

 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 1(134)
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APPENDIX D: PROBE & DIPOLE CALIBRATION DATA



Document

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Calibration Laboratory of
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Zughestrasse 40, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 108**

Client

RTS (RIM Testing Services)Certificate No. **E53-3225_Jan12**

CALIBRATION CERTIFICATE

Client

E530V3 - SN:3225

Calibration procedure(s)

QA CAL-01.v6, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date:

January 11, 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&T) critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4410B	GB41260374	31-Mar-11 (No. 217-01572)	Apr-12
Power sensor E4412A	MY414988071	31-Mar-11 (No. 217-01572)	Apr-12
Reference 3 dB Attenuator	SN: 55094 (3)	29-Mar-11 (No. 217-01569)	Apr-12
Reference 20 dB Attenuator	SN: 55096 (20)	29-Mar-11 (No. 217-01567)	Apr-12
Reference 30 dB Attenuator	SN: 55129 (30)	29-Mar-11 (No. 217-01570)	Apr-12
Reference Probe R530CVC	SN: 3013	29-Dec-11 (No. E53-3213, Oct-11)	Oct-12
DAE4	SN: 8594	3-May-11 (No. DAE4-8594, May-11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8644C	U53640301700	4-Aug-09 (in house check Apr-11)	In house check, Apr-13
Network Analyzer HP 8753E	U5357360565	18-Oct-09 (in house check Oct-11)	In house check, Oct-12

Calibrated by:	Name Robert Radford	Function Laboratory Technician	Signature
Approved by:	Name Katja Pekom	Function Technical Manager	Signature

Issued: January 12, 2012

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

Certificate No. **E53-3225_Jan12**

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 100**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1529-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization $\beta = 0$ ($f < 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E-field uncertainty inside TSL (see below ConvF).
- NORMff_{x,y,z} = NORM_{x,y,z} * Frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx,y,z: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f < 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical Isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ES3DV3 – SN:3225

January 11, 2012

Probe ES3DV3

SN:3225

Manufactured: September 1, 2009
 Calibrated: January 11, 2012

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



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ES3DV3- SN:3225

January 11, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μ V/Vm) ² *	1.26	1.26	1.30	± 10.1 %
DCP (mV) ²	101.2	100.8	101.2	

Modulation Calibration Parameters

usb	Communication System Name	PAR	A	B	C	VR	Unc ¹ (k=2)
100000	CW	0.00	X	0.00	0.00	1.00	±0.7 %
			Y	0.00	0.00	1.00	±0.8 %
			Z	0.00	0.00	1.00	±0.4 %

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%.

* The uncertainties of NormX,Y,Z do not affect the B² field uncertainty inside TSL (see Pages 5 and 6).

¹ Numerical insulation parameter uncertainty not required.

² 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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ES3DV3- SN:3225

January 11, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225

Calibration Parameter Determined in Head Tissue Simulating Media

<i>f</i> (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	Conoff X	Conoff Y	Conoff Z	Alpha	Depth (mm)	Unit (mm)
750	41.9	0.89	6.42	6.42	6.42	0.27	2.04	± 12.0 %
1000	41.5	0.97	6.06	6.06	6.06	0.35	1.74	± 12.0 %
1510	40.9	1.40	5.23	5.23	5.23	0.73	1.21	± 12.0 %
1950	40.0	1.40	4.98	4.98	4.98	0.58	1.41	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.79	1.26	± 12.0 %
2600	39.0	1.98	4.32	4.32	4.32	0.77	1.37	± 12.0 %

¹ Frequency validity of a 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to a 50 MHz. The uncertainty is the RSS of the Conoff uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

² At frequencies below 3 GHz, the validity of tissue parameters (*ε* and *σ*) can be reduced to a 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 a 5%. The uncertainty is the RSS of the Conoff uncertainty for indicated target tissue parameters.

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ES3DV3- SN:3225

January 11, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225

Calibration Parameter Determined in Body Tissue Simulating Media

f/MHz ¹	Relative Permittivity ²	Conductivity (S/m) ³	ConvX	ConvY	ConvZ	Alpha	Depth (mm)	Unit (mm)
750	66.5	0.96	6.27	6.27	6.27	0.36	1.74	± 12.0 %
1000	66.0	1.05	6.07	6.07	6.07	0.29	2.02	± 12.0 %
1510	63.3	1.52	4.92	4.92	4.92	0.59	1.57	± 12.0 %
1950	63.3	1.52	4.87	4.87	4.87	0.59	1.49	± 12.0 %
2450	52.7	1.96	4.30	4.30	4.30	0.68	1.16	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.80	0.99	± 12.0 %

¹ Frequency validity of ± 100 MHz only applies for DASY v6.4 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.

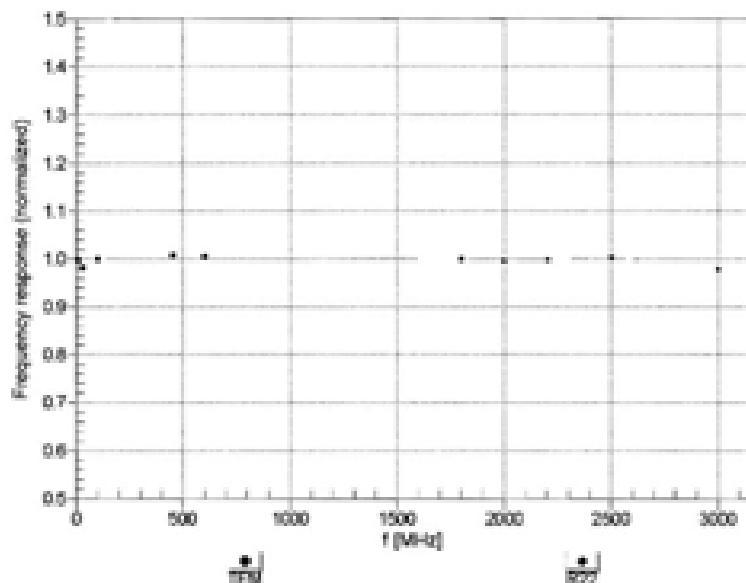
² At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SART values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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ES90V3- SN3225

January 11, 2013

Frequency Response of E-Field (TEM-Cell:RFL110 (XX, Waveguide: R22)



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

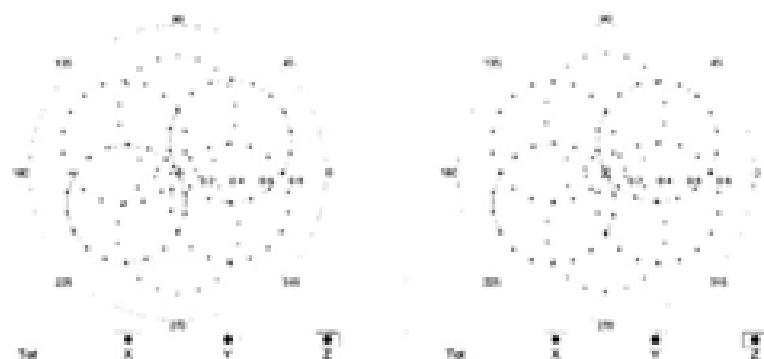
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ESDRV3-0943225

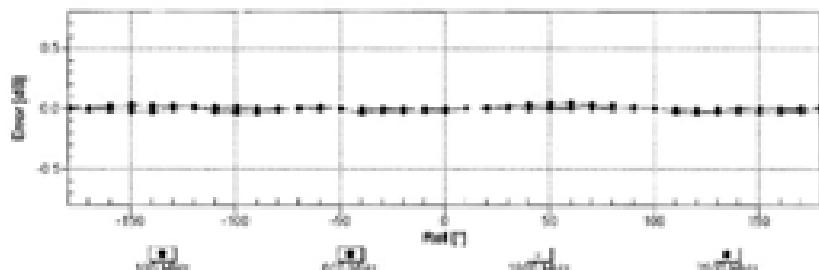
January 11, 2013

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

$f=600$ MHz, TEM



$f=1800$ MHz, R22



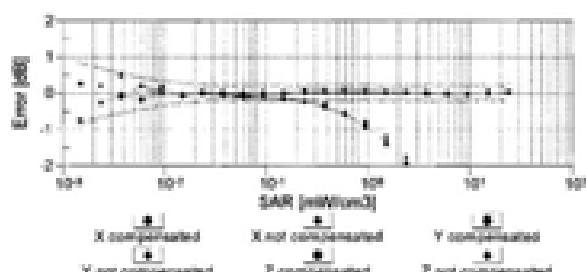
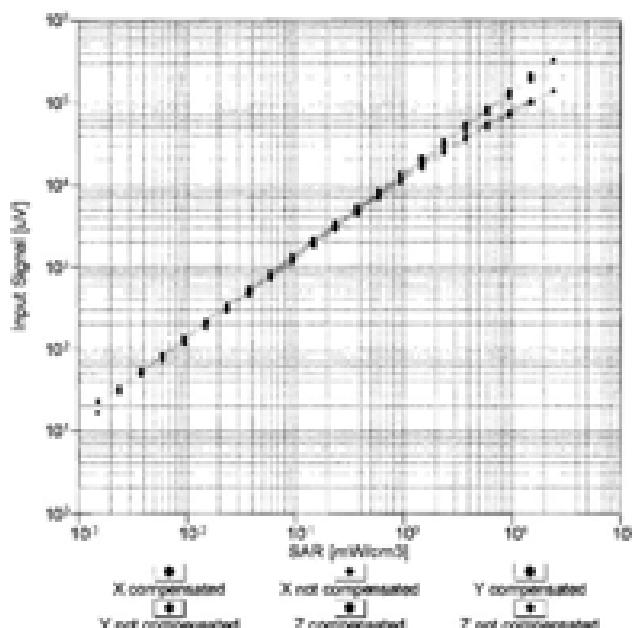
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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ES30V3- SA3225

January 11, 2013

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

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



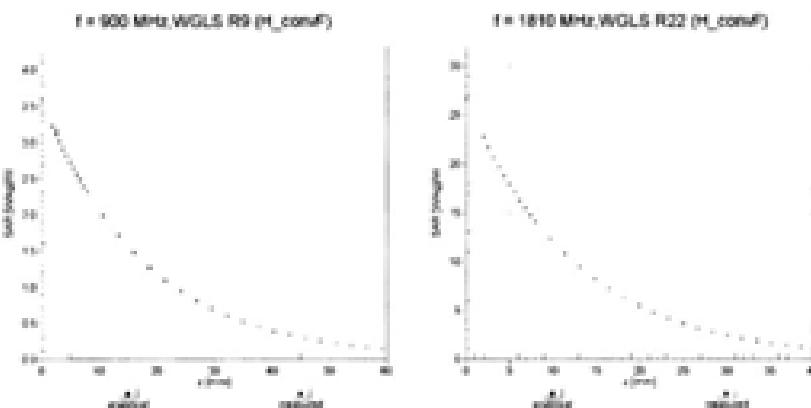
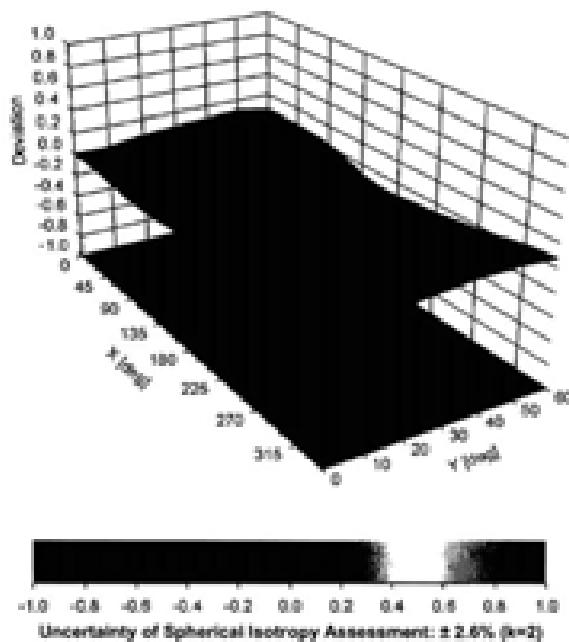
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E530(V3)-596-3225

January 11, 2013

Conversion Factor Assessment**Deviation from Isotropy in Liquid**
Error (a, b), f = 900 MHz

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ES3DV3- SN:3225

January 11, 2012

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	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

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Accreditation No.: SCS 100

Client **RTS (RIM Testing Services)**

Certificate No. **ES3-3225_Jan13**

CALIBRATION CERTIFICATE

Object	ES3Dv3 - SN:3225		
Calibration procedure(s)	QA CAL-01.v6, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes		
Calibration date	January 10, 2013		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurement (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility, environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 444196	0841790874	29-Mar-12 (No. 212-01108)	Apr-13
Power sensor 444128	MFY1498897	29-Mar-12 (No. 212-01108)	Apr-13
Reference 1 dB Attenuator	SN: 100014 (3x)	29-Mar-12 (No. 212-01108)	Apr-13
Reference 20 dB Attenuator	SN: 100086 (20x)	29-Mar-12 (No. 212-01108)	Apr-13
Reference 10 dB Attenuator	SN: 100129 (10x)	29-Mar-12 (No. 212-01108)	Apr-13
Reference Photo (ESDQV)	SN: 3013	26-Oct-12 (No. 013-0013, Dec12)	Dec-13
DA74	SN: 950	29-Jun-12 (No. DA74-050, Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8643C	U5364CJU1700	8-Aug-09 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8751C	U5373900505	18-Oct-07 (in house check Oct-12)	In house check: Oct-13
Calibrated by	Name	Function	Signature
	Jelena Kadić	Laboratory Technician	
Approved by	Katja Pešović	Technical Manager	
Issued: January 14, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No. **ES3-3225_Jan13**

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1526-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\beta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1600$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not affect the E-field uncertainty inside TSL (see below ConvF).
- $NORM_{f(x,y,z)} = NORM_{x,y,z} * \text{frequency_response}$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCP_{x,y,z}$: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR : PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- $A_{x,y,z}$, $B_{x,y,z}$, $C_{x,y,z}$, $D_{x,y,z}$, $VR_{x,y,z}$: 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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * \text{ConvF}$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical Anisotropy** (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 - SN3225

January 10, 2013

Probe ES3DV3

SN:3225

Manufactured: September 1, 2009
 Calibrated: January 10, 2013

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

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ES3DV3 - SN:3225

January 10, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μ V/Vm) ^a	1.39	1.19	1.31	\pm 10.1 %
DOP (mV) ^b	100.5	101.5	99.9	

Modulation Calibration Parameters

US	Communication System Name	A	B	C	D	VR	Unc ^c (k=2)
G	Gmr	X	0.0	0.0	1.0	0.00	107.5
		Y	0.0	0.0	1.0		108.4
		Z	0.0	0.0	1.0		108.9

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

^a The uncertainty of Norm(X,Y,Z) do not affect the E² field uncertainty inside TIS. (see Pages 8 and 9).

^b Numerical linearity parameter: uncertainty not required.

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

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ES3DV3- SN:3225

January 10, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225

Calibration Parameter Determined in Head Tissue Simulating Media

f(MHz) ^a	Relative Permittivity ^b	Conductivity (S/m) ^b	ConEF X	ConEF Y	ConEF Z	Alpha	Depth (mm)	Uncert. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.42	1.54	± 12.0 %
900	41.5	0.97	6.19	6.19	6.19	0.43	1.52	± 12.0 %
1810	40.0	1.40	5.35	5.35	5.35	0.63	1.39	± 12.0 %
1950	40.0	1.40	5.09	5.09	5.09	0.60	1.23	± 12.0 %
2450	39.2	1.80	4.65	4.65	4.65	0.61	1.63	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.60	1.32	± 12.0 %

^a Frequency validity of > 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to < 80 MHz. The uncertainty is the RSD of the ConEF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^b At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be reduced to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSD of the ConEF uncertainty for indicated target tissue parameters.

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

ES3DV3- SN:3225

January 18, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^D	Conductivity (S/m) ^D	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unc. (std)
750	55.5	0.96	6.27	6.27	6.27	0.49	1.51	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.73	1.35	± 12.0 %
1810	53.3	1.52	6.04	6.04	6.04	0.57	1.47	± 12.0 %
1950	53.3	1.52	4.94	4.94	4.94	0.58	1.60	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.70	1.16	± 12.0 %
2650	52.5	2.16	4.11	4.11	4.11	0.67	0.99	± 12.0 %

^C Frequency validity of ± 10% only applies for DASY v4.4 and higher (see Page 25, else it is restricted to ± 5% MHz). The uncertainty is the RSD of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

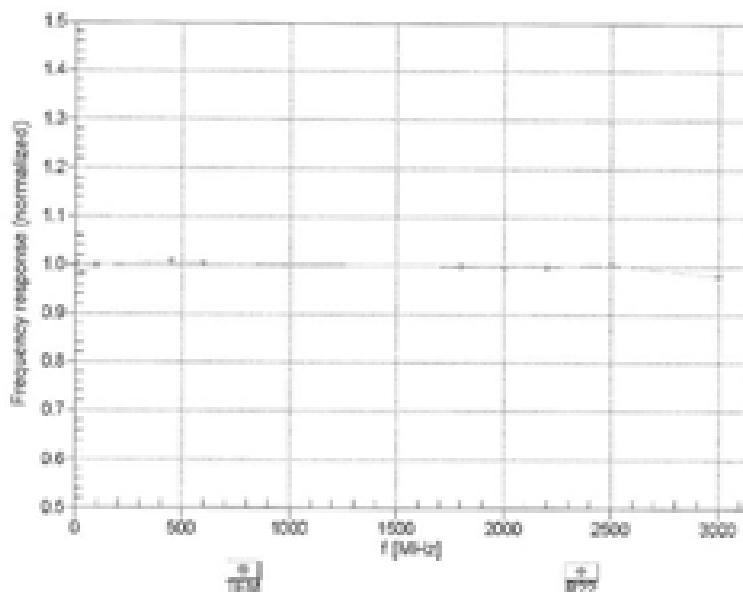
 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 21(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 22(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

E5307v2- 0943225

January 10, 2013

Frequency Response of E-Field
 (TEM-Cell:RFL110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 0.3\%$ ($k=2$)

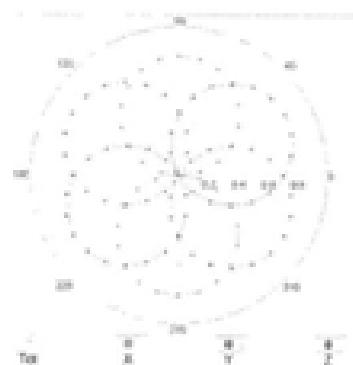
 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 23(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

E530V3-5413229

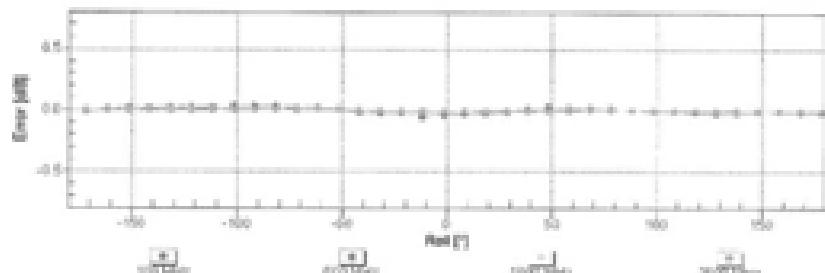
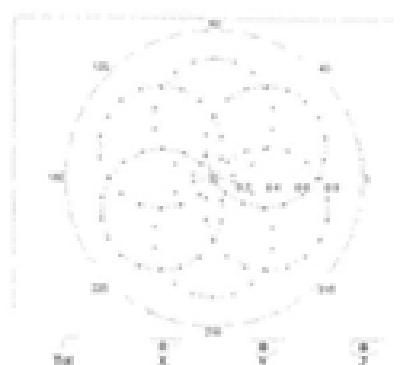
January 10, 2013

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

$f=600$ MHz, TEM



$f=1800$ MHz, R22



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

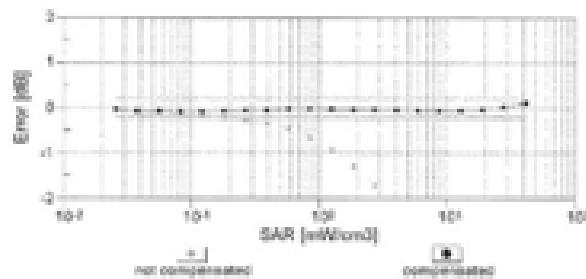
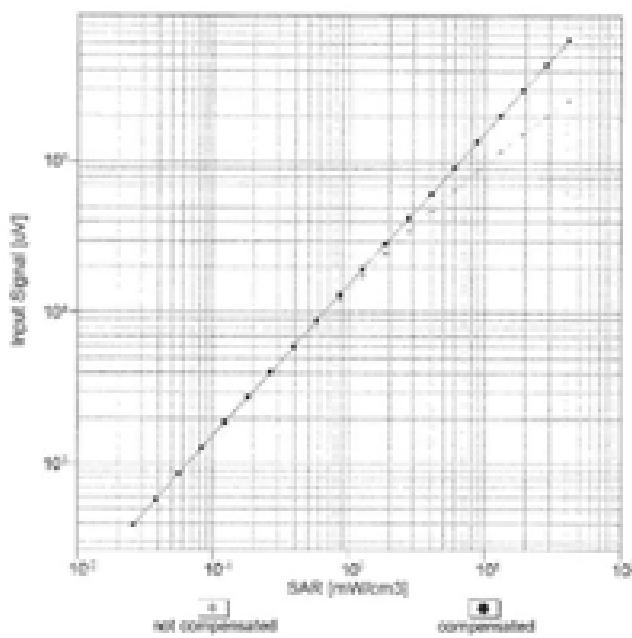
 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 24(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 25(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

ES337V3-20130205

January 18, 2013

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



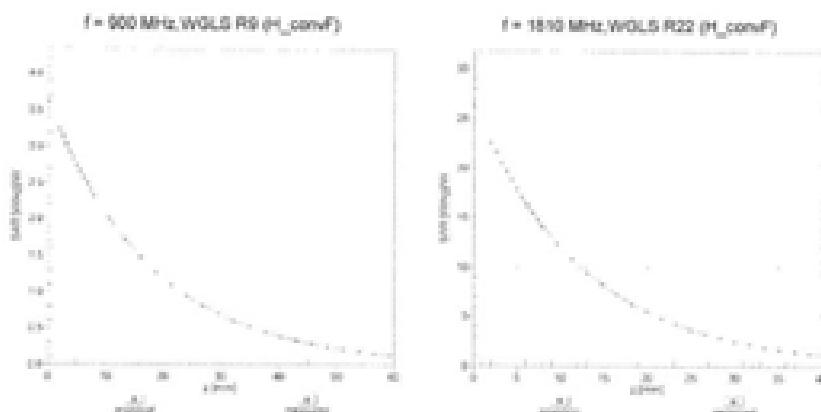
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

RIM Testing Services	Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report	Page 26(134)
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E930V3-343229

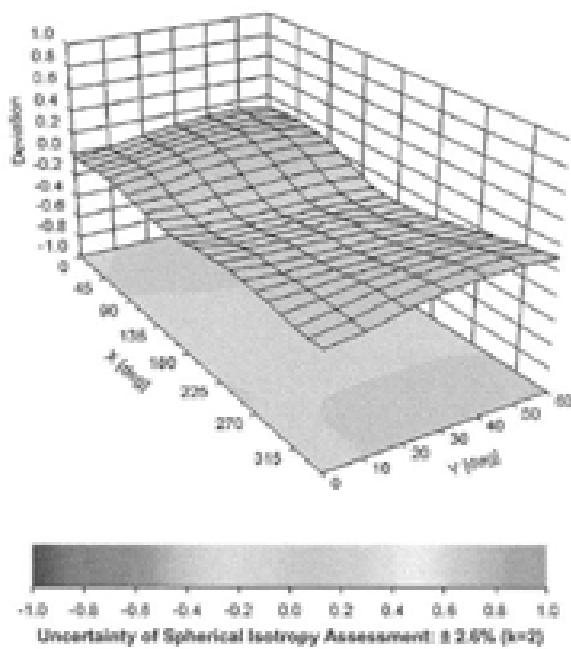
January 10, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (4, 9), f = 900 MHz



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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW
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ES3DV3 - SN:3225

January 10, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	8.3
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

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02

Calibration Laboratory of
Schmid & Partner
Engineering AG
Ringstrasse 40, 8044 Zurich, Switzerland



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

Accredited by the Swiss Accreditation Service (SAS).
The Swiss Accreditation Service is one of the signatories to the ILAC
Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 108**

Client: **RTS (RIM Testing Services)**

Certificate No: **EX3-3592_Nov12**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3592**

Calibration procedure(s): **QA CAL-01.v6, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **November 14, 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 ± 2)°C and humidity < 70%.

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

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter (44198)	0841293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor (44134)	MT914999037	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SP: 53004 (3c)	27-Mar-12 (No. 217-01537)	Apr-13
Reference 20 dB Attenuator	SP: 55206 (20c)	27-Mar-12 (No. 217-01526)	Apr-13
Reference 20 dB Attenuator	SP: 55129 (20c)	27-Mar-12 (No. 217-01530)	Apr-13
Reference Probe E5304V2	SP: 50131	29-Dec-11 (No. 093-0013_Dec11)	Dec-12
DME4	SP: 990	29-Jun-12 (No. 0404-990_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8044C	US3642001700	4-Aug-09 (in house check Apr-13)	In house check: Apr-13
Network Analyzer HP 8753E	US373460585	16-Oct-01 (in house check Oct-01)	In house check: Oct-01

Calibrated by:	Name: Daniel Leibler	Function: Laboratory Technician	
Approved by:	Name: Katja Polovic	Function: Technical Manager	

Issued: November 14, 2012

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

Certificate No: **EX3-3592_Nov12**

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW	

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zürcherstrasse 44, 8044 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'kalibrage
S Servizio svizzero di verifiche
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS).
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1529-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization $\phi = 0$ ($\phi \leq 900$ MHz in TEM-cell; $\phi > 900$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainty of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NOM_{x,y,z} = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $\phi \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $\phi > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): In a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

EX3DV4 - SN:3592

November 14, 2012

Probe EX3DV4

SN:3592

Manufactured: September 18, 2006
 Calibrated: November 14, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY72 system!)

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EX3DV4 - SN:3592

November 14, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3592

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	U _{meas} (k=2)
Norm (g/V)(Vrms) ²	0.49	0.47	0.47	± 10.1 %
DCP (mV) ²	95.2	96.1	100.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR	A dB	B dB	C dB	VR mV	U _{meas} ³ (k=2)
0	CW	0.00	X 0.0	0.0	1.0	101.4	±3.0 %
			Y 0.0	0.0	1.0	104.3	
			Z 0.0	0.0	1.0	109.2	

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%.

¹ The uncertainties of Norm,X,Y,Z do not affect the E² field uncertainty inside TSL (see Pages 5 and 6).

² Numerical integration parameter: uncertainty not reported

³ Uncertainty is determined using the rms. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

EX3DV4 - SN:3592

November 16, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3592

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^a	Relative Permittivity ^b	Conductivity (S/m) ^c	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unc. (k=2)
2000	39.0	1.96	6.45	6.45	6.45	0.53	0.79	± 12.0 %
5200	36.0	4.06	4.73	4.73	4.73	0.40	1.80	± 13.1 %
5500	35.6	4.06	4.28	4.28	4.28	0.44	1.80	± 13.1 %
5800	35.3	5.27	4.12	4.12	4.12	0.48	1.80	± 13.1 %

^a Frequency validity of ± 10% only applies for DASY v4.4 and higher (see Page 2), also it is restricted to ± 10 MHz. The uncertainty is the RMS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^b At frequencies below 2 GHz, the validity of tissue parameters (ϵ_r and σ) can be relaxed to ± 10% if equal compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ_r and σ) is restricted to ± 5%. The uncertainty is the RMS of the ConvF uncertainty for indicated target tissue parameters.

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 37(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

EX3DV4 - SN:3592

November 14, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3592

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^a	Relative Permeability ^b	Conductivity (S/m) ^c	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unc. (k=2)
2000	52.5	2.16	0.59	0.59	0.59	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.02	4.02	4.02	0.48	1.90	± 13.1 %
5500	48.6	5.65	3.96	3.96	3.96	0.55	1.90	± 13.1 %
5800	48.2	6.00	3.57	3.57	3.57	0.57	1.90	± 13.1 %

^a Frequency validity of ± 10% MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 30 MHz. The uncertainty is the RSD of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

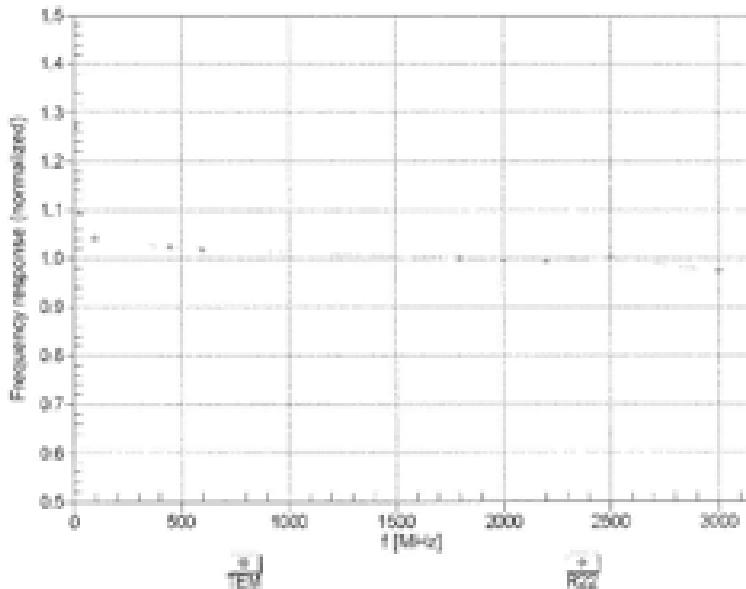
^b At frequencies below 2.0Hz, the validity of tissue parameters (μ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3.0Hz, the validity of tissue parameters (μ and σ) is restricted to ± 5%. The uncertainty is the RSD of the ConvF uncertainty for indicated target tissue parameters.

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

EX03-0502

November 14, 2012

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



Uncertainty of Frequency Response of E-field: $\pm 6.5\%$ ($k=2$)

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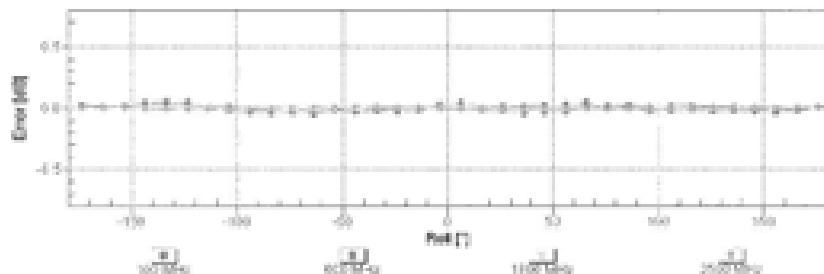
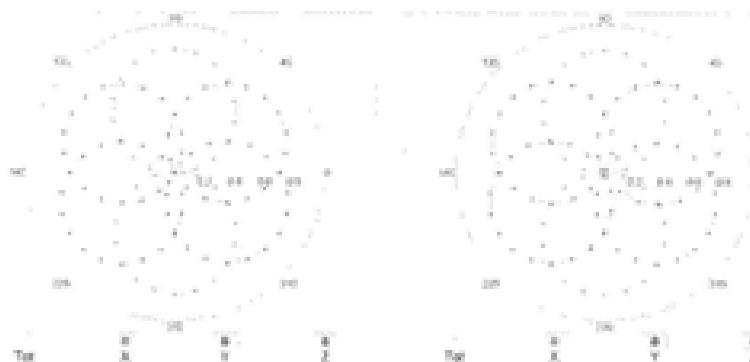
EX00014-0011002

November 14, 2012

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

$f=600$ MHz, TEM

$f=1800$ MHz, R22



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

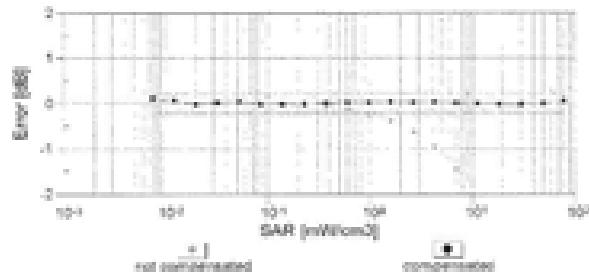
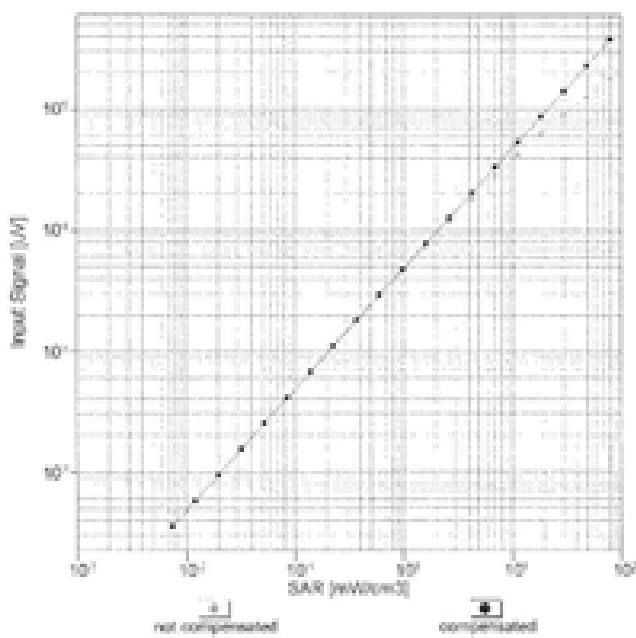
	Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report	Page 40(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02 FCC ID: L6ARFL110LW L6ARFP120LW IC 2503A-RFL110LW 2503A-RFP120LW

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW

EDO-04-026-0004

November 14, 2013

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



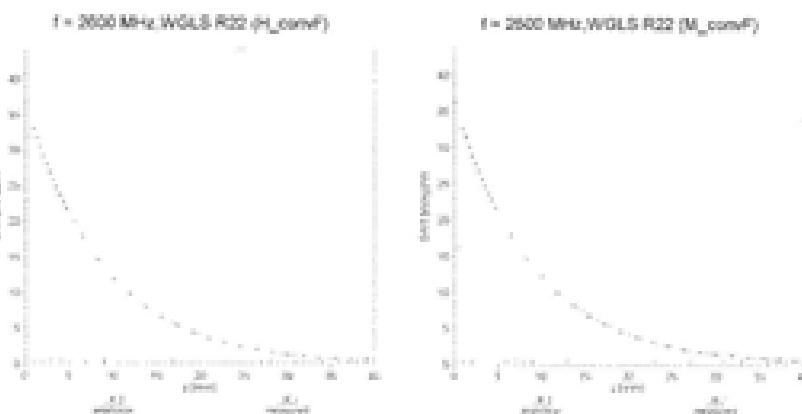
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

RIM Testing Services	Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report	Page 42(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02

EX30941-EM43592

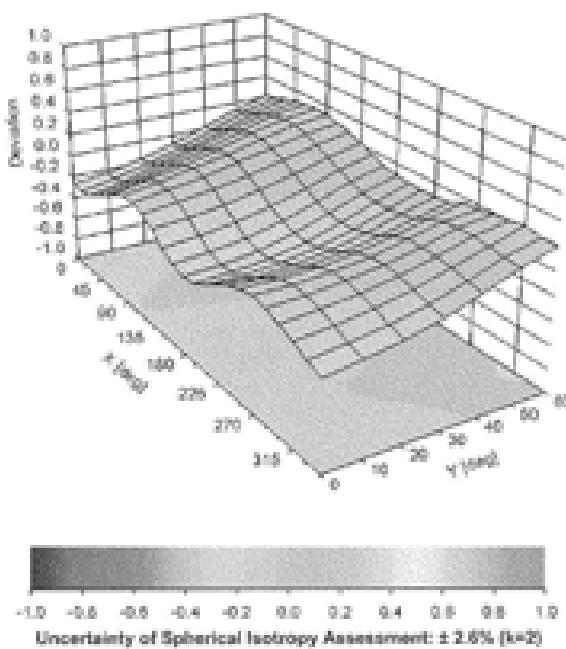
November 14, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (6, 2), f = 900 MHz



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

 <p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report</p>				Page 43(134)
Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW



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EX3DV4 - SN:3592

November 14, 2012

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3592**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-13.6
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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Calibration Laboratory of
Schmid & Partner
Engineering AG
Zürcherstrasse 41, 8004 Zürich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 108**

Client **RIM Testing Services**

Certificate No. **ET3-1644_Nov12**

CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1644**

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

Calibration date: **November 13, 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&T) critical for calibration:

Primary Standards	<input checked="" type="checkbox"/>	Cal Date (Certificate No.)	Scheduled Calibration
Power meter (EM190)	<input checked="" type="checkbox"/>	29-May-12 (No. 212-01508)	Aug-13
Power sensor (EM103A)	<input checked="" type="checkbox"/>	29-May-12 (No. 212-01508)	Aug-13
Reference 3 dB Attenuator	<input checked="" type="checkbox"/>	27-May-12 (No. 212-01520)	Aug-13
Reference 20 dB Attenuator	<input checked="" type="checkbox"/>	27-May-12 (No. 212-01520)	Aug-13
Reference 30 dB Attenuator	<input checked="" type="checkbox"/>	27-May-12 (No. 212-01520)	Aug-13
Reference Probe E530H2	<input checked="" type="checkbox"/>	29-Dec-11 (No. 070-0013_001/11)	Dec-12
DAE4	<input checked="" type="checkbox"/>	20-Jun-12 (No. DAE4-0000_001/12)	Jun-13
Secondary Standards	<input checked="" type="checkbox"/>	Check Date (in house)	Scheduled Check
RF generator RF6040C	<input checked="" type="checkbox"/>	4-Aug-12 (in house check, Aug-12)	In-house check, Aug-13
Network Analyzer NFA-8750E	<input checked="" type="checkbox"/>	18-Oct-01 (in house check, Oct-01)	In-house check, Oct-13

Calibrated by:	Name	Function	Signature
	Jeton Kastell	Laboratory Technician	
Approved by:	Katja Pykava	Technical Manager	

Issued: November 13, 2012

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

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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Ratio (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2009

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization $\beta = 0$ ($f < 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainty of NORM_{x,y,z} does not affect the E-field uncertainty inside TSL (see below ConvF).
- NORM_{f,x,y,z} = NORM_{x,y,z} * Frequency response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- 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 set-ups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY4 version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ET3DV6 - SN1644

November 13, 2012

Probe ET3DV6

SN:1644

Manufactured: November 7, 2001
 Calibrated: November 13, 2012

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

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ET3DV6- SN:1644

November 13, 2012

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1644

Basic Calibration Parameters:

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/V(mV) ²) ⁴	1.71	1.97	1.98	± 10.1 %
DCP (mV) ⁵	98.5	98.7	97.5	

Modulation Calibration Parameters:

UID	Communication System Name	PAW		A dB	B dB	C dB	WR mV	Unc ⁶ (k=2)
0	Cell	0.00	x	0.0	0.0	1.0	193.5	± 1.5 %
			x	0.0	0.0	1.0	212.0	
			x	0.0	0.0	1.0	201.7	

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%.

⁴ The uncertainties of Norm(X,Y,Z) do not affect the E2 field uncertainty inside TSI, (see Pages 5 and 6).

⁵ Numerical linearization parameter uncertainty not required.

⁶ Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field values.

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ET3DV6 - SN:1644

November 13, 2013

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1644

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^a	Relative Permittivity ^b	Conductivity (S/m) ^b	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	UncL (k=2)
750	41.9	0.99	6.57	6.57	6.57	0.44	2.25	± 12.0 %
900	41.5	0.97	6.24	6.24	6.24	0.38	2.02	± 12.0 %
1810	40.0	1.40	5.21	5.21	5.21	0.60	2.10	± 12.0 %
1950	40.0	1.40	5.16	5.16	5.16	0.60	2.09	± 12.0 %
2450	39.2	1.60	4.60	4.60	4.60	0.65	2.00	± 12.0 %

^a Frequency validity of ± 10% MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RUS of the Comif uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^b At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10%. If liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RUS of the Comif uncertainty for indicated target tissue parameters.



Document

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ET3DV6- SN:1644

November 13, 2012

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1644**Calibration Parameter Determined in Body Tissue Simulating Media**

f (GHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	Const X	Const Y	Const Z	Alpha	Depth (mm)	Uncst. (k=2)
750	66.6	0.96	6.30	6.30	6.30	0.30	2.61	± 12.0 %
900	66.0	1.06	6.06	6.06	6.06	0.31	2.99	± 12.0 %
1810	53.3	1.52	4.75	4.75	4.75	0.80	2.40	± 12.0 %
1950	53.3	1.52	4.75	4.75	4.75	0.80	2.28	± 12.0 %
2450	52.7	1.96	4.11	4.11	4.11	0.50	2.15	± 12.0 %

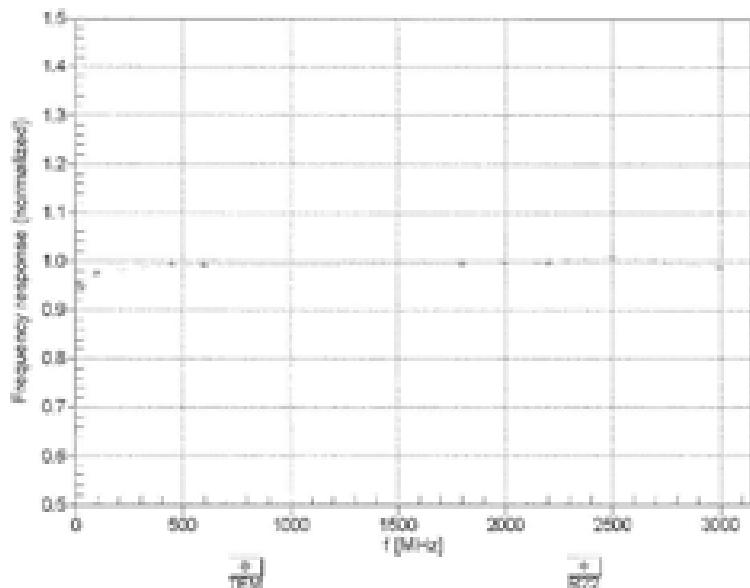
¹ Frequency validity of ± 10% MHz only applies for DASY v4.4 and higher (see Page v), else it is restricted to ± 10 MHz. The uncertainty is the RSS of the Const¹ uncertainty at calibration frequency and the uncertainty for the indicated frequency band.² At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be referred to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 10%. The uncertainty is the RSS of the Const¹ uncertainty for indicated target tissue parameters.

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ET3DwG-5A1044

November 13, 2012

Frequency Response of E-Field
 (TEM-CellRFL110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 0.3\%$ ($k=2$)

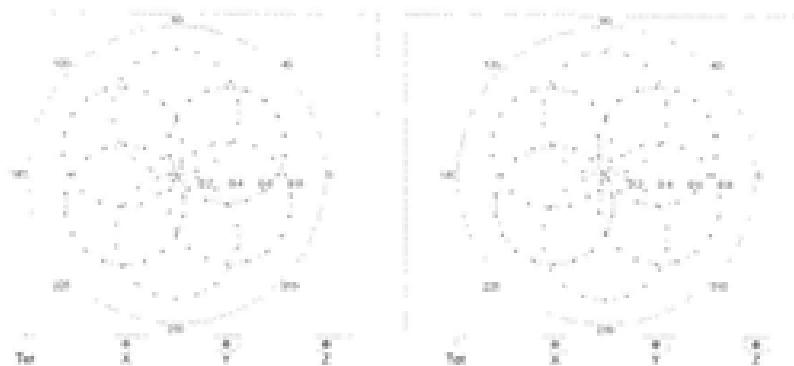
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ET307V0- SN 7044

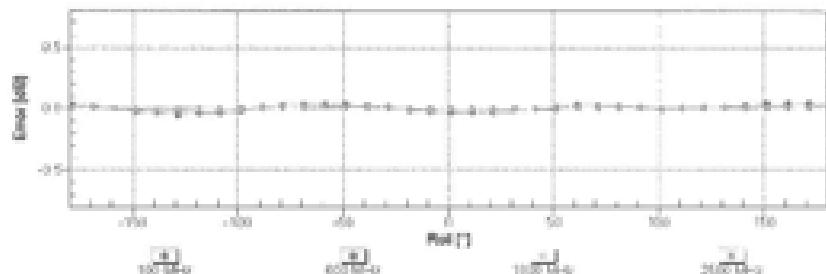
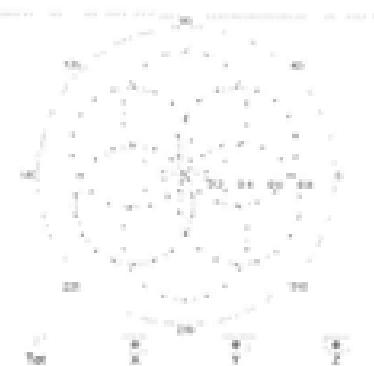
November 13, 2013

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

$f=600$ MHz, TEM



$f=1800$ MHz, R22



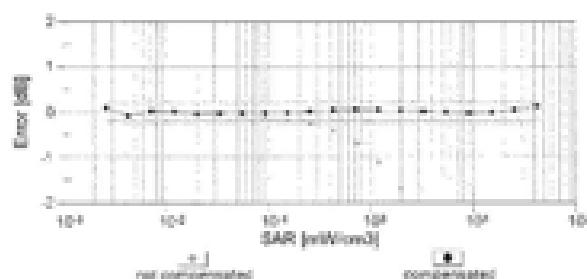
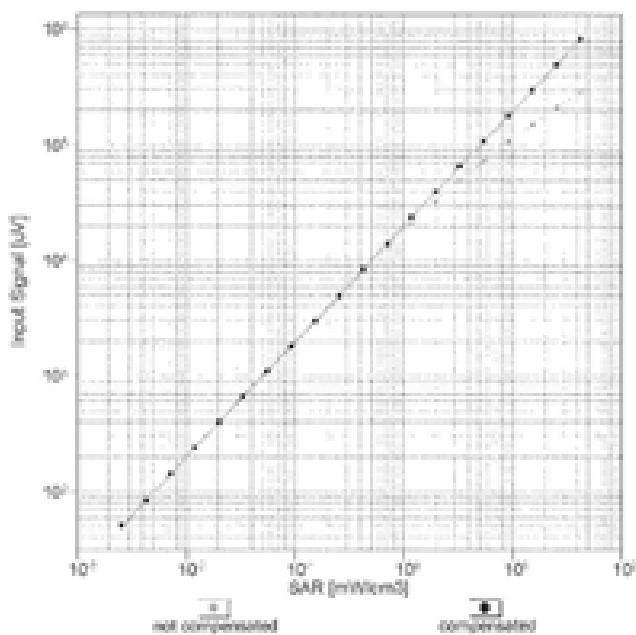
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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ET304V0- SN: 1044

November 13, 2012

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



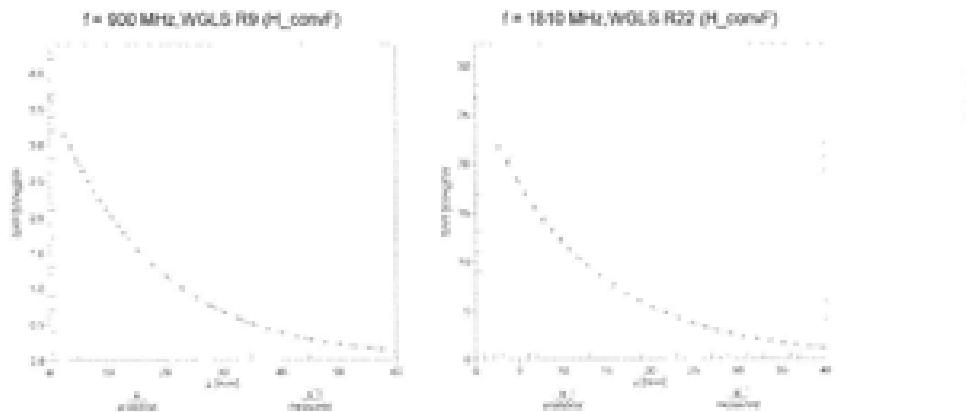
Uncertainty of Linearity Assessment: ± 0.6% (n=2)

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ET3Dw8- SN1644

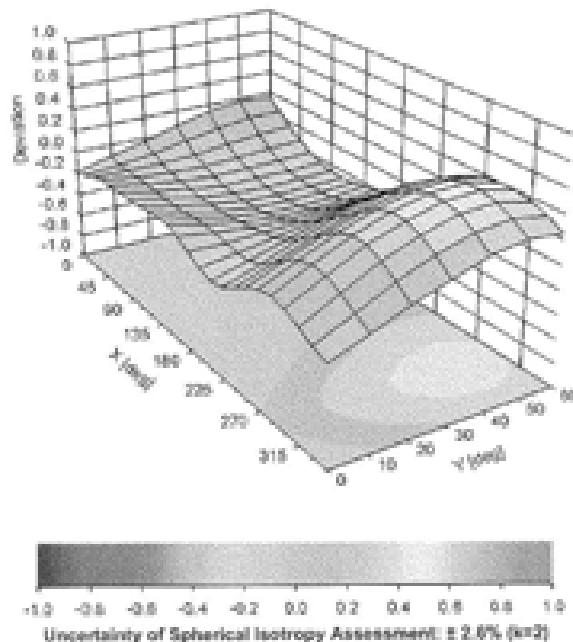
November 13, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, β), $f = 900$ MHz





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ET3DV6- SN:1644

November 13, 2012

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1644**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	61.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	enabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	60 mm
Tip Diameter	6.0 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

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Accreditation No.: **SCS 108**

Client **RIM**

Certificate No: **D750V3-1021_Jan11**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1021**

Calibration procedure(s) **QA CAL-05.v8**
 Calibration procedure for dipole validation kits

Calibration date: **January 06, 2011**

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

All calibrations have been conducted in the closed laboratory facility, environment temperature (23 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&T) critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter DPM-442A	GB037480704	06-Oct-10 (No. 212-012966)	Oct-11
Power sensor HP 8481A	U5357292780	06-Oct-10 (No. 212-012966)	Oct-11
Reference 20 dB Attenuator	SH: 53881-250g	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SH: 5547.2 / 080327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe E550973	SH: 3205	20-Apr-10 (No. E53-3205_Apr10)	Apr-11
DAE4	SH: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (In-house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-10 (In house check Oct-10)	In house check: Oct-11
RF generator PAB3 (MT-06)	100000	4-Aug-09 (In house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8752E	U537390585 54206	18-Oct-09 (In house check Oct-10)	In house check: Oct-11

Calibrated by **Jelon Kastell** Function **Laboratory Technician** Signature

Approved by **Kaja Polakow** Technical Manager

Issued: January 6, 2011

Certificate No: **D750V3-1021_Jan11**

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.3 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 mW / g
SAR normalized	normalized to 1W	8.48 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.36 mW / g ± 17.0 % (b=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.28 mW / g
SAR normalized	normalized to 1W	5.02 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.45 mW / g ± 16.8 % (b=2)



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Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	59.1 Ω + 1.7 jΩ
Return Loss	-29.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.633 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 01, 2010

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DASY5 Validation Report for Head TSL

Date/Time: 05.01.2011 15:51:17

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1021

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: HSL750

Medium parameters used: $f = 750$ MHz; $\sigma = 0.91$ mho/m; $\epsilon_r = 42.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; CoaxF(6.37, 6.37, 6.37); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.6 Build (401)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

Pin=250mW; dip=15mm; dist=3.0mm/Zoom: Scan (7x7x7)/Cube 0; Measurement grid:

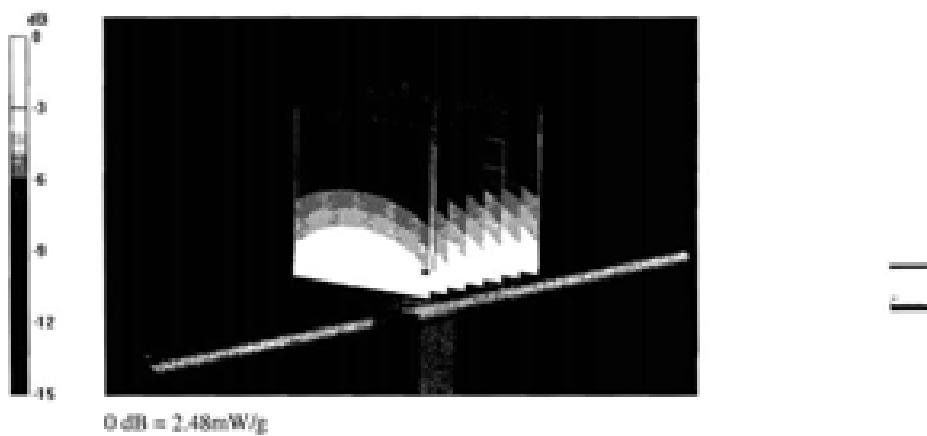
dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.5 V/m; Power Drift = -0.00432 dB

Peak SAR (extrapolated) = 3.24 W/kg

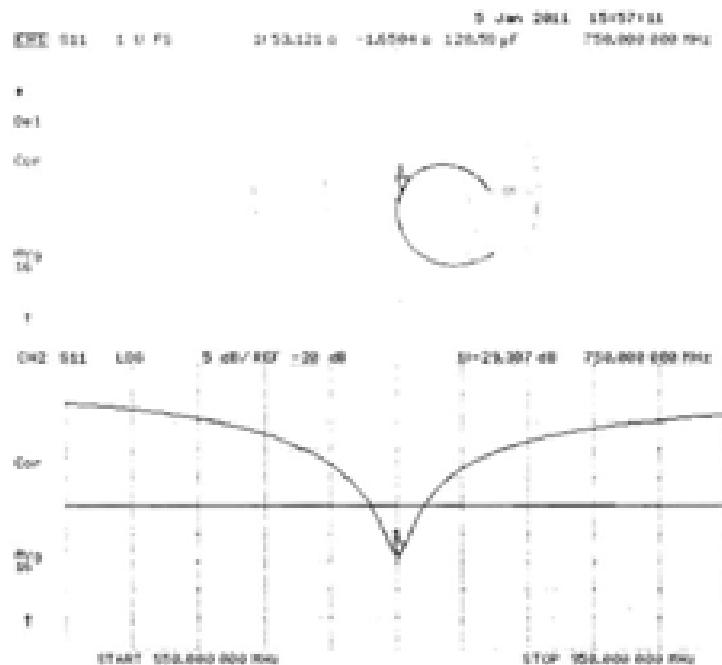
SAR(1 g) = 2.12 mW/g; SAR(10 g) = 1.28 mW/g

Maximum value of SAR (measured) = 2.48 mW/g



	<p>Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report </p>	<p>Page 62(134) </p>
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Impedance Measurement Plot for Head TSL



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Calibration Laboratory of
Schmid & Partner
Engineering AG
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 106**

Client **RTS (RIM Testing Services)**

Certificate No. **D750V3-1021_Jan13**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1021**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **January 07, 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&TC critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter DPM-440A	040214460704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 4491A	053373907103	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20-dB Attenuator	SH: 0208 (20x)	27-Mar-12 (No. 217-01520)	Apr-13
Type-N mismatch combination	SH: 0247.3 / 03027	27-Mar-12 (No. 217-01520)	Apr-13
Reference Probe E530V3	SH: 3205	28-Dec-12 (No. E530-3205, Dec-12)	Dec-13
DUTs	SH: 021	27-Jun-12 (No. DUT4-021_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 4491A	MT410202317	18-Oct-12 (in house check Oct-12)	In house check: Oct-13
RF generator R&S RMX100	1000005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8752E	05337390585 84206	18-Oct-12 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Leif Klyner** Function: **Laboratory Technician** Signature:

Approved by: **Katja Polivka** Function: **Technical Manager** Signature:

Issued: January 8, 2013

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

Certificate No: **D750V3-1021_Jan13**

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 Systems 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	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	32.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(32.0 ± 0.2) °C	41.4 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test:	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.48 W/kg ± 17.0 % (n=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.81 W/kg ± 18.8 % (n=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.7 Ω - 0.2 jΩ
Return Loss	-25.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.003 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 01, 2010

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DASYS Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPIEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1021

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $\epsilon = 750 \text{ MHz}$; $\sigma = 0.89 \text{ S/m}$; $\mu = 41.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASYS2 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sa601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASYS2 52.8.4(1032); SEMCAD X 14.6.8(7028)

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

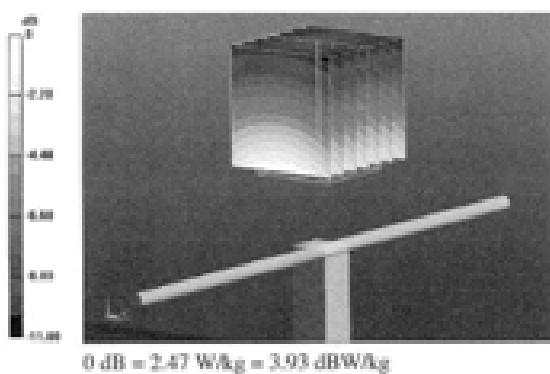
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.107 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.23 W/kg

SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.38 W/kg

Maximum value of SAR (measured) = 2.47 W/kg

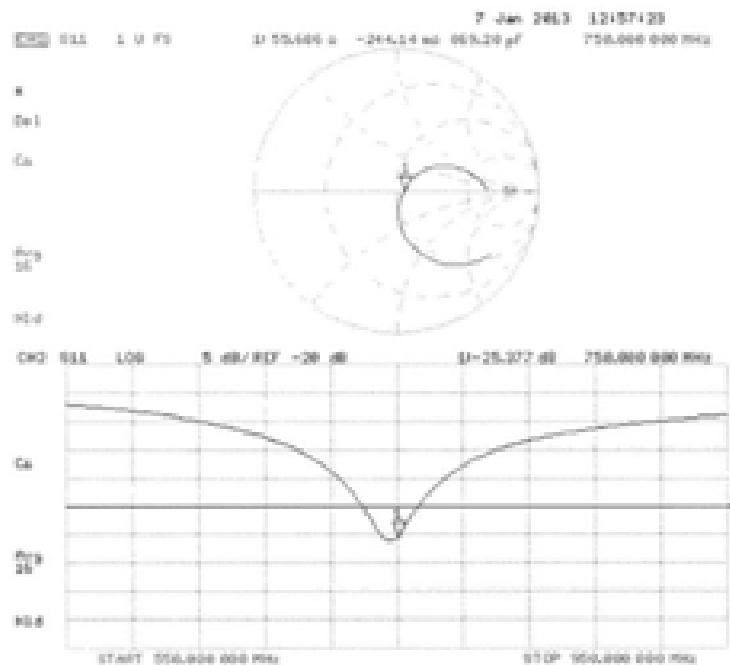




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Impedance Measurement Plot for Head TSL

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- S** Servizio svizzero di verifiche
- S** Swiss Calibration Service

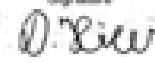
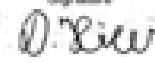
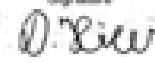
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Accreditation No. SCS 100

ATS - AT&T Testing Services

Contract No. D005V2-400_Jan11

CALIBRATION CERTIFICATE

Object	D635V2 - SN: 446																																																														
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits																																																														
Calibration date:	January 21, 2011																																																														
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility, environment temperature (20 ± 0)°C and humidity < 70%.</p> <p>Calibration Equipment used (MATE, critical for calibration):</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM-442A</td> <td>CB007480704</td> <td>08-Oct-10 (No. 217-01266)</td> <td>Oct-11</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>U5372982763</td> <td>08-Oct-10 (No. 217-01266)</td> <td>Oct-11</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SAI 5086 (20g)</td> <td>30-Mar-10 (No. 217-01158)</td> <td>Mar-11</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SAI 5047.2 / 04327</td> <td>30-Mar-10 (No. 217-01162)</td> <td>Mar-11</td> </tr> <tr> <td>Reference Probe E500V3</td> <td>SAI 3265</td> <td>30-Apr-10 (No. E50-3225_Apr10)</td> <td>Apr-11</td> </tr> <tr> <td>D4EA</td> <td>SAI 601</td> <td>19-Jun-10 (No. D4EA-601_Jun10)</td> <td>Jun-11</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Power sensor HP 8481A</td> <td>MF410902317</td> <td>18-Oct-09 (in house check Oct-09)</td> <td>In house check: Oct-11</td> </tr> <tr> <td>RF generator R&S SMF-06</td> <td>100005</td> <td>4-Aug-09 (in house check Oct-09)</td> <td>In house check: Oct-11</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>U537398285 (SAI06)</td> <td>18-Oct-01 (in house check Oct-10)</td> <td>In house check: Oct-11</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Calibrated by:</th> <th>Name</th> <th>Function</th> <th>Signature</th> </tr> </thead> <tbody> <tr> <td></td> <td>Dirk Reh</td> <td>Laboratory Technician</td> <td></td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Approved by:</th> <th>Name</th> <th>Function</th> <th>Signature</th> </tr> </thead> <tbody> <tr> <td></td> <td>Katja Potowik</td> <td>Technical Manager</td> <td></td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter EPM-442A	CB007480704	08-Oct-10 (No. 217-01266)	Oct-11	Power sensor HP 8481A	U5372982763	08-Oct-10 (No. 217-01266)	Oct-11	Reference 20 dB Attenuator	SAI 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11	Type-N mismatch combination	SAI 5047.2 / 04327	30-Mar-10 (No. 217-01162)	Mar-11	Reference Probe E500V3	SAI 3265	30-Apr-10 (No. E50-3225_Apr10)	Apr-11	D4EA	SAI 601	19-Jun-10 (No. D4EA-601_Jun10)	Jun-11	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MF410902317	18-Oct-09 (in house check Oct-09)	In house check: Oct-11	RF generator R&S SMF-06	100005	4-Aug-09 (in house check Oct-09)	In house check: Oct-11	Network Analyzer HP 8753E	U537398285 (SAI06)	18-Oct-01 (in house check Oct-10)	In house check: Oct-11	Calibrated by:	Name	Function	Signature		Dirk Reh	Laboratory Technician		Approved by:	Name	Function	Signature		Katja Potowik	Technical Manager	
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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1526-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.0	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	805 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.8	0.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.3 ± 6 %	0.80 mho/m ± 6 %
Head TSL temperature during test	(21.8 ± 0.2) °C	—	—

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR normalized	normalized to 1W	9.56 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.63 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.56 mW / g
SAR normalized	normalized to 1W	6.24 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.27 mW / g ± 16.5 % (k=2)



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Appendix**Antenna Parameters with Head TSL.**

Impedance, transformed to feed point	49.6 Ω ± 7.7 jΩ
Return Loss	-22.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.386 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 semiigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 24, 2001

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DASY5 Validation Report for Head TSL

Date/Time: 21.01.2011 10:18:05

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:446

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL900

Medium parameters used: $\Gamma = 835$ MHz; $\sigma = 0.89$ mho/m; $\epsilon_r = 41.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

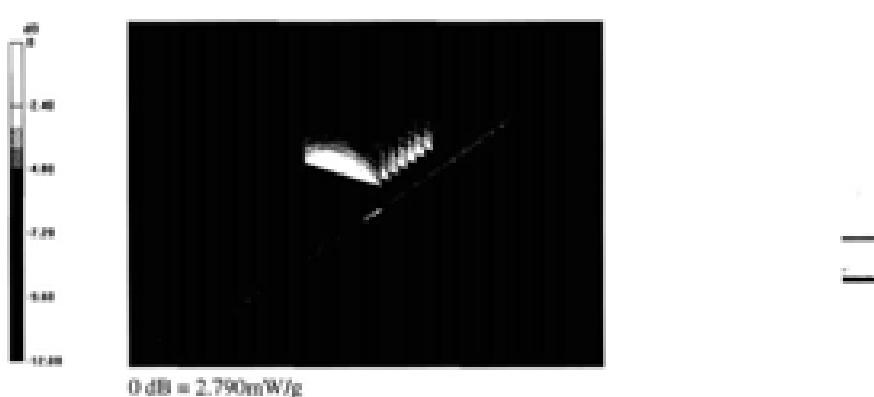
Pin=250 mW Ad=1.5mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.426 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.600 W/kg

SAR(1 g) = 1.39 mW/g; SAR(10 g) = 1.56 mW/g

Maximum value of SAR (measured) = 2.790 mW/g

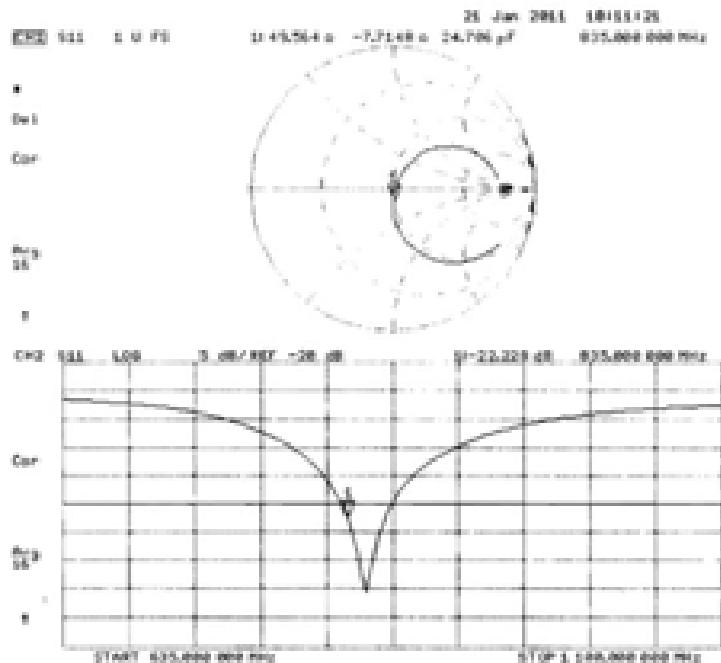




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Impedance Measurement Plot for Head TSL

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Registration No. 5000 100

Client: PTS (PMI Testing Services)

Contract No: D835V2-446_Jan13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 446		
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	January 07, 2013		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (27 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (MATE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0037482704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	U0372982703	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SM 5058 (006)	27-Mar-12 (No. 217-01520)	Apr-13
Type-N mismatch combination	SM 5047.3 / 00327	27-Mar-12 (No. 217-01520)	Apr-13
Reference Probe E8300V3	SM 5005	29-Dec-12 (No. E830-2010, Dec12)	Dec-13
DAE4	SM 601	27-Jun-12 (No. DAE4-601, Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MPH1000317	18-Oct-07 (in house check: Oct-11)	In house check: Oct-13
RF generator R&S SMT-05	1000005	04-Aug-09 (in house check: Oct-11)	In house check: Oct-13
Network Analyzer HP 8752B	U037298285 54206	18-Oct-01 (in house check: Oct-11)	In house check: Oct-13
Calibrated by:	Name:	Function:	Signature:
	Leif Klymmer	Laboratory Technician	
Approved by:	Katja Peters	Technical Manager	
Issued: January 6, 2013			

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S: Swiss Calibration Service

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Mutualized Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1529-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/S 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	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	805 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	42.0 ± 0.1%	0.90 mho/m ± 0 %
Head TSL temperature change during test	< 0.5 °C	—	—

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.09 W/kg ± 17.8 % (n=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.13 W/kg ± 16.5 % (n=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 0.5 jΩ
Return Loss	-23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.385 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 semi rigid 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	SPIAO
Manufactured on	October 24, 2001

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DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 446

Communication System: CW; Frequency: 835 MHz
 Medium parameters used: $\epsilon = 835 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\mu = 42$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN0206; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 S2.8.4(1052); SEMCAD X 14.6.8(7028)

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

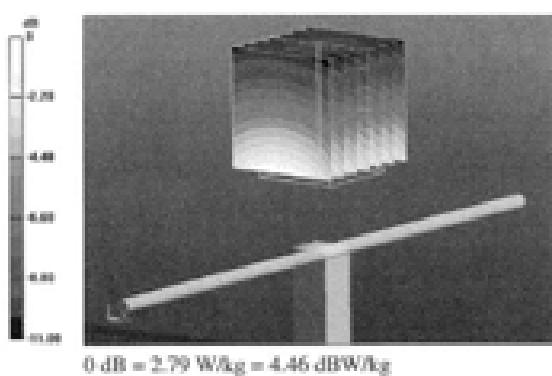
Measurement grid: dx=3mm, dy=3mm, dz=3mm

Reference Value = 56.630 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.61 W/kg

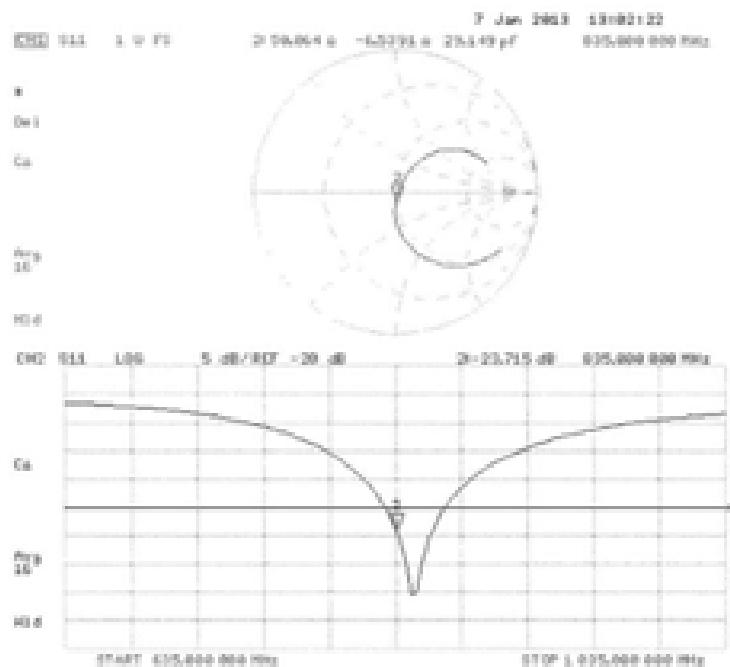
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.55 W/kg

Maximum value of SAR (measured) = 2.79 W/kg



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Impedance Measurement Plot for Head TSL



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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02

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Accreditation No.: **SCS 108**

Client: **RTS (RIM Testing Services)**

Certificate No: **D635V2-43043_Apr11**

CALIBRATION CERTIFICATE

Object: **D635V2 - SN: 43043**

Calibration (measurement): **QA CAL-05.v8**
 Calibration procedure for dipole validation kits

Calibration date: **April 07, 2011**

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

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

Calibration Equipment used (NIST TR) (used for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-4024	Q807460704	08-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 4431A	U8072902703	08-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SH 30000 (prog)	29-Mar-11 (No. 217-01266)	Apr-12
Type N mismatch combination	SH 3047 2 / 08027	29-Mar-11 (No. 217-01271)	Apr-12
Reference Probe E50043	SH 3045	30-Apr-10 (No. E50-3286_Apr10)	Apr-11
DME4	SH 601	18-Jun-10 (No. DME4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 4431A	MP11082117	18-Oct-10 (in house check Oct-10)	In house check: Oct-11
RF generator RAB-SMT-06	U70304	4-Aug-10 (in house check Oct-10)	In house check: Oct-11
Network Analyzer HP 8752B	U807390505 54096	18-Oct-10 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name: Jelon Kastell	Function: Laboratory Technician	
Approved by:	Name: Katja Polenz	Function: Technical Manager	

Issued: April 7, 2011

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Certificate No: **D635V2-43043_Apr11**

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 106**

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 2006
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY5	V5.2.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	935 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	40.6 ± 6 %	0.88 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	—	—

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.33 mW / g
SAR normalized	normalized to 1W	9.32 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.43 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.52 mW / g
SAR normalized	normalized to 1W	6.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.14 mW / g ± 18.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 Ω - 0.4 Ω
Return Loss	-27.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 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 semi-rigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
 No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Design Modification by End User

The dipole has been modified with Tuner Rings (TR) placed with identification markings close to the end of each dipole arm. Calibration has been performed with TR attached to the dipole.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 07, 2006

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DASY5 Validation Report for Head TSL

Date/Time: 07/04/2011 09:28:21

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d643

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL900

Medium parameters used: $f = 835$ MHz; $\sigma = 0.88$ mho/m; $\epsilon_r = 40.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ESMDV3 - SN3205; Coef F(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sef01; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5; V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Plane=250 mW /dm=15mm/Cube @:

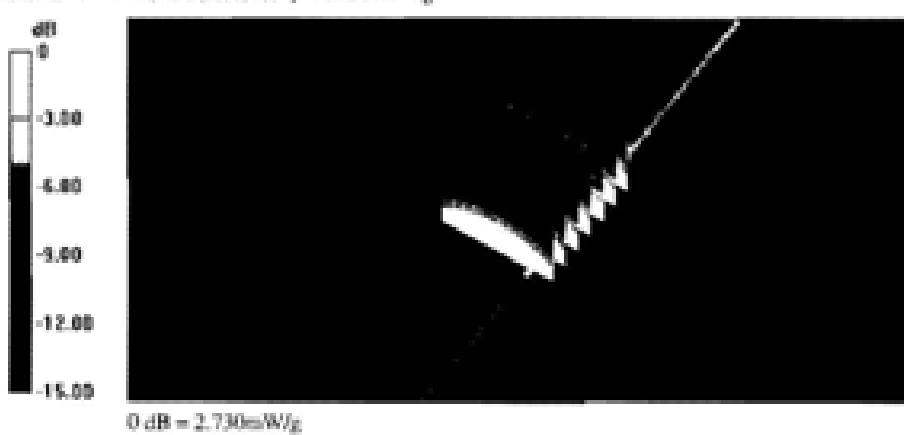
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.201 V/m; Power Draft = 0.07 dB

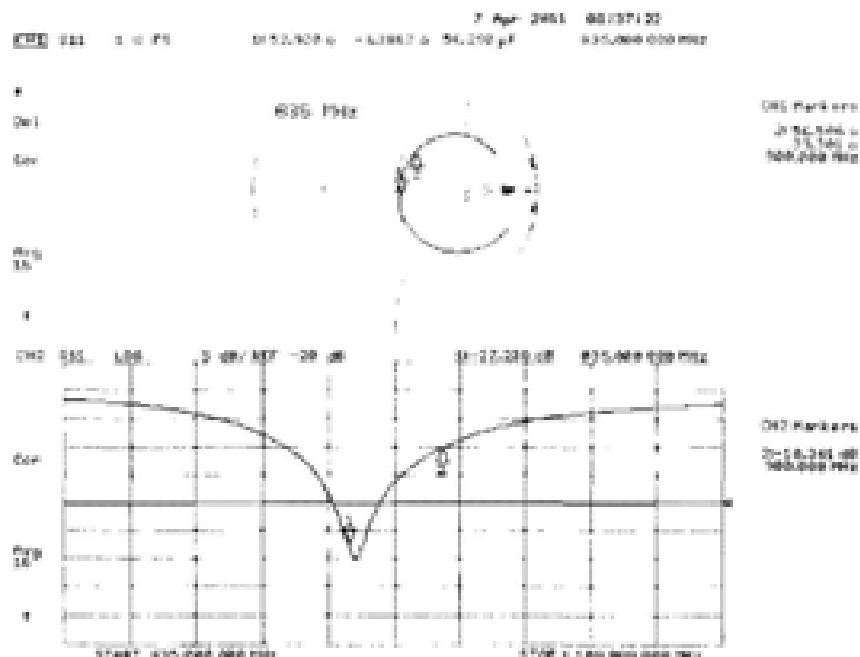
Peak SAR (extrapolated) = 3.504 W/kg

SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.52 mW/g

Maximum value of SAR (measured) = 2.730 mW/g



Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW
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Impedance Measurement Plot for Head TSL.


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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1800W2-2d020_Jan11**

CALIBRATION CERTIFICATE

Object: **D1800W2 - SN: 2d020**

Calibration procedure(s): **QA CAL-05.v8**
 Calibration procedure for dipole validation kits

Calibration date: **January 13, 2011**

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

All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 2)°C and humidity < 70%.

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

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	080374800704	06-Oct-10 (No. 217-01286)	Oct-11
Power sensor HP 8481A	U537262793	06-Oct-10 (No. 217-01288)	Oct-11
Reference 20 dB Attenuator	SH: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SH: 5047.2 / 08327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe E530W3	SH: 3205	30-Apr-10 (No. E53-3205, Apr10)	Apr-11
DAE4	SH: 601	10-Jun-10 (No. DAE4-601, Jun10)	Jun-11
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power sensor HP 8481A	MY110002137	18-Oct-02 (in house check Oct09)	In house check: Oct-11
RF generator PAB (RF1-04)	1030000	4-Aug-09 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8750B	U53726265 (84209)	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Dimos Iliev** **Name** **Function** **Signature**


Approved by: **Katja Pokorni** **Name** **Function** **Signature**


Issued: **January 13, 2011**

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature during test	(21.3 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL.	Condition	
SAR measured	250 mW input power	9.78 mW / g
SAR normalized	normalized to 1W	20.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL.	Condition	
SAR measured	250 mW input power	9.13 mW / g
SAR normalized	normalized to 1W	20.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.5 mW / g ± 18.5 % (k=2)



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Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	46.5 Ω - 7.3 jΩ
Return Loss	-21.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.216 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 07, 2001

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DASYS Validation Report for Head TSL

Date/Time: 13.01.2011 12:34:12

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN:28020

Communication System: CW; Frequency: 1800 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.38$ mho/m; $\epsilon_r = 38.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: ES3DV3 - SN3205; ConvP(5.05, 5.05, 5.05); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Snd01; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: Q0000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

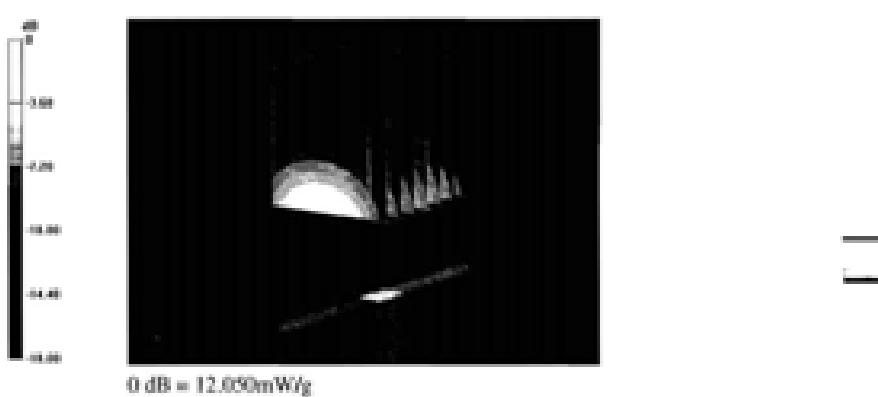
$P_{in}=250$ mW $Ad=10$ mm, $dist=3.0$ mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurements
 grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 96.654 W/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 17.902 W/kg

SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.13 mW/g

Maximum value of SAR (measured) = 12.051 mW/g

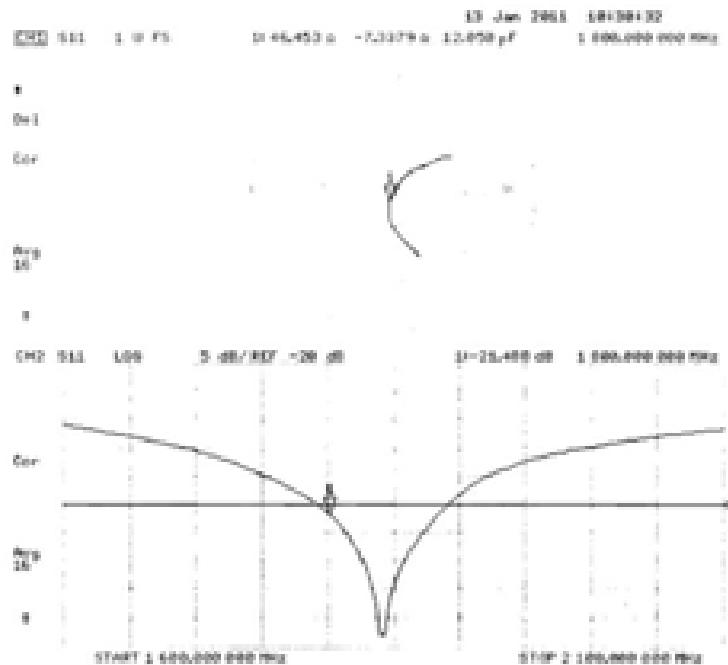




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Impedance Measurement Plot for Head TSL

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Calibration Laboratory of
Schmid & Partner
Engineering AG
Drahtgassestrasse 40, 8004 Zurich, Switzerland



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Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS).
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 106**

Client **RTS (RIM Testing Services)**

Certificate No.: **D1800V2-2d020_Jan13**

CALIBRATION CERTIFICATE

Object	D1800V2 - SN: 2d020		
Calibration procedure(s)	QA GAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	January 09, 2013		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (p.u.). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&T/C critical for calibration):</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter RFL-4420A	04037-44020794	01-Nov-12 (No. 217-016440)	Oct-13
Power sensor HP 8481A	U53372902780	01-Nov-12 (No. 217-016440)	Oct-13
Reference 20 dB Attenuator	SPR: 50068 (204)	27-Mar-12 (No. 217-015120)	Apr-13
Type-N mismatch combination	SPR: 50047.3 / 60397	27-Mar-12 (No. 217-015120)	Apr-13
Reference Probe E5307V3	SPR: 50025	26-Dec-12 (No. E533-02000, Dec-12)	Dec-13
DAU4	SPR: 621	27-Jun-12 (No. DAU4-621_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MFY-100202017	18-Oct-12 (in house check Oct-12)	In house check: Oct-13
RF generator RFL-5M1-06	1000006	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8752E	U533729028 84706	18-Oct-09 (in house check Oct-11)	In house check: Oct-13
Calibrated by:	Name: Janet H-Naoua	Function: Laboratory Technician	
Approved by:	Name: Kaja Polkow	Function: Technical Manager	
Issued: January 9, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: D1800V2-2d020_Jan13

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



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 Swiss Calibration Service

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 Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1526-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/S 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	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.81 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.5 W/kg ± 17.0 % (n=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	26.3 W/kg ± 16.5 % (n=2)

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Appendix:

Antenna Parameters with Head TSL

Impedance, transformed to feed point	45.2 Ω - 8.3 jΩ
Return Loss	- 29.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.216 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	September 07, 2001

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DASY5 Validation Report for Head TSL.

Date: 09/01/2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2a620

Communication System: CW; Frequency: 1800 MHz

Medium parameters used: $\epsilon = 1.38$ S/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.04, 5.04, 5.04); Calibrated: 28.12.2012;
- Sensor-Surface: Jamn (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: Q0000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

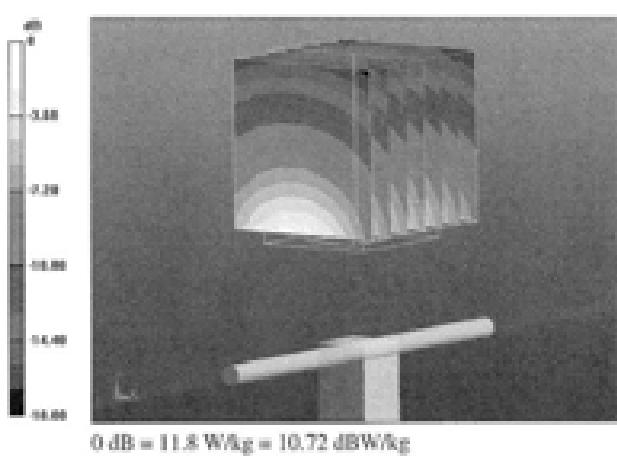
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.870 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 17.5 W/kg

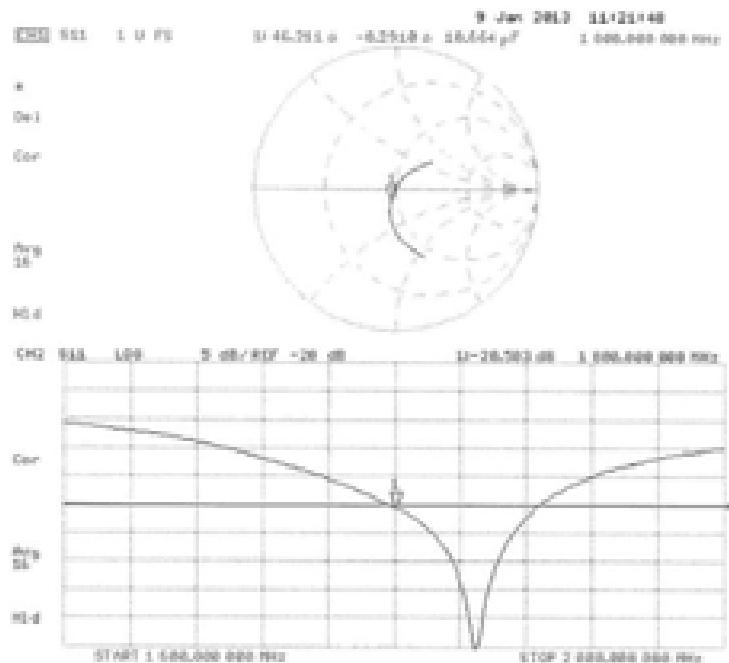
SAR(1 g) = 9.61 W/kg; SAR(10 g) = 5.06 W/kg

Maximum value of SAR (measured) = 11.8 W/kg



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Impedance Measurement Plot for Head TSL.



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Calibration Laboratory of
Schmid & Partner
Engineering AG
Zuegstrasse 49, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 108**Client **RTS (RIM Testing Services)**Certificate No: **D1900V2-545_Jan11****CALIBRATION CERTIFICATE**

Object	D1900V2 - SN: 545		
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits		
Calibration date:	January 13, 2011		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility, environment temperature (23 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-642A	0807480704	08-Oct-10 (No. 217-01298)	Oct-11
Power sensor HP 8481A	U537292763	08-Oct-10 (No. 217-01298)	Oct-11
Reference 20 dB Attenuator	SPN 10889 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-A mismatch combination	SPN 5047.2 / 06327	30-Mar-10 (No. 217-01152)	Mar-11
Reference Probe E8302V3	SPN 3209	20-Apr-10 (No. E830-3209_Apr10)	Apr-11
DAU4	SPN 601	10-Jun-10 (No. QAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (In House)	Scheduled Check
Power sensor HP 8481A	MY41029317	18-Oct-09 (In house check Oct-09)	In house check: Oct-11
RF generator R&S SMU-08	155005	4-Aug-09 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8752E	U537292945 SH208	18-Oct-09 (in house check Oct-10)	In house check: Oct-11
Calibrated by:	Name Christi Rev	Function Laboratory Technician	Signature
Approved by:	Name Katja Pöhlki	Function Technical Manager	Signature
Issued: January 14, 2011			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: **D1900V2-545_Jan11**

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



S Schweizerischer Kalibrierdienst
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S Servizio svizzero di isometria
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS).
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASYS	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.3) °C	39.8 ± 6 %	1.43 mho/m ± 6 %
Head TSL temperature during test	(21.2 ± 0.3) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR normalized	normalized to 1W	40.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.26 mW / g
SAR normalized	normalized to 1W	31.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	30.8 mW / g ± 16.5 % (k=2)



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Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	50.8 Ω + 1.8 Ω
Return Loss	-34.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 15, 2001

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DASY5 Validation Report for Head TSL

Date/Time: 13.01.2011 14:52:49

Test Laboratory: SPIAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:545

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL_U12_BB

Medium parameters used: $f = 1900$ MHz; $\epsilon = 1.43$ mho/m; $\sigma = 38.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sm601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V32.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

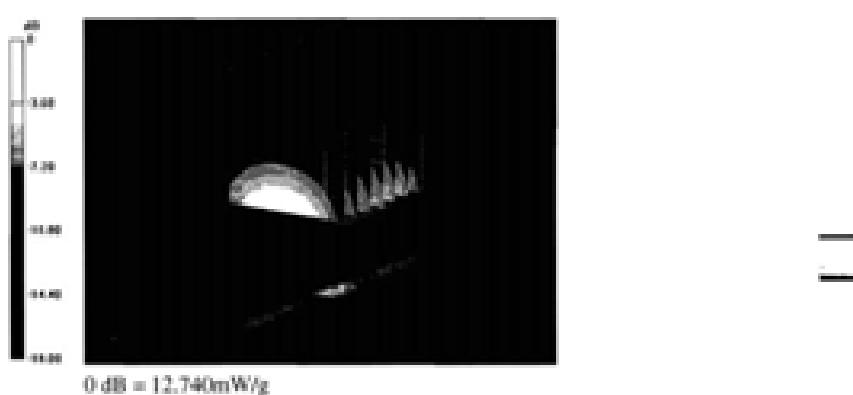
Pin=250 mW; dL=10mm, dist=3.0mm (ES-Probe)/Zoom: Scan (7x7x7) /Cube 0; Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.053 mW/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.648 W/kg

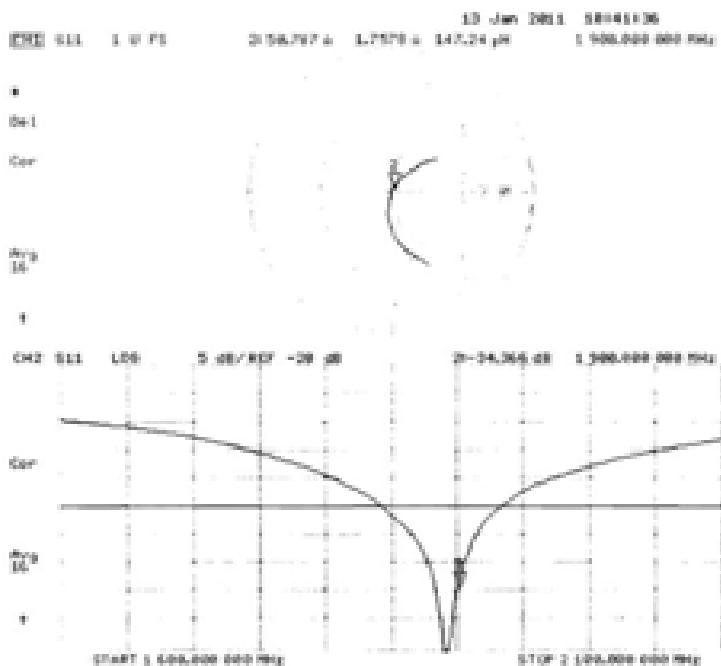
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 3.26 mW/g

Maximum value of SAR (measured) = 12.743 mW/g



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Impedance Measurement Plot for Head TSL.



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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1900V2-545_Jan13**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 545
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 09, 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 (NIST/ICRL critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-HDPA	08074800704	01-Nov-12 (No. 217-09140)	Oct-13
Power sensor HP 8481A	US072927603	01-Nov-12 (No. 217-09140)	Oct-13
Reference 20 dB Attenuator	SRI 5058 (904)	27-Mar-12 (No. 217-09130)	Apr-13
Type N mismatch combination	SRI 5247.3 (90327)	27-Mar-12 (No. 217-09130)	Apr-13
Reference Probe ESD02V3	SRI 3206	26-Dec-12 (No. ESD-02008, Dec12)	Dec-13
DAU4	SRI 601	27-Jun-12 (No. DAU4-601, Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	848109002017	18-Oct-12 (in house check Oct-12)	In house check: Oct-13
RF generator RIG SMT-06	1030009	26-Aug-12 (in house check Oct-12)	In house check: Oct-13
Network Analyzer HP 8750B	US073900085 (84206)	18-Oct-12 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name: Irene D-Riccardi	Function: Laboratory Technician	Signature:
Approved by:	Name: Katja Pekkola	Function: Technical Manager	Signature:

Issued: January 9, 2013

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

Certificate No: **D1900V2-545_Jan13**

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Multilateral Agreement for the recognition of calibration certificates.

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/S 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 I.)

DASY Version	DASY5	V52.0.4
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

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	± 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.1 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω \pm 1.7 Ω
Return Loss	-34.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.198 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 semi rigid 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 15, 2001

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DASY5 Validation Report for Head TSL

Date: 09/01/2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 545

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $\Gamma = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.4$; $\rho = 1000$ kg/m³

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 Sa601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QUB000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

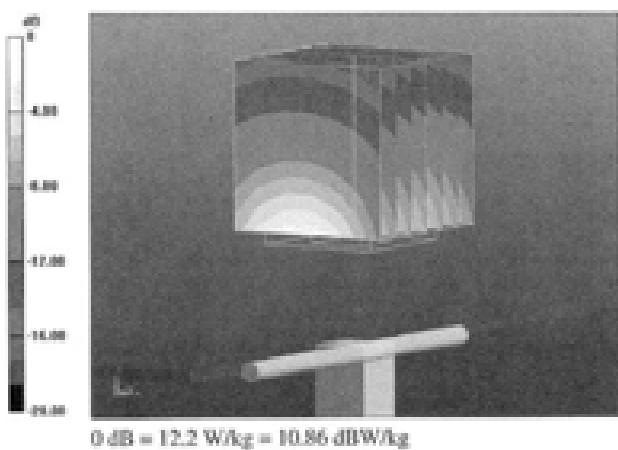
Measurement grid: dx=3mm, dy=3mm, dz=3mm

Reference Value = 95.493 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.1 W/kg

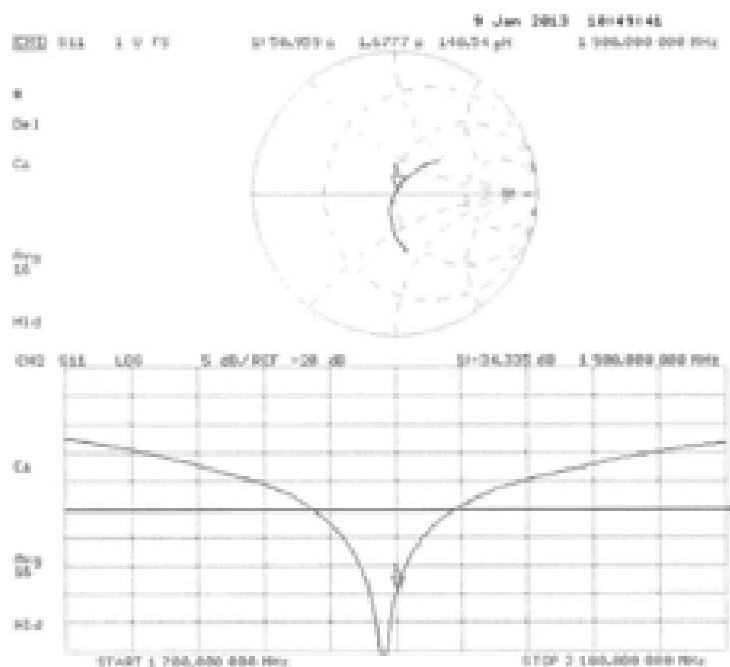
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.26 W/kg

Maximum value of SAR (measured) = 12.2 W/kg



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Impedance Measurement Plot for Head TSL



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Accreditation No.: **SCS 199**

Client **RTS (RIM Testing Services)**

Certification No.: **D1900V2-56075_Apr11**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 56075**

Calibration procedure(s) **QA.CAL-05.v8**
 Calibration procedure for dipole validation kits

Calibration date **April 5, 2011**

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

All calibrations have been conducted in the closed laboratory facility, environment temperature (20 ± 5°C) and humidity < 70%.

Calibration Equipment used (ML1E critical for calibration):

Primary Standards	ID #	Cal Date (Cert No./Cal No.)	Scheduled Calibration
Power meter EPM 4424	425279402704	08-Oct-10 (No. 2117-012989)	Oct-11
Power sensor HP 4911A	175279502793	08-Oct-10 (No. 2117-012989)	Oct-11
Polarimeter 20 dB Attenuator	584 5086 (20g)	29-Mar-11 (No. 2117-013681)	Apr-11
Type-N connector combination	584 5047 2 / 08027	29-Mar-11 (No. 2117-012771)	Apr-11
Polarimeter Probe E530V3	584 5010	30-Apr-10 (No. E530-3208, Apr10)	Apr-11
DA84	584 601	19-Jun-10 (No. DA84-601, Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 4911A	584 10202117	18-Oct-10 (in house check Oct 09)	In house check: Oct-11
RF generator RFS 5MT-00	1060555	4-Aug-09 (in house check Oct-08)	In house check: Oct-11
Network Analyzer HP 8753E	175279502555 54096	18-Oct-11 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Name:** **Mike Hall** **Function:** **Laboratory Technician**

Approved by: **Name:** **Kalja Pekola** **Function:** **Technical Manager**

Issued: April 5, 2011

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

Certificate No.: **D1900V2-56075_Apr11**

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY5	V62.0.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacers
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	23.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.41 mho/m ± 6 %
Head TSL temperature during test	(21.3 ± 0.2) °C

SAR result with Head TSL

SAR averaged over 1 cm ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR normalized	normalized to 1W	40.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.4 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ² (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	0.29 mW / g
SAR normalized	normalized to 1W	21.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW / g ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5 Ω + 6.1 $\mu\Omega$
Return Loss	-23.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
 No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	ÖPELAÖ
Manufactured on	January 24, 2008

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DASYS Validation Report for Head TSL

Date/Time: 05/04/2011 12:41:39

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:54975

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 1900$ MHz; $\alpha = 1.41$ mho/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: ESQDW3 - SN:286; Conv:H3.0R, 5.0%, 5.09 v; Calibrated: 30.04.2010
- Sensor-Surface: Arms (Mechanical Surface Detector)
- Electronics: DASYS601; Calibrated: 10.08.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD0000P50AA; Serial: 1009
- Measurements SW: DASYS52_V12.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2929)

Head / d=10mm, Pm=250 mW / Cube 0:

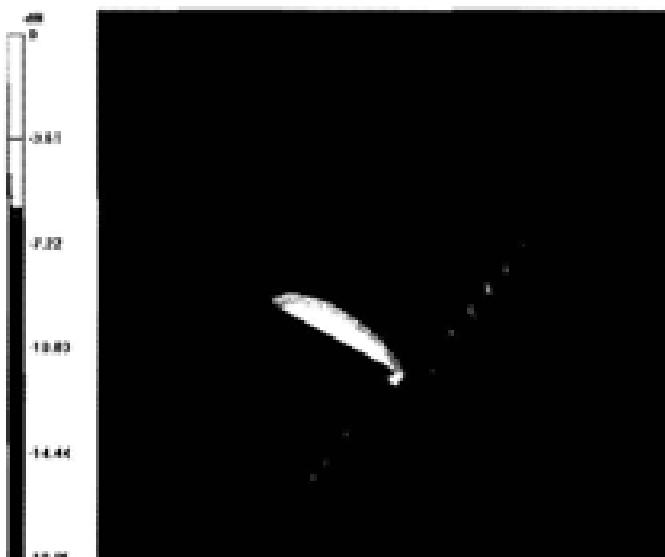
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.376 W/m³; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.796 W/kg

SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.29 mW/g

Maximum value of SAR (measured) = 12.476 mW/g



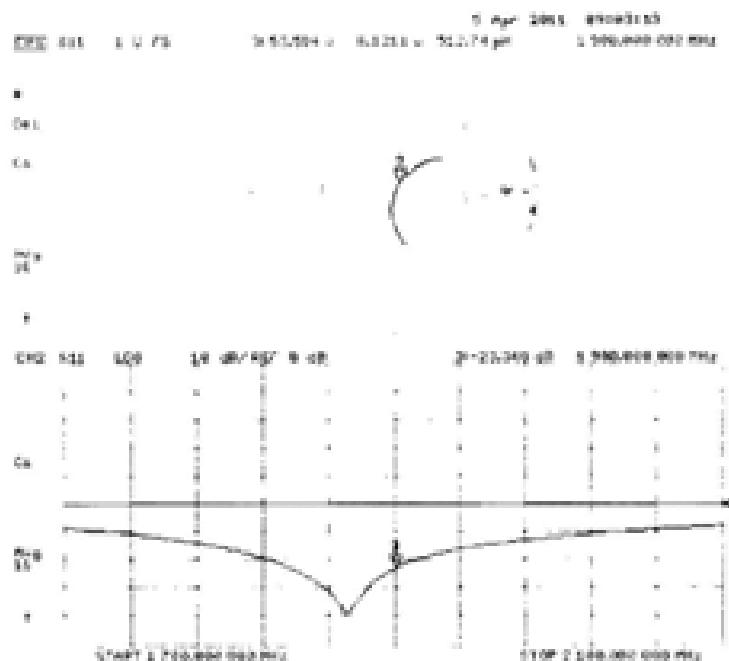
0-dB = 12.476 mW/g



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Impedance Measurement Plot for Head TSL

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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D2450V2-747_Nov11**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 747																																														
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz																																														
Calibration date	November 09, 2011																																														
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (23 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (MMTE critical for calibration)</p> <table border="1"> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> <tr> <td>Power meter DPM-442A</td> <td>Q8374902704</td> <td>05-Oct-11 (No. 217-01457)</td> <td>Oct-12</td> </tr> <tr> <td>Power sensor HP 84811A</td> <td>U837292793</td> <td>05-Oct-11 (No. 217-01457)</td> <td>Oct-12</td> </tr> <tr> <td>Reference 20-dB Attenuator</td> <td>SAI 50488 (20g)</td> <td>29-Mar-11 (No. 217-01368)</td> <td>Apr-12</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SAI 5047.2 / 06327</td> <td>29-Mar-11 (No. 217-01371)</td> <td>Apr-12</td> </tr> <tr> <td>Reference Probe E8300V3</td> <td>SAI 3209</td> <td>29-Apr-11 (No. 233-32995, Apr11)</td> <td>Apr-12</td> </tr> <tr> <td>QAM4</td> <td>SAI 601</td> <td>04-Jul-11 (No. D4E4-601, Jul11)</td> <td>Jul-12</td> </tr> </table> <table border="1"> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (In House)</th> <th>Scheduled Check</th> </tr> <tr> <td>Power sensor HP 84811A</td> <td>MY81000217</td> <td>18-Oct-09 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>RF generator PAB (SMT-06)</td> <td>1000005</td> <td>04-Aug-09 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>U8373900085 (84206)</td> <td>18-Oct-01 (in house check Oct-11)</td> <td>In house check: Oct-12</td> </tr> </table> <p>Calibrated by: Udo Kasten Instrument Technologist </p> <p>Approved by: Kaja Pihlaja Technical Manager </p> <p>Issued: November 9, 2011</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter DPM-442A	Q8374902704	05-Oct-11 (No. 217-01457)	Oct-12	Power sensor HP 84811A	U837292793	05-Oct-11 (No. 217-01457)	Oct-12	Reference 20-dB Attenuator	SAI 50488 (20g)	29-Mar-11 (No. 217-01368)	Apr-12	Type-N mismatch combination	SAI 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12	Reference Probe E8300V3	SAI 3209	29-Apr-11 (No. 233-32995, Apr11)	Apr-12	QAM4	SAI 601	04-Jul-11 (No. D4E4-601, Jul11)	Jul-12	Secondary Standards	ID #	Check Date (In House)	Scheduled Check	Power sensor HP 84811A	MY81000217	18-Oct-09 (in house check Oct-11)	In house check: Oct-13	RF generator PAB (SMT-06)	1000005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13	Network Analyzer HP 8753E	U8373900085 (84206)	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration																																												
Power meter DPM-442A	Q8374902704	05-Oct-11 (No. 217-01457)	Oct-12																																												
Power sensor HP 84811A	U837292793	05-Oct-11 (No. 217-01457)	Oct-12																																												
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Network Analyzer HP 8753E	U8373900085 (84206)	18-Oct-01 (in house check Oct-11)	In house check: Oct-12																																												

Certificate No: **D2450V2-747_Nov11**

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Calibration Laboratory of
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Engineering AG
Zürcherstrasse 43, 8004 Zurich, Switzerland



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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAs)
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	1.60 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.64 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	54.1 mW / g ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.39 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.3 mW / g ± 16.8 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω + 1.0 $\text{j}\Omega$
Return Loss	-31.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.561 ms
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
 No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 01, 2000

RIM Testing Services	Document Appendix D for the BlackBerry® Smartphone Model RFP121LW SAR Report	Page 125(134)
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DASYS Validation Report for Head TSL

Date: 09.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 747

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $\epsilon = 1.84$ mho/m; $c_s = 37.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASYS2 Configuration:

- Probe: ES3DV3 - SN3208; ComP(4.45, 4.45, 4.45); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DMA54 Sa601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASYS2 52.6.20482); SEMCAD X 14.4.5(3634)

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

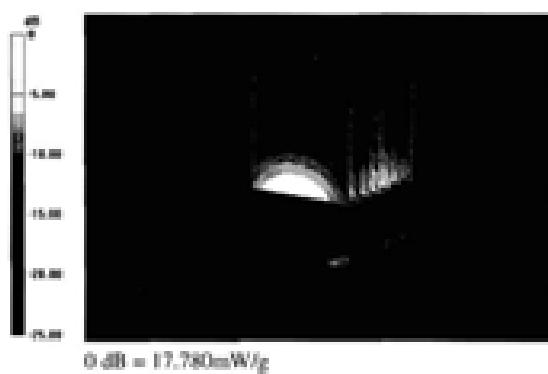
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.1 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 28.853 W/kg

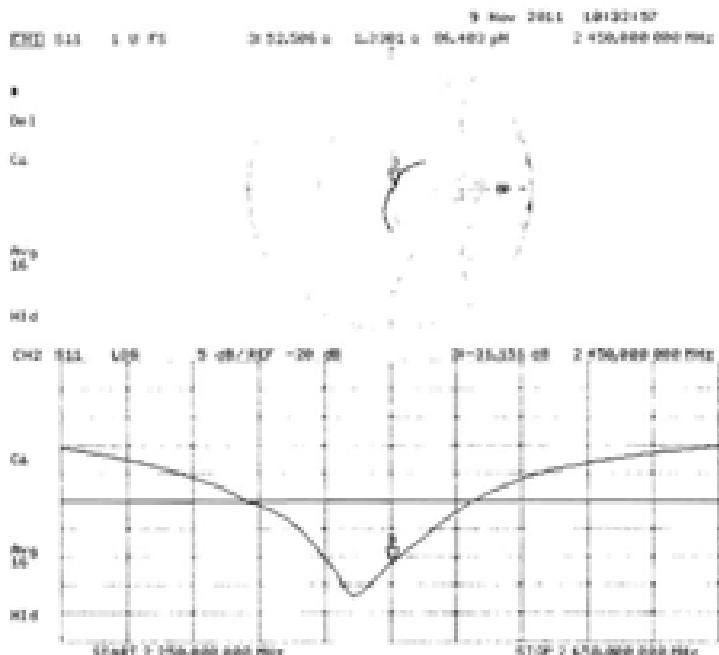
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.39 mW/g

Maximum value of SAR (measured) = 17.782 mW/g



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Impedance Measurement Plot for Head TSL.



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



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Accreditation No.: **SCS 106**

Client **RTS (RIM Testing Services)**

Certificate No: **D6GHzV2-1003_Nov11**

CALIBRATION CERTIFICATE

Object	D6GHzV2 - SN: 1003
Calibration procedure(s)	QA CAL-22.v1 <i>Calibration procedure for dipole validation kits between 3-6 GHz</i>
Calibration date:	November 15, 2011

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

All calibrations have been conducted in the closed laboratory facility; environment temperature (20 ± 3°C) and humidity < 70%.

Calibration Equipment used (MINTE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	Q637480794	05-Oct-11 (No. 217-01487)	Oct-12
Power sensor HP 8481A	U637298783	05-Oct-11 (No. 217-01487)	Oct-12
Reference 20 dB Attenuator	SM 5086 (20dB)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SM 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EXC004	SM 3923	04-Mar-11 (No. EXC-3923_Mar11)	Mar-12
DNA	SM 601	04-Jun-11 (No. DAE-4-601_Jun11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	In-House Check
Power sensor HP 8481A	MY410902917	18-Oct-09 (in house check Oct-11)	In-house check: Oct-12
RF generator R&S (SM1106)	130005	04-Aug-09 (in house check Oct-11)	In-house check: Oct-12
Network Analyzer HP 8753B	U6373005695 (4206)	18-Oct-09 (in house check Oct-11)	In-house check: Oct-12

Calibrated by:	Name: Dmitri Sav	Function: Laboratory Technician	Signature:
Approved by:	Name: Katja Polkova	Function: Technical Manager	Signature:

Issued: November 16, 2011

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

Certificate No: **D6GHzV2-1003_Nov11**

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Zürcherstrasse 43, 8001 Zurich, Switzerland



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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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



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Measurement Conditions

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

DASY Version	DASY5	V62.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.46 mho/m ± 6 %
Head TSL temperature change during test	± 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	0.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.8 mW / g ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	23.0 mW / g ± 16.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.8	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.75 mho/m ± 6 %
Head TSL temperature change during test	± 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	0.02 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	87.3 mW / g ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.50 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.7 mW / g ± 16.5 % (k=2)



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Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	32.0 °C	36.3	5.27 mho/m
Measured Head TSL parameters	(32.0 ± 0.2) °C	33.7 ± 6 %	5.03 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 ² (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.4 mW / g ± 17.5 % (k=2)

SAR averaged over 10 cm ² (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.20 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.5 mW / g ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point:	51.1 Ω - 8.7 jΩ
Return Loss:	-21.2 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point:	52.3 Ω - 2.7 jΩ
Return Loss:	-29.2 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point:	56.7 Ω - 4.3 jΩ
Return Loss:	-22.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction):	1.202 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
 No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 09, 2004

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DASY5 Validation Report for Head TSL

Date: 15.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

IMUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1033

Communication Systems: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
 Medium parameters used: $f = 5200$ MHz; $\sigma = 4.46$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³. Medium parameters used: $f = 5500$ MHz; $\sigma = 4.75$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³. Medium parameters used: $f = 5800$ MHz; $\sigma = 5.03$ mho/m; $\epsilon_r = 33.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3903; ConvP(5.41, 5.41, 5.41), ConvP(4.91, 4.91, 4.91), ConvP(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAB4 Sx601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.393 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 30.134 W/kg

SAR(1 g) = 8.16 mW/g; SAR(10 g) = 2.33 mW/g

Maximum value of SAR (measured) = 18.725 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 = 66.819 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 35.056 W/kg

SAR(1 g) = 8.82 mW/g; SAR(10 g) = 2.5 mW/g

Maximum value of SAR (measured) = 21.019 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 = 62.220 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 33.743 W/kg

SAR(1 g) = 8.03 mW/g; SAR(10 g) = 2.28 mW/g

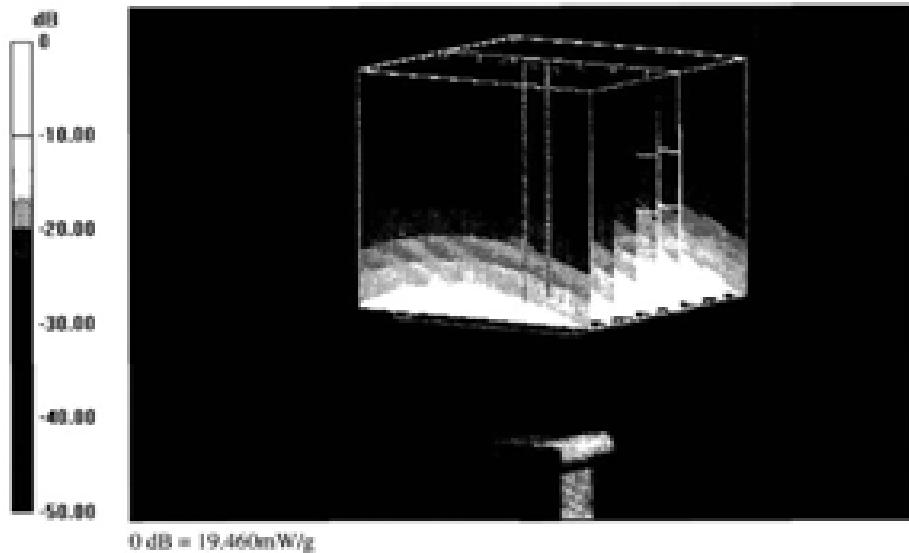
Maximum value of SAR (measured) = 19.463 mW/g



Document

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Author Data Andrew Becker	Dates of Test Nov 22, 2012 – Feb 28, 2013	Test Report No RTS-6026-1303-02	FCC ID: L6ARFL110LW L6ARFP120LW	IC 2503A-RFL110LW 2503A-RFP120LW
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0 dB = 19.460mW/g

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Impedance Measurement Plot for Head TSL

