

# 9. System Validation from Original equipment supplier

| ccredited by the Swiss Accreditat   | tion Service (SAS)   | Accreditation  | No.: SCS 108   |
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| he Swiss Accreditation Service  | is one of the signatories  |  |  |
| Aultilateral Agreement for the re   | ecognition of calibration  |  |  |
| Client SGS-TW (Aude   | n)   | Certificate No   | D2450V2-727_Apr10  |
| CALIBRATION C   | ERTIFICATE   |  |  |
| Object  | D2450V2 - SN: 7  | 27   |  |
|   |  |  |  |
| Calibration procedure(s)  | QA CAL-05.v7   |  |  |
|   | Calibration proce  | dure for dipole validation kits  |  |
|   |  |  |  |
|   |  |  |  |
| Calibration date:   | April 29, 2010   |  |  |
|   |  |  |  |
|   |  | onal standards, which realize the physical un<br>robability are given on the following pages ar  |  |
| The measurements and the unce   | ertainties with confidence p   |  | nd are part of the certificate.  |
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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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



SWISS BRATH

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

Accreditation No.: SCS 108

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# Glossary:

| TSL   | tissue simulating liquid        |
|-------|---------------------------------|
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) 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 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), 'Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

# Additional Documentation:

d) 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.

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# **Measurement Conditions**

| DASY Version  | DASY5                     | V5.2 |
|---------------|---------------------------|------|
| Extrapolation | Advanced Extrapolation    |      |
| Phantom       | Modular Flat Phantom V4.9 |      |

|                              |                   |             | _ |
|------------------------------|-------------------|-------------|---|
| Distance Dipole Center - TSL | 10 mm             | with Spacer | 1 |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm |             |   |
| Frequency                    | 2450 MHz ± 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 ± 0.2) °C | 39.8 ± 6 %   | 1.78 mho/m ± 6 % |
| Head TSL temperature during test | (21.5 ± 0.2) °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              | 13.2 mW / g                |
| SAR normalized  | normalized to 1W                | 52.8 mW / g                |
| SAR for nominal Head TSL parameters                                     | normalized to 1W                | 53.2 mW /g ± 17.0 % (k=2)  |
|   |                                 |                            |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL                 | condition                       |                            |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL<br>SAR measured | condition<br>250 mW input power | 6.22 mW / g                |
|   |                                 | 6.22 mW / g<br>24.9 mW / g |

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prosecuted to the fullest extent of the law.



# **Body TSL parameters**

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 52.7         | 1.95 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 54.2 ± 6 %   | 2.01 mho/m ± 6 % |
| Body TSL temperature during test | (22.5 ± 0.2) °C |              |                  |

# SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL                                     | Condition                       |                            |
|---|---------------------------------|----------------------------|
| SAR measured  | 250 mW input power              | 13.4 mW / g                |
| SAR normalized  | normalized to 1W                | 53.6 mW / g                |
| SAR for nominal Body TSL parameters   | normalized to 1W                | 53.2 mW / g ± 17.0 % (k=2) |
|   |                                 |                            |
|   |                                 |                            |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL                                   | condition                       |                            |
|   | condition<br>250 mW input power | 6.23 mW / g                |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL<br>SAR measured<br>SAR normalized | Contraction                     | 6.23 mW / g<br>24.9 mW / g |



Certificate No: D2450V2-727\_Apr10

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#### Appendix

# Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.3 Ω + 1.7 jΩ |
|--------------------------------------|-----------------|
| Return Loss                          | - 28.9 dB       |

#### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 50.3 Ω + 3.6 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | - 29.0 dB       |  |

#### **General Antenna Parameters and Design**

| Electrical Delay (one direction) | 1.150 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. 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            |
|-----------------|------------------|
| Manufactured on | January 09, 2003 |

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# **DASY5 Validation Report for Head TSL**

Date/Time: 22.04.2010 16:30:51

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:727

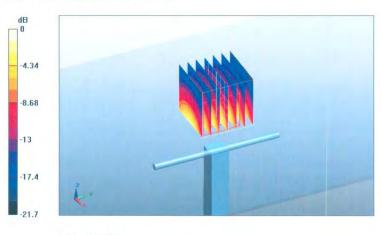
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium: HSL U11 BB Medium parameters used: f = 2450 MHz;  $\sigma = 1.78 \text{ mho/m}$ ;  $\varepsilon_r = 39.8$ ;  $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

#### Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement

grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 101.0 V/m; Power Drift = 0.064 dB Peak SAR (extrapolated) = 26.8 W/kg SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.22 mW/g Maximum value of SAR (measured) = 16.9 mW/g



0 dB = 16.9 mW/g

Certificate No: D2450V2-727\_Apr10

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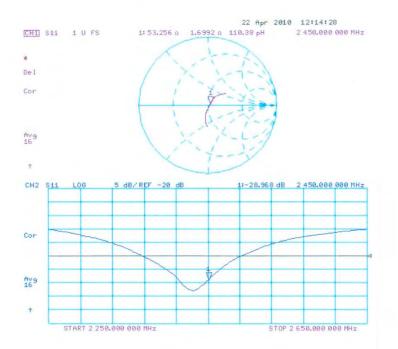
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# Impedance Measurement Plot for Head TSL





Certificate No: D2450V2-727\_Apr10

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# **DASY5 Validation Report for Body**

Date/Time: 29.04.2010 14:57:43

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:727

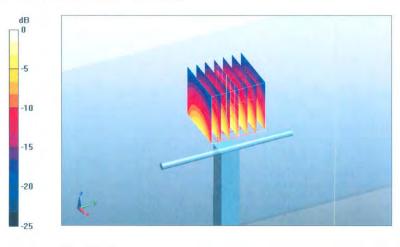
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium: MSL U11 BB Medium parameters used: f = 2450 MHz;  $\sigma = 2 \text{ mho/m}$ ;  $\varepsilon_r = 54.1$ ;  $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection) .
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010 .
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57 .

# Pin250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement

grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 96.1 V/m; Power Drift = 0.00929 dB Peak SAR (extrapolated) = 27.7 W/kg SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.23 mW/g Maximum value of SAR (measured) = 17.6 mW/g



 $0 \, dB = 17.6 \, mW/g$ 

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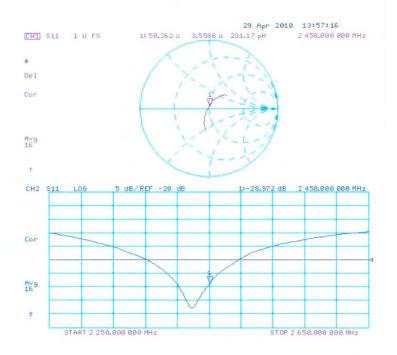
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# Impedance Measurement Plot for Body TSL





Certificate No: D2450V2-727\_Apr10

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| The Swiss Accreditation Service   | e is one of the signatorie   |  |  |
|---|--|--|--|
| Multilateral Agreement for the r  |  |  |  |
| Client SGS-TW (Aud  | -  |  | No: D5GHzV2-1023 Jan10   |
| CALIBRATION O   |  |  |  |
| CALIBRATION   | ERIFICATE  |  |  |
| Object  | D5GHzV2 - SN:  | 1023   |  |
|   | 01.011.00.1  |  |  |
| Calibration procedure(s)  | QA CAL-22.v1<br>Calibration proce  | dure for dipole validation kits be   | etween 3-6 GHz   |
|   |  |  |  |
|   |  |  |  |
| Calibration date:   | January 21, 2010   | )  |  |
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| The measurements and the unce<br>All calibrations have been conduc<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator  | ertainties with confidence p<br>cted in the closed laborator<br>TE critical for calibration)<br>ID #<br>GB37480704<br>US37292783<br>SN: 5086 (20g)   | robability are given on the following pages a<br>ry facility: environment temperature (22 ± 3)<br>Cal Date (Certificate No.)<br>06-Oct-09 (No. 217-01086)<br>06-Oct-09 (No. 217-01086)<br>31-Mar-09 (No. 217-01025)  | and are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10  |
| The measurements and the unce<br>All calibrations have been conduc<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination   | ertainties with confidence p<br>cted in the closed laborator<br>TE critical for calibration)<br>ID #<br>GB37480704<br>US37292783<br>SN: 5086 (20g)<br>SN: 5047.2 / 06327   | robability are given on the following pages a<br>ry facility: environment temperature (22 ± 3)<br>Cal Date (Certificate No.)<br>06-Oct-09 (No. 217-01086)<br>06-Oct-09 (No. 217-01086)<br>31-Mar-09 (No. 217-01025)<br>31-Mar-09 (No. 217-01029)   | and are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10  |
| The measurements and the unce<br>All calibrations have been conduct<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4  | tertainties with confidence p<br>cted in the closed laborator<br>TE critical for calibration)<br>ID #<br>GB37480704<br>US37292783<br>SN: 5086 (20g)<br>SN: 5047.2 / 06327<br>SN: 3503  | robability are given on the following pages a<br>ry facility: environment temperature (22 ± 3)<br>Cal Date (Certificate No.)<br>06-Oct-09 (No. 217-01086)<br>06-Oct-09 (No. 217-01086)<br>31-Mar-09 (No. 217-01025)<br>31-Mar-09 (No. 217-01029)<br>11-Mar-09 (No. EX3-3503_Mar09)   | Ind are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Mar-10  |
| The measurements and the unce<br>All calibrations have been conduc<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination   | ertainties with confidence p<br>cted in the closed laborator<br>TE critical for calibration)<br>ID #<br>GB37480704<br>US37292783<br>SN: 5086 (20g)<br>SN: 5047.2 / 06327   | robability are given on the following pages a<br>ry facility: environment temperature (22 ± 3)<br>Cal Date (Certificate No.)<br>06-Oct-09 (No. 217-01086)<br>06-Oct-09 (No. 217-01086)<br>31-Mar-09 (No. 217-01025)<br>31-Mar-09 (No. 217-01029)   | and are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10  |
| The measurements and the unce<br>All calibrations have been conduct<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4  | tertainties with confidence p<br>cted in the closed laborator<br>TE critical for calibration)<br>ID #<br>GB37480704<br>US37292783<br>SN: 5086 (20g)<br>SN: 5047.2 / 06327<br>SN: 3503  | robability are given on the following pages a<br>ry facility: environment temperature (22 ± 3)<br>Cal Date (Certificate No.)<br>06-Oct-09 (No. 217-01086)<br>06-Oct-09 (No. 217-01086)<br>31-Mar-09 (No. 217-01025)<br>31-Mar-09 (No. 217-01029)<br>11-Mar-09 (No. EX3-3503_Mar09)   | Ind are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Mar-10  |
| The measurements and the unce<br>All calibrations have been conduc<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Power sensor HP 8481A   | ertainties with confidence p       cted in the closed laborator       TE critical for calibration)       ID #       GB37480704       US37292783       SN: 5086 (20g)       SN: 5086 (20g)       SN: 503       SN: 601       ID #       MY41092317  | cal Date (Certificate No.)       06-Oct-09 (No. 217-01086)       06-Oct-09 (No. 217-01086)       31-Mar-09 (No. 217-01026)       31-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       07-Mar-09 (No. EX3-3503_Mar09)       07-Mar-09 (No. DAE4-601_Mar09)       Check Date (in house)       18-Oct-02 (in house check Oct-09)   | and are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Mar-10  |
| The measurements and the unce<br>All calibrations have been conduct<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Power sensor HP 8481A<br>RF generator R&S SMT-06   | in the closed laborator       TE critical for calibration)       ID #       GB37480704       US37292783       SN: 5086 (20g)       SN: 5086 (20g)       SN: 5047.2 / 06327       SN: 601       ID #       MY41092317       100005  | robability are given on the following pages a<br>ry facility: environment temperature (22 ± 3)<br>06-Oct-09 (No. 217-01086)<br>06-Oct-09 (No. 217-01086)<br>31-Mar-09 (No. 217-01029)<br>31-Mar-09 (No. 217-01029)<br>11-Mar-09 (No. EX3-3503_Mar09)<br>07-Mar-09 (No. DAE4-601_Mar09)<br>Check Date (in house)<br>18-Oct-02 (in house check Oct-09)<br>4-Aug-99 (in house check Oct-09)   | and are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Scheduled Check   |
| The measurements and the unce<br>All calibrations have been conduc<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Power sensor HP 8481A   | ertainties with confidence p       cted in the closed laborator       TE critical for calibration)       ID #       GB37480704       US37292783       SN: 5086 (20g)       SN: 5086 (20g)       SN: 503       SN: 601       ID #       MY41092317  | cal Date (Certificate No.)       06-Oct-09 (No. 217-01086)       06-Oct-09 (No. 217-01086)       31-Mar-09 (No. 217-01026)       31-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       07-Mar-09 (No. EX3-3503_Mar09)       07-Mar-09 (No. DAE4-601_Mar09)       Check Date (in house)       18-Oct-02 (in house check Oct-09)   | and are part of the certificate.<br>°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Scheduled Check<br>In house check: Oct-11   |
| The measurements and the unce<br>All calibrations have been conduct<br>Calibration Equipment used (M&<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Power sensor HP 8481A<br>RF generator R&S SMT-06   | in the closed laborator       TE critical for calibration)       ID #       GB37480704       US37292783       SN: 5086 (20g)       SN: 5003       SN: 601       ID #       MY41092317       100005       US37390585 S4206 | Cal Date (Certificate No.)       06-Oct-09 (No. 217-01086)       06-Oct-09 (No. 217-01086)       06-Oct-09 (No. 217-01025)       31-Mar-09 (No. 217-01025)       31-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       07-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       11-Mar-09 (No. 217-01029)       11-Mar-09 (No. DAE4-601_Mar09)       07-Mar-09 (No. DAE4-601_Mar09)       Check Date (in house)       18-Oct-02 (in house check Oct-09)       4-Aug-99 (in house check Oct-09)       18-Oct-01 (in house check Oct-09)                              | and are part of the certificate.<br>*C and humidity < 70%.<br>Scheduled Calibration<br>Oct-10<br>Oct-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Mar-10<br>Scheduled Check<br>In house check: Oct-11<br>In house check: Oct-11<br>In house check: Oct-10 |
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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

# Glossary:

| TSL   | tissue simulating liquid        |
|-------|---------------------------------|
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

# Calibration is Performed According to the Following Standards:

- a) IEC Std 62209 Part 2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", Draft Version 0.9, December 2004
- b) Federal Communications Commission Office of Engineering & Technology (FCC OET), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

# Additional Documentation:

c) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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No.134, Wu Kung Road, Wuku Industrial Zone, Taipei County, Taiwan /台北縣五股工業區五工路 134 號 f (886-2) 2298-0488



#### **Measurement Conditions**

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

| DASY Version                 | DASY5  | V5.2        |
|------------------------------|--|-------------|
| Extrapolation                | Advanced Extrapolation                                   |             |
| Phantom                      | Modular Flat Phantom V5.0                                |             |
| Distance Dipole Center - TSL | 10 mm  | with Spacer |
| Area Scan resolution         | dx, dy = 10 mm   |             |
| Zoom Scan Resolution         | dx, dy = 4.0 mm, dz = 2.5 mm                             |             |
| Frequency                    | 5200 MHz ± 1 MHz<br>5500 MHz ± 1 MHz<br>5800 MHz ± 1 MHz |             |

#### Head TSL parameters at 5200 MHz

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters      | 22.0 °C         | 36.0         | 4.66 mho/m       |
| Measured Head TSL parameters     | (22.0 ± 0.2) °C | 34.8 ± 6 %   | 4.58 mho/m ± 6 % |
| Head TSL temperature during test | (21.2 ± 0.2) °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 | 7.85 mW / g                |
| SAR normalized  | normalized to 1W   | 78.5 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 77.9 mW / g ± 19.9 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                            |
| SAR measured  | 100 mW input power | 2.22 mW / g                |
| SAR normalized  | normalized to 1W   | 22.2 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.0 mW / g ± 19.5 % (k=2) |

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# 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 | 34.1 ± 6 %   | 4.86 mho/m ± 6 % |
| Head TSL temperature during test | (21.2 ± 0.2) °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 | 8.35 mW / g                |
| SAR normalized  | normalized to 1W   | 83.5 mW / g                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 82.7 mW / g ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                            |
|---|--------------------|----------------------------|
| SAR measured  | 100 mW input power | 2.35 mW / g                |
| SAR normalized  | normalized to 1W   | 23.5 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.3 mW / g ± 19.5 % (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 | 33.7 ± 6 %   | 5.13 mho/m ± 6 % |
| Head TSL temperature during test | (21.2 ± 0.2) °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              | 7.75 mW / g                |
| SAR normalized  | normalized to 1W                | 77.5 mW / g                |
| SAR for nominal Head TSL parameters   | normalized to 1W                | 76.7 mW / g ± 19.9 % (k=2) |
|   |                                 |                            |
|   |                                 |                            |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL                                   | condition                       |                            |
|   | condition<br>100 mW input power | 2.18 mW / g                |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL<br>SAR measured<br>SAR normalized |                                 | 2.18 mW / g<br>21.8 mW / g |

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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 | 47.5 ± 6 %   | 5.52 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °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 | 8.02 mW / g                |
| SAR normalized  | normalized to 1W   | 80.2 mW / g                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 79.7 mW / g ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                            |
|---|--------------------|----------------------------|
| SAR measured  | 100 mW input power | 2.22 mW / g                |
| SAR normalized  | normalized to 1W   | 22.2 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 22.1 mW / g ± 19.5 % (k=2) |

#### 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 | 46.8 ± 6 %   | 5.89 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °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              | 8.49 mW / g                |
| SAR normalized   | normalized to 1W                | 84.9 mW / g                |
| SAR for nominal Body TSL parameters  | normalized to 1W                | 84.3 mW / g ± 19.9 % (k=2) |
|  |                                 |                            |
|  |                                 |                            |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL  | condition                       |                            |
|  | condition<br>100 mW input power | 2.33 mW / g                |
| SAR measured   |                                 | 2.33 mW / g<br>23.3 mW / g |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL<br>SAR measured<br>SAR normalized<br>SAR for nominal Body TSL parameters | 100 mW input power              |                            |

Certificate No: D5GHzV2-1023\_Jan10

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#### Body TSL parameters at 5800 MHz

| Tho | following | naramotore | and | calculations | MORO | applied  |  |
|-----|-----------|------------|-----|--------------|------|----------|--|
| THE | PHILVIOIO | parameters | anu | calculations | were | applieu. |  |

|                                  | 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 | 46.1 ± 6 %   | 6.26 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °C |              |                  |

# SAR result with Body TSL at 5800 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | condition          |                            |
|---|--------------------|----------------------------|
| SAR measured  | 100 mW input power | 7.37 mW / g                |
| SAR normalized  | normalized to 1W   | 73.7 mW / g                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 73.2 mW / g ± 19.9 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                            |
|---|--------------------|----------------------------|
| SAR measured  | 100 mW input power | 2.02 mW / g                |
| SAR normalized  | normalized to 1W   | 20.2 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.0 mW / g ± 19.5 % (k=2) |



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#### Appendix

# Antenna Parameters with Head TSL at 5200 MHz

| Impedance, transformed to feed point | 51.1 Ω - 7.6 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | -22.4 dB        |  |

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

| Impedance, transformed to feed point | 52.4 Ω - 2.0 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | -30.4 dB        |  |

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

| Impedance, transformed to feed point | 58.4 Ω - 0.5 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | -22.2 dB        |  |

# Antenna Parameters with Body TSL at 5200 MHz

| Impedance, transformed to feed point | 51.0 Ω - 6.9 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | -23.3 dB        |  |

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

| Impedance, transformed to feed point | 51.2 Ω - 0.5 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | -37.9 dB        |  |

# Antenna Parameters with Body TSL at 5800 MHz

| Impedance, transformed to feed point | 56.8 Ω + 1.3 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | -23.8 dB        |  |

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1.179 ns

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)

After long term use with 40 W 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. 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             |
|-----------------|-------------------|
| Manufactured on | February 05, 2004 |

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

Date/Time: 21.01.2010 18:04:15

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1023

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: HSL 3-6 GHz

Medium parameters used: f = 5200 MHz;  $\sigma = 4.6 \text{ mho/m}$ ;  $\varepsilon_r = 34.7$ ;  $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5500 MHz;  $\sigma = 4.88 \text{ mho/m}$ ;  $\varepsilon_r = 34.1$ ;  $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5800 MHz;  $\sigma = 5.16 \text{ mho/m}$ ;  $\varepsilon_r = 33.7$ ;  $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.36, 5.36, 5.36), ConvF(4.85, 4.85, 4.85), ConvF(4.74, 4.74, 4.74); Calibrated: 11.03.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front): Type: OD000P50AA: Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157: SEMCAD X Version 14.0 Build 57

# Configuration D5GHzV2 Dipole (Head)/d=10mm, Pin=250mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:

Measurement grid: dx=4mm, dy=4mm, dz=2.5mm Reference Value = 64 V/m; Power Drift = 0.080 dB Peak SAR (extrapolated) = 30.4 W/kg SAR(1 g) = 7.85 mW/g; SAR(10 g) = 2.22 mW/g Maximum value of SAR (measured) = 15.2 mW/g

Configuration D5GHzV2 Dipole (Head)/d=10mm, Pin=250mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm Reference Value = 65 V/m; Power Drift = 0.053 dB Peak SAR (extrapolated) = 34 W/kg

SAR(1 g) = 8.35 mW/g; SAR(10 g) = 2.35 mW/gMaximum value of SAR (measured) = 16.3 mW/g

# Configuration D5GHzV2 Dipole (Head)/d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan

(4x4x2.5mm), dist=2mm (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm Reference Value = 61.5 V/m; Power Drift = 0.067 dB Peak SAR (extrapolated) = 33 W/kg SAR(1 g) = 7.75 mW/g; SAR(10 g) = 2.18 mW/gMaximum value of SAR (measured) = 15.4 mW/g

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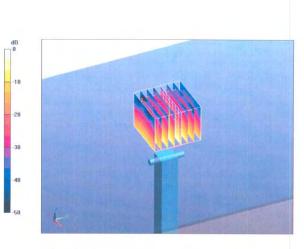
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0 dB = 15.4 mW/g

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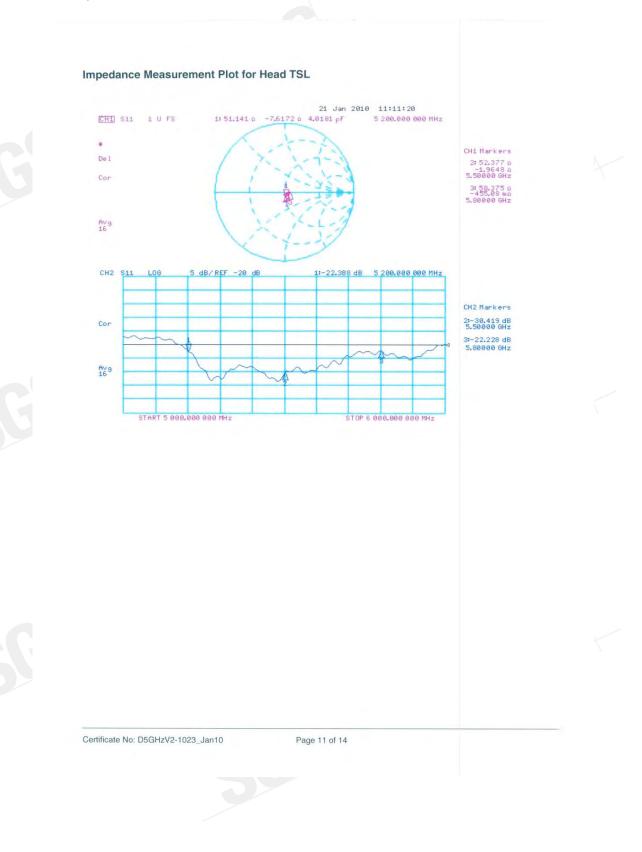
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# **DASY5 Validation Report for Body TSL**

Date/Time: 20.01.2010 16:22:13

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1023

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: MSL 3-6 GHz

Medium parameters used: f = 5200 MHz;  $\sigma$  = 5.52 mho/m;  $\epsilon_r$  = 47.5;  $\rho$  = 1000 kg/m<sup>3</sup> Medium parameters used: f = 5500 MHz;  $\sigma = 5.89 \text{ mho/m}$ ;  $\varepsilon_r = 46.8$ ;  $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: f = 5800 MHz;  $\sigma = 6.26$  mho/m;  $c_c = 46.1$ ; p = 1000 kg/m<sup>3</sup> Phantom section: Flat Section

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

#### DASY5 Configuration:

- Probe: EX3DV4 SN3503; ConvF(4.88, 4.88, 4.88), ConvF(4.37, 4.37, 4.37), ConvF(4.57, 4.57, 4.57); Calibrated; 11.03.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

# Configuration D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:

Measurement grid: dx=4mm, dy=4mm, dz=2.5mm Reference Value = 60.3 V/m; Power Drift = -0.00586 dB Peak SAR (extrapolated) = 31.3 W/kg SAR(1 g) = 8.02 mW/g; SAR(10 g) = 2.22 mW/gMaximum value of SAR (measured) = 15.6 mW/g

Configuration D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm Reference Value = 61 V/m; Power Drift = 0.017 dB Peak SAR (extrapolated) = 35.2 W/kg SAR(1 g) = 8.49 mW/g; SAR(10 g) = 2.33 mW/g

Maximum value of SAR (measured) = 16.8 mW/g

# Configuration D5GHzV2 Dipole (Body)/d=10mm, Pin=100mW, f=5800 MHz/Zoom Scan (4x4x2.5mm), dist=2mm (8x8x10)/Cube 0:

Measurement grid: dx=4mm, dy=4mm, dz=2.5mm Reference Value = 55.6 V/m; Power Drift = 0.00363 dB Peak SAR (extrapolated) = 32.4 W/kg SAR(1 g) = 7.37 mW/g; SAR(10 g) = 2.02 mW/g Maximum value of SAR (measured) = 14.8 mW/g

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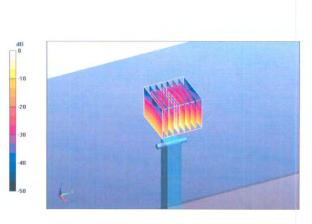
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 $0 \, dB = 14.8 \, mW/g$ 

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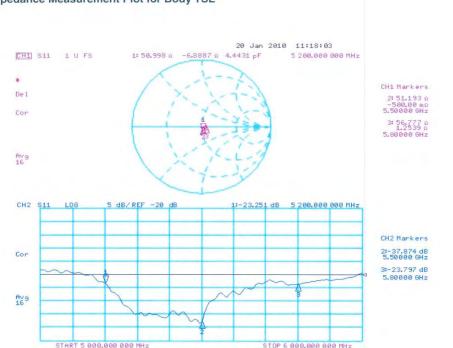
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#### Impedance Measurement Plot for Body TSL





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