Appendix 3-10: Validation measurement data

5200MHz system check (Body) / Forward conducted power: 100mW

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1070

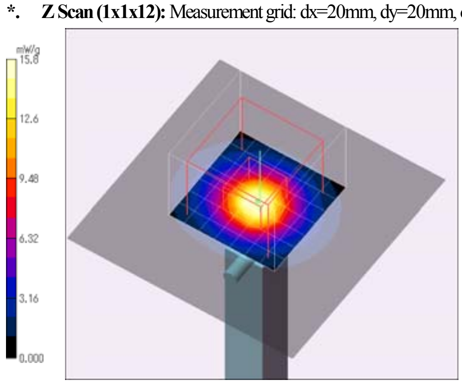
DASY4 Configuration:
- Probe: EX3DV4 - SN3679; ConvF(4.04, 4.04, 4.04); Calibrated: 2010/04/23
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

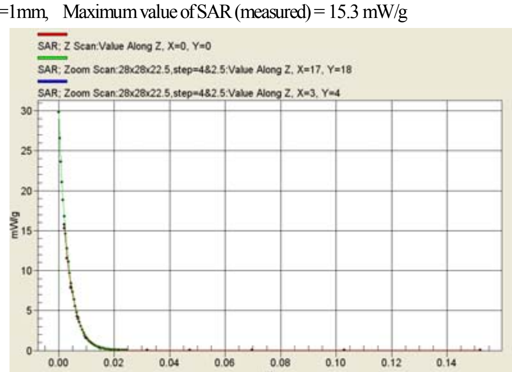
Date tested: 2010/11/30 Tested place: No.7 Shielded room Tested by: Hiroshi Naka

Communication System: CW; Frequency: 5200 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5200 MHz; σ = 5.37 S/m; ε_r = 47.1; ρ = 1000 kg/m^3

Area Scan: (61x61x1): Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (interpolated) = 16.9 mW/g

Zoom Scan:(8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 61.5 V/m; Power Drift = 0.016 dB, Peak SAR (extrapolated) = 29.8 W/kg
SAR(1 g) = 8.01 mW/g (+5.5%, vs. SPEAG cal.); SAR(10 g) = 2.29 mW/g,
Maximum value of SAR (measured) = 15.8 mW/g
***. Z Scan (1x1x12):** Measurement grid: dx=20mm, dy=20mm, dz=1mm, Maximum value of SAR (measured) = 15.3 mW/g





Additional information:
*.position of distance of Dipole to phantom: 8mm (10mm to liquid), liquid depth: 144mm
*.ambient: 23.5deg.C / 34.0 %; liquid temeprature: (before) 22.9 deg.C. /(after) 22.9deg.C.
*.white cubic: zoom scan area, red big cubic: SAR(10g), red small cubic: SAR(1g)

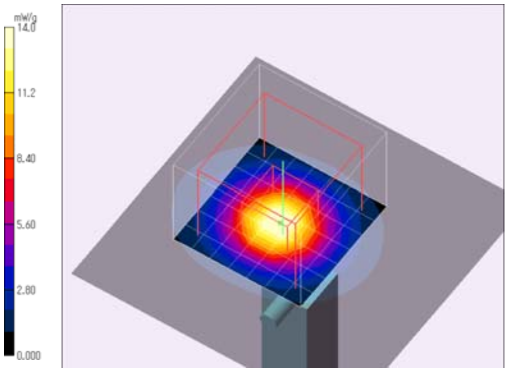
Appendix 3-10: Validation measurement data (cont'd)
5200MHz system check (Body) / Forward conducted power: 100mW (cont'd)

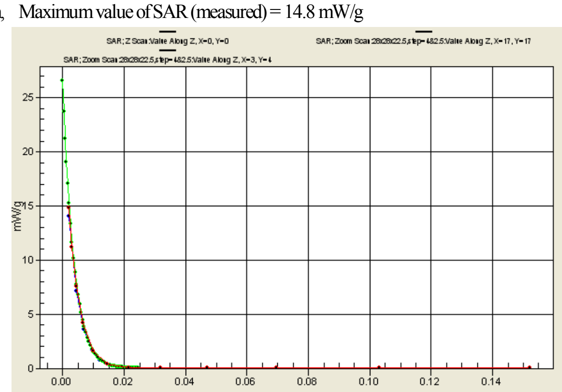
DASY4 Configuration:
- Probe: EX3DV4 - SN3679; ConvF(4.04, 4.04, 4.04); Calibrated: 2010/04/23
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2010/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

Date tested: 2010/12/1 Tested place: No.7 Shielded room Tested by: Hiroshi Naka

Communication System: CW; Frequency: 5200 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5200 MHz; σ = 5.38 S/m; ε_r = 47.2; ρ = 1000 kg/m^3

Area Scan:(61x61x1): Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (interpolated) = 16.1 mW/g
Zoom Scan: (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 51.4 V/m; Power Drift = -0.099 dB, Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 7.42 mW/g (-2.2%, vs. SPEAG cal.); SAR(10 g) = 2.15 mW/g
Maximum value of SAR (measured) = 14.0 mW/g
*. **Z Scan (1x1x12):** Measurement grid: dx=20mm, dy=20mm, dz=1mm, Maximum value of SAR (measured) = 14.8 mW/g



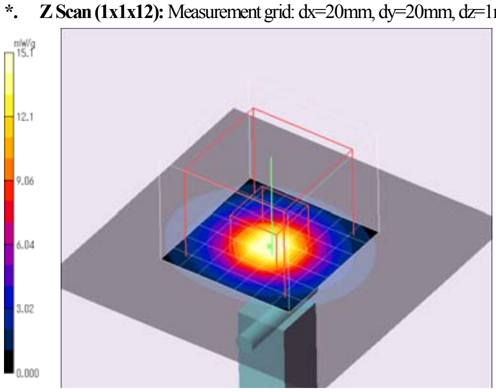


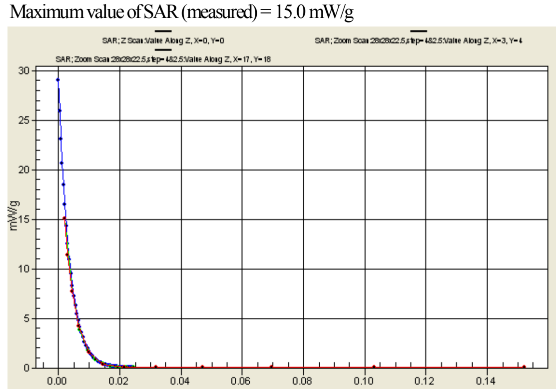
Additional information:
*.position of distance of Dipole to phantom: 8mm (10mm to liquid), liquid depth: 144mm
*.ambient: 23.9deg.C / 38.0 %; liquid temeprature: (before) 23.6 deg.C. /(after) 23.4 deg.C.
*.white cubic: zoom scan area, red big cubic: SAR(10g), red small cubic: SAR(1g)

Date tested: 2010/12/2 Tested place: No.7 Shielded room Tested by: Hiroshi Naka

Communication System: CW; Frequency: 5200 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used: f = 5200 MHz; σ = 5.35 S/m; ε_r = 46.8; ρ = 1000 kg/m^3

Area Scan: (61x61x1): Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (interpolated) = 17.1 mW/g
Zoom Scan: (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 60.7 V/m; Power Drift = 0.055 dB, Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 7.95 mW/g (+4.7%, vs. SPEAG cal.); SAR(10 g) = 2.28 mW/g,
Maximum value of SAR (measured) = 15.1 mW/g
*. **Z Scan (1x1x12):** Measurement grid: dx=20mm, dy=20mm, dz=1mm, Maximum value of SAR (measured) = 15.0 mW/g





Additional information:
*.position of distance of Dipole to phantom: 8mm (10mm to liquid), liquid depth: 144mm
*.ambient: 24.0deg.C / 38.0 %; liquid temeprature: (before) 23.7 deg.C. /(after) 23.4 deg.C.
*.white cubic: zoom scan area, red big cubic: SAR(10g), red small cubic: SAR(1g)

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070)

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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 **UL Japan**

Certificate No: **D5GHzV2-1070_Mar09**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1070
Calibration procedure(s)	QA CAL-22.v1 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	March 13, 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 EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	01-Jul-08 (No. 217-00864)	Jul-09
Type-N mismatch combination	SN: 5047.2 / 06327	01-Jul-08 (No. 217-00867)	Jul-09
Reference Probe EX3DV4	SN: 3503	11-Mar-09 (No. EX3-3503_Mar09)	Mar-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 16, 2009

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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:

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

Additional Documentation:

c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Measurement Conditions

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

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

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	4.53 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	100 mW input power	7.66 mW / g
SAR normalized	normalized to 1W	76.6 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**76.3 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.15 mW / g
SAR normalized	normalized to 1W	21.5 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**21.4 mW / g ± 19.5 % (k=2)**

[1] Correction to nominal TSL parameters according to c), chapter "SAR Sensitivities

Certificate No: D5GHzV2-1070_Mar09 Page 3 of 14

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.34 mW / g
SAR normalized	normalized to 1W	83.4 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**83.0 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 mW / g
SAR normalized	normalized to 1W	23.4 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**23.2 mW / g ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.3 ± 6 %	5.08 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	100 mW input power	7.79 mW / g
SAR normalized	normalized to 1W	77.9 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**77.4 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.18 mW / g
SAR normalized	normalized to 1W	21.8 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**21.6 mW / g ± 19.5 % (k=2)**

[1] Correction to nominal TSL parameters according to c), chapter "SAR Sensitivities"

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Telephone: +81 463 50 6400 / Facsimile: +81 463 50 6401

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.7 ± 6 %	5.30 mho/m ± 6 %
Body TSL temperature during test	(21.2 ± 0.2) °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.63 mW / g
SAR normalized	normalized to 1W	76.3 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**75.9 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 mW / g
SAR normalized	normalized to 1W	21.2 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**21.1 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.68 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	8.04 mW / g
SAR normalized	normalized to 1W	80.4 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**79.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.22 mW / g
SAR normalized	normalized to 1W	22.2 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**22.0 mW / g ± 19.5 % (k=2)**

[1] Correction to nominal TSL parameters according to c), chapter "SAR Sensitivities

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Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	6.05 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.13 mW / g
SAR normalized	normalized to 1W	71.3 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**70.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.96 mW / g
SAR normalized	normalized to 1W	19.6 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**19.4 mW / g ± 19.5 % (k=2)**

[1] Correction to nominal TSL parameters according to c), chapter "SAR Sensitivities

Certificate No: D5GHzV2-1070_Mar09 Page 6 of 14

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.2 Ω - 10.7 jΩ
Return Loss	-19.5 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.2 Ω - 7.1 jΩ
Return Loss	-22.9 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.0 Ω - 3.0 jΩ
Return Loss	-24.0 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.6 Ω - 9.7 jΩ
Return Loss	-20.1 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.5 Ω - 5.8 jΩ
Return Loss	-24.6 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.3 Ω - 1.6 jΩ
Return Loss	-24.2 dB

Certificate No: D5GHzV2-1070_Mar09 Page 7 of 14

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns

After long term use with 40 W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2008

Certificate No: D5GHzV2-1070_Mar09 Page 8 of 14

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

DASY5 Validation Report for Head TSL

Date/Time: 12.03.2009 15:30:50

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1070

Communication System: CW-5GHz; Frequency: 5200 MHzFrequency: 5500 MHzFrequency: 5800 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5200 MHz; σ = 4.5 mho/m; ε_r = 35.2; ρ = 1000 kg/m^3 Medium parameters used: f = 5500 MHz; σ = 4.78 mho/m; ε_r = 34.6; ρ = 1000 kg/m^3 Medium parameters used: f = 5800 MHz; σ = 5.06 mho/m; ε_r = 34.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY4 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.36, 5.36, 5.36)ConvF(4.85, 4.85, 4.85)ConvF(4.74, 4.74, 4.74); Calibrated: 11.03.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.2 Build 87

d=10mm, Pin=100mW, f=5200 MHz/Area Scan (61x61x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 16 mW/g

d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (8x8x10), dist=2mm (8x8x10)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 53.6 V/m; Power Drift = 0.051 dB
Peak SAR (extrapolated) = 29.8 W/kg
SAR(1 g) = 7.66 mW/g; SAR(10 g) = 2.15 mW/g
Maximum value of SAR (measured) = 15.8 mW/g

d=10mm, Pin=100mW, f=5500 MHz 2/Zoom Scan (8x8x10), dist=2mm (8x8x10)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 54.8 V/m; Power Drift = -0.075 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 8.34 mW/g; SAR(10 g) = 2.34 mW/g
Maximum value of SAR (measured) = 17 mW/g

d=10mm, Pin=100mW, f=5800 MHz 2/Zoom Scan (8x8x10), dist=2mm (8x8x10)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 51.1 V/m; Power Drift = 0.056 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 7.79 mW/g; SAR(10 g) = 2.18 mW/g
Maximum value of SAR (measured) = 16.3 mW/g

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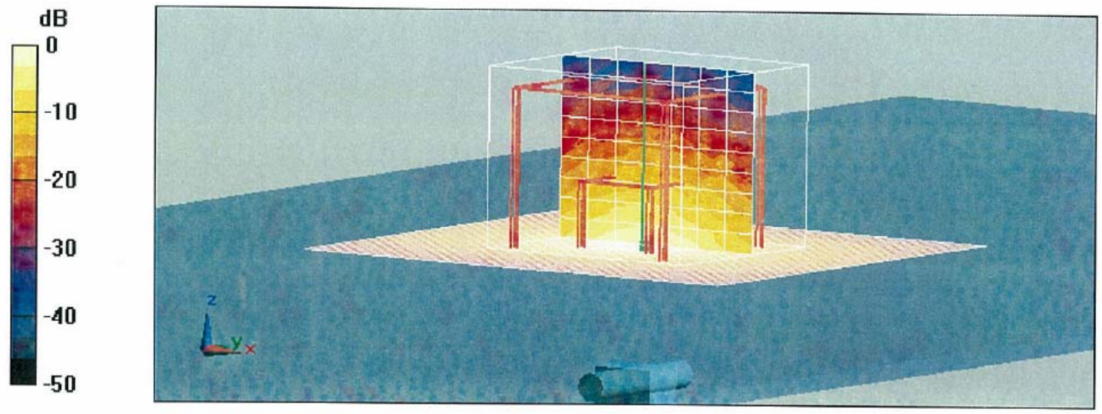
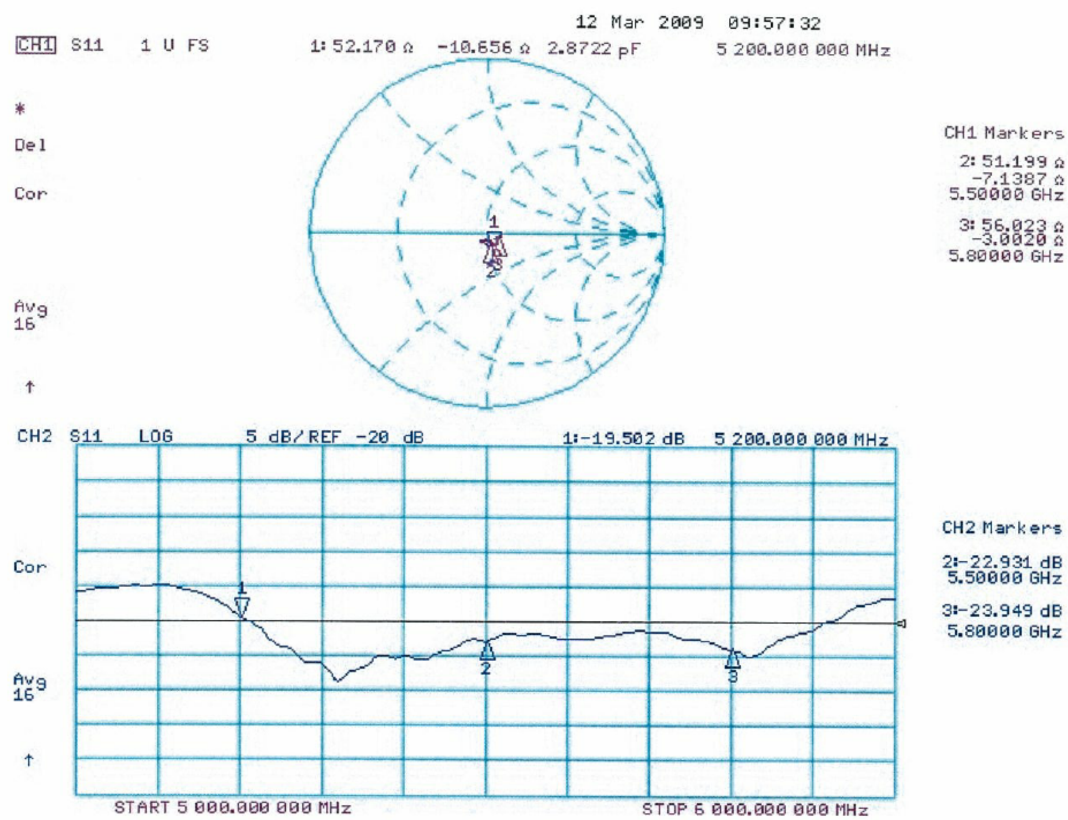
Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)



0 dB = 16.3mW/g

Certificate No: D5GHzV2-1070_Mar09 Page 10 of 14

Impedance Measurement Plot for Head TSL



Certificate No: D5GHzV2-1070_Mar09 Page 11 of 14

Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

DASY5 Validation Report for Body TSL

Date/Time: 13.03.2009 15:27:11

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1070

Communication System: CW-5GHz; Frequency: 5200 MHzFrequency: 5800 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5200 MHz; σ = 5.3 mho/m; ε_r = 47.7; ρ = 1000 kg/m^3 Medium parameters used: f = 5800 MHz; σ = 6.05 mho/m; ε_r = 46.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY4 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.88, 4.88, 4.88)ConvF(4.57, 4.57, 4.57); Calibrated: 11.03.2009
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.2 Build 87

d=10mm, Pin=100mW, f=5200 MHz/Area Scan (61x61x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 16.2 mW/g

d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (8x8x10), dist=2mm (8x8x10)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 49.8 V/m; Power Drift = 0.014 dB
Peak SAR (extrapolated) = 28.8 W/kg
SAR(1 g) = 7.63 mW/g; SAR(10 g) = 2.12 mW/g
Maximum value of SAR (measured) = 15.9 mW/g

d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (8x8x10), dist=2mm (8x8x10)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 49.2 V/m; Power Drift = -0.00119 dB
Peak SAR (extrapolated) = 32.5 W/kg
SAR(1 g) = 8.04 mW/g; SAR(10 g) = 2.22 mW/g
Maximum value of SAR (measured) = 17.1 mW/g

d=10mm, Pin=100mW, f=5800 MHz/Zoom Scan (8x8x10), dist=2mm (8x8x10)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 44.5 V/m; Power Drift = 0.00108 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 7.13 mW/g; SAR(10 g) = 1.96 mW/g
Maximum value of SAR (measured) = 15.3 mW/g

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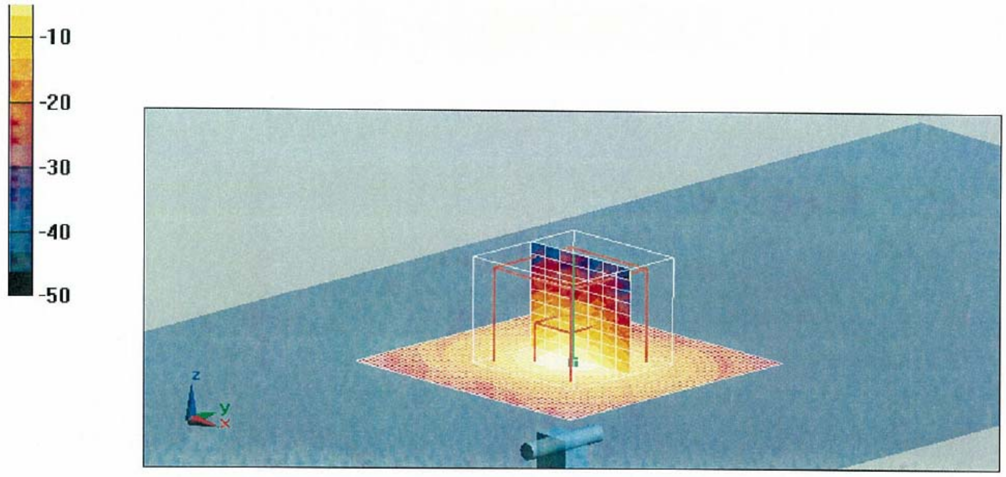
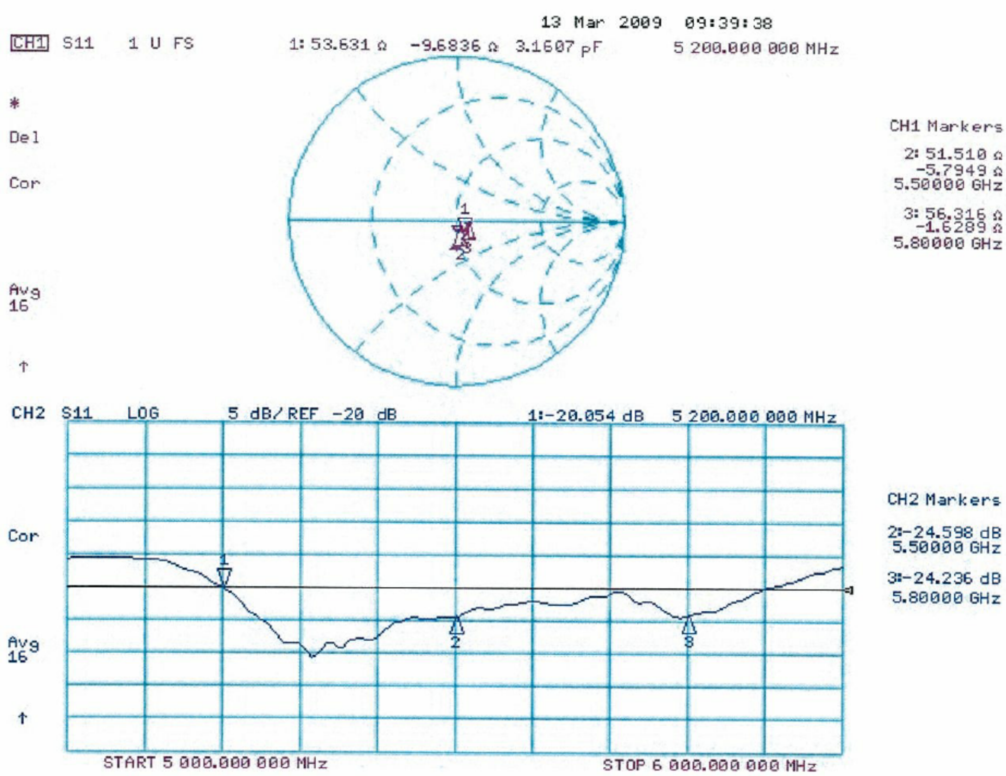
Appendix 3-11: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)



0 dB = 15.3mW/g

Certificate No: D5GHzV2-1070_Mar09 Page 13 of 14

Impedance Measurement Plot for Body TSL



Certificate No: D5GHzV2-1070_Mar09 Page 14 of 14

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679)

Calibration Laboratory of
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Engineering AG
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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 **UL Japan (PTT)**

Certificate No: **EX3-3679_Apr10**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3679

Calibration procedure(s): QA CAL-01.v6, QA CAL-14.v3, QA CAL-23.v3 and QA CAL-25.v2
Calibration procedure for dosimetric E-field probes

Calibration date: April 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 ± 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	29-Sep-09 (No. DAE4-660_Sep09)	Sep-10

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-09)	In house check: Oct10

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Fin Bomholt	R&D Director	F. Bomholt

Issued: April 24, 2010

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Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

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Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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C Service suisse d'étalonnage
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
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,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., ϑ = 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 ϑ = 0 (f ≤ 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 ≤ 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.

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

Probe EX3DV4

SN:3679

Manufactured:	September 9, 2008
Last calibrated:	March 11, 2009
Recalibrated:	April 23, 2010

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4 SN:3679

April 23, 2010

DASY - Parameters of Probe: EX3DV4 SN:3679

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.58	0.57	0.52	± 10.1%
DCP (mV)[B]	85.5	86.8	86.1	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	300	± 1.5%
			Y	0.00	0.00	1.00	300	
			Z	0.00	0.00	1.00	300	

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 E^2-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 recatangular distribution and is expressed for the square of the field value.

Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4 SN:3679 April 23, 2010

DASY - Parameters of Probe: EX3DV4 SN:3679

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)
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	6.83	6.83	6.83	0.43	0.80 ± 11.0%
5200	± 50 / ± 100	36.0 ± 5%	4.66 ± 5%	4.54	4.54	4.54	0.45	1.90 ± 13.1%
5300	± 50 / ± 100	35.9 ± 5%	4.76 ± 5%	4.38	4.38	4.38	0.45	1.90 ± 13.1%
5500	± 50 / ± 100	35.6 ± 5%	4.96 ± 5%	4.41	4.41	4.41	0.45	1.90 ± 13.1%
5600	± 50 / ± 100	35.5 ± 5%	5.07 ± 5%	3.98	3.98	3.98	0.50	1.90 ± 13.1%
5800	± 50 / ± 100	35.3 ± 5%	5.27 ± 5%	4.14	4.14	4.14	0.50	1.90 ± 13.1%

[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.

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EX3DV4 SN:3679 April 23, 2010

DASY - Parameters of Probe: EX3DV4 SN:3679

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)
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	7.04	7.04	7.04	0.42	0.84 ± 11.0%
5200	± 50 / ± 100	49.0 ± 5%	5.30 ± 5%	4.04	4.04	4.04	0.53	1.95 ± 13.1%
5300	± 50 / ± 100	48.5 ± 5%	5.42 ± 5%	3.75	3.75	3.75	0.55	1.95 ± 13.1%
5500	± 50 / ± 100	48.6 ± 5%	5.65 ± 5%	3.58	3.58	3.58	0.60	1.95 ± 13.1%
5600	± 50 / ± 100	48.5 ± 5%	5.77 ± 5%	3.39	3.39	3.39	0.60	1.95 ± 13.1%
5800	± 50 / ± 100	48.2 ± 5%	6.00 ± 5%	3.74	3.74	3.74	0.65	1.95 ± 13.1%

[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.

Certificate No: EX3-3679_Apr10 Page 6 of 11

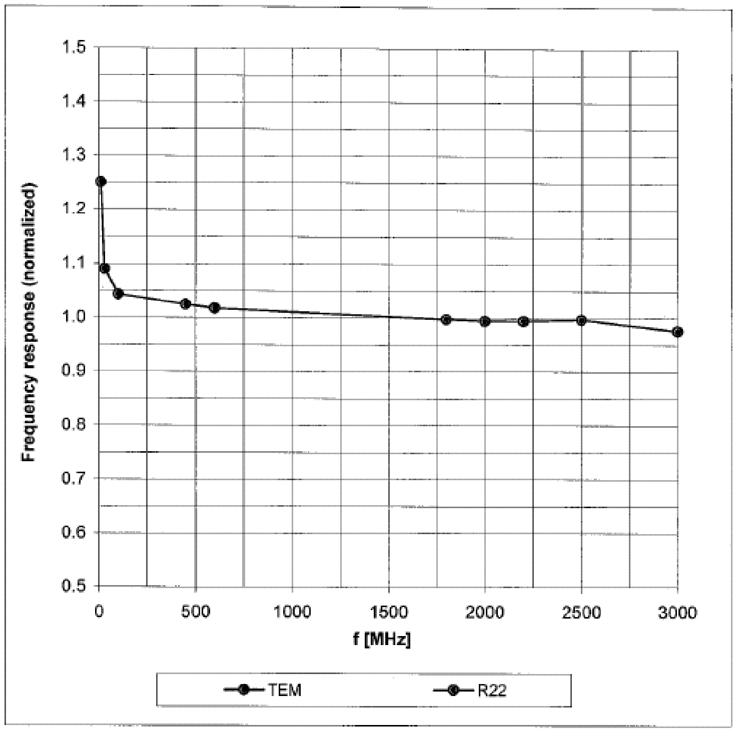
Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4 SN:3679

April 23, 2010

Frequency Response of E-Field

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



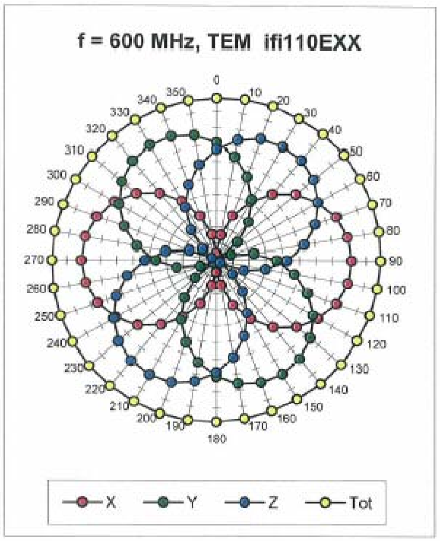
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

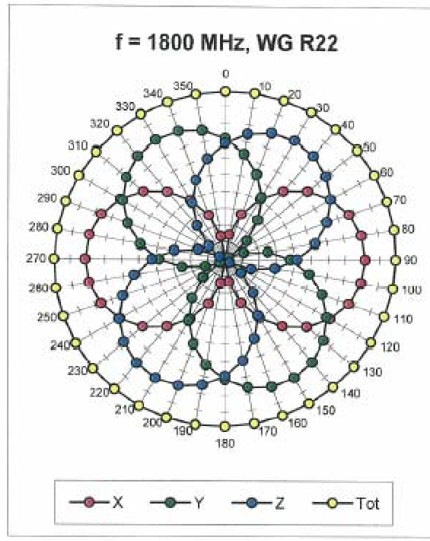
Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

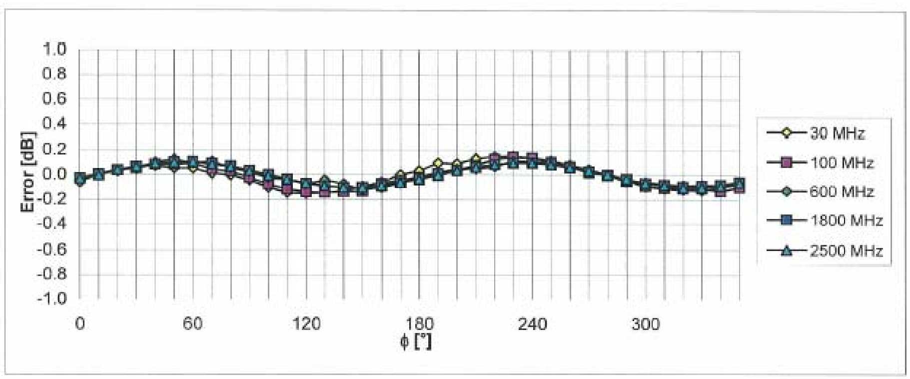
EX3DV4 SN:3679

April 23, 2010

Receiving Pattern (ϕ), ϑ = 0°







Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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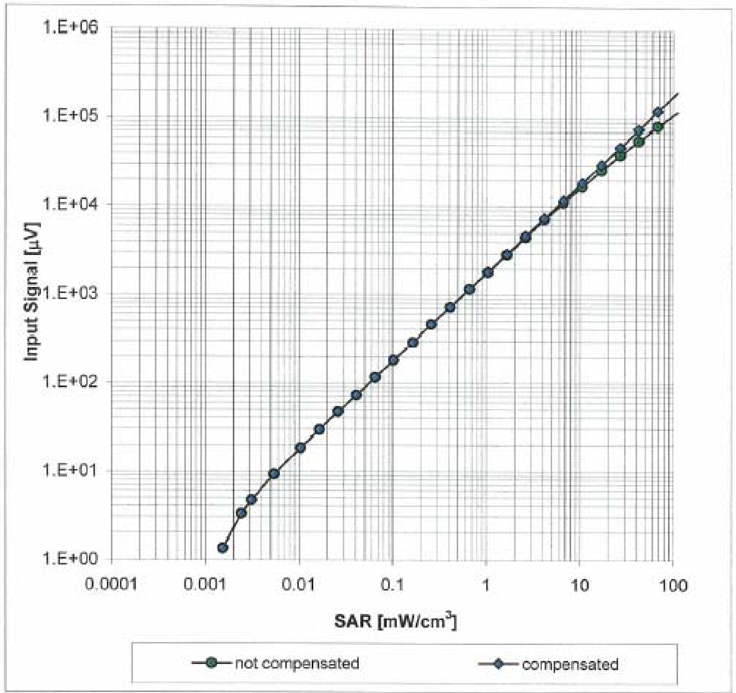
Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

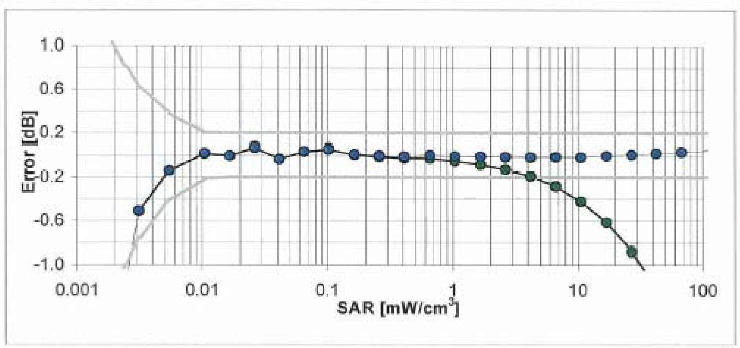
EX3DV4 SN:3679

April 23, 2010

Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)





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

Certificate No: EX3-3679_Apr10

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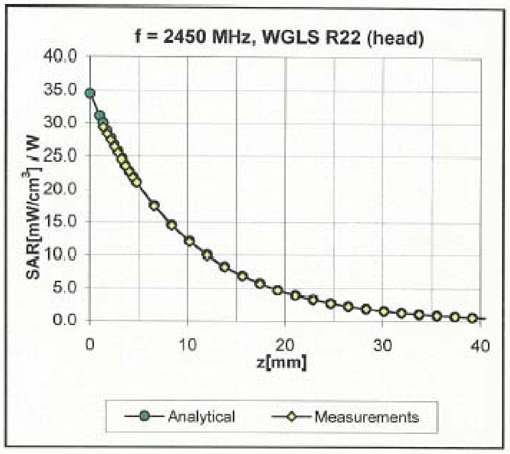
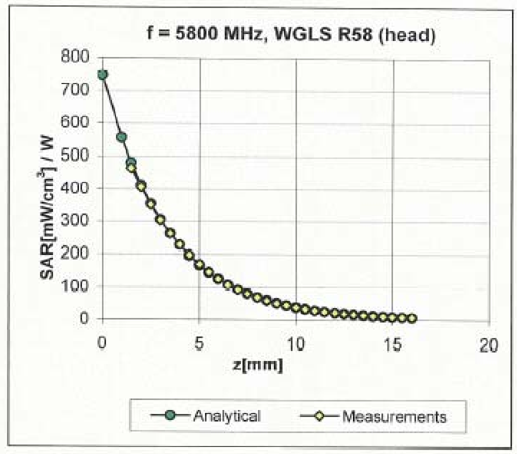
Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4 SN:3679

April 23, 2010

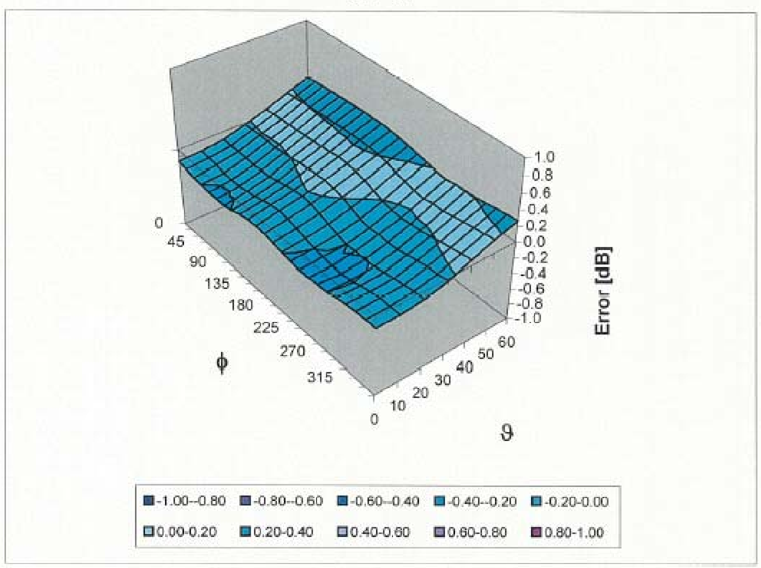
Conversion Factor Assessment





Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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Appendix 3-12: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4 SN:3679 April 23, 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	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Certificate No: EX3-3679_Apr10 Page 11 of 11

Appendix 3-13: Reference

[1] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.

[2] Katja Pokovic, Thomas Schmid, and Niels Kuster, "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM '97, Dubrovnik, October 15-17, 1997, pp. 120-124.

[3] Katja Pokovic, Thomas Schmid, and Niels Kuster, "E-_field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.

[4] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[5] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.

[6] SPEAG uncertainty document for DASY 4 System from SPEAG (Schmid & Partner Engineering AG).

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