



Calibration Certificate of DASY

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: D835V2-499_Mar10

CALIBRATION CERTIFICATE

Object D835V2 - SN: 499

Calibration procedure(s) QA CAL-05.v7
Calibration procedure for dipole validation kits

Calibration date: March 22, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|--------------------------------|-----------------------|
| Power meter EPM-442A | GB37480704 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Power sensor HP 8481A | US37292783 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 31-Mar-09 (No. 217-01025) | Mar-10 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 31-Mar-09 (No. 217-01029) | Mar-10 |
| Reference Probe ES3DV3 | SN: 3205 | 26-Jun-09 (No. ES3-3205_Jun09) | Jun-10 |
| DAE4 | SN: 601 | 02-Mar-10 (No. DAE4-601_Mar10) | Mar-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---------------------------|------------------|-----------------------------------|------------------------|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-09) | In house check: Oct-10 |

| Calibrated by: | Name | Function | Signature |
|----------------|-------------|-----------------------|-----------|
| | Dimco Iliev | Laboratory Technician | |

| Approved by: | Name | Function | Signature |
|--------------|---------------|-------------------|-----------|
| | Katja Pokovic | Technical Manager | |

Issued: March 22, 2010

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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:

- 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.



Calibration Certificate of DASY

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 | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 835 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 41.5 | 0.90 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 42.9 ± 6 % | 0.91 mho/m ± 6 % |
| Head TSL temperature during test | (22.0 ± 0.2) °C | --- | --- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 2.43 mW / g |
| SAR normalized | normalized to 1W | 9.72 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 9.71 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 1.58 mW / g |
| SAR normalized | normalized to 1W | 6.32 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 6.31 mW / g ± 16.5 % (k=2) |



Calibration Certificate of DASY

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 | 55.3 ± 6 % | 1.01 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °C | --- | --- |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 2.53 mW / g |
| SAR normalized | normalized to 1W | 10.1 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 9.82 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | Condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 1.66 mW / g |
| SAR normalized | normalized to 1W | 6.64 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 6.49 mW / g ± 16.5 % (k=2) |



Calibration Certificate of DASY

Appendix

Antenna Parameters with Head TSL

| | |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 52.2 Ω - 3.2 $j\Omega$ |
| Return Loss | - 28.4 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 50.1 Ω - 5.9 $j\Omega$ |
| Return Loss | - 24.7 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.391 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 10, 2003 |



DASY5 Validation Report for Head TSL

Date/Time: 22.03.2010 10:17:58

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:499

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

Medium: HSL900

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.91 \text{ mho/m}$; $\epsilon_r = 42.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

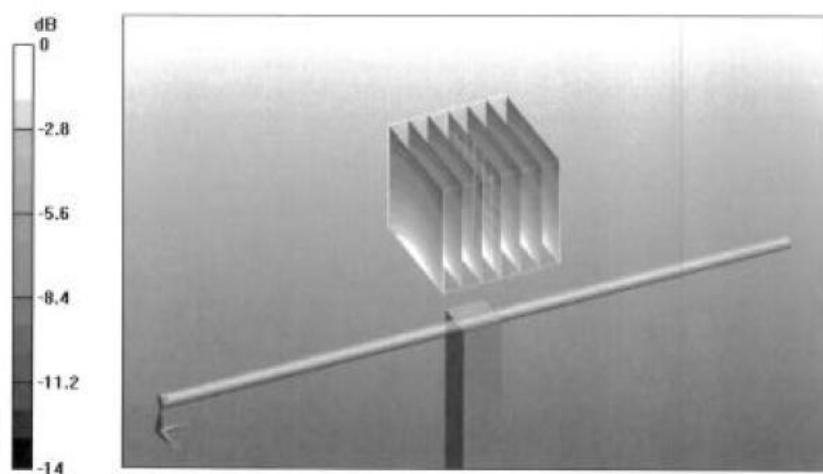
Pin=250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.5 V/m; Power Drift = 0.00691 dB

Peak SAR (extrapolated) = 3.63 W/kg

SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.58 mW/g

Maximum value of SAR (measured) = 2.84 mW/g

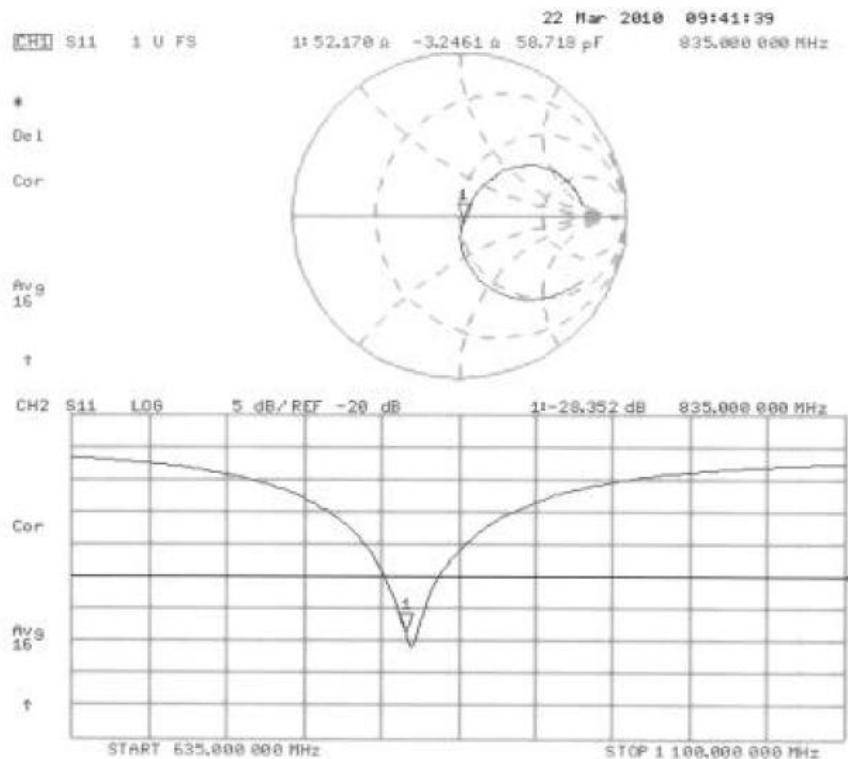


0 dB = 2.84mW/g



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Impedance Measurement Plot for Head TSL





DASY5 Validation Report for Body

Date/Time: 22.03.2010 14:07:53

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:499

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

Medium: MSL900

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ mho/m}$; $\epsilon_r = 55.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.97, 5.97, 5.97); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

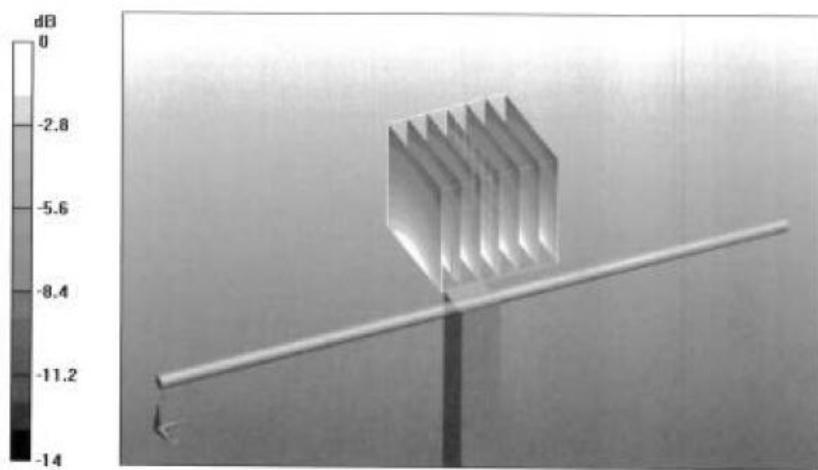
Pin250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.6 V/m; Power Drift = 0.011 dB

Peak SAR (extrapolated) = 3.73 W/kg

SAR(1 g) = 2.53 mW/g; SAR(10 g) = 1.66 mW/g

Maximum value of SAR (measured) = 2.94 mW/g

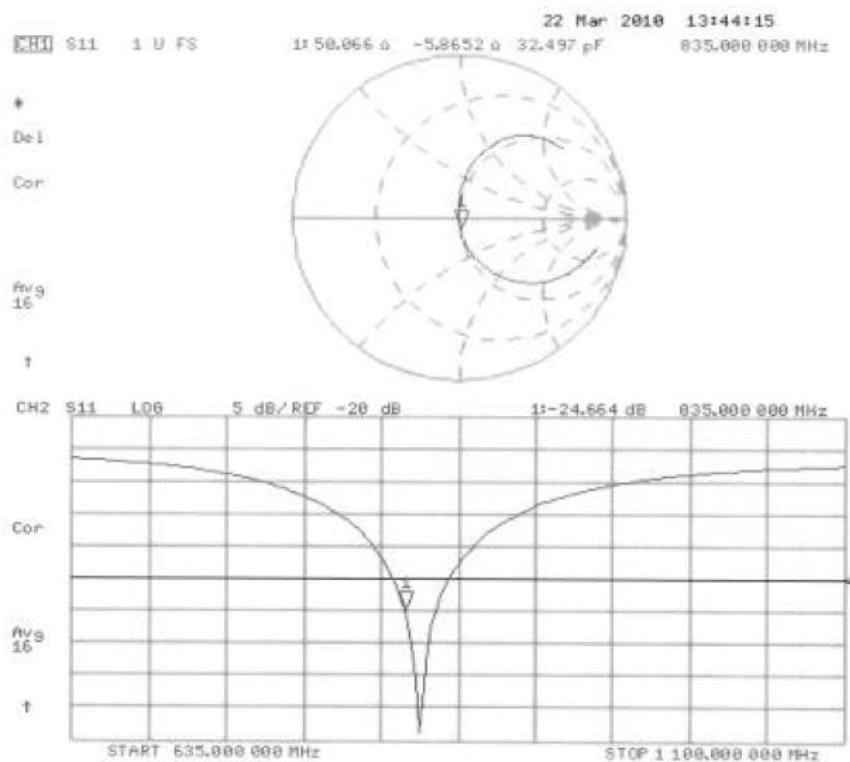


0 dB = 2.94mW/g



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Impedance Measurement Plot for Body TSL





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Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: D1900V2-5d041_Mar10

CALIBRATION CERTIFICATE

Object D1900V2 - SN: 5d041

Calibration procedure(s) QA CAL-05.v7
Calibration procedure for dipole validation kits

Calibration date: March 23, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|--------------------------------|-----------------------|
| Power meter EPM-442A | GB37480704 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Power sensor HP 8481A | US37292783 | 06-Oct-09 (No. 217-01086) | Oct-10 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 31-Mar-09 (No. 217-01025) | Mar-10 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 31-Mar-09 (No. 217-01029) | Mar-10 |
| Reference Probe ES3DV3 | SN: 3205 | 26-Jun-09 (No. ES3-3205_Jun09) | Jun-10 |
| DAE4 | SN: 601 | 02-Mar-10 (No. DAE4-601_Mar10) | Mar-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---------------------------|------------------|-----------------------------------|------------------------|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-09) | In house check: Oct-10 |

| Calibrated by: | Name | Function | Signature |
|----------------|-------------|-----------------------|-----------|
| | Dimco Iliev | Laboratory Technician | |

| Approved by: | Name | Function | Signature |
|--------------|---------------|-------------------|-----------|
| | Katja Pokovic | Technical Manager | |

Issued: March 23, 2010

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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:

- 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.



Calibration Certificate of DASY

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 | 41.1 ± 6 % | 1.45 mho/m ± 6 % |
| Head TSL temperature during test | (21.5 ± 0.2) °C | ---- | ---- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 10.1 mW / g |
| SAR normalized | normalized to 1W | 40.4 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 39.8 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 5.25 mW / g |
| SAR normalized | normalized to 1W | 21.0 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 20.9 mW / g ± 16.5 % (k=2) |



Calibration Certificate of DASY

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 | 54.9 ± 6 % | 1.58 mho/m ± 6 % |
| Body TSL temperature during test | (21.5 ± 0.2) °C | ---- | ---- |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 10.4 mW / g |
| SAR normalized | normalized to 1W | 41.6 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 40.0 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|----------------------------|
| SAR measured | 250 mW input power | 5.57 mW / g |
| SAR normalized | normalized to 1W | 22.3 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 22.1 mW / g ± 16.5 % (k=2) |



Calibration Certificate of DASY

Appendix

Antenna Parameters with Head TSL

| | |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 50.9 Ω + 5.9 $j\Omega$ |
| Return Loss | - 24.6 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 46.3 Ω + 5.7 $j\Omega$ |
| Return Loss | - 23.1 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 | July 04, 2003 |



DASY5 Validation Report for Head TSL

Date/Time: 23.03.2010 12:03:30

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041

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

Medium: HSL U11 BB

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.45 \text{ mho/m}$; $\epsilon_r = 41.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); 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

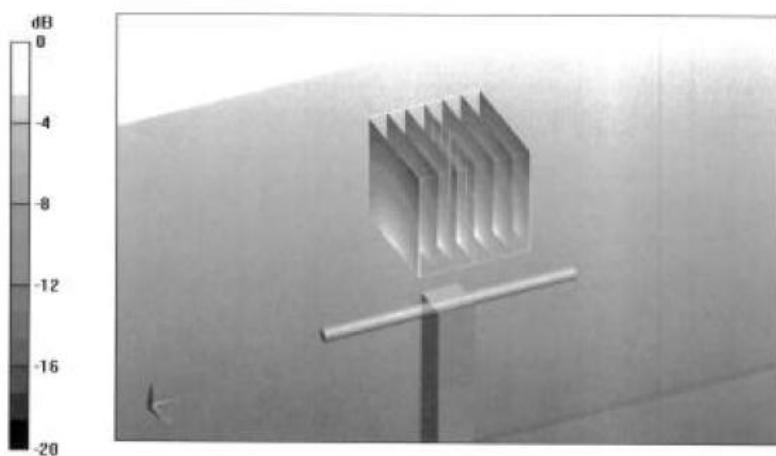
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.8 V/m; Power Drift = 0.040 dB

Peak SAR (extrapolated) = 18.4 W/kg

SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.25 mW/g

Maximum value of SAR (measured) = 12.7 mW/g

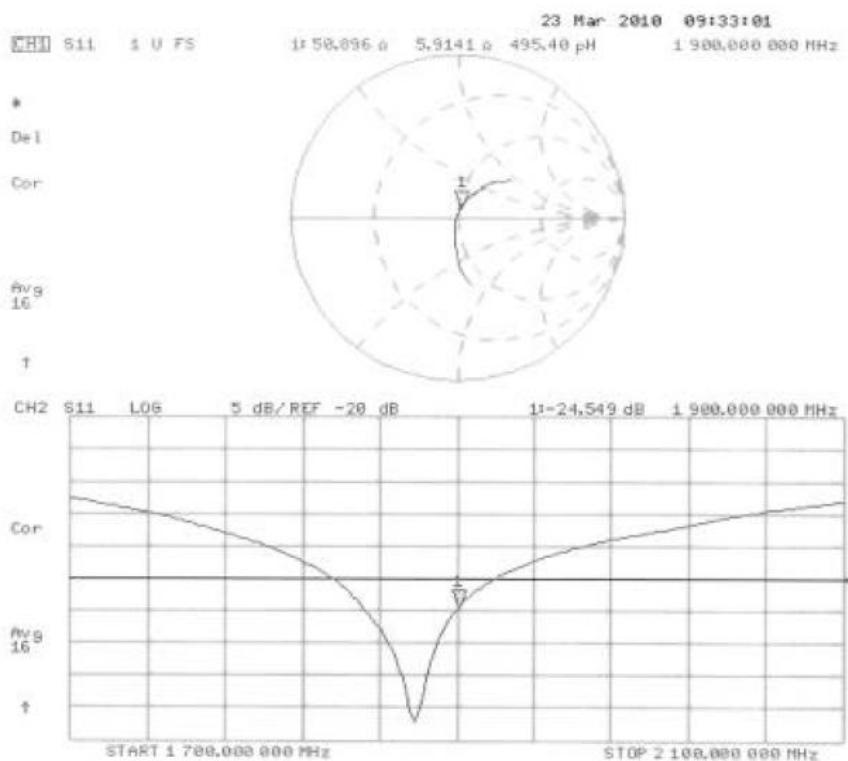


0 dB = 12.7mW/g



Calibration Certificate of DASY

Impedance Measurement Plot for Head TSL





DASY5 Validation Report for Body

Date/Time: 17.03.2010 12:43:32

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d041

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

Medium: MSL U11 BB

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.58 \text{ mho/m}$; $\epsilon_r = 55$; $\rho = 1000 \text{ kg/m}^3$

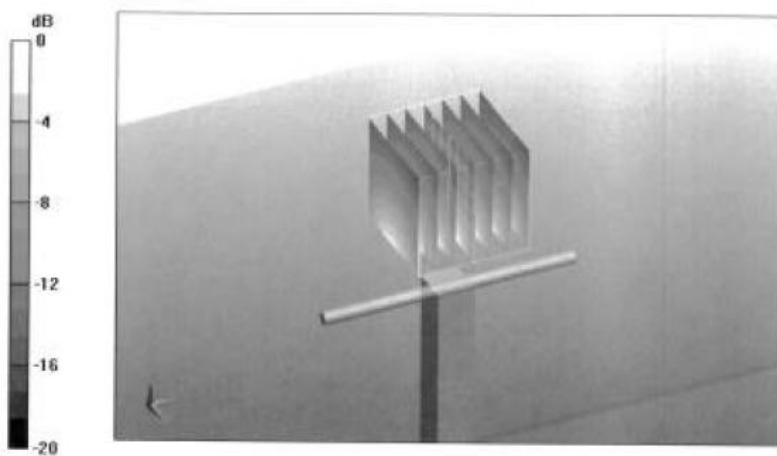
Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); 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 = 96.1 V/m; Power Drift = 0.017 dB
Peak SAR (extrapolated) = 17.5 W/kg
SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.57 mW/g
Maximum value of SAR (measured) = 13.1 mW/g

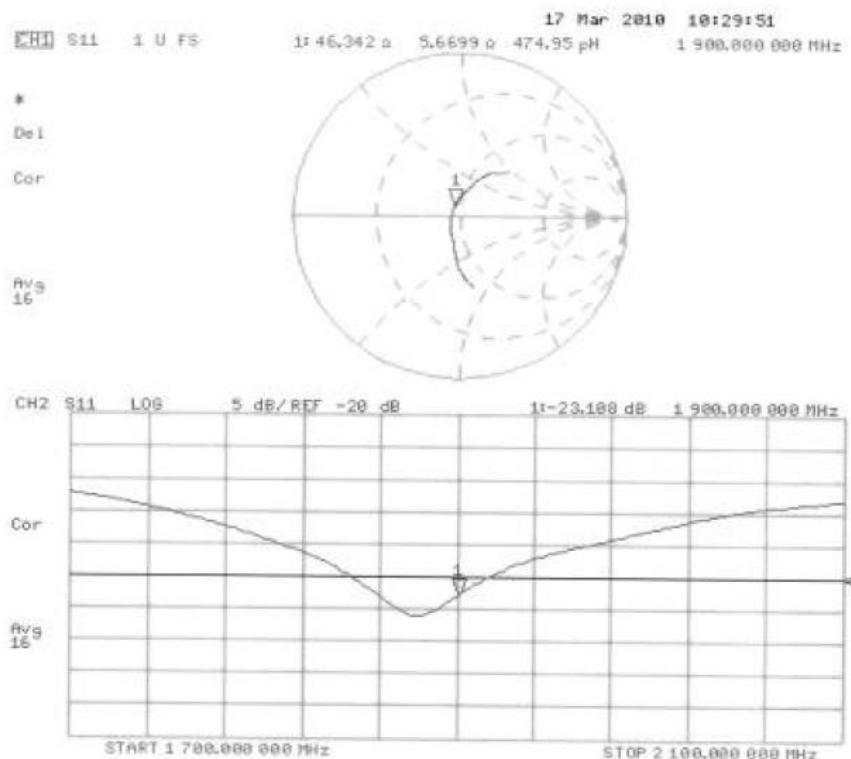


0 dB = 13.1mW/g



Calibration Certificate of DASY

Impedance Measurement Plot for Body TSL





Calibration Certificate of DASY

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Zeughausstrasse 43, 8004 Zurich, Switzerland



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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **DAE4-778_Sep09**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 778**

Calibration procedure(s) **QA CAL-06.v20**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **September 18, 2009**

Condition of the calibrated item **In Tolerance**

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 | 30-Sep-08 (No: 7670) | Sep-09 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Calibrator Box V1.1 | SE UMS 006 AB 1004 | 05-Jun-09 (in house check) | In house check: Jun-10 |

Calibrated by: Name **Dominique Steffen** Function **Technician** Signature

Approved by: Name **Fin Bomholt** Function **R&D Director** Signature

Issued: September 18, 2009

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Calibration Certificate of DASY

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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 DASY system to align probe sensor X to the robot coordinate system. |

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The 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:* 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.



Calibration Certificate of DASY

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = $6.1\mu V$, 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 | $404.759 \pm 0.1\% (k=2)$ | $403.533 \pm 0.1\% (k=2)$ | $405.087 \pm 0.1\% (k=2)$ |
| Low Range | $3.98990 \pm 0.7\% (k=2)$ | $3.96736 \pm 0.7\% (k=2)$ | $3.99650 \pm 0.7\% (k=2)$ |

Connector Angle

| | |
|---|---------------------------|
| Connector Angle to be used in DASY system | $308.5^\circ \pm 1^\circ$ |
|---|---------------------------|



Calibration Certificate of DASY

Appendix

1. DC Voltage Linearity

| High Range | | Reading (μ V) | Difference (μ V) | Error (%) |
|------------|---------|--------------------|-----------------------|-----------|
| Channel X | + Input | 199989.9 | -19.33 | -0.01 |
| Channel X | + Input | 19998.71 | -1.49 | -0.01 |
| Channel X | - Input | -19997.52 | 2.48 | -0.01 |
| Channel Y | + Input | 200005.5 | -2.55 | -0.00 |
| Channel Y | + Input | 19998.69 | -1.31 | -0.01 |
| Channel Y | - Input | -20000.77 | -1.07 | 0.01 |
| Channel Z | + Input | 199996.6 | -1.53 | -0.00 |
| Channel Z | + Input | 19995.31 | -4.89 | -0.02 |
| Channel Z | - Input | -20004.85 | 0.02 | 0.02 |

| Low Range | | Reading (μ V) | Difference (μ V) | Error (%) |
|-----------|---------|--------------------|-----------------------|-----------|
| Channel X | + Input | 1999.2 | -0.67 | -0.03 |
| Channel X | + Input | 198.75 | -1.25 | -0.62 |
| Channel X | - Input | -202.40 | -2.40 | 1.20 |
| Channel Y | + Input | 1999.9 | -0.34 | -0.02 |
| Channel Y | + Input | 198.02 | -2.08 | -1.04 |
| Channel Y | - Input | -202.77 | -2.77 | 1.38 |
| Channel Z | + Input | 1998.9 | -1.13 | -0.06 |
| Channel Z | + Input | 197.15 | -2.65 | -1.33 |
| Channel Z | - Input | -202.66 | -2.76 | 1.38 |

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 (μ V) | Low Range Average Reading (μ V) |
|-----------|-----------------------------------|--|---|
| Channel X | 200 | -11.65 | - |
| | -200 | 5.27 | 4.21 |
| Channel Y | 200 | -1.68 | -2.17 |
| | -200 | 0.94 | 0.50 |
| Channel Z | 200 | -10.40 | -10.34 |
| | -200 | 7.99 | 8.37 |

3. Channel separation

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

| | Input Voltage (mV) | Channel X (μ V) | Channel Y (μ V) | Channel Z (μ V) |
|-----------|--------------------|----------------------|----------------------|----------------------|
| Channel X | 200 | - | 3.78 | 0.43 |
| Channel Y | 200 | 2.72 | - | 3.55 |
| Channel Z | 200 | 1.91 | -1.15 | - |



Calibration Certificate of DASY

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 | 16047 | 16291 |
| Channel Y | 16164 | 15200 |
| Channel Z | 16419 | 16616 |

5. Input Offset Measurement

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

Input 10MΩ

| | Average (μ V) | min. Offset (μ V) | max. Offset (μ V) | Std. Deviation (μ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | -0.27 | -1.21 | 0.66 | 0.34 |
| Channel Y | -1.11 | -2.22 | 0.27 | 0.51 |
| Channel Z | -1.33 | -2.34 | -0.31 | 0.45 |

6. Input Offset Current

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

7. Input Resistance

| | Zeroing (MΩ) | Measuring (MΩ) |
|-----------|--------------|----------------|
| Channel X | 0.2000 | 203.5 |
| Channel Y | 0.2000 | 203.3 |
| Channel Z | 0.2000 | 203.9 |

8. Low Battery Alarm Voltage (verified during pre test)

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

9. Power Consumption (verified during pre test)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vcc) | +0.0 | +6 | +14 |
| Supply (- Vcc) | -0.01 | -8 | -9 |



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Accreditation No.: SCS 108

Client **Auden**

Certificate No: **DAE4-910_Sep09**

CALIBRATION CERTIFICATE

Object DAE4 - SD 000 D04 BK - SN: 910

Calibration procedure(s) QA CAL-06.v20
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: September 18, 2009

Condition of the calibrated item In Tolerance

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ 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 | 30-Sep-08 (No: 7670) | Sep-09 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Calibrator Box V1.1 | SE UMS 006 AB 1004 | 05-Jun-09 (in house check) | In house check: Jun-10 |

Calibrated by: Name Dominique Steffen Function Technician Signature

Approved by: Fin Bornholt R&D Director Signature

Issued: September 18, 2009

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Accreditation No.: SCS 108

Glossary

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

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The 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*: 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.



Calibration Certificate of DASY

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = $6.1\mu V$, 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 | $403.468 \pm 0.1\% (k=2)$ | $402.794 \pm 0.1\% (k=2)$ | $403.267 \pm 0.1\% (k=2)$ |
| Low Range | $3.98156 \pm 0.7\% (k=2)$ | $3.93790 \pm 0.7\% (k=2)$ | $3.95318 \pm 0.7\% (k=2)$ |

Connector Angle

| | |
|---|---------------------------|
| Connector Angle to be used in DASY system | $332.5^\circ \pm 1^\circ$ |
|---|---------------------------|



Calibration Certificate of DASY

Appendix

1. DC Voltage Linearity

| High Range | Reading (μ V) | Difference (μ V) | Error (%) |
|-------------------|--------------------|-----------------------|-----------|
| Channel X + Input | 200007.9 | 0.26 | 0.00 |
| Channel X + Input | 19999.78 | -0.42 | -0.00 |
| Channel X - Input | -20000.04 | -1.04 | 0.01 |
| Channel Y + Input | 199998.4 | 0.89 | 0.00 |
| Channel Y + Input | 19996.78 | -2.72 | -0.01 |
| Channel Y - Input | -20001.06 | -1.46 | 0.01 |
| Channel Z + Input | 199996.4 | -0.15 | -0.00 |
| Channel Z + Input | 19997.21 | -2.39 | -0.01 |
| Channel Z - Input | -20000.90 | 0.01 | 0.01 |

| Low Range | Reading (μ V) | Difference (μ V) | Error (%) |
|-------------------|--------------------|-----------------------|-----------|
| Channel X + Input | 2000.2 | 0.25 | 0.01 |
| Channel X + Input | 198.01 | -1.79 | -0.89 |
| Channel X - Input | -201.04 | -1.14 | 0.57 |
| Channel Y + Input | 2000.2 | -0.04 | -0.00 |
| Channel Y + Input | 198.23 | -1.77 | -0.88 |
| Channel Y - Input | -202.23 | -2.23 | 1.12 |
| Channel Z + Input | 1999.7 | -0.72 | -0.04 |
| Channel Z + Input | 197.54 | -2.46 | -1.23 |
| Channel Z - Input | -202.83 | -2.83 | 1.42 |

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 (μ V) | Low Range Average Reading (μ V) |
|-----------|-----------------------------------|--|---|
| Channel X | 200 | -14.99 | -16.70 |
| | -200 | 18.86 | 16.76 |
| Channel Y | 200 | 5.73 | 5.43 |
| | -200 | -7.07 | -7.23 |
| Channel Z | 200 | -11.68 | -11.63 |
| | -200 | 10.57 | 10.18 |

3. Channel separation

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

| | Input Voltage (mV) | Channel X (μ V) | Channel Y (μ V) | Channel Z (μ V) |
|-----------|--------------------|----------------------|----------------------|----------------------|
| Channel X | 200 | - | 2.48 | -1.62 |
| Channel Y | 200 | 2.03 | - | 5.13 |
| Channel Z | 200 | 2.11 | 0.30 | - |



Calibration Certificate of DASY

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 | 16170 | 16227 |
| Channel Y | 15395 | 15569 |
| Channel Z | 16720 | 16928 |

5. Input Offset Measurement

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

Input $10M\Omega$

| | Average (μV) | min. Offset (μV) | max. Offset (μV) | Std. Deviation (μV) |
|-----------|---------------------|-------------------------|-------------------------|----------------------------|
| Channel X | -0.86 | -2.19 | 0.75 | 0.58 |
| Channel Y | -0.88 | -2.32 | 0.63 | 0.57 |
| Channel Z | -1.64 | -2.82 | 0.09 | 0.57 |

6. Input Offset Current

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

7. Input Resistance

| | Zeroing (MOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 0.2000 | 198.8 |
| Channel Y | 0.1999 | 198.8 |
| Channel Z | 0.1999 | 199.9 |

8. Low Battery Alarm Voltage (verified during pre test)

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

9. Power Consumption (verified during pre test)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vcc) | +0.0 | +6 | +14 |
| Supply (- Vcc) | -0.01 | -8 | -9 |



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Client Sporton (Auden)

Certificate No: ET3-1787_May10

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1787

Calibration procedure(s) QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2
Calibration procedure for dosimetric E-field probes

Calibration date: May 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 |
|----------------------------|-----------------|--------------------------------|-----------------------|
| Power meter E4419B | GB41293874 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41495277 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41498087 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 30-Mar-10 (No. 217-01159) | Mar-11 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 30-Mar-10 (No. 217-01161) | Mar-11 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 30-Mar-10 (No. 217-01160) | Mar-11 |
| Reference Probe ES3DV2 | SN: 3013 | 30-Dec-09 (No. ES3-3013_Dec09) | Dec-10 |
| DAE4 | SN: 660 | 20-Apr-10 (No. DAE4-660_Apr10) | Apr-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---------------------------|--------------|-----------------------------------|------------------------|
| RF generator HP 8848C | 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-09) | In house check: Oct10 |

| Calibrated by: | Name | Function | Signature |
|----------------|----------------|-----------------------|-----------|
| | Jeton Kastrati | Laboratory Technician | |

| Approved by: | Name | Function | Signature |
|--------------|---------------|-------------------|-----------|
| | Katja Pokovic | Technical Manager | |

Issued: May 22, 2010

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Certificate No: ET3-1787_May10

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

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

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

Methods Applied and Interpretation of Parameters:

- $NORMx,y,z$: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORMx,y,z$ are only intermediate values, i.e., the uncertainties of $NORMx,y,z$ does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- $NORM(f)x,y,z = NORMx,y,z * frequency_response$ (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.
- $DCPx,y,z$: 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.
- $Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z$: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *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 $NORMx,y,z * ConvF$ 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 ± 50 MHz to ± 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.



ET3DV6 SN:1787

May 18, 2010

Probe ET3DV6

SN:1787

| | |
|------------------|--------------|
| Manufactured: | May 28, 2003 |
| Last calibrated: | May 26, 2009 |
| Recalibrated: | May 18, 2010 |

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



Calibration Certificate of DASY

ET3DV6 SN:1787

May 18, 2010

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

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|--------------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 1.60 | 1.79 | 2.10 | $\pm 10.1\%$ |
| DCP (mV) ^B | 92.4 | 95.5 | 91.0 | |

Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dBuV | C | VR mV | Unc ^E (k=2) |
|-------|---------------------------|------|-------------|----------------------|----------------------|----------------------|-------------------------|---------------------------|
| 10000 | CW | 0.00 | X Y Z | 0.00 0.00 0.00 | 0.00 0.00 0.00 | 1.00 1.00 1.00 | 300.0 300.0 300.0 | $\pm 1.5\%$ |

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%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the maximum deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



ET3DV6 SN:1787

May 18, 2010

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

Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] | Validity [MHz] ^c | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---------|-----------------------------|--------------|--------------|---------|---------|---------|-------|-----------------|
| 750 | ± 50 / ± 100 | 41.5 ± 5% | 0.90 ± 5% | 6.56 | 6.56 | 6.56 | 0.52 | 1.96 ± 11.0% |
| 835 | ± 50 / ± 100 | 41.9 ± 5% | 0.89 ± 5% | 6.21 | 6.21 | 6.21 | 0.42 | 2.23 ± 11.0% |
| 1750 | ± 50 / ± 100 | 40.1 ± 5% | 1.37 ± 5% | 5.36 | 5.36 | 5.36 | 0.49 | 1.18 ± 11.0% |
| 1900 | ± 50 / ± 100 | 40.0 ± 5% | 1.40 ± 5% | 5.09 | 5.09 | 5.09 | 0.66 | 2.20 ± 11.0% |
| 2450 | ± 50 / ± 100 | 39.2 ± 5% | 1.80 ± 5% | 4.50 | 4.50 | 4.50 | 0.99 | 1.63 ± 11.0% |

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.



ET3DV6 SN:1787

May 18, 2010

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

Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] | Validity [MHz] ^c | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---------|-----------------------------|--------------|--------------|---------|---------|---------|-------|-----------------|
| 750 | ± 50 / ± 100 | 55.5 ± 5% | 0.96 ± 5% | 6.22 | 6.22 | 6.22 | 0.48 | 2.20 ± 11.0% |
| 835 | ± 50 / ± 100 | 55.2 ± 5% | 0.97 ± 5% | 6.12 | 6.12 | 6.12 | 0.39 | 2.45 ± 11.0% |
| 1750 | ± 50 / ± 100 | 53.4 ± 5% | 1.49 ± 5% | 4.72 | 4.72 | 4.72 | 0.63 | 2.90 ± 11.0% |
| 1900 | ± 50 / ± 100 | 53.3 ± 5% | 1.52 ± 5% | 4.47 | 4.47 | 4.47 | 0.88 | 2.39 ± 11.0% |
| 2450 | ± 50 / ± 100 | 52.7 ± 5% | 1.95 ± 5% | 4.03 | 4.03 | 4.03 | 0.99 | 1.35 ± 11.0% |

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

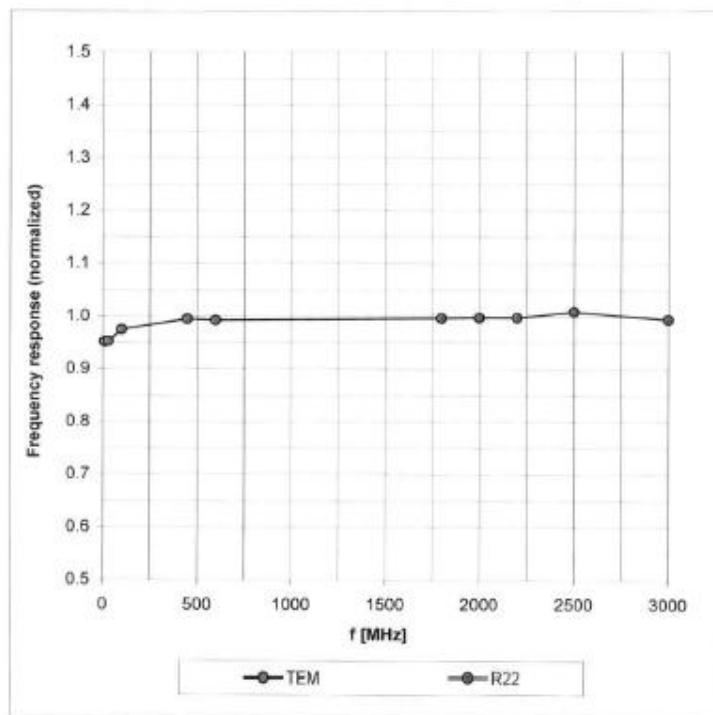


ET3DV6 SN:1787

May 18, 2010

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

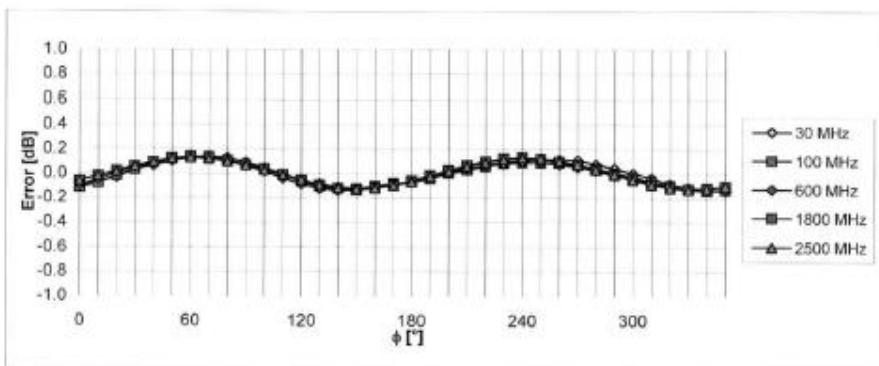
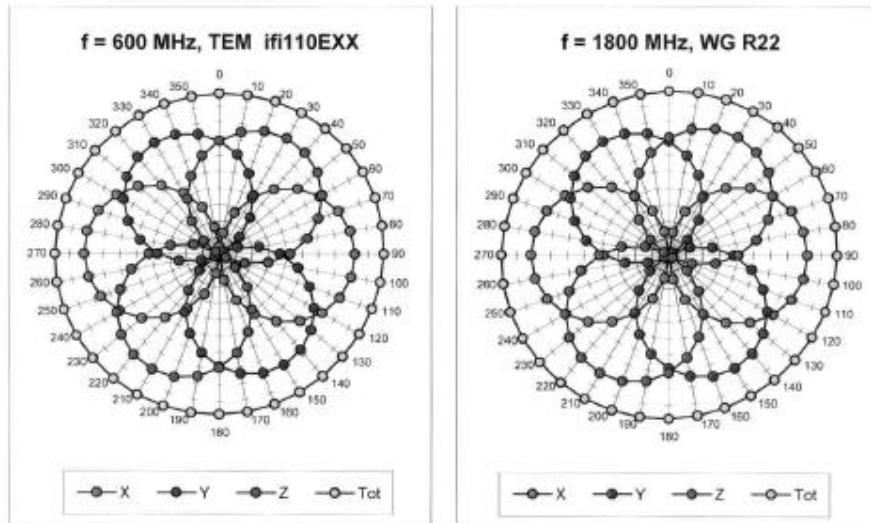


Calibration Certificate of DASY

ET3DV6 SN:1787

May 18, 2010

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



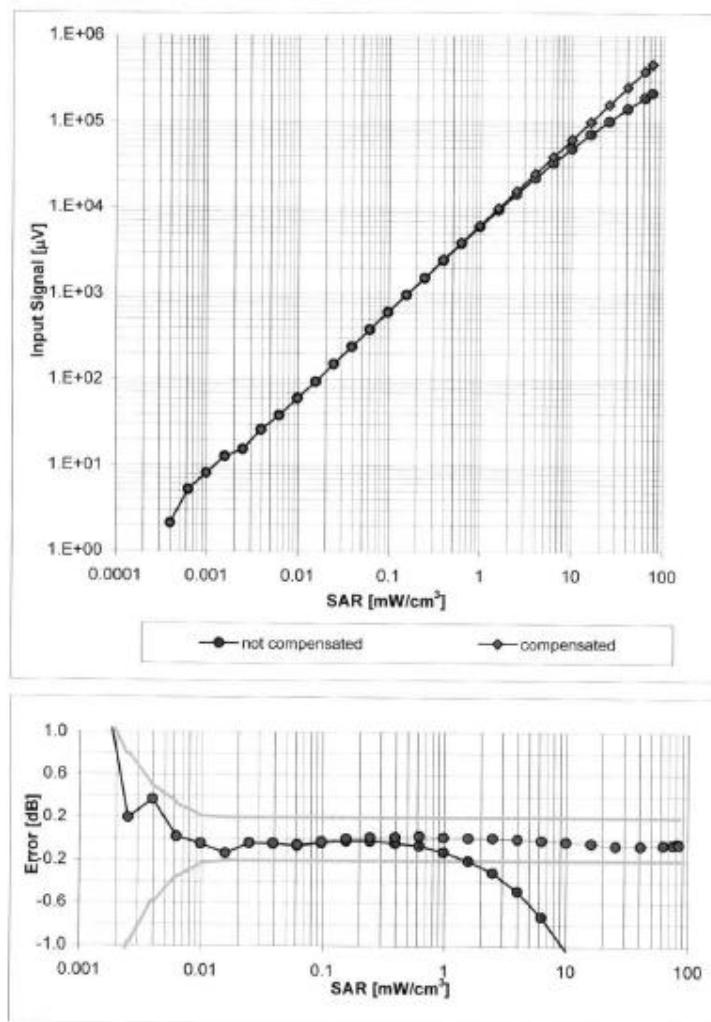
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)



ET3DV6 SN:1787

May 18, 2010

Dynamic Range f(SAR_{head})
(Waveguide R22, f = 1800 MHz)



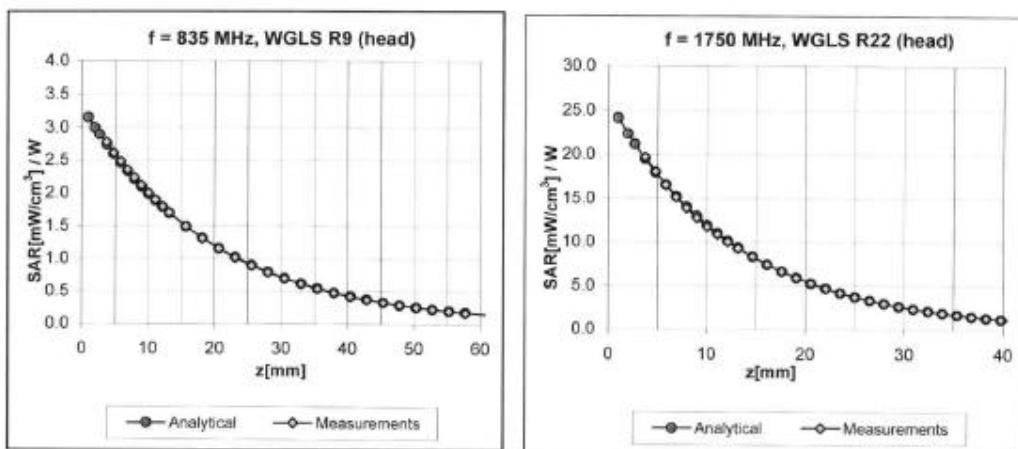
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)



ET3DV6 SN:1787

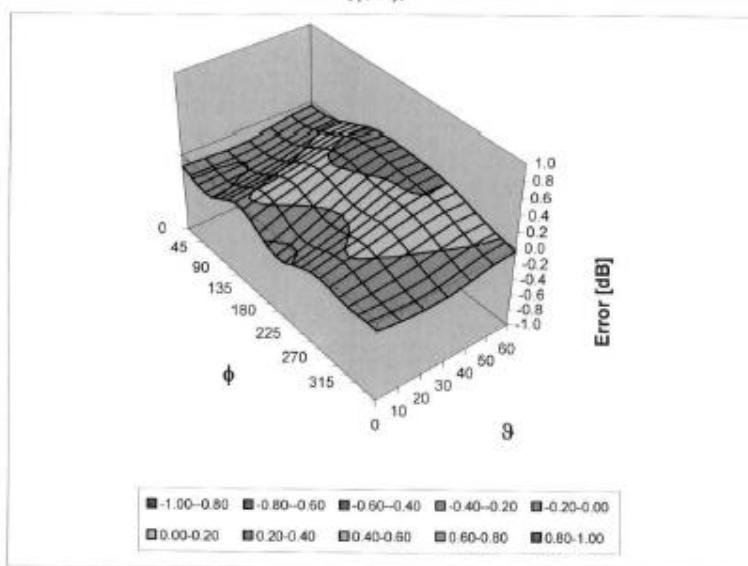
May 18, 2010

Conversion Factor Assessment



Deviation from Isotropy in HSL

Error (ϕ, θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



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May 18, 2010

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 |



Calibration Certificate of DASY

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



S Schweizerischer Kalibrierdienst
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Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: ET3-1788_Sep09

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1788

Calibration procedure(s) QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2
Calibration procedure for dosimetric E-field probes

Calibration date: September 23, 2009

Condition of the calibrated item In Tolerance

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 | 1-Apr-09 (No. 217-01030) | Apr-10 |
| Power sensor E4412A | MY41495277 | 1-Apr-09 (No. 217-01030) | Apr-10 |
| Power sensor E4412A | MY41498087 | 1-Apr-09 (No. 217-01030) | Apr-10 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 31-Mar-09 (No. 217-01026) | Mar-10 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 31-Mar-09 (No. 217-01028) | Mar-10 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 31-Mar-09 (No. 217-01027) | Mar-10 |
| Reference Probe ES3DV2 | SN: 3013 | 2-Jan-09 (No. ES3-3013_Jan09) | Jan-10 |
| DAE4 | SN: 660 | 9-Sep-08 (No. DAE4-660_Sep08) | Sep-09 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---------------------------|--------------|-----------------------------------|------------------------|
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-07) | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-08) | In house check: Oct-09 |

| Calibrated by: | Name | Function | Signature |
|----------------|-----------------|-----------------------|-----------|
| | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: September 23, 2009

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

Certificate No: ET3-1788_Sep09

Page 1 of 9



Calibration Certificate of DASY

Calibration Laboratory of
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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 |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis |

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z*: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). *NORMx,y,z* are only intermediate values, i.e., the uncertainties of *NORMx,y,z* does not effect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * 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*.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *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 *NORMx,y,z * 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 ± 50 MHz to ± 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.



ET3DV6 SN:1788

September 23, 2009

Probe ET3DV6

SN:1788

| | |
|------------------|--------------------|
| Manufactured: | May 28, 2003 |
| Last calibrated: | September 23, 2008 |
| Recalibrated: | September 23, 2009 |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ET3DV6 SN:1788

September 23, 2009

DASY - Parameters of Probe: ET3DV6 SN:1788

Sensitivity in Free Space^A

| | | |
|-------|---------------------|-------------------------------------|
| NormX | 1.79 ± 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ |
| NormY | 1.68 ± 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ |
| NormZ | 1.74 ± 10.1% | $\mu\text{V}/(\text{V}/\text{m})^2$ |

Diode Compression^B

| | |
|-------|--------------|
| DCP X | 95 mV |
| DCP Y | 98 mV |
| DCP Z | 91 mV |

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **835 MHz** **Typical SAR gradient: 5 % per mm**

| | | |
|---|---------------|---------------|
| Sensor Center to Phantom Surface Distance | 3.7 mm | 4.7 mm |
| SAR _{be} [%] Without Correction Algorithm | 10.4 | 6.8 |
| SAR _{be} [%] With Correction Algorithm | 0.8 | 0.5 |

TSL **1750 MHz** **Typical SAR gradient: 10 % per mm**

| | | |
|---|---------------|---------------|
| Sensor Center to Phantom Surface Distance | 3.7 mm | 4.7 mm |
| SAR _{be} [%] Without Correction Algorithm | 12.5 | 8.3 |
| SAR _{be} [%] With Correction Algorithm | 0.8 | 0.4 |

Sensor Offset

Probe Tip to Sensor Center **2.7 mm**

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%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

^B Numerical linearization parameter: uncertainty not required.

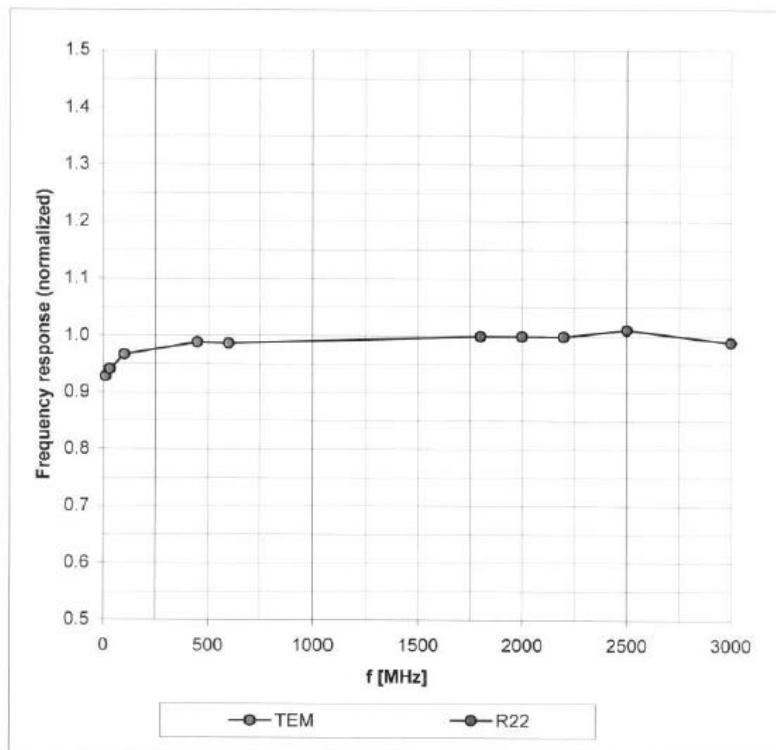


ET3DV6 SN:1788

September 23, 2009

Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)



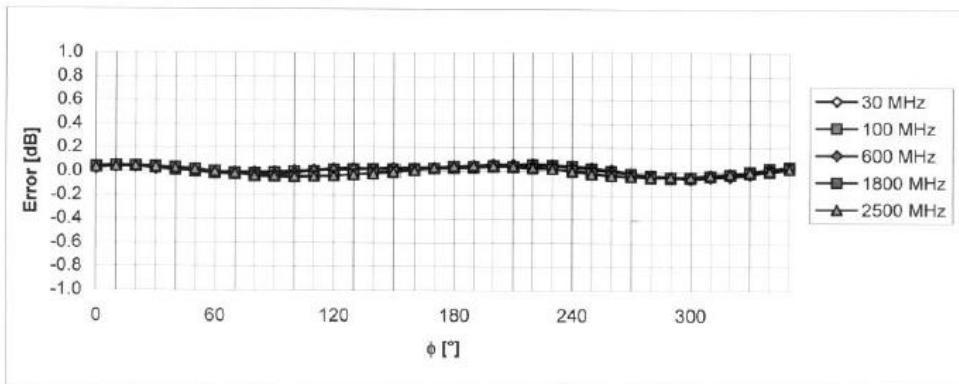
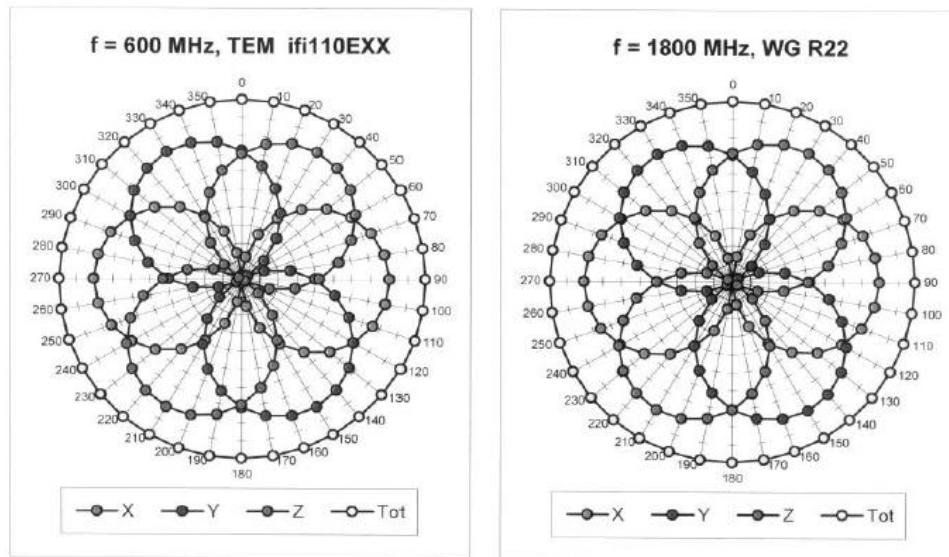
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)



ET3DV6 SN:1788

September 23, 2009

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



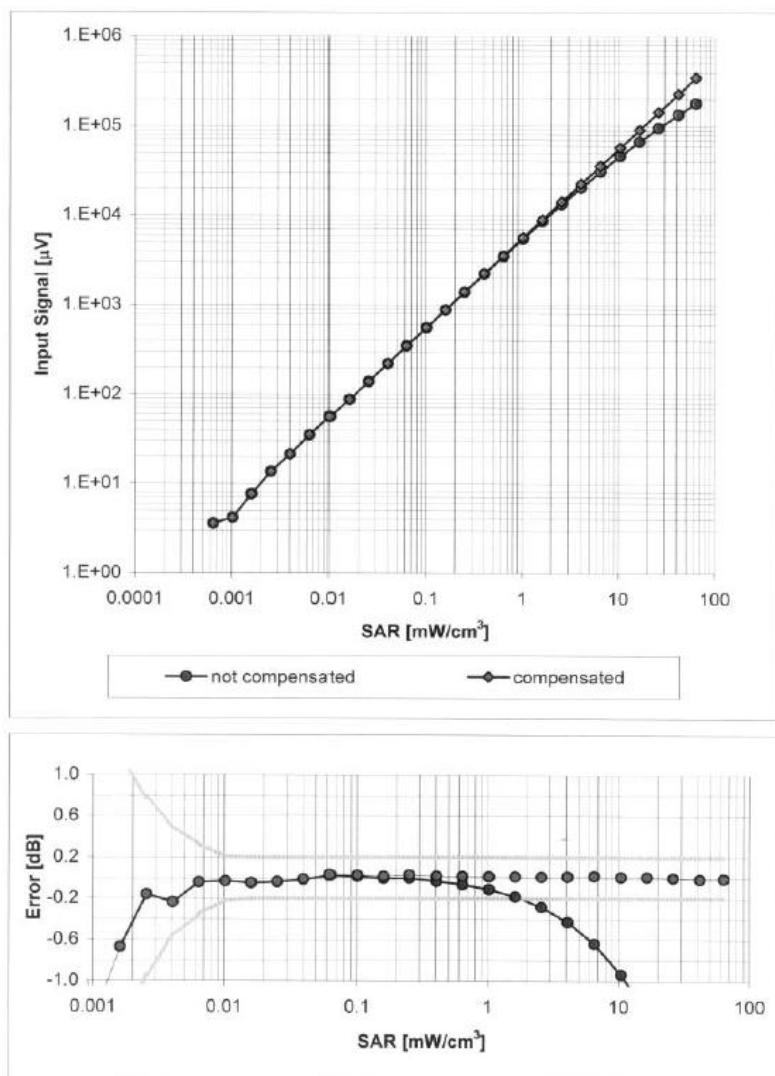
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)



ET3DV6 SN:1788

September 23, 2009

Dynamic Range f(SAR_{head})
(Waveguide R22, f = 1800 MHz)



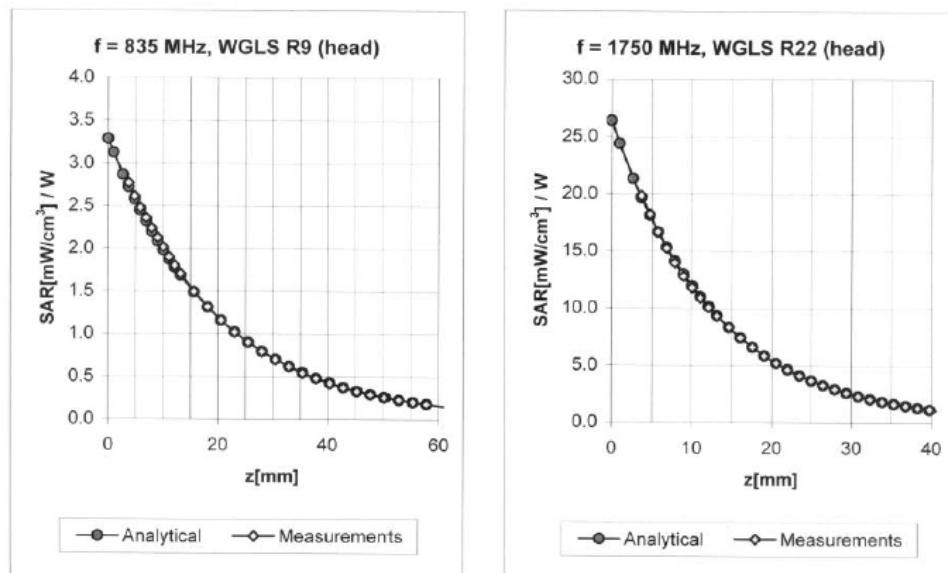
Uncertainty of Linearity Assessment: ± 0.6% (k=2)



ET3DV6 SN:1788

September 23, 2009

Conversion Factor Assessment



| f [MHz] | Validity [MHz] ^c | TSL | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty |
|---------|-----------------------------|------|----------------|----------------|-------|-------|-------|----------------------------|
| 835 | $\pm 50 / \pm 100$ | Head | $41.5 \pm 5\%$ | $0.90 \pm 5\%$ | 0.35 | 2.50 | 6.30 | $\pm 11.0\% \text{ (k=2)}$ |
| 1750 | $\pm 50 / \pm 100$ | Head | $40.1 \pm 5\%$ | $1.37 \pm 5\%$ | 0.50 | 2.63 | 5.40 | $\pm 11.0\% \text{ (k=2)}$ |
| 1900 | $\pm 50 / \pm 100$ | Head | $40.0 \pm 5\%$ | $1.40 \pm 5\%$ | 0.68 | 2.24 | 5.11 | $\pm 11.0\% \text{ (k=2)}$ |
| 2450 | $\pm 50 / \pm 100$ | Head | $39.2 \pm 5\%$ | $1.80 \pm 5\%$ | 0.99 | 1.77 | 4.48 | $\pm 11.0\% \text{ (k=2)}$ |

| | | | | | | | | |
|------|--------------------|------|----------------|----------------|------|------|------|----------------------------|
| 835 | $\pm 50 / \pm 100$ | Body | $55.2 \pm 5\%$ | $0.97 \pm 5\%$ | 0.33 | 2.65 | 6.08 | $\pm 11.0\% \text{ (k=2)}$ |
| 1750 | $\pm 50 / \pm 100$ | Body | $53.4 \pm 5\%$ | $1.49 \pm 5\%$ | 0.58 | 3.48 | 4.77 | $\pm 11.0\% \text{ (k=2)}$ |
| 1900 | $\pm 50 / \pm 100$ | Body | $53.3 \pm 5\%$ | $1.52 \pm 5\%$ | 0.75 | 2.85 | 4.52 | $\pm 11.0\% \text{ (k=2)}$ |
| 2450 | $\pm 50 / \pm 100$ | Body | $52.7 \pm 5\%$ | $1.95 \pm 5\%$ | 0.99 | 1.54 | 4.19 | $\pm 11.0\% \text{ (k=2)}$ |

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

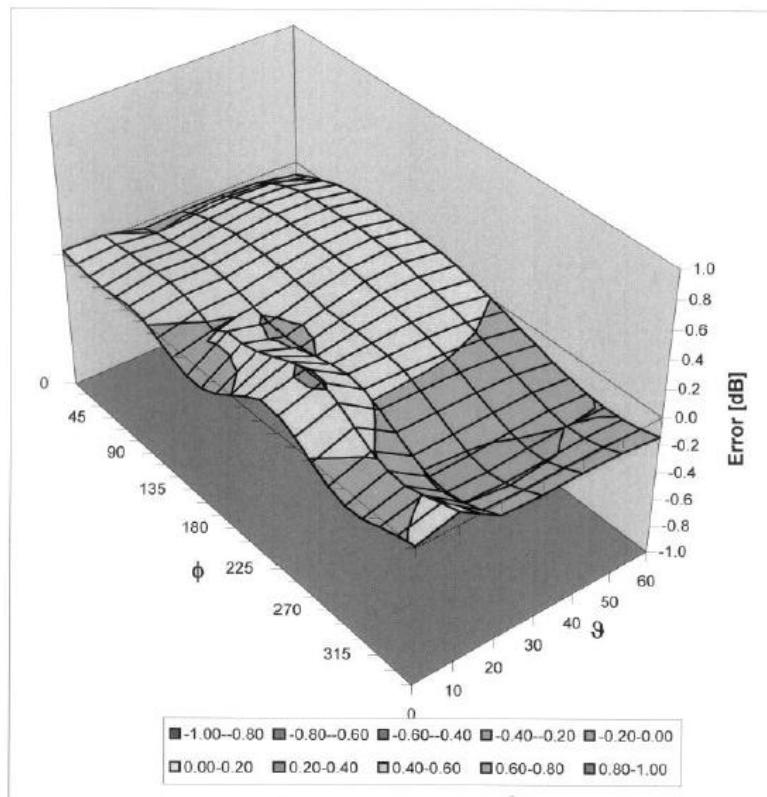


ET3DV6 SN:1788

September 23, 2009

Deviation from Isotropy in HSL

Error (ϕ, θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



Appendix D. FCC 3G SAR Measurement Procedures

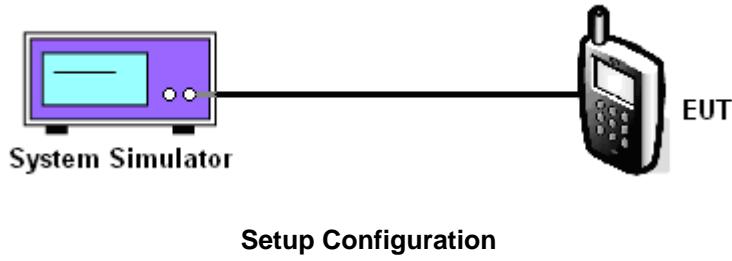
Conducted Output Power:

The EUT was tested according to the requirements of the FCC 3G procedures and the 3.1.2.3.4.

A detailed analysis of the output power verification is provided as the table below:

| Function Type | Reverse Traffic Channel | Test Mode | Data Rates (kbps) | Power Control | Low Ch | Mid. Ch | High Ch |
|---------------|-------------------------|-------------|-------------------|---------------|--------|---------|---------|
| | | | | | 1013 | 384 | 777 |
| CDMA2000 BC0 | EVDO Rev.0 | Subtype:0/1 | RTAP 153.6 | All Up | 24.18 | 24.25 | 24.38 |
| | EVDO Rev.A | Subtype:2 | RETAP 4096 | All Up | 24.12 | 24.22 | 24.33 |

| Function Type | Reverse Traffic Channel | Test Mode | Data Rates (kbps) | Power Control | Low Ch | Mid. Ch | High Ch |
|---------------|-------------------------|-------------|-------------------|---------------|--------|---------|---------|
| | | | | | 25 | 600 | 1175 |
| CDMA2000 BC1 | EVDO Rev.0 | Subtype:0/1 | RTAP 153.6 | All Up | 24.69 | 23.98 | 24.12 |
| | EVDO Rev.A | Subtype:2 | RETAP 4096 | All Up | 24.66 | 23.94 | 24.15 |

CDMA2000 Setup Configuration:

1. The EUT was connected to System Simulator, Agilent 8960. Refer to the drawing of Setup Configuration.
2. The RF path losses were compensated into the measurements.
3. A call was established between EUT and System Simulator with following setting:
 - a. For 1xEV-DO, set the Protocol Release and Data Rate
 - b. Set the Power Control to All Up Bits
4. The transmitted maximum output power was recorded.

| Call Setup Screen | | | | | |
|---|--|---------------|--------|------|--------|
| Call Control Operating Mode Active Cell Start Data Connection Close Session Handoff Setup ▼ AT Max Power 23 dBm/1.23MHz | Active Cell Operating Mode | | | | |
| | Access Terminal Information (AT Reported) | | | | |
| | Session Seed: Hardware ID Type (Hex): Hardware ID (Hex): Hardware ID (Decimal): | | | | |
| | Access Terminal Information (AN Assigned) | | | | |
| | UATI 024: ----- UATI Color Code: ----- MAC Index: ----- | | | | |
| | Protocol Release | | | | |
| | Session App | 0 (1xEV-DO) | | | |
| | Test Applica | A (1xEV-DO-A) | | | |
| | Limited TAP | B (1xEV-DO-B) | | | |
| | AT Directe | C | | | |
| DRC Value Fi | ----- | | | | |
| ACK Channel | ----- | | | | |
| Active Cell Idle | | | | | |
| Sys Type: IS-856 | | | | | |
| 1 of 3 | IntRef | Offset | PLSub0 | RTAP | 2 of 3 |

1xEV-DO setting for Protocol Release (Rev.0 or Rev.A)



| Call Setup Screen | | | |
|-----------------------|---|--|------------------------------|
| Call Control | Active Cell Operating Mode | | CallParms |
| Operating Mode | | | Cell Power |
| Active Cell | Access Terminal Information (AT Reported) Session Seed: Harduare ID Type (Hex): Harduare ID (Hex): Harduare ID (Decimal): | | -86.00 dBm/1.23 MHz |
| Start Data Connection | Access Terminal Information (AN Assigned) UATI 024: ---- UATI Color Code: ---- IAC Index: ---- | | Cell Band |
| Close Session | RTAP Rate Session App: 9.6 kbps Test App: 19.2 kbps Limited TAP: 38.4 kbps AT Directed: 76.8 kbps DRC Value F: 153.6 kbps ACK Channel | | US PCS |
| Handoff Setup | | | Channel |
| AT Max Power | | | 1175 |
| 23 dBm/1.23MHz | | | |
| | Active Cell Idle IntRef Offset PLSub0 RTAP | | Application Config |
| | | | FTAP Rate |
| 1 of 3 | | | 307.2 kbps (2 Slot, QPSK) |
| | | | RTAP Rate |
| | | | 9.6 kbps |
| | | | |
| | | | 1 of 3 |

1xEV-DO setting for RTAP data rate

| Call Setup Screen | | | |
|-----------------------|--|--|----------------------------------|
| Call Control | Active Cell Operating Mode | | CallParms |
| Operating Mode | | | Cell Power |
| Active Cell | Access Terminal Information (AT Reported) Session Seed: Harduare ID Type (Hex): Harduare ID (Hex): Harduare ID (Decimal): | | -86.00 dBm/1.23 MHz |
| Start Data Connection | Access Terminal Information (AN Assigned) UATI 024: ---- UATI Color Code: ---- IAC Index: ---- | | Cell Band |
| Close Session | Application Configuration R-Data Packet Size Enhanced T: 128 AT Directed: 256 DRC Value F: 512 ACK Channel: 768 Reverse Data: 1024 Expected Err: 1536 | | US PCS |
| Handoff Setup | | | Channel |
| AT Max Power | | | 1175 |
| 23 dBm/1.23MHz | | | |
| | Active Cell Idle IntRef Offset PLSub0 RETAP | | Application Config |
| | | | F-Traffic Format |
| | | | 4 (1024,2,128) (307.2k, QPSK) |
| | | | R-Data Pkt Size |
| | | | 128 bits |
| 1 of 3 | | | 1 of 3 |

1xEV-DO setting for RETAP data rate



Reference:

- [1] SAR Measurement Procedures for 3G Devices CDMA 2000/Ev-Do/WCDMA/HSDPA, June 2006
Laboratory Division Office of Engineering and Technology Federal Communications Commission
- [2] 3.1.2.3.4 Maximum RF Output Power 3GPP2 C.S0033-0 Version 2.0, Date: 12 December 2003
Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Terminal