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Client **CCS\_CN**

Certificate No: **Z16-97077**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 817**

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

Calibration date: **May 31, 2016**

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 7307    | 19-Feb-16(SPEAG,No.EX3-7307_Feb16)       | Feb-17                |
| DAE4                    | SN 771     | 02-Feb-16(CTTL-SPEAG,No.Z16-97011)       | Feb-17                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-16 (CTTL, No.J16X00893)           | Jan-17                |
| Network Analyzer E5071C | MY46110673 | 26-Jan-16 (CTTL, No.J16X00894)           | Jan-17                |

|                | 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: Jun 2, 2016

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**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
- 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%.



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**Measurement Conditions**

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

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | 52.8.8.1258 |
| 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 | 38.8 $\pm$ 6 % | 1.81 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 | 13.0 mW / g                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 51.7 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 | 6.15 mW / g                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.5 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 | 53.2 $\pm$ 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 <sup>3</sup> (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   | 51.5 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 | 6.07 mW / g                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.4 mW / g $\pm$ 20.4 % (k=2) |



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**Appendix****Antenna Parameters with Head TSL**

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 51.0Ω+ 4.41jΩ |
| Return Loss                          | - 27.0dB      |

**Antenna Parameters with Body TSL**

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 47.7Ω+ 4.00jΩ |
| Return Loss                          | - 26.6dB      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.269 ns |
|----------------------------------|----------|

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

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

**Additional EUT Data**

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



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**DASY5 Validation Report for Head TSL**

Date: 05.31.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 817**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.814$  S/m;  $\epsilon_r = 38.78$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

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

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7307; ConvF(7.36, 7.36, 7.36); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

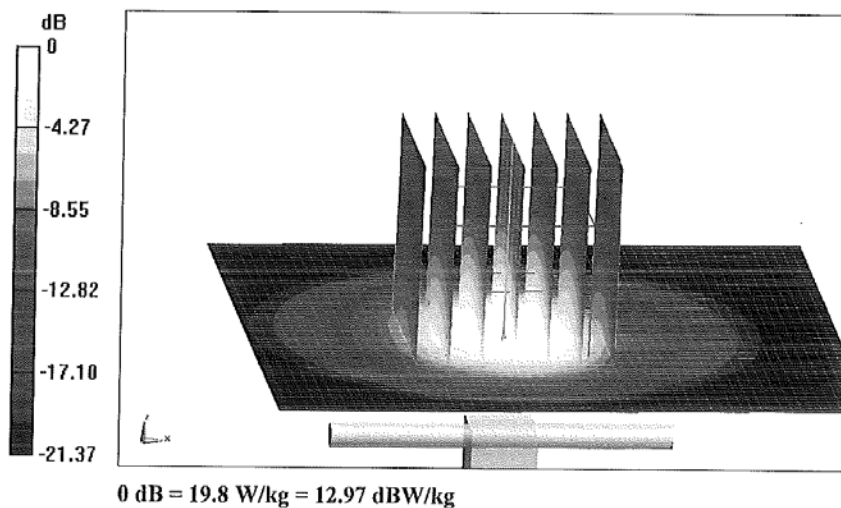
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 104.8 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.2 W/kg

**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.15 W/kg**

Maximum value of SAR (measured) = 19.8 W/kg

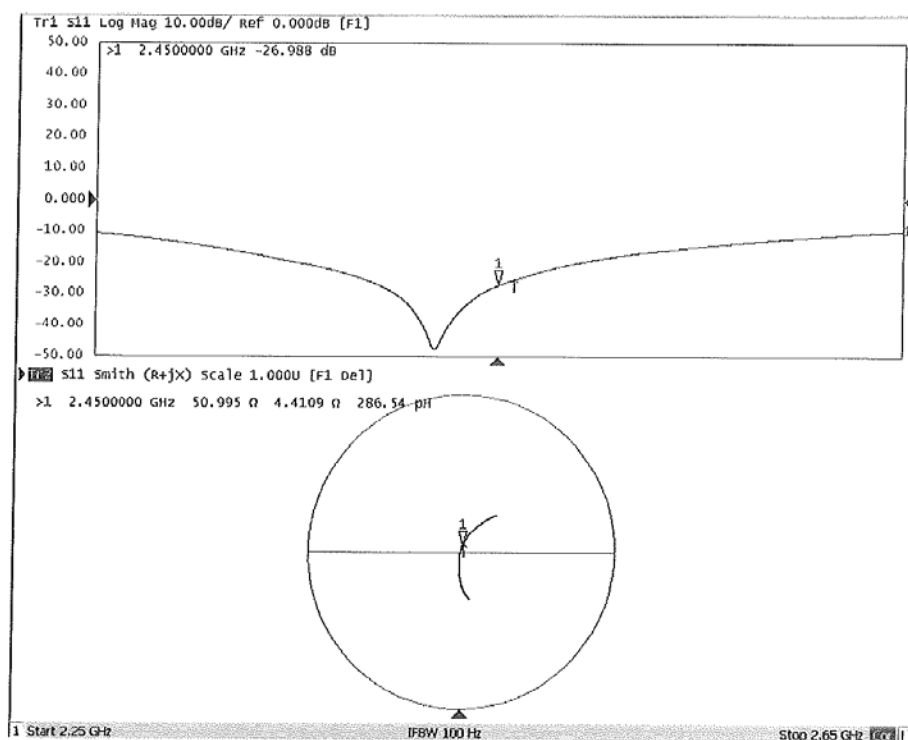




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## Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL**

Date: 05.31.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 817**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.936$  S/m;  $\epsilon_r = 53.17$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

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

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7307; ConvF(7.22, 7.22, 7.22); Calibrated: 2/19/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

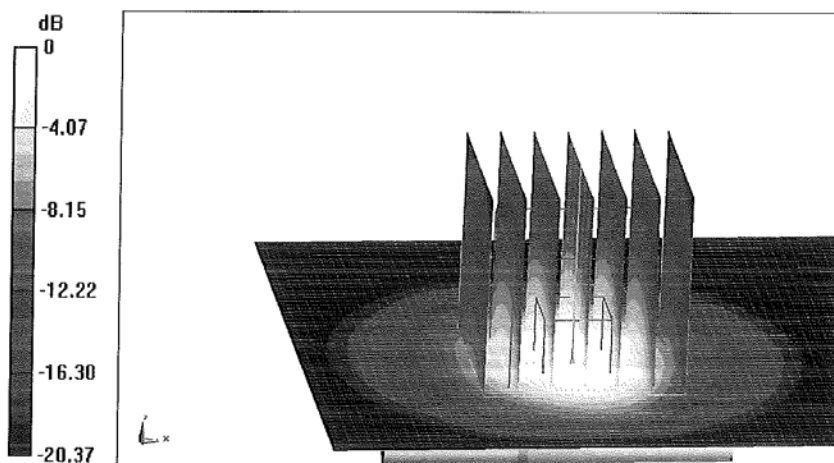
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 93.64 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 25.1 W/kg

**SAR(1 g) = 12.8 W/kg; SAR(10 g) = 6.07 W/kg**

Maximum value of SAR (measured) = 19.2 W/kg

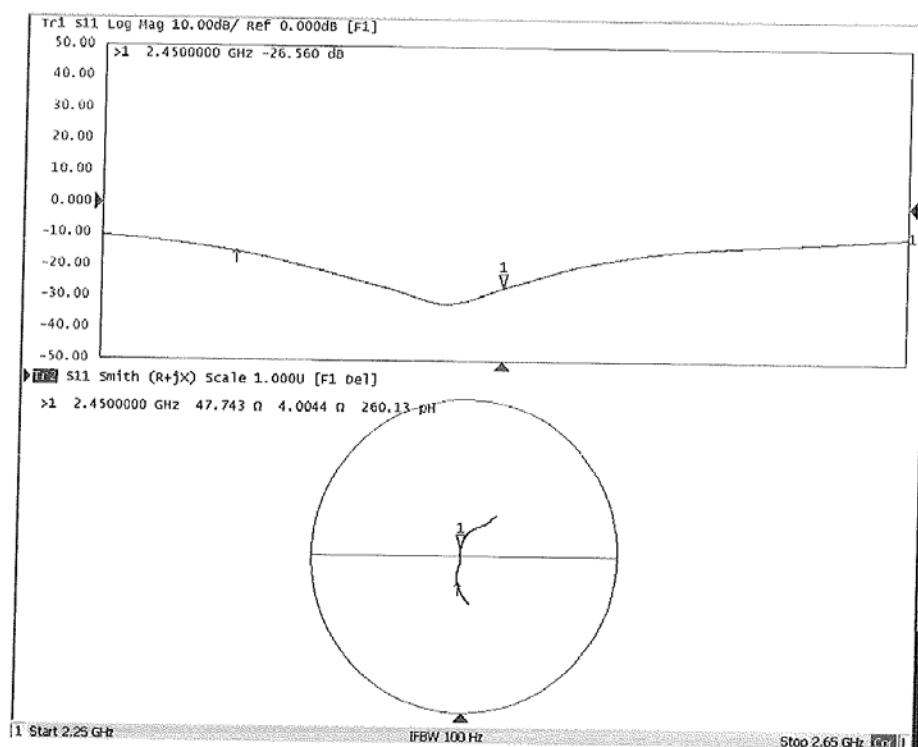
**0 dB = 19.2 W/kg = 12.83 dBW/kg**



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## Impedance Measurement Plot for Body TSL



**D2450V2, Serial No.817 Extended Dipole Calibrations**

Per IEEE Std 1528-2003, the dipole should have a return loss better than -20dB at the test frequency to reduce uncertainty in the power measurement.

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

**Justification of the extended calibration**

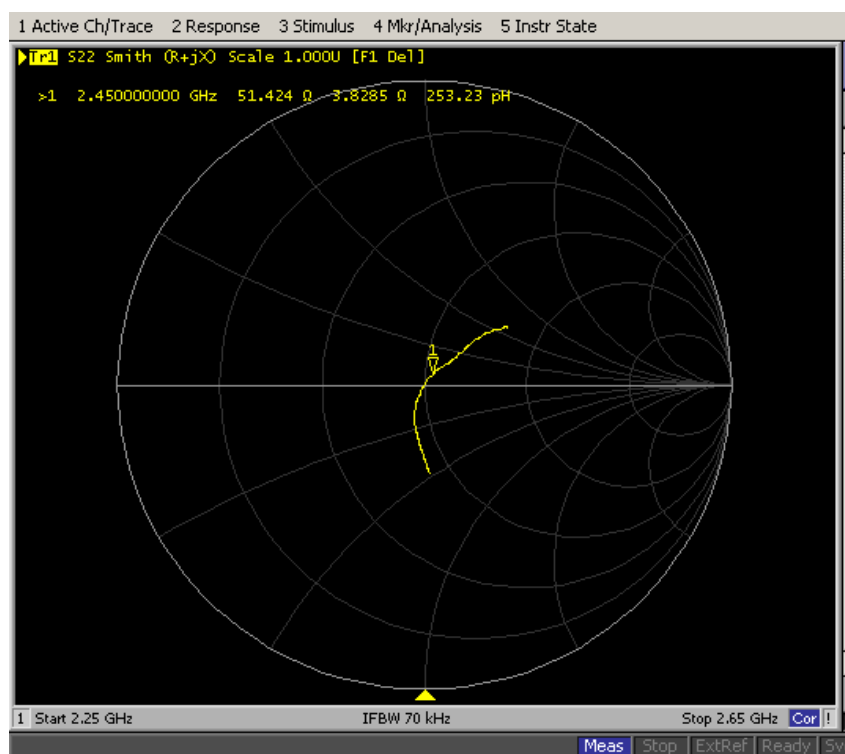
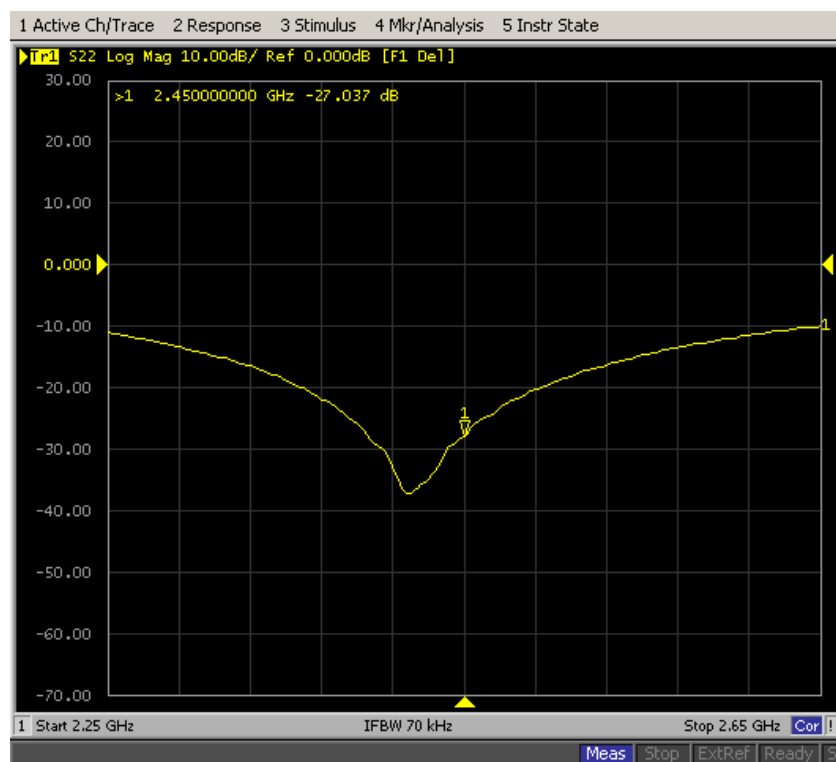
| D2450V2 Serial No.817 |                  |           |                      |             |                           |             |
|-----------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
| 2450 Head             |                  |           |                      |             |                           |             |
| Date of Measurement   | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 5.31.2016             | -26.988          | --        | 50.995               | --          | 4.4109                    | --          |
| 5.30.2017             | -27.037          | 0.18      | 51.424               | 0.469       | 3.8285                    | 0.5824      |

| D2450V2 Serial No.817 |                  |           |                      |             |                           |             |
|-----------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
| 2450 Body             |                  |           |                      |             |                           |             |
| Date of Measurement   | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 5.31.2016             | -26.560          | --        | 47.743               | --          | 4.0044                    | --          |
| 5.30.2017             | -26.006          | 2.09      | 49.534               | 1.791       | 5.1394                    | 1.135       |

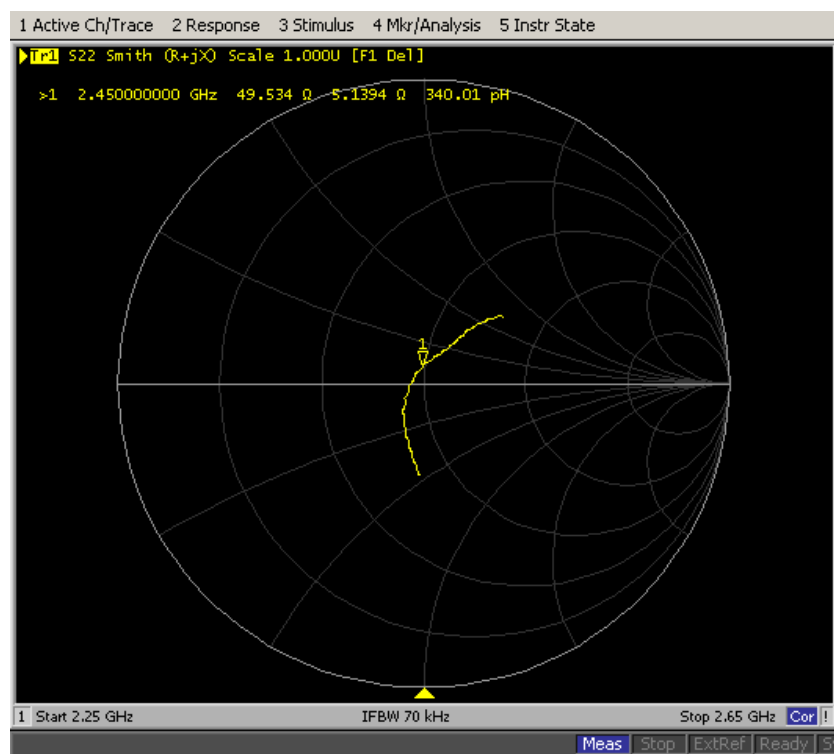
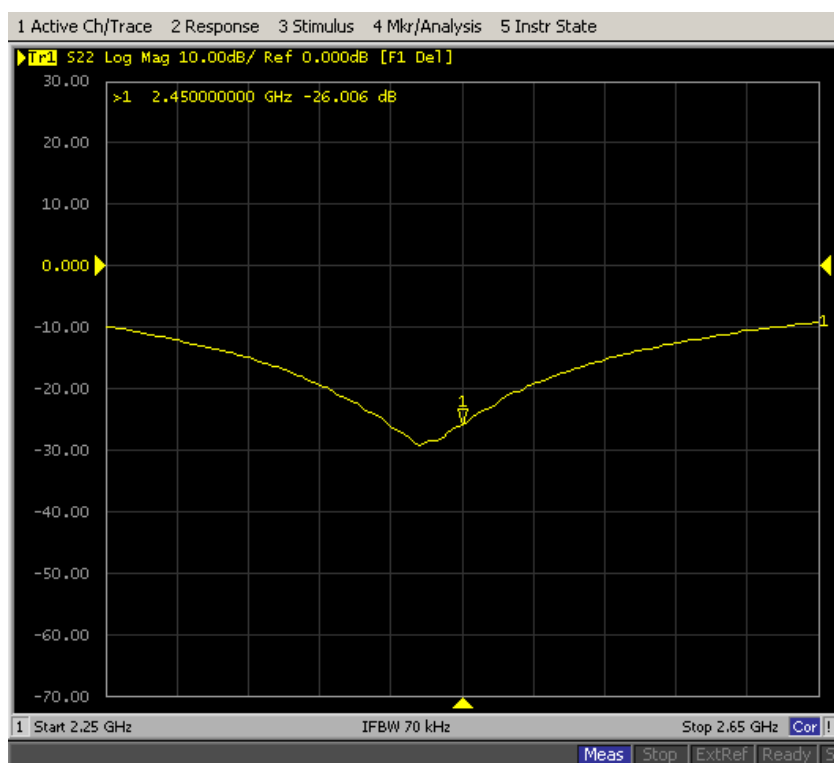
The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Dipole Verification Data D2450V2 Serial No.817

2450 MHz-Head



2450 MHz-Body





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Client **CCS\_CN**

Certificate No: **Z16-97078**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1095**

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

Calibration date: **May 25, 2016**

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                |
| ReferenceProbe EX3DV4   | SN 7307    | 19-Feb-16(SPEAG,No.EX3-7307_Feb16)       | Feb-17                |
| DAE4                    | SN 771     | 02-Feb-16(CTTL-SPEAG,No.Z16-97011)       | Feb-17                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-16 (CTTL, No.J16X00893)           | Jan-17                |
| NetworkAnalyzer E5071C  | MY46110673 | 26-Jan-16 (CTTL, No.J16X00894)           | Jan-17                |

|                |             |                                   |           |
|----------------|-------------|-----------------------------------|-----------|
|                | 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: May 31, 2016

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**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
- 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%.



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**Measurement Conditions**

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

|                              |                                                                                                                      |                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------|
| DASY Version                 | DASY52                                                                                                               | 52.8.8.1258                      |
| Extrapolation                | Advanced Extrapolation                                                                                               |                                  |
| Phantom                      | Triple Flat Phantom 5.1C                                                                                             |                                  |
| Distance Dipole Center - TSL | 10 mm                                                                                                                | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4 mm, dz = 1.4 mm                                                                                           | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5200 MHz $\pm$ 1 MHz<br>5300 MHz $\pm$ 1 MHz<br>5500 MHz $\pm$ 1 MHz<br>5600 MHz $\pm$ 1 MHz<br>5800 MHz $\pm$ 1 MHz |                                  |

**Head TSL parameters at 5200 MHz**

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 36.0           | 4.66 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 36.8 $\pm$ 6 % | 4.61 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | ----           | ----                 |

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

|                                                         |                    |                               |
|---------------------------------------------------------|--------------------|-------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                               |
| SAR measured                                            | 100 mW input power | 7.76 mW / g                   |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 77.9 mW /g $\pm$ 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                               |
| SAR measured                                            | 100 mW input power | 2.21 mW / g                   |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.2 mW /g $\pm$ 22.2 % (k=2) |



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**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 | 36.7 ± 6 %   | 4.71 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 | 8.07 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 81.0 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                           |
| SAR measured                                            | 100 mW input power | 2.30 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.1 mW /g ± 22.2 % (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 | 36.4 ± 6 %   | 4.91 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 | 8.22 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 82.5 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                           |
| SAR measured                                            | 100 mW input power | 2.33 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.4 mW /g ± 22.2 % (k=2) |



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**Head TSL parameters at 5600 MHz**

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 36.3 ± 6 %   | 5.01 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ----         | ----             |

**SAR result with Head TSL at 5600 MHz**

|                                                         |                    |                           |
|---------------------------------------------------------|--------------------|---------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                           |
| SAR measured                                            | 100 mW input power | 8.19 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 82.2 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                           |
| SAR measured                                            | 100 mW input power | 2.33 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.4 mW /g ± 22.2 % (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 | 36.1 ± 6 %   | 5.17 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 | 7.83 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 78.6 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                           |
| SAR measured                                            | 100 mW input power | 2.20 mW / g               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.1 mW /g ± 22.2 % (k=2) |



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**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 | 48.4 ± 6 %   | 5.39 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 | 7.47 mW / g               |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 74.5 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                           |
| SAR measured                                            | 100 mW input power | 2.14 mW / g               |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.4 mW /g ± 22.2 % (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 | 48.3 ± 6 %   | 5.51 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 | 7.74 mW / g               |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 77.2 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                           |
| SAR measured                                            | 100 mW input power | 2.20 mW / g               |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 22.0 mW /g ± 22.2 % (k=2) |



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## 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 | 49.1 ± 6 %   | 5.58 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 | 8.10 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 81.1 mW / g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                            |
| SAR measured                                            | 100 mW input power | 2.36 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 23.7 mW / g ± 22.2 % (k=2) |

## Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 48.5         | 5.77 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 49.0 ± 6 %   | 5.70 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 | 7.97 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 79.8 mW / g ± 23.0 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                            |
| SAR measured                                            | 100 mW input power | 2.26 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 22.7 mW / g ± 22.2 % (k=2) |



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**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 | 48.7 ± 6 %   | 5.93 mho/m ± 6 % |
| Body TSL temperature change during test | <1.0 °C         | ----         | ----             |

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

|                                                |                    |                           |
|------------------------------------------------|--------------------|---------------------------|
| SAR averaged over 1 $cm^3$ (1 g) of Body TSL   | Condition          |                           |
| SAR measured                                   | 100 mW input power | 7.71 mW / g               |
| SAR for nominal Body TSL parameters            | normalized to 1W   | 77.2 mW /g ± 23.0 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Body TSL | Condition          |                           |
| SAR measured                                   | 100 mW input power | 2.17 mW / g               |
| SAR for nominal Body TSL parameters            | normalized to 1W   | 21.8 mW /g ± 22.2 % (k=2) |



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### Appendix

#### Antenna Parameters with Head TSL at 5200 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 49.2Ω - 5.46jΩ |
| Return Loss                          | - 25.1dB       |

#### Antenna Parameters with Head TSL at 5300 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 47.2Ω - 3.86jΩ |
| Return Loss                          | - 26.2dB       |

#### Antenna Parameters with Head TSL at 5500 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 53.4Ω - 5.61jΩ |
| Return Loss                          | - 23.9dB       |

#### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 56.6Ω - 1.04jΩ |
| Return Loss                          | - 24.0dB       |

#### Antenna Parameters with Head TSL at 5800 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 53.0Ω - 6.28jΩ |
| Return Loss                          | - 23.4dB       |

#### Antenna Parameters with Body TSL at 5200 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 49.5Ω - 3.51jΩ |
| Return Loss                          | - 29.0dB       |

#### Antenna Parameters with Body TSL at 5300 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 47.7Ω - 1.89jΩ |
| Return Loss                          | - 30.4dB       |



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**Antenna Parameters with Body TSL at 5500 MHz**

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 54.0Ω - 3.83jΩ |
| Return Loss                          | - 25.5dB       |

**Antenna Parameters with Body TSL at 5600 MHz**

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 59.3Ω + 0.88jΩ |
| Return Loss                          | - 21.4dB       |

**Antenna Parameters with Body TSL at 5800 MHz**

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 55.1Ω - 6.15jΩ |
| Return Loss                          | - 22.4dB       |

**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 |
|-----------------|-------|



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**DASY5 Validation Report for Head TSL**

Date: 05.23.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1095**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,  
Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.614$  mho/m;  $\epsilon_r = 36.82$ ;  $\rho = 1000$   
kg/m<sup>3</sup>, Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.713$  mho/m;  $\epsilon_r = 36.71$ ;  $\rho =$   
1000 kg/m<sup>3</sup>, Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.911$  mho/m;  $\epsilon_r = 36.41$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.006$  mho/m;  $\epsilon_r =$   
36.27;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.171$  mho/m;  
 $\epsilon_r = 36.05$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Center Section

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

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7307; ConvF(5.32,5.32,5.32); Calibrated: 2016/2/19,  
ConvF(5.02,5.02,5.02); Calibrated: 2016/2/19, ConvF(4.85,4.85,4.85);  
Calibrated: 2016/2/19, ConvF(4.52,4.52,4.52); Calibrated: 2016/2/19,  
ConvF(4.45,4.45,4.45); Calibrated: 2016/2/19,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2016/2/02
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10  
(7372)

**Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 71.75 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 31.7 W/kg  
**SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.21 W/kg**  
Maximum value of SAR (measured) = 18.7 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 = 73.42 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 33.6 W/kg  
**SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.3 W/kg**  
Maximum value of SAR (measured) = 19.5 W/kg

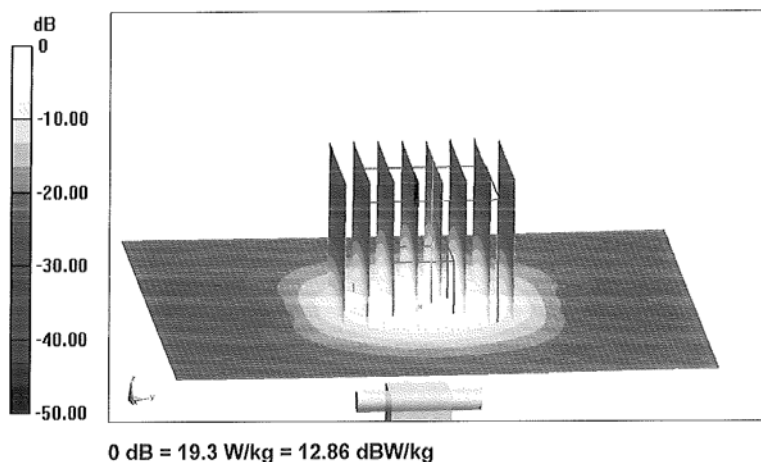


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Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan,  
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 72.44 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 36.1 W/kg  
SAR(1 g) = 8.22 W/kg; SAR(10 g) = 2.33 W/kg  
Maximum value of SAR (measured) = 19.9 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 = 72.62 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 34.9 W/kg  
SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.33 W/kg  
Maximum value of SAR (measured) = 19.7 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 = 72.13 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 34.6 W/kg  
SAR(1 g) = 7.83 W/kg; SAR(10 g) = 2.2 W/kg  
Maximum value of SAR (measured) = 19.3 W/kg

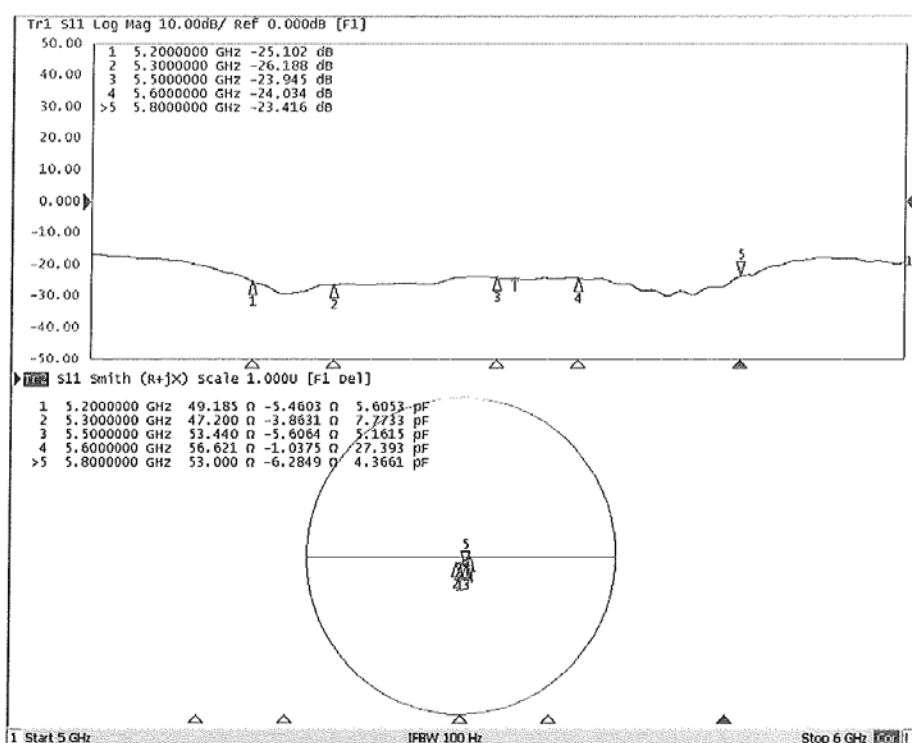




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## Impedance Measurement Plot for Head TSL





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**DASY5 Validation Report for Body TSL**

Date: 05.25.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1095**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,  
Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.391$  mho/m;  $\epsilon_r = 48.36$ ;  $\rho = 1000$   
kg/m<sup>3</sup>, Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.513$  mho/m;  $\epsilon_r = 48.26$ ;  $\rho =$   
1000 kg/m<sup>3</sup>, Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.582$  mho/m;  $\epsilon_r = 49.14$ ;  
 $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.703$  mho/m;  $\epsilon_r =$   
49.04;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.932$  mho/m;  
 $\epsilon_r = 48.71$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Right Section

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

**DASY5 Configuration:**

- Probe: EX3DV4 - SN7307; ConvF(4.48,4.48,4.48); Calibrated: 2016/2/19,  
ConvF(4.29,4.29,4.29); Calibrated: 2016/2/19, ConvF(3.97,3.97,3.97);  
Calibrated: 2016/2/19, ConvF(3.72,3.72,3.72); Calibrated: 2016/2/19,  
ConvF(3.91,3.91,3.91); Calibrated: 2016/2/19,
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2016/2/02
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10  
(7372)

**Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 66.16 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 27.8 W/kg  
**SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.14 W/kg**  
Maximum value of SAR (measured) = 17.0 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 = 65.52 V/m; Power Drift = -0.02 dB  
Peak SAR (extrapolated) = 29.9 W/kg  
**SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.2 W/kg**  
Maximum value of SAR (measured) = 17.8 W/kg



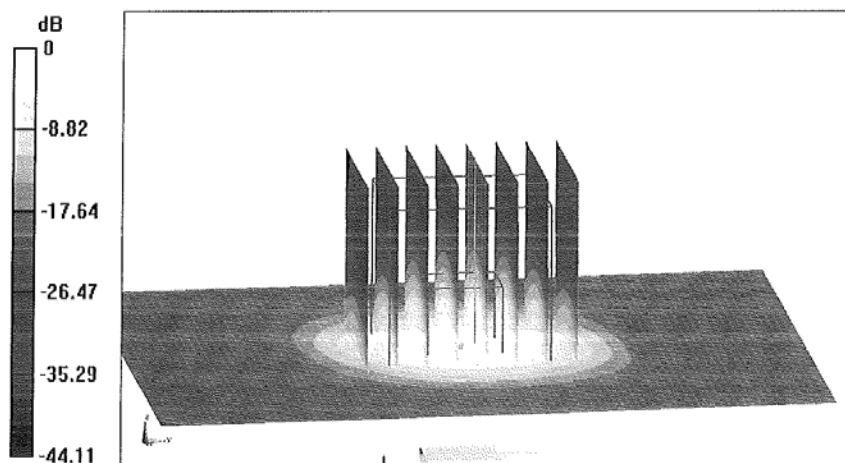
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**Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 66.84 V/m; Power Drift = -0.00 dB  
Peak SAR (extrapolated) = 30.8 W/kg  
**SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.36 W/kg**  
Maximum value of SAR (measured) = 18.5 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm  
Reference Value = 69.68 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 30.8 W/kg  
**SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.26 W/kg**  
Maximum value of SAR (measured) = 18.5 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 = 68.24 V/m; Power Drift = 0.04 dB  
Peak SAR (extrapolated) = 31.6 W/kg  
**SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.17 W/kg**  
Maximum value of SAR (measured) = 18.2 W/kg

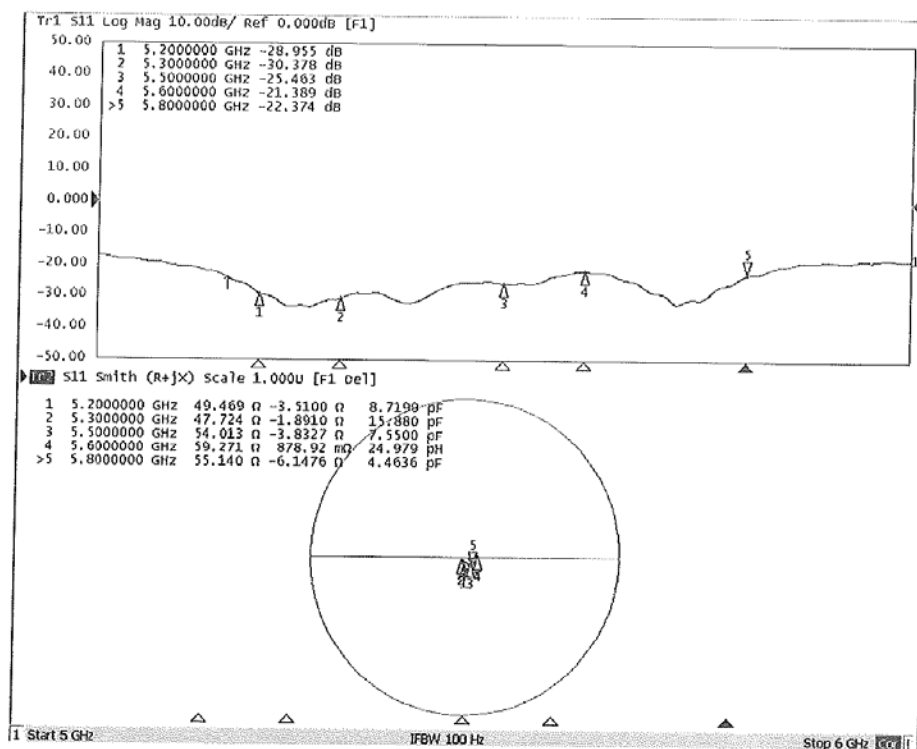




In Collaboration with  
**s p e a g**  
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## Impedance Measurement Plot for Body TSL



## D5GHzV2, Serial No.1095 Extended Dipole Calibrations

Per IEEE Std 1528-2013, the dipole should have a return loss better than -20dB at the test frequency to reduce uncertainty in the power measurement

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

### Justification of the extended calibration

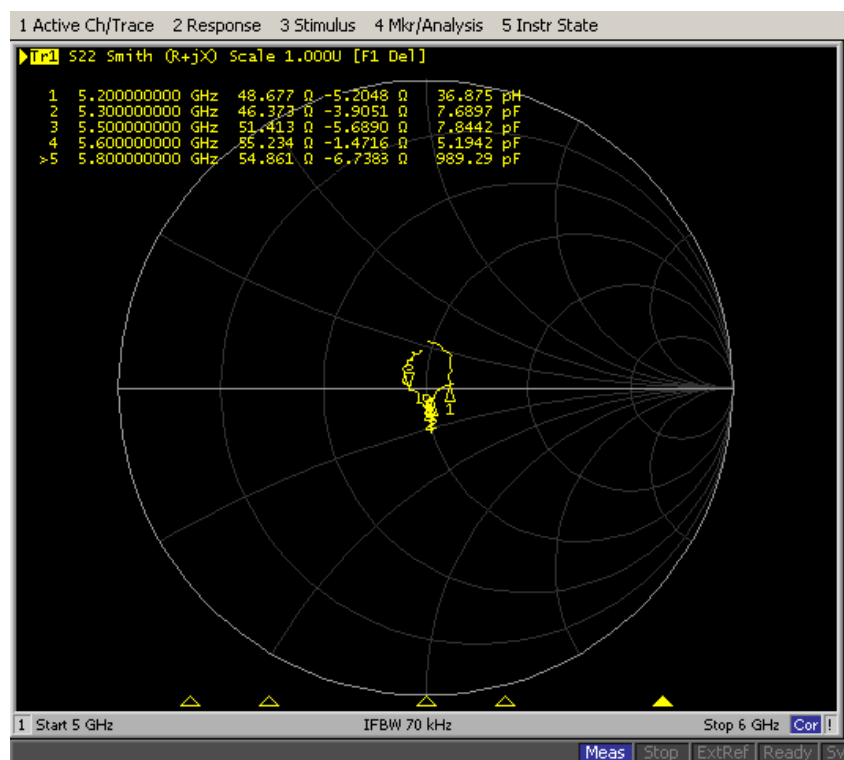
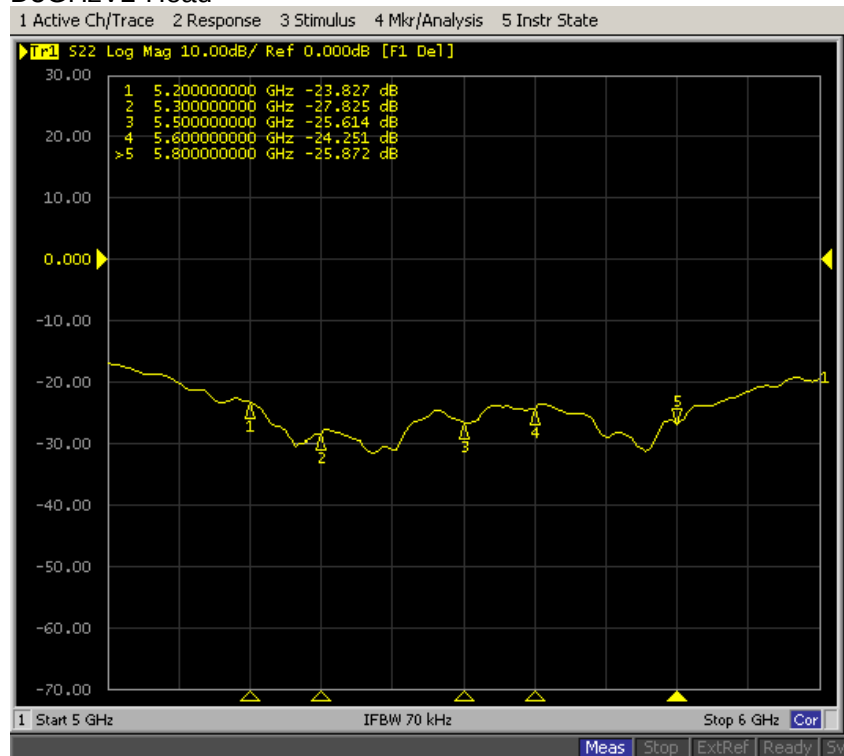
| D5GHzV2 Serial No.1095 |           |                  |           |                      |             |                           |             |
|------------------------|-----------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
| Head                   |           |                  |           |                      |             |                           |             |
| Date of Measurement    |           | Return Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 5200MHz                | 5.25.2016 | -25.102          | --        | 49.185               | --          | -5.4603                   | --          |
|                        | 5.23.2017 | -23.827          | 5.08      | 48.677               | 0.508       | -5.2048                   | 0.2555      |
| 5300MHz                | 5.25.2016 | -26.188          | --        | 47.200               | --          | -3.8631                   | --          |
|                        | 5.23.2017 | -27.825          | 6.25      | 46.373               | 0.827       | -3.9051                   | 0.042       |
| 5500MHz                | 5.25.2016 | -23.945          | --        | 53.440               | --          | -5.6064                   | --          |
|                        | 5.23.2017 | -25.614          | 6.97      | 51.413               | 2.027       | -5.6890                   | 0.0826      |
| 5600MHz                | 5.25.2016 | -24.034          | --        | 56.621               | --          | -1.0375                   | --          |
|                        | 5.23.2017 | -24.251          | 0.90      | 55.234               | 1.387       | -1.4716                   | 0.4341      |
| 5800MHz                | 5.25.2016 | -23.416          | --        | 53.000               | --          | -6.2849                   | --          |
|                        | 5.23.2017 | -25.872          | 10.5      | 54.861               | 1.861       | -6.7383                   | 0.4534      |

| D5GHzV2 Serial No.1095 |           |                  |           |                      |             |                           |             |
|------------------------|-----------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
| Body                   |           |                  |           |                      |             |                           |             |
| Date of Measurement    |           | Return Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 5200MHz                | 5.25.2016 | -28.955          | --        | 49.469               | --          | -3.5100                   | --          |
|                        | 5.23.2017 | -28.384          | 1.97      | 50.314               | 0.845       | -3.5312                   | 0.0212      |
| 5300MHz                | 5.25.2016 | -30.378          | --        | 47.724               | --          | -1.8910                   | --          |
|                        | 5.23.2017 | -31.358          | 3.22      | 46.806               | 0.918       | -1.5284                   | 0.3626      |
| 5500MHz                | 5.25.2016 | -25.463          | --        | 54.013               | --          | -3.8327                   | --          |
|                        | 5.23.2017 | 24.064           | 5.49      | 52.539               | 1.474       | -3.5216                   | 0.3111      |
| 5600MHz                | 5.25.2016 | -21.389          | --        | 59.271               | --          | 0.8789                    | --          |
|                        | 5.23.2017 | -22.755          | 6.39      | 58.225               | 1.046       | 0.8415                    | 0.0374      |
| 5800MHz                | 5.25.2016 | -22.374          | --        | 55.140               | --          | -6.1476                   | --          |
|                        | 5.23.2017 | -23.183          | 3.62      | 55.119               | 0.021       | -6.6894                   | 0.5418      |

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

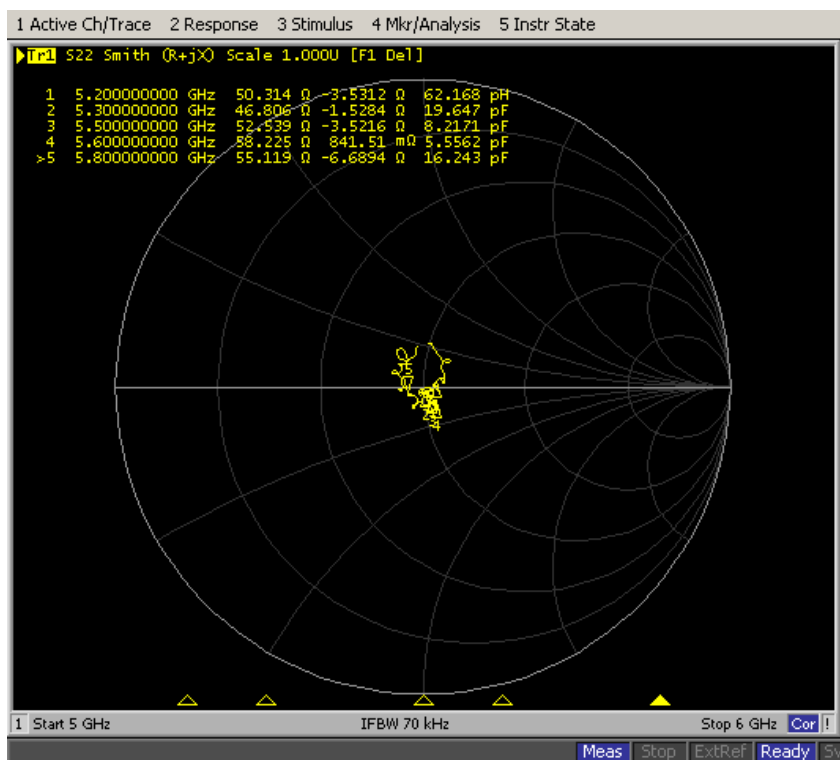
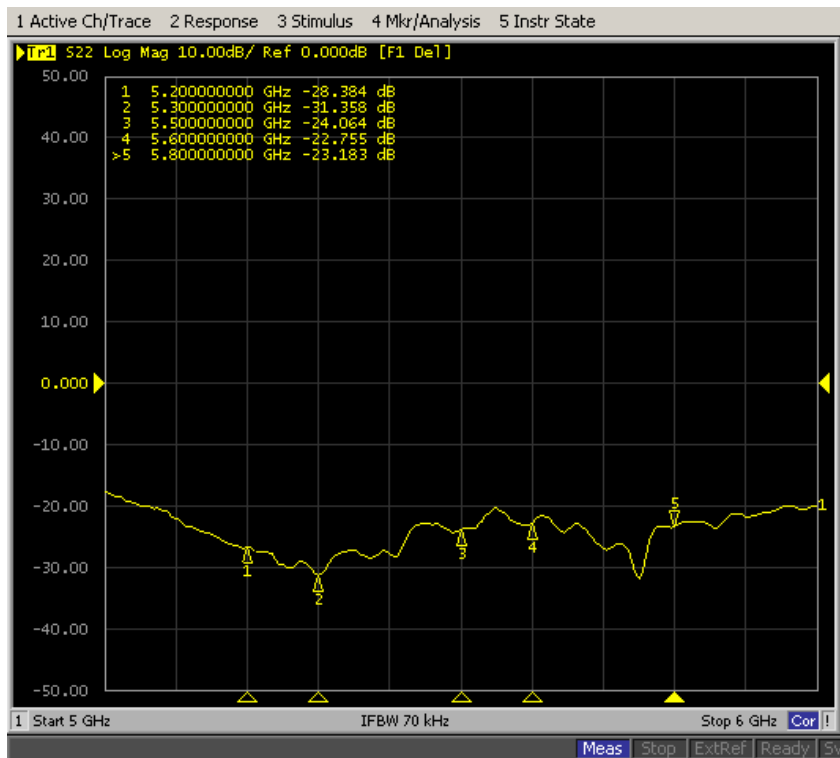
Dipole Verification Data D5GHzV2 Serial No.1095

D5GHzV2-Head



Dipole Verification Data D5GHzV2 Serial No.1095

## D5GHzV2-Body



Schmid &amp; Partner Engineering AG

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## IMPORTANT NOTICE

### USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

**Battery Exchange:** The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

**Shipping of the DAE:** Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-stop Failures:** Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair:** Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

**Important Note:**

**Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.**

**Important Note:**

**Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.**

**Important Note:**

**To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.**

Schmid &amp; Partner Engineering

TN\_BR040315AD DAE4.doc

11.12.2009

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Client **CCS-CN (Auden)**Certificate No: **DAE4-1245\_Jul17****CALIBRATION CERTIFICATE**Object **DAE4 - SD 000 D04 BM - SN: 1245**Calibration procedure(s) **QA CAL-06.v29  
Calibration procedure for the data acquisition electronics (DAE)**Calibration date: **July 20, 2017**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&amp;TE critical for calibration)

| Primary Standards             | ID #               | Cal Date (Certificate No.) | Scheduled Calibration  |
|-------------------------------|--------------------|----------------------------|------------------------|
| Keithley Multimeter Type 2001 | SN: 0810278        | 09-Sep-16 (No:19065)       | Sep-17                 |
| Secondary Standards           | ID #               | Check Date (in house)      | Scheduled Check        |
| Auto DAE Calibration Unit     | SE UWS 053 AA 1001 | 05-Jan-17 (in house check) | In house check: Jan-18 |
| Calibrator Box V2.1           | SE UMS 006 AA 1002 | 05-Jan-17 (in house check) | In house check: Jan-18 |

|                |                           |                                   |               |
|----------------|---------------------------|-----------------------------------|---------------|
| Calibrated by: | Name<br>Dominique Steffen | Function<br>Laboratory Technician | Signature<br> |
| Approved by:   | Sven Kühn                 | Deputy Manager                    |               |

Issued: July 20, 2017

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