

Date: 2012-04-02

Test Laboratory: SGS Korea (Gimpo Laboratory)
 File Name: WLAN_Back Screen_11a_5Mbps_CH165_Main ANT.dad

DUT: 62230ANHMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

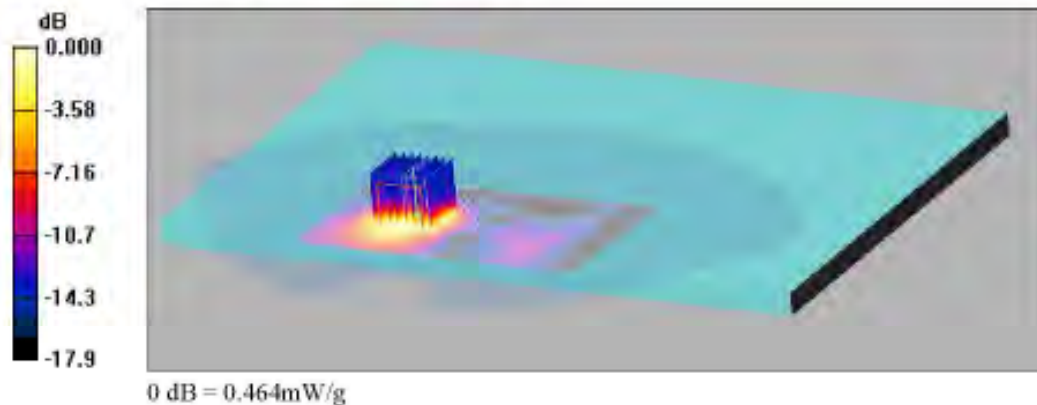
Communication System: WLAN(11a_U-NII Upper); Frequency: 5825 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 5825$ MHz; $\sigma = 6.22$ mho/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11a_CH165_Back Screen_Main ANT/Area Scan (81x141x1): Measurement
 grid: dx=10mm, dy=10mm
 Maximum value of SAR (interpolated) = 0.475 mW/g

WLAN_11a_CH165_Back Screen_Main ANT/Zoom Scan (8x8x13)/Cube 0:
 Measurement grid: dx=4mm, dy=4mm, dz=2mm
 Reference Value = 2.13 V/m; Power Drift = -0.118 dB
 Peak SAR (extrapolated) = 0.920 W/kg
SAR(1 g) = 0.258 mW/g; SAR(10 g) = 0.112 mW/g
 Maximum value of SAR (measured) = 0.464 mW/g



Date: 2012-04-02

Test Laboratory: SGS Korea (Gimpo Laboratory)
 File Name: WLAN_Back Screen_11a_5Mbps_CH149_AUX ANT.dad

DUT: 62230ANHMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

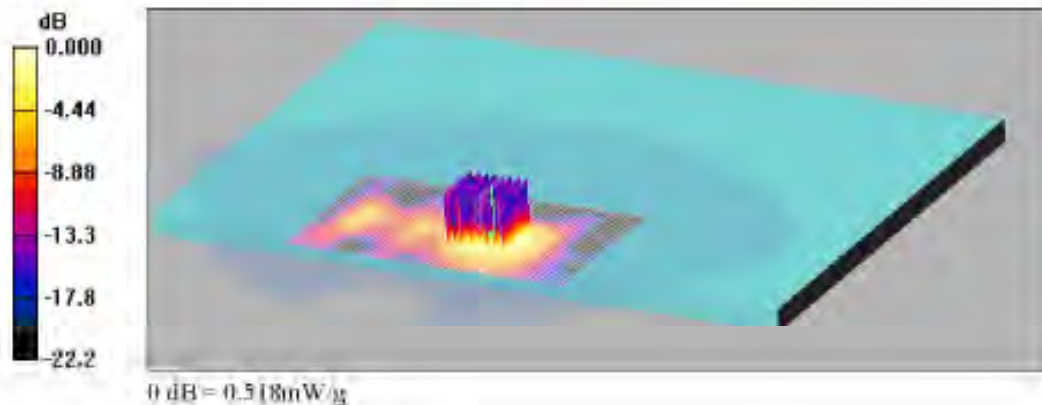
Communication System: WLAN(11a_U-NII Upper); Frequency: 5745 MHz; Duty Cycle: 1/1
 Medium parameters used: $f = 5745 \text{ MHz}$; $\sigma = 6.12 \text{ mho/m}$; $\epsilon_r = 47.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11a_CH149_Back Screen_AUX ANT/Area Scan (81x141x1): Measurement
 grid: dx=10mm, dy=10mm
 Maximum value of SAR (interpolated) = 0.514 mW/g

WLAN_11a_CH149_Back Screen_AUX ANT/Zoom Scan (8x8x13)/Cube 0:
 Measurement grid: dx=4mm, dy=4mm, dz=2mm
 Reference Value = 3.42 V/m; Power Drift = 0.396 dB
 Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.280 mW/g; SAR(10 g) = 0.119 mW/g
 Maximum value of SAR (measured) = 0.518 mW/g



Date: 2012-04-02

Test Laboratory: SGS Korea (Gumpo Laboratory)
 File Name: WLAN_Base_11n20_HT8_CH149_MIMO ANT.daa

DUT: 62230ANIMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

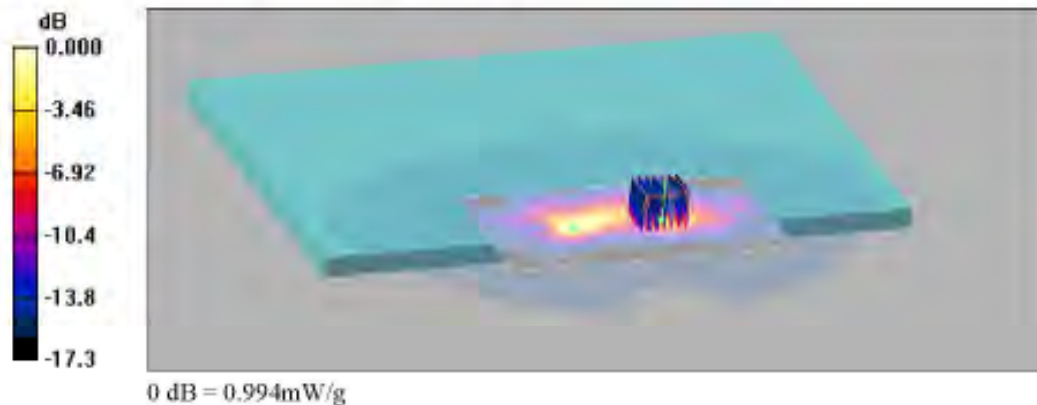
Communication System: WLAN(11a_U-NII Upper); Frequency: 5745 MHz; Duty Cycle: 1/1
 Medium parameters used: $f = 5745 \text{ MHz}$; $\sigma = 6.12 \text{ mho/m}$; $\epsilon_r = 47.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11n20_CH149_Base_MIMO ANT/Area Scan (91x151x1): Measurement grid:
 $dx=10\text{mm}$, $dy=10\text{mm}$
 Maximum value of SAR (interpolated) = 0.917 mW/g

WLAN_11n20_CH149_Base_MIMO ANT/Zoom Scan (7x7x12)/Cube 0: Measurement
 grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$
 Reference Value = 8.17 V/m; Power Drift = 0.043 dB
 Peak SAR (extrapolated) = 2.17 W/kg
SAR(1 g) = 0.502 mW/g; SAR(10 g) = 0.160 mW/g
 Maximum value of SAR (measured) = 0.994 mW/g



Date: 2012-04-02

Test Laboratory: SGS Korea (Gumpo Laboratory)
 File Name: WLAN_Base_11n20_HT8_CH149_MIMO ANT.daa

DUT: 62230ANIMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

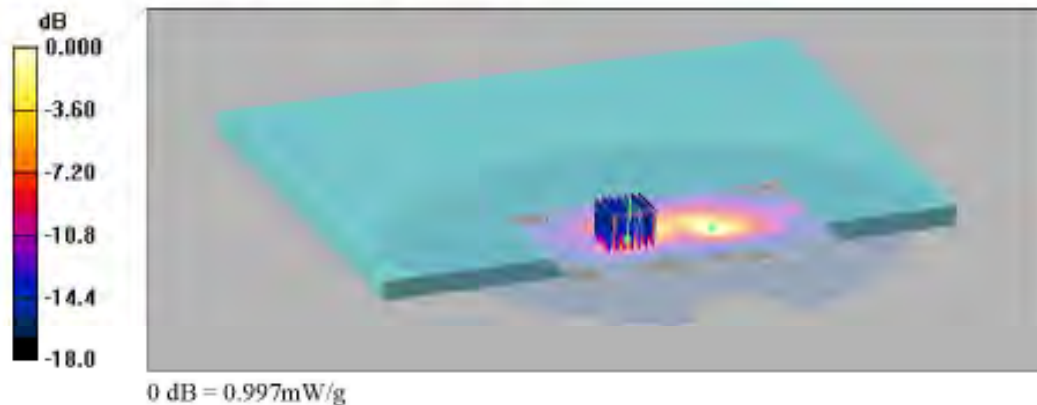
Communication System: WLAN(11a_U-NII Upper); Frequency: 5745 MHz; Duty Cycle: 1/1
 Medium parameters used: $f = 5745 \text{ MHz}$; $\sigma = 6.12 \text{ mho/m}$; $\epsilon_r = 47.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11n20_CH149_Base_MIMO ANT/Area Scan (91x151x1): Measurement grid:
 $dx=10\text{mm}$, $dy=10\text{mm}$
 Maximum value of SAR (interpolated) = 0.917 mW/g

WLAN_11n20_CH149_Base_MIMO ANT/Zoom Scan (7x7x12)/Cube 1: Measurement
 grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$
 Reference Value = 8.17 V/m; Power Drift = 0.043 dB
 Peak SAR (extrapolated) = 2.15 W/kg
SAR(1 g) = 0.474 mW/g; SAR(10 g) = 0.144 mW/g
 Maximum value of SAR (measured) = 0.997 mW/g



Date: 2012-04-02

Test Laboratory: SGS Korea (Gumpo Laboratory)
 File Name: WLAN_Base_11n20_CH151_MIMO ANT.dsa4

DUT: 62230ANIMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

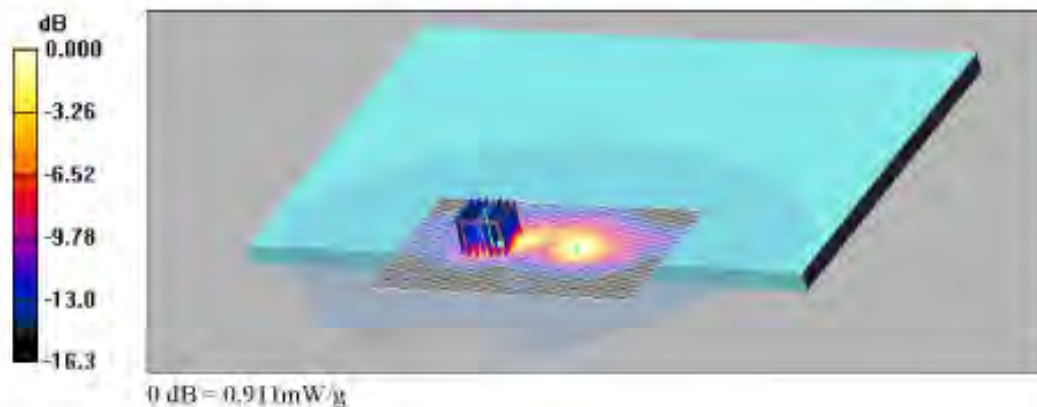
Communication System: WLAN(11a_U-NII Upper); Frequency: 5755 MHz; Duty Cycle: 1/1
 Medium parameters used: $f = 5755$ MHz; $\sigma = 6.13$ mho/m; $\epsilon_r = 47.7$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11n20_CH151_Base_MIMO ANT/Area Scan (91x151x1): Measurement grid:
 dx=10mm, dy=10mm
 Maximum value of SAR (interpolated) = 0.929 mW/g

WLAN_11n20_CH151_Base_MIMO ANT/Zoom Scan (7x7x12)/Cube 0: Measurement
 grid: dx=4mm, dy=4mm, dz=2mm
 Reference Value = 8.72 V/m; Power Drift = 0.199 dB
 Peak SAR (extrapolated) = 2.08 W/kg
SAR(1 g) = 0.477 mW/g; SAR(10 g) = 0.162 mW/g
 Maximum value of SAR (measured) = 0.911 mW/g



Date: 2012-04-02

Test Laboratory: SGS Korea (Gimpo Laboratory)
 File Name: WLAN_Base_11n20_CH151_MIMO ANT.dsa4

DUT: 62230ANIMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

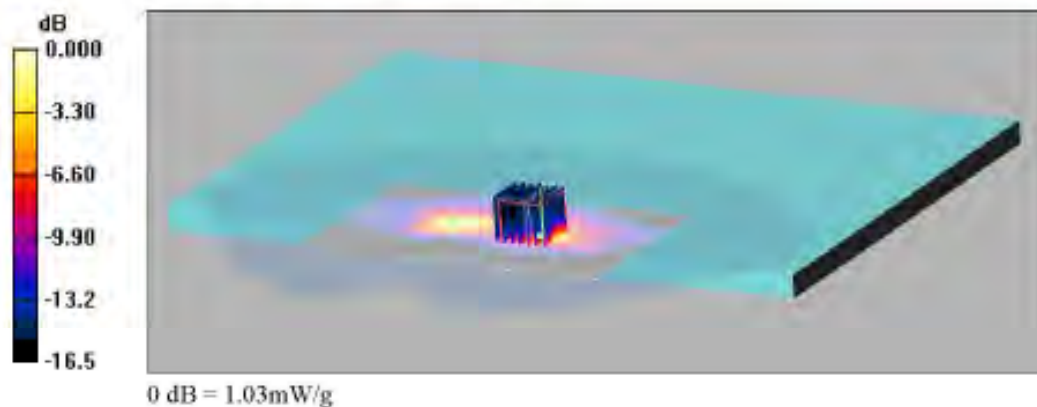
Communication System: WLAN(11a_U-NII Upper); Frequency: 5755 MHz; Duty Cycle: 1/1
 Medium parameters used: $f = 5755 \text{ MHz}$; $\sigma = 6.13 \text{ mho/m}$; $\epsilon_r = 47.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11n20_CH151_Base_MIMO ANT/Area Scan (91x151x1): Measurement grid:
 dx=10mm, dy=10mm
 Maximum value of SAR (interpolated) = 0.929 mW/g

WLAN_11n20_CH151_Base_MIMO ANT/Zoom Scan (7x7x12)/Cube 1: Measurement
 grid: dx=4mm, dy=4mm, dz=2mm
 Reference Value = 8.72 V/m; Power Drift = 0.199 dB
 Peak SAR (extrapolated) = 2.28 W/kg
SAR(1 g) = 0.510 mW/g; SAR(10 g) = 0.161 mW/g
 Maximum value of SAR (measured) = 1.03 mW/g



Date: 2012-04-02

Test Laboratory: SGS Korea (Gimpo Laboratory)

File Name: WLAN_Back Screen_11n40_HT8_CH151_MIMO ANT.da4

DUT: 62230ANHMW(NP900X4B); Type: Module(Note PC); Serial: HSP991GC200041R
Program Name: WLAN_Body

Communication System: WLAN(11a_U-NII Upper); Frequency: 5755 MHz; Duty Cycle: 1/1

Medium parameters used: $f = 5755$ MHz; $\sigma = 6.13$ mho/m; $\epsilon_r = 47.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(3.66, 3.66, 3.66); Calibrated: 2011-06-21
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2012-01-20
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

WLAN_11n40_CH151_Back Screen_MIMO ANT/Area Scan (91x151x1):

Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.247 mW/g

WLAN_11n40_CH151_Back Screen_MIMO ANT/Zoom Scan (7x7x12)/Cube 0:

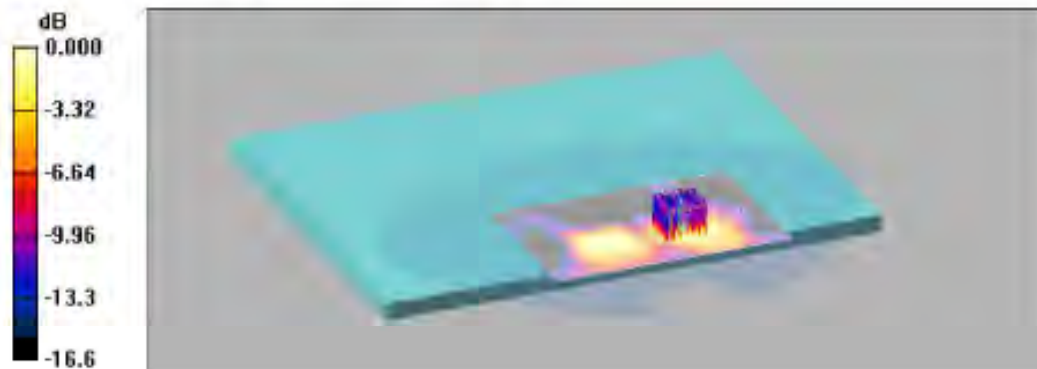
Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.23 V/m; Power Drift = -0.095 dB

Peak SAR (extrapolated) = 0.517 W/kg

SAR(1 g) = 0.147 mW/g; SAR(10 g) = 0.065 mW/g

Maximum value of SAR (measured) = 0.257 mW/g



Appendix B

Uncertainty Analysis (2.45GHz)

a	b	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob. Dist.	Div.	Ci (1g)	1g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.0	N	1	1	6.0	∞
Axial isotropy	E.2.2	0.5	R	1.73	0.71	0.20	∞
hemispherical isotropy	E.2.2	2.6	R	1.73	0.71	1.06	∞
Boundary effect	E.2.3	0.8	R	1.73	1	0.46	∞
Linearity	E.2.4	0.6	R	1.73	1	0.35	∞
System detection limit	E.2.5	0.25	R	1.73	1	0.14	∞
Readout electronics	E.2.6	0.3	N	1	1	0.30	∞
Response time	E.2.7	0	R	1.73	1	0.00	∞
Integration time	E.2.8	2.6	R	1.73	1	1.50	∞
RF ambient Condition –Noise	E.6.1	3	R	1.73	1	1.73	∞
RF ambient Condition – reflections	E.6.1	3	R	1.73	1	1.73	∞
Probe positioning– mechanical tolerance	E.6.2	1.5	R	1.73	1	0.87	∞
Probe positioning– with respect to phantom	E.6.3	2.9	R	1.73	1	1.67	∞
Max. SAR evaluation	E.5.2	1	R	1.73	1	0.58	∞
Test sample positioning	E.4.2	2.3	N	1	1	2.30	9
Device holder uncertainty	E.4.1	3.6	N	1	1	3.60	∞
Output power variation–SAR drift measurement	6.62	5	R	1.73	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	2.31	∞
Liquid conductivity – deviation from target values	E.3.2	5	R	1.73	0.64	1.85	∞
Liquid conductivity – measurement uncertainty	E.3.2	1.2	N	1	0.64	0.77	5
Liquid permittivity – deviation from target values	E.3.3	5	R	1.73	0.6	1.73	∞
Liquid permittivity – measurement uncertainty	E.3.3	1.1	N	1	0.6	0.66	5
Combined standard uncertainty				RSS		9.44	216
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		18.88	

Uncertainty Analysis (5GHz)

a	b	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob . Dist.	Div.	Ci (1g)	1g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.55	N	1	1	6.55	∞
Axial isotropy	E.2.2	0.5	R	1.73	0.71	0.20	∞
hemispherical isotropy	E.2.2	2.6	R	1.73	0.71	1.06	∞
Boundary effect	E.2.3	0.8	R	1.73	1	0.46	∞
Linearity	E.2.4	0.6	R	1.73	1	0.35	∞
System detection limit	E.2.5	0.25	R	1.73	1	0.14	∞
Readout electronics	E.2.6	0.3	N	1	1	0.30	∞
Response time	E.2.7	0	R	1.73	1	0.00	∞
Integration time	E.2.8	2.6	R	1.73	1	1.50	∞
RF ambient Condition –Noise	E.6.1	3	R	1.73	1	1.73	∞
RF ambient Condition – reflections	E.6.1	3	R	1.73	1	1.73	∞
Probe positioning– mechanical tolerance	E.6.2	1.5	R	1.73	1	0.87	∞
Probe positioning– with respect to phantom	E.6.3	2.9	R	1.73	1	1.67	∞
Max. SAR evaluation	E.5.2	1	R	1.73	1	0.58	∞
Test sample positioning	E.4.2	2.3	N	1	1	2.30	9
Device holder uncertainty	E.4.1	3.6	N	1	1	3.60	∞
Output power variation–SAR drift measurement	6.62	5	R	1.73	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	2.31	∞
Liquid conductivity – deviation from target values	E.3.2	5	R	1.73	0.64	1.85	∞
Liquid conductivity – measurement uncertainty	E.3.2	2.68	N	1	0.64	1.72	5
Liquid permittivity – deviation from target values	E.3.3	5	R	1.73	0.6	1.73	∞
Liquid permittivity – measurement uncertainty	E.3.3	1.20	N	1	0.6	0.72	5
Combined standard uncertainty				RSS		9.92	216
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		19.84	

Appendix C

Calibration Certificate

- PROBE (ET3DV6, EX3DV4)

- DAE 3

- 2450 MHz / 5 GHz DIPOLE

- PROBE Calibration Certificate (ET3DV6)

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

Approved 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: SGS (Dymstec)

Certificate No.: ET3-1782_Apr11

CALIBRATION CERTIFICATE

Object: ET3DV6 - SN:1782

Calibration procedure(s): QA CAL-01.v7, QA CAL-12.v6, QA CAL-23.v4, QA CAL-25.v3
Calibration procedure for dosimetric E-field probes

Calibration date: April 14, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41495277	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	23-Apr-10 (No. DAE4-654_Apr10)	Apr-11
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-09 (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:	Jeton Kasrafi	Laboratory Technician	
Approved by:	Kolja Pokovic	Technical Manager	
Issued: April 14, 2011			

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

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



S Schweizerischer Kalibrierdienst
 S 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 100

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\beta = 0$ ($f \leq 800$ MHz in TEM-cell; $f > 1000$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- $NORM(f)_{x,y,z} = NORM_{x,y,z} \cdot \text{frequency_response}$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCP_{x,y,z}$: 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
- $A_{x,y,z}$; $B_{x,y,z}$; $C_{x,y,z}$: $A_{x,y,z}$ 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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} \cdot \text{ConvF}$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): In a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

ET3DV6 – SN:1782

April 14, 2011

Probe ET3DV6

SN:1782

Manufactured: April 15, 2003
Calibrated: April 14, 2011

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

ET3DV6-SN:1782

April 14, 2011

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc. (k=2)
Norm. ($\mu V/(V/m)^2$) ^a	2.07	1.66	1.92	$\pm 10.1\%$
DGP (mV) ^b	96.4	95.6	97.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc. ^c (k=2)
10BDD	CW	0.00	X	0.00	0.00	1.00	111.1	$\pm 1.9\%$
			Y	0.00	0.00	1.00	141.0	
			Z	0.00	0.00	1.00	145.1	

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 Norm X, Y, Z do not affect the E^2 field uncertainty inside TSL (see Pages 5 and 6).

^b Numerical linearization parameter, uncertainty not required.

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

ET3DV6-SN:1782

April 14, 2011

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^E	Relative Permittivity ^F	Conductivity (S/m) ^F	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unit (k=2)
450	43.5	0.67	6.89	6.89	6.89	0.21	2.29	± 13.4 %
935	41.5	0.90	6.22	6.22	6.22	0.88	1.83	± 12.0 %
1750	40.1	1.37	5.14	5.14	5.14	0.57	2.53	± 12.0 %
1900	40.0	1.40	4.95	4.95	4.95	0.68	2.54	± 12.0 %
2450	39.2	1.80	4.37	4.37	4.37	0.80	1.93	± 12.0 %

^E Frequency velocity of ± 100 MHz only applies for DASY v4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the CorrF, 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 η) can be relaxed to ± 10% if head compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and η) is restricted to ± 5%. The uncertainty is the RSS of the CorrF uncertainty for indicated target tissue parameters.

ET3DV6- SN:1782

April 14, 2011

DASY/EASY - Parameters of Probe: ET3DV6- SN:1782

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)	Unit: (k=2)
450	56.7	0.94	7.49	7.49	7.49	0.16	2.34	± 13.4 %
835	55.2	0.97	6.03	6.03	6.03	0.85	1.72	± 12.0 %
1750	53.4	1.49	4.54	4.54	4.54	0.64	2.70	± 12.0 %
1900	53.3	1.52	4.34	4.34	4.34	0.63	2.57	± 12.0 %
2450	52.7	1.95	3.94	3.94	3.94	0.99	1.21	± 12.0 %

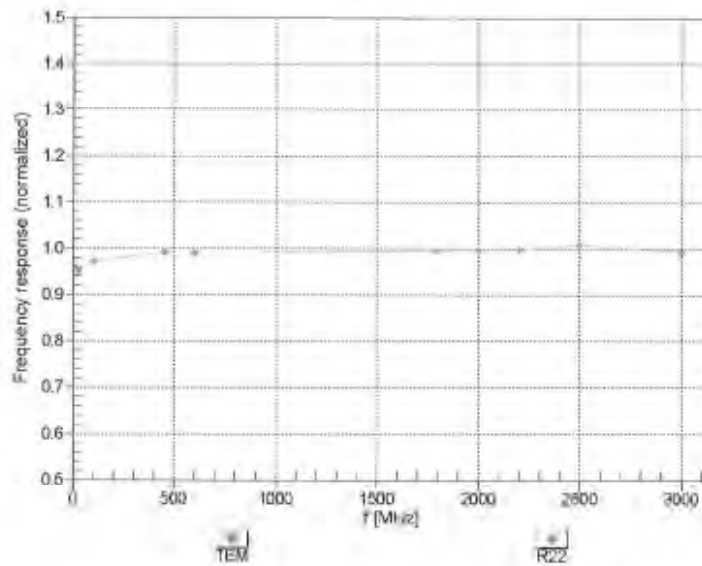
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2); else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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 parameter.

ET313V8- SN:1782

April 14, 2011

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

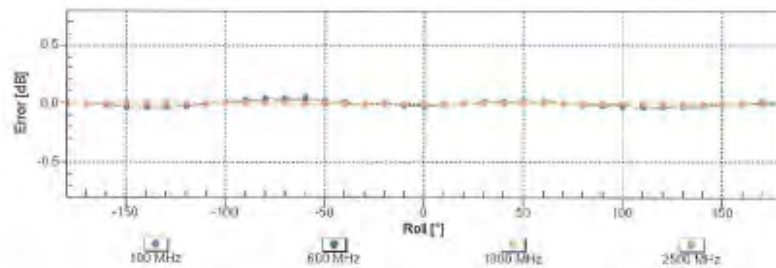
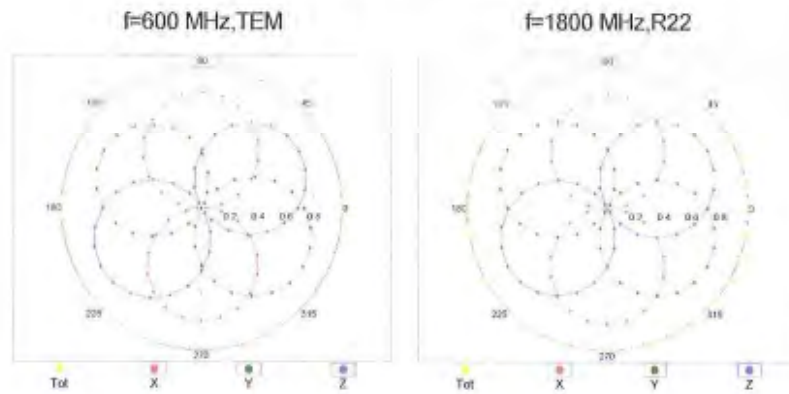


Uncertainty of Frequency Response of E-field: $\pm 5.3\%$ ($k=2$)

ET3DV6- SN:1782

April 14, 2011

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

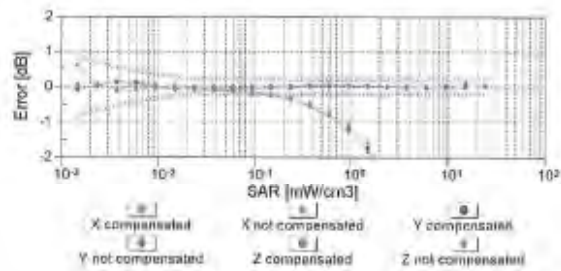
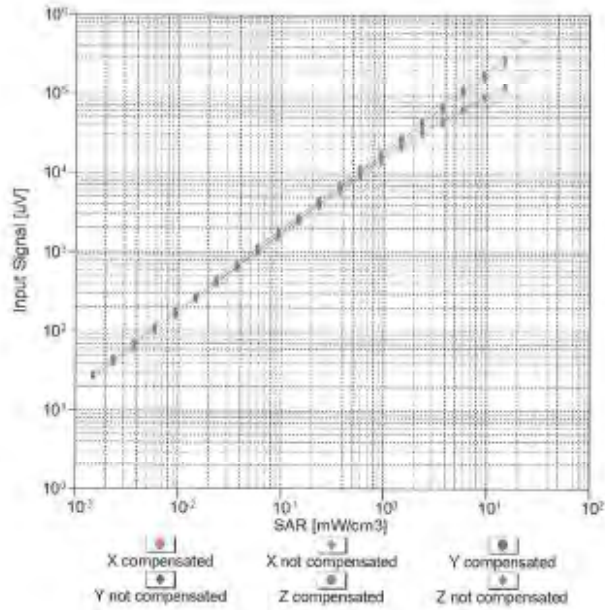


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

ET3DV6-SN:1782

April 14, 2011

Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)

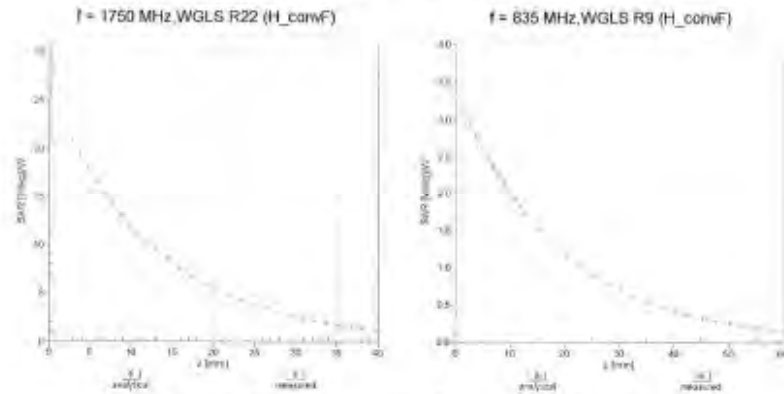


Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

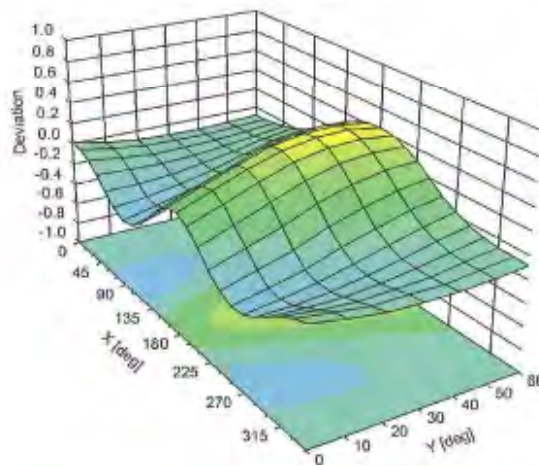
ET3DV6-SN:1782

April 14, 2011

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ , θ), $f = 900$ MHz



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

ET3DV6- SN:1782

Apr 18, 2011

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

Other Probe Parameters

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

- PROBE Calibration Certificate (EX3DV4)

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



S S Schweizerischer Kalibrierdienst
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Accreditation No.: SCS 108

Client: SGS (Dymstec)

Certificate No.: EX3-3791_Jun11

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3791

Calibration procedure(s): QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
 Calibration procedure for dosimetric E-field probes

Calibration date: June 21, 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity < 70%.

Calibration Equipment used (M&PE critical for calibration):

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB4129387a	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor EM12A	MY41495037	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: S5055 (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: B54	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642UD1700	4-Aug-99 (in house check Oct-09)	in house check: Oct-11
Network Analyzer HP 8753E	US37300685	18-Oct-01 (in house check Oct-10)	in house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokojec	Technical Manager	
Approved by:	Niels Kusler	Quality Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			
Issued: June 21, 2011			

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



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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization, $\beta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,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.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,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.

EX3DV4 – SN:3791

June 21, 2011

Probe EX3DV4

SN:3791

Manufactured: February 18, 2011
Calibrated: June 21, 2011

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

EX3DV4-SN:3791

June 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.61	0.56	0.55	$\pm 10.1\%$
DCP (mV) ^B	103.5	101.7	100.4	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^C (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	120.9	$\pm 1.9\%$
			Y	0.00	0.00	1.00	121.4	
			Z	0.00	0.00	1.00	126.5	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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

^B Numerical linearization parameter; uncertainty not required.

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

EX3DV4-SN:3791

June 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

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)
2600	39.0	1.96	6.41	6.41	6.41	0.63	0.72	± 12.0 %
3700	37.7	3.12	5.88	5.88	5.88	0.35	1.09	± 13.1 %
5200	36.0	4.88	4.81	4.81	4.81	0.40	1.90	± 13.1 %
5300	35.9	4.76	4.43	4.43	4.43	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.39	4.39	4.39	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.07	4.07	4.07	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.13	4.13	4.13	0.45	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_r 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_r and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4-SN:3791

June 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4- SN:3791

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	UncL (k=2)
2600	52.5	2.16	6.32	6.32	6.32	0.79	0.60	± 12.0 %
3700	51.0	3.55	5.76	5.76	5.76	0.31	1.43	± 13.1 %
5200	49.0	5.30	3.96	3.96	3.96	0.55	1.90	± 13.1 %
5300	48.9	5.42	3.79	3.79	3.79	0.55	1.90	± 13.1 %
5500	48.6	5.65	3.48	3.48	3.48	0.60	1.90	± 13.1 %
5600	48.5	5.77	3.26	3.26	3.26	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.66	3.66	3.66	0.60	1.90	± 13.1 %

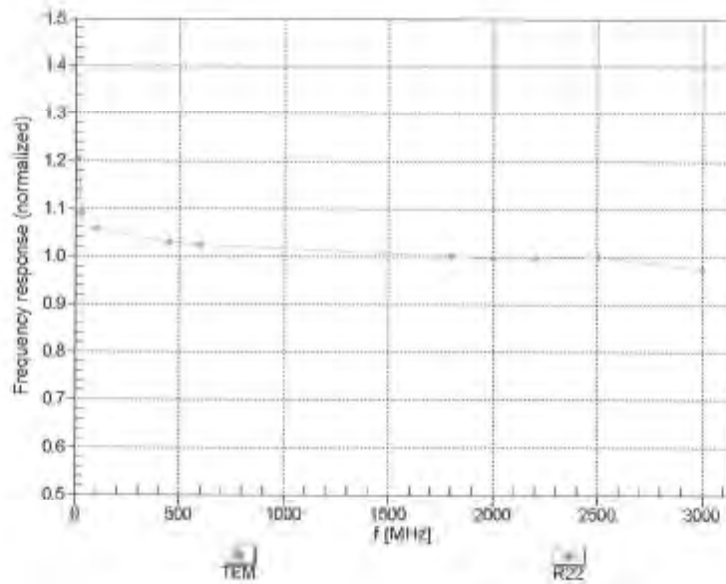
¹ Frequency validity of ± 100 MHz only applies for DASY v6.0 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

² At frequencies below 3 GHz, the validity of tissue parameters (ε and α) 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 α) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

EX3DV4- SN:3791

June 21, 2011

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



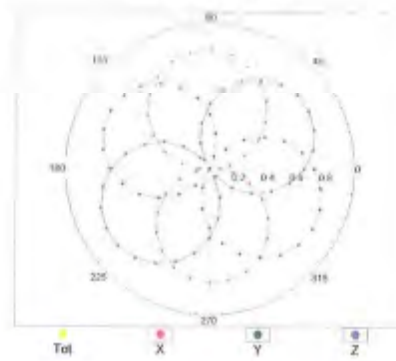
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

EX3DV4-SN:3791

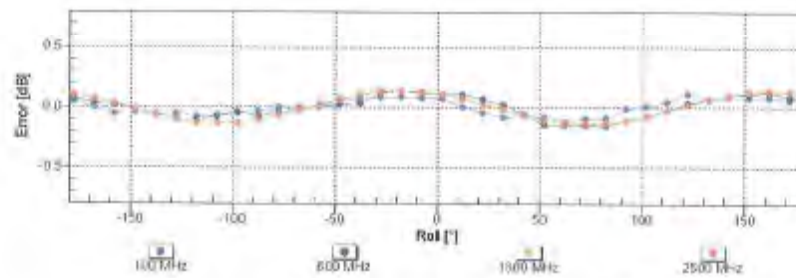
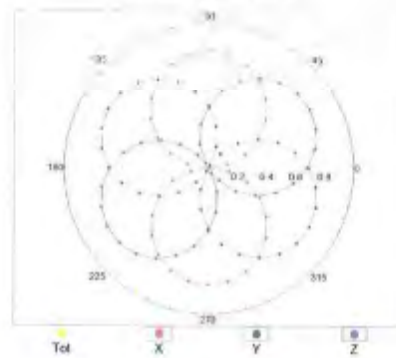
June 21, 2011

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

f=600 MHz,TEM



f=1800 MHz,R22

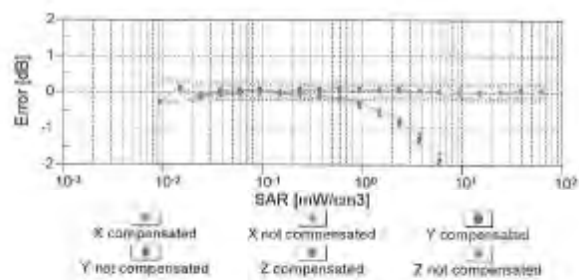
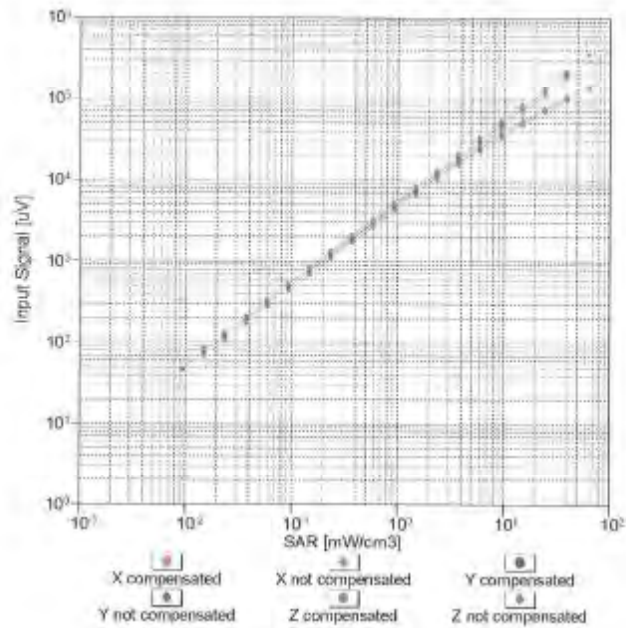


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4- SN:3791

June 21, 2011

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$)

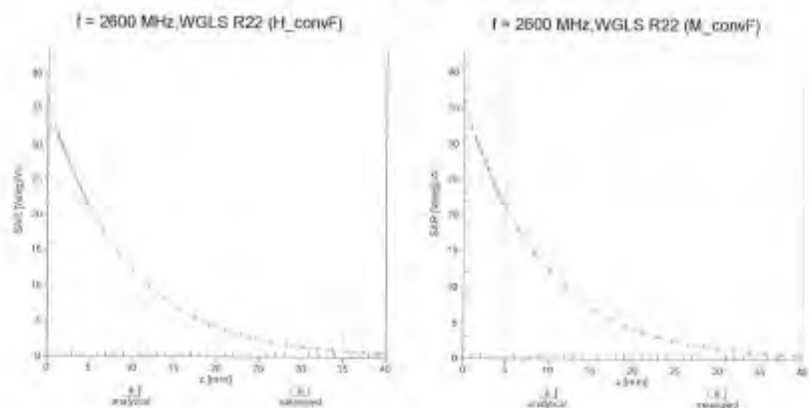


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

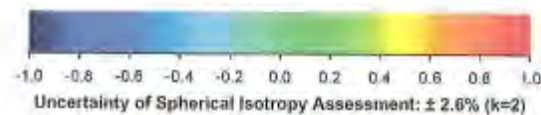
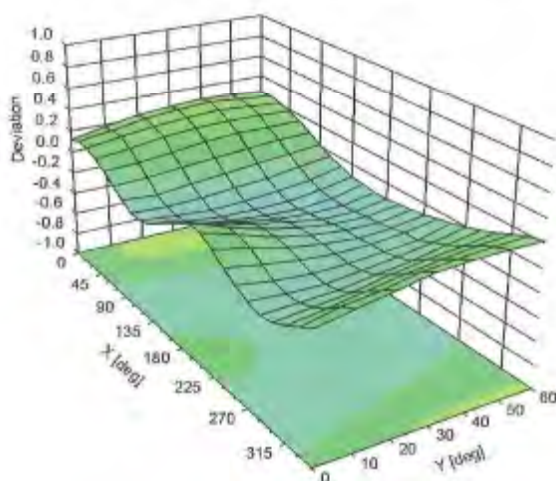
EX3DV4- SN:3791

June 21, 2011

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), $f = 900 \text{ MHz}$



EX3DV4- SN:3791

June 25, 2011

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

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

-DAE 3 Calibration Certificate

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



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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No: **DAE3-567_Jan12**

CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 567**

Calibration procedure(s) **QA CAL-06.v24
 Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **January 20, 2012**

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 (IM&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Kathley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V2.1	SE UWS 063 AA 1001	05-Jan-12 (in house check)	In house check, Jan-13

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bornholt	R&D Director	

Issued: January 20, 2012

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

**Calibration Laboratory of
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 Zeughausstrasse 43, 8004 Zurich, Switzerland



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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

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV

Low Range: 1LSB = 61 nV, full range = -1...+3 mV

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

Calibration Factors	X	Y	Z
High Range	404.763 $\pm$ 0.1% (k=2)	404.411 $\pm$ 0.1% (k=2)	404.499 $\pm$ 0.1% (k=2)
Low Range	3.85035 $\pm$ 0.7% (k=2)	3.97119 $\pm$ 0.7% (k=2)	3.95014 $\pm$ 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	7.5 $^{\circ}$ $\pm$ 1 $^{\circ}$
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Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	19998.82	3.53	0.00
Channel X + Input	20005.03	-4.17	0.02
Channel X - Input	-19996.67	3.44	-0.02
Channel Y + Input	19997.37	2.30	0.00
Channel Y + Input	19999.48	-1.11	-0.01
Channel Y - Input	-19988.88	1.52	-0.01
Channel Z + Input	19994.27	-0.68	-0.00
Channel Z + Input	20001.19	0.52	0.00
Channel Z - Input	-19995.78	4.48	-0.02

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	1999.73	-1.35	-0.07
Channel X + Input	200.29	-1.35	-0.67
Channel X - Input	-197.22	0.97	-0.49
Channel Y + Input	1999.97	-1.02	-0.05
Channel Y + Input	200.82	-0.73	-0.36
Channel Y - Input	-198.58	-0.24	0.12
Channel Z + Input	2000.13	-0.92	-0.05
Channel Z + Input	200.68	-0.79	-0.39
Channel Z - Input	-199.26	-0.95	0.48

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	8.01	1.84
	-200	-13.55	-1.50
Channel Y	200	-1.13	-2.69
	-200	1.35	1.24
Channel Z	200	4.36	4.11
	-200	-5.92	-6.33

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-2.44	-2.08
Channel Y	200	7.42	-	-1.51
Channel Z	200	5.84	8.06	-

4. AD-Converter Values with Inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	16326	15742
Channel Y	16161	15582
Channel Z	15953	16228

5. Input Offset Measurement

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

Input: 1DMQ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.24	-1.71	1.46	0.53
Channel Y	-0.13	-2.46	1.08	0.49
Channel Z	-0.85	-2.00	0.31	0.42

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

- 2450 MHz Dipole Calibration Certificate

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



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Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No: **D2450V2-734_May10**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 734**

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

Calibration date: **May 27, 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 client's laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-08 (No. 217-01066)	Oct-10
Power sensor HP 8481A	US37292783	05-Oct-08 (No. 217-01066)	Oct-10
Reference 20 dB Attenuator	SN: 5066 (20g)	30-Mar-10 (No. 217-01168)	Mar-11
Type-N mismatch comparison	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 801	02-Mar-10 (No. DAE4-801_Mar10)	Mar-11
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power sensor HP 8481A	MY41032317	18-Oct-02 (In house check Oct-09)	In house check: Oct-11
RF generator R&S BMT-06	100005	4-Aug-99 (In house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390908 S4208	18-Oct-01 (In house check Oct-09)	In house check: Oct-10

Calibrated by:	Name Dimce Iliev	Function Laboratory Technician	Signature
Approved by:	Name Kolja Pokovic	Function Technical Manager	Signature

Issued: May 27, 2010

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V5.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 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 $\pm$ 0.2) °C	39.0 $\pm$ 6 %	1.76 mho/m $\pm$ 6 %
Head TSL temperature during test	(21.5 $\pm$ 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	12.6 mW / g
SAR normalized	normalized to 1W	51.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	51.7 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.03 mW / g
SAR normalized	normalized to 1W	24.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.2 mW / g $\pm$ 16.5 % (k=2)

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	53.6 ± 6 %	1.97 mho/m ± 6 %
Body TSL temperature during test	(21.6 ± 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	13.4 mW / g
SAR normalized	normalized to 1W	53.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	53.5 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.31 mW / g
SAR normalized	normalized to 1W	25.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	25.2 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.8 \Omega + 3.2 j\Omega$
Return Loss	- 26,4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.8 \Omega + 4.4 j\Omega$
Return Loss	- 27,1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.163 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	May 07, 2003

DASY5 Validation Report for Head TSL

Date/Time: 25.05.2010 14:48:11

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:734

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

Medium: HSL U11 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.76$ mho/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConnF(4,53,4,53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 61

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

Reference Value = 101.2 V/m; Power Drift = 0.030 dB

Peak SAR (extrapolated) = 26.1 W/kg

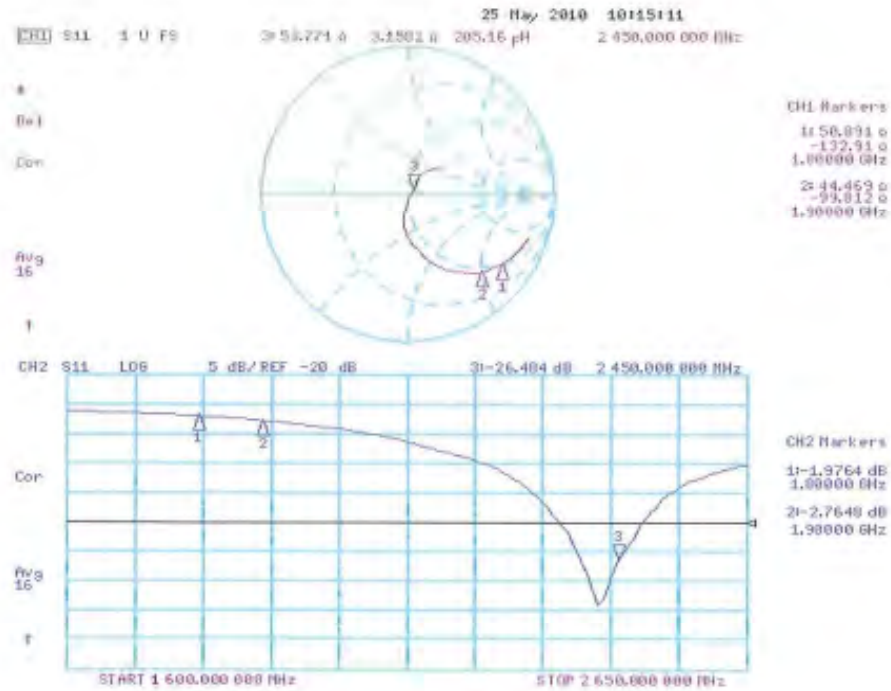
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 6.03 mW/g

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



0 dB = 16.7mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 27.05.2010 10:14:45

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:734

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

Medium: MSL U11 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.97$ mho/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³

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: 02.03.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version (4.0 Build 6)

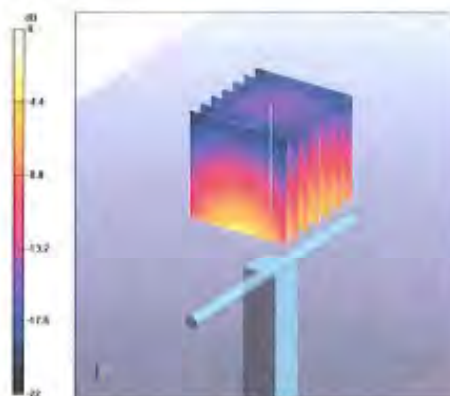
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0; Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.7 V/m; Power Drift = -0.030 dB

Peak SAR (extrapolated) = 27.3 W/kg

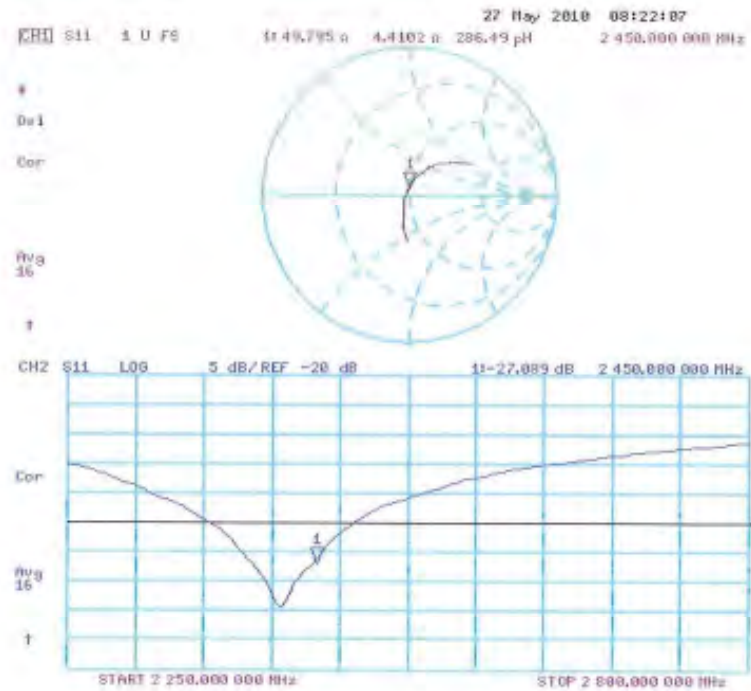
SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.31 mW/g

Maximum value of SAR (measured) = 17.4 mW/g



0 dB = 17.4mW/g

Impedance Measurement Plot for Body TSL



-5 GHz Dipole Calibration Certificate (5.2 GHz, 5.8 GHz)

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Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No.: **D5GHZ-1106_Jun11**

CALIBRATION CERTIFICATE

Object **D5GHZV2 - SN: 1106**

Calibration procedure(s) **QA CAL-22.v1
 Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **June 21, 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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $\leq 70\%$.

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37400704	09-Oct-10 (No. 217-01208)	Oct-11
Power sensor HP 8481A	US37292763	09-Oct-10 (No. 217-01208)	Oct-11
Reference 20 dB Attenuator	SN: 0088 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 6047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX3DV4	SN: 3503	04-Mar-11 (No. EX3-3503_Mar11)	Mar-12
DAB4	SN: 601	8-Jun-11 (No. DAB4-601_Jun11)	Jun-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	19-Oct-02 (in house check Oct-08)	In house check: Oct-11
RF generator R&S SMT-05	100005	4-Aug-03 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37330585 S4205	19-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name Dimco Iliev	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: June 21, 2011

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4,0 mm, dz = 1.4 mm	
Frequency	5200 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 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 $\pm$ 0,2) °C	35,8 $\pm$ 6 %	4,50 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0,5 °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	8,23 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	82,2 mW / g $\pm$ 17,0 % (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 for nominal Head TSL parameters	normalized to 1W	23,3 mW / g $\pm$ 16,5 % (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 $\pm$ 0,2) °C	34,8 $\pm$ 6 %	5,08 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0,5 °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	8,08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80,5 mW / g $\pm$ 17,0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2,30 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22,9 mW / g $\pm$ 16,5 % (k=2)

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	49.0 ± 5 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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	7.58 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	75.8 mW / g ± 18.1 % (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 for nominal Body TSL parameters	normalized to 1W	21.2 mW / g ± 17.6 % (k=2)

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	47.8 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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	7.66 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	76.5 mW / g ± 18.1 % (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 for nominal Body TSL parameters	normalized to 1W	21.2 mW / g ± 17.6 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$52.9 \Omega - 9.8 j\Omega$
Return Loss	-20.1 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	$52.7 \Omega - 6.9 j\Omega$
Return Loss	-22.8 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	$49.6 \Omega - 9.3 j\Omega$
Return Loss	-20.6 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	$55.5 \Omega + 0.9 j\Omega$
Return Loss	-25.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.189 ns
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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	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 20.06.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN: 1106

Communication System: CW; Frequency: 5200 MHz, Frequency: 5800 MHz

Medium: HSL 502 A

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.5$ mho/m; $\epsilon_r = 35.8$; $\rho = 1000$ kg/m³; Medium parameters used: $f = 5800$ MHz; $\sigma = 5.08$ mho/m; $\epsilon_r = 34.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 08.06.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.231 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 30.485 W/kg

SAR(1 g) = 8.23 mW/g; SAR(10 g) = 2.34 mW/g

Maximum value of SAR (measured) = 18.450 mW/g

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

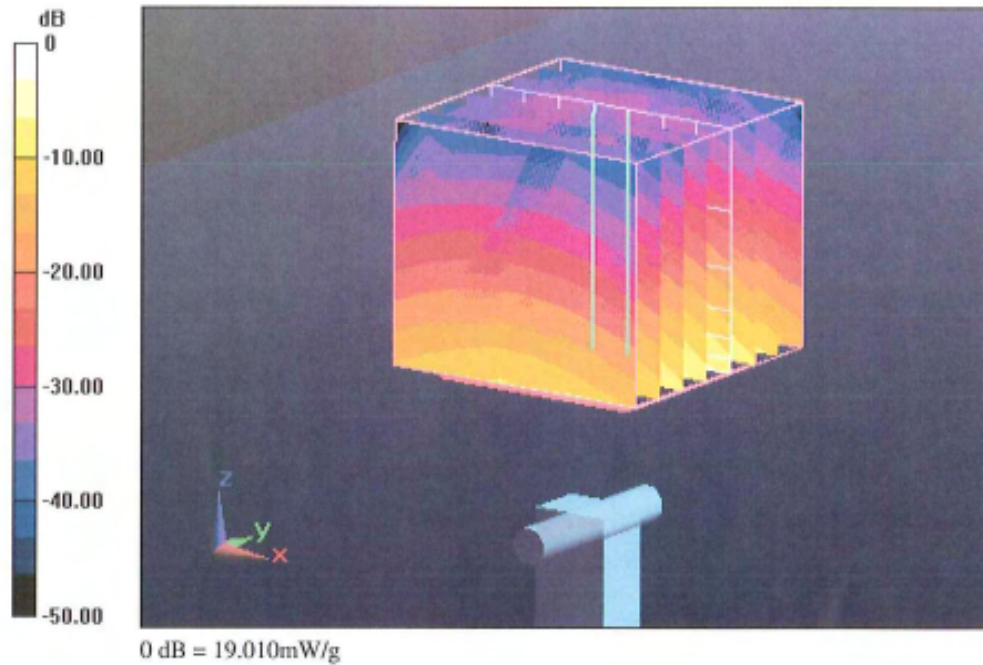
dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.792 V/m; Power Drift = 0.03 dB

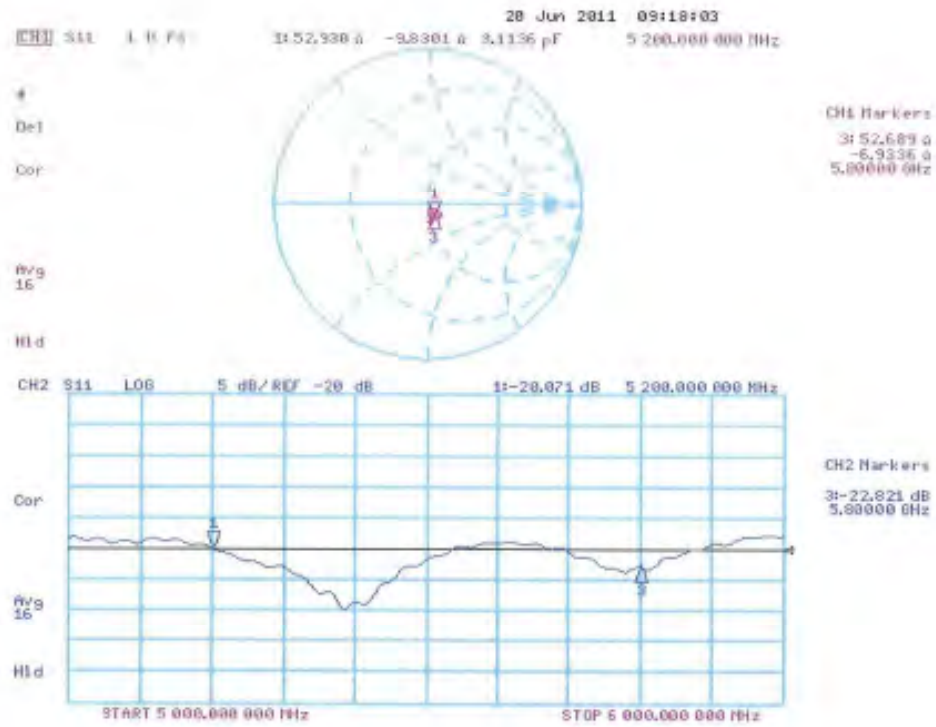
Peak SAR (extrapolated) = 33.712 W/kg

SAR(1 g) = 8.09 mW/g; SAR(10 g) = 2.3 mW/g

Maximum value of SAR (measured) = 19.009 mW/g



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.06.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN: 1106

Communication System: CW; Frequency: 5200 MHz, Frequency: 5800 MHz

Medium: MSL 501

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.41$ mho/m; $\epsilon_r = 49$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.21$ mho/m; $\epsilon_r = 47.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91), ConvF(4.38, 4.38, 4.38); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA64 Sn601; Calibrated: 08.06.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3654)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.327 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 29.350 W/kg

SAR(1 g) = 7.58 mW/g; SAR(10 g) = 2.12 mW/g

Maximum value of SAR (measured) = 17.624 mW/g

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

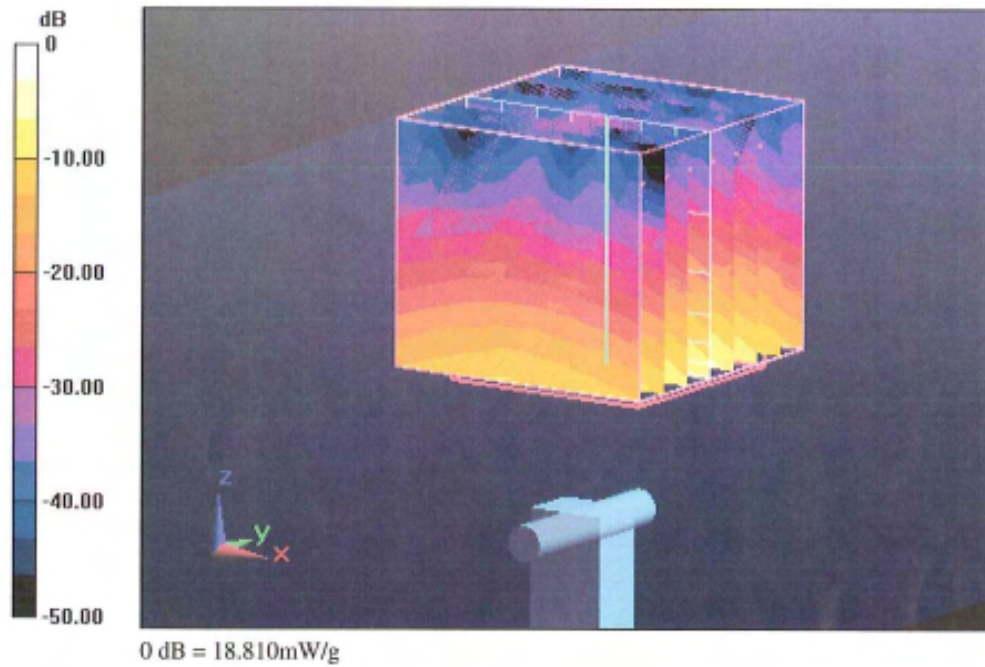
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 56.058 V/m; Power Drift = -0.02 dB

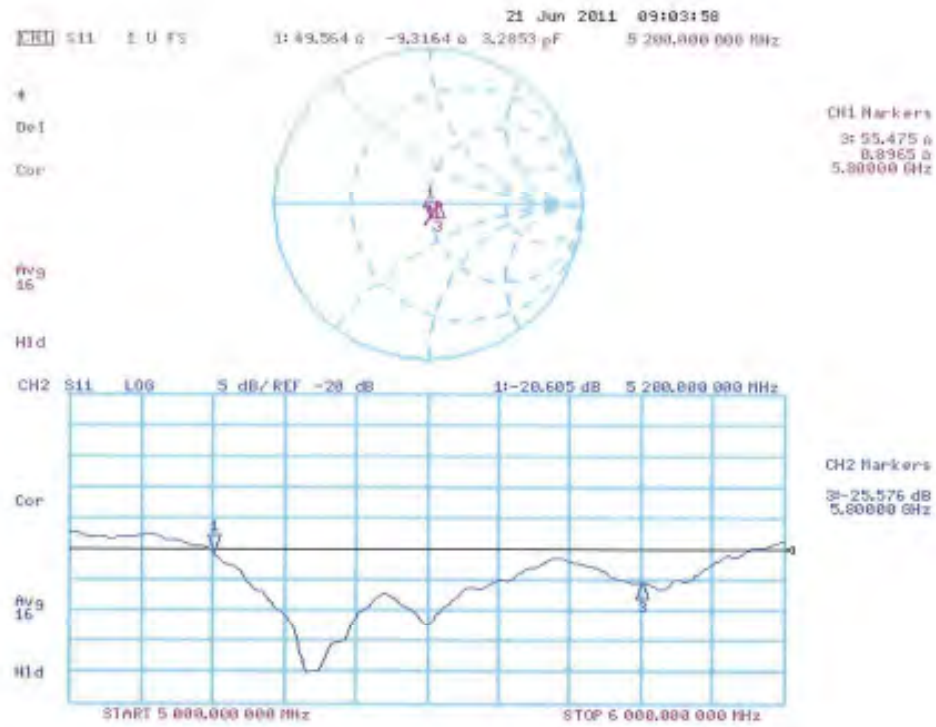
Peak SAR (extrapolated) = 35.029 W/kg

SAR(1 g) = 7.66 mW/g; SAR(10 g) = 2.12 mW/g

Maximum value of SAR (measured) = 18.810 mW/g



Impedance Measurement Plot for Body TSL





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-5 GHz Dipole Calibration Certificate (5.5 GHz)

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zughaistrasse 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**

Client **SGS (Dymstec)**

Certificate No: **D5GHzV2-1106_Nov11**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1106**

Calibration procedure(s) **QA CAL-22.v1**
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: **November 15, 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%.

Condition Equipment used (M&E critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8401A	DS37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX2DV4	SN: 3503	04-Mar-11 (No. EX3-3503_Mar11)	Mar-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601-Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8401A	MY41082317	18-Oct-08 (in house check Oct-11)	In house check: Oct-12
RF generator R&S SMT-08	110005	04-Aug-09 (in house check Oct-11)	In house check: Oct-12
Network Analyzer HP 8753E	US17380585 84206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: November 17, 2011

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

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



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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5500 MHz $\pm$ 1 MHz	

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	4.86 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.2 $\pm$ 6 %	4.75 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0,5 °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	8.88 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	87.9 mW / g $\pm$ 17,0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.52 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.9 mW / g $\pm$ 16,5 % (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	40.6	5.65 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	47,2 $\pm$ 6 %	5.87 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0,5 °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	8.21 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	81.7 mW / g $\pm$ 16,1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.27 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	22.6 mW / g $\pm$ 17,6 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.7 Ω - 3.2 $j\Omega$
Return Loss	-29.6 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.8 Ω - 1.9 $j\Omega$
Return Loss	-33.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 13.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1106

Communication System: CW; Frequency: 5500 MHz

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.75$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DY4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.617 V/m; Power Drift = 0.06 dB

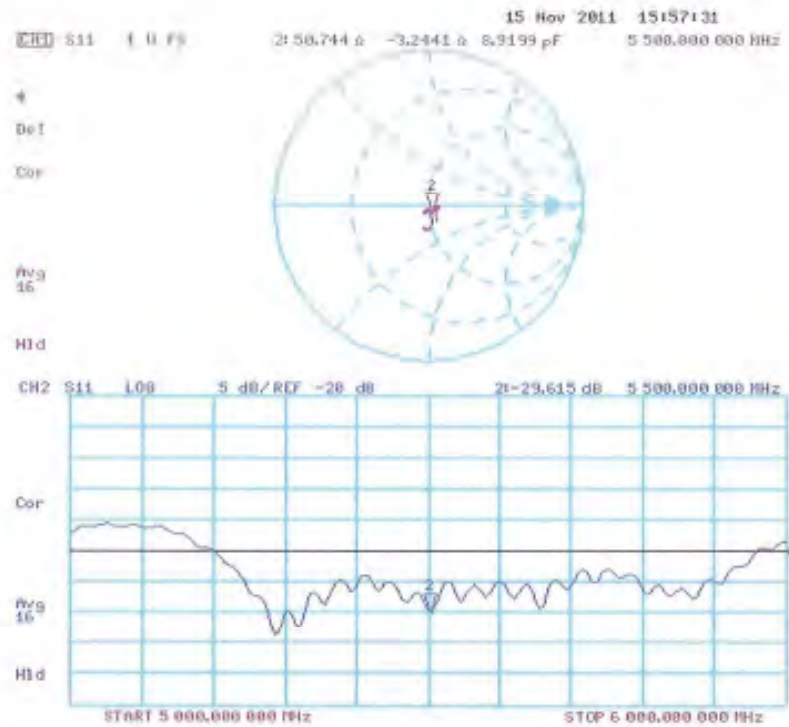
Peak SAR (extrapolated) = 35.293 W/kg

SAR(1 g) = 8.88 mW/g; SAR(10 g) = 2.52 mW/g

Maximum value of SAR (measured) = 21.227 mW/g



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 14.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1106

Communication System: CW; Frequency: 5500 MHz

Medium parameters used: $f = 5500$ MHz; $\sigma = 5.87$ mho/m; $\epsilon_r = 47.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvP(4.43, 4.43, 4.43); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.363 V/m; Power Drift = -0.0064 dB

Peak SAR (extrapolated) = 35.196 W/kg

SAR(1 g) = 8.21 mW/g; SAR(10 g) = 2.27 mW/g

Maximum value of SAR (measured) = 19.467 mW/g



Impedance Measurement Plot for Body TSL

