

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191  
Tel: +86-10-62304633-2117  
E-mail: emf@caict.ac.cn      http://www.caict.ac.cn

Client      **SGS**

Certificate No:      **Z22-60487**

## CALIBRATION CERTIFICATE

Object      D1900V2 - SN: 5d028

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



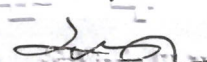
Calibration date:      November 2, 2022

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	106276	10-May-22 (CTTL, No.J22X03103)	May-23
Power sensor NRP6A	101369	10-May-22 (CTTL, No.J22X03103)	May-23
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG,No.EX3-7464_Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG,No.Z22-60007)	Jan-23
Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL, No.J22X00409)	Jan-23
Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL, No.J22X00406)	Jan-23

	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: November 7, 2022

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



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com      <http://www.caict.ac.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) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- c) 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.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com      <http://www.caict.ac.cn>

### Measurement Conditions

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

<b>DASY Version</b>	DASY52	52.10.4
<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 ± 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 ± 0.2) °C	40.5 ± 6 %	1.39 mho/m ± 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	9.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>39.5 W/kg ± 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	5.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>20.6 W/kg ± 18.7 % (k=2)</b>



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com      <http://www.caict.ac.cn>

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

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.5Ω+ 8.80jΩ
Return Loss	- 21.1dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.106 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
-----------------	-------

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com      <http://www.caict.ac.cn>

**DASY5 Validation Report for Head TSL**

Date: 2022-11-02

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d028**

Communication System: UID 0, CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.388$  S/m;  $\epsilon_r = 40.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(8.18, 8.18, 8.18) @ 1900 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Reference Value = 99.98 V/m; Power Drift = -0.02 dB

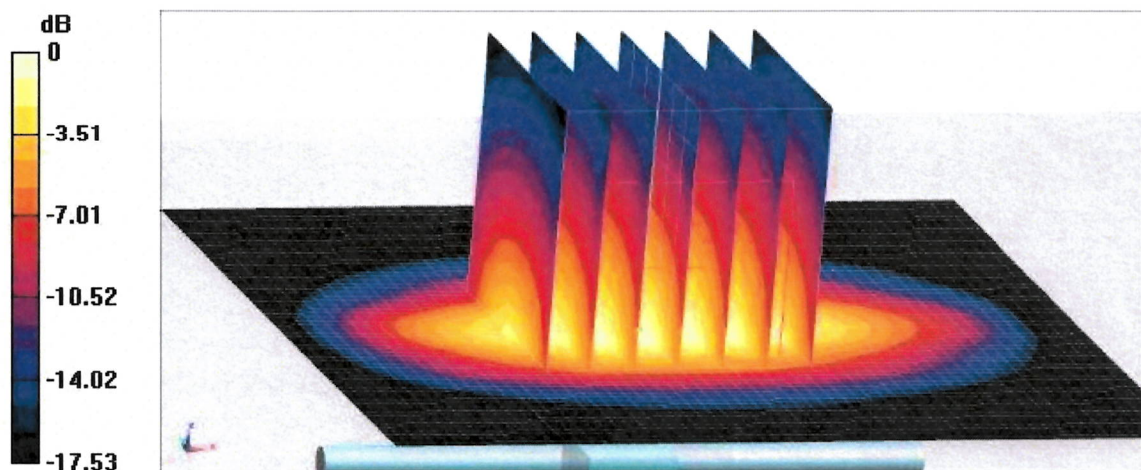
Peak SAR (extrapolated) = 18.0 W/kg

**SAR(1 g) = 9.8 W/kg; SAR(10 g) = 5.13 W/kg**

Smallest distance from peaks to all points 3 dB below = 9.5 mm

Ratio of SAR at M2 to SAR at M1 = 54.9%

Maximum value of SAR (measured) = 15.1 W/kg

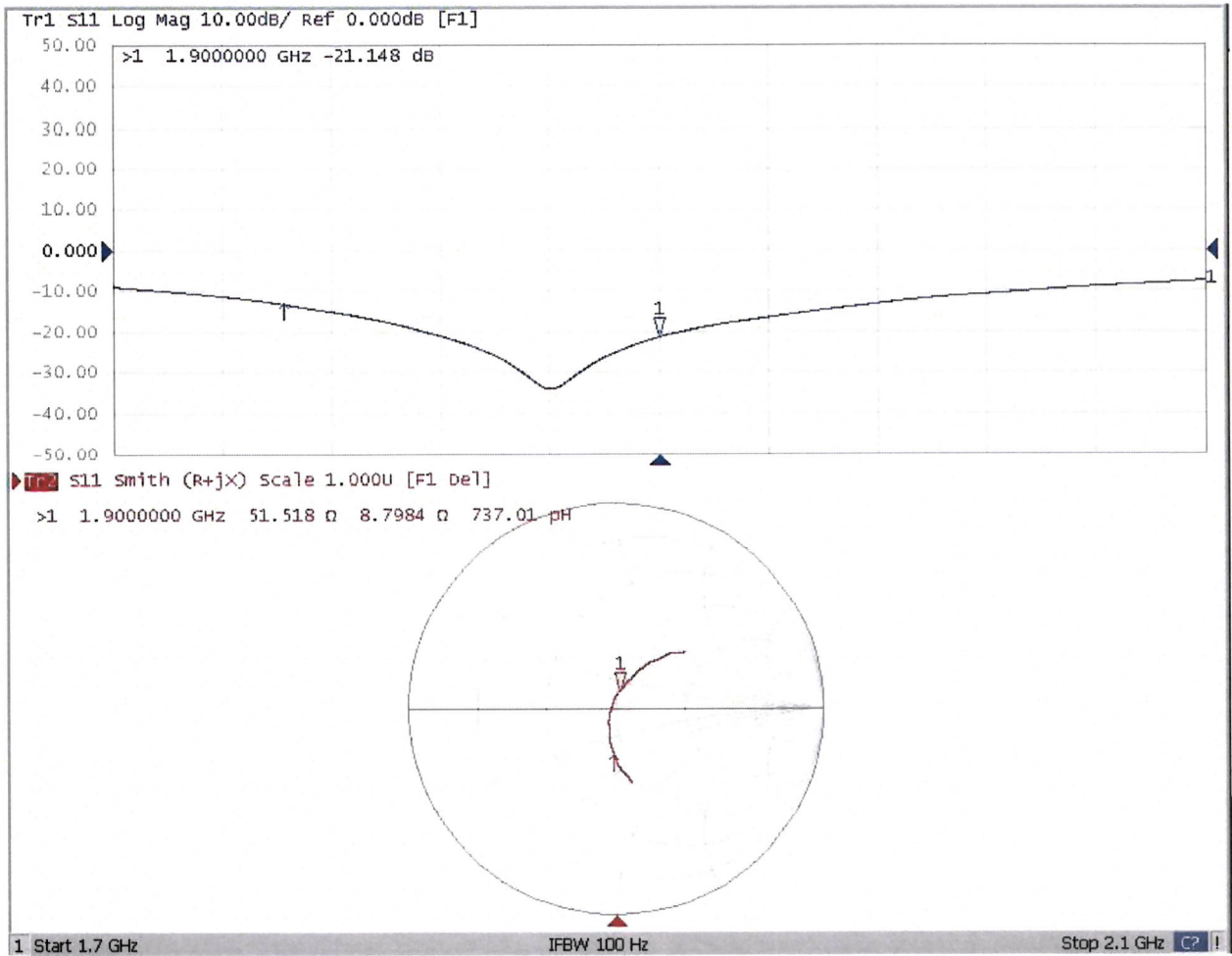


0 dB = 15.1 W/kg = 11.79 dBW/kg



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2117  
E-mail: cttl@chinattl.com      <http://www.caict.ac.cn>

### Impedance Measurement Plot for Head TSL





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

SGS

Certificate No: Z20-60328

## CALIBRATION CERTIFICATE

Object

D2450V2 - SN: 922

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

August 27, 2020

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	106276	12-May-20 (CTTL, No.J20X02965)	May-21
Power sensor NRP6A	101369	12-May-20 (CTTL, No.J20X02965)	May-21
ReferenceProbe EX3DV4	SN 3617	30-Jan-20(SPEAG,No.EX3-3617_Jan20)	Jan-21
DAE4	SN 771	10-Feb-20(CTTL-SPEAG,No.Z20-60017)	Feb-21
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	25-Feb-20 (CTTL, No.J20X00516)	Feb-21
NetworkAnalyzer E5071C	MY46110673	10-Feb-20 (CTTL, No.J20X00515)	Feb-21

	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: September 3, 2020

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



### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / 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	V52.10.4
<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 ± 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 ± 0.2) °C	39.5 ± 6 %	1.79 mho/m ± 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	12.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>51.9 W/kg ± 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	5.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.7 W/kg ± 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	56.0Ω+ 1.63 jΩ
Return Loss	- 24.7dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.027 ns
----------------------------------	----------

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

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

### Additional EUT Data

Manufactured by	SPEAG
-----------------	-------



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: 08.27.2020

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 922**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.787$  S/m;  $\epsilon_r = 39.53$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.65, 7.65, 7.65) @ 2450 MHz; Calibrated: 2020-01-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2020-02-10
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 103.7 V/m; Power Drift = -0.04 dB

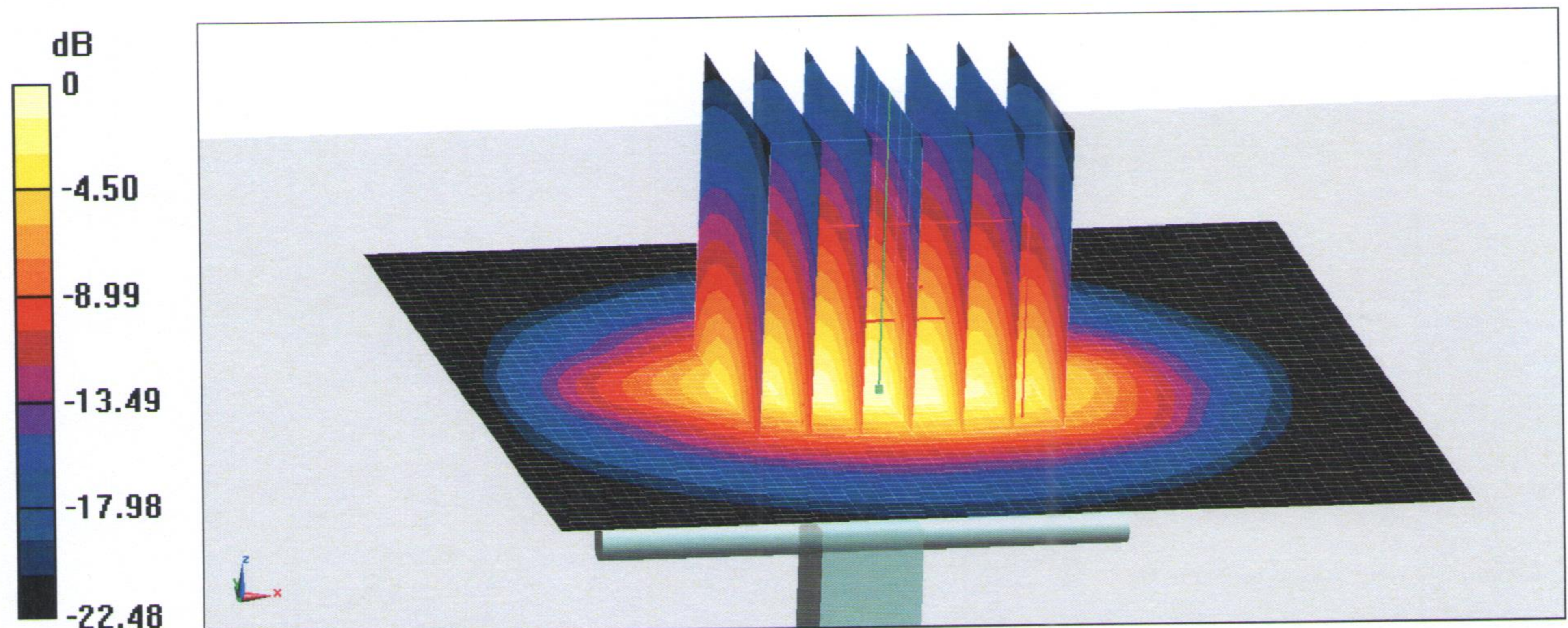
Peak SAR (extrapolated) = 27.4 W/kg

**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.91 W/kg**

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 46.9%

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

