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7. DAE & Probe Calibration Certificate

Accreditation No.: SCS 108 Certificate No: DAE4-1336_Jun12
Certificate No: DAE4-1336_Jun12
N: 1336
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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.

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DC Voltage Measurement

A/D - Converter Resolution nominal High Range: 1LSB =

full range = -100...+300 mV full range = -1......+3mV 6.1µV. Low Range: 1LSB = 61nV. DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.371 ± 0.1% (k=2)	403.127 ± 0.1% (k=2)	403.194 ± 0.1% (k=2)
Low Range	3.96695 ± 0.7% (k=2)	3.96890 ± 0.7% (k=2)	3.99405 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	122.5 ° ± 1 °

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Appendix

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	199994.11	-3.29	-0.00
Channel X + Input	20001.83	0.90	0.00
Channel X - Input	-19999.76	0.45	-0.00
Channel Y + Input	199997.52	0.39	0.00
Channel Y + Input	19998.61	-2.15	-0.01
Channel Y - Input	-20001.36	-1.00	0.00
Channel Z + Input	199993.95	-3.37	-0.00
Channel Z + Input	19998.98	-1.78	-0.01
Channel Z - Input	-20001.47	-0.97	0.00

Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	2002.07	0.90	0.04
Channel X + Input	202.26	0.62	0.31
Channel X - Input	-197.79	0.45	-0.23
Channel Y + Input	2001.57	0.59	0.03
Channel Y + Input	201.46	-0.01	-0.01
Channel Y - Input	-198.80	-0.34	0.17
Channel Z + Input	2001.54	0.51	0.03
Channel Z + Input	200.53	-1.00	-0.50
Channel Z - Input	-199.57	-1.21	0.61

2. Common mode sensitivity

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	5.99	4.73
	- 200	-3.24	-5.13
Channel Y	200	4.30	4.27
	- 200	-5.85	-5.85
Channel Z	200	8,94	9.05
	- 200	-12.06	-12.09

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	100	6.36	-0.99
Channel Y	200	9.20	4/10/11	7.23
Channel Z	200	8.41	6.54	4

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4. AD-Converter Values with inputs shorted

	High Range (LSB)	Low Range (LSB)
Channel X	15917	15922
Channel Y	15876	15535
Channel Z	15842	16395

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec Input $10 M\Omega$

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (µV)
Channel X	1.30	-0.23	2.19	0.37
Channel Y	-0.29	-1.58	1.23	0.56
Channel Z	-2.08	-3.18	-0.96	0.49

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	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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Client Auder

Certificate No: ES3-3071_Jun12

Accreditation No.: SCS 108

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3071

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

Calibration date: June 22, 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 (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No: 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Claudio Leubier	Laboratory Technician	Ud
Approved by:	Katja Pokovic	Technical Manager	26 Mg
			Issued: June 22, 2012

Certificate No: ES3-3071_Jun12

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Glossary:

tissue simulating liquid NORMx,y,Z sensitivity in free space sensitivity in TSL / NORMx,y,z ConvF DCP

diode compression point crest factor (1/duty_cycle) of the RF signal CF A.B.C modulation dependent linearization parameters a rotation around probe axis

Polarization w

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

i.e., 8 = 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
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 \leq 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCPx_iy_iz_i$: 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
- 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 measurements for 12 800 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 \pm 50 MHz to \pm 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset. The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ES3DV3 - SN:3071

June 22, 2012

Probe ES3DV3

SN:3071

Manufactured: Calibrated:

December 14, 2004 June 22, 2012

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

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ES3DV3- SN:3071 June 22, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3071

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) ²) ^A	1.12	1.22	0.96	± 10.1 %
Norm (µV/(V/m) ²) ^A DCP (mV) ⁸	101.5	99.2	99.2	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	WR mV	Unc* (k=2)
0	CW	0.00	X	0.00	0.00	1.00	107.3	±3.3 %
			Y	0.00	0.00	1.00	108.0	
			Z	0.00	0.00	1.00	99.5	

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%.

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The uncertainties of NormXY,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

Numerical linearization parameter uncertainty not required.

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



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June 22, 2012 ES3DV3-SN:3071

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3071

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity [†]	Conductivity (Sim)	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	5.91	5,91	5.91	0.37	1.63	± 12.0 %
835	41.5	0.90	5.68	5.68	5.68	0.77	1.14	± 12.0 %
900	41.5	0.97	5.57	5.57	5.57	0.48	1,40	± 12.0 %
1450	40,5	1.20	5.00	5.00	5.00	0.32	1.98	± 12.0 %
1750	40.1	1.37	4.89	4.89	4.89	0.80	1.25	± 12.0 %
1900	40.0	1.40	4.66	4.66	4.66	0.80	1.20	± 12.0 %
2000	40.0	1.40	4.63	4.63	4,63	0.80	1.24	± 12.0 %
2450	39.2	1.80	4.08	4.08	4.08	0.80	1.28	± 12.0 %

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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.

At frequencies below 3 GHz, the validity of tissue parameters (a and n) can be relaxed to ± 10% if figuid compensation formula is applied to measured SAR values. Afterguencies above 3 GHz, the validity of tissue parameters (a and n) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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ES3DV3- SN:3071 June 22, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3071

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) c	Relative Permittivity F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.78	5.78	5.78	0,65	1.24	±12.0 %
835	55.2	0.97	5.69	5.69	5.69	0.36	1.76	± 12.0 %
900	55.0	1.05	5.62	5.62	5.62	0.67	1.27	± 12.0 %
1450	54.0	1.30	5.04	5.04	5.04	0.66	1.31	± 12.0 %
1750	53.4	1.49	4.50	4.50	4.50	0.74	1,29	± 12.0 %
1900	53.3	1.52	4.29	4.29	4.29	0.60	1.44	± 12.0 %
2000	53.3	1.52	4.37	4.37	4.37	0.62	1.46	± 12.0 %
2450	52,7	1.95	3.87	3.87	3,87	0.80	1.08	± 12.0 %

Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), like # 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.

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

Certificate No: ES3-3071 Jun12

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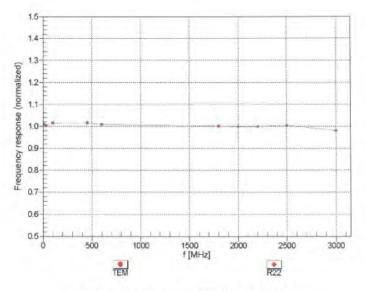
Page: 491 of 616

ES3DV3-SN:3071

June 22, 2012

Frequency Response of E-Field

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



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

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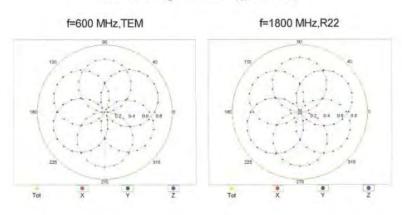
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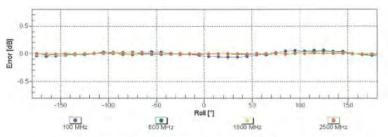


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ES3DV3-SN:3071 June 22, 2012

Receiving Pattern (6), 9 = 0°





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

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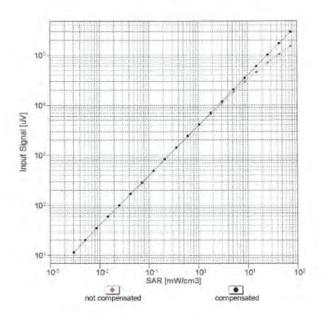
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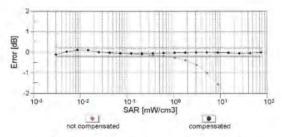


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ES3DV3-SN:3071 June 22, 2012

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





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

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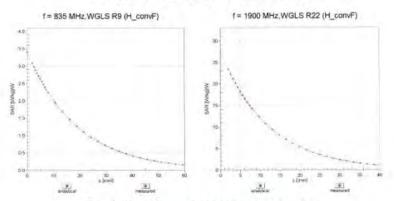
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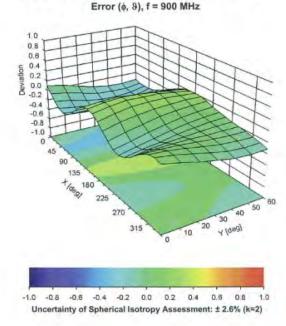
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ES3DV3-SN:3071 June 22, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid



Certificate No: ES3-3071 Jun12

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ES3DV3- SN:3071 June 22, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3071

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	54.9
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	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Certificate No: ES3-3071_Jun12

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





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Accreditation No.: SCS 108 Certificate No: EX3-3820_Dec12

C

CALIBRATION CERTIFICATE

EX3DV4 - SN:3820

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

December 10, 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 (M&TE critical for calibration)

Primary Standards	(D)	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293B74	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID OIL	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Function Laboratory Technician Katja Pokovic Technical Manager Approved by: Issued: December 11, 2012 This calibration certificate shall not be reproduced except in full without written approval of the laboratory

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





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

Accreditation No.: SCS 108

Accredited by the Swiss Accreditation Service (SAS)

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Glossary:

TSL NORMx,y,z tissue simulating liquid sensitivity in tree space sensitivity in TSL / NORMx.y.z. DCP

diode compression point crest factor (1/duty_cycle) of the RF signal A.B.C modulation dependent linearization parameters

Polarization o or 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:

 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 Tachniques", 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 $\theta = 0$ ($f \le 900$ MHz in TEM-cell; $f \ge 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,y,z * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal
- 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 ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Lemperature Transfer Standard for f ≤ 800 MHz) and inside wavegulde 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: EX3-3820 Dec12

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EX3DV4 - SN:3820

December 10, 2012

Probe EX3DV4

SN:3820

Manufactured: Calibrated:

September 2, 2011 December 10, 2012

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

Certificate No: EX3-3820_Dec12

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EX3DV4- SN:3820

December 10, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3820

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) ²) ^A	0.44	0.35	0.44	± 10.1 %
DCP (mV) ^{ff}	99.1	100.3	99.4	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	Ç dB	VR mV	Unc (k=2)
0	CW	0.00	X.	0.0	0.0	1.0	149.3	±3.0 %
			. Y.	0.0	0.0	1.0	179,2	
			Z	0.0	0.0	1.0	147.4	

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: EX3-3820_Dec12

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A The uncertainties of NormX,Y,Z do not affect the E³-field uncertainty inside TSL (see Pages 5 and 6)

Numerical linearization parameter: uncertainty not required.

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



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EX3DV4- SN:3820

December 10, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3820

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)
835	41.5	0.90	9.19	9.19	9.19	0.80	0.66	± 12.0 %
1750	40.1	1,37	7.81	7.81	7.81	0.49	0.77	± 12.0 %
1900	40.0	1.40	7.51	7.51	7.51	0.46	0.78	± 12.0 %
2100	39.8	1.49	7.64	7.64	7.64	0.42	0.81	± 12.0 %
2450	39.2	1.80	6.74	6.74	6.74	0.37	0.89	± 12.0 %
5200	36.0	4.66	5.01	5.01	5.01	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.76	4.76	4.76	0.45	1.80	± 13.1 %
5500	35.6	4.96	4.58	4.58	4.58	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.31	4.31	4.31	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.45	1.80	± 13.1 %

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

At frequencies below 3 GHz, the validity of Issue parameters (ϵ and σ) can be relaxed to \pm 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 \pm 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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EX3DV4-SN:3820

December 10, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3820

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^E	Relative Permittivity	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	9.07	9.07	9,07	0.32	1:10	± 12.0 %
1750	53.4	1.49	7.60	7.60	7.60	0.37	0.91	± 12.0 %
1900	53.3	1.52	7.30	7.30	7.30	0.26	1.19	± 12.0 %
2100	53.2	1.62	7.56	7.56	7.56	0.25	1.17	± 12.0 %
2450	52.7	1.95	6.84	6.84	6,84	0.80	0.61	± 12,0 %
5200	49.0	5.30	4.23	4.23	4.23	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.95	3,95	3.95	0.55	1,90	± 13.1 %
5500	48.6	5.65	3.63	3.63	3.63	0.60	1.90	± 13.1 %
5600	48.5	5.77	3,39	3.39	3.39	0.65	1.90	± 13.1 %
5800	48.2	6.00	3.83	3.83	3.83	0.60	1.90	± 13.1 %

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.

At frequencies below 3 GHz, the validity of lissue parameters (s and o) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAP values. Af requencies above 3 GHz, the validity of itsue parameters (s and o) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Certificate No. EX3-3820_Dec12

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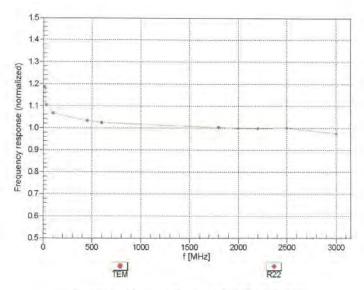
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EX3DV4-SN:3820

December 10, 2012

Frequency Response of E-Field

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



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

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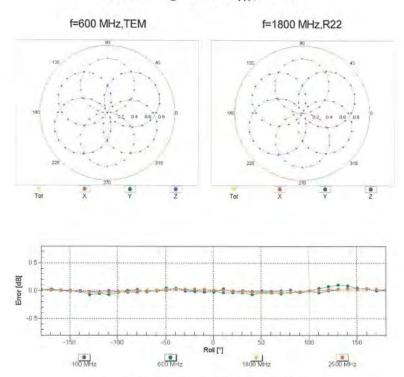
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EX3DV4- SN:3820 December 10, 2012

Receiving Pattern (ϕ), $9 = 0^{\circ}$



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

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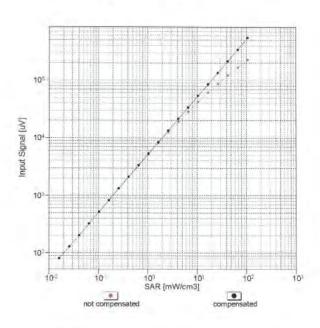


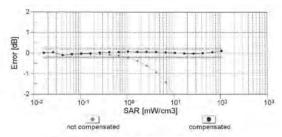
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EX3DV4-SN:3820

December 10, 2012

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





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

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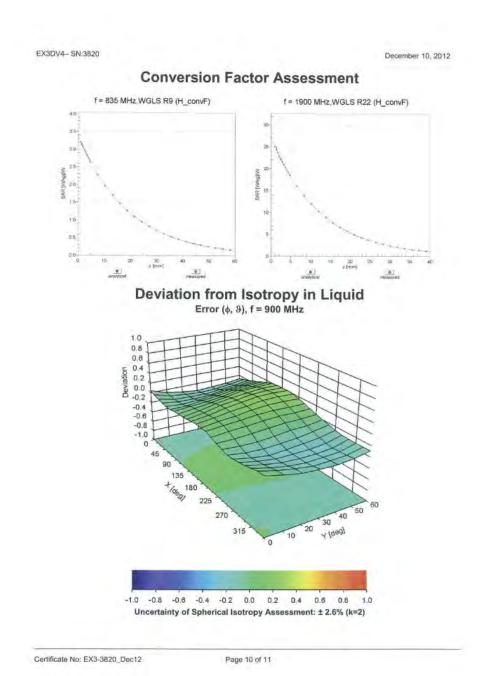
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EX3DV4-SN:3820

December 10, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3820

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (")	-69.3
Mechanical Surface Detection Moda	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2,5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Certificate No: EX3-3820_Dec12

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Accreditation No.: SCS 108

SGS-TW (Auden) Certificate No: DAE4-1336_May13 **CALIBRATION CERTIFICATE** DAE4 - SD 000 D04 BM - SN: 1336 Object QA CAL-06, v26 Calibration procedure(s) Calibration procedure for the data acquisition electronics (DAE) Calibration date: May 23, 2013 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 Cal Date (Certificate No.) Scheduled Calibration Keithley Multimeter Type 2001 SN: 0810278 02-Oct-12 (No:12728) Oct-13 Secondary Standards Check Date (in house) Scheduled Check SE UWS 053 AA 1001 07-Jan-13 (in house check) Auto DAE Calibration Unit In house check: Jan-14 Calibrator Box V2.1 SE UMS 006 AA 1002 07-Jan-13 (in house check) In house check: Jan-14 Name Function Eric Hainfeld Calibrated by: Technician Fin Bomholt Deputy Technical Manager Luces Issued: May 23, 2013 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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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
 - 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.

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DC Voltage Measurement

A/D - Converter Resolution nominal

 $\begin{array}{lll} \mbox{High Range:} & 1 \mbox{LSB} = & 6.1 \mu\mbox{V} \,, & \mbox{full range} = & -100...+300 \mbox{ mV} \\ \mbox{Low Range:} & 1 \mbox{LSB} = & 61 \mbox{NV} \,, & \mbox{full range} = & -1......+3 \mbox{mV} \\ \mbox{DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec} \end{array}$

Calibration Factors	X	Y	Z
High Range	403.456 ± 0.02% (k=2)	403.207 ± 0.02% (k=2)	403.280 ± 0.02% (k=2)
Low Range	3,96591 ± 1.50% (k=2)	3.96908 ± 1.50% (k=2)	3.99337 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	122.5°±1°

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Appendix

1. DC Voltage Linearity

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	199996.98	1.17	0.00
Channel X + Input	20001.78	1.50	0.01
Channel X - Input	-20000.03	0.93	-0.00
Channel Y + Input	199993.44	-2.19	-0.00
Channel Y + Input	19999.20	-0.98	-0,00
Channel Y - Input	-20002.36	-1.35	0.01
Channel Z + Input	199993.74	-1.97	-0.00
Channel Z + Input	19998.32	-1.83	-0.01
Channel Z - Input	-20002.54	-1.46	0.01

Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	2000.34	-0.07	-0.00
Channel X + Input	201.19	0.16	80.0
Channel X - Input	-198.81	0.01	-0.01
Channel Y + Input	2000.13	-0.33	-0.02
Channel Y + Input	200.05	-0.83	-0.41
Channel Y - Input	-200.10	-1.14	0.57
Channel Z + Input	2000.59	0.31	0.02
Channel Z + Input	200.18	-0.69	-0.34
Channel Z - Input	-199.90	-0.85	0.43

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	6.44	4.67
	- 200	-3.73	-4.80
Channel Y	200	10.39	10.66
	- 200	-9.92	-9.79
Channel Z	200	10.68	10.35
	- 200	-11.83	-12.04

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	2.2	5.56	-0.75
Channel Y	200	8.84	-	7.76
Channel Z	200	8.66	6.07	. ×

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4. AD-Converter Values with inputs shorted

	High Range (LSB)	Low Range (LSB)
Channel X	15911	15227
Channel Y	15869	14671
Channel Z	15839	15960

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec Input 10MQ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (µV)
Channel X	0.96	-0.43	2.20	0.41
Channel Y	-0.95	-2.41	1.35	0.49
Channel Z	-0.65	-1.67	0.76	0.41

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	

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0,01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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Certificate No: EX3-3848_Apr13

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CALIBRATION CERTIFICATE EX3DV4 - SN:3848 QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure(s) Calibration procedure for dosimetric E-field probes Calibration date: April 30, 2013 This calibration certificate documents the traceability to national standards, which realize the physical units of mea 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%

Primary Standards ID		Cal Date (Certificate No.)	Scheduled Calibration	
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14	
Power sensor E4412A.	MY41498087	(4-Apr-13 (No. 217-01733)	Apr-14	
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14	
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735) Apr-14		
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14	
Reference Probe ES30V2	SN: 3013	28-Dec-12 (No. ES3-3013 Dec12)	Dec-13	
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14	
Secondary Standards	ID.	Check Date (in house)	Scheduled Check	
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check; Apr-15	
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13	

	Name	Function	Signature
Calibrated by	Israe El-Naoug	Laboratory Technician	Deran Andanie
Approved by:	Katja Pokovic	Technical Manager	Jak Ky
			(ssued: May 1, 2013)

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Calibration Laboratory of Schmid & Partner

Engineering AG eughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst Service suisse d'étatonnage Servizio svizzero di taratura 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:

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

diade compression point crest factor (1/duty_cycle) of the RF signal modulation dependent linearization parameters CF A, B, C, D

a rotation around probe axis Polarization o

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

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 affect 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,v,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
- Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z; A, B, C, D 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 measurements for $t \ge 800$ 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 \pm 50 MHz to \pm 100
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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EX3DV4 - SN:3848

April 30, 2013

Probe EX3DV4

SN:3848

Manufactured:

October 25, 2011

Repaired: Calibrated:

April 22, 2013 April 30, 2013

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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EX3DV4-SN:384B April 30, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3848

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m) ²) ^A	0.41	0.41	0.45	± 10.1 %
DCP (mV) ^B	98.8	100.8	99.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dBõV	C	D dB	WR mV	Unc* (k=2)
0	CW	X	0.0	0.0	1.0	0.00	145,1	±3.0 %
		Y.	0.0	0.0	1.0		150.4	
		Z	0.0	0.0	1.0		152.4	

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%.

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The uncertainties of NormX,Y,Z do not affect the E¹-field uncertainty inside TSL (see Pages 5 and 6).

Numerical financization parameter: uncertainty not required.

Uncertainty is determined using the max. deviation from linear response applying rectaingular distribution and is expressed for the square of the initial value.



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April 30, 2013 EX3DV4- SN:3848

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3848

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity F	Conductivity (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	10.01	10.01	10.01	0.76	0.58	± 12.0 %
835	41.5	0.90	9.67	9.67	9.67	0.73	0.59	± 12.0 %
900	41.5	0.97	9.57	9.57	9.57	0.80	0.50	± 12.0 %
1750	40.1	1.37	8.41	8.41	8.41	0.48	0.78	± 12.0 9
1900	40.0	1.40	8,13	8.13	8.13	0.50	0.74	± 12.0 9
2000	40.0	1.40	8.01	8.01	8.01	0.80	0.60	± 12.0 9
2300	39.5	1.67	7.69	7.69	7.69	0.45	0.79	± 12.0 9
2450	39.2	1.80	7.15	7.15	7.15	0.29	1.06	±12.09
2600	39.0	1,96	6.89	6.89	6.89	0.49	0.75	± 12.0 9
5200	36.0	4.66	5.45	5.45	5.45	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.22	5.22	5.22	0.35	1.80	±13.1 9
5600	35.5	5.07	4.49	4.49	4.49	0.40	1.80	± 13.1 9
5800	35.3	5.27	4.88	4.88	4.88	0.40	1.80	± 13,1 %

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⁵ 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.

At frequencies below 3 GHz, the validity of issue parameters (s and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At requencies above 3 GHz, the validity of fisaule parameters (s and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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April 30, 2013 EX3DV4- SN:3848

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3848

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	9.59	9.59	9.59	0.36	0.91	± 12.0.%
835	55.2	0.97	9.43	9.43	9.43	0.27	1.14	± 12.0 %
900	55.0	1.05	9.35	9.35	9.35	0.33	0.96	± 12.0 %
1750	53.4	1.49	7.78	7.78	7.78	0.35	0.83	± 12.0 %
1900	53.3	1.52	7.41	7.41	7.41	0.45	0.80	± 12.0 %
2000	53.3	1.52	7,57	7.57	7.57	0.32	0.91	± 12.0 %
2300	52.9	1.81	7.20	7.20	7.20	0.75	0.60	± 12.0 %
2450	52.7	1.95	7.12	7.12	7,12	0.76	0.55	± 12.0 %
2600	52.5	2.16	6.98	6.98	6.98	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.79	4.79	4.79	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.71	4.71	4.71	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.42	4.42	4.42	0.30	1.90	± 13.1 %
5800	48.2	6.00	4.42	4.42	4.42	0.50	1.90	±13.1 %

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.

All requences below 3 GHz, the validity of issue parameters (a and o) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. Afterguencies below 3 GHz, the validity of tissue parameters (c and o) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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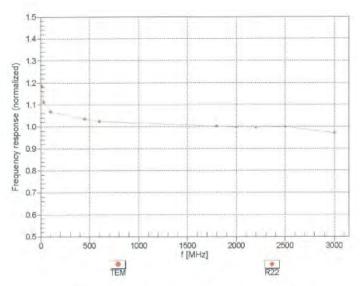


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April 30, 2013

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



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

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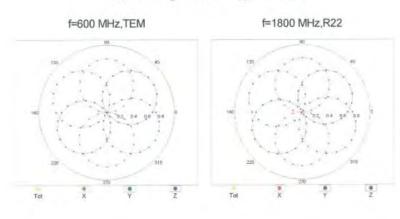
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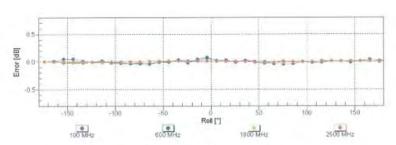


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EX3DV4- SN:3848 April 30, 2013

Receiving Pattern (\$\phi\$), 9 = 0°





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

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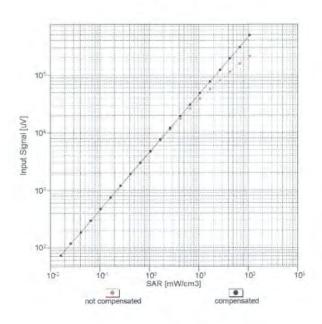
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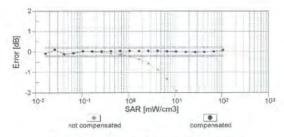


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Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)





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

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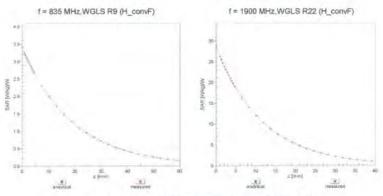
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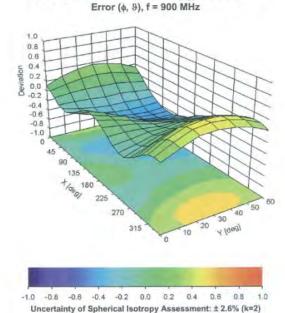
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Conversion Factor Assessment



Deviation from Isotropy in Liquid



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April 30, 2013

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EX3DV4-5N:3848

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3848

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (")	-54.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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8. Uncertainty Budget

Measurement Uncertainty evaluation

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c Tolerance	Db.shilia	e = f(d,k)		f	g	h=c * f / e	i=c * g / e	k
Tolerance	Dan L - L : ! ! !							r.
	Probabilit					Standard	Standard	vi. or
/	у	Div.	Div Value	ci (1g)	ci (10g)	uncertainty	uncertainty	Veff
Uncertaint	Distributi					+ %. (1 a)	+ %. (10 a)	
								∞
								∞
4.70%	R	√ 3	1.732	1	1	2.71%	2.71%	∞
2.40%	R	√3	1.732	1	1	1.39%	1.39%	∞
1.00%						0.58%	0.58%	∞
2.00%		_				1.15%	1.15%	∞
0.30%	N					0.30%	0.30%	∞
0.80%	R	√3	1.732			0.46%	0.46%	∞
2.60%	R	√3	1.732	1	1	1.50%	1.50%	∞
3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
3.00%	R	√3	1.732	1	1	1.73%	1.73%	∞
0.40%	R	√3	1.732	1	1	0.23%	0.23%	∞
2.90%	R	√3	1.732	1	1	1.67%	1.67%	∞
1 00%	R	./3	1 732	1	1	0.58%	0.58%	∞
1.0070		γ 5	1.702			0.0070	0.5676	
3.60%	N	1	1	1	1	3.60%	3.60%	M-1
2.90%	N	1	1	1	1	2.90%	2.90%	M-1
0.00%	D	/ 2	1 722	1	1	0.00%	0.00%	∞
5.00%	R	√ 3	1.732	1	1	2.89%	2.89%	∞
4.00%	R	√3	1.732	1	1	2.31%	2.31%	8
1.90%	N	1	1	1	0.84	1.90%	1.60%	∞
4.71%	N	1	1	0.78	0.71	3.67%	3.34%	M-1
4.20%	N	1	1	0.23	0.26	0.97%	1.09%	М
3.40%	R	√3	1.732	0.78	0.71	1.53%	1.39%	∞
3.4370	.,	, 5	1.732	0.70	0.,1	1.5576	1.5776	-
0.40%	R	√3	1.732	0.23	0.26	0.05%	0.06%	∞
	RSS					11.19%	11.03%	
						22.37%	22.05%	
	1.00% 2.00% 0.30% 0.80% 2.60% 3.00% 3.00% 1.00% 2.90% 1.00% 5.00% 4.71% 4.20% 3.40%	3.50% R 4.70% R 2.40% R 1.00% R 2.00% R 0.30% N 0.80% R 2.60% R 3.00% R 3.00% R 1.00% R 3.00% R 4.00% R 1.00% R	3.50% R √3 4.70% R √3 2.40% R √3 1.00% R √3 2.00% R √3 0.30% N 1 0.80% R √3 2.60% R √3 3.00% R √3 3.00% R √3 3.00% R √3 1.00% R √3	3.50% R √3 1.732 4.70% R √3 1.732 2.40% R √3 1.732 2.40% R √3 1.732 2.00% R √3 1.732 2.00% R √3 1.732 0.30% N 1 1 1 0.80% R √3 1.732 2.60% R √3 1.732 3.00% R √3 1.732 3.00% R √3 1.732 3.00% R √3 1.732 3.00% R √3 1.732 1.00% R √3 1.732 2.90% R √3 1.732 1.00% R √3 1.732 1.00% R √3 1.732 4.00% R √3 1.732 1.00% R √3 1.732 1.90% N 1 1 1 4.71% N 1 1 4.71% N 1 1 3.40% R √3 1.732	3.50% R √3 1.732 1 4.70% R √3 1.732 1 2.40% R √3 1.732 1 1.00% R √3 1.732 1 2.00% R √3 1.732 1 0.30% N 1 1 1 0.80% R √3 1.732 1 2.60% R √3 1.732 1 3.00% R √3 1.732 1 3.00% R √3 1.732 1 2.90% R √3 1.732 1 1.00% R √3 1.732 1 1.00% R √3 1.732 1 2.90% N 1 1 1 1.00% R √3 1.732 1 4.00% R √3 1.732 1 4.00% R √3 1.732 1 1.90% N 1 1 1	3.50% R √3 1.732 1 1 4.70% R √3 1.732 1 1 2.40% R √3 1.732 1 1 1.00% R √3 1.732 1 1 2.00% R √3 1.732 1 1 0.30% N 1 1 1 1 1 0.80% R √3 1.732 1 1 1 2.60% R √3 1.732 1 1 1 3.00% R √3 1.732 1 1 1 3.00% R √3 1.732 1 1 1 4.00% R √3 1.732 1 1 1 1 1.00% R √3 1.732 1<	3.50% R √3 1.732 1 1 2.02% 4.70% R √3 1.732 1 1 2.71% 2.40% R √3 1.732 1 1 1.39% 1.00% R √3 1.732 1 1 0.58% 2.00% R √3 1.732 1 1 0.58% 2.00% R √3 1.732 1 1 0.03% 0.80% R √3 1.732 1 1 0.46% 2.60% R √3 1.732 1 1 0.46% 2.60% R √3 1.732 1 1 1.50% 3.00% R √3 1.732 1 1 1.73% 0.40% R √3 1.732 1 1 1.67% 1.00% R √3 1.732 1 1 1.67% 1.00% R √3 1.732 1 1 2.90% 3.60% N 1	3.50% R

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9. Phantom Description



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10. System Validation from Original Equipment Supplier

eughausstrasse 43, 8004 Zurio		HAC MRA	Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accredite The Swiss Accreditation Service Multilateral Agreement for the r	e is one of the signatorie	es to the EA	n No.: SCS 108
SGS-TW (Aude	en)	Certificate N	o: D835V2-4d063_May12
CALIBRATION (CERTIFICATE		
Object	D835V2 - SN: 4d	063	
Calibration procedure(s)	QA CAL-05.v8 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	May 25, 2012		
The measurements and the unce	ertainties with confidence p	ional standards, which realize the physical ur robability are given on the following pages ar ry facility: environment temperature (22 ± 3)°	nd are part of the certificate.
The measurements and the unce All calibrations have been condu- Calibration Equipment used (M&	ertainties with confidence p cted in the closed laborator TE critical for calibration)	robability are given on the following pages at ny facility: environment temperature $(22\pm3)^{\circ}$	nd are part of the certificate. C and humidity < 70%.
The measurements and the unce All calibrations have been conduct Calibration Equipment used (M&) Primary Standards	ertainties with confidence p coted in the closed laborator TE critical for calibration) ID #	robability are given on the following pages at ry facility: environment temperature (22 ± 3)* Cal Date (Certificate No.)	nd are part of the certificate. C and humidity < 70%. Scheduled Calibration
The measurements and the unce All calibrations have been condu- Calibration Equipment used (M& Primary Standards Power meter EPM-442A	entainties with confidence p cted in the closed laborator TE critical for calibration) ID # GB37480704	robability are given on the following pages at ry facility: environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451)	C and humidity < 70%. Scheduled Calibration Oct-12
The measurements and the unce All calibrations have been condu- Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A	entainties with confidence p cted in the closed laborator TE critical (or calibration) ID # GB37480704 US37292783	robability are given on the following pages at ry facility: environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-0ct-11 (No. 217-01451)	C and humidity < 70%. Scheduled Calibration Oct-12 Oct-12
The measurements and the unce All calibrations have been condu- Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ertainties with confidence p coted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k)	robability are given on the following pages at ny facility: environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530)	ord are part of the certificate. C and humidity < 70%. Scheduled Calibration Oct-12 Oct-12 Apr-13
The measurements and the unce All calibrations have been condu- Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ertainties with confidence p coted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327	robability are given on the following pages at ry facility: environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-0ct-11 (No. 217-01451) 05-0ct-11 (No. 217-01530) 27-Mar-12 (No. 217-01533)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13
The measurements and the unce All calibrations have been condu- Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	ertainties with confidence p coted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k)	robability are given on the following pages at ny facility: environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530)	ord are part of the certificate. C and humidity < 70%. Scheduled Calibration Oct-12 Oct-12 Apr-13
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The measurements and the unce All calibrations have been conducted. Calibration Equipment used (M& 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	entainties with confidence p coted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317	Cal Date (Certificate No.) Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check; Oct-13
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The measurements and the unce All calibrations have been conductable to the combination of the combination of the conductable to the conductable t	entainties with confidence p coted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5067 22 / 06327 SN: 601 ID # MY41092317 100005 US37390586 S4206 Name	Cal Date (Certificate No.) Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01530) 27-Mar-11 (No. 217-01530) 27-Mar-12 (No. 217-01531) 30-Dec-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) Function	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

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





C

Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura 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 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.

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: D835V2-4d063_May12

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Measurement Conditions

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

DASY5	V52.8.1
Advanced Extrapolation	
Modular Flat Phantom	
15 mm	with Spacer
dx, dy , $dz = 5 mm$	
835 MHz ± 1 MHz	
	Advanced Extrapolation Modular Flat Phantom 15 mm dx, dy, dz = 5 mm

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	40.6 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		-

SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.47 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.18 mW /g ± 16.5 % (k=2)

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	54.3 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	2000	20000

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.58 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.35 mW / g ± 16.5 % (k=2)

Certificate No: D835V2-4d063_May12

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.6 \Omega + 0.3 J\Omega$	
Return Loss	- 29.1 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω - 2.9 ΙΩ	
Return Loss	- 28.9 dB	

General Antenna Parameters and Design

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Electrical Delay (one direction)	1.390 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	November 27, 2006	

Certificate No: D835V2-4d063_May12

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DASY5 Validation Report for Head TSL

Date: 25.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d063

Communication System: CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz; $\sigma = 0.89 \text{ mho/m}$; $\varepsilon_t = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- · Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

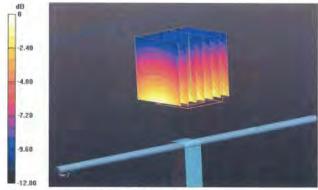
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.199 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.481 mW/g

SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.54 mW/g

Maximum value of SAR (measured) = 2.75 mW/g



0 dB = 2.75 mW/g = 8.79 dB mW/g

Certificate No: D835V2-4d063_May12

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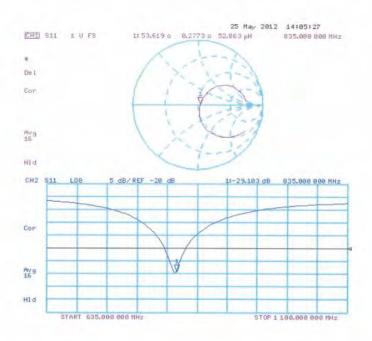
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Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d063_May12 Page 6 of 8

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DASY5 Validation Report for Body TSL

Date: 25.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d063

Communication System: CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz; $\sigma = 1$ mho/m; $\varepsilon_r = 54.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

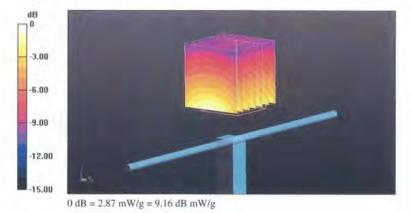
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 55.303 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.569 mW/g

SAR(1 g) = 2.46 mW/g; SAR(10 g) = 1.62 mW/g

Maximum value of SAR (measured) = 2.87 mW/g



Certificate No: D835V2-4d063 May12

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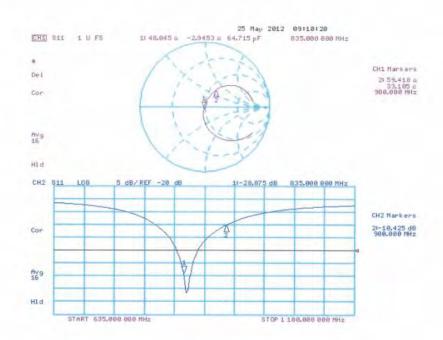
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Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d063_May12

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





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Client SGS-TW (Auden)

Certificate No: D1750V2-1008_May12

CALIBRATION CERTIFICATE D1750V2 - SN: 1008 Calibration procedure(s) QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz May 29, 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 (M&TE critical for calibration) Primary Standards ID II Cal Date (Certificate No.) Scheduled Calibration Power meter EPM-442A GB37480704 05-Oct-11 (No. 217-01451) Oct-12 Power sensor HP 8481A US37292783 05-Oct-11 (No. 217-01451) Oct-12 Reference 20 dB Attenuator SN: 5058 (20k) 27-Mar-12 (No. 217-01530) Type-N mismatch combination SN: 5047.2 / 06327 27-Mar-12 (No. 217-01533) Apr-13 Reference Probe ES3DV3 SN: 3205 30-Dec-11 (No. ES3-3205, Dec11) Dec-12 SN: 601 04-Jul-11 (No. DAE4-601_Jul11) Jul-12 Secondary Standards Check Date (in house) Scheduled Check MY41092317 18-Oct-02 (in house check Oct-11) In house check: Oct-13 In house check: Oct-13 Power sensor HP 8481A 04-Aug-99 (in house check Oct-11). RF generator R&S SMT-06 100005 Network Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-11) In house check: Oct-12 Name **Function** Calibrated by: Israe El-Naouq Laboratory Technician Deran El-Daoug Approved by: Katja Pokovic Technical Manager Issued: May 29, 2012 This calibration certificate shall not be reproduced except in full without written approval of the laboratory

Certificate No: D1750V2-1008_May12

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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.

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: D1750V2-1008_May12

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Measurement Conditions

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

DASY Version	DASY5	V52.B.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	1.34 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	****	year

SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.76 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	35.6 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.69 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	19.0 mW /g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.9 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	-	-

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.03 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	36.5 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.88 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	19.7 mW / g ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 0.5 μΩ
Return Loss	- 45.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0 Ω - 0.3 μΩ		46.0 Ω - 0.3 μΩ	
Return Loss	- 27.5 dB			

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	February 11, 2009	

Certificate No: D1750V2-1008_May12

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DASY5 Validation Report for Head TSL

Date: 29.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1008

Communication System: CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz; $\sigma = 1.34 \text{ mho/m}$; $\varepsilon_r = 40.5$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

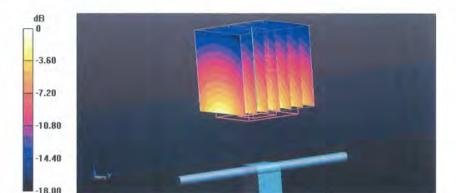
DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(5.22, 5.22, 5.22); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 93.240 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 15.463 mW/g SAR(1 g) = 8.76 mW/g; SAR(10 g) = 4.69 mW/g

Maximum value of SAR (measured) = 10.9 mW/g



0 dB = 10.9 mW/g = 20.75 dB mW/g

Certificate No: D1750V2-1008_May12

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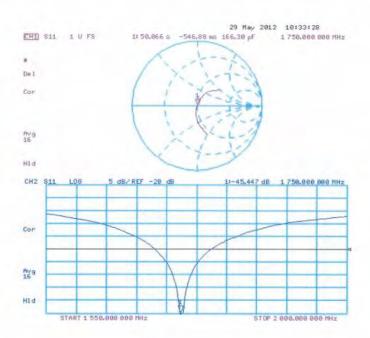
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Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1008_May12

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DASY5 Validation Report for Body TSL

Date: 29.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1008

Communication System: CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz; $\sigma = 1.46 \text{ mho/m}$; $\varepsilon_r = 52.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.85, 4.85, 4.85); Calibrated: 30.12.2011;
- · Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom; Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

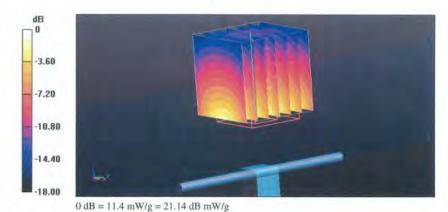
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.190 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 15.359 mW/g

SAR(1 g) = 9.03 mW/g; SAR(10 g) = 4.88 mW/g

Maximum value of SAR (measured) = 11.4 mW/g



Certificate No: D1750V2-1008_May12

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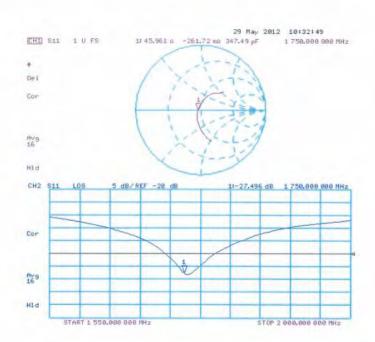
No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134 號

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Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1008_May12

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Calibration Laboratory of Schmid & Partner Engineering AG 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

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Object	D1900V2 - SN: 5	d018	
Self-ment of the second of the second			
Calibration procedure(s)	QA CAL-05.v8 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	June 21, 2012		
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		onal standards, which realize the physical ur robability are given on the following pages ar	and the second s
the measurements and the union	attaining min contractine p	robability are given on the lonewing pages a	distriction of the control of the first first distriction.
		ry facility: environment temperature $(22 \pm 3)^{\circ}$	
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All callibrations have been conducted that callibration Equipment used (M&	cted in the closed laborator		
VI calibrations have been conductalibration Equipment used (M&	cted in the closed laborator	ry facility, environment temperature $(22\pm3)^\circ$	C and humidity < 70%.
All calibrations have been conductable. Calibration Equipment used (M& Primary Standards Power meter EPM-442A	cted in the closed laborator TE critical for calibration)	ry facility: environment temperature $(22 \pm 3)^{\circ}$ Cal Date (Certificate No.)	C and humidity < 70%. Scheduled Calibration
All calibrations have been conducted (M& Calibration Equipment used (M& Calibration Equipment	cted in the closed laborator TE critical for calibration) ID # GB37480704	ry lacility, environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451)	C and humidity < 70%. Scheduled Calibration Oct-12
	cted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783	ry lacility, environment temperature (22 ± 3)* Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451)	C and humidity < 70%. Scheduled Calibration Oct-12 Oct-12
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All calibrations have been conducted in Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	cted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327	ry lacility: environment temperature (22 ± 3) ⁿ Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-0151) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13
All calibrations have been condu- Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ESSDV3 DAE4	ted in the closed laborator TE critical for calibration) ID # GB374B0704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205	ry lacility: environment temperature (22 ± 3)** Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12
All calibrations have been conducted in Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601	Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12
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All calibrations have been condu- Calibration Equipment used (M& 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	cted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (In house) 18-Oct-02 (In house check Oct-11) 04-Aug-99 (In house check Oct-11) 18-Oct-01 (In house check Oct-11)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
All calibrations have been condu- Calibration Equipment used (M& 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 delwork Analyzer HP 8753E	ted in the closed laborator TE critical for calibration) ID # GB374B0704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206 Name	Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. 283-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-11) Function	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13. In house check: Oct-13.
All calibrations have been condu- Calibration Equipment used (M& 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	cted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (In house) 18-Oct-02 (In house check Oct-11) 04-Aug-99 (In house check Oct-11) 18-Oct-01 (In house check Oct-11)	Scheduled Calibration Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

Certificate No: D1900V2-5d018_Jun12

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Servizio svizzero di taratura Swise Calibration Service

Accreditation No.: SCS 108

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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:

- 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.

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; D1900V2-5d018_Jun12

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Measurement Conditions

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

	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	40,2 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	in.c	

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.88 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.9 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.23 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW /g ± 16.5 % (k=2)

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	52.7 ± 6 %	1.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	40.5 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.39 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.5 mW / g ± 16.5 % (k=2)

Certificate No: D1900V2-5d018_Jun12

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.3 \Omega + 3.2 \Omega$	
Return Loss	-29.4 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9 Ω + 3.1 jΩ	
Return Loss	- 27,0 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 ns
	71827137

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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	June 04, 2002	

Certificate No: D1900V2-5d018_Jun12

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DASY5 Validation Report for Head TSL

Date: 21,06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d018

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; $\sigma = 1.38$ mho/m; $\varepsilon_r = 40.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;

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

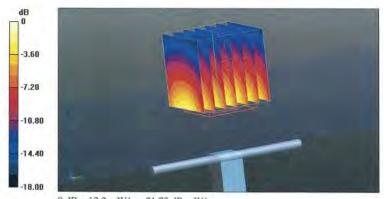
· Electronics: DAE4 Sn601; Calibrated: 04.07.2011

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

DASY52 52.8.1(838); SEMCAD X 14.6,5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 97.845 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 17.531 mW/g SAR(1 g) = 9.88 mW/g; SAR(10 g) = 5.23 mW/g Maximum value of SAR (measured) = 12.2 mW/g



0 dB = 12.2 mW/g = 21.73 dB mW/g

Certificate No; D1900V2-5d018_Jun12

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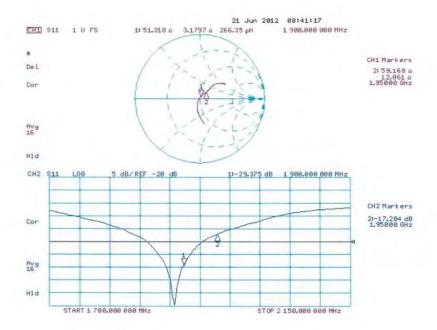
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No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134 號 t (886-2) 2299-3279 f (886-2) 2298-0488 www.tw.sgs.com



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Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d018 Jun12

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DASY5 Validation Report for Body TSL

Date: 21.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d018

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; $\sigma = 1.53$ mho/m; $\epsilon_r = 52.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;

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

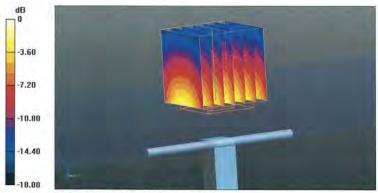
Electronics: DAE4 Sn601; Calibrated: 04.07.2011

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

DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.712 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 17.826 mW/g SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.39 mW/g Maximum value of SAR (measured) = 12.9 mW/g



0 dB = 12.9 mW/g = 22.21 dB mW/g

Certificate No: D1900V2-5d018_Jun12

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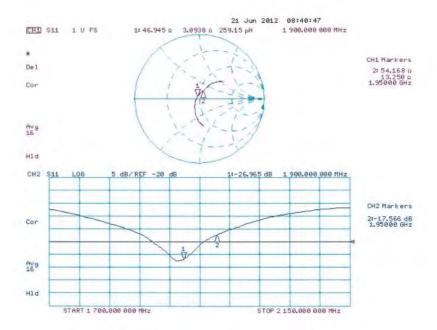
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Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d018_Jun12

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





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Multilateral Agreement for the recognition of calibration certificates

Client Auden

Accreditation No.: SCS 108

C

CALIBRATION C	ERTIFICATE		
Object	D2450V2 - SN: 8	369	
Calibration procedure(s)	QA CAL-05.v8 Calibration proce	edure for dipole validation kits abo	ove 700 MHz
Calibration date:	June 15, 2012		
		probability are given on the following pages an ry facility: environment temperature $(22 \pm 3)^{\circ}$ 0	
	TE critical for calibration)		
Calibration Equipment used (M&	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter EPM-442A	ID # GB37480704	Cal Date (Certificate No.) 05-Oct-11 (No. 217-01451)	Scheduled Calibration Oct-12
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704 US37292783	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451)	Oct-12 Oct-12
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ID # GB37480704 US37292783 SN: 5058 (20k)	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530)	Oct-12 Oct-12 Apr-13
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID # GB37480704 US37282783 SN: 5058 (20k) SN: 5047.2 / 06327	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533)	Oct-12 Oct-12 Apr-13 Apr-13
Calibration Equipment used (M& 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: 5058 (20k)	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530)	Oct-12 Oct-12 Apr-13
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	ID # GB37480704 US37282783 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check
Calibration Equipment used (M& 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: 5056 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01530) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13
Calibration Equipment used (M& 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: 5056 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12
Calibration Equipment used (M& 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: 5056 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-12
Calibration Equipment used (M& 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: 5056 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-98 (in house check Oct-11) 18-Oct-01 (in house check Oct-11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M& 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: 5056 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13
	ID # GB37480704 US37292783 SN: 5056 (20k) SN: 5047.2 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	05-Oct-11 (No. 217-01451) 05-Oct-11 (No. 217-01451) 27-Mar-12 (No. 217-01530) 27-Mar-12 (No. 217-01533) 30-Dec-11 (No. ES3-3205_Dec11) 04-Jul-11 (No. DAE4-601_Jul11) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-98 (in house check Oct-11) 18-Oct-01 (in house check Oct-11)	Oct-12 Oct-12 Apr-13 Apr-13 Dec-12 Jul-12 Scheduled Check In house check: Oct-13 In house check: Oct-13

Certificate No: D2450V2-869_Jun12

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

Accreditation No.: SCS 108

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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:

- 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.

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. D2450V2-869_Jun12

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Measurement Conditions

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) "C	38.9 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	_	Jenn-

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	54.3 mW /g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.41 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.4 mW /g ± 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	51.6 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0,5 °C		_

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.0 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.06 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.0 mW / g ± 16.5 % (k=2)

Certificate No: D2450V2-869_Jun12

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 6.0 jΩ		
Return Loss	- 23.7 dB		

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.0 \Omega + 6.4 \Omega$
Relum Loss	- 23.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1 159 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole, The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	August 18, 2010

Certificate No: D2450V2-869_Jun12

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DASY5 Validation Report for Head TSL

Date: 15.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 869

Communication System; CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.86 mho/m; ϵ_r = 38.9; ρ = 1000 kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- · Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 99.524 V/m; Power Drift = 0.08 dB Peak SAR (extrapolated) = 28.407 mW/g SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.41 mW/gMaximum value of SAR (measured) = 17.5 mW/g



0 dB = 17.5 mW/g = 24.86 dB mW/g

Certificate No: D2450V2-869 Jun12

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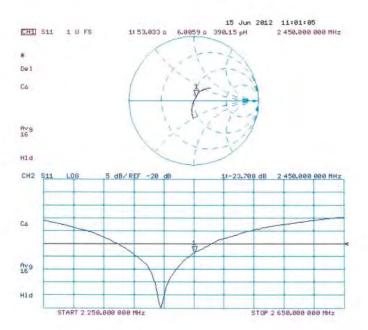
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Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-869_Jun12

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DASY5 Validation Report for Body TSL

Date: 14.06,2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 869

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; $\sigma = 2.01 \text{ mho/m}$; $\epsilon_r = 51.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

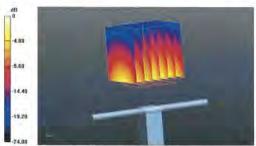
DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;

- · Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.289 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 26.649 mW/g SAR(1 g) = 13 mW/g; SAR(10 g) = 6.06 mW/g Maximum value of SAR (measured) = 17.0 mW/g



0 dB = 17.0 mW/g = 24.61 dB mW/g

Certificate No: D2450V2-869_Jun12

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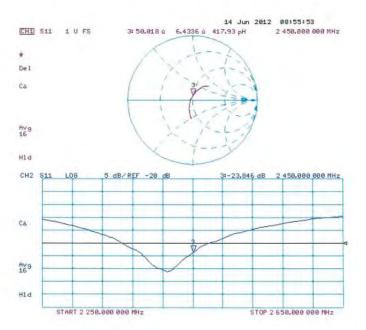
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Impedance Measurement Plot for Body TSL



Certificate No: D2450V2-869_Jun12

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





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Accreditation No.: SCS 108

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Certificate No: D5GHzV2-1040 Jun12

CALIBRATION CERTIFICATE D5GHzV2 - SN: 1040 Calibration procedure(s) QA CAL-22.v1 Calibration procedure for dipole validation kits between 3-6 GHz Calibration date: June 19, 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 (M&TE critical for calibration) Primary Standards Cal Date (Certificate No.) Scheduled Calibration Power meter EPM-442A GB37480704 05-Oct-11 (No. 217-01451) Oct-12 Power sensor HP 8481A US37292783 05-Oct-11 (No. 217-01451) Oct-12 Reference 20 dB Attenuator SN: 5058 (20k) 27-Mar-12 (No. 217-01530) Apr-13 SN: 5047.2 / 06327 27-Mar-12 (No. 217-01533) Type-N mismatch combination Apr-13 Reference Probe EX3DV4 SN: 3503 30-Dec-11 (No. EX3-3503_Dec11) Dec-12 DAE4 SN: 601 04-Jul-11 (No. DAE4-601_Jul11) Secondary Standards ID# Check Date (in house) Scheduled Check MY41092317 Power sensor HP 8481A 18-Oct-02 (in house check Oct-11) In house check: Oct-13 RF generator R&S SMT-06 100005 04-Aug-99 (in house check Oct-11) In house check: Oct-13 Network Analyzer HP 8753E US37390585 S4206 18-Oct-01 (in house check Oct-11) In house check: Oct-12 Function Calibrated by Laboratory Technician Technical Manager Approved by: Katia Pekovic

Certificate No: D5GHzV2-1040_Jun12

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Issued: June 20, 2012



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Calibration Laboratory of Schmid & Partner

Engineering AG usstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst Service suisse d'étalonnage C Servizio svizzero di taratura 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:

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

Calibration is Performed According to the Following Standards:

- a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld" and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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: D5GHzV2-1040_Jun12

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Measurement Conditions

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

DASY Version	DASY5	V52.8.1
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	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22,0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	4.52 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	_

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.20 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	81.5 mW /g ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.4 mW /g ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	-

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8,82 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	87.5 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.52 mW / g
SAFI for nominal Head TSL parameters	normalized to 1W	25.0 mW / g ± 19.5 % (k=2)

Certificate No: D5GHzV2-1040_Jun12

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Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	5.11 mho/m ± 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	8.23 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	81.6 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2,35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23,3 mW / g ± 19.5 % (k=2)

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Body TSL parameters at 5200 MHz

he following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22,0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.37 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	-	

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7,37 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	73.1 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2,07 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.5 mW / g ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.76 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.87 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	78.1 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.7 mW / g ± 19.5 % (k=2)

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Body TSL parameters at 5800 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.0 ± 6 %	6.16 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	7.44 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	73.8 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.06 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.4 mW / g ± 19.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.2 Ω - 7.1 jΩ
Return Loss	- 22.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.5 Ω - 4.4 jΩ	
Return Loss	- 26.8 dB	

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.3 Ω - 2.7 jΩ	
Return Loss	- 24.9 dB	

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.6 Ω - 5.5]Ω	
Return Loss	- 25,2 dB	

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	52.5 Ω - 3.2 Ω	
Return Loss	- 28.1 dB	

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56,6 Ω - 1,3 μΩ	
Return Loss	- 24.0 dB	

General Antenna Parameters and Design

T T	
Electrical Delay (one direction)	1,202 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG	
Manufactured on	December 30, 2005	

Certificate No: D5GHzV2-1040_Jun12

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DASY5 Validation Report for Head TSL

Date: 19.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1040

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 4.52$ mho/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5500 MHz; $\sigma = 4.8$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma = 5.11$ mho/m; $\epsilon_r = 34.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.41, 5.41, 5.41); Calibrated; 30.12.2011, ConvF(4.91, 4.91, 4.91); Calibrated; 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated; 30.12.2011;
- 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 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 65.507 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 30.371 mW/g

SAR(1 g) = 8.2 mW/g; SAR(10 g) = 2.36 mW/g

Maximum value of SAR (measured) = 19.0 mW/g

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 = 66.096 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 35.013 mW/g

SAR(1 g) = 8.82 mW/g; SAR(10 g) = 2.52 mW/g

Maximum value of SAR (measured) = 21.2 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 = 62.419 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 34.147 mW/g

SAR(1 g) = 8.23 mW/g; SAR(10 g) = 2.35 mW/g

Maximum value of SAR (measured) = 20.0 mW/g

Certificate No: D5GHzV2-1040_Jun12

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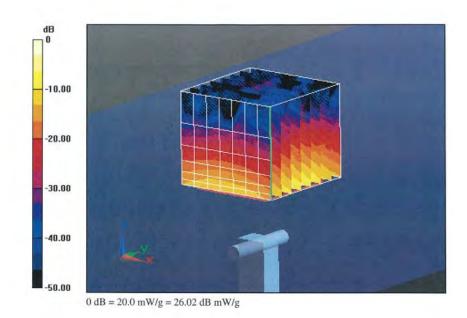
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Certificate No: D5GHzV2-1040_Jun12

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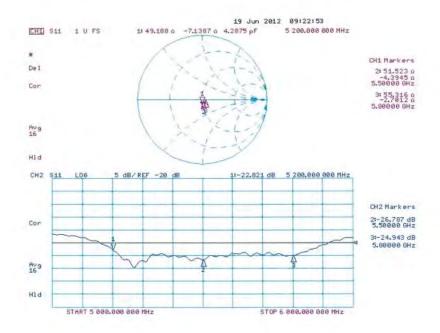
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Impedance Measurement Plot for Head TSL



Certificate No: D5GHzV2-1040 Jun12

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DASY5 Validation Report for Body TSL

Date: 18.06.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type; D5GHzV2; Serial: D5GHzV2 - SN: 1040

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz; $\sigma = 5.37$ mho/m; $\epsilon_r = 47$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5500 MHz; $\sigma = 5.76$ mho/m; $\epsilon_r = 46.5$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma = 6.16 \text{ mho/m}; \ \varepsilon_r = 46; \ \rho = 1000 \text{ kg/m}^3$

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); Calibrated: 30.12.2011, ConvF(4.43, 4.43, 4.43); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- 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 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 58.667 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 29,022 mW/g

SAR(1 g) = 7.37 mW/g; SAR(10 g) = 2.07 mW/g

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

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 = 58.708 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 33.769 mW/g

SAR(1 g) = 7.87 mW/g; SAR(10 g) = 2.19 mW/g

Maximum value of SAR (measured) = 19.0 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 = 55.529 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 34.868 mW/g

SAR(1 g) = 7.44 mW/g; SAR(10 g) = 2.06 mW/g

Maximum value of SAR (measured) = 18.1 mW/g

Certificate No: D5GHzV2-1040_Jun 12

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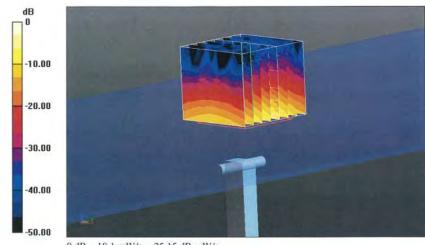
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0 dB = 18.1 mW/g = 25.15 dB mW/g

Certificate No: D5GHzV2-1040 Jun12

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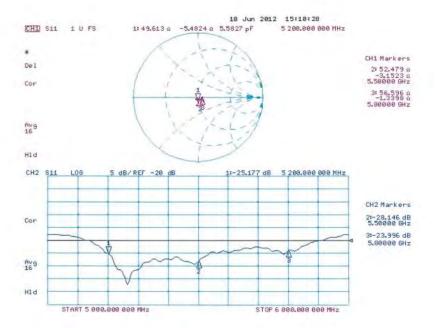
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Impedance Measurement Plot for Body TSL



Certificate No: D5GHzV2-1040_Jun12

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





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SGS-TW (Auden)

Certificate No: D835V2-4d063_May13

Object	D835V2 - SN: 4d	083	
o injuri	DOGGVE GIVE TO	000	
Calibration procedure(s)	QA CAL-05.v9		
	Calibration proce	dure for dipole validation kits a	bove 700 MHz
Calibration date:	May 28, 2013		
This salibentian contilinate document	ande the terresolution to notif	and standards which realize the physical	unite of managements (CI)
		onal standards, which realize the physical robability are given on the following pages	
All calibrations have been conduc	cted in the closed laborator	ry facility: environment temperature (22 ± 3)°C and humidity < 70%.
Calibration Equipment used (M&	TE critical for calibration)		
	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
rimary Standards		Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13
Primary Standards Power meter EPM-442A	(D.#		
Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ID # GB37480704 US37292783	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	Oct-13 Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID # GB37480704 US37292783 SN: 5058 (20k)	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Oct-13 Oct-13 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Atteruator Type-N mismatch combination Reference Probe ES3DV3	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Oct-13 Oct-13 Apr-14 Apr-14
Calibration Equipment used (M8' 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: 5058 (20k) SN: 5047.3 / 06327 SN: 3205	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	(D.# GB37480704 US37292783 SN: 5058 (20K) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
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-08	ID # GB37480704 US37292783 SN: 5056 (20k) SN: 5047.3 / 05327 SN: 3205 SN: 601 ID # MY41092317	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In touse check: Oct-13
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: 5058 (20K) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4205	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In bouse check: Oct-13
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: 5056 (20k) SN: 5047.3 / 05327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4205	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
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 RIF generator R&S SMT-06 Network Analyzer HP 8753E Calibrated by:	ID # GB37480704 US37292783 SN: 5056 (20k) SN: 5047.3 / 05327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4205 Name Left Klysner	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12) Function Laboratory Technician	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-11 In house check; Oct-11

Certificate No: D835V2-4d063_May13

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Calibration Laboratory of Schmid & Partner Engineering AG Zeoghausstrasse 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 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
- 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.

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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		-

SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2,47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.51 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.21 W/kg ± 16.5 % (k=2)

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	54.5 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	****	-

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.40 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.16 W/kg ± 16.5 % (k=2)

Certificate No: D835V2-4d063_May13

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω - 3.5 jΩ	
Return Loss	- 28.9 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 5.2 μΩ
Return Loss	- 23,9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.388 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	November 27, 2006

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DASY5 Validation Report for Head TSL

Date: 28.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d063

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz; $\sigma = 0.94 \text{ S/m}$; $\varepsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 25.04.2013

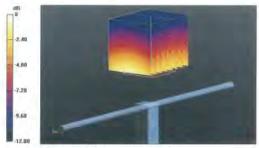
Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x8x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 56.884 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 3.76 W/kg

SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.6 W/kgMaximum value of SAR (measured) = 2.91 W/kg



0 dB = 2.91 W/kg = 4.64 dBW/kg

Certificate No: D835V2-4d063_May13

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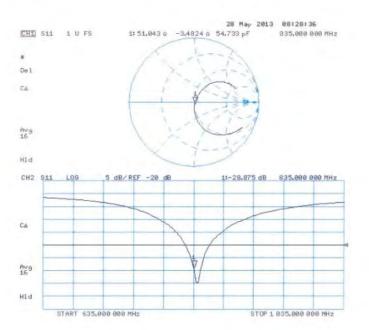
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No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134 號 t (886-2) 2299-3279 f (886-2) 2298-0488



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Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d063 May13

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DASY5 Validation Report for Body TSL

Date: 27.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d063

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz; $\sigma = 1$ S/m; $\varepsilon_r = 54.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 55.014 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 3.56 W/kg

SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.57 W/kgMaximum value of SAR (measured) = 2.81 W/kg



Certificate No: D835V2-4d063_May13.

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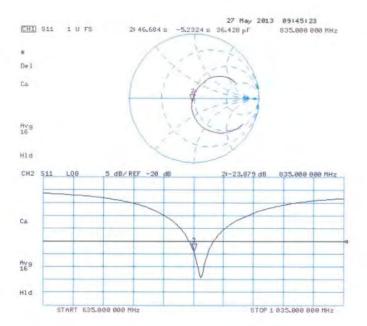
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Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d063_May13

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Client SGS-TW (Auden)

Accreditation No.: SCS 108

S

Cartificate No. D1750V2-1008 May13

Object	D1750V2 - SN: 1	800	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits ab	oove 700 MHz
Calibration date:	May 29, 2013		
The measurements and the unce	ertainties with confidence p	conal standards, which realize the physical u robability are given on the following pages any facility: environment temperature (22 \pm 3)	and are part of the certificate.
Calibration Equipment used (M&	TE critical for calibration)		
	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards Power meter EPM-442A	ID # GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704 US37292783	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	Oct-13 Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ID # GB37480704 UB37292783 SN: 5058 (20k)	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Oct-13 Oct-13 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Oct-13 Oct-13 Apr-14 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3	ID # GB37480704 UB37292783 SN: 5058 (20k)	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Oct-13 Oct-13 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Telerence 20 dB Attenuator Type-N mismatch combination Telerence Probe ES3DV3 JAE4 Secondary Standards	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. ESS-3205_Dec12) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr(13)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Pype-N mismatch combination Reference Probe ES3DV3 JAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr(13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
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: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
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: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Interence 20 dB Attenuator ype-N mismatch combination Interence Probe ES3DV3 IAE4 Recondary Standards Power sensor HP 8481A IF generator R&S SMT-06 Interence HP 8753E	ID # GB37480704 US37292783 SN: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-98 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
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 RE generator R&S SMT-06 Network Analyzer HP 8753E	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M& 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: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206 Name Lell Klysner	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12) Function Leboratory Technician	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
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 RE generator R&S SMT-06 Network Analyzer HP 8753E	ID # GB37480704 US37292783 SN: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-98 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13

Certificate No: D1750V2-1008_May13

Page 1 of 8

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





S Schweizerischer Kalibrierdiens 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 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
- EC 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.

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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	1.32 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		1000

SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.5 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.7±6%	1.47 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		-

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.3 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.2 \Omega + 0.2 j\Omega$	
Return Loss	- 50.1 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.0 t2 - 0.1 jt2	
Return Loss	- 27.6 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	February 11, 2009	

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DASY5 Validation Report for Head TSL

Date: 28.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1008

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz; $\sigma = 1.32 \text{ S/m}$; $\varepsilon_r = 39.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

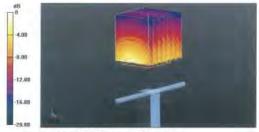
DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(5.18, 5.18, 5.18); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95,241 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 16.2 W/kg SAR(1 g) = 9.04 W/kg; SAR(10 g) = 4.83 W/kg

Maximum value of SAR (measured) = 11.2 W/kg



0 dB = 11.2 W/kg = 10.49 dBW/kg

Certificate No: D1750V2-1008 May13

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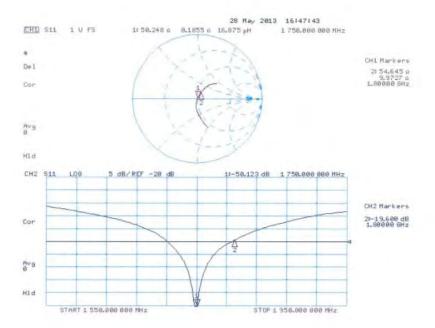
SGS Taiwan Ltd. 台灣檢驗科技股份有限公司

No.134,Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134 號 t (886-2) 2299-3279 f (886-2) 2298-0488



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Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1008_May13

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DASY5 Validation Report for Body TSL

Date: 29.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1008

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz; $\sigma = 1.47 \text{ S/m}$; $\epsilon_r = 51.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

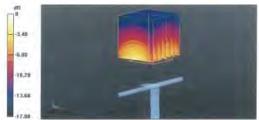
Probe: ES3DV3 - SN3205; ConvF(4.83, 4.83, 4.83); Calibrated: 28.12.2012;

- · Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 93.817 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 16.3 W/kg

SAR(1 g) = 9.46 W/kg; SAR(10 g) = 5.07 W/kgMaximum value of SAR (measured) = 11.9 W/kg



0 dB = 11.9 W/kg = 10.76 dBW/kg

Certificate No: D1750V2-1008_May13

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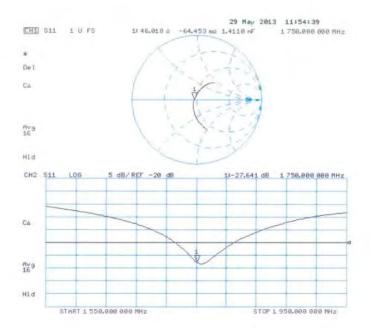
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Impedance Measurement Plot for Body TSL



Certificate No: D1750V2-1008_May13

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





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Client SGS-TW (Auden)

Accreditation No.: SCS 108

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Certificate No: D1900V2-5d027_May13

Object	D1900V2 - SN: 5	id027	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	May 02, 2013		
		ional standards, which realize the physical un robability are given on the following pages ar	
		ry facility: environment temperature (22 \pm 3)°(C and humidity < 70%.
Calibration Equipment used (M&		ry facility: environment temperature (22 ± 3)°1 Cal Date (Certificate No.)	C and humidity < 70%. Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter EPM-442A	TE critical for calibration)		Scheduled Calibration Oct-13
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor NP 8481A	TE critical for calibration) ID # GB37480704 US37292783	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13 Oct-13
Celibration Equipment used (M8 Primary Standards Power meter EPM-442A Power sensor NP 8481A Reference 20 dB Attenuator	TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k)	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Scheduled Calibration Oct-13 Oct-13 Apr-14
Calibration Equipment used (M8 Primary Standards Cower meter EPM-442A Cower sensor HP 8481A Reference 20 dB Attenuator ype-N mismatch combination	TE critical for calibration) (D #) GB37480704 US37292783 SN: 5056 (20k) SN: 5047.3 / 06327	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14
Calibration Equipment used (M& Primary Standards Power meter EPM-442A	TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k)	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Scheduled Calibration Oct-13 Oct-13 Apr-14
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Telerence 20 dB Attenuator Type-N mismatch combination Telerence Probe ES3DV3	TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ESS-3205_Dec12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Teleference 20 dB Attenustor Type-N mismatch combination Teleference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A	TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41082317	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-801_Apr13) Check Date (in house)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
Calibration Equipment used (M& Primary Standards Cower meter EPM-442A Power sensor HP 8481A Teleference 20 dB Attenuator ype-N mismatch combination teleference Probe ES3DV3 IAE4 Recondary Standards Cower sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration) ID # GB37480704 US37292783 SN: 5047.8 / 06327 SN: 5047.8 / 06327 SN: 601 ID # MY41082317 100005	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ESS-3205, Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator (ype-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41082317	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-801_Apr13) Check Date (in house)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
Calibration Equipment used (M& Primary Standards Power moter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	TE critical for calibration) ID # GB37480704 US37292783 SN: 5047.8 / 06327 SN: 5047.8 / 06327 SN: 601 ID # MY41082317 100005	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ESS-3205, Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Failibration Equipment used (M& Frimary Standards lower meter EPM-442A lower sensor HP 8481A leterence 20 dB Attenuator ype-N mismatch combination leterence Probe ES3DV3 IAE4 lecondary Standards lever sensor HP 8481A IF generator R&S SMT-06 letwork Analyzer HP 8753E	TE critical for calibration) ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41082317 100005 US37390585 S4208	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Dct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Calibration Equipment used (M& Primary Standards Power moter 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	TE critical for calibration) ID # GB37480704 US37292783 SN: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41082317 100005 US37390585 S4208 Name	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. ESS-3205, Dec12) 25-Apr-13 (No. DAE4-801_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12)	Scheduled Calibration Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13

Certificate No: D1900V2-5d027_May13

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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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C Service sulsse d'étalonnage
Servizio avizzero 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 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
- EC 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.

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%.

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Measurement Conditions

DASY Version	DASY5	V52.8.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

s 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	39.3 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	parties.	

SAR result with Head TSL

SAR averaged over 1 cm2 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9,71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.5 W/kg ± 16.5 % (k=2)

Body TSL parameters

	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	54.0 ± 6 %	1.51 mho/m ± 6.%
Body TSL temperature change during test	< 0.5 °C	_	

SAR result with Body TSL

SAR averaged over 1 cm ⁵ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10,1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.7 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.5 Ω + 3.5 jΩ	
Return Loss	- 29.2 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$44.7 \Omega + 4.8 j\Omega$	
Return Loss	- 22,4 dB	

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 17, 2002

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DASY5 Validation Report for Head TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d027

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; $\sigma = 1.37 \text{ S/m}$; $\epsilon_r = 39.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.215 V/m; Power Drift = 0.08 dB Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.09 W/kgMaximum value of SAR (measured) = 12.2 W/kg



0 dB = 12.2 W/kg = 10.86 dBW/kg

Certificate No: D1900V2-5d027_May13

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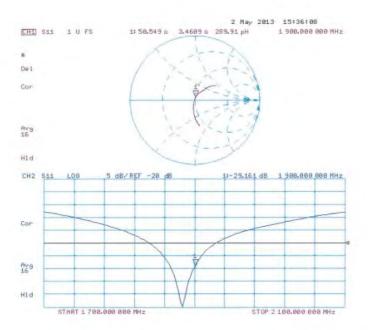
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d027

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz; $\sigma = 1.51$ S/m; $\epsilon_r = 54$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.215 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 17.1 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.37 W/kgMaximum value of SAR (measured) = 12.6 W/kg



0 dB = 12.6 W/kg = 11.00 dBW/kg

Certificate No: D1900V2-5d027_May13

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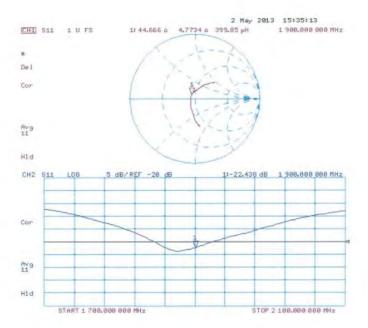
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Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

CALIBRATION C	ERTIFICATE		
Object	D2450V2 - SN: 7	27	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ove 700 MHz
Calibration date:	May 02, 2013		
The measurements and the unce	rtainties with confidence p	onal standards, which realize the physical un robability are given on the following pages an vy facility: environment (emperature $(22 \pm 3)\%$	d are part of the certificate
Calibration Equipment used (M&)	E critical for calibration)		
15,000,000,000,000,000,000		Cai Date (Certificate No.)	Scheduled Calibration
Primary Standards	E critical for calibration) ID # GB37480704	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13
Primary Standards Power meter EPM-442A	ID#		
Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID# GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Oct-13 Oct-13 Apr-14 Apr-14
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: 5058 (20k) SN: 5047.3 / 06327 SN: 3205	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
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: 5058 (20k) SN: 5047.3 / 06327	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Oct-13 Oct-13 Apr-14 Apr-14
Calibration Equipment used (M&) Primary Standards Power meter EPM-442A Power sensor HP 9481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4 Secondary Standards	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV3 DAE4	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 801	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID# MY41092317	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
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: 5058 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID# MY41092317 100005	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11)	Oct-13 Oct-13 Apr-14 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37380585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ES3-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-11) 18-Oct-01 (in house check Oct-12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
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: 5056 (20k) SN: 5047.3 / 06327 SN: 3205 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. ESS-3205_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

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Certificate No: D2450V2-727_May13



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





S Schweizerischer Kalibrierdienst
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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:

- 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
- EC 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.

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%.

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Measurement Conditions

DASY Version	DASV5	V52.8.6
Extrapolation	Advanced Extrapolation	102.00
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL.	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	- mark	-

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.9 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.1 W/kg ± 16.5 % (k=2)

Body TSL parameters

	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	51.2 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	-	

SAR result with Body TSL

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	51.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	24.0 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$55.6 \Omega + 1.9 J\Omega$	
Return Loss	- 25.0 dB	

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$51.9 \Omega + 4.0 j\Omega$
Return Loss	- 27.2 dB

General Antenna Parameters and Design

Figure 1-11 Dectors fairly discretarily	1,150 ns
Electrical Delay (one direction)	1,130118

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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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	January 09, 2003

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DASY5 Validation Report for Head TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 727

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; $\sigma = 1.83 \text{ S/m}$; $\varepsilon_r = 37.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

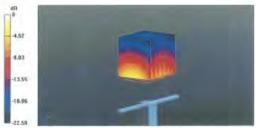
DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4,52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.668 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 28.6 W/kg

SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.35 W/kgMaximum value of SAR (measured) = 17.5 W/kg



0 dB = 17.5 W/kg = 12.43 dBW/kg

Certificate No: D2450V2-727_May13

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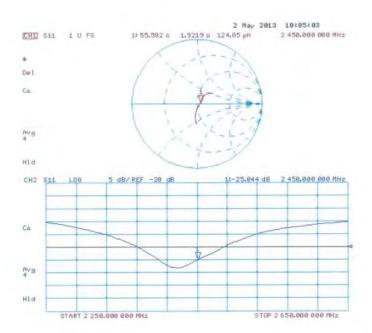
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 727

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz; $\sigma = 2.03 \text{ S/m}$; $\varepsilon_r = 51.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

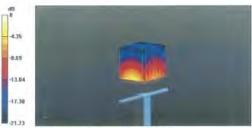
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 95.668 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 27.5 W/kg SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.09 W/kgMaximum value of SAR (measured) = 17.5 W/kg



0 dB = 17.5 W/kg = 12.43 dBW/kg

Certificate No: D2450V2-727_May13

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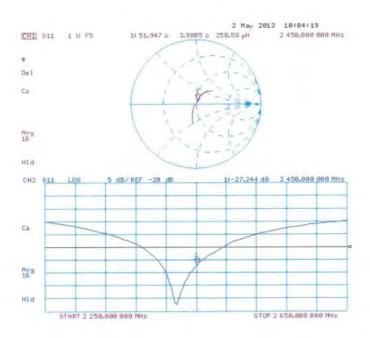
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Impedance Measurement Plot for Body TSL



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Client SGS-TW (Auden)

Accreditation No.: SCS 108

Certificate No: D5GHzV2-1104_May13

bject	D5GHzV2 - SN: 1	104	
Calibration procedure(s)	QA CAL-22.v2 Calibration proce	dure for dipole validation kits bet	ween 3-6 GHz
Calibration date:	May 07, 2013		
The measurements and the uncer	rtainties with confidence pe	onal standards, which realize the physical unobability are given on the following pages ary facility: environment temperature $(2Z\pm3)^{st}$	nd are part of the certificate.
Calibration Equipment used (M&T	E critical for calibration)		
	1-3	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards	ID #	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640)	Scheduled Calibration Oct-13
Primary Standards Power meter EPM-442A	1-3	Cal Date (Certificate No.) 01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	
Primary Standards Power meter EPM-442A Power sensor HP 8481A	ID # GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator	ID # GB37480704 US37292783	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640)	Oct-13 Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ID # GB37480704 US37292783 SN: 5058 (20k)	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736)	Oct-13 Oct-13 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID # GB37480704 US372927B3 SN: 5058 (20k) SN: 5047.3 / 06327	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739)	Oct-13 Oct-13 Apr-14 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ID # GB37460704 US372927B3 SN: 5058 (20k) SN: 5047.3 / 05327 SN: 3503	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. EX3-3503_Dec12)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13
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 EX3DV4 DAE4 Secondary Standards Power sensor HP 8461A	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 05327 SN: 3503 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apri-13 (No. 217-01736) 04-Apri-13 (No. 217-01739) 26-Dec-12 (No. EX3-3503_Dec12) 25-Apri-13 (No. DAE4-601_Apri-13)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3503 SN: 601	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. EX3-3503_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 08327 SN: 3503 SN: 601 ID # MY41092317	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. EX3-3503_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8461A RF generator R&S SMT-06	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3503 SN: 601 ID # MY41092317 100005	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 26-Dec-12 (No. EX3-3503_Dec12) 25-Apr-13 (No. DAE4-601_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11)	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-08 Notwork Analyzer HP 8753E	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5047.3 / 06327 SN: 3503 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apr-13 (No. 217-01736) 04-Apr-13 (No. 217-01739) 28-Dec-12 (No. EX3-3503_Dec12) 25-Apr-13 (No. DAE4-801_Apr13) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12)	Oct-13 Oct-13 Apr-14 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13
Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8461A RF generator R&S SMT-06	ID # GB37480704 US37292783 SN: 5058 (20k) SN: 5057 (20k) SN: 5047.3 / 08327 SN: 3503 SN: 601 ID # MY41092317 100005 US37390585 S4206	01-Nov-12 (No. 217-01640) 01-Nov-12 (No. 217-01640) 04-Apri-13 (No. 217-01736) 04-Apri-13 (No. 217-01739) 28-Dec-12 (No. EX3-3503_Dec12) 25-Apri-13 (No. DAE4-601_Apri-3) Check Date (in house) 18-Oct-02 (in house check Oct-11) 04-Aug-99 (in house check Oct-12) Function	Oct-13 Oct-13 Apr-14 Apr-14 Dec-13 Apr-14 Scheduled Check In house check: Oct-13 In house check: Oct-13 In house check: Oct-13

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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 108

Accordited 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 sensitivity in TSL / NORM x,y,z
N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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%.

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Measurement Conditions

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

DASY Version	DASY5	V52.8.6
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	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36,0	4,66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-man-	5000

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.0 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5300 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.68 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.4 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.1 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.1 ± 6 %	4.96 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.62 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.2 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5800 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.8 ± 6 %	5.17 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	1	-

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm2 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

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Body TSL parameters at 5200 MHz

	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	46.9 ± 6 %	5.43 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	Color.	-

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm2 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.64 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22,0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.56 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.77 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	77.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm2 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg ± 19.5 % (k=2)

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Body TSL parameters at 5600 MHz

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48,5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.2 ± 6 %	5.94 mha/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	, was	1949

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ² (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.25 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	22.6 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

	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	45.9 ± 6 %	6.22 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	-	-

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75,4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ² (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.8 W/kg ± 19.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52,6 Ω - 9,7 jΩ	
Return Loss	- 20.2 dB	

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	52.6 Ω - 2.8 jΩ	
Return Loss	- 28.6 dB	

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.2 Ω = 5.1 jΩ
Return Loss	-21.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.5 Ω - 1.0 jΩ
Return Loss	- 25.5 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.1 Ω - 8.0 μΩ
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	51.9 Ω - 2.0 jΩ
Return Loss	-31.4 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.7 Ω - 3.7 Ω
Return Loss	-21.2 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	$56.0 \Omega + 1.5 j\Omega$	
Return Loss	- 24.7 dB	

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.207 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 24, 2010

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DASY5 Validation Report for Head TSL

Date: 07.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1104

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: f = 5200 MHz; $\sigma = 4.58$ S/m; $\epsilon_r = 34.7$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5300 MHz; $\sigma = 4.68$ S/m; $\epsilon_r = 34.5$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5600 MHz; $\sigma = 4.96$ S/m; $\epsilon_r = 34.1$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5800 MHz; $\sigma = 5.17$ S/m; $\epsilon_r = 33.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(5.1, 5.1, 5.1);
 Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81);
 Calibrated: 28.12.2012;
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601: Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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 = 65.914 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 31.2 W/kg

SAR(1 g) = 8.27 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 19.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,

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

Reference Value = 66.338 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 32.5 W/kg

SAR(1 g) = 8.51 W/kg; SAR(10 g) = 2.44 W/kg

Maximum value of SAR (measured) = 20.0 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

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

Reference Value = 65.836 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 34.4 W/kg

SAR(1 g) = 8.62 W/kg; SAR(10 g) = 2.45 W/kg

Maximum value of SAR (measured) = 20.7 W/kg

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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz 2/Zoom Scan,

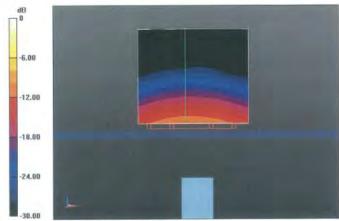
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.381 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 33.9 W/kg

SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.3 W/kg

Maximum value of SAR (measured) = 19.8 W/kg



0 dB = 19.8 W/kg = 12.97 dBW/kg

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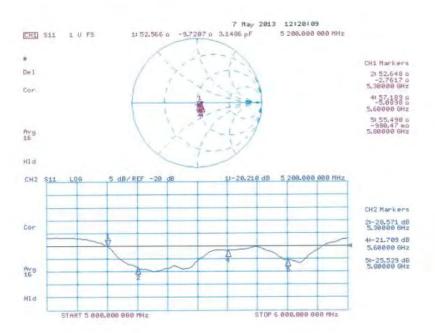
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 06.05,2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1104

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: f = 5200 MHz; $\sigma = 5.43$ S/m; $\varepsilon_t = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: f = 5300 MHz; $\alpha = 5.56 \text{ S/m}$; $\epsilon_t = 46.8$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: f = 5600 MHz; $\sigma =$ 5.94 S/m; ε_f = 46.2; ρ = 1000 kg/m³, Medium parameters used: f = 5800 MHz; σ = 6.22 S/m; ε_r = 45.9; ρ = 1000 kg/m

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); Calibrated: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated; 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38): Calibrated: 28.12.2012:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

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 = 59.375 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 30.1 W/kg

SAR(1 g) = 7.64 W/kg; SAR(10 g) = 2.14 W/kg

Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,

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

Reference Value = 59.419 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.4 W/kg

SAR(1 g) = 7.77 W/kg; SAR(10 g) = 2.17 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

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

Reference Value = 59.408 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 36.4 W/kg

SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.29 W/kg

Maximum value of SAR (measured) = 20,3 W/kg

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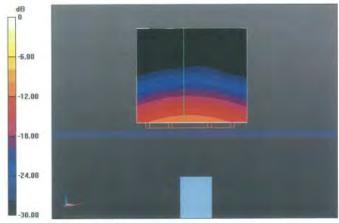
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Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 56.084 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 35.3 W/kg SAR(1 g) = 7.6 W/kg; SAR(10 g) = 2.1 W/kgMaximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

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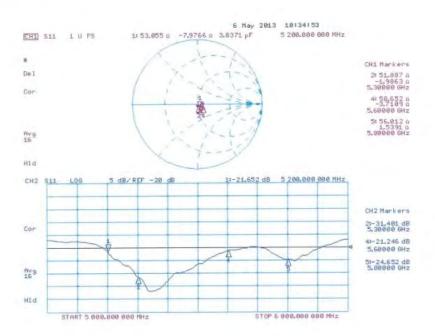
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Impedance Measurement Plot for Body TSL



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- End of 2nd part of report -

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