	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 1(119)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

APPENDIX D: PROBE & DIPOLE CALIBRATION DATA

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Calibration Laboratory of Schmid & Partner Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: **SCS 108**

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

Certificate No: **ES3-3225_Jan12**

CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN:3225**

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

Calibration date: **January 11, 2012**

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

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

Calibration Equipment used (MATE critical for calibration)


Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	0841290874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	SN4448087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: 55054 (3x)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: 55086 (20x)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: 55129 (30x)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013, Cal 1)	Dec-12
DAE4	SN: 854	3-May-11 (No. DAE4-854, May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8649C	U52640201700	4-Aug-09 (in house check Apr-11)	In house check Apr-13
Network Analyzer HP 8733E	U527290555	18-Oct-01 (in house check Oct-12)	In house check Oct-12

Calibrated by: **Jason Kastner** Laboratory Technician

Approved by: **Katja Petrus** Technical Manager

Issued: January 12, 2012

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Accreditation No.: **SCS 108**

Glossary:


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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}: Assessed for E-field polarization $\beta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below Cor_{nF}).
- NORM_n(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 Cor_{nF}.
- DCP_{x,y,z}: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- Cor_{nF} 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} * Cor_{nF} whereby the uncertainty corresponds to that given for Cor_{nF}. A frequency dependent Cor_{nF} is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): In a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ES3DV3 – SN:3225

January 11, 2012

Probe ES3DV3

SN:3225

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

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

ES3DV3- SN:3225

January 11, 2012

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/V/m)^2$ ^a	1.26	1.26	1.30	$\pm 10.1\%$
DCP $(\mu V)^2$	101.2	100.8	101.2	

Modulation Calibration Parameters

usb	Communication System Name	PAR		A dB	B dB	C dB	WR mV	Unc ^b (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	101.7	$\pm 1.7\%$
			Y	0.00	0.00	1.00	113.4	
			Z	0.00	0.00	1.00	110.4	

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

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

^b Numerical linearization parameter: uncertainty not required.

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



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

ES3DV3- SN:3225

January 11, 2012

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	Coef F X	Coef F Y	Coef F Z	Alpha	Depth (mm)	Unc. (RMSE)
750	41.9	0.89	6.42	6.42	6.42	0.27	2.04	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.35	1.74	± 12.0 %
1810	40.0	1.40	5.23	5.23	5.23	0.73	1.21	± 12.0 %
1950	40.0	1.40	4.98	4.98	4.98	0.58	1.41	± 12.0 %
2450	39.2	1.80	4.50	4.50	4.50	0.79	1.26	± 12.0 %
2600	38.0	1.96	4.32	4.32	4.32	0.77	1.32	± 12.0 %

¹ Frequency validity of a 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RMS of the Coef² uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
² All frequencies below 3 GHz, the validity of tissue parameters (ρ and σ) can be relaxed to ± 10% if equal compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ρ and σ) is restricted to ± 5%. The uncertainty is the RMS of the Coef² uncertainty for indicated target tissue parameters.

ES3DV3- SN:3225

January 11, 2012

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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Uncert. (k%)
750	55.5	0.96	6.27	6.27	6.27	0.36	1.74	± 12.0 %
900	55.0	1.05	6.07	6.07	6.07	0.29	2.02	± 12.0 %
1810	53.3	1.52	4.92	4.92	4.92	0.50	1.57	± 12.0 %
1950	53.3	1.52	4.87	4.87	4.87	0.50	1.49	± 12.0 %
2450	52.7	1.95	4.30	4.30	4.30	0.68	1.16	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.80	0.99	± 12.0 %

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

² At frequencies below 3 GHz, the validity of tissue parameters (ρ 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 (ρ and σ) is restricted to ± 5%. The uncertainty is the RSS of the CorrF uncertainty for indicated target tissue parameters.

Author Data
Andrew Becker

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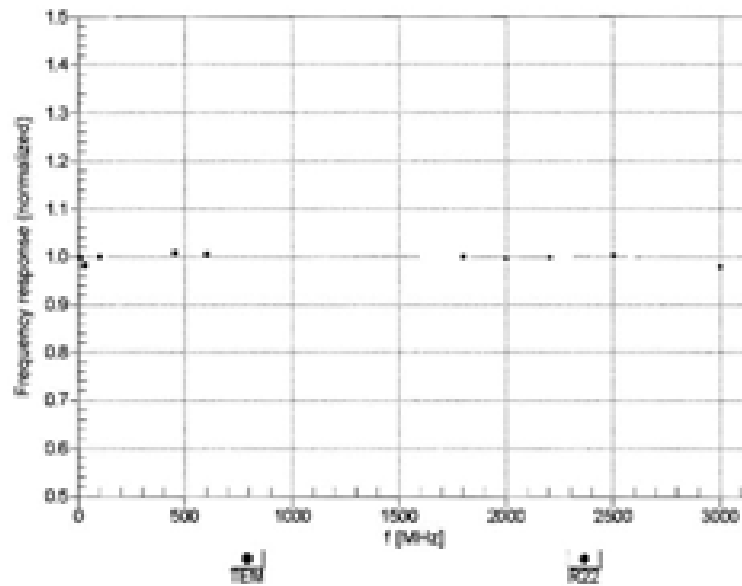
FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

E530V3- 09-3225

January 11, 2012

Frequency Response of E-Field (TEM-Cell: R1110 EXX, Waveguide: R22)



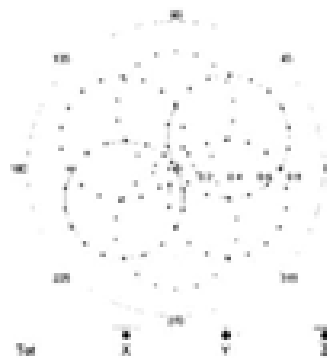
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ES3225-04-3225

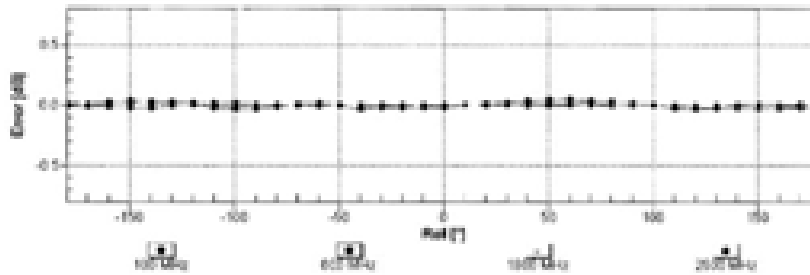
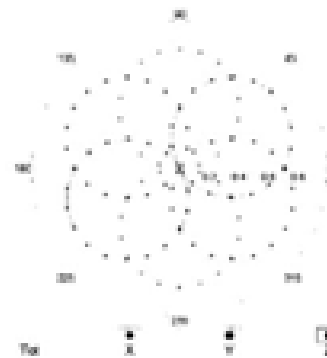
January 11, 2012

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

f=600 MHz, TEM



f=1800 MHz, R22

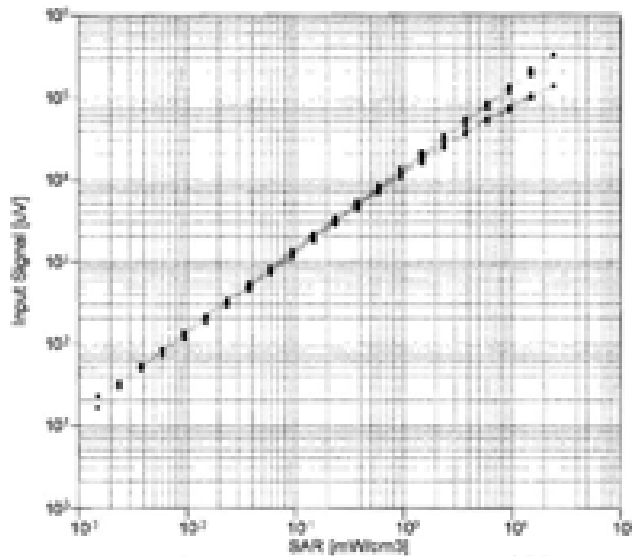


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

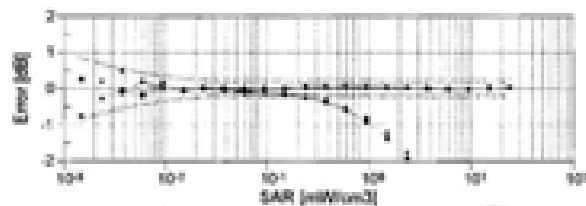
ES30V3- 04:3225

January 11, 2012

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



X compensated X not compensated Y compensated
 Y not compensated Z compensated Z not compensated



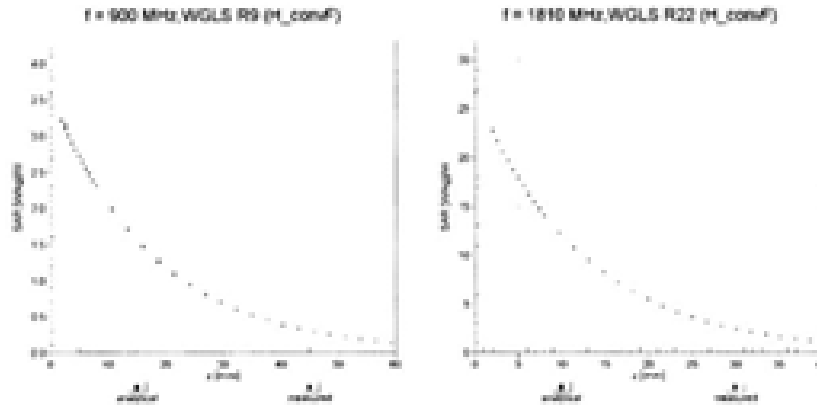
X compensated X not compensated Y compensated
 Y not compensated Z compensated Z not compensated

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

ES330V3- SW3225

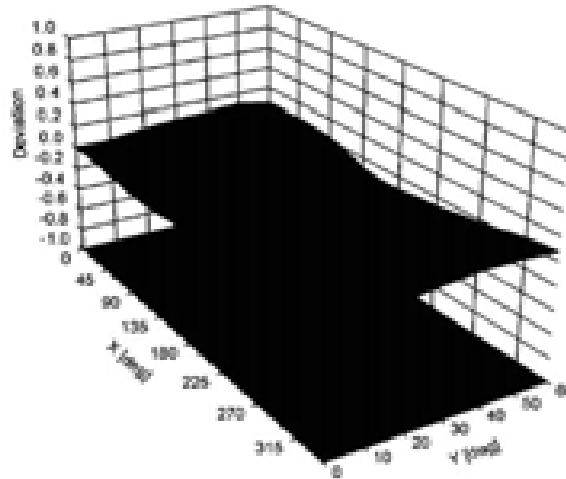
January 11, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (δ, θ), f = 900 MHz





Author Data
Andrew Becker

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FCC ID:
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2503A-RFL110LW

ES3DV3- SN:3225

January 11, 2012

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Accreditation No.: **SIC 148**

Client **RTS (RIM Testing Services)**

Certificate No: **ES3-3225_Jan13**

CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN:3225**

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



Calibration date: **January 10, 2013**

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

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


Calibration Equipment used (MPE critical for calibration):

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter F44196	084179074	28-Mar-12 (No. 217-01008)	Apr-13
Power sensor E44134	8714149807	28-Mar-12 (No. 217-01008)	Apr-13
Reference 1-dB Attenuator	SN: 87034 (20)	27-Mar-12 (No. 217-01001)	Apr-13
Reference 20-dB Attenuator	SN: 87086 (208)	27-Mar-12 (No. 217-01002)	Apr-13
Reference 30-dB Attenuator	SN: 87126 (208)	27-Mar-12 (No. 217-01003)	Apr-13
Reference Probe S/SK7V2	SN: 3213	28-Dec-12 (No. ES3-3013, Dec12)	Dec-13
DAF4	SN: 660	20-Jun-12 (No. DAF4-660, Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
HP generator HP 8448C	US2642UC1700	4-Jul-06 (in house check Apr-12)	In house check: Apr-13
Network Analyzer HP 8710E	US37380580	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kasnal	Laboratory Technician	
Approved by:	Kaja Pokovic	Technical Manager	

Issued: January 14, 2013

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Accreditation No.: **SCS 108**

Glossary:


TSL	issue 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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

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ES3DV3 - SN3225

January 10, 2013

Probe ES3DV3

SN:3225

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

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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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ES3DV3- SN:3225

January 10, 2013

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/m/(\text{V/m})^2$) ¹	1.28	1.18	1.31	$\pm 10.1\%$
DCP (mV) ²	100.5	101.5	99.9	

Modulation Calibration Parameters


URS	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Unc ³ (k=2)
0	CDT	X	0.0	0.0	1.0	0.00	107.5	$\pm 7.7\%$
		Y	0.0	0.0	1.0		106.4	
		Z	0.0	0.0	1.0		105.9	

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%.

¹ The uncertainties of NormX, Y, Z do not affect the E² field uncertainty inside T33, (see Pages 5 and 6).

² Numerical linearization parameter; uncertainty not required.

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

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ES3DV3 - SN:3225

January 10, 2013


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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unc. (k%)
750	41.9	0.89	6.56	6.56	6.56	0.42	1.54	± 12.0 %
900	41.5	0.97	6.19	6.19	6.19	0.43	1.52	± 12.0 %
1810	40.0	1.40	5.35	5.35	5.35	0.63	1.39	± 12.0 %
1950	40.0	1.40	5.09	5.09	5.09	0.80	1.23	± 12.0 %
2450	39.2	1.80	4.65	4.65	4.65	0.61	1.63	± 12.0 %
2600	39.0	1.96	4.43	4.43	4.43	0.80	1.32	± 12.0 %

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

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

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ES3DV3- SN:3225

January 10, 2013


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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unc. (k%)
750	55.5	0.96	6.27	6.27	6.27	0.48	1.51	± 12.0 %
900	55.0	1.05	6.12	6.12	6.12	0.73	1.25	± 12.0 %
1810	53.3	1.52	5.04	5.04	5.04	0.57	1.47	± 12.0 %
1850	53.3	1.52	4.94	4.94	4.94	0.58	1.50	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.70	1.16	± 12.0 %
2600	52.5	2.16	4.11	4.11	4.11	0.67	0.99	± 12.0 %

¹ Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 25), else it is restricted to ± 50 MHz. The uncertainty is the RMS of the CorrF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

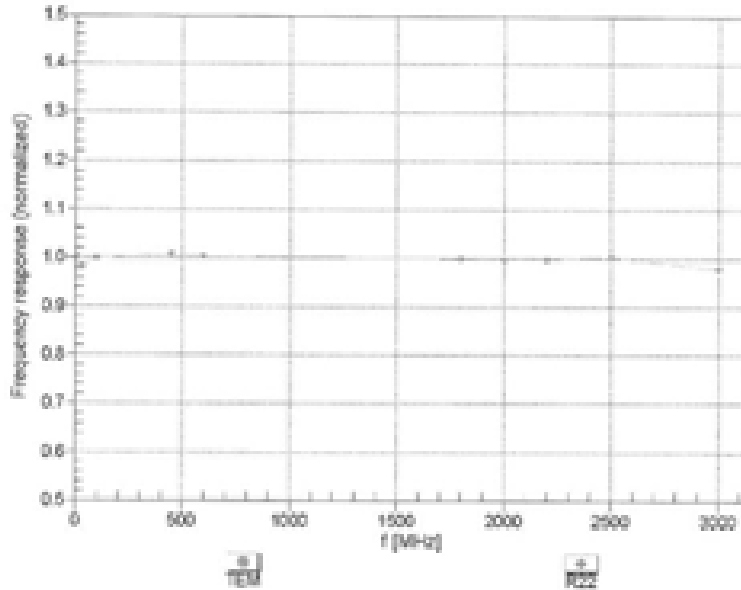
² At frequencies below 1 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 1 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RMS of the CorrF uncertainty for indicated target tissue parameters.

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ES330v3- 04/3/2013

January 10, 2013

Frequency Response of E-Field (TEM-Cell: iR1110 EXX, Waveguide: R22)



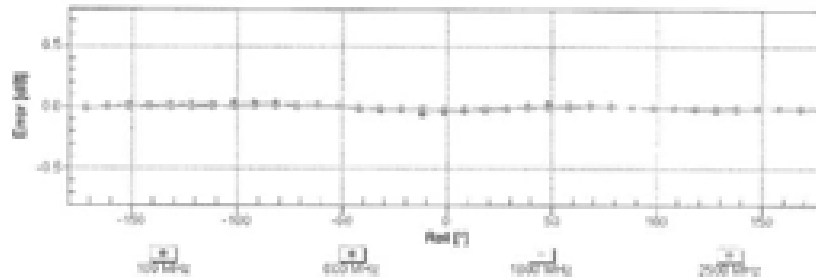
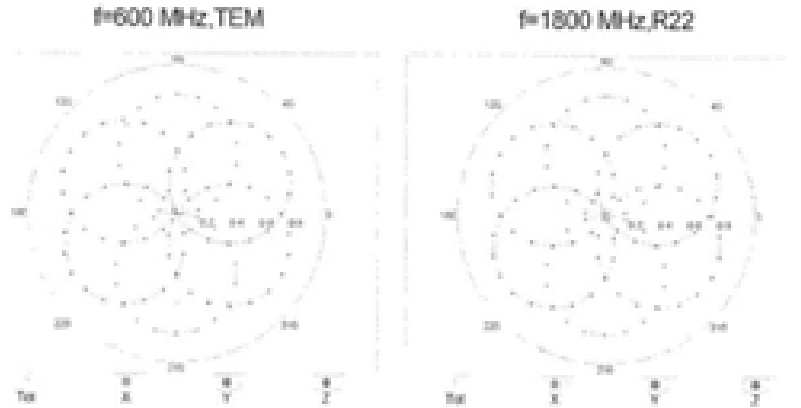
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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ES3225-5N-3225

January 10, 2013

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

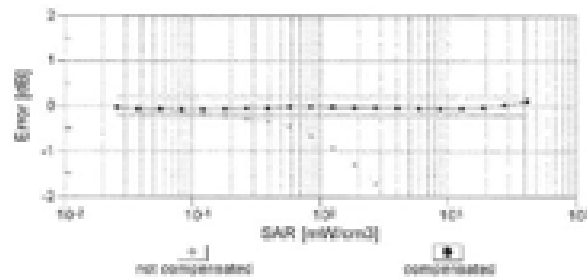
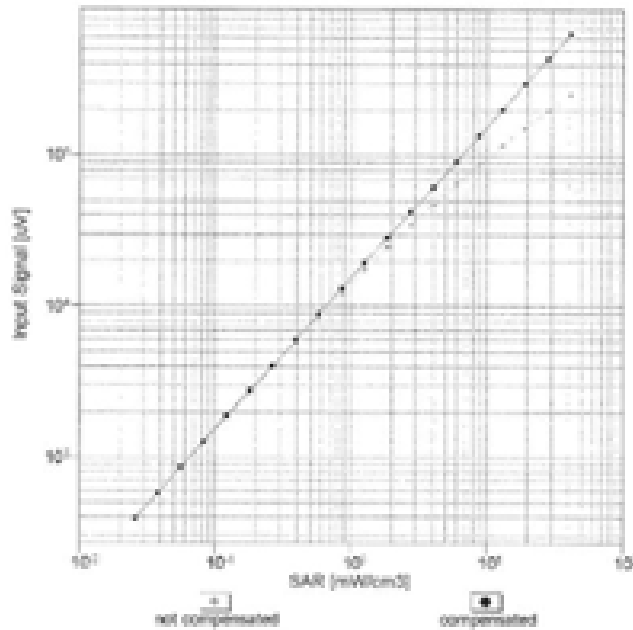


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)


ES3325- 243225

January 10, 2013

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



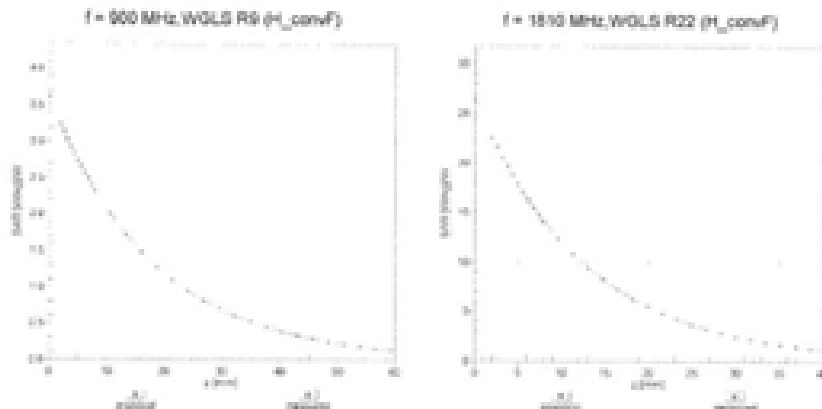
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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ES32V3-343225

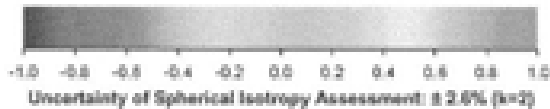
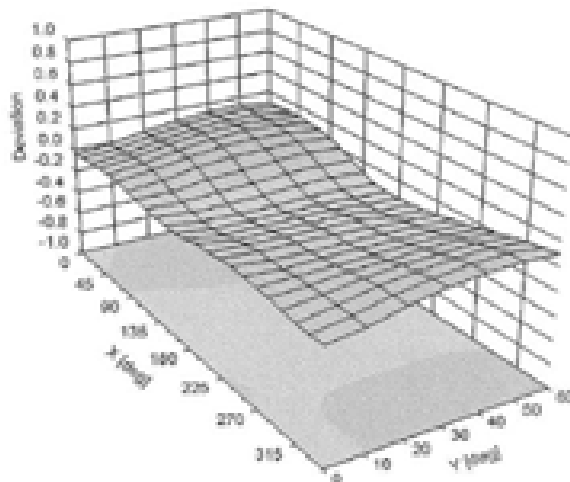
January 10, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$





Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

ES3DV3 - SN:3225

January 10, 2013

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	8.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

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

Client **RTS (RIM Testing Services)**

Certificate No: **EX3-3502_Nov12**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN-3502**

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

Calibration date: **November 14, 2012**

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

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

Calibration Equipment used (MPE critical for calibration)


Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E44198	0841200874	29-Mar-12 (No. 217-01908)	Apr-13
Power sensor E44124A	M191489001	29-Mar-12 (No. 217-01908)	Apr-13
Reference 5 dB Attenuator	SN: 55034 (3c)	27-Mar-12 (No. 217-01911)	Apr-13
Reference 20 dB Attenuator	SN: 55080 (20c)	27-Mar-12 (No. 217-01912)	Apr-13
Reference 30 dB Attenuator	SN: 55126 (30c)	27-Mar-12 (No. 217-01913)	Apr-13
Reference Probe E5304V2	SN: 3013	29-Dec-11 (No. 033-3013_Dec11)	Dec-12
DNA	SN: 660	25-Jun-12 (No. 0464-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8440C	US3642U01F00	4-Aug-09 (in house check Apr-11)	in house check Apr-13
Network Analyzer HP 8753E	US37360050	18-Oct-01 (in house check Oct-10)	in house check Oct-13

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

Approved by: **Kajko Polovic** (Name) / **Technical Manager** (Function) / *[Signature]* (Signature)

Issued: November 14, 2012

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

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

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EX3DV4 - 3M2002

November 14, 2012

Probe EX3DV4

SN:3592

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

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



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

EX3DV4 - SN:3592

November 14, 2012

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm. $(\mu V/W/m^2)^2$	0.40	0.41	0.41	$\pm 10.1\%$
DCP $(mV)^2$	95.2	98.1	100.6	

Modulation Calibration Parameters


UID	Communication System Name	PAR		A dB	B dB	C dB	WR mV	Unc ¹ (k=2)
0	OW	0.00	X	0.0	0.0	1.0	101.4	$\pm 3.0\%$
			Y	0.0	0.0	1.0	104.3	
			Z	0.0	0.0	1.0	109.2	

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

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

² Numerical linearization parameter; uncertainty not required.

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

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EX3DV4 - SN:3592

November 14, 2012


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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	CorrF X	CorrF Y	CorrF Z	Alpha	Depth (mm)	Unc. (k%)
2600	39.0	1.96	6.45	6.45	6.45	0.53	0.79	± 12.0 %
5200	36.0	4.66	4.73	4.73	4.73	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.28	4.28	4.28	0.44	1.80	± 13.1 %
5800	35.3	5.27	4.12	4.12	4.12	0.48	1.80	± 13.1 %

¹ Frequency validity of ± 100 kHz only applies for DASY v1.4 and higher (see Page 23), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the CorrF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

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EX3DV4-SN-3592

November 14, 2012


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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	Coeff X	Coeff Y	Coeff Z	Alpha	Depth (mm)	Unc. (k=2)
2600	52.5	2.16	6.59	6.59	6.59	0.80	0.50	± 12.6 %
5200	49.0	5.30	4.02	4.02	4.02	0.48	1.00	± 13.1 %
5500	48.6	5.85	3.66	3.66	3.66	0.56	1.00	± 13.1 %
5800	48.2	6.00	3.57	3.57	3.57	0.57	1.00	± 13.1 %

¹ Frequency validity of ± 100 MHz only applies for EASY of 4 and higher (see Page 2); also it is restricted to ± 50 MHz. The uncertainty is the RSS of the Coeff uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

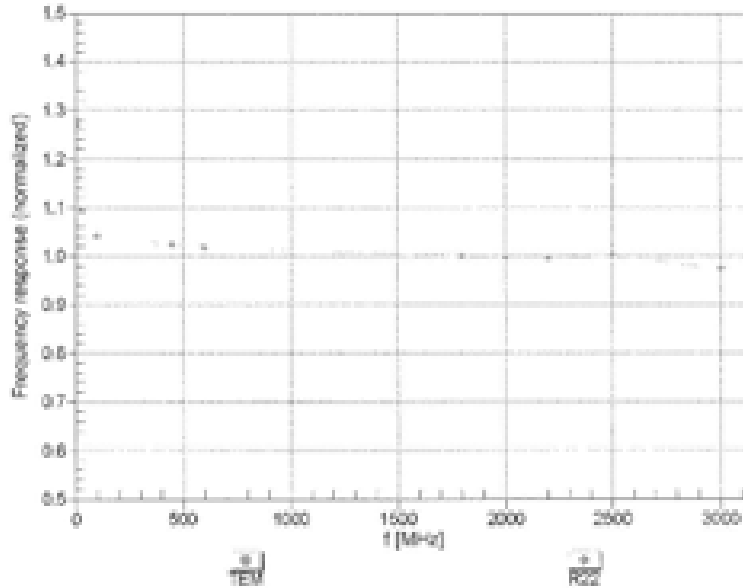
² At frequencies below 3 GHz, the validity of tissue parameters (ρ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ρ and σ) is restricted to ± 5%. The uncertainty is the RSS of the Coeff uncertainty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

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EX303A--SN3002

November 14, 2012

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



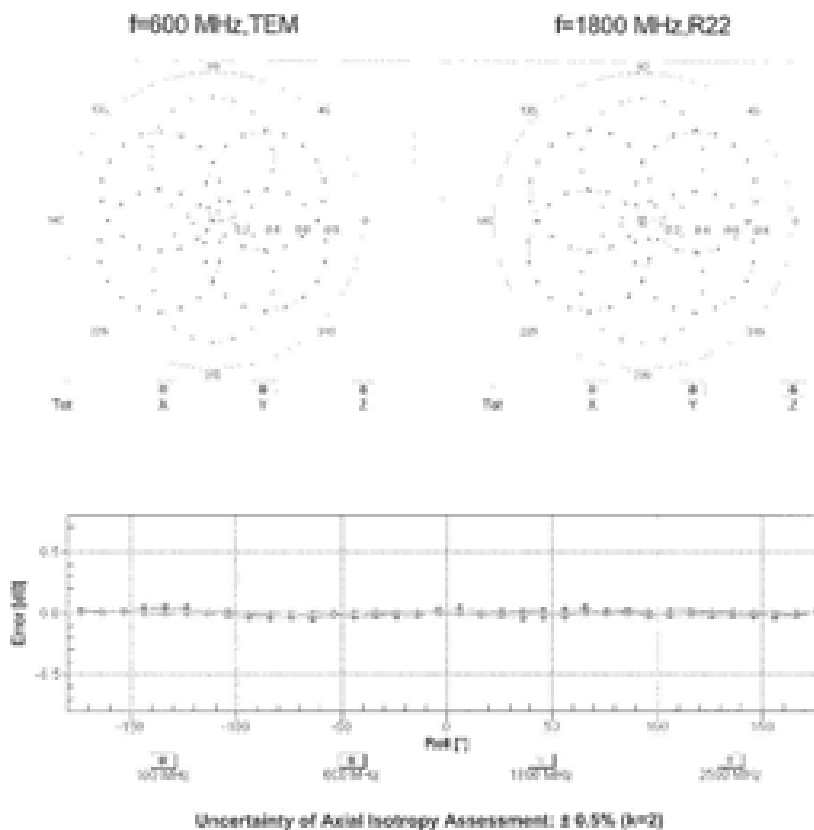
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)


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EX03V6-SN3092

November 14, 2012

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

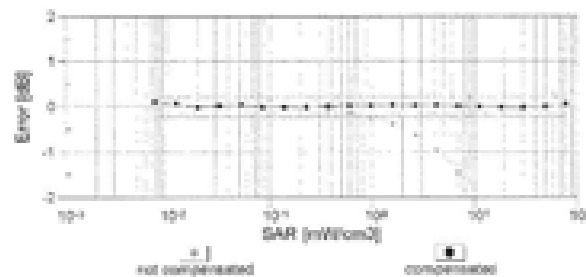
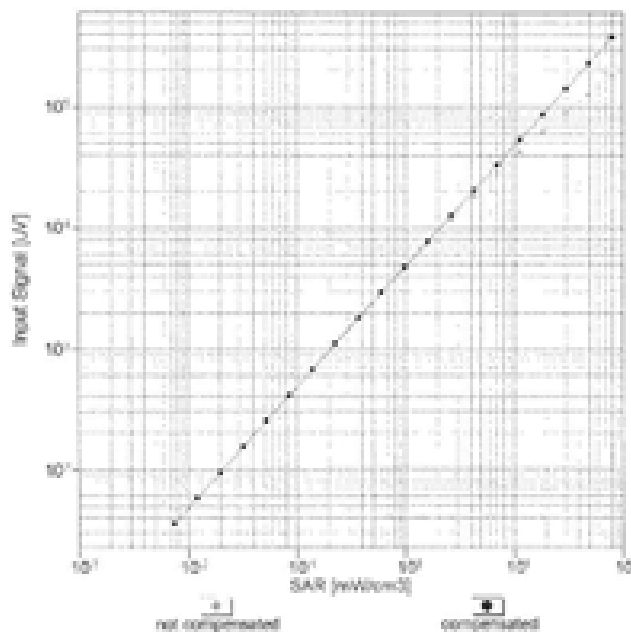


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E00014-02/0302

November 14, 2012

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

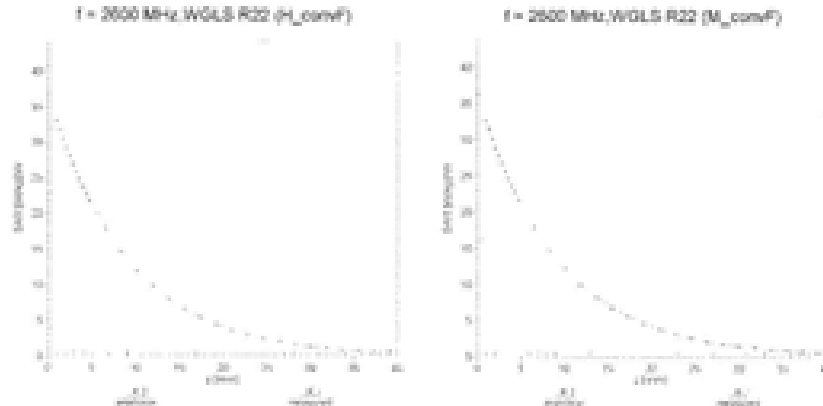


Uncertainty of Linearity Assessment: ± 0.4% (k=2)

EKG304-3M3592

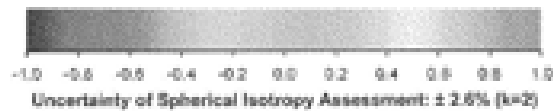
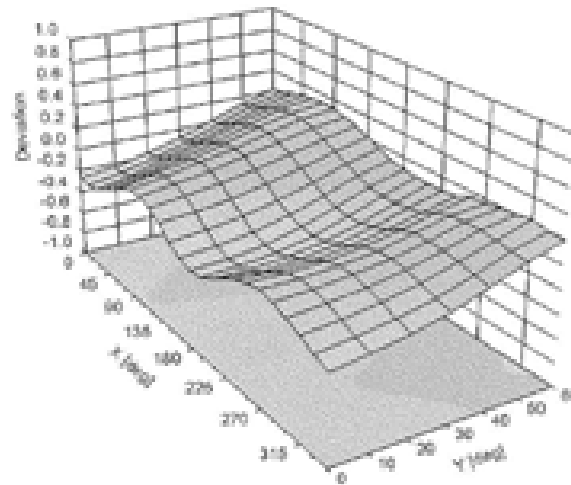
November 14, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900$ MHz





Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW


EX3DV4 - SN:3592

November 14, 2012

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-13.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

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Accreditation No.: **SCS 108**


Client **RTS (RIM Testing Services)**

Certificate No: **ET3-1644_Nov12**

CALIBRATION CERTIFICATE	
Object	ET30V0 - SN:1644
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date	November 13, 2012
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (23 ± 3)°C and humidity = 70%.</p> <p>Calibration Equipment used (MATE critical for calibration)</p>	

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E-61193	G84128874	29-Mar-12 (No. 217-01509)	Apr-13
Power sensor E-6113A	M741499097	29-Mar-12 (No. 217-01509)	Apr-13
Reference 3 dB Attenuator	SN: 55054 (70)	27-Mar-12 (No. 217-01537)	Apr-13
Reference 20 dB Attenuator	SN: 55086 (20)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: 55129 (30)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe E-530V2	SN: 3073	29-Dec-11 (No. 193-3013, Dec-11)	Dec-12
DAE4	SN: 690	20-Jun-12 (No. 243-4460, Jun-12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8640C	U53943J01700	4-Aug-09 (in house check Apr-11)	In-house check Apr-13
Network Analyser HP 8730E	U532360590	18-Oct-01 (in house check Oct-12)	In-house check Oct-13

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

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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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, $f \cdot NORM_{x,y,z}$
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization β	β rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\beta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2006

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\beta = 0$ ($f \leq 300$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not affect the E-field uncertainty inside TSL (see below $ConvF$).
- $NORM(f)_{x,y,z} = NORM_{x,y,z} \cdot \text{frequency_response}$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of $ConvF$.
- $DCP_{x,y,z}$: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- $A_{x,y,z}$; $B_{x,y,z}$; $C_{x,y,z}$; $VR_{x,y,z}$: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- $ConvF$ and boundary Effect Parameters: Assessed in fat phantom using E-field (or Temperature Transfer Standard for $f \leq 300$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 300$ 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 $NORM_{x,y,z} \cdot ConvF$ whereby the uncertainty corresponds to that given for $ConvF$. A frequency dependent $ConvF$ is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a fat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ET3DV6 - SN:1644

November 13, 2012

Probe ET3DV6

SN:1644

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

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

ET3DV6 - SN:1644

November 13, 2012

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $\mu_{\text{W}}/(\text{V/m})^2$ ¹	1.71	1.97	1.98	$\pm 10.1\%$
DCP μm^2 ²	99.5	98.7	97.5	

Modulation Calibration Parameters


UID	Communication System Name	FAR		A dB	B dB	C dB	VM mV	Unc ³ (k=2)
0	Cell	0.00	X	0.0	0.0	1.0	180.0	$\pm 0.5\%$
			Y	0.0	0.0	1.0	212.0	
			Z	0.0	0.0	1.0	201.7	

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

¹ The uncertainties of Norm X, Y, Z do not affect the E² field uncertainty inside T34 (see Pages 5 and 6).

² Numerical linearization parameter uncertainty not required.

³ 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:1644

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ²	Coeff X	Coeff Y	Coeff Z	Alpha	Depth (mm)	Uncl. (k=2)
750	41.9	0.89	6.57	6.57	6.57	0.44	2.25	± 12.0 %
900	41.5	0.97	6.24	6.24	6.24	0.38	2.32	± 12.0 %
1810	40.0	1.40	5.21	5.21	5.21	0.60	2.10	± 12.0 %
1950	40.0	1.40	5.16	5.16	5.16	0.60	2.09	± 12.0 %
2450	39.2	1.60	4.60	4.60	4.60	0.65	2.00	± 12.0 %

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

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

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ET3DV6- SN:1644

November 13, 2012


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

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity (S/m) ³	Coeff X	Coeff Y	Coeff Z	Alpha	Depth (mm)	Unc. (k=2)
750	55.5	0.96	6.30	6.30	6.30	0.33	2.61	± 12.0 %
900	55.0	1.05	6.06	6.06	6.06	0.31	2.99	± 12.0 %
1810	53.3	1.52	4.75	4.75	4.75	0.80	2.40	± 12.0 %
1900	53.3	1.52	4.75	4.75	4.75	0.80	2.28	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.50	2.15	± 12.0 %

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

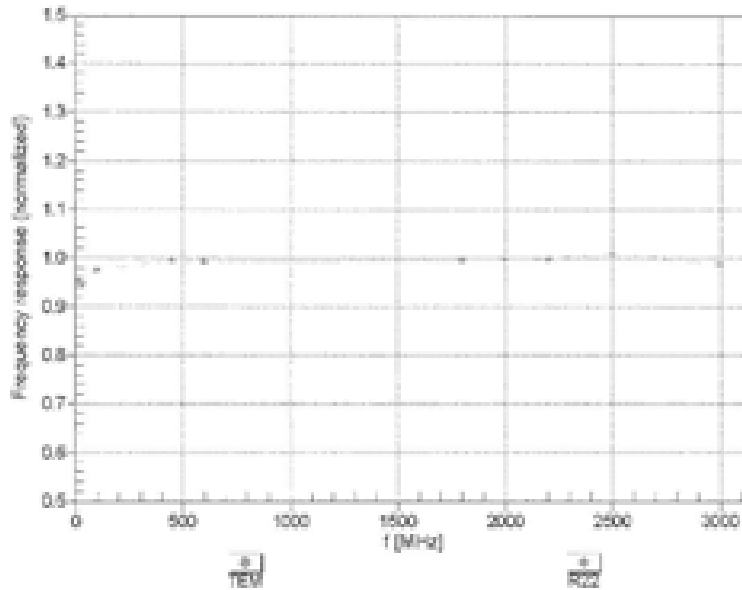
² At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 8%. The uncertainty is the RSS of the CoEFF uncertainty for indicated target tissue parameters.

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ET30V01- 04;1644

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Frequency Response of E-Field (TEM-Cell:IR1110 EXX, Waveguide: R22)



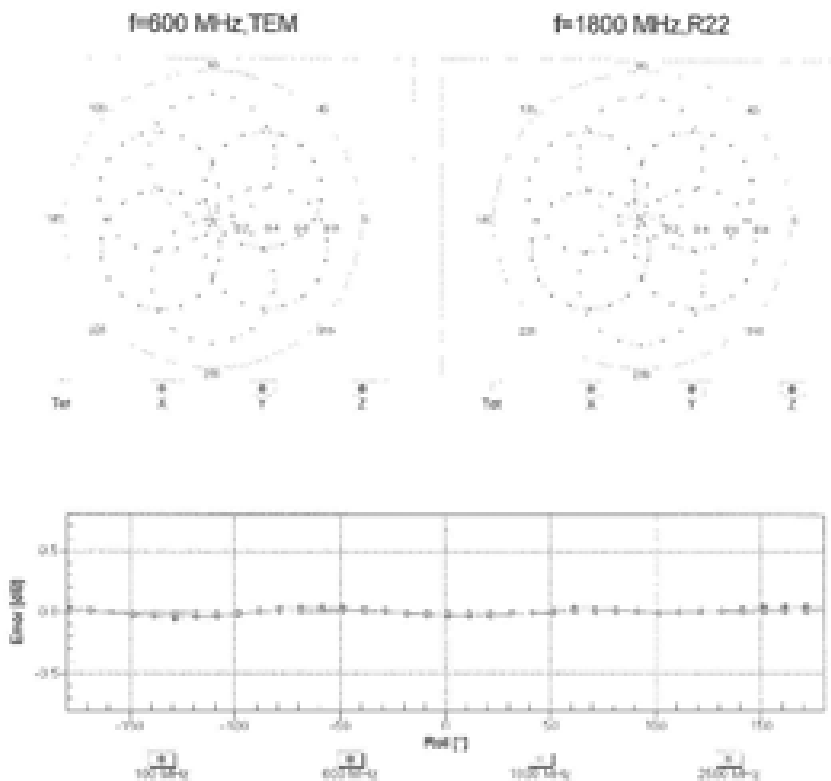
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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ET3016- SN1644

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

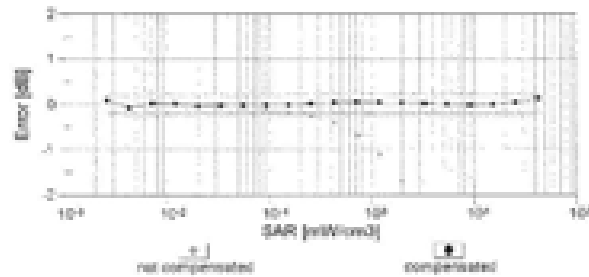
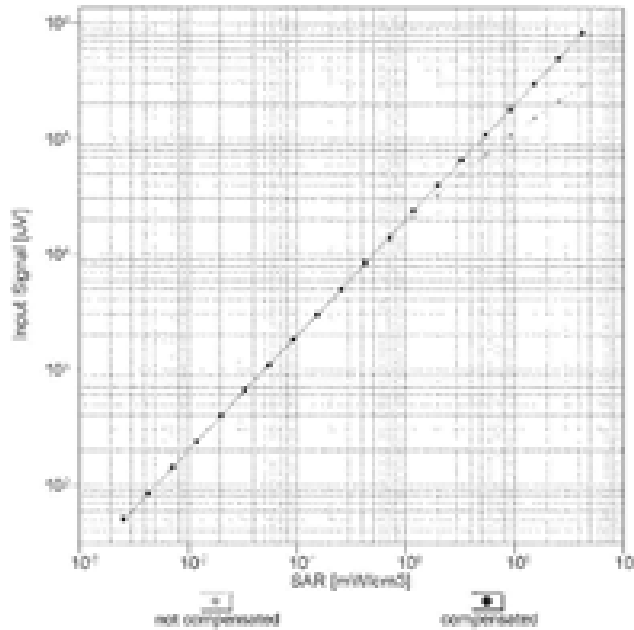


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)


ETS0146- 04/10/11

November 13, 2012

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



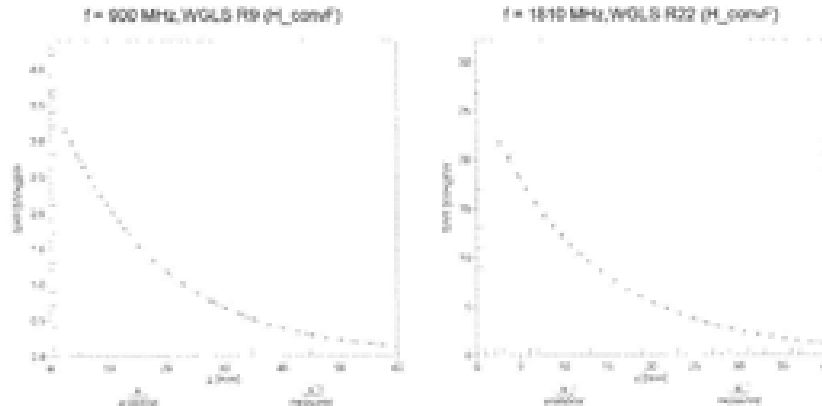
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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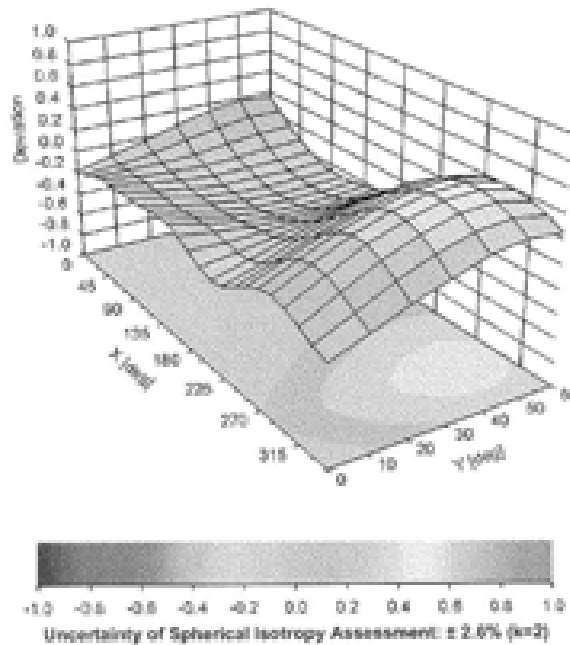
ETS0V6-5N1644

November 13, 2012

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (k, 3), f = 900 MHz





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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	61.5
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	enabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Calibration Laboratory of Schmid & Partner Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland




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Accreditation No.: **SCS 108**

Client **RIM**

Certificate No.: **D750V3-1021_Jan11**

CALIBRATION CERTIFICATE			
Object	D750V3 - SN: 1021		
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits		
Calibration date:	January 05, 2011		
<p>This calibration certificate documents the accessibility 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 (MATE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	CE57480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37282763	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20-dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SN: 3005	30-Apr-10 (No. ES3-3005_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in-house)	Scheduled Check
Power sensor HP 8481A	MP41092317	18-Oct-09 (in house check Oct-09)	In-house check: Oct-11
RF generator P&S SMT-06	100005	4-Aug-09 (in house check Oct-09)	In-house check: Oct-11
Network Analyzer HP 8733E	US37380065 84205	18-Oct-01 (in house check Oct-10)	In-house check: Oct-11
Calibrated by:	Name Jason Kästner	Function Laboratory Technician	Signature 
Approved by:	Name Kajsa Pokovic	Technical Manager	
Issued: January 6, 2011			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
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FCC ID:
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Measurement Conditions

DASY system configuration, as far as not given on page 5.

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

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	$(22.0 \pm 0.2) \text{ °C}$	$42.3 \pm 6 \%$	$0.91 \text{ mho/m} \pm 6 \%$
Head TSL temperature during test	$(22.0 \pm 0.2) \text{ °C}$	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	3.12 mW / g
SAR normalized	normalized to 1W	8.48 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.36 mW / g $\pm 17.0 \%$ (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.38 mW / g
SAR normalized	normalized to 1W	5.52 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.45 mW / g $\pm 16.8 \%$ (k=2)



Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω - 1.7 jΩ
Return Loss	-29.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 ns
----------------------------------	----------


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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 01, 2010

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASY5 Validation Report for Head TSL

Date/Time: 05.01.2011 15:51:17

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL750

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

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; CoaxF(6.37, 6.37, 6.37); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Snt01; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY52, V52.6 Build (401)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

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

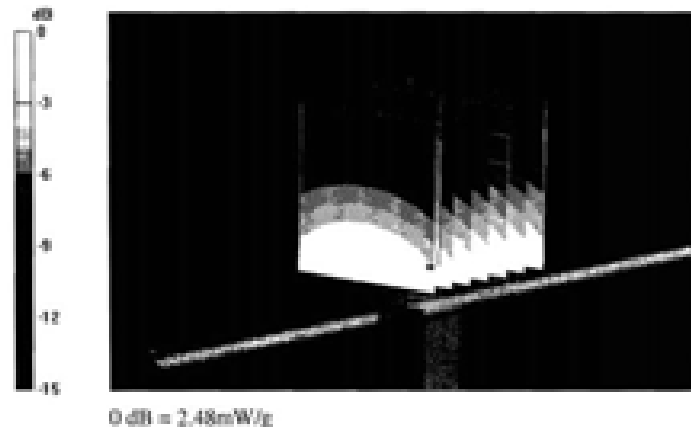
$dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 33.5 V/m; Power Drift = -0.00432 dB

Peak SAR (extrapolated) = 3.24 W/kg

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

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



Author Data
Andrew Becker

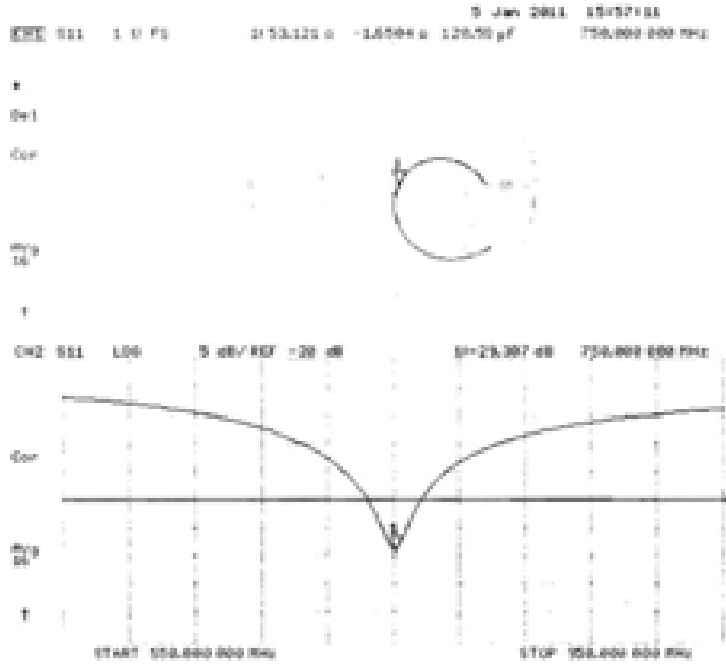
Dates of Test
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FCC ID:
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Impedance Measurement Plot for Head TSL



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D750V3-1021_Jan13**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1021**

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



Calibration date: **January 07, 2013**

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

All calibrations have been conducted in the closest laboratory facility: environment temperature (22 ± 3)°C and humidity = 70%.


Calibration Equipment used (MATE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	04827480704	01-Nov-12 (No. 217-01040)	Oct-13
Power sensor HP 8481A	US32760785	01-Nov-12 (No. 217-01040)	Oct-13
Reference 20-dB Attenuator	SN: 3058 (20x)	27-Mar-12 (No. 217-01030)	Apr-13
Type-N mismatch combination	SN: 6047.3 / 06327	27-Mar-12 (No. 217-01030)	Apr-13
Reference Probe E5307x3	SN: 3705	28-Dec-12 (No. E53-3205_Dec12)	Dec-13
DAQ#4	SN: 601	27-Jun-12 (No. DA64-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	M741002317	18-Oct-09 (in house check Oct-11)	In house check: Oct-13
RF generator RLS (SMT-06)	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8713E	US32760585 (4206)	18-Oct-09 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Lutz Klyener	Function Laboratory Technician	Signature 
Approved by:	Name Katja Polowik	Technical Manager	

Issued: **January 8, 2013**

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
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Measurement Conditions

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

DASY Version	DASY5	V52 a.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.4 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

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

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.91 W/kg ± 14.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.033 ns
----------------------------------	----------


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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 01, 2010

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASYS Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 750 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN:205; CorvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sa601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

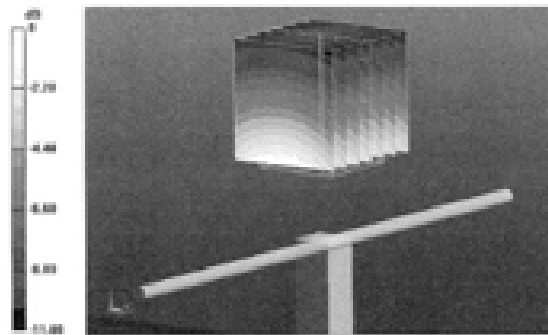
Measurement grid: $d_x=5\text{mm}$, $d_y=5\text{mm}$, $d_z=5\text{mm}$

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

Peak SAR (extrapolated) = 3.23 W/kg

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

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



Author Data
Andrew Becker

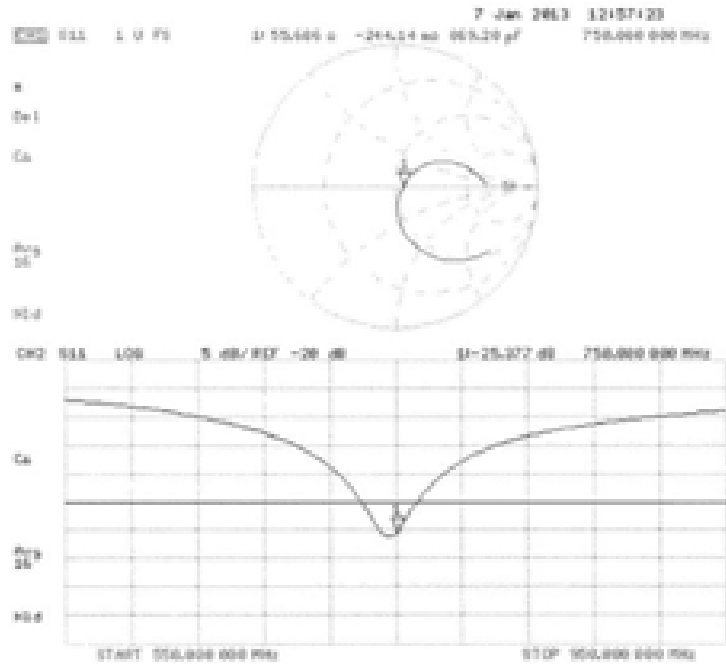
Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Impedance Measurement Plot for Head TSL



Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Accredited by the Swiss Accreditation Service (SAS)
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Accreditation No.: **SCS 108**

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

Certificate No.: **D835V2-446_Jan11**

CALIBRATION CERTIFICATE			
Object	D835V2 - SN: 446		
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits		
Calibration date:	January 21, 2011		
<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 (MATE critical to calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	Q830480704	06-Oct-10 (No. 217-01296)	Oct-11
Power sensor HP 8481A	US37292763	06-Oct-10 (No. 217-01296)	Oct-11
Reference 20 dB Attenuator	SA: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SA: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES30V3	SA: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SA: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MPH1092317	18-Oct-09 (in house check Oct-09)	In house (check): Oct-11
RF generator R&S SMY-06	100005	4-Aug-09 (in house check Oct-09)	In house (check): Oct-11
Network Analyser HP 8730E	US37380585 (4206)	18-Oct-01 (in house check Oct-10)	In house (check): Oct-11
Calibrated by:	Name Dirce Rey	Function Laboratory Technician	Signature 
Approved by:	Name Katja Pokorski	Function Technical Manager	Signature 
<p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Issued: January 21, 2011</p>			

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Measurement Conditions

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

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

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	32.0 °C	41.5	0.80 mho/m
Measured Head TSL parameters	(32.0 ± 0.2) °C	41.3 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature during test	(21.8 ± 0.2) °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 mW / g
SAR normalized	normalized to 1W	9.56 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.63 mW / g ± 17.6 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 mW / g
SAR normalized	normalized to 1W	6.24 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.37 mW / g ± 16.5 % (k=2)



Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.8 Ω - 7.7 $j\Omega$
Return Loss	- 32.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.360 ns
----------------------------------	----------


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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 24, 2001

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASYS Validation Report for Head TSL

Date/Time: 21.01.2011 10:18:05

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL900

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

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 S0601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4.5L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASYS2, VS2.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

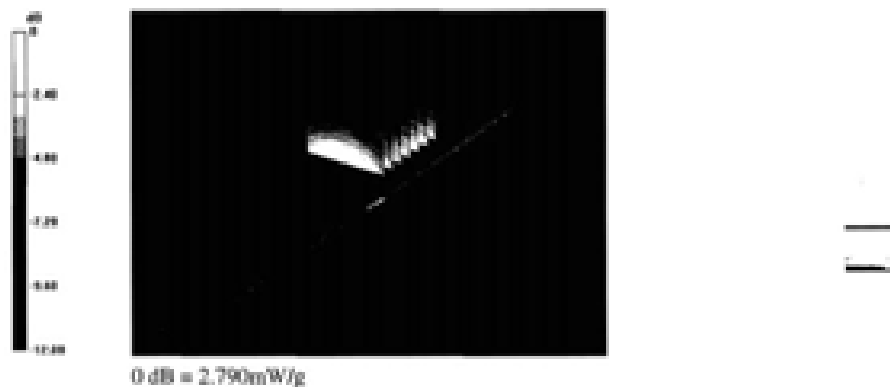
Pin=250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm


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

Peak SAR (extrapolated) = 3.600 W/kg

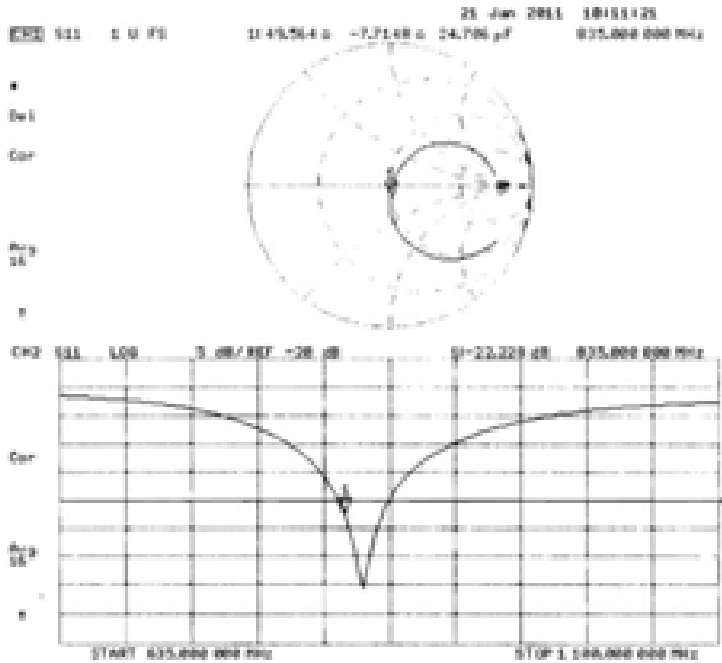
SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.56 mW/g


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



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Impedance Measurement Plot for Head TSL



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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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Accreditation No.: **SCS 108**

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

Certificate No: **D835V2-446_Jan13**

CALIBRATION CERTIFICATE

Object: **D835V2 - SN: 446**
 Calibration procedure(s): **QA CAL-05.v9
 Calibration procedure for dipole validation kits above 700 MHz**
 Calibration date: **January 07, 2013**



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

All calibrations have been conducted in the closed laboratory facility: environment temperature (20 ± 2)°C and humidity < 70%.

Calibration Equipment used (MATE critical for calibration)


Primary Standards	ID #	Cal Date / Certificate No.	Scheduled Calibration
Power meter EPM-412A	0820480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292785	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (304)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01530)	Apr-13
Reference Probe ESGDV0	SN: 3205	28-Dec-12 (No. 853-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
HP generator R&S (SM7-09)	100005	01-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8713E	US37390385 54206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by:	Name Leif Ryner	Function Laboratory Technician	Signature 
Approved by:	Name Katja Poliwski	Function Technical Manager	Signature 

Issued: **January 8, 2013**

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Measurement Conditions

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

DASY Version	DASYS	V92.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 0 %	0.92 mho/m ± 0 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.39 W/kg ± 17.0 % (k=2)

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



Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.1 Ω - 6.5 j Ω
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.395 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 SAR1 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 Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

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

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

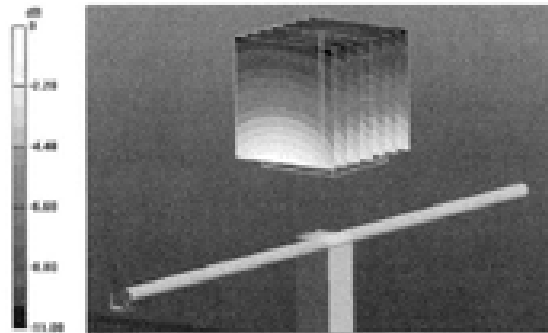
Measurement grid: $d_x=5\text{mm}$, $d_y=5\text{mm}$, $d_z=5\text{mm}$

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


Peak SAR (extrapolated) = 3.61 W/kg

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

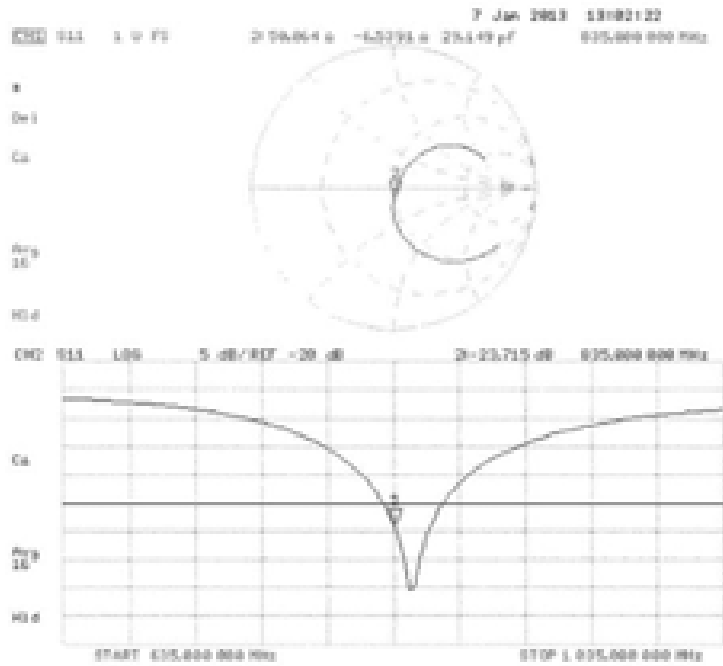
Maximum value of SAR (measured) = 2.79 W/kg




0 dB = 2.79 W/kg = 4.46 dBW/kg

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Impedance Measurement Plot for Head TSL



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Author Data	Dates of Test	Test Report No	FCC ID:	IC
Andrew Becker	Nov 22 2012 – Feb 28 2013	RTS-6026-1302-13	L6ARFL110LW	2503A-RFL110LW

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Accreditation No.: **SCS 108**


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

Certificate No.: **D635V2-4d043_Apr11**

CALIBRATION CERTIFICATE			
Object	D635V2 - SN: 4d043		
Calibration procedure(s)	GA CAL-05.v8 Calibration procedure for dipole validation kits		
Calibration date:	April 07, 2011		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the client laboratory facility, environment temperature: (20 ± 3)°C and humidity: < 70%.</p> <p>Calibration Equipment used (NISTE critical for calibration)</p>			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 8PM-4024	0180488704	06-Oct-10 (No. 217-01264)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01264)	Oct-11
Reference 30 dB Attenuator	SN: 3046 (70g)	29-Mar-11 (No. 217-01268)	Apr-12
Type-N mismatch combination	SN: 3047 2 / 06007	29-Mar-11 (No. 217-01271)	Apr-12
Reference Probe ES30V3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	18-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MP41062317	18-Oct-09 (in house check Oct-09)	In house check Oct-11
RF generator RAS SMT-06	102005	4-Aug-09 (in house check Oct-09)	In house check Oct-11
Network Analyser HP 8712B	US37390585 54056	18-Oct-09 (in house check Oct-09)	In house check Oct-11
Calibrated by:	Name Jelton Kasriel	Function Laboratory Technician	Signature   Issued April 7, 2011
Approved by:	Name Katja Polonic	Function Technical Manager	
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Certificate No: **D635V2-4d043_Apr11**

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	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 71(119)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Measurement Conditions

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

DASY Version	DASY5	V5.2.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	$d_x, d_y, d_z = 5 \text{ mm}$	
Frequency	$935 \text{ MHz} \pm 1 \text{ MHz}$	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.99 mho/m
Measured Head TSL parameters	$(22.0 \pm 0.2) \text{ °C}$	$40.6 \pm 6 \%$	$0.98 \text{ mho/m} \pm 6 \%$
Head TSL temperature during test	$(22.0 \pm 0.2) \text{ °C}$	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	3.33 mW / g
SAR normalized	normalized to 1W	9.92 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.43 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.32 mW / g
SAR normalized	normalized to 1W	6.08 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.14 mW / g \pm 15.5 % (k=2)

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.8 Ω - 3.4 jΩ
Return Loss	-27.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.291 ns
----------------------------------	----------

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


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

Design Modification by End User

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 07, 2006

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 74(119)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASYS Validation Report for Head TSL

Date/Time: 07.04.2011 09:28:21

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d043

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

Medium: HSI-900

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

Phantom section: Flat Section

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

DASYS Configuration:

- Probe: ES3DV3 - SN3205; CoaxF(6.03, 6.03, 6.03); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Set601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 4-91; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASYS2, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

P_{in}=250 mW /d=15mm/Cube 0;

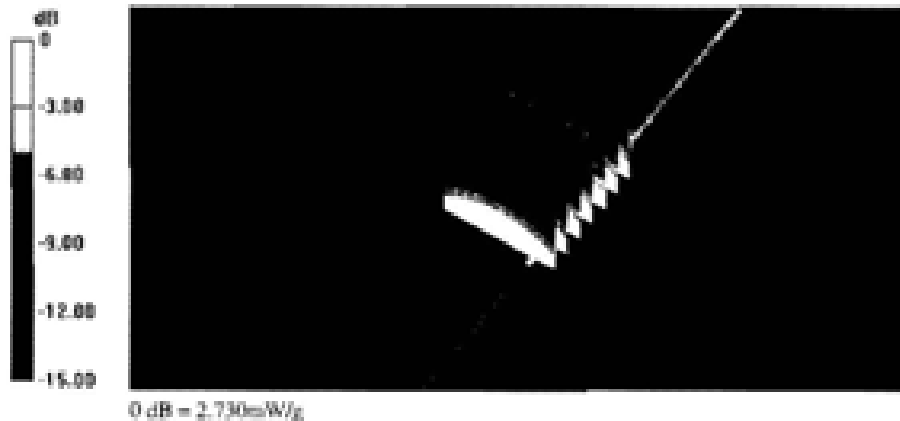
Measurement grid: $d_x=5\text{mm}$, $d_y=5\text{mm}$, $d_z=5\text{mm}$

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

Peak SAR (extrapolated) = 3.904 W/kg

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

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



Author Data
Andrew Becker

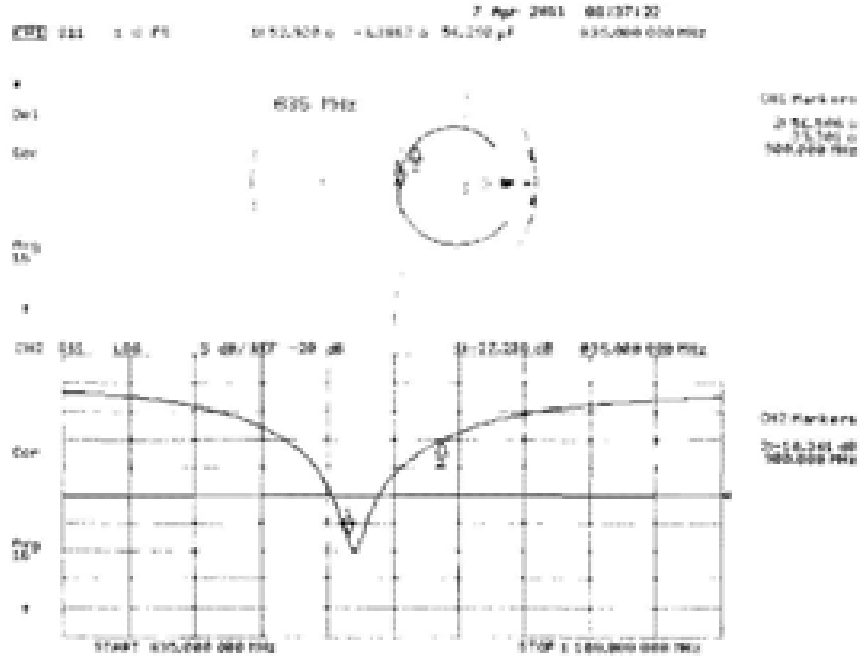
Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Impedance Measurement Plot for Head TSL



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No.: **D1800V2-2d020_Jan11**

CALIBRATION CERTIFICATE

Object **D1800V2 - SN: 2d020**

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

Calibration date: **January 13, 2011**

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

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

Calibration Equipment used (MPE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0820480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	U527262763	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20-dB Attenuator	SA: 5086 (20g)	30-Mar-10 (No. 217-01156)	Mar-11
Type-N mismatch combination	SA: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ESS0V3	SA: 3205	30-Apr-10 (No. ESS-3205_Apr10)	Apr-11
DAE4	SA: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11


Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MP41002317	18-Oct-02 (in house check Oct-08)	In house check: Oct-11
RF generator R&S (SMT-06)	103005	4-Aug-09 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8713E	U527260585 54206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Dimas Bar** (Name) / **Laboratory Technician** (Function) / *[Signature]* (Signature)

Approved by: **Katja Pöschel** (Name) / **Technical Manager** (Function) / *[Signature]* (Signature)

Issued: January 13, 2011

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

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Measurement Conditions

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

DASY Version	DASYS	V52.6
Extrapolation	Advanced Extrapolation	
Phantoms	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	$\delta x, \delta y, \delta z = 5$ mm	
Frequency	1800 MHz \pm 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 \pm 0.2) °C	38.0 \pm 6 %	1.38 mho/m \pm 6 %
Head TSL temperature during test	(21.3 \pm 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.78 mW / g
SAR normalized	normalized to 1W	39.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.3 mW / g \pm 17.0 % (k=2)

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



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

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L6ARFL110LW

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Appendix

Antenna Parameters with Head TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.216 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 07, 2001

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASY5 Validation Report for Head TSL

Date/Time: 13.01.2011 12:34:12

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL U12 BB

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

Phantom section: Flat Section

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

DASY5 Configuration:

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

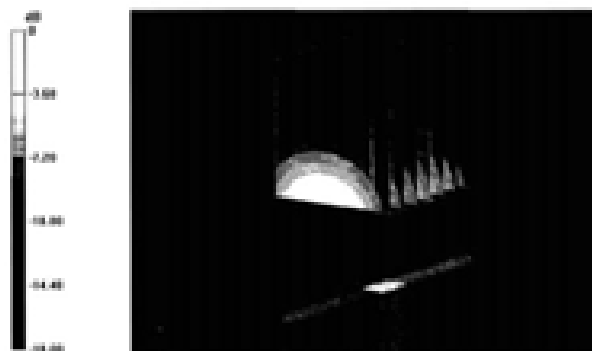
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm


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

Peak SAR (extrapolated) = 17.902 W/kg

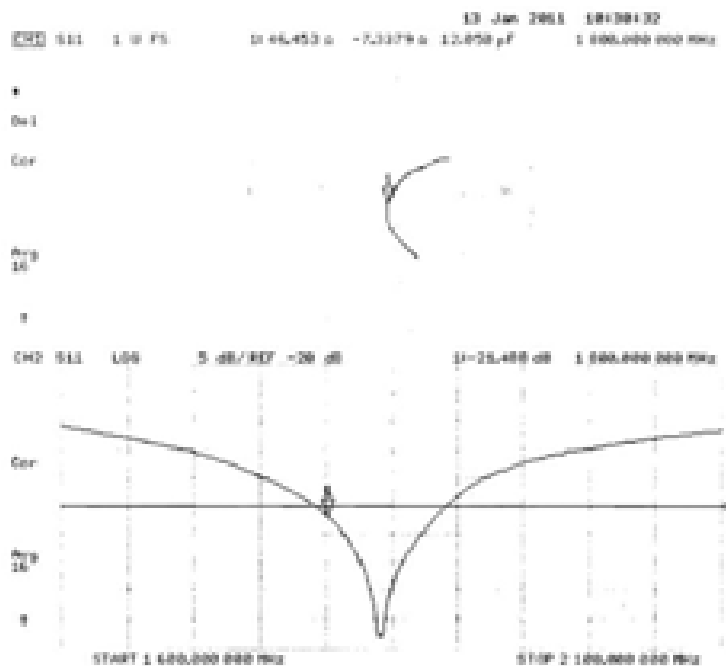
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.13 mW/g


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



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Impedance Measurement Plot for Head TSL



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Accreditation No.: **SCS 108**

Class **RTS (RIM Testing Services)**

Certificate No: **D1800V2-2d020_Jan13**

CALIBRATION CERTIFICATE																																															
Object	D1800V2 - SN: 2d020																																														
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz																																														
Calibration date:	January 09, 2013																																														
<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 (MATE critical for calibration):</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM-442A</td> <td>0807480704</td> <td>01-Nov-12 (No. 217-01640)</td> <td>Oct-13</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US07260760</td> <td>01-Nov-12 (No. 217-01640)</td> <td>Oct-13</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 3058 (206)</td> <td>27-Mar-12 (No. 217-01630)</td> <td>Apr-13</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 0047.3 / 00307</td> <td>27-Mar-12 (No. 217-01630)</td> <td>Apr-13</td> </tr> <tr> <td>Reference Probe E33013</td> <td>SN: 3005</td> <td>28-Dec-12 (No. E33-3005_Dec12)</td> <td>Dec-13</td> </tr> <tr> <td>DAD4</td> <td>SN: 601</td> <td>27-Jun-12 (No. DAD4-601_Jun12)</td> <td>Jun-13</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>MFV11002017</td> <td>18-Oct-09 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>RF generator RLS SMT-06</td> <td>100005</td> <td>04-Aug-09 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>Network Analyzer HP 8713E</td> <td>US07260545 (4206)</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	0807480704	01-Nov-12 (No. 217-01640)	Oct-13	Power sensor HP 8481A	US07260760	01-Nov-12 (No. 217-01640)	Oct-13	Reference 20 dB Attenuator	SN: 3058 (206)	27-Mar-12 (No. 217-01630)	Apr-13	Type-N mismatch combination	SN: 0047.3 / 00307	27-Mar-12 (No. 217-01630)	Apr-13	Reference Probe E33013	SN: 3005	28-Dec-12 (No. E33-3005_Dec12)	Dec-13	DAD4	SN: 601	27-Jun-12 (No. DAD4-601_Jun12)	Jun-13	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MFV11002017	18-Oct-09 (in house check Oct-11)	In house check: Oct-13	RF generator RLS SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13	Network Analyzer HP 8713E	US07260545 (4206)	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	0807480704	01-Nov-12 (No. 217-01640)	Oct-13																																												
Power sensor HP 8481A	US07260760	01-Nov-12 (No. 217-01640)	Oct-13																																												
Reference 20 dB Attenuator	SN: 3058 (206)	27-Mar-12 (No. 217-01630)	Apr-13																																												
Type-N mismatch combination	SN: 0047.3 / 00307	27-Mar-12 (No. 217-01630)	Apr-13																																												
Reference Probe E33013	SN: 3005	28-Dec-12 (No. E33-3005_Dec12)	Dec-13																																												
DAD4	SN: 601	27-Jun-12 (No. DAD4-601_Jun12)	Jun-13																																												
Secondary Standards	ID #	Check Date (in house)	Scheduled Check																																												
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RF generator RLS SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13																																												
Network Analyzer HP 8713E	US07260545 (4206)	18-Oct-01 (in house check Oct-12)	In house check: Oct-13																																												
Calibrated by:	Name Irene El-Masry	Function Laboratory Technician	Signature 																																												
Approved by:	Name Rajja Polovic	Function Technical Manager	Signature 																																												
Issued: January 9, 2013																																															
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	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 83(119)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Measurement Conditions

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

DASY Version	DASY5	V52.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	± 0.5 °C	---	---

SAR result with Head TSL

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

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.3 W/kg ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	40.2 Ω - 8.3 jΩ
Return Loss	-20.5 dB

General Antenna Parameters and Design

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


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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 07, 2001

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 86(119)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASYS Validation Report for Head TSL

Date: 09.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 20020

Communication System: CW; Frequency: 1800 MHz

Medium parameters used: $f = 1800 \text{ MHz}$; $\sigma = 1.38 \text{ S/m}$; $\epsilon_r = 38.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; CoreP(5.04, 5.04, 5.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

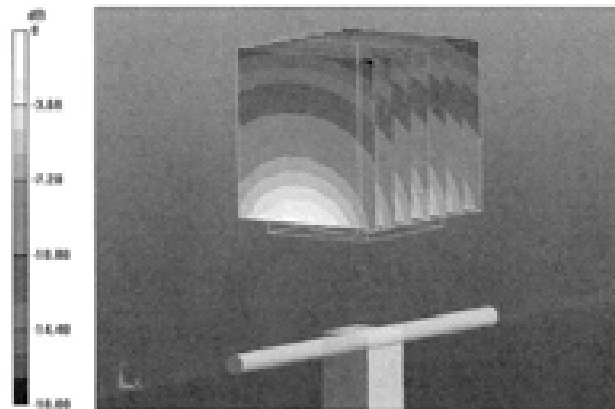
Measurement grid: $d_x=5\text{mm}$, $d_y=5\text{mm}$, $d_z=5\text{mm}$

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


Peak SAR (extrapolated) = 17.5 W/kg

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

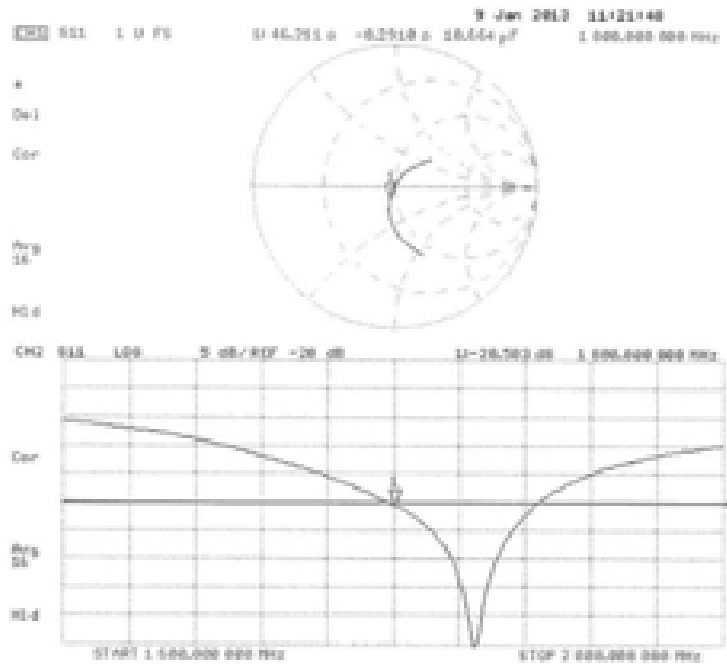
Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg

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Impedance Measurement Plot for Head TSL



Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1900V2-545_Jan11**

CALIBRATION CERTIFICATE																																															
Object	D1900V2 - SN: 545																																														
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits																																														
Calibration date:	January 13, 2011																																														
<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 (MATE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM-642A</td> <td>0807480704</td> <td>06-Oct-10 (No. 217-01266)</td> <td>Oct-11</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US07262763</td> <td>06-Oct-10 (No. 217-01266)</td> <td>Oct-11</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5086 (20g)</td> <td>30-Mar-10 (No. 217-01158)</td> <td>Mar-11</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 5047.2 / 50327</td> <td>30-Mar-10 (No. 217-01162)</td> <td>Mar-11</td> </tr> <tr> <td>Reference Probe E500V3</td> <td>SN: 3025</td> <td>30-Apr-10 (No. E53-3025_Apr10)</td> <td>Apr-11</td> </tr> <tr> <td>DAE4</td> <td>SN: 601</td> <td>10-Jun-10 (No. DAE4-601_Jun10)</td> <td>Jun-11</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Power sensor HP 8481A</td> <td>MP47092317</td> <td>18-Oct-09 (in house check Oct-09)</td> <td>In house check: Oct-11</td> </tr> <tr> <td>RF generator R&S SM7-06</td> <td>100005</td> <td>4-Aug-09 (in house check Oct-09)</td> <td>In house check: Oct-11</td> </tr> <tr> <td>Network Analyser HP 8710E</td> <td>US07260985 S4206</td> <td>18-Oct-01 (in house check Oct-10)</td> <td>In house check: Oct-11</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter EPM-642A	0807480704	06-Oct-10 (No. 217-01266)	Oct-11	Power sensor HP 8481A	US07262763	06-Oct-10 (No. 217-01266)	Oct-11	Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11	Type-N mismatch combination	SN: 5047.2 / 50327	30-Mar-10 (No. 217-01162)	Mar-11	Reference Probe E500V3	SN: 3025	30-Apr-10 (No. E53-3025_Apr10)	Apr-11	DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MP47092317	18-Oct-09 (in house check Oct-09)	In house check: Oct-11	RF generator R&S SM7-06	100005	4-Aug-09 (in house check Oct-09)	In house check: Oct-11	Network Analyser HP 8710E	US07260985 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration																																												
Power meter EPM-642A	0807480704	06-Oct-10 (No. 217-01266)	Oct-11																																												
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Network Analyser HP 8710E	US07260985 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11																																												
Calibrated by:	Dirk Bieri Name	Laboratory Technician Function	<i>[Signature]</i> Signature																																												
Approved by:	Reto Fritschli Name	Technical Manager Function	<i>[Signature]</i> Signature																																												
Issued: January 14, 2011																																															
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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.5 ± 6 %	1.43 mho/m ± 6 %
Head TSL temperature during test	(21.2 ± 0.2) °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR normalized	normalized to 1W	40.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.8 mW / g ± 17.8 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.26 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.8 mW / g ± 14.8 % (k=2)



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω + 1.8 $j\Omega$
Return Loss	-34.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 15, 2001

	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 92(119)
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DASY5 Validation Report for Head TSL

Date/Time: 13.01.2011 14:52:49

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL U12 BB

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

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvR(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAD4 Srf01; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

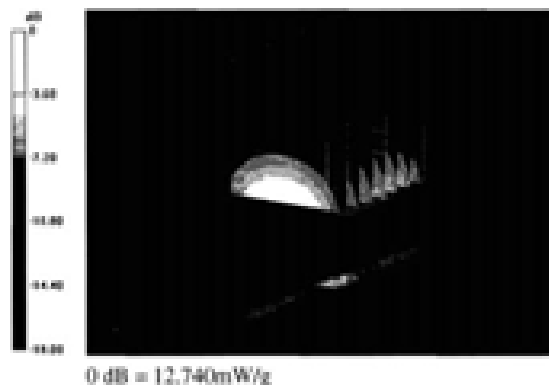
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm


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

Peak SAR (extrapolated) = 18.648 W/kg

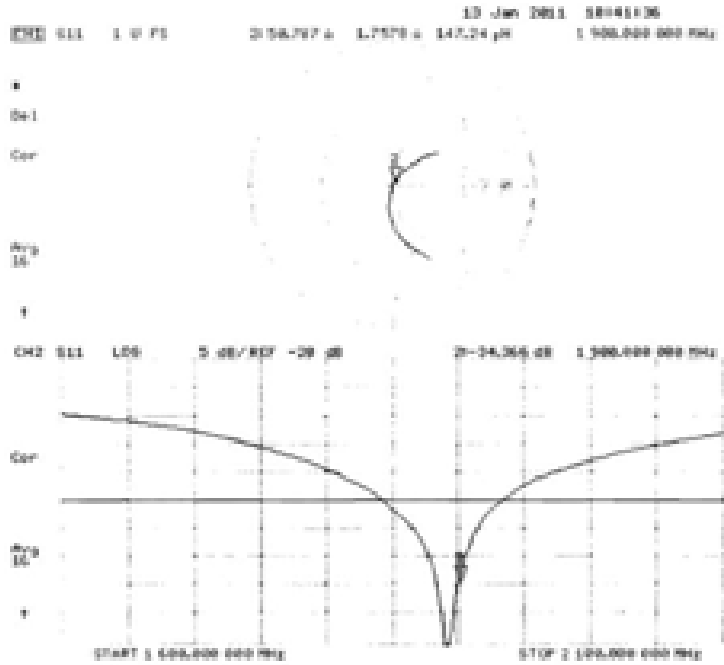
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.26 mW/g


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



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Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 108

Client **RTS (RIM Testing Services)**

Certificate No: D1900V2-545_Jan13

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 545
 Calibration procedure(s): QA CAL-05.v9
 Calibration procedure for dipole validation kits above 700 MHz
 Calibration date: January 09, 2013

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

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

Calibration Equipment used (NMTE critical for calibration)


Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power Meter EPM-400A	0807480704	01-Nov-12 (No. 217-01940)	Oct-13
Power sensor HP 8401A	US07290760	01-Nov-12 (No. 217-01940)	Oct-13
Reference 20-dB Attenuator	SR: 3058 (20x)	27-Mar-12 (No. 217-01500)	Apr-13
Type-N mismatch combination	SR: 5047.3 / 50307	27-Mar-12 (No. 217-01500)	Apr-13
Reference Probe 6100Y3	SR: 3006	26-Dec-12 (No. E53-0006_Dec12)	Dec-13
CAL4	SR: 601	27-Jun-12 (No. 0484-001_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8401A	MY41080217	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator NMS SM7 06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8710B	US07290585 54208	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Ismael El-Hachem** (Name) / **Laboratory Technician** (Function) / *Ismael El-Hachem* (Signature)
 Approved by: **Kolja Pokorski** (Name) / **Technical Manager** (Function) / *Kolja Pokorski* (Signature)

Issued: January 9, 2013

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Measurement Conditions

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

DASY Version	DASY5	V02.8.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied:

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

SAR result with Head TSL

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

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

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.0 Ω + 1.7 jΩ
Return Loss	- 34.3 dB

General Antenna Parameters and Design

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


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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 15, 2001

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DASY5 Validation Report for Head TSL

Date: 09.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 1900 MHz

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

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; CorvP(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sa601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

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

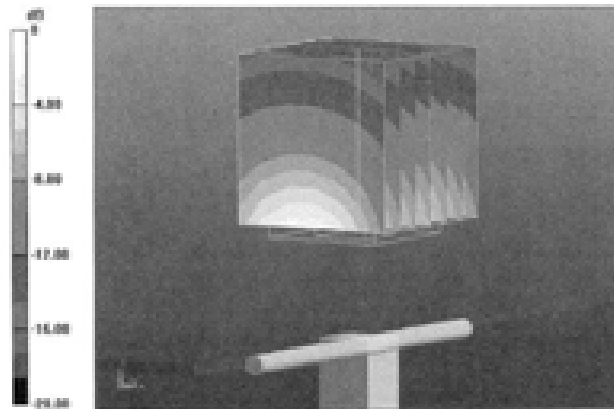
Measurement grid: $d_x=5$ mm, $d_y=5$ mm, $d_z=5$ mm


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

Peak SAR (extrapolated) = 18.1 W/kg

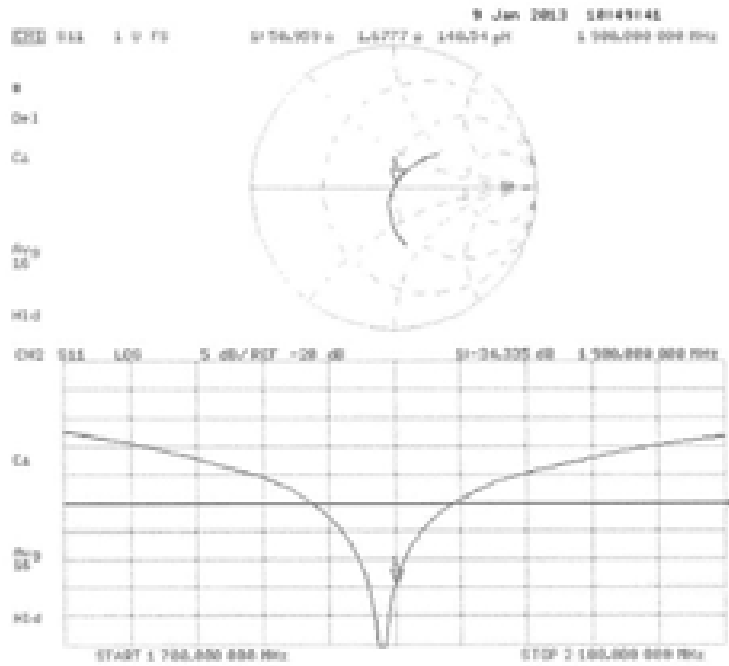
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.26 W/kg

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



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Impedance Measurement Plot for Head TSL



Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D1900V2-5d075_Apr11**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d075**

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



Calibration date **April 5, 2011**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 0.5°C and humidity < 70%).


Calibration Equipment used (MPE) critical for calibration(s)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM 440A	42537460704	08-Oct-10 (No. 217-01260)	Oct-11
Power sensor HP 3461A	LS27290783	08-Oct-10 (No. 217-01260)	Oct-11
Attenuator 20 dB Attenuator	SN: 1086 (J02)	29-Mar-11 (No. 217-01260)	Apr-12
Type-N mismatch combination	SN: 2047.2 / 06207	29-Mar-11 (No. 217-01271)	Apr-12
Reference Probe E5307A	SN: 2005	30-Apr-10 (No. E53-2005_Apr10)	Apr-11
SAB4	SN: 801	10-Jun-10 (No. DAB4-801_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 3461A	M14 100217	18-Oct-07 (in house check Oct-08)	In house check - Oct-11
RF generator RAS SMT-50	100056	4-Aug-09 (in house check Oct-09)	In house check - Oct-11
Network Analyzer HP 8713C	1523739295 54204	18-Oct-01 (in house check Oct-10)	In house check - Oct-11

Calibrated by:	Mike Mall	Function: Laboratory Technician	Signature: 
Approved by:	Katja Pollock	Technical Manager	

Issued: April 5, 2011

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	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 101(119)
	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

**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**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Measurement Conditions

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

DASY Version	DASYS	V50.0.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V1.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters


The following parameters and calculations were applied.

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

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 mW / g
SAR normalized	normalized to 1W	40.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	40.4 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.29 mW / g
SAR normalized	normalized to 1W	21.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	21.0 mW / g ± 16.5 % (k=2)

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Appendix

Antenna Parameters with Head TSL

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

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 ns
----------------------------------	----------


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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	January 24, 2008

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DASY5 Validation Report for Head TSL

Date/Time: 05.04.2011 12:41:39

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:54075

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

Medium: HSL U12 BB

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

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ESCHAC - SNT200; Core:HS.09, 1.09, 5.09; Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detectors)
- Electronics: DAB Set01; Calibrated: 10.06.2010
- Phantom: Flat Phantom SNT (front); Type: QD000P95AA; Serial: 1001
- Measurement SW: DASY52, V12.6.2 Build (424)
- Postprocessing SW: SIMCAD-X, V14.4.4 Build (2029)

Head / $d=10$ mm, $P_{in}=250$ mW / Cube 0:

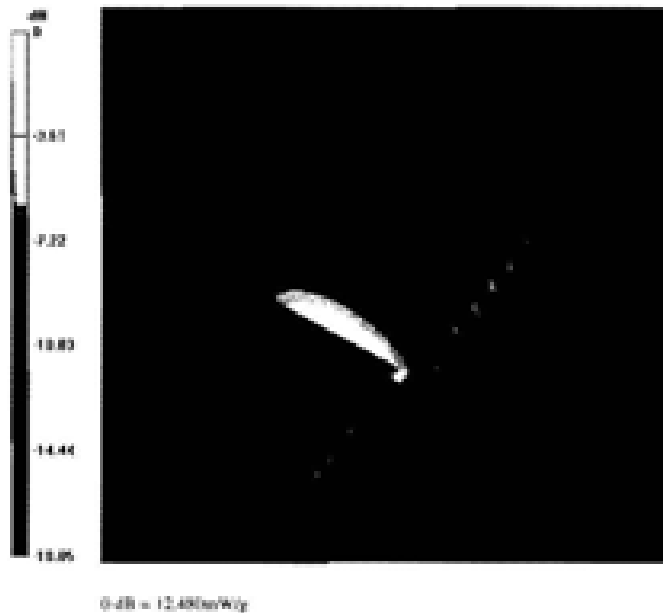
Measurement grid: $d_x=5$ mm, $d_y=5$ mm, $d_z=5$ mm


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

Peak SAR (extrapolated) = 18.796 W/kg

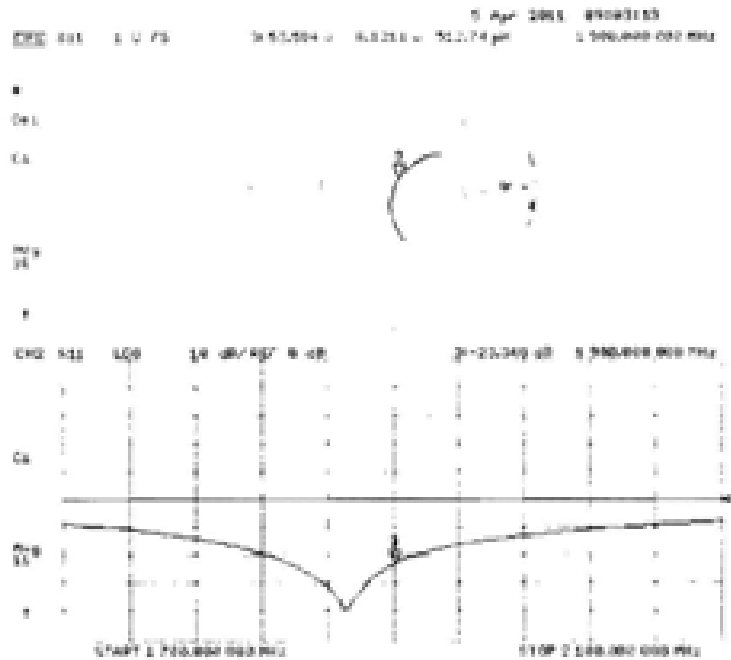
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.29 mW/g

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



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Impedance Measurement Plot for Head T&L



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

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Accreditation No.: **SCS 106**

Client **RTS (RIM Testing Services)**

Certificate No: **D2450V2-747_Nov11**

CALIBRATION CERTIFICATE																																															
Object	D2450V2 - SN: 747																																														
Calibration procedure(s)	QA CAL-05.v6 Calibration procedure for dipole validation kits above 700 MHz																																														
Calibration date	November 09, 2011																																														
<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 < 30%.</p> <p>Calibration Equipment used (MPE 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>0837483704</td> <td>05-Oct-11 (No. 217-01451)</td> <td>Oct-12</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>US37262783</td> <td>05-Oct-11 (No. 217-01451)</td> <td>Oct-12</td> </tr> <tr> <td>Reference 20-dB Attenuator</td> <td>SN: 5086 (20g)</td> <td>29-Mar-11 (No. 217-01366)</td> <td>Apr-12</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 5047.2 / 06327</td> <td>29-Mar-11 (No. 217-01371)</td> <td>Apr-12</td> </tr> <tr> <td>Reference Probe ES30V3</td> <td>SN: 3205</td> <td>29-Apr-11 (No. ES3-3205_Apr11)</td> <td>Apr-12</td> </tr> <tr> <td>DAB4</td> <td>SN: 601</td> <td>04-Jul-11 (No. DAB4-601_Jul11)</td> <td>Jul-12</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>MY41062017</td> <td>18-Oct-09 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>RF generator RMS SMT-05</td> <td>100005</td> <td>04-Aug-09 (in house check Oct-11)</td> <td>In house check: Oct-13</td> </tr> <tr> <td>Network Analyser HP 8703E</td> <td>US37390585 54206</td> <td>18-Oct-01 (in house check Oct-11)</td> <td>In house check: Oct-12</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal. Date (Certificate No.)	Scheduled Calibration	Power meter EPM-442A	0837483704	05-Oct-11 (No. 217-01451)	Oct-12	Power sensor HP 8481A	US37262783	05-Oct-11 (No. 217-01451)	Oct-12	Reference 20-dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01366)	Apr-12	Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12	Reference Probe ES30V3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12	DAB4	SN: 601	04-Jul-11 (No. DAB4-601_Jul11)	Jul-12	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power sensor HP 8481A	MY41062017	18-Oct-09 (in house check Oct-11)	In house check: Oct-13	RF generator RMS SMT-05	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13	Network Analyser HP 8703E	US37390585 54206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
Primary Standards	ID #	Cal. Date (Certificate No.)	Scheduled Calibration																																												
Power meter EPM-442A	0837483704	05-Oct-11 (No. 217-01451)	Oct-12																																												
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Network Analyser HP 8703E	US37390585 54206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12																																												
Calibrated by:	Name Jaron Kasriel	Function Laboratory Technician	Signature 																																												
Approved by:	Name Katja Pilawa	Function Technical Manager	Signature 																																												
Issued: November 9, 2011																																															
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	Document Appendix D for the BlackBerry® Smartphone Model RFL111LW SAR Report			Page 107(119)
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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) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW	IC 2503A-RFL110LW
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Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

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

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



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

IC
2503A-RFL110LW

Appendix

Antenna Parameters with Head TSL

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

General Antenna Parameters and Design

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


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

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

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

Additional EUT Data

Manufactured by	SPEAQ
Manufactured on	December 01, 2008

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	Author Data Andrew Becker	Dates of Test Nov 22 2012 – Feb 28 2013	Test Report No RTS-6026-1302-13	FCC ID: L6ARFL110LW

DASY5 Validation Report for Head T&L

Date: 09.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

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

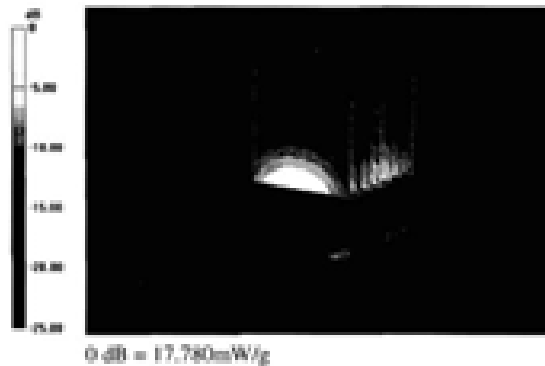
Communication System: CW; Frequency: 2450 MHz
 Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.84 \text{ mho/m}$; $\epsilon_r = 37.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)


DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: Q0000P50AA; Serial: 1001
- DASY52 52.6.2(487); SEMCAD X 14.4.5(3634)

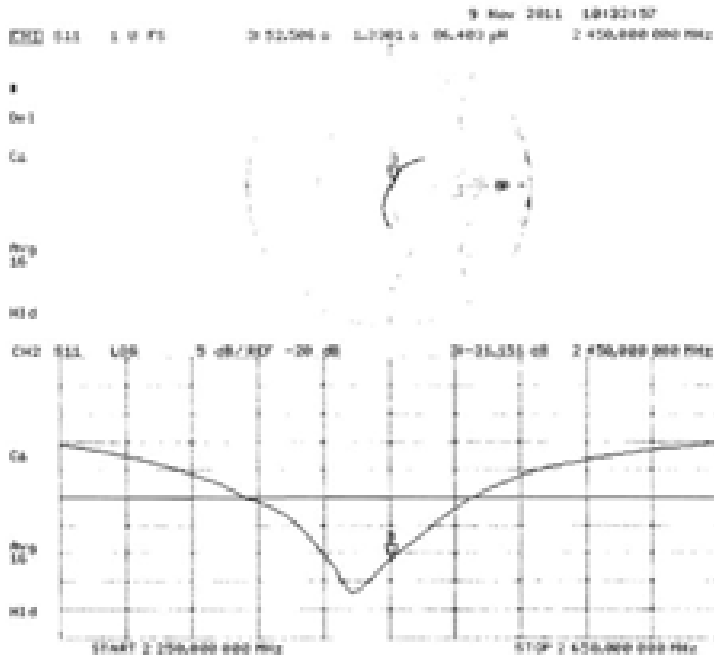
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: $d_x=5\text{mm}$, $d_y=5\text{mm}$, $d_z=5\text{mm}$
 Reference Value = 102.1 V/m; Power Drift = 0.04 dB
 Peak SAR (extrapolated) = 28.853 W/kg
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.39 mW/g
 Maximum value of SAR (measured) = 17.782 mW/g



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Impedance Measurement Plot for Head TSL



Author Data
Andrew Becker

Dates of Test
Nov 22 2012 – Feb 28 2013

Test Report No
RTS-6026-1302-13

FCC ID:
L6ARFL110LW

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Accreditation No.: **SCS 108**

Client **RTS (RIM Testing Services)**

Certificate No: **D5GHzV2-1033_Nov11**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1033**

Calibration procedure(s) **QA CAL-22.v1
 Calibration procedure for dipole validation kits between 3-8 GHz**

Calibration date: **November 15, 2011**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (20 ± 2)°C and humidity = 70%.

Calibration Equipment used (MATE critical for calibration)


Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	0607480704	05-Oct-11 (No. 217-01401)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01401)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 26327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX20N	SN: 3628	04-Mar-11 (No. EX3-3628_Mar11)	Mar-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092017	18-Oct-09 (in house check Oct-11)	In house check: Oct-13
HP generator PXS SMT-06	100005	04-Aug-09 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8712B	US37300646-54206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by: **Dirce Bar** (Name), **Laboratory Technician** (Function), *[Signature]* (Signature)

Approved by: **Kaja Polonski** (Name), **Technical Manager** (Function), *[Signature]* (Signature)

Issued: November 16, 2011

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Accreditation No.1 **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	$\Delta x, \Delta y = 4.0 \text{ mm}, \Delta z = 1.4 \text{ mm}$	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz \pm 1 MHz 5500 MHz \pm 1 MHz 5800 MHz \pm 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 \pm 0.2) °C	34.6 \pm 6 %	4.46 mho/m \pm 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	8.16 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.8 mW / g \pm 17.0 % (k=2)

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

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.0	4.96 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	34.2 \pm 6 %	4.75 mho/m \pm 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	8.82 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	87.3 mW / g \pm 17.0 % (k=2)

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

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Head TSL parameters at 5800 MHz


The following parameters and calculations were applied.

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

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.4 mW / g ± 17.6 % (k=2)

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

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Appendix

Antenna Parameters with Head TSL at 5200 MHz

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

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	52.9 Ω - 2.7 jΩ
Return Loss	- 29.2 dB

Antenna Parameters with Head TSL at 5800 MHz

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

General Antenna Parameters and Design


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

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

Additional EUT Data

Manufactured by	SPEAQ
Manufactured on	July 09, 2004

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DASY5 Validation Report for Head TSL

Date: 15.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
 Medium parameters used: $f = 5200$ MHz; $\sigma = 4.46$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5500$ MHz; $\sigma = 4.75$ mho/m; $\epsilon_r = 34.2$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.03$ mho/m; $\epsilon_r = 33.7$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)


DASY52 Configuration:

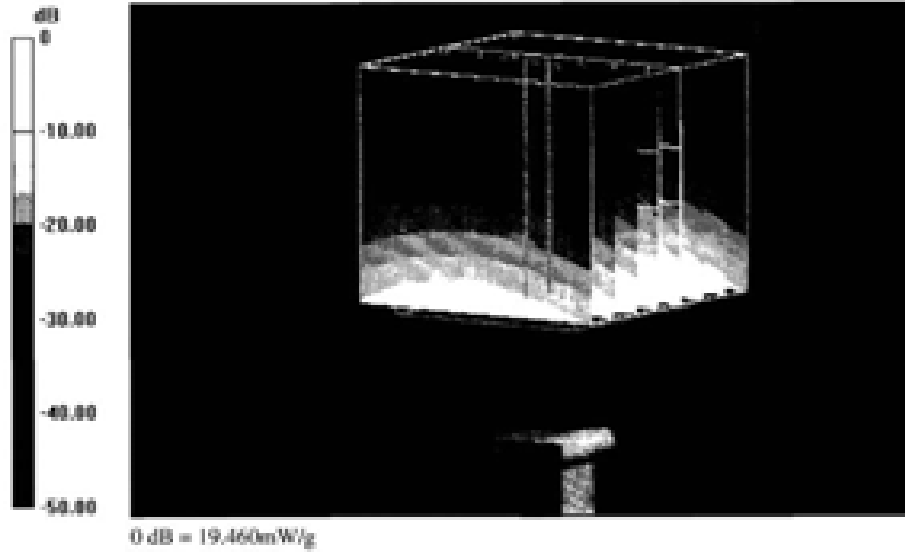
- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.91, 4.91, 4.91), ConvF(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.S(3634)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
 Reference Value = 65.595 V/m; Power Drift = 0.07 dB
 Peak SAR (extrapolated) = 30.134 W/kg
 SAR(1 g) = 8.16 mW/g; SAR(10 g) = 2.33 mW/g
 Maximum value of SAR (measured) = 18.725 mW/g

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
 Reference Value = 66.819 V/m; Power Drift = 0.03 dB
 Peak SAR (extrapolated) = 35.056 W/kg
 SAR(1 g) = 8.82 mW/g; SAR(10 g) = 2.5 mW/g
 Maximum value of SAR (measured) = 21.019 mW/g

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

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Impedance Measurement Plot for Head TSL

