Appendix 3-7: Simulated tissue parameter confirmation

The dielectric parameters were checked prior to assessment using the 85070E dielectric probe kit.
The dielectric parameters measurement is reported in each correspondent section.

Dielectric parameter measurement results

Date	Freq. [MHz]	Ambient Temp [deg.C.]	Ambient Humidity [%RH]	Liq.T.[deg.C.] Before	Liq.T.[deg.C.] After	Liquid Depth [mm]	Parameters	Target value #1:Std. (*1)	Target value #2:Cal. (*2)	Measured	Deviation for #1 (Std.)[%]	Limit [%]	Deviation for #2 (Cal.)[%]	Limit [%] (*2)
Sept. 5, 2011	5200	24.1	63	24.0	24.0	(149)	Relative permittivity: εr [-]	**49.01**	**47.2**	49.80	**+1.6**	±5	**+5.5**	±6
							Conductivity: σ [S/m]	**5.299**	**5.37**	5.554	**+4.8**	±5	**+3.4**	±6
Sept. 6, 2011	5800	25.0	63	24.9	24.9	(149)	Relative permittivity: εr [-]	**48.2**	**46.2**	48.80	**+1.3**	±5	**+5.6**	±6
							Conductivity: σ [S/m]	**6.00**	**6.16**	6.244	**+4.1**	±5	**+1.4**	±6
Sept. 9, 2011	2450	23.8	63	23.7	23.7	(158)	Relative permittivity: εr [-]	**52.7**	**52.5**	50.17	**-4.8**	±5	**-4.4**	±6
							Conductivity: σ [S/m]	**1.95**	**1.96**	1.976	**+1.3**	±5	**+0.8**	±6

*1. The target value is a parameter defined in OET65, Supplement C.
*2 For 5200MHz and 5800MHz, the target value and limit are parameter defined in the calibration data sheet of D5GHzV2 (sn:1070) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D5GHzV2-1070_Feb11, the data sheet was filed in this report.).
For 2450MHz, the target value and limit are parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Jan11, the data sheet was filed in this report.).

***. Decision on Simulated Tissues of 5200MHz**

In the current standards (e.g., IEEE 1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given at 3000MHz and 5800MHz. As an intermediate solution, dielectric parameters for the frequencies between 5000 to 5800 MHz were obtained using linear interpolation. Furthermore, dielectric parameters for the frequencies above 5800MHz were obtained using linear extrapolation. Therefore the dielectric parameters of 5200MHz (the frequency for the validation) and other SAR tested frequencies in listed below were decided as following.
Standard, interpolated and extrapolated dielectric parameters for head and body tissue simulating liquid in the frequency range 3000 to 5825MHz.

f (MHz)	Head Tissue εr	Head Tissue σ [S/m]	Body Tissue εr	Body Tissue σ [S/m]	Reference
3000	**38.5**	**2.40**	**52.0**	**2.73**	**Standard**
5800	**35.3**	**5.27**	**48.2**	**6.00**	**Standard**
5190	-	-	49.03	5.288	Interpolated
5200	-	-	49.01	5.299	Interpolated
5230	-	-	48.97	5.334	Interpolated
5240	-	-	48.96	5.346	Interpolated
5260	-	-	48.93	5.369	Interpolated
5270	-	-	48.92	5.381	Interpolated
5310	-	-	48.87	5.428	Interpolated
5320	-	-	48.85	5.439	Interpolated

f (MHz)	Head Tissue εr	Head Tissue σ [S/m]	Body Tissue εr	Body Tissue σ [S/m]	Reference
5755	-	-	48.26	5.947	Interpolated
5765	-	-	48.25	5.959	Interpolated
5785	-	-	48.22	5.982	Interpolated
5795	-	-	48.21	5.994	Interpolated
5825	-	-	48.17	6.029	Extrapolated

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Appendix 3-8: System validation data

Prior to the SAR assessment of EUT, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are in the table below.

System validation results															
Date	Freq. [MHz]	Liquid Type	Ambient		Liquid Temp. [deg.C.]			Liquid Depth [mm]	Permittivity measured εr [-]	Conductivity measured σ [S/m]]	Power drift [dB]	System dipole validation target & measured			
												SAR 1g [W/kg] (at 1W)		Deviation [%]	Limit [%]
			Temp [deg.C.]	Humidity [%RH]	Check	Before	After					Target value	Measured (*3)		
Sept. 5, 2011	5200	Body	24.3	63	24.0	24.0	23.9	149	49.8	5.55	-0.019	**77.1**(*1)	80.3 (8.03 (at 100mW))	**+4.2**	±10
Sept. 6, 2011	5800	Body	24.8	59	24.9	24.6	24.6	149	48.8	6.24	0.051	**72.4**(*1)	72.1 (7.21 (at 100mW))	**-0.4**	±10
Sept. 9, 2011	2450	Body	23.8	57	23.7	23.6	23.6	158	50.2	1.98	-0.076	**50.9**(*2)	50.0 (12.5 (at 250mW))	**-1.8**	±10

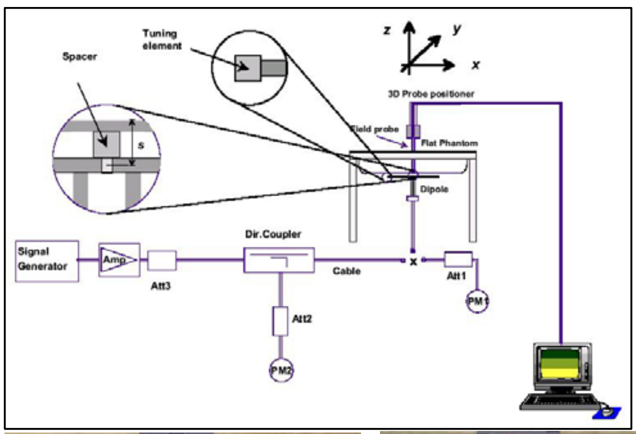
Note: Refer to Appendix 3-10 Validation measurement data for the above result representation in plot data.

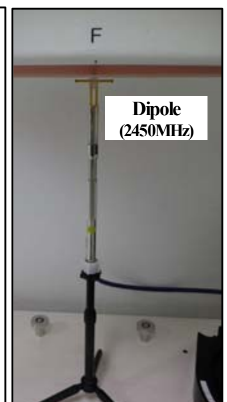
*1. The target value is a parameter defined in the calibration data sheet of D5GHzV2(sn:1070) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D5GHzV2-1070_Feb11, the data sheet was filed in this report.).

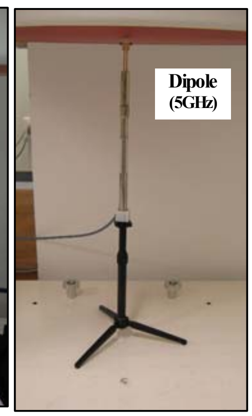
*2. The target value is a parameter defined in the calibration data sheet of D2450V2 (sn:822) dipole calibrated by Schmid & Partner Engineering AG (Certification No. D2450V2-822_Jan11, the data sheet was filed in this report.).

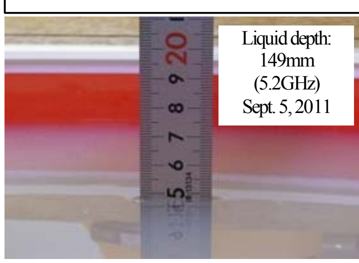
*. We performed the system validation based on FCC requirement, "The 1-g or 10-g SAR values measured using the required tissue dielectric parameters should be within 10% of manufacturer calibrated dipole SAR values. However these manufacturer calibrated dipole target SAR values should be substantially similar to those defined in IEEE Standard 1528." and FCC permits "SAR system verification with the actual liquid used for EUT's SAR measurement, should be the default operating procedures." We confirmed the this dipole manufacture's validation data for head is within 5% against IEEE Standard 1528 (manufacture's cal.: 54.4W/kg (+3.8% vs. std.: 52.4W/kg). so we can only use Body liquid validation data for our system verification

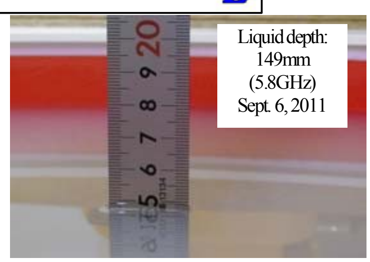
*3. The measurement value was normalized to 1W forward power.

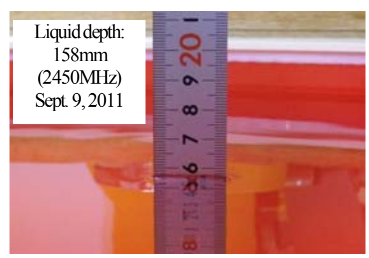












Test setup for the system performance check

Appendix 3-9: Validation uncertainty

Uncertainty of system check setup	Under 3GHz	
	1g SAR	10g SAR
combined measurement uncertainty of the measurement system (k=1)	± 9.9%	± 9.6%
expanded uncertainty (k=2)	± 19.9%	± 19.3%

	Error Description	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	vi, veff
A	Measurement System						(std. uncertainty)	(std. uncertainty)	
1	Probe calibration	±5.9 %	Normal	1	1	1	±5.9 %	±5.9 %	∞
2	Axial isotropy	±4.7 %	Rectangular	√3	0.7	0.7	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy (flat, <5°)	±2.6 %	Rectangular	√3	0.7	0.7	±1.1 %	±1.1 %	∞
4	Boundary effects	±1.0 %	Rectangular	√3	1	1	±1.2 %	±1.2 %	∞
5	Probe linearity	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
6	System detection limit	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	System readout electronics	±0.3 %	Normal	1	1	1	±0.3 %	±0.3 %	∞
8	Response time	±0.0 %	Rectangular	√3	1	1	±0.0 %	±0.0 %	∞
9	Integration time	±0.0 %	Rectangular	√3	1	1	±0.0 %	±0.0 %	∞
10	RF ambient - noise	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
11	RF ambient - reflections	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
12	Probe positioner mechanical tolerance	±0.4 %	Rectangular	√3	1	1	±0.2 %	±0.2 %	∞
13	Probe positioning with respect to phantom shell	±2.9 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
14	Max.SAR evaluation	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
B	Dipole								
15	Dipole axis to liquid distance	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2 %	∞
16	Input power and SAR drift measurement	±4.7 %	Rectangular	√3	1	1	±4.7 %	±4.7 %	3
C	Phantom and Setup								
17	Phantom uncertainty	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
18	Liquid conductivity (target)	±5.0 %	Rectangular	√3	0.64	0.43	±1.8 %	±1.2 %	∞
19	Liquid conductivity (meas.)	±2.9 %	Normal	1	0.64	0.43	±1.9 %	±1.2 %	3
20	Liquid permittivity (target)	±5.0 %	Rectangular	√3	0.6	0.49	±1.7 %	±1.4 %	∞
21	Liquid permittivity (meas.)	±2.9 %	Normal	1	0.6	0.49	±1.7 %	±1.4 %	3
	Combined Standard Uncertainty						±9.9 %	±9.6 %	88
	Expanded Uncertainty (k=2)						±19.9 %	±19.3 %	

*. This measurement uncertainty budget is suggested by IEEE 1528 and determined by Schmid & Partner Engineering AG.[6]

Uncertainty of SAR measurement system /Validation	5~6 GHz	
	1g SAR	10g SAR
combined measurement uncertainty of the measurement system (k=1)	± 12.1%	± 11.9%
expanded uncertainty (k=2)	± 24.2%	± 23.7%

	Error Description	Uncertainty Value	Probability distribution	Divisor	ci (1g)	ci (10g)	ui (1g)	ui (10g)	vi, veff
A	Measurement System						(std. uncertainty)	(std. uncertainty)	
1	Probe calibration	±6.8 %	Normal	1	1	1	±6.8 %	±6.8 %	∞
2	Axial isotropy	±4.7 %	Rectangular	√3	0.7	0.7	±1.9 %	±1.9 %	∞
3	Hemispherical isotropy (*flat phantom, <5°)	±2.6 %	Rectangular	√3	0.7	0.7	±1.1 %	±1.1 %	∞
4	Boundary effects	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2 %	∞
5	Probe linearity	±4.7 %	Rectangular	√3	1	1	±2.7 %	±2.7 %	∞
6	System detection limit	±1.0 %	Rectangular	√3	1	1	±0.6 %	±0.6 %	∞
7	System readout electronics	±0.3 %	Normal	1	1	1	±0.3 %	±0.3 %	∞
8	Response time	±0.8 %	Rectangular	√3	1	1	±0 %	±0 %	∞
9	Integration time	±2.6 %	Rectangular	√3	1	1	±0 %	±0 %	∞
10	RF ambient - noise	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
11	RF ambient - reflections	±3.0 %	Rectangular	√3	1	1	±1.7 %	±1.7 %	∞
12	Probe positioner mechanical tolerance	±0.8 %	Rectangular	√3	1	1	±0.5 %	±0.5 %	∞
13	Probe positioning with respect to phantom shell	±9.9 %	Rectangular	√3	1	1	±5.7 %	±5.7 %	∞
14	Max.SAR evaluation	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
B	Dipole								
15	Dipole axis to liquid distance	±2.0 %	Rectangular	√3	1	1	±1.2 %	±1.2%	∞
16	Input power and SAR drift measurement	±4.7 %	Normal	1	1	1	±4.7 %	±4.7 %	∞
C	Phantom and Setup								
17	Phantom uncertainty	±4.0 %	Rectangular	√3	1	1	±2.3 %	±2.3 %	∞
18	Liquid conductivity (target)	±5.0 %	Rectangular	√3	0.64	0.43	±1.8 %	±1.2 %	∞
19	Liquid conductivity (meas.)	±3.0 %	Normal	1	0.64	0.43	±1.9 %	±1.3 %	∞
20	Liquid permittivity (target)	±5.0 %	Rectangular	√3	0.6	0.49	±1.7 %	±1.4 %	∞
21	Liquid permittivity (meas.)	±3.2 %	Normal	1	0.6	0.49	±1.9 %	±1.6 %	∞
	Combined Standard Uncertainty						±12.1 %	±11.9 %	∞
	Expanded Uncertainty (k=2)						±24.2 %	±23.7 %	

*. This measurement uncertainty budget is suggested by Schmid & Partner Engineering AG. [6]

Appendix 3-10: Validation measurement data

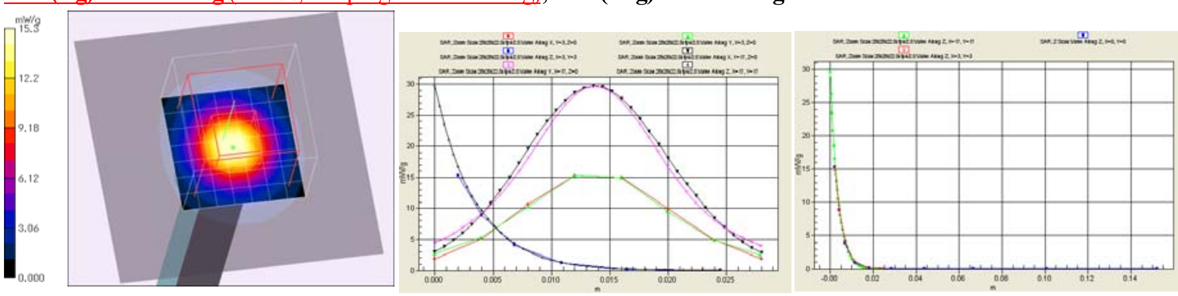
(September 5, 2011) 5200MHz system check (Body) / Forward conducted power: 100mW

EUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1070
Communication System: CW; Frequency: 5200 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used(24.0deg.C.): f = 5200 MHz; σ = 5.55 S/m; ε_r = 49.8; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: EX3DV4 - SN3679; ConvF(4.1, 4.1, 4.1); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2011/02/10
- 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

Area Scan: (61x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 16.7 mW/g
Z Scan (1x1x10): Measurement grid: dx=20mm, dy=20mm, dz=2mm; Maximum value of SAR (measured) = 15.4 mW/g

Zoom Scan:(xy28,z22.5/4,2&r1.5) (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 60.9 V/m; Power Drift = -0.019 dB, Maximum value of SAR (measured) = 15.3 mW/g
Peak SAR (extrapolated) = 29.8 W/kg (-4.1%, vs. speag-cal=31.1W/kg)
SAR(1 g) = 8.03 mW/g (+4.2%, vs. speag-cal=7.71mW/g); **SAR(10 g) = 2.29 mW/g**



Additional information:
*.position: distance of dipole to phantom: 8mm (10mm to liquid), liquid depth: 149mm
*.ambient: 24.3 deg.C / 63 %RH; liquid temperature: (before) 24.0 deg.C /(after) 23.9 deg.C
*.white cubic: zoom scan area, red big cubic: SAR(10g), red small cubic: SAR(1g)
*.Tested by: Hiroshi Naka / Tested place:No.7 shielded room., Date tested: September 5, 2011

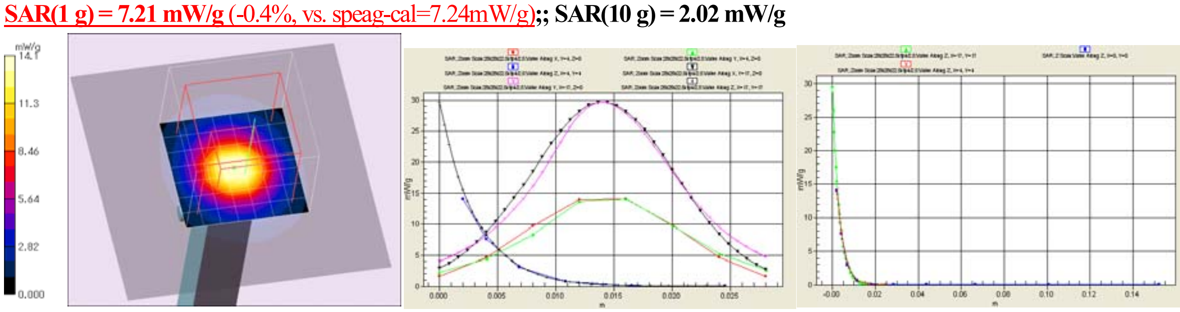
(September 6, 2011) 5800MHz system check (Body) / Forward conducted power: 100mW

EUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1070
Communication System: CW; Frequency: 5800 MHz; Crest Factor: 1.0
Medium: MSL5800; Medium parameters used(24.9deg.C.): f = 5800 MHz; σ = 6.24 S/m; ε_r = 48.8; ρ = 1000 kg/m^3

DASY4 Configuration:
- Probe: EX3DV4 - SN3679; ConvF(3.94, 3.94, 3.94); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn626; Calibrated: 2011/02/10
- 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

Area Scan: (61x61x1): Measurement grid: dx=10mm, dy=10mm; Maximum value of SAR (interpolated) = 15.7 mW/g
Z Scan (1x1x10): Measurement grid: dx=20mm, dy=20mm, dz=2mm; Maximum value of SAR (measured) = 14.0 mW/g

Zoom Scan:(xy28,z22.5/4,2&r1.5) (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm;
Reference Value = 55.4 V/m; Power Drift = 0.051 dB, Maximum value of SAR (measured) = 14.1 mW/g
Peak SAR (extrapolated) = 29.7 W/kg (-10.0%, vs. speag-cal=33.0W/kg)
SAR(1 g) = 7.21 mW/g (-0.4%, vs. speag-cal=7.24mW/g);; **SAR(10 g) = 2.02 mW/g**



Additional information:
*.position: distance of dipole to phantom: 8mm (10mm to liquid), liquid depth: 149mm
*.ambient: 24.8 deg.C / 59 %RH; liquid temperature: (before) 24.6 deg.C /(after) 24.6 deg.C
*.white cubic: zoom scan area, red big cubic: SAR(10g), red small cubic: SAR(1g)
*.Tested by: Hiroshi Naka / Tested place:No.7 shielded room., Date tested: September 6, 2011

Appendix 3-10: Validation measurement data (cont'd)

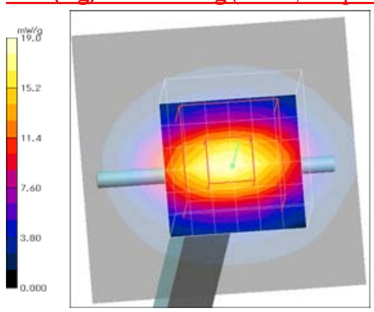
(September 9, 2011) 2450MHz system check (Body) / Forward conducted power: 250mW

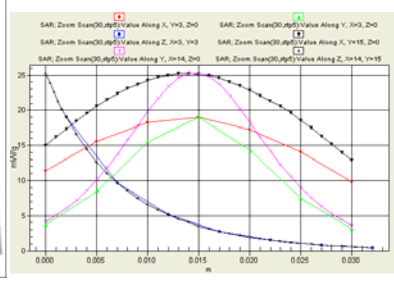
EUT: Dipole 2450 MHz; Type: D2450V2; Serial: 822
Communication System: CW; Frequency: 2450 MHz; Crest Factor: 1.0
Medium: M2450; Medium parameters used(23.7deg.C.): f = 2450 MHz; σ = 1.98 S/m; ε_r = 50.2; ρ = 1000 kg/m^3

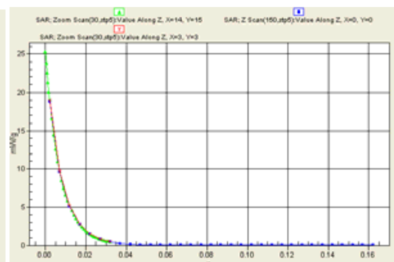
DASY4 Configuration: - Probe: EX3DV4 - SN3679; ConvF(7.34, 7.34, 7.34); Calibrated: 2011/05/19
- Sensor-Surface: 2mm (Mechanical Surface Detection) - Electronics: DAE4 Sn626; Calibrated: 2011/02/10
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1059; Phantom section: Flat Section
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan(60,stp15) (41x41x1): Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (interpolated) = 19.1 mW/g
Z Scan(150,stp5) (1x1x33): Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 18.8 mW/g

Zoom Scan(30,stp5) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm;
Reference Value = 99.4 V/m; Power Drift = -0.076 dB, Maximum value of SAR (measured) = 19.0 mW/g
Peak SAR (extrapolated) = 25.2 W/kg (-6.7%, vs. speag-cal=27.0W/kg)
SAR(1 g) = 12.5 mW/g (-1.8%, vs. speag-cal=12.73mW/g); **SAR(10 g) = 5.88 mW/g**







Additional information:
*.position: distance of dipole to phantom: 8mm (10mm to liquid), liquid depth: 158mm
*.ambient: 23.8 deg.C / 57 %RH; liquid temperature: (before) 23.6 deg.C /(after) 23.6 deg.C
*.white cubic: zoom scan area, red big cubic: SAR(10g), red small cubic: SAR(1g)
*.Tested by: Hiroshi Naka / Tested place:No.7 shielded room., Date tested: September 9, 2011

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Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822)

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 (PTT)

Certificate No: D2450V2-822_Jan11

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 822
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits
Calibration date:	January 05, 2011

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-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-10)	In house check: Oct-11

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

Issued: January 5, 2011

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Certificate No: D2450V2-822_Jan11 Page 1 of 9

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

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Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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.

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

Measurement Conditions

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

DASY Version	DASY5	V52.6
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	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.74 mho/m ± 6 %
Head TSL temperature during test	(21.0 ± 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	13.5 mW / g
SAR normalized	normalized to 1W	54.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**54.4 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.33 mW / g
SAR normalized	normalized to 1W	25.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**25.3 mW /g ± 16.5 % (k=2)**

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Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.5 ± 6 %	1.96 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 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	12.8 mW / g
SAR normalized	normalized to 1W	51.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**50.9 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.91 mW / g
SAR normalized	normalized to 1W	23.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**23.6 mW / g ± 16.5 % (k=2)**

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Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω + 3.6 jΩ
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.7 Ω + 5.2 jΩ
Return Loss	- 25.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 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	December 11, 2008

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

DASY5 Validation Report for Head TSL

Date/Time: 04.01.2011 14:12:13

Test Laboratory: SPEAG, Zurich, Switzerland

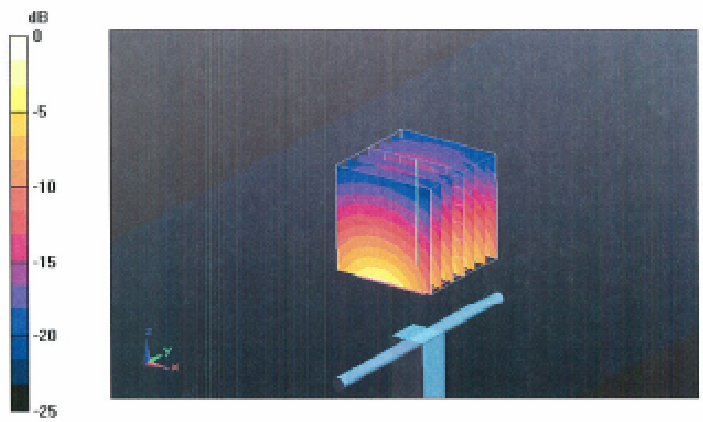
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:822

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U12 BB
Medium parameters used: f = 2450 MHz; σ = 1.75 mho/m; ε_r = 38.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6 Build (401)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

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 = 103.5 V/m; Power Drift = 0.039 dB
Peak SAR (extrapolated) = 27.7 W/kg
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.33 mW/g
Maximum value of SAR (measured) = 17.4 mW/g

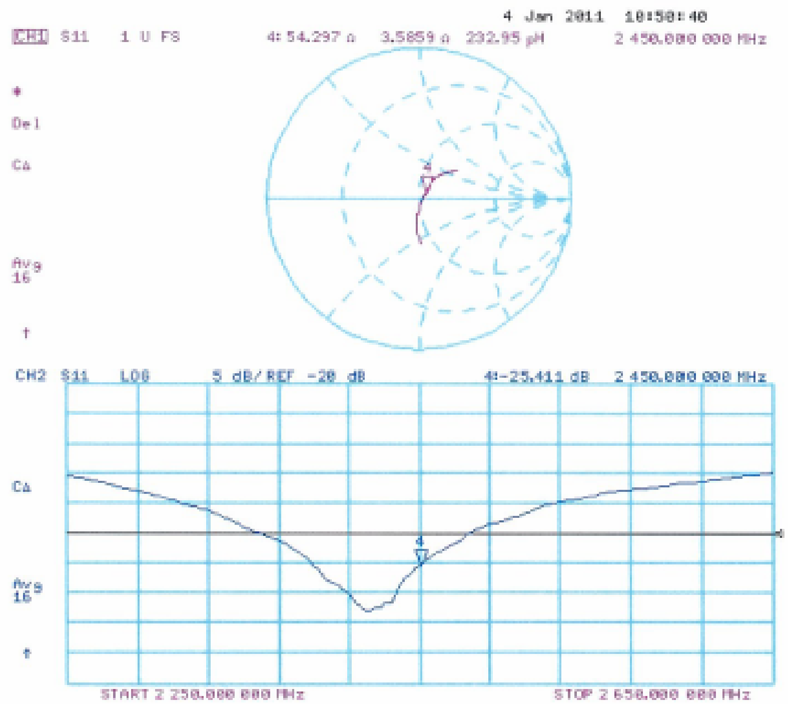


0 dB = 17.4mW/g

Certificate No: D2450V2-822_Jan11 Page 6 of 9

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-822_Jan11 Page 7 of 9

Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

DASY5 Validation Report for Body

Date/Time: 05.01.2011 12:40:53

Test Laboratory: SPEAG, Zurich, Switzerland

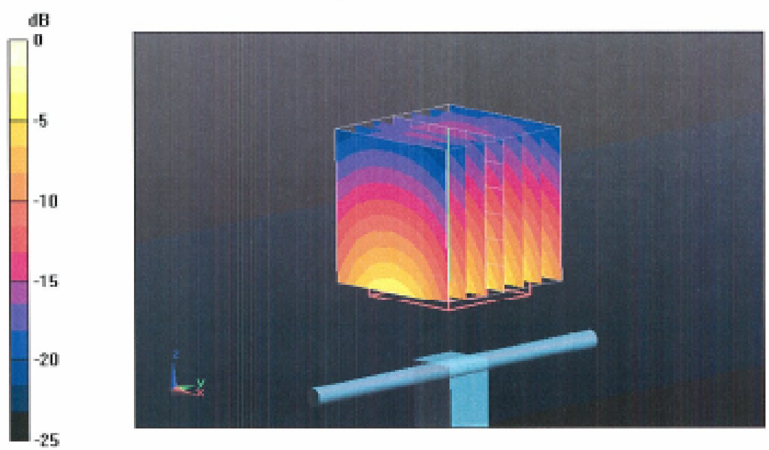
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:822

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL U12 BB
Medium parameters used: f = 2450 MHz; σ = 1.97 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6 Build (401)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

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 = 95.7 V/m; Power Drift = -0.024 dB
Peak SAR (extrapolated) = 27.1 W/kg
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.91 mW/g
Maximum value of SAR (measured) = 16.9 mW/g



0 dB = 16.9mW/g

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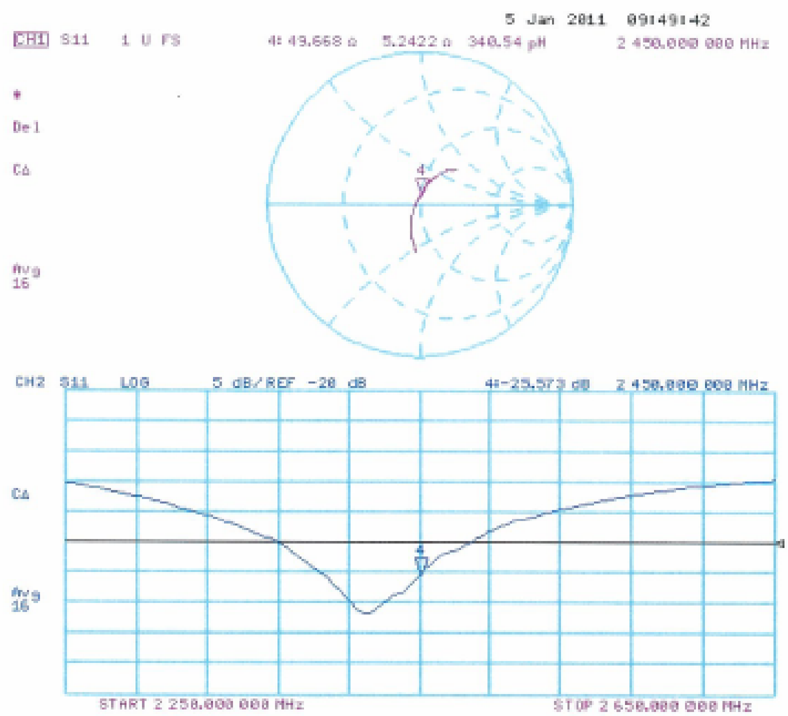
Appendix 3-11: Calibration certificate: Dipole (D2450V2) (sn:822) (cont'd)

Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-822_Jan11 Page 9 of 9

Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070)

Calibration Laboratory of
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Accreditation No.: **SCS 108**

Client **UL Japan (PTT)**

Certificate No: **D5GHzV2-1070_Feb11**

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:	February 16, 2011

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe EX3DV4	SN: 3503	05-Mar-10 (No. EX3-3503_Mar10)	Mar-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-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-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 16, 2011

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Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Calibration Laboratory of
Schmid & Partner
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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 62209-2, "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", March 2010

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 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Measurement Conditions

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

DASY Version	DASY5	V52.6
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 = 2.0 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	35.3 ± 6 %	4.50 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	8.24 mW / g
SAR normalized	normalized to 1W	82.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**82.1 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	normalized to 1W	**23.3 mW / g ± 19.5 % (k=2)**

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Appendix 3-12: 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	36.2 ± 6 %	4.86 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	8.92 mW / g
SAR normalized	normalized to 1W	89.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**89.4 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.50 mW / g
SAR normalized	normalized to 1W	25.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 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	35.6 ± 6 %	5.17 mho/m ± 6 %
Head TSL temperature during test	(22.1 ± 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	8.25 mW / g
SAR normalized	normalized to 1W	82.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**82.6 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 mW / g
SAR normalized	normalized to 1W	23.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.2 mW / g ± 19.5 % (k=2)**

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Appendix 3-12: 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	47.2 ± 6 %	5.37 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 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	7.77 mW / g
SAR normalized	normalized to 1W	77.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**77.1 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 mW / g
SAR normalized	normalized to 1W	21.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.6 ± 6 %	5.75 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 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	8.34 mW / g
SAR normalized	normalized to 1W	83.4 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**82.7 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.29 mW / g
SAR normalized	normalized to 1W	22.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**22.7 mW / g ± 19.5 % (k=2)**

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Appendix 3-12: 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	46.2 ± 6 %	6.16 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.30 mW / g
SAR normalized	normalized to 1W	73.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**72.4 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.00 mW / g
SAR normalized	normalized to 1W	20.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**19.8 mW / g ± 19.5 % (k=2)**

Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.5 Ω - 10.2 jΩ
Return Loss	-19.9 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.3 Ω - 8.2 jΩ
Return Loss	-21.8 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.0 Ω - 5.6 jΩ
Return Loss	-23.6 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	54.3 Ω - 9.3 jΩ
Return Loss	-20.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.8 Ω - 8.6 jΩ
Return Loss	-21.3 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.8 Ω - 3.9 jΩ
Return Loss	-25.6 dB

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Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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

UL Japan, Inc.
Shonan EMC Lab.
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Telephone: +81 463 50 6400 / Facsimile: +81 463 50 6401

Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

DASY5 Validation Report for Head TSL

Date/Time: 11.02.2011 15:14:35

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: HSL 5000
Medium parameters used: f = 5200 MHz; σ = 4.5 mho/m; ε_r = 35.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5500 MHz; σ = 4.86 mho/m; ε_r = 36.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 5.17 mho/m; ε_r = 35.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.36, 5.36, 5.36), ConvF(4.85, 4.85, 4.85), ConvF(4.74, 4.74, 4.74); Calibrated: 05.03.2010
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

Pin=100mW/d=10mm, f=5200 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 65.848 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.362 W/kg
SAR(1 g) = 8.24 mW/g; SAR(10 g) = 2.34 mW/g
Maximum value of SAR (measured) = 16.014 mW/g

Pin=100mW/d=10mm, f=5500 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 66.309 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 36.103 W/kg
SAR(1 g) = 8.92 mW/g; SAR(10 g) = 2.5 mW/g
Maximum value of SAR (measured) = 17.730 mW/g

Pin=100mW/d=10mm, f=5800 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 63.058 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 35.384 W/kg
SAR(1 g) = 8.25 mW/g; SAR(10 g) = 2.32 mW/g
Maximum value of SAR (measured) = 16.408 mW/g

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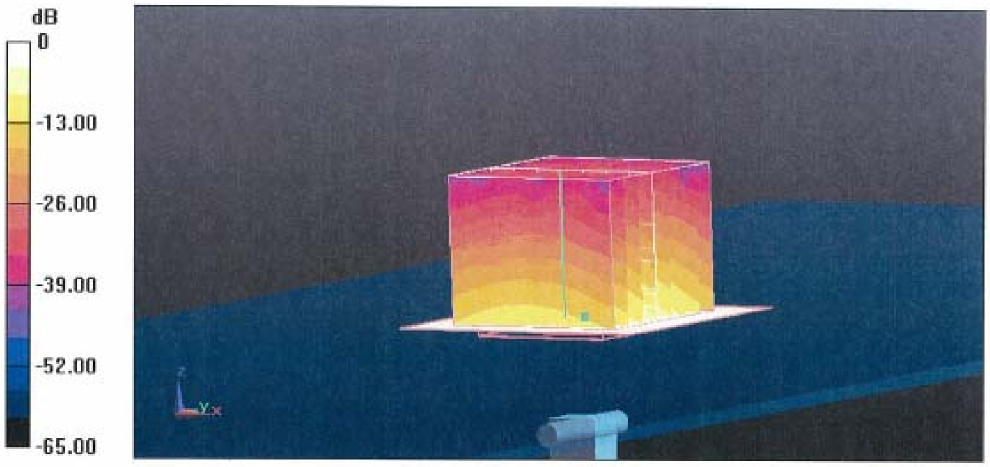
Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)



0 dB = 16.560mW/g

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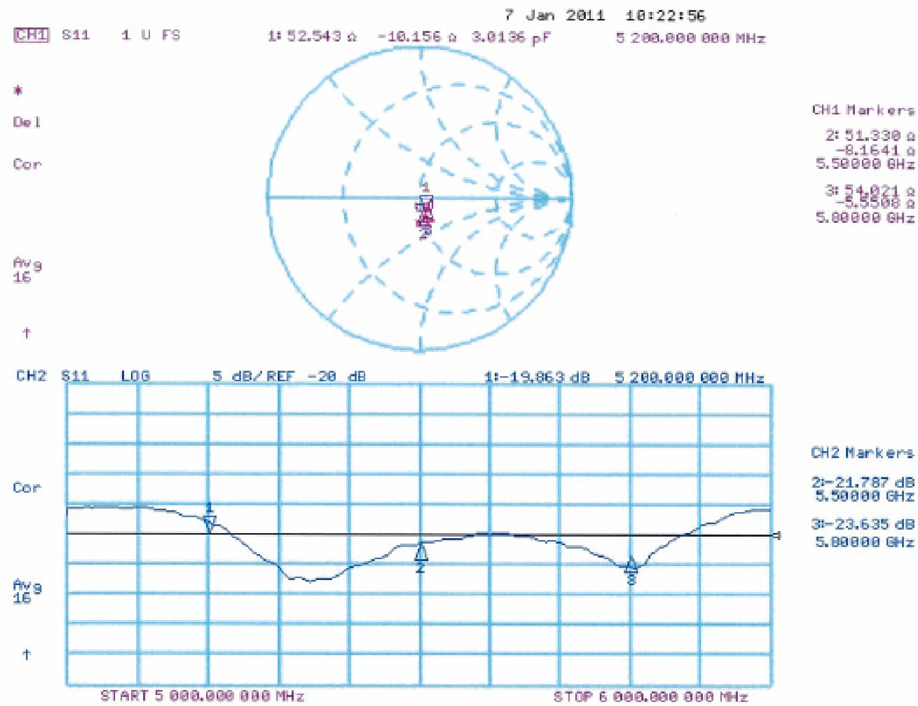
Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Impedance Measurement Plot for Head TSL



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Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

DASY5 Validation Report for Body TSL

Date/Time: 16.02.2011 15:22:06

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL 5000 MHz
Medium parameters used: f = 5200 MHz; σ = 5.4 mho/m; ε_r = 47.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5500 MHz; σ = 5.78 mho/m; ε_r = 46.6; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 6.16 mho/m; ε_r = 46.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.88, 4.88, 4.88), ConvF(4.37, 4.37, 4.37), ConvF(4.57, 4.57, 4.57); Calibrated: 05.03.2010
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

Pin=100mW/d=10mm, f=5200 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 60.047 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 31.080 W/kg
SAR(1 g) = 7.77 mW/g; SAR(10 g) = 2.15 mW/g
Maximum value of SAR (measured) = 15.512 mW/g

Pin=100mW/d=10mm, f=5500 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 60.794 V/m; Power Drift = 0.0024 dB
Peak SAR (extrapolated) = 35.594 W/kg
SAR(1 g) = 8.34 mW/g; SAR(10 g) = 2.29 mW/g
Maximum value of SAR (measured) = 16.750 mW/g

Pin=100mW/d=10mm, f=5800 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 54.748 V/m; Power Drift = -0.0008 dB
Peak SAR (extrapolated) = 33.007 W/kg
SAR(1 g) = 7.3 mW/g; SAR(10 g) = 2 mW/g
Maximum value of SAR (measured) = 14.959 mW/g

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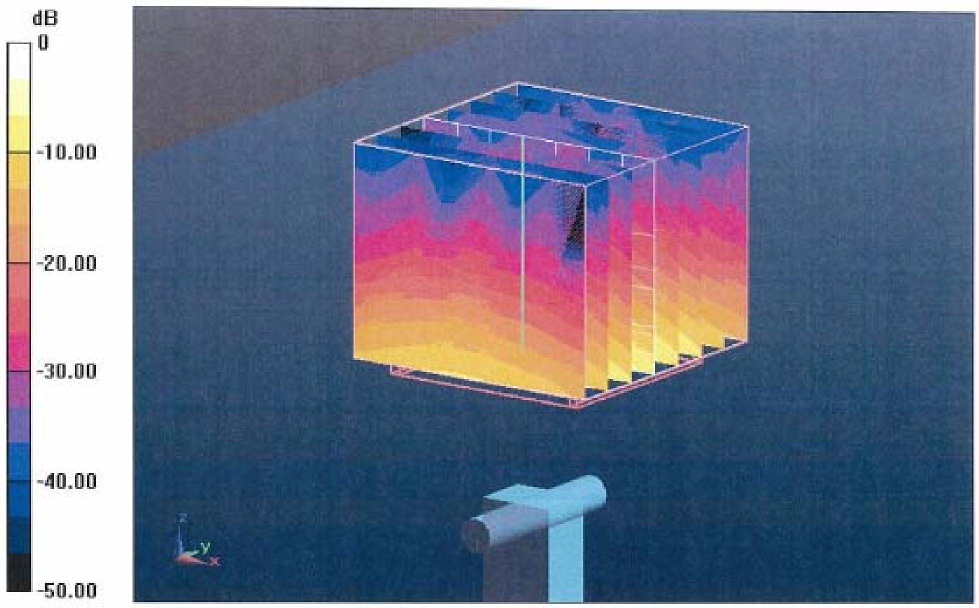
Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

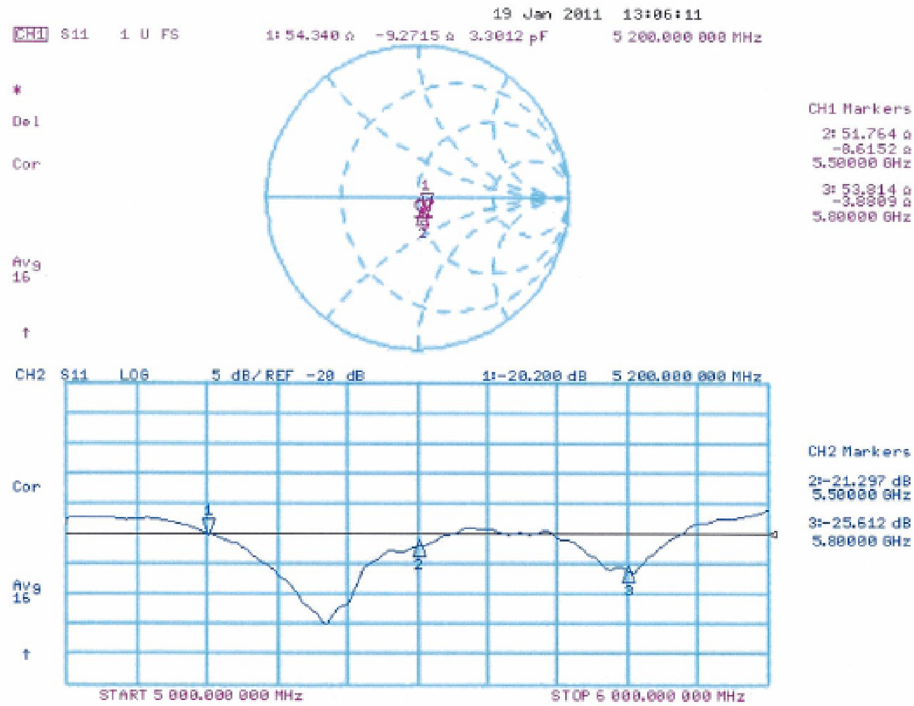


0 dB = 15.170mW/g

Certificate No: D5GHzV2-1070_Feb11 Page 13 of 14

Appendix 3-12: Calibration certificate: Dipole (D5GHzV2) (sn:1070) (cont'd)

Impedance Measurement Plot for Body TSL



Certificate No: D5GHzV2-1070_Feb11 Page 14 of 14

Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679)

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 (PTT)

Certificate No: EX3-3679_May11

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3679

Calibration procedure(s): QA CAL-01.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v3
Calibration procedure for dosimetric E-field probes

Calibration date: May 19, 2011

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

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

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	[signature]
Approved by:	Fin Bomholt	R&D Director	[signature]

Issued: May 19, 2011

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

Certificate No: EX3-3679_May11 Page 1 of 11

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Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

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

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

Accredited by the Swiss Accreditation Service (SAS)
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 affect 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.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z* are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- *VR:* VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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.

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Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

Probe EX3DV4

SN:3679

Manufactured: September 9, 2008
Calibrated: May 19, 2011

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

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Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.59	0.54	0.53	± 10.1 %
DCP (mV)[B]	94.8	96.0	97.1	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	128.0	±3.0 %
			Y	0.00	0.00	1.00	118.6	
			Z	0.00	0.00	1.00	117.6	

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 max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2450	39.2	1.80	6.99	6.99	6.99	0.62	0.71	± 12.0 %
5200	36.0	4.66	4.62	4.62	4.62	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.40	4.40	4.40	0.45	1.80	± 13.1 %
5500	35.6	4.96	4.27	4.27	4.27	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.11	4.11	4.11	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.11	4.11	4.11	0.50	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4- SN:3679

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2450	52.7	1.95	7.34	7.34	7.34	0.74	0.67	± 12.0 %
5200	49.0	5.30	4.10	4.10	4.10	0.52	1.95	± 13.1 %
5300	48.9	5.42	3.88	3.88	3.88	0.55	1.95	± 13.1 %
5500	48.6	5.65	3.65	3.65	3.65	0.56	1.95	± 13.1 %
5600	48.5	5.77	3.45	3.45	3.45	0.60	1.95	± 13.1 %
5800	48.2	6.00	3.94	3.94	3.94	0.55	1.95	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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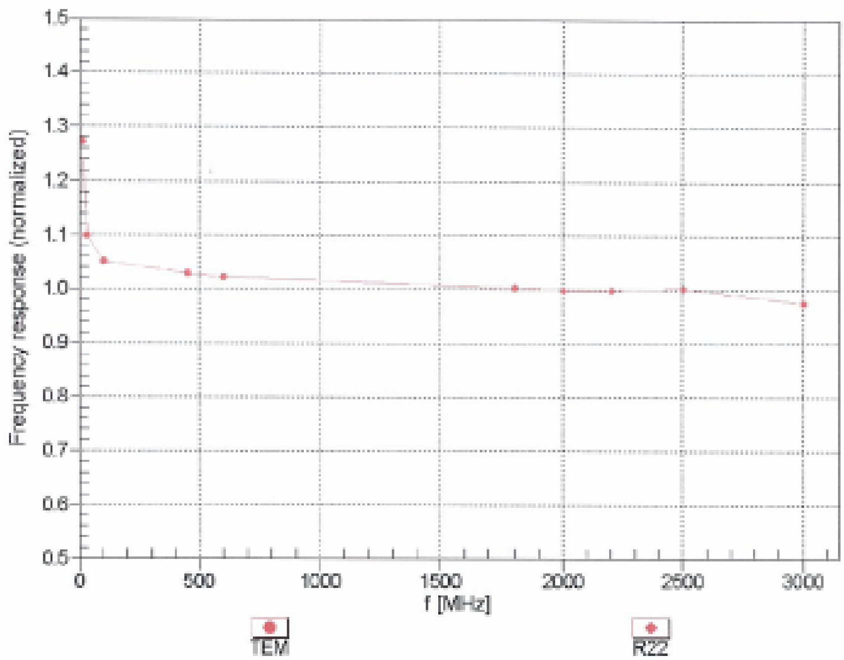
Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

Frequency Response of E-Field

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



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

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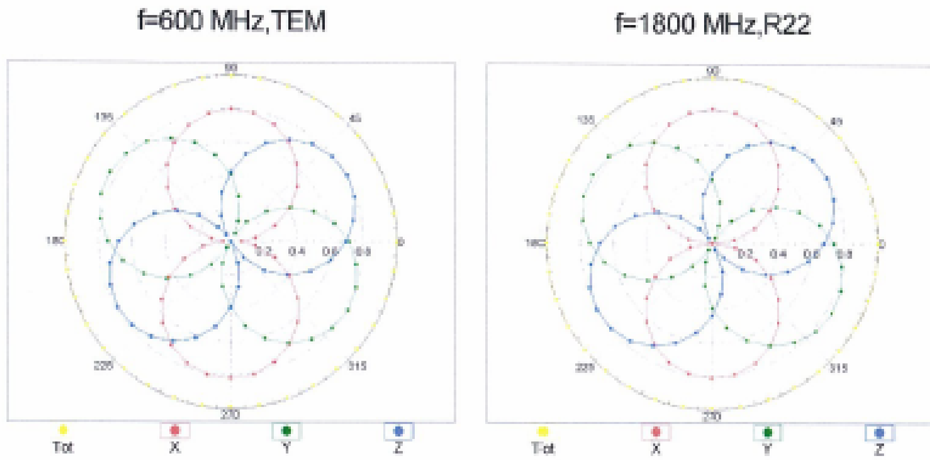
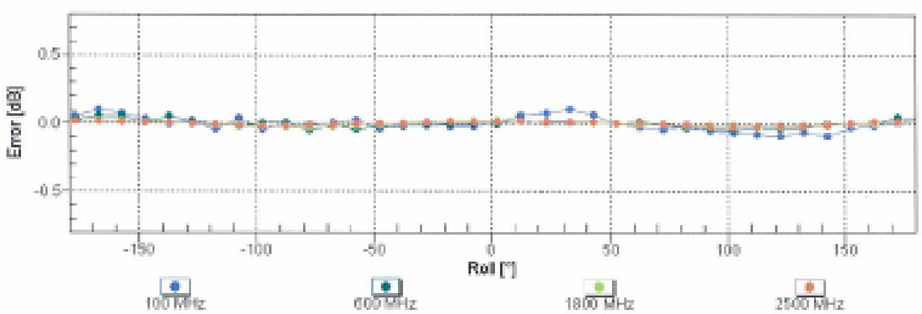
Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

Receiving Pattern (ϕ), $\vartheta = 0°$





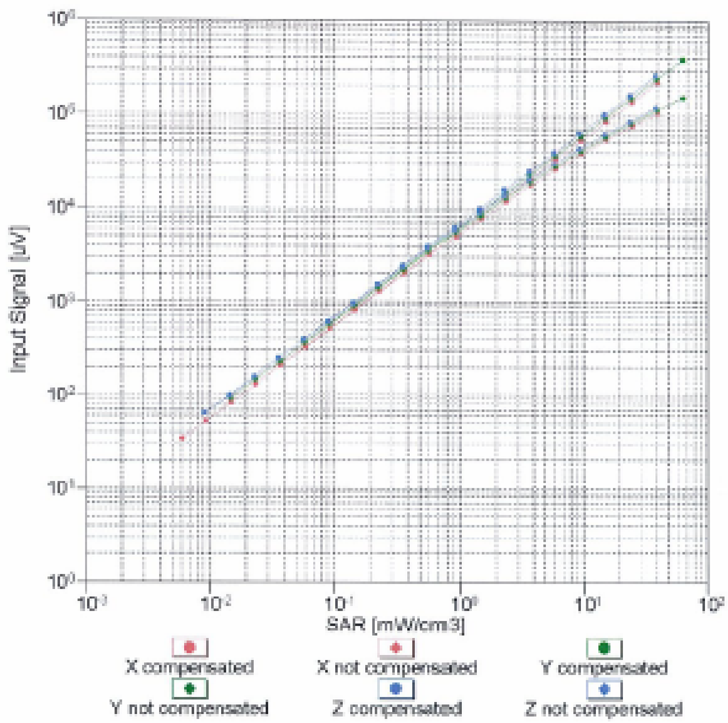
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

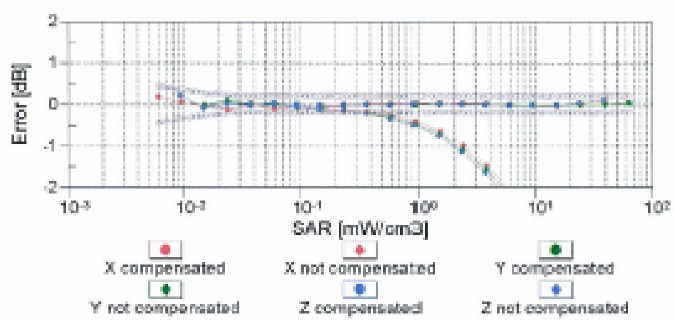
Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4– SN:3679 May 19, 2011

Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)





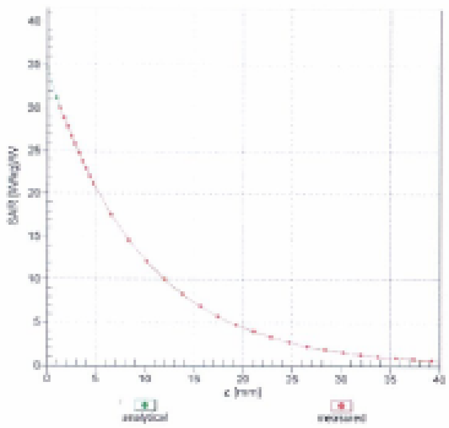
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

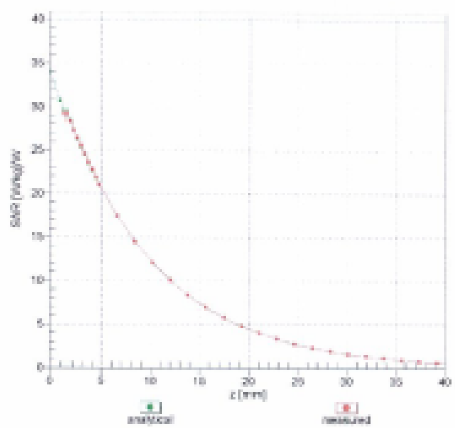
Certificate No: EX3-3679_May11 Page 9 of 11

Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

EX3DV4– SN:3679 May 19, 2011

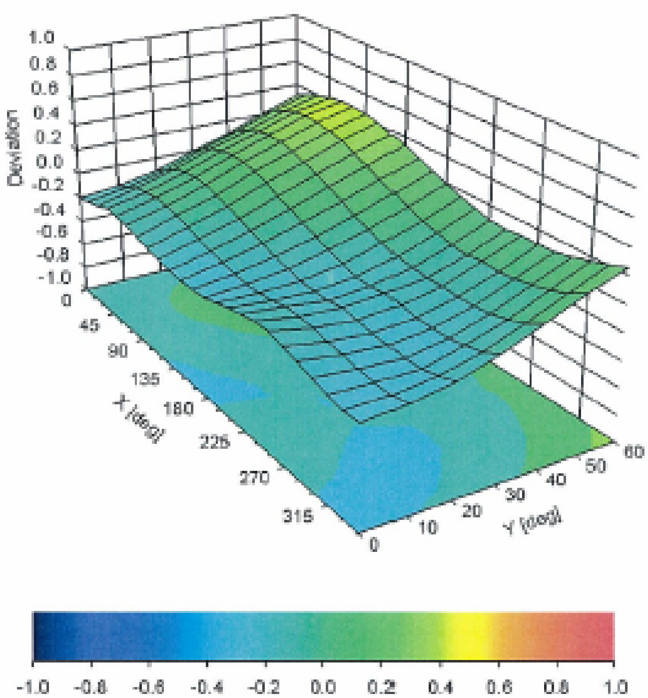
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3679_May11 Page 10 of 11

Appendix 3-13: Calibration certificate: E-Field Probe (EX3DV4) (sn:3679) (cont'd)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3679

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

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Appendix 3-14: 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).