup>  
Reference Value = 34.45 V/m; Power Drift = 0.06 dB<sup>4/</sup>  
Peak SAR (extrapolated) = 30.9 W/kg<sup>4/</sup>  
**SAR(1 g) = 7.16 W/kg; SAR(10 g) = 2 W/kg<sup>4/</sup>**  
Maximum value of SAR (measured) = 15.5 W/kg



## Validation Report for Body TSL of 5.5GHz

Test Laboratory: BTL Inc. Date: 2018/12/25<sup>4/</sup>System Check\_B5500\_7396<sup>4/</sup>DUT: Dipole D5GHzV2;SN:1160;<sup>4/</sup>

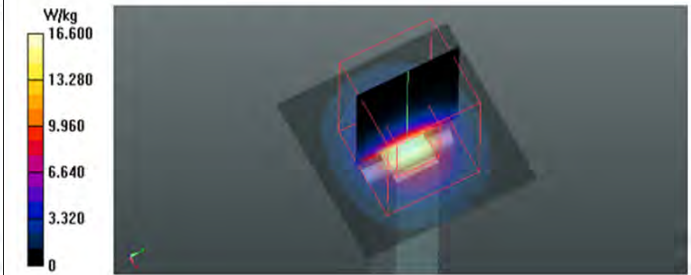
Communication System: UID 0, CW (0); Frequency: 5500 MHz; Duty Cycle: 1:1<sup>4/</sup>  
Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.797$  S/m;  $\epsilon_r = 47.264$ ;  $\rho = 996$  kg/m<sup>3</sup> <sup>4/</sup>  
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>4/</sup>

DASY Configuration:<sup>4/</sup>

- Probe: EX3DV4 - SN7396; ConvF(4.38, 4.38, 4.38) @ 5500 MHz; Calibrated: 2018/5/29 <sup>4/</sup>
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 23.0$  <sup>4/</sup>
- Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>4/</sup>
- Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>4/</sup>
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>4/</sup>

↓  
**Area Scan (5x5x1):** Interpolated grid:  $dx=10$  mm,  $dy=10$  mm<sup>4/</sup>  
Maximum value of SAR (interpolated) = 16.4 W/kg<sup>4/</sup>

↓  
**Zoom Scan (7x7x12)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=2$ mm<sup>4/</sup>  
Reference Value = 38.51 V/m; Power Drift = -0.17 dB<sup>4/</sup>  
Peak SAR (extrapolated) = 33.9 W/kg<sup>4/</sup>  
**SAR(1 g) = 7.72 W/kg; SAR(10 g) = 2.16 W/kg<sup>4/</sup>**  
Maximum value of SAR (measured) = 16.6 W/kg



Validation Report for Body TSL of 5.6GHz	Validation Report for Body TSL of 5.8GHz
<p>Test Laboratory: BTL Inc.      Date: 2018/12/25<sup>+</sup></p> <p>System Check_B5600_7396<sup>+</sup></p> <p>DUT: Dipole D5GHzV2;SN:1160<sup>+</sup></p> <p>Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: f = 5600 MHz; <math>\sigma</math> = 5.947 S/m; <math>\epsilon_r</math> = 47.073; <math>\rho</math> = 996 kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"><li>• Probe: EX3DV4 - SN7396; ConvE(4.38, 4.38, 4.38) @ 5600 MHz; Calibrated: 2018/5/29 <sup>+</sup></li><li>• Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0 <sup>+</sup></li><li>• Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li><li>• Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li><li>• DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li></ul> <p>↓</p> <p>Area Scan (6x6x1): Interpolated grid: dx=10 mm, dy=10 mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 16.5 W/kg<sup>+</sup></p> <p>↓</p> <p>Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm<sup>+</sup></p> <p>Reference Value = 38.11 V/m; Power Drift = -0.17 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 35.4 W/kg<sup>+</sup></p> <p>SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.2 W/kg<sup>+</sup></p> <p>Maximum value of SAR (measured) = 17.2 W/kg</p> <div><div>W/kg 17.200 13.760 10.320 6.880 3.440 0</div></div>	<p>Test Laboratory: BTL Inc.      Date: 2018/12/25<sup>+</sup></p> <p>System Check_B5800_7396<sup>+</sup></p> <p>DUT: Dipole D5GHzV2;SN:1160<sup>+</sup></p> <p>Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1<sup>+</sup></p> <p>Medium parameters used: f = 5800 MHz; <math>\sigma</math> = 6.239 S/m; <math>\epsilon_r</math> = 46.673; <math>\rho</math> = 996 kg/m<sup>3</sup> <sup>+</sup></p> <p>Ambient Temperature : 23.2 °C; Liquid Temperature : 22.5 °C<sup>+</sup></p> <p>DASY Configuration:<sup>+</sup></p> <ul style="list-style-type: none"><li>• Probe: EX3DV4 - SN7396; ConvE(4.5, 4.5, 4.5) @ 5800 MHz; Calibrated: 2018/5/29 <sup>+</sup></li><li>• Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 23.0 <sup>+</sup></li><li>• Electronics: DAE4 Sn1390; Calibrated: 2018/5/11 <sup>+</sup></li><li>• Phantom: SAM Right; Type: Twin SAM; Serial: 1896 <sup>+</sup></li><li>• DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)<sup>+</sup></li></ul> <p>↓</p> <p>Area Scan (6x5x1): Interpolated grid: dx=10 mm, dy=10 mm<sup>+</sup></p> <p>Maximum value of SAR (interpolated) = 16.6 W/kg<sup>+</sup></p> <p>↓</p> <p>Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm<sup>+</sup></p> <p>Reference Value = 37.07 V/m; Power Drift = -0.19 dB<sup>+</sup></p> <p>Peak SAR (extrapolated) = 35.6 W/kg<sup>+</sup></p> <p>SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.16 W/kg<sup>+</sup></p> <p>Maximum value of SAR (measured) = 16.9 W/kg</p> <div><div>W/kg 16.900 13.520 10.140 6.760 3.380 0</div></div>

Calibrator: *Rot - Liang*

Approver: *Herbert Lim*