



## **Appendix C. DASYS Calibration Certificate**

The DASYS calibration certificates are shown as follows.



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



S Schweizerischer Kalibrierdienst, C Service suisse d'etalonnage, S Servizio svizzero di taratura, S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: D835V2-4d091\_Nov09

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d091
Calibration procedure(s): QA CAL-05.v7, Calibration procedure for dipole validation kits
Calibration date: November 23, 2009

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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Includes items like Power meter EPM-442A, Power sensor HP 8481A, Reference 20 dB Attenuator, etc.

Calibrated by: Jeton Kastrati, Laboratory Technician
Approved by: Katja Pokovic, Technical Manager
Signatures and names are present.

Issued: November 24, 2009

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

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



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

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

Accreditation No.: **SCS 108**

**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:**

- 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
- 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
- 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:**

- 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.



**Measurement Conditions**

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

|                              |                           |             |
|------------------------------|---------------------------|-------------|
| DASY Version                 | DASY5                     | V5.2        |
| Extrapolation                | Advanced Extrapolation    |             |
| Phantom                      | Modular Flat Phantom V4.9 |             |
| Distance Dipole Center - TSL | 15 mm                     | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm         |             |
| Frequency                    | 835 MHz $\pm$ 1 MHz       |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|                                  | Temperature         | Permittivity   | Conductivity         |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters      | 22.2 °C             | 41.5           | 0.90 mho/m           |
| Measured Head TSL parameters     | (22.0 $\pm$ 0.2) °C | 41.6 $\pm$ 6 % | 0.89 mho/m $\pm$ 6 % |
| Head TSL temperature during test | (22.0 $\pm$ 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 | 2.38 mW / g                                      |
| SAR normalized  | normalized to 1W   | 9.52 mW / g                                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>9.60 mW / g <math>\pm</math> 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 1.56 mW / g                                      |
| SAR normalized  | normalized to 1W   | 6.24 mW / g                                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>6.28 mW / g <math>\pm</math> 16.5 % (k=2)</b> |



**Body TSL parameters**

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 55.2         | 0.97 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 53.2 ± 6 %   | 1.01 mho/m ± 6 % |
| Body TSL temperature during test | (21.8 ± 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 | 2.55 mW / g                       |
| SAR normalized  | normalized to 1W   | 10.2 mW / g                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>9.80 mW / g ± 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                   |
|---|--------------------|-----------------------------------|
| SAR measured  | 250 mW input power | 1.67 mW / g                       |
| SAR normalized  | normalized to 1W   | 6.68 mW / g                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>6.49 mW / g ± 16.5 % (k=2)</b> |



**Appendix**

**Antenna Parameters with Head TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 52.0 $\Omega$ - 1.4 j $\Omega$ |
| Return Loss                          | - 32.3 dB                      |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.5 $\Omega$ - 3.1 j $\Omega$ |
| Return Loss                          | - 29.2 dB                      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.406 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 | September 15, 2008 |

DASY5 Validation Report for Head TSL

Date/Time: 23.11.2009 10:32:03

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d091

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.89$  mho/m;  $\epsilon_r = 41.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

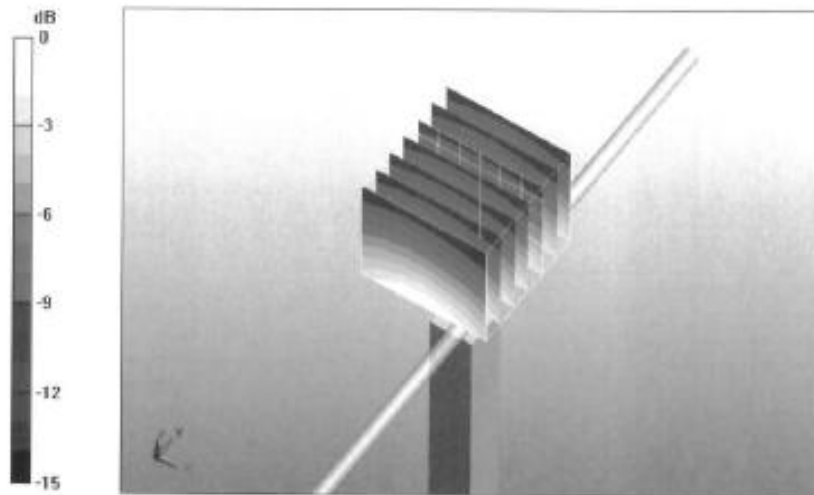
Pin=250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.3 V/m; Power Drift = 0.020 dB

Peak SAR (extrapolated) = 3.56 W/kg

SAR(1 g) = 2.38 mW/g; SAR(10 g) = 1.56 mW/g

Maximum value of SAR (measured) = 2.78 mW/g

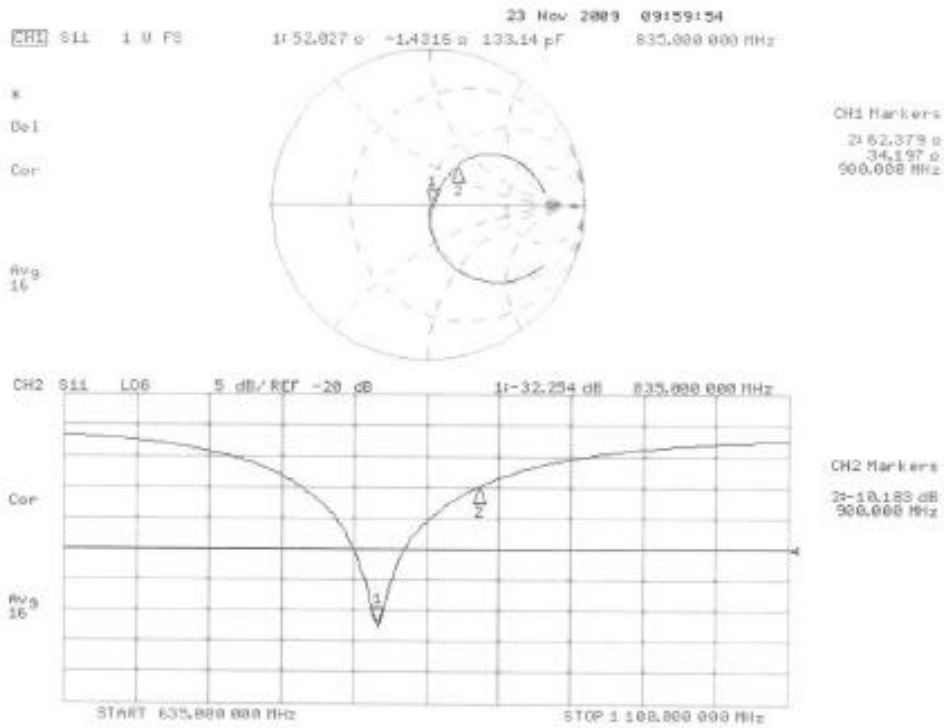


0 dB = 2.78mW/g





Impedance Measurement Plot for Head TSL





**DASY5 Validation Report for Body**

Date/Time: 16.11.2009 10:48:20

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d091**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL900

Medium parameters used:  $f = 835$  MHz;  $\sigma = 1.01$  mho/m;  $\epsilon_r = 53.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.07, 5.97, 5.97); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASYS, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

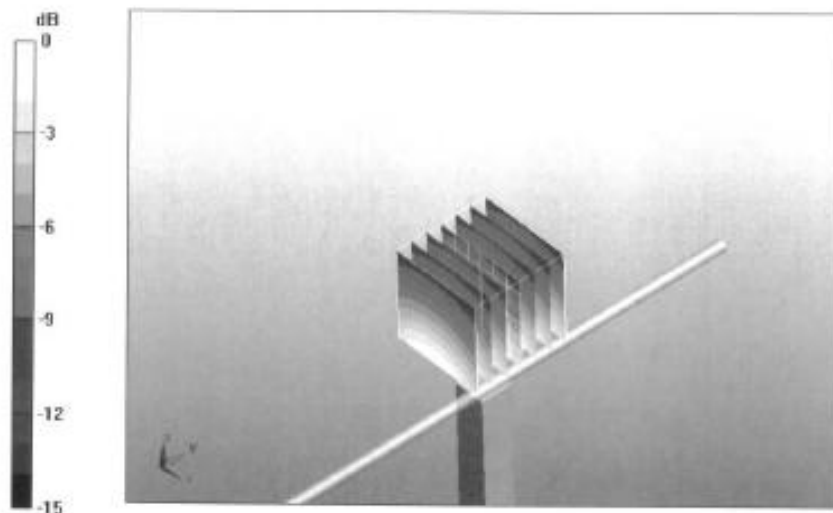
**Pin250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.7 V/m; Power Drift = 0.016 dB

Peak SAR (extrapolated) = 3.79 W/kg

**SAR(1 g) = 2.55 mW/g; SAR(10 g) = 1.67 mW/g**

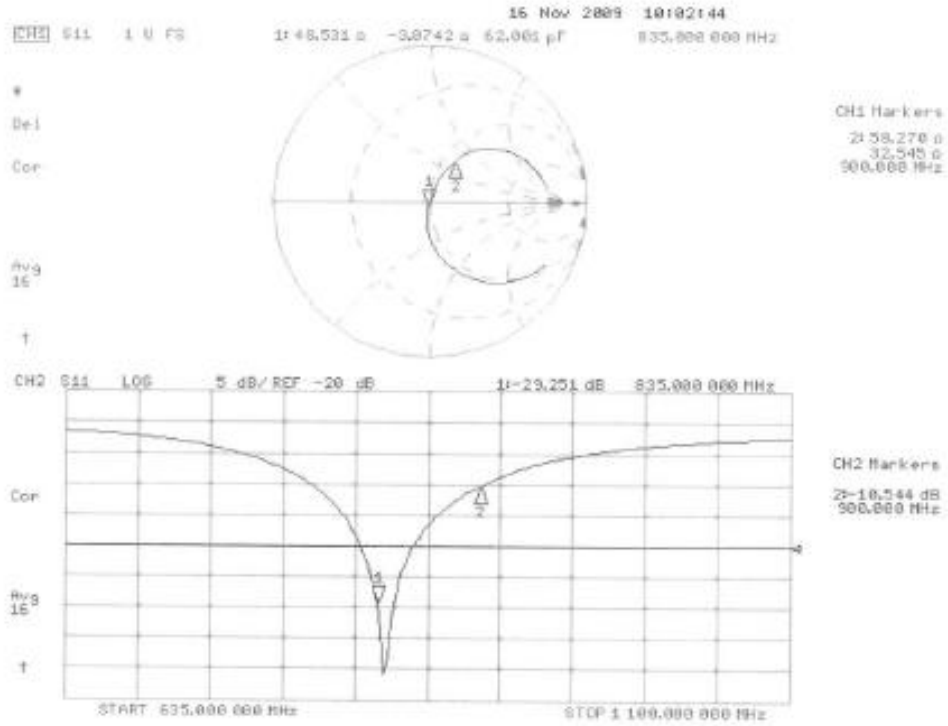
Maximum value of SAR (measured) = 2.95 mW/g



0 dB = 2.95mW/g



Impedance Measurement Plot for Body TSL





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



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Accredited by the Swiss Accreditation Service (SA5), The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: D1900V2-5d118\_Nov09

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d118
Calibration procedure(s): QA CAL-05.v7
Calibration procedure for dipole validation kits
Calibration date: November 24, 2009

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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Lists equipment like Power meter EPM-442A, Power sensor HP 8461A, Reference 20 dB Attenuator, etc.

Table with 4 columns: Secondary Standards, ID #, Check Date (in house), Scheduled Check. Lists equipment like Power sensor HP 8461A, RF generator R&S SMT-06, Network Analyzer HP 8753E.

Calibrated by: Jelon Kastrali, Function: Laboratory Technician, Signature: [Handwritten]
Approved by: Katja Pokovic, Function: Technical Manager, Signature: [Handwritten]

Issued: November 25, 2009

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

**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:**

- 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
- 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
- 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:**

- 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.



**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 |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm         |             |
| Frequency                    | 1900 MHz ± 1 MHz          |             |

**Head TSL parameters**

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters      | 22.0 °C         | 40.0         | 1.40 mho/m       |
| Measured Head TSL parameters     | (22.0 ± 0.2) °C | 39.8 ± 6 %   | 1.44 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 | 9.97 mW / g                       |
| SAR normalized  | normalized to 1W   | 39.9 mW / g                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>39.2 mW / g ± 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                   |
|---|--------------------|-----------------------------------|
| SAR measured  | 250 mW input power | 5.20 mW / g                       |
| SAR normalized  | normalized to 1W   | 20.8 mW / g                       |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>20.6 mW / g ± 16.5 % (k=2)</b> |



**Body TSL parameters**

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 53.3         | 1.52 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 53.5 ± 6 %   | 1.58 mho/m ± 6 % |
| Body TSL temperature during test | (21.2 ± 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 | 10.1 mW / g                       |
| SAR normalized  | normalized to 1W   | 40.4 mW / g                       |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | <b>39.6 mW / g ± 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                   |
|---|--------------------|-----------------------------------|
| SAR measured  | 250 mW input power | 5.30 mW / g                       |
| SAR normalized  | normalized to 1W   | 21.2 mW / g                       |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | <b>21.0 mW / g ± 16.5 % (k=2)</b> |





**Appendix**

**Antenna Parameters with Head TSL**

|                                      |                                 |
|--------------------------------------|---------------------------------|
| Impedance, transformed to feed point | 52.2 $\Omega$ + 6.0 $\mu\Omega$ |
| Return Loss                          | - 24.1 dB                       |

**Antenna Parameters with Body TSL**

|                                      |                                 |
|--------------------------------------|---------------------------------|
| Impedance, transformed to feed point | 46.8 $\Omega$ + 7.1 $\mu\Omega$ |
| Return Loss                          | - 21.9 dB                       |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.202 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 | August 21, 2009 |



**DASY5 Validation Report for Head TSL**

Date/Time: 24.11.2009 14:53:56

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d118**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U11 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.44$  mho/m;  $\epsilon_r = 39.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASYS, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

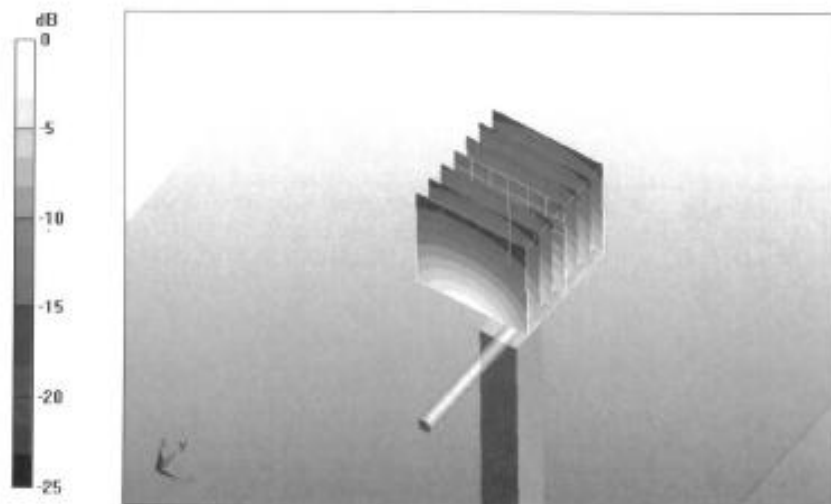
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 96.5 V/m; Power Drift = 0.028 dB

Peak SAR (extrapolated) = 18.2 W/kg

**SAR(1 g) = 9.97 mW/g; SAR(10 g) = 5.2 mW/g**

Maximum value of SAR (measured) = 12.5 mW/g



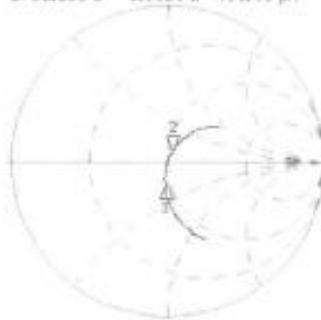
0 dB = 12.5mW/g



Impedance Measurement Plot for Head TSL

24 Nov 2009 10:19:15  
S11 1 U FS 2+52.186 a 5.9629 a 499.49  $\mu$ H 1.900.000.000 MHz

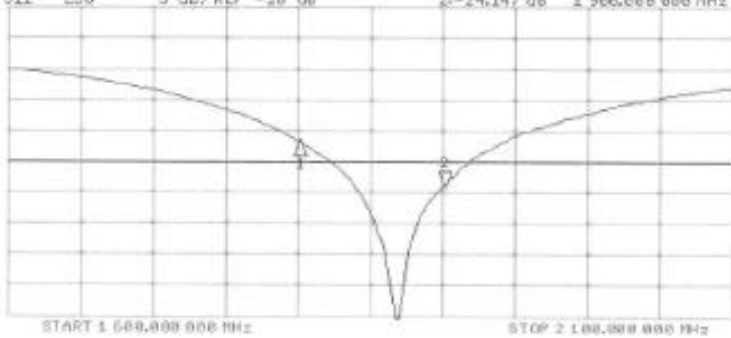
\*  
Del  
Cor  
Avg  
15



CH1 Markers  
1+46.165 a  
-33.738 a  
1.900000 GHz

CH2 S11 L08 5 dB/REF -20 dB 2-24.147 dB 1.900.000.000 MHz

Cor  
Avg  
16



CH2 Markers  
1+16.663 dB  
1.900000 GHz

DASY5 Validation Report for Body

Date/Time: 17.11.2009 14:25:42

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d118

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL U10 BB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.58$  mho/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASYS, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

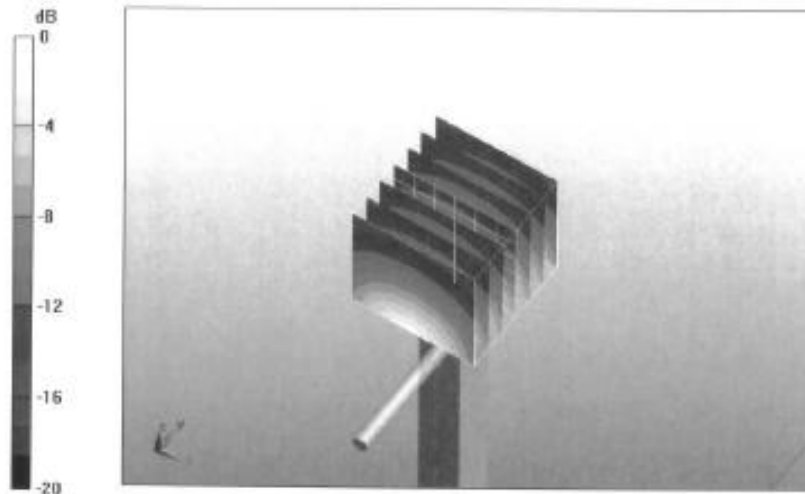
Pin250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.1 V/m; Power Drift = 0.010 dB

Peak SAR (extrapolated) = 17.5 W/kg

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.3 mW/g

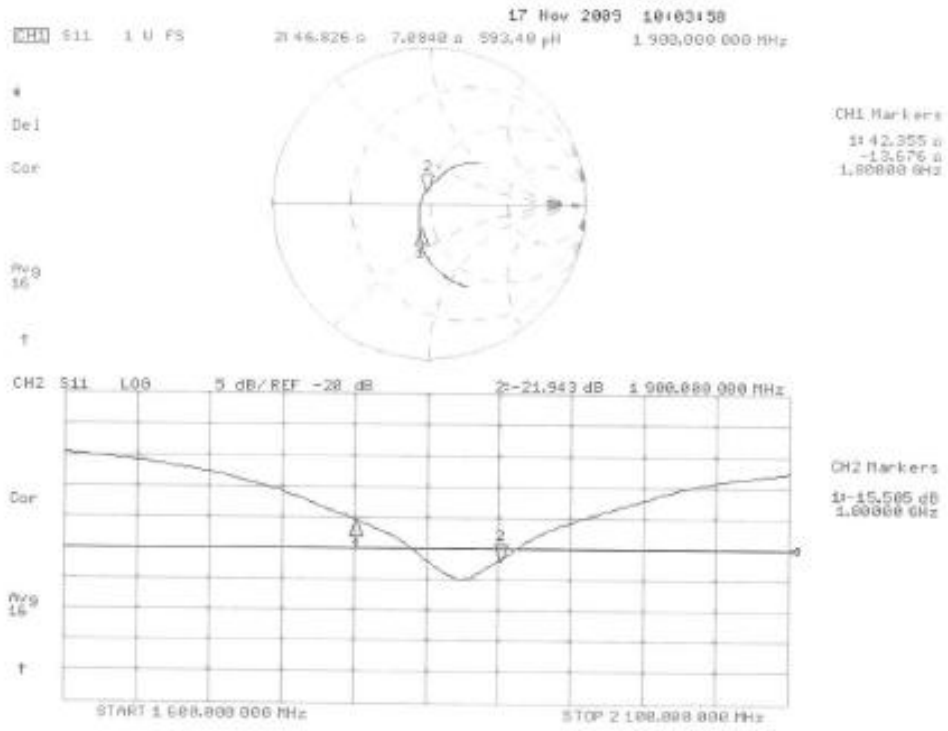
Maximum value of SAR (measured) = 12.8 mW/g



0 dB = 12.8mW/g



### Impedance Measurement Plot for Body TSL





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



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

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

Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: D2450V2-840\_Mar10

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 840
Calibration procedure(s) QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date: March 18, 2010

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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Includes rows for Power meter EPM-442A, Power sensor HP 8481A, Reference 20 dB Attenuator, Type-N mismatch combination, Reference Probe ES3DV3, DAE4, Secondary Standards, and their respective check dates.

Calibrated by: Jeton Kastrati, Laboratory Technician
Approved by: Katja Pokovic, Technical Manager

Handwritten signatures of Jeton Kastrati and Katja Pokovic.

Issued: March 22, 2010

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**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**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:**

- 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
- 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
- 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:**

- 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.



**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 V4.9 |             |
| Distance Dipole Center - TSL | 10 mm                     | with Spacer |
| 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 | 40.4 ± 6 %   | 1.80 mho/m ± 6 % |
| Head TSL temperature during test | (22.0 ± 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 | 13.1 mW / g                      |
| SAR normalized  | normalized to 1W   | 52.4 mW / g                      |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>52.7 mW /g ± 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                  |
|---|--------------------|----------------------------------|
| SAR measured  | 250 mW input power | 6.17 mW / g                      |
| SAR normalized  | normalized to 1W   | 24.7 mW / g                      |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | <b>24.8 mW /g ± 16.5 % (k=2)</b> |





**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 ± 0.2) °C | 54.4 ± 6 %   | 2.00 mho/m ± 6 % |
| Body TSL temperature during test | (21.4 ± 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 | 13.1 mW / g                |
| SAR normalized  | normalized to 1W   | 52.4 mW / g                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 52.1 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                            |
|---|--------------------|----------------------------|
| SAR measured  | 250 mW input power | 6.13 mW / g                |
| SAR normalized  | normalized to 1W   | 24.5 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 24.5 mW / g ± 16.5 % (k=2) |



**Appendix**

**Antenna Parameters with Head TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.7 $\Omega$ + 2.0 j $\Omega$ |
| Return Loss                          | - 27.9 dB                      |

**Antenna Parameters with Body TSL**

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.6 $\Omega$ + 3.5 j $\Omega$ |
| Return Loss                          | - 29.1 dB                      |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.163 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 | July 20, 2009 |

**DASY5 Validation Report for Head TSL**

Date/Time: 18.03.2010 10:23:42

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:840**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U11 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.8$  mho/m;  $\epsilon_r = 40.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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 157; SEMCAD X Version 14.0 Build 57

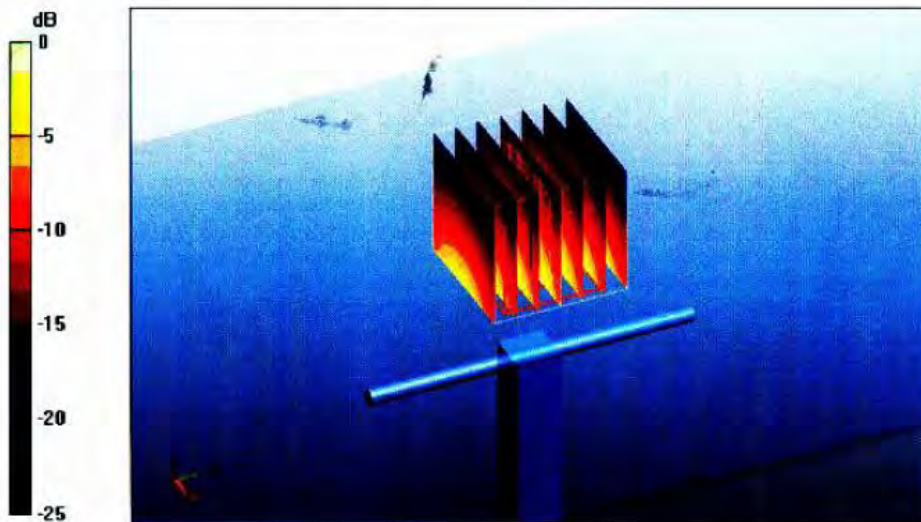
**Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 100 V/m; Power Drift = 0.058 dB

Peak SAR (extrapolated) = 26.5 W/kg

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

Maximum value of SAR (measured) = 16.7 mW/g



0 dB = 16.7mW/g

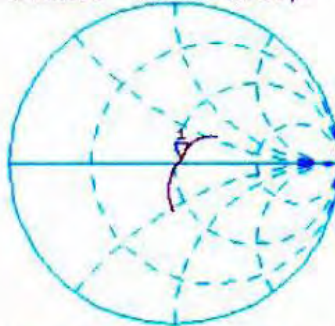




### Impedance Measurement Plot for Head TSL

18 Mar 2010 10:02:35  
[CH1] S11 1 U FS 1: 53.658 n 1.9570 n 127.13 pH 2 450.000 000 MHz

\*  
Del  
CA  
Avg  
16



CH2 S11 LOG 5 dB/REF -20 dB 1:-27.948 dB 2 450.000 000 MHz

CA  
Avg  
16



**DASY5 Validation Report for Body**

Date/Time: 18.03.2010 12:46:13

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:840**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U11 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 54.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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 157; SEMCAD X Version 14.0 Build 57

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

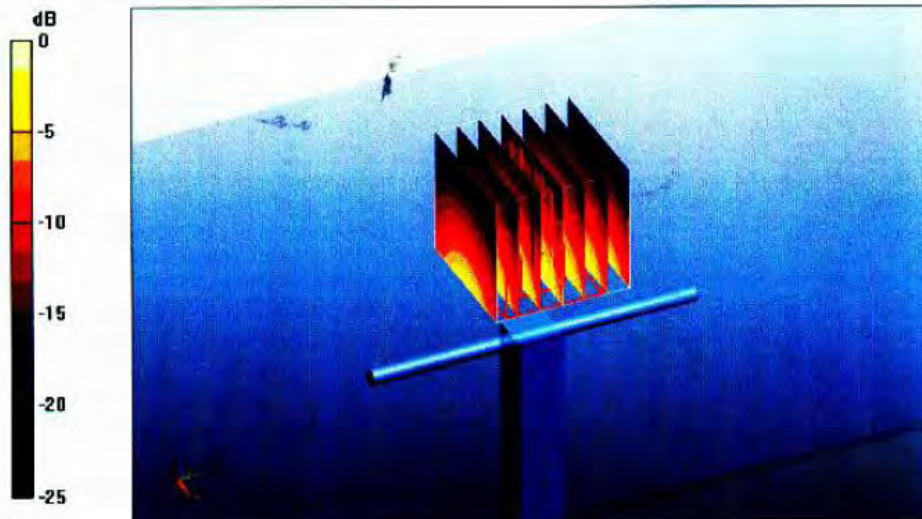
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.5 V/m; Power Drift = 0.014 dB

Peak SAR (extrapolated) = 27 W/kg

**SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.13 mW/g**

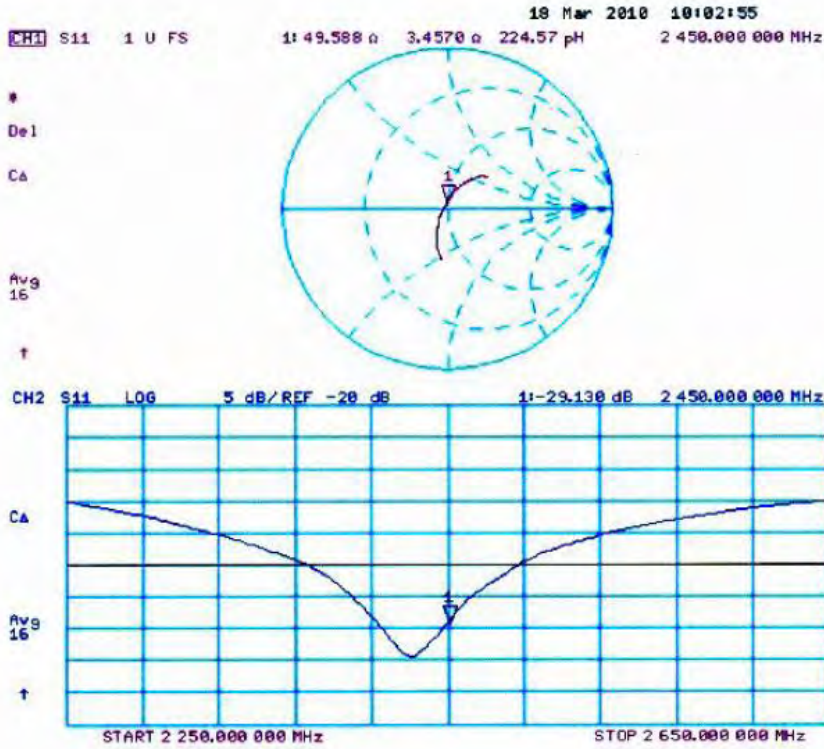
Maximum value of SAR (measured) = 17.3 mW/g



0 dB = 17.3mW/g



### Impedance Measurement Plot for Body TSL







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



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Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: DAE4-1210\_Nov10

CALIBRATION CERTIFICATE

Object DAE4 - SD 000 D04 BJ - SN: 1210  
Calibration procedure(s) QA CAL-06.v22  
Calibration procedure for the data acquisition electronics (DAE)  
Calibration date: November 18, 2010

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 (Certificate No.) | Scheduled Calibration  |
|-------------------------------|--------------------|----------------------------|------------------------|
| Keithley Multimeter Type 2001 | SN: 0810278        | 28-Sep-10 (No: 10376)      | Sep-11                 |
| Secondary Standards           | ID #               | Check Date (in house)      | Scheduled Check        |
| Calibrator Box V1.1           | SE UMS 006 AB 1004 | 07-Jun-10 (in house check) | In house check: Jun-11 |

Calibrated by: Name Andrea Guntli Function Technician Signature  
Approved by: Name Fin Bornholt Function R&D Director Signature

Issued: November 18, 2010

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



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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

### Glossary

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

### Methods Applied and Interpretation of Parameters

- **DC Voltage Measurement:** Calibration Factor assessed for use in DAS Y system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- **Connector angle:** The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
  - **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
  - **AD Converter Values with inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
  - **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
  - **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - **Input resistance:** Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
  - **Power consumption:** Typical value for information. Supply currents in various operating modes.



**DC Voltage Measurement**

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1µV , full range = -100...+300 mV  
Low Range: 1LSB = 61nV , full range = -1.....+3mV

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

| Calibration Factors | X                    | Y                    | Z                    |
|---------------------|----------------------|----------------------|----------------------|
| High Range          | 404.092 ± 0.1% (k=2) | 404.921 ± 0.1% (k=2) | 405.027 ± 0.1% (k=2) |
| Low Range           | 3.99932 ± 0.7% (k=2) | 3.98397 ± 0.7% (k=2) | 3.99953 ± 0.7% (k=2) |

**Connector Angle**

|   |              |
|---|--------------|
| Connector Angle to be used in DASY system | 68.0 ° ± 1 ° |
|---|--------------|

**Appendix**

**1. DC Voltage Linearity**

| High Range        | Reading ( $\mu\text{V}$ ) | Difference ( $\mu\text{V}$ ) | Error (%) |
|-------------------|---------------------------|------------------------------|-----------|
| Channel X + Input | 200001.5                  | -1.32                        | -0.00     |
| Channel X + Input | 20000.95                  | 0.95                         | 0.00      |
| Channel X - Input | -19998.31                 | 1.39                         | -0.01     |
| Channel Y + Input | 200000.7                  | -1.08                        | -0.00     |
| Channel Y + Input | 20000.03                  | 0.23                         | 0.00      |
| Channel Y - Input | -19999.95                 | -0.35                        | 0.00      |
| Channel Z + Input | 200010.3                  | -0.33                        | -0.00     |
| Channel Z + Input | 19997.81                  | -2.89                        | -0.01     |
| Channel Z - Input | -20001.02                 | -1.32                        | 0.01      |

| Low Range         | Reading ( $\mu\text{V}$ ) | Difference ( $\mu\text{V}$ ) | Error (%) |
|-------------------|---------------------------|------------------------------|-----------|
| Channel X + Input | 1999.6                    | -0.26                        | -0.01     |
| Channel X + Input | 199.98                    | -0.02                        | -0.01     |
| Channel X - Input | -200.01                   | -0.01                        | 0.00      |
| Channel Y + Input | 2000.6                    | 0.54                         | 0.03      |
| Channel Y + Input | 199.17                    | -1.03                        | -0.51     |
| Channel Y - Input | -200.54                   | -0.84                        | 0.42      |
| Channel Z + Input | 1999.9                    | -0.05                        | -0.00     |
| Channel Z + Input | 199.17                    | -0.93                        | -0.47     |
| Channel Z - Input | -201.25                   | -1.15                        | 0.58      |

**2. Common mode sensitivity**

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

|           | Common mode Input Voltage (mV) | High Range Average Reading ( $\mu\text{V}$ ) | Low Range Average Reading ( $\mu\text{V}$ ) |
|-----------|--------------------------------|--|---|
| Channel X | 200                            | -6.04  | -7.77                                       |
|           | -200                           | 8.97   | 7.28  |
| Channel Y | 200                            | -8.99  | -8.75                                       |
|           | -200                           | 7.60   | 7.00  |
| Channel Z | 200                            | 12.34  | 11.86                                       |
|           | -200                           | -14.01                                       | -14.18                                      |

**3. Channel separation**

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

|           | Input Voltage (mV) | Channel X ( $\mu\text{V}$ ) | Channel Y ( $\mu\text{V}$ ) | Channel Z ( $\mu\text{V}$ ) |
|-----------|--------------------|-----------------------------|-----------------------------|-----------------------------|
| Channel X | 200                | -                           | 3.24                        | 0.60                        |
| Channel Y | 200                | 1.78                        | -                           | 3.29                        |
| Channel Z | 200                | 1.92                        | -0.13                       | -                           |





**4. AD-Converter Values with inputs shorted**

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

|           | High Range (LSB) | Low Range (LSB) |
|-----------|------------------|-----------------|
| Channel X | 15945            | 17239           |
| Channel Y | 15959            | 16297           |
| Channel Z | 15874            | 17186           |

**5. Input Offset Measurement**

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

Input 10M $\Omega$

|           | Average ( $\mu$ V) | min. Offset ( $\mu$ V) | max. Offset ( $\mu$ V) | Std. Deviation ( $\mu$ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | 0.14               | -1.10                  | 1.73                   | 0.40                      |
| Channel Y | -0.64              | -1.49                  | 0.23                   | 0.33                      |
| Channel Z | -1.30              | -2.71                  | 0.16                   | 0.44                      |

**6. Input Offset Current**

Nominal Input circuitry offset current on all channels: <25fA

**7. Input Resistance** (Typical values for information)

|           | Zeroing (kOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 200            | 200              |
| Channel Y | 200            | 200              |
| Channel Z | 200            | 200              |

**8. Low Battery Alarm Voltage** (Typical values for information)

| Typical values | Alarm Level (VDC) |
|----------------|-------------------|
| Supply (+ Vcc) | +7.9              |
| Supply (- Vcc) | -7.6              |

**9. Power Consumption** (Typical values for information)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vcc) | +0.01             | +6            | +14               |
| Supply (- Vcc) | -0.01             | -8            | -9                |



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **ET3-1787\_May11**

## CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1787**

Calibration procedure(s) **QA CAL-01.v7, QA CAL-23.v4, QA CAL-25.v3  
Calibration procedure for dosimetric E-field probes**

Calibration date: **May 20, 2011**

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 (Certificate No.)        | Scheduled Calibration  |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B         | GB41293874      | 31-Mar-11 (No. 217-01372)         | Apr-12                 |
| Power sensor E4412A        | MY41498087      | 31-Mar-11 (No. 217-01372)         | Apr-12                 |
| Reference 3 dB Attenuator  | SN: S5054 (3c)  | 29-Mar-11 (No. 217-01369)         | Apr-12                 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 29-Mar-11 (No. 217-01367)         | Apr-12                 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 29-Mar-11 (No. 217-01370)         | Apr-12                 |
| Reference Probe ES3DV2     | SN: 3013        | 29-Dec-10 (No. ES3-3013_Dec10)    | Dec-11                 |
| DAE4                       | SN: 654         | 3-May-11 (No. DAE4-654_May11)     | May-12                 |
|                            |                 |                                   |                        |
| Secondary Standards        | ID              | Check Date (in house)             | Scheduled Check        |
| RF generator HP 8648C      | US3642U01700    | 4-Aug-99 (in house check Oct-09)  | In house check: Oct-11 |
| Network Analyzer HP 8753E  | US37390585      | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

|   | Name                  | Function              | Signature            |
|---|-----------------------|-----------------------|----------------------|
| Calibrated by:  | <b>Jeton Kastrati</b> | Laboratory Technician |                      |
| Approved by:  | <b>Katja Pokovic</b>  | Technical Manager     |                      |
|   |                       |                       | Issued: May 23, 2011 |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. |                       |                       |                      |





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### Glossary:

|                          |   |
|--------------------------|---|
| TSL                      | tissue simulating liquid  |
| NORM <sub>x,y,z</sub>    | sensitivity in free space   |
| ConvF                    | sensitivity in TSL / NORM <sub>x,y,z</sub>  |
| DCP                      | diode compression point   |
| CF                       | crest factor (1/duty_cycle) of the RF signal  |
| A, B, C                  | modulation dependent linearization parameters   |
| Polarization $\varphi$   | $\varphi$ rotation around probe axis  |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center),<br>i.e., $\vartheta = 0$ is normal to probe axis |

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

- 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
- 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

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>** are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- VR**: VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

# Probe ET3DV6

## SN:1787

Manufactured: May 28, 2003  
Calibrated: May 20, 2011

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)



## DASY/EASY - Parameters of Probe: ET3DV6 - SN:1787

### Basic Calibration Parameters

|   | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|---|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 1.56     | 1.79     | 2.09     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                                     | 99.8     | 100.5    | 95.9     |               |

### Modulation Calibration Parameters

| UID   | Communication System Name | PAR  |   | A<br>dB | B<br>dB | C<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-------|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 10000 | CW                        | 0.00 | X | 0.00    | 0.00    | 1.00    | 131.5    | $\pm 3.0 \%$              |
|       |                           |      | Y | 0.00    | 0.00    | 1.00    | 105.0    |                           |
|       |                           |      | Z | 0.00    | 0.00    | 1.00    | 114.9    |                           |

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%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the  $E^2$ -field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

## DASY/EASY - Parameters of Probe: ET3DV6 - SN:1787

### Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 750                  | 41.9                               | 0.89                            | 6.71    | 6.71    | 6.71    | 0.71  | 1.91       | ± 12.0 %    |
| 835                  | 41.5                               | 0.90                            | 6.39    | 6.39    | 6.39    | 0.68  | 1.94       | ± 12.0 %    |
| 900                  | 41.5                               | 0.97                            | 6.27    | 6.27    | 6.27    | 0.66  | 1.99       | ± 12.0 %    |
| 1450                 | 40.5                               | 1.20                            | 5.58    | 5.58    | 5.58    | 0.51  | 2.57       | ± 12.0 %    |
| 1750                 | 40.1                               | 1.37                            | 5.28    | 5.28    | 5.28    | 0.55  | 2.32       | ± 12.0 %    |
| 1900                 | 40.0                               | 1.40                            | 5.03    | 5.03    | 5.03    | 0.51  | 2.44       | ± 12.0 %    |
| 2000                 | 40.0                               | 1.40                            | 5.01    | 5.01    | 5.01    | 0.55  | 2.24       | ± 12.0 %    |
| 2450                 | 39.2                               | 1.80                            | 4.41    | 4.41    | 4.41    | 0.71  | 1.83       | ± 12.0 %    |

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



## DASY/EASY - Parameters of Probe: ET3DV6- SN:1787

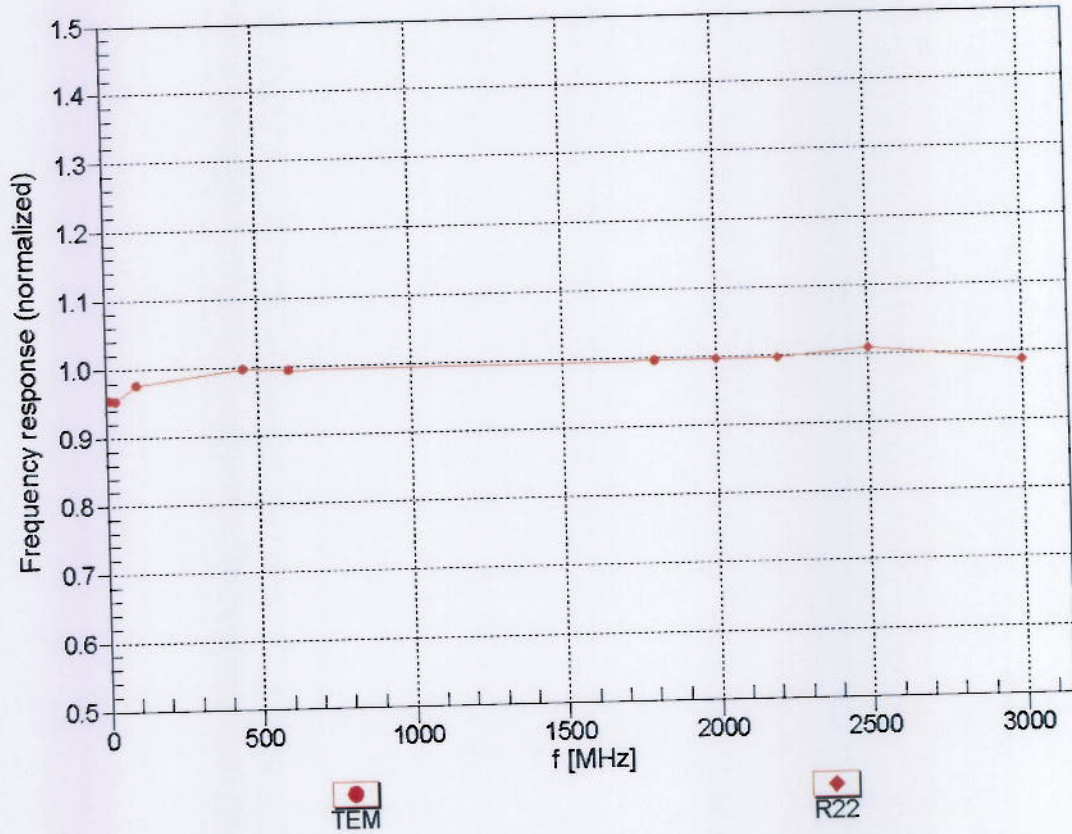
### Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 750                  | 55.5                               | 0.96                            | 6.35    | 6.35    | 6.35    | 0.76  | 1.83       | ± 12.0 %    |
| 835                  | 55.2                               | 0.97                            | 6.22    | 6.22    | 6.22    | 0.67  | 2.02       | ± 12.0 %    |
| 900                  | 55.0                               | 1.05                            | 6.17    | 6.17    | 6.17    | 0.72  | 1.87       | ± 12.0 %    |
| 1450                 | 54.0                               | 1.30                            | 5.35    | 5.35    | 5.35    | 0.57  | 2.35       | ± 12.0 %    |
| 1750                 | 53.4                               | 1.49                            | 4.74    | 4.74    | 4.74    | 0.56  | 2.86       | ± 12.0 %    |
| 1900                 | 53.3                               | 1.52                            | 4.48    | 4.48    | 4.48    | 0.56  | 2.76       | ± 12.0 %    |
| 2000                 | 53.3                               | 1.52                            | 4.50    | 4.50    | 4.50    | 0.60  | 2.47       | ± 12.0 %    |
| 2450                 | 52.7                               | 1.95                            | 3.96    | 3.96    | 3.96    | 0.99  | 1.18       | ± 12.0 %    |

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

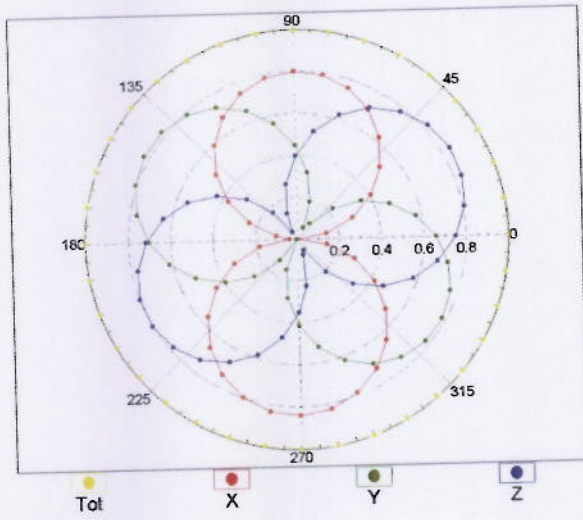
### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



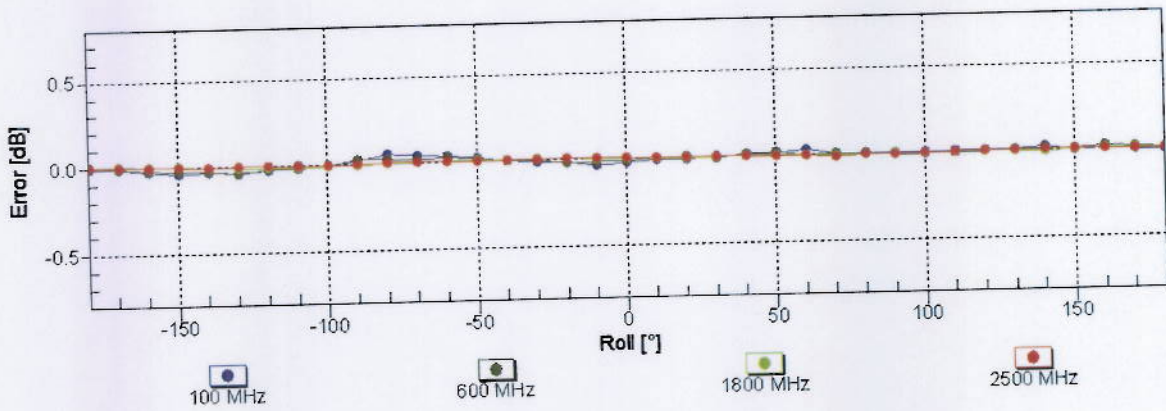
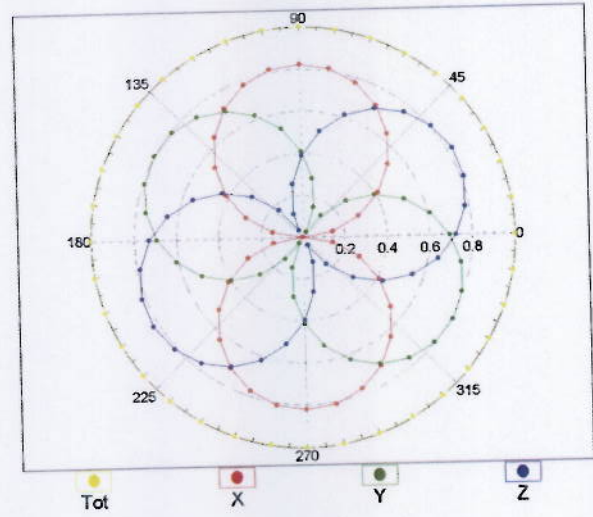
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

## Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz, TEM



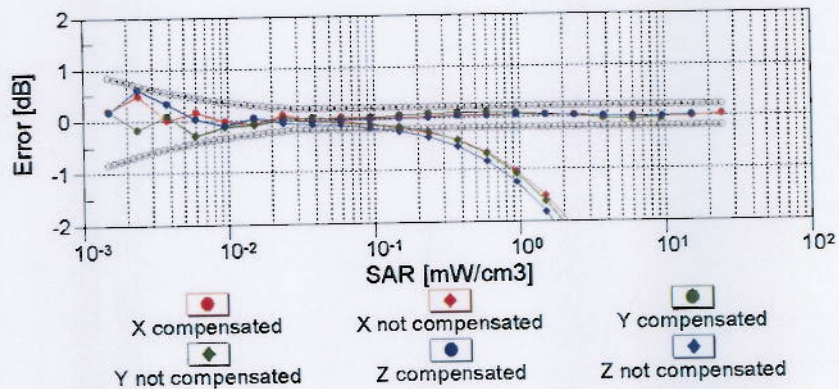
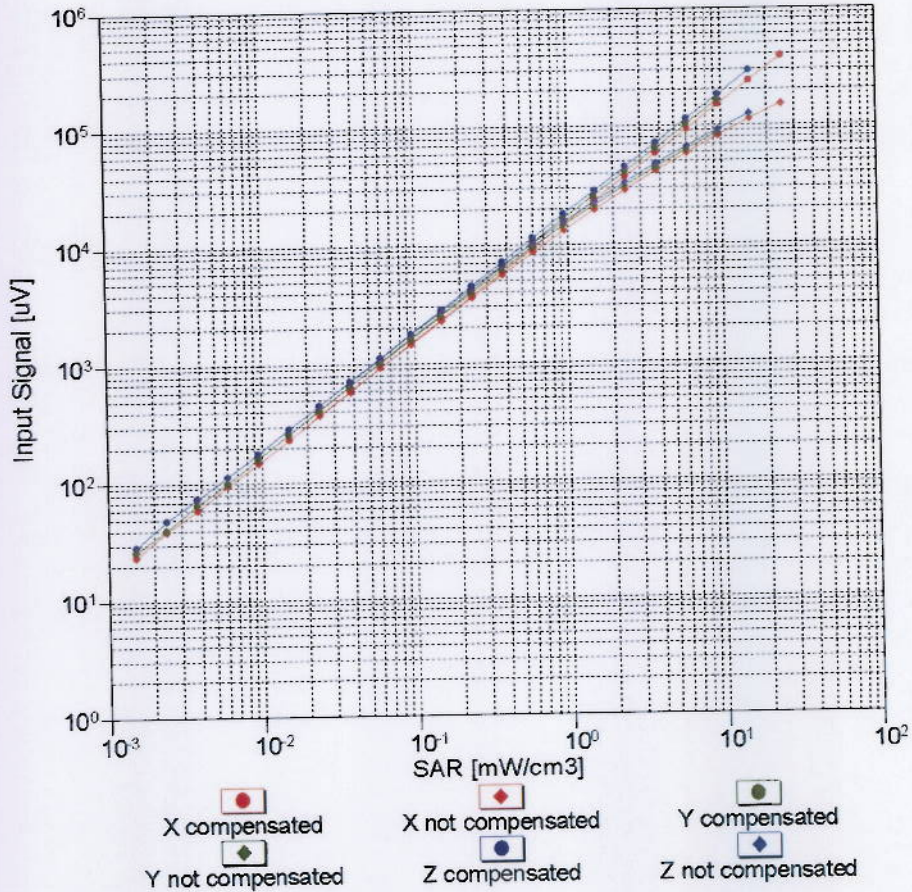
f=1800 MHz, R22



Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

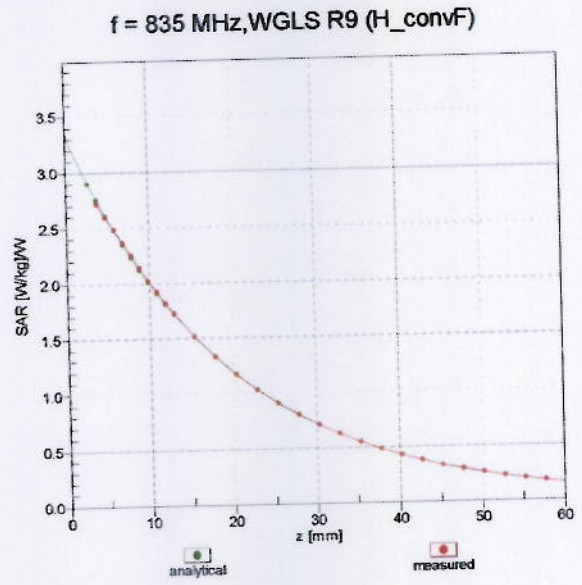
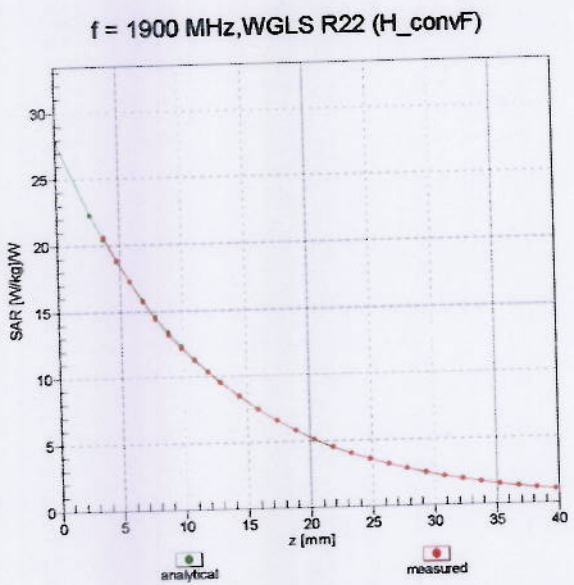


## Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f = 900 MHz)

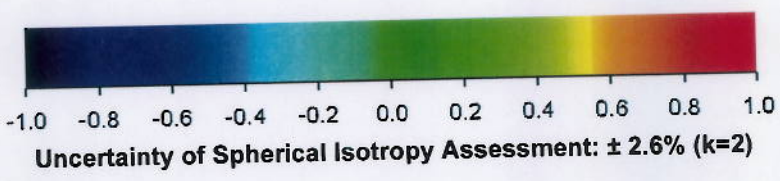
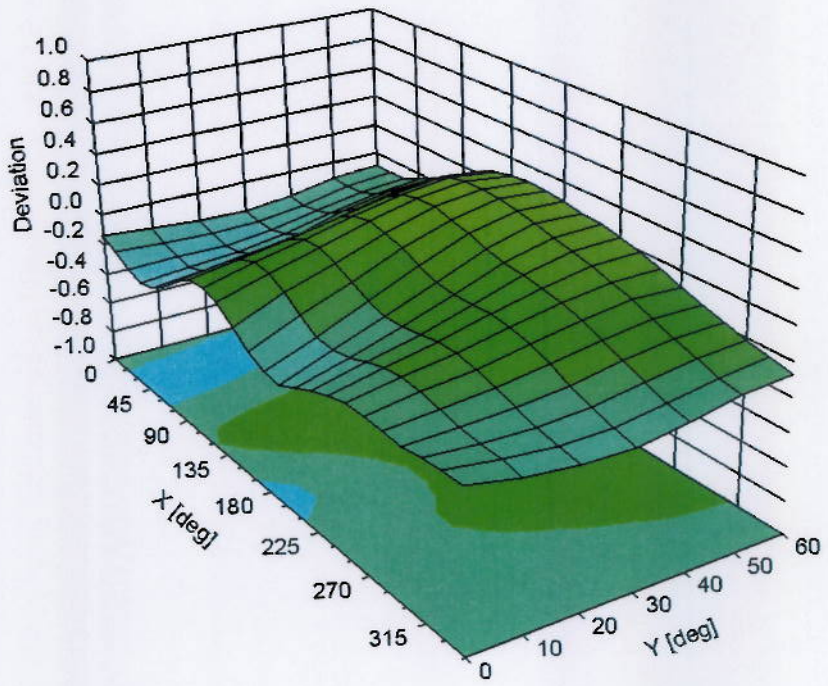


**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment



## Deviation from Isotropy in Liquid Error ( $\phi, \theta$ ), f = 900 MHz





**DASY/EASY - Parameters of Probe: ET3DV6 - SN:1787****Other Probe Parameters**

|   |                |
|---|----------------|
| Sensor Arrangement                            | Triangular     |
| Connector Angle (°)                           | Not applicable |
| Mechanical Surface Detection Mode             | enabled        |
| Optical Surface Detection Mode                | disabled       |
| Probe Overall Length                          | 337 mm         |
| Probe Body Diameter                           | 10 mm          |
| Tip Length                                    | 10 mm          |
| Tip Diameter                                  | 6.8 mm         |
| Probe Tip to Sensor X Calibration Point       | 2.7 mm         |
| Probe Tip to Sensor Y Calibration Point       | 2.7 mm         |
| Probe Tip to Sensor Z Calibration Point       | 2.7 mm         |
| Recommended Measurement Distance from Surface | 4 mm           |

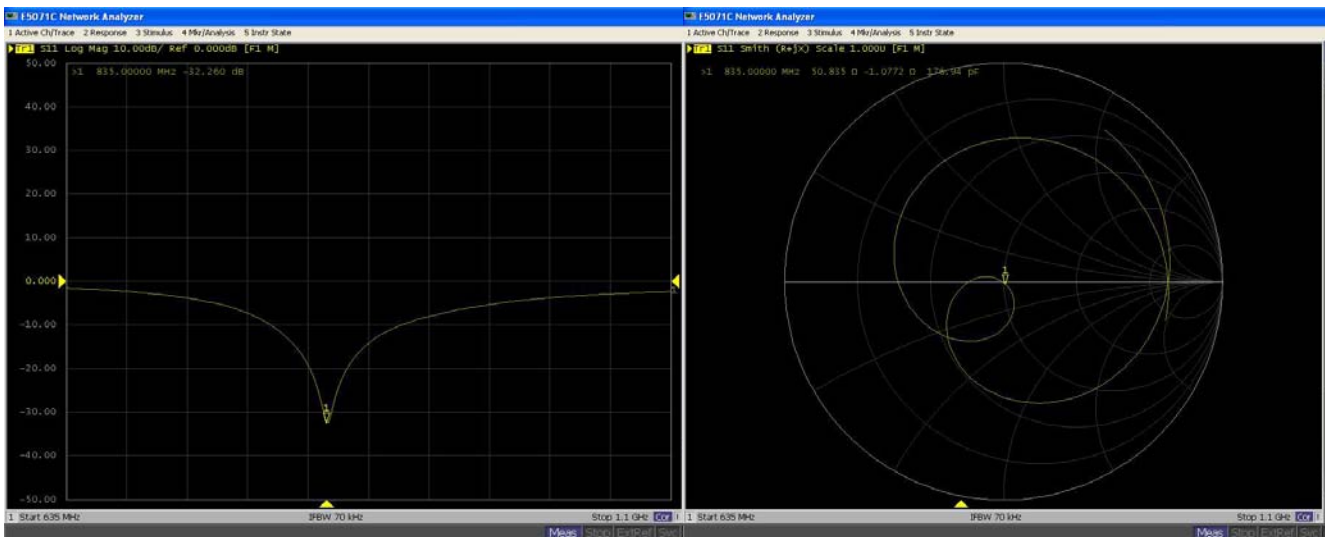
## Appendix C. DASY Calibration Certificate -Extended Dipole

### Calibrations

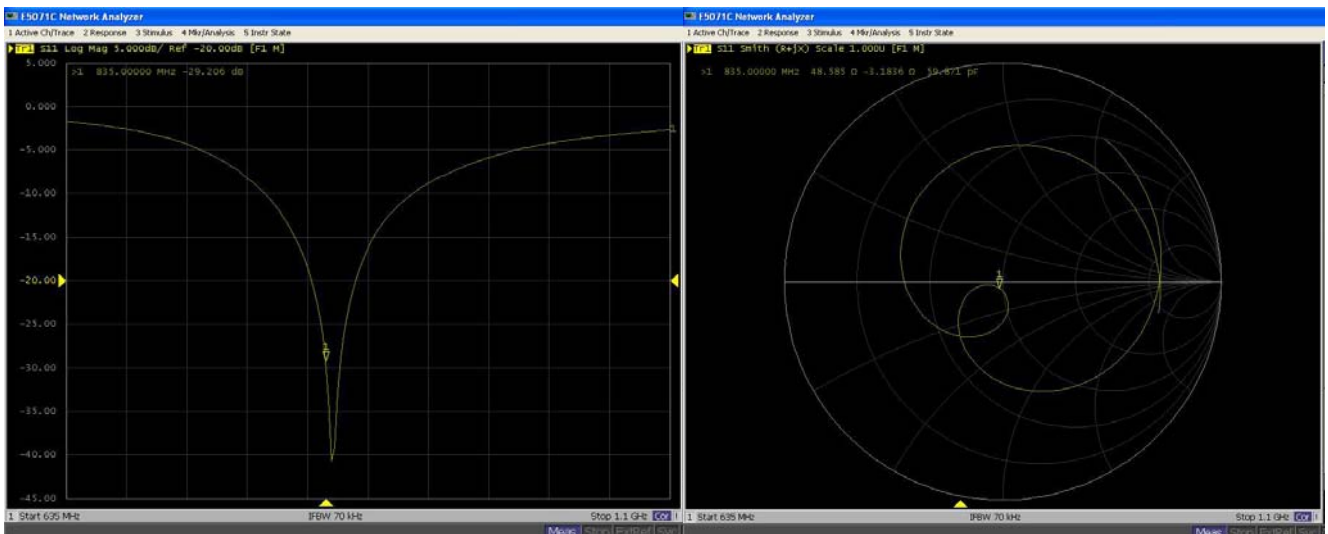
Referring to KDB 450824, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

<Dipole Verification Data> - D835V2, serial no. 4d091

835MHz - Head



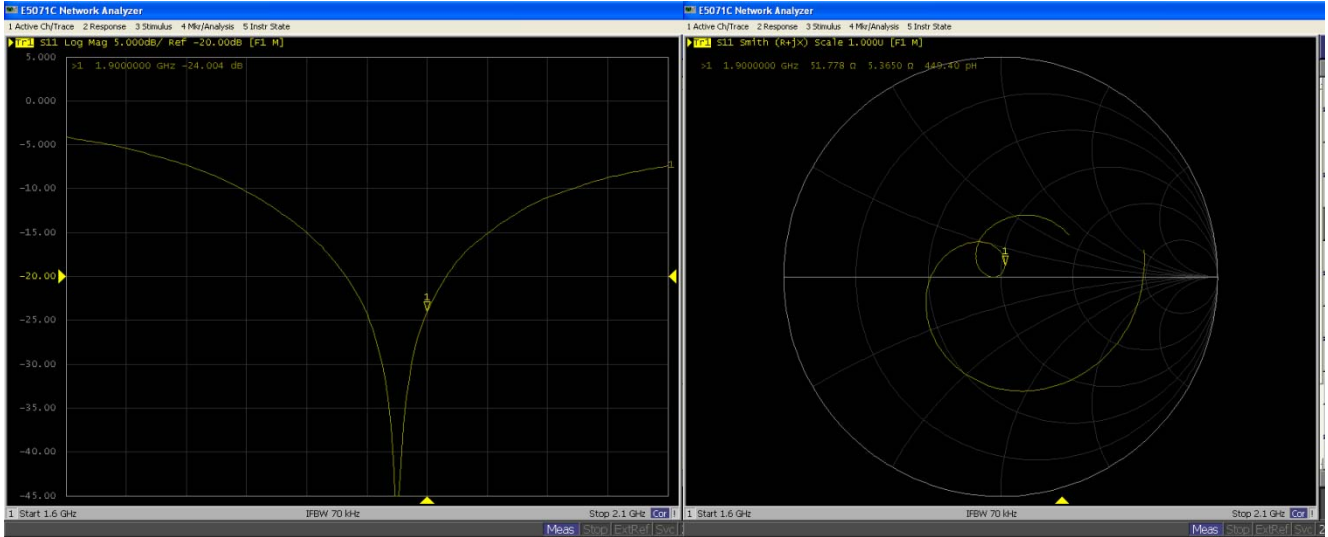
835MHz – Body



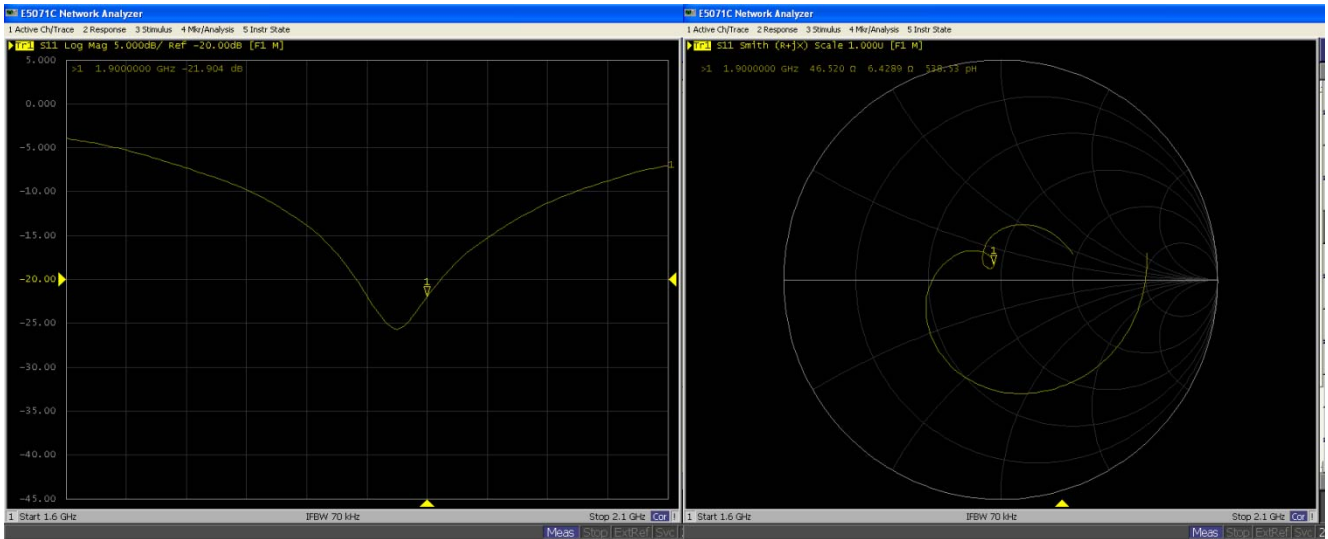


<Dipole Verification Data>- D1900V2, serial no. 5d118

1900MHz – Head



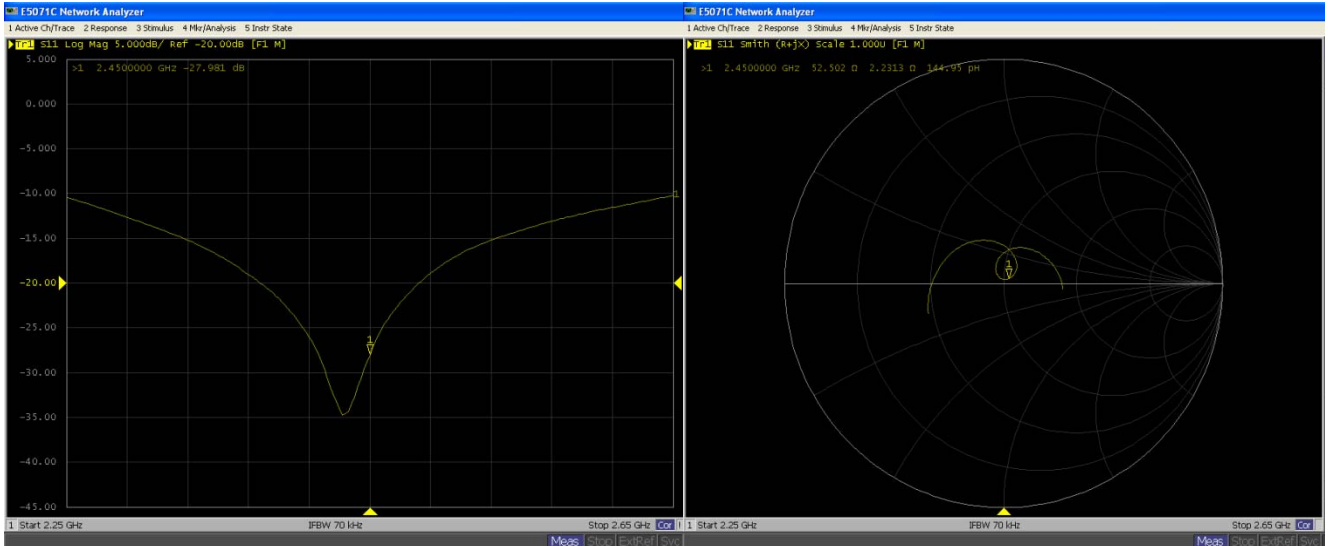
1900MHz - Body



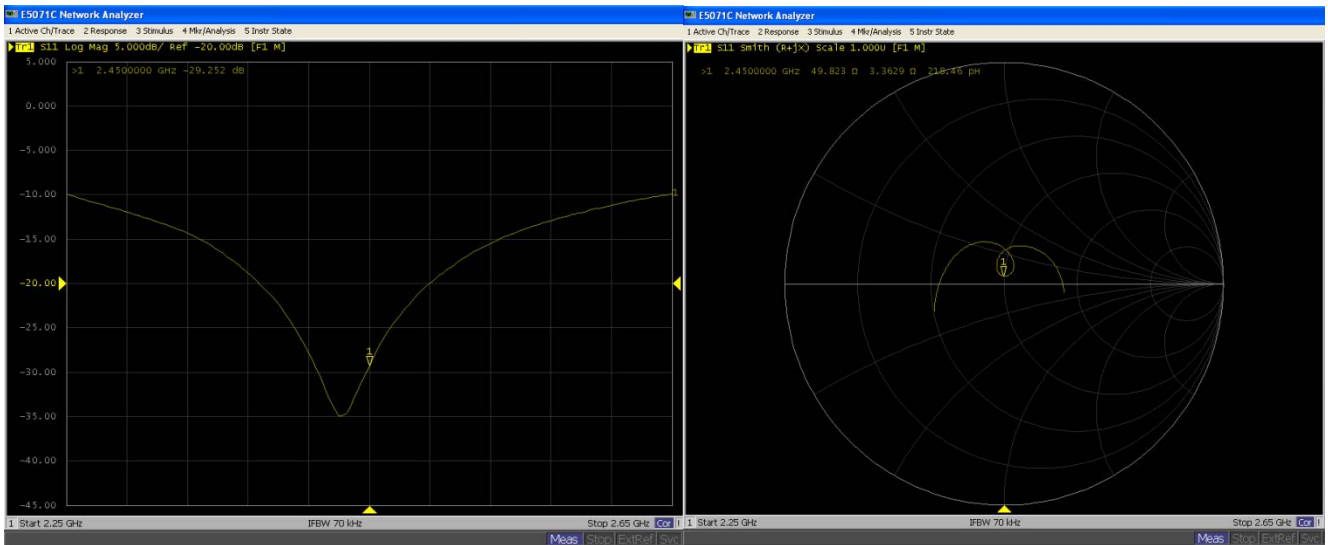


<Dipole Verification Data>- D2450V2, serial no. 840

2450MHz – Head



2450MHz - Body





<Justification of the extended calibration>

| D835V2 – serial no. 4d091 |                  |           |                      |             |                           |             |                  |           |                      |             |                           |             |
|---------------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
|                           | 835 Head         |           |                      |             |                           |             | 835 Body         |           |                      |             |                           |             |
| Date of Measurement       | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 11.23.2009                | -32.254          |           | 52.027               |             | -1.4316                   |             | -29.251          |           | 48.531               |             | -3.0742                   |             |
| 11.22.2010                | -32.26           | 0.006     | 50.835               | 1.192       | -1.0772                   | 0.3544      | -29.206          | 0.045     | 48.585               | 0.054       | -3.1836                   | 0.1094      |

| D1900V2 – serial no. 5d118 |                  |           |                      |             |                           |             |                  |           |                      |             |                           |             |
|----------------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
|                            | 1900 Head        |           |                      |             |                           |             | 1900 Body        |           |                      |             |                           |             |
| Date of Measurement        | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 11.24.2009                 | -24.147          |           | 52.186               |             | 5.9629                    |             | -21.943          |           | 46.826               |             | 7.084                     |             |
| 11.23.2010                 | -24.004          | 0.143     | 51.778               | 0.408       | 5.365                     | 0.5979      | -21.904          | 0.039     | 46.52                | 0.306       | 6.4289                    | 0.6551      |

| D2450V2 – serial no. 840 |                  |           |                      |             |                           |             |                  |           |                      |             |                           |             |
|--------------------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|------------------|-----------|----------------------|-------------|---------------------------|-------------|
|                          | 2450 Head        |           |                      |             |                           |             | 2450 Body        |           |                      |             |                           |             |
| Date of Measurement      | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) | Return-Loss (dB) | Delta (%) | Real Impedance (ohm) | Delta (ohm) | Imaginary Impedance (ohm) | Delta (ohm) |
| 03.18.2010               | -27.948          |           | 53.658               |             | 1.957                     |             | -29.13           |           | 49.588               |             | 3.457                     |             |
| 03.17.2011               | -27.981          | 0.033     | 52.502               | 1.156       | 2.2313                    | 0.2743      | -29.252          | 0.122     | 49.823               | 0.235       | 3.3629                    | 0.0941      |

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.