JQA

Attachment 3 – Dosimetric E-Field Probe – ET3DV6, S/N: 1679 Calibration Data

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **JQA (PTT)**

Certificate No: **ET3-1679_Dec08**

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1679
Calibration procedure(s)	QA CAL-01.v6 and QA CAL-23.v3 Calibration procedure for dosimetric E-field probes
Calibration date:	December 15, 2008
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-08 (No. 217-00788)	Apr-09
Power sensor E4412A	MY41495277	1-Apr-08 (No. 217-00788)	Apr-09
Power sensor E4412A	MY41498087	1-Apr-08 (No. 217-00788)	Apr-09
Reference 3 dB Attenuator	SN: S5054 (3c)	1-Jul-08 (No. 217-00865)	Jul-09
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-08 (No. 217-00787)	Apr-09
Reference 30 dB Attenuator	SN: S5129 (30b)	1-Jul-08 (No. 217-00866)	Jul-09
Reference Probe ES3DV2	SN: 3013	2-Jan-08 (No. ES3-3013_Jan08)	Jan-09
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09

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

	Name	Function	Signature
Calibrated by:	Marcel Fehr	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 16, 2008

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).

- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.

- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.

- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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.

Probe ET3DV6

SN:1679

Manufactured:	May 7, 2002
Last calibrated:	November 15, 2007
Recalibrated:	December 15, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1679

Sensitivity in Free Space[A]

NormX	**1.90** ± 10.1%	$\mu V/(V/m)^2$	
NormY	**1.85** ± 10.1%	$\mu V/(V/m)^2$	
NormZ	**1.89** ± 10.1%	$\mu V/(V/m)^2$	

Diode Compression[B]

DCP X	**92** mV
DCP Y	**94** mV
DCP Z	**93** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL   **900 MHz**   **Typical SAR gradient: 5 % per mm**

		3.7 mm	4.7 mm
Sensor Center to Phantom Surface Distance			
SAR_{be} [%]	Without Correction Algorithm	9.6	5.8
SAR_{be} [%]	With Correction Algorithm	0.9	0.6

TSL   **1810 MHz**   **Typical SAR gradient: 10 % per mm**

		3.7 mm	4.7 mm
Sensor Center to Phantom Surface Distance			
SAR_{be} [%]	Without Correction Algorithm	10.2	6.0
SAR_{be} [%]	With Correction Algorithm	0.8	0.6

Sensor Offset

|	
Probe Tip to Sensor Center	**2.7** mm

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.
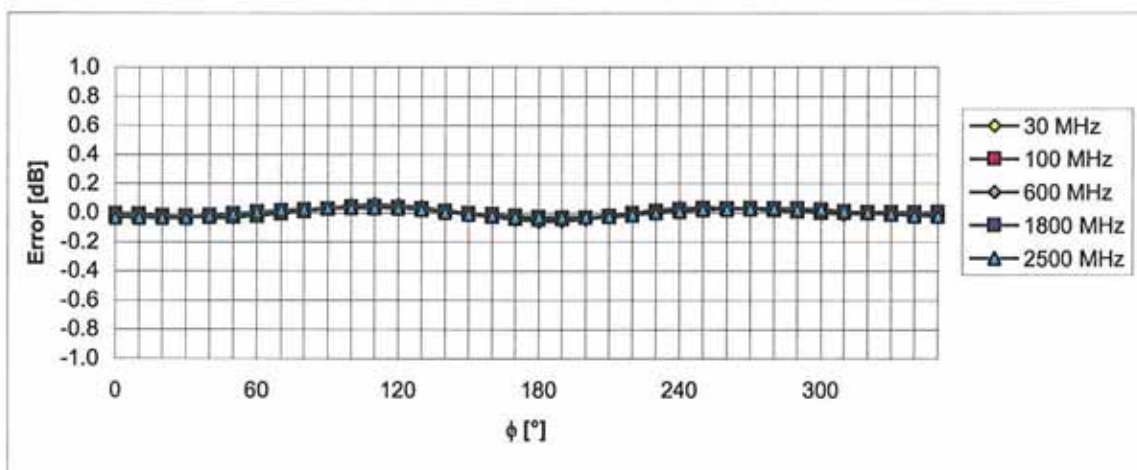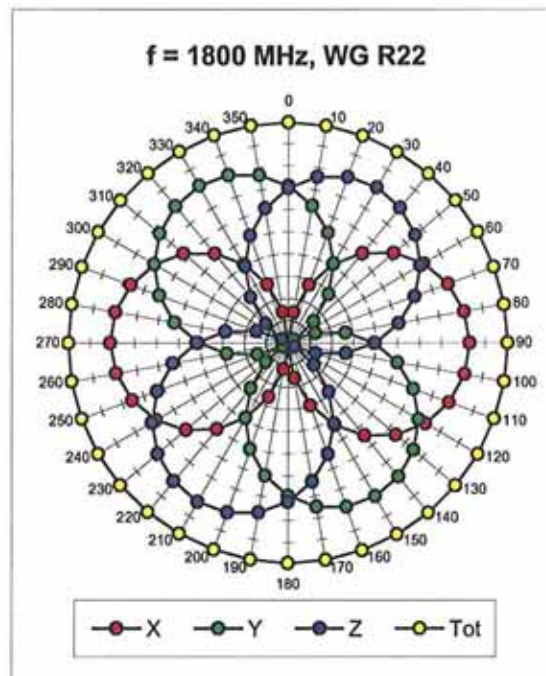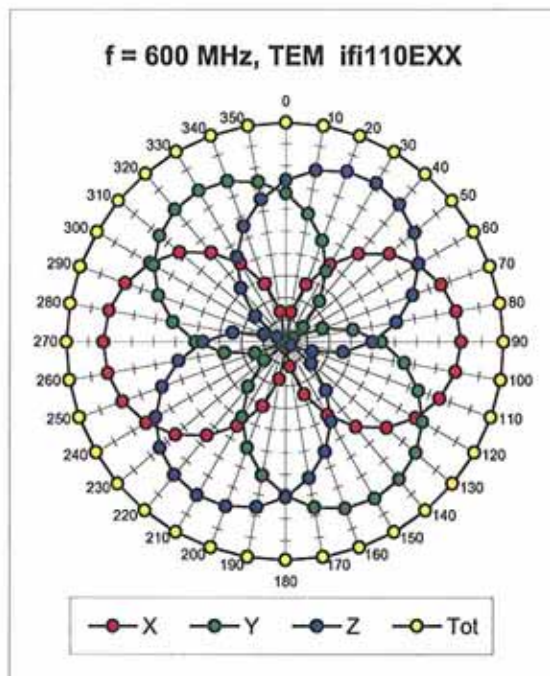
Frequency Response of E-Field
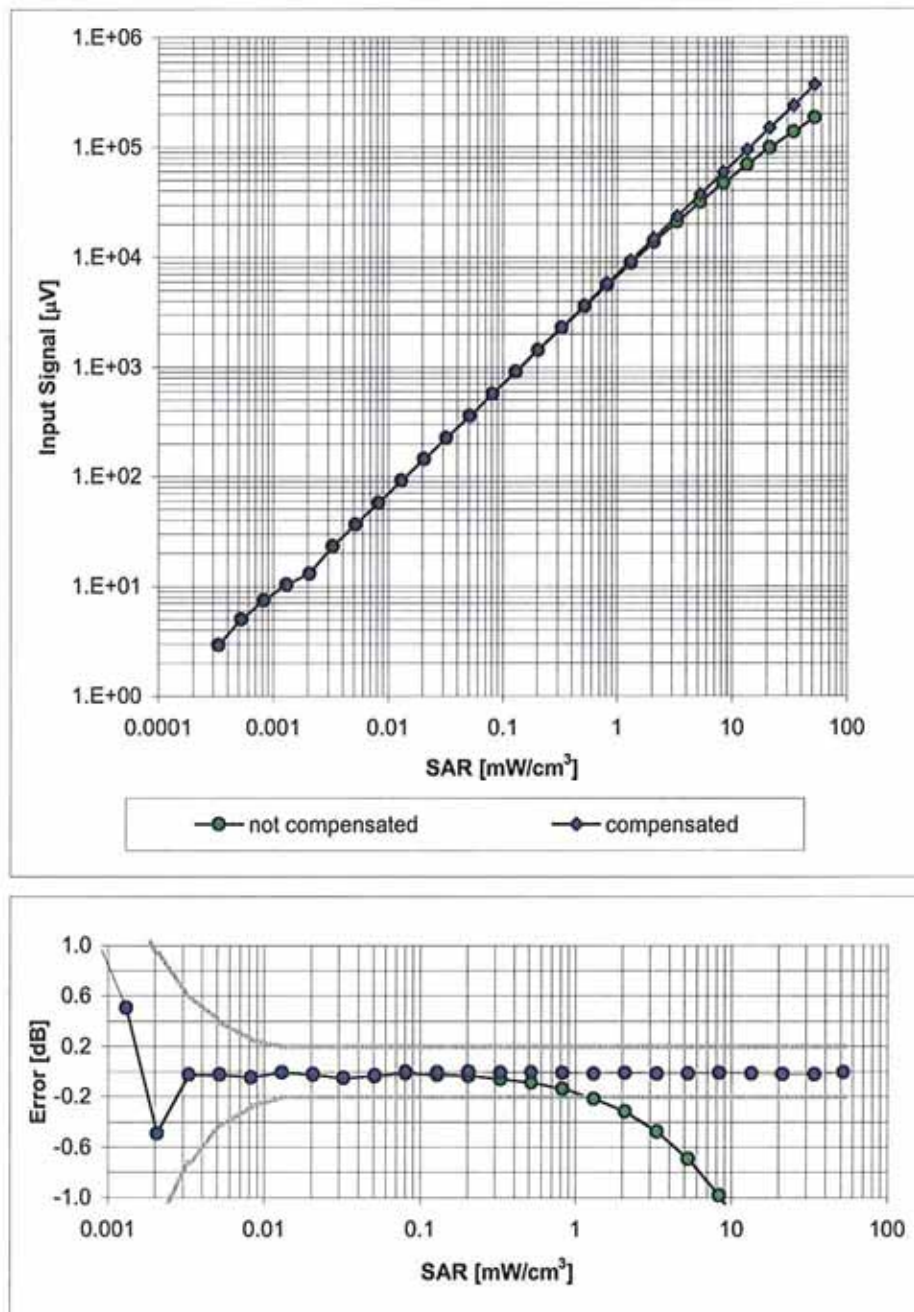
(TEM-Cell:ifi110 EXX, Waveguide: R22)
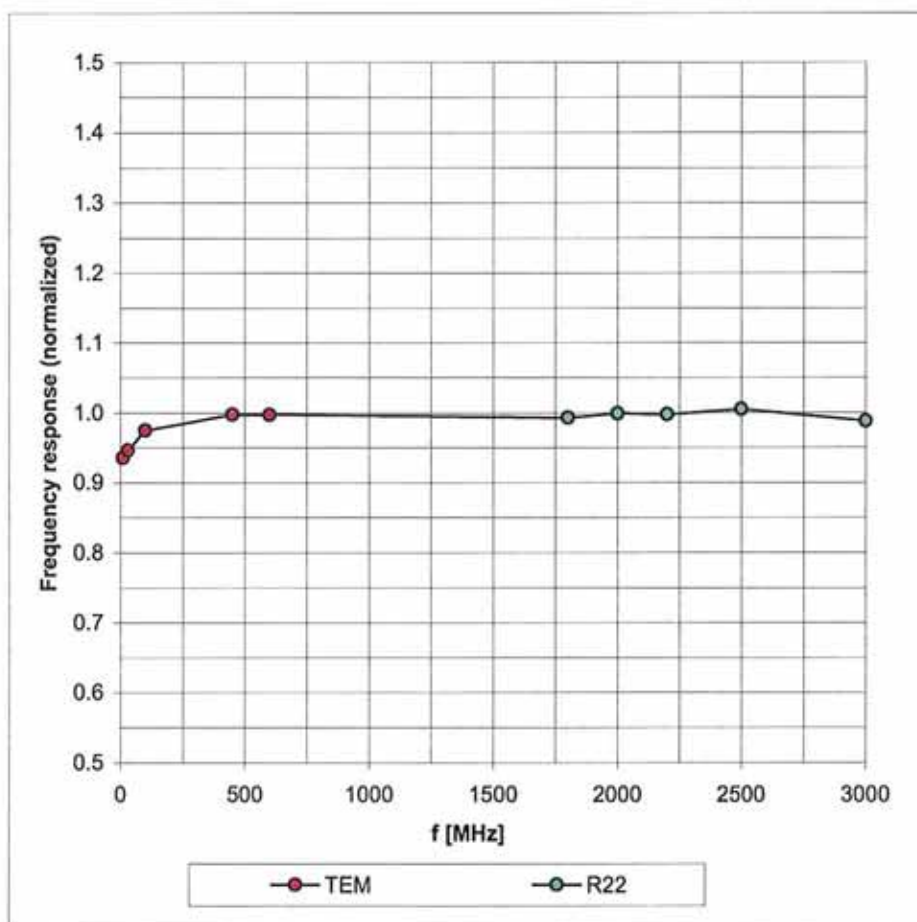
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (φ), ϑ = 0°

f = 600 MHz, TEM ifi110EXX
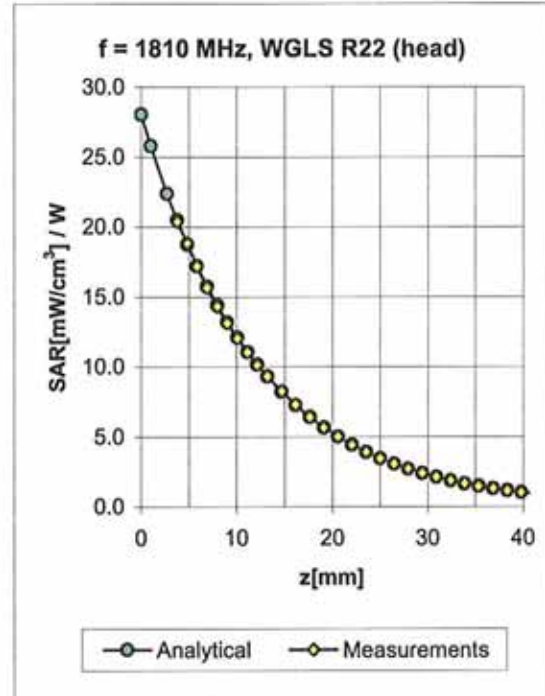

—●—X   —●—Y   —●—Z   —○—Tot

f = 1800 MHz, WG R22

—●—X   —●—Y   —●—Z   —○—Tot

Legend:
- —◇— 30 MHz
- —■— 100 MHz
- —◇— 600 MHz
- —■— 1800 MHz
- —△— 2500 MHz

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

Dynamic Range f(SAR$_{head}$)

(Waveguide R22, f = 1800 MHz)

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

Conversion Factor Assessment
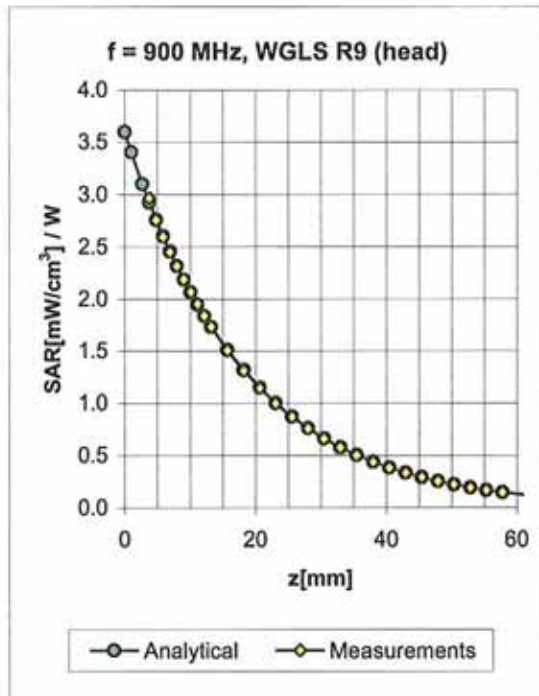
| f [MHz]	Validity [MHz]^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.38	2.35	6.29	± 11.0% (k=2)
1450	± 50 / ± 100	Head	40.5 ± 5%	1.20 ± 5%	0.38	3.45	5.37	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.57	2.41	5.31	± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.70	2.15	5.02	± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.99	1.65	4.64	± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.30	2.97	6.22	± 11.0% (k=2)
1450	± 50 / ± 100	Body	54.0 ± 5%	1.30 ± 5%	0.52	2.54	5.07	± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.60	2.40	4.86	± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.70	2.30	4.76	± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.99	1.61	4.05	± 11.0% (k=2)

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

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz
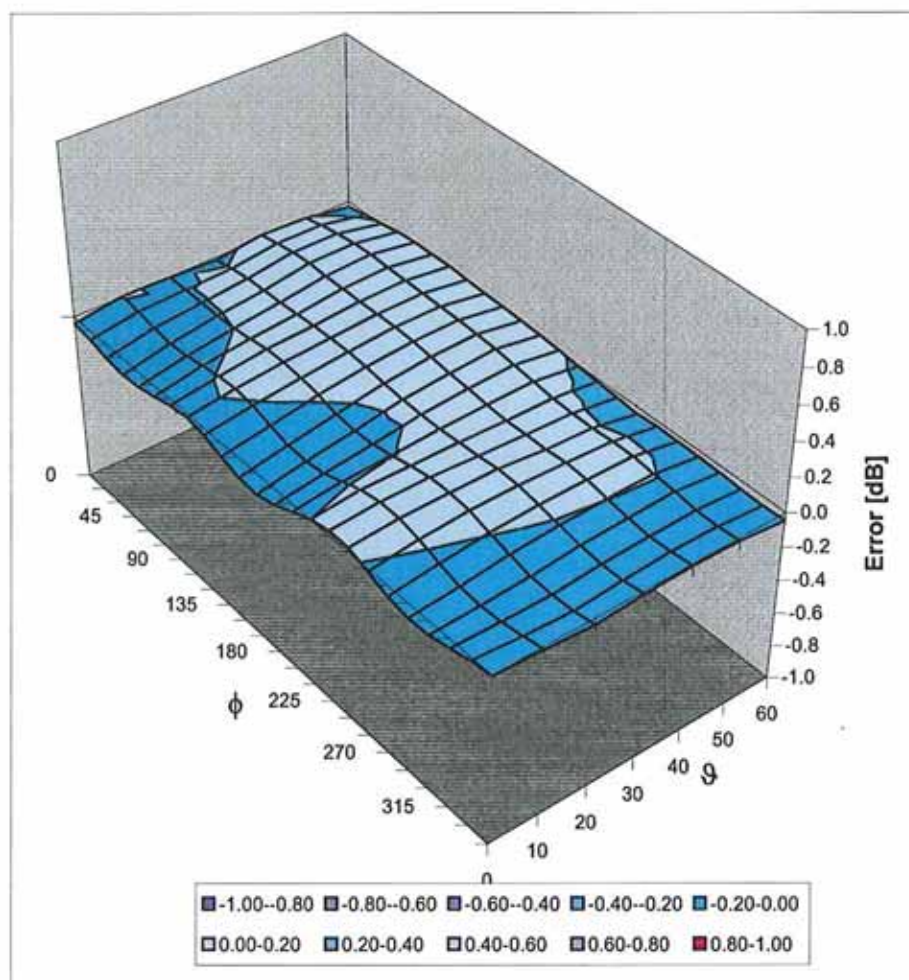
Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Attachment 4-1 – System Validation Dipole – D835V2, S/N: 4d081 Calibration Data

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

Client   **JQA (PTT)**

Certificate No: **D835V2-4d081_Jul09**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d081
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	July 13, 2009
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV2	SN: 3025	30-Apr-09 (No. ES3-3025_Apr09)	Apr-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10

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

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

Issued: July 13, 2009

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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.

Measurement Conditions

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.4 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature during test	(22.2 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.42 mW / g
SAR normalized	normalized to 1W	9.68 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**9.71 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 mW / g
SAR normalized	normalized to 1W	6.36 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**6.38 mW /g ± 16.5 % (k=2)**

---

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.0 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature during test	(22.5 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.58 mW / g
SAR normalized	normalized to 1W	10.3 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**10.1 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.69 mW / g
SAR normalized	normalized to 1W	6.76 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**6.65 mW / g ± 16.5 % (k=2)**

---

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.8 Ω - 2.9 jΩ
Return Loss	- 29.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω - 4.2 jΩ
Return Loss	- 26.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.394 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	October 17, 2008

DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d081

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: HSL 900 MHz
Medium parameters used: f = 835 MHz; σ = 0.89 mho/m; ε_r = 40.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.86, 5.86, 5.86); Calibrated: 30.04.2009

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 07.03.2009

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

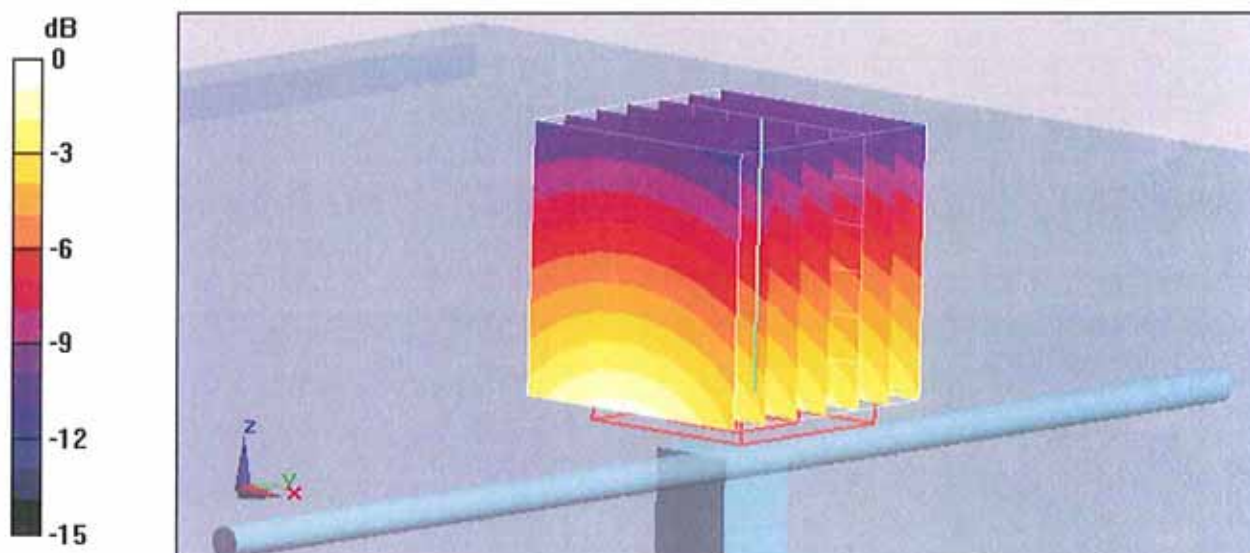- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

Pin=250mW; dip=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.6 V/m; Power Drift = 0.00419 dB
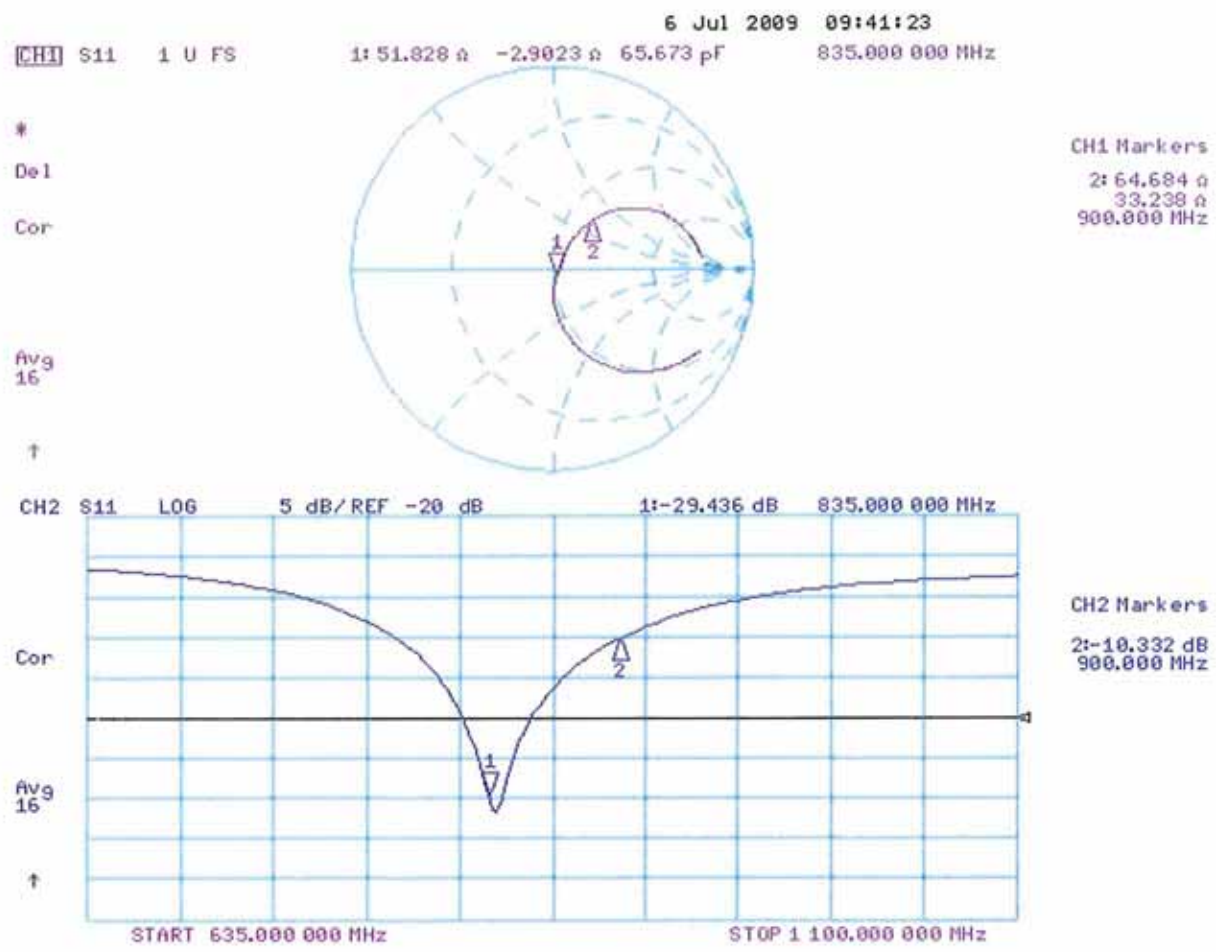Peak SAR (extrapolated) = 3.6 W/kg
SAR(1 g) = 2.42 mW/g; SAR(10 g) = 1.59 mW/g
Maximum value of SAR (measured) = 2.81 mW/g

0 dB = 2.81mW/g

Impedance Measurement Plot for Head TSL

CH1 S11 1 U FS   1: 51.828 Ω -2.9023 Ω 65.673 pF   835.000 000 MHz

*

Del

Cor

Avg
16

↑

CH1 Markers

2: 64.684 Ω
33.238 Ω
900.000 MHz

CH2 S11 LOG   5 dB/ REF -20 dB   1:-29.436 dB   835.000 000 MHz

Cor

Avg
16

↑

CH2 Markers

2:-10.332 dB
900.000 MHz

START 635.000 000 MHz   STOP 1 100.000 000 MHz

DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d081

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: MSL900
Medium parameters used: f = 835 MHz; σ = 0.99 mho/m; ε_r = 53; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.79, 5.79, 5.79); Calibrated: 30.04.2009

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 07.03.2009

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

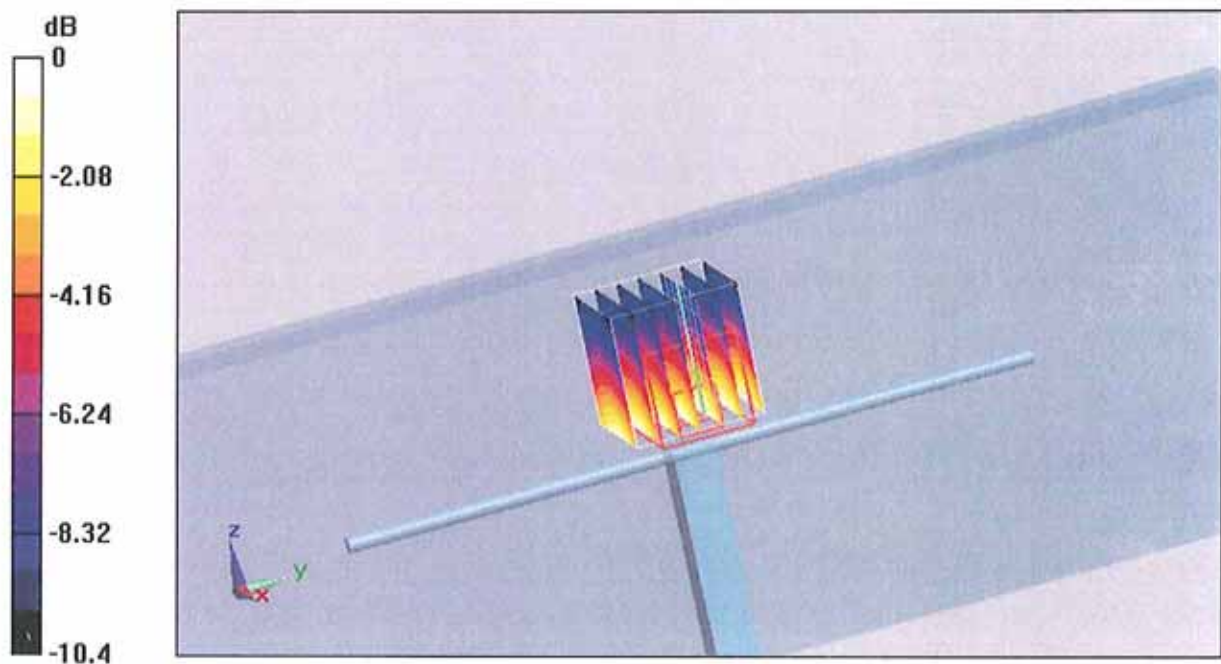- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

Pin = 250mW, d = 15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.7 V/m; Power Drift = 0.011 dB
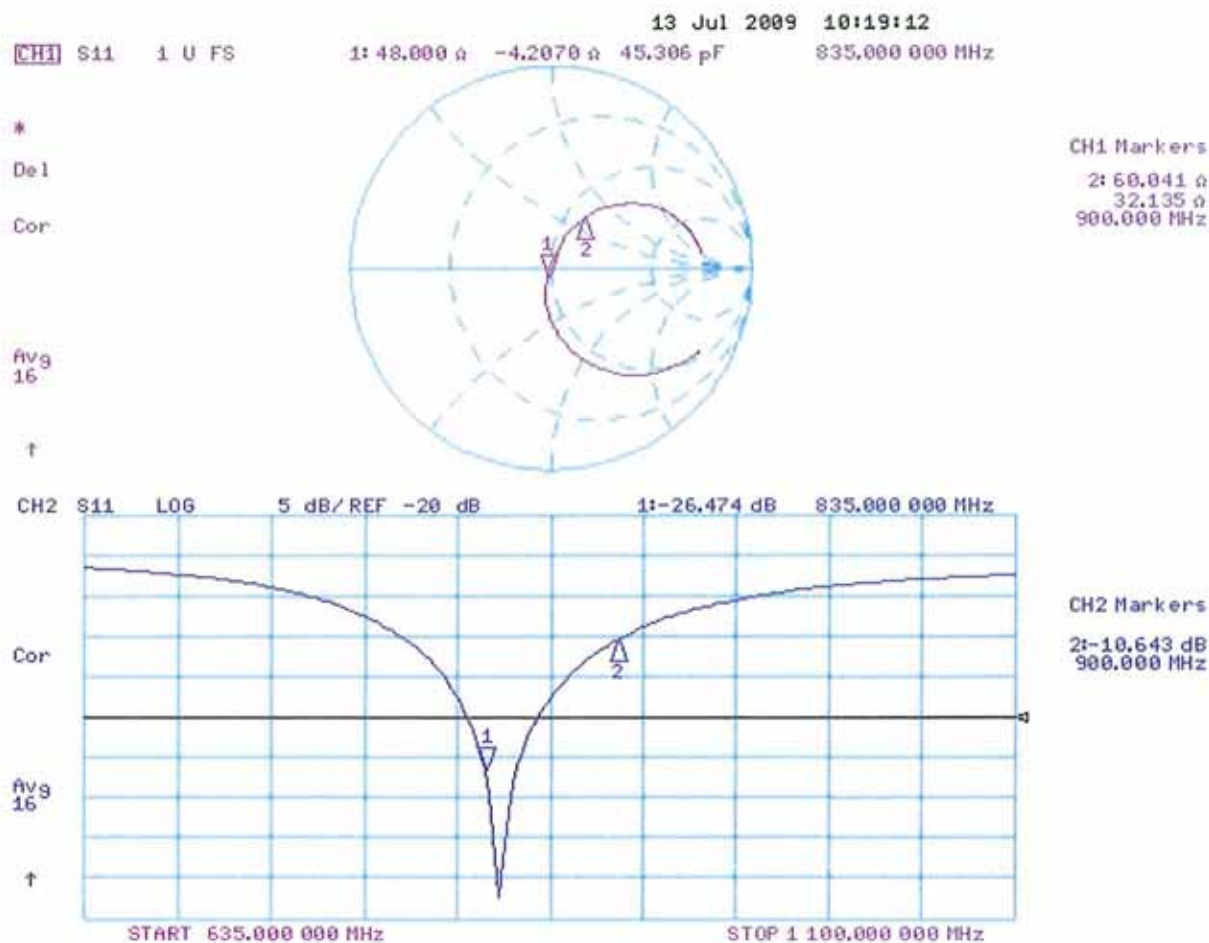Peak SAR (extrapolated) = 3.77 W/kg
SAR(1 g) = 2.58 mW/g; SAR(10 g) = 1.69 mW/g
Maximum value of SAR (measured) = 3 mW/g

0 dB = 3mW/g

Impedance Measurement Plot for Body TSL

13 Jul 2009 10:19:12

CH1 S11 1 U FS   1: 48.000 Ω   -4.2070 Ω   45.306 pF   835.000 000 MHz

CH1 Markers

2: 60.041 Ω
32.135 Ω
900.000 MHz

Del

Cor

Avg
16

CH2 S11 LOG   5 dB/REF -20 dB   1:-26.474 dB   835.000 000 MHz

CH2 Markers

2:-10.643 dB
900.000 MHz

Cor

Avg
16

START 635.000 000 MHz   STOP 1 100.000 000 MHz

Attachment 4-2 – System Validation Dipole – D1900V2, S/N: 5d112 Calibration Data

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

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Accreditation No.: **SCS 108**

Client **JQA (PTT)**

Certificate No: **D1900V2-5d112_Jul09**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d112
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	July 14, 2009
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV2	SN: 3025	30-Apr-09 (No. ES3-3025_Apr09)	Apr-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10

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

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 14, 2009

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

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ilac-MRA

SWISS CALIBRATION

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

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) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

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.

Measurement Conditions

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.9 ± 6 %	1.43 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	250 mW input power	10.5 mW / g
SAR normalized	normalized to 1W	42.0 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**41.7 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.49 mW / g
SAR normalized	normalized to 1W	22.0 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**21.9 mW / g ± 16.5 % (k=2)**

---

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5 ± 6 %	1.55 mho/m ± 6 %
Body TSL temperature during test	(21.1 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.6 mW / g
SAR normalized	normalized to 1W	42.4 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**42.0 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.60 mW / g
SAR normalized	normalized to 1W	22.4 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**22.3 mW / g ± 16.5 % (k=2)**

---

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω + 7.6 jΩ
Return Loss	- 22.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω + 7.9 jΩ
Return Loss	- 21.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 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 28, 2008

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d112

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL U11 BB
Medium parameters used: f = 1900 MHz; σ = 1.43 mho/m; ε_r = 40.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.88, 4.88, 4.88); Calibrated: 30.04.2009

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 07.03.2009

- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

Pin = 250 mW; dip = 10 mm, scan at 3.0 mm/Zoom Scan (dist=3.0 mm, probe 0deg) (7x7x7)/Cube 0:
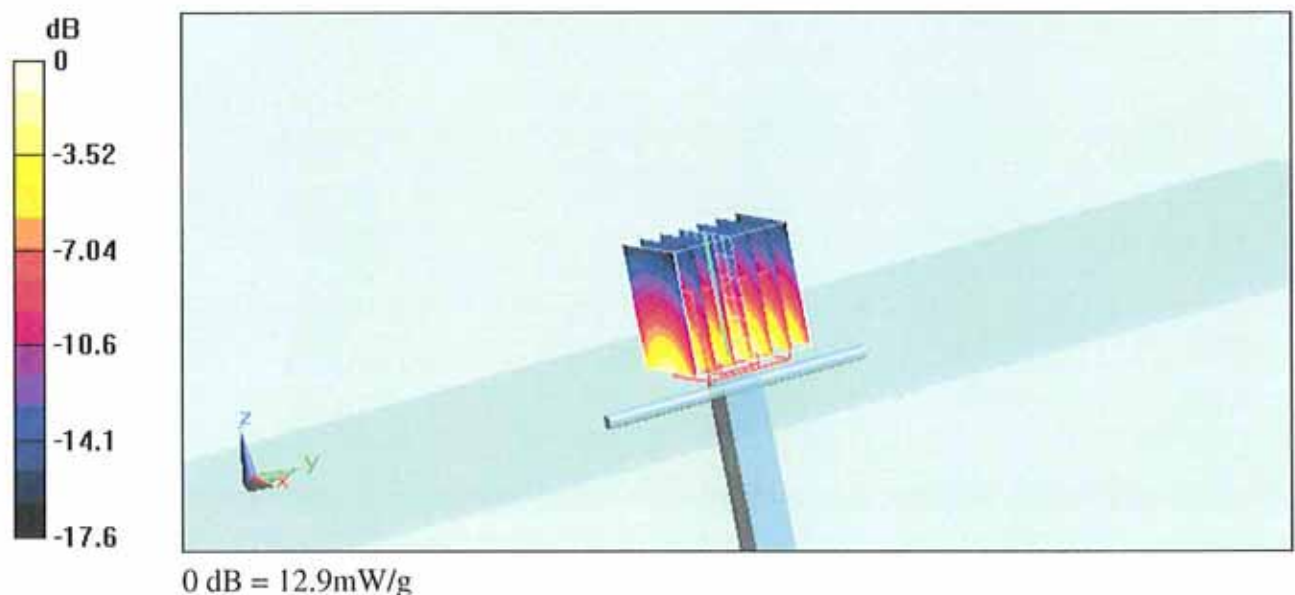Measurement grid: dx=5mm, dy=5mm, dz=5mm
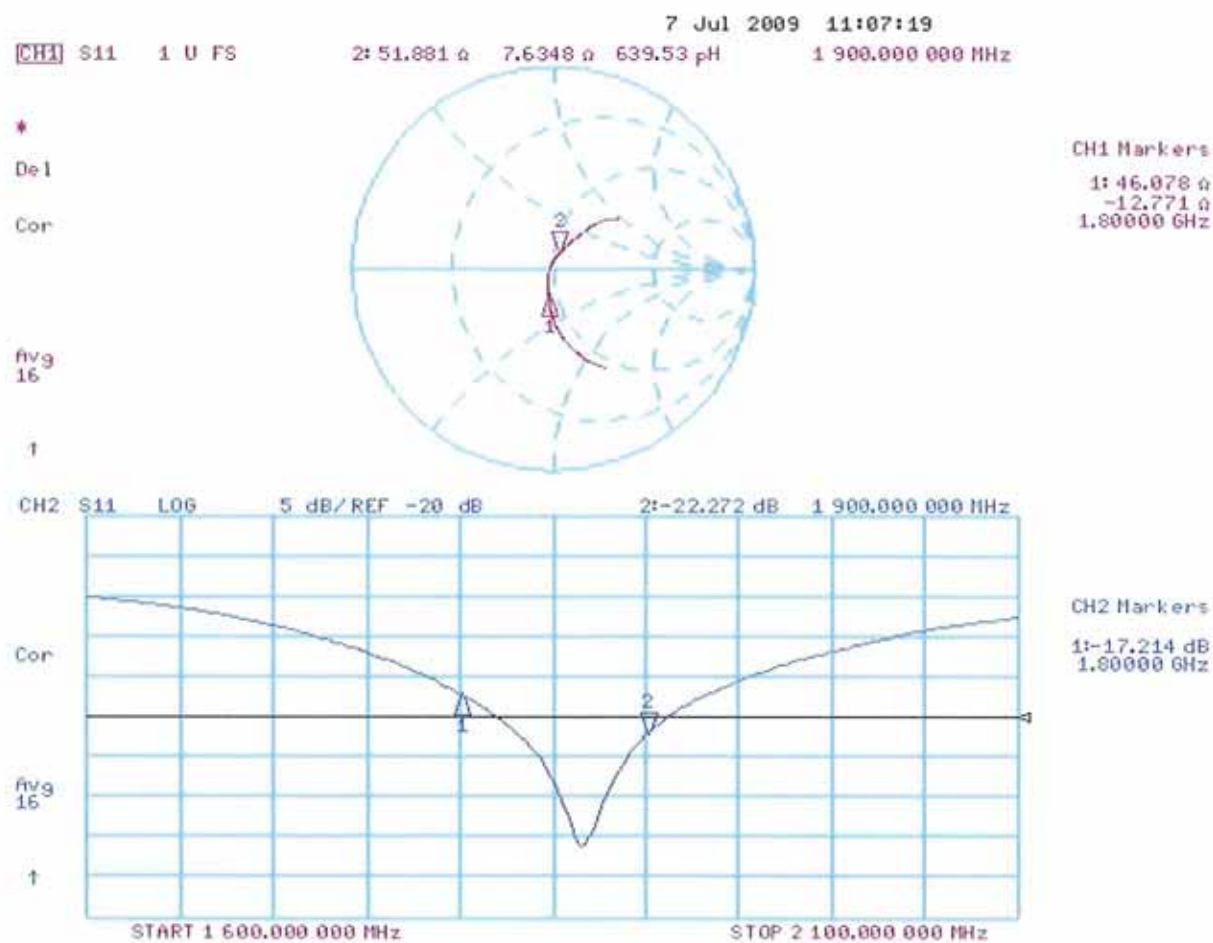Reference Value = 98.2 V/m; Power Drift = 0.042 dB
Peak SAR (extrapolated) = 19.2 W/kg
SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.49 mW/g
Maximum value of SAR (measured) = 12.9 mW/g

0 dB = 12.9mW/g

Impedance Measurement Plot for Head TSL

7 Jul 2009 11:07:19

CH1 S11   1 U FS   2: 51.881 Ω   7.6348 Ω   639.53 pH   1 900.000 000 MHz

Del

Cor

CH1 Markers
1: 46.078 Ω
   −12.771 Ω
1.80000 GHz

Avg
16

↑

CH2 S11   LOG   5 dB/REF −20 dB   2:−22.272 dB   1 900.000 000 MHz

Cor

CH2 Markers
1:−17.214 dB
1.80000 GHz

Avg
16

↑

START 1 600.000 000 MHz   STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d112

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: MSL U10 BB
Medium parameters used: f = 1900 MHz; σ = 1.55 mho/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.46, 4.46, 4.46); Calibrated: 30.04.2009

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 07.03.2009

- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

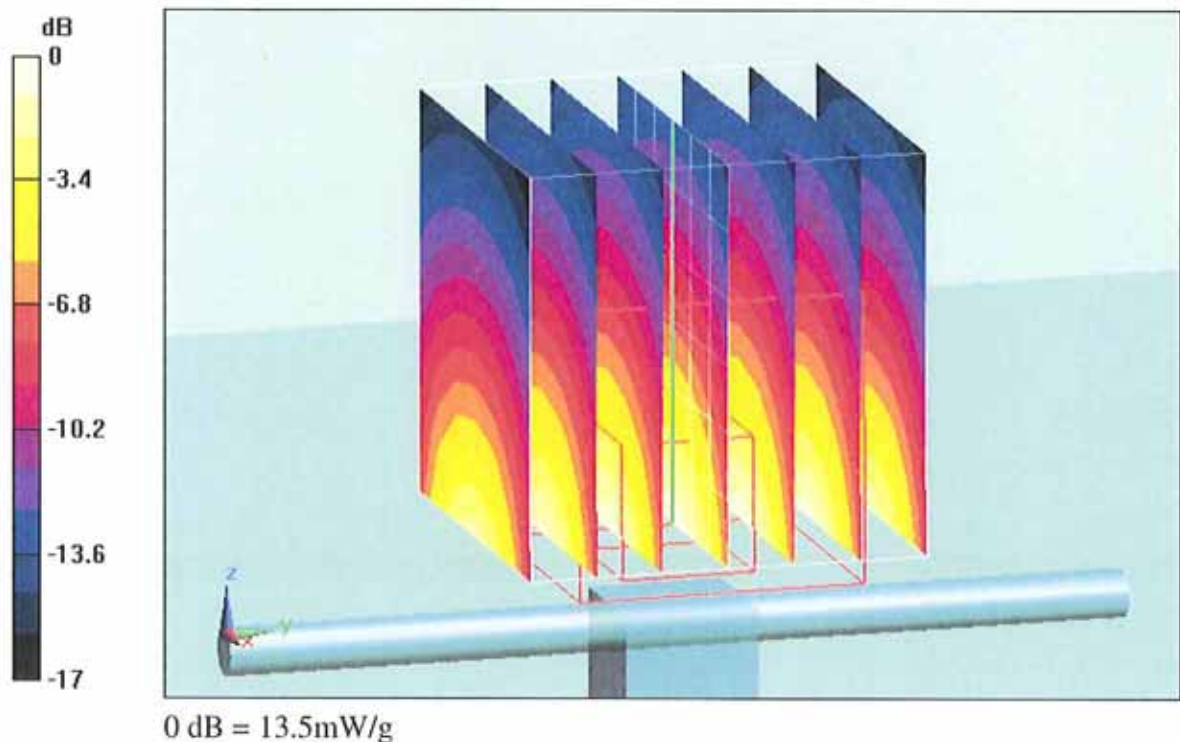**Pin = 250 mW; dip = 10 mm, scan at 3.0mm/Zoom Scan (dist=3.0mm, probe 0deg) (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.1 V/m; Power Drift = -0.00971 dB
Peak SAR (extrapolated) = 18.8 W/kg
SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.6 mW/g
Maximum value of SAR (measured) = 13.5 mW/g

0 dB = 13.5mW/g

Impedance Measurement Plot for Body TSL