

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>1(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>
		FCC ID: <b>L6ARFY110LW</b>
		IC <b>2503A-RFY110LW</b>

#### **APPENDIX D: PROBE & DIPOLE CALIBRATION DATA**



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR  
Report Rev 2**

Page  
**2(49)**

Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

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



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

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

Accreditation No.: **SCS 108**Client **RTS (RIM Testing Services)**Certificate No. **ES3-3225\_Jan13**

### **CALIBRATION CERTIFICATE**

Object **ES3DV3 - SN:3225**Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4**  
Calibration procedure for dosimetric E-field probesCalibration date: **January 10, 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  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&amp;TE critical for calibration)

Primary Standards	ID	Cali Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Page 1 of 11

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>3(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

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**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 $\varphi$	$\varphi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis

**Calibration is Performed According to the Following Standards:**

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

**Methods Applied and Interpretation of Parameters:**

- $NORMx,y,z$ : Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide).  $NORMx,y,z$  are only intermediate values, i.e., the uncertainties of  $NORMx,y,z$  does not affect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- $NORM(f)x,y,z = NORMx,y,z * frequency\_response$  (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCPx,y,z$ : 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
- $Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z$ :  $A, B, C, D$  are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  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  $NORMx,y,z * ConvF$  whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>4(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

ES3DV3 – SN:3225

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!)



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**5(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

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 ( $\mu$ V/(V/m) <sup>2</sup> ) <sup>A</sup>	1.29	1.19	1.31	± 10.1 %
DCP (mV) <sup>B</sup>	100.5	101.5	99.9	

**Modulation Calibration Parameters**

UID	Communication System Name		A dB	B dB $\sqrt{\mu}$ V	C	D dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	157.5	±2.7 %
		Y	0.0	0.0	1.0		158.4	
		Z	0.0	0.0	1.0		165.9	

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%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).<sup>B</sup> Numerical linearization parameter: uncertainty not required.<sup>E</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**6(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

ES3DV3– SN:3225

January 10, 2013

**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225****Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (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	0.80	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	0.80	1.32	± 12.0 %

<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**7(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

ES3DV3– SN:3225

January 10, 2013

**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3225****Calibration Parameter Determined in Body Tissue Simulating Media**

<b>f (MHz)<sup>c</sup></b>	<b>Relative Permittivity<sup>f</sup></b>	<b>Conductivity (S/m)<sup>f</sup></b>	<b>ConvF X</b>	<b>ConvF Y</b>	<b>ConvF Z</b>	<b>Alpha</b>	<b>Depth (mm)</b>	<b>Unct. (k=2)</b>
750	55.5	0.96	6.27	6.27	6.27	0.48	1.51	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.73	1.25	± 12.0 %
1810	53.3	1.52	5.04	5.04	5.04	0.57	1.47	± 12.0 %
1950	53.3	1.52	4.94	4.94	4.94	0.58	1.50	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.70	1.16	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.67	0.99	± 12.0 %

<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\alpha$ ) 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 ( $\epsilon$  and  $\alpha$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

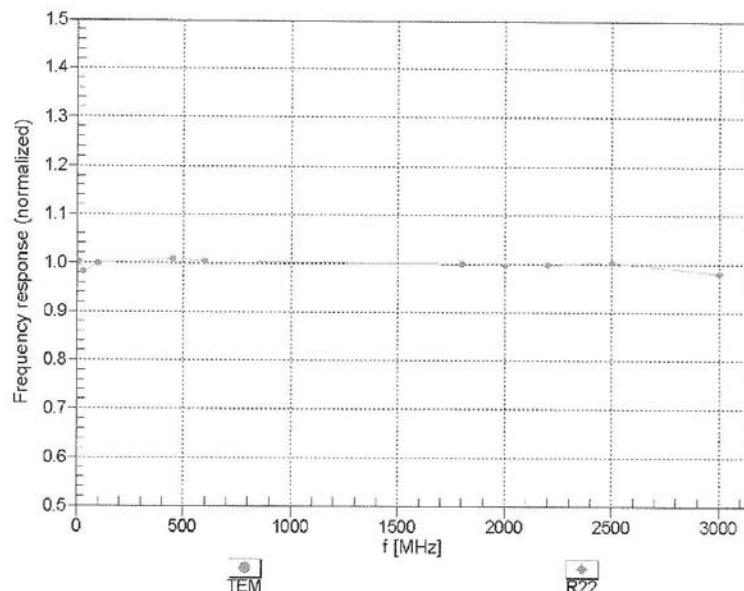


Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**8(49)**Author Data  
**Andrew Becker**Dates of Test  
**July 02 –August 15, 2013**Test Report No  
**RTS-6046-1308-34 Rev 2**FCC ID:  
**L6ARFY110LW**IC  
**2503A-RFY110LW**

ES3DV3– SN:3225

January 10, 2013

**Frequency Response of E-Field**  
(TEM-Cell:ifi110 EXX, Waveguide: R22)Uncertainty of Frequency Response of E-field:  $\pm 6.3\% (k=2)$



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**9(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

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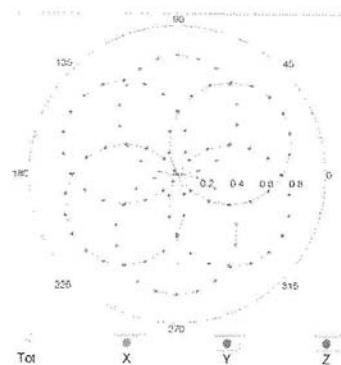
**2503A-RFY110LW**

ES3DV3– SN:3225

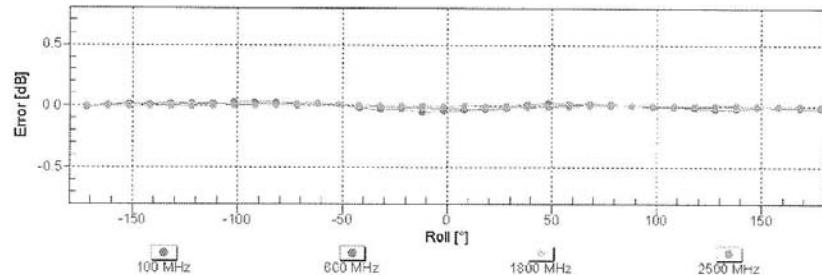
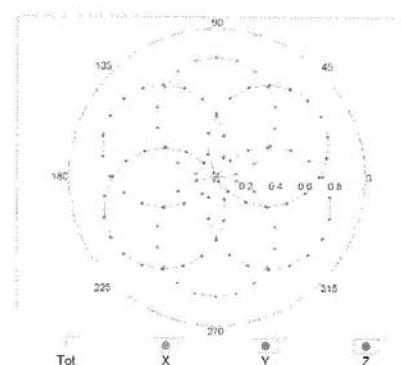
January 10, 2013

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

f=600 MHz, TEM



f=1800 MHz, R22

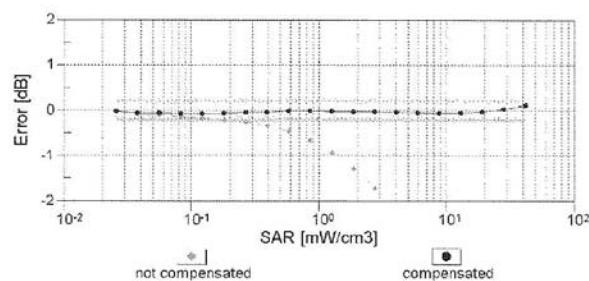
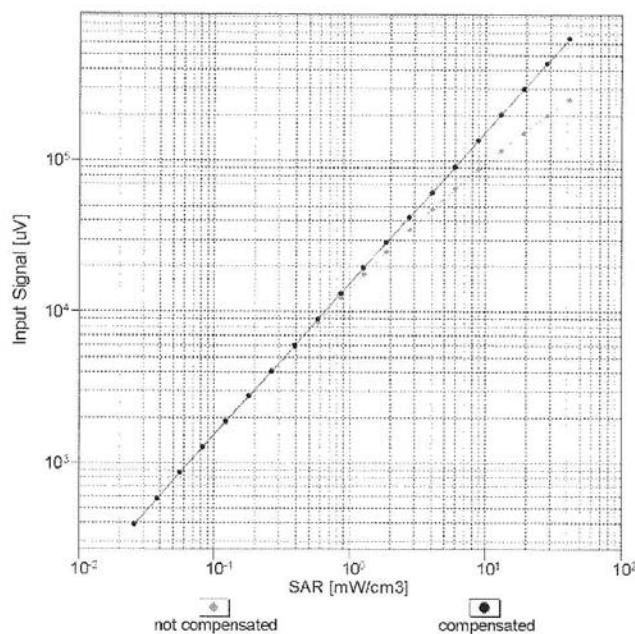
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

Author Data  
**Andrew Becker**Dates of Test  
**July 02 –August 15, 2013**Test Report No  
**RTS-6046-1308-34 Rev 2**FCC ID:  
**L6ARFY110LW**IC  
**2503A-RFY110LW**

ES3DV3– SN:3225

January 10, 2013

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



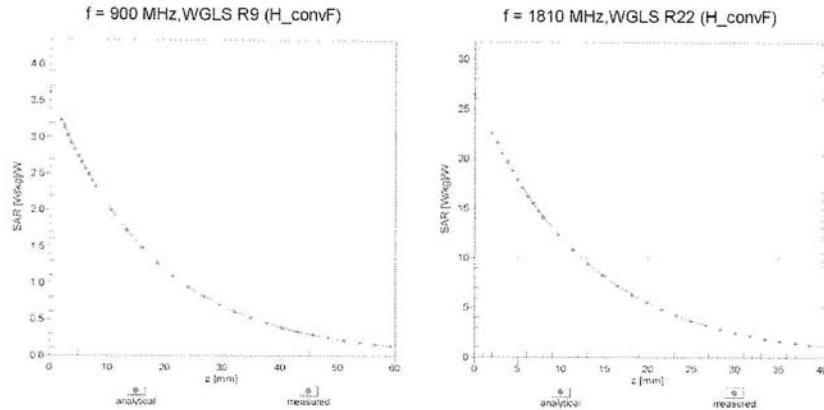
**Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )**

Author Data  
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**July 02 –August 15, 2013**Test Report No  
**RTS-6046-1308-34 Rev 2**FCC ID:  
**L6ARFY110LW**IC  
**2503A-RFY110LW**

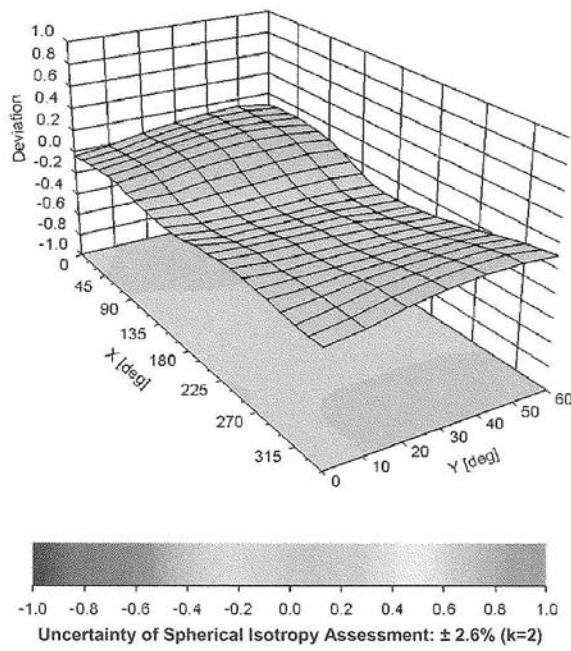
ES3DV3– SN:3225

January 10, 2013

### Conversion Factor Assessment



### Deviation from Isotropy in Liquid

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



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**12(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

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



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**13(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

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Accreditation No.: **SCS 108**Client **RTS (RIM Testing Services)**Certificate No: **EX3-3548\_Jan13****CALIBRATION CERTIFICATE**Object **EX3DV4 - SN:3548**Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4**  
 Calibration procedure for dosimetric E-field probesCalibration date: **January 15, 2013**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
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Calibrated by:	Name: <b>Jeton Kastrati</b>	Function: <b>Laboratory Technician</b>	Signature:
Approved by:	Name: <b>Katja Pokovic</b>	Function: <b>Technical Manager</b>	Signature:

Issued: January 15, 2013

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Certificate No: EX3-3548\_Jan13

Page 1 of 11

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>14(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

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- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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.
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- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: 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.
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- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
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	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>15(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

EX3DV4 – SN:3548

January 15, 2013

# Probe EX3DV4

SN:3548

Manufactured: November 16, 2004  
Calibrated: January 15, 2013

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



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**16(49)**

Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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EX3DV4- SN:3548

January 15, 2013

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3548****Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	0.36	0.44	0.43	$\pm 10.1\%$
DCP (mV) <sup>B</sup>	103.2	98.0	98.7	

**Modulation Calibration Parameters**

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc <sup>C</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	181.3	$\pm 3.3\%$
		Y	0.0	0.0	1.0		149.2	
		Z	0.0	0.0	1.0		198.9	

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%.

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

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

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



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**17(49)**

Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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EX3DV4– SN:3548

January 15, 2013

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3548****Calibration Parameter Determined in Head Tissue Simulating Media**

$f$ (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2600	39.0	1.96	7.15	7.15	7.15	0.47	0.86	± 12.0 %
5200	36.0	4.66	5.13	5.13	5.13	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.79	4.79	4.79	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.61	4.61	4.61	0.45	1.80	± 13.1 %

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**18(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

EX3DV4- SN:3548

January 15, 2013

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3548****Calibration Parameter Determined in Body Tissue Simulating Media**

$f$ (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2600	52.5	2.16	7.08	7.08	7.08	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.68	4.68	4.68	0.52	1.90	± 13.1 %
5500	48.6	5.65	4.15	4.15	4.15	0.52	1.90	± 13.1 %
5800	48.2	6.00	4.19	4.19	4.19	0.60	1.90	± 13.1 %

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**19(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

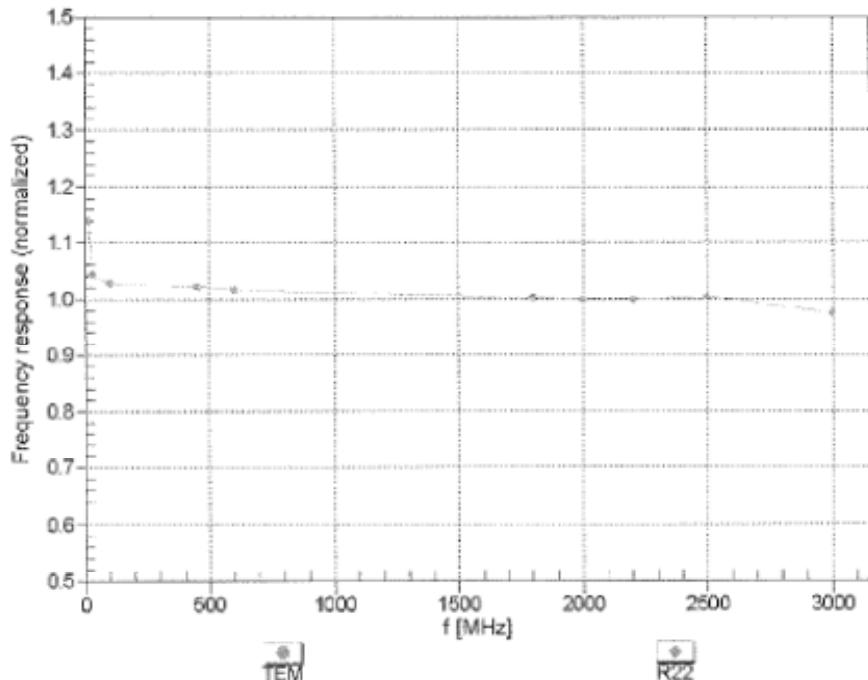
**L6ARFY110LW**

IC

**2503A-RFY110LW**

EX3DV4- SN:3548

January 15, 2013

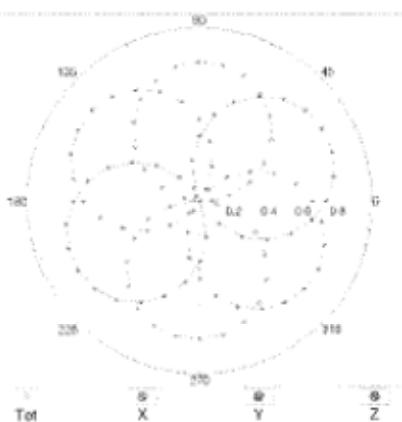
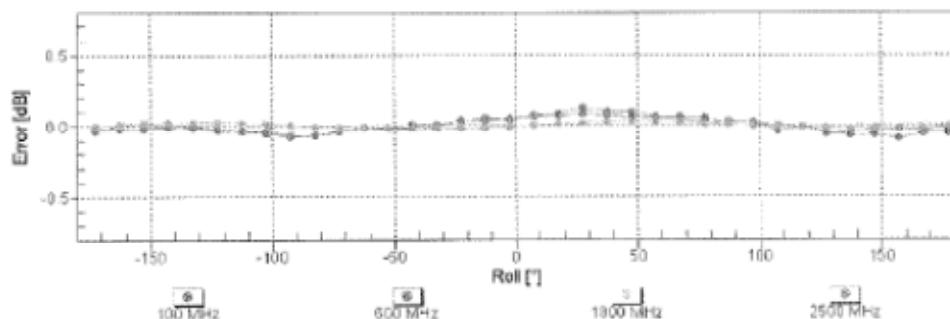
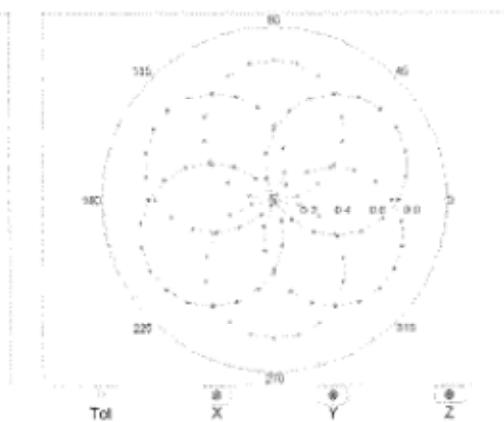
**Frequency Response of E-Field**  
(TEM-Cell:ifi110 EXX, Waveguide: R22)Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

Author Data  
**Andrew Becker**Dates of Test  
**July 02 –August 15, 2013**Test Report No  
**RTS-6046-1308-34 Rev 2**FCC ID:  
**L6ARFY110LW**IC  
**2503A-RFY110LW**

EX3DV4- SN:3548

January 15, 2013

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

**f=600 MHz, TEM****f=1800 MHz, R22**

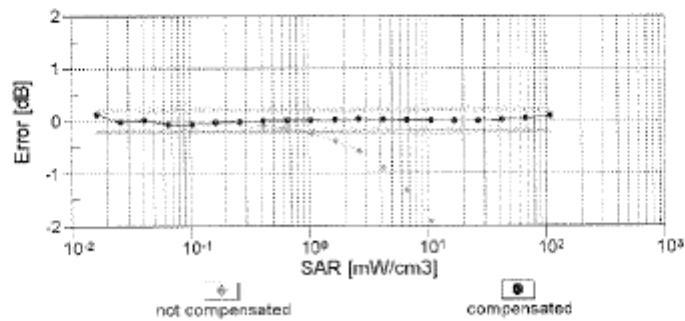
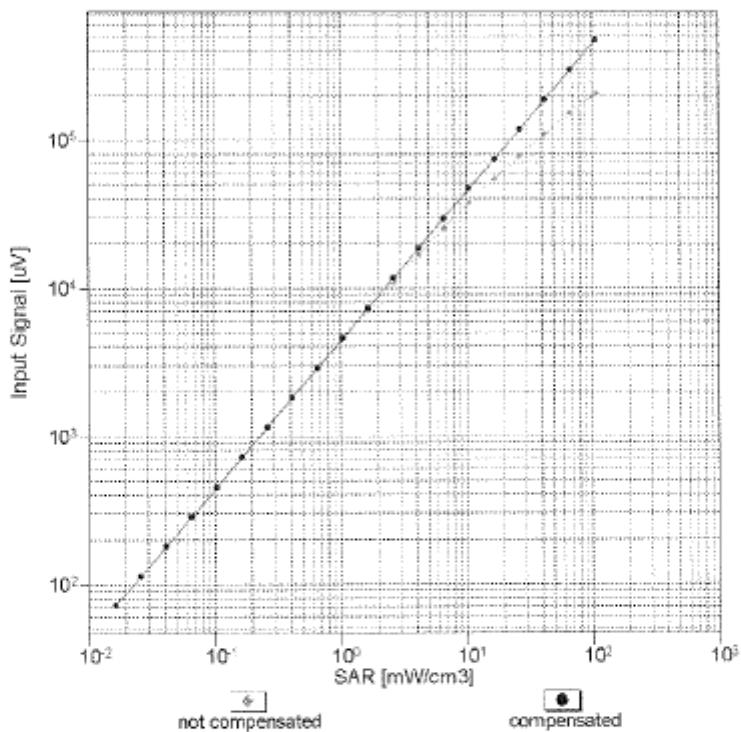
**Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )**

Author Data  
**Andrew Becker**Dates of Test  
**July 02 –August 15, 2013**Test Report No  
**RTS-6046-1308-34 Rev 2**FCC ID:  
**L6ARFY110LW**IC  
**2503A-RFY110LW**

EX3DV4- SN:3548

January 15, 2013

### Dynamic Range f(SAR<sub>head</sub>) (TEM cell , f = 900 MHz)


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



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**22(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

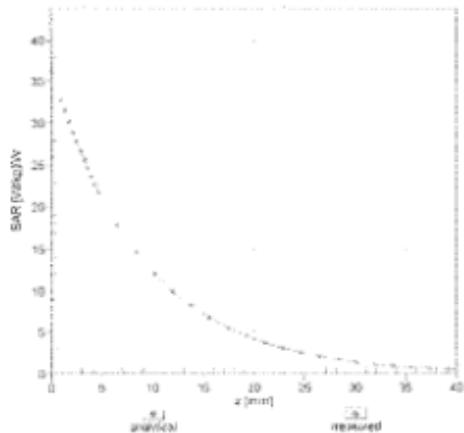
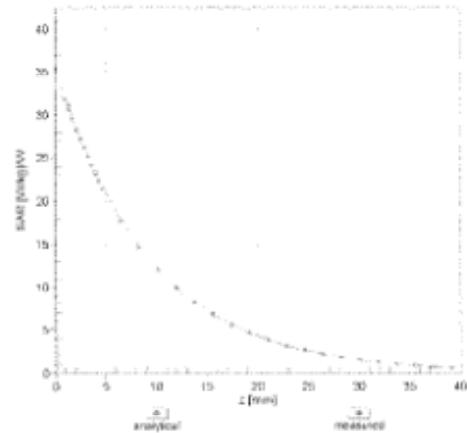
IC

**2503A-RFY110LW**

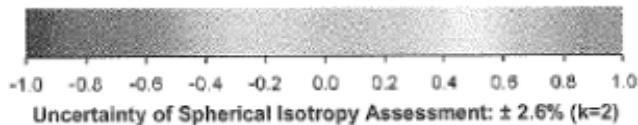
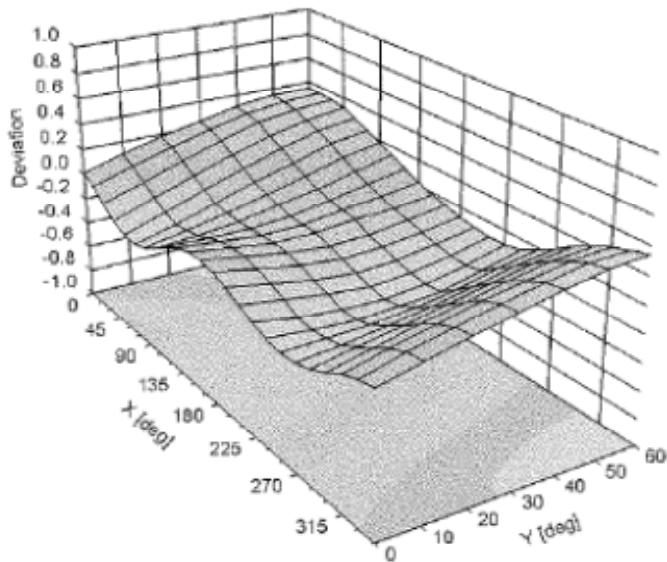
EX3DV4- SN:3548

January 15, 2013

## Conversion Factor Assessment

 $f = 2600 \text{ MHz, WGLS R22 (H_convF)}$  $f = 2600 \text{ MHz, WGLS R22 (M_convF)}$ 

## Deviation from Isotropy in Liquid Error ( $\phi$ , 9), $f = 900 \text{ MHz}$





Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR  
Report Rev 2**Page  
**23(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW**

EX3DV4- SN:3548

January 15, 2013

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3548****Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-72.5
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



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**24(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

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**2503A-RFY110LW**

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



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**C** Service suisse d'étalonnage  
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**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**Client **RTS (RIM Testing Services)**Certificate 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 MHzCalibration 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&amp;TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Name** **Leif Klysner** **Function** **Laboratory Technician** **Signature**

Approved by: **Katja Pokovic** **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: **D835V2-446\_Jan13**

Page 1 of 6

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>25(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

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



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**C** Servizio svizzero di taratura  
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Accreditation No.: **SCS 108**

**Glossary:**

<b>TSL</b>	tissue simulating liquid
<b>ConvF</b>	sensitivity in TSL / NORM x,y,z
<b>N/A</b>	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.

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%.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**26(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****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	835 MHz ± 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL**

SAR averaged over 1 cm <sup>3</sup> (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	9.39 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.13 W/kg ± 16.5 % (k=2)



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**27(49)**Author Data  
**Andrew Becker**Dates of Test  
**July 02 –August 15, 2013**Test Report No  
**RTS-6046-1308-34 Rev 2**FCC ID:  
**L6ARFY110LW**IC  
**2503A-RFY110LW****Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	50.1 $\Omega$ - 6.5 $j\Omega$
Return Loss	- 23.7 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.385 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	October 24, 2001

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>28(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

### **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:  $f = 835$  MHz;  $\sigma = 0.92$  S/m;  $\epsilon_r = 42$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

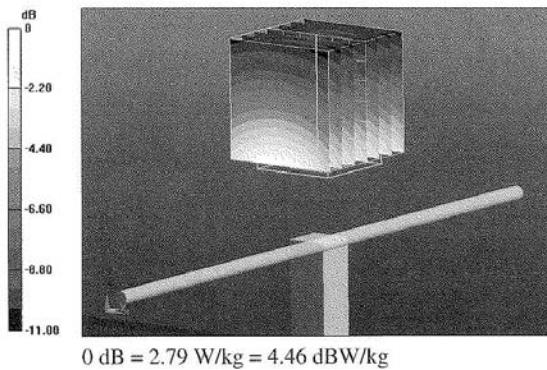
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.650 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



Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

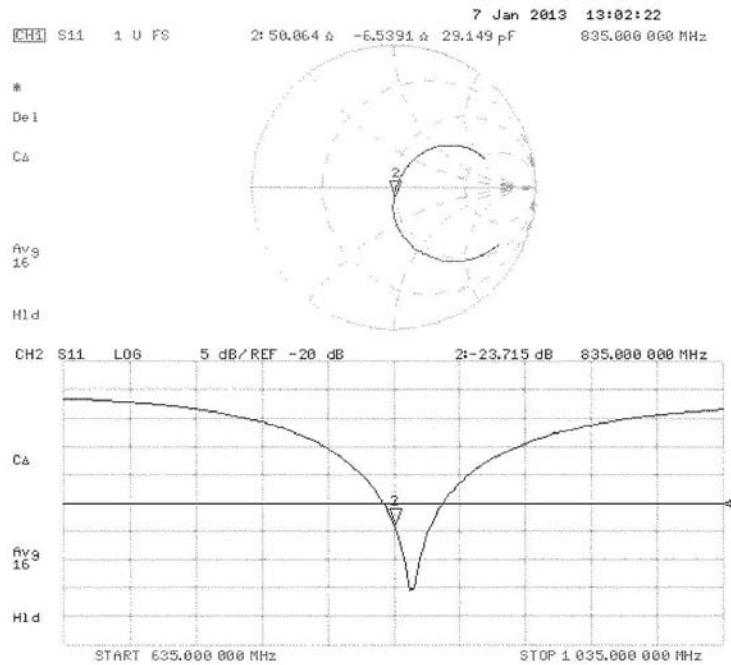
Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Impedance Measurement Plot for Head TSL**



Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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**Calibration Laboratory of**  
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**Engineering AG**  
**Zeughausstrasse 43, 8004 Zurich, Switzerland**



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**C** Service suisse d'étalonnage  
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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\_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		
<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 (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13
Calibrated by:	Name Israe El-Naouq	Function Laboratory Technician	Signature 
Approved by:	Katja Poković	Technical Manager	
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

Page 1 of 6

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>31(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
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Accreditation No.: **SCS 108**

**Glossary:**

<b>TSL</b>	tissue simulating liquid
<b>ConvF</b>	sensitivity in TSL / NORM x,y,z
<b>N/A</b>	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.

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%.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**32(49)**

Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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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	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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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)



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**33(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	51.0 $\Omega$ + 1.7 $j\Omega$
Return Loss	- 34.3 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.198 ns
----------------------------------	----------

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

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

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

**Additional EUT Data**

Manufactured by	SPEAG
Manufactured on	November 15, 2001

	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>34(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

### 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:  $f = 1900$  MHz;  $\sigma = 1.38$  S/m;  $\epsilon_r = 39.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; 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:

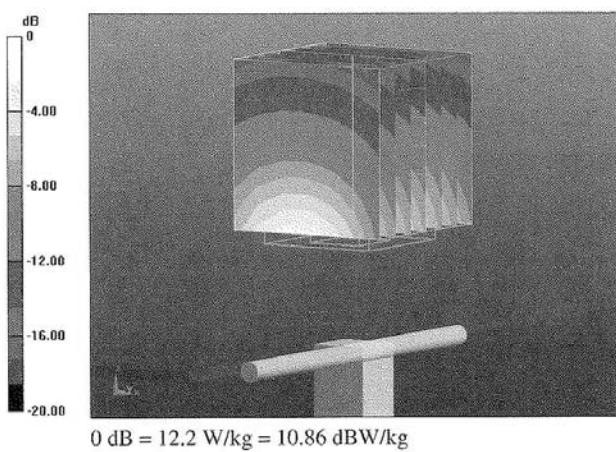
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.493 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





Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**35(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

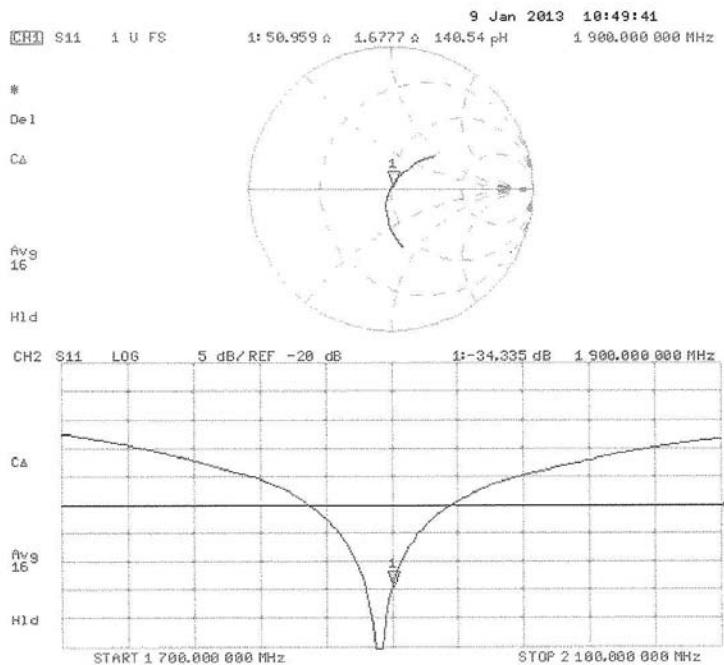
Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Impedance Measurement Plot for Head TSL**



Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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Multilateral Agreement for the recognition of calibration certificates

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**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: Name **Jelton Kastrati** Function **Laboratory Technician** Signature

Approved by: Name **Katja Pokovic** Function **Technical Manager** Signature

Issued: November 9, 2011

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	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>37(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

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

**Glossary:**

<b>TSL</b>	tissue simulating liquid
<b>ConvF</b>	sensitivity in TSL / NORM x,y,z
<b>N/A</b>	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.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**38(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Measurement Conditions**

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

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

**Head TSL parameters**

The following parameters and calculations were applied.

	<b>Temperature</b>	<b>Permittivity</b>	<b>Conductivity</b>
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	37.7 ± 6 %	1.84 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

**SAR result with Head TSL**

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

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	<b>Condition</b>	
SAR measured	250 mW input power	6.39 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.3 mW /g ± 16.5 % (k=2)</b>



Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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## **Appendix**

### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	$52.5 \Omega + 1.3 j\Omega$
Return Loss	- 31.2 dB

### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.161 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	December 01, 2003



Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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### **DASY5 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:  $f = 2450$  MHz;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

#### **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 = 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





Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**41(49)**

Author Data

**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

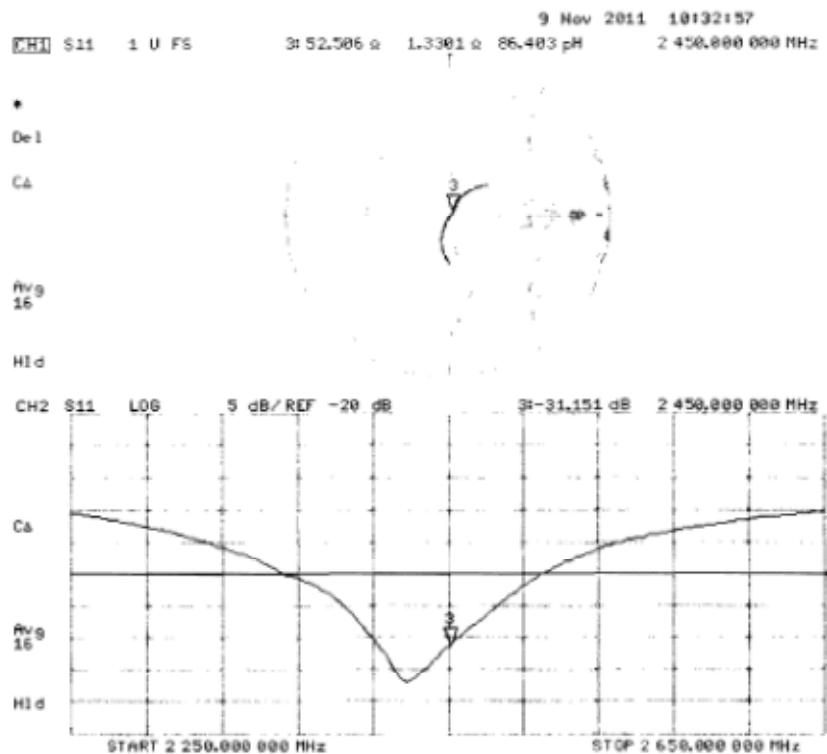
Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Impedance Measurement Plot for Head TSL**



Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D5GHzV2-1033\_Nov11**

## **CALIBRATION CERTIFICATE**

Object **D5GHzV2 - SN: 1033**

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

Calibration date: **November 15, 2011**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB337480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX3DV4	SN: 3503	04-Mar-11 (No. EX3-3503_Mar11)	Mar-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: Name **Dmitri Iliev** Function **Laboratory Technician** Signature

Approved by: Name **Katja Pokovic** Function **Technical Manager** Signature

Issued: November 16, 2011

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	Document <b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>43(49)</b>
Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

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Accreditation No.: **SCS 108**

**Glossary:**

<b>TSL</b>	tissue simulating liquid
<b>ConvF</b>	sensitivity in TSL / NORM x,y,z
<b>N/A</b>	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.



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**44(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Measurement Conditions**

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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	35.6	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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.82 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	87.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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)



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**45(49)**Author Data  
**Andrew Becker**

Dates of Test

**July 02 –August 15, 2013**

Test Report No

**RTS-6046-1308-34 Rev 2**

FCC ID:

**L6ARFY110LW**

IC

**2503A-RFY110LW****Head TSL parameters at 5800 MHz**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	35.3	5.27 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	33.7 ± 6 %	5.03 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	---	---

**SAR result with Head TSL at 5800 MHz**

SAR averaged over 1 cm <sup>3</sup> (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	<b>79.4 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.28 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.5 mW / g ± 16.5 % (k=2)</b>



Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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## Appendix

### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	51.1 $\Omega$ - 8.7 $j\Omega$
Return Loss	- 21.2 dB

### Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	52.3 $\Omega$ - 2.7 $j\Omega$
Return Loss	- 29.2 dB

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.7 $\Omega$ - 4.3 $j\Omega$
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

 <b>RTS Testing Services™</b>	Document	<b>Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2</b>	Page <b>47(49)</b>
	Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>

### **DASY5 Validation Report for Head TSL**

Date: 15.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1033**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz  
 Medium parameters used:  $f = 5200 \text{ MHz}$ ;  $\sigma = 4.46 \text{ mho/m}$ ;  $\epsilon_r = 34.6$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5500 \text{ MHz}$ ;  $\sigma = 4.75 \text{ mho/m}$ ;  $\epsilon_r = 34.2$ ;  $\rho = 1000 \text{ kg/m}^3$ , Medium parameters used:  $f = 5800 \text{ MHz}$ ;  $\sigma = 5.03 \text{ mho/m}$ ;  $\epsilon_r = 33.7$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.91, 4.91, 4.91), ConvF(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

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

Reference Value = 65.595 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:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$

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:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$

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**

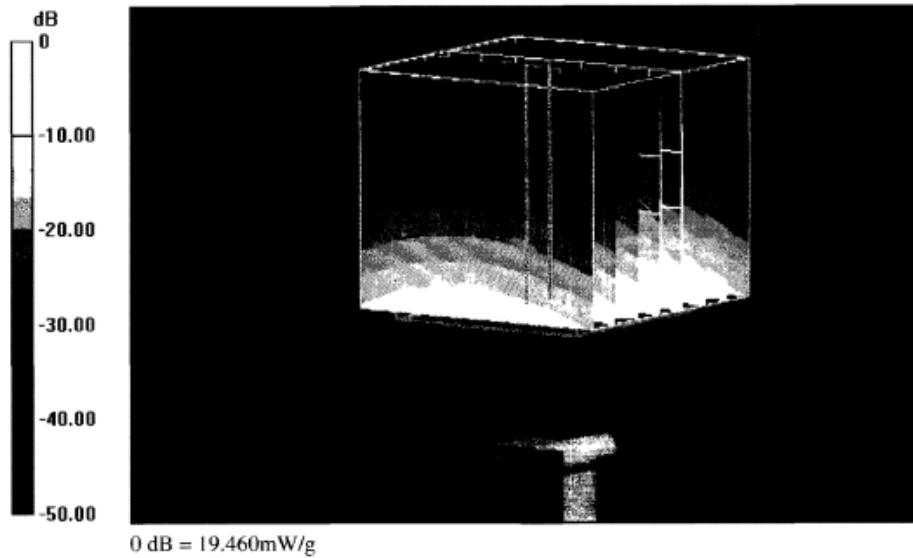
Maximum value of SAR (measured) = 19.463 mW/g



Document

**Appendix D for the BlackBerry® Smartphone Model RFY111LW SAR Report Rev 2**Page  
**48(49)**

Author Data <b>Andrew Becker</b>	Dates of Test <b>July 02 –August 15, 2013</b>	Test Report No <b>RTS-6046-1308-34 Rev 2</b>	FCC ID: <b>L6ARFY110LW</b>	IC <b>2503A-RFY110LW</b>
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0 dB = 19.460mW/g



Author Data	Dates of Test	Test Report No	FCC ID:	IC
Andrew Becker	<b>July 02 –August 15, 2013</b>	<b>RTS-6046-1308-34 Rev 2</b>	<b>L6ARFY110LW</b>	<b>2503A-RFY110LW</b>

**Impedance Measurement Plot for Head TSL**

