

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 1(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

APPENDIX D: PROBE & DIPOLE CALIBRATION DATA

		Revision History	
Rev. Number	Date	Changes	
Initial	May 23, 2013	-----	
Rev 2	Dec 16, 2014	Added equipment used for 802.11a Hotspot mode SAR testing	
		1. Page 35-45	

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 2(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

**Calibration Laboratory of
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Zeughausstrasse 43, 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: **E53-3225_Jan12**

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 probes**

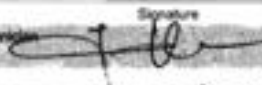
Calibration date: **January 11, 2012**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (0c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5096 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. E53-3013, Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654, May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-09 (in house check Apr-11)	In house check Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check Oct-12

Calibrated by:	Jelon Kastrell	Function Laboratory Technician	Signature 
Approved by:	Kaja Pokovic	Technol Manager	

Issued: January 12, 2012
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 3(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ 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:

- NORM_{x,y,z}: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ 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 E²-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.
- 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 $f \leq 800$ 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} * 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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 4(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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!)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 5(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3– SN-3225

January 11, 2012

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/\sqrt{V/m})^2$ ^A	1.26	1.20	1.30	± 10.1 %
DCP (mV) ^A	101.2	100.8	101.2	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc [†] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	107.7	±1.7 %
			Y	0.00	0.00	1.00	113.4	
			Z	0.00	0.00	1.00	110.4	

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%.

^A The uncertainties of NormX,Y,Z do not affect the E² field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter; uncertainty not required.

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

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			6(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN:3225

January 11, 2012

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^a	Conductivity (S/m) ^b	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.42	6.42	6.42	0.27	2.04	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.35	1.74	± 12.0 %
1810	40.0	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	1.96	4.32	4.32	4.32	0.77	1.32	± 12.0 %

^c 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.

^a 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 RSS of the ConvF uncertainty for indicated target tissue parameters.

	Document			Page 7(139)
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN-3225

January 11, 2012

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^e	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k%)
750	55.5	0.96	6.27	6.27	6.27	0.36	1.74	± 12.0 %
900	55.0	1.05	6.07	6.07	6.07	0.29	2.02	± 12.0 %
1810	53.3	1.52	4.92	4.92	4.92	0.50	1.57	± 12.0 %
1950	53.3	1.52	4.87	4.87	4.87	0.59	1.49	± 12.0 %
2450	52.7	1.95	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 %

^c 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.

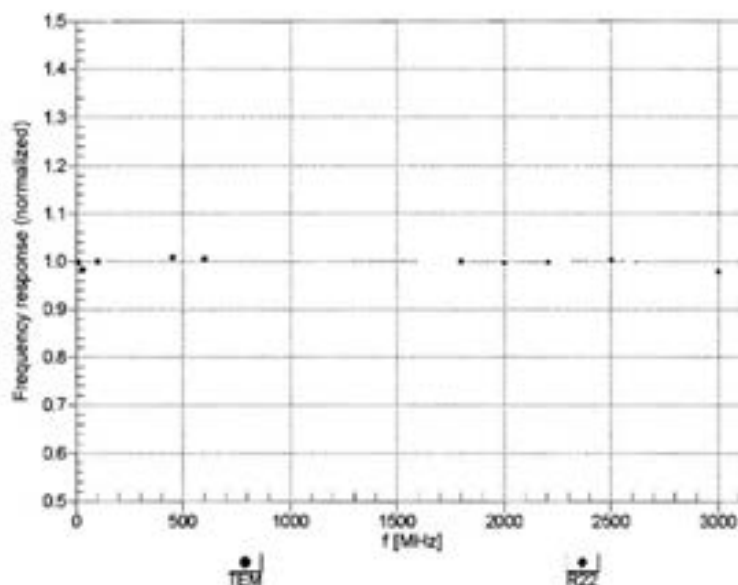
^e At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 8(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES30V3- SN:3225

January 11, 2012

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



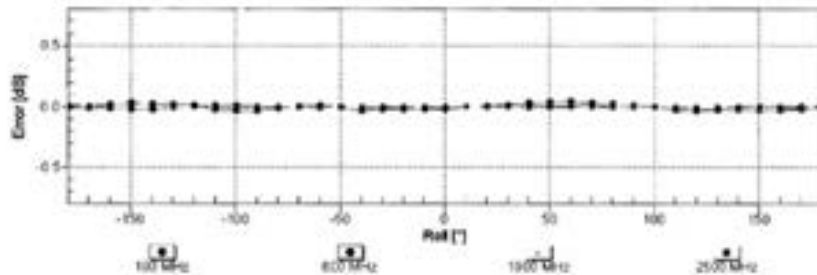
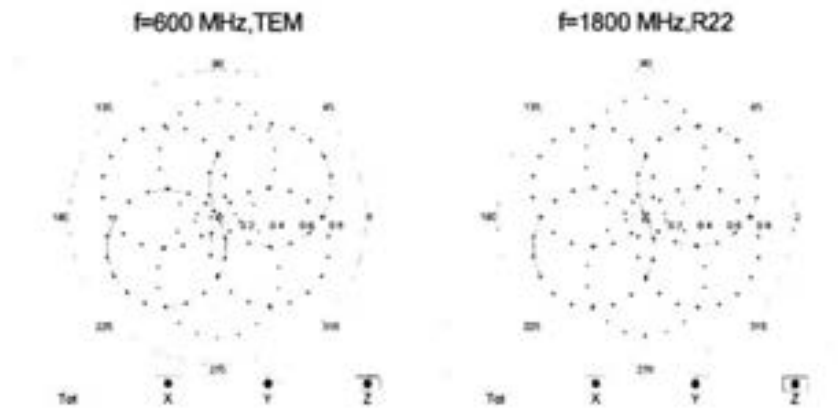
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 9(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3OV3- SN:3225

January 11, 2012

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

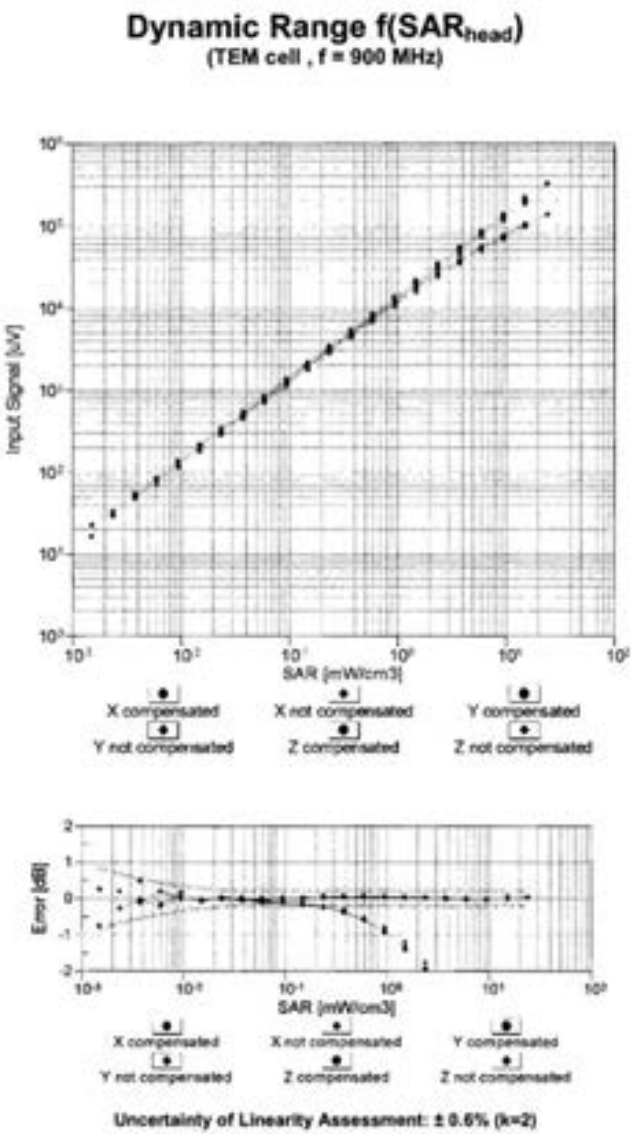


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 10(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN-3225

January 11, 2012

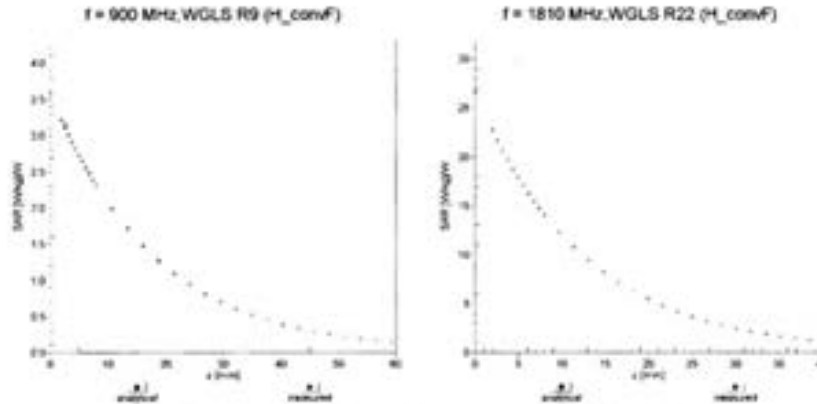


	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 11(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN:3225

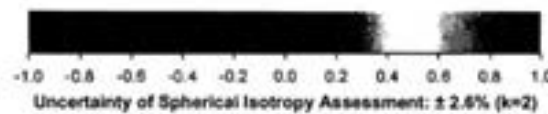
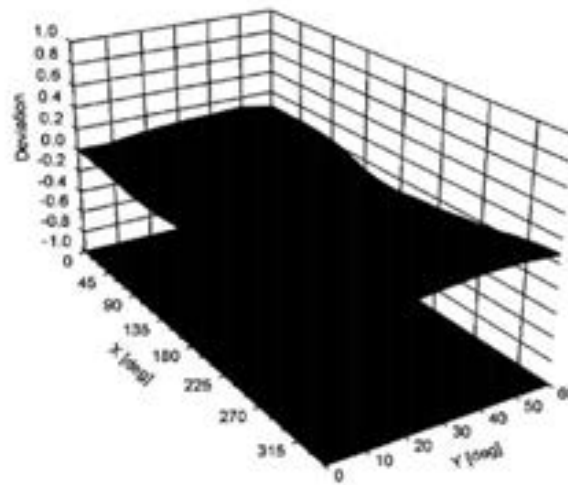
January 11, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), f = 900 MHz



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 12(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 13(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 probes**

Calibration 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&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E44196	0841293674	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: 55054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: 55066 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: 55129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013, Dec12)	Dec-13
DAF4	SN: 660	20-Jun-12 (No. DAF4-660, 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	US37380585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kasari	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: January 14, 2013			
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	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 14(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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
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Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization $\beta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-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
- 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} * 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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 15(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			16(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.29	1.19	1.31	$\pm 10.1 \%$
DCP (mV) ^B	100.5	101.5	99.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\mu\text{V}/\mu\text{V}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	157.5	$\pm 2.7 \%$
		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%.

^A The uncertainties of Norm X, Y, Z do not affect the E^2 field uncertainty inside TSI (see Pages 5 and 6).

^B Numerical linearization parameter; uncertainty not required.

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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 17(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3– SN 3225

January 10, 2013

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^b	Conductivity (S/m) ^b	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 %

^c 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.

^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 RSS of the ConvF uncertainty for indicated target tissue parameters.

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			18(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN:3225

January 10, 2013

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^a	Conductivity (S/m) ^b	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
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 %

^c 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.

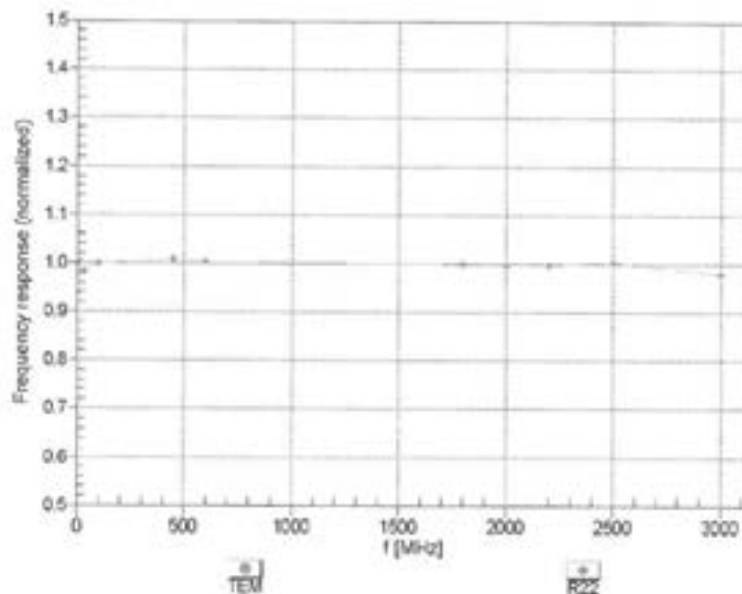
^a At frequencies below 3 GHz, the validity of tissue parameters (ϵ' and ϵ'') can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ' and ϵ'') is restricted to ± 5%. The uncertainty is the RSS of the ConvF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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 19(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3OV3- SN-3225

January 10, 2013

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



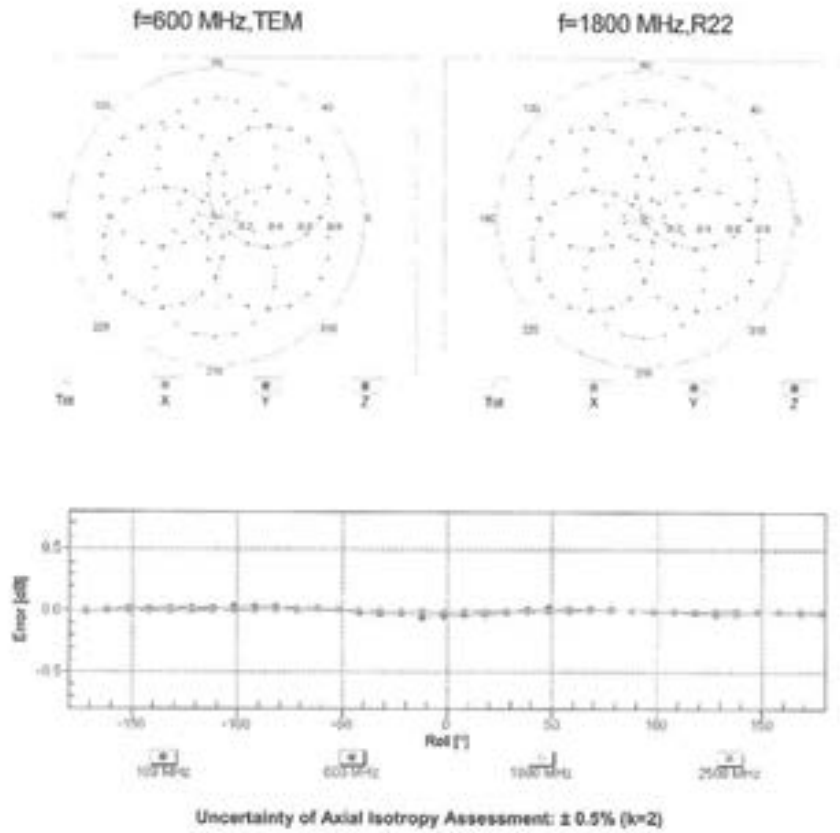
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 20(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- 5N3225

January 10, 2013

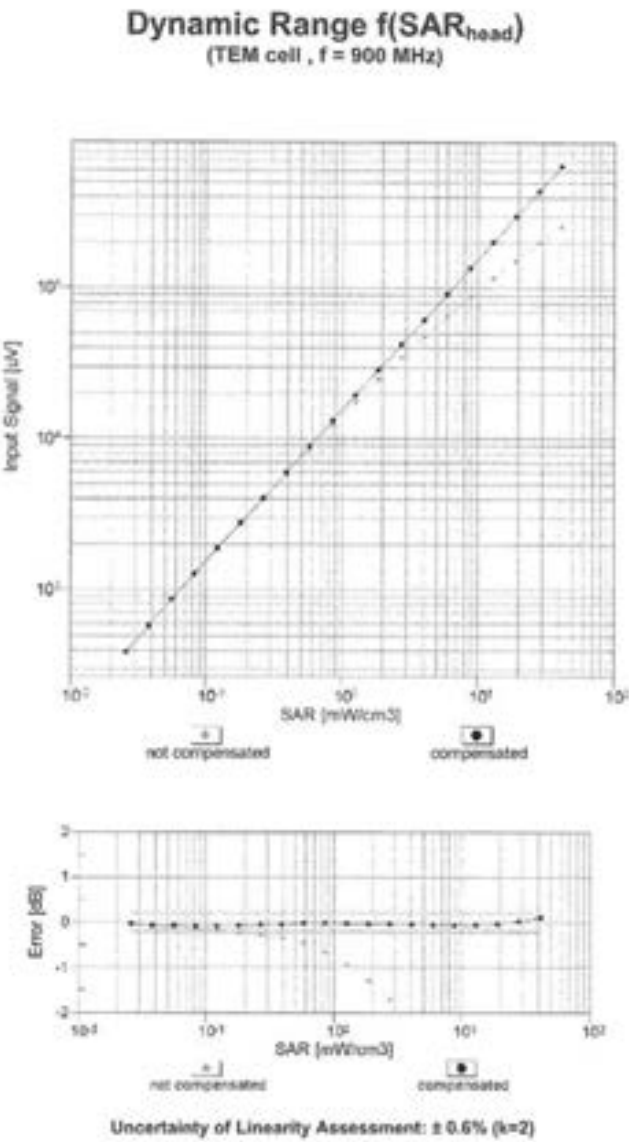
Receiving Pattern (ϕ), $\theta = 0^\circ$



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 21(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN-3225

January 10, 2013

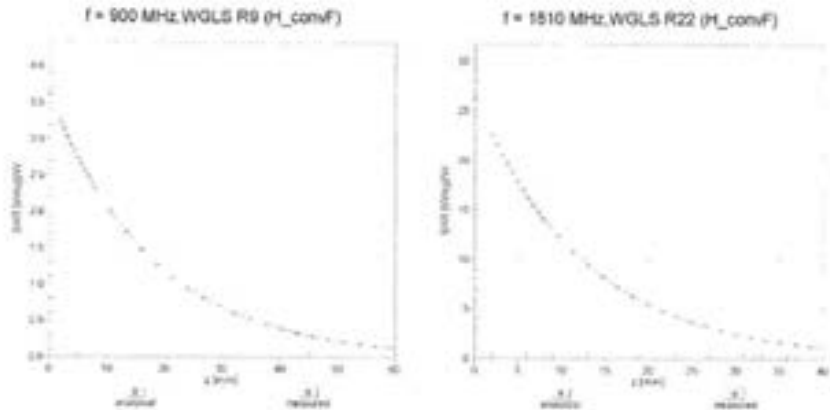


	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 22(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ES3DV3- SN:3225

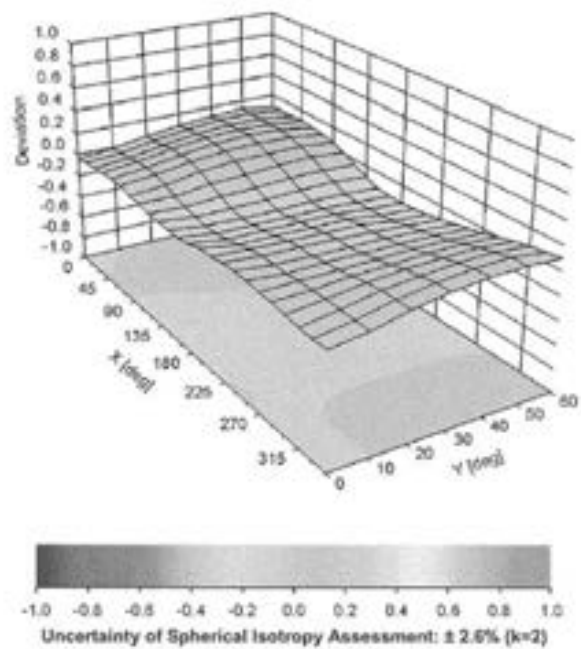
January 10, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), f = 900 MHz



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 23(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 RFL111LW SAR Report Rev 2			Page 24(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zweigacherstrasse 43, 8084 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: **EX3-3592_Nov12**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3592**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **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 ± 3)°C and humidity = 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	0B41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41488057	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: 55054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: 55085 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: 55129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES30V2	SN: 3013	29-Dec-11 (No. ES3-3013, Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660, Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8640C	US3542US1200	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyser HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Claudio Lesbier	Function Laboratory Technician	Signature 
Approved by:	Name Katja Polovic	Technical Manager	

Issued: November 14, 2012
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 25(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Calibration Laboratory of
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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
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ 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:

- NORM_{x,y,z}:** Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ 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^2 -field uncertainty inside TSL (see below ConvF).
- NORM θ (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 $f \leq 800$ 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} * 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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 26(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 DASY2 system!)

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			27(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4– SN:3592

November 14, 2012

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m))^2$ ^A	0.49	0.47	0.41	± 10.1 %
DCP (mV) ^B	95.2	96.1	100.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^C (k=2)
0	CW	0.00	X	0.0	0.0	1.0	121.4	±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%.

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

^B Numerical linearization 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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 28(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN:3592

November 14, 2012

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	UncL (k=2)
2600	39.0	1.96	6.45	6.45	6.45	0.53	0.79	± 12.0 %
5200	38.0	4.66	4.73	4.73	4.73	0.40	1.80	± 13.1 %
5500	35.6	4.96	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 %

^c Frequency validity of ± 100 MHz only applies for DASY v1.4 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.

^d At frequencies below 3 GHz, the validity of tissue parameters (ε and α) 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 α) 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 RFL111LW SAR Report Rev 2			Page 29(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN:3592

November 14, 2012

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
2600	52.5	2.16	6.59	6.59	6.59	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.02	4.02	4.02	0.48	1.00	± 13.1 %
5500	48.6	5.85	3.66	3.66	3.66	0.55	1.00	± 13.1 %
5800	48.2	6.00	3.57	3.57	3.57	0.57	1.00	± 13.1 %

^c 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.

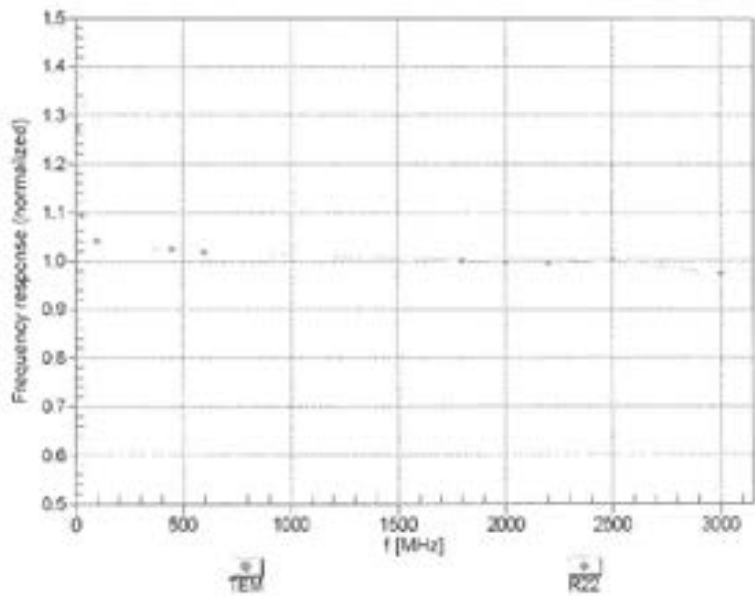
^d At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 0%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 30(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN 3592

November 14, 2012

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

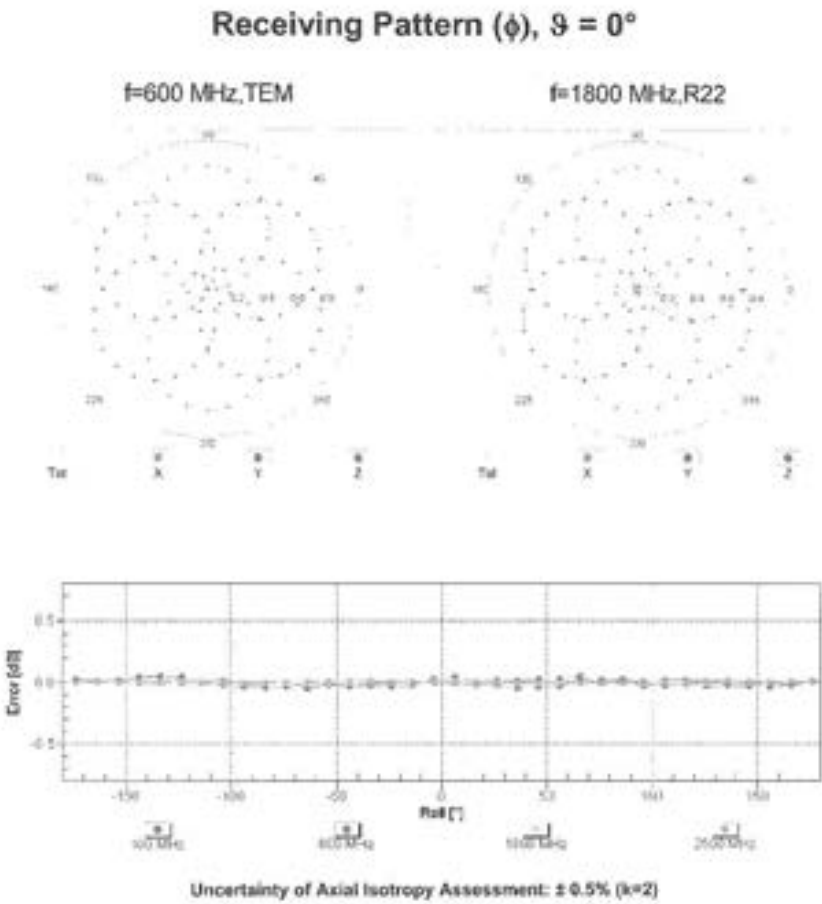


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 31(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN:3592

November 14, 2012





Author Data
Andrew Becker

Dates of Test
**Nov 22 2012 – Feb 28 2013
December 10-12, 2014**

Test Report No
**RTS-6026-1302-13
Rev 3**

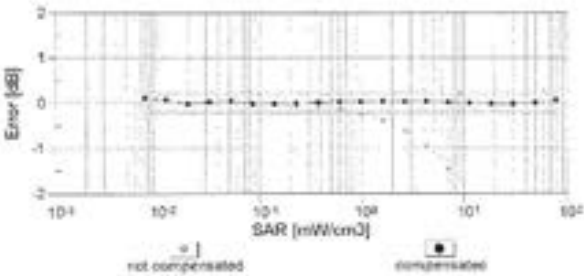
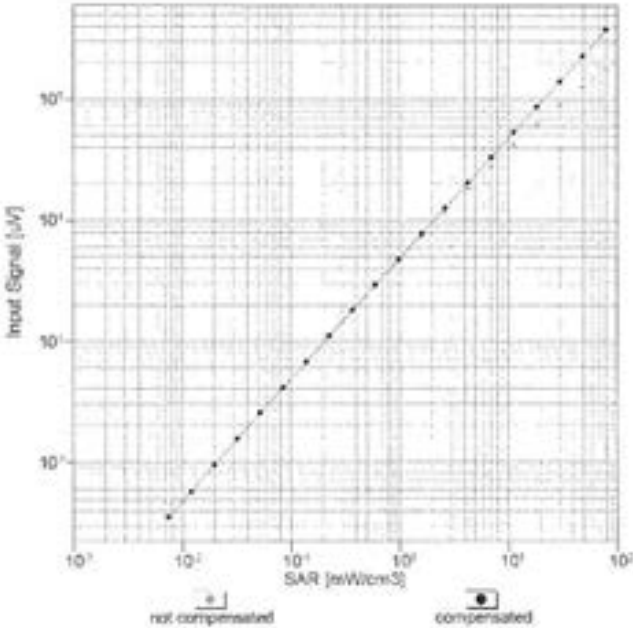
FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

EX3DV4-SN.3592

November 14, 2012

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



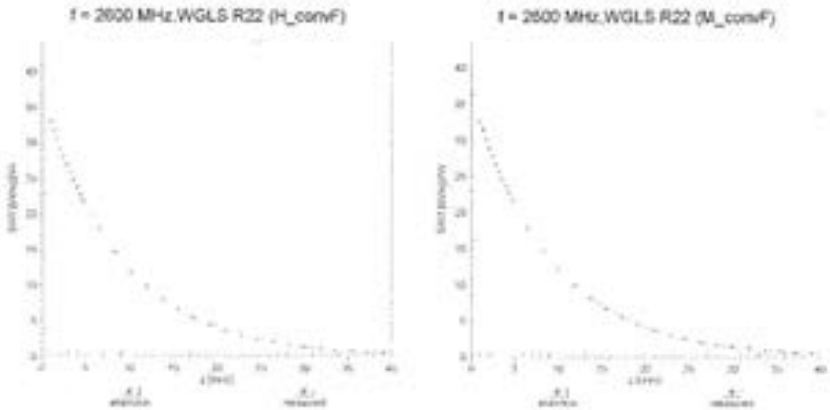
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 33(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN:3592

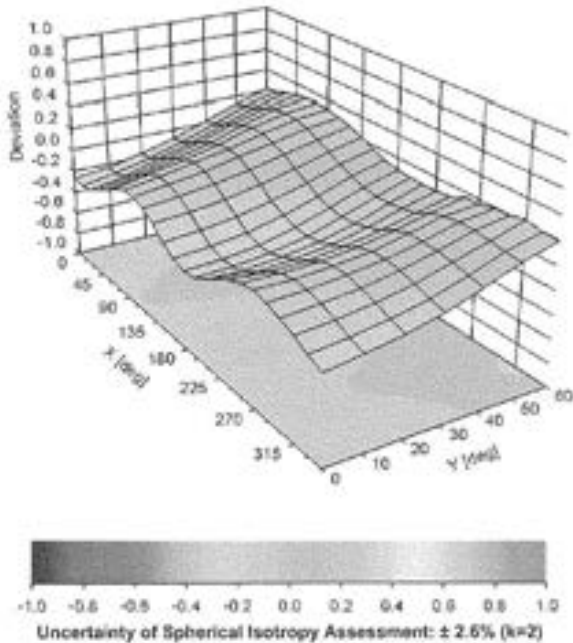
November 14, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), f = 900 MHz



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 34(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 35(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 108**

Client: **Blackberry Waterloo**

Certificate No: **EX3-3592_Nov14**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN 3592**

Calibration procedure(s): **QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

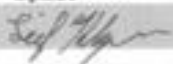
Calibration date: **November 10, 2014**

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 < 10%.

Calibration equipment used (MATE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	0841290674	03-Apr-14 (No. 217-01811)	Apr-15
Power sensor S4412A	3MY41488087	03-Apr-14 (No. 217-01811)	Apr-15
Reference 3 dB Attenuator	SN: 50254 (2c)	03-Apr-14 (No. 217-01811)	Apr-15
Reference 20 dB Attenuator	SN: 50277 (20c)	03-Apr-14 (No. 217-01811)	Apr-15
Reference 30 dB Attenuator	SN: 50129 (30c)	03-Apr-14 (No. 217-01811)	Apr-15
Reference Probe ES-2DV2	SN: 3013	30-Dec-13 (No. 653-3013 Dec13)	Dec-14
DAE4	N/A 460	13-Dec-13 (No. DAE4-660, Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642US1700	4-Aug-99 (in house check Apr-13)	In house check Apr-15
Network Analyzer HP 8753F	US37390885	18-Oct-01 (in house check Oct-14)	In house check Oct-15

	Name	Function	Signature
Calibrated by:	Lail Kiyane	Laboratory Technician	
Approved by:	Katja Fuhrer	Technical Manager	
Issued: November 10, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: **EX3-3592_Nov14**

Page 1 of 11

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 36(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization ϕ	α rotation around probe axis
Polarization θ	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
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- 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; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-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
- 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 $f < 800$ 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.
- Connector Angle: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 37(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4 – SN:3592

November 10, 2014

Probe EX3DV4

SN:3592

Manufactured: September 18, 2006
Calibrated: November 10, 2014

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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 38(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN 3592

November 10, 2014

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norms $(\mu V/(V/m))^2$ ^a	0.48	0.47	0.40	$\pm 10.1\%$
DCP ^b (mV) ^c	95.2	98.0	98.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB V/μV	C	D dB	VR mV	Unc ^b (k=2)
0	CW	X	0.0	0.0	1.0	0.00	145.9	$\pm 3.5\%$
		Y	0.0	0.0	1.0		150.9	
		Z	0.0	0.0	1.0		145.1	

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

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

^b Numerical linearization 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.

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			39(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4- SN:3592

November 10, 2014

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^a	Conductivity (S/m) ^a	ConvF X	ConvF Y	ConvF Z	Alpha ^b	Depth (mm)	Unct. (k=2)
2600	39.0	1.96	6.80	6.80	6.80	0.36	0.93	± 12.0 %
5250	35.9	4.71	4.63	4.63	4.63	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.20	4.20	4.20	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.34	4.34	4.34	0.40	1.80	± 13.1 %

^a Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v1.4 and higher (see Page 2); else it is restricted to a 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 200 MHz respectively. Above 5 GHz frequency validity can be extended to ± 150 MHz.

^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 RSS of the ConvF uncertainty for indicated target tissue parameters.

^c Alpha/Depth are determined during calibration. SPFLAB warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			40(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4 - SN:3592

November 10, 2014

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^E	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	UncL (k=2)
2600	52.5	2.18	6.84	6.84	6.84	0.78	0.62	± 12.0 %
5250	48.9	5.36	4.06	4.06	4.06	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.78	3.78	3.78	0.45	1.90	± 13.1 %
5750	48.3	5.94	3.81	3.81	3.81	0.50	1.90	± 13.1 %

^E Frequency validity above 200 MHz of a 100 MHz only applies for DASY v4.4 and higher (see Page 2), since it is restricted to a 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 200 MHz is a 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 60, 125, 160 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to a 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed 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 ConvF uncertainty for indicated target tissue parameters.

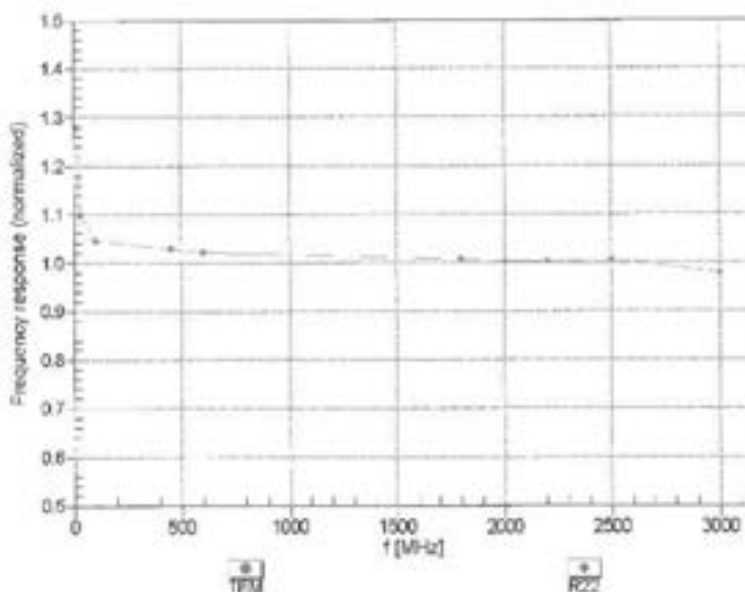
^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 7% for frequencies below 3 GHz and below ± 2% for frequencies between 3 & 6 GHz at any distance larger than half the probe tip diameter from the boundary.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 41(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4-5N3592

November 10, 2014

Frequency Response of E-Field (TEM-Cell: if110 EXX, Waveguide: R22)



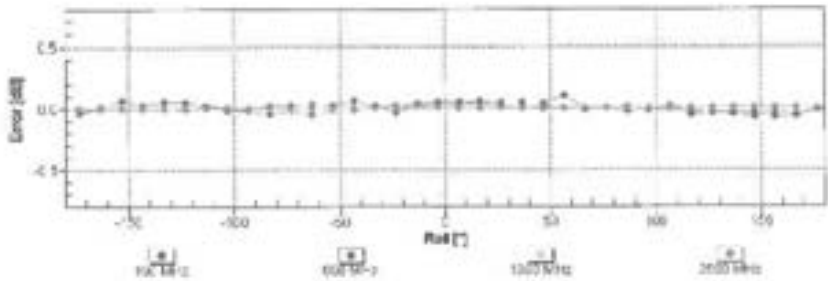
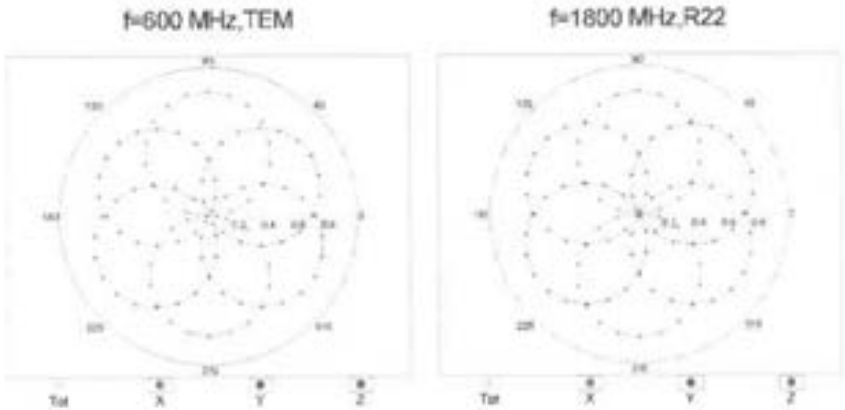
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 42(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX00V4- SN:3592

November 10, 2014

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



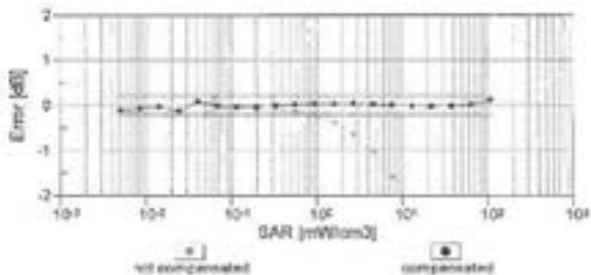
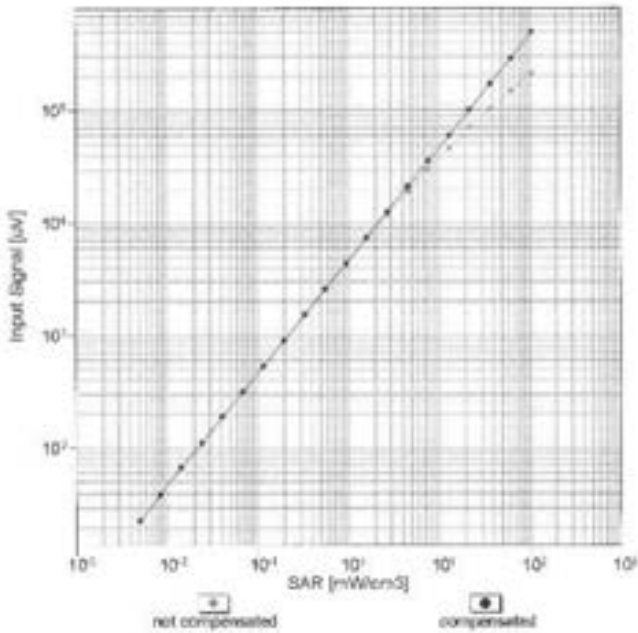
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 43(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX03DV4 - SN:3592

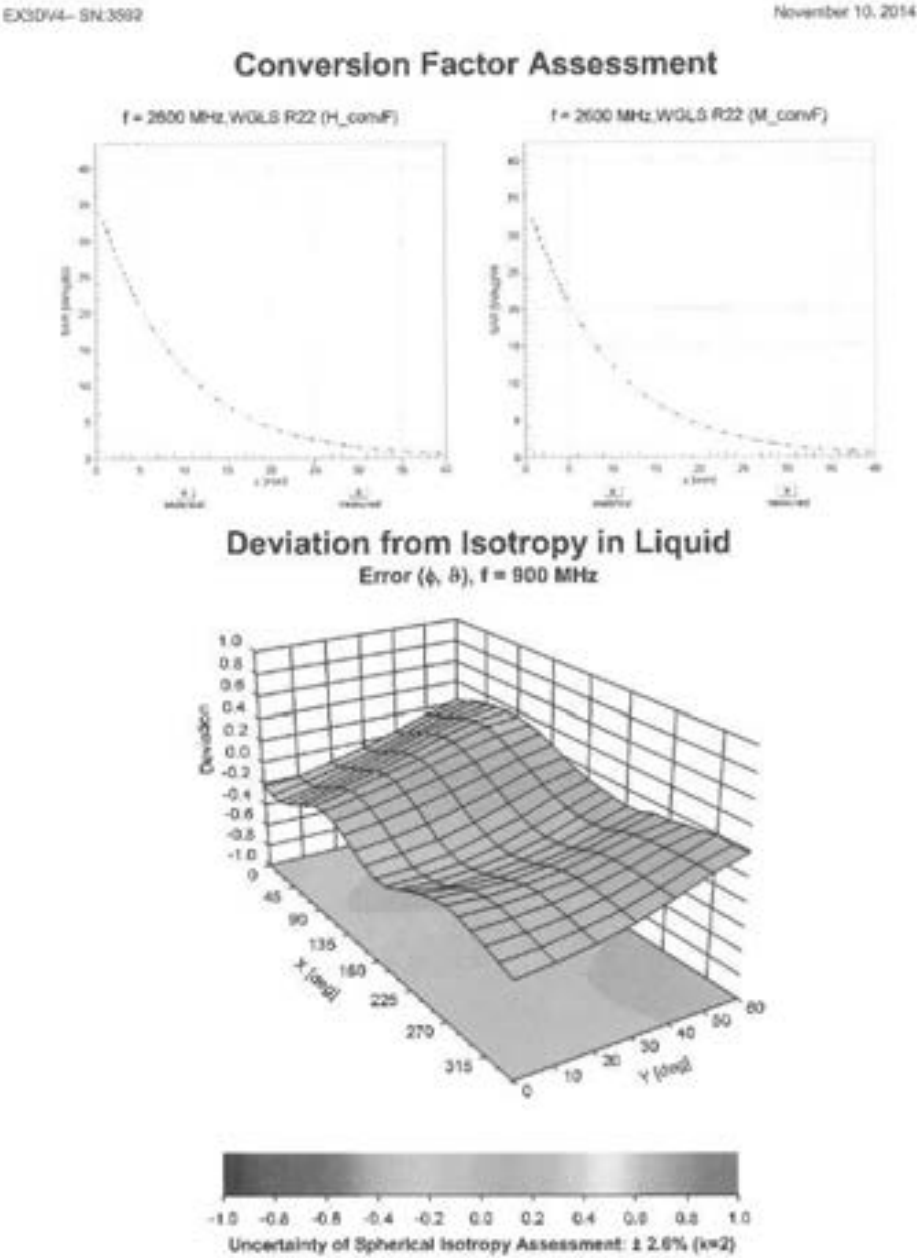
November 10, 2014

Dynamic Range f(SAR_{head})
(TEM cell , f_{cell}= 1900 MHz)



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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 44(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 45(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

EX3DV4-- SN:3592

November 10, 2014

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-13.3
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	2.8 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	1.4 mm

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 46(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 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

Client **RTS (RIM Testing Services)**

Certificate No: **ET3-1644_Nov12**

CALIBRATION CERTIFICATE

Object **ET3DV8 - SN:1644**

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

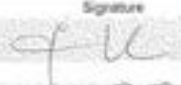
Calibration date **November 13, 2012**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4413A	MY41466087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: 55054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: 55096 (20c)	27-Mar-12 (No. 217-01528)	Apr-13
Reference 30 dB Attenuator	SN: 55179 (30c)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe E530V2	SN: 3013	26-Dec-11 (No. E53-3013, Dec11)	Dec-12
DAE4	SN: 680	20-Jun-12 (No. DAE4-680, Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642J01700	4-Aug-09 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8703E	US37380585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastak	Laboratory Technician	
Approved by:	Katja Pokorski	Technical Manager	
Issued: November 13, 2012			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 47(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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
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	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ 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:

- NORM_{x,y,z}: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ 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 E²-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.
- 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 fat 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 fat 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 Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 48(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ET3DV6 – SN:1644

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!)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 49(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 $(\mu V/m)^2$ ^a	1.71	1.97	1.98	± 10.1 %
DCP (mV) ^b	99.5	98.7	97.5	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^c (k=2)
0	CW	0.00	X	0.0	0.0	1.0	193.5	±3.5 %
			Y	0.0	0.0	1.0	212.0	
			Z	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%.

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

^b Numerical linearization 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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 50(139)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW
		IC 2503A-RFL110LW		

ET3DV6– SN:1644

November 13, 2012

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^d	Conductivity (S/m) ^e	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Uncl. (k=2)
750	41.9	0.89	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	2.52	± 12.0 %
1810	40.0	1.40	5.21	5.21	5.21	0.80	2.10	± 12.0 %
1950	40.0	1.40	5.16	5.16	5.16	0.80	2.09	± 12.0 %
2450	39.2	1.80	4.60	4.60	4.60	0.65	2.00	± 12.0 %

^c 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.

^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 RSS of the ConvF uncertainty for indicated target tissue parameters.

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			51(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ET3DV6- SN:1644

November 13, 2012

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Uncert. (k=2)
750	55.5	0.96	6.30	6.30	6.30	0.33	2.61	± 12.0 %
900	55.0	1.05	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 %
1900	53.3	1.52	4.75	4.75	4.75	0.80	2.28	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.50	2.15	± 12.0 %

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

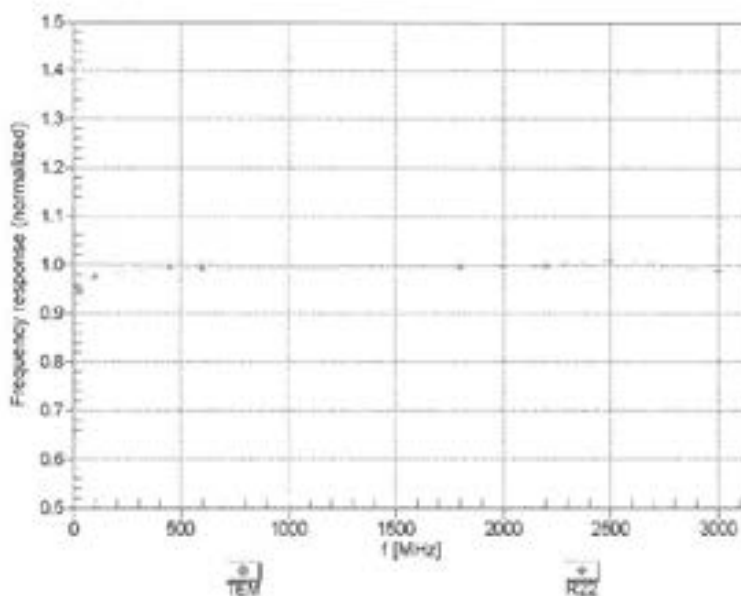
² At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 52(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ET30V6-SN:1544

November 13, 2012

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



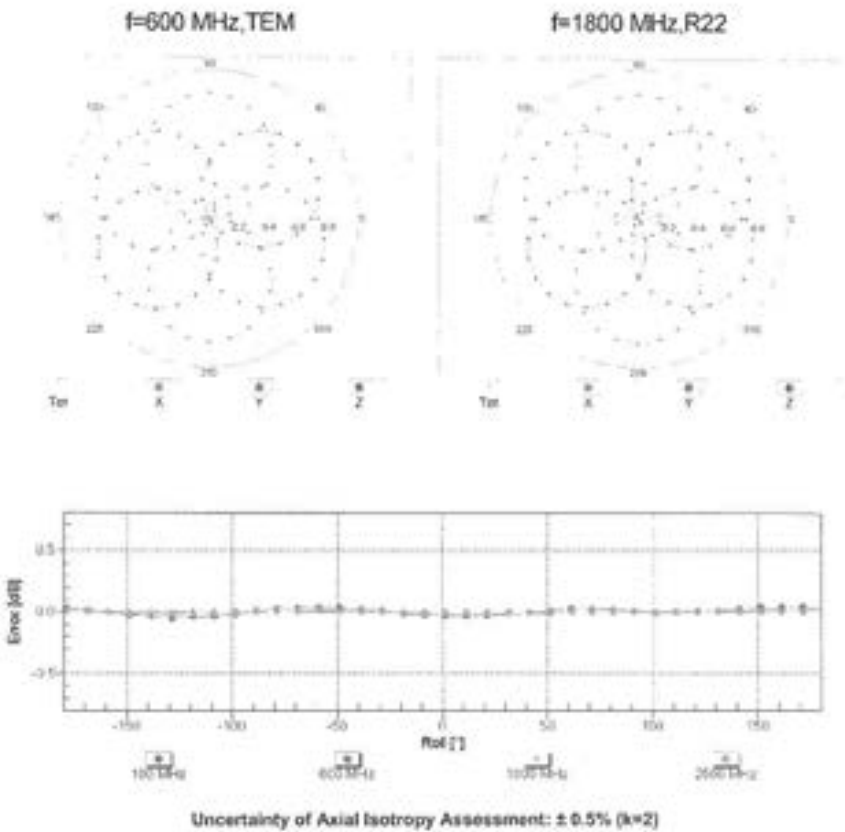
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 53(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ET30V6-5N-1644

November 12, 2012

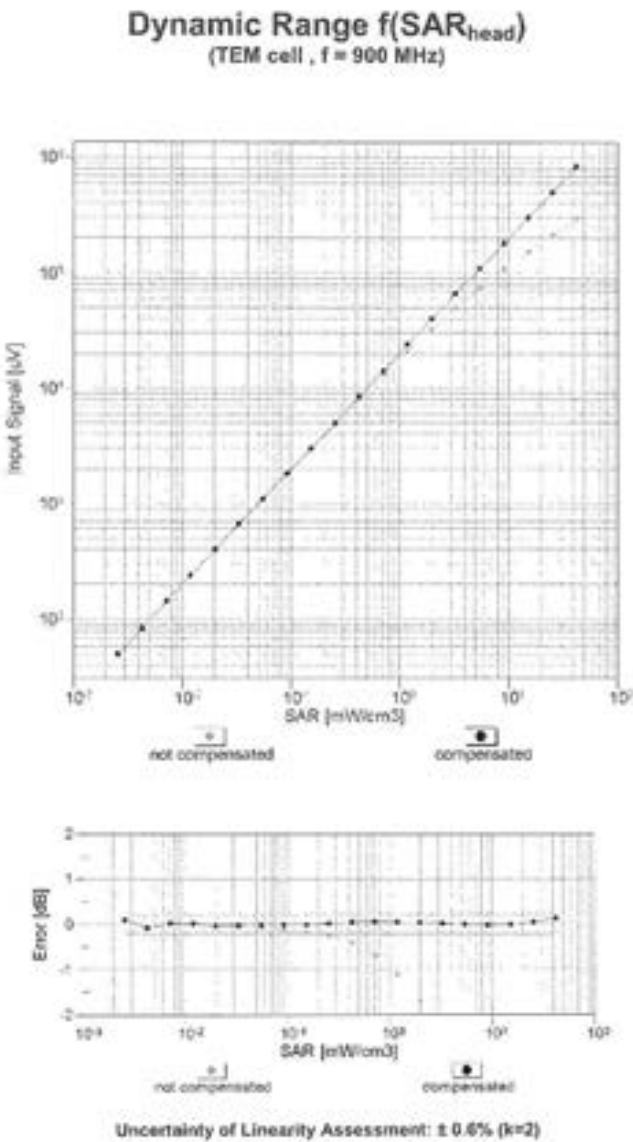
Receiving Pattern (ϕ), $\theta = 0^\circ$



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 54(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

ET3QV6- 5N-1644

November 13, 2012

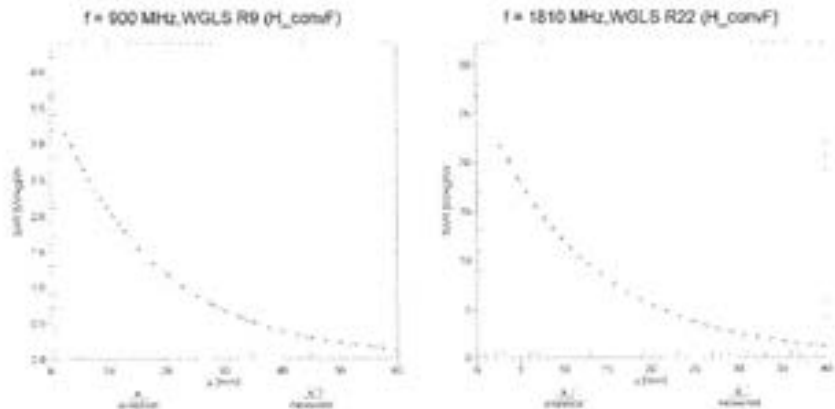


	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 55(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

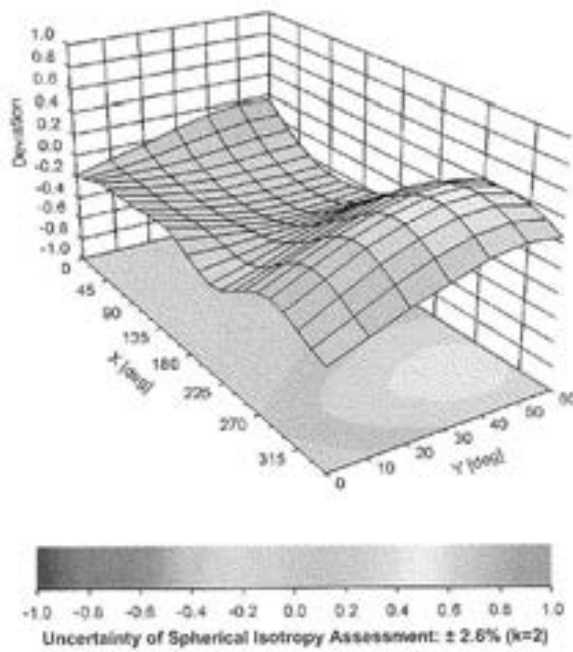
ET3DV6- SN1644

November 13, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid
Error (φ, θ), f = 900 MHz



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 56(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 Deflection Mode	enabled
Optical Surface Detection Mode	enabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 57(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 05, 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 (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GEG7480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5085 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES32V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 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-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 54206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: January 5, 2011

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

Certificate No: **D750V3-1021_Jan11**

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 58(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 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 RFL111LW SAR Report Rev 2			Page 59(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 mW / g
SAR normalized	normalized to 1W	5.52 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.45 mW / g ± 16.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 60(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω - 1.7 $\mu\Omega$
Return Loss	- 29.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 61(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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: $f = 750 \text{ MHz}$; $\sigma = 0.91 \text{ mho/m}$; $\epsilon_s = 42.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.37, 6.37, 6.37); 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 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:

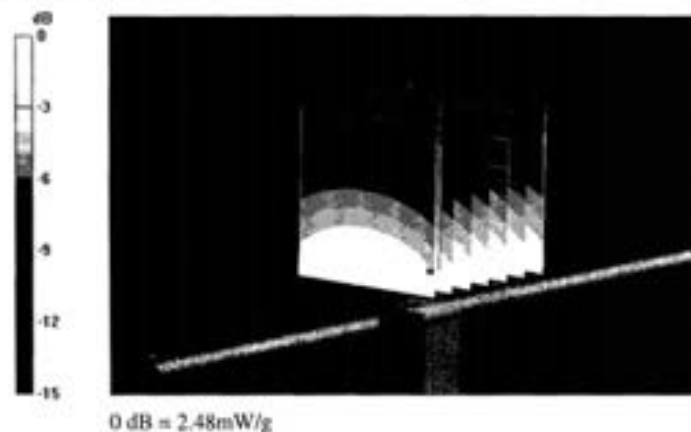
$dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.24 W/kg

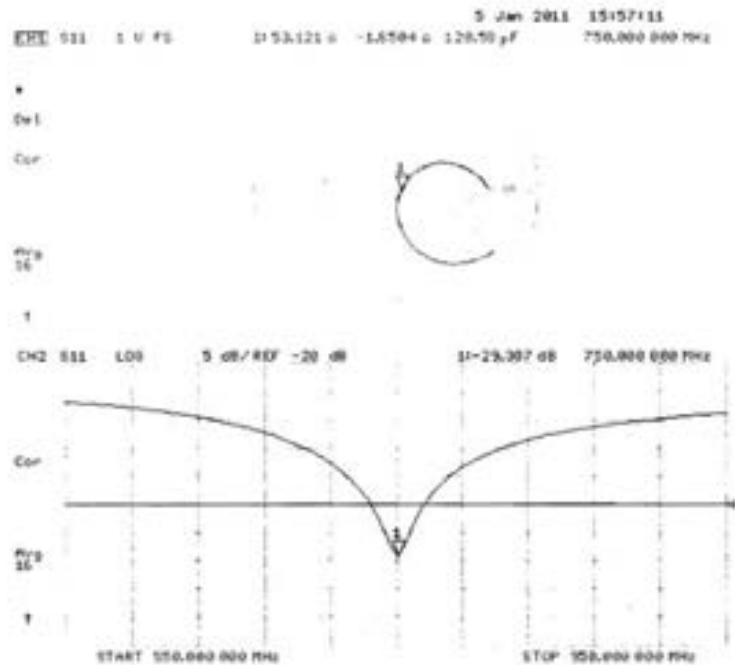
SAR(1 g) = 2.12 mW/g; SAR(10 g) = 1.38 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 62(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 63(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Accreditation No.: **SCS 108**

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&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	G837480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37262763	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. 217-01530)	Apr-13
Reference Probe E53073	SN: 3205	28-Dec-12 (No. E53-3205_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-07 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37300585 54206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Lail Klytner	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Technical Manager	

Issued: **January 8, 2013**

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Certificate No: **D750V3-1021_Jan13**

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 64(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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.

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			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			65(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 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	8.46 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.51 W/kg ± 16.5 % (k=2)

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			66(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.7 Ω - 0.2 $j\Omega$
Return Loss	- 25.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 67(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 750 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); 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/ $P_{in}=250 \text{ mW}$, $d=15\text{mm}$ /Zoom Scan (7x7x7)/Cube 0:

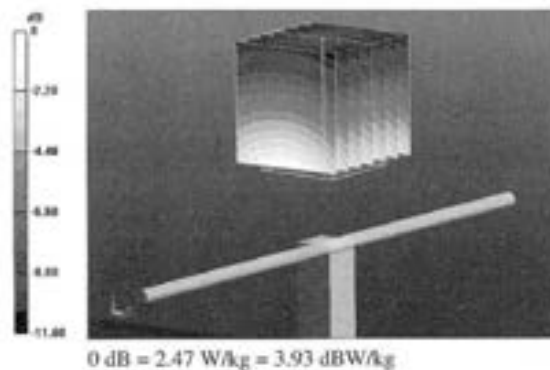
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.23 W/kg

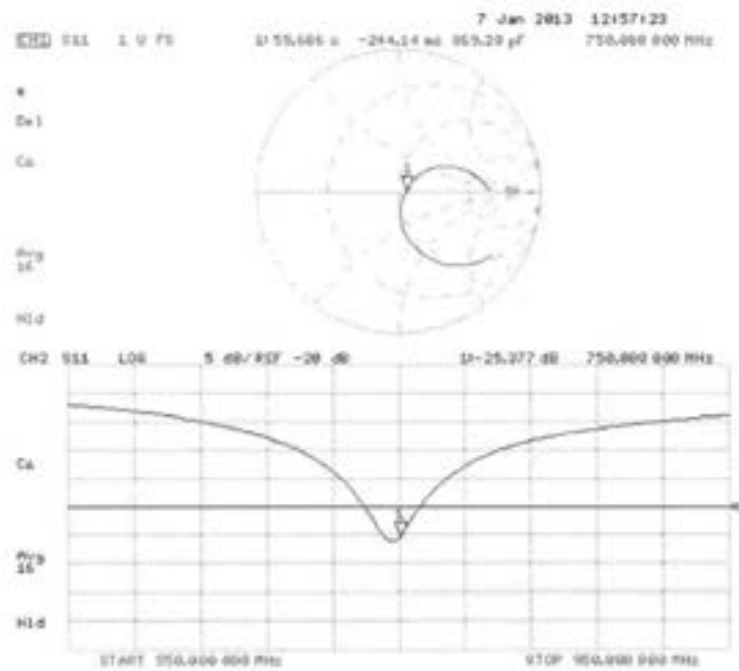
SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.38 W/kg

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 68(139)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW
		IC 2503A-RFL110LW		

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 69(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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_Jan11**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 446**

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

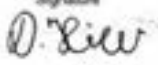
Calibration date: **January 21, 2011**

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 (M&E critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	G837480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 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-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37380585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name Dimitry Rev	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 

Issued: January 21, 2011
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Certificate No: **D835V2-446_Jan11**

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 70(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Accreditation No.1 **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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 71(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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	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	41.3 ± 6 %	0.89 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)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 72(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.6 Ω - 7.7 $j\Omega$
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 semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 24, 2001

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 73(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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: $f = 835 \text{ MHz}$; $\sigma = 0.89 \text{ mho/m}$; $\epsilon_r = 41.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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 /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement

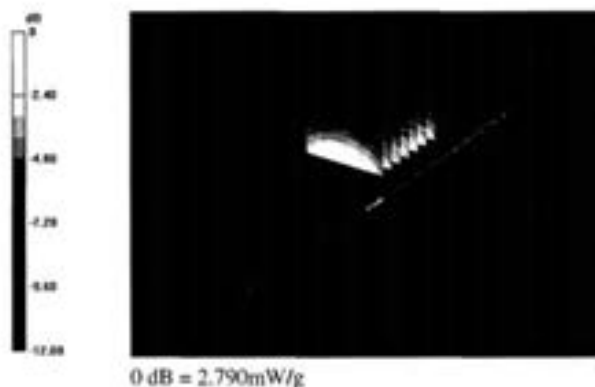
grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 3.600 W/kg

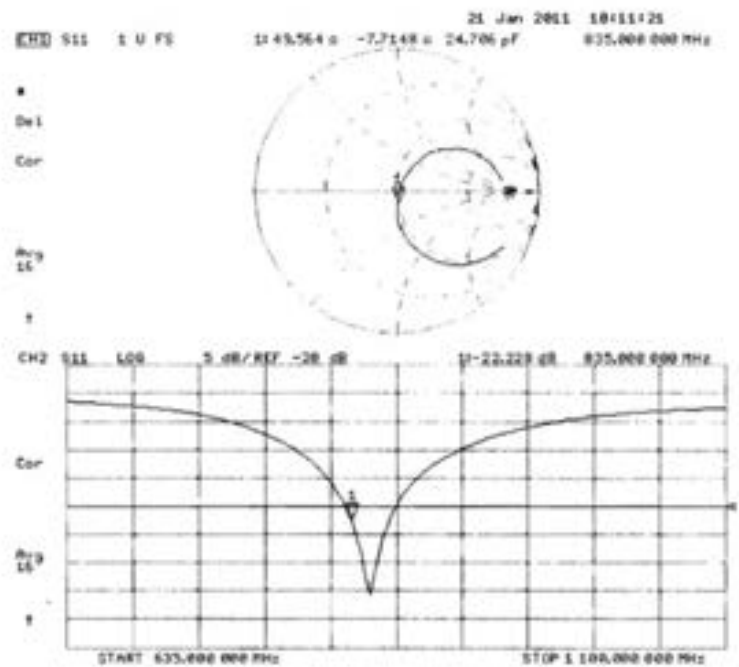
SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.56 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 74(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 75(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 MHz

Calibration date: **January 07, 2013**

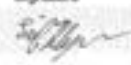
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 0.1^\circ\text{C})$ and humidity $< 70\%$.

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0837480704	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 (20n)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01530)	Apr-13
Reference Probe ESGDV3	SN: 3005	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 SMJ-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 54206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Kystner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

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 Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 76(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 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 RFL111LW SAR Report Rev 2			Page 77(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 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	9.39 W/kg ± 17.6 % (k=2)
SAR averaged over 10 cm ³ (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 RFL111LW SAR Report Rev 2			Page 78(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 6.5 j Ω
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 Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 79(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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: $f = 835 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\epsilon_r = 42$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 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:

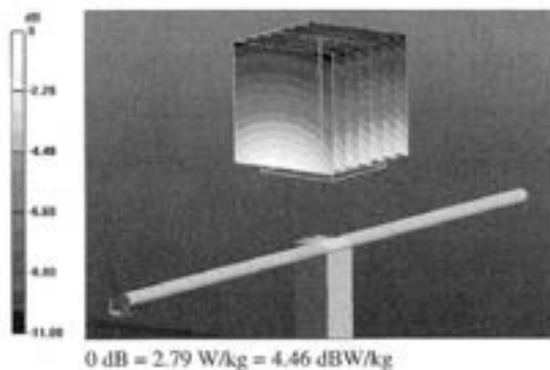
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.650 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.61 W/kg

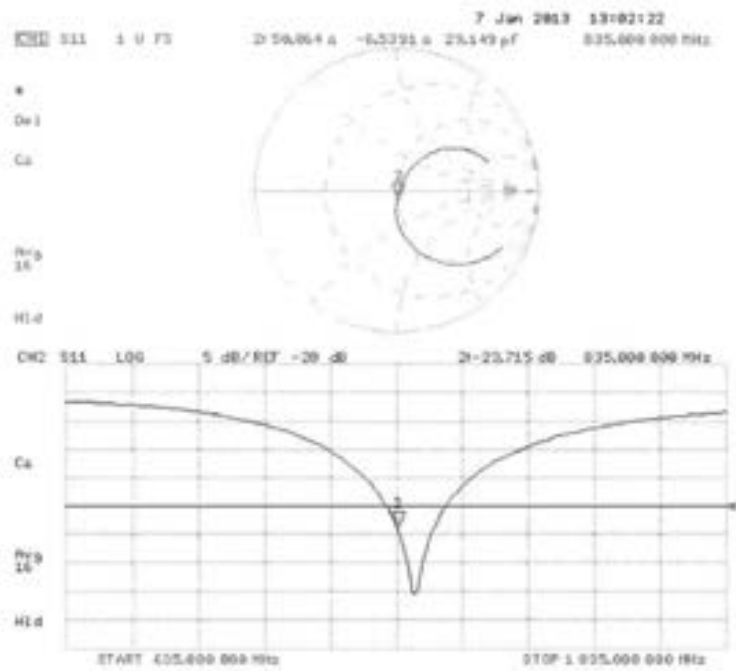
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.55 W/kg

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 80(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 81(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D835V2-4d043_Apr11**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d043**

Calibration procedure(s) **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.

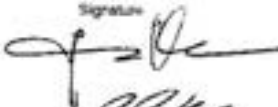
All calibrations have been conducted in the climate laboratory facility, environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (NISTE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Sched/And Calibration
Power meter EPM-442A	D83/486704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292793	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type N Power switch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	EN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 6C1	10-Jun-10 (No. DAE-4-6C1_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41082317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator RAS SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8710E	US37390585 54206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Jeton Kasribi** Function: **Laboratory Technician**

Approved by: **Katja Polovic** Technical Manager

Signature



Issued: April 7, 2011

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

Certificate No: **D835V2-4d043_Apr11**

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 82(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Calibration Laboratory of
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Zeughausstrasse 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.1: **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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 83(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 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 ± 16.5 % (k=2)

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			84(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 Ω - 3.4 j 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 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.

Design Modification by End User

The dipole has been modified with Teflon Rings (TR) placed within identified 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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 85(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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:4d043

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

Medium: HSL900

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.88 \text{ mho/m}$; $\epsilon_r = 40.6$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Pin=250 mW /d=15mm/Cube 0:

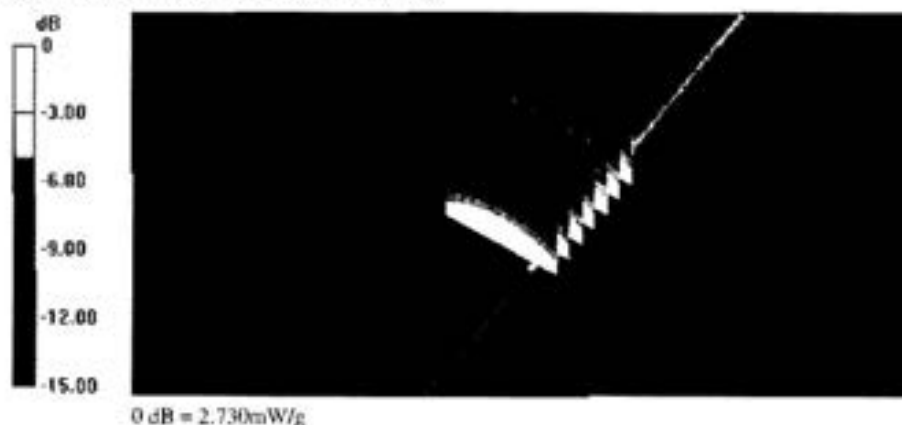
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.504 W/kg

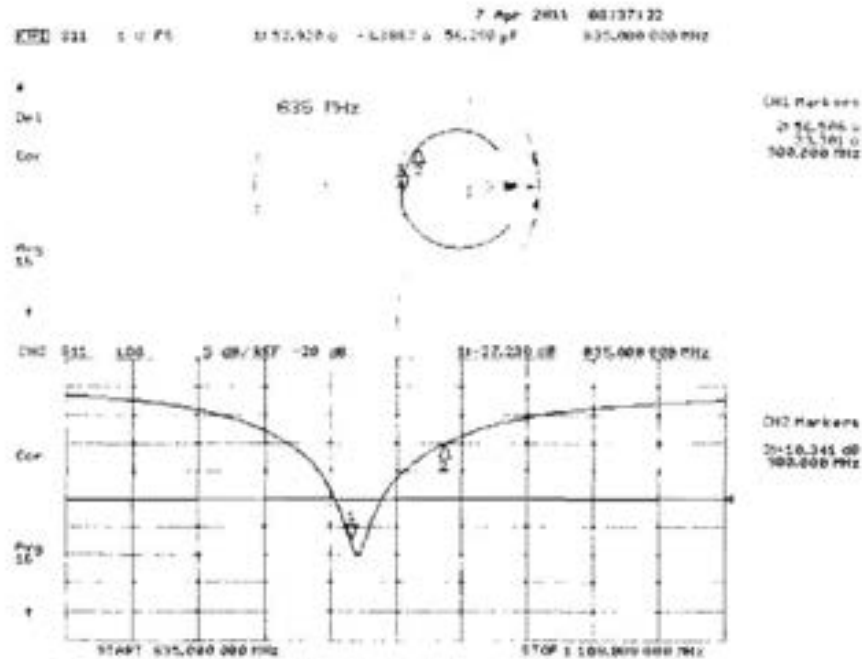
SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.52 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 86(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 87(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1800V2-2d020_Jan11**

CALIBRATION CERTIFICATE

Object **D1800V2 - SN: 2d020**

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

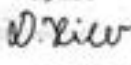
Calibration date: **January 13, 2011**

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0837480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292763	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5066 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047 2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 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-02 (in house check Oct-09)	in house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	in house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	in house check: Oct-11

Calibrated by:	Name Dimitri Iliev	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 

Issued: January 13, 2011
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D1800V2-2d020_Jan11

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 88(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 89(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 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	39.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.2 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.13 mW / g
SAR normalized	normalized to 1W	20.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.5 mW / g ± 16.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 90(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	46.5 Ω - 7.3 j Ω
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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 91(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

DASY5 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:2d020

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.05, 5.05, 5.05); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

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

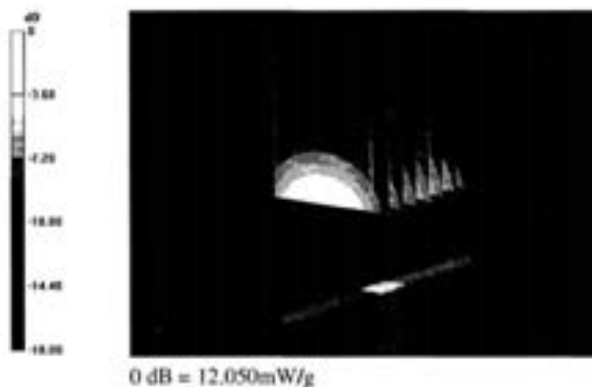
grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 17.902 W/kg

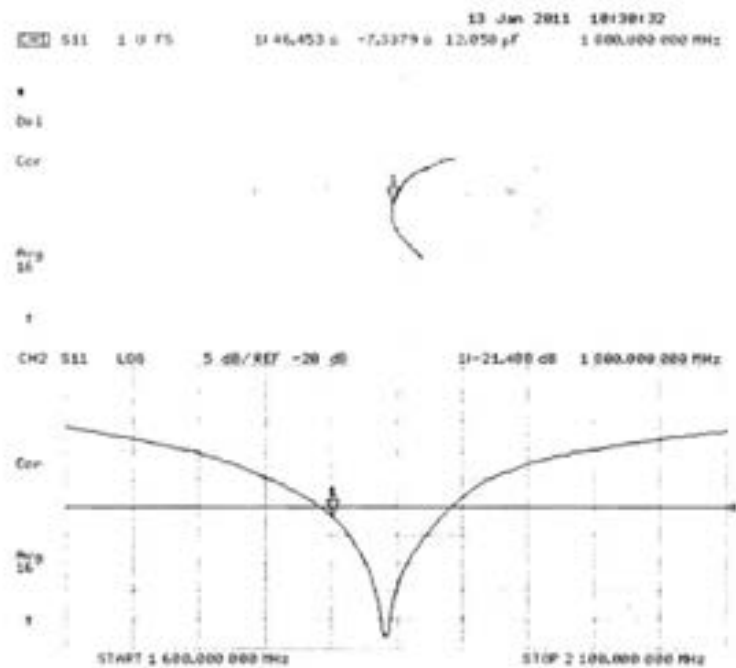
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.13 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 92(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 93(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1800V2-2d020_Jan13**

CALIBRATION CERTIFICATE

Object **D1800V2 - SN: 2d020**

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

Calibration date: **January 09, 2013**

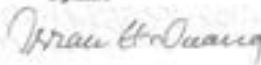
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (MATE 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. 217-01530)	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	MY41092217	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 94206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Israa El-Niaouq	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	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**

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 94(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 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 RFL111LW SAR Report Rev 2			Page 95(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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	38.9 ± 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 ² (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ² (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.3 W/kg ± 16.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 96(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.2 Ω - 8.3 $j\Omega$
Return Loss	- 20.5 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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 97(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

DASY5 Validation Report for Head TSL

Date: 09.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d020

Communication System: CW; Frequency: 1800 MHz

Medium parameters used: $f = 1800$ MHz; $\sigma = 1.38$ 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: 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:

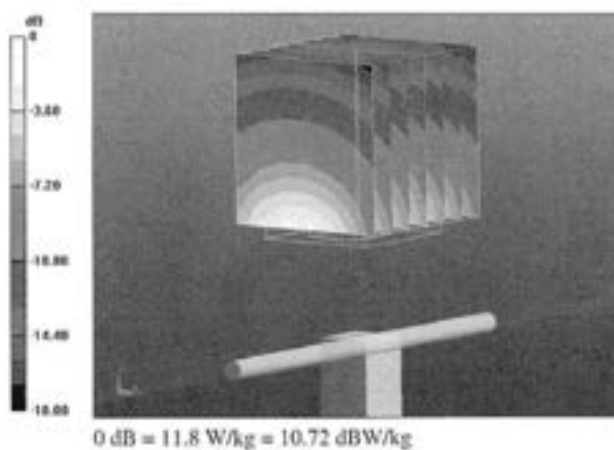
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 17.5 W/kg

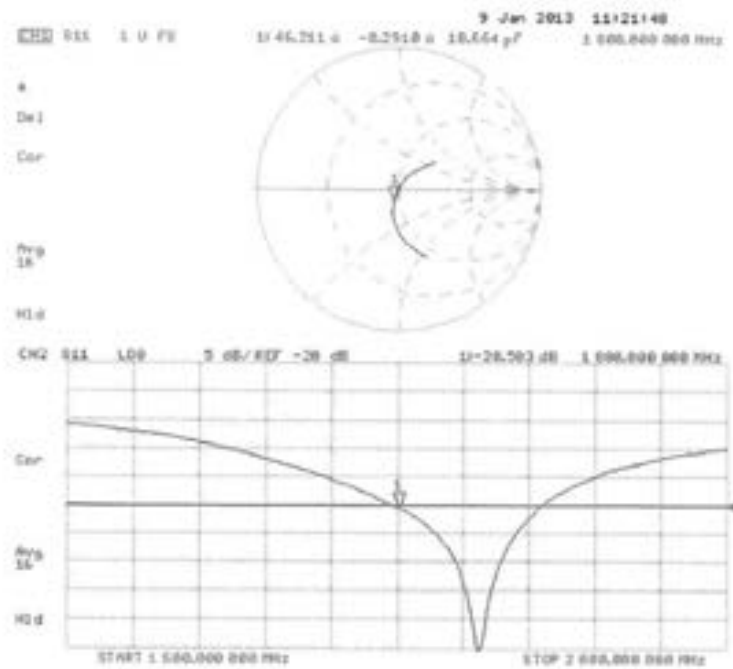
SAR(1 g) = 9.61 W/kg; SAR(10 g) = 5.06 W/kg

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 98(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 99(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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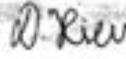
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Accreditation No.: **SCS 108**

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		
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&E critical for calibration):			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5066 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 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-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11
Calibrated by:	Name Dimitri Bay	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Technical Manager	
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Certificate No: D1900V2-545_Jan11

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 100(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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.

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 101(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.5 ± 6 %	1.43 mho/m ± 6 %
Head TSL temperature during test	(21.2 ± 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	10.2 mW / g
SAR normalized	normalized to 1W	40.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.0 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.26 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW / g ± 16.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 102(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω + 1.8 j 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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 103(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

DASY5 Validation Report for Head TSL

Date/Time: 13.01.2011 14:52:49

Test Laboratory: SPEAG, 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; $\sigma = 1.43$ mho/m; $\epsilon_r = 38.6$; $\rho = 1000$ 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: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

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

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

Peak SAR (extrapolated) = 18.648 W/kg

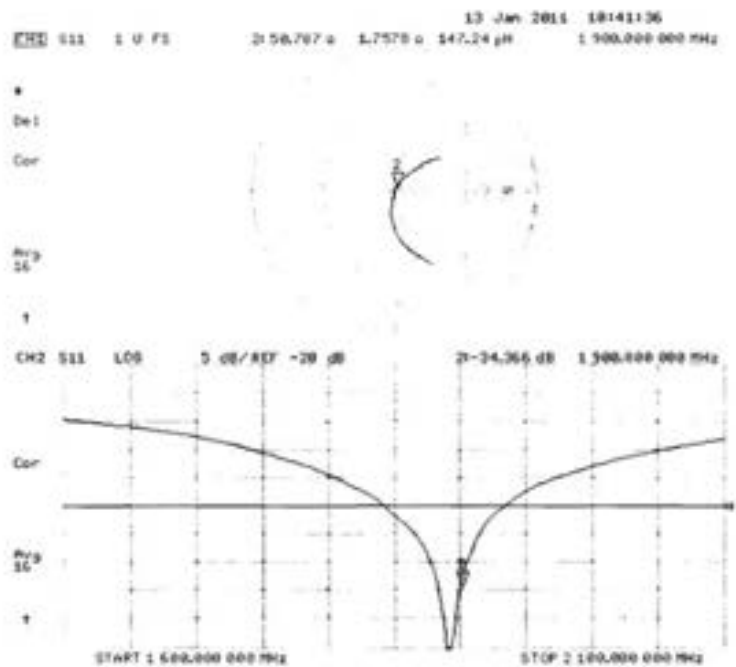
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.26 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 104(139)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW
		IC 2503A-RFL110LW		

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 105(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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**

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**

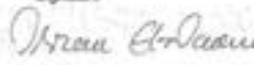
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (MATE 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: 9056 (70%)	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 ES30V3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE#	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41002317	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 Ismail El-Hachouq	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	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 Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 106(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Accredited by the Swiss Accreditation Service (SAS)
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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 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 RFL111LW SAR Report Rev 2			Page 107(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 ³ (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 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)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 108(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω + 1.7 j Ω
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 Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 109(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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/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 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:

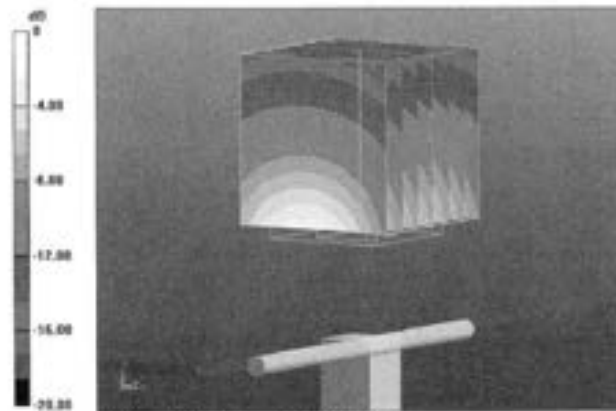
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

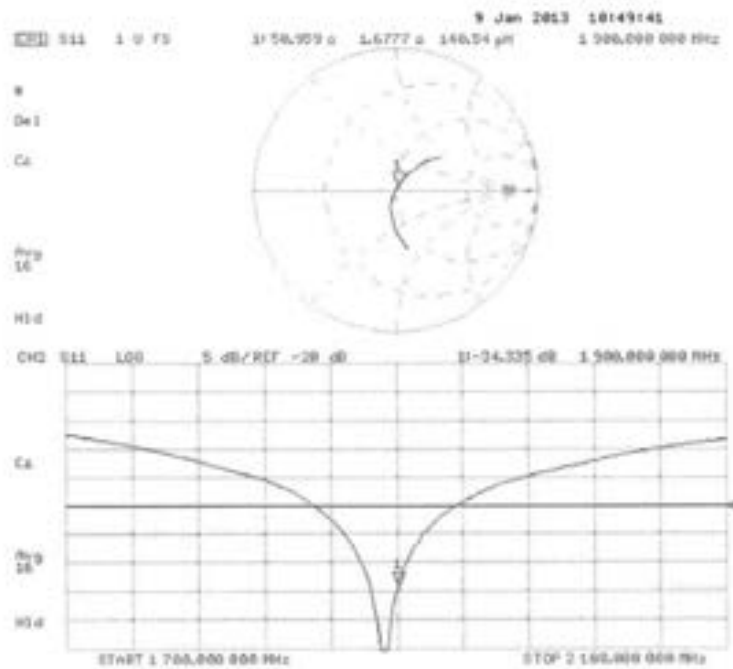
Maximum value of SAR (measured) = 12.2 W/kg



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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 110(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 111(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 112(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No.: **D1900V2-5d075_Apr11**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d075**

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.

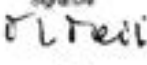
All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $\leq 70\%$.

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

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0837480794	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Polarprobe 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type N mismatch combination	SN: 5047.2 / 06027	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe E530V3	SN: 3205	30-Apr-10 (No. E53-3205_Apr10)	Apr-11
DAB4	SN: 601	10-Jun-10 (No. DAB4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41992317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100095	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390525 54206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Approved by: **Katja Pokovic** **Technical Manager**

Signature



Issued: April 8, 2011

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

Certificate No.: **D1900V2-5d075_Apr11**

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 113(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 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 RFL111LW SAR Report Rev 2			Page 114(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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, 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	39.8 ± 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 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	40.4 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.29 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)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 115(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.5 Ω + 6.1 j Ω
Return Loss	-23.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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	January 24, 2006

	Document			Page
	Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			116(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

DASY5 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:5d075

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

Medium: HSL U12 BB

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

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES7DV3 - SN1205; Cons:15.09, 5.09, 5.09; Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sat901; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SBMCAD X, V14.4.4 Build (2629)

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

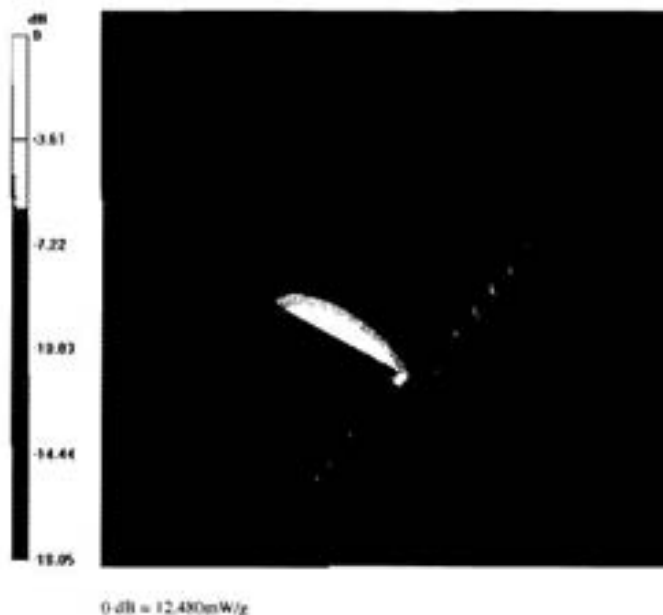
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.376 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.796 W/kg

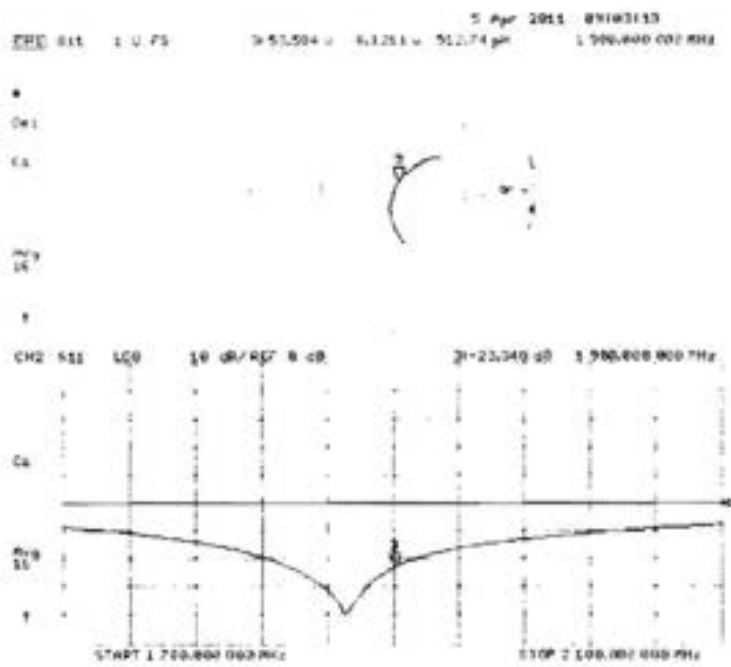
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.29 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 117(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 118(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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.v6
Calibration procedure for dipole validation kits above 700 MHz**

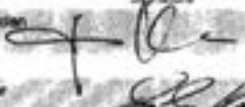
Calibration date: **November 09, 2011**

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0837480704	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 ES30V3	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 54206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: **Jeton Kastner** (Name) **Laboratory Technician** (Function)  (Signature)
Approved by: **Katja Pokovic** (Name) **Technical Manager** (Function)  (Signature)

Issued: November 9, 2011

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

Certificate No: D2450V2-747_Nov11

Page 1 of 6

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 119(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 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 RFL111LW SAR Report Rev 2			Page 120(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.84 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 ± 16.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 121(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω + 1.3 j Ω
Return Loss	-31.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 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, 2003

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 122(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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: C/W; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.84$ mho/m; $\epsilon_r = 37.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 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:

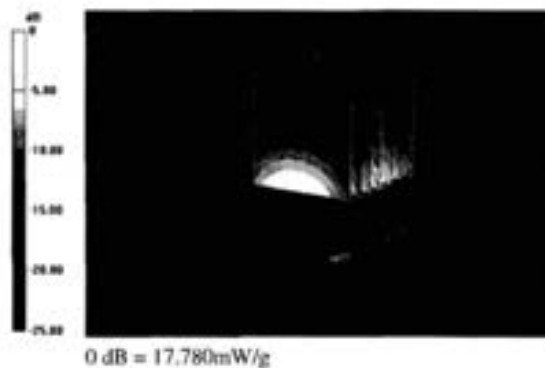
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 28.853 W/kg

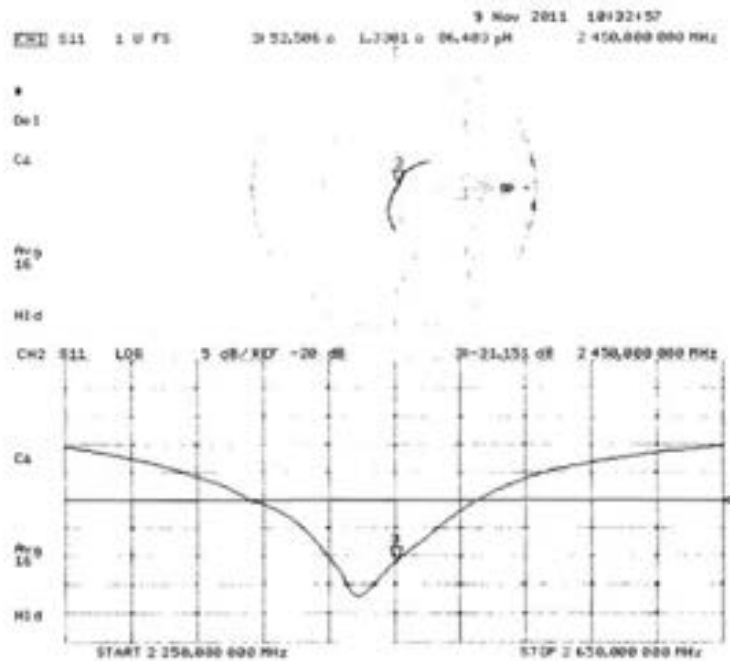
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.39 mW/g

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



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 123(139)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW
				IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 124(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 3-8 GHz

Calibration date: **November 15, 2011**

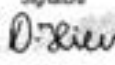
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	G837480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	06-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 Dence Slav	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	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: D5GHzV2-1033_Nov11

Page 1 of 8

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 125(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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 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 RFL111LW SAR Report Rev 2			Page 126(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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 cm³ (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 cm³ (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 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.82 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	87.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (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 RFL111LW SAR Report Rev 2			Page 127(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	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 ³ (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 ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (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	22.5 mW / g ± 16.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 128(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

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

Antenna Parameters with Head TSL at 5800 MHz

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns
----------------------------------	----------

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

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

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 129(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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:

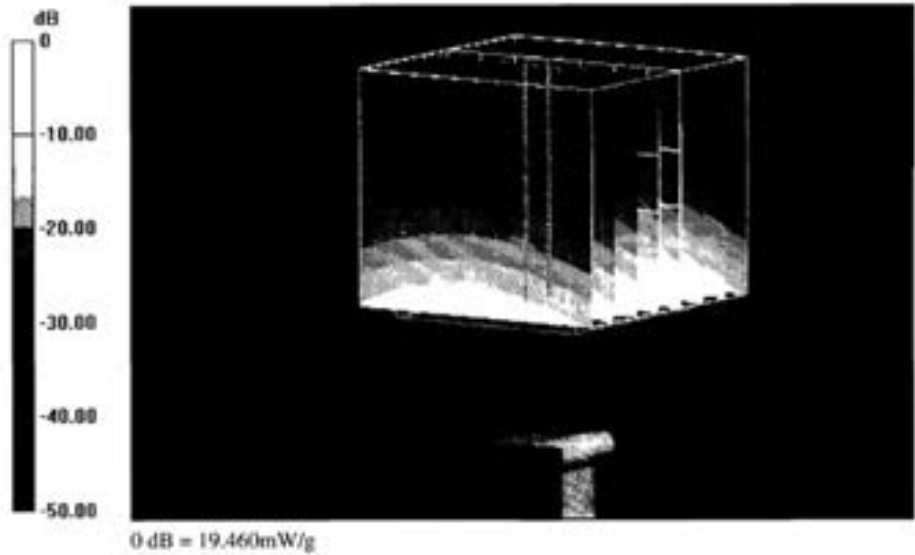
- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.91, 4.91, 4.91), ConvF(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52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

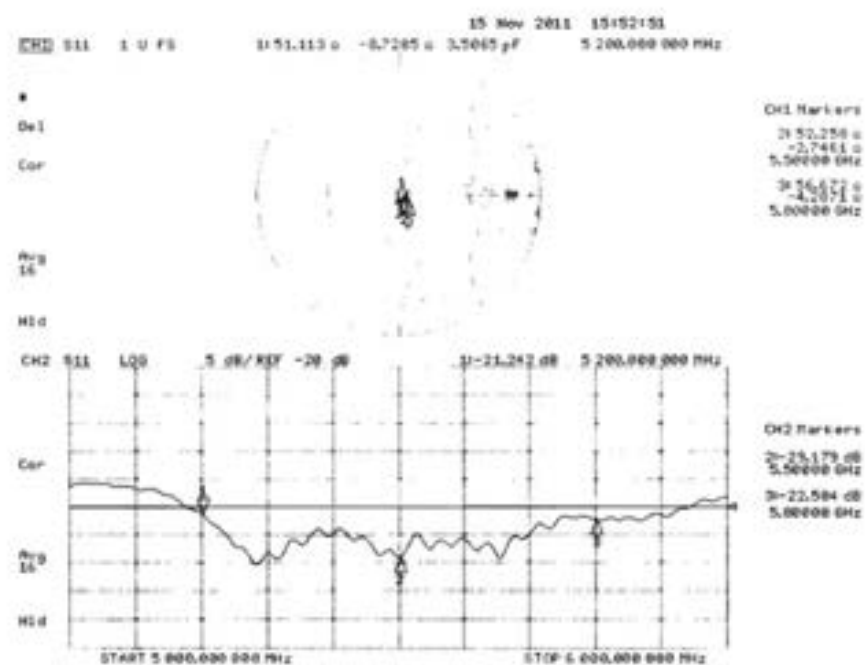
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
Reference Value = 62.220 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 33.743 W/kg
SAR(1 g) = 8.03 mW/g; SAR(10 g) = 2.28 mW/g
Maximum value of SAR (measured) = 19.463 mW/g

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 130(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 131(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 132(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

**Calibration Laboratory of
Schmid & Partner
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Zeughausstrasse 43, 8004 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 100**

Client **Blackberry Waterloo**

Certificate No: **D5GHzV2-1033_Nov13**

CALIBRATION CERTIFICATE																																															
Object	D5GHzV2 - SN: 1033																																														
Calibration procedure(s)	QA CAL-32.v2 Calibration procedure for dipole validation kits between 3-6 GHz																																														
Calibration date:	November 08, 2013																																														
This calibration certificate documents the traceability to national standards, which relies 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 (MATE critical for calibration) <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>US37480704</td> <td>06-Oct-13 (No. 217-01827)</td> <td>Oct-14</td> </tr> <tr> <td>Power sensor HP 8451A</td> <td>US37262763</td> <td>06-Oct-13 (No. 217-01827)</td> <td>Oct-14</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>MF41082317</td> <td>06-Oct-13 (No. 217-01828)</td> <td>Oct-14</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>S/N: 5056 (20kg)</td> <td>04-Apr-13 (No. 217-01736)</td> <td>Apr-14</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>S/N: 5047.3 / 00327</td> <td>04-Apr-13 (No. 217-01736)</td> <td>Apr-14</td> </tr> <tr> <td>Reference Probe ES32V3</td> <td>S/N: 3205</td> <td>26-Dec-12 (No. 253-3205_Dec12)</td> <td>Dec-13</td> </tr> <tr> <td>DAE4</td> <td>S/N: 601</td> <td>25-Apr-13 (No. DAE4-601_Apr13)</td> <td>Apr-14</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>HP generator R&S SMT-06</td> <td>100005</td> <td>04-Aug-09 (in house check Oct-13)</td> <td>In house check: Oct-15</td> </tr> <tr> <td>Network Analyser HP 8753E</td> <td>US37260585 54206</td> <td>18-Oct-01 (in house check Oct-13)</td> <td>In house check: Oct-14</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter EPM-442A	US37480704	06-Oct-13 (No. 217-01827)	Oct-14	Power sensor HP 8451A	US37262763	06-Oct-13 (No. 217-01827)	Oct-14	Power sensor HP 8481A	MF41082317	06-Oct-13 (No. 217-01828)	Oct-14	Reference 20 dB Attenuator	S/N: 5056 (20kg)	04-Apr-13 (No. 217-01736)	Apr-14	Type-N mismatch combination	S/N: 5047.3 / 00327	04-Apr-13 (No. 217-01736)	Apr-14	Reference Probe ES32V3	S/N: 3205	26-Dec-12 (No. 253-3205_Dec12)	Dec-13	DAE4	S/N: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	HP generator R&S SMT-06	100005	04-Aug-09 (in house check Oct-13)	In house check: Oct-15	Network Analyser HP 8753E	US37260585 54206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14
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Calibrated by:	Name Glaudio Leutler	Function Laboratory Technician	Signature 																																												
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 																																												
This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: November 8, 2013																																															

Certificate No: **D5GHzV2-1033_Nov13**

Page 1 of 8

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 133(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

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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:

- IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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 RFL111LW SAR Report Rev 2			Page 134(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
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	4.06 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 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	7.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (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	36.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 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	8.51 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	84.4 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.9 W/kg ± 19.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 135(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	5.06 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	—	—

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg ± 19.5 % (k=2)

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 136(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	48.1 Ω - 9.6 $j\Omega$
Return Loss	- 20.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.3 Ω - 4.1 $j\Omega$
Return Loss	- 27.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	57.8 Ω - 4.0 $j\Omega$
Return Loss	- 21.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.213 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 09, 2004

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 137(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

DASY5 Validation Report for Head TSL

Date: 08.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.46 \text{ S/m}$; $\epsilon_r = 35$; $\rho = 1000 \text{ kg/m}^3$,

Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 4.75 \text{ S/m}$; $\epsilon_r = 34.6$; $\rho = 1000 \text{ kg/m}^3$,

Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.06 \text{ S/m}$; $\epsilon_r = 34.2$; $\rho = 1000 \text{ kg/m}^3$

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); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sx601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52.52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 64.635 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 29.5 W/kg

SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 18.4 W/kg

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 = 64.397 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 33.8 W/kg

SAR(1 g) = 8.51 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 20.3 W/kg

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

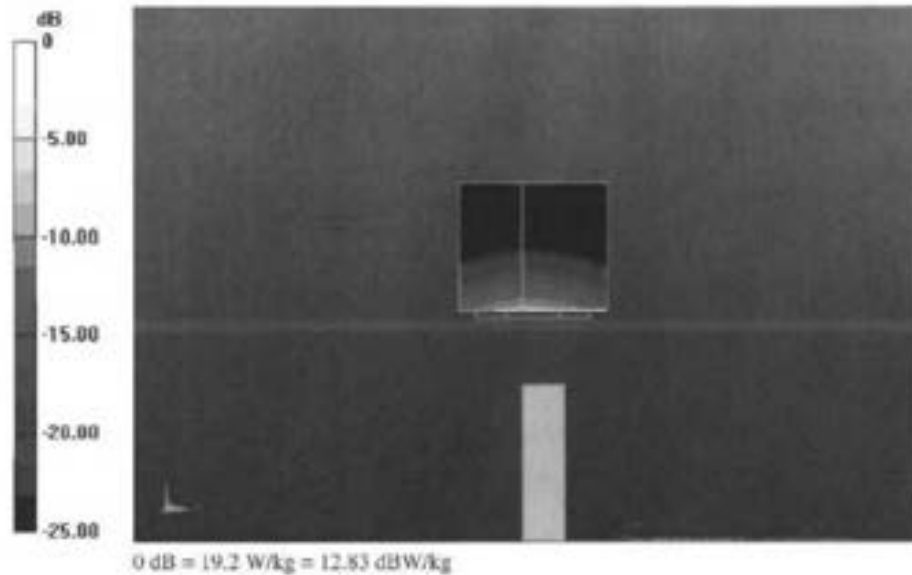
Reference Value = 61.128 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 33.0 W/kg

SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.28 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 138(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW



	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report Rev 2			Page 139(139)
Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013 December 10-12, 2014	Test Report No RTS-6026-1302-13 Rev 3	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW

Impedance Measurement Plot for Head TSL

