## **APPENDIX C CALIBRATION DOCUMENTS**

- 1. EX3DV4 SN: 1380 Probe Calibration Certificate
- 2. D2450V2 SN: 724 Dipole Calibration Certificate





#### Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Client

**EMC Technologies** 

Certificate No: ET3-1380\_Dec10

Accreditation No.: SCS 108

# CALIBRATION CERTIFICATE

Object

ET3DV6 - SN:1380

Calibration procedure(s)

QA CAL-01.v6, QA CAL-12.v6, QA CAL-23.v3 and QA CAL-25.v2

Calibration procedure for dosimetric E-field probes

Calibration date:

December 9, 2010

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11
	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	I-ll-
Approved by:	Katia Pokovic	Technical Manager	

Issued: December 9, 2010

Certificate No: ET3-1380 Dec10

Page 1 of 11

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





Schweizerischer Kalibrierdienst
Service suisse d'étalonnage

C Service suisse d etalonnage
Servizio svizzero di taratura

Accreditation No.: SCS 108

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

Glossary:

TSL tissue simulating liquid
NORMx,y,z sensitivity in free space
ConvF sensitivity in TSL / NORMx,y,z
DCP diode compression point

CF crest factor (1/duty\_cycle) of the RF signal A, B, C modulation dependent linearization parameters

Polarization  $\phi$   $\phi$  rotation around probe axis

Polarization 9 9 rotation around an axis that is in the plane normal to probe axis (at measurement center),

i.e., 9 = 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:

- NORMx,y,z: Assessed for E-field polarization 9 = 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 E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z \* frequency\_response (see Frequency Response Chart). This linearization is
  implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included
  in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C are numerical linearization parameters assessed based on the data of
  power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the
  maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Certificate No: ET3-1380\_Dec10

Page 2 of 11





December 9, 2010

# Probe ET3DV6

SN:1380

Manufactured:

Αι

August 16, 1999

Last calibrated:

December 11, 2009 December 9, 2010

Recalibrated:

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ET3-1380\_Dec10

Page 3 of 11





# DASY/EASY - Parameters of Probe: ET3DV6 SN:1380

#### **Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	1.68	1.63	1.73	± 10.1%
DCP (mV) <sup>B</sup>	94.0	93.7	93.6	

# **Modulation Calibration Parameters**

UID	Communication System Name	PAR		A dB	B dBuV	С	VR mV	Unc <sup>E</sup> (k=2)
10000	cw	0.00	X	0.00	0.00	1.00	170.7	± 2.9 %
			Υ	0.00	0.00	1.00	136.1	
			Z	0.00	0.00	1.00	175.3	

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%.

Certificate No: ET3-1380\_Dec10

Page 4 of 11





<sup>&</sup>lt;sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

<sup>&</sup>lt;sup>B</sup> Numerical linearization parameter: uncertainty not required.

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

# DASY/EASY - Parameters of Probe: ET3DV6 SN:1380

#### Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz] <sup>C</sup>	Permittivity	Conductivity	ConvF X Co	nvFY Con	vF Z	Alpha	Depth Unc (k=2)
300	±50/±100	45.3 ± 5%	$0.87 \pm 5\%$	7.81	7.81	7.81	0.30	1.50 ± 13.3%
450	± 50 / ± 100	$43.5 \pm 5\%$	$0.87 \pm 5\%$	6.95	6.95	6.95	0.22	2.32 ± 13.3%
900	± 50 / ± 100	$41.5 \pm 5\%$	$0.97 \pm 5\%$	6.03	6.03	6.03	0.46	2.27 ± 11.0%
1640	± 50 / ± 100	$40.3 \pm 5\%$	1.29 ± 5%	5.45	5.45	5.45	0.52	2.60 ± 11.0%
1810	± 50 / ± 100	$40.0 \pm 5\%$	$1.40 \pm 5\%$	5.21	5.21	5.21	0.62	2.40 ± 11.0%
1950	± 50 / ± 100	$40.0 \pm 5\%$	$1.40 \pm 5\%$	4.92	4.92	4.92	0.60	2.20 ± 11.0%
2450	± 50 / ± 100	$39.2 \pm 5\%$	$1.80 \pm 5\%$	4.54	4.54	4.54	0.99	1.64 ± 11.0%

<sup>&</sup>lt;sup>C</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Certificate No: ET3-1380\_Dec10

Page 5 of 11





# DASY/EASY - Parameters of Probe: ET3DV6 SN:1380

#### Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz] <sup>C</sup>	Permittivity	Conductivity	ConvF X Co	nvFY Cor	ıvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	$56.7 \pm 5\%$	$0.94 \pm 5\%$	7.31	7.31	7.31	0.15	2.33 ± 13.3%
900	± 50 / ± 100	$55.0 \pm 5\%$	$1.05 \pm 5\%$	5.86	5.86	5.86	0.51	2.27 ± 11.0%
1810	± 50 / ± 100	$53.3 \pm 5\%$	$1.52 \pm 5\%$	4.59	4.59	4.59	0.75	2.53 ± 11.0%
1950	± 50 / ± 100	$53.3 \pm 5\%$	$1.52 \pm 5\%$	4.57	4.57	4.57	0.70	2.30 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.09	4.09	4.09	0.99	1.56 ± 11.0%

<sup>&</sup>lt;sup>c</sup> The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Certificate No: ET3-1380\_Dec10

Page 6 of 11

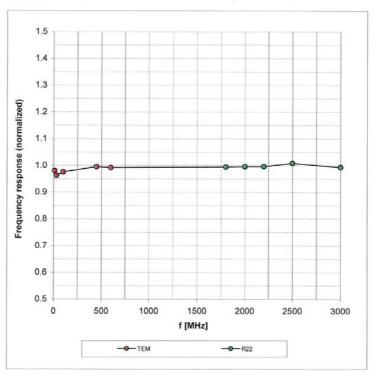




December 9, 2010

# Frequency Response of E-Field

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



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

Certificate No: ET3-1380\_Dec10

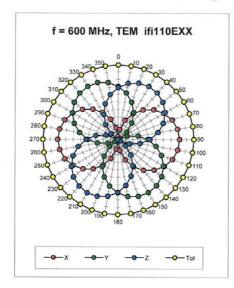
Page 7 of 11

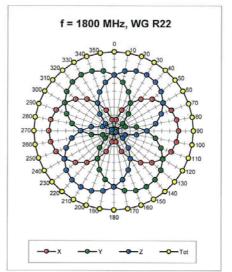


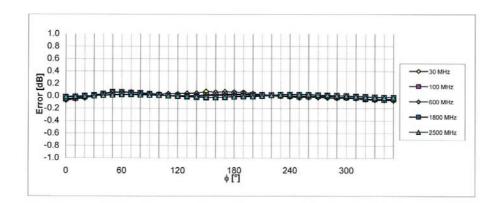


December 9, 2010

# Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$







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

Certificate No: ET3-1380\_Dec10

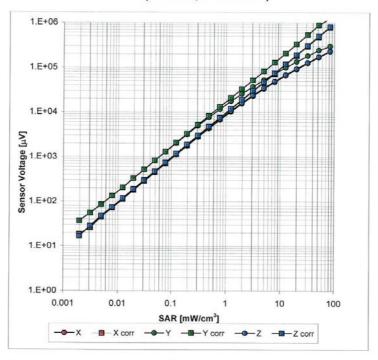
Page 8 of 11

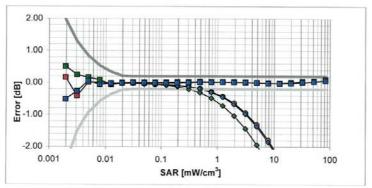




# Dynamic Range f(SAR<sub>head</sub>)

(TEM cell, f = 900 MHz)





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

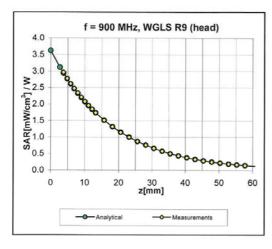
Certificate No: ET3-1380\_Dec10

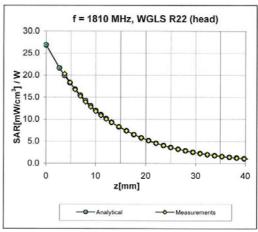
Page 9 of 11





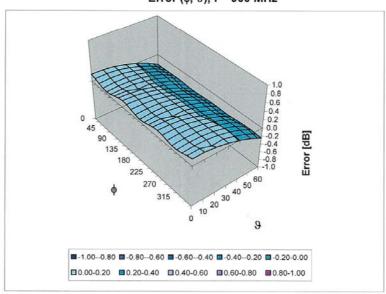
#### **Conversion Factor Assessment**





# **Deviation from Isotropy in HSL**

Error ( $\phi$ ,  $\vartheta$ ), f = 900 MHz



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

Certificate No: ET3-1380\_Dec10

Page 10 of 11





December 9, 2010

# Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	enabled
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	3.7 mm

Certificate No: ET3-1380\_Dec10

Page 11 of 11





## Calibration Laboratory of

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





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

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

C

CALIBRATION	CERTIFICATE		
Object	D2450V2 - SN: 7	<b>2</b> 4	
Calibration procedure(s)	QA CAL-05.v7 Calibration proce	edure for dipole validation kits	
Calibration date:	December 09, 20	010	
	1-V2-1	robability are given on the following pages a ry facility: environment temperature (22 ± 3)	(4) The Annual (4) (1) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4
		y admity of mornion temperature (EE 2 0)	Cara namany v 7078.
Calibration Equipment used (M&T	TE critical for calibration)		
Calibration Equipment used (M&		Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)	Scheduled Calibration Oct-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704	Cal Date (Certificate No.) 06-Oct-10 (No. 217-01266)	Scheduled Calibration Oct-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ID #  GB37480704 US37292783	Cal Date (Certificate No.) 06-Oct-10 (No. 217-01266) 06-Oct-10 (No. 217-01266)	Scheduled Calibration Oct-11 Oct-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID #	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)  Check Date (in house)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11 Scheduled Check
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID #  MY41092317	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)  Check Date (in house)  18-Oct-02 (in house check Oct-09)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11 Scheduled Check In house check: Oct-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)  Check Date (in house)  18-Oct-02 (in house check Oct-09)  4-Aug-99 (in house check Oct-09)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11 Scheduled Check In house check: Oct-11 In house check: Oct-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)  Check Date (in house)  18-Oct-02 (in house check Oct-09)  4-Aug-99 (in house check Oct-09)  18-Oct-01 (in house check Oct-10)	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11 Scheduled Check In house check: Oct-11 In house check: Oct-11 In house check: Oct-11
Calibration Equipment used (M&Terimary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E Calibrated by:	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206  Name	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)  Check Date (in house)  18-Oct-02 (in house check Oct-09)  4-Aug-99 (in house check Oct-09)  18-Oct-01 (in house check Oct-10)  Function	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11 Scheduled Check In house check: Oct-11 In house check: Oct-11
Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	ID #  GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3205 SN: 601  ID #  MY41092317 100005 US37390585 S4206  Name	Cal Date (Certificate No.)  06-Oct-10 (No. 217-01266)  06-Oct-10 (No. 217-01266)  30-Mar-10 (No. 217-01158)  30-Mar-10 (No. 217-01162)  30-Apr-10 (No. ES3-3205_Apr10)  10-Jun-10 (No. DAE4-601_Jun10)  Check Date (in house)  18-Oct-02 (in house check Oct-09)  4-Aug-99 (in house check Oct-09)  18-Oct-01 (in house check Oct-10)  Function	Scheduled Calibration Oct-11 Oct-11 Mar-11 Mar-11 Apr-11 Jun-11 Scheduled Check In house check: Oct-11 In house check: Oct-11 In house check: Oct-11

Certificate No: D2450V2-724\_Dec10

Page 1 of 6





#### Calibration Laboratory of

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





S Schweizerischer Kalibrierdienst

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

Accreditation No.: SCS 108

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

#### Glossary:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z 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.

Certificate No: D2450V2-724\_Dec10

Page 2 of 6





#### **Measurement Conditions**

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

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

## **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	1.91 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR normalized	normalized to 1W	52.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	52.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.04 mW / g
SAR normalized	normalized to 1W	24.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.2 mW / g ± 16.5 % (k=2)

Page 3 of 6

Certificate No: D2450V2-724\_Dec10





#### **Appendix**

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.3 \Omega + 4.3 j\Omega$
Return Loss	- 26.5 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 ns
Licotrical Dolay (one ancolion)	1.102 110

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 16, 2002

Certificate No: D2450V2-724\_Dec10





#### **DASY5 Validation Report for Body**

Date/Time: 09.12.2010 13:23:23

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:724

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

Medium: MSL U12 BB

Medium parameters used: f = 2450 MHz;  $\sigma = 1.92 \text{ mho/m}$ ;  $\varepsilon_r = 52.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY5 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 10.06.2010

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

Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)

Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

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

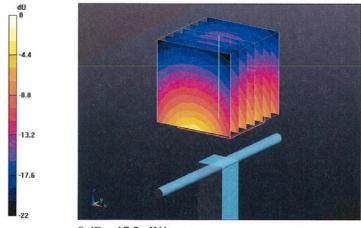
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.3 V/m; Power Drift = -0.059 dB

Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13 mW/g; SAR(10 g) = 6.04 mW/g

Maximum value of SAR (measured) = 17.2 mW/g



0 dB = 17.2 mW/g

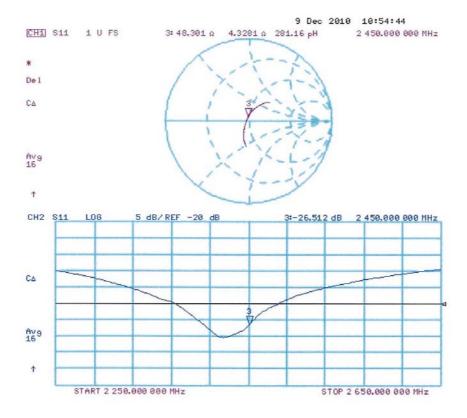
Certificate No: D2450V2-724\_Dec10

Page 5 of 6





#### Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-724\_Dec10

Page 6 of 6



