



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: 10.11.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1075**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.503$  S/m;  $\epsilon_r = 53.51$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.95, 4.95, 4.95); Calibrated: 4/15/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 2016-08-22
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

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

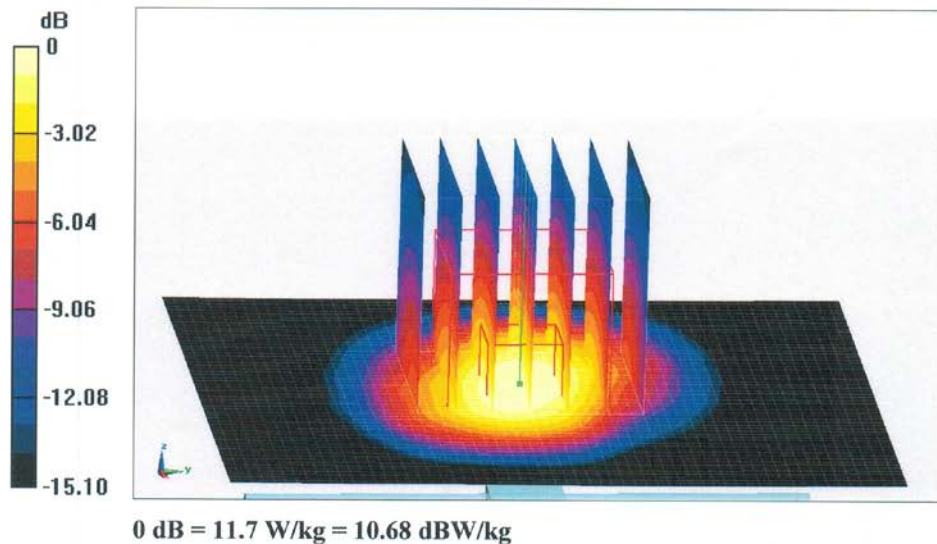
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 91.74 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 15.6 W/kg

**SAR(1 g) = 9.45 W/kg; SAR(10 g) = 5.23 W/kg**

Maximum value of SAR (measured) = 11.7 W/kg

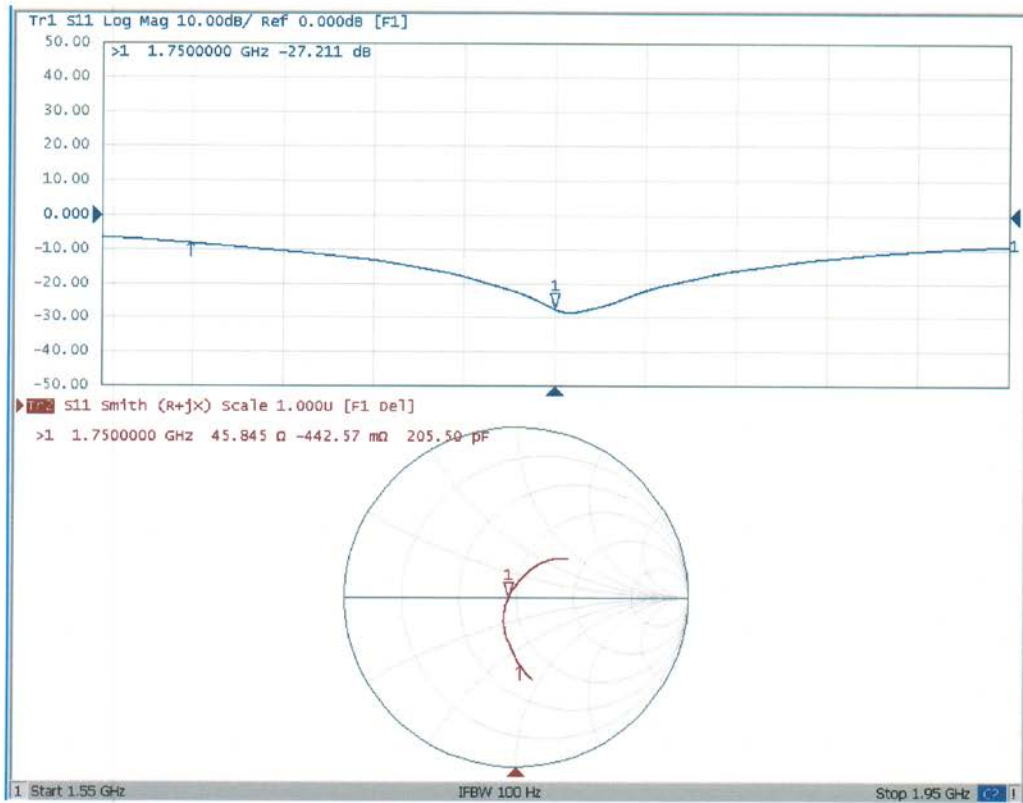




In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

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



## 6.5. D190V2 Dipole Calibration Certificate



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



CALIBRATION  
No. L0570

Client

SMQ

Certificate No: Z15-97117

**CALIBRATION CERTIFICATE**

Object D1900V2 - SN: 5d162

Calibration Procedure(s) FD-Z11-2-003-01  
Calibration Procedures for dipole validation kits

Calibration date: September 16, 2015

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        | 101919     | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                |
| Power sensor NRP-Z91    | 101547     | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                |
| Reference Probe EX3DV4  | SN 3846    | 24-Sep-14(SPEAG, No.EX3-3846_Sep14)      | Sep-15                |
| DAE4                    | SN 910     | 16-Jun-15(SPEAG, No.DAE4-910_Jun15)      | Jun-16                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 02-Feb-15 (CTTL, No.J15X00729)           | Feb-16                |
| Network Analyzer E5071C | MY46110673 | 03-Feb-15 (CTTL, No.J15X00728)           | Feb-16                |

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

Issued: September 23, 2015

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

Certificate No: Z15-97117

Page 1 of 8



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

**Glossary:**

|       |  |
|-------|--|
| TSL   | tissue simulating liquid                   |
| ConvF | sensitivity in TSL / 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, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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.

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | 52.8.8.1222 |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 1900 MHz $\pm$ 1 MHz     |             |

### Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.9 $\pm$ 6 % | 1.38 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                                |
|---|--------------------|--------------------------------|
| SAR measured  | 250 mW input power | 9.96 mW / g                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 40.4 mW / g $\pm$ 20.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                                |
| SAR measured  | 250 mW input power | 5.20 mW / g                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 21.0 mW / g $\pm$ 20.4 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 54.6 $\pm$ 6 % | 1.51 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                                |
|---|--------------------|--------------------------------|
| SAR measured  | 250 mW input power | 10.2 mW / g                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 41.2 mW / g $\pm$ 20.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                                |
| SAR measured  | 250 mW input power | 5.37 mW / g                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.6 mW / g $\pm$ 20.4 % (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

### Antenna Parameters with Head TSL

|                                      |              |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 51.0Ω+2.72jΩ |
| Return Loss                          | - 30.9dB     |

### Antenna Parameters with Body TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 48.4Ω+ 3.95jΩ |
| Return Loss                          | - 27.3dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.301 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: cntl@chinattl.com Http://www.chinattl.cn

#### DASY5 Validation Report for Head TSL

Date: 09.16.2015

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.378$  S/m;  $\epsilon_r = 40.94$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(7.26, 7.26, 7.26); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P5I CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

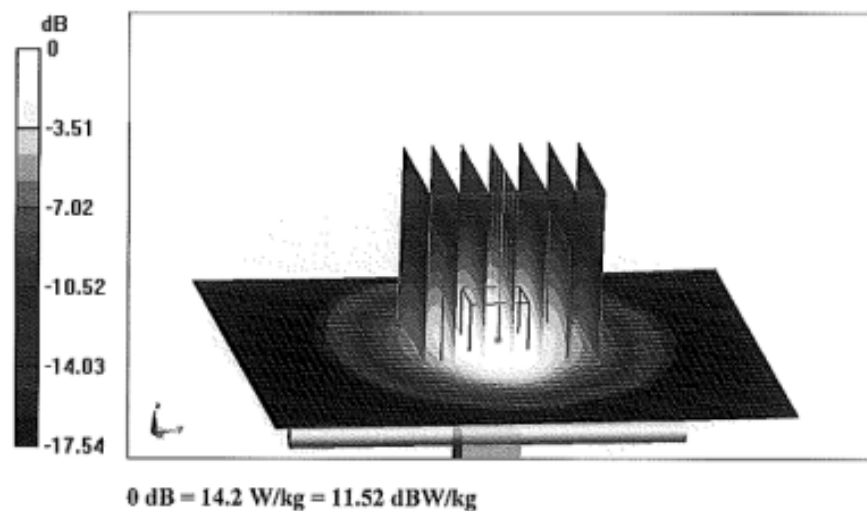
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 104.1 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.2 W/kg

Maximum value of SAR (measured) = 14.2 W/kg

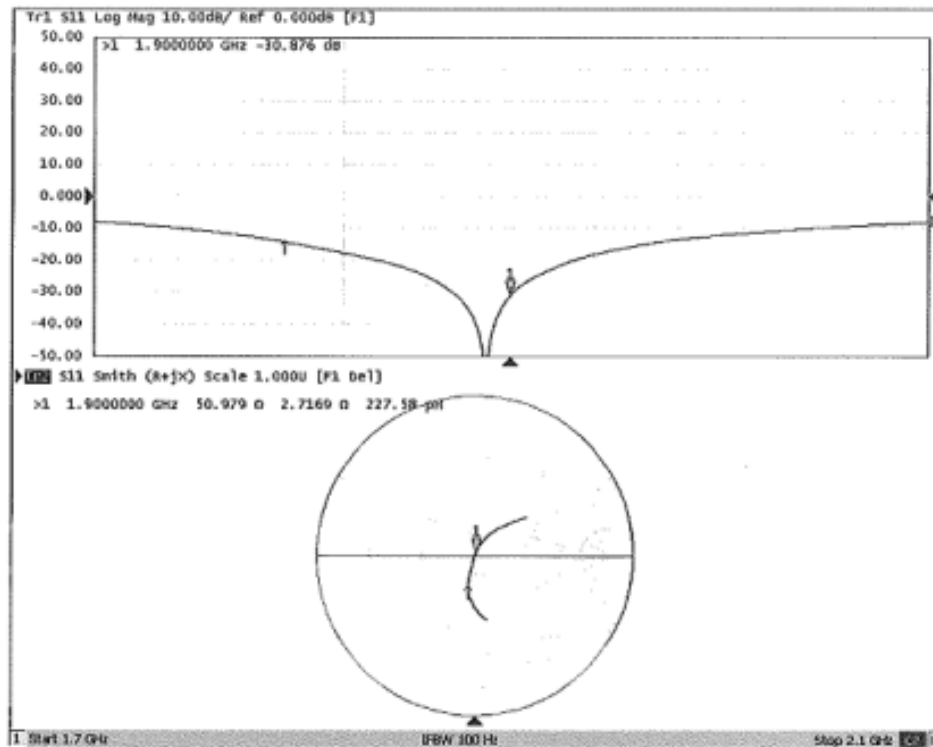




In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

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

### Impedance Measurement Plot for Head TSL







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: 09.16.2015

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162**

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

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.507$  S/m;  $\epsilon_r = 54.56$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(7.15, 7.15, 7.15); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

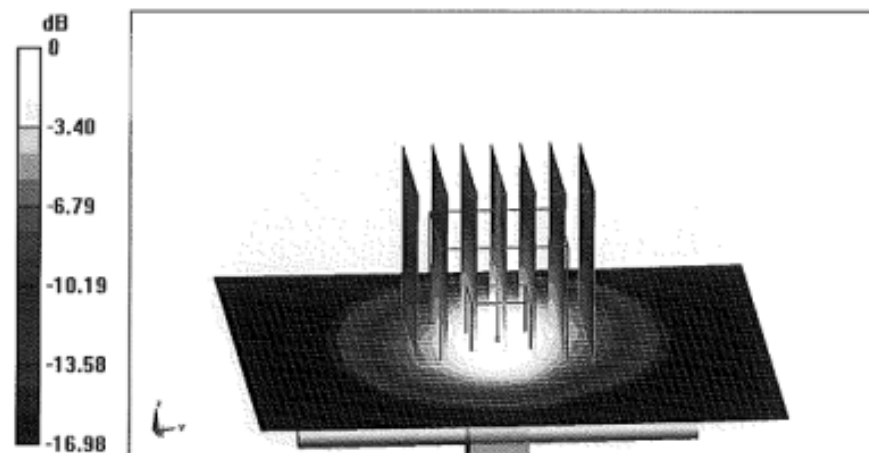
$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 100.5 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 18.4 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.37 W/kg**

Maximum value of SAR (measured) = 14.7 W/kg



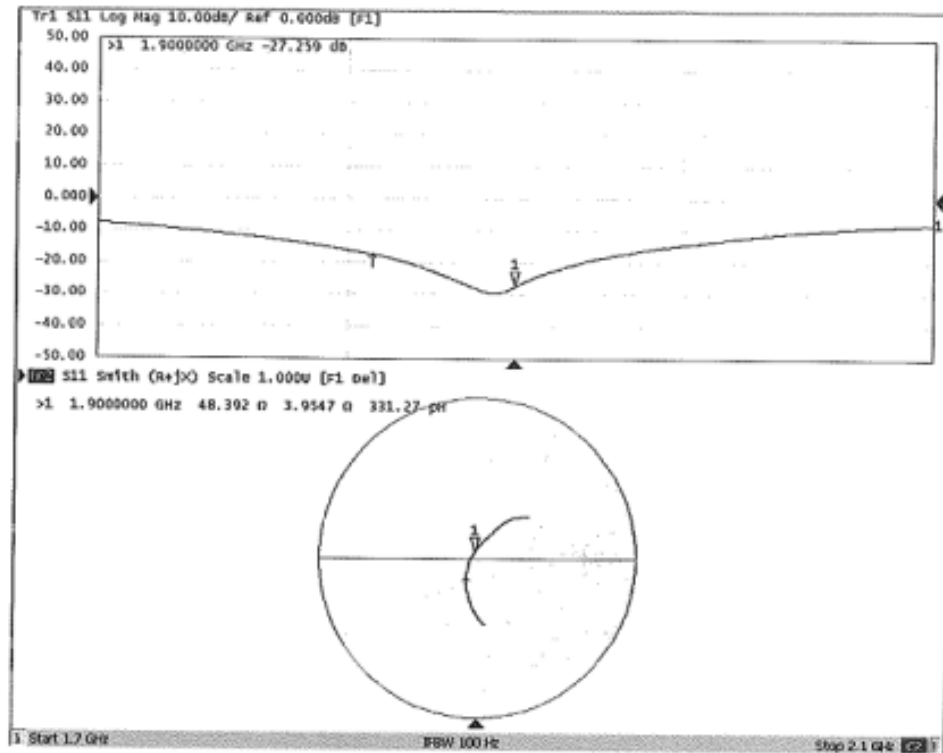
0 dB = 14.7 W/kg = 11.67 dBW/kg



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



## 6.6. D2450V2 Dipole Calibration Certificate



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>



CALIBRATION  
No. L6570

Client

SMQ

Certificate No: Z15-97122

**CALIBRATION CERTIFICATE**

Object D2450V2 - SN: 818

Calibration Procedure(s) FD-Z11-2-003-01  
Calibration Procedures for dipole validation kits

Calibration date: September 14, 2015

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)℃ 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 NRP2        | 101919     | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                |
| Power sensor NRP-Z91    | 101547     | 01-Jul-15 (CTTL, No.J15X04256)           | Jun-16                |
| Reference Probe EX3DV4  | SN 3846    | 24-Sep-14(SPEAG,No.EX3-3846_Sep14)       | Sep-15                |
| DAE4                    | SN 910     | 16-Jun-15(SPEAG,No.DAE4-910_Jun15)       | Jun-16                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 02-Feb-15 (CTTL, No.J15X00729)           | Feb-16                |
| Network Analyzer E5071C | MY46110673 | 03-Feb-15 (CTTL, No.J15X00728)           | Feb-16                |

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

Issued: September 23, 2015

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: csl@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, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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: +86-10-62304633-2501  
E-mail: ett1@chinattl.com Http://www.chinattl.cn

### Measurement Conditions

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

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | 52.8.8.1222 |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz     |             |

### Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 39.0 $\pm$ 6 % | 1.83 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Head TSL

| SAR averaged over 1 $cm^3$ (1 g) of Head TSL   | Condition          |                                |
|--|--------------------|--------------------------------|
| SAR measured                                   | 250 mW input power | 13.3 mW / g                    |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 52.7 mW / g $\pm$ 20.8 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Head TSL | Condition          |                                |
| SAR measured                                   | 250 mW input power | 6.19 mW / g                    |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 24.6 mW / g $\pm$ 20.4 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.9 $\pm$ 6 % | 1.94 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | <1.0 °C             | ----           | ----                 |

### SAR result with Body TSL

| SAR averaged over 1 $cm^3$ (1 g) of Body TSL   | Condition          |                                |
|--|--------------------|--------------------------------|
| SAR measured                                   | 250 mW input power | 12.8 mW / g                    |
| SAR for nominal Body TSL parameters            | normalized to 1W   | 51.1 mW / g $\pm$ 20.8 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Body TSL | Condition          |                                |
| SAR measured                                   | 250 mW input power | 5.99 mW / g                    |
| SAR for nominal Body TSL parameters            | normalized to 1W   | 23.9 mW / g $\pm$ 20.4 % (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: cntl@chinatl.com Http://www.chinatl.cn

## Appendix

### Antenna Parameters with Head TSL

|                                      |                            |
|--------------------------------------|----------------------------|
| Impedance, transformed to feed point | $52.0\Omega + 4.41j\Omega$ |
| Return Loss                          | - 26.4dB                   |

### Antenna Parameters with Body TSL

|                                      |                            |
|--------------------------------------|----------------------------|
| Impedance, transformed to feed point | $49.4\Omega + 4.75j\Omega$ |
| Return Loss                          | - 26.4dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.271 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: 09.14.2015

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.831$  S/m;  $\epsilon_r = 39.04$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(6.56, 6.56, 6.56); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

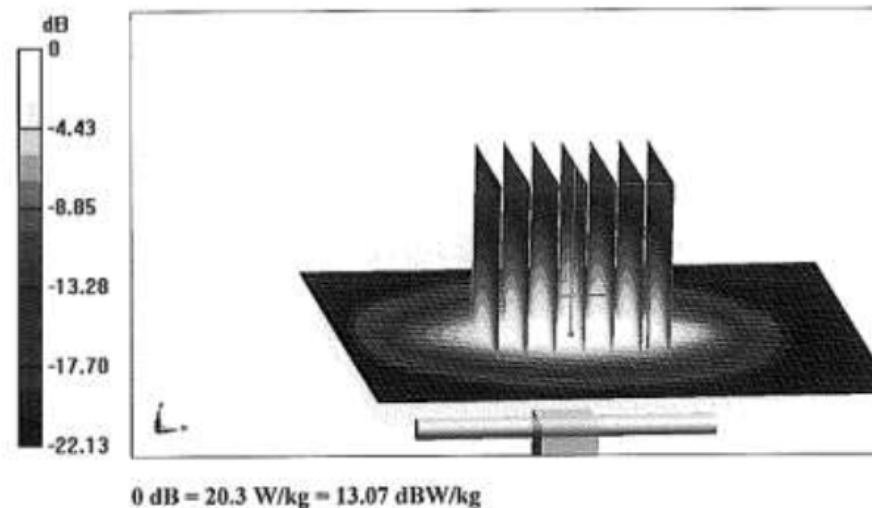
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 108.4 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.0 W/kg

SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.19 W/kg

Maximum value of SAR (measured) = 20.3 W/kg

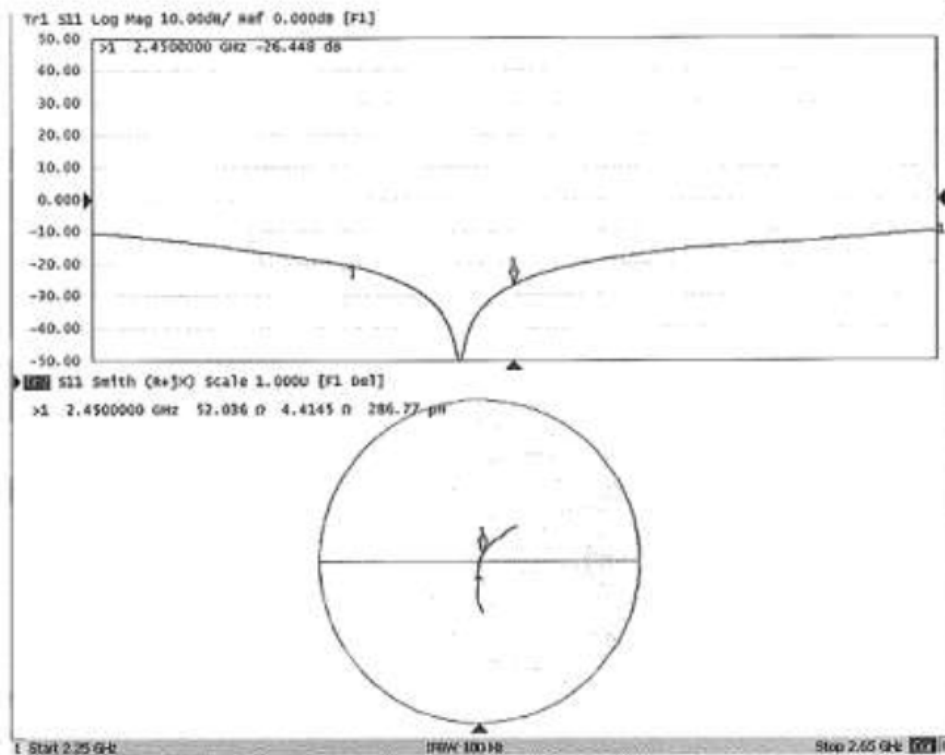




In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

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 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: 09.14.2015

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.944$  S/m;  $\epsilon_r = 51.85$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

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

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3846; ConvF(6.9, 6.9, 6.9); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 6/16/2015
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

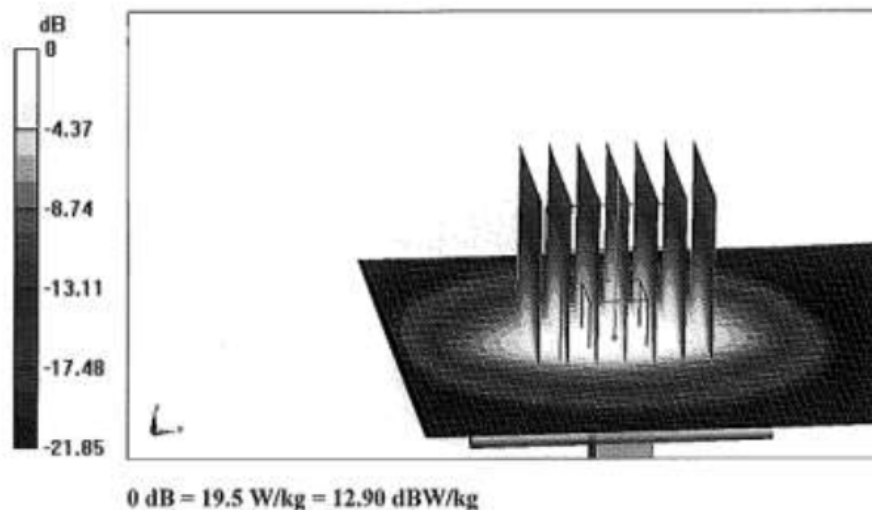
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 94.30 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 26.7 W/kg

**SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.99 W/kg**

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

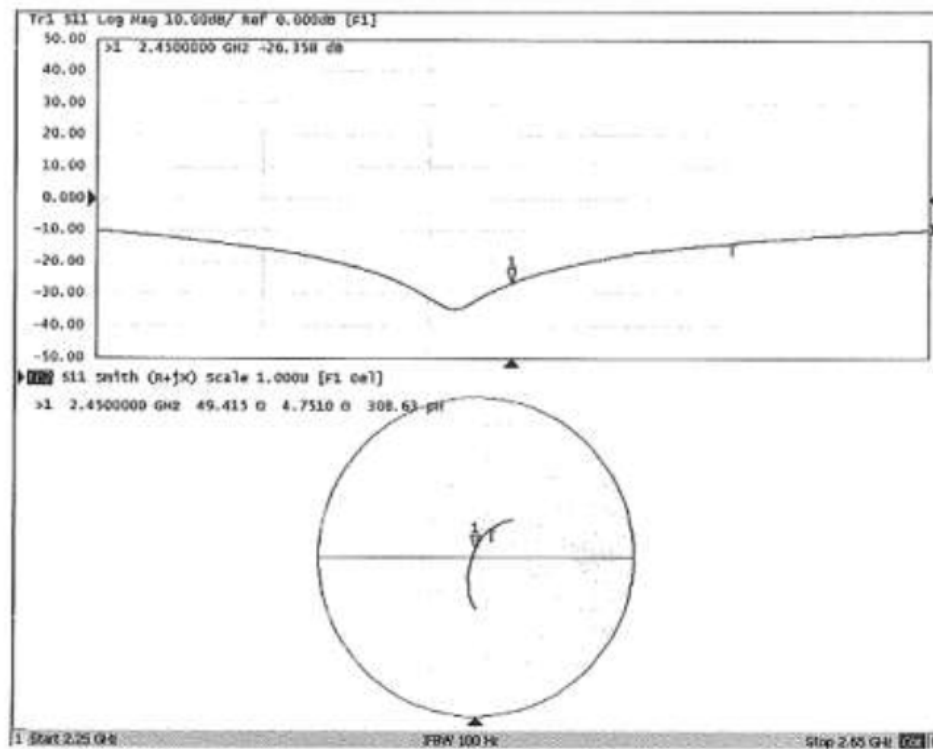






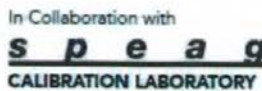

In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyun Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: cml@chinatti.com Http://www.chinatti.cn

### Impedance Measurement Plot for Body TSL



## 6.7. DAE4 Calibration Certificate

中国  
国际互  
校准  
CALIBRA  
CNAS LO

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

Client : **CIQ(Shenzhen)**Certificate No: **Z16-97120**

**CALIBRATION CERTIFICATE**

Object DAE4 - SN: 1315 *JD462*

Calibration Procedure(s) FD-Z11-2-002-01  
Calibration Procedure for the Data Acquisition Electronics (DAEx)

Calibration date: July 26, 2016

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards      | ID #    | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|------------------------|---------|--|-----------------------|
| Process Calibrator 753 | 1971018 | 27-June-16 (CTTL, No:J16X04778)          | June-17               |

|                | Name        | Function                          | Signature          |
|----------------|-------------|-----------------------------------|--------------------|
| Calibrated by: | Yu Zongying | SAR Test Engineer                 | <i>[Signature]</i> |
| Reviewed by:   | Qi Dianyuan | SAR Project Leader                | <i>[Signature]</i> |
| Approved by:   | Lu Bingsong | Deputy Director of the laboratory | <i>[Signature]</i> |

Issued: July 27, 2016

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



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
E-mail: [ttl@chinattl.com](mailto:ttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

**Glossary:**

DAE data acquisition electronics  
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
 E-mail: cttl@chinattl.com Http://www.chinattl.cn

### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB =  $6.1\mu\text{V}$ , full range =  $-100\dots+300\text{ mV}$   
 Low Range: 1LSB =  $61\text{nV}$ , full range =  $-1\dots+3\text{mV}$

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X                          | Y                          | Z                         |
|---------------------|----------------------------|----------------------------|---------------------------|
| High Range          | $405.179 \pm 0.15\% (k=2)$ | $405.018 \pm 0.15\% (k=2)$ | $404.98 \pm 0.15\% (k=2)$ |
| Low Range           | $3.99015 \pm 0.7\% (k=2)$  | $3.98549 \pm 0.7\% (k=2)$  | $3.98861 \pm 0.7\% (k=2)$ |

### Connector Angle

|   |                          |
|---|--------------------------|
| Connector Angle to be used in DASY system | $20.5^\circ \pm 1^\circ$ |
|---|--------------------------|



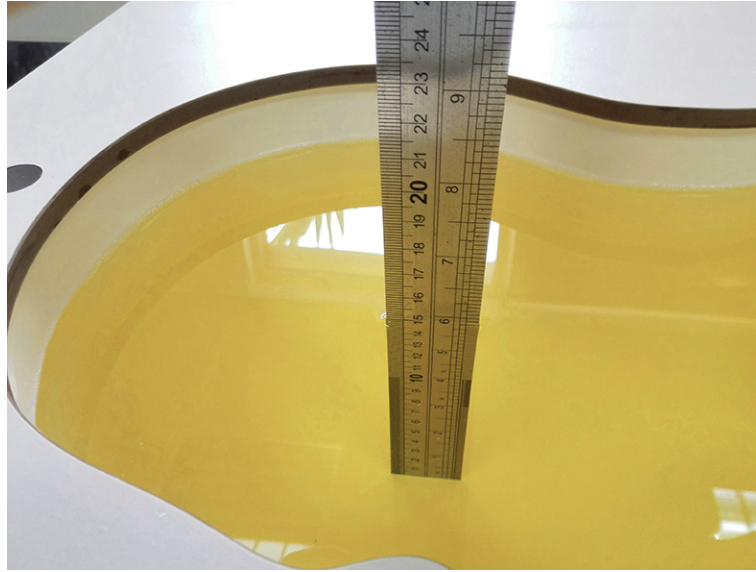
**Acceptable Conditions for SAR Measurements Using Probes and Dipoles  
Calibrated under the SPEAG-CTTL Dual-Logo Calibration Program to  
Support FCC Equipment Certification**

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by CTTL (*China Telecommunication Technology Labs*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and CTTL, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following. The conditions in this KDB are valid until December 31, 2015.

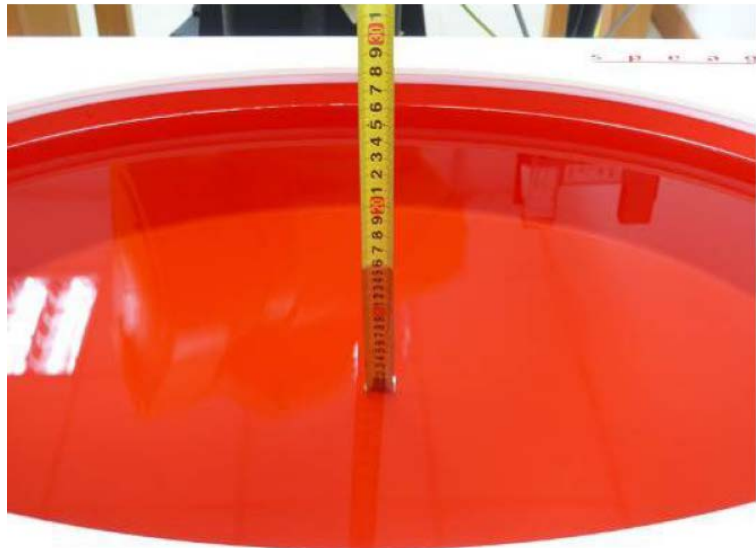
- 1) The agreement established between SPEAG and CTTL is only applicable to calibration services performed by CTTL where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. CTTL shall inform the FCC of any changes or early termination to the agreement.
- 2) Only a subset of the calibration services specified in the SPEAG-CTTL agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
  - a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
    - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by CTTL, are excluded and cannot be used for measurements to support FCC equipment certification.
    - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics or probe sensor model based linearization methods that are not fully described in SAR standards are excluded and cannot be used for measurements to support FCC equipment certification.
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the CTTL QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by CTTL. Equivalent test equipment and measurement configurations may be considered only when agreed by both SPEAG and the FCC.
  - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 systems or higher version systems that satisfy the requirements of this KDB.
- 3) The SPEAG-CTTL agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by CTTL under this SPEAG-



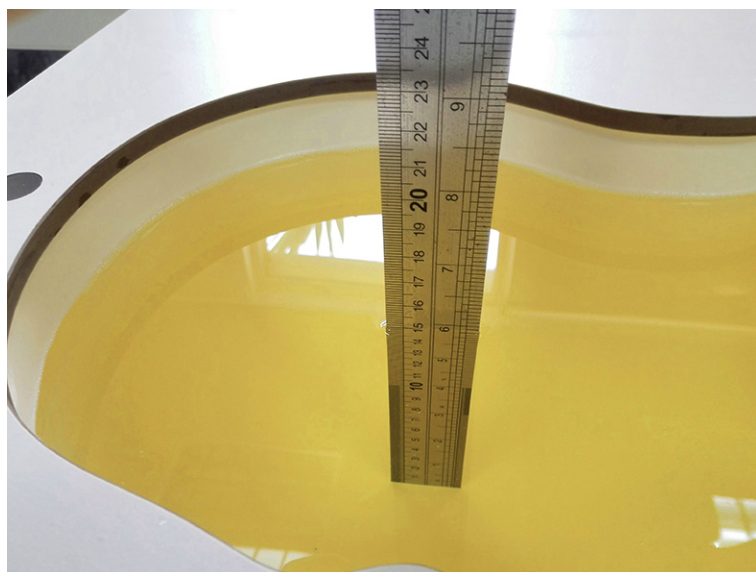
## 7. Test Setup Photos



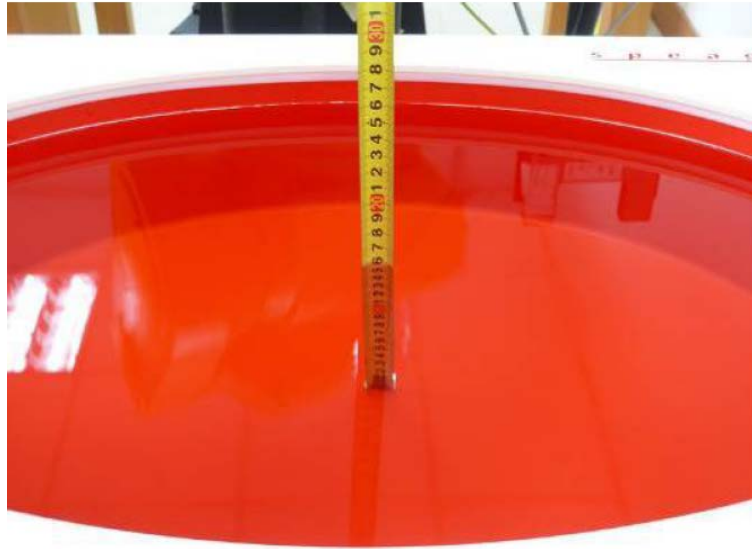
Photograph of the depth in the Head Phantom (750MHz, 15.1cm depth)



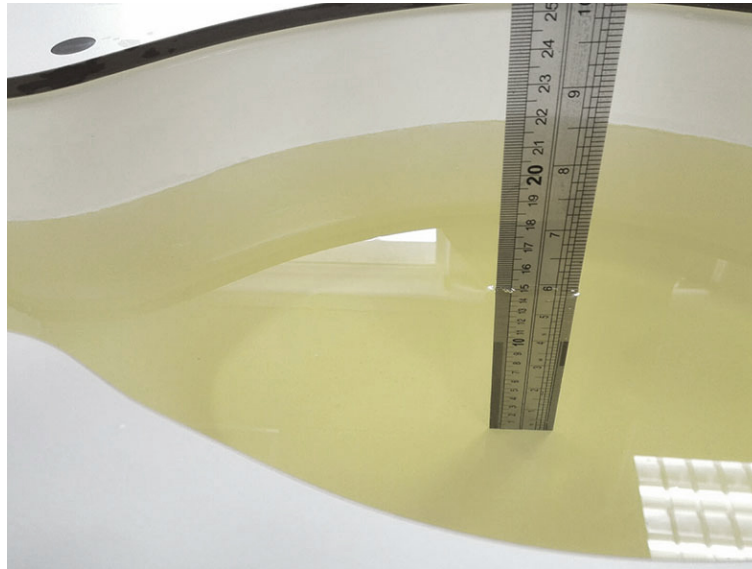
Photograph of the depth in the Body Phantom (750MHz, 15.2cm depth)



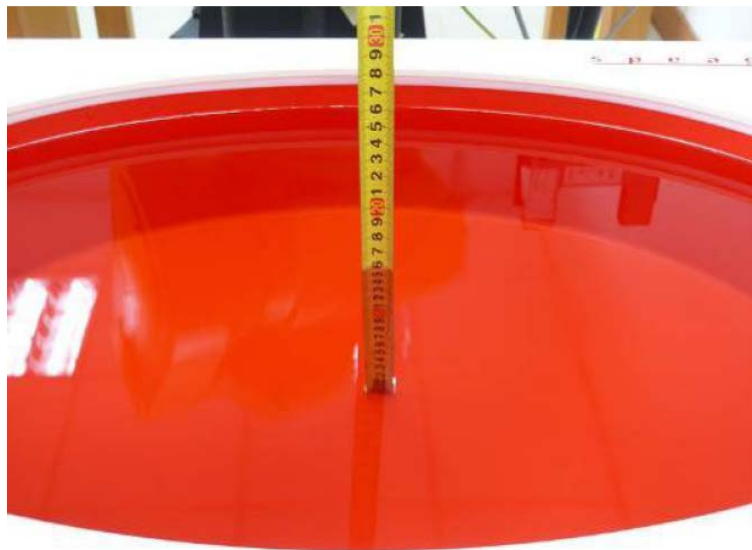
Photograph of the depth in the Head Phantom (835MHz, 15.2cm depth)



**Photograph of the depth in the Body Phantom (835MHz, 15.3cm depth)**

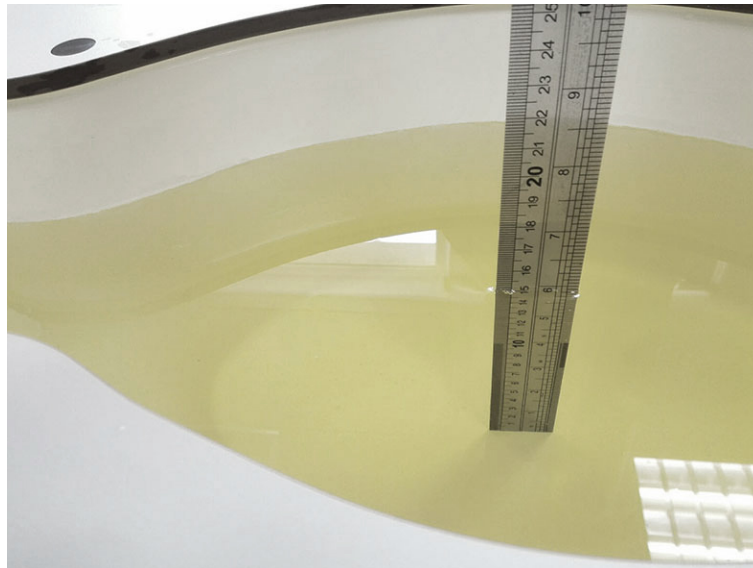


**Photograph of the depth in the Head Phantom (1750MHz, 15.2cm depth)**

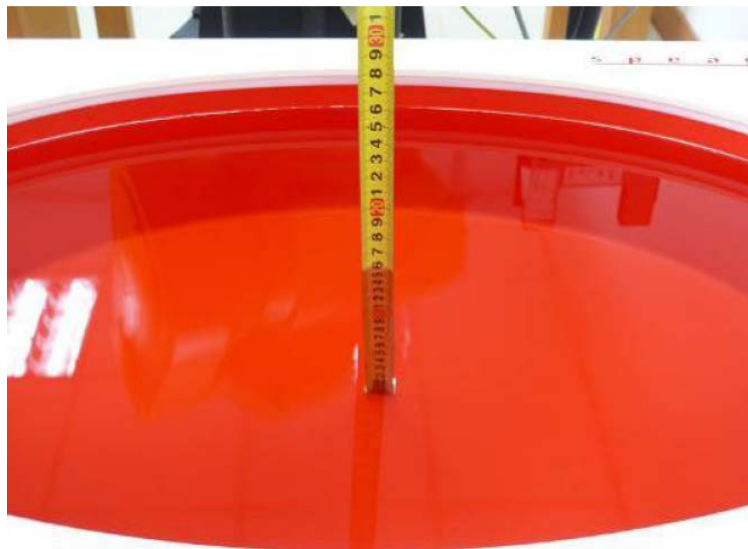


**Photograph of the depth in the Body Phantom (1750MHz, 15.3cm depth)**

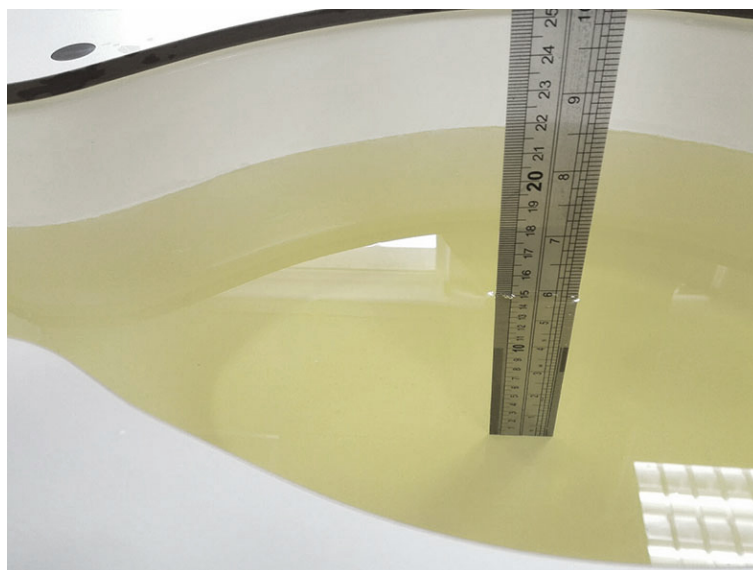




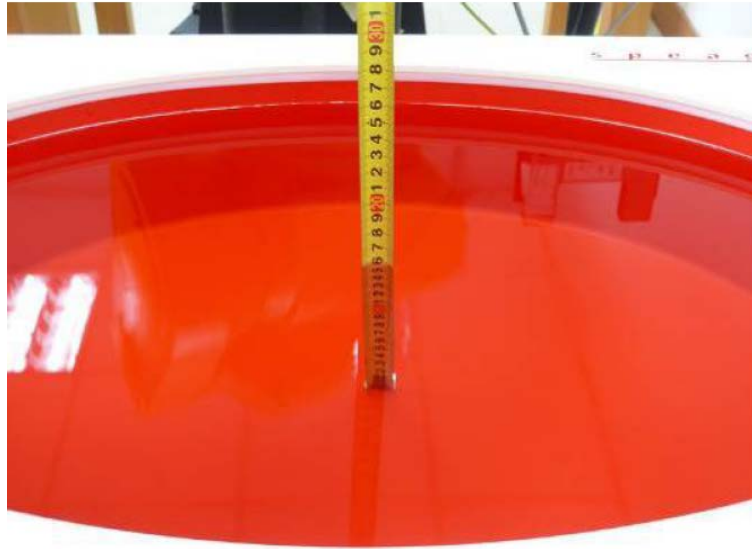
**Photograph of the depth in the Head Phantom (1900MHz, 15.1cm depth)**



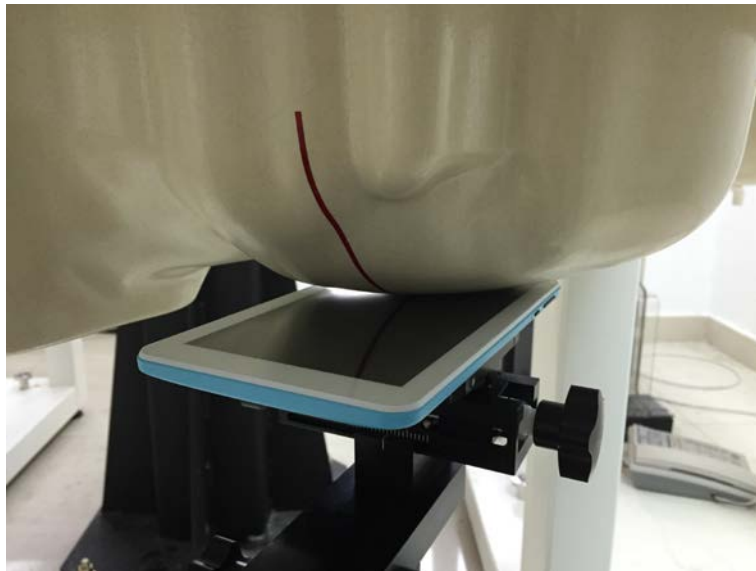
**Photograph of the depth in the Body Phantom (1900MHz, 15.3cm depth)**



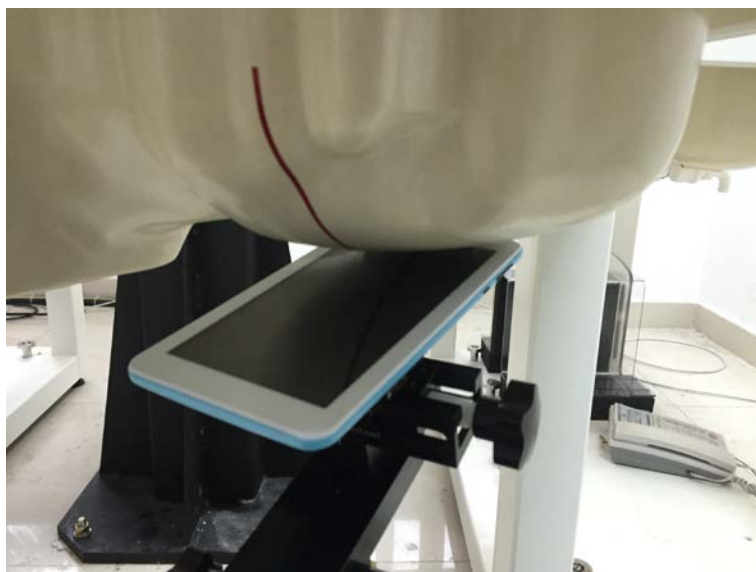
**Photograph of the depth in the Head Phantom (2450MHz, 15.2cm depth)**



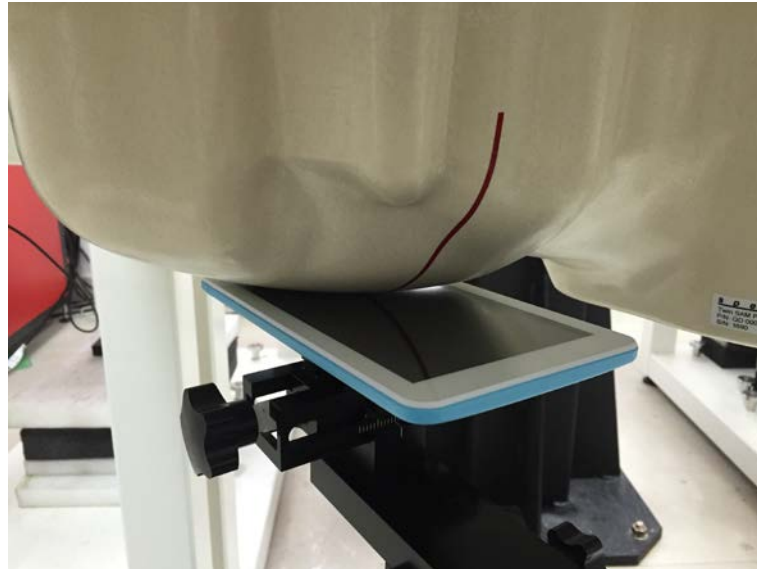
**Photograph of the depth in the Body Phantom (2450MHz, 15.4cm depth)**



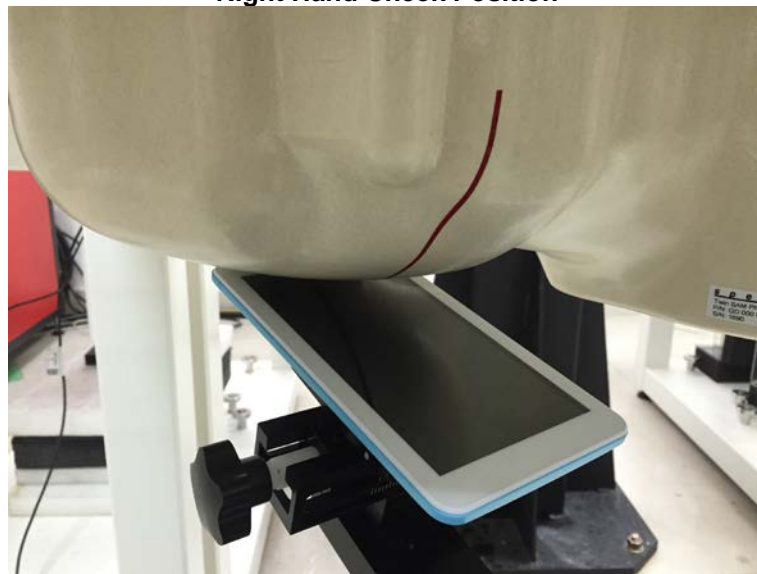
**Left Hand Cheek Position**



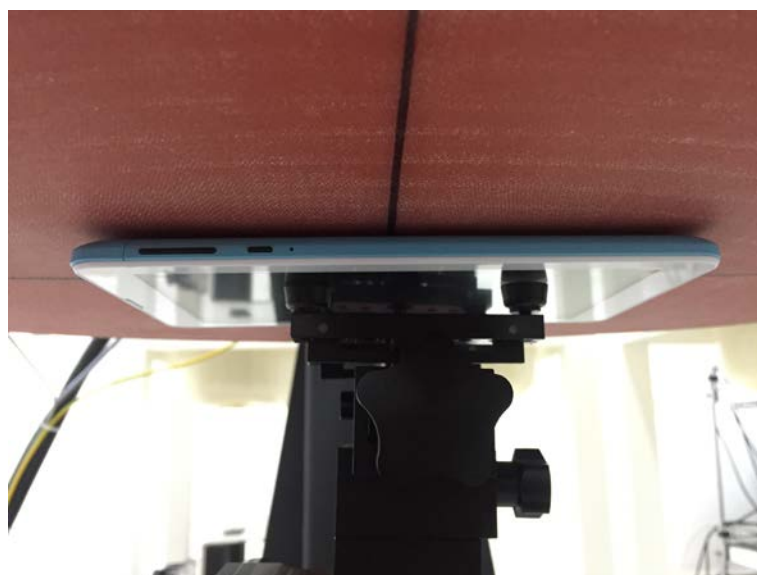
**Left Hand Tilt 15 Degree Position**



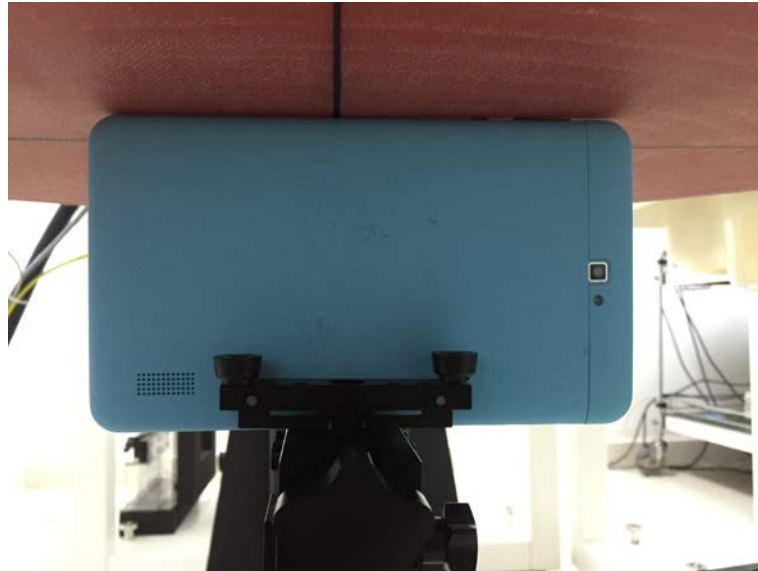
**Right Hand Cheek Position**



**Right Hand Tilt 15 Degree Position**



**Test Position 1 - Body-worn, the rear side of the EUT towards phantom (The distance was 0mm)**



**Test Position 2 - Body-worn, the left side of the EUT towards ground (The distance was 0mm)**



**Test Position 3 - Body-worn, the right side of the EUT towards ground (The distance was 0mm)**



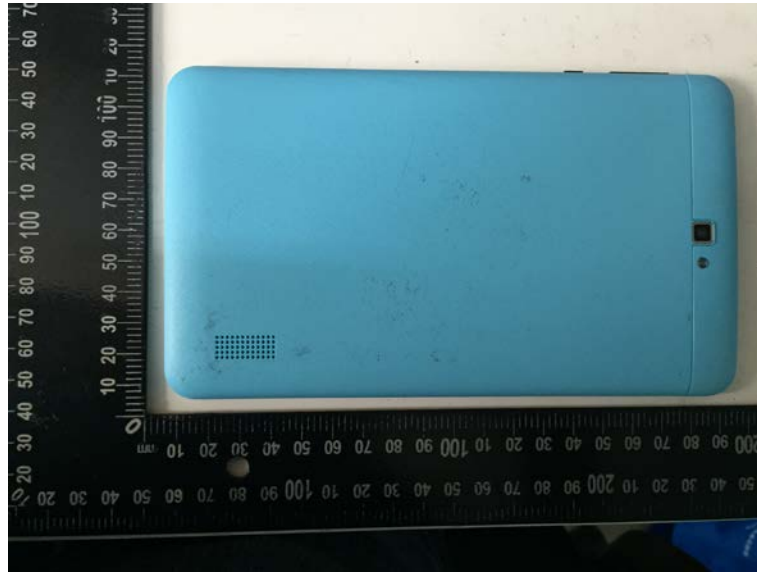
**Test Position 4 - Body-worn, the top side of the EUT towards ground (The distance was 0mm)**



**Test Position 5 - Body-worn, the bottom side of the EUT towards ground (The distance was 0mm)**



## 8. External Photos of the EUT



.....End of Report.....