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Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW

APPENDIX C: PROBE & DIPOLE CALIBRATION DATA

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Probe 1643

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



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Accreditation No.: **SCS 0108**

Client: **BlackBerry Waterloo**

Certificate No.: **ET3-1643_Mar15**

CALIBRATION CERTIFICATE

Object:	ET3DV6 - SN:1643
Calibration procedure(s):	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	March 13, 2015
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.	
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.	
Calibration Equipment used (M&TE critical for calibration)	

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41489087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013, Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660, Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Iraae Elnaciq	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: March 13, 2015
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW	IC 2503A-RHR190LW
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Calibration Laboratory of Schmid & Partner Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

Glossary:


TSL	tissue simulating liquid
$NORM_{x,y,z}$	sensitivity in free space
$ConvF$	sensitivity in TSL / $NORM_{x,y,z}$
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization 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
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 $\theta = 0$ ($f \leq 900$ 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 $ConvF$).
- $NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response$ (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.
- Connector Angle: The angle is assessed using the information gained by determining the $NORM_{x,y,z}$ (no uncertainty required).


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Probe ET3DV6

SN:1643

Manufactured: November 7, 2001
 Calibrated: March 13, 2015

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

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ET3DV6- SN:1643

March 13, 2015

ASY/EASY - Parameters of Probe: ET3DV6 - SN:1643

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m))^A$	1.76	1.95	1.75	$\pm 10.1 \%$
DCP (mV) ^B	101.5	100.5	102.4	

Modulation Calibration Parameters


UFD	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	261.1	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		237.4	
		Z	0.0	0.0	1.0		267.0	

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.

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

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ET3DV6- SN:1643

March 13, 2015

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1643


Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	Unct. (k=2)
750	41.9	0.89	6.69	6.69	6.69	0.32	3.00	± 12.0 %
900	41.5	0.97	6.09	6.09	6.09	0.33	3.00	± 12.0 %
1810	40.0	1.40	5.18	5.18	5.18	0.80	2.02	± 12.0 %
1950	40.0	1.40	4.93	4.93	4.93	0.80	2.06	± 12.0 %
2450	39.2	1.80	4.58	4.58	4.58	0.80	1.62	± 12.0 %

^C Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F 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.

^G Alpha/Depth are determined during calibration. SPEAG 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.

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ET3DV6- SN:1643

March 13, 2015

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1643


Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	Unct. (k=2)
750	55.5	0.96	6.29	6.29	6.29	0.36	2.49	± 12.0 %
900	55.0	1.05	6.00	6.00	6.00	0.33	3.00	± 12.0 %
1810	53.3	1.52	4.50	4.50	4.50	0.80	2.60	± 12.0 %
1950	53.3	1.52	4.56	4.56	4.56	0.80	2.23	± 12.0 %
2450	52.7	1.95	3.93	3.93	3.93	0.70	1.60	± 12.0 %

^C Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F 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.

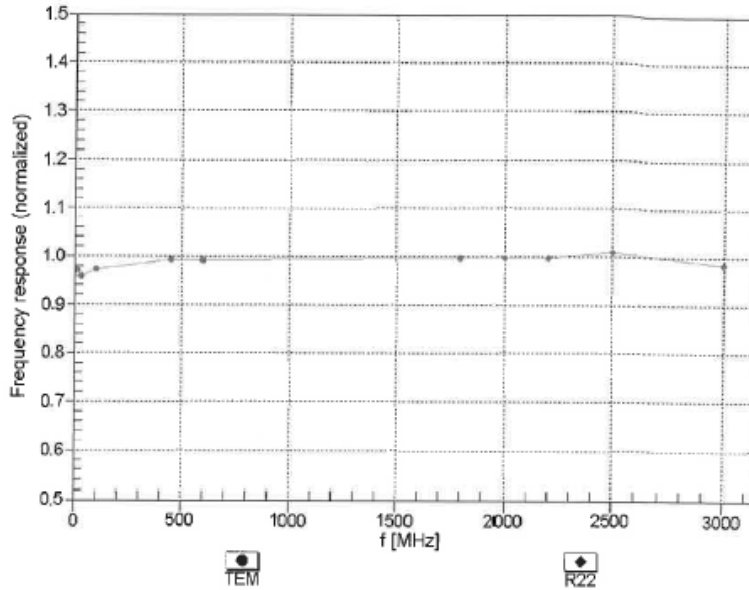
^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from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

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ET-30V6-SN:1643

March 13, 2015

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



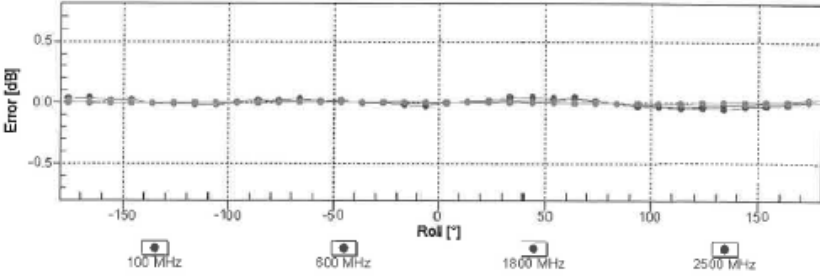
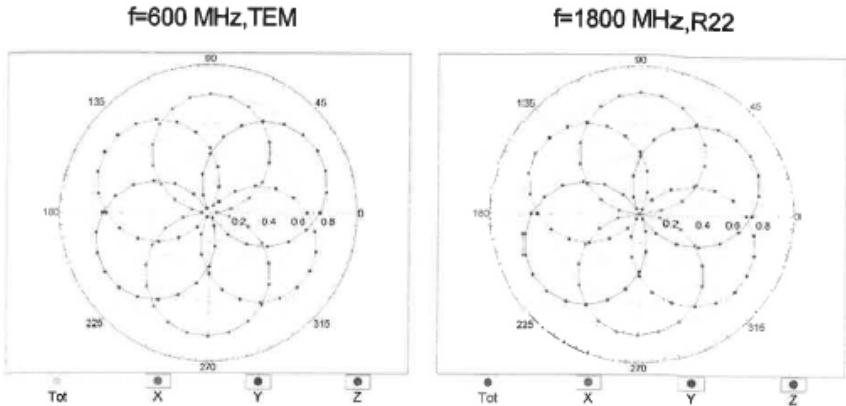
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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ET3DV6-SN:1643

March 13, 2015

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



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



Author Data
Andrew Becker

Dates of Test
Mar 30 – May 14, 2015

Test Report No
RTS-6067-1505-05

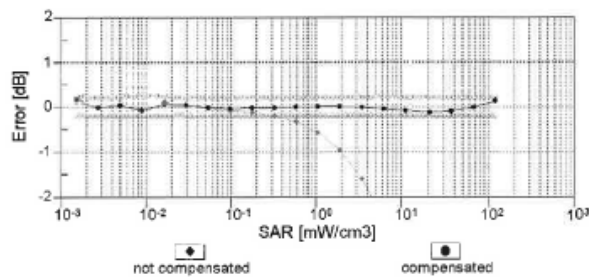
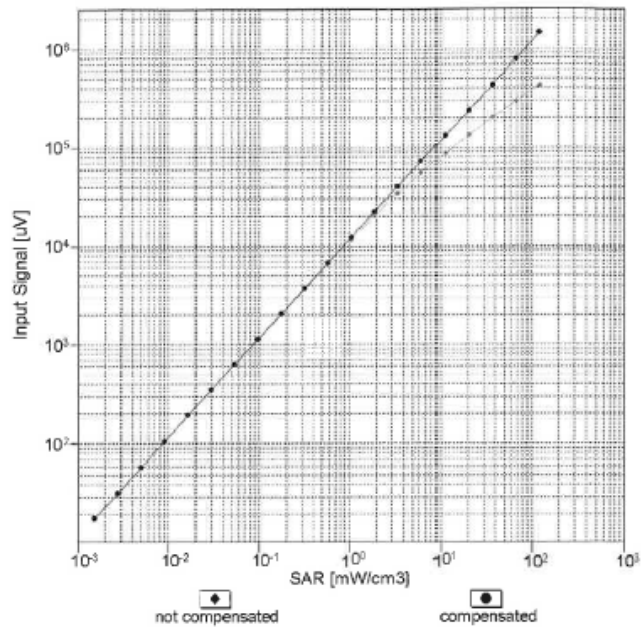
FCC ID:
L6ARHR190LW

IC
2503A-RHR190LW

ET3-1643- SN:1643

March 13, 2015

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



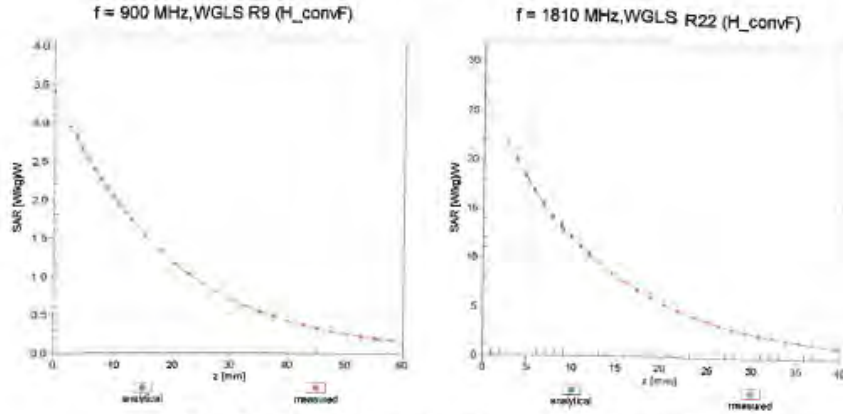
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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ET3-DV6-SN:1643

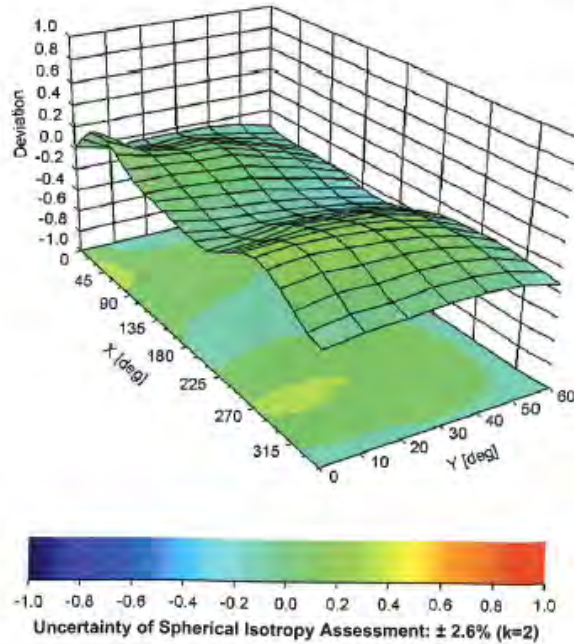
March 13, 2015


Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900$ MHz



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ET3DV6- SN:1643

March 13, 2015

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1643

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	3.8
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	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

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Probe 3225

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



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Mutual Recognition Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**


Client: **BlackBerry Waterloo**

Certificate No: **ES3-3225_Feb15**

CALIBRATION CERTIFICATE	
Object	ES3DV3 - SN:3225
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 25, 2015
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>	

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
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Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642UD1700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37380585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: February 25, 2015
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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Accreditation No.: **SCS 0108**

Glossary:


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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
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
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:

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- $NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response$ (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 $ConvF$.
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- 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.
- Connector Angle: The angle is assessed using the information gained by determining the $NORM_{x,y,z}$ (no uncertainty required).


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Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW

Probe ES3DV3

SN:3225

Manufactured: September 1, 2009
 Repaired: February 18, 2015
 Calibrated: February 25, 2015

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

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ES3DV3 - SN:3225

February 25, 2015

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
$N_{\text{CAL}} (\mu\text{V}/(\text{V/m})^2)^{\text{A}}$	1.07	1.00	1.12	± 10.1 %
$D_{\text{CAL}} (\text{mV})^{\text{B}}$	107.0	106.0	105.6	

Modulation Calibration Parameters


UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	196.9	±3.3 %
		Y	0.0	0.0	1.0		189.2	
		Z	0.0	0.0	1.0		195.9	

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 NormX,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.

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ES3DV3- SN:3225

February 25, 2015

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


Calibration Parameter Determined in Head Tissue Simulating Media

f(MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unct. (k=2)
750	41.9	0.89	6.50	6.50	6.50	0.61	1.31	± 12.0 %
900	41.5	0.97	6.22	6.22	6.22	0.30	1.84	± 12.0 %
1810	40.0	1.40	5.26	5.26	5.26	0.50	1.46	± 12.0 %
1950	40.0	1.40	5.01	5.01	5.01	0.80	1.11	± 12.0 %
2300	39.5	1.67	4.77	4.77	4.77	0.75	1.25	± 12.0 %
2450	39.2	1.80	4.60	4.60	4.60	0.57	1.49	± 12.0 %
2600	39.0	1.96	4.40	4.40	4.40	0.72	1.30	± 12.0 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^f 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.

^g AlphaDepth are determined during calibration. SPEAG 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.

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

ES3-013-SN:3225

February 25, 2015

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


Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^f	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth ^h (mm)	Unct. (k=2)
750	55.5	0.96	6.19	6.19	6.19	0.80	1.23	± 12.0 %
900	55.0	1.05	6.07	6.07	6.07	0.53	1.41	± 12.0 %
1810	53.3	1.52	4.89	4.89	4.89	0.63	1.46	± 12.0 %
1950	53.3	1.52	4.86	4.86	4.86	0.44	1.86	± 12.0 %
2300	52.9	1.81	4.48	4.48	4.48	0.80	1.29	± 12.0 %
2450	52.7	1.95	4.34	4.34	4.34	0.72	1.14	± 12.0 %
2600	52.5	2.16	4.06	4.06	4.06	0.80	1.08	± 12.0 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^f 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.

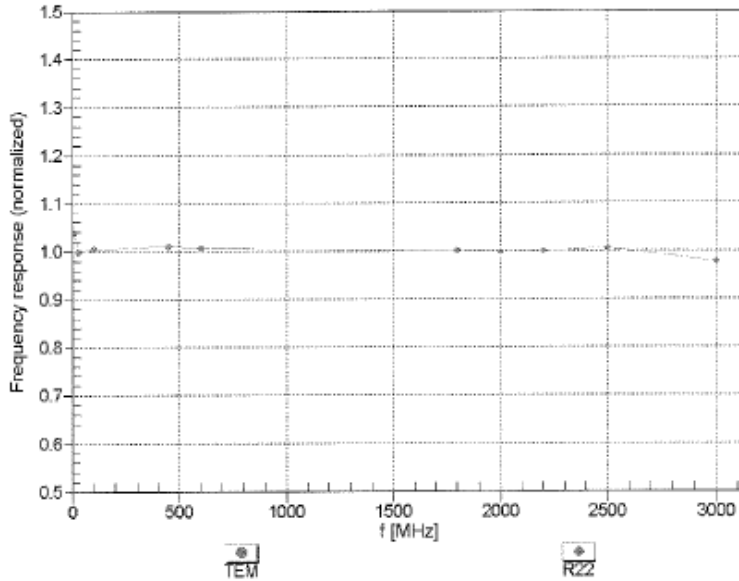
^h AlphaDepth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the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

		Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report		Page 19(79)
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ES-3225- SN:3225

February 25, 2015

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



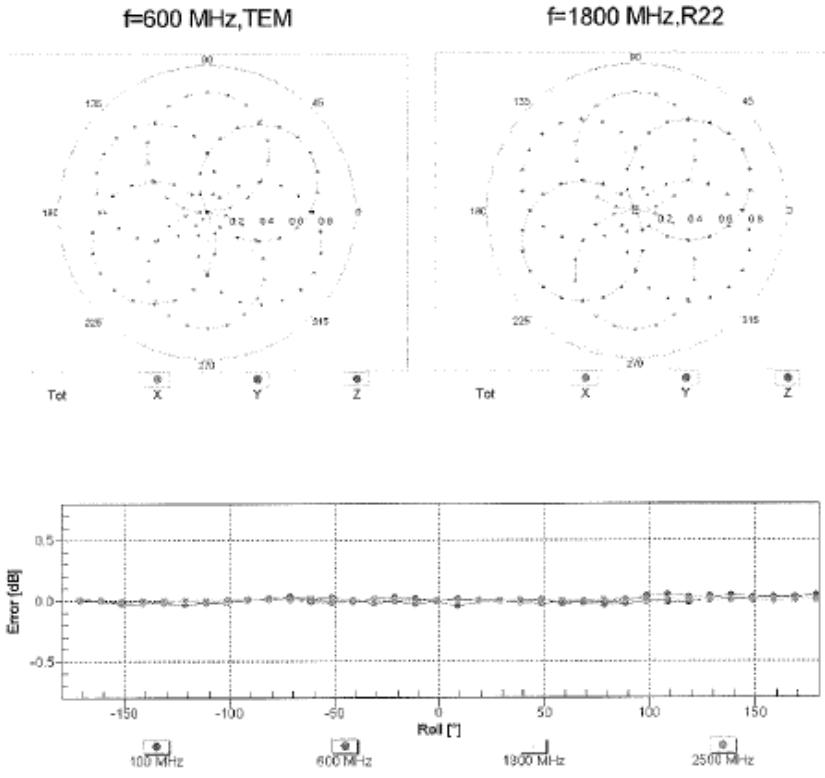
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

ES-3225-SN:3225

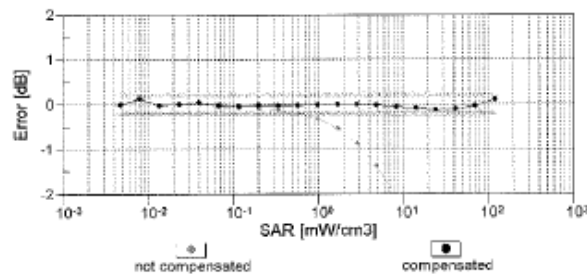
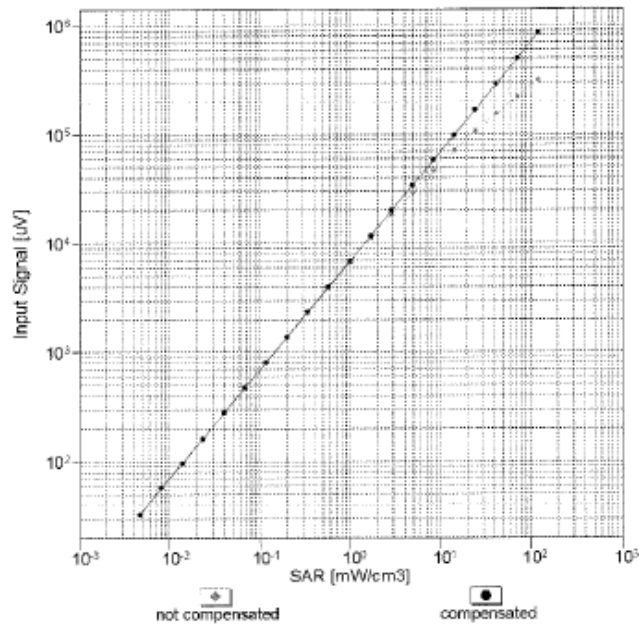
February 25, 2015

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



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

(TEM cell, $f_{eval} = 1900$ MHz)



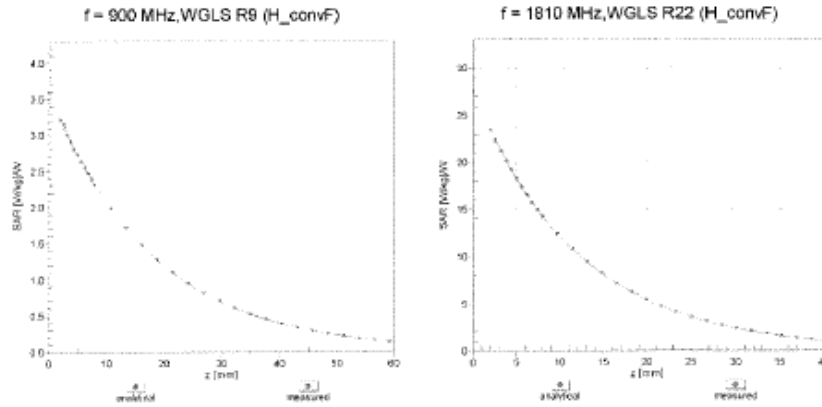
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

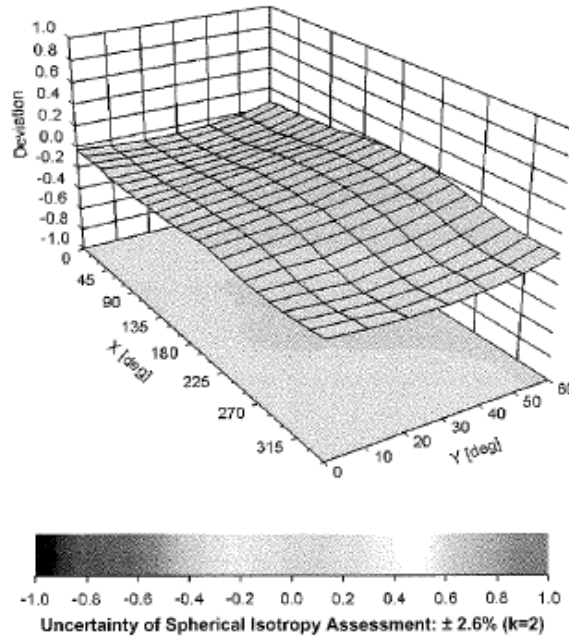
ES3-3225


February 25, 2015

Conversion Factor Assessment



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



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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW


ES3DV3- SN:3225

February 25, 2015


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

Optic Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-61.4
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 C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 24(79)
		Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Probe 3592

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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



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Multilateral Agreement for the recognition of calibration certificates

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**


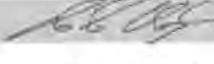
Calibration date: **November 10, 2014**

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 < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S9054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S6129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013, Dec13)	Dec-14
DAE4	SN: 880	13-Dec-13 (No. DAE4-880, Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-89 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753F	US37390685	18-Oct-01 (in house check Oct-14)	In house check: Oct-16


	Name	Function	Signature
Calibrated by:	Leif Klyaner	Laboratory Technician	
Approved by:	Katja Fukovic	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**

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	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 26(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

**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, D	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
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 $\theta = 0$ ($f \leq 900$ 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}; 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).

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Author Data	Dates of Test	Test Report No	FCC ID:	IC
Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW

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!)

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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)
Norm ($\mu\text{V}/(\text{V}/\text{m})^{\wedge}$) [^]	0.48	0.47	0.40	$\pm 10.1\%$
DCP (mV^{\wedge}) [^]	95.2	98.0	98.8	

Modulation Calibration Parameters


UID	Communication System Name		A	B	C	D	VR mV	Unc ^E (k=2)
			dB	dB $\sqrt{\mu\text{V}}$		dB		
0	CW	X	0.0	0.0	1.0	0.00	145.9	$\pm 3.3\%$
		Y	0.0	0.0	1.0		156.9	
		Z	0.0	0.0	1.0		149.1	

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%.

[^] 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.

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

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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 ^f	Conductivity (Sim) ^f	ConvF X	ConvF Y	ConvF Z	Alpha ^g	Depth (mm) ^g	Unct. (k=2)
2600	39.0	1.98	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 %

^c Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 84, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^f 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 ± 6%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^g Alpha/Depth are determined during calibration. SPFA3 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 3-8 GHz at any distance larger than half the probe tip diameter from the boundary.

EX3DV4 - SN:3592

November 10, 2014

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


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 ^g	Depth (mm) ^g	Unct. (k=2)
2600	52.5	2.16	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 %

^c Frequency validity above 300 MHz of ± 10% MHz only applies for DASY V4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the 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 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^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.

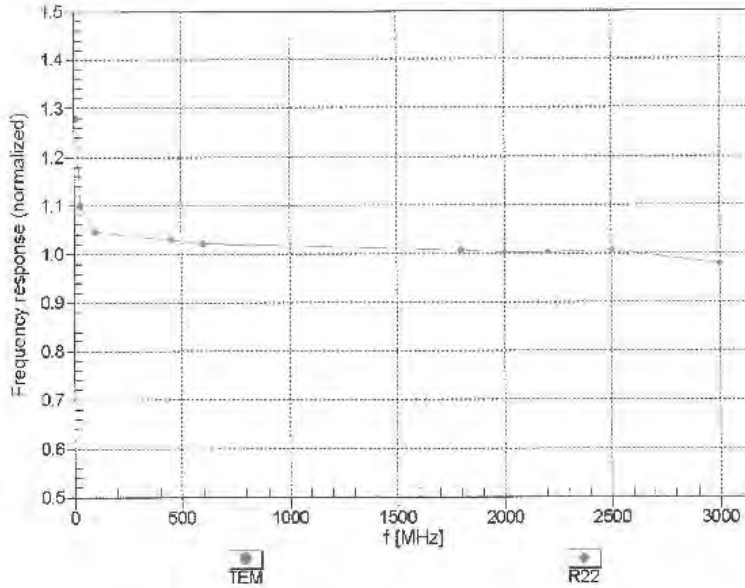
^g Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3.6 GHz at any distance larger than half the probe lip diameter from the boundary.

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Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW


EX3DV4- SN:3592

November 10, 2014

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



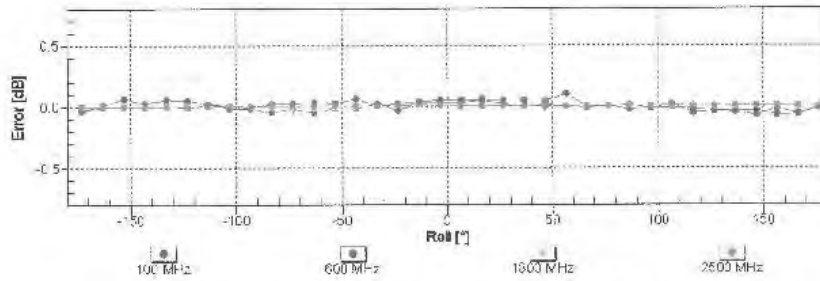
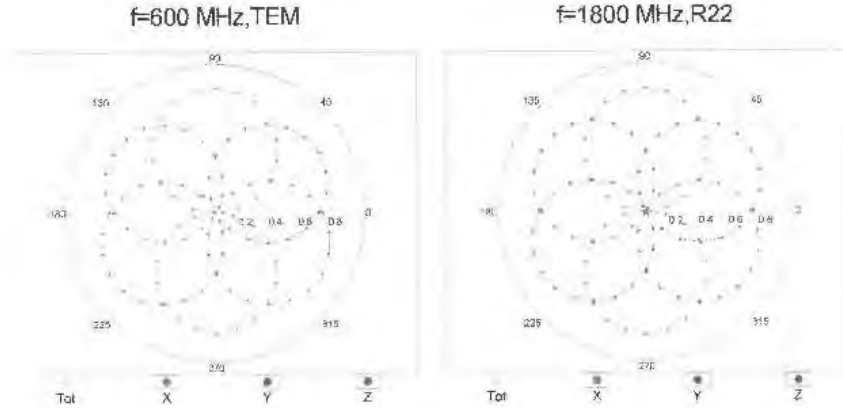
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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EX3DV4- SN:3592

November 10, 2014

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



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



Author Data
Andrew Becker

Dates of Test
Mar 30 – May 14, 2015

Test Report No
RTS-6067-1505-05

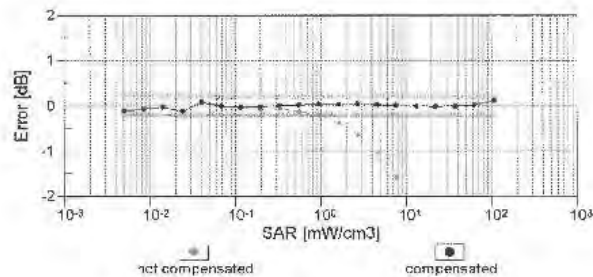
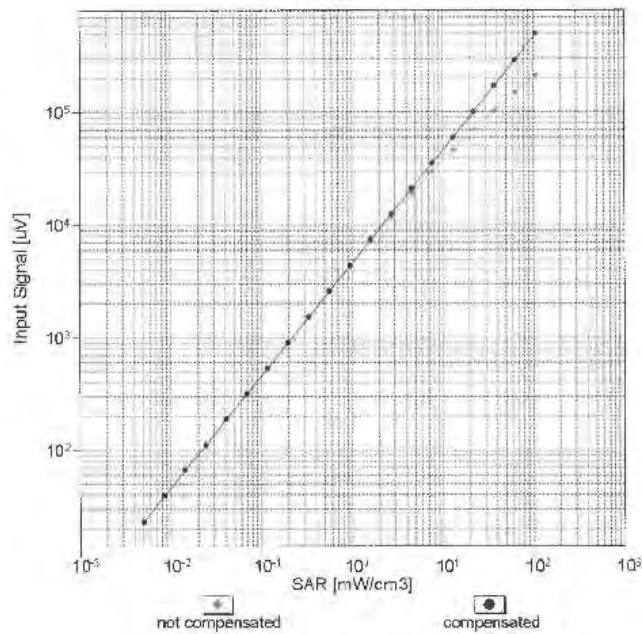
FCC ID:
L6ARHR190LW

IC
2503A-RHR190LW

EX3DV4 SN:3592

November 10, 2014

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



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

Author Data
Andrew Becker

Dates of Test
Mar 30 – May 14, 2015

Test Report No
RTS-6067-1505-05

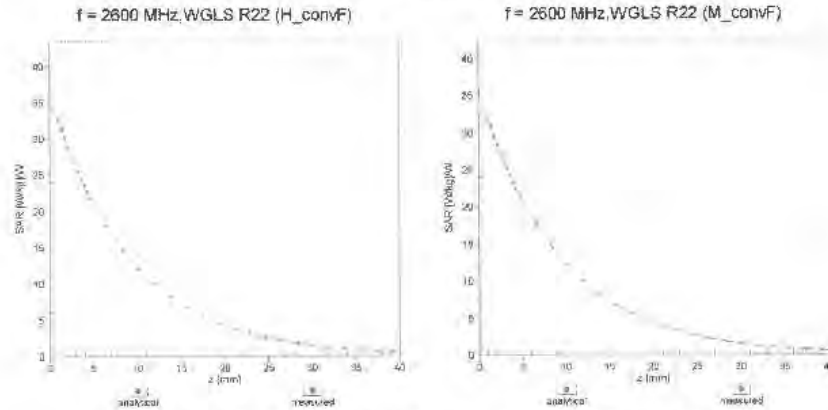
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L6ARHR190LW

IC
2503A-RHR190LW

EX3DV4- SN:3592

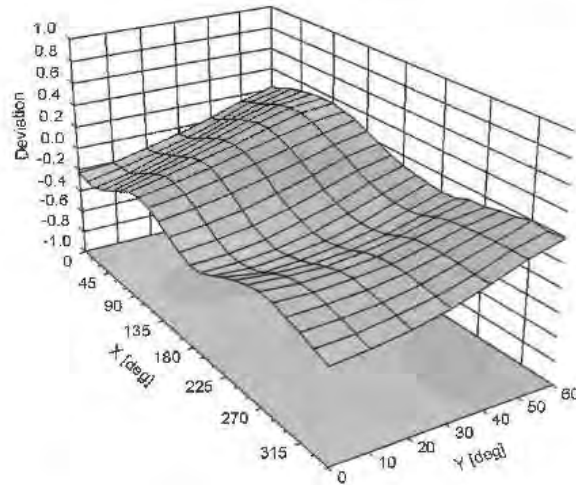
November 10, 2014

Conversion Factor Assessment




Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

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Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW

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	2.5 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	1.4 mm

750 Dipole

**Calibration Laboratory of
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Accreditation No.: **SCS 0108**


Client **Blackberry Waterloo**

Certificate No: **D750V3-1021_Mar15**

CALIBRATION CERTIFICATE			
Object	D750V3 - SN:1021		
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	March 11, 2015		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01916)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
Calibrated by:	Name Michael Weber	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: March 11, 2015
<p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>			

Certificate No: D750V3-1021_Mar15

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	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 37(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "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
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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	40.8 ± 6 %	0.90 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	2.10 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.28 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.42 W/kg ± 16.5 % (k=2)

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	Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			39(79)
Author Data	Dates of Test	Test Report No	FCC ID:	IC
Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.3 Ω + 0.3 jΩ
Return Loss	- 25.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.032 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 C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 40(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

DASY5 Validation Report for Head TSL

Date: 11.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750$ MHz; $\sigma = 0.9$ S/m; $\epsilon_r = 40.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

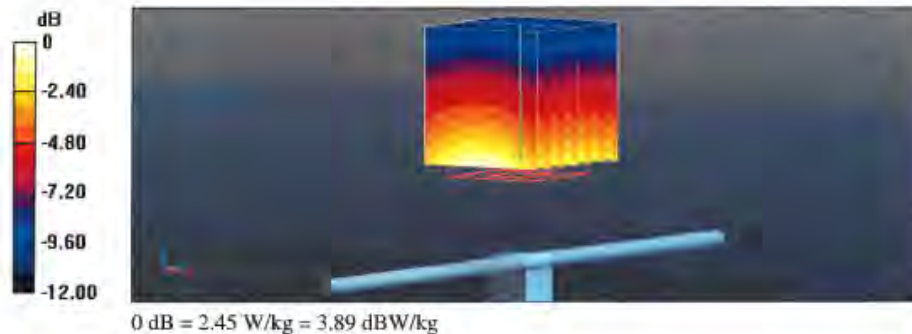
Measurement grid: dx=5mm, dy=5mm, dz=5mm


Reference Value = 54.15 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 3.15 W/kg

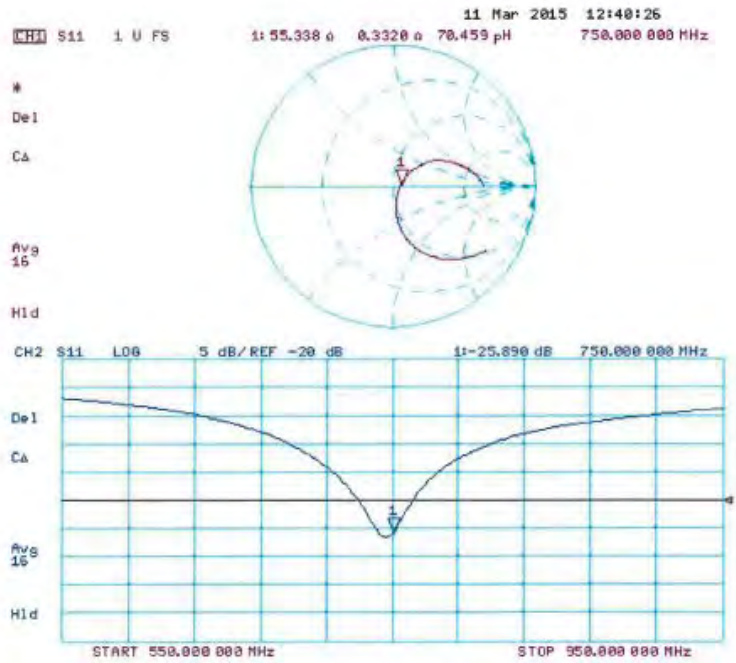
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.37 W/kg


Maximum value of SAR (measured) = 2.45 W/kg



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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Impedance Measurement Plot for Head TSL



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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

835 Dipole

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Accreditation No.: **SCS 0108**


Client: **Blackberry Waterloo**

Certificate No: **D835V2-446_Mar15**

CALIBRATION CERTIFICATE			
Object	D835V2 - SN:446		
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	March 11, 2015		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB87480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_D0014)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-15)	In house check: Oct-16
Network Analyzer HP 8753E	US3730585 S4205	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
Calibrated by:	Name Michael Weber	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
			Issued: March 12, 2015
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Certificate No: D835V2-446_Mar15

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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Accreditation No.: **SCS 0108**

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 1528-2013, "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
- KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"


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%.

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 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	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.28 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.06 W/kg ± 16.5 % (k=2)

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.6 Ω - 4.8 j Ω
Return Loss	- 26.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.383 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

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

DASY5 Validation Report for Head TSL

Date: 11.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 835$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 40.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.2, 6.2, 6.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

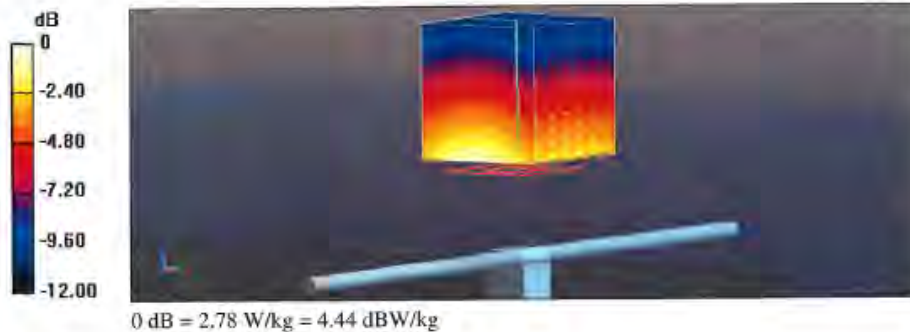
Measurement grid: dx=5mm, dy=5mm, dz=5mm


Reference Value = 56.83 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.55 W/kg

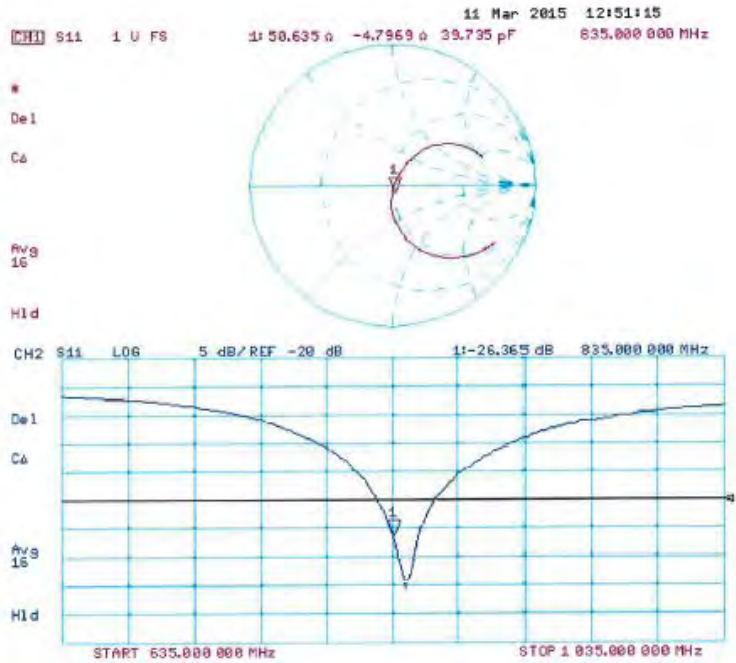
SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg

Maximum value of SAR (measured) = 2.78 W/kg



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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05
			IC 2503A-RHR190LW

Impedance Measurement Plot for Head TSL



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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05
		FCC ID: L6ARHR190LW	IC 2503A-RHR190LW

1800 Dipole

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Accreditation No.: **SCS 0108**


Client: **Blackberry Waterloo**

Certificate No.: **D1800V2-2d020_Mar15**

CALIBRATION CERTIFICATE			
Object	D1800V2 - SN: 2d020		
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	March 12, 2015		
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	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
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Certificate No: D1800V2-2d020_Mar15

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW IC 2503A-RHR190LW

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Accreditation No.: **SCS 0108**

Glossary:

TSL tissue simulating liquid
Con \sqrt{F} sensitivity in TSL / NORM x,y,z
N/A not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "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
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"


Additional Documentation:

- d) DASy4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 50(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	1.41 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.2 W/kg ± 16.5 % (k=2)

	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 51(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	45.8 Ω - 8.4 j Ω
Return Loss	- 20.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.215 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 C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 52(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

DASY5 Validation Report for Head TSL

Date: 12.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

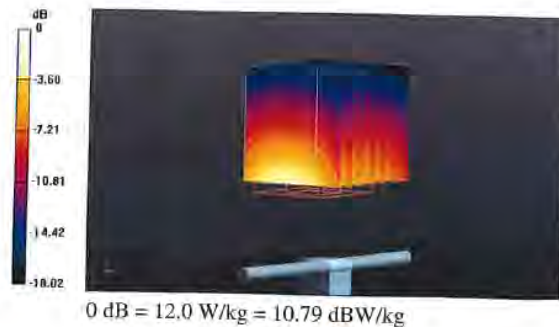
Communication System: UID 0 - CW; Frequency: 1800 MHz
 Medium parameters used: $f = 1800 \text{ MHz}$; $\sigma = 1.41 \text{ S/m}$; $\epsilon_r = 39.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

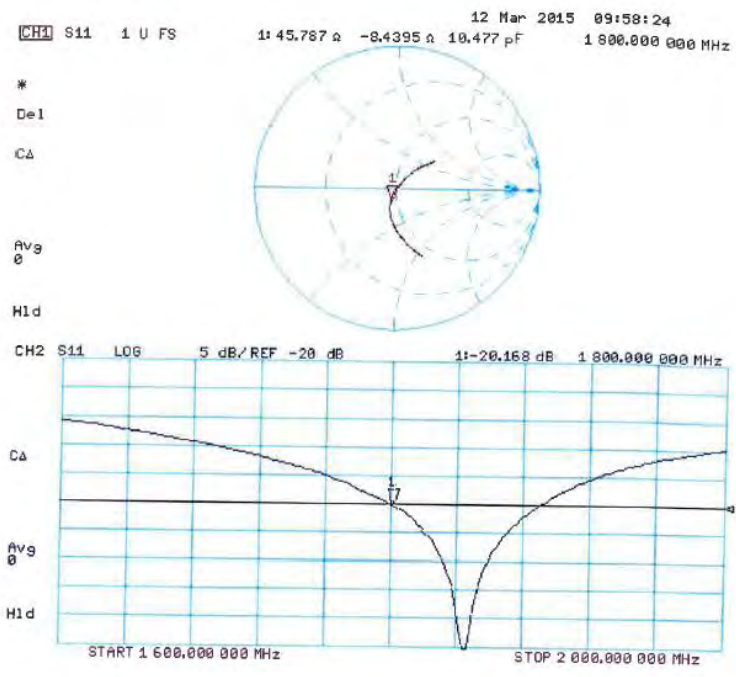
- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
 Reference Value = 94.84 V/m; Power Drift = 0.03 dB
 Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.08 W/kg
 Maximum value of SAR (measured) = 12.0 W/kg



Impedance Measurement Plot for Head TSL



1900 Dipole

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	Document		Page	
	Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report		54(79)	
Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW	IC 2503A-RHR190LW

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



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Accreditation No.: **SCS 0108**

Client: **BlackBerry Waterloo**

Certificate No: **D1900V2-545_Mar15**

CALIBRATION CERTIFICATE

Object: **D1900V2 - SN:545**

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

Calibration date: **March 12, 2015**

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 ± 0)°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	GB37490704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP B481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP B481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20K)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15


Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP B753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Claudio Leubler** (Name), **Laboratory Technician** (Function), *[Signature]* (Signature)

Approved by: **Katja Pokovic** (Name), **Technical Manager** (Function), *[Signature]* (Signature)

Issued: March 13, 2015

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	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 55(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "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
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"


Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 56(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
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	39.0 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.88 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg ± 16.5 % (k=2)

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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$50.9 \Omega + 0.9 j\Omega$
Return Loss	-37.7 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. 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 C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 58(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

DASY5 Validation Report for Head TSL

Date: 12.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.38 \text{ S/m}$; $\epsilon_r = 39$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

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


Reference Value = 96.17 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.1 W/kg

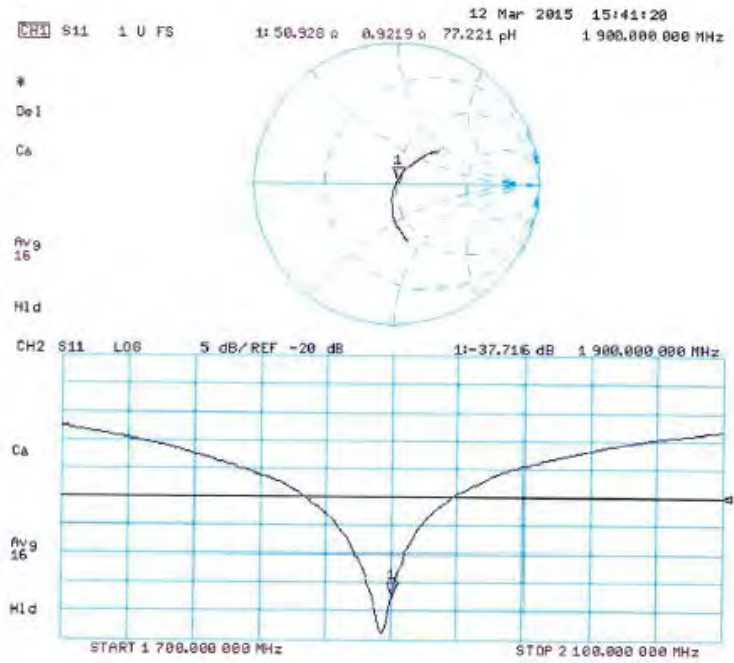
SAR(1 g) = 9.88 W/kg; SAR(10 g) = 5.18 W/kg

Maximum value of SAR (measured) = 12.1 W/kg



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	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Impedance Measurement Plot for Head TSL



2450 Dipole

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Accreditation No.: **SCS 108**

Client **Blackberry Waterloo**

Certificate No: **D2450V2-791_Sep13**

CALIBRATION CERTIFICATE																																															
Object	D2450V2 - SN: 791																																														
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz																																														
Calibration date:	September 10, 2013																																														
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM-442A</td> <td>GB97480704</td> <td>01-Nov-12 (No. 217-01640)</td> <td>Oct-13</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US37282783</td> <td>01-Nov-12 (No. 217-01640)</td> <td>Oct-13</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5058 (20k)</td> <td>04-Apr-13 (No. 217-01736)</td> <td>Apr-14</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 5047.3 / 06327</td> <td>04-Apr-13 (No. 217-01739)</td> <td>Apr-14</td> </tr> <tr> <td>Reference Probe FS3DV3</td> <td>SN: 3205</td> <td>28-Dec-12 (No. ES3-3205_Dec12)</td> <td>Dec-13</td> </tr> <tr> <td>DAE4</td> <td>SN: 601</td> <td>25-Apr-13 (No. DAF4-601_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>Power sensor HP 8481A</td> <td>MY41092317</td> <td>18-Oct-02 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>RF generator R&S SMT-06</td> <td>100005</td> <td>04-Aug-99 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585 S4206</td> <td>18-Oct-01 (in house check Oct-12)</td> <td>In house check: Oct-13</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter EPM-442A	GB97480704	01-Nov-12 (No. 217-01640)	Oct-13	Power sensor HP 8481A	US37282783	01-Nov-12 (No. 217-01640)	Oct-13	Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14	Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14	Reference Probe FS3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13	DAE4	SN: 601	25-Apr-13 (No. DAF4-601_Apr13)	Apr-14	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13	RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13	Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration																																												
Power meter EPM-442A	GB97480704	01-Nov-12 (No. 217-01640)	Oct-13																																												
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Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13																																												
Calibrated by/	Name Israël El-Nadour	Function Laboratory Technician	Signature 																																												
Approved by:	Katja Pokovic	Technical Manager																																													
			Issued: September 10, 2013																																												
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	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 61(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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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**

Glossary:

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

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"


Additional Documentation:

- d) DASy4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 62(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

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	
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	39.4 ± 6 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	51.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.03 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.0 W/kg ± 16.5 % (k=2)

	Document Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report			Page 63(79)
	Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.1 Ω + 3.4 $j\Omega$
Return Loss	- 23.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.153 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	January 24, 2006

		Document		Page
		Appendix C for the BlackBerry® Smartphone Model RHR191LW (SQW100-4) SAR Report		64(79)
Author Data	Dates of Test	Test Report No	FCC ID:	IC
Andrew Becker	Mar 30 – May 14, 2015	RTS-6067-1505-05	L6ARHR190LW	2503A-RHR190LW

DASY5 Validation Report for Head TSL

Date: 10.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 791

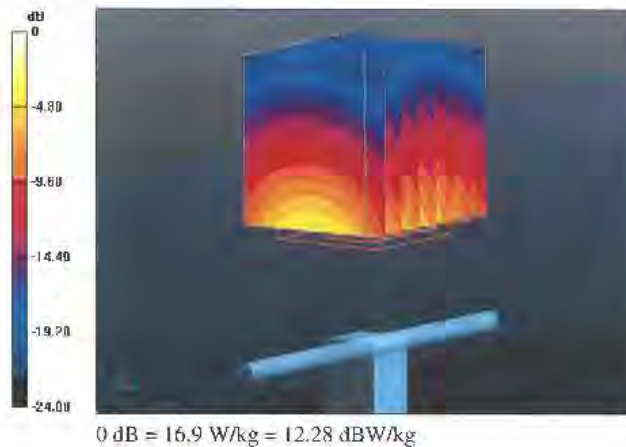
Communication System: UID 0 - CW; Frequency: 2450 MHz
 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.83$ S/m; $\epsilon_r = 39.4$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 99.824 V/m; Power Drift = 0,04 dB
 Peak SAR (extrapolated) = 26.7 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.03 W/kg
 Maximum value of SAR (measured) = 16.9 W/kg



Author Data
Andrew Becker

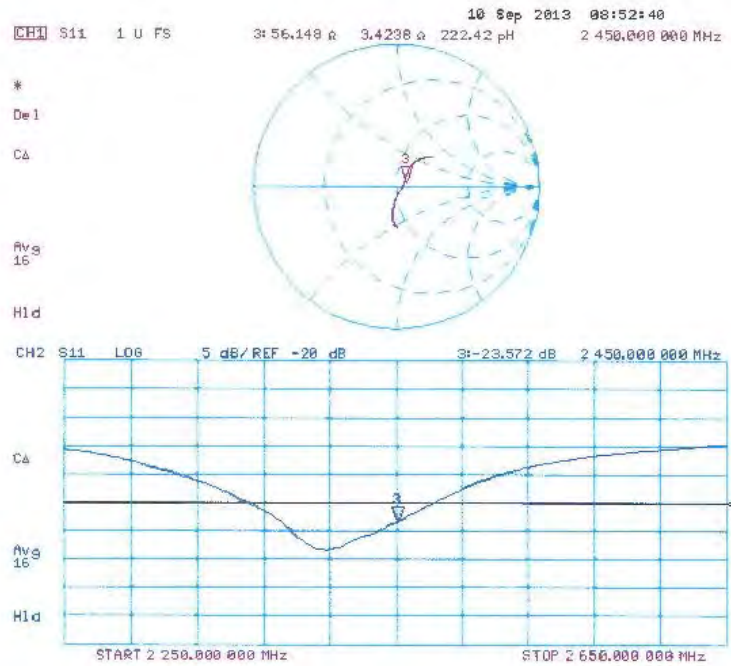
Dates of Test
Mar 30 – May 14, 2015

Test Report No
RTS-6067-1505-05

FCC ID:
L6ARHR190LW

IC
2503A-RHR190LW

Impedance Measurement Plot for Head TSL



2600 Dipole

**Calibration Laboratory of
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Accreditation No.: **SCS 0108**


Client: **Blackberry Waterloo**

Certificate No: **D2600V2-1033_Mar15**

CALIBRATION CERTIFICATE			
Object	D2600V2 - SN: 1033		
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz		
Calibration date:	March 13, 2015		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	16-Oct-01 (in house check Oct-14)	In house check: Oct-15
Calibrated by:	Name Jeton Kastrioti	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 
			Issued: March 13, 2015
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

Certificate No: D2600V2-1033_Mar15

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 Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 0108**

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 1528-2013, "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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

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%.



Author Data Andrew Becker	Dates of Test Mar 30 – May 14, 2015	Test Report No RTS-6067-1505-05	FCC ID: L6ARHR190LW	IC 2503A-RHR190LW
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Measurement Conditions

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

DASY Version	DASY5	V52.6.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.2 ± 6 %	2.00 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	14.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.0 W/kg ± 16.5 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.7 Ω - 5.3 j Ω
Return Loss	-25.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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	March 03, 2009

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DASY5 Validation Report for Head TSL

Date: 13.03.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1033

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: $f = 2600$ MHz; $\sigma = 2$ S/m; $\epsilon_r = 37.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.49, 4.49, 4.49); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

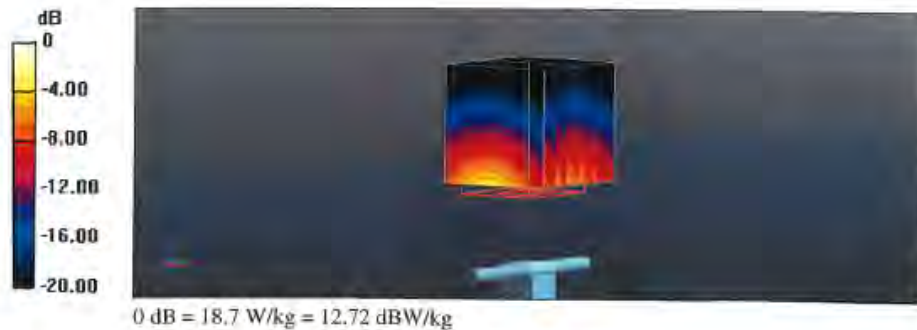
Measurement grid: dx=5mm, dy=5mm, dz=5mm


Reference Value = 101.6 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 30.3 W/kg

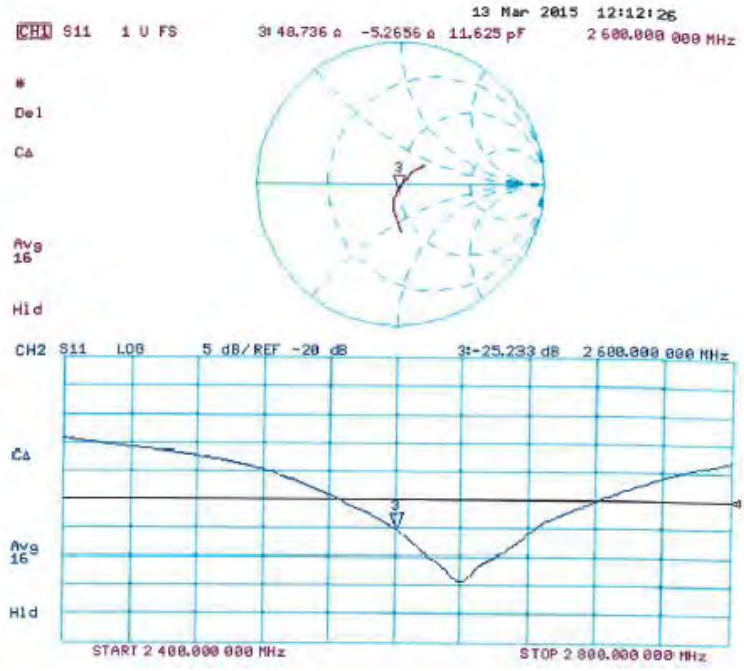
SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.33 W/kg

Maximum value of SAR (measured) = 18.7 W/kg



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Impedance Measurement Plot for Head TSL



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		FCC ID: L6ARHR190LW	IC 2503A-RHR190LW

5000 Dipole

Calibration Laboratory of Schmid & Partner Engineering AG
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Accreditation No.: **SCS 108**


Client **Blackberry Waterloo**

Certificate No: **D5GHzV2-1033_Nov13**

CALIBRATION CERTIFICATE			
Object	D5GHzV2 - SN: 1033		
Calibration procedure(s)	QA CAL-22.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 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	GBS7480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047 3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-15
Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: November 8, 2013
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Certificate No: D5GHzV2-1033_Nov13

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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:

- a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- c) 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:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY5	V52.8.7
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	4.66 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	22.6 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	35.6	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)

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)

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Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	49.1 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

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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: $f = 5200$ MHz; $\sigma = 4.46$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.75$ S/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.06$ S/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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


DASY52 Configuration:

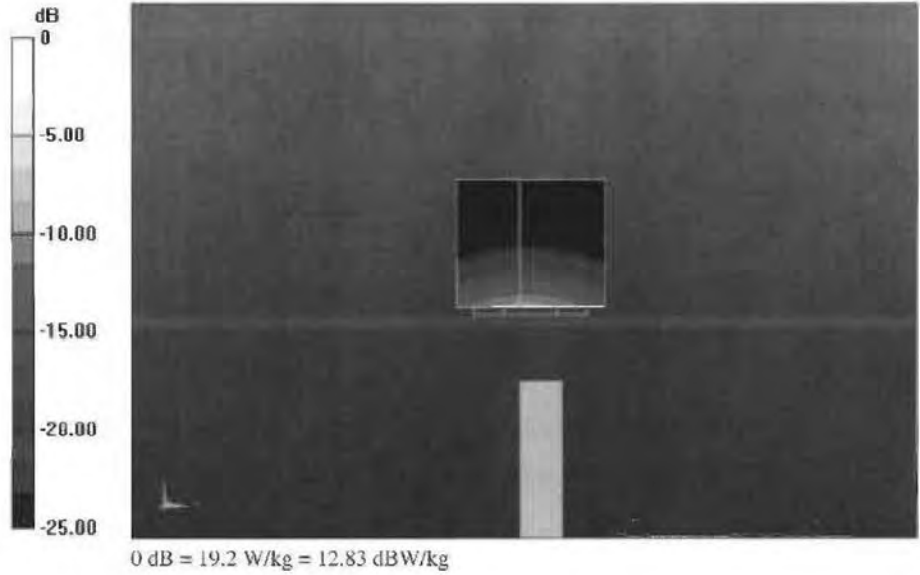
- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 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 = 0.08 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

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Author Data
Andrew Becker

Dates of Test
Mar 30 – May 14, 2015

Test Report No
RTS-6067-1505-05

FCC ID:
L6ARHR190LW

IC
2503A-RHR190LW

Impedance Measurement Plot for Head TSL

